M

Rapid Environmental Impact Assessment

For

The Proposed Expansion

M/s Matrix Laboratories Limited, Unit-8

at

Gethula Chodavaram Village, Vizianagaram district, A.P

MATRIX

Matrix Laboratories Limited
Sai Ram Towers, Alexander Road
Secunderabad – 500 003

Period: Post Monsoon Season-2005

Prepared by

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RAMKY GROUP

Executive Summary

EXECUTIVE SUMMARY

Matrix Laboratories Limited
Unit-8, G. Chodavaram Village
Pusapatirega Mandal, Vizianagram District
Andhra Pradesh

Prepared by
Ramky Infra Consulting Pvt Ltd
Hyderabad

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Matrix Laboratories is a public limited company listed on the major stock exchanges in India and is engaged in the manufacture of Active Pharmaceutical Ingredients (APIs) and Solid Oral Dosage Forms.

The company's focus on Quality, Safety, Environment and Occupational Health is pronounced and some of its plants are approved by regulatory agencies such as **US-FDA, EDQM -EU, TGA (Australia)** and some of the largest multinational pharmaceutical companies.

Matrix Laboratories Limited, Unit- 8, an, existing bulk drug manufacturing unit established near Gethula Chodavaram village, Pusapatirega mandal, Vizianagaram district, Andhra Pradesh is going for an expansion of its production capacity to meet the current market demand for bulk drugs in the international market.

In the present expansion proposal, Matrix Laboratories Ltd, Unit-8 is proposing to add 9 new products (bulk drugs) including two intermediates and increase the production capacities of 6 of the existing 11 products. This brings the total number of products manufacture at this site to 15. The details of the production after expansion are shown in the table below.

Details of the Production after the Proposed Expansion

S.No	Products	Quantity in TPM	Remarks
1	Tiaprofenic Acid	3	Existing Product. Capacity enhanced
2	Naproxen Sodium	50	Existing product. Capacity enhanced
3	Trazodone HCl	3	Existing product. Capacity enhanced
4	Allopurinol	8	Existing product. Capacity enhanced
5	Nabumetone	1	Existing product. Capacity enhanced
6	Citalopram Hydrobromide	2.5	Existing product. Capacity enhanced
7	Efavirenz	15	New Product
8	Abacavir Sulfate	3	New Product
9	Nelfinavir Mesylate	5	New Product
10	Indinavir Sulfate	3	New Product
11	Ciprofloxacin Hydrochloride	25	New Product
12	CME Intermediate	16.6	New Product
13	Zidovudine	25	New Product
14	Gabapantene	40	New Product
15	Naproxen Intermediate (Acetyl Yara Yara)	50	New Product

1.1 RESOURCE REQUIREMENT

a) Land

Activity	Land in Hectares	
	Existing	**Proposed**
Production Blocks	1.97	1.6
Utilities	3.03	0.45
	5.0	**2.05**
Green Belt	20.0	
Total	**27.05**	

No additional land is being procured for the present expansion proposal.

b) Water Balance

The water requirement for the existing plant operations is about 183 m^3/day and after the proposed expansion, the water requirement is about 970 m^3/day. The water requirement for both the existing and after the proposed expansion shall be met from the bore wells onsite. The water requirement for both the existing and proposed expansion is provided hereunder.

Water Requirement (m^3/day)

S. No	Category	Existing	Proposed	Total
1	Process	38.0	523	561
2	Washings		10	10
3	Cooling towers make-up/bleed off	75.0	49	124
4	Boiler feed/blow down	30.0	145	175
5	Softener regeneration	-	30	30
6	DM Plant Regeneration	-	30	30
7	Domestic & others including canteen, toilets, drinking water etc	25.0	-	25
8	Gardening/ Horticulture	15.0	-	15
	Total	**183.0**	**787**	**970**

The wastewater generated from the existing plant operations is about 56.05 m^3/day. The wastewater generation after the proposed expansion is about 700 m^3/day. The waste water generated from both the existing and proposed facilities is provided hereunder.

Wastewater Generation (m^3/day)

<table>
<tr><th>S. No</th><th>Category</th><th>Existing</th><th>Proposed</th><th>Total</th></tr>
<tr><td>1</td><td>Process</td><td>35.55</td><td>538.45</td><td>574</td></tr>
<tr><td>2</td><td>Washings</td><td rowspan="6">20.5</td><td>10.00</td><td>10</td></tr>
<tr><td>3</td><td>Cooling towers make-up/bleed off</td><td>15.5</td><td>15.5</td></tr>
<tr><td>4</td><td>Boiler feed/blowdown</td><td>15.5</td><td>15.5</td></tr>
<tr><td>5</td><td>Softener regeneration</td><td>30</td><td>30</td></tr>
<tr><td>6</td><td>DM Plant Regeneration</td><td>30</td><td>30</td></tr>
<tr><td>7</td><td>Domestic & others including canteen, toilets, drinking water etc</td><td>4.5</td><td>25</td></tr>
<tr><td>8</td><td>Gardening/ Horticulture</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td>Total</td><td>56.05</td><td>643.95</td><td>700</td></tr>
</table>

c) Raw Material

The raw materials required for the process are bought from the local (indigenous) market while some has its source from the foreign countries (imported).

d) Manpower

Around 200 people are proposed to be employed in addition to the existing manpower available for the proposed expansion.

e) Power

The industry is operating with APTRANSCO power supply and a separate sub-station has been installed at the plant site. In the proposed expansion, an additional 2 × 1000 KVA generator is being added in addition to the existing ones to augment the power supply during the power failures.

f) Diesel

The diesel requirement for the existing production is about 300 KL per annum to operate the DG sets on the site. The total diesel is being procured from M/s Hindustan Petroleum Corporation Ltd (HPCL) whenever it is required. There is no drastic increase in the diesel requirement in the present expansion, HSD of 600 Kl/annum is required after expansion to meet the fuel demand of the additional 2× 1000 KVA Dg sets being proposed.

g) Coal

In the proposed expansion, one 4 TPH and another 15 TPH boilers are being planned in addition to the existing boilers of 2 and 5 TPH capacities depending on the tonnage of the production, and the steam required for evaporating the high TDS streams following expansion. The total coal required for this is around 78 TPD. The coal will be procured from Sinagreni Collaries and the transportation will be by road.

1.2 BASELINE ENVIRONMENTAL STATUS

An area covering 10 kms radially, with the M/s Matrix Laboratories Ltd, Unit-8 site being the epicenter has been selected for the baseline data collection. Baseline studies were conducted for the post monsoon season for various environmental components viz. air, noise and water, land and socio-economic status so as to evaluate the impacts and delineate mitigative measures for the likely impacts to be arised out of the proposed activities.

a) Air Environment

Six ambient air quality monitoring stations were selected based on the topographical and the meteorological conditions. The salient features of the air quality monitoring is as follows.

- The minimum level of SPM recorded in the study area was 175 $\mu g/m^3$ at Kanimella and the maximum level recorded was 280$\mu g/m^3$ at the project site
- The minimum level of RSPM recorded in the study area was 50 $\mu g/m^3$ at Narava and the maximum level recorded was 110 $\mu g/m^3$ at the project site
- SO_2 levels are in the range of 21 to 38 $\mu g/m^3$. Maximum SO_2 concentration was recorded near Plant site and minimum at Narava
- NO_X levels were in the range of 30 to 41 $\mu g/m^3$. Maximum NO_X concentration was recorded near the Plant site and minimum at Perapuram
- The maximum value of Lead in Particulate matter was recorded at Plant Site, which was 0.3 $\mu g/m^3$
- Carbon monoxide was found to be varying between 0.9 mg/m^3 to 1.1 mg/m^3.

Apart from the above critical parameters like SPM, RPM, SO_2, NO_X, specific parameters like NH_3, HCl were also monitored and were found to be below the detectable limits. HC was monitored as Methane and was found to be within the permissible limits.

b) Noise Environment

Six noise monitoring stations were identified for the assessment of the existing noise levels keeping in view the nature of the monitoring location i.e. residential areas in villages, schools, bus stations etc. The noise levels are as follows.

- The minimum noise level 45dB (A) was recorded at Perapuram village while the maximum noise level was 67 dB (A) recorded at Pidibimavaram.

- Day equivalent noise levels (Ld) values were found to be ranging between 53.7 dB (A) at Kanimetta to 64.3 dB (A) near Pidibhimavaram.

➢ Night equivalent noise levels (Ln) values were found to be ranging between 48.3 dB (A) at Kanimetta to 58.5 dB (A) near Pidibhimavaram.

c) Water Environment

Seven ground water and three surface water samples along with two observation wells were collected in the study area based on the following considerations

- Location of major water bodies
- Representative conditions
- Potential users

The samples were analyzed for various physical and chemical parameters. The parameters were found to be within the designated limits prescribed for drinking water standards for most of the samples collected in the study area.

d) Soil Environment

Eight soil samples were collected at selected locations in the study area to assess the existing soil conditions in and around the plant site. The soil is grey to brick red in color comprising red soils, sandy and clayey loam soils. The soil analysis showed no alarming levels of pollutants and is rich in minerals and is suitable for agriculture.

1.3 IDENTIFICATION AND PREDICTION OF IMPACTS AND MANAGEMENT PLAN

1.3.1 Environment Management Plan – Air Pollution Control

Various sources of air pollution from the plant are from boiler, DG set, incinerator, fugitive and process emissions from the manufacturing process. The emissions from the various plant operations and the details of control equipment proposed to be provided are given below:

Stack Emission Details

Source	Units	SPM	SO_2	NO_x
4 TPH coal fired boiler	g/sec	0.4	1.31	1.11
15 TPH Coal fired boiler	g/sec	1.7	5.21	4.17
Incinerator – 6500 kg/d	g/sec	0.6	1.74	1.39

Predictions were carried out as per CPCB guidelines "Assessment of Impact to Air Environment: Guidelines for conducting air quality modeling". The predicted results for SO_2 and NO_x emissions are presented herewith.

Predicted Increase in Ground Level Concentrations – SPM, SO_2 & NO_X

Pollutant	Baseline Max. Value - ($\mu g/m^3$)	Predicted GLC's - ($\mu g/m^3$)	Overall Scenario- ($\mu g/m^3$)
Particulate Matter	280	2.09	282.09
Sulphur dioxide (SO_2)	38	6.48	44.48
Oxides of Nitrogen (NO_X)	41	5.29	46.29

The major process emissions from the plant are carbondioxide, hydrogen chloride and sulphur dioxide while the fugitive emissions are due to various solvent emissions used in the process. The control measures for the boiler, incinerator, process and fugitive emissions are provided hereunder.

- Scrubbers for controlling the process emissions from the plant
- Chilled water coolant vent condensers to control the fugitive emissions
- Adequate stack height of 30 m for the 15 TPH boiler and 40 m for the 6.5 TPD incinerator for better dispersion of gaseous emissions
- Bag Filter to control the particulate emissions from the 15 TPH boiler and Multiclones for other boilers

1.3.2 Environment Management Plan – Noise Pollution Control

The values of noise observed at the plant site are primarily due to the plant activities. Noise observed is also due to vehicular traffic and utilities like DG set, cooling towers etc. precautionary measures like provision of ear plugs to workers, regular maintenance of the noise generating equipment will be carried out to reduce the noise levels. In addition to this well developed green belt is being maintained to attenuate the noise levels in the plant area.

1.3.3 Environment Management Plan – Water Pollution Control

The sources of wastewater from the plant are the process wastewater, washes and wastewater from utilities, domestic wastewater etc. The wastewater generation from the existing plant operations is about 56.05 m^3/day. The wastewater generation after the proposed expansion would be around 700 m^3/day.

Out of the 700 m^3/day, Process Effluent is about 574 m^3/day and the waste water from the utilities is about 126 m^3/day.

The effluent treatment scheme is devised on segregation approach of the waste water into high and low TDS streams. The treatment approach for various streams is presented below.

- All high TDS effluent are first neutralized and then sent to onsite forced evaporation system.
- All low TDS process effluent streams, along with waste water utilities and the forced evaporator condensate are proposed to be treated in the onsite effluent treatment plant and then disposed off into sea through marine outfall at 30 m^3/hr peak flow rate after meeting the marine disposal standards.

1.3.4 Environment Management Plan - Solid Waste

The solid waste generation from the existing plant operations is about 8.51 TPD and after the proposed expansion, the total solid waste generation is about 56.21 TPD.

The forced evaporation salts, ETP sludge, inorganic wastes, incinerator ash and the spent carbon of about 25.01 TPD will be sent to landfill at the nearest CHWTSDF. The fly ash generated from the boiler after the expansion is about 31.2 TPD which will be given to end users.

1.4 GREEN BELT DEVELOPMENT

A very well developed green belt is being maintained in an area of about 20.00 hectares in the plant premises. The purpose of the greenbelt is to capture the emissions to air and attenuate the noise generated, prevention of erosion of topsoil and above all improve the aesthetics.

1.5 SOCIO-ECONOMIC STATUS

Study area of 25 km radius around the plant site covers 47 villages. The demographic features of the study area are presented below.

Demographic Pattern

Total population	103206
Total Male Population	51892
Total Female Population	51314
SC Population	10444
ST Population	2088
Total Literates	43471
Literacy rate	42.12 %
Sex ratio	988 females for every 1000 males

The socio economic conditions in the area will improve as a result of the proposed expansion of the unit as there will be increased employment opportunities and parallel improvement in the infrastructure facilities in the region to cater to the needs of the population.

1.6 CONCLUSION

Overall the proposed expansion of M/s Matrix Laboratories Limited, Unit-8 does not cause any adverse environmental impacts and can be recommended for environmental clearance.

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CHAPTER-I
INTRODUCTION

Chapter - 1
Introduction

1.0 PREAMBLE

M/s Matrix Laboratories Ltd, Unit- 8 is an existing bulk drug manufacturing industry situated in Vizianagaram district, Andhra Pradesh planning for an expansion of its production capacities. The plant is located at a distance of 55 km from Visakhapatnam.

The plant currently has consent to manufacture 11 products (six products at any given time). During the present expansion Matrix Laboratories Ltd is proposing to add 9 new products (bulk drugs) including 2 intermediate products and increase the production capacities of 6 of the existing 11 products. This brings the total number of products to be manufactured to 15.

1.1 THE PROPONENT

The Unit 8, located at **Gethula Chodavaram Village, Pusapatirega Mandal, Vizianagaram District, Andhra Pradesh** is one of the manufacturing units of Matrix Laboratories Ltd having its Corporate Office at Secunderabad, Andhra Pradesh. Matrix Laboratories Ltd is a public limited company listed on the major stock exchanges in India and is engaged in the manufacture of Active Pharmaceutical Ingredients (APIs), Intermediates, Formulations/ Solid Oral Dosage Forms. The development and manufacture of quality intermediates, bulk actives have been critical to the success of Matrix Laboratories Ltd in delivering innovative and affordable products for both the domestic as well as international markets.

With about 2000 employees, including over 200 R&D scientists, Matrix Laboratories Ltd conducts research & development, and manufactures products at the company's cGMP facilities located near Hyderabad and Visakhapatnam in Andhra Pradesh, India. The company's Solid Oral Dosage Forms facility is located near Nashik, about 150 km from Mumbai.

The company's focus on Quality, Safety, Environment and Occupational Health is pronounced and some of its plants are approved by regulatory agencies such as **US-FDA, EDQM - EU, TGA (Australia)** and some of the largest multinational pharmaceutical companies.

products (bulk drugs) including 2 intermediates. Details of the proposed expansion are as follows.

Table 1.2

Details of the Production after the Proposed Expansion

S.No	Products	Quantity in TPM	Remarks
1	Tiaprofenic Acid	3	Existing Product. Capacity enhanced
2	Naproxen Sodium	50	Existing product. Capacity enhanced
3	Trazodone HCl	3	Existing product. Capacity enhanced
4	Allopurinol	8	Existing product. Capacity enhanced
5	Nabumetone	1	Existing product. Capacity enhanced
6	Citalopram Hydrobromide	2.5	Existing product. Capacity enhanced
7	Efavirenz	15	New Product
8	Abacavir Sulfate	3	New Product
9	Nelfinavir Mesylate	5	New Product
10	Indinavir Sulfate	3	New Product
11	Ciprofloxacin Hydrochloride	25	New Product
12	CME Intermediate	16.6	New Product
13	Zidovudine	25	New Product
14	Gabapantene	40	New Product
15	Naproxen Intermediate (Acetyl Yara Yara)	50	New Product

1.2.3 Water Consent and Details

Matrix Laboratories Ltd, Unit-8 at Vizianagaram has valid water consent issued by the Andhra Pradesh Pollution Control Board vide **Order No. APPCB/VSP/VZN/91/HO/W/2005/26 dated 10-05-2005 valid upto 28-02-2006** for the following details.

Table 1.3

Water Consent Details (Dated 10-05-2005)

S. No	Outlet description	Max. daily discharge (lpd)	Point of disposal
1	High TDS process and wash effluents	3,950.00	Forced evaporation
2	Low TDS process and wash effluents after treatment	31,600.00	Into sea through a sub outfall at Thammayapalem (v)
3	Domestic effluents	20,500.00	Septic tank followed by soak pit

1.2.4 Air Consents and Details

Matrix Laboratories Ltd, Unit-8, at Vizianagaram has a valid consent by the Andhra Pradesh Pollution Control Board vide **Order No. APPCB/VSP/VZN/91/HO/2005/A/26 dated 10-05-2005 valid upto 28-02-2006** for the following utilities.

Table 1.4
Air Consent and Details

S.No	Description of chimney
1	Attached to 800 kg/day solid waste incinerator
2	Attached to 2 TPH coal fired boiler (stand by)
3	Attached to 5 TPH coal fired boiler
4	Attached to 2 X 380 KVA + 500 KVA DG sets

1.2.5 Hazardous Waste Authorization

Matrix Laboratories Ltd, Unit-8 at Vizianagaram has hazardous waste authorization issued by the Andhra Pradesh Pollution Control Board vide **Order No. APPCB/VSP/VZN/117/HWM dated 12-05-2005 valid upto 28-02-2006** for the following hazardous wastes.

Table 1.5
Hazardous Waste Authorization and Details

S.No	Waste Details	Quantity Per Month
1	Used/waste lubricating oil	45.00 litres
2	ETP Sludge	2,700.00 kg
3	Incinerator Ash	120.00 kg
4	Organic residue	6,106.50 kg
5	Detoxified M.S/ G.I/HDPE/Plastic Drums of hazardous chemicals and wastes	4,860.00 kg
6	Spent carbon	637.80 kg

Matrix Laboratories Ltd, Unit-8 is a signatory member of the Hyderabad Waste Management Project for the treatment, storage and disposal of hazardous wastes as per the prescribed guidelines vide **Letter ref. REEL/TSDF/02/712 dated 28-01-2003.**

1.2.6 Explosives and Fire Department Clearances

The unit has valid clearance for the handling and storage of explosive and flammable material on-site vide **Order No. P/HQ/AP/15/1082(P4543) Dated 03-08-2005** for the import and storage of 120 KL petroleum. The clearance obtained is valid till 31-12-2005.

1.2.7 Public Liability Insurance

The plant has public liability insurance policy for a premium about of Rs. 436, 501 with a one time indemnity limit of Rs. 5.0 crores and a three time indemnity limit of Rs.15 crores and a gross contribution of Rs. 207,660 towards the environment fund vide **Policy no. 62 dated 01-04-2005 valid upto 31-03-2006**.

1.2.8 Clearance from R&B Department for Construction of Marine outfall Pipeline

A letter for the consent to lay a pipeline from the plant to the outfall at Thammayyapalem was applied vide letter **MLL/P&A/R&B/2006 dated February 2nd 2006.**

A consent to lay the pipeline was obtained from the Guripam Gram Panchayat vide letter **dated 11-1-2006**.

1.3 BACKGROUND OF THE PROJECT

Due to variable position in the market during the recent years Matrix Laboratories Ltd, Unit-8 is going for an expansion, by increasing the production of 6 existing products and adding 8 new products (bulk drugs) and 1 intermediate to the already existing production. However, it is pertinent to mention that they have dropped four of the existing consented products Viz- Ranitidine HCl, Vitamin K_3, Diltiazem HCl, Trimethoprim. The details of the same have been given in **Table 1.2**.

1.4 NEED FOR EIA STUDIES

In all chemical, pharmaceutical and bulk drug manufacturing industries, the plant activities must co-exist satisfactorily with its surrounding environment so as to reduce the environmental impact caused due to these activities. To control the adverse impacts, a sound and safe environmental management plan has to be implemented by the proponents, which makes environmental protection as essential requirement along with production profits.

In order to assess the likely impacts arising out of the proposed expansion on the surrounding environment and evaluating means of alleviating the likely negative impacts, if any, from the proposed project, Matrix Laboratories Ltd has retained Ramky Infra Consulting Private Ltd as their environmental consultant to assess the likely impacts arising out of the proposed expansion. RICPL had carried out the Rapid Environmental Impact Assessment (REIA) studies for various environmental components which are likely to be affected.

1.4.1 EIA of Development Projects

The notification of MoEF dated 27th January 1994 and its subsequent amendment dated 04.05.1994, expansion and modernization of any activity or new projects shall not be undertaken in any part of India unless it is accorded environmental clearance by the Central government in accordance with the procedures specified in its notification. As per the procedure, anybody who desires to undertake expansion and modernization of any activity or new projects or project listed in Schedule I should submit an application to the Secretary, MoEF, New Delhi.

The application shall be made in the Proforma specified in Schedule II of the notification and it should be accompanied by a project report which shall, inter-alia include an Environmental Impact Assessment Report [Environmental Management Plan and details of public hearing as specified in Schedule [IV] prepared in accordance with the guidelines issued by the Central Government in the MoEF from time to time.

1.4.2 Justification of the Project

Bulk drugs proposed to be manufactured during expansion by Matrix Laboratories Ltd are widely used in pharmaceutical industry all over the world and also in our country. At present only few industries in India are manufacturing these particular products, which have good market potential.

1.5 ENVIRONMENTAL IMPACT ASSESSMENT

The EIA study encompasses 25 km radius area with the proposed project as its centre.

1.5.1 Scope

The scope of study includes detailed characterization of existing status of environment in the study area of 25 km with the proposed project as its centre for various environmental components viz. air, noise, water, land, biological and socio-economic components and other parameters of interest. However, since the impacts from the proposed expansion are likely to be felt within the immediate 10 Km radius, a study area of 10 Km with the plant as the epicenter was considered for all practical purposes. The envisaged scope of EIA is as follows:

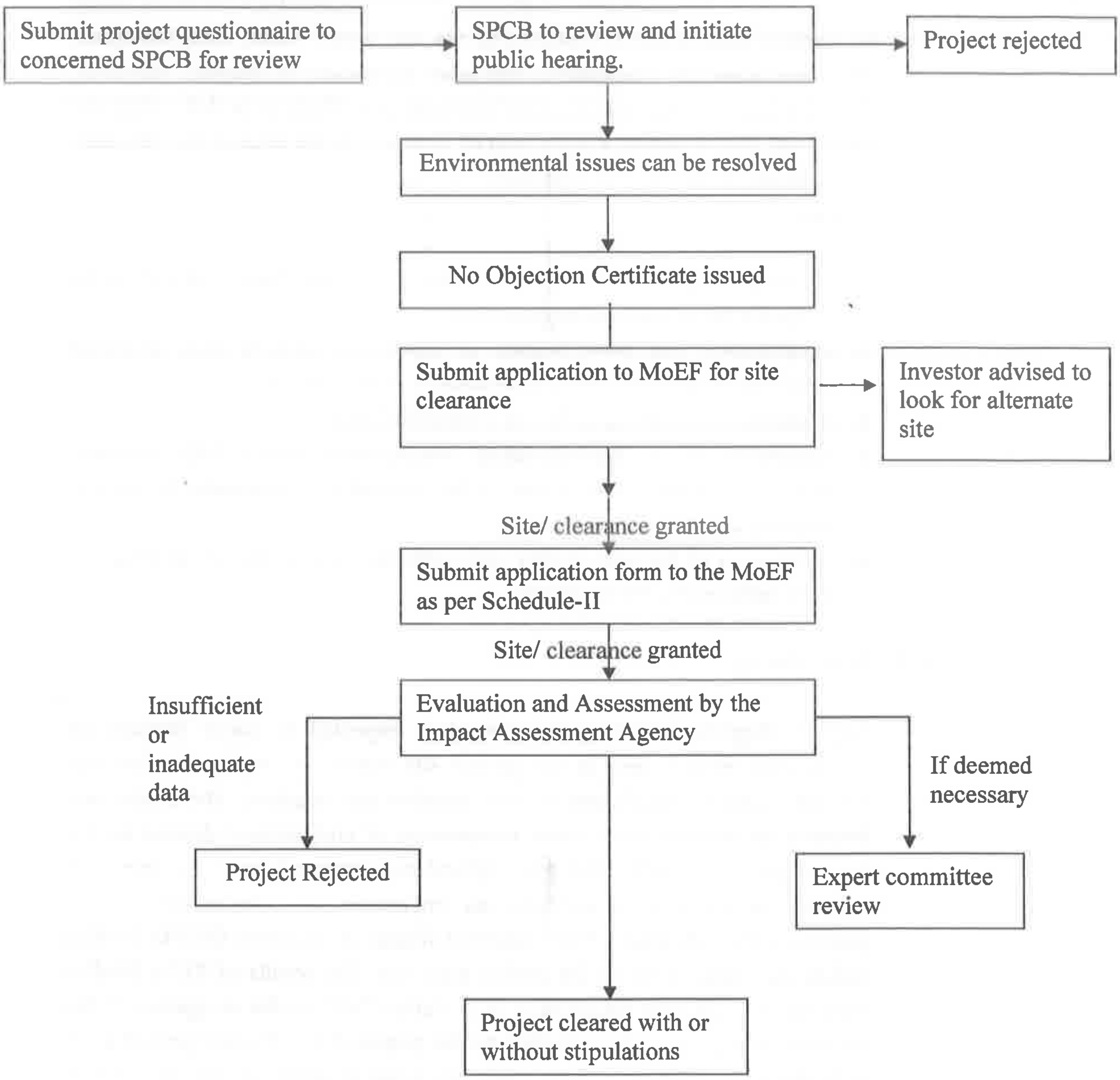
- To assess the present status of air, noise, water, land, biological and socio-economic components of environment
- Identification and quantification of significant impacts from proposed project operations on various components of environment
- Evaluation of proposed pollution control facilities
- Preparation of an Environmental Management Plan (EMP) outlining additional control technologies to be adopted for mitigation of adverse impacts, if any
- Delineation of the post-project environmental quality monitoring program to be followed by the proponent

1.5.2 Methodology

Any developmental activity in general is expected to cause impacts on surrounding environment at the project site during its implementation and operation phases, which can be both positive and negative. The nature and intensity of impacts on different components of environment depend on the type of project activities and geographical conditions of the study area. The impacts of the project activities on environmental components can be quantified through Rapid Environmental Impact Assessment (REIA) Studies within the impact zone of the project activities. The results of REIA Studies form the basis for the preparation of a viable EMP for the mitigation of the adverse impacts. The REIA Studies for the proposed construction project deals with detailed studies for various environmental components viz. Air, noise, water, land, biological and socio-economic environment in the post monsoon season of 2005. The procedure for obtaining environmental clearance is given as a flow-chart as **Figure 1.1**.

Figure 1.1

Procedure for Obtaining Environmental Clearance



1.5.3 Study Period

For the preparation of REIA report for the proposed project, the data was collected representing post monsoon season i.e., September to December 2005 of the study area. The micro climatic parameters were recorded using automatic weather monitoring station for the study period. Wind speed, wind direction and relative humidity were recorded on hourly basis. Minimum & Maximum temperatures were also recorded during the study period.

1.5.4 Air Environment

For the environmental impact studies, an area covering 25 km radial distance surrounding the proposed construction project was identified as study area (Impact Zone).

The topographical information of project site, study area and details about different activities related to the project operations was collected. Different parameters like SPM, SO_2 and NO_x were identified as related to the project activities for representing the baseline status of ambient air quality within the study area.

1.5.5 Noise Environment

Excessive noise levels cause adverse effects on human beings and associated environment including domestic animals, wild life, natural eco-system and structures. Hence noise survey is carried out at the project site and nearby villages. Noise levels (A-Weighted) were measured using precision sound level meter.

1.5.6 Water Environment

Information on water resources in the study area was collected. The parameters of prime importance for water quality studies were selected under physical and chemical groups etc and were analysed. Samples were collected at different locations in the study area.

1.5.7 Land Environment

Soil samples were collected from the project site, not only at its immediate vicinity but also in the surrounding villages in a 25 km radial zone. Physico-chemical properties of the soils were determined. Information on land use pattern in the study area was also collected. Information regarding existing cropping pattern, their types and yield of the crop was collected from various sources.

1.5.8 Eco-system

Information on eco-system within 25 km radius was collected from the state Agricultural and Forest departments. The important flora species native to the area was enumerated.

1.5.9 Socio-Economic Environment

A field study was conducted within 25 km radius of the site and the surrounding impact zone. The parameters selected under socio-economic component were demographic structure of the study area, provision of basic amenities, industries likely to come up in the study area, welfare facilities proposed by the project proponent, safety training and management, community and occupational health hazards. Relevant information was collected from selected villages and analyzed.

1.6 THE PROJECT

1.6.1 Location

The proposed expansion is being carried out at the bulk drug manufacturing unit at **Gethula Chodavaram Village, Pusapatirega mandal, Vizianagram District of Andhra Pradesh**. The nearest major town is Vizianagaram which is connected to all major towns and cities in the state by rail and road. There are no national parks and ecologically sensitive areas in the study area. The present study covers a 10 Km radius area with the plant site as the epicentre.

The area is plain and devoid of rocky outcrops, and is not covered by any notified forests. The plant site is well connected by road and rail, the National highway No.5 connecting Chennai and Kolkata and a broad gauge main railway line connecting Chennai and Howrah is passing 22 km from the site, the nearest railway station Vizianagaram. The nearest airport and port is Visakhapatnam. The airport is at a distance of about 55 km from the plant site. The location map showing location of the plant site is given in **Figure 1.2** and the plant layout is given as **Figure 1.3**.

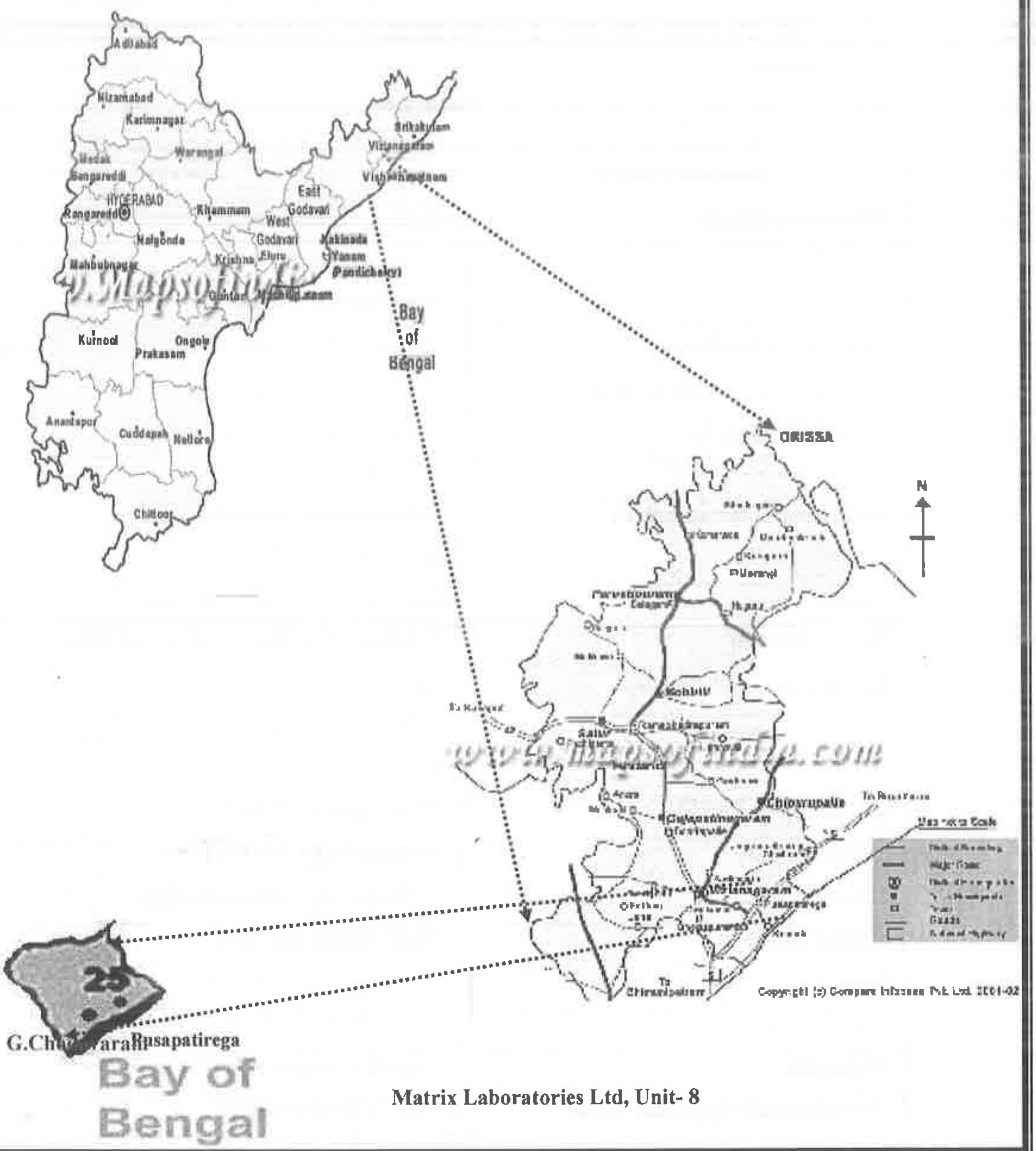
1.6.2 Site Features

The environmental setting of the proposed project is given in the following table.

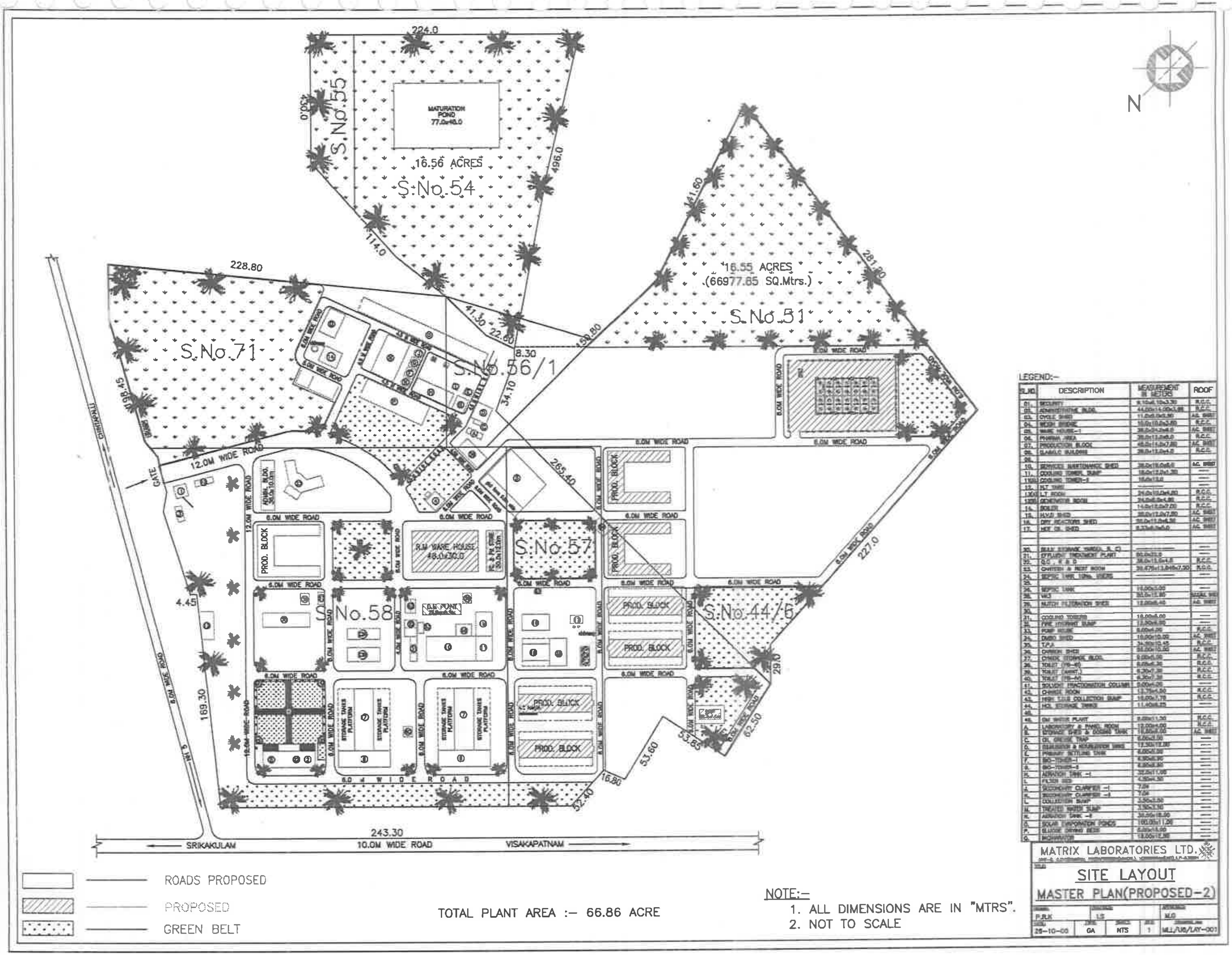
Table 1.6
Site Features of the Proposed Expansion of the Bulk Drug Unit

Selection Criteria	Details
Name of the Industry	Matrix Laboratories Ltd, Unit-8
Location	G.Chodavaram village, Pusapatirega mandal, Vizianagaram district
Geographical Positions	18° 12.37' N Latitude and 83° 29.087' E Longitude
Elevation above Mean sea level	50.29 M above MSL
Average Temperature	37.9°C (Max) & 20.2°C (Min)
Average annual rainfall	1130 mm
Land required for the activity	27.05 Hectares or 66.86 acres
Present land use	Industrial
Nature of Soil	Red loamy and loamy clay soils
Nature of terrain	Undulated Flat Plains with dotted hillocks
Predominant wind direction	NE
Nearest Highway	National Highway No.-5 (NH-5) connecting Chennai-Kolkata
Nearest railway station	Vizianagaram (22 km)
Nearest Airport	Visakhapatnam (55 Km)
Nearest Habitat	G.Chodavaram village (0.5 km)
Nearest Town	Vizianagaram (22 Km)
Nearest city	Visakhapatnam (55 Km)
Hills / valleys	Few dotted hillocks in the study area
Monuments	None in the study area
Archeologically important places	None in the study area
National parks	None in the study area
Forests	None in the study area
Water bodies	Champavathi, Kandivalasa,
List of important industries in the study area	Matrix Laboratories (existing units), Dr. Reddy's Labs, Aurobindo Pharma, SMS Pharma, Andhra Organics Ltd, Vizianagaram Biotech Ltd, C.P. Aqua Ltd

Figure 1.2 Location Map of the Project



Matrix Laboratories Ltd, Unit- 8


N
MATURATION POND 77.0x40.0
16.56 ACRES
S.No.54
S.No.55
224.0
430.0
496.0
114.0
16.55 ACRES
(66977.85 SQ.Mtrs.)
S.No.51
141.60
281.80
228.80
S.No.71
198.45
41.30
22.60
8.30
159.80
S.No.56/1
34.10
265.40
12.0M WIDE ROAD
GATE
CHINTAPALLI
ADMN. BLDG.
PROD. BLOCK
R.M. WARE HOUSE 48.0x30.0
S.No.57
S.No.58
S.No.44/6
227.0
29.0
62.50
53.85
53.60
16.80
52.40
4.45
169.30
STORAGE TANKS PLATFORM
6.0M WIDE ROAD
243.30
SRIKAKULAM
10.0M WIDE ROAD
VISAKAPATNAM
LEGEND:-
SL.NO.
DESCRIPTION
MEASUREMENT IN METERS
ROOF
MATRIX LABORATORIES LTD.
SITE LAYOUT
MASTER PLAN(PROPOSED-2)
25-10-00
NTS
MLL/U6/LAY-001
ROADS PROPOSED
PROPOSED
GREEN BELT
TOTAL PLANT AREA :- 66.86 ACRE
NOTE:-
1. ALL DIMENSIONS ARE IN "MTRS".
2. NOT TO SCALE

1.7 RULES FOR PREVENTION & CONTROL OF ENVIRONMENTAL POLLUTION

For prevention and Control of Environmental Pollution, the Ministry of Environment and Forests have notified the following acts.

- The Water (Prevention and control of Pollution) Act, 1974 and its subsequent amendments
- The Air (Prevention and control of Pollution) Act, 1981 and its subsequent amendments
- The Noise Pollution (Regulation and control) Rules, 2000
- The Environment (Protection) Act 1986 and Environment (Protection) Rules, 1986
- Public Liability Insurance Act, 1991
- Forest (Conservation) Act 1980
- Manufacture, Storage and Import of Hazardous Chemicals, rules 1989 and amended 2000

The above acts are amended by MoEF from time to time through official notifications, and Environment (Protection) Act prescribes from time to time several emission and discharge standards for specific industries and also in general for all industries which has to be complied.

1.8 APPLICABLE STANDARDS

For the preparation of this report reference has been made to existing standards. The standards used in this report are reproduced here in the following section for ready reference.

There are three forms of waste products associated with the manufacturing process from both the existing as well as proposed products. Their nature and origin is discussed below.

1.8.1 Air Quality Standards

- National Ambient Air Quality Standards- Notified by the CPCB June'95 **(Refer Table 1.7)**
- Ambient Air quality standards with respect to noise- Notified by the Central Pollution Control Board (CPCB), June'95 **(Refer Table 1.8)**

1.8.2 Water Quality and Wastewater discharge Standards

- India Standard: Drinking Water Specifications- IS 10500:1991- Bureau of Indian Standards(BIS) **(Refer Table 1.9)**
- General Standards for Discharge of Environmental Pollutants-GSR 422(E) **(Refer Table 1.10)**

1.8.3 Diesel Generator Sets

- Stack height for Diesel Generator sets and emission standards, CPCB, Emission Regulations Part IV, COINDS/26/1986-87

Table 1.7
National Ambient Air Quality Standards
Central Pollution Control Board (CPCB) June'95, India
{S.O. 384 (E), Air (Prevention & Cont. of Pollution) Act, 1981 dated April 11, 1994}.

Pollutants	*Time weighted average*	*Concentration in Ambient Air*			*Method of Measurement*
		Industrial Area	*Residential Rural & Other areas*	*Sensitive Areas*	
Sulphur Dioxide (SO_2) $\mu g/m^3$	*Annual Average **	*80*	*60*	*15*	*1. Improved West and Geake method*
	*24 hours***	*120*	*80*	*30*	*2. Ultraviolet fluorescence*
Oxides of Nitrogen (NO_2) $\mu g/m^3$	*Annual Average **	*80*	*60*	*15*	*1. Jacob & Hochheiser modified (Na - Arsenite) Method*
	24 hours 8*	*120*	*80*	*30*	*2. Gas Phase Chemiluminescence*
Suspended Particulate Matter (SPM) $\mu g/m^3$	*Annual Average **	*360*	*140*	*70*	*High Volume sampling, (Average flow rate not less than 1.1 m^3/minute*
	*24 hours***	*500*	*200*	*100*	
Respirable Particulate Matter (size > 10 mm) (RPM) $\mu g/m^3$	*Annual Average **	*120*	*60*	*50*	*Respirable particulate matter sampler*
	*24 hours***	*150*	*100*	*75*	
Lead (Pb) $\mu g/m^3$	*Annual Average **	*1.0*	*0.75*	*0.50*	*AAS Method after sampling using EPM 2000 or equivalent filter paper.*
	*24 hours***	*1.5*	*1.00*	*0.75*	
Ammonia mg/m^3	*Annual Average **	*0.1*	*0.1*	*0.1*	
	*24 hours***	*0.4*	*0.4*	*0.4*	
Carbon Monoxide (CO) mg/m^3	*8 hours***	*5.0*	*2.0*	*1.0*	*Non dispersive infrared spectroscopy*
	1 hour	*10.0*	*4.0*	*2.0*	

* *Annual arithmetic mean of minimum of 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*

Note:

1. *National Ambient Air Quality Standards: the levels of air quality with an adequate margin of safety, to protect the public health, vegetation and property.*
2. *Wherever and whenever two consecutive values exceeds the limit specified above for the respective category, it would be considered adequate reason to institute regular / continuous monitoring and further investigations.*
3. *The State Government / State Board shall notify the sensitive and other areas in the respective states within a period of six months from the date of Notification of National Ambient Air Quality Standards.*

Table 1.8 (a)
Ambient Air Quality Standards With Respect to Noise-
Central Pollution Control Board (CPCB) June'95, India

SCHEDULE - III- AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Area Code	*Category of Area*	*Limits in 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:

1. *Day Time is recorded in between 6 a.m. and 9 p.m.*
2. *Night time is recorded in between 9 p.m. and 6 a.m.*
3. *Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority.*
4. *Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.*
5. *Mixed categories of areas should be declared as one of the four above mentioned categories by the Competent Authority and the corresponding standards shall apply.*

Source: EPA Notification [G.S.R. 1063 (E) dt. 26.12.1989 published in the Gazette No. 643 dt. 26.12.1989].

Table 1.8 (b)
Noise 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*
¾	*107*

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.

Table 1.9
India Standard: Drinking Water Specifications- IS 10500:1991
Bureau of India Standards (BIS)
(AMENDMENT NO. 1 JANUARY 1993)
(First Revision) IS 10500: 1991

S.No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
1	2	3	4	5	6	7
			Essential Characteristics			
i	Colour, Hazen units, Max	5	Above 5, consumer acceptance decreases	25	3025 (Part 4) : 1983	Extended to 25 only if toxic substances are not suspected, in absence of alternate sources
ii	Odour	Unobjectionable	-	-	3025 (Part 5) : 1983	a. Test cold and when heated b. Test at several dilutions
iii	Taste	Agreeable	-	-	3025 (Parts 7 & 8) : 1984	Test to be conducted only after safety has been established
iv	Turbidity, NTU, Max	5	Above 5, consumer acceptance decreases	10	3025 (Part 10) : 1984	-
v	pH value	6.5 to 8.5	Beyond this range the water will affect the mucous membrane and / or water supply system	No relaxation	3025 (Part 11) : 1984	-
vi	Total hardness (as $CaCO_3$) mg/l, Max	300	Encrustation in water supply structure and adverse effects on domestic use	600	3025 (Part 21) : 1983	-
vii	Iron (as Fe) mg/l, Max #	0.3	Beyond this limit taste/ appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria	1.0	32 of 3025 : 1964	-
viii	Chlorides (as Cl) mg/l Max	250	Beyond this limit, taste, corrosion and palatability are affected	1000	3025 (Part 32) : 1988	-

S.No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
1	2	3	4	5	6	7
			Essential Characteristics			
ix	Residual, free chlorine, mg/l Min	0.2	-	-	3025 (Part 26) : 1986	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be Min 0.5 mg/l.
x	Fluoride (as F), mg/l Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	23 of 3025 : 1964	-
xi	Dissolved solids mg/l Max	500	Beyond this palatability decreases and may cause gastro intestinal irritation	2000	3025 (Part 16) : 1984	-
xii	Calcium (as Ca), mg/l Max	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 40) : 1991	-
xiii	Magnesium (as Mg), mg/l Max	30	Encrustation to water supply structure and adverse effects on domestic use	100	16, 33, 34 of IS 3025 : 1964	-
xiv	Copper (as Cu), mg/l Max #	0.05	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this.	1.5	36 of 3025 : 1964	-
xv	Manganese (as Mn) mg/l Max #	0.1	Beyond this limit taste/ appearance are affected, has adverse effect on domestic uses and water supply structures	0.3	35 of 3025 : 1964	-
xvi	Sulphate (as SO_4) mg/l Max	200	Beyond this causes gastro intestinal irritation when	400 (see col 7)	3025 (Part 24) : 1986	May be extended up to 400 provided (as Mg)

S.No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
1	2	3	4	5	6	7
Essential Characteristics						
			magnesium or sodium are present.			does not exceed 30
xvii	Nitrate (as NO_3), mg/l Max	45	Beyond this methaemoglobinemia takes place	100	3025 (Part 34) : 1988	-
xviii	Phenolic compounds (as C_6H_5OH) mg/l Max	0.001	Beyond this, it may cause objectionable taste and odor	0.002	54 of 3025 : 1964	-
xix	Mercury (as Hg) mg/l Max #	0.001	Beyond this, the water becomes toxic	No relaxation	(see Note) Mercury ion analyzer	To be tested when pollution is suspected
xx	Cadmium (as Cd), mg/l Max #	0.01	Beyond this, the water becomes toxic	No relaxation	(See Note)	To be tested when pollution is suspected
xxi	Selenium (as Se), mg/l Max #	0.01	Beyond this, the water becomes toxic	No relaxation	28 of 3025 : 1964	To be tested when pollution is suspected
xxii	Arsenic (as As), mg/l Max #	0.05	Beyond this, the water becomes toxic	No relaxation	3025 (Part 37) : 1988	To be tested when pollution is suspected
xxiii	Cyanide (as CN), mg/l Max	0.05	Beyond this limit, the water becomes toxic	No relaxation	3025 (Part 27) : 1986	To be tested when pollution is suspected
xxiv	Lead (as Pb), mg/l Max #	0.05	Beyond this limit, the water becomes toxic	No relaxation	(see Note)	To be tested when pollution is suspected
xxv	Zinc (as Zn) mg/l Max #	5	Beyond this limit it can cause astringent taste and an opalescence in water.	15	39 of 3025 : 1964	To be tested when pollution is suspected
xxvi	Anionic detergents (as MBAS) mg/l Max	0.2	Beyond this limit it can cause a light froth in water	1.0	Methyleneblue extraction method	To be tested when pollution is suspected
xxvii	Chromium (as Cr^{6+}) mg/l Max #	0.05	May be carcinogenic above this limit	No relaxation	38 of 3025 : 1964	To be tested when pollution is suspected
xxviii	Polynuclear aromatic hydrocarbons (as PAH)mg/l	-	May be carcinogenic	-	-	-
xxix	Mineral oil mg/l Max	0.01	Beyond this limit undesirable taste	0.03	Gas chromatogr	To be tested when pollution is

S.No	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
1	2	3	4	5	6	7
Essential Characteristics						
			and odor after chlorination take place		aph ic method	suspected
S.No .	**Substance or Characteristic**	**Requirement (Desirable Limit)**	**Undesirable Effect outside the Desirable Limit**	**Permissible Limit in the Absence of Alternate Source**	**Methods of Test (Ref to IS)**	**Remarks**
1	2	3	4	5	6	7
xxx	Pesticides mg/l Max	Absent	Toxic	0.001	-	-
xxxi	Radioactive materials a. Alpha emitters Bq/l, Max b. Beta emitters pci/l, Max	- -	- -	0.1 1	58 of 3025 : 1964 - -	-
xxxii	Alkalimity mg/l Max	200	Beyond this limit taste becomes unpleasant	600	13 of 3025 : 1964	-
xxxiii	Aluminum (as Al) mg/l Max #	0.03	Cumulative effect is reported to cause dementia	0.2	31 of 3025 : 1964	-
xxxiv	Boron (as Bo) mg/l Max	1	-	5	29 of 3025 : 1964	-

Note : # -Atomic absorption spectrophotometric method may be used.

Table 1.10
General Standards for discharge of Environment Pollutants
GSR 422(E)
THE ENVIRONMENTAL (PROTECTION) RULES, 1986 [1] [SCHEDULE - VI]
(See Rule 3A) PART - A: EFFLUENTS

S.No (1)	Parameter (2)	Standards			
		Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)	Marine Coastal Areas (d)
1	Color and Odor	See 6 of Annexure – I	--		
2	Suspended Solids mg/l, Max.	100	600	200	a. For Process waste water - 100 b. For cooling water effluent 10 percent above total suspended matter of influent.
3	Particular size of suspended solids	Shall pass 850 micron IS Sieve	--	--	a. Floatable solids max. 3mm b. Settleable solids max. 850 microns
4	****	**	--	**	--
5	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6	Temperature	Shall not exceed 5°C above the receiving water temperature	--	--	Shall not exceed 5°C above the receiving water temperature
7	Oil and Grease mg/l, Max.	10	20	10	20
8	Total residual chlorine mg/l, Max.	1.0	--	--	1.0
9	Ammonical Nitrogen (as N), mg/l, Max.	50	50	---	50
10	Total Kjeldahl Nitrogen (as NH_3) mg/l, Max.	100	--	--	100
11	Free Ammonia (as NH_3) mg/l, Max.	5.0	--	--	5.0
12	Biochemical oxygen demand (5 days at 20°C), mg/l Max.	30	350	100	100
13	Chemical Oxygen demand, mg/l Max.	250	-	-	250

S.No (1)	Parameter (2)	Standards			
		Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)	Marine Coastal Areas (d)
14	Arsenic (as As), mg/l Max.	0.2	0.2	0.2	0.2
15	Mercury (as Hg), mg/l Max.	0.01	0.01	-	0.01
16	Lead (as Pb), mg/l Max.	0.1	1.0	-	2.0
17	Cadmium (as Cd), mg/l Max.	2.0	1.0	-	2.0
18	Hexavalent Chromium (as Cr+6), mg/l Max	0.1	2.0	-	1.0
19	Total Chromium (as Cr), mg/l Max	2.0	2.0	-	2.0
20	Copper (as Cu), mg/l Max.	3.0	3.0	-	3.0
21	Zinc (as Zn), mg/l Max.	5.0	15	-	15
22	Selenium (as Sc.), mg/l Max.	0.05	0.05	-	0.05
23	Nickel (as Ni), mg/l Max.	3.0	3.0	-	5.0
24	**	**	**	**	**
25	**	**	**	**	**
26	**	**	**	**	**
27	Cyanide (as CN), mg/l Max.	0.2	2.0	0.2	0.2
28	**	**	**	**	**
29	Fluoride (as F) mg/l Max.	2.0	15	-	15
30	Dissolved Phosphates (as P), mg/l Max.	5.0	-	-	--
31	**	**	**	**	**
32	Sulphide (as S), mg/l Max	2.0	-	-	5.0
33	Phenoile Compounds (as C_6H_5OH) mg/l Max.	1.0	5.0	-	5.0
34	Radioactive Materials a Alpha emitter micro curie/ml b. Beta emitter micro curie/ml	10^{-7} 10^{-7}	10^{-7} 10^{-7}	10^{-7} 10^{-7}	10^{-7} 10^{-7}
35	Bio-assay test	90% survival of	90%	90%	90% survival of fish

S.No (1)	Parameter (2)	Standards			
		Inland Surface Water (a)	Public Sewers (b)	Land for Irrigation (c)	Marine Coastal Areas (d)
		fish after 96 hours in 100% effluent	survival of fish after 96 hours in 100% effluent	survival of fish after 96 hours in 100% effluent	after 96 hours in 100% effluent
36	Manganese (as Mn), mg/l Max	2	2	-	2
37	Iron (as Fe), mg/l Max.	3	3	-	3
38	Vanadium (as V), mg/l Max	0.2	0.2	-	0.2
39	Nitrate Nitrogen, mg/l Max.	10	-	-	20
40					

1. *Schedule VI inserted by rule 2 (d) of the Environment (Protection) Second Amendment Rules, 1993 notified vide G.S.R. 422 (E) dated 19.05.1993, published in the Gazette No. 174 dated 19.05.1993.*
2. *Omitted by Rule 2 (d) (i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No. G.S.R. 801 (E) dated 31.12.1993.*
3. *6 of Annexure - I All efforts should be made to remove colour and unpleasant odour as far as possible.*

1.8.4 Diesel Generator Sets: Stack Height

The minimum height of stack to be provided with each generator set can be worked out by using the following formula:

$H = h + 0.2 \times \sqrt{kVA}$

H = Total height of stack in meter

h = Height of the building I meters where the generator set is installed

KVA = Total generator capacity of the set in kVA.

Based on the above formula the minimum stack height to be provided with different range of generator sets may be categorized as follows:

For Generator Sets	Total Height of Stack (in m) above the building
50- KVA	Ht. Of the building + 1.5 m
50 – 100 KVA	Ht. Of the building + 2.0 m
100 – 150 KVA	Ht. Of the building + 2.5 m
150 – 200 KVA	Ht. Of the building + 3.0 m
200 – 250 KVA	Ht. Of the building + 3.5 m
250 – 300 KVA	Ht. Of the building + 3.5 m

Similarly for higher KVA ratings a stack height can be worked out using the above formula.

Notified by CPCB
[Emission Regulations Part IV: COINDS/26/1986-87]

1.8.5 Standards and Guidelines for Control of Noise Pollution from Stationary Diesel Generator (DG) Sets

(A) Noise Standards for DG sets (15-500 kVA)

The total sound power level, Lw, of a DG set should be less than 94+10 log10 (kVA), dB(A), at the manufacturing stage, where, KVA is the nominal power rating of a DG set.

This level should fall by 5 dB (A) every five years, till 2007, i.e. in 2002 and then in 2007.

(B) Mandatory acoustic enclosure/acoustic treatment of room for stationary DG sets (5 KVA and above)

Noise from the DG set should be controlled by providing an acoustic enclosure on by treating the room acoustically.

The acoustic enclosure/acoustic treatment of the room should 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 night time). The measurement for Insertion Loss may be done at different points at 0.5m from the acoustic enclosure/room, and then averaged.

The DG set should also be provided with proper exhaust muffler with Insertion Loss of minimum 25 dB (A).

(C) Guidelines for the manufacturers/users of DG sets 5 KVA and above)

01 *The manufacturer should 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).*

02 *The user should 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.*

03 *The manufacturer should furnish noise power levels of the unsilenced DG sets as per standards prescribed under (A).*

CHAPTER-II
PROCESS DESCRIPTION

Chapter-2
Process Description

2.1 PREAMBLE

In the present chapter, a discussion of the project details and the utilities being proposed in the present expansion is done. This chapter deals all the above issues by categorizing them into the existing and the proposed expansion heads and is explained in detail. The contents of this chapter are explained under the following heads.

- Resource requirement like the land, water, power and man-power
- Raw material requirement
- Products in the existing and the proposed expansion
- Pollution loads – Air /Water/Solid waste
- Material Balance and Process description product wise
- Wastewater pollution loads stage wise for all products

2.2 RESOURCE REQUIREMENT

2.2.1 Land Requirement

The present site is being operated in about 27.05 hectares or 66.86 acres of land. For the proposed expansion, Matrix Laboratories Ltd, Unit-8 is not proposing to acquire any additional land as the land for the existing project is sufficient for the expansion also. The new infrastructure additions to the plant are as follows:

- Addition of five new production blocks
- Two boilers of 4 and 15 TPH capacities to meet production as well forced evaporation facility needs for wastewater treatment
- Upgradation of the Effluent Treatment Plant
- Setting up one new solid waste incinerator of 5000 Kg/day and liquid waste incinerator of 1500 Kg/day capacities.

The above additions do not bring much change in the land-use statement of the plant site except for the addition of a few production blocks and other utilities. The approval from the Mandal Revenue Inspector- Pusapatirega Mandal is enclosed at the end of the EIA report as annexure.

The land use break up details of the project site both existing and proposed are given in the following table

Table 2.1
Land-Use Break-Up for the Site

Activity	Land in Hectares	
	Existing	Proposed
Production Blocks	1.97	1.6
Utilities	3.03	0.45
	5.0	**2.05**
Green Belt	20.0	
Total	**27.05**	

2.2.2 Water Requirement

The present water requirement of the plant is about 183 m^3/day and the proposed quantity is 970 m^3/d. The entire water requirement of the plant will be met from the bore-wells present within the plant premises only. The plant has sufficient quantities of water to meet the requirements of the proposed expansion also. The water requirement of the plant after expansion for process is given in the following table and summarized overall requirement inclusive of utilities and domestic required is presented in the tables to follow:

Table 2.2

Water Requirement – Product Wise (After Expansion)

S. No	Products	Water requirement – Liters/d
1	Tiaprofenic acid	2000.00
2	Naproxen Sodium	153895.5
3	Trazodone Hydrochloride	4125.0
4	Allopurinol	25164.3
5	Nabumetone	1800.0
6	Efavirenz	53125.0
7	Abacavir Sulfate	3192.2
8	Nelfinavir Mesylate	5560.0
9	Indinavir Sulfate	3028.6
10	CME Intermediate	20966.2
11	Citalporam Hydrobromide	10035.2
12	Gabapentene	9240.8
13	Ciprofloxacin Hydrochloride	96556.7
14	Zidovudine	130633.9
15	Naparoxen intermediate (Acetyl Yara Yara)	41500.0
	Total	**561003.4**
		561 m^3/d

Table 2.3

Water Requirement for the Existing Facilities

S. No	Category	Quantity (m^3/day)
1	For Process and washings	38.0
2	Cooling towers make-up	75.0
3	Boiler feed	30.0
4	Domestic & others including canteen, toilets, drinking water etc	25.0
5	Gardening/ Horticulture	15.0
	Total	**183.00**

The water requirement for the proposed expansion is given in the following table.

Table 2.4
Water Requirement after the Proposed Expansion

S. No	Category	Quantity (m^3/day)
1	For Process & washings	561.00
2	Cooling towers make-up	124.00
3	Boiler feed	175.00
4	Domestic & others including canteen, toilets, drinking water etc	35.00
5	Softener regeneration	30.00
6	DM Plant regeneration	30.00
7	Gardening/ Horticulture	15.00
	Total	**970.00**

Note: The water consumption for the boiler is based on recycling of steam condensate (it may be possible to recycle about >70% recycling of condensate back to either boiler feed or cooling tower

It is pertinent to mention that Matrix Laboratories Ltd, Unit-8 can take up manufacturing of all the proposed products at the same time after the proposed expansion by the creation or addition of new production blocks. Hence, it is proposed to seek permission for the maximum water requirement towards the production of proposed product mix and capacities.

2.2.3 Manpower Requirement

The manpower requirement of existing plant and after the proposed expansion are given in the **Table 2.5**.

Table 2.5
Manpower Requirement

Category	No. of persons employed	
	Existing	**After Expansion**
Managerial	12	15
Supervisory	10	25
Administrative	4	15
Skilled workers	150	275
Unskilled workers	130	175
Total	**306**	**505**

2.2.4 Process Plants and Machinery

The existing machinery in the plant consists of Process Reactors, Centrifuges, Condensers, Scrubbing system, Distillation apparatus, Heat exchangers, Packing lines and Specialized Laboratory equipment required for the plant. In addition to the proposed equipment Matrix Laboratories Ltd, Unit-8 will be using the spare capacities available in the existing unit.

a) Plant Layout

The layout of the process plants, auxiliary plants and the storage area showing the existing and the proposed expansion is given as **Figure 1.3** in chapter-I.

b) Process Plants

There are five production blocks with Pharma and utilities section. The various process plants classified under the above sections are shown in the plant layout.

c) Auxiliary Plants

In addition to the above process plants, Matrix Laboratories Ltd, Unit-8 has the following auxiliary plants to support the process operations. They are steam boilers, Reverse osmosis plants/ systems, softening plants/ DM plants, cooling water system, air pollution control/ treatment units and Effluent Treatment Plant.

d) Heat Exchangers/ Sub-coolers

The company has 48 heat exchangers of various capacities. At present 25 heat exchangers are used for chemical unit operations. It is proposed to convert /modify the balance chilling plants to suit the requirement. Atleast one will be kept as stand by for using in emergencies.

Apart from the heat exchangers, the present unit has about 17 sub-coolers of varying capacities to remove excess heat generated during the reactions and also to condense the solvent. The number of heat exchangers and sub-coolers are sufficient for the proposed expansion also and hence no increase in their number is being anticipated.

e) Nitrogen gas

The company has nitrogen gas generating unit of capacity of 25m^3/hr. The gas is primarily used for storage tanks and for road tankers of existing products. The requirement for the bulk drugs manufacturing can be met from the existing unit itself and hence no increase in the capacity is being envisaged in the proposed expansion also.

f) Compressed Air

The plant has unit capacity of 50 m^3/hr, which is more than the present requirement. At present the air being used for instrumentation and drying after washing, which requires about 20 m^3/hr and for speciality chemicals 10 m^3/hr and the remaining can be used for bulk drugs unit requirements.

2.2.5 Power & Fuel

a) Power

The industry is operating with APTRANSCO power supply and a separate sub-station has been installed at the plant site. Three generators with a total installed capacity of 1260 KVA (2 ×380 KVA and 500 KVA) were installed to supplement the power requirement during the power failures. In the proposed expansion, additional 2 × 1000 KVA generators are being added in addition to the existing ones.

b) Fuel

i) Diesel

The diesel requirement for the existing production is about 300 KL per annum to operate the DG sets on the site. The total diesel is being procured from M/s Hindustan Petroleum Corporation Ltd (HPCL) whenever it is required. There is no drastic increase in the diesel requirement in the present expansion, HSD of 600 Kl/annum is required after expansion to meet the fuel demand of the additional 2× 1000 KVA Dg sets being proposed.

ii) Coal

The coal requirement is purely to meet the requirements of the existing 5 TPH and 2 TPH boilers which are presently being used at the site. The exact coal requirement for the boiler is about 1800 MT per annum and is procured Singareni

Collieries Ltd and the transportation is by road. In the proposed expansion, 4 and 15 TPH boilers are being planned depending on the tonnage of the production and also the steam required for evaporating the high TDS streams.

2.2.6 Incinerator

At the existing unit an 800 Kg/day solid waste incinerator is already working and in the proposed expansion an additional solid waste incinerator of 5000 Kg/day and liquid waste incinerator of 1500 kg/d is being planned. It is pertinent to mention that a part of the solid waste generated from the plant operations (i.e. including process operations and the utilities) shall be sent for recovery with authorized parties and the remaining shall be incinerated on-site or sent to the CHWTSDF at Parawada whichever gets into operation first.

2.3 MATERIAL BALANCE AND PROCESS DETAILS

Matrix Laboratories Limited, Unit-8 is presently manufacturing eleven bulk drugs. As part of expansion the production capacity of some of the existing 6 products is being increased and 8 new products (bulk drugs) and 1 intermediate are being added owing to increased demand in the market for the medicines. The list of proposed products along with production capacities and their product wise brief process description, flow charts, chemical reactions and material balance are given in the end of this chapter.

2.3.1 Existing Products

The plant at present is manufacturing eleven products namely Tiaprofenic acid, Naproxen sodium, Allopurinol, Trazadone Hydrochloride, Fluconazole, Baclofen, Sulfasalazine, Citalopram Hydrobromide, Nabumetone, Nefazodone Hydrochloride and Midazolam.

2.3.2 Proposed Products

During the proposed expansion Matrix Laboratories Ltd, Unit-8 is adding eight new products (bulk drugs) and one intermediate and enhancing the production capacity of existing 6 products and dropping 5 products .The list of proposed products along with the production capacities is given in the table below. The material balances, process flow sheets of the existing products are given at the end of this chapter.

Table 2.6
List of Proposed Products (Capacities after Expansion)

S. No	Products	Quantity in TPM	Remarks
1	Tiaprofenic Acid	3	Existing Product. Capacity enhanced
2	Naproxen Sodium	50	Existing product. Capacity enhanced
3	Trazodone HCl	3	Existing product. Capacity enhanced
4	Allopurinol	8	Existing product. Capacity enhanced
5	Nabumetone	1	Existing product. Capacity enhanced
6	Citalopram Hydrobromide	2.5	Existing product. Capacity enhanced
7	Efavirenz	15	New Product
8	Abacavir Sulfate	3	New Product
9	Nelfinavir Mesylate	5	New Product
10	Indinavir Sulfate	3	New Product
11	Ciprofloxacin Hydrochloride	25	New Product
12	CME Intermediate	16.6	New Product
13	Zidovudine	25	New Product
14	Gabapantene	40	New Product
15	Naproxen Intermediate (Acetyl Yara Yara)	50	New Product

2.4 POLLUTION LOADS

The stage wise effluent characteristics of the proposed products are given at the end of this chapter.

2.4.1 Gaseous Emissions

Emissions from the process, fugitive emissions during the handling of the solvents and chemicals and Boiler emissions, are the major sources of the emissions to the air from the plant. The emissions from the boiler are Particulate Matter (SPM, RSPM, SO_2 and NO_X) and process emissions from the existing products are CO_2, HCl, H_2 and N_2 and that from the proposed products will be Carbon di oxide, Hydrogen gas, HCl, Ammonia, SO_2, Nitrogen and oxides of nitrogen etc.

a. **Process Emissions**

Though most of the process emissions are recovered or scrubbed using various scrubbers a definite amount of emissions are always emitted from the plant and this constitute the emissions from the process operations. Stage- wise process emissions are tabulated for each product for both the existing products and proposed products. It is pertinent to mention that not all products yield emissions during their manufacture. Hence, only those products which yield emissions during the reactions are given in the subsequent tables. The control equipment for the process emissions is given in the Environmental Management Plan (given as Chapter-5).

Table 2.7
Gaseous Generation/ Emissions from the Existing Products

Product	Stage	Gases Generated	Generation Rate (g/sec) per Kg of Product	Emission Rate (g/sec) per Kg of Product
Naproxen Sodium	I	CO_2	0.24	0.24
Nabumetone	II	H_2	0.001	0.001
Fluconazole	I	HCl	0.012	Traces
		CO_2	0.011	0.011
		N_2	0.009	0.009
Baclofen	IV	CO_2	0.011	0.011
Sulfasalazine	I	CO_2	0.036	0.036
Nefazodone HCl	II	N_2	0.009	0.009
Midazolam	I	HCl	0.003	Traces
	III	N_2	0.002	0.002

Note-Generation rate calculated based on per kg production of the product

Table 2.8
Gaseous Generation/ Emissions from the Proposed Products (After Expansion)

Product	Stage	Gases Generated	Generation Rate (g/sec) per Kg of Product	Emission Rate (g/sec) per Kg of Product
Naproxen Sodium	I	CO_2	3.54	3.54
Trazodone HCl	II	HCl	0.48	Traces
Abacavir Sulfate	II	HCl	0.16	Traces
Nabumetone	II	H_2	0.003	0.003
CME Intermediate	I	CO_2	0.82	0.82
	III	HCl	0.61	Traces
		NH_3	0.28	Traces
		SO_2	1.07	1.07
Ciprofloxacin	II	H_2	0.16	0.16
Gabapentene	I	HCl	38.39	Traces
	II	CO_2	4.62	4.62
Zidovudine	III	N_2	4.12	4.12
		NO	2.95	2.95

Note-Generation rate calculated based on per kg production of the product

b. Boiler Emissions

The emissions from the utilities include that from the boiler and DG sets. The plant has two existing coal fired boilers of capacities 5 and 2 TPH to cater to the steam requirements and three DG sets of 2×380 KVA and 500 KVA capacities . In the current expansion proposal Matrix Laboratories Ltd, Unit-8 is proposing to add additional boilers of capacities 4 and 15 TPH to meet the increased demand for the steam following expansion and two additional. DG sets of 1000 KVA each will be added in addition to the existing ones. The emissions details are presented below:

Table 2.9

Boiler Emissions

Source	Coal consumption (TPD)	Units	SPM	SO_2	NO_x
Existing					
2.0 T Coal Fired Boiler	6	g/sec	1.1	0.69	0.56
5.0 T Coal Fired Boiler	15	g/sec	2.8	1.74	1.39
Proposed					
4 TPH Coal fired boiler	12	g/sec	0.4	1.31	1.11
15 TPH Coal fired boiler	45	g/sec	1.7	5.21	4.17

c. **Fugitive Emissions**

The fugitive emissions are quantified from the material balance of each product and are presented in chapter 4 – Prediction of Impacts. The control equipment for fugitive emissions is given in Chapter-5 as Environmental Management Plan.

2.4.2 Liquid Wastes

Liquid wastes from the plant are in the form of process and washing wastes and the domestic effluents from various sources in the plant. The total liquid wastes from the existing production facilities are in the tune of 56.05 m^3/day and that after proposed expansion will be 700 m^3/d and the details of the above have been discussed in detail in the following chapters.

a) **Process Wastes**

Liquid wastes generated mainly during the chemical reactions, from the brine chilling units and floor washings is about 35.55 m^3/day from the existing production facilities. The nature of the effluent will be purely chemical. The waste water generated from the process after the proposed expansion will be 574 m^3/d and that from the washings will be 10 m^3/d.

b) **Wastewater from the steam system**

The blow down from the steam boiler constitutes the wastewater from the steam system. The wastewater from the process and washings and the steam system after the proposed expansion is in detail explained in the subsequent chapters.

c) Wastewater from Process and the domestic sources

The wastewater from the domestic use includes sanitary waste, canteen and toilet wastes. This accounts to be around 20.5 m^3/day from the existing facilities and 25 m^3/d after the proposed expansion.

The wastewater generated from the plant will be treated to meet the marine/ coastal standards in the effluent treatment plant and after that it is disposed into the sea through the marine outfall. There is no drastic increase in the domestic water requirements and hence the wastewater from the domestic purposes is expected to be more or less of the same quantity even after the expansion.

d) Summary of wastewater generation

The overall wastewater generation from the unit before and after expansion is summarized in the following tables. The wastewater generation is given below.

Table 2.10 (a)
Wastewater Generation (m^3/day) - Existing

S. No	Category	Wastewater Generation (m^3/day)
1	Process and washings	35.55
2	Cooling towers	-
3	Boiler	-
4	Domestic & others including canteen, toilets, drinking water etc	20.5
5	Gardening/ Horticulture	-
	Total	**56.05**

Table 2.10 (b)
Wastewater Generation (m^3/day) - (After Expansion)

S. No	Category	Wastewater generation (m^3/day)
1	Process	574.0 #
2	Cooling towers bleed off	15.5
3	Boiler blow down	15.5
4	Softener regeneration	30.0
5	DM Plant regeneration	30.0
6	Domestic & others including canteen, toilets, drinking water etc	35.0
7	Gardening/ Horticulture	-
	Total	**700.00**

The effluent generation from the manufacture of existing and proposed products is given in the following sections.

Table 2.10 (c)

Water Requirement (m^3/day)

S. No	Category	Existing	Proposed	Total
1	Process and washings	38.0	523	561
2	Cooling towers make-up/bleed off	75.0	49	124
3	Boiler feed/blow down	30.0	145	175
4	Softener regeneration	-	30	30
5	DM Plant Regeneration	-	30	30
4	Domestic & others including canteen, toilets, drinking water etc	25.0	-	25
5	Gardening/ Horticulture	15.0	-	15
	Total	**183.0**	**787**	**970**

Table 2.10 (d)

Wastewater Generation (m^3/day)

S. No	Category	Existing	Proposed	Total
1	Process and washings	35.55	538.45	574
2	Cooling towers make-up/bleed off	-	15.5	15.5
3	Boiler feed/blow down	-	15.5	15.5
4	Softener regeneration	-	30	30
5	DM Plant Regeneration	-	30	30
4	Domestic & others including canteen, toilets, drinking water etc	20.5	4.5	25
5	Gardening/ Horticulture	-	-	-
	Total	**56.05**	**643.95**	**700**

Table 2.11

Wastewater Generation from Process - Existing Products

S. No	Name of the Product	Effluent Generation (l/d)	
		High TDS	**Low TDS**
1	Tiaprofenic acid	190	475
2	Naproxen/Naproxen Sodium	2605	8194
3	Trazadone HCl	416	276
4	Allopurinol	533	13980

S. No	Name of the Product	Effluent Generation (l/d)	
		High TDS	Low TDS
5	Fluconazole	36	306
6	Baclofen	215	243
7	Sulfasalazine	271	0
8	Citalopram HBr	83	138
9	Nefazodone HCl	82	91
10	Nabumetone	0	1000
11	Midazolam (Lab scale)	33	73
		4464	24776
	TOTAL	**= 29240 liters/day**	
	Process + wash	= 35550 liters/day	
		Say 35.55m^3/d	

Table 2.12
Wastewater Generation from the Proposed Products (After Expansion)

S.No	Products	Wastewater liters/d
1	Tiaprofenic acid	2021.9
2	Naproxen Sodium	154137.9
3	Trazodone Hydrochloride	4156.6
4	Allopurinol	25236.9
5	Nabumetone	1802.4
6	Efavirenz	53183.3
7	Abacavir Sulfate	3208.6
8	Nelfinavir Mesylate	5560.0
9	Indinavir Sulfate	3085.4
10	CME Intermediate	20943.3
11	Citalporam Hydrobromide	11042.4
12	Gabapentene	20190.6
13	Ciprofloxacin Hydrochloride	97720.3
14	Zidovudine	130501.5
15	Naparoxen Intemedidate	41500.0

S.No	Products	Wastewater liters/d
	Total	**574291.1**
		=574 m^3/day

The list of raw materials and the pollution loads viz., TDS-Inorganic (Fixed solids), TDS-Organic (Volatile solids), COD for individual products are worked out based on material balance and the details of the same are furnished at the end of this chapter.

2.4.3 Solid wastes

The sources of solid waste from the plant are from the process, incinerator, boiler, DG sets, ETP, Forced evaporator etc. The total solid waste generated from the existing facilities is around 0.11 TPD and that after the proposed expansion is 25.01 TPD. The quantification of the solid wastes at each stage of the process is given in detail in the subsequent chapters.

Table 2.13

Stage-Wise Solid Waste Generation from the Proposed Products (After Expansion)

Product	Stage	Solid Waste			
		Solid Organic Residue	Liquid Organic Residue	Other Wastes (Carbon and Hyflow)	Inorganic Waste
		Kg/day			
Tiaprofenic acid	I	0	16.51	0	0
	II	22.86	3.11	0	13.0
Naproxen sodium	I	450.13	0	0	0
	II	18.14	0	173.7	0
	III	0	0	0	0
Trazadone HCl	I	0	0	0	0
	II	45.8	0	0	0
	III	17.19	0	9.38	0
Allopurinol	I	19.24	48.06	0	0
	II	0	0	18.57	0
	III	36.87	0	0	0
Nabumetone	I	8.16	0	0	0
	II	13.16	0	8.57	0
Efavirenz	I	460.16	0	39.06	0
	II	80.31	0	14.06	0
Abacavir sulfate	I	26.38	0	0	0
	II	39.73	0	24.44	0
	III	0	0	8.33	0
Nelfinavir mesylate	I	28.91	0	0	0
	II	31.42	0	0	0
Indinavir sulfate	I	32.4	0	8.57	0
	II	0	0	4.76	0
CME Intermediate	I	0	0	0	0
	II	0	14.79	0	0
	III	57.65	37.64	0	0
Citalopram HBr	I	199.6	0	0	24.4
	II	-0.7	0	0	0
	III	0	0	0	0
	IV	16.0	0	16.0	0
	V	0	0	3.2	0
Gabapantene	I	0	0	0	0

Product	Stage	Solid Waste			
		Solid Organic Residue	Liquid Organic Residue	Other Wastes (Carbon and Hyflow)	Inorganic Waste
		Kg/day			
	II	0	0	0	0
	III	1468.6	0	66.5	0
Ciprofloxacin HCl	I	0	216.5	0	273.6
	II	423.1	162.7	0	0
	III	20.8	0	0	0
	IV	0	0	0	0
	V	3.5	0	86.5	0
	VI	24.2	34.6	0	0
Zidovudine	I	539.56	37.88	0	0
	II	33.99	579.33	0	0
	III	0	0	0	0
	IV	571	0	75.75	0
Total		**4688.14**	**1151.17**	**557.39**	**626.16**

The summarized solid waste from the plant before and after expansion is given in the following table.

Table 2.14
Solid Wastes Generation

Source	Quantity (TPD)		Remarks
	Existing	After Expansion	
Forced evaporator salts	-	15.1	Sent to TSDF at Hyderabad
ETP sludge	0.09	8.6	Sent to TSDF at Hyderabad
Inorganic wastes	-	0.63	Sent to TSDF at Hyderabad
Incinerator ash	0.004 #	0.12	Sent to TSDF at Hyderabad
Spent carbon	0.02	0.56	Sent to TSDF at Hyderabad
Fly ash	8.4	31.2	Sold to local Brick Manufacturers
Total	**0.11**	**25.01**	

Note: # The Solid and liquid organic residue of 5839.31 kg/d i.e., 5.83 TPD is being sent to the incinerator and the incinerator ash of about 116.786 kg/d i.e 0.12 TPD is being sent to the TSDF.

2.5 MATERIAL BALANCE AND PROCESS DETAILS

Product wise brief process description, flow charts, chemical reactions and material balance are given in subsequent sections of this chapter.

2.6 PROPOSED PRODUCTS

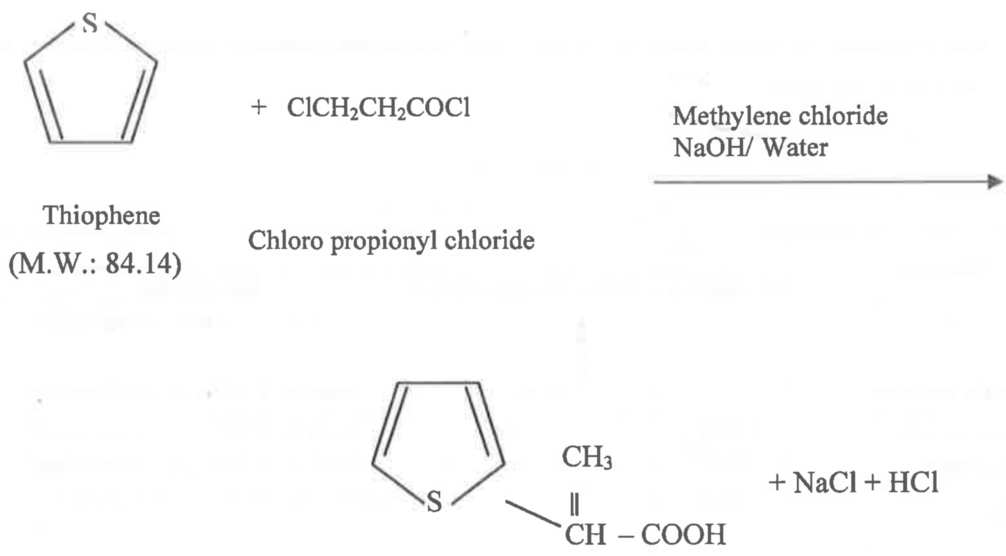
2.6.1 Tiaprofenic Acid- 3 TPM

a) Process Description

Stage-I (RS)-2-(2-Thienyl) Propanoic Acid (Stage-1)

Condensation of Thiophene with 2-chloropropionyl chloride gives an ester which on hydrolysis and acidification gives Stage-1(α-Methyl thiophene acetic acid)

The principal reaction involved is given below.



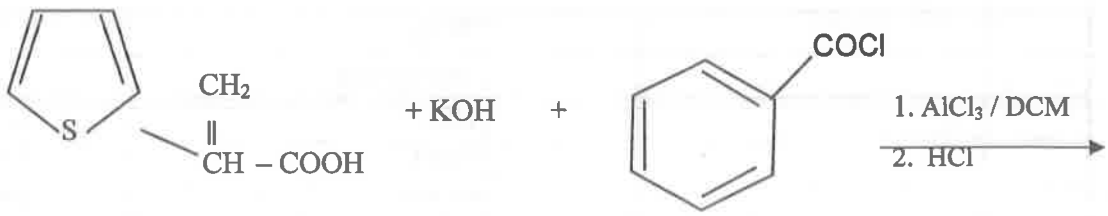
α-Methyl thiophene acetic acid
(M.W.: 156)

Stage -I

$$\underset{84}{C_4H_4S} + \underset{127}{C_3H_4Cl_2O} + \underset{40}{NaOH} \xrightarrow[H_2O]{MDC} \underset{156}{C_7H_8O_2S} + \underset{58.5}{NaCl} + \underset{36.5}{HCl}$$

Stage-II Tiaprofenic Acid

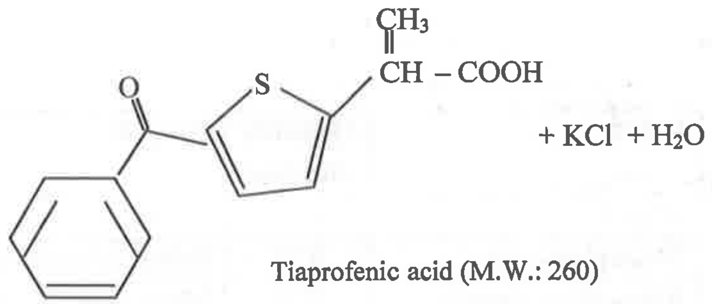
Benzoylation of (RS)-2-(2-thienyl) propanoic acid using benzoyl chloride and aluminium chloride in methylene chloride affords tiaprofenic acid.



α-Methyl thiophene acetic acid
(M.W.: 156)

Benzoyl chloride
(M.W.: 140.5)

Stage -II



Tiaprofenic acid (M.W.: 260)

$$\underset{156}{C_7H_8O_2S} + \underset{140.5}{C_7H_5OCl} + \underset{56.09}{KOH} \xrightarrow{AlCl_3} \underset{260}{C_{14}H_{12}O_3S} + \underset{74.59}{KCl} + \underset{18}{H_2O}$$

b) Material Balance **Tiaprofenic Acid**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Thiophene	0.57	Stage-I product	0.83
2	Methylene chloride	5.71	**solvent recovery**	
3	Chloro proponyl chloride	0.71	Methylene chloride	5.49
4	Sodium hydroxide flakes	0.23	**Solvent Loss**	
5	Water	11.43	Methylene Chloride	0.23
			Wastewater	
			Water	11.43
			Inorganics	
			HCl	0.19
			NaCl	0.31
			NaOH	0.02
			Organic residue	
			Thiophene	0.13
			Chloro propionyl chloride	0.04
	Total	**18.66**	**Total**	**18.66**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	0.83	Tiaprofenic acid	1
2	Benzoyl chloride	0.57	**Solvent recovery**	
3	Alluminium chloride	0.22	Methylene chloride	2.47
4	Potassium hydroxide	0.23	**Solvent Loss**	
5	Methylene chloride	2.86	Methylene chloride	0.11
6	Conc. HCl	0.22	**Wastewater**	
7	Water	8.57	Water	8.57
8	NaOH	0.2	water from conc. HCl	0.15
			water from the reaction	0.07
			Inorganics	

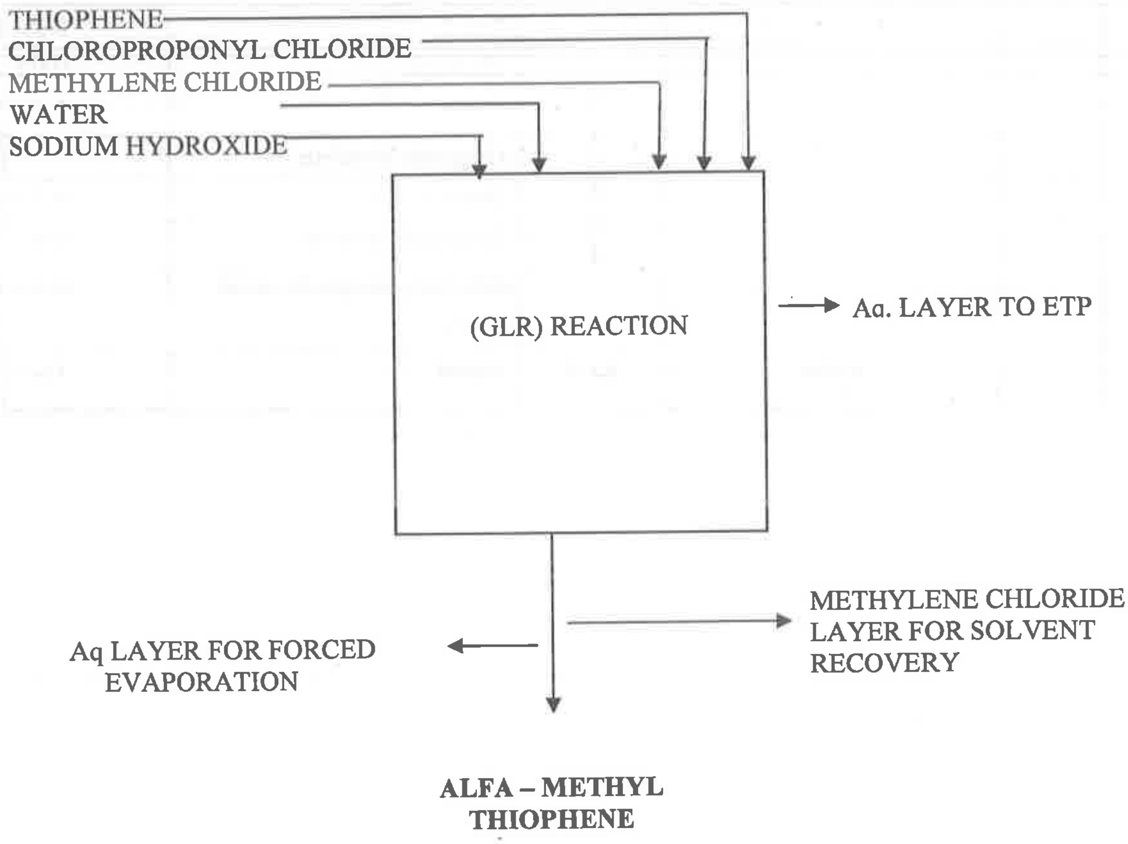
Tiaprofenic Acid

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			KCl	0.29
			NaCl	0.29
			HCl left	0.07
			KOH	0.01
			Organic residue	
			Stage-I	0.23
			Benzoyl chloride	0.03
			$Al(OH)_3$ inorganic solid waste	0.13
	Total	**13.7**	**Total**	**13.7**

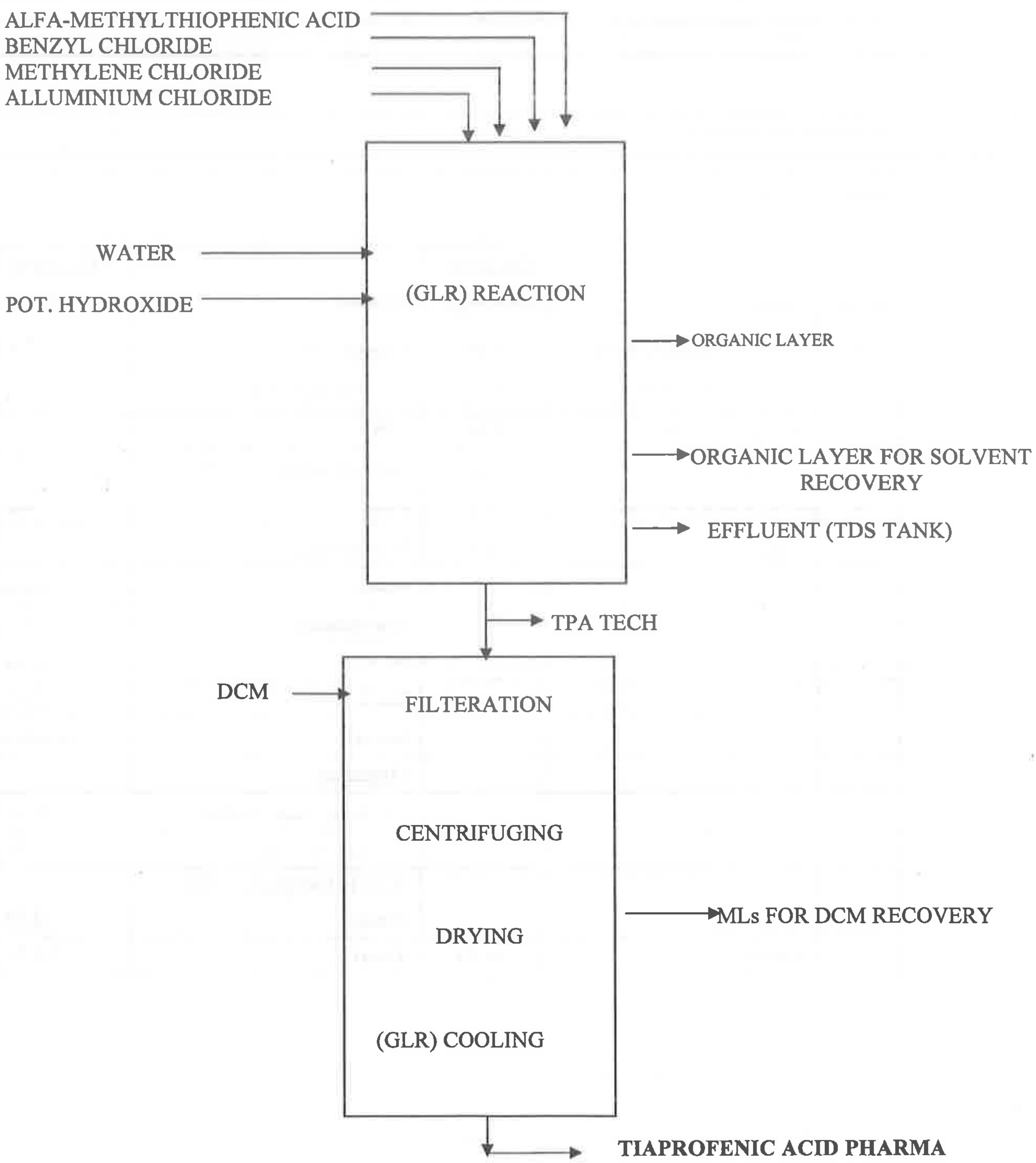
Tiaprofenic Acid

c) Process Flow Sheet

Stage – I



Stage-II **Tiaprofenic Acid**



2.6.2 Naproxen Intermediate-50 TPM

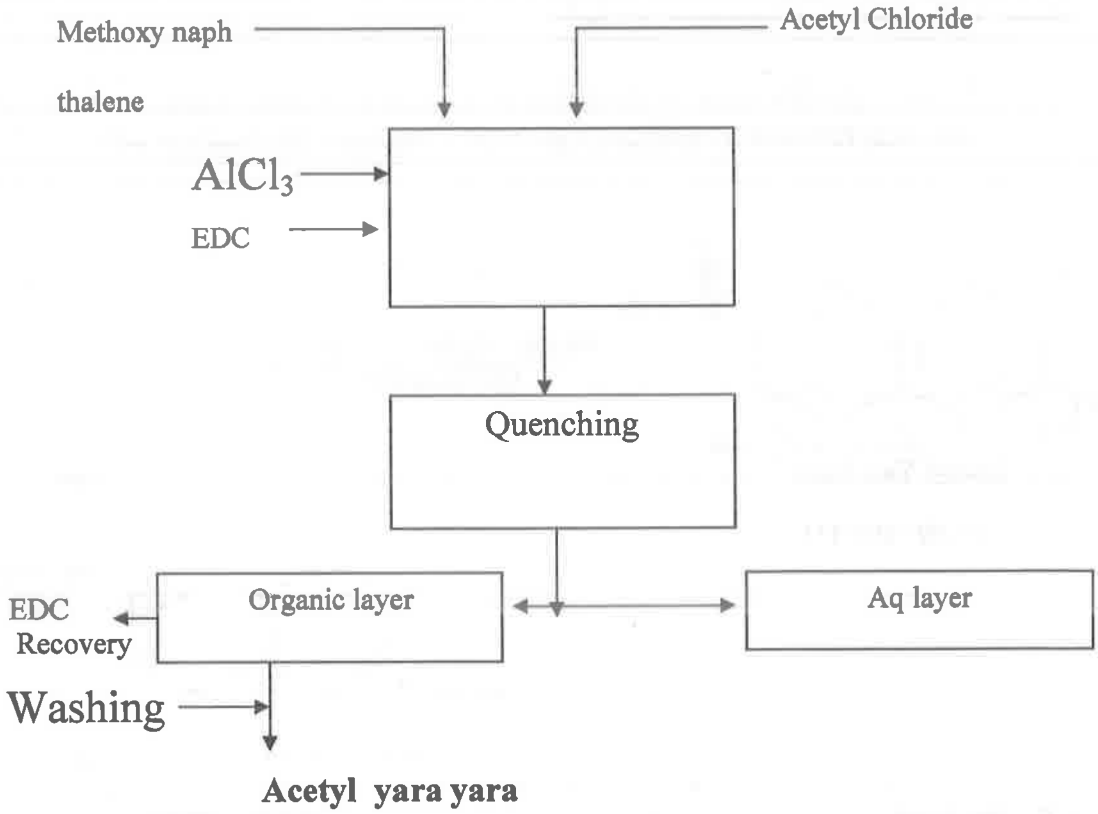
$$\underset{158}{C_{11}H_{10}O} + \underset{78.5}{C_2H_3ClO} \longrightarrow \underset{200}{C_{13}H_{12}O_2} + \underset{36.5}{HCl}$$

a) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Methoxy naphthalene	1.00	Acetyl yara yara	1
2	Alluminium chloride	0.33	**Solvent Recovery**	
3	Acetyl chloride	0.60	EDC	7.3
4	DM Water	25.00	**Solvent Loss**	
5	Ethylene dichloride	7.5	EDC	0.2
7	NaOH	0.3	**Wastewater**	
			water	25.0
			Inorganics	
			HCl	0.18
			NaCl	0.43
			NaOH	0.0004
			Organics	
			Methoxy naphthalene	0.21
			Acetyl chloride	0.20
			$AlOH_3$ Inorganic solid waste	0.19
	Total	**34.71**	**Total**	**34.71**

(c) Process Flow Sheet

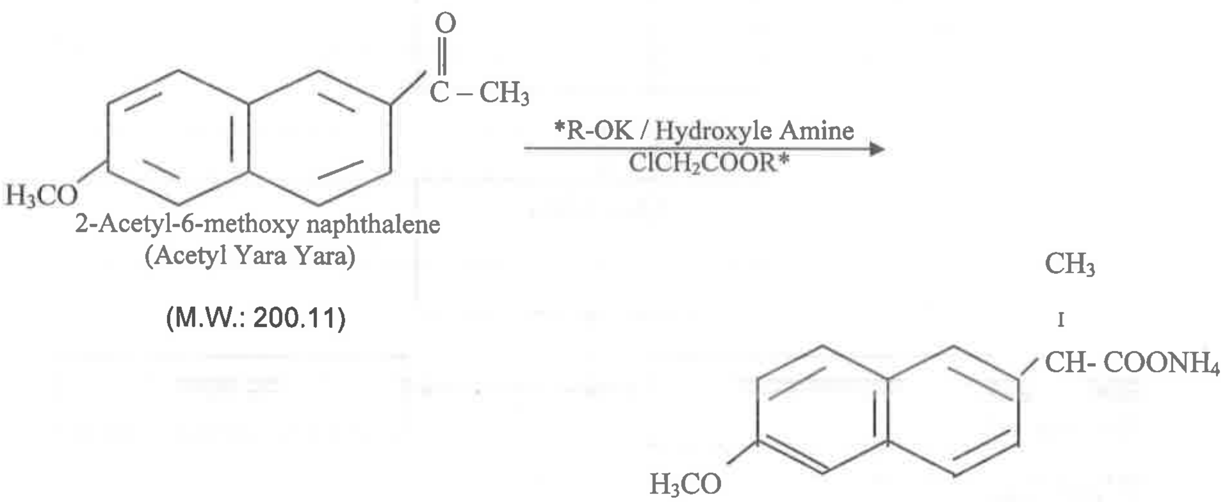


2.6.3 Naproxen Sodium- 50 TPM

a) Process Description

Stage- I DL-Naproxen (Ammonium Salt)

Darzen's glycidic ester condensation of 2-acetyl-6-methoxy naphthalene (Acetyl yara yara) followed by hydrolysis gives DL - Naproxen (Ammonium salt).



