Public Disclosure Authorized

Public Disclosure Authorized

E4180v3

GOVERNMENT OF TAMILNADU

DEPARTMENT OF FISHERIES

ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR FISH LANDING CENTRE AT PORTO-NOVO - ANNANKOVIL

FINAL REPORT

WAPCOS CENTRE FOR ENVIRONMENT

WAPCOS LIMITED

(A GOVERNMENT OF INDIA UNDERTAKING)

PLOT NO. 76-C, SECTOR - 18, GURGAON - 122 015 , HARYANA

CONTENTS

C O N T E N T S

CHAPTER-1 INTRODUCTION

1.1	General	1-1
1.2	Project Description	1-1
1.2.1	Porto-Novo Annankovil Fishing Centre	1-3
1.3	Need for the Project	1-5
1.4	Mathematical Model Studies	1-7
1.5	Stakeholders Meeting	1-9
1.6	Design of Various components	1-9
1.7	Objectives of the EIA Study	1-39
1.8	Methodology for the EIA study	1-39
1.9	Outline of the Report	1-44

CHAPTER-2 ENVIRONMENTAL BASELINE STATUS

2.1	General	2-1
2.2	Meteorology	2-3
2.3	Ambient Air Quality	2-6
2.4	Noise environment	2-10
2.5	Landuse pattern	2-13
2.6	Tides	2-13
2.7	Currents	2-14
2.8	Marine water quality	2-14
2.9	Sediments Characteristics	2-25
2.10	Marine Ecology	2-28
2.11	Socio-economic aspects	2-44

CHAPTER-3 ASSESSMENT OF IMPACTS

3.1 Introduction 3-1
3.2 Water Environment 3-1
3.3 Impacts on Noise Environment 3-8
3.4 Impacts on Air Environment 3-10
3.5 Impacts on Socio-economic Environment 3-12

CHAPTER-4 ENVIRONMENTAL MANAGEMENT PLAN

4.1 General 4-1
4.2 Land environment 4-1
4.3 Solid waste disposal 4-1
4.4 Water environment 4-2
4.5 Air environment 4-3
4.6 Control of noise 4-4
4.7 Environmental Management Plan 4-4

CHAPTER-5 ENVIRONMENTAL MONITORING PROGRAMME

5.1 The need 5-1
5.2 Areas of concern 5-1
5.3 Marine water & sediment quality 5-2
5.4 Ambient air quality 5-4
5.5 Noise 5-4
5.6 Summary of environmental monitoring programme 5-5
5.7 Environmental Monitoring Programme 5-6

CHAPTER-6 COST ESTIMATES

6.1 Environmental Management Plan (EMP) 6-1
6.2 Environmental Monitoring Programme 6-1

LIST OF TABLES

Table – 1.1	Village-wise Fishing Craft in Porto-novo area	1.6
Table – 1.2	Design Fleet	1.6
Table -1.3	Summary of cost estimates	1-38
Table -1.4	Scopping matrix for the EIA study of proposed project	1-40
Table - 1.5	Summary of data collection from various sources	1-43
Table-2.1	Average meteorological conditions of the project area district	2-5
Table-2.2	Details of ambient air quality monitoring stations	2-6
Table-2.3	Ambient air quality status in the study area	2-6
Table-2.4	Ambient air quality status-SPM	2-8
Table-2.5	Ambient air quality status-RPM	2-9
Table-2.6	Ambient air quality status-SO_2	2-9
Table-2.7	Ambient air quality status-NOx	2-10
Table-2.8	Ambient noise levels in the study area	2-12
Table-2.9	Equivalent noise levels in the study area	2-12
Table-2.10	Landuse pattern of the study area	2-13
Table-2.11	Location details of various sampling stations	2-15
Table-2.12	Analysis results of physico-chemical parameters in marine water	2-20
Table-2.13	Analysis results of nutrients in marine water	2-21
Table-2.14	Analysis results of major elements in marine water	2-23
Table-2.15	Analysis results of Trace metals in marine water	2-24
Table-2.16	pH, Nutrients, Oil & Grease in Sediments	2-25
Table-2.17	Soil texture and organic matter in sediments	2-25
Table-2.18	Trace metals in Sediment	2-26
Table-2.19	Primary productivity in marine water	2-28
Table-2.20	Phytoplankton population at various sampling stations	2-29
Table-2.21	Zooplankton population at various sampling locations	2-33
Table-2.22	Macro-benthos in sediments at various sampling stations	2-37
Table-2.23	Meio-benhos at various sampling stations	2-39

Table-2.24	list of major fin fish species observed at Parangipatti coastal water	2-42
Table-2.25	Demographic profile of the project taluka	2-44
Table-3.1	Typical composition of untreated sewage	3-2
Table-3.2	Average noise levels generated by the operation of various construction equipment	3-9
Table-3.3	Predicted noise levels due to the operation of various construction equipment	3-9
Table-3.4	Fuel combustion during construction phase	3-10
Table-3.5	Short-term (24 hr) increase in concentration of SO_2	3-11
Table-4.1	Cost estimates for solid waste management	4-2
Table-4.2	Maximum exposure periods for different noise levels	4-4
Table-5.1	Summary of Environmental Monitoring Programme during Project construction phase	5-5
Table-5.2	Summary of Environmental Monitoring Programme during Project operation phase	5-6
Table-6.1	Summary of cost estimate for implementing Environmental Management Plan	6-1
Table-6.2	Summary of cost estimate required for implementation during Construction phase	6-1

LIST OF FIGURES

Figure-1.1 vellar River
Figure-1.2 Proposed improvement scheme
Figure-1.3 Proposal of improvement with minimum dredging
Figure-2.1 Study Area Map
Figure-2.2 Temperature variation in project area
Figure-2.3 Rainfall variation in project area
Figure-2.4 Humidity variation in project area
Figure-2.5 Air and noise monitoring locations
Figure-2.6 Land use classification of the study area

CHAPTER – I

INTRODUCTION

CHAPTER-1

INTRODUCTION

1.1 GENERAL

The Tsunami disaster of December 26, 2004 had devastated many areas along the Indian coastline. The state of Tamilnadu was badly hit leaving a trail of disaster. It is estimated that about 8000 persons perished in the disaster and damaging the properties of many others. Physical infrastructure was badly hit as a result of the Tsunami.

The damage to fisheries infrastructure including closure of bar mouths in the wake of disaster has restricted access of the fishermen to sea, thus affecting fishing activity. Rehabilitation and reconstruction efforts offer opportunities for realizing the integrated coastal zone management and sustainable coastal livelihoods in the affected areas.

The Department of Fisheries, Government of Tamil Nadu awarded the Consulting Services as part of the Tsunami Rehabilitation and Reconstruction efforts for the 'Permanent Stability of Coastal Inlet at Vellar River' to Water and Power Consultancy Services (India) Ltd., New Delhi as per the Agreement No. CR 49/2006-07 dated 13th March, 2007. The present document covers the EIA study be prepared as a part of the above assignment.

1.2 PROJECT DESCRIPTION

River confluences near inlet of river Vellar from south side (Refer Figure-1.1). A small fish landing centre is situated towards left of this river Vellar inlet. The creeklet meets Vellar river at junction from where Porto-nova-Annionkoil light house can be seen. A deserted island is observed on the way to the Vellar river inlet.

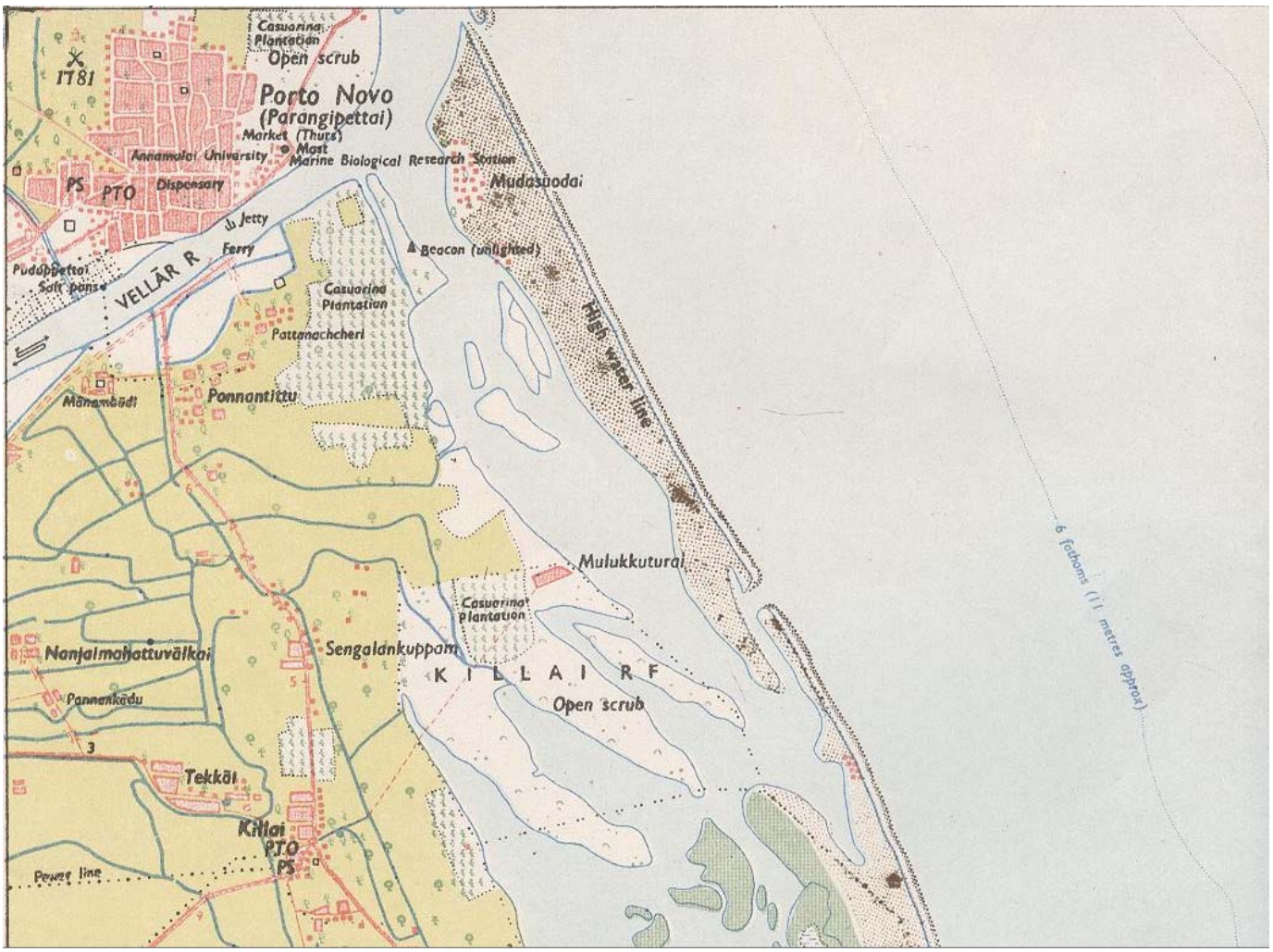


Figure – 1.1 VELLAR RIVER

Prior to Tsunami this island sandpit had human habitations, and after Tsunami, all the survivors have been rehabilated on main land. At junction the river is quite wide with depth ranging from 1m to 2m. The main island sandpit is well stabilized by growth of trees and past human habitations. The newly formed sand spit protrudes towards north. The Inlet width is of the order 150 m and depth is shallow and waves are directly breaking at inlet. The area of proposed fish landing centre at Porto-Novo – Annankoil is now full of sand. A channel has been dredged from Vellar River to this fish landing centre to facilitate navigation of the boats.

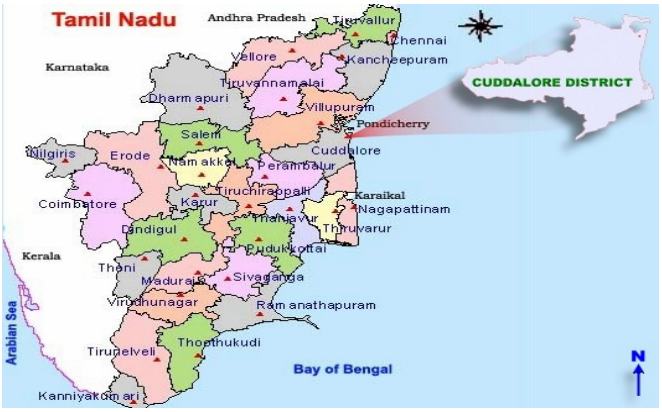
1.2.1 PORTO-NOVO - ANNANKOVIL FISHING CENTRE

Annankovil is one of the fishing center in Cuddalore district and includes fishing villages like Chinnor South and North, Indiranagar, Killai, M.G.R Nagar, Muzhukkuthurai, Chinna Vaikal, Koozhaiyar, Madavapallam, Pudupettai, Samiyar Pettai. Porto-novo- Annankovil is 20 km away from the nearest town Chidambaram and can be reached by road. Frequent buses are plying between these two places. The National Highway (NH 45A), linking Chennai with Kanniyakumari passes through Chidambaram.

Annankovil (Porto-Novo) is located on the bank of river Vellar. The Vellar River flowing in southeast direction, originates in the Shervaroyan Hills of Salem District. In the course of flow of distance 480 km, it forms the estuarine system at Porto-Novo (Parangipettai), before it joins Bay of Bengal.

Porto-novo- Annankovil fishing village is located at Latitude 11˚29’ 50” N and Longitude 79˚46’ 18” E. The site is located in river mouth and totally protected from the waves and storms during rough weather conditions and is one of the favorable site for the development of the fish Landing Center.

Vellar estuary is used as the nursery ground for fish fry and fingerlings of the principle cultivable finfishes and milkfish. Pearl spot, Etroplus suratensis is available in appreciable numbers from October to January. During monsoon and post monsoon seasons, large number of juveniles of giant perchis is noticed.



Survey No: 78 & 78/2 of
Parangipettai village

Latitude : 11˚29' 50" N

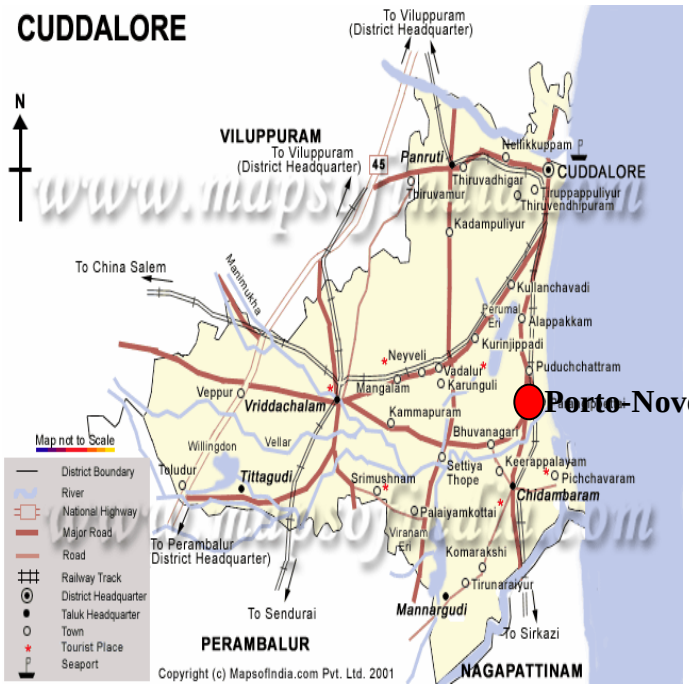
Longitude: 79˚46' 18" E

Taluk : Chidambaram

District : Cuddalore

The nearest railway station is at Parangipettai (2 Km)

From C. Mutlur situated in NH-45A, a Bitumen road around 5 km length connecting to the Site.



Fifteen fishermen cooperative society is functioning at Porto-novo itself and its main activity is selling of requisites to fishermen, marketing the landings and provide the financial assistance to its members. All the infrastructure facilities such as roads for transport, electricity, telecommunications, water supply etc are available at Porto-novo. School up to XII standard is functioning at Porto-novo and college at Chidambaram, which is 20 Km away. The nearest railway station is at Parangipettai on Chidambaram - Cuddalore line and Chidambaram is the main junction close to Porto-novo.

Presently, the fishermen of Porto-novo are carrying out the unloading of the fish catch along the bank of the branch of river Vellar. This branch flows in the

North South direction which flows to a distance of 3 km, where it reaches C. Pudupettai. The traditional boats of this area ply through this channel itself.

A landing centre is operating at Mudasal Oodai which is located in the Killai backwater channel on the other bank of the river Vellar. The landing centre is 750 m away from the proposed FLC. As there is no proper road connectivity between these two places and the fishermen of Porto-novo prefer to carryout the landing operation in Porto-novo itself with lot of hazels to avoid a long distance of 30 km travel by road. To overcome these hazels a fish landing centre has been proposed at Porto-novo– Annankovil, which had been a long standing demand for the development.

The proposal of improvement, recommended in the Detailed Project Report for permanent stability of coastal inlet at Vellar River, contemplates a lead channel of 125 m bed width dredged to -2.0 m below CD from sea face to Porto-Novo. This channel is protected by a 700 m long guide bund on north side. In addition, a 50 m wide berthing channel is also proposed to be dredged to -1.50 m below CD in north-south direction for the proposed Fish Landing Centre (FLC) at Porto Novo, connecting to the main branch of Vellar River. This berthing channel is protected by a parallel 600 m reclamation bund on the east side.

1.3 NEED FOR THE PROJECT

The proposed Porto-novo– Annankoil bar mouth is situated about 18 km from Chidambaram in Cuddalore District. This bar mouth is located in the confluence of Vellar River. About 15 fishermen villages situated in and around using this bar mouth for venturing into sea for fishing operations. After Tsunami, bar mouth has silted up and sand bar has been formed. It is essential that the bar mouth is opened for maintaining the estuarine habitats. Hence, it is proposed to dredge the bar mouth at Vellar river at Porto-novo and to adopt suitable structure for maintaining the permanent opening of river mouth. In addition, one fish landing centre is also proposed in the Vellar river basin at Porto-novo. As per the Fisheries department statistics, 112 Motorised

Fishing Vessels, 142 FRP Catamaran (OBM) and 52 country crafts are registered in Porto-novo– Annankoil fishing village. The total fish catch size from 1st April 2008 to 31 March 2009 is 9500 tones.

Table- 1.1 Village-wise Fishing Craft in Porto-novo area

S. No.	Name of the Fishing Village	Fishing Craft			Total
		MFVs	Motorised	Non Motorised	
1	Annankovil	-	23	-	23
2	Samiyar Pettai	-	45	75	120
3	Chinnor North	-	21	40	61
4	Chinnor South	-	40	40	80
5	Indiranagar	-	15	15	30
6	C. Pudupettai	-	15	90	105
7	Pudukuppam	-	4	110	114
	Total		163	370	533

Table 1.2 Design Fleet

. No.	Category of vessel / Length	Existing	Proposed	Total	No. of boat operating per day (80%)	Average Landing per Vessel (Kg)	Total Annual Landing (Tone)	Remarks
1	FRP Boat (8 M)	163	87	250	200	100	4000.00	
2	Mechanized Boat (9 - 12M)	-	50	50	40	250	2000.00	Expected to be migrated from Mudasal oodai on commencement of the commercial activity of this FLC
3	Traditional Boat	370		250	200	75	3000.00	Out of 370 country crafts around 20% of crafts to expected get conversion as a motorised boat
Total				**300**	270		**9000.00**	

Note: It is understood that the Government of India in the 11th Five year plan suggested / directed that there will not be any further increase in the fleet strength and instead the Government directed to explore

various possibilities to exploit the deep sea fishing. Hence the strength of the boat 270 is freezed and the same is taken into account for arriving the Berthing, Landing and outfitting quay.

1.4 LANDING CENTRE ENTRANCE CHANNEL

Mathematical model studies were carried for the channelisation and stabilization of Vellar River. The detail study is explained in the Feasibility report of Stability of Coastal inlet for Vellar River submitted earlier by WAPCOS. Subsequently, a joint meeting was held at Chennai along with the officials of Department of Fisheries on 19.05.2008 on various components of improvement proposals. Officials from Department of Fisheries pointed out that while the cost of Structural measures works out, the cost of dredging has gone high. Considering above aspects, a solution was formulated based on the suggestions of Department of Fisheries to minimize the cost of dredging and the total cost as a whole. In place of creating the full fledged channel of 250 m width and – 2.5 m CD depth, it is proposed to provide a lead channel of 125 m width dredged to -2.0 m CD through flood shoals from sea face up to the junction of berthing channel. For the fish landing operation, a branch channel is diverted and the same channel is being utilized for the landing centre. Presently, no depths are available in the branch channel and the fishermen with the help of tidal variation carry out the landing operation. The main river channel is dredged to – 2.0 m below CD to maintain the mouth opening and the branch channel is dredged to -1.50 m below CD so that sufficient depth is made available for the free movement of fishing boats without any depth constraint. The dredged branch channel is maintained at the width maximum of 140 m and minimum of 50 m to cater the needs of the motorised fishing boats plying in this area.

The behavior of the river in existing condition and under proposed condition has been studied. The design parameters and effect of proposed

improvement of the channel i.e. providing guide bunds, dredging channel can be obtained from model studies. The flow in Vellar River is confined between two banks and flow is along the axis of channel. In the surveyed area width varies between 300 m to 700 m from upstream to sea end. Flow direction is well defined. Considering nature of flow and task to be carried out one dimensional model study has been preferred.

The conclusions and recommendations of Model Studies are given as below

i) Vellar inlet is identified as unstable in nature and characterized as a bar by-passing type.

ii) The cause of instability is more littoral drift in comparison to tidal prism.

iii) Presence of gorge at inlet and deep pockets at upstream reaches indicate prevalence of good monsoon discharge.

iv) The present mechanism of maintenance of inlet can be attributed to the fact that in monsoon months, the high discharge scour the inlet bar and rest of the year, the tidal prism combat littoral drift and maintain the passage for navigation. In absence of rainfall in a year, the inlet is likely to be closed.

v) The present tidal prism has been computed to be 4.40 million cum. With the proposed improvements, the tidal prism increases to 5.43 million cum. It is not a substantial increase. Hence, besides providing lead channel, a guide bund has been also proposed to channelise the flood water towards the main inlet.

vi) The proposal of improvement contemplates a lead channel from sea face to Porto-Novo of 125 m width at bed dredged to -2.0 m below CD protected by a 700 m long guide bund on north side.

vii) The straight lead channel will improve tidal prism, provide well defined navigational channel and guide bunds will direct the flood flow towards inlet and protect the channel from return drift, which makes the channel tortuous.

viii) The channel still remains as bar by-passing type, indicating possibility of formation of flood shoal/ebb shield inside river in front of inlet. This is required to be removed at certain interval of year, particularly in absence of monsoon rain.

1.5 STAKEHOLDERS' MEETING

A Stakeholders' meeting was conducted on February 27, 2008 at Vellar river site, in which the local fishermen representatives and the Department of Fisheries Officials participated. The suggestions regarding the opening of bar mouth given by the local Fishermen representatives and the Department of Fisheries Officials during the Stakeholders' meeting were considered in the final recommended proposal of improvement, which are as follows:

- To deepen the main Vellar river channel by dredging to maintain the maximum possible depths and to stabilize the inlet permanently by providing guide bunds on both the banks of Vellar River

- To construct a FLC at Annankovil with Landing facilities and other infrastructure

- To provide maximum length of the southern side guide bund

1.6 DESIGN OF VARIOUS COMPONENTS

Guide Bunds

It is evident from the results of model studies, that the channelisation of flow is the best option to stabilize the coastal inlet of Vellar river. A guide bund on tidal flats extending up to sea face will restrict spreading of flow at high water, which increase the flushing capacity to maintain the inlet.

