Initial Environmental Examination

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IND: Tamil Nadu Urban Flagship Investment Program – Tiruchirappalli Underground Sewerage System

Prepared by Tiruchirappalli City Corporation of Government of Tamil Nadu for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 22 December 2017)

Currency Unit	–	Indian rupee (₹)
₹1.00	–	$0.0156
$1.00	=	₹64.0300

ABBREVIATIONS

ADB	–	Asian Development Bank
ASI	–	Archaeological Survey of India
CMSC	–	Construction Management and Supervision Consultant
CPCB	–	Central Pollution Control Board
CTE	–	consent to establish
CTO	–	consent to operate
EAC	–	Expert Appraisal Committee
EHS	–	Environmental, Health and Safety
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
ESS	–	Environmental and Social Safeguards
ESZ	–	Eco Sensitive Zone
GRC	–	grievance redress committee
GRM	–	grievance redress mechanism
GOI	–	Government of India
GoTN	–	Government of Tamil Nadu
IEE	–	Initial Environmental Examination
MOEFCC	–	Ministry of Environment, Forest and Climate Change
NOC	–	No Objection Certificate
PIU	–	Project Implementation Unit
PMU	–	Project Management Unit
ROW	–	right of way
SIDCO	–	Small Industries Development Corporation
SPS	–	Safeguard Policy Statement
STP	–	Sewage Treatment Plant
TCC	–	Tiruchirappalli City Corporation
TNPCB	–	Tamil Nadu Pollution Control Board
TNUFIP	–	Tamil Nadu Urban Flagship Investment Program
TNUIFSL	–	Tamil Nadu Urban Infrastructure Financial Services Limited
TWADB	–	Tamil Nadu Water and Drainage Board
ULB	–	urban local body
WHO	–	World Health Organization
WTP	–	water treatment plant

WEIGHTS AND MEASURES

°C	degree celsius
km	kilometre
lpcd	litre per capita per day
m	metre
Mgd	million gallons per day
ml	millilitre

Mld	million litres per day
mm	millimetre
nos.	numbers
km^2	square kilometer

NOTE

In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

1. The Tamil Nadu Urban Flagship Investment Program (TNUFIP) will advance India's national urban flagship programs to develop priority urban and environmental infrastructure in ten cities located within strategic industrial corridors of Tamil Nadu (the State), including those within the East Coast Economic Corridor (ECEC), to enhance environmental sustainability, climate resilience, and livability. It will also strengthen the capacity of state and local institutions and improve urban governance. TNUFIP is aligned with the following impact: urban livability and climate resilience in cities of economic importance improved. TNUFIP will have the following outcomes: smart and climate resilient urban services delivered in ten cities in priority industrial corridors.

2. The TNUFIP is structured under three outputs: (i) sewage collection and drainage improved and climate-friendly sewage treatment systems introduced, (ii) access to reliable and smart drinking water services improved, and (iii) Institutional capacity, public awareness, and urban governance strengthened. TNUFIP will be implemented over an 8-year period beginning in 2018, and will be funded by Asian Development Bank (ADB). via its multitranche financing facility (MFF).
3.

4. **The Subproject.** Tiruchirappalli is one of the largest cities in the state of Tamil Nadu, located on the Chennai – Dindigul National Highway (NH - 45). It is situated in the center of the state, on the banks of the Cauvery River. In this subproject to be implemented under the ADB funded TNUFIP, it is proposed to provide underground sewerage system in the presently uncovered areas core part of Tiruchirappalli City, and in also it its extended area. These areas are located in eastern part of the Tiruchirappalli City Corporation (TCC). Subproject includes the following civil works components: (i) sewage collection system (312.217 kilometre (km) length of sewers and 12,109 manholes), (ii) 24 nos. of lift stations, (iii) 5 nos. of pump stations, (iv) 24 km length pumping main sewers, (v) new sewage treatment plant (STP) of 30 million litres per day (MLD) capacity at Keelakalkandar kottai, (vi) rehabilitation of existing 37 MLD STP at Panjapur, and (vii) 44,569 house service connections. Treatment facility is proposed under design-build-operate-transfer (DBOT) contract, and therefore at present STP design is preliminary.

5. **Project implementation arrangements**. The Municipal Administration and Water Supply Department (MAWS) of Government of Tamil Nadu acting through the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) is the state-level executing agency. A project management unit (PMU) will be established in TNUIFSL headed by a Project Director and Deputy Project Director (senior official from Commissionerate of Municipal Administration, CMA), and comprising dedicated full-time staff from TNUIFSL for overall project and financial management. The implementing agencies are project urban local bodies (ULBs). TCC is the Implementing Agency for this subproject. A project implementation unit (PIU) will be established in TCC headed by a full-time Project Manager (Executive Engineer or above) and comprising dedicated full-time staff of the TCC for day-to-day implementation of the subproject. PIU is assisted by Construction Management and Supervision Consultant (CMSC) in implementation. Environmental and Social Safeguards (ESS) Managers in PMU/TNUIFSL will coordinate all the safeguard related activities of the subproject and will ensure the compliance with environmental management plan (EMP) and EARF. Environmental Specialist of the CMSC will assist PIU in implementation of subproject in compliance with EMP and EARF, and will carry out all necessary tasks.

6. **Screening and assessment of potential impacts**. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for

environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. As per the Government of India (GoI) Environmental Impact Assessment (EIA) Notification, 2006, this subproject do not require EIA study or environmental clearance. The potential environmental impacts of the subproject have been assessed using ADB Rapid Environmental Assessment (REA) Checklist for Sewerage. The potential negative impacts were identified in relation to pre-construction, construction and operation.

7. **Categorization.** Based on results of the assessment and ADB Safeguard Policy Statement (SPS), 2009, the subproject is classified as environmental Category B, i.e., subproject potential adverse environmental impacts are less adverse than those of category A, and are site-specific, and in most cases mitigation measures can be designed more readily than for category A projects . An initial environmental examination (IEE) is required.

8. **Description of the Environment.** Subproject components are located in Tiruchirappalli City, an urban area surrounded by land that was converted for agricultural use many years ago. Sewer lines will be laid in the public roads, within the road carriage way, and pumping/lifting stations will be constructed on identified government owned vacant land parcels, in or close to residential areas. Tiruchirappalli is bound on the north by Namakkal District, northeast by Perambalur District, east by Thanjavur District, southeast by Pudukottai District, south by Sivaganga and Madurai Districts, southwest by Dindigul District and on the west by Karur District. The city is known for its educational institutions, industries and temples, and is a commercial and tourist hub of Tamil Nadu. The most prominent landmark is the Archaeological Survey of India (ASI) protected Rock Fort Temple and Erumbeeswarar Temple. No components are located within the boundary of the protected monument, however, sewer network proposed in the surrounding residential areas fall within the 300 m regulated zone of Erumbeeswarar Temple, and will require prior permission from National Monument Authority (NMA) to conduct the works.

9. **Potential environmental impacts and mitigation measures.** The subproject is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented because: (i) the components will involve straightforward construction and operation, so impacts will be mainly localized; (ii) there are no significant sensitive environmental features in the project sites although careful attention needs to be paid to minimizing disruption to population of urban area and (iii) predicted impacts are site-specific and likely to be associated with the construction process and are produced because the process is invasive, involving excavation and earth movements. Subproject includes construction of new 30 MLD STP. Considering the following no significant impacts envisaged (i) the location of STP away from the habitations, (ii) design of treatment process to treat wastewater to meet disposal standards, and, (iii) disposal of treated wastewater into an irrigation channel, in which at present untreated wastewater from subproject areas is discharged, no significant impacts due to STP envisaged.

10. In this IEE, negative impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant. Sewage pumping and lifting stations, which collect sewage and pump to an higher elevation pump station or to the STP, are likely to generate odor. Lifting stations are comparatively small, handle low volumes of sewage, and therefore odor nuisance is limited. Although utmost care is taken to locate pumping and lifting stations away from the houses, due to design considerations and land constraints, some sites are located close to the houses. Another impact is that of STP operation: from malfunction or decrease in treatment efficiency and sludge handling and disposal. This will result

in release of untreated or partially treated wastewater that will pollute environment and cause public health issues. Accumulation of silt in sewers in areas of low over time, overflows, blockages, power outages, harmful working conditions for the workers cleaning sewers etc. may create nuisance, unhealthy and hazardous conditions.

11. From the STP, it is proposed to dispose treated wastewater into Uyyakondan channel, flowing at 2.7 km from the STP site. This is a major irrigation channel, taking off from Cauveri River at Kulathalai Kattnali, upstream of Tiruchirappalli, and flows about 40-50 km prior to reaching the city, and then flows through the centre of Tiruchirappalli city for about 18 km, carrying storm water, and wastewater from the unsewered city areas. It finally discharges into Valavandhan kottai pond/tank at Thuvakudi, about 20-22 km from the proposed STP discharge point. Channel water is used for only irrigation. No water quality data available at present, however, channel mostly carries wastewater within the city, and therefore existing quality likely to be poor except during upstream flow. Baseline water quality of channel will be established during the detailed design phase. Discharge from STP will be properly treated to meet the disposal standards, and therefore no notable impacts envisaged on channel water quality. This open channel flows for another 20-22 km downstream, allowing further dilution via self-purification prior to reaching the tank/pond. .Pond water is used only irrigation. Wastewater is treated to set standards at the STP prior to its disposal into Uyyakondan channel. Considering the existing status of channel, and the degree of treatment and self-purification via 20-22 km turbulent flow in open channel, no significant impacts envisaged. Proper systems should be put in place at the proposed STP to ensure that treated wastewater at all times meet the stipulated standards prior to its disposal into this channel

12. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result significant measures have already been included in the designs for the infrastructure. Various design related measures suggested for: STP treatment process design to meet disposal standards, ensuring efficient treatment, odor control including: appropriately locating sewage wells within site as far as away from the houses; developing tree cover; enclosed facilities; gas collection and treatment facilities, and design and operation measures to prevent odor build up; standard operating procedures for operation and maintenance; imparting necessary training; safety and personal protection equipment for workers, etc., For the existing STP, proposed rehabilitation works will ensure that wastewater is properly treated to meet disposal standards prior to its disposal.

13. Potential impacts during construction are considered significant but temporary, and are common impacts of construction in urban areas, and there are well developed methods to mitigate the same. Except sewer works, all other construction activities (lifting and pumping stations) will be confined to the selected sites, and the interference with the general public and community around is minimal. In these works, the temporary negative impacts arise mainly from construction dust and noise, hauling of construction material from the existing government licensed mining areas, waste and equipment on local roads (traffic, dust, safety etc.,), mining of construction material, occupation health and safety aspects. Sewer works will be conducted along public roads in an urban area congested with people, activities and traffic. Therefore sewer works may have adverse, but temporary, impacts arising mainly: from the disturbance of residents, businesses and traffic due to construction work; safety risk to workers, public and nearby buildings due to deep trench excavations in the road; access impediment to houses and business, disposal of large quantities of construction waste, etc. These are all general impacts of construction in urban areas, and there are well developed methods of mitigation that are suggested in the EMP.

14. **Environmental Management Plan.** An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels, along with the delegation of responsibility to appropriate agency. As stated above, various design related measures are already included in the project design. During construction, the EMP includes mitigation measures such as (i) selection of construction methodology near protected monuments in discussion with the ASI, having the excavation observed by person with archaeological knowledge for chance finds, etc., (ii) proper planning of sewer works to minimize the public inconvenience (iii) barricading, dust suppression and control measures (iv) traffic management measures for works along the roads and for hauling activities; (v) provision of walkways and planks over trenches to ensure access will not be impeded; and (vi) finding beneficial use of excavated materials to extent possible to reduce the disposal quantity. EMP will guide the environmentally-sound construction of the subproject. EMP includes a monitoring program to measure the effectiveness of EMP implementation and include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

15. The EMP is included in the bid and contract documents to ensure compliance with the conditions set out in this document. The contractor will be required to submit to PIU, for review and approval, a site environmental management plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; and (iii) monitoring program as per EMP. No works are allowed to commence prior to approval of SEMP. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times.

16. **Consultation, disclosure and grievance redress mechanism.** The stakeholders were involved in developing the IEE through discussions on-site and a public consultation workshop at city level, after which views expressed were incorporated into the IEE and in the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the ADB, TCC and TNUIFSL websites. The consultation process will be continued during project implementation as required. A grievance redress mechanism (GRM) is described within the IEE to ensure any public grievances are addressed quickly.

17. **Monitoring and Reporting.** Contractor will submit a monthly EMP implementation report to PIU. PIU, with the assistance of TCC, will monitor the compliance of Contractor, prepare a Quarterly Environmental Monitoring Report and submit to PMU. The PMU will oversee the implementation and compliance, and will submit semi-annual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website. Monitoring reports will also be posted on TCC and TNUIFSL websites

18. **Conclusions and Recommendations.** Therefore, as per ADB SPS, this subproject is classified as environmental category B and does not require further environmental impact assessment. To conform to government guidelines, STPs requires consent to establish (CTE) and consent to operate (CTO) from Tamil Nadu Pollution Control Board (TNPCB), which shall be obtained for both the new and the proposed rehabilitation of existing STP prior to construction and operation, respectively. For works located within the regulated zone of the protected monument (within 300 m boundary), prior permission as applicable shall be obtained from National Monument Authority prior to construction. This IEE is prepared based on the preliminary design, and shall be updated by PIU during detailed design phase to reflect final project design and will be reviewed and approved by PMU. The updated IEE will be submitted to ADB for concurrence and disclosure.

I. INTRODUCTION

A. Background

1. The Tamil Nadu Urban Flagship Investment Program (TNUFIP) will advance India's national urban flagship programs to develop priority urban and environmental infrastructure in ten cities located within strategic industrial corridors of Tamil Nadu (the State), including those within the East Coast Economic Corridor (ECEC), to enhance environmental sustainability, climate resilience, and livability. It will also strengthen the capacity of state and local institutions and improve urban governance.

2. TNUFIP will be implemented over an 8-year period beginning in 2018, and will be funded by Asian Development Bank (ADB). via its multitranche financing facility (MFF). The executing agency is the Department of Municipal Administration and Water Supply (MAWS) of the State acting through the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL) who will establish a program management unit (PMU). The urban local bodies (ULBs) will be the implementing agencies for projects and will establish program implementing units (PIU).

3. TNUFIP is aligned with the following impact: urban livability and climate resilience in cities of economic importance improved. TNUFIP will have the following outcomes: smart and climate resilient urban services delivered in ten cities in priority industrial corridors. The TNUFIP is structured under following three outputs:

(i) **Output 1: Sewage collection and drainage improved and climate-friendly sewage treatment systems introduced.** This will include: (i) new (179 million liters per day [MLD]) and rehabilitated sewage (175 MLD) treatment capacity developed with solar power for operations installed on a pilot basis; (ii) reuse of treated sewage water for industrial purposes in selected areas; (iii) new and improved sewage collection pipelines (2,810 kilometers [km]) constructed with 100% household connections made (426,600 household connections); (iv) 173 new sewage pumping stations of 6,390 kilowatts (KW) capacity added; (v) 20 community water and sanitation committees formed with female participation; and (vi) climate resilient drainage and flood management systems established (250 km tertiary and 50 km primary and secondary).

(ii) **Output 2: Access to reliable and smart drinking water services improved.** This will include: (i) smart water supply distribution systems (1,520 km pipelines) established within 110 new district metered areas to reduce NRW and provide regular water supply with 100% household connections (171,000 household connections); (ii) new transmission mains (120 km); (iii) 30 number of pump houses of 1,530 KW capacity; and (iv) new water storage reservoirs (40 reservoirs totaling 70 million liters). The TNUFIP will scale up smart water pilots in Chennai under TA-9048 to reduce nonrevenue water levels and optimize operational efficiency through the latest technologies in smart metering and digital diagnostic tools.

(iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This will include: (i) establishing a new state-level Urban Data and Governance Improvement Cell in the Commissionerate of Municipal Administration (CMA); (ii) establishing a new Project Design and Management Center in CMA; (iii) introducing and implementing a state-wide performance-based urban governance improvement program for all 135 cities in Tamil Nadu to improve financial management, revenues, administration, service delivery, gender and social inclusion, and wastewater

reuse and fecal sludge management; and (iv) implementing public awareness campaigns in areas of water conservation, sanitation, and hygiene in 10 project cities. Project design consultants (PDC) will be recruited to prepare new projects meeting ADB requirements.

4. **Scope of Project 1.** Tranche 1 is representative of MFF investments and will support subprojects in 6 cities (Chennai, Coimbatore, Rajapalayam, Tiruchirappalli, Tirunelveli, and Vellore). Outputs of tranche 1 include:

(i) **Output 1: Sewage collection and drainage improved and climate-friendly sewage treatment systems introduced.** This includes: (i) 5 new STPs of 153 MLD treatment capacity including one STP with 2 megawatts (MW) solar-power installation for operations; (ii) 2 rehabilitated STPs of 61 MLD capacity; (iii) 8,000 cubic meter (m3) per day of treated wastewater reused; (iv) 1,860 km of new sewage collection pipelines with 100% household connections; (v) 124 new pump/ lift stations of 4,470 KW capacity; and (vi) 297,500 new household sewer connections. The breakdown by city is as follows: (i) sewage collection system with new 32 MLD STP and one rehabilitated 24 MLD STP in Tirunelveli with treated effluent supplied for industrial reuse; (ii) sewage collection system with new 2 MW solar-powered 30.53 MLD STP in Coimbatore; (iii) sewage collection system with new 30 MLD STP and one rehabilitated 37 MLD STP in Tiruchirappalli; (iv) sewage collection system with new 50 MLD STP in Vellore; (v) sewage collection system in four areas of Chennai; and (vi) sewage collection with new 10 MLD STP in Rajapalayam, and 12 community water and sanitation committees formed with female participation.

(ii) **Output 2: Access to reliable and smart drinking water services improved.** This will support 4 areas of Chennai with the following: (i) 275.6 km of smart water supply distribution pipes in 20 newly established district metered areas to manage and reduce NRW connected to computerized control and data acquisition systems; (ii) 30,800 household metered connections; (iii) 11 km of new transmission pipes; (iv) 9 new storage reservoirs (4 underground and 5 overhead) of 11 million liters capacity; and (v) 5 pump stations of 230 KW capacity.

(iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This will include: (i) establishing a new state-level Urban Data and Governance Improvement Cell in the CMA; (ii) establishing a new Project Design and Management Center in the CMA; (iii) introducing and implementing a state-wide performance-based urban governance improvement program for all 135 cities under CMA to improve financial management (audited accounts), municipal revenues (taxes, user fees), administration (filling vacancies), and gender mainstreaming (gender equality social inclusion plan implementation); and (iv) implementing public awareness campaigns in areas of water conservation, sanitation, and hygiene. The PDC will be recruited for preparing projects in subsequent tranches.

5. Tiruchirappalli City has an existing underground sewerage scheme covering part of the core (old) city area. TCC has recently implemented Tiruchirappalli-Srirangam sewerage scheme, under the National River Conservation Project (NRCP) grant, to cover part of core area. A considerable portion of the core city area is still unsewered, along with the added areas and poses significant health risk and pollution by way of sewage discharge into low-lying area and water bodies including the Cauvery and Coleroon rivers. It is therefore proposed to provide a sewer system in the presently uncovered area of TCC under the ADB funded TNUFIP. Proposed

subproject includes: (i) sewage collection system (312.217 kilometre (km) length of sewers and 12,109 manholes), (ii) 24 nos. of lift stations, (iii) 5 nos. of pump stations, (iv) 24 km length pumping main sewers, (v) new sewage treatment plant (STP) of 30 million litres per day (MLD) capacity at Keelakalkandar kottai, (vi) rehabilitation of existing 37 MLD STP at Panjapur, and (vii) 44,569 house service connections.

B. Purpose of this Initial Environmental Examination Report

6. ADB requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for environmental assessment are described in ADB's Safeguard Policy Statement (SPS), 2009. The potential environmental impacts of the subproject have been assessed using ADB Rapid Environmental Assessment (REA) Checklist for Water Supply (Appendix 1). Then potential negative impacts were identified in relation to pre-construction, construction and operation of the improved infrastructure, and results of the assessment show that the subproject is unlikely to cause significant adverse impacts that are irreversible, diverse or unprecedented. Thus, this initial environmental examination (IEE) has been prepared in accordance with ADB SPS's requirements for environment category B projects.

7. This IEE is based on the detailed project report prepared by TCC. The IEE was based mainly on field reconnaissance surveys and secondary sources of information. No field monitoring (environmental) survey was conducted, however, the environmental monitoring program developed as part of the environmental management plan (EMP) will require the contractors to establish the baseline environmental conditions prior to commencement of civil works. The results will be reported as part of the environmental monitoring report and will be the basis to ensure no degradation will happen during subproject implementation. Stakeholder consultation was an integral part of the IEE.

C. Report Structure

8. This Report contains the following ten (10) sections including the executive summary at the beginning of the report:

(i) Executive summary;
(ii) Introduction;
(iii) Description of the project;
(iv) Policy, legal and administrative framework;
(v) Description of the environment;
(vi) Anticipated environmental impacts and mitigation measures;
(vii) Public consultation and information disclosure;
(viii) Grievance redress mechanism;
(ix) Environmental management plan; and
(x) Conclusion and recommendation.

II. DESCRIPTION OF THE PROJECT

A. Project Area

9. Tiruchirappalli is one of the largest cities in the state of Tamil Nadu, located on the Chennai – Dindigul National Highway (NH - 45). It is situated in the center of the state, on the banks of Cauvery River (Figure 1), which runs west to east along the northern periphery of the city. Tiruchirappalli City, spreading over an area of 146.90 square kilometre (km^2), was upgraded from Special Grade Municipality to Corporation in the year 1994. Srirangam, a small island situated in Cauvery River, and is part of the city. In 2011, the corporation limit was expanded eastwards to

include adjoining local bodies (four village panchayats of Paappakurichi , Ellakudi, Aalathur and Keelkalkandar Kottai, and Thiruverumbur Town Panchayat), and corporation area increased by 20.33 km^2 to 167.23 km^2. TCC has a population of 916,674 (census 2011) and 65 municipal wards, grouped into four administrative zones: Srirangam, Ariyamangalam, Golden Rock and K. Abishekapuram.

10. The city has prepared a sewage master plan which proposes to extend the existing underground sewage system (UGSS) to cover all the zones, though a four phase program. Phase one has already been completed, so the ADB supported TNUIP will focus on Phase II, which includes recently added areas in the eastern area and remaining uncovered areas in the core city area. The new UGSS will include piped reticulation, pump/ lift stations and additional treatment capacity through construction of a 30 MLD STP in Keelakalkandar Kottai and improvements to the existing STP in Panjappur located on the Tiruchirappalli – Madurai highway. The project area under TNUFIP has been divided into 13 sewerage zones based on contour levels, and hierarchy of the drain system and their tentative locations arrived at for designing the most cost effective system. The proposed sewage collection system, to the extent possible, has been proposed to convey sewage by gravity.

B. Existing Sewerage System

11. The existing UGSS covers most of the higher density old town areas with gravity collection and pumping to the waste stabilization ponds STP at Panjappur on the southern periphery of TCC with effluent discharged to Koraiyar River and ultimately to the Cauvery River. Sewage from the uncovered areas within TCC limits is discharged to open drains which ultimately discharge into the network of channels including the Uyyakondan, Koraiyar and Thirumanjana Cauvery which finally empty into the Cauvery and Coleroon Rivers. A small capacity treatment pond, spread over 10 acre of land and of approximate capacity 2.5 MLD, at Panjakarai on Srirangam island discharges effluent to Coleroon River (the northern branch of Cauvery River that skirts Srirangam on the north). Details of sewerage schemes implemented till date in TCC are presented below:

(i) **Srirangam UGSS Scheme (1956)**. Srirangam (erstwhile municipality) was the first area to be provided with UGSS in 1956. Gravity UGSS with three pump stations were constructed in the then developed areas. Sewage was conveyed to the sewage pond at Panjakarai.

(ii) **Tiruchi UGSS Scheme (1987)**. The next UGSS scheme was implemented during 1987-1992 covering the high density areas,. covering seven (7) blocks constituting the core area of current TCC. Sewage was conveyed through a network of pumping stations to the main pumping station at Promenade Road and from there, to the lagoons/ STP at Panjappur, about 7 km south of City along the Tiruchirappalli – Madurai - Tuticorin Highway (NH-45B).

(iii) **National River Action Plan (NRAP) Scheme (1995/1996)**. Under this Government of India scheme, intervention measures for abatement of pollution of Cauvery River was implemented in Tiruchirappalli. Interceptor collectors in major open drains within the city limits were constructed and sewage pumped the waste stabilization pond (WSP) based STP at Panjappur for treatment and disposal.

(iv) **UGSS Augmentation Scheme under National River Conservation Plan (NRCP), 2008.** Under this GoI scheme, augmentation of the UGSS commenced in 2003 and was completed in 2008.This scheme essentially covered old town area of Srirangam, Golden Rock zone (erstwhile Golden Rock Municipal area also known as “Ponmalai” and subsequently merged into TCC) and areas in Tiruchirappalli. The island of Srirangam was fully covered, with a network of sub-

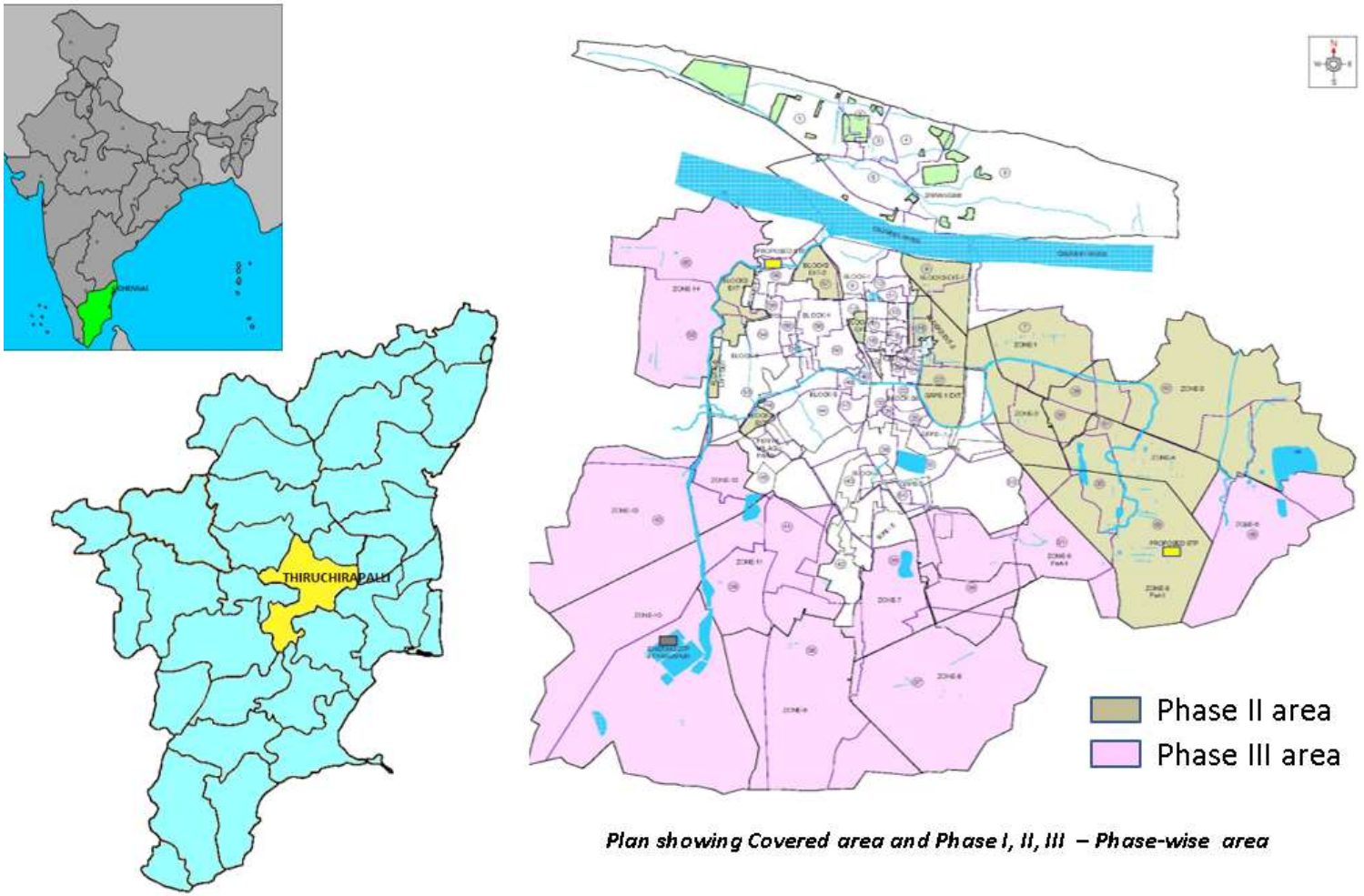
pumping stations (5 nos.) and lift stations (6 nos.) which were needed due to sub-surface conditions, sandy with high groundwater table, which precluded laying of sewers at depths greater than 3 m. Sewage from Srirangam is pumped across Cauvery River along Chennai – Dindigul National Highway (NH45) to the Golden Rock Pump Station (GRPS-1) in the city. Sewage from areas in the city is conveyed to GRPS – 2 along the National Highway 45 By-Pass Road. Sewage from both the aforementioned GRPS is conveyed through individual pumping mains to the MPS – II at Anna Stadium and ultimately to the STP at Panjappur.

12. Overall, at present, about 31 percent of total TCC area is covered with sewerage system, which serve about 52 percent of the total TCC population. The city, situated on the south bank of Cauvery River, comprises a network of storm water drains and channels which convey runoff and partially treated wastewater and discharge into water bodies. City is prone to flooding during monsoon season due to flash floods in Cauvery and Coleroon rivers. Increasing urbanization from regional industrial growth and expansion of city limits by inclusion of adjoining sub-urban and rural local bodies has further increased the demand for proper UGSS service. The zones which require UGSS coverage are as follows: (i) East Zone – Ariyamangalam east and north-east of the core town area, (ii) West Zone – K. Abhisekapuram west and south of the core town area, and (iii) South Zone – Golden Rock to south and south-east of core town area.

13. The sewage master plan of TCC includes three remaining phases for UGSS expansion as follows: Phase II – East Zone; Phase III – West Zone, and Phase IV – South Zone. It is proposed that Phase II and III will be implemented under TNUFIP, with Phase II implemented under Tranche 1, and Phase III in subsequent tranches. Phase IV is not yet planned. This subproject therefore focuses on Phase II, and includes provision of UGSS to the East Zone (Ariyamangalam) comprising, presently uncovered areas in the Old City, and extended areas in the eastern part of the city. The overall coverage, in terms of population, by Phase II completion will be about 75%. The balance 25% will be covered under Phases III and IV.

14. **Existing situation in subproject area (East Zone)**. At present in east zone, sanitation is based on septic tanks and sullage/ soak pits. During the monsoon season the capacity of these on site facilities is exceeded causing sullage and septic tank overflow to enter open drains that discharge into the Uyyakondan channel that skirts the southern periphery of the Eastern Zone areas. This is an irrigation channel, and also acts as a major storm water drain traverses the entire width of TCC towards the eastern boundary and ultimately discharges into Vallavandhan Kottai Pond. Additionally, low-lying high density areas in the city town area also discharge untreated sewage to Koraiyar river. Therefore, TCC has identified the wards in the eastern zone (Ariyamangalam) and un-serviced areas of the old city as high priority areas to be covered by UGSS through this Phase II scheme in order to abate pollution of major channels and Cauvery River.

Figure 1: Location of Subproject



Plan showing Covered area and Phase I, II, III – Phase-wise area

C. Proposed Project

15. This subproject shall provide sewerage system in east zone (phase II) which covers all areas in Ariyamangalam Zone and omitted areas in the old city area of TCC. Collection system for Phase-II has been divided into thirteen (13) sewer sub-zones: 1 to 6 are in the Ariyamangalam Zone (added areas and areas located in east zone) and the balance 7 comprise old city area. Sewer sub-zoning is done for design of the collection system to maximize gravity flow. Collection / command area of the sewer sub-zone is designed to be collected at a sewage pumping station (SPS) if gravity collection is not feasible. Intermediate pumping to avoid significant depth of excavation or to provide sewerage in low-lying or counter-sloped areas has been achieved using lift stations. System is designed as a separate underground system catering only to domestic wastewater; storm runoff generated during rains will be carried by existing open drains and dispose into natural streams / water bodies. Industrial wastewater will not be disposed into sewers. System is designed for 110 liters per capital per day, based on sewage generation rate of 80% of water supply. System is design with gravity flow as far as possible, however topography do not permit a complete gravity system from collection to inlet at the STP, and therefore wherever required sewage lifting and pumping stations introduced to optimize the system design.

16. Following Table shows the nature and size of the various components of the subproject. Location of subproject components and conceptual layout plans are shown in Figure 2 to Figure 6.

D. Implementation Schedule

17. Contract will be awarded by May-June 2018. Construction is likely to start in June 2018, and will take about 36 months to complete. The detailed implementation schedule (including design/pre-construction, construction, commissioning, and operation phases) will be provided in the updated IEE per detailed design.

Table 1: Proposed Subproject Components

Infrastructure	Function	Description	Location
Sewer network	Collect wastewater from houses and convey by a combination of gravity and pressure pumping to the STP	312.217 km - *200-1000 mm diameter sewers* - 244. 299 km uPVC pipes - 49.899 km DWC pipes - 18.019 km CI pipes **Manholes** 12,109 nos. (brickwork & reinforced cement concrete) Minimum distance between manholes of 30 m is adopted for sewer size up to 400 mm and larger spacing up to 100 m for large diameter sewers. Manholes type and sizes are as follows: For depths up to 2.5 m (Rectangular) • Up to 1.2m depth – 0.75m x 1.20m • Up to 2.5m depth – 0.90m x 1.50m For depths above 2.5 m (Circular) • Upto 6.0m depth – 1.5m diameter • Above 6.0m depth – 1.8m diameter	Sewers will be laid underground in the roads and internal streets in the project area comprising 13 sewerage sub-zones (Ariyamangalam Zone - 6 nos.; and omitted areas in Old Town - 7 nos.). Sewer lines will be laid in the centre of road by cutting black top, within the road right of way. In wider roads, like SH, NH, divided 2-way roads etc., sewers will be laid in the service roads, and where service roads are unavailable, will be laid along the edge of the road, but mostly within the black top portion. For the roads where adequate land in the road shoulder is available along the blacktop and is clear of any structures or activities, pipes will be laid in this earthen shoulder. Large diameter pipes will be laid mostly on main roads (300 – 1000 mm), while the tertiary sewers of small size (200 mm to 300 mm dia) that collect wastewater from each house will be laid in all streets in the subproject area. Trench size to bury the sewer will be of 0.8 m to 1.6 m wide and 1.2 m to 5 m deep (6 m in small terminal stretches near pump stations) For manholes, an area of 1.5 mx1.5m to 2.5m x 2.5m will be excavated
Sewage lift stations (LS)	Lifting station is a small pumping station to lift the sewage to higher level and discharge into a ridge manhole for transporting to the pumping station. Lifting station has a collection well	24 nos. *Components of LS* • Lift well (circular) • Non-clog submersible pump sets • Control panel box *Lift stations are essentially proposed as enlarged manholes (either road-side on available land or on road center by enlarging a collection system manhole) fitted with two sewage pumps (small capacity) and a curb or road-side wall mounted Pump Control Panel.*	Lift well will be constructed on the road (like manhole) where the sewer ends terminates into the lift well. Pumps will be installed in the well, and a control panel box will be installed near the well. Lift stations are proposed at following locations:

<table>
<tr><th>Infrastructure</th><th>Function</th><th>Description</th><th>Location</th></tr>
<tr><td></td><td>with submersible pumps accommodated inside. The screen arrangement is provided in the previous manhole to the lift station.</td><td></td><td>
<table>
<tr><th>S. No</th><th>Zone</th><th>Lifting Station Location</th></tr>
<tr><td>1</td><td>1</td><td>(Arimangalum) Arputha Sami Puram</td></tr>
<tr><td>2</td><td rowspan="2">2</td><td>Anjanayar Kovil Street</td></tr>
<tr><td>3</td><td>Diamond Layout</td></tr>
<tr><td>4</td><td rowspan="5">3</td><td>Raja Veethi</td></tr>
<tr><td>5</td><td>Papakurichy Village</td></tr>
<tr><td>6</td><td>Mahalaxmi Nagar Extn</td></tr>
<tr><td>7</td><td>Meenaxi Nagar,S.A.S. Nagar</td></tr>
<tr><td>8</td><td>Lakshmi Nagar</td></tr>
<tr><td>9</td><td rowspan="2">4</td><td>Sri Ram Nagar</td></tr>
<tr><td>10</td><td>Amman Nagar South Extension</td></tr>
<tr><td>11</td><td rowspan="2">B2-U1</td><td>Devathanam,Jayakumar Nagar</td></tr>
<tr><td>12</td><td>Sangeevi Nagar</td></tr>
<tr><td>13</td><td rowspan="3">B2-U2</td><td>Bharathiyar St</td></tr>
<tr><td>14</td><td>Vethathri nagar</td></tr>
<tr><td>15</td><td>Vishwas Nagar Main Road, Thavallur Extn</td></tr>
<tr><td>16</td><td rowspan="3">B3-U1</td><td>Thigaraj Nagar</td></tr>
<tr><td>17</td><td>Vekailamman Nagar</td></tr>
<tr><td>18</td><td>Siva Nager Extension</td></tr>
<tr><td>19</td><td>B3-U2</td><td>Mahizhaum poo salai</td></tr>
<tr><td>20</td><td>B4-U</td><td>Pazhaiya Kuttai Road</td></tr>
<tr><td>21</td><td>B5-U</td><td>Collector office road</td></tr>
<tr><td>22</td><td>B6-U</td><td>Ammayapa nagar</td></tr>
<tr><td>23</td><td>GRPS1-U</td><td>Pichai Nagar</td></tr>
</table>
</td></tr>
<tr><td>Sewage pumping stations (SPS)</td><td>Collect sewage and pump to main pumping stations</td><td>5 nos.
Components of SPS
• Inlet chamber
• Screen chamber
• Grit well
• Suction well
• Pump room (3 x 2 m2)
• Non-clog submersible pump sets</td><td>Sewage pump stations are proposed at following locations:
1. Chidambaram nagar-Ariyamangalam
2. Ariyamangalam (Inside Solid waste dump yard)
3. Win Nagar
4. Rajarajeshwari Nagar
5. Keelakalkandar kottai</td></tr>
<tr><td>Pumping main sewers</td><td>Transfer sewage from SPS to another SPS or to STP</td><td>24 km
150-700 mm diameter CI sewers</td><td>Pumping main will be laid along the main roads, and the internal roads connecting sewage pumping stations and STP. Sewers will be laid underground in the road carriage way.
Pumping mains include: main sewers from two main SPS to proposed</td></tr>
</table>

<table>
<tr><th>Infrastructure</th><th>Function</th><th>Description</th><th>Location</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Dia (mm)</th><th>Length (m)</th><th>%</th><th>Material</th></tr>
<tr><td>150</td><td>7,785</td><td>31.3%</td><td>CI</td></tr>
<tr><td>200</td><td>6,155</td><td>24.8%</td><td>CI</td></tr>
<tr><td>250</td><td>3,995</td><td>16.1%</td><td>CI</td></tr>
<tr><td>350</td><td>2,160</td><td>8.7%</td><td>CI</td></tr>
<tr><td>500</td><td>1,900</td><td>7.6%</td><td>CI</td></tr>
<tr><td>600</td><td>50</td><td>0.2%</td><td>CI</td></tr>
<tr><td>700</td><td>2,810</td><td>0.9%</td><td>CI</td></tr>
<tr><td></td><td>24,855</td><td></td><td></td></tr>
</table>
</td><td>STP at Keelkalkandar Kottai; from sub-SPS and Lift Stations to main SPS; and,
from Lift Stations (13 nos.) within collection system to existing MPS/ SPS in Old Town Area</td></tr>
<tr><td>Sewage Treatment Plant (STP)</td><td>Treatment of collected wastewater to comply with disposal standards</td><td>New
STP of capacity 30 MLD
Proposed process: SBR (sequential batch reactor). This is indicative, actual process to be designed by the Design-Build contractor after the bid award:

Components:
• Mechanical screens
• Grit removal,
• Flow measurement and flow splitter box
• Batch reactors with individual inlet flow control and a fully automated process
• Sludge management system</td><td>Proposed STP is located at Keelakalkandar Kottai in the outskirts of the city. Land is owned by the TCC. Site is surrounded by vacant/agricultural lands. A threshing platform used by local villagers for threshing and drying of crops, occupies a small portion of the proposed site. This is considered in the social impact assessment studies, and the Resettlement Plan being prepared for the subproject will address the issues related loss of common property resource. A small village temple situated in western side, about 300 m from proposed STP site. Nearest house is located at about 500 m from the site.

