



***Tamil Nadu Sustainable Urban Development Project (TNSUDP)***

**Storm Water Drainage Project for the  
Selected Areas of Chennai Corporation**

**Final Environmental Assessment Report**

**January 2015**

**Storm Water Drains Department,  
Corporation of Chennai**

## **Executive Summary**

### **1. INTRODUCTION**

1. Government of Tamil Nadu has proposed to implement the World Bank supported Tamil Nadu Sustainable Urban Development program (TNSUDP) to improve the delivery of urban services. The provision of Storm Water Drains to selected areas of Corporation of Chennai is one of the sub-projects proposed to be implemented by the Corporation of Chennai (CoC). This component is coordinated by Government of Tamil Nadu with Tamil Nadu Urban Infrastructure Financial Services Ltd. (TNUIFSL), Chennai as the fund Manager. This sub project is proposed to be implemented along the roadsides and canals and doesn't involve any Land Acquisition and required land is owned by the Corporation of Chennai.

### **2. PROJECT DESCRIPTION**

2. The Storm Water Drainage project for the selected areas of Corporation of Chennai proposed to be taken up under the TNSUDP involves construction of storm water drains and canals in the project area. This sub project proposed to be implemented in the 4 Zones of the CoC. The total length of the drains to be constructed is about 270.33 kilometres including the 11.05 km length in the canals. RCC rectangular drains have been proposed for construction. Wherever necessary, RCC Pre-cast Drains have been proposed in place of cast in situ if the drain width is up to 2m.
3. This sub-project involves 39 contract packages including new storm water drains, rehabilitation of existing/unsized/dilapidated storm water drains and improvements to the existing canals. The Administrative zones covered under this sub-project are Part of Zone VII Ambattur – Padikuppam –Nolambur area, Zone XI Valasaravakkam, Ramapuram and Porur Area and Part of Zone XII Alandur – Mugalivakkam, Meenambakkam and Manappakkam area.

### **3. APPLICABILITY OF ESMF**

4. Projects proposed under TNSUDP 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 Framework exclusively prepared for TNSUDP.
5. The project as per the ESMF, is categorized as E2 category with lesser impacts than E1 projects and requires Environmental assessment to be carried out and management measures be prepared.

### **4. ENVIRONMENTAL ASSESSMENT**

6. The EA was carried out with an objective to identify and assess the environmental impacts arising out of implementation of the Storm Water Drain Construction and develop and Environmental Management Plan (EMP) to mitigate the identified

impacts. The EA involved screening of the project, quantitative and qualitative surveys to collect the relevant information, field visits to the project area, catchment areas, canals, etc. and consultations with the community.

#### 4.1 ENVIRONMENTAL REGULATORY REQUIREMENTS

7. A review of national, state, regional and World Bank environmental laws, rules and regulations relevant to the proposed SWD project indicates that in addition to the safeguard policies of the Bank and construction safety requirements, the project would require permission to cut the trees (41 nos) that will be cut during the construction phase of the project.

#### 4.2 BASELINE ENVIRONMENTAL PROFILE

8. Chennai city is underlain by various geological formations from ancient Archaeans to recent Alluviums and the climate is generally hot and humid. The ambient air quality ranges between a high of  $175\mu\text{g}/\text{m}^3$  at Thiruvottiyur to a low of  $8\mu\text{g}/\text{m}^3$  at NEERI CSIR campus. The noise levels are generally high in commercial areas and the soil/sediment quality in the city reflects that there is no toxic element present beyond to the safe limits. Ground water with a pH of 7.4-7.9, electrical conductivity 780-1288  $\mu\text{mho}/\text{cm}$ , Total Dissolved Solids of 580-910 mg/l, total and calcium hardness of 260-482 mg/l and 168-340 mg/l, the ground water quality is within the prescribed standards.

#### 4.3 ASSESSMENT OF IMPACTS

9. The major impacts of the project are expected to be during the construction phase leading air and noise quality deterioration, Health and Safety impacts to the works and local communities, traffic diversion and utility shifting, access to private properties, back flow of water from the canals, solid waste dumping and disposal of excavated silt from the drains.
10. The project is expected to lead to cutting of about 41 trees. In addition, another 242 trees located in the construction area of the proposed drains. The project proposes to carry out compensatory plantation of 10 times the trees that may be lost due to the project.

#### 4.4 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

11. In summary, the expected impacts are of small scale, temporary and site specific depending on the implementation of the project and will not exceed the construction and major environmental norms. To mitigate the identified impacts an Environmental Management Plan has been prepared along with specific cost estimated for implementation. A summary of key EMP measures are provided below and a detailed EMP is provided in Section 7 in Table 7.1. The EMP will be form part of the contract document.

**Key Environmental Management Measures proposed in the SWD to selected areas of Chennai Corporation**

| Sl.no | Potential Impact                                     | Mitigation Measures  | Responsible agencies                       |
|-------|--|--|--|
|       | <b>PRE-CONSTRUCTION STAGE AND CONSTRUCTION PHASE</b> |  |  |
| 1     | Clearances   | All clearance required from other departments and Environmental aspects shall be ensured and made available before start of work.<br>For trees identified for cutting, obtain prior permission from the Deputy Commissioner, CoC prior to commencement of work.  | COC  |
| 2     | Tree Cutting   | i) Provide adequate protection to the trees to be retained with tree guards (e.g. Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars) as required.<br>ii) Take adequate care to determine to root protection zone and minimise root loss.<br>iii) Trees shall be removed from the construction sites before commencement of construction<br>iv) Undertake afforestation in nearby areas.   | Contractor / COC                           |
| 3     | Utility Relocation                                   | i) Identify the common utilities that would be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc.<br>ii) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.<br>iii) Where ever the entry and exit to houses/ establishments are affected due to construction activities, alternate temporary arrangement for crossing over shall be provided.  | COC / Concerned departments/<br>Contractor |
| 4     | Planning of temporary Traffic arrangements           | i) 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.<br>ii) 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. | Contractor / COC                           |

|   |  |   |                  |
|---|--|---|------------------|
|   |  | <b>The guidance for traffic management provided in Section 7.3.9 of the EA report shall be referred to for preparation of the traffic plan.</b>   |                  |
| 5 | Temporary flooding during construction activity. | <ul style="list-style-type: none"> <li>i) Desilting activity shall be scheduled during non-flooding season.</li> <li>ii) Proper drainage arrangements to be made, to avoid the overflowing of existing drains due to construction activity.</li> </ul>  | Contractor/ COC  |
| 6 | Prevention of accidents                          | <ul style="list-style-type: none"> <li>i) Prevention of accidents involving human beings, animals or vehicles falling or accidents during construction period. This needs to be ensured with proper barricading, signage boards and lighting etc.</li> <li>ii) The project engineer of COC will plan and direct the contractor to execute the work progressively so that the length of the open excavated trench is minimised in order to reduce possible accidents</li> </ul>  | Contractor / COC |
| 8 | Barricading site                                 | The construction area should be barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians.   | Contractor       |
| 9 | Labour camp & facilities                         | <p>Setting up of labour camps needs to be done as per the procedures. Adequate potable water facilities, sanitation and drainage etc., in conformity with the Indian labour laws shall be ensured.</p> <p>The contractor shall also guarantee the following:</p> <ul style="list-style-type: none"> <li>i) The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction.</li> <li>ii) The construction will commence only upon the written approval of the Engineer.</li> <li>iii) The Contractor shall construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.</li> <li>iv) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities.</li> <li>v) The sewage system for the camp shall be designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Ensure adequate water supply is to be provided in all toilets and urinals.</li> <li>vi) The contractor shall provide garbage bins in the camps and ensure that these are regularly</li> </ul> | Contractor       |

|    |                                 |  |                  |
|----|---------------------------------|--|------------------|
|    |                                 | emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer.<br>vii) Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor.   |                  |
| 10 | Safety Aspects                  | <ul style="list-style-type: none"> <li>i) Adequate precautions shall be taken to prevent the accidents and from the machineries. All machines used shall conform to the relevant Indian standards Code and shall be regularly inspected by the COC.</li> <li>ii) Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil.</li> <li>iii) Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc.</li> <li>iv) Welder's protective eye-shields shall be provided to workers who are engaged in welding works.</li> <li>v) Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.</li> <li>vi) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs.</li> <li>vii) 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.</li> <li>viii) 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.</li> <li>ix) The contractor shall 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.</li> </ul> | Contractor       |
| 11 | 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.   | Contractor/ COC  |
| 12 | Disposal of                     | The excavated /desilted material shall be disposed off without any accumulation. The soil  | Contractor / COC |

|  |  |  |
|--|--|--|
| desilted / excavated material, construction and other waste. | <p>excavated from the canal and river shall be tested for quality, adequately treated with methods like bioremediation and proper reuse option explored. The rest may be safely disposed. The disposal shall be done in the existing dump yards of Chennai Corporation at Kodungaiyur and Perungudi or any other site identified by Chennai Corporation.</p> <p>The following shall be ensured during silt disposal</p> <ul style="list-style-type: none"> <li>(a) The dumping does not impact natural drainage courses</li> <li>(b) No endangered / rare flora is impacted by such dumping</li> <li>(c) Settlement area located at least 1.0 km away from the site.</li> <li>(d) Should be located in non residential areas located in the down wind side</li> <li>(e) located at least 100m from the designated forest land.</li> <li>(f) avoid disposal on productive land.</li> <li>(g) should be located with the consensus of the local community, in consultation with the engineer</li> <li>(h) All vehicles delivering material to the site shall be covered to avoid material spillage.</li> </ul> |  |
|--|--|--|

| <b>OPERATION PHASE</b> |                         |   |                             |
|------------------------|-------------------------|---|-----------------------------|
| <b>Sl.no</b>           | <b>Potential Impact</b> | <b>Mitigation Measures</b>  | <b>Responsible agencies</b> |
| 13                     | Maintenance             | <ul style="list-style-type: none"> <li>i) It shall be ensured by the COC that drains are not clogged. The following practices should be adopted in maintaining storm water drains:</li> <li>ii) Drains shall be regularly inspected and cleaned especially prior to monsoons.</li> <li>iii) All damaged or missing drain covers should be replaced immediately</li> <li>iv) Rubbish and silt that has been removed from the drainage system should not be left alongside the drain and shall be immediately disposed in pre-identified site with necessary precautions</li> </ul> | COC                         |

|    |  |  |     |
|----|--|--|-----|
| 14 | Impairment of receiving water quality due to mixing of waste water | <ul style="list-style-type: none"> <li>i) Avoid mixing of wastewater from household, commercial, industrial and other establishments.</li> <li>ii) Provision for connecting domestic liquid waste to sewerage system is to be made during drain construction to avoid mixing of wastewater.</li> <li>iii) Periodical monitoring shall be carried out and sources of wastes/ effluent etc are to be identified by the COC. COC may initiate action to ensure proper linking of such connections to other waste disposal systems and it shall be ensured that the drains carry only the rainwater.</li> <li>iv) In case of any industrial effluent identified, necessary action be taken in co-ordination with the TNPCB.</li> </ul> | COC |
| 15 | Tree Planting & Protection   | <ul style="list-style-type: none"> <li>i) Plantation of trees shall be carried out along the streets of Manapakkam, Mugalivakkam, Ramapuram, Padikuppam, Nolumbur and Ambattur etc or any other place possible like parks in the nearby areas.</li> <li>ii) Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars, use of plate compactors near trees may also be considered where necessary.</li> <li>iii) Growth and survival of trees planted shall be ensured and monitoring done at least for a period of 3 years. Survival status shall be monitored on monthly basis by Engineer in-charge.</li> </ul>   | COC |
| 16 | Flood management   | Flood management system may be developed with forecasting and warning to protect areas prone to flooding and action be taken as necessary, like bailing out of water, relocation of residents to other locations etc.  | COC |



12. In addition the project proposes (i) groundwater recharge through construction of catchpits at 10m interval and recharging structures at 100m in the proposed storm water drainage network. Recharging structures will be increased in short distances wherever feasible (ii) construction of sediment trap at the confluence point of drain with the water body, so that the sediments are deposited in the silt trap at every 10m (iii) design of box type drains in RCC with cover on top, MS frame with wire mesh for major drains, flow of storm water through FRP gratings and public awareness programs to minimize the solid waste deposits in the drains.
13. To avoid back flow from the rivers in to the drains, flap gates are proposed in the drains. Further, Anna University is carrying out an overall storm water drainage modelling, based on which suitable mitigation measures will be implemented to manage flooding and other impacts (if any).
14. A detailed environmental management plan has been developed integrating these aspects and also the measures monitoring the implementation of EMP. A budget of about Rs. 8.0 million has been provided for the EMP measures of the project.
15. The EMP shall be implemented by the Corporation of through its dedicated environmental and social safeguards specialists and will submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

## 5. SOCIAL IMPACT ASSESSMENT

16. The sub project involves improvements to the canal and construction of storm water drains. As the construction of storm water drains in the road sides and the roads are owned and maintained by the corporation there is no social impacts. However, the social impacts are visible in the canals and hence covered in the socio economic survey. The canals covered are Nandampakkam canal, Padikuppam Canal, Nolambur Canal and Ambattur SIDCO canal. The total length of these canals is about 11.05 kilometres.
17. It has been identified that the project involves resettlement of about 281 Project Affected Families and hence is classified as **S1** Category. The project requires Social Impact Assessment and Resettlement Action Plan which has been carried out.

## 6. STAKEHOLDERS' CONSULTATION

18. Consultations were held in the form of Focussed Group Discussions (FGDs) with those living near the drains and canals, Project Affected Families (PAFs) for obtaining the opinion on the project. In addition to the FGDs, COC has also proposed to conduct detailed consultation for the project.
19. During the FGDs, public in general welcomed the proposal to provide the storm water drain project which will prevent inundation of the adjoining areas.

## **7. IMPLEMENTATION MONITORING/ GRC**

20. Corporation of Chennai has proposed to take up the Storm Water Drainage (SWD) project to selected areas of Chennai Corporation through its Storm Water Drain Department. The project has a total of 39 packages at an estimated project cost of Rs.1104.43 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 CoC upon completion of construction activities.
21. CoC has proposed to engage Project Management Consultants (PMC) for managing SWD Project. The PMC will include Environmental and Social specialists also as part of the team to monitor the day to day activities.
22. The Chennai Corporation has also proposed to appoint Environmental and Social Safeguards specialists for ensuring adoption and compliance of ESMF.
23. The Corporation of Chennai will have a two level Grievance Redressal mechanism to handle the grievances of the project affected persons and for all the grievances relating to the implementation of Storm Water Drain project.
24. The project level GRC will have The Zonal Officer /Assistant Commissioners of CoC, Any one Elected representative, A person who is publicly known in the local area and Superintending Engineer (SWD) (Convener). The Appellate level GRC will constitute Deputy Commissioner (Works) and Regional Deputy / Joint Commissioners (Central/South)
25. COC shall submit monthly reports on the status of compliance with the ESMF requirements to TNUIFSL.

## Environmental Assessment for SWD to selected areas of Chennai Corporation

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## 1 INTRODUCTION

**1.1** Government of Tamil Nadu has proposed to implement the World Bank supported Tamil Nadu Sustainable Urban Development program (TNSUDP) to improve the delivery of urban services. The provision of Storm Water Drains to selected areas of Corporation of Chennai is one of the sub-projects proposed to be implemented by the Corporation of Chennai. This component is coordinated by, Government of Tamil Nadu with Tamil Nadu Financial Services Ltd. (TNUIFSL), Chennai as the fund Manager. This sub-project is proposed to be implemented in the roadsides and required land is owned by the Corporation of Chennai and canals and doesn't involve any Land Acquisition.

**1.2** The Corporation of Chennai (CoC) has expanded its area during 2011 by adding adjacent local bodies. Chennai city is divided in to 200 divisions/wards that are grouped in 15 zones. In order to provide storm water drains to the selected areas of Chennai Corporation, a Detailed Project Report has been prepared. This project proposed to be taken up under proposed Tamil Nadu Sustainable Urban Development Project (TNSUDP) intends to cover part of zones 7 & 12 and zone 11 of Corporation of Chennai with an estimated cost of about Rs.1104.43 crores.

### **Environmental and Social Management Framework (ESMF):**

**1.3** Projects proposed under TNSUDP 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 Framework exclusively prepared for TNSUDP.

**1.4** The proposed SWD to selected areas of COC falls involves construction of new storm water drainage network along the road sides to facilitate smooth flow of stormwater to subsequent drains/canals, and improvement of existing drains & canals within the right of way of the canals. This project is expected to cause minor impacts temporarily during construction like traffic management, access issues etc and during operation, might cause issues related to maintenance of drains, disposal of silt, flooding issues etc. Hence this project is categorised under E2 category as per ESMF, which has much lesser impacts than E1 projects. The E2 project is similar to the Category B project as World Bank Safeguard Policy and require Environmental assessment to be carried out and management measures be prepared.