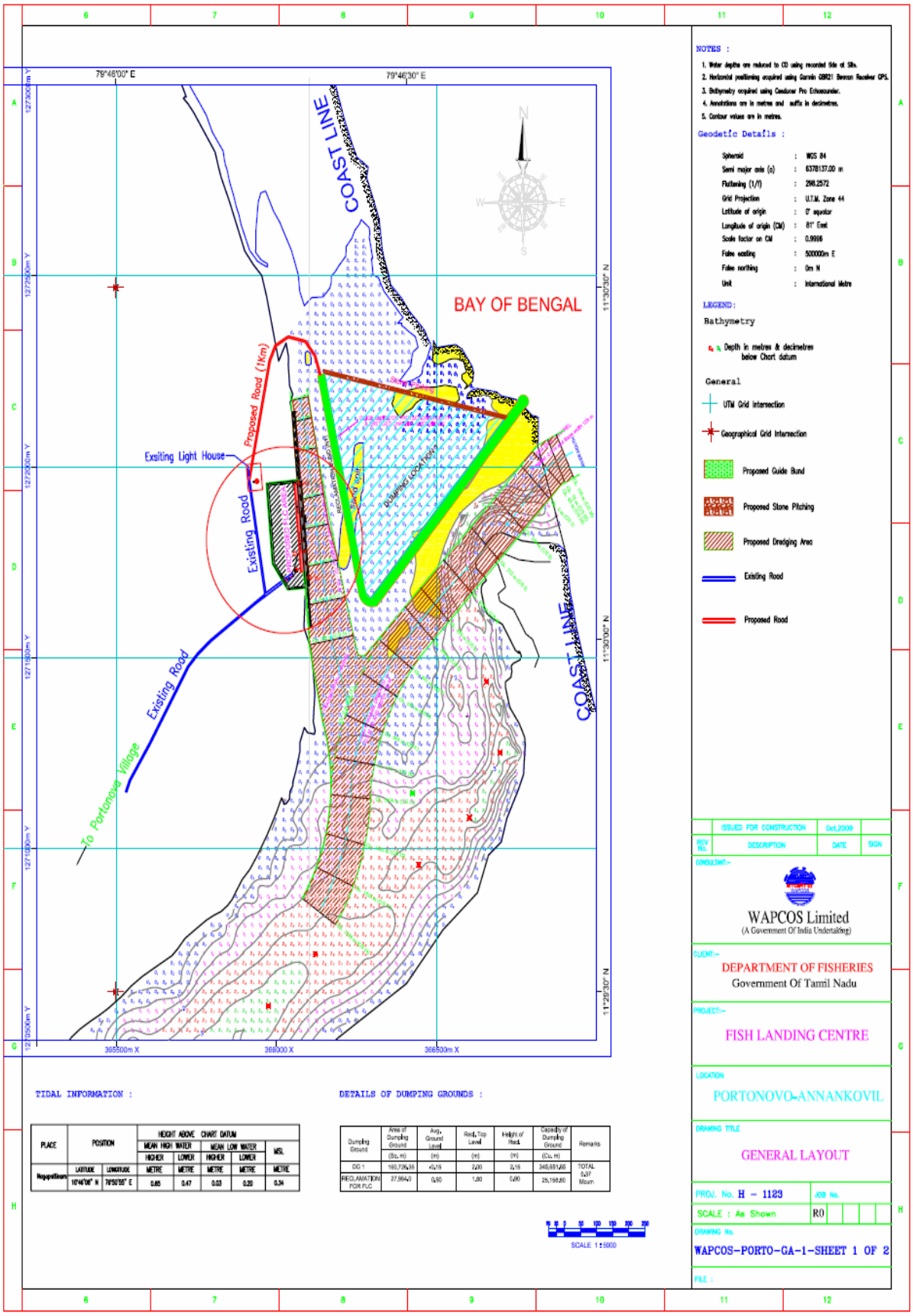
The improvement scheme contemplates an approach channel having a 125 m bottom width and dredged to -2.00m CD. This channel is protected by a 700 m long guide bund on north side, extending from sea shore up to sea face running through shallow sand flats.

Design for Proposed Guide Bunds

A 700 m long guide bund is proposed on northern side of the dredged channel, and berthing channel is protected by a parallel proposed 600 m

reclamation bund (Side channel guide bund) on the east side. The berthing channel location has shown in Fig. 1.2.

Project Details Explaining During Stakeholders Meeting on 27.2.2008


NOTES :
1. Water depths are reduced to CD using recorded tide at Site.
2. Horizontal positioning acquired using Garmin GBR21 Beacon Receiver GPS.
3. Bathymetry acquired using Ceaducer Pro Echosounder.
4. Annotations are in metres and suffix in decimetres.
5. Contour values are in metres.
Geodetic Details :
Spheroid : WGS 84
Semi major axis (a) : 6378137.00 m
Flattening (1/f) : 298.2572
Grid Projection : U.T.M. Zone 44
Latitude of origin : 0° equator
Longitude of origin (CM) : 81° East
Scale factor on CM : 0.9996
False easting : 500000m E
False northing : 0m N
Unit : International Metre
LEGEND:
Bathymetry
Depth in metres & decimetres below Chart datum
General
UTM Grid Intersection
Geographical Grid Intersection
Proposed Guide Bund
Proposed Stone Pitching
Proposed Dredging Area
Existing Road
Proposed Road
COAST LINE
BAY OF BENGAL
Proposed Road (1Km)
Exsiting Light House
Existing Road
To Portonova Village
79°46'00" E
79°46'30" E
11°30'30" N
11°30'00" N
11°29'30" N
365500m X
366000 X
366500m X
ISSUED FOR CONSTRUCTION
Oct,2009
REV No.
DESCRIPTION
DATE
SIGN
CONSULTANT:-
WAPCOS Limited
(A Government Of India Undertaking)
CLIENT:-
DEPARTMENT OF FISHERIES
Government Of Tamil Nadu
PROJECT:-
FISH LANDING CENTRE
LOCATION
PORTONOVO-ANNANKOVIL
DRAWING TITLE
GENERAL LAYOUT
PROJ. No. H - 1123
JOB No.
SCALE : As Shown
R0
DRAWING No.
WAPCOS-PORTO-GA-1-SHEET 1 OF 2
FILE :
TIDAL INFORMATION :
PLACE
POSITION
HEIGHT ABOVE CHART DATUM
MEAN HIGH WATER
MEAN LOW WATER
MSL
HIGHER
LOWER
LATITUDE
LONGITUDE
METRE
Nagapattinam
10°46'00" N
79°50'55" E
0.85
0.47
0.03
0.20
0.34
DETAILS OF DUMPING GROUNDS :
Dumping Ground
Area of Dumping Ground
Avg. Ground Level
Red. Top Level
Height of Red.
Capacity of Dumping Ground
Remarks
(Sq. m)
(m)
(m)
(m)
(Cu. m)
DG 1
160,726.35
-0.15
2.00
2.15
346,651.65
TOTAL 0.37 Mcum
RECLAMATION FOR FLC
27,564.0
0.90
1.80
0.90
25,158.60
SCALE 1:5000

Dredging

As per the DPR, recommended proposal of improvement includes a lead channel extending from sea face to Porto-Novo in the main channel of river Vellar. The designed dredged depth and bottom width of proposed dredged channel is -2.0 m CD and 125 m respectively. The channel extends inside the river, where deeper pockets of -2.50 m depth are available. In addition, a 50 m wide berthing channel is also proposed to be dredged to -1.50 m below CD in north-south direction for the proposed Fish Landing Centre (FLC) at Porto Novo, connecting to the main branch of Vellar River. The total quantity of capital dredging works out to 1,48,520 m^3 and the dredging area is 1387.04 m^2. The proposal of improvement with minimum dredging is given in Figure-1.2.

Disposal of Dredged Materials

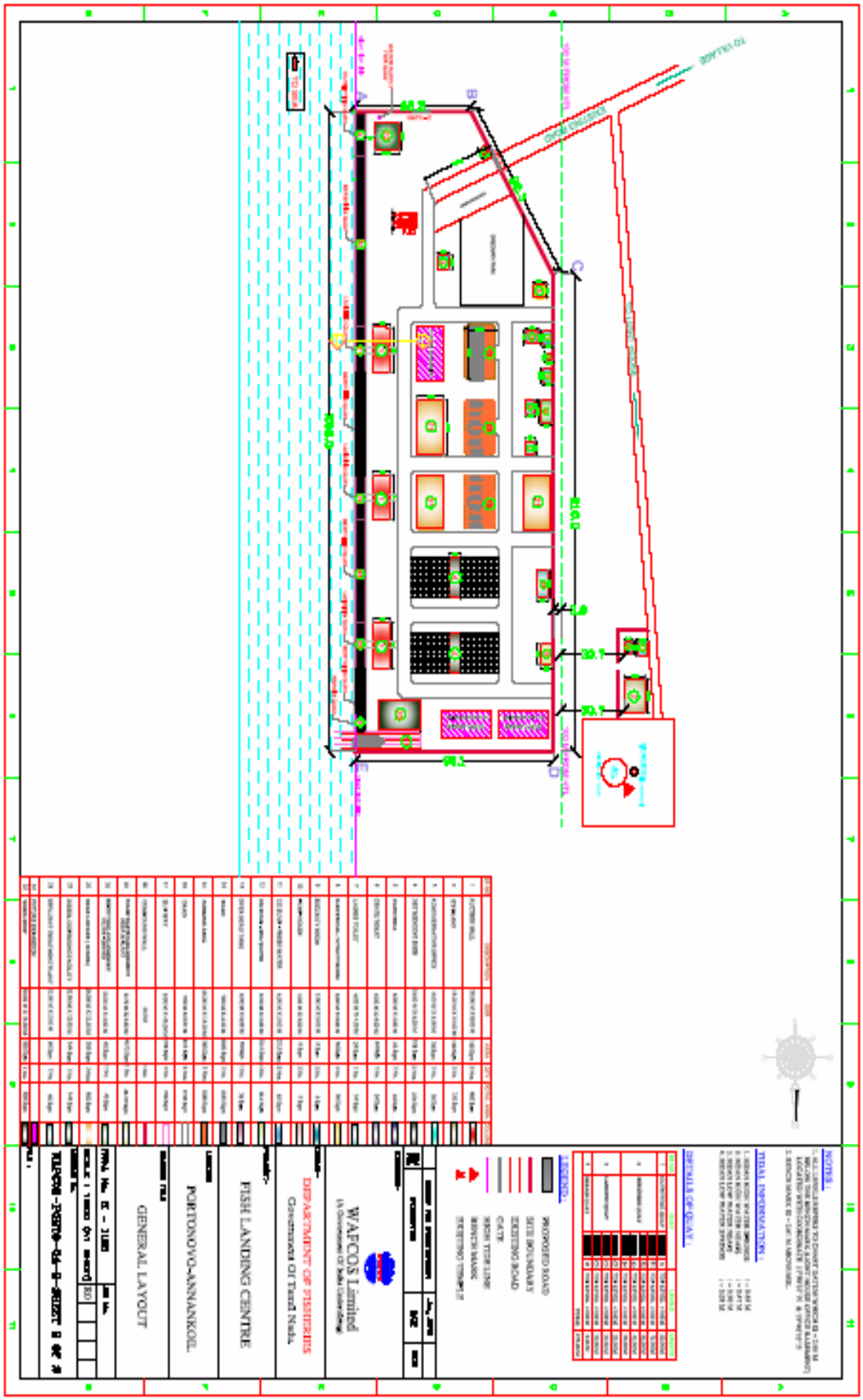
It is proposed to dump the dredged material on the V-portion on the east side between the northern guide bund and reclamation bund. Some portion of the dredged quantity of berthing channel can be utilized for the reclamation of proposed Fish Landing Centre (FLC) area.

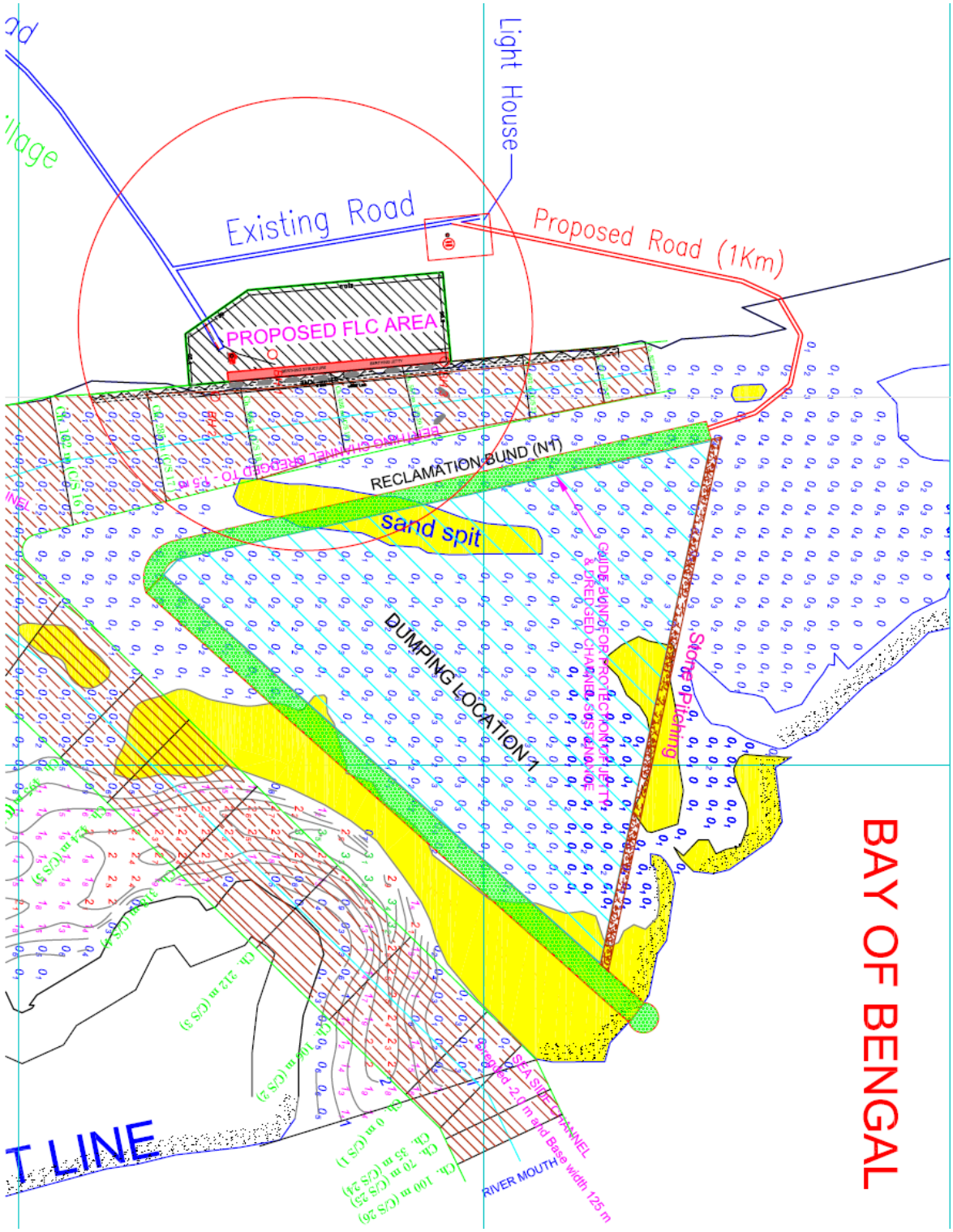
Landside Facilities

The facilities for the landing centre are to be provided according to the EU norms and the same has been considered while designing the waterfront and landside facilities.

Land side strengthening

As the Porto-novo-Annankoil fish landing centre is located on the bank of river Vellar on the east bay, sufficient backup land is available for the development of foreshore facilities for the harbour. Total land area of 3.0 hectare is required for accommodating the required limited shore-based facilities of the fish landing centre which is to be accomplished from the earth borrowed from outside the project area.


WAPCOS Limited
DEPARTMENT OF FISHERIES
FISH LANDING CENTRE
PORTONOVO-ANNANKOIL
GENERAL LAYOUT


Light House
Existing Road
Proposed Road (1Km)
PROPOSED FLC AREA
RECLAMATION BUND (NT)
Sand spit
DUMPING LOCATION 1
BAY OF BENGAL
T LINE
RIVER MOUTH

Alternatively, the earth for land strengthening can be obtained from dredging the shallow water areas in the harbour basin, provided it works out cheaper than borrowing earth from main land areas.

The top of the land after strengthening level is proposed at an average R.L. of +1.80 m slightly higher than that of quays to give a gentle slope from landside to waterside to enable easy drainage of surface water.

Bund

The slopes of the finished land on the waterside for boat parking/building/repair yard are proposed to be protected by the bund. The bund is provided with trap stones of weight 10 kg to 20 kg overlying a filter layer of trap stone quarry spalls up to 5 kg. The primary layer is protected by the trap stones of weight 35 to 50 kg as armour layer.

Auction Hall

The fish auction hall is a sheltered building meant for cleaning, sorting, weighing, auctioning, icing, packing and loading of the freshly landed fish. To minimize exposure of fresh fish to sun, dust, air and to avoid long haulage of fish, the fish auction hall is located close to the landing quay.

A temporary auction hall of size 25 x 10 m exists on Annankovil beside the road. Since the size of the existing auction hall is not sufficient to carry out the auctioning process and the proposed landing centre is away from the existing auction hall, a separate auction hall is provided just behind the landing quay. The size of the auction hall is 20 m X 8 m, 3 Nos.

Fish Loading Areas

Behind the fish auction hall, appropriate fish loading areas are provided to enable vehicles to approach the auction hall from behind for transportation of auctioned fish to consumer markets.

Packing Hall

After auctioning, the fish available for fresh consumption has to be packed immediately for transportation to market places. Required space is provided in the auction hall.

Approach Road and Internal Roads

The fish landing centre near Annankovil is made approachable by an all weather asphalt road from the road proceeding to the light house. Once the full fledged landing centre becomes operative, the flow of vehicles and people would increase manifold and the approach road would become congested due to heavy inflow of vehicles and groups of people thronging to the fishery centre for fish purchase during fish landing hours. Thus a two - lane approach is proposed.

Within the fishery harbour complex, internal asphalt roads of sufficient width are proposed. The internal roads provide road communication with the earmarked for various utilities. The road widths shown in the harbour layout include the pedestrian and vehicular traffic lanes-cum-service lines such as sewerage, drainage, fresh water supply, lighting etc.

Parking Area for Vehicles

There will be many fish traders and consumers and other people visiting the fishery harbour with their vehicles such as trucks, vans, auto rickshaws, scooters, bi-cycles, tri-cycles etc., for collecting and transporting fish to nearby fish markets and consumer centers. In addition, there will be vehicles connected with the fishery industry bringing ice and other commodities.

Fishery Administrative Office

An administrative office is necessary for management and maintenance of harbour facilities, for regulating activities relating to fishery industry such as fish market, fish prices and for controlling the movement of fishing vessels in and out of the harbour. As such, the proposed fishery harbour complex provides for a fishery administrative office as shown in the harbour layout located very close to fish auction hall to monitor the fish sales activities. The existing auction hall is renovated to form the office building.

Apart from the Administrative office, the fishery harbours need a Co-operative society for welfare of Fishermen and their family. Since the large number of

fishermen's using this harbour need to a Co-operative society in the Fish landing centre.

Public Toilet Block

From the sanitation point of view and essentially for maintaining a cleaner fishery harbour, adequate lavatories, urinals and bathing facilities for ladies and gents need to be provided near places where people tend to concentrate in large numbers. The location of Gents and Ladies Toilets is shown in the harbour layout .

Fresh Water Supply and Distribution

Fresh water supply during the operation of fishery harbour must be adequate to meet the requirements of fishing vessels to carry on their fishing trips, fish box washing, drinking water, etc.,

The proposed fishery harbour complex provides for supply of potable water to vessels on outfitting quayside. Daily fresh water requirement for the entire fishery harbour complex is as follows:

Fresh Water Demand

Drinking Water	- 25 lpcd
Fish box washing	- 10 Liters / box / day
Miscellaneous use	- 15 % Total Requirement
Water for Personal Use	- 300 Boat X 3 Persons / boat x 25 lpcd
	- 22, 500 liters.
Fish Box Washing	- 370 Box x 10 Liters / box / Day
	-3,700 liters.
Sub Total	- 26,200 liters.
Miscellaneous use	- 26,200 x 15%
	- 3930 liters,
Total	- 30130 liters ,

The proposed fishery harbour complex has provision for an overhead water tank capacity of 50,000 liters and 2 no. of underground sumps (with open space for an additional sump) 1,00,000 liters for a total of 2 days reserve capacity for the landing center. The location of the Overhead Water tank is as shown in the harbour layout Fig. 1.2. The fresh water is sourced from TWAD Board supply from Parangipettai village.

Sea Water Supply and Distribution System

Quantum of water required in fish handling and Auction hall for cleaning fresh fish, Floor cleaning and Fish box washing would be manifold compared to water required for personal use. The daily requirement of Sea water in the Fish Landing Centre is computed as below:

Fish Washing

Taken at 1 litre / Kg of fish handled in auction hall in peak season per day (24,000 kg) = (24,000 Kg x 1 litre / Kg) = 24000 litres

Cleaning of Fish Auction Hall premises

Taken at 10 litres / sq.m of floor area / day (Considering 50% less for high pressure cleaning systems) = 480 sq.m x 10 litres/sq.m = 4800 litres

	Sub total = 38800 Liters
Miscellaneous use	- 15 % X 38800 liters
	- 5820 liters
Total	- 28800 liters.

A separate pumping station with seawater distribution system other than normal fresh water distribution system with the Under Ground water tank capacity of 50000 litres is proposed in the fish Landing Centre.

The Seawater Ground water tank is located in a place close to the fish auction hall as shown in the harbour layout drawing Fig 1.2, so that seawater can be distributed to fish auction hall for cleaning purposes.

Design of Effluent Treatment Plant and Solid waste Management System

Prediction of trade effluent generated

Fresh Water

From above fresh water demand is 30,130 lit/ day. 80% of this fresh water demand will come out as sewage. Total estimated fresh water sewage is 24,104 lit/day.

Sea Water

From above sea water demand is 28,800 lit/ day. 80% of this sea water demand will come out as sewage. Total estimated sea water sewage is 23,040 lit/day.

Maximum Trade effluent generated is 47,144 lit/day. So the effluent treatment plant is designed for handling 50 KLD of trade effluent. The detailed design and features of the ETP is given below:

Method of Treatment : Fluidized Bed / Fluidized Aerobic Bio Reactor System

DESIGN BASIS

The Sewage cum Effluent Treatment Plant is designed for a capacity of treating 50,000 Litres/Day @ 3.0 m3/Hr.

Raw Sewage Characteristics taken for design basis

S.No	Description of the Parameter	Value
1	Ph	6.5-7.5
2	BOD (Biological Oxygen Demand)	300mg/lit
3	COD (Chemical Oxygen Demand)	900mg/lit
4	TSS (Total Suspended Solids)	150mg/lit
5	Oil & Grease	50mg/lit

Treated Water Characteristics

S.No	Description of the Parameter	Value
1	pH	6.5-7.5
2	BOD (Biological Oxygen Demand)	≤20mg/lit
3	COD (Chemical Oxygen Demand)	≤100mg/lit
4	TSS (Total Suspended Solids)	≤30mg/lit
5	Oil & Grease	Traces

Note: The outlet from Sewage Treatment Plant will match the Pollution Control Board Norms for inland disposal

TREATMENT SCHEME FOR PROPOSED PLANT

Primary Treatment

Screening, Collection sump & Oil skimmer tank are the components proposed under Primary treatment.

Secondary Treatment

Fluidized Bed / Fluidized Aerobic Bio Reactor filled with high quality self supporting cylindrical shaped Poly Propylene Material and Clarifier are the components proposed under secondary treatment.