Treated wastewater from the STP will be disposed into Uyyakondal channel, an irrigation channel that skirts the southern periphery of the Eastern Zone (the subproject area). This is also acts a a major storm water drain in the city traversing the entire width of TCC and ultimately discharges into Vallavandhan Kottai Pond (irrigation tank). At present, this channel also caters to the untreated/partially treated wastewater from the subproject area, and ultimately discharging the wastewater into the irrigation tank. With the implementation of this subproject, wastewater from subproject area will be collected by underground drains, treated at the STP, and disposed into Uyyakondal channel.</td></tr>
<tr><td></td><td></td><td>Rehabilitation
Improvement of existing STP at Panjappur to handle augmented flows from Old Town
STP capacity 37 MLD
Process: waste stabilization pond
Proposed works include: repairs to pretreatment units, connections, sluice gates, construction of bunds for facultative ponds and polishing ponds, scrapping of sludge, reconstruction of effluent channel, and removal</td><td>Existing STP is located at Panjappur approximately 7-km south of the City along Tiruchirappalli – Madurai - Tuticorin Highway (NH-45B). Treated wastewater from STP is being disposed into Koraiar River, a tributary of Cauvery.</td></tr>
</table>

Infrastructure	Function	Description	Location
		of sludge, old clay bed, and disposal, relaying of clay bed in anaerobic ponds (2 Nos), facultative ponds (2 Nos) and polishing pond (1 No).	
Outfall sewer	Disposal of treated water from new STP into Uyyakondal channel	2.7 km length 800 mm dia CI (cast iron) pipe	From STP at Keelakalkandar Kottai to Uyyakondan channel, situated south of the STP.
House service connections	Collect sewage from individual houses and convey into network	• 44,569 nos. (domestic)	At each household, connected to wastewater outlet drain

Figure 2: Layout Plan on Revenue Map for SPS1

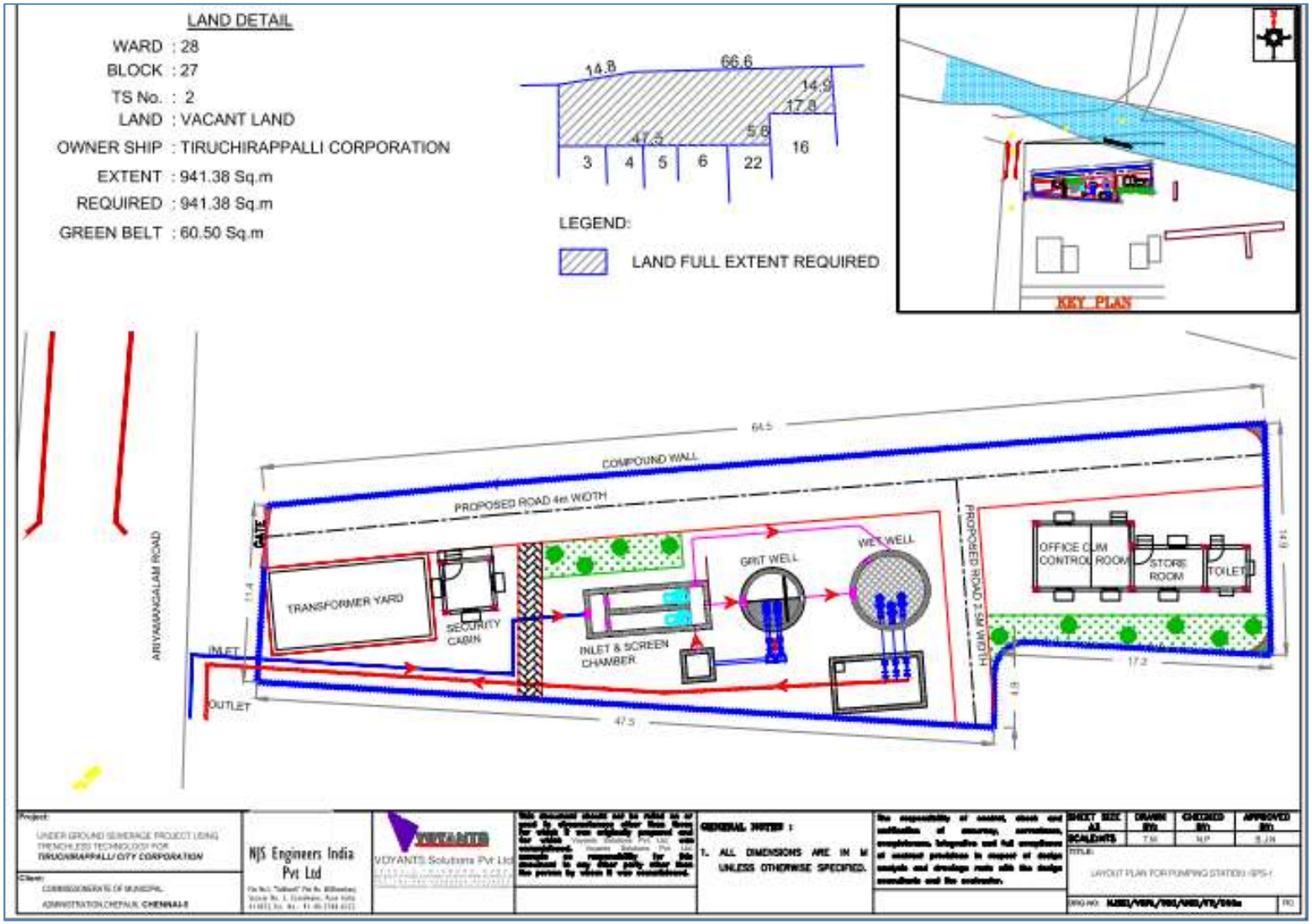


Figure 3: Layout Plan on Revenue Map for SPS 2

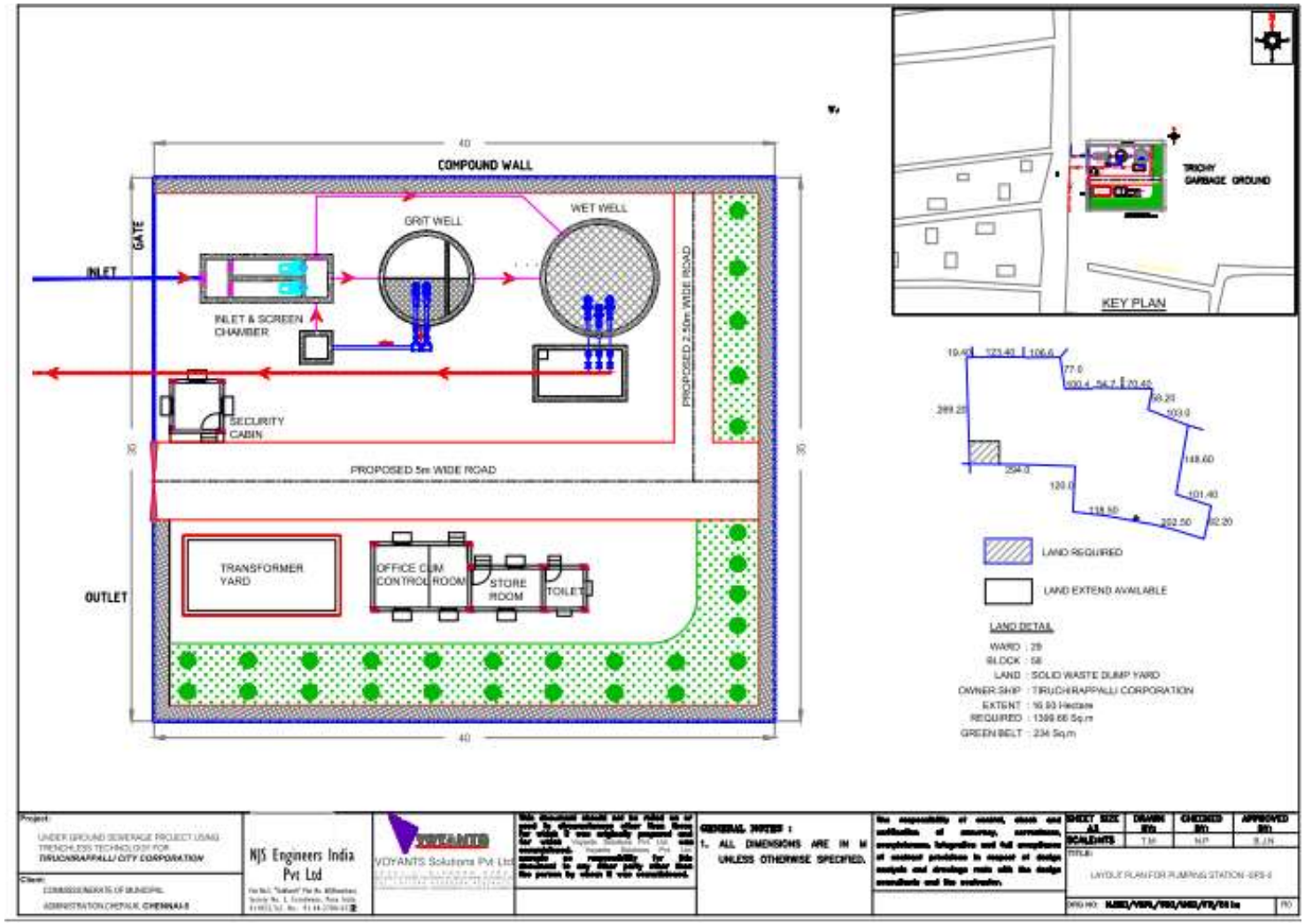


Figure 4: Layout Plan on Revenue Map for SPS 3

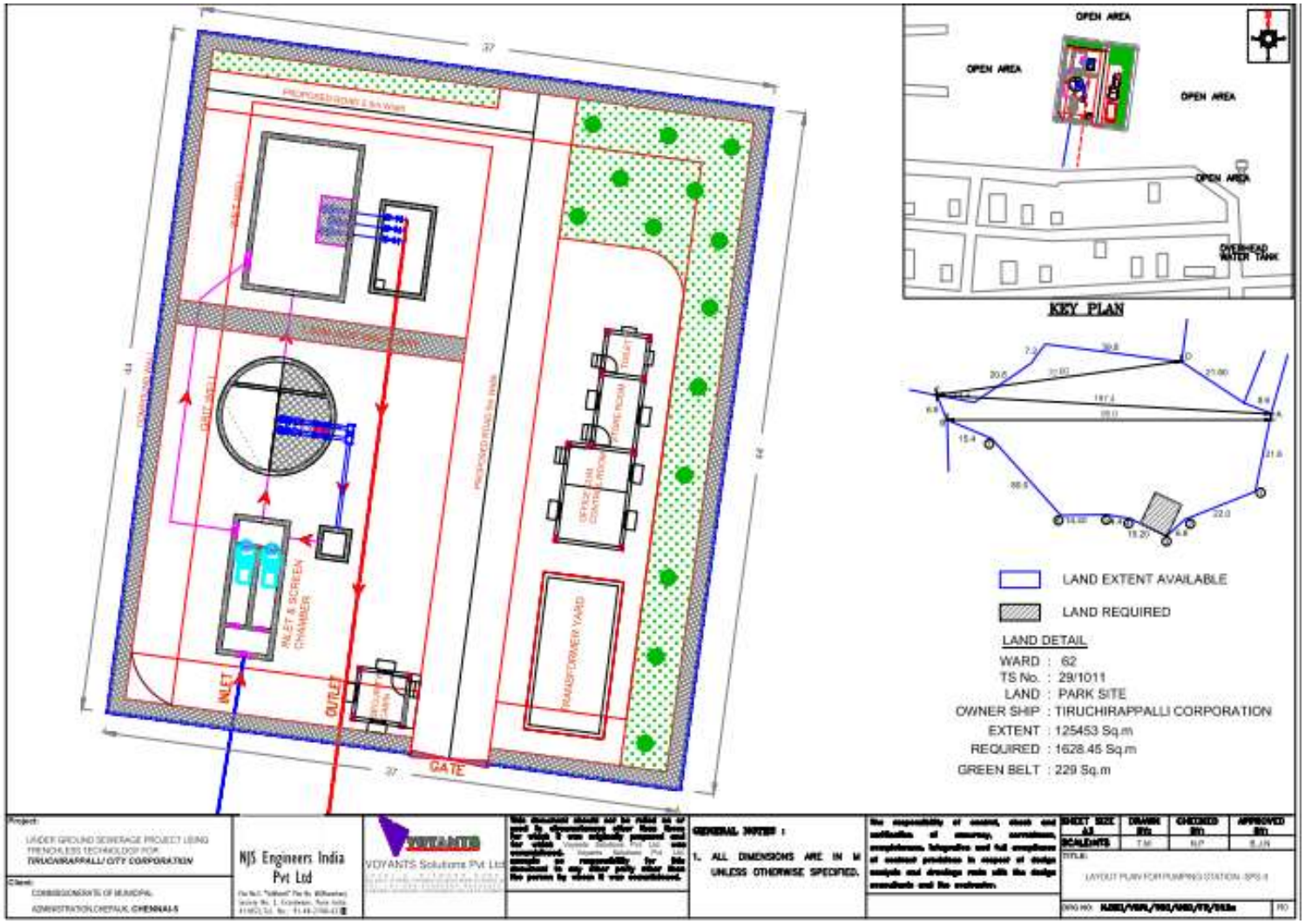


Figure 5: Layout Plan on Revenue Map for SPS-4

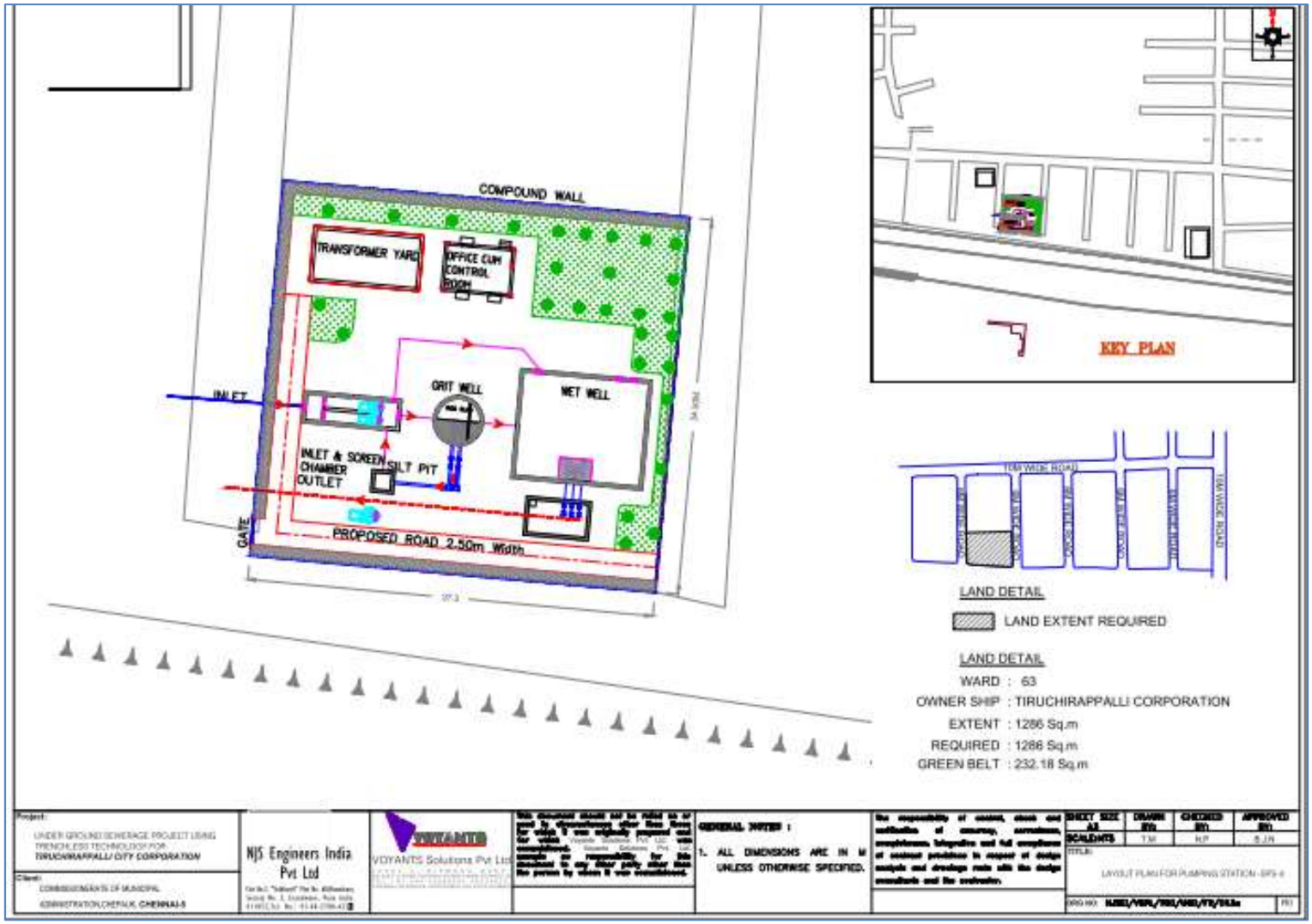


Figure 6: Layout Plan on Revenue Map for SPS 6

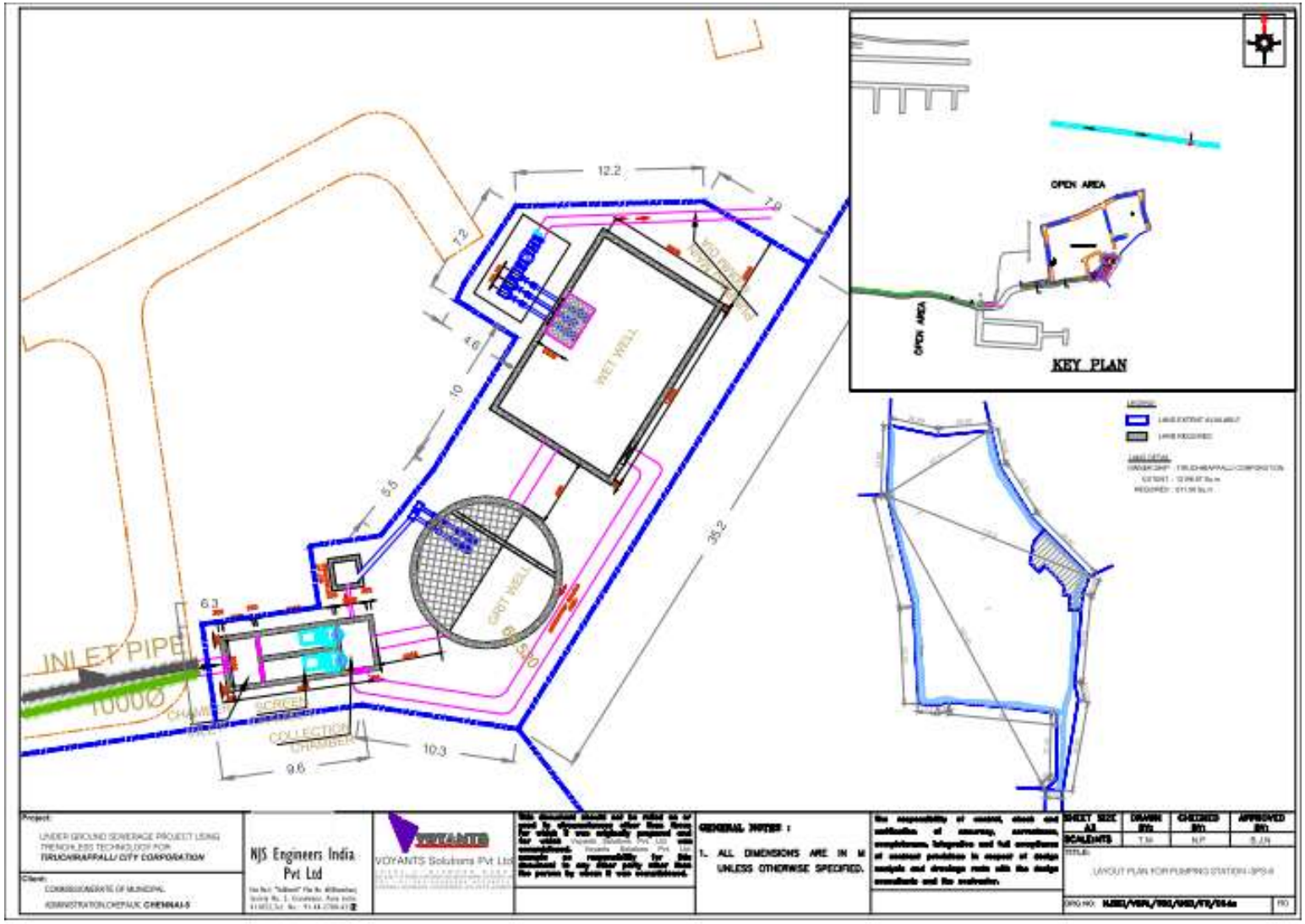
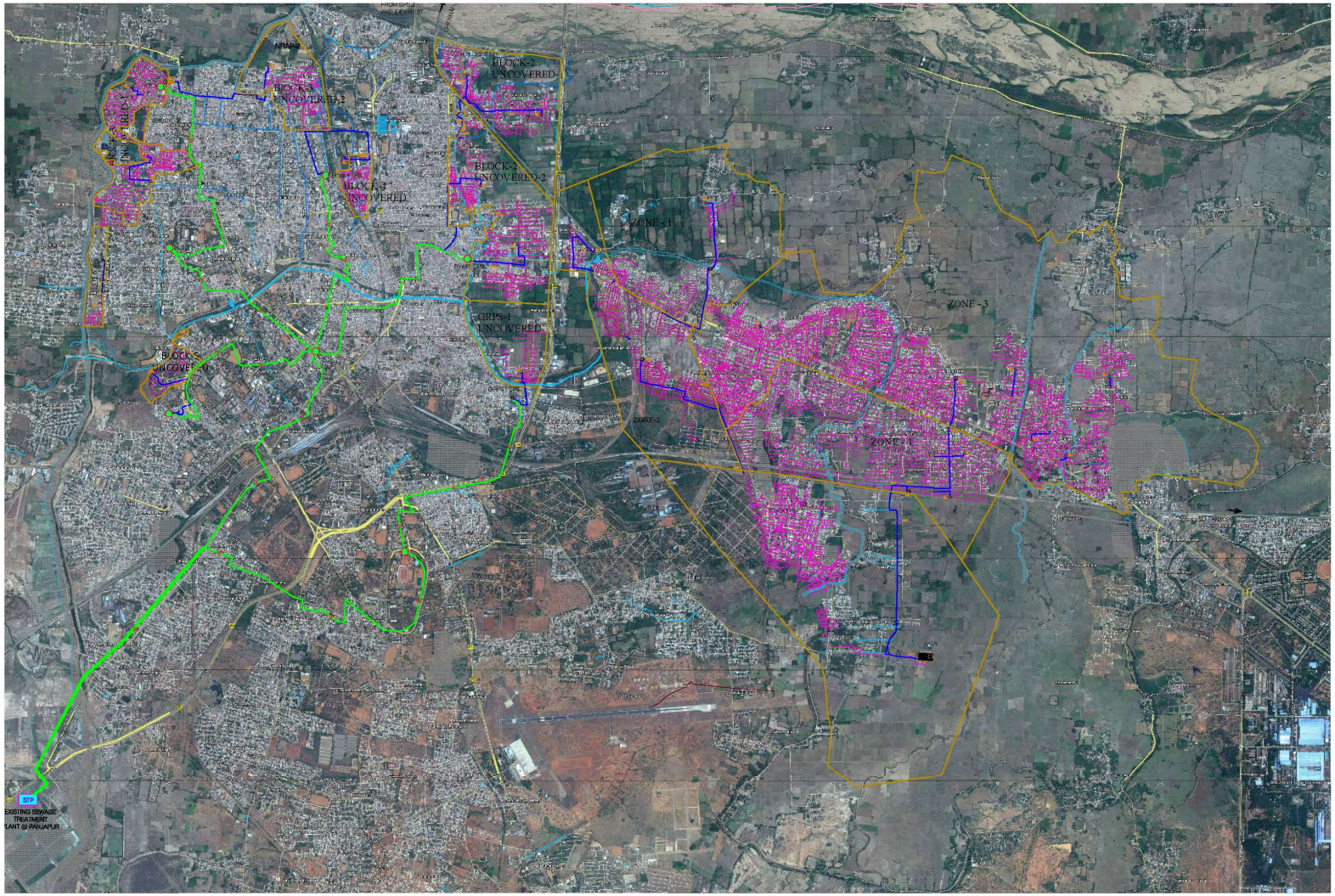


Figure 7: Proposed Sewer Network



III. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB Policy

18. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. This states that ADB requires environmental assessment of all ADB investments.

19. **Screening and categorization.** The nature of the environmental assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project; the sensitivity, scale, nature, and magnitude of its potential impacts; and the availability of cost-effective mitigation measures. Projects are screened for their expected environmental impacts, and are assigned to one of the following four categories:

(i) Category A. A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required.
(ii) Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination is required.
(iii) Category C. A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. No environmental assessment is required although environmental implications need to be reviewed.
(iv) Category FI. A proposed project is classified as category FI if it involves investment of ADB funds to or through a Financial Intermediary (FI).

20. **Environmental Management Plan.** An EMP, which addresses the potential impacts and risks identified by the environmental assessment, shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the project's impact and risks.

21. **Public disclosure.** ADB will post the safeguard documents on its website as well as disclose relevant information in accessible manner in local communities:

(i) final or updated IEE upon receipt; and
(ii) environmental monitoring reports submitted by the implementing agency during project implementation upon receipt.

B. National Environmental Laws

22. **Environmental assessment.** The Government of India EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for Environmental Assessment in India. This states that Environmental Clearance is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorized as A or B depending on the scale of the project and the nature of its impacts.

23. Category A projects require Environmental Clearance from the central Ministry of Environment, Forests and Climate Change (MoEFCC). The proponent is required to provide preliminary details of the project in the prescribed manner with all requisite details, after which an Expert Appraisal Committee (EAC) of the MoEFCC prepares comprehensive Terms of Reference (ToR) for the EIA study. On completion of the study and review of the report by the EAC, MoEFCC considers the recommendation of the EAC and provides the Environmental Clearance if appropriate.

24. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level EAC categorizes the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares ToR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the Environmental Clearance based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

25. None of the components of this underground sewerage system subproject falls under the ambit of the EIA Notification 2006, and, therefore EIA Study or Environmental Clearance is not required for the subproject.

26. **Applicable environmental regulations.** Besides EIA Notification 2006, there are various other acts, rules, policies and regulations currently in force in India that deal with environmental issues that could apply to infrastructure development. The specific regulatory compliance requirements of the subproject are shown in Table 2.

Table 2: Applicable Environmental Regulations

Law	Description	Requirement
Water (Prevention and Control of Pollution) Act of 1974, Rules of 1975, and amendments	Act was enacted to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water. Control of water pollution is achieved through administering conditions imposed in consent issued under to this Act. All pollution potential activities will require consent to establish (CTE) from Tamil Nadu Pollution Control Board (TNPCB) before starting implementation and consent to operate (CTO) before commissioning.	Construction of Proposed STP will require CTE and CTO from TNPCB, before starting of construction and before commissioning of STP respectively For Rehabilitation of the existing defunct STP, CTE and CTO from TNPCB is required.
Environment (Protection) Act, 1986 and Central Pollution Control Board (CPCB) Environmental Standards.	Emissions and discharges from the facilities to be created or refurbished or augmented shall comply with the notified standards	To comply with applicable notified standards Table 3 and Table below respectively present wastewater disposal standards for STPs and sludge composting standards for use as compost manure
Noise Pollution (Regulation and Control) Rules, 2000 amended up to 2010.	Rule 3 of the Act specifies ambient air quality standards in respect of noise for different areas/zones.	To comply with the noise standards.
Air (Prevention and Control of Pollution) Act, 1981, amended 1987 and its Rules, 1982.	- Applicable for equipment and machinery's potential to emit air pollution (including but not limited to diesel generators and vehicles); - CTE and CTO from TNPCB; - Compliance to conditions and emissions standards stipulated in the CTE and CTO.	For the subproject, the following will require CTE and CTO from TNPCB: (i) diesel generators; and (ii) hot mix plants, wet mix plants, stone crushers, etc. if installed for construction.

Law	Description	Requirement
Solid Wastes Management Rules, 2016	Rules to manage municipal solid waste generated; provides rules for segregation, storage, collection, processing and disposal.	Solid waste generated at proposed facilities shall be managed and disposed in accordance with the SWM Rules
Construction and Demolition Waste Management Rules, 2016	Rules to manage construction and to waste resulting from construction, remodeling, repair and demolition of any civil structure. Rules define C and D waste as waste comprising of building materials, debris resulting from construction, re-modeling, repair and demolition of any civil structure.	Construction and demolition waste generated from the project construction shall be managed and disposed as per the rules
Labor Laws	The contractor shall not make employment decisions based upon personal characteristics unrelated to job requirements. The contractor shall base the employment relationship upon equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment or retirement, and discipline. The contractor shall provide equal wages and benefits to men and women for work of equal value or type.	Appendix 2 provides applicable labor laws including amendments issued from time to time applicable to establishments engaged in construction of civil works.
The Ancient Monument and Archaeological Sites and Remains (Amendment and Validation) Act 2010	The Rules designate areas within a radius of 100 m and 300 m from the “protected property/ monument/ area” as “prohibited area” and “regulated area” respectively. Henceforth, no permission for construction of any public projects or any other nature shall be granted in the prohibited areas of the protected monument and protected area In respect of regulated area, the Competent Authority may grant permission for construction, reconstruction, repair and renovation on the basis of recommendation of the National Monument Authority duly taking note of heritage bye-laws, which shall be prepared in respect of each protected monument and protected area	The proposed sewer network in Zone-3 is passing within the 300m of the Erumbeeswarar Temple (an Archaeological survey of India or ASI protected monument). Some sewer lines fall within 100 m boundary of ASI monument. All the works within 300 to be conducted prior approval of competent authority (National Monument Authority)

Table 3: Effluent Disposal Standards of Sewage Treatment Plants Applicable to All Modes of Disposal

S. No.	Parameter	Standard	
		Location	**Concentration not to exceed**
1	pH.	Anywhere in the country	6.5 - 9.0
2	Bio-Chemical Oxygen Demand (BOD)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	20
		Areas/regions other than mentioned above	30
3	Total Suspended Solids (TSS)	Metro Cities*, all State Capitals except in the State of Arunachal Pradesh, Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, and Union territory of Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	<50
		Areas/regions other than mentioned above	<100
4	Fecal Coliform (FC) (Most Probable Number per 100 milliliter, MPN/100ml	Anywhere in the country	<1000

*Metro Cities are Mumbai, Delhi, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad and Pune.

Note :
(i) All values in mg/l except for pH and Fecal Coliform.
(ii) These standards shall be applicable for discharge into water bodies as well as for land disposal/applications.
(iii) The standards for Fecal Coliform shall not apply in respect of use of treated effluent for industrial purposes.
(iv) These Standards shall apply to all STPs to be commissioned on or after the 1st June, 2019 and the old/existing STPs shall achieve these standards within a period of five years from date of publication of this notification in the Official Gazette.
(v) In case of discharge of treated effluent into sea, it shall be through proper marine outfall and the existing shore discharge shall be converted to marine outfalls, and in cases where the marine outfall provides a minimum initial dilution of 150 times at the point of discharge and a minimum dilution of 1500 times at a point 100 meters away from discharge point, then, the existing norms shall apply as specified in the general discharge standards.
(vi) Reuse/Recycling of treated effluent shall be encouraged and in cases where part of the treated effluent is reused and recycled involving possibility of human contact, standards as specified above shall apply.
(vii) Central Pollution Control Board/State Pollution Control Boards/Pollution Control Committees may issue more stringent norms taking account to local condition under section 5 of the Environment (Protection) Act, 1986".

Table 4: Standards for Sludge Reuse as Manure

S**tandards for Composting** . As there are no specific standards notified for sludge reuse, the compost quality standards notified under the Solid Waste Management Rules, 2016 (Schedule II A, Standards for Composting) have been adopted here. According to the standards "In order to ensure safe application of compost, the following specifications for compost quality shall be met, namely:-			
Parameters	**Units**	**Organic Compost (FCO 2009)**	**Phosphate Rich Organic Manure (FCO 2013)**
Arsenic	mg/kg	10	10
Cadmium	mg/kg	5	5
Chromium		50	50
Copper		300	300
Lead		100	100
Mercury		0.15	0.15
Nickel		50	50
Zinc		1000	1000
C/N ratio		<20	<20:1
PH		6.5 – 7.5	(1:5 solution) maximum 6.7
Moisture, percent by weight, maximum		15.0 – 25.0	25.0
Bulk density (g/cm3)		<1	Less than 1.6
Total Organic Carbon, per cent by weight, minimum		12	7.9
Total Nitrogen (as N), per cent by weight, minimum	percent by weight	0.8	0.4
Total Phosphate (as P205) percent by weight, minimum	percent by weight	0.4	10.4
Total Potassium (as K20), percent by weight, minimum	percent by weight	0.4	-
Color			
Odor		Absence of foul Odor	
Particle size		minimum 90% material should pass through 4.0 mm is sieve	minimum 90% material should pass through 4.0 mm is sieve
Conductivity, not more Than	dsm-1	4	**8.2**
* compost (final product) exceeding the above stated concentration limits shall not be used for food crops. however, it may be utilized for purposes other than growing food crops.			

27. **Clearances/permissions to be obtained by Contractor**. Following Table 3 shows the list of clearances/permissions required for project construction. This list indicative and the contractor should ascertain the requirements prior to start of the construction, and obtain all necessary clearances/permission prior to start of construction.

Table 5: Clearances and Permissions Required for Construction

	Construction Activity	**Statutory Authority**	Statute under which Clearance is Required	Implementation	Supervision
1	Construction of new STP and rehabilitation of existing STP	TNPCB	Consent to establish (CTE) and consent to operate (CTO) under Water Act, 1974	Project Implementation Unit (PIU) and Contractor	PIU

	Construction Activity	Statutory Authority	Statute under which Clearance is Required	Implementation	Supervision
2	Tree Cutting	Department of Forest and District Collector	Clearances from the authorities as per the Tamil Nadu Timber Transit Rules,1968 or latest.	PIU	Implementing Agency and Project Management Unit (PMU)
3	Hot mix plants, Crushers and Batching plants	TNPCB	CTE and CTO under Air Act, 1981	Contractor	PIU
4	Discharges from construction activities	TNPCB	CTE and CTO under Water Act, 1974	Contractor	PIU
5	Storage, handling and transport of hazardous materials	TNPCB	Hazardous Wastes (Management and Handling) Rules. 1989 Manufacturing, Storage and Import of Hazardous Chemicals Rules, 1989	Contractor	PIU
6	Sand mining, quarries and borrow areas	Department of Geology and mining, GoTN	Not applicable Contractor to obtain material from the existing government licensed mines / quarries; Contractor will require prior approval of PIU for obtaining material from a particular source. PIU to review and approve only existing licensed mines	Contractor	PIU
7	New quarries and borrow areas	MOEFCC	Not applicable No new quarries / borrow areas will be created for the subproject.	Contractor	PIU
8	Groundwater extraction	Public Works Department	(Groundwater) Tamil Nadu Groundwater Development and Management Act 2000	Contractor	PIU
9	Disposal of bituminous wastes	Tamil Nadu State Pollution Control Board	Hazardous Wastes (Management and Handling) Rules. 1989	Contractor	PIU
10	Temporary traffic diversion measures	-	MoRTH 112 SP 55of IRC codes	Contractor	PIU

28. **ADB SPS Requirements.** During the design, construction, and operation of the project the Project Management Unit (PMU) and Project Implementation Units (PIUs) will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines *(*(both General Guidelines and sector specific guidelines of water and sanitation projects to be referred, http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines)). These standards contain performance levels and

measures that are normally acceptable and applicable to projects. When Government of India regulations differ from these levels and measures, the PMU and PIUs will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the PMU and PIUs will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

Table 6: WHO Ambient Air Quality Guidelines

Table 1.1.1: WHO Ambient Air Quality Guidelines[7,8]		
	Averaging Period	Guideline value in µg/m³
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

Table 7: World Bank Group's EHS Noise Level Guidelines

Table 1.7.1- Noise Level Guidelines[54]		
	One Hour L_{Aeq} (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational[55]	55	45
Industrial; commercial	70	70

IV. DESCRIPTION OF THE ENVIRONMENT

A. Methodology Used for Baseline Study

29. **Data collection and stakeholder consultations.** Data for this study has been primarily collected through comprehensive literature survey, discussion with stakeholder agencies, and field visits to the proposed subproject sites.

