SFD Lite Report

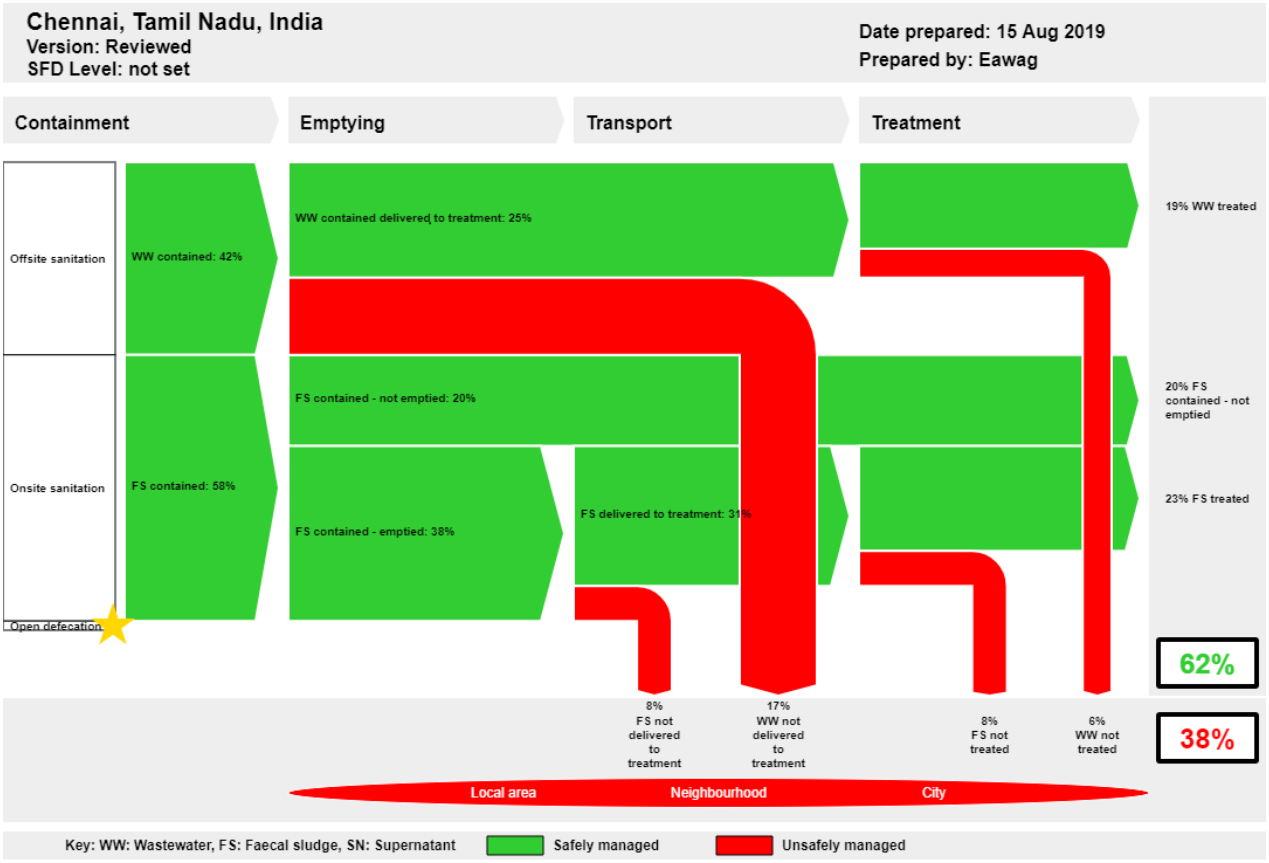
Chennai

India

This SFD Lite Report was prepared by:
The Swiss Federal Institute of Aquatic Science and Technology
(Eawag- Sandec).

Date of production/ last update: 07/09/2019

1. The SFD Graphic



The SFD Promotion Initiative recommends preparation of a report on the city context, the analysis carried out and data sources used to produce this graphic.
Full details on how to create an SFD Report are available at: sfd.susana.org

2. SFD Lite information

Produced by:

- The Swiss Federal Institute of Aquatic Science and Technology (Eawag-Sandec). Abishek Narayan (Eawag-Sandec) and Kripa Ramachandran (Eawag-Sandec).
- Special thanks: Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB).

