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Scoping Exercise to Support Sustainable Urban Sanitation in Tamil Nadu

PRIMARY STUDY REPORT

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Abbreviations

ADTP	Assistant Director of Town Panchayats
BMGF	Bill and Melinda Gates Foundation
BSUP	Basic Services for Urban Poor
CMWSSB	Chennai Metro Water Supply and Sewerage Board
CPHEEO	Central Public Health Environmental Engineering Organisation
CRPF	Central Reserve Police Force
CWSS	Combined Water Supply Scheme
DTCP	District Town and Country Planning
EO	Executive Officer
GoTN	Government of Tamil Nadu
IIHS	Indian Institute for Human Settlements
ITI	Industrial Training Institute
LPA	Local Planning Authority
MLD	Million Litres per Day
MoC	Memorandum of Cooperation
MoUD	Ministry of Urban Development
MT	Metric Tonne
NH	National Highway
NUSP	National Urban Sanitation Policy
OD	Open Defecation
OHT	Over Head Tank
PSP	Public Stand Post
PVC	Poly Vinyl Chloride
RCC	Reinforced Cement Concrete
RO	Reverse Osmosis
SC	Scheduled Caste
ST	Scheduled Tribes
STP	Sewage Treatment Plant
SWM	Solid Waste Management
TN	Tamil Nadu
TNCWW	Tamil Nadu Construction Workers Welfare
TP	Town Panchayat
TWAD	Tamil Nadu Water and Drainage (Board)
ULB	Urban Local Body

1 Study Background

1.1 Urban Sanitation in Tamil Nadu

Urban settlements in India are grappling with the challenge of severe deficits along the 'full cycle of sanitation'. Public systems in India have historically hailed sewerage as the sole solution for urban households, but the fact is that nearly two-thirds of urban households depend on on-site sanitation systems, i.e., septic tanks and pit latrines (Census of India, 2011a). Adequate attention needs to be paid to comprehensive management of human excreta, whether sewage or septage, if the deficits of urban sanitation in India are to be addressed. This has been highlighted in India's National Urban Sanitation Policy (NUSP) (MoUD, 2008), the draft advisory and policy on Septage Management issued by the Ministry of Urban Development (MoUD), and in the Septage Management Operative Guidelines issued by the Government of Tamil Nadu (GoTN, 2014a).

Taking due cognisance of the predominance of on-site sanitation systems in the State, the Government of Tamil Nadu (GoTN) committed to improving urban sanitation in mission mode, and issued the operative guidelines for septage management across the State in September, 2014. These guidelines underlined the importance of standardising the design and construction of septic tanks, instituting standard operating procedures for collection and transportation of septage, and implementing possible co-treatment options at the existing under-utilised Sewage Treatment Plants (STP), apart from creating new infrastructure and systems for comprehensive septage management.

The Bill and Melinda Gates Foundation (BMGF) came forward to assist the GoTN in developing and implementing sustainable sanitation solutions for urban Tamil Nadu (TN). The objectives of the Tamil Nadu sanitation mission include elimination of Open Defecation (OD); safe containment, treatment, and safe disposal of human excreta, so that public health, hygiene and dignity can be achieved for urban households and urban areas in the state. The BMGF signed a Memorandum of Cooperation (MoC) with GoTN for the same, in August 2015.

With a view to scope the tasks that need to be carried out under the TN sanitation mission, including identification of the institutional arrangements and capacities required, Indian Institute for Human Settlements (IIHS) was commissioned to carry out a scoping exercise (study). This scoping study comprises a secondary review, supplemented with primary data collection in select urban areas, and the conduct of consultations with identified stakeholders; to understand better the situation of sanitation in the urban areas of the State. The State-level analyses are supplemented with primary studies and consultations in two urban locations in the State—a Town Panchayat (TP) cluster, and a municipality.

This is the report for a primary study conducted in Pammal Municipality and two TPs of Periyanaicken-palayam and Narasimhanaicken-palayam in Coimbatore. It provides a brief profile of these urban locations, with a focus on urban sanitation and water. This study is based primarily on the primary data collection carried out by the IIHS team in 2015, supplemented by secondary sources like the Census of India.

1.2 Project Objectives and Scope of Work

The objectives of the project are:

- Carrying out a situational analysis of urban sanitation in TN.
- Conducting an institutional, financial and legal analysis for sustainable urban sanitation solutions in TN (and two pilot urban areas).
- Landscaping of key stakeholders, supporters, potential partners for the government's efforts and ongoing initiatives on urban sanitation in TN.
- Facilitating engagement with relevant stakeholders, including, but not restricted to, government officials and community groups.
- Facilitating exposure visits to successful examples of FSM in similar contexts.
- Develop recommendations for high level interventions by the Technical Support Unit that is going to be established by the GoTN

Building on the secondary study, primary study was carried out in the selected two locations to gain an in-depth understanding of the current arrangements and practices for the full-chain of sanitation—ranging from design and construction practices of on-site sanitation systems to septage collection and waste disposal. This included in-depth interviews with select households, masons and contractors, private business operators, as well as government officials. In addition, an in-depth institutional and financial analysis will be conducted including detailed stakeholder mapping.

1.3 Scope and Structure of this Document

For the Primary Study, the dimensions investigated for the two urban locations, were:

- Different types of toilets, collection/containment structures, and disposal/treatment systems in the two locations, across different settlement types or housing typology
- Decision making process of constructing latrines with septic tanks or other on-site sanitation systems
- Perceptions on functioning of septic tanks and their cleaning or de-sludging
- Frequency of de-sludging and expenditure incurred on cleaning the septic tanks
- Concerns or issues of respondents in respect of sanitation and other environmental conditions.

First, based on secondary data, and reconnaissance, the team mapped and identified the different types of settlement and housing typologies. From each of the significant typologies, different types of household and neighbourhood sanitation arrangements were sought to be covered.

In doing so, a purposive sampling was adopted for choosing study respondents, spread across different on-site sanitation arrangements located in the relevant housing typologies.

The primary study used a mix of a map-based reconnaissance, discussions with selected household respondents, and other stakeholders in the study locations. In addition, observations and documentation of built structures and systems was also undertaken. A semi-structured questionnaire and a direct observation schedule were used.

Household Sanitation Arrangements across Housing Typologies Covered

Table 1-1 presents the distribution of canvassed households across household typologies and with different household sanitation arrangements in Pammal.

Table 1-1: Distribution of Study Households across building types and sanitation arrangements: Pammal

Sl. No.	Housing Typology	No. of HHs	Area Name	Ward No.	Sanitation Arrangements
1	Independent houses/villas	2	Pasumpon Nagar	6	Individual Household Latrine, Septic tank connected to soak pit
					latrine and Septic tank
2	Multi-storey Apartments	1	Shankar Nagar	1	Individual Household Latrine, Septic tank connected to soak pit
3	Plotted development	2	Shankar Nagar	1	Individual Household Latrine, Septic tank connected to soak pit
4	Row housing with no side setbacks	2	Jagajeevan Ram Street	7	Individual Household Latrine, Septic tank
5	Low income houses	4	Shivshankaran Street	7	Individual Household Latrine, Septic tank
					Individual Household Latrine, without Septic tank (Only Soak Pits)
			Thiruvallur Street	5	Access to shared toilet (3 to 4 HHs)
					Access to public toilet
6	Government Housing (BSUP)	1	Thiruvallur Street	5	Individual household toilet, Septic tank
7	Slums	4	Rajiv Gandhi Nagar, Fathima Nagar	1	Open Defecation

Source: IIHS Primary Study, 2015

The sample had respondents from diverse occupations including those in government service, entrepreneurs, and wage labour. Of the surveyed, 12 households owned the plot of land on which their houses were built, 3 of the 12 houses were built 30 to 35 years ago and 4 houses were built between 4 and 12 years ago. The average household size was five and the respondents included 5 men and 8 women.

Table 1-2 presents the distribution of canvassed households across household typologies and with different household sanitation arrangements in the Coimbatore TPs.

Table 1-2: Distribution of Study households across various building typologies and sanitation arrangements: Coimbatore TPs.

Sl. No.	Housing Typology	Name of the Town	No. of HHs studied	Area Name	Ward No	Sanitation Arrangements
1	Independent houses/villas	Periyanaicken-palayam	2	Seerkali Amman koil street,	4	Twin Pit latrine
				JadalNaidu street	15	Twin Pit latrine
		Narasimhanaicken-palayam	2	Ramaswamy Nagar, Surya	9 & 2	With latrine and cess pit

Table 1-2: Distribution of Study households across various building typologies and sanitation arrangements: Coimbatore TPs.

Sl. No.	Housing Typology	Name of the Town	No. of HHs studied	Area Name	Ward No	Sanitation Arrangements
		Idigarai	1	RamanujaNagar, 2nd street	-	With latrine and septic tank
2	Multi-storey Apartments	Periyanaicken-palayam	1	-	1	With Latrine and Septic tank connected to soak pit
3	Plotted development	Periyanaicken-palayam	2	Ranganathapuram	13	With Latrine and Septic tank connected to soak pit
		Narasimhanaicken-palayam	1	Priya Garden	-	With latrine and septic tank
4	Row housing near the storm water drain	Periyanaicken-palayam	2	Annanagar	7	Public toilets
5	Low income houses	Periyanaicken-palayam	1	Seerkali amman koil street 2	4	Earlier Open Defecation. Built toilet one year ago
6	Government Housing (BSUP)	Periyanaicken-palayam	1	Kasthuri palyam	13	With latrine and septic tank
		Idigarai	1	Amman colony	-	Open defecation
7	Slums	Periyanaicken-palayam	4	Vivekanandapuram	1	Open defecation
		Veerapandi (No. 4)	2	Nandawana Nagar, Devinagar	6,10	Public toilets

Source: IIHS Primary Study , 2015

The sample had respondents from diverse occupations including those who were software engineers, labourers, landlords, and drivers. Most of the respondents were employees of LMW and Pricol industries in Periyanaicken-palayam. There was also a maintenance manager of a multi-storied apartment.

The average size of households in Periyanaicken-palayam was 5. When compared to households with latrines, households where OD was practiced tend to have younger people, more children, higher females as household heads, and were less educated. The team interacted with an equal number of male and female respondents.

Other Respondents Covered

In both the locations, the team interacted with other groups of people involved in the sanitation cycle to collect information on sanitation:

a) **Municipal Officers:** Officers from Pammal Municipality and four TPs in Coimbatore, were consulted. In addition to the Executive Officers (EO) and elected representatives from these Urban Local Bodies (ULBs), the team also interacted with ULB staff, including engineers, sanitary workers, and other staff involved to sanitation, health and related positions.
b) **Cesspool Vehicle Operator:** The team interacted with a private cesspool vehicle operator, operating in and around Pammal. In addition, the team met with representatives from the cesspool operators' federation based out of Coimbatore, and active in the TPs.
c) **Builders and developers**: In both the locations, the team interacted with builders who had executed housing projects ranging from small independent houses to multi-storey apartments and layouts, over the last two to three decades that they have been in business.
d) **Masons:** In each if the two locations, two or three masons were interviewed. These included those for who this is a family tradition and they are from these areas, as well in a few cases, in-migrant masons from other states.

1.4 Scoping and Limitations

- The current field-study was a scoping exercise and hence the interactions were structured to understand the different salient features of sanitation structures, practices and key stakeholders. While numbers of interactions are mentioned, these do not purport to be a quantitative survey, and the qualitative nature of findings needs to be kept in view.
- Primary study locations were limited to two areas: near Chennai and near Coimbatore. It is expected that a much larger number of variations, both in systems and practices, across the full chain of sanitation will be observable once the inquiry is expanded across the State. Even in these two locations, a large number of interesting practices have been captured. Some generic lessons and challenges can be extracted from these.
- While there is information available from Census and NFHS on physical availability of toilets, there is little information, even with ULBs, on de-sludging, conveyance and treatment. These aspects need a comprehensive baseline survey to be conducted.
- The current study was able to commence the process of consulting masons, builders, de-sludging operators, and other private and non-government agencies involved in urban sanitation in the State, the findings may be treated with caution as detailed discussions are needed to generate options for resolution of some of the difficult issues in practice, e.g., in respect of regulation without adequate infrastructure for deposition of septage.

2 City Profile of Pammal

2.1 Location of Pammal

2.1.1 Location and Regional Context

Pammal is located in Kancheepuram district of TN. It is adjacent to the Chennai International Airport and is considered a suburb of Chennai. The town is located next to National Highway (NH) 45, which connects Chennai to Tiruchirappalli in the south.

Figure 2-1 Location of Pammal Town-

Source:(Wikipedia, 2016) and (Map, 2016)

2.1.2 Linkages and Connectivity

Located next to Chennai, Pammal is well-connected by road, rail, and air transport. The town falls between the Chennai bypass Road on the west and Tiruchirappalli-Chennai Highway (Irumbiliyur-Muduchur-Oragadam Road) on the east. The Pammal main road

running across the town connects these two highways and the settlements further west, including Periyapanicheri and Kovur. The Tiruneermalai road on the southern part of the town, connects Pammal to the popular Ranganatha Temple situated on the Tiruneermalai hill.

Pammal is very well-connected with busses to surrounding areas like Pallavaram, Anakaputhur, Tiruneermalai and Pozhichalur. The closest railway station to Pammal is the Pallavaram Railway Station, local trains connecting Chennai and its sub-urban areas and trains going towards Kancheepuram and further south, can be accessed here. Pammal is just 7 km away from the Chennai International Airport operating flights to various parts in India and around the world.

2.1.3 Physiography and Topology

Pammal town is mostly flat with a minimal slope. The areas close to the Chengaluneermalai hill are at a higher altitude.

Plate 2-1 Chengaluneermalai hill on the western side of Pammal Town

Source: Photo: IIHS Primary Study, 2015, Map: Pammal Municipality

2.2 Demographic and Socio-economic Profile of Pammal

2.2.1 Population and Growth

The Census of India, 2011 reported the population of Pammal to be 75,870 (about 19,000 households), and its geographical area as 13.8 sq.km (Census, 2011). The town has witnessed rapid growth in population through the past four decades, as presented in Table 2-1

Table 2-1 Decadal Population Growth Rates of Pammal and surrounding towns

Town/City	1961–71	1971–81	1981–91	1991–2001	2001–11	Population (2011)
Chennai	42.8 %	32.7 %	17.2 %	13.1 %	7.0 %	4,646,732
Pammal	**-**	**207.6 %**	**31.2 %**	**37.0 %**	**51.7 %**	**75,870**
Anakaputhur	45.9 %	40.6 %	59.1 %	31.1 %	50.5 %	48,050
St. Thomas Mount cum Pallavaram	74.2 %	21.3 %	19.1 %	6.1 %	3.9 %	43,795
Meenambakkam	57.0 %	23.4 %	23.0 %	-5.1 %	18.8 %	24,334

Source: Town Directory, Census 2001 & PCA 2011

The average household size in Pammal is a little more than four, slightly higher than the average for urban TN, which is at 3.88 (Census, 2011). A tenth of the population is below 6 years of age, similar to the state urban population cohorts. The sex ratio was 998.1, comparable to urban TN's 999.98 (Census, 2011). The sex ratio for population below the age of 6 was 956.9, higher than the overall State urban figure of 951.7 (Census, 2011).

2.2.2 Literacy and Education

Ninety-one per cent of the population of the town above the age of 6 is literate (Census, 2011). The corresponding figure for urban TN is 87 per cent. The male and female literacy rates are also higher than the urban TN averaging, at 94 and 88 per cent respectively (Census, 2011). The census town directory of 2001 lists 35 schools and one polytechnic in the town.

2.2.3 Social Composition

More than 19 per cent of the population in Pammal are members of the Scheduled Castes (SC), and 0.16 per cent are members of the Scheduled Tribes (ST) (Census, 2011). The percentage of the SC population is considerably higher than the overall state urban figure of 14.2 per cent while for STs, the figure is marginally lower than the state figure at 0.38 per cent (Census, 2011).

Adi Dravidas, Paraiyans, Arunthathiyars, Pallans and Adi Andhras were the most prominent SC communities in the town, and the Kaniyans, Kattunayakans and Irulas were the main ST communities in Pammal (Census Town Directory, 2001).

The 2001 Census had reported that 77 per cent of the town's population were Hindus, and Christians and Muslims made up 12 and 11 per cent of the population respectively. Tamil is the dominant language in the town, with 93 per cent of the residents speaking the language. Telugu, Urdu and Malayalam are others languages spoken in the town.

2.2.4 Workforce Participation

The workforce participation rate of the town is 43 per cent, marginally lower than the State urban figure of 44.6 per cent (Census, 2011). Male and female workforce participation rates are similar to the average urban figures for the State, at 65 per cent and 21 per cent respectively (Census, 2011). About 86 per cent of the workforce is engaged as main workers, comprising 37 per cent of the population (Census, 2011).

Historically, Pammal and its neighbouring settlements of Chrompet, Nagalkeni, etc., have had a number of leather tanneries. These are reported to have shut down in the last few years.

2.3 In-city Transportation

The Pammal main road running between the Chennai bypass road and Tiruchirappalli - Chennai highway, and the Tiruneermalai road carry the maximum traffic load. Government and private buses operate to Chennai (via Pallavaram), Pozhichalur and Tiruneermalai. Auto rickshaws (sharing and private) are also noted as a major means of transportation for people. More than 50 per cent of the households in the town own a motorised two-wheeler and the percentage of households with a car, jeep or van is 8 per cent (Census, 2011).