30. The literature survey broadly covered the following:

(i) Project details, reports, maps, and other documents prepared by technical consultants, TCC, ADB project preparatory technical assistance (PPTA) Team etc.;
(ii) Discussions with Technical experts of the PPTA team, TNUIFSL, implementing agency, DPR preparation agency, and other relevant government agencies;
(iii) Secondary data from previous project reports and published articles, and
(iv) Literature on land use, soil, geology, hydrology, climate, socioeconomic profiles, and other planning documents collected from government agencies and websites.

31. **Ocular inspection.** Several visits to the project sites were made during IEE preparation period in 2017 to assess the existing environment (physical, biological, and socioeconomic) and gather information with regard to the proposed sites and scale of the proposed project. A separate socioeconomic study was conducted to determine the demographic information, existing service levels, stakeholder needs and priorities.

B. Physical Resources

1. Location, Area and Connectivity

32. Tiruchirappalli is one of the largest cities in the state of Tamil Nadu, located on the Chennai – Dindigul National Highway (NH - 45). It is situated in the center of the state, on the banks of the Cauvery river. Tiruchirappalli is well connected with major cities in Tamil Nadu by rail and road network. By virtue of its location, Tiruchirappalli City serves as an important link from north to south and east to west across the state. Tiruchirappalli, Srirangam and Golden rock are part of Tiruchirappalli urban agglomeration and also developing as a regional metropolis, extending its influence over the entire Tiruchirappalli and Thanjavur districts. The influence of Tiruchirappalli extends up to Cuddalore, Villupuram, Vellore, Salem, Erode, Dindigul and Pudukottai Districts. Geographically, Tiruchirappalli is situated at the middle of Tamil Nadu, connected by 4 National Highways, 2 State Highways and several District Roads with other major towns of the state. Tiruchirappalli is an important Divisional Headquarters of Southern Railways. Tiruchirappalli is well connected by rail to Chennai, Kanyakumari, Madurai, Thanjavur, Rameswaram, Coimbatore and Bangalore. Tiruchirappalli junction is the main station for passengers as well as goods movement. Tiruchirappalli has an International Airport located on the Pudukottai road at a distance of 6 km. City is connected by air with Chennai, Madurai, Thiruvananthapuram, Srilanka, Singapore and Arab countries.

33. Tiruchirappalli is bound on the north by Namakkal District, northeast by Perambalur District, east by Thanjavur District, southeast by Pudukottai District, south by Sivaganga and Madurai Districts, southwest by Dindigul District and on the west by Karur District. It is a city known for its educational institutions, industries, and temples. Tiruchirappalli, is a commercial and tourist hub of Tamil Nadu. The most prominent landmark is ASI protected Rock Fort Temple, a spectacular monument perched on a massive rocky outcrop which rises abruptly from the plains to tower over the old city.

34. Tiruchirappalli City spreading over an area of 146.90 km^2 was upgraded from Special Grade Municipality to Corporation in the year 1994. During the year 2011, the adjacent local bodies in the eastern direction of City, such as Paappakurichi Village Panchayat, Ellakudi Village Panchayat, Aalathur Village Panchayat, Keelkalkandar Kottai Village Panchayat and Thiruverumbur Town Panchayat measuring 20.33 km^2 were added with Corporation. Thus the total area of TCC became 167.23 km^2. TCC area is divided into 65 wards with a population of 9.16 lakhs (2011).

2. Topography, Soils and Geology

35. Tiruchirappalli lies between 10º 10’ and 11º 20’ of the northern latitude and 78º 10’ and 79º 0' of eastern latitude. The general slope of the city is towards east. Pachamalai Hill is an important peak rising up to 1,015-m, located at Sengattupatti Reserve Forest.

36. Tiruchirappalli falls under Cauvery river basin. The Cauvery River is the most important river in the district and the tributaries of Cauvery, i.e. Coleroon River, Koraiyar river, Ariyar, Malattar channel and Uyyakondan channel also drain in Tiruchirappalli. The river splits into two branches, the northern branch being called the Coleroon (Kollidam) and the southern branch called Cauvery River. Ponnaniar, Uppamodai and Siddhayalli reservoirs are mainly used for irrigation purposes in this region. All the channels except Cauvery are ephemeral in nature. The gradient of ground water table, in general, is towards Cauvery river. Cauvery river flows from NW to SE and drains about 81,155 km^2 of the southern peninsula. The river has been dammed since 2nd century AD at the Grand Anicut. The drainage network of the river is dense and the river forms a delta at Tiruchirappalli. Prominent geomorphic units identified in Tiruchirappalli are alluvial plains, shallow and deep buried sediments, valley fills and structural hills.

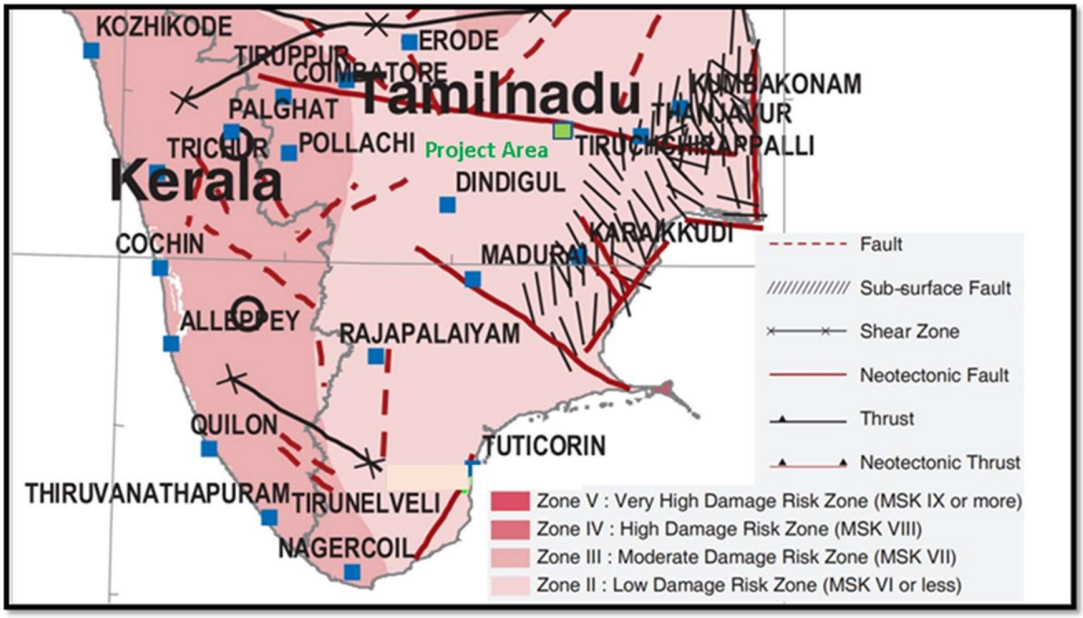
37. Geologically, Tiruchirappalli is underlain by formations ranging in age from Achaean to recent formation. Crystalline rocks comprising Charnockites, gneiss occupy a major part of the district. Alluvial deposits are restricted to major drainage courses and foothill zones. The geology of Tiruchirappalli is mainly hard rock, mostly Charnockites and mixed gneiss with river alluvium. There are no known or reported cases of land subsidence in or close to the subproject area. The cretaceous formations consisting of limestone, calcareous shale, clay, argillaceous sandstones etc. occur in parts of Tiruchirappalli. The hydro-geology of the city is represented by hard rock aquifers along the northern and north- western part.

38. The important aquifer systems in Tiruchirappalli are constituted by weathered and fractured crystalline rocks. Groundwater occurs under prelatic conditions in the weathered residuum and under semi-confined to confined conditions in deeper fracture zones. Recent alluvial deposits and semi-consolidated formations are found to form localized, discontinuous aquifers with low to moderate field potentials.

3. Seismology

39. Bureau of Indian Standards, based on the past seismic history, grouped the country into four seismic zones, viz. Zone-II, -III, -IV and –V. Of these, Zone V is the most seismically active region, while zone II is the least. The project area is in Low Damage Risk Zone II and as per the Modified Mercalli (MM) intensity scale, which measures the impact of the earthquakes on the surface of the earth, the project region is in MSK VI or less which indicates low intensity.

Figure 8: Seismic Zone of Project Area



Source: BMTPC.

4. Climatic Conditions

40. The variation of temperature throughout the year exhibits hot and dry climate with high temperatures and low degree of humidity. The region experiences four main seasons: Winter Season (December to February), Summer Season (March to May), Windy Season (June to August) and Monsoon (September to November).

41. The normal annual rainfall over the district varies from about 730 mm to about 900 mm. It is the minimum around Musiri (731.9 mm) in the western part. It gradually increases towards north, east and south and reaches a maximum around Manapparai (908.5 mm). The district has a tropical climate. The period from April to June is generally hot and dry. The weather is pleasant during the period from November to January. Usually mornings are more humid than afternoons. The relative humidity varies between 50% and 85% in the mornings while in the afternoon it varies between 70% and 92%.

Table 8: Annual Rainfall in Tiruchirappalli

Year	2011	2012	2013	2014	2015	Normal Rainfall
Rainfall in mm	806.90	626.90	522.90	535.70	862.0	818.0

Source: IMD Chennai.

5. Surface Water

42. The entire district forms part of Cauvery river basin. Cauvery is the major, and the only perennial river in the district. The northern branch of Cauvery, known as 'Coleroon' is mainly a flood carried, while the southern branch retains the name Cauvery. The entire district falls in Cauvery basin and drained by Cauvery River and its tributaries like Ayyar, Uppar, and partly by Maruthaiyar, Ponnanaiyar, Koraiyar and partly by Vellar river System. The drainage pattern, in general, is dendritic. The general slope of district is towards the central part where Cauvery and Coleroon rivers flow. There are small residual hills scattered in western and southern part of the

district, prominent among them is Rock Fort hill, located in the heart of Tiruchirappalli. Periyakulam, a big lake,and Vathiyar kulam lake are located within the project area, and Koraiyar river flows in the west of the project area,

43. Water quality monitoring of Cauvery river is conducted regularly by Central Pollution Control Board (CPCB), and sampling points are established throughout its course. In Tiruchirapally City, there are 2 sampling points - one just upstream and one just downstream of the city, and 2 more sampling points are located at about 30 km upstream (at Pettaivaithalai,) and 30 km downstream (at Grand Anaicut). Samples are collected regularly from these sampling points. According to the water quality data of 2014, river water quality is classified as B as per the surface water quality classification of central pollution control board[1]; pH of water ranged between 7.4 and 8.4 and, Bio-chemical oxygen demand (BOD) ranged between 1.2 and 10.8 mg/l.. Following Table presents the Cauvery River water quality.

44. There are several channels/streams criss-cross the city. These include Uyyakondan, Koraiyar and Thirumanjana Cauvery which finally empty into the Cauvery and Coleroon Rivers. No water quality data is available on the channels, however, at present, wastewater from the unsewered areas of the city enter these channel and ultimately pollute rivers. From the proposed STP, the treated wastewater will be discharged into Uyyakondan Channel that discharges into Vallavandhankottai irrigation Tank/pond. At present no water quality data is available, the baseline profile of Uyyakondan channel will be established during the detailed design phase by DBO Contractor.

1

Designated Best Use Classification of Surface water

Designated best use	Quality Class	Primary Water Quality Criteria
Drinking water source without conventional treatment but with chlorination	A	➢ Total coliform organisms (MPN*/100 ml) shall be 50 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 6 mg/l or more, and ➢ Biochemical Oxygen Demand 2 mg/l or less
Outdoor bathing (organized)	B	➢ Total coliform organisms(MPN/100 ml) shall be 500 or less ➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 5 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/l or less
Drinking water source with conventional treatment	C	➢ Total coliform organisms(MPN/100 ml) shall be 5000 or less ➢ pH between 6 and 9 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Biochemical Oxygen Demand 3 mg/l or less
Propagation of wildlife and fisheries	D	➢ pH between 6.5 and 8.5 ➢ Dissolved Oxygen 4 mg/l or more, and ➢ Free ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, and controlled disposal	E	➢ pH between 6.0 and 8.5 ➢ Electrical conductivity less than 2250 micro mhos/cm, ➢ Sodium Aborption Ratio less than 26, and Boron less than 2 mg/l.

* MPN: Most Probable Number
(Source: CPCB, 1978)

Table 9: Water Quality of Cauvery River near Tiruchirappalli

Locations	D=O (mg/l)			pH			Conductivity (µmhos/cm)			BOD (mg/l)			Nitrate- N+ Nitrite-N (mg/l)			Fecal Coliform (MPN/100ml)			Total Coliform (MPN/100ml)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Water Quality Criteria	> 4 mg/l			6.5-8.5						< 3 mg/l						< 2500 MPN/100ml			< 5000 MPN/100ml		
Cauvery At Pettaivaithalai, Tiruchirappalli	6.4	10.8	8.6	7.9	8.8	8.3	287	812	575	0.5	3.7	1.3	0	0.5	0.2	260	170000	24822	320	350000	54768
Cauvery At Tiruchirappalli U/S	5.9	9.7	8.1	7.9	8.7	8.4	236	686	489	0.2	7.2	1.8	0.03	0.37	0.2	220	170000	23957	330	280000	57494
Cauvery At Tiruchirappalli D/S	1.2	8.4	5.5	7.4	8.6	8	279	1438	829	0.7	18	5.5	0	6.14	0.7	320	11000000	975610	390	22000000	1939974
Cauvery At Tiruchirappalli, Grand Anaicut	3.7	10.2	6.5	7.8	8.8	8.2	274	1323	728	0.8	12	3.7	0.05	0.48	0.2	320	540000	73607	390	920000	127304

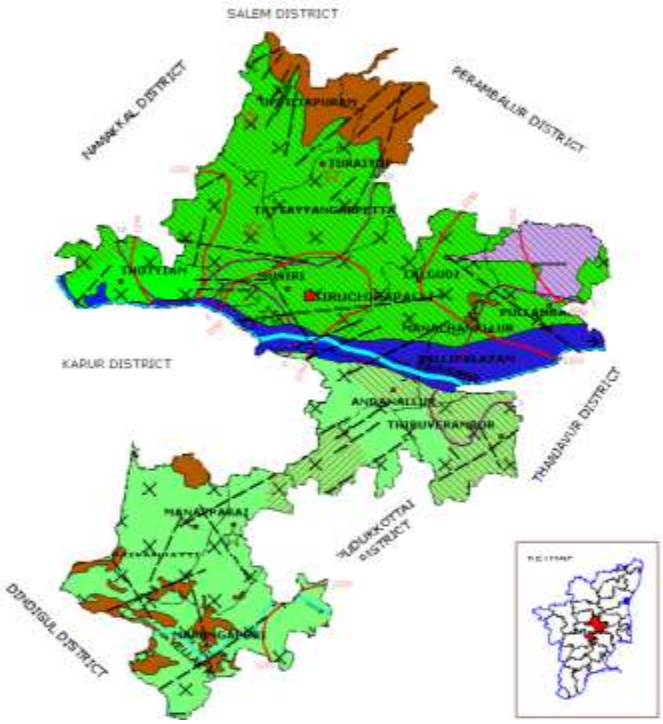
Source: cpcbenvis.nic.in.

The values that exceed standards are shaded for easy reference

6. Groundwater

45. The estimation of groundwater resources for the district has shown that out of 14 blocks, 4 blocks are categorized as over exploited, one block as 'critical' and rest are 'safe'.

Figure 9: Ground Water Prospects in Project Area



	Wells Feasible	Rigs Suitable	Depth Of Well (M)	Discharge (LPM)	Suitable Artificial
Soft Rock Aquifer	Dug Well Tube Well	Manual Direct Rotary	10 - 20 40 - 100	100 - 300	Percolation Pond/Recharge Shaft
Soft Rock Aquifer	Dug Well Tube Well	Manual Direct Rotary	10 - 20 60 - 150	60 - 300 400 - 1000	Recharge Shaft
Hard Rock Aquifer	Dug Well Bore Well	Manual DTH	12 - 20 60 - 120	10 - 60	Percolation Pond/Recharge Wells
Hard Rock	Dug Well Bore Well	Manual DTH	10 - 15 60 - 150	60 To 180	Check Dams/ Percolation Ponds
	District Boundary			Block Boundary	
	District Headquarter			Block Headquarters	
	Water Level-Pre-Monsoon (Decadal Mean 1993-2002) Mbgl		1250	EC In Microsiemens / Cm At 25°C	
	River			Lineament	
	Fluoride Greater Than Maximum Permissible Limit (1.5mg/L)			Nitrate Greater Than Maximum Permissible Limit (45mg/L)	
	Hilly Area				

Source: CGWB.

46. **Groundwater Quality**. Ground water in phreatic aquifers in Tiruchchirappalli district, in general, is colorless, odorless and slightly alkaline in nature. The electrical conductivity of ground water in phreatic zone (in micro siemens at 25ºC) during May 2006 was in the range of 570 to 4550 µS/cm and major parts of the district are having the electrical conductivity above 1700 µS/cm. According to Central Pollution Control Board (CGWB), In general the ground water is suitable for drinking and domestic uses in respect of all the constituents except Fluoride of higher concentration at Siruganallur (1.85 mg/L) and few places are having higher concentration of more than BIS permissible limit.

47. **Ambient Air and Noise Quality**: No regular ambient air or noise quality monitoring is conducted by TNPCB in Tiruchirappalli. Following data shows the random monitoring conducted for 24 hours by TNCPB/CPCB to record air quality in 2014. The data shows the oxides of sulphur and nitrogen in ambient air is well below the ambient air quality standards, however, particulate matter is above the standard. Of the 5 monitoring locations, two locations recorded particulate matter well within the limited, one location slightly above the limits, and at the remaining two locations, particulate matter is much higher than the limit. Dry weather conditions and traffic contribute to the high particulate matter in ambient air. No data on ambient noise levels available.

Table 10: Ambient Air Quality in Tiruchirappalli

		Average Concentrations of Air Pollutants (24 hours) in µg/m3		
	Monitoring Location in the City	**SO_2**	**NO_2**	**RSPM**
1	Gandhi Nagar	12	17	92
2	Main guard gate	11	17	68
3	Bishop heber college	9	14	40
4	Golden Rock	10	15	48
5	Central bus Stand, Tiruchirappalli	13	19	113
NAAQ standard (24 hrs)		50	40	60

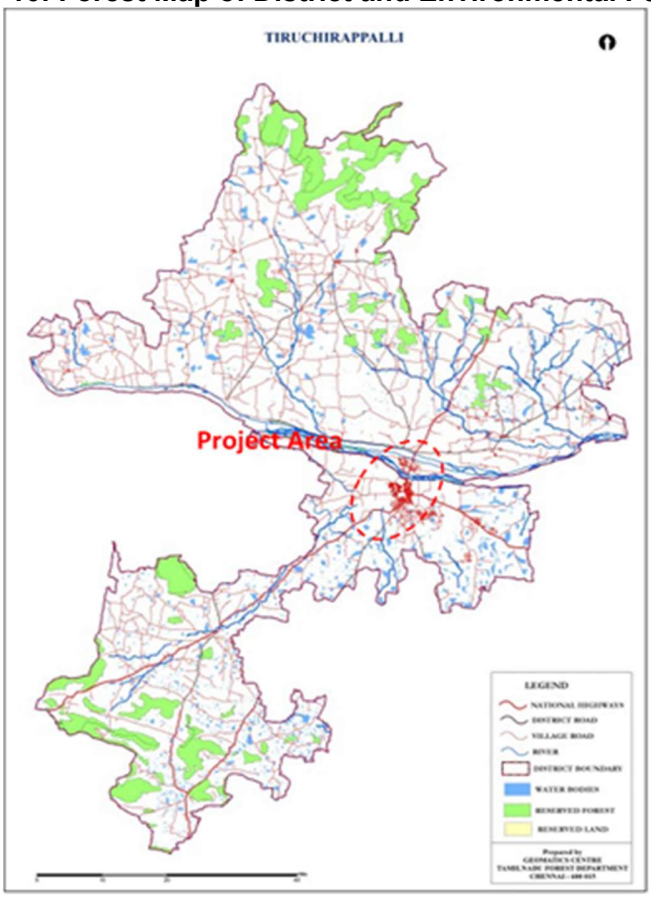
Source: Air pollution data base in Tamil Nadu ENVIS Center GoTN – 2014.

C. Ecological Resources

48. Tamil Nadu is located in the southernmost State of the Indian peninsula is spread over 130,058 km^2, which constitutes 3.96% of the area of the country. Tamil Nadu has a spectrum of nine major forest types ranging from wet evergreen forest to moist deciduous, dry deciduous, sholas, grass lands and scrub forest. The Western Ghats, the longest hill range in the State is one of the 25 global hotspots of bio-diversity and one of the three mega centers of endemism in India.

49. Project area, Tiruchirappalli town, is an urban area surrounded by land that was converted for agricultural use many years ago. Tiruchirappalli city is surrounded by vast agricultural lands. There is no remaining natural habitat in the town, and the flora is limited to artificially planted trees and shrubs, and the fauna comprises domesticated animals (cows, goats, pigs and chickens), plus other species able to live close to man (urban birds, rodents and some insects). There are no sensitive areas like forest or protected areas in the project area or nearby project area.

Figure 10: Forest Map of District and Environmental Features



D. Economic Development

1. Land Use

50. The total geographical area of Tiruchirappalli is 33988hectares, of which net Land put to non- agriculture occupied 13059 hectares and this accounted for 38.42 percent of the total area in the district. Area under net cultivable area accounted for 28,13 percent of the total land, i.e. 9560 hectares (Table 9).

Table 11: Land Use Pattern in Tiruchirappalli (Area in Ha)

Land Use	2005	
	Area (ha)	%
Forest	234	0.69
Barron and uncultivated land	1134	3.34
Land put to non- agriculture	13059	38.42
Cultivable waste	1850	5.44
Permanent pasture	54	0.16
Area under not included in cultivate	1174	3.45
Current Fallows	926	2.72
Other Fallows	5997	17.64
Net cultivable area	9560	28.13
Total	33988	100.00

Source: Records of Office of Joint Director of Agriculture, Tiruchirapalli.

2. Industry and Agriculture

51. The Bharath Heavy Electricals Limited established one of its Manufacturing units in Tiruchirappalli for producing high pressure boilers in 1961 and envisaged creation of ancillary units in the private sector, in and around Tiruchirappalli to off load items of low and medium Technology. As a result in the last three decades a phenomenal growth of small scale industries numbering as on date to 400 units have been set up by entrepreneurs in Thuvakkudi, Ariyamangalam, Thiruverumbur Indl. Estates. The Industrial units are giving gainful and consistent employment to nearly 18,000 people.

52. Other public sector undertakings and a Railway Workshop at Ponmalai are part of industrial growth of the District. The district also has a large number of units established in Textiles and apparels followed by engineering and repairing and servicing. Large numbers of micro, small and medium scale enterprises (MSMEs) have been established in textile and apparels and engineering units. Majority of the investments in this district have taken place in non-electrical machinery. Large part of the investments has also taken place in metals and metal products.

Table 12: Small Industries Development Corporation (SIDCO) Industrial Estates in Tiruchirappalli District

Name of Estate	Area (acres)
Ariyamangalam	17.64
Thuvakudi	478.84
Thiruverumbur	74.54
Thuvakudi (WCR)	14.24
Vazhavanthankotti –WIP	86.00
Vazhavanthankotti - P I	56.00
Vazhavanthankotti – P II	38.00
Kumbakudi	87.50

53. **Agriculture**. The Cauvery River irrigates about 51,000 ha in Tiruchirappalli, Lalgudi and Musiri Divisions. Variety of crops are grown in this district and agriculture is the main occupation for most of the people in the district. Rice, millets, cereals, pulses, sugarcane, groundnut, cotton and banana are most common crops cultivated in the district.

54. **Education.** About 33 engineering colleges have come up in and around Tiruchirappalli, that includes the well-known National Institute of Technology, Tiruchirappalli. The City also has a prestigious management institution, the Bharathidasan Institute of Management. Among the many arts and science colleges, St. Joseph's College is the oldest. This city has given great Tamil scholars whose contributions to Tamil literature have been very significant.

3. Infrastructure

55. **Water Supply.** Cauvery River is the major source of water supply in Tiruchirappalli City. The protected water supply scheme to erstwhile Tiruchirappalli Municipality was implemented in 1895 with the head works located on the banks of Cauvery river at Kambarasanpettai, which is 3 km upstream of the city. Under the comprehensive water supply system, the ULB has provided 96,075 individual connections i.e.76,686 (80%) metered and 19,389 (20%) unmetered. In terms of population, individual service connections cover 46% of the total population. 4,037public fountains at various locations cover 35% of the city’s population. Bore wells with hand pumps cover another 5% and rest 13% are uncovered by the existing system.).

56. Water supply improvement scheme for TCC is currently under implementation at a project cost of ₹2214 million with assistance from JICA (Japan International Cooperation Agency) fund through TNUIFSL. This scheme aims to provide equitable water supply in all parts of the city ensuring 135 lpcd norms.

57. **Sewerage.** TCC is equipped with a partially implemented UGSS. Sewage from sewered areas within corporation limits is collected through the existing collection system and conveyed by gravity to existing lift stations and sub-pumping stations, and then pumped through the main sewage pump stations to the STPs. Sewage from unsewered areas is presently discharged through open drains and channels which ultimately drain into the network of channels such as Uyyakondan, Koraiyar, Thirumanjana Cauvery etc., which finally empty into the Cauvery and Coleroon rivers, except Uyyakondan which terminates at Vallavandhan Kottai Pond/tank. The existing STPs comprises of oxidation ponds (87 MLD). Wastewater from the Panjappur STP is discharged into Koraiyar river in the south Presently the UGSS in TCC covers 42,666 residential and 557 commercial assessments as of 2015.

58. **Solid Waste Management**. Solid waste management in the city is handled by TCC. About 400 tons of solid waste is collected from the city, mostly by door-to-door collection system. From households waste is transferred to transfer stations, and from there to composting and dumping yards located in the city outskirts. A composting and dumping yard is located in Ariyamangalam in the subproject area. TCC also procured two plastic shredding machines and training imparted to the women self-help group members as well as to the sanitary workers. Shredded plastics is in progress and it is being used for road laying works.

59. **Transportation.** Tiruchirappalli is situated at the middle of Tamil Nadu, connected by 4 national highways, 2 state highways and several district roads with other major towns of the state. Tiruchirappalli is an important divisional headquarters of Southern Railways. Tiruchirappalli is well connected by rail to Chennai, Kanyakumari, Madurai, Thanjavur, Rameswaram, Coimbatore and Bangalore. Tiruchirappalli junction is the main station for passengers as well as goods movement. Tiruchirappalli has an International Airport. located on the Pudukottai road at a distance of 6 km. City is connected by air with Chennai, Madurai, Thiruvananthapuram, Srilanka, Singapore and Arab countries.

E. Socio Cultural Resources

1. Demography

60. As per Census 2011, Tiruchirappalli city population was 847,387 of which 418,400 are males while 428,987 are females. Total households are 214,529. Population of children less than 6 year is 79,723 which is 9.41 % of total population. Sex ratio is 1,025 against state average of 996. Child sex ratio is 960 compared to Tamil Nadu state average of 943. Literacy rate is 91.38 % higher than state average of 80.09 %; male and female literacy rates are 94.85% and 88.01%, respectively.

Table 13: Demographic Characteristics of Tiruchirappalli District (Census)

Description	2011	2001
Actual Population	2,722,290	2,418,366
Male	1,352,284	1,208,534
Female	1,370,006	1,209,832

Description	2011	2001
Population Growth	12.57%	10.10%
Area km^2	4,509	4,509
Density/km^2	604	536
Proportion to Tamil Nadu Population	3.77%	3.88%
Sex Ratio (Per 1000)	1013	1001
Child Sex Ratio (0-6 Age)	947	955
Average Literacy	83.23	77.9
Male Literacy	89.72	86.55
Female Literacy	76.87	69.31
Total Child Population (0-6 Age)	272,456	270,043
Male Population (0-6 Age)	139,946	138,162
Female Population (0-6 Age)	132,510	131,881
Literates	2,038,981	1,673,478
Male Literates	1,087,765	926,354
Female Literates	951,216	747,124

2. History, Culture and Tourism

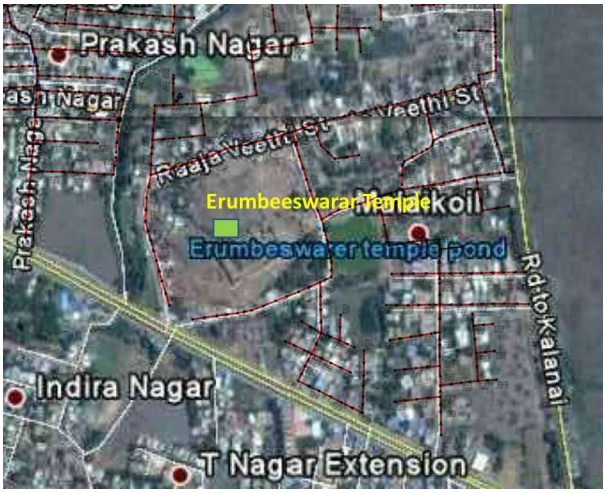
61. Woraiyur , a part of present day Tiruchirappalli, was the capital city of Cholas from 300 BC onwards. This is supported by archaeological evidences and ancient literatures. There are also literary sources which tell that Woraiyur continued to be under the control of Cholas even during the days of Kalabhra interregnum (A.D. 300 - 575). Later, Woraiyur along with the present day Tiruchirappalli and its neighboring areas came under the control of Mahendra Varma Pallava I, who ascended the throne in AD 590. Till AD 880, according to the inscriptions, this region was under the hegemony of either the Pallvas or the Pandyas. It was in AD880, Aditya Chola brought a downfall to the Pallava dynasty. From that time onwards Tiruchirappalli and its region became a part of Greater Cholas. In AD 1225 the area was occupied by the Hoysalas. Afterwards, it came under the rule of later Pandyas till the advent of Mughal rule.

62. Tiruchirappalli was for some time under the Mughal rule, which was put to an end by the Vijayanagar rulers. The Nayaks, the Governors of Vijayanagar empire, ruled this area till AD 1736. It was Viswanatha Nayaka who built the present day Teppakulam and the Fort. The Nayak dynasty came to an end during the days of Meenakshi.

63. The Muslims ruled this region again with the aid of either the French or the English armies. For some years, Tiruchirappalli was under the rule of Chanda Sahib and Mohamed Ali. Finally the English brought Tiruchirappalli and other areas under their control. Soon after the area was ceded to East India Company as per the agreement at the eve of the Kanatic war, Tiruchirappalli district was formed under the Collectorship of Mr. John (Junior) Wallace in 1801. District was then under the hegemony of British for about 150 years till India's independence.

64. **Culture and Tourism:** Owing to its rich history and culture, Tiruchirappalli has various archeological and religious places of prominence. Following two monuments are notified as nationally important monuments by ASI, and one monument (Erumbeeshwarar Temple) is located within the project area. No components are located within the temple / monument area, sewer lines proposed in the surrounding residential areas are close to the monument (i.e. within 300 m boundary of the monument, which is called regulated boundary of ASI), requiring prior permission to conduct works.

(i) **Erumbeeswarar Temple**. Hindu temple dedicated to the deity Shiva. Built on a 60-foot (18 m) tall hill, it is accessible via a flight of steps. The temple's main shrines and its two prakarams (outer courtyards) are on top of the hill, while a hall and the temple tank are located at the foothills. The temple is one in a series built by Aditya Chola (871-907 CE) along the banks of Cauvery river, to commemorate his victory in the Tirupurambiyam Battle. It has several inscriptions from the Chola Empire dating back to the 10th century. This is located within the project area.



(ii) **Rock Fort Temple**. Rock Fort Temple (well-known Uchipillayar Temple), the landmark of the city, is on the shores of Cauvery River. It is perched on a massive rocky outcrop at an altitude of 83 m above the mean sea level. The Thayumanaswamy Temple, dedicated to Lord Shiva, is situated halfway to the top. It has a 100-pillar hall and a vimana covered with gold. On the southern face of the rock are several beautifully carved rock-cut cave temples of the Pallava period. This is located outside the project area.

65. Other prominent places of interest around Tiruchirappalli, which are located outside project area, are:

(i) Srirangam: The Sri Ranganathaswamy Temple at Srirangam, situated 6 km north of the city, is among the most revered shrines dedicated to Lord Vishnu in South India, and is the largest temple complex in the world. Shrouded in a haze of coconut palms away to the north, the temple is built on an island in the middle of Cauvery and covers an area of 2.5 km^2. Enclosed by seven rectangular walled courtyards, this temple has 21 spires (“gopurams”), the largest of which was completed in 1987 and measures 73m in height. Srirangam is connected to the mainland by a bridge. The temple is replete with excellent carvings and numerous shrines dedicated to various gods.

(ii) Thiruvanaikaval: The Jambukeswara Temple, dedicated to Lord Shiva, is situated just 2 km east of Srirangam and houses five concentric walls and seven gopurams. Legend has it that an elephant once worshipped the Lord under the holy Jambu tree, and hence the name Jambukeswara. The principal deity is the Shiva lingam, almost submerged in water, which flows from the subterranean spring in the sanctum sanctorum.

(iii) Samayapuram: The Samayapuram Mariamman Temple is located 12-km north of the City at the junction of the National Highway connecting Tiruchirappalli and Chennai. The Mariamman Temple is one of the most visited shrines in Tamil Nadu, dedicated to Mariamman, a manifestation of the primeval energy Shakti as the mother Goddess. Samayapuram was a local capital of the Vijayanagar rulers in the vicinity of Tiruchirappalli, and was known as Vikramapuram.

(iv) Natharvali Dargah: It is an ancient Dargah, which is more than 1000 years old with marvelous architecture with the doom being made up of shining marbles giving a great look to the Dargah. It is situated in the heart of Tiruchirappalli City.

66. **Other Places of Interest**. The other temples in and around the city, but are located outside project area, include Thiruvallarai Vishnu Temple, Uraiyur Nachiyaar Temple, Uraiyur Vekkali Amman Temple, Thiruppaigeeli Siva Temple, Brahma temple at Thirupattur and Thirupparaithurai Shiva temple. Kollam pond in Crawford lies along the Tiruchirappalli-Madurai Railway line. This pond is home to different types of bird varieties including common crane, ducks and the kingfisher.

F. Subproject Site Environmental Features

67. Features of the selected subproject sites are presented in the following table.

Table 14: Site Environmental Features

Infrastructure	Location and Environmental Features	Site Photograph
Proposed Sewage pumping stations – 1	**Sewage pumping stations – 1 at Chidambaram Nagar, Ariyamangalam** Proposed site is located in ward no 28 near Uyyakondan channel on vacant land owned by TCC Site is located on road side in between a warehouse and Uyyakondan channel. Development around the site very sparse, houses are located away from the site (> 100 m) t. Site is covered with shrubs and bushes, and couple of trees, which needs to be cut down.	
Proposed Sewage pumping stations – 2	**Sewage pumping stations – 2 at Solid waste dumping site, Ariyamangalam** This is located in village Ariyamangalam within the existing solid waste dumping site. Sufficient vacant land available in the site to accommodate SPS. The land owned by TCC. There are no house close by (>50 m)	

Infrastructure	Location and Environmental Features	Site Photograph
Proposed Sewage pumping stations – 3	**Sewage pumping stations – 3 at Balaji Nagar / Win Nagar** Site is located in the outskirts of the city, There are no houses close by (> 100 m). The SPS is proposed on land owned by TCC	
Proposed Sewage pumping stations – 4	**Sewage pumping stations – 4 at Rajarajeshwari Nagar** The proposed SPS is located in the outskirts of the city in Rajarajeshwari nagar near Railway line,. The land owned by TCC. Houses are located away from the site (>50 m)	
Proposed Sewage treatment plant and Sewage pumping stations – 6*	**STP and Sewage pumping stations – 6 station and Sewage treatment plant** at Keelakalkandar Kottai The proposed sewage pumping stations and STP are located in the outskirts of the city in Keelakalkandar Kottai along with 30 MLD STP. The land is presently owned by the TCC but it has a crop Threshing platform used by local villagers for Threshing and drying of the crops. Access to this platform or new platform will be developed for the villagers. A small village temple situated in western side about 300 m from proposed STP site, a buffer zone of local plants species will be developed and maintained along with STP for protection of aesthetic value of area. Site is located away from the houses (>500 m)	 

Infrastructure	Location and Environmental Features	Site Photograph
Rehabilitation of Existing Sewage treatment Plant	**Rehabilitation of existing 37 MLD plant at Panjapur** The existing STP is located at about 7 km from Tiruchirappalli Railway Station lying to the east of the Madurai Road in Panjapur village. The TCC has about 230 ha of land, and STP is located in this land. There are no houses nearby the site (>400 m) After treatment from polishing ponds, the treated effluent is discharging into Koraiyar River. There are 2 existing STPs at this site: (i) 37 MLD STP constructed in 1987, improved in 2003, and (ii) 50 MLD STP constructed in 2008. Total installed treatment capacity of the existing plants at Panjapur is 87 MLD. Under this subproject, the Old STP of 37 MLD, which is currently not in working condition, is proposed for rehabilitation. This STP will be used to treat additional sewage generated from the areas which are being provided with sewer system under this subproject.	 
Sewage lift stations (LS)	Road Side Lifting station is a small pumping station to lift the sewage to higher level and to discharge into ridge manhole for transporting to the pumping station. Lifting station has a collection well with submersible pumps accommodated inside. Lift stations are essentially proposed as enlarged manholes (either road-side on available land or on road center by enlarging a collection system manhole) fitted with two sewage pumps (small capacity) and a curb or road-side wall mounted Pump Control Panel. Where lifting stations are proposed along the roads, there is no buffer land for trees and high compound available, at such places other design and operation related measures are included in the project design	 LS 33

Infrastructure	Location and Environmental Features	Site Photograph
		 LS 44
Sewer network	Sewer lines will be laid in the center of road by cutting open the surface . In wider roads, like NH, divided 2-way roads etc., sewers will be laid along the edge of the road, but mostly within the carriageway. In the outskirts where adequate land in the road shoulder is available along the blacktop and is clear of any structures or activities, sewers will be laid in the earthen shoulder. Large diameter sewers will be laid on main roads (300 – 700 mm), while the tertiary sewers of small size (150 mm to 300 mm dia) that collect wastewater from each house will be laid in all streets in the subproject area. Trench size to bury the sewer will be of 0.8 m to 1.5 m wide and 1 m to 6 m deep. Most of the roads in central part of the town (old town area) are narrow and congested with traffic, pedestrians and activities. Sewers will also be laid in the roads located within 300 m of Erumebeeshwarar temple (ASI monument) to provide sewerage system to the areas around the temple	 

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

68. Potential environmental impacts of the proposed infrastructure components are presented in this section. Mitigation measures to minimize/mitigate negative impacts, if any, are recommended along with the agency responsible for implementation. Monitoring actions to be conducted during the implementation phase is also recommended to reduce the impact.

