Tamil Nadu Sustainable Urban Development Project (TNSUDP)

Environmental Impact Assessment and Social Impact Assessment for supply of TTRO water for Industries, Power plants and institutions located in Manali - Minjur Corridor, Manali-Ennore Corridor in North Chennai by Chennai Metropolitan Water Supply and Sewerage Board

Prepared by ***April 2016***

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ABBREVIATIONS

CMWSSB – Chennai Metropolitan Water Supply and Sewerage Board

CMDA – Chennai Metropolitan Development Authority

DBOT – Design Build Operate Transfer

TTRO – Tertiary Treatment Reverse Osmosis

EMP – Environmental Management Plan

DCZMA – District Coastal Zone Management Authority

TNSCZMA – Tamil Nadu State Coastal Zone Management Authority

MOEFCC – Ministry of Environment, Forest and Climate Change

MLD – Mega Liters per Day

TNUIFSL – Tamil Nadu Urban Infrastructure Financial Services Limited

TNUDP – Tamil Nadu Urban Development Project

ESMF – Environmental and Social Management Framework

FMB – Field Measurement Book

TNPCB – Tamil Nadu pollution Control Board

PPE – Personal Protective Equipments

TDS – Total Dissolved Solids

TSS – Total Suspended Solids

ROW – Right of Way

RO – Reverse Osmosis

DI pipes – Ductile Iron pipes

BOQ – Bill of Quantities

PM – Particulate Matter

BOD_5 - Biochemical Oxygen Demand (5 days)

CMA - Chennai Metropolitan Area

GRC - Grievance Redressal Committee

COD - Chemical Oxygen Demand

Hrs - Hours

O & M – Operation & Maintenance

KM - Kilometre

KW - Kilowatt

DO – Dissolved Oxygen

Lpcd - Litres per capita per day

m - Metres

mg/kg - milligram per kilo gram

MI - milliliter

MLD - Million Litres per day

MPN - Most Probable Number

RCC - Reinforced Cement Concrete

Sq.Km - Square Kilometre

STP - Sewage Treatment Plant

°C - degree Celsius

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EXECUTIVE SUMMARY

1. INTRODUCTION

Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) is a statutory responsible body for providing water supply and sewerage infrastructures for the entire city and CMA. CMWSSB has now planned to reduce the fresh water consumption of industries by reusing Tertiary treated water. CMWSSB intends to construct a Tertiary Treatment Reverse Osmosis (TTRO) plant of 45 MLD capacity at Kodungaiyur. Treated water will be supplied to the industries, power plants and institutions in Manali- Minjur Corridor, Manali- Ennore Corridor in North Chennai through a conveying main of length 28.5 km. The size of the conveying main varies from 300 mm to 800 mm. The project has been proposed under the scheme of Tamil Nadu Sustainable Urban Development Project (TNSUDP) with financial assistance from World Bank.

2. PROJECT DESCRIPTION

The proposed project involves construction of TTRO plant of 45 MLD and laying of conveying mains of length 28.5km from the plant to various industries, power plants and institutions in Manali- Minjur Corridor, Manali- Ennore Corridor in North Chennai. The total project cost is estimated as Rs. 255 Crores. The pipe line shall be laid along the berm of the road and there shall not be any acquisition of private land.

Description of the TTRO Plant:

Site Location of TTRO Plant	:	Kodungaiyur
Site Latitude and Longitude	:	13°08'49.92''N 80°15'47.68''E

The secondary treated water received under pressure will be sent to equalization tanks to reduce variation in characteristics. Pre-treatment is the first stage of treatment and consist of removal of settable suspended matters and removal of impurities. Chlorine dioxide dosing in equalization tank helps to remove organics and the elimination of micro biological growth. The equalized effluent is then routed to Rapid gravity filtration system through filter feed pumps. This filtration system will trap the

suspended solids present in the feed water. The filtered water is then routed under pressure to ultra-filtration system. The UF treated water is stored in a UF permeate storage tank to supply water to Industries and also for internal use in TTRO. Rejects & backwash from RO and UF system will be blended and disposed into Buckingham canal. It shall be ensured that the rejects stays within the prescribed limits of CPCB.

DESCRIPTION OF THE CONVEYING MAIN

An 800 mm dia DI pipeline for conveying main will be provided for a length of 19 km 600 mm dia DI pipeline for a length of 7 KM and 300 mm dia DI conveying main for a length of 2.5 Km for distributing the TTRO water to Industries in North Chennai. The proposed conveying main will be laid along the berm of the Buckingham canal road on the Buckingham canal side. The conveying main will be crossing at Buckingham canal, Ennore creek and railway lines at three locations.

Environmental Regulatory Requirements:

A review of National, State and Regional and World Bank environmental laws, rules and regulation relevant to the proposed project indicated that in addition to the safeguard policies of the Bank and construction safety requirements, the project would require CRZ clearance from MoEFCC, Government of India, approval from public works Department and Southern railway for laying conveying main.

Applicability of ESMF:

The Project proposed shall be implemented safeguarding the environmental and social concerns of the development activity. The requirements for ensuring environmental and social safeguards have been stipulated in the TNUIFSL's Environmental and Social Management Frame work exclusively prepared for TNSUDP.

3. DESCRIPTION OF THE ENVIRONMENT

A baseline survey has been conducted in and around the project during summer (March-May) 2014.

Meteorology

Meteorological data was collected during the period (January 2015 – May 2015). Wind speed, Wind direction, Temperature and Relative humidity were recorded on hourly basis. The minimum and maximum temperature during summer and winter vary

between 34.3°C and 25.8°C. High relative humidity between 67 and 85% prevail throughout the year. Higher rates of relative humidity are observed between November and January i.e., 83 to 85%.

Air Quality

Around 8 air quality locations were monitored for SO2, NOx, and Particulate matter (PM) <2.5 µm and <10µm in the study area. The observed air pollutants were within the limits as per NAAQ standards.

Water Quality

The water quality was assessed in eight locations. Based on the physic-chemical analysis, the surface water samples are unacceptable for drinking purposes.

Noise Quality

Noise levels during day time were observed during day time was found to be in the range of 50.8 to 54.8 dB (A). Noise levels observed during night time fall in the range of 41.5 to 43.6 dB (A).

Soil Quality

The soil quality was assessed in eight locations. The soil from the study area shows that the soil quality is less fertile.

Socio-Economic

A sample survey has been conducted to collect qualitative information about socio-economic environment of the area. People in the Manali & North Chennai area are mainly employed in Industries and also engaged in fishing.

Ecological Environment

Ecological survey was done to understand baseline ecological status, important floristic elements, fauna structure. As per baseline studies, there were no endangered, threatened & protected plants and animal species were recorded in the study area. Hence, no significant adverse impact was envisaged on ecology.

4. ENVIRONMENTAL IMPACT ANALYSIS

The impacts on Topography, Land use pattern and Landscape Surface / Ground Water Resources Water Quality Ambient Air Quality Ambient Noise Quality Traffic and Transport Ecology will be minimal on account of the proposed mitigation measures. The construction of conveying main shall be done in the berm of the road and the space required for construction will be 2.5m to 3m. There will be obstruction of traffic flow wherever the width of the road is very less.

Mitigation Measures

The impacts during the construction phase on the environment would be basically of transient nature and expected to reduce gradually on completion of the construction activities. Rejects from TTRO Plant shall be blended and shall be discharged into the Buckingham Canal through the existing channel. The resultant Total Dissolved Solids in the blended effluent will be around 1700 mg/l which meets the inland surface water standards prescribed by the Tamil Nadu Pollution Control Board.

Pipe carrying bridges will be proposed across Buckingham canal and Ennore Creek without affecting the water regime. Piers for the pipe carrying bridge will be constructed on suitable foundation for which Construction of coffer dams shall be envisaged for free water regime at construction site of coffer dam.

Continuous monitoring will be performed periodically to estimate the impacts in the surrounding environment and to take appropriate mitigation measures to bring down the pollution load. Laying of conveying main will be carried out in stretches so as to ensure smooth flow of traffic and safety of workers during construction phase. Proper traffic management plan shall be prepared and it shall be implemented only after the approval of the concerned authority.

5. ENVIRONMENTAL MANAGEMENT PLAN

As the project is proposed to be implemented by DBOT contractor, DBOT contractor shall adhere to the EMP envisaged in the report. However the DBOT contractor has to

obtain approval from CMWSSB before commissioning the construction activities with due care to protect the environment. The EMP cost for the project is Rs. 285 Lakhs (vide Table No. 5.7).

Environmental Management Plan for Pre-Construction Phase

S.No	Activity	Mitigation measures	Responsible agencies
1	Utility Relocation	1. Identify the common utilities to be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc 2. Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.	DBOT Contractor
2	Baseline parameters	Baseline parameters have been recorded during the EIA study and monitoring would be carried out as per plan provided.	DBOT Contractor
3	Planning of temporary traffic arrangements	1. Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works. 2. The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of wok each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen. 3. Conveying main will be laid for a length of 500m on the berm of the Kathivakkam highroad of 500 m. During construction phase there may be temporary traffic diversion. But this may be only for short duration. Necessary Barricades, sign board will be erected for the convenience of pedestrians and motorists.	--
4	Disposal of	The excess earth from excavation for conveying main shall be disposed off within the TTRO site	DBOT

	construction debris and excavated materials.	in Kodungaiyur for filling as directed by CMWSSB. Construction debris shall be disposed in suitable site identified for safe disposal, in relatively low lying areas, away from the water bodies, residential and agricultural fields etc., and got approved by the Engineer. 2. Care should be taken that dumped material does not affect natural drainage system. 3. Minimize the construction debris by balancing the cut and fill requirements. 4. All vehicles delivering material to the site shall be covered to avoid material spillage.	Contractor
5	Design Criteria	All the units of treatment plant shall be designed in such a way that it can withstand maximum load and without compromising performance. It shall be provided with stand by unit and modules for Ultra-filtration and Reverse Osmosis. The design shall take into consideration all the measures identified. Revised Environmental Management plan shall be prepared for both construction and operation period and be submitted along with the design and got approved from the engineer concerned.	Prospective Contractor

Environmental Management Plan for Construction Phase

S.NO	DESCRIPTION	MEASURES PROPOSED
		TTRO Plant
1	Preparation of Project site and Disposal of construction debris	i. Isolate the construction area with flexible enclosures/curtains so that the air emissions will not spread in the surroundings. Sprinkling of water in the construction area and unpaved roads. Proper maintenance of vehicles shall be done. ii. Minimize dust generating activities.

		iii. Cover heavy vehicles moving offsite. iv. Restrict vehicle speed on construction roads and ensure vehicles use only dedicated construction roads and access points. v. Visually monitor particulate emissions from diesel vehicles and carryout regular maintenance of equipment. vi. The top soil will be protected and compacted after completion of work. Top soil from the TTRO area will be stored in stock piles for gardening purposes and filling low-lying areas in the vicinity of the proposed TTRO plant. vii. The contractor shall identify the sites for excess amount of debris disposal and should be finalized prior to start of the earthworks; taking into account the following (a) The dumping does not impact natural drainage courses (b) No endangered / rare flora is impacted by such dumping (c) Settlement area located at least 1.0 km away from the site. (d) Should be located in non residential areas located in the downwind side (e) Located at least 100m from the designated forest land. (f) Avoid disposal on productive land. (g) Should be located with the consensus of the local community , in consultation with the engineer and shall be approved by the highways department.

		(h) Minimize the construction debris by balancing the cut and fill requirements.
2	Informatory Signs and Hoardings	The contractor shall provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required or as suggested by the Engineer.
3	Handling of waste	1. Construction is more of management. Proper estimate of material is a very first measure to minimize the undue wastage. 2. Rubbish, debris and bitumen wastes remaining after blacktop works should be cleaned and disposed off in a safe place. 3. Materials classified as chemical wastes will need special handling and storage arrangements before removal for appropriate treatment at the chemical waste treatment facility. 4. The recyclable items like metal, plastic should be sent to recyclable industry, and rest of this scrap should be stored in a covered area.
4	Safety Aspects	1. Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall confirm to the relevant Indian standards Code and shall be regularly inspected by the PIA. 2. Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. 3. Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc. 4. Welder's protective eye-shields shall be provided to workers who are engaged in welding works. 4. Earplugs shall be provided to workers exposed to loud noise, and workers working in

		crushing, compaction, or concrete mixing operation. 5. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs. 6. The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. 7. The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. 8. The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. 9. Adequate precautions will be taken for avoiding any disturbances any disturbances to any existing utility lines, if at all any present. If any damages occur to the utility line it will be rectified immediately.
5	Water pollution from construction wastes	All precautionary measures will be taken to prevent the wastewater generated during construction from entering into streams or the irrigation systems. The construction site would be provided with sufficient and suitable toilet facilities for workers to maintain proper standards of hygiene. These facilities include provision of septic tank followed by soak pit and maintained to ensure minimum impact on nearby water bodies and environment. Contaminated runoff from storage should be captured in ditches or ponds with an oil trap at the outlet.
6	First Aid	The contractor shall arrange for:

		i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone. ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital
7	Using of modern machineries	Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period.
8	Establishment of the Environmental Lab	For Monitoring of Air, Water, Noise and Soil and quality of TTRO rejects.
Conveying Main		
1	Dust Pollution near settlements	1. Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day. 2. Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage.
2	Laying of conveying main in the stretch of 300m in Kattukuppam area.	1. Laying of conveying main within stretch to be carried during noon time where there is less movement. 2. Adequate personnel will be deployed to regulate traffic movement and to ensure smooth flow wherever necessary in the stretch of Kattukuppam will be informed well in advance about laying of conveying main in stretches so that residents will not feel any inconveniences. 3. During monsoon work will be suspended temporarily. 4. Using modern machineries such as JCB's, back hoes etc. will be used to minimize the construction period.

3	Laying of Conveying main across Ennore creek	1. The pipe carrying bridge shall be constructed during non-monsoon period. 2. Supporting piers of 45 Nos. for pipe carrying bridge shall be circular in shape. 3. Piers shall be constructed parallel to the existing Ennore creek fly over 4. Supporting piers and their foundation shall not affect Ennore creek water flow.
4	Crossings at Buckingham canal near CPCL	Conveying main shall be laid through the proposed pipe carrying bridge across Buckingham canal for which necessary permission has been obtained from PWD.
5	Traffic arrangements	Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works. The traffic arrangement in Kattukuppam area is given in the above 2nd point. The construction of conveying main near Kathivakkam high school shall be carried out in such a way that it should not obstruct the flow of traffic as there is traffic congestion. The width of the road at that point is 10m, but only 3m shall be availed for construction and remaining 7m shall be provided for movement of vehicles. The construction work near the school shall be completed as quickly as possible. The conveying main will be laid using trenchless technology at the junction where the Buckingham canal road crosses Manali high road to prevent obstruction in the traffic flow. Proper traffic management plan shall be prepared and it shall be implemented only after the approval of the concerned authority. Detailed traffic plan is given in **Chapter** 6 – **Section** 6.3 & **Fig** – 6.2.

Environmental Management Plan for Operation Phase

Sl.No.	Activity	Mitigation Measures	Responsible Agencies
1	Safety measures	Safety equipments: Chlorine institute approved respiratory equipments like air masks-full face for working in leak area, canister type gas mask. ammonia torches, emergency require kit, Weather sock, Safety helmets, goggles, rubber boots, gloves and colored vests (aprons) etc shall be made available Safety plan or manual shall be prepared and got approved from the CMWSSB prior to commissioning of the TTRO plant. The safety plan should include parameters for maintenance to ensure safety, monitoring checklist, safety information etc. Surge tanks shall be provided to prevent bursting by absorbing sudden rise of pressure.	DBOT contractor
2	Energy efficiency	1. Solar energy shall be used for the street lights. 2. Pumps with Variable frequency drives shall be used in order to optimize the operating pressure of the membranes. 3. LED lamps will be used for in house lighting.	
3.	Water Environment	1. The rejects arising from the operation of TTRO will be blended with the balance secondary treated effluent of the STP in the maturation pond to bring the TDS levels within standards. 2. To avert burst in the pumping main, air relief valves (19 Nos.) will be installed at interval of 1km along the distribution pumping main.	Water Environment

		3. Supporting piers for pipe carrying bridge across Ennore creek and Buckingham canal shall be circular in shape and Coffer dams shall be constructed to provide water free regime for speedy construction and shall be removed after construction.	
4.	Safety Training and information	1. Display Charts of PFD, safety checks, maintenance procedure, etc shall be made available. 2. Emergency Action Plan shall be prepared as applicable and be made available at the site. 3. Operators shall be provided with necessary training periodically. 4. EHS guidelines of World bank shall be ensured during project implementation. 5. Hazardous chemicals used in the operation shall comply with the manufacture, storage and import of hazardous chemical rules 1989. 6. The contractor shall prepare emergency preparedness plan and emergency announcement procedures for local residents.	
5.	Environmental Monitoring	The prospective contractor shall carry out Environmental Monitoring according to the guidelines given in the **Table 5.6**	

The EMP shall be implemented by the CMWSSB of through its dedicated environmental and social safeguards specialists and will submit monthly reports on the status of compliance with ESMF requirements to TNUIFSL.

6. SOCIAL IMPACT ASSESSMENT

The project component involves the following activities:

i) Construction of TTRO plant at Kodungaiyur (45MLD) and development of roads inside Kodungaiyur STP land.

ii) Laying conveying main of length 28.5Km.

There are no encumbrances or disturbances during the construction of TTRO plant and conveying main. The construction of TTRO plant in the land owned and possessed by CMWSSB and doesn't have any social impacts, hence the proposed sub-project has been categorized as "S3" as per ESMF of TNSUDP. Necessary provisions for traffic management is given in **Chapter** 5 (Environmental Management Plan), **Table** – 5.3.

GRIEVANCE REDRESSAL MECHANISM

CMWSSB has proposed to engage project management consultants (PMC) for managing the project. The PMC will include Environmental and social specialists also as part of the team to monitor the day to day activities.

The CMWSSB has also proposed to appoint Environmental and social safeguards specialists for ensuring adoption and compliance of ESMF.

The CMWSSB will have Grievance Redressal mechanism to handle the grievances of the project.

A project level Grievance Redressal Committee (GRC) will be set up and the members are as follows (preferably one of them as women)

1) Superintending Engineer (Projects -CMWSSB)
2) Any one elected representative
3) A person who is publicly known in the local area
4) Executive Engineer (Projects- CMWSSB)

The complaints will be acknowledged to the complainant. Efforts will be made by CMWSSB to ensure closure of complaint within a maximum period of 30 days from the date of its receipt. Serious issues shall be attended as early as possible. If not satisfied

with the resolution provided by GRC, the complaints shall be handled at higher level i.e, Chief engineer of CMWSSB.

If there is any grievance, it involves a process of consultation and negotiation with the committee. The grievances relating to the problem will be recorded and each step in the resolution process also will be recorded. The elected representative will be involved in representing the issue and act as communication link between the persons involved. When the problems are identified, it will be taken to the personnel who respond and pass the information to the committee immediately. It is then the role of the committee to investigate and consult with the persons to evaluate the seriousness of the issues and work with the management to resolve the problem.

CMWSSB shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

The contact details of the Grievance Addressal Committee are given below:

Chief Engineer,
Chennai Metropolitan Water Supply and Sewerage Board
No.1 Pumping Station Road, Chindatripet,
Chennai – 600 002.
Phone No: 28451300

To register complaints, contact the following phone number:
Phone No: 45674567

To register complaints through internet, visit the following link:
http://www.chennaimetrowater.tn.nic.in//services/complaint.htm

7. PUBLIC CONSULTATION

As per the World Bank policy on access to information and disclosure, the proposed project attracts Public Hearing. The Public Hearing was arranged by the Chennai Metropolitan Water Supply & Sewerage Board. Information on Public Consultation is given adequately to the Public by means of notice, personal contact, etc. Views expressed in the Public Hearing are for early implementation of proposed project.

8. IMPLEMENTATION OF THE PROPOSED PROJECT AND INSTITUTIONAL ARRANGEMENTS AT CMWSSB

The proposed project involves construction of TTRO Plant of 45 MLD and laying of conveying main of 28.5 km from the TTRO Plant and various industries in the Manali industrial area and in north Chennai. This project will be implemented by CMWSSB under the scheme of Tamil Nadu sustainable urban development project (TNSUDP) at an estimating cost of Rs.255 Crores.

The environmental management plan identified for the construction will be included in the bid documents for ensuring implementation of the environmental safeguards. The management measures identified for the operation phase will be taken up by the CMWSSB upon completion of construction activities.

Project Management Consultant (PMC): CMWSSB has proposed to appoint project management consultants (PMC) for managing the project. Environmental and social specialists also will form part of the team of PMC for ensuring adoption and compliance of ESMF. PMC shall submit monthly ESMF compliance report to CMWSSB for the project.

CMWSSB shall submit monthly reports to TNUIFSL on the status of compliance with the ESMF requirements.

9. PROJECT BENEFITS

The proposed project aims at treating the secondary treated water suitable for industrial use. Reduction of fresh water consumption by industries and more fresh water shall be made available for potable use in the city. The project will also be able to meet the industries increasing fresh water demands in future.

1. INTRODUCTION

1. 1 PREAMBLE

Chennai Metropolitan Area (CMA) spread over an area of 1189 sq.km and comprises of Chennai City, Municipalities, Town Panchayats and Village Panchayats comprised in Panchayat unions and one cantonment namely St. Thomas Mount. The city population as per the 2011 census was about 4.646 million and that of the Chennai Metropolitan area was 8.653 million. Rapid urbanization is taking place not only in the city but also in the surrounding urban local bodies (ULBs), Municipal areas, and Town Panchayats: Due to this rapid urbanization, it warrants for providing essential infrastructures such as road, street lights. EB-cables, water supply, sewerage and solid waste disposal etc., Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) is a statutory responsible body for providing water supply and sewerage infrastructures for the entire city and CMA. Though its present operation is limited to the Greater Chennai Corporation Cit y limit, the Board is extending its services to entire CMA according to the need in phased manner.

Urban development schemes in the notified areas are governed by the Master plan of **Chennai Metropolitan Development Authority (CMDA)**. The respective Local Bodies are responsible for the infrastructural facilities. Chennai Metropolitan Water supply and Sewerage Board (CMWSSB) is the authorized agency to provide water supply and sewerage -facilities to some of the Local Bodies around Chennai in the CMA and, also in areas of CMWSSBs jurisdiction. Chennai city sewerage system comprises of 12 Sewage Treatment Plants (STPs) which are located at Kodungaiyur (3 Nos-270 MLD), Koyambedu (3 Nos- 204 MLD), Nesapakkam (3 Nos-117 MLD) and Perungudi (3 Nos-126 MLD).

1.1.1 Expansion of City Limit

The city limit was expanded in the year 1978 by adding erstwhile 15 Panchayats adjoining the City and extended to an area of 174 sq. km. CMWSSB covered of providing water supply and sewerage infrastructures to the entire city since its formation in 1978. Such infrastructures now being provided by the urban local bodies are insufficient.

Hence, it was felt essential to expand the city by annexing the deserving urban local bodies contiguous to the Chennai City.

In view of the above, the Government vide G.O. (Ms) No: 256, MA&WS (Election) Department, dated 26.12.2009 expanded the City by adding 9 Municipalities, 8 Town Panchayats and 25 Village Panchayats. The extent of the expanded City limit is 426 sq.km. As directed in G.O. the basic activities such as zoning the area based on the population etc., have been carried out for formation of new city by the Corporation of Chennai.

1.1. 2 Status of Implementing Water Supply Schemes in the Expanded City limit

CMWSSB is already implementing water supply schemes in few Local Bodies (LBs) in Chennai Metropolitan Area under JNNURM etc., and they are in various stages of completion.

1.1. 3 Source of Water Supply

The main source of water supply to the Chennai city is from surface water sources such as Poondi, Cholavaram and Red hills reservoirs and also from ground water sources from Araniar and Kosasthalaiar basin. Chennai city does not have any perennial source of water. The water supply has been augmented by Krishna Water Supply scheme with supply of water from the State of Andhra Pradesh and by Chennai Water Supply Augmentation Project with supply of water from Veeranam Tank.

A desalination plant of capacity 100 MLD is commissioned recently near Kattupalli village, Minjur. Another 100 MLD capacity desalination plant is at Nemmili at the southern outskirts of Chennai.

1.1.4 Sewerage System of Chennai

The Sewerage System for Chennai City has been divided into 5 drainage zones. These zones of macro systems covering the entire city have independent zonal collections conveyance, treatment and disposal facilities. There are 12 plants in Chennai city having a total treatment capacity of 612 MLD. Details of STPs available in Chennai is given in the below

Table 1. 1 - Availability of Treated Effluent with STP Details

S.No	Location of STPs	Existing Capacity (in MLD)	Remarks
1	Zone I & II at Kodungaiyur	270	
2	Zone III at Koyambedu	214	
3	Zone-IV at Nesapakkam	117	
4	Zone-V at Perungudi	126	18 MLD under construction
Total		727	

1. 2 NEED FOR THE PROJECT

M/s. Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) plans to reuse the sewage generated in the city for industrial use thereby reducing the fresh water consumption by the industries operating in the vicinity of the Chennai metropolitan area as there is no alternative reliable source of fresh water adjacent to the city and also to ensure a sustainable water source to the industry.

1.2. 1 Need for the Environmental Assessment Study

Rapid urbanization has resulted in a significant impact on the environment. All the concerned authorities have realized that development cannot be sustained unless the environment is protected. Therefore, most of the governments in the world have made it mandatory for project developers to carryout Environmental Assessment (EA) of their development project(s) and prepare Environmental Management Plans (EMPs) so that the environmental quality is protected.

ENVIRONMENTAL CATEGORIZATION

The proposed project of providing TTRO plant falls under "**E1**" category of the Environmental and Social Management Framework of TNSUDP and hence environmental assessment is to be carried out, and necessary management measures are to be prepared for implementation.

1. 3 SCOPE OF THE STUDY

- To assess the effect on Land, Air, Water and Noise environment and measures proposed and to take mitigation measure for any adverse effects.
- To assess impact on wildlife (including birds) habitat in project area, if any; Assessment of impact on flora and fauna which would possibly be affected by the project and to suggest plans for their conservation.
- To collect available water quality data; observe and analyze water quality at the project area and to collect information on known pollution sources in the area
- To evaluate the impact of the project on public health, quality of life etc. during construction and after commissioning of the project.
- To assess impact on human settlements in project area, if any. To assess impact of project on existing and proposed infrastructure including roads and to identify measures for overcoming the same.
- Analysis of Census data for demographic profile.
- Construction and operational phases identifying mitigatory measures.
- Prepare sound Environment Management plan (EMP) outlining additional control technologies to be adopted for mitigation of adverse impacts, if any.

1. 4 METHODOLOGY

Any development activity in general is expected to cause impacts on surrounding environment at the project site during its implementation and operation phases, which can be both positive and negative. The nature and intensity of impacts on different components of environment depend on the type of project activities and geographical conditions of the study area. The impacts of the project activities on environmental components are quantified through Environmental Assessment (EA) studies within the impact zone of the project activities. The Results of EA studies form the basis for the preparation of a viable EMP for mitigation of the adverse impacts. The EA studies for the underground sewerage system deals with detailed studies for the various environmental components viz. air, noise, water, land, biological and socio-economic environment.

1. 5 STUDY AREA

a. TTRO site:

The EIA study encompasses the area within 10 km radius of the proposed TTRO Plant project. For the preparation of EIA report for the TTRO Plant, the baseline data was collected during summer period 2014. The micro climatic parameters were recorded using automatic weather monitoring station for the study period. Wind speed, wind direction and relative humidity were recorded on hourly basis. Minimum & Maximum temperatures were also recorded during the study period.

b. Conveying Main:

The conveying main will be laid along the Buckingham canal road owned by Public Works Department on the Buckingham canal side and across Ennore creek. Width available for laying the conveying main along Buckingham canal is more than 1.5m will be sufficient and complies with the norms of CMWSSB. The conveying main consists of 800 mm dia DI pipeline for a length of 19 km 600 mm dia DI pipeline for a length of 7 KM and 300 mm dia DI conveying main for a length of 2.5 Km for distributing the TTRO water to Industries in North Chennai. Moreover the proposed conveying main will be laid below ground level; hence there is no disturbance to the existing overhead electric lines. The conveying main will be laid in such a manner that there won't be any possibility of cross connection either with the sewer line or water line. The conveying main will be taken on a separate dedicated pipe carrying bridge at cross section 'C' as indicated in **Figure 2.8**.

1. 6 COMPONENTS OF THE STUDY

a) Air Environment

The description of the existing air environment in and around the proposed project site is based on actual monitoring during summer 2014.

b) Noise Environment

The baseline noise levels in and around 10 km radius of the proposed Project Site were established as per the Noise Pollution Level (Regulation and Control) Rules, 2000 in line with the Ambient Air Quality monitoring stations.

c) Water Environment

The baseline water environment in and around 10 km radius of the proposed Project Site were established in line with the ISO 19001 Standards. Buckingham canal and Ennore creek are the water bodies which are very close to the alignment and thus they are also considered for the study.

d) Land Environment

Soil samples were collected from the project site, not only at its immediate vicinity but also in the surrounding villages in the study area. Physico-chemical properties of the soils were determined; information on land use pattern in the study area was also collected. The proposed TTRO site is located in the Sewage treatment plant area of CMWSSB in Kodungaiyur.

e) Ecosystem

Information on eco-system within the study area was collected from the State Agricultural and Forest departments. The important floral species native to the project area is enumerated and discussed in the Chapter 3. A physical survey was also undertaken to validate the correctness of the data collected.

f) Socio-Economic Environment and Occupational Health

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

1. 7 STRUCTURE OF THE REPORT

The report is structured as below.

- **Chapter 1 - Introduction,**
- **Chapter 2 - Project Description,**
- **Chapter 3 - Description of Environment,**
- **Chapter 4 - Environmental Impact Analysis**

- **Chapter 5 – Environmental Management Plan**
- **Chapter 6 - Socio Impact Assessment Report**
- **Chapter 7 – Public Consultation**
- **Chapter 8 - Implementation of the Proposed Project and Institutional Arrangements at CMWSSB.**
- **Chapter 9 - Project Benefits.**

2. PROJECT DESCRIPTION

CMWSSB has proposed a TTRO Plant of capacity 45 MLD at kodungaiyur and supply of treated water to industries, power plants and institutions located in Manali-Minjur Corridor, Manali-Ennore Corridor in North Chennai through conveying main of length 28.5 km. It will be laid along the Buckingham canal side of the Buckingham canal road and across Ennore Creek. The conveying main will be laid on pipe carrying bridge across Buckingham Canal and Ennore Creek.

Project Components

a) TTRO Plant at Kodungaiyur (45 MLD)
b) Conveying main of length 28.5 km.

Salient details of the TTRO plant and the conveying main is as follows:

2. 1 SALIENT DETAILS OF TTRO PLANT AND CONVEYING MAIN

TTRO PLANT

Feature	Details
Site Location	Kodungaiyur
Site Latitude and Longitude	13°08'49.92''N 80°15'47.68''E
Topography	Barren land
SOI Topo sheet	66 C/4 and 66 C/8
Above Mean Sea level in m	6 m
Population of the project village	Kodungaiyur total population- 41617
Surrounding Villages (2 Km Radius)	Kodungaiyur, Manali, Kaviarasu Kannadasan nagar, Thiruvottiyur, Chinna sekkadu and Sathangadu
Nearest City	Chennai
Nearest Town	Thiruvottiyur
Nearest Highway	Tondaiyarpet High Road (1.5 Km)- South Manali High Road (2 Km)- North East
Nearest water bodies	Buckingham Canal at a distance of 2 Km from

	the Site boundary of the TTRO plant (W) Kosasthalaiyar River- at a distance of 7 Km from the Site boundary (N) Ennore Creek – 10.1 km (NE)

CONVEYING MAIN

S. No.	Selection Criteria	Details
1.	Topography	Barren land
2.	Nearest Water bodies	• Conveying main will be laid along the Buckingham canal side and across Ennore creek • Bay of Bengal-2.17 km - E • Kanniyamman pettai Lake-5.89 Km – W
3.	State, National boundaries	NIL
4.	Nearest Highway	• Ennore high road – 459m - E • Kathivakkam high road -387m - E
5.	Defense installations	NIL
6.	Densely populated or built-up area	• Ennore – 1.8 Km – NNE • Manali new town – 4.22 Km - WSW
7.	Archeologically important places	NIL
8.	Reserved Forest	NIL
9.	National Parks / Wildlife Sanctuaries	NIL
10.	Earthquake zone	Zone III

2. 2 PROJECT LOCATION

Figure 2. 1 - Satellite imagery of the project site

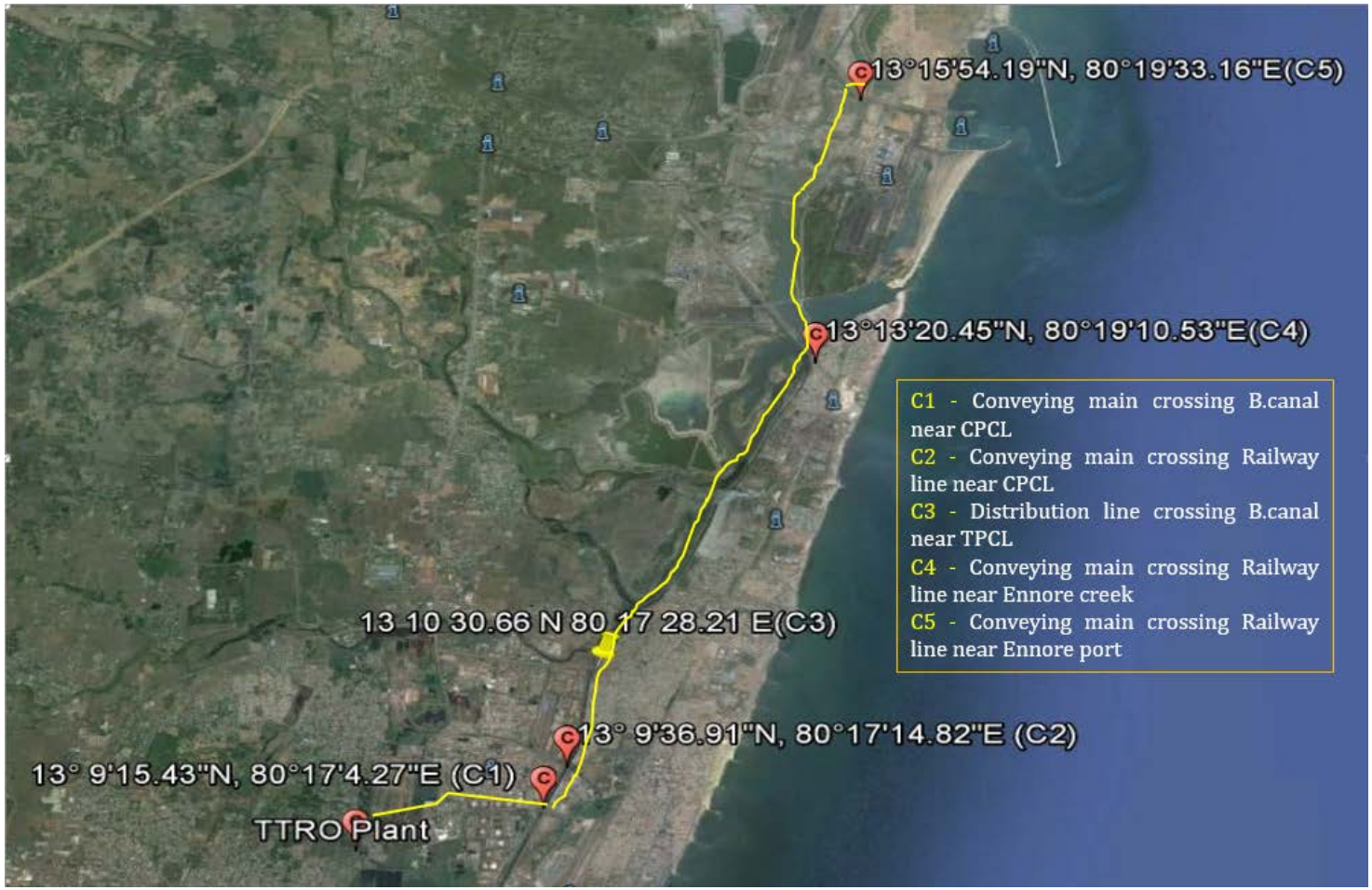


Figure 2. 2 - Location of Conveying Main

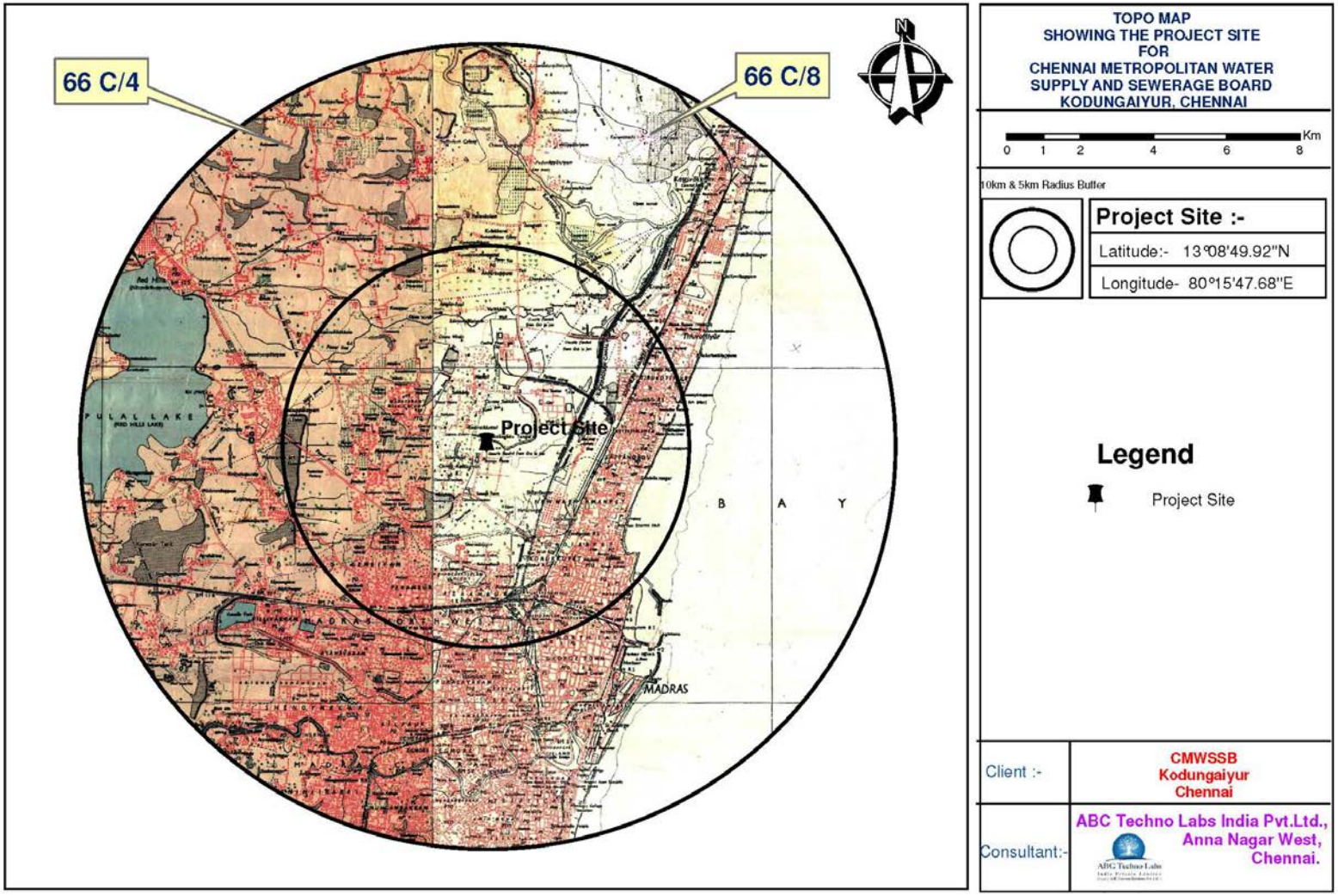


Figure 2. 3 - Topo map (10 Km Radius)