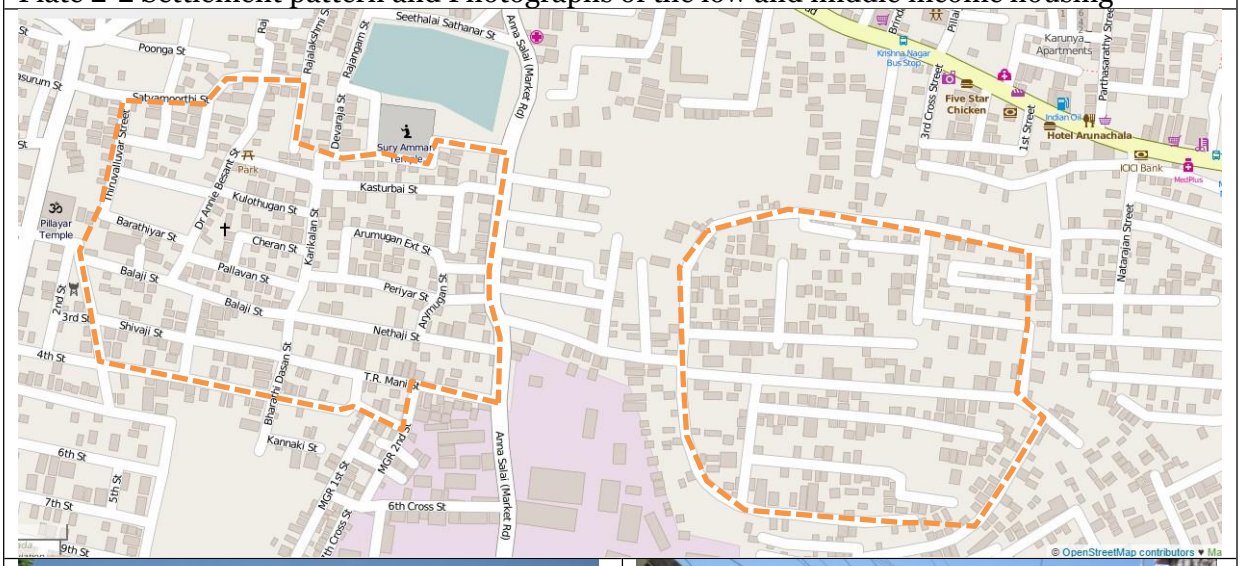
2.4 Settlement Patterns, Housing and Slums

2.4.1 Settlement Pattern and Housing Typologies

The northern part of town has low-rise high density stand-alone residential buildings restricted to a height of G+2 floors. The pattern is similar to the southern side of the main Pammal road. Most of the urban poor pockets are a part of these settlements. The south-western part of town is an organised layout-based development with individual bungalows/villas and apartment. The main commercial establishments are along the Pammal main road. The southernmost part of the town along the Tiruneermalai Road, houses the industrial areas. The housing typologies across these settlement patterns are described below.

A majority of the housing type in Pammal is low-and-middle-income housing. The areas of VOC Nagar, Bhavani Nagar & Nimnabad areas and most of the other localities house single and double storied permanent buildings in the town. The materials used for construction of these houses are brick and Reinforced Cement Concrete (RCC), generally flat roof type. Sometimes small commercial settlements form a part of these houses. The settlement pattern and the housing types are depicted in Plate 2-2 below.

Plate 2-2 Settlement pattern and Photographs of the low and middle income housing



Source: Open Street Maps; IIHS Primary Study

The inhabitants of the Shankar Nagar area are higher-income households of the town. The buildings are generally individual villas or bungalows. There are also large group houses and apartments. The materials used for construction of these houses are brick and RCC, generally flat roof type.

Pammal Colony is a congregation of two slum pockets in Ward numbers 5 & 7. The houses are made of single-storey, detached structures that are located without any order. The materials used for the construction of these houses are exposed brick walls and have thatched or pitched roofs. A few houses also have flat RCC roofs and brick walls with very little space between the dwelling units.

Plate 2-4 Settlement pattern and Photographs of the urban poor

Source: Open Street Maps; IIHS Primary Study

2.4.2 Slums

More than 17,000 people or approximately 23 per cent of the town's population, live in slums (Census, 2011). The average household size of the slum population is 4.16, higher than the town average. The sex ratio of slums was higher than the figure for the town, at 1013. The type of buildings in slums was presented in the previous section.

According to the Pammal Municipality, there are seven notified and four non-notified slums in the town, as presented in Table (2-3) and Map 1.

Table 2-2 List of Slums in Pammal

Sl. No.	Name of the Slum	Ward No.
Notified:		
1	Moovendhara Nagar	2
2	Pammal Colony	5
3	Pammal Colony	7
4	Moongil Eri	12
5	Kalyanipuram	18
6	Nagalkeni	19

Table 2-2 List of Slums in Pammal		
Sl. No.	**Name of the Slum**	**Ward No.**
7	Easwari Nagar (Thideer Nagar)	21
Non-Notified:		
8	Easwaran Nagar	14
9	Rajiv Gandhi Nagar	15
10	Seit Sahib Lane	18
11	Adam Nagar	21
Source: Pammal Municipality		

Map 1 Location of Slums in Pammal

Source: Pammal Municipality and IIHS Primary Study, 2015

3 Urban Environmental Services in Pammal

3.1 Water Supply

3.1.1 Household Arrangements

More than 80 per cent of households depend on tap water for their needs (Census, 2011). Of this, 51 per cent have access to treated tap water, usually public piped water supply. Almost a third of the households have taps but with water coming from untreated sources. This is more than double of TN urban average for tap with untreated sources. The other major source is groundwater, which provides water for more than 8 per cent of households.

A comparison of household water supply arrangements between Pammal, the average of urban TN, and the average of urban India is presented in Table 3-1. While Pammal has a lower physical coverage of taps with treated water, as compared to Urban TN and Urban India, its dependency on hand pumps and bore wells is similar to the Urban TN average, but much lower compared to National urban figures.

Table 3-1 Comparison of Water Supply Arrangements in Pammal, Urban TN and Urban India

Sl. No.	Source of Water	Pammal	Urban Tamil Nadu	Urban India
1	Tap water from treated source	50.7 %	66.3 %	62.0 %
2	Tap Water from untreated source	31.3 %	14.0 %	8.6 %
3	Well	4.1 %	4.3 %	6.2 %
4	Hand pump/Tube well/Borehole	10.5 %	12.6 %	20.8 %
5	Surface water sources	0.4 %	0.4 %	0.7 %
6	Other sources	3.1 %	2.3 %	1.7 %

Source: Census of India, 2011

Location of source of water:

About 68 per cent of households in Pammal reported access to water supply arrangements within their premises, while 29 per cent reported access nearby but not within their household premises. Table 3-2 shows that Pammal households have better physical access to drinking water than average urban TN .

Table 3-2 Location of source of drinking water: Pammal and urban Tamil Nadu

Sl. No.	Location	Pammal	Urban TN
1	Within the premises	68.2 %	54.0 %
2	Near the premises	28.5 %	40.2 %
3	Away	3.3 %	5.7 %

Source: Census of India, 2011

3.1.2 Household Arrangements for Potable Water

a. Supply from Chennai Metro water

The main source of drinking water supplied by Pammal Municipality is from a Combined Water Supply Scheme (CWSS) from Alandur, by the Chennai Metro Water Supply and Sewerage Board (CMWSSB, or Metro water). Water is supplied once in 6 days for 2.5 hours only. Municipal officers estimate a supply of 50 lpcd from this source.

At present, there are 10,189 house service connections (HSCs), 15 commercial, and 19 industrial water supply connection in the town. Ward No. 3 has the highest number of house service connections (806) in the town. (cf. Annexure 3 forward-wise water connections).

b. Supplementary Public Provisioning

Since the supply of drinking water under CWSS is intermittent (once in 6 days), to facilitate regular drinking water supply, 619 Public Stand Posts (PSPs) are provided at various locations in the town for to supply drinking water to the people who cannot afford to have a house service connection (Refer to Annexure 3 for a ward-wise list of PSPs).

Mini power pumps connected to Reverse Osmosis (RO) plants with storage tanks, have been installed in Pammal (cf. Annexure 3). In this arrangement, water drawn from the bore well through submersed pump is connected to the RO plant and the treated water is stored in a Poly Vinyl Chloride (PVC) tank (1000 lit capacity) and users draw water from it.

Plate 3-1 Public stand posts delivering drinking water in Pammal

Source: IIHS Primary Study, 2015

There are 25 such installation across the town (refer to Annexure 3 for ward-wise details), especially close to the urban poor settlements. The pumps are operated by the local residents themselves who use them on need basis.

3.1.3 Household Arrangements for non-potable water

a. Self-Supply

Due to limited and intermittent municipal water supply, many households have private open wells or bore wells within their premises.

b. Supplementary Public Provisioning (Mini power pumps, Hand pumps & Municipal Wells)

The Pammal Municipality has also made arrangements of water for non-drinking purposes such as bathing, washing, cleaning, etc. The main sources of such water are from the mini power pumps. In addition, there are hand pumps and few public wells too. There are 105 mini power pumps connected to storage tanks (2000 lit capacity) and public taps whence people collect water. These pumps are operated by the residents on need basis, in general, installations near urban poor settlements are operated about 10 times in a day and the other for about 2 to 3 times.

Plate 3-2: Mini Power Pumps for Non-potable Water in Pammal

Source: IIHS Primary Study, 2015

There are 142 hand pumps and at various locations in the town and two municipal wells which are seasonally operated (during monsoon). While in use, water from these wells is pumped to about 80 PSPs across areas in and around Shankar Nagar and Nagalkeni.

Plate 3-3 Hand Pumps in Pammal

Source: IIHS Primary Study, 2015

City Level Water Infrastructure

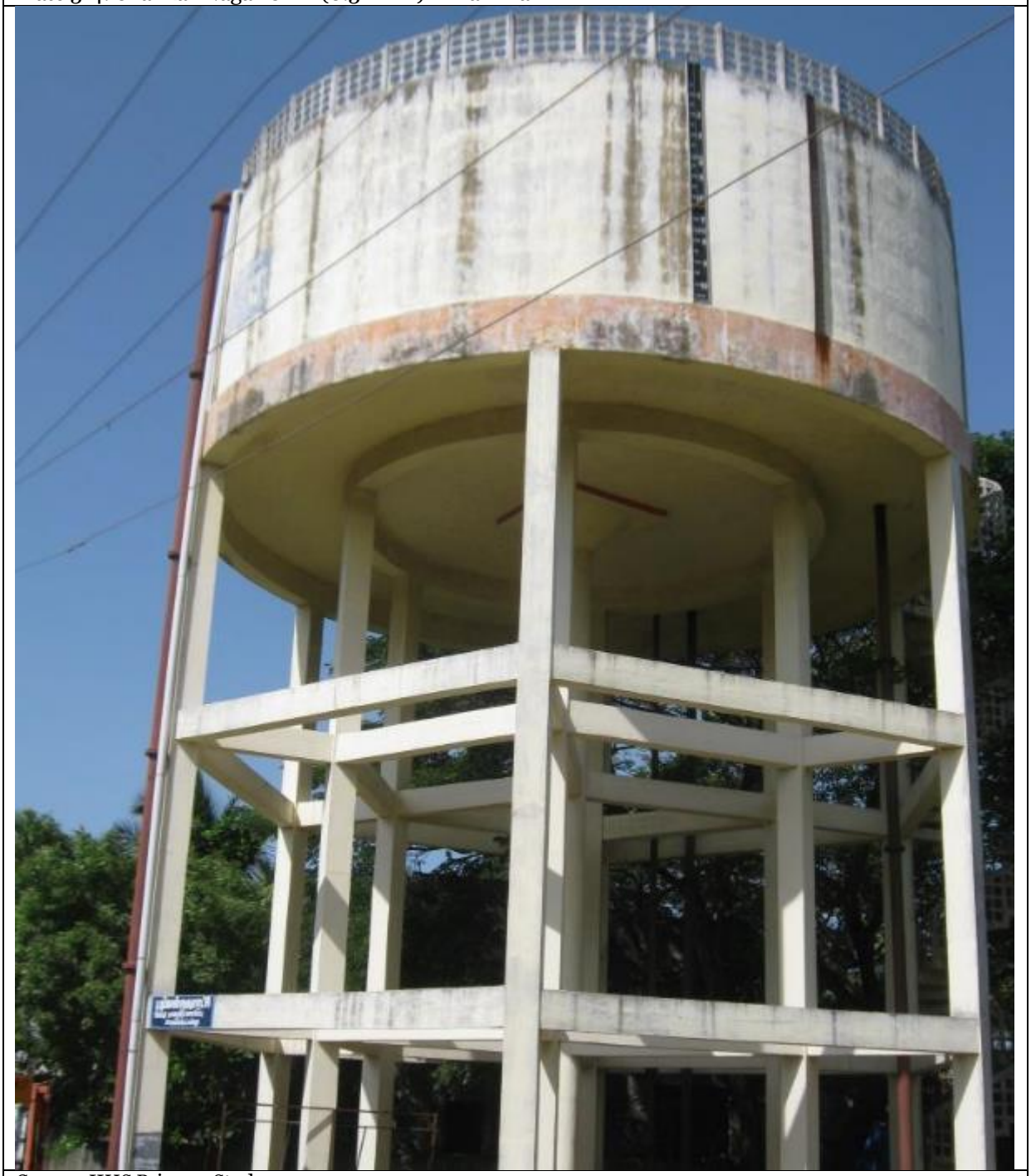
The main source of water as mentioned in this scheme is from the Chembarambakkam Lake. Though treated water is supplied, for additional safety, water is further disinfected using iodine and chlorine at the storage sump (1 Million Litres per Day (MLD) capacity) situated in HL colony in Pammal regularly. Water is pumped into three overhead tanks in the town serving to three water zones. Water from CWSS, is pumped to Anakaputhur, the adjacent town, from the same sump. Table 3-3 and Map 2 presents details of storage infrastructure and distribution zones in Pammal.

Table 3-3 Water Storage Infrastructure and Distribution in Pammal

Sl. No.	Location of OHT	Capacity	Zone	Wards covered
1	Municipal Office	0.3 MLD	1	4, 5, 6, 7, 8 9, 10, 11 and parts of 3 & 12
2	Shankar Nagar	0.3 MLD	2	1, 2, 3, 13, 14 and parts of 3, 12, 17 & 21
3	Nagalkeni	0.15 MLD	3	15, 16, 18, 19, 20 and parts of 17 & 21

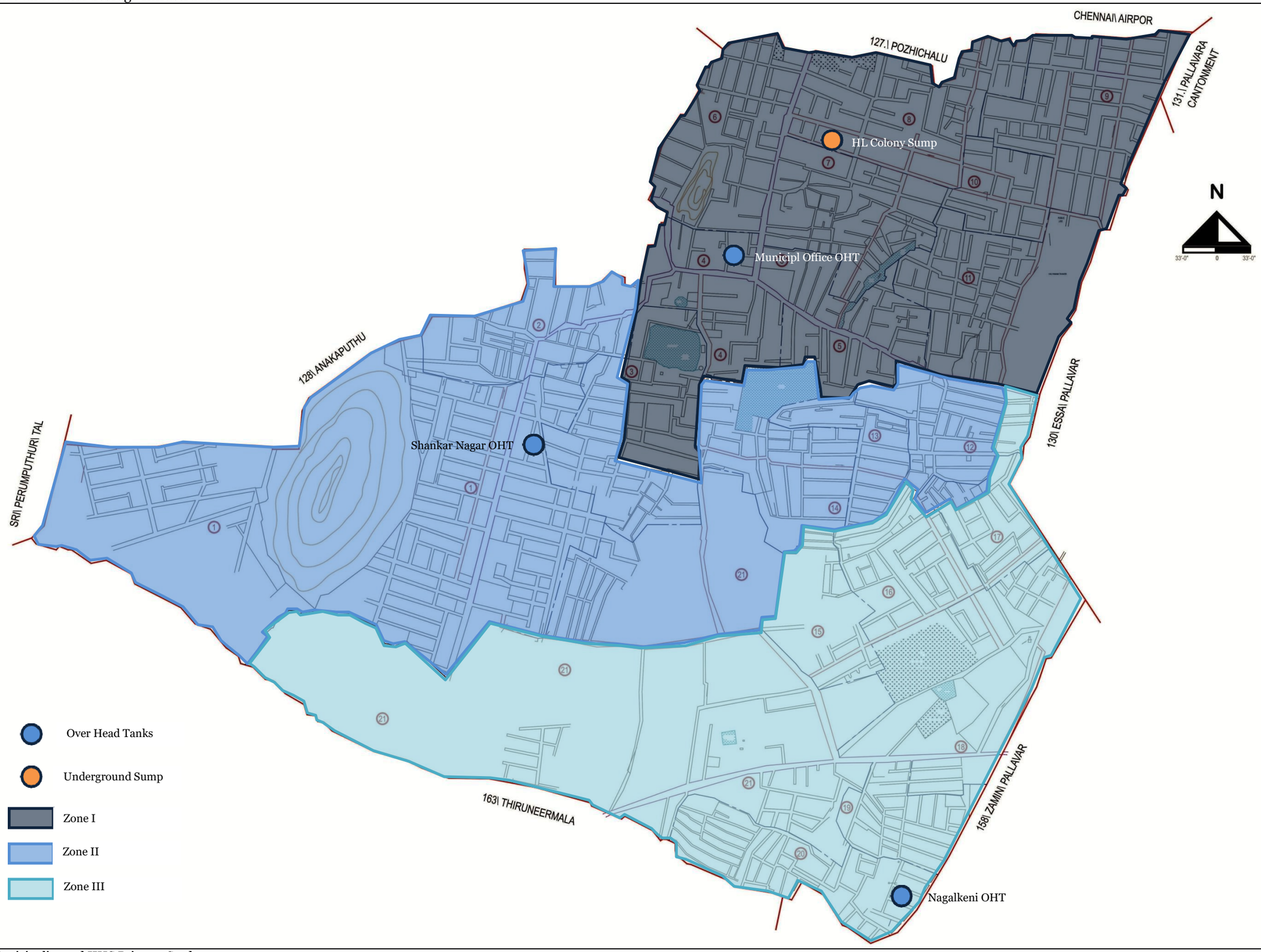
Source: Pammal Municipality

Plate 3-4: Shankar Nagar OHT (0.3 MLD) in Pammal



Source: IIHS Primary Study, 2015

Map 2: Water Zones and Water Storage Infrastructure



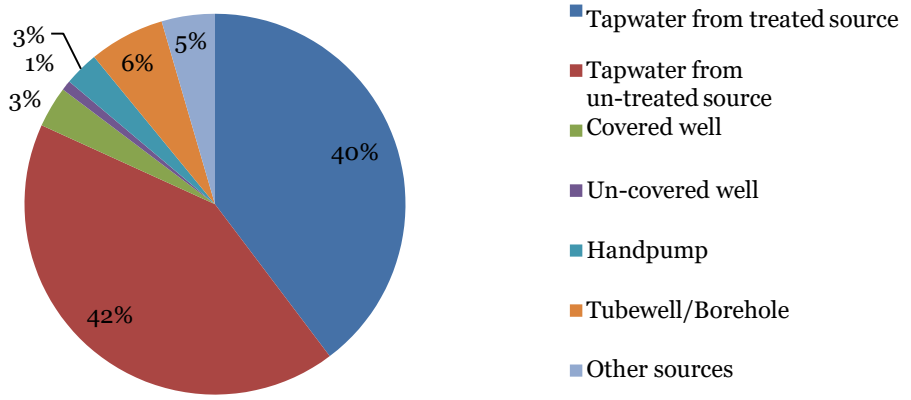
Source: Pammal Municipality and IIHS Primary Study, 2015

Discussions with municipal officers indicate that the overhead storage tanks are filled 3 to 4 times in a day indicating that about 2.25 to 3 MLD of water is being distributed.