69. Screening of potential environmental impacts are categorized into four categories considering subproject phases: location impacts and design impacts (pre-construction phase), construction phase impacts and operations and maintenance phase impacts.

(i) **Location impacts** include impacts associated with site selection and include loss of on-site biophysical array and encroachment either directly or indirectly on adjacent environments. It also includes impacts on people who will lose their livelihood or any other structures by the development of that site.
(ii) **Design impacts** include impacts arising from Investment Program design, including technology used, scale of operation/throughput, waste production, discharge specifications, pollution sources and ancillary services.
(iii) **Construction impacts** include impacts caused by site clearing, earthworks, machinery, vehicles and workers. Construction site impacts include erosion, dust, noise, traffic congestion and waste production.
(iv) **O&M impacts** include impacts arising from the operation and maintenance activities of the infrastructure facility. These include routine management of operational waste streams, and occupational health and safety issues.

70. Screening of environmental impacts has been based on the impact magnitude (negligible/moderate/severe – in the order of increasing degree) and impact duration (temporary/permanent).

71. This section of the IEE reviews possible project-related impacts, in order to identify issues requiring further attention and screen out issues of no relevance. ADB SPS (2009) require that impacts and risks will be analyzed during pre-construction, construction, and operational stages in the context of the project's area of influence.

72. The ADB Rapid Environmental Assessment Checklist in http://www.adb.org/documents/guidelines/environmental_assessment/eaguidelines002.asphas been used to screen the project for environmental impacts and to determine the scope of the IEE.

73. In the case of this project (i) most of the individual elements involve simple construction and operation, so impacts will be mainly localized and not greatly significant; (ii) negative impacts associated with sewage facilities such as odor are already considered in the design and siting, (iii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving excavation and earth movements; and (iv) being mostly located in an urban area, will not cause direct impact on biodiversity values. The project will be in properties held by the local government and access to the project location is through public rights-of-way and existing roads hence, land acquisition and encroachment on private property will not occur.

A. Pre-Construction Impacts – Design and Location

74. **Design of the Proposed Components**. Technical design of the (i) sewage pumping and lifting stations; and (ii) sewer network including manholes and house connections, follows the relevant national planning and design guidelines, focusing on providing a robust system which is easy to operate, sustainable, efficient and economically viable.

75. **Sewage treatment**. A new STP and rehabilitation of an existing STP is proposed in the subproject. It is proposed to utilize the existing 88 MLD capacity waste stabilization pond (WSP) based STP at Panjapur. Total installed treatment capacity of the existing plant at Panjapur is 87

MLD (50MLD +37MLD) of which 51MLD plant is working and 37MLD plant is defunct. Since additional sewage flow will be generated by proposed sewer network in the currently uncovered areas under the subproject , , rehabilitation of 37 MLD plant is proposed to handle these additional flow from the subproject area.

76. A new 30 MLD STP is proposed to be constructed at the identified site to treat the sewage generated from the Zone 1,2,3,4 and part of zone-6 under Phase-II. This STP will also meet the demand of zones 5, remaining part of zone-6, where sewer system is proposed under Phase-III. STP will be implemented on DBOT basis, and in 2 modules. It is proposed that the treated wastewater will be discharged into Uyyakondan channel, which is flowing at a distance of 2.7 km northeast of STP site. This channel ultimately discharges into Vallavandhan Kottai Pond (irrigation tank), after flowing for about 20-22 km from the proposed STP discharge point. Water from Vallavandhan Kottai is used for irrigation in its command area.

77. Uyyakondan is an irrigation channel passing through the centre of Tiruchirappally city and also serves as the ultimate carrier of storm water on the southern part of the city. It takes off River Cauvery from the head sluice located at Pettavaithalai, and after flowing over a distance of over 70 km it discharges into Vallavandhan Kottai Pond, an irrigation tank. It flows for about 18 km in the city; the initial stretch of 8 km are passes through the old Trichy town, which is already covered with sewer system. The remaining 10 km stretch passes through the eastern side of Trichy, which does not have a sewer system, and therefore untreated sewage is mostly discharged into this channel. Channel after leaving the Trichy city flows down for about 25 km and discharges ultimately into Vallavandhan Kottai Pond/tank, from where water is used for irrigation.

78. An alternative option of reusing the treated wastewater for industrial purposes is also being explored, and a study has already been initiated to prepare the feasibility report for reuse. If this reuse option is found feasible, the treated wastewater will be further treated to the required quality for industrial reuse. Depending on the demand, wastewater will be reused, and remaining wastewater, if any, will be discharged into Uyyakondan channel.

79. STP is proposed for implementation under design-build mode of contract, and therefore the STP will be designed by a successful bidder to meet the treatment standards.

80. **Nuisance from STP**. Proposed STP Keelakalkandar Kottai is located away from developed areas, and there is no development at present in and around the site, which is mostly comprised of agricultural and vacant lands. Nearest house is at about 500 m, and this area too is sparsely developed. However, considering the future development potential, adequate green buffer around the plant should be developed to minimize/mitigate impacts such as bad odor, poor aesthetics, etc. Following measures shall be implemented:

(i) Providing a green buffer of 20-30 m wide all around the STP with trees in multi-rows and land scaping. This will act as a visual screen around the facility and will improve the aesthetic appearance.

81. **Sewage sludge** generally consists of organic matter, pathogens, metals and micro pollutants. The concentration of parameters such as metals can be influenced by input to the sewers system from industry. Since no industrial wastewater is allowed into sewers, it is unlikely that sludge contains heavy metals. The sludge from reactors will be collected in sludge sump and conveyed to centrifuge for dewatering. The sludge in the form of a wet cake will be further air-dried in the sludge drying beds. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an excellent organic fertilizer for application to the land. Adequate drying is however necessary to ensure maximum kill of enteric bacteria. To achieve adequate drying minimum drying period shall be ensured. The drying period, which will be varying depending on the season will be determined during operation and be followed. A sludge management plan will be developed by the STP facility designer.

82. Properly dried sludge can be used as soil conditioner. Periodic testing of dried sludge will be conducted to ensure that it does not contain heavy metals that make it unsuitable for food crops. Tests will be conducted to confirm the concentrations below the following standards. As there are no specific standards notified for sludge reuse, the compost quality standards notified under the Solid Waste Management Rules, 2016 have been adopted here (refer Table 4 for standards to be met).

83. Following measures shall be implemented during the detailed design and implementation phase:

(i) Prepare sludge management plan to ensure safe collection, adequate treatment prior to reuse / disposal
(ii) Conduct periodic testing of sludge to check its quality according to set standards for reuse as manure/soil conditioner
(iii) Provide training on safe handling of sludge, along with proper apparatus and personnel protection equipment (PPEs) to workers

84. **Existing STP Rehabilitation.** The major repair and rehabilitation works proposed in the existing defunct WSP based STP of 37 MLD capacity at Panjappur will improve its functioning and treatment efficiency. Site is located away from residential areas (> 400 m). Sludge drying beds will also be provide to further treat/dry/compost the partially dried sludge collected from the WSP ponds. This is to ensure proper treatment prior to its reuse as manure or disposal. At present, as this is defunct, there is no valid CTO from TNPCB. First, CTE needs to be obtained by PIU during detailed design phase, and CTO after completion of works, but prior to start of operation of rehabilitated STP. Periodic testing of sludge and provision of training and appropriate apparatus along with PPEs will be provided to workers.

85. **Sewer system – collection and conveyance.** The sewerage system is designed as a separate system of sewage collection (i.e. caters only to wastewater). Existing surface road side drains in the project area cater to collection and conveyance of runoff during rains. The underground gravity sewers will carry sewage from households to the nearest lifting or pumping station, from where the sewage is pumped to the STP. To maximize the benefits as intended, TCC will ensure that all existing septic tanks are phased out by bypassing the inlet and connecting the toilet discharge from each house directly to sewerage system.

86. Accumulation of silt in sewers in areas of low over time, overflows, blockages, power outages, harmful working conditions for the workers cleaning sewers etc. are some of the issues that are taken into consideration during the sewer system design. Measures such as the following are included in sewer system design to ensure that the system provides the benefits as intended:

(i) selection of construction methodology near protected monuments in discussion with the ASI, having the excavation observed by person with archaeological knowledge for chance finds, etc.;
(ii) Limit the sewer depth where possible;
(iii) Sewers shall be laid away from water supply lines and drains (at least 1 m), if not possible, sewer lines shall be laid below the water lines;
(iv) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm);
(v) In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material (that has no or least infiltration risk) shall be selected (stoneware pipes shall be avoided)
(vi) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes;
(vii) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry;
(viii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation.

87. **Sewage Pumping stations and lift stations**. It is proposed to construct 24 sewage lift stations, 5 new sewage pumping stations. These will receive sewage from the catchment area via the sewer network and pump to higher level manholes or pumping stations or to STP as per the design. Lift stations are necessitated where in the design the depth of sewer exceeds the downstream interlinking manhole invert levels. Therefore, in such situations, the feasible and practical solution was to opt for a low capacity lift station with submersible pumps to lift and convey the collected sewage from peripheral areas to the downstream system through a bell-mouth chamber.

88. Lift stations will cater to small area, and will be located at lowest point where the sewage from catchment area will be collected, and then pumped to a higher level manhole for further gravity flow or to a pumping station, from where it is ultimately pumped to the STP. Lift station will consists of a sewage sump or suction well, below the ground, to receive sewage, submersible pumps in the sump to pump out, and an electrical panel board for operation of pumps above the ground. A generator set will also be provided at each lift station.

89. **Sewage pump stations** will also perform same function as sewage lift stations but cater to much larger area or sewage flow, and will also have several components, and occupy

comparatively larger area. Components of the proposed sewage pumping stations include:

(i) Screen well;
(ii) Grit well;
(iii) Collection well.

90. At the these pumping or lifting stations, the operation involves accumulation of incoming sewage in the suction well, and then pumping out as the sewage level reaches the designed pumping depth. The water level in the well rises up before the pumping cycle starts, and as the pumping is performed the water level goes down, registering its lowest depth at the end of pumping of cycle. This cycle of rising and lowering will continue throughout the day and night, however, the duration between successive pumping cycles will significantly vary depending on the sewage generation. During morning and evening peak hours, sewage will accumulate quickly, and pumping frequency will be high. The sewage retention time in the suction well therefore varies throughout the day, with very high retention periods during the nights and mid-days.

91. **Odor from pump and lift stations.** In the suction wells, the sewage emits gases, which accumulated in the air above water surface. The gas may include odorous compounds like hydrogen sulphides (H_2S), amines, fatty acids, aldehydes, ketones and other volatile organic compounds (VOCs). As the water level rises before the pumping cycle, it physically displaces the air, along with the odorous gas compounds. H_2S is the most dominant odor causing compound, and therefore can cause nuisance to nearby households. When sewage becomes stagnant, H_2S is generated in the anaerobic conditions. The quantum of H_2S generation depend on quantity of accumulated sewage and sewage retention time that create anaerobic conditions. Both increase in quantity of sewage accumulation and retention time will increase the H_2S generation. Design considerations are included to minimize the both as much as possible. Pumping stations cater to large area and will have high capacity of suction wells and pump sets, while lift stations are small with lower capacity of suction wells and pumps sets. The retention time is kept to its lowest possible so that there is no stagnation of sewage for long time which could create anaerobic conditions.

Measures for pumping stations

(i) Maintain buffer distance from nearest residences;
(ii) Locate pumping station as far as away from the road;
(iii) Develop green buffer zone around the facility with a combination of tall and densely growing trees in multi rows as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance
(iv) Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells.
(v) RCC Slab to be designed and fixed in a modular manner such that access to pumps/appurtenances and other equipment can be provided for maintenance / replacement / renewal purposes.
(vi) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating / grill work shall be provided over the sections (or full cross section if required) where workers will stand / work for inspection and repair/O&M purposes.
(vii) Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by positioning vent in such a way that cover slab fitment / movement/drawl if required for maintenance purposes is not compromised.
(viii) Height of vent to be provided appropriately and a minimum 2 m above the lintel

level (top level) of window(s)/passageways/doors in the nearby adjoining buildings.

(ix) Provision of odor control/mitigation system as per site conditions/requirements. Suitable granular activated carbon filter with bird-screen fitted at the vent outlet to control odor. Size of GAC (including material size) should be selected based on the vent diameter and expelled air flow rate expected.

(x) Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength-corrosion resistant heavy duty construction shall be proposed.

(xi) In locations/cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit.

(xii) Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile/Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption.

(xiii) Develop standard operating procedures / operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations;

(xiv) Provide training to the staff in SOPs and emergency procedures;

(xv) Periodic monitoring of H_2S levels at sewage pumping and lifting stations using handheld H_2S meters[2].

92. **Lifting stations** are also to be located at technically feasible locations (lowest point to where sewage can be conveyed from households by gravity) within or close to the residential areas which are being served by respective lifting station. Given very limited land availability in urban areas like the project area, that too of government owned lands, locating the lifting stations away from the houses is not practical in Tiruchirappalli, sites for lifting stations were identified based on the technical suitability and availability of government owned land parcels to avoid land acquisition. Many of the sites are located along the river, which is the lowest point, and most of the area are highly dense. Odor nuisance from lifting stations is very limited compared to pumping stations. Lift stations are essentially proposed as enlarged manholes (either road-side on available land or on road center by enlarging a collection system manhole) fitted with two sewage pumps (small capacity) and a curb or road-side wall mounted Pump Control Panel. Following odor control and mitigation measures are considered:

(i) Provide closed wells fitted with necessary ventilation wherever required;

(ii) Provide greenbelt (tree cover) around the lift stations, wherever possible;

(iii) a suitable arrangement such to capture the gaseous emissions from the wells and treat via scrubber/activated carbon filter before letting out into the ambient air; such system should be designed appropriately to meet the likely emissions/flow rate of respective lifting stations.

93. **Noise from pumping operations**. Operation of pumps and motors and diesel generators is a major source of noise. As the pumping and lifting stations are located in the residential areas, with few located very close to the houses, noise generated from lifting/pump stations can have continuous negative impacts on the surrounding population. High inside noise levels can affect

2

the health of operators and staff at the facilities, and therefore, noise levels needs to be maintained within and outside the plant at acceptable levels.

(i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80 dB(A) at a distance of 1 m[3];
(ii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise;
(iii) Use acoustic enclosures – manufacturer specified, for all pumps, motors;
(iv) Procure only CPCB approved generatorsto meet air emission and noise level requirements;
(v) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors
(vi) Provide ear plugs designated for noise reduction to workers;
(vii) Consult the ASI and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals;
(viii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be finalized in consultation with ASI; no equipment causing vibration and heavy noise should be used.

94. **Energy Efficiency**. Project area is mostly plain and gently sloping ground, it is therefore not technically feasible or economical to design a completely gravity system to collect sewage from individual houses and transfer the same the STP on the outskirts of the city. It necessitated provision of lifting and pumping stations, which are optimized to the extent possible to minimize the overall pumping. In the current design, sewage will be collected from the houses via sewer network and conveyed by gravity to the lifting station. Lifting stations are designed just to lift the sewage to higher level and deliver it to a nearby sewer manhole on the higher elevation, from there it can flow by again by gravity, rather than pumping directly to a pumping station. This optimized the energy consumption.

95. To optimize the power consumption, the hydraulic design shall follow optimal approach, and the following also considered in design and selection of pumping systems. According to Manual for the Development of Municipal Energy Efficiency Projects in India (jointly developed by Bureau of Energy Efficiency (BEE) and International Finance Corporation in 2008), energy savings, at minimum, of 25% to 40% is possible with appropriate measures. The following measures shall be considered and incorporated into the subproject designs:

(i) Using low-noise and energy efficient pumping systems;
(ii) Efficient Pumping system operation;
(iii) Installation of Variable Frequency Drives (VFDs).

96. **Tree cutting at selected project sites**. As presented in the baseline profile of subproject sites, there are no notable tree cover in the project sites. There are few trees in the Proposed STP Keelakalkandar Kottai site, which may require to be removed for construction of new units. Sewers are proposed within the roads, and therefore no tree cutting envisaged. Following measures need to be implemented to minimize and/or compensate for the loss of tree cover.

(i) Minimize removal of trees by adopting to site condition and with appropriate; layout

[3] Indian Standards require to maintain the noise level of 70 dBA or less during night time. However, in case of STPs/WTPs/Water Supply Head works, where heavy duty pump sets are to be installed and the noise levels may even exceed 80 decibels at 1 m distance, noise level will be measured at the time of commissioning the units and necessary mitigation measures such as noise barriers will be installed if required.

design of pumping stations, particularly at Proposed STP Keelakalkandar kottai site;
(ii) Obtain prior permission for tree cutting;
(iii) Plant and maintain 10 trees for each tree that is removed.

97. **Utilities**. Telephone lines, electric poles and wires, water lines, drains, if exists within the proposed project locations may require to be shifted. All the selected project sites are vacant and unused government lands, there are no notable existing utilities. Sewer lines are proposed within the road way, where there are no utilities. In the outer areas where there is adequate earthen shoulder along the road carriage way, sewer lines can be accommodated in the shoulder. In such cases, the work may require shifting of utilities on the shoulder. To mitigate the adverse impacts due to relocation of the utilities, the contractor, in collaboration with the City Corporation will

(i) identify the locations and operators of these utilities to prevent unnecessary disruption of services during construction phase; and
(ii) instruct construction contractors to prepare a contingency plan to include actions to be done in case of unintentional interruption of services.

98. **Site selection of construction work camps, stockpile areas, storage areas, and disposal areas**. Priority is to locate these near the project location but at least 100m away from residential areas, groundwater wells and surface water bodies.. However, if it is deemed necessary to locate elsewhere, sites to be considered will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems. Residential areas will not be considered for setting up construction camps to protect the human environment (i.e., to curb accident risks, health risks due to air and water pollution and dust, and noise, and to prevent social conflicts, shortages of amenities, and crime). Extreme care will be taken to avoid disposals near forest areas, water bodies, or in areas.

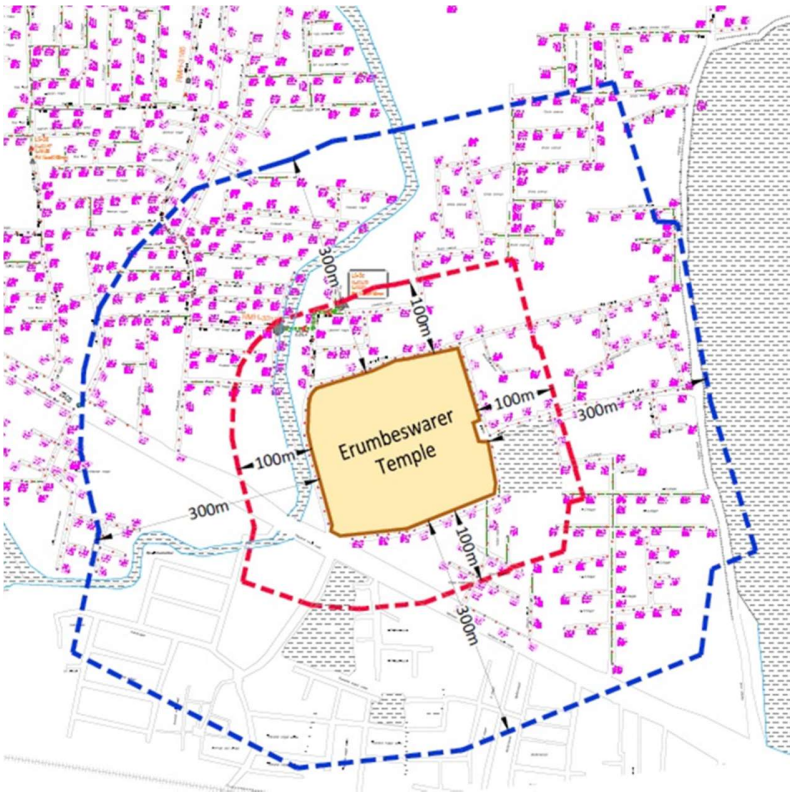
99. **Debris, construction waste, sludge from STP rehabilitation works.** Significant quantities of construction waste, debris etc., will be generated from the proposed repair and rehabilitation works at the existing STP in Panjappur. Dried sludge will be scrapped and removed for disposal. Similarly, it is proposed to remove bottom and side clay layer from the STP ponds. Following measures shall be implemented during the design/preconstruction phase:

(i) Conduct sampling and testing of sludge from all ponds (one composite sample from each pond); parameters to be tested are given in environmental monitoring plan;
(ii) Devise the disposal method based on sludge characteristics (if it is hazardous, it shall be handled and disposed as per the Hazardous waste rules of MoEFCC);
(iii) Sludge (if not hazardous) shall be transported to solid waste disposal sites in the city, and shall be disposed or used as daily cover for other waste;
(iv) Clay layer shall also be tested if it appears to be contaminated by visual appearance; in any case, a top layer of 6 inch shall be considered as part of the sludge and disposed accordingly;
(v) Clay may be used in solid waste disposal site as daily cover on the waste;
(vi) Devise any suitable reuse method based on the quality of clay;
(vii) Employ proper methods for removal of sludge and clay with safety of workers, environment utmost priority; provide on-site awareness sessions and training for workers on working conditions and safe handling of sludge and provide PPEs to workers;
(viii) Any other construction waste / debris shall be properly disposed; priority shall be given to reuse, recycle so that disposal is avoided, provided it is suitable and safe

for such usage.

100. **Site selection of sources of materials**. Significant quantities of coarse aggregate and fine aggregate will be required for construction works. Contractor should procure these materials only from the quarries permitted/licensed by Department of Geology and Mining. Contractor should procure material from existing quarries. No new quarry areas should be created / established for the subproject.

101. **Social and Cultural Resources – Works near Protected Monuments and Chance Finds**. No works are proposed in the protected monument (Erumbeeswarar Temple, see fig) located in the subproject area. However, as this monument is located within the city surrounded by residential areas, some works (sewer lines) are also to be conducted in the regulated area (i.e. up to 300 m from the monument boundary), No direct interference with the monuments anticipated. Moreover, all works within 300 m distance of monument will be conducted with the prior permission of ASI/NMA. Necessary precautionary measures, as listed below, including if any measures suggested by ASI, to be followed. Any work involving ground disturbance can uncover and damage archaeological and historical remains. For this project, excavation will occur in project sites for foundations, laying pipelines, and for construction of underground structures at pumping/lifting stations. Tiruchirappalli is an historical city, there are few sites protected by or ASI. Given its historical importance, there may be archaeological / historical remains under ground, and risk of uncovering them cannot be ruled out, especially in the old town area. City Corporation will follow chance find protocol to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved:



Measures for works in regulated buffer zone (300 m) outside monument

(i) Obtain prior permission from ASI/NMA for the works to be conducted within the regulated zone of monument; submit detailed construction drawings clearly indicating the details of proposed excavations and works, use of equipment and machinery, etc., to ASI for their review; incorporate any suggestions/recommendations of ASI in project design and implementation

(ii) Consult ASI) and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

(iii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be in line with the ASI recommendations
(iv) No equipment causing vibration (eg, pneumatic drills, excavators etc.,) and heavy noise should be used; works shall be conducted manually
(v) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens
(vi) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area

Measures for Chance finds

(i) Construction contractors to follow these measures in conducting any excavation work;
- Create awareness among the workers, supervisors and engineers about the chance finds during excavation work;
- Stop work immediately to allow further investigation if any finds are suspected;
- Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ.

B. Construction Impacts

102. Main civil works in the subproject include laying of sewer lines and construction of sewage pumping and lifting stations at the identified sites.

103. Sewage pumping and lifting stations works will be confined to sites, and construction will include general activities like site clearance, excavation for foundations, and creation of concrete structures will be one of the major construction activities for this project, as many of the subproject components will be fixed to concrete plinths and most will be housed in buildings with at least some concrete structural elements. Most such structures will be constructed from reinforced concrete (RC), where steel reinforcing rods and bars are placed and attached by hand to create an interior skeleton for the foundations, walls, columns, plinths, etc, and heavy-duty metal and timber/plywood formwork is bolted around the outside to build a mould into which pre-mixed concrete is poured. Once the concrete has set, the formwork is removed, and the concrete surface is finished by masons by hand if necessary. Some buildings, such as the pump station, facilities, etc., may be constructed from brick work, in which case this work will be done using standard house-building techniques. Since these works are confined to the boundary of identified sites, there is no direct or significant interference of construction work with the surrounding land use. However, construction dust, noise, use of local roads for transportation of construction material, waste, labour camps etc., will have negative impacts, which needs to be avoided or mitigated properly.

104. Subproject also include linear works (laying of 312 km of tertiary sewers, and 24 km of pumping mains along the roads). This covers entire all uncovered and newly extended area of Tiruchirappalli City. Sewers will be laid along almost all the roads. Small sewers (tertiary sewers) that collect sewage from households will be laid in all streets and roads, the larger sewers that collect sewage from tertiary sewers and convey to pumping stations will be laid mostly on wider main roads. Sewers will be laid by open cut method and Pipe Jacking method will be used for NH, Rail and Canal Crossing.

105. Open cut trenching method of sewer laying involves trench excavation in the road, placing sewers in the trench, jointing and testing, and refilling with the excavated soil. Proposed pipes for tertiary sewers are double wall corrugated (DWC) pipes and uPVC pipes and trunk sewers and conveying mains (pumping mains) are of cast iron. The diameter of gravity sewer ranges from 200 mm to 1000 mm, of which nearly 92% of the sewers are of size between 200 mm and 250 mm. The size of pumping main ranges from 150mm to 700mm. According to the design the sewers will be laid at a depth of 1 to 6.5 m. The width of the trench excavation along the roads will vary from 0.8 m to 1.4 m, and the depth varies from a minimum of 1 m to 6.5 m. Nearly 92 % length of sewers will be laid in trench of depth 3 m of less, and only about 3 % of sewers will be laid deeper between 5 and 6.5 m. The design is optimized to minimize the sewer depth to the extent possible with an optimal combination of sewer depth and pumping requirements. Details of sewer construction are provided in the following Table 16.

Table 15: Sewer Construction

Proposed Depth of Sewers	Total Length of Sewers to be Laid (in m)	% of Length
Up to 2m	220979	71%
2m – 4m	70093	23%
4m – 6.5m	19550	6%

106. Earth work excavation will be undertaken by machine (backhoe excavator) and include danger lighting and using sight rails and barricades. The work will also be supplemented manually where there is no proper working area (e.g., very narrow streets) for the backhouse excavators. As trenches are deep (up to 6.5 m), there is risk of collapse of trenches and/or damage to surrounding buildings, safety risk to pedestrians and traffic. Necessary precautions such as bracing / shoring in the trench will be provided for trenches of more than 1.2 m deep. The normal working hours will be 8 hours daily, the total duration of each stage depends on the soil condition and other local features. Excavated soil will be used for refilling the trench after placing the sewer and therefore residual soil after pipe laying and refilling is not significant. Total earthwork excavation will be nearly 542,565 m^3, of which nearly 98% will be reused, and the remaining 10,851 m^3 of excess soil needs to be disposed safely.

107. Although sewer laying work involves quite simple techniques of civil work, the invasive nature of excavation in the urban area where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as residents, businesses, and the community in general. These anticipated impacts are temporary and for short duration, however, needs to be mitigated.

108. Comprising old town area of Tiruchirappalli, project area is mostly characterized by high density residential areas and very narrow streets and roads. Outer areas are comparatively less dense, however, erstwhile village areas which are added to corporation, and which are part of subproject area, are also have dense habitations in the core village areas. Outer areas are mainly a mix of old village habitations with narrow streets, and few well planned newly developed / developing residential layouts in the lands previously under agricultural use. Old and new developments are intercepted with agricultural and vacant lands.

109. Anticipated impacts during the construction phase are discussed below along with appropriate mitigation measures to avoid, minimize or mitigate those impacts to acceptable levels.

110. **Sources of Materials**. Significant amount of sand and coarse aggregate will be required for this project, which will be sourced from quarries. Quarries inevitably cause extensive physical changes; as construction materials are excavated from the ground, leaving large cavities, or levelling hillsides, etc. The physical damage caused by quarries is controlled by allowing them to operate within specific limited areas only, so the damage is restricted in extent and not allowed to spread indiscriminately. New quarries are subject to a rigorous process of environmental assessment to ensure appropriate siting and adequate environmental controls on the operation. It will therefore be important to ensure that construction materials for this project are obtained from existing government approved licensed quarries only, to ensure these controls are in place. In Tiruchirappalli, construction sand is normally obtained from Public works department, GoTN's authorized mining areas , and gravel and aggregate is available locally in Tiruchirappalli district (about 10 km from the city). Contractor should not create any new borrow pits / quarries. The contractor should also make a concerted effort to re-use as much excavated material from this project as possible. The construction contractor will be required to:

(i) Obtain construction materials only from government approved quarries with prior approval of PIU;
(ii) PIU to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval;
(iii) Contractor to submit to PIU on a monthly basis documentation on material obtained from each sources (quarry/ borrow pit);
(iv) Avoid creation of new borrow areas, quarries etc., for the project; if unavoidable, contractor to obtain all clearances and permissions as required under law, including Environmental Clearance prior to approval by PIU.

111. **Air Quality**. Construction work, especially from earthwork activities, coupled with dry and windy working conditions, material and debris transport, and works along the public roads carrying significant traffic, have high potential to generate dust. Significant quantities of earthwork will be conducted in the subproject, spread all over the project area. Nearly 542,565 m3 of earthwork is anticipated from the subproject, and 98% of which will be reused for filling the trenches. Also emissions from construction vehicles, equipment, and machinery used for excavation and construction will induce impacts on the air quality. Anticipated impacts include dust and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons. Dust generation from construction work in individual and confined work sites lifting and pumping stations etc., will be mainly during the initial construction phase of earth work, as the site is confined, dust can be effectively controlled with common measures. Dust generation will be significant during sewer laying along the roads. Increase in dust/ particulate matter in ambient air is detrimental, and may have adverse impacts on people and environment. To mitigate the impacts, construction contractors will be required to:

For all construction works

(i) Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations; provide 2 m high barricades for the sewer works
(ii) Damp down the soil and any stockpiled material on site by water sprinkling; (3-4 times a day - before the start of work, 1-2 times in between, and at the end of the day); when working in the roads there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving;
(iii) Reduce the need to sprinkle water by stabilizing surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface

soils in a stabilized condition;

(iv) Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process;

(v) Cover the soil stocked at the sites with tarpaulins and surround by dust screens;

(vi) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work area. Limiting soil disturbance will minimize dust generation;

(vii) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks;

(viii) Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area; minimize the drop height when moving the excavated soil

(ix) Clean wheels and undercarriage of haul trucks prior to leaving construction site;

(x) Ensure that all the construction equipment, machinery are fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate.

(xi) no vehicles or plant to be left idling at site generators to be at placed maximum distance from properties

(xii)

For sewer works

(i) Barricade the construction area using hard barricades (of 2 m height) on both sides

(ii) Initiate site clearance and excavation work only after barricading of the site is done

(iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.), to the barricaded area;

(iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area

(v) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones;

(vi) Conduct work sequentially - excavation, sewer laying, backfilling; testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done.

(vii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for back filling, this will avoid stocking of material, and minimize the dust.

(viii) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from backfilled section. Road restoration shall be undertaken immediately.

112. **Immediate road restoration after refilling the trench**. Excavation and refilling activities disturb the top soil, and under the influence of wind, traffic, pedestrians, and other activities etc., produces dust. There is large potential to generate significant quantities of dust after refilling the trench, and prior to road relaying. It is a common practice not to restore the road immediately after refilling the trench so as to allow sufficient time for the refilled material to stabilize naturally. Given the dry and windy conditions, and heavy traffic and other activities along the roads, the refilled trenches with loose top soil along the roads will generate maximum dust, and create very unhealthy conditions. Moreover, as the barricades/dust screens will removed after the trench is refilled, there will be absolutely nothing to control the dust generation. Dust control activities like

wetting of top soil will not be effective given the site conditions. It is therefore necessary to restore/relay the road surface immediately or take suitable steps to arrest the dust. Soil consolidation technique shall be used so that road can be restored immediately.

(i) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.

113. **Surface Water Quality**. . Run-off from stockpiled materials and chemicals from fuels and lubricants during construction works can contaminate water quality of the receiving water bodies and streams/rivers. Project area receives rainfall in southwest and northeast monsoon seasons, between June/July to November/December. Periyakulam, a big lake,and Vathiyar kulam lake are located within the project area, and Koraiyar river flows in the west of the project area, The Uyyakondan channel also flows through the project area besides, there are canals and other small water bodies in and around the project area. Project area mostly drains into these water bodies. It is important that runoff from the construction areas, which may contain silt and chemical traces do not enter these water bodies. Impact will be temporary, and but needs to be mitigated. Construction contractor will be required to:

(i) All earthworks be conducted during the dry season to prevent the problem of soil/silt run-off during rains;
(ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; do not stock earth/material close to water bodies (at least100 m)
(iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used;
(iv) Install temporary silt traps, oil traps, or sedimentation basins along the drainage leading to the water bodies;
(v) Place storage areas (with impermeable surface) for fuels and lubricants away from any drainage leading to water bodies; these should be at least 100 m away from water bodies and groundwater wells;
(vi) Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management;
(vii) Dispose any wastes generated by construction activities in designated sites; and
(viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).

114. Construction of bridges across canals/streams to cross over sewers will have negative impact on water quality of canals/streams. Following measures to be implemented:

(i) Conduct works in the water body (especially foundation work) only during no-flow season;
(ii) Select a construction method which is less disruptive (e.g., precast type);
(iii) Do not spill construction chemicals, fuels, lubricants in the water body;
(iv) Clean up the site immediately after construction is complete; construction debris, materials, etc., shall be cleared and pre project condition restored or improved.

115. **Surface and Groundwater Quality**. Another physical impact that is often associated with excavation is the effect on drainage and the local water table if groundwater and surface water

collect in the voids. In the project area, groundwater table is much deeper than the anticipated excavation depth and therefore this impact is not envisaged. However during the rains, water will be collected in open pits and trenches. The water collected in excavated pits will contain silt and disposal of this in drainage channels lead to silting. To avoid this the contractor needs to be implement the following measures:

(i) As far as possible control the entry of runoff from upper areas into the excavated pits, and work area by creation of temporary drains or bunds around the periphery of work area;
(ii) Pump out the water collected in the pits / excavations to a temporary sedimentation pond; dispose off only clarified water into drainage channels/streams after sedimentation in the temporary ponds;
(iii) Consider safety aspects related to pit collapse due to accumulation of water.

116. **Generation of Construction Wastes.** Solid wastes generated from the construction activities are excess excavated earth (spoils), discarded construction materials, cement bags, wood, steel, oils, fuels and other similar items. Domestic solid wastes may also be generated from the workers' camp. Improper waste management could cause odor and vermin problems, pollution and flow obstruction of nearby watercourses and could negatively impact the landscape. Total earthwork excavation will be nearly 542,565 m3, of which nearly 98% will be reused, and the remaining 10,851 m3 of excess soil needs to be disposed safely. The following mitigation measures to minimize impacts from waste generation shall be implemented by the contractor:

(i) Prepare and implement a Construction Waste (Spoils) Management Plan (format is given in Appendix 3);
(ii) As far as possible utilize the debris and excess soil in construction purpose, for example for raising the ground level or construction of access roads etc.;
(iii) Avoid stockpiling any excess spoils at the site for long time. Excess excavated soils should be disposed off to approved designated areas immediately;
(iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should located away from residential areas, forests, water bodies and any other sensitive land uses;
(v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; create a compost pit (with impermeable bottom and sides) at workers camp sites for disposal of biodegradable waste; non-biodegradable/recyclable material shall be collected separately and sold in the local recycling material market;
(vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed off via licensed (by TNPCB) third parties;
(vii) Prohibit burning of construction and/or domestic waste;
(viii) Ensure that wastes are not haphazardly thrown in and around the project site; provide proper collection bins, and create awareness to use the dust bins; recycle waste material where possible
(ix) Conduct site clearance and restoration to original condition after the completion of construction work; PIU to ensure that site is properly restored prior to issuing of construction completion certificate.

117. Significant quantities of construction waste, debris etc., will be generated from the proposed repair and rehabilitation works at the existing STP in Panjappur. These are discussed in the preconstruction stage impacts, and measures as suggested shall be implemented.

118. **Noise and Vibration Levels**. Except new pumping station site near slaughterhouse, all the work sites pumping stations, lifting stations and sewers are located within the town area. Sewer lines are spread over entire project area. All these sites are located within habitations, where there are houses, schools and hospitals, religious places and businesses. The sensitive receptors are the general population in these areas. Increase in noise level may be caused by excavation, particularly breaking of cement concrete or bitumen roads for laying of sewers, operation of construction equipment, and the transportation of equipment, materials, and people. Vibration generated from construction activity, for instance from the use of pneumatic drills, will have impact on nearby buildings. Trenches deeper than 2-3 m require removal of rocks (soft to hard), will generate heavy noise and vibrationf. This impact is negative short-term, and reversible by mitigation measures. The construction contractor will be required to:

(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance, especially near schools and other sensitive receptors
(ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimise sound impact to surrounding sensitive receptor; and
(iii) Maintain maximum sound levels not exceeding 70 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s.
(iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; if any building at risk, structural survey be completed prior to work, to provide baseline in case any issues from vibration, and if building is structurally unsound that measures taken to avoid any further damage
(v) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;
(vi) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

119. Besides the above, works in the regulated buffer zone of protected monuments requires special precautions to avoid any potential disturbance / damage to the monuments. Noise, dust and vibration emanating from the works, if not properly planned or executed may disturb / damage the monument. Following measures are to be implemented:

(i) Obtain prior permission from ASI/NMA for the works to be conducted within the regulated zone of monument; submit detailed construction drawings clearly indicating the details of proposed excavations and works, use of equipment and machinery, etc., to ASI for their review; incorporate any suggestions/recommendations of ASI in project design and implementation
(ii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be in line with the ASI recommendations
(iii) No equipment causing vibration (eg, pneumatic drills, excavators etc.,) and heavy noise should be used; works shall be conducted manually
(iv) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens
(v) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area

120. **Accessibility and Traffic Disruptions**. Excavation along the roads for laying of sewers, hauling of construction materials and operation of equipment on-site will cause traffic problems. There are several roads (national and state highways, and other major roads providing regional connectivity) in the project area that carry considerable traffic. These roads also centres of commercial activities. Internal roads in the project area are narrow, except in the newly developing residential layout which comparatively have wide roads. In old city area, roads are very narrow and congested with activities, traffic and pedestrians. As the sewer lines are proposed to be laid within the road carriage way, it will disrupt the traffic in one-traffic lane. In the narrower roads, sewers will be laid in the center of the road, and therefore during the work traffic movement will be mostly disrupted.

