

# Initial Environmental Examination

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IND: Tamil Nadu Urban Flagship Investment Program  
– Underground Sewerage System for Phase II of  
Municipal Corporation Covering Zones 3 to 7 in  
Vellore City

Prepared by Vellore City Municipal Corporation, Government of Tamil Nadu for the Asian Development Bank.



## CURRENCY EQUIVALENTS

(as of 11 May 2018)

Currency Unit	–	Indian rupee (₹)
₹1.00	–	\$0.015
\$1.00	=	₹67.09

## 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
DWC	–	double wall corrugated
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
GOTN	–	Government of Tamil Nadu
IEE	–	initial environmental examination
MOEFCC	–	Ministry of Environment, Forest and Climate Change
NOC	–	no objection certificate
PIU	–	program implementation unit
PMU	–	program management unit
PPTA	–	project preparatory technical assistance
REA	–	rapid environmental assessment
ROW	–	right-of-way
SEIAA	–	State Environmental Impact Assessment Authority
SPS	–	Safeguard Policy Statement
STP	–	sewage treatment plant
TNPCB	–	Tamil Nadu Pollution Control Board
TNUFIP	–	Tamil Nadu Urban Flagship Investment Program
TNUIFSL	–	Tamil Nadu Urban Infrastructure Financial Services Limited
VCMC	–	Vellore City Municipal Corporation
WHO	–	World Health Organization

## WEIGHTS and MEASURES

°C	degree Celsius
km	kilometer
lpcd	liter per capita per day
msl	mean sea level
m	meter
mm	millimeter
Mgd	million gallons per day
MLD	million liters per day
km <sup>2</sup>	square kilometer

## **NOTE**

In this report, "\$" refers to United States dollars.

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## EXECUTIVE SUMMARY

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 impacts: (i) universal access to basic water and sanitation services achieved; (ii) "world-class" cities and industrial corridors across the state developed; and (iii) water security, reduced vulnerability to climate change in urban areas, and enhanced share of renewable energy achieved. TNUFIP will have the following outcomes: livability and climate resilience in at least ten cities in priority industrial corridors enhanced.

The TNUFIP is structured under three outputs: (i) climate-resilient sewage collection and treatment, and drainage systems developed in at least eight cities; (ii) water supply systems in at least 5 cities improved with smart features; 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).

**The Subproject.** Vellore, located in the northern part of Tamil Nadu on a corridor connecting Bangalore-Chennai, is a very prominent education and health center in Tamil Nadu and as well as India. In this subproject to be implemented under the ADB funded TNUFIP, it is proposed to provide underground sewerage system in added areas (Zones 3 to 7 covering areas of Alamelumangapuram, Sathuvachari, Shenpakkam, Konavattam, Vasanthapuram and Velapadi) of Vellore City Municipal Corporation (VCMC). These areas are located in the south of Palar River, surrounding the old core city of Vellore, which is already provided with UGSS. VCMC area is located on both sides of River Palar. Subproject includes the following civil works components: (i) sewage collection system (209.5 kilometers (km) length of sewers and 8,649 manholes), (ii) seven lift stations, (iii) five pump stations, (iv) 15.77 km length pumping main sewers, (v) sewage treatment plant (STP) of 50 million liters per day (MLD) capacity and 2 km length outfall sewer from STP to disposal point, and (vi) 43,270 house service connections. STP is proposed under design-build contract, and therefore at present STP is design is preliminary.

**Project Implementation Arrangements.** The Municipal Administration and Water Supply Department (MAWS) of Government of Tamil Nadu (GOTN) 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 borides (ULBs). Vellore City Municipal Corporation (VCMC) is the implementing agency for this subproject. A program implementation unit (PIU) will be established in VCMC headed by a full-time Project Manager (Executive Engineer or above) and comprising dedicated full-time staff of the VCMC for day-to-day implementation of the subproject. PIU is assisted by construction management and supervision consultant (CMSC) in implementation. Environmental and social safeguard (ESS) managers in PMU/TNUIFSL will coordinate all the safeguard related activities of the subproject and will ensure the compliance with 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.



**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 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 Checklist for Sewerage. The potential negative impacts were identified in relation to pre-construction, construction and operation.

**Categorization.** Based on results of the assessment and ADB Safeguard Policy Statement (SPS), 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.

**Description of the Environment.** The subproject components are located in Vellore, in the northern part of Tamil Nadu. It is an important city providing one of the best education and healthcare facilities in the country. Topography of Vellore city is mostly plain with slight slope from west to east. It experiences dry and hot climate and average annual rainfall is nearly 1000 mm. Vellore is an historical city, and there are three nationally important protected monuments: Vellore Fort, located in the center of the city, and temple and a mosque located inside the Fort. None of the components are located within the protected monuments, but few components are located near the monument – sewer lines and a sewage pumping station (SPS 6) are proposed within 300 m distance of monument (which is regulated buffer zone). Sewage pumping station is proposed at about 250 m from the monument. Small sections of sewer line also fall within 100 m of monument. All works within 300 m from the boundary (regulated buffer zone) of protected monument will require prior permission from National Monument Authority (NMA). This will be obtained prior to start of construction works. City is originally developed on the southern bank of River Palar. Due to expansion in all directions including north, the present municipal area of the city spread over both banks of the river. At present, sewerage system is available in the old town area of Vellore, and under the current project it is proposed to provide sewerage system in the areas located around the old city area, in the northern part of Palar River. Project area comprises zones of Alamelumangapuram, Sathuvachari, Shempakkam, Konavattam, Vasanthapuram, and Velapadi (Zone 3 to Zone 7). Proposed sub project components are located within the urban area of Vellore City. Sewers will be laid in the public roads, and lifting stations, pumping stations, and STP will be constructed on government owned vacant land parcels. Due to lack of suitable lands, four out of five pumping station sites are located close to houses. STP is located on the northern bank of River Palar, surrounded three sides by agricultural and vacant lands and river Palar, and on northern side by residential areas, from about 50 m distance. It is proposed to provide maximum available buffer towards north by utilizing the available land in the site and appropriate layout design, and by also located units with maximum odor potential away from houses. It is proposed to dispose the treated effluent into Pandiyan Channel at 2 km from the STP. Part of the municipal area in the eastern part of the city is under reserve forest, none of the components however are located in the forest area.

**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.

Sewerage system performs a crucial function of safely collecting, transporting, treating and disposing domestic wastewater, including, human excreta (designed as a separate system). Subproject is likely to have numerous positive impacts on the environment and public health. 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 to further pump to a higher elevation manhole, pump station or STP, are likely to generate odor. Although utmost care is taken to locate these 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. Mixing of industrial waste in sewage is also identified as one of the risk which could render treatment inadequate. 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.

Although there are no components located in the monument area, there are residential areas developed around the Fort (especially in the north) within its regulated buffer zone (300 m). Besides sewer lines, a sewage pumping main and a sewage pumping station is also proposed within the regulated zone.) Permission will also entail Archaeological Survey of India's (ASI) scrutiny of proposals to ensure that there is no risk of damage to the protected monument due to proposed works. Components will be implemented with ASI permission, and recommendations, if any, of ASI will be included in the project implementation.

STP site is located on the northern side of Palar River. The treated wastewater from STP will be disposed into an irrigation canal (Pandiyan Channel). This channel originates from Kalinjur lake and carries its overflow for irrigation needs and discharges surplus in Palar River after flowing 15-16 km through outer areas of Vellore city (for about 4-5 km) and through agricultural lands (for about 10-12 km). Water from the channel is used for irrigation purposes along its course. Since Kalinjur lake is mostly dry, this channel seldom carries overflow, and along its course, untreated wastewater from surrounding residential areas join the channel, so most of the time the flow in the channel is low and comprises only wastewater. Owing to good monsoon, during the IEE preparation, lake was full, and overflow noticed. Lake also receives untreated wastewater from surrounding residential areas of Vellore city. Considering the existing situation where untreated wastewater is disposed into channel/lakes, the proposed disposal of treated wastewater meeting the disposal standards to Pandiyan channel is unlikely to have any significant adverse impacts. Technical assessment indicates that Pandiyan channel hydraulic capacity is adequate to carry the STP discharge safely throughout its course from the STP and up to Palar River. Sludge management plan will be prepared during the detailed design phase for treatment, disposal or safe reuse of sludge. Monitoring of treated wastewater and sludge quality, safe reuse limits are provided in EMP.

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 measures suggested for odor control including: appropriately locating sewage wells within site as far as away from the houses; developing tree cover; covered 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, measures to maintain the STP treatment efficiency, and development of green buffer zone around the STP, etc.

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/pumping stations and STP) 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, waste and equipment on local roads (traffic, dust, safety etc.), mining of construction material from the existing government licensed mining areas, occupation health and safety aspects. Sewer works will be conducted along public roads in an urban area congested with people, activities and traffic. Therefore these works will have significant 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, especially in narrow roads; 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.

**Environmental Management Plan.** An 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) proper planning of sewer works to minimize the public inconvenience (ii) barricading, dust suppression and control measures (iii) traffic management measures for works along the roads and for hauling activities; (iv) provision of walkways and planks over trenches to ensure access will not be impeded; and (iv) 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.

The EMP is 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. 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.

**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, VCMC and TNUFSL websites. The consultation process will be continued during project implementation. A grievance redress mechanism is described within the IEE to ensure any public grievances are addressed quickly.

**Monitoring and Reporting.** Contractor will submit a monthly EMP implementation report to PIU. PIU, with the assistance of VCMC, 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 VCMC and TNUIFSL websites

**Conclusions and Recommendations.** 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 establish (CTE) and consent to operate (CTO) from Tamil Nadu Pollution Control Board (TNPCB) for the STP. 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 impacts: (i) universal access to basic water and sanitation services achieved; (ii) "world-class" cities and industrial corridors across the state developed; and (iii) water security, reduced vulnerability to climate change in urban areas, and enhanced share of renewable energy achieved. The investment program will have the following outcome: livability and climate resilience in at least 10 cities in priority industrial corridors enhanced. The TNUFIP is structured under following three outputs:

- (i) **Output 1: Climate-resilient sewage collection and treatment, and drainage systems developed in at least eight cities.** This includes (i) 187 million liters per day (MLD) of new and 155 MLD of rehabilitated sewage treatment capacity developed, with solar power systems installed for STP operations on a pilot basis; (ii) treated wastewater reused for industrial purposes in selected areas; (iii) 2,810 kilometers (km) of sewage collection pipelines constructed, with 426,600 households connected; (iv) 173 sewage pumping stations with a combined capacity of 6,390 kilowatts (kW) constructed; (v) 20 all-female community water and sanitation committees formed; and (vi) climate-resilient drainage and flood management systems (250 km of tertiary and 50 km of primary and secondary drains) established in selected cities.<sup>1</sup>
- (ii) **Output 2: Water supply systems in at least five cities improved with smart features.** This includes (i) smart water supply distribution systems (1,520 km pipelines) established within 110 new district metered areas (DMAs) to reduce NRW and provide regular water supply, with 100% of households (total of 171,000) connected; (ii) 120 km of transmission mains built; (iii) 30 pump stations (1,530 kW capacity) constructed; and (iv) 40 water storage reservoirs (combined capacity of 70 million liters), covering Chennai, Coimbatore, Cuddalore, Tiruppur, and Thoothukudi.
- (iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This includes (i) establishing within CMA (a) a new state-level urban data and governance improvement cell, and (b) a new project design and management center; and (ii) implementing (a) state-wide performance-based

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<sup>1</sup> The eight cities are Ambur, Chennai, Coimbatore, Rajapalayam, Tiruchirappalli, Tirunelveli, Tirupur, and Vellore. Drainage systems are proposed in Chennai, Cuddalore, and Thoothukudi.

urban governance improvement program for Tamil Nadu's 135 cities to improve revenue, financial management, administration, service delivery, gender mainstreaming, wastewater reuse, and fecal sludge management; and (b) public awareness campaigns on water conservation, sanitation, and hygiene in project cities. The program will intensify the capacity building of key urban institutions and continue providing incentives for urban governance improvement. Project design consultants will be recruited by the PMU to prepare new projects in subsequent tranches that meet 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: Climate-resilient sewage collection and treatment, and drainage systems developed in six cities.** This includes (i) five new STPs with a combined treatment capacity of 165 MLD constructed, including one STP with a 2-megawatt solar photovoltaic system installed to power its operations; (ii) one STP (37 MLD capacity) rehabilitated; (iii) 8,000 cubic meters treated wastewater reused per day; (iv) 1,860 km of new sewage collection pipelines constructed, with 100% households connected (297,547 households); (v) 124 pump/lift stations (combined capacity of 4,473 kW) constructed; and (vi) 12 all-female community water and sanitation committees formed. The breakdown by city is: (i) new Tirunelveli—sewage collection system and 32 MLD STP (to supply treated wastewater for industrial reuse) constructed;<sup>2</sup> (ii) new Coimbatore sewage collection system and 30 MLD STP, with a 2-megawatt solar photovoltaic system, constructed;<sup>3</sup> (iii) new Tiruchirappalli—sewage collection system with 30 MLD STP constructed and existing 37 MLD STP rehabilitated; (iv) new Vellore—sewage collection system and 50 MLD STP constructed; (v) new Chennai—sewage collection systems constructed in four areas in Chennai; and (vi) new Rajapalayam sewage collection system and 21 MLD STP constructed. In addition, in each city, two all-female community water and sanitation committees will be formed.
- (ii) **Output 2: Water supply systems in one city improved with smart features.** Four areas in Chennai will have (i) 275 km of distribution pipelines constructed, with 100% metered connections (30,800 households) in 20 newly established DMAs to manage and reduce NRW;<sup>4</sup> (ii) 11 km of new transmission pipes constructed; (iii) nine new storage reservoirs (four underground and five overhead) of combined capacity of 11 million liters constructed; and (iv) five pump stations (combined capacity of 230 kW) constructed.
- (iii) **Output 3: Institutional capacity, public awareness, and urban governance strengthened.** This includes (i) establishing within CMA (a) a new state-level urban data and governance improvement cell, (b) a new project design and management center, and (c) a state-wide performance-based urban governance improvement program implemented for all 135 cities to improve financial management (audited accounts), municipal revenues (taxes and user fees), municipal administration (filling vacancies), and gender mainstreaming (gender

<sup>2</sup> Tirunelveli signed a purchase agreement for treated effluent from the proposed STP with an adjoining industrial park.

<sup>3</sup> This pilot project will (i) produce 90% of the STP's energy requirement; (ii) reduce 72% of annual energy charges; and (iii) avoid 3,400 tons of carbon dioxide equivalent of emissions per year.

<sup>4</sup> Smart water features in Tranche 1 include online automatic pressure sensors and flow meters, 100% household metered connections using DMA-based distribution management, and energy-efficient water pumps.

action plan);<sup>5</sup> and (ii) public awareness campaigns on water conservation, sanitation, and hygiene implemented. Governance improvement and awareness consultants will support output 3.

5. Vellore, located in the northern part of Tamil Nadu, is a very prominent educational and healthcare hub in the Country. City has two top educational institutes in the country. It is also an industrial hub, and is a top exporter of leather goods. Existing underground sewerage system cover the core (old) city area of Vellore. At present sewerage system is provided only in the core area of the city, which covers 5.95 km<sup>2</sup> area, about 6.5% of the total municipal area and about 11% of total population. It is proposed provide sewerage system in the remaining areas of the city in two phases (phase II and phase III). Phase II covers the area immediately surrounding the core city, on the southern side of Palar River. Rest of the areas in the southern and northern outskirts will be taken up for sewerage in Phase III. Under the ADB funded TNUFIP, it is proposed develop UGSS in phase II area, covering 26% area and 41% population.

6. Proposed subproject includes: (i) sewage collection system (209.5 kilometer (km) length of sewers and 8,649 manholes), (ii) seven lift stations, (iii) five pump stations, (iv) 15.77 km length pumping main sewers, (v) sewage treatment plant (STP) of 50 million liters per day (MLD) capacity and 2 km length outfall sewer from STP to disposal point, and (vi) 43,270 house service connections.

## **B. Purpose of this IEE Report**

7. 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 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.

8. This IEE is based on the detailed project report (DPR) prepared by VCMC through an external DPR consultant. However, the treatment and disposal system (STP) is proposed under design-build type implementation, therefore, at present only preliminary designs are prepared. Detailed design for STP will be conducted by the design-build contract during detailed design phase of STP. Therefore for treatment and disposal system, this IEE is based on preliminary designs, and will be updated during the detailed design. 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.

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<sup>5</sup> Details are in the Facility Administration Manual and Attached Technical Assistance Report (accessible from the list of linked documents in Appendix 2).



## **C. Report Structure**

9. 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**

10. Project area comprises Alamelumangapuram, Sathuvachari, Shenpakkam, Konavattam, Vasanthapuram, Velapadi covering 32 municipal wards (17 fully and 15 partly, out of total 60 wards) in the southern part of Palar River in Vellore City, in Vellore District in the northern part of Tamil Nadu State. Total population of subproject area is 261,881 (design base population of 2020) and has a geographical area of 23.04 square kilometer (km<sup>2</sup>).

### **B. Existing Sewerage System**

11. At present, underground sewerage system is provided in core town area of Vellore Town covering 24 wards out of the 48 wards of the erstwhile Vellore Municipality. This system covers only about 6-7% of area and about 10-11% of population of the present municipal corporation area consisting of total 60 wards. Sewage is collected via underground sewers, conveyed to sewage treatment plant (STP) near Muthumandapam at Old Parar Bridge. The STP process is based on activated sludge process (ASP), and the capacity is 10.28 MLD. After treatment the treated wastewater is disposed into Velavadi Eri (lake/pond) in Alamelumangapuram, which is used for agricultural purpose.

12. Rest of the households depend on septic tanks and soak pits, and few households also let the sewage directly into open drains. Existing open drains carry both sullage and storm water. The sullage from the northern part of the town is collected from the main drains along Arni road and Katpadi road which is then taken to sewage pumping station site near the existing Palar water supply Head works by gravity and then taken across Palar River to its northern bank by means of pumping and finally let into the sewage farm of about 20 acres located at Virugampattu Village.

13. The sullage from the southern portion of the town is collected through drains/streams channeling through Salavanpet, Velapadi, Suriyakulam which then runs parallel to the railway line along the western corporation limit and bye-pass road and crosses the Katpadi road and let into Palar river. Wastewater accumulates at many places, resulting in breeding of mosquitoes and flies resulting in insanitary conditions. Indiscriminate disposal of wastewater from the city directly into the River Palar lead to pollution of river.

14. VCMC proposed provide sewerage system to cover entire area of the current municipal corporation area in two phases (phase II and phase III). Phase II covers the area immediately surrounding the core city, on the southern side of Palar River. Rest of the areas in the southern and northern outskirts is proposed under phase III. In the present subproject, phase II of the sewerage system will be implemented. This covers sewerage zones of 3, 4, 5, 6 and 7, with 26% of municipal area and 41% of municipal population. In terms of municipal wards it will cover 17 wards fully (17 to 24, 26, 27, 54 to 60), and 15 wards partially (16, 25, 30, 31, 33, 35 to 41, 51 to 53).

15. Vellore City Municipal Corporation (VCMC) is the responsible agency for providing basic urban services including sewerage in the City, and is the implementation agency for this subproject. Detailed project report for the underground sewage scheme in Phase II has been prepared by VCMC through an external consultant.

### **C. Proposed Project**

16. Table 1 shows the nature and size of the various components of the subproject. Location of subproject components and conceptual layout plans are shown in Figure 1 to Figure 5. 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 115 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.

### **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. 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 Sewerage Subproject Components**

Infrastructure	Function	Description	Location																																																												
Sewer network	Collect wastewater from houses and convey by a combination of gravity and pressure pumping to the sewage treatment plant (STP)	<p>209.5 km 200-1300 mm diameter sewers</p> <table border="1"> <thead> <tr> <th>Dia (mm)</th><th>Length (m)</th><th>%</th><th>Material</th></tr> </thead> <tbody> <tr><td>200</td><td>178864</td><td>85.4%</td><td>PVC/DWC/RCC</td></tr> <tr><td>250</td><td>5293</td><td>2.5%</td><td>DWC/RCC</td></tr> <tr><td>300</td><td>2898</td><td>1.4%</td><td>DWC/RCC</td></tr> <tr><td>350</td><td>4402</td><td>2.1%</td><td>DWC/RCC</td></tr> <tr><td>400</td><td>5053</td><td>2.4%</td><td>DWC/RCC</td></tr> <tr><td>450</td><td>2478</td><td>1.2%</td><td>DWC/RCC</td></tr> <tr><td>500</td><td>2581</td><td>1.2%</td><td>CI/RCC</td></tr> <tr><td>600</td><td>3486</td><td>1.7%</td><td>CI/RCC</td></tr> <tr><td>700</td><td>643</td><td>0.3%</td><td>CI/RCC</td></tr> <tr><td>800</td><td>42</td><td>0.0%</td><td>CI/RCC</td></tr> <tr><td>900</td><td>776</td><td>0.4%</td><td>CI/RCC</td></tr> <tr><td>1200</td><td>30</td><td>0.01%</td><td>BWSC</td></tr> <tr><td>1300</td><td>2966</td><td>1.4%</td><td>BWSC/RCC</td></tr> <tr><td colspan="2"><b>209512</b></td><td></td><td></td></tr> </tbody> </table> <p style="text-align: right;"><i>mm = millimeter</i> <i>m = meter</i></p> <p><b>Manholes</b> 8,649 no. (brickwork and reinforced cement concrete) Minimum distance between manholes of 30 m is adopted for sewer size up to 400 mm and larger spacing up to 100m for large diameter sewers.</p>	Dia (mm)	Length (m)	%	Material	200	178864	85.4%	PVC/DWC/RCC	250	5293	2.5%	DWC/RCC	300	2898	1.4%	DWC/RCC	350	4402	2.1%	DWC/RCC	400	5053	2.4%	DWC/RCC	450	2478	1.2%	DWC/RCC	500	2581	1.2%	CI/RCC	600	3486	1.7%	CI/RCC	700	643	0.3%	CI/RCC	800	42	0.0%	CI/RCC	900	776	0.4%	CI/RCC	1200	30	0.01%	BWSC	1300	2966	1.4%	BWSC/RCC	<b>209512</b>				<p>Sewers will be laid underground in the roads and internal streets in the project area comprising Zone 3 to Zone 7 (Alamelumangapuram, Sathuvachari, Shempakkam, Konavattam, Vasanthapuram, Velapadi covering 32 municipal wards).</p> <p>Sewer lines will be laid in the center 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.</p> <p>Large diameter pipes will be laid mostly on main roads (300 – 1300 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.</p> <p>Trench size to bury the sewer will be of 0.8 m to 1.5 m wide and 1.2 m to 6 m deep. Some sewage pumping stations (e.g. SPS 6) is located inside a residential area and accessible by only a narrow road. There will be two pipelines (incoming and outgoing pumping mains) in the narrow road.</p> <p>For manholes, an area of 1.5 mx1.5m to 2.5m x 2.5m will be excavated.</p>
Dia (mm)	Length (m)	%	Material																																																												
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Sewage lift stations	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 with submersible pumps accommodated inside. The screen arrangement is provided in the	<p>7 nos. Components of Lift Station</p> <ul style="list-style-type: none"> <li>Lift well of dia 2.0 m to 2.5 m and depth 5 – 7.5 m</li> <li>Non-clog submersible pump sets</li> <li>Control panel box</li> </ul> <p>4 Lift Station have one suction well each (LS-8, LS-10, LS-11, LS-12), and 3 have two suction wells each (LS-7, LS-9, LS-12a)</p>	<p>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:</p> <ol style="list-style-type: none"> <li>LS7-Near Palar river Sathuvachari</li> <li>LS-8 Near Drupathi amman koil, Shempakkam</li> <li>LS-9 Pillaiyar koil st, Shempakkam</li> <li>LS-10 Near Dinamalar office, Konavattam</li> <li>LS-11 Jeevarathinam St, Konavattam</li> <li>LS-12 Arumugam St, Vasanthapuram</li> <li>LS-12a Near Thideer nagar OHT, Shempakkam</li> </ol>																																																												

Infrastructure	Function	Description	Location																											
	previous manhole to the lift station.																													
Sewage pumping stations (SPS)	Collect sewage and pump to main pumping stations	5 nos. Components of SPS <ul style="list-style-type: none"><li>Inlet chamber length (2 – 3.5 m), width (1.5 m) and depth (2.3 – 4.3 m)</li><li>Screen chamber length (4 – 4.5 m), width (2 - 3.5 m) and depth (2.3 – 5.3 m)</li><li>Grit well Dia (4.5 – 8 m) and depth (3.3 – 6.3 m)</li><li>Suction well Circular at SPS 3 and 7 Dia (5.5 – 6 m) and depth (6.6 – 8.7 m) Rectangular at SPS 4, 5 and 6 length (9.5 – 15.5 m), width (6 - 12 m) and depth (8.4 – 9.6 m)</li><li>Pump room (3 x 2 m<sup>2</sup>)</li></ul> Non-clog submersible pump sets	Sewage pump stations are proposed at following locations: 1. SPS-3 Alamelumanga puram 2. SPS-4 Vasantham nagar, Sathuvachari, 3. SPS-5 Solid waste management segregation shed, Sathuvachari 4. SPS-6 Shenbakkam 5. SPS-7 Velapadi																											
Pumping main sewers	Transfer sewage from SPS to another SPS or to STP	15.77 km 300-800 mm diameter Cast Iron sewers <table><tr><th>Diameter</th><th>Material</th><th>Length (in m)</th></tr><tr><td>150mm</td><td>CI</td><td>575</td></tr><tr><td>200 mm</td><td>CI</td><td>1285</td></tr><tr><td>250 mm</td><td>CI</td><td>75</td></tr><tr><td>300 mm</td><td>CI</td><td>4340</td></tr><tr><td>450 mm</td><td>CI</td><td>4250</td></tr><tr><td>600 mm</td><td>CI</td><td>770</td></tr><tr><td>800 mm</td><td>CI</td><td>4475</td></tr><tr><td>Total</td><td></td><td>15770</td></tr></table>	Diameter	Material	Length (in m)	150mm	CI	575	200 mm	CI	1285	250 mm	CI	75	300 mm	CI	4340	450 mm	CI	4250	600 mm	CI	770	800 mm	CI	4475	Total		15770	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 main from SPS 6 will be laid partly along the bank of Palar River. Two pumping mains from SPS 5 and SPS 6 will carry sewage to STP, which is located on the northern side of Palar, over a pipe bridge to be constructed across Palar River.
Diameter	Material	Length (in m)																												
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800 mm	CI	4475																												
Total		15770																												
Sewage Treatment Plant (STP)	Treatment of collected wastewater to comply with disposal standards	New STP of capacity 50 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:	Site is located at Viruthampattu on the northern (left) bank of River Palar  STP site is located adjacent to a solid waste management (segregation) facility There are agricultural lands between the river and the site. Housing development is in the north and the nearest house is at about 50 m. Site is vacant and covered with																											

Infrastructure	Function	Description	Location
		<ul style="list-style-type: none"> <li>• Mechanical screens</li> <li>• Grit removal,</li> <li>• Flow measurement and flow splitter box</li> <li>• Batch reactors with individual inlet flow control and a fully automated process</li> <li>• Sludge management system</li> </ul>	<p>shrubs and bushes. Site is accessible by an existing road.</p> <p>Treated sewage will be disposed into Pandiyan Channel, which is an overflow channel of Kalinjur lake. Water is used for irrigation.</p>
Outfall sewer	Disposal of treated water from STP into Pandiyan Channel	2 km length 800 mm dia ductile iron pipe	Pipes will be laid from STP to Pandiyan Channel; initially sewer will be laid in the internal roads, and then along public road to the disposal point.
House service connections	Collect sewage from individual houses and convey into network	<ul style="list-style-type: none"> <li>• 43,270</li> </ul>	At each household, connected to wastewater outlet drain

Figure 1: Proposed Sewerage Schemes and Phasing in Vellore



Note: Phase II is proposed in the present subproject under TNUFIP.