Date of production: 07/09/2019

3. General city information

Chennai, the capital of state of Tamil Nadu is located on a flat coastal plain known as the Eastern Coastal Plains. Its average elevation is around 6.7 m (22 ft), and its highest point is 60 m (200 ft). It is the fourth largest metropolitan city in India.

Two major rivers meander through Chennai: the Cooum River through the centre and the Adyar River to the south. A third river, the Kosastalaiyar River, flows through the northern fringes of the city before draining into the Bay of Bengal, at Ennore. The Buckingham Canal, 4 km (2.5 mi) inland, runs parallel to the coast, linking the two rivers. The Otteri Nullah, an east–west stream, runs through north Chennai and meets the Buckingham Canal at Basin Bridge. Several lakes of varying size are located on the western fringes of the city (Government of Tamil Nadu, 2017).

Chennai city is governed by the Greater Chennai Corporation (GCC), formerly known as Corporation of Madras. Established in 1688, it is the oldest municipal corporation in India and the second oldest corporation in the world. In 2011, the jurisdiction of the Chennai Corporation was expanded from 174 square kilometres (67 sq mi) to an area of 426 square kilometres (164 sq mi) by the annexure of 42 adjacent Urban Local Bodies (ULBs). The estimated present population of the city is 7.1 million as per GCC.

4. Service outcomes

Table 1 shows the SFD Matrix and the data used to prepare the SFD Graphic. Overall, the SFD Graphic depicts that 62% of excreta is safely managed while 38% is discharged untreated to the environment.

The 62% of the excreta properly managed originates from Wastewater (WW) contained delivered to treatment and treated (19%), Faecal Sludge (FS) contained-not emptied (20%) and FS contained-emptied, delivered to treatment and treated (23%) from On-site Sanitation Systems (OSS). The 38% of the excreta unsafely managed is distributed as: WW contained but not delivered to treatment (17%), WW contained-delivered to treatment but not treated (6%), FS not delivered to treatment (8%) and FS delivered to treatment but not treated (8%).

In 2017, GCC declared itself Open Defecation Free (ODF) after efforts were made to address the concern of Chennai's poor ranking in Swachh Survekshan 2017, where its ranking plummeted to 235 from 36 in 2016 (Resolution No.721/2017). Despite this declaration, canals, river banks and beach shorelines continue to report open defecation, yet the overall percentage is negligible. Some low income settlements situated along the river banks and canals report open defecation due to a combination of factors which range from 'habit' to lack of maintenance of the public toilets (Field observations). Efforts are on to further better the sanitation system in the city as exemplified by the most latest Swacch Survekshan ranking in 2019 (MoHUA, 2019).

Table 1: SFD Matrix for Chennai (Eawag, 2019).

Chennai, Tamil Nadu, India, 15 Aug 2019. SFD Level: not set
Population: 7100000
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

System label	Pop	W4a	W5a	F3	F4	F5
System description	Proportion of population using this type of system	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated
T1A1C1 Toilet discharges directly to a centralised combined sewer	21.0	60.0	75.0			
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	21.0	60.0	75.0			
T1A3C10 Fully lined tank (sealed), no outlet or overflow	46.0			80.0	80.0	75.0
T1A4C10 Lined tank with impermeable walls and open bottom, no outlet or overflow	9.0			30.0	80.0	75.0
T1A6C10 Unlined pit, no outlet or overflow	3.0			0.0	0.0	0.0

Overview on technologies and methods used for different sanitation systems through the sanitation service chain is as follows:

4.1. Offsite sanitation systems (sewered areas)

The Master Plan for Wastewater Management (Sewerage) was formulated in 1978 to serve the population expected in 2008. Extension of sewer systems to the newly developed areas and improvements to the existing system were carried out based on this Master Plan. During 1989–1991, proposals were formulated for short term and long term improvements to the sewerage interceptor system, sewage pumping stations, pumping mains and sewage treatment plants. The works were carried out in stages for improvement to the collection system, pumping stations and sewage treatment plants (CMWSSB, 2018).