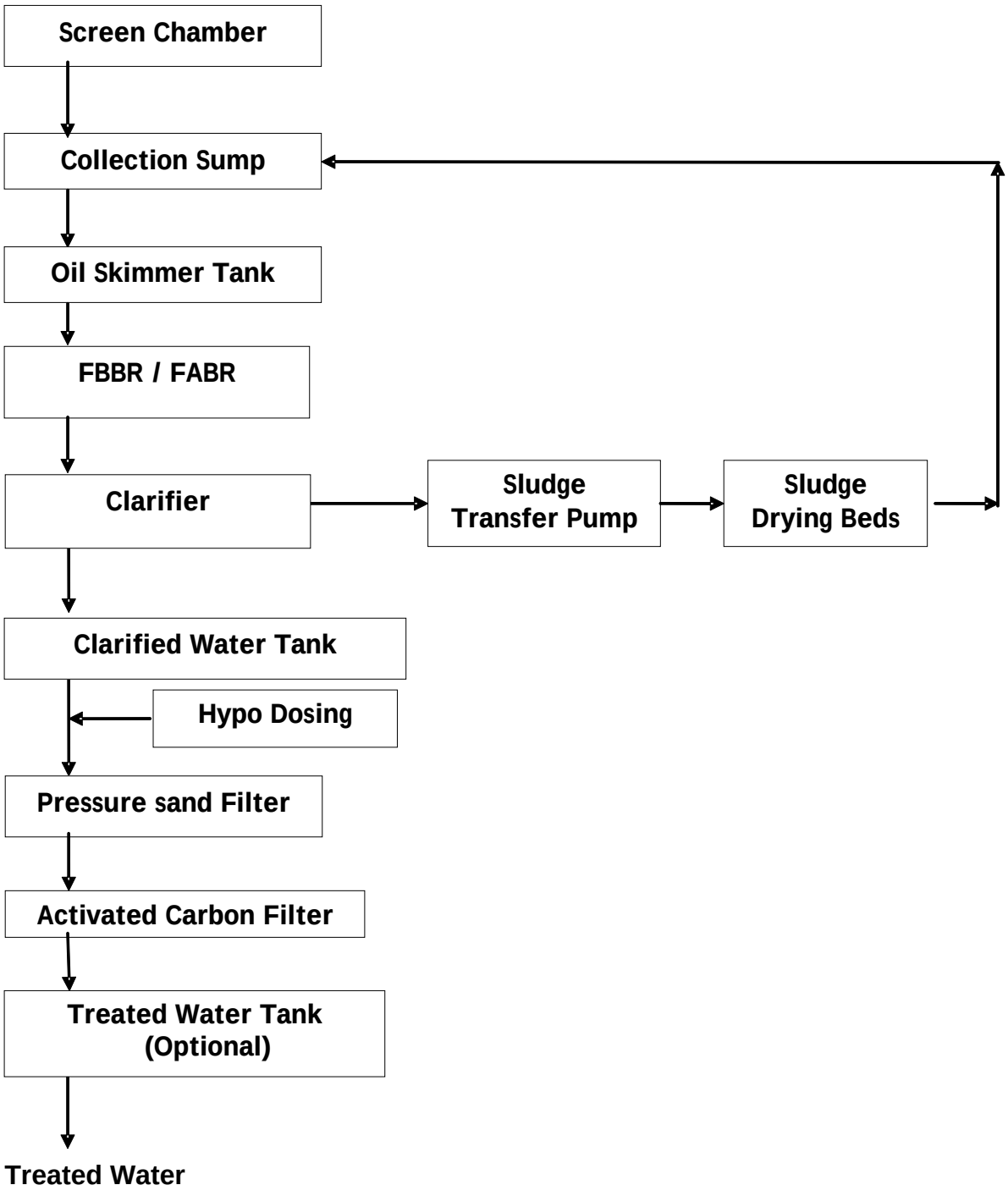
Tertiary Treatment

Disinfection, Pressure Sand Filter, Activated Carbon Filter and Treated Water Tank (Optional) are the units proposed under the tertiary treatment facilities

Water Recycling Details

1. Toilet Flushing	:	12000	Litres/Day
2. Sold to Agriculture irrigation purpose	:	35144	Litres/Day
Total Water Recycled	:	**47**	KLD

PROCESS FLOW DIAGRAM



PROCESS DESCRIPTION:-

Primary Treatment:-

Screen Chamber:-

The sewage enters in to the Screen Chamber by gravity flow where Screen is fixed to remove the large debris entering into the Collection Sump.

Collection Sump:-

The Screen Chamber outlet is collected in the Collection Sump, from where the sewage is aerated for even mixing and it is pumped to Oil Skimmer Tank.

Oil Skimmer Tank:-

The sewage from Collection Sump is pumped into the Oil Skimmer tank. Here Oil & grease are removed to a maximum extent.

2. Secondary Treatment:-

Fluidized Bed / Fluidized Aerobic Bio-Reactors:-

The Sewage from the oil skimmer tank flows in to Fluidized Bed / Fluidized Aerobic Bio Reactor. The Fluidized Bed / Fluidized Aerobic Bio Reactors are provided with 'State-of-the-Art' diffused aeration system. In the aeration process, oxygen transfer takes place by molecular diffusion through the interface film between air and liquid and increases in proportion to the interface area for a given flow thereby, the surface area increases and the velocity of the bubbles decreases with number of bubbles. This factor contributes to the higher oxygen transfer capacity of diffused aeration system. The Fluidized Bed / Fluidized Aerobic Bio Reactors is filled with high quality self supporting cylindrical shaped vessel made of Poly Propylene. Bacterial growth shall be generated by providing compressed air in Bio-Reactors (FBBR / FABR) and get attached to the PP media to form fixed film which reduces BOD, COD & Organic Pollutants.

Clarifier:-

The treated water from the FBBR / FABR flows into the Clarifier, where feed well is provided to reduce the force of the wastewater to allow it settle down, where the solids gets settled at the bottom of the tank and the clear supernatant water overflows into the clarified water tank. The settled sludge is transferred from Clarifier to Sludge Drying Beds for separating the sludge and water, and this water is transferred to Collection Sump and solid sludge can be used as manure.

Clarified Water Tank:-

The overflow water from the Clarifier is collected in the Clarified Water Tank.

3. Tertiary Treatment:-

Disinfection:-

The clear water is dosed with hypo for the disinfectant.

Pressure Sand Filter:-

The Pressure Vessel is of MSEP construction, filled with graded filter media supported on layers consists of pebbles and sand. The filtration media is chosen from carefully cleaned, sieved and graded filter sand.

A mixture of coarse and fine sand in predetermined proportion facilitates in depth filtration. In-depth filtration provides longer runs between backwashes and better quality of filtrate compared to surface filtration.

Activated Carbon Filter:-

The Pressure Vessel is of MSEP construction, filled with graded filter media supported on layers consists of pebbles, sand and activated carbon. The filtration media is chosen from carefully cleaned, sieved and graded filter sand.

A mixture of coarse, fine sand and activated carbon in predetermined proportion facilitates in depth filtration. In-depth filtration provides

longer runs between backwashes and better quality of filtrate compared to surface filtration.

Treated Water Tank:-

The filtrate water from Pressure Sand Filter and Activated Carbon Filter is collected in the treated water tank.

PROCESS DESIGN DETAILS:-

Screen Chamber:-

Normal flow designed	:	3.0 m^3/hr
No. of Screen Chamber	:	One
Angle of Inclination	:	45^0
Width of the Opening	:	25mm
Size Of the screen chamber	:	0.5m X 0.5m x 1.3m T.D
Free Board	:	300mm
MOC of Screen Chamber	:	RCC with Epoxy Coating

Collection Sump:-

Normal Flow Designed	:	3.0 m3/hr
No of Sump	:	One
Retention Time	:	10hrs
Volume of the Sump	:	30 m3
Size of the Sump	:	3.0m X 3.0m X 3.3m T.D
Free Board	:	300mm
MOC of Collection Sump	:	RCC with Epoxy Coating

Oil Skimmer Tank:-

Normal Flow Designed	:	3.0 m3/hr
No of Tanks	:	One
Volume of the Tank	:	24 m3
Size of the tank	:	3.2m Dia X 3.5m T.D
Free Board	:	500mm

MOC of Oil Skimmer Tank	:	RCC with epoxy coating

Fluidized Aerobic / Fluidized Bed Bio Reactors:-

Type	:	Attached Growth System
Normal flow designed	:	3.0 m3/hr
No. of Tanks	:	One
Hydraulic Retention Time	:	7hrs
Volume of the Tanks	:	21.87 m3
Size of the FBBR	:	2.70m X 2.70m X 3.5m T.D
Free Board	:	500mm
Area required for the reactor	:	6.0 m2
MOC of FBBR	:	RCC with Epoxy Coating
Inlet BOD to the Reactor	:	300mg/lit
BOD Loading	:	18Kgs/Day

Clarifier:-

Normal Flow Designed	:	3.0 m3/hr
Supernatant Overflow	:	3.0 m3/hr
No. of Tanks	:	One
Hydraulic Retention Time	:	3hrs
Volume of the Tank	:	9.0 m3
Size of the Tank	:	1.75 m X 1.75m X 3.5m T.D
Free Board	:	500mm
MOC of Clarifier	:	RCC with Epoxy Coating
Area of the Clarifier	:	3.1m2
SWD	:	2.5m +0.5m

Clarified Water Tank:-

Normal Flow Designed	:	3.0 m3/hr

No. of Tanks	:	One
Retention Time	:	3hrs
Volume of the Tank	:	9 m3
Size of the Tank	:	1.75m X 1.75m X 3.5m T.D
Free Board	:	500mm
MOC of Clarified Water Tank	:	RCC with Epoxy Coating

Sludge Drying Beds:-

No of Tanks	:	Three
Size of the Tank	:	0.5m X 0.5m X 1.0m T.D
Free Board	:	300mm
MOC	:	Brick Work

Treated Water Tank:-

Normal Flow Designed	:	3.0 m3/hr
No. of Tanks	:	One
Retention Time	:	5hrs
Volume of the Tank	:	15.0 m3
Size of the Tank	:	2.3m X 2.3m X 3.5m T.D
Free Board	:	500mm
MOC of Treated Water Tank	:	RCC with Epoxy Coating

Features & Benefits of the Proposed System over other methods of treatment:-

1. Less Area is required
2. Less sludge generation than any other system
3. Easy Operation
4. No Recirculation of sludge is required
5. Consistent process results

6. Lower expansion and retrofit costs due to modular construction and Reduced excavation

7. Short wastewater retention time allows for a smaller footprint

8. Minimal head loss through system

9. Low Energy Consumption

10. Reduced life cycle costs as compared to suspended growth systems

11. Simple operation, less lab testing for process control

12. Easily modified for upgrades, retrofits and multiple applications

13. No Primary Settling Tank is required

14. Capable of Handling Shock Loads

15. Minimum Civil works

16. Since the system is fully automatic, no round the clock monitoring is required.

SPECIFICATIONS FOR EQUIPMENTS-

1. Screen

DESCRIPTION	
Quantity	1 No
MOC	MSEP Screen with 25mm Spacing.

2. Raw Sewage Pump

DESCRIPTION	
Quantity	2Nos(1W +1S)
Flow	3.0m^3/hr
Head	10m
Motor	1HP
Type	Submersible
MOC	CI
Make	Sharp /Equivalent

3. Oil Skimmer

DESCRIPTION	
Quantity	1 No
MOC	MSEP

4. Sludge Transfer Pump for Oil Skimmer

DESCRIPTION	
Quantity	1 No
Flow	1.0m^3/hr
Head	15 m
MOC	CI
Motor	1HP
Make	Kirloskar/Equivalent

5. Air Blower

DESCRIPTION	
Quantity	2Nos(1W +1S)
Capacity	43 m^3/Hr
Head	4MWC
Make	Kay International/Equivalent
Motor	5HP
Motor Make	Kirloskar/Elgi/Equivalent

6. Coarse Bubble Membrane Aerator

DESCRIPTION	
Quantity	2 Nos
Flow	10 m^3/hr
Make	IFU-GERMANY/Equivalent
Size	150mm Dia
MOC	EPDM
Medium Of Flow	Air
Type	Disc Type
Dimension Of Bubble	5mm
Temperature Tolerance	85^{0}C
Type Of Arrangement	Retrievable

7. Fine Bubble Membrane Aerator

DESCRIPTION	
Quantity	4 Nos
Flow	14 m^3/hr
Make	IFU-GERMANY/Equivalent
Size	90mm Dia X 1000mm Height
Medium Of Flow	Air
Type	Sleeve Type
Dimension of Bubble	1mm – 2mm
Service Temperature	80 ° C
Type of Arrangement	Retrievable
Membrane Construction	High Grade EPDM

8. FABR / FBBR Media

DESCRIPTION	
Type	Self Supported, Cylindrical Shape
MOC	PP
Quantity	1Lot
Colour	Black
Maximum Continuous Operating Temperature	80^0C
Specific gravity	0.90-0.95 Kg/m^3
Media Usage	FBB Reactors

9. Mechanical Arrangement for FABR / FBBR

DESCRIPTION	
Quantity	1Set
MOC	MSEP

10. Mechanical Arrangement for Clarifier

DESCRIPTION	
Quantity	1Set
MOC	MSEP

11. Sludge Transfer Pump

DESCRIPTION	
Quantity	1No
Flow	1.0m^3/hr
Head	15m
MOC	CI
Motor	1HP
Make	Kirloskar /Equivalent

12. Filter Feed Pump

DESCRIPTION	
Quantity	2Nos(1W +1S)
Capacity	3.0 m^3/Hr
Head	35m
Motor	1.5HP
MOC	CI
Make	Kirloskar/Equivalent

13. Hypo Dosing System

DESCRIPTION	
Quantity	1No
Type	Diaphragm
Capacity	0-5LPH
Pressure	6 Bar
Max.Suction Pressure	1.5m
Make	e-Dose / Equivalent
PP –Storage Tank	50 Litres

14. Pressure Sand Filter

DESCRIPTION	
Quantity	1 No
Diameter Of the Vessel	600mm
Height Of the Vessel	1500mm
Normal Flow	3000 LPH
Filtering Media	Graded Pebbles/Sand
M.O.C	MSEP
Minimum Pressure	2.0Kg/cm^2
Maximum Pressure	3.5Kg/cm^2
Bursting Pressure	10Kg/cm^2
Valve	Multiport
Pipe Line	40NB
Type	Vertical

15. Activated Carbon Filter

DESCRIPTION	
Quantity	1 No
Diameter Of the Vessel	400mm
Height Of the Vessel	1800mm
Normal Flow	3000 LPH
Filtering Media	Graded Pebbles/ Sand/ Activated Carbon
M.O.C	MSEP
Minimum Pressure	2.0Kg/cm^2
Maximum Pressure	3.5Kg/cm^2
Bursting Pressure	10Kg/cm^2
Valve	Multiport
Pipe Line	40NB
Type	Vertical

16. Piping

DESCRIPTION	
Interconnected Pipes, Fittings and Valves	1 Lot
Make	Supreme, Jindal, Prince /Equivalent
MOC	UPVC,MS

Note: Airline header pipes will be in MS and other pipes will be in UPVC.

17. Electrical Works

DESCRIPTION	
Quantity	1 No.
Make	L & T

Electrical Panel will be supplied for the above mentioned mechanical equipments.

Electrical Load Details:-

S.No	Description	Operating Load KW	Total Load KW	Quantity	Running Hrs	Total KWH/Day
1	Raw Sewage Pump	0.75	1.5	2Nos	20.0	15.0
2	Sludge Transfer Pump for oil Skimmer Tank	0.75	0.75	1No	0.5	0.375
3	Air Blower with Motor	3.7	7.4	2Nos	24.0	88.8
4	Sludge Transfer Pump	0.75	0.75	1No	0.5	0.375
5	Filter Feed Pump	1.1	2.2	2Nos	20.0	22.0
6	Hypo Dosing Pump	0.04	0.04	1No	20.0	0.8
					Total Load	**127.35**
					80% of Total Load	**101.88**

Chemical Consumption Per Month

-

S.No	Description	Quantity
1	Hypo	1.5Kgs/Month

Civil Works Dimensions

S. No	Description	Size (M)	Quantity	Type	Volume m^3
1	Screen Chamber	0.5L X 0.5W x 1.3 T.D	1No	RCC	**0.325**
2	Collection Sump	3.0L X 3.0W X 3.3 T.D	1No	RCC	**29.7**
3	Oil Skimmer Tank	3.2m Dia X 3.5m Ht	1No	RCC	**28.14**
4	FBBR	2.70 L X 2.70 W X 3.5 T.D	1No	RCC	**25.51**
5	Clarifier	1.75L X 1.75W X 3.5 T.D	1No	RCC	**10.72**
6	Clarified Water Tank	1.75L X 1.75W X 3.5 T.D	1No	RCC	**10.72**
7	Treated Water Tank(Optional)	2.3L X 2.3W X 3.5T.D	1No	RCC	**18.51**
8	Drying Beds	0.5 L X 0.5 W X 1.0 T.D	3Nos	BW filled with sand, Gravels	**0.75**
9	Plant Room	3.0 L X 3.0 W X 3.0 H	1 No	BW	
				Total Volume	**124.375**

Total Area Required for Civil Works: 10 m L x 3.5m W = 35.0 m^2

Pricing: -

Total Project cost: Rs. 25 lakhs (Inclusive of Civil, Mechanical and Electrical components).

Design of Solid Waste Management System (Collection, Treatment & Disposal):

The predicted total Municipal Solid Waste (Predominantly Fish Waste) i.e. expected is 3.0 Tons/Day (Max.). Given below is the system that will deal with the predicted solid waste generated.

Collection

Solid waste comprises all other bulky rubbish, old pieces of rope and netting, broken fish boxes and so on. A typical collection point made of locally available stone and concrete (the size of the waste centre depends on local requirements) shall be constructed.

Recycling

Metal items shall be collected and sold to scrap dealers. Tyres can be turned into fenders, timber fish boxes can be sold as fuel wood. Styrofoam boxes should be avoided because they break up easily and cannot be recycled safely (they give off dangerous fumes when burnt).

Offal *Collection*

Fish should be cleaned and gutted on the journey back to the landing centre. Offal should never be dumped inside the fish landing centre basin or discarded in corners within the fish landing centre area or village because, besides giving off offensive smells, it also poses a health hazard by attracting pests. Plastic 100-litre drums with airtight lids should be bought and used to collect offal from fish markets or moored boats.

Method of Treatment : Bio-Mechanical Composting

Process Flow Sheet:

Process Description:

Step 1: MSW along the Fish waste (offal) collected from the Fish landing centre shall be transferred to a Platform

Step 2: Waste from platform is transferred into the bio-mechanical composting machine where the waste is shredded and mixed with Saw dust or paper which acts as absorbent. Bacterial inoculum is also fed into the composting machine. In a process time of 15 minutes, the waste will be uniformly shredded and odour mixed with bacteria which can perform a speedy digest of the organics. Raw compost is drawn as output from the bio-mechanical composting machine. Batch size of the machine will be 125 Kg minimum. In 12 cycles the entire waste can be digested to form raw compost.

Step 3: The raw compost is cured for 2 weeks to get a good quality compost material.

Step 4: The final compost is ready to use for gardening.

Components of the Solid waste treatment system:

1. One no. of composting machine

2. One shredder
3. Suitable curing system
4. Bagging arrangement.

The cost of the solid waste management system comes to Rs. 18 lakhs (Inclusive of civil, electrical, mechanical components)

Oil spill Mitigation during the operation of FLC

The oil spillage, if any that occurs during the operations of the fishing craft causes a potential health hazard for the aquatic biota. Oil boom is proposed near the complex so that the any oil that is spilled can be arrested by using he boom. The trapped oil is sucked out using a hand suction pump and transferred to the Oil collection container as shown above.

Waste Oil: The waste oil should be collected in modified 200-litre oil drums strategically placed inside the fishing shelter. The drums must not remain in contact with the ground because, if they get wet or damp, they may corrode and lead to leakage.

Specialized oil processing companies take back used oil for reprocessing.

Net Mending Shed

After every fishing trip, the nets will be wet and damaged to some extent. As such, a top covered net mending shed, but opened from all the four sides is required for the fishermen to repair their damaged nets sitting under the sunshade. Therefore 2 net mending shed of size 18 x 6 m is provided behind the berthing quay. Already one Net mending shed in using by fisherman (nearer to proposed site), considering that one Net mending shed was proposed size of 18 m X 6 m. More areas could be added at the center as and when found necessary. The location of the net mending shed is as shown in the harbour layout Fig. 1.2

Drainage and Sewerage System

Sewerage, drainage and solid waste from the fish auction hall and other building infrastructures of the entire fishery harbour complex before letting into the open seawaters is to be properly disinfected and treated for contaminants for which provision is made for roadside dust bins, septic tanks, soak pits and sewage treatment plant. Surface drainage and the storm water from the drains provided on either side of road sections can be directly let in to the sea without treatment. Separate septic tanks, soak pits and manholes wherever feasible should be built in the fishery harbour complex to collect and guide sewage and disposed off after sewage treatment. The water drains on either side of the roads are to be kept covered by pre-cast slabs for maintenance and safety of pedestrian's traffic.

Provision for the drainage and sewerage system including the roadside dustbins, septic tanks, soak pits, manholes, sewage treatment plant, storm water drains etc. within the fishery harbour complex. In side the Fish Landing centre A solid waste collection Area provided. The location of the Solid waste collection Area is as shown in the harbour layout Fig. 1.2.

Electric Power and Lighting System

Landing and outfitting quays need to be well illuminated for easy access by the fishing boats by providing high tower lights required for unloading of fish catch from the vessels arriving during night hours. Walkways and approaches to the landing and outfitting quays need to be lighted for safety and security reasons. Power plug points should be provided at the landing and outfitting quays for plug-in service so that the vessels can draw power from main electricity supply while idle-berthing in order to save their battery power.

Three – phase electric power supply exists up to Porto-novo town. Provision on lump sum basis is made for 11 KVA, electric sub-station within the fishery harbour complex. An electric sub station is provided for the same purpose the location of which is shown in harbour layout Fig. 1.2.

Canteen

Canteen is required for those working in the fishery harbour premises and for those visiting the harbour on business trips. However, as per CRZ regulation the Canteen has been located beyond the 100 m line from HTL. The location of canteen is shown in the harbour layout Fig. 1.2

Security

It has been proposed to provide a compound wall of 850 m on the roadside and barbed wire fencing on the waterfront to provide security for the entire Fish Landing Centre. A security Room was provided to regulate and security to the people working in a Fish Landing Centre. The location of Security Room is shown in the harbour layout Fig. 1.2.

Cost Estimate

The capital cost of the construction of Fish Landing Centre at Porto-novo-Annankoil has been estimated as **Rs. 13.50 crores**. The summary of cost estimates are given in Table-1.3.

TABLE-1.3

Summary of cost estimates (FLC)

Porto-novoFish Landing Centre		
Sl.No	**Description**	**Amount in Lakhs**
I	**Water Side**	
	b) Diaphragm Wall	412.45
	c) Dredging	209.41
	Sub Total	**621.86**
II	**Civil Works including Electricals**	**456.37**
III	**Machineries**	**100.72**
IV	**Charges**	
	Advertisement Charges	10.00
	Documentation Charges	5.00
	Environmental Clearance works and Fees	10.00
	Provision for unexpected sub soil variation	35.00
V	**Other Charges**	
	Petty Supervision Charges - 2.5%	26.96
	Labour Welfare Charge - 0.3%	3.23
	Unforeseen expenditure - 2.5%	26.96
	Escalation - 5%	53.91
	Total Cost	**1350.00**

1.7 OBJECTIVES OF THE EIA STUDY

The main objective of the EIA study is to assess the positive as well as negative environmental impacts likely to accrue as a result of the construction and operation of the proposed project. After identifying the negative impacts, a suitable management plan is to be suggested to ameliorate the adverse impacts. An Environmental Monitoring Programme is also suggested for the parameters which needs frequent observations during project operation phase. Thus, the key objectives of the EIA study are to:

- ensure sustainable development with minimum environmental degradation;
- to prevent long-term environmental negative impacts by incorporating a suitable Environmental Management Plan (EMP);
- suggest an Environmental Monitoring Programme, and
- estimate budgetary requirements for implementation of the EMP and Environmental Monitoring Programme.

1.8 METHODOLOGY FOR THE EIA STUDY

The purpose of this section is to enumerate the steps carried out in an Environmental Impact Assessment (EIA) study. The same are briefly described in the following paragraphs.

Scoping Matrix

A list of all likely impacts likely to accrue as a result of operation and construction of the proposed fishing harbour has been prepared. In the next step, a manageable number of attributes which are likely to be affected as a result of the proposed project were selected. The various criteria applied for the selection of the important impacts are as follows:

- magnitude of impact
- extent of impact
- significance, and of impact
- special sensitivity of impact

Based on the preliminary site visit and applying the above mentioned criteria a "Scoping Matrix" was prepared for identification of impacts from as many sources possible on the different environmental aspects.

The scoping matrix derived for the present EIA study is delineated in Table-1.2.

