*Executive Summary*

*of*

# *Comprehensive Environmental Impact Assessment of proposed Captive marine terminal and coal conveyor off Panaiyur Chinnakkuppam for Cheyyur UMPP*

*Project Proponent:*

**Coastal Tamil Nadu Power Ltd.**

**A wholly owned subsidiary**

**of**

**Power Finance Corporation Ltd. (A Govt. of India Undertaking)**

## 1.0 INTRODUCTION

The Government of India, through its Ministry of Power introduced the Ultra Mega Power Project (UMPP) Program with the objective of developing large capacity power projects in India. So far, 16 such UMPPs have been identified and are proposed to be located in various States.

The UMPPs, each with a capacity of about 4,000 MW, involve economies of scale based on large generation capacities based at single location, utilize super critical technology to reduce emissions and potentially have lower tariff costs for electricity generated.

Power Finance Corporation Ltd. (PFC) has been designated to act as a nodal agency and Central Electricity Authority (CEA), GoI, is the technical partner for the development of UMPPs while the MoP is involved as a facilitator.

PFC incorporates wholly owned subsidiaries as Special Purpose Vehicles (SPVs) under the Companies Act for these UMPPs to conduct the bidding process in accordance with the 'Guidelines for Determination of tariff by Bidding process for procurement of Power by Distribution Licensees, 2005 (as amended) issued by Ministry of Power, Govt. of India from time to time.

One such UMPP project is proposed to be set up near village Cheyyur, District Kancheepuram, Tamil Nadu (hereinafter referred to as Cheyyur UMPP). The power plant would be using coal to be imported through a captive port proposed near village Panaiyur, District Kancheepuram, Tamil Nadu. Ministry of Power, Govt. of India has allocated a share of 1600 MW to the State of Tamil Nadu from power to be generated from Cheyyur UMPP. For this project, a SPV namely Coastal Tamil Nadu Power Ltd. (CTNPL) was incorporated by PFC as a wholly owned subsidiary on January 9, 2007.

The site for the Cheyyur UMPP at Cheyyur and the captive port at Panaiyur was finalized in consultation with CEA and the Government of Tamil Nadu. The Ministry of Environ and Forest has issued the Terms of Reference for the Environment Impact Assessment Studies for the main plant (in Feb 20090 as well as the captive port (in Feb 2010).

Govt. of Tamil Nadu has issued notifications under section 3(2) of the 'Tamil Nadu Acquisition of Land for Industrial Purposes, 1997' for the acquisition of lands in Villages Vedal, Ganagadevkuppam**,** Chitarkadu, Cheyyur-B and Vilangadu for Main Plant and Ash Dyke and Village Panaiyur for the Captive port. The public hearing for the Main Plant and Ash Dyke was held on 10th June 2010 in Cheyyur**.**

The power project would be using coal to be imported through a marine coal handling facility (at Panaiyur) located at a distance of approximately 5 km to the east of the main power plant location (at Cheyyur). The Coal from the port would be transported from the port to the main plant through a closed conveyor system. The total coal import is estimated at 12 to 14 Million Metric Tons per annum and the estimated daily consumption is 40000 to 45,000 MT

CTNPL has appointed National Institute of Ocean Technology (NIOT) for conducting EIA studies for the new development proposal. The feasibility study for the transport of coal from the port to the main plant through conveyors has been carried out by RITES. This report details the Comprehensive Environmental Impact Assessment (CEIA) for the proposed development of marine facilities and coal conveyor corridor off Panaiyur.

## 2.0 CHEYYUR AND ITS ENVIRONS

The main UMPP plant site is located near Cheyyur village in Cheyyur Block of Kanchipuram district in Tamil Nadu Coastal area. The nearest railway station is Melmaruvathur (20 km)/ Maduranthakam (22 km). The railway stations are well connected to Chennai through broad gauge railway system. The nearest airport is at Chennai located at a distance of about 96 km from the site. The site needs to be connected with State Highway (East Coast Road)/National Highway (NH-45).

The East Coast Road (ECR) connecting Chennai and Puducherry passes through the eastern side of the UMPP main plant site and the Buckingham Canal runs in-between the ECR and the Bay of Bengal.

## 3.0 SITE DESCRIPTION

The site for the marine facilities lies in Panaiyur village (off Cheyyur). The total land area is about 84 acres (Survey No. 350 pt and 346 pt) and lies in between Panaiyur Chinnakuppam and Panaiyur Periakuppam hamlets. The water front is about 650m long. The water front is completely free from any activity. The land area identified is abutting the water front and is predominantly vacant land with some coconut plantations of recent origin and some fenced private houses also of recent construction.

There is no inhabitation in the water front and back up area. The identified project land area has no sand dunes and is fairly flat. There are no religious or archaeological structures within this area. Two fishing hamlets are located to the north and south of the proposed site and are connected to the road on the landward side by a kutcha road. There is a metal

road connecting ECR and Panaiyur Periyakuppam. A kutcha road branches off from the metal road to connect Panaiyur chinnakuppam. The metal road crosses Buckingham Canal at about a distance of 1 km. from ECR. The distance of the site from ECR is about 1.5 km. The road directly crosses the Buckingham Canal as there is no flow in the canal. There is no culvert or duct across the road where the road crosses the canal.

## 4.0 PROPOSED CONSTRUCTION OF BERTHS FOR COAL HANDLING

The proposed berth shall be designed for a draft of 19m. The length of the coal berth shall be 650m and there shall be two berths with four grab unloaders. The coal berth will be located within breakwaters so that tranquil conditions exist for year round operations.

### 4.1 Design Approach

Field data collection studies for waves, tides, currents, bathymetry, sub bottom profile and shore profiling were carried out by NIOT to provide inputs for engineering feasibility design. The oceanographic parameters were measured during the month of May (2010) during summer and also during the month of October during monsoon to assess seasonal variations. These data were used for calibration of the models to predict waves and tides. Predictions have been carried out for annual return periods for waves for harbour operations and 100-year return period for breakwater design.

Based on the bathymetry data and wave rose diagrams for the area, the harbour layout, navigational channel alignment, harbour entrance, approach trestle and jetty have been fixed. Two primary factors that govern the harbour layout selection are:

a) Tranquility requirements for shipping operations
b) Navigational requirements for ship maneuvering

It is observed that the seabed off Panaiyur drops to 10 m below Chart Datum within a distance of 1.2 km from the shore. Thereafter steepness of the slope is relatively less and drops down to 20 m below Chart Datum over a further distance of 5.5 km from the 10 m contour.