### **Environmental Assessment for SWD to selected areas of COC:**

**1.5 Objective:** The objective of this EA for SWD to selected areas of Chennai Corporation is to identify and assess the environmental impacts arising out of implementation of the Storm Water Drain Construction and to prepare necessary Environment Assessment Reports and mitigate the impacts through Environmental Management Plan (EMP).

**1.6 Scope:** The scope of this Environmental Assessment (EA) is to study the baseline

of Environmental status of the project area, assess the impacts from the project implementation, identify issues through FGDs, consultations, prepare management plan, and making necessary provision in cost estimates and bid documents.

1.7 This EA is prepared in line with the Environmental and Social Management Framework (ESMF) of TNUIFSL specifically evolved for the proposed Tamil Nadu Sustainable Urban Development Project (TNSUDP).

### **Methodology**

1.8 In the screening stage, it is decided whether particular project is required to decide whether an EA is required and focus on projects most likely to have significant impacts, those where impacts are uncertain and those where environmental management input is likely to be required. In the present scenario, the storm water drainage system projects are excluded from the Environmental Clearance (As per Ministry of Environment and Forests (MoEF) Notification issued on 14th September 2006). However, there is a need of environmental assessment prior to undertake any developmental activity to predict the environmental impacts, if any, due to implementation of the proposed activity and for eliminating or lessening the impact.

1.9 Quantitative and Qualitative surveys were conducted and relevant information was collected, analyzed and compiled to prepare Environmental and Resettlement Action Plans, wherein the issues before, during and post project implementation will be addressed in view of environmental and social impacts owing to the proposed implementation of the project.

1.10 The baseline information was collected during the field trips from local offices and from community. During Field Visits, Transect Walks were conducted through project area, catchment areas, canals, etc. and data was collected through observation and FGDs with the community.

1.11 As far as Scoping of the EIA is concerned, five environmental components viz. land, air, water, biodiversity and social & aesthetic and the proposed project activities under SWD to selected areas of CoC have been taken into consideration for impacts assessment.

### **Structure of the EA Report:**

1.12 First section provides an introduction to the project and report.

1.13 Second section briefly explains the project setting.

1.14 The third section provides the project description for the SWD project to selected areas of the Chennai Corporation.

1.15 The fourth section provides a review of the regulatory requirements

1.16 The fifth section covers baseline environmental status

1.17 The impacts from the proposed project activities on the environmental baseline are discussed in the sixth section.

1.18 Environmental Management Plan (EMP) with necessary costs and budget

provisions are provided in section seven.

**1.19** Section 8 provides a summary on the Social impact assessment.

**1.20** Section 9 provides a brief on the consultation and community participation

**1.21** Section 10 covers the institutional arrangements and implementation proposal of COC for SWD.

## 2 BACKGROUND

**2.1** Chennai otherwise called as Madras city is the Capital city for the State of Tamil Nadu. Chennai is the fourth largest metropolitan city in India with an area of 174 sq.km and a population of 4.68 million (as per census 2011). Corporation of Chennai is responsible for provision of civic amenities with in Chennai including provision of Storm Water Drains (SWD). At present Chennai Corporation maintains 303 kms of Bus route Roads and 2475 kms of interior roads including cement concrete roads.

**2.2** As many as nine municipalities, eight town panchayats and twenty five village panchayats have been brought under the Chennai Corporation limits, raising the city population from 46.81 lac to 62.2 lac (as per 2011 census). Merger of the expanded area has resulted in an increase in the area of corporation from 174 Sq. Km. to 429.79 Sq. Km. According to the present status, Corporation of Chennai is divided into fifteen (15) administrative zones out of which eight (8) zones namely Thiruvottiyur, Manali, Madhavaram, Ambattur, Valasaravakkam, Alandur, Perungudi and Shozinganallur fall in the expanded area and remaining seven zones are in old city area.

**2.3 Geography:** Chennai is a seaside city where the sea is an ecstasy in blue, hugging the second largest beach in the world. From the sky, it looks neat with majestic long straight roads and the silvery streams meandering through the city. Dotted with clumps of trees and a low skyline, it is a sprawling city.

**2.4** Chennai, sometimes referred to as the "Gateway to South India", is located on the south-eastern coast of India in the north-eastern part of Tamil Nadu on a flat coastal plain known as the Eastern Coastal Plains. Its average elevation is around 6.7 metres (22 ft), and its highest point is 60 m (200 ft). Two rivers meander through Chennai, the Cooum River through the centre and the Adyar River to the south. A part of the Adyar river forms a tidal creek before joining the sea.

**2.5** A third river, the Kosasthalaiyar, flows through the northern fringes of the city before draining into the sea at Ennore. Adyar and Cooum rivers are heavily polluted with effluents and wastes from domestic, commercial and industrial sources. The state government periodically removes silt and pollution from the Adyar river, which is less polluted than the Cooum. A protected estuary on the Adyar forms a natural habitat for several species of birds and animal. The Buckingham Canal runs parallel to the coast, linking the two rivers. The Otteri Nullah, an east-west stream, runs through north Chennai and meets the Buckingham Canal at Basin Bridge. Several lakes of varying size are located on the western fringes of the city.

**2.6** Chennai is divided into four broad regions: North, Central, South and West. North Chennai is primarily an industrial area. Central Chennai is the commercial heart of the city and includes an important business district, Parry's Corner. South Chennai and West Chennai, previously mostly residential, are fast becoming commercial, home to a growing number of information technology firms, financial companies and call



centres. The city is expanding quickly along the Old Mahabalipuram Road and the Grand Southern Trunk Road (GST Road) in the south and towards Ambattur, Koyambedu and Sriperumbudur in the west.

**2.7 Topography:** Chennai is a low-lying area and the land surface is almost flat. The even topography of the land throughout the area makes it difficult to render the subdivisions into natural regions. It rises slightly as the distance from the seashore increases average elevation of the town is not more than 7 m above mean sea level and the average slope varies at less than 0.7 m per Km, while some localities are just at sea level and drainage in such area remains a serious problem.

**2.8 Soil Condition:** Chennai's soil is mostly clay, shale and sandstone. The city is classified into three regions based on geology and as sandy areas, clayey areas and hard rock areas. Sandy areas are found along the river banks and coasts such as Thiruvanmiyur, Adyar, Kottivakkam, Santhome, George Town, Tondiarpet and the rest of coastal Chennai. Here rainwater runoff percolates quickly through the soil. Clay underlies most of the city including T. Nagar, West Mambalam, Anna Nagar, Perambur and Virugambakkam. Areas of hard rock include Guindy, Perungudi, Velachery, Adambakkam and a part of Saidapet. In clayey and hard rock areas, rainwater percolates slowly, but it is held by the soil for a longer time.

**2.9 Climate:** Chennai has a tropical climate, specifically a tropical wet and dry climate. The city lies on the thermal equator and is also on the coast, which prevents extreme variation in seasonal temperature. The weather is hot and humid for most of the year. The hottest part of the year is late May to early June, known locally as Agni Nakshatram ("fire star") or as Kathiri Veyyil, with maximum temperatures around 35–40°C. The coolest part of the year is January, with minimum temperatures around 15–22°C. The lowest temperature recorded is 13.8°C and the highest recorded temperature is 45°C. The average annual rainfall is about 140 cm. The city gets most of its seasonal rainfall from the north–east monsoon winds, from mid–October to mid–December. Cyclones in the Bay of Bengal sometimes hit the city. The highest annual rainfall recorded is 257 cm in 2005. Prevailing winds in Chennai are usually south westerly between April and October and north easterly during the rest of the year.

**2.10 Corporation of Chennai:** The Corporation of Chennai (previously Madras) is the Oldest Municipal Institution in India established on the 29th September 1688. A charter was issued on the 30th December, 1607 by East Indian Company constituting the "Town of Fort St. George" and all the territories thereunto belonging, not exceeding the distance of ten miles from the Fort, into a Corporation. The Parliamentary Act of 1792 gave the Corporation power to levy Municipal Taxes in the City. The Municipal administration properly commenced from the Parliamentary Act, 1792 making provision for the good order and administration of the city. The Municipal Act has been amended introducing from time to time major changes in the constitution and powers of the Corporation. The Madras Municipal Corporation Act, 1919 (as amended) provides the basic statutory authority for the administration now. The Council of 200 councilors is headed by the Worshipful Mayor and Council meets

ordinarily once in a month. The executive wing is headed by the Commissioner. There are Deputy Commissioners and various Heads of Departments and 15 Zonal Officers at present. The estimated present population of Chennai is 6.5 Million.

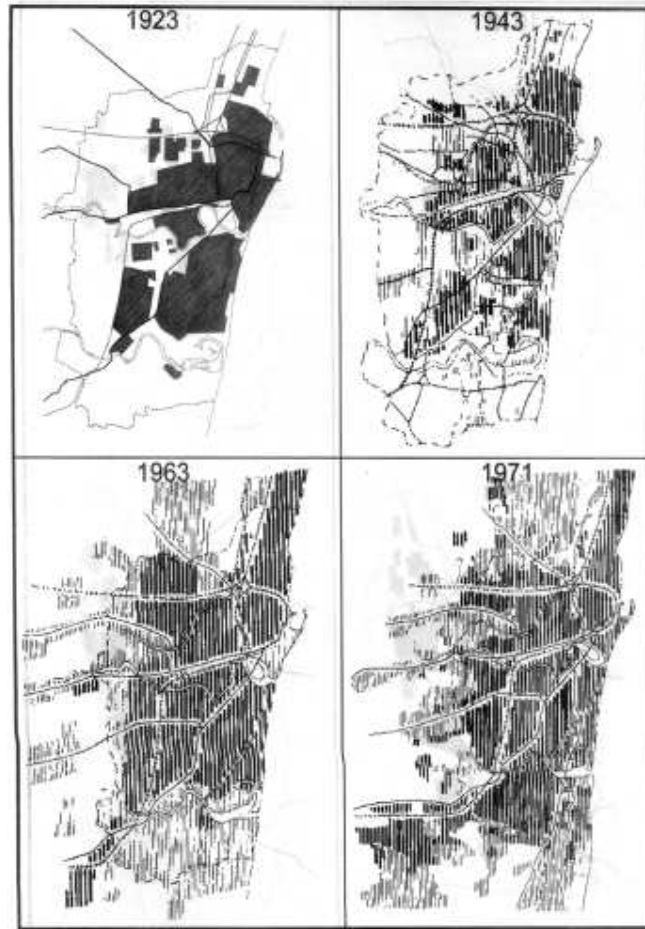


Fig: 2.1 Growth of Chennai City

**2.11** Chennai Corporation is maintaining 1160 roads to a length of 370 Km and storm water drain to a length of 962 Km. Total numbers of street lights in Chennai city under the maintenance of Chennai Corporation is 2, 13, 045 and using 19 megawatts per day, and spending 2 lakhs for electric consumption per day. Chennai Corporation having 260 parks and constructed 113 community halls for public purpose. Chennai Corporation is removing 5000-5200 MT of solid waste per day through 966 conservancy vehicles and maintaining Kodungaiyur and Perungudi dumping grounds for dumping the solid waste. The total birth reported in Chennai city is 400 per day and death is 180 per day. Currently 23,538 staffs are working in it. The Annual Budgetary estimate of Chennai Corporation in 2012-13 revenue is 1326.11 crores and expenditure is 1232.97 crores. Surplus income is 93.14 crores.

**2.12** Existing Stormwater Drain Situation in Chennai: As per survey conducted of the project area, there are about 205 Km of drains of width 0.60 m or more. Storm water

drainage system in the project area is not sufficient and adequate. The drains do not have proper connectivity and ultimate linkage to natural waterways/ water bodies for efficient disposal of storm water runoff. Because of the flat terrain and partial & insufficient coverage of the project area with storm water drains, flooding and water stagnation is the recurrent feature in many areas during the monsoon period.

**2.13** Storm Water Drains are maintained by the Department of Storm Water Drains. At present it maintains about 1660.31 km of Storm Water Drains.

**Need for the SWD:**

**2.14** The extended areas of Chennai corporation are developing rapidly. And presently they do not have any comprehensive drainage network (existing network length is only 224 km, built by the erstwhile ULBs about 5 to 10 years ago); and are facing frequent flooding/inundation, during monsoon season/heavy rains. The Chennai core city (area: 174 sq km) has already been covered with a drainage network, implemented in the year 2014.

**2.15** Water logging and flooding occurs regularly in low-lying areas of the Chennai city and its suburbs because of inadequacy or non-functioning of the local drainage infrastructure. The storm water drainage system in the extended city area including the project area is not adequate. The drains are not properly linked to natural waterways/ water bodies for efficient disposal of storm water runoff. To resolve these issues, the Corporation of Chennai has prepared a detailed project report (DPR) for implementing the storm water drainage system in the selected areas. In order to overcome the flooding and inundation and resultant impacts, a Storm Water Drainage Project is one of the necessary required infrastructures.

### 3 PROJECT DESCRIPTION

3.1 Storm Water Drains in Chennai are maintained by the Storm Water Drains Department of the Corporation of Chennai. At present it maintains about 1660.31 km of Storm Water Drains.

3.2 The sub project will be implemented in the selected areas of the Corporation of Chennai comprising of the following Administrative Zones and Divisions/Wards covering about 53.76 sq.kms.

3.3 The Administrative zones covered under this sub-project are Part of Zone VII, Zone XI, and Part of Zone XII.

3.4 Each of these zones are further divided into divisions or Wards

**Table-3.1 Project Area for SWD in Selected Areas of Chennai Corporation**

|     | <b>Administrative Zone</b> | <b>Location</b>                                     |
|-----|----------------------------|---|
| I   | part area of zone VII      | Ambattur, Padikuppam and Nolumbur                   |
| II  | area of zone XI            | Valasaravakkam, Ramapuram and Porur                 |
| III | part area of zone XII      | Alandur, Mugalivakkam, Meenambakkam and Manappakkam |

3.5 **Classification of Storm Water Drains:** The Storm Water Drains are broadly divided into two groups as per drain classification in Chennai. 1. Macro Drains and 2. Micro Drains. The Macro drains are natural drains that are maintained by PWD and 2. Micro Drains are the drains maintained by Corporation of Chennai. The Micro drains are further divided into storm water drains and canals.

3.6 This project involves construction of new storm water drains, rehabilitation of existing/unsized/dilapidated storm water drains and improvements to the existing canals. Further, the storm water drains are classified as follows:

- (i) Collector Drains i.e. Street Drains end in feeder drains.
- (ii) Feeder drains join the arterial drains,
- (iii) Arterial drains will join in the canals and
- (iv) Canals will join the river.

#### **Project components**

3.7 The length of the proposed storm water drain network in the project area is about 110 km. Total length of proposed new and existing drains to be used as such & to be reconstructed, the drains of all categories viz. Arterial, Feeder and Collector drains, comes to about 270.33 Km.

| Type of Drain                | Length (Km) |
|------------------------------|-------------|
| Collector Drain              | 110         |
| Feeder Drain                 | 71          |
| Arterial Drain               | 51          |
| Reconstruction of Drains     | 28          |
| Macro and Major Micro Canals | 11          |
| Total Length                 | 271         |

3.8 The drains range from minimum of 600mmx750mm to maximum of 4000mmx3000mm. The width of the canals range from 2m to 11m.

3.9 Most of the newly proposed drains are along the roads. Reconstruction/Augmentation of existing drains, which were found inadequate, has been proposed. RCC rectangular drains have been proposed for construction. Wherever necessary, RCC Pre-cast Drains have been proposed in place of cast in situ.

3.10 Other components are construction of culverts and cross drainage works, Rain Water Harvesting structures, Silt catch traps, fencing to the canals to prevent dumping of solid wastes, gratings in the canals to prevent entry of solid wastes into the system, etc.