121. Works related to all the remaining components (lifting and pumping stations) will be confined to the selected sites, therefore there is no direct interference of these works with the traffic and accessibility.

122. Hauling of construction material, equipment, construction waste, etc., to and from the work site may increase the road traffic on local roads. This will further inconvenience the local community and road users. Potential impact is negative but short term and reversible by mitigation measures. The construction contractor will be required to:

Sewer works

(i) Prepare a sewer work implementation plan in each zone separately and undertake the work accordingly; ensure that for each road where the work is being undertaken there is an alternative road for the traffic diversion; take up the work in sequential way so that public inconvenience is minimal;
(ii) Plan the sewer work in coordination with the traffic police; provide temporary diversions, where necessary with clear signage and effectively communicate with general public;
(iii) Avoiding conducting work in all roads in a colony at one go; it will render all roads unusable due to excavations at the same time, creating large scale inconvenience
(iv) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones;
(v) Confine work areas in the road carriageway to the minimum possible extent; all the activities, including material and waste/surplus soil stocking should be confined to this area. Proper barricading should be provided; avoid material/surplus soil stocking in congested areas – immediately removed from site/ or brought to the as and when required;
(vi) Limit the width of trench excavation as much as possible by adopting best construction practices; adopt vertical cutting approach with proper shoring and bracing; this is especially to be practiced in narrow roads and deeper sewers; if they deep trenches are excavated with slopes, the roads may render completely unusable during the construction period;
(vii) Leave spaces for access between mounds of soil to maintain access to the houses/properties; access to any house or property shall not be blocked completely; alternative arrangements, at least to maintain pedestrian access at all times to be provided;
(viii) Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the access;

(ix) Inform the affected local population in advance about the work schedule, a week before, and a day before start of work
(x) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum;
(xi) Keep the site free from all unnecessary obstructions;
(xii) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services;
(xiii) At work site, public information/caution boards shall be provided including contact for public complaints.

Hauling (material, waste/debris and equipment) activities

(i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites;
(ii) Schedule transport and hauling activities during non-peak hours (peak hours 7 to 10 AM and 4 to 7 PM);
(iii) Locate entry and exit points in areas where there is low potential for traffic congestion;
(iv) Drive vehicles in a considerate manner;
(v) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.

123. **Socio-Economic – Income**. Sites for all projects components are carefully selected in government owned vacant lands and therefore there is no requirement for land acquisition or any resettlement. Blocking of access to the business / livelihood activities, especially during pipeline laying along the roads, may impact the income of households. However, given the alignment of pipeline within the road carriage way, and also the measures suggested for ensuring accessibility during sewer works, notable but temporary impact is envisaged. Some shops and other premises along the roads may lose business income if the access will be impeded by excavation of trenches, the presence of heavy vehicles and machinery, etc. Access disruption to hospitals, socio cultural places etc., will inconvenience public. Implementation of the following best construction measures will avoid the disturbance reduce the inconvenience and disturbance to the public. Resettlement and social issues are being studied in a parallel resettlement planning study of this subproject.

(i) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations;
(ii) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches;
(iii) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around;
(iv) Control dust generation;
(v) Immediately consolidate the backfilled soil and restore the road surface; this will also avoid any business loss due to dust and access inconvenience of construction work.

(vi) Employee best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive features like hospitals, and schools;
(vii) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and
(viii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.

124. **Socio-Economic – Employment**. Manpower will be required during the 24-months construction stage. This can result in generation of temporary employment and increase in local revenue. Thus potential impact is positive and long-term. The construction contractor will be required to employ local labour force as far as possible.

125. **Occupational Health and Safety**. Workers need to be mindful of the occupational hazards which can arise from working in confined areas such as trenches, working at heights, near the heavy equipment operating areas etc.,. Potential impacts are negative and long-term but reversible by mitigation measures. The construction contractor will be required to:

(i) Follow all national, state and local labor laws (indicative list is in Appendix 2);
(ii) Develop and implement site-specific occupational health and safety (OHS) Plan, informed by OHS risk assessment seeking to avoid, minimise and mitigate risk, which shall include measures such as: (a) safe and documented construction procedures to be followed for all site activities; (b) ensuring all workers are provided with and use personal protective equipment; (c) OHS Training[4] for all site personnel, (d) excluding public from the work sites; and (e) documentation of work-related accidents; Follow International Standards such as the World Bank Group's Environment, Health and Safety Guidelines[5]'
(iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites;
(iv) Secure all installations from unauthorized intrusion and accident risks;
(v) Provide Health and Safety orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;
(vi) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted;
(vii) Ensure the visibility of workers through their use of high visibility vests and other PPE when working in or walking through heavy equipment operating areas;
(viii) Ensure moving equipment is outfitted with audible back-up alarms;
(ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for

[4] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

[5] http://www.ifc.org/wps/wcm/connect/a99ab8804365b27aa60fb6d3e9bda932/EHS-Guidelines+101-Webinar.pdf?MOD=AJPERES

storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and

(x) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively;

(xi) Provide supplies of potable drinking water;

(xii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances.

126. **Community Health and Safety**. Sewers works and deep excavations along the roads and narrow streets, and hauling of equipment and vehicles have potential to create safety risks to the community. Deep excavations without any proper protection may endanger the close by buildings. Hazards posed to the public, specifically in high-pedestrian areas may include traffic accidents and vehicle collision with pedestrians. Potential impact is negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Confine work areas; prevent public access to all areas where construction works are on-going through the use of barricading and security personnel;

(ii) Attach warning signs, blinkers to the barricading to caution the public about the hazards associated with the works, and presence of deep excavation

(iii) Minimize the duration of time when the sewer trench is left open through careful planning; plan the work properly from excavation to refilling and road relaying

(iv) Control dust pollution – implement dust control measures as suggested under air quality section;

(v) Ensure appropriate and safe passage for pedestrians along the work sites;

(vi) Provide road signs and flag persons to warn of on-going trenching activities;

(vii) Restrict construction vehicle movements to defined access roads and demarcated working areas (unless in the event of an emergency);

(viii) Enforce strict speed limit (20-30 kmph) for plying on unpaved roads, construction tracks;

(ix) Provide temporary traffic control (e.g. flagmen) and signs where necessary to improve safety and smooth traffic flow;

(x) Where traffic is diverted around crossings, traffic control or careful selection of the exit from the working areas will be provided with the aim of ensuring that vehicles join the road in a safe manner;

(xi) At sensitive locations particularly where there are schools and markets close to the road, awareness of safety issues will be raised through neighbourhood awareness meetings;

(xii) All drivers and equipment operators will undergo safety training;

(xiii) Maintain regularly the construction equipment and vehicles; use manufacturer-approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

109. **Construction Camps.** Contractor may require to set up construction camps – for temporary storage of construction material (sewer, cement, steel, fixtures, fuel, lubricants etc.,), and stocking of surplus soil, and may also include separate living areas for migrant workers. The contractor will however be encouraged to engage local workers as much as possible. Operation of work camps can cause temporary air, noise and water pollution, and may become a source of conflicts, and unhealthy environment if not operated properly. Potential impacts are negative but short-term and reversible by mitigation measures. The construction contractor will be required to:

(i) Consult PIU before locating project offices, sheds, and construction plants;
(ii) Select a camp site away from residential areas (at least 100m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation
(iii) Avoid tree cutting for setting up camp facilities;
(iv) Provide a proper fencing/compound wall for camp sites;
(v) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas
(vi) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit;
(vii) Ensure conditions of liveability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers;
(viii) Camp shall be provided with proper drainage, there shall not be any water accumulation;
(ix) Provide drinking water, water for other uses, and sanitation facilities for employees; drinking water should be regularly tested to confirm that drinking water standards are met
(x) Prohibit employees from cutting of trees for firewood; contractor should provide cooking fuel (cooking gas); fire wood not allowed;
(xi) Train employees in the storage and handling of materials which can potentially cause soil contamination;
(xii) Wastewater from the camps shall be disposed properly either into sewer system; if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements; (100 m away from surface water body or groundwater well)
(xiii) Recover used oil and lubricants and reuse or remove from the site;
(xiv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for bio degradable waste, and non-biodegradable/recyclable waste shall be collected and sold in local market;
(xv) Remove all wreckage, rubbish, or temporary structures which are no longer required; and
(xvi) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site.

C. Operation and Maintenance Impacts

127. Operation and Maintenance of the sewerage system will be carried out by TCC . Operation will involve collection and conveyance of wastewater from houses to nearest lifting / pumping stations; operation of lifting/pumping stations to pump accumulated sewage main pumping stations; operation of main pumping stations to pump accumulated sewage to STP, treatment of sewage at STP to meet the disposal standards; and final disposal of treated wastewater, and treatment and disposal of sludge. STP is proposed under DBOT modality, and the contractor will prepare detailed designs for STP including the outfall sewer and disposal arrangements. At present, treatment and disposal system is designed in outline only (preliminary design); and during the detailed design phase, the assessment will be updated accordingly.

128. **Treated wastewater disposal from STP**. As per the preliminary design proposals, it is proposed to dispose treated wastewater into Uyyakondan channel, flowing at 2.7 km from the STP site. This is a major irrigation channel, taking off from Cauveri River at Kulathalai Kattnali, upstream of Tiruchirappalli, and flows about 40-50 km prior to reaching the city, and then flows through the centre of Tiruchirappalli city for about 18 km, carrying storm water, and wastewater from the unsewered city areas. It finally discharges into Valavandhan kottai pond/tank at Thuvakudi, about 20-22 km from the proposed STP discharge point. Channel water is used for only irrigation. No water quality data available at present, however, channel mostly carries wastewater within the city, and therefore existing quality likely to be poor except during upstream flow. Baseline water quality of channel will be established during the detailed design phase. Discharge from STP will be properly treated to meet the disposal standards, and therefore no notable impacts envisaged on channel water quality. This open channel flows for another 20-22 km downstream, allowing further dilution via self-purification prior to reaching the tank/pond. .Wastewater is treated to set standards at the STP prior to its disposal into Uyyakondan channel. Considering the existing status of channel, and the degree of treatment and self-purification via 20-22 km turbulent flow in open channel, no significant impacts envisaged. Proper systems should be put in place at the proposed STP to ensure that treated wastewater at all times meet the stipulated standards prior to its disposal into this channel.

129. As stated above, at present the treatment and disposal system design is preliminary, and as per this the existing capacity of channel is adequate to convey the discharge to downstream water bodies. This proposal will however be further reviewed by DBOT Contractor during detailed design to ensure its techno economic and environmental feasibility by studying the water quality and hydrologic characteristics of the receiving water bodies (channel and pond/tank) to avoid any inundation risks due to channel discharge from STP and possible water quality degradation etc., Any disposal action will require permission/consent of TNCPB, which will be obtained during the detailed design phase, and final discharge point will be firmed up accordingly.

130. Following measures are suggested for detailed design stage to finalize disposal arrangements:

(i) Conduct baseline water quality assessment of Uyyakondan channel, and Valavandhan kottai pond/tank at discharge points; assess impacts on water quality due to STP discharge, and ensure that water quality is not degraded from the existing condition.
(ii) Assess hydrological parameters of receiving water bodies (Uyyakondan channel and Valavandhan kottai pond/tank) for safe discharge of STP water, implement appropriate measures as required based on the assessment to eliminate risk of inundation.
(iii) Obtain TNPCB and Public Works Department (PWD) consent to dispose treated wastewater into Uyyakondal channel

131. **Sewage sludge**. No estimate sewage sludge generation from the STP is available. Since start of its operation, sludge has not been removed from the ponds. Sewage sludge contains harmful substances such as bacteria and pathogens, and nutrients like nitrogen, phosphates. Improper handling and disposal of the sludge will have adverse impacts on health and environment. A sludge management plan will be prepared; this will be simple activity for the WSP based STP. The ponds will be allowed to dry naturally, and the sludge will be collected from the basins by mechanical means. Sludge will be further air dried/composted in sludge drying beds for adequate time. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an

excellent organic fertilizer for application to the land. The reuse of sludge should be preceded by rigorous bacteriological tests to confirm that the treatment methods render all dried sludge and effluent free from enteric bacteria and pathogens, so that it is safe to humans, animals and crops. Sludge shall also need to be periodically tested for presence of heavy metals, to check if it meets the compost standards specified the Solid Waste Management Rules, 2016.

132. **Quality of Raw Sewage**. As discussed previously, one of the critical aspects in STP operation is, change in raw sewage characteristics at inlet of STP may affect the process and output quality. The system is designed for municipal wastewater, which does not include industrial effluent. Characteristics of industrial effluent widely vary depending on the type of industry, and therefore disposal of effluent into sewers may greatly vary the inlet quality at STP, and will upset process and affect the efficiency. Tiruchirappalli houses various small and medium scale units; food, cotton, textiles, wood, paper, plastic, chemical, engineering, electrical units are established.. Although proposed sewer network will not cater to industrial wastewater, It is important to ensure that no wastewater from industries enters the sewer network with strict monitoring and enforcement. Following measures are to be implemented:

(i) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers;
(ii) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB.

133. **Odor and Noise from Sewage lifting and pumping stations**. Various measures are included in the design of these facilities giving utmost importance to odor and noise. Therefore it is anticipated there will not be any significant generation of odor or noise that will impact the surrounding households. Following measures are to be implemented during the operation:

(i) Strictly follow standard operating procedures / operational manual for operation and maintenance of lifting and pump stations.
(ii) Ensure that operating staff is properly trained, and have clear understanding of odor issues vis a vis its relation with operational practices.
(iii) Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells.
(iv) Conduct periodic H_2S monitoring at pumping and lifting stations using handheld H_2S meters.[6]

134. **Sewer network.** During the system design life (15/30 years for mechanical/civil components) it shall not require major repairs or refurbishments and should operate with little

[6] There are no any standards notified by Government of India or Government of Tamil Nadu. However, Central Pollution Control Board (CPCB) has stipulated Guidelines on Odor Pollution and its Control. These guidelines deal only with the basics of odor pollution, its sources and measurement, technologies for its control etc. but do not specify any threshold limits for odor-causing pollutants. Therefore, as part of mitigation, provision for odor control measures has been made in the sewage pumping stations for all UGSS subprojects. However, in case of STPs, the odor-causing processing units will be located far off to the extent possible within the premises so as to mitigate the odor nuisance. Further, the technology for treating sewage plays a vital role since release of gases like H2S cannot be avoided in the process involving anaerobic decomposition whereas release of H2S will almost be nil in case of aerobic treatment. PIU and design engineers have not specified any odor standards adopted elsewhere in the preliminary design as not to limit the technology that can be considered by the bidders in the treatment of domestic sewage. Sufficient mitigation measures have been taken for all sewage pumping stations and will be taken for all STPs when finalizing/revising the IEEs based on the detailed engineering design.

maintenance beyond routine actions required to keep the equipment in working order. The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Any repairs will be small-scale involving manual, temporary, and short-term works involving regular checking and recording of performance for signs of deterioration, servicing and replacement of parts.

135. There are also certain environmental risks from the operation of the sewer system, most notably from leaking sewer pipes as untreated faecal material can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the operating agency establishes a procedure to routinely check the operation and integrity of the sewers, and to implement rapid and effective repairs where necessary. There is an occupation health risk to workers engaged in sewer maintenance activities. Following measures should be followed:

(i) Establish regular maintenance program, including:
   a. Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas
   b. Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration; and
   c. Monitoring of sewer flow to identify potential inflows and outflows
   d. Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages);

(ii) Maintain records; review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed;

(iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system.

(iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers.

(v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc.

(vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance.

(vii) Provide all necessary personnel protection equipment.

(viii) Do not conduct manual cleaning of sewers; for personnel engaged sewer maintenance work, there is a risk due to oxygen deficiency and harmful gaseous emissions (hydrogen sulphide, methane, etc.); provide for adequate equipment (including oxygen masks) for emergency use.

VI. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Overview

136. The active participation of stakeholders including local community, NGOs/CBOs, etc., in all stages of project preparation and implementation is essential for successful implementation of the project. It will ensure that the subprojects are designed, constructed, and operated with utmost consideration to local needs, ensures community acceptance, and will bring maximum benefits to the people. Public consultation and information disclosure is a must as per the ADB policy.

137. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders of the subproject are: residents, shopkeepers and businesspeople who live and work near sites where facilities will be built (sewer network and pumping/lifting stations), government and utility agencies responsible for provision of various services in project area. Secondary stakeholder are: NGOs and CBOs working in the area, community representatives, beneficiary community in general, government agencies, TNUIFSL, Government of Tamil Nadu and the ADB.

B. Public Consultation

138. The public consultation and disclosure program is a continuous process throughout the project implementation, including project planning, design and construction.

1. Consultation during Project Preparation

139. The subproject proposal is formulated by Tiruchirappalli corporation in consultation with the public representatives bodies in the project area to suit their requirements.

140. Focus-group discussions with affected persons and other stakeholders were conducted to learn their views and concerns. A socio economic household survey has been conducted in the project area, covering sample households, to understand the household characteristics, health status, and the infrastructure service levels, and also the demand for infrastructure services. General public and the people residing along the project activity areas were also consulted. A project area level consultation workshop is conducted in Tiruchirappalli with the public representatives and prominent citizens, NGOs etc. The formal consultations were held on November 3, 2017 (details are provided in Appendix 9). .

141. It was observed that people are willing to extend their cooperation as the proposed project will provide sewerage system, enhance basic infrastructure service levels and overall living standard of the public. The public expressed their concern regarding the nuisance and disturbance (dust, road closure and traffic management activities) during the construction stage which can have impact on their day to day activities. Construction on narrow roads is seen as biggest hindrance. Public demanded for advance notice before construction and proper warning signs along the construction area to avoid accidents and inconvenience. Public opined that an appropriate operation and maintenance system should be in place for sewerage system for its best functioning and to have the maximum health and aesthetic benefits. Issue of bad odors from lifting and pumping stations located close to the houses is also raised. Project team explained proposed EMP to manage the negative impacts, including odor prevention and control measures included in the design and operation.

2. Consultation during construction

142. Prior to start of construction, PIU will conduct information dissemination sessions at various places and solicit the help of the local community, leaders/prominent for the project work. Focus group meetings will be conducted to discuss and plan construction work (mainly pipeline work) with local communities to reduce disturbance and other impacts and also regarding the project grievance redress mechanism. Project information and construction schedule will be provided to the public via mass media (newspapers, television, ULB websites etc.,). A constant communication will be established with the affected communities to redress the environmental issues likely to surface during construction phase. Contractor will provide prior public information (in Tamil and English) about the construction work in the area, , 7 days prior to the start of work and again a day before the start of work via pamphlets (a sample public information template is provided in Appendix 4). At the work sites, public information boards will also be provided to disseminate project related information.

C. Information Disclosure

143. Executive summary of the IEE will be translated in Tamil and made available at the offices of PMU, PIU, and TCC and also displayed on their notice boards. Hard copies of the IEE will be accessible to citizens as a means to disclose the document and at the same time creating wider public awareness. Electronic version of the IEE in English and Executive Summary in Tamil will be placed in the official website of the TNUIFSL and TCC after approval of the IEE by ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

144. Public information campaigns to explain the project details to a wider population will be conducted. Public disclosure meetings will be conducted at key project stages to inform the public of progress and future plans. Prior to start of construction, the PIU will issue Notification on the start date of implementation in local newspapers A board showing the details of the project will be displayed at the construction sites for the information of general public.

145. Local communities will be continuously consulted regarding location of construction camps, access and hauling routes and other likely disturbances during construction. The road closure together with the proposed detours will be communicated via advertising, pamphlets, radio broadcasts, road signage, etc.

VII. GRIEVANCE REDRESS MECHANISM

146. A common GRM will be in place to redress social, environmental or any other project related grievances. The GRM described below has been developed in consultation with stakeholders. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The campaign will ensure that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements per project entitlement matrix, and Project Management Unit (PMU) and Trichy Project Implementation Unit (PIU) will ensure that their grievances are addressed.

147. Affected persons will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes or through telephone hotlines at accessible locations, by e-mail, by post, or by writing in a complaints register in ULB or PIU or TCMC offices. PIU Safeguards officer will have the responsibility for timely grievance redress on safeguards and gender issues and for registration of grievances, related disclosure, and communication with the aggrieved party.

148. GRM provides an accessible, inclusive, gender-sensitive and culturally appropriate platform for receiving and facilitating resolution of affected persons' grievances related to the project. A two-tier grievance redress mechanism is conceived, one, at project level and another, beyond project level. For the project level GRM, a Grievance Redress Committee (GRC) will be established in PIUs; Safeguards officer, supported by the social, gender and environmental safeguards specialist of CMSC will be responsible for creating awareness among affected communities and help them through the process of grievance redress, recording and registering grievances of non-literate affected persons.

149. GRM aims to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. All grievances – major or minor, will be registered. Documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved will be undertaken. PIU will also be responsible for follow-through for each grievance, periodic information dissemination to complainants on the status of their grievance and recording their feedback (satisfaction/dissatisfaction and suggestions).

150. In case of grievances that are immediate and urgent in the perception of the complainant, the contractor, and supervision personnel of the CMSC and PIU will resolve the issue on site, and any issue that is not resolved at this level will be dealt at PIU head level for immediate resolution. Should the PIU fail to resolve any grievance within the stipulated time period, the unresolved grievances will be taken up at TCMC level. In the event that certain grievances cannot be resolved even at TCMC level, particularly in matters related to land purchase/acquisition, payment of compensation, environmental pollution etc., they will be referred to the district level Grievance Redress Committee (GRC) headed by the District Collector. Any issue which requires higher than district level inter-departmental coordination or grievance redress, will be referred to the state level Steering Committee.

151. GRC will meet every month (if there are pending, registered grievances), determine the merit of each grievance, and resolve grievances within specified time upon receiving the complaint-failing which the grievance will be addressed by the state-level Steering Committee. The Steering Committee will resolve escalated/unresolved grievances received.

152. **Composition of GRC**. GRC will be headed by the District Collector, and members include: PIU head, Safeguards Officer of PIU, representative of TNPCB, one elected representative / prominent citizen from the area, and a representative of affected community. GRC must have a women member.

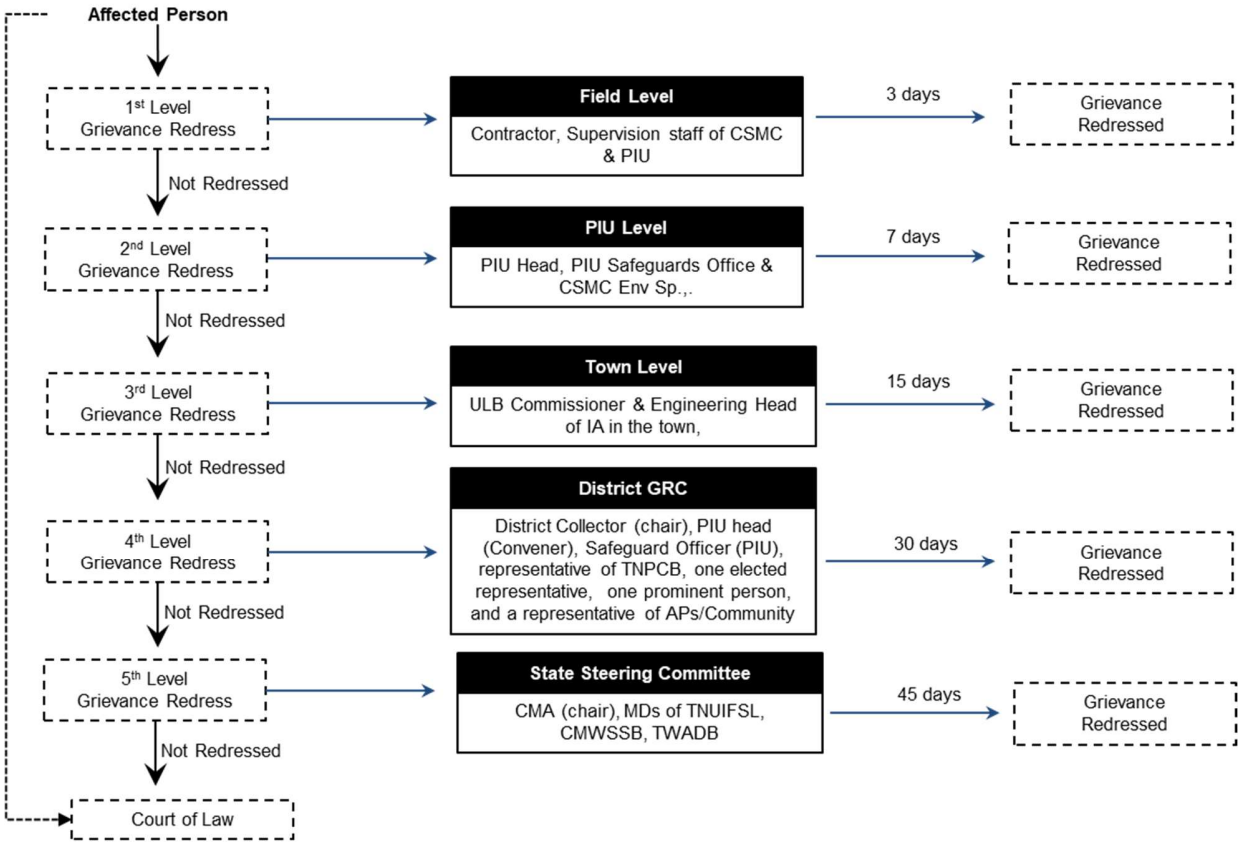
153. **State level steering committee** will include Commissioner of Municipal Administration as chair, member include managing directors of TNUIFSL, CMWSSB, TWAD Board and others as necessary.

154. **Areas of Jurisdiction.** The areas of jurisdiction of the GRC, headed by the District Collector will be (i) all locations or sites within the district where subproject facilities are proposed, or (ii) their areas of influence within the District. The SC will have jurisdictional authority across the state (i.e., areas of influence of subproject facilities beyond district boundaries, if any).

155. The multi-tier GRM for the project is outlined in Figure 11, each tier having time-bound schedules and with responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required. The GRC will continue to function throughout the

project duration. The implementing agencies/ULBs shall issue notifications to establish the respective PIU level grievance redress cells, with details of composition, process of grievance redress to be followed, and time limit for grievance redress at each level.

Figure 11: Proposed TNUFIP Grievance Redress Mechanism



156. **Recordkeeping**. Records of all grievances received, including contact details of complainant, date the complaint was received, nature of grievance, agreed corrective actions and the date these were effected and final outcome will be kept by PIU (with the support of CMSC) and submitted to PMU.

157. **Information dissemination methods of the GRM**. The PIU, assisted by CMSC will be responsible for information dissemination to affected persons and general public in the project area on grievance redress mechanism. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated. The campaign will ensure that the poor, vulnerable and others are made aware of grievance redress procedures and entitlements per agreed entitlement matrix including. whom to contact and when, where/ how to register grievance, various stages of grievance redress process, time likely to be taken for redress of minor and major grievances, etc. Grievances received and responses provided will be documented and reported back to the affected persons. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the PIU, offices, ULB notice boards and on the web, as well as reported in the semi-annual environmental and social monitoring reports to be submitted to ADB. A Sample Grievance Registration Form has been attached in Appendix 5.

158. **Periodic review and documentation of lessons learned.** The PMU will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the PIU's ability to prevent and address grievances.

159. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the respective PIU. Cost estimates for grievance redress are included in resettlement cost estimates.

160. **Country legal procedure**. An aggrieved person shall have access to the country's legal system at any stage, and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

161. **ADB's Accountability Mechanism.** In the event that the established GRM is not in a position to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters or the ADB India Resident Mission. The complaint can be submitted in any of the official languages of ADB's developing member countries. Before submitting a complaint to the Accountability Mechanism, it is recommended that affected people make a good faith effort to resolve their problems by working with the concerned ADB operations department (in this case, the resident mission). Only after doing that, and if they are still dissatisfied, they could approach the Accountability Mechanism. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

162. An environmental management plan (EMP) has been developed to provide mitigation measures to reduce all negative impacts to acceptable levels.

163. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between TNUIFSL, PMU, TCMC, PIU, consultants and contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (i) provide a pro-active, feasible and practical working tool to enable the measurement and monitoring of environmental performance on site; (ii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the subproject; (iii) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (iv) ensure that safety recommendations are complied with. The EMP includes a monitoring program to measure the environmental condition and effectiveness of implementation of the mitigation measures. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries.

164. The contractor will be required to submit to PIU, for review and approval, a site environmental management plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; and (iii) monitoring program as per SEP. No works are allowed to commence prior to approval of SEMP.

165. A copy of the EMP/approved SEMP will be kept on site during the construction period at all times. The EMP included in the bid and contract documents. Non-compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance.

166. For civil works, the contractor will be required to (i) carry out all of the mitigation and monitoring measures set forth in the approved EMP; and (ii) implement any corrective or preventative actions set out in safeguards monitoring reports that the employer will prepare from time to time to monitor implementation of this IEE, EMP and SEMP. The contractor shall allocate budget for compliance with these IEE, EMP and SEMP measures, requirements and actions.

167. The following tables show the potential environmental impacts, proposed mitigation measures and responsible agencies for implementation and monitoring.

Table 16: Design Stage Environmental Impacts and Mitigation Measures (included in DPR)

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
Design of Proposed STP	Deficient treatment due to substandard operation / system malfunction	(i) Design process to meet the Central Pollution Control Board (CPCB) disposal standards of inland water disposal (i) Ensuring continuous uninterrupted power supply, including a back-up facility (such as generator) (ii) Providing operating manual with all standard operating procedures (SOPs) for operation and maintenance of the facility (iii) Necessary training to ULB staff dealing with STP. (iv) Extended contractor period for O&M, proper transfer of facility to ULB with adequate technical know-how on O&M and hands-on training to ULB staff (v) Provision for online monitoring of crucial wastewater quality parameters at the inlet and outlet of the plant	DBOT Contractor and PIU	Project cost - DB Contractor
	Degradation of receiving water body quality and inundation risk	(i) Conduct baseline water quality assessment of Uyyakondan channel, Valavandhan kottai pond/tank and River Cauvery at discharge points; assess impacts on water quality due to STP discharge, and ensure that water quality is not degraded from the existing condition (ii) Assess hydrological parameters of receiving water bodies (Uyyakondan channel and Valavandhan kottai pond/tank) for safe discharge of STP water, implement appropriate measures as required based on the assessment to eliminate risk of inundation (iii) Obtain TNPCB and Public Works Department (PWD) consent to dispose treated wastewater into Uyyakondal channel	DBOT Contractor and PIU	Project cost - DB Contractor
	Odour nuisance	(i) Providing a green buffer of 15-20 m wide all around the STP with trees in multi-rows and land scaping. This will act as a visual screen around the facility and will improve the aesthetic appearance.	DBOT Contractor and PIU	Project cost - DB Contractor
	Sludge disposal	(i) Prepare sludge management plan to ensure safe collection, adequate treatment prior to reuse / disposal (ii) Conduct periodic testing of sludge to check its quality according to set standards for reuse as manure/soil conditioner	DBOT Contractor and PIU	Project cost - DB Contractor

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		(iii) Provide training on safe handling of sludge, along with proper apparatus and personnel protection equipment (PPEs) to workers		
	Tree cutting	(i) Minimize removal of trees by adopting to site condition and with appropriate layout design/alignment, , particularly at Proposed STP site (ii) Obtain prior permission for tree cutting (iii) Plant and maintain 10 trees for each tree that is removed	PIU/TCC	Project Costs
Sewer network	Nuisance due to leaks, overflows, contamination of water supplies, occupation health and safety of workers, etc.	(i) Limit the sewer depth where possible (ii) Sewers shall be laid away from water supply lines and drains (at least 1 m). if not possible, sewer lines shall be laid below the water lines (iii) In all cases, the sewer line should be laid deeper than the water pipeline (the difference between top of the sewer and bottom of water pipeline should be at least 300 mm) (iv) In unavoidable cases, where sewers are to be laid close to storm water drains, appropriate pipe material (that has no or least infiltration risk) shall be selected (stoneware pipes shall be avoided) (v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes; (vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry (vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation	PIU/TCC	Project Costs
Construction works in the regulated buffer zone of ASI monument (Erumbeeswarar Templ)	Distrubance / damage to monument	(i) Obtain prior permission from ASI/NMA for the works to be conducted within the regulated zone of monument; submit detailed construction drawings clearly indicating the details of proposed excavations and works, use of equipment and machinery, etc., to ASI for their review; incorporate any suggestions/recommendations of ASI in project design and implementation (ii) Consult ASI) and local communities in advance of the work to identify and address key issues, and avoid	PIU/TCC	Project Costs

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		working at sensitive times, such as religious and cultural festivals. (iii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be in line with the ASI recommendations (iv) No equipment causing vibration (eg, pneumatic drills, excavators etc.,) and heavy noise should be used; works shall be conducted manually (v) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens (vi) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area		
Sewage pumping stations	Odour nuisance	**Measures specific (additional) to New Pumping Station near household area** (i) Maintain maximum buffer distance from the nearest residences to the pumping station wells; (ii) Locate pumping station as far as away from the road (iii) Develop green buffer zone around the facility with a combination of tall and densely growing trees in multi rows as per the land availability to control odor and also act as visual shield, and improve aesthetical appearance **Design measures for all pumping stations** (i) Proposed wells to be closed using RCC slabs. Design of RCC slab to consider both superimposed loads (human and equipment loads) and severe corrosion risk from sewer gas from within wells. (ii) RCC Slab to be designed and fixed in a modular manner such that access to pumps / appurtenances and other equipment can be provided for maintenance / replacement / renewal purposes. (iii) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metalled grating / grill work shall be provided over the sections (or full cross section if required) where workers will stand / work for inspection and repair/O&M purposes. (iv) Provision of passive gas ventilation arrangement by providing a take-off vent from top of well by	PIU/TCC	Project Costs

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		positioning vent in such a way that cover slab fitment / movement / drawl if required for maintenance purposes is not compromised. (v) Height of vent to be provided appropriately and a minimum 2 m above the lintel level (top level) of window(s) / passageways / doors in the nearby adjoining buildings. (vi) Provision of odor control / mitigation system as per site conditions / requirements • Suitable granular activated carbon filter with bird-screen fitted at the vent outlet to control odor. Size of GAC (including material size) should be selected based on the vent diameter and expelled air flow rate expected. • (vii) Submersible sewage pumps of suitable rating, minimum submergence requirements, open impeller with cutting-tearing arrangement and high strength-corrosion resistant heavy duty construction shall be proposed. (viii) In locations / cases where sewage flow in the present to intermediate design stage is envisaged to be low, position of the submersible pumps and design of the collection well floor by providing necessary side benching / sloped flooring to allow for higher submergence during low flow shall be made to ensure regular pump operation and avoid sewage stagnation beyond the permissible limit. (ix) Diesel Generators shall be provided for all pump stations and in cases of lift stations with space for control room. In cases of lift manholes (road-side or road-center type structures with only provision of kerb-side kiosk), an electrical cut-out provision shall be made for connecting an Emergency Mobile / Skid Mounted Diesel Generator for pumping out during long period of electricity supply interruption. (x) Develop standard operating procedures / operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations		

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		(xiii) (xi) Provide training to the staff in SOPs and emergency procedures Conduct periodic H_2S monitoring		
Sewage lifting stations	Odor nuisance	(i) Provide closed wells fitted with necessary ventilation and odor abatement systems such as GAC air filters fitted to the ventilation shaft outlet(s). (ii) Provide greenbelt (tree cover) around the lift stations, wherever possible	PIU/TCC	Project costs
Sewage pumping and lifting stations	Noise	(i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80 dB(A) at a distance of 1 m (ii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise (iii) Use acoustic enclosures – manufacturer specified, for all pumps, motors (iv) Procure only CPCB approved generators to meet air emission and noise level requirements (v) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors (vi) Provide ear plugs designated for noise reduction to workers (vii) Consult the Archaeological survey of India (ASI) and local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals. (viii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be finalized in consultation with ASI; no equipment causing vibration and heavy noise should be used (ix) Obtain prior permission from ASI/NMA for components located within the regulated zone of monument; incorporate any suggestions/recommendations of ASI in project design and implementation	PIU/TCC	Project costs
Sewage pumping and lifting stations	Energy consumption	(i) Using low-noise and energy efficient pumping systems (ii) Efficient Pumping system operation (iii) Installation of Variable Frequency Drives (VFDs)	PIU/TCC	Project Costs