Hence it is proposed to locate the jetty beyond the 10 m contour and have the berthing area and an approach channel dredged to the required depths. It is proposed to have two berths for handling two cape size carriers simultaneously along a continuous jetty. The approach trestle will be approximately 1400 m long and the berthing jetty will be about 650 m long. The berthing jetty and approach trestle will be perpendicular to the shoreline.

## 4.2 Proposed Harbour Layout

Based on the wave characteristics and wave rose diagrams for the site berth and breakwater alignments has been assessed for the project. The layout has been studied through detailed numerical simulations for assessing tranquillity within the breakwaters for various design wave heights and directions.

### 4.2.1 Proposed Breakwater layout

There are two breakwaters to provide the required tranquillity – a 1575 m long breakwater on the northern side and a 1970 m long breakwater on the southern/eastern side. While the northern breakwater lies in water depths 11m to 14.5 m the southern/eastern breakwater lies in water depths 10m to 13.5 m. The length of the approach channel is about 5.0 km. The berths are oriented along the approach and normal to the shore.

This layout was tested for tranquillity conditions based on comprehensive modelling using MIKE21. It has been concluded that in this layout safety against beam seas is ensured. Many of critical wave combinations studied in the numerical model are non-existent thus eliminating critical conditions. Berths are safe for the possible waves in this proposed marine handling facility. At entrance, wave heights exceed 1.0m for some amount of time. The direction of these critical waves match generally with the monsoon period.

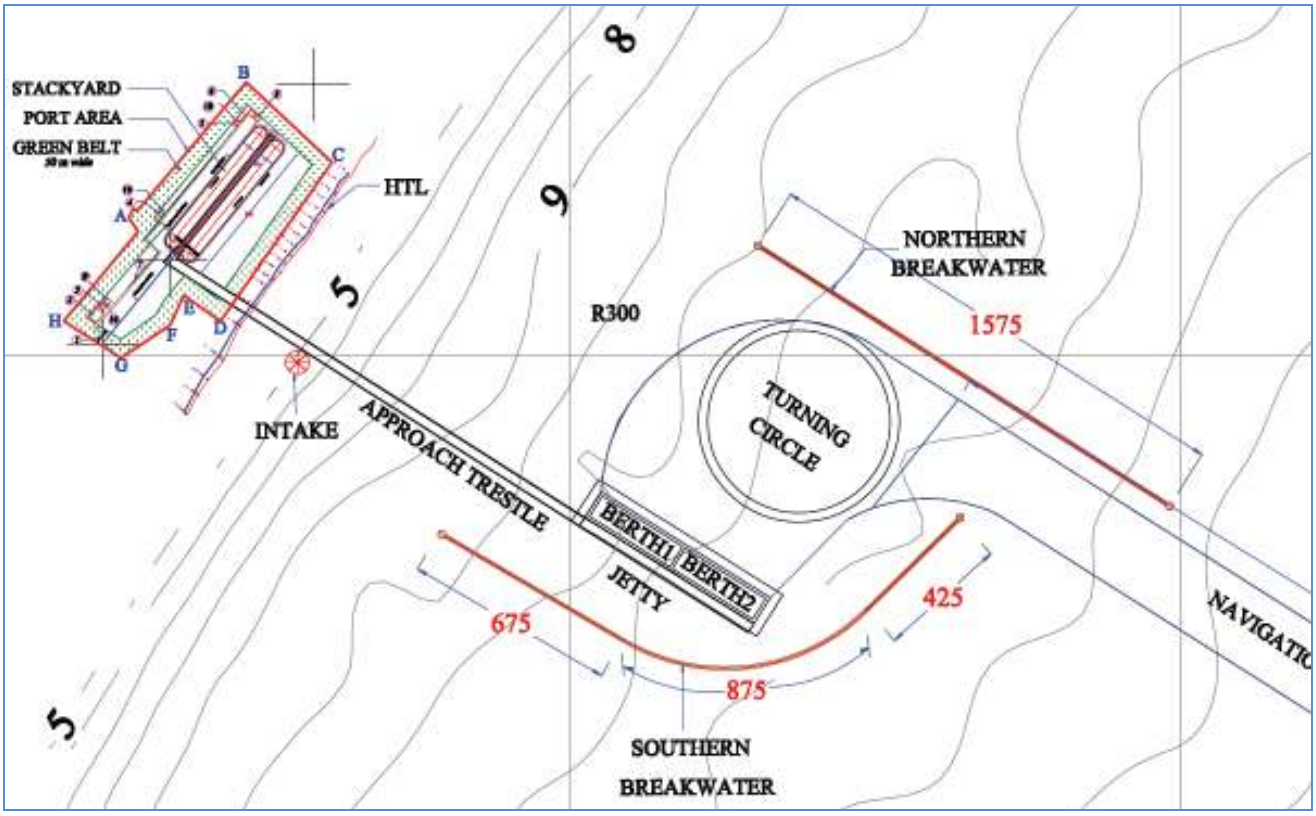


**Fig 4.1 Proposed breakwater and jetty layout**

In this case the manoeuvrability is satisfied without risk of grounding, as the navigational channel is aligned perpendicular to the shoreline. Modeling studies for wave transformations at the entrance indicate 1.5m to 2m wave heights during southwest monsoon (May to September) for offshore wave directions of 165° to 180°. This occurrence is predicted for about one month. Navigation simulation studies indicate that manoeuvrability of vessels for wave heights upto 2.5m at the entrance is manageable. The layout suggested is favourable because

- wave heights at the berth are within specified limits except weather downtime
- navigational requirements are in general satisfied for most part of the year
- dredging quantities are low

## 4.3 Design of Harbour Elements

*Jetty & Approach Trestle*

The berthing jetty will be in continuation of the approach trestle and normal to the shoreline. It will be a continuous jetty of 650 m length accommodating two berths each capable of berthing capesize coal carriers upto 150,000 DWT. It will have a width of 25 m and a deck level of + 5.0 m CD.

*Handling System*

The berths will be provided with grab unloaders of suitable capacity for unloading coal from the coal carriers. It is proposed to have four ship unloaders for handling two vessels at a time. There will be two streams of conveyors running parallel.

*Approach trestle*

The approach trestle is proposed to be aligned along the berthing face of the jetty so that the berth conveyors are taken along the approach trestle. Approximate length of the trestle is proposed to 1275m with a width of 15m from the shore upto the water intake structure and thereafter will be 10m wide. The trestle will be supported on pile foundation. The actual pile length shall be based on pile capacity calculations when detailed soil investigations are carried out. There will be 3 rows of piles. It will carry the two conveyors, a road way and the intake pipelines.

