Panjappur STP, Trichy
Co-treatment Case Study

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A. City Profile

Tiruchirappalli, also known as Trichy, is the fourth largest city in Tamil Nadu[1]. Located along the Cauvery River delta, Trichy is a centre for trade, education, pilgrimage along with being the administrative headquarters of Tiruchirappalli district[2]. The presence of a large number of energy equipment manufacturing units in and around the city has earned it the title of "Energy equipment and fabrication capital of India"[3].

Spread over an area of 167.23 km^2, Trichy had a population of 0.847 million (number of households was 0.214 million) in 2011[4]. The daily floating population was estimated at around 0.25 million (in 2016)[5].

Access to Sanitation: As per Census 2011, 81 percent of households in Trichy had Individual Household Latrines (IHHLs). Further, while 14 percent of households were using public toilets, the remaining 5 percent were defecating in the open. (For details refer Annex 1).

The city has around 450 Community Toilets (CTs) which are being operated and maintained with the help of women's self-help groups[6]. In December 2016 Trichy was declared Open Defecation Free (ODF).

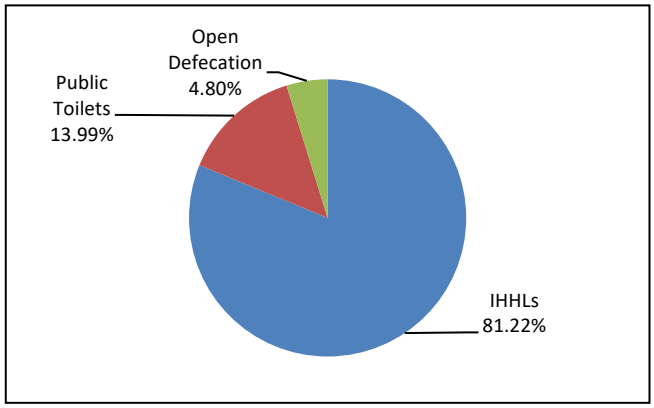


Figure 1: Access to toilets in Trichy (Census, 2011)

Sewage collection and conveyance systems: As per Census 2011, 56 percent of households (96,752) in the city were connected to Underground Sewerage System (UGSS). Wastewater from households (and establishments) connected to the UGSS is transported through a network of sewers[7]. The collection system includes 2 Main Pumping Stations (MPS), 24 Sub Pumping Stations (SPS) and 26 Lift Stations (LS). The collected sewage is conveyed to the centralized Sewage Treatment Plant (STP) at Panjappur. While 60 percent of the CTs are connected to UGSS, the remaining 40 percent are connected to septic tanks[8].

Of the 65 wards in the city, 25 are fully covered with UGSS while another 25 are partially covered and 15 wards are presently uncovered[9]. In terms of geographical area, only 12.95 km^2 (8 percent) is fully covered by UGSS, 51.31 km^2 (31 percent) is partially covered and 102.97 km^2 (62 percent) is completely non-sewered[10]. The fully covered areas coincide with the core city area. (For a map of areas covered by UGSS refer Annex 2) Although Trichy – Srirangam scheme, the most recently implemented sewerage scheme, covered Srirangam – Golden Rock zone and non-sewered parts of

[1] After Chennai, Coimbatore and Madurai
[2] Source: SFD Report Tiruchirappalli 2016, A Report prepared by Centre for Science and Environment as a part of the SFD Initiative.
[3] Ibid.
[4] Source: Census 2011
[5] Source: SFD Report Tiruchirappalli 2016, A Report prepared by Centre for Science and Environment as a part of the SFD Initiative.
[6] Source: https://timesofindia.indiatimes.com/city/trichy/trichy-declared-open-defecation-free-after-survey/articleshow/56270842.cms
[7] Network length is 441.93 km; Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement, Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[8] 233 are connected to sewerage network while 151 are connected to septic tanks. Source: SFD Report Tiruchirappalli 2016, A Report prepared by Centre for Science and Environment as a part of the SFD Initiative.
[9] Source: Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[10] Ibid.

the core city, the areas on the periphery of the TCC limits remains non-sewered and rely on onsite sanitation systems[11].