The said Master Plan was updated in 1991 to cater to the needs of population expected in 2021 and the proposal envisages improvement to (a) sewage collection and conveyance system in the city which includes strengthening of the existing collection system for all zones, strengthening the existing conveyance system including force main, improvement to critical sewage pumping stations, provision of collection and conveyance system for non-sewered areas, (b) the sewage treatment and disposal facilities (CMWSSB, 2018).

The wastewater system for the city has been divided into five drainage zones. These zones of macro systems covering the entire city have independent zonal collections, conveyance, treatment and disposal facilities. The erstwhile Chennai city had 100% coverage for water supply and sewerage facilities. Following the expansion in 2011, Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) is mandated to

provide water supply and sewerage facilities in all the 42 added areas on par with erstwhile Chennai city. Of the 42 added areas, underground sewerage has already been implemented in 4 areas, and in another 15 areas it is under implementation. Under the Tamil Nadu Urban Flagship Investment Programme (TNUFIP), it is proposed to provide sewerage schemes in another 4 areas namely Manali, Chinnasekkadu, Karambakkam and Manapakkam, covering an extent of 27 square kilometres (Figure 2).

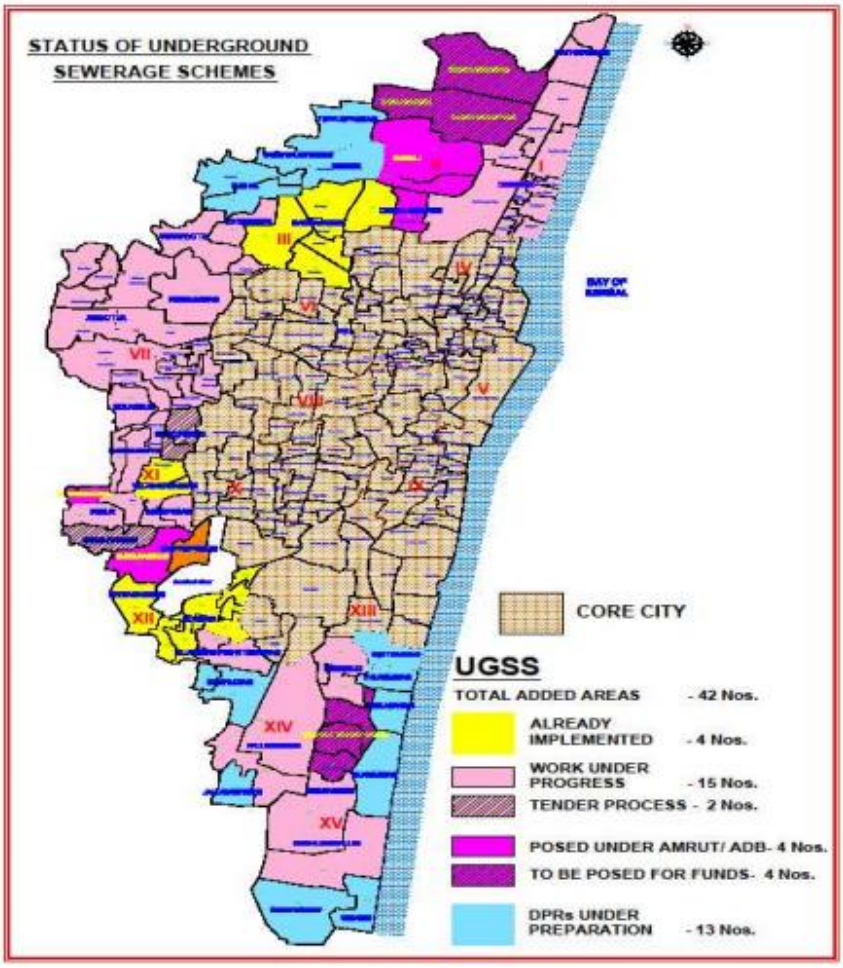


Figure 2: Status of Under Ground Sewerage Scheme (UGSS) in Chennai City.