*Capital Dredging*

The approach channel shall be 230m wide at the bottom and 20.5 m deep below CD. Starting at 13 m contour near the entrance between breakwaters, the channel extends upto 20.5 m contour at a distance of 3,500 m. The turning basin is 550 m in diameter and will have a depth of 19.0 m below CD. The berthing areas will have a depth of 19 m below CD. The approach channel will have marker buoys on either side.

Since the terminal is offshore beyond 10m contour, it is proposed to execute the dredging of the channel, turning basin and berthing areas through trailing suction dredger and dredged material will be disposed off at the pre-determined dumping ground. The dumping ground has been identified through mathematical model studies to ensure that the dumped material does not come back to the dredged areas.

Estimated capital dredging quantity in the navigational channel is 4 million $m^3$. Length of the channel is 5 Km. Estimated quantity of dredging in the basin is 3.8 million $m^3$. Therefore total estimated quantity of dredging is 7.8 million $m^3$. The duration of dredging has been estimated over 6 months within the port basin and twelve months in the navigational channel.

***Transit stackyard at the port area***

It is proposed to have an emergency stockyard at the foreshore to stock the coal unloaded from the ship in case of breakdown of the downstream conveyor system. This stockyard will not be regularly used and will be empty most of the time. In case of emergency only this will be stocked with coal which will be removed as soon as the system is restored. This will be designed to store two parcels of capesize vessels.

There will be two stacks of 500 m length; 50 m width and 10 m stack height on either side of the equipment track berm, giving a total capacity of 310,000 Te equivalents to two parcels of capesize carriers.

The stockyard will be surrounded on all the sides with a 50 m wide greenbelt to prevent coal dust from moving over to the adjoining areas. A suitable water sprinkler system will also be provided to arrest generation of coal dust. A proper drainage system with a settling pond will be provided to take care of rain and sprinkled water

## 4.4 COAL TRANSPORTATION FROM PORT TO POWER PLANT

The coal unloaded at the terminal is proposed to be transported directly to the power plant stockpile. However, for meeting any exigency, an emergency stockpile in the port area has been planned with a storage capacity of about 300,000 T equivalents to two ship loads of cape size vessel.

From the transfer point in the backup area of port terminal, transfer point of the power plant stockpile it is proposed to install two streams of belt conveyors of matching capacity i. e. 4,000 TPH each.

Based on reconnaissance survey of the proposed Port & Power Plant sites as well as the adjoining areas in the vicinity of the sites, a conveyor alignment connecting the port stockpile and the plant has been proposed. A pipe conveyor system (with a pipe diameter of 650mm formed out of 2400mm belt width with a speed of 6m / sec.) is recommended for transportation of coal from the marine terminal to the proposed UMPP at Cheyyur

**Advantages of pipe conveyor are:**

1. Elimination of multiple transfer points
2. Elimination of multiple drive units
3. Elimination of en route spillage and dust generation
4. Significantly lower power requirements
5. Lower space requirement for installation
6. Lesser degradation of material
7. Lower structural and foundation cost

## 5.0 PRELIMINARY EVALUATION OF LIKELY IMPACTS (SCOPING)

The evaluation of the project location is done for the MoEF siting criteria and concluded that the project is NOT sited in an ecologically sensitive area. The project operations are carried out within the port area. The coal containers proposed to be handled is not hazardous or toxic and therefore there is NO RISK involved in the construction or operation stages of the project.

### 5.1 Scoping outcome

- The proposed marine facilities are exclusively for handling coal the UMPP at Cheyyur.
- There are no mangroves, coral reefs or critical habitats in the area or its vicinity.
- Capital dredging and dumping activities are likely to cause impacts on water/sediment quality, benthic ecology, bathymetry and shoreline;
- Impacts on hydrodynamics and littoral transport from breakwater construction are expected
- The proposed outfall is located in the offshore areas at about 14m water depths and shall be taken along the corridor prepared for the coal conveyor. Impacts of higher temperature and salinity at discharge are expected to be neglgible. The land acquisition / resettlement issue associated with the coal conveyor is addressed in the terrestrial EIA report.
    - As cooling towers are provided, the discharge waters are expected to have temperature increase of upto $5^{o}C$ above ambient. Location of the marine outfall for disposal of reject water needs to focus on impact from increased temperature and salinity concentrations than ambient.

- Handling of coal are likely to cause air quality impacts from dispersion of particulate matter
- Impacts from coal conveyor corridor construction and operation shall be negligible as pipe conveyors shall be used resulting in negligible fugitive dust emissions. Also the conveyor shall be carried out trestles with adequate clearance thereby resulting in minimum impact on ECR and Buckingham Canal. The routing is also through uninhabited areas resulting in negligible impact on socio economics.
- Construction activities causing air quality impacts are temporary, intermittent and reversible;
- Impacts on noise quality from piling and dredging operations shall be temporary and limited to the project site

***Estimation of impacts - Design***

Given the knowledge of the project setting, present environmental conditions, baseline status of the study area through previous investigations, the following assessments have been considered significant and are required to be assessed.

- Prediction of impacts on water quality from dredge dump disposal and impacts on benthic ecology at disposal site
- Accretion / erosion impacts on the coastline due to change in hydrodynamics from breakwater construction.
- Design of an appropriate location for locating the marine outfall for discharge of reject waters and withdrawal of make up water using MIKE21
- Design of diffuser configuration to ensure well mixed conditions and dilution in the vicinity (mixing zone) of the outfall using CORMIX.
- Ecological impacts due to disposal of brine and high temperature water through the outfall
- Assessment of air quality impacts from dispersion of particulate matter from stockpiles and conveyors during loading operations

Impacts on air & noise quality due to construction activities shall be short-term and cease to exist after construction is completed. While these can be considered insignificant, following assessments are required to be done to obtain a quantitative estimate.

- Air quality impacts due to transportation of construction materials during construction phase and vehicular emissions and ship emissions during the operations phase.
- Noise levels at receptor during piling and dredging operations (during construction phase).

## 6.0 BASELINE STUDY - DATA COLLECTED BY NIOT

NIOT collected primary data, by undertaking field visits and surveys to collect samples for three seasons and conduct physio-chemical and biological analyses. Current metres were deployed at three locations. Water quality was analysed at 10 locations along with sediment quality and biological characteristics.