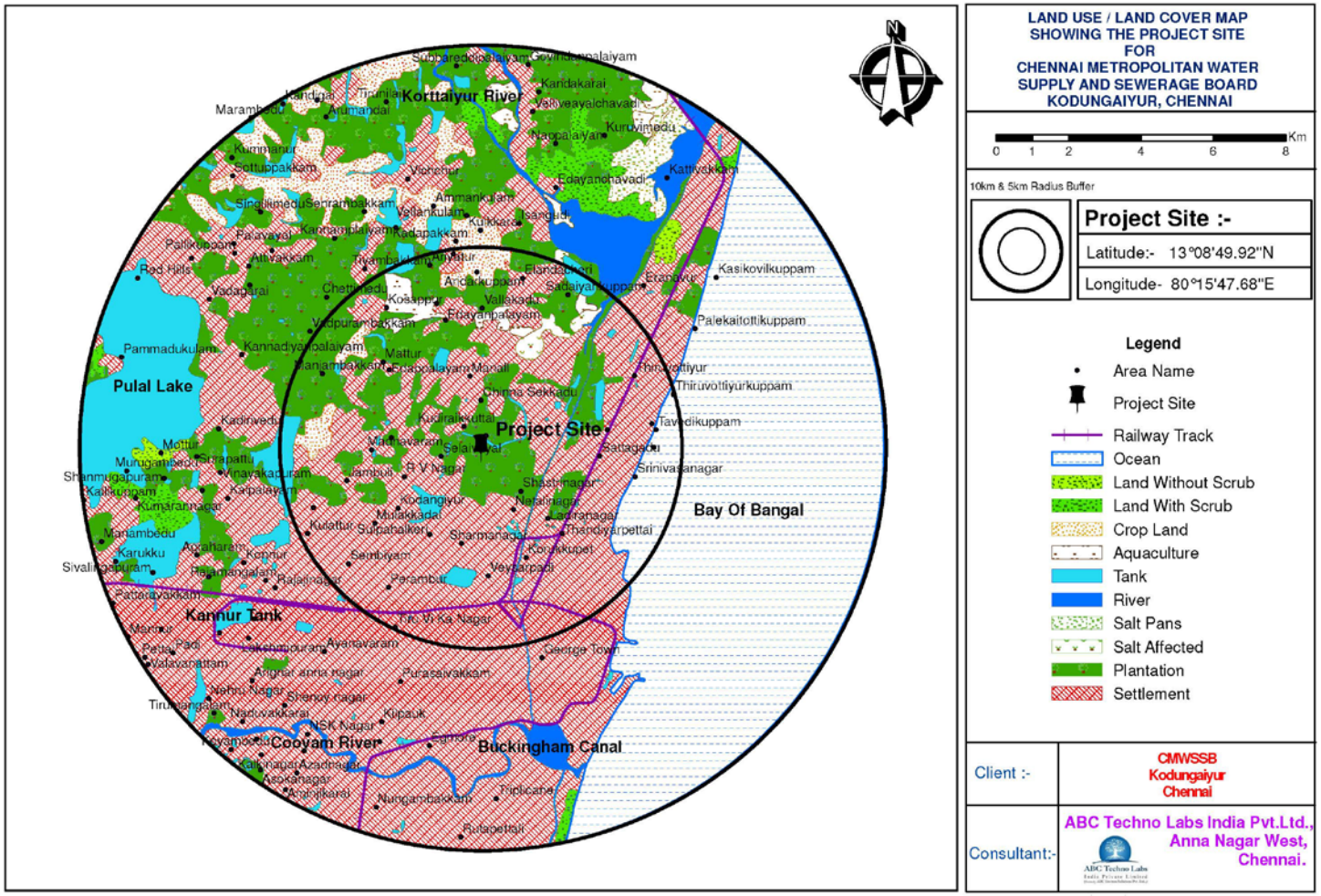


Figure 2. 4 – Land use map (10 Km Radius)

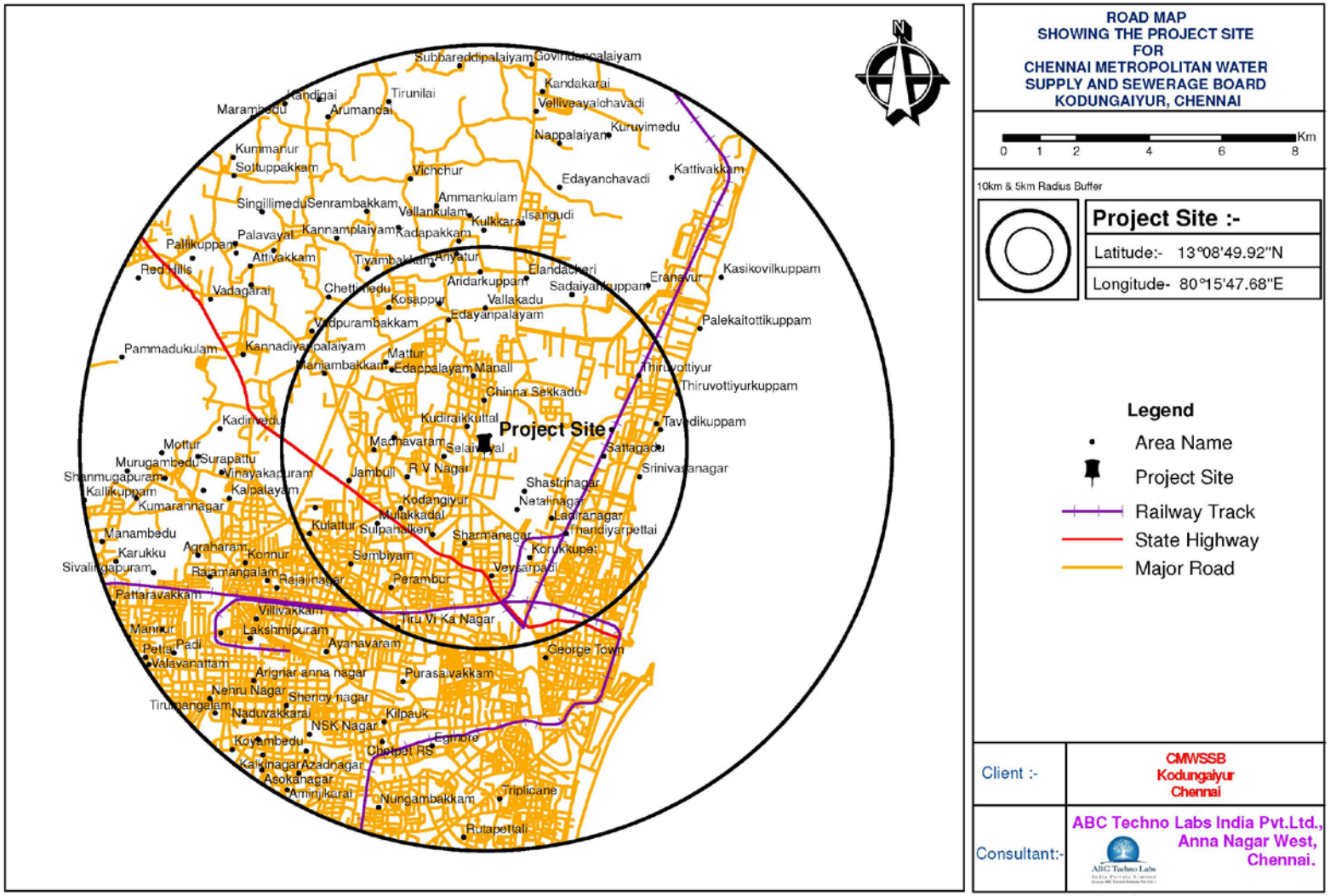


Figure 2. 5 - Road network map

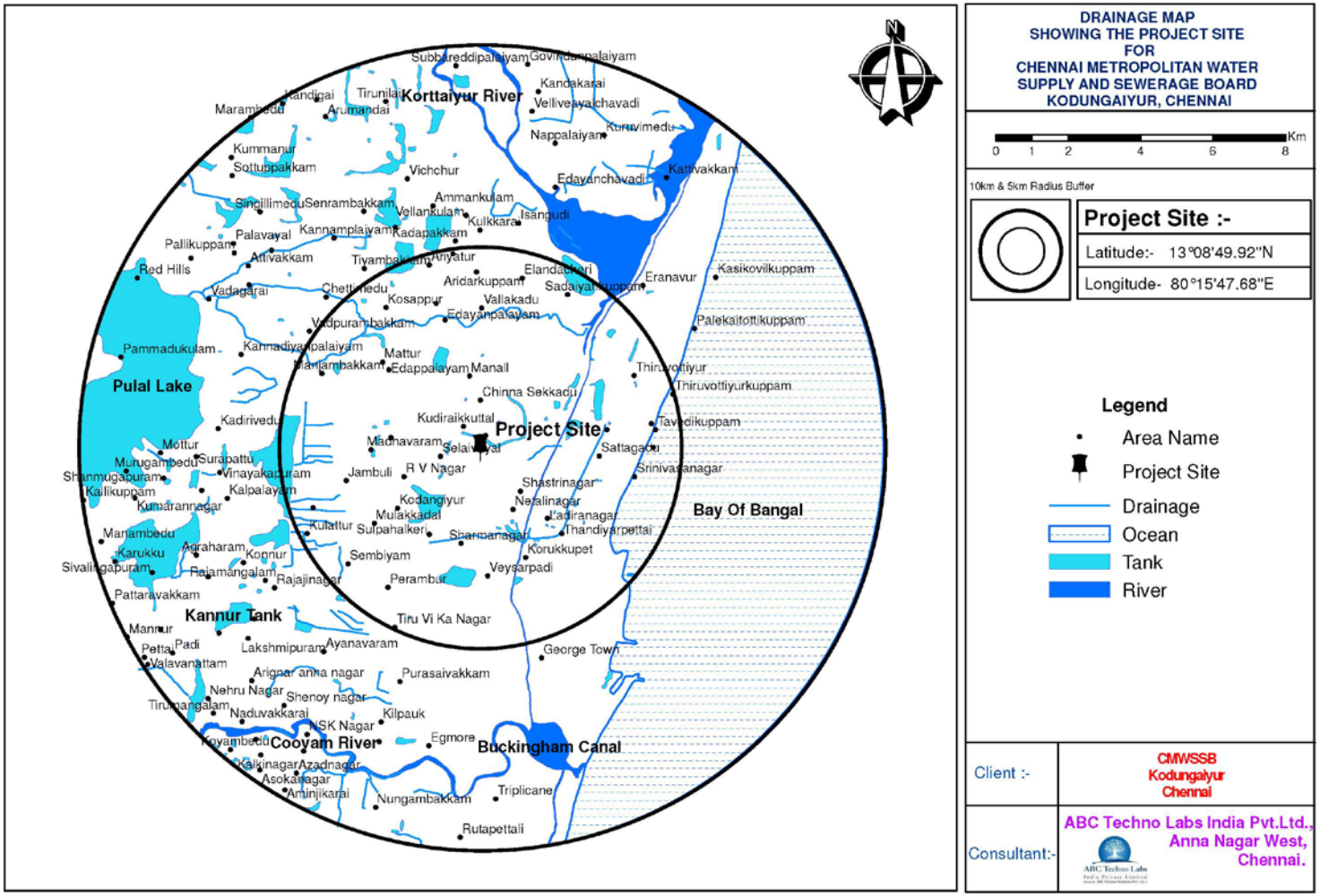


Figure 2. 6 - Drainage pattern Map

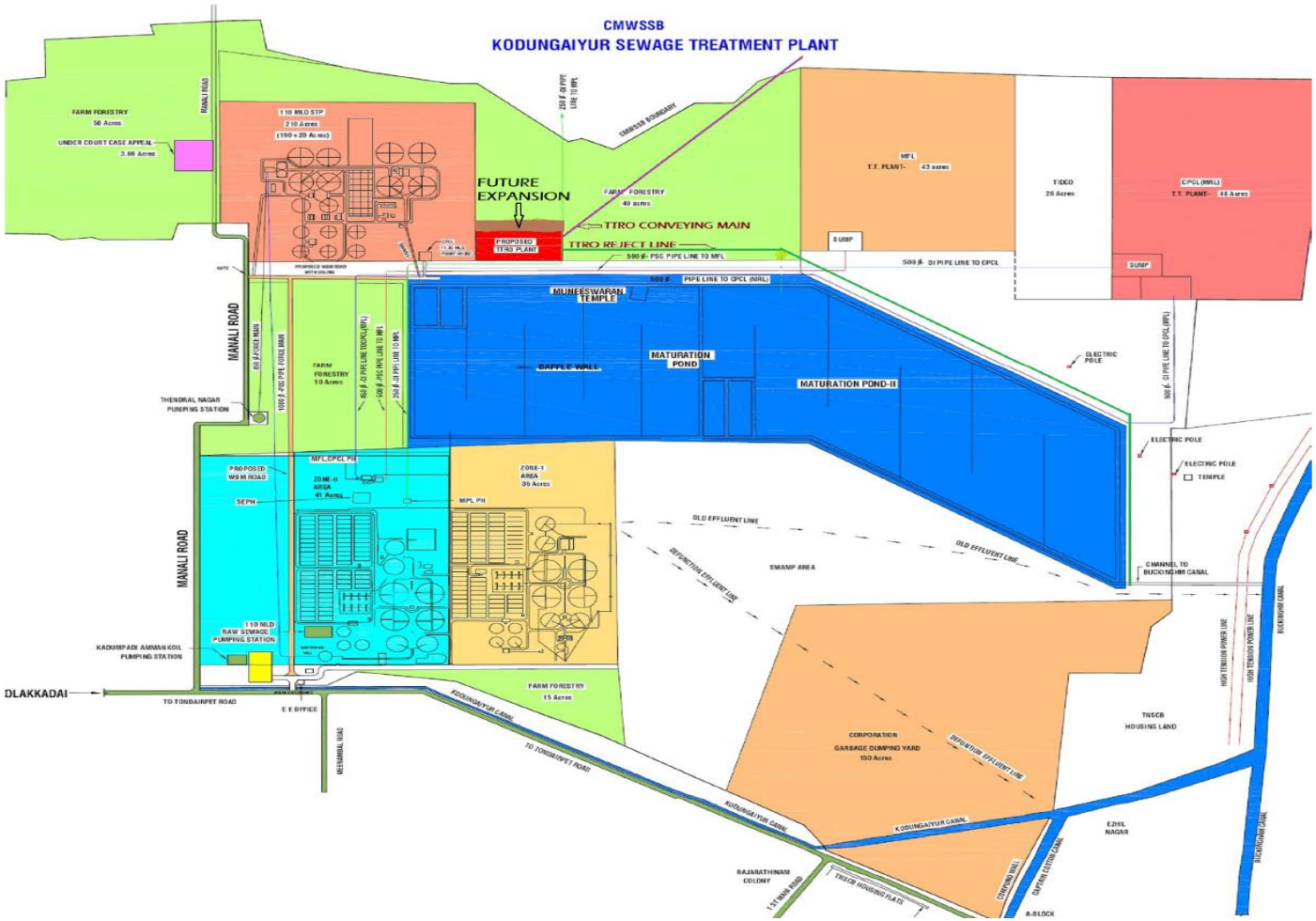


Figure 2. 7 - Site Layout

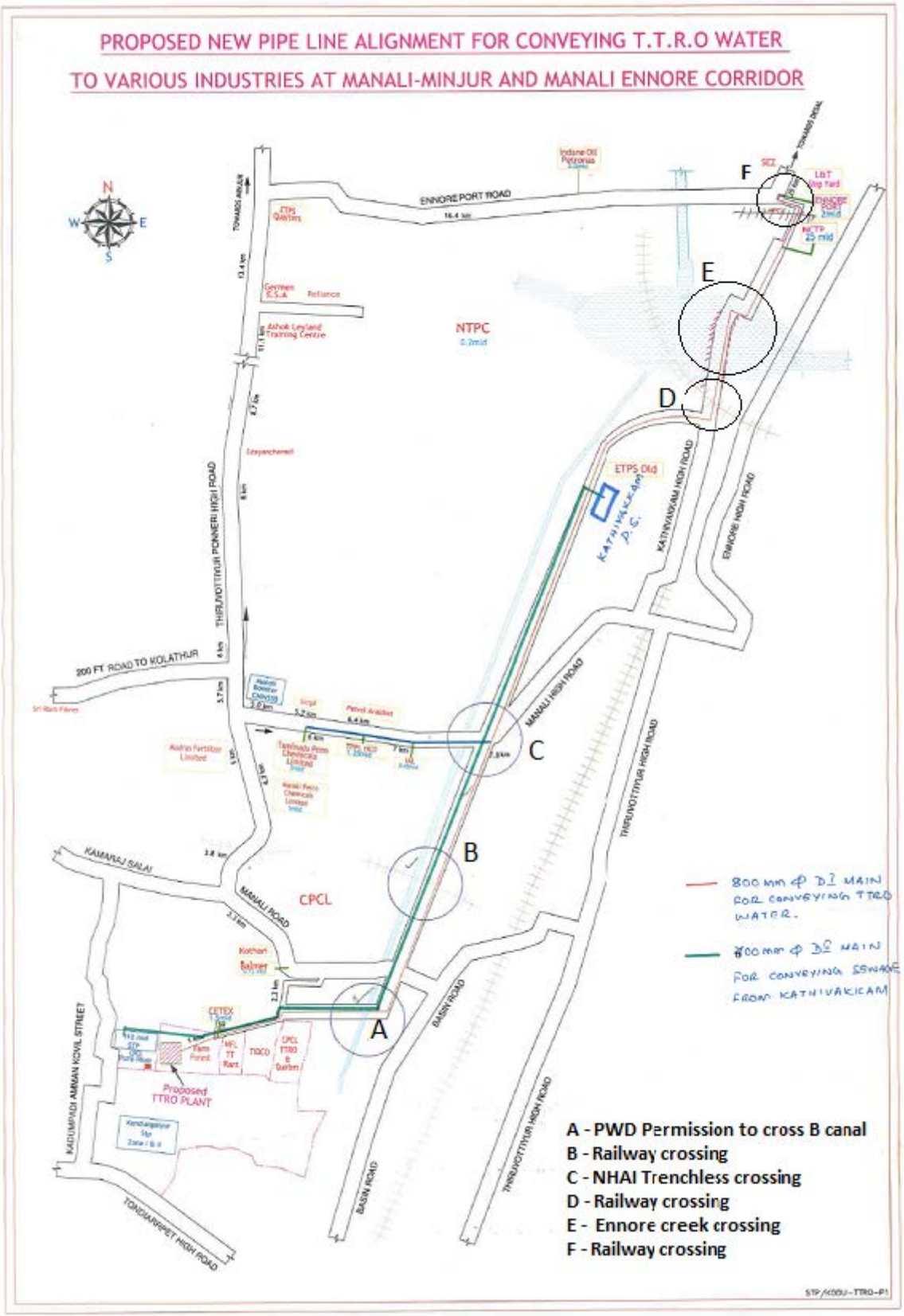


Figure 2. 8 – Details of Crossings of the Conveying main

2. 3 KODUNGAIYUR SEWAGE TREATMENT PLANT

The Sewage Treatment Plant at Kodungaiyur is located on the northern periphery of Chennai. The sewage collected in North Chennai and part of Central Chennai is being treated as per Pollution Control Board norms in the 3 sewage treatment plants viz., **Zone I (80MLD), Zone II (80 MLD) and 110 MLD** plant and the effluent is discharged into Buckingham Canal. The co ordinates of the discharge line are as follows;

S.NO	POINTS	CO ORDINATES
1	Site boundary	13º 08' 31.39'' N 80º 16' 11.95'' E
2	Blending point	13º 08' 28.30'' N 80º 16' 15.19'' E
3	Discharge point	13º 08' 8.884'' N 80º 16' 34.514''E

The Kodungaiyur STP covers an area of about 739 acres with farm land consisting of Coconut, Palm & Eucalyptus trees.

The CMWSS Board has taken up the initiative of supplying secondary treated sewage from Kodungaiyur Sewage Treatment Plant to the Industries at Manali to the tune of 36 MLD. Power is generated in the 110MLD capacity sewage treatment plant through Bio-Gas Engine by which about 11,000 Kwh per day is being produced from the year 2006 and utilized for the operation of sewage treatment plant. Hence the drawl of power from the TNEB grid is minimized. About 55mld sewage each is being treated at Kodungaiyur STPs Zone I & II and around 90 MLD in 110 MLD STP.

2.3.1 Demand & Assessment of TTRO Water

Demand assessment from industries in North Chennai city was The entrusted to M/s ITCOT Consultancy and Services Ltd and after a detailed survey of the industries in Manali -Ennore corridor, Manali - Minjur corridor. The consultants have furnished the anticipated water demand for 2015, 2020 & 2030. This is prescribed in the below table.

Table 2. 1 - Demand of TTRO water

S.No.	Corridor/Company	Demand in 2015 (MLD)			Demand in 2020 (MLD)	Demand in 2030(MLD)
		Diversion from current consumption	Additional demand from existing consumers	Total		
A	Manali-Ennore Corridor					
i)	TPL	3.00	0	3.0	**3.00**	**3.00**
ii)	Ennore Port Limited	1.00	0.50	1.50	**2.00**	**2.00**
iii)	TPPL HCD	1.35	0.00	1.35	**1.35**	**1.35**
iv)	Southern Railway (Manali)	2.0	0	2.0	**2.00**	**2.00**
v)	CETEX	0.26	0.64	0.90	**1.50**	**1.90**
vi)	KPCL	0.31	0.03	0.34	**0.34**	**0.34**
vii)	IAL	0.15	0	0.15	**0.45**	**0.45**
viii)	Balmer Lawrie & Co.,	0.12	0	0.12	**0.12**	**0.12**
ix)	GMR Power	0	0	0	**2.50**	**2.50**
x)	Others	2.47	0.00	2.47	**3.86**	**3.90**

S.No.	Corridor/Company	Demand in 2015 (MLD)			Demand in 2020 (MLD)	Demand in 2030(MLD)
		Diversion	Addition	Total		
	New Projects					
xi)	Indo Rama Petro Chemicals	0	0	0	20.0	20.0
xii)	Plastic Park	0	0	0	2.20	2.20
xiii)	L&T Shipping	0	0	0	2.00	2.00
xiv)	Others	0	2.81	2.81	3.32	7.88
	Total (A)	**10.66**	**3.98**	**14.64**	**44.64**	**49.64**
B	**Manali-Minjur Corridor**					
i)	NCTPS	3.96	11.04	15.00	25.00	25.00
ii)	NTPC TECL	0.12	0.00	0.12	0.12	0.12
iii)	Indian Oil Petronas	0.24	0.00	0.24	0.24	0.24
	Total (B)	**4.32**	**11.04**	**15.36**	**25.36**	**25.36**
	Total (A + B)	**14.98**	**15.02**	**30.0**	**70.0**	**75.0**

2. 4 PROJECT COST

The estimated cost for construction of 45 MLD capacity Tertiary Treatment Reverse Osmosis Plant at Kodungaiyur is prepared based on the prevailing market rates for Electrical and Mechanical works and the CMWSS Board schedule of rates for the year 2013-14 for civil works. The total project cost worked out to Rs. 255 Crores including provision for charges payable to Tamil Nadu Electricity Board for getting Electricity connection, provision towards Value Added Tax, Service Tax, and Tamil Nadu Construction Labour Welfare Fund.

2. 5 LAND

2.5.1. 45 MLD TTRO Plant

The site houses three sewage Treatment plants. Staff quarters, Form forest and IT Plant in 491 Acres of land out of the available 601 Acres of land. The proposed 45 MLD capacity TTRO plant is to be constructed near maturation pond, in an extent of 10 Acres. The rest of the 103 Acres is reserved for future expansion of sewage treatment plants. The land proposed for construction of 45 MLD Tertiary Treatment Reverse Osmosis Plant belongs to CMWSS Board and no land acquisition and cost is involved.

Table 2. 2 - Land requirement for TTRO Plant

Sl. No	Details of Location	Measurement (Acres)
1)	Land requirement for 45 MLD TTRO Plant at Kodungaiyur	7
2)	Land requirement for Future expansion of TTRO Plant at Kodungaiyur	3
	Total	10

2.5.2 Treated water conveying main

It is proposed to construct a collection sump with pump-sets suitable for conveying the 45 MLD of TTRO water to industries initially and 60 MLD of TTRO water latter during 2030. A 800 mm dia DI pipeline for conveying main shall be provided for a length of 19

km 600 mm dia DI pipeline for a length of 7 KM and 300 mm dia DI conveying main for a length of 2.5 Km for distributing the TTRO water to Industries in North Chennai. In addition, a separate 1 1kv/440v sub-station with a transformer and with standby D.G shall be provided to operate the pumping equipments to pump the TTRO water. Location of the sub-station will be within TTRO plant premises at appropriate location as per the decision of CMWSSB and DBOT contractor.

Pipeline will be laid along the berm of the road and thus does not require any private land acquisition.

Table 2.3 - Land Ownership of the roads for the Proposed TTRO Conveying main

S.No	Location	Size of Main (mm)	Start Chainage	Final Chainage	Length (m)	Right of way Available	Regulatory Authority	Approval Status	CRZ Requirement
1	Inside Kodungaiyur STP Land						CMWSSB's Own Land	Not Applicable	-
	Disposal line	800	0	5500	5500	1.5m		Application for discharge of rejects into B canal is submitted	CRZ II
2	MFL & CPCL TT Plant Road	800	5500	7225	1725	1.5m	MFL&CPCL	Application is submitted	Nil
3	B' Canal Crossing	800	7225	7325	100	1.5m	PWD	Approval obtained	CRZ – II
4	IOCL Road	800	7325	7425	100	1.5m	Corporation of Chennai	Approval is in process	CRZ-II

5	Highways Crossing Manali Road	800	7425	7450	25	1.5m	National Highway	Approval is in process	CRZ-II
6	PWD 'B' Canal Road	800	7450	8150	700	1.5m	PWD	Approval is in process	CRZ – II
7	Railway Crossing	800	8150	8175	25	1.5m	Southern Railway	Approval obtained	CRZ – II
8	PWD 'B' Canal road	800	8175	9885	1710	1.5m	Govt. of India	Approval obtained	CRZ – II
9	Highways Crossing Basin Bridge - Manali Road	800	9885	9915	30	1.5m	State Highway (Gov. of TN)	Approval obtained	CRZ – II
10	PWD 'B' Canal Road	800	9915	15950	6035	1.5m	Govt. of India	Approval is in process	CRZ – II
11	Kathivakkam High Road	800	15950	16035	85	1.5m	State Highway (Gov. of TN)	Approval is in process	CRZ – II
12	Railway Subway Crossing	800	16035	16060	25	1.5m	Southern Railways	Approval is in process	CRZ – II
13	Kathivakkam High Road	800	16060	16450	390	1.5m	State Highway (Gov. of TN)	Approval is in process	CRZ – II
14	Ennore Creek	800	16450	17300	850	1.5m	--	--	CRZ I
15	Highways Road (Upto NCTPS)/ Beach - Ennore Port Road	800	17300	19000	1700	1.5m	State Highway (Gov. of TN)	Approval is in process	CRZ II
	Total (800mm)				**19000**				
16	Old Ennore port road (NCTPS to	600	19000	21300	**2300**	1.5m	NCTPS	Approval is in process	CRZ II

	Ennore Kamarajar port)								
17	L&T Port Road	600	21300	26000	**4700**	1.5m	State Highway (Gov. of TN)	Approval is in process	CRZ II
	Total (600mm)				**7000**				
18	Highways Road Basin Bridge - Manali Road	300	0	2500	**2500**	1.5m	State Highway (Gov. of TN)	Approval is in process	Nil

Permission for laying conveying main in the right of way of the existing roads in National High ways and railway crossing near CPCL and PWD road have been obtained from the concern authorities as detailed in the **Table 2.3**. Approvals for laying the conveying main along the National Highways Authority, Public Works Department, Government of Tamil Nadu, crossing across Railway line from Southern Railway are given in **Annexure II.**

A pipe carrying bridge will be constructed during non-monsoon period. The pipe carrying bridge will be supported on piers without affecting water flow. The proposed pipe carrying bridge will be constructed on the downstream side of the Ennore Creek Flyover. Hence no negative impact is anticipated.

STRUCTURES ACROSS ENNORE CREEK

Foundation for pipe carrying bridge will be accomplished by means of Coffer Dams with puddle bags filled with clay or impervious material including diversion of flow, removing and pumping out of water etc. RCC foundation and pillars intended for pipe carrying bridge will be designed and constructed to withstand earthquake, Tsunami, structural stability of the pipe carrying bridge will be ensured. RCC circular pillars for the pipe carrying bridge will be erected at 20 m intervals. Construction of pipe carrying bridge will be carried out during the period from March to September. The pipe carrying bridge will be parallel to Ennore Creek Flyover.

STATUS OF CRZ CLEARANCE

The application for CRZ Clearance is submitted to the Convener of DCZMA / District Environment Engineer, TNPCB Arumbakkam on 12-11-2015. The approval for CRZ clearance has been given by DCZMA and TNSCZMA, further it is recommended to NCZMA for its approval.

ANALYSIS OF ALTERNATIVES

Alignment of conveying main was considered based on land availability and impacts on socio-economic aspects. The following table describes the best alternative alignment of conveying main along Buckingham canal road and Ennore creek.

S. No	Alignment 1: Figure 2.9 (Thiruvottiyur Ponneri High Road)	Alignment 2: Figure 2.10 (Buckingam Canal side and across Ennore creek)	Remarks
1.	Motorable road access to beneficiary Industries	The present alignment is considered due to availability of right of way.	Alignment 2 was considered in view of availability of land for laying the conveying main besides least disturbance to habitation and environment. Moreover there is no need for acquisition of any private land for the proposed conveying main.
2.	Known route i.e. Thiruvottiyur -Ponneri High road. However this alignment of conveying main is not possible due to non availability of land. The alignment was given in **Figure 2.3**.	Proposed conveying main will be laid along the berm of Buckingham canal road.	

Alignment 2 was considered in view of (i)availability of land, (ii)Less traffic congestion and (iii) Impact on Ennore creek is temporary as pipe carrying bridge will be constructed parallel to the existing Ennore creek fly over for laying the conveying main

There will be only least disturbance to habitation and environment. Moreover there is no need for acquisition of any private land for the proposed conveying main.

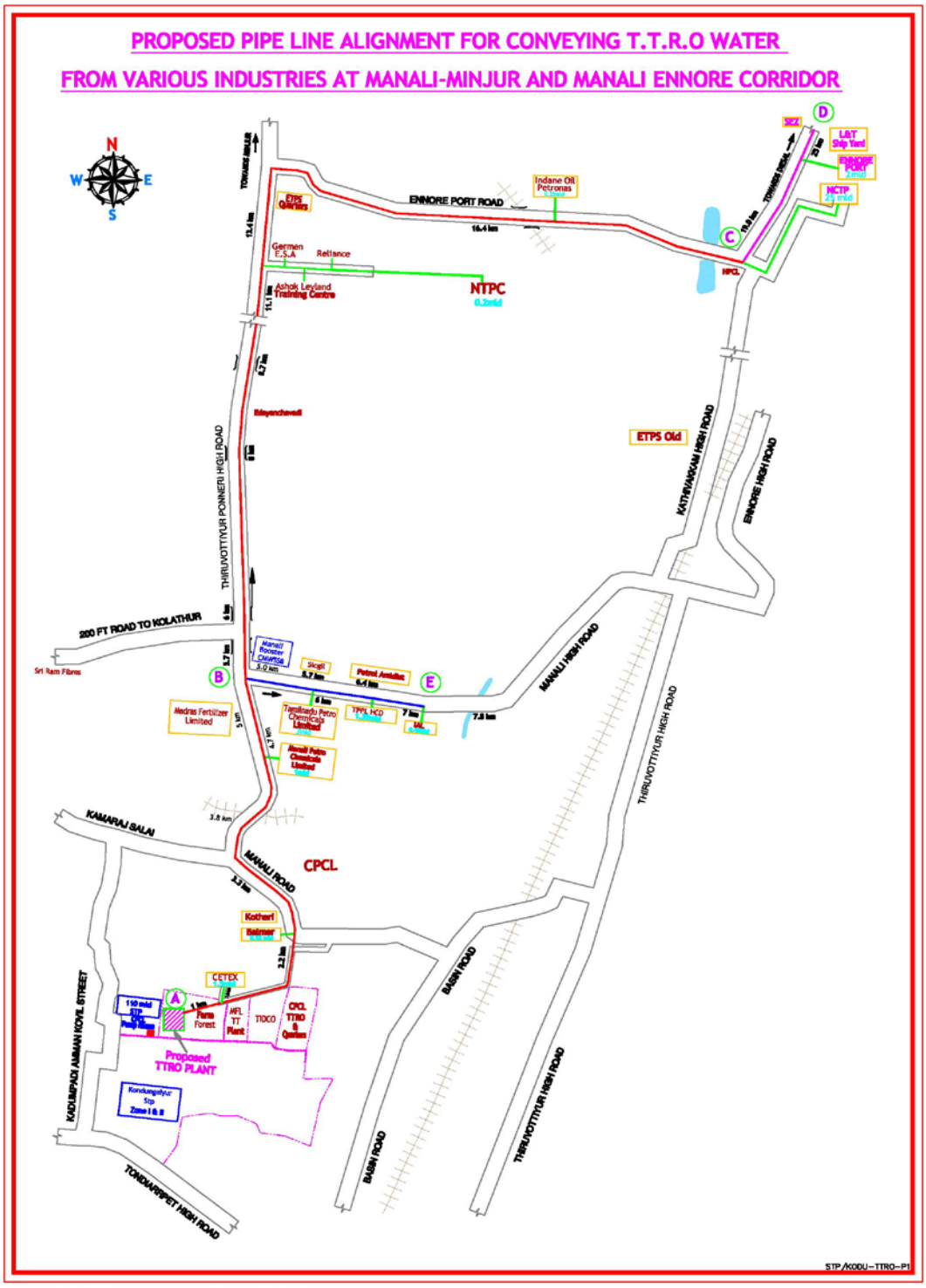


Figure 2. 9 – TTRO Pipeline Alignment 1 (Thiruvottiyur Ponneri High road)

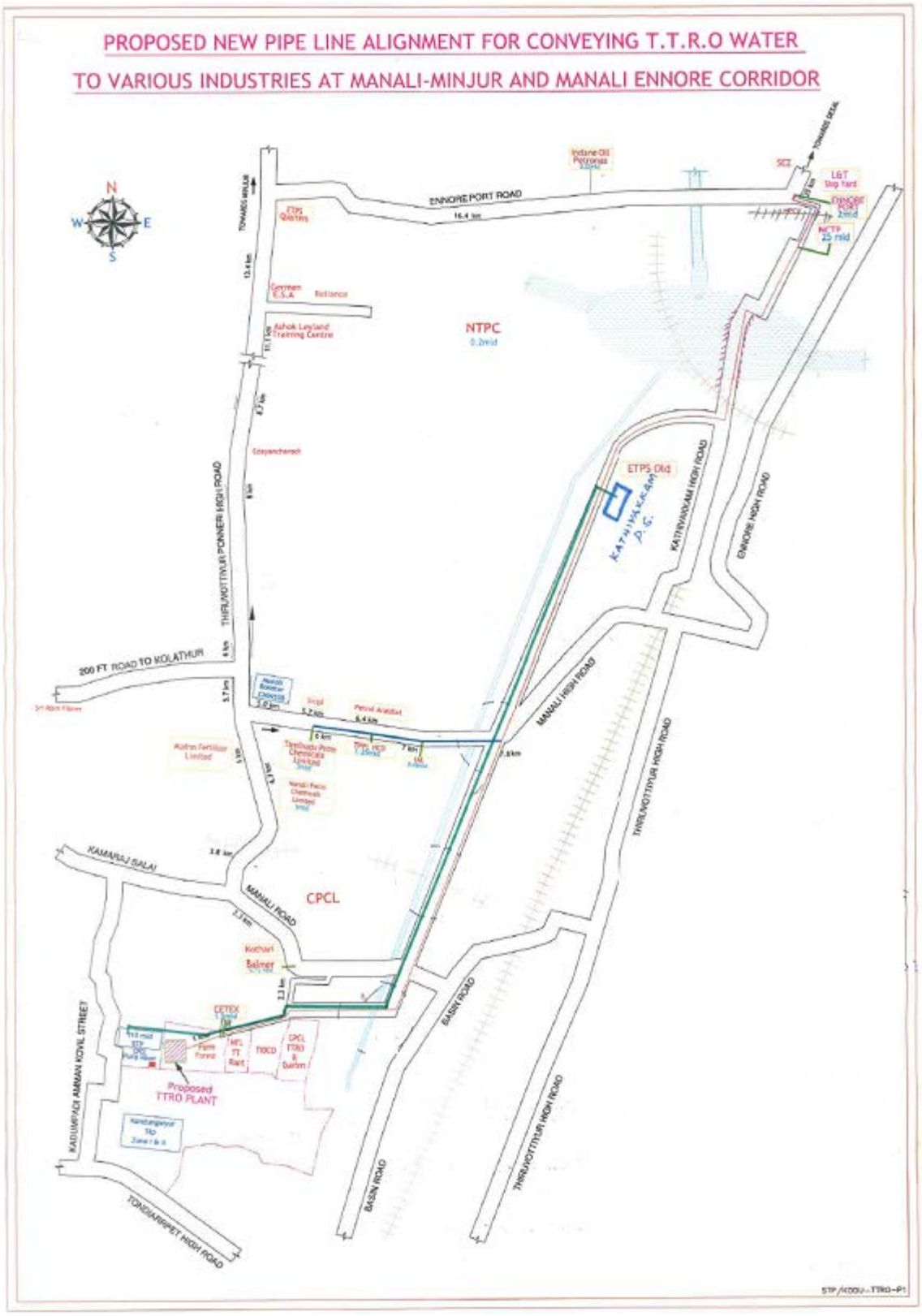


Figure 2. 10 – TTRO Pipeline Alignment 2

2. 6 OPERATION & MAINTENANCE COST

The expenditure for operation and maintenance of the TTRO plant & TTRO water conveying Pipeline including salary to the staffs cost of chemicals, spares, replacement, repair work, power consumption charges, structure maintenance etc. is Rs.3000 lakhs per year which will be met out by CMWSS Board from its own resources.

2. 7 FUNDING

The entire project cost of Rs 255 Crores has been proposed under the scheme of Tamilnadu Sustainable Urban Development Project (TNSUDP) with financial assistance from World Bank.

Table 2.4 - Project cost

Construction of 45 MLD capacity TTRO Plant at Kodungaiyur & Conveying pipeline for conveying treated water to Industries in North Chennai

S.No	DESCRIPTION OF WORK	AMOUNT Rs in lakhs
1	Construction of 45 MLD capacity TTRO Plant at Kodungaiyur	14500.00
2	Conveying pipeline for conveying treated water from Kodungaiyur to Industries in North Chennai	11000.00
	TOTAL	**25500.00**

A) Construction of 45 MLD capacity TTRO Plant at Kodungaiyur

S.No.	Description of Item	Amount Rs. in Lakhs
1	**Construction of 45 MLD capacity TTRO Plant at Kodungaiyur**	**6947.34**
2	Labour cost, other civil , mechanical electrical works	2948.66
	TOTAL	**9896.00**
3	Provision for necessary rate revision of Schedule of rates for the year 2014 -15 @ 6%	593.76
	Sub Total	**10489.76**
4	Contingencies @ 2.5% (say)	262.24
	Sub Total	**10752.00**

5	Preparation of Plans & estimate@ 1 %	107.52
6	Tools & Plants @ 2.5 %	268.80
7	Supervision charges @ 12 %	1290.24
		12418.56
8	Provision for TNEB service connection charge	345.00
9	Provision for central excise **12.36%**and CST@ 2%,service tax**@4%**	977.77
10	Provision for Port Handling & Inland Freight @5% on Material cost	312.75
11	Works contract & Service Tax	252.11
12	Insurance	125.10
	Grand Total	**14431.29**
	Say	**14500.00**

B) Conveying pipeline for conveying treated water from Kodungaiyur to Industries in North Chennai

1	Laying of pipeline including testing and trenchless work	4585.55
2	Construction of sluice/air valve/scour valve chambers	25.00
3	Trenchless work for major road crossing(5 Nos)	50.00
4	Provision for pipe carrying bridge across nullah/Odai(5 locations)	100.00
5	Provision for pipe carrying bridge across crossing Kosasthalaiyar River	750.00
6	Subtotal	**5510.55**
7	Contingencies @ 2.5% (say)	137.76
	Sub Total	**5648.31**
8	Preparation of Plans & estimate@ 1 %	56.48
	Tools & Plants @ 2.5 %	141.21
9	Supervision charges @ 12 %	677.80
10	Provision for shifting of utilities	100.00
11	Road cut restoration charges	3675.00
12	Provision for obtaining clearance from other Departments	100.00
13	Appointment of PMC consultant & provision for third party inspections	500.00
14	Provision for establishing Laboratory, Green belt ,reject line and providing fencing	100.00

	Subtotal	**10998.80**
	TOTAL	**10998.80**
	Say	**11000.00**

2. 8 ROAD CONNECTIVITY

Tondiarpet High Road is situated in the South direction about 1.5 Km from the proposed site and Manali High Road situated at a distance of 2 Km towards North East and Ennore Kathivakkam High Road at about 2.5 Km from the proposed TTRO plant.