(Source: https://chennaimetrowater.tn.gov.in/pdf/CMWSSBUGSSDraftIEE.pdf**)**

According to CMWSSB data, as of 2017, 82% of the core city area is covered by sewer network (CMWSSB, 2018). Official statistics reveal that as on June 2019, 737,290 households have obtained sewage connections in all of Chennai (KII-1, 2019). Even though the legitimate cost of securing new connection is INR 7,500 (approx. $100) and no Infrastructure Development Charges (IDC) are levied up to ground plus one level, consumers say that with the addition of 'overhead costs' and contractor charges, the cost becomes prohibitively high for them to afford a new connection. Currently, CMWSSB is weighing the possibility of providing for the payment of connection fee in instalments to make it accessible and affordable (KII-2, 2019).

Even in the sewered areas, officials say that the lack of maintenance and upkeep of the household connections, especially in old settlements in the core parts of the city have been a source of constant threat to the environment and human health (Figure 3). During the monsoon months and rainy seasons, every zone receives a minimum of three complaints a day from middle-high income households (Figure 4). Officials apprehend that many of such cases go unreported or the consumers in low-income households take shortcuts such as connecting their sewers to storm water drains to fix the problem (FGD-2, 2019).

Figure 3 : A damaged household connection with leakage on the road in Zone 13 (Kripa/Eawag/2019).

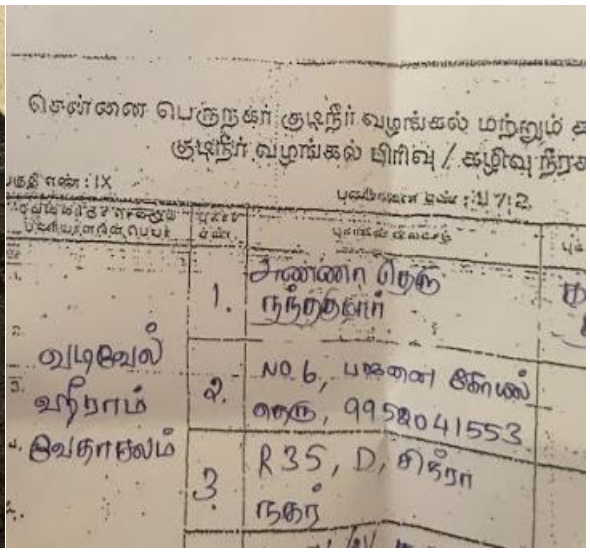


Figure 4 : Complaints to fix damage/faults in household sewer connections in zone 9 (Kripa/Eawag/2019).

There are over 200 pumping stations and 12 Sewage Treatment Plants (STPs) in Chennai that are under operation with a treatment capacity of 727 Million Litres Per Day (MLD). More details on the STPs in Chennai are furnished below (Figure 5).

Sl. No.	Name of Sewage Treatment Plant	Year of Commissioning	Treatment Capacity (in MLD)
1.	Kodungaiyur - Zone I	1991	80
2.	Kodungaiyur - Zone II	1989	80
3.	Kodungaiyur - Zone I & II	2006	110
4.	Koyambedu - Zone III	1978	34
5.	Koyambedu - Zone III	2005	60
6.	Koyambedu - Zone III	2015	120
7.	Nesapakkam - Zone IV	1974	23
8.	Nesapakkam - Zone IV	2006	40
9.	Nesapakkam - Zone IV	2014	54
10.	Perungudi - Zone V	2006	54
11.	Perungudi - Zone V	2012	60
12.	Alandur - Zone V	2003	12
Total			727

Figure 5: Snapshot of the information on STPs in Chennai.
(Source: https://chennaimetrowater.tn.gov.in/seweragesystem.html**)**

Out of these 12 STPs, co-treatment is being undertaken at three locations namely, Nesapakkam, Perungudi and Kodungaiyur. Figure 6 shows septage lorries decanting faecal sludge at Nesapakkam. Nesapakkam services the south-western to western parts of the city, Kodungaiyur services the north and central parts of the city while Perungudi services the southern part of the city (Field Observation; KII-2, 2019).

Figure 6: Septage lorries decanting at Nesapakkam STP (Kripa/Eawag/2019).