2-Acetyl-6-methoxy naphthalene
(Acetyl Yara Yara)

(M.W.: 200.11)

DL-Naproxen (Ammonium salt)

(M.W.: 247.26)

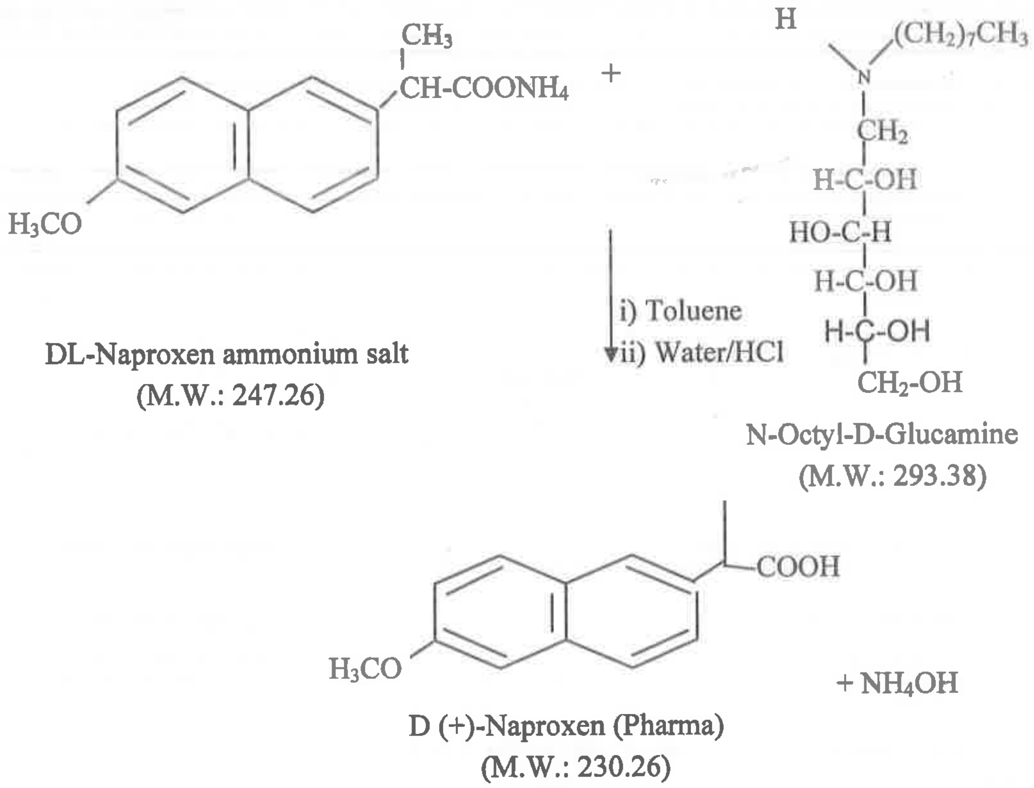
* R = Sec. Butyl

$$\underset{200}{C_{13}H_{12}O_2} + \underset{150.5}{C_6H_{11}ClO_2} + \underset{112.09}{C_4H_9KO} + \underset{40}{NaOH} + \underset{36.5}{HCl} + \underset{69.5}{NH_2OH.\ HCl} + \underset{18}{H_2O} \longrightarrow$$

$$\longrightarrow \underset{247}{C_{14}H_{17}O_3N} + \underset{148}{2\ C_4H_{10}O} + \underset{74.59}{KCl} + \underset{58.5}{NaCl} + \underset{36.5}{HCl} + \underset{18}{H_2O} + \underset{44}{CO_2\uparrow}$$

Stage- II D (+) Naproxen (Pharma)

Treatment of DL - Naproxen with N-Octyl-D-glucamine gives D (+)-Naproxen-N-Octyl glucamine salt, which on acidification followed by extraction into Toluene and then crystallization gives Naproxen (Pharma).

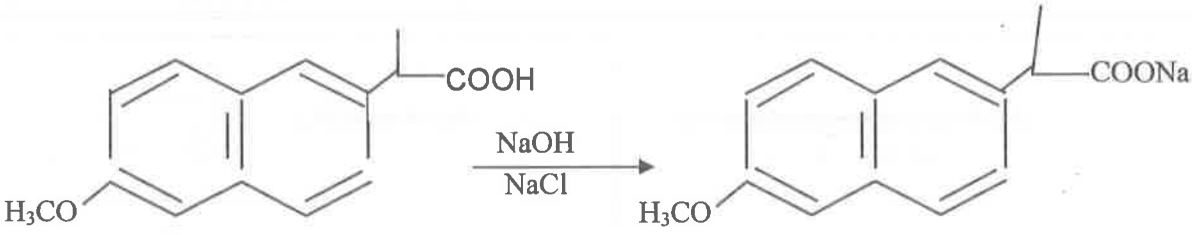


$$\underset{247}{C_{14}H_{17}O_3N} + \underset{18}{H_2O} \longrightarrow \underset{230}{C_{14}H_{14}O_3} + \underset{35}{NH_4OH}$$

Naproxen Sodium

Stage- III Naproxen Sodium

Salt formation of naproxen (Pharma) with Sodium hydroxide gives Naproxen Sodium.



D (+)-Naproxen (Pharma)

(M.W.: 230.26)
(M.F: $C_{14}H_{14}O_3$)

Naproxen Sodium

(M.W.: 252.52)
(M.F: $C_{14}H_{14}O_3Na$)

$$\underset{230}{C_{14}H_{14}O_3} + \underset{40}{NaOH} \longrightarrow \underset{252}{C_{14}H_{13}O_3Na} + \underset{18}{H_2O}$$

b) Material Balance
Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Acetyl yara yara	0.93	DL Naproxen	1.03
2	Potassium-2-butoxide	0.58	2- Butanol	0.62
3	2- Butyl chloro acetate	0.70	**Wastewater**	
4	C.S Lye	0.93	Water	38.60
5	HA HCl	0.34	Water from neutralization	0.08
6	Conc. HCl	0.76	**Inorganics**	
7	Water	38.68	KCl	0.31
			Excess HCl	0.60
			NaCl	0.25
			Excess NaOH	0.76
			HA HCl	0.05

Naproxen Sodium

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			HCl	0.15
			Gases	
			CO_2	0.18
			Organic residue	
			Acetyl yara yara	0.09
			2- Butyl chloro acetate	0.07
			Potassium-2- butoxide	0.11
	Total	42.91	**Total**	**42.91**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	DL naproxen	1.03	D (+) naproxen sodium	0.95
2	Toulene	4.65	NOG (recovery)	0.47
3	NOG	0.49	NOG (loss)	0.02
4	HCl (33%)	0.35	**Solvent Recovery**	
5	Carbon	0.10	Toulene	4.51
6	CS Lye	0.63	Methanol	0.22
7	Acetic acid	0.26	**Solvent Loss**	
8	Methanol	0.23	Toulene	0.14
9	Water	44.73	Methanol	0.01
			Wastewater	
			Water	44.65
			Water from neutralization	0.15
			Inorganics	
			Sodium chloride	0.24
			Sodium hydroxide	0.30
			HCl	0.20
			Ammonium hydroxide	0.15
			Organics	
			Excess Acetic acid	0.01

Naproxen Sodium

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Sodium acetate	0.34
			Solid waste	
			Carbon sludge	0.10
			Organic residue	
			DL Naproxen	0.01
	Total	**52.48**	**Total**	**52.48**

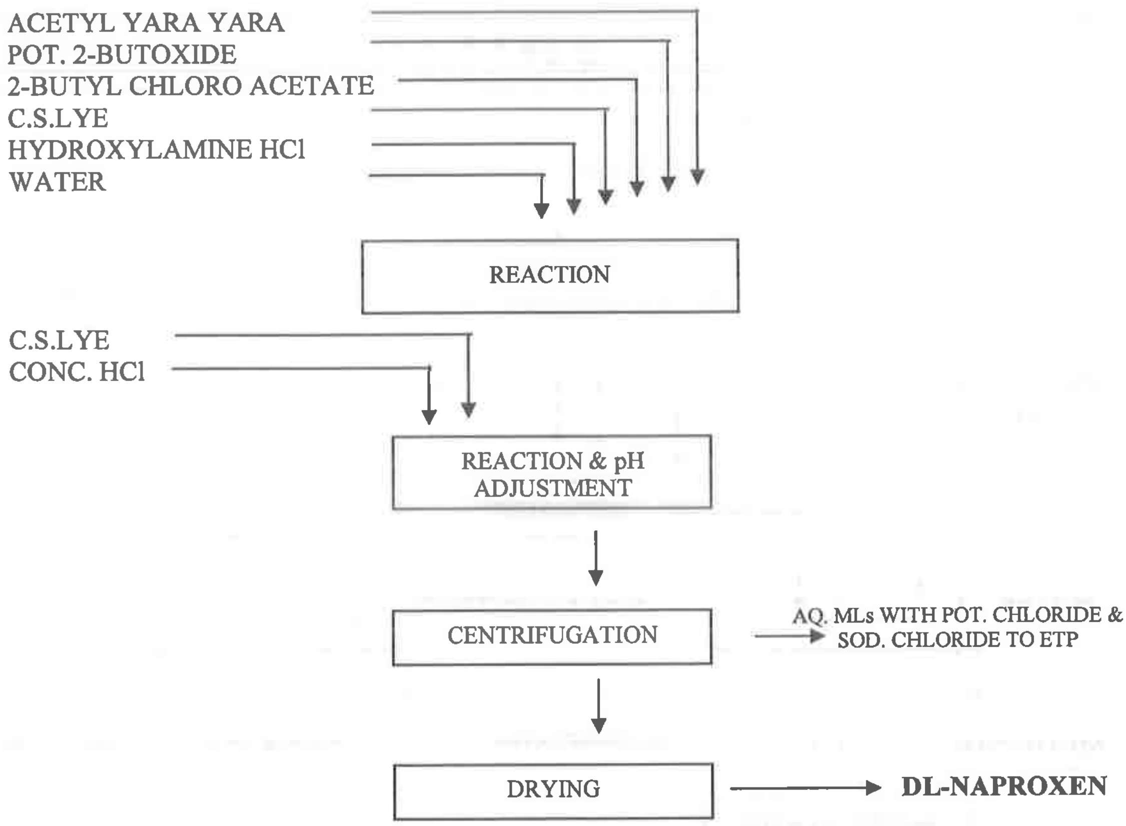
Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	D (+) naproxen pharma	0.95	Naproxen sodium	1
2	Sodium hydroxide	0.16	**Wastewater**	
3	Sodium chloride	0.47	Water	9.3
4	Water	9.30	Water from neutralization	0.1
			Inorganics	
			Sodium chloride	0.5
			Sodium hydroxide	0.001
			Organic	
			D (+) naproxen pharma	0.04
	Total	**10.88**	**Total**	**10.88**

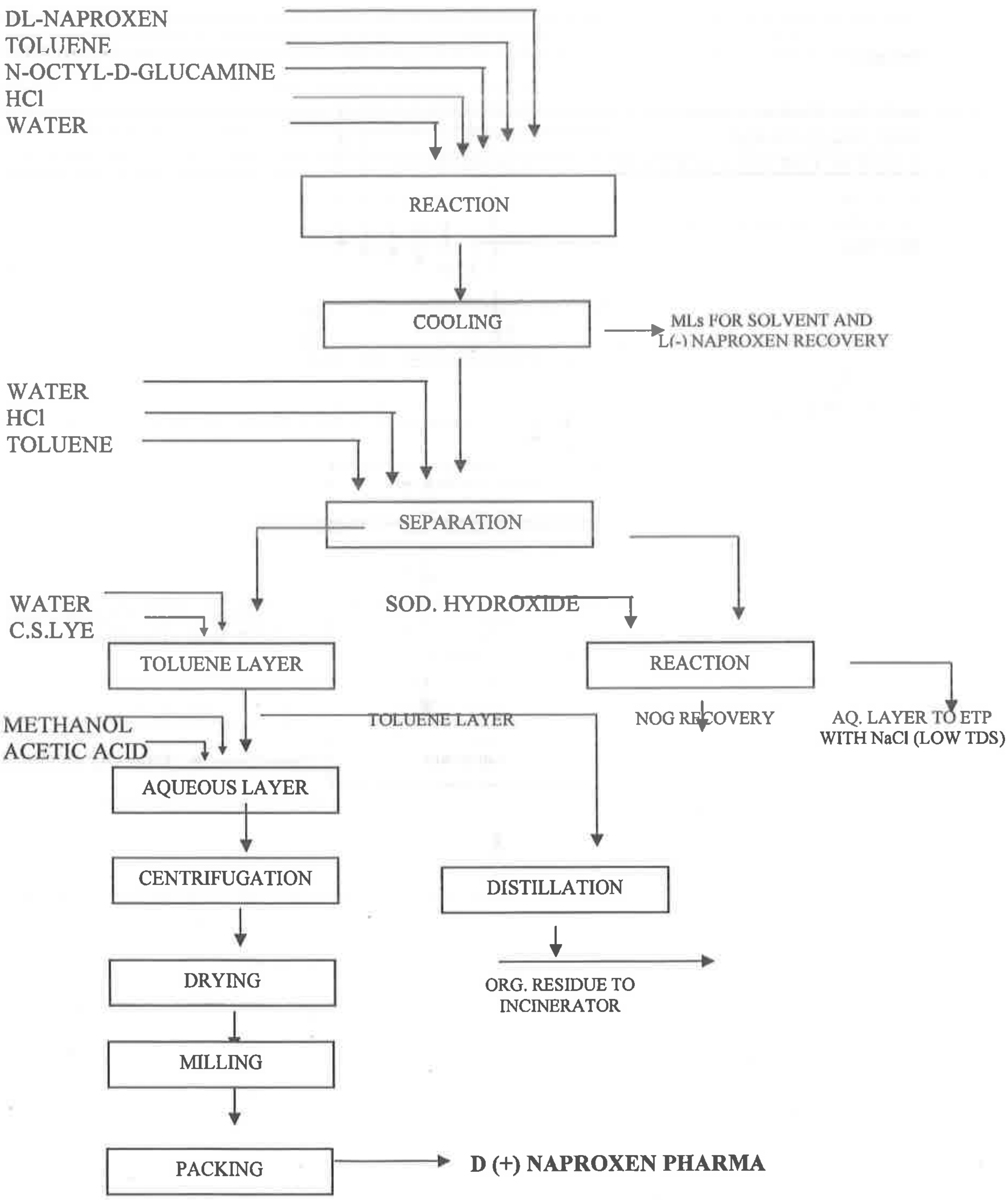
Naproxen Sodium

c) Process Flow Sheet

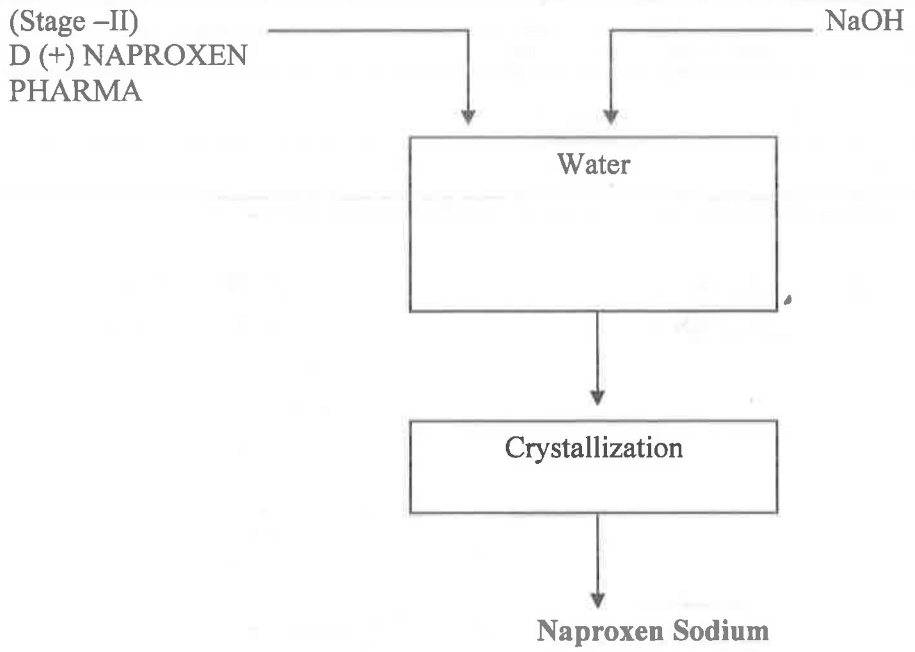
Stage-I



Stage - II


DL-NAPROXEN
TOLUENE
N-OCTYL-D-GLUCAMINE
HCl
WATER
REACTION
COOLING
MLs FOR SOLVENT AND
L(-) NAPROXEN RECOVERY
WATER
HCl
TOLUENE
SEPARATION
WATER
C.S.LYE
SOD. HYDROXIDE
TOLUENE LAYER
REACTION
METHANOL
ACETIC ACID
TOLUENE LAYER
NOG RECOVERY
AQ. LAYER TO ETP
WITH NaCl (LOW TDS)
AQUEOUS LAYER
CENTRIFUGATION
DISTILLATION
DRYING
ORG. RESIDUE TO
INCINERATOR
MILLING
PACKING
D (+) NAPROXEN PHARMA

Stage – III **Naproxen Sodium**

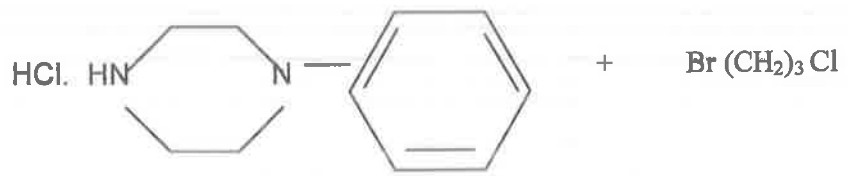


2.6.4 Trazodone Hydrochloride- 3 TPM

a) Process Description

Stage-I 1-(3-Chloropropyl)-4-(3-Chlorophenyl) Piperazine (TH – I)

1-(3-chlorophenyl) piperazine hydrochloride reacts with 1-bromo-3-chloro propane in water and acetone mixture using sodium hydroxide as a base followed by quenching into acidic water affords 1-(3-chloropropyl)-4-(3-chlorophenyl) piperazine hydrochloride. This, on basification and extraction into chloroform and distillation of solvent gives 1-(3-chloropropyl)-4-(3-chlorophenyl) piperazine base.

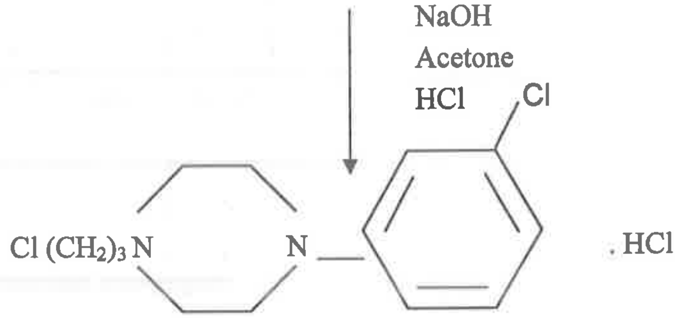


1-(3-chlorophenyl) piperazine

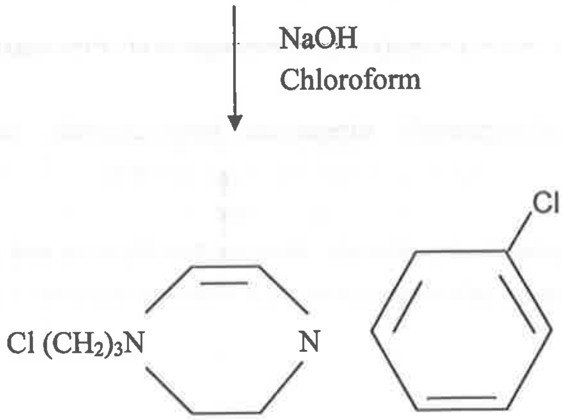
1-Bromo-3-Chloro propane

(M.W.: 233.10)
(M.F: $C_{10}H_{14}Cl_2N_2$)

(M.W.: 157.49)
(M.F: C_3H_6BrCl)



1-(3-chloropropyl)-4-(3-chlorophenyl) piperazine hydrochloride
(M.F: $C_{13}H_{19}N_2Cl_3$)

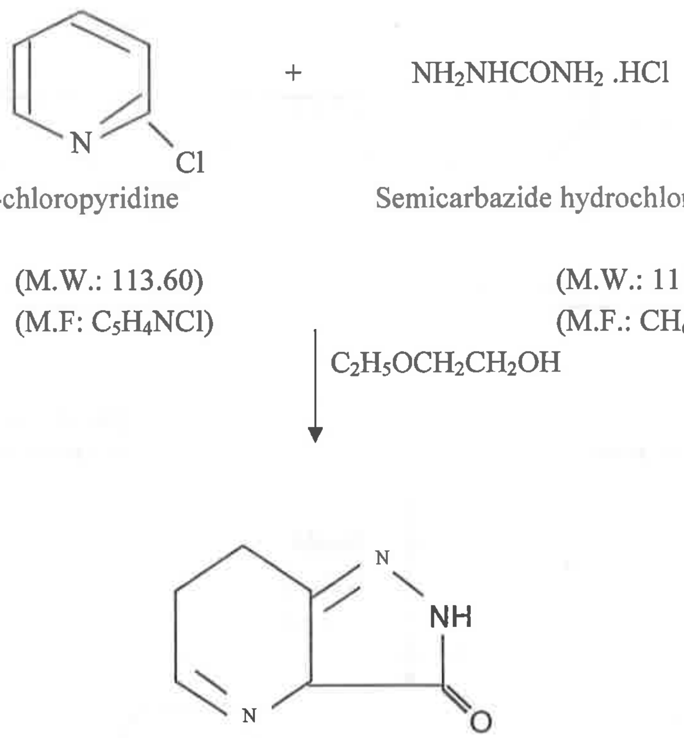


1-(3-chloropropyl)-4-(3-chlorophenyl) piperazine (TH-III) (M.W.: 273.15)
(M.F: $C_{13}H_{18}N_2Cl_3$)

$C_{10}H_{14}Cl_2N_2$ +	C_3H_6BrCl +	2 NaOH +	HCl	$\longrightarrow$	$C_{13}H_{18}N_2Cl_2$ +	$2H_2O$ +	NaCl +	NaBr
233	157.4	80	36.5		273	36	58.5	102.9
								+ ½ Cl_2
								35.5

Stage-II Sodium Salt of 1,2,4-Triazolo- [4,3-a]-Pyridin-3-One (TH–II)

Reaction of 2-chloropyridine with semicarbazide hydrochloride in ethoxyethanol gives 1,2,4-Triazolo- [4,3-a]-pyridin-3-one.



2-chloropyridine (M.W.: 113.60) (M.F: C_5H_4NCl)

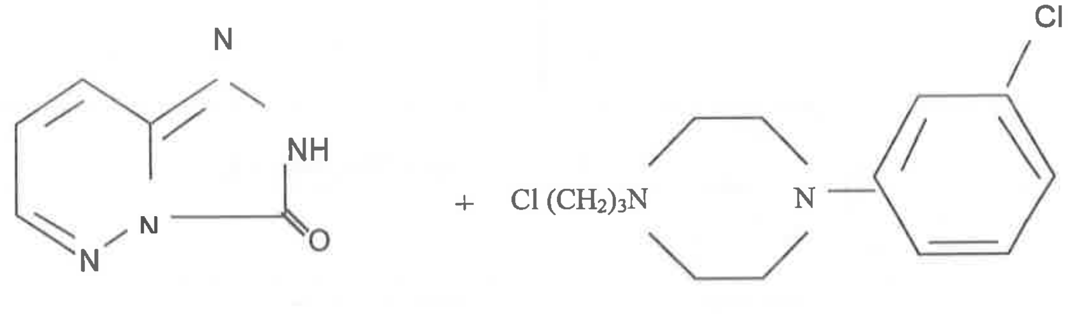
Semicarbazide hydrochloride (M.W.: 111.54) (M.F.: CH_6N_3ClO)

1,2,4-Triazolo- [4,3-a]-pyridin-3-one (TH-IV)
(M.W.: 135.06)
(M.F: $C_6N_3H_5O$)

$$\underset{113.5}{C_5H_4NCl} + \underset{111.5}{CH_6N_3ClO} \xrightarrow{C_2H_5OCH_2CH_2OH} \underset{135}{C_6H_5N_3O} + \underset{36.5}{HCl} + \underset{53.5}{NH_4Cl}$$

Stage-III Trazodone HCl (Technical) (TH– III)

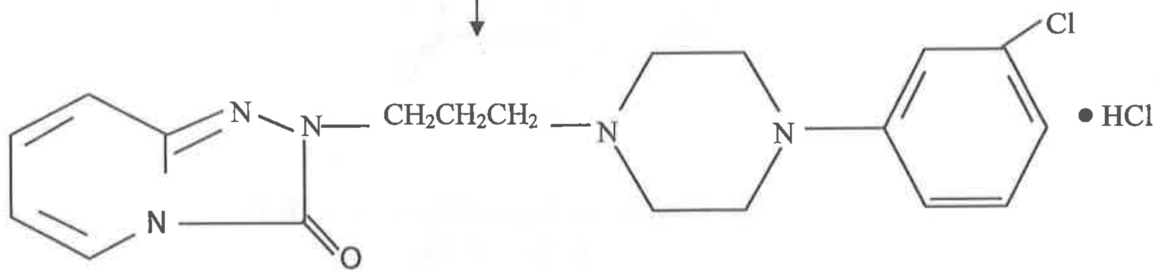
1-(3-chloropropyl)-4-(3-chlorophenyl) piperazine base reacts with 1,2,4-Triazolo[4,3-a] pyridin-3-one followed by acidification with IPA HCl gives Trazodone HCl (technical grade).



1,2,4-Triazolo[4,3-a] pyridin-3-one
(M.W.: 135)
(M.F: $C_6N_3H_5O$)

1-(3-chloropropyl)-4(3-chlorophenyl) piperazine
(M.W.: 273.15)
(M.F: $C_{13}H_{18}N_2Cl_2$)

NaoH
Xylene
IPA HCl

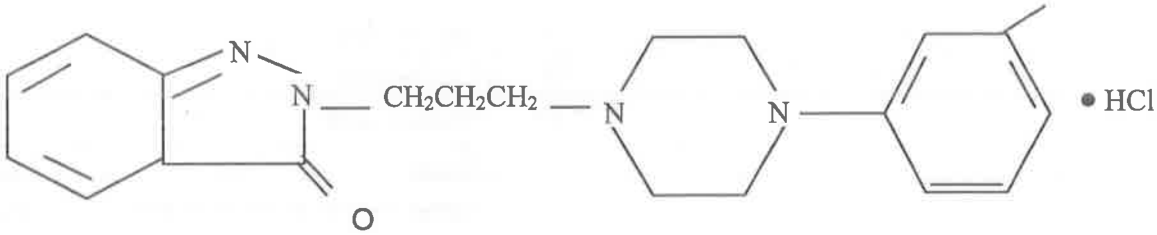


Trazodone HCl (Technical) (TH – V)
(M.W.: 408.32)
(M.F: $C_{19}H_{23}N_5Cl_2O$)

$$\underset{135}{C_6H_5N_3O} + \underset{273}{C_{13}H_{18}N_2Cl_2} \xrightarrow[\text{Xylene/ IPA- HCl}]{\text{NaOH}} \underset{408}{C_{19}H_{23}N_5Cl_2O}$$

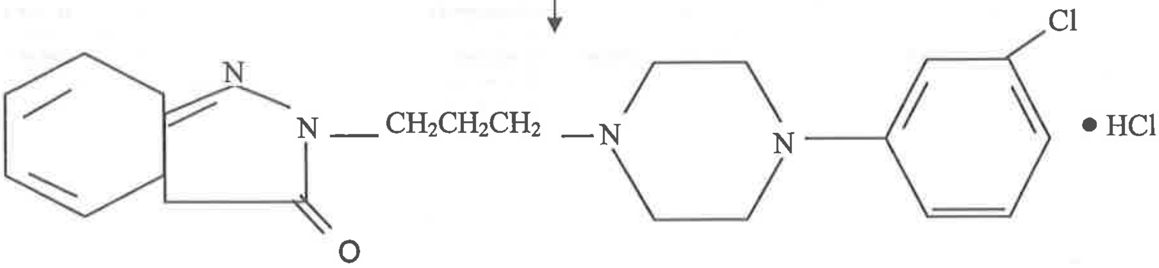
Stage-IV Trazodone HCl (pharma) (TH-IV)

Purification of Trazodone HCl (Technical) twice in methanol gives Trazodone HCl pharmacopoeial grade.



Trazodone HCl (Technical) (TH – V)
(M.W.: 408.32)
(M.F: $C_{19}H_{23}N_5Cl_2O$)

Purification in Methanol



Trazodone HCl Pharma (M.W.: 408.32)
(M.F: $C_{19}H_{23}N_5Cl_2O$)

$$\underset{408}{C_{19}H_{23}N_5Cl_2O} \xrightarrow[\text{Carbon}]{\text{Methanol}} \underset{408}{C_{19}H_{23}N_5Cl_2O}$$

b) Material Balance

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-II	1.88	Stage-III product	2.06
2	Bromo chloro propane	1.27	**Solvent recovery**	
3	CS Flakes	0.69	Chloroform	7.2
4	Chloroform	7.50	**Solvent Loss**	
5	Acetone	1.88	Chloroform	0.3
6	Water	15.63	**Wastewater**	
			Water	15.63
			water formed in the reaction	0.27
			Inorganics	
			Sodium bromide	0.78
			Sodium chloride	0.44
			Sodium hydroxide	0.08
			Organic	
			Acetone	1.88
			Stage-II	0.19
	Total	**28.8**	**Total**	**28.8**

Trazodone Hydrochloride

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	2- chloropyridine	1.50	Stage-IV product	1.56
2	semicarbazide HCl	1.56	**Solvent recovery**	
3	Ethoxy ethanol	1.56	Ethoxy ethanol	1.5
4	Water	9.38	**Solvent Loss**	
			Ethoxy ethanol	0.06
			Wastewater	
			water	9.38
			Inorganics	
			Ammonium chloride	0.62
			Gases	
			HCl	0.42
			Organic residue	0.46
	Total	**14.0**	**Total**	**14.0**

Stage-IV

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-III base	0.78	Trazadone Hydrochloride	1
2	Stage-IV	0.39	**Solvent recovery**	
3	Xylene	3.00	Xylene	2.91
4	IPA	0.50	IPA	0.48
5	Carbon	0.06	IPA-HCl	0.26
6	Hyflow	0.03	**Solvent Loss**	
7	IPA HCl	0.53	Xylene	0.09
8	Sodium hydroxide	0.12	IPA	0.02
9	Water	16.25	IPA-HCl	0.17
			Wastewater	
			Water	16.25
			Water generated from reaction	0.04

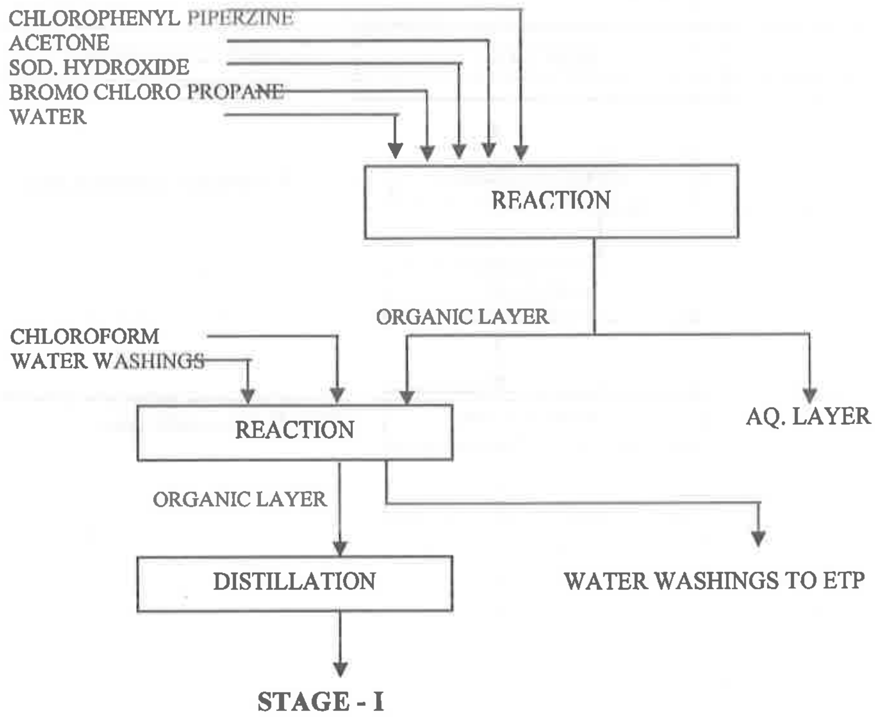
Trazodone Hydrochloride

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Inorganics	
			NaOH	0.02
			NaCl	0.14
			Solid waste	
			Carbon + Hyflow sludge	0.09
			Organic residue	0.17
	Total	**21.66**	**Total**	**21.66**

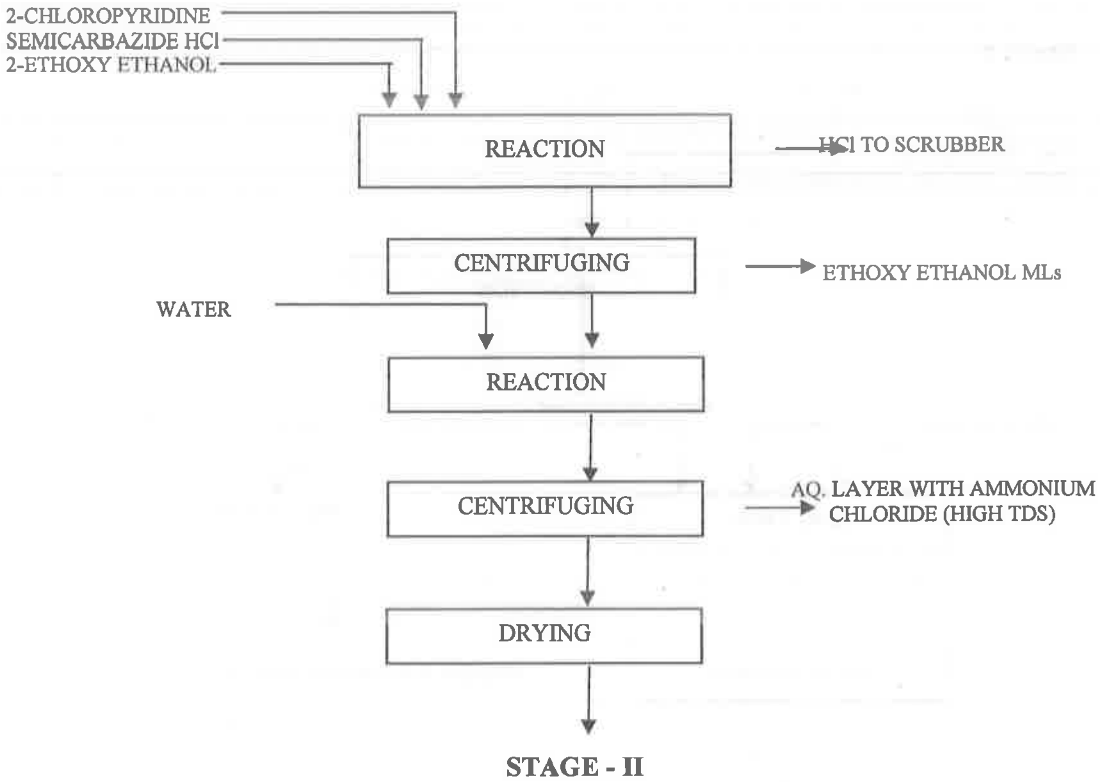
Trazodone Hydrochloride

c) Process Flow sheet

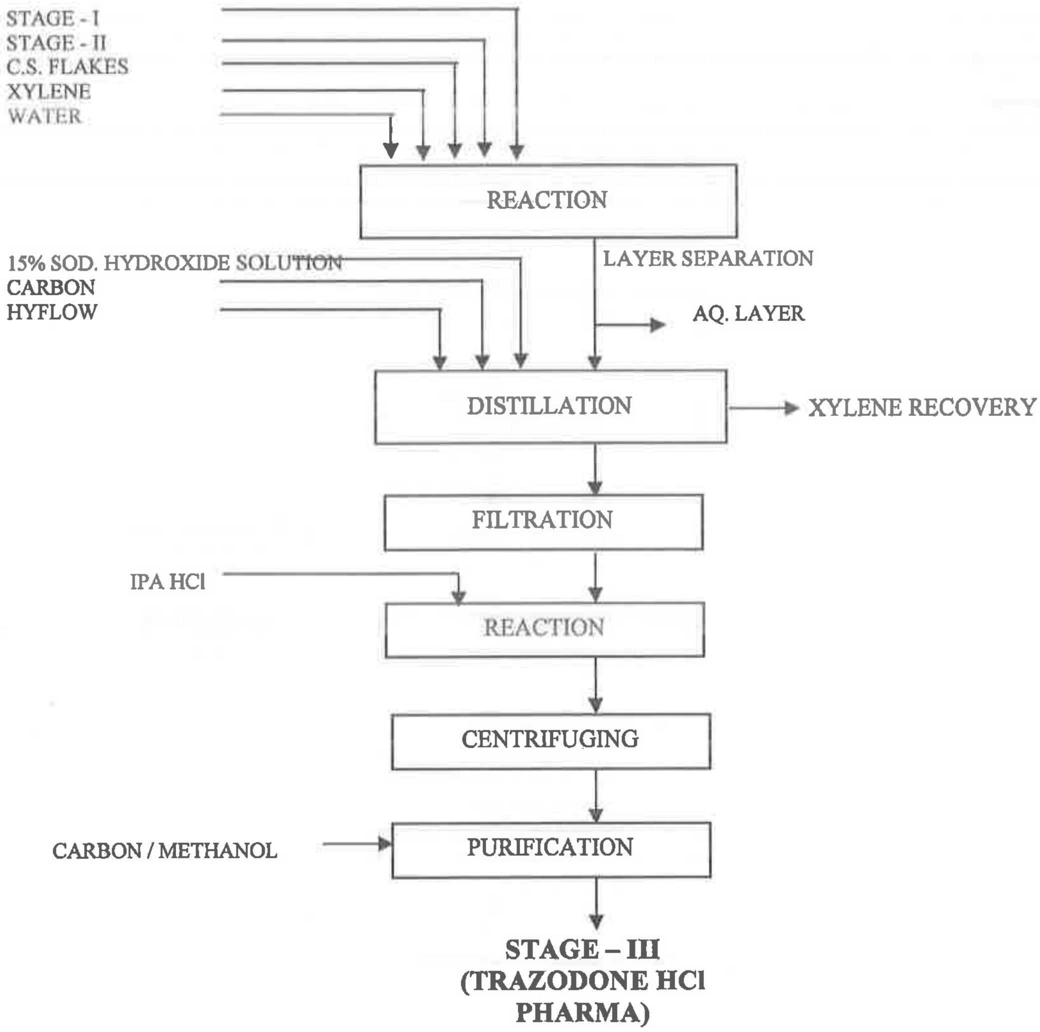
Stage-I



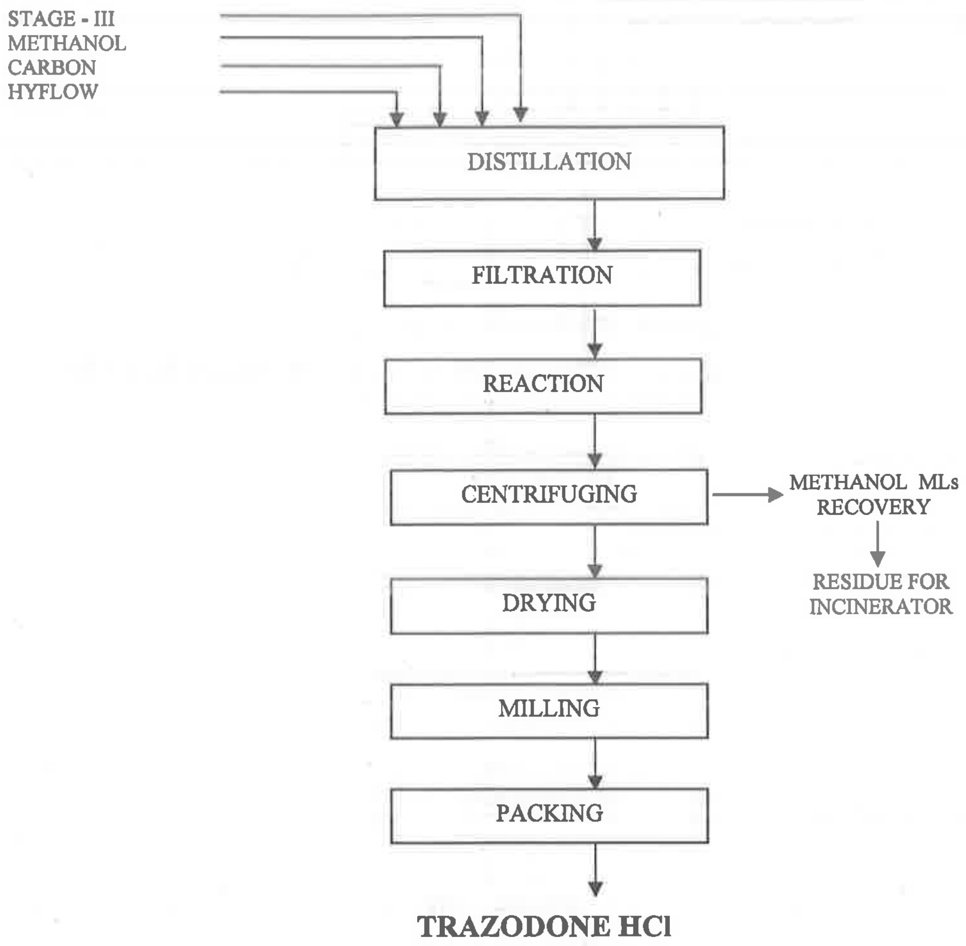
Stage – II **Trazodone Hydrochloride**



Stage – III **Trazodone Hydrochloride**



Stage – IV **Trazodone Hydrochloride**



2.6.5 Allopurinol-8 TPM

a) Process Description

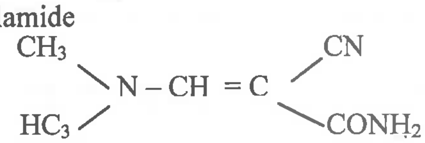
Stage-I 3-Morpholino-2-Cyano Acrylamide

Cyanoacetamide is condensed with triethyl orthoformate and dimethylamine in the presence of acetonitrile to give 3-dimethylamine-2-cyano-acrylamide.

$NC\text{-}CH_2\text{–}CONH_2$	+	$HC\ (OC_2H_5)_3$	+	$HN\ (CH_3)$
Cyanoacetamide		Triethyl Orthoformate		Dimethylamine
(M.W.: 84.08)		(M.W.: 148.21)		(M.W.: 45)
(M.F: $C_3H_4N_3O$)		(M.F: $C_7H_{16}O_3$)		(M.F: C_2H_7N)

$$\big\downarrow \text{Acetonitrile}$$

3-Dimethylamino-2-Cyano Acrylamide
(M.W.: 139)
(M.F: $C_6H_6N_3O$)

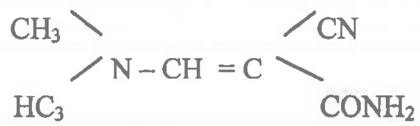


$$\underset{84}{NCCH_2CONH_2} + \underset{148}{HC(OC_2H_5)_3} + \underset{45}{HN(CH_3)_2} \longrightarrow \underset{139}{C_6H_9N_3O} + \underset{138}{3\ C_2H_5OH}$$

Stage- II 5-Amino Pyrazolo-4-Carboxamide Hemisulfate

3-Dimethyl-2-cyano acrylamide is reacted with hydrazine hydrate in aqueous medium to give 5-amino pyrazole-4-carboxamide, which on addition of sulfuric acid forms a hemisulfate.

Allopurinol



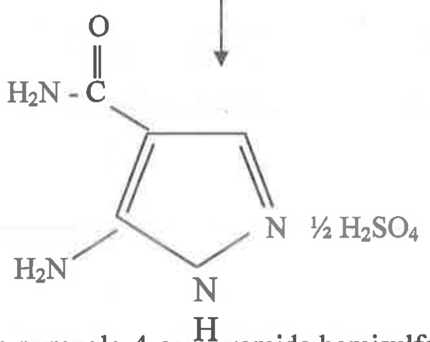
+ $H_2N\text{-}NH_2\,H_2O$

3-Dimehtyl -2-cyano acrylamide — Hydrazine hydrate

(M.W.: 139)
(M.F: $C_6H_6N_3O$)

(M.W.: 50.06)
(M.F: H_6N_2O)

Sulfuric acid



5-Amino pyrazolo-4-carboxamide hemisulfate

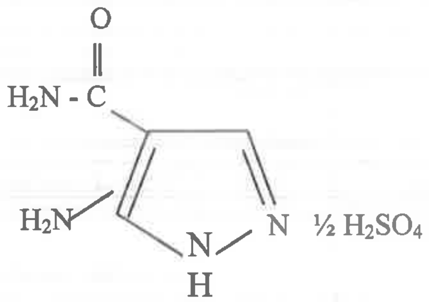
(M.W.: 175.03) - (M.F: $C_4H_6N_4O.\ ½\ H_2SO_4$)

$$\underset{139}{C_6H_9N_3O} + \underset{50}{HNNH_2H_2O} + \underset{49}{½\ H_2SO_4} \longrightarrow \underset{175}{C_4H_6N_4O.1/2H_2SO_4} + \underset{45}{(CH_3)_2NH}$$

Stage- III Allopurinol

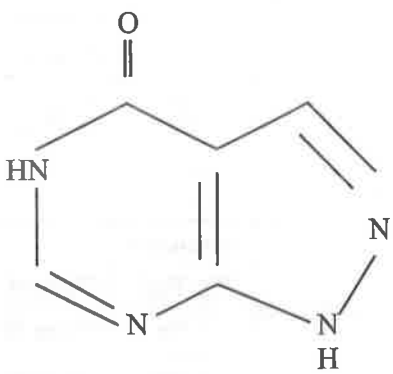
5-amino pyrazole-4-carboxamide hemisulfate on reaction with formamide gives Allopurinol technical.

Allopurinol



5-Amino pyrazolo-4-carboxamide hemisulfate
(M.W.: 175.03)
(M.F: $C_4H_6N_4O.\ ½\ H_2SO_4$)

↓ Formamide



Allopurinol

(M.W.: 136.1)

(M.F: $C_5\ N_4H_4O$)

$$\underset{175}{C_4H_6N_4O.1/2H_2SO_4} + \underset{45}{CH_3NO} \longrightarrow \underset{136}{C_5H_4N_4O} + \underset{66}{½\ (NH_4)_2SO_4} + \underset{18}{H_2O}$$

b) Material Balance **Allopurinol**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Cyano acetamide	1.71	Stage-I product	2.71
2	Triethyl ortho formate	3.04	**Solvent recovery**	
3	Dimethyl amine	0.92	Acetonitrile	0.77
4	Acetonitrile	0.81	**Solvent Loss**	
			Acetonitrile	0.03
			Ethanol generated in the reaction	2.69
			Organic residue	
			Cyano acetamide	0.07
			unreacted triethyl ortho formate	0.15
			Dimethyl amine	0.04
	Total	**6.48**	**Total**	**6.48**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.36	Stage-II compound	1.43
2	Hydrazine hydrate	0.50	**Wastewater**	
3	Carbon	0.07	water	58.93
4	Sulphuric acid	0.61	Water generated from hydrazine hydrate	0.15
5	Water	58.93	dimethyl amine (recovery)	0.37
			Inorganics	
			excess sulphuric acid in water	0.21
			Hydrazine sulfate from hydrazine hydrate	0.09
			Organics	

Allopurinol

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Product loss in water	0.22
			Solid waste	
			carbon sludge	0.07
	Total	**61.46**	**Total**	**61.46**

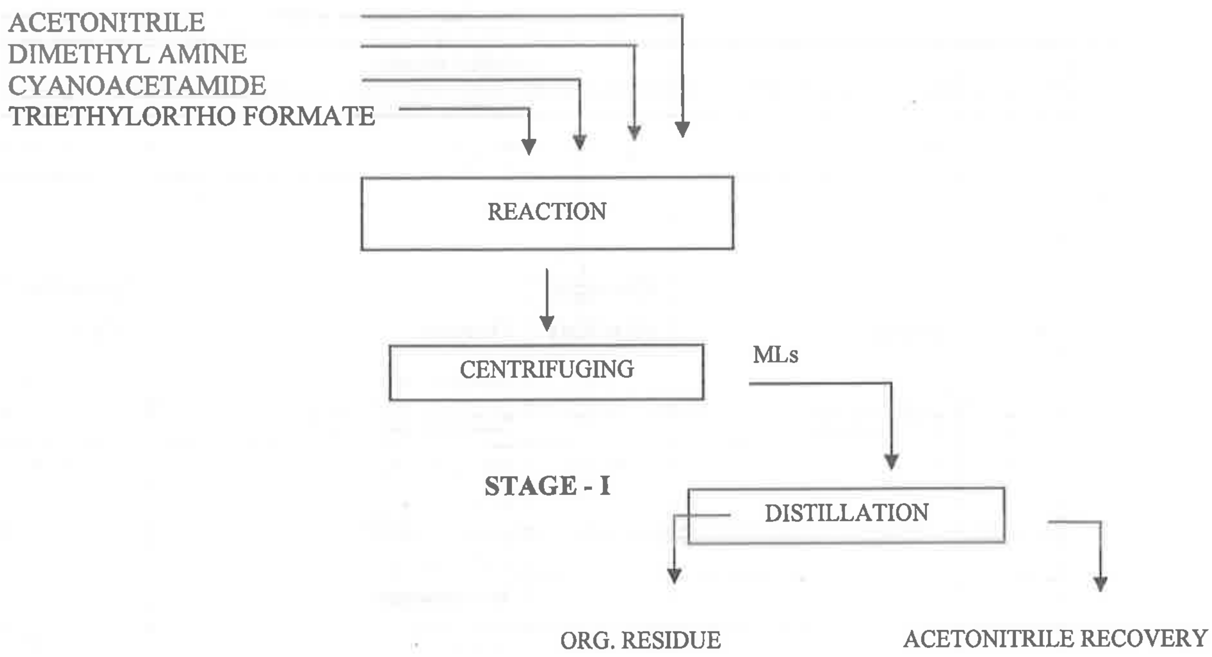
Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-II	1.43	Allopurinol	1
2	Formamide	3.64	**Solvent recovery**	
3	Water	37.86	Formamide	2.92
			Solvent Loss	
			Formamide	0.39
			Wastewater	
			Water	37.86
			Water formed in reaction	0.13
			Inorganics	
			Ammonium sulfate	0.49
			Organic residue	
			Stage-II	0.14
	Total	**42.93**	**Total**	**42.93**

c) Process Flow Sheet

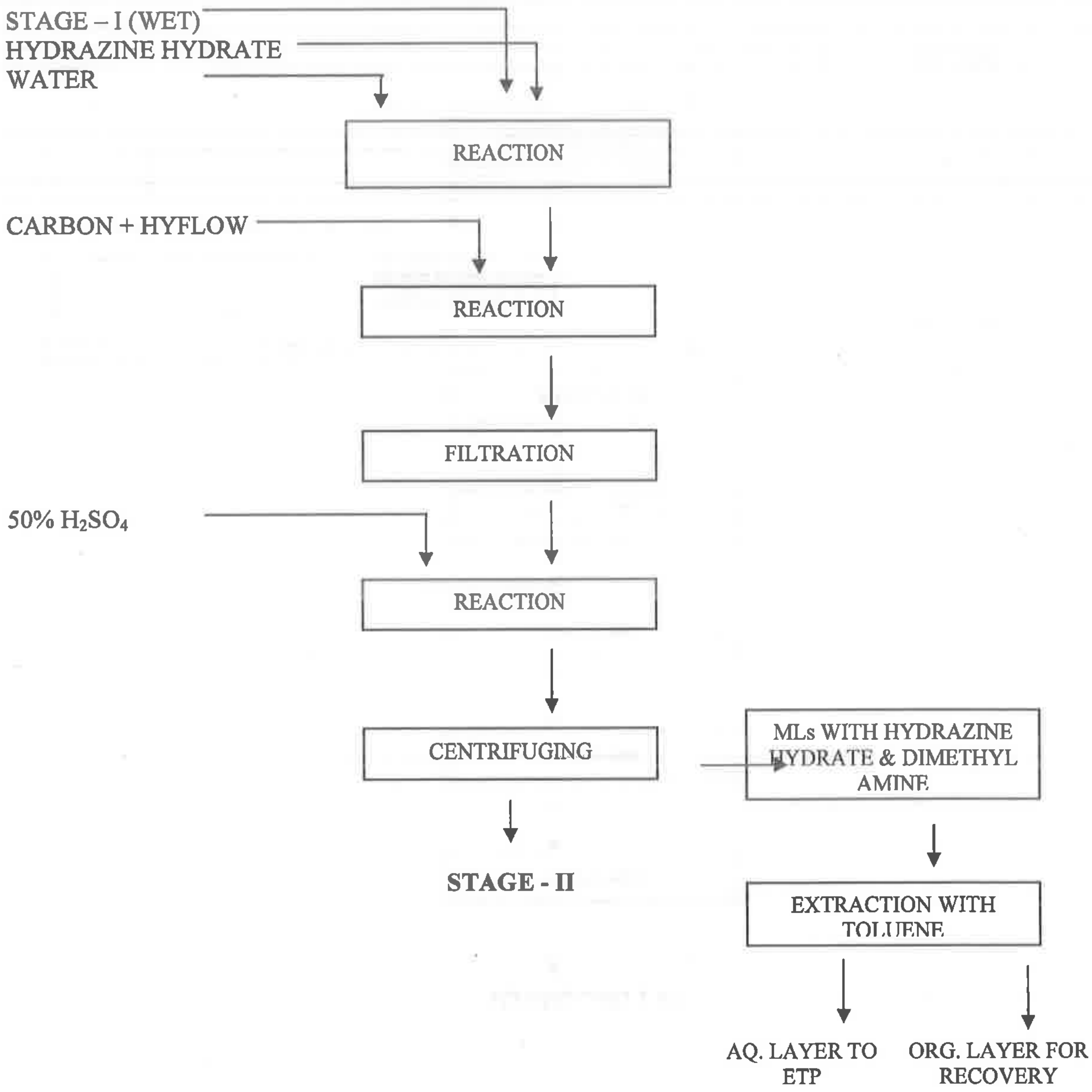
Allopurinol

Stage – I

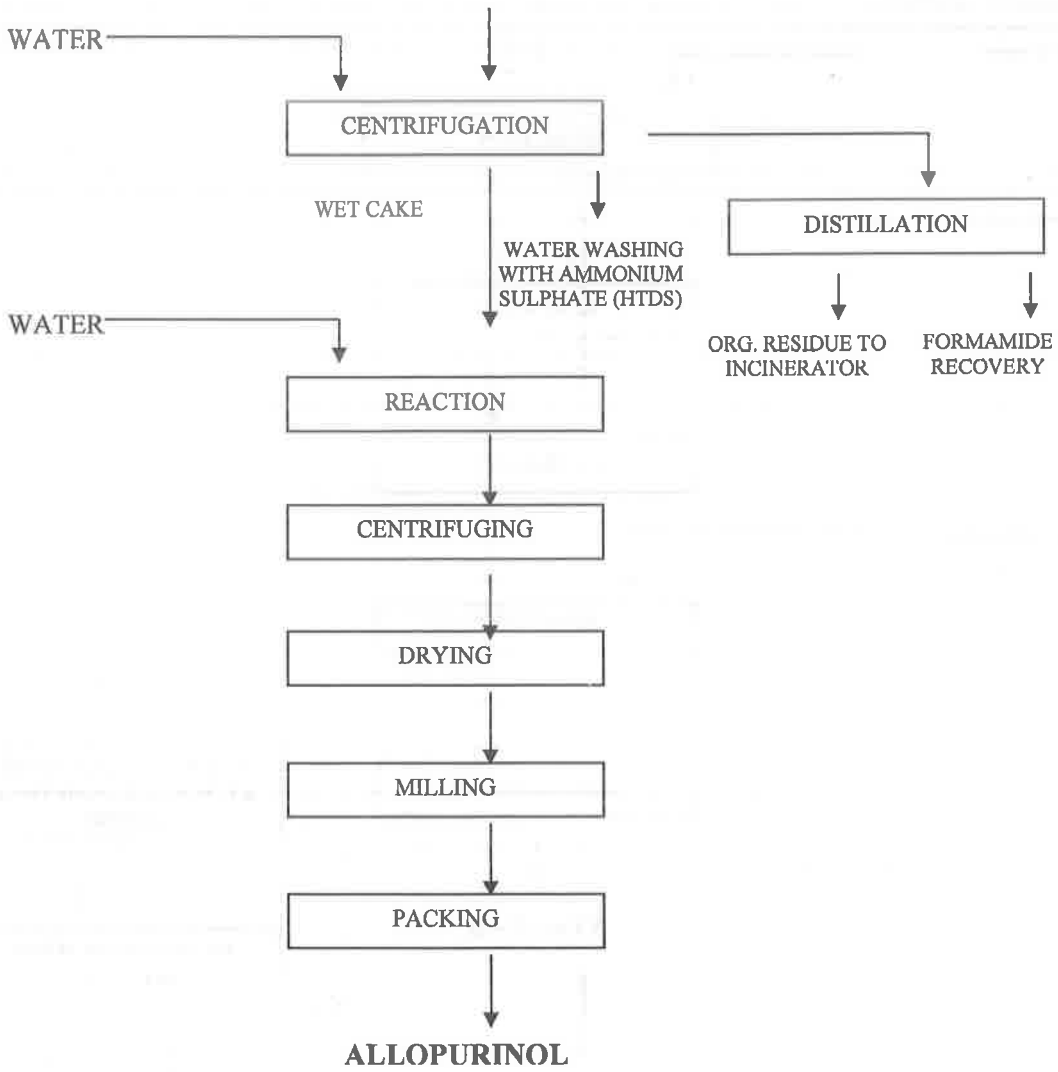


Stage-II

Allopurinol



Stage – III **Allopurinol**

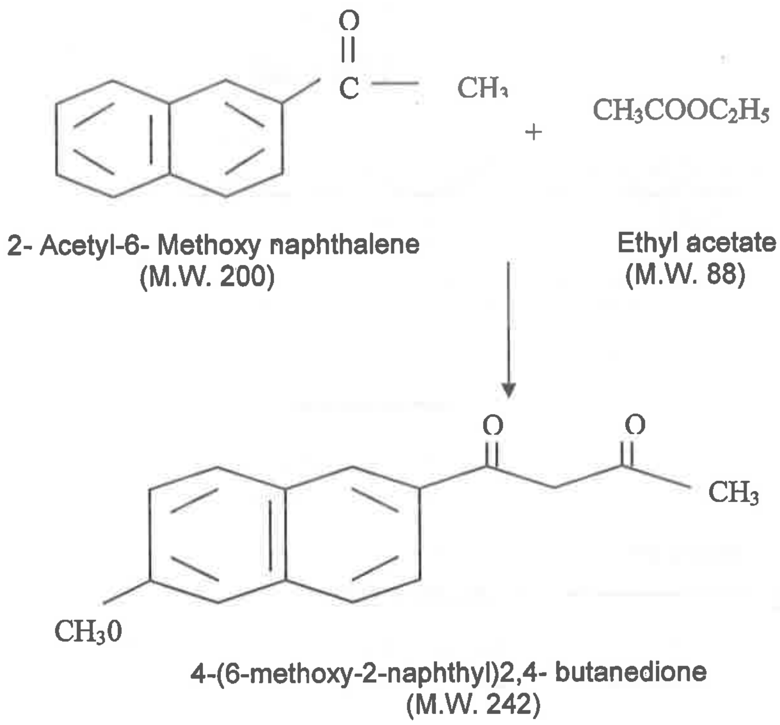


2.6.6 Nabumetone- 1 TPM

a) Process Description

Stage-I 4- (6-Methoxy 2-Naphthyl)-2,4-Butanedione

Reaction of 2-acetyl-6-methoxy naphthalene with ethyl acetate in presence of sodium methoxide gives Stage-1material.



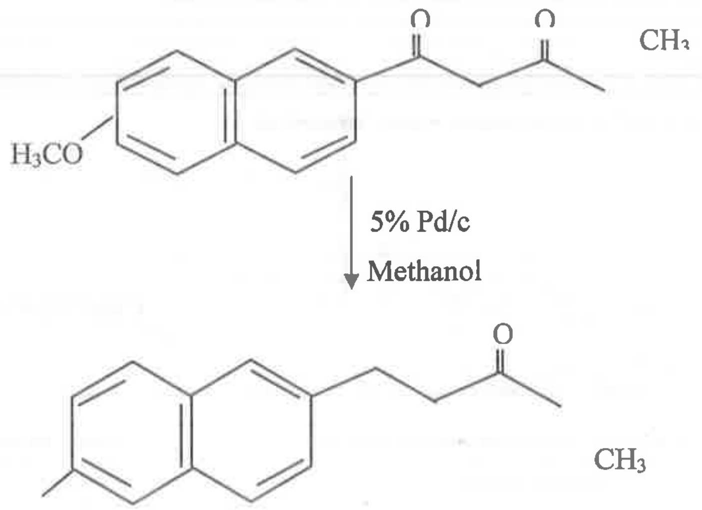
$$C_{13}H_{12}O_2 + CH_3COOC_2H_5 \longrightarrow C_{15}H_{14}O_3 + C_2H_5OH$$

200 88 . 242 46

Nabumetone

Stage-II Nabumetone

Reduction of Stage-1 material with 5% Pd/c gives Nabumetone.



Nabumetone
(M.W. 228)
(M.F. $C_{15}H_{16}O_2$)

$$C_{15}H_{14}O_3 + 2H_2 \xrightarrow{\text{Methanol}} C_{15}H_{16}O_2 + H_2O$$

242 4 5% Pd/C 228 18

b) Material Balance **Nabumetone**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Acetyl yara yara	1.43	Stage-I product	1.50
2	Ethyl acetate	4.29	**Solvent recovery**	
3	SMO powder	0.43	Ethyl acetate	3.51
4	water	60.00	**Solvent Loss**	
			Ethyl acetate	0.14
			Wastewater	
			Water	60.00
			Organic	
			SMO with sodium hydroxide and methanol with aq. Layer	0.43
			Ethanol formed in reaction	0.29
			Organic residue	
			Acetyl yara yara	0.27
	Total	**66.14**	**Total**	**66.14**

Stage-II

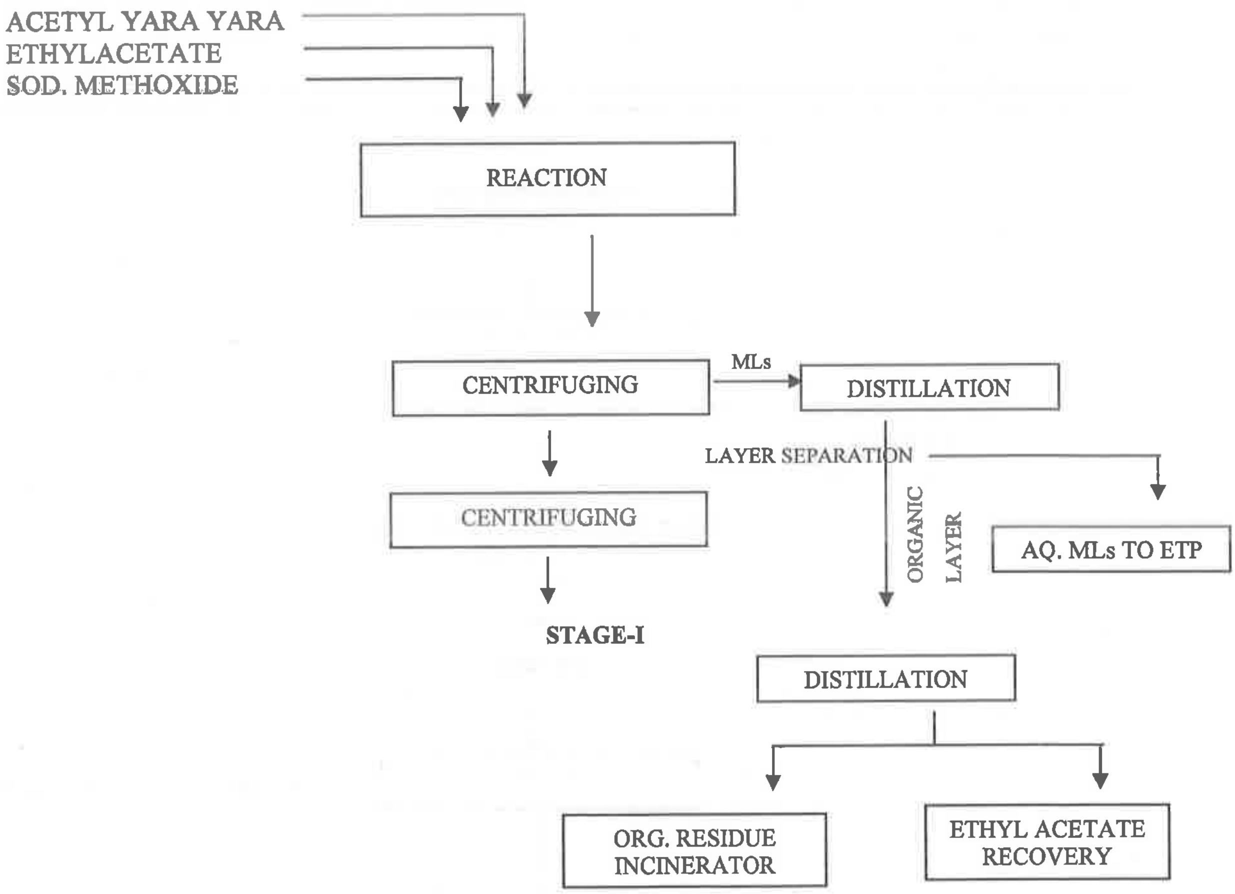
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.50	Nabumetone	1
2	Methanol	7.14	**Solvent recovery**	
3	Pd/C	0.14	Methanol	6.86
4	Carbon	0.14	**Solvent Loss**	
5	Hydrogen gas	0.02	Methanol	0.29
			Wastewater	
			Water formed in reaction	0.08
			Organic residue	
			Stage-I	0.44
			Solid waste	

Nabumetone

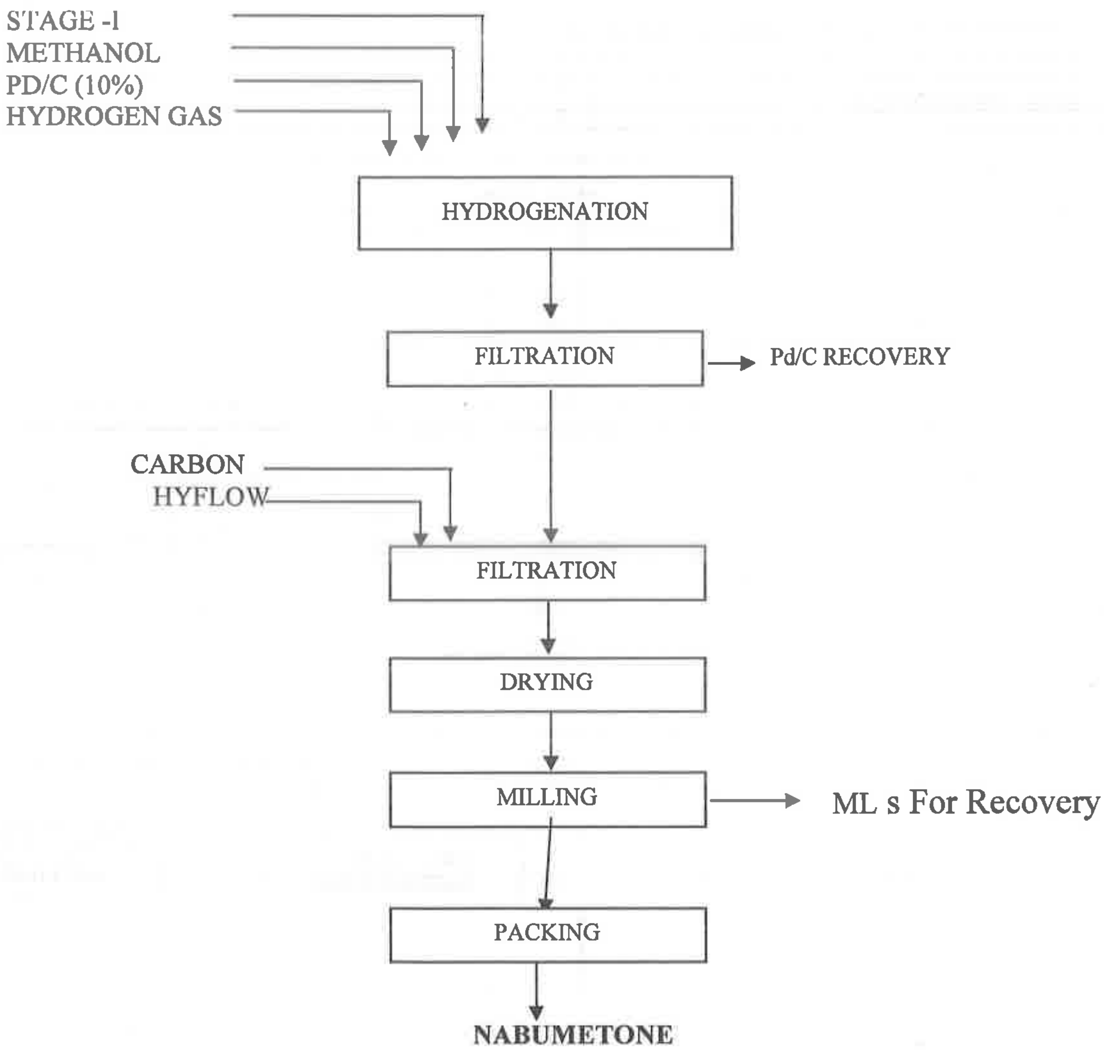
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Pd/C Sludge	0.14
			Carbon sludge	0.14
			Gases	
			Hydrogen	0.01
	Total	**8.95**	**Total**	**8.95**

c) Process Flow Sheet **Nabumetone**

Stage – I



Stage-II **Nabumetone**

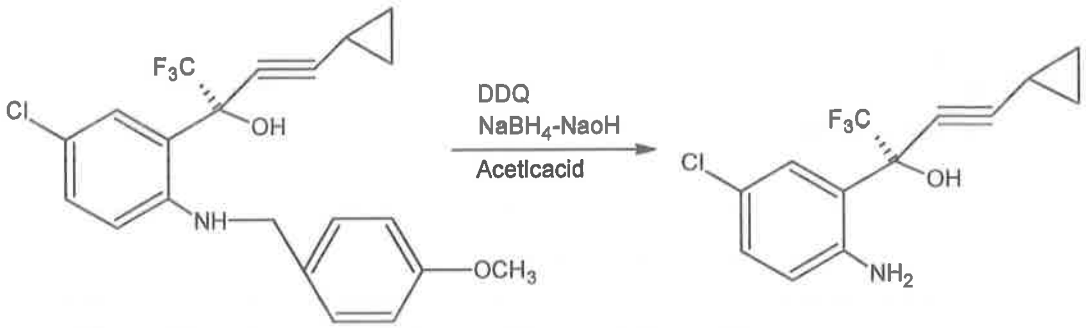


2.6.7 Efavirenz- 15 TPM

a) Process Flow Sheet

Stage-I

Reaction of(S)-5-Chloro-α-(Cyclopropylethynyl)-2-[((4-methoxy phenyl)methyl)amino]-α-(trifluoro methyl) benzene methanol with DDQ followed by reduction with Sodium boro hydride in Methanol gives Stage-1.



(S)-5-Chloro-α-(cyclopropylethynyl)-2-[((4-methoxy phenyl)methyl)amino]-α-(trifluoromethyl) benzene methanol

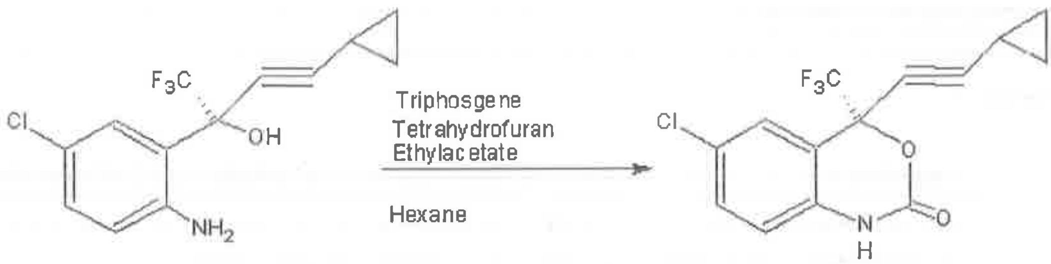
(S)-5-Chloro-α-(cyclopropylethynyl)-2-amino-α-(trifluoromethyl)benzene methanol

$$\underset{409.47}{C_{21}H_{19}O_2NF_3Cl} + \underset{60}{CH_3COOH} + \underset{48}{3\ O_2} + \underset{37.8}{NaBH_4} \xrightarrow[DDQ]{NaOH} \underset{289.47}{C_{13}H_{11}ONF_3Cl} + \underset{82}{CH_3COONa} + \underset{61.8}{HBO_3} + \underset{122}{C_8H_{10}O}$$

Stage-II

Reaction of Stage-1 with Triphosgene in THF followed by crystallization from Hexane gives Stage-2 (Efavirenz).

Efavirenz



(S)-5-Chloro-α-(Cyclopropylethynyl-
2-amino-α-(trifluoromeethyl) benzene
methanol

Efavirenz

$$C_{13}H1_{10}NF_3Cl + C_3O_3Cl_6 \xrightarrow[\text{EA, NaHCO}_3\text{, Hexane}]{\text{Triphosgene , THF}} C_{14}H_9O_2NF_3Cl + 2HCl + CO_2 + CCl_4$$

289.47 297 315.47 73 44 154

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	MMAA	1.56	Stage-I product	1.08
2	DDQ	0.88	**Solvent recovery**	
3	Toulene	13.20	Toulene	12.81
4	Methanol	3.75	methanol	3.56
5	Sodium bororhydride	0.05	N heptane	1.68
6	Sodium hydroxide Flakes	0.24	MTBE	0.45
7	Acetic acid	0.38	**Solvent Loss**	
8	MTBE	0.47	Toulene	0.4
9	N heptane	1.75	methanol	0.19
10	Hyflow	0.08	N heptane	0.07

Efavirenz

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
11	Water	62.50	MTBE	0.02
			Wastewater	
			water	62.50
			Water from neutralization	0.12
			Organic	
			P- Methoxy toulene	0.45
			Sodium acetate	0.31
			Inorganics	
			Boric acid	0.23
			Solid waste	
			Hyflow	0.08
			Organic residue	
			MMAA	0.04
			DDH_2Q	0.86
			DDQ	0.02
	Total	**84.86**	**Total**	**84.85**

Stage-II

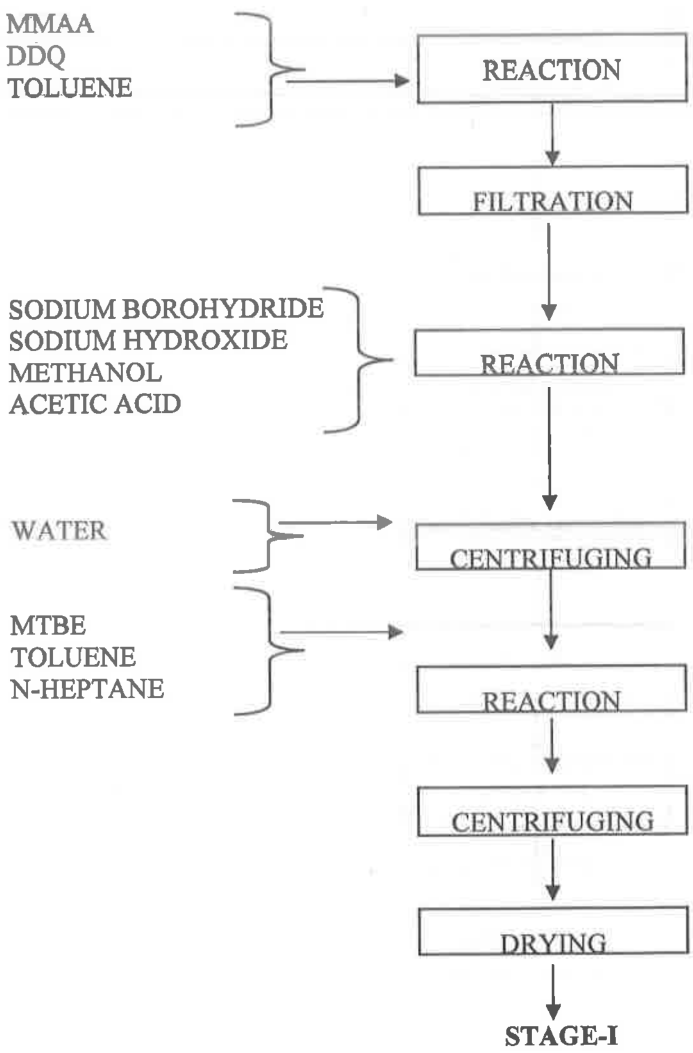
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.08	Efavirenz	1
2	THF	1.95	**Solvent recovery**	
3	Hexane	5.08	Ethyl acetate	2.74
4	Ethyl acetate	2.85	THF	1.8
5	carbon	0.03	Hexane	4.82
6	Triphosgene	0.50	**Solvent Loss**	
7	Water	43.75	Ethyl acetate	0.11
			THF	0.16
			Hexane	0.25

Efavirenz

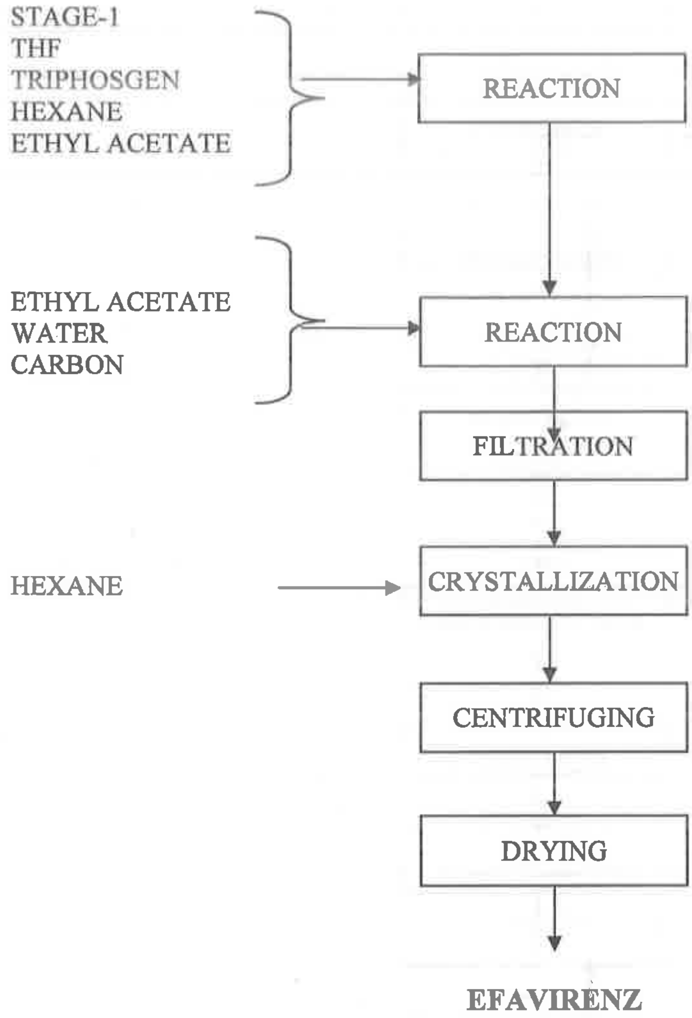
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Wastewater	
			Water	43.75
			Inorganic	
			HCl formed in reaction	0.23
			Organic	
			Triphosgene	0.18
			Solid waste	
			Carbon	0.03
			Organic Residue	
			Stage-I	0.16
	Total	**55.2**	**Total**	**55.2**

c) Process Flow Sheet **Efavirenz**

Stage-I



Stage-II **Efavirenz**

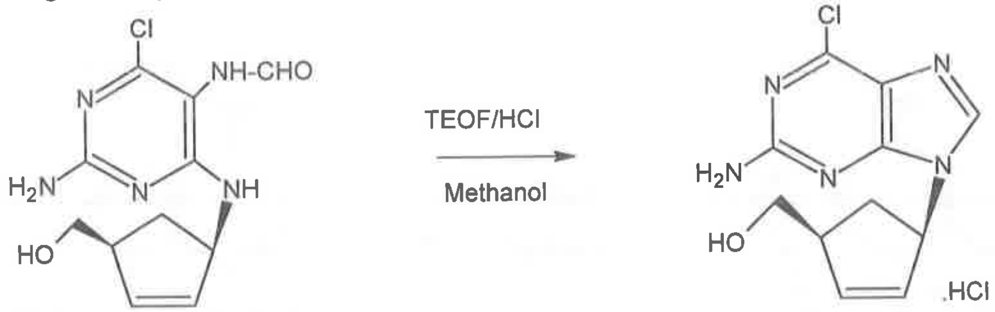


2.6.8 Abacavir Sulfate- 3 TPM

a) Process Description

Stage-I

Reaction of (1S, 4R)-4-[(2-Amino-6-chloro-5-formamido-4-pyrimidinyl) amino]-2-cyclopentene-1- Methanol with Hydrochloric acid in Triethyl Ortho formate gives Stage-1.



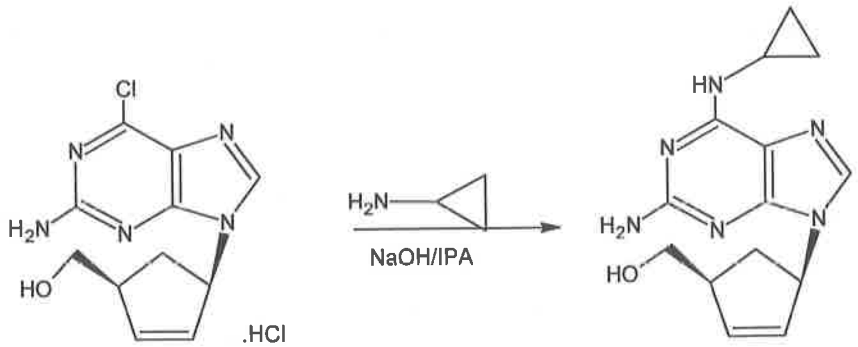
(1S, 4R)-4-[(2-Amino-6-chloro-5-formamido -4-pyrimidinyl) amino]-2-cyclopentene-1- Methanol

(1S, 4R)-4-(2-amino-6-chloro-9H-purin-yl)-2-Cyclopentene-1-methanol.HCl

$$\underset{267.5}{C_{10}H_{10}N_5O_2Cl} + \underset{36.5}{HCl} \xrightarrow[\text{Methanol}]{\text{TEoF}} \underset{286}{C_{10}H_9N_5OCl_2} + \underset{18}{H_2O}$$

Stage-II

On condensation of Stage-I with Cyclopropyl amine gives Stage-II.



(1S, 4R)-4-(2-amino-6-chloro-9H-purin-yl)-2-Cyclopentene-1-methanol.HCl

(1S, 4R)-4-(2-amino-6-(cyclopropylamino)-9H-purin-9-yl]-2-cyclopentene-1-methanol

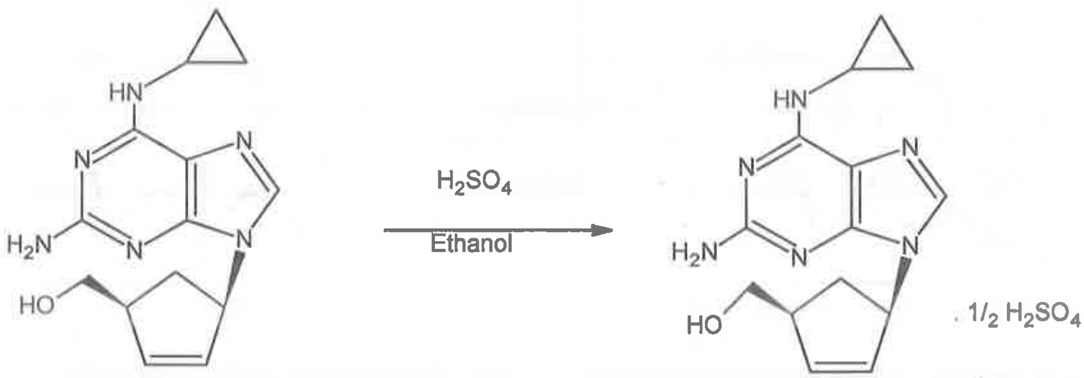
Abacavir Sulfate

$C_{10}H_9N_5OCl_2 + C_3H_5N + NaOH \xrightarrow[IPA]{} C_{13}H_{12}N_6O + NaCl + H_2O + HCl$

286 55 40 IPA 268 58.5 18 36.5

Stage-III

Salt formation of Stage-2 with Sulphuric acid Abacavir sulfate.



(1S, 4R)-4-(2-amino-6-(cyclopropylamino)-9H-purin-9-yl]-2-cyclopentene-1-methanol.