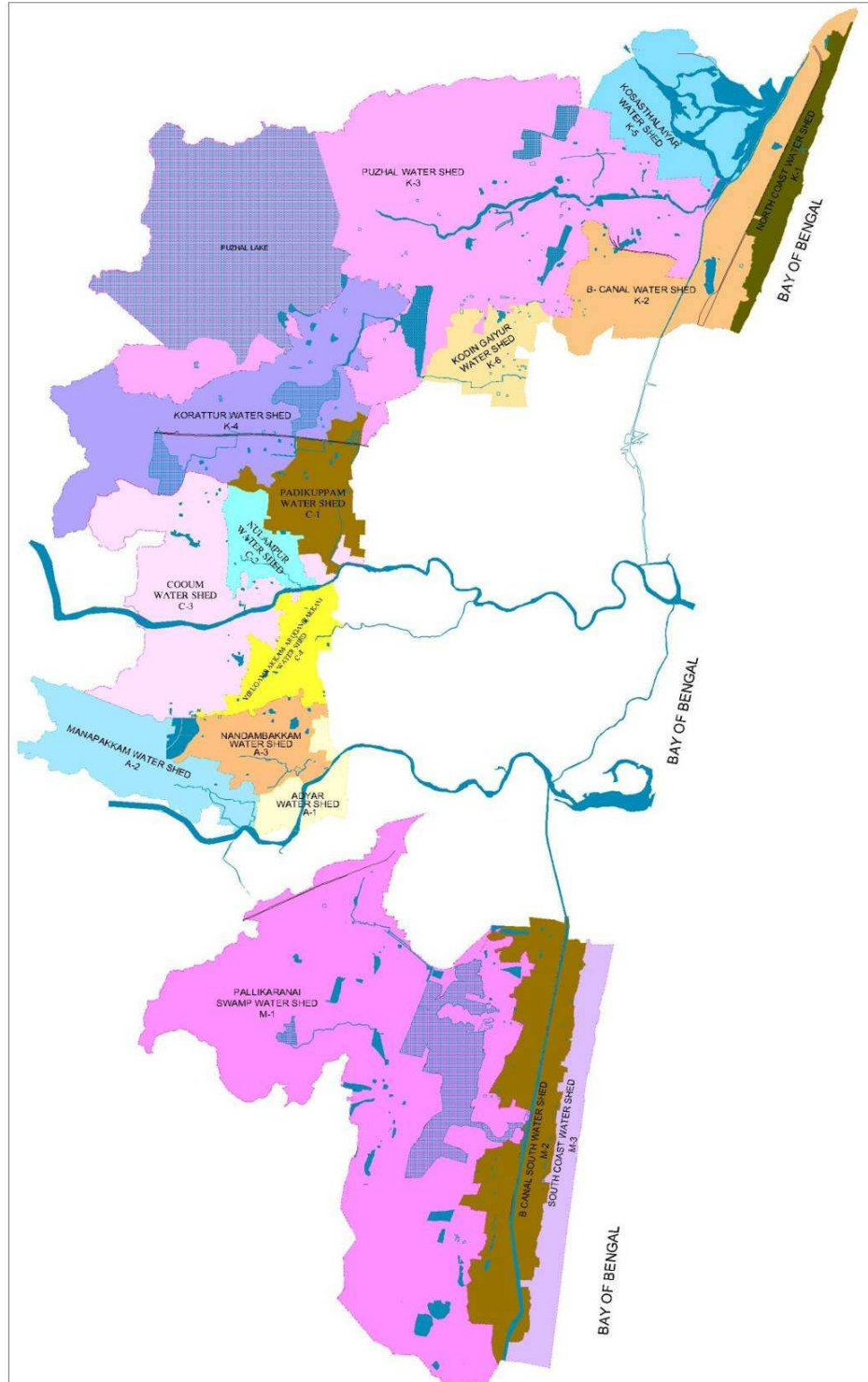


Figure 3.1 Watersheds of the expanded area of Chennai Corporation

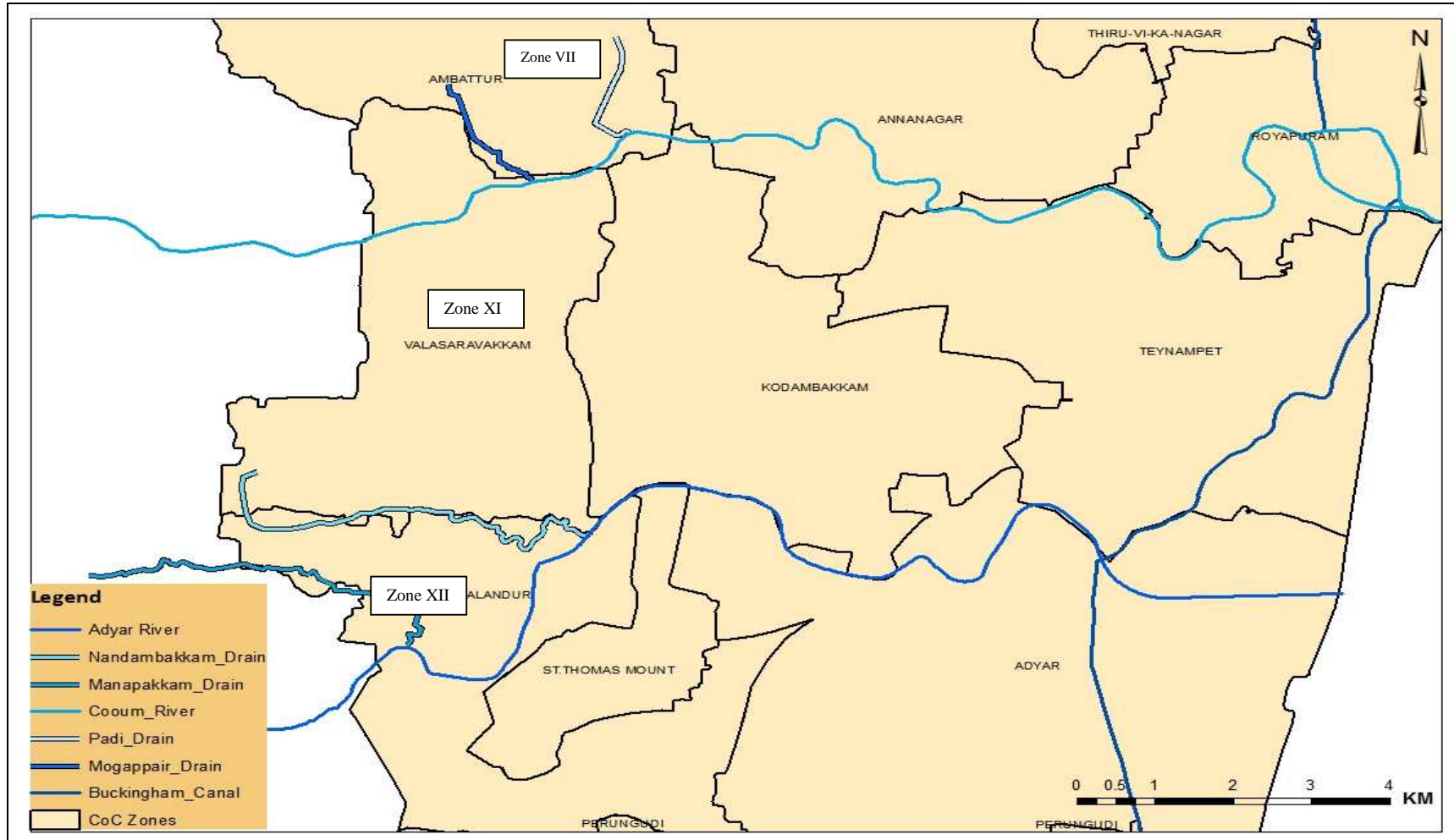


Figure 3.2 Map showing major drainage canals in Project area

#### 4 REVIEW OF ENVIRONMENTAL REGULATORY REQUIREMENTS, POLICIES & GUIDELINES

The national, state, regional and World Bank environmental laws, rules and regulations relevant to the proposed SWD to selected areas of Chennai Corporation are provided below:

| S.No | ACTS   | Relevance to TNUDF Projects  |
|------|--|--|
|      | <b>NATIONAL</b>  |  |
| 1.   | Wildlife Protection Act, 1972  | This Act seeks to protect wildlife, by creating protected areas and controlling trade in wildlife products. Project activities that cross over into protected area regimes then requisite permission must be obtained. The SWD to selected areas to COC does not involve any such areas and hence not applicable.  |
| 2.   | Water (Prevention And Control of Pollution) Act, 1974 and Tamil Nadu Water (Prevention And Control of Pollution) Rules, 1974 | Under this law, it is mandatory to obtain consent Tamil Nadu State Pollution Control Board (TNPCB) for outlets for discharge of effluents for any municipal projects. Not applicable for the project.  |
| 3.   | The Water (Prevention And Control of Pollution) Cess Act, 1977   | This Act provides for levy and collection of a cess by local authorities on water consumed by persons or industries to augment resources for Pollution Control Boards. Not applicable for the project.   |
| 4.   | Forest (Conservation) Act, 1980  | Projects with activities falling in reserved forest areas need a clearance from MoEFCC. The project area does not involve any forest area and not applicable.  |
| 5.   | Air (Prevention and Control of Pollution) Act 1981 and Tamil Nadu Air (Prevention of Control of Pollution) Rules 1983        | These laws address the prevention and control of air pollution. Under section 21 of this Act, it is mandatory to obtain consent from Pollution Control Board to establish or operate any industrial operation. Applicable, to maintain ambient air quality criteria during construction.   |
| 6.   | Environment (Protection) Act, 1986   | Popularly known as EP Act, it is an umbrella legislation that supplements existing environmental regulations. This law essentially links pollution and natural resource issues. Salient features of the Act are the following: <ul style="list-style-type: none"> <li>• Section 6 empowers the Government of India to make rules to regulate environmental pollution by stipulating standards and maximum allowable limits to prevent air, water, noise, soil and other environmental pollutants</li> <li>• Section 7 prohibits operations that emit pollutants in excess of standards</li> <li>• Section 9 regulates handling of hazardous</li> </ul> |



|     |  |  |
|-----|--|--|
|     |  | substances and identifies persons responsible for discharges and pollution prevention<br>General provisions of the act are applicable.   |
| 7.  | Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 (MSIHC Rules, 1989) | According to these rules, the user of hazardous chemicals has to follow procedures as stipulated in the rules to prevent and control hazards from such chemicals and to ensure safety and permission has to be obtained from the authority concerned for such activity.<br>Not applicable to the project.  |
| 8.  | Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008          | General provisions of the rules to follow the guidelines for handling and disposal of hazardous wastes are applicable to COC.  |
| 9.  | Bio Medical Waste (Management & Handling) Rules 1998                                   | The rules lays down the method of collection of hospital waste, its transportation and disposal based on scientific methods and applicable to COC.   |
| 10. | Municipal Solid waste (Management & Handling) Rules 2000                               | This notification by Ministry of Environment and Forest lays down the methods of handling Municipal Solid Waste (MSW) and its scientific disposal. Provisions of the rules are applicable to COC.<br>Draft MSWM Rules, 2013 have been published, which upon notification would supersede these rules.  |
| 11. | The Noise Pollution (Regulation and Control) Rules, 2000                               | The ambient noise levels in any area/zone shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule. The provisions are applicable for the project during construction.  |
| 12. | EIA Notification, dt 2006 (S.O.1533(E), dt.14/09/2006)                                 | The notification specifies that prior environmental clearance is required for the projects listed in the schedule of the notification before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity. The project does not attract this notification.  |
| 13. | Wetlands (Conservation and Management) Rules, 2010                                     | The rules lists the list of wetlands that needs to be protected like those covered under Ramsar Convention, those in UNESCO heritage site, those which are ecologically sensitive etc and prohibits the certain activities within such wetlands. The project does not involve any such areas and hence not applicable.   |
| 14. | Coastal Regulation Zone (CRZ) Notification, 2011 (S.O.19(E), dt. 06/01/2011)           | 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.<br>Adyar and Cooum Rivers present in the project area are the only waterbodies having CRZ implications. However the CRZ limits for these rivers are confined within the core city area, upto Maraimalai Adigal Bridge in Saidapet for Adayar (7km) |

|  |  |   |
|--|--|---|
|  |  | and upto Chetpet Bridge for Coom (9.6km) from the river mouth, whereas the project area near the rivers are at about 15km (Coom) and 11.5km (Adayar). The project area does not involve areas under CRZ, and hence the SWD activities in the project area do not attract the provisions of this notification.   |
| 15.  | Plastic waste (Management & handling) Rules 2011                                   | This rules provides guidelines for manufacturer of plastic bags with respect to thickness (40microns), labelling of plastic bags and prohibits availability to consumers free of cost.<br>Further, these rules lay the responsibility of disposal of these wastes in scientific manner with the municipalities/ urban local body. The provisions are applicable to COC.   |
| 16.  | Prohibition of Employment as Manual Scavengers' and their Rehabilitation Bill 2012 | This act prohibits construction of insanitary latrines and employment or engaging of manual scavenger for the purpose of manual scavenging. The project is only storm water drainage however, considering the spirit of the Bill, to avoid manual cleaning of the chambers and to facilitate maintenance by machineries, inspection doors are provided at 10m intervals.  |
| <b>OPERATIONAL POLICIES AND DIRECTIVES OF THE WORLD BANK</b> |  |   |
| 17.  | OP/BP 4.01 - Environmental Assessment  | Operational Policy 4.01 (OP 4.01) is one of the ten safeguard policies of the World Bank, which provides the Environmental Assessment (EA) guidance for the lending operations. The OP 4.01 requires the borrower to screen projects upstream in the project cycle for potential impacts. Thereafter, an appropriate EA approach to assess, minimize / enhance and mitigate potentially adverse impacts is selected depending on nature and scale of project. The EA needs to be integrated in the project development process such that timely measures can be applied to address identified impacts. The policy requires consultation with affected groups and NGOs to recognise community concerns and the need to address the same as part of EA.<br><br>TNUIFSL has adopted the principles of the above policy and has evolved a management framework to address the environmental issues in its lending operations. |

The environmental permission identified to be obtained is as below.

**Table 4.1 Permissions required**

| S.No | Activity         | Authority  |
|------|------------------|--|
| 1.   | Cutting of trees | Permission is to be obtained from the respective <b>Regional Deputy / Joint Commissioner</b> , COC for cutting of trees. |

**Process for obtaining permission for tree cutting:**

- i) A note shall be submitted by the SWD Department to the Regional Deputy / Joint Commissioner, COC with details of the project, trees, photos of the trees and a justification on the need for tree cutting.
- ii) Regional Deputy / Joint Commissioner, COC after review of the details submitted accords approval and forwards the note to the Parks Department of COC.
- iii) The Parks Department shall carry out tree cutting after which works shall be initiated.

## 5 BASELINE ENVIRONMENTAL STATUS

**5.1 Geology:** Chennai is underlain by various geological formations from ancient Archaeans to recent Alluviums. It can be grouped into three viz. (i) Archaean Crystalline Metamorphic rocks (ii) Upper Gondwanas comprised of sandstones, siltstones and shoals, tertiary (Eocene to Pliocene) sandstones and (iii) coastal and river Alluvium. (Source: Chennai Master Plan II; Vol. i).

**5.2 Meteorology of the region:** The meteorological data of the Chennai region includes temperature, relative humidity, wind speed, wind direction and rainfall which has been referred from a report submitted to Chennai Corporation.

**5.3 Temperature:** The region is within tropical semi-arid region. The climate is generally hot and dry. It is characterized with seasonal variations of cool season (winter) from November to February, hot season (summer) from March to mid-June and rainy season from mid-June to October. The mean monthly temperature is in the range 33.1 – 37.6°C, while in winter temperatures fluctuates between 28.1 – 30.6°C.

**5.4 Relative Humidity:** The mean annual humidity is 75.2% and highest percentage of humidity are observed during October to January and moderate in winter.

**5.5 Winds:** The predominant wind direction observed is from West-Northwest to East-Southeast. Whereas monsoon winds (west-south west) prevail during June-September with a mean wind speed of 11.8 kmph.

**5.6 Rainfall:** It has been recorded that Chennai receives 715mm of average rainfall mainly during north east monsoon during October to December. The mean annual rainfall is 1216 mm.