TABLE-1.4

Scoping Matrix for the EIA study of proposed project

S. No.	Activity	Likely Impacts
A.	**Actions affecting coastal marine ecology**	
1.	Location of fisheries capture zone along side harbour facilities	• Displacement of fishermen families
2.	Oil spill/leakage within project area	• Damage to marine ecology
3.	Dredging activities	• Short term increase turbidity level at dredging site causing decreased light penetration, adversely affecting the photosynthetic activity. • Alteration of bottom surface, which may be unfavorable for sustenance of benthic flora and fauna.
B.	**Actions affecting Recreational/Resort/ Beach along the coastal zone**	
1.	Location of harbour too close to the recreational areas	• Visible turbidity of disclosing of beach water.
2.	Escape of liquid and solid wastes from the harbour	• Silt deposition along the shoreline
C.	**Actions affecting the physio-chemical aspects**	
1.	Dredging activities	• Partitioning of contaminants from sediments to the water column • Generation of turbidity plumes as a result of dredging
2.	Construction activities	• Noise pollution and adverse impacts on aquatic flora
3.	Ship movement	• Pollution due to oil spills
4.	Groundwater abstraction	• Increase in sea water intrusion
D.	**Factors affecting socio-economic environment handling**	
1.	Increase in handling mechanized vessels capacity.	• Boost local economy • Improvement in employment potential

S. No.	Activity	Likely Impacts
		• Upgradation of infrastructure facilities
2.	Land acquisition	• Acquisition of private land
3.	Traffic	• Traffic congestion

The above mentioned "Scoping Matrix" has been used as a guideline for collection of data for various aspects of Environment to assess its baseline status.

Environmental Baseline study

Before the start of the project, it is essential to ascertain the baseline levels of appropriate environmental parameters which could be significantly affected by the implementation of the project. The planning of baseline survey emanates from short listing of impacts prepared during identification. The baseline study involves both field work and review of existing documents, which is necessary for identification of data which may already have been collected for other purposes.

As per the Ministry of Environment & Forests (MOEF) guidelines, the Study Area for the EIA study has been considered as the 10 km radius keeping the proposed project site at the centre. The baseline data on various environmental parameters like land use pattern, water quality, noise, meteorology, air quality, demography and socio-economics, terrestrial ecology and marine ecology was collected through field studies, literature review and collection of secondary data as available with various departments and locals.

The methodology adopted for various aspects of data collection is briefly described in the following paragraphs:

- **Marine Ecology**

The marine ecological survey was conducted in the month of May,2008. The surface as well bottom water samples were collected using mechanized vessels. Each location was fixed on benchmark and after reaching the site, the vessel was anchored.

Parameters like temperature, salinity and dissolved oxygen were estimated by an YSI temperature, salinity oxygen meter respectively at the site itself.

Plankton samples were collected by filtering a known volume of water by a plankton not of <60 μ mesh size bolting silk. Surface water was collected using a clean bucket without causing any disturbances. Likewise, the bottom water samples were collected by Nansen bottle. Sediment samples were collected by a grab sampler operated from the vessel.

The data on various aspects like major aquatic floral and faunal species, rare and endangered species, fisheries, crabs, prawns, mangroves, etc. was also collected as a part of primary data collection. Apart from this, the secondary data/information as available from the reported literature have been appropriately utilized in the EIA report.

- **Ambient Air quality**

Ambient air quality monitoring was conducted at three locations in the study area in the month of May to July 2008. The frequency of monitoring was twice a week for 12 consecutive weeks. The parameters monitored were RPM, SPM, SO_2 and NOx.

- **Noise Environment**

Noise levels in the study area were recorded with A-weighted noise level meter at various sampling locations in the study area in the month of May 2008. The readings were taken during day and night time and equivalent noise levels were estimated and used in the EIA report.

- **Socio-economic Aspects**

The data on demography, socio-economics was collected from secondary data sources like Census handbook, Statistical handbook, and revenue records, etc.

- **Landuse pattern**

The landuse pattern of the study area has been studied using digital satellite data, which was procured from National Remote Sensing Agency (NRSA), Hydarabad in the form of CD-ROM for IRS-1C, LISS III. Detailed ground truth studies were conducted for formulation of signature data set. A supervised classification was then conducted using the GIS & IMAGINE processing software packages available in house at WAPCOS Centre for Environment.

The landuse pattern has been also studied with use of revenue data (Census handbook).The summary of data collected from various sources as a part of the EIA study is outlined in Table-1.3.

TABLE-1.5

Summary of data collection from various sources

Aspect	**Mode of Data collection**	**Parameters monitored**	**Frequency**	**Source(s)**
Meteorology	Secondary	Temperature, humidity, rainfall	-	India Meteorological Department
Water quality	Primary	Physico-chemical biological parameters	Once a week for twelve consecutive weeks	Field studies
Ambient air quality	Primary	RPM, SPM, SO_2, NOx	Twice a week for twelve consecutive weeks	Field studies
Noise	Primary	Hourly noise and equivalent noise level	Once a week for twelve consecutive weeks	Field studies
Landuse	Primary and Secondary	Landuse pattern	-	NRSA and Ground truth studies
Marine Ecology	Primary and Secondary	Presence and abundance of various species	Once a week for twelve consecutive weeks	Field studies, and literature review
Socio-economic aspects	Secondary data	Demographic and socio-economic, Public health cultural aspects	-	Revenue Department and Literature review

Assessment of Impacts

With knowledge of the baseline conditions, project characteristics, the intensity of construction and operation activities and current critical conditions, detailed projections were made for the influence of the proposed project on physio-chemical, biological and social environment in the area. The impacts on environment due to construction and operation activities of the proposed project were identified.

The various aspects of the environment covered as a part of the Impact Assessment were:

- Land Environment
- Air Environment
- Noise Environment
- Terrestrial Environment
- Socio-Economic Aspects.

An attempt was made to predict future environmental scenario quantitatively to the extent possible. However, for non-tangible impacts, qualitative assessment has been done.

Environmental Management Plan

The Environmental Management Plan (EMP) was delineated to ensure that the adverse impacts likely to accrue are altogether removed or minimized to the extent possible. After selection of suitable and feasible environmental mitigation measures, the cost required for implementation of various environmental management measures has been estimated to have an idea of their cost-effectiveness.

Environmental Monitoring Programme

A post-project environmental monitoring programme has been suggested to oversee the environmental safeguards, to ascertain the agreement between prediction and reality and to suggest the remedial measures not foreseen during the planning stage but during the operation phase and to generate data for further use. The equipment, manpower and cost required for the implementation of environmental monitoring programme were also suggested.

1.9 OUTLINE OF THE REPORT

The contents of the EIA report are arranged as follows:

Chapter 1: The chapter gives an overview of the need for the project, objectives and need for EIA study etc.

Chapter 2: Baseline environmental conditions including physical, biological and socio-economic parameters, resource base and infrastructure have been described

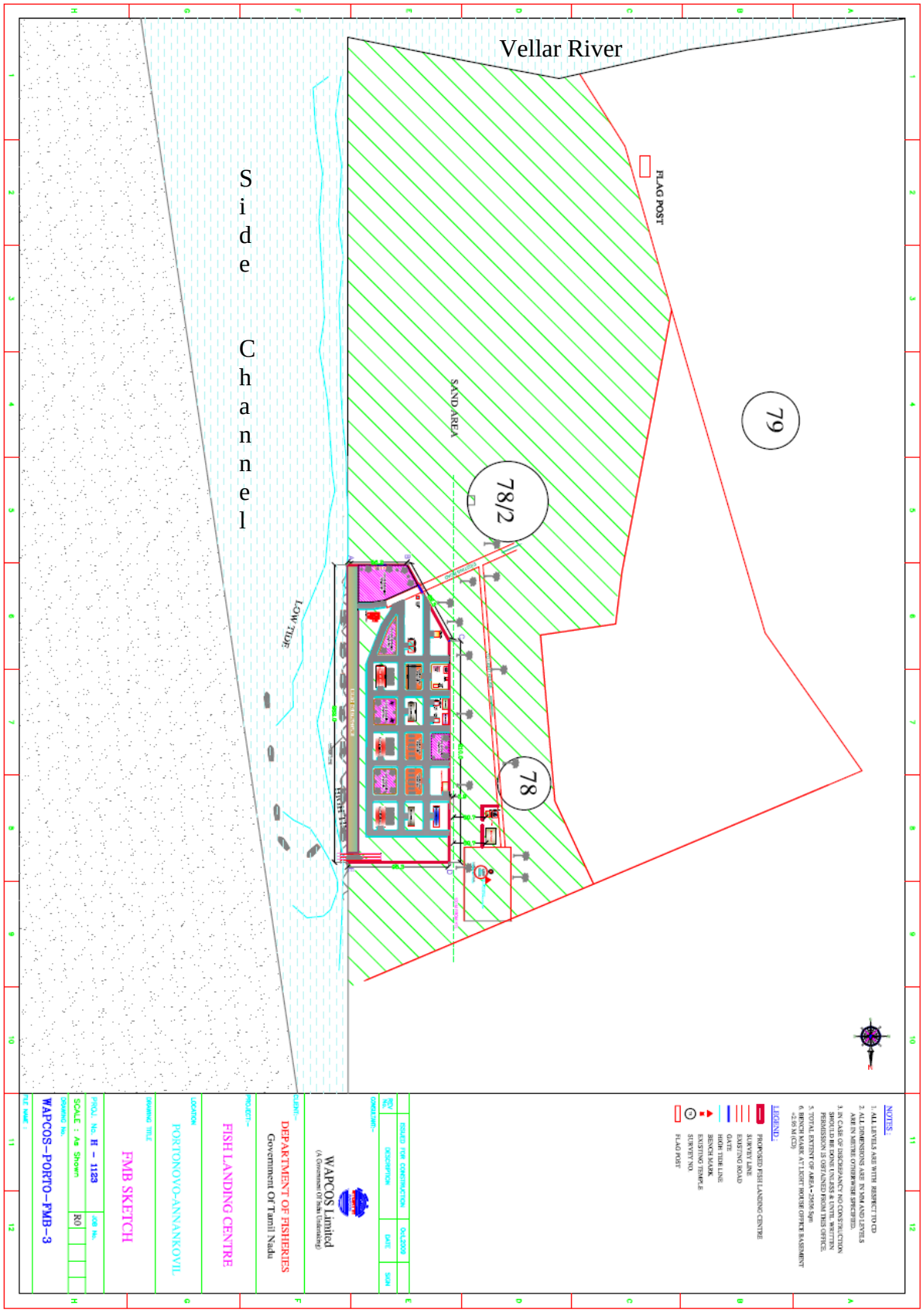
in this chapter. Before the start of the project, it is essential to ascertain the baseline conditions of appropriate environmental parameters which could be significantly affected by the implementation of the project. The planning of baseline survey emanates from short listing of impacts prepared during identification. The baseline study involves both field work and review of existing documents, which is necessary for identification of data which may already have been collected for other purposes.

Chapter 3: Anticipated positive and negative impacts as a result of the construction and operation of the proposed project were assessed in the Chapter. Prediction is essentially a process to forecast the future environmental conditions of the project area that might be expected to occur as a result of the construction and operation of the proposed project. An attempt has been made to predict future environmental conditions quantitatively to the extent possible. But for certain parameters, which cannot be quantified, the general approach is to discuss such intangible impacts in qualitative terms so that planners and decision-makers are aware of their existence as well as their possible implications.

Chapter 4: Environmental Management Plan (EMP) for amelioration of anticipated adverse impacts likely to accrue as a result of the proposed project. The approach for formulation of an Environmental Management Plan (EMP) is to maximize the positive environmental impacts and minimize the negative ones. After selection of suitable environmental mitigation measures, cost required for implementation of various management measures is also estimated.

Chapter 5: Environmental Monitoring Programme for implementation during project construction and operation phases has been delineated in this Chapter. The objective is to assess the adequacy of various environmental safeguards and to compare the predicted and actual scenario during construction and operation phases to suggest remedial measures not foreseen during the planning stage but arising during these phases and to generate data for further use.

Chapter 6: Cost for implementation of the Environmental Management Plan (EMP) and the Environmental Monitoring Programme has been summarized in this chapter.


Vellar River
FLAG POST
SAND AREA
79
78/2
78
Side Channel
LOW TIDE
HIGH TIDE
NOTES
1. ALL LEVELS ARE WITH RESPECT TO CD
2. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN METRES OTHERWISE SPECIFIED.
3. IN CASE OF DISCREPANCY NO CONSTRUCTION SHOULD BE DONE UNLESS & UNTIL WRITTEN PERMISSION IS OBTAINED FROM THIS OFFICE.
5. TOTAL EXTENT OF AREA = 2936 Sqm
6. BENCH MARK AT LIGHT HOUSE OFFICE BASEMENT = 4.50 M (CD)
LEGEND
PROPOSED FISH LANDING CENTRE
SURVEY LINE
EXISTING ROAD
GATE
HIGH TIDE LINE
BENCH MARK
EXISTING TEMPLE
SURVEY NO
FLAG POST
ISSUED FOR CONSTRUCTION
DESCRIPTION
DATE
SIGN
WAPCOS Limited
(A Government Of India Undertaking)
CONSULTANT
DEPARTMENT OF FISHERIES
Government Of Tamil Nadu
CLIENT
PROJECT
FISH LANDING CENTRE
LOCATION
PORTONOVO-ANNANKOVIL
DRAWING TITLE
FMB SKETCH
PROJ. No. H - 1123
JOB No.
SCALE : As Shown
R0
DRAWING No.
WAPCOS-PORTO-FMB-3
PLT NAME :

CHAPTER - II

ENVIRONMENTAL BASELINE STATUS

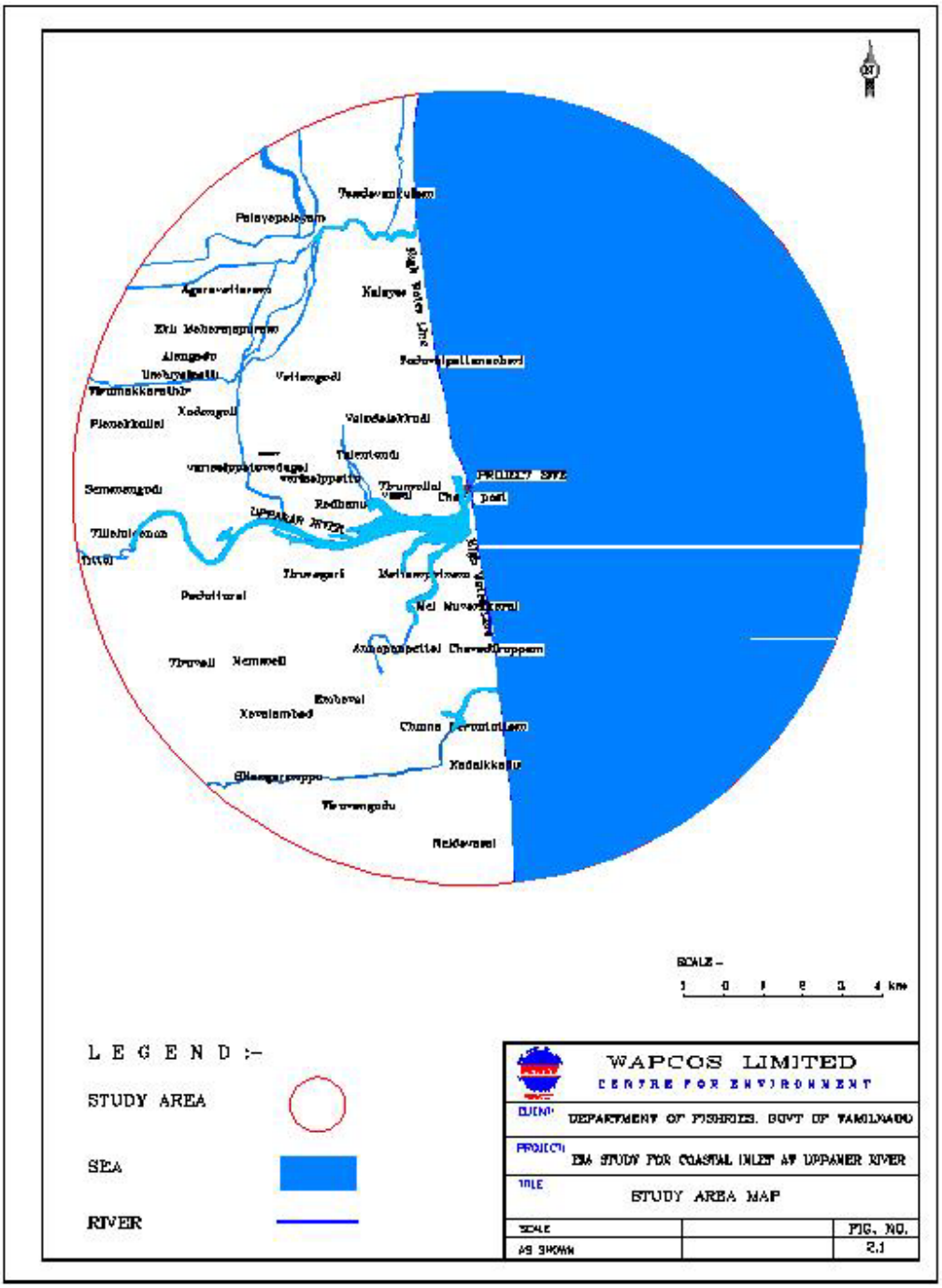
CHAPTER-2

ENVIRONMENTAL BASELINE STATUS

2.1 GENERAL

The assessment of baseline environmental setting is an essential component of any EIA study. Based on the “Scoping Matrix”, various parameters to be covered for assessment of baseline environmental setting are identified. Assessment of environmental impacts due to construction and commissioning of a proposed project requires a comprehensive and scientific consideration of various environmental aspects and their interaction with natural resources, namely, physico-chemical parameters i.e. meteorology, air quality, noise quality, land use and water quality, biological parameters i.e. terrestrial flora and fauna, marine flora and fauna, fish species, etc. and socio-economic parameters i.e. demography, occupational profile, etc.

As a part of the EIA study, a large quantum of related secondary data as available with departments like Forest, Fisheries, Revenue, etc. has been collected. Field surveys were conducted for primary data generation on various aspects including ambient air quality, water quality, noise, marine ecology, landuse pattern, etc. The Study Area considered for the EIA study has been considered as the area within radius of 10 km considering the proposed project site at the centre (Refer Figure-2.1). The major portion of the study area is under water. In such setting, impacts likely to accrue as a result of project construction and operation phases are expected to be occurring mainly on water front i.e. on marine environment. Thus, as a part of the EIA study, specific emphasis has been accorded to marine environment.



- As a part of the EIA study, the baseline status has been ascertained for the following aspects:
    - Meteorology
    - Ambient air quality
    - Noise environment
    - Landuse pattern
    - Waves
    - Tides

- Current
- Water quality
- Sediments
- Terrestrial Ecology
- Marine Ecology
- Demography and Socio-economics

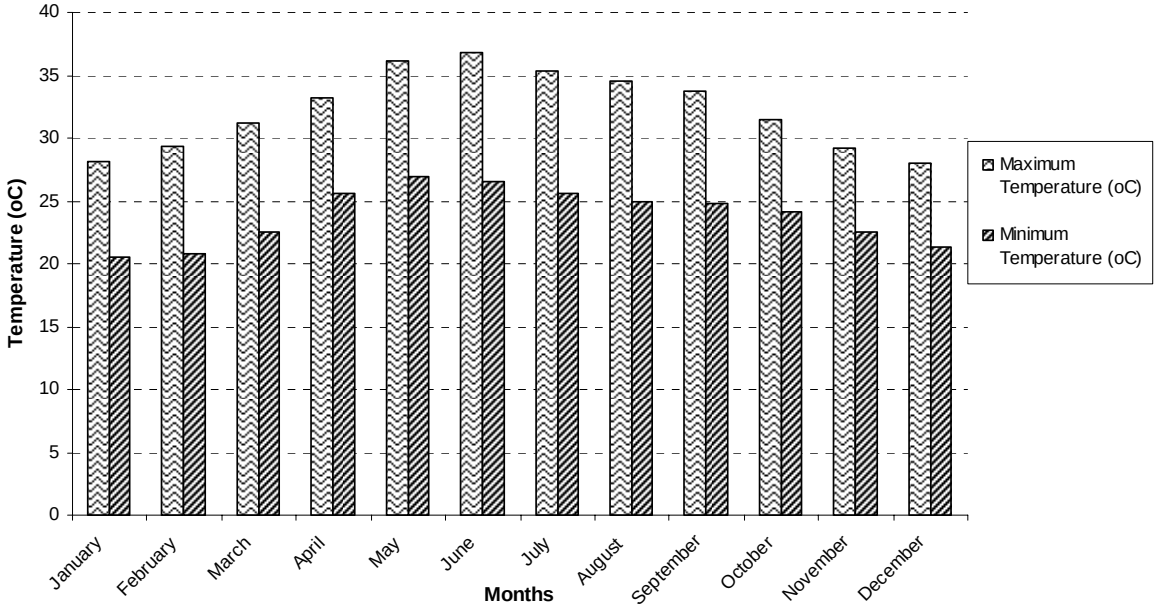
2.2 METEOROLOGY

The project area district is characterized by an oppressive summer and good seasonal rainfall and has four distinct seasons. The period from March to May comprises the summer season and in subsequent months from June to September, the area comes under the influence of south-west monsoons. The months of October to November constitute the post monsoon or retreating monsoon season and the period from December to February is the north-east monsoon season.

Temperature

In the project area district, the average maximum and the average minimum temperature being 36.60 ^{o}C in May and 20.52 ^{o}C in January respectively. The monthwise temperature variations in the project area are shown in Figure-2.2.

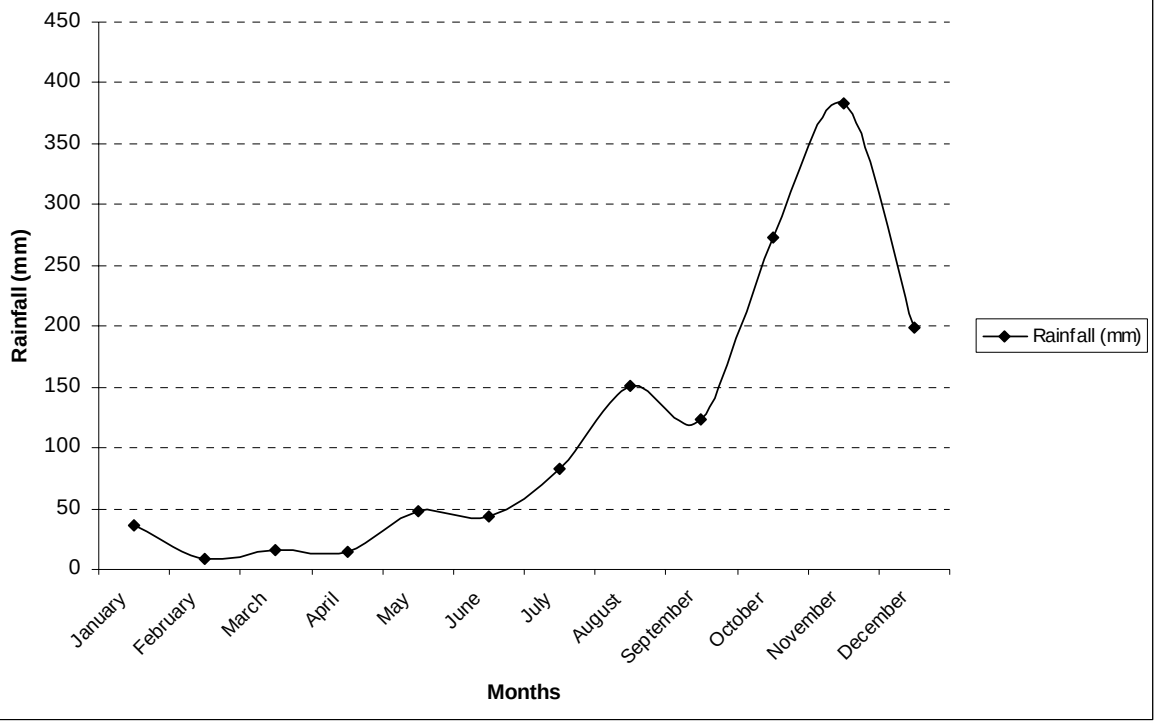
Figure-2.2
Month wise variation in Temperature in Project Area



Rainfall

In the project area district the average annual rainfall is 1378.1 mm. Majority of rainfall is received in the period from August to December. The monthwise rainfall received in the project area are shown in Figure-2.3.