Standard procedures were used for analysis and quality control. Sampling was conducted in season representing premonsoon during the month of June (2010), October 2010 (Monsoon season) and February 2011 (Post monsoon). The monsoon season is critical because of the possible discharges into the coastal waters comprising runoff from the upland through various creeks / water bodies

### 6.1 Water quality

The marine water quality parameters measured were pH, temperature, salinity, DO, BOD, TSS, Nutrients, Chlorophyll a, faecal coliforms etc. Ten stations (Fig.5.1) were selected for water quality sampling based on possible discharge locations, dredge dump location, hydrodynamic characteristics in the study area etc. Locations of the water quality sampling sites are given in Table 5.1. Summary of water quality parameters are provided in Table 5.2

**Table 6.1 Water, Sediment and Biological Sampling station locations**

| S. No | Sample Code | Latitude | Longitude | Classification |
|---|---|---|---|---|
| 1 | PFCWQ-1 | 12°18'41.52" | 80° 03' 26.40" | Near shore Northern boundary |
| 2 | PFCWQ- 2 | 12°18'16.10" | 80° 04' 28.34" | Offhore Northern boundary |
| 3 | PFCWQ- 3 | 12°18'22.72" | 80° 03' 9.05" | Near shore station |
| 4 | PFCWQ- 4 | 12°17'45.49" | 80° 04' 14.76" | Ofrshore station |

| S. No | Sample Code | Latitude | Longitude | Classification |
|---|---|---|---|---|
| 5 | PFCWQ- 5 | 12°17' 58.03" | 80° 02' 51.69" | Near shore station |
| 6 | PFCWQ- 6 | 12°17'29.63" | 80° 03' 53.98" | Offshore station |
| 7 | PFCWQ- 7 | 12°17' 36.65" | 80° 02' 36.60" | Nearshore station |
| 8 | PFCWQ- 8 | 12°17' 8.97" | 80°03' 40.38" | Offshore station |
| 9 | PFCWQ- 9 | 12°17'14.90" | 80° 02' 18.49" | Near shore southern boundary |
| 10 | PFCWQ- 10 | 12°16' 53.49" | 80° 03' 24.51" | Offshore southern boundary |

The southern boundary of the study area was fixed at a distance of 13.0 km north of Marakkanam coast for near shore station (PFCWQ9) and 14 Kms for offshore station (PFCWQ10) and the Northern boundary was fixed at 33 km (PFCWQ1) south of Mamallapuram coast. Samples were collected along two lateral transects viz., shallow waters (10m) and offshore (20m) during low and high tides. Following table provides summary of water quality parameters for the three seasons.

**Table 5.2 Summary of water quality parameters at the sampling locations**

| Parameters | Pre-monsoon | Monsoon | Post-Monsoon |
|---|---|---|---|
| Air Temperature (°C) | 28.1– 30.7 (29.9 ) | 29.1 -30.5 (29.8) | 28.5 – 32.0 (30.9) |
| Water Temperature (°C) | 29.1– 29.8 (29.5 ) | 28.5 – 29.9 (29.2) | 27.6 – 29.2 (28.1) |
| pH | 8.17 – 8.22 (8.19) | 8.15 – 8.20 (8.19) | 8.17 – 8.20 (8.18) |
| Salinity (ppt) | 34.2 – 36.0 (35.5) | 29.2 – 31.0 (30.5) | 33.5 – 34.9 (34.3) |
| TSS (mg/l) | 4.73 – 36.9 (15.3) | 8.32 – 18.3 (12.0) | 8.00 – 20.5 (12.2) |
| DO (mg/l) | 5.01 – 6.97 (5.94) | 5.98 – 6.93 (6.33) | 5.86 – 6.63 (6.35) |

| Parameters | Pre-monsoon | Monsoon | Post-Monsoon |
|---|---|---|---|
| BOD (mg/l) | 1.10 – 2.10 (1.61) | 1.20 – 2.10 (1.71) | 1.50 – 2.40 (1.81) |
| Ammonia Nitrogen (µg/l) | 0.43 – 0.58 (0.48) | 0.40 – 0.55 (0.46) | 0.38 - 0.53 (0.43) |
| Nitrate Nitrogen (µg/l) | 0.43 – 2.63 (1.19) | 0.90 – 2.17 (1.40) | 0.90 – 2.18 (1.40) |
| Nitrite Nitrogen (µg/l) | 0.02 – 0.13 (0.05) | 0.03 – 0.05 (0.03) | 0.02 – 0.05 (0.03) |
| Total Nitrogen (µg/l) | 10.4 – 79.7 (39.2) | 15.90 – 68.5 (52.4) | 30.1 – 57.6 (44.2) |
| Inorganic reactive phosphate (µg/l) | 0.09 – 0.55 (0.23) | 0.27 – 0.43 (0.38) | 0.13 – 0.43 (0.36) |
| Total phosphorus (µg/l) | 0.62 – 2.74 (1.47) | 1.15 -1.97 (1.60) | 1.23 – 2.08 (1.64) |
| Chlorophyll a (mg/m$^3$) | 0.57 – 2.06 (1.14) | 0.34 - 1.09 (0.88) | 0.56 – 1.76 (1.16) |
| Petroleum Hydro carbon (µg/l) | 0.56 – 1.03 (0.89) | 0.52 – 0.92 (0.69) | 0.47 – 0.72 (0.55) |
| Fecal Coliforms (CFU/100ml) | 130 – 180 (164) | 135 – 170 (154) | 130 – 180 (157) |
| Streptococcus faecalis (CFU/100ml) | 20 – 70 (54) | 20 – 60 (45) | 30 – 75 (54) |

Average value indicated within parentheses

***Heavy metals in water***

During the sampling off Panaiyurr coast it was observed that in general, heavy metal concentrations in the water were found to be low. Maximum concentration of 2.82 µg/L (manganese) was recorded at PFCWQ-3. The monsoon season recorded higher zinc concentrations than other metals concentrations. Postmonsoon samples recorded

maximum value (2.65◎g/L) of zinc at PFCWQ6 station when compared to all the other metals. It also reflects the background concentration of metal rather than human impact. In general, the sediment content also recorded maximum concentration of zinc, compared to all the metals estimated.

## 6.2 Sediment quality

### 6.2.1 Grain size

Grab samples were collected at about 102 locations within a 11km x 20 km area in a grid fashion in the nearshore and offshore locations off the Cheyyur project site. Grain size analysis of the samples was carried out in the geotechnical laboratory at NIOT. Grain size analysis indicated that the grab samples consisted predominantly of medium to fine sands with occasional silts / clays in a few locations. .