Table 17: Pre Construction Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Submission of updated EMP / SEP; EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint EHS Supervisor to ensure EMP implementation (ii) Submission of updated EMP/ SEP (ii) Timely submission monthly of monitoring reports including documentary evidence on EMP implementation such as photographs	Contractor	Contractor cost
Generation of sludge, clay, construction waste/debris from repair work of existing STP	Health and environmental impacts due to improper handling and disposal	(i) Conduct sampling and testing of sludge from all ponds (one composite sample from each pond); parameters to be tested are given in environmental monitoring plan (ii) Devise the disposal method based on sludge characteristics (if it is hazardous, it shall be handled and disposed as per the Hazardous waste rules of MoEFCC) (iii) Sludge (if not hazardous) shall be transported to solid waste disposal sites in the city, and shall be disposed or used as daily cover for other waste (iv) Clay layer shall also be tested if it appears to be contaminated by visual appearance; in any case, a top layer of 6 inch shall be considered as part of the sludge and disposed accordingly (v) Clay may be used in solid waste disposal site as daily cover on the waste (vi) Devise any suitable reuse method based on the quality of clay (vii)Employ proper methods for removal of sludge and clay with safety of workers, environment utmost priority; provide on-site awareness sessions and training for workers on working conditions and safe handling of sludge and provide PPEs to workers (viii)Any other construction waste / debris shall be properly disposed; priority shall be given to reuse, recycle so that disposal is avoided, provided it is suitable and safe for such usage	PIU/DBOT Contractor	Contractor cost
Utilities	Telephone lines, electric poles and wires, water lines within proposed project area	(i) Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; and (ii) Require construction contractors to prepare a contingency plan to include actions to be taken in case of unintentional interruption of services.	Contractor in coordination with PIU	Contractor cost
Construction work camps, stockpile areas, storage areas, and disposal areas.	Conflicts with local community; disruption to traffic flow and sensitive receptors	(i) Prioritize areas within or nearest possible vacant space in the project location; (ii) If it is deemed necessary to locate elsewhere, consider sites that will not promote instability and result in destruction of property, vegetation, irrigation, and drinking water supply systems; (iii) Do not consider residential areas; (iv) Take extreme care in selecting sites to avoid direct disposal to water body which will inconvenience the community. (v) For excess spoil disposal, ensure (a) site shall be selected preferably from barren, infertile lands. In case agricultural land needs to be selected, written	Contractor to finalize locations in consultation and approval of PIU	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
		consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 m away from surface water bodies; (c) no residential areas shall be located within 50 m downwind side of the site; and (d) site is minimum 250 m away from sensitive locations like settlements, ponds/lakes or other water bodies.		
Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	(i) Obtain construction materials only from the existing government approved quarries with prior approval of PIU (ii) PIU to review, and ensure that proposed quarry sources have all necessary clearances/ permissions in place prior to approval (iii) Contractor to submit to PIU on a monthly basis documentation on material obtained from each sources (quarry/ borrow pit) (iv) No new borrow areas, quarries etc., shall be developed for the project	Contractor to prepare list of approved quarry sites and sources of materials with the approval of PIU	Contractor cost
Consents, permits, clearances, NOCs, etc.	Failure to obtain necessary consents, permits, NOCs, etc. can result to design revisions and/or stoppage of works	(i) Obtain all necessary consents, permits, clearance, NOCs, etc. prior to award of civil works. (ii) Ensure that all necessary approvals for construction to be obtained by contractor are in place before start of construction (iii) Acknowledge in writing and provide report on compliance all obtained consents, permits, clearance, NOCs, etc.	Contractor and PIU	Cost of obtaining all consents, permits, clearance, NOCs, etc. prior to start of civil works responsibility of PIU.
Chance finds	Damage / disturbance to artifacts	(i) Construction contractors to follow these measures in conducting any excavation work (ii) Create awareness among the workers, supervisors and engineers about the chance finds during excavation work (iii) Stop work immediately to allow further investigation if any finds are suspected; (iv) Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ.	Contractor and PIU	Contractor cost
Temporary economic impacts	Disruption to vendors, hawkers on ROW during	(i) Contractor is required to provide notice to the shop owners of the need to shift kiosk/wares displayed on ROW as soon as the work plan is ready, with minimum 7 working days. (ii) (iii) No works can be commenced unless 100% shifted in sections ready for implementation.	CC and PIU	Contractor / PIU

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
	sewer laying works			

Table 18: Construction Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
EMP Implementation Training	Irreversible impact to the environment, workers, and community	(i) Project manager and all key workers will be required to undergo training on EMP implementation including spoils/waste management, Standard operating procedures (SOP) for construction works; occupational health and safety (OH and S), core labor laws, applicable environmental laws, etc.	Contractor	Contractor cost
Air Quality	Dust, emissions from construction vehicles, equipment, and machinery used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons.	**For all construction works** (i) Provide a dust screen (6 m high) around the construction sites of pumping and lifting stations , and STP; provide 2 m high barricades for the sewer works (ii) Damp down the soil and any stockpiled material on site by water sprinkling; (3-4 times a day - before the start of work, 1-2 times in between, and at the end of the day); when working in the roads there should permanently be one person responsible for directing when water sprinkling needs to take place to stop the dust moving; (iii)Reduce the need to sprinkle water by stabilizing surface soils where loaders, support equipment and vehicles will operate by using water and maintain surface soils in a stabilized condition (iv) Apply water prior to levelling or any other earth moving activity to keep the soil moist throughout the process (v) Cover the soil stocked at the sites with tarpaulins, and surround by dust screens. (vi) Control access to work area, prevent unnecessary movement of vehicle, public trespassing into work areas; limiting soil disturbance will minimize dust generation (vii) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks; (viii) Control dust generation while unloading the loose material (particularly aggregate, sand, soil) at the site by sprinkling water and unloading inside the barricaded area; minimize the drop height when moving the excavated soil.	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(ix) Clean wheels and undercarriage of haul trucks prior to leaving construction site (x) Ensure that all the construction equipment, machinery are fitted with pollution control devises, which are operating correctly, and have a valid pollution under control (PUC) certificate (xi) no vehicles or plant to be left idling at site generators to be at placed maximum distance from properties **For sewer works** (i) Barricade the construction area using hard barricades (of 2 m height) on both sides (ii) Initiate site clearance and excavation work only after barricading of the site is done (iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.,), to the barricaded area (iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area (v) Undertake the work section wise: a 500 m section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones (vi) Conduct work sequentially - excavation, sewer laying, backfilling; testing section-wise (for a minimum length as possible) so that backfilling, stabilization of soil can be done. (vii) Remove the excavated soil of first section to the disposal site; as the work progresses sequentially, by the time second section is excavated, the first section will be ready for back filling, use the freshly excavated soil for back filling, this will avoid stocking of material, and minimize the dust. (viii) Backfilled trench at any completed section after removal of barricading will be the main source of dust pollution. The traffic, pedestrian movement and wind will generate dust from backfilled section. Road restoration shall be undertaken immediately. (ix) Immediately consolidate the backfilled soil and restore the road surface; if immediate road restoration is not possible, provide a layer of plain cement concrete (PCC) of suitable mix on the backfilled trench so that dust generation, erosion is arrested and it will also provide a smooth riding surface for the traffic until the road is properly restored. Backfilled trench without any road restoration is a major source of dust.		
Surface water quality	Mobilization of settled silt materials, and chemical contamination	(i) All earthworks be conducted during the dry season to prevent the problem of soil/silt run-off during rains	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	from fuels and lubricants during construction can contaminate nearby surface water quality. Ponding of water in the pits / foundation excavations	(ii) Avoid stockpiling of earth fill especially during the monsoon season unless covered by tarpaulins or plastic sheets; do not stock earth/material close to water bodies (at least100 m) (iii) Prioritize re-use of excess spoils and materials in the construction works. If spoils will be disposed, only designated disposal areas shall be used; (iv) Install temporary silt traps, oil traps or sedimentation basins along the drainage leading to the water bodies; (v) Place storage areas (with impermeable surface) for fuels and lubricants away from any drainage leading to water bodies; these should be at least 100 m away from water bodies and groundwater wells) (vi) Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management (vii) Dispose any wastes generated by construction activities in designated sites; (viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).		
Pipe bridge construction across streams and canals	Degradation of water quality / silting of water body	(i) Conduct works in the water body (especially foundation work) only during no-flow season (ii) Select a construction method which is less disruptive (eg, precast type) (iii)Do no accidental spill construction chemicals, fuels, lubricants in the water body , by using spill traps / metal basins (iv) Clean up the site immediately after construction is complete; construction debris, materials, etc., shall be cleared and pre project condition restored or improved	Contractor	Contractor cost
	Water accumulation in trenches/pits	(i) As far as possible control the entry of runoff from upper areas into the excavated pits, and work area by creation of temporary drains or bunds around the periphery of work area (ii) Pump out the water collected in the pits / excavations to a temporary sedimentation pond; dispose off only clarified water into drainage channels/streams after sedimentation in the temporary ponds Consider safety aspects related to pit collapse due to accumulation of water	Contractor	Contractor cost
Noise and vibration Levels	Increase in noise level due to earth-moving and excavation equipment, and the transportation of	(i) Plan activities in consultation with PIU so that activities with the greatest potential to generate noise are conducted during periods of the day which will result in least disturbance; ; especially near schools and other sensitive receptors	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	equipment, materials, and people	(ii) Minimize noise from construction equipment by using vehicle silencers, fitting jackhammers with noise-reducing mufflers, and use portable street barriers to minimize sound impact to surrounding sensitive receptor; and (iii) Maintain maximum sound levels not exceeding 70 decibels (dBA) when measured at a distance of 10 m or more from the vehicle/s. (iv) Identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity; if any building at risk, structural survey be completed prior to work, to provide baseline in case any issues from vibration, and if building is structurally unsound that measures taken to avoid any further damage (v) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach; (vi) Consult local communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as night times,religious and cultural festivals. **Works near the ASI monument** (i) Obtain prior permission from ASI/NMA for the works to be conducted within the regulated zone of monument; submit detailed construction drawings clearly indicating the details of proposed excavations and works, use of equipment and machinery, etc., to ASI for their review; incorporate any suggestions/recommendations of ASI in project design and implementation (ii) Excavation and construction methodology to be used near the monuments (within the regulated area of 300 m of any monument) shall be in line with the ASI recommendations (iii) No equipment causing vibration (eg, pneumatic drills, excavators etc.,) and heavy noise should be used; works shall be conducted manually (iv) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens (v) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area		
Landscape and aesthetics – waste generation	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed	(i) Prepare and implement a Construction Waste Management Plan (refer Appendix 3) (ii) As far as possible utilize the debris and excess soil in construction purpose, for example for raising the ground level or construction of access roads etc.,	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
	concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	(iii) Avoid stockpiling any excess spoils at the site for long time. Excess excavated soils should be disposed off to approved designated areas immediately (iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should located away from residential areas, forests, water bodies and any other sensitive land uses (v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to designated solid waste disposal site; create a compost pit (with impermeable bottom and sides) at workers camp sites for disposal of biodegradable waste; non-biodegradable / recyclable material shall be collected separately and sold in the local recycling material market (vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed off via licensed (by TNPCB) third parties (vii) Prohibit burning of construction and/or domestic waste; (viii) Ensure that wastes are not haphazardly thrown in and around the project site; provide proper collection bins, and create awareness to use the dust bins, , recycle waste material where possible (ix) Conduct site clearance and restoration to original condition after the completion of construction work; PIU to ensure that site is properly restored prior to issuing of construction completion certificate		
Generation of sludge, clay, construction waste/debris from repair work of existing STP	Health and environmental impacts due to improper handling and disposal	(i) Conduct sampling and testing of sludge from all ponds (one composite sample from each pond); parameters to be tested are given in environmental monitoring plan (ii) Devise the disposal method based on sludge characteristics (if it is hazardous, it shall be handled and disposed as per the Hazardous waste rules of MoEFCC) (iii) Sludge (if not hazardous) shall be transported to solid waste disposal sites in the city, and shall be disposed or used as daily cover for other waste (iv) Clay layer shall also be tested if it appears to be contaminated by visual appearance; in any case, a top layer of 6 inch shall be considered as part of the sludge and disposed accordingly (v) Clay may be used in solid waste disposal site as daily cover on the waste (vi) Devise any suitable reuse method based on the quality of clay (vii) Employ proper methods for removal of sludge and clay with safety of workers, environment utmost priority; provide on-site awareness	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		sessions and training for workers on working conditions and safe handling of sludge and provide PPEs to workers (viii) Any other construction waste / debris shall be properly disposed; priority shall be given to reuse, recycle so that disposal is avoided, provided it is suitable and safe for such usage		
Accessibility and traffic disruptions	Traffic problems and conflicts near project locations and haul road	**Sewer works** (i) Prepare a sewer work implementation plan in each zone separately and undertake the work accordingly; ensure that for each road where the work is being undertaken there is an alternative road for the traffic diversion; take up the work in sequential way so that public inconvenience is minimal; prepare traffic management plans for each section (refer sample in Appendix 6) (ii) Plan the sewer work in coordination with the traffic police; provide temporary diversions, where necessary with clear signage and effectively communicate with general public (iii)Avoiding conducting work in all roads in a colony at one go; it will render all roads unusable due to excavations at the same time, creating large scale inconvenience (iv) Undertake the work section wise: a 500 section should be demarcated and barricaded; open up several such sections at a time, but care shall be taken to locate such sections in different zones (v) Confine work areas in the road carriageway to the minimum possible extent; all the activities, including material and waste/surplus soil stocking should be confined to this area. Proper barricading should be provided; avoid material/surplus soil stocking in congested areas – immediately removed from site/ or brought to the as and when required (vi) Limit the width of trench excavation as much as possible by adopting best construction practices; adopt vertical cutting approach with proper shoring and bracing; this is especially to be practiced in narrow roads and deeper sewers; if they deep trenches are excavated with slopes, the roads may render completely unusable during the construction period (vii) Leave spaces for access between mounds of soil to maintain access to the houses / properties; access to any house or property shall not be blocked completely; alternative arrangements, at least to maintain pedestrian access at all times to be provided (viii) Provide pedestrian access in all the locations; provide wooden/metal planks with safety rails over the open trenches at each house to maintain the access.	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(ix) Inform the affected local population in advance about the work schedule, a week before, and a day before to start of work (x) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum. (xi) Keep the site free from all unnecessary obstructions; (xii) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints. Provide information to the public through media – newspapers and local cable television (TV) services (xiii) At work site, public information/caution boards shall be provided including contact for public complaints **Hauling (material, waste/debris and equipment) activities** (i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites (ii) Schedule transport and hauling activities during non-peak hours; (peak hours 7 to 10 AM and 4 to 7 PM) (iii) Locate entry and exit points in areas where there is low potential for traffic congestion; (iv) Drive vehicles in a considerate manner (v) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.		
Socio-Economic Loss of access to houses and business	Loss of income	(i) Inform all businesses and residents about the nature and duration of any work well in advance so that they can make necessary preparations; (ii) Do not block any access; leave spaces for access between barricades/mounds of excavated soil and other stored materials and machinery, and providing footbridges so that people can crossover open trenches (iii) Barricade the construction area and regulate movement of people and vehicles in the vicinity, and maintain the surroundings safely with proper direction boards, lighting and security personnel – people should feel safe to move around (iv) Control dust generation (v) Immediately consolidate the backfilled soil and restore the road surface; this will also avoid any business loss due to dust and access inconvenience of construction work.	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(vi) Employee best construction practices, speed up construction work with better equipment, increase workforce, etc., in the areas with predominantly commercial, and with sensitive features like hospitals, and schools; (vii) Consult businesses and institutions regarding operating hours and factoring this in work schedules; and (viii) Provide sign boards for pedestrians to inform nature and duration of construction works and contact numbers for concerns/complaints.		
Socio-Economic – Employment	Generation of temporary employment and increase in local revenue	(i) Employ local labor force as far as possible (iii) Comply with labor laws	Contractor	Contractor cost
Occupational Health and Safety	Occupational hazards which can arise during work	(i) Follow all national, state and local labor laws (indicative list is in Appendix 2); (ii) Develop and implement site-specific occupational health and safety (OH and S) Plan , informed by OHS risk assessment seeking to avoid, minimise and mitigate risk, which shall include measures such as: (a) safe and documented construction procedures to be followed for all site activities; (b) ensuring all workers are provided with and use personal protective equipment; (c) OH and S Training[7] for all site personnel, (d) excluding public from the work sites; and (e) documentation of work-related accidents; Follow International Standards such as the World Bank Group's Environment, Health and Safety Guidelines[8]. (iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites; (iv) Secure all installations from unauthorized intrusion and accident risks (v) Provide H and S orientation training to all new workers to ensure that they are apprised of the basic site rules of work at the site, personal protective protection, and preventing injuring to fellow workers;	Contractor	Contractor cost

[7] Some of the key areas that may be covered during training as they relate to the primary causes of accidents include (i) slips, trips and falls; (ii) personal protective equipment; (iii) ergonomics, repetitive motion, and manual handling; (iv) workplace transport; and (v) legislation and responsibilities. Training can provide the foundations of competence but it does not necessarily result in a competent worker. Therefore, it is essential to assess staff competence to ensure that the training provided is relevant and effective. Supervision and monitoring arrangements shall be in place to ensure that training has been effective and the worker is competent at their job. The level of supervision and monitoring required is a management decision that shall be based on the risks associated with the job, the level of competence required, the experience of the individual and whether the worker works as part of a team or is a lone worker.

[8] http://www.ifc.org/wps/wcm/connect/a99ab8804365b27aa60fb6d3e9bda932/EHS-Guidelines+101-Webinar.pdf?MOD=AJPERES

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(vi) Provide visitor orientation if visitors to the site can gain access to areas where hazardous conditions or substances may be present. Ensure also that visitor/s do not enter hazard areas unescorted; (vii) Ensure the visibility of workers through their use of high visibility vests and other PPE when working in or walking through heavy equipment operating areas; (viii) Ensure moving equipment is outfitted with audible back-up alarms; (ix) Mark and provide sign boards for hazardous areas such as energized electrical devices and lines, service rooms housing high voltage equipment, and areas for storage and disposal. Signage shall be in accordance with international standards and be well known to, and easily understood by workers, visitors, and the general public as appropriate; and (x) Disallow worker exposure to noise level greater than 85 dBA for duration of more than 8 hours per day without hearing protection. The use of hearing protection shall be enforced actively. (xi) Provide supplies of potable drinking water; (xii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances		
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	(i) Consult PIU before locating project offices, sheds, and construction plants; (ii) Select a camp site away from residential areas (at least 100m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation (iii)Avoid tree cutting for setting up camp facilities (iv) Provide a proper fencing/compound wall for camp sites (v) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas (vi) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit (vii) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be used as accommodation for workers (viii) Camp shall be provided with proper drainage, there shall not be any water accumulation	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(ix) Provide drinking water, water for other uses, and sanitation facilities for employees (x) Prohibit employees from cutting of trees for firewood; contractor should provide cooking fuel (cooking gas); fire wood not allowed (xi) Train employees in the storage and handling of materials which can potentially cause soil contamination (xii) Wastewater from the camps shall be disposed properly either into sewer system; if sewer system is not available, provide on-site sanitation with septic tank and soak pit arrangements (xiii) Recover used oil and lubricants and reuse or remove from the site; (xiv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for bio degradable waste, and non-biodegradable / recyclable waste shall be collected and sold in local market (xv) Remove all wreckage, rubbish, or temporary structures which are no longer required; and (xvi) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site		
Work Camps and worksites	Temporary air and noise pollution from machine operation, water pollution from storage and use of fuels, oils, solvents, and lubricants Unsanitary and poor living conditions for workers	(i) As far as possible located the camp site within the work sites (at STP or large pumping station sites); if any camp to be established outside these, then select a camp site away from residential areas (at least 100 m buffer shall be maintained) (ii) Avoid tree cutting for setting up camp facilities (iii) Ensure that a proper compound wall is provided, and erect a wind/dust screen around (iv) Camp site shall not be located near (100 m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas (v) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit (vi) Provide proper temporary accommodation with proper materials, adequate lighting and ventilation, appropriate facilities for winters and summers; ensure conditions of livability at work camps are maintained at the highest standards possible at all times; (vii) Consult PIU before locating project offices, sheds, and construction plants; (viii)Minimize removal of vegetation and disallow cutting of trees (ix) Ensure conditions of livability at work camps are maintained at the highest standards possible at all times; living quarters and construction camps shall be provided with standard materials (as	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		far as possible to use portable ready to fit-in reusable cabins with proper ventilation); thatched huts, and facilities constructed with materials like GI sheets, tarpaulins, etc., shall not be allowed as accommodation for workers (x) Camp shall be provided with proper drainage, there shall not be any water accumulation (xi) Provide drinking water, water for other uses, and sanitation facilities for employees; drinking water should be regularly tested to confirm that drinking water standards are met (xii) Prohibit employees from cutting of trees for firewood; contractor should be provide proper facilities including cooking fuel (oil or gas; fire wood not allowed) (xiii) Train employees in the storage and handling of materials which can potentially cause soil contamination (xiv) Recover used oil and lubricants and reuse or remove from the site (xv) Manage solid waste according to the following preference hierarchy: reuse, recycling and disposal to designated areas; provide a compost pit for biodegradable waste, and non-biodegradable / recyclable waste shall be collected and sold in local market (xvi) Remove all wreckage, rubbish, or temporary structures which are no longer required (xvii) At the completion of work, camp area shall be cleaned and restored to pre-project conditions, and submit report to PIU; PIU to review and approve camp clearance and closure of work site		
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	(i) Remove all spoils wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required; and (ii) All excavated roads shall be reinstated to original condition. (iii) All disrupted utilities restored (iv) All affected structures rehabilitated/compensated (v) The area that previously housed the construction camp is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up. (vi) All hardened surfaces within the construction camp area shall be ripped, all imported materials removed, and the area shall be top soiled and regrassed using the guidelines set out in the revegetation specification that forms part of this document. (vii) The contractor must arrange the cancellation of all temporary services.	Contractor	Contractor cost

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(viii) Request PIU to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.		

Table 19: Operation Stage Environmental Impacts and Mitigation Measures

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
STP operation – inadequate treatment	Non-compliance with government regulations; public health, safety and environmental impacts	For operation of the STPs, (i) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the standards • (ii) Implement sludge management plan - : sludge management to collect, treat and dispose the accumulated sludge safely; sludge will be tested periodically for heavy metal concentration. (iii) Provide flow measurement devises at inlet and outlet, and maintain flow records (iv) Provision of appropriate training and personal protection equipment to the workers and staff (v) Conduct periodic testing of dried sludge /compost to check presence of heavy metals and confirming the concentrations to use as compost. (i) It shall not be used for food crops. (vi) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers (vii) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB	DBOT Contractor / TCC	Operating costs
Operation of sewage lifting and pumping stations	Odor nuisance	(i) Strictly follow standard operating procedures / operational manual for operation and maintenance of lifting and pump stations (ii) Ensure that operating staff is properly trained, and have clear understanding of odor issues vis a vis its relation with operational practices (iii) Ensure that pumping cycles are properly followed; and there is no buildup of sewage beyond design volume in the wells (iv) Conduct H_2S monitoring periodically	PIU and TCC	Operating costs
Operation and maintenance of sewerage system	Blocks, overflows, system malfunction, occupational health and safety	(i) Establish regular maintenance program, including: • Regular cleaning of grit chambers and sewer lines to remove grease, grit, and other debris that may lead to sewer backups. Cleaning should be conducted more frequently for problem areas • Inspection of the condition of sanitary sewer structures and identifying areas that need repair or maintenance. Items to note may include	PIU and TCC	Operating costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		cracked/deteriorating pipes; leaking joints or seals at manhole; frequent line blockages; lines that generally flow at or near capacity; and suspected infiltration or exfiltration; and • Monitoring of sewer flow to identify potential inflows and outflows • Conduct repairs on priority based on the nature and severity of the problem. Immediate clearing of blockage or repair is warranted where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, or sewer line blockages); (ii) Maintain records; review previous sewer maintenance records to help identify “hot spots” or areas with frequent maintenance problems and locations of potential system failure, and conduct preventative maintenance, rehabilitation, or replacement of lines as needed; (iii) When a spill, leak, and/or overflow occurs, keep sewage from entering the storm drain system by covering or blocking storm drain inlets or by containing and diverting the sewage away from open channels and other storm drain facilities (using sandbags, inflatable dams, etc.). Remove the sewage using vacuum equipment or use other measures to divert it back to the sanitary sewer system. (iv) Prohibit/prevent disposal of wastewater/effluent from industrial units in the sewers; ensure regular checking to ensure no illegal entry of industrial wastewater into sewers (v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc. (vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance (vii) Provide all necessary personnel protection equipment (viii) Do not conduct manual cleaning of sewers; for personnel engaged sewer maintenance work, there is a risk due to oxygen deficiency and harmful gaseous emissions (hydrogen sulphide, methane, etc.); provide for adequate equipment (including oxygen masks) for emergency use		

Table 20: Pre-Construction and Construction Stage Environmental Monitoring Plan

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
Preconstruction/Design					
Baseline water quality of receiving water body (Uyyakondan Channel, Vallavandhan Kottai Pond)	5 points (4 in channel - at discharge point, upstream & downstream, and 1 near Vallavandhavan kottai pond/tank 1 in the pond/tank,)	pH, TDS, TSS, DO, BOD, COD, E-coli, Total coliform, Nitrate, Total Phosphates, Oil and grease, Total hardness, Sulphate, Fluoride, Chloride, Ammonia, Aluminum, Manganese, Iron, Zinc, Nickel, Magnesium, Phenolic compounds, Chromium, Arsenic, Mercury, Cadmium, Lead, Pesticides	Twice (Pre monsoon and post monsoon during design phase)	Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (10 samples x 8000 per sample = 80,000)
Sludge quality from existing STP ponds	5 points (1 composite sample from each pond)	EC, pH, calcium, magnesium, % of total organic matter, Total organic carbon, N, P, K, Aluminum, feacal colofirm, As, Cu, Cd, Cr, Pb, Fe, Mn, Hg, Zn, Ni.	Once	Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (5 samples x 10000 per sample = 50,000)
Construction phase					
Construction disturbances, nuisances, public and worker safety,	All work sites	Implementation of construction stage EMP including dust control, noise control, traffic management, and safety measures. Site inspection checklist to review implementation is appended at Appendix 7	Weekly during construction	Supervising staff and safeguards specialists of CMSC	Staff and consultant costs are part of incremental administration costs
Ambient air quality	5 locations (locations 50 m downwind direction near sewer and pumping/lifting station work sites in the city);	• PM10, PM2.5 NO2, SO2, CO	Once before start of construction Quarterly (yearly 4-times) during construction (3 year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (65 samples x 5000 per sample = 325,000)
	1 location at Erubeeshwarar temple	• PM10, PM2.5 NO2, SO2, CO	Once prior to start of the works within 300 m of monument	Construction Contractor	Cost for implementation of monitoring measures

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
			fortnightly once during the works within 300 m of monument		responsibility of contractor (12 samples x 5000 per sample = 60,000)
Ambient noise	5 locations (locations near sewer and pumping / lifting station work sites in the city);	• Day time and night time noise levels	Once before start of construction Quarterly (yearly 4-times) during construction (3 year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (65 samples x 1500 per sample = 97,500)
	1 location at Erubeeshwarar temple	• Day time and night time noise levels	Once prior to start of the works within 300 m of monument fortnightly once during the works within 300 m of monument	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (12 samples x 1500 per sample = 18,000)
Surface water quality	4 locations (2 points in river Koraiyar u/s and d/s of discharge point, Uyyakondan channel u/s and d/s of project area	• pH, Oil and grease, Cl, F, NO3, TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalnity	Once before start of construction Half yearly during construction (3 year construction period)	Construction Contractor	Cost for implementation of monitoring measures responsibility of contractor (28 samples x 4000 per sample = 112,000)

Table 20: Operation Stage Environmental Monitoring Plan

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
Monitoring of treated	Inlet and outlet of STPs	Parameters as specified by TNPCB in the consent./	Monthly Once	TCC	TCC Operating Cost

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
wastewater quality from STP		disposal standards notified for STPs.			
Water quality of receiving channel	3 points in channel (1 at STP discharge location, 1 u/s and 1 d/s) 1 point in Vallavandhan Kottai Pond/tank	pH, Cl, F, NO3, TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalinity, heavy metals and pesticides	Monthly once during operation Yearly twice (pre & post monsoon)	TCC	O&M costs (water quality will be tested at the internal laboratory part of STP)
Odor monitoring at pumping stations	3 points (downwind direction) at all pumping stations: near suction well; outside the pumping station and at nearest house	Hydrogen sulphide (H2S)	Periodical (throughout the operation phase)	TCC	Handheld H2S meters to be procured as part of the project and operated by operating staff
Odor monitoring at lifting stations	2 points (downwind direction) at all lifting stations: near suction well and at nearest house	Hydrogen sulphide (H2S)	Periodical (throughout the operation phase)	TCC	Handheld H2S meters to be procured as part of the project and operated by operating staff
Sludge quality and suitability as manure	STP	Analysis for concentration of heavy metals and confirm that value are within the following limits (see Table 4)	Start of operation and Yearly once	TCC	O&M costs (testing to be done at an accredited external laboratory)

B. Implementation Arrangements

168. The Municipal and Water Supply Department (MAWS) acting through TNUIFSL will be the executing agency. A program steering committee, headed by Principal Secretary, MAWS, GOTN, will provide overall guidance and strategic directions to the program. A program management unit (PMU) for TNUFIP, headed by the Managing Director, TNUIFSL acting as Program Director will be established within TNUIFSL for overall management, planning, implementing, monitoring, reporting, and coordinating TNUFIP. The CMA will act as the Deputy Program Director in the PMU. The project ULBs, represented by respective Municipal Commissioners, will be the implementing agencies for works in cities/towns and will establish program implementing units (PIUs) headed by a municipal engineer as full-time Project Manager. PIUs will comprise of dedicated staff responsible for overseeing implementation of projects on a day-to-day basis. The PIUs will be supported by a contract management and supervision consultant (CMSC) recruited by TNUIFSL. For the institutional capacity, public awareness, and urban governance component, CMA acting through its Commissioner, will establish a PIU and appoint a governance improvement and awareness consultant (GIAC) responsible for supporting these activities.

169. The implementing agency for this subproject is TCC. A Project Implementation Unit (PIU) will be established in TCC headed by full-time a Project Manager (a senior official of TCC) and comprising dedicated full-time staff from engineering and other departments of TCC. PIU under the TCC will be responsible for planning, implementation, monitoring and supervision, and coordination of all activities of subproject. A Construction, Management and Supervision Consultant (CMSC) will be appointed to assist PIU in day-to-day implementation of the subproject.

170. **Safeguards Compliance Responsibilities**. Environmental and Social Safeguards (ESS) managers in the PMU, TNUIFSL will have overall responsibility of safeguard compliance with ADB SPS 2009. ESS Managers report to Vice President in the Projects Wing. At PIU level, a Safeguards Officer will be appointed, who will be an Assistant Engineer rank officer and will coordinate safeguard tasks at PIU. As expert support is available to PIU via CMSC, and the role of Safeguard Officer will be mainly to coordination, overseeing the implementation of safeguard tasks, grievance redress and reporting.

171. **PMU Safeguard Responsibilities**. Key tasks and responsibilities of the ESS Manager (Environment), for this subproject include the following:

DPR finalization and Bidding stage:

(i) Ensure that all design related measures of the EMP are included designs.
(ii) Ensure that EMP is included in bidding documents and civil works contracts including requirement for EHS supervisor with the contractor
(iii) Ensure that the bid/contract documents include specific provisions requiring contractors to comply with all applicable labor laws and core labor standards
(iv) Ensure that staff required for implementation of EMP (EHS officer) is included in the bid requirements
(v) Ensure that EMP cost is included in the project cost
(vi) Prior to invitation of bids and prior to award of contract ensure that all clearance/permissions as required for implementation of subproject are in place to the extent possible.

Construction stage:

(i) Prior to start of construction:
   a. Ensure that all necessary clearances/permissions/licences, including that of contractor's are in place prior to start of construction.
   b. Provide oversight on environmental management aspects of subprojects and ensure EMPs are implemented by PIUs and contractors.
(ii) Oversee and provide guidance to the PIU to properly carry out the environmental monitoring as per the EMP
(iii) Oversee grievance redress mechanism to address any grievances brought about in a timely manner; ensure that records are properly maintained
(iv) Consolidate quarterly environmental monitoring reports from PIU and submit semi-annual monitoring reports to ADB
(v) Oversee site closures to ensure that all work / facility sites are restored properly prior to issuing work completion certificate to the contractor

Operation stage. Ensure that all clearances as required for operation of project are in place prior to operation, such as consent to operate (CTO) for STPs from TNPCB

172. **PIU Safeguard Responsibilities**. Key tasks and responsibilities of the PIU assisted by CMSC for this subproject include the following:

DPR finalization and Bidding stage:

(i) Include design related measures of the EMP in the project design and DPR
(ii) Include EMP in the bidding documents and civil works contracts, including requirement of staff (EHS supervisor) with contractor for EMP implementation
(iii) Provide necessary budget in the project as IEE for EMO Implementation
(iv) Ensure that the bid/contract documents include specific provisions requiring contractors to comply with all applicable labor laws and core labor standards including:
   a. Labor welfare measures and provision of amenities;
   b. prohibition of child labor as defined in national legislation for construction and maintenance activities;
   c. equal pay for equal work of equal value regardless of gender, ethnicity, or caste;
   d. elimination of forced labor;
   e. the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.
(v) In the pre-bid meeting, provide insight into EMP measures, and overall compliance requirements to the bidders.
(vi) Obtain all clearance/permissions as required for implementation of subproject, prior to invitation of bids and/or prior to award of contract as appropriate.

Construction stage:

(i) Identify regulatory clearance requirements and obtain all necessary clearances prior to start of construction; ensure construction work by contractor is conducted in compliance with all government rules and regulations including pollution control, labour welfare and safety etc.
(ii) Obtain CTE from TNPCB and NMA permission for works within 300 m regulated boundary of ASI monument as applicable prior to construction.

(iii) Prior to start of construction organize an induction course for the training of contractors, preparing them on EMP implementation, environmental monitoring, and on taking immediate action to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation.
(iv) Ensure contractor compliance with staff resources as per the IEE/EMP/Bid
(v) Guide contractor on updating EMP / preparing Site Environmental Plan at the start of the project
(vi) Update IEE and EMP; ensure that IEE reflects the final design being implemented by contractor
(vii) Conduct public consultation and information disclosure as necessary
(viii) Take necessary action for obtaining rights of way
(ix) Supervise day-to-day EMP implementation on site by contractor, including the environmental monitoring plan;
(x) Supervise ambient environmental monitoring by contractors
(xi) Take corrective actions when necessary to ensure no environmental impacts
(xii) Submit quarterly environmental monitoring reports to PMU
(xiii) Conduct continuous public consultation and awareness
(xiv) Address any grievances brought about through the grievance redress mechanism in a timely manner as per the EMP
(xv) Monitor Contractor's compliance with the measures set forth in the EMP and any corrective or preventative actions set forth in a safeguards monitoring report that the PMU will prepare from time to time;
(xvi) Implement corrective or preventative actions in case of non-compliance or new/unanticipated impacts;
(xvii) Inform PMU promptly in case if any significant impacts surfaces, which were not identified in the IEE and develop necessary corrective actions as necessary and ensure implementation by the contractors; include all such impacts and suggested actions in the Quarterly Environmental Monitoring Reports
(xviii) Implementation grievance redress system, and undertake appropriate actions to redress the complaints; ensure that complaints/grievances are addressed in a timely manner and resolutions are properly documented;
(xix) Review and approve monthly progress reports submitted by Contractor on EMP compliance,
(xx) Prepare quarterly environmental monitoring reports and submit to PMU / TNUIFSL
(xxi) Provide any assistance in environmental safeguard related tasks as required by PMU to ensure compliance and reporting to ADB

Operation stage:
(i) Ensure that all clearances as required for operation of project are in place prior to operation, such as consent to operate (CTO) for STPs from TNPCB
(ii) Conduct environmental management and monitoring activities as per the EMP

173. **Contractor's Responsibilities:**

Bidding stage:
(i) Understand the EMP requirements and allocate necessary resources (budget, staff, etc.,)
(ii) Understand the regulatory compliance requirements related to labour welfare, safety, environment etc.

Construction stage:

(i) Mobilize EHS Supervisor prior to start of work.
(ii) Prepare SEMP and submit to PIU.
(iii) Ensure that all regulatory clearances (both project related and contractor related) are in place prior start of the construction work.
(iv) Confirm with PIU availability of rights of way at all project sites prior to start of work.
(v) Prepare and submit:
  a. Construction waste management (CWM) plan (sample is in Appendix 3)
  b. Traffic management (TM) plan (sample is Appendix 6)
  c. OHS Plan, pollution control plan, dust emergency response plan
(vi) Implement the mitigation measures as per the EMP including CWM and TM Plans
(vii) Follow the EMP measures/guidelines for establishment of temporary construction camps, construction waste disposal sites, and material borrow areas, etc.
(viii) Implement EMP and ensure compliance with all the mitigation and enhancement measures.
(ix) Conduct environmental monitoring (air, noise, water etc.,) as per the EMP
(x) Undertake immediate action as suggested by PIU to remedy unexpected adverse impacts or ineffective mitigation measures found during the course of implementation.
(xi) Submit monthly progress reports on EMP implementation to PIU.
(xii) Act promptly on public complaints and grievances related to construction work and redress in a timely manner in coordination with PIU and CMSC.
(xiii) Comply with applicable government rules and regulations.

C. Training Needs

174. The following Table 22 presents the outline of capacity building program to ensure EMP implementation. These capacity building and trainings will be conducted at the offices of PMU and PIU by the environmental safeguards specialist of PMU/PIU and their consultants, which are part of project implementation set-up, and therefore no separate or additional costs are envisaged. Adequate costs are already considered in project's capacity building program. The detailed program and specific modules will be customized for the available skill set after assessing the capabilities of the target participants and the requirements of the project by the PMU.

Table 21: Outline Capacity Building Program on Environmental Management Plan Implementation

Description	Target Participants and Venue	Estimate (₹)	Cost and Source of Funds
1. Introduction and Sensitization to Environmental Issues (1 day) - ADB Safeguards Policy Statement. - Government of India and Tamil Nadu. applicable safeguard laws, regulations and policies including but not limited to core labor standards, OHS, etc. - Incorporation of EMP into the project design and contracts. - Monitoring, reporting and corrective action planning.	All staff and consultants involved in the project At PMU (combined program for all PIU).	-	Included in the overall program cost

Description	Target Participants and Venue	Estimate (₹)	Cost and Source of Funds
2. EMP implementation (1/2 day) - EMP mitigation and monitoring measures - Roles and responsibilities. - Public relations, - Consultations. - Grievance redress. - Monitoring and corrective action planning. - Reporting and disclosure. - Construction site standard operating procedures (SOP) - Chance find (archeological) protocol -- Work near the ASI monuments AC pipe protocol - Traffic management plan - Waste management plan - Site clean-up and restoration	All PIU staff, contractor staff and consultants involved in the subproject. At PIU	-	To be conducted by CMSC at the PIU office; part of project implementation cost
3. Contractors Orientation to Workers (1/2 day) - Environment, health and safety in project construction	Once before start of work, and thereafter regular briefing every month once. Daily briefing on safety prior to start of work All workers (including unskilled laborers) Awareness and on-site training for workers and staff on sludge handling and disposal in existing STP repair work	-	Contractors' EHS officer to conduct program, with guidance of CMSC

D. Monitoring and Reporting

175. Immediately after mobilization and prior to commencement of the works, the contractor will submit a compliance report to PIU that all identified pre-construction mitigation measures as detailed in the EMP are undertaken. Contractor should confirm that the staff for EMP implementation (EHS supervisor) is mobilized. PIU will review, and approve the report and permit commencement of works.

176. During construction, results from internal monitoring by the contractor will be reflected in their monthly EMP implementation reports to the PIU. CMSC will monitor, review and advise contractors for corrective actions if necessary. Environmental monitoring report summarizing compliance and corrective measures, if any, taken will be prepared by CMSC team at PIU and submitted to PMU (Report format is at Appendix 8). During operation, PIU will conduct management and monitoring actions as per the operation stage EMP, and submit to PMU an annual report.