ABACAVIR SULFATE

$C_{13}H_{12}N_6O + ½\ H_2SO_4 \xrightarrow[Ethanol]{} C_{13}H_{12}N_6O.\ 1/2H_2SO_4$

268 49 317

Abacavir Sulfate

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	AFC	1.67	Stage-I product	1.50
2	TEOF	17.42	**Solvent recovery**	
3	CP HCl	2.38	Methanol	6.44
4	Methanol	6.71	TEOF + HCl	19.22
5	Water	31.11	**Solvent Loss**	
			Methanol	0.27
			TEOF + HCl	0.39
			Wastewater	
			Water	31.11
			Water formed in reaction	0.09
			Organic residue	
			AFC	0.26
	Total	**59.29**	**Total**	**59.29**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.50	Stage-II product	1.03
2	Cyclopropylamine	1.54	**Solvent recovery**	
3	IPA	13.33	IPA	12.8
4	CS Flakes	0.17	**Solvent Loss**	
5	Carbon	0.24	IPA	0.53
6	Water	0.36	**Wastewater**	
			Water goes with IPA Ml's	0.36
			Water formed in neutralization	0.07
			Inorganic	
			Sodium chloride	0.23
			Gases	
			HCl	0.14

Abacavir Sulfate

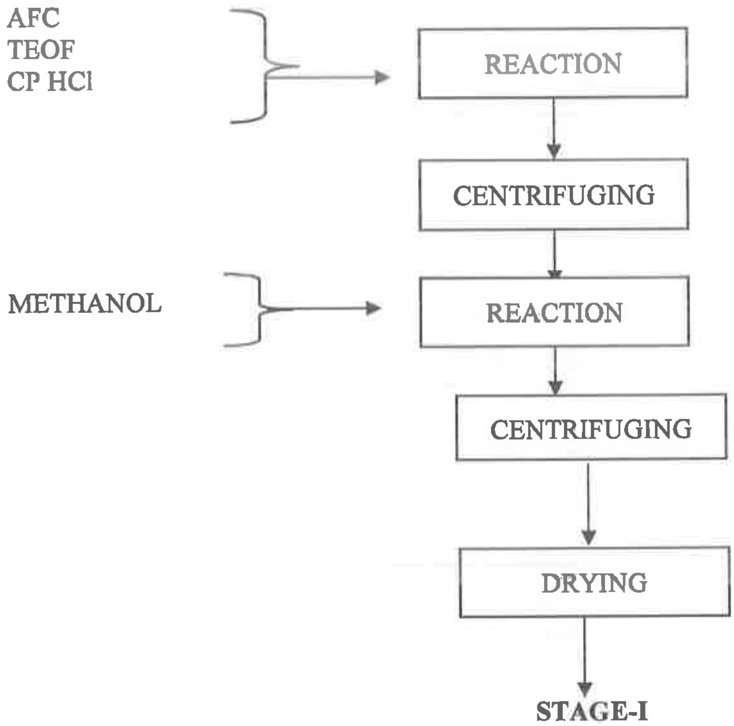
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Excess Cyclopropylamine	1.33
			Organic waste	
			Stage-I product	0.40
			Solid Waste	
			Carbon	0.24
	Total	**17.1**	**Total**	**17.1**

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-II	0.94	Abacavir	1
2	Sulphuric acid	0.17	**Solvent recovery**	
3	Ethanol	9.00	Ethanol	8.55
4	Carbon	0.08	**Solvent Loss**	
5	Water	0.46	Ethanol	0.5
			Wastewater	
			Water with Ethanol ML's	0.46
			Inorganic	
			Excess Sulphuric acid	0.01
			Solid waste	
			Carbon	0.08
	Total	**10.65**	**Total**	**10.65**

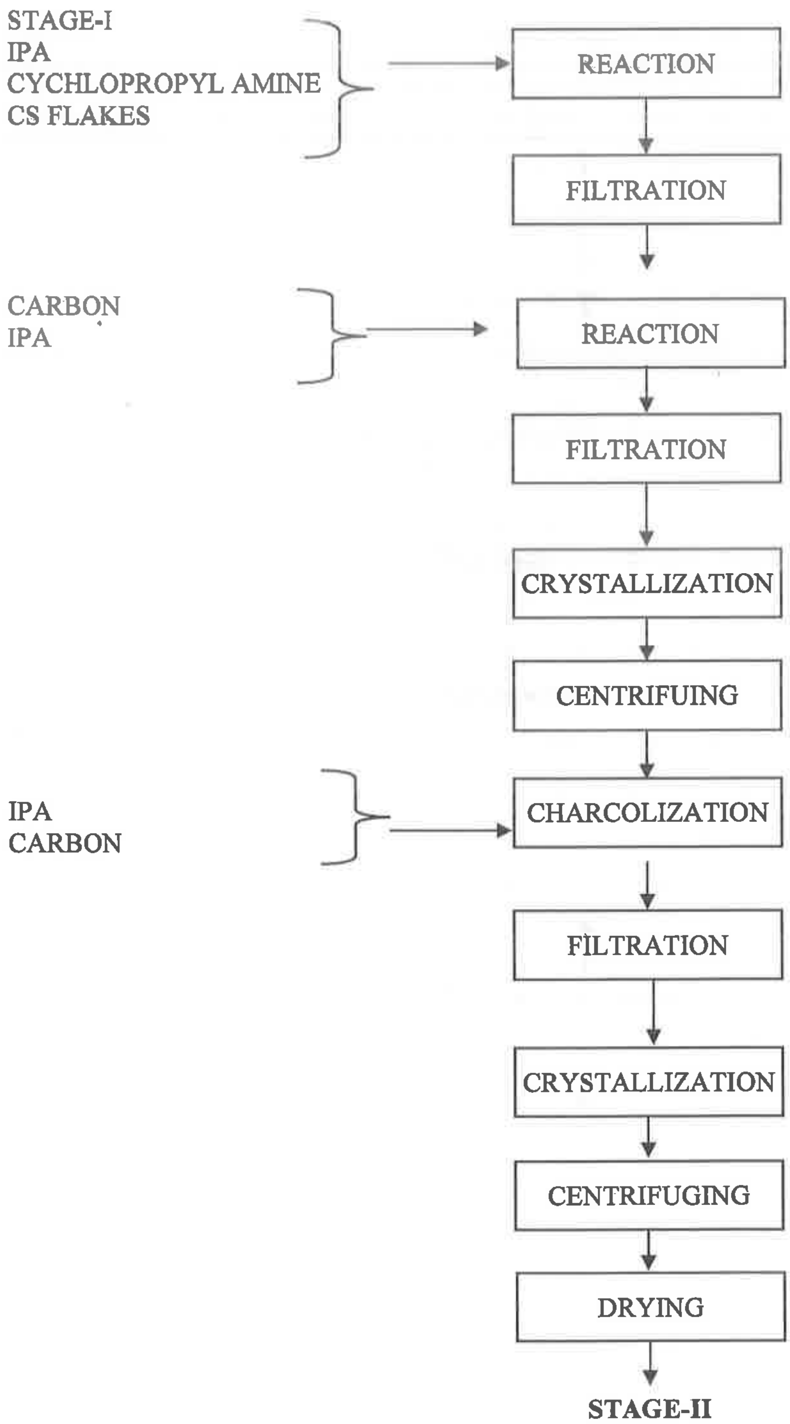
c) Process Flow Sheet **Abacavir Sulfate**

Stage-I

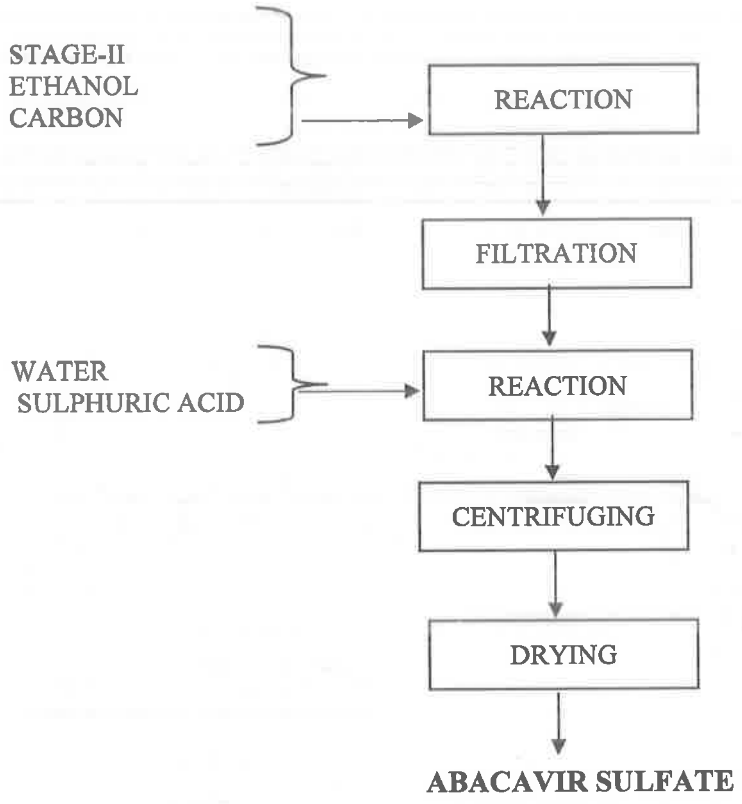


Abacavir Sulfate

Stage-II



Stage-III **Abacavir Sulfate**

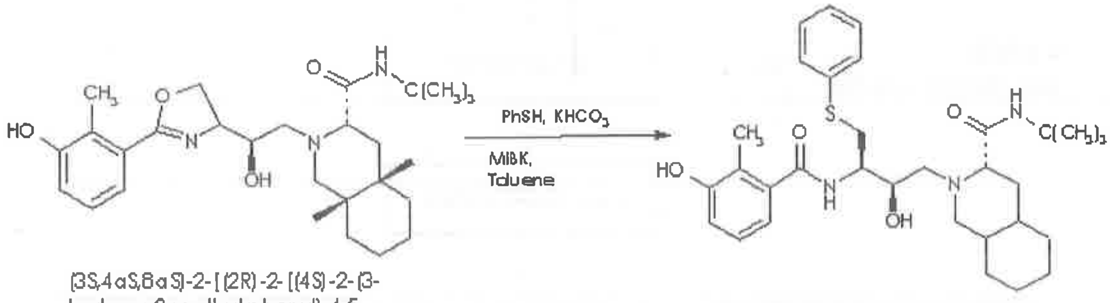


2.6.9 Nelfinavir Mesylate- 5 TPM

a) Process Description

Stage-I

Reaction of (3S,4aS,8aS)-2-[(2R)-2-[(4S)-2-(3-hydroxy-2-methylphenyl)-4,5-dihydrooxazol- 4-yl]-2-hydroxy ethyl] dicahydro isoquinoline-3-carboxylic acid-t-butyl amide (ODC) with Thiophenol in presence of Potassium bicarbonate gives Stage-1



(3S,4aS,8aS)-2-[(2R)-2-[(4S)-2-(3-hydroxy-2-methyl phenyl)-4,5-dihydro oxazol-4-yl]-2-hydroxy ethyl] dicahydroisoquinoline-3-carboxylic acid-t-butyl amide (ODC)

(3S,4aS,8aS)-N-(1,1-Dimethylethyl decahydro-2-[(2R,3R)-2-hydroxy-3-[(3-hydroxy-2-methylbenzoyl) amino]-4-(phenylthio) butyl]-3-isoquinoline carboxamide (Nelfinavir) (NFD-I)

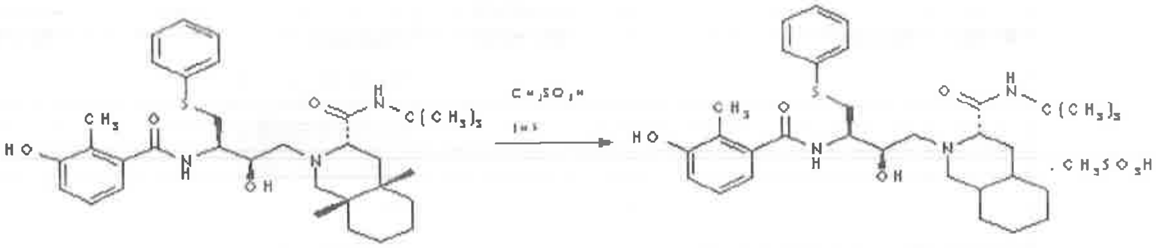
$$C_{25}H_{31}O_4N_3 + C_6H_5SH + KHCO_3 \xrightarrow[\text{MIBK, Toulene}]{\text{PhSH, KHCO}_3} C_{32}H_{38}O_4N_3S + \text{K salt} + 3_{1/2}\,O_2$$

437   110   100.09   560   39.09   48

Stage-II

Salt formation of Stage-1 with Methane sulphonic acid in THF and Acetone gives Nelfinavir Mesylate.

Nelfinavir Mesylate



(3S,4aS,8aS)-N-(1,1-Dimethylethyl decahydro-2-[(2R,3R)-2-hydroxy-3-[(3-hydroxy-2-methylbenzoyl)amino]-4-(phenylthio)butyl]-3-isoquinoline carboxamide
(Nelfinavir)
(NFD-I)

(3S,4aS,8aS)-N-(1,1-Dimethylethyl decahydro-2-[(2R,3R)-2-hydroxy-3-[(3-hydroxy-2-methylbenzoyl)amino]-4-(phenylthio)butyl]-3-isoquinoline carboxamide methane sulphonate
(Nelfinavir mesylate)
(NFD-II)

NELFINAVIR MESYLATE

$$\underset{560}{C_{32}H_{38}O_4N_3S} + \underset{96}{CH_3SO_3H} \xrightarrow[\text{Acetone, THF}]{} \underset{656}{C_{33}H_{42}O_7N_3S_2}$$

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	ODC	1.00	Stage-I product	1.05
2	MIBK	10.00	**Solvent recovery**	
3	Thiophenol	0.48	Toulene	5.82
4	Potassium bicarbonate	0.11	**Solvent Loss**	
5	Toulene	6.00	Toulene	0.18
6	Water	4.75	**Wastewater**	
			Water	4.75
			MIBK loss as ML'S	10.00
			Inorganic	

Nelfinavir Mesylate

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Potassium salt (Unreacted)	0.07
			Organic	
			Excess Thiophenol	0.27
			Organic residue	
			ODC	0.18
	Total	**22.34**	**Total**	**22.34**

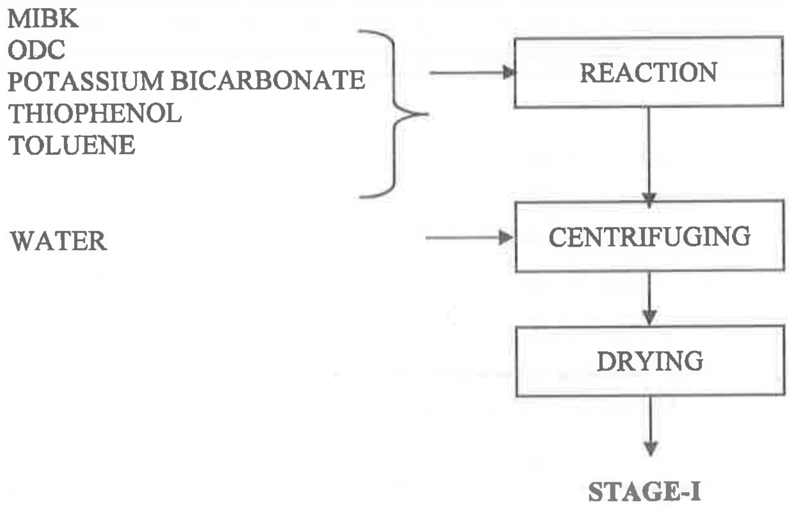
Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.05	Nelfinavir	1.00
2	Methane sulfonic acid	0.17	**Solvent Loss**	
3	THF	3.03	Acetone + THF loss	0.45
4	Acetone	4.62	**Wastewater**	
5	Water	30.0	water	30.00
			Acetone + THF ML's	7.20
			Organic	
			Excess methane sulfonic acid	0.02
			Organic residue	
			Stage-I	0.20
	Total	**38.87**	**Total**	**38.87**

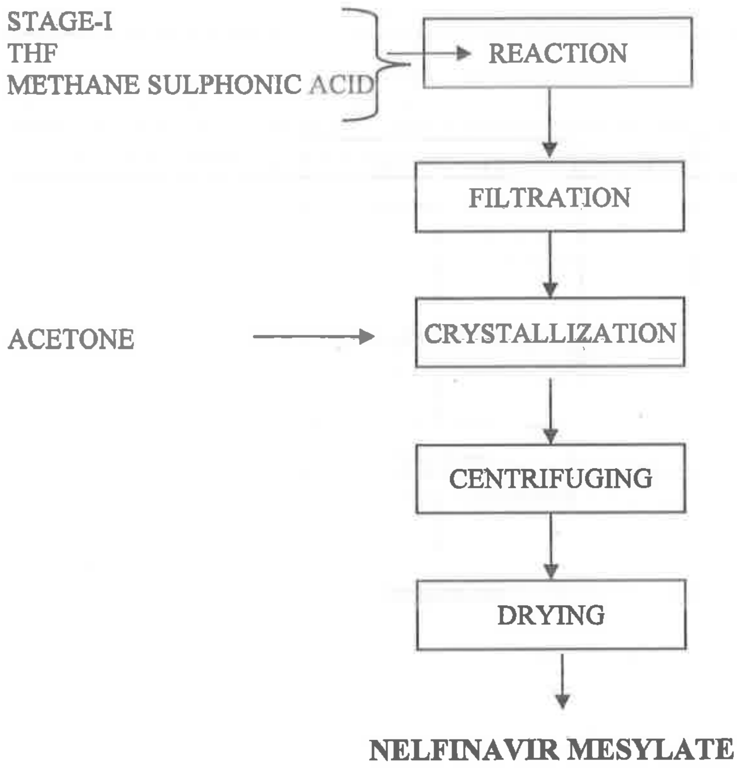
Nelfinavir Mesylate

b) Process Flow Sheet

Stage-I



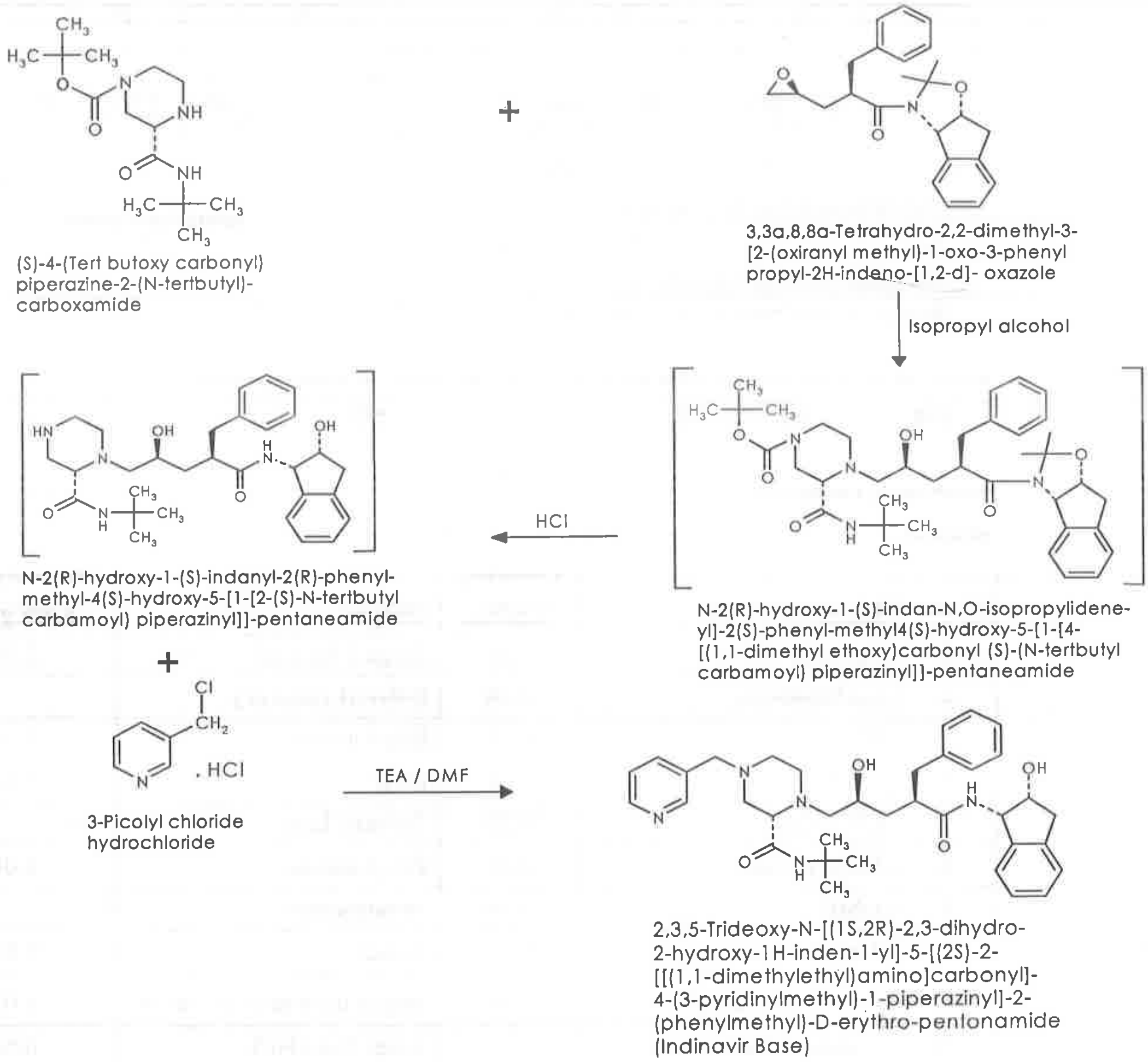
Stage-II **Nelfinavir Mesylate**



2.6.10 Indinavir Sulfate- 3 TPM

a) Process Description

Reaction of Carboxamide and oxizole compounds in Isopropyl alcohol followed by condensation with 3-Picolyl chloride HCl gives Stage-I.



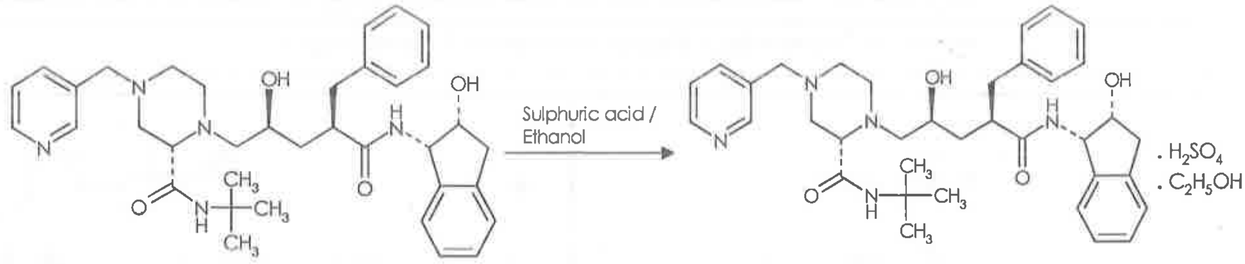
$$C_{14}H_{24}O_3N_3 + C_{24}H_{26}O_3N \xrightarrow[\text{IPA}]{} C_{38}H_{48}O_4N_5 + 2\,HCl$$

450	376	IPA	638	71

Indinavir Sulfate

Stage-II

Salt formation of Stage-1 with Sulphuric acid in Ethanol gives Indinavir sulfate.



2,3,5-Trideoxy-N-[(1S,2R)-2,3-dihydro-2-hydroxy-1H-inden-1-yl]-5-[(2S)-2-[[(1,1-dimethylethyl)amino]carbonyl]-4-(3-pyridinylmethyl)-1-piperazinyl]-2-(phenylmethyl)-D-erythro-pentonamide

INDINAVIR SULFATE

$$\underset{638}{C_{38}H_{48}O_4N_5} + \underset{98}{H_2SO_4} + \underset{46}{C_2H_5OH} \longrightarrow \underset{782}{C_{38}H_{38}O_4N_5.H_2SO_4.C_2H_5OH}$$

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Epoxide	0.86	Stage-I Product	0.90
2	Carboxamide	0.68	**Solvent recovery**	
3	IPA	1.78	Ethyl acetate	1.94
4	CP HCl	0.81	DMF	1.31
5	CS flakes	0.30	**Solvent Loss**	
6	Ethyl acetate	2.02	Ethyl acetate	0.08
7	DMF	1.38	**Wastewater**	
8	Triethyl amine	0.72	Water	29.81
9	3- Picolyl chloride	0.45	Water from neutralization	0.03
10	Sodium bicarbonate	0.19	water from HCl	0.54
11	Carbon	0.09	IPA goes with water	1.78
12	Water	29.81	DMF loss with water	0.07

Indinavir Sulfate

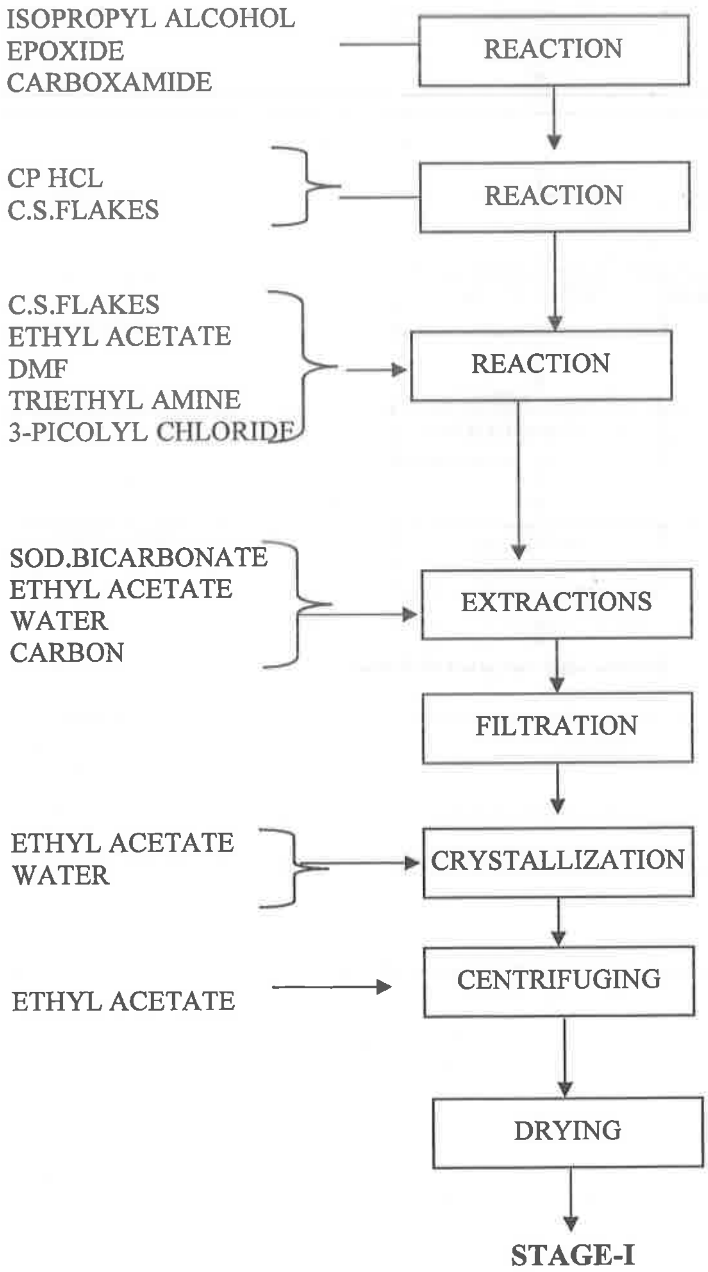
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Inorganics	
			Sodium chloride	0.08
			Excess Sodium hydroxide	0.25
			Sodium bicarbonate	0.19
			HCl (produced + remaining)	0.32
			Organics	
			Excess Carboxamide	0.04
			Excess Picolyl chloride	0.22
			TEA	0.72
			IPA & Tert butyl alcohol formed in reaction	0.39
			Organic residue	
			Epoxide	0.32
			Solid waste	
			Carbon	0.09
	Total	**39.09**	**Total**	**39.09**

Stage-II **Indinavir Sulfate**

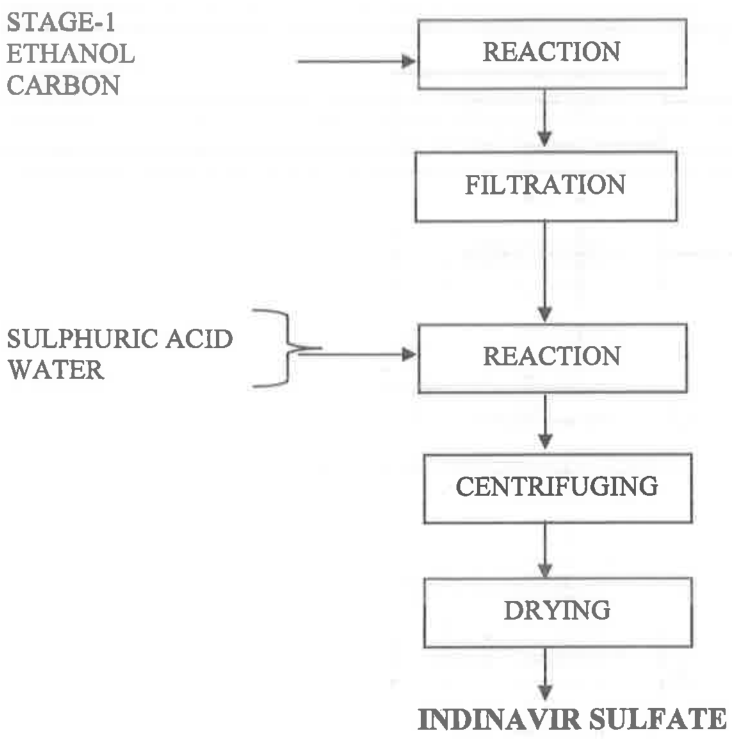
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	0.90	Indinavir Sulfate	1
2	Ethanol	8.10	**Solvent Loss**	
3	carbon	0.05	Ethanol	0.48
4	Sulphuric acid	0.14	**Wastewater**	
5	Water	0.48	Water into ethanol ML'S	0.48
			Ethanol ML's	7.62
			Organic	
			Stage-I	0.05
			Solid waste	
			Carbon	0.05
	Total	**9.67**	**Total**	**9.67**

c) Process Flow Sheet **Indinavir Sulfate**

Stage-I



Stage-II **Indinavir Sulfate**



2.6.11 Ciprofloxacin Hydrochloride-25 TPM

a) Process Description

2,4 Dichloro 5 fluoro benzene is reacted with Acetyl chloride in the presence of alluminium chloride to yield chloro fluoro acetophenone. 2,4 dichloro 5 fluoro acetophenone is reacted with sodium hydride and dimethyl carbonate in toulene followed by reaction with dimethyl formamide, dimethyl sulfate adduct and cyclopropyl amine to yield acrylate which on cyclisation and hydrolysis gives 1-cyclopropyl -6- fluoro-7- chloro -4- oxo-1,4- dihydro quinoline-3- carboxylic acid. It is further condensed with piperazine in n- Butanol media to yield ciprofloxacin crude. It is then purified and converted in to ciprofloxacin hydrochloride with hydrochloric acid in aqueous methanol.

Chemical reactions

Stage-I

$C_6H_3Cl_2F$+ CH_3COCl ⟶ $C_8H_5Cl_2OF$ + HCl
165 78.5 207 36.5

Stage-II

$C_8H_5OCl_2F$ + $C_3H_6O_3$ + NaH + C_3H_7N0 + C_3H_7N + ½ C ⟶
207 90 24 73 57 6

⟶ $C_{14}H_{12}O_3Cl_2NF$ + C_2H_7N + $2H_2$ + CH_3COONa
332 45 4 82

Stage-III

$C_{14}H_{12}O_3Cl_2NF$ + HCl + 2NaOH ⟶ $C_{13}H_9O_3NFCl$ + CH_3OH + 2NaCl + H_2O
332 36.5 80 281.5 32 117 18

Ciprofloxacin Hydrochloride

Stage-IV

$$\underset{281.5}{C_{13}H_9O_3NFCl} + \underset{86}{C_4H_{10}N_2} \longrightarrow \underset{331}{C_{17}H_{18}O_3N_3F} + \underset{36.5}{HCl}$$

Stage-V

$$\underset{\substack{\text{(Cipro crude)}\\331}}{C_{17}H_{18}O_3N_3F} \longrightarrow \underset{\substack{\text{(Cipro tech)}\\331}}{C_{17}H_{18}O_3N_3F}$$

Stage-VI

$$\underset{\substack{\text{(Cipro tech)}\\331}}{C_{17}H_{18}O_3N_3F} \longrightarrow \underset{\substack{\text{(Cipro pharma)}\\331}}{C_{17}H_{18}O_3N_3F}$$

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	DCF Benzene	0.96	Acetophenone	0.88
2	Acetyl chloride	0.42	**Solvent recovery**	
3	EDC	6.25	EDC	6.0
4	$AlCl_3$	1.25	**solvent Loss**	
5	Ice water	50.00	EDC	0.25
6	NaOH	0.67	**Wastewater**	
			Water	50.00
			Inorganics	
			Sodium chloride	0.74
			HCl	0.15
			Sodium Hydroxide	0.50
			Organics	
			Sodium acetate	0.35
			Organic waste	
			DCF Benzene	0.26

Ciprofloxacin Hydrochloride

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Alluminium hydroxide inorganic solid waste	0.33
	Total	**59.5**	**Total**	**59.5**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Acetophenone	0.88	Acrylate	1.2
2	DMC	0.81	**Solvent recovery**	
3	NaH (60%)	0.35	Methanol	0.57
4	DMF	0.45	Toulene	7.5
5	DMS	0.78	DMC recovery	0.42
6	CPA	0.23	**Solvent Loss**	
7	Acetic acid	0.68	Toulene	0.31
8	Toulene	7.81	**Wastewater**	
9	MeOH	0.59	water	9.15
10	Water	8.75	**Inorganics**	
11	C.S lye	0.75	C.S.Lye	0.45
12	Carbon	0.04	Na_2SO_4	0.52
			Organics	
			sodium acetate	0.60
			methanol	0.26
			Acetic acid	0.46
			gases	
			H_2	0.01
			DMA	0.16
			organic residue	
			Acetophenone	0.12

Ciprofloxacin Hydrochloride

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			DMC	0.07
			CPA	0.017
			DMF	0.18
			DMS	0.32
	Total	**22**	**Total**	**22**

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Acrylate	1.21	FQ acid	1.01
2	C.S. Flakes	0.40	**Solvent recovery**	
3	HCl (30%)	0.76	Toulene	4.08
4	Toulene	4.25	Methanol	0.79
5	Methanol	0.83	**Solvent Loss**	
6	Water	23.33	Methanol	0.04
			toulene	0.17
			Wastewater	
			water	23.40
			Inorganics	
			C.S flakes	0.11
			HCl	0.63
			NaCl	0.42
			Organics	
			Methanol	0.11
			Organic residue	
			Acrylate	0.03
	Total	**30.79**	**Total**	**30.79**

Ciprofloxacin Hydrochloride

Stage-IV

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	FQ acid	1.01	Cipro crude	0.97
2	Piperazine	0.81	**Solvent recovery**	
3	N- Butanol	8.54	N- Butanol	8.2
4	Water	11.92	**Solvent Loss**	
5	C.S.Lye	0.25	N- Butanol	0.34
			Wastewater	
			Water	11.92
			Inorganics	
			C.S.Lye	0.25
			HCl	0.11
			Organics	
			FQ acid	0.19
			Piperazine	0.56
	Total	**22.5**	**Total**	**22.5**

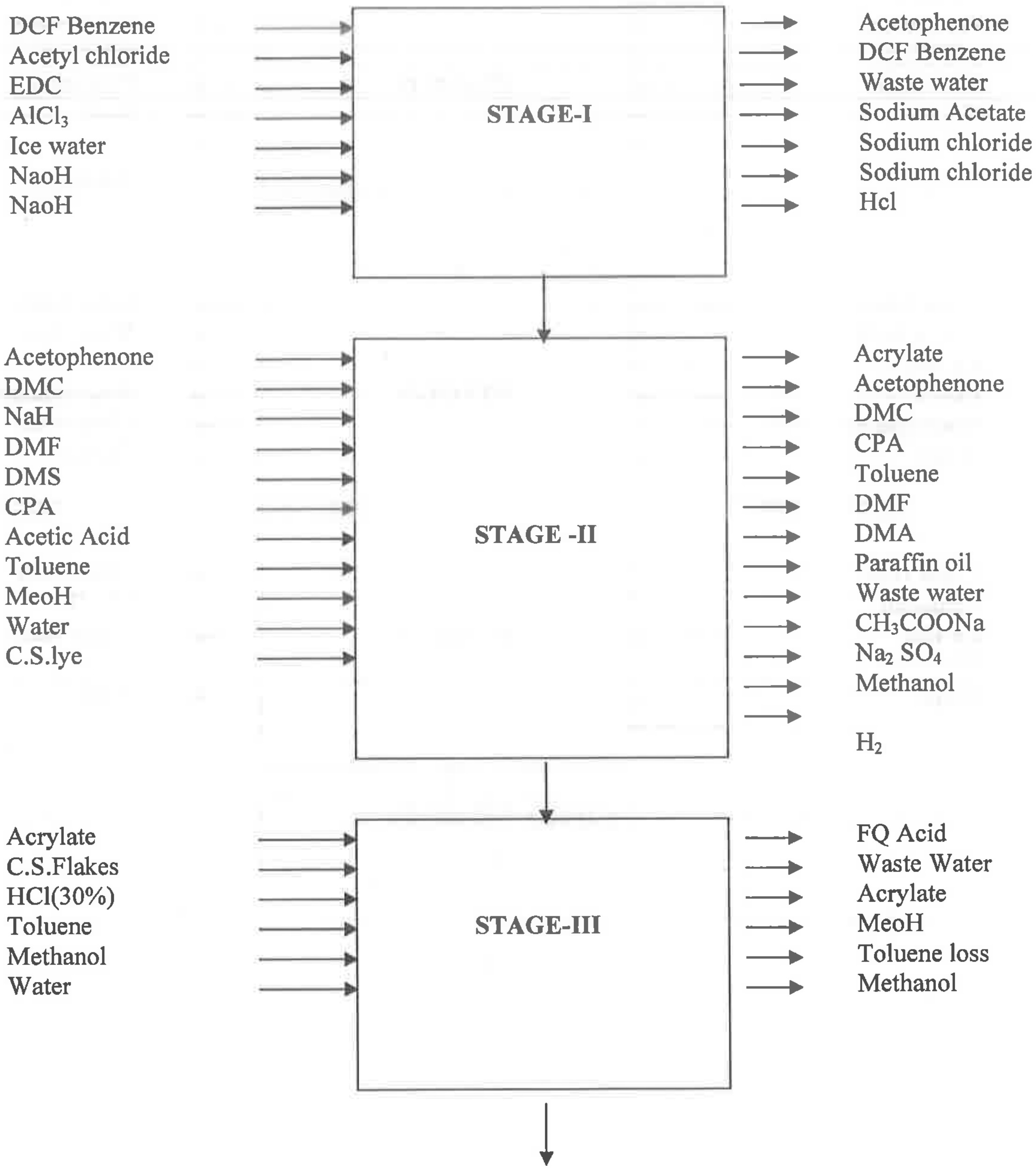
Stage-V

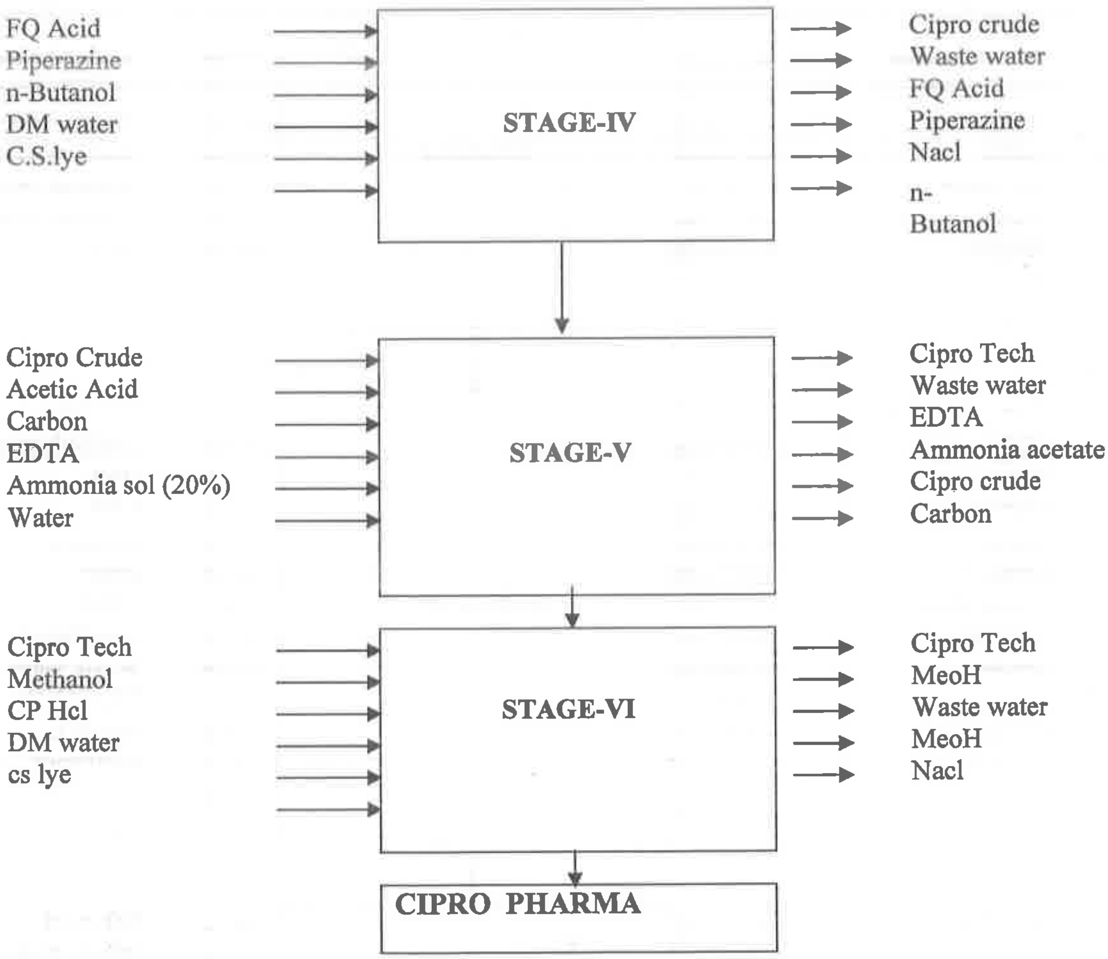
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Cipro crude	0.97	Cipro tech	0.94
2	Acetic acid	0.23	**Wastewater**	
3	Carbon	0.10	water	20.62
4	EDTA	0.004	**Organic**	
5	Ammonia Sol (20%)	0.69	Cipro crude	0.03
6	Water	20.00	**Inorganics**	
			Ammonium acetate	
			Organic residue	0.30
			EDTA	0.004
			Solid waste	
			Carbon	0.10
	Total	22	**Total**	**22**

Stage-VI **Ciprofloxacin Hydrochloride**

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Cipro tech	0.94	Cipro pharma	1
2	Methanol	6.04	**Solvent recovery**	
3	CP HCl	0.40	Methanol	5.66
4	DM Water	2.33	**Solvent Loss**	
5	C.S Lye	0.05	methanol	0.3
			Wastewater	
			Water	2.65
			Inorganics	
			NaCl	0.03
			Organic	
			Methanol	0.04
			Cipro tech	0.01
			Organic residue	
			Methanol	0.04
			Cipro tech	0.03
	Total	**9.77**	**Total**	**9.77**

c) Process Flow Sheet **Ciprofloxacin Hydrochloride**




FQ Acid
Piperazine
n-Butanol
DM water
C.S.lye
STAGE-IV
Cipro crude
Waste water
FQ Acid
Piperazine
Nacl
n-Butanol
Cipro Crude
Acetic Acid
Carbon
EDTA
Ammonia sol (20%)
Water
STAGE-V
Cipro Tech
Waste water
EDTA
Ammonia acetate
Cipro crude
Carbon
Cipro Tech
Methanol
CP Hcl
DM water
cs lye
STAGE-VI
Cipro Tech
MeoH
Waste water
MeoH
Nacl
CIPRO PHARMA

2.6.12 CME Intermediate-16.6 TPM

a) Process Description

Chlorination of hydroxy menthyl ester with thionyl chloride gives chloromenthyl ester. Reaction of cytosine with hexamethyl disilazane gives disilane compound. Condensation of chloromenthyl ester with cytosine disilane compound gives cytosine menthyl ester.

Stage-I

$C_{10}H_{20}O + C_2H_2O_3 + H_2SO_4 + NaHSO_3 + HCHO + Na_2CO_3 + H_2O$

156 74 98 104 30 106 18

$\downarrow$

$C_{12}H_{22}O_4 + Na_2SO_4 + NaSO_3CH_2O + CO_2 + 2H_2O + H_2$

230 142 132 44 36 2

Stage-II

$C_{12}H_{22}O_4 + ½\ C_4H_8S_2O_2 \longrightarrow C_{14}H_{24}SO_4 + H_2O$

230 76 288 18

Stage-III

$C_{14}H_{24}SO_4 + C_4H_5N_3O + SOCl_2 + C_6H_{19}NSi_2 + C_6H_{15}N + 2H_2O$

288 111 119 161 101 36

$\downarrow$

$C_{18}H_{27}O_4N_3S + SO_2 + HCl + NH_3 + C_6H_{20}O_2Si_2 + C_6H_{15}N.HCl$

381 64 36.5 17 180 137.5

b) Material Balance **CME Intermediate**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	L(-)- Menthol	1.54	Product (MGH)	0.68
2	Glyoxalic acid (50%)	0.47	**Solvent Recovery**	
3	Sulphuric acid	0.28	Cyclohexane	2.98
4	Cyclohexane	3.11	**Solvent Loss**	
5	Sodium bisulphite	0.35	Cyclohexane	0.12
6	Sodium Carbonate	0.32	**Wastewater**	
7	Formaldehyde	0.25	Water	21.62
8	Water	21.67	Water from Neutralization	0.11
			Inorganics	
			Sodium sulfate	0.42
			Sodium Carbonate	0.01
			Sodium Bisulphite	0.04
			Organics	
			Formaldehyde	0.16
			Glyoxalic acid	0.26
			Menthol	1.08
			Formaldehyde sulfite	0.39
			Gases	
			CO_2	0.13
	Total	**28.00**	**Total**	**28.0**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Menthyl Glyoxalate Hydrate	0.68	Product (HME)	0.82
2	Toulene	2.43	**Solvent recovery**	
3	Diethiane diol	0.23	Toulene + Hexane	7.7
4	Hexane	5.68	**Solvent Loss**	

CME Intermediate

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Toulene + Hexane	0.46
			Organic residue	
			Menthyl glyoxalate hydrate	0.02
			Diethianediol	0.01
	Total	**9.01**	**Total**	**9.01**

Stage-III

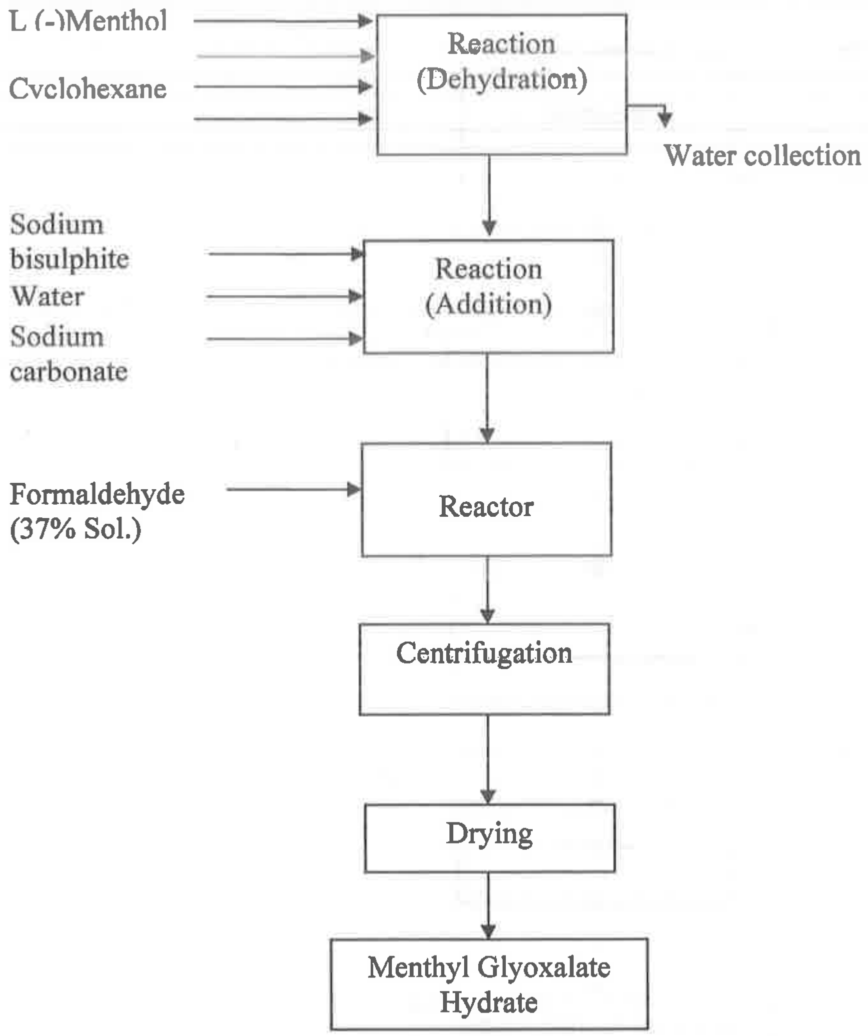
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Hydroxy menthyl ester	0.82	Product (CME)	1
2	Dichloro methane	4.05	**Solvent recovery**	
3	Dimethyl formamide	0.19	Toulene	0.78
4	Thionyl chloride	0.34	Hexane	1.83
5	Triethyl amine	0.29	Isopropyl alcohol	2.31
6	Cytosine	0.32	Dichloro methane	3.81
7	Toulene	0.81	DMF	0.18
8	HMDS	0.47	**Solvent Loss**	
9	Hexane	1.92	Toulene	0.03
10	Water	16.45	Hexane	0.1
11	Isopropyl alcohol	2.43	Isopropyl alcohol	0.12
			Dichloro methane	0.24
			DMF	0.01
			Wastewater	
			Water	16.35
			Inorganics	
			Thionyl chloride	0.03
			Organics	
			Triethylamine hydrochloride	0.36

CME Intermediate

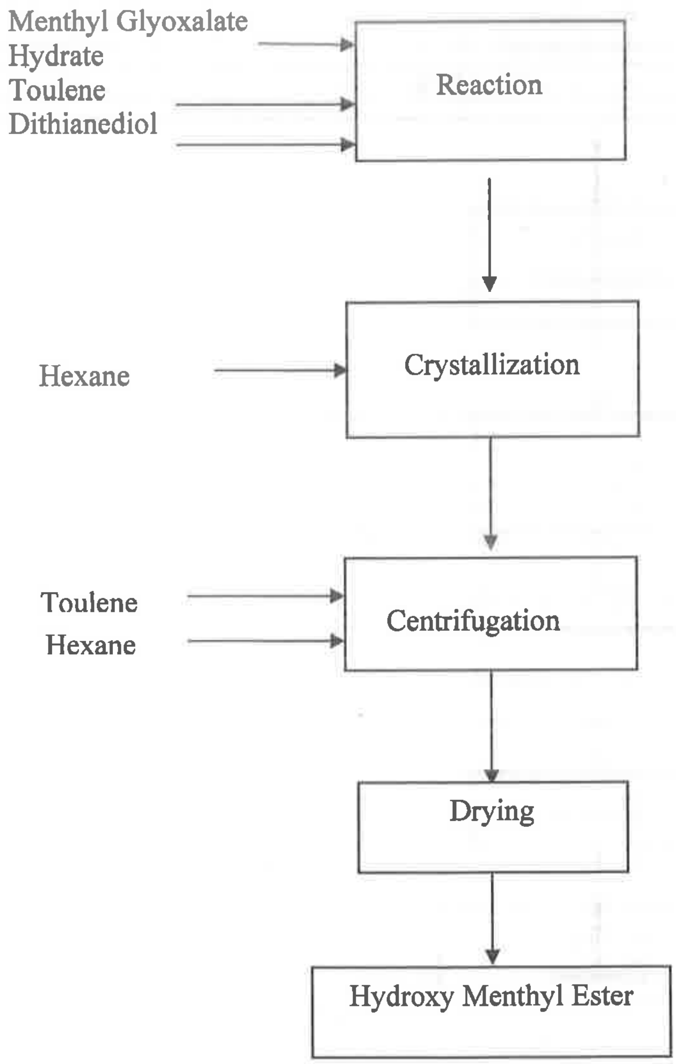
S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Hydroxy trimethyl silane	0.47
			Gases	
			NH_3	0.04
			HCl	0.10
			SO_2	0.17
			Organic residue	
			Hydroxy menthyl ester	0.07
			Triethylamine	0.02
			Cytosine	0.03
			HMDS	0.05
	Total	**28.11**	**Total**	**28.11**

c) **Process Flow Sheet** **CME Intermediate**

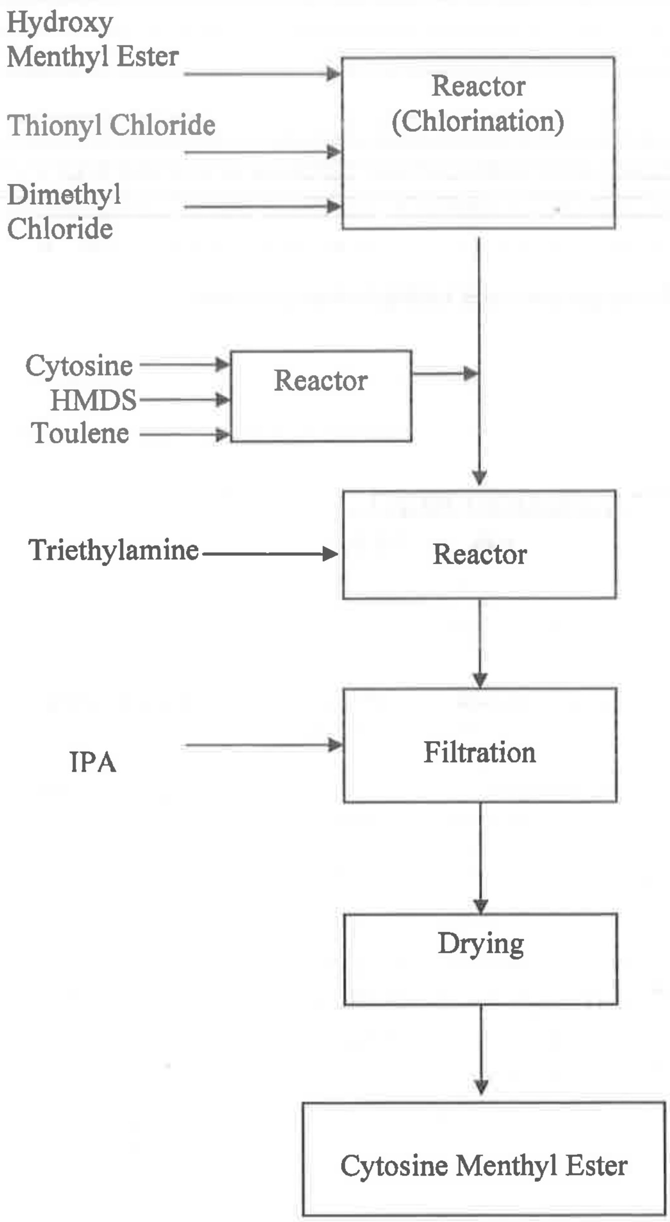
Stage-I



Stage-II **CME Intermediate**



Stage-III **CME Intermediate**



2.6.13 Gabapentene-40 TPM

a) Process Description

1-1 Cyclohexane Diacetic Anhydride is reacted with Ammonia to convert it to amide compound which is reduced with Sodium Hypo Chloride to convert it to 1 amino methyl cyclo hexane acetic acid hydrochloride known as amino compound. This intermediate is reacted with Tri Ethyl Amine to get the Gabapentene crude. It is then purified in Ethanol media to get the pure Gabapentene product.

Stage-I

$C_{10}H_{14}O_3 + 2NH_3 + HCl \longrightarrow C_{10}H_{17}O_3N + NH_4Cl$

182 34 36.5 199 53.5

Stage-II

$C_{10}H_{17}O_3N + NaOCl + NaOH + 2HCl \longrightarrow C_9H_{18}O_2NCl + 2NaCl + CO_2 + H_2O$

199 74.5 40 73 N- Butanol 207.5 117 44 18

Stage-III

$C_9H_{18}O_2NCl + C_6H_{15}N \longrightarrow C_9H_{17}O_2N + C_6H_{15}N.\ HCl$

207.5 101 171 137.5

b) Material Balance **Gabapentene**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Cyclohexane DAA	1.67	Stage-I	1.67
2	NH_3 (20%)	2.67	**Wastewater**	
3	Water	4.17	Water	4.17
4	HCl	2.80	**Inorganics**	
			Ammonium chloride	0.45
			NH_3	2.38
			Organics	
			Cyclohexane DAA	0.14
			Gases	
			HCl	2.49
	Total	**11.30**	**Total**	**11.30**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	1.67	Stage-II	1.417
2	Water	2.92	**Solvent recovery**	
3	Hypo solution	8.48	N-Butanol	6.8
4	NaOH flakes	0.58	**Solvent Loss**	
5	HCl	2.67	N-Butanol	0.28
6	N- Butanol	7.08	**Wastewater**	
			Water	11.01
			Inorganics	
			NaCl	0.80
			NaOH	0.31
			HCl	2.17
			Organics	
			Stage-I	0.31
			Gases	

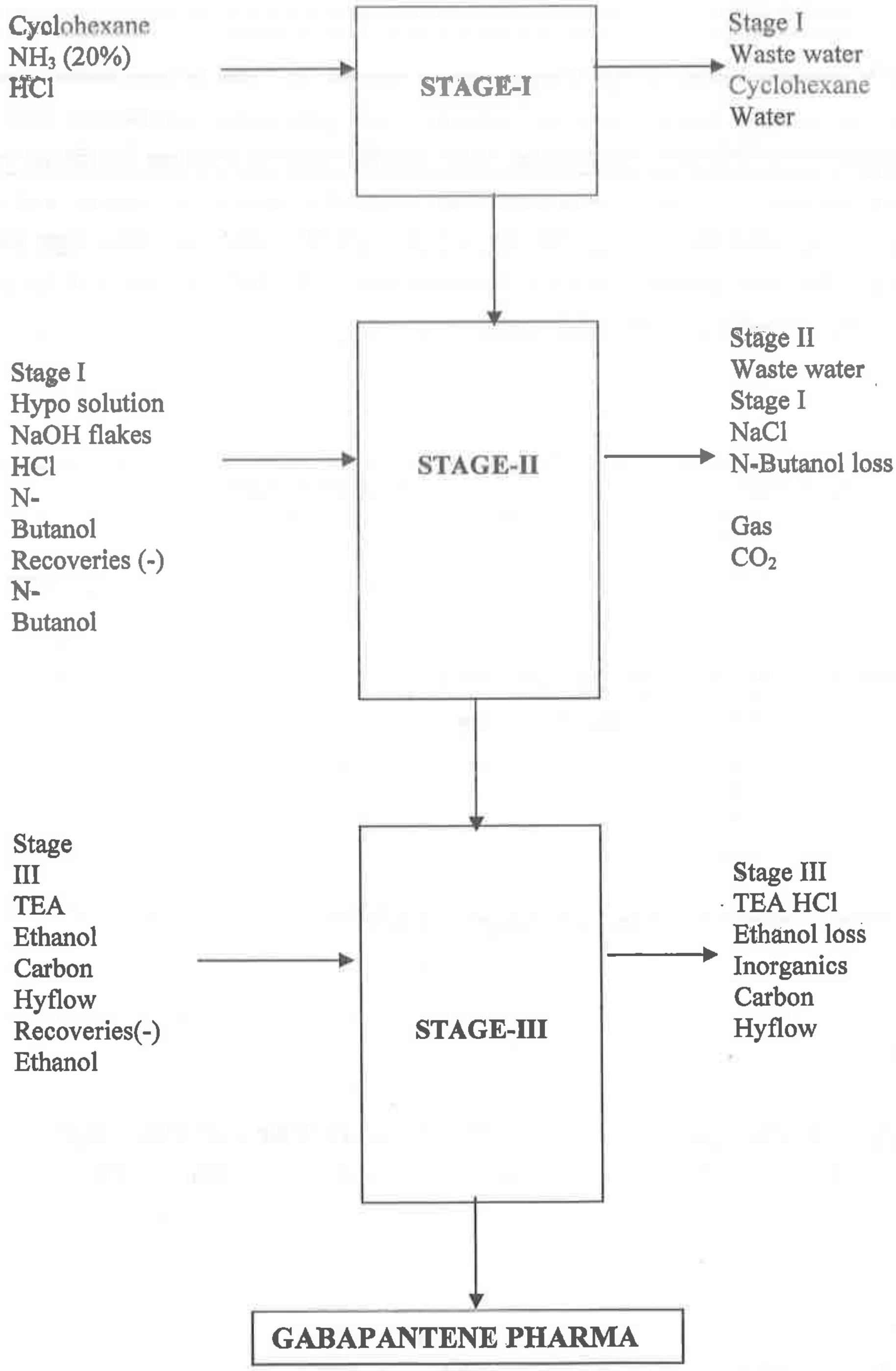
Gabapentene

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			CO_2	0.30
	Total	**23.4**	**Total**	**23.4**

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-III	1.42	Gabapentene Pharma	1
2	TEA	0.69	**Solvent recovery**	
3	Ethanol	13.33	Ethanol	12.67
4	Carbon	0.03	**Solvent Loss**	
5	Hyflow	0.02	Ethanol	0.67
			Organic residue	
			Stage-III	0.20
			TEA HCl	0.80
			TEA	0.10
			Solid waste	
			Carbon	0.03
			Hyflow	0.02
	Total	**15.49**	**Total**	**15.49**

c) Process Flow Sheet **Gabapentene**



2.6.14 Citalopram Hydrobromide-2.5 TPM

a) Process Description

BFB, Bromo Phthalimide, Magnesium is reacted in Tetra Hydro Furan media to get the product known as stage I product. It is then further condensed with DAP Magnesium Chloride, Phosphoric Acid, Acetic Acid in Toluene Media to get the intermediate. It is then condensed using Copper Cyanide, Ammonia, and acetic acid in aqueous media to get the intermediate which is distilled under high vacuum to get the pure product which is then reacted with Hydrobromic acid to get the Citalopram HBr as a pharma product.

Stage-I

$C_6H_4FBr + Mg + C_8H_5O_2Br \xrightarrow[THF]{} C_{14}H_9O_2FMgBr_2$

175 24 213 412

Stage-II

$C_{14}H_9O_2FMgBr_2 + 2H_2O + C_5H_{12}NMgCl + H_3PO_4$

412 36 145.5 98

$\downarrow$

$C_{19}H_{23}O_2NFBr.H_3PO_4 + ½ MgBr_2 + ½ MgCl_2 + Mg(OH)_2$

494 92 47.5 58

Stage-III

$C_{19}H_{23}O_2NFBr.H_3PO_4 + H_3PO_4 \xrightarrow[Toulene]{} C_{19}H_{21}ONFBr + 2H_3PO_4 + H_2O$

494 98 378 196 18

Stage-IV

$C_{19}H_{21}ONFBr + CuCN \longrightarrow C_{20}H_{21}ON_2F + CuBr$

378 89.5 324 143.5

Stage-V **Citalopram Hydrobromide**

$$\underset{324}{C_{20}H_{21}ON_2F} + \underset{81}{HBr} \longrightarrow \underset{405}{C_{20}H_{21}ON_2F.HBr}$$

b) Material Balance

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	BFB	3.00	Stage-I	2.66
2	Mg	0.44	**Solvent recovery**	
3	Bromopthalide	2.00	THF	17.1
4	THF	18.00	**Solvent Loss**	
5	Catalyst	0.02	THF	0.9
			Organic residue	
			BFB	1.87
			Bromopthalide	0.63
			Inorganic waste	
			Mg	0.29
			Catalyst	0.02
	Total	**23.46**	**Total**	**23.46**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-I	2.66	Stage-II	3.2
2	DAP $MgCl_2$	2.80	**Solvent recovery**	
3	Phosphoric acid	1.10	Toulene	17.28
4	Acetic acid	7.20	Acetic acid	7
5	Toulene	18.00	**Solvent Loss**	
6	DM Water	50.24	Toulene	0.42
			Acetic acid	0.2
			Wastewater	
			Water	50.00
			Inorganics	

Citalopram Hydrobromide

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			DAP $MgCl_2$	1.86
			H_3PO_4	0.47
			$MgCl_2$	0.31
			$MgBr_2$	0.60
			Mg $(OH)_2$	0.38
			Organics	
			Toulene	0.30
			Organic waste	
			Stage-I	-0.01
	Total	**82.00**	**Total**	**82.0**

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-II	3.20	SRP-III	2.3
2	NH_3 (25%)	13.80	**Solvent recovery**	
3	Water	23.00	Toulene	16.32
4	Toulene	17.00	**Solvent Loss**	
5	H_3PO_4	6.50	Toulene	0.68
			Wastewater	
			water	34.21
			Inorganics	
			Ammonium phosphate	9.80
			Organic	
			Stage-II	0.19
	Total	**63.50**	**Total**	**63.50**

Stage-IV **Citalopram Hydrobromide**

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Stage-III	2.30	Citalopram pure	0.92
2	CuCN	1.04	**Solvent recovery**	
3	Ammonia Sol (20%)	2.00	Toulene	46.08
4	Acetic acid	1.42	**Solvent Loss**	
5	DM Water	39.20	Toulene	1.92
6	Toulene	48	**Wastewater**	
7	EDTA	0.2	Water	40.80
8	Hyflow	0.1	**Inorganics**	
9	Carbon	0.1	CuCN	0.79
			CuBr	0.41
			Organics	
			Ammonium acetate	1.82
			Stage-III	1.2268
			Solid waste	
			Carbon	0.1
			Hyflow	0.1
			Organic residue	
			EDTA	0.20
	Total	**94.36**	**Total**	**94.36**

Stage-V

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Citalopram pure	0.92	Citalopram HBr	1
2	NaOH	0.04	**Solvent recovery**	
3	HBr	0.30	IPA	3.17
4	Acetone	16.00	Acetone	15.2
5	Water	13.00	**Solvent loss**	
6	IPA	3.3	IPA	0.13

Citalopram Hydrobromide

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
7	Carbon	0.02	Acetone	0.6
8	Hyflow	0.02	**Wastewater**	
			Water	13.02
			Inorganics	
			Sodium bromide	0.12
			Organics	
			Citalo base	0.12
			Acetone	0.20
			Solid waste	
			Carbon	0.02
			Hyflow	0.02
	Total	**33.6**	**Total**	**33.6**

c) Process Flow Sheet

Citalopram Hydrobromide

BFB Mg Bromopthalide THF Catalyst	STAGE-I	Stage I BFB Mg Bromopthalide THF loss Catalyst
Stage I DAP $MgCl_2$ Phosphoric Acid Acetic Acid Toluene DM water	STAGE-II	Stage II **Waste Water** Stage I DAP Mg Cl_2 H_3PO_4 $MgCl_2$ MgBr
Stage II NH_3 (25%) Water Toluene H_3PO_4	STAGE-III	Stage III **Waste Water** Stage II Sodium Phophate Toluene loss
Stage III CuCN Ammonia Sol.(20%) Acetic Acid DM Water Toluene EDTA Hyflow	STAGE-IV	stage IV Stage III Comp. Waste Water Ammonium acetate Water CuBr Toluene loss EDTA Hyflow
Citalopram Pure NaOH HBr Acetone Water IPA Carbon Hyflow	STAGE-V	Citalo Base Acetone Sodium Bromide Water Acetone loss IPA loss Carbon

CITALOPRAM HBr

2.6.15 Zidovudine-25TPM

a) Process Description

Tritylation of thymidine with triphenyl methyl chloride in dioxane yields trityl derivative of thymidine namely 5'-O-trityl thymidine.(Stage-I)5'-O-Trityl thymidine was reacted with methane sulfonyl chloride in presence of triethylamine and pyridine in methylene dichloride results 3'-O-Mesyl-5'-O-trityl thymidine upon treatment in methanol with triethylamine yields 2,3'-Anhydro-5'-O'-trityl thymidine (Stage-II).2,3'-Anhydro-5'-O-trityl thymidine was converted into 3'-Azido-5'-O-trityl thymidine (Stage-III) with sodium azide in dimethyl sulfoxide. Hydrolysis of 3'-Azido-5'-O-trityl thymidine with concentrated p-Toluene sulfonic acid in methanol to afford Zidovudine after purification in Ethyl acetate.

b) Chemical Reactions

Stage-I

$$C_{10}H_{14}N_2O_5 + C_{19}H_{15}Cl \longrightarrow C_{29}H_{28}O_5N_2 + HCl$$

242 278.5 484 36.5

Stage-II

$$C_{29}H_{28}O_5N_2 + CH_3SO_2Cl \xrightarrow[\text{Toulene}]{\text{Triethylamine}} C_{29}H_{26}O_4N_2 + CH_3HSO_3 + HCl$$

484 114.5 466 96 36.5

Stage-III

$$C_{29}H_{26}O_4N_2 + NaN_3 + H_2O \xrightarrow{\text{DMSO}} C_{29}H_{27}O_4N_5 + NaOH$$

466 65 18 509 40

Stage-IV

$$C_{29}H_{27}O_4N_5 + H_2O \xrightarrow[\text{Sulfonic acid}]{\text{Toulene}} C_{10}H_{13}N_5O_4 + C_{19}H_{16}O$$

509 18 267 260

c) Material Balance **Zidovudine**

Stage-I

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Thymidine	1.70	Try Thymidine	3.32
2	Triphenyl methyl chloride	2.56	**Solvent Recovery**	
3	TEA	1.42	Toulene	5.73
4	1,4 Dioxane	15.91	1,4 Dioxane	15.27
5	Toulene	5.97	**Solvent Loss**	
6	Water	11.36	Toulene	0.24
			1,4 Dioxane	0.63
			Wastewater	
			Water	11.36
			Organics	
			TEA HCl	0.94
			TEA	0.73
			Organic residue	
			Thymidine	0.05
			Triphenyl methyl chloride	0.65
	Total	**38.92**	**Total**	**38.92**

Stage-II

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Try Thymidine	3.32	Anhydrous trimidine	2.59
2	TEA	0.60	**Solvent recovery**	
3	Methane sulfonyl chloride	0.70	Toulene	10.91
4	C.S.Lye	0.94	**Solvent Loss**	
5	Toulene	11.36	Toulene	0.45
6	Water	32.95	**Wastewater**	

Zidovudine

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Water	32.95
			Inorganic	
			NaOH	0.15
			Na_2SO_4	0.79
			Organic	
			CH_3HSO_3	0.53
			TEA HCl	0.76
			Organic residue	
			Trithymidine	0.63
			TEA recovered	0.04
			Methane sulfonyl chloride	0.07
	Total	50	**Total**	50

Stage-III

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Anhydrous trimidine	2.59	Azido trithymidine	2.59
2	NaN_3	2.22	**Wastewater**	
3	Water	0.51	Water	92.47
4	NH_4Cl	0.28	**Solvent recovery**	
5	C.S.Lye	0.22	DMSO	15.33
6	HCl	0.2	**Solvent Loss**	
7	DMSO	16.14	DMSO	0.81
8	Water	92.05	**Inorganics**	
9	HNO_2	0.68	NaCl	0.30
			NaOH	0.69
			NaN_3	1.22
			HNO_2	0.2

Zidovudine

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			NH_4Cl	0.28
			HCl	0.02
			Gases	
			N_2	0.43
			NO	0.31
			Organic	
			Anhydrous trimidine	0.22
	Total	**114.9**	**Total**	**114.9**

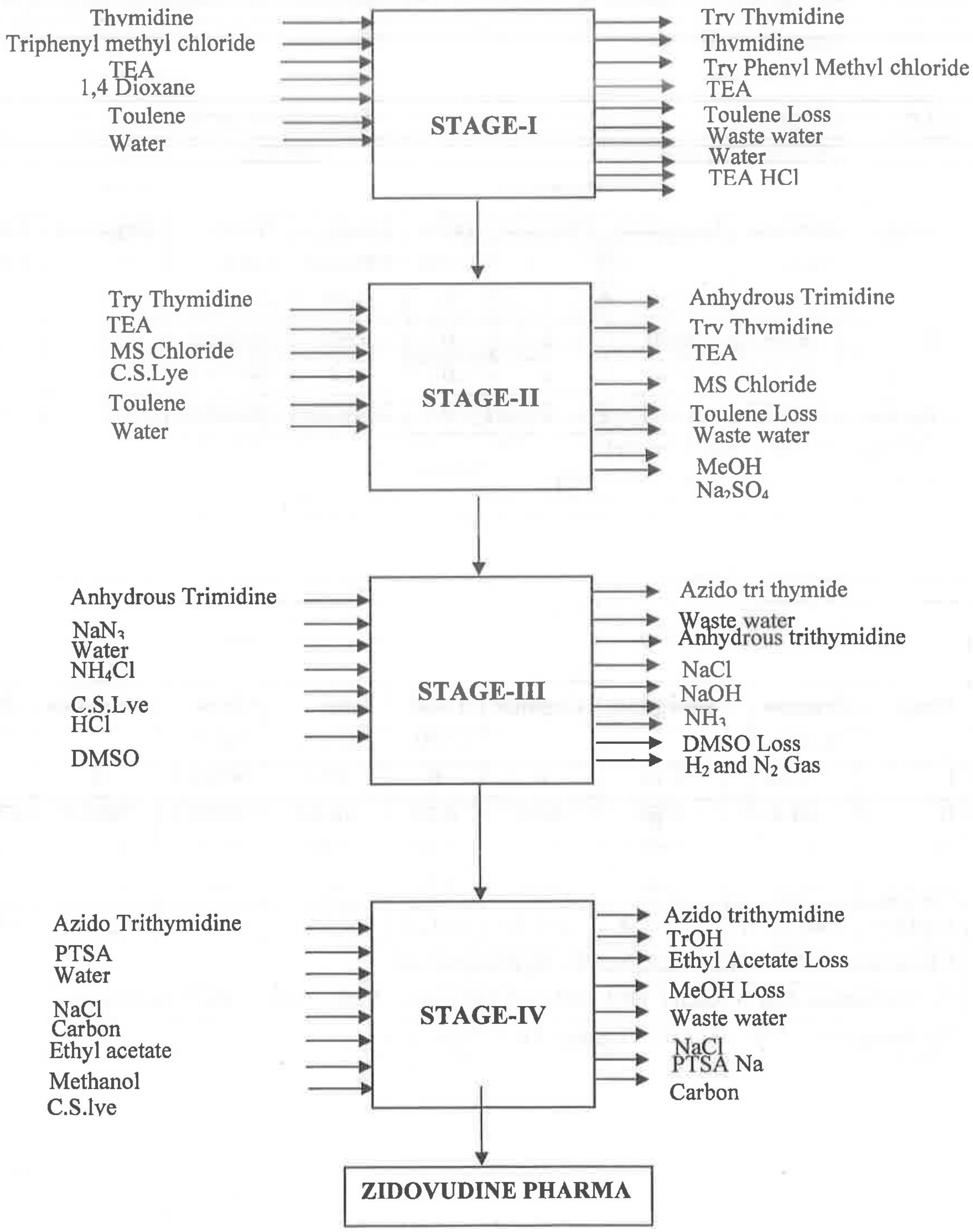
Stage-IV

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
1	Azido trithymidine	2.59	Zidovudine	1
2	PTSA	0.31	**Solvent recovery**	
3	Water	0.57	Ethyl acetate	16.41
4	NaCl	0.26	Methanol	18.78
5	Carbon	0.09	**Solvent Loss**	
6	Ethyl acetate	17.27	Ethyl acetate	0.86
7	Methanol	19.77	Methanol	0.99
8	Water	19.32	**Wastewater**	
9	C.S.Lye	0.15	Water	19.82
			Inorganics	
			NaCl	0.26
			NaOH	0.003
			Organics	
			Triphenyl methane	0.97
			PTSA Na	0.46
			Organic residue	

Zidovudine

S. No	Input	Quantity (Kg/Kg)	Output	Quantity (Kg/Kg)
			Azidotrithymidine	0.69
			Solid waste	
			Carbon	0.09
	Total	**60**	**Total**	**60**

d) Process Flow Sheet **Zidovudine**



2.7 POLLUTION LOADS/ CONCENTRATION

The stage wise effluent characteristics of the 15 proposed products are given in the following tables.

1.0	Product		Tiaprofenic Acid					
	Production per day		100 Kgs					
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	11.43	0.52	0	0	11.95	45562.5	0	0
II	8.79	0.66	0	0	9.45	75455.1	0	0
Kg/Kg	20.22	1.18	0	0	21.4	58558.4	0	0
Kg/Day	2021.87	118.4	0	0	2140.26	58558.4	0	0
I-Inorganics: HCl ,NaCl, NaOH								
II- Inorganics- KCl, NaCl, HCl, KOH								

2.0	Product		Naproxen Sodium					
	Production per day		1660 Kgs					
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	38.68	2.12	0	0	40.8	54862.7	0	0
II	44.8	0.89	0.35	0.28	46.04	19830.1	7901.7	6251.3
III	9.37	0.47	0.04	0.09	9.88	49730.7	4351.6	9660.5
Kg/Kg	92.85	3.48	0.39	0.37	96.73	37442.1	4251.7	3991.4
Kg/Day	154137.91	5771.24	655.35	615.22	160564.5	37442.1	4251.7	3991.4
I-Inorganics: KCl, HCl, NaCl, NaOH, Hydroxylamine								
II- Inorganics- NaCl, NaOH, HCl, NH_4OH, Organics- Acetic acid, Sodium acetate								
III- Inorganics- NaCl, NaOH, Organic- D(+) Naproxen pharma								

3.0	Product	Naproxen Intermediate						
	Production per day	1660 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	25	0.61	0.41	0.72	26.02	24389	16500	28693.5
Kg/Kg	25	0.61	0.41	0.72	26.02	24389	16500	28693.5
Kg/Day	41500	1012.1	684.75	1190.78	43196.8	24389	16500	28693.5
I-Inorganics: HCl, NaCl, NaOH, Organics- Methoxy naphthalene, Acetyl chloride								

4.0	Product	Trazadone Hydrochloride						
	Production per day	100 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	15.9	1.3	2.07	4.55	19.27	81930.1	130174.4	286585.1
II	9.38	0.62	0	0	10.42	66046.7	0	0
III	16.29	0.16	0	0	16.46	9880.9	0	0
Kg/Kg	41.57	2.08	2.07	4.56	46.14	50101.05	49785.3	109604.7
Kg/Day	4156.6	208.26	206.94	455.58	4614.0	50101.05	49785.3	109604.7
III-Inorganics: NaBr, NaCl, NaOH, Organic- Acetone, Stage-II compound								
IV- Inorganics- NH_4Cl								
V- Inorganics- NaOH, NaCl								

5.0	Product	Allopurinol						
	Production per day	260 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	0	0	0	0	0	0	0	0
II	59.08	0.3	0.22	0.58	59.6	5061.3	3765.8	9941.6
III	37.99	0.49	0	0	38.47	12774.2	0	0
Kg/Kg	97.06	0.78	0.22	0.59	98.07	8080.0	2291.9	6050.6

5.0	Product	Allopurinol						
	Production per day	260 Kgs						
	Kg/Kg					mg/l		
Kg/Day	25236.89	203.91	57.84	152.7	25498.65	8080.0	2291.9	6050.6
II-Inorganics: H_2SO_4, Hydrazine sulfate, Organics- Product loss in water								
III- Inorganics- $(NH_4)_2SO_4$								

6.0	Product		Nabumetone					
	Production per day		30 Kgs					
	Kg/Kg					mg/l		
Stage	**Process Water**	**Inorganic**	**Organic**	**Total COD**	**Total Effluent**	**Fixed Solids**	**Organics**	**Total COD**
I	60	0	0.71	0.97	60.71	0	11892.9	16237.2
II	0.08	0	0	0	0.08	0	0	0
Kg/Kg	60.08	0	0.71	0.97	60.79	0	11877.3	16215.9
Kg/Day	1802.37	0	21.41	29.23	1823.77	0	11877.3	16215.9
I-Organics: Sodium methoxide, Ethanol								

7.0	Product		Efavirenz					
	Production per day		500 Kgs					
	Kg/Kg					mg/l		
Stage	**Process Water**	**Inorganic**	**Organic**	**Total COD**	**Total Effluent**	**Fixed Solids**	**Organics**	**Total COD**
I	62.62	0.23	0.76	0.83	63.61	3675.6	12132.4	13309.2
II	43.75	0.23	0.18	0.03	44.16	5285.7	4100	861
Kg/Kg	106.37	0.46	0.94	0.87	107.77	4337.9	8828.6	8189.1
Kg/Day	53183.3	230.7	469.53	435.52	53883.52	4337.9	8828.6	8189.1
I-Inorganics: H_3BO_3, Organics- Para Methoxy toulene, Sodium acetate								
II- Inorganics- HCl, Organic- Triphosgene								

8.0	Product	Abacavir Sulfate					
	Production per day	100 Kgs					
	Kg/Kg				mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	31.21	0	0	0	31.21	0	0	0
II	0.42	0.23	0	0	0.65	530857.7	0	0
III	0.46	0.01	0	0	0.47	26585.4	0	0
Kg/Kg	32.09	0.24	0	0	32.32	7407.2	0	0
Kg/Day	3208.59	23.7	0	0	3232.4	7407.2	0	0
II- Inorganics- NaCl								
III- Inorganics- H_2SO_4								

9.0	Product	Nelfinavir Mesylate						
	Production per day	160 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	4.75	0.09	0.27	0.71	5.11	18042.11	57642.1	150445.9
II	30	0	0.02	0.68	30.02	0	790	22790
Kg/Kg	34.75	0.09	0.3	1.4	35.13	2466.2	8561.2	40239.4
Kg/Day	5560	13.7	47.6	223.7	5621.3	2466.2	8561.2	40239.4
I Inorganics- $KHCO_3$, K Salt, Organic- Thiophenol								
II- Organics- Methane sulfonic acid								

10.0	Product	Indinavir Sulfate						
	Production per day	100 Kgs						
	Kg/Kg					mg/l		
Stage	Process	Inorganic	Organic	Total	Total	Fixed	Organics	Total

10.0	Product		Indinavir Sulfate					
	Production per day		100 Kgs					
	Kg/Kg					mg/l		
	Water			COD	Effluent	Solids		COD
I	30.4	0.84	1.4	3.51	32.6	27677.2	45412.8	115644.3
II	0.48	0	0.05	0.13	0.53	0	104000	269360
Kg/Kg	30.9	0.84	1.4	3.6	33.1	27250.0	46317.2	118016.7
Kg/Day	3085.4	84.1	142.9	364.1	3312.3	27250.0	46317.2	118016.7
I Inorganics- NaCl, NaOH, $NaHCO_3$, HCl, Organics- Carboxamide, Picolyl chloride, TEA, Ipa and ter butyl alcohol								
II- Organics- Methane sulfonic acid								

11.0	Product		CME Intermediate					
	Production per day		550 Kgs					
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	21.73	0.47	1.9	3.68	24.09	21655.3	87225.9	169790.6
II	0	0	0	0	0	0	0	0
III	16.35	0.03	0.83	1.91	17.21	1725.6	50963.7	116718.8
Kg/Kg	38.1	0.5	2.73	5.6	41.31	13097.3	71654.5	147001.1
Kg/Day	20943.3	274.3	1500.68	3078.69	22718.29	13097.3	71654.5	147001.1
I- Inorganics- Na_2SO_4, Na_2CO_3, Sodium bisulphite, Organics- Formaldehyde, Glyoxalic acid, Menthol, Formaldehyde adduct								
III- Inorganics- Thionyl chloride, Organics- Triethylamine Hydrochloride, Hydroxy trimethyl silane								

12.0	Product		Citalopram Hydrobromide					
	Production per day		80 Kgs					
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	0	0	0	0	0	0	0	0

12.0	Product	Citalopram Hydrobromide					
	Production per day	80 Kgs					
	Kg/Kg					mg/l		
II	50.0	3.6	0.3	0.93	53.9	72036.0	6000	18780
III	34.21	9.8	0.19	0.31	44.2	286466	5676.7	8969.2
IV	40.8	1.19	3.05	5.56	45.04	29250.0	74676.5	136291.1
V	13.02	0.12	0.32	0.76	13.46	9216.6	24577.6	58464
Kg/Kg	138.03	15.71	3.86	7.57	156.6	106608.7	27972.2	54826.6
Kg/Day	11042.4	1256.91	308.9	605.41	12528.5	106608.7	27972.2	54826.6
II- Inorganics- DAP $MgCl_2$, H_3PO_4, $MgCl_2$, $MgBr_2$, Mg $(OH)_2$, Organics- Toulene								
III- Inorganics- Ammonium phosphate, Organic- Stage-II compound								
IV- Inorganics- CuCN, CuBr, Organics- Ammonium acetate, StageIII compound								
V- Inorganics- NaBr, Organics- Citalo base, Acetone								

13.0	Product	Gabapantene						
	Production per day	1330 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	4.17	2.83	0.14	0.29	7.14	679190.0	34180	71778
II	11.01	3.28	0.31	0.69	14.6	297554	27967.6	62927.1
III	0	0	0	0	0	0	0	0
Kg/Kg	15.18	8.6	0.45	0.99	24.23	402300.6	29672.7	65356.4
Kg/Day	20190.62	11440.16	599.11	1319.58	32229.89	402300.6	29672.7	65356.4
I- Inorganics- NH_4Cl, NH_3, Organics- Cyclohexane DAA								
II- Inorganics- NaCl, NaOH, HCl, Organics- Stage-I compound								
III-Inorganics- NaCl, HCl, NaOH, Organics- Sodium acetate								

14.0	Product	Ciprofloxacin Hydrochloride						
	Production per day	830 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	50	1.4	0.35	0.27	51.74	27963.3	6931.7	5406.7
II	9.15	0.45	1.32	1.35	10.92	49603.6	144191.3	147191.7
III	13.4	1.16	0.11	0.17	24.67	49570.2	4897.2	7345.8
IV	11.92	0.36	0.75	2.17	13.02	29923.1	62727.3	182314
V	20.62	0.3	0.03	0.07	20.95	14548.4	1414.5	3210.8
VI	2.65	0.03	0.05	0.08	2.74	12558.9	18838.4	30675.04
Kg/Kg	117.74	3.7	2.61	4.11	124.04	31439.9	22138.4	34897.0
Kg/Day	97720.29	3072.31	2163.46	3410.14	102956.07	31439.9	22138.4	34897.0
I- Inorganics- NaCl, HCl, NaOH, Organics- Sodium acetate								
II- Inorganics- C.S Lye, Na_2SO_4, Organics- Sodium acetate, Methanol, Acetic acid								
III-Inorganics- C.S Flakes, HCl, NaCl, Organics- Methanol								
IV- Inorganics- C.S.Lye, HCl, Organics- FQ Acid, Piperazine								
V- Inorganics- Ammonium acetate								
VI- Inorganics- NaCl, Organics- Methanol, Cipro tech								

15.0	Product	Zidovudine						
	Production per day	833.33 Kgs						
	Kg/Kg					mg/l		
Stage	Process Water	Inorganic	Organic	Total COD	Total Effluent	Fixed Solids	Organics	Total COD
I	11..36	0	1.67	4.94	13.03	0	147020	435315.6
II	32.95	0.94	1.3	2.3	35.2	28624.1	39386.3	70061.8
III	92.47	2.72	0.22	0.54	95.41	29436.1	2368.2	5849.5
IV	19.82	0.26	1.43	3.36	21.51	13313.7	72170.3	169701.2
Kg/Kg	156.6	3.93	4.62	11.16	165.15	25088.9	29488.5	71262.0
Kg/Day	130501.47	3274.13	3848.28	9299.9	137623.88	25088.9	29488.5	71262.0
I- Organics- Triethylamine HCl, Triethylamine								
II- Inorganics- NaOH, Na_2SO_4, Organics- CH_3HSO_3, Triethylamine HCl								
III-Inorganics- NaOH, NaCl, NH_4Cl, NaN_3, HNO_2, HCl								
IV- Inorganics- NaCl, NaOH, Organics- Triphenyl methane, PTSA Na								

2.8 RAW MATERIALS

The raw materials required for the fifteen products (after the expansion) are given in table below.

Product	Raw Materials	Quantity - (kg/d)
Tiaprofenic Acid		
	Methylene chloride	571.43
	Sodium hydroxide flakes	22.86
	Benzoyl chloride	57.14
	Alluminium chloride	22.29
	Potassium hydroxide	22.86
	Methylene chloride	285.71
	Conc. HCl	22.29
	NaOH	20
Naproxen Sodium		
	CS Lye	1544.19
	HA HCl	559.77
	Conc. HCl	1254.65
	Toulene	7720.93
	HCl (33%)	579.07
	Carbon	173.72
	CS Lye	1053.91
	Acetic acid	436.23
	Methanol	386.05
	Sodium hydroxide	265.21
	Sodium chloride	772.09
	Alluminium chloride	539.5
	Acetyl chloride	987.7
	DM Water	41500
	Ethylene dichloride	12450
	NaoH	485.55
Trazadone Hydrochloride		
	CS Flakes	68.75
	Chloroform	750
	Acetone	187.5
	Ethoxy ethanol	156.25
	Xylene	300
	IPA	50
	Carbon	6.25
	Hyflow	3.13
	IPA HCl	52.5

Product	Raw Materials	Quantity - (kg/d)
	Sodium hydroxide	11.56
Allopurinol		
	Triethyl ortho formate	789.29
	Acetonitrile	209.86
	Carbon	18.57
	Sulphuric acid	157.86
	Formamide	947.14
Nabumetone		
	Ethyl acetate	128.57
	SMO powder	12.86
	Methanol	214.29
	Pd/C	4.29
	Carbon	4.29
Efavirenz		
	Toulene	6601.56
	Methanol	1875.00
	Sodium bororhydride	23.44
	Sodium hydroxide Flakes	121.09
	Acetic acid	187.50
	MTBE	234.38
	N heptane	875.00
	Hyflow	39.06
	THF	976.56
	Hexane	2539.06
	Ethyl acetate	1425.78
	carbon	14.06
Abacavir Sulfate		
	TEOF	1742.22
	CP HCl	237.78
	Methanol	671.11
	IPA	1333.33
	CS Flakes	35.56
	Carbon	24.44
	Sulphuric acid	16.67
	Ethanol	900.00
	Carbon	8.33
Nelfinavir Mesylate		
	MIBK	1600
	Thiophenol	76.8
	Potassium bicarbonate	17.6
	Toulene	960
	THF	484.16

Product	Raw Materials	Quantity - (kg/d)
	Acetone	739.2
Indinavir Sulfate		
	IPA	177.62
	CP HCl	80.95
	CS flakes	30.48
	Ethyl acetate	201.90
	DMF	138.10
	Sodium bicarbonate	19.05
	Carbon	8.57
	Ethanol	810.00
	carbon	4.76
	Sulphuric acid	14.48
CME Intermediate		
	Sulphuric acid	156.08
	Cyclohexane	1709.46
	Sodium bisulphite	190.27
	Sodium Carbonate	178.38
	Formaldehyde	138.54
	Toulene	1337.84
	Hexane	3121.62
	Dichloro methane	2229.73
	Dimethyl formamide	104.05
	Toulene	445.95
	Hexane	1058.38
	Isopropyl alcohol	1337.84
Citalopram Hydrobromide		
	Mg	35.2
	THF	1440
	Catalyst	1.6
	Phosphoric acid	88
	Acetic acid	576
	Toulene	1440
	Toulene	1360
	H_3PO_4	520
	Acetic acid	113.6
	Toulene	3840
	EDTA	16
	Hyflow	8
	Carbon	8
	NaOH	3.2
	HBr	24
	Acetone	1280

Product	Raw Materials	Quantity - (kg/d)
	IPA	264
	Carbon	1.6
	Hyflow	1.6
Gabapantene		
	HCl	3724
	Hypo solution	11282.83
	NaOH flakes	775.83
	HCl	3546.67
	N- Butanol	9420.83
	Ethanol	17733.33
	Carbon	44.33
	Hyflow	22.17
Ciprofloxacin Hydrochloride		
	EDC	5187.50
	$AlCl_3$	1037.50
	NaOH	556.79
	Acetic acid	560.25
	Toulene	6484.38
	MeOH	491.08
	C.S lye	619.04
	Carbon	36.31
	C.S. Flakes	328.54
	HCl (30%)	632.88
	Toulene	3527.50
	Methanol	691.67
	N- Butanol	7089.58
	C.S.Lye	207.50
	Acetic acid	193.67
	Carbon	86.46
	EDTA	3.46
	Methanol	5014.58
	CP HCl	335.46
	C.S Lye	41.50
Zidovudine		
	Toulene	4971.39
	C.S.Lye	785.95
	Toulene	9469.32
	C.S.Lye	179.92
	HCl	170.45
	DMSO	13446.43
	HNO_2	568.16
	NaCl	217.79

Product	Raw Materials	Quantity - (kg/d)
	Carbon	75.75
	Ethyl acetate	14393.36
	Methanol	16476.61
	C.S.Lye	126.89

CHAPTER-III
BASELINE ENVIRONMENTAL STATUS

Chapter-3
Baseline Environmental Status

3.0 INTRODUCTION

The present study is to establish a baseline status and assess the potential impacts from the proposed expansion of the bulk drug manufacturing unit at Vizianagaram.

The manufacturing process of bulk drugs and pharmaceuticals, depending upon the scale of operation, has the potential to affect various components of environment such as air, water, noise, soil and biological settings. The impact caused on these components varies from insignificant to significant. Study of baseline environmental data in terms of parameters such as air quality, water quality, soil quality, noise levels, biological and socio-economic setting is essential to quantify the impacts of the proposed activity.

Baseline Environmental status in and around the plant site depicts the existing conditions of air, noise, water, soil and socio-economic environment. An area covering 10 kms radially, with the Matrix Laboratories Ltd, Unit-8 site being the epicenter has been selected for the baseline data collection. An area of 10 Km was considered for the present study instead of the 25 Km because the impacts likely to be generated from the proposed expansion is likely to be felt within the first 10 Km from the plant. The baseline data was collected for various environmental components viz. air, noise, and water, land and socio-economic status so as to evaluate the impacts that are likely to be arising out of the proposed activities. In keeping with the legislative requirements, RICPL has performed an REIA study based on the monitoring data collected for the post monsoon season (September '05 -December'05) in the study area. Details of the baseline study are presented in this chapter. From the inputs generated with respect to the baseline status, an environmental management plan has been prepared to manage and mitigate these impacts.

3.1 BASELINE ENVIRONMENTAL STATUS

This chapter gives an idea and description of the environmental status of the study area with reference to the prominent environmental attributes. The general study area covers about 10 Km radius with respect to the plant site. The impact identification always starts with the collection of primary or baseline data such as the ambient air quality, water quality, noise levels, land use patterns, flora & fauna and the socio-economic aspects within the 10 Km radius zone. The baseline monitoring was conducted from September to December 2005.

The topographical map showing all the major settlements and the existing transport networks is shown in the **Figure 3.1 (a) & (b)** and the map showing the sampling locations in **Figure 3.1(c)**.