**5.7 Landuse:** The existing landuse pattern in the project area is provided in Table below.

**Table 5.1: Landuse pattern of the Project Area**

| S.NO | LAND USE TYPE    | TOTAL AREA IN SQMT |
|------|------------------|--------------------|
| 1    | Agriculture Land | 1717716.234        |
| 2    | Built up         | 915576.239         |
| 3    | Canal            | 89712.11           |
| 4    | Drain            | 155664.75          |
| 5    | Industry         | 4665847.128        |
| 6    | Island           | 682.45             |
| 7    | Lake             | 358.431            |
| 8    | Lake             | 633553.548         |
| 9    | Open space       | 5808306.18         |

|    |                        |                    |
|----|------------------------|--------------------|
| 10 | Open Space with Grass  | 11961.133          |
| 11 | Open Space with Tree   | 1033189.986        |
| 12 | Play Ground            | 4060500.295        |
| 13 | Public and Semi Public | 825355.627         |
| 14 | Railway Line           | 53659.623          |
| 15 | RIVER                  | 1074832.089        |
| 16 | Road                   | 8794916.559        |
| 17 | Settlement             | 25397749.02        |
| 18 | Tank                   | 653318.724         |
| 19 | Tree                   | 1998813.128        |
| 20 | <b>Total Area</b>      | <b>57891713.26</b> |

5.8 Air Environment: The ambient air quality monitoring data has been collected from Central Pollution Control Board (CPCB) website for Chennai Corporation area for the year 2008. The average values obtained are presented in Table 4.2

**Table 5.2: Ambient air quality status of Chennai Corporation area**

| Parameter   | Type of Area | Yearly Average Value ( $\mu\text{g}/\text{m}^3$ ) | No of Observations | CPCB Standard ( $\mu\text{g}/\text{m}^3$ ), 2009 | Air Quality |
|---|--------------|---|--------------------|--|-------------|
| <b>Suspended Particulate Matter (SPM)</b>             |              |   |                    |  |             |
| Thiruvottiyur   | Industrial   | 173   | 114                | 60   | Low         |
| Kathivakkam, Chennai.                                 | Industrial   | 175   | 91                 | 60   | Low         |
| Manali, Chennai.                                      | Industrial   | 174   | 91                 | 60   | Low         |
| Madras Medical College, Chennai                       | Residential  | 108   | 81                 | 60   | Low         |
| NEERI CSIR Campus, Chennai.                           | Residential  | 94  | 93                 | 60   | Low         |
| <b>Respirable Suspended Particulate Matter (RSPM)</b> |              |   |                    |  |             |
| Thiruvottiyur   | Industrial   | 77  | 114                | 40   | Medium      |
| Kathivakkam, Chennai                                  | Industrial   | 68  | 91                 | 40   | Medium      |
| Manali, Chennai.                                      | Industrial   | 78  | 91                 | 40   | Medium      |
| Madras Medical College, Chennai                       | Residential  | 48  | 81                 | 40   | Medium      |
| NEERI CSIR Campus, Chennai.                           | Residential  | 48  | 93                 | 40   | Medium      |
| <b>Sulphur Di-oxide (SO<sub>2</sub>)</b>              |              |   |                    |  |             |
| Thiruvottiyur   | Industrial   | 13  | 113                | 50   | Low         |
| Kathivakkam, Chennai.                                 | Industrial   | 13  | 90                 | 50   | Low         |
| Manali, Chennai.                                      | Industrial   | 14  | 91                 | 50   | Low         |
| Madras Medical College, Chennai                       | Residential  | 6   | 80                 | 50   | Low         |
| NEERI CSIR  | Residential  | 6   | 93                 | 50   | Low         |

|                                       |             |    |     |    |     |
|---------------------------------------|-------------|----|-----|----|-----|
| Campus, Chennai.                      |             |    |     |    |     |
| Nitrogen Di-Oxide (NO <sub>2</sub> )x |             |    |     |    |     |
| Thiruvottiyur                         | Industrial  | 19 | 113 | 40 | Low |
| Kathivakkam, Chennai                  | Industrial  | 20 | 90  | 40 | Low |
| Manali, Chennai.                      | Industrial  | 21 | 91  | 40 | Low |
| Madras Medical College, Chennai       | Residential | 9  | 80  | 40 | Low |
| NEERI CSIR Campus, Chennai.           | Residential | 8  | 93  | 40 | Low |

5.9 The Air Quality sampling locations of Chennai area comprise of Residential and Industrial Category. The residential category includes Madras Medical College and NEERI CSIR Campus and Industrial Category includes, Thiruvottiyur, Kathivakkam and Manali area. The air quality monitoring results are interpreted as below:

5.10 The annual average concentration of Suspended Particular Matter levels in industrial area of Chennai Corporation was measured 174 µg/m<sup>3</sup> which is well under the CPCB standard of 500 µg/m<sup>3</sup> and the annual average concentration of Respirable Suspended Particular Matter was found as 74 µg/m<sup>3</sup> against the standards of 150 µg/m<sup>3</sup>.

5.11 **Noise Pollution:** The noise level survey conducted by the TNPCB reveals that noise level exceeded the limits mostly in commercial areas, mainly due to vehicular movement. During festive seasons in Chennai, the noise levels were noted high and particularly during Deepavali it exceeded 120 dB. (Source: Chennai Master Plan II; Vol. i)

5.12 **Soil:** Soil pH was recorded in the range of 8.1-8.5. As far as Total Organic carbon is concerned it was recorded in the range of 1486-3200 mg/kg while Total nitrogen was recorded in the range of 320- 912 mg/kg. Another nutrient, total phosphorous was recorded in the range of 129-352 mg/kg. Sodium and potassium was also recorded in the range of 90-312 mg/kg and 56-160 mg/kg respectively. Three heavy metals were also analysed and concentration of these metals was found well below to the standards. Above soil/sediment quality reflects that there is no toxic element present beyond to the safe limits prescribed by national/international agency thus excavated soil and sediment can be safely disposed of at suitable location.

**Table 5.3: Soil quality status in the Canals & Rivers in Chennai**

| S.No             | Parameters    | Virugambakkam Arumbakkam Canal | Adayar River | Gerugampakkam | TVS Canal |
|------------------|---------------|--------------------------------|--------------|---------------|-----------|
| Physico-Chemical |               |                                |              |               |           |
| 1                | pH            | 8.2                            | 8.4          | 8.3           | 8.4       |
| 2                | Total Organic | 1486                           | 3200         | 1682          | 1552      |

|              |                           |      |      |      |      |
|--------------|---------------------------|------|------|------|------|
|              | Carbon (mg/kg)            |      |      |      |      |
| 3            | Total Nitrogen (mg/kg)    | 355  | 912  | 610  | 320  |
| 4            | Total Phosphorous (mg/kg) | 142  | 352  | 241  | 145  |
| 5            | Sodium (mg/kg)            | 220  | 312  | 280  | 138  |
| 6            | Potassium (mg/kg)         | 56   | 160  | 110  | 58   |
| Heavy metals |                           |      |      |      |      |
| 7            | Iron                      | 3.4  | 3.4  | 2.8  | 2.1  |
| 8            | Lead                      | 0.26 | 0.97 | 0.30 | 0.61 |
| 9            | Chromium (mg/kg)          | BDL  | 0.01 | BDL  | BDL  |

**5.13 Ground Water Quality:** As reflected from the above results, pH of the collected ground water samples was recorded in the range of 7.4-7.9 shows slightly alkaline nature. As far as electrical conductivity is concerned, it was recorded in between 780-1288  $\mu\text{mho/cm}$  while Total Dissolved Solids were recorded in the range of 580-910 mg/l. Total and calcium hardness of ground water was also recorded in the range of 260-482 mg/l and 168-340 mg/l respectively. Fluoride and nitrate which are the two important parameters as far as ground water quality is concerned were also recorded within the permissible limit of BIS 10500.

**Table 5.4: Groundwater Quality in Chennai Corporation**

| S.No | Parameters                                     | Results  |          |          |          |
|------|--|----------|----------|----------|----------|
|      |  | Sample 1 | Sample 2 | Sample 3 | Sample 4 |
| 1    | pH   | 7.4      | 7.8      | 7.6      | 7.5      |
| 2    | Electrical Conductivity ( $\mu\text{mho/cm}$ ) | 1288     | 1242     | 820      | 900      |
| 3    | TDS (mg/l)                                     | 910      | 890      | 590      | 680      |
| 4    | Total Hardness (mg/l)                          | 480      | 482      | 264      | 304      |
| 5    | Calcium Hardness (mg/l)                        | 340      | 322      | 182      | 222      |
| 6    | Fluoride (mg/l)                                | 0.29     | 0.36     | 0.21     | 0.18     |
| 7    | Nitrate (mg/l)                                 | 2.4      | 1.2      | 0.9      | 1.4      |

**5.14 Flora and Fauna:** An assessment of the flora and fauna in the project area carried out in the project area involves information on trees, shrubs, etc and vertebrates and invertebrates. The most commonly found trees were Azadirachta indica, Thespesia populnea, Acacia auriculiformes, Acacia planifrons, and Prosopis juliflora. Sacred trees like Ficus religiosa and Ficus benghalensis and Hill Sacak Tree (Alangium salvifolium) are also present in the project area. Other common trees include Tamarindus indica, Pongamia Pinnata, Delonix regia, Borassus flabellifer,

Phoenix loureirii, Peltophorum pterocarpum. Shrubs and herbs included Clarotropis gigantea, Jatropha, Lantana camera, Abutilon indicum, Hibiscus, Achyranthes aspera, Sida acuta, Tridax procumbens, etc. Among fauna, different species of butterflies (*Eurema hecabe*, *Catopsilia puranthe*, *Aceraea violae*, *Hypolimnas missippus*), *Argiope* sp. Spider, Snails, mammals (*Palm squirrels*, *House rats*, *field rats*, *grey mongoose*), birds (*Crow pheasant*, *house crow*, *common myna*, *Red-vented bulbul*, *Little comorant*, *pond heron*, *white throated King-fisher*), amphibians (*Common Indian toad*, *Frog*) and reptiles (*Garden lizard*, *Monitor Lizard*, *Rat snake*) have been recorded.

**5.15 Flooding in Chennai:** During the rainy season, Chennai Corporation including expanded area faces inundation problem and experiences flood toll at number of locations. With the references, records, verification on site, interacting with the local people & the officials of Corporation, inferences are drawn that large portion is affected due to rain and water logging. Due to heavy rains and floods, the infrastructure (roads, drains etc.,) are damaged and need repairs and strengthening works. A huge amount is spent on this account.

**5.16** The last century records have shown that there were several catastrophic flooding in Chennai in 1943, 1978, 1985, 2002 and 2005 caused by heavy rain associated with cyclonic activity. These events of catastrophic flooding were found to be attributable to failure of the major rivers and other drainage systems. Flooding of less catastrophic nature occurs regularly in low-lying areas of the city and its suburbs because of inadequacy or non-functioning of the local drainage infrastructure.

**5.17** The reasons for this state of affairs are three-fold. Most of the existing waterways are silted and their flow channels and banks are obstructed with encroachments and structures. Dumping of solid wastes in the canals also contributes to water stagnation and flooding of nearby areas. Similar is the case with the reservoirs and tanks. Secondly several of the areas under tanks and their Anicut have been developed as residential neighborhoods over the years. Thirdly the geological structure particularly in the south-west is not conducive to water infiltration.

#### **Flood Experiences during last decades:**

- In 1976, Heavy flood and submergence was observed in the areas close to Adyar and Kosathalaiyar river banks. Flood water could not enter the ultimate disposal point, the sea, due to the prevalence of High Tide effects then.
- In 1985, Floods in Adyar was observed with a flood discharge of 63,000 Cusecs and the submergence of encroached flood plains.
- In 1996, Floods in Adyar, Cooum and Kosasthalaiyar rivers were observed. Poondi reservoir was surpluses with a flood discharge of 80000 cusecs.
- In 1996 the Karanodai Bridge collapsed.
- In 2005, a 100 years recurring rainfall of 40 cm in a day caused heavy inundation in and around the Chennai city and its suburban areas and more than 50,000 persons had to be evacuated from the low lying areas.
- In 2008 and 2010, due to heavy rainfall, several low-lying areas of Chennai were flooded.



Some Photographs showing flooding impacts in Chennai



Chennai Floods 2008

Chennai Floods 2008



Chennai Floods 2010

Chennai Floods 2010

## 6 ASSESSMENT OF IMPACTS

6.1 The proposed project is intended for better management of the hydrological situation and management of storm water, improvement of drainage and to prevent flooding in the low lying areas of the project area. However, the developmental activities which may be considered under the project both during under construction and operational phases may have some temporary or negligible impacts on various components of the environment. The baseline situation and the proposed activities have been analyzed for identifying the impacts from the project implementation.

**Table 6.1 Possible Impacts on Environment**

| Project Activities              | Components of Environment |             |       |               |              |              |       |                                 |                         |                   |   |
|---------------------------------|---------------------------|-------------|-------|---------------|--------------|--------------|-------|---------------------------------|-------------------------|-------------------|---|
|                                 | Land                      | Air         |       | Surface Water | Ground Water | Biodiversity |       | Social & Aesthetic              |                         |                   |   |
|                                 |                           | Air Quality | Noise |               |              | Flora        | Fauna | Resettlement & Land acquisition | Road and Traffic issues | Health and safety | Any damage to Public & sensitive property |
| Clearing and Cutting            | ?                         | ?           | ?     | X             | X            | ?            | X     | ?                               | ?                       | ?                 | X   |
| Excavation & Filling Operations | ?                         | ?           | ?     | ?             | X            | X            | X     | X                               | ?                       | ?                 | X   |
| Disposal of Excavated silt      | ?                         | X           | X     | ?             | X            | ?            | X     | X                               | X                       | X                 | X   |
| Construction Camps              | ?                         | X           | X     | ?             | X            | X            | X     | X                               | X                       | X                 | X   |
| Disposal of Storm water         | ?                         | X           | X     | ?             | X            | X            | X     | X                               | ?                       | ?                 | X   |

**Table 6.2 Potential Adverse/Negative Impacts**

| Phase wise project activities   | Potential Negative Impacts   |
|---------------------------------|--|
| During Construction             |  |
| Clearing and Cutting            | <ul style="list-style-type: none"> <li>▪ Loss of top soil</li> <li>▪ Vegetation loss due to cutting of small shrubs and trees</li> <li>▪ Increase of respirable suspended particulate matters &amp; dust in surrounding ambient air</li> <li>▪ Noise &amp; vibration disturbances of fauna and local population during cutting of tress</li> <li>▪ During clearing and cutting, there may be some hindrance in traffic due temporary increased machinery traffic</li> <li>▪ There may be little impacts on health's due to Increase of respirable suspended particulate matters and noise level</li> </ul> |
| Excavation & Filling Operations | <ul style="list-style-type: none"> <li>▪ Loss of top soil</li> <li>▪ Increase of respirable suspended particulate matters &amp; dust in surrounding ambient air</li> <li>▪ Noise &amp; vibration disturbances of fauna and local population during cutting of tress</li> <li>▪ Spillage of oil and other substances during the civil works</li> <li>▪ During excavation, there may be some hindrance in traffic due temporary increased machinery traffic</li> <li>▪ There may be little impacts on health's due to Increase of respirable suspended particulate matters</li> </ul>                        |
| Disposal of Excavated silt      | <ul style="list-style-type: none"> <li>▪ Soil and water contamination due to improper disposal of excavated material, construction and demolition wastes</li> <li>▪ Clogging of drains due to improper disposal of excavated material, construction and demolition wastes</li> <li>▪ Loss of vegetation at dumping yard</li> </ul>   |
| Construction of labor Camps     | <ul style="list-style-type: none"> <li>▪ Impacts on surrounding due to improper drainage, sanitation facilities, solid waste management facilities during the use of temporary construction sites (camps, machinery sites, storage facilities etc.)</li> </ul>   |
| Operational Phase               |  |
| Disposal of Storm water         | <ul style="list-style-type: none"> <li>▪ Contamination of storm water due to mixing of sewage or industrial wastewater</li> <li>▪ Clogging of drains due to deposition of eroded soil, improper cleaning</li> <li>▪ Formation of misquotes breeding grounds</li> <li>▪ Foul smell</li> </ul>   |

**6.2 Potential Negative Impact due to clear & cutting trees:** Trees can be harmed by construction work in several ways. Any break or tear in a tree's bark disrupts the flow of vital fluids and exposes wood to invasion by disease and decay microorganisms, which the tree must then expend energy to deal with. A trunk wound does not always cause corresponding loss of branches or foliage, so the consequences may not be fully

apparent. But a large wound in the trunk of a tree is serious-it cannot be repaired and will almost certainly result in future decay and loss of stem strength.

**Table 6.3: Details of Trees to be affected**

| Description   | No of trees |           |
|---|-------------|-----------|
| No. of Trees may be affected  |             | 41        |
| Highly vulnerable trees lying on the proposed drain corridor  | 31          | 31        |
| Moderate vulnerable trees lying in between the vicinity and 0.5 m distance of the proposed storm water drain which can be saved through precautions | 67          | 10        |
| Not vulnerable tree lying in between the vicinity and   | 144         | -         |
| <b>Total Trees lying nearby the proposed drain in the project area</b>  | <b>242</b>  | <b>41</b> |

The other impacts that may arise from the implementation of SWD are

- i) Traffic issues due to excavation and construction activity
- ii) Safety issues due to excavation
- iii) Access difficulty to adjacent landuse
- iv) Reverse flow into the drains from the canals
- v) Solid waste dumping in the drains
- vi) Disposal of excavated earth / silt
- vii) Social impact due to activities in the canals.

## 7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 To mitigate the identified impacts an Environmental Management Plan and Environmental Management Cost has been prepared.

7.2 The likely adverse impacts on various environmental components, viz., Land, Air, Water, Biodiversity and Social & Aesthetic have been assessed. Based on the identified impacts' potential, the management practice to be followed for minimizing and mitigating the impacts on the surround environment, the activity wise Environment Management Plan is drawn. In summary, the expected impacts are of small scale, temporary and site specific depending on the implementation of the project and will not exceed the construction and major environmental norms. The EMP will be form part of the contract document.