Water Supply in Slums:

The major source of water in the slum settlements in the town, is through the piped water supply provided by the Municipality. However, more than half of the water from piped supply is from an un-treated source. A few households depend on underground water sources like tube wells, hand pumps and wells.

Figure 3-1 Source of water in Slums



Source: Census of India, 2011

3.1.4 Water Tariffs

The Pammal Municipality provides water service connections to households, establishments, institutions and industries from drinking water under the CWSS after paying a fixed one-time connection charges. Thereafter, a monthly user fee is levied for the water used. This is a flat rate since there is no metering. The details of connection charges and monthly water supply charge are presented in Table 3-4.

Table 3-4 Water Supply Connection Costs in Pammal

Sl. No.	Type of Connection	Connection Charge (Rs.)	Monthly User Fee (Rs.)
1	Household	7,500	50
2	Commercial	10,000	100
3	Institutional	10,000	100
4	Industrial	12,500	150

Source: Pammal Municipality

Public water supply, i.e., PSP (under CWSS), purified water from mini power pumps with ROs for drinking purposes, and non-potable water from mini power pumps and wells, are all provided free of cost by the municipality.

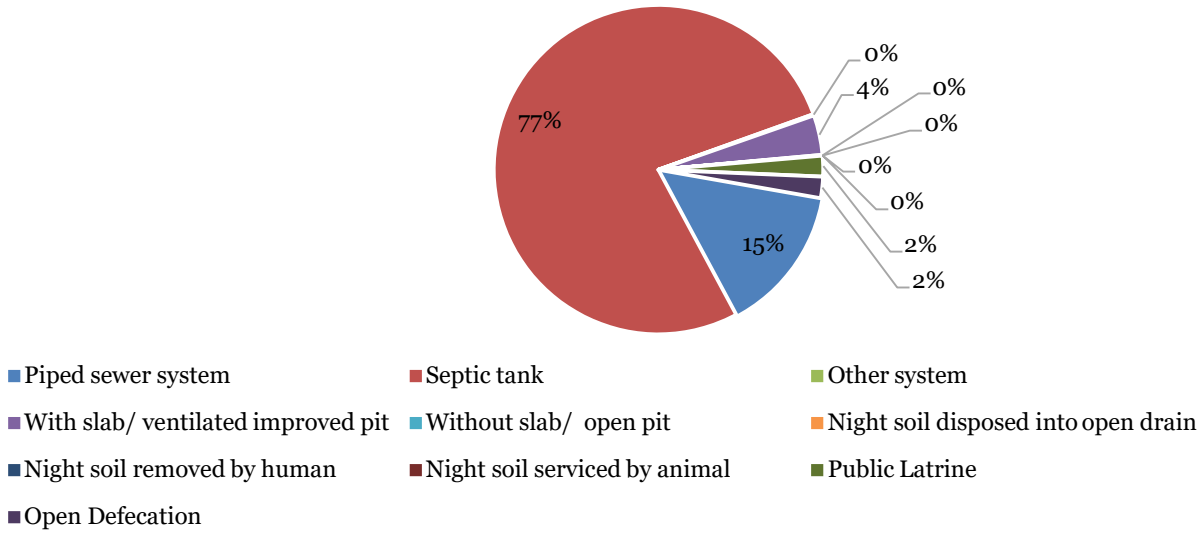
The water charges from the service connections are paid by the users at payment windows at the municipal office operated by the revenue section. Typically, users pay once in 6 months or annually along with the Property Tax. Municipal officers reported the recovery rate of water supply charges is about 80 per cent annually.

3.2 Sanitation

3.2.1 Household Arrangements

About 96 per cent of households in Pammal report having an individual household latrine within their premises. Almost 92 per cent of households have a flush or pour/flush toilet, with the majority, 77 per cent, depending on septic tanks (Census, 2011). Although the Census reports that 14 per cent of households are connected to a piped sewer network, the primary study does not validate this claim. Figure 3-2 presents household sanitation arrangements in Pammal.

Figure 3-2: Household Sanitation Arrangements in Pammal



Source: Census of India, 2011

Slum Sanitation:

About 88 per cent of slum households in Pammal have access to a latrine within their premises (Census 2011). Of the remaining 12 per cent, 8 per cent of households rely on public latrines while four per cent resort to OD (Census 2011). Amongst households with latrines, the most predominant arrangement is the use of septic tanks, with 61 per cent of slum households report having these structures.

A comparison of sanitation arrangements in Pammal, with averages across urban TN and urban India are presented in Table 3-5. The households in Pammal have a higher proportion of physical access to individual households, septic tanks being predominant, a lower incidence of OD or use of public latrines. The Primary Study showed, however, a near-absence of sewerage and perhaps a misclassification of toilets of other categories could also explain a small proportion of pit latrines being reported.

Table 3-5 : Comparison of Sanitation Arrangements between Pammal, Urban TN & Urban India

Sl. No.	Sanitation Arrangements	Pammal	Urban TN	Urban India
1	Latrine within premise	**95.9 %**	75.1 %	81 %
2	No latrine within premise	4.1 %	24.9 %	19 %
3	Piped sewer system	14.4 %	27.4 %	33 %
4	Septic tank	**77.4 %**	37.9 %	38 %
5	Other system	0.1 %	1.1 %	2 %
6	With slab/ ventilated improved pit	3.9 %	6.6 %	6 %
7	Without slab/ open pit	0.1 %	0.3 %	1 %
8	Night soil disposed into open drain	0.0 %	1.5 %	1 %
9	Night soil removed by human	0.0 %	0.2 %	0 %
10	Night soil serviced by animal	0.0 %	0.2 %	0 %
11	Public Latrine	2.0 %	8.6 %	6 %
12	Open Defecation	2.1 %	16.2 %	13 %

Source: Census of India, 2011

3.2.2 Household Arrangements in Study households

a. Households with individual toilets

Independent houses have built toilets either attached to the bedroom inside the house, or attached/separate structures. Out of the 13 households studied, 8 have such attached toilet facilities. Some have built toilets outside the house but within the premises which according to them is to cater to even visitors or guests. Five houses have toilets within the premises outside the house, and two houses (Pasumpon Nagar) have both an attached toilet and a common toilet, outside the house but within the premises for guest. Only one of the low income houses (Thiruvallur street) had built a toilet outside the premises. The toilets are mostly the Indian Pan type one with pour-flush arrangements. Only two houses had the western-type toilets with cistern flush.

All the eight houses with individual toilets have septic tanks to collect sewage which seemed to be working condition. Details about their structure is discussed in a later section.

Since all the toilets were built during the construction of house, a few years ago, respondents were unable to recall the cost break-down separately for the toilet. One of the respondents who built the attached toilet recently, reported having spent ₹10,000–₹15,000 on the western water closet/cistern, with an additional ₹5000 to provide a pipeline connecting the western closet to septic tank.

b. Households sharing toilets

The shared toilets are more prevalent in houses that are rented. The tenants were unhappy with this since the owners had individual toilets for their houses. Tenants also expressed concerns about cleaning arrangements for these shared toilets.

In Bhavani Nagar, near NSK Street, Ward No 13, a respondent built four houses 15 years ago within a single plot. The premises had two toilets which were shared by all the four households. The toilets were the Indian pan type one with a pour flush system connected to a septic tank. The previous year, the Government had built 'Namma Toilet' in front of the respondent's house which caused her discomfort. In order to avoid viewing the users of 'Namma Toilet' and keep away the odour from the same, she raised a wall in front of her house.

Plate 3-5: Shared Toilet in Pammal

Source: IIHS Primary Study, 2015

c. Households dependent on public toilets

About 300 households depend on public toilets, according to ULB estimates. There are seven Public toilets in Pammal—six of these also have a bathing facility (except Bajana Koil Street Public toilet). These Public Toilets have four seats each for men and women and one for children. Water supply is adequate in all the toilets. User fee is collected in one of the public toilets in Bajanai Koil Street. Refer to Annexure 3 for details.

Box 1 Namma Toilets Users: a case from Pammal

Shivashankaran Street has two houses which depend on the public toilet at Bajanai Koil Street. The respondent from one of the house expressed her inability to afford constructing a toilet in her house. The house is 35 years old passed on by her grandparents to her. The household had 7 people of which three were children under the age of 12 and two each male and female members. Her husband is a daily wage labourer who is the single earning member of the family. A sanitary worker taking care of a public toilet in Ward No. 7 says that about 150 people use the toilet each day. He cleans it twice a day. The major problem they face are that there are a set of miscreants who get drunk at night and come and damage the property by breaking doors or stealing metal parts to sell them off.

Source: IIHS Primary Study, 2015

d. Open defecation

Rajiv Gandhi Nagar and Fathima Nagar are two notified slums where respondents reported that they defecate in the open. The residents of Fathima Nagar defecate in the vacant land under the Chennai bypass Flyover. The residents of Rajiv Gandhi Nagar use the vacant land near the old quarry of Chengalneer Hills to defecate. The average time taken to go to the OD site one way is 15 minutes. The main reason reported for not possessing and using a toilet, was that they could not afford the cost of construction. The other reason was irregular water supply in Rajiv Gandhi Nagar where water is supplied once in 10 days. These household are willing to use public toilets provided there is regular water supply.

One of the most common problems stated by respondents, included the waiting period to avoid the presence of passers-by which is difficult as the OD site is near the crowded Chennai bypass and the presence of construction workers mostly men, working on constructing buildings in the vicinity.

One respondent who in a rented house claimed that there were many houses without toilets which were built and rented out, however, the owners of those same houses had toilets inside their houses. All the respondents said that they did not carry water for cleaning purpose, but would return home and clean themselves in their bathrooms.

Probing further on the health issues indicated that they were not aware of any illness related to OD and only acknowledged that it was unhygienic. Households were not willing to construct toilet citing affordability constraints, and expect the government to build toilets.

3.2.3 Types of Septic Tanks

According to the 2011 Census, 77 per cent of households have septic tanks. From field observations the predominant on-site sanitation system seen are septic tanks. The design of septic tanks submitted to the municipality along with building plans for approval, conform to the standards as prescribed in Central Public Health Environmental Engineering Organisation (CPHEEO). However, during construction, several modifications are made.

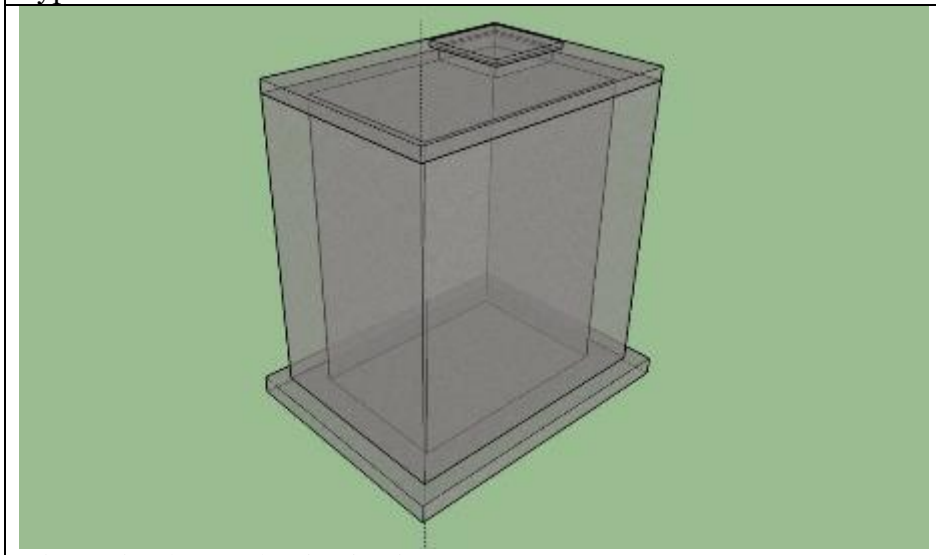
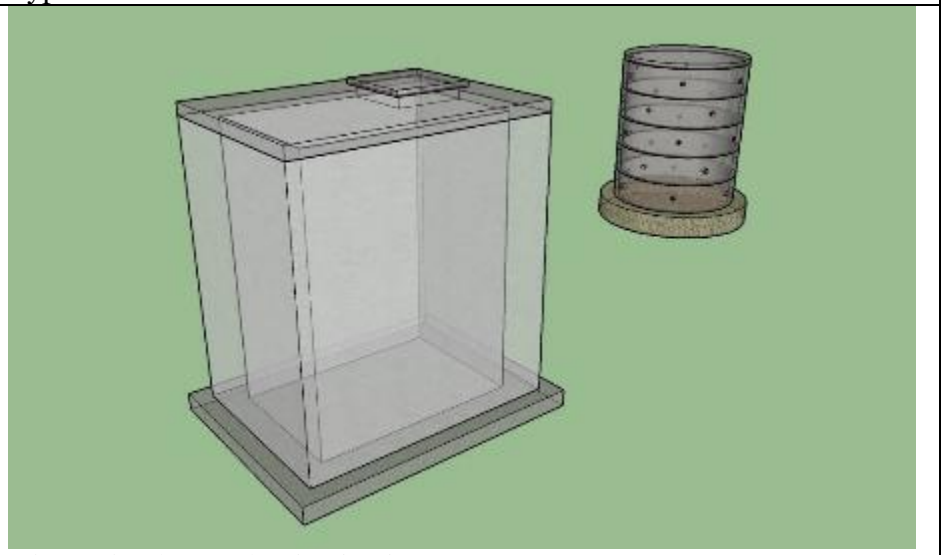
Based on the team's interaction with the Building Inspector, builders, residents and local masons, during our site reconnaissance, septic tanks can be classified into different sub-types, as presented in Table 3-6.