Several deficiencies such as operational failures, proximity to water bodies, lack of sustained monitoring and negligible transparency were observed during the field visit (Figure 7). These enable the discharge of untreated sewage into water bodies. A recent social audit carried out by an anti-graft and public accountability group also reveals the gross underestimation of the sewage generated in the city. The study has brought to the fore with primary and secondary evidence that nearly 1,000 MLD of sewage is discharged into water bodies without treatment (Arappor Iyakkam, 2017). In the absence of evidence to negate these findings, safe disposal of sewage must be prioritized to ensure that water bodies are free of contamination, consequently resulting in healthier environment and populace.

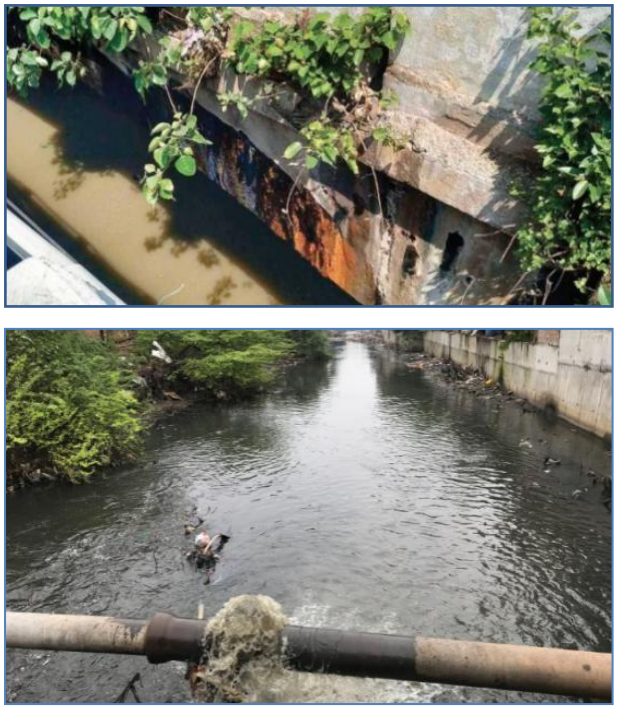


Figure 7: Leakage of sewage into Adyar River (top) and Captain cotton canal near Kodungaiyur (bottom) (Kripa/Eawag/2019)

In August 2019, the Chief Minister of Tamil Nadu on the floor of the Legislative Assembly made an announcement that a project for the mitigation of sewerage outfalls in Adyar, Buckingham canal and Cooum River basin in the city will be taken up and implemented on priority at a cost of Rs. 2,371 Crore (23,710 million) ($335,175,703). This plugging of sewage outfalls into these water bodies is expected to fix leakage of sewage into the aforementioned water bodies and enable safer disposal of sewerage from prime areas in the city (CMWSSB, 2019).

4.2. Onsite sanitation systems (Non-Sewered areas)

Out of the 200 wards within GCC, 125 are sewered and work for providing UGSS is under implementation is another 49 wards. In the rest of the wards, the project is still at a premature stage (CMWSSB, 2018). The non-sewered areas, inclusive of those under implementation and those that have not obtained household connections are primarily dependent on on-site sanitation systems (OSS)-mostly fully lined tanks sealed, lined tanks with impermeable walls and open bottom and unlined pits (Field observations).

Roughly about 58% of the Households (HH) is dependent on OSS in Chennai. Out of this, nearly 80% comprises Fully Lined Tanks Sealed (FLT Sealed), one that is common among middle income and high-income categories (Figure 8). Field observations corroborated with the experience of septage operators reveal that most consumers did not shy away from spending money on the construction of an FLT sealed since it covered a large part of the basement portions of their house entrances, vehicle parking, stairway or sometimes even the living room depending on the dimension of their houses (Field observations; KII-5, 2019; KII-6, 2019).

Figure 8:Sample of a containment system (FLT) that is most prevalent across the city (Kripa/Eawag/2019).