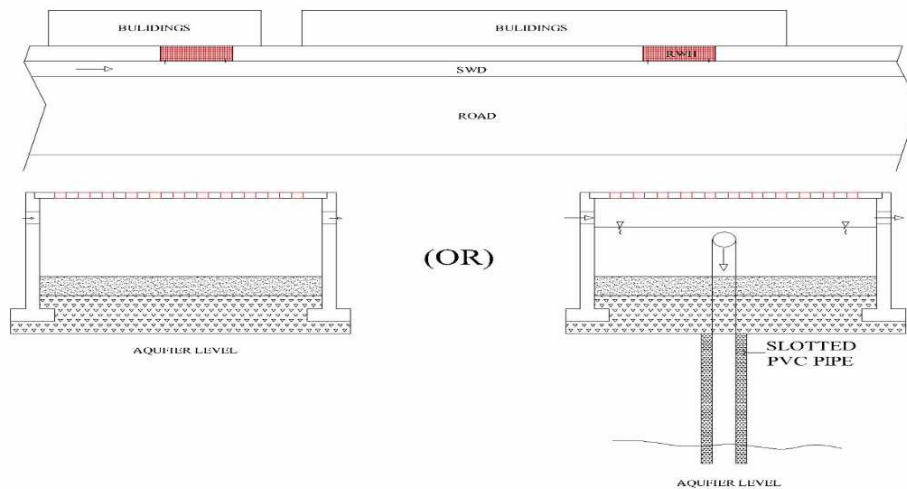
### 7.3 Management measures proposed in SWD to selected areas of CoC:

#### 7.3.1 Groundwater Recharge through Rainwater Harvesting:

Corporation of Chennai has envisaged rainwater harvesting through constructing catchpits and recharging structures in the proposed storm water drainage network. Rain water harvesting structure along with silt catching pit will be provided at every 30 m interval in the drains.

It is also proposed to construct ground water recharging structures of inner size 2100mm x600mm x600mm at an interval of 100 meters along the drains. The provision includes FRP Grating Cover with frame and coarse sand for filter media inside recharging pit. CoC proposed to provide more number of recharging structures wherever feasible.

Considerable improvement in ground water levels are likely through recharge measures taken up under the project.



### 7.3.2 Considerations made in the project for Minimising Impacts

The basic objective of the provision of storm water drains to the selected areas of Chennai Corporation in order to avoid the flooding and inundation and for proper disposal of storm water. Hence it is proposed to provide storm water drains in the selected administrative zones with full coverage.

The narrow streets and lanes are provided with one side drains in order to minimise impacts.

### 7.3.3 Sediment Control:

For control of sediments it is proposed to construct sediment trap at the confluence point of drain with the water body so that the sediments are deposited in the silt trap and settle over there which can be removed periodically. It is also possible to provide additional silt traps at the point where the cross drainage confluence and the silt from these silt traps shall be periodically removed.

### 7.3.4 Solidwaste Management:

At present Corporation of Chennai is having an effective management system in solid waste management. However, the people living nearer to water bodies and the commercial pockets situating near Water bodies are having tendency to throw solid waste into water bodies. Therefore the following are proposed in the SWD to selected areas of COC.

- i) Micro drains are designed as box type drain in RCC with cover on top which will curtail dumping of solid waste in drains.
- ii) Major micro drains belonging to Corporation of Chennai will be provided with top cover in MS frame with wire mesh to avoid dumping solid waste.
- iii) Rain water will flow into drains through FRP gratings to screen the solid waste from entering into drains.
- iv) Public awareness programs have been proposed through IEC activities to proper waste disposal to ensure public co-operation.

### 7.3.5 Access Difficulty:

It has been proposed to provide access ramp at critical locations to facilitate easy movement of vehicles and provision has been made in the estimates for providing temporary access to the adjacent landuses.

### 7.3.6 Public Awareness

Public play a major role in the successful functioning of proposed stormwater drain. Periodical awareness programs have been proposed to deal with the various aspects that are to be considered to improve the local public awareness by involving individually or with the voluntary organization groups.

### 7.3.7 Flood Management:

The project area is at a higher elevation compared to the core city on an average of about 9.0m. Major Disposal Channels in the project area are Manapakkam canal, Nandampakkam canal, Padikuppam canal, Virugampakkam canal, Arumpakkam canal, Nolambur canal, Adayar River, and Cooum River, and the final disposal point is the Bay of Bengal on the eastern side of Chennai city.

The storm water drainage network was originally designed for 31.39mm/hr rainfall intensity, on an hourly maximum basis, for a two year Return Interval (as per Indian Design guidelines of CPHEEO manual, 1999 section 3.3). Wherever possible, capacities of the drains have been enhanced to cater to 68mm/hr rainfall intensity.

#### **Integrated Flood Modelling by Anna University:**

To assess impacts due to flooding, currently Anna University is carrying out modelling for Chennai. The second part of this study includes interventions with necessary equipment support, training and capacity building for Corporation to address any flooding/inundation risks and a 3-year Operational support by Anna University etc during which time, Anna University will develop capabilities for real time modeling and handover the models to Chennai Corporation.

Flood Inundation scenario for the project area: Anna University in its study has identified that the inundation areas is around 2.86 sq.km and 1.65sq.km (inundation depths varying between 5cm to 100cm) for networks draining into Cooum and Adyar respectively. The details of the inundation range in the project area as identified in the study are given below.

**Table 7.1: DETAILS OF THE INUNDATION AREA RANGE IN ADYAR AND COOUM RIVERS**

| Depth of Inundation in Cm | Inundation Area - Adyar in Sq. Km. (Peak of Event) | Inundation Area - Adyar in Sq. Km. (End of Event) | Inundation Area - Cooum in Sq. Km. ( Peak of Event) | Inundation Area - Cooum in Sq. Km. ( End of Event) |
|---------------------------|--|---|---|--|
| 05 - 10 Cm                | 1.53   | 1.10  | 1.24  | 0.83   |
| 10-15 Cm                  | 0.77   | 0.29  | 0.81  | 0.59   |
| 15-20 Cm                  | 0.42   | 0.12  | 0.53  | 0.41   |
| 20-30 Cm                  | 0.25   | 0.07  | 0.59  | 0.43   |
| 30-40 Cm                  | 0.04   | 0.02  | 0.27  | 0.21   |
| 40-50 Cm                  | 0.02   | 0.02  | 0.15  | 0.12   |
| 50 Cm - 1.00 m            | 0.02   | 0.03  | 0.26  | 0.26   |
| <b>Total in Sq.km</b>     | <b>3.05 sq.km</b>                                  | <b>1.65 sq km</b>                                 | <b>3.85 sq km</b>                                   | <b>2.86 sq.km</b>                                  |

**Outcome of the study:**

Areas under River Adyar:

- Most of the inundations shown are very shallow.
- Out of the total extent of 17.2 sq km, 0.55 sq km shown to be above 10 cm deep inundations, an extent of 0.04 sqkm is assessed to be above 30-50 cm and 0.03 sqkm between 50-100 cm.

Areas under River Cooum:

- Most of the inundations shown are very shallow
- Out of the total extent of 37 sq km 2.03 sq km is shown to be above 10 cm deep inundations. An extent of 0.76 sq km is assessed to be above 30-50 cm and 0.26 sq km between 50-100 cm.

**Management measures:**

Based on the outcome of the study, management measures will be finalized jointly by Anna University and COC which be implemented.



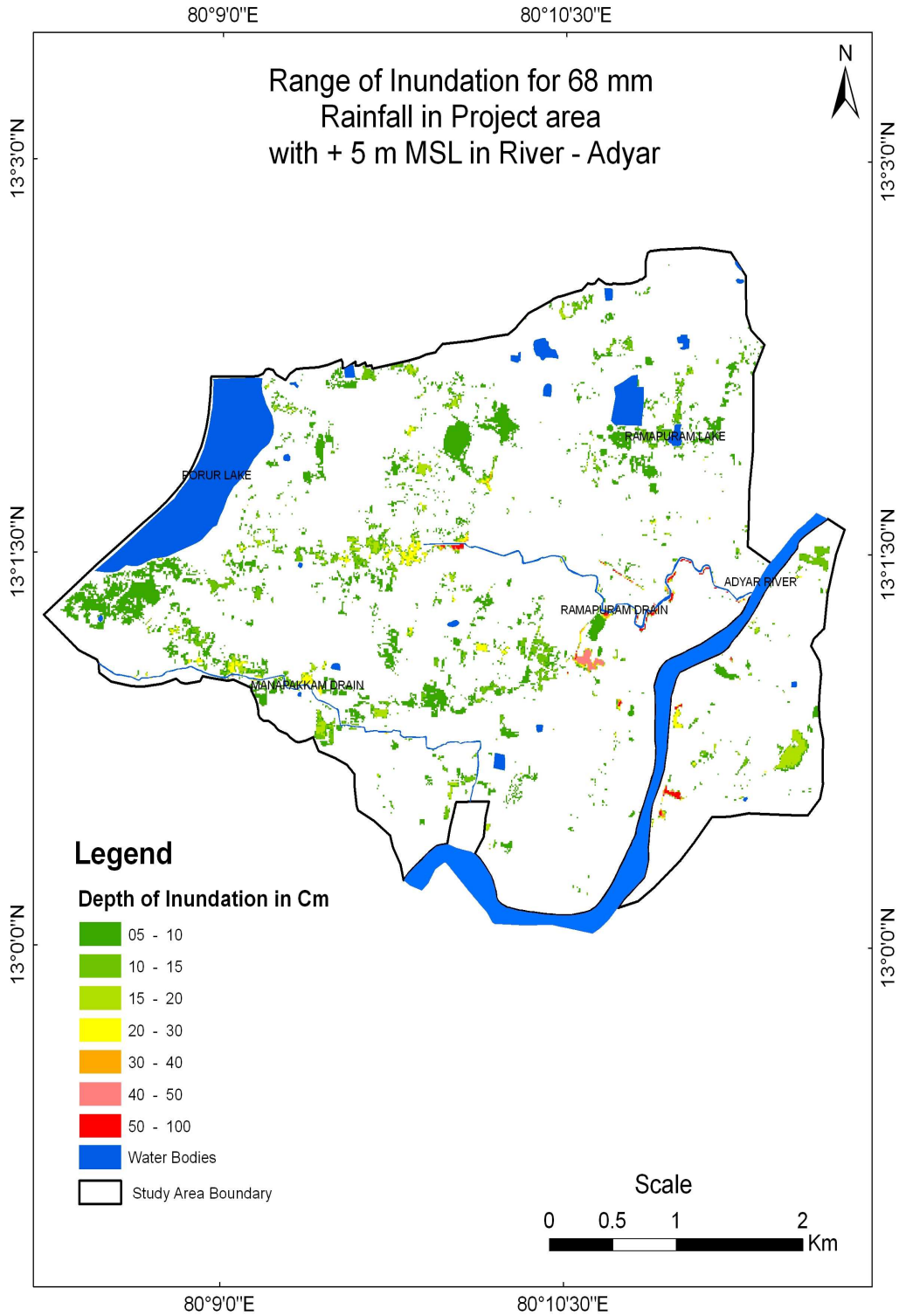


Fig 7.1 Range of Inundation at the end of event with 68 mm/hr rainfall in the project area with +5m MSL in Adyar River (END OF EVENT)

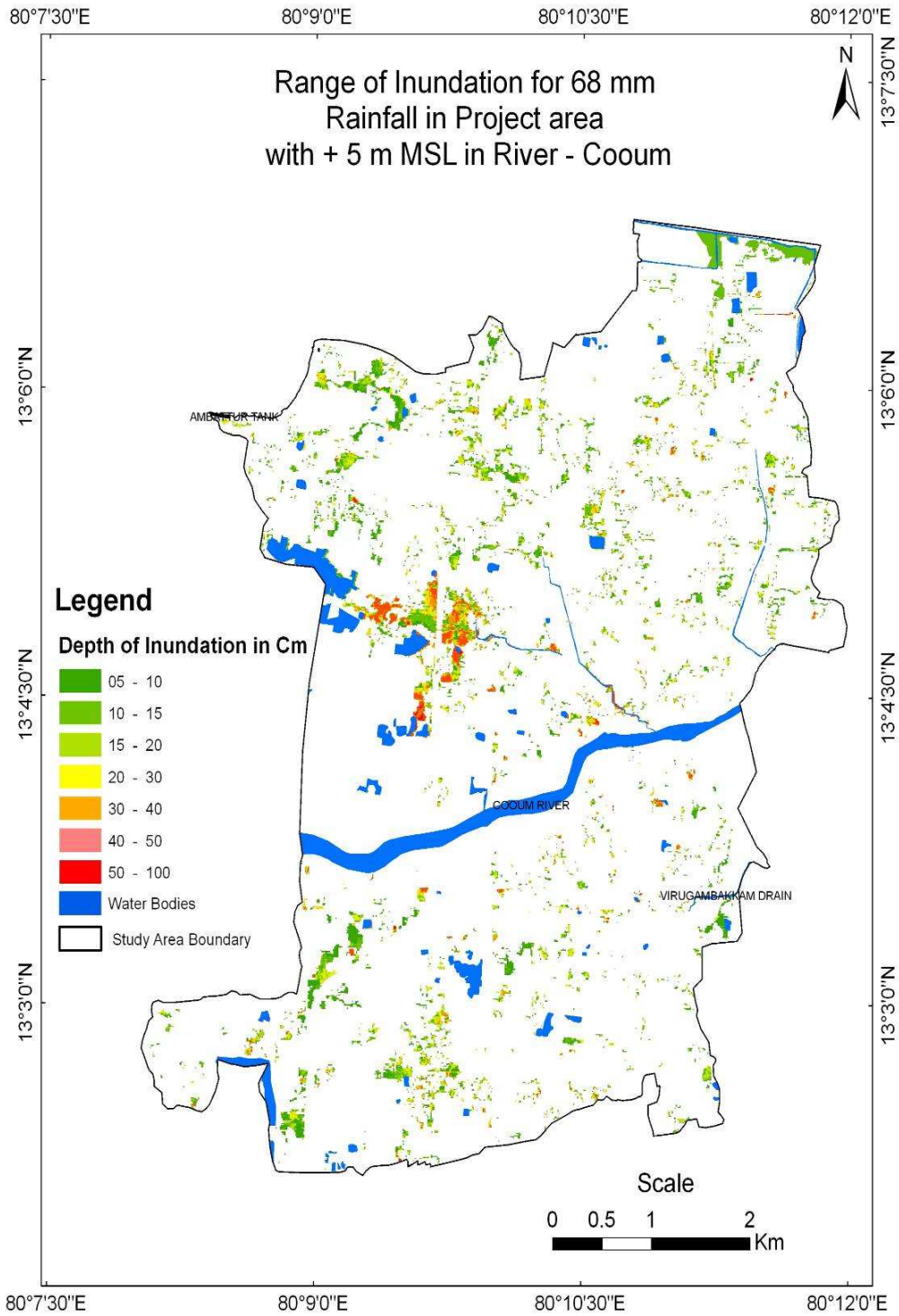


Fig 7.2 Range of Inundation at the end of event with 68 mm/hr rainfall in the project area with +5m MSL in Cooum River (END OF EVENT)

### 7.3.8 Disposal of excavated earth/ silt:

It is envisaged that large quantity of silt would have to be disposed from the drains and canals. The excess excavated earth will be conveyed to the existing dumping yards at Kodungaiyur and Perungudi. Necessary provision for conveyance of surplus earth has been made in the cost estimate. The vehicles conveying earth will be instructed to be covered with to avoid spreading of respirable suspended particulate matter & dust in the ambient air.

### 7.3.9 Traffic Management Measures

#### 7.3.9.1 Traffic Diversion

During the construction stage of storm water drain, traffic diversion or management may be required in any of the following conditions.

- i) If density of traffic is more in the construction road
- ii) Laying of storm water drain in major roads
- iii) If road width is lesser for traffic due to width of drains especially for arterial drains
- iv) Criticality of junction when drain crosses a junction
- v) Local significance

#### 7.3.9.2 Planning the works

The complexity of traffic diversion or management differs from scheme to scheme but the main objective is to maximise the safety of work force, publics living nearby and the travelling public and the second objective is to keep traffic flowing as freely as possible. So the traffic management should be a safe system of work for both operatives and road users.

During the planning stage of works the following points should be noted.

- Intimation to the public living or shops available adjoining the construction site.
- Attention must be paid to the needs of pedestrians. This applies especially in the vicinity of bus stops, shops, where larger numbers of people with physical/mental impairments may be expected.
- Construction works should be undertaken in the minimum time, taking up the minimum of road space, but without compromising safety. Where practicable, additional resources or time- reducing techniques should be considered.
- There must always be liaison with the Authority concerned to avoid concurrent works in close proximity.
- Period of execution based on the area specific. For example if an educational institution is present the works may be planned during holidays

- Transport authorities to be informed to plan their stops and routes if diverted
- There should be always liaison with traffic police and other emergency services

#### 7.3.9.3 Designing Traffic management

1. Before execution minimum lateral (sideways) clearance should be given between moving traffic and work space
2. Outer boundary of work space should be provided with barricading as specified in the SOR of CoC
3. Barricading should be visible in day and night and also adjacent to running traffic lane should be lined with traffic cones.
4. Adequate working space should be provided around the work place to allow temporary works
5. If density of traffic is more in construction road and the road is two way at least 5.5 m width should be maintained. If not possible a single way traffic may be enrooted on other possible way by providing proper indication on the entrance of road or before the diversion way. For one way traffic at least 3.3 m clearance should be given for heavy vehicle or public transport, but. Car only traffic may be maintained with 2.5 m width. Adequate warnings of narrow lanes must be given with proper sign board.
6. For construction of drains in the major roads the points discussed above is applicable along with the sign to vehicles to restrict the speed within 30 kmph while crossing construction site and sign indicating “ no overtaking” may be erected during working hours.
7. If road width is less than required i.e., at least 2.5 m for one way traffic during the period of construction , the road can be closed and traffic diverted along a suitable diversion road after according concurrence with traffic police and road authorities.
8. For crossing of drains through culverts in major roads, push thro technology is suggested. But if the culvert crosses through open excavation proper closing of traffic is required for crossing road.