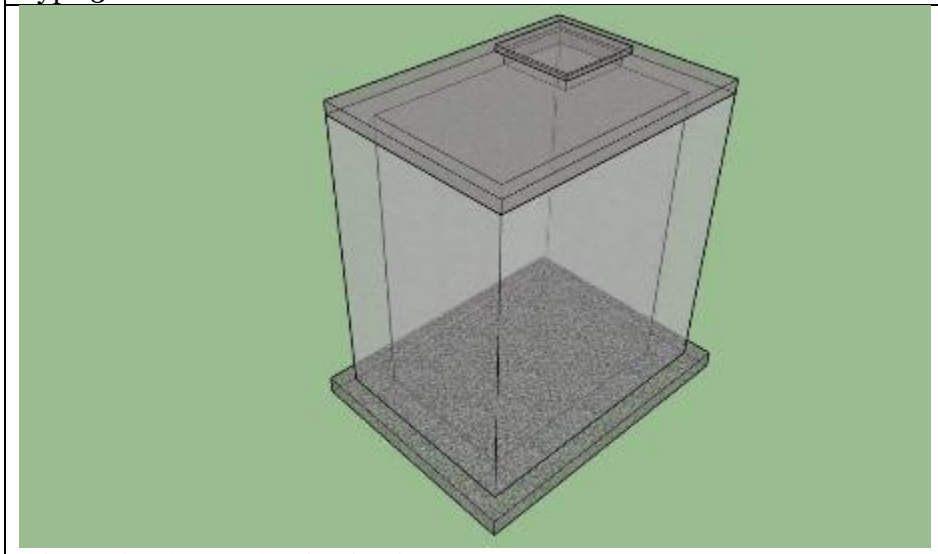
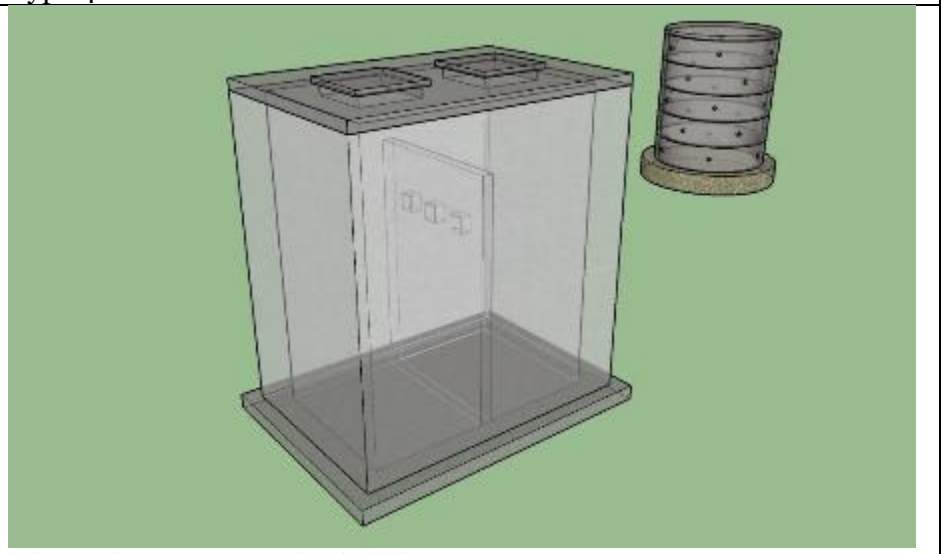
Table 3-6 : Types of septic tanks

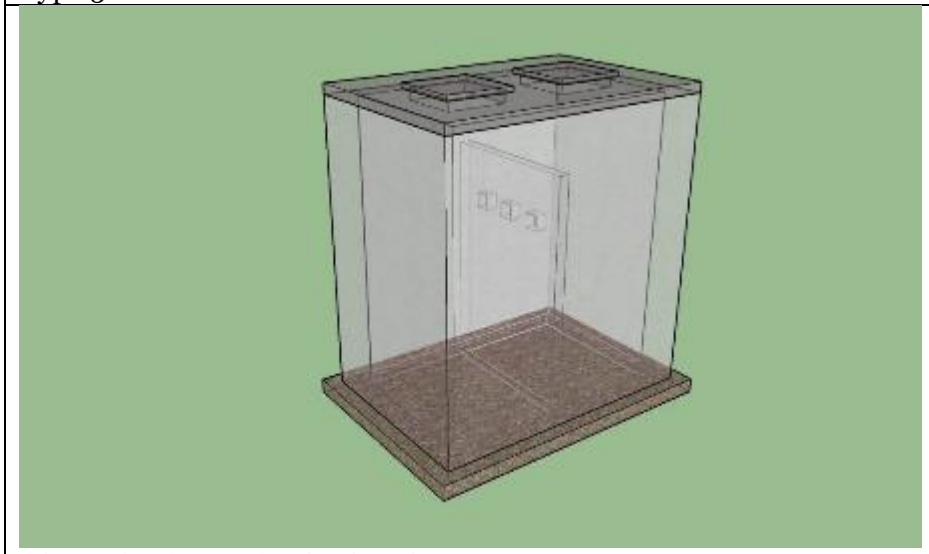
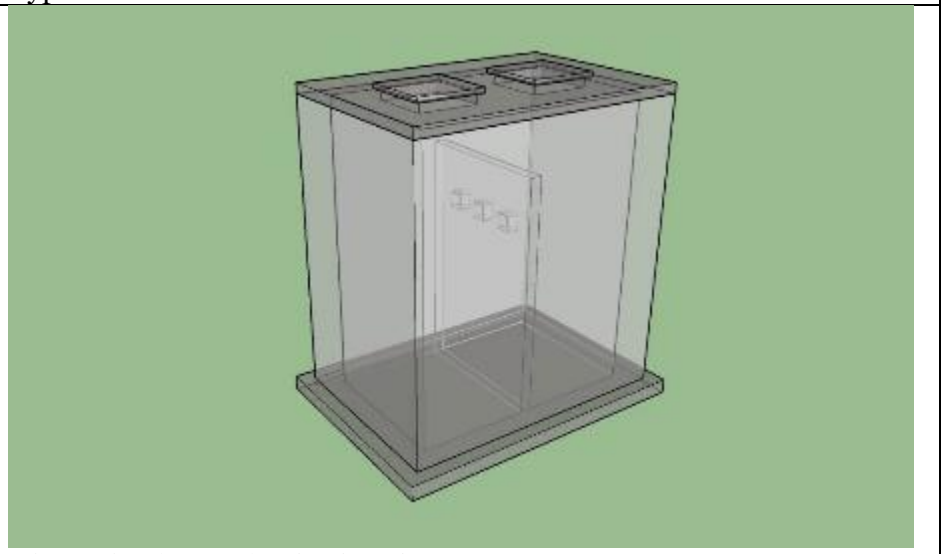
Sl. No.	Type	No. of Chambers	Water tightness	Outlet arrangements
1	Type I	Single chamber	Water tight	No outlet
2	Type II	Single chamber	Water tight	Soak pit
3	Type III	Single chamber	Porous	Percolating to ground
4	Type IV	Double	Water tight	Soak pit
5	Type V	Double	Porous	Percolating to ground
6	Type VI	Double	Water tight	No outlet
7	Type VII	Triple	Water tight	Soak pit
8	Type VIII	Triple	Porous	Soak pit

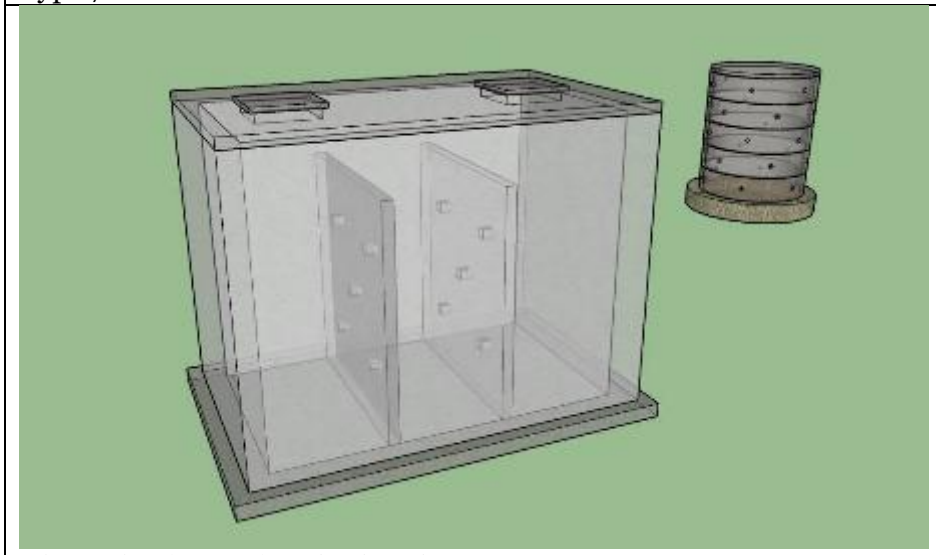
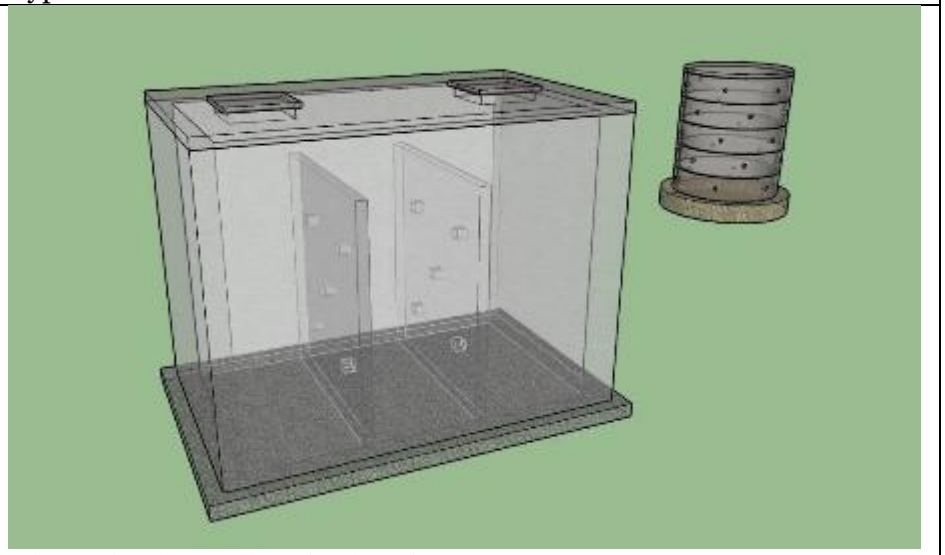
Source: IIHS primary study 2015

Figure 3-3: Illustration and Description of Type of Septic Tanks

Type 1:	Type 2:
	
Dimension(LxBxD): 6'x 4'x 8' Chambers: 1 Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (middle income group)	Dimension(LxBxD): 6'x 4'x 8' Chambers: 1 Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: Yes (4'dia & 5'deep) Other details: Generally noticed in single or double dwelling units (middle or high income group)

Type 3:	Type 4:
	
Dimension(LxBxD): 6'x 4'x 8' Chambers: 1 Base: Porous Walls: Porous or Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (low and middle income group)	Dimension(LxBxD): 8'x 5'x 10' Chambers: 2 (partition wall at the center with holes) Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: Yes (4'dia & 5'deep) Other details: Generally noticed in single or double dwelling units (middle or high income group)

Type 5:	Type 6:
	
Dimension(LxBxD): 8'x 5'x 10' Chambers: 2 (partition wall at the center with holes) Base: Porous Walls: Porous or Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (low and middle income group)	Dimension(LxBxD): 8'x 5'x 10' Chambers: 2 (partition wall at the center with holes) Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (middle and high income group)

Type 7:	Type 8:
	
Dimension(LxBxD): 12'x 7'x 10' Chambers: 3 (two partition walls with holes) Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: Yes (4'dia & 5'deep) Other details: Generally noticed in multiple dwelling unit buildings (group houses) or Bungalows/Villas (middle or high income group)	Dimension(LxBxD): 12'x 7'x 10' Chambers: 3 (two partition walls with holes) Base: Porous Walls: Porous or Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: Yes (4'dia & 5'deep) Other details: Generally noticed in multiple dwelling unit buildings (group houses) or Bungalows/Villas (middle or high income group)
Source: IIHS Primary Study 2015	

Though there are standards prescribed for design and construction of septic tanks by CPHEEO and the BIS, considerable divergences are observed in practice. Table 3-7 presents the differences in terms of structural masonry, septic tank size and design, and disposal systems.

Table 3-7 : Design Norms vs Construction in Practice of Septic tanks

Sl. No.	Aspects of Septic Tank	Standard Design Norms	Observed construction practice
1	Structural Masonry	Septic tank functions as a solid-liquid separation tank which should hold sewage for about two days. The supernatant is to flow out and the solids to settle down and thicken at the bottom so that it can be removed after two to three years. As per CPHEEO standards, it is recommended that the septic tank should be constructed using cement concrete with water proofing. This is to avoid percolation by achieving water tightness.	Households prefer to just construct support walls and plain cement concrete plinth with a bed 40mm coarse aggregates (a mixture of sand, rubble and crushed stones) at the bottom. This practice, according to local mason's, facilitates prolongs de-sludging since the sewage percolates in to the ground due to the absence of water proofing.
2	Septic Tank Size and Design	As per CPHEEO standards, the size of septic tanks is to be determined based on the household size and desired de-sludging frequency,	In practice, masons and builders oversize the septic tanks. The study revealed that the size of the septic tank is a function of financial capability, space availability and the imperative to avoiding frequent de-sludging. Hence, households prefer to have larger and deeper septic tanks built if they can afford it, and have sufficient space. According to masons, client households seek to minimise the recurring cost of de-sludging the septic tanks. Hence, masons build bigger sizes without bottom lining, to make way for percolation.
3	Disposal Systems	There are two types of wastes generated in septic tank 1. Liquid effluent which comes out of outlet every day; 2. Settled solids in the form of sludge that needs to be removed once in two or three years. For the liquid effluent, treatment is deemed appropriate by methods like soak pits or dispersion trenches with the caution that these sub-soil dispersion	For liquid effluent, two categories of arrangements are observed in practice: 1. With outlet: earlier, septic tank outlets were let into storm water drains. Now, the Municipality has attempted to ensuring that all the outlets are sealed, and the drains only receive sullage, i.e., kitchen and bathroom wash water 2. Soak pits: outlets of septic tank are connected to soak pits in few buildings.

Table 3-7 : Design Norms vs Construction in Practice of Septic tanks			
Sl. No.	**Aspects of Septic Tank**	**Standard Design Norms**	**Observed construction practice**
		systems shall be at least 20 m away from any drinking water source. The distance between the soak pit and adjacent dwelling is recommended to be at least 7 m to avoid any corrosive effect due to tank gases vented into atmosphere. Sludge needs to be emptied by mechanical vacuum tankers and should be sent for further treatment at sludge treatment units at STPs or appropriate septage treatment facility. For this regular de-sludging, access covers need to be provided.	Masons report providing soak pits at a distance of 10 feet from the septic tank and 20 feet away from the bore well in each house. De-sludging is not reported to be done at regular intervals, and access covers are not provided in all the buildings including in establishments. The tank is covered with an RCC slab and whenever there is a backflow of sewage in toilets, the concrete slab is broken open, enough to let the vacuum pipe inside the tank for cleaning, and the hole is closed again with concrete. The reason for such construction practice is explained as avoiding sewage overflow and breeding of mosquitoes.
Source: CPHEEO, IIHS Primary Study 2015			

Plate 3-6: Typical Household Septic Tank in Pammal

Source: IIHS Primary Study, 2015

The Table 3-8 below shows the details on the type of septic tanks observed during the household survey.

Table 3-8 : Summary of on-site sanitation systems observed through household survey

Sl. No.	Household No.	Household Size	Age of the Building (years)	Shape of Septic Tank	Size of Septic Tank (cum)	No. of Chambers	Watertight Base (Y/N)	Openable Access Cover (Y/N)	Outlet	Frequency of De-sludging (Yearly)	Last Cleaned
1	H1	15	10	Rectangular	10	2	N	Y	Soak Pit	Twice	6 months ago
2	H2	7	4	Rectangular	17.1	2	N	N	No Outlet	Not Required	-
3	H3	6	5	Rectangular	Could not determine as the septic tank was sealed underground and the respondent didn't know any details				-	-	-
4	H4	3	30	Rectangular	8.3	1	N	Y	-	-	2 years ago
5	H5	2	20	Rectangular	3	1	Y	Y	Soak Pit	-	1 year ago
6	H6	2	30	Rectangular	-	1	Y	Y	No Outlet	-	-
7	H7	6	12	Rectangular	5.7	2	-	-	No Outlet	-	1 year ago
8	H8	4	-	Rectangular	20	2	Y	N	No Outlet	-	-

Note: All households surveyed were single storied buildings (only ground floor)

Source: IIHS Primary Study 2015

Table 3-9 : Summary of construction practice by builders and masons

Sl. No.	Respondent	Number of buildings executed	Dimensions (LxBxD)	Avg. Capacity of Septic Tank (cu. mt.)	Water Tight		No. of chambers	Design of Partition Wall	Access covers	Outlet	Avg. Cost
					Side Walls	Bottom					
1	Builder 1	12	8'x 4'x 6'	6	Provided	Provided	3	5 Holes on the 2nd wall	One	To soak pit	` 50,000
2	Builder 2	300	Varies	10 to 12 HHs – 10 cu. mt. 4 HHs – 4 cu. mt.	Provided	provided	1	Not applicable	Some sealed some have openable cover	Depending on client's affordability, soak pit will be provided	` 65,000 to 75,000
3	Mason 1	90	7' x 4'x 10'	8	Provided	Not provided	2	5 Holes on the 2nd wall	Some sealed some have openable cover	To soak pit	` 70,000 (incl. Soak Pit)
4	Mason 2	150			Provided	Not provided	2	5 Holes on the 2nd wall	Some sealed some have openable cover	Depending on space availability, soak pit will be provided	
5	Mason 3	15	9' x 10' x 9'	23	Provided	Not provided	1	Not applicable	Some sealed some have openable cover	Depending on space availability, soak pit will be provided	Was a part of the building cost (difficult to give separate cost)

Notes: All septic tanks are constructed in rectangular shape

Source: IIHS Primary Study 2015

The Tables (4-8, 4-9 & 4-10) above show that there are considerable differences between the standards and designs prescribed, and what obtains in practice on ground. A number of local factors, and perceptions and beliefs, appear to be playing a key role in driving practices that need to be analysed further. These are re-visited again in the section describing the Coimbatore TPs.