As per Census 2011, approximately 34 percent of the households (58,995) in Trichy were connected to septic tanks. As per the SFD Report for Tiruchirappalli (2016) the design of septic tanks does not adhere to the design prescribed by Bureau of Indian Standards (BIS) and is in fact decided based on the space available and the discretion of local masons. The effluent from the septic tanks flows into open drains[12]. Septic tanks are desludged as and when required and desludging services are largely provided by private desludging operators. There are around 32 operators with 41 trucks of varying capacities ($4m^3$ – $8m^3$) operating in Trichy. The emptying fees charged to households ranges from INR 1,000 to 3,500 per trip[13]. Apart from private desludging operators, Tiruchirappalli City Corporation (TCC) operates an emptier of $4m^3$ capacity collecting ~0.756 million litres of septage per month through 190 trips[14]. A study on Sewage and Faecal Sludge Treatment in TCC has estimated that between 230 to 576 m^3/day[15] or 0.23 to 0.576 MLD of septage is generated in the city[16].

Sewage Treatment Facilities: The city has only one STP at Panjappur, which has an installed capacity of 88 MLD. The plant has two treatment trains of 30 MLD and 58 MLD respectively, of which only the 58 MLD plant is functioning at present.

- 30 MLD Plant: The plant was constructed in 1987 and was based on a lagoon system. It was augmented in 2003, by providing pre-treatment units and anaerobic ponds, under National River Action Plan (NRAP).
- The 58 MLD STP: The plant is based on a Waste Stabilization Pond (WSP) technology.

Trichy also has decentralised wastewater treatment systems serving group of households such as apartments/ colonies, community toilets.

Institutional Arrangements: Multiple institutions are involved in management of sewerage services in Trichy. While TWAD Board is responsible for planning, designing and construction of the sewerage system, TCC is responsible for its operation and maintenance. Private desludging operators and TCC are both responsible for septage management. The TCC licenses private desludging operators and allows them to decant septage in four SPSs which function as decanting stations. In addition, Tamil Nadu Pollution Control Board (TNPCB) is responsible for monitoring and evaluation of STPs.

City's plans for sanitation: As noted above the city has large areas that are yet to be covered by UGSS. TCC continues to upgrade its sewerage system through a phased approach which is likely to result in a significant increase in safe collection, conveyance and treatment of sewage. A plan for augmenting the sewerage infrastructure in the city, funded under AMRUT, has three phases which includes installation of sewer pipeline; construction of SPS and LS; rehabilitation of an existing 30 MLD Treatment Plant at Panjappur and construction of two new STPs at Kelakalkandar Kottai (32 MLD) and Kulumani (22 MLD) using Moving Bed Bio Reactor (MBBR) technology.

[11] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[12] Source: SFD Report Tiruchirappalli 2016, A Report prepared by Centre for Science and Environment as a part of the SFD Initiative.
[13] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[14] Ibid.
[15] 2 years cleaning frequency (180 septic tanks per day) 576 m^3, 3 year cleaning frequency (120 septic tanks per day) 384 m^3 and 5 years cleaning frequency (72 septic tanks per day) 230 m^3
[16] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017

B. Co treatment – Genesis

Trichy initiated co-treatment by allowing decanting of septage at pumping stations in 2012. Initially three SPSs were designated as decanting stations and a fourth one was added in May 2017. The four decanting stations are Anna Stadium, Thanjavur Road, Vayalur Road, and Vasudevan Street. Septage emptied at these decanting stations is conveyed to the Panjappur STP for further treatment through the existing sewerage system.

Even prior to the setting up of decanting stations, the Panjappur STP had a provision for private desludging trucks to discharge septage in the facultative ponds. The tipping fee was INR 80 per truckload. This facility has been discontinued and decanting is being carried out only at the four decanting stations.

The main driver for initiating co-treatment was the fact that majority of the households in the city were connected to on-site sanitation systems and private operators involved in desludging septic tanks were dumping septage into the city's open areas and water bodies. The TCC wanted to put an end to the unauthorised dumping of septage and the resultant pollution of the city's open areas and water bodies.