Figure 2: Proposed Sewerage Scheme Phase II in Vellore

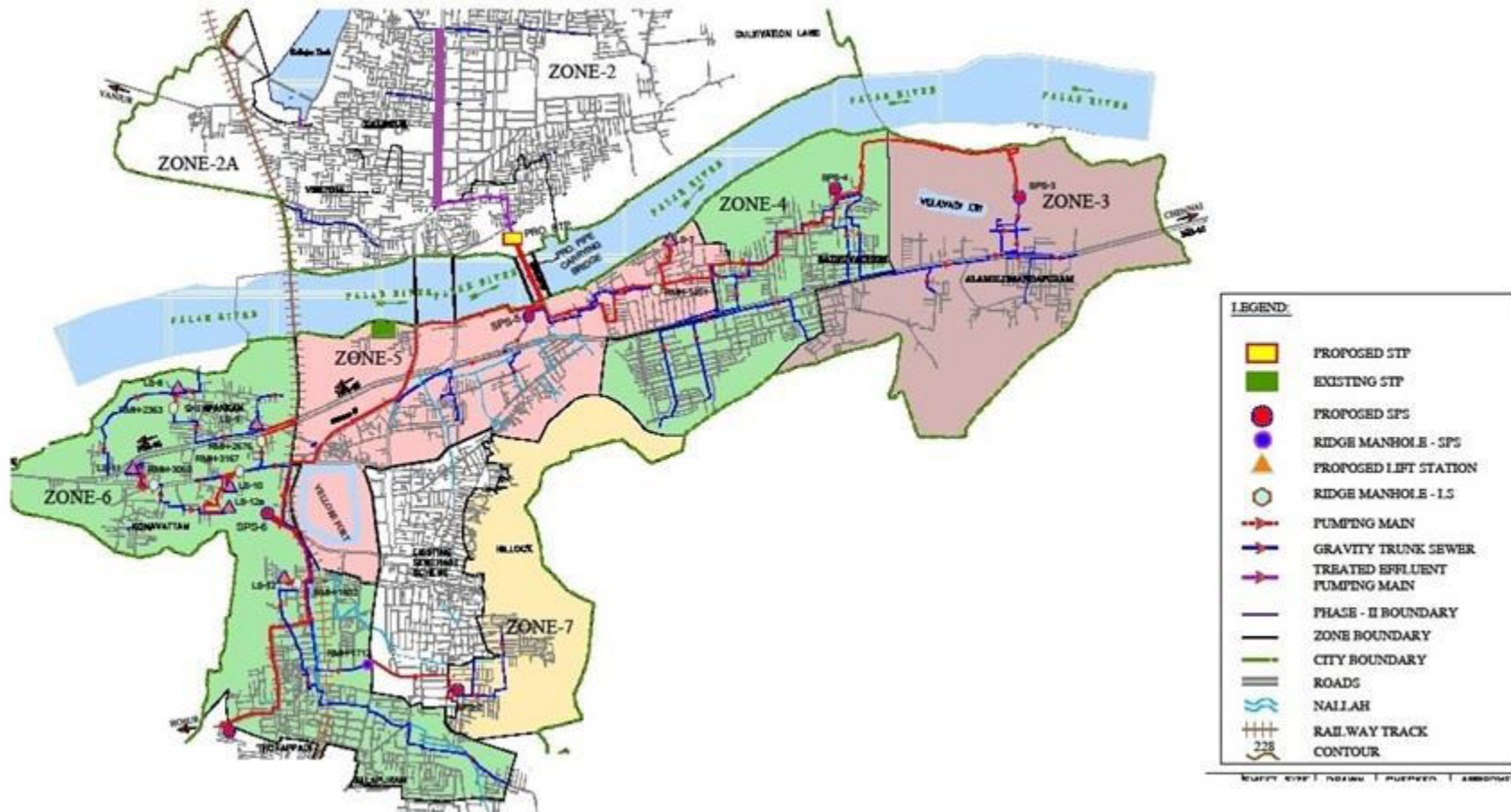


Figure 3: Pumping Main Pipe Bridge Alignment on Palar River





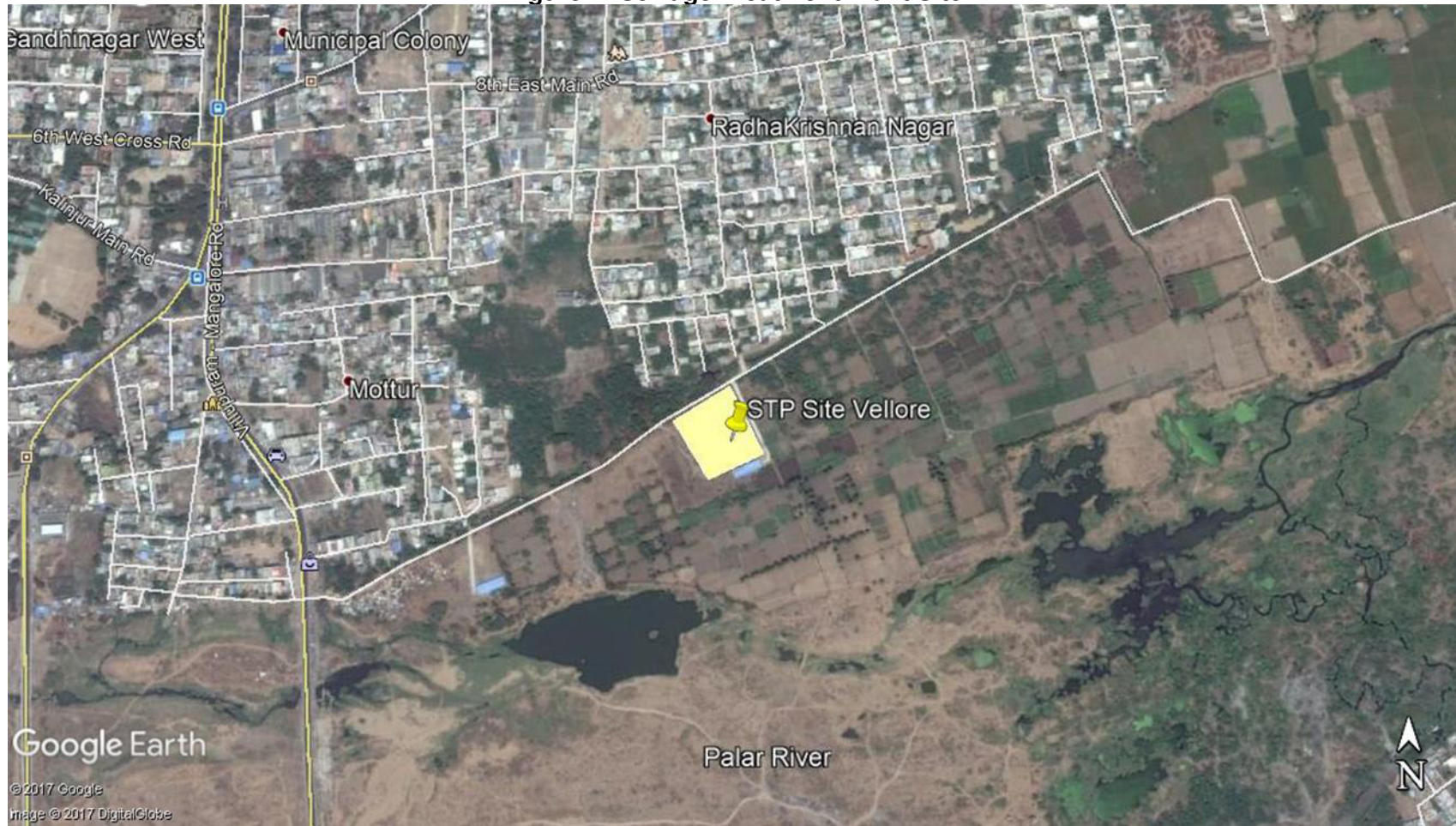
**Figure 4: Sewage Treatment Plant Site**



Figure 5: Outfall Sewer from Sewage Treatment Plant to Pandiyan Channel



### 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.	Sewage treatment plant STP requires CTE and CTO from TNPCB.  Application has to be submitted online at <a href="http://tnocmms.nic.in/OCMMS/">http://tnocmms.nic.in/OCMMS/</a>
Ancient Monuments and Archaeological Sites and Remains Acts, 1958, its Rules, 1959 and notification, 1992.  Ancient Monuments and Archeological Sites and Remains (Amendment and Validation) Act, 2010	This Act provides, inter alia, for the preservation of ancient and historical monuments and archaeological sites and remains of national importance - Notifies 100 Meters (m) around the monument as prohibited area and 100 to 300 m as regulated area for construction works; - No excavation/construction work is allowed within 100 m of boundary of the protected monument; - Requires prior permission of National Monument Authority (NMA) for taking up works within 300 m of the boundary of protected monuments	There are three protected monuments in Vellore: Fort, Old Mosque In The Fort, and Jalkanteswara Temple also located in the Fort. City is developed around this Fort, and there are residential areas all around.  One pumping station and (SPS 6), and sewer lines in the adjoining area of the Fort fall within 300 m regulated buffer from the boundary and therefore require prior permission of NMA
Environment (Protection) Act, 1986 and CPCB	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



Law	Description	Requirement
Environmental Standards.		Refer Table 3 and Table 4 below for 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.	<ul style="list-style-type: none"> <li>- Applicable for equipment and machinery's potential to emit air pollution (including but not limited to diesel generators and vehicles);</li> <li>- CTE and CTO from TNPCB;</li> <li>- Compliance to conditions and emissions standards stipulated in the CTE and CTO.</li> </ul>	Generators will require CTE and CTO from TNPCB Generators to comply with applicable emission standards.
Municipal 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, which will need to be followed by the project.

**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 Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, 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 Assam, Manipur, Meghalaya Mizoram, Nagaland, Tripura Sikkim, Himachal Pradesh, Uttarakhand, and Union territory of	<50

		Andaman and Nicobar Islands, Dadar and Nagar Haveli Daman and Diu and Lakshadweep	
		Areas/regions other than mentioned above	<100
4	Fecal Coliform (FC) (Most Probable Number per 100 milliliters (ml), 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 1 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**

<b>Standards for Composting.</b> 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/cm <sup>3</sup> )		<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 P <sub>2</sub> O <sub>5</sub> ) percent by weight, minimum	percent by weight	0.4	10.4
Total Potassium (as K <sub>2</sub> O), percent by weight, minimum	percent by weight	0.4	-
Color			
Odor		Absence of foul Odor	

<b>Standards for Composting.</b> 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)
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 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**

S. No	Construction Activity	Statutory Authority	Statute under which Clearance is Required	Implementation	Supervision
1	Sewage treatment plant (STP)	Tamil Nadu Pollution Control Board (TNPCB)	Consent to establish and consent to operate under Water Act, 1974	Contractor and program implementation unit (PIU)	PIU
1	Tree Cutting	Department of Forest and District Collector	Clearances from the authorities as per the Tamil Nadu Timber Transit Rules, 1968 or latest.	PIU	Implementation Agency and program management unit (PMU)
2	Hot mix plants, Crushers and Batching plants	TNPCB	Consent to establish and consent to operate under Air Act, 1981	Contractor	PIU
3	Discharges from construction activities	TNPCB	Consent to establish and consent to operate under Water Act, 1974	Contractor	PIU
4	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
5	Sand mining, quarries and borrow areas	Department of Geology and mining, Government of Tamil Nadu (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
6	For establishing new quarries and borrow areas	MOEFCC	Not applicable	Contractor	PIU

S. No	Construction Activity	Statutory Authority	Statute under which Clearance is Required	Implementation	Supervision
			No new quarries/borrow areas will be created for the subproject.		
7	Groundwater extraction	Public Works Department	(Groundwater) Tamilnadu Groundwater Development and Management Act 2000	Contractor	PIU
8	Disposal of bituminous wastes	Tamilnadu State Pollution Control Board	Hazardous Wastes (Management and Handling) Rules. 1989	Contractor	PIU
9	Temporary traffic diversion measures	-	MoRTH 112 SP 55 of IRC codes	Contractor	PIU

28. **ADB SPS Requirements.** During the design, construction, and operation of the project the PMU and 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](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. Sewage sludge shall be properly treated prior to its disposal and/reuse.



**Table 6: WHO Ambient Air Quality Guidelines**

Table 1.1.1: WHO Ambient Air Quality Guidelines <sup>7, 8</sup>		
	Averaging Period	Guideline value in $\mu\text{g}/\text{m}^3$
Sulfur dioxide ( $\text{SO}_2$ )	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide ( $\text{NO}_2$ )	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter $\text{PM}_{10}$	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $\text{PM}_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	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 <sup>54</sup>		
	One Hour $L_{Aeq}$ (dBA)	
Receptor	Daytime 07:00 - 22:00	Nighttime 22:00 - 07:00
Residential; institutional; educational <sup>55</sup>	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, VCMC, ADB project preparatory technical assistance (PPTA) Team etc.;
- (ii) Discussions with Technical experts of the PPTA team, TNUIFSL, VCMC, 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. Situated in the northern part of Tamil Nadu, about 135 km northwest of capital city Chennai, Vellore is an important city providing one of best education and healthcare facilities in the country. Vellore has two of India's top most educational institutes in India – Christian Medical College (CMC) and Vellore Institute of Technology (VIT). This city serves as the District Headquarters of Vellore District. Geographically, the city lies between 12°15' to 13°15' North latitudes and 78° 20' to 79° 50' east longitudes, on the southern bank of River Palar, but, presently, due to urban expansion the municipal corporation area falls on both sides of the river,

33. Vellore Municipality was constituted way back in 1866 under the provisions of Town Improvement Act, 1865 and it was upgraded as Corporation in 2008. Vellore City Municipal Corporation area spreads over an area of 87.92 km<sup>2</sup> with a population of 5.02 lakh as per 2011 census. The constituent parts of Vellore City Municipal Corporation (VCMC) are: Vellore city and the two erstwhile municipalities (Sathuvachari and Dharapadavedu), six town panchayats (Katpadi, Gandhi Nagar, Allapuram, Thorapadi, Shenbakkam, and Kalinjur) and nine village panchayats (Alamelumangapuram, Viruthampattu, Kangeyanallur, Virupatchipuram, Palavanchathu, Edyanchathu, Ariyur, Chitteri and Konavattam). VCMC is divided into 60 municipal wards.

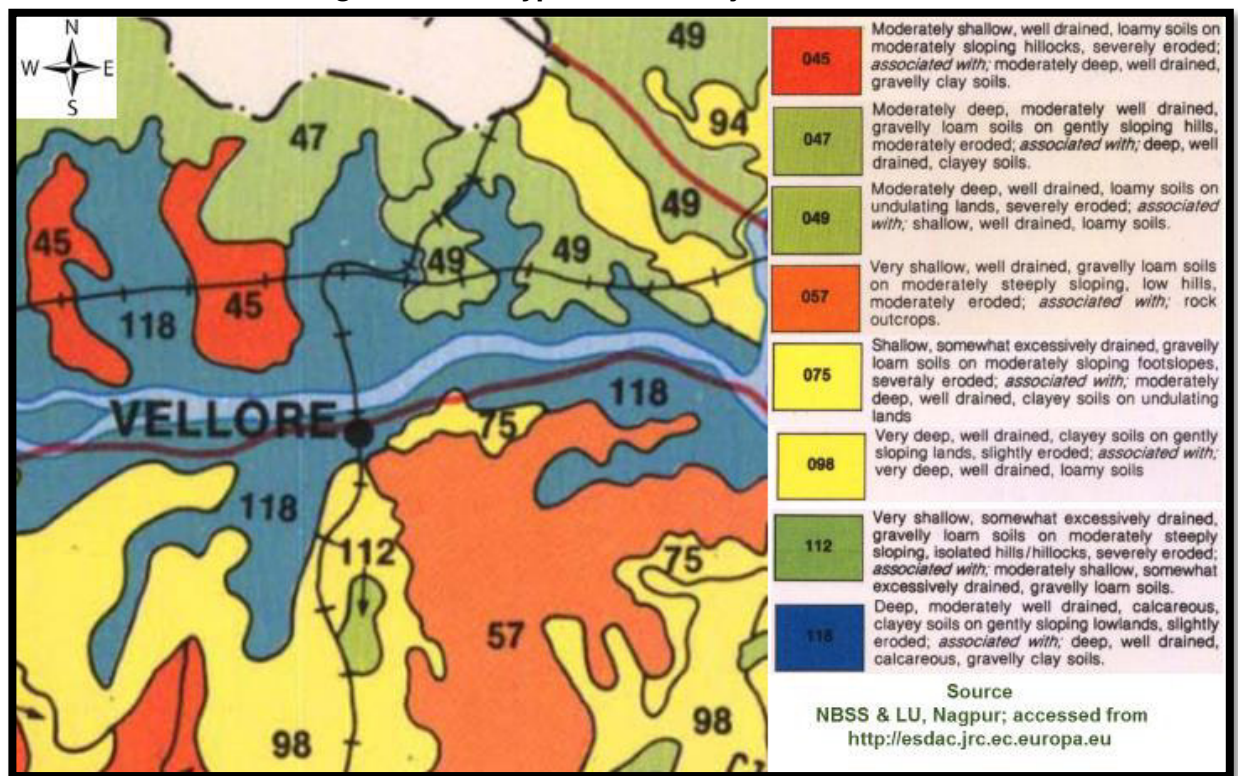
34. Vellore has a well-developed transport infrastructure and is well connected by Road and Rail with most cities and towns in India. National highways NH 234 and NH 46 crisscross the city. Vellore city has three railway stations, namely Katpadi junction, Vellore Cantonment and Vellore Town connecting the city to Chennai, Bangalore, Tirupati and Trichy. Nearest airports are at Chennai (130 km), Bengaluru (200 km); and Tirupati (100 km).

### **2. Topography, Soils and Geology**

35. The topography of Vellore city is mostly plain with slight slope from west to east. It is surrounded by hilly terrain in the eastern and south parts. The landscape in the hilly terrain is undulating to rugged, flanked by hill ranges belonging to Eastern Ghats.

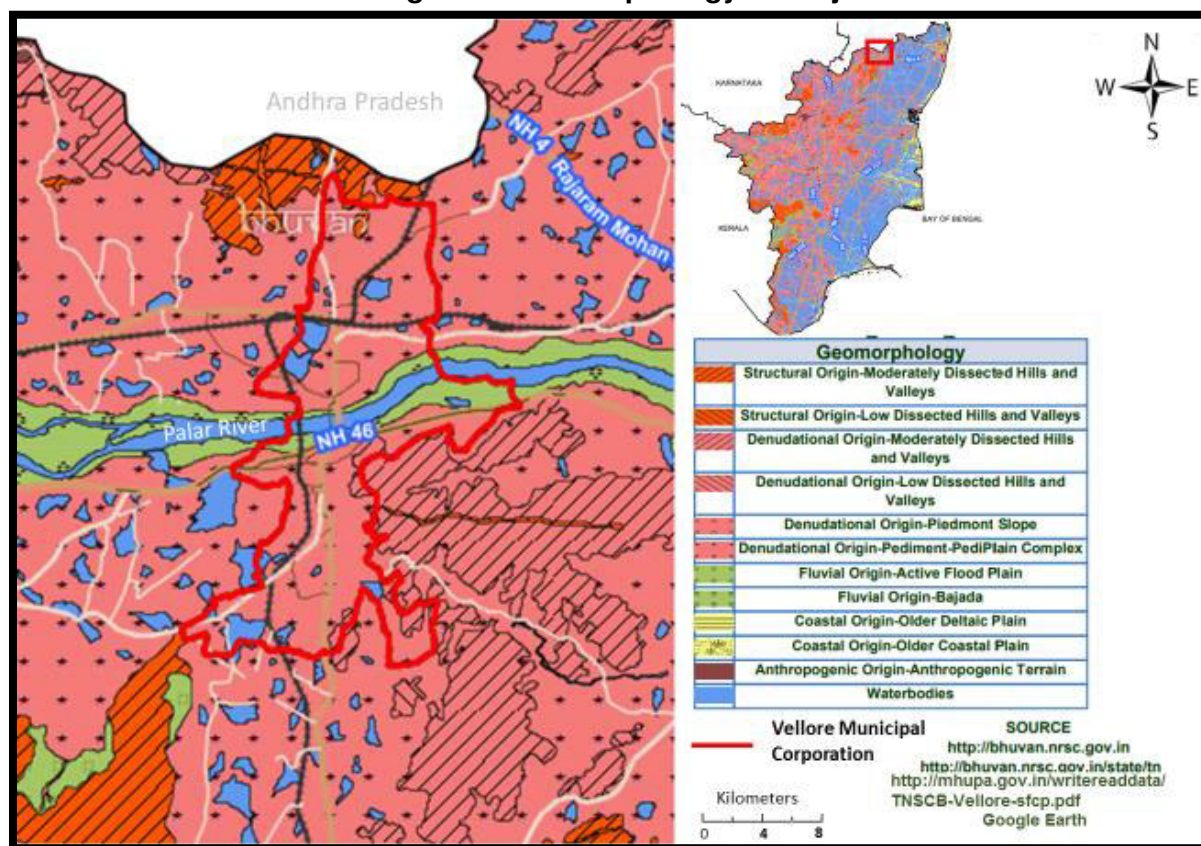
36. Soils in the region have been classified into: (i) Sandy soil, (ii) Sandy loam, (iii) Red loam, (iv) Clay, (v) Clayey loam, and (vi) Black cotton soils. Black loam soil is found in parts of Vellore Taluk. Gravelly clayey soils are found in most parts of the city and along river Palar. In the southern parts of the city loamy soils are found.

Figure 6: Soil Types in the Project Area



37. Geologically, the area is classified into hard rock and sedimentary formations. The Hard rock formations found in the region are the oldest rocks of the earth crust. They are azoic, crystalline and extremely contorted. Most common hard rock formations in the region are gneisses and charnockite. Sedimentary deposits are found along Palar River which are transported by running water mainly along the course as isolated patches.