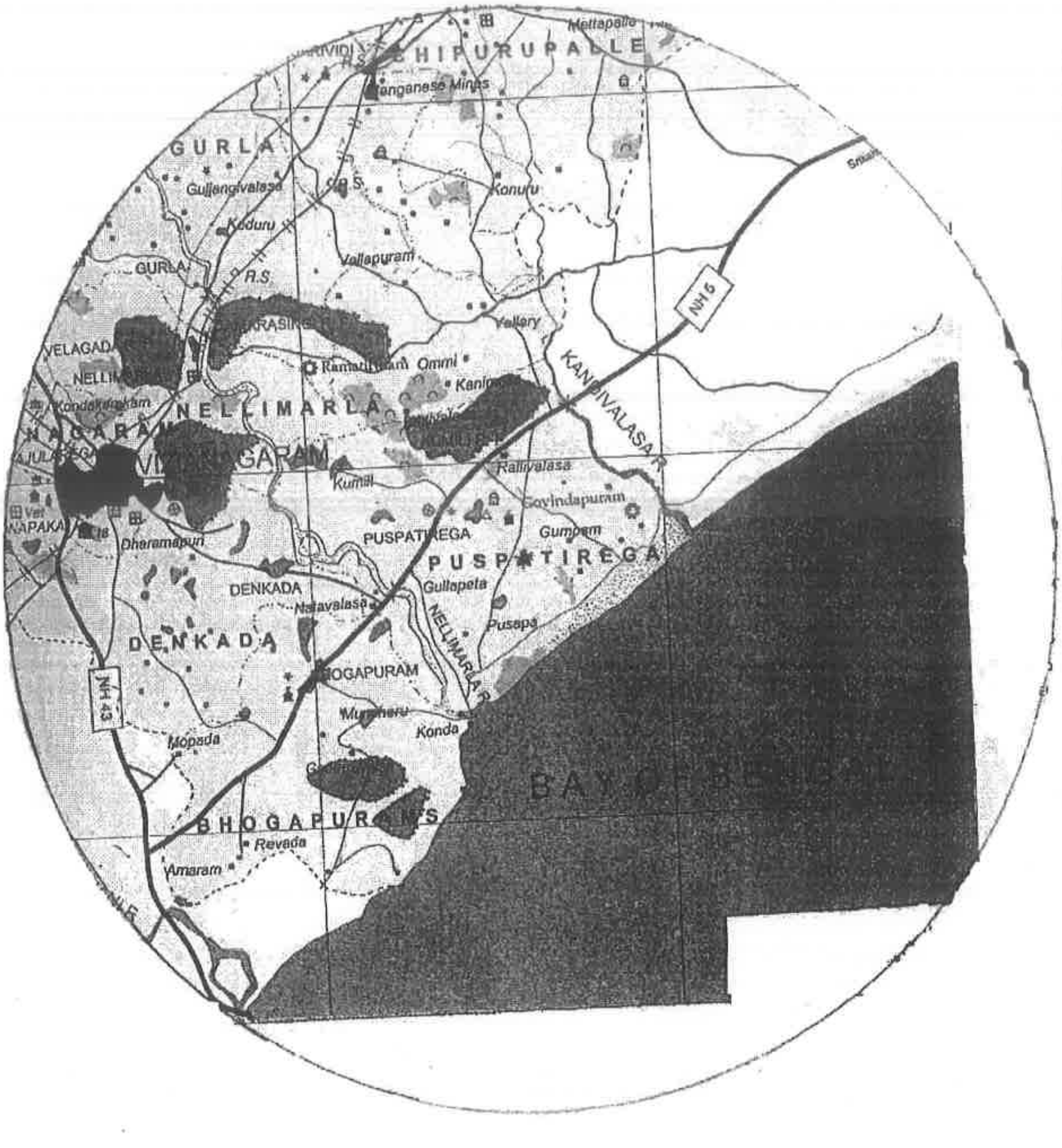
3.2 SITE DESCRIPTION AND ENVIRONS

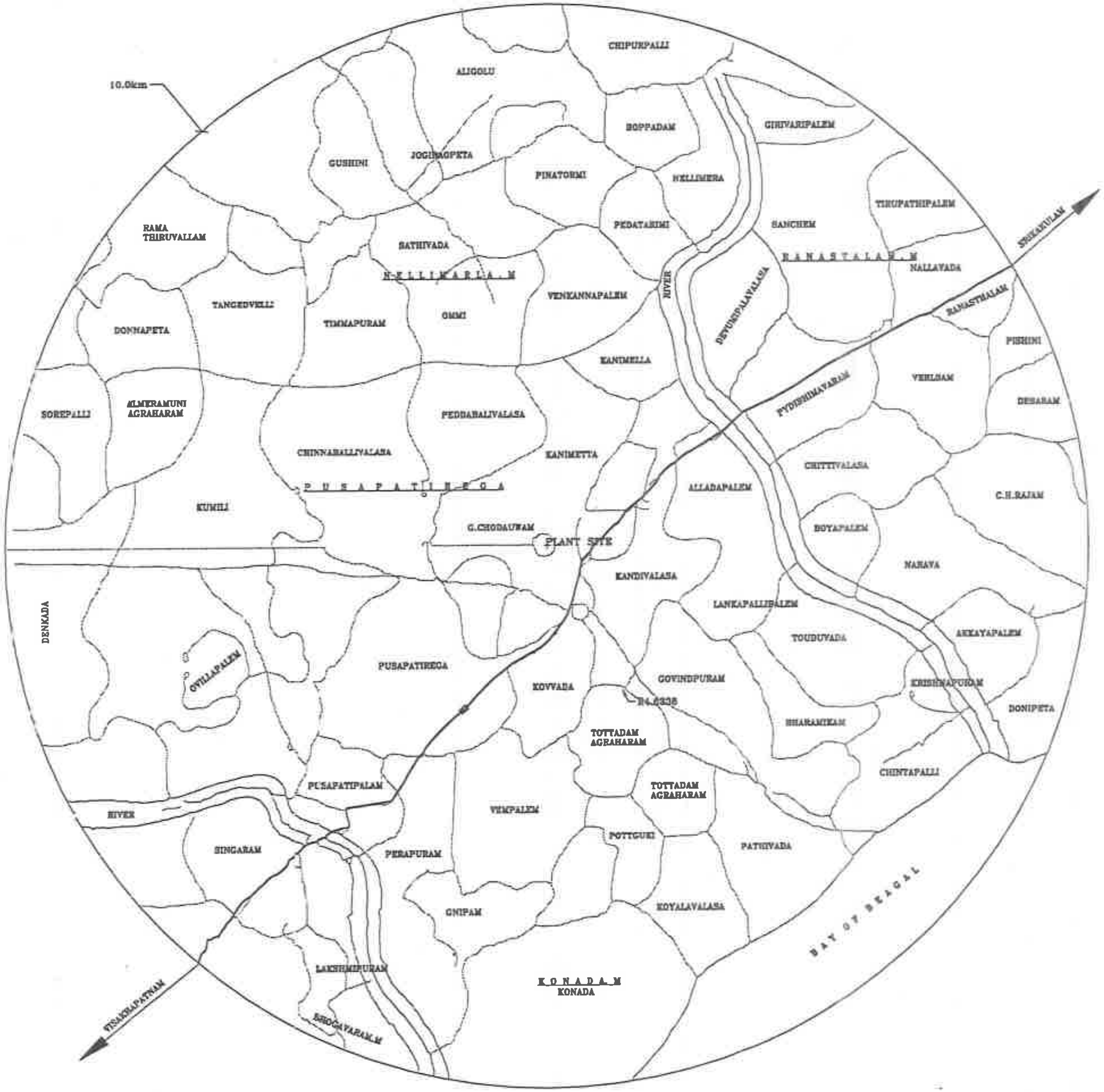
Vizianagaram District is situated with in the geographical co-ordinates of 17-15' and 19 – 15' of the northern latitude and 83 –00' and 83-45'' of the eastern longitude. The district is bounded on the east by Srikakulam District on the west and south by Visakhapatnam district, on the south – east by the Bay of Bengal and North West by Orissa State. The present site is located at Gethula Chodavaram, Pusapatirega mandal, Vizianagaram district at 18° 12.37' N and 83° 29.087' E at an altitude of 50.29m above the mean sea level. The study area predominantly comprises rural and semi-urban environment.

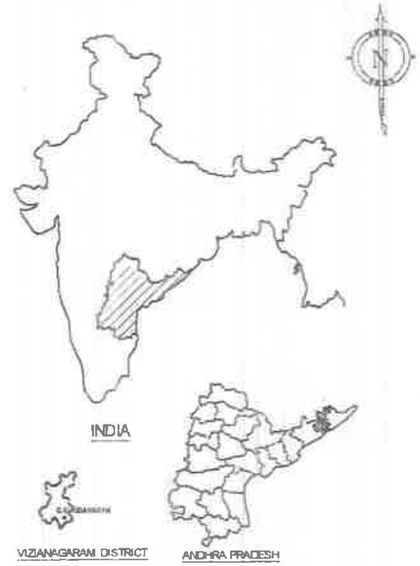
The present site is about 55 km from Visakhapatnam en route to Kolkata located on the road point of the National Highway No.5 (NH-5) connecting Chennai and Kolkata. The facility has accessibility via road and rail. The nearest railhead is at Vizianagaram at about 22 km from the site.

The study area is an undulated coastal plain. However, the area is dotted with a few hillocks. The nearest major road, National Highway no.5 (NH-5) is adjacent to the plant boundary and the broad gauge mainline connecting Chennai and Howrah is at about 22 km from the plant site. Champavathi is the river that flows in the area besides few other canals like the Kandivalasa and Nathavalasa. The study area is characterized by good drainage network as it is a coastal area.

Figure-3.1(a)
Topographical Map Showing 25 Km Radius







LEGEND:

- ROAD METALLED
- ROAD UN METALLED
- RIVER
- DISTRICT BOUNDARY
- MANDAL BOUNDARY
- VILLAGE BOUNDARY

REV. No.	DATE	DESCRIPTION	APPROVED

CLIENT: M/S. MATRIX LABORATORIES, HYDERABAD

PROJECT: REIA FOR PROPOSED EXPANSION OF BULK DRUG MANUFACTURING UNIT AT G.CHODAVARAM (V), PUSAPATIREGA (M), VIZIANAGARAM DIST.

DRAWN	navin	18.11.05
CHECKED	SUNIL	
APPROVED		

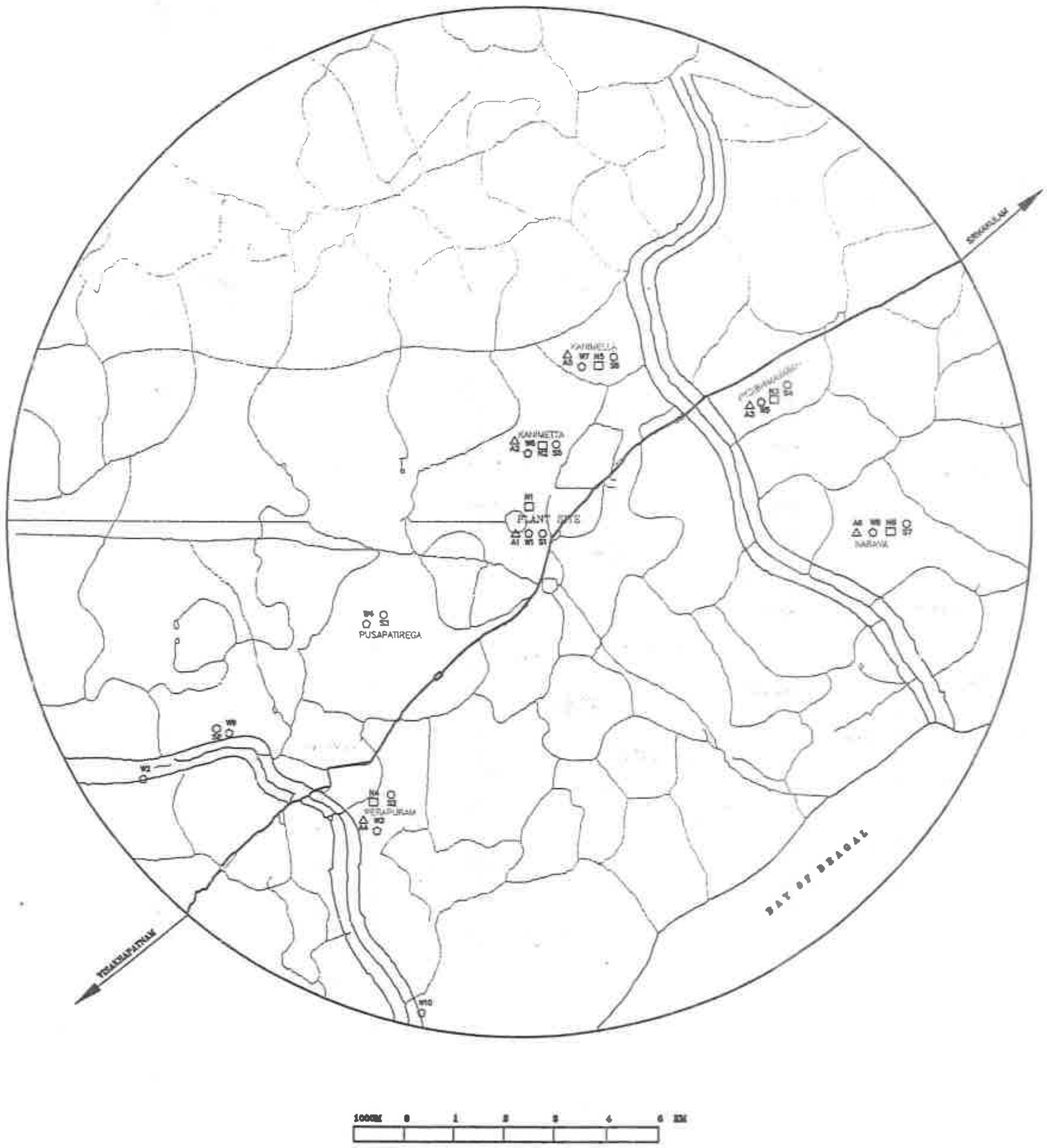
CONSULTANTS: RAMKY INFRA CONSULTING PVT.LTD.
RAMKY HOUSE, Rajbhavan Road, Somajiguda, Hyderabad–500 082

TITLE: TOPOGRAPHICAL MAP

SHEET SIZE	SCALE	REVISION
A3	nts	0

SHEET 1 OF 1

DWG No: RICPL/REIA/VZN/TOPOMAP/01



LEGEND:

AIR SAMPLE LOCATIONS	— △	△
WATER SAMPLE LOCATIONS	— ○	○
NOISE LEVEL LOCATIONS	— □	□
SOIL SAMPLE LOCATIONS	— ○	○

REV. No.	DATE	DESCRIPTION	APPROVED

CLIENT: M/S. MATRIX LABORATORIES, HYDERABAD

PROJECT: REIA FOR PROPOSED EXPANSION OF BULK DRUG MANUFACTURING UNIT AT G.CHODAVARAM (V), PUSAPATIREGA (M), VIZIANAGARAM DIST.

DRAWN	novin	09.12.05
CHECKED	MADHAVI	
APPROVED		

TURNKEY CONTRACTOR : RAMKY

TITLE: SAMPLE LOCATIONS

SHEET SIZE	SCALE	REVISION
A3	nts	0

DWG No: RICPL/REIA/VZN/SL/01

SHEET 1 OF 1

5

3.3 CLIMATE CONDITIONS

The climate in the study region is generally dry, humid and hot and is characterized with seasonal variations as follows:

Winter	December to February
Summer	March to May
Monsoon	June to August
Post Monsoon season	September to November

The climate setting of the area has been arrived by collecting the existing secondary data from IMD station at Visakhapatnam among other sources and by generation of primary data to ascertain the values. The nearest IMD station is Visakhapatnam airport.

Summary of the climatological data is presented here under. The data has been ascertained by establishment of an automatic weather/ meteorological station in the study area.

3.3.1 Climate

The climate of Vizianagaram district is characterized by high humidity nearly all the year round with oppressive summer and good seasonal rainfall. The summer season is from March to May. This is followed by South West monsoon season, which continues up to September. The period between September to December constitutes the post monsoon or retreating monsoon season. December to February is the season of generally fine weather. The climate of the hill parts of the district is different from that of the plain.

3.3.2 Rainfall

The normal rainfall of the district for the year is 1131 mm as against the actual rainfall of 740.6 mm received during 2002-03. The district gets the benefit of both the South –West and North- East monsoon.

3.3.3 Temperature

The temperature profile of this region is presented in the following table.

Table 3.1
Temperature Profile of the Study Area

Description	Minimum temperature (^{0}C)	Maximum Temperature (^{0}C)
Summer Season mean	32.3	37.9
Winter Season mean	20.2	27.5
Monsoon season mean	24.5	29.7

3.3.4 Humidity

Maximum Humidity	:	98%
Minimum Humidity	:	35%

3.3.5 Rainfall

Predominant rainy season (monsoon)	:	June to August
Average annual rainfall	:	1130 mm
Most rainy Month	:	August , September
Lean period	:	March to May

3.3.6 Wind Speed and Direction

Mean wind speeds (high)	:	15 kmph
Mean wind speeds (low)	:	5 kmph
Windy months	:	July to October

3.3.7 Predominant Wind Directions

January to March	: E, SE and S
April to June	: SSE, S and SSW
July to September	: S, SW and W
October to December	: N, NNE and NE

3.3.8 Soil

The soils in the district are red soils, red sandy loams, sandy loams and Laterite soils and they constitute 96 % of the total area. The soils in the district are predominantly loamy with medium fertility. There are mostly red loamy soils, as far as dry lands are concerned and clay loamy in case of wet lands.

3.4 METEOROLOGICAL CONDITIONS

Meteorology of the study area plays an important role in the air pollution studies. The prevailing micro-meteorological conditions at the plant site will regulate the dispersion and the dilution of air pollutants in the atmosphere. The predominant wind speed at the core zone will decide the direction and the distance of the dispersion of the pollutants and the most affected area from the proposed activities involved.

Regional meteorological scenario helps to understand the trends of the climatic factors. It also helps in determining the sampling stations in predicting the post project environmental scenario. Meteorological scenario exerts a critical influence on air quality as the pollution arises from the interaction of atmospheric contaminants with adverse meteorological conditions such as temperature inversions, atmospheric stability and topographical features.

The critical weather elements that influence air pollution are wind speed, wind direction, temperature, which together determines atmospheric stability. Hence it is an indispensable part of any air pollution studies and required for the interpretation of the base line information.

An hourly recording of the micro-meteorological parameters like the wind speed, wind direction, relative humidity, maximum and minimum temperature and the precipitation are given in the subsequent sections of the chapter.

3.5 MONITORING PERIOD

Meteorological data was generated for the study period during the months of September to December 2005 in the study area. An automatic meteorological monitoring station was installed on top of the General Administration Building/ Security Office inside the plant site. The height of the meteorological station was 12m above the ground level. Due care was taken in establishing the meteorological monitoring station to ensure free flow of winds without any obstructions.

Wind Speed, Wind Direction, Temperature and Relative Humidity were recorded on hourly basis for the total study period. Wind roses on sixteen-sector basis (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW) have been drawn for the study period. The meteorological data was recorded on hourly basis. The details of the wind pattern along with the wind speeds for the study period are presented in the following sections.

3.5.1 Wind Pattern

The predominant wind direction during the study period was NE to SW.

3.5.1.1 Wind Pattern Between September & October

During this period the most predominant wind direction recorded was N. In this period the winds were recoded frequency upto 7 Km/h. The particular frequency of the winds, its prevailed time and calm period is shown in the frequency **Table 3.2**, and the Graphical representation is shown in the **Figure 3.2**.

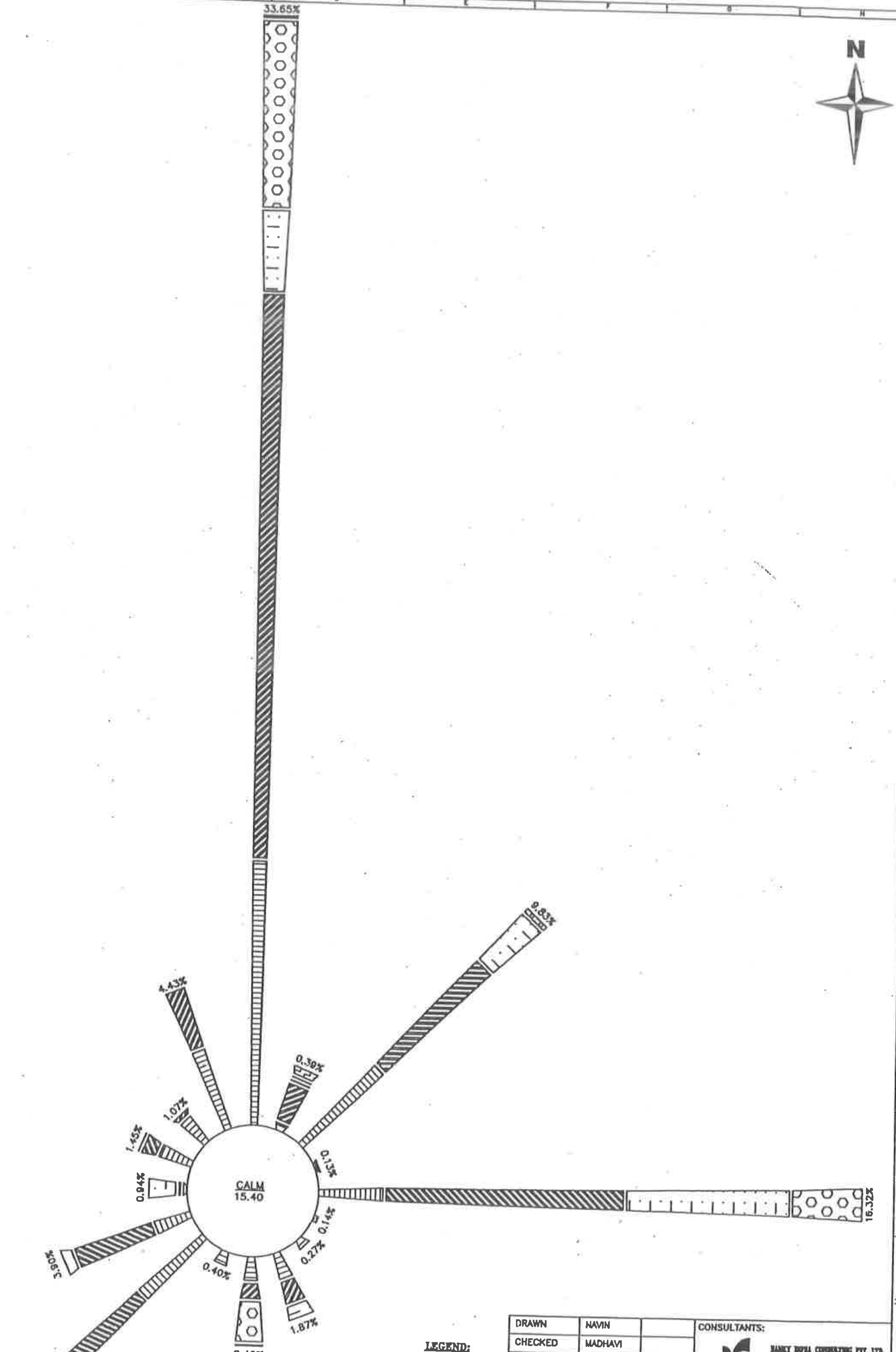
A glance at the average 24-hour wind rose diagram for the period from 15th September- 1st October -2005 reveals that calm conditions prevailed predominantly for 15.40% of the total time. During the rest of the time the winds were found to be blowing predominantly from N with a percentage frequency recording of 33.65% of the total time. E, NE and SW were the other directions, which recorded winds for about 16.32%, 9.83% and 7.39% of the total time respectively.

Table 3.2

September- October – 2005 Frequency Distribution Table for 00-24 hours

Direction	Wind speed (m/s)							
	Calm	0.5-2.	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	>=11.1	Total
N	0.00	8.10	17.25	2.48	5.74	0.08	0.00	33.65
NNE	0.00	0.22	1.14	0.02	0.01	0.23	0.00	0.39
NE	0.00	3.36	4.44	1.89	0.14	0.00	0.00	9.83
ENE	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
E	0.00	1.99	7.24	4.95	2.14	0.00	0.00	16.32
ESE	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.14
SE	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.27
SSE	0.00	0.80	0.67	0.40	0.00	0.00	0.00	1.87
S	0.00	0.72	0.45	0.00	1.21	0.04	0.00	2.42
SSW	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.4
SW	0.00	2.55	3.50	1.20	0.14	0.00	0.00	7.39
WSW	0.00	1.12	2.47	0.31	0.00	0.00	0.00	3.90
W	0.00	0.1	0.04	0.80	0.00	0.00	0.00	0.94
WNW	0.00	1.02	0.42	0.01	0.00	0.00	0.00	1.45
NW	0.00	0.94	0.13	0.00	0.00	0.00	0.00	1.07
NNW	0.00	2.55	1.88	0.00	0.00	0.00	0.00	4.43
Calm	15.40	0.00	0.00	0.00	0.00	0.00	0.00	15.40
Total	15.40	24.27	39.63	12.2	9.38	0.35	0.00	100

All Values are in percentages



LEGEND:

- 0.5–2
- 2.1–3.6
- 3.6–5.7
- 5.7–8.8
- 8.8–11.1
- >=11.1

DRAWN	NAVIN	
CHECKED	MADHAVI	
APPROVED		

TITLE

WINDROSE FOR
15th Sep – 1st Oct

DWG No:

CONSULTANTS:

RAMKY INFRA CONSULTING PVT. LTD.
RAMKY HOUSE, Rajbhavan Road,
Somajiguda, Hyderabad–500 082

SHEET SIZE	SCALE	REVISION
A4		0

SHEET 1 OF 1

3.5.1.2 Wind Pattern During October 2005

The frequency occurrence of wind in various speed categories was calculated on the basis of total number of observations recorded in that particular wind speed category during the study period and given in **Table 3.3**. The wind rose for the month of October 2005 is shown in **Figure 3.3**.

(a) Total Wind Pattern 00-24 hours

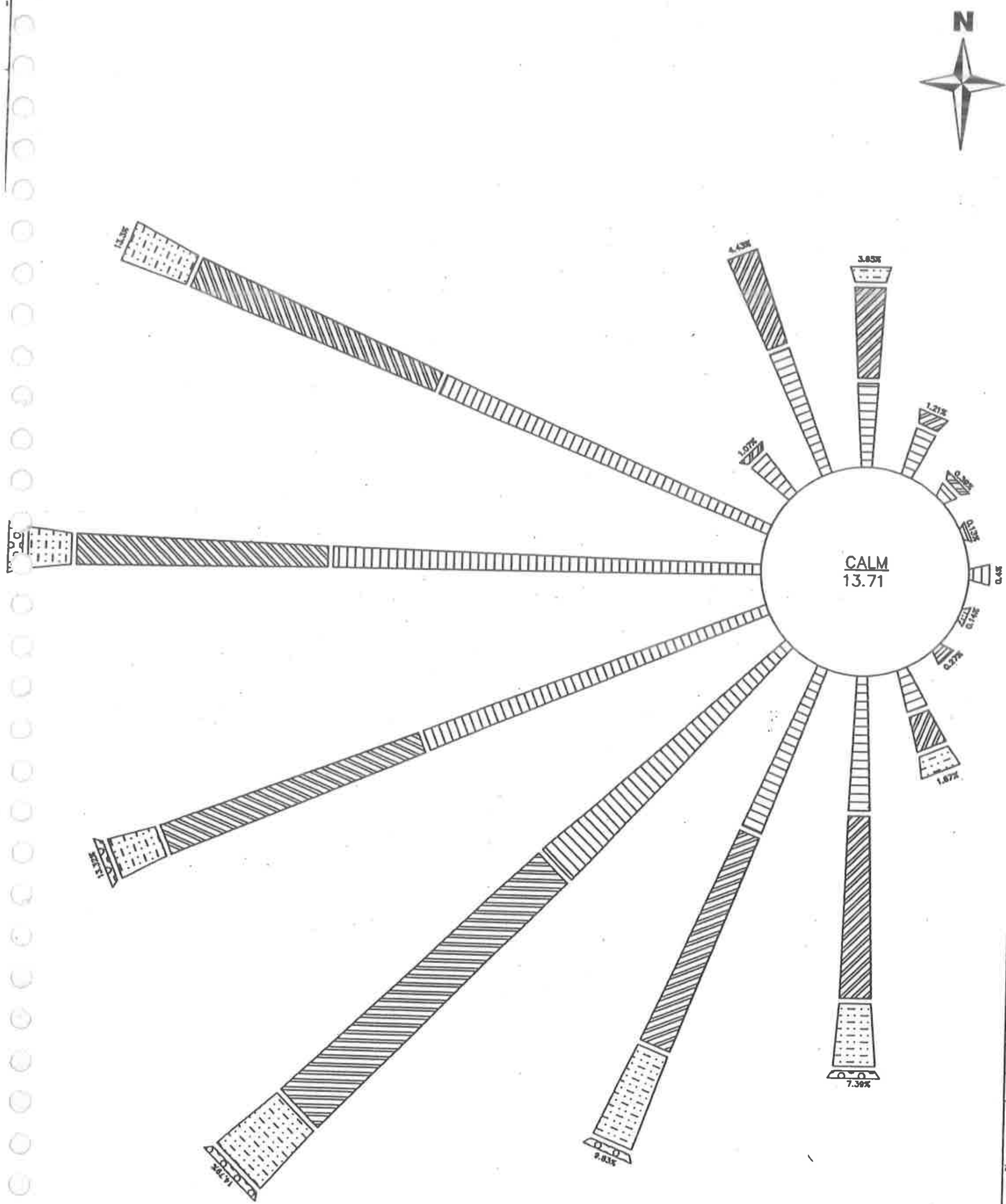
A glance at the average 24-hour wind rose diagram for the month of October-2005 reveals that calm conditions prevailed predominantly for 13.71% of the total time. During the rest of the time the winds were found to be blowing predominantly from SW with a percentage frequency recording of 14.79% of the total time. W, WSW and SSW were the other directions, which recorded winds for about 14.1%, 13.32% and 9.83% of the total time respectively.
The average wind speed was about 1.94 m/sec for the month of October.

Table 3.3

October – 2005 Frequency Distribution Table for 00-24 hours

Direction	Wind speed (m/s)							
	Calm	0.5-2.	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	>=11.1	Total
N	0.00	1.62	1.74	0.29	0.00	0.00	0.00	3.65
NNE	0.00	0.94	0.27	0.00	0.00	0.00	0.00	1.21
NE	0.00	0.26	0.14	0.00	0.00	0.00	0.00	0.39
ENE	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13
E	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.4
ESE	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.14
SE	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.27
SSE	0.00	0.80	0.67	0.40	0.00	0.00	0.00	1.87
S	0.00	2.55	3.50	1.20	0.14	0.00	0.00	7.39
SSW	0.00	3.36	4.44	1.89	0.14	0.00	0.00	9.83
SW	0.00	6.45	6.72	1.48	0.14	0.00	0.00	14.79
WSW	0.00	6.99	5.24	0.95	0.14	0.00	0.00	13.32
W	0.00	8.20	4.83	0.80	0.27	0.00	0.00	14.1
WNW	0.00	6.85	5.10	1.35	0.00	0.00	0.00	13.3
NW	0.00	0.94	0.13	0.00	0.00	0.00	0.00	1.07
NNW	0.00	2.55	1.88	0.00	0.00	0.00	0.00	4.43
Calm	13.71	0.00	0.00	0.00	0.00	0.00	0.00	13.71
Total	13.71	42.31	34.65	8.5	0.83	0	0	100

All Values are in percentages



LEGEND:

- 0.5–2
- 2.1–3.6
- 3.6–5.7
- 5.7–8.8
- 8.8–11.1
- >=11.1

DRAWN	NAVIN	
CHECKED	MADHAVI	
APPROVED		
TITLE	WINDROSE FOR OCTOBER – 2005	
DWG No:		

CONSULTANTS: RAMKY INFRA CONSULTING PVT. LTD.
RAMKY HOUSE, Rajbhavan Road, Somajiguda, Hyderabad-500 082

SHEET SIZE	SCALE	REVISION
A4		0
		SHEET 1 OF 1

3.5.1.3 Wind Pattern During November 2005

The frequency occurrence of wind in various speed categories was calculated on the basis of total number of observations recorded in that particular wind speed category during the study period and given in **Table 3.4**. The wind rose for the month of November 2005 is shown in **Figure 3.4**.

(a) Total Wind Pattern 00-24 hours

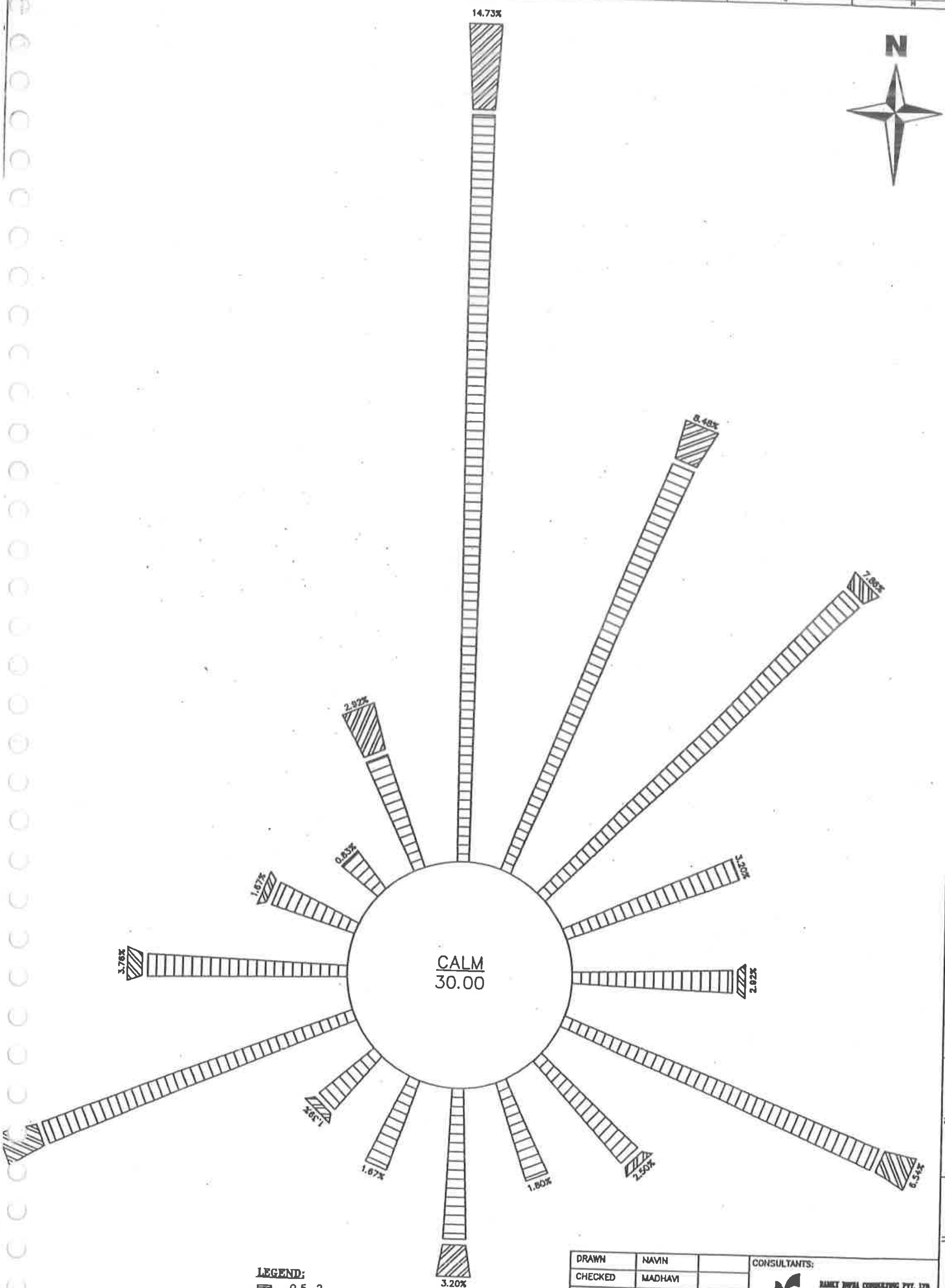
A glance at the average 24 hour wind rose diagram for the month of November-2005 reveals that the dominant wind direction is N (14.73%). The other predominant wind direction was NNE with a percentage frequency recording of 8.48% of the total time. NE, ESE and WSW were the other dominant directions, which recorded winds during this time period with a frequency recording of 7.86%, 6.54% and 6.53% of the total time respectively. The average wind speed in the month of November was 0.92 m/s.

Table 3.4

November – 2005 Frequency Distribution Table for 00-24 hours

Direction	Wind speed (m/s)							
	Calm	0.5-2.1	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	>=11.1	Total
N	0.00	13.20	1.53	0.00	0.00	0.00	0.00	14.73
NNE	0.00	7.78	0.70	0.00	0.00	0.00	0.00	8.48
NE	0.00	7.58	0.28	0.00	0.00	0.00	0.00	7.86
ENE	0.00	3.20	0.00	0.00	0.00	0.00	0.00	3.2
E	0.00	2.78	0.14	0.00	0.00	0.00	0.00	2.92
ESE	0.00	5.98	0.56	0.00	0.00	0.00	0.00	6.54
SE	0.00	2.36	0.14	0.00	0.00	0.00	0.00	2.5
SSE	0.00	1.80	0.00	0.00	0.00	0.00	0.00	1.8
S	0.00	2.64	0.56	0.00	0.00	0.00	0.00	3.2
SSW	0.00	1.67	0.00	0.00	0.00	0.00	0.00	1.67
SW	0.00	1.25	0.14	0.00	0.00	0.00	0.00	1.39
WSW	0.00	5.83	0.70	0.00	0.00	0.00	0.00	6.53
W	0.00	3.48	0.28	0.00	0.00	0.00	0.00	3.76
WNW	0.00	1.53	0.14	0.00	0.00	0.00	0.00	1.67
NW	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.83
NNW	0.00	2.09	0.83	0.00	0.00	0.00	0.00	2.92
Calm	30.00	0.00	0.00	0.00	0.00	0.00	0.00	30
Total	30.00	64.00	6.00	0.00	0.00	0.00	0.00	100

All Values are in percentages



LEGEND:

- 0.5–2
- 2.1–3.6
- 3.6–5.7
- 5.7–8.8
- 8.8–11.1
- >=11.1

DRAWN	NAVIN	
CHECKED	MADHAVI	
APPROVED		

TITLE

WINDROSE FOR
NOVEMBER – 2005

CONSULTANTS:

RAMKY INFRA CONSULTING PVT. LTD.
RAMKY HOUSE, Rajbhavan Road, Somajiguda, Hyderabad–500 082

SHEET SIZE	SCALE	REVISION
A4		0

DWG No:

SHEET 1 OF 1

15

3.5.1.4 Wind Pattern During December 2005

The frequency occurrence of wind in various speed categories was calculated on the basis of total number of observations recorded in that particular wind speed category during the study period and given in **Table 3.5**. The wind rose for 1st to 15 th December 2005 is shown in **Figure 3.5**.

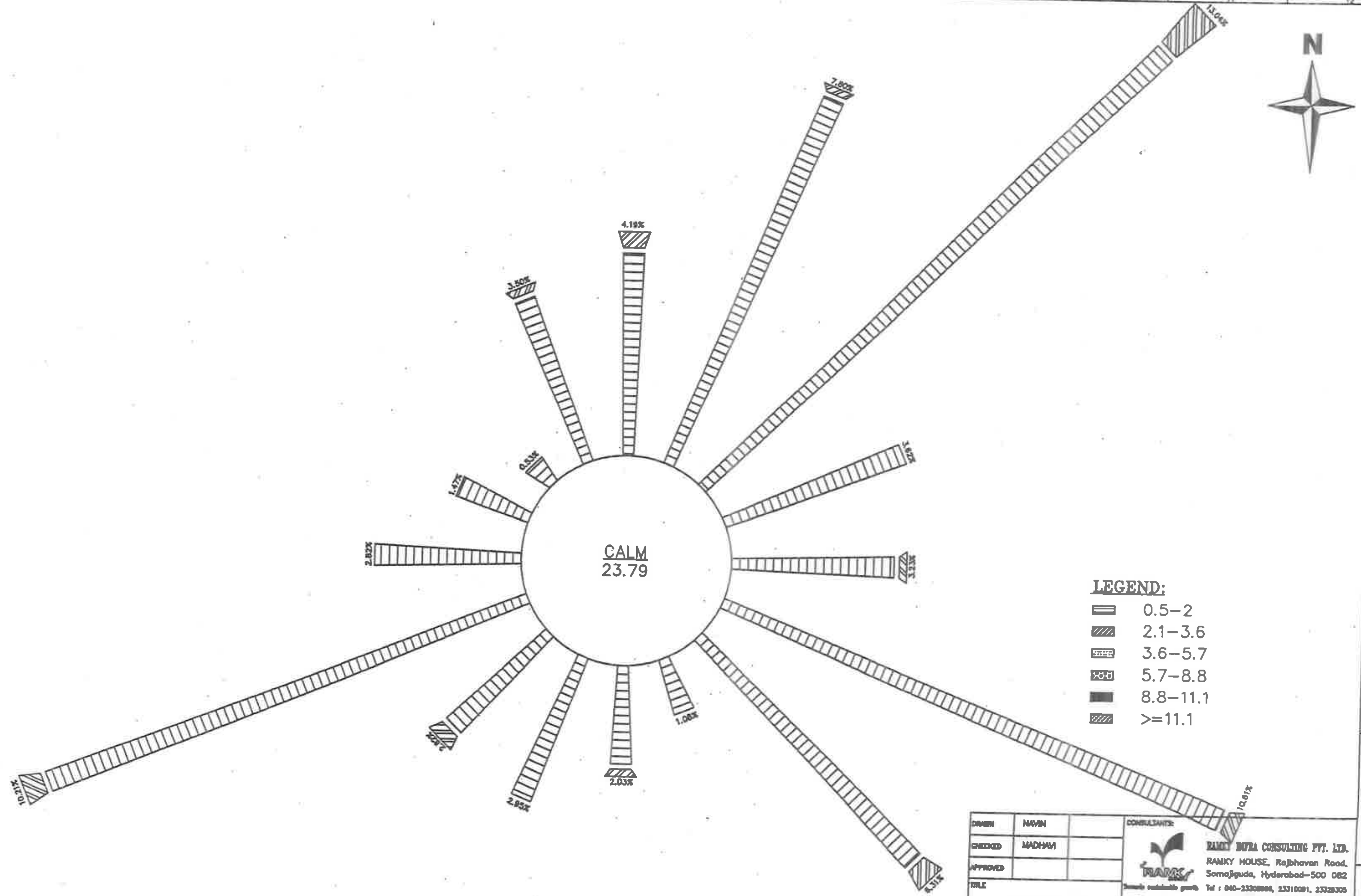
(a) Total Wind Pattern 00-24 hours

A glance at the wind rose diagram reveals that the most dominant wind direction is NE with a percentage frequency recording of 13.04% of the total time. The other dominant wind directions were observed to be ESE (10.61%), WSW (10.21%). The average wind speed was around 0.97 m/s.

Table 3.5
Frequency Distribution for the Period of December 2005 (0-24 Hours)

Direction	Wind speed (m/s)							
	Calm	0.5-2.1	2.1-3.6	3.6-5.7	5.7-8.8	8.8-11.1	>=11.1	Total
N	0.00	3.89	0.30	0.00	0.00	0.00	0.00	4.19
NNE	0.00	7.66	0.14	0.00	0.00	0.00	0.00	7.8
NE	0.00	12.09	0.95	0.00	0.00	0.00	0.00	13.04
ENE	0.00	3.62	0.00	0.00	0.00	0.00	0.00	3.62
E	0.00	3.09	0.14	0.00	0.00	0.00	0.00	3.23
ESE	0.00	10.34	0.27	0.00	0.00	0.00	0.00	10.61
SE	0.00	5.91	0.40	0.00	0.00	0.00	0.00	6.31
SSE	0.00	1.08	0.00	0.00	0.00	0.00	0.00	1.08
S	0.00	1.89	0.14	0.00	0.00	0.00	0.00	2.03
SSW	0.00	2.95	0.00	0.00	0.00	0.00	0.00	2.95
SW	0.00	2.55	0.27	0.00	0.00	0.00	0.00	2.82
WSW	0.00	9.81	0.40	0.00	0.00	0.00	0.00	10.21
W	0.00	2.82	0.00	0.00	0.00	0.00	0.00	2.82
WNW	0.00	1.47	0.00	0.00	0.00	0.00	0.00	1.47
NW	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.53
NNW	0.00	3.36	0.14	0.00	0.00	0.00	0.00	3.5
Calm	23.79	0.00	0.00	0.00	0.00	0.00	0.00	23.79
Total	23.79	73.06	3.15	0	0	0	0	100

All values are in percentages



DRAWN	NAVIN	
CHECKED	MADHAVI	
APPROVED		

TITLE

WINDROSE FOR 1-15 of DECEMBER

CONSULTANTS:

RAMKY INFRA CONSULTING PVT. LTD.
RAMKY HOUSE, Rajbhavan Road,
Somajiguda, Hyderabad−500 082

SHEET SIZE	SCALE	REVISION
A4		

DWG No:

SHEET

3.6 AMBIENT AIR QUALITY

The ambient air quality in the 10 Km radius study area with the plant site as the epicenter will form the baseline information over which the predicted impacts can be superimposed to find out the net impacts on the air quality in the project impact area. The design of the network of ambient air quality monitoring stations in the study area was done based on the following criteria.

- Meteorological conditions on a synoptic scale
- Topography of the study area
- Representation of the regional background levels
- Representation of the plant site
- Influence of the existing sources
- Major human settlements in the study area

The major industries in the area are Dr. Reddy's Laboratories, Andhra Organics, Aurobindo Pharma, SMS Pharmaceuticals, C.P. Aqua Ltd, Vizianagaram Biotech Ltd. It is pertinent to mention that this area is a hotspot for the development of bulk drug manufacturing industries making this the next hot destination for speciality chemicals, formulations and bulk drug manufacturing industries in Andhra Pradesh after Hyderabad. There are number of small and medium-scale industries in the area. Visakhapatnam is a major industrial area with a lot of heavy industries and a port and is about 55 km en route to Chennai on the National Highway No. 5 (NH-5). The prominent sources of air pollution in the study area are the existing industrial sources, vehicular movement, dust arising from the unpaved village roads, brick manufacturing, burning of sugar-cane plantation after harvesting and the domestic fuel burning. The pollutants of concern are the Particulate Matter, SO_2 and NO_X. Ambient air quality monitoring in the study area was carried for the pollutants of concern as per the project requirement. A total of 6 ambient air quality monitoring stations were selected as per the above considerations. Air quality monitoring stations were selected using simulation models within the study area keeping in view the topographical and the meteorological conditions.

3.7 PARAMETERS FOR SAMPLING & SAMPLING FREQUENCY

Ambient Air Quality Monitoring has been carried out for one season i.e. post monsoon with a frequency of twice a week for four weeks in a month for the entire season. The base line data of air environment is generated for the following parameters:

- Total Suspended Particulate Matter (TSPM)
- Respirable Suspended Particulate Matter (RSPM)
- Sulphur dioxide (SO_2)
- Oxides of Nitrogen (NO_X)
- Carbon monoxide (CO)
- Lead (Pb)
- Hydrocarbons (HC)
- Ammonia (NH_3)
- Acid Mist

The AAQM locations are given in the **Figure 3.1 (c)** and all the AAQM stations with respect to the epicenter are given in **Table 3.6**.

Table 3.6
Ambient Air Quality Monitoring Stations

Location	**Environmental Setting**
Plant Site	⇒ Core Zone ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Industrial activities, Vehicular traffic, Commercial, Agricultural & Domestic ⇒ Environmental Setting: Industrial
Kanimetta	⇒ 3.0 Km from the epicenter ⇒ N direction. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Dust arising from the roads, Industrial activities, vehicular traffic ⇒ Environmental Setting: Residential/ Industrial
Pidibhimavaram	⇒ NE direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Industrial, Vehicular traffic, Agricultural & Domestic activities ⇒ Environmental Setting: Mixed
Perapuram	⇒ SW direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Agricultural and Domestic activities, Dust arising from vehicular movement ⇒ Environmental Setting: Residential
Kanimella	⇒ N direction ⇒ 5.8 Km from the epicenter. ⇒ Activities contributing pollution: Unpaved village roads, Agricultural & Domestic activities ⇒ Environmental Setting: Residential

Location	Environmental Setting
Narava	⇒ E direction ⇒ 7.5 km from the epicenter. ⇒ Water resources: Ground Water ⇒ Activities contributing pollution: unpaved village roads, vehicular movements, Commercial, Agricultural & Domestic activities ⇒ Environmental Setting: Residential

The values of air quality pollutants of concern are presented in the following tables. The range of maximum concentrations reflects that the pollution level is low in most of the places as it is a rural area and surrounded mostly by villages. The value is higher at the plant site. An analysis of the data of the plant site with respect to downward side in particular and other monitoring sites in general represent the background levels.

Spatial and temporal variations in the air quality occur as a result of the air basin and the prevailing meteorological conditions of the study area. To assess the existing sub regional air status during the study period, the above factors govern the status at all the AAQ sampling stations.

3.8 DATA ANALYSIS OF AAQ LEVELS

The existing concentrations of the critical pollutants in the study area are represented in the following table. The range of maximum and minimum concentrations reflect that the pollution levels are varying depending on the prevailing activity. Background concentrations of the critical pollutants are established by comparing the concentrations at the plant site and that of the downwind locations with the pollutant concentrations at other locations. Besides the critical parameters like SPM, RPM, SO_2 and NO_X, ambient air quality was monitored for specific parameters like Ammonia, HCl etc and were found to be below the detectable limits. HC was monitored as Methane and was found to be within the limits.

Table 3.7
Ambient Air Quality Levels in the Study Area

Location	SPM			RPM			SO_2			NO_X		
	Max.	Min.	98th perc.	Max.	Min.	98th perc.	Max.	Min.	98th perc.	Max.	Min.	98th perc.
Plant Site	280	165	274.4	110	65	107.8	38	22	37.2	41	27	40.2
Kanimetta	185	137	181.3	70	52	68.6	21	15	20.5	36	25	35.2
Pidibhimavaram	177	149	173.4	63	53	61.7	23	13	22.6	34	27	33.3
Perapuram	181	151	177.4	63	52	61.7	27	19	26.4	30	21	29.4
Kanimella	175	130	171.5	68	50	66.7	22	17	21.5	32	23	31.3
Narava	179	120	175.4	50	45	49	21	15	20.6	31	21	30.3

Figure 3.7
SPM Levels in the Study Area

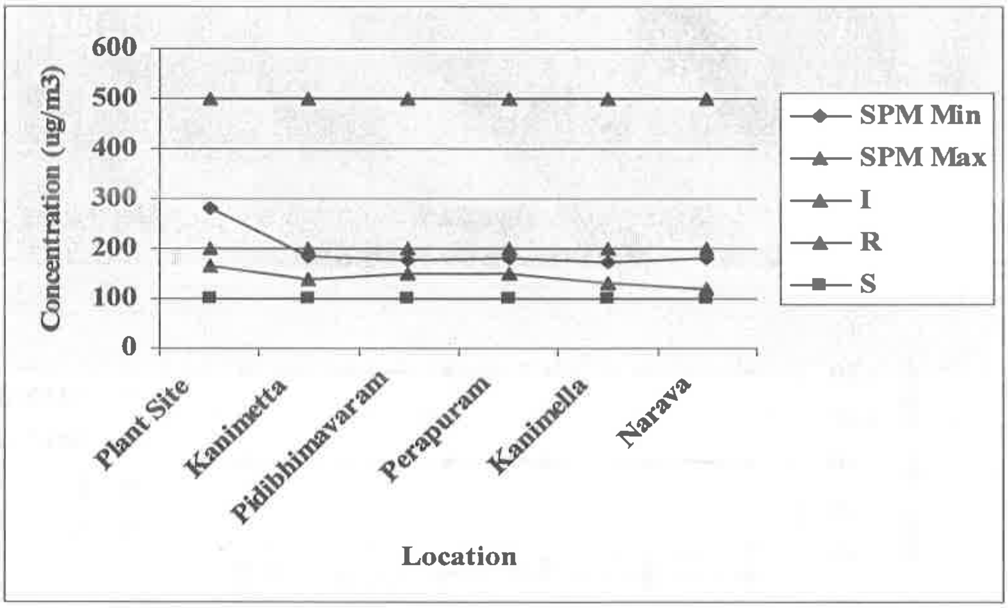


Figure 3.8
SO_2 Values in the Study Area

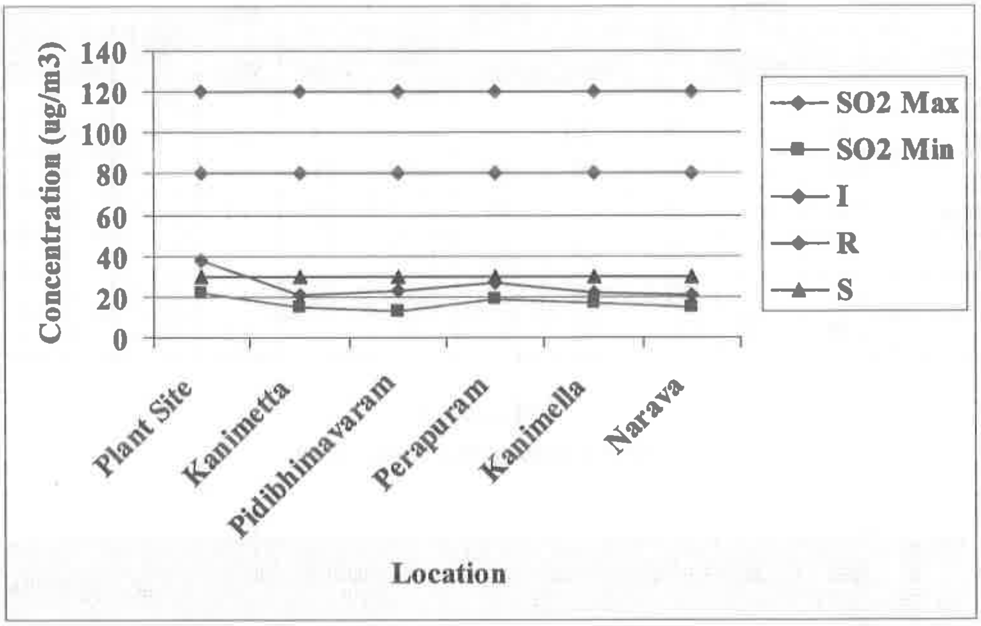
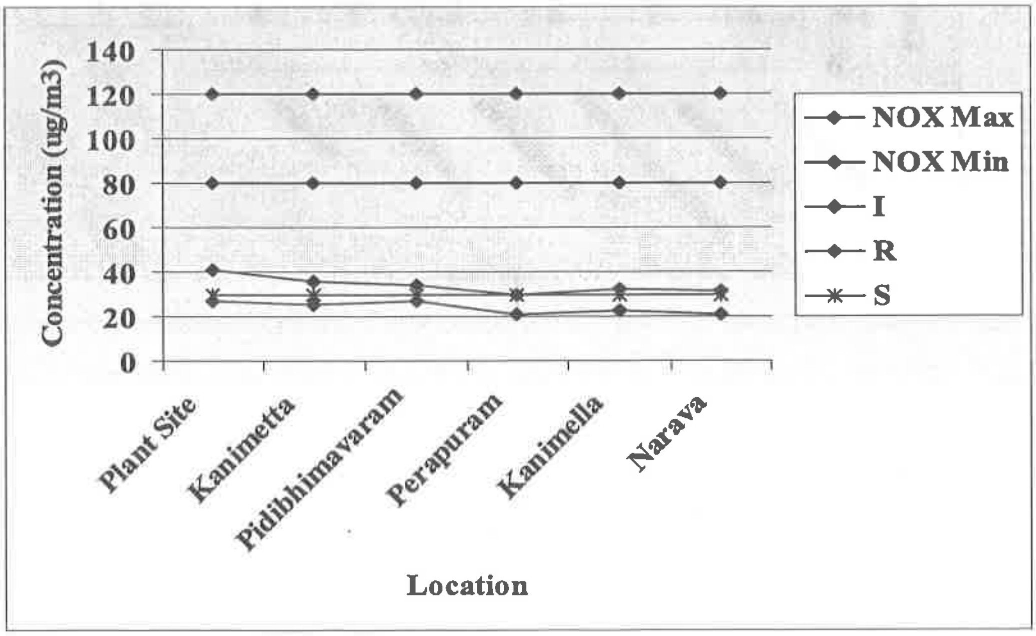


Figure 3.9
NO_x Values in the Study Area



3.9 DISCUSSIONS

- The minimum level of SPM recorded in the study area was 175 µg/m^3 at kanimella and the maximum level recorded was 280µg/m^3 at the project site
- The maximum level of RPM recorded in the study area was 110 µg/m^3 at the Plant site and the minimum level of 50 µg/m^3 at Narava
- SO_2 levels are in the range of 21 to 38 µg/m^3. Maximum SO_2 concentration was recorded near Plant site and minimum at Narava
- NO_X levels were in the range of 30 to 41 µg/m^3. Maximum NO_X concentration was recorded near the Plant site and minimum at Perapuram
- The maximum value of Lead in Particulate matter was recorded at Plant Site, which was 0.3 µg/m^3
- Carbon monoxide was found to be varying between 0.9 mg/m^3 to 1.1 mg/m^3.
- Besides the critical parameters like SPM, RPM, SO_2 and NO_X, ambient air quality was monitored for specific parameters like Ammonia, HCl etc and were found to be below the detectable limits.
- HC was monitored as Methane and was found to be within the limits.

3.10 AIR QUALITY INDEX

Air Quality Index (AQI) is a system developed to provide the public health with a meaningful measure of the ambient air quality. From the AQI, we can effectively rate air quality as ***Good, Fair, Poor*** or ***Very Poor***.

The AQI converts the concentrations of the five major air pollutants to a single numerical value and matching description. The AQI is based on the ambient concentrations of Carbon monoxide, Suspended Particulate Matter (PM10), Respirable Suspended particulate Matter (PM 2.5), Oxides of Nitrogen (NO_X), Ozone and Sulphur di oxide (SO_2). A minimum of three of the above pollutants is required to calculate the AQI. These pollutants were continuously monitored at all the stations mentioned earlier. The concentration of each pollutant is converted hourly to an AQI number, and the highest number of each hour becomes the AQI for that station.

Air quality index (AQI) for each village has been estimated. This is based on AQI formulae developed by Oak ridge national laboratory (ORNL), USA as given below.

$$\text{ORAQI} = \left(39.02 \sum X_i/X_s \right)^{0.967}$$

ORAQI = Oak ridge Air quality index
Xi = Environmental parameters (SPM, SO_2, and NO_x)
Xs = Environmental parameters (Considered)

AQI has been developed using three parameters viz. SPM, SO_2 and NO_x average concentration levels from the sampling stations. The station-wise concentration levels for different seasons are already discussed.

Table 3.8

AQI Standards, Ranges and its Effects

Air Quality Index		
AQI Rating	**Frequency in the Study Area**	**Description**
Good (1-25)	Almost all the time (>90%)	Desirable range; no known harmful effects to soil, water, vegetation, animals, materials, visibility or human health. The long-term goal is for air quality to be in this range for all the time in the study area
Fair (26-50)	Occasional-Typical- when weather conditions inhibit pollutant dispersion (<10%)	Acceptable range; adequate protection against harmful effects to soil, water, vegetation, animals, materials, visibility and human health
Moderate (51-100)	Seldom (< 1%)	Tolerable range; not all aspects of the human health or the environment are a adequately protected from possible adverse effects. Long term control action may be necessary, depending on the frequency, duration and the circumstances of the readings
Unhealthy (101-150)	Rare	Intolerable range; in this range, continued high readings could pose a risk

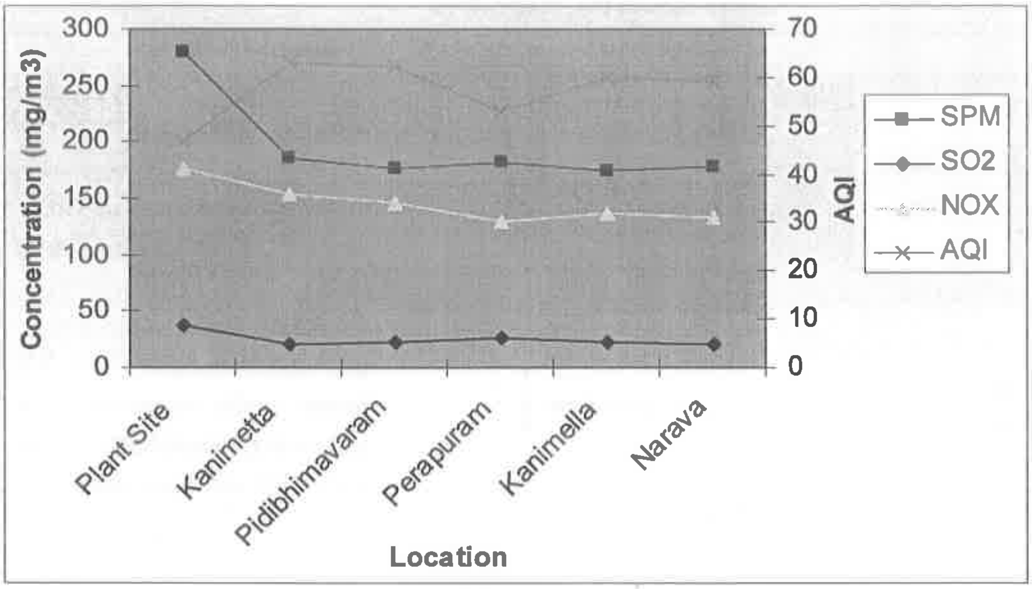
Air Quality Index		
AQI Rating	Frequency in the Study Area	Description
		to the public health
Very Unhealthy (151-300)	Very Rare	Children and adults with respiratory diseases viz. Asthma should avoid all outdoor activities; very dangerous to visibility, vegetation and human health; chances of precipitation as acid rain is high
Hazardous (301-500)	Very Rare	Everyone should avoid being exposed to this concentrations; very dangerous to human health, vegetation , materials, soil and water; precipitation as acid rain is very high; can cause death of life

Table 3.9

Air Quality Index and Air Quality

Village	SPM	SO_2	NO_X	AQI	Quality
Plant Site	280	38	41	47	Fair
Kanimetta	185	21	36	63	Moderate
Pidibhimavaram	177	23	34	62	Moderate
Perapuram	181	27	30	53	Moderate
Kanimella	175	22	32	60	Moderate
Narava	179	21	31	59	Moderate

Figure 3.10
AQI in the Study Area



3.10.1 Discussions

The Air Quality Index for all the Ambient Air Quality Stations in the study area is calculated. The overall Air Quality of the region is found to be Moderate to Fair.

3.11 WATER ENVIRONMENT

Water is one of the fundamental resources and is one of the most common substances. Although its chemical formula is deceptively simple, the effect of water on almost everything including the plant and the animal kingdom is far more consequential than might be imagined. It covers about 70% of the earth's surface. It occurs in all spheres of environment such as in oceans, on land surface, in lakes, in rivers, as ground water, water vapour and polar ice caps. It occurs in hard materials like ores and minerals too. It is the essential part of all living beings/ systems and is the medium from which life has evolved and in which life exists. Water is called "Universal Solvent" because of its extraordinary ability to dissolve many more substances in greater quantities than any liquids. Energy and matter are carried through various spheres of environment by water. The salinity of ocean water is a direct result of the ability of the water to dissolve rock materials as water flows over land to the sea. Polluted water and inadequate sanitation are the leading factors of human illnesses. Diseases and deaths are directly attributed to the lack of these essentials. Surface water is vital for human and plant kingdom. In India, where millions of people have no access to safe drinking water, the aspects of water quality and the related problems of pollution deserve serious considerations. Thus water is obviously an important topic in environmental science.

The study of water environment aspect in the ecosystem is to identify sensitive issues, and to take preventive measures by maintaining ecological homeostasis in the early stages of development of the project. In spite of the presence of two rivers in the study area, the area is a relatively dry area. Therefore mostly ground water samples were collected from different sources within the study area for impact assessment study. Important physical and chemical parameters were considered for depicting the baseline status of the study area. Most of the domestic water requirement is met from ground water sources i.e. from bore wells inside the study area. The water requirement for the proposed expansion is also met from the bore wells within the plant site.

A detailed water quality assessment was done to evaluate and assess the possible impacts of the proposed expansion on the water regime and quality.

3.11.1 Hydrogeology

The drainage of the area is towards South- South West to North, North East which is as indicated by the flow direction of the rivers in the area. The slope is around 1/200 to 1/150. From the North to South the topography is more of a rolling plain with conspicuous local undulations. This feature is attributed to the South Westerly slope of the terrain.

The area is plain with gentle slopes towards South and South West to North, North East. Ground water in the area occurs at relatively shallower depths. The water table is generally met at a depth of 3 to 4 meters. The yield of the wells range between 3000 to 3500 gph. Ground water occurs under the water table and in confined conditions. Occurrence of ground water is mostly through the sand stone acquirers. In general, the area uses ground water, which is plenty for all the requirements, though at certain places sea water intrusion into the water table had been reported.

3.12 PRELIMINARY SURVEY

A reconnaissance survey was conducted and 7 ground water samples and three surface water samples were collected to assess the water quality based on the following considerations.

- Location of major water bodies
- Representative conditions
- Potential users

3.12.1 Water Quality Assessment

Selected water quality parameters for water resources within 10 km of the study area have been used for describing the water environment and assessing the impacts on it. Studies on water environment aspects of ecosystem play an important role in preparation of environmental impact assessment report and to identify sensitive issues and take appropriate action by maintaining ecological homeostasis. To assess the water quality impacts, water resources in the impact area have been grouped into two classes.

a. Surface water resources including streams, tanks, rivers etc
b. Ground water resources in the deeper strata of the ground

3.12.2 Fresh Water Resources

a) Streams

There are no perennial fresh water streams flowing through the study area. However, there are a few water sources which are essentially used for irrigation process. Champavathi is the predominant river network in the area. Besides Champavathi, Kandivalasa and Nathavalasa are the other canal systems in the area and the study area is characterized by good drainage network as it is a coastal area.

b) Lakes

Several ponds and lakes are found in the vicinity of the plant site. Normally irrigation is carried out from these tanks.

c) Ground Water

Ground water is the only source for industrial use in the study area. Ground water is also used in this are for domestic purposes and irrigation. The ground water in this region is mostly extracted through tube wells and in a few places through dug wells. The water table is generally met at a depth of 7 to 10 meters. The yield of the wells range between 3000 to 3500 gph.

The raw water source for the plant is the existing ground water resources. Matrix Laboratories is applying several methods for reducing the water consumption through a number of conservation measures which includes the use of air coolers and bringing down the boiler blow down water by de mineralizing the feed water. The water thus conserved will be sufficient to meet requirements of the proposed expansion also.

3.12.3 Surface Water Resources

Champavathi is the river system in the study area. Nathavalasa and Kandivalasa are the surface water systems in the area and the study area is characterized by good drainage network as it is a coastal area. These flow towards the south. Presently the river water is not used for any industrial purpose as the river is situated nearly 8.0 Km from the nearest user with low quantity of water. It essentially acts as a storm water drain for run-off.

There are many ponds and tanks which cater to the needs of the surrounding villages. It has been observed that these ponds are rich in aquatic growth and are generally used for washing cattle and clothes.

3.12.4 Ground Water Resources

Ground water resource is ample in the study area. Every village has a number of traditional wells- large and small. The regulatory authorities are also providing tube wells fit with hand pumps for the drinking water requirements of the villages in the study area. Presently, the drinking water needs of the study area are met from the ground water resources.

Ground water potential has been assessed as per the data collected from the State Ground water Department, Irrigation Department, Command Area Development Authority and the Central Ground Water Board. In general, the entire region is mainly underlain by granites, gneisses and schists which area known to be hard rocks which have least porosity. However, ground water is found in pockets of the area in the zones of weathered jointed and fractured rocks.

The dug wells in the area generally tap in the weathered zone and very few extend downwards tapping joints and fractured zones. The thickness of the weathered zone varies from less than a meter to 25 m and the average area of cross-section of a domestic well is 6 m^2, whereas that of the irrigation well varies from 40 m^2 to 180 m^2. The yield of dug wells range from 10 m^3/day to 250 m^3/ day for a pumping period of 4 to 6 hours.

Bore wells in the area are of 150 mm diameter and area normally up to a depth of 15m to 100m. The yield of these wells vary from 0.3 to 75 m^3/hour and pumping period varies from 6 to 8 hours/day. Some bore wells located in the favorable zones yield better and withstand pumping for more than 15 to 20 hours. Statistical data from the State Public Health Engineering Department (PHED) indicate that nearly 80% of the bore wells yield between 0.3 to 10 m^3/hour and the maximum yield is obtained from bore wells drilled between 40 to 60m depth.

Most of the dug wells, dug cum bore and shallow bore wells up to 30 m tap the shallow aquifers and the bore wells deeper than 30m tap the water from the fractures occurring between 30 to 100 m depth which tap medium to deep aquifers.

The medium and deep aquifers are mainly confined between 30 and 80m depth in the semi-weathered to fractured zones. Many PHED and Irrigation bore wells tap these aquifers whose yield ranges between 1 to 75 m^3/hour levels.

3.12.5 Occurrence & Movement of Ground Water in Rock Formations

The joints and other opening sin the gneiss and granites, the pore spaces in the zone of weathering and bedding planes of the metamorphasized sediments determine the rate of percolation of water into sub-surface and the yield of the wells in the region. Red soil allows water to infiltrate slowly after saturation. The impervious calcareous clay bed below the top soil prevents the downward movement of water. Whereas, the areas covered by Loam/ Sandy Soils have relatively greater percolation because of its relatively high porosity and permeability.

Occurrence of ground water thus, is mainly controlled by water table conditions. The recharge of the ground water is mainly due to rainfall which is scant in the region. Therefore, the depth of the water table in the area is between 7m to 10 m below the ground level. But the ground water table is just near the surface in the wells bordering the canals.

Due to the inadequate data available on ground water conditions, estimation of water movement in the study area could not be possible. However, considering the overall features, the ground water movement appears to be from North West to South and from South East towards the Bay of Bengal.

3.12.6 Nature of Aquifer

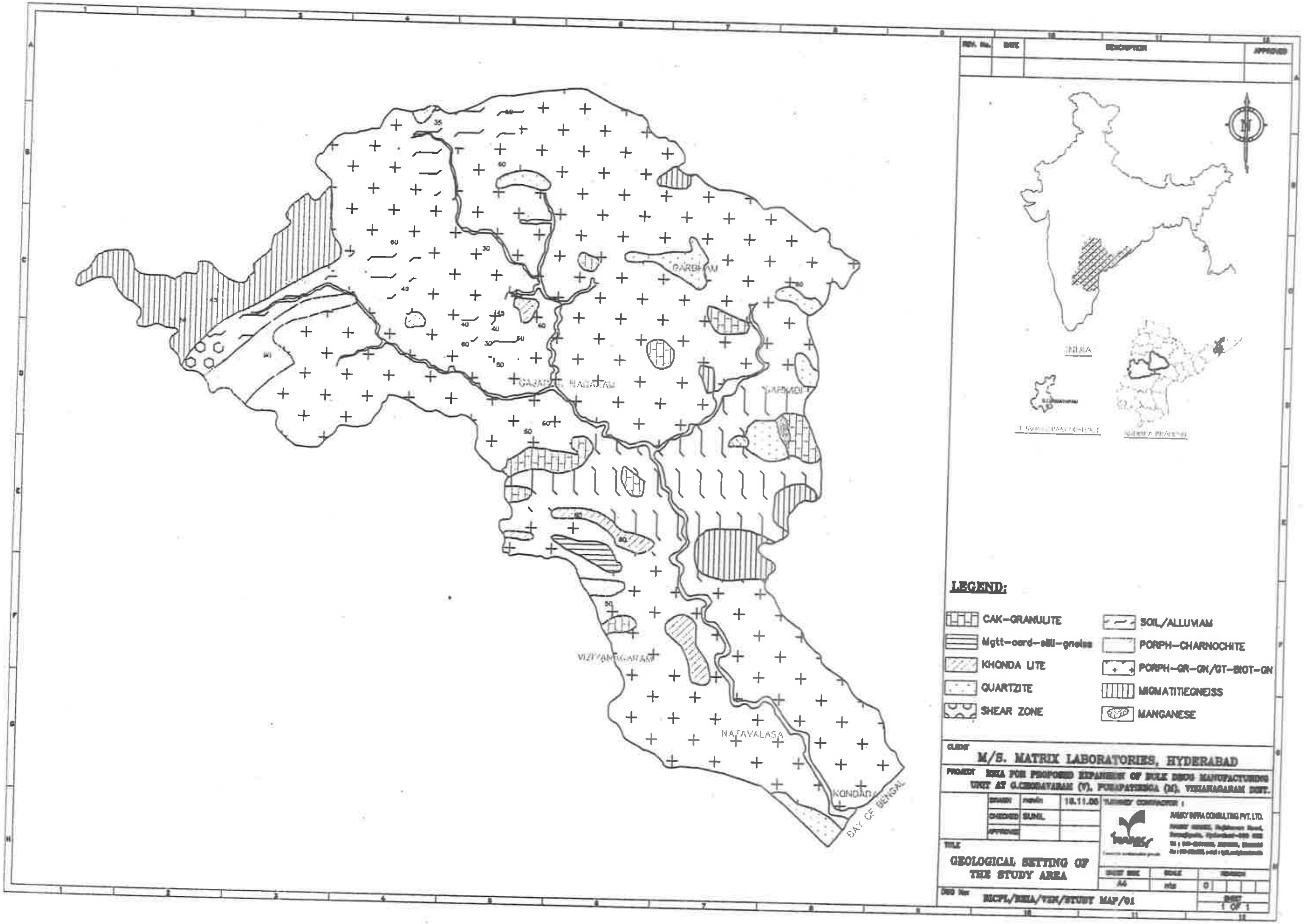
Ground water in the study area occurs under phreatic and semi-confined conditions, the hydro-geological regime of the area is influenced by Champavathi river. Out of the observation wells monitored by the CGWB and the state government, most of them were occurring in the plains followed by ones in the hilly terrains and a few in coastal plains. However, a limited number of wells reflecting the terrain conditions in all the three physiographic zones are summarized in the table. The static water levels in the pre-monsoon and post-monsoon ranged from 12.10 to 1.72 m bgl and 6.6 to 1.15 m bgl in the area respectively.

The top layer consists of red soil/ sandy loam and Laterite soils with a total thickness of 2-10 m. This layer is underlain by weathered zone in turn underlain by hard rock at many places. But in a few places, the weathered zone is followed by fractured zone. These zones together have the thickness of about 50-80 m has been inferred from the well inventory and soundings. The highest water table fluctuation is observed in hilly terrain and medium to the lowest in Vizianagaram plains and coastal plains. Various landforms formed by the river in the area influence the occurrence, distribution and fluctuations of the water table.

3.12.7 Depth of Ground Water and Variations

Dug wells are more common in the study area. Nearly 33% of the wells are shallow type and water table is within 6m depth. The deep dug wells are up to a depth of 20m.

The study of fluctuation in ground in ground water levels by the ground water board (CGWB) reveals that the fluctuation is in the order of 1.65m to 4.42m with an average fluctuation of 3.13m annually.


GARBHAM
GARIVIDI
GAJAPATHI NAGARAM
VIZIYANAGARAM
NATAVALASA
KONDADA
BAY OF BENGAL
INDIA
ANDHRA PRADESH
LEGEND:
CAK-GRANULITE
Mgtt-cord-sill-gneiss
KHONDA LITE
QUARTZITE
SHEAR ZONE
SOIL/ALLUVIAM
PORPH-CHARNOCHITE
PORPH-GR-GN/GT-BIOT-GN
MIGMATITIEGNEISS
MANGANESE
CLIENT
M/S. MATRIX LABORATORIES, HYDERABAD
PROJECT
DRAWN
18.11.05
CHECKED SUNIL
APPROVED
TURNKEY CONTRACTOR :
RAMKY INFRA CONSULTING PVT. LTD.
TITLE
GEOLOGICAL SETTING OF THE STUDY AREA
A4
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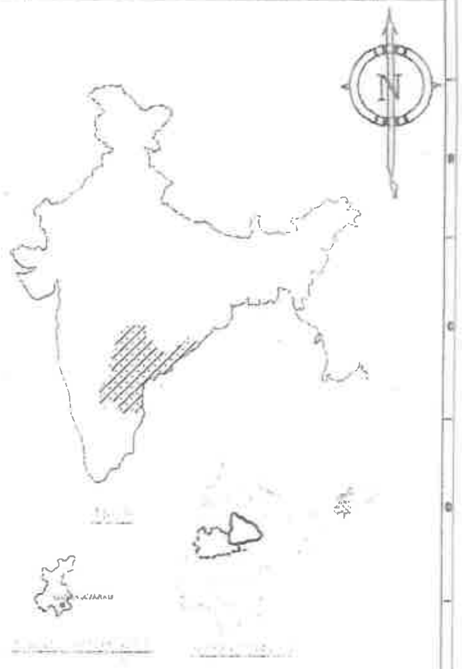
DWG No: RICPL/REIA/VZM/STUDY MAP/01
SHEET 1 OF 1

32



LEGEND:

CLIENT

M/S. MATRIX LABORATORIES, HYDERABAD

PROJECT: REIA FOR PROPOSED EXPANSION OF BULK DRUG MANUFACTURING UNIT AT G.CHODAVARAM (V), PUSAPATIREGA (M), VIZIANAGARAM DIST.

DRAWN		18.11.05	TURNKEY CONTRACTOR : RAMKY INFRA CONSULTING PVT. LTD. RAMKY HOUSE
CHECKED	SUNIL		
APPROVED			

TITLE: GROUND WATER POTENTIAL ZONES IN THE STUDY AREA

SHEET SIZE	SCALE	REVISION
A4	nts	0

DWG No: RICPL/REIA/VZN/STUDY MAP/03

SHEET 1 OF 1

REV. No.	DATE	DESCRIPTION	APPROVED

3.13 METHODOLOGY

Ground water from dug wells; tube wells and hand pumps cater to the drinking water needs of the villages in the region. The quality of ground water was assessed by taking samples and analyzed as per CPCB norms. Reconnaissance survey was undertaken and monitoring locations were selected based on the following consideration:

- Location of the aquifer
- Usage and source

A number of water samples in the study area were collected from ground water sources. The water samples were collected and analyzed for physical, chemical and microbiological characteristics as per CPCB guidelines and approved methods. The analysis results are given in the table.

3.13.1 Sampling Locations

The sampling locations and the surrounding environs are described in the table below and the water sampling locations are shown in **Figure 3.1 (c)**.

Table 3.10

Details of Water Quality Monitoring Locations

Location	Environmental Setting
Site	⇒ Core Zone ⇒ Water resources: Ground water –Borewell ⇒ Activities contributing pollution: Domestic & Industrial activities ⇒ Environmental Setting: Industrial
Champavathi	⇒ 8 Km from the epicenter ⇒ SW direction. ⇒ Water resources: Surface water body- flowing ⇒ Activities contributing pollution: Commercial, Agricultural, Domestic & Industrial activities
Perapuram	⇒ SW direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water- Borewell ⇒ Activities contributing pollution: Agricultural & Domestic activities
Pusapatirega	⇒ SSW direction

Location	Environmental Setting
	⇒ 4.0 Km from the epicenter. ⇒ Water resources: Open well ⇒ Activities contributing pollution: Agricultural and Domestic activities
Pidibhimavaram	⇒ NE direction ⇒ 6.5 Km from the epicenter ⇒ Water resources: Ground water from and pump ⇒ Activities contributing pollution: Agricultural, Domestic & Industrial activities
Kanimetta	⇒ N direction ⇒ 3.0 Km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Commercial, Agricultural & Domestic activities
Kanimella	⇒ N direction ⇒ 5.8 Km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Agricultural & Domestic activities
Narava	⇒ E direction ⇒ 7.5 Km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Agricultural & Domestic
Kandivalasa	⇒ 6.0 Km from the epicenter ⇒ NE direction. ⇒ Water resources: Surface water body- flowing ⇒ Activities contributing pollution: Commercial, Agricultural, Domestic & Industrial activities
Nathavalasa	⇒ 8.0 Km from the epicenter ⇒ SW direction. ⇒ Water resources: Surface water body- flowing ⇒ Activities contributing pollution: Commercial, Agricultural, Domestic & Industrial activities

3.13.2 Preliminary Observations

a) Champavathi Nadi

- The sample was collected at Nathavalasa which is at a distance of 8 Km in SW direction from the plant
- The sampling point is very close to the national highway
- The water body is a seasonally flowing body which is slightly turbid during the sampling time which can be attributed to the continuous spells of rain in the region

b) Perapuram

- The sample was collected at Perapuram which is about 6.5 Km SW of the plant site
- The water collected was clear and devoid of any visible color and odor
- It was observed that the water occurred at about 12 feet while digging the well and the dept of the well is about 90 feet
- The designated usage of the well is for the domestic requirement of the villagers and also for the agricultural requirements of the nearby fields.

c) Pusapatirega

- Pusapatirega is located at about 4.0 Km SSW of the plant site
- The water was struck at about 5 feet and the depth of the well is about 40 feet
- The surrounding environment is predominantly residential and the sampling point is very close to the road that leads to the village

d) Pidibhimavaram

- The sampling location is located at about 6.5 Km NE of the plant site
- The water is being used for drinking and other domestic purposes
- There is a primary school near the sampling location
- There is a sewage canal running very close to the bore well

e) Kanimetta

- The sample was collected near the school building in the village which is about 3.0 Km N of the plant site
- There is a rain water/ artificial harvesting pit next to the sample well
- The water was struck at 15 feet and the depth of the bore well is about 85 feet

f) Kanimella

- Kanimella village is about 5.8 Km N of the plant site
- The water was struck at about 25 feet and the depth of the bore well is about 90 feet
- The water is predominantly used for drinking and other domestic purposes
- There is a sewage drain running close to the sampling point

g) Narava

- Narava is about 7.5 Km E of the plant site
- The water sample was collected from a hand pump in the village
- The water was struck at 20 feet and the depth of the well is about 85 feet
- Washing, bathing and cleaning activities were observed near the sampling point

3.13.3 Analysis & Observations

The analysis results and the subsequent interpretations are given in this section.

Table 3.11 (a)
Water Quality- Physical Characteristics

Parameter	Unit	Method	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
Color	Pt-Co Units	APHA 2120 B	4.8	25.0	4.2	9.30	38.6
pH	-	APHA 4500 H^+ B	7.45	8.0	7.5	8.03	7.68
EC	µSimens/cm	APHA 2510 B	3094	407	1388	1203	346
TSS	mg/l	APHA 2540 D	8.91	40	9.1	9.12	60
TDS	mg/l	APHA 2540 C	1878	278	766	764	236

Table 3.11 (b)
Water Quality- Physical Characteristics

Parameter	Unit	Method	Kanimetta	Kanimella	Narava	Kandivalasa	Nathavalasa
Color	Pt-Co Units	APHA 2120 B	13.6	4.12	5.7	38.6	10.7
pH	-	APHA 4500 H^+ B	8.12	8.03	7.47	7.68	8.07
EC	µSimens/cm	APHA 2510 B	2450	842	897	346	4483
TSS	mg/l	APHA 2540 D	9.12	8.55	9.57	60	400
TDS	mg/l	APHA 2540 C	1410	510	686	236	3012

3.13.3.1 Discussions

- The color in the water can be attributed to the local geographical conditions and other factors like the domestic and industrial activities in the area. The color ranged from 4.2 Pt-Co units at Perapuram to 38.6 Pt-Co units in Kandivalasa and at Pidibhimavaram

- pH in the ground water can be attributed to several factors like natural causes, geo-hydrological conditions, domestic and agricultural activities, saline water ingression from the sea into the coastal aquifers and industrial activities in the area. pH in the samples ranged from 7.45 at the bore well in the plant site to 8.12 at Kanimetta

- Electrical conductivity is the cumulative index of the total salt content of the water which is capable of conducting a known potential of current. Electrical conductivity again can be attributed to the natural causes like the hydro-geological formations, saline water ingression into the coastal aquifers and anthropogenic activities like domestic and agricultural activities and industrial activities. EC in the study area ranged from 346 µSimens/cm at Pidibhimavaram and Kandivalasa to about 4483 µSimens/cm at Nathavalasa

- Total solids in the water is again an indicator of the salts of both anionic and cationic origin in the water. The TDS in the study area ranged from 236 mg/l at Pidibhimavaram and Kandivalasa to 3012 mg/l at Nathavalasa

Figure 3.13
Water Quality- Physical Characteristics

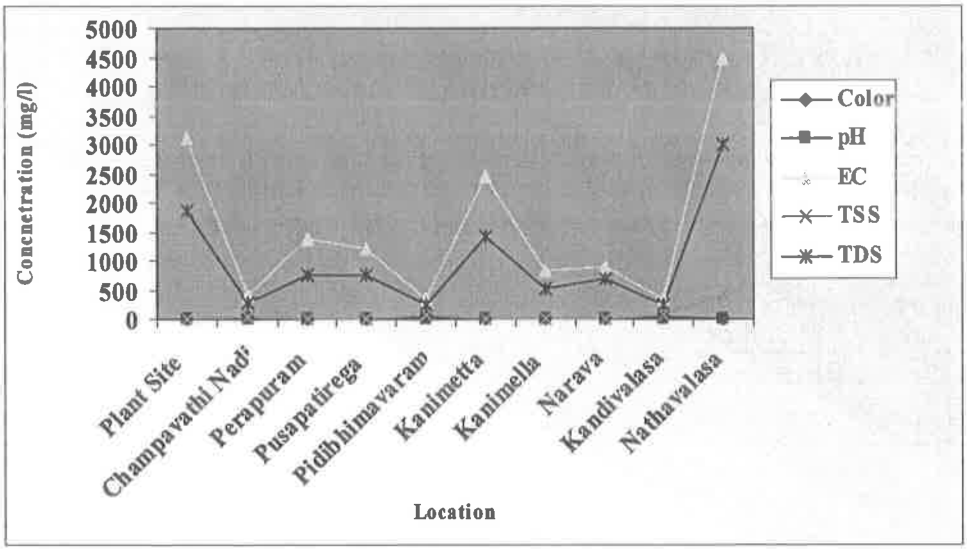


Table 3.12 (a)
Water Quality- Chemical Characteristics

Parameter	Unit	Method	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
Chlorides	mg/l	APHA 4500 Cl^- B	775	37	98	133	197
Sulfates	mg/l	APHA 4500 SO_4^{-2} D	102	47	77	58	36
Phosphates	mg/l	APHA 4500 P D	0.4	0.3	BDL	0.2	0.4
Nitrates	mg/l	IS: 3025 (Part 34)	0.4	0.3	2.3	2.5	1.6
Fluorides	mg/l	APHA 4500 F^- D	0.7	0.3	0.9	0.5	0.7
TA	mg/l	APHA 2340 B	383	167	355	227	291
TH	mg/l	APHA 2340 C	1211	141	469	416	473
Calcium	mg/l	APHA 3500 Ca B	291	35	124	129	113

Parameter	Unit	Method	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
Magnesium	mg/l	APHA 3500 Mg B	117	12	38	22	46
COD	mg/l	APHA 5220 B	25	34	40	28	6

Table 3.12 (b)
Water Quality- Chemical Characteristics

Parameter	Unit	Method	Kanimetta	Kanimella	Narava	Kandivalasa	Nathavalasa
Chlorides	mg/l	APHA 4500 Cl^- B	450	98	155	22	1404
Sulfates	mg/l	APHA 4500 SO_4^{-2} D	300	37	64	20	2078
Phosphates	mg/l	APHA 4500 P D	0.3	0.4	0.1	0.3	0.3
Nitrates	mg/l	IS: 3025 (Part 34)	2.3	2.4	1.5	0.5	0.2
Fluorides	mg/l	APHA 4500 F^- D	0.1	0.7	0.9	1.3	0.4
TA	mg/l	APHA 2340 B	171	243	283	139	107
TH	mg/l	APHA 2340 C	716	283	327	117	5087
Calcium	mg/l	APHA 3500 Ca B	198	66	79	29	343
Magnesium	mg/l	APHA 3500 Mg B	53	28	31	10	1028
COD	mg/l	APHA 5220 B	9	28	22	46	246

3.13.3.2 Discussions

- The Chloride values ranged from 22 mg/l at Kandivalasa to about 1404 mg/l at Nathavalasa. Chlorides can be attributed to the domestic, agricultural and industrial activities in the region and also the salt water ingression into the aquifers and the surface water bodies during the high tide
- Sulfates ranged from 20 mg/l at Kandivalasa to 2078 mg/l at Nathavalasa
- Phosphates and Nitrates ranged from 0.1 mg/l at Narava to 0.4 mg/l at the bore well in the plant site and Kanimella and 0.2 mg/l at Nathavalasa to 2.5 mg/l at Pusapatirega respectively
- Total alkalinity in the water samples ranged from 107 mg/l at Nathavalasa to 383 mg/l at the bore well in the plant site
- The hardness in the water samples ranged from about 117 mg/l at Kandivalasa to 5087 mg/l at Nathavalasa which can be attributed to the salt water ingression during the high tide time and the heavy rainfall in the catchment areas
- The COD values in the water samples ranged from 6 mg/l at Pidibhimavaram to 246 mg/l at Nathavalasa
- The Calcium levels in the water samples ranged from 29 mg/l at Kandivalasa to 343 at Nathavalasa
- The Magnesium in the water samples ranged from 10 mg/l at Kandivalsa to 1028 mg/l at Nathavalasa

Table 3.12 (c)
Water Quality- Chemical Characteristics (meq/l)

Parameter	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
Chlorides	21.85	1.043	2.76	3.75	5.556
Sulfates	2.12	0.97	1.603	1.20	0.749
Phosphates	0.012	0.0094	0.0031	0.0063	0.0126
Nitrates	0.0064	0.0048	0.037	0.040	0.025
Fluorides	0.05	0.021	0.0064	0.035	0.05
Calcium	14.52	1.74	6.18	6.43	5.638
Magnesium	9.62	0.987	3.12	1.81	3.785

Table 3.12 (d)
Water Quality- Chemical Characteristics (meq/l)

Parameter	Kanimetta	Kanimella	Narava	Kandivalasa	Nathavalasa
Chlorides	12.69	2.764	4.371	0.6205	396.10
Sulfates	6.246	0.770	1.332	0.4164	43.261
Phosphates	0.0094	0.012	0.0031	0.00947	0.0094
Nitrates	0.037	0.038	0.0241	0.0080	0.0032

Parameter	Kanimetta	Kanimella	Narava	Kandivalasa	Nathavalasa
Fluorides	0.0071	0.05	0.064	0.092	0.028
Calcium	9.88	3.293	3.942	1.447	17.11
Magnesium	4.36	2.304	2.550	0.822	84.59

Figure 3.14 (a)
Water Quality-Chemical Characteristics

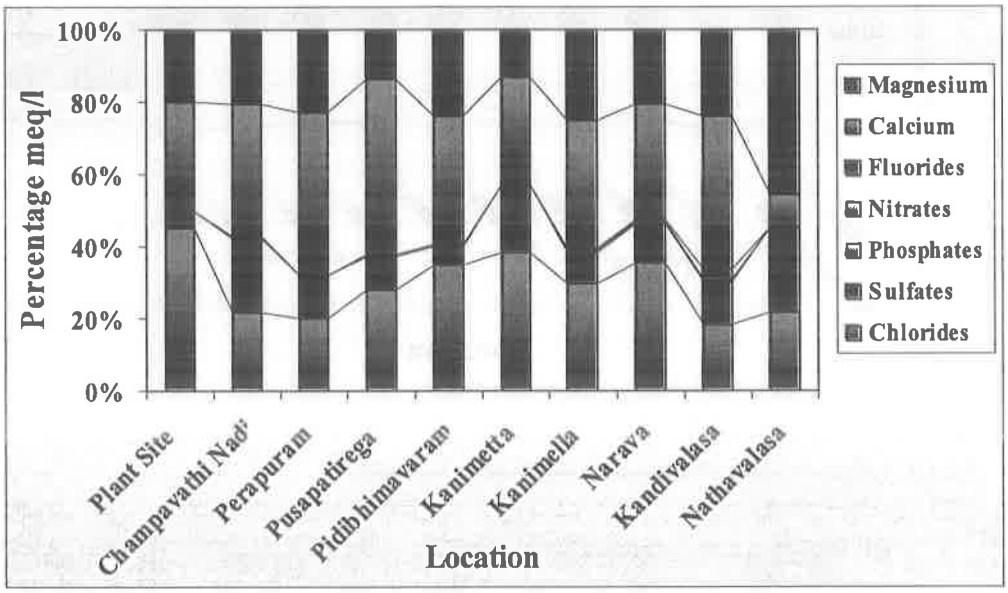
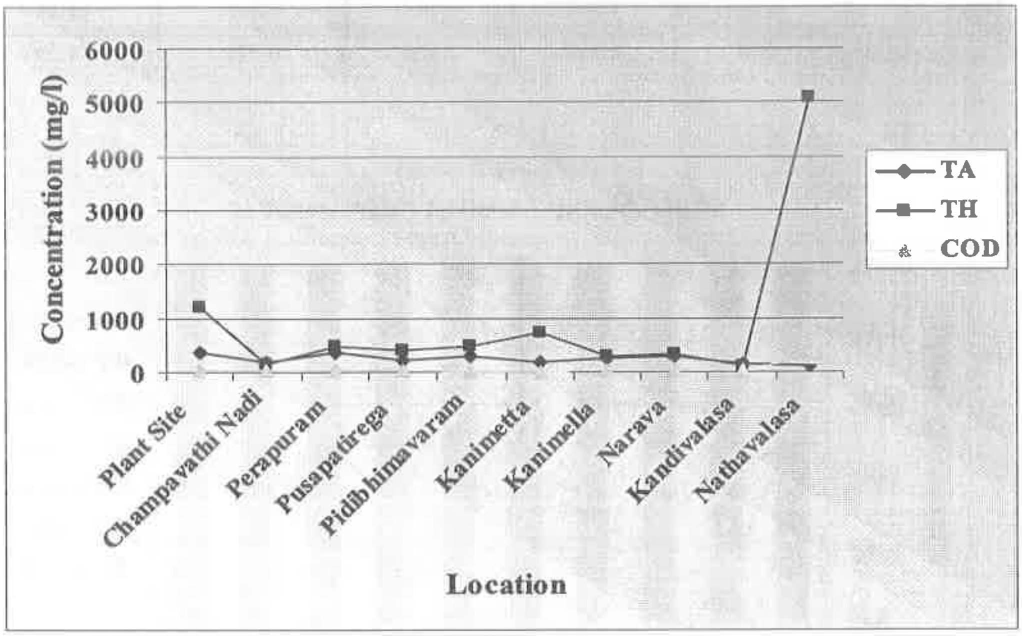


Figure 3.14 (b)
Water Quality- Chemical Characteristics



3.13.3.3 Metal Concentrations in the Water Samples

All the water samples collected during the study were analyzed for heavy metal concentrations in order to establish their toxicity. The metals analyzed were Iron, Arsenic, Manganese, Cadmium, Chromium, Copper, Lead and Zinc. The metal concentrations are as given below.