The Government of Tamil Nadu (GoTN) in its "Operative Guidelines for Septage Management for Urban and Rural Local Bodies, 2014" (hereafter referred to as Operative Guidelines) has identified Trichy's STP to serve as a regional facility for treating septage of Trichy, one Town Panchayat (Kuthapur) and four Panchayat Unions (Andanallur, Manikandam, Thiruverambur and Manachanallur). While there is no restriction on decanting of septage originating from the above mentioned areas, most of the septage loads arriving at the decanting stations are originating from within the TCC limits.

Households dependent on septic tanks rely on private desludging operators for emptying, transporting and disposing the collected septage. As per the Operative Guidelines only certified and licensed septage transporters are authorised to desludge and transport septage to the STP designated for co-treatment. In line with these provisions, all private desludging operators operating in Trichy have to obtain a license from the TCC. As per TCC's Council Resolution No 20, license fee of INR 2,000 is collected on a truck basis every year. In 2016-17, there were 27 operators and 35 trucks which were licensed by the TCC and this number has increased to 32 operators with 41 trucks in 2017-18. The emptying fees charged to households ranges from INR 1,000 to 3,500 per trip[17]. The tipping fee has been fixed at a nominal INR 30 / truckload. CTs existing in the city limits are emptied by TCC owned desludging trucks.

C. Co-Treatment at Panjappur STP

Plant Background

Co-treatment of septage is being undertaken at Panjappur STP. The plant site, which sprawls over 498 acres[18], is bounded on the west by Madurai road and on the east by River Koraiyar. The STP serves the parts of the city which are fully (12.95 km^2) and partly covered (51.31 km^2) by UGSS. Estimates suggest that approximately 44,000 house connections are served by the STP, each connection serves multiple households.

Panjappur STP has two treatment trains of 30 MLD and 58 MLD respectively. While the total installed capacity is 88 MLD, only 58 MLD train is functioning at present. The 58 MLD plant is based

[17] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017

[18] Of this only 30 acres are currently being used for disposal of construction and demolition wastes

on a Waste Stabilization Pond (WSP) technology. The plant has screen chamber, grit chamber, 2 anaerobic ponds, 2 facultative ponds and 2 maturation ponds. (Refer Annex 3) The sewage from the city reaches the STP through two separate lines from each of the MPSs. Combined sewage and septage flows ranging from 45,000 to 50,000 m^3 per day i.e., 45 – 50 MLD are received and treated at the STP. There is a spare capacity of ~8 – 13 MLD available at Panjappur.

The treated wastewater from the STP is discharged into the Koraiyar River and finally flows into river Cauvery. At present, the treated waste water is not being reused.

Planning and Implementation of Septage Co-treatment

There are 32 operators with 41 trucks of varying capacities ranging from 4m^3 – 8m^3 operating in Trichy. Table 1 presents details of the areas covered by private desludging operators in Trichy. These areas are not covered by UGSS and most households depend on on-site sanitation systems. Typical fees levied for desludging septic tanks varies from INR 1,000 to 3,500 per trip.

Table 1: Areas covered by private desludging operators zone / decanting station wise[19]

Decanting station	Areas covered by private desludging operators
Anna stadium	Ward Numbers 30,31, 33 to 39, 47 Kajamalai- JK Nagar, Kalkandar kottai, G-Corner, Subramaniapuram, Ponmalapatti, Karumandapam, KK Nagar, Airport, Gundur, Mathur and Puthur
Vayalur road	Srinivasan nagar, Uyyakondan, thirumalai, Woraiyur and Thillai nagar
Thanjavur Road Pookkollai	Kattur and Thiruvarmbur
Vasudevan Street	Data not available

Volume and Quality of Septage

A study on Sewage and Faecal Sludge Treatment in TCC has estimated that between 230 to 576 m^3/day[20] that is 0.23 to 0.576 MLD of septage should be generated in the city if regular cleaning of septic tanks is done[21]. On an average about 80 trucks of 6m^3 capacity dispose of septage at the four decanting stations on a daily basis which translates to 0.48 MLD[22]. The septage dumped at decanting stations (0.48 MLD) is 83 percent of the 0.576 MLD of septage that should be generated.

There is no system for assessing the quality of septage at the decanting stations. Thus it is not possible to make any deduction about the quality of septage decanted.