177. Based on PIU Quarterly monitoring reports and oversight visits to subproject work sites, PMU will submit semi-annual Environmental Monitoring Report (EMR). Once concurrence from the ADB is received the report will be disclosed on TNUIFSL, PMU and TCC websites.

178. ADB will review project performance against the TNUFIP commitments as agreed in the legal documents (loan and project agreements etc.). The extent of ADB's monitoring and supervision activities will be commensurate with the project's risks and impacts. Monitoring and

supervising of social and environmental safeguards will be integrated into the project performance management system

E. Environmental Management Plan Implementation Cost

179. Most of the mitigation measures require the contractors to adopt good site practices, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. The costs which are specific to EMP implementation and are not covered elsewhere in the projects are given below.

Table 22: Cost Estimates to Implement the EMP

	Particulars	Stages	Unit	Total Number	Rate (₹)	Cost (₹)	Costs Covered By
A.	**Implementation staff**						
1	EHS Supervisor	Construction	per month	36	35,000	1,260,000	Civil work contract
	Subtotal (A)					**1,260,000**	
B.	**Mitigation Measures**						
2	Providing odor control system sewage pumping & lifting stations (gas capturing & treatment at required stations) and handheld H2S meters for monitoring	Design	Lump sum provision	-	-	5,000,000	Provisional sums of contract (PIU)
3	Measures related to make the STP compliant with TNPCB consent	Design/ construction	-	-	-	-	TCC own funds
4	Provision for tree cutting and compensatory plantation measures (1: 10 ratio replantation)	Construction	Per tree	100	1,000	100,000	Project costs (PIU)
5	Preparation of plans traffic management plan, waste (spoils) management plan etc.,), traffic management at work sites (Pavement Markings, Channelizing Devices, Arrow Panels and Warning Lights)	Construction	Lump sum	-	-	300,000	Civil works contract
6	Safety barricading	Construction	Lump sum	Lumpsum	-	2,000,000	Civil works contract
	Subtotal (B)					**7,400,000**	
C.	**Monitoring Measures**						
1	Air quality monitoring	Construction	per sample	77	5,000	385,000	Civil works contract
2	Noise levels monitoring	Construction	Per sample	77	1,500	115,500	Civil work contract
3	Surface water monitoring	Construction	Per sample	28	4,000	112,000	Civil work contract
4	Baseline water quality of receiving water bodies of STP discharge	Design	Per sample	10	8000	80,000	Civil work contract
5	Sludge quality from existing STP ponds	Design	Per sample	5	10000	50,000	Civil work contract
	Subtotal (C)					**742,500**	
D.	**Capacity Building**						
1.	Training on EMP implementation	Pre-construction				**-**	Part of PIU and PMU , consultant tasks
2.	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite				-	Civil works contractor cost
	Subtotal (D)						

	Particulars	Stages	Unit	Total Number	Rate (₹)	Cost (₹)	Costs Covered By
	Total (A+B+C+D)				**₹**	**9,402,500**	

Contractor Cost - 4,302,500
PIU Cost - 5,100,000
Total - 9,324,500

IX. CONCLUSION AND RECOMMENDATIONS

180. The process described in this document has assessed the environmental impacts of all elements of the proposed underground sewerage subproject covering municipal area of Tiruchirappalli. All potential impacts were identified in relation to pre-construction, construction, and operation phases. Planning principles and design considerations have been reviewed and incorporated into the site planning and design process wherever possible; thus, environmental impacts as being due to the project design or location were not significant. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result significant measures have already been included in the designs for the infrastructure. This means that the number of impacts and their significance has already been reduced by amending the design. Various design related measures suggested for: STP treatment process design to meet disposal standards, ensuring efficient treatment, rehabilitation of existing STP to ensure proper treatment and sludge management, odor control at pumping stations, uninterrupted power supply provision; standard operating procedures for operation and maintenance; and imparting necessary training for ULB staff; providing necessary safety, no manual cleaning of sewers, and personal protection equipment for workers (protection against oxygen deficiency, harmful gaseous emissions) and sludge handling, and development of green buffer zone around the STP.

181. Sewage and pumping stations sites, which collect sewage from the sewer network and pump to higher level to convey to sewage to STP for safe treatment and disposal, are located within or near residential areas, which it will serve. These facilities may generate odor and may cause nuisance to nearby households. Site selection is done with utmost care to located as far as away from the houses, however, given design considerations and land constraints, some of the sites identified are close to the houses. New sewage pumping stations (5 nos.) are located within or close to residential areas. Various site planning, green buffer and design related measures are included in the project to prevent and control odor generation. These include: appropriately locating sewage wells within site maintaining maximum distance from the nearby houses; developing tree cover; closed facilities; design and operation measures to prevent odor; and, providing gas collection and treatment facilities. Erumbeeswarar temple, a protected monument, is located within the subproject areas surrounded by residential areas. Proposed provision of sewer network in this area also falls under the 300 m regulated buffer zone of monument. No impacts are envisaged as the works are not located within the monument, and also that works within 300 m area of the monument will be conducted with the prior permission of competent authority. Various measures are also suggested.

182. New lifting and pumping station sites (24 in all) are situated on government owned vacant land parcels, and sewers will be laid on the public roads. Therefore subproject do not involve any private land acquisition.

183. Except sewer works, all other construction activities will be confined to the selected sites, and the interference with the general public and community around is minimal. Major repair and rehabilitation works proposed at the existing STP, which is likely to generate large quantities of construction waste including sludge and used clay from sewage ponds. Proper measures to quality check, disposal and safe handling by workers suggested. There will be temporary negative impacts, arising mainly from construction dust and noise, hauling of construction material, waste and equipment on local roads (traffic, dust, safety etc.,), mining of construction material, occupation health and safety aspects. Sewer line works will be conducted along public roads in an urban area congested with people, activities and traffic, subproject is likely to significant impacts during construction. Impacts mainly arise from the construction dust and noise; from the disturbance of residents, businesses, traffic by the construction work, safety risk to workers, public and nearby buildings due to deep trench excavations, especially in narrow roads, dust, access impediment to houses and business, disposal of large quantities of construction waste, etc. These are all general impacts of construction in urban areas, and there are well developed methods of mitigation that are suggested in the EMP.

184. Once the new system is operating, the facilities will operate with routine maintenance, which should not affect the environment. Improved system operation will comply with the O&M manual and standard operating procedures to be developed for all the activities.

185. Mitigation will be assured by a program of environmental monitoring conducted during construction and operation to ensure that all measures are implemented, and to determine whether the environment is protected as intended. This will include observations on- and off-site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the PMU. There will also be longer-term surveys to monitor treatment efficiency of STP (raw and treated sewage quality), and sludge Mitigation and monitoring measures, along with the project agency responsible for such actions, form part of the Environmental Management Plan.

186. Stakeholders were involved in developing the IEE through face-to-face discussions, on site meetings, and a city level consultation workshop, which was conducted for larger public participation in the project. Views expressed by the stakeholders were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations and will be disclosed to a wider audience via the PMU, TCC and ADB websites. The consultation process will be continued during project implementation to ensure that stakeholders are engaged in the project and have the opportunity to participate in its development and implementation..

187. The project’s grievance redress mechanism will provide the citizens with a platform for redress their grievances, and describes the informal and formal channels, time frame, and mechanisms for resolving complaints about environmental performance.

188. The EMP will assist the project agencies and contractor in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. A copy of the updated EM/SEP shall be kept on-site during the construction period at all times. The EMP shall be made binding on all contractors operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

189. The citizens of the Tiruchirappalli City will be the major beneficiaries of this subproject. The new sewerage system will remove the human waste from those areas served by the network

rapidly and treated to an acceptable standard, and treated wastewater is utilized beneficial purposes. In addition to improved environmental conditions, the subproject will improve the overall public health in the project area. Diseases of poor sanitation, such as diarrhea and dysentery, should be reduced, so people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

190. Therefore, as per ADB SPS, the project is classified as environmental category B and does not require further environmental impact assessment. However, to conform to government guidelines STP requires consent to establishment (CTE) and consent to operate (CTO) from TNPCB. CTE will be obtained prior to construction, as the detailed design of STP will be undertaken by contractor. However, TCC shall contact TNPCB, and obtained in principle approval for disposal into Uyyakondan Channel. Existing STP will also require CTE and CTO. For the project components located within the regulated zone of protected monument, prior permission of ASI shall be obtained as applicable prior to construction. STP is proposed under DBOT contract modality, and therefore various suggested measures will be implemented during the detailed design and treatment and disposal arrangements will be finalized. This IEE shall be updated by PIU during the detailed design phase to reflect any changes, amendments and will be reviewed and approved by PMU.

Appendix 1: RAPID ENVIRONMENTAL ASSESSMENT CHECKLIST

Sewerage

Instructions:
- ❑ This checklist is to be prepared to support the environmental classification of a project. It is to be attached to the environmental categorization form that is to be prepared and submitted to the Chief Compliance Officer of the Regional and Sustainable Development Department.
- ❑ This checklist is to be completed with the assistance of an Environment Specialist in a Regional Department.
- ❑ This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB checklists and handbooks on (i) involuntary resettlement, (ii) indigenous peoples planning, (iii) poverty reduction, (iv) participation, and (v) gender and development.
- ❑ Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: India / Tamil Nadu Urban Flagship Investment Program – Supplying, laying, testing and commissioning of sewer network in the extended area and Uncovered area in core area of Tiruchirappalli including lifting station, pumping station, pumping main and treatment plant at Keelakalkandar kottai and Rehabilitation of existing 37MLD plant at Panjapur.

Sector Division: Urban Development

Screening Questions	Yes/No	Remarks
A. Project Siting **Is the project area…**		
• Densely populated?	☒Yes ☐No	Subproject activities are located in Tiruchirappalli City, a fastly developing urban area in the state of Tamil Nadu. Subproject area includes old town area of Tiruchirappalli, which is very densely populated. Outer areas are comparatively less dense. Old villages areas in the outer city have dense residential pockets, with narrow roads. Newly developing residential areas have low density and well planned layouts. Agriculture is still practiced in the outer areas.
• Heavy with development activities?	☒Yes ☐No	It is a developing area; urban expansion is considerable
• Adjacent to or within any environmentally sensitive areas?	☐Yes ☒No	-
• Cultural heritage site	☒ Yes ☐No	-The ASI protected monument Erumbeswarar temple is in close proximity to the nearby proposed network in Zone-3. However no components are located within the protected monument.
• Protected Area	☐Yes ☒No	-
• Wetland	☐Yes ☒No	-
• Mangrove	☐Yes ☒No	-
• Estuarine	☐Yes ☒No	-
• Buffer zone of protected area	☒Yes ☐No	-

• Special area for protecting biodiversity	☐Yes ☒No	-
• Bay	☐Yes ☒No	-
B. Potential Environmental Impacts **Will the Project cause…**		
Sewerage		
▪ impairment of historical/cultural monuments/areas and loss/damage to these sites?	☐ Yes ☒ No	The ASI protected monuments Erumbeswarar temple is in close proximity to the nearby proposed network in Zone-3 but the networks will be laid on existing roads and will not damage to these site
▪ interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	☒ Yes ☐ No	Few sewage lifting and pump stations are located close to the houses, and odorodor may create nuisance. Necessary measures are included to prevent and control odor; no net negative impacts envisaged
▪ dislocation or involuntary resettlement of people?	☐ Yes ☒ No	Do not involve land acquisition or resettlement
▪ disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?	☐ Yes ☒ No	No such possibilities; .sewerage system will cover entire population including urban poor; In fact, it will have positive health impact due to improved sanitation condition.
▪ impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?	☒ Yes ☐No	For proposed STP adequate capacity sewage treatment facility is being development under this subproject; It is proposed to rehabilitate the existing STP, which not adequately treating the sewage. Corrective Action plan suggested to improve the compliance.
▪ overflows and flooding of neighboring properties with raw sewage?	☒ Yes ☐ No	Sewerage system has been designed considering the population growth. It has been designed to accommodate sewage until design year. Design considers standard peak factors and therefore no such impact envisaged.
▪ environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?	☐ Yes ☒ No	-
▪ noise and vibration due to blasting and other civil works?	☒ Yes ☐ No	No blasting activities envisaged. Temporary nuisance/disturbance due to construction activities will be minimized with appropriate mitigation measures.
▪ risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?	☒ Yes ☐ No	In appropriate handling of sludge may have occupational health hazard. All necessary safety precautions will be taken to avoid any risk.
▪ discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?	☐ Yes ☒ No	There are no sources of hazardous material that will find its way into the sewers. Wastewater other than domestic will not be discharged into the sewers.
▪ inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?	☒ Yes ☐ No	Due to technical constraints and land availability, some lifting and pumping stations are located close to houses, however, necessary measures are included in site planning, design and operation. No net negative impacts envisaged
▪ road blocking and temporary flooding due to land excavation during the rainy season?	☒ Yes ☐ No	Complete road block are not envisaged; in narrow roads, traffic may be diverted but access will be ensure for pedestrians. All necessary precautions

		will be taken to prevent flooding during construction; flooding is unlikely as work will be mostly be conducted during dry season.
▪ noise and dust from construction activities?	☒ Yes ☐ No	No major noise generating activities like rock blasting is envisaged. As the sewers will be lain on the road surface, cutting open of road surface using pneumatic drills will produce noise. Appropriate measures are suggested to minimize impact. Dust will be temporary and will be controlled with proper measures.
▪ traffic disturbances due to construction material transport and wastes?	☒ Yes ☐ No	Proper planning, such as selection of routes and scheduling to avoid peak traffic hours, will be carried out in consultation with concerned authorities
▪ temporary silt runoff due to construction?	☒ Yes ☐ No	Earthworks will not be conducted during rains; plain topography and moderate to low rains, so no such impact envisaged
▪ hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?	☒ Yes ☐ No	A chance of failure of sewerage system is very remote; proper design and standard operating procedures will be followed in O&M; necessary equipment and training to workers will be provided
▪ deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?	☐ Yes ☒ No	sludge management plan will be implemented
▪ contamination of surface and ground waters due to sludge disposal on land?	☐ Yes ☒ No	Sludge will be dried in the ponds, no disposal of wet sludge on the land
▪ Health and safety hazards to workers from toxic gases and hazardous materials which may be contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and unstabilized sludge?	☒ Yes ☐ No	Manual cleaning of sewers and facilities will be avoided. All necessary health and safety training and necessary personal protection equipment will be given to workers and staff during operation of sewerage system
▪ Large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?	☐ Yes ☒ No	No such impact anticipated; local communities in the vicinity of the project would be employed as much as possible.
▪ Social conflicts between construction workers from other areas and community workers?	☐ Yes ☒ No	No such impact anticipated; local communities in the vicinity of the project would be employed as much as possible.
▪ risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?	☐ Yes ☒ No	Not applicable. Construction/operation will not involve use of explosives and chemicals.
▪ community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?	☐ Yes ☒ No	Operational area will be clearly demarcated and access will be controlled. Only worker and project concerned members will be allowed to visit the construction sites. .

Climate Change and Disaster Risk Questions The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.	Yes	No	Remarks
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunami or volcanic eruptions and climate changes?	√		Prone for flooding along the discharge canal under heavy rains and due to release of water in

			Uyyakondan channel from upstream.
Could changes in temperature, precipitation, or extreme events patterns over the Project lifespan affect technical or financial sustainability (e.g., changes in rainfall patterns disrupt reliability of water supply; sea level rise creates salinity intrusion into proposed water supply source)?		√	No
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		√	No
Could the Project potentially increase the climate or disaster vulnerability of the surrounding area (e.g., by using water from a vulnerable source that is relied upon by many user groups, or encouraging settlement in earthquake zones)?		√	No

Appendix 2: SALIENT FEATURES OF MAJOR LABOR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN CONSTRUCTION OF CIVIL WORKS

(i) Workmen Compensation Act, 1923 - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

(ii) Payment of Gratuity Act, 1972 - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years' service or more or on death at the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

(iii) Employees' PF and Miscellaneous Provisions Act, 1952 - The Act provides for monthly contributions by the employer plus workers @10 % or 8.33 %. The benefits payable under the Act are: (a) Pension or family pension on retirement or death as the case may be; (b) deposit linked insurance on the death in harness of the worker; (c) payment of PF accumulation on retirement/death etc.

(iv) Maternity Benefit (Amendment) Act 2017- The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

(v) Contract Labour (Regulation and Abolition) Act, 1970 - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided by the Principal Employer by Law. The principal employer is required to take Certificate of Registration and the Contractor is required to take a License from the designated Officer. The Act is applicable to the establishments or Contractor of principal employer if they employ 20 or more contract labor.

(vi) Minimum Wages Act, 1948 - The employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employment.

(vii) Payment of Wages Act, 1936 - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

(viii) Equal Remuneration Act, 1979 - The Act provides for payment of equal wages for work of equal nature to Male and Female workers and not for making discrimination against Female employees in the matters of transfers, training and promotions etc.

(ix) Payment of Bonus Act, 1965 - The Act is applicable to all establishments employing 20 or more workmen. The Act provides for payments of annual bonus subject to a minimum of 8.33 % of wages and maximum of 20 % of wages to employees drawing Rs. 3,500/- per month or less. The bonus to be paid to employees getting Rs. 2,500/- per month or above up to Rs.3,500/- per month shall be worked out by taking wages as Rs.2,500/- per month only. The Act does not apply to certain establishments. The newly set up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of the Act.

(x) Industrial Disputes Act, 1947 - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

(xi) Industrial Employment (Standing Orders) Act, 1946 - It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the employer on matters provided in the Act and get the same certified by the designated Authority.

(xii) Trade Unions Act, 1926 - The Act lays down the procedure for registration of trade unions of workmen and employees. The trade unions registered under the Act have been given certain immunities from civil and criminal liabilities.

(xiii) Child Labor (Prohibition and Regulation) Act, 1986 - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of child labor is prohibited in Building and Construction Industry.

(xiv) Inter-State Migrant Workmen's (Regulation of Employment and Conditions of Service) Act, 1979 - The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The inter-state migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home up to the establishment and back, etc.

(xv) The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and the Cess Act of 1996 - All the establishments who carry on any building or other construction work and employ 10 or more workers are covered under this Act. All such establishments are required to pay Cess at rate not exceeding 2% of the cost of construction as may be notified by the Government. The employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodation for workers near the workplace etc. The employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

Appendix 3: SAMPLE OUTLINE SPOILS (CONSTRUCTION WASTE) MANAGEMENT PLAN

- The Spoil Management Plan should be site specific and be part of the monthly Construction Management Plan.
- The contractor, in consultation with the PIU, has to find out appropriate location/s for the disposal of the excess soil generated. The spoils should be deposited only at these sites.
- Further precautions need to be taken in case of the contaminated spoils
- The vehicle carrying the spoil should be covered properly.
- The spoils generating from each site should be removed on the same day or immediately after the work is complete. The site / road should be restored to the original condition.

I. Spoils information

The spoil information contains the details like a) The type / material, b) Potential contamination by that type, c) Expected volume (site / component specific), d) Spoil Classification etc.

II. Spoils management

The Spoil Management section gives the details of a) Transportation of spoil b) disposal site details c) Precautions taken d) Volume of contaminated spoil, if present, d) Suggested reuse of disposal of the spoil

III. Documentation

The volume of spoil generated (site specific, date wise), site disposed, reuse / disposal details should be documented properly.

Appendix 4: PUBLIC INFORMATION NOTICE TEMPLATE

Public Announcement
Providing Underground Sewerage System Tiruchirappalli City
Tiruchirappalli City Corporation

Under this project, works are being conducted by xxxx Contractor to provide sewerage network in Tiruchirappalli

As part of this, works for laying pipeline / sewerage network will be taken up in -------- road----/ street/ lane ……. From……to (provide dates).

We request you to kindly co-operate for smooth implementation of the works.

We also request you to drive vehicles / pedestrians to walk carefully

Inconvenience caused is regretted.

PIU - Contact No.
Contractor – Contact no.

Appendix 5: SAMPLE GRIEVANCE REGISTRATION FORM

(To be available in Tamil and English)

The _____Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date	Place of registration	Project Town Project:			
Contact information/personal details					
Name		Gender	* Male * Female	Age	
Home address					
Place					
Phone no.					
E-mail					
Complaint/suggestion/comment/question Please provide the details (who, what, where, and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

Registered by: (Name of official registering grievance)	
Mode of communication: Note/letter E-mail Verbal/telephonic	
Reviewed by: (Names/positions of officials reviewing grievance)	
Action taken:	
Whether action taken disclosed:	Yes No
Means of disclosure:	

Appendix 6: SAMPLE OUTLINE TRAFFIC MANAGEMENT PLAN

A. Principles for TMP around the Water Pipes Construction Sites

1. One of the prime objectives of this TMP is to ensure the safety of all the road users along the work zone, and to address the following issues:

(i) the safety of pedestrians, bicyclists, and motorists travelling through the construction zone;
(ii) protection of work crews from hazards associated with moving traffic;
(iii) mitigation of the adverse impact on road capacity and delays to the road users;
(iv) maintenance of access to adjoining properties; and
(v) addressing issues that may delay the project.

B. Operating Policies for Traffic Management Plan

2. The following principles will help promote safe and efficient movement for all road users (motorists, bicyclists, and pedestrians, including persons with disabilities) through and around work zones while reasonably protecting workers and equipment.

(i) Make traffic safety and temporary traffic control an integral and high-priority element of project from planning through design, construction, and maintenance.
(ii) Inhibit traffic movement as little as possible.
(iii) Provide clear and positive guidance to drivers, bicyclists, and pedestrians as they approach and travel through the temporary traffic control zone.
(iv) Inspect traffic control elements routinely, both day and night, and make modifications when necessary.
(v) Pay increased attention to roadside safety in the vicinity of temporary traffic control zones.
(vi) Train all persons that select, place, and maintain temporary traffic control devices.
(vii) Keep the public well informed.
(viii) Make appropriate accommodation for abutting property owners, residents, businesses, emergency services, railroads, commercial vehicles, and transit operations.

3. **Figure A2 to Figure A12** illustrates the operating policy for TMP for the construction of water pipes and the sewers along various types of roads.

C. Analyze the impact due to street closure

4. Apart from the capacity analysis, a final decision to close a particular street and divert the traffic should involve the following steps:

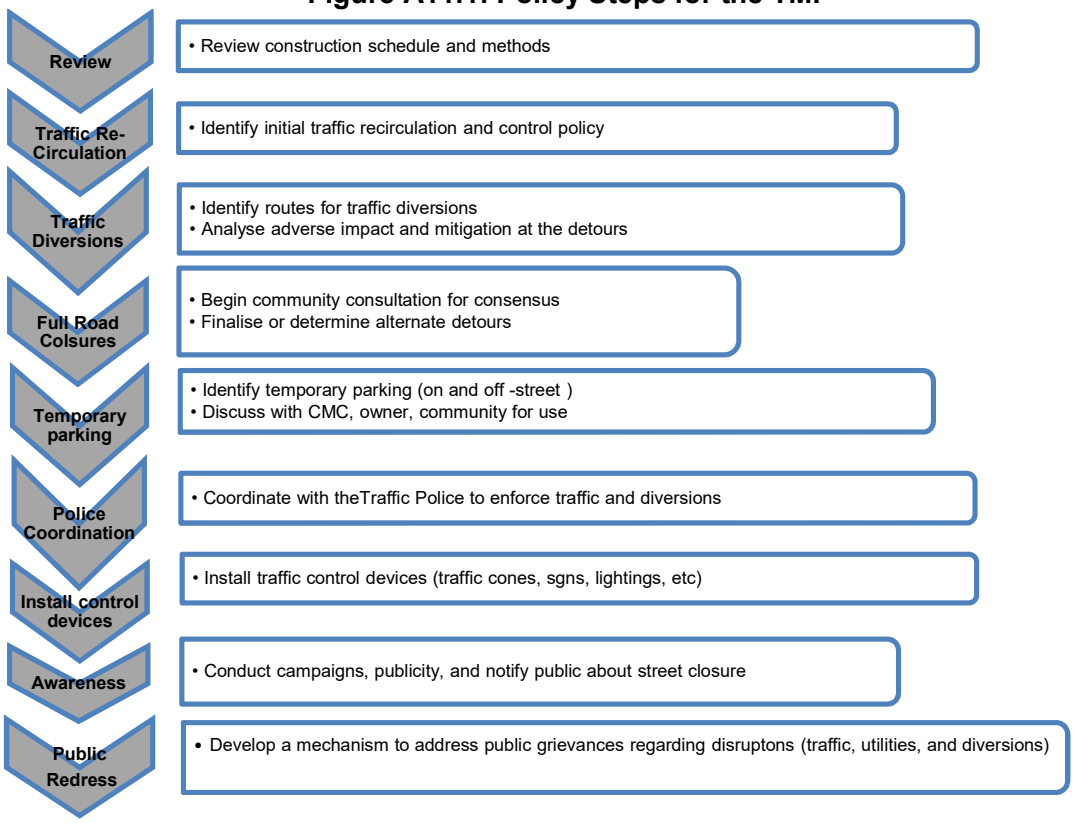
(i) approval from the ULB/Public Works Department (PWD) to use the local streets as detours;
(ii) consultation with businesses, community members, traffic police, PWD, etc, regarding the mitigation measures necessary at the detours where the road is diverted during the construction;
(iii) determining of the maximum number of days allowed for road closure, and incorporation of such provisions into the contract documents;
(iv) determining if additional traffic control or temporary improvements are needed along the detour route;
(v) considering how access will be provided to the worksite;

(vi) contacting emergency service, school officials, and transit authorities to determine if there are impacts to their operations; and

(vii) developing a notification program to the public so that the closure is not a surprise. As part of this program, the public should be advised of alternate routes that commuters can take or will have to take as result of the traffic diversion.

5. If full road-closure of certain streets within the area is not feasible due to inadequate capacity of the detour street or public opposition, the full closure can be restricted to weekends with the construction commencing on Saturday night and ending on Monday morning prior to the morning peak period.

Figure A11.1: Policy Steps for the TMP



D. Public awareness and notifications

6. As per discussions in the previous sections, there will be travel delays during the constructions, as is the case with most construction projects, albeit on a reduced scale if utilities and traffic management are properly coordinated. There are additional grounds for travel delays in the area, as most of the streets lack sufficient capacity to accommodate additional traffic from diverted traffic as a result of street closures to accommodate the works.

6. The awareness campaign and the prior notification for the public will be a continuous activity which the project will carry out to compensate for the above delays and minimize public claims as result of these problems. These activities will take place sufficiently in advance of the time when the roadblocks or traffic diversions take place at the particular streets. The reason for

this is to allow sufficient time for the public and residents to understand the changes to their travel plans. The project will notify the public about the roadblocks and traffic diversion through public notices, ward level meetings and city level meeting with the elected representatives.

7. The PIU will also conduct an awareness campaign to educate the public about the following issues:

(i) traffic control devices in place at the work zones (signs, traffic cones, barriers, etc.);
(ii) defensive driving behaviour along the work zones; and
(iii) reduced speeds enforced at the work zones and traffic diversions.

8. It may be necessary to conduct the awareness programs/campaigns on road safety during construction.

9. The campaign will cater to all types of target groups i.e. children, adults, and drivers. Therefore, these campaigns will be conducted in schools and community centers. In addition, the project will publish a brochure for public information. These brochures will be widely circulated around the area and will also be available at the PIU, and the contractor's site office. The text of the brochure should be concise to be effective, with a lot of graphics. It will serve the following purpose:

(i) explain why the brochure was prepared, along with a brief description of the project;
(ii) advise the public to expect the unexpected;
(iii) educate the public about the various traffic control devices and safety measures adopted at the work zones;
(iv) educate the public about the safe road user behaviour to emulate at the work zones;
(v) tell the public how to stay informed or where to inquire about road safety issues at the work zones (name, telephone, mobile number of the contact person; and
(vi) indicate the office hours of relevant offices.

E. Install traffic control devices at the work zones and traffic diversion routes

10. The purpose of installing traffic control devices at the work zones is to delineate these areas to warn, inform, and direct the road users about a hazard ahead, and to protect them as well as the workers. As proper delineation is a key to achieve the above objective, it is important to install good traffic signs at the work zones. The following traffic control devices are used in work zones:

(i) Signs
(ii) Pavement Markings
(iii) Channelizing Devices
(iv) Arrow Panels
(v) Warning Lights

11. Procedures for installing traffic control devices at any work zone vary, depending on road configuration, location of the work, construction activity, duration, traffic speed and volume, and pedestrian traffic. Work will take place along major roads, and the minor internal roads. As such, the traffic volume and road geometry vary. The main roads carry considerable traffic; internal roads in the new city areas are wide but in old city roads very narrow and carry considerable traffic. However, regardless of where the construction takes place, all the work zones should be

cordoned off, and traffic shifted away at least with traffic cones, barricades, and temporary signs (temporary “STOP” and “GO”).

12. **Figure A11.2 to Figure A11.6** illustrates a typical set-up for installing traffic control devices at the work zone of the area, depending on the location of work on the road way, and road geometrics:

(i) Work on shoulder or parking lane
(ii) Shoulder or parking lane closed on divided road
(iii) Work in Travel lane
(iv) Lane closure on road with low volume
(v) Street closure with detour

13. The work zone should take into consideration the space required for a buffer zone between the workers and the traffic (lateral and longitudinal) and the transition space required for delineation, as applicable. For the works, a 30 cm clearance between the traffic and the temporary STOP and GO signs should be provided. In addition, at least 60 cm is necessary to install the temporary traffic signs and cones.

14. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. Flaggers/ personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type) for regulating the traffic during night time.

16. In addition to the delineation devices, all the construction workers should wear fluorescent safety vests and helmets in order to be visible to the motorists at all times. There should be provision for lighting beacons and illumination for night constructions.

Figure A11.2 and A11.3: Work on shoulder or parking lane and Shoulder or parking lane closed on divided road

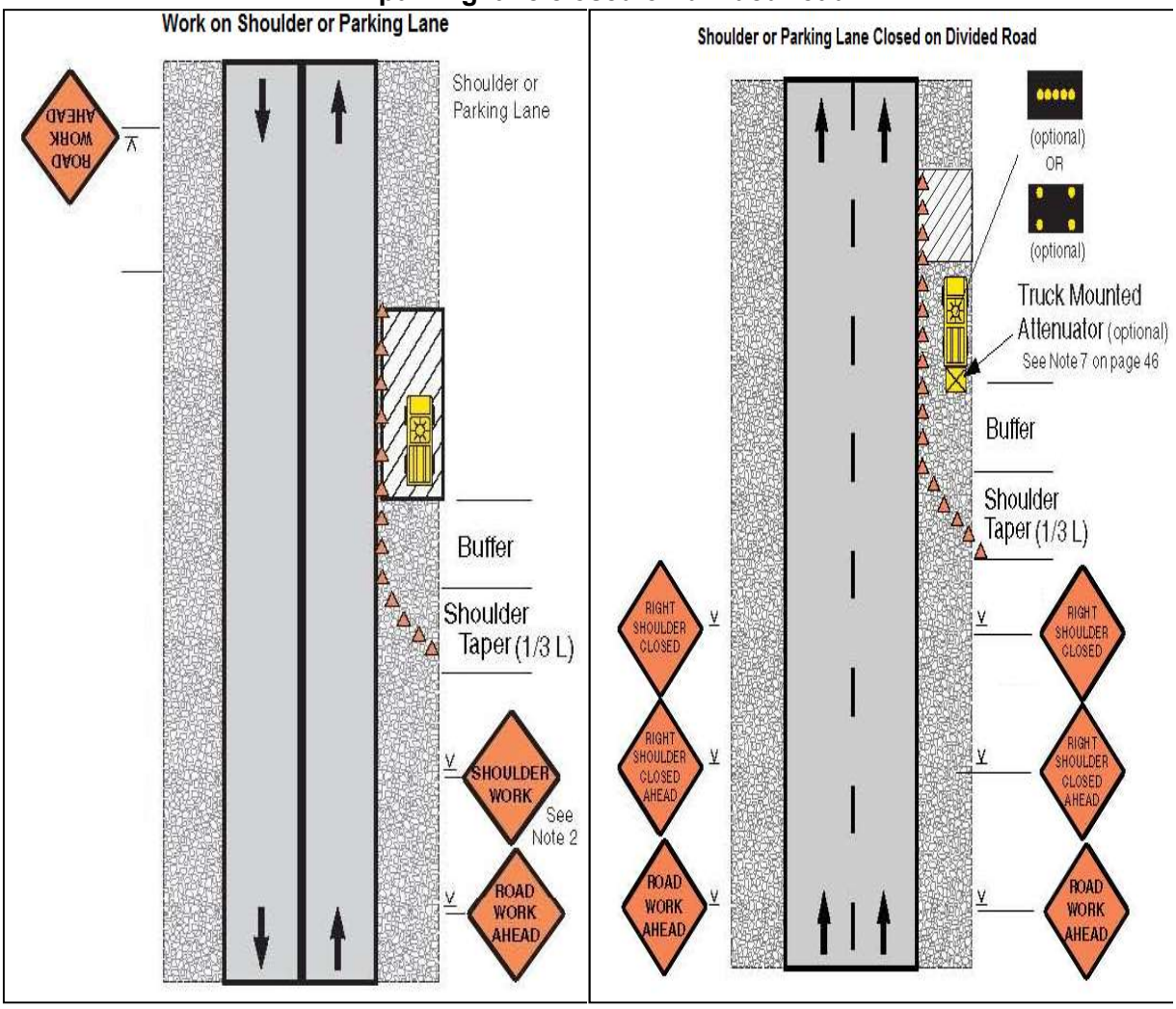


Figure A11.4 and A11.5: Work in Travel lane and Lane closure on road with low volume

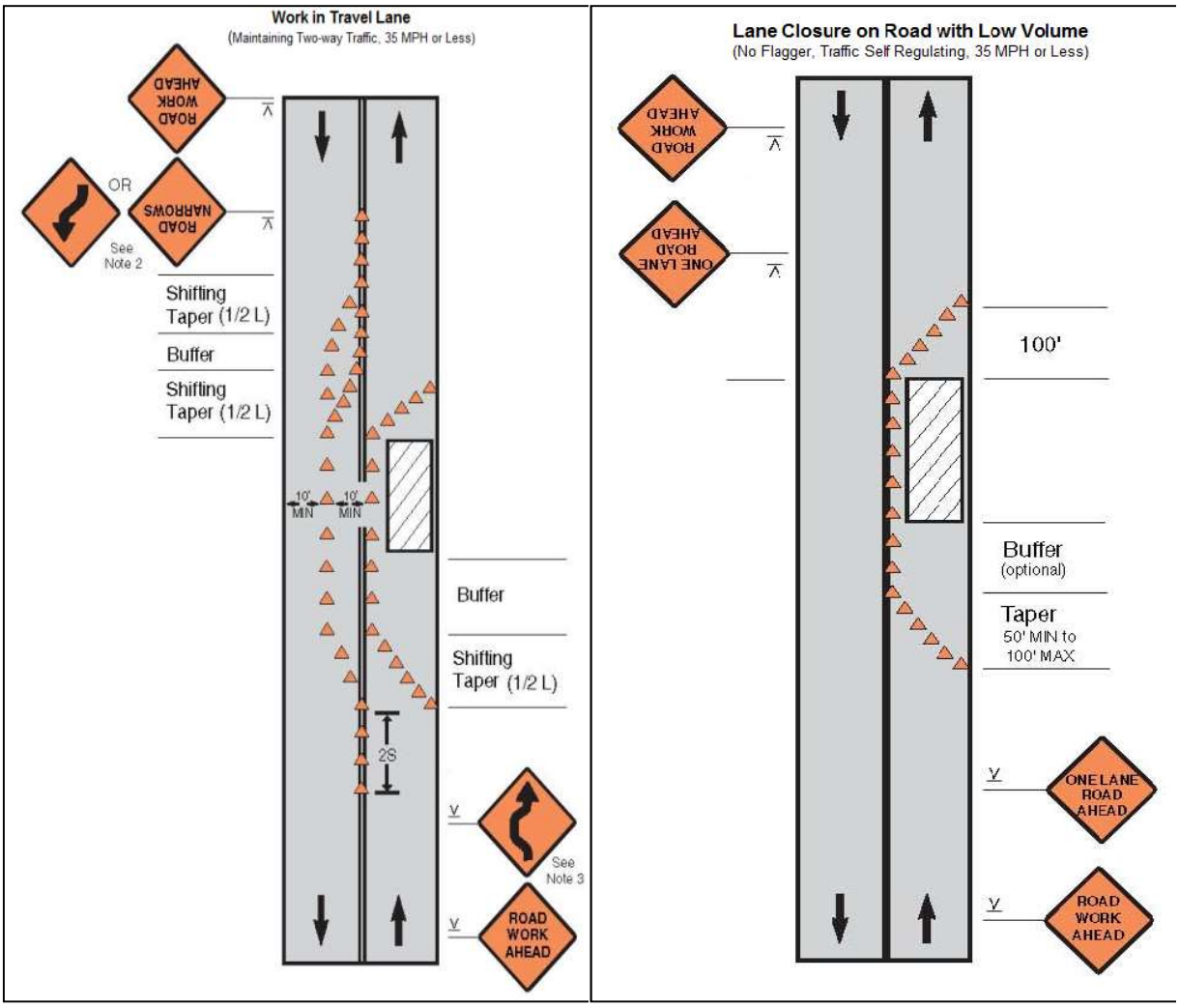
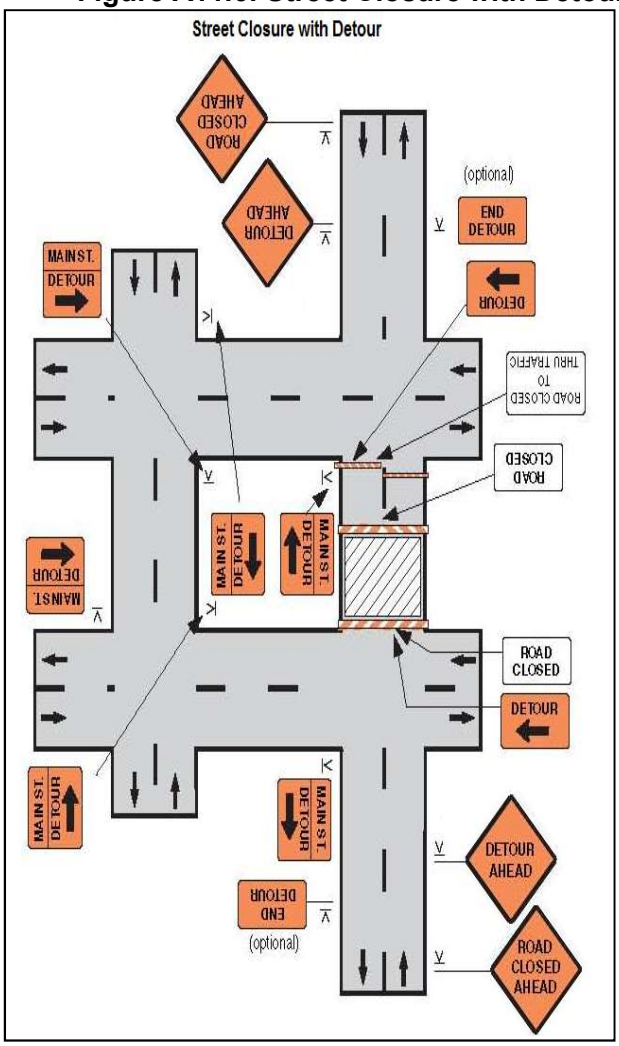


Figure A11.6: Street Closure with Detour



Appendix 7: SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name
Contract Number

NAME: _____ DATE: _____
TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER:

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Monitoring Items	Compliance
Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)	
EHS supervisor appointed by contractor and available on site	
Construction site management plan (spoils, safety, schedule, equipment etc.,) prepared	
Traffic management plan prepared	
Dust is under control	
Excavated soil properly placed within minimum space	
Construction area is confined; no traffic/pedestrian entry observed	
Surplus soil/debris/waste is disposed without delay	
Construction material (sand/gravel/aggregate) brought to site as and when required only	
Tarpaulins used to cover sand and other loose material when transported by vehicles	
After unloading , wheels and undercarriage of vehicles cleaned prior to leaving the site	
No AC pipes disturbed/removed during excavation	
No chance finds encountered during excavation	
Work is planned in consultation with traffic police	
Work is not being conducted during heavy traffic	
Work at a stretch is completed within a day (excavation, pipe laying and backfilling)	
Pipe trenches are not kept open unduly	
Road is not completely closed; work is conducted on edge; at least one line is kept open	
Road is closed; alternative route provided and public informed, information board provided	
Pedestrian access to houses is not blocked due to pipe laying	
Spaces left in between trenches for access	
Wooden planks/metal sheets provided across trench for pedestrian	
No public/unauthorized entry observed in work site	
Children safety measures (barricades, security) in place at works in residential areas	
Prior public information provided about the work, schedule and disturbances	
Caution/warning board provided on site	
Guards with red flag provided during work at busy roads	
Workers using appropriate PPE (boots, gloves, helmets, ear muffs etc)	
Workers conducting or near heavy noise work is provided with ear muffs	
Contractor is following standard and safe construction practices	
Deep excavation is conducted with land slip/protection measures	
First aid facilities are available on site and workers informed	
Drinking water provided at the site	
Toilet facility provided at the site	

Monitoring Items	Compliance
Separate toilet facility is provided for women workers	
Workers camps are maintained cleanly	
Adequate toilet and bath facilities provided	
Contractor employed local workers as far as possible	
Workers camp set up with the permission of PIU	
Adequate housing provided	
Sufficient water provided for drinking/washing/bath	
No noisy work is conducted in the nights	
Local people informed of noisy work	
No blasting activity conducted	
Pneumatic drills or other equipment creating vibration is not used near old/risky buildings	

Signature

_____

Sign off

Name	**Name**
Position	**Position**

Appendix 8: SEMI ANNUAL ENVIRONMENTAL MONITORING PLAN TEMPLATE

1. INTRODUCTION

- Overall project description and objectives
- Environmental category as per ADB Safeguard Policy Statement, 2009
- Environmental category of each subproject as per national laws and regulations
- Project Safeguards Team

Name	Designation/Office	Email Address	Contact Number
1. PMU			
2. PIUs			
3. Consultants			

- Overall project and sub-project progress and status
- Description of subprojects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

Package Number	Components/List of Works	Status of Implementation (Preliminary Design/Detailed Design/On-going Construction/Completed/O&M)[9]	Contract Status (specify if under bidding or contract awarded)	If On-going Construction	
				%Physical Progress	Expected Completion Date

2. COMPLIANCE STATUS WITH NATIONAL/STATE/LOCAL STATUTORY ENVIRONMENTAL REQUIREMENTS[10]

[9] If on-going construction, include %physical progress and expected date of completion

[10] All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s.