2. 9 MANPOWER

2.9.1 Key Personnel involved

The Operator's Key Staff employed during the design build services shall have the expertise and qualifications specified below.

Key Personnel required during Construction phase

Graduate Engineers (Civil, Electrical, Mechanical and Environmental Engineering) with minimum 5 years Experience in Operating & Maintaining a TTRO Plant/ STP / Desalination plant. – **6 Nos.**

Supervisors with Diploma qualification (Civil, Electrical, Mechanical and Environmental Engineering) with minimum 2 years Experience in Operating & Maintaining a TTRO Plant/ STP / Desalination plant. – **3 Nos.**

Key Personnel required during O&M period

Graduate Engineers (Civil, Electrical, Mechanical and Environmental Engineering) with minimum 5 years Experience in Operating & Maintaining a TTRO Plant/ STP / Desalination plant. – **4 Nos.**

Operators with Diploma qualification (Civil, Electrical, Mechanical and Environmental Engineering) with minimum 2 years Experience in Operating & Maintaining a TTRO Plant/ STP / Desalination plant. – **2 Nos.**

Others (Plumbers / fitters, Helpers, Security and Housekeeping**) – 13 Nos.**

2. 10 LIGHTING ARRANGEMENTS

Adequate provisions have been made in the Bid Documents for 12 nos of Tower lights and 60 street lights for TTRO plant.

2. 11 TECHNICAL DESCRIPTION OF THE PROJECT

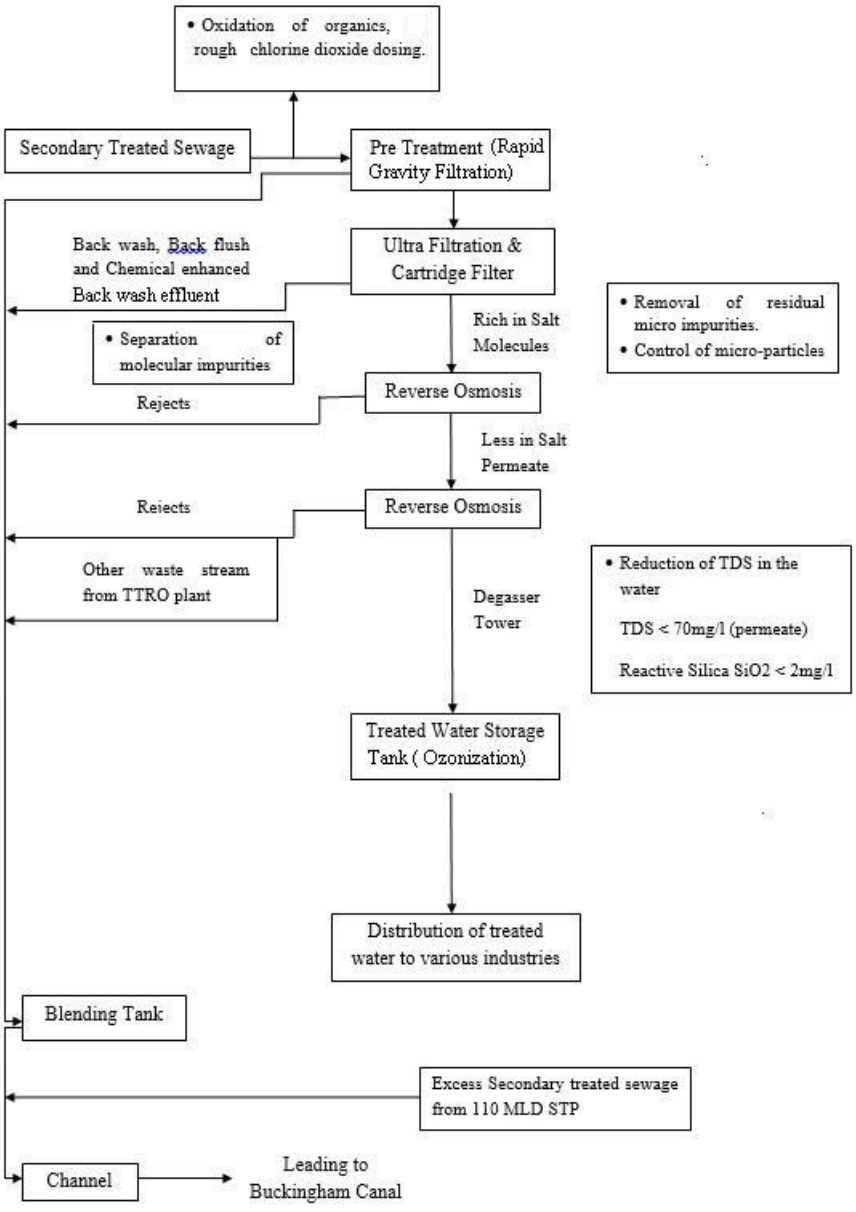


Figure 2. 11 Process Flow Sheet for 45 MLD TTRO Plant

The feed secondary treated water received under pressure is routed to Equalization tanks. These are twin compartment tanks having a common inlet sump. The variation in characteristics of treated water is reduced due to equalization in this tank, which is provided with necessary hold up time.

A. Pre Treatment

Pre-treatment block is the first stage of treatment and consists of removal of settable suspended particulate matters and removal of impurities like residual BOD and COD which may be harmful to the UF / RO membranes. This stage is achieved with the help of organics reduction through Chlorine Dioxide dosing followed by Rapid gravity filtration.

B. Organics Reduction through Chlorine Dioxide Dosing

Chlorine Dioxide is generated on-site and is dosed at the inlet sump of pre-chlorination contact tank/Rapid sand filter feed sump to eliminate micro biological growth and also to reduce the organics load of the feed water.

Submerged Encapsulated underwater U-tube type onsite chlorine dioxide generators are envisaged to generate chlorine dioxide at the dosing point, i.e.at the inlet sump of pre chlorination contact tank/Rapid sand filter feed sump with diffuser arrangement. Chlorine dioxide dosing shall be controlled based on the residual chlorine dioxide level in water, which is measured by means of online analyzer located at the discharge of the Filter Feed Pumps. The chlorinated effluent is then routed to Rapid sand Filtration system through Rapid sand Filter Feed Pumps located at the Pre Chlorination contact Tank / Rapid sand filter feed sump thorough a 1000mm dia CI LA class pipe

C. Suspended Solids Removal through Rapid sand gravity filtration system.

The filtration system proposed is the conventional Rapid gravity sand filters to trap the suspended solids present in the feed water to UF system. Filtration is a process for separating suspended and colloidal impurities from the effluent by passage through a porous media. The Rapid sand filter comprises of a bed of sand serving as a single medium granular matrix supported on gravel overlying an under drainage system. The

features of Rapid sand filtration include use of high filtration rates and coarser but more uniform filter media to utilize greater depths of filter media to trap influent solids without excessive head loss and backwashing of filter bed by reversing the flow direction to clean the entire depth of filter.

The filtered water will be taken to the Ultra filtration feed sump. The backwash water will be taken to the Disposal blending tank for final disposal. The Rapid sand filtration system shall work at a minimum recovery of 98%.

D. Ultra-Filtration System

The Rapid gravity Filtration outlet under pressure is routed to Ultra Filtration system. The Ultra Filtration system shall be either dead end or cross flow arrangement meeting minimum recovery guarantees as specified in tender documents. The UF treated water is Stored in a UF Permeate storage tank to provide hold up and store water required during UF back flush and chemical enhanced backwash steps.

The UF system shall also have Chemical Enhanced Backwash provision along with the normal back-flushing arrangement for cleaning of the UF membranes. The UF system shall be designed to have a minimum net permeate recovery of 88%. The Backwash / Back-flush effluent from the UF system shall be routed and collected in the Disposal Blending tank for mixing with other waste water streams of TTRO plant and further disposal outside battery limit. Dedicated UF Backwash pumps are provided to Backwash UF membranes during normal back flush steps and during Chemical Enhanced Backwash steps. Air scouring arrangement shall be provided for UF system, if required to meet the guarantees from UF system. The TTRO Plant contractor shall additionally provide Air blowers for UF Air scouring and any other TTRO Plant internal requirement as per recommendation by the UF system supplier.

The design of UF system shall ensure that the downstream units are not starved of the required quantity of water so as to ensure net treated water production capacity from the TTRO Plant.

A part of the outlet water from UF system shall also be routed directly to the Treated Water Storage tank for blending with RO permeate. This is carried out to meet the

desired TDS levels in treated water to be sent for distribution. The UF permeate Feed Tank shall receive the UF outlet water.

E. Reverse Osmosis

The UF outlet water from UF permeate tank is then pumped to cartridge filters through Cartridge Filter Feed pumps. Dedicated RO high pressure Feed pump is provided for each skid with VFD on the individual drive motor. Individual RO skids, fed with high pressure feed water, produce a permeate water stream of very low Dissolved solids and a reject water stream of high Dissolved solids content. The Reject stream shall be throttled in such a way to provide sufficient pressure to permeate stream for routing it to Degasser tower, which is kept at an elevation above the Treated Water Storage Tank.

Necessary piping and valve arrangements shall be provided to route a part of permeate stream to Suck Back tank in order to avoid keeping the membranes in dry conditions during standby operation of RO skids as well as during plant shutdown.

RO Membrane Cleaning

Cleaning of RO membrane is required periodically to maintain performance. A reject of quantity 1.5 MLD will be generated while cleaning RO units. After cleaning, rejects will be blended with secondary treated water and disposed to Buckingham Canal.

If treatment is needed before discharge of cleaning agents into Buckingham canal in the later stage, alternative arrangements shall be made to ensure that the discharge of cleaning agents stay within the discharge standards prescribed by CPCB.

F. Transfer of Treated Water

The Treated Water from Degasser is collected in Treated Water storage tank along with RO by-pass stream taken from UF permeate tank inlet header. This treated water stream is further transferred to the pipeline network for routing it to various industrial parks through Treated Water transfer pumps.

G. Disinfection System

Ozonation System

Ozonation process is adopted for disinfecting the RO outlet.

It is a technology that has been in continual commercial use for over 100 years and has distinct properties that allow disinfection of even heavily compromised water streams.

Ozone is an unstable molecule which readily gives up one atom of oxygen providing a powerful oxidizing agent which is toxic to most waterborne organisms. It is a very strong, broad spectrum disinfectant .It is an effective method to inactivate harmful protozoa that form cysts. It also works well against almost all other pathogens. Ozone is made by passing oxygen through ultraviolet light or a "cold" electrical discharge. To use ozone as a disinfectant, it must be created on-site and added to the water by bubble contact. This is used to breakdown the pollutant in the waste water.

Advantages of Ozonation

i. Kills bacteria effectively.
ii. Oxidizes substances such as iron and sulphur so that they can be filtered out of the solution.
iii. There are no nasty odours or residues produced from the treatment.
iv. Ozone converts back into oxygen quickly, and leaves no trace once it has been used.

H. Storage & pumping

It is proposed to provide the storage requirements for 60 MLD capacity treatment plant in the Phase- I [45 MLD) so that the same shall be utilized without any modification in Phase-2 (additional 15 MLD). The proposed storage and their hold-ups during various phases will be as follows:

Table 2.5 - Total Capacity / Liquid Hold up (m^3)

Tank	Material of construction	No of tanks	Total hold up hours	Total capacity/ liquid hold up(m^3)
Feed storage / equalization	RCC	1 (Twin compartment)	1.35	4000/3600

Intermediate storage / UF permeate tank	CS	1	1.34	3092/2750
Treated sewage water storage	RCC	1 (Twin compartment)	5.34	11900/10200

I. Treated water conveying main

It is proposed to construct a collection sump with pump-sets suitable for conveying the 45 MLD of TTRO water to industries initially and 60 MLD of TTRO water latter during 2030. A 800 mm dia DI pipeline for conveying main shall be provided for a length of 19km, 600 mm dia DI pipeline for a length of 7 KM and 300 mm dia DI conveying main for a length of 2.5Km for distributing the TTRO water to Industries in North Chennai. Accessibility for the proposed conveying main will be through existing roads belonging to PWD and Highways.

J. Disposal for Reject/ Backwash Stream

The waste water stream generated within the TTRO plant, such as Rapid gravity Filtration backwash, UF back flush/ Chemical Enhanced Backwash, RO reject stream and other overflows, drains etc are blended in a Disposal Blending tank and further transferred outside the TTRO Plant battery limit through Disposal Pumps. The discharge of rejects from TTRO plant through the existing channel intended for carrying the treated sewage from existing STP into CRZ-II zone of Buckingham canal. Obtaining of CRZ-II clearance is in the process.

K) Chemicals Usage: Chemical dosing shall be suitably located on first floor of the chemical house, whereas provision for chemicals storage shall be made on the ground floor. Bulk liquid chemicals such as conc. Hydrochloric acid ,Sodium Chlorite &caustic lye shall be stored outside chemical house in a dyked area. Transfer of these chemicals shall be done by their respective unloading pumps and transfer pumps.

1) **Conc HCl(33%) :** Conc HCl is used for generation of Chlorine Dioxide. Also used for chemical enhance back wash.
2) **Sodium Chlorite($NaClO_2$):** Sodium Chlorite is used for generation of Chlorine Dioxide.

3) **Chlorine Dioxide**: ClO_2 is a strong oxidizing agent, more effective than chlorine. ClO_2 is generated on site and is dosed at the inlet sump of equalization tank to eliminate micro biological growth. Chlorine dioxide generators use sodium chlorite and Hydrochloric acid, to produce Chlorine Dioxide, which negates the involvement of handling hazardous chlorine gas .

$5NaClO_2+4HCl = 4CLO_2+.5NaCl+2H_2O$

ClO_2 generator equipment room and ClO_2 generation and dosing monitoring room would be provided.

4) **Ferric chloride**. Used for coagulation purpose .However, this may not be required ,since the feed water is taken from the maturation pond having 72 hrs retention time. Being a DBO contract the bidder would decide on this.
5) **Anti scalant**: Used for removal of scaling in RO membrane.
6) **Caustic lye(NaOH)40-50% wt:** Used for Chemical enhance backwash
7) **Sodium by-sulfite:** Used before feeding to RO for de- chlorination purpose.

L) Analysis of Alternative Technology

Technical Alternatives are analyzed during the Plant Design are as follows:

i) Distillation
ii) Conventional Filters
iii) Disinfection

i) Distillation: It is the process used for water purification where water will be heated and pure water molecules will be separated. Distillation is commonly used in developing countries to minimize water borne diseases are common. It helps to remove mercury, lead and arsenic, but it does not remove chlorine or its byproducts. Distillation uses lot of heat energy and it is expensive. Reverse osmosis removes chlorine and its by-products. It claims to filter more contaminants than distillation and also it purifies water faster than filtration. Hence reverse osmosis is preferred.

ii) Filtration: Rapid sand filters provide rapid and efficient removal of relatively large suspended solids. It required low are when compared to slow sand filters. As rapid sand filtration removes only large particles, ultra filtration is required. Ultra Filtration helps to remove large quantities of micro particles and make the water safe. No periodic maintenance is required for ultra filtration.

iii) **Disinfection:** The project is designed with Ozone disinfection system as it oxidizes substances such as iron and sulphur compared to other disinfectants. Ozone is effective over a wide pH range and rapidly reacts with bacteria, viruses, and protozoans and has stronger germicidal properties than chlorination. Ozonation has a very strong oxidizing power with a short reaction time. Ozone leaves no residual and it saves money by eliminating on-going chemical cost. Ozone is effective on wastewater with TDS and TSS levels that may not be acceptable with UV disinfection. Therefore, filtration will not be necessary for ozone use in many wastewater applications. Thus Ozonation is preferred.

OZONATION	ULTRA VIOLET RADIATION
Ozone kills microorganisms	UV inactivates microorganisms
Ozone is a powerful oxidizer	UV is not an oxidizer
Ozone oxidizes the organics and inorganics that create chloramines, eliminating their production	UV breaks down chloramines that have been previously created
Ozone cells require no replacement; require annual periodic cleaning; no hazardous components	Mercury vapor lamps are replaced at 3-12 months; disposal procedures must be considered as lamp gases are considered hazardous waste

The contractor shall strictly adhere to the specifications for designing of various treatment units and refer process flow sheet given by CMWSSB during erection and commissioning.

2. 12 LEGAL, POLICY & ADMINISTRATIVE FRAME WORK

This section reviews the policies, regulations and administrative framework within which the project is to be implemented. The review includes the Environmental and Social framework of TNUIFSL, operational policies / directions of the World Bank and sector-specific environmental policies and regulations of the Govt. of India and Govt. of Tamilnadu.

a) The Water (Prevention and control of pollution) Act, 1974

These laws seek to control pollution of water and enhance the quality of water. Under this law, it is mandatory to obtain Consent to Establishment for TTRO plant and the effluent to be treated to meet the discharge standards of inland surface water and discharged as per the standards stipulated by TNPCB before discharge into the Canal or on land for irrigation and pay consent fees as stipulated for local bodies viz., Town Panchayat, Municipality, Corporation which are causing water pollution.

b) The Air (Prevention and control of pollution) Act, 1981 amended in 1987

This Act provides prevention, control and abatement of air pollution. With a framework similar to the Water Act, the Air Act gave the central and State Board's authority to issue consents to industries operating within the designated air pollution control areas. The State also prescribes emission standards for stationary and mobile sources.

c) The Environment Protection Act 1986, & Notifications

In order to create national environmental legislation, the EPA articulates a policy for environmental protection covering air, water and land and provide a framework for Central Government to coordinate between Central and State Authorities established under various laws, including the Water Act and Air Act. Under this umbrella Act, the Central Government must set National Ambient and Emissions Standards, establish procedures for managing hazardous substances, regulate industrial sites, investigate and research pollution issues and establish laboratories and collect and disseminate information.

Among other relevant legislation, the Public Liability Insurance Act (PLIA) of 1991 mandates that business owners operating with hazardous substances take out insurance policies covering potential liability from an accident and establish Environmental Relief Funds to deal with accidents involving hazardous substances. The National Environmental Appellate Authority Act of 1997 requires the Central Government to establish an authority to hear appeals on area restrictions where operations will not be carried out or will be carried out with certain safeguard measures.

d) National Archaeological sites prevention Acts

The Ancient Monuments and Archaeological Sites and Remains Act, 1958 In order to bring the legislation on par with constitutional provisions and providing better and effective preservation to the archaeological wealth of the country, The Ancient Monuments and Archaeological Sites and Remains Act 1958 (No 24 of 1958) was enacted on 28th August 1958. This Act provides for preservation of ancient and historical monuments and archaeological sites and remains of national importance, for regulation of archaeological excavations and for protection of sculptures, carvings and other like objects. Subsequently, the Ancient Monuments and Archaeological Sites and Remains Rules 1959 were framed. The Act along with Rules came into force with effect from 15 October 1959. This Act repealed The Ancient and Historical Monuments and Archaeological Sites and Remains (Declaration of National Importance) Act, 1951.

e) The Treasure Trove Act, 1878

The Indian Treasure Trove Act, 1878 (Act No. VI of 1878) was promulgated to protect and preserve treasure found accidentally but having the archaeological and historical value. This Act was enacted to protect and preserve such treasures and their lawful disposal. In a landmark development in 1886, James Burgess, the then Director General succeeded in prevailing upon the Government for issuing directions forbidding any person or agency to undertake excavation without prior consent of the Archaeological Survey and debarring officers from disposing of antiquities found or acquired without the permission of the Government.

f) The Antiquities and Art Treasures Act, 1972

The Antiquities and Art Treasures Act 1972 (No. 52 of 1972) is the latest Act enacted on 9th September 1972 for effective control over the moveable cultural property consisting of antiquities and art treasures. The Act regulates export trade in antiquities and art treasures, provides for prevention of smuggling of, and fraudulent dealings in, antiquities, authorizes compulsory acquisition of antiquities and art treasures for preservation in public places and provides for certain other matters connected therewith or incidental or ancillary thereto. This Act was supplemented with The Antiquities and Art Treasure Rules 1973. The Act and Rules have been in force with

effect from 5th April 1976. This legislation repealed The Antiquities Export Control Act, 1947 (Act No. XXXI of 1947).

g) The Noise Pollution (Regulation and Control) (Amendment) Rules, 2002

In order to curb the growing problems of noise pollution, the government of India has enacted the noise pollution rules 2000 that includes the following main provisions:

- The state government may categorize the areas as industrial or commercial or residential.
- The Ambient air quality Standards in respect of Noise for different areas has been specified.
- The State government shall take measures for abatement of noise including noise emanating from vehicular movement and ensure that the existing noise levels do not exceed the ambient air quality standards specified under these rules.
- Areas not less than 100 m around Hospitals, Educational institutions and Court is declared as silence area under these rules.
- A person found violating the provisions as to the maximum noise permissible in any particular area shall be liable to be punished for it, under the provision of these rules and any other law in force.

h) The Manufacture, Storage and import of Hazardous Chemical Rules, 1989 amended in 2000

It defines the terms used in this context, and sets up an authority to inspect, once a year, the industrial activity connected with hazardous chemicals and storage facilities.

i) Coastal Regulation Zone (CRZ) Notification, 2011.

This notification under Environment (Protection) Act; 1986 supplements the law on site clearance by declaring certain zones as CRZ and regulates activities in these zones. Further Govt of Tamil Nadu has also issued orders regulating development within 500 mts from the high water mark. The HTL of Buckingham Canal is situated at a distance of 2 Kms from the project site and this comes under CRZ-II as per CRZ notification 2011. So the conveying main to discharge of treated water into Buckingham canal requires

CRZ clearance. The proposed conveying main across and along Buckingham canal attracts CRZ II and conveying main across Ennore creek attracts CRZ-I.

j) Environmental and Social Management Framework (ESMF)

The Policy of TNUDF is to promote the principles of Environmental sustainability and Social relevance in the projects funded by TNUDF. The urban infrastructure projects depending on location and the nature of project activities will have varying impacts on urban environment which largely depends upon the complexities of project activities. To facilitate effective screening, TNUDF has categorized the projects in to different categories – E1, E2 and E3 linked to severity of impacts and regulatory requirements. Based on the social impacts projects are categorized as S1, S2 and S3 as per ESMF of TNSUDP.

The proposed TTRO at Kodungaiyur project comes under E -1 category as per the guidelines provided in ESMF and hence requires carrying out environmental assessment and preparation of Environmental Management Plan.

The proposed activity of the TTRO plant does not involve any social impact for both the construction of TTRO and laying of conveying main. Hence the project falls under S3 as per ESMF of TNSUDP.

Operational Policies and directives of World Bank:

- OP 4.01 for safeguard policies of World Bank which provides for the environmental assessment guidance for the lending operations is applicable. This OP 4.01 requires the borrower to screen projects for potential impacts and through appropriate EA assess, minimize and mitigate potentially adverse impacts from the project.

  The Environmental Assessment (EA) leads to be integrated in the project development process such that timely measures can be applied to address the identified impacts.

- Environmental Health and Safety guidelines of the World Bank are applicable for the project which shall be ensured during project implementation.

k) Clearances/ NOC Required from Competent Authority

S.NO	Activity	Clearance / NOC Required	Statutory Authority	Status
1	Establishment of Proposed TTRO Plant	Consent To Establishment under Air and Water Act	Tamilnadu Pollution Control Board.	Application is submitted
2	Operation of TTRO Plant	Consent To Operate under Air and Water Act	Tamilnadu Pollution Control Board.	Will be obtained Only after getting Consent to Establishment
3	(i)Conveying main crossing Buckingham canal (CRZ II) (ii)Conveying main crossing Ennore creek(CRZ I) (iii)Conveying main along Buckingham canal	CRZ clearance is to be obtained from MoEFCC through TNCZMA	Tamilnadu Coastal Zone Management Authority (TNCZMA) and MoEFCC	Application submitted and got approval from DCZMA & TNSCZMA
4	The discharge of rejects from TTRO plant through the existing channel intended for carrying the treated sewage from existing STP into CRZ-II zone of Buckingham canal.	CRZ clearance is to be obtained from MoEFCC through TNCZMA	Tamilnadu Coastal Zone Management Authority (TNCZMA) and MoEFCC	Application is Submitted

5	Discharge of RO rejects to Buckingham Canal	No Objection Certificate	Water Resources Organization- public Works Department, Tamilnadu	Application is submitted
6	Conveyance line crossing and laying near local roads and Highways	No objection certificate	Corporation of Chennai (COC) and Public Works Department (PWD) and Highways Authority	Approval has been obtained for laying the conveying main across high ways & PWD. Application has been submitted to COC
7	Conveyance line crossing Railway lines near Ennore creek and CPCL	No objection certificate	Railway Department	Approval has been obtained for crossing the railway line near CPCL .
8	Storage & Handling of hazardous chemicals	No objection certificate/ as applicable	TNPCB/Concerned authority as per this rule	Notification of chemical usage, prepation of emergency plans. Emergency plans as applicable for safety of employees and safety of TTRO plant to be prepared by the DBOT contractor.

l) Procedure for obtaining CRZ Clearance:

Completed Form I for seeking clearance for TTRO plant and conveying main attracting CRZ notification along with CRZ maps indicating HTL and LTL demarcated by the authorized agency i.e. Institute of Remote Sensing, Anna University, Chennai 600025 and EIA report to be submitted to the District Environment Engineer, Chennai who is the convener of District Coastal Management Committee (DCMC). Recommendations of DCMC will be forwarded to Tamil Nadu State Coastal Zone Management Authority (TNSCZMA) for consideration. TNSCZMA will forward the proposal for CRZ clearance to the National Coastal Zone Management Authority, Government of India, Ministry of Environment and Forests and Climate Change. MoEFCC will review and issue necessary clearance based on the recommendations of TNSCZMA.

3. DESCRIPTION OF THE ENVIRONMENT

3. 1 INTRODUCTION

Baseline Environmental Studies have been conducted to determine the existing status of various Environmental attributes viz., Climatic and Atmospheric conditions, Air, Water, Noise, Soil, Hydro geological, Land use pattern, Ecological and Socio-Economical environment, prior to setting up of the proposed project. This study would help to undertake corrective mitigation measures for protection of the environment on account of any change deviation of attributes due to activities of the proposed project.

3. 2 SCOPE OF BASELINE STUDY

An area, covering a 10 km radial distance from the project site is considered as the study area for the purpose of the baseline studies. As part of Environmental and Social Impact Assessment, this study was undertaken for a period from June 2014. Primary data on Water, Air, Land, Flora, Fauna & Socio-Economic data were collected by a team of Engineers and Scientists. Secondary data was collected from various Departments of State/Central Government Organizations, Semi-Government and Public Sector Organizations. **Table 3.1** gives various environmental attributes considered for formulating environmental baseline, frequency and monitoring methodology for various environmental attributes.

Table 3. 1 - Baseline Environmental Components & their Attributes, Frequency & Monitoring Methodology

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
1. Air Environment				
Meteorological Data				
• Wind speed • Wind direction • Dry bulb temperature • Wet bulb temperature • Relative humidity • Rainfall	At project site (Site specific)		Weather Monitoring Station	IS 5182 Part 1-20 Sit-specific primary data is essential Secondary data from IMD-Regional Meteorological Centre, Chennai

Ambient Air Quality				
• Suspended Particulate Matter (SPM) • Particulate Matter (PM 10) • Particulate Matter (PM 2.5) • Sulphur Di-oxide (SO_2) • Oxides of Nitrogen (NO_X) • Ammonia	Requisite locations in the project influence area	24 hourly twice a week 8 Hourly twice a week	• Gravimetric (High – Volume) • Gravimetric (High – Volume with Cyclone) • EPA Modified West & Gaeke method • Arsenite Modified Jacob & Hochheiser • Nessler's method	As per CPCB Standards under November 18th 2009 Notification for NAAQS
2. Noise Environment				
Hourly equivalent noise levels	Requisite locations in the project influence area	One day continuous on a working and non-working day	Sound level meter	IS: 4954-1968

3. Water environment				
Parameters for water quality: pH, temp, turbidity, Total hardness, total alkalinity, chloride, sulphate, nitrate, fluoride, sodium, potassium, Electrical Conductivity, Ammonical nitrogen, Nitrate-Nitrogen total phosphorus, , BOD, COD, Calcium, Magnesium, Total Dissolved Solids, Total Suspended Solids	Set of grab samples At requisite locations for ground and surface water	Once	Samples for water quality collected and analyzed as per IS : 2488 (Part 1-5) methods for sampling and testing of Industrial effluents Standard methods for examination of water and wastewater analysis published by American Public Health Association.	
4. **Land Environment**				
• Soil quality • Particle size distribution • Texture • pH • Electrical conductivity • Caution exchange capacity • Alkali metals	Requisite soil samples be collected as per BIS specification within project influence area	Once	Collected and analyzed as per soil analysis reference book, M.L.Jackson	

• Sodium Absorption Ratio (SAR) • Permeability • Porosity				
5. **Land Use**				
• Location code • Total project area • Topography • Drainage (natural) • Cultivated, forest plantations, water bodies, roads and settlements	-	-	• Global positioning system • Topo-sheets • Satellite Imageries	Drainage within the plant area and surrounding is very important for storm water impacts. From land use maps sensitive receptors (forests, parks, mangroves etc.) can be identified
6. Biological Environment				
Terrestrial				
Vegetation – species, list, economic importance, forest produce,		One season for terrestrial biota,	• Point quarter plot-less	

medicinal value, Importance value index (IVI) of trees, Wild animals **Avifauna** Rare and endangered species Sanctuaries/National park/Biosphere reserve		in addition to Vegetation studies during monsoon season	method (random sampling) for Terrestrial vegetation survey. • Secondary data to collect from Government offices, NGOs, published literature	
Socio-Economic				
• Demographic structure • Infrastructure resource base • Economic resource base • Health status: Morbidity pattern • Cultural and aesthetic attributes	Socio-economic survey is based on proportionate, stratified and random sampling method		• Survey is based on personal interviews and questionnaire. • Secondary data from census records, statistical hard books, toposheets, health records and relevant official records available with Govt. agencies	

3. 3 SAMPLING LOCATIONS

Sampling locations are selected for Air, Water, Noise and Soil. All the samples are analyzed and results are shown in below chapter.

The Air, Noise, Water and Soil Sampling locations were selected based on the following criteria. The Ambient air quality monitoring locations have been designed keeping in view the available Climatological norms of predominant wind direction and wind speed of the area.

The following points were also taken into consideration in designing the sampling locations

- Topography and terrain of the study area.
- Populated areas within the study area.
- Residential and sensitive area within the study area.

For the noise monitoring locations the above factors has been considered. Water sampling locations were collected based on the availability of the bore wells / open wells in the area. Geological environment has been considered for the collection of Soil sample collection.

3. 4 MICRO METEOROLOGY

3.4. 1 Temperature

The mean maximum and minimum temperatures during summer and winter vary between 34.3°C and 25.8°C. The highest temperature ever recorded is 43°C.

3.4. 2 Rainfall

Thiruvallur district generally experiences hot and humid climatic conditions. The district receives the rain under the influence of both southeast and northeast monsoons. Most of the precipitation occurs in the form of cyclonic storm caused due to the depressions in Bay of Bengal chiefly during northeast monsoon period. The southwest monsoon rainfall is highly erratic and summer rains are negligible.

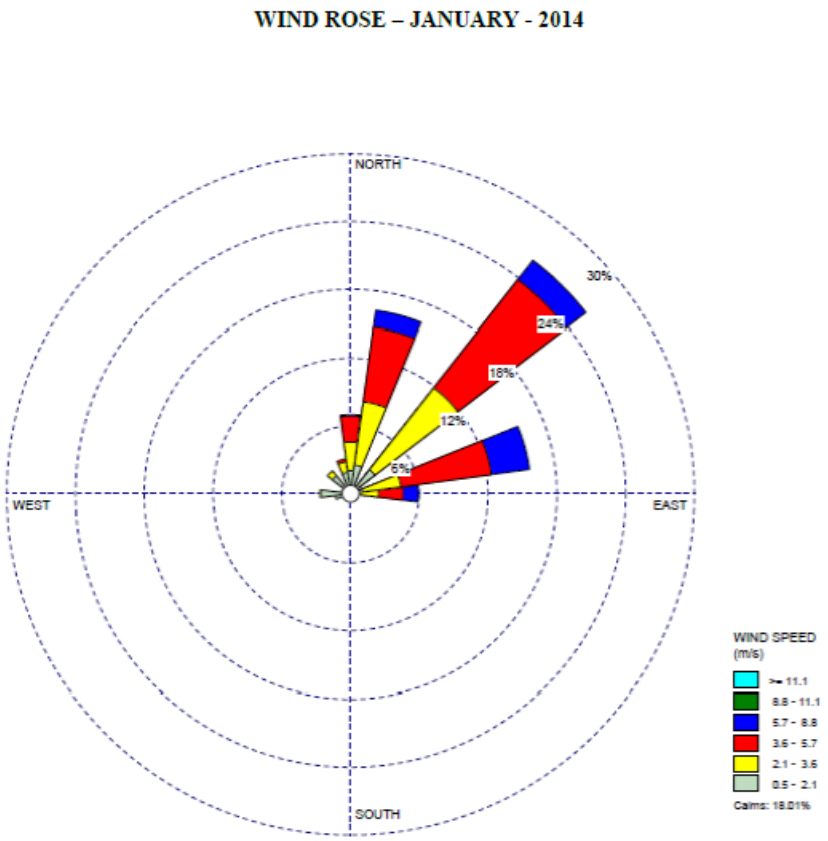
The average normal rainfall of the District is 1104 mm. Out of which 52% has been received during North East Monsoon period and 41% has been received during South West Monsoon period.

3.4. 3 Relative Humidity

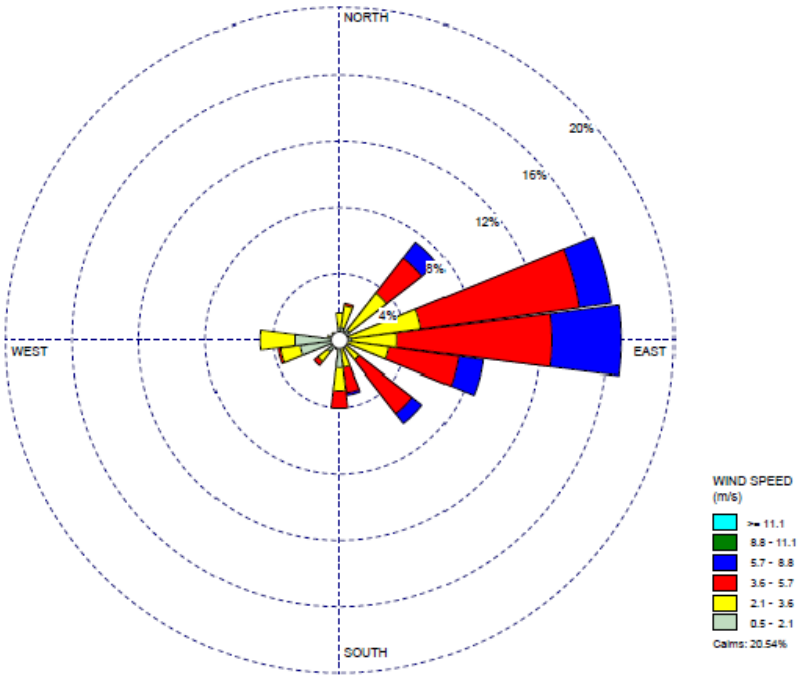
High relative humidity between 67 and 85% prevail throughout the year. Higher rates of relative humidity are observed between November and January i.e., 83 to 85%. In the months of June, the humidity is lower i.e., around 58%. Average relative humidity in the morning and evening are 74 and 64% respectively. The minimum and maximum temperature is 20°C & 37°C respectively.

3.4. 4 Wind Speed & Direction

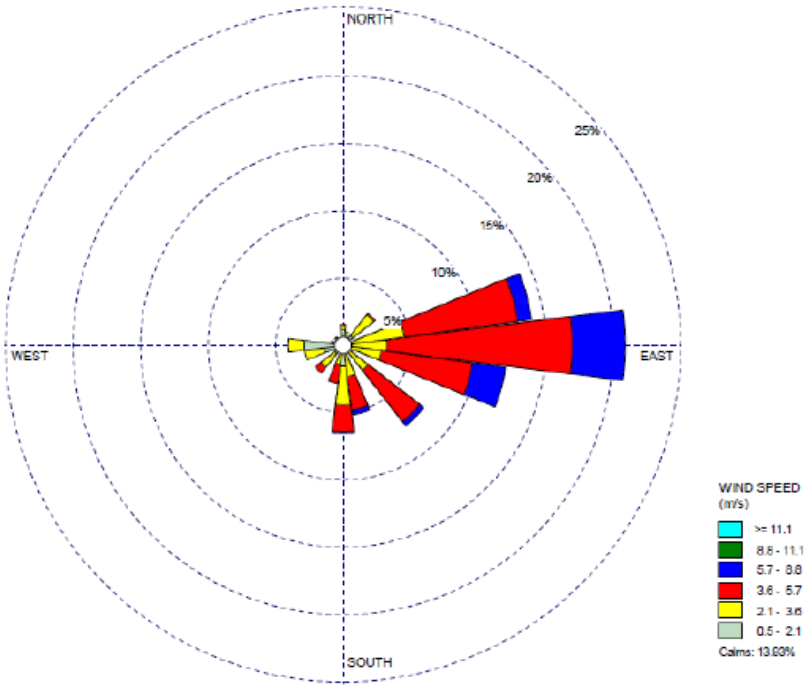
Figure 3. 1 - Wind Rose Diagram (January 2014 to May2014)



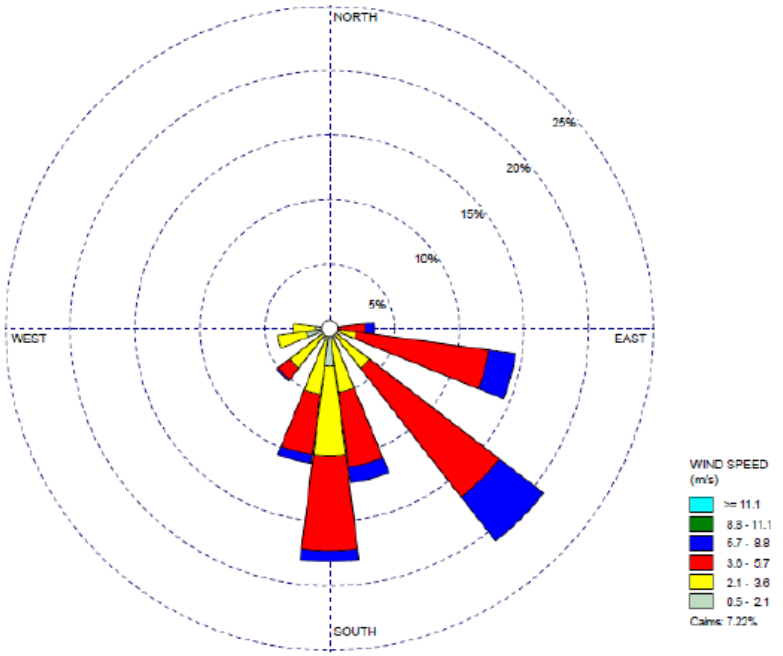
WIND ROSE FEBRUARY - 2014



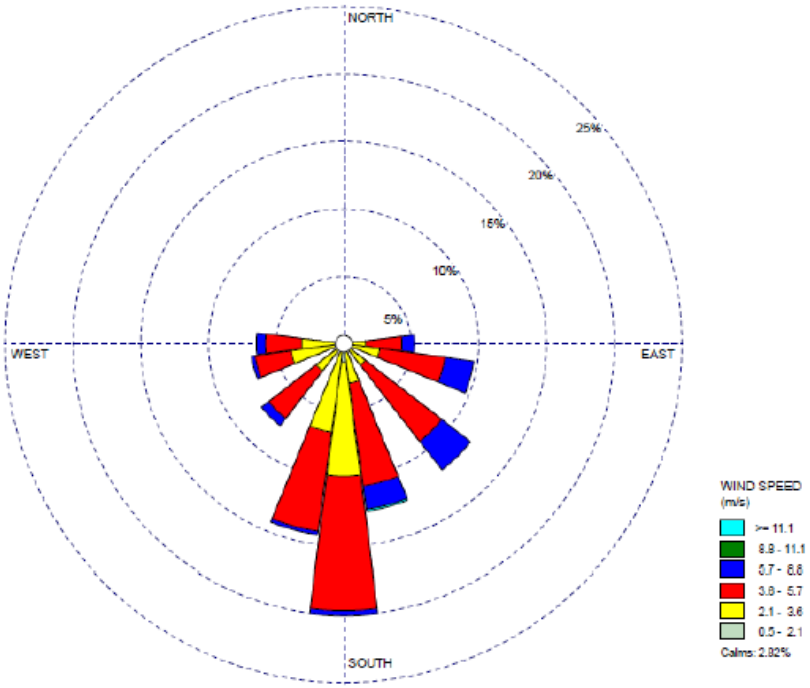
WIND ROSE – MARCH - 2014



WIND ROSE – APRIL - 2014



WIND ROSE – MAY - 2014



3.4. 5 Cloud cover

Cloud Cover During the winter and the summer seasons, the skies are observed to be generally very clear. In the post -monsoon season, generally light clouds were observed i n the evenings, with clear mornings. During the monsoon season, both in the mornings and evenings, the skies were found to be overcast

3. 5 AIR ENVIRONMENT

3.5. 1 Ambient Air Quality (AAQ)

The Ambient Air Quality (AAQ) status with respect to the study zone of 10 km radial distance from the plant site formed the baseline information over which the predicted impacts due to the proposed project were determined based on which the Environmental Management Plan (EMP) was prepared. The baseline status of the ambient air quality can be accessed through a scientifically designed ambient air quality-monitoring network based on the following considerations:

a) Meteorological conditions on synoptic scale
b) Topography of the study area
c) Representations of regional background levels
d) Representation of plant site
e) Representation of cross sectional distribution in the downward direction
f) Influences of the existing sources if any are to be kept at minimum
g) Inclusion of major distinct villages to collect the baseline status
h) The assessment of the impacts on air environment from the proposed activity was carried out using ambient air quality data monitored during the study period.