Infrastructure Investments and Operational Changes for Co-treatment

Decanting Station: There are four decanting facilities located within the city limits. These are Anna Stadium, Vayalur Road, Thanjavur Road (Pookkollai) and Vasudevan Street located in the zones of Ponmalai, K-Abhishekapuram, Aryamangalam and Srirangam respectively.

In all decanting stations, the existing infrastructure was that of an MPS as a part of the existing UGSS that pumps sewage to the centralised STP. The Vayalur Road and Thanjavur Road pumping stations were constructed under the 1987 Scheme of UGSS, and Anna stadium and Vasudevan Street were constructed under 2008 Scheme of UGSS. In 2012-2013, the pumping stations were converted to decanting facilities with addition of a chamber or a storage tank that could receive the septage from private desludging trucks. The decanting stations were provided with screens and grit removal units and the septage undergoes preliminary treatment before being mixed with sewage and being conveyed to the STP at Panjappur.

[19] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[20] Ibid.
[21] Ibid.
[22] Ibid.

A recent assessment[23] of the preliminary treatment units (screen and grit chamber) revealed that the existing infrastructure is not functioning as per design requirements[24]. The result is that the suspended solids and grit in septage passes through the decanting facility and enters the sewer system. Details of infrastructure at decanting stations and its present status is presented in Table 2.

Table 2: Decanting stations – Infrastructure Provision and present status[25]

Decanting station	Decanting Infrastructure	Screen	Grit Chamber
Anna Stadium	A small inlet chamber was constructed, which isn't functioning at present. The septage is thus directly disposed into the collection well	The screens aren't functioning. The screens have been placed vertically making cleaning difficult.	Grit Chamber works on simple gravity separation. Grit removal system is not functioning. Grit pumps are not working.
Vayaloor Road	The inlet opening for disposing septage from trucks and intermediate storage tank are both operational.	The screen is functioning but is in a poor condition. The spacing between the bars isn't equal. Some are too wide making it easy for the floating debris to pass through. The screens are placed inside the collection well, making it difficult to remove them for cleaning.	Grit Chamber works on simple gravity separation. Grit removal system is not functioning. Grit pumps are not working.
Thanjavur Road	The provision was permanently closed because of complaints raised by adjacent TNEB office and trucks were advised to discharge the septage in the screen well directly.	The screen is functioning but is in a poor condition. The screens are placed inside the collection well, making it difficult to remove them for cleaning.	None. Design has a grit chamber, but this has been not in use for a very long time. There are no grit pumps.
Vasudevan Street	None	The screen is functional and well maintained.	Grit Chamber works on simple gravity separation. Grit pumps are not working.

Retrofits or additions to the treatment process: There have been no retrofits or additions to the treatment process after mixing of septage with sewage prior to treatment.

Sampling and Monitoring Protocols*:* While the Operative Guidelines require regular testing of input quality of septage in order to identify metals or traces of industrial waste, sampling and testing of septage load at the decanting stations is currently not being practiced.

Record Keeping Protocols*:* While the decanting stations maintain a record of number of truck loads emptied on a daily basis the records do not capture the volume of septage disposed. Further, there is no manifest system for recording the origin of the septage load both in terms of source (residential, commercial) and geographical area (locality).

Safety protocols*:* As per the Operative Guidelines, all private operators must ensure that their staff (drivers and helpers) involved in the process of collection, treatment and disposal of septage should be equipped with protective safety gears, uniforms, tools and proper vacuum trucks, to ensure safe

[23] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[24] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[25] Ibid.

handling of septage. However, recent assessments observed minimal emphasis on worker health, hygiene and safety[26].

Financial Details

Capital Cost: The decanting stations used existing SPSs with additional provision of a receiving chamber /storage tank for receiving septage from the private desludging trucks. Further, the decanting stations have been provided with screens and grit removal units for preliminary treatment of septage prior to being added to the sewage. The cost implications have been minimal as per the TCC.

License Fee: For regularizing private desludging trucks, a license fee of INR 2,000 is collected per truck per year by TCC. The total amount collected as license fees for the year 2015-16 was INR 62,000[27]. It is likely that in 2017-18 around INR 82,000 would have been collected as license fee as there are 41 trucks licensed by TCC.