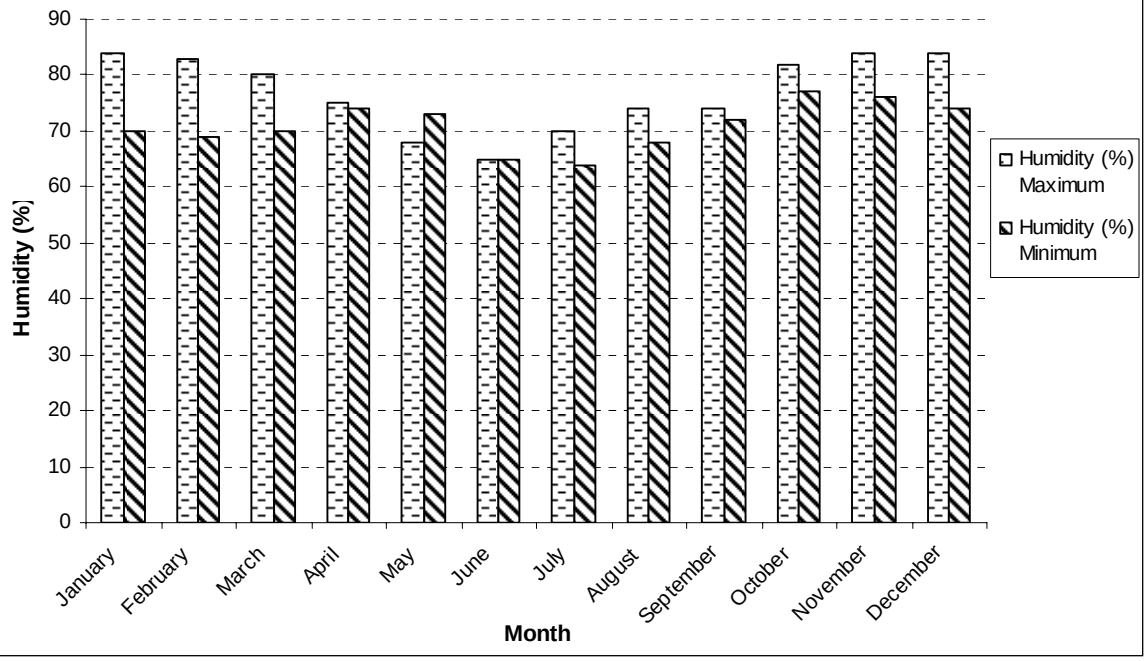
Figure-2.3
Monthwise Variation of Rainfall in Project Area



Humidity

The humidity is generally high throughout the year. During monsoon months i.e. November to February, humidity ranges from 80% to 85%. During rest of the year, humidity, varies from 83% to 84%. The annual relative humidity observed over the year is 77% and 71% at 08:30 and 17:30 hrs. The monthwise humidity variations in the project area are shown in Figure-2.4.

Figure-2.4
Monthwise Variation in Humidity in Project Area



The average meteorological conditions of the project area district are outlined in Table-2.1.

TABLE-2.1
Average meteorological conditions in the project area district

S.No	Month	Temperature (^oC)		Rainfall(mm)	Relative Humidity(%)	
		Max.	Min.		08:30 hrs	17:30hrs
1.	January	28.1	20.5	36.7	84	70
2.	February	29.3	20.8	9.4	83	69
3.	March	31.2	22.6	15.6	80	70
4.	April	33.2	25.6	14.0	75	74
5.	May	36.1	26.9	47.2	68	73
6.	June	36.8	26.6	43.1	65	65
7.	July	35.3	25.6	82.8	70	64
8.	August	34.5	25.0	150.3	74	68
9.	September	33.7	24.8	123.4	74	72
10.	October	31.5	24.1	273.6	82	77
11.	November	29.2	22.6	383.5	84	76
12.	December	28.0	21.3	198.5	84	74
	Annual	**32.2**	**23.9**	**1378.1**	**77**	**71**

2.3 AMBIENT AIR QUALITY

The ambient air quality was monitored as a part of the EIA study. The ambient air quality monitoring has been carried out with a frequency of two samples per week at three locations for a period of twelve consecutive weeks from August to September, 2007.

The parameters monitored as a part of the study are listed as below:

- Suspended Particulate Matter (SPM)
- Respirable Particulate Matter (RPM)
- Sulphur dioxide (SO_2)
- Oxides of Nitrogen (NOx).

Respirable Dust Samplers APM-451 of Envirotech Instruments are being used for monitoring Suspended Particulate Matter (SPM), Respirable fraction (<10 microns) and gaseous pollutants like SO_2 and NOx.

The ambient air quality monitoring stations covered as a part of EIA study are given in Table-2.2. The location of various sampling stations covered as a part of ambient air quality monitoring is shown in Figure-2.5.

TABLE-2.2

Details of ambient air quality monitoring stations

Stations	Location
AQ1	Pichavaram
AQ2	Killai
AQ3	Kilachavadi

The results of ambient air quality survey conducted during the period from August to September, 2007 are given in Table-2.3.

TABLE-2.3
Ambient air quality status in the study area (Unit : µg/m^3)

S. No.	SPM	RPM	SO_2	NOx
Pichavaram				
1	58	17.2	7.1	11.8
2	59	17.5	BDL	11.7
3	61	18.0	7.2	12.0

S. No.	SPM	RPM	SO_2	NOx
4	49	14.8	7.4	11.4
5	62	19.1	7.0	12.1
6	58	17.2	BDL	11.8
7	61	18.6	7.1	12.9
8	72	22.1	BDL	12.8
9	72	22.0	7.1	12.0
10	56	16.9	7.0	11.5
11	59	18.2	7.2	11.1
12	61	18.6	BDL	11.3
13	58	17.1	BDL	11.8
14	57	17.4	BDL	11.6
15	59	18.2	7.2	11.8
16	63	19.3	7.0	12.2
17	58	17.6	7.2	11.0
18	63	19.2	BDL	12.2
19	59	18.2	7.1	11.8
20	52	16.1	7.2	11.0
21	62	19.0	7.2	11.1
22	54	17.0	BDL	11.4
23	56	17.4	7.2	11.7
24	51	18.2	BDL	11.3
Killai				
1	49	14.8	7.1	12.8
2	56	17.0	BDL	11.6
3	58	17.5	7.2	12.3
4	63	19.2	BDL	12.1
5	50	15.2	7.1	12.4
6	55	16.9	BDL	12.9
7	56	17.1	7.1	11.7
8	61	19.0	7.5	11.9
9	65	20.1	BDL	11.9
10	71	21.5	7.1	12.1
11	62	19.0	7.0	11.3
12	57	17.5	7.0	11.0
13	58	17.8	BDL	11.8
14	63	19.4	7.2	12.1
15	60	18.3	BDL	12.1
16	59	17.8	7.0	11.4
17	63	18.7	7.3	11.9
18	68	20.1	7.2	12.1
19	66	19.6	7.1	11.3
20	63	19.0	7.0	11.0
21	53	17.0	7.3	11.8
22	72	21.5	7.2	12.1
23	54	16.2	7.0	12.1
24	69	20.4	7.2	11.4
Kilachavadi				

S. No.	SPM	RPM	SO_2	NOx
1	67	19.9	7.0	12.3
2	48	14.2	7.1	12.4
3	62	18.4	7.0	11.4
4	65	19.2	7.2	12.1
5	59	18.0	BDL	11.9
6	61	18.6	7.1	12.9
7	64	19.3	7.2	12.4
8	63	19.0	7.2	13.1
9	58	17.2	BDL	11.6
10	59	17.4	7.2	11.9
11	48	14.3	7.1	12.1
12	59	17.4	7.0	12.4
13	67	20.0	7.1	11.6
14	62	18.5	7.0	11.9
15	56	16.2	7.0	12.1
16	68	20.1	7.1	11.9
17	71	21.5	7.2	11.8
18	64	19.3	7.3	12.4
19	61	18.6	7.1	11.1
20	63	19.2	7.2	12.3
21	57	17.0	7.0	11.0
22	69	20.4	7.1	11.8
23	60	17.8	7.0	11.9
24	67	20.9	7.4	12.2

BDL : Below Detectable Limit

Observations on ambient SPM level

The summary of ambient SPM levels observed is given in Table-2.4.

TABLE-2.4
Ambient air quality status – SPM (Unit: µg/m^3)

Station	Maximum	Minimum	Average
Pichavaram	72	49	59.2
Killai	72	49	60.5
Kilachavadi	7	48	61.6

It is observed from Table-2.4 that the average concentration of SPM at various stations ranged from 59.2 to 61.6 $\mu g/m^3$, which is below the prescribed limits of 200 $\mu g/m^3$ specified for residential, rural and other areas.

Observations on RPM levels

The summary of ambient SPM levels observed is given in Table-2.5.

TABLE-2.5

Ambient air quality status-RPM (Unit : µg/m^3)

Station	Maximum	Minimum	Average
Pichavaram	22.1	14.8	18.1
Killai	21.5	14.8	18.4
Kilachavadi	21.5	14.2	18.4

It is observed from Table-2.5 that the average concentration of RPM at various stations ranged from 18.1 to 18.4 µg/m^3, which is below the prescribed limits of 100 µg/m^3 specified for residential, rural and other areas. Even the maximum value of 22.1 µg/m^3 observed at station near Pichavaram is well below the permissible limit.

Observations on ambient SO_2 levels

The summary of ambient SO_2 level as monitored during field studies is given in Table-2.6.

TABLE-2.6

Ambient air quality status – SO_2 (Unit:µg/m^3)

Station	Maximum	Minimum	Average
Pichavaram	7.4	BDL	7.2
Killai	7.5	BDL	7.1
Kilachavadi	7.7	BDL	7.1

It is observed from Table-2.6 that, the average concentration of SO_2 at various stations in the study area was much below the prescribed limits of 80 µg/m^3 specified for residential, rural and other areas. The highest SO_2 concentration of 7.7 µg/m^3 was observed at station near Kilachavadi was well below the prescribed limit of 80 µg/m^3 specified for residential, rural and other areas.

Observations on ambient NOx levels

The summary of ambient NOx levels is given in Table-2.7.

TABLE-2.7

Ambient air quality status – NOx (Unit : µg/m^3)

Station	Maximum	Minimum	Average
Pichavaram	12.9	11	11.7
Killai	12.9	11	11.9
Kilachavadi	13.1	11	12.0

It can be seen from Table-2.7 that during the study period, NOx concentration at all the three sampling stations was well below the limit prescribed for residential, rural and other areas (80 µg/m^3). The highest NOx concentration of 13.1 µg/m^3 was observed at station at Kilachavadi, which is well below the prescribed limit of 80 µg/m^3 specified for residential, rural and other areas.

2.4 NOISE ENVIRONMENT

Baseline noise data has been measured using A weighted sound pressure level meter. The survey was carried out in calm surroundings. Sound Pressure Level (SPL) measurement in the outside environment was made using sound pressure level meter. Hourly noise meter readings were taken at each site, and equivalent day time and night time noise levels were estimated. The ambient noise levels recorded and are tabulated in Table-2.8. The day time and night time noise levels are presented in Table-2.9. The ambient noise standards are enclosed as Annexure-II. The stations covered as a part of ambient air quality monitoring are shown in Figure-2.5.

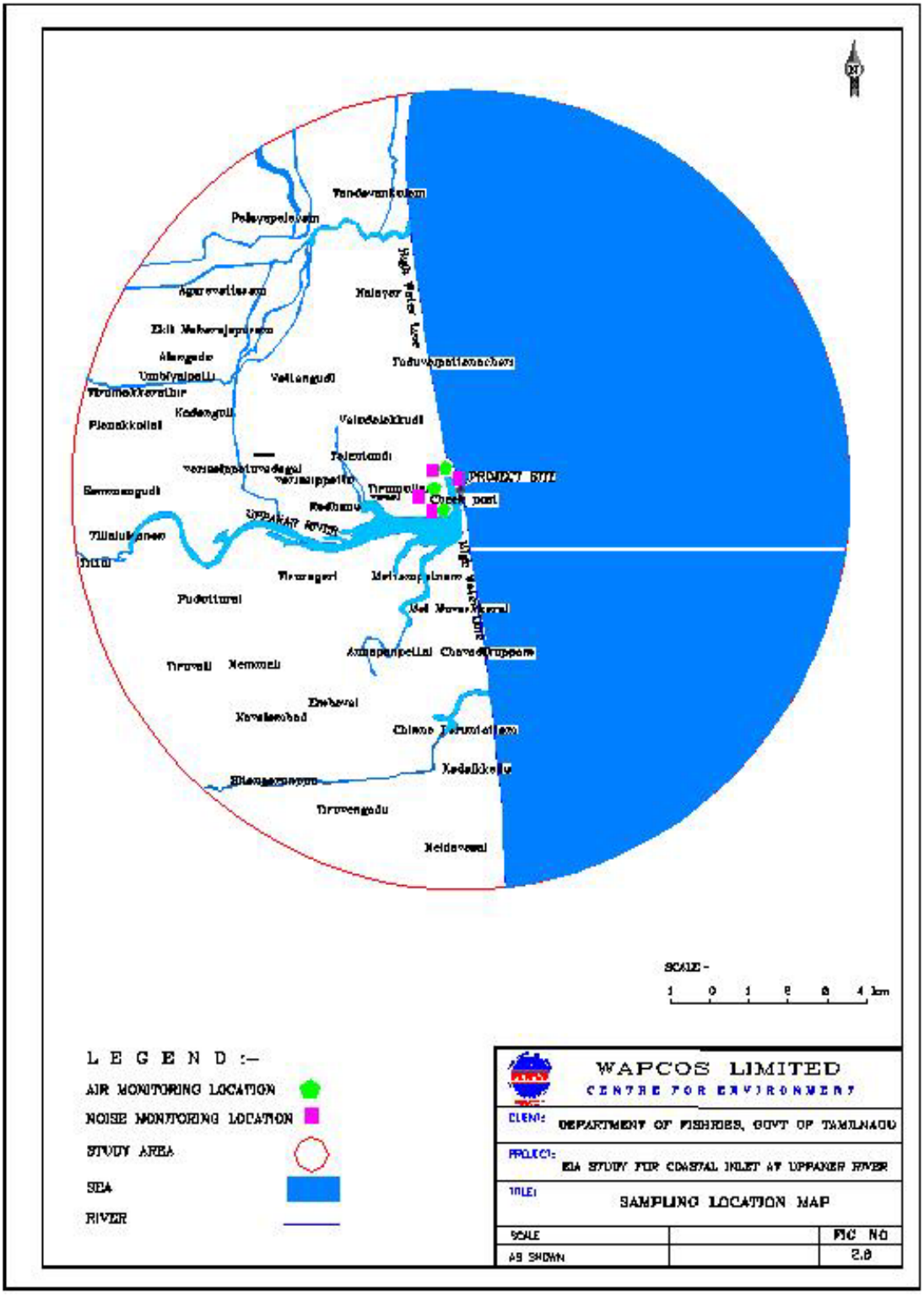

Tandavankulam
Palayapalayam
Agaravattasam
Nalayar
Ekit Maharajapuram
Alangadu
Umbiyalpatti
Vattangudi
Tiruvakkarathur
Kadangudi
Pianakkollai
Valadalakkudi
Talaiyandi
Semmangudi
Tirumullaivasal
Cheek post
Tillaiulkanee
Tittai
Tiruvageri
Pudottural
Annapanpettai
Chavadiruppam
Tiruvali
Nemmeli
Enchavai
Navalambad
Chinna Parunthattam
Kadaikkadu
Tiruvengadu
Neidavasal
SCALE -
1 0 1 2 3 4 km
L E G E N D :-
AIR MONITORING LOCATION
NOISE MONITORING LOCATION
STUDY AREA
SEA
RIVER
WAPCOS LIMITED
CENTRE FOR ENVIRONMENT
CLIENT: DEPARTMENT OF FISHRIES, GOVT OF TAMILNADU
PROJECT: EIA STUDY FOR COASTAL INLET AT UPPANER RIVER
TITLE: SAMPLING LOCATION MAP
SCALE
AS SHOWN
FIG NO
2.8

TABLE-2.8

Ambient noise level in the study area (Unit: dB(A))

Time	Pichavaram	Killai	Kilachavadi	Project site
6 AM – 7AM	36	37	38	37
7 AM – 8 AM	38	37	39	38
8 AM – 9AM	40	39	40	40
9 AM – 10AM	43	42	42	42
10AM – 11AM	44	44	43	43
11AM – 12 Noon	45	43	45	44
12 Noon – 1 PM	45	43	44	44
1 PM – 2 PM	44	43	44	44
2 PM – 3 PM	43	43	44	43
3 PM – 4 PM	42	44	44	42
4 PM – 5 PM	43	45	43	45
5 PM – 6 PM	44	45	46	46
6 PM – 7 PM	44	44	45	46
7 PM – 8 PM	44	43	43	43
8 PM – 9 PM	42	42	42	43
9 PM – 10 PM	40	40	41	41
10 PM – 11 PM	39	38	40	40
11PM–12 midnight	38	36	38	37
12 midnight– 1 AM	36	35	37	36
1 AM – 2AM	35	34	34	34
2 AM – 3 AM	34	34	34	34
3 AM – 4 AM	33	33	33	33
4 AM – 5AM	33	33	33	33
5 AM – 6 AM	33	33	33	33

TABLE-2.9

Equivalent noise levels in the study area (Unit : dB(A))

Location	Leq($_{day}$)	Leq($_{night}$)
Pichavaram	43.0	34.3
Killai	42.8	33.6
Kilachavadi	43.2	34.8
Near Project site	43.3	34.5

It may be seen from the Table-2.9 that the day time equivalent noise level ranged from a minimum of 42.8 dB(A) to a maximum of 43.3 dB(A). The night time equivalent noise level ranged from a minimum of 33.6 dB(A) to a maximum of 34.8 dB(A). The day and night time equivalent noise level at various sites located close to residential areas were compared with Ambient Noise Standards (Refer Annexure-II) and were observed to be well below the permissible limit specified for residential area.

2.5 LANDUSE PATTERN

The landuse pattern of the study area has also been studied using satellite data. The IRS, 1C-LISS III digital satellite data has been procured from National Remote Sensing Agency (NRSA), Hyderabad for assessing the landuse pattern of the study area. The raw satellite imagery has been processed in-house using ERDAS IMAGINE software. The signals of satellite imagery were verified by performing ground truthing and then final classification of satellite imagery was done. Based on this classification the landuse pattern of the study area was obtained. The classified imagery of the study area is shown in Figure 2.6.

It is observed from the Table-2.10, that the major portion of study area is occupied by water bodies (56.43%). Area under vegetation and agriculture accounts for about 7.42% and 28.95% of the total study area respectively. The area under settlements and marshy area is about 0.86%, and 3.36% respectively.

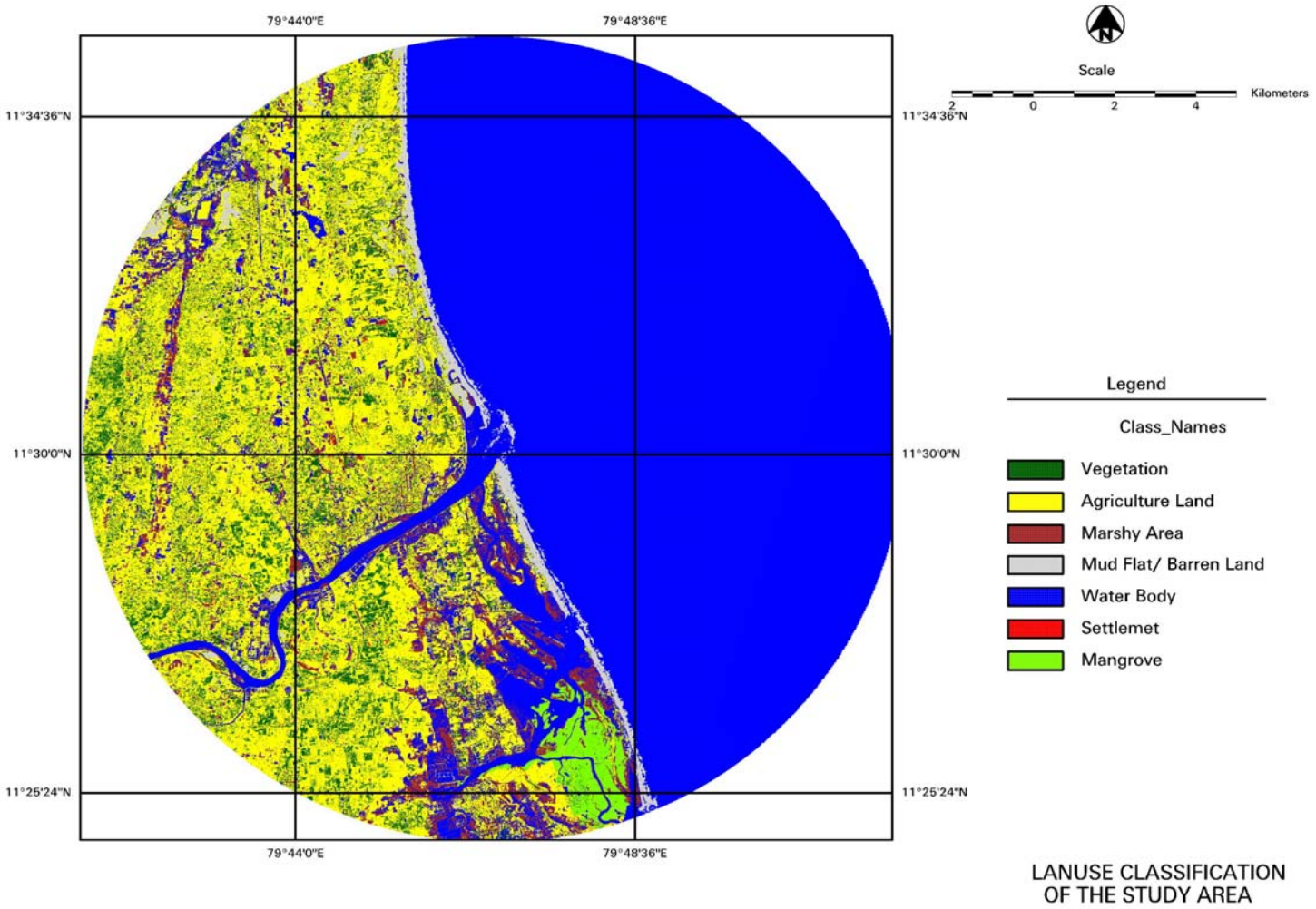
TABLE-2.10

Landuse pattern of the study area

Landuse category	Area (ha)	% of the total study area
Vegetation	2332.57	7.42
Agriculture	9061.99	28.95
Other uses	379.493	1.21
Marshy area	1055.56	3.36
Settlement	271.206	0.86
Water Bodies	17727.9	56.43
Mud flat/Barren land	587.288	1.87

2.6 TIDES

The tidal range in sea at Ennore varies between 0.30 m to 1.21 m, the tidal range in the river inside has reduced to 0.35 m during neap tide and 0.8 m during spring tide. It is also noticed that high water inside has remained more or less same with sea tide, the low water has gone up by 0.4 m. The rise of bed level at inlet due to littoral drift has pronounced effect on low water than on high water.



LANUSE CLASSIFICATION OF THE STUDY AREA

2.7 CURRENT

The coast being North South oriented and river being east-west oriented the velocity direction of 270^0 indicates ebb flow and direction of 90° indicates flood flow, and the peak ebb velocity is of the order of 0.3m/s and peak flood flow is one 0.15 m/s. In absence of upland discharge the flood and ebb velocity would be similar. The difference may be due to the fact that the flood and ebb channel may not be same at this location.

2.8 MARINE WATER QUALITY

The status of marine ecology in the pre-project stage and the likely impacts on marine ecology due to the construction and operation activities of the proposed fishing harbour project are the important aspects EIA study. Detailed marine ecological survey was conducted by Centre for Advance Study in Marine

Biology(CASMB), Annamalai University to establish the existing status of the marine water around the proposed project site.

The river Vellar originates from Servarayan hills in Salem district of Tamilnadu and floes through the Coleroon basin and merges in the Bay of Bengal through Vellar estuary (Lat. 11°24' N; Long. 79°46' E). Vellar estuary is a tropical, shallow, bar-built estuary having an average depth of 2.5. The Vellar estuary is influenced by semidiurnal tides and tidal amplitude extends upto a distance of about 15 kms upstream. During the monsoon season (October – December), it receives large quantity of fresh water from various sources. The sediments of this estuary is usually a mixture of sand, silt and mud. Compared to other estuaries of South India, the Vellar estuary is highly productive and it is a good nursery ground for fin and shell fishes. The details of sampling location and its geographical locations are given in Table-2.11.