Table 3.13 (a)
Water Quality- Metal Concentrations

Parameter	Unit	Method	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
Iron	mg/l	APHA 3500 Fe B	0.06	0.6	0.1	0.2	0.02
Arsenic	mg/l	APHA 3500 As B	BDL	BDL	BDL	BDL	BDL
Cadmium	mg/l	APHA 3111 B	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	mg/l	APHA 3111 B	<0.05	0.3	<0.05	<0.05	<0.05
Copper	mg/l	APHA 3111 B	<0.05	0.5	<0.05	<0.05	<0.05
Lead	mg/l	APHA	0.1	<0.05	0.1	0.1	0.1

Parameter	Unit	Method	Plant Site	Champavathi Nadi	Perapuram	Pusapatirega	Pidibhimavaram
		3111 B					
Manganese	mg/l	APHA 3111 B	<0.05	0.1	<0.05	0.1	<0.05
Zinc	mg/l	APHA 3111 B	<0.5	<0.5	<0.5	<0.5	<0.5

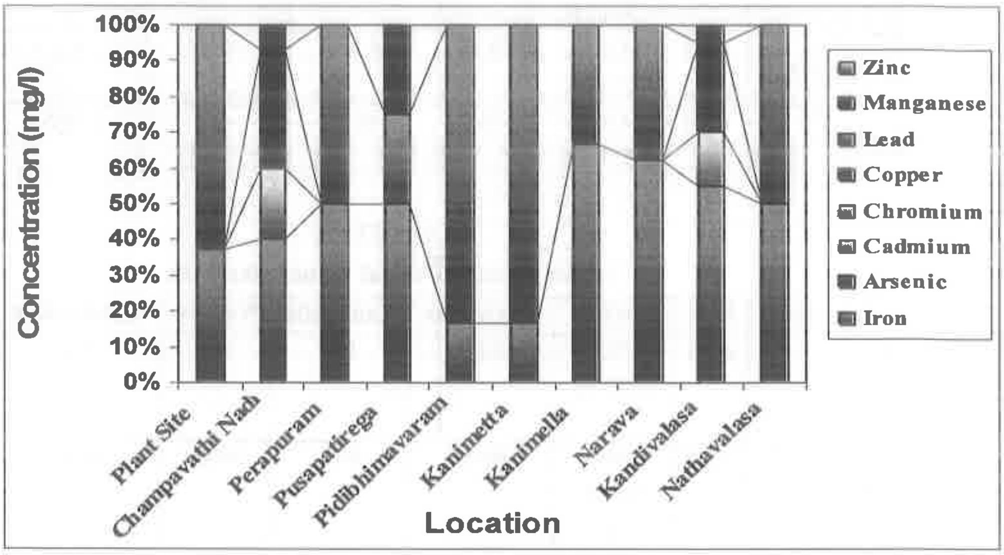
Table 3.13 (b)
Water Quality- Metal Concentrations

Parameter	Unit	Method	Kanimetta	Kanimella	Narava	Kandivalasa	Nathavalasa
Iron	mg/l	APHA 3500 Fe B	0.02	0.2	0.1	1.1	0.2
Arsenic	mg/l	APHA 3500 As B	BDL	BDL	BDL	BDL	BDL
Cadmium	mg/l	APHA 3111 B	<0.01	<0.01	<0.01	<0.01	<0.05
Chromium	mg/l	APHA 3111 B	<0.05	<0.05	<0.05	0.3	<0.05
Copper	mg/l	APHA 3111 B	<0.05	<0.05	<0.05	0.5	<0.05
Lead	mg/l	APHA 3111 B	0.1	0.1	0.06	<0.05	0.2
Manganese	mg/l	APHA 3111 B	<0.05	<0.05	<0.05	0.1	<0.05
Zinc	mg/l	APHA 3111 B	<0.5	<0.5	<0.5	<0.5	<0.5

It is observed from the above tables, that except for a few sampling points most of the sampling locations were showing metals within the prescribed standards. The locations with excess concentrations can be attributed to the local geology, hydro-geological conditions and anthropogenic activities like agricultural run-off and industrial activities.

Increase in the concentrations of various anions and cations in the water samples other parameters can be attributed to the local geology and the recent tidal influx of sea water as a result of which there was a massive churning of the surface water streams owing to the sea-water and fresh water interface during the tidal action. The graphical representation of the metal concentrations in the water samples of the study area have been presented in the figure below.

Figure 3.15
Metal Concentrations in the Water Sample



Apart from the above 10 water samples (3 surface and 7 ground water), about two observation wells as designated by the regulatory authorities to monitor the drawdown and the quality was also collected. The analysis results of the two observation wells are given below.

Table-3.14
Analysis in Observation Wells

Parameter	Unit	Method	OW1	OW2
Color	Pt-Co Units	APHA 2120 B	4.8	5.0
pH	-	APHA 4500 H^+ B	7.0	7.1
EC	µSimens/cm	APHA 2510 B	2807	2890
TSS	mg/l	APHA 2540 D	8.91	40
TDS	mg/l	APHA 2540 C	1825	1879
Chlorides	mg/l	APHA 4500 Cl^- B	615	638
Sulfates	mg/l	APHA 4500 SO_4^{-2} D	92	98
Phosphates	mg/l	APHA 4500 P D	0.1	BDL
Nitrates	mg/l	IS: 3025 (Part 34)	2.0	3.0
Fluorides	mg/l	APHA 4500 F^- D	1.1	1.0
TA	mg/l	APHA 2340 B	388	391
TH	mg/l	APHA 2340 C	672	662
Calcium	mg/l	APHA 3500 Ca B	291	35
Magnesium	mg/l	APHA 3500 Mg B	117	12
COD	mg/l	APHA 5220 B	25	34

Parameter	Unit	Method	OW1	OW2
Iron	mg/l	APHA 3500 Fe B	0.05	0.08
Arsenic	mg/l	APHA 3500 As B	BDL	BDL
Cadmium	mg/l	APHA 3111 B	BDL	BDL
Chromium	mg/l	APHA 3111 B	BDL	BDL
Copper	mg/l	APHA 3111 B	0.03	0.02
Lead	mg/l	APHA 3111 B	BDL	BDL
Manganese	mg/l	APHA 3111 B	BDL	BDL
Zinc	mg/l	APHA 3111 B	0.1	0.2

From the above table it is inferred that the water in both the observation wells in the plant premises of Matrix Laboratories Ltd, Unit-8 was found to be inline with the drinking water standards as prescribed in the IS-10500 standards.

3.14 NOISE ENVIRONMENT

3.14.1 General

The impacts of noise vary from Noise Induced Hearing Loss (NIHL) to annoyance depending upon the noise levels and tolerance levels of the individual. The baseline study for noise levels in the study area has been carried out by selecting a noise monitoring station based on the following criteria.

- Source of the noise
- Proximity of the noise generating source to the human settlements
- Exposure time
- Time- scaled dose-response ratio of the individual receptor

The impact of noise on the surrounding community generally depends upon the following aspects.

- Characteristics of the noise sources (i.e. either an instantaneous or a continuous source)
- Noise generation period during the day
- Location of the noise generating source with respect to the noise sensitive areas

While measuring the day-night equivalent noise levels (L_{dn}), it is considered that one event at night is equivalent to ten similar events during the day time. L_{dn} is similar to 24 hours equivalent sound level (L_{Eq}) except that, during the daytime 10 dB (A) weighing is added. The L_{dn} for a given location in a community may be calculated from the hourly (L_{Eq}) equivalent sound levels with a 10 dB (A) correction added to the night time value (L_n).

$$L_{dn} = 10 \text{ Log } (0.0416 [15 (10^{Ld/10}] + 9 (10^{Ln+10/10}]) + ...$$

Where L_d is the Equivalent noise levels at day (6.00 A.M to 9.00 P.M) and

L_n is the Equivalent noise levels at night (9.00 P.M to 6.00 A.M)

3.15 NOISE LEVELS IN THE STUDY AREA

3.15.1 Assessment of Noise Levels

The main objective of noise level assessment is to identify all the sources acceptable and unacceptable to study region. The acoustical environment varies dynamically in magnitude and character throughout most communities. The noise level variation can be temporal, spectral and spatial. The maximum impact of noise is felt on urban areas, which is mostly due to the commercial / industrial activities and vehicular movement during peak hours of the day.

The assessment of noise pollution in the study area has been carried out keeping the above said considerations. The existing status of noise levels within the study zone, has been undertaken through reconnaissance, identification of existing noise sources, land use pattern for monitoring of baseline noise levels.

Baseline noise levels have been monitored at different points within the study area using a noise level meter. 6 noise monitoring stations were identified for the assessment of the existing noise levels keeping in view the nature of the monitoring location i.e. residential areas in villages, schools, bus stations etc.

The noise monitoring stations are shown in the **Figure 3.1 (c)** and the distance and the direction of the noise monitoring locations with reference to the plant site (epicenter) is given in **Table 3.15.**

Table 3.15
Noise Level Monitoring Stations

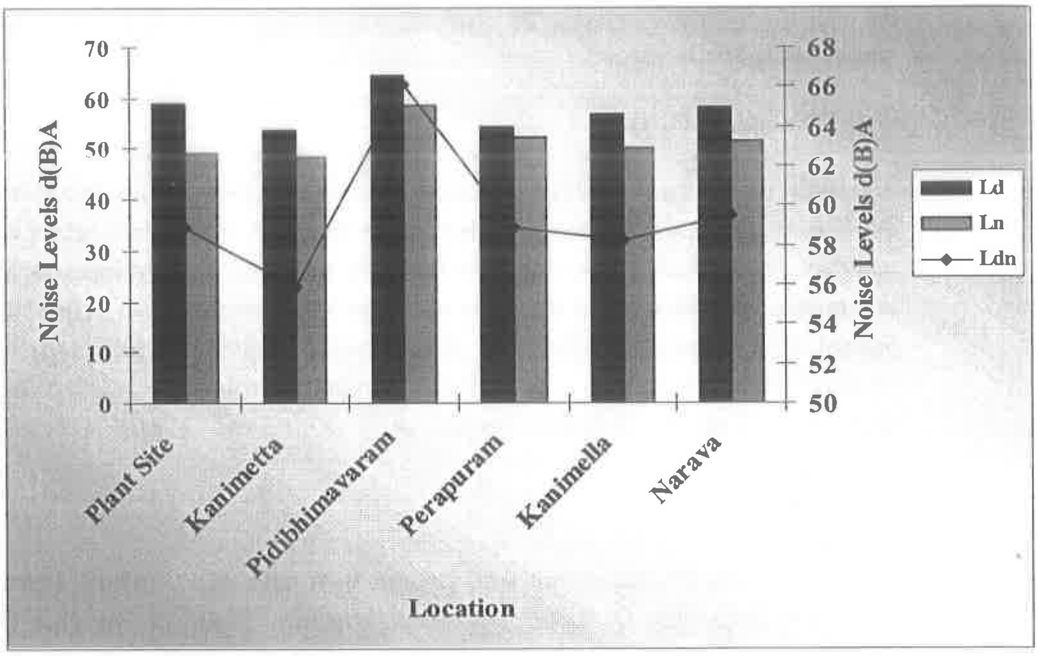
Location	Environmental Setting
Plant Site	⇒ Core Zone ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Industrial activities, Vehicular traffic, Commercial, Agricultural & Domestic
Kanimetta	⇒ 3.0 Km from the epicenter ⇒ N direction. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Dust arising from the roads, Industrial activities, vehicular traffic ⇒ Environmental Setting: Residential/ Industrial
Pidibhimavaram	⇒ NE direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Industrial, Vehicular traffic, Agricultural & Domestic activities ⇒ Environmental Setting: Residential
Perapuram	⇒ SW direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water ⇒ Activities contributing pollution: Agricultural and Domestic activities, Dust arising from vehicular movement ⇒ Environmental Setting: Residential
Kanimella	⇒ N direction ⇒ 5.8 Km from the epicenter. ⇒ Activities contributing pollution: Unpaved village roads, Agricultural & Domestic activities ⇒ Environmental Setting: Residential
Narava	⇒ E direction ⇒ 7.5 Km from the epicenter. ⇒ Water resources: Ground Water ⇒ Activities contributing pollution: unpaved village roads, vehicular movements, Commercial, Agricultural & Domestic activities ⇒ Environmental Setting: Residential

Baseline monitoring was carried out in surrounding villages of the study area for 24 hours to study the impact of the noise on the local environment. The day levels have been monitored between 6.00 A.M and 9.00 P.M and the night levels have been monitored between 9.00 P.M and 6.00 A.M.

Table 3.16
Noise Levels in the Study Area

Location➔	Plant Site	Kanimetta	Pidibhimavaram	Perapuram	Kanimella	Narava
Distance ➔Km	-	**1.0**	**3.9**	**3.4**	**2.8**	**4.7**
Direction ➔ Hours🡻	-	**NNE**	**NE**	**SW**	**N**	**E**
1	48.6	49.7	57.4	53.2	47.1	51.7
2	47.6	47.3	56.5	52.8	48.2	49.2
3	48.0	46.8	55.4	53.4	49.7	47.6
4	48.2	48.6	56.4	54.6	51.1	48.2
5	49.8	49.2	57.3	55.6	51.3	49.6
6	51.2	51.3	58.1	54.7	52.3	52.3
7	50.3	52.1	59.3	54.9	52.5	54.7
8	54.2	52.3	59.7	53.2	52.7	56.3
9	56.3	53.1	61.2	52.8	53.6	55.7
10	57.2	52.9	60.8	53.4	54.8	55.9
11	57.8	53.6	64.4	54.6	55.6	57.3
12	59.3	54.8	66.7	55.6	56.2	58.2
13	58.6	55.4	67.8	54.7	57.9	57.1
14	59.9	54.8	67.2	54.9	58.4	58.5
15	61.3	55.7	66.3	55.3	57.9	59.6
16	62.2	56.3	65.4	56.7	59.7	60.2
17	61.0	55.2	64.8	56.5	60.2	61.3
18	59.8	53.5	64.3	55.4	59.3	59.7
19	59.2	52.1	63.2	54.1	58.2	58.3
20	58.1	50.7	62.4	51.9	55.1	57.2
21	57.6	49.6	61.8	48.6	53.2	55.6
22	52.2	48.5	61.3	47.5	51.7	54.9
23	50.1	47.6	59.9	46.3	50.2	53.6
24	47.2	48.4	60.1	45.4	49.3	52.1
Day Equivalent	**58.7**	**53.7**	**64.3**	**54.5**	**56.9**	**58.0**
Night Equivalent	**49.2**	**48.3**	**58.5**	**52.4**	**50.1**	**51.5**

Figure 3.16
Comparative Noise Levels



3.15.3 Observations

The high values of noise observed at a few sampling stations are primarily due to the vehicular traffic and other anthropogenic activities.

3.15.4 Regional Scenario

Assessment of equivalent day and night noise levels in and around the plant site reveal that noise levels are ranging from 45 to 68 dB(A), which can be taken as the existing baseline status. The minimum noise level 45 dB (A) was recorded at Perapuram village while the maximum noise level was 68 dB (A) recorded at Pidibimavaram.

The day equivalent values calculated considering the noise levels recorded from 6 AM to 9 PM. The values were found to be ranging between 53.7 dB (A) at Kanimetta to 64.3 dB (A) near Pidibhimavaram.

Similarly night equivalent noise levels were calculated using the noise levels recorded from 10 PM to 5 AM. These values are critical since they affect the sleep in the residential and sensitive areas. The night equivalent values were found to be ranging between 48.3 dB (A) at Kanimetta to 58.5 dB (A) near Pidibhimavaram. The noise standards as per CPCB for Residential areas were

45 dB (A) for night equivalent and 55 dB (A) for day equivalent where as in the commercial areas the night equivalent is 55 dB (A) and day equivalent is 65 dB (A), and in industrial areas the night equivalent value is 70 dB (A) and day equivalent is 75 dB (A).

3.16 LAND ENVIRONMENT

The study on the land and biological aspects of the ecosystem is important for the EIA study to identify the sensitive issues and take appropriate action to maintain "Ecological Homeostasis" in the early stages of the development of the project. The objective of the study of the land environment is to define the present environment in which the developmental activity is proposed, to evaluate all possibilities to ensure that the proposed project has no negative impacts and if any, are definitely minimized.

3.16.1 Ecosystem

Ecosystem is an integrated unit that contains both animals and plants whose survival is dependent on biotic and abiotic structure. Based on the type of distribution of organisms and its physical setting the study area can be classified in to cropland, terrestrial and aquatic ecosystems. In order to understand the factors governing the system both abiotic (physical setting) and biotic factors (flora and fauna) have been described.

3.16.2 Physiography

Green pastures, grazing lands and agricultural fields, cover the area. The vegetation is strongly influenced by rainfall, temperature and humidity.

3.16.3 Geology

The project is located near G.Chodavaram village, Vizianagaram district in Andhra Pradesh. The area forms parts of the coastal plains and is characterized by undulated flat terrain with a few dotted hillocks.

The under ground water level normally abides the surface configuration. Ground water levels are reported to be deeper in elevated areas, and shallower in low lands which is the general phenomenon.

The general stratigraphic succession of geological formations occurring in the study area is given below.

Table 3.17
Stratigraphic Succession of Geological Formations in the Study Area

Age	Formations	Lithology
Recent	Alluvium	Soils, sands, silts and clays
	Younger Intrusives	Pegmatite's and quartz veins
		Phorphyroblastic charcockite Porphyritic granite gneiss
		Garnet biotite gneiss
Archaeans	Migmatities	Migmatized quartzites
		Cordierite biotite gneiss
		Migmatized sillimanite gneiss
	Older intrusives	Quartzo feldsphatic gneiss
	Charnackitic suite	Charnockites
		Pyroxene granulites
	Khondalitic suite	Garnet sillimanite gneiss
		Quartzites
		Calc-silicate rocks with or without Manganese

Source: Journal of Indian Geophysicists Union, 2003

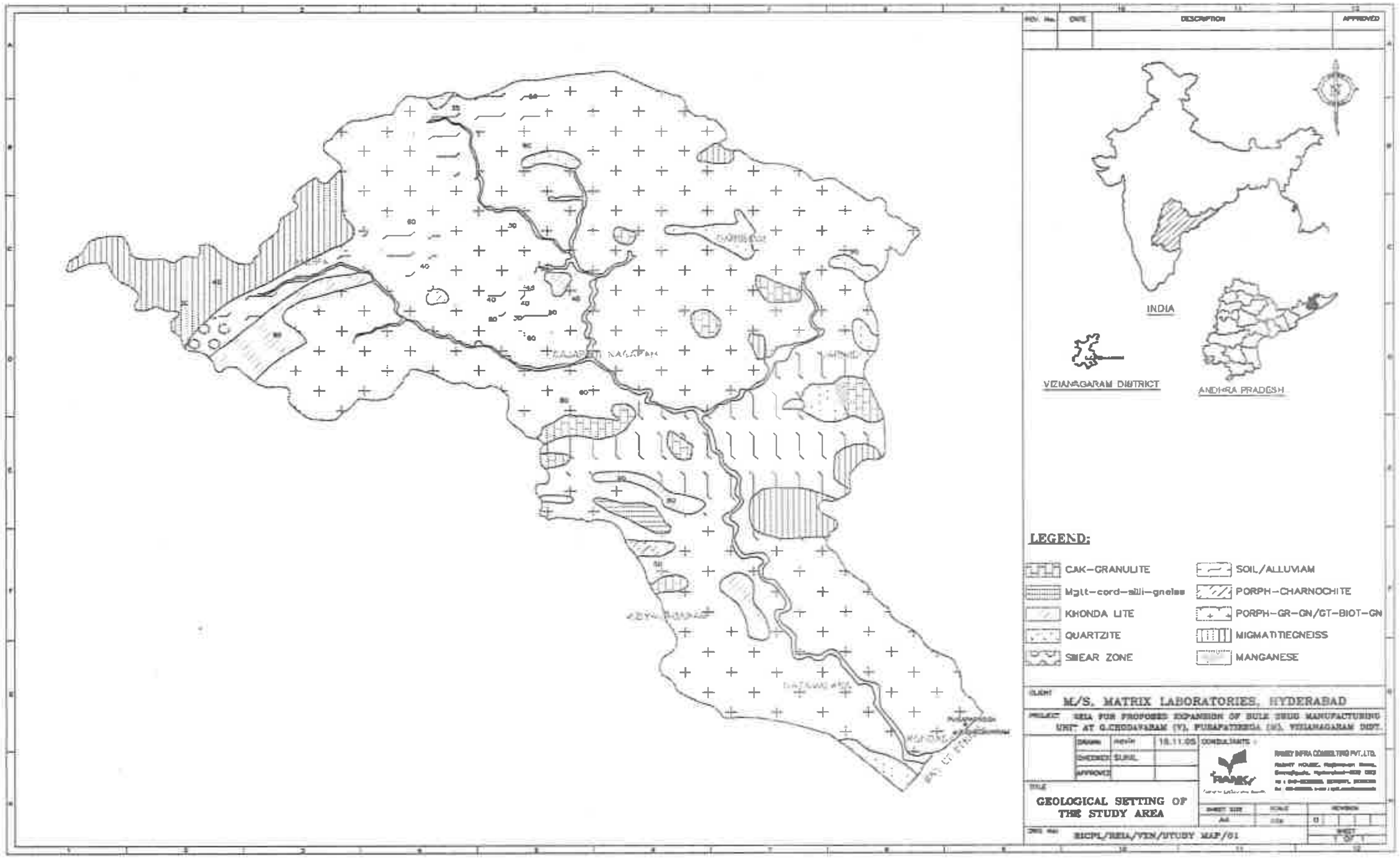
The upper catchment of the Champavathi river basin is covered by porphyritic granite gneiss and the lower catchment by garnet biotite gneiss. West of Andra, huge hill ranges consist of Khondalite rocks having strike direction of east west and dipping 80° NE. Khondalites are best exposed west of Pathamunginapalle, south of Nellimarla, east of Nelivada, east of Ramabhadrapuram, south of Kayllam having strike of NE-SE and dipping 40° SW. The trend of the hill ranges and strike of the foliation of the Khondalite is NE-SW. at places, the strike varies from NNE-SSW to ENE-WSW. Near Gajapathinagaram, the strike of the formation is NE-SW with a dip of 50°SW. A fault in NE-SW passes through this area.

Calc- silicate rocks form low hillocks in Northwest of Ambativalasa and are associated with Manganese ore bodies. They occur as elongated E-W outcrops and have very foliation, which us considered to be of bedding that strikes NW-SE and EW. These are invariable tight folded and have well-developed cleavage with characteristic ribbed weathering. Quartzite is present as alternate bands within khondalite rock at places. Quazrtzite occur as bands parallel to the strike of the foliation of the khondalites. Migmatite outcrops are exposed west of Andra village. Most of these hill ranges have strike direction of NE-SW and dip 30° to 40° E. In this area, a shear zone separates the khondalite suite of rocks from migmatite gneiss. An intrusive charnockite massif is located near Pedabantupalle. The geological setting of the area is shown in the map of the Vizianagaram district as **Figure 3.17.**

3.16.4 Lithology

The lithology in the study area is under the influence of natural agents and thus is weathered and fractured. It can be concluded that the area is underlain by one of the oldest formations in the geological history. It is noticed that the formation gets harder and impervious with depth. The topsoil in the area is followed by sandy soil matter that is underlain by weathered parent rock, the thickness of which is not considerable. This weathered rock is followed by a basement rock that is fine-grained granite. The major types of rocks in the study area are laterite and unclassified rocks.

Figure 3.17
Geological Setting



3.17 SOIL SAMPLING

Soil samples were collected at selected locations in the study area to assess the existing soil conditions in and around the plant site. This will establish the baseline characteristics and will facilitate in the identification of the incremental concentrations from the proposed activities at a larger stage. The baseline characteristics which are analyzed now includes the impact on soil due to the activities of the existing industries and other anthropogenic activities in the study area.

Thus the sampling locations are decided based on one or more criteria listed below:

- To determine the existing soil characteristics of the study area
- To determine the impact on soil characteristics due to the activities of the existing industries located in the study area
- To determine the impact on agricultural productivity of soil due to the proposed activity

The details of the sampling locations are given below.

Table 3.18

Details of Soil Quality Monitoring Locations

Location	Environmental Setting
Site	⇒ Core Zone ⇒ Water resources: Ground water –Borewell ⇒ Activities contributing pollution: Domestic & Industrial activities ⇒ Environmental Setting: Industrial
Perapuram	⇒ SW direction ⇒ 6.5 Km from the epicenter. ⇒ Water resources: Ground water- Borewell ⇒ Activities contributing pollution: Agricultural & Domestic activities
Pusapatirega	⇒ SSW direction ⇒ 4.0m from the epicenter. ⇒ Water resources: Open well ⇒ Activities contributing pollution: Agricultural and Domestic activities
Pidibhimavaram	⇒ NE direction

Location	Environmental Setting
	⇒ 6.5 Km from the epicenter ⇒ Water resources: Ground water from and pump ⇒ Activities contributing pollution: Agricultural, Domestic & Industrial activities
Kanimetta	⇒ N direction ⇒ 3.0 Km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Commercial, Agricultural & Domestic activities
Kanimella	⇒ N direction ⇒ 5.8 km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Agricultural & Domestic activities
Narava	⇒ E direction ⇒ 7.5 km from the epicenter. ⇒ Water resources: Ground Water from hand pump ⇒ Activities contributing pollution: Agricultural & Domestic
Kandivalasa	⇒ 7.5 km from the epicenter ⇒ SW direction. ⇒ Water resources: Surface water body- flowing ⇒ Activities contributing pollution: Commercial, Agricultural, Domestic & Industrial activities

The soil sampling points are shown in the base map of the region as **Figure 3.1 (c)**.

Table 3.19 (a)
Soil Quality in the Study Area

Parameter	Unit	Plant Site	Perapuram	Pusapatirega	Pidibhimavaram
pH	-	7.46	7.38	8.7	7.83
Moisture content	%	9.6	8.3	14.8	12.9
Organic matter	%	0.4	0.8	0.6	0.4
Sodium Absorption ratio	-	1.1	0.7	11.4	1.0
Chlorides	-	157	252	126	209

Parameter	Unit	Plant Site	Perapuram	Pusapatirega	Pidibhimavaram
Sulphates	mg/kg	80	230	72	110
Total Nitrogen	mg/kg	435	1357	456	371
Calcium	mg/kg	1154	1839	2632	2164
Magnesium	mg/kg	393	481	284	65
Sodium	mg/kg	165	128	2311	177
Potassium	mg/kg	44	395	183	46
Phosphorous	mg/kg	17	58	20	28
Iron	mg/kg	3741	4342	2763	864
Lead	mg/kg	16.7	13.9	17.3	9.6
Cadmium	mg/kg	0.2	BDL	0.1	0.4
Chromium	mg/kg	27.4	25.4	11.8	2.3
Copper	mg/kg	9.3	19.4	14.5	3.4
Zinc	mg/kg	9.7	26.1	14.9	13.7

Table 3.19 (b)
Soil Quality in the Study Area

Parameter	Unit	Kanimetta	Kanimella	Narava	Kanivalasa
pH	-	7.85	6.74	8.14	7.43
Moisture content	%	14.9	14.7	4.7	11.7
Organic matter	%	0.3	0.5	0.5	0.5
Sodium Absorption ratio	-	1.7	1.8	1.1	1.6
Chlorides	-	221	147	115	178
Sulphates	mg/kg	113	108	84	68
Total Nitrogen	mg/kg	397	430	192	343
Calcium	mg/kg	2177	174	973	1839
Magnesium	mg/kg	61	174	169	240
Sodium	mg/kg	2331	137	148	284
Potassium	mg/kg	189	64	50	526
Phosphorous	mg/kg	27	36	50	63
Iron	mg/kg	4342	2180	3168	3259
Lead	mg/kg	13.9	15.4	15.2	19.2
Cadmium	mg/kg	BDL	BDL	0.2	0.06
Chromium	mg/kg	25.4	21.2	23.4	17.7
Copper	mg/kg	24.2	10.6	24.2	9.3
Zinc	mg/kg	13.7	22.9	30.6	15.3

Table 3.20
Standard Soil Classification

Soil Tests	Classification	
pH	<4.50 Extremely Acidic	6.50-7.30- Neutral
	4.50- 5.00 Very Strongly Acidic	7.30-7.80- Slightly Alkaline
	5.00- 5.50- Strongly Acidic	7.60-8.50- Moderately Alkaline
	5.50-6.00- Moderately Acidic	8.50-9.00- Strongly Alkaline
	6.00-6.50- Slightly Acidic	>9.00- Very Strongly Alkaline
Electrical Conductivity (mmhos/cm)	Up to 1.00 – Average 1.01- 2.00- Harmful to germination 2.01-3.00- Harmful to crops sensitive to salts	
Organic Carbon	Up to 0.2- Very less	0.61-0.8- on an average sufficient
	0.21-0.4- Less	0.81-1.0- Sufficient
	0.41-0.5- Medium	>1.0- More than sufficient
Nitrogen (kg/Ha)	Up to 50- very less	151-300- Better
	51-100- less	<300- Sufficient
	101-150- Good	
Phosphorous (kg/Ha)	Up to 15- Very less	51-65- on an average sufficient
	16-30- less	65-80- Sufficient
	31-50- medium	> 80- More than sufficient
Potash (kg/Ha)	0-120- very less	241-300- Average
	120-180- less	301-360- Better
	181-200- Medium	> 300- more than sufficient

3.17.1 Observations

The soil is grey to brick red in color comprising red soils, sandy and clayey loam soils. The area in particular is covered by red sandy soils with a few patches of sandy clays. Due to the presence of clay in the soil, the permeability is moderate. Cultivable soils are spread over the maximum part of the study area.

3.17.2 Discussions

The soil analysis showed no alarming levels of pollutants. Except for the metallic constituents and their concentrations in the soil which can be attributed to the local geology, the soil quality in the study area can be described in rich in minerals and is suitable for agriculture.

3.18 ECOLOGY OF THE STUDY AREA

Over the years ecological and along with it the loss of biological diversity has become a national and a global concern. Ecological assessment therefore is very critical for decision making and for the siting of a developmental project or an industry.

Ecological systems along with its abiotic and biotic components are important features of an environment. Ecological studies carried out under any EIA therefore has to focus on the vegetation and the faunal elements. Systematic ecological studies carried out aid in proper decision making. It is important to carry out these studies in order to gauge the losses or benefits due to proposed project. Ecosystems provide human society certain services that are crucial for the existence for human species. Many of the anthropogenic activities cause environmental stress resulting in the damage and irreparable changes in the ecological setting of an area.

Large-scale industrial or any developmental projects alter the natural surrounding and hence impact the ecosystems and the ecosystem components viz. flora and fauna. Therefore, while implementing such projects it is imperative to understand the baseline status of floral and faunal diversity. The baseline data not only aids to design a project in such a way that the harmful impacts on the vegetation and fauna are avoided but also provides an insight to the mitigation plans to ameliorate the adverse impacts on the natural settings.

A check list of the flora and fauna of the study area is given in the subsequent tables after collecting them from the Forest Department and the Wild Life Conservator's office, Government of Andhra Pradesh.

3.18.1 Fauna

Fauna in the district is fairly high in the interior hill regions, but it is heavily threatened with extinction. The reasons for the depletion are mainly shrinkage of habitant and uncontrolled poaching. The principal animals and birds found from the seacoast to high plateau are yellow bat, Sloth bear, Wild buffaloes, Fox, Hare, Hyena, Jackal, Mongoose and birds of the Blue rock pigeon., House crow, House sparrow, Common myna pitta etc. Consequent on the enactment of the wild life protection act of 1972, it is hoped that wild life would improve and attain the past glory.

Table 3.21

Checklist of Reptiles & Amphibians

S. No	Common Name	Scientific Name
	Amphibians	
1	Common frog	*Rana tigrina*
2	Toad	*Bufo melanostictus*
3	Common Leap Frog	*Rana cyanaphletis*
4	Common Tree Frog	*Hyla species*
	Reptiles	
1	Garden Lizard	*Calotes versicolor*
2	Wall Lizard	*Hemidactylus brooki*
3	Giant Gecko	*Hemidactylus giganticus*
4	Monitor Lizard	*Varanus benghalensis*
5	Rat Snake	*Ptyas mucosus*
6	Wolf Snake	*Oligodon venustus*
7	Checkered Keel Back	*Xernochrophis piscator*
S.No	**Common Name**	**Scientific Name**
8	Cobra	*Naja naja*
9	Krait	*Bungarus coeruleus*
10	Russell's viper	*Vipera russelli*
11	Common Tortoise	*Kachuga tectus*
12	Terrapin	*Trionyx species*
13	Gecko	*Hemidactylus brooki*
14	Keeled Indian Mabuya	*Mabuya beddomi*
15	White dotted writhing sking	*Lygosoma dussemeri*

Source: Divisional Forest Office, Vizianagaram, State Forest Department, Andhra Pradesh

Table 3.22

Avifauna in the Study Area

S. No	Common Name	Scientific Name
1	Crow	*Cervus splendeus*
2	Bhraminy Kite	*Hallastur Indus*
3	Vulture	*Gyps benghalensis*
4	Myna	*Acidotheres tristis*
5	Owl	*Otus scops*
6	House Sparrow	*Passer domesticus*
7	Cuckoo	*Cuculus species*
8	Pigeon	*Pavo domesticus*
9	House Swift	*Apus affinis*
10	Erget	*Ergetta species*

Source: Divisional Forest Office, Vizianagaram, State Forest Department, Andhra Pradesh

Table 3.23
List of Mammals in the Study Area

Common Name	Scientific Name	Feeding Niche
Striped Squirrel	*Funambulus Spp*	Nuts, Seeds, Fruits
Bandicoot	*Bandicoota indica*	Grains, Seeds
Common Mongoose	*Herpestes edwardii*	Grains, Seeds, Small animals like rats
Musk Shrew	*Suncus coeruleus*	Grains, Insects
Field Mouse	*Ratus norvegicus*	Grains, Insects
House Rat	*Rattus rattus*	Grains, Insects
Bat	*Rhinolopus Spp*	Fruits, Insects
Jungle Cat	*Felis chous*	Carnivorous
Common Hare	*Lepus dayanus*	Grass, Shrubs
Bonnet Monkey	*Macaca radiata*	Fruits, Berries, Insects
Common Langur	*Presbytis entellus*	Fruits, Berries, Insects
Rhesus Monkey	*Macaca mulata*	Fruits, Berries, Insects
Striped Hyena	*Hyena hyena*	Carcass Feeder
Indian Wolf	*Canis lupas*	Carnivorous
Jackal	*Canis aureus*	Small animals

Source: Divisional Forest Office, Vizianagaram, State Forest Department, Andhra Pradesh

3.18.2 Flora

The floristic composition of the forests of the district is of much interest. The forest types found in the district are

□ Southern tropical moist mixed deciduous forests.
□ Northern tropical dry deciduous forests.
□ Southern tropical dry mixed deciduous forests.
□ Dry deciduous green forests.
□ Dry evergreen forests.

Forestry plays an important role in the economy of the district.

Table 3.24

List of Flora in the Area

S. No	Name of the species	Biological class
	Annonaceae	
1	Annona Reticulata	Phanero
2	Annona Squamosa	Phanero
3	Polyalthia cerasoides	Phanero
4	Cocculus hirsutus	Phanero
5	Cleome viscose	
	Capparidaceae	
6	Capparis sepiaria	Phanero
7	Capparis zeylanica	Phanero
	Cochlospermaceae	
8	Coohlospermum religiosum	Phanero
	Flacourtiaceae	
9	Flacourtia indica	Phanero
	Polygalaeae	
10	Polygala arvensis	Thero
11	Polygala erioptera	Thero
12	Portulaca wightiana	Thero
	Malvaceae	
13	Abutilon inidcum	Phanero
14	Hibiscus ovalifolius	Phanero (cultivated)
15	Sida Acuta	Thero
16	Sida cordifolia	Thero
17	Sida rhombifolia	Thero
	Linaceae	
18	Linum mysorense	Thero(cultivated)
19	Tribulus terrestris	Chamae
	Rutaceae	
20	Aegle marmelos	Phanero
	Balanitaceae	
21	Balanites aegyptiaca	Phanero
	Meliaceae	
22	Azardirachta indica	Phanero
23	Chloroxylon swietenia	Phanero
24	Cipadessa baccifera	Phanero
25	Melia azedarah	Phanero
	Celastraceae	
26	Maytenus rothiana	Phanero
	Rhamnaceae	
27	Zizypus mauritiana	Phanero
28	Zizyphus nummularia	Phanero
29	Zizipus xylopyrus	Phanero
	Sapindaceae	
30	Cardiospermum helicacabum	Phanero
31	Dodonea viscose	Phanero
32	Sapindus emarginatus	Phanero
	Anacardiaceae	
33	Mangnifera indica	Phanero
	Moringaceae	
34	Moringa oleifera	Phanero

S. No	Name of the species	Biological class
	Fabaceae	
35	Alysicarpus monilifer	Thero
36	Alysicarpus rugosus	Thero
37	Alysicarpus vaginalis	Thero
38	Arachis hypogea	Thero
39	Cajanus cajan	Thero
40	Dalbergia latifolia	Phanero
41	Erythrina indica	Phanero
42	Indigofera cordifolia	Thero
43	Derris glabra	Phanero
44	Rhyncosia minima	Thero
	Caesalpiniaceae	
45	Cassia auriculata	Phanero
46	Cassia occidentalis	Thero
47	Cassia tora	Thero
48	Delonix regia	Phanero
49	Tamarindus indicus	Phanero
	Mimisaceae	
50	Acacia auriculiformis	Phanero
51	Acacia leucopholea	Phanero
52	Acacia nilotica	Phanero
53	Albizzia lebbeck	Phanero
54	Albizzia procera	Phanero
55	Dichrostachys cinera	Phanero
56	Prosopis juliflora	Phanero
	Myrtaceae	
57	Eucalyptus sp.	Phanero
58	Psidium guajava	(cultivated)
	Onagraceae	
59	Jussiea suffruticosa	Hydro
	Punicaceae	
60	Punica granatum	Phanero
	Caricaceae	
61	Carica papaya	Phanero
	Cucurbitacea	
62	Coccinia grandis	Phanero
63	Luffa tuberosa	Phanero
	Cactacaee	
64	Opuntia elatior	Phanero
	Apiaceae	
65	Coriandrum sativum	Thero(cultivated)
	Rubiaceae	
66	Ixora arborea	Phanero
	Asteraceae	
67	Blumea membranacea	Thero
68	Eclipta alba	Crypto
69	Helianthusu annus	Thero(cultivated)
70	Lagasca mollis	Thero
71	Parthenium hysterophorus	Thero
72	Pulicaria angustifolia	Thero
73	Pulicaria wightiana	Thero

S. No	Name of the species	Biological class
74	Tgitus erecta	Thero
75	Tridax procumbens	Thero
76	Vernonia cinera	Thero
77	Xanthium strumarium	Thero
	Apocyanaceae	
79	Carrissa spinarum	Phanero
	Asclepaidaceae	
80	Calotrophis gigantean	Phanero
81	Lepatadenia pyrotechnica	Phanero
	Periplocaceae	
82	Cryptoategia grandiflora	Phanero
	Convolvulaceae	
83	Argyreia cymosa	Phanero
84	Ipomoea aquatica	Crypto
85	Ipomoea carnea ssp. Fistulosa	Thero
86	Rivea hypocrateriformis	Thero
	Cuscutaceae	
87	Cuscutta campestris	Phanero
	Solanaceae	
88	Capsicum annum	Thero(cultivated)
89	Datura metel	Thero
90	Lycopersicon Lycopersicum	Thero
91	Solanum melongena	Thero
92	Solanum nigrum	Thero
93	Withania somnifera	Thero
	Scrophulariaceae	
94	Striga lutea	Thero
	Bignoniaceae	
95	Striga lutea	Thero
96	Millingtonia hortensis	Phanero
97	Tecoma stans	Phanero
	Acanthaceae	
98	Barleria prionitis	Thero
99	Lepidagathes cristala	Thero
	Verbenaceae	
100	Lantana camara	Phanero
101	Tectona grandis	Phanero
102	Vitex negundo	Phanero
	Lamaiaceae	
103	Leucas aspera	Thero
104	Ocimum sanctum	Thero(cultivated)
	Nyctaginaceae	
105	Boerhaavia diffusa	Hemicrypto
106	Bougainvillea spectabilis	Phanero(cultivated)
	Amaranthaceae	
107	Aerva lanata	Thero
108	Celosia argentea	Thero
109	Celosia polygonoides	Thero
	Polygonaceae	
110	Polygonum glabrum	Crypto
111	Polygonum plebejum	Crypto

S. No	Name of the species	Biological class
	Santalaceae	
112	Santalum album	Phanero
	Euphorbiaceae	
113	Croton bonplandianum	Phanero(cultivated)
114	Croton gibbsonii	Phanero
115	Euphorbia hirta	Thero
116	Euphorbia pulcherrima	Phanero
117	Jatropha gossypifolia	Phanero
118	Phyllanthus fraternus	Phanero
119	Ricinus communis	Phanero (cultivated)
	Moraceae	
120	Ficus Benghalensis	Phanero
121	Ficus religiosa	Phanero
	Casuarinaceae	
122	Casuarina equisetifolia	Phanero
	Hydrocharitaceae	
123	Hydrilla verticillata	Crypto
124	Vallisneria spirallis	Crypto
	Cannaceae	
125	Canna indica	Crypto
	Musaceae	
126	Musa bulbisianacollia	Crypto
127	Musa paradisiacal	Crypto
	Agavaceae	
128	Agave vera-cruz	Crypto
129	Furcrea foetida	Crypto
	Asparagaceae	
130	Asperagus laevissimus	Phanero
	Pontederiaceae	
131	Eichornia crassipes	Crypto
	Commelinaceae	
132	Commelina benghalensis	Hemicrypto
133	Cyanotis tuberosa	Hemicrypto
	Arecaceae	
134	Borassus flabilifier	Phanero
135	Cocos nucifera	Phanero
136	Caryota urens	Phanero
137	Phoenix sylvestris	Phanero
	Typhaceae	
138	Typha angustifolia	Crypto
	Araceae	
139	Colocasia esculenta	Crypto
	Lemnaceae	
140	Lemna perpusilla	Crypto
141	Wolffia arrhiza	Crypto
	Alismataceae	
142	Sagitaria sagitifolia	Crypto
143	Ottelia alismoides	Crypto
	Potamogetonaceae	
144	Potamogeton sp.	Crypto
	Cyperaceae	

S. No	Name of the species	Biological class
145	Cyperus arenarius	Crypto
146	Crperus compressus	Crypto
147	Kyllinga memoralis	Crypto
	Poaceae	
148	Aristida funiculata	Crypto
149	Arthaxon lanceolatus	Crypto
150	Arundinella tenella	Crypto
151	Bambusa eruciformis	Crypto
152	Cenchrus ciliaris	Crypto
153	Chloris barbata	Crypto
154	Chrysopogon fulvus	Crypto
155	Cynodon dactylon	Crypto
156	Dactylactenium aegyptiacum	Crypto
157	Dichanthium annulatum	Crypto
158	Digitaria biformis	Crypto
159	Iseilema laxum	Crypto
160	Melanocenchris jacquemontii	Crypto
161	Panicum repens	Crypto
162	Pennisetum typhoides	Crypto
163	Saccharum officinatum	Crypto
164	Saccharum spontaneum	Crypto
165	Sporobolus indicus	Crypto
166	Themeda quadrivalvis	Crypto
167	Tipogon bromoides	Crypto
	Marsileaceae	
168	Marsilea quadrifolia	Crypto
169	Hardwickia	Crypto
170	Binata	Crypto
171	Albizia amara	Crypto
172	Tendu	Crypto
173	Ixora parviflora	Crypto
174	Gymnosporea	Crypto

Source: Divisional Forest Office, Vizianagaram, State Forest Department, Andhra Pradesh

3.19 SOCIO-ECONOMIC PROFILE

3.19.1 Introduction

Socio-economic status of the population is the indicator for the development of the region. Any developmental project of any magnitude will have a bearing on the living conditions and the economic of thc population in particular and the region as a whole. Similarly, the industrial development will have its share of socio-economic influence in the study area. This section delineates the overall appraisal of the socially relevant attributes.

The data collection on the impact of industrialization on socio-economic aspects in the study area has been done through analysis of the secondary data available for the study area.

3.19.2 Methodology

The methodology adopted in the assessment of socio-economic condition is given below:

- To evaluate the parameters in the assessment of socio-economic conditions of the population
- Analysis of the identified social attributes like population distribution, sex ratio, literacy rate, occupational structure, availability of public utilities etc, through literature like District Census Handbook, 2003-2004

3.19.3 Sources of Information

As per the scope of the present study, the information on socio-economic aspects has gathered and compiled from various secondary sources like the district census hand book for Vizianagaram district as these documents are comprehensive and authentic. The socio-economic details are briefly described in the following sections.

Vizianagaram district was formed on the 1st of June 1979, with the following talukas, with headquarters being Vizianagaram.

- Srungavarapu Kota, Vizianagaram and part of Bheemunipatnam talukas from Vizag district
- Salur, Bobbili, Parvathipuram and part of Cheepurupalli talukas from Srikakulam district

The above talukas were recognized into 12 talukas. This district is bounded on the east by Srikakulam district, on the southwest by Bay of Bengal and Northwest by the state of Orissa.

3.19.4 Demographic Particulars

Vizianagaram district extends over an area of **6,539 sq.km** with a density of **344** persons per sq.km, covering about **1,551** villages, out of which **66** are uninhabitated. The district can be divided into two distinct natural divisions i.e. plains and hilly regions. The agency area covers Pachipenta, Gummalakshmipuram mandals fully and Saluru, Makkuva, Ramabhadrapuram, Parvathipuram and Komrada partly.

The total population of the district is **22, 49, 254** as per the 2001 census comprising **11,19, 541 males** and **11,29,731 females**. The increase in the population during the decennium ending in 2001 census over the 1991 is **6.55%** for the district as against 26.8 % for the state. Out of the total population of 22, 49, 524, the **SC population** is about **2, 38, 023** and the **ST population** is **2, 14, 839** which comes to around **10.58%** and **9.55%** respectively.

According to the 2001 census, the rural population of the district is **18.37 lakhs** which comes to **82%** of the total population and the urban population is **4.12 lakhs** which is about **18%** of the total population.

The **sex ratio** of the district is about **1009** females per 1000 males.

3.19.5 Land Utilization in the District

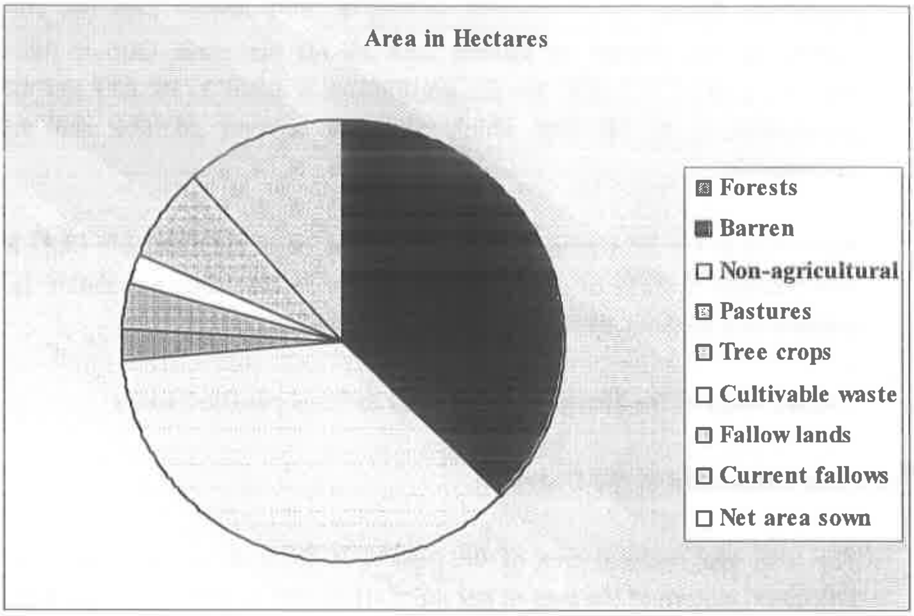
The total geographical area of the district is about 6, 30, 038 Ha. The land utilization pattern of the area as per the 2001 census is given in **Table 3.25**.

Table 3.25
Land Utilization

Classification	Area in Hectares	Percentage to the total area
Forests	1,11,978	17.8
Barren and un-cultivable land	77,753	12.3
Land put to non-agricultural uses	76,172	12.1
Permanent pastures and other grazing lands	4,899	0.8
Miscellaneous tree crops and other groves not included in the net area sown	6,848	1.1
Cultivable waste	4,667	0.7
Other fallow lands	14,731	2.3
Current fallow lands	24,232	3.9
Net area sown	3,08,758	49.0
Total	**6,30,038**	**100**

Source: Directorate of Economics and Statistics, Hyderabad; Chief Planning Officer, Vizianagaram

Figure 3.18
Land-Utilization Pattern



3.19.6 Agriculture

Vizianagaram is predominantly an agricultural district as 68.4% of the workers are engaged in agriculture and about 82% of the population of the district is living in rural areas and depend on agriculture for their livelihood. Rain fed farming is the characteristic of agriculture in the district as about 80% of its area is cultivated purely under rain fed conditions.

Paddy is mainly cultivated during Kharif season with 80% of its area under tank fed conditions which in turn depends on the local rain fall. The major crops grown in the district are Paddy, Mesta, Ground nut, Ragi, Bajra, Cotton, Sugarcane and Pulses. The average yields in the district are low due to the erratic rainfall generally received in the district.

3.19.7 Forests

The total forest area in the district is about 1,11,978 Ha, which constitute 17.8% of the total geographical area of the district. Cashew, Timber, Bamboo, Beedi leaves and fuel plantations are being raised in large extents to increase the forest wealth and to provide gainful employment to the tribals in the region.

3.19.8 Fisheries

There is a coast line of 28 km in the district with 8 main villages and 16 hamlets consisting of 6,933 fishermen population which are situated in Pusapatirega and Bhogapuram mandals.

3.19.9 Minerals

The important minerals that occur in the district are Manganese of high quality in Cheepurupalli, Merkamudidam and Garividi mandals. Ballasts (Kankar), Limestone Manganese and Lime Manganese occurs in Garividi and Merakuddidam mandals and Granite (column) in Parvathipuram and Makkuva mandal.

3.19.10 Industries

Industrial development in the district has been generally agro based viz, the establishment of Jute mills at Nellimarla, Vantibadi, Agraharam and Bobbili. Sugar factories at Latchiyyapeta village of Seethanagaram, Bheemasingi-Kumaram village of Jami mandal. Besides the above major agro-based industries, there are Ferro alloys factories at Shreeramnagar of Garividi mandal and Kothavalasa mandal which are mineral based. Apart from the above, there are resource based industries such as brick and tile making industries around Kothavalasa. There are industrial establishments such as bulk drug and pharmaceutical industries, general engineering, motor workshops, ground nut oil mills, rolling mills, RCC and spun pipes, saw mills and metal manufacturing industries. The industries in the study area are Dr. Reddy's Laboratories, Andhra Organics Ltd, SMS Pharmaceuticals, C.P. Aqua Ltd, Vizianagaram Biotech Ltd, Aurobindo Pharma Ltd

3.19.11 Electrification

There are 1,485 villages in the district and 100% electrification was achieved by 31st March 2004. The total per capita power consumption in the district is about 310.42 MKWH.

3.19.12 Transport and Communication

As on 31st March 2004, the total road length in the district is 4678.856 Km maintained by the National Highways Authority of India (NHAI), R&B and Zilla Parishad together. National Highways NH-5 and NH-43 passes through the district. Out of the above, 33.901 Km is cement concrete, 1719.768 Km is black topped, 1345.310 Km is metalled and 1579.877 Km is unmetalled.

3.19.13 Posts & Telegraphs

Out of the 12 towns and 1485 inhabited villages in the district, 633 villages are having postal facilities. Apart from the head post offices at Vizianagaram, Parvathipuram and Bobbili, 69 sub-post offices and 561 branch post offices are located in different parts of the district.

3.19.14 Medical and Health

There are 12 hospitals including the hospitals for special treatments, 6 dispensaries, 53 primary health centers and 4 MM units in the district. The total number of doctors working in the district is 177. The bed strength is 1008. The beds per lakh population are 45 and the doctors per lakh population are 8.

3.19.15 Education

Vizianagaram district has been comparatively backward in the field of education. The literacy rate is only 51.82% as against the state average of 61.55%.

The village-wise demographic and other socio-economic details are given in the following tables.

Table 3.26
Demographic Pattern in the Study Area

Name	No_HH	TOT_P	TOT_M	TOT_F
Gushini	726	3042	1538	1504
Perapuram	424	1901	961	940
Krishnapuram	105	473	232	241
Laxmipuram	108	591	327	264
Govindapuram	327	1351	679	672
Pathivada	742	3602	1850	1752
Pusapatipalem	146	682	356	326
Pusapatirega	1031	4731	2477	2254
Kumili	1299	5929	2991	2938
Pinatharimi	71	283	137	146
Boppadam	501	2435	1285	1150
Pedatharimi	114	446	219	227

Name	No_HH	TOT_P	TOT_M	TOT_F
Alugolu	889	3997	2084	1913
Vommi	492	2221	1120	1101
Kanimella	227	1238	646	592
Kanimetta	284	1234	634	600
Chinabattivalasa	146	647	335	312
Pedabattivalasa	52	279	151	128
Nellimarla (CT)	4281	19373	9323	10050
Sathivada	619	2955	1499	1456
Atmaramuni Agraharam	239	1071	530	541
Venkannapalem	6	17	10	7
Alladapalem	219	930	470	460
Bharanikam	102	501	239	262
Denkada	1464	6407	3318	3089
Kandivalasa	118	401	184	217
Konada	1928	9202	4674	4528
Saripalle	781	3322	1647	1675
D. Nelivada	50	234	114	120
Jogimpeta	304	1214	592	622
Chittivalasa	229	1018	501	517
Boyapalem	100	510	254	256
Naruva	304	1472	740	732
Akkayapalem	163	664	340	324
Pishini	421	2107	1071	1036
Ranastalam	0	0	0	0
Tirupati Palem	237	1083	569	514
Girivanipalem	104	413	203	210
Sancham	773	3547	1773	1774
Devunipalavalasa	132	518	258	260
Pydibhimavaram	585	2425	1237	1188
Varisam	345	1512	756	756
Chillapetarajam	597	2580	1253	1327
Chintapalle	32	151	79	72
Cheepurapalle	319	1223	606	617
Chodavaram	341	1335	659	676
Thotada	458	1939	971	968

Source: Census of India, 2001

Table 3.27

SC & ST Population in the Study Area

Name	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST
Gushini	377	194	183	51	28	23
Perapuram	153	81	72	5	3	2
Krishnapuram	98	49	49	6	3	3
Laxmipuram	0	0	0	571	313	258
Govindapuram	107	55	52	2	2	0
Pathivada	98	52	46	2	0	2
Pusapatipalem	90	45	45	0	0	0
Pusapatirega	762	423	339	8	3	5
Kumili	666	343	323	7	2	5
Pinatharimi	66	33	33	0	0	0
Boppadam	344	183	161	0	0	0
Pedatharimi	128	62	66	0	0	0
Alugolu	371	195	176	0	0	0
Vommi	357	179	178	0	0	0
Kanimella	118	58	60	0	0	0
Kanimetta	138	73	65	0	0	0
Chinabattivalasa	33	17	16	144	75	69
Pedabattivalasa	0	0	0	2	1	1
Nellimarla (CT)	2300	953	1347	364	171	193
Sathivada	395	221	174	19	11	8
Atmaramuni Agraharam	0	0	0	14	4	10
Venkannapalem	14	8	6	0	0	0
Alladapalem	113	61	52	3	1	2
Bharanikam	0	0	0	0	0	0
Denkada	794	431	363	320	162	158
Kandivalasa	80	38	42	28	11	17
Konada	136	64	72	15	9	6
Saripalle	357	190	167	8	3	5
D. Nelivada	20	16	4	43	22	21
Jogimpeta	158	73	85	5	2	3
Chittivalasa	122	59	63	0	0	0
Boyapalem	0	0	0	0	0	0
Naruva	132	69	63	0	0	0
Akkayapalem	107	53	54	7	3	4
Pishini	50	24	26	0	0	0
Ranastalam	0	0	0	0	0	0
Tirupati Palem	167	90	77	0	0	0

Name	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST
Girivanipalem	0	0	0	0	0	0
Sancham	273	138	135	0	0	0
Devunipalavalasa	269	137	132	0	0	0
Pydibhimavaram	230	108	122	16	9	7
Varisam	340	174	166	1	1	0
Chillapetarajam	79	39	40	13	5	8
Chintapalle	0	0	0	151	79	72
Cheepurapalle	79	33	46	281	144	137
Chodavaram	157	74	83	2	1	1
Thotada	166	79	87	0	0	0

Source: Census of India, 2001

Table 3.28

Literate/ Illiterate Population in the Study Area

Name	P_LIT	M_LIT	F_LIT	P_ILL	M_ILL	F_ILL
Gushini	940	618	322	2102	920	1182
Perapuram	629	369	260	1272	592	680
Krishnapuram	173	97	76	300	135	165
Laxmipuram	238	169	69	353	158	195
Govindapuram	594	350	244	757	329	428
Pathivada	754	490	264	2848	1360	1488
Pusapatipalem	286	188	98	396	168	228
Pusapatirega	2079	1273	806	2652	1204	1448
Kumili	2184	1367	817	3745	1624	2121
Pinatharimi	81	49	32	202	88	114
Boppadam	1064	731	333	1371	554	817
Pedatharimi	151	100	51	295	119	176
Alugolu	1301	916	385	2696	1168	1528
Vommi	703	445	258	1518	675	843
Kanimella	291	198	93	947	448	499
Kanimetta	481	270	211	753	364	389
Chinabattivalasa	199	110	89	448	225	223
Pedabattivalasa	67	41	26	212	110	102
Nellimarla (CT)	11822	6458	5364	7551	2865	4686
Sathivada	889	573	316	2066	926	1140
Atmaramuni Agraharam	399	233	166	672	297	375
Venkannapalem	8	6	2	9	4	5
Alladapalem	403	226	177	527	244	283
Bharanikam	148	76	72	353	163	190

Name	P_LIT	M_LIT	F_LIT	P_ILL	M_ILL	F_ILL
Denkada	4229	2366	1863	2178	952	1226
Kandivalasa	159	89	70	242	95	147
Konada	2414	1463	951	6788	3211	3577
Saripalle	1637	1009	628	1685	638	1047
D. Nelivada	84	54	30	150	60	90
Jogimpeta	438	269	169	776	323	453
Chittivalasa	283	174	109	735	327	408
Boyapalem	171	102	69	339	152	187
Naruva	437	261	176	1035	479	556
Akkayapalem	244	154	90	420	186	234
Pishini	757	510	247	1350	561	789
Ranastalam	0	0	0	0	0	0
Tirupati Palem	391	262	129	692	307	385
Girivanipalem	225	137	88	188	66	122
Sancham	1351	902	449	2196	871	1325
Devunipalavalasa	240	142	98	278	116	162
Pydibhimavaram	1304	757	547	1121	480	641
Varisam	501	302	199	1011	454	557
Chillapetarajam	488	294	194	2092	959	1133
Chintapalle	62	33	29	89	46	43
Cheepurapalle	454	277	177	769	329	440
Chodavaram	660	405	255	675	254	421
Thotada	1058	657	401	881	314	567

Source: Census of India, 2001

Table 3.29 (a)

Work-Force Distribution in the Study Area

Name	TOT_WORK_P	TOT_WORK_M	TOT_WORK_F
Gushini	1916	990	926
Perapuram	1043	595	448
Krishnapuram	314	159	155
Laxmipuram	266	138	128
Govindapuram	776	451	325
Pathivada	1816	1106	710
Pusapatipalem	307	215	92
Pusapatirega	2459	1484	975
Kumili	3163	1805	1358
Pinatharimi	152	91	61
Boppadam	1310	731	579

Name	TOT_WORK_P	TOT_WORK_M	TOT_WORK_F
Pedatharimi	267	138	129
Alugolu	1799	1207	592
Vommi	1249	714	535
Kanimella	906	491	415
Kanimetta	692	395	297
Chinabattivalasa	378	217	161
Pedabattivalasa	177	97	80
Nellimarla (CT)	6427	5025	1402
Sathivada	1519	916	603
Atmaramuni Agraharam	578	333	245
Venkannapalem	11	6	5
Alladapalem	444	289	155
Bharanikam	284	148	136
Denkada	2685	1908	777
Kandivalasa	216	114	102
Konada	4777	2842	1935
Saripalle	1706	988	718
D. Nelivada	140	70	70
Jogimpeta	638	354	284
Chittivalasa	460	303	157
Boyapalem	243	156	87
Naruva	868	443	425
Akkayapalem	472	241	231
Pishini	948	592	356
Ranastalam	0	0	0
Tirupati Palem	569	297	272
Girivanipalem	228	136	92
Sancham	017	1101	916
Devunipalavalasa	310	162	148
Pydibhimavaram	973	745	228
Varisam	830	477	353
Chillapetarajam	1371	763	608
Chintapalle	73	42	31
Cheepurapalle	655	342	313
Chodavaram	708	387	321
Thotada	943	595	348

Source: Census of India, 2001

Table 3.29 (b)
Work-Force Distribution in the Study Area

Name	NON_WORK_P	NON_WORK_M	NON_WORK_F
Gushini	1126	548	578
Perapuram	858	366	492
Krishnapuram	159	73	86
Laxmipuram	325	189	136
Govindapuram	575	228	347
Pathivada	1786	744	1042
Pusapatipalem	375	141	234
Pusapatirega	2272	993	1279
Kumili	2766	1186	1580
Pinatharimi	131	46	85
Boppadam	1125	554	571
Pedatharimi	179	81	98
Alugolu	2198	877	1321
Vommi	972	406	566
Kanimella	332	155	177
Kanimetta	542	239	303
Chinabattivalasa	269	118	151
Pedabattivalasa	102	54	48
Nellimarla (CT)	12946	4298	8648
Sathivada	1436	583	853
Atmaramuni Agraharam	493	197	296
Venkannapalem	6	4	2
Alladapalem	486	181	305
Bharanikam	217	91	126
Denkada	3722	1410	2312
Kandivalasa	185	70	115
Konada	4425	1832	2593
Saripalle	1616	659	957
D. Nelivada	94	44	50
Jogimpeta	576	238	338
Chittivalasa	558	198	360
Boyapalem	267	98	169
Naruva	604	297	307
Akkayapalem	192	99	93
Pishini	1159	479	680
Ranastalam	0	0	0
Tirupati Palem	514	272	242

Name	NON_WORK_P	NON_WORK_M	NON_WORK_F
Girivanipalem	185	67	118
Sancham	1530	672	858
Devunipalavalasa	208	96	112
Pydibhimavaram	1452	492	960
Varisam	682	279	403
Chillapetarajam	1209	490	719
Chintapalle	78	37	41
Cheepurapalle	568	264	304
Chodavaram	627	272	355
Thotada	996	376	620

Source: Census of India, 2001

CHAPTER-IV
IDENTIFICATION AND PREDICTION OF IMPACTS

Chapter-4
Identification and Prediction of Impacts

4.1 IDENTIFICATION OF IMPACTS

Any developmental activity in its wake will bring about some impacts associated with its origin, which can be broadly classified as reversible, irreversible, long and short-term impacts. In this chapter, an endeavor has been made to identify various environmental impacts associated with the plant operation and other activities wherein, there may be a chance of pollution.

Based on the possible worst case emissions and waste generation from the proposed expansion project and also taking into consideration the baseline environmental status at the proposed project site, the environmental factors that are likely to be affected (Impacts) are identified, quantified and assessed. Both instrumental (positive) and detrimental (negative) impacts are accounted for this purpose. The prediction of impacts helps in the preparation of a sound environmental management plan which has to be executed during the on-going activities for the proposed expansion project to minimize the adverse impacts on the environmental quality.

Mathematical models were used to quantitatively describe the cause-effect relationships between the sources of pollution and different components of environment.

4.2 METHODOLOGY

The potential impacts on the environment from Matrix Laboratories Ltd, Unit-8 are identified based on the nature of the various activities associated not only with the project implementation and operation, but also on the current status of the environmental quality at the project site.

4.3 POTENTIAL IMPACTS

All the potential significant environmental impacts associated with the project are grouped as below.

4.3.1 Air Environment

- Impacts on ambient air quality
- Impacts on ambient odor
- Impacts on ambient noise

4.3.2 Water Environment

- Impacts on surface & ground water quality
- Impacts on aquatic life

4.3.3 Land Environment

- Impacts on land use
- Impacts on soil fertility
- Impacts on agriculture
- Impacts on forests and wildlife

4.3.4 Socio Economics

- Impacts on demand-supply
- Impacts on natural resources
- Impacts on industry
- Impacts on infrastructure
- Impacts on employment

4.3.5 Indirect Impacts

- Impacts on public health and safety
- Impacts on cultural resources
- Impacts on ecology and biodiversity
- Impacts on aesthetics

4.4 PREDICTION OF IMPACTS

Prediction of impacts is the most important component in the environmental impact assessment studies. Several scientific techniques and methodologies are available to predict impacts of developmental activities on physico, ecological and socio-economic environments. Such predictions are superimposed over the baseline status of environmental quality to derive the ultimate scenario of environmental conditions. The prediction of impacts helps to prepare the environmental management plan required to be executed during the on-going activities for the project to minimize the adverse impacts on environmental quality.

Mathematical models are the best tools to quantitatively describe the cause-effect relationships between sources of pollution and different components of environment. The mathematical model used for predictions on air quality impact in the present study includes All Terrain Dispersion Models by Trinity Consultants INC, USA. In case of water, land and socio-economic environment, the predictions have been made based on available scientific knowledge and judgments.

The impact assessment is carried out for the following phases and presented in the following paragraphs.

- Impacts during development phase
- Impacts during operation phase

4.4.1 Impacts during Development Phase

The important activities involved during the development phase are:

- Land Acquisition
- Site Development
- Marine out fall system
- Socio economic impacts

The impacts due to above mentioned developmental activities are short term and are limited to the construction phase. The impacts will be mainly on air quality, marine water & sediment quality and socio-economics.

4.4.4.1 Land Acquisition

The proposed expansion is envisaged in the land already available with the plant. No additional land is proposed to be acquired for the proposed expansion. Therefore there will be no re-location or resettlement of the people in the surrounding areas and also no change in land use of this region.

4.4.4.2 Site Development

The current expansion is being proposed in the land already available with the plant and hence no major land development works are expected. The maximum construction labour at the site for small developmental works would be 100-150. Adequate measures are proposed by the management to see that drinking and sanitary facilities are provided for the construction labour.

Vehicular emissions are the major source of air quality impacts. The principal cause of air pollution during the construction phase is the diesel-powered vehicles used in haulage of aggregates, earth and other construction material. In addition, the construction yards are also one of the contributors to air pollution. Air quality could also be affected by dust & particulate matter arising due to site clearing, vehicular emissions, processing & handling of construction materials, construction of road over bridge, effluent treatment plant, common solid waste disposal, laying of onshore effluent conveyance pipeline and other civil structures. Gaseous emissions like Sulphur dioxide, Nitrous oxide, CO and HC might be released from the vehicular movement and also from the stationary sources like compressors, DG sets etc. The air impacts will be experienced only in the immediate vicinity of the construction areas. In the present case since the expansion is being done on the already levelled land the impacts will be negligible. However in any other case the impacts on the air environment could be negated on exercising controls such as sprinkling of water along unpaved roads, provision of acoustic enclosures to construction of machinery, setting up of construction yards away from habitations etc.

Generally the activities, which affect the air environment also, impact the noise environment. The issues related to air pollution during the construction phase also apply to noise pollution.

Runoffs from the construction yards and worker camps are some of the factors, which could affect the water environment. These runoffs if not properly collected, will affect the ecology of the water bodies. Further there might be a possibility of formation of water puddles in low lying areas which can create an environment conducive to disease carrying vectors and also affect the ground water quality. In the current expansion proposal as the sanitation facilities are already available no such impacts are predicted.

4.4.3 Marine Outfall System

The total effluent generated from the plant is around 700 m^3/d comprising of high TDS and Low TDS process effluents along with utilities. The high TDS effluent would be sent to the onsite forced evaporator and low TDS effluent streams along with wastewater from the utilities would be sent to the Effluent Treatment Plant onsite. As stated the total wastewater generation of 700 m^3/d will comprise of two groups of effluents having high TDS with quantity estimated at 138 m^3/d and other effluents with low TDS estimated at 436 m^3/d while the utilities account for 126 m^3/d.

The impacts generally felt on the marine environment during the laying of the outfall will be mainly:

- Changes in Sea Bed
- Marine Water Quality
- Disturbance to Bottom Fauna

Matrix Laboratories Limited, Unit-8 is presently transporting waste water through tankers to the storage tank of the marine outfall. Now since the 11.85 km cross country pipeline is being laid from the plant till Thammayyapalem village (onshore), the treated wastewater would be discharged into the sea through pipeline conveyance followed by marine outfall at the peak flow rate of 30 m^3/hr. The consent letters for the same from the R&B is given at the end of this report. The impacts of the construction of an onshore pipeline are given at the end of the chapter and the management plan is given in chapter-5.

4.4.4 Socio Economics Impacts

The socio-economic impacts during the construction phase could result due to migrant workers, worker camps, induced development etc. Due to the migrant workers there would impact on the existing infrastructure facilities in the surrounding villages such as Gethula Chodavaram. In addition there would be runoffs from the worker camps, which could find their way in to the surface water bodies. The construction phase impacts will be short term only.

4.5 IMPACTS DURING OPERATION

During the operation phase of the proposed expansion there would be impacts on the air environment, water environment, Land environment and socio-economic aspects. The following sections present the impacts during the operation phase.

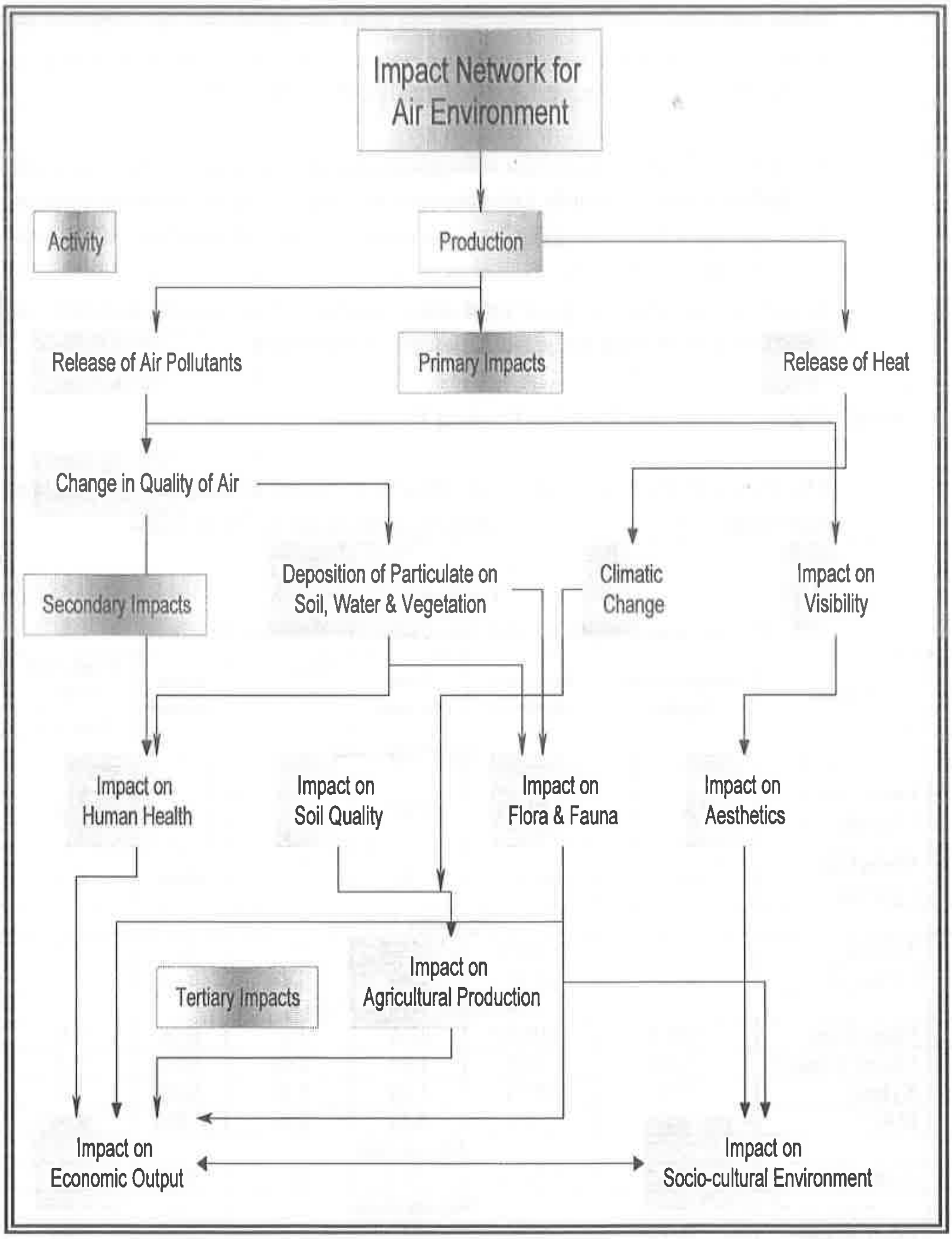
4.5.1 Prediction of Impacts on the Air Environment

Prediction of impacts from the proposed expansion on the ambient air quality was carried out using air quality simulation models. The main sources of pollution envisaged from the plant are:

- Fugitive emissions
- Process emissions
- Boiler emissions

The impact network of various pollutants in air is given as **Figure 4.1** as below.

Figure 4.1
Impact Network for Air Environment



4.5.2 Fugitive Emissions

These emissions will be resulted from the plant operations and are expected due to solvent evaporation losses, fugitive emissions are also generated during the construction and from the utility processes like the boiler, ETP etc.

Though the values predicted (in subsequent chapters) are found to be well within the threshold limits, Matrix Laboratories Ltd, Unit-8 is keen on further reducing the evaporation losses escaping into atmosphere by way of installing chilled water coolant vent condensers for solvent storage tanks to reduce evaporation losses and as well as by adopting good production practices. The fugitive emissions are identified at each stage in the entire process of operations.

4.5.2.1 Fugitive Emissions from the Existing Products

The details of existing products are already discussed in Chapter –I. The stage-wise fugitive emissions from the existing products are given as below.

Table 4.1
Cumulative Fugitive Emissions from the Existing Products

Stage	Solvent	Requirement (kg/day)	Recovery (kg/day)	Loss (kg/day)	Fugitive Emission (Kg/d)	Loss (g/sec)	Predicted WRC (mg/m^3)	TWA (mg/m^3)
	Tiaprofenic Acid							
I	Methylene Chloride	190.46	182.84	7.62	0.23	0.1	1.4	350
II	Methylene Chloride	95.23	91.42	3.81	0.11	0.04	0.7	350
	Naproxen Sodium							
II	Toluene	542.33	526.06	16.27	0.2	0.2	2.9	188
	Methanol	27.12	26.03	1.08	0.02	0.01	0.2	262
	Trazodone Hydrochloride							
III	Chloroform	124.5	119.52	4.98	0.1	0.06	0.9	250.0
IV	Ethoxy Ethanol	25.94	24.9	1.04	0.01	0.01	0.2	5.0
V	Xylene	49.8	48.31	1.49	0.01	0.02	0.3	434
	IPA	8.3	7.97	0.33	0.01	0.004	0.06	981
	Allopurinol							
I	Acetonitrile	121.07	116.23	4.84	0.1	0.06	0.9	67
	Nabumetone							
I	Ethyl Acetate	71.14	58.27	2.32	0.05	0.03	0.42	1440
II	Methanol	118.57	113.83	4.74	0.1	0.06	0.9	262
	Citalopram Hydrobromide							
II	Toluene	90	86.4	3.6	0.02	0.04	0.4	188
III	Toluene	85	81.6	3.4	0.03	0.04	0.6	188
IV	Toluene	240	230.4	9.6	0.1	0.1	1.7	188
V	IPA	16.5	15.84	0.66	0.01	0.01	0.1	981

Stage	Solvent	Requirement (kg/day)	Recovery (kg/day)	Loss (kg/day)	Residue (kg/day)	Fugitive Emission (Kg/day)	Loss (g/sec)	Predicted WRC (mg/m^3)	TWA (mg/m^3)
	Acetone	80	76	3	1	0.09	0.01	0.02	1780
	Flucanozole								
I	Methylene Chloride	72.6	68.24	4.36	0	0.131	0.002	0.02	350
	IPA	33	31.35	1.65	0	0.033	0.0004	0.01	981
II	Ethyl Acetate	13.75	13.06	0.688	0	0.014	0.0002	0.002	1440
	Methylene Chloride	66	62.04	3.96	0	0.119	0.001	0.02	350
	Toluene	4.4	4.22	0.18	0	0.002	0.00002	0.0003	188
	Baclofen								
I	Methanol	41.25	39.18	2.06	0	0.04	0.0005	0.01	262
II	Toluene	33	31.68	1.32	0	0.013	0.0002	0.002	188
III	Toluene	42.9	41.18	1.71	0	0.017	0.0002	0.003	188
	Sulfasalazine								
II	Methanol	41.25	33	8.25	0	-	0.10	1.48	262
	Nefazodone Hydrochloride								
I	Toluene	13.25	12.72	0.53	0	0.0053	0.0001	0.001	188
	IPA	21.03	13.91	5.9	0	0.12	0.001	0.02	981
	Methanol	0.83	0	0	0.83	0	0.01	0	262
II	Toluene	17.89	17.17	0.72	0	0.01	0.0001	0.001	188
IV	Toluene	12.42	11.93	0.5	0	0.005	0.0001	0.001	188
	IPA	19.54	13.25	5.7	0	0.11	0.001	0.02	981
	Midazolam								
I	Methanol	6	5.7	0.3	0	0.01	0.0001	0.001	262
	Toluene	9	8.64	0.36	0	0.0036	0.00004	0.001	188
II	Methylene Chloride	9	8.46	0.54	0	0.0162	0.0002	0.003	350
	Methanol	10.5	9.97	0.52	0	0.01	0.0001	0.002	262
III	Methanol	6	5.7	0.3	0	0.006	0.0001	0.001	262
	Methylene Chloride	14.4	13.53	0.86	0	0.02	0.0003	0.005	350
IV	Toluene	7.5	7.2	0.3	0	0.003	0.00003	0.001	188
V	Toluene	6	5.76	0.24	0	0.0024	0.00003	0.0004	188
	Methylene Chloride	4.5	4.23	0.27	0	0.0081	0.0001	0.001	350

Note: WRC's have been calculated basing on box model and taking the production block dimensions as 45 m× 14 m ×9.2 m and wind velocity as 0.5m/sec.

4.5.2.2 Fugitive Emissions from the Proposed Products

In the present expansion Matrix Laboratories Ltd, Unit-8 is proposing to increase the production capacities of 6 of its existing products and adding 8 new products. The details of the proposed expansion have already been discussed in chapter-I of this report. The cumulative fugitive emissions from the proposed products are given in the **Table 4.2.**

Table 4.2

Cumulative Fugitive Emissions from Proposed Products (After Expansion)

Stage	Solvent	Requirement (kg/day)	Recovery (kg/day)	Total Loss (kg/day)	Fugitive Emissions (kg/day)	Loss (g/sec)	WRC (mg/m^3)	TWA (mg/m^3)
	Tiaprofenic Acid							
I	Methylene Chloride	571.43	548.57	22.86	0.69	0.3	4.1	350
II	Methylene Chloride	285.71	274.29	11.43	0.34	0.1	2.1	350
	Naproxen Sodium							
II	Toluene	7720.93	7489.3	231.63	2.32	2.7	41.6	188
	Methanol	386.05	370.6	15.44	0.31	0.2	2.8	262
	Naproxen Intermediate							
I	Ethylene dichloride	12450	12076.5	373.5	7.5	0.1	1.3	40
	Trazodone HCl							
III	Chloroform	750	720	30	0.6	0.4	5.4	250.0
IV	Ethoxy Ethanol	156.25	150	6.25	01	0.1	1.1	5.0
V	Xylene	300	291	9	0.1	0.1	1.6	434
	IPA	50	48	2	0.04	0.02	0.4	981
	Allopurinol							
I	Acetonitrile	209.86	201.46	8.39	0.2	0.1	1.5	67
	Nabumetone							
I	Ethyl Acetate	128.57	105.3	4.2	0.1	0.1	0.8	1440
II	Methanol	214.29	205.71	8.57	0.2	0.1	1.5	262
	Efavirenz							
I	Toluene	6601.56	6403.52	198.05	1.98	2.3	35.6	188
	Methanol	1875	1781.25	93.75	1.88	1.1	16.9	262
	N-Heptane	875	840	35	0.35	0.4	6.3	2050
	MBTE	234.38	222.66	11.72	0.12	0.1	2.1	1188
II	Ethyl Acetate	1425.78	1368.75	57.03	1.14	0.7	10.3	1440
	Hexane	2539.06	2412.11	126.95	2.54	1.5	22.8	2638
	Abacavir Sulfate							
I	Methanol	671.11	644.27	26.84	0.54	0.3	4.8	262
II	IPA	1333.3	1280	53.33	1.07	0.6	9.6	981
III	Ethanol	900	855	45	0.9	0.5	8.1	1880
	Nelfinavir Mesylate							
I	Toluene	960	931.2	28.8	0.29	0.3	5.2	188
	MiBK	1600	1520.0	80	0.8	0.01	0.14	205
	Indinavir Sulfate							
I	Ethyl Acetate	201.9	193.83	8.08	0.16	0.1	1.5	1440
	IPA	177.62	170.52	7.1	0.14	0.002	0.03	981
	CME Intermediate							
I	Cyclohexane	1709.46	1641.08	68.38	1.37	0.8	12.3	1030

Stage	Solvent	Requirement (kg/day)	Recovery (kg/day)	Total Loss (kg/day)	Fugitive Emissions (kg/day)	Loss (g/sec)	WRC (mg/m^3)	TWA (mg/m^3)
	Dichloro Methane	2229.73	2095.95	133.78	4.01	1.6	24	50
	Citalopram HBr							
II	Toluene	1440	1382.4	57.6	0.34	0.7	6	188
III	Toluene	1360	1305.6	54.4	0.54	0.6	9.8	188
IV	Toluene	108800	104448	54.4	0.54	0.6	9.8	188
V	IPA	264	253.44	10.56	0.21	0.1	1.9	981
	Acetone	1280	1216	64	1.44	0.7	8.6	1780
	Zidovudine							
I	Toluene	4971.57	4772.71	198.86	1.99	2.3	35.7	188
	1,4- Dioxane	13257.52	12727.22	530.3	5.3	6.1	95.3	90
II	Toluene	9469.66	9090.87	378.79	3.79	4.4	68.1	188
IV	Ethyl Acetate	14393.88	13674.19	719.69	14.39	8.3	129.3	1440
	Methanol	16477.21	15653.35	823.86	16.48	9.5	148.1	262
	Gabapantene							
II	N-Butanol	9420.83	9044	376.83	3.77	4.4	67.7	150
III	Ethanol	17733.3	16846.67	886.67	17.73	10.3	159.4	1880
	Ciprofloxacin Hydrochloride							
I	Ethylene dichloride	5187.5	4980	207.5	4.15	2.4	37.3	40
II	Methanol	491.08	474.48	0	0	0	0	262
	Toulene	6484.38	6225	259.38	2.59	3	46.6	188
III	Toulene	3527.5	3386.4	141.1	1.41	1.6	25.4	188
	Methanol	691.67	657.08	34.58	0.69	0.4	6.2	262
IV	N- Butanol	7089.58	6806	283.58	2.84	3.3	50.9	150
VI	Methanol	5014.58	4698.15	316.4	4.95	3.7	44.4	262

Note: WRC's have been calculated taking the production block dimensions as 45 m× 14 m ×9.2 m and wind velocity as 0.5m/sec

4.5.3 Process Emissions

Process emissions from the existing products are CO_2, HCl, H_2 and N_2 and that from the proposed products will be Carbon di oxide, Hydrogen gas, HCl, Ammonia, SO_2, DMA, Nitrogen and oxides of nitrogen. Most of the process emissions are recovered or scrubbed using various scrubbers. Since the uncontrolled process emissions are very minimal prediction of impacts for process gases is not resorted to. The process emissions from both the existing as well as the proposed products are given in **Tables 4.3** and **4.4** respectively.

Table 4.3
Process Emissions from the Existing Products

Product	Stage	Gases Generated	Generation Rate (g/sec) per Kg of product	Emission Rate (g/sec) per Kg of product	Control Equipment
Naproxen Sodium	I	CO_2	0.24	0.24	Vented out
Nabumetone	II	H_2	0.001	0.001	Vented out
Fluconazole	I	HCl	0.012	Traces	Alkali Scrubbers
		CO_2	0.011	0.011	Vented out
		N_2	0.009	0.009	Vented out
Baclofen	IV	CO_2	0.011	0.011	Vented out
Sulfasalazine	I	CO_2	0.036	0.036	Vented out
Nefazodone HCl	II	N_2	0.009	0.009	Vented out
Midazolam	I	HCl	0.003	Traces	Alkali Scrubbers
	III	N_2	0.002	0.002	Vented out

Note-Emission rate calculated based on per kg production of the product

Table 4.4
Process Emissions- Proposed Products

Product	Stage	Gases Generated	Generation Rate (g/sec) per Kg of product	Emission Rate (g/sec) per Kg of product	Control Equipment
Naproxen Sodium	I	CO_2	3.54	3.54	Vented out
Trazadone Hydrochloride	II	HCl	0.48	Traces	Alkali Scrubbers
Abacavir Sulfate	II	HCl	0.16	Traces	Alkali Scrubbers
Nabumetone	II	H_2	0.003	0.003	Vented out
CME Intermediate	I	CO_2	0.82	0.82	Vented out
		HCl	0.61	Traces	Alkali Scrubbers
		NH_3	0.28	Traces	Alkali Scrubbers
	III	SO_2	1.07	1.07	Vented out
Ciprofloxacin	II	H_2	0.16	0.16	Vented out
	I	HCl	38.39	Traces	Alkali Scrubbers
Gabapentene	II	CO_2	4.62	4.62	Vented out
Zidovudine		N_2	4.12	4.12	Vented out
	III	NO	2.95	2.95	Vented out

Note-Emission rate calculated based on per kg production of the product

4.5.4 Boiler Emissions

The major source of emissions to air from the plant, besides process and fugitive emissions are the emissions from the boiler. Matrix Laboratories Ltd, Unit-8 at the Vizianagaram unit have one 5 TPH and a 2 TPH coal fired boiler respectively vide the air consent issued by the AP Pollution Control Board (vide **Order No. APPCB/VSP/VZN/91/HO/2005/A/26 dated 10-05-2005 valid upto 28-02-2006).**

The present coal requirement for the existing 5 TPH boiler is 15 TPD. While the 2 TPH boiler is used for standby purposes only and the maximum requirement of coal for this boiler is 6 TPD. The coal requirement for the boilers is procured from Singareni Collieries Ltd and the transportation is by road. In the proposed expansion, an additional coal fired boilers of 4 and 15 TPH are being added depending on the tonnage of the production and also the steam required for evaporating the high TDS streams. It is quite obvious that the coal requirement will also increase substantially with the increase in the installed capacity which is around 57 TPD.

Particulate matter followed by SO_2 and NO_x are the major emissions from the boiler. To minimize Particulate matter, a multi cyclone exists for both the existing boilers. For the proposed 15 TPH boiler a bag filter or ESP is proposed.

4.5.5 Atmospheric Dispersion of Stack Emissions

Prediction of impacts from air emissions of the proposed expansion is carried out only for boiler emissions since emission from process are of very low volume and have very little potential to show detectable concentrations at any point of measurement.

4.5.5.1 Details of Mathematical Modeling

An attempt has been made to predict impacts of the plant emissions on ambient air quality by means of air quality simulation models. The ultimate step in such an approach is to run the available data through a screening model where a rough computation of the worst case scenario is obtained.

In the present case, computation of 24 hour average ground level concentrations was carried out using All Terrain Dispersion Model (ATDM). ATDM is a Breeze Air product of Trinity Consultants, Texas. The model is based on algorithms contained in two US EPA dispersion models, ISCST2 and COMPLEX1 and also incorporates the procedure used in the POSTIT post processor to calculate concentrations in intermediate terrain.

ATDM is based on Gaussian dispersion which incorporates the Pasquile-Gifford (P-G) dispersion parameter for estimating horizontal cross wind and vertical dispersion.

4.5.5.2 ATDM Model

The All Terrain Dispersion Model (ATDM) is a hybrid Gaussian dispersion model that calculates concentrations from point, area, and volume source emissions in simple, intermediate, and complex terrain.

For receptors located in simple terrain (terrain below stack top) ATDM uses the dispersion algorithms from the ISCST2 model

For receptors located in complex terrain (terrain above plume centerline), ATDM uses the dispersion algorithm from the COMPLEX1 model

For receptors located in intermediate terrain, ATDM uses both the ISCST2 and the COMPLEX1 algorithms to estimate the one hour average concentration at each receptor location and reports the larger of the two values as the calculated concentration

ATDM calculates the plume rise and plume centerline elevation for a given source to determine whether a receptor is located in a simple, complex or intermediate terrain with respect to that source. Depending on the terrain regime of the receptor, the model then uses one of the three approaches described below to calculate the one-hour average concentration at that receptor resulting from the emissions from the source.

a. Simple Terrain

For receptors locating in simple terrain (terrain below stack top), ATDM uses the dispersion algorithms from the ISCST2 model. As in ISCST2, ATDM accounts for the effects of building downwash using the Huber-Synder and Schulman-Scire algorithms, depending on the height of the stack above the building.

User specified terrain stack base elevations are used in the ISCST2 dispersion calculations according to EPA recommended approach for simple terrain. In this approach, final plume rise is calculated to determine the plume centerline elevation above sea level, and this elevation is used for all downwind distances from the stack. Therefore, the plume centerline remains parallel to sea level without regard to changes in the underlying terrain.

b. Complex Terrain

For receptors located in complex terrain (above plume centerline), ATDM uses the dispersion algorithm from the COMPLEX1 model. This algorithm is similar to that of the ISCST2 model in that it uses the same Gaussian dispersion equation and plume rise equations.

c. Intermediate Terrain

A receptor is said to be located in intermediate terrain if its elevation is greater than stack top elevation but less than plume centerline elevation. For such receptors, EPA recommends that both the ISCST2 and COMPLEX1 dispersion algorithms be used to estimate the one hour average concentration at the receptor location and the larger of the two values be used as the calculated concentration. The ATDM POSTIT post processor uses the same approach.

d. Multiple sources

When modeling multiple sources, ATDM sums the calculated one hour average concentrations from each source to estimate the total concentration at a given receptor location. It is possible that the given receptor may be located in simple terrain with respect to one source and complex/intermediate terrain with respect to another source. In this situation ATDM calculates concentrations independently for each source using the correct approach for the particular terrain regime and sums the results. ATDM classifies the receptor as being in intermediate terrain in this situation.

e. Model Output

The output capabilities are the same as the ISCST2 model. The output file may contain the first six highest concentration values at each receptor, maximum concentration tables, and daily concentration tables for each averaging period. A terrain regime indicator appears next to each output concentration value. This flag is used to indicate the terrain regime in which each receptor was located when the concentration value was calculated.

4.5.5.3 Input data for the model

i) Identified Sources

The prediction of impact has been carried out using air quality simulation models. The main sources of pollution envisaged from the proposed expansion are as follows:

- Process Emissions
- Emissions from Utilities – Boilers, DG Set etc.
- Solid Waste Incinerator

a) Process Emissions

The process emissions from the proposed expansion have already been presented in **Table 4.3** of this chapter. Since the quantities envisaged are minimal they have not been considered for prediction of impacts.

b) Emissions from utilities

Matrix Laboratories Ltd, Unit-8 is proposing to add an additional boiler of capacities 4 and 15 TPH to meet the increased demand for the steam following expansion and two DG sets of 1000 KVA each will be added in addition to the existing ones.

Predictions are carried out for the proposed boilers of 4 and 15 TPH capacities and for incinerator emissions. The emissions from the existing boiler are not considered as its impact is already encompassed in the baseline values. The DG sets will only be operated in case of power failures therefore they have not been considered for prediction of impacts.

c) Emissions from Incinerator

Matrix Laboratories Ltd, Unit-8 is proposing to add additional solid waste incinerator of 5000 kg/d and liquid waste incinerator of 1500 kg/d to meet the increased solid waste generation following expansion. The emissions from the incinerator have been shown in table below. The predictions are carried out for 6500 kg/d incinerator. The emissions from the plant are given in the **Table 4.5.**

Table 4.5
Emissions from the Utilities

Source	Height (m)	Dia. (m)	Temp. in ^{O}K	Gas Vel. (m/sec)	Units	SPM	SO_2	NO_x
EXISTING								
2.0 T Coal Fired Boiler	30	0.9	385	6.2	g/sec	2.8	1.74	1.39
5.0 T Coal Fired Boiler	30	1.5	431	7.6	g/sec	1.1	0.69	0.56
Incinerator- 800 Kg/d	40	0.5	373	7.08	g/sec	0.081	0.012	0.048
PROPOSED								
4 TPH coal fired boiler	30	0.9	420	10	g/sec	0.4	1.31	1.11
15 TPH Coal fired boiler	35	1.4	433	15	g/sec	1.7	5.21	4.17
Incinerator – 6500 kg/d	40	1.5	431	8.5	g/sec	0.6	1.74	1.39
Note: Predictions carried out only for proposed units								

b) Receptors Considered

About 3600 receptors have been considered in a 10 km radial zone around the project site. A polar grid with radial interval of 10^0 starting from 0^0 to 360 ^{0} was selected with ring distances on each radial being as given in following table.