Tipping Fee: Fee of INR 30 is charged per truck per trip as tipping fee. During the period 1st April 2015 to 31st May 2016 INR 86,220 were collected through 2,874 truck trips[28]. The tipping fee collections are likely to be INR 0.72 million assuming 80 trips per day for 300 working days in a year. (Table 3)

Table 3: Charges for co-treatment – License Fee and Tipping Fee

Type of charge	Frequency	Rate (in INR)	Yearly Collections (approximate)
License Fee	Per truck per year	INR 2000	INR 82,000
Tipping fee	Per truck per trip	INR 30	INR 720,000

Performance Details

The STP at Panjappur was designed to meet BOD below 30 mg/L and TSS below 100 mg/L as discharge standards. The Central Pollution Control Board (CPCB) 2013 report[29] has performance data on Trichy WSP showing 74 percent removal for both BOD and COD (Table 4). Further, a study on Sewage and Faecal Sludge Treatment in TCC observed that the removal efficiency of BOD was 59 percent and COD was 57 percent (Table 5).

The performance deficiency seems to be linked to the condition of the STP and inadequate O&M rather than the addition of septage at decanting stations across the city. Once the improvements recommended by the recent studies are implemented and functional, TCC should assess the performance of the STP and impact of septage addition.

Table 4: Performance data on Trichy STP- CPCB 2013 report[30]

Inlet		Outlet			
BOD (mg/L)	COD (mg/L)	BOD(mg/L)	% Removal	COD (mg/L)	% Removal
100	286	26	74%	75	74%

[26] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017
[27] Ibid
[28] Ibid.
[29] http://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMjlfMTQ1ODExMDk5Ml9OZXdJdGVtXzE5NV9TVFBfUkVQT1JULnBkZg==
[30] Source: Sewage and Faecal Sludge Treatment in Tiruchirappalli City Corporation: Current Status, Proposed Plans and Recommendations for Improvement (Draft), Prepared by IIHS in partnership with Gramalaya, Keystone and CDD, December 2017

Table 5: Performance on Key Parameters[31]

Parameter	Average Results (mg/L)		Compliance with discharge standards		% Removal	
	Head works	Effluent	1986	2002	Expected	Actual
BOD @ 20°C for 5 days	103	42	NO	No	95-97%	59%
COD	303	130	Yes	No	-	57%
Total Suspended Solids (TSS)	163	40	No	No	90-95%	76%
Ammonia Nitrogen as NH4-N	32	21	Yes	No	-	35%
Total Nitrogen as N	45	27	Yes	No	_	39%
Fats, Oil, and Grease (FOG)	Not measured		-	-	-	-
Faecal Coliform (MPN/100 mL)	1600		None	-	95-98%	

D. Impact of Co-treatment

City population being served by co-treatment: The initiative has been successful in serving the un-sewered parts of Trichy. Given that there are approximately 80 trips every day (average capacity of 6m^3) to the Panjappur STP, it is estimated that the co-treatment of septage at Panjappur is able to provide septage treatment solution for between 54,000 – 150,000 households with septic tanks[32].

Regularisation of private desludging operators: The 41 private trucks that are licensed by TCC have been provided with a safe and economical option for discharging septage.

Environmental Impact: The initiative has ensured that unauthorised dumping of septage in the city's open areas has reduced substantially.

Source of Revenue for the STP: The license fee and tipping fee collected from private desludging operators / trucks is generating revenue for TCC. In 2017-18 INR 82,000 are likely to be have been collected as license fee from 41 trucks licensed by TCC. In the same year, tipping fee collections are likely to be INR 0.72 million assuming 80 trips per day for 300 working days in a year.

E. Key lessons and Practices

- The sound policy framework put in place by the GoTN in the form of the "Operative Guidelines for Septage Management for Urban and Rural Local Bodies" has laid out the broad contours for co-treatment in the state. It has created an enabling environment for the adoption of this practice by ULBs like TCC.
- The Panjappur STP is identified as a regional facility for treating septage of the area under TCC, one Town Panchayat (Kuthapur) and four Panchayat Unions (Andanallur, Manikandam, Thiruverambur and Manachanallur). Although most of the septage at present is originating from Trichy it is likely that septage flows from the surrounding Town Panchayats and Panchayat Unions will increase with time.
- The fact that the costs have been kept minimal (@ INR 30 per truck) has ensured that the private operators have been discharging at the designated decanting facilities. They now have a dedicated place to discharge the septage rather than trying to evade the enforcement authorities and discharge the septage in open areas / waterways.
- The design of the decanting facility has an inlet chamber for decanting. The screens and grit chamber for preliminary treatment of septage ensure that the grit and large objects are removed prior to its mixing with the sewage. Unfortunately the preliminary treatment

[31] Ibid.