3.5. 2 Monitoring Location and Methodology

To establish the existing baseline status of air quality in and around the TTRO site a network of seven AAQ sampling locations were selected within 10 km aerial distance. The locations were decided on the basis of meteorological data and the topography of the area. Further, a monitoring location was selected at the project site to get the baseline status of the air quality within 10 Km around the project site.

Table 3. 2 - Techniques used for Baseline analysis

S.No	Parameter	Technique
1	Particulate Matter (PM10 & PM2.5)	PM10 Particulate Sampler & Fine Particulate Sampler (Gravimetric method)
2	Respirable Particulate Matter	Respirable Dust Sampler (Gravimetric method)
3	Sulphur Dioxide	Modified West and Gaeke
4	Nitrogen Oxide	Jacob & Hochheiser
5	Ammonia	Nessler's method

3.5. 3 Results and Discussions

The existing ambient air quality at the identified locations and the corresponding standards are presented in **Table 3.3**. The table below lists minimum, maximum, 98th percentile and mean values of concentrations of PM10, PM2.5, SO_2, NO_2 and Ammonia are monitored.

Table 3. 3 - Air Quality Results

Code	Location	PM_{10}				$PM_{2.5}$				SO_2				NO_X				NH_3			
		Min	Max	Avg	98th Per	Min	Max	Avg	98th Per	Min	Max	Avg	98th Per	Min	Max	Avg	98th Per	Min	Max	Avg	98th Per
AAQ1	Project Site	51	66	58.2	65.3	24	31	27.6	30.4	7.5	10.5	9.6	10.4	11.8	14.4	13.2	14.1	17	31	25.1	30.4
AAQ2	Vyassarpadi	47	61	51.4	60.7	21	27	24.3	26.7	6.9	10.1	8.6	9.9	13.6	17.1	15.2	16.9	8.1	12.3	10.2	12.1
AAQ3	Kaviyarasu Kannadasan Nagar	53	68	60.5	67.4	23	32	27.8	31.8	7.3	8.4	7.9	8.3	12.6	16.3	14.4	16.1	13.8	21.3	17.1	21.1
AAQ4	Madhavaram	46	55	50.7	54.3	19	27	23.7	26.6	5.8	7.2	6.5	7.1	12.3	15.8	14.1	15.5	BDL(<5)			
AAQ5	Manali	59	74	66.8	73.2	29	41	35.4	40.5	9.1	15.6	12.4	15.2	16.8	24.9	20.1	24.6	26	47	36.3	46.1
AAQ6	Tondaiyarpet	55	69	62.9	68.3	25	33	29.1	32.7	8.2	13.8	11.1	13.5	15.7	22.6	19.2	22.3	21	38	29.4	37.6
AAQ7	Edayanchavadi	53	73	63.8	72.4	28	37	32.8	36.4	8.7	14.6	11.7	14.3	14.6	18.4	16.5	18.1	19	34	27.2	33.6
AAQ8	Manali New Town	52	64	58.1	63.7	22	28	24.9	27.6	7.5	10.6	9.1	10.4	15.1	20.8	17.9	20.5	14	22	18.1	21.7
CPCB / MoEF Standards																					
Industrial /Residential / Rural and Other Area		**100**				**60**				**80**				**80**				**400**			

3.5. 4 Observation for AAQ Results

The maximum value (PM10) of 66.8 µg/m^3 was observed at Manali (AAQ5) and next higher value of 63.8µg/m^3 was observed at Edayanchavadi (AAQ7). The lower value of 54.3 µg/m^3 was observed at Madhavaram (AAQ4). The maximum value (PM2.5) of 35.4 µg / m^3 was observed at Manali (AAQ5). Similarly SO_2, NO_2 and NH_3 were found to be high in Manali (AAQ5). However, all the ambient air quality levels are found to be within the CPCB Standards.

3. 6 NOISE ENVIRONMENT

The baseline noise levels in and around the project site were established in-line with the Noise Standards. Noise monitoring was carried out at following 8 locations given in **Table 3.4.**

Noise levels were monitored using a calibrated portable noise level recorder on an hourly basis for 24 hours, once at each location. Levels of noise monitored during 6 AM to 9 PM were considered for the day noise levels and those monitored during 9 PM to 6 AM were considered for night noise levels. Day and night Leq values were computed based on the monitored noise levels and are presented in **Table 3.4**.

Table 3. 4 - Noise Monitoring Locations & Results

Location Code	Sample location	Leq day [dB(A)]	Leq Night [dB(A)]	Leq [dB(A)]
N1	Project Site	51.6	42.6	50.1
N2	Vyassarpadi	53.9	43.1	52.3
N3	Kaviyarasu Kannadasan Nagar	52.7	42.9	51.1
N4	Madhavaram	51.9	42.2	50.3
N5	Manali	54.8	43.6	53.2
N6	Tondaiyarpet	53.4	43.1	51.8
N7	Edayanchavadi	50.8	41.5	49.2
N8	Manali New Town	53.6	42.8	52

3. 7 WATER ENVIRONMENT

3.7. 1 Surface Water

Buckingham Canal is situated at a distance of 2 Kms. Sampling has been collected in Ennore creek(SW2) and Buckingham canal(SW1) and it is given in **Table 3.6**. Ennore creek is a backwater located in Ennore, Chennai along the coromandel coast of Bay of Bengal. The creek covers an area of 2.25 Km^2. The creek is nearly 400m wide, elongated in northeast-southwest direction and merging with the backwater bodies. The north-south trending channels of the creek connect it with the pulicat lake to the north and to the distributaries of the kosasthalaiyar river in the south.

Remarks: Sampling locations was so chosen near the proposed pipe carrying bridge of the conveying main.

3.7. 2 Ground Water

Ground water table in the study area during pre-monsoon is about 2.0 m BGL and about 1.5 mt BGL during post monsoon period

3.7. 3 Baseline Water Quality

Detailed water quality assessment is necessary in areas where there is intensive ground water development, Industrialization and urbanization as it is also subjected to qualitative changes in the environment around. Quality of water is influenced considerably by the quality of its source and occurrence. In order to describe and assess

the impact on water quality by the proposed project, ground water and surface water samples at 10 locations were collected within the 10 km radius and tested for physical and chemical parameters.

3.7. 4 Sampling and Analysis

Initially, reconnaissance survey was carried out to identify suitable water sample collection locations. During the reconnaissance survey on site, TDS and pH were tested and the locations were captured using GPS. While selecting the sampling locations for detailed hydro geochemical analysis the following were given much importance.

- Those water bodies on which human activities could have an impact, either by utilizing water or by discharging effluents.
- Water abstraction and utilization by domestic users.

Eight water sources were selected for sampling for ground water and two surface water sampling was done one each in B'Canal and Ennore creek during this period. The location and source of water samples collected are given in **Table 3.5** and **3.6**.

Table 3. 5 - Ground Water quality results

S.No	Parameters	Unit	Test method	Limit as per IS 10500 : 2012	W1	W2	W3	W4
1	Colour	Hazen	APHA 22nd EDITION	5	Nil	1	4	Nil
2	Odour	-	APHA 22nd EDITION	Unobjectionable	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2002)	6.5-8.5	6.86	7.47	6.75	7.41
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2002)	Not Specified	2760	6310	4328	1097
5	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2002)	1	0.9	0.6	3.1	1.2
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2003)	500	1610	3501	2398	661
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009	200	770	956	359	259
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2003)	200	200	220	400	340
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2003)	250	694	1715	1005	55
10	Sulphate as SO_4	mg/l	APHA 22nd EDN- 4500- SO_4^{2-} E	200	160	271	237	68

11	Fluoride as F	mg/l	APHA 22nd EDN- -4500-F B&D	1.0	0.89	0.54	0.88	0.50
12	Nitrate as NO_3	mg/l	APHA 22nd EDN- -4500- NO_3^- B	45	22	84	11	69
13	Ammonia as N	mg/l	APHA 22nd EDN- -4500- NH_3 B&C	0.5	2.6	5.17	0.45	0.14
14	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2002)	Not Specified	3.54	3.57	6.63	0.92
15	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	260	920	750	122
16	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	7.8	52	32	106
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2003)	75	208	208	72	76
18	Magnesium as Mg	mg/l	APHA 22nd EDITION	30	61	106	44	17
19	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.3	0.52	0.21	0.41	BDL (<0.05)
20	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006	Not Specified	16	18	10.6	BDL(<4)

W1- Project Site, W2- Kodungaiyur, W3-Manali Housing Board, W4- Manali New Town

S. No	Parameters	Unit	Test method	Limit as per IS 10500 : 2012	W5	W6	W7	W8
1	Colour	Hazen	APHA 22nd EDITION	5	3	1	Nil	1
2	Odour	-	APHA 22nd EDITION	Unobjectionable	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2002)	6.5-8.5	7.12	7.40	7.21	7.26
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2002)	Not Specified	3120	3980	5310	3670
5	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2002)	1	1.6	1.3	2.1	0.8
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2003)	500	1660	2266	3132	1936
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009	200	657	458	598	946
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23-1986(Reaff:2003)	200	480	540	430	400
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2003)	250	403	813	1067	620
10	Sulphate as SO_4	mg/l	APHA 22nd EDN- 4500-SO_4^{2-} E	200	242	233	752	416
11	Fluoride as F	mg/l	APHA 22nd EDN- -4500-F	1.0	0.67	1.48	0.71	0.62

			B&D					
12	Nitrate as NO_3	mg/l	APHA 22nd EDN- -4500-NO_3^- B	45	91	1.7	1	12
13	Ammonia as N	mg/l	APHA 22nd EDN- -4500-NH_3 B&C	0.5	1.61	1.86	0.25	0.20
14	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2002)	Not Specified	0.34	0.07	0.54	0.06
15	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	270	710	680	316
16	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	Not Specified	64	8.2	24	15
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2003)	75	174	80	140	220
18	Magnesium as Mg	mg/l	APHA 22nd EDITION	30	54	63	61	97
19	Iron as Fe	mg/l	IS : 3025 Part 53-2003	0.3	BDL(<0.05)	0.16	0.49	0.22
20	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006	Not Specified	12.2	8.1	10.3	BDL(<4)

W5- Nappalayam, W6- Kondakarai, W7- Athipet, W8- Pattamandhri, BDL- Below Detection Limit

Table 3. 6 - Surface Water Quality Results (Buckingham Canal and Ennore Creek)

S. No	Parameters	Unit	Test method	SW1	SW2
1	Colour	Hazen	APHA 21st EDITION	37	16
2	Odour	-	APHA 21st EDITION	Odour Observed	Odour Observed
3	pH at 25°C	-	IS : 3025 Part 11- 1983 (Reaff: 2002)	7.39	8.04
4	Electrical Conductivity,	µS/cm	IS : 3025 Part 14- 1984 (Reaff: 2002)	3050	56100
5	Turbidity	NTU	IS : 3025 Part 10-1984 (Reaff: 2002)	9.6	1.1
6	Total Dissolved Solids	mg/l	IS : 3025 Part 16-1984 (Reaff: 2003)	1580	34800
7	Total Hardness as $CaCO_3$	mg/l	IS : 3025 Part 21-2009	393	6400
8	Total Alkalinity as $CaCO_3$	mg/l	IS : 3025 Part 23- 1986(Reaff:2003)	550	136
9	Chloride as Cl	mg/l	IS : 3025 Part 32-1988 (Reaff: 2003)	500	19100
10	Sulphate as SO_4	mg/l	APHA 21st EDI-4500- SO_4^{2-} E	86	2690
11	Fluoride as F	mg/l	APHA 21st EDI-4500-F B&D	0.55	1.64
12	Nitrate as NO_3	mg/l	APHA 21st EDI-4500- NO_3^- B	1.9	1
13	Ammonia as NH_3	mg/l	APHA 21st EDI-4500- NH_3 B&C	51.5	1.89

14	Phosphate as PO_4	mg/l	IS : 3025 Part 31-1988 (Reaff:2002)	15	1.67
15	Sodium as Na	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	380	11300
16	Potassium as K	mg/l	IS : 3025 Part 45-1993 (Reaff:2003)	37	398
17	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2003)	82	407
18	Magnesium as Mg	mg/l	APHA 21st EDITION	46	1213
19	Iron as Fe	mg/l	IS : 3025 Part 53-2003	13.9	0.11
20	Anionic Surfactants as MBAS	mg/l	APHA 21st EDI 5540 C	0.22	BDL(<0.025)
21	Total Suspended Solids	mg/l	IS : 3025 Part 17-1984 (Reaff: 2002)	41	8
22	Dissolved Oxygen as O_2	mg/l	IS:3025:Part-38:1989 (Reaff:2003)	4.8	6.4
23	Chemical Oxygen Demand	mg/l	IS:3025:Part-58:2006	417	24
24	Bio-Chemical Oxygen Demand at 27° C for 3 days	mg/l	IS:3025:Part-44:1993 (Reaff:2003)	94	3.7
25	Total Coliforms	MPN/100ml	IS 10500 – 1622 (1981) (Reaff – 2003)	>161/100ml	16/100ml
26	Faecal Coliforms	MPN/100ml	IS 10500 – 1622 (1981)(Reaff – 2003)	>161/100ml	11/100 ml

SW1 – Buckingham canal, SW2 – Ennore Creek (13°12'50.57"N, 80°18'50.43"), BDL – Below Detection limit

3.7. 5 Observations

A) Ground water resources

- The pH of ground water in the study area varies between 6.75 to 7.47 and Conductivity varies from 1097 to 6310 µS/cm.
- TDS values were found to be from 661 to 3132 mg/l and Total Hardness varied from 359 – 956 mg/l. This indicates that water in the study area were very hard in nature. The Total alkalinity also varies from 200 to 540 mg/L.
- Sodium and potassium are naturally occurring elements of groundwater. Industrial and domestic wastes also add sodium to groundwater. It is one of the major contributors to salinity of water. The concentration of sodium in the studied samples varied from 260 to 920 mg/l. The potassium content ranged from 7.8 to 106 mg/l.
- The chloride content in the studied area ranged from 55 - 1715 mg/l. The sulphate, nitrate and fluoride content in the ground water are found to be within the IS standards in all the samples.

B) Surface Water Resources

Buckingham canal

- The pH of surface water is slightly alkaline in nature and Conductivity is about 3050 µS/cm which indicate that water is saline in nature.
- TDS values was found to be 1580 mg/l. Perusal on the ionic contents of the surface water sources, the quality of surface resource are fresh to brackish in nature.
- Based on the physic-chemical analysis, the surface water samples are unacceptable for drinking purposes.
- Dissolved oxygen levels of the surface water are more than 94 mg/l which indicate that surface water source are good medium for aquatic life.
- It is also noted that coliforms are observed in the surface water samples (>161/100ml)
- The quality of Buckingham Canal water does not support aquatic life adequately due to discharge of treated effluent from Industries

Ennore Creek:

- The pH of surface water is slightly alkaline in nature and Conductivity is about 56100 µS/cm which indicate that water is saline in nature.
- TDS values was found to be 34800 mg/l. Perusal on the ionic contents of the surface water sources, the quality of surface resource are fresh to brackish in nature.
- Based on the physic-chemical analysis, the surface water samples are unacceptable for drinking purposes.
- Dissolved oxygen levels of the surface water are more than 6.4 mg/l which indicate that surface water source are good medium for aquatic life.
- It is also noted that coliforms are observed in the surface water samples (>16/100ml).

3.8 LAND ENVIRONMENT

It is essential to determine the type & quality of .soil in the study area and identify the current impacts of urbanization on soil quality and also predict probable impacts due to the proposed plant. Accordingly, a study of assessment of the baseline soil quality was carried out.

For studying soil quality of the region, sampling locations were selected to assess the existing soil conditions in and around the 'Project area based on various land use conditions. The physical and chemical concentrations were determined. The samples were collected from different specified depths viz., 30cm, 60cm and 100cm

The present study of the soil quality establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the proposed plant. The sampling locations have been identified with the following objectives;

- To determine the baseline soil characteristics of the study area.
- To determine the impact of proposed project on soil characteristics and
- To determine the impact on soils more importantly loss of fertility from agricultural productivity point of view.

Various locations within 10-km radius of the plant site were selected for soil sampling. At each location, soil samples were collected from three different depths viz., 30cm, 60cm, and 100cm below the surface. The samples were analyzed for physical and chemical characteristics. The samples have been analyzed as per the established scientific methods for physico-chemical parameters.

3.8. 1 Soil Characteristics

a) Soil Type

Soil type and its fertility of an area are essential to plan for cropping. Soils are primarily derived from parent rocks. The colour, texture and mineral content are normally used to classify the soil. The soil in the study area is classified into 3 types. They are as follows.

S. No	Soil Classification
1	Deep, moderately well drained, calcareous, clayey soils
2	Very shallow somewhat excessively drained, gravelly loam soils
3	Moderately deep, moderately well drained, gravelly clay soils

Sandy clay soil type is present in of the study area.

b) Soil quality

To assess the soil quality in the study area, soil sample was collected and analyzed for physical and chemical parameters as per the standard methods. The sampling locations are given in **Table 3.7**.

Table 3.7 - Soil Analysis Results

S. No.	Parameters	S1	S2	S3	S4	S5	S6	S7	S8
1	pH	8.46	8.28	8.36	7.85	8.66	8.26	8.33	8.45
2	Electrical Conductivity, mS/cm	1.324	0.464	0.242	0.174	0.752	0.924	0.562	0.352
3	Available Nitrogen, mg/kg	129	32	43	33.6	114	64	48	61.6
4	Available Phosphorous, mg/kg	84	41.7	54.3	38.4	96	81.6	53.6	74.6
5	Available Potassium, mg/kg	411	238	266	184	315	214	302	270
6	Exchangeable Calcium as Ca, m.eq / 100g	6.82	5.27	6.12	3.85	4.96	5.26	4.17	5.64
7	Exchangeable Magnesium as Mg, m.eq/100g	5.36	4.74	5.36	2.72	3.84	4.32	3.28	4.36
8	Exchangeable Sodium as Na, m.eq / 100g	1.48	1.22	1.08	0.67	1.74	1.18	1.27	1.45
9	Organic matter (%)	0.74	0.56	0.47	0.38	0.58	0.47	0.52	0.37
10	Texture Classification	Clay	Clay	Sandy Clay	Sandy Clay Loam	Clay	Clay	Clay	Clay
11	Sand (%)	28.4	32.0	52.1	55.6	31.2	36.4	35.5	36.8
12	Clay (%)	66.5	44.2	36.4	23.8	57.5	52.8	42.6	48.2
13	Silt (%)	5.1	23.8	11.5	20.6	11.3	10.8	21.9	15.0
S1- Project Site, S2- Vyassarpadi , S3- Kaviyarasu Kannadasan Nagar ,S4- Madhavaram, S5- Manali, S6- Tondaiyarpet , S7- Edayanchavadi, S8- Manali New Town									

3.8. 2 Discussion

The pH indicates that the soils in the study areas are basic in nature, with the pH varying in the range of 7.85 to 8.66. The Electrical Conductivity was observed in the range of 0.174-1.324 ms/cm.

The Nitrogen values are in the range of 32 – 114 mg/kg indicating that soils have very low Nitrogen levels. The Phosphorous values are in the range of 38.4 – 96 mg/kg indicating that soils have an average Phosphorous levels. The Potassium values range between 184 – 411 mg/kg, which indicate that the soils have better quantity of Potassium. The Organic matter (%) values range between 0.38 - 0.74. The soil from the study area shows that they are less fertile.

3. 9 BIOLOGICAL ENVIRONMENT

The existing Flora and Fauna in the study area is mentioned below. As per Botanical Survey of India records and available published literature pertaining to the study area and current detailed study of project site, no threatened, endangered and rare plant species were observed from the study area.

No reserve forest, protected forest, turtle breeding ground, elephant and /or tiger reserve is within 10 km radius of the project site. However the alignment runs parallel to Buchingham canal and crosses Ennore creek for distribution. So these have been considered for the study and the details are given below.

The stretch of B.canal where conveying main has been proposed to be laid do not have any significant impact on flora and fauna. Migratory birds were not observed frequently during the study period. Birds like green shank, purple moorhen, barbet and cormorant are spotted in North Chennai occasionally and besides the rare ones, common birds like coot, egret and kingfisher are always there. City wildlife warden K. Geethanjali says that there are calls or information of unusual sightings of flamingos and pelicans in north Chennai [*Source: Deccan chronicle dated 22 Feb 2015*].

3.9.1 Marine Ecology

a) Phytoplankton

Samples were collected from two locations. One at Ennore Creek mouth and another at Northern part of the North break water. Plankton samples were collected by using

Plankton net of 20 [tm. The diameter of the mouth of net is 40 cm and length is 100 cm. The speed of net towed was restricted to <5 knots. The collected sample was filtered through net and was stored in sterile bottle, after preserving the same with the addition of Lugol solution.

The volume of water was determined by using following formula:

$V = r^2.d$

Where:

V = Volume of water filtered through net.

r = Radius at the mouth of the net.

d = Distance through which the net towed.

The collected samples

The diversity of plankton species was evaluated by the most widely used Shannon Diversity Index. The formula for the calculation of the Shannon diversity index is given below:

$$H = \sum_{i=1}^{S} - (P_i * \ln P_i)$$

Where:

H = the Shannon diversity index

P, = fraction of the entire population made up of species

i S = number of species encountered

E = sum from species `1' to species 's'

The list of phytoplankton species identified and its diversity and density during the Monsoon, Post Monsoon and Pre Monsoon Seasons are given in **Table 3.8, 3.9 & 3.10.**

It can be inferred from the table that during the Pre Monsoon Season the diversity of phytoplankton species, the least biodiversity was observed at sampling location, PP-1 (in Ennore Creek mouth) and the highest diversity was observed at PP-2 (near North of Northern breakwater). The density ranged from 111 to 270 individual/ litre. In the Monsoon the diversity was in the range of 0.84 — 1.21, which denotes low to normal diversity. The density was in the range of 88 — 139 individual/ litre. In the Post Monsoon the diversity was in the range of 1.20 —2.48, which denotes normal to high

diversity. The highest density was observed at PP-2. In the Pre Monsoon the diversity was in the range of 2.9 — 4.1, which denotes very high diversity. The density was in the range of 171 — 301 individual/ litre and the highest diversity was observed at station PP-2. From the results it is evident that, the phytoplankton diversity and density was higher during Pre Monsoon season when compared with Monsoon season.

Table 3.8 - Diversity and Density of Phytoplankton in Monsoon Season

S. No.	Name	PP-1	PP-2
1	**Spermatophyta**		
(i)	Azolla Sp.	x	x
(ii)	Spirodela Sp.	x	x
2	**Chlorophyta**		
(i)	Westella	y	y
(ii)	Selenastrum	x	x
(iii)	Chlorella Sp.	y	x
(iv)	ClostriumSp	x	x
(v)	MougeotiaSp	y	y
(vi)	Oocystis Sp.	y	x
(vii)	Stichococcos Sp.	y	x
(viii)	Tetrastrum Sp.	x	x
(ix)	Chlamydomonas Sp.	y	x
(x)	Pediastrum Sp.	x	y
(xi)	Volvox Sp.	y	x
(xii)	Zygnema Sp.	x	x
(xiii)	Ulothrix Sp.	x	x
(xiv)	Dictyosphaerium Sp.	x	x
3	**Cyanophyta**		
(i)	Gloetrichia Sp.	x	y
(ii)	Phormidium Sp.	y	x
(iii)	Lyngbya Sp.	x	x
(iv)	Oscillatoria Sp.	x	x
(v)	Fragelira Sp.	y	x
(vi)	Althrospira Sp.	x	x
(vii)	Cylindrospermum Sp.	x	x
4	**Diatoms (Bacillareophyceae)**		
(i)	Tabellaria Sp.	x	x
(ii)	Synedra Sp.	x	y
(iii)	Navicula Sp.	y	x
5	**Chrysophyta**		

(i)	Cocconeis Sp.	x	x
(ii)	Achnanthes Sp.	x	x
(iii)	Cyclotella Sp.	x	y
(iv)	Rhizosolenia Sp.	x	x
6	**Xanthothytea**		
(i)	Botryococcus Sp.	x	y
7	**Rhobophyta**		
(i)	Gracilaria Sp.	x	x
(ii)	Champia Sp.	x	x
Diversity Index		0.84	0.99
Density (individual/litre)		88	115

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

Table 3.9 - Diversity and Density of Phytoplankton in Post Monsoon Season

S. No.	Name	PP-1	PP-2
1	**Spermatophyta**		
(i)	Azolla Sp.	y	x
(ii)	Spirodela Sp.	x	x
2	**Chlorophyta**		
(i)	Westella	x	x
(ii)	Selenastrum	x	x
(iii)	Chlorella Sp.	x	x
(iv)	ClostriumSp	y	x
(v)	MougeotiaSp	x	x
(vi)	Oocystis Sp.	x	x
(vii)	Stichococcos Sp.	x	y
(viii)	Tetrastrum Sp.	x	x
(ix)	Chlamydomonas Sp.	y	x
(x)	Pediastrum Sp.	x	x
(xi)	Volvox Sp.	x	x
(xii)	Zygnema Sp.	x	y
(xiii)	Ulothrix Sp.	x	y
(xiv)	Dictyosphaerium Sp.	y	x
3	**Cyanophyta**		
(i)	Gloetrichia Sp.	x	x
(ii)	Phormidium Sp.	x	y
(iii)	Lyngbya Sp.	y	x
(iv)	Oscillatoria Sp.	y	y
(v)	Fragelira Sp.	y	x
(vi)	Althrospira Sp.	x	x

(vii)	Cylindrospermum Sp.	y	x
4	**Diatoms (Bacillareophyceae)**		
(i)	Tabellaria Sp.	x	x
(ii)	Synedra Sp.	y	y
(iii)	Navicula Sp.	y	y
5	**Chrysophyta**		
(i)	Cocconeis Sp.	y	y
(ii)	Achnanthes Sp.	x	y
(iii)	Cyclotella Sp.	x	y
(iv)	Rhizosolenia Sp.	y	x
6	**Xanthothytea**		
(i)	Botryococcus Sp.	y	y
7	**Rhobophyta**		
(i)	Gracilaria Sp.	x	y
(ii)	Champia Sp.	x	y
Diversity Index		1.87	2.48
Density (individual/litre)		178	270

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

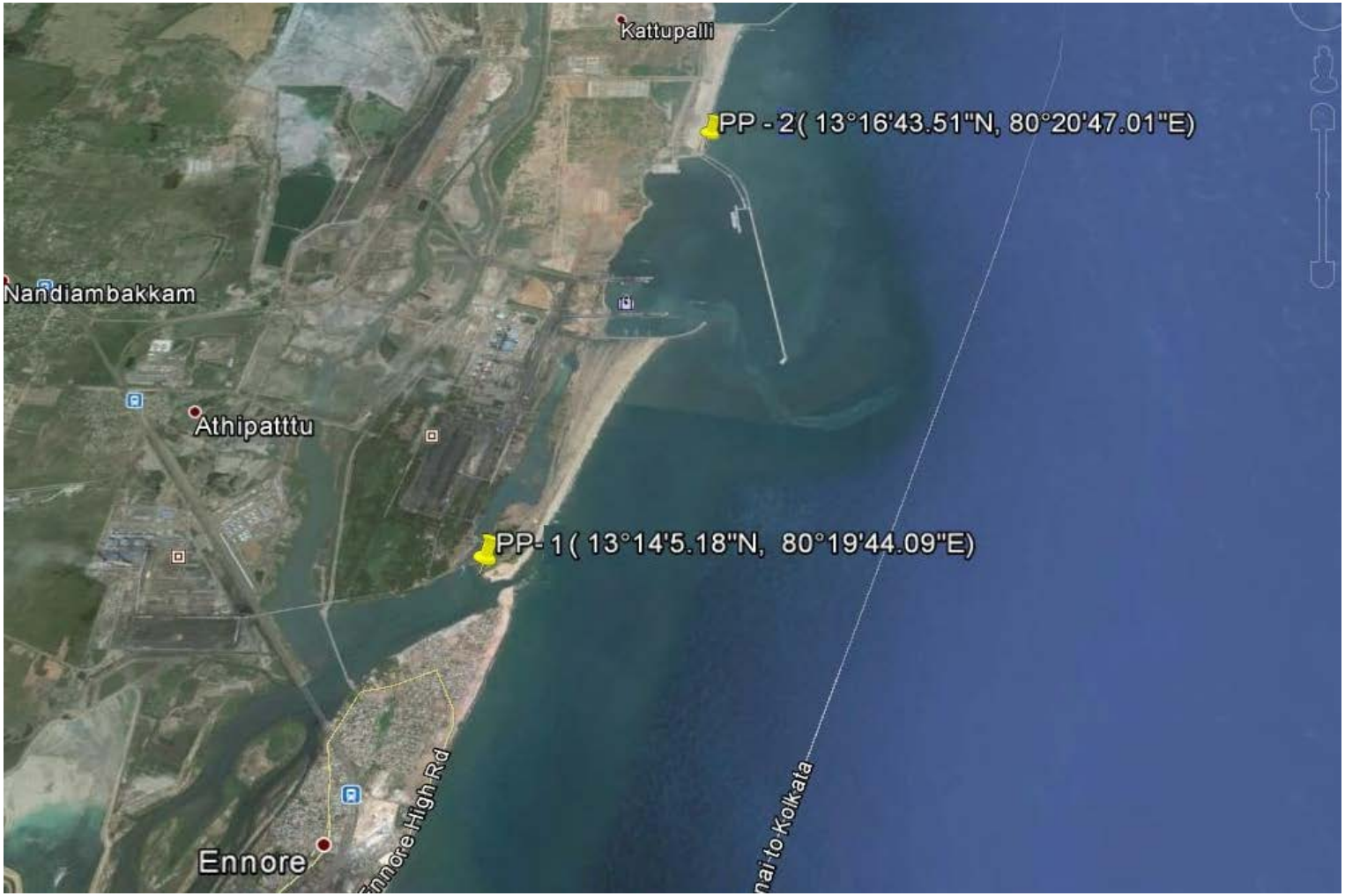
Table 3.10 - Diversity and Density of Phytoplankton in Pre Monsoon Season

S. No.	Name	PP-1	PP-2
1	**Spermatophyta**		
(i)	Azolla Sp.	y	y
(ii)	Spirodela Sp.	y	y
2	**Chlorophyta**		
(i)	Westella	x	x
(ii)	Selenastrum	y	x
(iii)	Chlorella Sp.	x	y
(iv)	ClostriumSp	y	y
(v)	MougeotiaSp	y	x
(vi)	Oocystis Sp.	x	y
(vii)	Stichococcos Sp.	y	x
(viii)	Tetrastrum Sp.	y	y
(ix)	Chlamydomonas Sp.	y	x
(x)	Pediastrum Sp.	y	x
(xi)	Volvox Sp.	y	x
(xii)	Zygnema Sp.	y	x

(xiii)	Ulothrix Sp.	y	x
(xiv)	Dictyosphaerium Sp.	y	y
3	**Cyanophyta**		
(i)	Gloetrichia Sp.	y	x
(ii)	Phormidium Sp.	y	y
(iii)	Lyngbya Sp.	x	x
(iv)	Oscillatoria Sp.	y	x
(v)	Fragelira Sp.	y	y
(vi)	Althrospira Sp.	y	x
(vii)	Cylindrospermum Sp.	y	x
4	**Diatoms (Bacillareophyceae)**		
(i)	Tabellaria Sp.	y	y
(ii)	Synedra Sp.	y	y
(iii)	Navicula Sp.	y	y
5	**Chrysophyta**		
(i)	Cocconeis Sp.	y	x
(ii)	Achnanthes Sp.	y	x
(iii)	Cyclotella Sp.	y	x
(iv)	Rhizosolenia Sp.	y	x
6	**Xanthothytea**		
(i)	Botryococcus Sp.	y	x
7	**Rhobophyta**		
(i)	Gracilaria Sp.	y	x
(ii)	Champia Sp.	y	x
Diversity Index		3.6	4.1
Density (individual/litre)		198	199

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

Figure 3.2 - Sampling Location of Phytoplankton



b) Zooplankton

Sample collection was carried out in the similar method as that of phytoplankton. The result of the zooplankton analysis is tabulated in **Table 3.11, Table 3.12 and Table 3.13.** The least biodiversity (Diversity Index DI — 1) was observed at sampling location ZP-2 and the highest biodiversity was observed at ZP-1. The density was in the range of 156-350 individual/litre. Locations of ZP1 and ZP2 are shown in the **Figure 3.2.**

In the Monsoon the diversity was in the range 0.70 — 1.20, which denotes low to normal diversity. In the Post Monsoon the diversity was in the range of 2.20 — 4.60, which denotes normal to high diversity. And in the Pre Monsoon the diversity was in the range 2.10 — 4.60, which denotes very high diversity. The density was in the range 156 — 370 and highest was observed at ZP-2.

From the results it is evident that, the zooplankton diversity and density was higher during Pre Monsoon season when compared with Monsoon season.

Table 3.11 - Diversity and Density of Zooplankton in Monsoon Season

S. No.	Name	ZP-1	ZP-2
1	**Protozoa**		
(i)	Naegleria Sp.	x	y
2	**Coelenterates**		
(i)	Gonotheca	x	x
3	**Rotifers**		
(i)	Philodina Sp.	x	x
(ii)	Euchlanis Sp.	y	x
(iii)	Proales Sp.	x	y
(iv)	Flagellates Sp.	y	x
(a)	Ceratium	x	x
(b)	Peridinium	x	x
(v)	Monostyla	x	y
(vi)	Keratella Sp.	x	y
(vii)	Brachionus Sp.	x	x
4	**Cladocera**		
(i)	Daphnia Sp.	y	x
5	**Ostracoda**		
(i)	Ostracod Sp.	x	x
6	**Flagellate**		
(i)	Cerocomonas	x	y
(ii)	Dinomonas Sp.	x	y
7	**Leptostraca7**		

(i)	Epinebalia Sp.	y	x
8	**Ciliates**		
(i)	Pleuronenema Sp.	y	x
(ii)	Aspidisca Sp.	x	x
	Copepoda		
	Diaptomus	x	x
	Crustacea		
(i)	Daphnia Sp.	y	x
(ii)	Cyclops Sp.	x	y
Diversity Index		0.98	0.70
Density (individual/litre)		88	62

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

Table 3.12 - Diversity and Density of Zooplankton in Post Monsoon Season

S. No.	Name	ZP-1	ZP-2
1	**Protozoa**		
(i)	Naegleria Sp.	y	x
2	**Coelenterates**		
(i)	Gonotheca	x	y
3	**Rotifers**		
(i)	Philodina Sp.	x	x
(ii)	Euchlanis Sp.	x	x
(iii)	Proales Sp.	y	x
(iv)	Flagellates Sp.	y	x
(a)	Ceratium	y	x
(b)	Peridinium	y	x
(v)	Monostyla	x	x
(vi)	Keratella Sp.	x	x
(vii)	Brachionus Sp.	x	x
4	**Cladocera**		
(i)	Daphnia Sp.	y	y
5	**Ostracoda**		
(i)	Ostracod Sp.	x	x
6	**Flagellate**		
(i)	Cerocomonas	x	x
(ii)	Dinomonas Sp.	x	x
7	**Leptostraca7**		
(i)	Epinebalia Sp.	x	y
8	**Ciliates**		
(i)	Pleuronenema Sp.	x	x
(ii)	Aspidisca Sp.	x	x
	Copepoda		
	Diaptomus	x	x
	Crustacea		
(i)	Daphnia Sp.	x	x
(ii)	Cyclops Sp.	x	x
Diversity Index		1.68	1.96

Density (individual/litre)	161	120

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

Table 3.13 - Diversity and Density of Zooplankton in Pre Monsoon Season

S. No.	Name	ZP-1	ZP-2
1	**Protozoa**		
(i)	Naegleria Sp.	y	x
2	**Coelenterates**		
(i)	Gonotheca	Y	y
3	**Rotifers**		
(i)	Philodina Sp.	X	y
(ii)	Euchlanis Sp.	y	x
(iii)	Proales Sp.	x	X
(iv)	Flagellates Sp.	Y	y
(a)	Ceratium	X	y
(b)	Peridinium	y	X
(v)	Monostyla	y	X
(vi)	Keratella Sp.	x	X
(vii)	Brachionus Sp.	y	X
4	**Cladocera**		
(i)	Daphnia Sp.	x	y
5	**Ostracoda**		
(i)	Ostracod Sp.	y	x
6	**Flagellate**		
(i)	Cerocomonas	x	x
(ii)	Dinomonas Sp.	x	x
7	**Leptostraca7**		
(i)	Epinebalia Sp.	x	y
8	**Ciliates**		
(i)	Pleuronenema Sp.	x	x
(ii)	Aspidisca Sp.	y	y
	Copepoda		
	Diaptomus	y	y
	Crustacea		
(i)	Daphnia Sp.	y	y
(ii)	Cyclops Sp.	x	x
Diversity Index		4.45	4.60
Density (individual/litre)		350	320

Note - x: denotes absence of species; y: denotes presence of species at the sampled location.

Figure 3.3 - Sampling Location of Zooplankton

3.9. 2 Flora

Some of the common plant species found in the study area *Arecaceae, Tamarindus indica, Eucalyptus sp., Azadirachta indica* etc.

- *Acacia arabica*
- *Bambusa arundinacea*
- *Pongamia pinnata*
- *Euphorbia hypericifolia L.*

Field studies conducted to assess fauna in study area. On the basis of field studies and secondary sources, there are no endangered animal species present in the study area.