3.2.4 Transportation of Septage

Septage from households is collected and transported by a private operator. There are three de-sludging vehicles with capacities of 10,000 to 12,000 litres each, fitted with a 24 HP pump for vacuum suction. A driver and a worker each are deployed for every vehicle to carry out the de-sludging operations. Each vehicle is reported to have carried out three to four de-sludging operations in during rainy days and two to three during the dry season. According to the operator, the usual de-sludging frequency varies from three to four years among households. The fee charged per trip varies between ₹1,200 and 1,800 depending on the size of the septic tank. The trip length was reported to be about 25 km.

The capital cost of the vehicle is about ₹20 lakh[1]. The vehicle is bought with open chassis and the holding tank and the suction machinery is built locally.

While the closest STP assigned for de-sludging operators to use for emptying, is located about 25 km away, a number of difficulties are reported in successfully transporting and emptying the septage loads into these STPs. Therefore, there has been reportage of informal emptying in non-designated areas, drains and grounds, in and around Pammal. These reports need to be ascertained, and underlying factors studied in detail.

[1] Based on IIHS team's interaction with the local private cess-pool operator

3.2.5 Treatment of Septage

At present, there are no facilities available for septage treatment in Pammal, and the nearest STP assigned for emptying septage is at Perungudi which is about 15km away.

However, innovations have been experimented in some locations.

Box 3: Household Level Initiative for effective management of Septic Tank

A resident of Pammal, X, has built a 'Green Home' which has earned wide acclaim. This is a zero-waste home, where everything from solid kitchen waste to wastewater is put to good use.
A septic tank in the garden receives septage and is treated with bacteria called *Bacillus subtilis*, that neutralises the sewage to turn waste into manure for plants in the garden.
A species of plant, *Canna Indica*, has been planted to phytoremediate the sullage water mainly the water from washing and bathing to remove soap and other solids. According to X, *Canna* and *Colacasia* digest soap and later provision should be made for percolation so that water does not stagnate in one place which forms the major source of mosquito breeding.
Under the drainage pipe, he has buried some worms that not only digest the organic matter but also feed on the mosquito eggs. He practices rain water harvesting by installing percolation pits and has made provision for collection of rain water from roof top to his open well in the year 2002.

3.3 Solid Waste Management

Solid waste management is carried out by both the municipality and a private agency in the town. Pammal Municipality manages waste in only 5 out of the 21 wards (Ward Nos. 7, 8, 9, 10 & 11) and the other 16 wards are managed by a private agency. At present, no user fee is separately charged by the Municipality for solid waste management.

a. Collection and Conveyance

Waste in the municipality is collected from each household on tricycles following the door to door collection system. Two sanitary workers per e tricycle carry out the function of collecting waste from households and sweeping the street in parallel. Waste collected by the tricycles is loaded into lorries or tractors and transported to the landfill/disposal site. (Cf. Annexure 3 for the list of vehicles and tools available with the ULB for solid waste management).

Plate 3-7: Vehicles used for solid waste collection in Pammal

Tricycles for collecting door to door waste

Tractor for collecting waste from tricycles, street sweeping and drain cleaning waste

Source: IIHS Primary Study, 2015

In addition to door to door collection, the municipality has also placed 60 community bins across the town at various commercial spaces, markets, main roads, etc. to collect solid waste. These bins are made of metal and have a capacity of750 kg. The bins can be lifted and transported by the refuse collector vehicle operated by the municipality.

The ULB officials estimate of solid waste generation is 45 tonnes per day. About 40 tonnes is collected every day, by 10 municipal staff and the rest by the private player.

b. Treatment and Disposal/Re-use

Only a about 5 Metric Tonne (MT) of the total waste collected is treated, this happens at the Tiruneermalai Resource Recovery Park situated at Vishweshwarapuram. Organic waste is composted using the windrow and vermi-composting methods. The compost produced is sold to farmers in the surrounding areas.

In addition to the resource recovery park, a bio-methanation plant has been established to treat food waste from restaurants and vegetable and meat waste from markets. It is situated along the foot hill of Changelnermalai (adjacent to Rajiv Gandhi Nagar Slum). The plant was

sponsored and implemented by SAM Foundation under the ExNoRa Green Pammal initiative and land was donated by Appaswamy Builders.

Plate 3-8: Biomethanation plant for treatment of food waste in Pammal

Source: IIHS Primary Study, 2015

c. Drain Cleaning

Surface drains are the main conveyors of storm-water in the town, often mixed with black water, i.e., with discharges from toilets into these drains. Solid waste and silt finds their way into these drains and often result in blockage and overflowing. To avoid this, municipal sanitary workers are deployed for drain cleaning in the town. Sanitary workers remove solid waste and silt from the drains using forks/pickers, and dump them along the road. Larger vehicles that collect the door to door waste from tricycles also pick up this waste and transport it to the disposal site.

Plate 3-9: Drain cleaning by sanitary worker in Pammal

Source: IIHS Primary Study, 2015

3.4 Storm Water Drainage

a. Natural storm water drainage

Pammal's natural storm water drainage pattern indicates that the storm drain converges from the surrounding areas of Anakaputhur and Pallavaram. Storm water from the southern part of the town flows into the Surya Amman Temple Tank and the Thirupunanthal Lake on the eastern side and to previously existing Moongil Eri on the western side. The main outlet from the Thirupunanthal Lake is the Nadavaivodai storm drain (along Elumalai Street) collecting storm water from either sides in the northern part of the town and finally draining out in to Adayar River near the airport on the north-eastern part of the town. Refer to the schematic Map 3 in the following pages for the broad natural drainage pattern in the town.

Plate 3-10: Thirupunanthal Lake in Pammal

Source: IIHS Primary Study, 2015

Plate 3-11: Main Storm Water Drains in Pammal

Main storm water drain from Thirupunanthal

Nadavaivodai storm drain

Source: IIHS Primary Study, 2015

b. Constructed drains

There is a good coverage of constructed surface storm drains in the town. Except for wards 1, 2, 3, 18 and 21 where these drains are partially covered, all other wards have fully covered storm water drains.

Plate 3-12: Surface Storm Water Drains in Pammal

Source: IIHS Primary Study, 2015

During monsoon, the areas of Moongil Eri (Ward 12), Mumthamizh Nagar (Ward 11) and Lakshminarayan Nagar (Ward 12) are prone to heavy water logging due to their proximity to the natural storm water drains. Two rescue-camps are designated viz. Annai Velankanni School and Sri Shankara Arts & Science College, for people to take shelter during heavy flood. Please refer to Map 3 for the drainage pattern and the coverage of constructed storm drains in the town.

While storm-water and grey water from the households and establishments flows in to the surface drains in the town, it is common to observe a large number of toilets draining excreta into the drains directly or indirectly. With the recent drive conducted by the municipality, it

is claimed that all such toilets and tanks, draining in to the open drains, have been plugged. However, visual evidence of toilets directly draining into drain is not uncommon. In addition, given the construction and management practices of toilets and the septic tanks, as described, it is highly likely that untreated fecal matter finds its way into drains through sub-surface leakage.

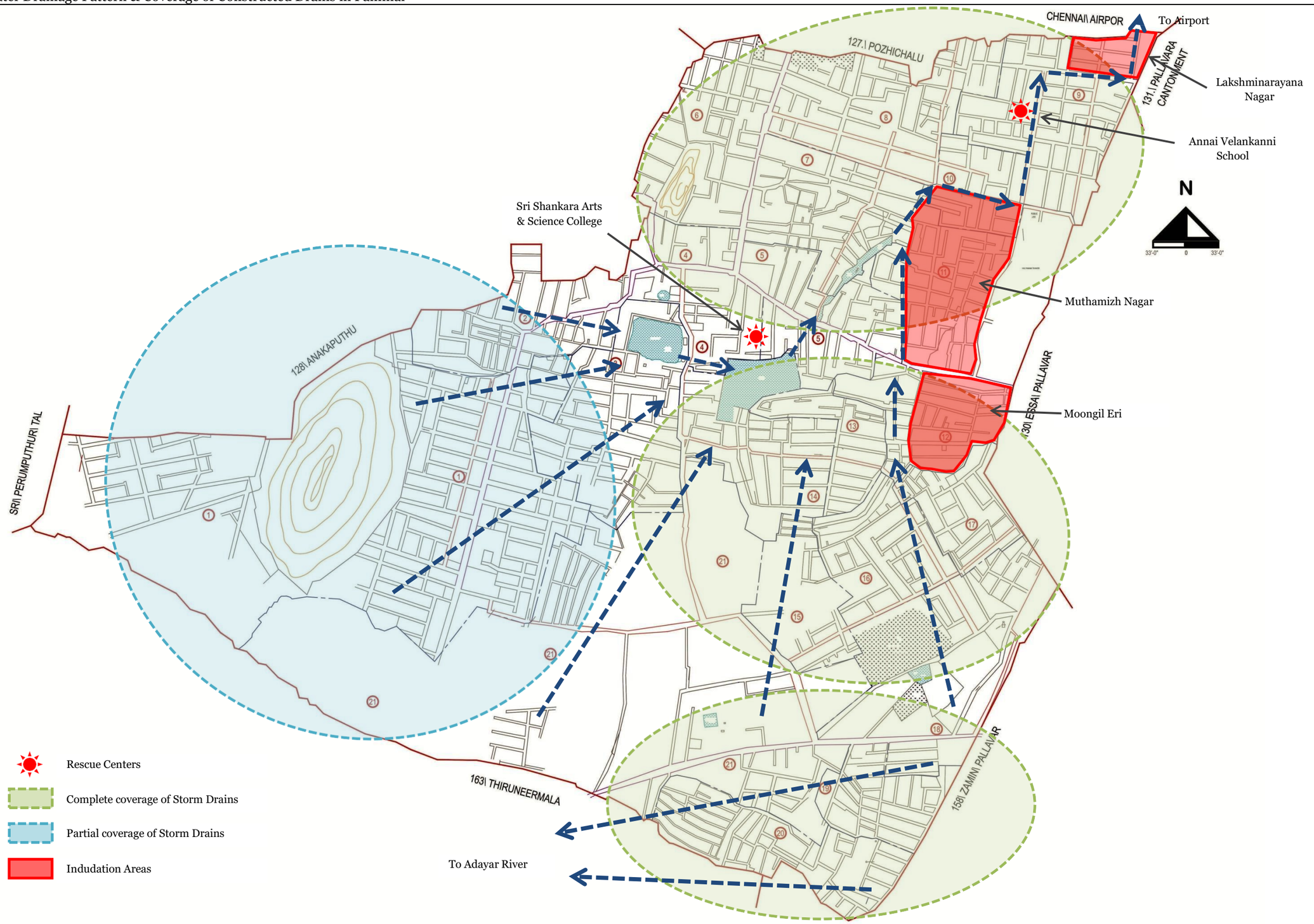
In deployment of staff for sanitary functions, solid waste management accounts for the major share, followed by drain-cleaning, as presented in Box 4.

Box 4: Staff Deployment in Public Health (Sanitation) Section in Pammal Municipality

One Sanitary Inspector is responsible for solid waste management in Pammal. He is assisted by two sanitary supervisors (one looking after wards 1 to 11 and the other 12 to 21). There are 93 sanitary workers operating under these supervisors. Out of the 93 workers, 25 are employed as office assistants and public toilet care-takers, 3 are on deputation and 5 to 10 remain absent each day leaving about 60 workers available each day. About 30 of them are deployed for solid waste collection in the 5 wards and the other 30 undertake drain cleaning in the entire town.

This means that monitoring the construction of toilets, as-built practices, and their regular de-sludging and maintenance, enjoys little priority and competent staff, leading to their neglect in the limited resources that the town has.

Map 3: Storm Water Drainage Pattern & Coverage of Constructed Drains in Pammal



Source: Pammal Municipality and IIHS Primary Study, 2015

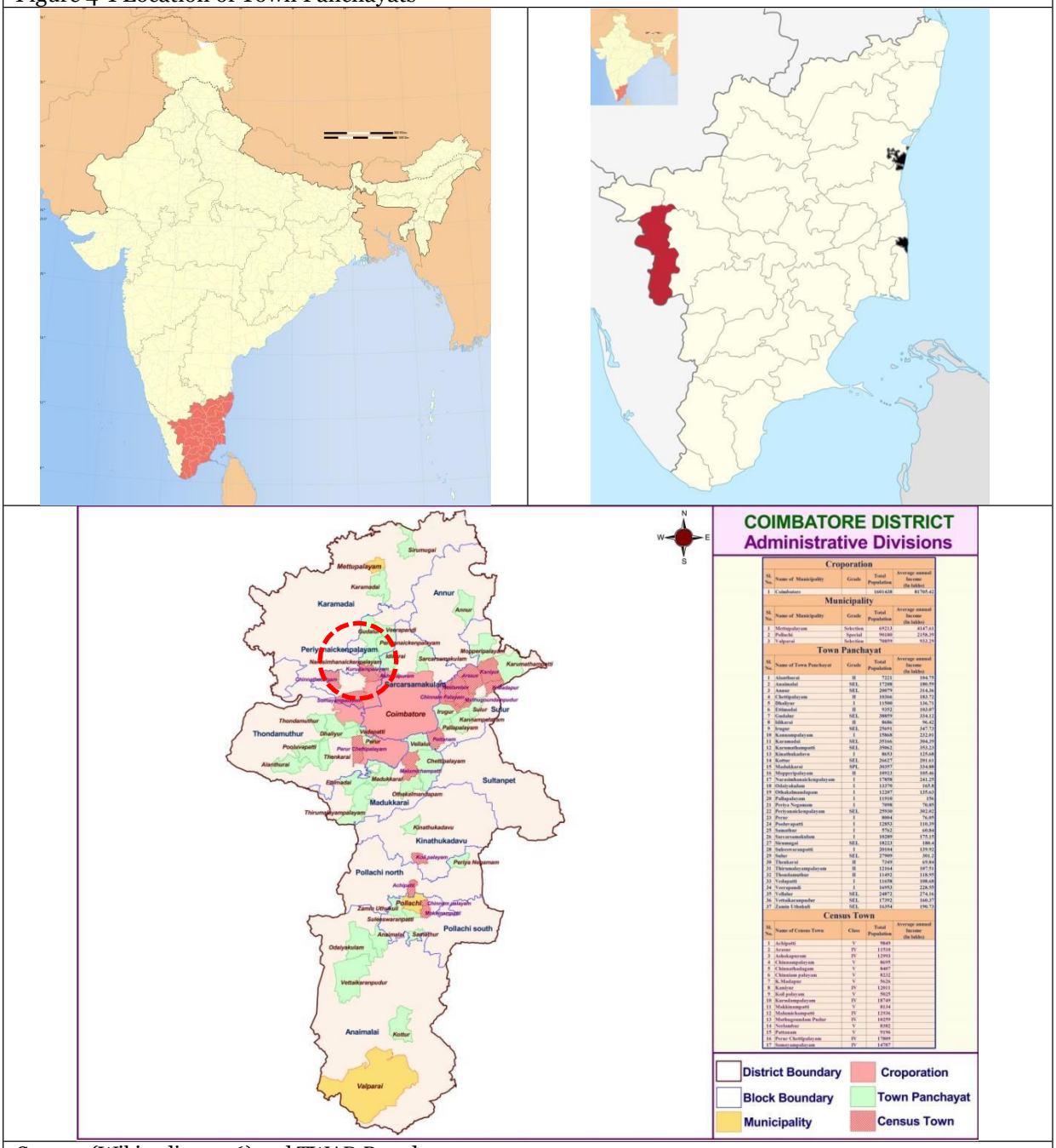
4 Profile of the Town Panchayats

4.1 Location of Town Panchayats Cluster

4.1.1 Location and Regional Context

The contiguous cluster of TPs consisting of Periyanaicken-palayam, Narasimhanaicken-palayam, Veerapandi (No. 4) and Idigarai are situated 17 km north of Coimbatore city. The Kousika river flowing east to west divides Periyanaicken-palayam and Narasimhanaicken-palayam. Idigarai is located in the east of the towns Periyanaicken-palayam and Narasimhanaicken-palayam and Veerapandi (No.4) is on the northern side of Periyanaicken-palayam.

Figure 4-1 Location of Town Panchayats



Source: (Wikipedia, 2016) and TWAD Board

4.1.2 Linkages and Connectivity

The major road is the Highway No. 67 running from Coimbatore to Gundlupete (near Hosur) via Ooty connects the towns of Periyanaicken-palayam and Narasimhanaicken-palayam to Coimbatore and Mettupalayam. Local roads radiating to the east from the highway connect Veerapandi (No. 4) and Idigarai. Veerapandi (No. 4) road running north to south connects Veerapandi (No. 4) to Periyanaicken-palayam and Idigarai.

Periyanaicken-palayam and Narasimhanaicken-palayam along the highway are well connected by buses (both government. and private buses) running between Coimbatore and Ooty and further north. Private busses connect the towns internally. A railway line between Coimbatore and Mettupalayam runs almost parallel to highway no. 67. A passenger train runs 5 times in a day. There is a railway station in Periyanaicken-palayam and Narasimhanaicken-palayam. The nearest airport is the Coimbatore airport which is well connected by domestic flights to various places in India and abroad.

4.1.3 Physiography and Topology

All the study towns are plain with a gradual slope from the west to the east. On the west is a Kurudi Hill range draining the rainwater falling on it creating a natural drainage system of a small river and streams passing through the study towns.