### 6.2.2 Heavy metals in sediments

In general, heavy metal concentrations in the sediments recorded low values. Maximum concentration of Cu (2.98❉**g/g**) was observed at PFCWQ3 station which may be inherent to the system in the absence of any discharges. The deposition of metals along these stations may be the contribution of coastal currents over a long period of time. .

In general, the maximum concentration of Zn (17mg/g) was observed at PFCWQ4 station during premonsoon and during monsoon peak value of Zn (0.22 mg/g**)** was recorded at PFCWQ6. The postmonsoon survey recorded maximum value (0.21 mg/g) of zinc at PFCWQ 3 & 4.

## 6.3 Biological sampling

Phytoplankton, zooplankton and macro benthos were measured for analysing the biological characteristics. A total number of 10 stations were selected for sampling for biological parameters based on location of proposed dredge dump, breakwater location and coolant water discharge location etc.

***Phytoplankton***

Analysis of phytoplankton samples are summarized as follows:

- Premonsoon season samples indicated presence of 35 species phytoplankton and the cell counts ranging from 16563 Nos./L to 24471 Nos./L along the sampling locations.
    - The diatom species *Biddulphia sinensis* showed significant presence in the total population of phytoplankton. This species belongs to rapid proliferating type in general oceanic conditions.
- During Monsoon season phytoplankton was represented by 25 species and the density varied between 10053 and 15977 Nos/L.
    - The diatom species *Biddulphia sinensis* and *Asterionella japonica* were found to be major contributer to the total population of phytoplankton during monsoon.
- During postmonsoon season, population density of phytoplankton varied between 16179 Nos./L and 20672 Nos./L and dominated by Biddulphia sinensi as well as Leptocylindrus danicus. These species belong to rapid proliferating type in general oceanic conditions.

The phytoplankton counts were higher along the near shore stations indicating possible availability of nutrients aiding the plankton growth. The diversity index scores indicated the healthy nature of the environment

***Zooplankton***

Analysis of samples for zooplankton indicates the following

- Density of the population varied from 302 to 1693 Nos./ $m^3$ during premonsoon period A total number of 18 species were recorded in the coastal waters. *Calanoid, Appendicularians, Zoea* larvae and fish eggs were the dominant forms of zooplankton recorded during premonsoon
- *Calanoids, Cyclopoids*, fish eggs were the dominant forms recorded during monsoon survey.
- The postmonsoon recorded a total of 17 species and dominated by *Calanoid, Cyclopoids, Evadne sp*. were the dominant form. The population density varied from 590 to 1464 Nos./ $m^3$ during postmonsoon season.

According to Menon 1931, periodic (Jan. to Mar.) occurrence of *Evadne sp*. along Chennai coast was recorded and the same has been reflected during the present study also. The zooplankton trend does not reflect any abnormalities.

***Benthos***

The sub tidal benthic organisms recorded moderate fluctuation of standing stock and diversity.

- During premonsoon survey the benthic population varied between 325 and 6125 Nos./$m^2$ .
- During monsoon season the variation was from 328 to 717 Nos./$m^2$.
- Postmonsoon season recorded population density variation between 455 to 6350 Nos./$m^2$

The faunal composition consisted of *Gastropods, Bivalves, Polychaetes, Nametodes* as the dominant group. The faunal composition consisted of *Gastropods, Bivalves, Polychaetes, Nametodes* as the dominant group. The population density recorded normal benthic ecosystem prevailing along the study area.

### 6.3.1 Flora and fauna

The coastal stretch along the project site is characterized by sandy beaches with sporadic distribution of spiny vegetations like *Spinifex littoreus*, and *Ipomoea sp*. Some *Casuarina* plantations (*Casuarina equisetifolia*) were also sighted. Mammals like jackals (*Canis aureus*) and domestic dogs (*Canis familiaris*) are found in this area.

While the port area is not a notified turtle nesting area by the wildlife conservator of Tamilnadu, it is reported that sandy stretches between Pondicherry to Mamallapuram coast have recorded sporadic turtle movement during the nestling season (January to March) every year. NIOT survey team visited the port area during the months of February – March to assess the port area. No eggs or turtles were located during the survey period.

## 6.4 Ambient Air Quality

The ambient air quality was monitored for three seasons.

The average $PM_{2.5}$ levels as observed at various stations in the study area ranged from 15.4 to 27μg/$m^3$. The values of $PM_{2.5}$ monitored during the field survey were well below the permissible limit of 40 μg/$m^3$ specified for industrial, residential, rural and other areas.

The average $PM_{10}$ levels as observed at various stations in the study area ranged from 32.0 to 55μg/$m^3$ during the survey conducted for various seasons. The values of $PM_{10}$ monitored

during the field survey were well below the permissible limit of 60 μg/$m^3$ specified for industrial, residential, rural and other areas.

The average $SO_2$ levels as observed at various stations in the study area ranged from 5.1 to 11μg/$m^3$. The $SO_2$ levels monitored during the field survey were well below the permissible limit of 50 μg/$m^3$ specified for industrial, residential, rural and other areas.

The $NO_2$ level monitored at various stations was below the detectable limit.

### 6.5 Noise Quality

The day time and night time equivalent noise level at various sampling stations ranged from 34.9 to 37.9 dB(A), and 29.5 to 32.5 dB(A) respectively. The equivalent noise level of all the stations were well below the permissible limits specified for residential area of 55 dB(A) for day time and 45 dB(A) for night time..

### 6.6 Vegetation in the operational areas

- The port area is about 84 acres in area, out of which 79 acres is patta dry land and 5 acres is poramboke land. Some coconut plantations of recent origin are observed in the proposed port area.
- Along the proposed conveyor corridor, there are 115 palm trees, 294 Coconut trees, 108 Cashew nut trees, 35 Mango trees, 78 Safeda trees & 400 other small trees & bushes

### 6.7 Summary of Baseline Environmental Status

Data on water and sediment quality and biology was measured by collecting data for three seasons viz., pre-monsoon, monsoon and post-monsoon to detect any possible seasonal variations. Analysis of the comprehensive field data reveals the following:

- The near shore coastal belt shows negligible variation in water quality. Beyond foreshore areas data reflects background concentrations. The area represents an environment free from anthropogenic inputs.
- Analysis of heavy metals in the water column and sediments indicate background concentrations free from anthropogenic inputs
- Biological characteristics of the site indicate significant plankton and benthic population with good diversity representing a healthy environment.