Proper diversion board indicating the “Road ahead is closed” the nature of work going ahead with authority name should be placed before the entrance of road with advance warning of diversion should be placed

before 100m of diversion with arrow sign for diversion before 3m from the diversion road.

A proper vehicle restraint and pedestrian barrier with proper signage board should be placed on either side of culvert crossing.

#### **7.3.10 Tree cutting and Compensatory plantation:**

Tree Cutting:

- (i). The presence of trees adjacent to the drains/ canals and the vulnerable trees from the drain construction activity are estimated as 242 and 41.
- (ii). Adequate precaution shall be taken during implementation to keep the tree cutting at minimum.
- (iii). However, when tree cutting is unavoidable, note with necessary details on the project and trees & photos and justification for tree cutting shall be submitted by the SWD Department to the respective Regional Deputy/ Joint Commissioner and permission be obtained.
- (iv). Tree cutting shall be carried out by the Parks Department of the COC prior to start of work.

Compensatory plantation:

- (i). Provision has been made in the cost estimate for plantation at ten times the number of vulnerable trees.
- (ii). Corporation has proposed to carryout compensatory plantation after completion of the drain construction, through its Parks Department which will also carry out the maintenance activities of the plantation.
- (iii). Around 410 trees shall be planted along the streets in the project areas, i.e., in Manapakkam, Mugalivakkam, Ramapuram, Padikuppam, Nolumbur and Ambattur and in the parks nearby, if any.
- (iv). List of suggested species of trees for the compensatory plantation is provided in the Annexure I.

#### **7.3.11 Safety requirements for Maintenance of drains**

The inspection doors are provided at a distance of 10m to facilitate maintenance only through machineries and equipments avoiding manual entry.

However in case of any need for manual maintenance the following shall be ensured.

- (a) A competent person should carry out a risk assessment and make recommendations on safety and health measures before undertaking work in confined space.
- (b) Allow only certified workers to work in the confined space.
- (c) Provide adequate ventilation.
- (d) Isolate the confined space.

- (e) Monitor the air quality throughout the entire working period by means of a gas detection device.
- (f) A person should be stationed outside the confined space to monitor the weather condition and keep communication with the workers inside.
- (g) if required ensure the use of approved breathing apparatus
- (h) Appropriate emergency procedures shall be formulated to deal with serious or imminent danger.
- (k) Instructions, training and advice shall be provided to all workers to be working within a confined space.

#### 7.3.12 Environmental Management Plan for SWD:

The management measures which are to be implemented during various stages of implementation of the proposed SWD to selected areas of Chennai Corporation have been provided in Table 7.2. The general Environmental, Health and Safety guidelines of World Bank shall also be applied for relevant stage and activities in implementing the project.

## **7.4 Benefits of the project**

7.4.1 The population in the project area will be benefited by the implementation of this project with reduction in inundation related issues.

7.4.2 Economic Benefits: Direct economic benefits such as the costs for the restoration of damaged roads, engaging earth work excavators, cost of pumping and associated fuel costs, the cost of materials such as sand bags, restoring cross drainages, small bridges etc will be reduced. Further, the cost of cash and kind reliefs to flood affected population, loss of livestock, other structures will be reduced after implementation of SWD Project. Further, indirect benefits such as improved health status of population due to reduced risk of exposure to water borne diseases such as malaria, dengue and resultant health impacts.

**TABLE 7.2 ENVIRONMENTAL MANAGEMENT PLAN FOR STORM WATER DRAINAGE TO SELECTED AREAS OF CHENNAI**

| Sl.no      | Potential Impact                                     | Mitigation Measures  | Responsible agencies   |
|------------|--|--|------------------------|
| <b>1.0</b> | <b>DESIGN PHASE MEASURES</b>                         |  |                        |
| 1.1        | Prevention of flooding                               | The drains shall be constructed to handle the maximum rainfall of 68mm/hr  |                        |
| 1.2        | Rainwater Harvesting & Recharge structures           | <ul style="list-style-type: none"> <li>i) Rain water harvesting structure along with silt catching pit (600 X 600 x 600 mm) shall be constructed along the drains at every 90 m interval as per the standards prescribed on the Chennai Corporation Storm Water Schedule of rates item no SCP-RWH-43A is provided in each cost estimate of drains separately.</li> <li>ii) Ground water recharging structures (2100mmx600mmx600mm) shall be constructed at an interval of 100 meters in drains.</li> </ul> | <b>Contractor/ COC</b> |
| 1.3        | Sediment Control                                     | For control of sediments it is proposed to construct sediment trap at the confluence point of drain with the water body so that the sediments are deposited in the silt trap and settle over there which can be removed periodically.  | <b>Contractor/ COC</b> |
| 1.4        | Prevention of solidwaste into drains                 | <ul style="list-style-type: none"> <li>i) Micro drains shall be constructed as box type drain in RCC with cover on top which will curtail dumping of solid waste in drains.</li> <li>ii) Major micro drains belonging to Corporation of Chennai will be provided with top cover in MS frame with wire mesh to avoid dumping solid waste.</li> </ul>  | <b>Contractor/ COC</b> |
| 1.5        | Safety in maintenance                                | Inspection doors shall be provided at an interval of 10m to facilitate maintenance activities only by machineries.   | <b>Contractor/ COC</b> |
| <b>2.0</b> | <b>PRE-CONSTRUCTION STAGE AND CONSTRUCTION PHASE</b> |  |                        |
| 2.1        | Clearances   | All clearance required from other departments and Environmental aspects shall be ensured and made available before start of work.  | COC                    |

|     |  |   |  |
|-----|--|---|--|
|     |  | For trees identified for cutting, obtain prior permission from the respective Regional Deputy / Joint Commissioner, CoC prior to commencement of work.  |  |
| 2.2 | Tree Cutting                               | <ul style="list-style-type: none"> <li>i) Provide adequate protection to the trees to be retained with tree guards (e.g. Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars) as required.</li> <li>ii) Take adequate care to determine to root protection zone and minimise root loss.</li> <li>iii) Trees shall be removed from the construction sites before commencement of construction</li> <li>iv) Undertake afforestation in nearby areas.</li> </ul>  | Contractor / COC                           |
| 2.3 | Utility Relocation                         | <ul style="list-style-type: none"> <li>i) Identify the common utilities that would be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc.</li> <li>ii) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.</li> <li>iii) Where ever the entry and exit to houses/ establishments are affected due to construction activities, alternate temporary arrangement for crossing over shall be provided.</li> </ul>   | COC / Concerned departments/<br>Contractor |
| 2.4 | Baseline parameters                        | <ul style="list-style-type: none"> <li>i) Base line parameters shall be recorded and ensured conformance till the completion of the project.</li> <li>ii) The contractor shall undertake periodical monitoring of air, water, noise and soil quality through an approved monitoring agency. The parameter to be monitored, frequency and duration of monitoring plan shall be prepared.</li> <li>iii) Adequate measures shall be taken and checked to control any pollution and report be sent to the Engineer.</li> </ul>  | Contractor / COC                           |
| 2.5 | Planning of temporary Traffic arrangements | <ul style="list-style-type: none"> <li>i) 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.</li> <li>ii) 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.</li> </ul> <p><b>The guidance for traffic management provided in Section 7.3.9 of the EA report shall be referred to for preparation of the traffic plan.</b></p> | Contractor / COC                           |



|      |  |   |                  |
|------|--|---|------------------|
| 2.6  | Temporary flooding during construction activity. | <ul style="list-style-type: none"> <li>i) Desilting activity shall be scheduled during non-flooding season.</li> <li>ii) Proper drainage arrangements to be made, to avoid the overflowing of existing drains due to construction activity.</li> </ul>  | Contractor/ COC  |
| 2.7  | Prevention of accidents                          | <ul style="list-style-type: none"> <li>i) Prevention of accidents involving human beings, animals or vehicles falling or accidents during construction period. This needs to be ensured with proper barricading, signage boards and lighting etc.</li> <li>ii) The project engineer of COC will plan and direct the contractor to execute the work progressively so that the length of the open excavated trench is minimised in order to reduce possible accidents</li> </ul>  | Contractor / COC |
| 2.8  | Barricading site                                 | The construction area should be barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians.   | Contractor       |
| 2.9  | Drainage flow                                    | <ul style="list-style-type: none"> <li>i) Alternate arrangement like diversion of the drainage be ensured to allow the natural flow.</li> <li>ii) It shall be ensured that none of the construction activities affect the natural flow of the drainage.</li> </ul>  | Contractor / COC |
| 2.10 | Storage of materials                             | <ul style="list-style-type: none"> <li>i) No construction materials should be stored on the road, on top of or beside drains and footpaths, or on any other public area as this may restrict public access to these utilities.</li> <li>ii) The contractor shall identify the site for temporary use of land for construction sites /storage of construction materials, etc.</li> <li>iii) Site for storage of construction materials to be identified without affecting the traffic and other common utilities, and the quality of the construction materials.</li> <li>iv) Construction materials should only be stored and prepared on the site if they do not obstruct the road or any surrounding public utility. Construction materials should only be transported to the worksite as and when required for construction</li> </ul> | Contractor / COC |
| 2.11 | Using of modern machineries                      | <ul style="list-style-type: none"> <li>i) Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period, it will reduce the construction period impacts to the near by residents.</li> </ul>  | Contractor       |
| 2.12 | Dust Pollution near                              | <ul style="list-style-type: none"> <li>i) All earth work will be protected in manner acceptable to the engineer to minimize generation of dust. Area under construction shall be covered &amp; equipped will dust collector.</li> </ul>   | Contractor       |

|      |   |   |            |
|------|---|---|------------|
|      | settlements   | <ul style="list-style-type: none"> <li>ii) Construction material shall be covered or stored in such a manner so as to avoid being affected by wind direction.</li> <li>iii) Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day.</li> <li>iv) Trucks carrying construction material to be adequately covered to avoid the dust pollution and to avoid the material spillage.</li> <li>v) Sprinkling of water to be done at regular intervals at places of work to protect the nearby inhabitants and road users.</li> </ul>   |            |
| 2.13 | Protection of residential / sensitive receptors.                | <ul style="list-style-type: none"> <li>i) Noisy construction operations in residential and sensitive areas should be done only between 7.30 am and 6.00 pm.</li> <li>ii) Preventive maintenance of construction equipment and vehicles to meet emission standards and to keep them with low noise.</li> <li>iii) Provision of enclosing generators and concrete mixers at site.</li> <li>iv) Sound barriers shall be installed during the construction phase to protect the inhabited areas from the noise from construction activities.</li> <li>v) Adequate barricading and safety measures to protect dust pollution and noise impacts on sensitive receptors like schools and hospital etc due to vehicle movement to be ensured prior to the start of work and their effectiveness to be checked during construction and operation phase.</li> </ul> | Contractor |
| 2.14 | Vehicular noise pollution at residential / sensitive receptors. | <ul style="list-style-type: none"> <li>i) Idling of temporary trucks or other equipment should not be permitted during periods of loading / unloading or when they are not in active use. The practice must be ensured especially near residential / commercial / sensitive areas.</li> <li>ii) Stationary construction equipment will be kept at least 500m away from sensitive receptors.</li> <li>iii) All possible and practical measures to control noise emissions during drilling shall be employed. The COC may direct to take adequate controls measures depending on site conditions.</li> </ul>  | Contractor |
| 2.15 | Noise from vehicles, plants and equipments                      | <ul style="list-style-type: none"> <li>i) Use of less noise generating cutting equipment's, provide personal protective equipment's such as ear plugs/muffs and other safety measures to labourers. In addition the concrete mixture to be used for construction works will be prepared in a location away from the locality to minimize the noise generated from the machinery.</li> </ul>   | Contractor |

|      |                                    |  |            |
|------|------------------------------------|--|------------|
|      |                                    | <ul style="list-style-type: none"> <li>ii) Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.</li> <li>iii) Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Engineer to keep noise levels at the minimum.</li> </ul>   |            |
| 2.16 | Labour camp & facilities           | <p>Setting up of labour camps needs to be done as per the procedures. Adequate potable water facilities, sanitation and drainage etc., in conformity with the Indian labour laws shall be ensured.</p> <p>The contractor shall also guarantee the following:</p> <ul style="list-style-type: none"> <li>i) The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction.</li> <li>ii) The construction will commence only upon the written approval of the Engineer.</li> <li>iii) The Contractor shall construct and maintain all labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.</li> <li>iv) Supply of sufficient quantity of potable water (as per IS) in every workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities.</li> <li>v) The sewage system for the camp shall be designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Ensure adequate water supply is to be provided in all toilets and urinals.</li> <li>vi) The contractor shall provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Engineer.</li> <li>vii) Unless otherwise arranged by local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Engineer will have to be provided by the contractor.</li> </ul> | Contractor |
| 2.17 | Pollution from Construction Wastes | <p>All waste arising from the project is to be disposed off in the manner that is acceptable by the Engineer.</p> <p>The engineer shall certify that all liquid wastes disposed off from the sites meet the discharge standard.</p>  | Contractor |

|      |                                      |  |                 |
|------|--------------------------------------|--|-----------------|
| 2.18 | Pollution from Fuel and Lubricants   | <p>i) The contractor shall ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refueling sites will be located at least 500 m from sensitive receptors.</p> <p>ii) 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.</p> <p>iii) 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.</p> <p>iv) Contractor shall 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.</p> <p>v) Engineer will certify that all arrangements comply with the guidelines of PCB/ MoEF or any other relevant laws.</p> | Contractor      |
| 2.19 | Flora and Chance found Fauna         | <p>The contractor will take reasonable precaution to prevent his 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.</p> <p>If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Engineer and carry out the Engineer's instructions for dealing with the same.</p> <p>The Engineer will report to the near by forest office (range office or divisional office) and will take appropriate steps/ measures, if required in consultation with the forest officials.</p>   | Contractor/ COC |
| 2.20 | Chance Found Archaeological Property | <p>All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation.</p> <p>The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer of such discovery and carry out the SC's instructions for dealing with the same, waiting which all work</p>   | Contractor/ COC |

|      |                                   |  |                 |
|------|-----------------------------------|--|-----------------|
|      |                                   | shall be stopped.<br><br>The Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.  |                 |
| 2.21 | Disposal of oil and grease        | A suitable site should be identified for safe disposal / without contaminating the source, in relatively low lying areas, away from the water bodies etc., as approved by the Engineer & as per specific procedures.   | Contractor/ COC |
| 2.22 | Safety Aspects                    | <ul style="list-style-type: none"> <li>i) 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 COC.</li> <li>ii) Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil.</li> <li>iii) Protective footwear and protective goggles to all workers employed on mixing of materials like cement, concrete etc.</li> <li>iv) Welder's protective eye-shields shall be provided to workers who are engaged in welding works.</li> <li>v) Earplugs shall be provided to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.</li> <li>vi) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs.</li> <li>vii) 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.</li> <li>viii) 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.</li> <li>ix) The contractor shall 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.</li> </ul> | Contractor      |
| 2.23 | Risk from Electrical Equipment(s) | <p>The Contractor shall take all required precautions to prevent danger from electrical equipment and ensure that -</p> <ul style="list-style-type: none"> <li>i) No material will be so stacked or placed as to cause danger or inconvenience to any person or the public.</li> <li>ii) All necessary fencing and lights will be provided to protect the public in construction zones.</li> </ul>   | Contractor      |

|      |  |  |                  |
|------|--|--|------------------|
|      |  | iii) 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.   |                  |
| 2.24 | First Aid  | The contractor shall arrange for:<br>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<br>ii) Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital   | Contractor       |
| 2.25 | 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.   | Contractor/ COC  |
| 2.26 | Disposal of desilted / excavated material, construction and other waste. | The excavated /desilted material shall be disposed off without any accumulation. The soil excavated from the canal and river shall be tested for quality, adequately treated with methods like bioremediation and proper reuse option explored. The rest may be safely disposed. The disposal shall be done in the existing dump yards of Chennai Corporation at Kodungaiyur and Perungudi or any other site identified by Chennai Corporation.<br>The following shall be ensured during silt disposal<br>(a) The dumping does not impact natural drainage courses<br>(b) No endangered / rare flora is impacted by such dumping<br>(c) Settlement area located at least 1.0 km away from the site.<br>(d) Should be located in non residential areas located in the down wind side<br>(e) located at least 100m from the designated forest land.<br>(f) avoid disposal on productive land.<br>(g) should be located with the consensus of the local community, in consultation with the engineer<br>(h) All vehicles delivering material to the site shall be covered to avoid material spillage. | Contractor / COC |