15% of the households, especially those in the annex areas which were former town panchayats have lined tanks with impermeable walls and open bottom (LIO) (Figure 9). These are typically frugally designed structures comprising pre-fabricated reinforced concrete rings assembled one of top of the other to save cost of constructing a fully lined pit. These are divided equally on having significant and non-significant risk to groundwater, as groundwater level fluctuates from anywhere between 80 ft. (24.3 m) to 500 ft. (152.4 m) all over the corporation boundary. Unlined pits are assumed to be 5% (based on KIIs) and are a common feature of the newly annexed town panchayats, lower income households and peripheral areas of the corporation.

Figure 9 : A sanitation worker preparing to clean an LIO in North Region, GCC (Kripa/Eawag/2019).

Collective experiences of the different stakeholders interviewed reveal that the newly annexed parts of the corporation lack strict monitoring of OSS which is leading to sewage getting dumped in water bodies and storm water drains indiscriminately. The authorities and the consumers get into an endless loop of blame game when the researcher tried to rationalize such practices. Rivers, canals, lakes, empty plots and storm water drains were found to be the most common receptors of sewage in these areas (Figure 10, 11 and 12).

Figure 10: Sewage being discharged into an open plot from Ward 80 (P Jawahar/EPS/2019).

Figure 11: Private lorry emptying at a canal in Navalur (Arappor Iyakkam/2017).

Figure 12: Sewage being discharged into a storm water drain in ward 145 (Kripa/ Eawag/2019).

The onsite sanitation systems are mechanically emptied at the behest of the consumers by private septage lorry operators using a vacuum truck. Generally, all the households with onsite sanitation systems get them emptied (Field observations and FGD). However, the frequency of emptying varies anywhere between one year (FLT sealed) to more than 12 years (for pits).

Currently, there are over 300 registered private desludging contractors organized rather informally. In Perungudi (South region) alone, nearly 200 lorries operate on a daily basis owing to the massive dependence on onsite sanitation systems in newer areas of GCC such as Perungudi and Shollinaganllur (Figure 13). The capacity of the private tanks varies from 2,500 litres to 5,000 litres. The operator receives nearly two or three emptying requests per day and charges anywhere between INR 600 ($8.49) and 1,500 ($21.21) per trip depending upon the distance from the STP. Around Perungudi, Nesapakkam and Kodungaiyur where there are facilities for co-treatment, contractors operate on an informal yet an organized understanding of the geographical and financial boundaries.

Figure 13 : Private lorry operators waiting to decant at Perungudi STP (Kripa/Eawag/2019).

While officials say that the contractors who violate safe disposal rules are fined heavily to discourage open and unsafe dumping, the lorry operators agree that they are often forced to take shortcuts to take extra trips or save up on the fuel cost by dumping in open canals or gardens in the areas belonging to neighbouring ULBs such as Navalur, Thalambur and Semmencherry (FGD-2; Suresh, 2018) (Figure 11).

4.3 Septage management related policies

In 2014, concerned by the unsafe and indiscriminate disposal of sewage, the Tamil Nadu government issued operative Guidelines for Septage Management for Urban and Rural Local Bodies within the state (G.O.(Ms) No. 106., dated 01.09.2014). The guidelines, among other things, seek to evaluate the existing septic tank designs and other storage/treatment systems and modify them based on the design provided. The local bodies are mandated to ensure proper collection (transportation) system and treatment of septage at the nearest STP and its safe disposal (Government of Tamil Nadu, 2014).

The 'National Policy on Faecal Sludge and Septage Management (NFSSM)' was launched in 2017. The key objective of the national FSSM Policy is to set the context, priorities, and direction for, and to facilitate, nationwide implementation of FSSM services in all Urban Local Bodies such that safe and sustainable sanitation becomes a reality for all (Government of India, 2017).

On the social justice front, the prohibition of employment as manual scavengers and their rehabilitation Act, 2013 defines insanitary latrine as a latrine which requires human excreta to be cleaned or otherwise handled manually, either in situ, or in an open drain or pit into which the excreta is discharged or flushed out, before

the excreta fully decompose in such manner as may be prescribed (The Gazette of India, 2013).

The 'Guidelines for Swachh Bharat Mission – Urban, 2014' considers even single pit latrines as insanitary latrines. The SBM mandates to convert 100% of households having insanitary latrines to sanitary latrines during the mission period 2014-19 as a way to completely eradicate manual scavenging (MoHUA, 2017).