Figure 7: Geomorphology of Project Area



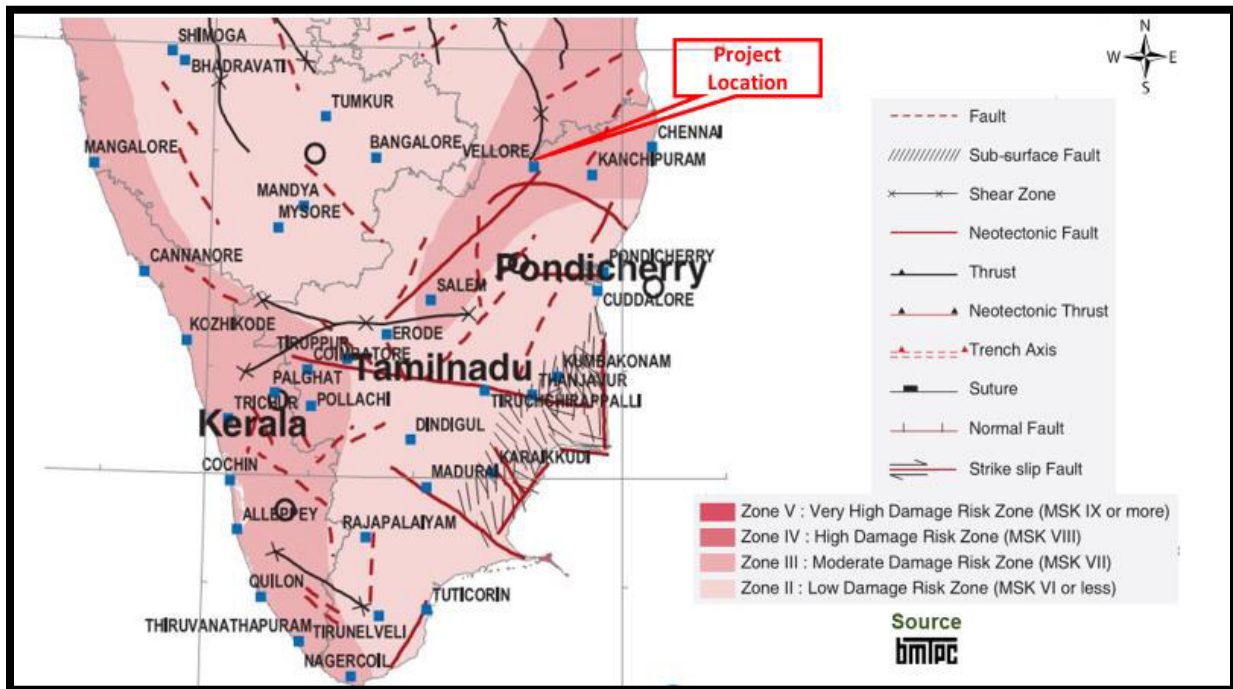
38. Geotechnical investigations conducted during the detailed design indicate that the top layer, varying from 1.5 m to 3.5 m, is characterized by soil, and hard rock encounters at the a depth of 4.5 m to 5 m. These two layers sandwich soft disintegrated and medium dense rocks. There are no known or reported cases of land subsidence in or close to the subproject area.

### 3. Seismology

39. According to Bureau of Indian Standards (BIS) [IS 1983 (Part I): 2002], Vellore town falls under Zone III and on the macro seismic intensity scale the project area falls under MSK VII (Moderate Damage Risk Zone). Structural design of infrastructure elements will be done with due consideration to relevant codes.

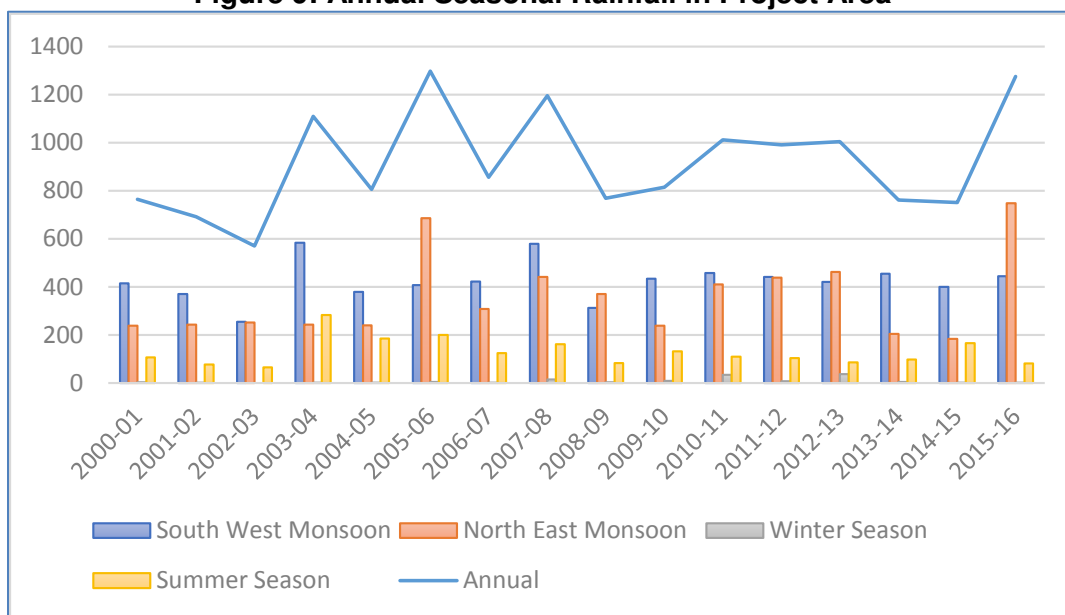


Figure 8: Seismic Zone of Project Area

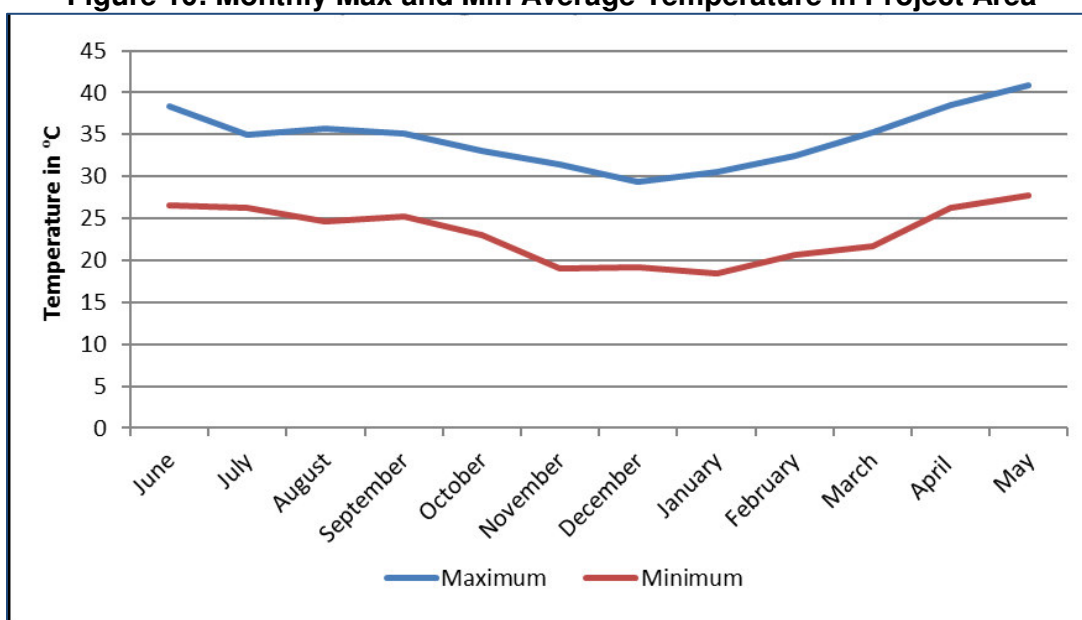


#### 4. Climatic Conditions

40. Vellore is in tropical zone, away from the sea and has an elevation of 220 m above the mean sea level (msl), hence the town experiences dry and hot climate. The average temperatures drop to around 18°C during November – January and during April – June reach 40°C. In summer the humidity ranges between 40% - 63% and in winter it raises to 67% - 86%. The average annual rainfall is 996.7 mm. The maximum rainfall occurs during September and October through northeast monsoon. The area gets a fairly good rain during southeast monsoon as well.

**Figure 9: Annual Seasonal Rainfall in Project Area**

Source: Directorate of Economics and Statistics 2015-16

**Figure 10: Monthly Max and Min Average Temperature in Project Area**

## 5. Surface Water

41. The project area lies within the watershed expanse of the Palar River Basin and consists of a network of tanks and canals. The River Palar is a prominent and historical feature of Vellore. River seldom flows, and according to local information, river experienced flow in 2015 due heavy floods after nearly two decades. There is surface water flow only for a few days in a year in this river. But considerable ground water potential exists in the Palar river bed. There are a number of subsurface water intake structures on the river bed.

42. Apart from Palar river there are few water bodies that dot in and around the city. Gopal Samuthram (Dharadavedu) and Kalinjur lakes on the north-western side and Sandulperi lake on the south are prominent ones. Other lakes/tanks in municipal are include Vellavadi Eri (meaning lake/pond), Thorapadi Eri, Otteri Eri, Periya Eri, and Sitteri Eri. Except Otteri eri, which is used for drinking purposes by surrounding village areas, water from these surface water bodies are not potable and are generally used for washing and irrigation (Figure 11).

43. Kalinjur lake is mainly fed by Palar River, and substituted by its catchment area. Consequently, lake is mostly dry or have very less water. Lake filled to its capacity in 2015 due to heavy rains and flood in River Palar in 2015, and with subsequent monsoons, at present lake holds good amount of water. Wastewater from surrounding areas also enter the lake. Lake water is not used for any potable purposes, but used for irrigation in the downstream, when the lake overflows, which is very rare. As per the local information, in the last 20 years, lake overflown twice – in 2004 and 2015. There are is notable aquatic life in the lake. No commercial or leisure or subsistence fishing is practiced.

**Figure 11: Pandiyan Channel**



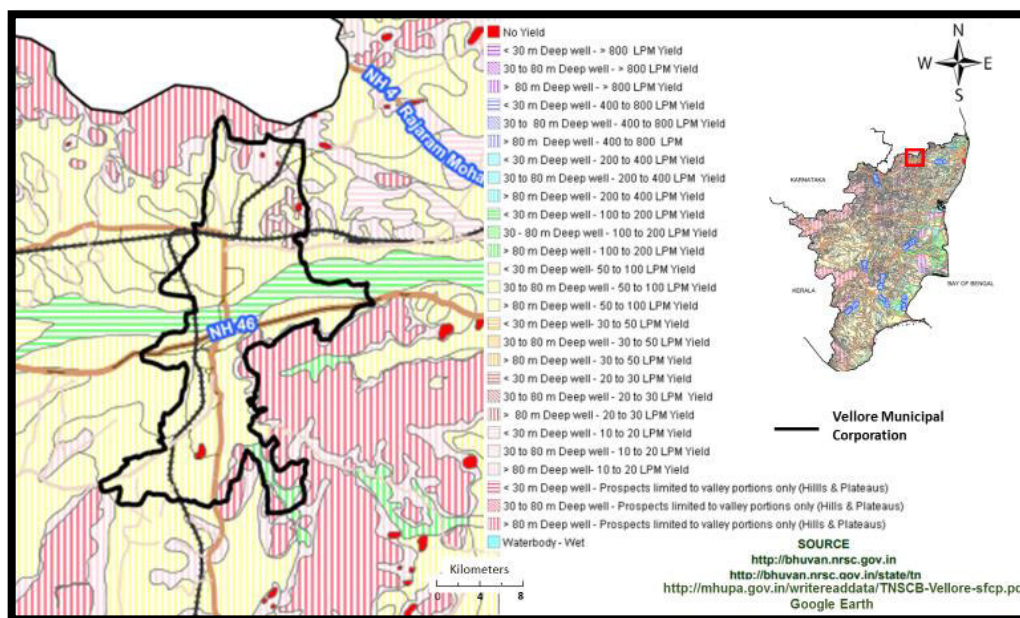
44. Kalinjur Lake has a surplus/overflow channel (called Pandiyan Channel) that discharges lake overflow for irrigation purposes and surplus is carried to Palar River. As shown in the figure above, it starts from the overflow weir of lake, and flows for about 15-16 km, mostly through agricultural lands and some residential areas. Residential areas along the channel dispose wastewater into drain, and in agricultural areas, water is used for irrigation purpose, and the channel ultimately joins River Palar in the downstream. Except when lake overflows, which is very rare, the channel carries only wastewater from the habitations along its course. Velavadi lake, which is located in the eastern part of the city, is used by VCMC for disposal of treated wastewater from the existing STP. This water is being used for irrigation.

## **6. Groundwater**

45. Palar river bed has a considerable ground water potential that facilitates a large-scale groundwater extraction from the river bed. Ground water is the main source of drinking water supply in the absence of reliable surface water source in the region. Million gallons of groundwater per day is pumped from the river bed for the major water supply schemes. Due to over exploitation of groundwater, 5 blocks of upper Palar Zone in Vellore District have been classified as Dark, where annual extraction is more than 85% of annual groundwater recharge and resulted in

depletion of water level. All these blocks are located on either bank of Palar river. Vellore district as a whole is categorized as “over-exploited” in terms of groundwater potential as of 2011 by Central Ground Water Board. The map below shows the ground water prospects in the project area according to which the water in the region is 30 m to 80 m deep and yield 100 to 200 liters per minute.

**Figure 12: Ground Water Prospects in Project Area**



Source: Bhuvan.

46. **Groundwater Quality.** As per Central Ground Water Board report of Ground water quality scenario in India, Vellore is categorized as fluoride affected district with concentration of more than 1.5mg/L. Table 2 summarizes the result of water quality analysis conducted during 2012 at 68 groundwater sampling wells that are spread across the district including wells from the project area. Groundwater was found to be alkaline which catalyzed the mineral leaching adding to the high concentration of fluoride in groundwater. Industries along with agricultural fields contribute to the nitrate and fluoride levels in groundwater.

14. In the entire Palar basin, pollution is more prevalent, in upper Palar where tanneries are located in large number from Vaniyambadi (70 km) to Walajahpet town (30 km). These tanning industries let the untreated or partially treated effluents in large volumes into the river system, thus polluting the cultivable soil and groundwater resources. Following table shows the groundwater quality in Vellore, maximum values of most of the parameters exceed permissible standards.

**Table 8: Groundwater Quality in Vellore**

Parameters	BIS standard (Desirable - Permissible)	Minimum	Maximum	Mean
pH	6.5 – 8.5	7.2	8.5	7.5
EC (µS)		670	4210	1663
Total dissolved solids (mg/L)	500 – 2000	388	2686	1059
Calcium (mg/L)	75 – 200	18	240	77
Magnesium (mg/L)	30 – 100	24	199	71
Sodium (mg/L)	200	15	621	204



Parameters	BIS standard (Desirable - Permissible)	Minimum	Maximum	Mean
Potassium (mg/L)	-	2	196	17
Nitrate (mg/L)	45 – 100	<1	46	11
Fluoride (mg/L)	1.0 – 1.5	0.02	3	1
Chloride (mg/L)	250 – 100	25	1170	275
Carbonate (mg/L)	-	<1	24	10
Bicarbonate (mg/L)	-	238	946	474
Sulphate (mg/L)	200 – 400	7	394	128

Source: P. J. Sajil Kumar, P. Jegathambal, E. J. James (2014), "Factors influencing the high fluoride concentration in groundwater of Vellore District, South India", Environ Earth Sci., 72:2437–2446.

## 7. Ambient Air Quality

47. At present there is no air quality monitoring station set up by Tamil Nadu Pollution Control Board (TNPCB), and therefore there is no air quality data available for Vellore City. Main source of air pollution in the city are vehicular traffic, road dust, construction and industrial activities. A 2016 air quality study at Green circle and old bus stand in the city has revealed that PM<sub>10</sub> and PM<sub>2.5</sub> concentration are higher than the prescribed NAAQ standards. Table below gives the concentration of different air pollutants. According to this study, the sampling was done continuously on an 8 hours for one day per month for period of three months (January 2016 to March 2016).

**Table 9: Ambient Air Quality at Traffic Junctions, Vellore, 2016**

Monitoring Location	Green Circle					Old Bus Stand				
	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	SO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	SO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	CO (mg/m <sup>3</sup> )
January	141.1	96.5	42.3	49.2	1.15	128.5	85.2	36.2	44.4	1.15
February	138.2	94.7	41.1	47.5	1.45	127.2	82.2	35.9	43.4	1.2
March	140.9	93.3	41.9	46.2	1.91	126.4	83	34.6	43.2	1.71
<b>NAAQ Standard</b>	<b>100</b>	<b>60</b>	<b>80</b>	<b>80</b>	<b>4</b>	<b>100</b>	<b>60</b>	<b>80</b>	<b>80</b>	<b>4</b>

Source: T. Peganvignesh and Sharpudin J. (2016), "Assessment Of Ambient Air Quality Monitoring In Traffic Junctions, Vellore", International Journal of Research in Engineering and Technology, Vol. 5 (5), pp. 214 – 217.

## 8. Ambient Noise Levels

48. There is noise data available for Vellore from TNPCB. Following table presents the noise level data across Vellore City from a research study conducted in 2016. Study monitored noise levels along different types of roads at nine locations. Noise levels at all location and at all times (day and night) exceeded the ambient noise standards.<sup>6</sup> Further, due to heavy traffic volumes, noise levels along highways/expressways and arterial roads were much higher than the noise levels on local streets.

**Table 10: Ambient Day-time Noise Levels in Vellore**

Roadways	Area name	Measures of noise levels (dBA)	Morning Peak 9:00-9:30	Morning off Peak 11:30-12:00	Afternoon off peak 2:30-3:00	Evening peak 6:00-6:30	Night off-peak 9:30-10:00
TYPE I	Local Street Long Bazar	Lmax	78.18	79.23	81.74	78.32	75.33
		Lmin	67.09	68.29	66.23	68.61	61.78
		Leq	72.16	72.68	71.81	74.08	72.33

<sup>6</sup> day and night time noise standards for residential areas = 55 dBA and 45 dBA and for commercial areas = 65 dBA and 55dBA.

Roadways	Area name	Measures of noise levels (dBA)	Morning Peak 9:00-9:30	Morning off Peak 11:30-12:00	Afternoon off peak 2:30-3:00	Evening peak 6:00-6:30	Night off-peak 9:30-10:00
	Arterial Roadway – Scudder Road	Lmax	81.45	82.33	78.81	77.48	79.72
		Lmin	74.44	71	70.8	70.53	70.42
		Leq	78.29	75.63	74.94	74.58	73.89
	Chittor Expressway	Lmax	81.51	79.94	81.58	82.7	78.73
		Lmin	65.24	70.55	68.63	70.16	65.37
		Leq	76.69	76.46	74.83	75.77	73.84
TYPE II	Local Street Gandhi Road	Lmax	74.37	73.09	70.83	76.05	74.81
		Lmin	62.93	62.47	62.47	64.94	64.35
		Leq	70.08	69.36	67.46	71.25	70.43
	Arterial Roadway Katpadi Road	Lmax	85.16	85.88	79.95	82.11	79.42
		Lmin	74.21	76.98	72.34	76.73	66.09
		Leq	79.77	79.79	76.13	79.12	75.29
	Madras Expressway	Lmax	81.62	84.62	80.68	82.35	78.71
		Lmin	74.11	72.03	68.98	71.86	69.75
		Leq	78.15	77.54	76.66	76.77	75.42
TYPE III	Local Street Main Bazar	Lmax	80.22	74.95	71.10	78.75	75.49
		Lmin	67.83	66.28	65.3	68.79	61.11
		Leq	72.66	70.24	68.05	73.46	69.52
	Arterial Roadway Officer's Line	Lmax	87.39	84	82.37	90	82.95
		Lmin	72.47	72.81	71.29	73.63	68.1
		Leq	80.99	78.26	77.36	77.79	75.2
	Thiruvannamalai Arni Expressway	Lmax	85.78	84.99	80.72	82.89	80.83
		Lmin	70.95	63.27	65.95	69.96	66.4
		Leq	79.65	76.98	74.53	77.73	77.02
Noise standards (day time), dB(A), Leq			65 (commercial areas)				

Source: SS Reddy, SK Hasan (2016), "Vehicular traffic noise in Vellore Municipality, Tamil Nadu, India – An Analysis", Amity journal of engineering and technology 1 (1), 48-52.

### C. Ecological Resources

49. Vellore city is located in the Eastern Ghats region and on the banks of Palar river basin. A part of the town (~103 ha, 8.90% of municipal area) forms part of the reserved forest. The Vellore and Palamathi reserved forest areas are located on the eastern side of the town. The southern and western sides of the town are mostly plain agricultural lands with a number of irrigation tanks. The southern bank of Palar river forms the northern boundary of the town. There are seven reserve forest areas in and around the Vellore municipal corporation, Punganur, Vilapakam, Palamathi, Kunjanur, Bagayam, Kannamangalam and Kavanur respectively.

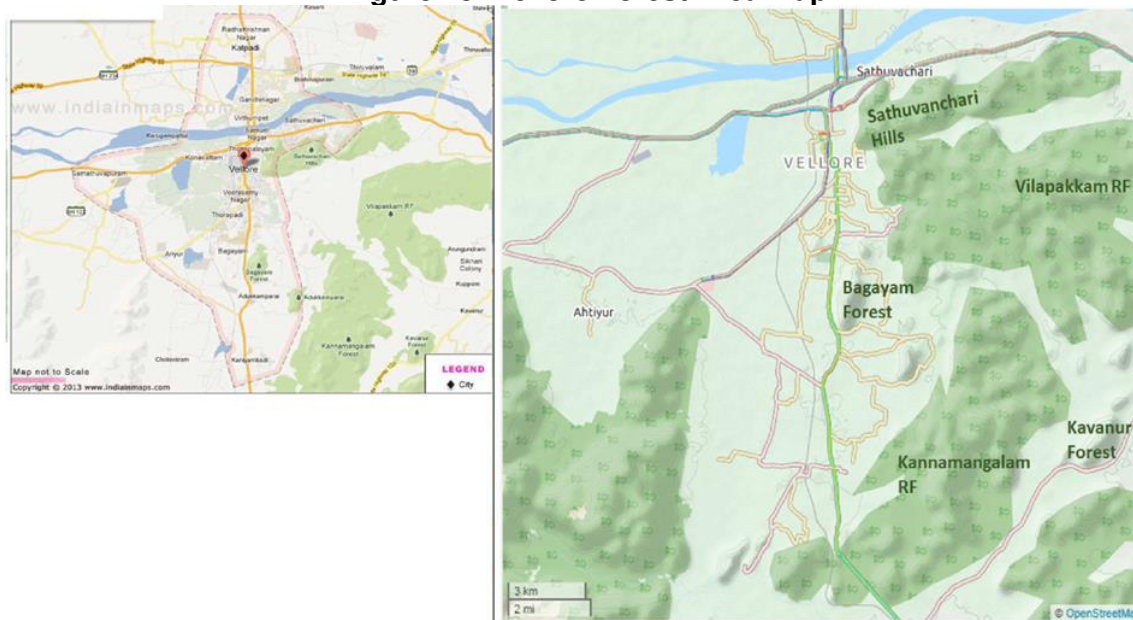
18. These forests are devoid of any large wildlife. Small mammals, reptiles and ground birds are commonly found in the reserve forests. Common monkeys are also frequently sighted on the outskirts of the city. Trees such as tamarind, teakwood, neem and other avenue species are found

within the city and along the roads. Lemongrass, known as 'manjampul,' is found in abundance on the surrounding hills.

50. Subproject components are all located in urban land parcels surrounded by developed lands or along the river which were converted to agricultural and/or urban use many years ago, and therefore there are no sensitive environmental features in or near the subproject sites. Sathuvachari hills in the eastern side of the city (Figure 13) are partly located in the city area, and are close to the project area. But none of the components are located in the forests.

51. The treated water is proposed to be disposed into Pandiyan Channel, which is an overflow channel of Kalinjur lake. Since lake is mostly dry, this channel seldom receives overflow. This channel meets River Palar, about 15-16 km downstream of Kalinjur lake. During its course, it collects wastewater from the surrounding areas (for about 4-5 km it flows through the habitation), and then it flows through agricultural lands, where its water, mostly wastewater, is used for irrigation. Channel is built in cement concrete within the municipal area, and after which it is of earthen section. The ecological value of this drain in the current situation is insignificant.

