CHAPTER 8: DECENTRALIZED SEWERAGE SYSTEM

8.1 DEFINITION

Decentralized sewerage system is defined as the collection, treatment, disposal / reuse of sewage from individual homes, clusters of homes, isolated communities or institutional facilities, as well as from portions of existing communities at or near the point of waste generation. Typical situation in which decentralized sewerage management should be considered or selected include:

1. Where the operation and maintenance of existing on-site systems must be improved.
2. Where individual on-site systems are failing and the community cannot afford the cost of a conventional sewage management system.
3. Where the community or facility is remote from existing sewers.
4. Where localized water reuse opportunities are available.
5. Where freshwater for domestic supply is in short supply.
6. Where existing STP capacity is limited and financing is not available for expansion.
7. Where, for environmental reasons, the quantity of effluent discharged to the environment must be limited.
8. Where the expansion of the existing sewage collection and treatment facilities would involve unnecessary disruption of the community.
9. Where the site or environmental conditions that require further sewage treatment or exportation of sewage are isolated to certain areas.
10. Where residential density is sparse.
11. Where regionalization would require political annexation that would be unacceptable to the community.
12. Where specific sewage constituents are treated or altered more appropriately at the point of generation.

8.2 CHALLENGES IN SUSTAINING A CENTRALIZED SEWERAGE

A centralized sewerage de facto is perceived as an underground sewer system to collect the sewage from all over a habitation and involves the challenges as described below.

8.2.1 Financial Sustainability

It implies a huge capital cost and mandates a full-fledged occupation of the coverage area to generate the revenue for its upkeep. In practice however, in the peri-urban areas and rural habitations, these are nearly impossible and the situation is escalating.

8.2.2 Idle Volumes and Time in Conventional Sewerage

Invariably, the sewers as a convention are designed for the ultimate population some 30 years away and the realization of the sewage volumes to use the designed sewer capacities results in idle volumes and idle expenditures as in Figure 8-1 and the underground sewers laid there merely become defunct with time and eventually go into repair. This is a non-productive expenditure in a sense, implying that the investment could have been utilized elsewhere as brought out in a classical illustration in Figure 8.1 .

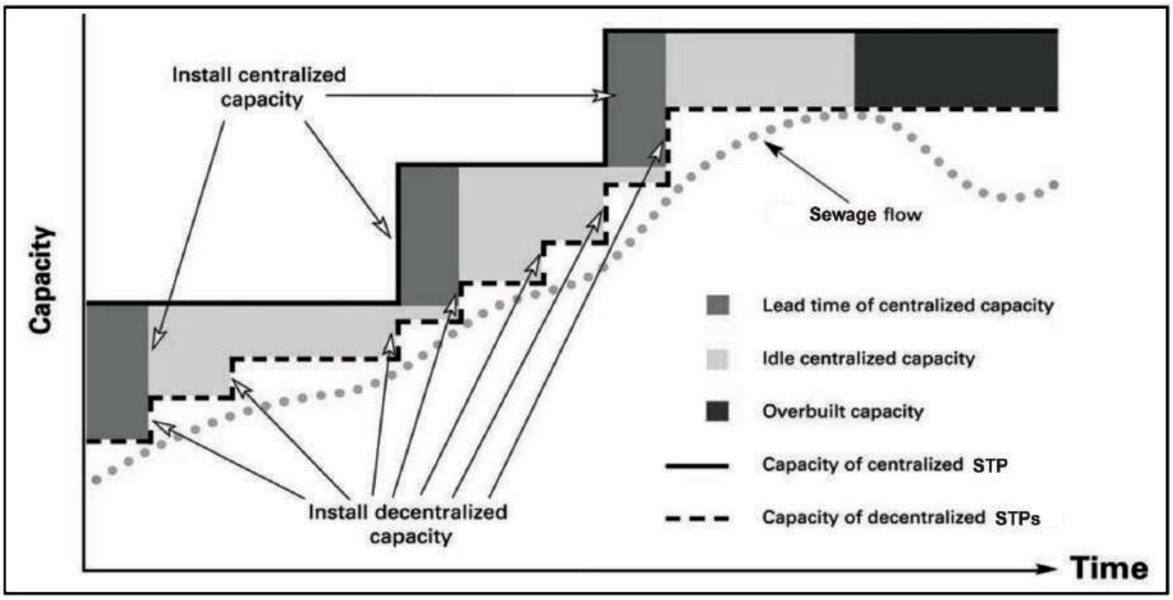


Figure 8.1 Logistics of capacity building in sewerage provision in centralized planning and decentralized planning of the collection and treatment facilities

8.2.3 Idle Investment in Conventional Sewerage

In conventional sewerage, the sewer sizes are also bigger and this brings in additional redundancy as in Figure 8.2.