Figure 4-2 Kurudi Hill Range on the western side of the TP cluster

Source: IIHS Primary Study, 2015

4.2 Demographic and Socio-economic Profile of Town Panchayats

4.2.1 Population and Growth

A cluster of four TPs were covered as a part of this primary study. Details about the four TPs are not always comparable, but are being presented to cover the scope of contexts and issues. The population size of the TPs studied in Coimbatore ranges between 8,600 and 26,000 with an average household size of 4, similar to the State average.

Table 4-1 Population of Studied Town Panchayats

Sl. No.	Name of the Town Panchayat	Population (2011)	No. of Households
1	Periyanaicken-palayam	25,930	7,377
2	Narasimhanaicken-palayam	17,858	5,023
3	Veerapandi (No. 4)	16,953	4,740
4	Idigarai	8,686	2,491

Source: Census 2011

Periyanaicken-palayam showed a steady population growth at the rate of 20 to 30 per cent each decade from 1971 to 2001 but slowed down to a 14 per cent increase in the decade between 2001 and 2011. Narasimhanaicken-palayam town's population grew a maximum of 62 per cent between 1991 and 2001 and about 60 per cent in the following decade. It experienced steady growth of about 20 per cent between 1971 and 1991 (refer to Table 4-2 for details). The decadal population details of Veerapandi (No. 4) and Idigarai were not available.

Table 4-2 Population Growth in Periyanaicken-palayam & Narasimhanaicken-palayam

Year	Periyanaicken-palayam		Narasimhanaicken-palayam	
	Population	Decadal Growth Rate	Population	Decadal Growth Rate
2011	25930	14 %	17858	58 %
2001	22844	27 %	11271	62 %
1991	18043	21 %	6972	21 %
1981	14914	22 %	5779	19 %
1971	12200	-	4843	-

Source: Town Directory, 2001; PCA 2011

There is an even distribution of men and women in each of the towns, the sex ratio is in the range of 993 to 1000 which is equivalent to the state average of 1000. The population below the age of 6 is about 8 to 9 per cent of the total population, almost equal to the state average of 10 per cent. However, the sex ratio among children below 6 years varies in each town, Narasimhanaicken-palayam has the highest ratio of 1017 and Periyanaicken-palayam is the lowest with 894.

4.2.2 Literacy and Education

Periyanaicken-palayam and Narasimhanaicken-palayam have literacy levels marginally higher than the State average of 87 per cent, at 89 and 88 per cent respectively. Veerapandi (No. 4) has 85 per cent literate population and Idigarai reported 80 per cent. Male literacy

rates are near to the state average of 92 per cent in Periyanaicken-palayam and Narasimhanaicken-palayam but a little lower in Veerapandi (No. 4) and Idigarai. Female literacy is more than 80 per cent in 3 of the towns except Idigarai, having only 74 per cent.

4.2.3 Social Composition

About 14.2 per cent of urban TN belongs to Scheduled Castes; in urban Coimbatore the figure drops slightly to 13.3 per cent. These figures are however, below the overall state average of 20 per cent. In urban TN, Arunthatiyars constitute the largest single caste group, accounting for 50 per cent of the scheduled caste population. In urban Coimbatore, this group forms 38.7 per cent of the total population of Scheduled Castes, with Adi Dravidas adding to 18 per cent of the total. The portion of Scheduled Caste population in the study towns (Periyanaicken-palayam, Narasimhanaicken-palayam, Veerapandi & Idigarai) is in the range of 6 to 16 per cent. In the study towns, these two castes – Arunthathiyars and Adi Dravidas - again form the largest section according to Census 200 (Census 2011 data for Scheduled Castes and Tribes at the sub-district level, is awaited).

In the case of Scheduled Tribes, the figures for urban TN and urban Coimbatore stand at 0.4 per cent and 0.3 per cent. In contrast, the share of Scheduled Tribes in the overall state and district population is 1.1 per cent and 0.8 per cent respectively. The study towns have an even lower share of Scheduled Tribes in their populations- ranging from 0.03 per cent to 0.2 per cent. Kattunayakans and Irulas are the largest Scheduled Tribes in the share of urban population in the state, forming 23 and 21 per cent of all Scheduled Tribes. In urban Coimbatore, Irulas and Malasars are the numerically dominant amongst Scheduled Tribes, forming 26 and 25 per cent of all Scheduled Tribes. The Town Directory of 2001 lists Kurumans and Irulas as the largest tribal groups in the study areas.

Hindus are the dominant religious group, forming more than 90 per cent of the population in all the study towns. Christians account for a small portion and Muslims form an even smaller portion in the towns. More than half of the people speak Tamil in 3 of the towns except Veerapandi (No. 4) where 90 per cent speak Tamil. Telugu, Kannada, Malayalam and Urdu are also spoken in the study towns.

4.2.4 Workforce Participation

The workforce participation rate in the towns is in the range of 47 to 53 per cent, close to the State urban average of 44 per cent. Male workforce participation rate stands between 65 and 70 per cent, while female workforce participation rate is in the range of 27 to 35 per cent. Idigarai leads in workforce participation rate among the study towns.

A portion of main workers is in the range of 42 to 48 per cent of the total working population, about 60 per cent are male and the rest female. Marginal workforce ranges between 3 and 5 per cent of the total working population in the towns.

4.3 Connectivity and Transportation

4.3.1 Public Transport System

Periyanaicken-palayam and Narasimhanaicken-palayam have access to a good public transport system as the highway connecting Coimbatore and Mettupalayam goes through the towns. The frequency of buses to either ends is as high as one in every 10 minutes during the day time. The towns of Idigarai and Veerapandi (No. 4) are moderately connected by private buses.

Railway stations in Periyanaicken-palayam and Narasimhanaicken-palayam provide access to the passenger train running five times a day between Coimbatore and Mettupalayam.

4.3.2 Individual Transport System

According to the 2011 census, about half (44 to 51 per cent) of the households in the towns own a motorised two-wheeler. The ownership of a four-wheeler ranges between 5 and 9 per cent of the total households in the study towns.

4.4 Housing and Slums

4.4.1 Housing

A majority of the houses in TPs are to a level of ground or ground plus one floor above. There are few group houses and small apartments seen in Periyanaicken-palayam and Narasimhanaicken-palayam. Census 2011 data reports the predominant material, more than 50 per cent (except in Idigarai), for roof construction as concrete suggesting. Burnt bricks are mainly used for construction of walls in the towns (50 to 77 per cent), but a good proportion of households also use un-burnt or mud bricks for wall construction. Flooring is mainly made in cement or covered with mosaic or floor tiles in the house in the studied towns. Refer to Annexure 4 for details on materials used for the construction of houses in the towns.

The housing and settlement typologies in the Study TPs include slum-type settlements with structures (using thatch, tiles, cloth, etc., for roofing); stand-alone houses (with roofing materials of tiles and brick walls); stand-alone houses (with cement concrete roofing and burnt brick walls); and the emerging G+1/2 housing structures. This range of housing typologies probably corresponds to the historical evolution of these TP areas, but not necessarily amenable to planned/unplanned classifications except in some cases.

Plate 4-1 Housing typologies in Town Panchayats



Stand Alone Houses – Semi-Permanent and Permanent Houses in TPs



G+1 Households in the towns

Source: IIHS Primary Study, 2015

4.4.2 Slums

According to the 2011 census in the towns studied, about 7 to 12 per cent of the population lives in slums. The number of people living in any one slum ranges from 600 to 2000 across the towns. Veerapandi (No. 4) has the maximum portion of its population living in slums (12 per cent). The average household size of slums in all the towns is about 4 (not too dissimilar to the towns' average). Scheduled Caste families are predominant (almost 100 per cent) in the towns of Narasimhanaicken-palayam and Idigarai. In the other two towns, families belonging to the Scheduled Caste form between 20 and 40 per cent of the population. Refer Annexure 4 for details on slums gathered from the respective TP offices.

Plate 4-2 Urban poor house typology in Town Panchayats

Source: IIHS Primary Study, 2015

5 Urban Environmental Services in Selected Town Panchayat Cluster in Coimbatore

5.1 Water Supply

5.1.1 Household Arrangements for Water Supply

The physical coverage of piped water supply through treated source is very good in the study towns. The proportion ranges between 85 and 99 per cent. A CWSS supplies water to all the study towns. A small portion of supply comes from untreated sources too. A few households depend on either or both open wells and bore wells. Table 5-1 presents the water supply arrangements in the study towns according to Census 2011.

Table 5-1 Comparison of Water Supply arrangements in TPs, Urban TN & Urban India								
Sl. No.	**Source of Water**	**Units**	**Periyanaicken-palayam**	**Narasimhanaicken-palayam**	**Veerapandi (No. 4)**	**Idigarai**	**Urban TN**	**Urban India**
1	Tap water from treated source	%	97.9	99.0	85.9	95.1	66.3	62.0
2	Tap Water from untreated source	%	1.1	0.5	8.0	1.8	14.0	8.6
3	Wells	%	0.3	0.1	1.4	1.2	4.3	6.2
4	Hand pump/Tube well/Borehole	%	0.4	0.0	1.0	1.6	12.6	20.8
5	Surface water sources	%	0.1	0.0	0.0	0.0	0.4	0.7
6	Other sources	%	0.3	0.4	3.7	0.3	2.3	1.7
Source: Census 2011								

In Periyanaicken-palayam and Narasimhanaicken-palayam, most households are covered by piped supply within their premises, at 81 and 84 per cent respectively, and only a fraction of households depend on the nearby PSPs. In Veerapandi (No. 4) and Idigarai, more than half of the households have piped supply within their premises, but a sizeable proportion of households depend on PSPs, as presented in Table 5-2.

Table 5-2 Location of water supply in TPs in comparison with Urban TN							
Sl. No.	**Source of Water**	**Units**	**Periyanaicken-palayam**	**Narasimhanaicken-palayam**	**Veerapandi (No. 4)**	**Idigarai**	**Urban TN**
1	Within the premises	%	81.4	84.2	65.4	50.6	54.0
2	Near the premises (within 100 m)	%	17.9	15.3	32.3	41.7	40.2
3	Away (> 100 m)	%	0.7	0.5	2.3	7.7	5.7
Source: Census 2011							

5.1.2 Arrangements for potable water

a. Household Arrangements

The drinking water supply to the town is from a CWSS implemented by Tamil Nadu Water and Drainage (TWAD) Board. The main source of water is from Pilur Dam which is about 50 km away from the TP cluster in the Nilgiris. Using the difference in altitude, water flows into the towns by gravity in to the storage infrastructure, and further to the households and public taps.

In Periyanaicken-palayam, water reaching the town from the CWSS is stored in four Overhead Tanks (OHTs) with a total installed capacity of 1.74 MLD situated at various locations in the town, as presented in Table 5-3.

Table 5-3 Water Storage Infrastructure and Distribution in Periyanaicken-palayam

Sl. No.	Location of OHT	Capacity	Zone	Wards covered
1	Tiruvike Nagar	0.54 MLD	1	1, 2, 4, 18 and Part of 3
2	Raju Nagar	0.3 MLD	2	16, 17 and Part of 3
3	Housing Board	0.5 MLD	3	5, 11, 12, 13 and Parts of 10, 14 & 15
4	SRKV	0.4 MLD	4	6, 7, 8, 9 and Parts of 10, 14 & 15

Source: Periyanaicken-palayam Town Panchayat

The OHTs are filled up for about three times in a day, depending on the supply of water from the source, and supplied to the households through house service connections and few public taps accessed by urban poor. It is estimated by the TP officials that about 43 to 46 lakh litres of water is supplied through this CWSS.

The frequency of supply to localities under each OHT is once in three days for a duration of about 2.5 hours. For example, if there are 10 to 15 streets or localities under each OHT, though the supply of water to the OHT is continuous, the distribution to each locality is manually controlled and ensured that each of the street or locality gets water at the frequency and duration mentioned above.

b. Public Provisioning

Close to 35 PSPs are provided are convenient locations in the Periyanaicken-palayam to provide households that can afford a house service connection with access to drinking water. The frequency and duration of supply is same as that mentioned above.

Plate 5-1 Public Stand Posts delivering drinking water in Anna Nagar

Source: IIHS Primary Study, 2015

5.1.3 Arrangements for non-potable water

a. Household

A small proportion of households in the study towns, have private bore wells or wells where water is pumped and used for non-potable purposes. Data is not available on the extent of these private arrangements.

b. Public Provisioning

Since the water from CWSS is intermittent, in Periyanaicken-palayam, the TP has installed about 46 bore wells in the town to draw groundwater for non-potable use of public. Few of these bore wells cater to public toilets, government buildings and institutions in the town, but the majority deliver water to PSPs across the town. There are about 2,500 such PSPs connected to these bore wells and it is estimated that about 5,000 people depend on them in Periyanaicken-palayam.

In addition to the above mentioned bore wells, three public open wells with submersed pumps supply water through PSP to three to four streets in the town. There are three hand pumps also in the town used by the public.

Arrangement for water, both potable and non-potable purposes as described in sections 5.1.2 and 5.1.3 above are similar in the other study towns of Narasimhanaicken-palayam, Veerapandi (No. 4) and Idigarai with variations in capacities and numbers.

5.1.4 Water Tariffs

The TPs provide water service connections to households, establishments and industries from drinking water under the CWSS on paying a fixed one-time connection charges. Thereafter, a monthly user fee is levied for the usage of water. The rate fixed is a flat rate as volumetric metering is not available. The tariffs for three TPs under study are presented in Table 5-4.

Table 5-4 Water Supply Connection Costs in TPs

Sl. No.	Type of Connection	Connection Charge (`)	Monthly User Fee (`)
Periyanaicken-palayam:			
1	Household	3,000	60
2	Commercial	5,000	140
3	Industrial	5,000	200
Narasimhanaicken-palayam:			
1	Household	7,000	60
2	Commercial	11,000	135
3	Industrial	11,000	205
Idigarai:			
1	Household	6,000	65
2	Commercial	12,000	125
3	Industrial	25,000	185

Source: Respective town panchayat offices, 2015

Public water supply, i.e., through PSP (under CWSS); and non-potable water from bore wells, open wells and hand pumps; are all provided free of cost by the TPs.

5.2 Sanitation

5.2.1 Household Arrangements for Sanitation

According to the 2011 census, close to 83 per cent of households have individual household latrines in Periyanaicken-palayam. Of the remaining households, 13 per cent are dependent on public latrines while more than 3 per cent engage in OD. OD is reported to be common in slums. For instance, the proximity of Vivekanandapuram and Kuppuchipalayam to railway tracks and agricultural fields respectively, and difficulties in accessing individual and public toilets, are factors explaining the continuance of OD in these locations.

In Narasimhanaicken-palayam, 75 per cent of households in the town have individual household latrines within their premises, close to 25 per cent do not own toilets. Public latrines are reported to be serving more than 19 per cent of the town, leaving 5 per cent of households that practise OD. Most of the households on Balavinayagar Nagar in this TP for instance, are reported to be resorting to OD.

In Idigarai, only about 52 per cent of all households in the town have individual household latrines. OD is prevalent, with 26 per cent of households having no other sanitation option. The usage of public latrines is also high, with 21 per cent of all households reported to be using these. Most households in slum settlements do not have access to any sanitation facilities and defecate in the open.

About 72 per cent of households in Veerapandi (No. 4) have an individual household latrine. The remaining 28 per cent of households are equally split between using public latrines and having to resort to OD.

Slum Sanitation

Census 2011 reports that the slums of Idigarai have the highest OD rate of 96 per cent, followed by Periyanaicken-palayam with 17 per cent of slum population defecating in the open. Veerapandi (No. 4) and Narasimhanaicken-palayam have 14 per cent and 12 per cent of OD being reported from the slums.

Only slums of the two towns of Periyanaicken-palayam and Veerapandi (No. 4) have individual household latrines. The slums of Periyanaicken-palayam have the highest coverage of individual household latrine, i.e., 71 per cent of households have individual household latrines. In Idigarai, most households in slum settlements do not have access to any sanitation facilities and defecate in the open. The slums of Narasimhanaicken-palayam are heavily depending on public latrines, reported to be up to 88 per cent.

5.2.2 Household Arrangements in Study Households

e. Households with individual toilets

Among the 10 households studied by the team, 8 households have Indian pour flush toilets and two households have both western and Indian pan type. A rich landlord household (in Periyanaicken-palayam) reported five toilets in their house of which four were cistern flush western type, and one an Indian type within the premises for the visitors.

Three houses have recently constructed toilets in Periyanaicken-palayam and Narasimhanaicken-palayam. In Periyanaicken-palayam, two of the households built have toilets five years ago. Earlier they used to defecate in the open, and report that they needed time to plan financially and afford the construction of toilet. They reported having spent about ₹50,000 on the construction of their toilets.

All the study houses have latrines in working condition. Since all the latrines were built during the construction of the houses, with the exception of two households, respondents were unable to provide cost break-down exclusively for their toilets.

f. Households dependent on public toilets

In Periyanaicken-palayam, the team interacted with four households who use public toilets at Vivekanandapuram and Annanagar. The Vivekanandapuram public toilet has 6 seats for men, 6 women. One of the user families, with a house located about 200 m away, uses this toilet facility, but they have a bathroom in their house which they use for bathing and washing.