**Figure 13: Vellore Forest Area Map**

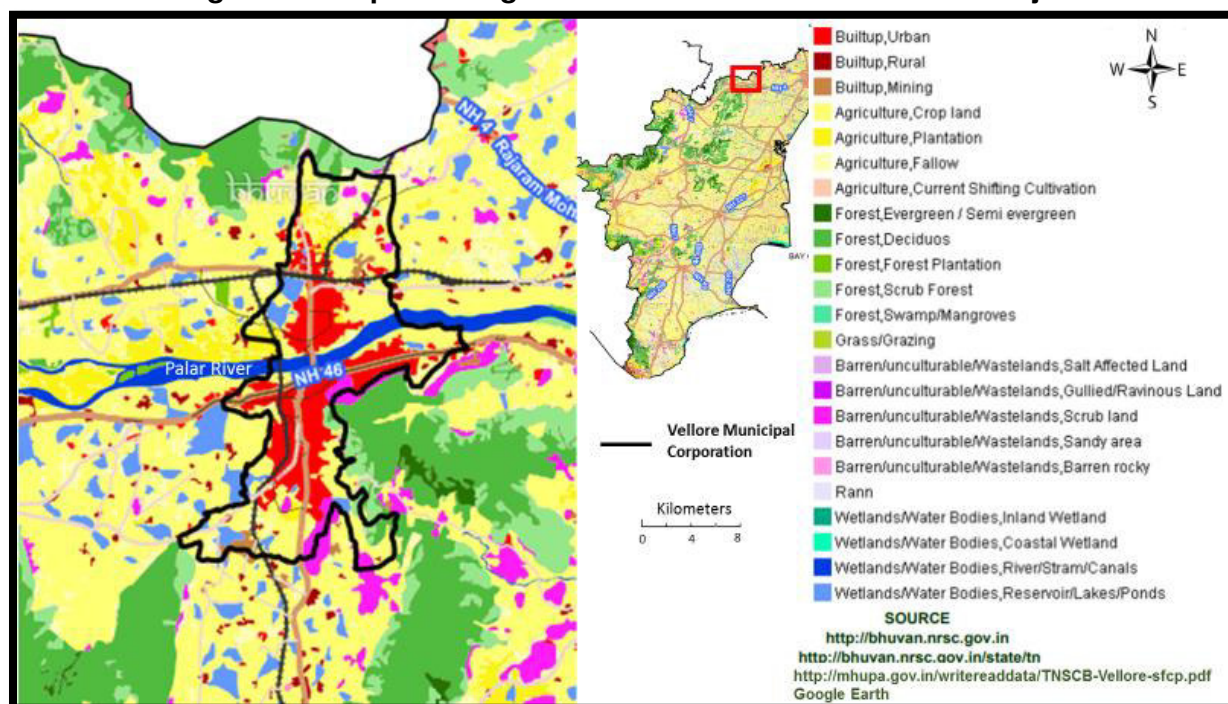


## **D. Economic Development**

### **1. Land Use**

52. The land area of the city is put to a variety of uses, like commercial, manufacturing, transportation, residential, recreational and administrative functions. According to existing master plan that gives details of land use pattern in the city and vicinity area residential areas occupies major percentage of the developed land in the city limits with 55.76% followed by public and semi-public with 16.46%, transport and communications with 14.49%, public and semi-public with 13.94% and commercial with 8.34%. Agriculture land in the undeveloped area is 26.9%. The thematic map below shows the general land use in the project area.

**Figure 14: Map Showing Land Use and Land Cover in the Project Area**



Source: Bhuvan.

## 2. Industry and Agriculture

53. The economy of Vellore city depends mostly on service sector and manufacturing sector than the primary sector. The city is host to India's two most premiere educational institutions namely Vellore Institute of Technology and Christian Medical College. Tanneries, Chemicals and Greaves, Brakes, foundry, Explosives industries are some of the contributors to the cities economy.

54. Major employment in the city is provided by leather industry, agricultural trading and industries located in and around the city. Approximately 83.35 per cent of the workforce is employed in tertiary sector comprising transport, services and commerce. The secondary sector activities like manufacturing and household industries employ 13.52 per cent of the total workforce in the city.

55. Vellore leather accounts for more than 37 percent of the country's export of leather and leather-related products. Tirumalai Chemicals and Greaves are among the international brands that have their manufacturing units in the city. Automobile and mechanical companies of global Brands, including SAME Deutz-Fahr, TVS-India, Mitsubishi, Greaves Cotton and MRF have their manufacturing units in the area. Brakes India Sholingur's division is located at Vellore-Sholingur and is a major employer in the area. Asia's biggest explosives manufacturing company, Tamil Nadu Explosives Limited (TEL), is located in Vellore at Katpadi. This is India's only government explosives company with more than a thousand employees. Kramski Stamping and Molding India Pvt Ltd, a German precision metal and plastic integrated-component manufacturing company with automotive, telecommunications, electronics and medical applications is located in Erayankadu, near Vellore. Major businesses in the city center are located on Officer's Line, Town Hall Road, Long Bazaar and Bangalore, Scudder, Arni, Gandhi and Katpadi Roads.

56. Agriculture is generally practiced along the Palar river banks and in the outskirts of the city. The workforce depending on agriculture is insignificant when compared to secondary and tertiary sectors, so is the contribution to the city economy.

### 3. Infrastructure

57. **Water Supply.** The city has intermittent water supply and availability. Unaccounted water loss is less than 30%. Treated water supply from the Combined Water Supply Scheme (CWSS) with river Cauvery as source (Mettur dam, about 200 km from Vellore) has started recently. The combined water scheme has helped the city deliver water at a frequency of 2 days cycle from an earlier 5-9 day cycle. The city envisages to reach the National Standards of water supply per capita (135 LPCD) and NRW (15%) by FY2019.

58. The city does not measure all its supply. It does not recycle waste water to meet its requirements and rain water harvesting is not prevalent. Flooding often occurs due to storm water run-off.

59. **Solid Waste Management.** Rapid growth of population and urbanization has resulted in increasing the volume of solid waste generation. The corporation produces around 240 to 300 Tons of waste per day. Day to day waste collection is done in 85% of the areas. But the collected waste is not segregated but dumped in the corporation dump yard. Decentralised segregation is practiced in 10 out of the 60 wards. The city municipal corporation took steps to move towards 100% resource recovery mechanisms through a decentralized framework for waste management systems. Around 42 locations across VCMC have been identified for operations. Current source segregation efficiency has increased from 44.4% (FY13-14) to 62.5% (FY15-16).

60. **Transportation.** The N.H 46 from Ranipet to Krishnagiri (forming part of Madras – Bangalore corridor) and the State Highway No.1 (Cuddalore – Chittoor) cut across the Vellore town. The city has two bus terminals: Town Bus Terminus and the Central Bus Terminus. Other bus terminals are located at Chittor Bus Stand, Bagayam and Katpadi (Junction bus stop). The Villupuram – Tirupathy metre gauge railway line passes through the town with Vellore cantonment and Vellore town railway station located within the town. One of the major B.G. railway corridors in the country, Chennai – Bangalore/ Coimbatore/Ernakulam runs about 5 km north of this town with Katpadi being the feeder railway junction to the town. The Vellore Katpadi Junction is a major railway junction on this BG railway corridor. The city has an airport near Abdullapuram used for aeronautical training programmes. The nearest international airports are Chennai International Airport (130 km) and Bengaluru International Airport (200 km); the nearest domestic airport is Tirupati Airport (100 km).

## E. Socio Cultural Resources

### 1. Demography

61. As per Census of India (2011), population density of the city is 15949 persons per km<sup>2</sup>. There are 48 wards in the city, among them Vellore (m. Corp) Ward No 06 is the most populous ward with a population of 7901 and Vellore (m. Corp) Ward No 27 is the least populous ward with population of 1622.

62. Vellore has 38% (about 70 thousand) population engaged in either main or marginal works. 58% male and 18% female population are working population. 54% of total male

population are full time workers and 4% are marginal (part time) workers. For women 16% of total female population are fulltime and 3% are marginal workers. A total of about 1.4 lakh people in the city are literate, among them about 74 thousand are male and about 69 thousand are female. Literacy rate (children under 6 are excluded) of Vellore is 86%. 91% of male and 82% of female population are literate here.

## **2. History, Culture and Tourism**

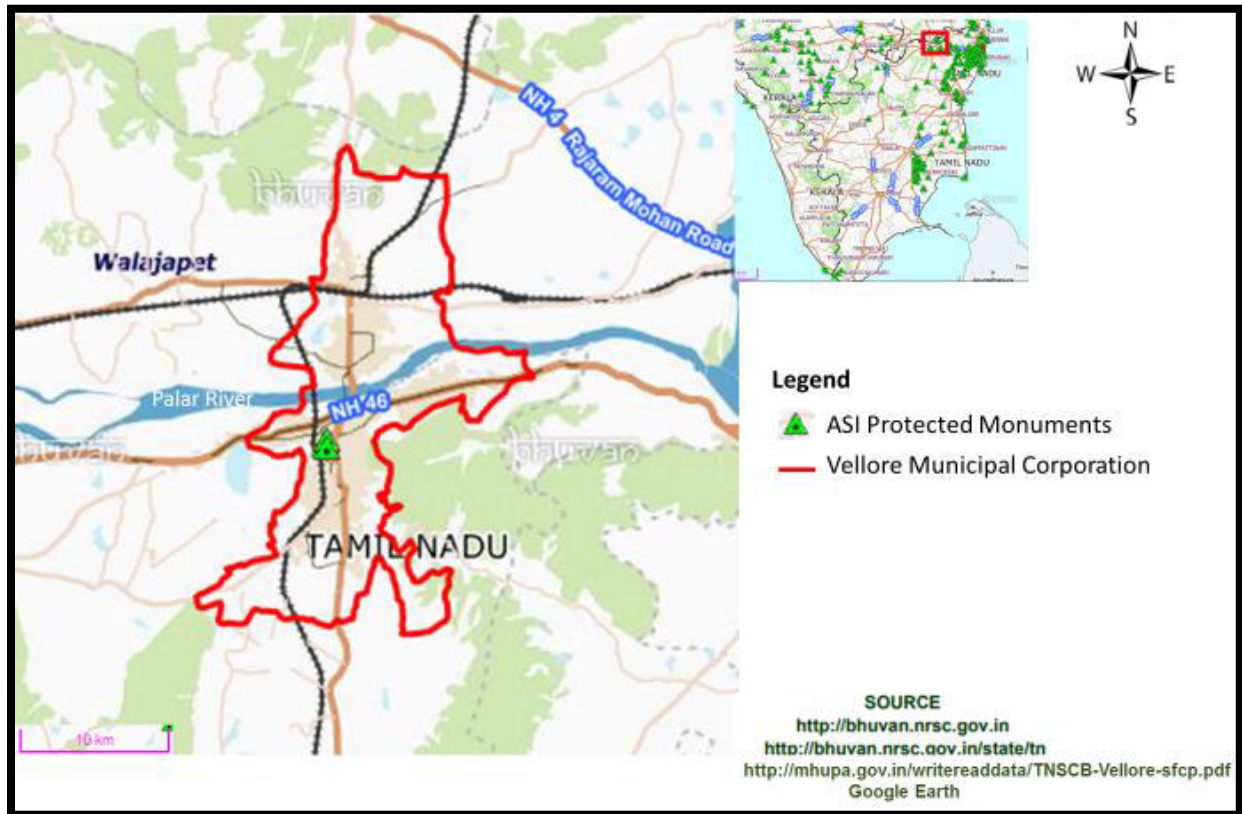
63. Vellore city has a unique heritage base that traces its roots back to the Megalithic period (C, 2500 years). The city was ruled by Vijayanagara Kings, Bijapur Sultans to Marathas, the Carnatic Nawabs and the British and traces of each of their periods in terms of sculpture and art is scattered across the city. Vellore District was a part of the then North Arcot District. Vellore was the base of Lord Cornwallis in his campaign against Tippu Sultan. It was here the family of Tippu was kept under the arrest after his fall. In A.D. 1806, the Sepoys of Vellore rose heroically in mutiny against the British army officer which was promptly quelled.

31. The Vellore city and the periphery areas have several iconic spots for tourism such as Vellore Fort, Golden temple, Government museum, Science park, Vainu Bappu Observatory, Amirthi Zoological Park and Yelagiri hills.

32. The Vellore fort retains its past glory with its ramparts, barlements, turrets, posts, and sally gates and with perennial water supply. The fort houses a church, Jalakantesvara temple, and many buildings. Many Government offices are located in these buildings. The Fort, Mosque inside the fort and Jalakantesvara temple are protected by the Archaeological Survey of India (ASI). Vellore Fort is a large 16th-century fort built by Vijayanagara kings. The fort was at one time the headquarters of the Aravidu Dynasty of the Vijayanagara Empire. The fort is known for its grand ramparts, wide moat and robust masonry. The fort houses the Jalakanteswarar Hindu temple, the Christian St. John's Church and a Muslim mosque, of which the Jalakanteswarar Temple is famous for its magnificent carvings. The first significant military rebellion against British rule erupted at this fort in 1806. It consisted a deep wet ditch (moat) and huge double walls with bastions projecting irregularly. The fort was constructed in granite and it spreads over an area of 133 acres.



**Figure 15: Archaeological Survey of India Protected Monument In Vellore**






Source: Bhuvan.

## **F. Subproject Site Environmental Features**



64. Features of the selected subproject sites are presented in Table 11.



**Table 11: Site Environmental Features**









Infrastructure	Location and Environmental Features	Photos	
Sewage treatment plant (STP)	<p>Proposed STP site is located at Viruthampattu on the bank of River Palar in the northern part VCMC area. Site is not located in the flood plain. Site is located adjacent to a solid waste management (segregation) facility of the VCMC. Palar River, flowing west to east, almost bifurcates the VCMC area. Site is located adjacent to left bank (towards north) and there are agricultural lands between the river and the proposed STP site. Housing development is in the north of the proposed site, which is separated by a road, and the nearest house is at about 60 m from the closest boundary of the STP site, and separated by a road. There are about 10-15 houses in 100 m distance from STP boundary.</p> <p>Area of the site is 4-5 acres and owned by VCMC. Site is vacant and covered with shrubs and bushes. Site is accessible by an existing road.</p> <p>It is proposed to dispose treated wastewater into Pandiyan channel, which is the overflow/surplus flow channel of Kalinjur Lake. Channel flows at about 2 km from the STP site, and an outfall sewer will be laid from STP to Pandiyan channel. Water from this channel is utilized for irrigation along its course of about 15-16 km, before it reaches River Palar. Outfall sewer will be laid along main road within the road right of way.</p>		
			
			 <p data-bbox="1339 1341 1474 1370">Kalinjur lake</p>

Infrastructure	Location and Environmental Features	Photos
		<p data-bbox="909 224 1115 248">Pandiyan channel</p> <div data-bbox="1045 276 1772 1101"></div>

Infrastructure	Location and Environmental Features	Photos
<p>Sewage pumping stations (SPS)</p>	<p><b>Sewage Pumping Station – 3 at Alamelumangapuram</b>            Site is located adjacent to a small drain/stream, and along a road. This is newly developing residential area in the city outskirts. Nearest house is at about 25-30 m however, vacant housing plots are just adjacent to the site, and in near future the SPS will become adjacent to the houses. Site is vacant and covered with shrubs and bushes.</p> <p>Total area of the site is 0.53 acres and land is owned by Revenue Department (GOTN)</p>	
	<p><b>Sewage Pumping Station – 4 at Sathuvachari</b>            Site is located in the outskirts of the city close to River Palar. Site is adjacent to a small stream/drain. Houses and a school is located at about 50 m; adequate land area is available along the drain, and therefore the SPS will be constructed maintaining buffer from the school. An old septic tank constructed by Tamil Nadu Housing (THB) board is just adjoining the proposed site.</p> <p>Total area of the site is 0.97 acres and land is owned by VCMC.</p>	

Infrastructure	Location and Environmental Features	Photos	
	<p><b>Sewage Pumping Station – 5 at Sathuvachari</b>  Proposed site is located within a solid waste segregation yard operated by the VCMC on the bank of River Palar. A grave yard is located close (~ 50 m) to the site. Site is vacant. There are no houses close to the site (&lt;100 m).</p> <p>Total area of the site is 0.8 acres and land is owned by VCMC</p>		
	<p><b>Sewage Pumping Station – 6 at Shenabakkam</b>  Site is located within in the western part of the city surrounded by large expanse of government owned vacant lands. A low-income residential area (slum), developed on the government land is located close to the site (10 – 15 m). However, adequate land is available, and SPS will be constructed by maintaining buffer from the slum.</p> <p>Site is low-lying and located adjacent to a stream/drain. Site is filled partly with water, and there are few palm trees on the site.</p> <p>An Archaeological Survey of India (ASI) protected monument (Vellore Fort) is located at about 250-260 m from the boundary.</p> <p>Total area of the site is 0.95 acres and land is owned by Revenue Department, Government of Tamil Nadu</p>		



Infrastructure	Location and Environmental Features	Photos	
	<p><b>Sewage Pumping Station – 7 at Velapadi</b> Site is located within a residential area in the eastern part of the City. Site is vacant, covered with trees and shrubs, include a big, mature neem tree.</p> <p>Houses are located close to the site on all sides (10-20 m).</p>		
Sewer network	<p>Sewer lines will be laid in the center 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.</p>		
	<p>There are trees along the roads, which will be mostly avoided by slightly changing the alignment locally where required. Some of the sewer lines, which are to be laid within the road right of way, are located within the 300m distance of ASI protected monument (Vellore Fort).</p>		
	<p>Large diameter pipes will be laid mostly on main roads (300 – 1300 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.</p> <p>Trench size to bury the sewer will be of 0.8 m to 1.5 m wide and 1.2 m to 6 m deep.</p>		

Infrastructure	Location and Environmental Features	Photos	
	<p>Some sewage pumping stations (e.g. SPS 6) is located inside a residential area and accessible by only a narrow road. There will be two pipelines (incoming and outgoing pumping mains) in the narrow road.</p>		
			

## V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

65. 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.

66. 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.

67. 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).

68. 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.

69. The ADB Rapid Environmental Assessment Checklist in [http://www.adb.org/documents/guidelines/environmental\\_assessment/eaguidelines002.asphas](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.

70. 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 odour 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

71. **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.

72. **Design of Sewage Treatment Plant.** A 50 MLD STP is proposed to be constructed at the identified site to treat the sewage generated from the subproject areas. It is proposed that the treated wastewater will be disposed into Pandiyan Channel, the surplus/overflow channel of Kalinjur Lake, and will be utilized for irrigation in the lake command area. The disposal point in the channel is located at about 2 km from the STP. 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 prefixed treatment standards, notified for effluent disposal from STPs .

73. To comply with the standards, design-build contractor will select a suitable process and will agree with the PIU. Final Design Report evaluated various treatment options such as: waste stabilization ponds, aerated lagoons, conventional activated sludge process, extended aeration, Sequential Batch Reactor (SBR), Moving Bed Bio-film Reactor (MBBR), Membrane Bio-Reactor (MBR) and Up flow Anaerobic Sludge Blanket (UASB) Process, and inferred that *“to meet the required effluent standards for the discharge of wastewater, a biological treatment plant must be constructed. There are several biological (secondary) treatment processes possible, ranging from land-intensive and low-technology waste stabilization ponds to very compact high-technology processes. In order to select the feasible alternatives the process requirements must be known. Apart from construction and running costs, factors that need to be taken into account in selecting appropriate processes for Vellore Underground Sewerage (UGS) Scheme include: (i) consistent effluent quality, (ii) less area requirement, (iii) process flexibility, (iv) easy operation and maintenance, (v) economic viability, and (vi) aesthetics with surroundings. It was decided to adopt Design Build (DB) method. The selection of appropriate treatment technology and detailed design for inviting detailed proposals for implementation will get from specialized agencies”*.

74. The STP will require uninterrupted power supply for operation of all the activities from inlet to treatment, and for sludge dewatering. Disruption in power supply will lead to process upset, may affect the efficiency of treatment, and result in treated effluent quality not meeting the disposal standards. Following measures are integrated into design and contracts to ensure efficient operation:

- (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 VCMC staff dealing with STP;
- (iv) Extended contractor period for O&M, proper transfer of facility to VCMC with adequate technical know-how on O&M and hands-on training to VCMC staff;
- (v) Provision for online monitoring of crucial wastewater quality parameters at the inlet and outlet of the plant as per the discharge standards;

75. 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. Although proposed system will not serve industrial establishments, and industrial effluent can't be discharged in to municipal sewers, there are industries in subproject area with wastewater discharges, Following measures are suggested to safeguard sewerage system efficiency:

- (i) No industrial wastewater shall be allowed to dispose into municipal sewers;
- (ii) No domestic wastewater from industrial units shall be allowed into municipal sewers;
- (iii) Ensure that there is no illegal discharge through manholes or inspection chambers;
- (iv) Conduct public awareness programs; in coordination with TNPCB;
- (v) Conduct regular wastewater quality monitoring (at outlet of STP) to ensure that the treated effluent quality complies with the standards; quality of incoming sewage and also within the process units will also checked to ensure proper functioning of STP

76. Proposed STP site is located at Viruthampattu on the bank of River Palar in the northern part VCMC area. Site is located adjacent to a solid waste management (segregation) facility of the VCMC. Palar Site is located adjacent to left bank (towards north) and there are agricultural lands between the river and the proposed STP site. Housing development is in the north of the proposed site, which is separated by a road, and the nearest house is at about 60 m from the closest boundary of the STP site. Except in the north where there are houses from 60 m distance, proposed site is surrounded by agricultural and vacant and Palar River. SBR process being an aerobic process and conducted in a compacted and a closed system with automated operation, odour nuisance will be very minimal. Limited bad odours may be generated from wet well, primary treatment units and sludge treatment. Adequate buffer around the plant, that is within the boundary of the STP site with better planning of layout away from the houses in the north is to be followed. Besides operating the plant as per the standard operating procedures, which will further minimize the odour potential, the following measures are also included in the site planning and design:

- (i) Develop the STP layout plan within the identified site such that maximum buffer space be provided towards the houses in the north, in the layout develop, office or other such facilities towards to houses, so that they will act as buffer;
- (ii) Providing a green buffer zone 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;
- (iii) provide odor control/treatment system Dewatering units shall be located in enclosed building vented to odor control unit, and health and safety precaution shall be put in place H<sub>2</sub>S build up; and
- (iv) Locate sludge drying beds maintaining maximum distance from the residential areas in the north.

77. **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. Dewatering units will be in enclosed building vented to odour control unit, and health and safety precaution shall be put in place H<sub>2</sub>S build up. 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 (15 days) 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. Sludge shall be periodically tested for presence of heavy metals and to ensure it meets standards for the application to land. Proper sludge handling methods should be employed. Personal Protection Equipment should be provided to the workers.

78. 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. Rules stipulate that “In order to ensure safe application of compost, the following specifications for compost quality shall be met”:

**Table 12: Characteristic of Sludge for Use as Soil Conditioner**

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/cm <sup>3</sup> )		<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 P <sub>2</sub> O <sub>5</sub> ) percent by weight, minimum	percent by weight	0.4	10.4
Total Potassium (as K <sub>2</sub> O), 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

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)
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.

Source: Standards for Composting, Schedule II A, Solid Waste Management Rules, 2016.

FCO = Fertilizer Control Order, 1985, amendments in 2009 and 2013.

**79. 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, City Corporation 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.

**80.** 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) 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.

**81. Sewage Pumping stations and lift stations.** It is proposed to construct seven sewage lift stations, and five sewage pumping stations, which 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.

**82.** 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 of dia 2 m to 2.5 m and 5 m to 7.5 m deep, 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 of required size.

83. **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 sewage pumping station include:

- (i) Inlet chamber - length (2 – 3.5 m), width (1.5 m) and depth (2.3 – 4.3 m);
- (ii) Screen chamber - length (4 – 4.5 m), width (2 - 3.5 m) and depth (2.3 – 5.3 m)
- (iii) Grit well - Dia (4.5 – 8 m) and depth (3.3 – 6.3 m);
- (iv) Suction well - Circular at SPS 3 and 7 - Dia (5.5 – 6 m) and depth (6.6 – 8.7 m)
- (v) Suction well - Rectangular at SPS 4, 5 and 6 - length (9.5 – 15.5 m), width (6 - 12 m) and depth (8.4 – 9.6 m);
- (vi) DG set platform; and
- (vii) Pump room.

84. 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.

85. **Odor from pump 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.

86. Given that lifting stations and pumping stations are to be located at technically feasible locations (e.g., 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 pumping/lifting station. Given the very limited land availability in urban areas like the project area, that too of government owned lands, locating the pumping stations ideally about 50-100 m away from the houses is not practical. in Vellore, sites for pumping stations were identified based on the technical suitability and availability of government owned land parcels to avoid land acquisition. Given the comparatively higher potential of odor generation, priority has been given to accommodate pumping stations at more suitable locations away from houses and mostly in sparsely populated

areas. Sites which are located close have been selected only in cases where there are no other alternative lands available.

87. Following design related measures are included in the sewage pumping and lifting station design. As presented in the baseline profile, few lifting stations are located along the roads within the road right of way. In such cases there is no buffer space between the houses and the lifting station, and also no layout planning related measures as given below including creating buffer area around the facility may not be feasible. Odor potential of lifting stations is very minimal given small scale operation, however, given close location to houses, design related measures as given below are included.

**88. Layout planning related measures.**

- (i) Siting of wells within the identified site at an internal location as far as possible from adjoining residential buildings;
- (ii) Develop green buffer zone around the facilities 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; and
- (iii) Provision of high compound wall.