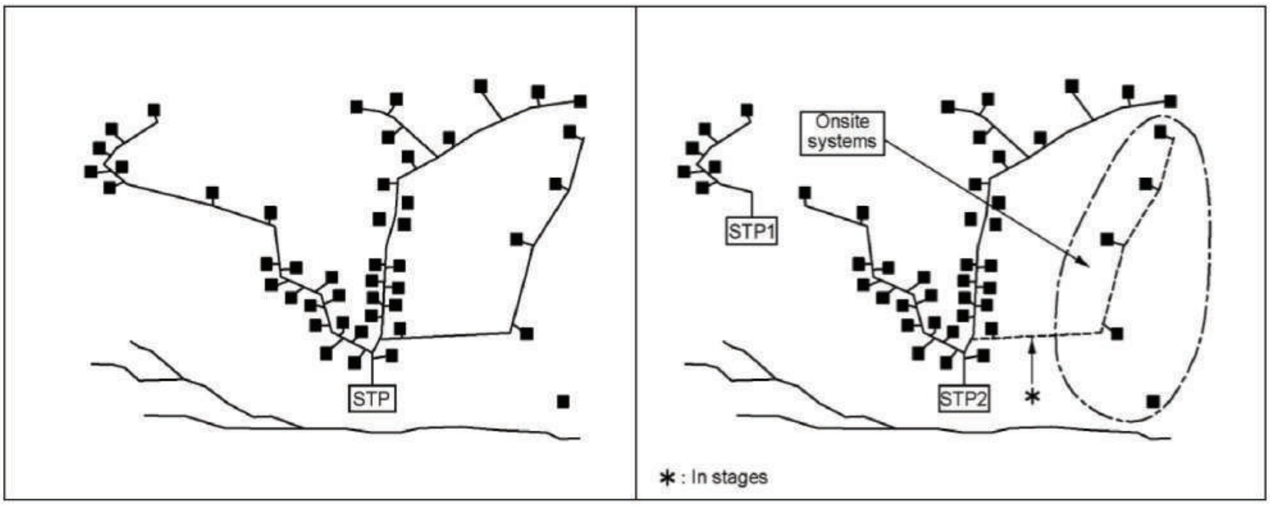


Figure 8.2 Concept of centralized system at left Vs. decentralized system at right

For example, by considering the illustration in Figure 8-2, the map to the left shows the typical conventional sewerage with all the sewers funneling to a single STP and the sector to the top right is actually sparsely developed and the sewers are designed for a flow some 30 years hence. This results in a situation where the manhole covers get stolen and people start using the manholes as a virtual garbage bin, which in turn is compounded by rainfall and lead to a near complete choking of the sewer system. The net result is, if and when the sector gets populated, a massive rehabilitation programme of the sewer system becomes implied often leading to indiscriminate cutting open of the roads. A further difficulty is the STP, which is grossly underutilized and the treated sewage quality suffers due to prolonged hydraulic retention. By contrast, if we consider the same sector to be served by a decentralized sewer system as in the map to the right, it can be seen that the above problems are surmounted not only physically, but also financially investments are saved to begin with.

8.2.4 Problems of House Service Connections

It is also a fact that while the investment on provision of sewerage is usually met out of capital grant funding, the cost of house service connections is to be met by the house owners and herein lies another conflict. Whereas houses have not come up in some sectors, these house service connections get time deferred and to that extent, repeated road cuts become a perpetual affair over a long time. As and when the houses are built, service connection requests arise. An approach that has been tried out is the provision of house service connection sewers even in the beginning itself and blank it at the property boundary and connect it only when the house gets built up and the applicant pays up the costs thereof.