TABLE-2.11
Location details of various sampling stations

S.No.	Station Name	Distance from mouth (km)	Latitude	Longitude
1.	Mouth	0	11°30'323	079°46'543
	Annan Koli	0.5	11°30'122	079°46'660
2.	Mudasalodai East	0.5	11°29'963	079°46'437
3.	Parangipettai coast	1	11°29'613	079°46'525

Environmental monitoring survey was carried out on January 2008 representing post monsoon season over an area of 2 km in and around the Vellar river mouth area. Samples were collected from four stations assessing the existing environmental conditions. The various environmental parameters such as temperature, salinity, turbidity, TSS, EC, DO, BOD, nitrate, nitrite, ammonia, total nitrogen, inorganic phosphate and total phosphorous were monitored. All parameters were estimated following standard methods. Biological variables have also been studied and this includes microbes, planktons (both Phyto and zoo) and benthos (macro and meio). Sediment samples were also collected and analyzed for various parameters including microbes. Species of fishes identified from the study area have also been incorporated.

Methodology

Water and Sediment Sampling

Water samples were collected using Universal water sampler below the surface and transferred to the pre cleaned polypropylene and glass containers. Sediment samples were collected using a Peterson Grab, transferred to clean polythene bags and transported to the laboratory. The samples were air-dried. The plant root and other debris were removed and stored for further analysis.

Water Analysis

Temperature, Salinity and pH

The physical parameters like pH, temperature and salinity were measured i*n-situ* in field condition. The subsurface temperature was measured with a mercury thermometer having ± 0.02°C accuracy and the pH of water was measured by a calibrated pH pen (pH ep-3 model). With the use of a hand refractometer (Erma Company, Japan), the salinity of samples was measured. Water samples collected for dissolved oxygen estimation were transferred carefully to BOD bottles. The DO was immediately fixed and these were brought to the laboratory for further analysis.

Preservation and Laboratory Analysis

After collection, all samples were immediately cooled to 4°C and then brought to the laboratory in an insulated thermocool box. As soon as returning to the laboratory, water samples were filtered through Whatman GF/C filter paper and analyzed for organic matter and all other nutrients. Unfiltered samples were used for the estimation of total nitrogen and total phosphate. All analysis were carried out as per suitable standardization procedures.

Dissolved Oxygen

The modified Winkler's method described by Strickland and Parsons (1972) was adopted for the estimation of dissolved oxygen fixed at collection site. The values were expressed in mg/l.

Nitrate and Nitrite

The nitrate and nitrite content of samples were analysed by following the method described by Strickland and Parsons (1972). The nitrite was estimated from highly colored azo dye formed by the addition of N (1-Napthyl) ethylene diamine dihydro-chloride and sulfanilamide into the solution were then measured at 543 nm in a spectrophotometer. Same procedure was followed for the estimation of nitrate. For this, nitrate was reduced to nitrite by copper coated cadmium column. The calculated values were expressed in μg/l

Inorganic Phosphate (IP)

The single solution mixed reagent procedure developed by Murphy and Riley (1962) was followed for the estimation of Inorganic Phosphate levels in water samples. This involves the conversion of phosphate into phosphomolybdic acid which was then reduced to molybdinum blue color complexes and then the intensity of colour was measured at 882 nm in a spectrophotometer. The calculated value was expressed in μg/l.

Total Phosphate (TP)

The Total Phosphate in samples was estimated by employing the method described by Menzel and Corwin (1964). This procedure involves the conversion of organically bound Phosphate into Inorganic Phosphate by wet oxidation of samples with potassium persulphate in an autoclave for 30 minutes at 15 lbs. The converted Inorganic Phosphate was then estimated by using the method described by Murphy and Riley (1962). The subtraction of original Inorganic Phosphate from Total Phosphate yielded the Organic Phosphate of collected water sample.

Reactive Silicate

The reactive silicate content of water was estimated by following the method of Strickland and Parsons (1972). In this method the intensity of blue color formed by silico-molybdate complex was measured in a spectrophotometer at 810 nm and the calculated values were expressed in μg/l.

Sediment Analysis

The analysis of textural composition, pH, total phosphorus and total nitrogen, the air-dried sediment samples were used as such. For all other analyses of organic matter, nutrients and trace metals, sediment samples were ground to fine powder and dried in the oven at 110°C to constant weight for an hour.

Total Organic Carbon (TOC)

The estimation of total organic carbon in sediment was performed by adopting the method of El Wakeel and Riley (1956). The procedure involves chromic acid digestion and subsequent titration with ferrous ammonium sulphate

solution in the presence of 1, 10 phenonthroline indicator. The values calculated are expressed in mgC/g of sediment.

Primary Productivity

The primary productivity in the Cuddalore coast was estimated following the dark and light bottle method (Strickland and Parsons, 1972). The dissolved oxygen concentration during the experiment was determined by following modified Winkler's method.

Chlorophyll `a'

The samples were filtered through Whatman GF/C filter papers and the chlorophyll was extracted into 90% acetone. The resulting colored acetone extract was measured in a spectrophotometer at different wavelengths and the same acetone extracts were acidified and measured for the phaeo-pigments. The methodology is described in detail in APHA manual (1989).

Phytoplankton

Phytoplankton samples were collected from the surface waters of the study areas by towing a plankton net (mouth diameter 0.35 m) made a bolting silk [No.25 mesh size 63 µ) for half an hour. These samples were preserved in 5% neutralized formalin and used for qualitative analysis. For the quantitative analysis of phytoplankton, the settling method described by Sukhanovo (1978) was adopted. Numerical plankton analysis was carried out using Utermohl's inverted plankton microscope.

Phytoplankton was identified using the standard works of Venkataraman (1939), Cupp (1943), Subramanian (1946), Prescott (1954), Desikachary (1959 and 1987), Hendey (1964), Steidinger and Williams (1970) and Taylor (1976).

Zooplankton

Zooplankton samples were collected from the surface waters of the study areas by horizontal towing of a plankton net with mouth diameter of 0.35 m, made of bolting silk (No. mesh size 48 µ) for half an hour. These samples were preserved in 5% neutralized formalin and used for quantitative analysis. The zooplankton was identified using the classical works of Dakin and Colefax

(1940), Davis (1955), Kasthurirangan (1963) and Wickstead (1965). The numerical plankton analysis was carried out using Utermohl's inverted plankton microscope.

Benthic Community

For studying the benthic organisms, sediment samples were collected using a Petersen grab. The wet sediment sieved with varying mesh sizes for segregating the organisms. The sieved organisms were staines with rose bengal and sorted to different groups. The number of organisms in each grab sample was expressed in number per meter square. According to size, benthic animals are divided into three groups. (i) macrobenthos (ii) meiobenthos and (iii) microbenthos (Mare, 1942). Macrobenthos are organisms which are retained in the sieve having mesh size between 0.5 and 1 mm. For Meiobenthos, the lowest size attributed is 63 µ and the upper limit depends upon the mesh size of the sieve used for separating macrobenthos from Meiobenthos.

Physico Chemical Parameters

The analysis results of major physio-chemical parameters is given in Table-2.12.

TABLE 2.12

Analysis results of physico-chemical parameters in marine water

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Temperature (°C)	27.8	28.3	27.9	28.5
Salinity (‰)	34.5	33	34	35.0
pH	8.3	8.2	8.2	8.3
EC (x10^3 mho)	49.5	46.0	47.6	48.6
Light Penetration (m)	1.8	0.7	1.0	2.8
DO (mg/l)	5.05	4.50	4.52	5.20
BOD (mg/l)	1.61	1.85	2.81	0.78
TSS (mg/l)	45	56	65	25

The temperature of the surface water samples ranged from 27.8°C to 28.5°C and the maximum value was recorded at Parangipettai coast 0.5 km from the mouth.

The pH remained alkaline 8.2 at all the stations. There is no fresh water influence was recorded during the time of collection and thus the salinity of surface water samples varied from 33 to 35 ppt. The lowest concentration was recorded at Annan Koil and the maximum concentration was noticed at Parangipettai coastal water.

The dissolved oxygen (DO) is an index to study the productivity of an environment. It is mainly depends on the nature and abundance of the planktonic organisms, monsoonal downpour, salinity etc. The DO values recorded in the four stations were given in the table. The higher DO level of 5.20 mg/l was recorded at Parangipettai coastal water and the lower (4.50mg/l) value recorded at Annakoil.

The higher (2.81mg/l) value of BOD was recorded at Mudasalodai and the lower (0.95 mg/l) value recorded at Parangipettai coastal water. BOD refers to the quantity of Oxygen required by bacteria and other microorganisms in the biochemical degradation and transformation of organic matter under aerobic conditions. The BOD values are also again suggesting that the water is fairly clean.

Nutrients

The analysis results of various nutrients in marine water is given in Table-2.13.

TABLE-2.13

Analysis results of nutrients in marine water

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Nitrite (µmol/l)	0.21	0.23	0.38	0.63
Nitrate (µmol/l)	8.88	6.87	2.38	3.90
Ammonia (µmol/l)	0.04	0.03	0.66	0.01
Total Nitrogen (µmol/l)	11.83	8.54	5.98	16.62
Inorganic Phosphate	0.84	1.74	1.44	0.03

(µmol/l)				
Total phosphorus (µmol/l)	0.88	3.34	3.47	0.56
Silicate (µmol/l)	18.62	16.68	31.96	3.89
Oil & Grease (µg/l)	0.315	7.20	6.20	6.91

Total Phosphorus

In the surface water samples, the phosphate concentrations were varied between the minimum of 0.56 and maximum of 3.47 µmol/l. The maximum concentration of nitrate was recorded at Mudasalodai mouth and minimum value recorded at Parangipettai coastal region.

Nitrite

The nitrite concentration shows a very wide deviation in the water samples and it performs conservatively. The maximum concentration of nitrite (0.63µmol/l) is observed at Parangipettai station when the salinity value is 35 ‰ and minimum concentration (0.21µmol/l) is observed at mouth of the Vellar. The behavior of nutrients is very important as the estuarine regions are highly productive and acts as breeding ground for many marine organisms.

Nitrate

The nitrate concentration also shows wide variation in the samples. It behaves conservatively. The primary source of nitrogen in seawater is nitrate and it is thermodynamically most stable form of nitrogen and limiting factor for primary production. The nitrate concentrations were varied between 2.38 and 8.88µmol/l. The maximum concentration (8.88µmol/l) recorded at vellar mouth and the minimum concentration (2.38µmol/l) was recorded at Mudasalodai mouth.

Silicate

Silicate values do not follow any trend. The range was very wide compared to other nutrients. In all of our four study area, this nutrient showed wide variation in the range from3.89 to31.96µmol/l. The maximum value (31.96µmol/l) was recorded at Mudasalodai and the minimum value (3.89µmol/l) was recorded at

Parangipettai region. As seen in the case of nitrite and nitrate, silicate also behaves conservatively.

Major Elements

The analysis results of major elements in water is given in Table-2.14.

TABLE 2.14
Analysis results of major elements in marine water

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Calcium (mg/l)	420	380	400	440
Magnesium (mg/l)	1150	1120	1164	1188
Sodium (mg/l)	12.6	12.6	12.6	12.6
Potassium (mg/l)	7.0	7.0	6.8	7.0
Sulphate (mg/l)	1328.912	1403.980	1397.324	1364.579
Chloride (mg/l)	17080.6	17799.5	17580.5	17784.5

Chloride, Sodium, sulphate, magnesium, calcium, potassium and fluoride are widely considered as major ions in the coastal water

Calcium

The concentration of calcium in the water samples varied from 380 to 440 mg/l with an average of 410 mg/l. The calcium concentration was recorded maximum at Parangipettai and minimum at Annankoil respectively

Magnesium

Magnesium concentrations varied between 1120 – 1188 mg/l with the mean concentration 1155.5 mg/l. The maximum concentration (1188 mg/l) was recorded at Parangipettai and minimum concentration recorded (1120 mg/l) Annan Koil.

Sodium

Sodium is the most dominant cation in the waters and the mean values of the cations show the following order of concentration.

Na > K> Mg > Ca

The concentrations of sodium ions in all the samples were recorded at 12.6 mg/l and marginal variation was observed due to the lack of freshwater inflow from the river.

TRACE METALS IN WATER

The analysis results of trace metals in marine waters are given in Table-2.15.

TABLE 2.15

Analysis results of Trace metals in marine water

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Zinc (µg/l)	2.05	1.80	2.25	1.73
Nickel (µg/l)	5.95	6.3	7.9	7.2
Cadmium (µg/l)	0.31	0.29	0.55	0.39
Lead (µg/l)	5.89	6.68	6.75	5.95
Mercury (ng/l)	25	20	28	15

The concentration of trace metals viz., Zinc (Zn), Nickel (Ni), Cadmium (Cd), Lead (Pb) and Mercury (Hg) in the coastal water of the study area is presented in Table.

The concentration of Zn in the study areas were varied between 1.73 and 2.25 mg/l, when compared with other stations, the maximum value recorded at Mudasalodai mouth and minimum value was recorded at Parangipettai station.

Nickel

The concentrations of Ni ranged between 5.95 and 7.9 µg/l with mean concentrations of 6.85µg/l. The maximum concentration (7.9µg/l) was recorded at Mudasalodai mouth and minimum concentration (5.95 µg/l) was recorded at mouth of vellar.

Cadmium

Cadmium is one of the most mobile and toxic heavy metals in the marine environment. The results of cadmium concentration varied from 0.29 to 0.55µg/l with mean concentrations of 0.38µg/l.

Lead

The estimated concentrations of lead for surface waters ranged from 0.08 to 1.29 mg/l with a mean concentration of 0.57 mg/l.

Mercury

Mercury is one of the most toxic heavy metals in the marine environment. The results of Hg concentrations varied widely from 15ng/l to 60ng/l with mean concentrations of 35ng/l. The maximum concentration (60ng/l) was recorded at Mudasalodai mouth and minimum concentration (15ng/l) was recorded at Parangipettai station.

2.9 Sediment characteristics

The various physico-chemical characteristics of sediments is given in Tables-2.16 and 2.17.

TABLE - 2.16

pH, Nutrients, Oil & Grease in Sediments

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
pH	8.0	8.0	7.9	8.0
Oil & Grease (µg/g)	5.23	10.19	10.94	10.36
Total Nitrogen (µg/g)	4.15	7.60	7.30	7.95
Total Phosphorus (µg/g)	2.53	3.29	3.46	3.83

TABLE-2.17

Soil texture and Organic matter in sediments

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Sand (%)	88.75	85.50	88.09	83.25
Silt (%)	4.52	5.96	3.55	7.65
Clay (%)	6.73	8.54	8.36	9.10
Organic matter (mg/g)	4.63	5.26	5.65	3.73

The pH of sediment varied from 7.9 to 8.0 waters indicated higher pH values was recorded at Vellar mouth and Parangipettai coast stations, whereas lower values were noticed in Annan Koil and Mudasalodai Mouth coastal.

Oil & greases

The oil and greases concentration in the sediment samples were varied from 5.23 to 10.94µg/g. The maximum concentration of oil & grease was recorded at Mudasalodai mouth and the minimum was recorded at vellar mouth.

Total Phosphorus

The total phosphorus concentrations were varied between 2.53 and 3.83µg/g. The maximum concentration of phosphorus was recorded at Parangipettai and minimum value recorded at Vellar mouth region.

Total Nitrogen

The total nitrogen concentration ranged between 4.15 and 7.95µg/g. The maximum concentration of nitrate was recorded at Parangipettai and minimum value recorded at Vellar mouth. Increase in total nitrogen (TN), total phosphorus (TP) and total organic carbon (TOC) in the clayey substratum and decreases with increasing grain size of the sediment.

Organic matter

The amount of organic matters in the sediment samples of the respective study area were analyzed and represented in table. Organic matters of the sediment samples varied from 3.73 to 5.65 mg/g. The maximum concentration of organic matter was recorded at Annankoil and minimum was recorded at Parangipettai. This may be due to the location of the area. The Annan koil is a one of the landing centre in the Parangipettai.

TRACE METALS IN SEDIMENT

The concentration of trace metals in sediments is given in Table-2.18.

TABLE – 2.18

Trace metals in Sediment

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Zinc (µg/g)	16.30	18.20	15.25	15.95

Nickel (µg/g)	10.9	9.15	5.90	5.30
Cadmium (µg/g)	8.95	7.50	12.60	5.32
Lead (µg/g)	7.55	8.20	8.35	9.25
Mercury (ng/g)	BDL	15	20	BDL

The maximum concentration of heavy metals was recorded at Annankoil due to high input of metals from the boat activities and also the station is located in the river mouth, naturally it receive more wastes from terrestrial areas and also nearby fish landing activities.

Zinc

Zinc occurs as trace constituent in number of silicate minerals, but it is a major component in a few economic sulphide mineral deposits. Among the environmentally important trace metals analyzed, zinc recorded at high concentrations in the range from 15.25 to 18.20 mg/g with a mean concentration of 37.7 mg/g in the sediments. The maximum concentration was recoded at Annankoil and it was minimum at Mudasalodai mouth.

Nickel

Nickel is a transition metal having some geochemical characteristics similar to zinc. In the present investigation, Nickel in the sediment samples varied from 5.30 to 10.9 mg/g with a mean concentration of 7.81mg/g.

Cadmium

Cadmium ranged from 5.32 to12.60 mg/g with a mean concentration of 8.59 mg/g in the sediments. The minimum concentration was recorded at Parangipettai station and it was maximum at Mudasalodai mouth.

Lead

Lead is a heavy metal that occurs in nature mainly as lead sulphide. The concentrations of lead varied between 7.55 and 9.25 mg/g with a mean concentration of 8.3 mg/g is observed in the sediment.

Mercury

Mercury is one of the most toxic heavy metals in the marine environment. The Hg concentrations in the sediment varied widely from 15ng/l to 20ng/l with

mean concentrations of 17.5 ng/l. The maximum concentration (20ng/l) was recorded at Mudasalodai mouth and minimum concentration (15ng/l) was recorded at Annankoil.

2.10 MARINE ECOLOGY

The primary productivity as observed at various sampling stations for marine water is given in Table-2.19.

TABLE – 2.19
Primary productivity in marine water

Parameters	Station Name			
	Vellar Mouth	Annan Koil	Mudasalodai Mouth	Parangipettai
Primary Productivity (mg C/m^3/hr)	32.56	29.31	39.54	24.36
Chlorophyll 'a' (mg/m^3)	4.251	4.315	4.835	2.642
Phaeophytin (mg/m^3)	3.842	3.682	4.113	1.835
Phytoplankton Total (Nos/l)	22328	21291	30849	2613
Zooplankton Total (No./m^3)	46620	77376	83952	10080
Total Biomass (ml/100 m^3)	62.4	84.6	92.3	20.1

Primary productivity

The primary productivity of all the four stations was studied. The maximum primary productivity 39.54mg C/m^3/h was recorded at Mudasalodai mouth and minimum 24.36mg C/m^3/h was at Parangipettai station.

Chlorophyll a

Chlorophyll'a content of all the four stations was analyzed and it varied between 2.642 and 4.835 mg/m^3. The maximum was recorded (2.642 mg/m^3) at Mudasalodai mouth and minimum (4.835 mg/m^3) at Parangipettai coast respectively.

Phaeo-pigment

Phaeo-pigment content also analyzed and it was recorded as minimum (1.835 mg/m^3) at Parangipettai station and maximum (4.113 mg/m^3) at Mudasalodai mouth.

Phytoplankton

The total phytoplankton populations of the four stations were identified. The minimum phytoplankton density (2613 Nos./l) was recorded at Parangipettai coastal water and maximum of (30849 Nos./l) at Mudasalodai mouth.

Total Biomass

The minimum total biomass 20.1 ml/100 m^3 was recorded at Parangipettai station and maximum total biomass of 92.3 ml/100 m^3 at Mudasalodai mouth.

Phytoplanktons

The phytoplankton population at all the four stations were analyzed and the results are summarized in Table-2.20. The total phytoplankton populations of the four stations were identified. The phytoplankton density varied from 2613 Nos./l to 30849 Nos./l. The minimum was recorded at Parangipettai coastal water and maximum was at Mudasalodai mouth.

TABLE-2.20
Phytoplankton population at various sampling stations

Station Name: Vellar Mouth

Sl. No.	Name of the Organisms / Species	Cells./l	Total No. in whole sample	% Composition
Class : Bacillariophyceae				
Order : Centrals				
Family : Coscinodisceae				
1.	*Coscinodiscus* sp	1413	1413	6.33
Family :Triceratiinae				
1.	T*riceratium* sp	5524	5524	24.74
Family :Biddulphoidae				
1.	*Biddulphia aurita*	2229		9.98
2.	*Bellerochea* sp	1185	3414	5.31
Order : Pennales				
Family : Naviculaceae				

1	*Navicula* sp	588	588	2.63
DINOFLAGELLATES **Class : Pyrrophyceae** **Order : Peridiniales**				
1	*Ceratium macroceros*	3078		13.78
2	*Ceratium furca*	5576		24..97
3	*Ceratium tripos*	2736	11390	12.25
	Total	**22328**		

Station Name: Annan Koil

Sl. No.	Name of the Organisms / Species	Cells./l	Total No. in whole sample	% Composition
Class : Bacillariophyceae **Order : Centrals** **Family : Coscinodisceae**				
1	*Coscinodiscus* sp	115	115	0.54
Family :Triceratiinae				
1.	*Triceratium* sp	1742	1742	8.18
Family :Chaetoceraceae				
1	*Chaetoceros brevis*	1425	1425	6.69
Family :Biddulphoidae				
1	*Biddulphia aurita*	2139	2139	10.05
Family :Solenoidae				
1	*Rhizosolenia robusta*	1425	1425	6.69
Order : Pennales **Family : Naviculaceae**				
1	*Nitzschia closterium*	1815		8.52
2	*Navicula vonhoffeni*	1366	3181	6.41
Family : Fragilariaceae				
1	*Thalassionema nitzschioides*	3535	3535	16.61
DINOFLAGELLATES **Class : Pyrrophyceae** **Order : Dinophysiales**				
1	*Dinophysis caudate*	1994	1994	9.57
Class : Pyrrophyceae				

Order : Peridiniales				
1	*Ceratium furca*	5576		7.58
2	*Ceratium tripos*	2736		8.07
3	*Protoperidinium* sp	1278		6.00
4	*Noctiluca*	1124	10714	5.28
	Total	**21291**		

Station Name: Mudasalodai Mouth

Sl. No.	Name of the Organisms / Species	Cells./l	Total No. in whole sample	% Composition
Class : Bacillariophyceae				
Order : Centrals				
Family : Coscinodisceae				
1	*Coscinodiscus* sp	1764	1764	5.72
Family :Triceratiinae				
1	*Triceratium* sp	1826	1826	5.92
Family :Biddulphoidae				
1	*Bellerochea* sp	4381	4381	14.20
Family :Solenoidae				
1	*Rhizosolenia robusta*	3213	3213	10.42
Order : Pennales				
Family : Naviculaceae				
1	*Pleurosigma elongatum*	1758		5.70
2	*Nitzschia closterium*	2642	4400	8.56
Family : Fragilariaceae				
1	*Thalassiothrix frauenfeldii*	2357	2357	7.64
DINOFLAGELLATES				
Class : Pyrrophyceae				
Order : Dinophysiales				
1	*Dinophysis caudata*	1766	1766	8.72
Class : Pyrrophyceae				
Order : Peridiniales				
1	*Ceratium macroceros*	1828		5.92
2	*Ceratium furca*	3271		10.62

3	*Ceratium tripos*	3999		12.96
4	*Protoperidinium* sp	2044	11142	6.63
	Total	**30849**		

Station Name: Parangipettai -0.5

Sl. No.	Name of the Organisms / Species	Cells./l	Total No. in whole sample	% Composition
DIATOM				
Class : Bacillariophyceae				
Order : Centrals				
Family : Coscinodisceae				
1	*Coscinodiscus* sp	858	858	32.84
Family :Triceratiinae				
1.	*Triceratium* sp	94	94	3.60
Family:Eupodiseaceae				
1	*Odentella mobiliensis*	125	125	4.78
Order : Pennales				
Family : Naviculaceae				
1	*Pleurosigma sp*	218		8.34
2	*Stephanopyxis palmeriana*	125	343	4.78
Family : Fragilariaceae				
1	*Thalassiothrix frauenfeldii*	905	905	3463
DINOFLAGELLATES				
Class : Pyrrophyceae				
Order : Dinophysiales				
1	*Prorocentrum micans*	94	94	3.60
Class : Pyrrophyceae				
Order : Peridiniales				
1	*Protoperidinium* sp	195	195	7.46
	Total	**2613**		

Zooplanktons

The zooplankton population was analyzed at four stations and two results are summarized in Table-2.21. The zooplankton populations of all the four stations were analyzed. The minimum population 10080 Nos./m^3 was recorded at Parangipettai coastal water. The maximum zooplankton population 83952 Nos./m^3 was recorded at Mudasalodai mouth.