Chennai faced one of the worst summers this year with acute water shortage. Under the stewardship of CMWSSB, Chennai has been preparing to become the first Indian city to recycle sewage and supply it for industrial purposes. A new treatment plant is being built in Kodungaiyur, which is nearing completion. This plant will supply recycled sewage water to industries, thereby ensuring that fresh drinking water is reserved for residential use. Once the plant is commissioned, the freshwater saved will be supplied to residential areas in Tiruvottiyur, Tondiarpet, Royapuram, Madhavaram, and Manali in the north zone, and Chintadripet, Purasawalkam, Egmore, T Nagar, and Mambalam in the central zone of the city. The move will help city tide over acute water crisis situation like the one the city faced this summer (Vishwanath, 2019).

The Chennai Metropolitan Area Ground Water (Regulation) Act, 1987, and rules of the year 1989 and Tamil Nadu Ground Water (Development and Management) Act, 2003, covers the whole of Chennai city (Tamil Nadu Government Gazette, 1987). In a bid to protect the ground water, the laws envisage mandatory licensing for judicious extraction and transportation of ground water for any purpose other than domestic purpose. In the recent times, the courts are coming down strongly on those who violate these provisions(Deccan Chronicle, 2018).

In harmony with the CMWSSB water reuse plan, the GCC launched a by-law that sets the rules for mandatory wastewater recycling. According to these rules, permits for all new developments will only be awarded with wastewater recycling planned into the design. The rules state that only water from toilets are to be connected to the sewerage network, the rest should be used for groundwater recharge after a simple organic filtration. In case of multi-storied apartments, the rules say that the recycled water should be used for toilet flushing (Tamil Nadu Government Gazette, 2019).

4.4 Ongoing and proposed sanitation projects

Recognising the need for additional STPs in the newly annexed areas of GCC, CMWSSB is setting up new sewage treatment plants in many places, including Shollinganallur (Zone 15) and Tiruvottriyur (Zone 1), which are likely to be in place soon. The city's STPs which currently have a consolidated treatment capacity of 727 MLD per day will be expanded by an additional 85 MLD with the opening of these plants. Apart from reducing the growing pressure on existing STPs to absorb the load from these new areas, these new plants are expected to bring down incidents of raw untreated sewage being directly let out into water bodies in the extended parts of the city (KII-3, Vishwanath, 2019).

The state ministry for urban and rural water supply has announced the instalment scheme for new water and sewer connection fees in the floor of the assembly. While this is yet to be implemented on the ground, the move is expected to make securing household connections to water and sewer more affordable (KII-1, 2019).

Under the overhaul and rehabilitation plans for the STPs, the existing units in Nesapakkam and other units which work on the principle of Activated Sludge Processing (ASP) method shall be upgraded to Sequential Batch Reactor (SBR) technology. This is likely to improve not just the speed and scale of the processing but also the quality of the treated sewage. In addition, the input capacity of the existing units in some of the earliest STPs is expected to be expanded commensurate with the population dependent on it (KII-3, 2019).

5. Data and assumptions

The objectives of preparing this SFD report are a) to improve understanding of the current situation relating to sanitation service delivery in Chennai and b) to provide decision-makers in Chennai with an advocacy document that can be used to aid the taking of appropriate actions for improving the sanitation situation in the city, especially in the light of poor Swachh Survekshan ranking compared to other big ULBs.

Population is taken to be 7,100,000 (7.1 Million), as per the most recent data shared by Greater Chennai Corporation in their official website. This includes the population of the newly annexed areas after Census 2011. However, the total number of households within the newly expanded Chennai Corporation boundary is unknown. To compute this, census 2011 data were used where the city's population before expansion was reported as 4,646,732 and total households were enumerated as 1,142,121. Based on this, every household is assumed to comprise 4 members on an average.

To compute the population covered by UGSS, the number of households that had secured sewer connections were available from CMWSSB, which is 737,290. The total population covered by UGSS was extrapolated to be 2,958,987 (42%) based on the above data.