3.9.3 Fauna

Scientific Name	English Name/Local Name
Aves	
Quilis contronix	Grey quail
Corvus splendens	House crow
Pycnonotus jokokus	White browed bulbul
Tchitrea paradisi	Paradise flycatcher
Passer domisticus	House sparrow
Cinnyris asiatica	Purple sunbird
Megalaima merulinus	Indian cuckoo
Hierococys varius	Common Hawk Cuckoo
Centropus sinensis	Crow pheasant
Reptiles	
Ptyas mucosus	Rat snake
Nerodia piscator	Fresh water snake
Naja	Cobra
Vipera russeli	Viper
Calotes versicolor	Garden lizard
Amphibian	
Rana hexadactyla	Frog
Rana tigrina	Bull frog
Mammals	
Funambulus Sp.	Squirrel
Rattus norvegicus	Field mouse

3. 10 SOCIO-ECONOMIC ENVIRONMENT

Review of secondary data (District Census Statistical Handbooks - 2011) with respect to population, occupation structure and infrastructure facilities available for 10 km radius study area. As per 2011 census the study area had a total population of 41617. Socio-Economic status of the population is an indicator for the development of the region. Any developmental project of any magnitude will have a bearing on the living conditions and on the economic base of population in particular and the region as a whole. Similarly, the proposed activities will have its share of socio-economic influence in the study area. The section delineates the overall appraisal of society relevant attributes. The data collection for evaluation of impact of proposed project on socioeconomic aspects in the study area has been done through primary household survey method and through the analysis of secondary data collected for the given study area. Population of the following villages in the impact area is furnished in **Table 3.14.**

IMPACT ON NEARBY SENSITIVE RECEPTORS

Nearest Receptor	Distance (km)	Impact of Noise	Impact of Dust
Thiruthangal Nadar College	0.76	• The relatively short term nature and small scale of the works suggest that generated noise levels will not be excessive or cause any major long term nuisances or inconvenience • The works are not considered to present a significant contribution to background noise levels and hence to the local or wider environment, except on a very short term scale. • Any equipment at the pumping station capable of transmitting audible ground borne vibration to nearby houses should be adequately vibration isolated	• The material transported to the construction site will be covered and where appropriate wetted, to minimize dust nuisance. Similarly, care will be taken to minimize dust nuisance arising from the transport of waste material from the work sites. • The local air quality will not be significantly impacted upon by the works. • The generation of dusts is not considered be significant and will not present any long term problems or nuisances to the surrounding area.
Our Lady's MHSS,M.R Nagar	1.7		
Grace MHSS, Senthil Nagar	1.6		
Don Bosco School, KKD Nagar	1.8		
Noor Hospital	1.7		
NRV Hospital	2.6		
Mosque near Thiruthangal Nadar College	0.8		
Kalsathamman Temple	1.3		
Our Lady of Health Shrine, Muthamil Nagar	1.9		

The nearest sensitive receptors to the site are Thiruthangal Nadar College which is 0.76Km and Mosque near Thiruthangal Nadar college which is 0.8Km to the site. There are schools and hospitals nearest to the site but they are not within 1Km radius of the site.

Table 3.14 - Population Details of the Nearby Villages (As per Census 2011)

S. No	Village/ Town name	Total no. of Household	Total no. of Male	Total no. of Female	Total no. of Population	Total no. of Male-SC Population	Total no. of Female-SC Population	Total no. of SC Population	Total no. of Male-ST Population	Total no. of Female-ST Population	Total no. of ST Population
1	Kodungaiyur	42992	168387	84085	84302	15741	15843	31584	98	102	200
2	Chinna Sekkadu	3238	6365	6031	12396	1875	1790	3665	6	7	13
3	Manali	11034	22791	22953	45744	1239	1316	2555	11	10	21
4	Thiruvottiyur	63862	125300	124146	249446	13782	13121	35332	245	257	502
5	Madavaram	29792	119105	59887	59218	7352	7412	14764	333	153	180
6	Tondaiarpet	3422	8124	7711	15835	599	657	1256	26	8	26
7	Thiru Vi Ka Nagar	58890	118040	117082	235122	16964	16740	33704	171	157	328
8	Moolakadai	7226	16030	16122	32152	8130	8468	16598	25	19	44
9	Perambur	10127	22605	22304	44909	7242	7381	14623	15	13	28
10	Athipattu	2762	5623	5411	11034	2251	2254	4505	147	152	299
11	Kolathur	18420	36618	35526	72144	4074	3951	8025	221	67	288
12	Kathivakkam	9354	18466	18151	36617	2911	2807	5718	65	71	136

I) TRANSPORTATION

Metropolitan Transport Corporation (MTC) runs passenger buses to Kodungaiyur from other major parts of the Chennai city. There are 3 Bus terminuses in Kodungaiyur. They are Kaviarasu Kannadasan Nagar (KKD Nagar), Parvathi nagar & Muthamizh nagar.

As there is no railway line passing through kodungaiyur, residents normally go to Perambur (nearest railway station) or Vyasarpadi Jeeva to travel in trains.

II) COLLEGES

- Thiruthangal Nadar College, Selavayal
- Muthu Kumaraswamy Arts and Science College, Muthamil Nagar

III) SCHOOLS

- St. Ann's Matriculation Higher Secondary School, Tabalpetty, Chennai
- Sacred Heart Matriculation Higher Secondary School, Muthamizh Nagar
- St. Joseph's Matriculation Higher Secondary School, Seetharam Nagar
- Government High school, in K.K.D Nagar
- Don Bosco Matriculation Higher secondary school,Erukkancherry
- Sri Sayee Vivekananda Higher Secondary School, Muthamil Nagar
- Gurumoorthy High school
- FES Matriculation Higher secondary school, Muthamil Nagar
- Our Lady's Matriculation Higher Secondary School, M.R Nagar
- Grace Matriculation Higher Secondary School, Senthil Nagar
- St.Mary's Matriculation School
- Velankani Matriculation Higher Secondary School, Muthamil Nagar
- Sri Ayyappa matriculation school
- Vivekanada Vidyalaya matriculation school
- Lakshmi Narayana Matriculation school, Selavayal
- Oxford Matriculation School
- Bharathi Nursery & Primary School,Block V, KKD Nagar
- Mother Therasa Matriculation Higher Secondary School,KKD Nagar
- Bharathi Nursery & Primary School, Block I, Muthamil Nagar

- CSI Bain Matriculation Higher Secondary School, Muthamil Nagar
- Don Bosco Matriculation Higher secondary school,KKD Nagar
- Radha Krishnan Matriculation Higher secondary school, Krishnamoorthy Nagar
- RC Infantia (Pre School),Kamarajar salai
- Stella Rani welfare trust
- Good Samaritan Primary School,Erukkenchery

IV) NEIGHBOURHOODS

Most notable neighbourhoods in Kodungaiyur are Amudham Nagar, Selavayal, Narayanasamy Garden, Soundarya Nagar, Parvathi nagar, Venkateswara Nagar (Part I & II), Seetharam Nagar, R.V.Nagar, Union Carbide Colony, Sastri nagar, Jambuli newcolony, Ponnusamy Nagar, Krishna Moorthy Nagar, Vivekananda Nagar, Soundarya Nagar, Ambika Nagar,Chinnandi madam etc. Apart from these, Muthamil Nagar, MR Nagar, KKD Nagar, Gandhi Nagar and Parvathi Nagar are most important places.

V) CHURCHES AND TEMPLES

Most famous Churches are

- Church of South India
- ECI Good Shepherd Church, R.V Nagar Junction
- CPIM Church, Parvathi Nagar
- Church Of God in India
- ACA Church
- St. Sebastian's church
- Our Lady of Health Shrine, Muthamil Nagar
- Our Lady Jecintho church
- Good Samaritan Fellowship (Hosanna Tower), Chinnadi Madam Road
- Shekinah Assembly (Worship Center), Opp. Pavithra Hospitals, Erukkancherry.
- Blessing Of Jesus Ministry, Kodungaiyur
- TELC Peniel lutheran church, Thai Nagar, Kodungaiyur.
- Kodungaiyur Christian (Brethren) Assembly, Seetharam Nagar

Temples are

- Bhavani Amman kovil, Muthamil Nagar
- Vembuliamman kovil, Jambuli street
- Guru Vinayagar temple, R.V Nagar
- Venkatesa permual temple, Balaji Nagar
- Sri Siddhi Vinayagar temple, Venkateswara Nagar
- Kalasathamman Koil, Parvathy Nagar
- Shankara Vinayagar temple, Periya Kodungaiyur
- Nagathamman Koil, Union Carbide colony
- Om Shakthi Vinayagar Temple, M.R.Nagar,T.H Road,Chennai.
- Kumbali Amman Koil, Kamarajar Salai, Periya Kodungaiyur, Chennai.
- Sri Kaalikambal kovil, Chinna Kodungaiyur
- Sri Prasana Venkatasa Ramaswamy Perumal Kovil, Parthasarathy Street, Near M.R. Nagar.
- Sri Gangai Amman Koil, Teachers Colony 6th Cross, Kodungaiyur.

Mosques are at

- (masjid-e-al-ameen)Muthamil Nagar
- Chinna kodungaiyur(masjid an-noor makka madrasa) in Gandhi nagar
- Masjid near to thiruthangal nadar college
- Masjid Mohyideen in KKD nagar
- Masjid placed near to Gandhi statue at kodungaiyur
- Masjid in Thiruvalluvar Nagar
- Masjid near to Arul Nagar
- Jumma Masjid in MKB nagar
- Masjid-e-Hussainia in Moolakadai

VI) THEATRE

The only theatre in Kodungaiyur is 'Pandiyan Theatre A/C-dts formerly known as 'Odian Mani Theatre'.

VII) HOSPITAL

The most famous hospital located in Kodungaiyur (Erukanchery) is Pavithra Hospital. Also KVT Health centre had opened a new branch next Pavithra Hospital its Namely "K.V.T Speciality Hospital" Which as a 24/7 Emergency Facility with Multi Speciality Hospital in the Circular.

Other Hospitals are:

- Subha Hospital, Muthamil Nagar
- Noor Hospital, Chinna Kodungaiyur
- Fathima Hospital,Kodungaiyur, Near Moolakadai
- NRV Hospital, Kodungaiyur
- Arjun Hospital, Kaviarasu Kannadasan Nagar
- ESI dispensary, M.R Nagar.

Another hospital with good treatment facilities near to Kodungaiyur is St. Anthony's hospital (Thapalpetti, Madhavaram)

4. ENVIRONMENTAL IMPACT ANALYSIS

4. 1 INTRODUCTION

Environmental Impact can be defined as "any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration". Generally, environmental impacts can be classified as primary or secondary impacts. Primary impacts are those, which are attributed directly by the project while secondary impacts are those, which are induced by primary impacts and include the associated investments and changed patterns of the social and economic activities by the action.

This section identifies and assesses the potential changes in the environment that could be expected from the proposed project. The impacts have been predicted for the proposed activities assuming that the impact due to the existing activities has already been covered under base line environmental monitoring and continue to remains same till the operation of the project. The proposed project activities would create impact on the environment in two distinct phases i.e., construction and operation phases. Impacts are identified, predicted and evaluated based on the analysis of the information collected from following:

- Project information (as discussed in Chapter-2); and
- Baseline information and site visits of the study area (as discussed in Chapter-3);

This section also describes mitigation measures, which have been suggested for the adverse impacts likely to be caused due to activities of both construction and operation phases of the project.

The identification of likely impacts during construction and operational phases of the proposed project has been done based on likely activities having their impact on one or another environmental parameters. The details of the activities and their impacts have been worked out in the following sections.

4. 2 IDENTIFICATION OF LIKELY IMPACTS

Every activity and operation has either adverse or beneficial impacts on the environmental. The environmental impact identification has been done based on proposed project activities. All the activities from construction phase to operational phases of the project have been broadly covered, which is given in **Table 4.1** and **4.2**. The activities and operations are considered on the basis of proposed process as described in the project description **section 2.**

Table 4. 1 - Activity-Impact Identification Matrix for Construction Phase of the Proposed Project

Construction phase		Potential impacts													
Main Activities	**Sub Activities**	**Land use**	**Landscape**	**Land/Soil environment**	**Surface /Ground**	**Water Quality**	**Air Quality**	**Solid waste generation**	**Ambient Noise level**	**Traffic and transport**	**Resource use (Energy)**	**Ecology**	**Socio – economic**	**Culture/ Heritage**	**Agriculture in the**
Site Preparation	Site Clearing & Cleaning Ground leveling Waste handling and its transportation Soil Compaction	✓	✓				✓	✓	✓			✓			
Labour deployment camp siting	Construction of Labour sheds to accommodate labour Supply of water Supply of fuel/ Energy Waste handling & its disposal Sewage disposal		✓	✓	✓	✓	✓	✓			✓		✓	✓	

Excavation	Moving of Heavy Machinery Soil Extraction and Slacking Soil Loading and Transportation for Disposal Various Tools Like Crow Bar Foundations for heavy machinery installation Construction Power through onsite Diesel Generators			✓			✓	✓	✓	✓	✓				✓
Material handling & Storage	Transportation and Unloading of material from trucks Storage &Handling of steel sheets, metals, Fabricated structure, Cement, Concrete, Bricks, Steel etc. Conveyance of material within the project site			✓		✓	✓		✓	✓	✓		✓		
Plant Building construction	Transportation of material to construction site Preparation/ Mixing of construction material Supply of water Operation of construction machinery (like cranes, Concrete Mix Plant, Floor Developer, Forklift etc,) Handling and disposal of construction wastes , Diesel Generator		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

	Operation														
Erection of sheds, installation of Machinery Building Fittings &Furnishing	Erection of sheds -welding/ cutting onsite Installation .of heavy machinery, pumps Mechanical installation and Electrical installation Drilling and Fixing Painting/ White washing Disposal of Wastes (empty paint cans, containers, electrical waste, wooden and metal waste etc.)						✓	✓	✓		✓				
Demobilization of construction equipment	Dismantling of temporary support construction structures/ equipments Removal of construction machinery Transportation of Construction/ Dismantled waste Site cleaning/ washings			✓			✓	✓	✓	✓					
Site Commissioning	Trials functioning of Production &Warehousing units, Conveying and packing system, plumbic fixtures, Electrical gadgets, Fire fighting system, Effluent treatment plant, Lifts etc., Recruitments				✓	✓	✓	✓							

Laying Conveying Main		✓	✓				✓	✓	✓			✓			

Table 4. 2 - Activity: Impact Identification Matrix for Operation Phase of the Proposed Project

Potential Activities	**Air quality**	**Water quality**	**water resource**	**Ground water resource**	**Land and soil quality**	**Noise quality**	**Traffic volume**	**Ecological**	**Land use pattern**	**Socio economic**	**Air quality**	**Cultural impact**	**tourism**	**Onsite risks-hazards**
Transportation of man and utilities materials	✓				✓	✓	✓							✓
Operation of Assembly and Packaging units including labeling, storage and utilities functioning.	✓	✓	✓		✓	✓		✓			✓			✓
Storage of Flammables like High Speed Diesel etc.	✓				✓									✓
Water demand for domestic purposes & utilities etc.,			✓							✓	✓			
Waste water disposal		✓	✓	✓	✓									
Wastes-packaging & other solid waste disposal					✓		✓			✓	✓			✓
Hazardous material and Waste storages	√	√			√		✓			✓				✓
Employment							✓			✓				✓

4. 3 IMPACTS IDENTIFIED

Based on activity – impact interaction matrix for construction and operation phase of the proposed project as shown in **Table 4.1 & 4.2** respectively, following impacts have been identified:

i. Construction phase of proposed project would have impacts on the followings:

- Topography, Land use pattern and Landscape
- Land / Soil Environment
- Surface / Ground Water Resources
- Water Quality
- Ambient Air Quality
- Ambient Noise Quality
- Traffic and Transport
- Ecology
- Socio-economic

ii. Operation phase of the project would have likely impacts on the following

- Air Quality
- Water Quality
- Ground water Resources & Surface water Resources
- Land and Soil Quality
- Noise Quality
- Traffic Volume
- Ecological
- Socio-economic
- Onsite Risks – Hazards

4.3. 1 Construction Phase

The proposed facility is being developed at Kodungaiyur zone, Tamil Nadu. The development period for the initial phase is considered as 2 to 3 years. Design of pipe carrying bridge will be done so as to avoid any obstruction in the flow of Buckingham canal and Ennore creek.

The likely temporary and permanent changes on the topography of the site would be following:

- Local labours will be employed hence is shelter not required.
- Temporary – Movement of construction vehicles like excavators, pay loaders, trucks, other vehicles for bringing construction material and construction work may bring minor temporary change in the land use in and around the site by parking the vehicles on the open spaces and roads near the site and
- Permanent – Erection and installation of the various plant structures and establishment of plant building (manufacturing block, warehouse, office etc.,) and utilities will bring permanent change to the local land use of the site.

a) Impact on Air Quality

- Air quality in and around the project site would be impacted to some extent due to construction and construction related activities. The main impact will be during site leveling, excavation, construction material handling etc., the likely emissions from construction activities would include the following:
- Fugitive dust emissions from excavation work, digging, stacking of soils, filling, handling of construction material, transportation of material, emission due to movement of tyres and plying of heavy construction machinery etc.,
- Traffic movement at the site and also increase in traffic volume on the connecting roads will rest in increase in vehicular emissions and
- Gaseous emissions from operation of diesel generators for power requirement during construction phase.
- However, the fugitive and other emissions due to the construction activities will most likely remain localized and confined to the project area, but adequate mitigation measures would be required to reduce the pollutant concentration and prevent their spread around the site.

b) Impact on Noise Quality

Noise is atmospheric pollution. Noise is an unwanted sound dumped into the atmosphere without regard to the adverse effect it may have. Noise not only interferes

with the communications but also affects peace of mind, health and behavior. Sudden loud sound can cause acute damage to the eardrum and the tiny hair cells in the internal ear whereas prolonged noise result in a temporary loss of hearing or even permanent impairment. It not only causes headache and irritability but also affect the sensory and nervous system of the body.

Any behavioral changes are recorded as a result of exposure to high-level noise not only in human being but also in animals. The undesired sound may cause annoyance. Noise can cause tension in muscles, nervous irritability and strain. Several birds have been observed stop-laying eggs; animal's changes their places, and also stop migration of birds.

The major sources of noise due to construction activities can be classified under three heads.

- Use of heavy machineries and vehicles during construction and demolition.
- Use of transportation during building operation period.
- Operation of D.G. sets.

Noise pollution is the results of the inefficient design of the engines in the vehicles and also the close vicinity of heavy traffic. The short distances between roads and buildings increase the effect of pollution on the buildings and users.

It is envisaged that operation of these construction material will generate noise levels between 75-80 dB (A). The combined effect of these noise sources may cross 90 dB (A) at the construction site, however noise dissipates as it spreads in area beyond the site boundary. There will be requirement of providing adequate mitigation measure so that at the boundary of the construction site, the noise level can be kept less than 75 dB (A).

c) Impact on Water Quality

During the construction process, it is necessary to use pure drinking water to prepare lightweight concrete; In the absence of pure water, the seawater may be used with hydraulic lime and cement. It helps in preventing too quick drying of the-mortar.

However, it is not advisable to use sea water in making pure lime mortar or surkhi mortar because it will lead to efflorescence.

It is assumed that no wastewater will be generated onsite during construction activities except domestic sewage from campsite. While laying 800m pipeline, there will be no contamination of ground water. A major source of terrestrial water quality impact will be run-off from storm water, and site construction activities associated with construction works. Minimal water quality impact is anticipated for lying of inlet pumping mains. Pollutants in the runoff would mainly contain suspended solids from excavation or dredging and/or oil and grease from mechanical equipment operation. Such runoff may pollute the receiving waters when entering the river environment.

The laying of conveying main will be carried out in the right of way of Buckingham canal road. So, the hydrology and quality of Buckingham canal will not be affected.

The anticipated impact from the construction of terrestrial components would be insignificant. Nevertheless, for good site practice and appropriate mitigation measures are recommended to be implemented during construction of new facilities

Impact on Creek/Canal

Pipe carrying bridges will be proposed across Buckingham canal and Ennore Creek. Construction of pipe carrying bridge may affect water regime temporarily and necessary management actions are to be taken during pre construction and construction phase.

With respect to the crossing at creek the proposed pipe carrying bridge will be laid along the existing Ennore creek fly over with pillars parallel to the existing pillars, hence no new impacts are envisaged on the water flow except for temporary during construction.

Migratory birds are normally visiting during winter season. But however there will not be any disturbances for the migratory birds for their movement as the visit of migratory birds is rare and almost nil from March to September and therefore construction of pipe carrying bridges shall be carried out during the period from March to September.

e) Impact on Land - Solid/Hazardous Waste Storage

The following solid wastes are likely to be generated during the initial construction phase:

General Site Wastes

Materials and equipment used on site would produce packaging and container wastes. The volume of general site wastes generated will be dependent on the Contractor's operating procedure and practices. With the implementation of the recommended mitigation measures (including site practices), the potential environmental impacts resulting from the storage, handling and transportation of general site wastes would be minimal.

f) Workforce Wastes

Throughout construction, the workforce would generate general refuse, comprising food scraps, paper, empty containers etc., The amount of general refuse which is likely to arise will be largely dependent on the size of the workforce employed by the contractor. Though with the implementation of waste management practices at the site, it is not expected that there would be any adverse environmental impacts arise from the storage, handling and transportation of workforce wastes.

g) Maintenance and Chemical Wastes

Chemical wastes arising during the construction phase may pose serious environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the Chemical Waste Regulations (CWR). These hazards include:

- Toxic effects to workers;
- Adverse impacts from spills on water gathering ground and other ecological sensitive areas; and
- Fire hazards.

Substances generated are likely to include some chemical wastes such as cleaning fluids, solvents, lubrication oil and fuel. Equipment maintenance activities would also involve

the use of a variety of chemicals, oil and lubricants, including heavy-duty cleaners, organic solvents, degreasers, brake fluids, battery acid and soldering fluids.

h) Ecology

There is no activity of tree cutting for the proposed TTRO plant. Hence, no impact is envisaged on the vegetation in the project site.

i) Socio-economic

As the proposed project is located in the Selaivoyal Village, no negative impact is envisaged on the socio-economic status of the area in terms of acquisition of agriculture land or displacement of people etc, However, the construction phase will require construction workers, which will largely be drawn from the local population and nearby towns. Thus, it will provide temporary employment to number of families and that will be a positive impact due to the proposed project.

The proposed project will also employ skilled people and that may be sought from outside. These people will largely be based in nearby small towns.

Overall, the construction phase will have positive impact on socio-economic condition of the people in the area, as it will provide direct and indirect revenues of income generation.

i) Impact on Traffic

The construction of conveying main shall be done in the berm of the road and the space required for construction will be 2.5m to 3m. There will be obstruction of traffic flow wherever the width of the road is very less.

4.4 MITIGATION MEASURES DURING CONSTRUCTION PHASE

The impacts during the construction phase on the environment would be basically of transient nature and expected to reduce gradually on completion of the construction activities. There will be beneficial impact due to installation of TTRO plant as the treated effluent will be utilized by the industries, thereby conserving fresh water resources. Proposed green belt all around TTRO plant will enhance air quality and aesthetic aspects. In order to mitigate them, the following measures are proposed.

4.4.1 Air Environment

- The impact of emissions both from tyre movements and vehicular exhaust emissions required to be minimized by proper maintenance of vehicles, sprinkling of water on unpaved roads at the construction site and planned movement of vehicles.
- The emissions from diesel generators need to be controlled to minimize impacts of air emissions by optimized operations, orientation at the site and providing adequate stack height for wider dispersion of gaseous emissions.
- Drawn conclusion is that no significant impact on air quality is envisaged due to construction and related activities. Any impact on air quality will likely be restricted within the localized area. Application of adequate mitigation measures by the Construction Management Contractors will further reduce the intensity of such impacts.
- The diesel generators (DG Sets) to be installed will be in conformance with recent requirement of acoustic enclosure to achieve 75 dB (A) level at 1m from its enclosure.
- Wherever materials (aggregates, sand, etc.) are more likely to generate fine airborne particles during operations, nominal wetting by water could be practiced. Workers / labour should be given proper air masks and helmets.
- Stockpiles of imported material kept on site shall be contained within hoarding, dampened and/or covered during dry and windy weather.
- Material stockpiled alongside trenches should be covered with tarpaulins.
- Stockpile of cement should be covered entirely by impermeable sheeting.
- All dusty materials shall be sprayed with water prior to any loading, unloading or transfer operation so as to keep the dusty materials wet.
- Water sprays shall be used during the delivery and handling of sands aggregates and the like.
- Pipes will be brought to the site in well maintained trucks.

ii) Mitigation measures for dust control

- Paving
- Applying Dust Suppressants
- Graveling
- Using Water Sprays
- Reducing Vehicle Speed
- Material storages/warehouses
- Cleaning Up Spills Promptly

4.4.2 Water Environment

- Proper mitigation measures (like provision of sewage collection tank and soak pit for treatment and disposal will be required for the sewage generated onsite during the construction phase. This will minimize any potential impact owing to the escape/discharge of untreated sewage into the nearby land or drain.
- Contaminated runoff from storage should be captured in ditches or ponds with an oil trap at the outlet. Contaminated plastic sheeting should be packed and disposed off site.
- The construction site would be provided with sufficient and suitable toilet facilities for workers to maintain proper standards of hygiene. These facilities include provision of septic tank followed by soak pit and maintained to ensure minimum impact on nearby water bodies and environment;

Noise Environment

- It is also advisable that on site workers using high noise equipment adopt noise personal protective devices;

4.4.3 Land environment

- Mitigation measures should include provision of a collection area where waste can be stored and loaded prior to removal from the site.
- Rapid and effective collection of site wastes will be required to prevent waste materials being blown around by wind, flushed or leached into the environment, and odour nuisance.

- Delivery of material on site must be done over a durable, impervious and level surface, so that first batch of material does not mix with the site surface. Availability of covered storage should be assured. Mobile and covered storage boxes with easy drawing and filling mechanism can be used, which can be used over a number of sites.

4.4.4 Handling of wastes

- Materials classified as chemical wastes will need special handling and storage arrangements before removal for appropriate treatment at the chemical waste treatment facility. Wherever possible opportunities should be taken to reuse and recycle materials. Provided that the handling, storage and disposal of chemical wastes are in accordance with these requirements, adverse environmental impacts should not result.
- Construction is more of management. Proper estimate of material is a very first measure to minimize the undue wastage.
- Bitumen emulsion should be used wherever feasible. Contractors should be encouraged to heat with kerosene, diesel or gas to gradually substitute fuel wood. Fuel wood usage for heating should be limited to unsound log i.e. dead and fallen trees.
- Bitumen should not be applied during strong winds to avoid danger of forest fire. Bitumen emulsion should not be used in rains. No bitumen must be allowed to flow into the side drain. The bitumen drums should be stored in a designated place and not be scattered along the roadside.
- Rubbish, debris and bitumen wastes remaining after blacktop works should be cleaned and disposed off in a safe place.
- Materials wasted on site should be reused at the same place. For example, use of excavated earth in landscaping, or use of waste pieces of floor tiles in floor of porch or outdoor spaces, or use of remaining pieces of glass from window panes into ventilators, skylights and boundary wall, or reuse of ply and other timber pieces into furniture etc.,

- These practices suggest the measures for reduction of waste. However, each type of waste needs special attention and specific kind of management, as the wastes from different activities poses different characteristics.
- Hazardous materials must not be stored near surface waters and should be stored near plastic sheeting to prevent leaks and spills.
- Demolished brick masonry and concrete is a good material for filling. Steel from RCC must be carefully segregated and rest of the material should be crushed on site only. Crushed masonry and concrete is even good for manufacture of synthetic aggregate.
- The recyclable items like metal, plastic should be sent to recyclable industry, and rest of this scrap should be stored in a covered area.

4.4.5 Traffic

- Conveying main will be laid for a length of 500m on the berm of the Kathivakkam highroad of 500 m. During construction phase there may be temporary traffic diversion. But this may be only for short duration. Necessary Barricades, sign board will be erected for the convenience of pedestrians and motorists.
- The construction of conveying main near Kathivakkam high school shall be carried out in such a way that it should not obstruct the flow of traffic as there is traffic congestion. The width of the road at that point is 10m, but only 3m shall be availed for construction and remaining 7m shall be provided for movement of vehicles. The construction work near the school shall be completed as quickly as possible.
- The conveying main will be laid using trenchless technology at the junction where the Buckingham canal road crosses Manali high road to prevent obstruction in the traffic flow. Proper traffic management plan shall be prepared and it shall be implemented only after the approval of the concerned authority.
- All the vehicles passing through Buckingham canal road in Kattukuppam area connecting Kathivakkam High Road shall be diverted through the village road parallel to it. For traffic management in Kattukuppam area, **Chapter** 6 – **Section:** 6.3 shall be referred for guidance.

4.5 OPERATIONAL PHASE

4.5.1 Impact on Air Quality

The key potential air quality impact during the operational phase of the TTRO would be the emissions arising from the operation of D.G. Sets and the fumes / vapours from the storage/handling of chemicals. No impact on Air quality is anticipated along the conveying main.

The use of D.G. sets is anticipated only during power failure and hence is temporary and requires standard measures. The emission from chemicals is expected to be throughout the operation of TTRO and hence needs adequate and specific management measures.

4.5.2 Impact on Noise Environment

- The major noise generating equipment during operational phase is the air blowers, ventilation fans, water pumps and DG Sets.
- All equipments are likely to be operated simultaneously during operational phase except DG Set, which is used as a power backup during power failure at pump station.
- All these are expected to result in increase in existing noise levels within the plant premises and in the immediate surroundings.

Table 4. 3 - Potential Impacts on Noise Environment due to the Proposed Facility

Phase	Potential Noise Sources
Construction	Site Preparation ➢ Heavy Earth moving equipment at site ➢ Soil compaction by vehicles ➢ Construction Activity ➢ Vehicle Movement
Operational	➢ Vehicle movement ➢ Proposed TTRO operations

Table 4. 4 - Noise level of Construction Machinery

Construction machinery	d BA at 2m distance	Mitigation Measures
Truck	85	Operators of heavy machinery and workers in near vicinity should be provided with ear plugs and other safety gears.
Crane	85	
Permissible level	55	

4.5.3 Impact on Water Environment

TTRO intends to treat, treated sewage from STP to fulfil the industrial water requirement. In view of this fresh water demand will be reduced. Fresh water now supplied to the existing industries will be diverted for immediate needs of domestic households.

By this way natural resource like fresh water is conserved. Rejects from the TTRO plant will be discharged into Buckingham Canal. Due to this there will not be any odour problems. Thus proposed TTRO plant is beneficial to the industries & community.

Rejects from TTRO plant 15 MLD with TDS concentration of 8000 mg/l will be blended with 135 MLD of secondary treated water from STP's at kodungaiyur and discharged into Buckingham Canal. The resultant Total Dissolved Solids in the blended effluent will be around 1700 mg/l which meets the inland surface water standards prescribed by the Tamil Nadu Pollution control board.

Impact of TDS on Buckingham Canal

An elevated level of TDS represents the presence of high toxic metals and other elements. Higher level of TDS makes water salty or brackish. Higher level of TDS affects animals much more than humans. In bodies of water, like rivers, higher levels of total dissolved solids often harm aquatic species. The TDS changes the mineral content of the water, which is important to survival of many animals. Also, dissolved salt can dehydrate the skin of aquatic animals, which can be fatal. It can increase then temperature of the water, which many animals can't survive in.

The existing TDS at discharge point is 1580mg/l and the TDS level in the Ennore creek is 34800mg/l. Since the level of TDS in the Creek is very high compared to the TDS of the rejects, there is no impact of TDS on Buckingham canal. The treated effluents from various industries are being discharged into Buckingham canal, no flora and fauna are observed. Since the quality of Buckingham canal water is very poor, it cannot be used for domestic purposes. Moreover the fishing activities takes place 12.5Km downstream away from the point of discharge. The distance between the discharge point and fishing activities at creek are far apart, hence the impact of TDS on fishing activity is minimum.

Since there are no aquatic species, present condition, in view of the above, the level of TDS in treated water will not have any effect on the canal.

Kosasthalaiyar River runs parallel to Buckingham canal before confluence with Ennore Creek. The approximate distance of Kosasthalaiyar River from proposed conveying main varies between 70m and 160m. Since the Kosasthalaiyar River is not connected with the Buckingham canal, the TDS level of the rejects will have no impact on the river. The conveying main is proposed to be laid along the Buckingham canal road and hence it doesn't interrupt with the flow of Kosasthalaiyar River.

The rejects from TTRO Plant will have High TDS Concentration which induces impact on the canal water quality. Since it is being blended with secondary treated water, there will be a reduced impact on the downstream water quality and the water from the Canal is not being used for any domestic purposes.

4.5.4 Impacts Due to Waste Generation

Small amount of domestic waste from site management office, chemical waste from equipment maintenance are expected during operation of the TTRO. Improper onsite storage of domestic waste can rise the adverse environmental impact such as odour nuisance, vermin and pests, water quality impacts, and adverse visual impacts. Spent oil from generators considered to be hazardous waste and it shall be sent to Tamil Nadu Pollution Control Board approved recyclers

4.5.5 Safety

The TTRO plant operation requires use of various chemicals in the different stages of the process. Some of the chemicals used during the operation phase might be hazardous and can cause safety issues due to improper storage or handling.

4. 5.6 Impact on Heritage or Cultural Aspects

There are no historical monuments and structures in the proposed area and insignificant impact is envisaged from the proposed project on heritage or cultural aspects in the study area.

4.5.7 Social Impact Assessment

For assessing the social impacts as per ESMF, a study was carried out and it was observed that the project activities do not involve any land acquisition or encroachment removal. Detailed information on the social Impact Assessment is given in **Chapter 6.**

4.5.8 Emergency Overflow

The emergency overflow events are anticipated in case of pump failure, the electrical power supply interruption, mechanical failure of primary, secondary and tertiary treatment units, .disinfection units, as well as blockage of river outfall. Through existing disposal arrangements – operation of TTRO will be stopped. Standby required for equipments/ units. The emergency overflow due to electrical power supply interruption will be prevented by using DG Set.

These emergency overflow events is expected to be ill-frequent and of short duration.

4. 6 MITIGATION MEASURES

4.6.1 Air Environment

- The gaseous pollutants will be generated mainly from Diesel Fuel combustion from diesel generators, material handling and also from operation of transportation vehicles. Diesel generators will be operated only for emergency power backup. The emission' source diesel generators will have adequate stack height will conformance to the set norms of CPCB and regular maintenance of diesel engines has to be ensured.

- A part from the above, the possible sources of dust emission will be the transportation vehicles. These will mainly contribute to NOx and Carbon Monoxide. Since the truck trips are less, vehicular emissions will be insignificant. However, management will ensure that all the private and commercial vehicles entering into the site are in proper condition and there is no visual sign of major emissions from the vehicles. Also it is to be ensured that all the vehicles are regularly holding valid Pollution under Control Certificates.

- The chemical holding tanks will be provided with necessary scrubbing arrangement to prevent emission of fumes.

4.6.2 Noise Environment

In operational stage, one DG set of capacity 750 KVA will be installed in pump house with inbuilt acoustic enclosure as per the CPCB guidelines and VFD (Variable Frequency Drive) installed motors will be used.

AMBIENT NOISE STANDARDS

Ambient Noise Standards	L Day	L Night
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

The mitigation measures proposed are

- Inbuilt acoustic enclosure will be provided for the DG set and silencer, air release valve, essential hoods etc for suppression of noise to meet the standards of 75 dB(A) at 1 meter from the enclosure surface.
- Design of downstream equipments for blowers.
- Strong and Heavy-duty steel base frame shall be provided for housing D.G. Set. There must be provision for Air-Intake and Air-Exhaust silencer(s) for preventing leakage of sound.
- The motors and pumps are selected in such a way that the noise levels will be in the range of 40 – 55 dB.
- Ear plugs and Ear muffs will be provided for the workers near noise generating sources.
- Thick canopy type of trees will be planted to attenuate noise any arising from the TTRO. The greenbelt will be developed along the plant boundary in line with the guidelines of CPCB.

4.6.3 Water Environment

- The rejects arising from the operation of TTRO will be blended with the balance secondary treated effluent of the STP in the maturation pond to bring the TDS

levels within standards. This is then disposed into the Buckingham canal through existing pipeline.

- Supporting piers of pipe carrying bridge at Buckingham canal shall be circular and laid on existing pipe carrying bridge so that no hindrance to the flow of Buckingham canal. Coffer dam shall be constructed for each pier foundation in order to provide water free regime for speedy construction of piers for pipe carrying bridge. On completion of pier construction, coffer dam shall be removed.
- Supporting piers for pipe carrying bridge across Ennore creek shall be circular in shape and shall be constructed parallel to the existing pipe carrying bridge. Coffer dams shall be constructed to provide water free regime for speedy construction and shall be removed after construction
- Rain water harvesting system will be provided in TTRO plant.
- The sewage from the toilets in the administrative building and operator facilities will be taken to the existing STP for treatment.
- Secondary Treated effluent from the STP shall be used for flushing in toilets of TTRO premises.
- To avert burst in the pumping main, air relief valves (19 Nos.) will be installed at interval of 1km along the distribution pumping main. This will result in conservation of treated water and prevent flooding.

4.6.4 Safety Measures

- The plant shall be protected with fencing to prevent unauthorised entry.
- Handrails and guards will be installed around tanks, trenches, pits, stairwells, and other hazardous areas.
- Storage and handling of chemicals shall be as per the applicable code of safety issued for the chemicals.
- Hazardous chemicals used in the operation shall comply with the Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Necessary training to the personnel will be provided periodically by the operator.

- EHS guidelines of the World Bank shall be ensured during project implementation.

4.6.5 Measures for Operation of TTRO

Inherent Design of TTRO Plant

a) Bio-fouling in the system: The TTRO Plant has ClO_2 dosing at the inlet to control the microbiological growth in the system thereby reducing the chance of organic fouling in membranes. The RO membranes are not tolerant to the presence of Chlorine/ Chlorine Dioxide in the feed water. Hence the TTRO Plant has Anti-Oxidant dosing at the inlet of RO membranes for de-chlorination purpose. However, if organic fouling occurs in membranes, it will only result in slight increase in frequency of membrane cleaning operation and will not affect the overall process performance of the plant.

Hence adequate standby skids shall be provided for UF & RO systems in order to ensure continuous production of treated water in the eventuality of taking out any skid due to maintenance activities arising out of biological fouling.

b)Optimization of RO plant

- Number of stages in a RO shall be designed to take care of multiple feeds and sufficient by-passes as necessary.
- Wherever necessary stand-by units / equipments shall be provided to ensure smooth operation of the plant.
- Recycling and reuse within the plant shall be provided to the maximum extent possible.

c) COMMISSIONING AND O&M SPARES

- **For automatic operation, a**larm for end of cycle shall be provided.

<u>Reverse Osmosis (RO) Skids</u>:

- The entire operation of RO system is envisaged to be automatic (PLC based). Manual cleaning of RO membrane shall be under supervision of operator.
- All instrumentation as required for monitoring and control of process and operating parameters in the TTRO Plan system to be provided.

- Suitable instruments to measure the consumption of various chemicals and utilities for establishing the performance of the system are to be provided
- Necessary instruments (like On-line analyzers) with corresponding panel display in control room for the plant shall be provided for various quality parameters to ensure smooth & trouble free operation & control of the plant .
- For pumps/blowers to be located on grade level, the motors shall be protected by canopies.
- Draining arrangements shall be provided for all units as necessary
- All effluent holdup tanks shall be provided with overflow lines, sampling and gauging hatches etc.
- Adequate number of sampling points shall be provided at the inlet and outlet of each treatment sections
- The specifications / requirements specified are bare minimum only; the DBO contractor shall follow Good engineering practices and incorporate maximum operational flexibility in the system.
- Intermediate storage tanks shall be provided to hold water required for internal consumption such as backwash and chemical solution preparation, to ensure uninterrupted operation of TTRO.
- Adequate storage arrangements shall be provided for treated water to provided uninterrupted water supply to industrial parks even during maintenance or other eventualities like power failure etc.

d) Facility for Workers

Within the plant site during construction phase, the base emanating such as toilet, drinking water, electricity health, first aid facility and safety gadgets will be provided.

4.6.6 Social Environment

During implementation of the proposed project adequate measures will be undertaken based on the observations specific to the alignment of the transmission line (Pumping main).

1. It is observed that there is no common utilities like telephone cables, Electrical cables, Water lines along the alignment of the transmission main.
2. No trees and no Endangered/ Rare flora are found along the alignment of the transmission main.
3. Construction debris will be minimized by balancing the cut and fill requirements.
4. Top soil will be protected and compacted after completion of work.
5. It is also verified that there will not be any possibility of cross connection with sewer line.
6. Construction will be taken place phase wise so that sections are available for smooth flow of traffic.

4.6.7 Green Belt Development

Green belt of 4300 m^2 is proposed to implement in the project site. 33% of area earmarked for greenbelt and about 200 trees of native species are proposed to be planted. If any tree or shrub is identified to be cut the same shall be removed with the approval of concerned authority

Trees like Mahagony, Neem, Indian beech and Asoka trees shall be planted at an interval of 3 meters each. Watering of trees shall be done regularly with the available secondary treated water.