**89. Design related measures to prevent and control odor from pumping/lifting station operations.**

- (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 metaled 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 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) 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.
- (vii) 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.
- (viii) 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.
- (ix) Develop standard operating procedures/operational manual for operation and

maintenance of lifting and pump stations; this shall include measures for emerge situations.

- (x) Provide training to the staff in SOPs and emergency procedures.
- (xi) Periodically monitor H<sub>2</sub>S levels at sewage pumping and lifting stations using handheld H<sub>2</sub>S meters <sup>7</sup>.

90. **Provision of odor treatment system:** Besides the above measures, which are to be implemented at all sewage pumping and lifting stations, following measures are to be implemented for facilities located very close to the houses/properties.

- (i) For sewage pumping stations SPS 3, SPS 4, SPS 6 and SPS 7, which are located adjacent to houses (within 50 m), provide a suitable arrangement so as 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 pumping stations
- (ii) For lifting stations, the above arrangement should be provided where the buffer distance between sewage well and nearest house/property is less than 50 m.

91. **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. Although STP is located outside the city, noise control measures are necessary. High inside noise levels can affect 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 1m;<sup>8</sup>
- (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; and
- (vi) Provide ear plugs designated for noise reduction to workers.

<sup>7</sup> 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 H<sub>2</sub>S cannot be avoided in the process involving anaerobic decomposition whereas release of H<sub>2</sub>S 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.

<sup>8</sup> 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.



92. **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 or pumping station. In several places, 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.

93. 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; and
- (iii) Installation of Variable Frequency Drives (VFDs).

94. **Tree cutting at selected project sites.** As presented in the baseline profile of subproject sites, few trees are on the selected SPS sites at SPS 4, SPS 6 and SPS 7. At SPS 7, there is a mature and big Neem tree, which needs to be incorporate into layout plan of SPS to avoid tree removal of tree. 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 design of pumping stations, specifically at SPS 4, SPS 6 and SPS 7;
- (ii) Integrate mature neem tree at SPS 7 into the layout plan to avoid tree removal
- (iii) Obtain prior permission for tree cutting; and
- (iv) Plant and maintain 10 trees for each tree that is removed.

95. **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.

96. **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 100 m 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.

97. **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. Contract should not create / use any new borrow pits / quarries.

98. **Social and Cultural Resources.** 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 and at STP. Vellore has very rich history and heritage and is home to three nationally important protected monuments: Fort, Jalakanteshwara Temple and Old Mosque. The Temple and Old Mosque both are situated within the Fort. Fort is located within the city, surrounded by a wide moat. No components are proposed within the Fort area, however, there are houses located within the 300 m regulated distance from the fort boundary. SPS 6 is located at about 260 m from the fort boundary, which is within the 300 m regulated boundary. The main sewers leading to and coming out of SPS 6, will also fall within the 300 m regulated boundary (Figure 16). These works would be implemented obtaining permission, prior to construction. Project sites may contain archaeological or historical remains, and therefore there is a risk of uncovering them. Following measures are to be implemented, and City Corporation will also follow chance find protocol to ensure that any chance finds are recognised and measures are taken to ensure they are protected and conserved.

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

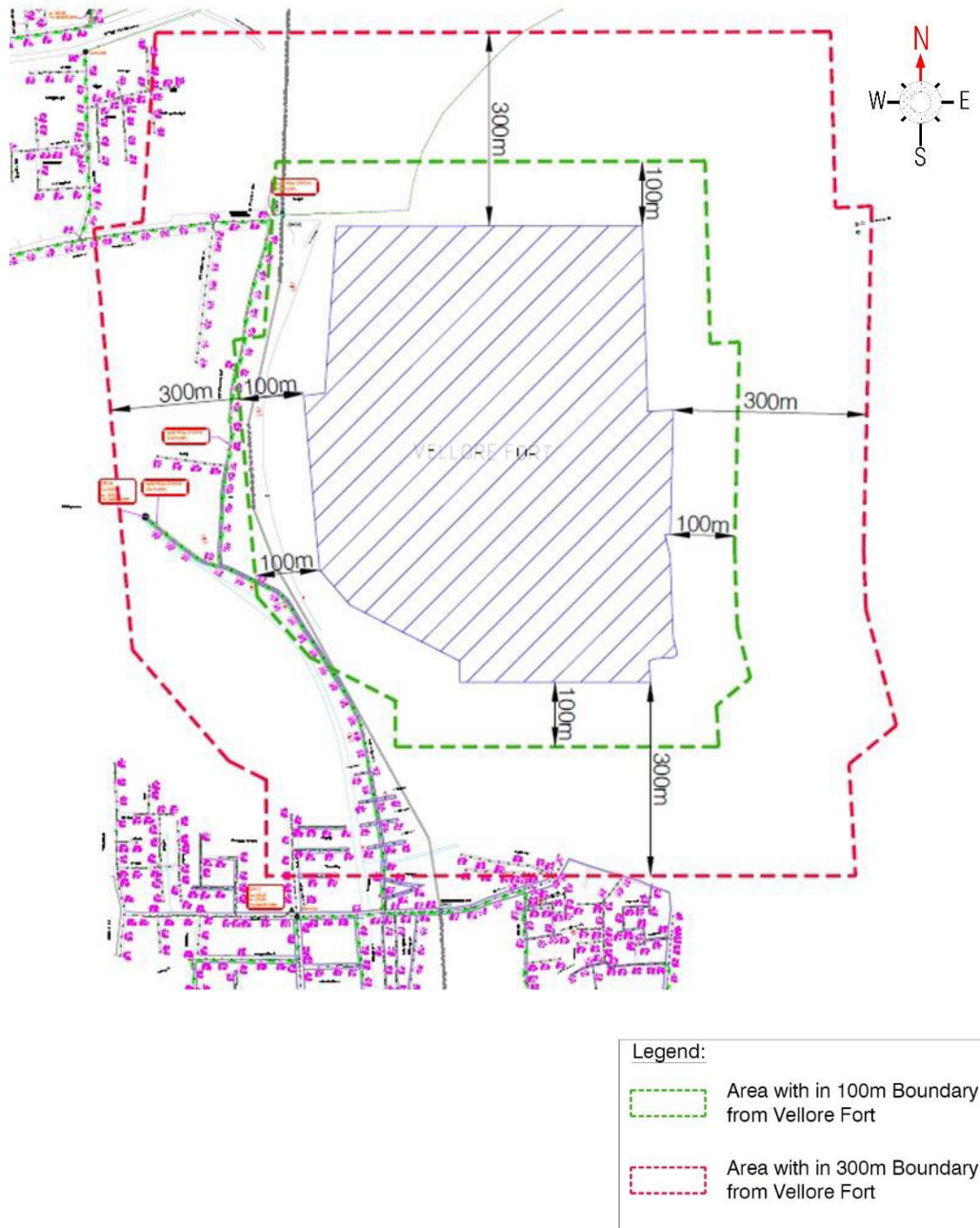
- (i) Obtain prior permission from ASI/NMA for the works to be conducted within the regulated zone of monument; submit detailed construction drawings clearly indicating the details of proposed excavations and works, use of equipment and machinery, etc., to ASI for their review; incorporate any suggestions/recommendations 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) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens; and
- (v) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area.

100. **Measures for Chance finds.**

- (i) Construction contractors to follow these measures in conducting any excavation work:
  - (a) Create awareness among the workers, supervisors and engineers about

- the chance finds during excavation work;
- (b) Stop work immediately to allow further investigation if any finds are suspected;
- (c) Inform local ASI office if a find is suspected, and taking any action they require to ensure its removal or protection in situ.

**Figure 16: Project Components in 300 m Boundary of ASI Monument**



## **B. Construction Impacts**

101. Main civil works in the subproject include construction of sewage treatment plant, sewage pumping and lifting stations at the identified sites. These 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, 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.

102. Technical components of the STP comprise a variety of pre-fabricated elements, which are installed on site as ready-made individual units. These will be directly brought from the manufacturers place to the sites lifted into position by crane, affixed to plinths or other installation points, and connected up to pipework and the electricity supply.

103. 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 221 km sewers along the roads). This covers entire project area comprising Alamelumangapuram, Sathuvachari, Shempakkam, Konavattam, Vasanthapuram, and Velapadi (Zone 3 to Zone 7) and 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 and STP will be laid mostly on wider main roads. Sewers will be laid by open cut method. SPS 6 at Shempakkam is connected by a narrow road to the main road. Each SPS will be connected with two sewers (incoming and outgoing); and therefore at SPS 6, two sewers will need to be laid in narrow road. SPS 3, SPS 4, and SPS 7 are located in residential areas, and for a short distance from main road to sites, sewers will need to be laid in the internal roads.

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 conveying mains (pumping mains) are of cast iron. Diameter of sewer ranges from 200 mm to 1300 mm, of which 85% of the sewers are of 200 mm. According to the design the sewers will be laid at a depth of 1 to 6 m. The width of the trench excavation along the roads will vary from 0.6 m to 1.8 m, and the depth varies from a minimum of 1 m to 6 m. Nearly 90% length of sewers will be laid in trench of depth 3 m or less. The design is optimized to restrict the sewer depth to a maximum of 6 m with an optimal combination of sewer depth and pumping requirements.

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 backhoe excavators. As trenches are deep (up to 6 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 over 375,000 m<sup>3</sup>, of which nearly 95% of excavated soil will be reused, and the remaining 18,750 m<sup>3</sup> 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. Situated around the old core city of Vellore, the project area is well developed, and has dense population, except in the outskirts and along the banks of Palar River. Agriculture and vacant lands can be observed in the outskirts. There are large vacant lands in the eastern part of the city. Two National highways (NH 46 and NH 234) pass through project area. Besides there are several important roads, Bangalore Road, Arcot Road, Old bypass road, SH 207, Vellore-Thoothkudi highway that pass through the project area. The next level roads are internal main roads providing connectivity within the city. These include: Azad road, Fort round road, Pillayar koil street, Shenabakkam road, shankarapalayam road, south avenue road, main bazaar road, Vasanathapuram road, etc.

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 Vellore, construction materials are normally obtained from government licensed suppliers. Contractor should not create/use 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 in an air shed that appears to already be degraded for dust. Significant quantities of earthwork will be conducted in the subproject, spread all over the project area. 95% of the excavated soil 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 like STP, 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. STP is located outside the city, away from habitation area. 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:

112. **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;
- (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 devices, which are operating correctly, and have a valid pollution under control (PUC) certificate; and
- (xi) no vehicles or plant to be left idling at site generators to be at placed maximum distance from properties.

113. **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; and
- (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.

**114. 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. 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.

**115. 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, with major share of its annual 1000 mm rain in northeast (October to December). River Palar flowing through the city forms northern boundary of project areas. River runs mostly dry throughout the year; it rarely flows. Velavadi eri (lake) is situated in the western part of the City. Besides, there are other small water bodies in and around the project area. Project area mostly drains into Palar River. It is important that runoff from the construction areas, which may contain silt and chemical traces do not enter the river and the 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 least 100 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).

116. To reach the STP located on the northern part from the project area located in the south, the pumping main sewer will be laid over a bridge across River Palar. Construction of bridge in the river may pollute river water, and degrade the river bed. Although river is mostly dry, following measures to be implemented by the contractor:

- (i) Schedule and complete the bridge works prior to onset of monsoon, and ensure that works are conducted during low flow time, when the river bed is dry;
- (ii) Works shall be conducted with minimum disturbance to river bed; implement best construction methods to minimize disturbance/consolidation of river bed; as far as possible avoid using heavy equipment mobilization;
- (iii) No labour camps or material storage camps shall be located in or near the river (500 m distance from river shall be maintained);
- (iv) Ensure no spillage of construction chemicals, fuels, oils etc.,
- (v) Ensure that construction site is cleared off of all the material and debris immediately after completion of works;
- (vi) Submit a site clean-up and restoration report to PIU for approval; and
- (vii) Conduct environmental monitoring as per the EMP.

117. **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 of only clarified water into drainage channels/streams after sedimentation in the temporary ponds; and
- (iii) Consider safety aspects related to pit collapse due to accumulation of water.

**118. 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 over 375,000 m<sup>3</sup>, of which nearly 95% will be reused, and the remaining 18,750 m<sup>3</sup> 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 of to approved designated areas immediately;
- (iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should be 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; and
- (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.

**119. Noise and Vibration Levels.** Except one pumping station, and STP, which are located close to Palar River, and slightly away from habitations, all other components are located within the developed area of the city, where there are houses, schools and hospitals, religious places and businesses in the surrounding area. 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. 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;

- (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; and
- (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.

120. 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) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens; and
- (iv) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area.

121. **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 four types of roads/highways in the project area that provide regional connectivity: national highway (NH), state highway (SH), major district roads (MDR) and other district roads (ODR). Sewers are proposed along:

- (i) NH46 Bangalore-Chennai highway;
- (ii) NH 234 Mangalore-Villupuram;
- (iii) SH 207 – Krishnagiri – Vellore;
- (iv) Old Bangalore Road;
- (v) Old Arcot Road;
- (vi) Old bypass road; and
- (vii) Vellore-Thoothkudi highway.

122. National highway and state highways carry considerable traffic, followed by other roads. Sewers will also be laid along the internal main roads that provide connectivity within the city. These include: Azad road, Fort round road, Pillayar koil street, Shenabakkam road, shankarapalayam road, south avenue road, main bazaar road, Vasanathapuram road etc., These roads also carry considerable flow of traffic and are centers of commercial activities.

123. Internal roads in the project area are narrow, and in outer areas roads are comparatively wide. 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.

124. Sewers leading to and coming out of SPS 6 at Shenabakkam will be laid through a very narrow road connecting the SPS 6 site with a main road. One sewer will be laid at a time, so that pedestrian access is maintained to the houses. For construction of manholes, an area of 1.5 m x 1.5 m to 2.5 m x 2.5 m will be excavated at regular interval's depending on the design - minimum distance between manholes of 30 m is adopted for sewer size up to 400 mm and larger spacing up to 100m for large diameter sewers. This will be kept open for longer duration (15- 20 days).

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

126. 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:

**127. 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 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;
- (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) In the roads that connect to SPS sites, which need to accommodate two main sewers (income and outgoing main sewers of SPS), plan work so that access to houses is maintained throughout the construction phase; first lay one sewer and close the trench, restore the road, and lay the second sewer.
- (viii) 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;

- (ix) 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.
- (x) Inform the affected local population in advance about the work schedule, a week before, and a day before start of work;
- (xi) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum;
- (xii) Keep the site free from all unnecessary obstructions;
- (xiii) 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; and
- (xiv) At work site, public information/caution boards shall be provided including contact for public complaints.

**128. 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 a.m. and 4 to 7 p.m.);
- (iii) Locate entry and exit points in areas where there is low potential for traffic congestion;
- (iv) Drive vehicles in a considerate manner; and
- (v) Notify affected public by public information notices, providing sign boards informing nature and duration of construction works and contact numbers for concerns/complaints.

**129. 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.

130. **Socioeconomic – 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 labor force as far as possible.

131. **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 labour 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<sup>9</sup> 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;<sup>10</sup>
- (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;
- (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;

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<sup>9</sup> 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.

<sup>10</sup> International Finance Corporation. Sustainability Webinar Series. [World Bank Group Environmental, Health and Safety Guidelines 101](#).



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

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

**133. 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 100 m 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 galvanized iron sheets, tarpaulins, etc., shall not be used as accommodation for workers;
- (viii) Camps 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**

134. Operation and maintenance (O&M) of the sewerage system will be carried out by Vellore City Municipal Corporation. 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 design-build modality, and the contract will prepared detailed designs for STP including the outfall

sewer and disposal arrangements. At present, treatment and disposal system is designed in outline only (preliminary design); detailed design will be conducted by the design-build contractor during detailed design phase, and the assessment will be updated accordingly.

**135. Treated wastewater disposal from Sewage Treatment Plant.** It is proposed to dispose treated wastewater from STP into an irrigation canal (Pandiyan Channel), that flows at about 2 km from the STP site. This channel originates from Kalinjur lake and carries its overflow for irrigation needs and discharges surplus into Palar River after flowing 15-16 km through outer areas of Vellore city (for about 4-5 km) and through agricultural lands (for about 10-12 km). Water from the channel is used for irrigation purposes along its course.

**136.** Kalinjur lake has its primary feeding channel is from Palar river, substituted by direct runoff from its small catchment. As river Palar runs mostly dry, Kalinjur also is dry. During 2015 heavy rains, water entered lake from Palar, and Kalinjur lake filled and overflow for about 15-20 days in December 2015. Currently, lake is nearly full given very good inflows. Once filled, the surplus water flows automatically over the surplus weir of the lake, into Pandiyan Channel. The capacity of channel appears not uniform, and is partly lined (concrete) and mostly unlined (earthen channel). Within the city area, houses located along the channel dispose wastewater into this drain. Since Kalinjur lake is mostly dry, this channel seldom carries overflow, so most of the time, the flow in the channel is low and comprises only wastewater. Technical assessment during the project preparation indicates that channel hydraulic capacity is adequate to carry the STP discharge throughout its course and up to Palar River. Since the implementation modality is design-build contract type, the STP and discharge arrangements, including capacity adequacy of channel to safely discharge the treated water, will be further assessed as part of the detailed design by design-build contractor. Any disposal action will require permission/consent of TNCPB, which will be obtained during the detailed design phase. Following measures will be implemented during the detailed design phase:

- (i) Conduct a detailed baseline assessment of receiving water body capacity considering worst case scenario – highest rainfall, overflow of Kalinjur lake, and including extreme weather events like intense rainfall etc.
- (ii) Conduct a detailed water quality assessment of receiving water body (Pandiyan channel and also of Palar river at Pandiyan channel discharge point including a control point on upstream); monitor water quality periodically during operation phase as per the environmental monitoring plan; and
- (iii) Obtain TNPCB consent for disposal of treated wastewater into Pandiyan channel.

**137.** At present no data on Pandian channel water quality is available. However, as stated above, except during lake overflow or during rains, it carries only wastewater discharges from the residential areas. Therefore the quality is poor, flow is not significant. The disposal of treated wastewater meeting the set quality standards, in fact, will improve the quality of channel water by dilution. As the discharge flow in the open channel, due to natural process of self-purification, the BOD will reduce and DO will increase further gradually. The treated water in the channel will be utilized for irrigation by surrounding farmers on its course by directly pumping from the channel. Entire water available may not be utilized fully throughout the year, and the rest will be discharged into River Palar. River Palar is mostly dry, and in last two decades as per the local information it flown only couple of times. There was no flow and River was completely dry during the project preparation phase as well. No water quality data available. Baseline water quality studies (for Pandian channel, and River Palar, if water flow is available) will be conducted during the detailed design phase. As the wastewater is treated to set standards and after its discharge into Pandian channel, it will flow for 15-16 km before reaching Palar River, when water is not fully utilized for

irrigation. Considering the existing status of channel, and the degree of treatment and self-purification via 15-16 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.

**138. Treatment efficiency and Compliance with Disposal Standards.** Sewage treatment facility will be designed to meet the STP disposal standards notified by MOEFCC. As discussed above, as per the preliminary proposal, the treated wastewater will be disposed into Pandiyan channel, from where water is used for irrigation (by direct pumping from channel to fields). Any change / lowering of treatment efficiency during operation may lead to poor quality of wastewater and affect the agricultural use. It is therefore critical that STP treats the sewage as designed. Operation and maintenance of STP and change in incoming sewage quality will have impact on the treatment efficiency.

**139. STP operation.** The operation procedures will be firmed up during the detailed design phase, including the amount of automated or manual operation. It must be ensured that the facility is operated with standard operating procedures and only by trained staff. Ensuring uninterrupted power supply with back-up facility is a must. Standard operating procedures and operation manual will be prepared by the design-build contractor. Besides routine operation, this should cover all necessary items such as preventive maintenance, periodic maintenance and emergency maintenance, replacement of pumps, motors, and other electro-mechanical parts as per the design life to optimize energy use and system efficiency etc., Adequate resources – technical and financial, has been taken into consideration in the project design. Manual will also include safety awareness and mock drills for worker safety.

**140. Quality of Raw Sewage.** 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. It is critical that no wastewater from industries is allowed into the sewer network with strict monitoring and enforcement, and public awareness programs.

**141. Use of treated wastewater for irrigation.** The treated wastewater disposed into Pandiyan Channel will be used for irrigation throughout its course by local farmers by direct pumping. This will benefit farmers with much needed and scarce water resource round the year. Use of wastewater for irrigation is associated with some health risks – from germs in wastewater, which may contaminate food and spread disease, health risk to farm workers from worms (helminths) and nematodes and chemical risk is associated if industrial wastewater enter the sewers. In Vellore, the sewer system will collect only domestic sewage, and it will not cater to industrial wastewater. STP will treat wastewater to disposal standards. The flow of the treated effluent in the open channel will further improve the quality of water. If the wastewater with bacteriological contaminants are used for food crops like lettuce, tomato, which are eaten without peeling or cooking, it will present a greater health risk if precaution such as such washing with chlorinated water or storing for adequate time in normal temperature before use (at least 10 days). According to the WHO, effluent which is used to irrigate trees, industrial/commercial (not food, like cotton) and fodder crops, fruit trees, and pasture should have less than one viable nematode egg per liter. Effluent used for the irrigation of food crops, sports fields, public parks, should have and less than one viable nematode egg per liter and less than 1000 faecal coliforms per 100 milliliters. In the areas around Vellore, all types of crops are cultivated, including vegetables, therefore this standard shall be met prior to its discharge into the channel. Proper monitoring of

water is required for use in irrigation, and is proposed in the environmental monitoring plan. This will be further studied during detailed design based on the final design and disposal arrangement.

142. **Sewage sludge.** No estimate of sludge generation from STP is available at this stage. 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. Sludge regularly accumulates in the treatment units during the process. STP will have proper facilities for handling, treatment and disposal of sludge safely with implementation of sludge management plan. Therefore no adverse impacts envisaged. This sludge from basins will be collected into sludge sump and conveyed to centrifuge unit for dewatering and thickening. This unit will be enclosed in a building and vented to odour control unit. 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. 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 in the Solid Waste Management Rules, 2016

143. STP is proposed under design-build contract modality, following measures needs to be considered and included in the detailed design of the STP:

- (i) Process design to meet the discharge standards;
- (ii) Regular monitoring to ensure that treated wastewater always meets the design disposal standards;
- (iii) Conduct a detailed baseline assessment of receiving water body capacity considering worst case scenario – highest rainfall, overflow of Kalinjur lake, and including extreme weather events like intense rainfall etc.,
- (iv) Conduct detailed water quality assessment of receiving water body (Pandiyan channel and also of Palar river at Pandiyan channel discharge point including a control point on upstream); monitor water quality periodically during operation phase as per the Environmental Monitoring Plan; obtain TNPCB consent for disposal of treated wastewater into Pandiyan channel
- (iv) Sludge management to collect, treat and dispose the accumulated sludge safely; sludge will be treated in a mechanical centrifuge which will thicken the sludge by separating the liquid, thicken sludge will be further dried, and dried sludge will be used as a soil conditioner in fields; Sludge will be tested periodically for heavy metal concentration;
- (v) Install sludge thickening system in an enclosed building and vented to odour control system;
- (vi) Locate sludge drying beds maintaining maximum distance from the residential areas in the north;
- (vii) Designing the entire system to maintain optimal flow and terminal pressure, and optimising the overall energy usage in sewer system, including STP;
- (viii) Using low-noise and energy efficient pumping systems;
- (ix) Installing the noise-producing pumps and motors etc., in enclosed buildings with noise reducing walls, and also maintaining adequate buffer to the nearby inhabited areas; and
- (x) Provision of appropriate personal protection equipment to the workers and staff.

144. Following measures are to be implemented during the operation phase, and should be appropriately included in the project design:

- (i) Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility;
- (ii) Ensure continuous uninterrupted power supply;
- (iii) Operate and maintain the facility following standard operating procedures of operational manual;
- (iv) Undertake preventive and periodic maintenance activities as required;
- (v) Maintain the mechanical/electrical parts as per the maintenance plan to avoid any hazards;
- (vi) Conduct periodic training to workers;
- (vii) Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check the equipment, and conduct mock drills to deal with emergency situations;
- (viii) Implement sludge management plan at the STP;
- (ix) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers;
- (x) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB:
  - a) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with design standards;
- (xi) Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming the concentrations to use as compost as specified in the Standards for Composting, Schedule II A, Solid Waste Management Rules, 2016, FCO = Fertilizer Control Order, 1985, amendments in 2009 and 2013. It shall not be used for food crops.

145. **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-à-vis its related 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<sub>2</sub>S monitoring (periodically at pumping stations and lifting stations);

146. **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 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.

147. 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 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; and
- (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**

148. 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.

149. 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, pumping/lifting stations and STP), 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, TNUISL, Government of Tamil Nadu and the ADB.

## **B. Public Consultation**

150. 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**

151. The subproject proposal is formulated by Vellore City Municipal Corporation in consultation with the public representatives in the project area to suit their requirements.

152. Focused 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. The general public and the people residing along the project activity areas were also consulted. A project area level consultation workshop was conducted in Vellore on September 28, 2017, with the public representatives and prominent citizens.