[32] Estimated based on number of households that can be serviced when septic tank sizes varies from 6 to 10 m^3 and when desludging is done once every 3 or 5 years.

infrastructure at the decanting stations is not working well and needs to be strengthened to ensure effective functioning.

- There is no segregation of domestic and commercial septage at present. Commercial septage with high content of Fats, Oils and Grease (FOG) should not be added at the decanting station because it can clog sewer pipes.
- There is a need for more stringent quality testing of septage, sewage at inlet and treated effluent at outlet point.
- Record keeping mechanisms need to be put in place to control and record the volumes of septage decanted at the decanting stations.
- Safety protocol should be put in place to identify and eliminate industrial waste from being disposed of at co-treatment facilities; this must include random testing of the septage arriving at the STP. Also protocols to ensure safety of the staff involved in decanting needs to be put in place.
- Evaluation by CPCB and other recent assessment of the treated effluent suggest that the performance of the STP is not adequate and the effluent does not meet discharge standards, which seems to be linked to the existing condition of the STP infrastructure and O&M at the plant. Recent studies have identified the improvements and retrofits required at the plant to improve performance, and the impact of septage and quality of septage should be assessed against the design performance after the improvements.

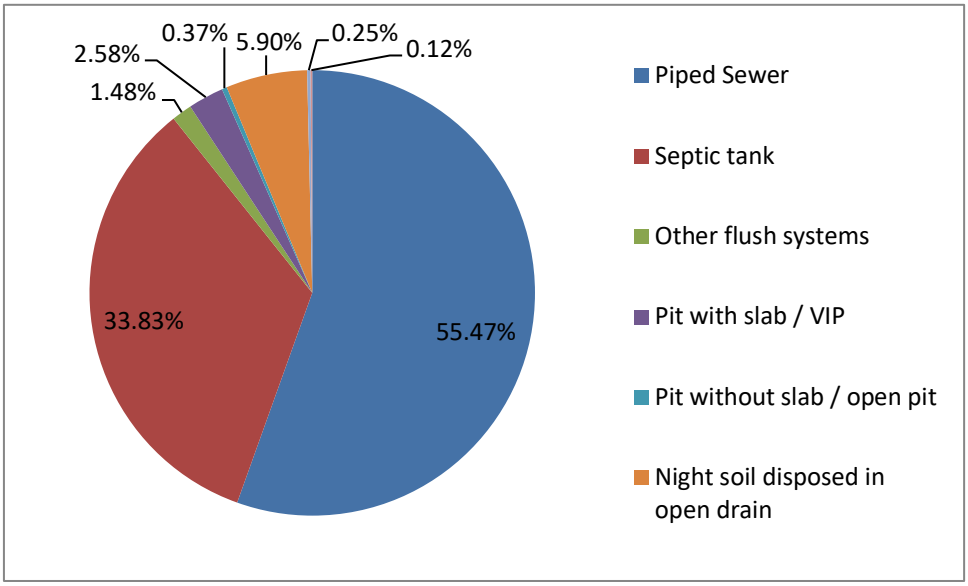
Annex 1: Status of access and collection and conveyance systems in Trichy

Table 1: Access to toilet facilities (Census 2011)

Access to Sanitation Facilities	Number of households	%
Individual Toilets	174,412	81.22
Public Toilets	30,034	13.99
Open defecation	10,297	4.80
Total households	214,743	100.00