4.6.8 Emergency Preparedness Plan

Various alarms will be also provided within the treatment facility and these alarms will also be tied into the main control panel at the Emergency Response Center. When emergencies arise within the treatment facility, the on-duty operator immediately reports the condition to the facility in-charge person. Appropriate personnel respond to the emergency with the necessary resources. When emergency condition notices are received by telephone at the Emergency Response Center, the operator on duty should ensure all pertinent information surrounding the emergency is accurately recorded. The contractor shall prepare emergency preparedness plan and emergency announcement procedures for local residents.

The following are the mitigation measures to be followed in case of Power Loss/Equipment Failure, chemical leakage, explosion and pipeline burst

- Implementation of prevention measures as required – particularly mutual aid agreements.
- Providing portable lighting at night.
- Pump flow around trouble area utilizing portable pumps.
- Checking spare parts inventory.
- Use of original equipment quality replacement parts.
- Usage of appropriate lifting and hoist equipment.
- Checking for bearing seizure due to overheating or insufficient lubrication.
- Always lubricate before restart.
- To determine if the power loss is local or area-wide.
- If loss is local, check out all electrical circuits for shorts or system overload.
- If the loss is area-wide, contact the power company and coordinate repair and start-up operations with them.

Surge tank

Surge tank will be provided to absorb sudden raise of pressure, as well as to quickly provide extra water during a brief drop in pressure. All other instruments like pressure gauges, pressure relief valves, level indicators, compound gauges, etc. as required for safe & trouble free operation of the system shall be provided. The contractor shall prepare an emergency preparedness plan ensuring all the necessary steps that avoid accidents.

During a major emergency, the water treatment plant and distribution system may suffer major damage resulting in very little flow of wastewater reaching the treatment facility. For this reason, careful coordination with the local water supply system is necessary; since it may well be that the waterworks restoration has priority over the wastewater treatment plant. Contractor shall prepare Emergency preparedness plan prior to the respective stages.

5. ENVIRONMENTAL MANAGEMENT PLAN

5. 1 OBJECTIVES

The Environmental Management Plan (EMP) is required to manage environmental impacts from the proposed project. It is a site specific plan developed to ensure that all necessary measures are identified and implemented in order to protect the environment. Site-specific EMP is formulated to mitigate significant adverse environmental impacts that are identified and quantified in the process of baseline and impact assessment. An EMP also ensures that the resources are utilized to maximum extent, waste generation is minimized, residuals treated adequately and by-products are recycled to the extent possible.

5. 2 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Environmental Management and Monitoring Plan is essential for effective implementation of identified mitigation measures during the operation phase. Construction of TTRO and pumping stations will be carried out by the contractor. The contractor will be selected by the competent authority of CMWSSB based on the technical capability and price quoted. The successful contractor will train the technical staff of the concern local bodies and CMWSSB during the construction and operation phase of sewerage scheme. Once the contractual obligation is over, then the trained technical personnel will undertake the job of operation and maintenance of the entire sewerage scheme.

Table 5. 1 - Environmental Clearances required prior to pre-construction phase

S.No	Description	Responsible Agency
1.	Consent to Establish (CTE) from TNPCB,	CMWSSB & DBOT Contractor
2.	Consent to Operate (CTO) from TNPCB,	
3.	CRZ Clearance from TNSCZMA/MoEF,	
4.	NOC for the disposal of the RO rejects into Buckingham canal from Public Works Department, Tamil Nadu,	
5.	Permission from Railways, PWD and Highways Authority for ROW for the distribution line.	

Table 5. 2 - Environmental Management Plan for Pre-Construction Phase

S.No	Activity	Mitigation measures	Responsible agencies
1	Tree cutting	There is no tree cutting activity envisaged in the site or in laying line of treated water conveyance. In case of any tree cutting compensatory plantation shall be done at ten times the number of trees cut.	--
2	Utility Relocation	1. Identify the common utilities to be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc 2. Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.	DBOT Contractor
3	Baseline parameters	Baseline parameters have been recorded during the EIA study and monitoring would be carried out as per plan provided.	DBOT Contractor
4	Planning of temporary traffic	1. Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works.	--

	arrangements	2. The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of wok each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen. 3. Conveying main will be laid for a length of 500m on the berm of the Kathivakkam highroad of 500 m. During construction phase there may be temporary traffic diversion. But this may be only for short duration. Necessary Barricades, sign board will be erected for the convenience of pedestrians and motorists.	
5	Treated water quality and disposal of rejects	1. Performance standards will always be maintained, ensuring efficient working condition of treatment plant to meet the TTRO outlet quality specified. 2. The quality of reject water after blending will comply with the discharge standards for disposal into inland water body.	DBOT Contractor and CMWSSB
6	Storage of materials	Pipes and other construction materials would be stored in the shed with asbestos roofing at vacant portion available in the TTRO site.	DBOT Contractor
7	Construction of labour camps & Influx of Labour	1. Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. 2. The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction. 3. The construction will commence only upon the written approval of the Engineer. 4. The contractor shall maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer.	DBOT Contractor

		5. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be planned. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided should be prepared and shall be approved by the engineer. 6. Unskilled labour will be recruited from local residents. 7. Development of code of conduct for camp rules, camp workers and disciplinary procedures. 8. Separate bath and wash facilities for women labours.	
8	Protection of site	The site will be enclosed with 1.8m chain link fence, lockable gates, designed to discourage entry by unauthorized persons and animals.	DBOT contractor
9	Safety measures for plant	1. Hand rails and guards will be installed around tanks, trenches, pits, stairwells, and other hazardous areas. 2. Portable ventilation and blower equipment, intrinsically safe, with sufficient hose, where required. 3.Portable lighting equipment intrinsically safe, where required. 4. Confined space entry shall comply with the Pollution Control Operation and OHSA regulations. 5. Facility design and layout shall have due regard to make confined space entry user friendly, optimizing sight and retrieval lines. 6. Adequate ventilation in pumping chambers and periodical inspection of conveying main	DBOT Contractor

		will be done by supervisor.	
10	Safety measures for Chemical Handling	1. Storage tanks of Bulk liquid chemicals such as conc. Hydrochloric acid, Sodium Chlorite & Caustic lye shall be stored as per the MSIHC rules and Code of safety. 2. Chemical storage tanks / solution preparation tanks shall be constructed in line with applicable code of safety and be provided with necessary fume absorbers/ scrubbers, 3. It shall be ensured that the constructions of chemical storage/handling/transferring units/ channels etc are resistant to corrosion. (eg. acid resistant coating for steel & cement used for HCL tank) 4. On-line free analyzer with controller, leak sensor with detector etc shall be provided as required. 5. All other instruments like pressure gauges, pressure relief valves, level indicators, compound gauges, etc. as required for safe & trouble free operation of the system shall be provided. 6. All drains from chemical house to be routed to a waste disposal tank of appropriate capacity and suitable neutralization arrangement before connecting the outlet to the disposal blending tank. 7. All dosing pumps shall have external pressure safety valves (if not provided internally). 8. Safety shower and eye wash facility shall be located just outside the chemical storage/ handling areas. 9. Any other item(s) if required for completeness of the system, safety requirements and to make the system operational shall be provided. 10. Gas detection and monitoring equipment where required. Where gas alarms are provided, install an indicator light outside the building so that the operator can check gas	DBOT contractor

		levels before entering the building. 11. The least harshest cleaning regiment shall be used for RO cleaning. RO cleaning solution tank shall be made of Solid FRP.	
11	Public liability Insurance and other policies	During Construction and operation, insurance and other policies for employees are taken to ensure immediate payment to the accident victims.	
12	Design Criteria	All the units of treatment plant shall be designed in such a way that it can withstand maximum load and without compromising performance. It shall be provided with stand by unit and modules for Ultra-filtration and Reverse Osmosis. The design shall take into consideration all the measures identified. Revised Environmental Management plan shall be prepared for both construction and operation period and be submitted along with the design and got approved from the engineer concerned.	DBOT Contractor

Table 5. 3 - Environmental Management Plan for Construction Phase

S.NO	DESCRIPTION	MEASURES PROPOSED	RESPONSIBLE AGENCIES
		TTRO Plant	
1	Preparation of Project site and Disposal of construction debris	• Isolate the construction area with flexible enclosures/curtains so that the air emissions will not spread in the surroundings. Sprinkling of water in the construction area and unpaved roads. Proper maintenance of vehicles shall be done. • Minimize dust generating activities. • Cover heavy vehicles moving offsite.	DBOT Contractor & CMWSSB

		• Restrict vehicle speed on construction roads and ensure vehicles use only dedicated construction roads and access points. • Visually monitor particulate emissions from diesel vehicles and carryout regular maintenance of equipment. • The top soil will be protected and compacted after completion of work. Top soil from the TTRO area will be stored in stock piles for gardening purposes and filling low-lying areas in the vicinity of the proposed TTRO plant. Mitigation measures should include provision of a collection area where waste can be stored and loaded prior to removal from the site. • The contractor shall identify the sites for excess amount of debris disposal and should be finalized prior to start of the earthworks; taking into account the following (a) The dumping does not impact natural drainage courses. Stockpiled debris should be covered with Tarpaulins (b) No endangered / rare flora is impacted by such dumping (c) Settlement area located at least 1.0 km away from the site. (d) Should be located in non residential areas located in the downwind side. (e) Located at least 100m from the designated forest land. (f) Avoid disposal on productive land. (g) Should be located with the consensus of the local community , in consultation with the engineer and shall be approved by the highways department. (h) Minimize the construction debris by balancing the cut and fill requirements.	

2	Clearing of Shrubs/Trees	To provide green belt all along the boundary and garland drains for storm water runoff. Provision of internal roads to access various treatment units and chemical storage tanks.	-
3	Handling of waste	1. Construction is more of management. Proper estimate of material is a very first measure to minimize the undue wastage. 2. Rubbish, debris and bitumen wastes remaining after blacktop works should be cleaned and disposed off in a safe place. 3. Materials classified as chemical wastes will need special handling and storage arrangements before removal for appropriate treatment at the chemical waste treatment facility. 4. The recyclable items like metal, plastic should be sent to recyclable industry, and rest of this scrap should be stored in a covered area. Bitumen emulsions shall be used wherever feasible. 5. Hazardous waste must not be stored near surface water sources	DBOT Contractor
4	Loose soil at construction site	During monsoon season run-off from construction site shall be routed to a temporary sedimentation tank for settlement of suspended solids.	DBOT Contractor
5	Noise from construction equipment	Develop and implement a construction noise management plan. This includes erection of barriers and acoustic measures for generators. It is also advisable that on site workers using high noise equipment adopt noise personal protective devices. There shall be restriction of working hours to minimize the impact on local residents.	DBOT Contractor

6	Pollution from Fuel, Lubricants and DG sets	1. All location and lay-out plans of such sites shall be submitted by the Contractor prior to their establishment and will be approved by the Engineer. 2. Contractor shall ensure that all vehicle/machinery and equipment operation, maintenance and refueling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. It shall also be ensured that adequate stack heights for wider dispersion of pollutants are provided for the DG sets. 3. Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites (list to be submitted to Engineer) and approved by the Engineer. All spills and collected petroleum products will be disposed off in accordance with MoEF and state PCB guidelines. 4. Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.	DBOT Contractor
7	Informatory Signs and Hoardings	The contractor shall provide, erect and maintain informatory/safety signs, hoardings written in English and local language, wherever required or as suggested by the Engineer.	DBOT Contractor/ PIA
8	Risk from Electrical Equipments	1. The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that - i) No material will be so stacked or placed as to cause danger or inconvenience to any person or the public. ii) All necessary fencing and lights will be provided to protect the public in construction zones. 2. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Engineer.	DBOT Contractor

9	Safety Aspects	1. Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall confirm to the relevant Indian standards Code and shall be regularly inspected by the PIA. 2. Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. 3. Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc. 4. Welder's protective eye-shields shall be provided to workers who are engaged in welding works. 5. Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. 6. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs. 7. The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract. 8. The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. 9. The contractor will not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form. 10. The selection of any further access roads to project working areas aim to avoid sensitive receptors such as centres of communities, hospitals, clinics and schools as far as practicable.	DBOT Contractor
10	Water	1. All precautionary measures will be taken to prevent the wastewater generated during	

	pollution from construction wastes	construction from entering into streams or the irrigation systems. 2. The construction site would be provided with sufficient and suitable toilet facilities for workers to maintain proper standards of hygiene. These facilities include provision of septic tank followed by soak pit and maintained to ensure minimum impact on nearby water bodies and environment. 3. Contaminated runoff from storage should be captured in ditches or ponds with an oil trap at the outlet.	DBOT Contractor / CMWSSB
11	First Aid	The contractor shall arrange for : i) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital.	DBOT Contractor
12	Using of modern machineries	Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period.	DBOT Contractor
13	Establishment of the Environmental Lab	Full fledged laboratory shall be established for Monitoring of Air, Water, Noise and Soil and quality of TTRO rejects and other parameters in the monitoring table.	DBOT Contractor
14	Flora and Chance found Fauna	It shall be ensured that reasonable precaution shall be taken to prevent workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any wild animal is found near the construction site at any point of time, it will be immediately reported to the nearby forest	Prospective Contractor &

		officer and appropriate steps measures will be taken in consultation with the forest officials.	CMWSSB
15	EHS Guidelines	Prospective contractor shall ensure proper execution of EHS Guidelines of World Bank	DBOT Contractor
		Conveying Main	
1	Disposal of construction debris and excavated materials.	1. The excess earth from excavation for conveying main shall be disposed off within the TTRO site in Kodungaiyur for filling as directed by CMWSSB. 2. Construction debris shall be disposed in suitable site identified for safe disposal, in relatively low lying areas, away from the water bodies, residential and agricultural fields etc., and got approved by the Engineer. 3. Care should be taken that dumped material does not affect natural drainage system. 4. Minimize the construction debris by balancing the cut and fill requirements. 5. 4. All vehicles delivering material to the site shall be covered to avoid material spillage.	DBOT Contractor
2	Laying of Conveying Main, Excavation of trench	1. Loose soil will be removed and considered with suitable bedding material so as to avoid sagging of pipes whenever necessary. 2. In order to avoid unauthorized entry and to ensure safety for public movement and necessary sign boards will be erected for any traffic diversion at appropriate places. 3. Well maintained vehicles will be deployed to present excessive noise generation. 4. Construction of coffer dams with puddle bags filled with clay/ silt or impervious material including diversion of flow, removing and pumping of water etc., including maintenance during the work and removal of the same after completion of work including cost and conveyance of all materials, labor charges and incidental charges etc. Complete as directed at site: (i)Ennore creek and (ii)Buckingham canal	DBOT Contractor

		5. Site for storage of pipes will be identified without affecting the traffic and common utilities. 6. While laying the conveying main along the Buckingham canal, the banks of canal shall not be disturbed.	
3	Utility crossings near CPCL	1. Pipes conveying petroleum products from CPCL to the industries in the Manali Area are above 0.5 road level, where as CMWSSB conveying main of 800 mm dia DI pipes shall be laid 1.2 m below ground level without any disturbances to the CPCL pipe lines under the supervision of CMWSSB authorities. 2. Pipe carrying bridge of distribution main (300 mm dia) shall be constructed parallel to the existing Bridge near Manali High Road without obstructing the flow. 3. The CMWSSB conveying main as proposed to lay at 1.2 m below ground level along the Buckingham canal side which shall be 2 m away from the existing sewer line. Moreover this existing sewer has been laid at depth of more than 3.5 m. Hence there is no impact or disturbance. In case of any damages to the existing sewer line the same shall be replaced immediately. 4. In the places where the utility line laid below ground level, CMWSSB's proposed conveying main will be laid manually with adequate protection.	
4	Dust Pollution near settlements	1. Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day. 2. Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage.	DBOT Contractor
5	Laying of conveying main in the stretch of	1. Laying of conveying main within stretch to be carried during noon time where there is less movement. 2. Adequate personnel will be deployed to regulate traffic movement and to ensure smooth	DBOT Contractor

	300m in Kattukuppam area.	flow wherever necessary in the stretch of Kattukuppam will be informed well in advance about laying of conveying main in stretches so that residents will not feel any inconveniences. 3. During monsoon work will be suspended temporarily. 4. Using modern machineries such as JCB's, back hoes etc. will be used to minimize the construction period. 5. Laying of conveying main shall be done only after obtaining approval for Traffic diversion plan from the concerned Traffic police department. 6. Traffic diversion signage board shall be erected at appropriate locations in concurrence with Traffic police.	
6	Traffic arrangements	1. Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works. 2. The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of wok each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen. For traffic management in Kattukuppam area, **Chapter:** 6 – **Section:** 6.3 shall be referred for guidance. 3. Conveying main will be laid for a length of 500m on the berm of the Kathivakkam highroad of 500 m. During construction phase there may be temporary traffic diversion. But this may be only for short duration. Necessary Barricades, sign board will be erected for the convenience of pedestrians and motorists.	DBOT Contractor

		4. The construction of conveying main near Kathivakkam high school shall be carried out in such a way that it should not obstruct the flow of traffic as there is traffic congestion. The width of the road at that point is 10m, but only 3m shall be availed for construction and remaining 7m shall be provided for movement of vehicles. The construction work near the school shall be completed as quickly as possible. 5. The conveying main will be laid using trenchless technology at the junction where the Buckingham canal road crosses Manali high road to prevent obstruction in the traffic flow. Proper traffic management plan shall be prepared and it shall be implemented only after the approval of the concerned authority.	
7	Laying of Conveying main across Ennore creek	1. The pipe carrying bridge shall be constructed during the period from March-September since the migratory bird visits during winter season. 2. While laying the foundation for piers, Coffer dam shall be constructed for each pier foundation in order to provide water free regime for speedy construction of piers for pipe carrying bridge. On completion of pier construction, coffer dam shall be removed and bed shall be restored. 3. Supporting piers for pipe carrying bridge shall be circular in shape. 4. Piers shall be constructed parallel to the existing Ennore creek fly over. 5. Foundation of pillars shall not be above the bed level.	DBOT Contractor
8	Vehicular noise pollution at residential / sensitive receptors.	1. Stationary construction equipment will be kept at least 500m away from sensitive receptors. 2. All possible and practical measures to control noise emissions during drilling shall be employed. Well maintained vehicles will be deployed.	DBOT Contractor

9	Protection of residential / sensitive receptors.	1. Preventive maintenance of construction equipment and vehicles to meet emission standards and to keep them with low noise. 2. Provision of enclosing generators and concrete mixers at site. 3. Sound barriers in inhabited areas shall be installed during the construction phase. 4. Adequate barricading / other measures to protect dust pollution near sensitive receptors like schools and hospital etc to be ensured.	DBOT Contractor
10	Barricading site	The construction site should be barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians.	DBOT Contractor
11	Crossings at Buckingham canal near CPCL & Ennore creek	Piers shall be constructed in 5 m interval across Buckingham canal and 20m interval across Ennore creek. While laying the foundation for piers, Coffer dam shall be constructed for each pier foundation in order to provide water free regime for speedy construction of piers for pipe carrying bridge. On completion of pier construction, coffer dam shall be removed and bed shall be restored.	DBOT contractor
12	Grievances	Grievance Redressal Mechanism is detailed in **Chapter** 6 – **Section** 6.5.	CMWSSB

Table 5. 4 – Environmental Management Plan for Operation Phase

Sl.No.	Activity	Mitigation Measures	Responsible Agencies
1	Safety measures	Safety equipments: Chlorine institute approved respiratory equipments like air masks-full face for working in leak area, canister type gas mask. ammonia torches, emergency require kit, Weather sock, Safety helmets, goggles, rubber boots, gloves and colored vests (aprons) etc shall be made available Safety plan or manual shall be prepared and got approved from the CMWSSB prior to commissioning of the TTRO plant. The safety plan should include parameters for maintenance	DBOT contractor

		to ensure safety, monitoring checklist, safety information etc. Material Safety Data Sheet for chemicals shall be displayed. Surge tank will be provided to absorb sudden raise of pressure, as well as to quickly provide extra water during a brief drop in pressure.	
2	Air pollution	1. Conformance to the set norms of CPCB and regular maintenance of diesel generators has to be ensured. 2. It is to be ensured that all the vehicles are regularly holding valid Pollution under Control Certificates. 3. Chemical holding tanks shall be provided with necessary scrubbing arrangements.	DBOT contractor
3	Water Environment	1. The rejects arising from the operation of TTRO will be blended with the balance secondary treated effluent of the STP in the maturation pond to bring the TDS levels within standards. 2. To avert burst in the pumping main, air relief valves (19 Nos.) will be installed at interval of 1km along the distribution pumping main. 3. Supporting piers for pipe carrying bridge across Ennore creek and Buckingham canal shall be circular in shape and Coffer dams shall be constructed to provide water free regime for speedy construction and shall be removed after construction	DBOT contractor
3	Handling of Waste	1. Rejects from the TTRO Plant shall be blended with Secondary treated water and disposed to Buckingham Canal. 2. The sewage from the toilets in the administrative building and operator facilities will be taken to the existing STP for treatment. 3. Secondary Treated effluent from the STP shall be used for flushing in toilets of TTRO premises. 4. Spent oil from generators considered being hazardous waste and it shall be sent to Tamil	DBOT contractor

		Nadu Pollution Control Board approved recyclers. 5. It shall be ensured that any discharge from the treatment unit to the Buckingham canal stay within the standards and additional arrangements for treatment shall be done if it is necessary in the future. 6. Chemical waste shall be handled adhering to the standards, safety requirements and disposed safely.	
4	Energy efficiency	1. Solar energy shall be used for the street lights. 2. Pumps with Variable frequency drives shall be used in order to optimize the operating pressure of the membranes. 3. LED lamps will be used for in house lighting.	DBOT contractor
5	Safety Training and information	1. Display Charts of PFD, safety checks, maintenance procedure, etc shall be made available. 2. Emergency Action Plan shall be prepared as applicable and be made available at the site. 3. Operators shall be provided with necessary training periodically. 4. EHS guidelines of World bank shall be ensured during project implementation. 5. Hazardous chemicals used in the operation shall comply with the manufacture, storage and import of hazardous chemical rules 1989. 6. The contractor shall prepare emergency preparedness plan and emergency announcement procedures for local residents.	DBOT contractor
6	First Aid	The contractor shall arrange for : i) A readily available first aid unit including an adequate supply of sterilized dressing materials	

		and appliances as per the Factories Rules in every work zone. ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital	
7	Noise from Operation	1. Necessary measures like thick canopy of trees for controlling noise from operation pumps DG sets etc shall be provided to control noise. 2. Necessary provisions like enclosure, vibration control mechanism and periodical maintenance shall be implemented to maintain the noise levels within the standards. 3. Periodic Monitoring shall be carried out and Noise Mitigation measures as applicable shall be implemented. (Eg: Noise barrier). Operator shall be provided with necessary PPE.	DBOT contractor
8	Health Check up	Employees and migrant labor health checkups for relevant parameters like BP, sugar, Chest X ray as per Factories Act. Monitor the health of workers within the project site to identify adverse health effects, and Periodically obtain feedback from local doctors regarding any potential indicators of adverse health effects due to environmental cause in the communities surrounding.	DBOT contractor
9	Environmental Monitoring	The prospective contractor shall carry out Environmental Monitoring according to the guidelines given in the **Table 5.6**	
10	Emergency Preparedness Plan	Emergency Preparedness Plan shall be prepared and submitted to CMWSSB and got approved prior to operation. Refer **Chapter** 4 – **Section:** 4.6.8.	DBOT contractor / CMWSSB

Table 5. 5 - Environmental Enhancement and Special Issues

S.No	Environmental enhancement and special issues		Location	Implementing Agency
1	Monitoring of environment parameters	i) Seasonal monitoring of Air, Water, Noise and Soil quality shall be done. ii) The parameter shall be monitored according to Environmental Monitoring Plan.	Project area	DBOT Contractor
2	Sensitive Areas	i) The dust and noise impacts due to vehicle movement during construction and their effectiveness shall be checked and minimized with precautionary measures.	Project area, Ennore creek	DBOT Contractor
3	Clearing of construction of camps and restoration	Site restoration plans shall be prepared for approval by the engineer. On completion of the works, all temporary structures shall be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site shall be left clean and tidy.	During construction period	DBOT Contractor
4	Tree Protection, Tree Planting	Selected plant species should be native in nature and should be able to grow under existing agro climatic conditions. Plant species would need minimum level of maintenance. The plants and trees selected in	Project area	

		construction with the forest department and neighbourhood resident may be organized as societies to maintain these green belts with incentives. Trees like Mahagony, Neem, Ashoka tree shall be planted. i) Due protection like Masonry tree guards will be given to the tree that might fall in the corridor of impact. iii) Re-plantation of at least twice the number of trees cut shall be carried out along the project area. Planting of trees along the entire stretch of road shall be carried out as an enhancement measure. iv) Growth and survival of trees planted shall be monitored at least for period of 5 years. Survival status shall also be reported on monthly basis to Engineer		DBOT Contractor

5.3 ENVIRONMENTAL MONITORING PLAN

Environmental monitoring program describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. All monitoring strategies and program have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analyzed statistically and submitted to concerned authorities. The design of a monitoring program must therefore have regard to the final use of the data before monitoring starts.

The monitoring program will have three phases

1. Construction phase
2. Monitoring phase
3. Post monitoring phase

5.3.1 Construction Phase

The proposed project envisages setting up of ***45MLD TTRO plant at Kodungaiyur, Chennai.*** The major construction activities involved in setting up the unit are construction of sheds for treatment units, stores, canteen etc. diesel generator, and other civil, mechanical and electrical equipment. The construction activities require clearing of vegetation, mobilization of construction material and equipment. The construction activities are expected to last for few months. Environmental monitoring to be carried out during the construction phase is given in **Table 5.6.**

Table 5. 6 - Environmental Monitoring Plan

Attributes	Parameters	Location	Frequency	Responsible Agency
Pre-Construction & Construction Phase				
Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO and Pb	4 locations	Seasonal	Implementing

	(standards as per CPCB)	(2 locations at TTRO, 2 locations at conveying line)	Sampling (3 times a year)	Agency
Water Quality	Ph, BOD, COD, DO, TDS, Pb, Oil & Grease and Detergents for Surface water. Water Ph, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater (standards as per TNPCB)	2 Locations (1 at Creek and another at Buckingham Canal)	Seasonal Sampling (4 times a year)	Contractor through approved monitoring agencies & Implementing agency
Noise Level	Noise level on Db (A) scale noise levels on dB (A) scale (as per MoEF Noise Rulers, 2000)	4 locations (1 at Boundary, 1 at TTRO, 2 locations at Conveying Main)	Seasonal Sampling (4 times a year)	Implementing agency
Soil Quality	Monitoring of Pb, sar and Oil & Grease (standards as per TNPCB)	2 locations at TTRO	Seasonal Sampling (4 times a year)	Implementing Agency
Health	All relevant parameters including HIV	-	Regular checkups as per Factories Act	DBOT Contractor
Operation Phase				
Air Emissions	PM_{10}, $PM_{2.5}$, SO_2, NO_x, CO and Pb (standards as per	2 locations (1 at TTRO, 1 at DG Set)	Seasonal Sampling (3 times a	DBOT Contractor & Implementing

	CPCB)		year)	Agency
Water Quality	Ph, BOD, COD, DO, TDS, Pb, Oil & Grease and Detergents for Surface water. Water Ph, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater (standards as per IS 10500:2012)	4 locations (1 at the rejects within site, 1 at point of discharge at Buckingham Canal, 1 at 500 m downstream, 1 at Ennore Creek)	Seasonal Sampling (4 times a year)	DBOT Contractor through approved monitoring agencies & Implementing Agency
Noise Level	Noise level on Db (A) scale noise levels on dB (A) scale (as per MoEF Noise Rulers, 2000)	4 locations (3 location within TTRO Site, 1 at Plant boundary in nearest receptor)	Seasonal Sampling (4 times a year)	DBOT Contractor & Implementing agency
Soil quality	Monitoring of Pb, sar and Oil & Grease	2 locations (1 random location within the site, 1 at the place near the chemical storage tank)	Seasonal Sampling (4 times a year)	Implementing Agency
Health	All relevant parameters (BP, Sugar, chest X-ray, Eye vision, etc.)	-	Regular checkups as per factories act.	DBOT Contractor & Implementing Agency
Safety	First Aid, replacement of PPE	-	yearly	DBOT Contractor & Implementing

				Agency
Green Belt Development	No. of plants, species, survival status	-	Once a year	DBOT Contractor & Implementing Agency

5.3.2 Operation Phase

During operational stage period air emissions from incinerator, power plant, DG set, landfill if any, wastewater characteristics, ash generation quantity, etc. are monitored. The following attributes which merit regular monitoring based on the environmental setting and nature of project activities are listed below:

- Point Source emissions and ambient air quality in nearby villages;
- Groundwater Levels and ground water quality;
- Water & wastewater quality & quantity;
- Solid waste characterization (Ash, leachate treatment plant & Septic tank/soak pit sludge);
- Soil quality;
- Noise levels (equipment and machinery noise levels, occupational exposures and ambient noise levels); and
- Ecological preservation and afforestation.

The monitoring plan provided above is in addition to the requirement of monitoring of plant efficiency and operation.

FORMATS FOR REPORTING

Formats for reporting / monitoring the progress / parameters achieved will be finalized in consultation with the successful bidder.

Environmental Compliance Report

The DBOT contractor shall submit a monthly progress report as per the reporting format approved by the CMWSSB engineer, on the status of the implementation of the EMP and get it duly approved by the engineer for its compliance and for proceeding with the work. The engineer and the Environmental and Social Safeguard (ESS)

Manager of TNUIFSL, who will have access and authority to monitor the status based on the same and for which necessary facilities shall be made by the contractor.

Formats for reporting / monitoring progress / parameters achieved and specific penalty measures as may be required to achieve / Implement the EMP will be finalized in consultation with the successful bidder.

Table 5. 7 – EMP Cost Details

CONSTRUCTION PHASE			
Sl.No	**Description**	**Amount (Rupees in Lakhs)**	**Remarks**
	TTRO Plant		
1	Disposal of construction debris	10	These items shall be included in the BOQ
2	To provide green belt all along the boundary	10	
3	Provision of internal roads to access various treatment units and chemical storage tanks.	10	
4	Sedimentation tank for settlement of suspended solids of storm water run off	10	
5	Chemical corrosion resistance coating for chemical storage tanks and drains against rust and chemical corrosion	5	
6	Barriers and acoustic measures for generators	2	
7	Informatory Signs and Hoardings	2	
8	Fencing and lights in construction zone	5	
9	Safety equipments and measures	20	

	as per Item No 10 of Table 5.2 (Chemical corrosion resistance coating, Safety shower, eye wash etc.,)		
10	Provision of Environmental Lab	49	
11	Reusing of secondary treated effluent for flushing	1	
12	Conveyance of sewage from Admin block to STP	0.5	
13	Disposal of construction debris and excavated materials along the alignment for filling low lying areas inside the premises of Kodungaiyur STP(1200m^3)	5	These items shall be included in the BOQ
14	Pollution control measures like water spraying for dust suppression during laying of conveying main.	5	
15	Barricading at construction site of Conveying main by way of providing GI sheets on both sides of trenches	5	
16	Environmental Monitoring during pre construction and construction	3.5	
17	Energy Efficient Lightings	2	

18	Construction of coffer and removal of the same after completion of work i)Ennore creek (45 piers each at 20 m interval with appropriate foundation) ii) Conveying main across (Piers each at 5m interval with appropriate foundation) Buckingham canal will be laid on the existing bridge (near CPCL)	100 15	This item has been included in the S. No. 13 under part F (Price Schedule) of the Bill of Quantities
	TOTAL COST / ANNUM	**260**	
OPERATION PHASE			
1	Safety equipments including protective instruments, Acoustic measures to control noise level as per TNPCB norms etc.	**20**	These items shall be included in the BOQ
2	Environmental Monitoring in the TTRO plant and along the conveying main	**3**	These items shall be included in the BOQ
3	Health check up (Eye, Skin and lungs) for personnel working in TTRO plant	**1**	These items shall be included in the BOQ
4	Safety Training and Information	**3**	These items shall be included in the BOQ
5	Traffic Management Provisions	**1**	These items shall be included in the BOQ
	TOTAL COST / ANNUM	**28**	

The estimated amount for Environmental Management Cost is Rs.287 Lakhs in which Provision for 115 lakhs is given in the bill of quantities.

6. SOCIAL IMPACT ASSESSMENT REPORT

6.1 PROJECT BRIEF

CMWSSB has proposed a TTRO Plant of capacity 45 MLD at kodungaiyur and supply of treated water to industries, power plants and institutions located at Manali-Minjur Corridor, Manali-Ennore Corridor in North Chennai through conveying main of length 28.5 km. It will be laid along the Buckingham canal side of the Buckingham canal road and across Ennore Creek. The conveying main will be laid on pipe carrying bridge across Buckingham Canal and Ennore Creek. This project is proposed to be taken up under Tamil Nadu Sustainable Urban Development Project with an estimated cost of Rs.255 Crores.

Project Components:

This sub-project involves the following project components

1. TTRO Plant at Kodungaiyur (45 MLD) and development of roads inside Kodungaiyur STP land.
2. Conveying main of length 28.5 km. The various components involved within the length of 28.5 Km are given below:

    i. MFL and CPCL Plant road
    ii. Buckingham canal crossing
    iii. IOCL road
    iv. Highways Crossing – Manali Road
    v. PWD – Buckingham canal road
    vi. Highways Crossing Basin Bridge – Manali road
    vii. PWD – Buckingham canal road
    viii. Kathivakkam High Road
    ix. Railway Subway Crossing
    x. Ennore Creek
    xi. Highways road (up to NCTPS)/ Beach – Ennore Port Road
    xii. Old Ennore Port Road (NCTPS to Ennore Kamarajar port)
    xiii. L & T Port road
    xiv. Highways road – Basin Bridge – Manali Road

6.2 TTRO PLANT AT KODUNGAIYUR (45 MLD)

The proposed 45 MLD capacity TTRO plant is to be constructed near maturation pond, in an extent of 10 Acres. The site layout is given in the **Figure 6.1**. The land proposed for construction of 45 MLD Tertiary Treatment Reverse Osmosis Plant belongs to CMWSS Board and no land alienation is required. FMB Extract for the plant site is given in **Annexure IV.**

Table 6.1 - Land requirement for TTRO Plant

Sl. No	Details of Location	Location	Current Land Use	Extent (Acres)
1)	Land requirement for 45 MLD TTRO Plant and disposal line	Kodungaiyur	Institutional	7
2)	Land requirement for Future expansion of TTRO Plant	Kodungaiyur	Institutional	3
3)	Development of Roads	Kodungaiyur	Institutional	

Table 6.2 – Land Ownership of the roads for the Proposed TTRO Conveying main

S.No	Location	Size of Main (mm)	Start Chainage	Final Chainage	Length (m)	Right of way Available	Ownership	Remarks
1	Inside Kodungaiyur STP Land						CMWSSB's Own Land	No social impact
	Disposal line	800	0	5500	5500	1.5m		No social impact
2	MFL & CPCL TT Plant Road	800	5500	7225	1725	1.5m	MFL&CPCL	No social impact
3	B' Canal Crossing	800	7225	7325	100	1.5m	PWD	No social impact
4	IOCL Road	800	7325	7425	100	1.5m	Corporation of Chennai	No social impact
5	Highways Crossing	800	7425	7450	25	1.5m	National Highway	No social impact

	Manali Road							
6	PWD 'B' Canal Road	800	7450	8150	700	1.5m	PWD	No social impact
7	Railway Crossing	800	8150	8175	25	1.5m	Southern Railway	No social impact
8	PWD 'B' Canal road	800	8175	9885	1710	1.5m	Govt. of India	No social impact
9	Highways Crossing Basin Bridge - Manali Road	800	9885	9915	30	1.5m	State Highway (Gov. of TN)	No social impact
10	PWD 'B' Canal Road	800	9915	15950	6035	1.5m	Govt. of India	No social impact
11	Kathivakkam High Road	800	15950	16035	85	1.5m	State Highway (Gov. of TN)	No social impact
12	Railway Subway Crossing	800	16035	16060	25	1.5m	Southern Railways	No social impact
13	Kathivakkam High Road	800	16060	16450	390	1.5m	State Highway (Gov. of TN)	No social impact
14	Ennore Creek	800	16450	17300	850	1.5m	--	No social impact
15	Highways Road (Upto NCTPS)/ Beach - Ennore Port Road	800	17300	19000	1700	1.5m	State Highway (Gov. of TN)	No social impact
	Total (800mm)				**19000**			

16	Old Ennore port road (NCTPS to Ennore Kamarajar port)	600	19000	21300	**2300**	1.5m	NCTPS	No social impact
17	L&T Port Road	600	21300	26000	**4700**	1.5m	State Highway (Gov. of TN)	No social impact
	Total (600mm)				**7000**			
18	Highways Road Basin Bridge - Manali Road	300	0	2500	**2500**	1.5m	State Highway (Gov. of TN)	No social impact

Permission for laying conveying main in the right of way of the existing roads in National High ways and railway crossing near CPCL and PWD road have been obtained from the concern authorities as detailed in the **Table 2.3**. Approvals for laying the conveying main along the National Highways Authority, Public Works Department, Government of Tamil Nadu, crossing across Railway line from Southern Railway are given in **Annexure II.**

A pipe carrying bridge will be constructed during non-monsoon period. The pipe carrying bridge will be supported on piers without affecting water flow. The proposed pipe carrying bridge will be constructed on the downstream side of the Ennore Creek Flyover. Hence no negative impact is anticipated.

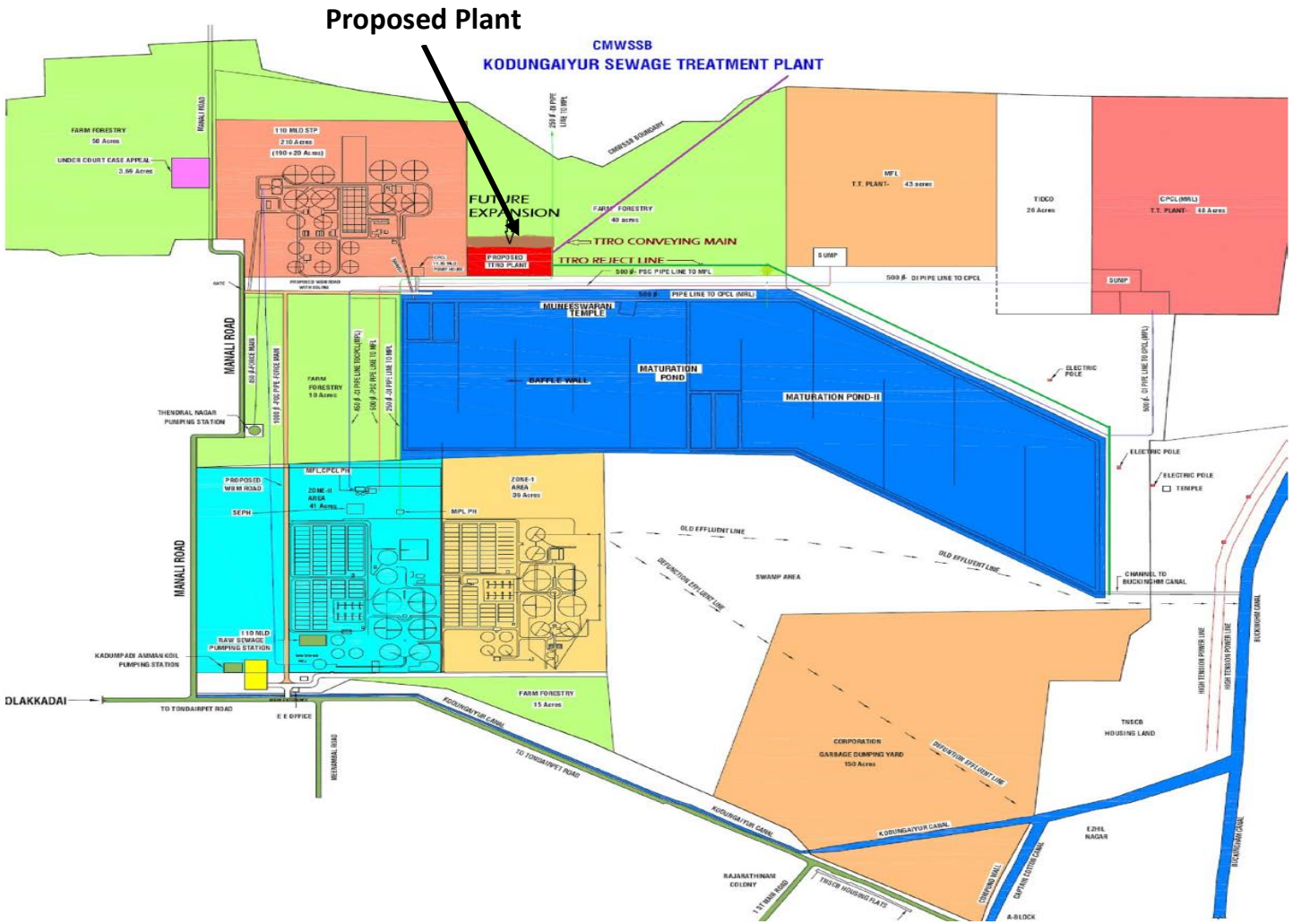


Figure 6.1 - Site Layout

Current land use: Sewage Treatment Plant, Tertiary treatment plant for secondary treated sewage. The site is free from encumbrances.