- During the site visits it was observed that the fishing villages abutting the proposed port area had about 60 small boats each for fishing operations. No trawlers were observed. These boats were landed on the beach across each of these villages.
- Site visit to the proposed project location during March 2011 indicated presence of some empty pits. No eggs or turtles were located during the survey.
- The ambient air quality for SPM (2.5 and 10 ◎g/$m^3$) and $SO_2$ and $NO_x$ are within the permissible levels for rural/residential area and represent the ambient conditions in the absence of any air pollution source
- There are negligible sources of noise generation and therefore the noise quality data represent ambient conditions. These are well within the limits for a residential area as per NAAQS.
- Landuse in the study area indicates major portion under water body (51.6%), followed by area under vegetation (22%) and area under agriculture (21.8%).
- Vegetation in the study area indicates some portions of land falling under 'reserve forest' comprising mainly of eucalyptus plantation and land area within 10 km radius comprises tropical dry evergreen forests, Tropical dry evergreen scrub and Southern Tropical Thorn forests
- Wildlife recorded in the study area comprises common species like jackals, hares, mongoose and common birds and do not comprise fauna that are endangered or endemic.
- Soil samples indicate predominant presence of fine sand with some silt and negligible clays. Subseabed profile shows that the area is devoid of hard / rocky strata.

## 7.0 PREDICTION OF IMPACTS

### 7.1.1 Air quality impacts

Impacts on ambient air quality are possible due to the following activities

- Construction material handling/ transportation of materials/ quarrying
- Construction activities including fabrication, welding, precasting
- Dispersion of particulate matter during coal handling operations and emergency storage and coal transport using conveyors
- Ship operations

The impacts on air quality during the construction phase are expected to be minimal and the ambient air quality shall remain within the permissible limits. In addition, the impacts are temporary, existing only for the period of the activity. Also, the impacts can be mitigated with simple, low cost EMPs, such as, covering trucks, checking vehicular emission compliance and masks for workers.

The proposal to transport coal from the port area to the main plant using pipe conveyors shall also not result in dispersion of fines as the entire operations is covered

### 7.1.2 Impacts of dredging

The primary water quality issue to be addressed is related to dredging. The quantity of capital dredging involved is 7.8 million $m^3$. A preliminary assessment of a dredge spoil impact was assessed by simulating the discharge of a single dredge load using MIKE21, a two dimensional hydrodynamic, sediment transport.

From the model results an area of 4km x 4km area is identified near 30m depths for dumping the dredged material. Dredging shall be carried out for over sixteen months in the channel and basin. This will result in removal of native benthic species within the dredge area. This would result in a medium-short-term-reversible impact but its environmental significance would be low because:

- Common benthic groups like copepods, nematods, polychaetes, gastropods etc are present in this location. These communities have widespread distribution not only in the proposed channel but also in all locations sampled. While during capital dredging these will be smothered, it is highly likely that these communities shall move into the rejuvenated channel and flourish; Typical example is the Ennore navigational channel and harbour area where significant increase in numbers were recorded after capital dredging was carried out.
- The channel and basin is devoid of threatened / endangered / endemic species;
- The location is not a spawning or breeding ground for fisheries was not observed in and around the project area;
- Sensitive phytoplankton like sea grasses or aquatic fauna are not present in this location;
- The area is not a significant fishing ground or feeding ground for fisheries. The fisheries in this area is confined to artesenal fishing with trawlers already having moved to offshore areas from the coast off Panaiyur

At the dredging site, the initial disturbances to benthic organisms result in smothering/death. Communities are expected to regenerate in a period of two years. The sediment analysis indicates low to average values for toxic heavy metals and shall not result in high water column concentrations due to the disturbance. The toxic metal concentrations are well within background concentrations and can be safely disposed as dredged material or as a landfill.

### 7.1.3 Impacts on fishing activities

It is expected that there will be improvement in breeding and spawning areas due to tranquil conditions provided by the breakwater. This has been observed in all harbours with breakwaters, e.g. Ennore. Eventually these fish will move out and would be available in the local areas for catch.

Restriction to fish boat movement during harbour construction is expected. Also during port operations there shall be interruption / restrictions to movement of boats due to vessel navigation. However this may be restricted to the time period of approximately half to one hour when the vessels are in movement in the navigation channel. Since only small boats and not trawlers / fishing vessels operate in the area, manoeuvring is not an issue. It is possible to manage and implement these restrictions locally. In order to improve the effort / catch, fishermen can be provided with additional infrastructure like better fish drying areas, ice plants and ice boxes for preservation. Fish processing units can be setup. The port operator can link the fishing villages with the consumer market and provide better market facilities for the fish catch.

### 7.1.4 Morphological changes to coastline due to breakwater

The results of the shoreline evolution was carried out using LITPACK module of MIKE21. Results of modelling with detached breakwaters indicates about 20 to 30m erosion at a distance of 350 m to the north of the breakwater and less than 20 m erosion at a distance of 600 m to the south of the breakwaters with some deposition in between the breakwaters.

Though, the annual net sediment transport is northerly in the order 0.19 x $10^6$ $m^3$/year, without placing any structure also, the coast is observed to be eroding (50-60 m after 1 year) in the north. This also corroborates with the IOM studies for shoreline to the north and south of Panaiyur.

### 7.1.5 Dispersion studies for cooling water discharge

The modelling illustrates that the offshore location has the capacity for handling the withdrawal and discharge of water for cooling waters.

The temperature and salinity increase within 500m from the outfall is estimated to rise by approximately 0.1$^{o}$C and 0.5 ppt respectively during non monsoon period and by 0.15$^{o}$C and 0.9 ppt respectively during monsoon period.