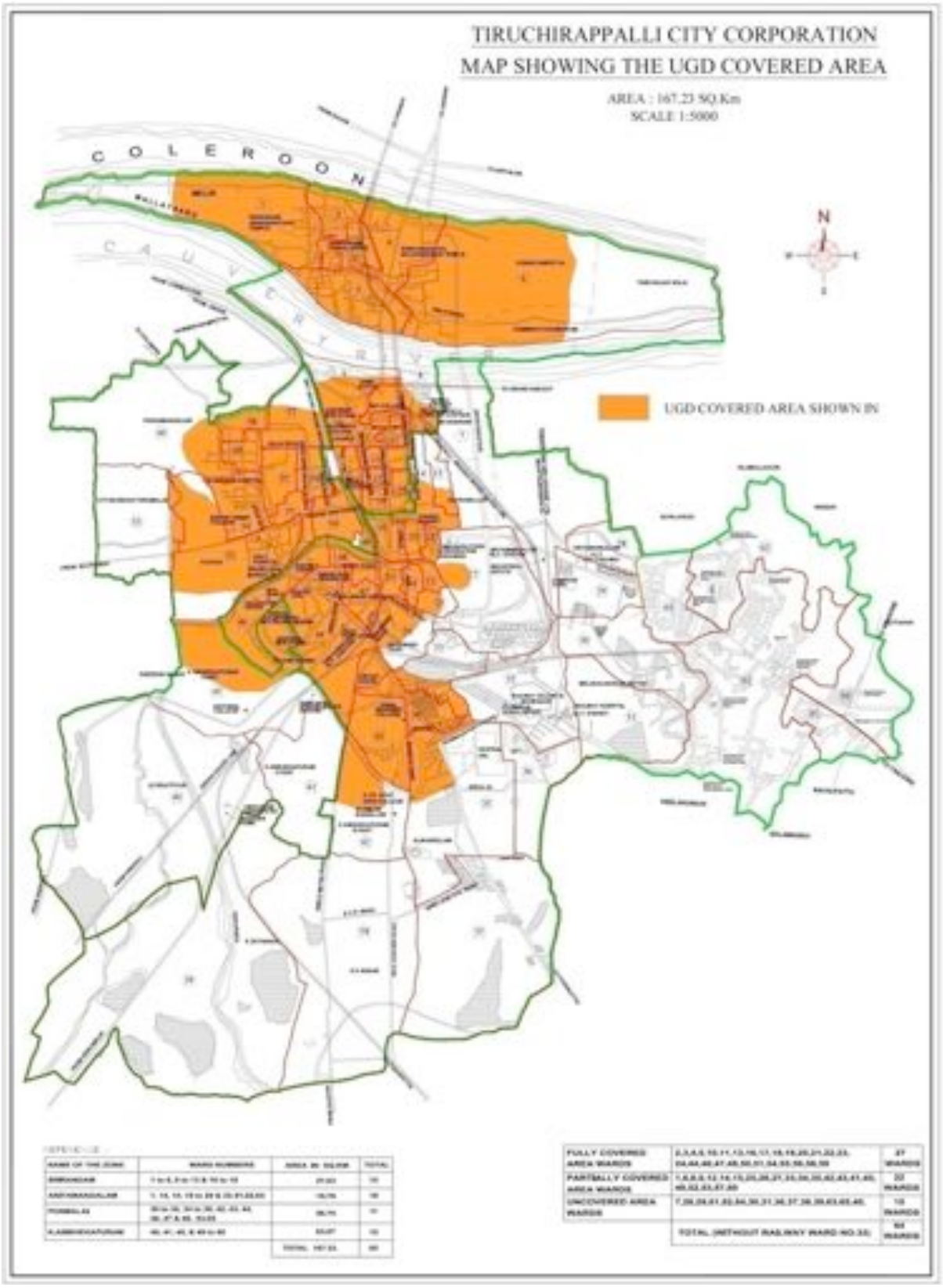
Table 2: Collection and Conveyance systems (Census 2011)

	Number of households	%
Piped sewer	96,752	55.47
Septic Tank	58,995	33.83
Other Flush System	2574	1.48
Pit with slab / VIP	4505	2.58
Without slab/ open pit	643	0.37
Night soil disposed into open drain	10,297	5.90
Night soil serviced by human	429	0.25
Night soil serviced by animal	214	0.12
Total	174409	100.00



Collection and Conveyance systems in Trichy, Census 2011

Annex 2: Map showing areas covered by UGD in Trichy



Source: SFD Promotion Initiative, Report of Trichy prepared by Centre for Science and Environment

Annex 3: Panjappur STP – Layout