Table 4.6
Ring Distances on Each Radial

Origin of polar coordinates							
Radial distance	100	200	300	400	500	600	700
Radial Distance	800	900	1000	1200	1400	1500	1600
Radial Distance	1800	1900	2000	2200	2400	2600	2800
Radial Distance	2900	3000	3200	3400	3500	3600	3800
Radial Distance	4000	4200	4400	4600	4800	5000	5200
Radial Distance	5400	5600	5800	5900	6000	6250	6500
Radial Distance	6750	7000	7250	7500	7750	8000	8250
Radial Distance	8500	8750	9000	9250	9500	9750	10000
Radial Distance	11000	12000	13000	14000	14500	15000	15500
Radial Distance	16000	16500	17000	17500	18000	18500	19000
Radial Distance	19500	20000	21000	22000	23000	24000	25000

c) **Meteorological Data**

For each hour the meteorological information fed into the model included the following:

- Wind speed
- Wind direction
- Ambient temperature
- Stability class
- Mixing heights

For the prediction of rise in ground level concentrations of pollutants, the actual meteorological data recorded at the project site for the study period is used. The meteorological data for this period is herewith provided which was averaged to produce one day (24 readings) met data. The meteorological data is given below in the format desired by IMD.

Table 4.7
Meteorological Data Collected for the Study Period Averaged for a Day

Hour	Wind speed		Predominant Wind Direction	Ambient Air Temperature	Ambient Air Temperature	Humidity	Mixing Height	Stability Class
	Km/hr	m/s	°	°C	°K	%	m	
1	5.0	1.4	45	19.5	292.5	80.5	820	5
2	4.9	1.4	42	18.8	291.8	81.2	900	4
3	5.1	1.4	51	19.2	292.2	80.8	850	4
4	5.1	1.4	355	20.1	293.1	79.9	800	6
5	4.3	1.2	350	20.9	293.9	79.1	920	6
6	4.6	1.3	355	21.4	294.4	78.6	800	5
7	4.8	1.3	225	22.2	295.2	77.8	860	4
8	4.7	1.3	220	23.8	296.8	76.2	920	4
9	4.7	1.3	220	25.1	298.1	74.9	970	3
10	4.6	1.3	45	26.3	299.3	73.7	1140	2
11	5.3	1.5	23	28.0	301.0	72.0	1230	2
12	5.2	1.4	23	29.1	302.1	70.9	1300	2
13	5.6	1.6	28	30.2	303.2	69.8	1470	2
14	7.0	1.9	24	31.8	304.8	68.2	1520	2

Hour	Wind speed		Predominant Wind Direction	Ambient Air Temperature	Ambient Air Temperature	Humidity	Mixing Height	Stability Class
15	4.8	1.3	42	30.8	303.8	69.2	1610	3
16	5.0	1.4	55	29.3	302.3	70.7	1700	3
17	4.7	1.3	50	27.9	300.9	72.1	1600	3
18	4.7	1.3	360	27.1	300.1	72.9	1540	4
19	3.9	1.1	351	25.9	298.9	74.1	1320	5
20	3.0	0.8	44	25.2	298.2	74.8	1240	6
21	3.3	0.9	46	23.2	296.2	76.8	1190	6
22	3.5	1.0	45	21.5	294.5	78.5	1060	4
23	4.3	1.2	40	20.4	293.4	79.6	970	4
24	4.8	1.3	21	19.8	292.8	80.2	820	4

4.5.5.4 Predicted Results

Predictions were carried out as per CPCB guidelines "Assessment of Impact to Air Environment: Guidelines for conducting air quality modeling" for the post monsoon season (15 th September to 15 th December 2005). The predicted results (contribution from the plant) for SPM, SO_2 and NO_X emissions are presented in the following tables and their respective Isopleths have been given as **Figures 4.1-4.3** respectively.

Table 4.8
Maximum Average GLC's

Sources	Pollutant conc - (µg/m^3)			Receptor Grid Position		Maximum contribution at (km)
	SPM	SO_2	NO_X	XR	YR	
Boilers (4 and 15 TPH) and Incinerator (6.5 TPD)	2.09	6.48	5.29	-273.62	-751.75	At 1.02 Km SW

From the above table it can be deciphered that the maximum GLC's were found to lie at a distance of 1.02 km in the predominant downwind direction SW from the plant site. The future predicted concentrations are estimated by super imposing the predicted values over the base line values and presented in table below. Since predicted SPM, SO_2 and NO_x levels in the study area are well within the prescribed statutory limits no major deleterious impacts on the air environment from the project are felt.

Table 4.9
Predicted Increase in Ground Level Concentrations - SPM, SO_2 & NO_X

Pollutant	Baseline Max. Value -($\mu g/m^3$)	Predicted GLC's - ($\mu g/m^3$)	Overall Scenario- ($\mu g/m^3$)
Particulate Matter	280	2.09	282.09
Sulphur dioxide (SO_2)	38	6.48	44.48
Oxides of Nitrogen (NO_X)	41	5.29	46.29

(24 hrly average)

Figure 4.2
Isopleth for SPM

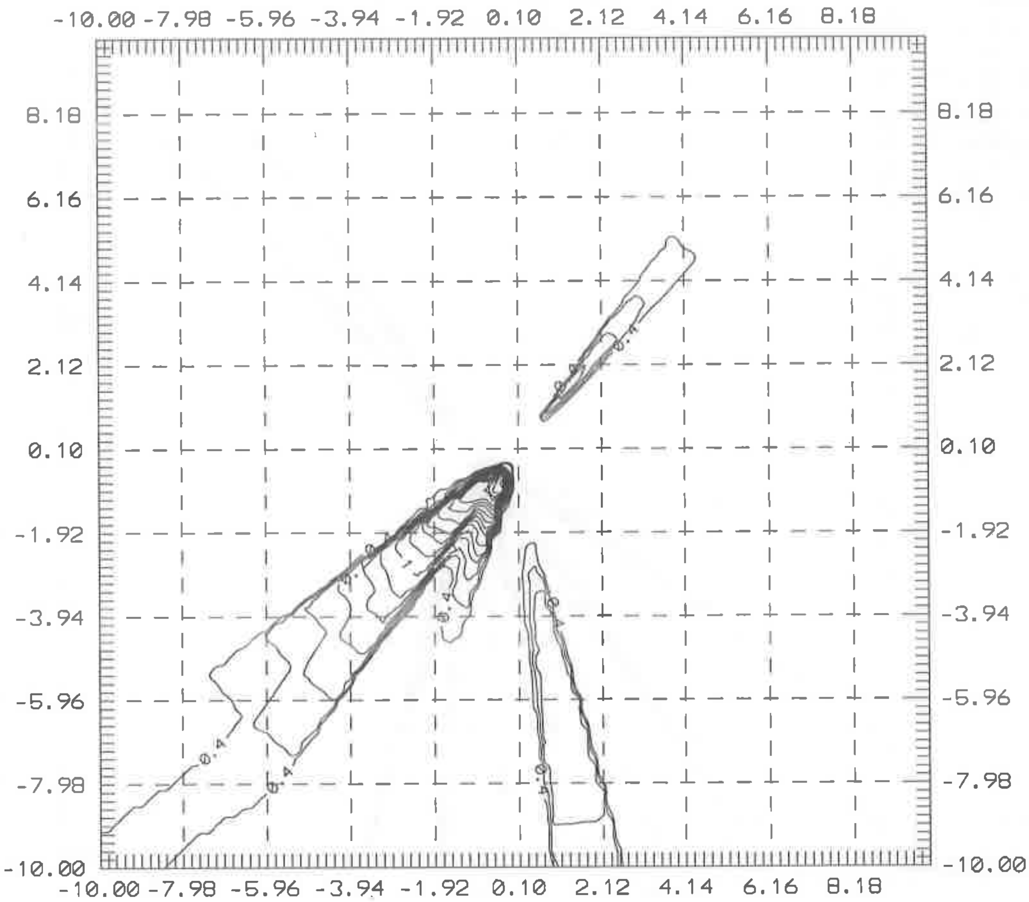


Figure 4.3
Isopleth for SO_2

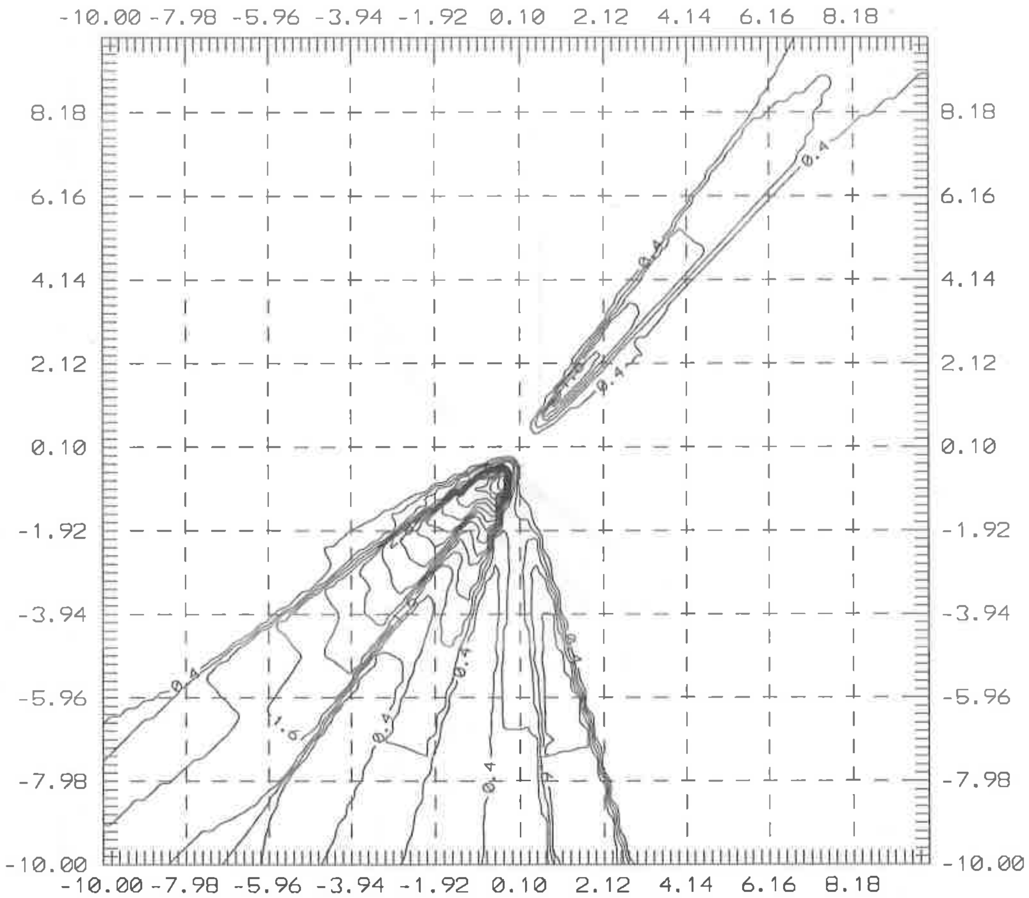
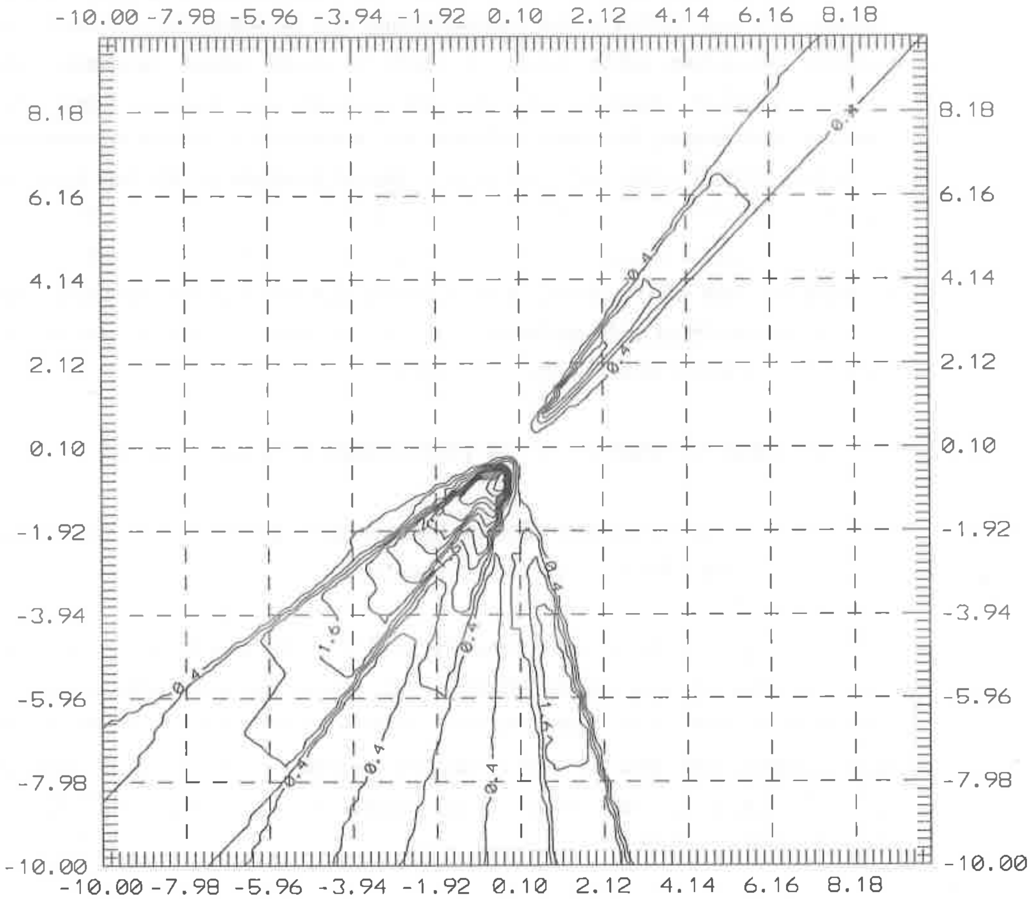


Figure 4.4
Isopleth for NO_X



4.5.5.5 IMPACTS ON AMBIENT ODOUR

It is pertinent to mention that in the present expansion proposal, Matrix Laboratories Ltd, Unit-8 is not manufacturing any products that are likely to generate obnoxious odour which is likely to create odour nuisance. The proposed products manufacture does not generate any odorous gases like chlorine, mercaptans, hydrogen sulphide etc. Ammonia is one of the process gases formed during the manufacture of proposed products which may have an impact on the environment. The discussion on the control and management of gaseous emissions is given in Chapter-5 as environmental management plan. Keeping in view of the above, it is expected that the fugitive emissions are likely to be localized and confined to the plant premises and the impact on the ambient air is minimal with respect to odour.

4.6 PREDICTION OF IMPACTS ON THE NOISE ENVIRONMENT

The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence.

An additional 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. For hemispherical sound wave propagation thorough homogeneous loss free medium, one can estimate noise levels at various locations, due to different sources using model based of first principle as per the following equation:

$$Lp_2 = Lp_1 - 20 \text{ Log } (r_2/r_1) - Ae_{1.2} \quad \ldots (1)$$

Where Lp_1 and Lp_2 are sound pressure levels at points located at distances r_1 and r_2, from the source and $Ae_{1.2}$ is the excess attenuation due to environmental conditions. Combined effect of all the sources can then be determined at various locations by logarithmic addition.

In the first approximation one can assume that for all general population, every noise source in the plant is a point source. The average equivalent sound power level of such a point source can be estimated for different distances and directions from hypothetical source by applying equation:

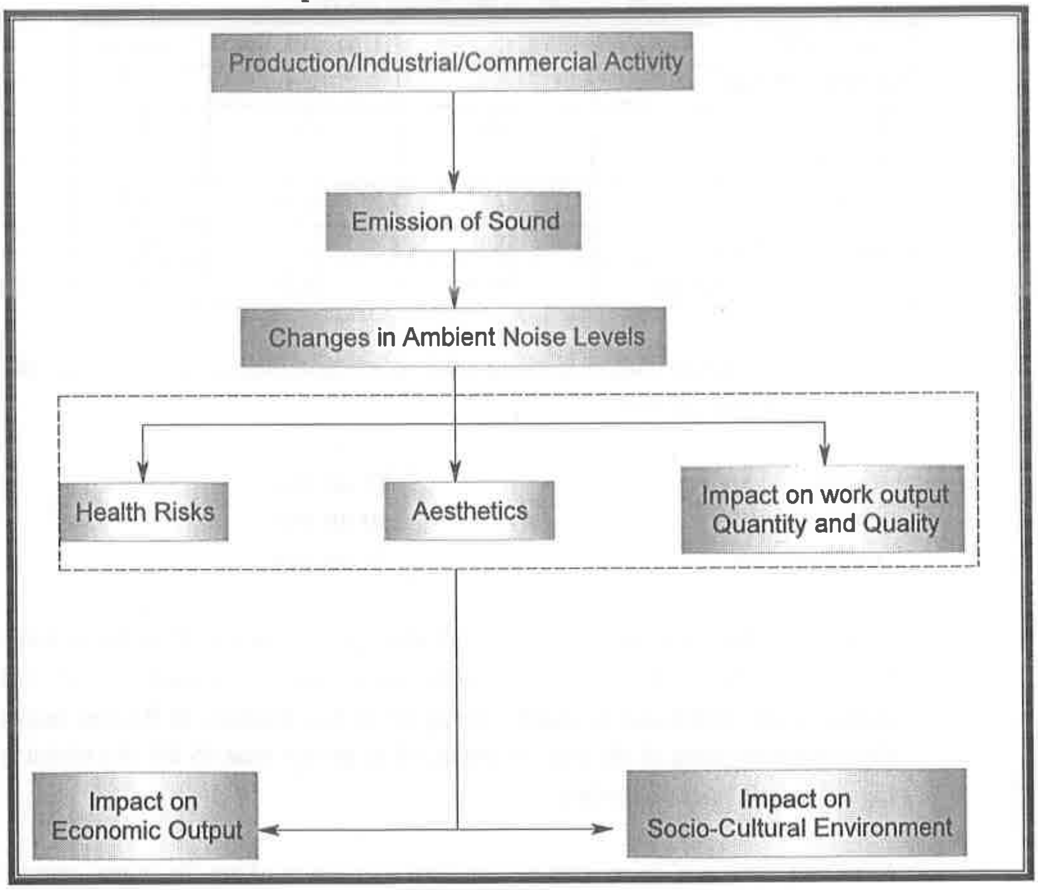
$$L_p = L_w - 20 \text{ Log } r - A_e - 8 \quad \ldots (2)$$

Where L_w is the sound power level of the source, L_p is the sound pressure level at a distance of r and A_e is environmental attenuation factor. A combined noise level L_p(Total) of all the sources at a particulate place is given by:

$$L_p(\text{Total}) = 10 \text{ Log } (10^{(Lp_1/10)} + 10^{(Lp_2/10)} + \ldots\ldots) \quad \ldots\ldots (3)$$

The impact network of various noise sources on the environmental attributes in an industrial area/ environment is given as figure below.

Figure 4.5
Impact Network of Noise Environment



The day-night noise equivalents in the study area was already discussed in the chapter-III i.e. the baseline environmental status of the study area. In the following table, however a mention of the Ldn values are given before proceeding for the modeling of the noise generating sources inside the plant area.

Table 4.10 a
Ldn Values in the Study Area

Location➔	Plant Site	Kanimetta	Pidibhimavaram
Distance ➔Km	-	1.0	3.9
Direction ➔ Hours🡻	-	NNE	NE
Day Equivalent	58.7	53.7	64.3
Night Equivalent	49.2	48.3	58.5
Day Night Equivalent	58.9	55.9	66.1

Table 4.10 b
Ldn Values in the Study Area

Location➔	Perapuram	Kanimella	Narava
Distance ➔Km	3.4	2.8	4.7
Direction ➔ Hours🡻	SW	N	E
Day Equivalent	54.5	56.9	58.0
Night Equivalent	52.4	50.1	51.5
Day Night Equivalent	58.9	58.2	59.5

The important noise sources from and their corresponding noise levels from the proposed project site are:

Boilers	:	85 dB (A)
DG set	:	90 dB (A)
Compressors	:	75 dB (A)

Of these generator is to be used only during power failure. Predictions have been made taking into account the generation from the operations and thus reflecting the worst case scenario. Noise level at a distance of 0.5 km radius after commissioning of the plant is predicted to be less than 45 dB (A) which is well within the plant boundary.

Assuming a 50 m X 50 m grid on the plant site and marking the major sources of noise viz. the DG sets, the compressors and the boilers on the grid a noise model was run. The outcome of the noise model is that the major impacts of the noise from these sources were felt in the immediate vicinity and it was reduced substantially over the entire plot. A 3D plot of the predicted noise levels and the 2D plot of the same is given for reference as Figure 4.6(a) and (b) respectively.

The noise model used was Noise Manager V1 designed by the Industrial Engineering Department, Srindhorn International Institute of Technology, Thammasat University, Thailand. It is a windows based software that calculates the noise levels in the grid considered and plots it graphically using the Microsoft Excel packages of the MS-Office package. This is very user friendly software and is quite popular among the research circles world-wide for its easy applicability.

Figure 4.6 (a)
3D View of the Predicted Noise Levels

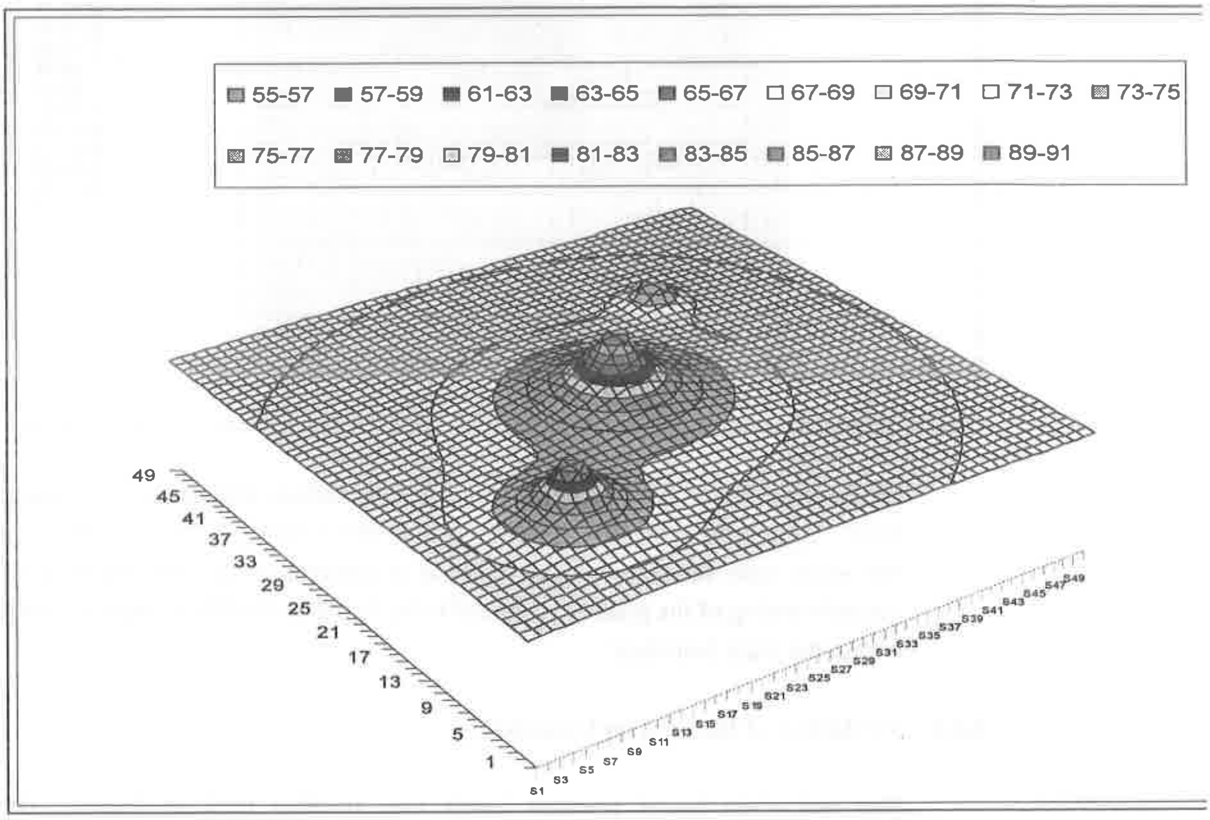
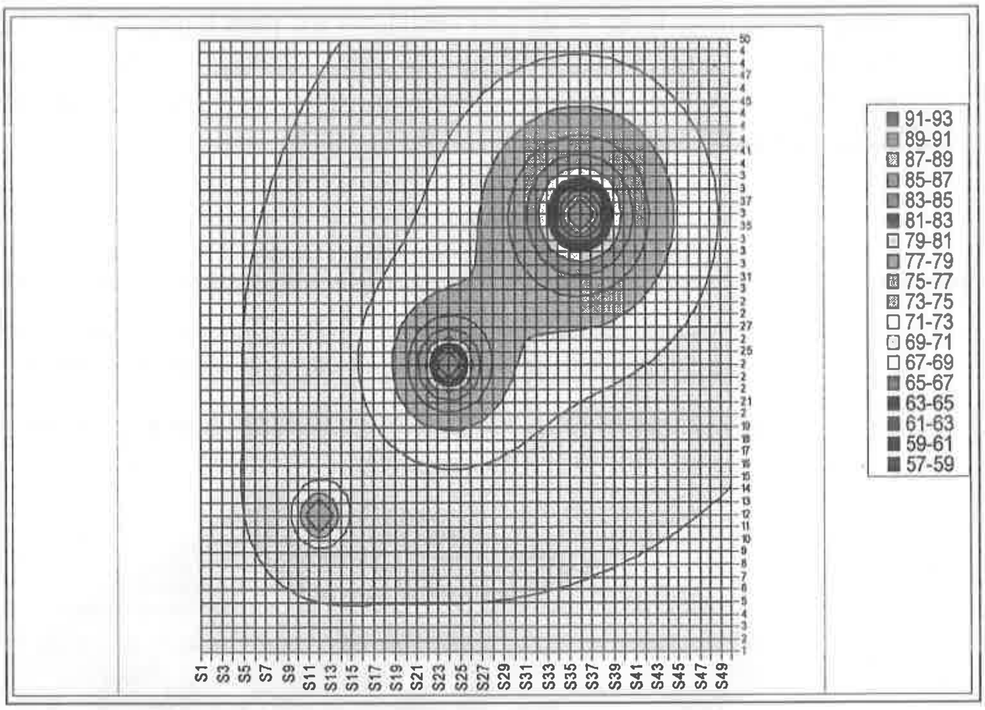


Figure 4.6 (b)
2D View of the Predicted Noise Levels



Of these generator is to be used during power failure. Predictions have been made taking into account the generation from the operations and thus reflecting the worst case scenario. Noise level at a distance of 0.5 km radius after commissioning of the plant is predicted to be less than 55 dB (A) which is well within the plant boundary.

4.6.1 Prediction of Impacts on Community

Day and night sound pressure levels Ldn is often used to describe the community exposure which includes 10 dB (A) night time penalties. The noise levels at a distance of 0.5 Km and above would be less than 55 dB (A). The nearest human settlements are more than 1.5 Kms away from the project site and thus the impacts on general public are predicted to be insignificant.

4.6.2 Prediction of Impact on Occupational Health

The damage risk criteria as enforced by OSHA (Occupational safety and Health Administration) to reduce hearing loss, stipulates that noise level up to 90 dB (A) are acceptable for 8 hrs working shift per day. In the proposed expansion there will be only two sources which will produce high noise levels i.e. generator and boiler. Out of these, the generator will be functioning during power failure only. At these places, continuous attendance of workers is not required and their presence will be only for a few hours. Hence these noise levels may not be of much concern from an occupational health point of view.

4.7 PREDICTION OF IMPACTS ON THE WATER ENVIRONMENT

4.7.1 Water Balance

The water requirement at for maximum production with the existing facilities would be about 183 m^3/day and for the proposed expansion it would be 970 m^3/day for all its purposes including process, floor and reactor washings, boiler, cooling tower, canteen/ domestic requirements. Water requirement for the project is met from the ground water sources within the plant premises and recirculating the water through the processes. Total water requirements for the project operations and wastewater/ effluent generation from the plant are presented in table below.

The impact of the existing plant operations as well as the proposed expansion is explained in detail in this section. But before going into the actual discussion of the impacts, a schematic of the impacts of the plant operations is given as a figure below.

Figure 4.7
Impact Network of the Water Environment

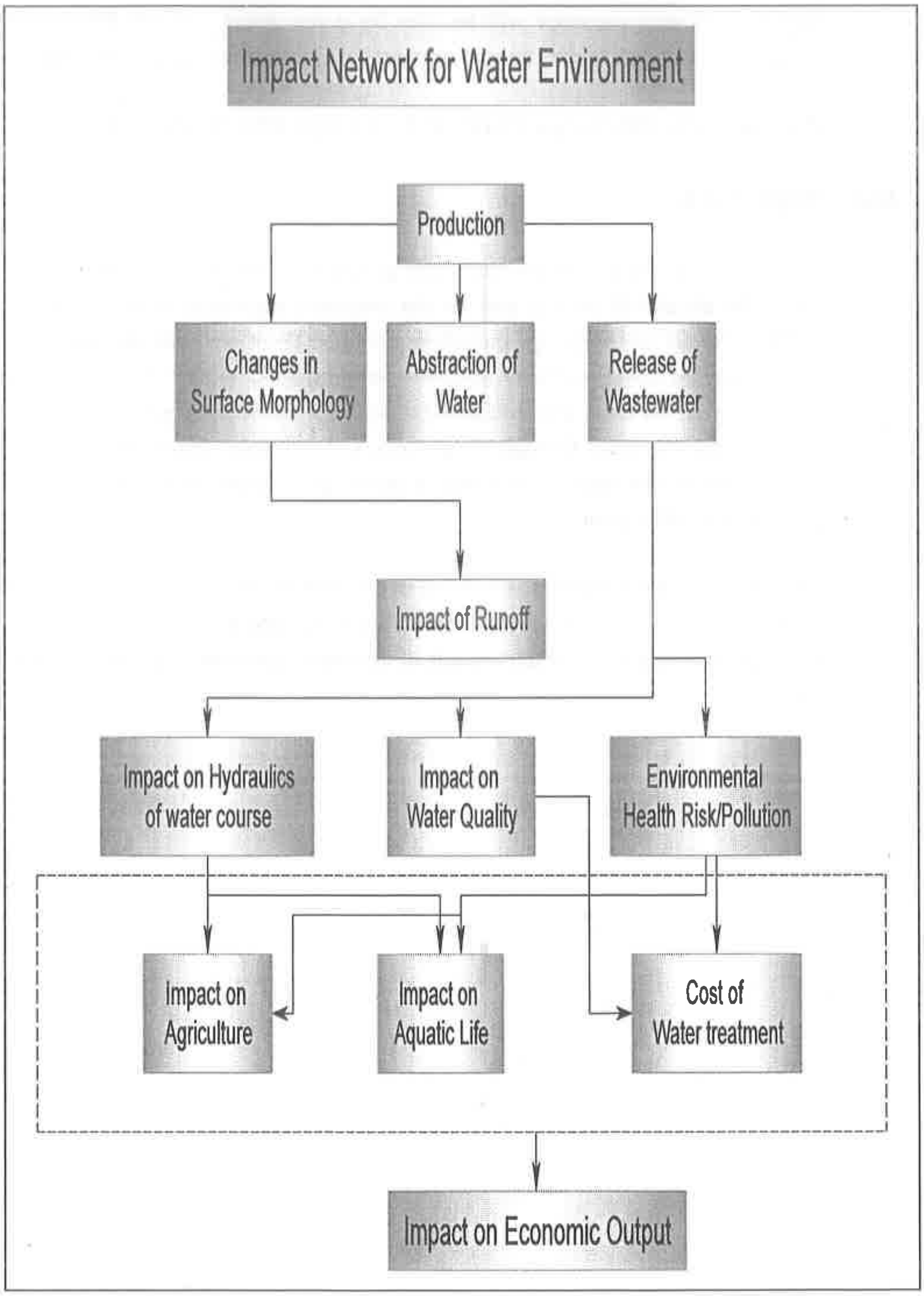


Table 4.11 (a)
Water vis-a- vis Wastewater Generation (m^3/day) - Existing

S. No	Category	Water Requirement	Wastewater generation
1	Process and washings	38.0	35.55
2	Cooling towers make-up/bleed off	75.0	-
3	Boiler feed/blowdown	30.0	-
4	Domestic & others including canteen, toilets, drinking water etc	25.0	20.5
5	Gardening/ Horticulture	15.0	-
	Total	**183.00**	**56.05**

Table 4.11 (b)
Water Requirement vis- a- vis Wastewater Generation (m^3/day)
(After Expansion)

S. No	Category	Water Requirement	Wastewater generation
1	Process & washings	561.0	574.0
2	Cooling towers make-up/bleed off	124.0	15.5
3	Boiler feed/blowdown	175.0	15.5
4	Softener regeneration	30.0	30.0
5	DM Plant regeneration	30.0	30.0
6	Domestic & others including canteen, toilets, drinking water etc	35.0	35.0
7	Gardening/ Horticulture	15.0	-
	Total	**970.00**	**700.00**

The pollution loads viz., TDS-Inorganic (Fixed solids), TDS-Organic (Volatile solids), COD for individual products are worked out based on material balance and the details of the same are furnished for the proposed products in the following tables.

Table 4.11 (c)
Water Requirement (m^3/day)

S. No	Category	Existing	Proposed	Total
1	Process and washings	38.0	523	561
2	Cooling towers make-up/bleed off	75.0	49	124
3	Boiler feed/blow down	30.0	145	175
4	Softener regeneration	-	30	30
5	DM Plant Regeneration	-	30	30
4	Domestic & others including canteen, toilets, drinking water etc	25.0	10	25 35
5	Gardening/ Horticulture	15.0	-	15
	Total	**183.0**	**787**	**970**

Table 4.11 (d)
Wastewater Generation (m^3/day)

S. No	Category	Existing	Proposed	Total
1	Process and washings	35.55	538.45	574
2	Cooling towers make-up/bleed off	-	15.5	15.5
3	Boiler feed/blowdown	-	15.5	15.5
4	Softener regeneration	-	30	30
5	DM Plant Regeneration	-	30	30
4	Domestic & others including canteen, toilets, drinking water etc	20.5	4.5	25
5	Gardening/ Horticulture	-	-	-
	Total	**56.05**	**643.95**	**700**

Table 4.12

Characteristics of Effluents Product Wise - Existing

S.No	Name of the product	Effluent generation (l/d)		TDS (mg/l)	COD (mg/l)	BOD (mg/l)
		High TDS	Low TDS			
1	Tiaprofenic acid	190	475	12290	5000	1740
2	Naproxen/Naproxen Sodium	2605	8194	21830	9550	3600
3	Trazadone HCl	416	276	10870	3530	1920
4	Allopurinol	533	13980	8150	2400	760
5	Fluconazole	36	306	29240	8950	3150
6	Baclofen	215	243	16070	7080	2200
7	Sulfasalazine	271	-	-	-	-
8	Citalopram HBr	83	138	15950	5850	2040
9	Nefazodone HCl	82	91	4640	1260	390
10	Nabumetone	-	1000	12460	1260	390
11	Midazolam (Lab scale)	33	73	3380	860	340

Table 4.13

Characteristics of Effluents Product Wise –After Expansion

S.No	Products	Wastewater	Fixed solids	Organics	Total COD
		Liters/day	mg/l	mg/l	mg/l
1	Tiaprofenic acid	2021.9	58558.4	0	0
2	Naproxen Sodium	154138	37442.1	4251.8	3991.4
3	Trazodone Hydrochloride	4156.6	50104.1	49785.3	109605
4	Allopurinol	25236.9	8080.01	2291.9	6050.7
5	Nabumetone	1802.4	0	11877.3	16215.9
6	Efavirenz	53183.3	4337.9	8828.6	8189.1
7	Abacavir Sulfate	3208.6	7407.2	0	0
8	Nelfinavir Mesylate	5560	2466.2	8561.2	40239.4
9	Indinavir Sulfate	3085.4	27250	46317.1	118017
10	CME Intermediate	20943.3	13097.3	71654.5	147001.1
11	Citalporam Hydrobromide	11042.4	106609	27972.2	54826.6
12	Gabapentene	20190.6	402301	29672.7	65356.4
13	Ciprofloxacin Hydrochloride	97720.3	31439.9	22139.4	34897
14	Zidovudine	130502	25088.9	29488.5	71262
15	Naparoxen intemedidate	41500	24389	16500	28693.5
	Total	574291	41071.3	18643.5	36881.2

4.7.2 Predicted Impacts on Water Quality

4.7.2.1 Water withdrawal impacts

The major source of raw water supply to the plant operations is from the bore-wells present within the plant premises. The water present is sufficient to meet not only the present needs but also the future needs of the plant. Therefore no major water withdrawal impact is envisaged. As described in the Chapter-3 and subsequent studies carried out by regulatory authorities, it was observed that the ground water in the area, especially in the plant site was found to be of satisfactory yields. But in order to establish a practice of resource conservation and recovery, Matrix Laboratories Ltd, Unit-8 is planning to recycle and reuse as much as water as possible for its utilities and process operations. Also, to increase the water recharging in the plant premises, Matrix Laboratories Ltd, Unit-8 has constructed artificial recharge pits along the boundary wall. A detailed report for the yields and the quality is given at the end of the report.

4.7.2.2 Impacts on Aquatic Life

The combined effluent of about 700 m^3/d will be treated at onsite ETP and later discharged into the sea via a marine outfall at 30 m^3/hour peak flow rate after complying with the stipulated regulatory guidelines. The location of the outfall point has been identified by National Institute of Oceanography after conducting baseline sea bed surveys. Matrix Laboratories Ltd, Unit-8 has obtained a clearance to construct a pipeline to discharge the treated effluents from the R&B authorities. A copy of the letter is given at the end of the report. The outfall point is so designed that the required number of dilutions are achieved at the discharge end of the outfall point so that there is little or no impact on the marine environment. Moreover it would be ensured by the management that the treated wastewater quality meets the marine discharge standards as per GSR 422E. Therefore it can be said that due to the treated water discharges into the marine environment no perceivable impacts are felt on the aquatic life. The analysis of the impacts of the marine outfall on the marine environment is given at the end of the Chapter.

4.7.2.3 Impact on Ground water Quality

No impacts on the ground water quality are envisaged because the industry will be treating the effluent at onsite ETP and finally disposes off all the treated effluent into the sea via a marine outfall. There are no discharges on land practised. Coming to solid waste another source of ground water pollution inorganic sludge generated is presently being sent to the Common Hazardous

Waste Treatment, Storage and Disposal Facility at Hyderabad. The same practice would be continued for the proposed expansion also i.e. sending the waste to HWMP or the nearest CHWTSDF which is proposed. The industry will design the storage facilities and primary treatment tanks with impervious bottom. If any spillages are occurred it will washed and collected and sent to effluent collection tank. The effluent treatment plant is explained in detail in the subsequent chapters with flow diagrams and schematics. In view of the above measures taken no negative impacts are envisaged on the ground water quality.

4.8 PREDICTION OF IMPACTS ON LAND ENVIRONMENT

Environmental Impacts on land environment have been classified primarily into 2 broad aspects, i.e. direct impacts on the soil and land in the area and impacts on the flora and fauna of the area. Land environment in the area has potential for contamination due to wastewater discharges directly on to the land and from impacts arising out of solid waste discharge on to the land.

Solid wastes from the proposed bulk drug expansion includes organic residue, hy-flow and carbon from the process reactions, metallic constituents added as catalysts, the sludge from the effluent treatment plant and forced evaporator salts.

The various sources of waste along with the quantity generated before and after expansion is presented in the table below.

Table 4.14 (a)

Solid Waste Generation – TPD

Source	Quantity (TPD)		
	Existing	After Expansion	Remarks
Forced evaporator salts	-	15.1	Sent to CHWTSDF
ETP sludge	0.09	8.6	
Inorganic wastes	-	0.63	
Incinerator ash	0.004	0.12	
Spent carbon	0.02	0.56	
Total	**0.11**	**25.01**	
Fly ash	8.4	31.2	Sold to local Brick Manufacturers

Note: The fly ash from the existing facilties is found to be 8 TPD and that from the proposed expansion will be 31.2 TPD. The fly ash has not been considered for the calculating the solid waste as it will be sold to the local brick manufacturers.

Table 4.14 (b)
Solid Waste Generation- TPD

Source	Quantity (TPD)		Remarks as per HW (M&H) Rules, 2003	Mode of Disposal
	Existing	After Expansion		
Forced evaporator salts	-	15.1	34.3 of Schedule-1	Sent to CHWTSDF
ETP sludge	0.09	8.6	34.3 of Schedule-1	
Inorganic wastes	-	0.63	34.3 of Schedule-1	
Incinerator ash	0.004	0.12	36.2 of Schedule-1	
Spent carbon	0.02	0.56	36.4 of Schedule-1	
Fly ash	8.4	31.2	Inert	Sold to local Brick Manufacturers
Total	**0.11**	**25.01**		

Significant solid waste generation from the bulk drug manufacturing unit in the existing form and after the expansion is from the boiler fly ash which is due to the usage of coal as the boiler fuel. The fly ash generated shall be disposed to the local brick manufacturers and the characterization of the fly ash is inert in nature.

In addition to the above, inert boiler ash is expected to be generated in the process of boiler operations when coal is used as the fuel; about 8.4 TPD generated from the existing facilities is sold to local brick manufacturing units. After the proposed expansion an increase of about 22.8 TPD of fly ash is anticipated due to the additional 4 and 15 TPH boilers being installed in addition to the existing boilers of 5 and 2 TPH capacities. However, it is to be noted that this waste is inert in nature and has no potential to damage the land environment.

The organic residue from the plant operations with the existing products and the proposed products is proposed to be sent to the incinerator. At present there is an 800 Kg/day solid waste incinerator installed to cater to the needs of the plant operations. In the proposed expansion, Matrix Laboratories Ltd, Unit-8 is proposing to add another solid waste incinerator of 5000 kg/d and liquid waste incinerator of 1500 Kg/d, or the wastes will be sent to the nearest common incinerator being planned at Parawada which ever comes up first. It is also being proposed to recover material of any commercial significance by sending it to authorized parties and the remaining part to incineration, the details of which are explained in the subsequent chapters.

The plant does not discharge any wastewater on to the ground. The treated water from the ETP is disposed off into the sea via a marine outfall. As a result of this there is no contamination of the soil due to the wastewater generated and hence the impacts due to the proposed expansion on the land environment are found to be negligible. To address the impacts on flora and fauna, it has been observed that there are no endangered species in the project area. Therefore there should not be any concern for the loss of important germplasm that needs conservation.

4.9 IMPACTS ON THE COMMUNITY

4.9.1 Public Safety

A number of activities that are likely to be carried out in the bulk drug manufacturing unit that have significant adverse impacts on the public safety are the stack emissions, and wastewater discharges. With the implementation of a strong environmental management plan, the communities residing near the plant site are unlikely to be exposed to any long-term hazards.

4.9.2 Aesthetics

Industrial buildings, boiler stack and the wastewater treatment plant do not present an aesthetic appeal to any surroundings. However, the project site is located away from the settlements and proposed greenbelt around the factory site, as a part of the environmental management plan, may help in improving the aesthetics of the environment.

4.9.3 Impact on Ecology

There are no wildlife sanctuaries located within 10 Km radius of the plant site. There are no known rare, endangered or ecologically significant animal and plant species. Except for a few wild species of plants and grasses and a few animals that are very commonly spotted in any rural environment, the study area does not have any endangered or endemic species of animals.

4.9.4 Impact on the Socio-Economics

The proposed expansion in the existing bulk drug manufacturing industry is likely to provide direct and indirect employment to about 200 people including the technical and non technical workers like contract labor employed during the construction phase and operation phase. The expansion is likely to increase the socio-economic status of the villages in the study area especially that of G.Chodavaram where the plant is being located. Due to proposed project the facilities for public transport, water supply telecommunications, education, public wealth, etc are likely to improve.

4.9.5 Impacts due to the Construction of the Pipeline

Matrix Laboratories Ltd, Unit-8 is planning to construct a 11 Km pipeline from the plant to Thammayyapalem village to discharge the effluents into the sea. The impact due to the construction of the pipeline is studied under three heads viz.

- Impacts on the Fishing Community & the Surrounding Places
- Impacts on the land environment
- Impacts on the marine environment

4.9.5.1 Impacts on the Fishing Community & Surrounding Areas

Matrix Laboratories Ltd, Unit-8 is proposing to construct a marine outfall 11 Km on land at Thammayyapalem village and 1.4 Km under the sea at 4m below the surface of the water. The most likely impacts due to the discharge of effluents are felt on the fish catch, planktonic count, sediment structure and composition. As per the studies carried out at selected locations for the construction of a marine outfall for Matrix Laboratories ltd, Unit-8, the following observations were given

a) Fish Catch

Based on the fish landings (specie content and weight), it is concluded that the waters in and around the marine outfall area seem to support a great wealth of fish life. The taxa (16 species) represented by 10 diverse groups from this area is suggestive of the fact that no impediment as a result of the effluent discharge by the industry.

No major changes in the landing grounds and fish is anticipated due to the construction of the marine outfall as the effluent is discharged after reducing the BOD, COD and TDS levels as per the designated norms for marine disposal. Since the outfall is 1.4 Km into the sea at a depth of 4 m, there is every chance of the effluent being diffused and diluted before it can have any impact on the marine environment.

b) Phytoplankton

Based on the findings, it is concluded that the sea water and the bottom sediments examined from near the outfall of the above industry contains normal microbial life and there appeared to be no adverse effect of the effluent on the composition and the abundance of the bacterial flora. However, the presence of relatively high bacterial counts in the water in the central sector (outfall area) relative to either north or south sectors appears to suggest their preference to that area. In the sediments there is no such clear increase in the bacterial count.

c) Zooplankton

Zooplanktons were abundant in the marine outfall area. A very interesting fact was the presence of fish eggs which indicates the representation of normal, good sea water conditions.

d) Benthos

No significant differences in index values between the North, South and Central locations could be observed. However, taking into account the overall composition of the fauna and the numerical abundance, there seems no immediate concern for life in the sea-bed in this location. All the observations nevertheless suggest that the diversity index could still be high though values on the other hand are close to the normal conditions.

e) Surrounding Places

It is pertinent to mention that there is a place of tourist importance at Chintapalli, which is a coastal village near to the discharge point. It was observed that there shall be no adverse impacts on Chintapalli beach due to the discharge of effluents as the effluents are likely to get diffused and diluted before they are likely to show any deleterious impacts on the marine/ coastal environment. However, care shall be taken to prevent any impacts by adhering to the disposal standards laid down by the CPCB as per the GSR 422 (e) regulations.

4.9.5.2 Impacts on the Land Environment

Due to the construction of a cross country pipeline, the most likely impacts are disturbances to the status quo of the soil. In order to minimize the impacts due to the construction of the pipeline, Matrix Laboratories Ltd, Unit-8 has sought permission from the R&B Department, Government of Andhra Pradesh to lay a pipeline following the road alignment. This would reduce the impacts on the land environment. Due care shall be taken during the laying of the pipes that there shall be no leakages in the course of discharge from the industry.

As on date Matrix Laboratories Ltd, Unit-8 is sending the treated effluent to the outfall by tankers. In the present proposal, Matrix Laboratories Ltd, Unit-8, is constructing a cross country pipeline from the plant to Thammayyapalem on land. The pipeline is laid at a depth of 1 m from the soil surface. The mode of transport of the effluent from the plant to the outfall is by gravity.

No private land is acquired during the construction of the pipeline.

Matrix laboratories Limited, Unit-8 is presently transporting waste water through tankers to the storage tank of the marine outfall. Now since the 11 km cross country pipeline is being laid from the plant till Thammayyapalem village (onshore), the treated wastewater would be discharged into the sea through pipeline conveyance followed by marine outfall at the peak flow rate of $30m^3/hr$. The consent letters for the same from the R&B is given at the end of this report. Therefore the impacts due to laying of the marine outfall have not been considered in the present scenario.

The details of the proposed pipeline are as follows:

Project Description:	A marine outfall project consisting of two components: a marine pipeline discharging industrial and domestic effluent 1400 m away from the coastline in 17 m water depth; an onshore pretreatment plant, where the effluent is screened to ensure that all particles in excess of 0.5mm are taken out of the effluent stream.
Location:	Thammayyapalem
Name of Client:	Matrix Laboratories Ltd, Unit-8
Capital Cost:	INR 1.0 Crores

a) Project Description

The ocean outfall pipeline has a total length of 1400 m consisting of a diffuser with a length of 300 m and a main pipeline of 1100 m. The effluent is discharged through multi-diffuser ports in 17m water depth. The pipeline diameter is 110 mm.

The onshore pretreatment plant will house the various control functions for the operation of the pipeline like valves, a balancing tank, effluent flow meter etc. The effluent will be pre-treated by means of milli-screens to take out all particles in excess of 0.5mm. The pre-treatment plant will also have the facility whereby primary treatment of the effluent can be added at a later stage, when considered necessary. All of the above-mentioned facilities will be housed in one closed off building, close to the shore, with adequate odour control facilities.

b) Summary

Matrix laboratories limited is presently transporting waste water through tankers to the storage tank of the marine outfall. There are presently two outlets that discharge effluent to the marine environment at the point of discharge. Matrix Laboratories Ltd, Unit-8 discharges treated industrial effluents generated on account of the plant operations. In addition to the industrial effluents, domestic sewage sludge from domestic activities is pumped to this surf zone outlet as well.

A long and detailed study has been conducted as part of obtaining regulatory approvals from the concerned authorities. In this connection, Matrix Laboratories Ltd, Unit-8 has carried out a detailed marine study and a effluent toxicology assay done through the Andhra University at Visakhapatnam which is given at the end of this chapter. The studies concentrated on two main options, a marine discharge option and a full land based treatment facility where the effluent is treated to general standards and the treated effluent discharged into the surf zone, through a short pipeline.

A detailed assessment was undertaken for both options, which included extensive public participation. The study concluded that there are no major environmental risks to the environment posed by either of these two options, while the marine outfall was significantly more cost effective.

Matrix Laboratories Ltd, Unit-8 decided to proceed with the marine outfall option for the disposal of the treated effluent after complying with the marine disposal standards as designated in the GSR 422 (e). The marine outfall project consists of two components:

- A marine pipeline discharging the effluent 1400 m away from the coastline in 17 m water depth.
- An onshore pretreatment plant, where the effluent is screened to ensure that all particles in excess of 0.5mm are taken out of the effluent stream.

c) Reticulation System

Matrix Laboratories Ltd, Unit-8 intends extending the effluent treatment plant after the proposed expansion into the marine disposal system near Thammayyapalem from the plant by taking a maximum advantage of the change in the slope/ gradient from the plant to the disposal point (about 59 m from the MSL) and the extent of the areas that can be drained by gravity to the proposed marine pipeline near Thammayyapalem.

Matrix Laboratories Ltd, Unit-8 intends to construct a 110 mm inverted siphon from the plant following the alignment of the existing road and a gravity sewer, in order to transfer the waste waters from Thammayyapalem to the outfall. The existing interceptor/ pump house and the disposal pipeline will be connected to the gravity sewer.

The wastewater flow through the inverted siphon will be low during the early stages of development, and will not provide self-cleaning velocities. In order to overcome this problem it is intended to supplement the wastewater flow by adding seawater at the disposal point.

Seawater will be pumped at a rate of about 20 l /sec to an "off-line" reinforced concrete reservoir at Thammayyapalem, and will be used to flush the system approximately once every four hours. Each flush will clear approximately one third of the inverted siphon, so that the contents of the inverted siphon will be cleared at least twice a day. As the wastewater flow increases the quantity of seawater used for flushing will be decreased. In the coming years it should no longer be necessary to add seawater to the system.

There will be high concentrations of dissolved solids in the waste waters. Pipes and materials will be selected to withstand the corrosive conditions that may arise in the different parts of the system.

d) Construction Considerations

The detailed designs of the marine outfall, as well as the pipeline material and construction method have not been finalized yet. However, the initial investigations indicate that the pipeline material will most probably be high density polyethylene (HDPE) and that the construction method will be a float-tow-sink operation.

Different 13m length sections of HDPE pipe will be welded together into longer lengths (say 100m to 200m lengths) with flange connections at each end, and with suitable weighting added to the section. The assembly yard where this take place, will be located inside the Thammayyapalem village or near the plant site whichever is convenient. The sections will be floated, towed out to sea and placed on the prepared seabed during favorable sea conditions. In this way, the programming of events can be such that the actual construction period is minimized and maximum advantage is taken of acceptable sea conditions. Vertebra armour for the exterior protection of about 200 m is also being provided for this facility.

The crossing of the surf zone at the location of the sea outfall requires special attention. The shoreline is a bit rocky with no open gullies in which a pipeline can be placed and protected. It is proposed to lay the pipe through the surf zone in a trench excavated in the rock. The trench typically would be 1.5m wide and 2.0m deep, with an even fall seaward. Afterwards, the trench would be backfilled with concrete. Moreover, RCC ballasts of 270 X 260 X 150 mm are being provided to support this structure on the water surface.

Detailed, near shore and offshore geophysical investigation has recently been completed determining water depths and sediment thickness at the Thammayyapalem area. An outfall route has been selected along a sandy corridor for the full length of the offshore outfall. The outfall will as far as possible be positioned perpendicular to the incoming waves in order to reduce wave forces on the outfall. The near shore section of the pipeline to a water depth of approximately 17 m will be buried beneath the seabed to a depth of about 1.5 to 2.0m. Thereafter the pipeline will be placed on top of the seabed. Along the whole length the outfall will be stabilized by means of concrete anchor weights.

e) Environmental Assessment

The EIA process which has been applied is based on the key principles of integrated environmental management, which are promoted by the Ministry of

Environment & Forests. Public consultation and communication with all key authorities formed an important component of the EIA.

On the basis of the findings made during this study, it was concluded that the coastal waters and the sediments opposite where the outfall of M/s Matrix Laboratories is situated, are free from any ill effects of the waste discharges. This was proved through the presence of normal phytoplankton species, microbial flora, zooplankton populations and the benthos communities. Data on the fisheries is similarly suggestive unimpeded conditions. Static toxicity (bioassay) test and Shrimp larvae have shown that the effluent can be considered non-toxic as the survival is 95 to 96% survival of post larvae at 10% concentration of the effluent which is in conformity with APPCB regulations.

It is concluded from the EIA that both the proposed effluent treatment options would be acceptable in terms of meeting the current legal requirements of the regulatory authorities. There are not major environmental risks to the marine or terrestrial environment posed by the construction and operation of either of the proposed effluent treatment and discharge project options. Both the proposed marine outfall and land-based option would present a few risks associated with normal operations; however, the land based option would present a slightly greater risk under conditions of operational failure.

From a purely financial perspective, the marine outfall is the more cost-effective option for achieving the benefit of effluent treatment and discharge according to acceptable standards. The net present cost of constructing the marine outfall (INR 100 Crores). Annual operating costs of the marine outfall are much less compared to the land-based facility.

Based on this study, it was decided to proceed with the marine outfall for the discharge of effluent to the sea.

f) Effluent Quality & Quantity

Initially the average volume (DWF) discharged through the outfall will be 700 m^3/ day and this does not include any seawater.

The marine outfall design will be based on a capacity of 30 m^3 /hour. This is equivalent to the expected peak wet weather flow.

The area presently has a mix of residential and industrial development particularly bulk drugs and specialty chemicals. The industries presently discharging their effluent via a marine outfall are Dr. Reddy's Laboratories, Aurobindo Pharma, Andhra Organics.

The most critical effluent constituents are high solid concentrations (25,000 mg/l), organics compounds (BOD & COD) at 100 mg/l and 250 mg/l respectively due to the presence of process streams from the effluent treatment plant in the discharged effluent.

g) Pre-Treatment Works

The total pre-treatment works will be housed under one roof and will be approximately 50m x 20m in size.

The different incoming effluent streams will be combined in a collection chamber. The effluent flows are measured by means of an open venturi flume to give a continuous flow record. Thereafter the effluent passes a fine rotating drum screen with an aperture. The fine screenings will be collected with a screw conveyor and will be pressed, with the excess liquid being returned to the effluent flow.

These pressings as well as the screenings from the coarse screen will be collected in closed containers which will be transported to the municipal landfill site for disposal. The pre-treatment plant also houses the controls for the marine outfall system. This includes a balancing tank, the necessary control valves, an air release valve and a pipe Y-junction to insert a pig for the occasional cleaning of the marine outfall.

The balancing tank collects the incoming effluent and ensures that the effluent can be discharged at a sufficiently high rate to avoid partially full flow in the outfall pipeline as well as low exit velocities through the diffuser ports which could otherwise result in entrainment of seawater into the diffuser section of the outfall. In this case a balancing tank with a capacity of approximately 100 m^3 will be required.

Because the pre-treatment plant is relatively close to the residential area (the nearest house is some 250m from the plant) and because of the fact that the effluent could have septic properties, it is important that an efficient odour control system is incorporated in the design. The odour producing areas in the plant will as far as possible be closed off, the air extracted and treated by means of a chlorinated water system.

Allowance is made for further treatment in future by reserving an area adjacent to the pre-treatment plant for primary sedimentation. A primary sedimentation tank with a diameter of about 25m will be required to give a reduction in suspended solids of at least 50% and a reduction in BOD5 of at least 20%.

There is sufficient hydrostatic head available at the pretreatment plant to discharge the effluent gravitationally, without the need for pumping, even at the peak flow rate of 30 m^3 /hour.

A back-up facility for power failures will be provided for the lights, the deodorising unit and the milli-screens. The coarse screen will be cleaned manually.

A monitoring system will be installed at the plant with radio-link to the permanently manned treatment works. The system will measure critical components of the plant and will sent an alarm should blockages or breakages occur. It is furthermore suggested that on-line water quality probes are installed in the plant giving continuous readings of certain constituents like for example pH, TDS and conductivity. Any unusual change in effluent composition can then be picked up and acted against.

4.9.5.3 Impacts on the Marine Environment

The impacts of the construction of the pipeline/ marine outfall on the marine environment are given at the end of this chapter.

Marine Monitoring Studies

Before discharging the wastewater from the industry into the marine waters of Bay of Bengal, the wastewater is being treated to meet the standards of the A.P. Pollution Control Board as applicable for the marine disposal.

The treated effluents are expected to have a Total Dissolved Solids (TDS) of 25,000 mg/l, Biological Oxygen Demand (BOD) of less than 100 mg/l and Chemical Oxygen Demand (COD) of less than 250 mg/l. The physical, chemical and biological characteristics of the marine waters discussed below are based on a detailed study conducted by the National Institute of Oceanography (NIO) near the coast of Bay of Bengal.

The overall conclusion of the study is that the water quality is generally good and is indicative of a healthy tropical coastal marine environment and that the treated industrial effluents could be safely discharged at a minimum depth of 17 m below the water surface.

a) Physical Characteristics

The physical parameters studied were sea floor gradient, tidal fluctuations, temperature fluctuations, salinity and flow field.

Sea Floor Gradient

The sea floor in the area was observed to be steeper near the coast (the average gradient being 1:50) to a water depth of 3.5 m and gentler beyond (average gradient being 1:150).

Tidal Fluctuations

Two high tides (1100 Hours and 2200 Hours) and two low tides (0400 Hours and 1600 Hours) occur every day with a tidal height difference of about 0.75 m.

Temperature Fluctuations

The temperature variation along the surface and vertically down was never more than 1°C during any part of the day or in any season indicating good mixing.

Salinity

The salinity varied from 31,500 mg/l in the winter to 34,500 mg/l in summer. Interestingly, there was slight decrease in the salinity levels with the increase in the depth.

Flow Field

The flow field showed a complete seasonal reversal at all depth, presumably wind forced. The velocity components were observed to be between 2 and 10 cm/s. In general, the physical characteristics gave an indication for effective dilution of any effluents discharged at a depth of 4 m below the water level.

b) Chemical Parameters

The chemical parameters studied were pH, Dissolved Oxygen (DO), Total Dissolved Solids (TDS) and Nitrogenous compounds.

pH

The pH values were ranging between 6.9 and 8.2 and were within the range expected for sea water. In general, the pH values were slightly higher at the bottom than at the surface.

Dissolved Oxygen (DO)

The dissolved oxygen ranged between 4.1 and 4.8 mg/l.

Total Dissolved Solids (TDS)

The TDS limits were within the range of 34,000 to 42,500 mg/l with typical seasonal variation expected of sea waters.

Nitrogenous Compounds

Total Nitrogen was mostly within the range of 12 to 20 µmol/l which is within acceptable limits. However, organic nitrogen was slightly high suggesting existence of faecal matter. In general, the chemical characteristics gave an indication of a normal tropical marine environment.

c) Biological Parameters

The parameters studied were planktonic count, benthos and micro-organisms.

Plankton

The phytoplankton bio-mass concentrations were as expected for typical tropical marine coastal environment. The concentrations of Chlorophyll A,B,C, Carotinoids, Suspended Solids (seston), particulate oxidizable carbon were as given below.

Table 4.15
Chlorophyll Concentrations

Form	Concentration µg/l
Chlorophyll A	0.55 -7.35 (mean = 2.30)
Chlorophyll B	0-2.08 (mean = 0.23)
Chlorophyll C	0 – 7.82 (mean = 1.39)
Carotinoids	0 – 7.86 (mean = 1.64)
Suspended Solids (seston)	6900 – 55,400 (mean = 24,000)
Particulate Oxidizable	550- 3880 (mean = 1250)

Source: Report on Coastal Monitoring & Assay for Selectged Locations close to marine outfall of M/s Matrix Laboratories (formerly M/s Vera Laboratories) near G.Chodavaram, Poosapatirega (M), Vizianagaram (dist)

Benthos

The benthic fauna were normal and rich as expected for typical tropical coastal sub-tidal environment. The fauna was mainly composed of Polychaeta (71%) with Molluscs (11%) and Crustacea (9%).

The mean benthic populations were 350 +/- 180 and 480 +/- 270 no/ Sq.m in winter and summer respectively. The corresponding biomass concentrations were 1.12 +/- 0.85 and 0.77 +/- 0.51 g/ Sq.m.

Aquatic Ecology

Significant Aquatic Ecosystem

With all the surface water streams in the region being highly polluted with sewage and the water quality being sub-standard to sustain aquatic life, the only important eco-system in the region is the coast of Bay of Bengal.

Micro-Flora & Micro-Fauna

The coastal waters have healthy aquatic environment. The plankton and benthic populations are no different from a typical tropical coastal marine environment. The microbial population appears to be highly unsteady and some find their origin in the sewage discharged.

Commercial Fishing

Commercial fishing is an important activity along this coast. The important varieties include shark, skates, cat fishes, lesser sardines, perches, red mullets, caranx, sear and prawns.

Marine Aquatic Life

The A.P. Pollution Control Board has directed the industry to discharge the treated effluents into marine outfall. Since the commercial fishing all along the coast is a socio-economically important activity, the study of impacts on aquatic life from the factory discharge attains significance.

The industry has approached NIO to carry out studies for location of the area for disposal of treated effluents. NIO carried out following studies and submitted their reports for the following parameters- oceanographic, hydrochemical, hydrobiological and toxicological.

Based on the reports, NIO identified an area at Survey No. 92 at Thammayyapalem village of Pathivada for the outfall off the shore, because the thickness of the soft sediments of the area increases towards the sea and no surface or sub-surface rock features have been observed in the study area.

The flow pattern beyond 1.3 Km is shore parallel and hence the pollutants loose identity before the land fall. Disposal at the identified area will have negligible impact on the marine environment.

The identified area can assimilate about 1210 m^3/hour of the discharge of treated effluent as against about 11 m^3/hour. The dilution factor varies from 6000 to 31,000 times. The effluent to be treated has to meet the stipulated standards and diluted by 25% before disposal.

Based on the recommendations of NIO, M/s Matrix Laboratories Ltd (formerly M/s Vera Laboratories) has laid down the sub-marine pipeline of 1.5 Km into the sea with diffuser system at the end to the discharge the treated wastewater from the plant into the coastal waters of Bay of Bengal.

M/s Matrix Laboratories Ltd (formerly M/s Vera Laboratories) has also constructed two tanks of 500 m^3 each with impervious lining near the disposal area to store the treated wastewater. Suitable centrifugal pump arrangements have been made for pumping of treated water from the sump to the disposal point.

As per the directions laid down in the consent issued by the A.P. Pollution Control Board, the industry has started disposing the treated wastewater and presently the same is being transported through own secured transport from the factory premises to the pumping site. Every tanker load of treated water is being diluted with 30-40% fresh water for disposal into the sea.

Toxicological Studies

Bio-assay tests have become important tools in the toxicological studies. The work bio-assay signifies a test in which a living tissue organism or group of organisms is issued as a reagent for the determination of the potency of any physically active substance of an unknown activity.

The treated effluents from the factory have been analyzed for routine chemical constituents. The toxicity tests were carried out by using the marine bio-assay

(96[th], short term). The test animals (*Peneas indicus*) were used at the laboratory temperature and the toxicity test were investigated as per standard procedure.

Four concentrations 25%, 50%, 75% and 100% of the effluent were selected for the tests. At the each concentration, the test animals were introduced to assess the toxicity of the effluents. At each interval the experimental tanks were checked for the constant pH and salinity. The effect of the effluent on the state of Prawns in the experimental tanks were recorded at 24, 48, 72 and 9 hours.

The results indicate that the survival of the animals at different time intervals, upto 75% concentration, and the survival was 100%. At 100% of the concentration (90- 100%), the survival rate is comparatively less.

The gist of the report on the coastal monitoring and bio-assay for selected locations to a marine outfall of M/s Matrix Laboratories (formerly M/s Vera Laboratories) near G.Chodavaram (vil.), Pusapatirega (m), Vizianagaram (dist) is given below. The objectives of the study are:

- To study the phyto and zoo plankton species composition and abundance and evaluate species diversity
- To evaluate the benthic faunal diversity and richness (i.e. numerical abundance and biomass) at the pre-determined locations in the sea and elucidate the faunal assemblages at the community level of organization
- To evaluate the bacterial loads (TVC, Total coli-forms, Faecal coliforms) for sediments under open sea conditions
- To evaluate the effluent toxicity through marine bio-assay experiments
- To provide information on the fisheries close to the outfall area through a survey of the potential fish landing centers

Methods of Sampling & Analysis

Altogether, three transects were selected close to the marine outfall of M/s Matrix Laboratories (formerly M/s Vera Labs) near G.Chodavaram village in Vizianagaram district on the Northeast coast of India. Altogether, the transects one each from the North (N), Central (C) and South (S) sectors were selected. Surface hauls for phyto and zooplankton and sediment samples for benthos were collected at 5, 10 and 15 m depth levels. The specific tasks included collection of phytoplankton (net hauls and unit samples), micro-biology, zooplankton (300µ), benthos (dredge & grab) and testing the effluent (bio-assay) as per the protocols detailed below.

Microbial Studies

A total of 18 samples, 9 each of water and sediment, were collected from 3 transects at depths of 5, 10 and 15 m respectively. The methods of collection, inoculation and enumeration were according to the procedures detailed in the ICMAM methodology volume for biological parameters, 1998.

Surface water samples were collected using sterilized glass stoppered bottles. A sub-sample was filtered through a sterile Whatman Filter Paper No.1 and 100 ml filtered water was inoculated using a micro-pipette with autoclaved tips followed by surface plating techniques for growth. Inoculated plates were wrapped in Paraffin and incubated at 37°C. Enumeration was carried out on number of colony forming units (CFU) at 24, 48 and 72 and 96 hours. The bacterial numbers were expressed as no.s CFU/100 ml of water. The MPN values were calculated from the populations in the Maconkey's Broth at dilutions of 0.1, 1.0 and 10 ml and the values were expressed as MPN index for 100 ml.

Bottom sediments were collected as sub-sample from the grab sample with a sterile spatula, 5 g of wet sediment was mixed thoroughly in 100 ml of sterile 50% sea water, allowed to settle for 10-15 minutes after which the overlying water was used for inoculation. Inoculated plates were incubated and enumeration of colonies done as for the water samples. The sediment sample was filtered through a dried and pre-weighted Whatman No.1 filter paper. The filter paper along with the sediment was dried at 60°C till a constant weight was obtained. The bacterial populations were expressed as no.s/g dry weight of sediment.

Phytoplankton

Qualitative enumeration was carried out based on net hauls. The surface samples were collected with the help of plankton net (30 m) towed behind the boat for about 5-10 minutes. Buffered formaldehyde (5%) was used for fixing the material. In the laboratory, the samples were examined with the help of Olympus Japan Research Microscope (X400). Species (taxonomic) identification was carried out according to Subramanyan (1946), Santhanam et, al (1987) and Tomas (1997). The quantification of phytoplankton was carried out on Lugol Fixed (21 volumetric samples) employing a Sedgewick Rafter Counting Chamber as per UNESCO (1978).

Zooplankton

A net of diameter 75 cm and gauze of mesh size of 300 m was used to collect zooplankton samples. A digital flow meter (Hydrobios, Germany) was employed to measure the amount of water filtered through the net. Art every instance, the net was operated twice to obtain samples for qualitative enumeration and biomass estimation. At each station, the net was operated for 10 minutes and samples for qualitative studies preserved in 4-5% buffered Formaldehyde for further analysis. The different taxa were identified according to Sewell (1929), Kasturirangan (1963), Newell & Newell (1977), Smith (1977) and Zheng Zhong et,al (1989).

Benthos

Benthic investigations consists of collection of sea-bed samples from 9 locations at 3 selected transects namely North (N), Central (C) and South (S). Samples were collected with the help of a naturalists' dredge (wherever possible) and a Van veen grab sampler (0.06 m^2). In general, 0.5 mm sieve was used for separating macro benthos and washing the sediment with copious sea water. Sieving was carried out on-board. After sieving the fannules (live animals) were carefully separated and together with residual sediment, if any were fixed in 5-7% 9 (neutral) formaldehyde, labeled and stored for further examination. In the laboratory, the sediments were washed again under tap water and the material is preserved in 5-7% Formaldehyde or De-natured Spirit containing Rose Bengal stain. For qualitative enumeration, each sample was examined under a binocular microscope. The organisms were separated into different taxonomic groups for further identification. All taxa were identified to their specific, generic or other higher levels to the extent possible with the help of standard taxonomic references (e.g. Polychaeta: Fauvel, 1953, Day, 1967) and available expertise.

During the study, a naturalist's dredge (30X47 cm) was used to collect the epifauna. The dredge made of a metal frame, fitted with a nylon mesh (1.0 cm) and appropriately weighed, proved very useful and worked quite satisfactorily. At each location, the dredge was hauled for 10 minutes. All fauna thus obtained were washed with seawater in a large tray and after an initial separation; the animals were carefully transferred into polythene containers, labeled and preserved in 7% Formaldehyde/ De-natured spirit for later study. While sorting, only live material was picked.

Statistical Treatment

Species richness (Margalef's *d*), Shannon-Weaver diversity ($H'Log_e$), and Evenness (*J*) were determined by using PRIMER V5.0 (Plymouth Routines in Multivariable Ecological Research). Significance test of sample grouping was made using the Analysis of Similarities (ANOSIM) (Clark & Green, 1988) as implemented in PRIMER.

Results

Phytoplankton

Altogether 17 samples, 9 from surface and 8 from the bottom at 9 stations located along 3 transects, were examined. Observations have shown that there were as many as 61 species of Phytoplankton (net hauls) represented by 4 groups namely Centrales (37), Pennales (18), Dinophycenas (5) and Cyanophyceans (1) listed at the end of this report were encountered. In the unit samples, overall, there were 46 species. Centrales formed the bulk (74.1%) of the population followed by Pennales (25.4%). Dinophyceans and Cyanophyceans are poorly represented (4% and 0.1% respectively). *Skeletonema costatum* (65.5%), *Pseudonitzschia pungens* (8.2%) and *Pseudonitzschia seriala* (7.6%) were the most important taxa. The following table-1 contains station and depth-wise data. There was a general preponderance of *Skeletonema costatum* at all transects.

Spatially, differences in the composition of phytoplankton between transects 1-3 (South, Central and North) were not discernable. *Skeletonema costatum, Pseudonitzschia pungens, P.seriala* and *Cylindrotheca closterium* (*Nitzschia closterium*) were the predominant species in all the transects contributing to over 80% of the total population.

Numerical Abundance

Overall phytoplankton abundance varied between 159 no.s/ml (N1) and 837 no.s/ml (S2) and the observed mean being 365 no.s/ml. During the study, altogether 41 species of Phytoplankton represented by Bacillariophycea, (56 species), Dinophycea (5species), Cyanophycea (1) shown at the end of the report were encountered. *Skeletonema costatum* (65.49%), *Nitzschia pungens* (8.18%), *Nitzschia serriata* (7.6%) and *Leptocylindricus minimus* (2.43%) accounted upto 84% of the total population numerically. Spatially, differences in the species composition and abundance patterns were discernible (ANOSIM Global R 0.465, P: 0.14). In the North transect there were 24 species. Numerical abundance varied between 159 no.s/ml (N1) and 256 no.s/ml (N2).

In the South sector, there were 33 species. In the Central sector influenced by the outfall conditions, there were 31 species. In table-2, Phytoplankton diversity indices are presented. It would appear from the findings; the Central sector has a low Margalei index (mean d'28) and Shannon Weaver index (mean 1.4) relative to the North and South sectors attributable to the influence of the outfall and this locality.

Table 4.16

Numerical Abundance of Phytoplankton (no.s/ml)

Species	Stations/ Depth (m)										
	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)	N1 (5)	N2 (10)	N3 (15)	Total	%
Skeletonema costatum	142	592	530	60	262	243	43	175	107	2154	
Melosira Sp.	-	7	5	5	-	-	2	-	2	21	0.64
Thallosiosira coromandeliana	-	-	-	2	5	-	-	-	-	7	0.21
T.subtitlis	6	-	3	-	-	-	2	2	5	18	0.55
T. decipens	2	2	2	-	-	-	-	-	-	6	0.18
Leptocylindricus minimus	17	53	3	2	5	-	-	-	-	80	2.43
L.danicus	3	8	8	2	2	-	8	3	3	37	1.42
Rhizosolenia stoteriforthii	6	13	5	10	3	-	5	3	5	50	1.52
R.alata	5	-	7	7	-	-	-	-	-	19	0.58
Chaetoceros lorenzianus	3	-	-	2	-	-	-	-	-	5	0.15
C.compressus	3	-	2	2	-	-	2	-	-	9	0.27
C.curviselus	2	3	7	7	-	-	5	-	-	24	0.73
C.affinis	-	7	2	-	2	-	8	-	-	19	0.58
Biddulphia mobilensis	3	5	2	-	3	-	2	-	-	15	0.46
Lauderia annulata	5	-	3	-	-	-	-	-	-	8	0.24
Coscinodiscus marginatus	2	3	-	-	-	2	2	-	-	7	0.21
Hemisalus sinensis	2	-	-	5	-	-	-	2	-	9	0.27
Eucampia zoodiacus	-	-	2	2	-	2	-	3	-	9	0.27

Species	Stations/ Depth (m)										
	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)	N1 (5)	N2 (10)	N3 (15)	Total	%
Corethon inermii	-	-	-	2	-	-	-	-	-	2	0.05
Bacillaria paradoxa	-	-	-	-	7	-	-	-	-	7	0.21
Bacteriastrum varians	-	-	-	-	-	-	2	-	-	2	0.05
Nitzschia pungens	95	50	22	25	7	3	32	30	5	269	8.15
N. serriata	42	30	22	25	18	32	28	18	35	250	
N.closterium	6	17	-	-	13	5	-	3	3	47	1.48
N.longissima	2	8	5	3	5	-	.2	2	2	24	0.73
N. sigma	-	8	-	-	-	-	-	-	-	13	0.40
N.sigmoidea	2	10	2	-	-	2	-	-	-	14	0.43
Navicula Sp.	8	5	-	2	3	5	-	3	2	30	0.94
Thallosiotrix fraunfeldii	2	8	-	-	-	3	-	-	-	13	0.40
T. longissima	-	2	2	-	-	-	-	2	-	4	0.12
T. nitzschiodes	-	-	2	-	2	-	3	3	3	13	0.40
Anuphora Sp.	3	2	2	-	5	-	-	-	-	12	0.38
Asterionella japonica	28	-	-	5	3	-	8	5	-	49	1.49
Cymbella Sp.	-	2	2	-	-	-	2	2	3	11	0.38
Procentrum micans	-	-	2	-	-	-	3	-	-	5	0.15
Pleurosigma angulatum	-	-	3	2	-	2	-	-	-	7	0.21
Gyrosigma balticum	-	-	-	-	2	-	-	-	2	4	0.12
Ceratium fulcatum	-	-	-	2	-	-	-	-	-	2	0.05
Peridinium depressum	-	2	-	-	-	-	2	-	2	4	0.12
Perinidium Sp.	-	-	-	-	3	5	-	-	-	8	0.24
Oscilaltoria Sp.	-	2	-	-	-	-	-	-	-	2	0.05

Species	Stations/ Depth (m)										
	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)	N1 (5)	N2 (10)	N3 (15)	Total	%
Total	**389**	**837**	**643**	**172**	**350**	**304**	**159**	**258**	**179**	**3289**	**100**
%	**11.83**	**25.45**	**19.55**	**5.23**	**10.64**	**9.24**	**4.83**	**7.78**	**5.44**	**100**	

Source: Report on Coastal Monitoring & Bio Assay for selected locations close to the marine outfall of M/s Matrix Laboratories Ltd (formerly M/s Vera laboratories)

Table 4.17

Diversity Indices of Phytoplankton

Description	Stations/ Depth (m)								
	N1 (5)	N2 (10)	N3 (15)	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)
S	18	15	14	23	22	23	20	18	11
N	159	256	179	389	837	643	172	350	301
D	3.354	2.525	2.506	3.689	3.120	3.402	3.691	2.902	1.749
J’	0.775	0.472	0.550	0.651	0.432	0.432	0.751	0.420	0.351
H’ (log)	2.241	1.277	1.452	2.041	1.336	0.936	2.251	1.213	0.842

Source: Report on Coastal Monitoring & Bio Assay for selected locations close to the marine outfall of M/s Matrix Laboratories Ltd (formerly M/s Vera laboratories)

S- total no. of species; N- total individuals; d- Margalef index; J’-Evenness; H- Shannon index

Microbiology

The results were tabulated based on the CFU’s obtained by 96 hours after inoculation in the selective media as detailed below. The total viable counts (TVC) on Zobell’s Marine Agar (Hemidia 2216), Total Coliforms (TC) and *E.coli* like organisms (ECLO) on MaConkey’s Agar (Hemidia 081), *Vibrio* like organisms (VLO), *Vibrio cholera* like organisms (VCLO), *V. parahaemolyticus* like organisms (VPLO) from TCS agar (Hemidia M189), *Pseudomonas aeruginosa* like organisms (PALO) on Citrus media (Hemidia 024).

In surface water, total viable counts (TVC) on marine agar ranged from a low of $7.5X10^2$ (N1) to a high of 36.0X 10^4 no.s/100 ml (C3). Total coliforms (TC) ranged from a low of $1.5X10^4$ no.s/100 ml at S1, N2 to a high of $12.0X10^4$ no.s/100 ml at C3. Total vibrio counts were relatively high ranging between $1.5X10^4$ no.s/100 ml (S1 &N2) and $15.5X10^4$ no.s/100 ml (C3). The MPN ranged between 9 at S1 to 150 at C3.

Table 4.18
Surface Water

Station	TVC (no.sX10^4/100 ml)	TC (no.sX10^4/100 ml)	VLO (no.sX10^4/100 ml)	FC (no.sX10^4/100 ml)	MPN (no.s/100 ml)
C1	15	5.5	8.5	0.014	23
C2	25	9.5	12	0.028	43
C3	36	12	15.5	0.75	150
S1	14	2.5	1.5	0.007	9
S2	24	4	6.5	0.015	23
S3	29	9.5	14	0.064	93
N1	7.5	3.5	2.5	0.039	75
N2	10	1.5	1.5	0.015	23
N3	22	4	4.5	0.028	13

Source: Report on costal monitoring & bio assay for selected monitoring locations close to the marine outfall of M/s Matrix laboratories

In sediments, TVC ranged from a low $2.4X10^4$ no.s/g (S1) to a high $7X10^4$ no.s/g (N3). TC ranged from $0.9X10^4$ no.s/g (N1) to $2.4X10^4$ no.s/g (C3) and Vibrios ranged from $0.9X10^4$ no.s/g (N1) to $3.4X10^4$ no.s/g (N3). The table below gives the details.

Table 4.19
Surface Water

Station	TVC (no.sX10^4/100 ml)	TC (no.sX10^4/100 ml)	VLO (no.sX10^4/100 ml)
C1	3.4	1.6	1.0
C2	4.3	1.7	1.6
C3	5.0	2.1	2.0
S1	2.4	1.0	1.1
S2	3.5	1.6	1.8
S3	4.2	1.3	2.0
N1	2.8	0.9	0.9
N2	3.5	1.1	1.6
N3	7.0	2.0	3.1

Source: Report on costal monitoring & bio assay for selected monitoring locations close to the marine outfall of M/s Matrix laboratories

Based on the findings, it is concluded that the sea water and the bottom sediments examined from near the outfall of the above industry contains normal microbial life and there appeared to be no adverse effect of the effluent on the composition and the abundance of the bacterial flora. However, the presence of relatively high bacterial counts in the water in the central sector (outfall area) relative to either north or south sectors appears to suggest their preference to that area. In the sediments there is no such clear increase in the bacterial count.

Zooplankton

Altogether 21 diverse taxonomic groups were encountered. The following table shows the numerical abundance (no.s/m^3). Copepods constituted an overwhelming size (68.5%) of the total zooplankton population throughout. Out of these, Calanoids (59.24%) and Cyclopods (9.09%) accounted from most of the population numerically. Fish eggs (14.52%) were the next important element in the order of their abundance. Spatially (i.e. the transects 1-3), the trends were similar, Calanoid, Copepods accounting for most of the population. Overall, Zooplankton abundance varied from 246 (South, 15 m) to as high as 1454 no.s/m^3 (North 5m). Region wise, mean numerical abundance was highest at the North transect (1221 no.s/m^3, 48%), followed by Central (760 no.s/m^3, 30%) and South (549 no.s/m^3, 22%) locations. A noteworthy finding is the presence of significant fish eggs (upto 502-508 no.s/m^3) in the zooplankton in the samples collected from the central sector (outfall area) indicative of a normal seawater conditions.

Table 4.20

Numerical Abundance of Zooplankton (no/m^3)

Species	Stations/ Depth (m)										
	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)	N1 (5)	N2 (10)	N3 (15)	Total	%
Siphonophora	-	1	-	1	11	11	3	16	3	51	0.67
Polychaeta Larvae	-	3	1	-	-	-	5	5	-	14	0.18
Calanoida	349	683	137	271	305	213	1009	857	671	4495	59.24
Cyclopoida	44	103	31	28	16	48	164	177	79	690	9.09
Harpacticoida	-	-	-	5	1	1	3	1	1	12	0.16
Amphipoda	-	-	-	-	-	-	-	1	-	1	0.01

Species	Stations/ Depth (m)										
	S1 (5)	S2 (10)	S3 (15)	C1 (5)	C2 (10)	C3 (15)	N1 (5)	N2 (10)	N3 (15)	Total	%
Deapod Larvae	-	-	-	-	1	-	-	-	-	1	0.01
Cirripede Nauplii	4	35	3	1	9	-	19	-	1	79	1.04
Crustaceean Protozoa	7	70	3	8	16	11	40	7	4	198	1.81
Crustacean Zoea	-	1	1	7	1	1	3	32	8	54	0.71
Cladocera	4	-	-	1	-	-	-	-	-	5	0.007
Gastropod veliger	4	15	4	17	-	-	5	59	20	124	1.81
Bivalve veliger	5	15	5	15	-	-	-	9	7	56	0.23
Chaetognatha	19	8	34	166	7	17	144	93	19	507	8.68
Appendicularia	11	13	20	8	5	3	48	16	13	137	1.83
Fish eggs	3	3	7	35	502	508	-	28	11	1102	14.82
Fish larvae	-	-	-	25	4	-	-	24	3	56	0.74
Megalopa	-	-	-	-	-	-	1	1	-	3	0.04
Lucifers	-	-	-	-	-	-	-	1	-	1	0.01
Tomlopterus	-	-	-	-	-	-	-	1	-	1	0.01
Favelia	-	-	-	-	-	-	-	1	-	1	0.01
Total	**450**	**954**	**246**	**588**	**878**	**313**	**1454**	**1368**	**849**	**7588**	**100**
%	**5.9**	**12.5**	**3.2**	**7.7**	**11.6**	**1-.7**	**19.2**	**18.0**	**11.0**	**100**	**100**

Source: Report on costal monitoring & bio assay for selected monitoring locations close to the marine outfall of M/s Matrix laboratories

Benthos

Altogether 47 species of macro benthic fauna represented by 12 diverse taxa were encountered during the survey. These included Polychaetes, Decapods, Cumaceans, Ostracods, Isopods, Amphipods, Gastropods, Bivalves (Juvenile), Ophiuroids, Namerteans, Cephalochordates and Pisces. Amphipods (42.97%), Polychaetes (31.13%), Isopods (6.59%), Molluscan juveniles (8.59%) were numerically important groups and constitutes upto 91% of the total population.

Among Polychaetes, Cunicids (mostly *Lumbrineris Sp.*) outnumbered others and constituted upto 6.7% of the total population.

In the dredge hauls (3 samples), the fauna were represented by nine major taxa. These included Desmospongia, Anthozoans, Polychaetes, Decapods, Gastropods, Bivalves, Asteroids, Holothuroids and Pisces. Altogether 33 species of epifauna (dredge haul) were recorded during the study. Numerically Olivid, *Olivancelllaria gibbosa* constituted the bulk (43.5%) of the population, followed by Buccinid, *Babylonia spirala* (12.7%), *Cardiles antiquate* (8.3%), Gastropods (13%) and Asteroids (13 no.s) as against other groups. Anthozoans were mostly represented by *Cavernularia Sp* (4.3%) and Decapods by *Porlumus sanguinoeuis* (3.6%). Altogether there were 253 individuals at 3 locations, the faunal diversity varied between 6 no.s/haul (North) and 154 no.s/haul (South). Spatially, South locations contributed to as much as 61% of the total dredge fauna, followed by Central (37%) and North (2%).

Numerically, macrobenthic faunal densities varied from 100 no.s/m^2 (North 15 m) to as many as 1449 no.s/m^2 (South, 5m). Spatially, South transects supported s much as 48.6% of the total benthic population as against North (28.22%) and Central (23.2%) locations. There were appreciable differences in the overall abundance regionally. This was also reflected in the faunal groups. There was greater richness of individuals at the South than either North or Central areas, represented mostly by Amphipods (622 mean no.s/m^2) and Polychaetes (294 mean no.s/m^2)

Table 4.21

Numerical Abundance of Epi-Fauna (no.s/haul)

Species	North	Central	South	Total	%
Gorgonians	5	-	-	5	1.98
Tetilla dactyloidea	-	1	-	1	0.40
Virgularia Sp	-	1	-	1	0.40
Cavernularia	-	10	1	11	4.35
Dioptara neapolifana	-	-	1	1	0.40
Albunea Sp.	-	1	-	1	0.40
Calappa sp.	-	2	-	2	0.79
Matuta planipes	-	1	-	1	0.40
M. lunaris	-	3	-	3	1.19

Species	North	Central	South	Total	%
Portunus Sp.	-	-	2	2	0.79
P. sanguinolentus	-	9	-	9	3.56
Babylonia spirata	-	9	32	32	12.65
Vexillum Sp.	-	2	1	3	1.19
Nassarius variegates		-	2	2	0.79
Capulids	-	-	2	2	0.79
Cyllene fuscata	-	1	-	1	0.40
Oliva vidua	-	2	1	3	1.19
Agaronia nebulosa	--	6	6	12	4.74
Olivancilaria gibbosa	-	20	90	110	43.48
Persicula ventricosa	-	1	-	1	0.40
Ptychobella nodulosa	-	-	3	3	1.19
Terebra Sp.	-	2	-	2	0.79
Diplomerzia duplicate	-	-	1	1	0.40
Philline aperta	-	1	-	1	0.40
Limopsis multistrata	1	2	-	2	0.79
Modiolus Sp.	-	-	1	2	0.79
Placuna placenta	-	17	-	1	0.40
Cardites antiquate	-	16	5	21	8.30
Macta mera	-	1	-	1	0.40
Sunneta donacina	-	3	-	3	1.19
Dosinia erythroea	-	-	1	1	0.40
Astropecien velitaris	-	3	1	4	1.58
Lpetopentaca javanicus	-	2	-	2	0.79
Pleuronectinidae	-	1	3	4	1.58
Psedorhombus Sp	-	1	1	2	0.79

Species	North	Central	South	Total	%
Total	6	93	154	253	
%	2.37	36.76	60.87	100	100

Source: Report on costal monitoring & bio assay for selected monitoring locations close to the marine outfall of M/s Matrix laboratories

In general, the in faunal abundance was dominated by Amphipods (284-642 no.s/m^2) followed by Polychaetes (250-294 no.s/m^2) and Crustaceans (38- 147 no.s/m^2) in North and South transects. In contrast, the central transect is dominated by Polychaetes (200 no.s/m^2) followed by Amphipods (119 no.s/m^2) and Crustaceans (114 no.s/m^2). A noteworthy feature is the presence of relatively high Molluscan juveniles (111 no.s/m^2) at the Central transect while at the other locations, their presence were a mere 53 (North) and 42 no.s/m^2 (South).

The following table shows the marine benthic diversity at the North, Central and South transects. No significant differences in *d'* (mean 2.71-2.85) and *H'* values (2.2-2.64) between the North, South and Central locations could be observed. However, taking into account the overall composition of the fauna and the numerical abundance, there seems no immediate concern for life in the sea-bed in this location. All the observations nevertheless suggest that the diversity index could still be high (i.e. upto 4-6 incase of Margalef's Index). *H'* values on the other hand are close to the normal conditions.

Table 4.22

Diversity Indices for Macro benthos

Description	Stations/ Depth (m)								
	N1 (5)	N2 (10)	N3 (15)	C1 (5)	C2 (10)	C3 (15)	S1 (5)	S2 (10)	SC3 (15)
S	17	16	23	22	20	15	13	24	25
N	433	608	983	608	658	400	650	1383	1449
D	2.635	2.340	3.193	3.276	2.928	2.337	4.853	3.180	3.29
J'	0.898	0.736	0.717	0.879	0.840	0.880	0.851	0.707	0.655
H' (log)	2.545	2.040	2.249	2.717	2.516	2.382	2.182	2.247	2.407

Source: Report on Coastal Monitoring & Bio Assay for selected locations close to the marine outfall of M/s Matrix Laboratories Ltd (formerly M/s Vera laboratories)

S- total no. of species; N- total individuals; d- Margalef index; J'-Evenness; H- Shannon index

Fisheries

Data on fisheries was collected from the landing centers around the shed (marine outfall inlet) i.e. from Thammayyapalem village. The catch manly dominated by Elasmobranchs (Skates) about 95-100% to the total catch (as Elasmobranchs are abundant in this area). The following table gives information in detail.

Table-4.23

Fish Landing Details

Boat	Total Catch (Kg)	Dominant Species
I	70	*Rhynchobatus sp, Himantura sp, Manta sp*
II	60	
III	90	
IV	80	
V	75	
VI	80	
VII	70	
VIII	80	
IX	70	
X	75	

Source: Report on Coastal Monitoring & Bio Assay for selected locations close to the marine outfall of M/s Matrix Laboratories Ltd (formerly M/s Vera laboratories)

General Description

Fishermen belonging to this region operate with Dinghi fiber boats of 8.5-11m. The depth range of fishing is approximately 6-36 m. The gear used is line net and is dependant upon the target fish sought which in-turn depends on commercial importance of the fish in that particular season and its abundance. Duration of each haul is one hour. The boats leave the shore at 0500 AM, 1100 AM, 1700 PM and comes back to the shore at 1100 AM, 1800 PM and 0600 AM respectively. The groups represented in this region are Carangids, Mackarels, Anchovies, Seer Fish and Pomfrets. The following tabulation gives the species diversity.

Table 4.24

Fishes in the Region

Group	Species
Carangids	*Alceps Sp, Caraux Sp, Decapterus Sp, Scomberoids Sp*
Mackarels	*Rasterliger Sp*
Anchovies	*Stolephorous Sp, Thryssa Sp*
Seer Fishes	*Scomberomorous Sp*
Cat Fishes	*Tachysurus Sp*
Pomfrets	*Pampus Sp, Parastomateus Sp*
Thread Fin Breams	*Nemipterus Sp*
Pony Fishes	*Gazza Sp, Leiognathus Sp*
Goat Fish	*Upeneus Sp*
Ribbon Fish	*Truchurus Sp*

Source: Report on Coastal Monitoring & Bio Assay for selected locations close to the marine outfall of M/s Matrix Laboratories Ltd (formerly M/s Vera laboratories)

Based on the fish landings (specie content and weight), it is concluded that the waters in and around the marine outfall area seem to support a great wealth of fish life. The taxa (16 species) represented by 10 diverse groups from this area is suggestive of the fact that no impediment as a result of the effluent discharge by the industry.