|      |  |  |                        |
|------|--|--|------------------------|
| 2.27 | Clearing of construction camps and restoration | <ul style="list-style-type: none"> <li>i) Contractor to prepare site restoration plans, the plan is to be implemented by the contractor prior to demobilization.</li> <li>ii) On completion of the works, all temporary structures will be cleared away, all rubbish cleared, excreta or other disposal pits or trenches filled in and effectively sealed off and the site left clean and tidy, at the contractor's expenses, to the entire satisfaction of the engineer.</li> </ul> | Prospective contractor |
| 2.28 | Project implementation                         | It shall be ensured that the Environmental, Health and Safety guidelines of World Bank are adhered to as applicable for activities during construction.  | Contractor / COC       |

| <b>3.0 OPERATION PHASE</b> |  |  |                             |
|----------------------------|--|--|-----------------------------|
| <b>Sl.no</b>               | <b>Potential Impact</b>  | <b>Mitigation Measures</b>   | <b>Responsible agencies</b> |
| 3.1                        | Maintenance  | <ul style="list-style-type: none"> <li>i) It shall be ensured by the COC that drains are not clogged. The following practices should be adopted in maintaining storm water drains:</li> <li>ii) Drains shall be regularly inspected and cleaned especially prior to monsoons.</li> <li>iii) All damaged or missing drain covers should be replaced immediately</li> <li>iv) Rubbish and silt that has been removed from the drainage system should not be left alongside the drain and shall be immediately disposed in pre-identified site with necessary precautions</li> <li>v) It shall be ensured that the Environmental, Health and Safety guidelines of World Bank (Generic and Water &amp; Sanitation) are adhered to relevant activities during operation.</li> </ul> | COC                         |
| 3.2                        | Impairment of receiving water quality due to mixing of waste water | <ul style="list-style-type: none"> <li>i) Avoid mixing of wastewater from household, commercial, industrial and other establishments.</li> <li>ii) Provision for connecting domestic liquid waste to sewerage system is to be made during drain construction to avoid mixing of wastewater.</li> <li>iii) Periodical monitoring shall be carried out and sources of wastes/ effluent etc are to be identified by the COC. COC may initiate action to ensure proper linking of such connections to other waste disposal systems and it shall be ensured that the drains carry only the rainwater.</li> </ul>  | COC                         |

|     |  |  |     |
|-----|--|--|-----|
|     |  | iv) In case of any industrial effluent identified, necessary action be taken in co-ordination with the TNPCB.  |     |
| 3.3 | Nuisance due to clogging of drains, formation of mosquito breeding grounds etc., | i) Ensure timely desilting of drains<br>ii) Create awareness among the people not to throw garbage and other waste into the drains   | COC |
| 3.4 | Disposal of stormwater   | i) Mixing of wastewater from households, commercial, industrial and other establishments will be avoided through improved sewerage system in the project area through periodical monitoring of water quality.<br>ii) Possibility of reusing the stormwater for secondary uses with minimum treatment shall be explored and implemented.  | COC |
| 3.5 | Tree Planting & Protection   | i) Plantation of trees shall be carried out along the streets of Manapakkam, Mugalivakkam, Ramapuram, Padikuppam, Nolumbur and Ambattur etc or any other place possible like parks in the nearby areas.<br>ii) Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars, use of plate compactors near trees may also be considered where necessary.<br>iii) Growth and survival of trees planted shall be ensured and monitoring done at least for a period of 3 years. Survival status shall be monitored on monthly basis by Engineer in-charge. | COC |
| 3.6 | Flood management   | Flood management system may be developed with forecasting and warning to protect areas prone to flooding and action be taken as necessary, like bailing out of water, relocation of residents to other locations etc.  | COC |
| 3.7 | Solid waste Management   | i) Provide additional bins in critical locations<br>ii) Ensure frequent collection and disposal of waste<br>iii) Carryout periodical awareness programmes to educate the public / stakeholders   | COC |



### Environmental Monitoring Plan

To monitor the extent of environmental impact of the proposed /implemented project, the contractor has to periodically monitor the ambient environmental quality along the proposed project area. The monitoring requirement for the different environmental components is presented in table below

### Environmental Monitoring Plan

| <b>Air Quality Monitoring</b>   |  |
|---------------------------------|--|
| Project stage                   | Construction   |
| Parameter                       | SPM, RPM, SO <sub>2</sub> , NO <sub>x</sub> , CO and Pb  |
| Sampling Method                 | Use method specified by CPCB for analysis  |
| Standards                       | Ambient Air Quality Standards, CPCB, 1994, Air (Prevention and Control of Pollution) Act,1981  |
| Frequency                       | Once every season except monsoon during construction period  |
| Duration                        | As per CPCB guidelines for monitoring  |
| Location                        | Sensitive locations, especially in the downwind direction along the alignment.   |
| Measures                        | Wherever air pollution parameters increase above specified standards, additional measures as decided by the engineer shall be adopted  |
| Implementation                  | Contractor through approved monitoring agencies  |
| Supervision                     | COC  |
| <b>Water quality Monitoring</b> |  |
| Project stage                   | Construction & Operation period (as agreed)  |
| Parameter                       | Parameters for Surface water quality standards (IS; 2296)<br>Water pH, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater.   |
| Sampling Method                 | Grab sample to be collected and analysis as per Standard Methods for Examination of water and Waste water.   |
| Standards                       | Indian standards for Inland Surface Water (IS; 2296, 1982) and for Drinking water (IS; 10500,1991)   |
| Frequency                       | Once every season during construction and during operation period.   |
| Duration                        | Grab sampling  |
| Location                        | Locations representing water quality in the drain and ground water quality   |
| Measures                        | At locations of variation in water quality/increased pollution, remedial measures to be adopted /all inflow channels shall be checked for pollution loads  |
| Implementation                  | Contractor through approved monitoring agencies  |
| Supervision                     | COC  |
| <b>Noise Level Monitoring</b>   |  |
| Project stage                   | Construction   |
| Parameter                       | Noise levels on dB (A) scale.  |
| Special guidance                | <ul style="list-style-type: none"> <li>• Free field at 1 m from the equipments whose noise level are being determined.</li> <li>• Equivalent noise levels using an integrated noise level meter kept at a distance of 15m from edge of pavement</li> </ul> |

|                                |  |
|--------------------------------|--|
| Standards                      | National Ambient Air Quality Standards in respect of Noise, Noise Pollution (Regulation and Control) Rules, 2000   |
| Frequency                      | Seasonal during construction period.   |
| Duration                       | Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged   |
| Location                       | <ul style="list-style-type: none"> <li>• Wherever the contractor decides to locate the equipment yard.</li> <li>• At sensitive locations such as school, hospitals etc along the alignment.</li> </ul> |
| Measures                       | In case of noise levels causing disturbance to the sensitive receptors, management measures as suggested in the EMP shall be carried out.  |
| Implementation                 | Contractor through approved monitoring agencies  |
| Supervision                    | COC  |
| <b>Soil Quality Monitoring</b> |  |
| Project stage                  | Construction & Operation (as agreed)   |
| Parameter                      | Soil quality parameters (Pb, SAR and Oil & Grease, monitoring silt for presence of toxic metals , etc)   |
| Sampling Method                | <ul style="list-style-type: none"> <li>• Sample of soil collected to be acidified and analysed using absorption spectrophotometer</li> </ul>   |
| Standards                      | Threshold for each contaminated set by IRIS database of USEPA until national standards are promulgated   |
| Frequency                      | <ul style="list-style-type: none"> <li>• During the pre monsoon post monsoon seasons each year for the entire construction and operation phase</li> </ul>  |
| Duration                       | Grab sampling  |
| Location                       | <ul style="list-style-type: none"> <li>• At sample locations in the receiving waterbodies, at the places of dumping silt, excavated earth.</li> </ul>  |
| Measures                       | At location of increased in pollution levels, source shall be identified and measures adopted.   |
| Implementation                 | Contractor through approved monitoring agencies  |
| Supervision                    | COC  |

Apart from the above mentioned monitoring requirements, any major accidents / spillage during bulk transport of hazardous materials by the contractor, depending on the type of spillages / accidents, the parameters to be monitored will be decided by the engineer and should be carried out by the contractor through approved monitoring agencies and supervised by the Implementing agency at their own cost.

**FORMATS FOR REPORTING:**

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

**Environmental Compliance Report**

The contractor shall submit a monthly progress report as per the reporting format approved by the 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, 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.

**Cost estimates for Environmental Management Plan:**

The budget proposed for implementation of environmental management measures proposed in the SWD to selected areas of COC are given in Table below.

**Table 7.3 Cost estimate for EMP in proposed SWD in selected areas of COC**

| Sl.No     | Management Activities   | Unit                                | Rate            | Amount, (Rs.) | Reference to BOQ/ Estimate                                 |
|-----------|---|-------------------------------------|-----------------|---------------|--|
| <b>A-</b> | <b>During Construction Phase</b>  |                                     |                 |               |  |
| 1.        | Sprinkling of water on the exposed site and dust suppression barriers to minimize the generation of dust and respirable suspended particulate matters                           | LS                                  | -               |               | It is included as a part of work to done in SI No 2 of BOQ |
| 2.        | Compensatory plantation after the completion of the activity (plantation of 190 trees and landscaping works) including maintenance during O&M                                   | LS                                  | -               | 4,10,000      | Included in EMP cost as SI No 12 of Cost estimate. .       |
| 3.        | Provision of temporary barriers and proper signage for avoiding traffic congestion including traffic management measures  | LS                                  | -               | 28,20,000     | Included as SI No 14 of Abstract Cost estimate.            |
| 4.        | Lead and lift for excavated silts up to dumping area  | considered in the main project cost |                 |               | Included in SI No 13 of BOQ                                |
| 5.        | Provision of Proper drainage, sanitation along with water supply and temporary camps for habitation of labours  | LS                                  | -               |               | Included in conditions of contract                         |
| 6.        | Provision for temporary arrangements to cross drains during execution   | considered in the main project cost |                 | 109,00,000    | Included in as SI No 15 of Abstract Cost estimate.         |
| 7.        | Provision of Flap gates (where FSL of receiving body is higher)   | To be fixed wherever necessary      |                 | 69,80,000     | Included in as SI No8 of Abstract Cost estimate            |
| 8.        | Provision for rain water harvesting along the alignment of drains   | considered in the main project cost |                 |               | Included in SI No 10 of BOQ                                |
| 9.        | <b>Environmental Monitoring</b>   |                                     |                 |               |  |
| (i).      | 8 hourly Air Quality Monitoring (2 Monitoring stations in project area) four times during construction period (Total No. of <a href="#">Samples at 8</a> Nos. Two stations =32) | Market Rate                         | Rs.15000/sample | 4,80,000      | Included in EMP cost as SI No 12 of Cost estimate of.      |

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|          |  |  |                            |            |   |
|----------|--|--|----------------------------|------------|---|
| (ii).    | Noise level Monitoring twice in a day ( at 5 locations including construction sites) six times during construction period  | Market Rate                                      | Rs.500 for each monitoring | 600000     | Included in EMP cost as SI No 12 of Abstract Cost estimate. |
| (iii)    | Water Quality Monitoring (at 2 Monitoring station per water shed in the project area) twelve times during construction period (Total No. of Samples at 4 per watershed . TOTAL= 168                                    | Market Rate                                      | Rs.10000/ sample           | 1680000    | Included in EMP cost as SI No 12 of Cost estimate .         |
| (iv)     | Soil Quality Monitoring ( 10 stations per watershed of the project area including the silt dumping area, three times during construction period (Total No. of <a href="#">Samples at 30</a> nos. per water shed = 210) | Market Rate                                      | Rs. 8000/ sample           | 1680000    | Included in EMP cost as SI No 12 of Abstract Cost estimate. |
| <b>B</b> | <b>During Operational Phase</b>  |  |                            |            |   |
| 10.      | Lead for disposal of wastes / silt from the drains   | considered in the Operation and maintenance cost |                            |            |   |
| 11.      | <b>Environmental Monitoring</b>  |  |                            |            |   |
| (i).     | Water Quality Monitoring (at 3 Monitoring stations in the project area) twice after construction period (Total No. of <a href="#">Samples at 6Nos.</a> per zone= 36 )  | Market Rate                                      | Rs.10000/ sample           | 360000     |   |
| (ii).    | Soil Quality Monitoring (4 stations of the project area including the silt dumping area, once after construction period (Total No. of <a href="#">Samples at 4Nos.</a> per zone=24 )                                   | Market Rate                                      | Rs. 8000/ sample           | 192000     |   |
| 12.      | Training programs for the labourers  | LS   |                            | 1000000    | Included in EMP cost as SI No 12 of Cost estimate .         |
| 13.      | PPEs for the labourers   | LS   |                            | 150000     | Included in EMP cost as SI No 12 of Cost estimate.          |
| 14.      | Public Awareness and Capacity Building   | LS   | -                          | 1500000    | Included in EMP cost as SI No 12 of Cost estimate.          |
|          | Total (A+B)  |  |                            | 28,75,2000 |   |
|          | Sub-Total - EMP Cost   |  |                            | 80,52,000  |   |

## **8 SOCIAL IMPACT ASSESSMENT AND RESETTLEMENT ACTION PLAN**

**8.1** This proposed sub-project of providing storm water drainage to selected areas of Chennai Corporation involves construction of storm water drains and canals. This sub project is proposed to be implemented in the three Zones of the CoC. The total length of the drains to be constructed is about 270.33 kilometres including the 11.05 km length in the canals. This sub-project involves 39 contract packages including canals, new storm water drains, rehabilitation of existing/unsized/dilapidated storm water drains and improvements to the existing canals. While most of the contract packages related to network will be implemented within the existing RoW of the road sections and there are no impacts to be affected, though there will be temporary impacts in the nature of loss of access to residences during the implementation. The social impacts will be restricted to 4 packages for the canals. This sub-project is expected to affect 19 encroachers and displace 262 non-title holders (Squatters) who are staying along the canals and require to be resettled in line with the process and provisions of Environmental and Social Management Framework (ESMF) adopted by TNUISL for this project ( under finalization) and 19 encroachers.

**8.2** In order to assess the social impacts socio economic census survey was carried out by the corporation and found out that it involves resettlement of 281 Project Affected Families including about 25% women headed families. Due to the substantial displacement this sub-project is classified as **S1** Category and accordingly a Social Impact Assessment was carried out to determine the nature and magnitude of impacts and based on the assessment, a Resettlement Action Plan ( RAP) is prepared. And the details such as baseline socio-economic characteristics of the displaced families, outcome of consultations and plan for resettlement in coordination with the procurement and civil works time table and proposed implementation arrangements are available in the RAP.

**8.3** The census socio-economic survey reveals that the displaced families are mostly residences in the site for several years and are belonging to the poor and marginal section of Chennai with 40% belongs to Scheduled Castes. The average monthly income is about Rs.6,500 (USD 110). The housing condition include most of them have a decent housing with average size of about 600 sq.ft with access to basic amenities in their houses Most of them are engaged in informal jobs and less than 3% have regular earnings. .

**8.4** The PAFs are proposed to be relocated in the Tamil Nadu Slum Clearance Board (TNSCB) tenements, which is already constructed and ready to occupy. The CoC is in close consultation with the TNSCB to finalise the resettlement of the PAFs. The choice of alternative sites among those available, will be discussed with displaced families will be finalised. The estimated R&R cost for this sub project is about Rs.24.05 Crores (about USD 4 Million) which is subject to correction. The entire cost will be met out of CoC own funds.

8.5 This RAP will be implemented by Storm Water Drains Department of CoC and will have environment and social specialists who will support the implementation. The project Management consultants ( PMC) will assist CoC in the implementation of this component and PMC team will have social specialists having experience with resettlement and community development aspects and will be supported by social workers who will mobilise the displaced families and prepare them for resettlement and new way of life in the new resettlement site. TNUIFSL will carry out concurrent monitoring and a final impact evaluation will be carried through independent consultants to assess the changes in the living standards of the affected families after one year of their resettlement.

8.6 There are two levels of grievance Redressal mechanism has been proposed. One at the appellate level comprises of Deputy Commissioner (Works) and Regional Deputy/Joint Commissioners and the project level grievance committee consists of Zonal Officer/Assistance Commissioners of CoC, person of repute from the local area and elected representative and Superintending Engineer (SWD) will be constituted to deal with the grievances and complaints of the PAPs and local people.

8.7 The RAP's implementation will be coordinated in such way that the key actions will be completed prior to invitation of bids and the displaced families will be moved and paid other eligible R&R assistance prior to award of contract.