153. It was observed that people were 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 safety, traffic issues, disturbance utilities during construction. Stakeholder suggested that road restoration works to be taken up immediately after laying the sewers to minimize the public inconvenience. Few stakeholders also suggested to ensure meeting treated wastewater disposal standards prior to disposal into Kalinjur lake. 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**

154. 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 (i.e., newspapers, ULB websites). 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**

155. Executive summary of the IEE will be translated in Tamil and made available at the offices of PMU, PIU, and Vellore Corporation 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 Vellore Corporation after approval of the IEE by ADB. Stakeholders will also be made aware of grievance register and redress mechanism.

156. 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.

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

## **VII. GRIEVANCE REDRESS MECHANISM**

158. 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 program management unit (PMU) and Vellore program implementation unit (PIU) will ensure that their grievances are addressed.

159. 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 VCMC 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.

160. 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.

161. 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).

162. 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 VCMC level. In the event that certain grievances cannot be resolved even at VCMC level, particularly in matters related to land purchase/acquisition, payment of compensation, environmental pollution etc., they will be referred to the district level 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.

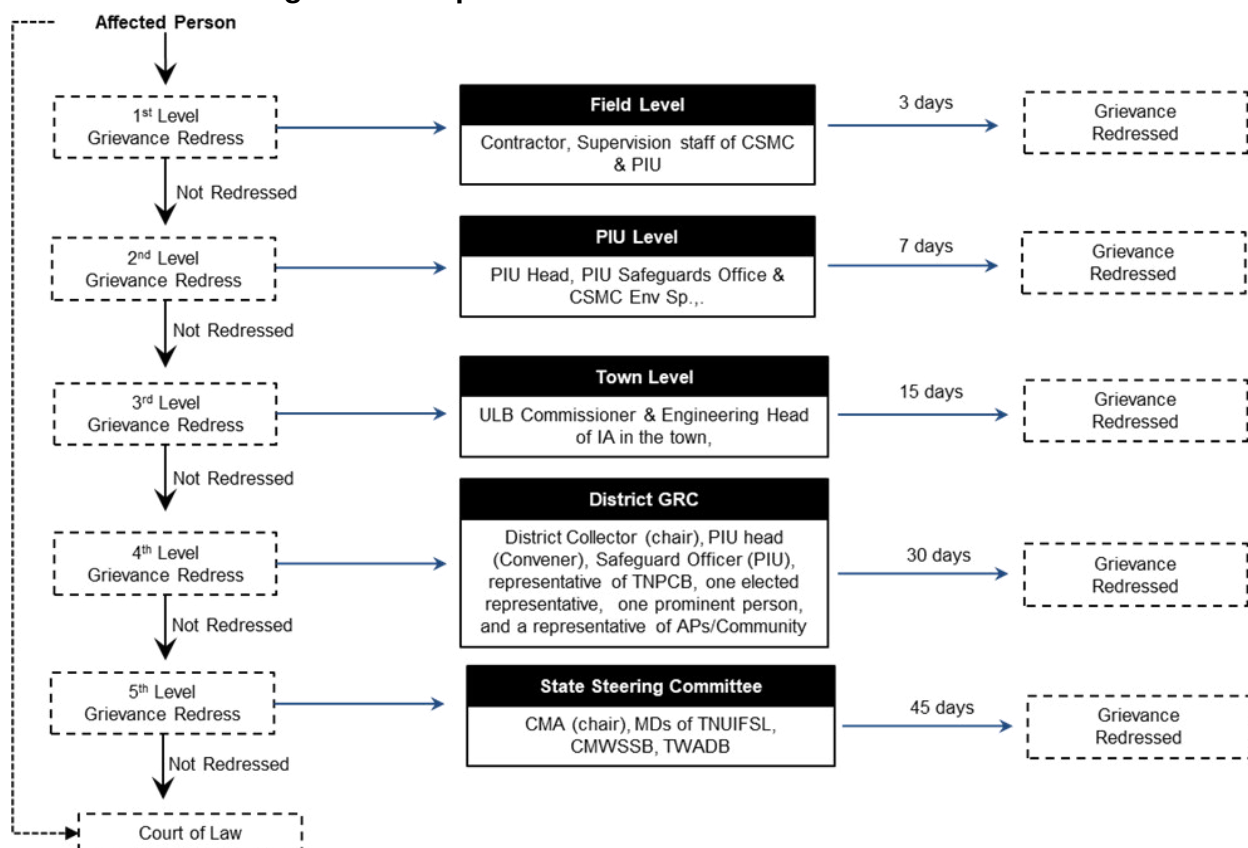
163. GRC will meet every month (if there are pending, registered grievances), determine the merit of each grievance, and resolve grievances within specified time upon receiving the complaint-filing which the grievance will be addressed by the state-level steering committee. The steering committee will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

164. **Composition of Grievance Redress Committee.** 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.

165. **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.

166. **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 steering committee will have jurisdictional authority across the state (i.e., areas of influence of subproject facilities beyond district boundaries, if any).

167. The multitier GRM for the project is outlined below (Figure 16), 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 17: Proposed TNUFIP Grievance Redress Mechanism**

CMA = Commissioner of Municipal Administration, CMSC = construction management and supervision consultant, CMWSSB = Chennai Metropolitan Water Supply and Sewerage Board, GRC = grievance redress committee, PIU = program management unit, TNUIFSL = Tamil Nadu Urban Infrastructure Financial Services Limited, TWADB = Tamil Nadu Water and Drainage Board.

168. **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.

169. **Information dissemination methods of the Grievance Redress Mechanism.** 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.

170. **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.

171. **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.

172. **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.

173. **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**

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

175. The EMP will guide the environmentally-sound construction of the subproject and ensure efficient lines of communication between TNUIFSL, PMU, VCMC, 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.

176. 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.

177. 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.

178. 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.

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



**Table 13: Design Stage Environmental Impacts and Mitigation Measures (Sewage Treatment Plant)**

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
Design of sewage treatment plant (STP)	Deficient treatment due to substandard operation/system malfunction	<ul style="list-style-type: none"> <li>(i) Design the treatment process to meet the applicable discharge standards</li> <li>(i) Ensuring continuous uninterrupted power supply, including a back-up facility (such as generator)</li> <li>(ii) Providing operating manual with all standard operating procedures (SOPs) for operation and maintenance of the facility</li> <li>(iii) Necessary training to urban local body (ULB) staff dealing with STP.</li> <li>(iv) Extended contractor period for operation and maintenance (O&amp;M), proper transfer of facility to ULB with adequate technical know-how on O&amp;M and hands-on training to ULB staff</li> <li>(v) Provision for online monitoring of crucial wastewater quality parameters at the inlet and outlet of the plant (biochemical oxygen demand or BOD, potential of Hydrogen or pH, ammonia etc.)</li> </ul>	Design-build (DB) Contractor and program implementation unit (PIU)	Project cost - DB Contractor
STP treatment efficiency	Change of inlet sewage parameters and deficient treatment quality	<ul style="list-style-type: none"> <li>(i) No industrial wastewater shall be allowed to dispose into municipal sewers</li> <li>(ii) No domestic wastewater from industrial units shall be allowed into municipal sewers</li> <li>(iii) Ensure that there is no illegal discharge through manholes or inspection chambers</li> <li>(iv) Conduct public awareness programs; in coordination with Tamil Nadu Pollution Control Board (TNPCB)</li> <li>(v) Conduct regular wastewater quality monitoring (at inlet and at outlet of STP) to ensure that the treated effluent quality complies with the applicable standards</li> </ul>	PIU/VCMC	PIU Costs
Discharge of treated wastewater into Pandiyan channel	Channel capacity adequacy and water quality impacts	<ul style="list-style-type: none"> <li>(i) Conduct a detailed baseline assessment of receiving water body capacity considering worst case scenario – highest rainfall, overflow of Kalinjur lake, and including extreme weather events like intense rainfall etc.,</li> <li>(ii) Conduct detailed water quality assessment of receiving water bodies (Pandiyan channel and also of Palar river at Pandiyan channel discharge point including a control point on upstream)</li> <li>(iii) Monitor water quality periodically during operation phase as per the environmental monitoring plan; Obtain TNPCB consent for disposal of treated wastewater into Pandiyan channel</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
	Odour nuisance	<ul style="list-style-type: none"> <li>(i) Develop the STP layout plan within the identified such that maximum buffer space be provided towards the houses in the north; in the layout develop, office or other such facilities towards to houses, so that they will act as buffer</li> <li>(ii) Providing a green buffer zone of 15-20 meters (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.</li> <li>(iii) provide odor control/treatment system</li> <li>(iv) Dewatering units shall be located in enclosed building vented to odor control unit, and health and safety precaution shall be put in place H<sub>2</sub>S build up.</li> <li>(v) Locate sludge drying beds maintaining maximum distance from the residential areas in the north</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor
	Sludge disposal	<ul style="list-style-type: none"> <li>(i) Prepare sludge management plan (collection, treatment, drying, disposal and periodic testing) and integrate into design, construction and operation</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor
	Noise	<ul style="list-style-type: none"> <li>(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</li> <li>(ii) Use appropriate building materials and construction techniques for pump houses which can absorb sound rather than reflect noise</li> <li>(iii) Use acoustic enclosures – manufacturer specified, for all pumps, motors</li> <li>(iv) Procure only CPCB approved generators with low emission and low noise fitted with acoustic enclosures</li> <li>(v) Provide sound mufflers for ventilators in the plant rooms; and sound proof doors</li> <li>(vi) Provide ear plugs to workers</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor
STP	Energy consumption	<ul style="list-style-type: none"> <li>(i) Using low-noise and energy efficient pumping systems</li> <li>(ii) Efficient Pumping system operation</li> <li>(iii) Installation of Variable Frequency Drives (VFDs)</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor
STP	Tree cutting	<ul style="list-style-type: none"> <li>(i) Minimize removal of trees by adopting to site condition and with appropriate layout design/alignment</li> <li>(ii) Obtain prior permission for tree cutting</li> <li>(iii) Plant and maintain ten trees for each tree that is removed</li> </ul>	DB Contractor and PIU	Project cost - DB Contractor

**Table 14: Design Stage Environmental Impacts and Mitigation Measures (Sewer network including SPS and LS)**

<b>Field</b>	<b>Anticipated Impact</b>	<b>Mitigation Measures</b>	<b>Responsibility of Mitigation</b>	<b>Cost and Source of Funds</b>
Sewer network	Nuisance due to leaks, overflows, contamination of water supplies, occupation health and safety of workers, etc.	<ul style="list-style-type: none"> <li>(i) Limit the sewer depth where possible</li> <li>(ii) Sewers shall be laid away from water supply lines and drains (at least 1 meter or m); if not possible, sewer lines shall be laid below the water lines</li> <li>(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 millimeters or mm)</li> <li>(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)</li> <li>(v) For shallower sewers and especially in narrow roads, use small inspection chambers in lieu of manholes;</li> <li>(vi) Design manhole covers to withstand anticipated loads and ensure that the covers can be readily replaced if broken to minimize silt/garbage entry</li> <li>(vii) Ensure sufficient hydraulic capacity to accommodate peak flows and adequate slope in gravity mains to prevent buildup of solids and hydrogen sulfide generation</li> </ul>	Program implementation unit (PIU)	PIU costs
Sewage lifting and pumping stations	Odor nuisance	<p><b>Site layout planning</b></p> <ul style="list-style-type: none"> <li>(i) Siting of wells within the identified site at an internal location as far as possible from adjoining residential buildings</li> <li>(ii) Develop green buffer zone around the facilities 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</li> <li>(iii) Provision of high compound wall</li> </ul> <p><b>Design measures</b></p> <ul style="list-style-type: none"> <li>(i) Proposed wells to be closed using reinforced concrete cement (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.</li> <li>(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.</li> </ul>	PIU	PIU costs

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		<p>(iii) Since human intervention is involved and safety shall be primary and critical consideration, additional protection by way of a metaled 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&amp;M purposes.</p> <p>(iv) 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.</p> <p>(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.</p> <p>(vi) 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.</p> <p>(vii) 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.</p> <p>(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.</p> <p>(x) Develop standard operating procedures / operational manual for operation and maintenance of lifting and pump stations; this shall include measures for emerge situations</p> <p>(xi) Provide training to the staff in SOPs and emergency procedures</p>		
	Sewage pumping and lifting stations located close to houses	(i) For sewage pumping stations SPS 3, SPS 4, SPS 6 and SPS 7, which are located adjacent to houses (within 50 m), a suitable arrangement so as to capture the gaseous emissions from the wells and treat via scrubber/activated carbon filter before letting out into	PIU	PIU costs

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		the ambient air; such system should be designed appropriately to meet the likely emissions/flow rate of respective pumping stations (ii) For lifting stations, the above arrangement should be provided as per site requirement.		
	Noise	(i) Procure good quality latest technology high pressure pumps that guarantee controlled noise at a level of around 80dB(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	PIU	PIU costs
Sewerage system	Energy consumption	(i) Using low-noise and energy efficient pumping systems (ii) Efficient Pumping system operation (iii) Installation of Variable Frequency Drives (VFDs)	PIU	PIU costs
	Tree cutting	(i) Minimize removal of trees by adopting to site condition and with appropriate layout design/alignment (ii) Integrate mature neem tree at SPS seven into the layout plan to avoid tree removal (ii) Obtain prior permission for tree cutting (iii) Plant and maintain 10 trees for each tree that is removed	PIU	PIU costs
Location of project components near ASI monument	Potential damage/disruption	(i) 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 (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 monument (within the regulated area of 300 m) shall be finalized in consultation with ASI; dust control measures shall be put in place (iv) Construction contractors to follow these measures in conducting any excavation work	PIU	PIU costs

Field	Anticipated Impact	Mitigation Measures	Responsibility of Mitigation	Cost and Source of Funds
		(v) 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; (vi) Inform local ASI office if a find is suspected, and taking any action they require to ensure its removal or protection in situ.		

**Table 15: Pre-Construction Stage Environmental Impacts and Mitigation Measures (Applicable for All Components)**

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
Submission of updated environmental management plan (EMP)/site environmental plan (SEP); EMP implementation and reporting	Unsatisfactory compliance to EMP	(i) Appoint environmental, health and safety (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 costs
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 program implementation unit (PIU)	PIU costs
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.	Contractor to finalize locations in consultation and approval of PIU	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
		(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 consent from landowners (not lessees) will be obtained; (b) debris disposal site shall be at least 200 meters (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	PIU costs
Consents, permits, clearances, no objection certificates (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.	CC and PIU	PIU costs for project approvals Contract cost for construction approvals
Chance finds	Damage/disturbance to artifacts	(i) Construction contractors to follow these measures in conducting any excavation work <ul style="list-style-type: none"> <li>Create awareness among the workers, supervisors and engineers about the chance finds during excavation work</li> <li>Stop work immediately to allow further investigation if any finds are suspected;</li> </ul>	CC and PIU	Contractor Costs



Field	Anticipated Impact	Mitigation Measures	Responsible for Implementation	Cost and Source of Funds
		<ul style="list-style-type: none"> <li>Inform State Archaeological Department if a find is suspected, and taking any action they require to ensure its removal or protection in situ.</li> </ul>		
Temporary economic impacts	Disruption to vendors, hawkers on ROW during sewer laying works	(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) No works can be commenced unless 100% shifted in sections ready for implementation.	CC and PIU	Contractor / PIU

**Table 16: Construction Stage Environmental Impacts and Mitigation Measures (applicable for all components)**

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	Project cost / PMU 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.	<b>For all construction works</b> (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	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(vii) Use tarpaulins to cover the loose material (soil, sand, aggregate etc.,) when transported by open trucks;</p> <p>(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.</p> <p>(ix) Clean wheels and undercarriage of haul trucks prior to leaving construction site</p> <p>(x) Ensure that all the construction equipment, machinery are fitted with pollution control devices, which are operating correctly, and have a valid pollution under control (PUC) certificate</p> <p>(xi) no vehicles or plant to be left idling at site generators to be at placed maximum distance from properties</p> <p><b>For sewer works</b></p> <p>(i) Barricade the construction area using hard barricades (of 2 m height) on both sides</p> <p>(ii) Initiate site clearance and excavation work only after barricading of the site is done</p> <p>(iii) Confine all the material, excavated soil, debris, equipment, machinery (excavators, cranes etc.,), to the barricaded area</p> <p>(iv) Limit the stocking of excavated material at the site; remove the excess soil from the site immediately to the designated disposal area</p> <p>(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</p> <p>(vi) In the roads that connect to SPS sites, which need to accommodate two main sewers (income and outgoing main sewers of SPS), plan work so that access to houses is maintained throughout the construction phase; first lay one sewer and close the trench, restore the road, and lay the second sewer;</p>		

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(vii) 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.</p> <p>(viii) 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.</p> <p>(ix) 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.</p> <p>(x) 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.</p>		
Surface water quality	<p>Mobilization of settled silt materials, and chemical contamination from fuels and lubricants during construction can contaminate nearby surface water quality.</p> <p>Ponding of water in the pits / foundation excavations</p>	<p>(i) All earthworks be conducted during the dry season to prevent the problem of soil/silt run-off during rains</p> <p>(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 least 100 m)</p> <p>(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;</p> <p>(iv) Install temporary silt traps, oil traps or sedimentation basins along the drainage leading to the water bodies;</p> <p>(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)</p> <p>(vi) Store fuel, construction chemicals etc., on an impervious floor, also avoid spillage by careful handling; provide spill collection sets for effective spill management</p>	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(vii) Dispose any wastes generated by construction activities in designated sites; (viii) Conduct surface quality inspection according to the Environmental Management Plan (EMP).		
	Pollution of Palar River due to construction of pipe bridge	(i) Schedule and complete the bridge works prior to onset of monsoon, and ensure that works are conducted during low flow time, when the river bed is dry (ii) Works shall be conducted with minimum disturbance to river bed; implement best construction methods to minimize disturbance / consolidation of river bed; as far as possible avoid using heavy equipment mobilization (iii) No labor camps or material storage camps shall be located in or near the river (100 m distance from river shall be maintained) (iv) Ensure no accidental spillage of construction chemicals, fuels, oils etc., by using spill traps / metal basins (v) Ensure that construction site is cleared off of all the material and debris immediately after completion of works (vi) Submit a site clean-up and restoration report to PIU for approval (vii) Conduct environmental monitoring as per the EMP.	Contractor	Contractor costs
	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 costs
Noise Levels and vibration	Increase in noise level due to earth-moving and excavation equipment, and the transportation of equipment, materials, and people	(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 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.	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(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</p> <p>(v) Horns should not be used unless it is necessary to warn other road users or animals of the vehicle's approach;</p> <p>(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.</p> <p><b>Works near the ASI monument</b></p> <p>(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</p> <p>(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</p> <p>(iii) Dust control measures shall be put in place; all work areas to be barricaded and enclosed with dust screens</p> <p>(iv) Conduct air quality and noise monitoring weekly throughout construction phase in the 300 m regulated area</p>		
Landscape and aesthetics – waste generation	Impacts due to excess excavated earth, excess construction materials, and solid waste such as removed concrete, wood, packaging materials, empty containers, spoils, oils, lubricants, and other similar items.	<p>(i) Prepare and implement a Construction Waste Management Plan (refer Appendix 3)</p> <p>(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.,</p> <p>(iii) Avoid stockpiling any excess spoils at the site for long time. Excess excavated soils should be disposed of to approved designated areas immediately</p> <p>(iv) If disposal is required, the site shall be selected preferably from barren, infertile lands; sites should be located away from residential areas, forests, water bodies and any other sensitive land uses</p> <p>(v) Domestic solid wastes should be properly segregated in biodegradable and non-biodegradable for collection and disposal to</p>	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>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</p> <p>(vi) Residual and hazardous wastes such as oils, fuels, and lubricants shall be disposed off via licensed (by TNPCB) third parties;</p> <p>(vii) Prohibit burning of construction and/or domestic waste;</p> <p>(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</p> <p>(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</p>		
Accessibility and traffic disruptions	Traffic problems and conflicts near project locations and haul road	<p><b>Sewer works</b></p> <p>(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)</p> <p>(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</p> <p>(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</p> <p>(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</p> <p>(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</p>	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>in congested areas – immediately removed from site/ or brought to the as and when required</p> <p>(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</p> <p>(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</p> <p>(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.</p> <p>(ix) Inform the affected local population in advance about the work schedule , a week before, and a day before to start of work</p> <p>(x) Plan and execute the work in such a way that the period of disturbance/ loss of access is minimum.</p> <p>(xi) Keep the site free from all unnecessary obstructions;</p> <p>(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</p> <p>(xiii) At work site, public information/caution boards shall be provided including contact for public complaints</p> <p><b>Hauling (material, waste/debris and equipment) activities</b></p> <p>(i) Plan transportation routes so that heavy vehicles do not use narrow local roads, except in the immediate vicinity of delivery sites</p> <p>(ii) Schedule transport and hauling activities during non-peak hours (peak hours 7 to 10 a.m. and 4 to 7 p.m.);</p> <p>(iii) Locate entry and exit points in areas where there is low potential for traffic congestion;</p> <p>(iv) Drive vehicles in a considerate manner</p>		



Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		(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. (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.	Contractor	Contractor costs
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 costs
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 (OHS) Plan, informed by OHS risk assessment seeking to avoid, minimize and mitigate risk, which shall include measures	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>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 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.<sup>a</sup></p> <p>(iii) Ensure that qualified first-aid is provided at all times. Equipped first-aid stations shall be easily accessible throughout the sites;</p> <p>(iv) Secure all installations from unauthorized intrusion and accident risks</p> <p>(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;</p> <p>(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;</p> <p>(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;</p> <p>(viii) Ensure moving equipment is outfitted with audible back-up alarms;</p> <p>(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</p> <p>(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.</p> <p>(xi) Provide supplies of potable drinking water;</p> <p>(xii) Provide clean eating areas where workers are not exposed to hazardous or noxious substances</p>		

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
Community Health and Safety.	Traffic accidents and vehicle collision with pedestrians during material and waste transportation	<ul style="list-style-type: none"> <li>(i) Consult PIU before locating project offices, sheds, and construction plants;</li> <li>(ii) Select a camp site away from residential areas (at least 100 m buffer shall be maintained) or locate the camp site within the existing facilities of City Corporation</li> <li>(iii) Avoid tree cutting for setting up camp facilities</li> <li>(iv) Provide a proper fencing/compound wall for camp sites</li> <li>(v) Camp site shall not be located near ( 100m) water bodies, flood plains flood prone/low lying areas, or any ecologically, socially, archeologically sensitive areas</li> <li>(vi) Separate the workers living areas and material storage areas clearly with a fencing and separate entry and exit</li> <li>(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</li> <li>(viii) Camp shall be provided with proper drainage, there shall not be any water accumulation</li> <li>(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</li> <li>(x) Prohibit employees from cutting of trees for firewood; contractor should provide cooking fuel (cooking gas); fire wood not allowed</li> <li>(xi) Train employees in the storage and handling of materials which can potentially cause soil contamination</li> <li>(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)</li> <li>(xiii) Recover used oil and lubricants and reuse or remove from the site;</li> <li>(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-</li> </ul>	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		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 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	Contractor	Contractor costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>(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)</p> <p>(xiii) Train employees in the storage and handling of materials which can potentially cause soil contamination</p> <p>(xiv) Recover used oil and lubricants and reuse or remove from the site</p> <p>(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</p> <p>(xvi) Remove all wreckage, rubbish, or temporary structures which are no longer required</p> <p>(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</p>		
Post-construction clean-up	Damage due to debris, spoils, excess construction materials	<p>(i) Remove all spoils wreckage, rubbish, or temporary structures (such as buildings, shelters, and latrines) which are no longer required; and</p> <p>(ii) All excavated roads shall be reinstated to original condition.</p> <p>(iii) All disrupted utilities restored</p> <p>(iv) All affected structures rehabilitated/compensated</p> <p>(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.</p> <p>(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.</p> <p>(vii) The contractor must arrange the cancellation of all temporary services.</p> <p>(viii) Request PIU to report in writing that worksites and camps have been vacated and restored to pre-project conditions before acceptance of work.</p>	Contractor	Contractor costs

<sup>a</sup> IFC Sustainability Webinar Series. [World Bank Group Environmental, Health and Safety Guidelines 101](#).