Effluent Toxicity through Bio Assay

Introduction

Toxicity of the effluent can be studied by several methods. Among all the methods, bioassay is the most important one to determine the sensitivity of the organisms on exposure to a toxicant. Bioassay is defined as the test in which a living tissue, organism or group of organism are used as a reagent for determination of the potency of any physiologically active substance of unknown activity. In this method, a test species is exposed to different concentrations of the toxicant in a given time in order to know the nature and degree of response. During acute toxicity test, the tolerance response of the organism is evaluated by exposing it to the specified toxicant is observed for a period of 96 hours. Static bioassay method is a widely used short-term response experiment and this also provided the results instantaneously. In this experiment, the response of a toxicant to the organism is measured in terms of mortality or lethality. Lethal concentration (LC) of a toxicant is the concentration that affects as specified portion of the population within a definite period of time. LC_{50} is a parameter at which the toxic concentration shows 50% mortality of the population within a definite period of time such as 24, 48, 72 and 96 hours and these inturn represent the median tolerance limit (MTL) and the Medium Lethal Concentration (MLC). In recent years, LC_{50} experiments are carried out in a static renewable media and the medium is changed for every 3 hours. Because of this renewable method, the excretory wastes and other mucous secretions of the organism in response of the toxicant, if any, can be eliminated. As this is a reliable method and yields good result, it has become widely used.

The LC_{50} values have been reported for several organisms exposed to heavy metals and other organic pollutants. For the heavy metal Cadmium, the LC_{50} was observed to be 1.193 ppm for post-larvae of *Peneaus monodon* and 0.72 ppm for *P. duroranum* and 3.025 ppm for *P. pencillatus*. This value appears to be more for *P. pencillatus* exposed to Zinc (4.267 ppm). These values were 7.223 ppm, 2.535 ppm, 3.119 ppm and 6.223 ppm for the post-larvae of *P.indicus* exposed to Lead, Copper, Cadmium and Zinc respectively. An LC_{50} value of 2.57 ppm of hydrogen sulfide for juveniles of *Metapeneas monoceros* and for the same species. Kelthane, a pesticide was more toxice with an LC_{50} value of 0.156 ppm and a LC_{50} of 1.5 ppm was noticed for *P. indicus* post-larvae for Phosphamidon, Ammonia and Nitrate-Nitrogen also appears to be toxic and their LC_{50} values were observed to be 29.77 ppm and 40.86 ppm for juvenile *P. pencillatus*.

In the present investigation, the effluent from the plant was tested for its toxicity by exposing *Peneaus monodon* post-larvae.

Methodology

The test species used for the study is *Peneaus monodon* post-larvae. They were obtained from a shrimp hatchery and transported to the laboratory in plastic bags filled with ambient sea water (12 ppm) saturated with oxygen. The post larvae were transferred immediately into plastic containers and maintained same way as in the hatchery. Care was taken while handling, the post larvae to avoid any damage. Crowding was avoided during maintenance of the larvae in the laboratory. Almost uniform sized post-larvae (9 to 9.5 mm) were considered for the experiment. Only active and inter-moult post larvae were considered for the experiments. They were acclimatized to the laboratory conditions for a period of 48 hours before use. Aeration was provided throughout the period of maintenance and experimental regimen. The post larvae were fed with commercial diet two times daily based on 10% of body weight. In addition, a supplementary diet of *Artemia* flakes was given daily. Excess food was removed every day by siphoning.

Experimentation

Static renewal bioassays were reduced by using the above test. Five concentrations of the effluent were used and they consisted of 10, 25, 50 and 100% effluents. These concentrations were prepared by mixing distilled water and care was taken to maintain the salinity. Post larvae (twenty) were exposed to each of the above concentrations for a period of 96 hours. The mortality, if any was monitored every 24 hours and recorded. The concentrations were also renewed daily. Parallel control were maintained throughout the experiments. Commercial diet and aeration was provided as described above. These experiments were repeated three times and the results calculated.

Observations

The following table represents the results of the three independent experiments conducted for 96 hours with different concentrations of the effluent. The average rates of mortality of post-larvae are presented in the table below.

Effect of Effluent on the Mortality Rate of *P.monodon* post-larvae

1st Experiment

Concentration of Effluent (%)	Mortality Rate (%)			
	24 hours	48 hours	72 hours	96 hours
10	0	0	5	10
25	25	50	50	100
50	85	90	100	100
75	100	100	100	100
100	100	100	100	100

2nd Experiment

Concentration of Effluent (%)	Mortality Rate (%)			
	24 hours	48 hours	72 hours	96 hours
10	0	0	5	5
25	30	40	40	55
50	30	100	100	100
75	100	100	100	100
100	100	100	100	100

3rd Experiment

Concentration of Effluent (%)	Mortality Rate (%)			
	24 hours	48 hours	72 hours	96 hours
10	0	0	5	5
25	25	40	40	45
50	80	80	100	100
75	100	100	100	100
100	100	100	100	100

Average mortality rates of *P.monodon* post-larvae

Concentration of Effluent (%)	Mortality Rate (%) +/- Standard Error			
	24 hours	48 hours	72 hours	96 hours
10	0	0	5+/-0	6.6 +/- 2.4
25	26.6 +/-2.4	43.3+/-4.7	43.3+/-4.7	51.6+/-4.7
50	81.6+/-2.4	86.6+/-2.21	100	100
75	100	100	100	100
100	100	100	100	100

There was no mortality of post larvae at 24 hours and 48 hours on exposure to 10% concentration of the effluent but further the exposure to 72 and 96 hours caused a marginal mortality of 5 and 6.6% respectively. At 25 and 50% concentrations of the effluent, the mortality rates increased with increasing exposure period and this increase of mortality ranged from 26.6 to 51.6 over a period of 96 hours exposure to 25% concentration of the effluent. For 50% concentration of the effluent, relatively higher mortality rates of 81.6 and 86.6% were observed at 24 and 48 hours exposure and later the mortality rates reached 100% from 72 hours onwards. The effluent concentration of 75 and 100% caused cent percent mortality at all percentages of exposure i.e. from 24 to 96 hours indicating acute toxicity of the effluent on the post-larvae. The data indicate that the effluent is toxic in nature to the test species except at 10% concentration.

There was no mortality in controls that maintained in parallel for the above experiments.

Report

The data suggests that the effluent is toxic to the test species studied. However, according to the APPCB regulations, it is acceptable if there is 90% survival at 10% concentrations of the effluent. Therefore, the effluent can be treated as non-toxic as there is 95 to 96% survival of post-larvae at 10% concentration of the effluent.

Final Conclusion

On the basis of the findings made during this study, it was concluded that the coastal waters and the sediments opposite where the outfall of M/s Matrix Laboratories is situated, are free from any ill effects of the waste discharges. This was proved through the presence of normal phytoplankton species, microbial flora, zooplankton populations and the benthos communities. Data on the fisheries is similarly suggestive unimpeted conditions. Static toxicity (bioassay) test and Shrimp larvae have shown that the effluent can be considered non-toxic as the survival is 95 to 96% survival of post larvae at 10% concentration of the effluent which is in conformity with APPCB regulations.

CHAPTER-V
ENVIRONMENTAL MANAGEMENT PLAN

Chapter-5 Environmental Management Plan

5.1 OBJECTIVE

The purpose of the environmental management plan (EMP) is to minimize the potential environmental impacts from the project and to mitigate the consequences. EMP reflects the commitment of the project management to protect the environment as well as the neighboring populations. The potential environmental impact envisaged from the project is studied on the following environmental components:

- Air pollution from the boiler stacks
- Fugitive emissions during the construction phase
- Raw material handling and consumption
- Fugitive emissions from the process & effluent treatment
- Water pollution due to the wastewater generation
- Soil pollution due to solid waste disposal

5.2 ENVIRONMENTAL MANAGEMENT PLAN

Preparation of environmental management plan is required for the formulation and monitoring of environmental protection measures during and after construction of the proposed expansion. The plan should indicate the details as to how various measures proposed to be taken for mitigation of adverse impacts if any from the proposed expansion project.

The following sections describe the environmental management plan for the proposed expansion during the construction as well as the operation phases.

5.2.1 Construction Phase

Construction activity envisaged as part of expansion is addition of one production block for manufacturing bulk drugs and pharmaceuticals. Excepting for this construction activity no major site levelling activities are envisaged. However during construction activities if any dust is generated, it will be controlled by using water spraying on roads and other dust generating sources.

No additional sanitation facilities are required as all such facilities are already available. Use of existing toilet and restroom facilities even by the construction workers is recommended and suggested for implementation.

The effect of noise on the nearby habitation during construction activities will be negligible as the nearest habitat is more than 0.5 km from the plant. However construction labor would be provided with noise protection devices like ear muffs, and occupational safety ware. Moreover it is recommended that all noise generating equipments are to be stopped during night time. The waste oil generated by the construction equipment would be disposed by it to authorized recyclers and any unauthorized dumping of waste oil is prohibited.

The effects due to the construction of the marine outfall will be negligible as all precautions will be taken while laying the pipeline. The removed topsoil all along the route of the pipeline will be replaced back thus preventing soil erosion. The dredgers used for digging will be regularly oiled and maintained to prevent noise pollution and the dust generated while laying the pipeline will be settled by sprinkling water.

5.2.2 Operation Phase

The unit has always aimed at sustainable development and in this context only it has implemented several measures to curtail pollution to maximum extent. This is achieved by deploying technologies like scrubbers, multi cyclones, forced evaporation systems, incinerators and a full fledged effluent treatment plant. Matrix Laboratories Ltd has a dedicated green belt area and is also proposing to have acoustic enclosures for lowering the noise levels coming out from the DG set and other noise generating equipment. The pipeline carrying the effluents from the plant to the sea will be regularly monitored for leakages all along the route by manually employing persons or by placing sensors in the pipeline and the leakage if any will be immediately plugged to prevent any sort of environmental damage.

5.3 Air Pollution Control

The sources of air emission identified from the expansion of the plant are Process Emissions, Boiler Emissions and Fugitive Emissions.

5.3.1 Fugitive Emissions

Fugitive emissions from the plant operations are mainly resulted from solvent handling operations at storage and process units. Solvent losses can be controlled by installing chilled vent condensers and water circulators so that the losses are minimized. The principle fugitive emissions from the plant are in the form of

Methylene chloride, Toluene, Methanol, Chloroform, Ethoxy ethanol, Xylene, IPA, Acetonitrile, Ethyl acetate, THF which are controlled by installing chilled vent condensers. The solvent losses are kept to the minimum by having good preventive and operational controls, frequent checks of all moving equipment, replacement of glands and seals of pumps at regular intervals to minimize losses. In addition to controlling the solvent losses Matrix Laboratories Ltd is also proposing to recover (around 97-98%) of most of the solvents by adopting good engineering practices. These recovered solvents will be reutilized in the process thus bringing down not only the total requirement of the solvents during the manufacturing process but it also reduces the total cost incurred on purchasing the solvents by a huge margin. A typical fugitive emission control device adopted by MLL is given in the **Figure 5.1**, while in the following table the control measures proposed are furnished.

Table 5.1
Control Measures Proposed for Controlling Fugitive Emissions

S. No	Description	Control Measure
1	To Control losses during transferring from section to section	Dedicated pipelines, solvent storage tanks provided with proper flame arrestors.
2	To Control losses during manufacturing process	All vents are provided after the chillers

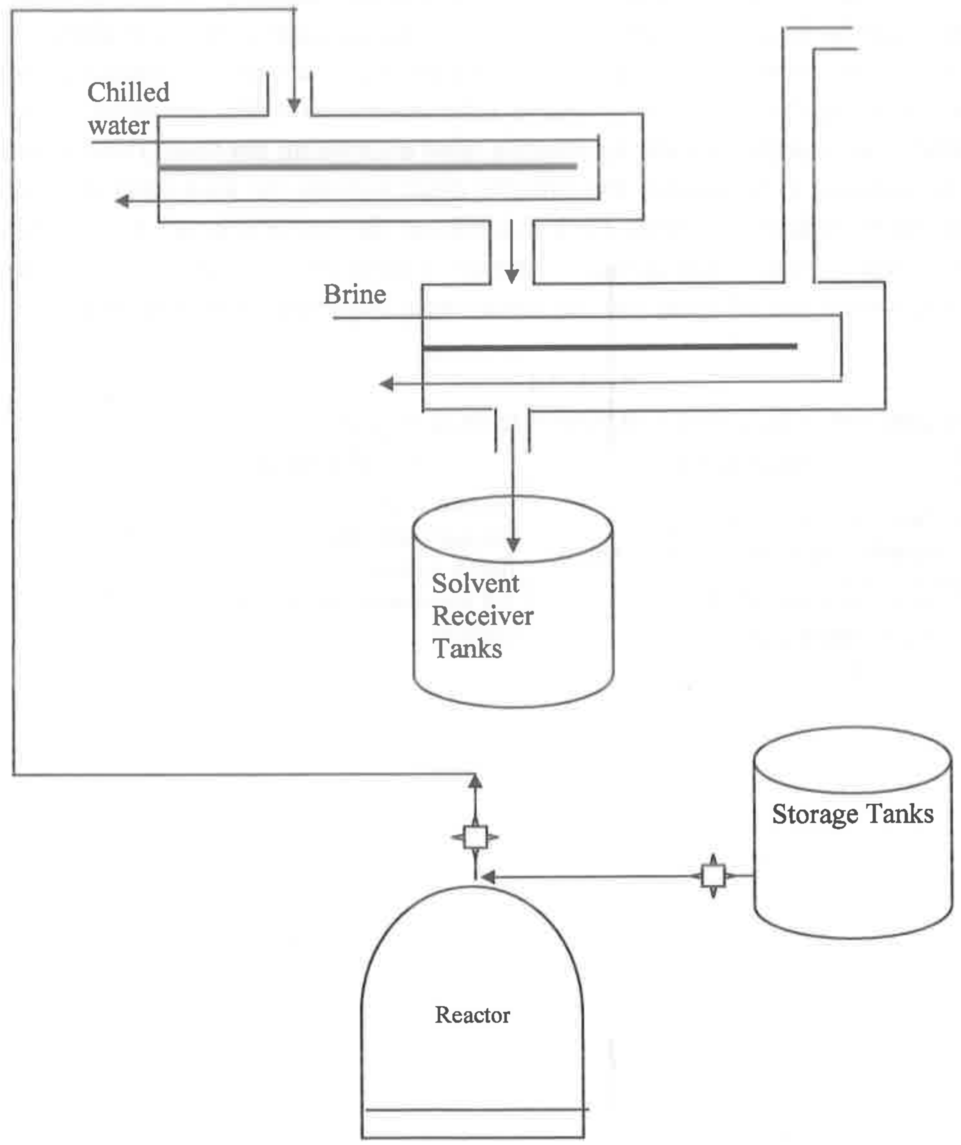


Figure 5.1
Typical Fugitive Emission Control Measure

5.3.2 Process Emissions & Control

The process emissions coming out from the products manufactured as part of expansion are Carbon dioxide, Hydrogen, HCl and Nitrogen and oxides of nitrogen, Dimethylamine, Sulfur dioxide and Ammonia. The Hydrogen Chloride and Sulfur dioxide gases are proposed to be scrubbed using

Caustic solution while Dimethyl amine gas will be scrubbed using water and the scrubbed effluent will be sent to the ETP for further treatment. Whereas other gases like Hydrogen, Nitrogen and Carbon dioxide are left into atmosphere as they are minimal in quantity. The schematic diagram of a typical scrubber employed at MLL is given in **Figure 5.2** and scrubber design at Matrix Laboratories Ltd is given as **Figure 5.3**. The process emissions along with quantification of emission rate from the existing products and the proposed products have been described in detail in Chapter-4.

5.3.3 Odour Control

Though Matrix Laboratories Ltd is not manufacturing or proposes to manufacture any product that would generate odorous gases, it however proposes to control whatever little odour that might be generated during the process by adopting physical adsorption techniques or by using chemical adsorbents and bio-scrubbers.

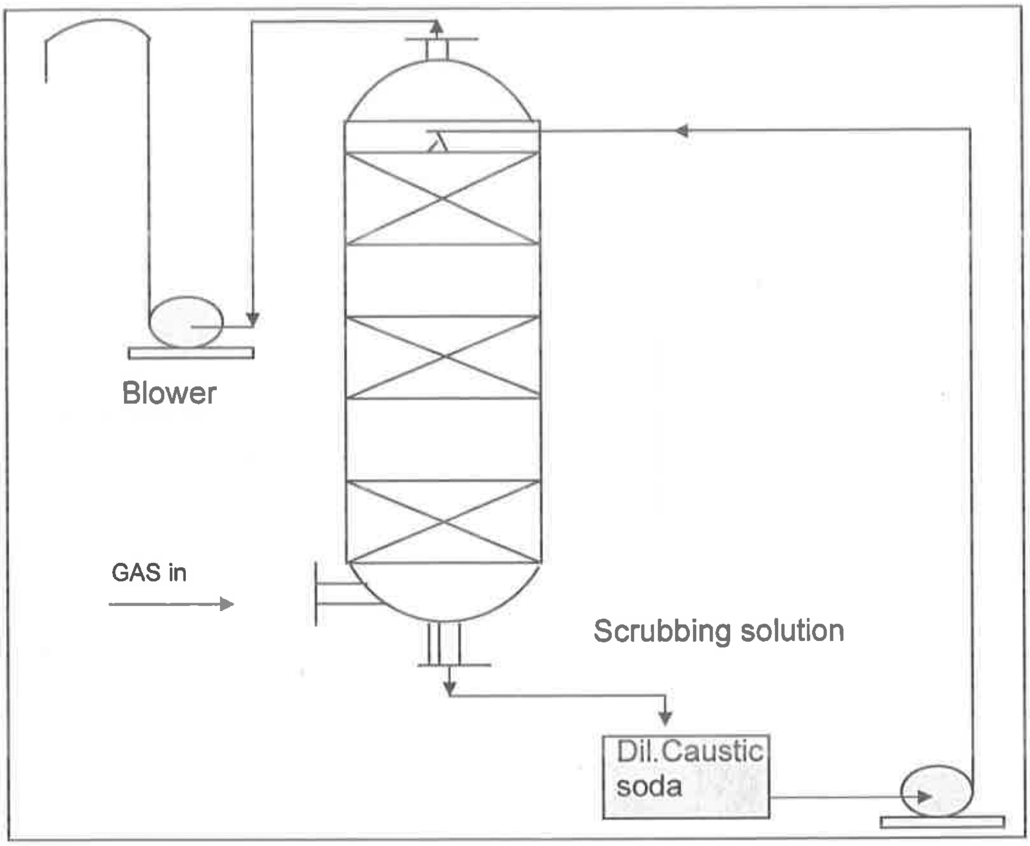
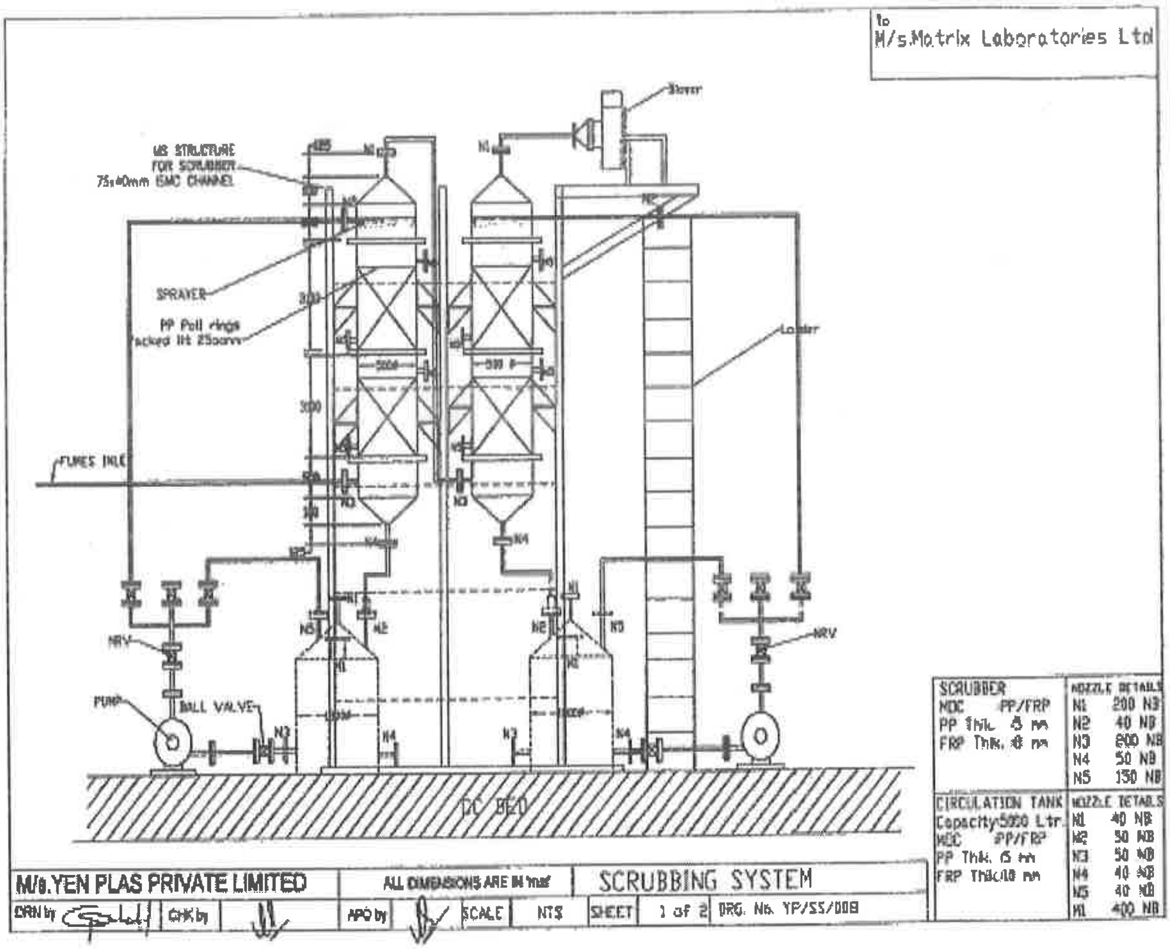


Figure-5.2
Scrubbers for Process Emissions

Figure 5.3
Scrubber at Matrix Laboratories Ltd



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5,2 – "
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5.3.4 Boiler Emissions – Control Measures

The plant has two coal fired boilers of 2 TPH and 5 TPH capacities and during proposed expansion Matrix Laboratories Ltd is proposing to add two boilers of capacities 4 and 15 TPH to meet the additional steam requirements. The control measure in place for the existing boilers is cyclone to control SPM and adequate stack height as required by CPCB guidelines for proper dispersion of Sulphur-dioxide and Oxides of Nitrogen. For the 15 TPH boiler, a bag filter and for the 5 TPH a cyclone is proposed to control the emissions and the same is shown as **Figure 5.4**. The estimated emissions are:

Table 5.2

Emissions from the Utilities

Source	Stack Height Required as per MOEF #	SPM	SO_2	NO_x	Stack Heights	Compliance
Existing	meters	mg/Nm^3			Meters	
Emission Standards as per APPCB		115	-	-		
2 TPH Coal Fired Boiler	18.4	107	19.1	77.1	30	Complies
5 TPH Coal Fired Boiler	21.4	126.3	27.8	85.2	30	Complies
500 KVA DG set	7.9	125.3	32.0	98.1	8	Complies
Proposed for Expansion						
4 TPH Boiler	22.7	48	149	119	30	Will Comply
15 TPH Boiler	33.7	105	328	262	35	Will Comply
Emission Standards as per MoEF for incinerator		30	200	200		Will Comply
Incinerator – 6500 kg/d	28.03	30	200	200	40	Will Comply
Note:	For SO_2 emissions from boiler required stack height is $14(Q)^{0.3}$ Where Q= SO_2 in Kg/hr For DG set stack height required is = H=h+0.2* Sqrt (KVA) Where h= Height of the building where DG set is installed in m, KVA= Total generation capacity					

Calculations for stack height				
Boiler	*2 TPH*	*5 TPH*	*4 TPH*	*15 TPH*
Coal consumption	*6TPD*	*10TPD*	*12 TPD*	*45 TPD*
Sulphur %	*0.5%*	*0.5%*	*0.5%*	*0.5%*
Sulphur dioxide content	*6000*0.005*2/24 = 2.5 kg/hour*	*10000*0.005*2/24 = 4.16 kg/hour*	*12000*0.05*2/24 =5 Kg/hr*	*45000*0.05*2/24* =18.75 Kg/hr
Stack Height H meters	*14 (SO_2 kg/hr)$^{0.3}$*	*14 (SO_2 kg/hr)$^{0.3}$*	*14 (SO_2 kg/hr)^{a}*	*14 (SO_2 kg/hr)$^{0.3}$*
Stack height as per MoEF	*= 14(2.5)$^{0.3}$ = 18.4*	*14(4.16)$^{0.3}$ = 21.4*	*=14*(5)$^{0.3}$=22.7m*	*=14(18.75)$^{0.3}$=33.7*
Existing stack height/ proposed stack height	*30 m*	*30 m*	*30 m*	*35 m*

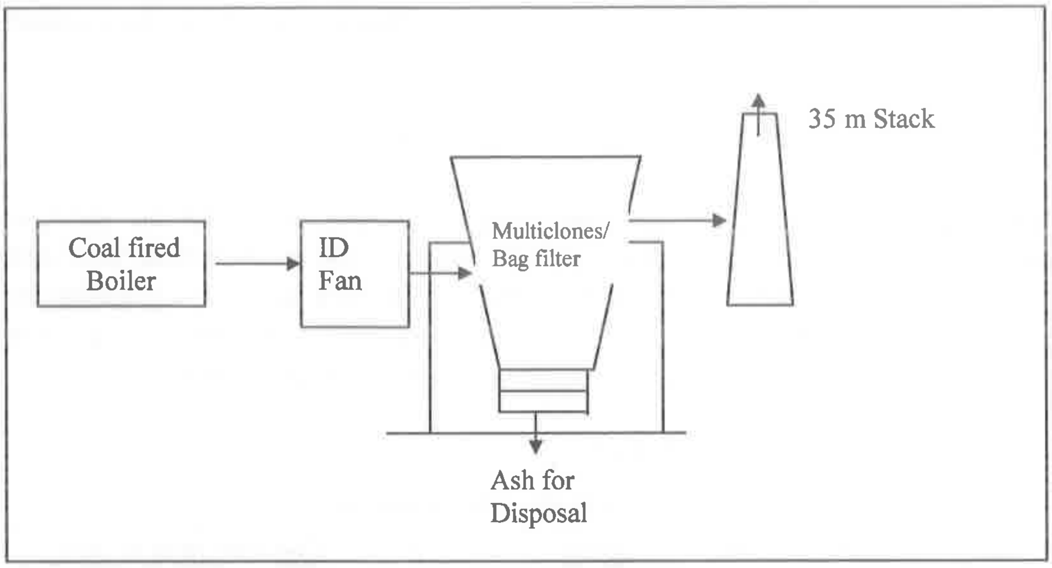


Figure 5.4
Air Pollution Control Systems for the Proposed Boiler

5.4 Water Pollution Control & Management

The wastewater generated from the plant are from process, reactor and floor washes and wastewater from utilities viz., Boiler blow down, Cooling tower blow downs, Forced evaporator condensate, DM plant ,Softener, Domestic wastewater etc.

5.4.1 Wastewater Treatment scheme

The wastewater treatment scheme at Matrix Laboratories Ltd is devised based on segregation approach i.e. High TDS and Low TDS.

- All high TDS effluent are first neutralized and then sent to onsite forced evaporation system.
- All low TDS effluent streams are treated in a well designed effluent treatment plant and then disposed off into sea through marine outfall after ensuring that the treated wastewater meets the marine disposal standards.

During manufacturing of the existing products the wastewater generated is 56.05 m^3/day out which 35.55 m^3/day is from process and utilities and the remaining is domestic wastewater. The high TDS streams is sent to forced evaporator and rest of the Low TDS process wastewater along with the forced evaporator condensate is sent to effluent treatment plant for treatment and the treated effluent is disposed off into the sea via a marine outfall after complying with the stipulated regulatory guidelines.

The same segregation approach is going to be followed to treat effluents resulted from the proposed expansion project.

5.4.2 Wastewater Characteristics of Process Streams after Expansion

The wastewater streams from all the individual stages have been studied for the pollution concentration levels with respect to TDS inorganic and organic. These concentrations have been estimated from the material balance of the products. The cut off mark taken for segregating the effluent streams into high TDS and low TDS is 30000 mg/l. The stages contributing for high TDS effluent have been segregated for the proposed expansion products and are presented below.

Table 5.3

Product Wise High TDS effluents- After Expansion

		Pollution Load in kg/day				Concentration in mg/l		
Product	**Stage**	**Process wastewater**	**In organics**	**Organics**	**COD**	**Fixed solids**	**Organics**	**Total COD**
Tiaprofenic acid	I	1142.9	52.1	0	0	45562.5	0	0
	II	879.1	66.3	0	0	75455.2	0	0
Naproxen Sodium	I	64208.9	3522.7	0	0	54862.7	0	0
	III	15560.4	773.8	67.7	150.3	49730.7	4351.6	9660.5
Trazodone Hydrochloride	I	1589.7	130.2	206.9	455.6	81930.1	130174.4	286585.1
	II	937.5	61.9	0	0	66046.7	0	0
Abacavir Sulfate	II	42.5	22.6	0	0	530857.7	0	0
Citalopram Hydrobromide	II	4000	288.1	24.0	75.1	72036.0	6000.0	18780.0
	III	2736.8	784.0	15.5	24.6	286465.9	5676.7	8969.2
Gabapentene	I	5541.7	3763.8	189.4	397.8	679190.0	34180.0	71778.0
	II	14649	4358.9	409.7	921.8	297553.9	27967.6	62927.0
Ciprofloxacin Hydrochloride	II	7591.0	376.5	1094.6	1117.4	49603.7	144191.3	147191.7
	III	19420.2	962.7	95.1	142.7	49570.2	4897.2	7345.8
Total		**138299.5**	**15163.7**	**2103.0**	**3285.2**	**109643.8**	**15205.9**	**23753.9**

Table 5.4

Product Wise Low TDS effluents - After Expansion

		Pollution Load in kg/day				Concentration in mg/l		
Product	**Stage**	**Process wastewater**	**In organics**	**Organics**	**COD**	**Fixed Solids**	**Organics**	**Total COD**
Naproxen sodium	II	74368.6	1474.7	587.6	464.9	19830.09	7901.7	6251.3
Naproxen ntermedaite	I	41500	1012.1	684.8	1190.8	24389.0	16500.0	28693.5
Trazadone Hydrochloride	III	1629.4	16.1	0	0	9880.9	0	0
Allopurinol	II	15359.6	77.7	57.8	152.7	5061.3	3765.8	9941.6
	III	9877.3	126.2	0	0	12774.3	0	0
Nabumetone	I	1800.0	0	21.5	29.3	0	11892.9	16237.1
	II	2.37	0	0	0	0	0	0
Efavirenz	I	31308.3	115.08	379.8	416.7	3675.7	12132.4	13309.2
	II	21875.0	115.63	89.7	18.83	5285.7	4100.0	861.0
Abacavir Sulfate	I	3120.5	0	0	0	0	0	0
	III	45.6	1.21	0	0	26585.4	0	0
Nelfinavir mesylate	I	760.0	13.71	43.9	114.4	18042.1	57642.1	150445.9
	II	4800.0	0	3.8	109.4	0	790	22790
Indinavir Sulfate	I	3037.7	84.1	137.9	351.3	27667.2	45412.8	115644.3
	II	47.7	0	4.9	12.9	0	104000	269360.0
CME Intermediate	III	8993.2	15.5	458.4	1049.7	1725.6	50963.7	116718.8
Citalopram Hydrobromide	IV	3264.0	95.5	243.7	444.9	29250.0	74676.5	136291.01
	V	1041.6	9.6	25.6	60.9	9216.6	24577.6	58463.9
Ciprofloxacin Hydrochloride	I	41500	1160.5	287.7	224.4	27963.3	6931.7	5406.7
	IV	9890.8	296.0	620.5	1803.3	29923.01	62727.3	182314.0
	V	17115.3	249.0	24.3	55.0	14548.4	1414.5	3210.8
	VI	2203.0	28.0	41.5	67.6	12558.9	18838.3	30675.0
Zidovudine	I	9469.7	0	1392.3	4122.3	0	147020.0	435315.6
	II	27462.0	786.01	1081.6	1924.04	28624.2	39386.3	70061.8
	III	77054.05	2268.2	182.5	450.8	29436.2	2368.2	5849.5
	IV	16515.8	219.9	1192.0	2802.8	13313.7	72170.3	169701.2
Total		**435989.2**	**8423.2**	**8603.8**	**17895.4**	**19319.8**	**19734**	**41045.5**

5.4.3 Combined Effluent Characteristics of Effluents going to ETP after Expansion

The combined effluent characteristics of the effluent going to the ETP are presented in the Table below.

Table 5.5
Combined Wastewater Characteristics of Raw Effluent to ETP

S.No	Source	Flow	Fixed solids	Organics	Total COD	Final Disposal
		(m^3/d)	**mg/l**	**mg/l**	**mg/l**	
1	Low TDS process effluent	436	19319.8	19734	41045.5	To onsite ETP
2	Reactor washings	10	2000	1500	3000	
3	Boiler blow down	15.5	5000	25	50	To reverse osmosis plant and the reject to marine outfall
4	Cooling tower bleed off	15.5	1000	25	50	
5	DM Plant	30	10000	75	100	
6	Softener	30	5000	100	150	
7	Domestic	25	750	700	400	To onsite ETP
	Subtotal	**562**	**16023.5**	15378.3	**31930.4**	
8	FE Condensate	138	0	3041.2	4750.8	To onsite ETP
	Total	**700**	12864.5	13159.4	**26572.1**	

5.4.4 Details of Effluent Treatment Plant

i) Existing ETP scheme

Wastewater from the process reactions, the reactor and floor washings and the boiler blow down is collected in a collection sump of capacity (247.5 m^3) and is pumped into a screening chamber (2.43 m^3) while passing it through a primary oil and grease chamber or trap (8.7 m^3) to remove oil and grease from the effluents. Then the effluent is subjected to equalization in an equalization tank to achieve homogeneity of the effluents. After equalization, the effluent is neutralized to bring down the pH to neutral conditions or at least to ensure a uniform pH for the entire effluent by adding buffers. After neutralization, the effluent is subjected to sedimentation in a primary sedimentation tank (72 m^3) to remove any settleable solids. After removing the solids, the effluent is subjected to anaerobic treatment in an anaerobic tank of capacity 900 m^3 and is passed through an intermediate clarifier (85 m^3) to further remove solids. Then the effluent is subjected to recalculation by diffusing system in a bio tower (46 m^3) and then followed by an activated sludge unit (378 m^3) to remove BOD and into a final clarifier of 49 m^3 to remove any settleable solids. This effluent is collected in a collection sump of capacity to store 22.1 m^3 and is subjected to filtration through pressurized sand filters (5 m^3/hr) and carbon filter of 7 m^3/hr. The final treated effluent is collected in a sump of capacity 22.5 m^3 and is pumped to the pumping station (500 m^3) near the sea and finally into the sea through the marine outfall.

The marine outfall has been designed to carry effluents up to 30 m^3/hour and is more than enough to cater to the proposed expansion loads also. The existing ETP units and their capacities is given in **Table 5.6** while effluent characteristics is shown in **Table 5.7**.

Table 5.6
ETP Units-Capacities-Existing

S. No	Unit	Capacity
1	Primary oil and grease chamber	8.7 m^3
2	Screen chamber	2.43 m^3
3	Secondary oil and grease chamber	49.6 m^3
4	Collection cum neutralization tank	247.5 m^3
5	Neutralization tank	352.8 m^3
6	Primary Sedimentation tank	72 m^3
7	Anaearobic tank	900 m^3
8	Intermediate clarifier	85 m^3
9	Biotower I & II	46 m^3
10	Activated sludge unit-II	378 m^3
11	Final clarifier	49 m^3
12	Treated water collection sump	22.1 m^3
13	Duel filter	5 m^3/hr
14	Carbon filter	7 m^3/hr
15	Final collection sump	22.5 m^3
16	Pumping station near sea	500 m^3

Table 5.7
Effluent Characteristics-Existing

		Existing		
Parameter	**Unit**	**ETP Inlet**	**ETP Outlet**	Marine discharge Standards as per GSR 422E
pH	-	6.5-8.0	7.0-7.5	**5.5-9.0**
TSS	mg/l	1800	<100	**100**
TDS-Inorganic	mg/l	12863	<12000	-
BOD	mg/l	21000	<100	100

Besides having a full fledged ETP as discussed above and as shown in the schematics there are other infrastructure facilities like solar evaporation ponds, sludge drying beds and forced evaporation system. The detailed schematic diagram of the existing ETP facilities is shown in **Figure 5.5** and **Figure 5.6** respectively.

Figure 5.5 Schematics of Existing ETP

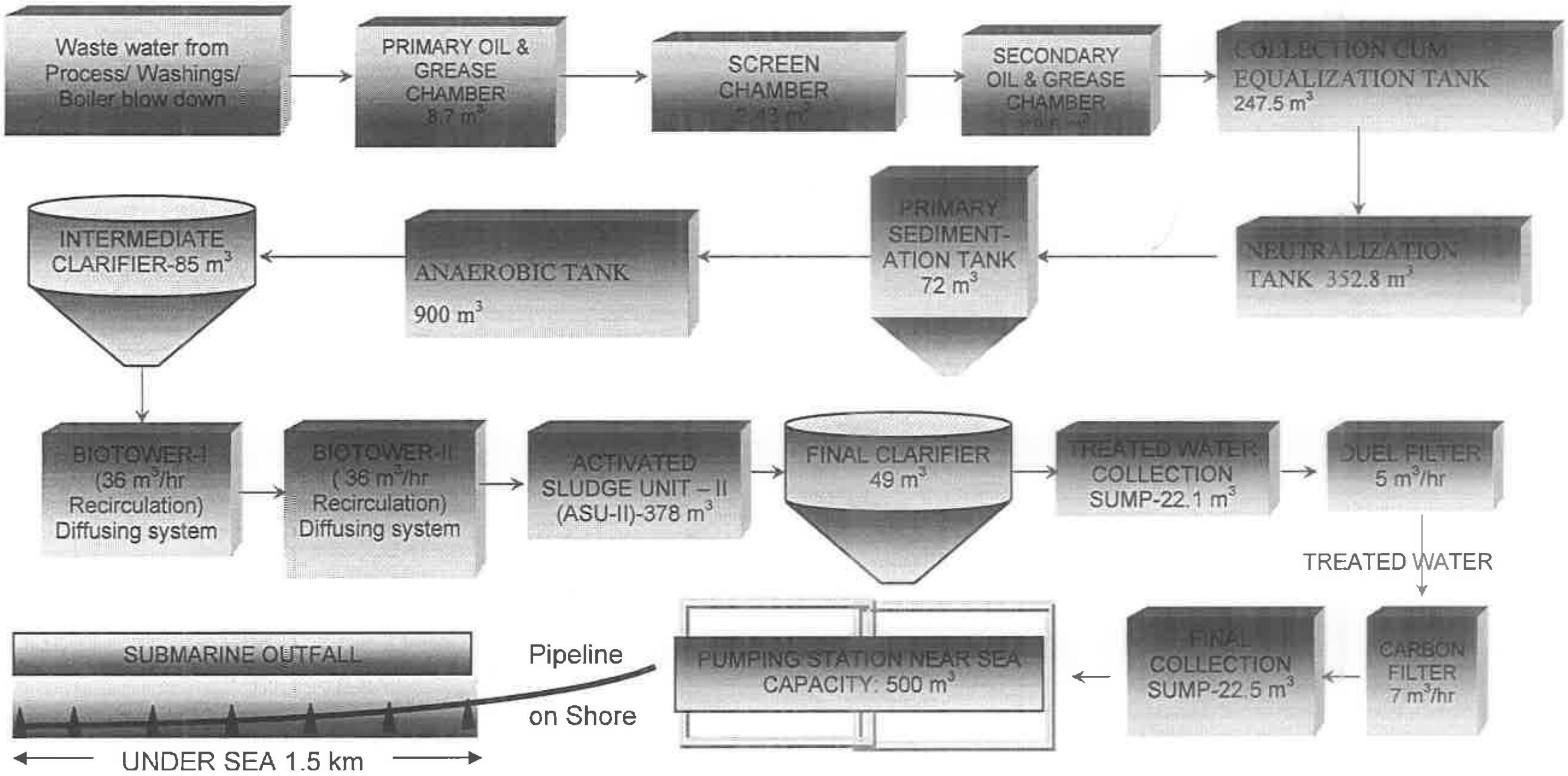
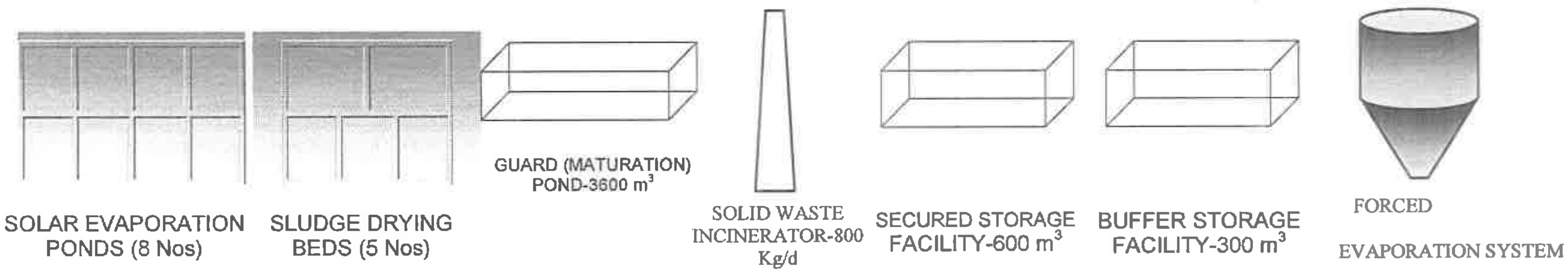


Figure 5.6
Additional Facilities at the ETP- Existing



5.4.5 Details of Proposed ETP for Expansion

The existing ETP capacity is 100 m^3/day. The wastewater quantity after expansion is 700 m^3/day. Therefore it is required to upgrade the existing ETP to meet the requirements of the expansion project. The effluent treatment scheme for the expansion plant will be based on the existing treatment schemes for both High TDS and Low TDS effluents. The High TDS effluent of about 138 m^3/d will be subjected to forced evaporation, the low TDS process effluent along with washings, domestic wastewater, and forced evaporator condensate of about 609 m^3/d will be sent to the onsite ETP. The non process wastewater like boiler blow down, cooling tower bleed off, DM Plant regeneration and Softener water of 91 m^3/d will sent to the reverse osmosis plant and the water from this plant will be recycled and reused for the plant operations while the RO reject will be disposed off into the sea via marine outfall. The new effluent treatment plant will be constructed to meet the requirements of the increased flow after expansion. The design of the new effluent treatment plant will be on the similar lines as that of the existing one but with an increased capacity.

In the present proposal, in order to meet the treatment requirements of the increased effluent quantity, Matrix Laboratories Ltd is proposing to add two treatment units of 300 m^3 /day capacity in the same lines as the existing ETP schematics.

In addition to this M/s Matrix Laboratories Ltd is also proposing to install reverse osmosis plant to recover and reutilize the wastewater generated from the utilities like boiler blow down, cooling tower condensate, DM Plant and Softener for the plant operations. The details of the proposed Forced evaporator, Reverse osmosis system and Multiple effect evaporator are given in subsequent sections of this chapter.

The detailed sketch of the proposed ETP is given as **Figure 5.7** and the description of the Design of the proposed ETP is given below.

Proposed Scheme Of Treatment:

The treatment comprises of primary stage (physico- chemical treatment) followed by secondary stage (bio-chemical treatment) and tertiary stage (chemical oxidation and filtration, adsorption and absorption) to achieve the stipulated standards. The characteristics of the raw wastewater going to the ETP are presented in **Table 5.8**.

Table 5.8
Characteristics of Raw Wastewater

S. No	Parameter	Concentration*
1	pH	6 – 9
2	Suspended solids	2000 - 3000
3	COD	25000 - 30000
4	BOD	8000 – 10000

The scheme of treatment is described below and the proposed scheme of treatment for the process effluents is depicted in **Figure 5.7** and that of the non process effluents is depicted in **Figure 5.8.**

Primary Treatment: The process wastewater is led directly to the screen chamber. In the drains, screens shall be provided for retaining coarse matter. The screens are manual type and are to be cleaned at regular intervals. Two stages of screens are provided i.e. coarse screen followed by fine screens. The wastewater is then taken to grit, oil and grease chamber for removal of grit, oil and grease. Two such units are provided and are to be used in a cyclic manner. Cleaning of grit, oil and grease chamber is to be done manually. The wastewater is then led to an equalization tank for attenuation of variation in waste flow rate and characteristics. For mixing, and to avoid solids from settling in the equalization tank, air shall be bubbled in the equalization tank through a grid placed at the base of the tank. Wastewater from the equalization tank is pumped to the flash mixing tank where chemicals (alum, lime, and polyelectrolyte) are homogenously mixed with the wastewater. The wastewater then flows into the flocculation chamber where a slow paddling allows for suspended particles to agglomerate. The flocculated wastewater is then taken to a settling tank (provided as a tube deck settling tank) where the sludge settles to the bottom. The sludge collected in the bottom of the settling tank is periodically withdrawn and applied on sludge drying beds for dewatering and drying. Clarified water i.e. supernatant from the settling tank is provided further treatment. Up to this stage the ETP is provided in a single module catering for 600 cum/day. From this stage, the ETP shall be provided in 2 modules with each module catering to 300 cum/day.

Secondary Treatment: The primary treated wastewater is subjected to bio-chemical oxidation in 2 stages. The first stage is an aerated lagoon with sludge recycling. The proposed size of each of the aerated lagoon is 22 m X 88 m X 5 m SWD. Aeration shall be done by diffused air aeration with the help of fine bubble diffusers connected to air blowers. Excess sludge from the aerated lagoons shall be taken for sludge dewatering and drying.

The second stage of treatment shall be done in FAB (fluidized aerobic bed reactors) which is an attached growth system working on extended aeration principle. Aeration is done by diffused air aeration with the help of medium bubble diffusers connected to air blowers. For immobilizing the bacteria/micro-organisms, high surface area to volume media (UV treated PVC) shall be put in the aeration tanks. For each module there shall be 2 aeration tanks with each of size 5.5 m X 5.5 m X 4.2 m SWD. Following the FAB aeration tanks, the wastewater is led to a tube deck settling tank for solid – liquid separation. The sludge collected in the settling tank is taken for dewatering and drying. The overflow from the settling tank is subjected to tertiary treatment.

Tertiary treatment: Overflow from the secondary clarifier is taken to chemical oxidation tank for chemically oxidizing the residual pollutants. Oxidising chemical shall be added for chemical oxidation. The chemical oxidation unit shall have a detention time of 30 minutes to ensure proper contact and reaction. The wastewater from chemical oxidation is then collected in a sump and pumped to a pressure sand filter for removal of particulate matter. The wastewater is then taken through an activated carbon column for removal of trace organics and pollutants (chlorine, color, trace organics etc.,) and finally through an organic scrubbing bed. The backwash of the pressure sand filters and activated carbon column are taken to sludge drying beds for dewatering and drying. Underflow from the sludge drying beds is taken back to equalization tank. The overflow is discharged as marine outfall.

The sizes and specifications of the various units for the proposed ETP are presented in tables below.

Sizes and Specifications of Various Units for the Proposed Plant

Civil Works

Specification Table

Unit	**Screen Chamber**
Duty	For removal of coarse matter
No. of units	Two (to be used in alternately)
Size	2.0 m X 1.0 m X 0.8 m SWD
MOC	RCC M-20

Unit	**Oil And Grease Trap**
Duty	To enable removal of oil and grease.
No. of units	Two (to be used alternately)
Size	1.66 m X 5 m X 1.5 m SWD
MOC	RCC M-20

Unit	**Equalization Tank**
Duty	To attenuate variation in flow and characteristics.
Number of Units	Two (to be used alternately)

Unit	Equalization Tank
Size	10 m X 10 m X 3.0 m SWD
Volume	about 300 cum
MOC	RCC M-20

Unit	Primary Settling Tank
Duty	To enable solid-liquid separation
Number of Units	One
Type	Tube deck
Size	3.6 m X 3.6 m X 2.5 m SWD
M.O.C.	RCC M-20

Upto this stage the units are designed for a flow of 600 cum/day. From this stage the ETP is in 2 modules with each module catering for 300 cum/day.

Unit	Extended Aeration Tank
Duty	To enable bio chemical oxidation of the wastewater
Number of Units	Two
Size	88 m X 22 m X 5 m SWD
MOC	RCC M-20

Unit	Aeration Tank
Duty	To enable bio chemical oxidation of the wastewater
Number of Units	Four
Size	13.4 m X 13.4 m X 4.2 m SWD + 0.5 m FB
MOC	RCC M-20

Unit	Secondary Settling Tank
Duty	To enable solid-liquid separation
Number of Units	One
Type	Tube deck

Unit	Secondary Settling Tank
Size	2.7 m X 2.7 m X 2.5 m SWD;
M.O.C.	RCC M-20

Unit	Chemical Oxidation Tank
Duty	To chemically oxidize the treated wastewater.
Number of Units	One
Size	6 m X 2.0 m X 1.0 m SWD+ 0.3m FB
M.O.C.	RCC M-20

Unit	Sump
Duty	To hold treated wastewater for tertiary treatment
Number of Units	One
Size	8.7 m X 8.7 m X 2.0 m SWD
Volume	about 150 cum
MOC	RCC M-20

Unit	Sludge Drying Beds
Duty	For dewatering and drying of sludge.
Number of Units	Sixteen (to be used in a cyclic manner)
Size	15.0 m X 15.0 m X 0.6 m SWD + 0.4 m FB
MOC	Base in PCC and walls in brick work.
Provisions	Splash pad, underdrains, filling of media

Alternately a sludge dewatering system such as a filter press can be adopted which would reduce the area of sludge drying beds.

Mechanical works:

Specification Tables

Unit	Screens
Duty	To retain coarse matter in wastewater
No. of units	Two (coarse followed by fine screen in each chamber)
Size	To suit drain size; with 15 mm and 6 mm

Unit	Screens
	opening.
Type	Bar screen made of MS flats 25 X 5 mm
MOC	MSEP.

Unit	Aeration Grid For Equalization Tank
Duty	To bubble air for mixing and to avoid solids from settling
No. of units	One
Size	To suit size of equalization tank.
Type	Piping network with header and laterals.
MOC	HDPE / PVC.

Unit	Pumps
Duty	To pump wastewater for onward treatment.
No. of units	Two (one as 100% stand-by)
Capacity	25 cum/hr.
Head	10 m.
Type	Non clog, self priming centrifugal pumps.

Unit	Flash Mixing Tank
Duty	To enable mixing of chemicals and wastewater.
Number of Units	One
Size	0.5 m X 0.5 m X 2.0 m SWD
MOC	MSEP
Provision	Provision is to be made for housing of flash mixer

Unit	Flash Mixer
Duty	To homogenously mix chemicals and wastewater in the flash mixing tank
Number of Units	One
Capacity	To suit flash mixing tank
MOC	Shaft and propeller in SS.

Unit	Chemical Tanks
Duty	To enable preparation, holding and feeding of chemical solutions for treatment.

Unit	Chemical Tanks
Number of Units	Three (alum, lime and polyelectrolyte)
Capacity	1000 lts – 2No ; 50 lts – 1 No.
MOC	HDPE

Unit	Agitator
Duty	To enable preparation of chemical solutions
No. of units	Three
Rating	1.0 HP
Type	Slow speed paddle type
MOC	Shaft & paddle in SS 316
Drive	Electric motor coupled to speed reduction gear box.

Unit	Alum And Lime Dosing Pump
Duty	To dose alum in a regulated manner
Number of Units	Four (2 working +2 standby)
Capacity	0-6 lph each
Type	Electronic variable dosing
Make	e- dose, Etatron

Unit	Polyelectrolyte Dosing Pump
Duty	To dose polyelectrolyte in a regulated manner
Number of Units	Two (1 working +1 standby)
Capacity	0-6 lph each
Type	Electronic variable dosing
Make	e- dose, Etatron

Unit	Flocculator Tank
Duty	To enable flocculation of coagulated wastewater
Number of Units	One
Size	1.8 m X 1.8 m X 2.0 m SWD
MOC	MSEP
Provision	Provision is to be made for housing of flocculator

Unit	Flocculator
Duty	To enable flocculation if coagulated wastewater.
Number of Units	One
Capacity	To suit flocculation tank.
MOC	Shaft in SS and paddles in wood
Drive	Electric motor coupled to speed reduction gear box.

Unit	Tube Deck Media (Primary)
Duty	To enable solid – liquid separation
No. of units	One
Quantity	One lot, as required
MOC	Chevron type UV treated PVC

Unit	Diffusers For Extended Aeration Tank
Duty	To supplement air in aeration tank for bio-chemical oxidation.
No. of units	Four lots (one for each aeration tank)
MOC	PVC/HDPE grid and coarse bubble diffusers.

Unit	Aeration Grid For Extended Aeration Tank
Duty	To supply air from blower to diffusers.
Number of Units	Two (one for each aeration tank)
Size	To suit size of aeration tank.
MOC	PVC/HDPE

Unit	Blowers For Extended Aeration Tank
Duty	To supplement air to the air grid.
No. of units	Eight (one as 100% stand-by)
Rating	25.0 HP each.
Type	Twin lobe rotary type.

Unit	Diffusers
Duty	To supplement air in aeration tank for bio-chemical oxidation.
No. of units	Four lots (one for each aeration tank)
MOC	PVC/HDPE grid and coarse bubble diffusers.

Unit	Aeration Grid For Aeration Tanks
Duty	To supply air from blower to diffusers.
Number of Units	Two (one for each aeration tank)
Size	To suit size of aeration tank.
MOC	PVC/HDPE

Unit	Blowers
Duty	To supplement air to the air grid.
No. of units	Four (one as 100% stand-by)
Rating	30.0 HP each.
Type	Twin lobe rotary type.

Unit	Fab Media
Duty	High surface area to volume ratio of media shall be provided in the aeration tank for immobilizing the microbes.
Quantity	One lot, as required
MOC	UV treated PP.

Unit	Tube Deck Media (Secondary)
Duty	To enable solid – liquid separation
No. of units	One
Quantity	One lot, as required
MOC	Chevron type UV treated PVC

Unit	Hypochlorite Tank
Duty	To hold hypochlorite solution
No. of units	One
Volume	500 liters
MOC	HDPE

Unit	Chlorine Dosing Pump
Duty	To dose chlorine solution in a regulated manner
Number of Units	Two (1 working +1 standby)
Capacity	0-6 lph each @ 5 m head
Type	Electronic variable dosing

Unit	Chlorine Dosing Pump
Make	e- dose, Etatron

Unit	Filter Feed Pumps
Duty	To pump wastewater for onward treatment.
No. of units	Two (one as 100% stand-by)
Capacity	30.0 cum/hr.
Head	30 m.
Type	Non clog, self priming centrifugal pumps.

Unit	Pressure Sand Filter
Duty	To enable removal of fine suspended particles.
No. of units	One.
Size	1.8 m dia., 1.8 m HOS
MOC	MS.

Unit	Activated Carbon Column
Duty	To enable removal of trace pollutants.
No. of units	One
Size	1.8 m dia., 1.8 m HOS.
MOC	MS.

Unit	Organic Scrubbing Bed
Duty	To scrub organics in the wastewater.
No. of units	One
Size	1.8 m dia., 1.8 m HOS.
MOC	MSEP.

Unit	Motor Control Center
Duty	*For operation and protection of all electrical items.*
Incoming	*MCCB of adequate rating, ammeter, voltmeter, copper bus bar and phase indicating lamps.*
Out going	Contactors of suitable rating of DOL type for motor rating up to 10 HP and Star-Delta type for motor ratings above 10 HP, thermal overload relay with built-in single phase preventer and HRC fuses for extra protection.

Make	All electrical items shall be of L&T, English Electric, GEC, Crompton, IMP, MECO or Siemens. Separate panels shall be provided for each of the streams being fed to the RO
Electrical cabling	All interconnecting cabling within ETP shall be in PVC insulated, armored /unarmored, aluminum conductor of standard make. Cabling, as far as practicable, shall be underground.

Unit	**Interconnecting Piping And Valves**
Duty	Interconnection between the various units of the STP.
Type	a) Piping: Generally all piping shall be in HDPE/PVC/GI/CI and of suitable size & pressure rating. b) All valves shall be of polypropylene/CI/GM

Characteristics of treated wastewater: The expected characteristics of the treated wastewater on adopting the scheme of treatment are given in table below and shall be complying with 4SR 422(E) for discharge into marine outfall.

Table 5.9
Characteristics Of Treated Wastewater

S. No	Parameter	Concentration*
1	pH	6.5 - 8
2	BOD (5 day at 20 ^{0}C)	$\leq$ 100
3	COD	$\leq$ 250
4	TSS	$\leq$ 30
5	Other parameters	As per limits stipulated in 4SR 422(E) for marine outfall.

**All parameters except pH expressed as mg/l*

Figure 5.7
Schematics of Proposed ETP

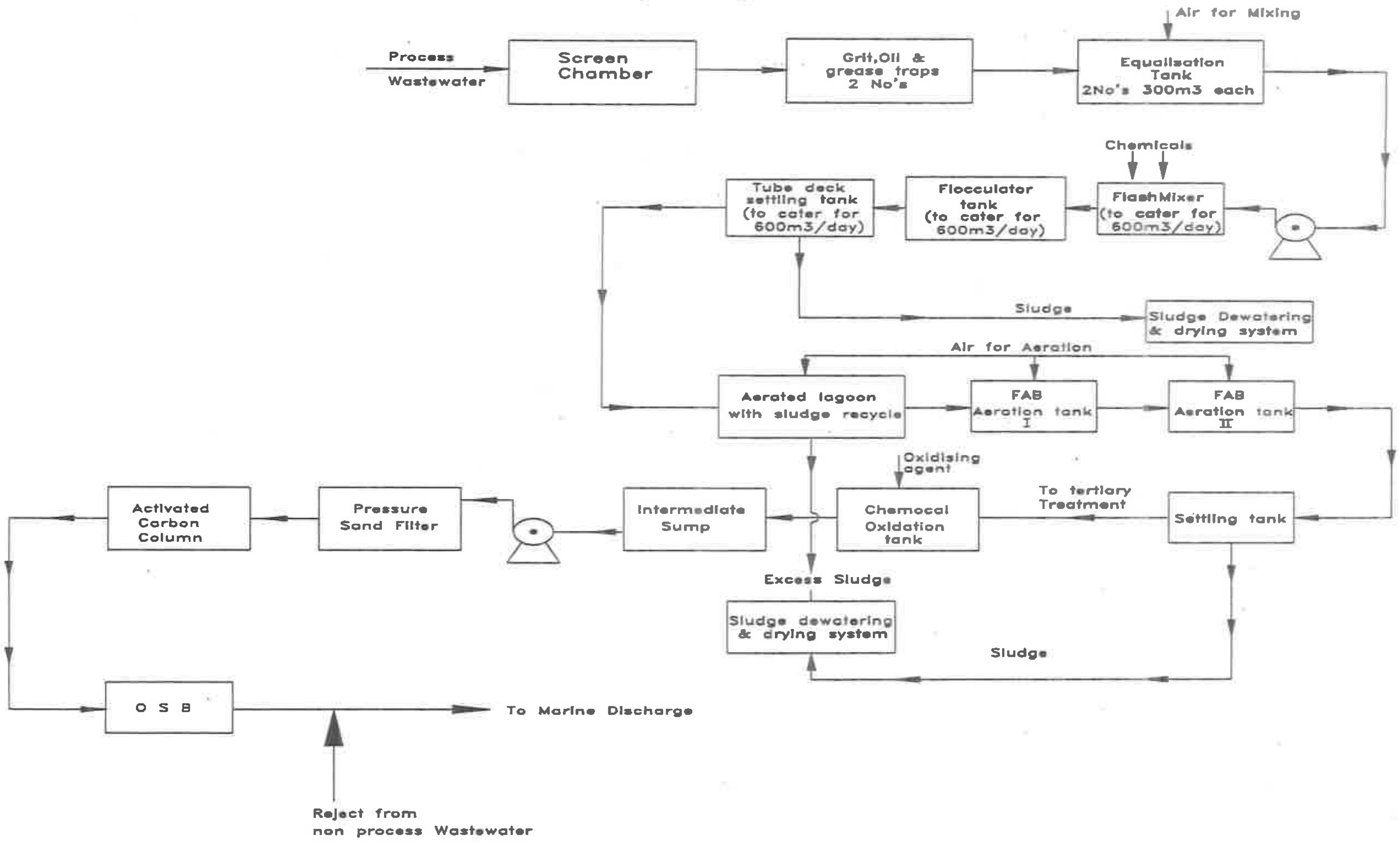
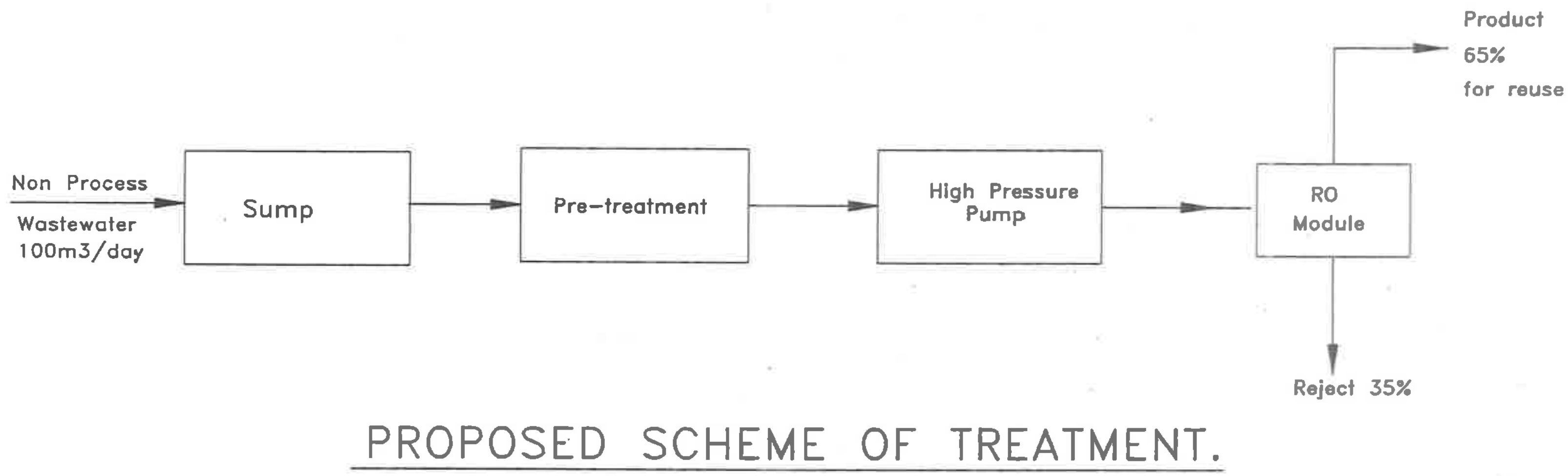


Figure-5.9
Treatment Scheme for Non- Process Effluents



5.4.5.1 Forced Evaporation System

i) Existing

The forced evaporation system at unit-8 is of 25 KL multi- stage evaporator with bottom cone type shell and tube. The total number of evaporators installed are two in total with a condenser of 40 m^2 capacity and 1.5 lakh liter capacity RCC/LDPE line bitumen coated collection tank. The utilities required for the above process are steam of about 2.5 to 4.0 Kg/cm^2 and RT water for cooling. The system has a capacity of treating about 9-10 m^3 of high TDS effluents at a distillation rate of about 500-600 liters per hour and a solar evaporation of 800 M^2 surface area.

ii) Proposed

In addition to the above forced evaporator of capacity to evaporate 25 KLD an additional evaporator of 150 KLD is being proposed to cater to the increased high TDS wastewater quantity of 138 m^3/d generated following the proposed expansion. The condensate from the forces evaporator will be sent to the onsite ETP for further treatment and disposal and the salts resulting from the forced evaporator will be sent to the TSDF. The operating procedure for the forced evaporation system is as follows:

1. The high TDS effluent is collected from various process streams in a common collection tank and is subjected to equalization by adjusting the pH to neutral and the neutralized effluent is pumped into another sump at 5-6 m^3 at a time.

2. The high TDS streams are transferred to the evaporators I & II till it overflows through cock valve at 3000 liters each

3. A known steam pressure of 3-5 Kg/cm^3 is applied to the evaporator I and the vapors are allowed to the evaporator II where the evaporator II gets heated up due to water vapor of the evaporator I

4. Due to the high pressure of vapors from evaporator I, the effluents in the evaporator II gets converted into vapor which on passing through condenser, the distillation of water starts. The distillation is continued

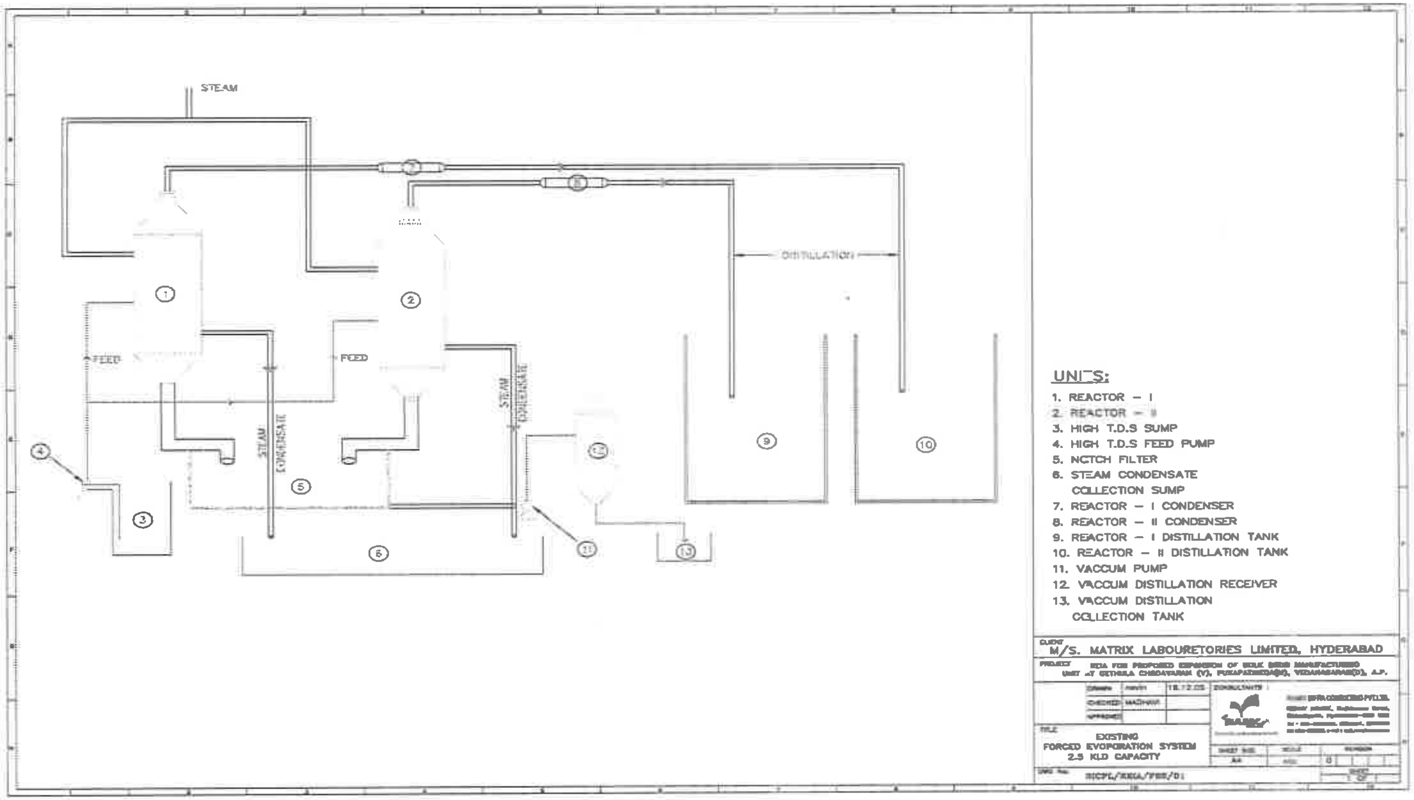
5. The pump is started and the rate of pumping is adjusted in such a way that the distillation from the evaporator is continued keeping the rate of distillation and rate of transfer of high TDS effluents into vapors same

6. The bottom valve of the cone is slowly opened while distillation is being done and to check only residue should be dropped or else it is closed till distillation of 9000 to 10000 liters of high TDS is completed

7. Finally, the residue is drained and is sent to solar evaporation ponds for drying. After the proposed expansion, Matrix Laboratories Ltd is planning to put up a Multiple effect evaporator to treat the increased effluent quantity.

A detailed sketch of the forced evaporation system is given as **Figure 5.9**.

Figure 5.9
Forced Evaporation System



5.4.5.2 MULTIPLE EFFECT EVAPORATOR

Combined high TDS stream from different sections (having an average TDS content of about 10% fixed solids) is fed to calendria after pre-heating. The plant is specially designed for handling the high TDS Effluent. The description is as below:

The preheated feed is then fed to calandria No1 at top, which works on falling film principle. The feed get well distributed to all the tubes due presence of a properly designed efficient liquid distributor. The liquid looses its flash heat if any and accounts for flash evaporation at top of calandria. The liquid has natural free fall and falls in each tube as falling film across the full wall of each tube. The liquid gains heat by heat transfer due to condensing hot vapors on out side surface of tubes. The liquid starts evaporating at constant boiling temperature and both liquid film and evaporated vapors travel down.

The concentrate is collected at bottom portion of calandria from where it is pumped further. The evaporated vapors enter the vapor separator connected at the bottom where due to centrifugal action the droplets get separated out. These droplets are pooled back to the concentrate leaving the bottom portion of calandria. The vapors leave the vapor separator from the top.

Vapors from VS 1 of Calandria No.1 is fed to shell side of Calandria No.2 and part of vapors fed to TVR suction and compressed by high pressure steam to reduce steam consumption and which increases steam economy.

Part of the product moved out from bottom portion of calandria is recycled back to top portion of calandria to maintain required wetting, in the tubes. The balance product is fed into calendria 2. Calendria 2 also works on same Falling Film Principle as Calendria 1.

Second stream i.e Process feed (High TDS) with 20% initial solids is also fed as additional feed to Cal 3. Calandria No. 3 works on forced circulation principle as it handles higher concentration of product. Centrifugal pump takes the product from flash vessel and circulates through the Calandria from the bottom. Adequate velocities are maintained in tubes for better heat transfer and also to retard fowling. The product gains sensible heat as it travels up inside the tubes. Hot vapors on shell side condense and provide the required heat.

The Hot liquid enters the flash vessel through a pressure-reducing device and gets flash evaporated inside the flash vessel. The concentrate gets recycled as explained above and the evaporated vapors move out from center at top of flash vessel. The feed to the forced circulation evaporator is introduced through a side tapping at suction line of pump, and product is discharged from another side tapping at discharge of pump.

Calandria No. 4 also works on same forced circulation principle as Calandria No.3, as it handles further concentrated product. The description is same as that of Cal 3. However, here separate product pump takes out the product. Final concentrate of both feed steams combined is taken out from effect 4.

The condensate generated in effect No1 is taken out from shell side at bottom and flashed on shell side for calendria 2 & similarly from Calandria No. 2 to Calendria No. 3, Calendria No.3 to Calendria No.4. Finally combined condensate is pumped out by a common condensate pump at the lowest temperature. This flash heat recovery greatly helps steam economy.

The non condensables from each effect shell side are drawn parallely and sent to shell side of condenser. The total non condensables are continuously pumped out by a vacuum pump connected to shell side of condenser.

The concentrated mass from the last calendria is taken out in the crystallizer, cooled and filtered to obtain the solids. Solids thus obtained will be collected to bags and transferred to temporary storage shed and then to TSDF. The Instrumentation and control Philosophy for Evaporator is given below:

A central Instrumentation and control panel facilitates the operator to start, stop and monitor the plant from one central place. All the push buttons required for the plant are housed in this panel. Temperature measurement at various places like all pre heater input / output temperature, calandria No.1 shell side temperature, each vapor separator boiling temperatures, cooling water in/out temperatures, calandria outlet vapour temperature for forced circulation evaporator etc are sensed by individual temperature sensors (RTDs) and displayed in sequence in a single scrolling type temperature scanner/indicator housed on panel. One can read these temperatures automatically in sequence or manually at any of the above points randomly. This helps operator to monitor the plant effectively.

An inter lock sequence provided ensures starting and stopping of plant in pre-determined correct sequence only and not other wise due to any mistake in operation. Further interlock for tripping of one pump ensures tripping of all pumps for safety reason.

An alarm enunciator indicates tripping of any pump and abnormal parameters if any. This part provides a facility to monitor the plant and indicates the operator for corrective action.

An automatic PID level control loop checks the level in the bottom of calendria and regulates product flowing out from each evaporator to next evaporator and finally from last effect out. As a result it ensures constant levels and avoids fluctuations in performance of total plant. The loop consists of a level sensor, a PID controller electronic type, an E/P converter (convert electronic signal to pneumatic signal) and a pneumatic control valve.

An automatic PID pressure control loop on inlet steam line ensures constant and safe steam supply to plant ensuring the constant pressure in the calendria no.1.

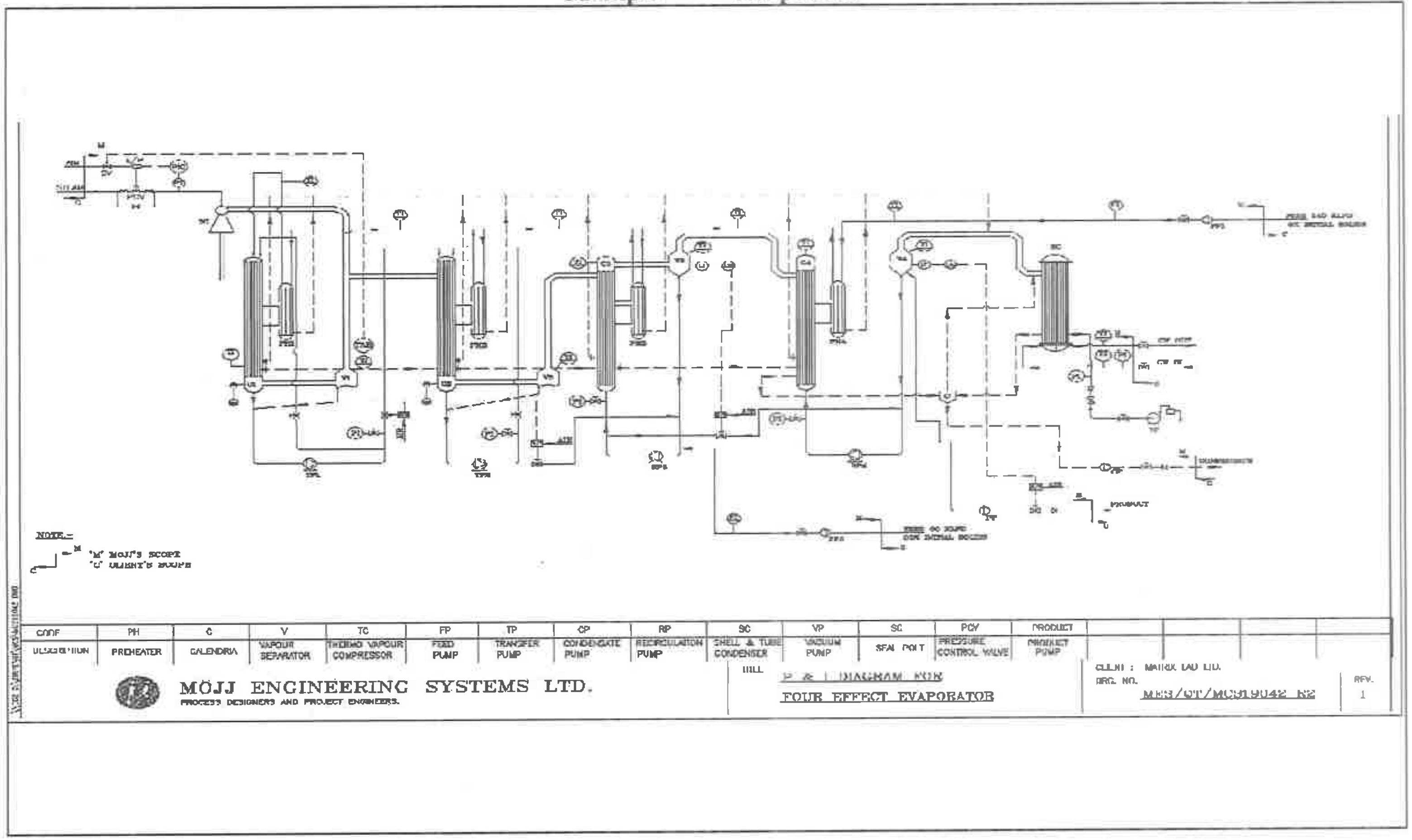
This ensures uniform steam supply to plant and there by uniform performance of plant. This also ensures temperature of first effect not to cross pre-determined value. A solenoid valve loop provided extra ensures safe boiling temperature in effect No 1. These safe temperatures ensure no over heating of product at any stage, which other wise may cause, un desired fowling of tubes.

A magnetic type flow meter is provided on the feed line of the plant so that operator can read and adjusts the feed rate to plant exactly.

With above one can maintain a constant feed rate to plant. A constant supply of steam to plant. As a result the performance of plant is expected to be uniform. Further due to monitoring of safe maximum temperatures on heating and boiling side of first effect no over heating of tubes can occur and as a result charring of product on tubes is avoided.

The detailed sketch of the proposed Multiple Effect Evaporator is given as **Figure 5.10**.

Figure 5.10
Multiple Effect Evaporator



5.4.5.3 Reverse Osmosis System

M/s Matrix Laboratories Limited is proposing to reutilize the non process effluents of about 91 m^3/d coming from the plant i.e the wastewater coming from the Boiler blow down, Cooling tower bleed off, DM Plant , Softener by subjecting them to reverse osmosis system. The reject from the reverse osmosis plant will be disposed off into the sea via marine outfall. The detailed operating procedure of the R.O system is provided here under.

1. Reverse osmosis, also known as hyper filtration, is the finest filtration known. This process will allow the removal of particles as small as ions from a solution.

2. Reverse osmosis is used to purify water and remove salts and other impurities in order to improve the color, taste or properties of the fluid. The most common use for reverse osmosis is in purifying water. It is used to produce water that meets the most demanding specifications that are currently in place.

3. Reverse osmosis uses a membrane that is semi-permeable, allowing the fluid that is being purified to pass through it, while rejecting the contaminants that remain.

4. Reverse osmosis technology uses a process known as cross-flow to allow the membrane to continually clean itself. As some of the fluid passes through the membrane the rest continues downstream, sweeping the rejected species away from the membrane.

5. The process of reverse osmosis requires a driving force to push the fluid through the membrane, and the most common force is pressure from a pump. The higher the pressure, the larger the driving force. As the concentration of the fluid being rejected increases, the driving force required to continue concentrating the fluid increases.

6. Reverse osmosis is capable of rejecting bacteria, salts, sugars, proteins, particles, dyes, and other constituents that have a molecular weight of greater than 150-250 Daltons.

7. The separation of ions with reverse osmosis is aided by charged particles. This means that dissolved ions that carry a charge, such as salts, are more likely to be rejected by the membrane than those that are not charged, such as organics. The larger the charge and the larger the particle, the more likely it will be rejected.

5.4.5.4 Artificial Recharging of Ground Water

Besides putting up a full fledged effluent treatment plant and other infrastructure for treating wastewater from the process and domestic sources in the plant area, M/s Matrix Laboratories Ltd is keen on protecting the natural resources in the area by designing artificial recharge pits for recharging the ground water being drawn for the plant operations.

Percolation pits or Rain water harvesting pits are designed at every 5m intervals all along the periphery of the site and all the pipes transferring the storm water is connected to the pit. The design and the construction of the percolation pit is done in a way to ensure maximum percolation and recharge. The design of the percolation is graphically shown in the following figure.

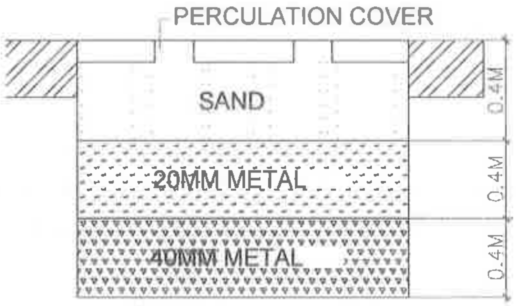


Figure 5.11
Percolation Pits in the Plant Site

5.4.5.5 Depth of Ground Water and Variations

Dug wells are more common in the study area. Nearly 33% of the wells are shallow type and water table is within 6m depth. The deep dug wells are up to a depth of 20 m.

The study of fluctuation in ground water levels by the ground water board (CGWB) reveals that the fluctuation is in the order of 1.65m to 4.42m with an average fluctuation of 3.13 m annually.

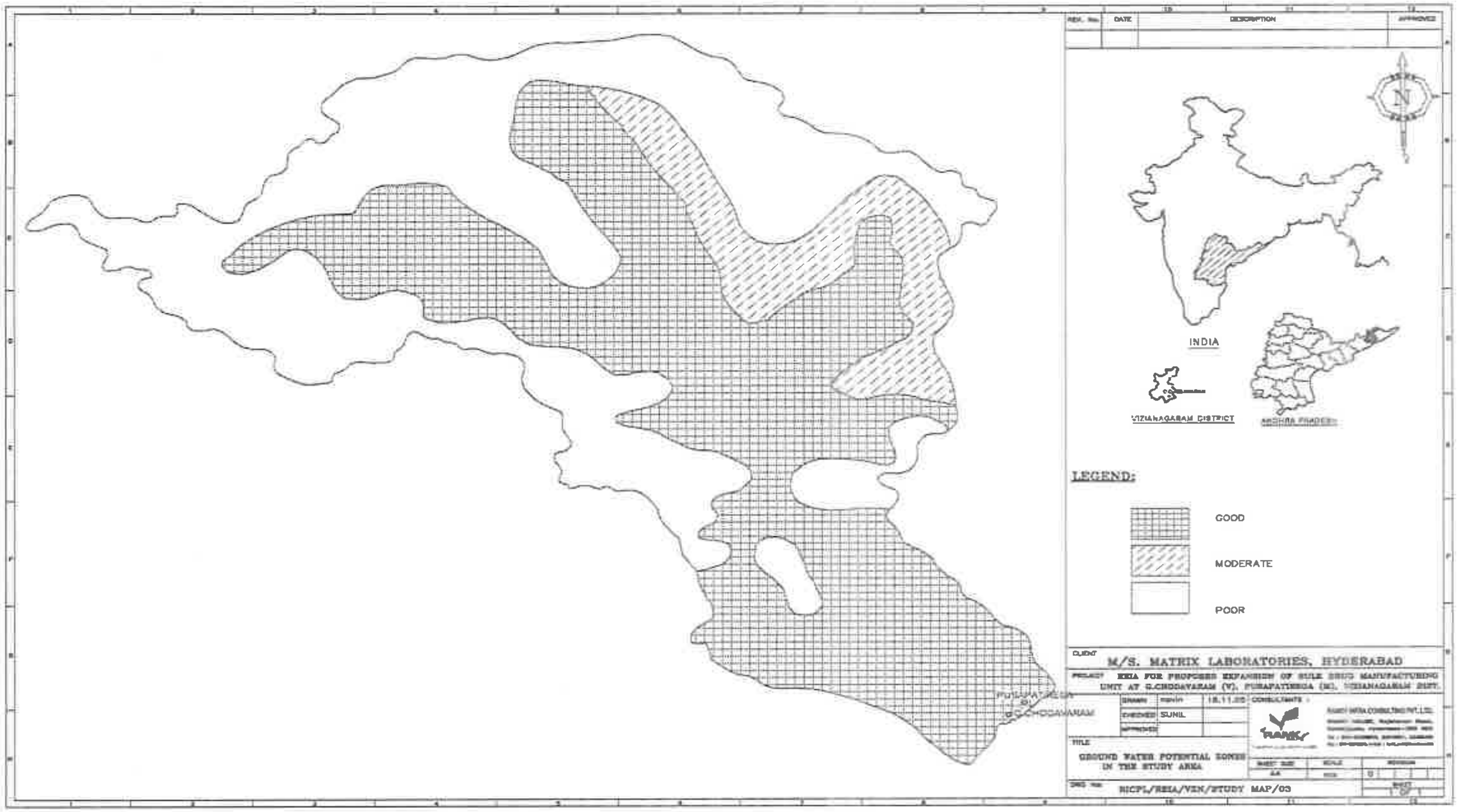
5.4.5.6 Nature of Aquifer

Ground water in the study area occurs under phreatic and semi-confined conditions, the hydro-geological regime of the area is influenced by Champavathi river. Out of the observation wells monitored by the CGWB and the state government, most of them were occurring in the plains followed by ones in the hilly terrains and a few in coastal plains. The static water levels in the pre-monsoon and post-monsoon ranged from 12.10 to 1.72 m bgl and 6.6 to 1.15 m bgl in the area respectively.

The top layer consists of red soil/ sandy loam and Laterite soils with a total thickness of 2-10 m. This layer is underlain by weathered zone in turn underlain by hard rock at many places. But in a few places, the weathered zone is followed by fractured zone. These zones together have the thickness of about 50-80 m has been inferred from the well inventory and soundings. The highest water table fluctuation is observed in hilly terrain and medium to the lowest in Vizianagaram plains and coastal plains. Various landforms formed by the river in the area influence the occurrence, distribution and fluctuations of the water table.

The areas of potential recharge in the study area clearly identified on the district map of Vizianagaram and given as **Figure 5.12**.

Figure 5.12
Ground Water Potential In The Study Area



5.5 MANAGEMENT OF SOLID WASTES

Solid wastes from the proposed bulk drug expansion includes organic residue, spent carbon and hyflow waste, metallic constituents added as catalysts, the sludge from the effluent treatment plant, salts from Forced evaporator etc. The plant has a solid waste incinerator of capacity 800 kg/d and an additional solid waste incinerator of 5000 kg/d and liquid waste incinerator of 1500 kg/d is proposed to be added during expansion.

The characteristics of the sludge from the effluent treatment plant and the incinerator ash have been collected and subjected to analysis for critical parameters. The characteristics of the sludge and the ash are given in the table below.

Table 5.10
Solid Waste Characteristics

Parameter	Unit	ETP Sludge	Incinerator Ash
pH	-	7.61	6.91
Total Volatile Solids	%	75	1-2%
Total Fixed Solids	%	25	98-99%
Chlorides	mg/kg	3091	148102
Sulfates	mg/kg	237	20637
Nitrates	mg/kg	250	1346
Phosphates	mg/kg	11.8	26.9

It is pertinent to mention that both the above wastes are sent to land fill for disposal. The sludge and the incinerator wastes are presently sent to the CHWTSDF at Hyderabad and in future may be sent to the nearest CHWTSDF which is being planned at Visakhapatnam. The characteristics of the wastes and the classifications as per the Hazardous Wastes Handling and Management Rules, 2003 is given in Chapter-IV.

5.5.1 Solid Waste Incinerator

The existing solid waste incinerator of 800 Kg/d was installed by Thermax. The total process solid waste that would be generated following expansion of the unit amounts to about 6500 kg/d. In order to cater to the increased quantity of the solid waste that would be generated following expansion M/s Matrix laboratories limited is proposing to add one solid waste incinerator and one liquid waste incinerator of 5000 kg/d and 1500 kg/d capacities respectively. These incinerators will be installed by Allied furnaces.

Significant solid waste generation from the bulk drug manufacturing unit in the existing form and after the expansion is from the boiler fly ash which is due to the usage of coal as the boiler fuel. The fly ash generated shall be disposed to the local brick manufacturers and the characterization of the fly ash is inert in nature. M/s Matrix Laboratories Ltd is also planning to recover economically important organic solid wastes like Acetyl yara yara, DMF and TEA and plans to sell them to the third parties while the rest will be sent to the onsite incinerator. This procedure not only reduces the waste generated from the plant but also generates income incurred to the plant. The stage wise solid waste generated from the proposed products is given in detail in chapter 4 of this report.

The characteristics and the quanity of the solid waste going to incinerator are given in **Table 5.11**.

Table 5.11
Solid Waste Quantity and Composition

S. No	Type of waste	Composition	Average CV	Type of waste	Feed rate Kg/hr
1	Solid Waste	90% Organics 5% In organics 5% Moisture	4000	5000	250
2	Liquid Waste	100% Organics	6000	1500	75
3	High TDS stream	Water	Nil	20 Kl	1000

System Description and Operational Methodology

Rotary kiln is a versatile chamber for handling all kinds of waste. Rotary Kiln mainly consists of rotating horizontal shell fixed with charging and discharge hoods at both ends, supported by two sets of trunion and thrust roller assembly. The shell will be rotated by girth gear and pinion sprocket mechanism using the reduction gear box with variable speed drive to adjust the required kiln speed. The charging hood has openings for the, burner, charging chute, liquid waste injection nozzle.

The Rotary Kiln will be of direct firing type with burner at front end. The products of combustion flow with the moving waste will transfer the heat to wastes co-currently. The gases evolved from the wastes will be routed to the post combustion chamber. The ashes and non-combustible matters if any will be collected at the discharge end of the kiln.

Liquid waste injection

Pumpable liquid / aqueous wastes will be sprayed in the Rotary Kiln through lances

Solid waste handling

A cart dumper lifts the packets to the mouth of hopper. The waste drops into the hopper.

Operation

The kiln rotation / tumbling action exposes the waste to heat continuously resulting incomplete removal of organics. The waste retention time, which is a function of kiln geometry and rotation speed, can be varied by a variable speed drive (VVF)

Ash Discharge Mechanism

Kiln is operated in non-slagging mode, by controlling the temperature, to avoid melting of salts. The ash tumbles out of the Rotary Kiln through the bottom opening of the discharge hood. The hot ash will be then collected in a bin with quench arrangement.

Post Combustion Chamber

The volatile gases from the kiln will be incinerated at post combustion chamber by thermal oxidation. The necessary air for combustion will be provided at the post combustion chamber. The burner provided here will ignite these gases and will act as the support flame for sustaining the combustion of the gases. The chamber will be maintained at a temperature of 11000°C ± 100°C with 2 seconds residence time to enable the complete oxidation of the gases. Fuel will be added to maintain this temperature, and sufficient turbulence is provided using air jets and baffle wall arrangement. Thus the 3 Ts of incineration i.e. time, temperature and turbulence is achieved

Maximum Oxidation Efficiency

To get high oxidation efficiency for the destruction of all volatile organic compounds, post combustion chamber will be designed to assure the minimum values of the following operating conditions for 99.99% destruction and removal efficiency.

- Temperature
- Residence time
- Turbulence

Temperature

Temperature is controlled by controlling the fuel burning rate through the burners automatically.

Residence Time

Sufficient residence time for flue gases will be provided in the post combustion chamber. The dimensions of the chamber itself are such as to give the residence time more than 2 seconds under all operating conditions.

Turbulence

Good turbulence is assured by proper design of inlet suction to the post combustion chamber. It is positioned such that the incoming V.O.C. laden flue gases should pass through the burner flame under excess air condition. In addition, the direction of flame assure a swirling vortex action which maximizes turbulence of the burning mass.

Interconnecting Ductings

All interconnecting ductings considered by us in our offer will be made out IS : 2062 grade-A, 5 mm thick plates with refractory lining from inside / external insulation, as required. Flange joints are provided as per requirement.

COMBUSTION SYSTEM

The combustion system mainly consists of :

- Burners
- Combustion air fan
- Necessary pipelines and valves.

The combustion system covered under our offer consists of fuel burners suitable for Gas, complete with combustion air blower fuel heating and pumping unit and air pipings, valves, etc., within our battery limit. The burners will be external mix low air pressure atomisation type and complete with sequence burner control, auto ignition system, flame failure device, etc.

The components are sufficient to ensure smooth and safe operation of the burners with controls on low / high pressure, no flame, high / low temperature of chambers, etc. The components are of reliable make. The burners will be of low NO_x type to maintain the NO_x level.

A separate combustion air blower is provided to give necessary air required for the combustion of fuel and wastes in the post combustion chamber. The necessary piping with valves and gauges will be provided for the air line upto the chamber. These pipelines will be of ERW `B' class and flange jointed.

Gas Cooling System

The gases leaving the post combustion chamber and Spray Incinerator are at 1100°C.These gasses are first cooled by air to around 800 and quenched to 200°C with high TDS water in spray drier. The evaporator is of co-current type. Here your RO Rejects free can be sprayed into the chamber to cool the products of combustion from the post combustion chamber.

The water / high T.D.S. effluent is sprayed into the chamber with the help of a centrifugal pump and atomized using disc atomiser. Water absorbs heat from the hot gases for its latent heat of evaporation thereby reducing the temperature of the total mixture. The evaporator works on the principle of spray dryer, and salts can be collected at bottom. Thus you get indirect heat recovery as well as Zero Liquid Discharge form your system. Rapid quenching of flue gases from 800°C to 200°C ensures that dioxins & furons are not formed.