## 9 CONSULTATION AND COMMUNITY PARTICIPATION

### Public Disclosure:

9.1 The draft Environmental Assessment Report (EA) and the Executive Summary have been disclosed in the websites of the Corporation of Chennai and TNUIFSL. The links are provided below.

COC

<http://chennaicorporation.gov.in/images/swd/Draft%20EA%20Chennai%20%20ISWD%20Dec%208,%202014.pdf>

TNUIFSL

<http://www.tnuifsl.com/Draft%20EA%20Chennai%20%20ISWD%20Dec%208,%202014.pdf>

9.2 The World Bank has issued their no-objection to the draft EA report on 19<sup>th</sup> January, 2015, and the final document will be disclosed in the websites of COC and TNUIFSL.

### Public Consultations:

9.3 During the initial surveys conducted during DPR preparation, brief discussions have been carried out in the project area. However currently, the Corporation of Chennai carried out consultations in the form of Focused Group Discussions (FGD) with the nearby residents in the project area on various days.

9.4 General Consultations and separate consultations with women were held in the project area on 27.12.2014 , 05.01.2015 and 06.01.2015. The details of the FGDs carried out are as follows:

| Sl.No | Location                           | FGD type                                    | Date and Time        |
|-------|------------------------------------|---|----------------------|
| 1     | JJ Nagar @ Nandampakkam Canal      | General                                     | 27.12.2014 @ 11:30am |
| 2     | JJ Nagar @ Nandampakkam Canal      | Women                                       | 27.12.2014 @ 12:30am |
| 3     | Gangaiamman Nagar @ Nolambur canal | Generl                                      | 27.12.2014 @ 3:30pm  |
| 4     | Gangaiamman Nagar @ Nolambur canal | Women                                       | 27.12.2014 @ 4:00pm  |
| 5     | Padikuppam Canal –zero point       | General                                     | 05.01.2015 @ 4:00pm  |
| 6     | Padikuppam Canal – zero point      | Commercial Squatters                        | 06.01.2015 @ 9:30am  |
| 7     | Padikuppam canal – middle reach    | Commercial Squatters                        | 06.01.2015 @ 10:00am |
| 8     | Padikuppam Canal – middle reach    | Commercial Squatters & Residential Squatter | 06.01.2015 @ 10:40am |

|   |                                 |                      |                       |
|---|---------------------------------|----------------------|-----------------------|
|   |                                 | including Women      |                       |
| 9 | Padikuppam canal – middle reach | Commercial Squatters | 06.01.2015 @ 11:45 am |



FGD with women in Zone XI



FGD in Zone VII

**9.5** Majority of the participants were the identified PAPs in the proposed SWD project. Corporation explained them about the entitlements and relocation aspects as per ESMF to clear their concerns regarding relocation site and livelihood.

**9.6** Most of the participants mentioned that they were affected by the inundation during the rains in 2005, and to some extent in 2008 and 2010. They welcomed the project stating that they expect that the flooding would come down with the implementation of the SWD project.

Specific consultation in Project Area:

**9.7** In addition to these FGDs, COC also proposed to conduct detailed specific consultation with the public in the project area including the PAPs for the proposed SWD, prior to bidding.



## 10 IMPLEMENTATION PROPOSAL AND INSTITUTIONAL ARRANGEMENTS AT COC

**10.1** The Storm Water Drainage (SWD) project for the selected areas of Chennai Corporation will be implemented by the Storm Water Drain Department of the Chennai Corporation.

**10.2** Under TNSUDP, the storm water drainage network in part of Zones VII, XI and XII flowing into Adayar and Cooum Rivers at an estimated project cost of Rs.1104.43 crores is proposed to be taken up in a total of 39 packages.

**10.3** The works for drainage network flowing into Adyar River are proposed under 9 packages for a total length of around 82.31km, including a separate package for Nandambakkam canal. Similarly, the works for drainage network flowing into Cooum River are proposed under 30 packages for a total length of around 188.02km. This includes the Padikuppam canal, Korattur TNHB canal, Ambattur SIDCO canal, and Nolumbur canal as four separate packages.

**10.4** 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 CoC upon completion of construction activities.

**10.5 Project Management Consultant (PMC):** COC has proposed to appoint Project Management Consultants (PMC) for managing SWD 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 COC for the project.

**10.6 Environmental and Social Safeguard Specialists:** The Chennai Corporation proposed to appoint Environmental and Social Safeguards specialists for overseeing environmental and social safeguards compliance in all the projects of COC. The E&S Safeguard specialists will directly report to the DC (Works).

**10.7** COC shall submit monthly reports to TNUIFSL on the status of compliance with the ESMF requirements.

**10.8 Grievance Redressal Mechanism:** The Corporation of Chennai will have the following mechanism to address the grievance of the project affected persons:




Appellate Level Grievance Redressal Committee with following members




- Deputy Commissioner (Works)
- Regional Deputy / Joint Commissioners (Central/South)


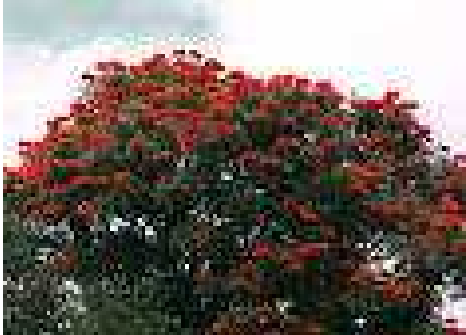


A project level grievance redressal committee will be set up and the members are as follows (preferably one of them as women)

- The Zonal Officer /Assistant Commissioners of CoC
- Any one Elected representative
- A person who is publicly known in the local area
- Superintending Engineer (SWD) (Convener)

**Annexure I Suggested list of species for plantation**

|  |  |   |
|--|--|---|
|  <p>Gulmohar</p>  | <p><b>Flame tree</b> : <i>Delonix regia</i> is a species of flowering plant in the family <a href="#">Fabaceae</a>, subfamily <a href="#">Caesalpinioideae</a>. It is noted for its fern-like leaves and flamboyant display of flowers. In many tropical parts of the world it is grown as an <a href="#">ornamental tree</a> and in English it is given the name Royal Poinciana or Flamboyant. It is also one of several trees known as <a href="#">Flame tree</a>.</p> <p>In Nepal, India and Pakistan it is known as Gulmohar.</p> |   |
| <p>It requires a tropical or near-tropical climate, but can tolerate drought and salty conditions. The tree is most commonly propagated by seeds.</p> <p>The tree sheds large woody pods and brittle branches that get broken off in the wind due to weak stem</p> |  |   |
|    | <p>Flowering season<br/>                 April–June</p>  |  |
| <p>Royal poinciana gets 30-40 ft (9.1-12.2 m) tall, but its elegant wide-spreading umbrella-like canopy can be wider than its height.</p>  |  |   |
|   | <p>Royal poinciana has shallow, wide-spreading roots that will not allow under planting and the roots can be a threat to building foundations and sidewalks.. Seedlings will come up all around the tree. the pods are used for fuel and called "woman's tongue" because of the rattling noise they make when the wind blows them</p>  |   |

|   |  |  |
|---|--|--|
|    | <p><b><i>PELTOPHORUM PTEROCRUPUM(COPPER POD):</i></b><br/>Golden Flamboyant, Yellow Flamboyant, Yellow Flame Tree, Yellow Poinciana, <b>Perunkonrai</b> in Tamil</p> <p>Popular ornamental tree grown around the world.</p> <p>The trees can be planted for avenue trees alternately with <i>Delonix regia</i> (Gulmohur) to give a striking yellow and red effect in summer, as has been done on on <b>Hughes road</b> in <b>Mumbai</b>.</p> <p>Yellow Poinciana is a wonderful shade or specimen tree for a large landscape, especially when in full bloom, and it can make a street tree as long as it receives regular pruning to control its weedy,</p> |  |
| <p><b>Yellow Gulmohar</b></p>   |  |  |
|   | <p>Flowering season<br/>May through September<br/>Trees begin to flower after about four years</p>   |  |
| <p>The dark green, delicate, feathery leaflets provide a softening effect for the tree's large size and create a welcoming, dappled shade.</p> <p>The entire tree's canopy is smothered with a yellow blanket of flowers, appearing in showy, terminal panicles and exuding a delicious, grape-like perfume.</p> <p>The <u>wood</u> has a wide variety of uses, including cabinet-making and the foliage is used as a <u>fodder</u> crop</p> <p><b>Breakage:</b> susceptible to breakage ;weak and tends to break</p> <p><b>Plant only single-trunked trees along streets and other public areas to ensure a durable plant.</b></p> |  |  |

|  |  |   |
|--|--|---|
|  <p><b>Honey suckle</b><br/><i>Spathodea campanulata</i></p>  | <p><b><i>Spathodea campanulata</i>, <u>Bignoniaceae</u></b> commonly known as<br/><b>Fountain Tree,</b><br/><b>African Tulip Tree,</b><br/><b>Flame-of-the-forest,</b><br/><b>Rudra Palash, Pichkari or Nandi Flame</b></p> <p>It is a tree that grows between 7–25 m (23–82 ft) tall</p> <p>This tree is planted extensively as an <u>ornamental tree</u> throughout the tropics and is much appreciated for its very showy reddish-orange or crimson (rarely yellow), campanulate <u>flowers</u></p> |   |
|    | <p>The tree blooms in the month of <b>August and September</b> and last for a couple of weeks</p>  |  |
|   | <ul style="list-style-type: none"> <li>• As Food: The seeds are edible and used in many parts of Africa.</li> <li>• As Timber: In its original habitat, the soft, light brownish-white wood is used for carving and making drums.</li> <li>• As Poison: The hard central portion of the fruit is used to kill animals.</li> <li>• As Medicine: The bark has laxative and antiseptic properties, and the seeds, flowers and roots are used as medicine.</li> </ul>                                      |   |
| <ul style="list-style-type: none"> <li>• The bark is chewed and sprayed over swollen cheeks. The bark may also be boiled in water used for bathing newly born babies to heal body rashes.</li> <li>• <i>Spathodea campanulata</i> Beauv. is an important plant widely used in traditional medicine in Africa and the therapeutic uses include</li> <li>• aids, anti-inflammatory and hypoglycemic activities</li> <li>• The natural dye was obtained from different solvent extracts of <i>Spathodea campanulata</i> flowers.</li> </ul> |  |   |



## Sarakondrai

*Cassia fistula*, Fabaceae  
known as the **golden shower tree**

### MEDICAL USES:

In Ayurvedic medicine, golden shower tree is known as *aragvadha*, meaning "disease killer". The root is considered a very strong purgative, and self-medication or any use without medical supervision is strongly advised against in Ayurvedic texts.

State flower of Kerala in India ;

a popular ornamental plant and is an herbal medicine  
small tree with less branches

The flowers are of ritual importance in the Vishu festival  
of the Kerala state

the tree was depicted on a 20 Indian rupees stamp  
*Cassia acutifolia*, the pudding-pipe tree, furnishes the  
cassia pods of commerce.

The streets of old Delhi and the other parts of India can  
be seen with full bloom of thousands of golden yellow  
Amaltas



## Neem, *Azadirachta indica* Meliaceae

flowering in  
**May**



Indian Lilac



The tender shoots and flowers of the neem tree are eaten as a vegetable in India  
Neem leaves are dried in India and placed in cupboards to prevent insects eating the clothes and also while storing rice in tins.  
Neem leaves are dried and burnt in the tropical regions to keep away mosquitoes



fruits and seeds are the source of neem oil  
Flowering **April- May**

Neem products are believed by Ayurvedic practitioners to be anthelmintic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative.<sup>[6]</sup> It is considered a major component in Ayurvedic and Unani medicine and is particularly prescribed for skin diseases

### **1. Arali, *Nerium oleander*; Apocynaceae**



*Nerium oleander* is an evergreen shrub or small tree  
Oleander grows to 2–6 m (6.6–20 ft) tall, with spreading to erect branches.

The leaves are in pairs or whorls of three, thick and leathery, dark green, narrow lanceolate, 5–21 cm (2.0–8.3 in) long and 1–3.5 cm (0.39–1.4 in) broad, and with an entire margin.

The flowers grow in clusters at the end of each branch; they are white, pink, red or yellow, 2.5–5 cm (0.98–2.0 in) diameter, with a deeply 5-lobed corolla with a fringe round the central corolla tube.



Oleander grows well in warm subtropical regions, where it is extensively used as an ornamental plant in landscapes, parks, and along roadsides.

It is drought tolerant

Mainly grown on road to avoid overview by drivers of vehicles and to reduce road hurdles as in tree branch breakings

**Annexure II Model Format for reporting on Sub-Project ESMF Compliance**

*(Implementation of Environmental and Social Management measures)*

1. 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.
2. 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.

|  |               |  |                                   |
|--|---------------|--|-----------------------------------|
| <b>Sub-Project Name :</b>  |               | <b>Loan / Disbursement No :</b>              |                                   |
| <b>Borrower:</b>   |               | <b>PMC Consultant :</b>                      |                                   |
| <b>Date of commencement:</b>   |               | <b>Date of completion:</b>                   |                                   |
| <b>Period of reporting:</b>  |               |  |                                   |
| <b>Total Package:</b>  |               | <b>Reporting Package:</b>                    |                                   |
| <b>Nature of work/ component:</b>  |               |  |                                   |
| <b>Contractor:</b>   |               |  |                                   |
| <b>Environmental Category:</b>   |               | <b>Social Category:</b>                      |                                   |
| <b>Project Stage/Phase :</b> (Pre- Construction /Construction/Operation) Please select appropriate phase |               |  |                                   |
| <b>I Environmental Aspects</b>   |               |  |                                   |
| <b>A. Environmental Permissions</b>  | <b>Status</b> | <b>Cost (in Rs.)<br/>if any/<br/>Remarks</b> | <b>Remarks<br/>Responsibility</b> |



|   |                    |  |   |
|---|--------------------|--|---|
| Tree Cutting  |                    |  |   |
| Others, if any  |                    |  |   |
| <b>B. Management measures</b>   | <b>Implemented</b> |  | <b>Responsibility</b><br>(COC/PMC/<br>Contractor/Other) |
| a. Environmental screening/ Site evaluation   |                    |  |   |
| b. Public consensus status, meetings etc  |                    |  |   |
| c. Utility relocation   |                    |  |   |
| 1.  |                    |  |   |
| 2.  |                    |  |   |
| d. Labour Camps   |                    |  |   |
| 1 Temporary shelters (construction and clearing/restoration plan/Engineer permission) |                    |  |   |
| 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 /construction equipments  |  |  |
| ▪ First Aid  |  |  |
| ▪ Safety appliances  |  |  |
| e. Storage of construction materials   |  |  |
| <b>C. Protection of environment and sensitive receptors (residential areas, schools, hospitals, etc)</b> |  |  |
| <b>1. Air Environment</b>  |  |  |
| a. Dust from construction activities   |  |  |
| b. Vehicular emissions during construction   |  |  |
| <b>2. Water Environment</b>  |  |  |
| 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 overs with WS  |  |  |
| 2 alternate arrangements for temporary supply disruptions  |  |  |
| <b>3.Noise Environment</b>   |  |  |
| a. Vehicular noise   |  |  |
| b. Noise from construction activities  |  |  |
| <b>4. Biological Environment</b>   |  |  |
| a. Tree cutting – Target/ Progress   |  |  |

|  |  |  |
|--|--|--|
| b. Compensatory plantation – Target/ Progress                          |  |  |
| c. Protection of existing flora and fauna                              |  |  |
| <b>5. Soil/Land</b>  |  |  |
| a. Top soil protection   |  |  |
| b. Disposal of excavated material/<br>construction debris              |  |  |
| c. Fuel and lubricants – spillage and disposal                         |  |  |
| <b>6. Archaeological Property encountered</b>                          |  |  |
| <b>7. Monitoring Plan (to compare with pre<br/>project parameters)</b> |  |  |
| a. Air Quality   |  |  |
| b. Water quality   |  |  |
| c. Noise   |  |  |
| d. Soil quality  |  |  |
| <b>8. Other Issues encountered</b>                                     |  |  |
| 1. Details of any objections and status                                |  |  |
| 2. Any incidents and status  |  |  |
| 3. Any other   |  |  |

|                           |
|---------------------------|
| <b>II. Social Aspects</b> |
|---------------------------|

| Status of R&R activities           | Target | Achievement till previous month | Progress during this month | Cumulative | Remarks |
|------------------------------------|--------|---------------------------------|----------------------------|------------|---------|
| 1. Payment of compensation to PAFs |        |                                 |                            |            |         |
| <b>Location 1</b>                  |        |                                 |                            |            |         |
| Location 2                         |        |                                 |                            |            |         |
| Location 3                         |        |                                 |                            |            |         |
| Location 4                         |        |                                 |                            |            |         |
| 2. Resettlement details            |        |                                 |                            |            |         |
| Location 1                         |        |                                 |                            |            |         |
| Location 2                         |        |                                 |                            |            |         |
| Location 3                         |        |                                 |                            |            |         |
| Location 4                         |        |                                 |                            |            |         |

)