6.3 CONVEYING MAIN (PIPE LINE ALIGNMENT)

The transmission line (28.5 km long) will be laid along the Buckingham canal. An 800 mm dia DI pipeline for conveying main shall be provided for a length of 19 km 600 mm dia DI pipeline for a length of 7 KM and 300 mm dia DI conveying main for a length of 2.5 Km for distributing the TTRO water to Industries in North Chennai.

Required right of way (ROW): 1.5 m all along Buckingham canal road of Buckingham canal side. The pipeline alignment is given in **Figure 2.10**. Strip maps of conveying main are also given in **Figure 6.2**.

A part of pumping main will be laid in a stretch of 300m along the side of Buckingham canal road owned by PWD, Govt. of Tamil Nadu in the Kattukuppam area where settlements exists. The Pumping main in this stretch will be laid along a strip of land available on the edge of Buckingham canal road at about 1.3 m below ground level on the LEFT side of the road and opposite side of the settlement. A video clipping is also taken in the strip map section 'B' (Kattukuppam area).

Based on the interactions with local people it is noticed that residents of Kattukuppam area belongs to fisherman community and do not interfere with laying of pumping main. Kattukuppam habitation is seen over a length of 300m from the Ennore creek bridge. The proposed conveying main will be adjacent to Buckingham canal and there will not be any disturbance to the residents of Kattukuppam. In fact this will be a beneficial for the residents in respect of indirect job opportunities.

It is observed that during construction phase there will not be any impact or hindrance to these settlements as the pumping main will be laid on the berm which is on the left side of the Buckingham Canal road. It has observed that two wheelers & cycles are mostly used by the residents. Since the earthwork will be carried out without affecting traffic & people, there will not be any significant impact on the traffic. Short term interruptions are expected as a result of specific types of works. Temporary diversion will be provided with the approval of the engineer. Detailed traffic control plans will be prepared and submitted to the engineers for approval, one week prior to commencement of works.

The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of wok each day, SIGNAGES, safety measures for transport of hazardous materials and arrangement of flagmen.

The conveying main will be laid using trenchless technology at the junction where the Buckingham canal road crosses Manali high road to prevent obstruction in the traffic flow. Proper traffic management plan shall be prepared and it shall be implemented only after the approval of the concerned authority.

Figure 6.2 Rerouting Traffic near Kattukuppam

All the vehicles passing through Buckingham canal road in Kattukuppam area connecting Kathivakkam High Road shall be diverted through the village road parallel to it. In all other roads where pipeline is going to be laid has enough space for transportation, as only 3 to 3.5m will be required for laying pipelines. Beyond this point upto Kathivakkam high school the width of the road is around 10m, but only 3m shall be availed for construction and remaining 7m shall be provided for movement of vehicles. The construction work near the school shall be completed as quickly as possible.

In fact the bushes & weeds will be cleared along the side of road which is in turn it will be beneficial to the local people besides employment opportunities. Dust generation during earthwork will be suppressed by the water spraying. If at all any negative impact occurred it will be temporary only which would be attended immediately.

During construction phase adequate provision for installing air release valves, scour valves will be installed in the pumping main to avoid any bursting.

Discussion with the local representative Mr. Thangamani with regard to negative impacts of laying of conveying main, he has informed that there is no need for any displacement of tenement or disturbance to the local community.

Social impacts due to implementation of the proposed project are assessed and the same are given below:

1. There is no loss of land and assets.
2. There is no loss of shelter or Homestead land
3. There is no loss of income or means of livelihood
4. There is no loss of access to productive resources, shelter and residences
5. There is no loss of collective impacts on groups such as loss of community, assets, common properties, resources and other sources.
6. Establishment of Construction Camps does not require any land acquisition as the camps will be established within the plant premises if required.

Based on the above this sub project falls under the Social Category of **S3** as per the ESMF of TNSUDP.

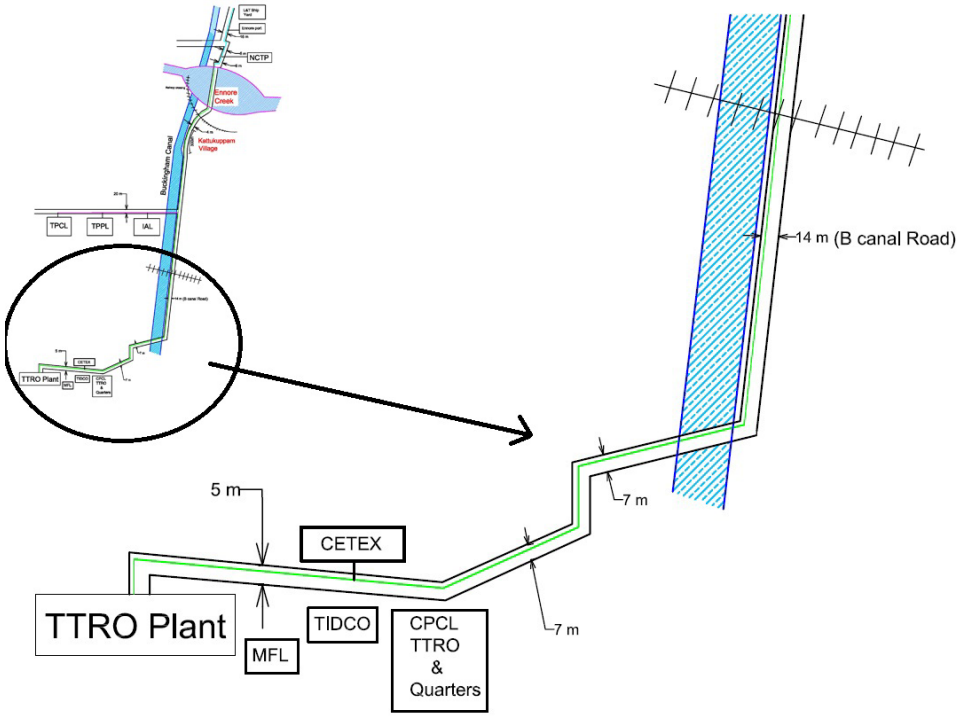
UNIDENTIFIED IMPACTS

Any unidentified social impact during construction phase of the conveying main will be mitigated as per the ESMF Social Safeguards policy and compensated as per the Entitlement Matrix. .

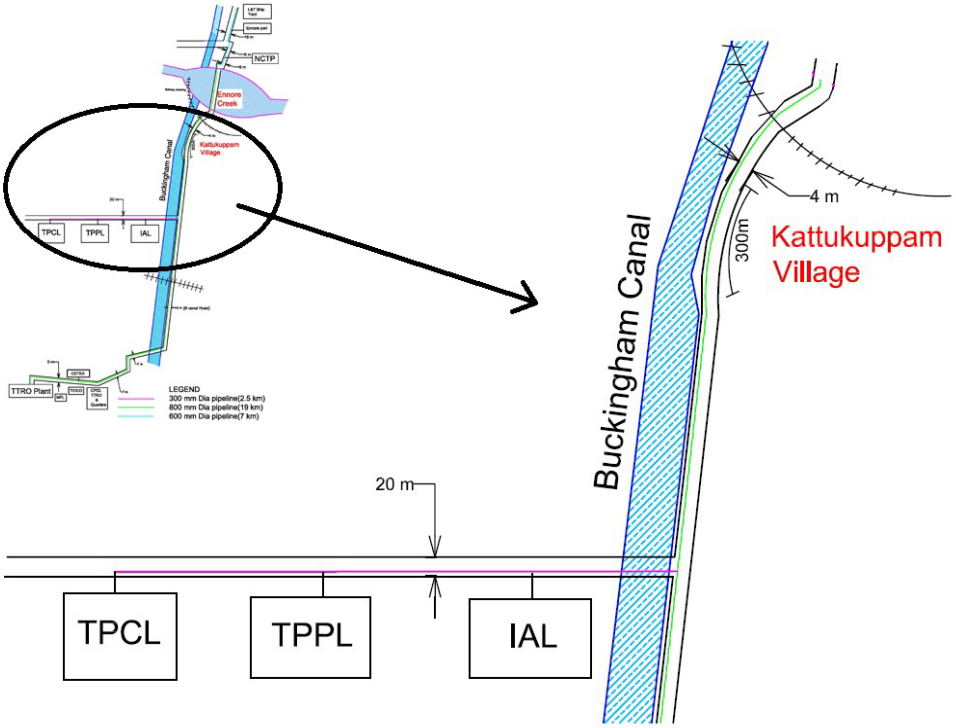
The Photographs showing stretch of 300 m where settlement exists is given below:

Figure 6.3 – Strip Map of Alignment of Conveying Main

Strip Map – Section A



Strip Map – Section B



Strip Map– Section C

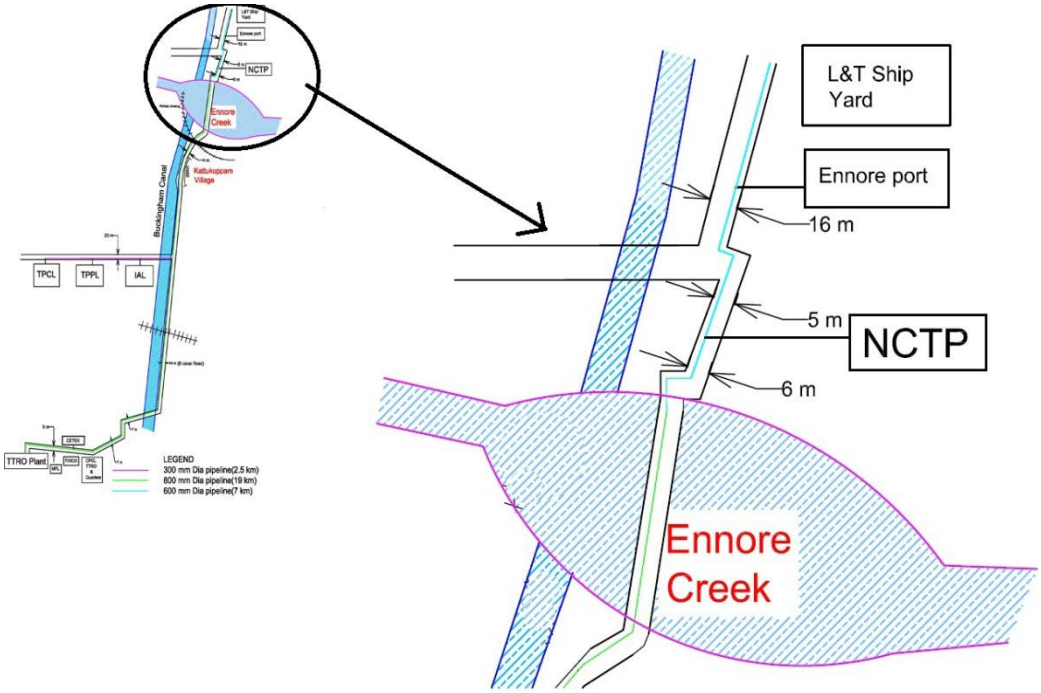


Figure 6.4 – Proposed Pipe Carrying Bridge of Conveying Main across Ennore Creek Parallel to Ennore Creek flyover

SOCIAL IMPACTS AND MEASURES

POSSIBLE IMPACTS	MITIGATION MEASURES
• Due to Influx of Labour • Safety of the Population during construction of all the sub components • Health of the population resulting from project activities • Impact on access/movement of the population during construction	• Unskilled labour will be preferentially recruited from the Local Residents. • Development of a code of conduct for camp workers, camp rules and disciplinary procedures. • Construction of temporary drainage channels - to control the direction and movement of any run-off. • All stockpiled materials to be suitably covered - to prevent dust generation by wind action. • Restriction of work hours - to minimise the noise impact on local residents. • In order to avoid unauthorized entry and to ensure safety for public movement and necessary sign boards will be erected for any traffic diversion at appropriate places. • A strict Project speed limit will be enforced for Project vehicles using unmade tracks. • The selection of any further access roads to Project working areas will aim to avoid sensitive receptors such as centres of communities, hospitals, clinics and schools as far as practicable.

Land Ownership of the roads for the Proposed TTRO Transmission line

S.No	Location	Regulatory Authority	Size of Main (mm)	Length (m)	Right of way Required	Right of way Available
1	Inside Kodungaiyur STP Land	CMWSSB's Own Land	800	5500	1.4m	1.5m
2	MFL & CPCL TT Plant Road	MFL&CPCL	800	1725	1.4m	1.5m
3	B' Canal Crossing	PWD	800	100	1.4m	1.5m
4	IOCL Road	Corporation of Chennai	800	100	1.4m	1.5m
5	Highways Crossing Manali Road	National Highway	800	25	1.4m	1.5m
6	PWD 'B' Canal Road	PWD	800	700	1.4m	1.5m
7	Railway Crossing	Southern Railway	800	25	1.4m	1.5m
8	PWD 'B' Canal road	Govt. of India	800	1710	1.4m	1.5m
9	Highways Crossing Basin Bridge - Manali Road	State Highway (Gov. of TN)	800	30	1.4m	1.5m
10	PWD 'B' Canal Road	Govt. of India	800	6035	1.4m	1.5m
11	Kathivakkam High Road	State Highway (Gov. of TN)	800	85	1.4m	1.5m
12	Railway Subway Crossing	Southern Railways	800	25	1.4m	1.5m
13	Kathivakkam High Road	State Highway (Gov. of TN)	800	390	1.4m	1.5m
14	Ennore Creek	--	800	850	1.4m	1.5m
15	Highways Road (Upto NCTPS)/ Beach - Ennore Port Road	State Highway (Gov. of TN)	800	1700	1.4m	1.5m
	Total (800mm)			**19000**	1.4m	
16	Old Ennore port road (NCTPS to Ennore Kamarajar port)	NCTPS	600	**2300**	1.2m	1.5m
17	L&T Port Road	State Highway (Gov. of TN)	600	**4700**	1.2m	1.5m
	Total (600mm)			**7000**		
18	Highways Road Basin Bridge - Manali Road	State Highway	300	**2500**	0.6m	1.5m

Pipeline will be laid along the berm of the road and thus does not require any private land acquisition.

6.4 IMPLEMENTATION MONITORING

The Project Engineer will issue a Readiness Certificate which contains the details of the site to the Contractor.

During the project execution the CMWSSB will submit monthly progress report to TNUIFSL regarding social impacts. Social Screening Form is attached as **Annexure V.**

6.5 GRIEVANCE REDRESSAL MECHANISM

The CMWSSB will have Grievance Redressal mechanisms to handle the grievances of the project.

A project level Grievance Redressal Committee (GRC) will be set up and the members are as follows (preferably one of them as women)

1. Superintending Engineer (Projects -CMWSSB)
2. Any one elected representative
3. A person who is publicly known in the local area
4. Executive Engineer (Projects- CMWSSB)

GRIEVANCE REDRESSAL COMMITTEE (GRC)

The GRC shall

- Convene meetings of the committee as necessary at such place or places in the Project Implementation Agency as he considers appropriate; and
- Conduct the proceedings in an informal manner as he considers appropriate with the object to bring an amicable settlement between the parties.

Step by step approach will be followed for redressing grievances. First, the aggrieved Project Affected Person to approach the GRC in the first stage and the grievance committee will look into the grievances and resolve the issues. The proceedings of GRC will be documented.

If not satisfied with the resolution provided by GRC, then the complainants can appeal to higher level.

The complaints will be acknowledged to the complainant. Efforts will be made by CMWSSB to ensure closure of complaint within a maximum period of 30 days from the date of its receipt. Serious issues shall be attended as early as possible. If not satisfied with the resolution provided by GRC, the complaints shall be handled at higher level i.e, Chief engineer of CMWSSB.

If there is any grievance, it involves a process of consultation and negotiation with the committee. The grievances relating to the problem will be recorded and each step in the resolution process also will be recorded. The elected representative will be involved in representing the issue and act as a communication link between the persons involved.

When the problems are identified, it will be taken to the personnel who respond and pass the information to the committee immediately. It is then the role of the committee to investigate and consult with the persons to evaluate the seriousness of the issues and work with the management to resolve the problem.

CMWSSB shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

The contact details of the Grievance Redressal Committee are given below:

Chief Engineer,
Chennai Metropolitan Water Supply and Sewerage Board
No.1 Pumping Station Road, Chindatripet,
Chennai – 600 002.
Phone No: 28451300

To register complaints, contact the following phone number:
Phone No: 45674567

To register complaints through internet, visit the following link:
http://www.chennaimetrowater.tn.nic.in//services/complaint.htm

7. PUBLIC CONSULTATION

Information on Public Consultation are given adequately to the Public by means of notice, personal contact, etc,. The minutes of public consultation are as follows:

Proceedings of the Public Hearing/Stake Holders Meeting conducted on 30/10/2015 in connection with the Construction of Tertiary Treatment Reverse Osmosis Plant of Capacity 45 MLD at Kodungaiyur and Laying Conveying Main for Treated Water Distribution System to various industries.

As per the World Bank policy on access to information and disclosure, the proposed project attracts Public Hearing. The Public Hearing was arranged by the Chennai Metropolitan Water Supply & Sewerage Board. The concerned persons having plausible stake in environment aspects were requested to attend the meeting.wide canvassing has been made by issuing notices door to door and keeping displays.

The following were present during public meeting

1. Mr. K. Krishnaswamy, Chief Engineer (O & M-II) i/c, CMWSSB
2. Mr. J. M. Anees, Executive Engineer (STP North) i/c
3. Mr. S. P. Jeyaprakash, Assistant Executive Engineer, Kodungaiyur STP
4. Dr R. K. Jayseelan, Technical Director, ABC Techno Labs India Pvt Ltd
5. Ms. S. Sivaranjani , Assistant Engineer, TNPCB

Mr. Krishnaswamy, Chief Engineer (O & M-II) i/cof Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) presided over the meeting.

A statement showing list of participants present during the public hearing is given below:

Sl.No	Name of Participant	Designation	Organisation	Signature
1.	R.K.Chandrasekaran	EE/Civil	NCTPS. (TNEB)	
2	S.Mohan	AVP/Env[illegible]	AMR Power	
3.	K.SITHARAMAN	AM·CIVIL	TPL	
4.	S.Nagalingam	Sr.AM	TPL	
5.	D.Manoharan	A.E[illegible]	[illegible]	
6.	R.Rajaraman	Supt Dett. TWAD Brd Ch-5	TWAD Brd Chennai-5	
7	S.VENKATESWARAN	S. Railway	S.Rly.	
8	JONE	—	public.	
9	Amulasamy	—	Public	
10	S.RAJENDRAN	—	Public	
11	S.BASKARAN	AGM(B)	MPL	
12	V. John Rathinaraj	Manager	MPL	
13	P. Vasudevan	Sr.Manager	CPCL	
14	M.N. Suresh	Engineer	CPCL	
15	P. Manalidaran	Manager	MFL	
16	C.R.DHARANIPATH		ARUF 2.	

Mr. J. M. Anees, Executive Engineer CMWSSB welcomed the Presiding Officer, other officer on the dais and the people from the surrounding area who came to attend the meeting for the proposed project. All stake holders as well as general public introduced themselves. Mr. Manoharan (Plant Engineer, Nesapakkam STP) gave a brief introduction about all the STP's constructed and operated by CMWSSB in Chennai.

Mr. J.M. Anees, requested Dr.R. K.Jayseelan Technical Director, ABC Techno Labs India Pvt. Ltd, an Environmental consultancy for the presentation of proposed TTRO plant at Kodungaiyur. He had described the salient features and benefits of the upcoming TTRO plant. He specifically presented about the need and benefits of the TTRO plant. After this presentation the session was left for discussion.

Salient Details of TTRO plant

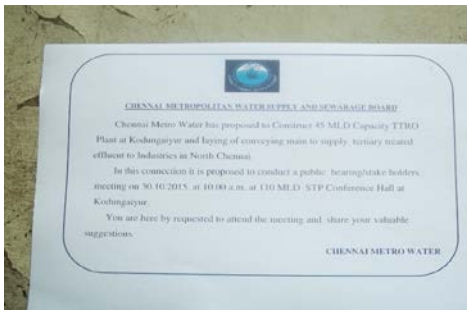
Feature	Details
Site Location	Kodungaiyur
Site Latitude and Longitude	13°08'49.92''N 80°15'47.68''E
Topography	Barren land
SOI Topo sheet	66 C/4 and 66 C/8
Above Mean Sea level in m	6 m
Population of the project village	Kodungaiyur total population- 41617
Surrounding Villages (2 Km Radius)	Kodungaiyur, Manali, Kaviarasu Kannadasan nagar, Thiruvottiyur, Chinna sekkadu and Sathangadu
Nearest City	Chennai
Nearest Town	Thiruvottiyur
Nearest Highway	Tondaiyarpet High Road (1.5 Km)- South Manali High Road (2 Km)- North East
Nearest water bodies	Buckingham Canal at a distance of 2 Km from the Site boundary of the TTRO plant (W) KosasthalaiyarRiver- at a distance of 7 Km from the Site boundary (N)

Salient Details of Conveying Main

S. No.	Selection Criteria	Details
1.	Topography	Barren land
2.	Nearest Water bodies	• Conveying main will be laid along the Buckingham canal • Bay of Bengal-2.17 km - E • Kanniyamman pettai Lake-5.89 Km – W
3.	State, National boundaries	NIL
4.	Nearest Highway	• Ennore high road – 459m - E • Kathivakkam high road -387m - E
5.	Defense installations	NIL
6.	Densely populated or built-up area	• Ennore – 1.8 Km - NNE • Manali new town – 4.22 Km - WSW

7.	Archeologically important places	NIL
8.	Reserved Forest	NIL
9.	National Parks / Wildlife Sanctuaries	NIL
10.	Earthquake zone	Zone III

Public Hearing canvassing photos are given below:



The discussions of the meeting are as follows:

S.No	Query	Reply
1	Mr. R. K. Chandrasekara Executive Engineer, NCTPS asked about the cost of the tertiary treated water. Most of the participants in the public hearingwere curious about the cost of the tertiary treated water.	Mr.Krishnaswamy, Chief Engineer (O&M-II), CMWSSB replied that, the cost of the project will be decided later.
2	Mr. Mohan from M/s. GMR Power shared his experience regarding phosphate removal problem in reverse osmosis. He requested Dr. R. K. Jayseelan to give his suggestion to overcome this problem.	Dr. R. K. Jayaseelan replied that it is very important to maintain the feed water characteristics of reverse osmosis. As the treated effluent which will be used as feed water contain phosphate concentration 0.3 mg/l hence it does not require separate treatment for phosphate removal. Mr. Muralidar from Madras Fertilizer Limited added his views on the same. Mr. K. Krishnaswamy, Chief Engineer told that all these suggestions will considered while execution.
3	Mr. P. Vasudevan Senior Manager, Chennai Petroleum Corporation Limited requested CMWSSB to use Sequential Batch Reactor technique instead of Activated Sludge Process for secondary	The project is only about treating the secondary effluent through Tertiary Treatment Reverse Osmosis plant and supplying water to the beneficiaries.

	treatment. There was discussion about sludge drying process also. Necessary clarifications were made to the all the participants.	
4	Mr. S. Rajendran (public) raised question regarding employment opportunities in the project.	Mr.J.M.Anees, Executive Engineer (CMWSSB)replied that there will be employment opportunities for the people residing in the surrounding villages.

Executive Engineer Mr. J. M. Anees CMWSSB concluded the meeting by thanking Mr. K. Krishnaswamy Chief Engineer (O & M-II) i/c, CMWSSB, S. Sivaranjani Assistant Engineer, TNPCB, S. P. Jeyaprakash Assistant Executive Engineer, Kodungaiyur STP, Dr R. K. Jayseelan, Technical Director, ABC Techno Labs India Pvt Ltd& all the stake holders as well as local public/ participants.

Mr. K. Krishnaswamy Chief Engineer (O & M-II) i/c

Mr. J. M. Anees, Executive Engineer (STP North) i/c

8. IMPLEMENTATION OF THE PROPOSED PROJECT AND INSTITUTIONAL ARRANGEMENTS AT CMWSSB

The proposed project involves construction of TTRO Plant of 45 MLD and laying of conveying main of 28.5 km from the TTRO Plant and various industries in the manali industrial area and in north Chennai. This project will be implemented on DBOT basis by CMWSSB under the scheme of Tamil nadu sustainable urban development project (TNSUDP) at an estimating cost of Rs.255 Crores.

The project is proposed to be implemented by DBOT contractor. The management measures identified for contractor will be included in the bid document. The DBOT contractor shall develop and prepare specific EMP in line with the management measures identified in the EIA report. The same shall be submitted to CMWSSB for approval prior to construction or along with designs.
Implementation of the management measures by the contractor shall be ensured by CMWSSB and report on ESMF compliance shall be submitted to TNUIFSL periodically.

The environmental management plan identified for the construction will be included in the bid documents for ensuring implementation of the environmental safeguards. The management measures identified will be taken up by the CMWSSB & DBOT contractor upon completion of construction activities.

8.1 ENVIRONMENTAL MANAGEMENT CELL

The proposed TTRO project will be implemented on D.B.O.T basis; hence the contractor will form his own Environmental Management Cell.

Project Management Consultant (PMC): CMWSSB has proposed to appoint project management consultants (PMC) for managing the project. Environmental and social specialists also will form part of the team of PMC for ensuring adoption and compliance of ESMF. PMC shall submit monthly ESMF compliance report to CMWSSB for the project.

8.2 GRIEVANCE REDRESSAL MECHANISM

The CMWSSB will have Grievance Redressal mechanism to handle the grievances of the project.

A project level Grievance Redressal Committee (GRC) will be set up and the members are as follows (preferably one of them as women)

1. Superintending Engineer (Projects -CMWSSB)
2. Any one elected representative
3. A person who is publicly known in the local area
4. Executive Engineer (Projects- CMWSSB)

GRIEVANCE REDRESSAL COMMITTEE (GRC)

The GRC shall

- Convene meetings of the committee as necessary at such place or places in the Project Implementation Agency as he considers appropriate; and
- Conduct the proceedings in an informal manner as he considers appropriate with the object to bring an amicable settlement between the parties.

Step by step approach will be followed for redressing grievances. First, the aggrieved Project Affected Person to approach the GRC in the first stage and the grievance committee will look into the grievances and resolve the issues. The proceedings of GRC will be documented.

If not satisfied with the resolution provided by GRC, then the complainants can appeal to the grievance redressal mechanisms available at the office of CMA/DTP/CoC at Chennai.

The complaints will be acknowledged to the complainant. Efforts will be made by CMWSSB to ensure closure of complaint within a maximum period of 30 days from the date of its receipt. Serious issues shall be attended as early as possible. If not satisfied with the resolution provided by GRC, the complaints shall be handled at higher level i.e, Chief engineer of CMWSSB.

If there is any grievance, it involves a process of consultation and negotiation with the committee. The grievances relating to the problem will be recorded and each step in the resolution process also will be recorded. The elected representative will be involved in representing the issue and act as communication link between the persons involved. When the problems are identified, it will be taken to the personnel who respond and pass the information to the committee immediately. It is then the role of the committee

to investigate and consult with the persons to evaluate the seriousness of the issues and work with the management to resolve the problem.

CMWSSB shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

The contact details of the Grievance Redressal Committee (GRC) are given below:

Chief Engineer,
Chennai Metropolitan Water Supply and Sewerage Board
No.1 Pumping Station Road, Chindatripet,
Chennai – 600 002.
Phone No: 28451300

To register complaints, contact the following phone number:
Phone No: 45674567

To register complaints through internet, visit the following link:
http://www.chennaimetrowater.tn.nic.in//services/complaint.htm

9. PROJECT BENEFITS

9.1 PRESENT SCENARIO

The main source of water supply to the Chennai city is from surface water sources such as Poondi, Cholavaram and Red hills reservoirs and also from ground water sources from Araniar and Korataliar basin. Chennai city does not have any perennial source of water. The water supply has been augmented by Krishna Water Supply scheme with supply from the State of Andhra Pradesh and by Chennai Water Supply Augmentation Project with supply from Veeranam Tank.

A desalination plant of capacity 100 MLD is commissioned near Kattupalli village, Minjur. Another 100 MLD capacity desalination plant is commissioned at Nemmili at the southern outskirts of Chennai.

9. 2 PRELIMINARY ASSESSMENT ON SUITABILITY OF TREATED WATER USAGE BY INDUSTRIES

Three sewage Treatment plants have already been constructed in Zone-I &II at Kodungaiyur site of capacity 80 MLD, 80 MLD & 110 MLD. The sewage now received and treated in Zone I &II is in the order of 200 MLD. The secondary treated effluent of about 36 MLD is now being supplied to Chennai 'Petroleum Corporation Ltd, (23 MLD), Madras Fertilizers Ltd (11.50 MLD) & Manali Petro Chemicals Ltd (1.5 MLD) for further treatment by the respective industries and use. The balance treated effluent is being let into the Buckingham canal.

As the Demand for TTRO water is now assessed from the Industries in North Chennai by M/s ITCOT Consultancy and services, it is proposed to construct a TTRO Plant of 45 MLD capacity at Kodungaiyur to supply TTRO water to meet their demands.

The study results are positive and on the basis of occupancy level and maturity of industrial parks and compound annual growth rate envisaged, the water demand for 2014-15 & 2019- 20 is projected at 46.7 MLD & 60.0 MLD respectively.

Based on the study, an overwhelming 70 to 92 percentage of the units have evinced interest in buying TTRO water from M/s CMWSSB.

9. 3 PROJECT BENEFITS & FUTURE SCENARIO

The proposed project aims at treating the secondary treated water suitable for industrial use. Some of the major project benefits are given below:

- Industrial Consumers will be supplied with treated water with good quality. So far the industrial consumers are depending on the fresh water from lake and ground water
- Reduction of fresh water consumption by industries and more fresh water shall be made available for potable use in the city
- The project will also be able to meet the industries increasing fresh water demands in future. Meeting the growing needs of industries for fresh water supply by the water supply authorities would also be difficult since the fresh water requirement of the city also increases in time.
- Employment generation in terms of skilled and un-skilled manpower due to plant construction and operation.
- The availability of water is sustainable irrespective of the season throughout the year.

ANNEXURE – I

SUPERINTENDING ENGINEER (WWT&R)

Lr. no CMWSSB/EE(STP/N)/TTRO/CRZ/Spl/2015 Date: 11.11.2015

To

The Convener, DCZMA /The District Environmental Engineer,
Tamil Nadu Pollution Control Board,
Sri Jothi Complex, 1st Floor,
#1,Murugesan Street, Bala Vinayagar Nagar,
Arumbakkam, Chennai - 600 106.

Sir,

Sub: CMWSSB - STP(N) – Construction of 45 MLD TTRO Plant at Kodungaiyur by M/s. **Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)**- Form-I CRZ Application submitted - Reg.

CMWSSB has proposed to Construct a 45 MLD TTRO Plant at Kodingaiyur and lay conveying main to supply to Industries in North Chennai. Since the project falls under CRZ necessary Form-I application is submitted herewith for obtaining clearance under CRZ-II and CRZ-I

Hence, it is hereby requested that necessary clearance under CRZ notification for the establishment at the earliest.

11.11.15 PC-?　　11/11/15 SS/STP(N)　　11/11/15

SUPERINTENDING ENGINEER (WWT&R)

o/c

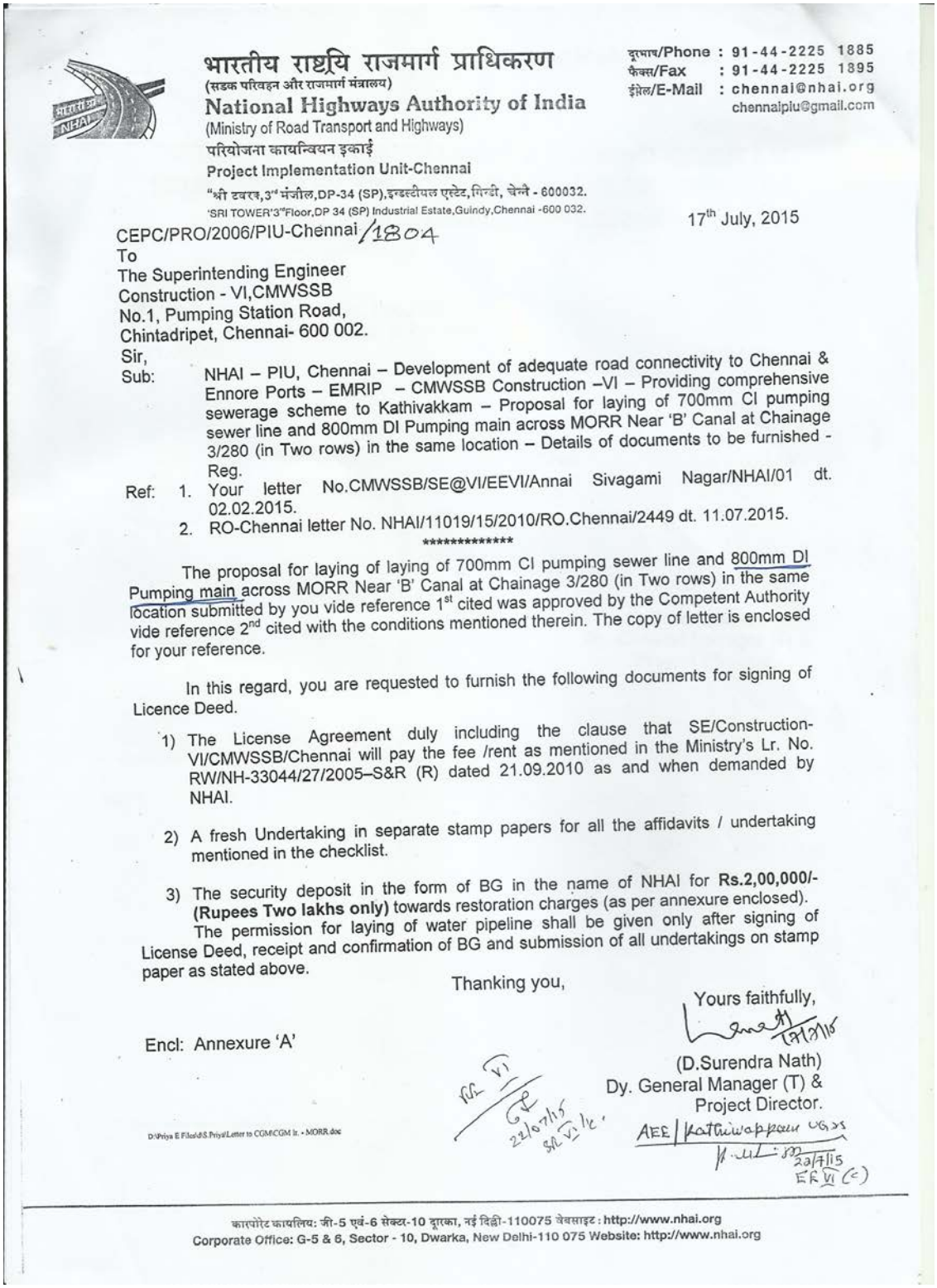
Encl: 1. Form-I application - 2 Sets
2. Check List - 2 Sets
3. Cadastral map of 1:4000 scale with report - 2 Sets
4. Annexure - 2 Sets

O/o. DEE, TNPC Board, CHENNAI

ABC Techno Labs

ANNEXURE – II

Approval from National Highways Authority of India



भारतीय राष्ट्रिय राजमार्ग प्राधिकरण
(सडक परिवहन और राजमार्ग मंत्रालय)
National Highways Authority of India
(Ministry of Road Transport and Highways)
परियोजना कार्यान्वियन इकाई
Project Implementation Unit-Chennai
"श्री टवर्स,3rd मंजील,DP-34 (SP),इन्डस्टीयल एस्टेट,गिन्डी, चेन्नै - 600032.
'SRI TOWER'3rd Floor,DP 34 (SP) Industrial Estate,Guindy,Chennai -600 032.

दूरभाष/Phone : 91-44-2225 1885
फैक्स/Fax : 91-44-2225 1895
ईमेल/E-Mail : chennai@nhai.org
chennaipiu@gmail.com

CEPC/PRO/2006/PIU-Chennai/1804

17th July, 2015

To
The Superintending Engineer
Construction - VI,CMWSSB
No.1, Pumping Station Road,
Chintadripet, Chennai- 600 002.

Sir,

Sub: NHAI – PIU, Chennai – Development of adequate road connectivity to Chennai & Ennore Ports – EMRIP – CMWSSB Construction –VI – Providing comprehensive sewerage scheme to Kathivakkam – Proposal for laying of 700mm CI pumping sewer line and 800mm DI Pumping main across MORR Near 'B' Canal at Chainage 3/280 (in Two rows) in the same location – Details of documents to be furnished - Reg.

Ref: 1. Your letter No.CMWSSB/SE@VI/EEVI/Annai Sivagami Nagar/NHAI/01 dt. 02.02.2015.
2. RO-Chennai letter No. NHAI/11019/15/2010/RO.Chennai/2449 dt. 11.07.2015.

****

The proposal for laying of laying of 700mm CI pumping sewer line and 800mm DI Pumping main across MORR Near 'B' Canal at Chainage 3/280 (in Two rows) in the same location submitted by you vide reference 1st cited was approved by the Competent Authority vide reference 2nd cited with the conditions mentioned therein. The copy of letter is enclosed for your reference.

In this regard, you are requested to furnish the following documents for signing of Licence Deed.

1) The License Agreement duly including the clause that SE/Construction-VI/CMWSSB/Chennai will pay the fee /rent as mentioned in the Ministry's Lr. No. RW/NH-33044/27/2005–S&R (R) dated 21.09.2010 as and when demanded by NHAI.

2) A fresh Undertaking in separate stamp papers for all the affidavits / undertaking mentioned in the checklist.

3) The security deposit in the form of BG in the name of NHAI for **Rs.2,00,000/- (Rupees Two lakhs only)** towards restoration charges (as per annexure enclosed).

The permission for laying of water pipeline shall be given only after signing of License Deed, receipt and confirmation of BG and submission of all undertakings on stamp paper as stated above.