In Ward no 7, Annanagar, about 450 houses are located along the stretch of the storm water drain built on Poramboke Land[2] according to the residents. Only four of these houses have built toilets, and other households were constrained by lack of space, and are dependent on the public toilet provided at the end of the street. Concerns raised by these users included:

i. The number of users is high and hence the loading rate is high per seat.
ii. Due to over-loading, there is continuous odour problem.
iii. The sanitary worker deployed to clean, comes only on alternate days. He is an old man and suffers from illnesses and hence not able to look after the toilet adequately.
iv. Users also complained about irregular cleaning, and disinfectants not being used.

g. Households practicing Open defecation

In Veerapandi (No. 4), the team observed contrasting situations of people defecating in the open. In the two wards representing two different circumstances, people refuse to use public toilets; and others continue to defecate in the open in spite of having individual toilets. Box 5 presents some of the anecdotes of how OD is viewed by different stakeholder groups.

[2] A class of land meaning Wasteland for grazing etc.

Box 5: Open Defecation – constraints and practices

OD is a common sight along the railway station street in ward number 10 of Veerapandi (No. 4). The ward councillor for that ward (elected four years ago) has been struggling to convince and change the attitude of residents of Indranagar who refuse to use the public toilet built in Devinagar which is about 500 m away. Every day early morning she comes out for inspection but her efforts are in vain: 'controlling 250 people from defecating in the open is a huge number for a single lady'.

Ward X of Veerapandi (No. 4) has 250 households (with a population of 750) of which 50 houses have toilets. Of the remaining 200 households, about 150 households are from S-nagar who use the public toilet. The remaining houses are in Annanagar who refuse to use the public toilet and defecate in the open. They prefer usually early mornings from 5 am to 7 am, or late evenings when it is dark from 7 pm to 11 pm. The TP Chairman also requested assistance from factory owners nearby but this is yet to bear fruit.

The ward councillor of Ward No X admits that he and his family members do not use the toilet within their house. His family has shifted to this locality five years ago when government allocated land for people under the Basic Services for Urban Poor (BSUP) scheme. The toilet was built about a year ago and is connected to a soak pit. The family is not aware of how the toilet is constructed and the function of the soak pit hence, he feels by using the toilet, the wastewater from the toilet will overflow in front of his house as there is no drainage or provision made for sewage to flow. Now the toilet is used as a store room of fodder for cattle and sheep.

A detailed survey was conducted in Periyanaicken-palayam by the TP staff to identify households without toilets to plan for benefits under SBM, and also as a baseline assessment for a septage management project concept proposed by TWAD Board in 2014. It was identified that 1,118 households in Periyanaicken-palayam do not have toilets, but 542 out of these do not have space for construction of individual toilets. Therefore, a demand for construction of 576 individual toilets was proposed for this town. Under SBM, for the year 2015–16, a target of 86 toilets has been set by the TP officials for households. The applications were issued to the households, received and uploaded and are awaiting sanction from the State Govt. Ward wise details of households without toilets are included in the Annexure 4.

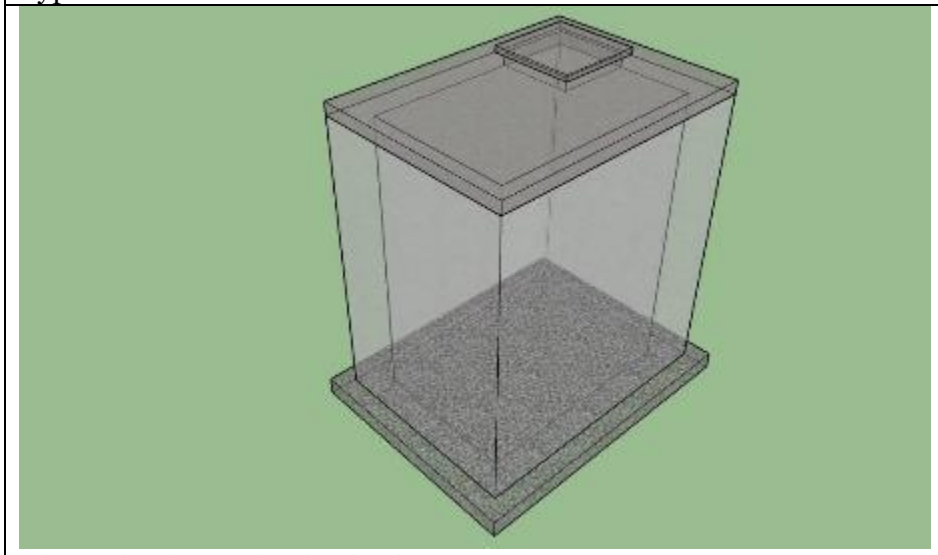
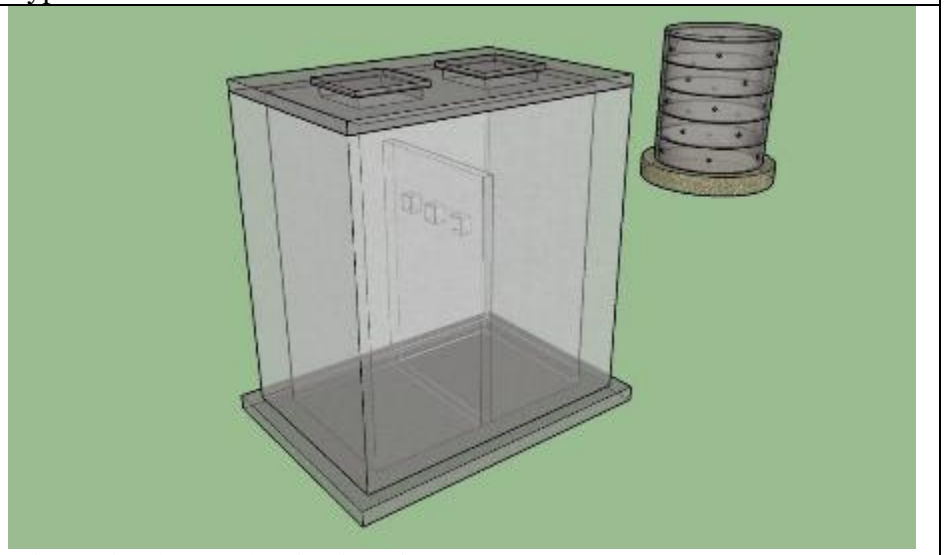
5.2.3 On-site Sanitation Systems

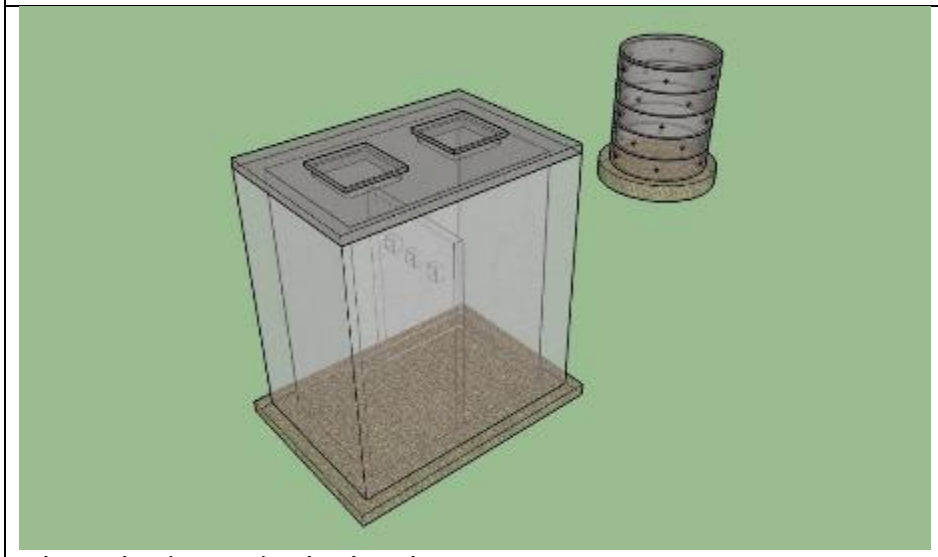
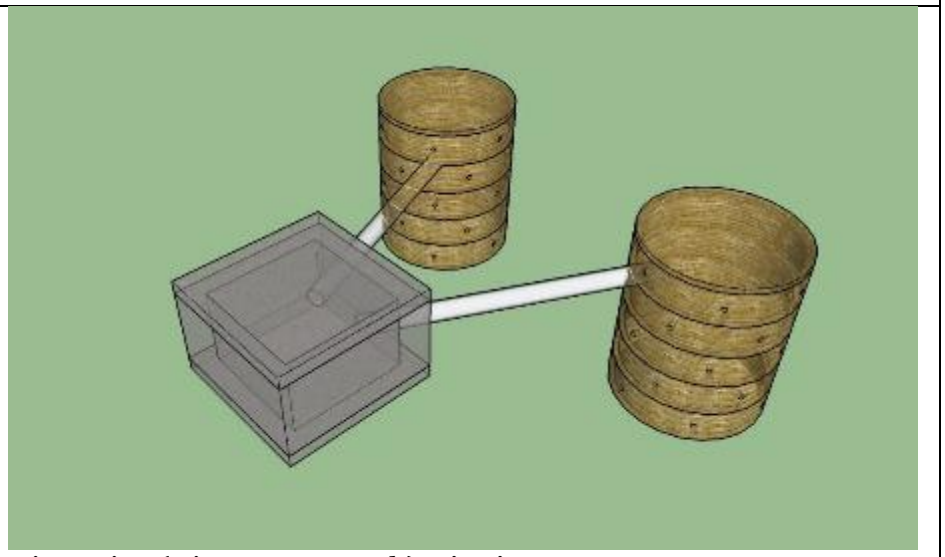
a. Type of on-site sanitation systems

From field observations, the predominant on site sanitation system appears to be the septic tanks. Based on interactions with local masons and builders, these can be further classified into Septic Tanks, Cess pits and twin pit latrines, as presented in Table 5-5.

Table 5-5 : Types of On-site sanitation systems						
Sl. No.	**Type**	**Name of the system**	**Shape**	**No. of Chambers**	**Water tightness**	**Outlet Arrangement**
1	Type I	Septic tank	Rectangular	Single chamber	Porous	No outlet
2	Type II	Septic tank	Rectangular	Double chamber	Water tight	Soak pit
3	Type III	Septic tank	Rectangular	Double chamber	porous	Soak pit
4	Type IV	Twin Pit	Circular	Single chamber	Porous	No outlet
5	Type V	Cess pit	Circular	Single chamber	Porous	Percolating to ground
Source: IIHS primary study 2015						

Please refer to Table 5-6 for illustration of the above mentioned on-site containment systems prevalent in the study TPs of Coimbatore.

Table 5-6 : Illustration and Description of Type of Septic Tanks	
Type 1:	Type 2:
	
Dimension(LxBxD): 6'x 4'x 8' Chambers: 1 Base: Porous Walls: Porous or Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (low and middle income group)	Dimension(LxBxD): 8'x 5'x 10' Chambers: 2 (partition wall at the center with holes) Base: Non-Porous Walls: Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: Yes (4'dia & 5'deep) Other details: Generally noticed in single or double dwelling units (middle or high income group)

Type 3:	Type 4:
 Dimension(LxBxD): 8'x 5'x 10' Chambers: 2 (partition wall at the center with holes) Base: Porous Walls: Porous or Non-Porous Top Slab: RCC Access Cover (Y/N): Yes Soak Pit: No Other details: Generally noticed in single or double dwelling units (low and middle income group)	 Dimension (Diameter & Depth): 4'x 8' Chambers: 2 (Twin Pits - used alternatively) Base: Porous Walls: Porous Top Slab: RCC, Thatch, Wood, etc. Other details: Generally noticed in single or double dwelling units (low income group)

Type 5: Cess-Pit	
 Dimension (Diameter & Depth): 4'x 8' Chambers: 1 Base: Porous Walls: Porous (made of stone) Top Slab: RCC, Thatch, Wood, etc. Other details: Generally noticed in single or double dwelling units (low income group)	
Source: IIHS Primary Study 2015	

Twin Pit Latrines

An example of a twin-pit latrine is to be seen in the house in Periyanaicken-palayam, who is a tenant in the house built by a temple trustee since 7 years. This house has a twin pit latrine where twin pits are laid adjacent to the toilet. Each pit is of 1.5 m Diameter and 6 feet deep. The first pit was cleaned 6 years back and the second pit was cleaned last year.

Plate 5-2 Twin Pit System in Periyanaicken-palayam

Source: IIHS Primary Study 2015

Septic Tanks

The standards prescribed for design and construction of septic tanks by CPHEEO and the BIS, and the actual practice on ground in the study TPs, in terms of structural masonry, septic tank size and design, and disposal systems, are presented in Table 5-7.

Table 5-7 : Design Norms vs Construction in Practice of Septic tanks

Sl. No.	Aspects of Septic Tank	Standard Design Norms	Observed construction practice
1	Structural Masonry	Septic tank functions as a solid–liquid separation tank which should hold sewage for about two days. The supernatant is to flow out and the solids to settle down and thicken at the bottom so that it can be removed after two to three years. As per CPHEEO standards, it is recommended that the septic tank should be constructed using cement concrete with water proofing. This is to avoid percolation by achieving water tightness.	Households prefer to just construct two walls and at the bottom use the Plain Cement Concrete plinth with a bed of 40mm coarse aggregates (a mixture of sand, rubble and crushed stones). This practice, according to local masons, facilitates increased holding time and delays period to de-sludging since sewage percolates due to the absence of water proofing.

Table 5-7 : Design Norms vs Construction in Practice of Septic tanks			
Sl. No.	**Aspects of Septic Tank**	**Standard Design Norms**	**Observed construction practice**
2	Septic Tank Size and Design	As per CPHEEO standards, the size of septic tanks is to be determined based on the household size and desired de-sludging frequency,	In practice, masons and builders are observed to oversize the septic tanks. The Study revealed that the size of the septic tank is a function of financial capability, space availability and the imperative to avoid frequent de-sludging. Hence, households prefer to build larger and deeper septic tanks if they can afford it and if they have sufficient space. According to masons, client households seek to avoid the recurring operational cost of de-sludging the septic tanks. Hence, masons build bigger tanks without bottom lining to make way for percolation. The de-sludging interval for ICC metal aggregates lined septic tank is expected to be once in four years.
3	Disposal Systems	There are two types of wastes generated in septic tank 1. Liquid effluent which comes out of outlet every day; 2. Settled solids in the form of sludge that needs to be removed once in two or three years. For the liquid effluent, treatment is deemed appropriate by methods like soak pits or dispersion trenches with the caution that these sub-soil dispersion systems shall be at least 20 m away from any drinking water source. The distance between the soak pit and adjacent dwelling is recommended to be at least 7 m to avoid any corrosive effect due to tank gases vented into atmosphere. Sludge needs to be emptied by mechanical vacuum tankers and should be sent for further treatment at sludge treatment units at sewage treatment plants	For liquid effluent, there are two categories of arrangements with outlet: earlier the septic tank outlets were let into storm water drains to receive the liquid waste. Now, TPs are attempting to get all such outlets sealed, and the drains only receive the sullage, i.e., kitchen and bathroom wash water. Soak pits: In order to avoid frequent de-sludging, the outlet of septic tank is connected to soak pits. Masons report providing soak pits at a distance of about 10 feet from the septic tank and about 20 feet away from the bore well in each house. One of the households, with G+1 floor has five toilets, for which a septic tank of L= 10ft X B = 8 feet X D = 10 feet is provided (at a construction cost of

Table 5-7 : Design Norms vs Construction in Practice of Septic tanks			
Sl.No.	**Aspects of Septic Tank**	**Standard Design Norms**	**Observed construction practice**
		or appropriate septage treatment facility. For this regular de-sludging, access covers need to be provided.	70,000 approximately). The mason has acquired this knowledge from his father. The septic tank has no baffle walls. It is under the house structure, and the dimensions are based on an intended de-sludging frequency of about five years. A soak pit is not provided as it is perceived to be not good for soil and de-sludging using cess pool vehicle is considered safer practice.
Source: CPHEEO, IIHS Primary Study 2015			

Community Septic tanks

Idigarai TP has an interesting case of a settlement at ward no 15 for a slum under BSUP scheme, where a community septic tank has been constructed a year ago with a biogas plant, but people refuse to get house service connections The reasons for this are:

i. Many BSUP houses are partially constructed, and people are unable to bear the full cost of construction, and hence, they continue to defecating in the open.
ii. The road in this settlement is made up of cement concrete which makes it very difficult to dig and lay house service connections. One of the government contractors however pointed out that residents were given six months to get their toilets constructed
iii. Some people feel that connecting to community septic tank will eventually create problems as it gets filled up, and they will have backflow inside their house.

Hence, out of the 200 houses in this settlement, very few have toilets with soak pits, and the rest continue defecating in the open.

Plate 5-3 Various Septic Tanks observed in the Town Panchayats

Source: IIHS Primary Study, 2015

Cess Pool/Cess Pits

A cesspool is a large structure consisting of concrete cylinder rings with an open bottom or perforated sides. It is usually a meter in diameter and four to five meters deep. It is covered with a hatch, and the sewage is kept in it till it automatically biodegrades. The solids are settled deep inside the base of the cesspool while the liquid percolates into the soil through the concrete. The difference between septic tank and cess-pool appear to be:

* Cesspools do not treat wastewater while septic tanks have sewage treatment options.