The proportion of various onsite sanitation systems mentioned in the report is based on a rapid field visit by the author to different parts of the city and various rounds of discussions with different stakeholders.

In addition, and in order to prepare the SFD Graphic, the following key assumptions were made:

- 42% of the total population of Chennai is having offsite sanitation systems where: 21% of the population have their toilets connected to the centralized sewer system (T1A1C1) and another 21% of the population have their toilets connected to a centralised foul/separate sewer (T1A1C2) with the transport efficiency assumed to be 60% (variables W4a for each system both set to 60%) since there are significant number of sewer connections leading to stromwater drains and urban water bodies, also the ageing infrastructure of sewers that present leaks as reported above. The treatment efficiency is assumed to be 75% (variables W5a for each system both set to 75%) as the STPs are in good working conditions, but are overloaded, and reports of discharge of semi-treated wastewater into urban water bodies (Kaveri and Thirumurthy, 2019; Field observations).
- Most of the commercial establishments, institutions, etc. which are located within the old municipal limit have sewerage connections.
- 58% of the total population of Chennai is having OSS, out of which 46% of the total population of the city is having fully lined tanks (sealed), no outlet or overflow (T1A3C10), 9% is having lined tanks with impermeable walls and open bottom, no outlet or overflow (T1A4C10) and 3% is having unlined pits with no outlet or overflow (T1A6C10).
- There is no clear differentiation between the volume of effluent and solid FS generated from tanks and pits, hence to reduce the maximum error, it is assumed to be 50% each (step two of the Graphic Generator).
- 65% of the households that have their onsite sanitation systems emptied when they are full unless there are natural leakages. Thus, variable F3 was set to 80%, 30% and 0% for fully lined tanks, lined tanks and unlined pits, respectively based on expert knowledge and interviews (KII6, 2019). This means that 20% overall is FS contained but not emptied.

- It is assumed that 80% of the collected faecal sludge from tanks is delivered to treatment (variable F4 set to 80%) and 75% of the faecal sludge delivered to treatment plants is treated (variable F5 set to 75%) (Field observations; KII6, 2019).

6. List of data sources

Below is the list of all data sources used for the production of the SFD Lite report.

Reports and literature

- Arappor Iyakkam (2017) Why Chennai Stinks? Citizens' effort to understand and solve the Sewage problem. Chennai.
- CMWSSB (2018) Sewerage System. Available at: https://chennaimetrowater.tn.gov.in/seweragesystem.html.
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- The Gazette of India (2013) The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act 2013.
- Vishwanath, M. (2019) 'Chennai set to become first Indian city to supply recycled sewage to industries', The New Indian Express, 30 July. Available at: http://www.newindianexpress.com/states/tamil-nadu/2019/jul/30/chennai-set-to-become-first-indian-city-to-supply-recycled-sewage-to-industries-2011647.html.

Key informant interviews

- KII 1, 2019. Interview with Mr. Shanmuga Sundaram, Public Relations Manager, CMWSSB.
- KII 2, 2019. Interview with Mr.V.G Ramasamy, Superintending Engineer (Central), CMWSSB.
- KII 3, 2019. Interview with Mr. Anand Kumar, Assistant Executive Engineer, Nesapakkam STP.
- KII 4, 2019. Interview with Mr.Jagannath Kumar, Plant-in charge, Pumping station, Erukkancherry.

- KII 5, 2019. Interview with Mr. Charles Chellaraj, septage lorry operator, Madha Transport.
- KII 6, 2019. Interview with Mr. Loganathan, Septage lorry operator and organizer, Septage lorry drivers association, Perungudi.
- KII 7, 2019. Interview with Ms. Madhumitha Vishwanath, Journalist, The New Indian Express.

Focus Group Discussion

- Residents of Ward 27, Zone 3, GCC.
- Officials and workers of Zone office, Zone 13, CMWSSB.

Field visit and observations

- STP at Nesapakkam and Perungudi.
- Pumping station at Nesapakkam and Erukkancherry.
- Various wards within GCC.
- Notified slum in Greenways Road and Srinivasapuram.

SFD Chennai, India, 2019

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SFD Promotion Initiative