Of these, *Titinopsis* sp (47.30%) were predominantly observed at all the stations, except station 3 (Mudasal odai mouth), it had *Acartia spinicaudata*.

TABLE-2.21
Zooplankton population at various sampling locations

Station Name: Vellar Mouth

Sl. No.	Name of the Organisms / Species	Nos./m^3	Total No. in whole sample	% Composition
Foraminifera				
1	*Globigerina* sp	3780	3780	8.11
Spirotricha				
1.	*Tintinnopsis* sp	22050		47.30
2	*Favella* sp	1260	23310	2.70
Cladocera				
1	*Evadne* sp	3150	3150	6.76
Calanoida				
1	*Pontella* sp	4410	4410	9.46
Cyclopoida				
1	*Oithona similis*	3780	3780	8.11
Larval Forms				
1	Bivalve veliger	1890		4.05
2	Gastropod veliger	2520		5.41
3	Copepod nauplii	2520		5.41

4	Barnacle nauplii	1260	8190	2.70
	Total	**46620**		

Station Name: Annan Koil

Sl. No.	Name of the Organisms / Species	Nos./m^3	Total No. in whole sample	% Composition
Foraminifera				
1	*Radiolaria* sp	5616	5616	7.26
Spirotricha				
1.	*Tintinnopsis* sp	5616		7.26
2	*Favella* sp	4992	10608	6.45
Cladocera				
1	*Penilia* sp	1248	1248	1.61
Calanoida				
1	*Paracalanus* sp	9984		12.90
2	*Acrocalanus* sp	8112		10.48
3	*Acartia spinicauda*	3744	21840	4.84
Cyclopoida				
1	*Oithona rigida*	8736		11.29
2	*Oithona brevicornis*	5616		7.26
3	*Oithona similis*	6864	21216	8.87
Harpacticoida				
1	*Longopedia* sp	4368	4368	5.65
Sagittoida				
1	*Sagitta* sp	3120	3120	4.03
Appendicularia				
1	*Oikopleura* sp	4368	4368	5.65
Larval Forms				

1	Copepod nauplii	4992	4992	6.45
	Total	**77376**		

Station Name: Mudasalodai Mouth

Sl. No.	Name of the Organisms / Species	Nos./m^3	Total No. in whole sample	% Composition
Spirotricha				
1	*Favella* sp	5724	5724	6.82
Calanoida				
1	*Paracalanus* sp	8268		9.85
2	*Acrocalanus* sp	6996		8.33
3	*Canthocalanus pauper*	3816		4.55
4	*Nanocalanus minor*	5724		6.82
5	*Calanopia minor*	1908		2.27
6	*Acartia spinicauda*	8268	34980	9.85
Cyclopoida				
1	*Oithona rigida*	9540		11.36
2	*Oithona similis*	4452		5.30
3	*Corycaeus danae*	7632	21624	9.09
Harpacticoida				
1	*Euterpina acutifrons*	6996	6996	8.33
Appendicularia				
1	*Oikopleura* sp	5088	5088	6.06
Larval Forms				
1	Copepod nauplii	9540	9540	11.36
	Total	**83952**		

Station Name: Parangipettai

Sl. No.	Name of the Organisms / Species	Nos./m^3	Total No. in whole sample	% Composition
Calanoida				
1	*Labidocera* sp	3360		33.33
2	*Acartia* sp	4480	7840	44.44
Decapoda				
1	*Lucifer* sp	2240	2240	22.22
	Total	**10080**		

Macrobenthos

The numerical abundance of macrobenthos in all the four sampling sites were studied and the results are summarized in Table-2.22. The minimum of 328 no/m^2 was recorded at Vellar mouth and maximum of 1868 no/m^2 was recorded at Parangipettai. The *Glycera alba* and *Nephtys* sp. were most dominant macrobenthos in the region of vellar mouth. In these two species *Glycera alba* was the dominant species and it plays more than 60% of the total population. Regarding Annankoil, *Glycera alba* and *Ampitheo* sp. were the dominant species compared with other *Nephtys* sp. and *Polydora ciliate.* Especially in Parangipettai station, the gastropod *Turritella attanuata* and the polychaete *Glycera alba* were the dominant species. These two species plays more than 40% of the total population.

The common species of macrobenthos were *Perineries cultrifera, Polydora ciliate, Glycera alba, Nephtys* sp., *Gattyana deludens, Sabella* sp., *Chaetopterus* sp., *Ampitheop* sp., were found to be common in all the four stations.

TABLE-2.22

Macro-benthos in sediments at various sampling stations

Station Name: Vellar Mouth

Sl. No.	Name of the Species	Nos./ m^2	Percentage
Polychaetes			
3.	*Glycera alba*	197	60.06
4.	*Nephtys* sp.	131	39.94
	Total	**328**	

Station Name: Annan koil

S. No.	Name of the Species	Nos./ m^2	Percentage
Polychaetes			
1	*Polydora ciliata*	164	21.75
2	*Glycera alba*	229	30.37
3	*Nephtys* sp.	164	21.75
Amphipods			
1.	*Ampitheo* sp.	197	26.13
	Total	**754**	

Station Name: Mudasalodai Mouth

Sl. No.	Name of the Species	Nos./ m^2	Percentage
Polychaetes			
1	*Polydora ciliata*	131	19.97
2	*Glycera alba*	164	25.00
3	*Nephtys* sp.	197	30.03
Amphipods			
1.	*Ampitheo* sp.	164	25.00
	Total	**656**	

Station Name: Parangipettai

Sl. No.	Name of the Species	Nos./ m^2	Percentage
Polychaetes			

1	*Polydora ciliata*	164	8.78
2	*Perineries cultrifera*	164	8.78
3	*Gattyana deludens*	164	8.78
4	*Glycera alba*	393	21.04
5	*Nephtys* sp.	262	14.03
6	*Sabella* sp.	131	7.01
7	*Chaetopterus* sp.	66	3.53
Gastropods			
1	*Turritella attanuata*	393	21.04
Amphipods			
1.	*Ampitheo* sp.	131	7.01
	Total	**1868**	

Meiobenthos

The abundance of meiobenthos in all the four sampling sites studied and the results are summarized in Table-2.23. The minimum meiofauna (126 no/10cm^2) was identified at Vellar mouth and maximum(310 no/10cm^2) at Parangipettai station. Meiobenthos community of the four sampling sites were most dominated by foraminiferans i.e. *Rosalina agglutinans, Eponides repandus*, nematodes i.e *Halalaimus filum, H. gracilis* and polychaets *Nephtys* sp

The meiofauna *Perineries cultrifera, Glycera alba, Nephtys* sp. *Daptonema conicum, Quinqueloculina* sp., *Eponides repandus, Spirillina limbata, Rotalia translucens, Rosalina globularis, Halalaimus filum, Viscosia* sp., *Spirillina limbata* and *Theristus* sp. *Ammonia beccarii*, *Cornoboides advena, R. bradyi* were observed as common in all the four sampling sites.

TABLE-2.23

Meiobenthos at various sampling stations

Station Name: Vellar Mouth

S. No.	Name of the Species	Nos./ 10 cm^2	Percentage
Polychaetes			
1	*Perineries cultrifera*	1	4.00
2	*Glycera alba*	2	8.00
3	*Nephtys* sp.	1	4.00
Nematodes			
1	*Daptonema conicum*	3	12.00
2	*Tripyloides gracilis*	2	8.00
3	*Halalaimus gracilis*	2	8.00
Harpacticoid copepods			
1	*Euterpin acutifrons*	2	8.00
Foraminiferans			
1	*Eponides repandus*	3	12.00
2	*Rotalia translucens*	4	16.00
3	*Rosalina globularis*	5	20.00
	Total	**25**	

Station Name: Annan Koil

Sl. No.	Name of the Species	Nos./ 10 cm^2	Percentage
Polychaetes			
1	*Perineries cultrifera*	2	7.69
2	*Glycera alba*	1	3.85
3	*Nephtys* sp.	2	7.69
Nematodes			

1	*Daptonema conicum*	2	7.69
2	*Tripyloides gracilis*	3	11.54
3	*Viscosia* sp.	1	3.85
4	*Halalaimus gracilis*	2	7.69
Harpacticoid copepods			
1	*Euterpin acutifrons*	2	7.69
Foraminiferans			
1	*Eponides repandus*	3	11.54
2	*Rotalia translucens*	3	11.54
3	*Rosalina bradyi*	3	11.54
4	*R. globularis*	2	7.69
	Total	**26**	

Station Name: Mudasalodai Mouth

Sl. No.	Name of the Species	Nos./ 10 cm^2	Percentage
Polychaetes			
1	*Perineries cultrifera*	1	2.86
2	*Glycera alba*	2	5.71
3	*Nephtys* sp.	2	5.71
Nematodes			
1	*Daptonema conicum*	3	8.57
2	*Tripyloides gracilis*	5	14.29
3	*Viscosia* sp.	2	5.71
4	*Halalaimus gracilis*	2	5.71
Harpacticoid copepods			
1	*Euterpin acutifrons*	3	8.57

Foraminiferans			
1	*Eponides repandus*	5	14.29
2	*Rotalia translucens*	4	11.43
3	*Rosalina bradyi*	3	8.57
4	*R. globularis*	3	8.57
	Total	**35**	

Station Name: Parangipettai coast (0.5 km)

Sl. No.	Name of the Species	Nos./ 10 cm^2	Percentage
Polychaetes			
1	*Polydora ciliata*	2	1.09
2	*Glycera alba*	3	1.63
3	*Nephtys* sp.	2	1.09
4	*Sabella* sp.	2	1.09
Nematodes			
1	*Polygastrophora septembulba*	5	2.72
2	*Daptonema conicum*	3	1.63
3	*Theristus* sp.	4	2.17
4	*Tripyloides gracilis*	3	1.63
5	*Viscosia* sp.	3	1.63
6	*Halalaimus filum*	9	4.89
7	*H. gracilis*	6	3.26
8	*Metachromadora remanei*	3	1.63
Harpacticoid copepods			
1	*Euterpina acutifrons*	6	3.26
2	*Macrosetella* sp.	3	1.63
Foraminiferans			

Sl. No.	Name of the Species	Nos./ 10 cm^2	Percentage
1	*Textularia agglutinans*	8	4.35
2	*Quinqueloculina* sp.	16	8.70
3	*Eponides repandus*	17	9.24
4	*Triloculina* sp.	8	4.35
5	*Spirillina limbata*	7	3.80
6	*Rotalia translucens*	15	8.15
7	*R. bradyi*	12	6.52
8	*Rosalina agglutinans*	18	9.78
9	*Ammonia beccarii*	10	5.43
10	*Nonion depressulum*	8	4.35
11	*Cornoboides advena*	6	3.26
12	*Bolivina abbreviata*	5	2.72
	Total	**184**	

Fisheries

The list of major fin fish species observed at Parangipattai coastal water are listed in Table-2.24.

TABLE-2.24

List of major fin fish species observed at Parangipattai coastal water

1	*Alectis indicus*
2	*Ambassis commersonii*
3	*Arothron immaculatus*
4	*Boleopthalmus boddarti*
5	*Caranx sem*
6	*Chanos chanos*
7	*Chelonodon patoca*
8	*Cynoglossus arel*
9	*Cynoglossus puncticeps*
10	*Drepane punctata*
11	*Eleutheronema tetradactylum*
12	*Elops machnata*
13	*Ephippus orbis*

14	*Epinephelus caeruleopunctatus*
15	*Epinephelus tauvina*
16	*Etroplus suratensis*
17	*Gazza minuta*
18	*Gerres abbreviatus*
19	*Gerres filamentosus*
20	*Gnathonodon speciosus*
21	*Hemiramphus far*
22	*Himantura uarnak*
23	*Ilisha kampeni*
24	*Lactoria cornuta*
25	*Lagocephalus lunaris*
26	*Lates calcarifer*
27	*Leiognathus equulus*
28	*Lethrinus nubulosus*
29	*Liza parsia*
30	*Lutjanus fulviflamma*
31	*Latjanus johni*
32	*Latjanus lutjanus*
33	*Latjanus russelli*
34	*Megalaspis cordyla*
35	*Mene maculate*
36	*Mugil cephalus*
37	*Muranesox bagio*
38	*Mystus gulio*
39	*Nematolosa nasus*
40	*Oreochromis mossambicus*
41	*Platex teira*
42	*Platycephalus indicus*
43	*Plotosus canius*
44	*Pomadasys kakkan*
45	*Scatophagus argus*
46	*Scomberoides lysan*
47	*Secutor incidiator*
48	*Siganus canaliculatus*
49	*Siganus javus*
50	*Sillago sihama*
51	*Sphyraena barracuda*
52	*Stolephorus indicus*
53	*Strongylura leiura*
54	*Terapon jarbua*
55	*Terapon puta*
56	*Terapon theraps*
57	*Tetrosomus gibbosus*
58	*Thrysoidea macrura*
59	*Thyryssa mystax*
60	*Triacanthus biaculeatus*
61	*Upeneus sulphurus*

2.11 SOCIO-ECONOMIC ASPECTS

The proposed project is located in Cuddalore district of Tamilnadu. Cuddalore occupies an area of about 3678 sq.km. The total population of the district is about 2285395, with males and females constituting about 50.36% and 49.64% respectively. The overall sex ratio in the district is about 986 females per 1000 males. The average population density is about 626 persons per sq. km. Urban population constitutes about 33.01% of the total population. The overall literacy rate in the district is 71.01%, which is slightly lower than that of the state average of 73.45%. Scheduled caste and scheduled tribe population accounts for about 27.76% and 0.52% of the total population.

The proposed project is located in Parangipettai (Porto Novo), which is located in the Chidambaram Taluka of Cuddalore district. The demographic profile of the project taluka is given in Table-2.25.

TABLE-2.25

Demographic profile of the project taluka

Parameters	Numbers
Number of Households	91026
Total Population	409047
Total Males	204264
Total Females	204783
Sex ratio	1003
Average Family Size	4.5
Scheduled Caste Population	117599
Scheduled Tribe Population	3475
Total Literates/ Literacy Rate	271359
Male Literates/ Male Literacy Rate	151560
Female Literates/ Female Literacy Rate	119799
Total Working Population	164535
Main Workers	117819
Marginal Workers	46716
Non Working Population	244512

Source: Census 2001

CHAPTER – III

ASSESSMENT OF IMPACTS

CHAPTER-3

ASSESSMENT OF IMPACTS

3.1 INTRODUCTION

Based on the project details and the baseline environmental status, potential impacts that are expected to accrue as a result of the proposed project have been identified. The Environmental Impact Assessments for quite a few disciplines are subjective in nature and cannot be quantified. Wherever possible, the impacts have been quantified. However, for intangible impacts, a qualitative assessment has been done. This Chapter deals with anticipated positive as well as negative impacts due to the construction and operation phases of the proposed project.

3.2 WATER ENVIRONMENT

a) Construction phase

Impacts due to effluents from labour camps

The peak labour strength likely to be deployed during construction phase for commissioning of groyen, dredging and construction of fish loading centre shall be about 200. Most of the labour force will come from nearby villages. The labour force engaged by the contractor could come from outside areas. A part of the labour population would stay in area. The balance are likely to stay in labour camps close to the project site during construction phase. It is assumed that about 50% i.e. 100 labour will stay at the site. Based on this the total water requirement for the labour congregating in the area for during construction phase who will stay during the construction phase are estimated as below:

- Peak labour strength : 200
- Labours likely to stay at construction site (50%) : 100
- Married families (80% of 100) : 80
- Single : 20
- Husband and wife both working (80% of 80) : 64
- Families (64/2) : 32

- Families where only husband is working (50% of 32) : 16
- Family size (assumed) : 4
- Total number :

  32x4+16x4+20=212 = 212 --- (A)
- Add 5% for the persons who will be service provider like shops, repairing facilities, etc. : 11
- 50% of service providers will have families : 6
- Total number : 6x4+5=29 - (B)

Total population (A+B) = (A + B) = 212+29=241
Say 250
Water requirement : 70 lpcd
Total water requirement : 17.5 m^3/day

About 50 labour would stay at the construction site, only during working hours. The water requirement for such labour shall be 2.25 m^3/day @ 45 lpcd. Thus, total water requirement works out to (17.5 +2.25) about 20 m^3/day.

The sewage generated is normally taken as 80% of the total water requirement i.e. (0.8 x 20) about 16 m^3/day. The domestic water normally contains high BOD, which needs proper treatment and disposal, otherwise, it can have an adverse impact on the DO levels of the receiving body.

The disposal of sewage without treatment can cause problems of odour and water pollution. The typical composition of untreated sewage is given in Table-3.1.

TABLE-3.1

Typical composition of untreated sewage

Parameter	**Value**
Total Solids, mg/l	720
Total Dissolved Solids, mg/l	500
Total Suspended Solids, mg/l	220
BOD mg/l	220
Oil and grease, mg/l	100
Alkalinity (as $CaCO_3$), mg/l	100
Total Phosphorus, mg/l	80
Total Nitrates, mg/l	40

Parameter	Value
Bicarbonates, mg/l	100
Carbonates, mg/l	10
Nitrates, mg/l	40
Phosphates, mg/l	40
Chlorides, mg/l	50
Sulphates, mg/l	30
Calcium, mg/l	40
Magnesium, mg/l	40
Potassium, mg/l	15
Sodium, mg/l	70

It is clear from Table-3.1, that BOD is the major pollutant, as far as sewage is concerned. Normally untreated sewage would find its way to natural drainage system which ultimately confluences into the sea. However, these natural drains are seasonal in nature and are likely to remain dry in the non-monsoon months. During this period, the flow of untreated sewage from the labour colonies in these drains can lead to development of anaerobic conditions, with associated water quality problems. However, in the present case it must be mentioned that the total quantity of sewage (11 m^3/day) generated by the labour during construction phase is quite small and is not expected to cause any adverse impact on the marine water quality. However, it is proposed to treat the sewage from labour camps before disposal. The details are outlined as a part of Environmental Management Plan (EMP) in Chapter-4 of this Report.

Impacts due to dredging

The project envisages dredging in the lead channel extending from sea face to Porto-Novo in the main channel of river velar. The channel extends upto the point, where natural depth of -2.00 m is available. As per the Detailed Project Report, the total quantum of dredging works out to about 0.36 Mm^3. The major part of dredging would be carried inside the tranquil conditions existing in river Vellar. Since the dredged material near this coastal inlet is sandy, hence, dredging is recommended through a crust cat dredger an amphibian dredger.

The potential environmental effects of dredging can be categorized as impacts due to dredging process itself and those due to disposal of the dredged material. During the dredging process effects may arise due to the excavation of sediments at the bed, loss material during transport to the surface, overflow from the dredger whilst loading and loss of material from the dredger and/or pipelines during transport.

Impacts on benthic organisms

During all dredging operations, the removal of material from the sea bed also removes the animals living on and in the sediments (benthic animals). With the exception of some deep burrowing animals or mobile surface animals that may survive a dredging event through avoidance, dredging may initially result in the complete removal of animals from the excavation site.

The density of meio-benthos ranged from 126 to 310 No./10cm^2. The abundance of macro-fauna ranged from 328 to 1868 no./m^2. None of macro- and meio-fuanal species observed at the site were coming under rare, endangered or threatened category. All were common benthic species.

The recovery of disturbed habitats following dredging ultimately depends upon the nature of the new sediment at the dredge site, sources and types of re-colonising animals, and the extent of the disturbance. In soft sediment environments recovery of animal communities generally occurs relatively quickly and a more rapid recovery of communities has been observed in areas exposed to periodic disturbances, such as maintained channels. Thus, in area under maintenance dredging in subsequent years, the recovery of benthic organisms is not expected to be significant. However, in the proposed project, maintenance dredging is not expected, hence, there will be sufficient recovery of benthic organisms in subsequent years.

Impacts on Suspended sediments and turbidity levels

When dredging and disposing of non-contaminated sediments, the key impacts are the increase in suspended sediments and turbidity levels. Any dredging method releases suspended sediments into the water column, during the excavation itself. In many cases, the locally increased suspended

sediments and turbidity associated with dredging and disposal is obvious from the turbidity 'plumes' which may be seen trailing behind dredgers or disposal sites.

Increase in suspended sediments and turbidity levels from dredging operations may under certain conditions have adverse effects on marine animals and plants by reducing light penetration into the water column and by physical disturbance. The increase is likely to last for a period of 10-15 days after the cessation of dredging activities. This trend is noticeable under flood as well as ebb conditions.

Increased suspended sediments can effect filter feeding organisms, such as shellfish, through clogging and damaging feeding and breathing process. Similarly, young fish can be damaged if suspended sediments become trapped in their gills and increased fatalities of young fish have been observed in heavily turbid water. Adult fish are likely to move away from or avoid areas of high suspended solids, such as dredging sites.

The increase in turbidity results in decrease in the depth that light is able to penetrate the water column which may affect submerged seaweeds and plants, by temporarily reducing productivity and growth rates. Since, the benthic fauna is moderately developed in the areas, hence impacts on this account are not expected to be significant. The degree of resuspension of sediments and turbidity during dredging and disposal depends on:

- sediments being dredged (size, density and quality of the material),
- method of dredging (and disposal),
- hydrodynamic regime in the dredging and disposal area (current direction and speed, mixing rate, tidal state), and
- existing water quality and characteristics (background suspended sediment and turbidity levels).

In most cases, sediment resuspension is only likely to present a potential problem if it is moved out of the immediate dredging location by tidal processes. In general, the effects of suspended sediments and turbidity are generally short term (<1 week after activity) and near-field (<1km from

activity). These are of concern only, if sensitive species are located in the vicinity of the maintained channel. Since, no sensitive species are observed in the areas to be dredged, hence, no adverse impacts are anticipated.

Impacts on marine water quality

Redox potential (eH) and pH are two variables that control the characteristics of chemicals and heavy metals in water and sediment. As long as the pH remains around 8 and eH < 150 mV , most of the chemicals and metals will remain bound to the solid phase without being released into the surrounding water. Only anoxic conditions reduce the eH below this level and hence if dissolved oxygen level is normal no leaching of chemicals and heavy metals will occur.

In the present survey sites pH was 8.0 to 8.1 and dissolved oxygen ranged from 4.50 to 5.20 mg/l which is normal for a marine ecosystem. Dissolved oxygen levels are not reduced to anoxic conditions. Under these circumstances, there is no possibility of any of the chemicals or metals being leached into the water. Moreover, sediment samples collected from all the sites were uncontaminated. As such no adverse impact due to dredging on the chemical characteristics of water or sediment is expected.

Impacts due to dredging and disposal of organic matter and nutrients

The release of organic rich sediments during dredging or disposal can result in the localised removal of oxygen from the surrounding water. Depending on the location and timing of the dredge this may lead to the suffocation of marine animals and plants within the localised area or may deter migratory fish or mammals from passing through. However, removal of oxygen from the water is only temporary, as tidal exchange would quickly replenish the oxygen supply. Therefore, in most cases where dredging is taking place in open coastal waters, this localised removal of oxygen has little, if any, effect on marine life.

Impacts due to contaminated sediments

Another possible impact is the release of toxicants from the sediment if the sediment is contaminated. In the case of contaminated sediment acute toxicity, chronic toxicity and bioaccumulation are the possible effects. But all these are short term and insignificant and no serious effects have been reported from any earlier instances or experimental studies.

In all the sites surveyed, the sediment samples analyzed did not show the presence of any appreciable levels of contamination and hence may not pose any such problems.

Impact on phytoplankton and primary productivity

Biomass of phytoplankton depends mainly on the availability of light in nutrient rich waters. Dredging and disposal may lead to increased turbidity and consequent reduction of light penetration for short periods. This may affect primary productivity and plankton biomass. However, turbidity due to dredging and dumping will be observed only in a localised area and only for a very short duration. Hence these impacts are not expected to be significant in nature.

Impacts on benthos

The dredging and dumping generally affect the benthos. These are related to removal of the benthic organisms from the dredging site and burial of benthic organisms at the dumping site. The dredged material takes away most of the benthos along with it and while dumping it most of the organisms present are buried under the deposited material. This will result in reduced number and diversity of benthic organisms at the dumping site. However, earlier studies show that the dredged site will be colonized by benthic organisms within a very short time. Moreover biomass and diversity of benthos will also be restored to the earlier level within a very short time.

Benthic fauna did not contain any rare or endangered species and consisted of common species only. It can be expected that these species will colonize within a short time from dislodging.