**Summary of estimate of impacts**

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| **Air Quality Impacts** | | |
| Generation of SPM due to construction material handling | Estimated 24-hour average SPM concentrations are within NAAQS standards of 60◎g/m$^3$ | Low and will cease to contribute pollution and construction is complete |
| Vehicular emissions during transportation of construction materials for 800 numbers/day of vehicles | The increase in the concentration of NOx, CO and HC at a distance of 500m is negligle and the overall concentrations conform to NAAQS | Regular emission checks on vehicles must be mandatory as the location is new and pristine. |
| Construction activities like precasting, fabrication, welding | - | Low; It shall be ensured that construction debris shall be cleared by contractor after completion of construction |
| Emissions from vehicular traffic during cargo handling for additional number of 2200 vehicles/day | The increase in the concentration of NOx, CO and HC at a distance of 500m is negligle and the overall concentrations conform to NAAQS | Low |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| Generation of SPM from coal stackyard | 24-hour average SPM concentrations are estimated as 0.72 ◎g/$m^3$ for D-stability class | Low impact as the coal unloading will be within hoppers thereby minimizing fugitive dust. Also the coal will be in wet condition during handling. The emergency stackyard will also have wet coal only. There will be sprinklers for keeping the coal in a wet condition. An alround green belt of 50m is proposed as a buffer zone. |
| Generation of SPM during Loading/unloading of coal | | |
| Generation of SPM during coal transport using conveyors | Closed conveyors with negligible SPM generation as in the case of Ennore shall be used. | Low impact as the conveyors are closed / pipe without any contact with the atmosphere |
| Emissions and SPM from ships berthed at the jetty | The increase in the concentration of SPM, $SO_2$, NOx, CO and HC within the jetty area is negligle and the overall concentrations conform to NAAQS | Low |
| **Noise Quality Impacts** | | |
| Capital dredging | Noise levels are reduced to background levels within 100m from the source and conforms to NAAQS. No noise sensitive receptors within 500m | Low |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| Piling operations | Noise levels are reduced to background levels within 50m from the source and conforms to NAAQS. No noise sensitive receptors within 500m | Low |
| Construction vehicle transport | Noise levels are 70 dB(A) at 200m distance from the road and the increase is found to negligible at 500m | Low |
| **Water Quality Impacts** | | |
| Water for construction and turbid runoff from construction site | Negligible, groundwater shall not be tapped. No turbid runoff due to scanty rainfall | No impact |
| Water usage by labour force and generation of wastewater | Negligible | No impact |
| Sediment resuspension, release of toxic substances and nutrients from sediments during capital dredging | Sediment suspension is negligible, since concentrations retun to background levels within 12 hours of dredging. Sediments are not toxic | Low, Dredging shall be stopped durimg spawning periods |
| **Hydrodynamics / shoreline changes** | | |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| Impact of detached breakwater construction | Accretion / erosion is negligible. Some deposition within the breakwater along shoreline observed. Gnerally stable coast as interpreted from satellite imageries over 40 years | Low as breakwater is located beyond 6m contours upto which littoral transport is predominant.<br>EMP requires dredging and bypassing of sediments deposited within the harbour area to avoid any shore connection in the long term |
| **Biology/Benthic Ecology** | | |
| Loss of benthos/biomass due to capital dreding | The site appear to be productive.<br>Recolonization is expected within 2-3 months of dredging. | No impact |
| Impacts of breakwater | It is expected that the breakwaters will provide tranquil conditions for breeding and spawning of fishes as observed in other existing breakwaters. | Positive impact in the long term |
| **Landuse / Aesthetics** | | |
| Quarrying for breakwater construction material | Removal of boulders thereby changing landforms and topography | Low when material is procured from approved quarries. |
| **Socio-economics** | | |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| Capital dredging | Temporary removal of benthos, however rejuvenation expected in 3-4 months | Temporary / Low negative impact. Low when dredging is not carried during fishery ban period. |
| Coal Conveyor | No impact on air quality as it is a closed system. Crossing of ECR shall be on trestles with adequate clearance. Crossing of Buckingham Canal shall also be on trestles thereby having negligible impact on the flow. Also it is noted that this part of the Buckingham Canal has negligible water during the various seasons in the year. The 30m wide corridor shall result in removal of some trees, however no habitations shall be affected as the alignment is planned through uninhabited areas. | Negligible impact. Appropriate afforestation plans in consultation with the forest department shall be taken up |
| Vehicular traffic | Large numbers of vehicles phying in the area for transporting materials over a period of 3-4 years | High impact limited to construction period. Impacts include accidents, air and noise pollution. Check posts and speed limits required |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| Employment | Temporary employment during construction and several employment opportunities and allied industries during operations | Positive impact |
| Fisheries | Improvement in breeding and spawning areas due to tranquil conditions provided by the breakwater. Eventually these fish will move out and would be available to the local for catch | Positive impact |
| Fishermen population | Restriction to fish boat movement during harbour construction.<br>Interruptions to movement of boats during operations due to vessel navgiation. | Medium impact Since the fishermen operate small boats and have beach landing only, the restrictions it is possible to manage locally. These restrictions would be applicable only during vessel movement in the navigational channel. Additional infrastructure like better fish drying areas, ice plants and ice boxes can be provided for preservation. Fish processing units can be setup. |

| Issues considered | Results of prediction | Level of significance with EMP |
|---|---|---|
| **Cooling water discharge – water quality & Ecological impacts** | | |
| • Pipeline Laying | • Removal of negligible quantities of benthic flora/fauna<br>• The impacts are short-term and cease after construction is complete.<br>• Pipelines shall not be routed through coral formations | • Low (limited to construction phase only) |
| • Discharge of reject water from the outfall | • Low when discharged at 10 to 14m water depths with multiport diffusers at locations specified by NIOT | • Low at a distance of 500m from the source where temperature and salinity excesses fall within the range of ambient natural variations.<br>• Since the temperature and salinity variations return to ambient conditions within 500m, impacts on aquatic ecology is LOW. |
| **Environmental Costs of Project** | Low because breakwaters are detached and is likely to result in negligble accretion / erosion; Cooling water discharges have localized impacts. Impacts of project limited to construction phase | |
| **Benefits** | Benefits to country and state are large scale power generation and employment | |
| **NET IMPACT** | Net benefits to the region | |

## 8.0 ENVIRONMENTAL MANAGEMENT PLAN

The nodal agency of Project Proponent / Operator, such as the Environmental Management Cell (EMC) must be empowered by all the agencies at the port to address pollution issues. The EMC must co-ordinate with the contractors for implementation of EMPs during the construction phase. Issues such as green belt development, vessel management; health and safety may be co-ordinated by this nodal agency thus being solely responsible for the environmental quality.

Environmental monitoring in the port area shall be undertaken by Project Proponent / Operator. Annual monitoring of air, water and sediment quality shall be carried out routinely for the port area.

### 8.1 Mitigation measures

The impacts of the various activities of the proposed development and the specific measures that need to be implemented during the design, construction and operation phases of the project form part of the implementation. Best housekeeping practices shall be incorporated in the design, construction and operation phases of the project.