* Cesspools are underground well-like containers used for the storage of biodegradable substances while septic tanks are mainly used to store human waste and have a drainage facility. Plate 5-4 shows the design of a typical cess pit

Plate 5-4 Cess pits in TPs

Source: IIHS Primary Study, 2015

Box 6: Concrete rings for constructing cess-pits: at Idigarai

- Manufacturers of cess pit rings have started their business in Idigarai in recent months, after obtaining training in Singanallur. Concrete rings of different diameters ranging from 2 ft to 6 ft are made, for which pre-cast moulds of these diameters are available. The materials used are cement, jelly, sand and reinforced steel. The mixture is poured and allowed to settle for one week.
- About 20 pieces are sold in one month at a price of ₹350 per ring, including delivery and installation.
- These rings are not only used in constructing cess pits but also in water-holding sumps.
- Rings used for cess pit, are provided with holes. Holes are provided for the convenience of lifting and installing, and to allow sewage percolation.
- Rings are preferred over stone structures since the earth filling between the walls tends to get damp resulting in collapse of the structure collapses. Concrete rings do not collapse, and become stronger by absorbing moisture.

Source: IIHS Primary Study, 2015

The previous sub-sections show that there are considerable differences between the standards and designs prescribed, and what obtains in practice on ground. There are many similarities between the practices in Pammal and Coimbatore TPs, while local variations are there as expected.

Many of these divergences are critical to appreciate in improving the standards and performance of toilet containment structures. It is clear that while known as septic tanks, many of the structures and systems are indeed in the nature of pits, soak-pits, cess-pits or merely holding tanks with liquids being discharged regularly sub-surface or through drain-out systems into drains and open areas.

Apparently, popular perceptions and the construction practices ascribe the round or circular structures to being pits or soak pits, whereas rectangular structures, howsoever constructed, are deemed to be akin to septic tanks.

Box 7 lays out the prescribed procedure for building proper toilets and containment structures.

Box 7: Regulations Pertaining to Toilets in TPs

Building bye-laws and permissions at TP level play a key role in understanding the regulation pertaining to existence of household toilet and wastewater containment systems. The building permissions are approved by the EO of the TP under the TN Panchayat Building Rules, 1997 (there is no separate planning or building section in the office). The approval is limited to construction of up to 4,000 sq. ft. of residential and 2,000 sq. ft. of commercial buildings, and to a height of G+2 Floors. All building exceeding this built area need to seek permission from the District Town and Country Planning (DTCP) Office or the Local Planning Authority (LPA) in Coimbatore.

The key steps involved obtaining building permission from the TP Office are:

1. Submission of Application (Appendix-B) by the owner along with building plans, sale deed or documents indicating land ownership, etc.
2. The application should be endorsed by the Licensed Building Surveyor (LBS) empanelled under the TP office
3. The EO needs to conduct a site inspection (vacant land) and approve the building permission application, and issue an executive order
4. The land owner needs to pay 1 per cent of the building cost to the Manual Workers General Welfare Fund of the Tamil Nadu Construction Workers Welfare (TNCWW) Board Chennai before final approval
5. The owner of the land starts the construction of the building

The presence of toilets and septic tank details in building application and drawings is a mandatory in both commercial and residential buildings proposed. However, the approval process needs much to be desired, and actual as-built construction of toilets or septic tanks is currently not monitored by the TP office before the building is put into use.

Hence, the above information underlines the fact that households, masons and builders, as well as enforcement agencies suffer from deficits that has resulted in the current situation. This information also highlights the need for considerable re-orientation and re-education of customers, masons and builders, as well as better resourcing, staffing, and procedures of approving, enforcement and regulation agencies.

5.2.4 Transportation of Septage in Study TPs

About a decade ago, in Periyanaicken-palayam, septic tanks outflow was typically let out into open drains. This practice was sought to be stopped by sealing such structures. However, many households do not have properly constructed tanks. The town has a de-sludging truck but this is typically used for removing the water from public toilet tanks. Much of this is reported to be disposed of in agricultural fields with consent of the farmers. Apart from farm-lands, some of the de-sludging trucks are also periodically reported to be disposing septage in open areas. In Narasimhanaicken-palayam, the TP is in process of identifying land for disposal of septage.

Plate 5-5 Cess-Pool Vehicle operating in Idigarai

Source: IIHS Primary Study, 2015

5.2.5 Treatment of Septage

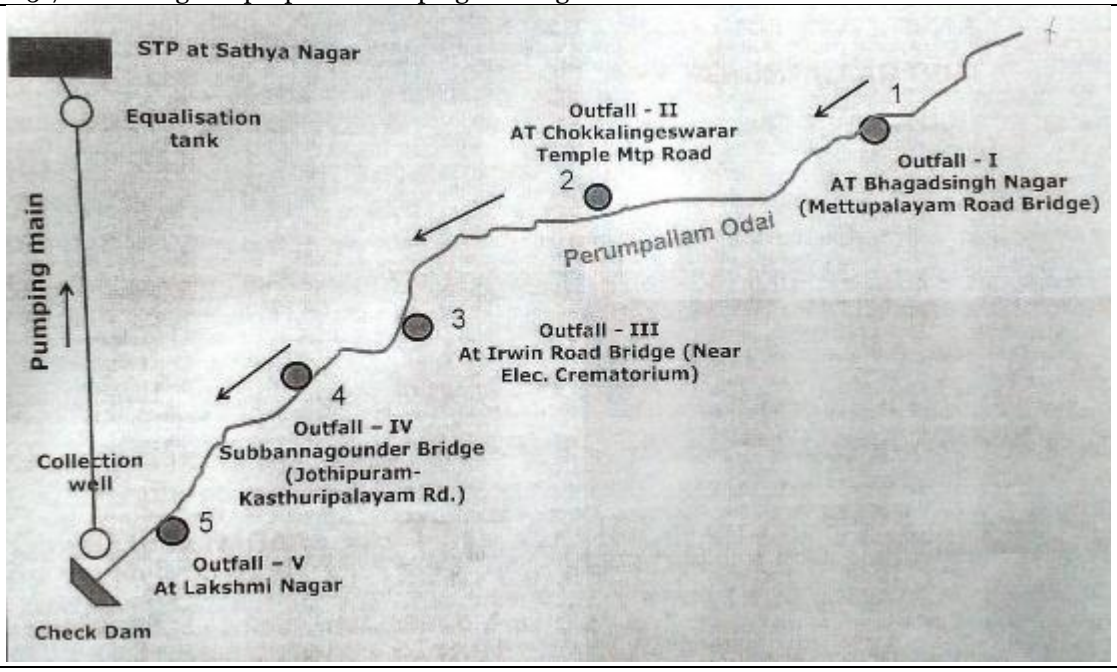
During the field visits it was observed that the septage collected by the cess-pool vehicle (both ULB's and Private) discharge the waste in to agricultural lands. Farmers request for the septage as it is rich in nutrients. The discharged septage is allowed to completely dry up and the land is ploughed and cropped.

Plate 5-6 Land Application of Septage in Farm Lands as Soil Conditioner in Periyanaicken-palayam

Source: IIHS Primary Study, 2015

At present, there are no sewage or septage treatment facilities in or around these TPs (Coimbatore STP being the closest facility). IIHS team's interactions with the Assistant Engineer from the ADTP office revealed that the TWAD Board has proposed a concept plan for sewage management in Periyanaicken-palayam in 2014. The main outfalls into Perumpallam Odai (main storm drain) are identified, and it is proposed to intercept the flow at the check dam, collect the wastewater in an existing well, and pumps it to the STP site. Refer to Plate 5-7 for the project concept diagram. The STP is proposed to be situated at the old solid waste resource recovery park at Sathya Nagar (Cost details shown in Table 5-8)

Plate 5-7 Flow Diagram proposed in Septage Management DPR



Source: Septage Management DPR, 2014

Table 5-8 : Cost Abstract of DPR for Septage Management Proposed by TWAD Board		
Sl. No.	**Description**	**Amount (` in Lakhs)**
1	Cleaning, removal of debris, de-silting, etc., at Perumpallam Odai	10.00
2	Pumping station at Lakshminagar	157.14
3	Pumping station at common collection well	51.87
4	Construction of STP	274.10
	Sub-Total (1)	493.11
5	Contingency Charges @ 1%	4.93
6	Unforeseen Charges @about 2.5%	12.33
7	Provision for Road Restoration Charges to be paid to SH, NH, Railway Crossing, etc.	107.00
	Sub-Total (2)	617.37
8	Centage Charges @ 5%	30.87
	Sub-Total (3)	648.24
9	Preparation of DPR @ 1%	6.48
	Grand Total	**654.72**
Source: Asst. Engineer, ADTP, In-charge for Periyanaicken-palayam		

The proposal is currently under consideration of the Government Small scale treatment systems are being tried out in different locations in and around Coimbatore, one being a site inside a residential complex in Idigarai.

Another example of innovation is observed in an integrated campus level management of wastewater and reuse, Periyanaicken-palayam, as presented in Box 8.

Box 8. Sri Ramakrishna Mission: Industrial Training Institute (ITI) in Periyanaicken-palayam

The Ramakrishna Mission has started a group of educational institutions from schools to diploma level in 150 acres of land on the main road of Periyanaicken-palayam. The interaction with one of the training officer there in ITI revealed that they have a full cycle of septage management in place. In ITI, the strength is 400 students with accommodation facility. The campus has 100 urinals and 10 toilets connected to a septic tank and two soak pits of 2 m dia. The septic tank was built ten years ago, and is 20 feet long and 20 feet deep. A separate collection tank is provided for wash water from urinals which is used for gardening.

The Institution has its own cess-pool vehicle which de-sludges septic tanks and disposes the septage in their own agricultural land spanning 365 acres.

5.3 Solid Waste Management

Solid waste management is carried out by TPs with support from NGOs in the study towns. Currently, no user fee is charged by the TPs for solid waste management.

d. Collection and Conveyance

The waste is collected through a door-to-door collection system. Tricycles and Mini Trucks are used for collection of waste from households and establishments, in these towns. Waste from the tricycles and mini trucks, is loaded in to tractors or tipper lorries, and then transported to the compost yards, called Resource Recovery Parks.

Plate 5-8 Vehicles used for solid waste collection in TPs

Push Carts collecting waste from door to door and transferring in to Tipper Lorry for transportation to the resource recovery park in Periyanaicken-palayam

Source: IIHS Primary Study, 2015

In addition to door to door collection, TPs have also placed community bins across the towns at various commercial spaces, markets, main roads etc. Wastes from these bins are collected by the tractors or tipper lorries, and is transported to the Resource Recovery Parks.

e. Treatment and Disposal/Reuse

Organic wastes are segregated at the compost yards is treated by windrow composting methods. The compost produced is sold out to farmers in the surrounding areas.

The old resource recovery park situated at Sathya Nagar which spreads across 1.5 acres is not being used currently since the inception of the new Solid Waste Management (SWM) site near the housing board layout in the town. It is reserved for the construction of STP under the scheme proposed by TWAD board discussed earlier under 5.2.5.

Plate 5-9 Solid Waste Management sites in TPs

Compost Yard of Narasimhanaicken-palayam

Compost Yard of Veerapandi (No. 4)

Source: IIHS Primary Study, 2015

Table 5-9 summarises the solid waste management practices across the study TPs.

Table 5-9 Snapshot of Solid Waste Management in TPs

Component of SWM	Periyanaicken-palayam	Narasimhanaicken-palayam	Veerapandi (No. 4)	Idigarai
Existence of door to door collection	Yes	Yes	Information not available	Yes
Coverage	All 18 Wards (8410 HHs)	12 out of 15 Wards (5415 HHs)	Information not available	13 out of 15 Wards (2385 HHs)
Quantity Collected	8.5 MT	4 MT	Information not available	1 MT
Source Segregation	Only in Ward No. 7	No	Information not available	No
Vehicles used for Primary Collection	Push Carts	Mini Truck (Ape)	Information not available	Push Carts
Vehicles used for Secondary Collection	Tractors, Mini Truck and Tipper	Tractors	Information not available	Tractors
No. of Community Bins	NA	15	Information not available	15
Where is the collected waste transported to	Resource Recovery Parks	Compost Yard	Resource Recovery Park	Compost Yard
Is the waste treated	Yes	Partially	Yes	Yes
What is the method of treatment	Windrow and Vermi-Composting	Windrow Composting	Windrow Composting	Windrow Composting
Disposal of waste without treatment	No	Partial	No	No
User fee for SWM services	No	No	No	No

Source: Respective town panchayat offices, 2015

5.4 Storm Water Drainage

c. Natural storm water drainage

The surface run-off from the Kurudi Hill Range on the western side of the study TPs' cluster, creates the dominant natural drainage pattern existing in the area. One of the main carrier is the Kousika River that runs from the foot hill (north of the Central Reserve Police Force (CRPF) Training College in Narasimhanaicken-palayam), dividing Periyanaicken-palayam and Narasimhanaicken-palayam, and flows eastwards through Idigarai and further to as far as Tirrupur. Another stream originating from the foot hills, runs north east to Periyanaicken-palayam and through Veerapandi (No. 4), and further to Karamadai and beyond. A third stream flows from the hills through southern side of Narasimhanaicken-palayam and drains in to the Kousika River.

Plate 5-10 Main Constructed Storm Water Drains in Periyanaicken-palayam and Narasimhanaicken-palayam

Main Storm Drain of Periyanaicken-palayam

Main Storm Drain of Narasimhanaicken-palayam

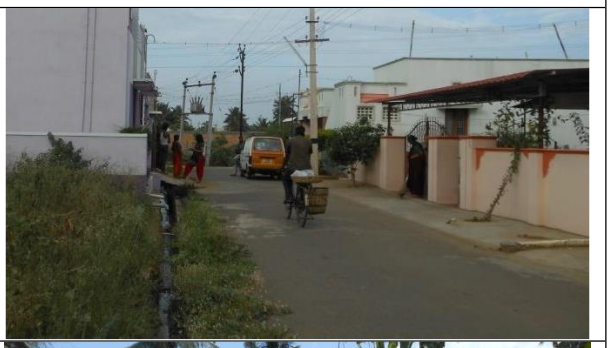
Check Dam on the Kousika River in Narasimhanaicken-palayam

Source: IIHS Primary Study, 2015

d. Constructed drains

There is a good coverage of constructed surface storm drains in all the study TPs, as presented in photographs from these towns.

Plate 5-11 Surface Storm Water Drains in TPs

Source: IIHS Primary Study, 2015

6 Conclusions

The Secondary Review had highlighted the following issues for validation and further study as a part of the Primary Study:

- Issues of access
- Full cycle of sanitation
- Water stress
- Public health outcomes
- Behaviour change
- Knowledge generation
- Institutional priority to urban sanitation and financing

The fore-going Sections have highlighted a number of salient features in respect of access and the full cycle of sanitation:

1) Open Defecation: It is quite clear that issues of access to sanitation, and the practice of OD are important issues in urban TN. Study locations show that there are larger deficits in the small TPs compared to the municipalities, but these also point to two important issues. One, the nature of settlements, especially slums prevent individual household toilets because of space and affordability constraints. These render communities to be dependent on community and public toilets where these are available. Availability too may not translate into regular use if these toilets are no maintained and managed properly, as reported from many locations. Two, there is also reportage of members resorting to OD even in households that have toilets. While cultural factors are used to explain such behaviours, many are also related to perceived imperatives to reduce load on own toilets, and hence prolong the period to de-sludging.
2) Toilet Design, Construction and Containment: In both the study locations, there is considerable divergence noted between prescribed standards and actual practices. One, the study shows the considerable sub-types and variations of containment structures, a recurring theme being porosity of base and side walls and typical over-design for size to avoid de-sludging for long periods of time. Two, unlike popular perception, many of these structures are not septic or safe containment mechanisms, but may be actually in the nature of pits, soak-pits, cess-pits or merely holding tanks with liquids being discharged regularly sub-surface or through drain-out systems into drains and open areas. Apparently, popular perceptions and the construction practices ascribe the round or circular structures to being pits or soak pits, whereas rectangular structures, howsoever constructed, are deemed to be akin to septic tanks.
3) De-sludging and Conveyance: at present, de-sludging services are provided by private operators, and some ULBs have their own vehicles too. The equipment used include basic trucks fitted with suction pumps, and safety gear does not seem to be used. Sludge operators report a number of difficulties including unwillingness of households to clean regularly, non-existence or very distant availability of locations to empty sewage, and other barriers to their operations. Regulation has also reported to have been lax leading to disposal of sewage in non-designated areas. De- sludging seems to be enjoying a negative perception amongst households to be avoided as much as possible. This part of the chain requires considerable

strengthening both from the supply and demand side, supported by regulatory frameworks that promote desirable safe conveyance practices.

4) Treatment and Safe Disposal: At present, there are only a few STPs in or near the study locations. Hence, the bulk of septage cleared from septic tanks is reported to be emptied in farm fields with consent of farmers who utilise this as manure. The lack of STPs or emptying points nearby seems to be the biggest constraint to safe treatment and disposal.
5) Linkage with other environmental services: the linkages of sanitation with other environmental services viz. water supply, solid waste management, and drainage, are located in the urban settlement pattern in these study locations. The links of containment structures with drainage is quite obvious when drains become repositories of not just sullage but also fecal matter. Recent attempts to seal open discharge of toilets into drains appear to be bearing results, it is not clear whether and to what extent sub-surface leakages find their way into drains, and pollute groundwater. These issues will need further investigation.
6) Institutional and related issues: As highlighted in the Secondary analysis, the institutional capacities of ULBs, especially the TPs, are limited. Further, the available resources for sanitation are claimed a large measure by solid waste management, that is much more visible to all stakeholders. It will take considerable effort, human and financial resources, to accord institutional priority to the full chain of human excreta management, from improved construction and maintenance of containment structure, to improved de-sludging and conveyance, to finally, safe disposal and treatment.

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