Impacts on fisheries

The most important impact on fishes may be suspended solid load or changes in the food chain. The high turbidity due to heavy suspended solid load during dredging or disposal of dredged materials results in clogging of gills of fishes thereby causing asphyxiation. But since fishes are free swimming they very well avoid such areas and move to safer areas. Once the turbidity is over due to currents, they come back to the area. Due to this capability of the fishes there is no significant adverse impact on fishes and fisheries is expected on fisheries as a result of dredging.

Impacts due to reclamation

The project envisages reclamation by backfilling the dredged material. It has been generally found that, if sediments are not toxic in-situ, they do not become so even after the disposal. The dredged material to be used for backfilling is non-toxic and uncontaminated, hence, adverse impacts on ground water quality due to infiltration over reclaimed area and land environment are not anticipated.

b) Operation phase

The proposed fishery harbour complex has provision for an overhead water tank capacity of 50,000 liters and 2 no. of underground sumps (with open space for an additional sump) 1,00,000 liters for a total of 2 days reserve capacity for the landing center. The fresh water is sourced from TWAD Board supply from Parangipettai village.

3.3 IMPACTS ON NOISE ENVIRONMENT

(a) Construction phase

The major sources of noise during construction phase are due to operation of various construction equipment. The noise levels generated by various construction equipments are given in Table-3.2.

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all the equipments are operating at a common point. Likewise, to predict the worst case scenario, attenuation due to various factors too have not been considered for noise modeling.

TABLE-3.2

Average noise levels generated by the operation of various construction equipment

Equipment	Noise level [dB(A)]
Floating pontoon with mixer machine and crane	70
Winch machine	80
Transit mixer	75
Dumpers	75
Generators	85
Batching plant	90
Air compressors	90
Pile drivers	115

Modeling studies were conducted to assess the increase in noise level due to operation of various construction equipment, and the results are given in Table-3.3.

TABLE-3.3

Predicted noise levels due to the operation of various construction equipment

Distance (m)	Ambient noise level (dB(A))	Increase in noise level due to construction activities (dB(A))	Noise level due to construction activities (dB(A))	Increase in ambient noise level due to construction activities (dB(A))
30	45	70	70	25
50	45	66	66	21
100	45	60	60	15
200	45	54	55	10
500	45	46	49	4
1000	45	36	46	1
1500	45	36	45.5	0.5
2000	45	34	45	-

It is clear from Table 3.3, that at a distance of 100 m and 200 m from the construction site, the increase in noise levels will be about 10 dB(A) and 15 dB(A) respectively. The nearest residential areas are at a distance of about 1 km from the proposed project site. Hence, no adverse impacts are anticipated on noise levels due to the proposed project.

b) Operation phase

No major impacts on noise environment are anticipated during project operation phase.

3.4 IMPACTS ON AIR ENVIRONMENT

(a) Construction phase

Impacts due to fugitive emissions

The major pollutant in the construction phase is SPM being air-borne due to various construction activities. The vehicular movement generates pollutants such as NOx, CO and HC. But, the vehicular pollution is not expected to lead to any major impacts. The soils in the project area are sandy in texture, and are likely to generate dust as a result of vehicular movement. However, the fugitive emissions generated due to vehicular movement are not expected to travel beyond a distance of 200 to 300 m. The impact on air environment during construction phase is not expected to be significant, since, there are habitation in the vicinity of the site.

Impacts due to operation of construction equipment

The combustion of diesel in various construction equipment could be one of the possible sources of incremental air pollution during the construction phase. The fuel utilization rates of various equipments expected to be in operation during construction phase is given in Table-3.4. Under the worst case scenario, it has been considered that equipment used for construction of berth and earthwork at each site, are operating at a common point.

TABLE-3.4

Fuel combustion during construction phase

Equipment	Fuel consumption rate (lph)	No. of units	Total fuel consumption (l)
Dumpers	30	4	120
Generators	30	2	60
Batching plant	40	1	40
Dumpers	20	4	80

Loaders and unloaders	25	3	75
Excavators	25	2	50
Water tanker	8	5	40
Total			**465**

The major pollutant likely to be emitted due to construction of diesel in various construction equipment shall be SO_2. The short-term increase in SO_2 concentration has been predicted using Gaussian plume dispersion model. The results are summarized in Table-3.5.

TABLE-3.5

Short-term (24 hr) increase in concentration of SO_2 ($\mu g/m^3$)

Wind Speed (m/s)	Distance (km) 0.1	0.2	0.3	0.4
0.2	$2.60x10^{-34}$	$1.27x10^{-10}$	$6.36x10^{-6}$	$5.19x10^{-4}$
0.85	$1.56x10^{-7}$	$2.91x10^{-4}$	$2.43x10^{-4}$	$2.3x10^{-4}$
1.53	$4.08x10^{-4}$	$9.66x10^{-4}$	$2.33x10^{-4}$	$1.19x10^{-3}$
2.78	$6.03x10^{-4}$	$6.82x10^{-4}$	$1.44x10^{-4}$	$4.47x10^{-5}$
4.30	$5.22x10^{-4}$	$6.82x10^{-4}$	$1.44x10^{-4}$	$4.47x10^{-5}$
5.98	$3.91x10^{-4}$	$3.56x10^{-4}$	$7.05x10^{-5}$	$3.22x10^{-4}$
7.00	$3.78x10^{-4}$	$3.04x10^{-4}$	$6.04x10^{-5}$	$2.76x10^{-5}$

It is evident from Table-3.5 that the maximum short-term increase in SO_2 is observed as 0.00119 $\mu g/m^3$, which is at a distance of 200 m from the emission source. The incremental concentration is quite low and does not require any specific control measure. Thus, the operation of construction equipment is not expected to have any major impact on the ambient air quality as a result of the project.

(b) Operation phase

During operation stage apart from emissions generated due to vehicular movement, no other sources of air pollution are anticipated. The major source of air pollution in the post-project phase is the vehicular movement for transportation of fish catch to different destinations of markets. On an average about 10 to 20 trucks per day will move in the area. The pollution levels due to those are not expected to be significant to cause significant adverse impact on ambient air quality.

3.5 IMPACTS ON SOCIO-ECONOMIC ENVIRONMENT

(a) Construction phase

In the construction stage the peak labour force, skilled and unskilled labour, is estimated at about 200. About 100 labour population are likely to come from nearby sites. The balance, i.e. 50 labour and their family members are likely to stay near construction sites. Thus, it is necessary to develop adequate infrastructure facilities, so that the requirements of the immigrating labour population are met.

(b) Operation phase

The proposed project will give a boost to fishing activities in the area. The proposed project will develop the following infrastructure as well:

- Fish auction hall
- Public toilet
- Security or guard house
- Fresh water supply and distribution network
- Overhead tank for fresh water storage
- Electric power supply and distribution
- Net mending sheds
- Internal roads
- WBM hard surfaces for parking of vehicles
- Land area for setting up ice plant cum chilled storage
- Boat repair yard for undertaking repair of boats.

Thus, the project would have a significant positive impact on the overall economy of the area.

CHAPTER – IV

ENVIRONMENTAL MANAGEMENT PLAN

CHAPTER-4

ENVIRONMENTAL MANAGEMENT PLAN

4.1 GENERAL

The Environmental Management Plan proposes to integrate the baseline conditions, impacts likely to occur, and the supportive and assimilative capacity of the system. The most reliable way to achieve the above objective is to incorporate the management plan into the overall planning and implementation of the project. The Environmental Management Plan (EMP) for the proposed fisheries harbour is classified into the following categories:

- Land Environment
- Water Environment
- Air Environment
- Control of Noise
- Greenbelt Development
- Socio-Economic Environment

4.2 LAND ENVIRONMENT

The construction of groyen would require large quantities of construction materials which shall be procured from nearby quarries. The impacts of the construction phase on the environment would be transient in nature lasting only till the construction activities continue. The surface roads, which are proposed to be utilized during construction, shall be black topped to avoid fugitive dust. These measures will reduce the entrainment of fugitive emissions to a large extent. Adequate provisions shall be made for timely repair of roads. On completion of construction the roads should be black topped.

4.3 SOLID WASTE DISPOSAL

During construction and operation phases, the solid wastes so generated will contain mainly vegetable matter followed by paper, cardboard, packaging materials, wood boards, polythene, etc. The total solid waste to be generated would be of the order of 0.13 t/day. Likewise, in the project

operation phase, about 0.66 t/day of solid waste will be generated from domestic sources. Adequate facilities for collection and conveyance of municipal wastes generated at the disposal site shall be developed. A provision of Rs.1.9 million has been earmarked for the solid waste disposal. The details are given in Table-4.1.

TABLE-4.1

Cost estimates for solid waste management

S. No.	**Item**	**Cost (Rs. million)**
1.	One covered tempo for conveyance of solid waste to the landfill	1.0
2.	Manpower cost for 4 persons @ Rs.5000/month for 2 years including 10% escalation/year	0.5
3.	Preparation of landfill site including surveying, levelling, excavation, lining, etc.	0.4
	Total	**1.9**

4.4 WATER ENVIRONMENT

The major source of water pollution in the construction and operation phases is the sewage generated by the workers and employees. During construction phase about 24m^3/day of sewage is expected to be generated. It is proposed to construct twenty (20) community toilets within the labour camps. An amount of Rs.30,000 is likely to be spent for construction of a community toilet. Thus, a total expenditure of Rs.0.6 million is likely to be incurred for this purpose.

The sewage can be treated in septic tank and disposed off over land through absorption trenches. It is proposed to construct one septic tank for treatment of sewage generated during construction phase. A provision of Rs.0.2 million has been earmarked for construction of septic tanks. These facilities can be used in the project operation phase as well. The treated sewage from septic tanks can be discharged into the existing sewerage network of the area.

The effluent from auction hall etc. will contain oil and grease particles which shall be treated in an oil skimmer and suitably disposed after treatment. The oil skimmers should be made available at the berthing quay. The collected oily matter can be stored in cans, etc. and disposed off at designated landfill sites finalized in consultation with the district administration. An amount of Rs.0.5 million has been earmarked for this purpose.

4.5 AIR ENVIRONMENT

Control of Pollution due to increased vehicles

The major source of air pollution in the proposed project is the increased vehicular movement in the project construction phase. The movement of other vehicles is likely to increase, as the commissioning of the project would lead to significant development in the area. Thus, as a control measure, vehicles emitting pollutants above the standards should not be allowed to ply either in the project construction or in the operation phases. Vehicles and construction equipment should be fitted with internal devices i.e. catalytic converters to reduce CO and HC emissions.

All the roads in the vicinity of the project site and the roads connecting the quarry sites to the construction site should be paved or black topped to minimize the entrainment of fugitive emissions. If any of the roads stretches cannot be black topped or paved due to some reason or the other, then adequate arrangements must be made to spray water on such stretches of the road.

4.6 CONTROL OF NOISE

During construction phase, the use of various construction equipment is the major source of noise. However, based on the modeling studies, the noise due to operation of various construction equipment is not likely to have any adverse impact on the habitations in nearby habitats. However, efforts need to be made to reduce the noise generated by the various construction equipment. Exposure of workers near the high noise levels areas can be

minimized. This can be achieved by job rotation/automation, use of ear plugs, etc. To prevent the adverse impacts, the exposure to high noise levels should be restricted as per the exposure period outlined in Table-4.2. Workers operating in the high noise areas should be provided with earplugs.

TABLE-4.2

Maximum exposure periods for different noise levels as per OSHA

Maximum equivalent continuous noise level (dB(A))	Unprotected exposure period (hrs) per day for an 8 hr/day and 5 days per week
90	8
95	4
100	2
105	1
110	0.5
115	0.25
120	No exposure permitted at or above this level

4.7 Environmental Management Plan

During Construction Phase

S. No.	Aspects	Mitigation Measures	Roles and Responsibilities
1.	**Air Environment**		
		• Regular sprinkling of water will be made to control fugitive dust. • Better maintained vehicles and mechanical devices to be used. • Construction workers should use masks.	• Contractor
2.	**Noise Environment**		
		• Appropriate measures for minimizing noise from vehicles and mechanical devices to be taken. • DG set to be installed in acoustic enclosures with	• Contractor

S. No.	Aspects	Mitigation Measures	Roles and Responsibilities
		silencers.	
3.	**Land Environment**		
		• Earthquake resistant designs to be followed for construction. • Minimum land clearance to minimize soil erosion	• Contractor
4.	**Surface Water**		
		• Run-off of fuel / engine oil and lubricants from construction sites will be controlled. • Labor camps will be established with adequate sanitation facilities away from the HTL.	• Contractor
5.	**Waste Water**		
		• Drainage, catch pits / sedimentation tanks for waste water, prior to discharge. • Treatment of waste water to adhere to CRZ requirements.	• Contractor
6.	**Dredge Disposal**		
		• Dredge spoils to be utilised for reclamation / disposed outside the CRZ.	• Contractor
7.	**Solid Waste**		
		• To be dumped in identified sites for final disposal by the local body.	• Contractor
8.	**Fresh Water Supply**		
		• Piped water supply to be made to the fish landing centre from TWAD sources through separate distribution lines.	• Contractor
9.	**Biological Environment**		
		• Minimum changes to aquatic environment through waste control. • Complete clean-up and restoration of the aesthetic quality of the surroundings after construction • No natural tidal courses to be interfered with.	• Contractor
10.	**Landscape / Greenery**		
		• Green belt around the fish landing centre and on roads to be set up. • Mangrove species like *Avicennia marina* and *Avicennia officinalis* should be planted being good absorbers of heavy metals.	• Contractor

DURING OPERATION PHASE

S. No.	Aspects	Mitigation Measures	Roles and Responsibilities
1.	**Air Environment**		
		• Regular sprinkling of water to be made to control fugitive dust. • Vehicles with emission control devices to be encouraged. • Half-yearly monitoring of air quality status to be done.	• Executive Engineer and Site Engineer
2.	**Noise Environment**		
		• Restriction on vehicular horns to be imposed. • DG set to be installed in acoustic enclosures with silencers. • Day time activities to be encouraged.	• Executive Engineer and Site Engineer
3.	**Surface Water**		
		• Regular monitoring of parameters viz. temperature, pH, DO, BOD/COD, salinity, turbidity, TSS, Nitrite-Nitrogen, Nitrate-Nitrogen, Ammonia-Nitrogen, Phosphate-Phosphorus, Chlorophyl a, oil and grease, heavy metals, total coliform / faecal coliform, etc, to be made and reported. • Safeguard from oil spills by the fishing vessels/boats. • Surface run-off from oil handling areas should be treated for oil separation before discharge.	• Executive Engineer And Site Engineer
4.	**Waste Water / Solid Waste**		
		• Vessel repairing / overhauling, etc to be done only in the identified space. Waste water to be treated prior to discharge. • Putrefied and discarded fish parts to be disposed of at designated area.	• Executive Engineer and Site Engineer
5.	**Biological Environment**		
		• No untreated discharge of wastes, dumping of garbage into sea. • Litter bins to be provided and disposed of to designated site(s) of Cuddalore Municipality • MPEDA guidelines for hygienic	• Executive Engineer and Site Engineer

S. No.	Aspects	Mitigation Measures	Roles and Responsibilities
		fish handling to be followed • Awareness Programmes for biodiversity conservation to be organized in association with Local Municipality, local fishermen and fisherwomen cooperative societies, District Collector of Cuddalore district and NGOs involving women and school children from the coastal villages.	
6.	**Quality of Life**		
		• First aid / medical facilities to be extended to the indigent people. • Awareness Programme on hygiene and natural hazards to be organized.	• Executive Engineer and Site Engineer

CHAPTER – V

ENVIRONMENTAL MONITORING PROGRAMME

CHAPTER-5

ENVIRONMENTAL MONITORING PROGRAMME

5.1 THE NEED

Monitoring is an essential component for sustainability of any developmental project. It is an integral part of any environmental assessment process. Any development project introduces complex inter-relationships in the project area between people, various natural resources, biota and the many developing forces. Thus, a new environment is created. It is very difficult to predict with complete certainty the exact post-project environmental scenario. Hence, monitoring of critical parameters is essential in the post-project phase.

Monitoring of environmental indicators signal potential problems and facilitate timely prompt implementation of effective remedial measures. It will also allow for validation ofthe assumptions and assessments made in the present study.

Monitoring becomes essential to ensure that the mitigation measures planned for environmental protection function effectively during the entire period of project operation. The data so generated also serves as a data bank for prediction of post-project scenarios in similar projects.

5.2 AREAS OF CONCERN

From the monitoring point of view, the important parameters are marine water quality, ambient air quality, noise, etc during project construction phase. An attempt is made to establish early warning system which indicate the stress on the environment. Suggested monitoring parameters and programmes are described in the subsequent sections.

5.3 MARINE WATER & SEDIMENT QUALITY

Construction phase

The chemical and biological characteristics of marine water quality shall be monitored once in three months during project construction phase. Both

surface and bottom waters should be sampled and analysed. The parameters to be monitored are as follows:

Marine Water

Physico-chemical parameters

- pH
- Salinity
- Conductivity
- TDS
- Turbidity
- D.O.
- BOD
- Phosphates
- Nitrates
- Sulphates
- Chlorides

Biological parameters

- Light penetration
- Chlorophyll
- Primary Productivity
- Phytoplanktons (No. of species and their density)
- Zooplanktons (No. of species and their density)

Sediments

Physio-chemical parameters

- Texture
- pH
- Total Kjeldahl Nitrogen
- COD
- Sodium
- Potassium
- Phosphates
- Chlorides
- Sulphates

Biological Parameters

- Benthic Meio-fauna
- Benthic Macro-fauna

The marine water and sediment sampling and analysis be conducted by an external agency. A provision of Rs.0.8 million has been earmarked for this purpose.

Operation Phase

The chemical characteristics of marine water quality should be monitored once in three months and biological parameters once a year during project operation phase. Both surface and bottom waters should be sampled and analysed. The parameters to be monitored are as follows:

Marine Water

Physico-chemical parameters

- pH
- Salinity
- Conductivity
- TDS
- Turbidity
- D.O.
- BOD
- Phosphates
- Nitrates
- Sulphates
- Chlorides

Biological parameters

- Light penetration
- Chlorophyll
- Primary Productivity
- Phytoplanktons (No. of species and their density)
- Zooplanktons (No. of species and their density)

Sediments

Physio-chemical parameters

- Texture
- pH
- Total Kjeldahl Nitrogen
- COD

- Sodium
- Potassium
- Phosphates
- Chlorides
- Sulphates

Biological Parameters

- Benthic Meio-fauna
- Benthic Macro-fauna

The marine water and sediment sampling and analysis be conducted by an external agency. A provision of Rs.0.6 million/year has been earmarked for this purpose.

5.4 AMBIENT AIR QUALITY

Construction Phase

Ambient air quality monitoring is recommended to be monitored at three stations close to the groyen construction site. The monitoring can be conducted for three seasons. For each season monitoring can be conducted twice a week for 4 consecutive weeks. The parameters to be monitored are SPM, RPM, SO_2 and NOx. An amount of Rs. 0.144 million has been earmarked for this purpose. This is based on the fact that the construction phase is to last for one year. The ambient air quality monitoring during project construction operation phase can be conducted by an agency approved by Tamilnadu Pollution control Board.

Operation phase

No monitoring measures have been recommended for ambient air quality monitoring during project operation phase.

5.5 NOISE

The noise level monitoring during construction phase will be carried out by the project staff and a noise meter can be purchased. An amount of Rs.0.05 million has been earmarked for this purpose.

5.6 SUMMARY OF ENVIRONMENTAL MONITORING PROGRAMME

The summary of Environmental Monitoring Programme for implementation during project construction and operation phases is given in Tables-5.1 and 5.2 respectively.

TABLE-5.1
Summary of Environmental Monitoring Programme for implementation during project construction phase

S. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
1.	**Marine water**			
	Physico-chemical parameters	pH, Salinity, EC, TDS, Turbidity, Phosphates, Nitrates, Sulphates, Chlorides.	Once in three months	3 to 4 sites
	Biological parameters	Light penetration, Chlorophyll, Primary Productivity, Phytoplanktons, Zooplanktons	Once in three months	3 to 4 sites
2.	**Sediments**			
	Physico-chemical parameters	Texture, pH, Sodium, Potassium, Phosphate, Chlorides, Sulphates	Once in three months	3 to 4 sites
	Biological parameters	Benthic Meio-fauna, Benthic Macro-fauna	Once in three months	3 to 4 sites
3.	Ambient air quality	SPM, RPM, SO_2 and NOx	- Summer, Post-monsoon and Winter seasons. - Twice a week for four consecutive weeks per season.	Close to construction site(s)
4.	Noise	Equivalent Noise Level	During peak construction activities	Construction Site(s)

TABLE-5.2

Summary of Environmental Monitoring Programme for implementation during project operation phase

S. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
1.	**Marine water**			
	Physico-chemical parameters	pH, Salinity, EC, TDS, Turbidity, Phosphates, Nitrates, Sulphates, Chlorides.	Once in three months	3 to 4 sites
	Biological parameters	Light penetration, Chlorophyll, Primary Productivity, Phytoplanktons, Zooplanktons	Once a year	3 to 4 sites
2.	**Sediments**			
	Physico-chemical parameters	Texture, pH, Sodium, Potassium, Phosphate, Chlorides, Sulphates	Once in three months	3 to 4 sites
	Biological parameters	Benthic Meio-fauna, Benthic Macro-fauna	Once in a year	3 to 4 sites

5.7 Environmental Monitoring Programme

During Construction Phase

S. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
1.	**Marine water**			
	Physico-chemical parameters	pH, Salinity, EC, TDS, Turbidity, Phosphates, Nitrates, Sulphates, Chlorides.	Once in three months	3 to 4 sites
	Biological parameters	Light penetration, Chlorophyll, Primary Productivity, Phytoplanktons, Zooplanktons	Once in three months	3 to 4 sites
2.	**Sediments**			
	Physico-chemical parameters	Texture, pH, Sodium, Potassium, Phosphate,	Once in three months	3 to 4 sites

S. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
		Chlorides, Sulphates		
	Biological parameters	Benthic Meio-fauna, Benthic Macro-fauna	Once in three months	3 to 4 sites
3.	Ambient air quality	$PM_{2.5}$, PM_{10}, SO_2 and NOx	- Summer, Post-monsoon and Winter seasons. - Twice a week for four consecutive weeks per season.	Close to construction site(s)
4.	Noise	Equivalent Noise Level	During peak construction activities	Construction Site(s)

DURING OPERATION PHASE

S. No.	Aspects	Parameters to be monitored	Frequency of monitoring	Location
1.	**Marine water**			
	Physico-chemical parameters	pH, Salinity, EC, TDS, Turbidity, Phosphates, Nitrates, Sulphates, Chlorides.	Once in three months	3 to 4 sites
	Biological parameters	Light penetration, Chlorophyll, Primary Productivity, Phytoplanktons, Zooplanktons	Once a year	3 to 4 sites
2.	**Sediments**			
	Physico-chemical parameters	Texture, pH, Sodium, Potassium, Phosphate, Chlorides, Sulphates	Once in three months	3 to 4 sites
	Biological parameters	Benthic Meio-fauna, Benthic Macro-fauna	Once in a year	3 to 4 sites

CHAPTER – VI

COST ESTIMATE

CHAPTER-6

COST ESTIMATES

6.1 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The cost estimates for implementing EMP shall be Rs.2.92 million. The details are given in Table-6.1).

TABLE-6.1

Summary of cost estimate for implementing Environmental Management Plan (EMP)

S. No.	Parameter	Cost (Rs. million)
1.	Solid Waste Management	1.91
2.	Sanitary facilities at labour camps	0.80
3.	Treatment of effluent from workshops	0.50
4.	Greenbelt development	0.12
5.	Purchase of noise meter	0.05
6.	Implementation of Environmental Monitoring Programme during construction phase (Refer Table-6.2)	0.95
	Total	**4.32**

6.2 ENVIRONMENTAL MONITORING PROGRAMME

The cost required for implementation of Environmental Monitoring Programe during construction phase is Rs.0.95 million. The details are given in Table-6.2.

TABLE-6.2

Summary of cost estimates required for implementation during Project construction phase

S. No.	Parameter	Cost (Rs. million)
1.	Marine Ecology	0.8
2.	Ambient air quality	0.144
	Total	**0.944 say Rs. 0.95 million**

The cost required for implementation of Environmental Monitoring Programme during operation phase is Rs.0.60 million/year, which is required for marine water quality monitoring.