Thanking you,

Yours faithfully,

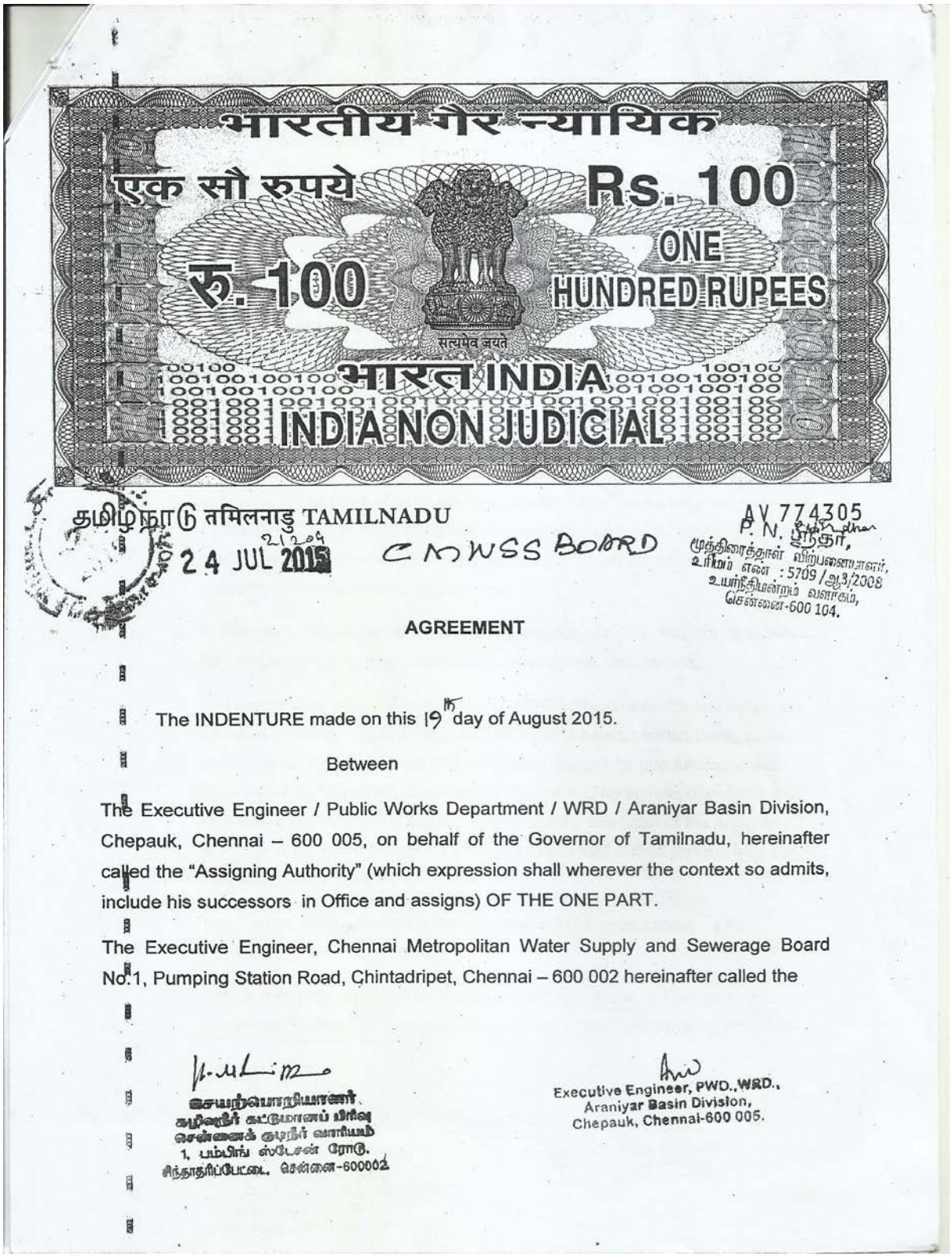
(D.Surendra Nath)
Dy. General Manager (T) &
Project Director.

Encl: Annexure 'A'

D:\Priya E Files\d\S.Priya\Letter to CGM\CGM lr. - MORR.doc

कारपोरेट कार्यालय: जी-5 एवं-6 सेक्टर-10 द्वारका, नई दिल्ली-110075 वेबसाइट : http://www.nhai.org
Corporate Office: G-5 & 6, Sector - 10, Dwarka, New Delhi-110 075 Website: http://www.nhai.org

Approval from Public Works Department, Government of Tamil Nadu



भारतीय गैर न्यायिक

एक सौ रुपये Rs. 100

रु. 100 ONE HUNDRED RUPEES

सत्यमेव जयते

भारत INDIA

INDIA NON JUDICIAL

தமிழ்நாடு தமிலநாடு TAMILNADU

24 JUL 2015 CMWSS BOARD

AV 774305

P. N. [illegible]

முத்திரைத்தாள் விற்பனையாளர்,
உரிமம் எண் : 5709 /அ3/2008
உயர்நீதிமன்றம் வளாகம்,
சென்னை-600 104.

AGREEMENT

The INDENTURE made on this 19th day of August 2015.

Between

The Executive Engineer / Public Works Department / WRD / Araniyar Basin Division, Chepauk, Chennai – 600 005, on behalf of the Governor of Tamilnadu, hereinafter called the "Assigning Authority" (which expression shall wherever the context so admits, include his successors in Office and assigns) OF THE ONE PART.

The Executive Engineer, Chennai Metropolitan Water Supply and Sewerage Board No.1, Pumping Station Road, Chintadripet, Chennai – 600 002 hereinafter called the

செயற்பொறியாளர்,
சென்னைக் குடிநீர் வாரியம்
1, பம்பிங் ஸ்டேசன் ரோடு,
சிந்தாதிரிப்பேட்டை, சென்னை-600002

Executive Engineer, PWD., WRD.,
Araniyar Basin Division,
Chepauk, Chennai-600 005.

"GRANTEE" which expression shall wherever the context so admits, include her executor, administrator, legal representative and assigns) OF THE OTHER PART WITNESSETH AND as follows:

The land specified in the schedule is hereby granted to the Executive Engineer, Chennai Metropolitan Water Supply and Sewerage Board, No.1, Pumping Station road, Chintadripet, Chennai – 600 002 for laying of 700 mm dia and 800 mm dia CI Pumping Main across Buckingham Canal by constructing a new pipe carrying bridge near Manali – Tiruvottiyur State Highway on Track rent basis for a period of one year commencing from 19.08.2015 to 18.08.2016 subject to the following conditions to which the aforesaid grantee is agree.

1. The grant is liable for cancellation, if it be found that it was grossly inequitable or was made under a mistake of fact or owing to misrepresentation of fraud or in excess of the limits of authority delegated to the office sanctioning the grant or that there was an irregularity in the procedure. Cancellation of any of these grounds may be ordered by the any authority to which the sanctioning authority is administratively subordinate.
2. In the event of such cancellation of the grant, the grantee shall not be entitled for compensation for any loss caused to her by the cancellation.
3. The grantee has paid the sum of Rs.5,00,000/- (Rupees Five lakhs only) vide Demand Draft No. 112573 / dated 21.07.2015 drawn on Indian Bank, Anna Salai Branch, Chennai – 600 002 for caution deposit for due fulfilment and observance by him of the conditions in the grant. The sum so deposited shall be liable to the forfeited to the Government under the order of the assigning authority in the event of failure by the grantee to fulfil and observe any of the conditions of the grant.
4. The grantee shall not use the land or suffer it to be used except for the purpose for which it is granted.
5. The grantee may laying 700 mm dia CI and 800 mm dia CI Pumping main across the Buckingham Canal by constructing a new pipe carrying bridge in

செயற்பொறியாளர்
கழிவுநீர் தடுமானம் பிரிவு
சென்னைக் குடிநீர் வாரியம்
1, பம்பிங் ஸ்டேசன் ரோடு,
சிந்தாதிரிப்பேட்டை, சென்னை-600002.

Executive Engineer, PWD.,WRD.,
Araniyar Basin Division,
Chepauk, Chennai-600 005.

accordance with the plans accepted by the assigning authority and as approved by the competent authority.

6. The grantee shall maintain the said Pumping main in a clean and sanitary condition to the satisfaction of the assigning authority and shall also maintain the structures if any erected thereon as aforesaid in good and substantial repair to the satisfaction of the assigning authority.

7. The grantee shall not without the previous written sanction of the assigning authority, permit any person.

8. The grantee shall be answerable to the Government of Tamilnadu for all or any injury or damages done to the said land other Government property thereon, except as is permitted by the foregoing conditions.

9. The grant hereby given may be revoked by the assigning authority after giving one month's notice in writing and the Government (or) the Chief Engineer without notice for emergent reasons (the said Government (or) the Chief Engineer being the sole judge of the emergency) and shall be terminable by the grantee by giving to the assigning authority one month's notice in writing but without prejudice to any right of action or remedy of the assigning authority in respect of any antecedent breach of any of the foregoing conditions. The grant may be surrendered by the grantee by giving to the assigning authority one month notice in writing but without prejudice to any rights of action of remedy of the assigning authority in respect of any antecedent, breach of any of the foregoing condition.

10. The grantee shall not in case of such revocation or termination be entitled to any compensation in respect of any building, fences and structures on the land or any other improvements effected by the grantee to the land but she may before the revocation or termination of the grant takes effect, if the grant is revoked without notice, within such time, as may be allowed by the assigning authority in that behalf remove such buildings, fences and structures.

11. The laying 700 mm dia CI and 800 mm dia CI Pumping main across the Buckingham Canal by constructing a new pipe carrying bridge which will be

செயற்பொறியாளர்
கழிவுநீர் கட்டுமானப் பிரிவு
சென்னைக் குடிநீர் வாரியம்
1, பம்பிங் ஸ்டேசன் ரோடு,
சிந்தாதிரிப்பேட்டை, சென்னை-600002.

Executive Engineer, PWD., WRD.,
Araniyar Basin Division,
Chepauk, Chennai-600 005.

constructed by the grantee shall be maintained by them after handing over to the Assigning Authority.

SPECIAL CONDITIONS.

12. The rent now fixed is subject or revision by the Government from time to time I agree by the same.

13. If any damage is done to any of the Public Works Department / Water Resources Department property, it should be repaired by the grantee.

14. Advance intimation should be given to the officer concerned before commencement of the works.

15. The grantee shall apply for its renewal before 30 days the expiry of this agreement.

Permission accorded by the Chief Engineer, PWD, WRO, Chennai Region, Chepauk, Chennai – 5 vide letter no. T1 /1513/ NOC / CMWSSB/2015 dated 01.07.2015.

16. The applicant should not let out any sewage water into channel.

17. The design and drawing of the above laying 700 mm dia CI and 800 mm dia CI Pumping main across the Buckingham Canal by constructing a new pipe carrying bridge should be communicated to the Executive Engineer, WRD, Araniar Basin Division, Chennai for approval and the work schedule should also be informed for monitoring the construction prior to commencement of the work.

18. The applicant should enter into an agreement with the Executive Engineer, PWD, WRO, Araniyar Basin Division, Chennai – 5 and it should be renewed every year before 30 days of expiry of the lease agreement.

19. The applicant should laying 700 mm dia CI and 800 mm dia CI pumping main across the Buckingham Canal by constructing a new pipe carrying bridge at their own cost and they are solely responsible for the structural safety and stability of the proposed structures.

செயற்பொறியாளர்
கழிவுநீர் கட்டுமானப் பிரிவு
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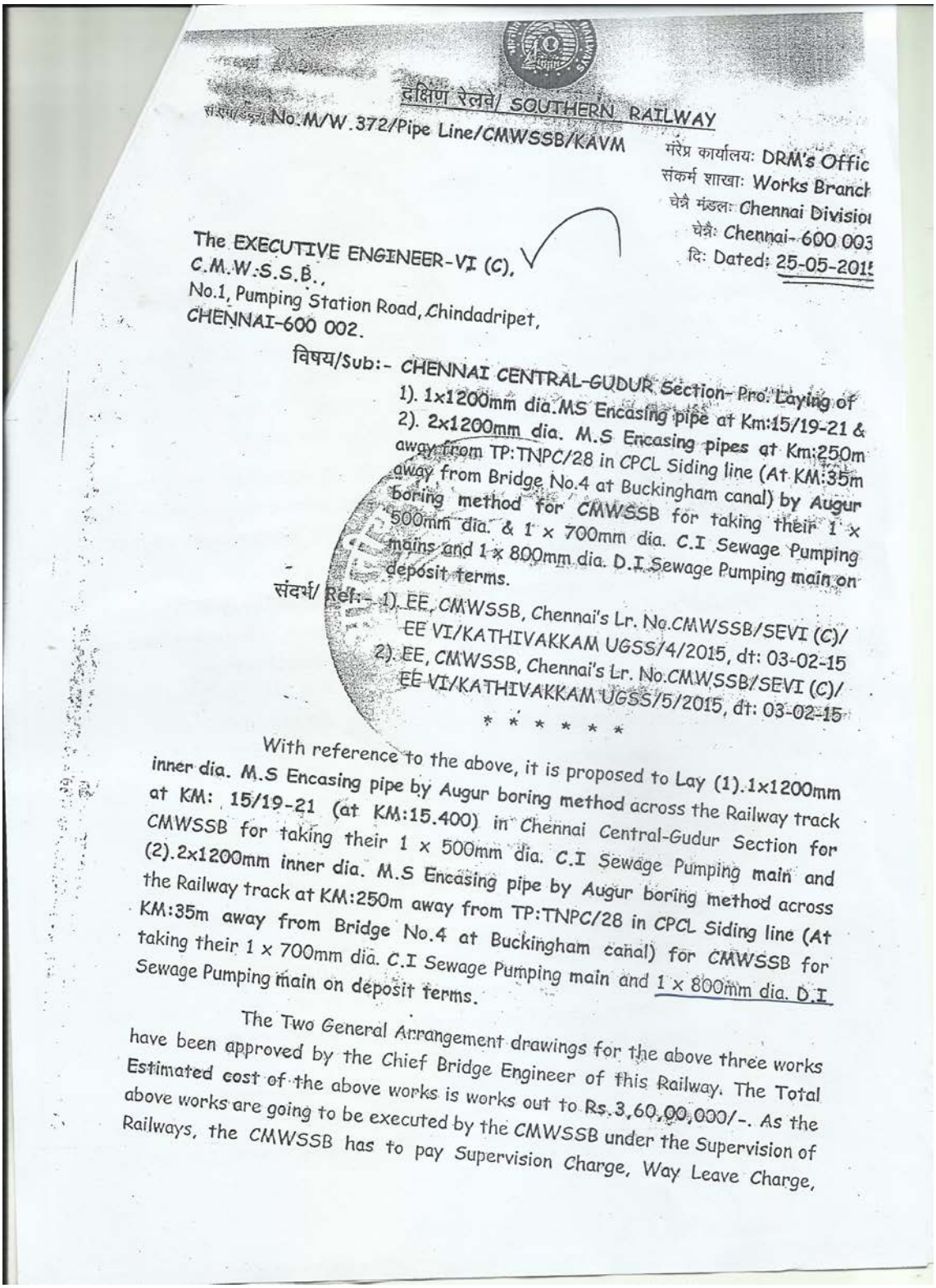
1, பம்பிங் ஸ்டேசன் ரோடு,
சிந்தாதிரிப்பேட்டை, சென்னை-600002.

Executive Engineer, PWD.,WRD.,
Araniyar Basin Division,
Chepauk, Chennai-600 005.

Approval from Southern Railways



दक्षिण रेलवे/ SOUTHERN RAILWAY

संख्या/ No. M/W.372/Pipe Line/CMWSSB/KAVM

मंरेप्र कार्यालय: DRM's Offic
संकर्म शाखा: Works Branch
चेन्नै मंडल: Chennai Division
चेन्नै: Chennai-600 003
दि: Dated: 25-05-201

The EXECUTIVE ENGINEER-VI (C),
C.M.W.S.S.B.,
No.1, Pumping Station Road, Chindadripet,
CHENNAI-600 002.

विषय/Sub:- CHENNAI CENTRAL-GUDUR Section- Pro. Laying of
1). 1x1200mm dia.MS Encasing pipe at Km:15/19-21 &
2). 2x1200mm dia. M.S Encasing pipes at Km:250m away from TP:TNPC/28 in CPCL Siding line (At KM:35m away from Bridge No.4 at Buckingham canal) by Augur boring method for CMWSSB for taking their 1 x 500mm dia. & 1 x 700mm dia. C.I Sewage Pumping mains and 1 x 800mm dia. D.I Sewage Pumping main on deposit terms.

संदर्भ/ Ref:- 1). EE, CMWSSB, Chennai's Lr. No.CMWSSB/SEVI (C)/ EE VI/KATHIVAKKAM UGSS/4/2015, dt: 03-02-15
2). EE, CMWSSB, Chennai's Lr. No.CMWSSB/SEVI (C)/ EE VI/KATHIVAKKAM UGSS/5/2015, dt: 03-02-15

* * * * * *

With reference to the above, it is proposed to Lay (1).1x1200mm inner dia. M.S Encasing pipe by Augur boring method across the Railway track at KM: 15/19-21 (at KM:15.400) in Chennai Central-Gudur Section for CMWSSB for taking their 1 x 500mm dia. C.I Sewage Pumping main and (2).2x1200mm inner dia. M.S Encasing pipe by Augur boring method across the Railway track at KM:250m away from TP:TNPC/28 in CPCL Siding line (At KM:35m away from Bridge No.4 at Buckingham canal) for CMWSSB for taking their 1 x 700mm dia. C.I Sewage Pumping main and 1 x 800mm dia. D.I Sewage Pumping main on deposit terms.

The Two General Arrangement drawings for the above three works have been approved by the Chief Bridge Engineer of this Railway. The Total Estimated cost of the above works is works out to Rs.3,60,00,000/-. As the above works are going to be executed by the CMWSSB under the Supervision of Railways, the CMWSSB has to pay Supervision Charge, Way Leave Charge,

Annual Maintenance Charge, Land License Fee, the amounts required Traction, Signaling and Electrical branches of this Railway for carrying out portion of work, if any, to this Railway.

For collecting the Way Leave Charge, Annual Maintenance Charge, Land License Fee and other branch charges, it will be processed separately and advised later. An agreement will also to be executed with this Railway. The Supervision Charge at 12.50% on overall cost of the above work is works out to Rs.45,00,000/- The CMWSSB has paid a sum of Rs.12,04,000/- as Registration fee on 04-02-2015 and Rs.12,00,000/- as Centage Charge on 24-03-2015. Hence the balance amount of Rs. 32,96,000/- has to be remitted by the CMWSSB to this Railway for further process.

Hence the Executive Engineer-VI (C), CMWSSB, No.1, Pumping Station Road, Chintadripet, Chennai-2 is requested to arrange to remit a sum of Rs.32,96,000/-(Rupees Thirty two lakhs ninety six thousands only) being the Supervision Charge for the above works.

The above Supervision Charge may be remitted to the Senior Divisional Cashier, Chennai Division, Southern Railway, Chennai-600003 and advice the remittance particulars to this office to process further.

(S.ANBALAGAN)
Divisional Engineer/CTR,
for Divl.Rly. Manager/Works/MAS.

Copy to: 1). Sr.DFM/MAS for information please.

2). Sr.DPM/MAS for information and he is requested to receive the above amount and issue necessary receipt for the same to this office please.

3). Sr.DEE/TRD/MAS, Sr.DSTE/MAS, Sr.DEE/GENL/MAS for information and they are requested to arrange to submit the amount required for carrying out their portion of work, if any, to this office for further process please.

4). SSE/Land/Drg.Branch for information and to collect Way Leave Charge, Land License fee, Annual maintenance charges and other branch amounts from the party and making agreement, etc. for the above works.

Annexure III

Model Format for Reporting on Supply of TTRO water for Industries, Power Plants and Institutions of CMWSSB ESMF Compliance

(Implementation of Environmental and Social Management Measures)

- The objective of these guide lines is to assist the PMC / ULB or the borrower in preparing the project compliance report, the clearly documents the Environmental and social issues encountered in the sub project and the compliance of the EAR and SAR recommendations.
- The sub-project compliance report shall have an exclusive section on Environmental and social / R&R issues of the projects and provide the following information.

Sub-Project Name :		**Loan / Disbursement No :**	
Borrower:		**PMC Consultant :**	
Date of commencement:		**Date of completion:**	
Period of reporting:			
Total Package:		**Reporting Package:**	
Nature of work/ component:			
Contractor:			
Environmental Category:		**Social Category:**	
Project Stage/Phase : (Pre- Construction /Construction/Operation) Please select appropriate phase			
I ENVIRONMENTAL ASPECTS			
A. Environmental Permissions	**Status**	**Cost (in Rs.) if any**	**Remarks Responsibility**
Tree Cutting			
Others, if any			
B. Management measures	**Implemented**		**Responsibility**
a. Environmental screening/ Site evaluation			
b. Public consensus status, meetings etc			
c. Utility relocation			
1.			
2.			
d. Labour Camps			
1 Temporary shelters			

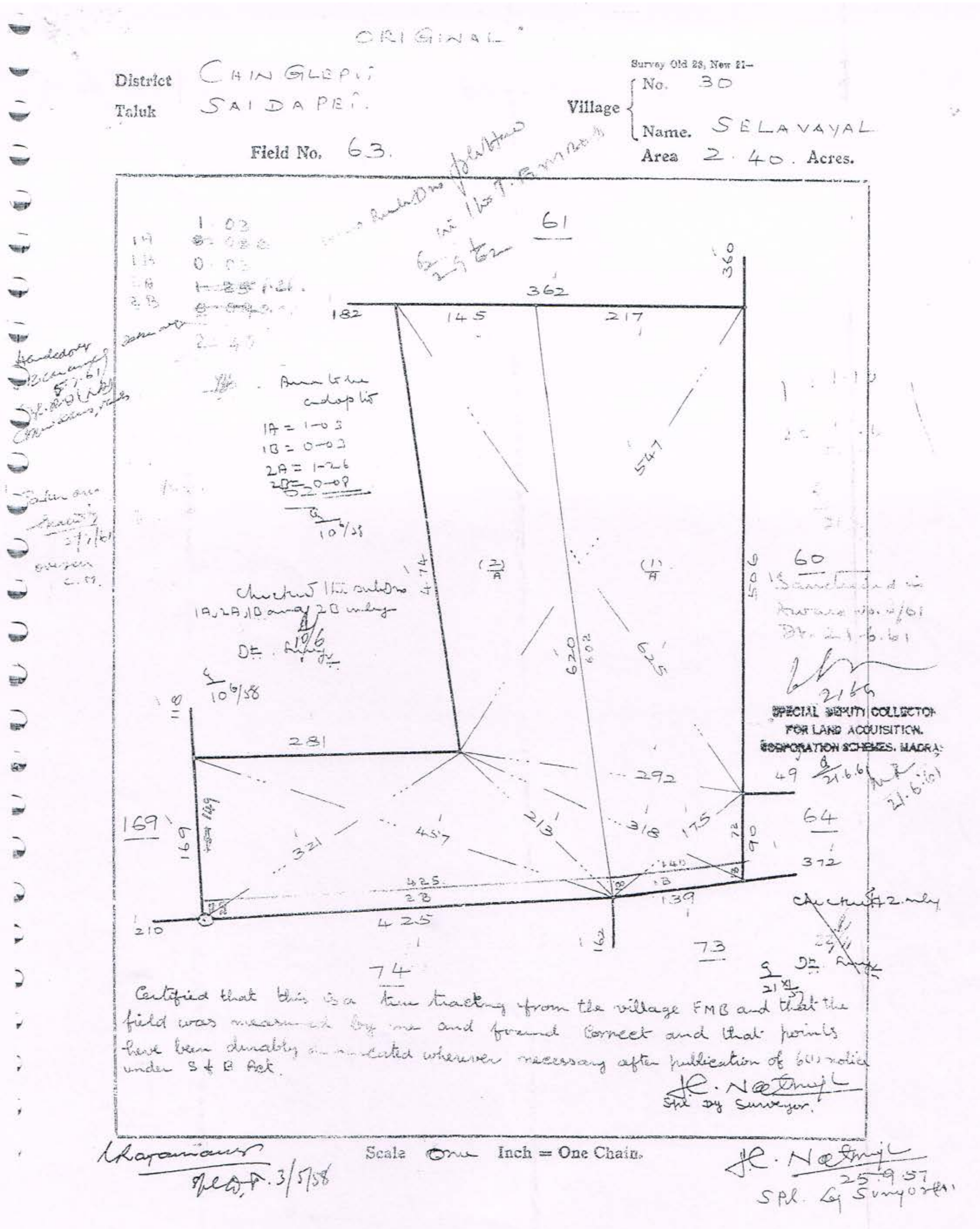
2 Potable water supply		
3 Sanitation and drainage		
4 Electricity/Lighting		
e. Traffic arrangements		
• Traffic Diversion Plan		
• Signages		
• Road Cut Plan /resurfacing		
d. Safety aspects		
• Accident prevention		
• Risk from electric		
• First Aid		
• Safety appliances		
e. Storage of construction materials		
C. Protection of environment and sensitive receptors (residential areas, schools, hospitals, etc)		
1. Air Environment		
a. Dust from construction		
b. Vehicular emissions during		
2.Water Environment		
a. Prevention of Flooding in project site due to excavation/low lying areas.		
b. Discharge of treated waste water.		
c. Prevention of contamination of groundwater/ surface water.		
d. Laying of mains		
1 cross over with WS		
2 alternate arrangements for temporary supply disruptions		
3.Noise Environment		
a. Vehicular noise		
b. Noise from construction		
4. Biological Environment		
a. Tree cutting - Target/ Progress		
b.Compensatory plantation - Target/ Progress		
c. Protection of existing flora and fauna		

5. Soil/Land		
a. Top soil protection		
b.Disposal of excavated material/ construction debris		
c. Fuel and lubricants - spillage and disposal		
6.Archaeological Property encountered		
7. Monitoring Plan (to compare with pre project		
a. Air Quality		
b. Water quality		
c. Noise		
d. Soil quality		
8. Other Issues encountered		
1. Details of any objections and status		
2. Any incidents and status		
3. Any other		

II SOCIAL ASPECTS

Status of R&R activities	**Target**	**Achievement till previous month**	**Progress during this month**	**Cumulative**	**Remarks**
1. Payment of compensation to PAFs					
Location 1					
Location 2					
Location 3					
Location 4					
2. Resettlement details					
Location 1					
Location 2					
Location 3					
Location 4					
3. Any other impacts identified during implementation					

ANNEXURE IV

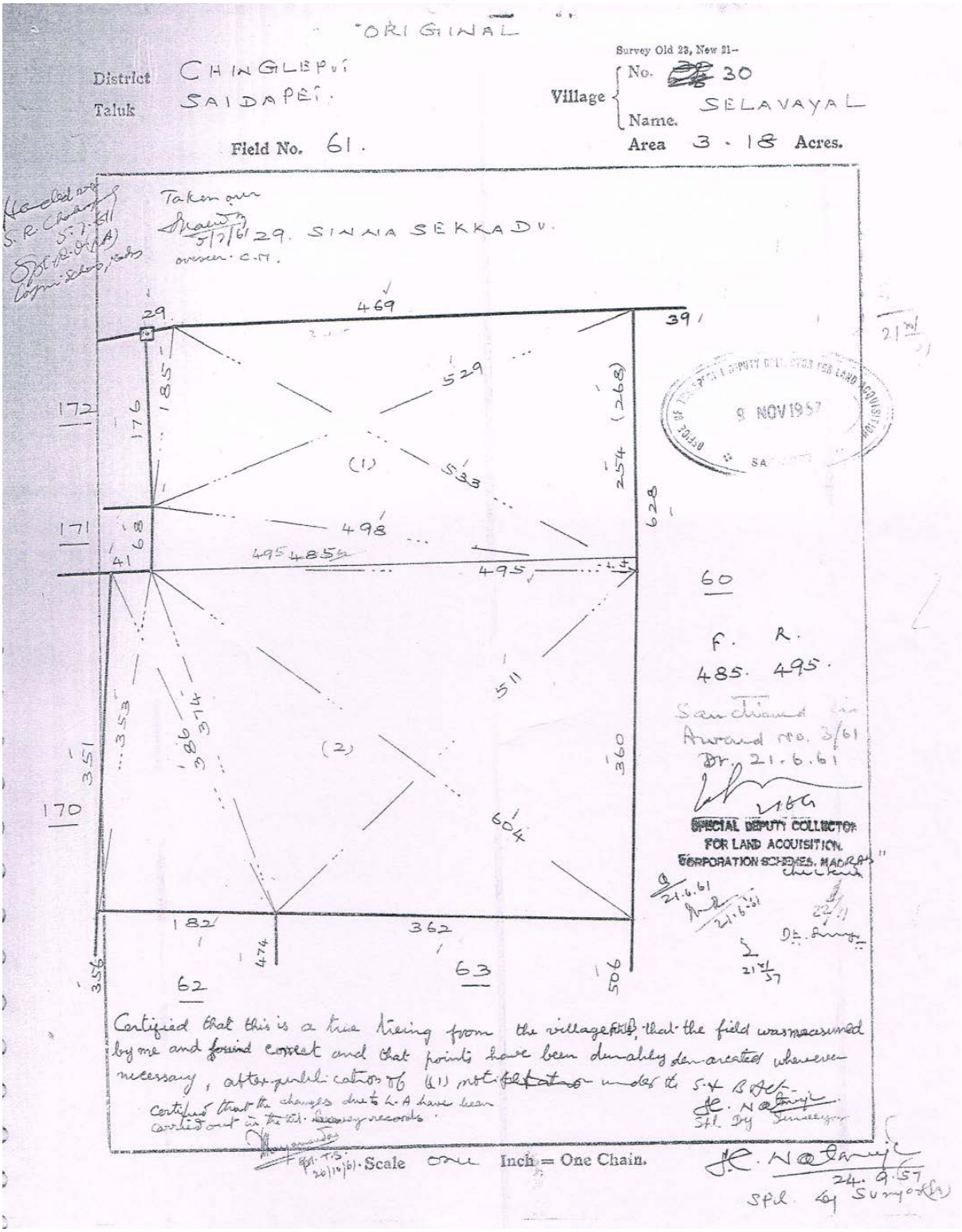

ORIGINAL
District CHINGLEPUT
Taluk SAIDAPET
Survey Old 23, New 21—
Village No. 30
Name. SELAVAYAL
Field No. 63.
Area 2 . 40 . Acres.
61
60
64
73
74
169
Certified that this is a true tracing from the village FMB and that the field was measured by me and found correct and that points have been durably demarcated wherever necessary after publication of 6(i) notice under S & B Act.
Spl Dy Surveyor.
SPECIAL DEPUTY COLLECTOR FOR LAND ACQUISITION. CORPORATION SCHEMES, MADRAS
Scale One Inch = One Chain.
25.9.57
Spl. Dy Surveyor

ORIGINAL

District CHINGLEPUT
Taluk SAIDAPET.

Survey Old 23, New 21–
Village { No. 30
Name. SELAVAYAL

Field No. 61.
Area 3 · 18 Acres.



Certified that this is a true tracing from the village plan, that the field was measured by me and found correct and that points have been duly demarcated wherever necessary, after publication of (1) notification under the S.4 B.A.C.

Certified that the changes due to L.A have been carried out in the village records.

Scale One Inch = One Chain.

24.9.57
Spl. Dy Surveyor

Survey Old 26, New 32

District CHINGLEPUT

Taluk SAIDAPET

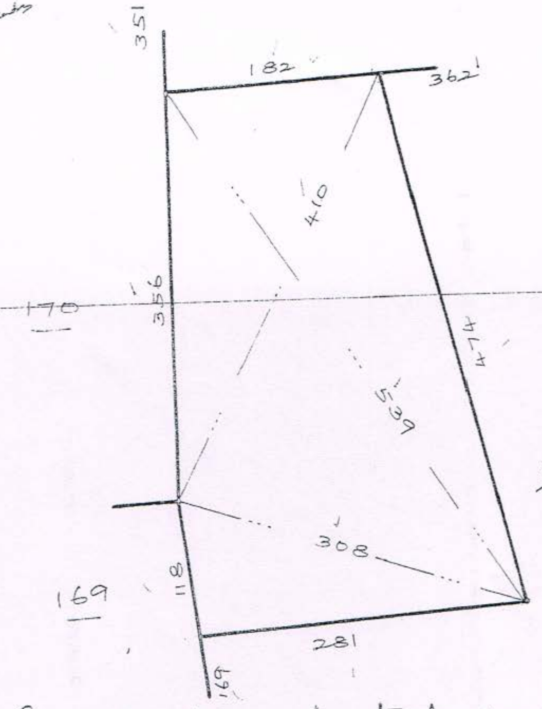
Village { No. 30 / Name. SELAVAYAL }

Area 1 - 11 · Acres.

Field No. 62

Taken over ... 5/7/61 ...

Handed over ... 8-7-61 Spl. R.I (LA) ... Schemes ...



Sanctioned in Award No. 3/61 Dt. 21.6.61

21/6/61

SPECIAL DEPUTY COLLECTOR
FOR LAND ACQUISITION
CORPORATION SCHEMES, MADRAS

21.6.61 21.6.61

Checked 24/11 ... 21/11/57

Certified that this is a true tracing from the village FMB, that the field was measured by me and found correct, and that points have been durably demarcated wherever necessary, after publication of 6(1) notice under S & B Act.

Spl. Dy Surveyor.

Changes due to L.A. have been carried out in the village accounts. ... Spl. T.S.

Scale One Inch = One Chain.

Spl. Dy Surveyor 26-9-57

ANNEXURE V

SOCIAL SCREENING FORM

Name of the Borrower : CMWSSB

Project Location : KODUNGAIYUR

Project :Construction of TTRO plant of capacity 45 MLD at Kodungaiyur and supply of TTRO water to Industries and Power plants and Institutions located at Manali-Minjur and Manali-Ennore Corridor

Land Use, Resettlement, and/or Land Acquisition				
S No.	**COMPONENTS**	**YES**	**NO**	**DETAILS**
1	Does the project involve acquisition of private land?		✓	
2	Alienation of any type of Government land including that owned by Urban Local Body?		✓	
3	Clearance of encroachment from Government / Urban Local body Land?		✓	
4	Clearance of squatters/hawkers from Government / Urban Local Body Land?		✓	
5	Number of structures, both authorized and/or unauthorized to be acquired / cleared/		✓	
6	Number of household to be displaced?		✓	
7	Details of village common properties to be alienated Pasture Land (acres) Cremation/ burial ground and others specify?		✓	
8	Describe existing land uses on and around the project area (e.g., community facilities, agriculture, tourism, private property)?		✓	
9	Will the project result in construction workers or other people moving into or		✓	

	having access to the area (for a long time period and in large numbers compared to permanent residents)?			
10	Are financial compensation measures expected to be needed?		✓	
Loss of Crops, Fruit Trees, Household Infrastructure and livelihood				
S No.	**COMPONENTS**	**YES**	**NO**	**DETAILS**
11	Will the project result in the permanent or temporary loss of the following?			
11.1	Crops?		✓	
11.2	Fruit trees / coconut palms? Specify with numbers		✓	
11.3	Petty Shops/ Kiosks		✓	
11.4	Vegetable/Fish/Meat vending		✓	
11.5	Cycle repair shop		✓	
11.6	Garage		✓	
11.7	Tea stalls		✓	
11.8	Grazing		✓	
11.9	Loss of access to forest produce (NTFP)		✓	
11.10	Any others - specify		✓	
Welfare, Employment, and Gender				
S No.	**COMPONENTS**	**YES**	**NO**	**DETAILS**
12	Is the project likely to provide local employment opportunities, including employment opportunities for women?	✓		Qualified and Experienced personnel from the local area will be considered for employment in TTRO plant
13	Is the project being planned with sufficient attention to local poverty alleviation objectives?		✓	Not Applicable

14	Is the project being designed with sufficient local participation (including the participation of women) in the planning, design, and implementation process?	✓		
Historical, Archaeological, or Cultural Heritage Sites				
S No.	**COMPONENTS**	**YES**	**NO**	**DETAILS**
Based on available sources, consultation with local authorities, local knowledge and/or observations, could the project alter:				
15	Historical heritage site(s) or require excavation near the same?		✓	
16	Archaeological heritage site(s) or require excavation near the same?		✓	
17	Cultural heritage site(s) or require excavation near the same?		✓	
18	Graves, or sacred locations or require excavations near the same?		✓	
Tribal Population/Indigenous People				
19	Does this project involves acquisition of any land belonging to Scheduled Tribes?		✓	
20	Population proposed to be benefitted by the proposed project	✓		Only Industries which require TTRO water as detailed in the report
21	No. of Females proposed to be benefitted by the proposed project		✓	Not Applicable
22	Vulnerable households /population to be benefitted			Not Applicable
23	No. of BPL Families to be benefitted			Not Applicable

Date: _____

24/3/16.

Signature and name of the Borrower

SUPERINTENDING ENGINEER
CMWSS BOARD
PUMPING STATION ROAD
CHINTADRIPET, CHENNAI-600 002.

Enclosures: Land details for the project sites, location, survey numbers, extent available and

required, land use classification, current use of the site, land ownership, alienation / acquisition ESMF / MAR 2015 / VOL-II 10 **TNSUDP** status, FMB extracts, as required along with a certificate giving availability of sites required for the project by the borrower.

ANNEXURE VI

ENVIRONMENTAL SCREENING FORM

(to be prepared by the Borrowers for each project)

Name of the Borrower : CMWSSB

Project location : KODUNGAIYUR

Project : Construction of TTRO plant of capacity 45 MLD at Kodungaiyur and supply of TTRO water to Industries and Power plants and Institutions located at Manali-Minjur and Manali-Ennore Corridor

Project Components				
Sl.no	**Components**	**Details**		
1	Brief description of the project proposal	CMWSSB has proposed a TTRO Plant of capacity 45 MLD at Kodungaiyur and supply treated water to industries, power plants and institutions located at Manali-Minjur Corridor, Manali-Ennore Corridor in North Chennai through conveying main of length 28.5 km.		
2	Number of project sites and Project components	TTRO site within CMWSSB site in Kodungaiyur.		
3	Details of Alignment and Component	Laying of conveying lines for a total length of 28.5km for distribution industries and powerplants in North Chennai.		
4	Location of the Project Sites & Current Use (Provide information for all sites involved in the project)	Existing vacant site belonging to CMWSSB near STP in Kodungaiyur.		
	Biological Environment			
Sl.no	**Components**	**Yes**	**No**	**Details**
5	Is the project adjacent to any of			

	the following (Provide information for all sites and alignment of the project)			
(i).	Cultural Heritage site		✓	
(ii).	Protected Area		✓	
(iii).	Wet Land/ Mangrove/ Estuarine Region	✓		Ennore Creek
(iv).	Natural Forests		✓	
(v).	Other Sensitive Environmental Components as listed in ESMF		✓	
(vi).	Residences, schools, hospitals etc		✓	
(vii).	Drinking water source, upstream and downstream uses of rivers etc		✓	
(viii).	Lowlying areas prone to flooding / areas of Tidal Influence (CRZ)	✓		Buckingham Canal and Ennore Creek
6.	Does the proposed project could cause the following			
(i).	Impact on Surrounding Environmental Conditions		✓	
(ii).	Degradation of land / eco-systems		✓	
(iii).	Loss or impacts on Cultural / heritage properties		✓	
(iv).	Water Resource Problems		✓	
(v).	Pollution of Water bodies / ground water	✓		Disposal of rejects
(vi).	Cutting of Trees / Loss of Vegetation		✓	
(vii).	Health & Safety Risks in the neighbourhood	✓		
(viii).	Potential risk of habitat fragmentation due to the clearing activities? (eg. Hindrance to the local bio diversity like disturbing		✓	

	the migratory path of animals/ birds etc.)			
	Physical Environment			
	Components	**Yes**	**No**	**Details**
7	Will the project affects the River flow pattern, stream pattern or any other irrigation canal?		✓	
8	Water quantity? Estimated usage of water quantity for the project	✓		2 KLD
9	Estimated energy consumption for the project activities	✓		450 kWh per month
10	Any other resources proposed to be utilized for project activity? (eg., ground water)			Nil
	Geology / Soils			
	Components	**Yes**	**No**	**Details**
11	Does the project activity involve cutting and filling/ blasting etc…?		✓	
12	Will the project cause physical changes in the project area (e.g., changes to the topography) due to excavation, earthwork etc…?		✓	
13	Will the project involve any quarrying/ mining etc?		✓	
	Pollution			
	Components	**Yes**	**No**	**Details**
14	Will the project use or store dangerous substances (e.g., large quantities of hazardous chemicals/ materials like Chlorine, Diesel, Petroleum products etc…)?	✓		To be determined by the DBOT contractor

15	Will the project produce solid or liquid wastes?	✓		
16	Will the project cause air pollution or increase in emission of pollutants?		✓	
17	Will the project generate or increase noise?	✓		
18	Will the project generate water pollution (water bodies/ groundwater)?	✓		
19	Will the project cause construction Hazard to workers/ residents		✓	
20	Is there a potential for release of toxic gases or accident risks			To be determined by the DBOT contractor
	Environmental Enhancement Measures			
	Components	**Yes**	**No**	**Details**
21	Has the Project design considered the following?			
(i).	Is the project design considering energy conservation measures/ energy recovery options?	✓		
(ii).	Is the project considering waste minimisation or waste reuse/recycle options?	✓		The TTRO plant is proposed for treating secondary treated sewage effluent to ensure reuse for industrial purposes.
(iii).	Has the project design considered RWH or any other environmental enhancement measure?	✓		
(iv).	Has the project design considered extreme events, drought, flood, natural disasters?	✓		

	General			
22	Please indicate whether any other features of the project that could influence ambient environment		✓	
23	Has any consultation with the public or stakeholders been conducted?	✓		

Date: _____

Signature and name of the Borrower

SUPERINTENDING ENGINEER
CMWSS BOARD
No.1, PUMPING STATION ROAD,
CHINTADRIPET, CHENNAI-600 002.

Enclosures: (Provide maps with the geographical location of the project; and an appropriately-scaled map clearly showing the project area and project sites with land use, existing buildings, infrastructure, vegetation, adjacent land use, utility lines, access roads and any planned construction, as required).