**Table 17: Operation Stage Environmental Impacts and Mitigation Measures**

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
STP operation – malfunction and effect on efficiency	Public health, safety and environmental impacts	(i) Ensure proper knowledge transfer, hands-on training to municipal staff engaged in STP operation has been provided by contractor prior to handover of facility (ii) Ensure continuous uninterrupted power supply (iii) Operate and maintain the facility following standard operating procedures of operational manual (iv) Undertake preventive and periodic maintenance activities as required (v) Maintain the mechanical / electrical parts as per the maintenance plan to avoid any hazards (vi) Conduct periodic training to workers (vii) Ensure that all safety apparatus at STP including personal protection equipment are in good condition all times; and are at easily accessible and identifiable place; periodically check the equipment, and conduct mock drills to deal with emergency situations (viii) Implement sludge management plan at the STP (ix) No wastewater from industrial premises (including domestic wastewater) shall be allowed to dispose into municipal sewers (x) Monitor regularly and ensure that there is no illegal discharge through manholes or inspection chambers; conduct public awareness programs; in coordination with TNPCB (vii) Conduct regular wastewater quality monitoring at inlet and at outlet of STP to ensure that the treated effluent quality complies with the standards (viii) Conduct periodic testing of dried sludge/compost to check presence of heavy metals and confirming stipulated concentrations to use as compost	PIU / VCMC	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-à-vis its related 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 monitoring (periodically at pumping stations and lifting stations);	PIU/VCMC	Operating costs
Operation and maintenance of sewerage system	Blocks, overflows, system malfunction, occupational health and safety	(i) Establish regular maintenance program, including: <ul style="list-style-type: none"> <li>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</li> <li>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</li> </ul>	PIU/VCMC	Operating costs

Field	Anticipated Impact	Mitigation Measures	Responsible for Mitigation	Cost and Source of Funds
		<p>infiltration or exfiltration; and</p> <ul style="list-style-type: none"> <li>• Monitoring of sewer flow to identify potential inflows and outflows</li> <li>• 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);</li> </ul> <p>(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;</p> <p>(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.</p> <p>(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</p> <p>(v) Develop an Emergency Response System for the sewerage system leaks, burst and overflows, etc.</p> <p>(vi) Provide necessary health and safety training to the staff in sewer cleaning and maintenance</p> <p>(vii) Provide all necessary personnel protection equipment</p> <p>(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</p>		



**Table 18: Construction Stage Environmental Monitoring Plan (STP)**

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
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	1 location (STP, at the boundary of the site downwind direction)	PM <sub>10</sub> , PM <sub>2.5</sub> NO <sub>2</sub> , SO <sub>2</sub> , CO	Once before start of construction Quarterly (yearly 4-times) during construction (3 year construction period)	DB Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (13 samples x 5000 per sample = 65,000)
Ambient noise	2 location s (STP, at the boundary of the site downwind direction and nearest properly)	Day time and night time noise levels	Once before start of construction Quarterly (yearly 4-times) during construction (3 year construction period)	DB Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (26 samples x 1500 per sample = 39,000)
Surface water quality	2 sampling locations (- Palar River, upstream and downstream of pipe bridge work site)	pH, Oil and grease, Cl, F, NO <sub>3</sub> , TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalinity	Once before start of construction Half yearly during construction (3 year construction period)	DB Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (14 samples x 4000 per sample = 56,000)
Baseline water quality of receiving water body (Pandiyan Channel)	4 points (1 at outfall discharge point in Pandiyan channel; 1 at discharge location into Palar River, and 2 points in Palar river – upstream and downstream of Pandiyan channel discharge point)	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	Once before start of construction  Twice (Pre monsoon and post monsoon during design phase)	DB Contractor	Cost for implementation of monitoring measures responsibility of DB contractor (12 samples x 8000 per sample = 96,000)
Baseline sediment quality in channel	2 points (1 at STP discharge location, 2 at discharge location into Palar River)	EC, pH, calcium, magnesium, % of total organic matter, Total organic carbon, N,	Once before start of construction	DB Contractor	Cost for implementation of monitoring measures

Monitoring field	Monitoring location	Monitoring parameters	Frequency	Responsibility	Cost and Source of Funds
		P, K, Aluminum, faecal coliform, As, Cu, Cd, Cr, Pb, Fe, Mn, Hg, Zn, Ni.	Once during construction (pre monsoon)		responsibility of DB contractor (4 samples x 10000 per sample = 40,000)

**Table 19: Construction Stage Environmental Monitoring Plan (Sewer network including SPS and LS)**

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
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	4 locations (4 monitoring locations 50 m downwind direction near sewer and pumping station work sites in the city, one location must be near the Fort);	<ul style="list-style-type: none"> <li>PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO</li> </ul>	Once before start of construction Quarterly (yearly 4-times) during construction (3 year period considered)	Contractor	Cost for implementation of monitoring measures responsibility of contractor (52 samples x 5000 per sample = 260,000)
	1 location at Vellore Fort	<ul style="list-style-type: none"> <li>PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO</li> </ul>	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 5000 per sample = 60,000)
Ambient noise	4 locations (4 monitoring locations 50 m downwind direction near sewer and pumping station work sites in the city, one location must be near the Fort);	<ul style="list-style-type: none"> <li>Day time and night time noise levels</li> </ul>	Once before start of construction Quarterly (yearly 4-times) during construction (3 year period considered)	Contractor	Cost for implementation of monitoring measures responsibility of contractor (52 samples x 1500 per sample = 78,000)
	1 location at Erubeeshwarar temple	<ul style="list-style-type: none"> <li>Day time and night time noise levels</li> </ul>	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 1500 per sample = 18,000)
Surface water quality	3 sampling locations (1 - Palar River, downstream work sites, 2 – Velavadi Tank, 3- sample from fort moat)	pH, Oil and grease, cast iron, F, NO <sub>3</sub> , TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalinity	Once before start of construction Half yearly during construction (3 year construction period considered)	Contractor	Cost for implementation of monitoring measures responsibility of contractor (21 samples x 4000 per sample = 84,000)

**Table 20: Operation Stage Environmental Monitoring Plan (STP)**

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
Monitoring of treated wastewater quality from sewage treatment plant (STP)	Inlet and outlet of STP, and within the treatment process	Parameters as specified by Tamil Nadu Pollution Control Board (TNPCB) in the consent. Concentration of various parameters in treated wastewater shall be within the specific limits as per the discharge standards for STP.	Daily	Vellore City Municipal Corporation (VCMC)	VCMC Operating Cost
Water quality of receiving channel	4 points (1 at outfall discharge point in Pandiyan channel; 1 at discharge location into Palar River, and 2 points in Palar river – upstream and downstream of Pandiyan channel discharge point)	pH, Cl, F, NO <sub>3</sub> , TC, FC, Hardness, Turbidity BOD, COD, DO, Total Alkalinity, coliform  heavy metals and pesticides	Monthly once during operation  Yearly twice (pre & post monsoon)	VCMC	O&M costs (water quality will be tested at the internal laboratory part of STP)
Water quality of overflow water	At just upstream of irrigation water abstraction point	Nematode (should be less than one viable nematode egg per liter) Faecal coliforms (less than 1000 faecal coliforms per 100 ml).	Monthly once during operation	VCMC	O&M costs (water quality will be tested at the internal laboratory part of STP)
Odor monitoring at STP	2 points (downwind direction) with in STP and at nearest house	Hydrogen sulphide (H <sub>2</sub> S)	Half yearly (yearly twice) and as and when based on public complaints	VCMC	O&M Costs

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
			(throughout the operation phase)		
Ambient noise	two locations (STP, at the boundary of the site downwind direction and nearest properly)	Day time and night time noise levels	Monthly once during operation	VCMC	O&M Costs
Sludge quality and suitability as manure	STP	Analysis for concentration of heavy metals and confirm that value are within the limits specified in the SWM rules.	Start of operation and Yearly once	VCMC	O&M costs (testing to be done at an accredited external laboratory)

**Table 21: Operation Stage Environmental Monitoring Plan (Sewer network including SPS and LS)**

Monitoring Field	Monitoring Location	Monitoring Parameters	Frequency	Responsibility	Cost and Source of Funds
Odor monitoring at pumping stations	three points (downwind direction) at all pumping stations: near inlet/suction well; outside the pumping station and at nearest house	Hydrogen sulphide (H <sub>2</sub> S)	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	VCMC	O&M Costs
	one point (at each SPS (downwind direction) at the boundary wall of the pumping stations	H <sub>2</sub> S	Periodically	VCMC	O&M Costs
Odor monitoring at lifting stations	three points (downwind direction) at all lifting stations: near inlet/suction well; outside the pumping station and at nearest house	H <sub>2</sub> S in ambient air	Half yearly (yearly twice) and as and when based on public complaints (throughout the operation phase)	VCMC	O&M Costs
	one point at each lift station (downwind direction) at the boundary wall of the pumping stations	H <sub>2</sub> S in ambient air	Periodically.	VCMC	O&M Costs

## B. Implementation Arrangements

180. 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.

181. The implementing agency for this subproject is Vellore City Municipal Corporation (VCMC). A program implementation unit (PIU) will be established in VCMC headed by full-time a Project Manager (a senior official of VCMC) and comprising dedicated full-time staff from engineering and other departments of VCMC. PIU under the VCMC 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.

182. **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 Officers 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 SO will be mainly to coordination, overseeing the implementation of safeguard tasks, grievance redress and reporting.

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

### 184. Detailed Project Report 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.

185. **Construction stage.**

- (i) Prior to start of construction:
  - Ensure that all necessary clearances/permissions/licences, including that of contractor's are in place prior to start of construction;
  - 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; and
- (v) Oversee site closures to ensure that all work/facility sites are restored properly prior to issuing work completion certificate to the contractor.

186. **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 STP from TNPCB.

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

188. **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) Labour 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, including consent to establish (CTE) from TNPCB for STP prior to invitation of bids and/or prior to award of contract as appropriate.

189. **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) 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;
- (iii) Ensure contractor compliance with staff resources as per the IEE/EMP/Bid;
- (iv) Guide contractor on updating EMP/preparing site environmental plan at the start of the project;
- (v) Update IEE and EMP; ensure that IEE reflects the final design being implemented by contractor;
- (vi) Conduct public consultation and information disclosure as necessary
- (vii) Take necessary action for obtaining rights of way;
- (viii) Supervise day-to-day EMP implementation on site by contractor, including the environmental monitoring plan;
- (ix) Supervise ambient environmental monitoring by contractors;
- (x) Take corrective actions when necessary to ensure no environmental impacts
- (xi) Submit quarterly environmental monitoring reports to PMU;
- (xii) Conduct continuous public consultation and awareness;
- (xiii) Address any grievances brought about through the grievance redress mechanism in a timely manner as per the EMP;
- (xiv) 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;
- (xv) Implement corrective or preventative actions in case of non-compliance or new/unanticipated impacts;
- (xvi) 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;
- (xvii) 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;
- (xviii) Review and approve monthly progress reports submitted by Contractor on EMP compliance;
- (xix) Prepare quarterly environmental monitoring reports and submit to PMU/TNUIFSL
- (xx) Provide any assistance in environmental safeguard related tasks as required by PMU to ensure compliance and reporting to ADB.

**190. Operation stage.**

- (ii) Obtain all clearances as required for operation of project prior to operation, such as consent to operate (CTO) for STP from TNPCB; and
- (iii) Conduct environmental management and monitoring activities as per the EMP.

**191. Contractor's Responsibilities:**

**192. Bidding stage.**

- (i) Understand the EMP requirements and allocate necessary resources (budget, staff, etc.); and

- (ii) Understand the regulatory compliance requirements related to labour welfare, safety, environment etc.

### 193. 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 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 traffic management 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; and
- (xiii) Comply with applicable government rules and regulations.

### C. Training Needs

194. 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 22: 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, occupational health and safety (OHS), etc. - Incorporation of environmental management plan (EMP) into the project design and	All staff and consultants involved in the project  At program management unit (PMU) (combined program for all program implementation unit or PIU)	-	Included in the overall program cost



Description	Target Participants and Venue	Estimate (₹)	Cost and Source of Funds
contracts - Monitoring, reporting and corrective action planning			
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 CSMC 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)	-	Contractors' EHS officer to conduct program, with guidance of CMSC

#### D. Monitoring and Reporting

195. 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.

196. 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. Quarterly 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.

197. Based on PIU quarterly monitoring reports and oversight visits to subproject work sites, PMU will submit semi-annual environmental monitoring report (SEMR). Once concurrence from the ADB is received the report will be disclosed on TNUIFSL, PMU and VCMC websites.

198. 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

199. 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 23: Cost Estimates to Implement the Environmental Management Plan**

	Particulars	Stages	Unit	Total Number	Rate (₹)	Cost (₹)	Costs Covered By
<b>A.</b>	<b>Implementation staff</b>						
1	Environmental, health and safety (EHS) Supervisor	Construction	per month	36	35,000	1,260,000	Civil work contract
	<b>Subtotal (A)</b>					<b>1,260,000</b>	
<b>B.</b>	<b>Mitigation Measures</b>						
1	Providing gas capture and treatment system at sewage treatment plant (STP), selected pumping and lifting stations	Design	Lump sum provision	-	-	5,000,000	Provisional sums of contract (PIU)
2	Consent for establishments and consent for operation from Tamil Nadu Pollution Control Board (TNPCB)	Pre construction	Lump sum			200,000	Project costs (PIU)
3	Provision for tree cutting and compensatory plantation measures (1:10 ratio replantation)	Construction	Per tree	100	1,000	100,000	Project costs (PIU)
4	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	-	-	250,000	Civil works contract
5	Safety barricading	Construction	Lump sum	Lump sum		2,000,000	Civil works contract
	<b>Subtotal (B)</b>					<b>7,520,000</b>	
<b>C.</b>	<b>Monitoring Measures</b>						
1	Air quality monitoring	Construction	per sample	77	5,000	385,000	
2	Noise levels monitoring	Construction	Per sample	90	1,500	135,000	
3	Surface water monitoring	Construction	Per sample	35	4,000	140,000	
4	Baseline water quality of Pandiyan Channel/Palar River	Design	Per sample	12	8000	96,000	
5	Channel sediment quality	Design	Per sample	4	10000	40,000	
	<b>Subtotal (C)</b>					<b>826,000</b>	
<b>D.</b>	<b>Capacity Building</b>						
1.	Training on environmental management plan (EMP) implementation	Pre-construction				-	Part of PIU and PMU ,

	Particulars	Stages	Unit	Total Number	Rate (₹)	Cost (₹)	Costs Covered By
							consultant tasks
2.	Contractors Orientation to Workers on EMP implementation	Prior to dispatch to worksite				-	Civil works contractor cost
	<b>Subtotal (D)</b>						
	<b>Total (A+B+C+D)</b>				₹	<b>9,606,000</b>	

Contractor Cost -4,306,000

PIU Cost -5,300,000

## IX. CONCLUSION AND RECOMMENDATIONS

200. The process described in this document has assessed the environmental impacts of all elements of the proposed underground sewerage subproject in Zones 3, 4, 5, 6 and 7 of Vellore City Municipal Corporation. 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: providing safe disposal of treated wastewater; efficient treatment to meet disposal standards, 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 sewage treatment plant.

201. Vellore is an historical city, and there are three nationally important (ASI protected) monuments in the city. Vellore Fort, located in the center of the city, and temple and a mosque located inside the Fort are the protected monument. Although there are no components located in the monument area, there are residential areas developed around the Fort (especially in the north) within its regulated zone (300 m), and provision of sewer system in these areas will require permission of NMA. Permission will also entail ASI's scrutiny of proposals to ensure that there is no risk of damage to the protected monument due to proposed works. Any recommendations of ASI will be included in the project implementation. Besides sewer lines, a sewage pumping main and a sewage pumping station is also proposed within the regulated zone. It will be ensured that these components will be implemented obtaining ASI permission prior to construction.

202. Palar River flows through the municipal corporation area dividing it into two parts. The subproject area, comprising zones 3 to 7, is situated on the southern side of the river. Proposed STP site is selected on the northern side of the river and treated wastewater from STP is proposed for disposal into a Pandiyan channel which is used for irrigation purposes. Since the STP is proposed under design-build contract, at present, the treatment and disposal system design is preliminary. The proposed discharge into channel will be studied in detail by establishing baseline

water quality and hydrology, and necessary measures will be included during the detailed design for water quality, safety, stability, inundation and erosion risk.

203. The site selected for STP is located on the banks of River Palar, next to a solid waste segregation facility of VCMC. Land is owned by VCMC, and the site is covered three sides by vacant and agricultural lands and river, and while the city development is in the north of the site. Nearest house is located at about 50 m from the site boundary. Considering the current and future development, various measures are included in the subproject design, including: design of a compact, superior process with low odor potential; sensitive layout design by maintaining adequate distance from the boundary, so that STP is inside the campus with a tree cover around, etc.,. All the lifting and pumping station sites 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.

204. 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, most of the sites identified are close to the houses. 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. Odor monitoring is proposed at pumping and lifting stations periodically.

205. STP malfunction or decrease in treatment efficiency will have adverse impacts. This will result in release of untreated or partially treated wastewater that will pollute the receiving water body, and may cause public health issues. Besides measures to select an efficient treatment process to treat sewage to disposal standards of MOEFCC, various measures are included in the design and operation phase to ensure that sewage system is operated and maintained with designed efficiency. Proper sludge management system to collect, treat and dispose safely will be developed and followed. Periodic monitoring of dried sludge to check suitability as a manure is suggested.

206. 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. 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.

207. 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

operation and maintenance manual and standard operating procedures to be developed for all the activities.

208. 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), sludge and odor at pumping stations. Mitigation and monitoring measures, along with the project agency responsible for such actions, form part of the Environmental Management Plan.

180. 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, VCMC 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. 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.

209. 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 EMP/ 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.

210. The citizens of Vellore 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 over-all 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.

211. 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 establish (CTE) and consent to operate (CTO) from Tamil Nadu Pollution Control Board. CTE will be obtained prior to construction, as the detailed design of STP will be undertaken by contractor. However, VCMC shall contact TNPCB, and obtained in principle approval for disposal into Pandiyan Channel. For the project components located within the regulated zone of protected monument (Vellore Fort), prior permission of ASI will be required. ASI permission shall be obtained prior to construction. STP is proposed under design-build contract modality, and therefore various suggested measures will be included during the detailed design.

212. This IEE shall be updated by PIU during the implementation phase to reflect any changes, amendments and will be reviewed and approved by PMU.

## 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 – Underground Sewerage Subproject in Zone 3, 4, 5, 6 and 7 of Vellore City Municipal Corporation

Sector Division: Urban Development

Screening Questions	Yes/No	Remarks
A. Project Siting Is the project area...		
Densely populated?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Subproject activities are located in Vellore City, some parts of which are densely populated. However, the core city area, which is highly dense, is not part of the project area. Newly developing residential areas have low density and well planned layouts. Agriculture is still practiced in the outer areas.
Heavy with development activities?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	It is a developing area; urban expansion is considerable
Adjacent to or within any environmentally sensitive areas?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Cultural heritage site	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Vellore is an historical city, and there are three nationally important (ASI protected) monuments in the city. Vellore Fort, located in the center of the city, and temple and a mosque located inside the Fort are the protected monument. No components are proposed in the monument. However, some components are located within 300 m regulated boundary of monument, therefore permission from the competent authority (NMA) will be required.
Protected Area	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Wetland	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Mangrove	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Estuarine	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Buffer zone of protected area	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	-
Special area for protecting biodiversity	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-
Bay	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	-

Screening Questions	Yes/No	Remarks
B. Potential Environmental Impacts Will the Project cause...		
Sewerage		
impairment of historical/cultural monuments/areas and loss/damage to these sites?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	No impairment envisaged as no components are located in the monument. The components which are located within 300 m will be implemented with prior ASI permission and duly implementing any recommendations of ASI. Therefore no impairment envisaged.
interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Few sewage lifting and pump stations are located close to the houses, and odor may create nuisance. Necessary measures are included to prevent and control odor; no net negative impacts envisaged
dislocation or involuntary resettlement of people?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Do not involve land acquisition or resettlement
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Adequate capacity sewage treatment facility is being development under this subproject; proper treatment process, regular monitoring is part of the project, so no degradation of water quality envisaged
overflows and flooding of neighboring properties with raw sewage?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Proper sludge collection, treatment and disposal process is part of STP; sewerage system caters only domestic sewage; no industrial effluent is allowed into sewers
noise and vibration due to blasting and other civil works?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Due to technical constraints and land availability, some 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Complete road blocks 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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

Screening Questions	Yes/No	Remarks
		will be temporary and will be controlled with proper measures.
traffic disturbances due to construction material transport and wastes?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	The STP design include adequate sludge treatment facilities
contamination of surface and ground waters due to sludge disposal on land?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	The STP design include adequate sludge treatment facilities and the dried sludge will be utilized as manure
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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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)?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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	Yes	No	Remarks
The following questions are not for environmental categorization. They are included in this checklist to help identify potential climate and disaster risks.			
Is the Project area subject to hazards such as earthquakes, floods, landslides, tropical cyclone winds, storm surges, tsunamis or volcanic eruptions and climate changes?	√		Moderate earth quake risk zone (Zone III)
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		√	No



marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?			
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

## **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 at 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 Act, 1951 - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- (v) Contract Labor (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.

## **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, (e) 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 1: PUBLIC INFORMATION NOTICE TEMPLATE**

**Public Announcement  
Providing Underground Sewerage System in Vellore City  
Vellore City Municipal Corporation**

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

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.

**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:	

## **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 TMP**

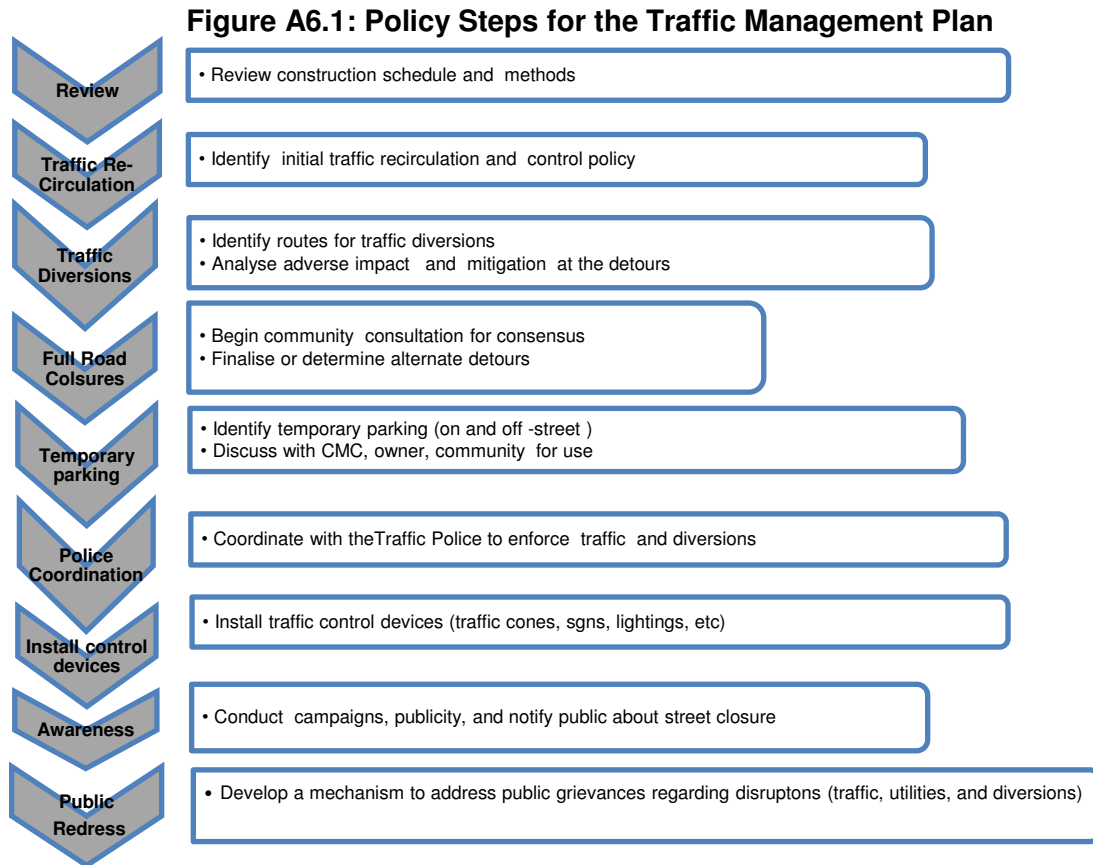
2. The following principles will help promote safe and efficient movement for all road users (motorists, bicyclists, and pedestrians, including persons with disabilities) through and around work zones while reasonably protecting workers and equipment.
  - (i) Make traffic safety and temporary traffic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



#### **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 centres. 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:

- Signs
- Pavement Markings
- Channelizing Devices
- Arrow Panels
- 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:

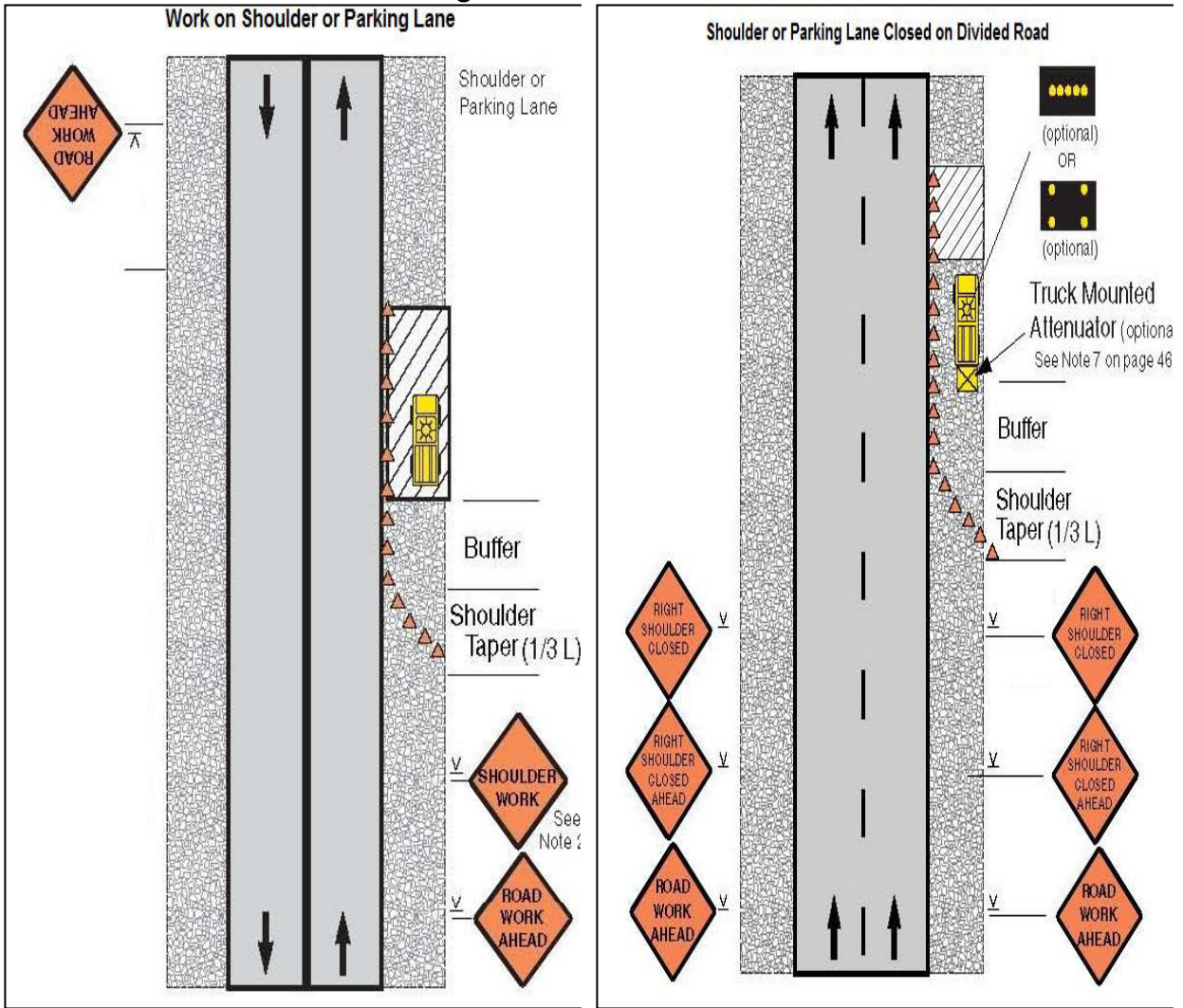
- Work on shoulder or parking lane
- Shoulder or parking lane closed on divided road
- Work in Travel lane
- Lane closure on road with low volume
- Street closure with detour

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.