The evaporator is of vertical cylindrical construction and is made of IS:2062 grade-A, 5mm plate with adequate gussets and stiffeners. Equipment is suitable refractory lining in order to avoid heat losses and to maintain the low skin temperature. Multiple cyclone separators are used for trapping of solids

Scrubbing System

The scrubbing system consists of:

- Venturi scrubber - for SPM trapping and gas scrubbing
- Droplet separator - for gas – liquid separation

- Demister pad - for moisture removal
- Recirculation tanks and pumps are used for circulating the scrubber liquor
- Parameters like SO_2, HCl and suspended particulate matters that are generated in the process are reduced to acceptable level in the flue gas scrubbing system. At this stage, acidic polluting gases are absorbed and transferred from gases into neutralised liquid according to the following chemical reaction:

$HCl + NaOH \longrightarrow NaCl + H_2O$

$SO_2 + \frac{1}{2} O_2 + 2\ NaOH \longrightarrow Na_2SO_4 + H_2O$

I.D Fan

Induced draught fan of reputed make will be supplied along with the system. It will be of centrifugal type and will be complete with motor, pulleys, V-belts, etc. The impeller and shaft of the I.D. fan will be of SS-316 material. The I.D. Fan is meant to ensure a negative pressure throughout the working system. V.V.V.F. drive is provided to vary the speed of fan since the load variation can be taken care. This will avoid any toxic gases escaping to the atmosphere without proper incineration.

Chimney

The off gases after cleaning will be discharged into the atmosphere through a stack of 40 metres height having a top diameter of 1200 mm. The stack will have sampling point at 15 m. Elevation, manhole, drain point, ladder and platform upto the sampling nozzle, lightning arrestor with conductor strip. The top edge, of 300 mm height, will be of SS-316 to avoid edge corrosion. The chimney is of self supporting type broadly conform to IS 6533 standards.

Refractories and Insulation

Refractory bricks manufactured by dry press process with high quality selected and blended fireclays, pre-calcined to high temperature will be used. Special shaped bricks will be used to form circles and circular shapes wherever required. The bricks will be with low impurities percentage and high refractoriness, volume stability at high temperature, spalling resistance and ability to withstand slag penetration. The refractories will conform to Indian Standard Specifications [IS : 8]. The castable material wherever used will be of standard A.C.C. make and will be hydraulic setting type. M.S. Anchors welded to the plate at regular spacing will hold the castable in position and keep the lining monolithic.

Motor Control Centre Panel

Self standing, sheet metal cubicle, fabricated from 14 SWG CRCA steel, complete with relays, contactors, fuse meters, control instruments, busbar, gland plates, indicating lamps, alarm hooter, selector switch, etc. The panel will be suitable for front operation. The housing of motor control centre will be dust and vermin proof design conforming toIP:54 as per IS:2147. The minimum size of wire for control circuit will be 1.5 mm2, whereas it will be 2.5 mm2 for power circuit. This panel will be non-compartmental, non-draw out type. The control circuit will operate at 240volts, A.C., 50 hz, single phase supply available from phase and neutral.

P.L.C. - P.C. Based Control System

A P.L.C. based control panel will be supplied for carrying out all temperature control and logical operations. A commercial P.C. based operator work station linked to the P.L.C. will also be provided with the supervisory SCADA package. Alarm annunciations, trenchings and mimics will be developed using the SCADA package. P.L.C. Panel will control the following functions of the process:

[1] All safety controls and interlocks
[2] Temperatures at primary chamber, post combustion chamber and quencher
[3] Pressure control of water spray at quencher
[4] Suction pressure control at chambers

P.I.D. loops required will be generated in the P.L.C. software and no separate P.I.D. controllers will be used. The entire system will be supplied with one no. printer. While using the P.C. based operator panel, all operations of the above equipment will be handled from the P.C. which replaces most of the selector switches, push buttons, indicating lamps which would have been in the control system when contactor logic and discrete controllers are used instead of P.L.C. All digital and analog input / output modules will be arranged on the rack with C.P.U. and power supply inside the P.L.C. panel. All I/Os will be wired upto the terminal blocks provided for cable termination from the field. Sufficient M.C.B.'s will beprovided for I/O modules and C.P.U. to safeguard the modules. P.L.C. used will be from Siemens / Ge-Fanuc / Allen Bradley or equivalent makes.

Quality of Residues After Incineration

Based on the analysis and from our past experience, ash / residue after incineration can be easily collected at discharge hood this can be collected in water sealed pot arrangement. The salts evenly spread are unlikely to come together as a fusion mass because percentage of salts present in the waste are comparatively less. Carbon will be comfortably oxidised leaving the salts free.

Achievement / Control of Emission Limits

The burners installed at Rotary Kiln and post combustion chamber are of low air pressure type with controlled air supply ensuring lower NO_x formation. At the post combustion chamber, the incineration process is done with excess air well distributed to avoid formation of phosgene, CO or HC. The other parameters like SO_2, HCl and suspended particulate matters that are generated in the process are reduced to acceptable level in the flue gas scrubbing system. At this stage, acidic polluting gases are absorbed and transferred from gases into neutralized liquid according to the following chemical reaction

Prevention of Dioxins

The system is designed to provide sufficient residence time, high temperature [above 10000°C] with sufficient turbulence. This ensures total destructions of all organics and suppression of release of free Chlorine from waste with enough Hydrogen potential. Since high oxygen potential is also maintained, all hydrocarbons are oxidised. The rapid cooling the flue gasses from 1000°C to around 200°C, reduces the chances of Dioxin formation.

Emission Norms

System is designed to meet the following PCB emission norms:

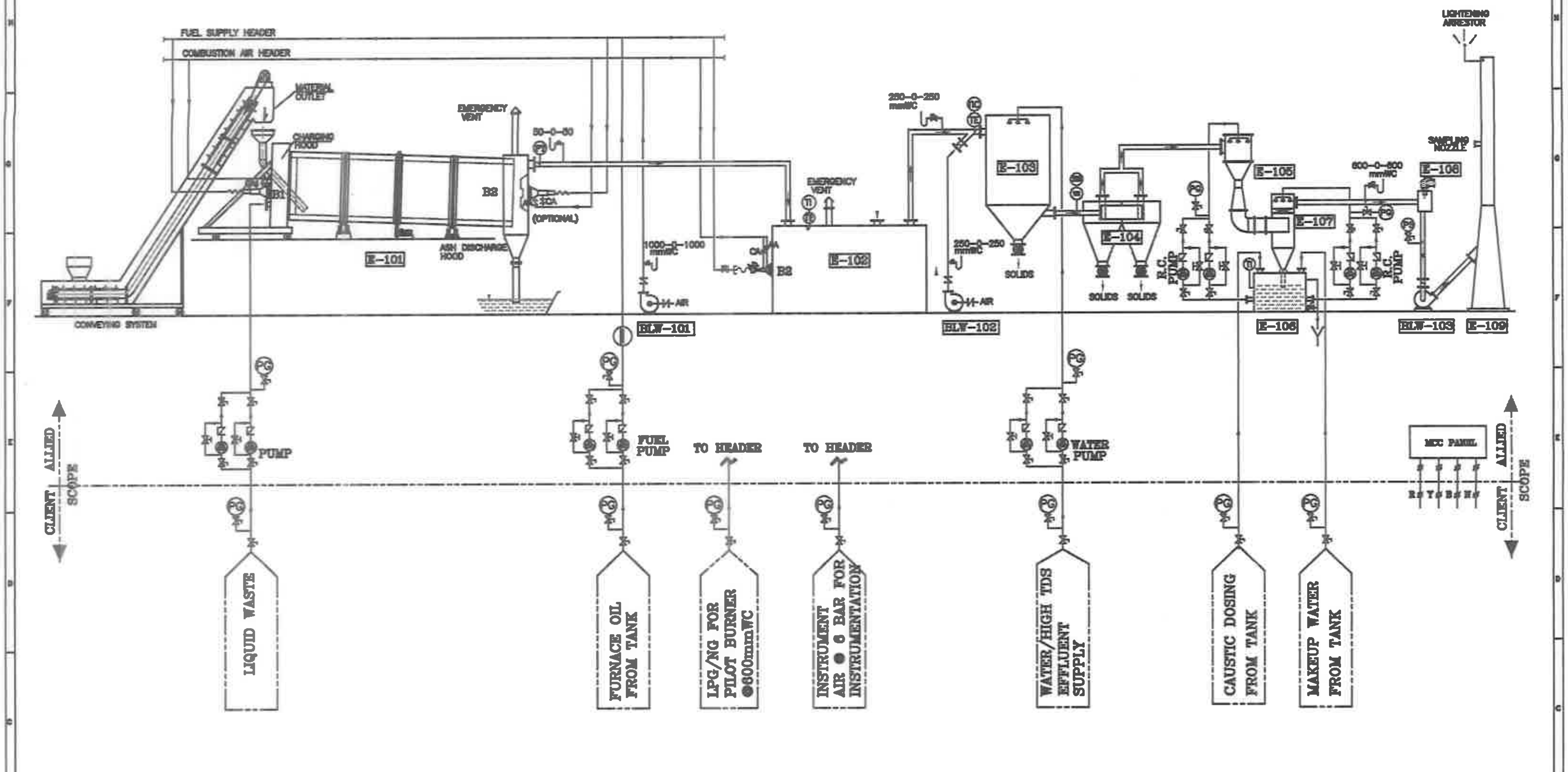
- Particulates : 50 mg/Nm^3
- SO_2 : 200 mg/Nm^3
- CO : 100 mg/Nm^3
- HCl : 50 mg/nm^3
- NO_x : 400 mg/Nm^3

Technical specifications Of the Proposed Incinerator

The general specifications of the incinerator are given in the table below.

Equipment	Rotary Kiln Incinerator
Location of Installation	Vishakapatnam
Operation Hours	Continuous
Capacity of Incinerator	250 Kg/hr Solid waste and 75 Kg/hr Liquid waste

The complete technical specifications for all the units of the incinerator have been attached as annexure at the end of this chapter and the design of the incinerator has been given in **Figure 5.13**.



NO.	EQPT. NAME
E-101	ROTARY KILN
E-102	POST COMBUSTION CHAMBER
E-103	SPRAY EVAPORATIVE COOLER
E-104	MULTI CYCLONE
E-105	VENTURI SCRUBBER
E-106	RECIRCULATION TANK
E-107	DROPLET SEPERATOR
E-108	REHEATER
E-109	STACK
BLW-101	COMBUSTION AIR BLOWER
BLW-102	EXCESS AIR BLOWER
BLW-103	I.D.FAN
B1-B2	FUEL BURNER

LEGEND	
	BALL VALVE
	BUTTERFLY VALVE
	GATE VALVE
	GLOBE VALVE
	AIR VENT
	NEEDLE VALVE
	NON RETURN VALVE
	'U' TUBE MANOMETER

LEGEND	
	LEVEL INDICATOR
	DAMPER
	OPEN DRAIN
	HEATER
	PROCESS LINING
	FLUE DUCT

ALLIED FURNACES

ALLIED HOUSE 1st ROAD, CHEMBUR, MUMBAI -400 071

DRN.	YOGESH	22.6.06	CLIENT:- MATRIX LABORATORIES LTD. VISHAKHAPATNAM
CHD.	NKM		
APPD.			
SCALE		N.T.S.	EQUIPMENT :- INCINERATION SYSTEM
WT. IN kgs.		-	TITLE :- FLOW DIAGRAM
JOB No.	AF/Q06/196	DRG. No.:- AF/Q06/196/01	REV.:- 0

5.6 CONTROL OF NOISE POLLUTION

The noise generating units in the plant is boiler, DG set, Compressors etc. The noise drops to 45 dB (A) at a distance of 1.5 km from the project site. As the nearest habitat is more than 1.5 km from the project site the impact on the general public will be minimal. However all necessary precautionary measures like ear plugs to workers, regular maintenance of noise generating equipment will be carried out to reduce the noise levels. The ambient noise levels recorded in the plant area are presented in table below.

Table 5.12
Noise Levels in the Plant Area

S. No	Location	Noise Levels dB(A)
1	Security Room	56.1
2	Canteen	55.5
3	Production Block-I	68.1
4	Production Block-II	67.8
5	Near Boiler House	52.6 (Shut down)
6	Near Administrative Block	57.7
7	Store Yard	49.1
8	DG Set	56.2 (Shut Down)
9	Cooling Tower	80.2
10	Chilling tower	62.0

The noise levels at the boundary of the plant are 50 dB(A).

5.6.1 Noise Pollution Management

The existing noise pollution management measures are;

- Acoustic Enclosure for all the high noise level equipments
- All the design/installation precautions as specified by the manufacturers with respect to noise control are strictly adhered to

- High noise generating sources are insulated adequately by providing suitable enclosures;
- Other than the regular maintenance of the various equipment, ear plugs are provided to the personnel close to the noise generating units;
- All the openings like covers, partitions are designed properly.

5.7 GREEN BELT DEVELOPMENT

MLL has an area of 20.00 Ha allocated for green belt. The same is being retained now without any disturbances. The green belt is well developed and helps to capture the fugitive emissions, attenuate the noise generated and improve the aesthetics. Attempts are always being made to ensure that all open spaces, where tree plantation may not possible, will be covered with shrubs and grass to prevent erosion of topsoil. Adequate attention is being paid to maintenance and protection of green belt.

5.8 WASTE MINIMIZATION OPTIONS

Matrix Laboratories Ltd is a cGMP certified bulk drug and activated pharmaceutical ingredients manufacturer. It is a corporate philosophy at Matrix Laboratories Ltd that there should be maximum resource conservation in order to conserve the natural resources available and thus making a way for a sustainable development regionally as well as globally. In this context, Matrix Laboratories Ltd is implementing the following waste minimization options.

❖ Recycle and reuse of condensate water from the utilities like DM plant for boiler feed to meet the steam requirement and thus reducing the dependency on fresh water for utilities.

❖ Solvent recovery to ensure that no fugitive emissions are let out during the handling of raw materials and also during the operations. This is also done because most of the solvents used in the manufacturing process are expensive. Almost 97-98% of the solvents are recovered so as to reduce costs towards buying them.

- Process emissions are scrubbed and if any gas is found to be useful in the process it shall be used.
- Certain organic residues are recovered and sold to authorized dealers
- Fly ash is utilized for brick manufacturers in the area

5.9 ENVIRONMENTAL MANAGEMENT CELL

An efficient environmental management cell exists at Matrix laboratories Ltd. The Environmental Cell is headed by the General Manager followed by the senior Manager (Environment). They are supported by engineers and chemists and horticulturist along with other technicians.

The department is the nodal agency to co-ordinate and provides necessary services on environmental issues during operation of the project. This environmental group is responsible for implementation of environmental management plan, interaction with the environmental regulatory agencies, reviewing draft policy and planning. This department interacts with Andhra Pradesh State Pollution Control Board (APPCB) and other environment regulatory agencies. The department also interacts with local people to understand their problems and to formulate appropriate community development plan.

5.10 COMPLIANCE TO CONSENT CONDITIONS AS PER SCHEDULE-B

As per the existing CFE/ CFO, Matrix Laboratories Ltd, Unit-8 was directed to comply to the following conditions as per the Schedule-B to which Matrix Laboratories Ltd, Unit-8 has complied. The details of the compliance to the Schedule-B of the consent are given below in **Table 5.13**.

Table 5.13
Compliance to Schedule-B of the Consents

Consent Condition	Compliance
Industry shall not manufacture any new products without obtaining CFE of the Board	No new products without obtaining CFE are being manufactured
The industry shall comply with CREP recommendations with reference to Bulk Drugs Manufacturing	CREP recommendations are being complied and the CREP is given at the end of this report
Industry shall install flow meter with totalizer at the Pumping Station at Thammayyapalem to record the effluent pumped into sea	A flow meter has been installed at the Pump House at Thammayyapalem
The industry shall carryout groundwater monitoring in their premises through groundwater department by providing 2-3 observation wells	2 observations wells are being monitored regularly by third party agencies and periodically by the groundwater department
The industry shall submit monthly data to the R.O/Z.O of APPCB regarding production and wastewater disposal	Monthly reports are being submitted to the R.O
The industry shall comply with Hazardous Wastes (Management & Handling) Rules, 1989 abd Amendments thereof	Complied
The industry shall remit water cess amounts, as and when assessment orders are issued by the Board	Complied
The industry shall restrict the production to the quantities permitted by the Board scrupulously	Complied

5.11 POST PROJECT MONITORING

A well-defined environmental monitoring program exists and the same would be followed for the expansion project. It would be ensured that trained and qualified staff supervises the monitoring of ambient air, stack gases, effluents, noise, etc. to see that prescribed standards laid down in the consent are obtained. The post project monitoring works is summarized in the following table:

Table 5.14
Environmental Management Plan

Environmental Component	Locations	Frequency	Parameters
Ambient Air quality	Three AAQ stations located at 120^0 angle between each	-Once in a month	For SPM, SO_2, NO_x
Stack Emissions	Plant site	Boilers and DG set	For SPM, SO_2 and NO_x
Process Emissions	Production Block, storage area	Once in a month	All solvents.
Wastewater quality	ETP(Inlet & Outlet)	Once in a month	pH, EC, TDS, SS, COD, BOD, Cl, SO_4, O & G.
Groundwater Quality	Borewells inside the plant	Once in 6 months	For IS 10500 parameters
Solid waste	Storage area	Every container sent to TDSF	-

In order to comply with the environmental protection measures as suggested in the above sections, Matrix Laboratories Ltd has allotted Rs. 12.0 Crores towards the following described in **Table 5.15**.

Table 5.15

Costs Towards Environmental Infrastructure

Environmental Protection Measures	Costs in INR in Lakhs
Water Pollution Control & Management	
1. Effluent Treatment Plant	400.00
2. Reverse Osmosis System	100.00
3. Multiple Effect Evaporator	200.00
4. On-shore pipeline for marine disposal	100.00
Air Pollution Control & Management	
1. Scrubbers	20.00
2.Multiclones	10.00
Hazardous Wastes Management	
Incinerator	250.00
Environmental Monitoring & Analysis	20.00
Total	**1100.00**

The six months stack monitoring data for both the boiler and the incinerator, the treated effluent characteristics and the ambient air quality as monitored in the plant site at various locations have been presented in tables below.

Table 5.16

Air Quality (Stack Emissions)

S. No	Parameter	Units	Month					
			April	March	February	January	December	November
			2006				2005	
Stack attached to 5.0 TPH Coal Fired Boiler								
1	PM	mg/Nm^3	92	187	93	90	90	83
2	SO_2	mg/Nm^3	90	77	88	77	76	77
3	NO_X	mg/Nm^3	66	49	61	55	55	44
Stack attached to the 800 Kg/d Incinerator								
4	PM	mg/Nm^3	73	72	80	90	74	78
5	SO_2	mg/Nm^3	41	42	37	48	35	39
6	NO_X	mg/Nm^3	36	44	41	38	40	41

- From the above table it can be observed that the stack emissions for both the boiler and the incinerator were within the permissible limits.

Table 5.17

Treated Effluent Analysis (From ETP)

S. No	Parameter	Units	APPCB Standard	Month					
				April	March	February	January	December	November
1	pH	-	6.5-8.5	7.4	7.9	7.7	7.9	7.4	7.9
2	COD	mg/l	250	192	177	184	175	195	177
3	BOD	mg/l	100	88	79	86	83	90	81
4	TSS	mg/l	100	57	52	44	50	57	40

- As seen from the above table all the parameters monitored were well within the permissible limits.

Table 5.18

Ambient Air Quality in the Plant Site

S. No	Parameters	Units	Standard	Months					
				April	March	February	January	December	November
Security Gate (E)									
1	TSPM	μg/m³	200	138	143	160	153	165	166
2	RSPM	μg/m³	100	40	52	47	34	42	44
3	SO_2	μg/m³	80	11.4	11.6	11	12	12.4	13.4
4	NO_X	μg/m³	80	19.8	24.2	22.3	20.5	22	24.7
Production Block-4 (W)									
5	TSPM	μg/m³	200	146	144	141	140	147	133
6	RSPM	μg/m³	100	52	49	44	43	43	39
7	SO_2	μg/m³	80	11.6	10.8	10.2	9.7	11	11.2

S. No	Parameters	Units	Standard	Months					
				April	March	February	January	December	November
8	NO_X	µg/m³	80	21.3	22.4	22.8	23	23.5	19.8
Back Side of ETP (S)									
9	TSPM	µg/m³	200	122	117	129	141	152	152
10	RSPM	µg/m³	100	45	35	36	37	46	47
11	SO_2	µg/m³	80	8.8	11	9.9	10.4	12	11.6
12	NO_X	µg/m³	80	17.6	22.5	20.6	24	21.8	21.5

- All the values were within the permissible limits given for the rural areas.

The details of the VOC,s monitored in the plant and the methodology adopted have been presented below.

Table 5.19
Details Of VOCs Monitoring Locations

S. No	Manufacturing Block	Location	Solvents in usage in Mfg. While monitoring VOC
1	PB-01	Centre of the PB-01 At Ground Floor	Toluene
2	PB-02	Tray Dryer (TD-201), (TD-202) Room	Ethyl Acetate, Ethanol, Methanol
3	PB-03	Centre of the PB-03 At First Floor & Second Floor	Methanol, Toluene
4	PB-04	Centre of the PB-04 At First Floor	Toluene, Acetone, Methanol

Table 5.20
VOC Concentration In The Air

S. No	Manufacturing Block Location	Exposure of Volatile Ogranic Compound (with TLV Limit)	Total VOCs Value
1	PB-01: Centre of the PB-01 at Ground Floor	Toluene (50 ppm)	15 ppm
2	PB-02: Tray Dryer (TD-201), (TD-202) Room	Ethyl Acetate (400 ppm), Ethanol (1000 ppm), Methanol (200 ppm)	382 ppm
3	PB-03: Centre of the PB-03 at First Floor & Second Floor	Methanol (200 ppm), Toluene (50 ppm)	21 ppm
4	PB-04: Centre of the PB-04 at First Floor	Toluene (50 ppm), Acetone (500 ppm), Methanol (200 ppm)	35 ppm

Methodology Adopted

The Total Volatile Organic Compounds (TVOCs) monitor is a dual channel Photo Ionization Detector (PID) and consists of an electrodeless discharge UV lamp as the high energy Photon source for the PID. Both channels of the Detector are located in the ionization chamber. As organic vapour pass by the lamp, they are photo-ionized and the ejected electrons are detected as current.

The first channel current primarily results from the ionized gases. The second channel current measured the ionized gases plus photoelectric emission of electrons from the metal surface, which is a function of the UV light intensity. The dual channel currents can thus be used to compensate the variation of the light intensity due to lamp contamination and degradation.

The dual channel structure allows the VOC monitor to determine the ionizable gas concentration accurately to a ppm (parts per million) level without frequent calibrations. The PID sensor detects a broad range of organic vapours. The standard lamp yields the best resolution and sensitivity. The lamp is powered with high photon energies to measure a greater number of compounds, whereas, low photon energies are selectively for easily ionizable compounds such as aromatics.

The PID sensor for the VOC monitor is constructed as a small cavity in front of the UV lamp. A diaphragm inside the monitor continuously draws air through the sensor and then discharges it through a gas outlet port on the side of the monitor.

A single chip microcomputer is used to control the operation, which measures the sensor readings and calculates the gas concentrations based on calibration to know standard gases.

This VOCs monitor has the capacity to measure VOCs in the range of low levels (1 ppm) to 1000 ppm. PID provides a compact, accurate, affordable and reliable real time gas monitoring of Total Volatile Organic Compounds.

VOC Monitor Details

Monitoring has been performed by using VOC monitor manufactured by RAE Systems INC., USA; Model: Mini RAE; Equipment Serial No.: 900144. The content of total Volatile Organic Compounds has been monitored at each and every place in the particular Block/Location, but the VOC value represented here in this document is only the overall highest value observed. In principle, the equipment is being calibrated before and after the monitoring of the VOCs. The VOC monitor is calibrated by Isobutylene gas (concentration 100 ppm, Lot No. 85054 Cyl 33, Expiry Date of Isobutylene: July 2008)

Annexures

ANNEX - 1

MATRIX LABORATORIES LTD.
INCINERATION SYSTEM
ANNEXURE-III
TECHNICAL SPECIFICATION

1.0 GENERAL SPECIFICATIONS

Equipment	:	Rotary Kiln Incinerator
Location of Installation	:	Vishakhapatnam
Operation Hours	:	Continuous
Capacity of Incinerator	:	250 kg/hr Solid waste 75 kg/hr liquid waste
Thermal Capacity of system	:	1.65 M Kcal/hr

2.0 ROTARY KILN

2.1	Process principle	:	Partial oxidation
2.2	Type of operation	:	Continuous.
2.3	Operating temperature	:	$850^0C \pm 50^0C$.
2.4	Design temperature	:	1000^0C.
2.4	Overall size of chamber [Kiln]	:	2.0 m Ø x 5.0 m length [Tentative].
2.6	Material of construction of Kiln [shell]	:	Boiler quality, plate.
2.7	M.O.C. of charging and discharging	:	IS : 2062 grade-A, 5 mm thick plates
2.8	Refractory lining	:	200 mm thick shaped fire bricks.
2.9	No. of riding rings	:	2 Nos. of forged steel.
2.10	Support rollers with shaft and bearings	:	2 Sets of forged steel.
2.11	Thrust roller assemblies	:	2 Sets.
2.12	Main drive	:	Girth gear and pinion sprocket.
2.13	RPM	:	0.5 - 2.0.
2.14	Drive motor	:	10 hp / 750 rpm with VVVF drive
2.15	Ash discharge	:	From discharging hood
2.16	Ash collection	:	In ash bins with water quench
2.17	Accessories	:	Emergency stack, manhole, view ports

ANNEX - 1

2.18 WASTE FEED ARRANGEMENT

2.18.1 Solid Wastes	:	Cart dumper with hoist Hopper with Double flap valve

2.19 Spray Lances for Aqueous Wastes

2.19.1. Type	:	Air atomized nozzles
2.19.2. Air required	:	200 kg/hr @ 6 kg pressure
2.19.3. Capacity	:	100 kg/hr each

2.20 Liquid waste Pumping unit :

2.20.1. Type	:	Gear Pump
2.20.2. Capacity	:	500 litres/hour.
2.20.3. Pressure	:	5 kg/cm^2.
2.20.2 Recommended motor	:	0.5 HP / 2800 rpm
2.20.5. Make of pump	:	Prakash / Rottdel / Equivalent
2.20.6. Quantity	:	1 No. + 1 standby

3.0. **POST COMBUSTION CHAMBER** :

3.1.	Service	:	To destroy the V.O.C. from kiln
3.2.	Material of construction	:	IS : 2062 grade-A, 5 mm thick shell with adequate stiffeners.
3.3.	Refractory lining	:	115 mm Fire bricks [60% Alumina], 115 mm Hot face insulation bricks, 115 mm Cold face insulation bricks 25 mm HYSIL Blocks.
3.4.	Operating temperature	:	$1100^0C + 100\ ^0C$
3.5.	Design temperature	:	1250^0C.
3.6	Overall dimension	:	2 m x 6.5 m length [Tentative]
3.7	Quantity	:	1 no
3.8	Accessories	:	View ports, manhole, access door, emergency vent etc.

4.0 INTERCONNECTING DUCTING and FLANGES

4.1.	Material of construction	:	IS : 2062 grade-A, of 5 mm thick plate.
4.2.	Flange thickness	:	12 mm thick.
4.3.	Refractory lining (depends on temperature)	:	115 mm IS : 6 quality fire bricks. 115 mm Insulation bricks

5.0. COMBUSTION SYSTEM : -

5.1. Fuel Burner :

5.1.1. Type : Low air pressure with external automation.

5.1.2. Burner locations and capacities
Option 1 :

Location	Nos.
Rotary Kiln	1 no.
Secondary chamber	1 no.

5.1.3. Fuel : Furnace Oil

5.1.4. Turn-down ratio : 3 : 1.

5.1.5. Make of L.A.P. burner : Continental / Equivalent.

5.1.6. Accessories of burner : Burner block, sensitrol oil valve, solenoid valves, butterfly valves, pilot ignition, U.V. flame detector and burner management system., panel etc.

5.2. Fuel Pumping and pumping Unit :

5.2.1.	Type	:	Gear pump.
5.2.2.	Capacity	:	500 litres/hour.
5.2.3.	Pressure	:	3-5 kg/cm^2.
5.2.4.	Recommended motor	:	0.5 HP / 2800 rpm
5.2.5.	Make of pump	:	Tushaco / Prakash/Rotodel/ Equivalent.
5.2.6	Accessories	:	Ring main system, heating unit etc.
5.2.7.	Quantity	:	Duplex
5.2.8	Heater type and capacity	:	Cartridge type electrical heater 10 kwh

ANNEX - 1

6.0 BLOWERS

6.1 COMBUSTION AIR BLOWER

6.1.1. Type	:	Centrifugal, direct driven.
6.1.2. Capacity	:	1000 m^3/hour.
6.1.4. Static pressure @ 20^0C	:	1200 mm WC.
6.1.5. Connected motor	:	10 HP.
6.1.6. Material of construction	:	IS : 2062 grade-A.
6.1.7. Make	:	Swastika / Universal / Equivalent.
6.1.8 Quantity	:	1 No.

6.2 EXCESS AIR BLOWER

6.2.1. Type	:	Centrifugal, direct driven.
6.2.2. Capacity	:	5000 m^3/hour.
6.2.3. Static pressure @ 20^0C	:	200 mm WC.
6.2.4. Connected motor	:	10 HP.
6.2.5. Material of construction	:	IS : 2062 grade-A.
6.2.6. Make	:	Swastika / Universal / Equivalent.
6.2.7 Quantity	:	1 No.

ANNEX - 1

7.0. <u>**GAS COOLING SYSTEM**</u> : -

7.1 Spray Drier

7.1.1.	Type	:	Co-current.
7.1.2.	Inlet gas temperature	:	$800^0C \pm 50^0C$.
7.1.3.	Outlet gas temperature	:	200^0C.
7.1.4.	Quench media	:	10% TDS effluent
7.1.5.	Quench water feed rate	:	1500 kg/hour.
7.1.6.	Quench medium pressure	:	3 kg/cm^2
7.1.7.	Material of construction	:	IS : 2062 grade-A + refractory lined.
7.1.8.	Overall size of chamber	:	4 m dia x 12 m height [Tentative].
7.1.9.	Method of injection	:	Through Disc atomizer
7.1.10	RPM	:	8000 rpm contolled by VFD
7.1.11	Motor for Disc atomizer	:	20 HP
7.1.10.	MOC of Atomiser	:	SS 316 L
7.1.11	Ash discharge		Bottom thro rotary air lock valve

7.2 Spray Pump

7.2.1	Quench pump type	:	Centrifugal
7.2.2	Capacity of pump	:	3 m^3 /hour.
7.2.3	Head	:	50 mtrs
7.2.3	Material of construction	:	SS-304.
7.2.4	Connected motor	:	2 HP / 2800 rpm.
7.2.5	Quantity of pumps	:	1 + 1 standby
7.2.6	Make of Pump	:	Johnson / KSB / Kirloskar / Equivalent

ANNEX-1

8.0 GAS CLEANING SYSTEM

8.1. Cyclone Separators

8.1.1	Type	:	Multi cyclone
8.1.2	Inlet temperature	:	200 °C
8.1.3.	Material of construction	:	SS 304
8.1.4.	Quantity	:	2 nos
8.1.5	Ash discharge	:	Through common MS Hopper and Rotary Valve at bottom

8.2. Venturi Scrubber

8.2.1.	Type	:	Venturi scrubber,
8.2.2	Inlet temperature	:	200 °C
8.2.3	Scrubbing Temperature	:	70 °C
8.2.4.	Material of construction	:	IS : 2062 grade-A, 5 mm thick plates
8.2.5	Lining	:	IS -8 Refractory bricks
8.2.6.	Nozzles MOC	:	SS 316 L
8.2.7.	Scrubbing media	:	2-3% Caustic solution

8.3 Recirculation Tank

8.3.1.	Liquid held	:	Caustic slurry
8.3.2	Temperature	:	80 °C
8.3.3	Make-up water required	:	650 lph
8.3.4.	Material of construction	:	IS : 2062 grade-A, 5 mm thick plates
8.3.5	Lining	:	Acid proof tile lining with furon bedding and pointing
8.3.6.	Accessories	:	Drain plug, level indicator, manhole etc.

ANNEX-1

8.4 Packed Bed Scrubber

8.4.1.	Type	:	Packed scrubber
8.4.2	Inlet temperature	:	75 °C
8.4.3.	Material of construction	:	IS : 2062 grade-A, 5 mm thick plates
8.4.4	Lining	:	Acid proof tile lining with furon bedding and pointing
8.4.5.	Packing media	:	Ceramic Rashig Rings / Intallox Saddle

8.5. Recirculation Pump

8.5.1	Circulation rate	:	15000 Liters / hour.
8.5.2	Circulation pump type	:	Centrifugal.
8.5.3	Capacity of pump	:	20 m^3/hour.
8.5.4	Material of construction of pump	:	Cast iron
8.5.5	Pressure	:	2-3 kg/cm^2.
8.5.6	Connected motor	:	10 HP / 2800 rpm.
8.5.7	Quantity of pump	:	2 No + 2 standby
8.5.8	Make	:	Process Pumps / equivalent

9.0. REHEATER BURNER

9.1.	Duty	:	To heat flue gasses above dew point to avoid condensation
9.2.	Temperature	:	110 deg. C
9.3.	Type of burner	:	Automatic packaged burner
9.4.	Material of construction Of chamber	:	IS : 2062 grade-A. with brick lining
9.5.	Fuel	:	HDS / Gas / LDO
9.6	Quantity	:	15 kg/hr

ANNEX - 1

10.0. INDUCED DRAUGHT FAN

10.1.	Type	:	Centrifugal.
10.2.	Capacity	:	20000 M^3/Hour.
10.3	Gas temperature	:	110°C
10.4.	Static pressure at 20°C	:	800 mm WC.
10.5.	Material of construction	:	SS-316L.
10.6.	Recommended motor	:	100 HP.
10.7.	Make	:	Reitz / Laxmi / Universal /Equivalent.
10.8	Quantity	:	1
10.9	Control	:	Thro Variable frequency drive

11.0. CHIMNEY

11.1.	Type	:	Self supporting.
11.2.	Height	:	30 m.
11.3.	Top diameter	:	800 mm
11.4.	Material of construction	:	IS : 2062 grade-A. with brick lining
11.5.	Sampling point	:	At 15 m elevation.

Chimney will be completed with platforms and ladder till sampling point, manhole, lightning arrestor with conductor strip, etc.

12.0. INTERCONNECTING PIPING

12.1.	MOC for caustic	:	Carbon Steel
12.2.	MOC for water	:	Carbon Steel Schedule 40
12.3.	MOC for fuel	:	Mild steel B Class
12.4.	MOC of combustion air piping	:	Mild steel B Class
12.5	MOC for liquid waste	:	SS 316 L

ANNEX-1

13.0. **PAINTING**

All fabricated equipment and ducting will be painted with one coat of red oxide primer and one coat of heat resisting aluminum paint. Piping will be as per I.S. standard colour codes.

14.0. **REFRACTORIES** :-

14.1 Bricks & Mortar

Sr.No.	Description.	Unit.	IS : 6.	IS : 8.	I.B.
1.	Al_2O_3 [minimum]	%	30	35 - 45 [Max.]	28
2.	Fe_2O_3 [minimum]	%	3.5	3.5	1.5
3.	P.C.E.	O.C.	28	29	25
4.	Bulk density	gms./cc	2.0	2.1	0.75 - 0.80
5.	Cold crushing strength	kg/cm^2	200	250	10
6.	Apparent porosity	%	27	25	70
7.	R.U.L.	ta^{0}C	1300	1300	N.A.
8.	P.L.C. at 1300^{0}C/2 hours	% max.	± 1.0	± 1.0	± 1.5 at 1000^{0}C
9.	Dimensional tolerance	± 1.5% or 2 mm Whichever is greater			
10.	FIRECLAY [IS : 8]	Al_2O_3 : 35%. Grain size : 0 - 4 mm. Setting : Heat setting			

15.0. **ELECTRICAL AND INSTRUMENTATION** :-

15.1. **M.C.C. Panel** :
The panel will be self standing, sheet metal, cubicle, dust and vermin proof, wired up complete with relays, contactors, fuses, meters, control instruments, busbar, gland plate, indicating lamps, alarm hooter, energy meter, selector switch, etc. This would have 3 phase, 4 wire supply and comprising of cable entry from top. The panel will be suitable for front operation. The panel will operate on 240 V 50 Hz Single phase

15.2. **List and make of instruments** :

Sr.No	Description.	Make.
1.	Thermocouple	Radix / General Instruments / Equiv.
2.	Temperature gauges	General Instruments / Radix Equiv.
3.	Pressure switch	Switzer / Danfoss / Equivalent
4.	Pressure gauge	Fiebig / Mass / / Wika Equivalent.
5.	Manometers	Scientific Devices / Telelin Equiv.
6.	Solenoid valve	Rotex/Avcon / Equivalent.
7.	Level indicator	R.K. Dutt / Telelin /Equivalent.
8.	Electrical and instrumentation cable	C.C.I. / Polycab Equivalent.
9.	Transmitters	Yokogawa / Emmerson

ANNEX-1

15.3 **Interlocks Logic For Incineration System**

S.No.	Equipment.	Deviation.	Action.
1]	I.D. Fan	Negative pressure less than set pressure Fan tripping	Shut-off all fuel valves in combustion chamber Annunciation on panel.
2]	Recirculation. Pump	Pump tripping	Shut-off all fuel valves in combustion chamber Annunciation on panel.
3]	Scrubber	Temperature higher than set range	Annunciation on panel.
4]	Quench pump	Pump tripping	Shut-off all fuel valves in combustion chamber Annunciation on panel.
5]	Spray Evaporative cooler	Temperature higher than set range	Annunciation on panel.
6]	Post combustion Chamber	Temperature higher than set range	Annunciation on panel.
7]	Fuel pump,	Pump tripping	Shut-off all fuel valves in combustion chamber Annunciation on panel.
7]	Liquid waste	Pump tripping	Shut-off liquid waste valve SI, Annunciation on panel.
8]	Combustion air blower Excess air blower	Blower tripping	Shut-off all fuel line, liquid waste valves. Annunciation on panel.
9]	Rotary Kiln	Temperature higher than set range Charging system fails	Shut-off all fuel line valves and waste feed Annunciation on panel.

ANNEX II

ANDHRA PRADESH POLLUTION CONTROL BOARD
2nd FLOOR, MAITRIVANAM, HUDA COMPLEX,
S.R. NAGAR, HYDERABAD – 38

Phone: 23734043, 23732132
Fax: 040 – 23733261
Grams : Kalusya Nivarana
Website :www.apspcb.org
E-mail: apspcb@hd2.dot.net.in

REGISTERED POST WITH ACK DUE
CONSENT ORDER FOR ESTABLISHMENT

Order No.APPCB/VSP/VZN/91/HO/2004/14 614 – **Dt.11.06.2004**

Sub: PCB – CFE – **M/s. Vera Laboratories Limited, Vizianagaram Dist.** – Consent for Establishment of the Board under Sec.25 of water (P&C of P) Act, 1974 and under Sec.21 of Air (P&C of P) Act 1981 – Issued – Reg.

Ref: 1) Your application dt.17.10.2003
2) R.O's inspection report dt.30.10.2003 & 25.05.2004
3) Your letters dt. 02.03.2004 & 20.03.2004

1. In the reference 1st cited, an application was submitted to the Board seeking Consent for Establishment (CFE) for change of product mix to produce the following products with installed capacities as mentioned below substantiating that the pollution load does not increase the existing pollution load with an additional investment of Rs.1.00 crores.

Sl. No.	Products	Existing TPM	After change of product mix TPM
1	Ranitidane HCL	5.0	Dropped
2	Tiaprofenic Acid	1.0	1.0
3	Vitamin K3	9.0	Dropped
4	Diltiazem HCl	1.1	- do -
5	Trimethoprim	10.0	- do -
6	Naproxen Sodium / Naproxen		3.5
7	Trazodone HCl		0.5
8	Allopurinol		4.5
9	Fluconazole		0.1
10	Baclofen		0.1
11	Sulfasulazine		0.5
12	Citalopram HBr		0.15
13	Nabumetone		0.5
14	Nefazodone Hcl		0.160
15	Midazolam (Lab scale)		0.01

Under this proposal, only products i.e. Tiaprofenic Acid, Naproxen Sodium / Naproxen , Trazodone HCl & Allopurinol shall be manufactured on regular basis and the remaining 7 products @ only 2 products at a given time on campaign basis shall be manufactured.

2. As per the application, the above activity is located within the existing premises located at G. Chodavaram (V), Pusapatirega (M), Vizianagaram Dist.

3. The above site was inspected by the Environmental Engineer, Regional office, Vizianagaram, A.P Pollution Control Board on 29.10.2003.

4. The Board, after careful scrutiny of the application and verification report of Zonal Officer, hereby issues CONSENT FOR ESTABLISHMENT to your unit / activity Under Section 25 of Water (Prevention & Control of Pollution) Act 1974 and Section 21 of Air (Prevention & Control of Pollution) Act, 1981 and the rules made there under. **This order is issued to manufacture the products as mentioned at para (1) only without increase in the existing pollution load in respect of air, water and solid waste.**

5. This Consent Order now issued is subject to the conditions mentioned in Schedule 'A' and Schedule 'B'.

6. This order is issued from pollution control point of view only. Zoning and other regulations are not considered.

MEMBER SECRETARY

Encl: Schedule 'A'
Schedule 'B'

To,
M/s. Vera Laboratories Limited,
G. Chodavaram (V),
Pusapatirega (M), Vizianagaram Dist.

Copy to: 1) The JCEE., Z.O., Visakhapatnam for information and necessary action.
2) The EE, R.O, Vizianagaram for information and necessary action.

SCHEDULE - A

1) There shall not be any perceptible odour outside the industry's premises.

2) Environmental Statement in form - V as per the provisions under Rule-14 of E (P) Act, 1996 and its amendments there of shall be submitted by 30th September of every year and this should also form a part of their annual report.

3) Progress on implementation of the project shall be reported to Board Office, Zonal Office and Regional Office, A.P. Pollution Control Board regularly.

4) Suitable automatic flow measuring devices and monitoring equipments shall be installed at appropriate points. Separate energy meters shall be provided for ETP and Air pollution Control equipments to record energy consumed.

5) All the rules and regulations notified by Ministry of Environment and Forests, Govt. of India in respect of noise pollution control measures shall be followed to avoid nuisance to public.

6) Consents for operation regularly from APPCB, as required Under Sec.25/26 of the Water (P&C of P) Act, 1974 and under sec. 21/22 of the Air (P&C of P) Act, 1981, for operation of the activity, before starting trial production. The Consent for Operation will be accorded only after ensuring compliance of all the conditions stipulated in this order.

7) Conditions issued by the Board in the consent order scrupulously be compiled with and carried out. Legal action will be initiated as per the provisions of the relevant Acts in case of non-compliance of any conditions of the consent order.

8) Notwithstanding anything contained in this conditional letter or consent, the Board hereby reserves its right and power Under Sec.27(2) of Water (Prevention and Control of Pollution) Act, 1974 and Under Sec.21(4) of Air (Prevention and Control of Pollution) Act, 1981 to review any or all the conditions imposed herein and to make such alternation as deemed fit and stipulate any additional conditions for the purpose of the Act by the Board.

9) The consent of the Board shall be exhibited in the factory premises at a conspicuous place for the information of the inspecting officers of different departments.

10) Compensation is to be paid for any environmental damage caused by it, as fixed by the Collector and District Magistrate as civil liability.

11) Appropriate Rain Water Harvesting (RWH) structure (s) shall be established on the available up-stream portion of the plant site. The applicant can approach the State Ground Water Authority, local Municipal / Urban Development Authorities and even private consultants to procure suitable design for these structures. If there is no land available in the industry premises, RWH structures must be raised on the roofs of Administrative Blocks or such buildings where sudden leakages or moisture in the air would not affect the quality of the process or product.

SCHEDULE - B

1) The industry shall stop the manufacturing of Ranitidine Hcl to control odour nuisance.

2) The Acetyl Yara Yara (Intermediate) shall not be manufactured and the same shall be purchased directly from the market as committed by the industry.

5) The industry shall segregate the High TDS & Low TDS effluents. The High TDS effluents shall be disposed by forced evaporation system. The Low TDS effluents shall be treated to the following standards and shall dispose through the marine outfall.

PH	6.5 - 8.5	mg/l
BOD (3 days at 27oC)	100.00	mg/l
Total Suspended Solids	100.00	mg/l
Mercury	0.01	mg/l
Arsenic	0.20	mg/l
Chromium (Hexavalent)	0.10	mg/l
Lead	0.10	mg/l
Cyanide	0.10	mg/l
Phenolics (C6H5OH)	1.00	mg/l
Sulfides (as S)	2.00	mg/l
Phosphate (as P)	5.00	mg/l
Oil and Grease	10.00	mg/l
Bioassay Test:- 90% survival after 96 hours in 10%		
COD	250.00	mg/l

6) The industry shall reduce the water consumption from 190 KLD to 183 KLD.

7) The industry shall comply the following pollution loads as result this change in product mix as committed in revised EMP.

a) The total effluent from the plant shall be reduced from 63.0 KLD to 56.05 KLD (Trade and Domestic). The details in reduction of pollution loads for trade and domestic breakup wise shall be as follows.

i) The trade effluent generation shall be reduced from 42.5 KLD to 35.55 KLD. The High TDS effluents shall be reduced from 10 KLD to 3.95 KLD. The Low TDS effluents shall be reduced from 32.5 KLD to 31.60 KLD.

ii) The domestic effluents shall remain same at 20.50 KLD.

b) The TDS loads shall be reduced from 407 kgs/day to 330 kgs/day, COD loads shall be reduced from 156 kgs/day to 124 kgs/day and BOD loads shall be reduced from 56 kgs/day to 46 kgs/day. The solvent losses shall be reduced from 396.70 kgs/day to 327.01 kgs/day. The process emissions shall be reduced from 37.05 kgs/day to 35.73 kgs/day. The total solid waste shall be reduced from 180.73 kgs/day to 160.04 kgs/day. oils, HDPE/Fibre dr. | Bottle / plastic bags)

8) All the units of ETP shall be impervious to prevent ground water pollution.

9) Domestic effluents shall be discharged into septic tank followed by subsurface dispersion trenches.

10) The industry shall not discharge any effluents out side the factory premises.

11) Separate meters with necessary pipeline shall be provided for assessing the quantity of water used for each of the purposes mentioned below.

a) Industrial cooling and boiler feed.
b) Domestic purposes.
c) Processing, whereby water gets polluted and pollutants are easily bio- degradable.
d) Processing, whereby water gets polluted and the pollutants are not easily

13) The following rules and regulations notified by the MOE&F, GOI shall be implemented.

a) Hazardous waste (Management and Handling), Rules,1989
b) Manufacture, storage and import of hazardous chemicals Rules, 1989.

14) The industry shall keep hazardous solid waste in secured storage tank until it is disposed to TSDF, Dindigal.

15) As per the existing 2 nos boilers 1 x 5 TPD & 1 x 6 TPH only one boiler will be under operation at a time and the other will be as standby - No additional boiler shall be install after change of product mix.

16) Existing D.G. sets of capacity 1 x 500 KVA + 2 x 380 KVA shall be operated with suitable noise absorption systems to control noise to the following CPCB standards.

The ambient noise level shall not exceed 75 dB(A) during day time and 70 dB(A) during night time.

17) Floor washing shall be admitted into the effluent collection system only and shall not be allowed to find their way in storm drains or open areas. Good house keeping shall be maintained both within the factory and in the premises. All pipe valves, Sewers and drains shall be leak proof.

18) The rules and regulations notified by Ministry of Law and Justice, GOI, regarding the Public liability insurance Act, 1991 shall be followed.

19) The industry shall notify to MoEF, GOI as per the explanatory note regarding the impact assessment notification dt. 27.1.1994 issued under E (P) Act 1986.

20) This Order is valid for a period of five years from the date of issue.

MEMBER SECRETARY

To,

M/s. Vera Laboratories Limited,
G. Chodavaram (V),
Pusapatirega (M),
Vizianagaram Dist.

ANNEX - III

ANDHRA PRADESH POLLUTION CONTROL BOARD
PARYAVARANA BHAVAN, A-3, INDUSTRIAL ESTATE, SANATHNAGAR

Phone: 040-23887500
Fax: 040-23815631
Grams: Kalusya Nivarana
Web Site: www.apspcb.org
E-Mail: apspcb@hd2.dot.net.in

CONSENT ORDER

BY REGISTERED POST WITH ACKNOWLEDGEMENT DUE

Consent Order No : APPCB/VSP/VZN/91/HO/2005/A/26 362 - **Date :** 10/05/2005

(Consent Order for operation of the plant under section 21 of Air(Prevention & Control of Pollution) Act 1981).

Consent is hereby granted under section 21 of the Air (Prevention & Control of Pollution) Act ,1981 (hereinafter reffered to as 'the Act') and the rules and orders made thereunder to

M/s Matrix Laboratories Limited,Unit - VIII
(formerly Vera Laboratories Ltd.,)
G.Chowdavaram (V)
Pusapatirega (M),
Vizianagaram District.,

(hereinafter referred to as ' the Applicant ') authorising to operate the industrial plant in the Air Pollution Control Areas as notified from the following Chimneys or outlets and the quantity of Emission discharged per hour on any day shall not exceed the figures as mentioned below.

Chimney No	Description of Chimney	Quantity of emissions in m3/hr. at peak flow
1	Attached to 800 kgs/day Solid Waste Incinerator	-
2	Attached to 2 TPH Coal Fired Boiler (Standby)	-
3	Attached to 5 TPH Coal Fired Boiler	-
4	Attached to 2 x 380 KVA + 500 KVA D.G. Sets	-

This is subject to the previsions of the Act and orders made thereunder and further subject to the terms and conditions incorporated in the schedule A and B enclosed to this order.

This consent order is valid for manufacture the products along with quantities as per Schedule - B only.

This consent shall be valid for a period ending with the **28th day of February 2006**

For and on behalf of the
A.P. Pollution Control Board

MEMBER SECRETARY

To
Matrix Laboratories Limited,Unit - VIII
(formerly Vera Laboratories Ltd.,)
G.Chowdavaram (V)
Pusapatirega (M),
Vizianagaram District.,

Copy to the JCEE, Zonal Office VISAKHAPATNAM for information and necessary action.
Copy to the Senior Environmental Engineer (CESS) for information and necessary action.
Copy to the Environmental Engineer Regional Office, VIZIANAGARAM for information and necessary action

SCHEDULE - A

1 The applicant shall make an application for grant of renewal of consent atleast 30 days before the date of expiry of this consent.

2 The industry shall immediately submit the revised application for consent to this Board in the event of any change in the raw material used, processes employed quantity of emissions etc.

3 a). All the fugitive emissions shall be controlled with proper measures.
b). The applicant shall also install the equipment such as wind speed recorder, wind direction recorder and rain fall measuring equipment.

4 The applicant shall at his own cost get the samples of emissions collected and analysed from the A.P.P.C.B. or any other Laboratories which are established as per the guidelines and norms of MoE & F,GOI and CPCB, New Delhi, every month for the parameters indicated in the condition No.5 and shall submit in duplicate the report thereof to the Board.

5 The emissions shall not contain constituents in excess of the prescribed limits mentioned below.

Chimney No	Parameter	Emission standards (mg/Nm3)
1	SPM	115.00
2	SPM	115.00
3	SPM	115.00

Ambient air quality standards shall not exceed the following :-

SPM - 200 ug/m3, RSPM - 100 ug/m3, SO2 - 80 ug/m3, NOx - 80 ug/m3

Noise Levels: Day time (6 AM to 9 PM) - 75 dB (A)
Night time (9 PM to 6 AM) - 70 dB (A)

6 The applicant shall not change or alter either the prescribed quality or the rate of emission without the previous written permission of the Board.

7 The applicant shall set up three ambient air quality monitoring stations for continuous recording of relevant critical parameters.

8 The applicant shall either:
Not later than 30 days from the date of issue of this consent order certify in writing to the Board that the applicant has installed or provided for an alternative electric power source sufficient to operate all facilities installed by the applicant to maintain compliance with the terms and conditions of the consent.

OR

Not later than 30 days from the date of this consent certify in writing to the Board that upon the reduction loss or failure of one or more primary sources of electric power to any facilities installed by the applicant to maintain compliance with the terms and conditions of this consent, the applicant shall halt, reduce or otherwise control production and/or all emissions in order to maintain compliance with the terms and conditions of this consent.

9 For the emission standards fixed under item 5, the applicant shall increase the stack height so as to ensure that the ground level concentrations notified by the Board are adhered to. In any case the minimum stack height should not be less than 30 meters and as per the ground level concentrations if it works out to be more than 30 meters the calculated stack height should be provided.

10 No control equipment or chimney shall be altered or replaced, erected or re-erected except with the previous approval of this Board.

11 A quarterly progess report shall be submitted to the Board stating therein the progress made in respect of execution of emission control works stated under this consent.

12 The applicant shall provide a sampling port with removable dummy of not less than 15 cm, diameter in the stack at a distance of 5 times the diameter of the stack from the nearest constraint such as bends etc., and they should provide a platform with suitable ladder below one meter of sampling port to accomodate three persons with instruments. The applicant shall also provide a 5amp. 250 V plug point on the platform and also provide adequate personnel, equipment etc., for collecting the samples.

13 The applicant shall also monitor the stack for the prescribed parameters and frequency as approved by the Board and shall maintain records of the emissions and the records shall be made available to the Board when called for.

14 Solid wastes that are likely to cause Air Pollution should be disposed off suitably as directed by the Board.

15 Wherein any Air Pollution Control area the emission of any Air Pollutant into the atmosphere in excess of the standards laid down by the Board occurs or is apprehended to occur due to accident or other unforeseen act or event, the person-in-charge of the premises from where such emission occurs or is apprehended to occur shall forthwith intimate the fact of such occurance or the apprehension of such occurance to this Board, telegraphically under intimation to the Collector and District magistrate.

16 In case of such episodal discharges/emissions mentioned in item 14 above, the industry should take immediate action to bring down the emission below the limits prescribed in the condition No. 5

17 A good house keeping shall be maintained both within the factory and in the premises. All hoods, pipes, valves, shall be leak proof.

18 The applicant shall comply with the directives/orders issued by the Board in this consent order and at all subsequent times without any negligence on his part. The applicant shall be liable for such legal action against him as per provisions of the Law/Act in case if non-compliance of any order/directive issued at any time and/or violation of the terms and conditions of this consent order.

19 The following records shall be maintained and made available to the Board officers during inspection.
i) Inspection book.
ii) Stack emission records.
iii) Ambient Air Quality records.

20 Green belt shall be maintained around the plant by plating a variety of trees in an area at least 4 times the built up area.

21 The applicant shall provide appropriate Rain Water Harvesting Systems on the available upstream portion of the plant site.

22 The applicant shall submit Environment statement in Form V before 30 th september every year as per Rule No. 14 of E(P) Act, 1986 Rules.

23 a) The existing control equipment if any shall be altered or replaced in accordance with the directions of the board within the prescribed time for compliance in this order.
b) For improving the efficieny of the emission levels set by the Board suitable control equipments should be installed.

24 At any time during the inspection of Pollution Control Board Officers or any other licencing/servicing authorities/if it is observed that the industry is not complying with any of the above conditions leading to pollution problems, this consent is liable for cancellation without further notice and all the services rendered by the servicing departments shall be withdrawn without further notice.

25 The industry is liable to pay compensation for any environmental damage caused by it, as fixed by the Collector and District Magistrate as Civil liability.

26 All the rules & regulations notified by Ministry of Environment and Forests, Government of India in respect of management, handling, transportation and storage of hazardous chemicals and wastes shall be followed.

27 All the rules & regulations notified by Ministry of Environment and Forests, Government of India in respect of microorganism, genetically engineered organisms or cells shall be followed.

28 All the rules & regulations notified by Ministry of Law and Justice, Government of India regarding Public Liability Insurance Act, 1991 shall be followed.

29 The industry shall provide a minimum stack height (H) to the DG Sets as per the following formula.
H = h + 0.2 SQRT(KVA)
KVA = Total generation capacity, h = Height of building where D.G.Set is installed in Metres.

30 The applicant shall exhibit the consent order of the Board in the factory premises at a prominent place for the information of the inspecting officers of the different departments.

31. The applicant shall put up two black boards of size 6 by 4 ft. at the main entrance to their plant. One board shall contain with the specific CFE and CFO conditions, specific to the plant and other board shall carry the latest water, air, noise and solid waste monitoring data as well as the maximum vulnerable zone, if the unit is storing/handling hazardous chemicals.

32. Separate power connection with energy meter shall be provided for the Pollution Control Equipments and record of power consumption and chemicals consumption for the operation of pollution control equipment shall be maintained separately.

Schedule – B

1) Industry shall manufacture the following products only.

Sl. No.	Products	Quantity in TPM
1.	Tiaprofenic Acid	1.0
2.	Naproxen Sodium / Naproxen	3.5
3.	Trazodone HCl	0.5
4.	Allopurinol	4.5
5.	Fluconazole	0.1
6.	Baclofen	0.1
7.	Sulfasulazine	0.5
8.	Citalopram HBr	0.15
9.	Nabumetone	0.5
10.	Nefazodone Hcl	0.160
11.	Midazolam (Lab scale)	0.01

Under this proposal, only products i.e. Tiaprofenic Acid, Naproxen Sodium / Naproxen, Trazodone HCl & Allopurinol shall be manufactured on regular basis and the remaining 7 products @ only 2 products at a given time on campaign basis shall be manufactured.

2) The industry shall comply with the conditions stipulated in the CFE order dt. 11.06.2004. The industry shall not produce any new products without obtaining CFE of the Board.

3) The industry shall comply with CREP recommendations with reference to Bulk Drug manufacturing.

4) The industry shall install flow meter with totaliser at the pumping station at Thimmayapalem to record the effluent pumped into sea, within two months.

5) The industry shall carryout ground water monitoring in their premises through ground water department by providing 2-3 observation wells.

6) The industry shall submit monthly data to the R.O., / Z.O., of APPCB regarding production & wastewater disposed.

7) The industry shall comply with Hazardous Wastes (Management and Handling) Rules, 1989 and Amendments thereof.

8) The industry shall remit water cess amounts, as and when assessment orders are issued by the Board.

9) The industry shall restrict the production to the quantities permitted by the Board scrupulously.

MEMBER SECRETARY

14.10.15 8/8

To

M/s. Matrix Laboratories Ltd., Unit – VIII
(formerly M/s. Vera Laboratories Ltd.,)
G. Chodavaram Village,
Pusapatirega Mandal,
Vizianagaram Dist.,

ANNEX IV

ANDHRA PRADESH POLLUTION CONTROL BOARD

PARYAVARANA BHAVAN, A-3, INDUSTRIAL ESTATE,
SANATHNAGAR

Phone:040-23887500
Fax:040-23815631
Grams:Kalusya Nivarana
Web Site:www.apspcb.org
E-Mail:apspcb@hd2.dot.net.in

CONSENT ORDER

BY REGISTERED POST WITH ACKNOWLEDGEMENT DUE

Consent Order No : APPCB/VSP/VZN/91/HO/W/2005/26 362 Date : 10/05/2005

Consent Order for Existing/New or altered discharge of sewage and/or trade effluents/outlet under Section 25/26 of the Act).

CONSENT is hereby granted under section 25/26 of the Water (Prevention & Control of Pollution) Act, 1974 (hereinafter reffered to as 'the Act') and the rules and orders made thereunder to

M /s. Matrix Laboratories Limited,Unit - VIII
(formerly Vera Laboratories Ltd.,)
G.Chowdavaram (V)
Pusapatirega (M),
Vizianagaram District.,

(hereinafter referred to as 'the Applicant') authorising to operate the industrial plant to discharge the effluents from the following outlets as detailed below.

Outlet No	Outlet Description	Max Daily Discharge(lits / day)	Point Of Disposal
1	High TDS Process and Wash Effluents	3950.00	Forced Evaporation
2	Low TDS Process and Wash Effluents after Treatment	31600.00	Into Sea Through a sub.outfall at Thammayapalem(V)
3	Domestic Effluents	20500.00	Septic Tank Followed By Soak Pit.

This is subject to the provisions of the Act and Rules and orders made there under and further subject to the terms and conditions incorporated in the Schedule A and Schedule B enclosed to this order.

This consent order is valid for manufacture the products along with quantities as per Schedule - B only.

This consent shall be valid for a period ending with the 28 th day of February 2006

For and on behalf of the
A.P. Pollution Control Board

MEMBER SECRETARY

10/5 3/8

To
M/s Matrix Laboratories Limited,Unit - VIII
(formerly Vera Laboratories Ltd.,)
G.Chowdavaram (V)
Pusapatirega (M),
Vizianagaram District.,

Copy to the J.C.E.E, Zonal Office VISAKHAPATNAM for information and necessary action.
Copy to the Senior Environmental Engineer (Cess) for information and necessary action.
Copy to the Environmental Engineer Regional Office VIZIANAGARAM for information and necessary action

SCHEDULE - A

The applicant shall make an application for grant of renewal of consent atleast 30 days before the date of expiry of this consent.

Necessary fee as prescribed for obtaining consent shall be paid by the applicant alongwith the consent application.

The quatity of efluent discharged shall not exceed the figures mentioned in the order

The industry shall immediately submit the revised application for consent to this Board in the event of any change in the trade effluent, raw material used and processes employed.

The applicant shall not change or alter either the quality or the quantity or the rate of the discharge or temperature or the route of discharge without the previous written permission of the Board.

5 The effluent discharged shall not contain constituents in excess of the tolerance limits mentioned below.

Outlet No	Parameter	Limiting Standards	
2	pH	6.50 - 8.50	
	BOD (3 day at 27 oC)	100.00	mg/l
	Total Suspended Solids	100.00	mg/l
	Mercury	0.20	mg/l
	Arsenic	0.10	mg/l
	Chromium Hexavalent	0.10	mg/l
	Lead	0.10	mg/l
	Cyanide	1.00	mg/l
	Phenolics (C6HROH)	1.00	mg/l
	Sulfides (as S)	2.00	mg/l
	Phosphate (as P)	5.00	mg/l
	Oil and Grease	10.00	mg/l
	Bioassay Test:- 90% of survival after 96 hours in 10%		
	COD	250.00	mg/l

7 The applicant shall develop the green belt around the plant by planting variety of trees in an area atleast 4 times the builtup area.

8 The applicant shall provide appropriate Rain Water Harvesting systems on the available u/s portion of the plant site.

9 Industry shall submit Environmental Statement in Form V before 30 th September every year as per Rule no: 14 of E(P) Act 1986 Rules.

10 The applicant shall display suitable caution board at the place where the effluent is entering any water body or any other place, to be indicated by the Board, indicating therein that the water body into which the effluents are being discharged is not fit for domestic usage/bathing.

11 The applicant shall

Not later than 30 days from the date of issue of this consent order, certify in writing to the Board that the applicant has installed or provided for an alternate electric power source sufficient to operate all facilities installed by the applicant to maintain compliance with the terms and conditions of the Consent. OR

Not later than 30 days from the date of this consent certify in writing to the Board that upon the reduction, loss or failure of one or more of the primary sources of electric power to any facilities installed by the applicant to maintain compliance with the terms and conditions of this consent, the applicant shall halt, reduce or otherwise control production and/or all discharges in order to maintain compliance with the terms and conditions of this consent.

12 The applicant shall at his own cost get the effluent samples collected both before and after treatment and analysed at the laboratories which are established as per the guidelines of CPCB/M.OE&F, GOI. every

14 The applicant shall not allow the discharge from other premises to mix with the discharge from his premises. Storm water shall not be allowed to mix with the trade and/or domestic effluent.

15 The following information shall be forwarded to the Member Secretary regularly every month.

a). Monthly statement of daily discharge of domestic as well as trade effluents.
b). Analysis reports of domestic as well as trade effluents.

16 The industry shall provide

a) Meters at the entrance of the water supply connection which are easily accessible for inspection and maintenance and for other purpose of the Act, provided that the place where it is fixed shall in no case be at a point before which water has been tapped by the consumer for utilisation for any purpose whatsoever.

b) Seperate meters with necessary pipe-line for assessing the quality of water used for each of the three purposes mentioned below.

1. Industrial cooling or boiler feed.
2. Domestic purposes.
3. Processing whereby water gets polluted and pollutants are easily bio-degradable.
4. Processing whereby water gets polluted and pollutants are not easily bio-degradable and are toxic.

c.The industry shall file the water cess returns in Form-I as required under section (5) of Water (Prevention and Control of Pollution) Cess Act, 1977 on or before the 5th of every calendar month, showing the quantity of water consumed in the previous month.

17 All Solid wastes arising in the premises shall be properly classified and disposed off to the satisfaction of the Board by:

i) Controlled incineration, wherever possible in case of combustible organic material.
ii) Vermiculture / Composting,in case of bio-degradable material.
iii) Secure land fill in case of non bio-degradable, chemically active/hazardous solid waste. Care shall be taken to ensure that the material doesnot give lechate which may percolate into ground water or carried away with strom run -off.

18 Any toxic material shall be detoxicated and dispoed as per the conditions stipulated in the authorisation obtained under Hazardous Wastes (Management and Handling) Rules, 1989 and its amendments thereof.

19 Any up-set condition in any of the plant/plants of the factory which is likely to result in increased effluent discharge and/or result violation of the standards mentioned above shall be reported to this Board telegraphically under intimation to the Collector and District Megistrate.

20 The applicant shall maintain good house keeping both within the factory and in the premises. All pipes, valves, sewers and drains shall be leak-proof. Floor washings shall be admitted into the effluent collection system only and shall not be allowed to find their way into storm drains or open areas.

21 The applicant shall comply with and carry out any other directives/orders issued by the Board subsequently without any negligence on his part. The applicant shall be liable for such legal action as per provisions of the Law/Act in case of non-compliance of any order/directives issued at any time and/or violation of the terms and conditions of this consent order.

22 An inspection book shall be opened and made available to the Board's Officers during their visit to the factory.

23 The applicant shall furnish to the visiting officer and/or the Board any information regarding the construction, installation or operation of the establishment or of effluent treatment system and such other particulars as may be pertinent for preventing and conrolling pollution of water.

24 Separate power connection with energy meter shall be provided for the Effluent treatment systems and records of power consumption and chemical consumption for the operation of Effluent treatment systems shall be maintained separately.

25. Not withstanding anything contained in this conditional letter or consent, the Board hereby reserves to it the right and power under Section 27(2) of the Water (Prevention & Control of Pollution) Act, 1974 to review any and/or all the conditions imposed herein above and to make such variations as deemed fit for the purpose of the Act by the Board.
26. At any time during the inspection of Pollution Control Board Officers or any other licensing/servicing it is observed that the industry is not complying with any of the above conditions leading to pollution problems this consent is liable for cancellation without further notice and all the services rendered by the servicing departments shall be withdrawn without further notice.
27. The industry is liable to pay compensation for any environmental damage caused by it, as fixed by the Collector and District Magistrate as Civil liability.
28. All the rules & regulations notified by Ministry of Environment and Forests, Government of India in respect of management, handling, transportation and storage of hazardous chemicals and waste shall be followed.
29. All the rules & regulations notified by Ministry of Environment and Forests, Government of India in respect of microorganisms, genetically engineered organisms or cells shall be followed.
30. All the rules & regulations notified by Ministry of Law and Justice, Government of India regarding Public Liability Insurance Act, 1991 shall be followed.
31. The applicant shall exhibit the consent order of the board in the factory premises at a prominent place for the information of the inspection officers of the different departments.
32. The applicant shall put up two black boards of size 6 by 4 ft. at the main entrance to their plant. One board shall contain with the specific CFE and CFO conditions, specific to the plant and other board shall carry the latest water, air, noise and solid waste monitoring data as well as the maximum vulnerable zone, if the unit is storing/handling hazardous chemicals.

Schedule – B

1) Industry shall manufacture the following products only.

Sl. No.	Products	Quantity in TPM
1.	Tiaprofenic Acid	1.0
2.	Naproxen Sodium / Naproxen	3.5
3.	Trazodone HCl	0.5
4.	Allopurinol	4.5
5.	Fluconazole	0.1
6.	Baclofen	0.1
7.	Sulfasulazine	0.5
8.	Citalopram HBr	0.15
9.	Nabumetone	0.5
10.	Nefazodone Hcl	0.160
11.	Midazolam (Lab scale)	0.01

Under this proposal, only products i.e. Tiaprofenic Acid, Naproxen Sodium / Naproxen, Trazodone HCl & Allopurinol shall be manufactured on regular basis and the remaining 7 products @ only 2 products at a given time on campaign basis shall be manufactured.

2) The industry shall comply with the conditions stipulated in the CFE order dt. 11.06.2004. The industry shall not produce any new products without obtaining CFE of the Board.
3) The industry shall comply with CREP recommendations with reference to Bulk Drug manufacturing.
4) The industry shall install flow meter with totaliser at the pumping station at Thimmayapalem to record the effluent pumped into sea, within two months.
5) The industry shall carryout ground water monitoring in their premises through ground water department by providing 2-3 observation wells.
6) The industry shall submit monthly data to the R.O., / Z.O., of APPCB regarding production & wastewater disposed.
7) The industry shall comply with Hazardous Wastes (Management and Handling) Rules, 1989 and Amendments thereof.
8) The industry shall remit water cess amounts, as and when assessment orders are issued by the Board.
9) The industry shall restrict the production to the quantities permitted by the Board scrupulously.

MEMBER SECRETARY

To
M/s. Matrix Laboratories Ltd., Unit – VIII

ANNEX - V

ANDHRA PRADESH POLLUTION CONTROL BOARD
Paryavaran Bhavan, A-III, Industrial Estate, Sanathnagar, Hyderabad-500 018

Phones : 040-23887500
040-23887505 (Dir)
Grams : "Kalushva Nivarana
Website : www.appcb.org
e.mail : JCEE_HWM@appcb.org

S. Surya Prasad, M. Tech.,
Joint Chief Environmental Engineer

Lr. No. Viz-1 /PCB/HWM/96- 939 —

Dt:07/07/2005

To
M/s. Matrix Laboratories, Ltd., Unit – 8,
(Formerly known as M/s. Vera Laboratories Ltd.,)
G.Chodavaram (V), Purapatirage (M0,
Vizianagaram district

Adweryen!

Sub: PCB – HWM - M/s. Matrix Laboratories, Ltd., Unit – 8, (Formerly known as M/s. Vera Laboratories Ltd.,) G.Chodavaram (V), Purapatirage (M0, Vizianagaram district - Iusse of Hazardous Waste authorisation under Hazardous Wastes (Management & Handling) Rules, 1989 and its amendments thereof – Revised Orders issued – Reg.

Ref: Lr.No.VIZ-1/PCB/HWM/98. dated 10/05/2005

* * *

The Hazardous waste authorisation issued to your industry vide reference cited is revised and the revised authorisation is enclosed herewith. The validity of authorization and the conditions of Schedule – A & B stipulated in the revised authorisation holds good.

Yours Faithfully,

Jt. Chief Environmental Engineer
(HWM)

ANDHRA PRADESH POLLUTION CONTROL BOARD
Paryavaran Bhavan, A-III, Industrial Estate, Sanathnagar, Hyderabad-500 018

Phones : 040-23887500
040-23887505 (Di)
Grams : "Kalushya Nivarana
Website : www.appcb.org
e.mail : info@appcb.org

S. Surya Prasad, M. Tech
Joint Chief Environmental Engineer

Lr. No. VIZ-1/PCB/HWM Dt. 6/7/05

AUTHORISATION

1. Number of Authorisation and date of issue - APPCB/VSP/VZN/117/HWM Dt. 12/05/2005

2. The Sr. General Manager,, M/s. Matrix Laboratories, Ltd., Unit - 8 is hereby granted an authorisation to operate a facility for of Hazardous Wastes namely

(1) Used / Waste Lubricating Oil	45.00 Litres/Month
(2) ETP Sludge	2,700.00 KiloGrams/Month
(3) Incinerator Ash	120.00 KiloGrams/Month
(4) Organic Residue	6,106.50 KiloGrams/Month
(5) Detoxified M.S / G.I / HDPE / Plastic Drums of Hazardous Chemicals and Hazardous Wastes.	4,680.00 Numbers/Year
(6) Spent Carbon	637.80 KiloGrams/Month

on their premises located at (Formerly known as M/s. Vera Laboratories Ltd.,) G.Chodavaram (V), purapatirega (M) , Vizianagaram. Also, The Sr. General Manager, M/s. Matrix Laboratories, Ltd., Unit - 8 is authorised to transport above Hazardous Wastes from their premises as following.

(1) Detoxified Containers and Container Liners of Hazardous Waste & chemicals.	Agencies authorised by APPCB.
(2) ETP Sludge	TSDF, Dindigal (V), R. R. District.
(3) Incinerator Ash	TSDF, Dindigal (V), R. R. District.
(4) Organic Residue	Incinerated in their own premises.
(5) Spent Carbon	TSDF, Dindigal (V), R. R. District.
(6) Used / Waste Lubricating Oil	Agencies authorised by APPCB.

3. The authorisation is granted for hazardous wastes only.

4. The authorisation shall be in force for a period upto 28/02/2006 from the date of issue.

5. The authorisation is subject to the terms and conditions enclosed at Schedule - A, Schedule - B and to such conditions as may be specified in the rules for the time being in force under the Environment (Protection) Act, 1986.

6. The authorisation is subject to the industry complying with all conditions of CFO.

Encl : Schedule 'A'
Schedule 'B'

Dt: 06/07/2005

JOINT CHIEF
ENVIRONMENTAL ENGINEER

To
The Sr. General Manager,,
M/s. Matrix Laboratories, Ltd., Unit - 8
(Formerly known as M/s. Vera Laboratories Ltd.,)
G.Chodavaram (V),purapatirega (M)
, Vizianagaram Dist.

SCHEDULE - A

[see rule 3(c) and 5(5)]

[FORM FOR GRANT OF AUTHORISATION FOR OCCUPIER OR OPERATOR HANDLING HAZARDOUS WASTES]

1 The industry shall comply with the provisions of the Environment (Protection) Act, 1986, and the Rules made thereunder.

2 The Authorisation or its renewal shall be produced for inspection at the request of any officer authorised by A.P. Pollution Control Board.

3 Any unauthorised change in personnel, equipment and working conditions as mentioned in the application by the person authorised shall constitute a breach of this authorisation.

4 An application for the renewal of authorisation shall be made as laid down in Rule 5 (6) (II) atleast 30 days before the date of expiry of authorisation.

5 APPCB shall renew the authorisation after examining the each case on merit, subject to the following I) On submission of annual returns by the occupier or operator of a facility in form-4.

II) On evidence of reduction in the waste generated or recycled or reused .

III) On fulfillment of conditions prescribed in the authorisation regarding management of waste in an environmentally sound manner.

6 All the hazardous wastes should be stored in a secured way so that they do not cause leachate problem or are carried away with run-off water during rains.

7 The occupier shall demarcate the secured storage area with a sign board indicating the name of hazardous waste.

8 First Aid box, Masks,Fire control equipments and other safety devices shall be provided to meet emergency situations.

9 The occupier shall educate the workers and nearby public of possible accidents and remedial measures.

10 For any accident or spillage of hazardous wastes causing damage to the Environment, the occupier or the transporter as the case shall be held responsible.

11 Weak acids, spent acids, spent chemicals, unrecovered solvents and chemicals should be collected, properly accounted and disposed to the institutions authorised by APPCB or other SPCBs. Necessary records should be maintained for this.

12 In case of closure of industry, the un-used/not consumed raw materials falling under the category of Hazardous Chemicals under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and Amendment Rules,2000 shall be removed and sold to other units within 90 days from the date of closure to prevent any possibility of occurance of an accident. In case the above hazardous chemicals have lost their properties originally required, then they shall be treated as Hazardous Waste and they should be disposed off only to the APPCB authorised agencies in a safe manner.

13 The occupier shall prepare/update Emergency preparedness plan for safe handling of hazardous waste from time to time and submit the same to APPCB. Emergency preparedness plan must be implemented immediately whenever there is fire, explosion or release of hazardous waste or hazardous waste constituents, which could endanger to human health or environment.

14 The occupier shall maintain inventory of hazardous wastes, in FORM - 3 of the Hazardous Wastes(Management and Handling) Rules,1989 & its Amendments thereof.

15. The occupier shall submit annual returns to APPCB in FORM - 4 of the

16 The occupier shall submit information on any accidents that have occured in handling of hazardous waste to APPCB in FORM - 5 of the Hazardous Wastes(Management and Handling) Rules, 1989 and its Amendments thereof.

17 The occupier or operator of facility shall ensure that the Hazardous Wastes are packed based on the composition in a manner suitable for handling, storage a[nd] transportation, and labeled accordingly. The labeling and packing shall be clearly visible and be able to withstand physical conditions and climatic factors.

18 Packaging, labeling and transportation of Hazardous Wastes shall be in accordance with the provisions of the rules issued by the Central Govt. under the Motor Vehicles Act, 1988 and other guidelines issued from time to time. The packaging and labeling shall be based on the composition and hazardous constituent of the waste, however all Hazardous Waste containers should be provided with a general label.

19 The driver who transports Hazardous Waste should be well acquainted about the procedure to be followed in case of an emergency during transit. The transporter shall carry a Transport Emergency (TREM) card (as given in the guidelines for management and handling of hazardous wastes) duly filled by the Hazardous Waste generator.

20 Any Environmental damage due to indiscriminate disposal of Hazardous Wastes shall be assessed by the appropriate authority. The clean up costs shall be recovered from the generator /operator/occupier/ transporter of the said Hazardous Wastes.

21 The industry shall maintain the 'Six Copy Manifest System' for the movement of wastes. The manifest copies should be furnished to the APPCB, Head Office, Hyderabad under intimation to the concerned Regional Office.

22 Containers / Container Liners of Hazardous Chemicals and Hazardous Wastes should be thoroughly detoxified before selling to APPCB authorised agencies. Proper records, specific to each Hazardous Chemical / Hazardous Waste containers / Container Liners should be maintained in the following way :

I) Number of containers received.
II) Date and method of detoxification.
III) Name of agencies to whom containers were sold with quantities.
IV) Transportation particulars.

23 Safe/secured storage facility should be provided to all recyclable solids / liquids till they are processed.

24 Industry should maintain good housekeeping with respect to all solid wastes,liquid wastes and effluents.

25 No Hazardous Wastes shall be mixed with any other wastes or shall be discharged to a common , other internal , external sewerage or other drainage system without prior approval of APPCB.

26 If HDPE bags are used for storing Hazardous Wastes, it should be ensured that they are perfectly sealed mechanically or double hot sealed.

27 If MS/HDPE bags or drums are used for storing Hazardous Wastes, these drums / bags should be ensured that they are perfectly sealed.

28 The Hazardous Wastes packed in HDPE bags or MS / plastic drums should be stored in a covered shed on a raised platform with leachate management system.

29 The industry shall follow the Guidelines for setting up of operating facility for Hazardous Waste Mangement published by CPCB (Documents series Hazwams / 11/ 98 - 99).

30 Andhra Pradesh Pollution Control Board reserves the right to review, impose additional condition or conditions, revoke, change or alter the terms and conditions of this authorisation. Also the Board reserves the right to withdraw the authorisation without any Prejudice / Notice on receiving any complaints by the Board regarding Environmental Pollution problems caused by the industry.

31 The person authorised shall not rent, lend, sell, transfer their industrial premises without obtaining prior permission of the State Pollution Control Board.

32 The authorised person shall take prior permission of the State Pollution Control Board to close down their Hazardous waste facility.

33 The industry shall dispose / sell recyclable wastes such as waste / used oil, used lead acid batteries and non - ferrous metal scrap to only the Agencies / Industries which are having valid Authorisation of APPCB and valid registration of MoEF, GOI or CPCB.

34 The industry shall comply with the provisions of Batteries (Management & Handling) Rules, 2001.

35 The industry shall provide secured temporary storage facility for storage of hazardous wastes.

36 The industry shall ensure the sale or bulk auctions in accordance with the HWM Amendment Rules, 2003.

37 The industry shall putup two sign boards (6x4 ft. each) at publicly visible places at the main gate. The first sign board shall provide information on conditions of CFE & CFO, and the second sign board shall provide information on release of pollutants - air emissions, water discharges and solid waste with details like quantity, nature of Hazardous chemicals being used in the plant and Hazardous Wastes generated etc.

JT CHIEF ENVIRONMENTAL ENGINEER
(HWM)

SCHEDULE - B

[see rule 3(c) and 5(5)

[FORM FOR GRANT OF AUTHORISATION FOR OCCUPIER OR OPERATOR HANDLING HAZARDOUS WASTES]

1 Industry shall give top priority for waste minimisation and cleaner production practices.

2 Industry shall maintain good house keeping & maintain proper records for Hazardous Wastes stated in Authorisation (FORM II).

3 Industry shall maintain 6 copy manifest system for transportation of waste generated and a copy shall be submitted to Board Office and concerned Regional Office.

4 Industry shall dispose / sell the hazardous wastes to only industries / agencies authorised by State Pollution Control Boards.They shall verify the authorisation of the board given to the party before disposing their wastes to the external party.

5 Industry shall take all necessary practical steps for prevention of oil spillages and carry over of oil from the premises.

6 Industry should transfer all disposable Hazardous Wastes which are presently stored in a secured way on their premises to the TSDF at Dindigal (V), R.R. District.

7 The industry shall provide online DO monitoring with recording facilities at aeration and bio-towers.

8 The industry shall provide bio-assay testing facilities for treated effluent before discharging to marine waters.

9 The Industry shall submit the condition wise compliance report of the conditions stipulated in Schedule A and Schedule B of this Authorisation halfyearly basis to Board Office, Hyderabad and concerned Regional Office.

JOINT CHIEF
ENVIRONMENTAL ENGINEER

ANNEX - VI

/DERABAD WASTE MANAGEMENT PROJECT

RAMKY
ENVIRO ENGINEERS LTD

Mk, HOUSE", Gulmohar Avenue, Rajbhavan Rd., Somajiguda, Hyderabad-500 082, India
nes : (040) 3311849, 3328305, Fax : (040) 330 2353, email : ramky@hd2.vsnl.net.in

Ref: REEL/TSDF/02/ 712   Date: 28/1/03

To
M/s. Veera Laboratories Ltd.,
Vizianagaram

Dear Sir,

Sub: Membership Registration in Hyderabad Waste Management Project – Hazardous Waste Management at TSDF, Dundigal – Reg.

Hyderabad Waste Management Project a Treatment, Storage and Disposal Facility has been in the service of Industries like yours since September 2001.

This facility can be utilized by you for:

- Safe disposal of Hazardous Waste in Hyderabad Waste Management Project, Treatment, Storage and Disposal facility (Scientifically Engineered Landfill).
- Mandatory compliance of Hazardous Wastes (Management and Handling) Rules, 1989 & 2000
- Liabilities transferred to Hyderabad Waste Management Project after transferring your waste
- Easy environmental clearances from APPCB/CPCB for Expansion / up gradation.
- It is requirement for all industries generating solid waste to register themselves with Hyderabad Waste Management Project (HWMP) to obtain necessary project clearances for establishment/operation from Andhra Pradesh Pollution Control Board.

In view of the above, please find herewith enclosed registration form.

Please submit the above forms duly filled along with all enclosures and requisite fee in the form of DD in favour of M/s. Ramky Enviro Engineers Ltd A/c. Hyderabad Waste Management Project payable at Hyderabad.

Should you need any further clarifications please feel free to contact personnel mentioned below.

Corporate office: Mr. B.Hari   Ph. No. 3311849/3310091/3308996

TSDF site: Dr. Srinivas   Ph. No. 928 – 55424/55425

Assuring you of our prompt and best services at all times

Yours sincerely,
For HYDERABAD WASTE MANAGEMENT PROJECT
(A Division of RAMKY ENVIRO ENGINEERS LTD.,)

(B.SANTHA RAM)
Asst. Manager

Encl.: As above

MATRIX LABORATORIES LIMITED (UNIT-8)

HAZARDOUS WASTE AUTHORIZATION

S.No.	Description	As per Consent	April	May	June	July	August	September
1	Waste oil	45 lt/month	——	48	——	52	——	40
2	ETP Sludge	2700 kgs/month	1800	1690	1600	1680	1800	780
3	Incinerator Ash	120 kg/month	48	41	31	32	44	17
4	Organic Residue	6106.5 kg/month	1500	1520	1660	1720	2080	690
5	Detoxified Drums	4680 No's/year	——	——	252	247	247	87

ANNEX VII

GOVERNMENT OF INDIA
MINISTRY OF COMMERCE & INDUSTRY
PETROLEUM AND EXPLOSIVES SAFETY ORGANISATION (PESO)
(Formerly Department of Explosives)
No.140, Rukhmini Laxmipati Road, Marshalls Road, Egmore,
Chennai 600008

Email : jtccechennai@explosives.gov.in
Phone/Fax No : 28514848/28514848
Dated : 3/8/2005

No. : P/HQ/AP/15/1082(P4543)

MATRIX LABORATORIES LTD.,
G.CHODAVARAM MANDAL,
District - VIZIANAGARAM , PIN - .
Andhra Pradesh)

- 3 AUG 2005

Sub :- Existing Petroleum Class A Installation at G. CHODAVARAM,G. CHODAVARAM District : VIZIANAGARAM , State : Andhra Pradesh - Licence No. P/HQ/AP/15/1082(P4543) - Reg Amendment of.

Sirs,
Please refer to your letter No.: nil , dated 2/8/2005

Licence No. P/HQ/AP/15/1082(P4543) dated 22/3/1996 valid upto 31/12/2005 is returned herewith duly amended for the storage of following kinds and quantities of petroleum products.

Description of Petroleum	Quantity licenced in K.L
Petroleum Class A in bulk	120 KL.
Petroleum Class A, otherwise than in bulk	Nil
Petroleum Class B in bulk	Nil
Petroleum Class B, otherwise than in bulk	Nil
Petroleum Class C in bulk	Nil
Petroleum Class C,otherwise than in bulk	Nil
Total Capacity	120 KL.

Please acknowledge the receipt.

Yours faithfully
(T O Sasi)
Controller of Explosives
for Jt. Chief Controller of Explosives

Copy forwarded to :-

The Chief Controller of Explosives , Nagpur.

The Dy. Chief Controller of Explosives Hyderabad Sub Circle Office ,Hyderabad .

The same may please be kept along with copy of licence and approved drawings. The earlier office copy of licence & drawings may be replaced.

FORM XV
(see Article 6 of the First Schedule)

LICENCE TO IMPORT AND STORE PETROLEUM IN INSTALLATION

Licence [illegible]. : P/HQ/AP/15/1082(P4543) (Amendment No. 1 dated : 3/8/2005) Fee Rs. 2050/- per year

Unit - 8

Licence is hereby granted to M/S MATRIX LABORATORIES LTD., [illegible], G.CHODAVARAM MANDAL, VIZIANAGARAM, Andhra Pradesh, PIN - valid only for the importation of 120 K.L Petroleum of the classes and quantities as herein specified and storage thereof in the place described below and shown on the approved plan No P/HQ/AP/15/1082(P4543) dated 3/8/2005 attached hereto subject to the provisions of the Petroleum Act, 1934 and the rule made thereunder and to the further conditions of this Licence.

The Licence shall remain in force till the 31st day of December 2005

Description of Petroleum	Quantity licenced in KL
Petroleum Class A in bulk	120 KL.
Petroleum Class A, otherwise than in bulk	Nil
Petroleum Class B in bulk	Nil
Petroleum Class B, otherwise than in bulk	Nil
Petroleum Class C in bulk	Nil
Petroleum Class C,otherwise than in bulk	Nil
Total Capacity	120 KL.

Licence Date : 22/3/1996

for Chief Controller of Explosives

DESCRIPTION OF THE LICENSED PREMISES

The licensed premises, the layout , boundaries and other particulars of which are shown in the attached approved plan are situated at G. CHODAVARAM, G. CHODAVARAM, VIZIANAGARAM, Andhra Pradesh, and consists of SIX ABOVEGROUND PETROLEUM CLASS C STORAGE TANK TOGETHER WITH CONNECTED OTHER FACILITIES.

ANNEX- VIII

February 21. 2005

To
M/s.Matrix Laboratories Limited (Unit-8)
G Chodavaram Village
Poosapatirega Mandal
Vizianagaram District.

Dear Sir,

Reference to your letter dated 15/02/2005, you are permitted to construct your factory buildings in the land bearing survey nos: 44, 51, 54, 55, 56, 57, 59, 60 & 71 of your bulk drug manufacturing factory.

Thanking you,

Yours faithfully,

P. Appalanaidu
సర్పంచ్ 21-2-05
గ్రామ పంచాయితీ
బోడమ్మ అగ్రహారం

ANNEX - IX

दि ओरिएण्टल इन्श्योरेंस कम्पनी लिमिटेड

THE ORIENTAL INSURANCE COMPANY LTD.,

SL. No. :

POLICY - SCHEDULE

Regd. Office : ORIENTAL HOUSE P.B. No. 7037, A-25/27, ASAF ALI ROAD, NEW DELHI - 110 002.

Office Code : 431100

Policy Type : **PUBLIC LIABILITY ACT POLICY**

Policy Yr./No. : 2006 62

Previous Policy yr./No. : 0

Covernote Number : 333335

Endorsement Yr./No. 0 0

Endt. Effctv. From : To :

Covernote Date : 01/04/2005

Empl. Client Code :

Dev. Off. Code : 888

Agent Code : 0

Total Premium : Rs.436,501.00

Name : ~~M/s Matrix Laboratories Ltd~~

Address of Insured : 1-1-151/1., IV Floor, Sairam Towers, Alexander Road, Secunderabad - 003.

Policy Issuing Office : Pin Code Fax/Tel : DIVISIONAL OFFICE-I, III FLOOR, NO.303/304/305, OASIS PLAZA, TILAKROAD, ABIDS, HYDERABAD.500001 24756783,24753279

Policy Period

From : 00:00 Hrs. on : 01/04/2005

To : Mid Night on 31/03/2006

OIC 100 % NIA 0 % UII 0 % NIC 0 % Others 0 %

Description of Risk: Bulk Drug Manuf.units including finished Dosage Formulations-All units of Matrix

INDEMNITY LIMIT:

Any One Accident: Rs.50,000,000.00

Aggregate during The Policy Period: (Not Exceeding three Times of Any One Accident of Indemnity Limit) Rs.150,000,000.00

Contribution Towards Enviornment Relief Fund: Rs.207,660.00

Net Premium: Rs.207,660.00

Service Tax: Rs.21,181.00

Total Collection : Rs.436,501.00

CONSOLIDATED STAMP DUTY TOWARDS POLICY INSURANCE STAMPS PAID VIDE C & IG Order No.54/13104/04 Dt.5/7/04

M M REDDY & CO.,
CHARTERED ACCOUNTANTS

Ph: 23318152 / 23736640

No.121/05-06

CERTIFICATE

We hereby certify that the Gross Block of Fixed Assets at Unit – 8 situated at G.Chodavaram Village, Poosapatirega Mandal, Vizayanagaram District, Andhra Pradesh of M/s. Matrix Laboratories Limited, Registered office situated at 1-1-151/1, Sairam Towers, Alexander Road, Seunderabad as at 31.03.2004, 31.03.2005 and 30.06.2005 as given below.

Gross Block of Fixed Assets as on			
	(Rs. Millions)		
Description of Assets	30.03.2004	30.03.2005	30.06.2005
Land	6.96	6.96	6.96
Buildings	148.49	147.70	147.70
Non Factory Buildings	0.21	7.95	7.95
Plant & Machinery	490.58	498.58	521.81
Electrical Equipment	45.69	45.83	46.94
Laboratory Equipment	19.28	26.34	34.17
Office. Equipment	4.33	4.44	4.72
Vehicles	2.84	1.38	0.83
Furniture - Fittings	4.90	5.06	5.06
Computers	0.52	1.28	1.61
Library	1.05	1.05	1.05
Total	724.85	746.57	778.80

The above Gross Block of Fixed Assets is true and correct and to the best of my knowledge and belief and is as per the checking of the books of accounts carried out by me in relation to the above mentioned Units.

For M M REDDY & CO
Chartered Accountants

M REDDY & CO. CHARTERED ACCOUNTANTS HYDERABAD

M Madhusudhana Reddy
Proprietor
Member Ship No. 213077

Date: 25.08.2005
Place: Hyderabad

305, Amrutha Ville, Right Wing, Opp. Yashodha Hospital, Rajbhavan Road, Somajiguda, Hyderabad – 82.

ANNEX X

MANDAL REVENUE OFFICE
POOSAPATIREGA

MANDAL REVENUE OFFICE
POOSAPATIREGA

FORM-II
(See Rule –4)

Notice of Demand under section 4 of The Andhra Pradesh Non-Agricultural Lands Assessment Act. 1963.

To
The Senior General Manager (operations)
Matrix Laboratories Limited
Gaitula chodavaram (V)
Poosapatirega Mandal.

Please take notice that you are assessed to assessment under the Andhra Pradesh Non-Agricultural Lands Assessment Act. 1963 land held by you in the village of Gaitula chodavaram. In Poosapatirega. Mandal under Vizianagaram District for the period from Fasli No. 1414 to as shown below.

1. Name of the Village or Town : Gaitula chodavaram.
2. Survey No. if any or boundaries ~~or House~~ No. : 57, 58. Allready cover. NALA. Extent (13.40) 57, 71, 60, 54, 51, 44, 55, 56, 59,
3. Extent (Registration) : Ac 57.21 cents
4. Use to which the land in Col.3 is put as determined by the Mandal Revenue Inspector : Bulk drugs Manufactoring company
5. Non-Agricultural Land Assessment determined by the Mandal Revenue Inspector of land in Col.3 :

Allready fixed. F 1403 Ac. 13.40 (Extent.) Rs. 37,146.00 37,146.00
Remaining Extent Ac 57.21 cents x 4046.8 = 231517.1 Sq Mts
NALA amount. = 231517.1 x 0.50 per sq. Mts 1,15,758.55
+ cess 0.37 paise per one Rupees 42 830.66
1,58,589.21 1,58 589.00
rounded to Rs. 1,58,589.00 Total NALA 1,95,735.00

You are further informed that the above assessment shall be payable within 30 days from the date of service of this notice and recovered as land revenue.

25/2/05
MANDAL REVENUE INSPECTOR - I
POOSAPATIREGA MANDAL

Station : Mandal Revenue Office
Poosapatirega

Date : 25-2.2005