Green Belt area 50m wide in four tiers is suggested for attentutation of fugitive dust. Appendix-C provides list of trees native to the port area and suggested tree plantation scheme.Density is as follows

| | | | |
|---|---|---|---|
| a) | Casurina | - 4 to 7 nos. / Sqm. | 20m wide Belt |
| b) | Euclaptus | - 4 to 5 nos./ Sqm. | 15m wide Belt |
| c) | Coconut | - 5 nos / 100 Sqm. | 10m wide Belt |
| d) | Casurina | - 4 to 7 nos. /Sqm. | 5m wide Belt |

Also wind barriers using HDPE screens are presently used for prevention of particulate matter dispersion. It can be seen that they are significantly tall to prevent particulate matter from being blow off by wind. These screens are used in some of the ports handling and storing coal. The same types of screens are suggested at the emergency stackyard at the port site of Panaiyur for minimization of particulate emissions.

#### 8.1.1 Tsunami early warning system

This site was not affected by the devastating tsunami of 2004. However the port shall have a link with the National Disaster Management Agency for early tsunami warning to plan

for evacuation and thereby minimize the damage especially to life. This would be useful in evacuating the vessels inside the breakwater to offshore locations. An organization chart with responsibilities for disaster management shall be prepared by the Port operator. There shall be a booklet with emergency numbers and addresses to contact during such events. Occasional drills for tsunami warning and mitigation shall be practised.

### 8.1.2 Operational criteria for port craft (Tugboats and mooring boats)

The tug boats will have operational constraints due to wind generated or short period waves. The limiting criteria for ordinary tugboats would be Hs<1.0-1.5 m and approximately 1.5 m for tractor tug boats. Modern mooring launches can operate at a wind speed of up to 30 knots and with a Hs< 1.0-1.3 m. Beyond the above mentioned limits the boats will face difficulty in delivering the lines from the ship to the mooring points. It is recommended that the Pilots, Tugboat Masters and crew are provided with adequate training and familiarisation prior to the commencement of operations at the proposed port facility. It is recommended that the key personnel are familiarised with the emergency procedures to deal with emergencies like engine and steering failure.

### 8.1.3 Fire fighting system for coal conveyor

The system shall be designed to give suitable fire protection for the facility based on Indian Standards or equivalent and shall conform to the provisions of the Tariff Advisory Committee's Fire Protection Manual.

The Fire hydrant system shall be designed to ensure that adequate quantity of water is available at all times, at all areas of the facility where a potential fire hazard exists. Each hydrant connection shall be provided with suitable length of hoses and nozzles to permit effective operation.

The hydrant service shall cover the entire facility, and shall have pumps, located in a common pump house. Adequate arrangement with jockey pumps, pressure switches etc. shall be provided to maintain the required pressure in the hydrant system. The operations of the Pumps provided for the system shall be automatic.

## 9.0 SUMMARY AND CONCLUSIONS

Various modelling studies carried out for determining engineering feasibility indicate the following;

- Wave heights at the berthing areas conform to tranquillity requirements specified in IS: 4651 (Part V) for bulk cargo operations.
- Wave heights at the entrance is within 1.0m for most part of the year except for one month during southwest monsoon when predicted waves range from 1.5m to 2.0m
- Results of navigation simulation studies indicate that with tug assistance manoeuvring of cape size vessels are possible.
- Capital dredging of 7.8million $m^3$ is required, while maintenance dredging is negligible (0.04 million $m^3$/year) possibly due to orientation and location of breakwaters
- Littoral transport modelling studies with detached breakwaters indicate that there is negligible accretion behind the breakwaters. Annual sand bypassing is negligible quantity is expected.

NIOT has carried out the CEIA study for the marine activities. NIOT evaluated the baseline data against known standards and criteria and have not identified any parameter that violates environmental standards mandated by the MoEF. The data also does not indicate values typically associated with anthropogenic pollution.

The project activities would result in a medium-short-term-reversible impact but its environmental significance would be low because:

1 Benthos present in this location are common groups like copepods, nematods, polychaetes, gastropods etc, which have widespread distribution not only in the proposed channel but also in all other locations sampled.

2 The proposed port area channel and basin is devoid of threatened / endangered / endemic species; Sensitive phytoplankton like sea grasses or aquatic fauna are not present in this location;

3 The location is not a spawning or breeding ground. This is not a notified turtle nesting ground even though there are occasional instances of sporadic turtle movement during the breeding seasons (Jan to March).

4 The operations of the port are restricted to offshore berths and coal transfer through closed/pipe conveyor to the main plant. The emergency stackyard is a contingency arrangement to handle emergencies only. Therefore the beach area will remain largely unaffected by the project operations and therefore will not

restrain any turtle movement (if any) in future. It should also be noted that the presence of port will provide larger protection to the coastal areas from villagers.

5 The area is not a significant fishing ground or feeding ground for fisheries. The fisheries in this area are confined to artisanal fishing Any impact to fisheries would be local and shall not affect the fisheries production of the state;

6 Dredging is expected to be straight forward as it would involve removal of soft clayey and fine sandy sediments without blasting requirement and therefore there shall be no threat to marine life

7 The impacts from increased turbidity from dredging and dumping on productivity, phytoplankton and zooplankton would have low significance due to the absence of endangered or threatened species in and around the vicinity of the channel.

8 Air quality impacts from construction activities shall be short term and reversible once construction is complete.

9 Since coal is carried through closed conveyors straight into the UMPP, generation of SPM would be negligible. Especially with present day technological developments for closed conveyors, this is justified.

10 The conveyor shall be supported on trestles at the ECR and Buckingham Canal crossings to ensure adequate clearance and negligible obstruction to water flow

11 The trees removed along the coal corridor shall be rehabilitated with the help of the Forest Department.

At the dredging site, the initial disturbance to benthic organisms shall result in smothering/death. Communities are expected to regenerate in a period of two years.

Modelling of the discharge with representative seasonal conditions and locations (for current velocity, temperature and salinity) was carried out using CORMIX and MIKE21. The temperature for the offshore diffuser reduces to 0.1$^{o}$C above ambient within 500m of the diffuser. The salinity decreases to 0.4ppt above ambient within 500m of the diffuser, which is well within the natural variation in ambient temperature and salinity values.

Results of littoral transport modelling studies for the breakwater layout indicates that there would be negligible accretion to the south of the breakwaters. The predictions indicate erosion to an extent of 25m to the south (at a distance of 600m) and at a distance of 350m north of the breakwaters with some deposition between the structures. An EMP

comprising removal of these sediments annually (sand bypassing) to the eroded areas would result in negligible shoreline changes.

Given the results of various modelling studies and environmental impact the project is acceptable with appropriate environmental management and mitigation plans.