Package No.	Subproject Name	Statutory Environmental Requirements[11]	Status of Compliance[12]	Validity if obtained	Action Required	Specific Conditions that will require environmental monitoring as per Environment Clearance, Consent/Permit to Establish[13]

3. COMPLIANCE STATUS WITH ENVIRONMENTAL LOAN COVENANTS

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

4. COMPLIANCE STATUS WITH THE ENVIRONMENTAL MANAGEMENT PLAN (REFER TO EMP TABLES IN APPROVED IEE/S)

- Confirm if IEE/s require contractors to submit site-specific EMP/construction EMPs. If not, describe the methodology of monitoring each package under implementation.

Package-wise Implementation Status

Package Number	Components	Design Status (Preliminary Design Stage/Detailed Design Completed)	Final IEE based on Detailed Design				Site-specific EMP (or Construction EMP) approved by Project Director? (Yes/No)	Remarks
			Not yet due (detailed design not yet completed)	Submitted to ADB (Provide Date of Submission)	Disclosed on project website (Provide Link)	Final IEE provided to Contractor/s (Yes/No)		

- Identify the role/s of Safeguards Team including schedule of on-site verification of reports submitted by consultants and contractors.

Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.

[11] Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.)

[12] Specify if obtained, submitted and awaiting approval, application not yet submitted

[13] *Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 2 trees for every tree, etc.*

- For each package, provide name/s and contact details of contractor/s' nodal person/s for environmental safeguards.
- Include as appendix all supporting documents including **signed** monthly environmental site inspection reports prepared by consultants and/or contractors.
- With reference to approved EMP/site-specific EMP/construction EMP, complete the table below.
- Provide the monitoring results as per the parameters outlined in the approved EMP (or site-specific EMP/construction EMP when applicable).
- In addition to the table on EMP implementation, the main text of the report should discuss in details the following items:

  (i) **Grievance Redress Mechanism.** Provide information on establishment of grievance redress mechanism and capacity of grievance redress committee to address project-related issues/complaints. Include as appendix Notification of the GRM (town-wise if applicable).

  (ii) **Complaints Received during the Reporting Period.** Provide information on number, nature, and resolution of complaints received during reporting period. Attach records as per GRM in the approved IEE. Identify safeguards team member/s involved in the GRM process. Attach minutes of meetings (ensure English translation is provided).

    - Confirm if any dust was noted to escape the site boundaries and identify dust suppression techniques followed for site/s.
    - Identify muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads.
    - Identify type of erosion and sediment control measures installed on site/s, condition of erosion and sediment control measures including if these were intact following heavy rain;
    - Identify designated areas for concrete works, chemical storage, construction materials, and refueling. Attach photographs of each area.
    - Confirm spill kits on site and site procedure for handling emergencies.
    - Identify any chemical stored on site and provide information on storage condition. Attach photograph.
    - Describe management of stockpiles (construction materials, excavated soils, spoils, etc.). Provide photographs.
    - Describe management of solid and liquid wastes on-site (quantity generated, transport, storage and disposal). Provide photographs.
    - Provide information on barricades, signages, and on-site boards. Provide photographs.
    - Provide information on
    - Checking if there are any activities being under taken out of working hours and how that is being managed.

Summary of Environmental Monitoring Activities (for the Reporting Period)[14]

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						
Operational Phase						

[14] Attach Laboratory Results and Sampling Map/Locations

Overall Compliance with CEMP/ EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

5. APPROACH AND METHODOLOGY FOR ENVIRONMENTAL MONITORING OF THE PROJECT

- Brief description on the approach and methodology used for environmental monitoring of each sub-project

6. MONITORING OF ENVIRONMENTAL IMPACTS ON PROJECT SURROUNDINGS (AMBIENT AIR, WATER QUALITY AND NOISE LEVELS)

- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		
			PM10 µg/m3	SO2 µg/m3	NO2 µg/m3

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					
			pH	Conductivity µS/cm	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

Noise Quality Results

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA_{eq} (dBA) (Monitoring Results)	
			Day Time	Night Time

7. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

- Summary of follow up time-bound actions to be taken within a set timeframe.

8. APPENDIXES

- Photos
- Summary of consultations
- Copies of environmental clearances and permits
- Sample of environmental site inspection report
- Other

SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project Name
Contract Number

NAME: _____ DATE: _____
TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER CONDITION:
_____

INITIAL SITE CONDITION: _____

CONCLUDING SITE CONDITION:

Satisfactory _____ Unsatisfactory _____ Incident _____Resolved _____ Unresolved _____

INCIDENT:
Nature of incident:
_____

Intervention Steps:
_____

Incident Issues

Resolution

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

Inspection

Emissions	Waste Minimization
Air Quality	Reuse and Recycling
Noise pollution	Dust and Litter Control
Hazardous Substances	Trees and Vegetation

Site Restored to Original Condition Yes ☐ No ☐

Signature
_____

Sign off

_____ _____
Name **Name**
Position **Position**

Appendix 9: DETAILS OF PUBLIC CONSULTATIONS

Details of Stakeholder Consultations was Held on November 3, 2017

Question raised and answers provided during consultations

1. V. Sellappan, Deputy President, Gandhi Salai, Kailash Nagar

	Questions	Answers
1	Without disturbing the local resident , works has to be done	While execution , the traffic diversion and safety measures like keeping Barricading system will consider to minimize the disturbance of local residents.
2	Once pipe line works has over, the excavated trench in the road has to be closed.	After hydraulic test of the laid pipe line, the excavated trench will be closed immediately by contractor. Then they will go next street.
3	scheme to has to be finished within stipulated time	Corporation arranging Project Management Consultancy for this Phase –II scheme. So Corporation and PMC will closely monitor the works and will complete within period (3 Years).

2. M. Thangamuthu, Retd, BHEL, Kailash Nagar

	Questions	Answers
1	Commercials hotels sewage load has to connect the proposed scheme.	The commercial sewage and institution sewage also considered in the proposed scheme.

3. Sellakannu, V. Sellappan, Kailash Nagar, Kattur

	Questions	Answers
1	Sewage odor has to control	Wherever the sewage pumping station are located in the Resident area , the odor control device like scrapper will installed to control odor .
2	scheme to has to be finished within stipulated time	Corporation arranging Project Management Consultancy for this Phase –II scheme. So Corporation and PMC will closely monitor the works and will complete within period (3 Years).
3	Sewage Treatment Plant has to locate faraway from resident areas.	The STP is located away from the local resident area.

4. V. JHIRUGNANSAMDAM, Lingam Nagar, Melapandamangalam, Kulumani Road

	Questions	Answers
1	Kindly consider the Lingam Nagar also under Phase –II.	The Lingam area will be covered under Phase –III (Next Phase) .

5. S.E Rajendren, Welfare Association, Anna Salai, Kailash Nagar

	Questions	Answers
1	the pipe line connection , from outlet of building to Compound wall (inside premises) has to consider under contractor.	From Phase –II scheme, inside premises pipe line also will be laid under contractor .
2	Future expansion area also has to be considered in this Phase –II.	The overall sewerage master plan including detail design has kept ready . When-ever the population density criteria will match will local population (100 Nos / hectare) , the sewage line will be laid under future phases .

6 A. Aruna Giri, Win Nagar, Kattur

	Questions	Answers
1	The scheme board has to keep in the street . In Board, the contractor Name, phone number and respective wards official number from TCC has to mention.	Will do necessary action in this regard.

7 P. Ramachandram , Win Nagar

	Questions	Answers
1	Sewage pumping station has to locate forway from resident area.	Most of the cases , the SPS has to proposed at Remote area only . Due to land constraint, SPS -4 only located in the Resident area , the odor control device like scrapper will be installed to control odor issues .

8. R. Ganesan ,Vignesh Nagar

	Questions	Answers
1	Without disturbing the local resident , works has to be done	While execution , the traffic diversion and safety measures like keeping Barricading system will consider to minimize the disturbance of local residents.
2	Once pipe line works has over, the excavated trench in the road has to be closed.	After hydraulic test of the laid pipe line, the excavated trench will be closed immediately by contractor. Then they will go next street.
3	scheme to has to be finished within stipulated time	Corporation arranging Project Management Consultancy for this Phase –II scheme. So Corporation and PMC will closely monitor the works and will complete within period (3 Years).
4	The road restoration has to finish once works has finished and the manhole cover has to be leveled with road surface level.	Contractor will do similar way and PMC and Corporation will monitor road restoration works also.

9. R.Rajanobili,Gandhi Nagar, Kattur

	Questions	Answers
1	What is the execution period and operation and maintenance period	3 years execution period and 5 years for O & M
2	The scheme board has to keep in the street. In Board, the contractor Name, phone number and respective wards official number from TCC has to mention.	Will do necessary action in this regard.
3	While road restoration, the road level should not increase with existing road level.	While doing road restoration works , the road level will be leveled with existing road level. Corporation assured to maintain road level.

10 P. Narayanasamy , Balaji Nagar , Kattur

	Questions	Answers
1	Manford school sewage has to consider in this phase.	Considered under Phase –II .

11. V. Ramachandran , Ellaikudi ,Kattur

News Paper Clippings About Public Consultations, November 4, 2017

Newspaper -The Hindu

Phase II of underground sewer project to begin soon

Tenders for the project, estimated to cost ₹344 crore, will be called soon

SPECIAL CORRESPONDENT
TIRUCHI

Tenders for executing the second phase of the underground drainage system, to extend the sewer lines to uncovered areas in about 25 wards in the city, are expected to be called soon. The project, sanctioned at a cost of ₹344 crore, under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), would provide underground sewer lines to five wards fully and to omitted areas in 20 other wards in the city.

Commissioner-cum-Special Officer, Tiruchi Corporation, N. Ravichandran, said that tenders for the project would be called within the next 15 days. "We will shortly submit the detailed project report for the phase-III of the project, entailing an investment of about ₹450 crore, and expect it to be approved soon. Once the phase-II and phase III of the scheme is completed, nearly 90% of the city will have underground sewer lines," Mr. Ravichandran told *The Hindu* after attending a stake holders meeting to discuss the environmental impact of the phase-II of the project which was held on Friday.

Providing an overview of the phase-II of the project at the meeting, S. Amudhavalli, City Engineer, said the Centre will contribute 50% of the project cost, the State government 30% and the remaining 20% will be borne by Tiruchi Corporation. Since the Corporation cannot raise the resource from its own funds, it had sought financial assistance from the Asian Development Bank.

The areas to be covered under the phase-II of the project have been carefully selected to prevent pollution of water bodies, including the Cauvery river and the Uyyakondan canal. The area towards Tiruverumbur had the maximum number of water bodies, she observed.

S. Amuthavalli, City Engineer, addressing a consultative meeting with stakeholders on the underground drainage system in Tiruchi on Friday. • PHOTO: M. MOORTHY

The project would cover wards 28, 29, 30, 61 and 62 fully and wards 7-9, 12-15, 21, 27, 31, 46, 52-54, 57-60 and 63-65 partially. Other parts of the city without underground sewer lines will be covered under phase-III.

Under phase-II sewer lines would be laid for a distance of 319 km and pumping mains for 22 km to provide 43,147 individual connections. Seven pumping stations and 23 lifting stations would be established. A new sewage treatment plant would be established at Keezha Kalkandarkottai with a capacity to treat about 27 million litres of sewage a day. The treated sewage could be used for agricultural purposes and there will be no adverse environmental impact due to the project, Ms. Amudhavalli said.

A section of residents, who participated in the meeting, called upon the Corporation authorities to ensure that all the five newly added wards (61 to 65) were fully provided with sewer lines and ensure that the project was completed within a specific time-frame. According to available indications, the second phase of the project is expected to be completed by 2021.

Newspaper - Dinakaran

திருச்சி பால்பண்ணை அருகில் கடந்த சில நாட்களாக பெய்த மழையில் தேங்கிகிடந்த தண்ணீரில் இரைதேடி வந்த நாரை கூட்டம்.

மாநகராட்சியின் அனைத்து பகுதிகளிலும்

5 ஆண்டுகளில் பாதாள சாக்கடை திட்ட பணிகள் நிறைவடையும்

கருத்துகேட்பு கூட்டத்தில் ஆணையர் தகவல்

திருவெறும்பூர், நவ.4: திருச்சி மாநகராட்சியின் அனைத்து பகுதிகளிலும் 5 ஆண்டுகளில் பாதாள சாக்கடை திட்ட பணிகள் நிறைவடைந்து விடும் என்று கருத்து கேட்பு கூட்டத்தில் ஆணையர் ரவிச்சந்திரன் தெரிவித்தார்.

மத்திய பொது சுகாதார மற்றும் சுற்றுச்சூழல் பொறியியல் நிறுவன விதிமுறைகளின் படி பாதாள சாக்கடை திட்டம் ரூ.344 கோடி மதிப்பீட்டில் தயாரிக்கப்பட்டு மாநகராட்சி பங்களிப்புடன் அம்ருத் திட்டத்தில் பாதாள சாக்கடை திட்டம் பகுதி 2 நடைமுறைப்படுத்தப்பட உள்ளது.

இது சம்பந்தமாக திருவெறும்பூர் அருகே காட்டூரில் நேற்று பொது மக்களிடம் சுற்றுசூழல் பாதிப்பு குறித்த கருத்து கேட்பு கூட்டம் நடந்தது. இதில் நகர பொறியாளர் அமுதவள்ளி தலைமை வகித்து பேசுகையில், அம்ருத் திட்டத்தில் திருச்சி மாநகராட்சி பகுதிகளில் பாதாளசாக்கடை விடுபட்ட பகுதிகளில் பாதாளசாக்கடை பகுதி 2 திட்டம் ரூ.344 கோடி செலவில் செயல்படுத்தப்படவுள்ளது. இந்த திட்டமானது திருச்சி மாநகராட்சியில் வார்டு எண்கள் 28, 29, 30, 61, 62 ஆகிய 5 வார்டுகளில் முழுமையாகவும் மற்றும் 20 வார்டுகளில் பகுதியாகவும் செயல்படுத்தப்பட உள்ளது.

பாதாள சாக்கடையின் பம்பிங் நிலையங்கள் அரியமங்கலம் முத்து குமாரசாமிநகர், மாநகராட்சி உர கிடங்கு வளாகம், எல்லக்குடி வின் நகர் ஆலத்தூர் ராஜராஜேஸ்வரி நகர், கீழகல்கண்டார்கோட்டை மற்றும் கழிவுநீர் சுத்திகரிப்பு நிலையம் அமைக்க கீழகல்கண்டார்கோட்டை தேர்வு செய்யப்பட்டுள்ளது. இந்த பாதாள சாக்கடை திட்டத்திற்கு 50 சதவீதம் மத்திய அரசும், 30 சதவீதம் மாநில அரசும், 20 சதவீதம் விளூபிக்கள் பங்களிப்புடன் செயல்படுத்தப்பட உள்ளது என்றார்.

பின்னர் பொது மக்களிடம் கருத்துகள் கேட்கப்பட்டது.

இதில் கலந்து கொண்ட நகர் நல வளாச்சி சங்கத்தினர், பொது மக்களிடமிருந்து விண்ணப்பங்கள் கொடுக்கப்பட்டு கருத்துக்கள் எழுத்து மூலமாக எழுதி வாங்கினர்.

கூட்டத்தில் மாநகராட்சி ஆணையர் ரவிச்சந்திரன் பேசும் போது, தமிழக அரசு திருச்சி மாநகராட்சிக்கு ஒரு வருடத்தில் பகுதி2 பாதாளசாக்கடை திட்டத்திற்கு ரூ.344கோடி, பகுதி3 திட்டத்திற்கு ரூ.450 கோடி என சுமார் 800 கோடி ரூபாய் என மிகப்பெரிய தொகையை ஒதுக்கியுள்ளது. பகுதி 2 திட்டம் இன்னும் 6 மாதத்தில் பணி தொடங்கி 3 ஆண்டுகள் நடைபெறும். திருச்சி மாநகராட்சியில் அதிகபட்சம் 5 ஆண்டுகளில் எல்லா பகுதிகளிலும் பாதாள சாக்கடை திட்ட பணிகள் முடிவடைந்து விடும். இதற்காக டெண்டர் கோரப்படும் என்று கூறினார்.

திருச்சி காட்டூர் காந்திநகரில் மாநகராட்சி சார்பில் நடந்த புதைவடிகால் பயன்பாடு குறித்த ஆலோசனை கூட்டத்தில் ஆணையர் ரவிச்சந்திரன் பேசுகிறார்.

700 ஊழியர்கள் நியமனம்

மேலும் 15 இடங்களில் மைக்ரோ கம்போஸ் திட்டம்

டாம்கோ திட்டங்கள் மூலம்

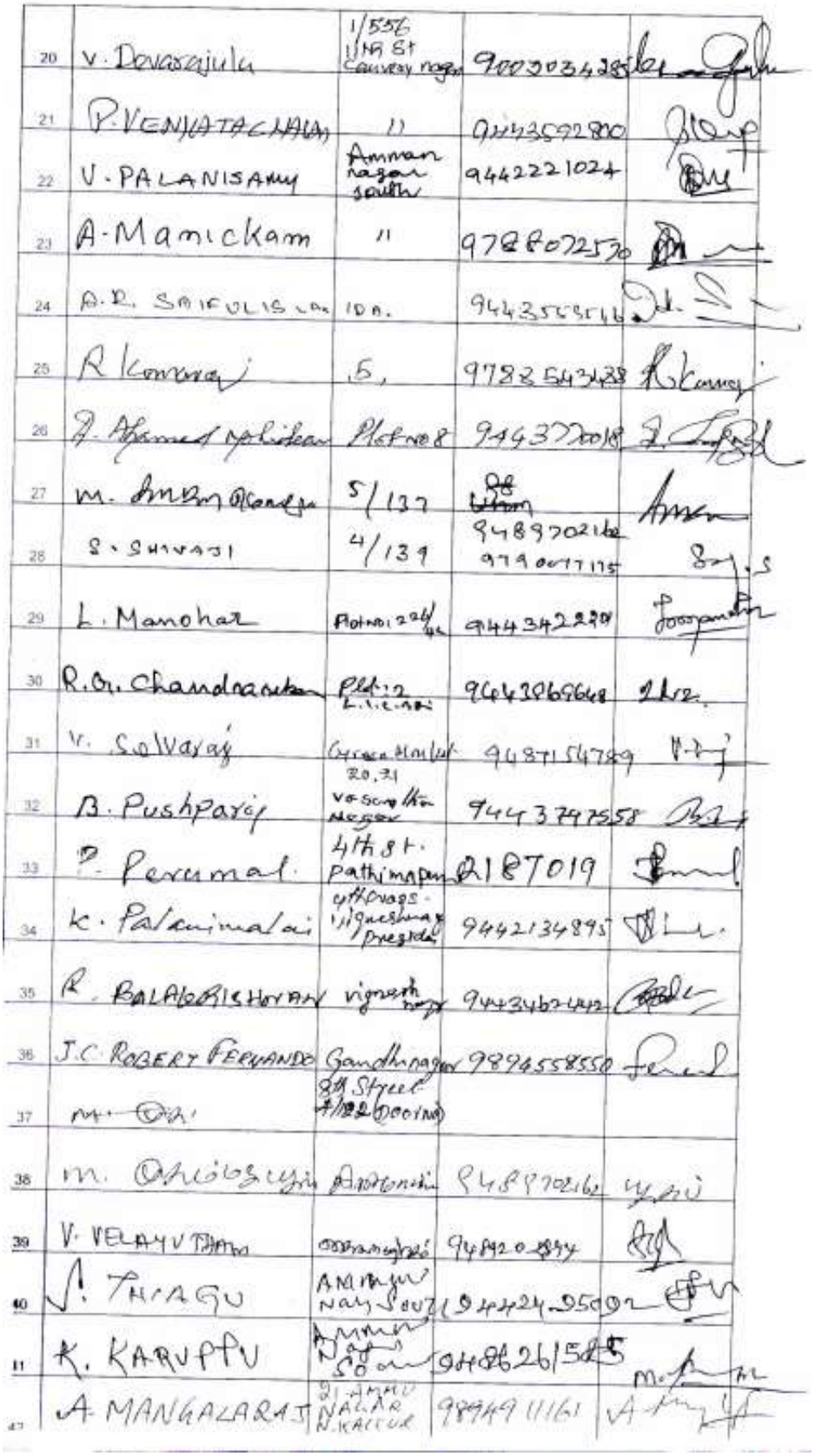
List of Participant

TIRUCHIRAPPALLI CITY CORPORATION

Provding UGSS Scheme under AMRUT (Phase II)

DATE 03.11.2017 Venue: Sakthi Mahal, Kattur

Sl.No	Name ~~of the Officials~~ (Thiruvalargal)	Address	Contact No.	Signature
1				
2				
15				
16	R. chandrasekaran.	4/163-C Vasantha Nagar. Thiruverumbur,	9788758123	[signature]
17	M Kumar	3/369	9487358053	[signature]
18	M. PANDIARAJAN	3/367	9443294581	[signature]
19	K. Arumugam	192	9894285149	[signature]



28 திருச்சிராப்பள்ளி மாநகராட்சி

S.No	Name	Address	Contact no	Signature
43	M. GANESAN	4/164F Valarmathi Nagar Kattur	9894788310	N. Ganes
44				
45	V. Ramamoorthy	15, Andal Nagar East Ambikapuram	9443312133	V. Ramoo
46				
47	R. Radhakrishnan (Radha krishnan)	[illegible] Anna Nala Sangam	9443749940	R. Ree
48				
49	M. Navaneetha Krishnan	TRICHY - 620011	9442828974	M N
50		21		
51	K. Balan	79	9600489112	K. Balan
52	A. NATARAJAN	WIN NAGAR	9442531170	[illegible]
53	S. DOSS	-do-	9965740011	[illegible]
54	A. ARUNAGIRI	-do-	7502594797	A. Arun
55	V. BALAKRISHNAN	KATTUR	9442893867	[illegible]
56	S. KANNAIYAN	3/212 KATTUR	9025394117	[illegible]
57	T. KARUPPANNAN	Vasantha nagar Kattur	9715939577	[illegible]
58	M. GOVINDARAJAN	"	9787485955	M. Govindaraj
59	A. Radhakrishnan	Kailashnagar	9786992644	[illegible]
60	R. NAVANEETHA KRISHNAN	Kailashnagar Gandhi Salai	9443673789	Krish
61	M. Thangamuthu	Kailashnagar.	9345124778	[illegible]
62	S. C. RAJENDRAN	No. 5 S/10 Kailash Nagar	9662948064	[illegible]
63	N. BALADANDAPANI	16 KANDAN NAGAR II	9790772267	N. Bala
64	J. PARIMELALAGAN	40. Main Road Sanjeevi Nagar; MK Kottai	9443532811	[illegible]
65				
66	V. RAJARAJAN.	43/9B Green St, Bharathi Nagar	7708841406	V. Raj.
67	T. JOHN SELVARAJ	4/12. V.V. COTTAGE, VIGNESH NAGAR	9865725480	T. J. Selvaraj
68	A. JOHN PAUL	RAGHAVENDRA NAGAR	9842440765	[illegible]
69	M. Chellappa [illegible]	kailash nagar	9842463607	[illegible]
70	V. [illegible]	[illegible] 3/4	9865122993	V. [illegible]
71	C. SUTHANTHIRARAJ	Prakash nagar	8838394952	[illegible]
72	P. Mohan Kumar	North Kattur Vayalur	9994652676	[illegible]
73	D. Jonedy [illegible]	[illegible]	9790053487	[illegible]
74	M. A. FRANCIS	[illegible]	9942320866	[illegible]

Sl No	Name	Address	Contact no	Signature
75	P. Rajendran	12, Thirumalai [illegible]	9443590678	[illegible]
76	V. Balasubramanian	[illegible]		
77	P. Ramachandran [illegible]	157.5th Street, [illegible] Extn	9487667577	[illegible]
78	P. Sivakumar.	2nd street Vasanthanagar	9597780406	[illegible]
79	D. [illegible]	[illegible]	9789333889	[illegible]
80	[illegible]	[illegible]	9842408000	[illegible]
81	S. [illegible]	154, [illegible]	9443302621	[illegible]
82	A. [illegible]	[illegible]	[illegible]	[illegible]
83	[illegible]	2/143 [illegible]	[illegible]	[illegible]
84	A. [illegible]	87, [illegible] Extn.,	94421-36485	[illegible]
85	A. Subramanian	,,	9688338861	[illegible]
86	R. [illegible]	6A [illegible]	9443776757	[illegible]
87	R. [illegible]	[illegible]	[illegible]	[illegible]
88				
89	V. Gopalakrishnan	10, Nehru St, Sanjeevi Nagar Ward-7	9443821241	V. Gopalakrishnan
90				
91	S. [illegible]	[illegible]	9600491363	[illegible]
92	A. [illegible]	Cholamnagar [illegible]	[illegible]	[illegible]
93	V. Rajagopal	-do-	9486122280	[illegible]
94	K. Balasubramanian	Janaki ammal [illegible] Ammayappa Nagar [illegible]	[illegible]	[illegible]
95				
96				
97	V. Ramachandran	No 3 4th Cross [illegible]	9944530751	[illegible]
98	S. Thangarajan	4/28 Vigneshnagar	9524436941	[illegible]
99	S. Subramaniyan	Vignesh Nagar	[illegible]	[illegible]
100	T. Devi	4/175, Vasantha Nagar, North Kattur TRY	8903406180	T. Devi
101	Rengaraj	Vasantha Nagar North Kattur. TRY - 19	9443766195	Rengaraj
[illegible]	[illegible]	No. 7, [illegible]	[illegible]	[illegible]

Sl	Name	Address	Contact No	Sign
	L. Vishwanathan	115, Amman Complex	94431-00342	[illegible]
	[illegible]	[illegible] Main		
		[illegible] Association	9790077187	[illegible]
	M. SIVASUBRAMANIAN	J NAGAR. TRY 18	9442502859	[illegible]
	S. Kaliappan	3/826 Venugopal nagar	9442168923	[illegible]
	M. GOPALAKRISHNAN	3/819 V.G. nagar	9944383374	[illegible]
	S. Chandrasekar	Balaji nagar	9965271119	[illegible]
	P. [illegible]	[illegible]	9952642395	[illegible]
	[illegible]	T.K. [illegible]	9600293425	[illegible]
		[illegible]		
		[illegible]		
		64 [illegible]		
	U. Balan	3/214 [illegible] nagar	9941456781	[illegible]
	M JAYARAJ	Balaji nagar	9443766464	[illegible]
	V. JAYACHANDRAN	Amman Nagar.	9442056413	[illegible]
	P. KANDASAMY	[illegible]	9486063359	[illegible]
	S. STALIN	[illegible]	9790180537	[illegible]
	S. XAVIER Jayaseelan	A/93 Ramalingam nagar	9842526527	[illegible]
	M. William Chelladurai	Plot 24 A, 10th Main St	9944186581	[illegible]
	K. S. Sivaramakrishnan	4/168 - Vasantha Nagar, Kattur, Trichy - 19.	9442503127	[illegible]
	S. S. Krishnamurthy	plot No 96, Ist cross & Ganesh Nagar, Kattur Po, Trichy 19.	9443112643	S.S.K. [illegible]
	S. GOWTHAMAN.	24A Ganesh nagar 3rd cross. 5th main kattur TRICHY-19	9443153507	S [illegible]
	[illegible]	22A [illegible]	9787555558	[illegible]
	C. GURUSAMY	Plot. 6 Amman nager 3rd St KATTUR. TRY-19	9994079102	[illegible]
	C. DURAIRAJ	Balaji nagar 8th cross. 8th cross	9600330886	[illegible]

Name	Address	Contact No	Sig.
D. HARIKRISHNAN	3/24 A Thiru Venkata Nagar Puthur Try 17.	9765577091	[signature]
P. MAHENDRAN	B.11 Saimahalakshmi nagar. Alathur mete	9442909180	[signature]
P. DHANARAJ	320, 6TH ST. Amman nagar (Amman nagar Asso)	9894987037	[signature]
S MANIMURUGAN	2135 A Ganesh Nagar Kattur—TRY-19	9952800204	[signature]
T. MOHANADOSS	4/155, 1st St Vasan (R) Nagar North Kattur	9442688911	[signature]
M. [illegible]	[illegible]	99762-44881	[signature]
A. MANIKANDAN	Flat 1 10th cross Gokul Nagar, Kattur	94437 06434	[signature]
R. Rajamanickam	8 Secretary Annamalai nagar,	9894530601	[signature]
R. Sivakumar	president Shanmuga nagar	9443879633	[signature]
V. Govindaraj	4/153 Vasanth Nagar North Kattur	V Govindaraj 9789975009	
P. Palanivel.	adviser Shanmuga nagar 504. [illegible]	9443764855	[signature]
A. Sheik Mansoor Ali	Joint Secretary Shanmuga Nagar welfare Assn UKT Malai Trichy	9443786203	[signature]
S.V. Velayutham	Treasurer - Shanmuga Nagar Welfare Assn. U.K.T. Malai Trichy	9443994189	[signature]
M Anbalagan	Vignesh nagar. Vignesh nagar welfare Associate	9443694[illegible]	[signature]

Name	Address	Contact No	Sig
(ம)·கார்த்திகை	114 A [illegible], 4th [illegible] 3, அண்ணாநகர் [illegible]	9944295242	[signature]
M. [illegible]	4/345, [illegible]	9903443931	[signature]
S. தண்டபாணி	4/482 - சக்தி நகர்	9442207327	[signature]
J. அமிர்தவாசகம்	4/34 [illegible] 4 [illegible]	9952465361	J. [signature]
V. [illegible]	[illegible]	9994904661	[signature]
[illegible]	[illegible]		[signature]
R.D. ராஜவேல்	Plot No 29 III CROSS WEST VISWAS NAGAR திருச்சி - 8	9842169409	R.D. [signature]
P. SYED MAHABOOB	3 [illegible] விவேகானந்த நகர் வார்டு எண் 30	9524156695	[signature]
P. DEENADAYALAN	[illegible] விவேகானந்த நகர் வார்டு எண் 30	96004 99106	P. [signature]
S-RAJENDRAN	பாலாஜி நகர் [illegible] வார்டு எண் 65	9655053575	[signature]
L. VIJAYKUMAR. BE	PLOT NO 3 [illegible] [illegible]	9442634146	[signature]
I. AMALRAJ	Plot No 29, 12th [illegible] Kattur Trichy-19	9865748730	[signature]

Name	Address	Contact No	Sig
P. Arunachalam	18 Green market North Kattu Try-19	9457366985	[illegible]
M. Nandagopalam	9/824 Krrngopal Nagar Kattm Trichy. 19	9788068574	[illegible]
S. JAYAPAL	12. KALAIGNAR NAGAR	8978128700	[illegible]
K. Thangaraj	5/113. Periyar Nagar Kattur Trichy.	9585223929	[illegible]
A. Mohamed Ghouse	75, Madnai Road, Trichy	7373207111	[illegible]
A. [illegible] Jayaseelan	No.132 Nagammai St Ext KK Kottai Trich 11	9443493659	[illegible]
T. SETHU	Plot 142 Priyanga Nagar 1st Street Hayathnagar Kattu	7094256511	[illegible]
K. Mehndwari	4, [illegible] Prakash Nagar Ext.	9643859270	[illegible]
S. John Joseph	1/132A Philominal [illegible] 3rd South Kattur	9677626635	[illegible]
[illegible]	4/3 [illegible]	9345798511	[illegible]
[illegible]	3/276 [illegible]	9790053457	[illegible]
P. [illegible]	4/92 [illegible] Tri-11	9791218600	[illegible]
S. Ramakrishna	[illegible] III St	9442659545 9994314271	[illegible]
R. [illegible] R.K. Puram	15/39 [illegible]	9952154801	[illegible]
[illegible]	[illegible] 4/76A [illegible] 62	9442502907	[illegible]

Name	Address	Contact No	Sig
Pankaja Murali	76 Railnagar East Ambikapuram Trichy 4.	8145941019	[signature]
M. Anmol	76, Anmol Vishal Illam, Sanjeevi Nagar, South Extn, Trichy-620002	9003376652	[signature]
K. Murugesan	83, Sanjeevi Nagar South Exth, Trichy-620002	9894287213	[signature]
J. PARIMELALAGAN	40 main Road. Sanjeevi Nagar	9443539811	[signature]
[illegible]	[illegible]	9488610365	[signature]
Jeeva Baskaran	3/-70 A Gandhi Street	9443592955	[signature]
[illegible]	TRICHY-4		
J. Mahalakshmi	79, Rail nagar	9442181403	J. Mahalakshmi
K. Meenakshi.	79, Rail nagar	9790222955	[signature]
[illegible]		9941720219	
A. Fathima Alphonse	4/29 Gandhi nagar [illegible]	9003375232	[signature]
S. [illegible]	3/20 [illegible]	9482769963	S. Banumathi
[illegible]	[illegible]	7708483539	[signature]
M. GURUSAMY	3rd cross [illegible]	9486390669	[signature]
S. CHANDRASEKARAN MALAYAPPA NAGAR WELFARE ASSOCIATION.	109, Annest, Malayappa Ngr, TRICHY-10	7904070600	[signature]
D. UDHAYAKUMAR	8A anna street malayappa nagar Trichy	9944773333	[signature]

திருச்சிராப்பள்ளி மாநகராட்சி 41

Name	Address	Cont. No.	Sig
P. Anbalagan.	27. Ex-servicemen colony III Street Ponmalai	9443131887	
T. Kamaraj	Amman Nagar South Extn.	[illegible]	
M.K.MURUGESAN	Amman Nagar.	9489562120	M.K. [illegible]
M.RAGAVENDRAN	Plot H-7b BALAJI NAGAR	7299909830	
P. Sankar	plot no 72 Balajinagar Kallur po Trichy. 19	9842402726	
[illegible]	9. [illegible] நகர் [illegible] திருச்சி. 620011	944229346	
M. [illegible]	7/15, [illegible]	9865068242	[illegible] 3.11.2017
[illegible]	[illegible]	994218 [illegible]	
M. [illegible]	[illegible]	9003377627	
S. [illegible]	[illegible]	9965344128	
D. [illegible]	4/42 காந்தி நகர் [illegible] திருச்சி. 19	97861137 48	D. [illegible]

(X) 1. ராமச்சந்திரன் — 9944530751
No/9 புதுத் தெரு
கணேஷ் நகர்
வார்டு 63

M. சேகர் (பொதுச்செயலாளர்)
ஒடுக்கப்பட்டோர் அனைத்திந்திய [illegible]
[illegible] கூட்டமைப்பு
போன்: 9543551376

Photographs of Stakeholder Consultations held on November 3, 2017