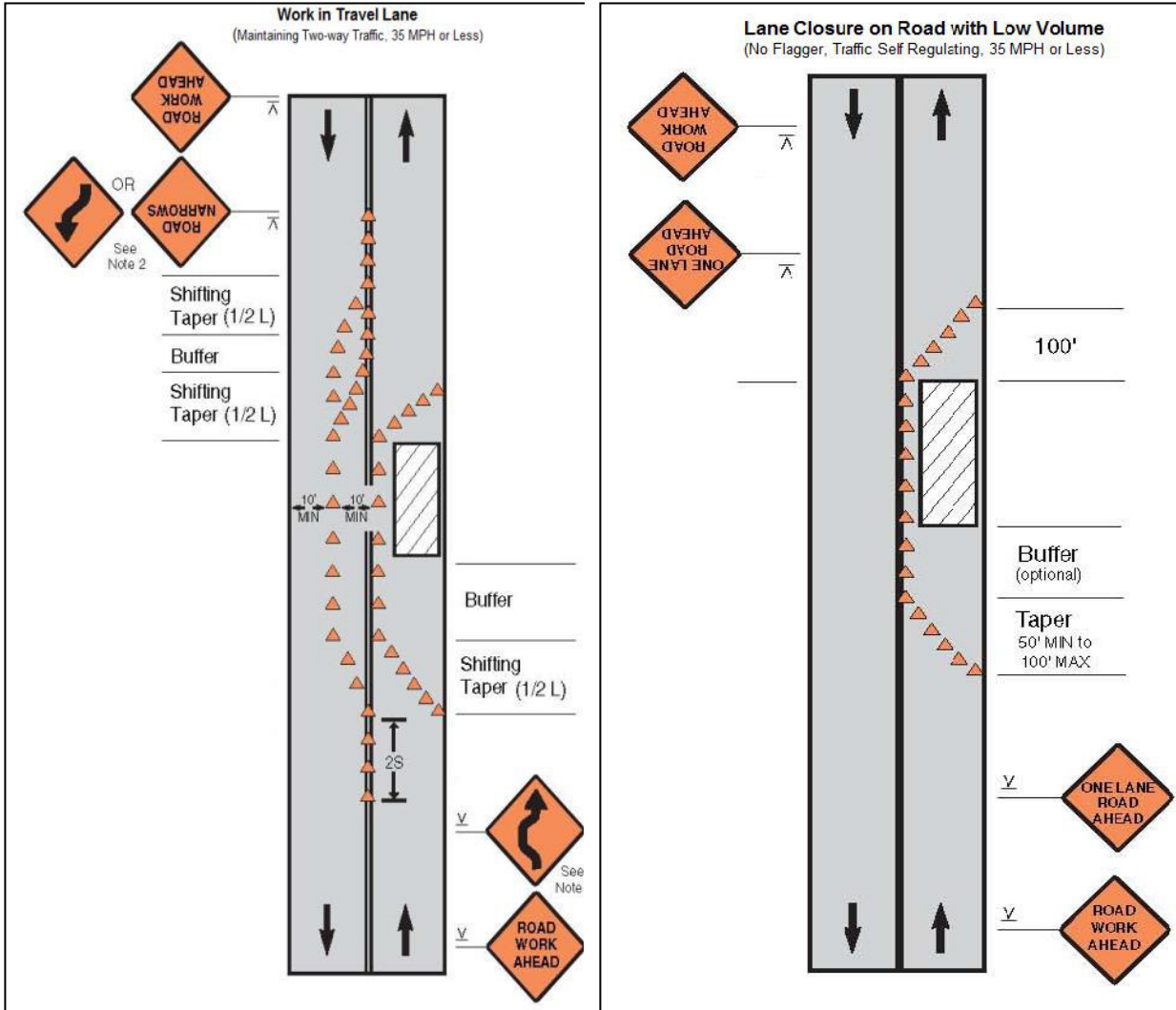
14. Traffic police should regulate traffic away from the work zone and enforce the traffic diversion result from full street closure in certain areas during construction. Flaggers/ personnel should be equipped with reflective jackets at all times and have traffic control batons (preferably the LED type)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

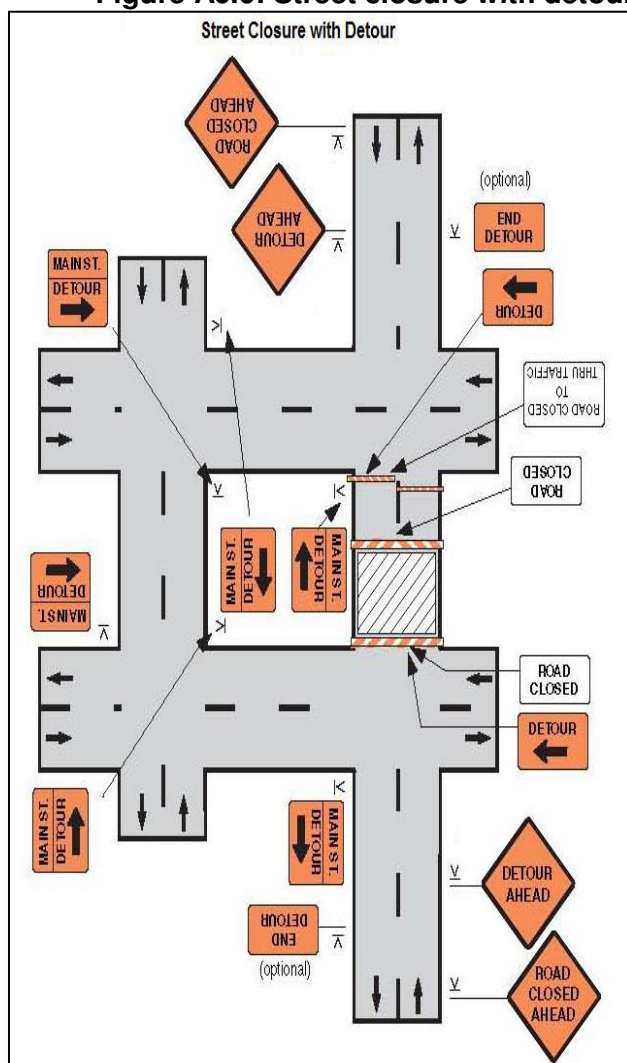
**Figure A6.2 and A6.3: Work on Shoulder or Parking Lane and Shoulder or Parking Lane Closed on Divided Road**



**Figure A6.4 and A6.5: Work in Travel Lane and Lane Closure on Road with Low Volume**



**Figure A6.6: Street closure with detour**



## 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
<b>Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)</b>	
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	
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**  
**Position**

\_\_\_\_\_  
**Name**  
**Position**

## SAMPLE SEMI-ANNUAL ENVIRONMENTAL MONITORING REPORT TEMPLATE

## I. 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 subproject progress and status
- Description of subprojects (package-wise) and status of implementation (preliminary, detailed design, on-going construction, completed, and/or O&M stage)

[illegible]

<sup>a</sup> If on-going construction, include % physical progress and expected date of completion.

Compliance status with National/State/Local statutory environmental requirements

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




<sup>a</sup> All statutory clearance/s, no-objection certificates, permit/s, etc. should be obtained prior to award of contract/s. Attach as appendix all clearance obtained during the reporting period. If already reported, specify in the "remarks" column.

<sup>b</sup> Specify (environmental clearance? Permit/consent to establish? Forest clearance? Etc.).

<sup>c</sup> Specify if obtained, submitted and awaiting approval, application not yet submitted.

<sup>d</sup> Example: Environmental Clearance requires ambient air quality monitoring, Forest Clearance/Tree-cutting Permit requires 2 trees for every tree, etc.

## II. Compliance Status with Environmental Loan Covenants

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

## III. 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.
- 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)**

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
<b>Design Phase</b>						
<b>Pre-Construction Phase</b>						
<b>Construction Phase</b>						
<b>Operational Phase</b>						

<sup>a</sup> 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

## IV. Approach and methodology for environmental monitoring of the project

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

## V. 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 $\mu\text{S/cm}$	BOD mg/L	TSS mg/L	TN mg/L	TP mg/L

### Noise Quality Results

Site No.	Date of Testing	Site Location	LA <sub>eq</sub> (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LA <sub>eq</sub> (dBA) (Monitoring Results)	
			Day Time	Night Time

### VI. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

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

### VII. 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 \_\_\_\_\_  
 Position \_\_\_\_\_

Name \_\_\_\_\_  
 Position \_\_\_\_\_

## STAKEHOLDER CONSULTATION

Conducted in Vellore on 28-Sep-2017 by VCMC

The administrative sanction has given by Principal Secretary for Municipal Administration and water supply (MC.6) Department vide GO (2D) No 52 date : 17.08.2107 to ULB for Underground sewerage scheme for Vellore Corporation – Phase –II – Scheme No : Estimate cost **Rs. 343.69** with following funding pattern:

<b>Sanctioned Project Cost</b>	<b>Rs. 343.69 Crore</b>
GOI share 50 %	Rs.171.84 Crore
GOTN Share 20 %	Rs. 68.74 Crore
ULB share 30 %	Rs.103.11 Crore
<b>Total</b>	<b>Rs. 343.69 Crore</b>

Under AMRUT scheme, the underground sewerage scheme to Vellore Corporation Phase –II has got Administrative sanction and the technical sanction is under processing. The stakeholders meeting has arranged by the commissioner and the Municipal Engineer, Vellore City Municipal Corporation on 28.9.2017 after 3.00 pm.

During the stakeholder meeting the Commissioner and Municipal Engineer has explained about the Scheme details of area coverage and wards coverage , the location of Sub- Sewage Pumping station (5 nos.), Pumping main routes, Treatment plant locations (50 MLD, at Viruthampattu) and discharge location.

List of stakeholders attended in Meeting: Presentation given by Vellore City Corporation, Vellore

<b>S. No.</b>	<b>Presentation Given by Vellore City Corporation, Vellore</b>
1	Mr. T. Balasubramanian, Municipal Engineer, Vellore City Municipal Corporation, Vellore
	<b>Presentation given by UGSS Consultant</b>
2	Mr. P.M. Saravanan, Senior Design Engineer, Voyants Solutions Pvt. Ltd, Chennai
	<b>Answers given regarding Pumping station locations and land details</b>
3	Mr. M. Kannan, Town Planning Officer, Vellore City Municipal Corporation, Vellore
	<b>List local residents and welfare associations attendees</b>
1	B.P Ravindra Kumar, 41, Thiagarapuram, Vellore-1.
2	R. Anbarasan, 102, Fifty Feet School Road, Sripadmarathy Nagar, Vasanthapuram, Vellore.
3	M.R. Madhavan, 19, First Street, Sripadmavathy Nagar, Vasanthapuram, Vellore
4	B. Kothandapani, 29th Ward, 102, E.S.M Street, Ajosandrapet, Vellore.
5	C. Shanmugam, No. 5/2 A, EB Nagar Phase III, Sathuvachani, Vellore-9.
6	K. kuppusamy, No. 25, EB Nagar Phase III, Sathuvachari, Vellore-9
7	A. Khader, No. 18 P3,SVC
8	S. Vinoth, No.26, EB Nagar Phase III, Sathuvachari, Vellore-9
9	N. Harish, Ward-19, Vallalar, Sathuvachari, Vellore-9.

10	A.M. Saisethuraman, Vellore
11	K. Purushothaman, Vellore
12	A. Kotti, Vellore
13	S. Vijaykumar, Vellore
14	A. Pitchimuthu, Vellore
15	K. Shanmugam, Vellore
16	R. Kothandapani, Vellore
17	S. Sriraghkumar, Vellore
18	N. Elavarasan, Vellore
19	S.A. Subbarayan, Vellore
20	K. Suriya Achare, Sainathapuram, Vellore.
21	CNR. Srinivasan, Vellore.

### Details of Discussion

#### 1. Gothandapani, ex. Member of Council, Engineer Subraian street

S. No.	Questions	Answers
1	Kindly select qualified contractor. The contractor should not give sub-contract.	Both experience-wise and financial-wise qualified contractor only will consider for this works.
2	Definition of sewage? Whether it mean only night soil/toilet or kitchen and both room waste also.	Wastewater from your shower, bathtub, washing machine, dishwasher, kitchen sink and toilet is all considered sewage .it isn't just from the toilet

#### 2. Mr. Kuppusamy, Sankaranpalayam

S. No.	Questions	Answers
1	What is duration of the scheme and when it will start?	The execution period is 3 years and Operation and Maintenance is 5 years.
2	The House service connection, from outlet of building to Compound wall ( inside premises ) has to consider under contract work.	From Phase –II scheme, inside premises pipe line also will be laid under contractor.
3	What is the basis fixing of HSC tariff?	Based on built-up area , the HSC tariff will be fixed.

#### 3. Mr. Surya Achari, Ex. Member of Council , Allapuram

S. No.	Questions	Answers
1	What is the basis fixing of HSC tariff?	Based on built-up area , the HSC tariff will be fixed.
2	The construction quality should be maintained properly.	Corporation arranging Project Management Consultancy for this Phase –II scheme. So Corporation and PMC will closely monitor the quality of the works.
3	Safety measures to be considered while executing the works	While execution, the traffic diversion and safety measures like keeping Barricading system will consider to minimize the disturbance of local residents.
4	The treated sewage should meet the effluent standards.	The appropriate modernize technology is proposed considering techno-economic analysis and meeting out latest effluent standards (CPCB).

#### 4. Mr.Jai Sankar, Ex. Member of Council , Thottapalayam



S. No.	Questions	Answers
1	The stone-ware pipes shall not be used for sewerage scheme.	The stone-ware pipes and RCC pipes are not chosen for this scheme.
2	Manhole cover should be strong.	As per IS code the manhole covers ( Heavy Duty ) quality will be maintained and which will resist the heavy traffic flow also.
3	The quality of pipe line should be double checked.	Including pipeline, manhole cover and other material will be checked in factory test and Third party inspection party also will be arranged for material testing.
4	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.

## 5. CNR. Srinivasan, Vellore

S. No.	Questions	Answers
1	While doing sewerage scheme, the other utilities like potable water supply works, side storm water drain, telephone cables etc.	Before the starting the excavation works , contractor will do trail pit and enquire to local resident about other utilities are passing through road. Accordingly contractor will do the work. Even the utilities got damaged, the contractor will restore the utilities.
2	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.

## 6 C. Shunmugam.EB Nagar,Phase –III, Sathuvacheri

S. No.	Questions	Answers
1	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).

## 7 B.P.Ravindra Kumar

S. No.	Questions	Answers
1	Manholes has to locate in the middle of the road	Yes. Manhole will be located in the middle of the road. From there house service connection will be connected.
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).

## 8. A. Kotti , Nethaji Road ,Shenbakkam ,Vellore

S. No.	Questions	Answers
1	While execution of works, the traffic diversion and safety measures has to considered.	While execution, the traffic diversion and safety measures like keeping Barricading system will consider to minimize the disturbance of local residents.

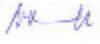
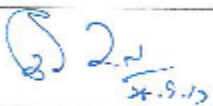


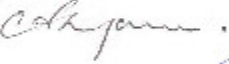



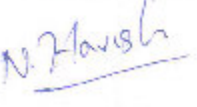
### Consultation Workshop Photographs



## வேலூர் மாநகராட்சி

பாதாள சாக்கடை திட்டம் பகுதி-2 சத்துவாச்சாரி, கொணவட்டம்,  
பேண்பாக்கம் ஆகிய பகுதிகளில் செயல்படுத்துதல்

கருத்துரு சட்ட நாள்: 28.09.2017

வ.எண்.	பெயர் / முகவரி	தொலைபேசி எண். / திமெயில்	கையொப்பம்
1	B. P. RAVINDRA KUMAR 41, Thiagarapuram, Vellore	98432 25291 narindra_vls@ yahoo.com	
2	R. ANBARASAN 102, Fifty feet School Sripadma rathay nagar, Varantheapuram, Vellore	90150 22847 anbarasan_rajagopal @s-mail.com	 24.9.17
3	P. R. SPADHARAN 19, Fifty feet Sripadma rathay nagar, Varantheapuram, Vellore	97870 23640	
4	B. KOTHANDAPAN E.M.C. 29th Ward 102 E.S.M. St Ajaynagar, Vellore	9369119417	
5	C. Shanmugam - EX BHEL No 3/2 A, EB Nagar phase III Sathuvachan, Vellore	9443625298	
6	K. Kuppasamy No 25, EB Nagar phase III Sathuvachan, Vellore	9994613679	
7	A. RAJESWAR No 18 P.S. SVC	9894439992	
8	S. Vinodh No. 26, EB Nagar, Phase 3 Sathuvachan, Vellore	8122643602	
9	N. Harish Ward - 19, Vallalar, Sathuvachan, Vellore	9566746425	

வ.எண்.	பெயர் / முகவரி	தொலைபேசி எண். / இமேயில்	கையொப்பம்
10.	A.M.SAISETHURAMAN	9003389662	A.M.S. SETHURAM
11.	K.PURUSHOTHAMAN	9894941490	K. Purushothaman
12.	AKOTTI	9894671083	Akotti
13.	S.VIYAYAKUMAR	9994293840	S.V.
14.	A.Pitchimuttu	9486057045	A. Pitchimuttu
15.	K. Shanmugasundaram	9043068982	K. Shanmugasundaram
16.	R. KOTHANANDARAMAN	9443365599	R. Kothanandaraman
17.	M. Sundaramma	9788028862	M. Sundaramma
18.	S. SURESHKUMAR	9488170004	S. Suresh
19.	N. Elavaraseli	9444622149	N. Elavaraseli
20.	S. a. Subbarayan	9647648992	S. a. Subbarayan

[illegible]



**News Item Related to Consultation Workshop in Tamil Newspaper  
(Dinamalar, dated 1 October 2017)**

பள்ளியில், விஜயதசமியை நடைபெற்றது. அருகில் தாளாளர் வாழ்ந்தார், மேலாளர் தூங்காதேவி.

பணை குடுபிடிக்கத் தொடங்கி உள்ளது. இந்நிலையில் உரிய அனுமதி பெறாமலும், பாதுகாப்பு நடவடிக்கை இன்றியும்

ஹும், பட்டாசு கடைகளில் தீயணைப்பு கருவிகள் உள்ளதா? தண்ணீர், மணல் பக்கெட்டுகள் தயார் நிலையில்

யாளர்கள் மீது கடும் நடவடிக்கை எடுக்கப்படும். இவ்வாறு போலீசார் தெரிவித்தனர்.

ரத்து 652 மேன்ஹோல்கள் மற்றும் 50.00 எம்எஸ்டி கொள்ளளவு கொண்ட சுத்திகரிக்கும் நிலையம் ஆகியவை அமைக்கப்பட உள்ளன.

இதைத்தொடர்ந்து, பகுதி-3ன் கீழ் காட்பாடி, தாரா படவேடு, காந்தி நகர், கழிஞ்சூர், தொரப்பாடி, சித்தேரி மற்றும் சின்ன அல்லாபுரம் பகுதியில் பாதாள சாக்கடைத் திட்டப்பணிகள் மேற்கொள்ள 400.00 கோடி மதிப்பீட்டில் விரைவில் நிர்வாக அனுமதி வழங்கப்படும் நிலையில் உள்ளது.

இதற்கான கருத்துக்கேட்பு கூட்டம், வேலூர் மாநகராட்சி அலுவலகத்தில் கடந்த 28ம் தேதி நடந்தது. இதில், யாராலும் ஆட்சேபனை தெரிவிக்கப்படாமல் கூட்டம் நடந்து முடிந்தது.

## பாதாள சாக்கடை திட்ட 2வது கட்டப்பணிகள் வேலூரில் செயல்படுத்த மக்கள் கருத்துக்கேட்பு

**வேலூர், அக்.1-**

வேலூர் மாநகராட்சியில் பாதாள சாக்கடைத் திட்டம் பகுதி-2, செயல்படுத்துவது தொடர்பாக மக்கள் கருத்துக்கேட்பு கூட்டம் நடந்தது.

வேலூர் மாநகராட்சியின் மொத்த பரப்பளவு 87.915 சதுர கி.மீ. ஆகும். மக்கள்தொகை (2011ம் ஆண்டு கணக்கெடுப்பின்படி) 5 லட்சத்து 4 ஆயிரத்து 79 பேர் ஆகும். மாநகராட்சி நிர்வாக வசதிக்காக 4 மண்டலங்களாக பிரிக்கப்பட்டு, ஒவ்வொரு

மண்டலத்துக்கும் 15 வார்டுகள் வீதம் உள்ளன. தமிழ்நாடு நகர்ப்புற வளர்ச்சி திட்டம் 3, திட்டத்தின் கீழ் பழைய வேலூர் நகராட்சியில் 48 வார்டுகளில் 24 வார்டுகள் (இப்போதைய வேலூர் மாநகராட்சியில் உள்ள 60 வார்டுகளில் 14 வார்டுகள்) பாதாள சாக்கடைத் திட்டப்பணிகள் முடிந்துள்ளது. இதையடுத்து, பாதாள சாக்கடைத் திட்டம் பகுதி-2ன் கீழ் அலமேலுமங்காபுரம், சத்துவாச்சாரி, சேண்பாக்கம், கொணவட்டம், கஸ்பா மற்றும் வேலப்பாடி பகுதிகளில்

பாதாள சாக்கடை திட்டப்பணிகள் மேற்கொள்ள 343.69 கோடி மதிப்பீடு தொகைக்கு அம்சநீர் திட்டம், ஆசிய வளர்ச்சி வங்கி மூலமாக வழங்கப்படும் தொகையை, தமிழ்நாடு நகர்ப்புற உட்கட்டமைப்பு நிதி நிறுவனம் மற்றும் தமிழ்நாடு உட்கட்டமைப்பு நிதி சேவை நிறுவனம் வாயிலாக நிர்வாக அனுமதி பெறப்பட்டு, தொழில்நுட்ப அனுமதி பெறும் நிலையில் உள்ளது.

இதற்காக, 5 கழிவுநீர் உந்து நிலையம், 7 கழிவுநீர் இறைப்பு நிலையம், 8 ஆயி