Here again, it is a question of idle investment at start with no foreseeable return of the same on the house service connection costs.

Another issue is surreptitious connections by house owners and the impracticality of checking each and every such connection by the limited staff of the local body and may well be connivance also. By opting for decentralized sewer system, first of all, the command area to be supervised for such surreptitious connections get much smaller and the monitoring mechanism becomes effective.

8.2.5 Conflict of Levies for Recovering the Sewer Costs

Whereas the capital costs are mostly met out of grant funding, the O&M expenses are to be generated by the local body at most times. The meagre revenues generated by taxes and water and sewerage charges are too meagre to even break even in the local body accounts, leave alone increasing the reserve funds. When an unwieldy coverage of a conventional sewerage is implemented, the problem gets compounded all the more because the house service connections do not keep pace and the revenues are meagre. Thus, even the cost spent on the house sewer connections becomes a virtual write-off over a period of time.

8.3 CONCEPT OF DECENTRALIZED SEWERAGE

The decentralized sewerage concept implies localized collection and localized treatment of excreta and sullage in micro zones within a major habitation, keeping it in tandem with densification and progressively duplicating it, as and when other micro zones densify.

It will ensure that every micro zone owns up its excreta and sullage management and cannot expect a faraway habitation to receive and inherit it a prospect, which will sooner or later lead to inter conflicts and destabilize progress. Thus, the provision of both the collection system and treatment can be made compatible to the pace of development by juxtaposing on-site sanitation as well in its fold. The treatment systems of sewage in the on-site system and the off-site system are shown in Figure 8.3 hereunder.

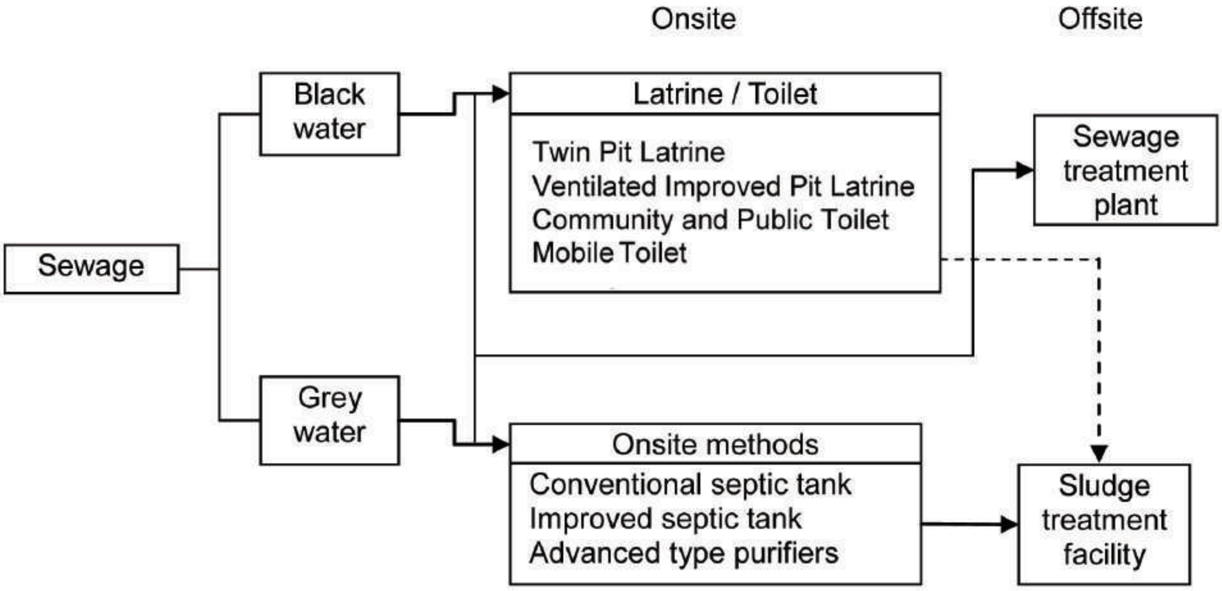


Figure 8.3 On-site and Off-site sewage treatment system

Note: There can be cases where both black and grey water can be treated together.

8.3.1 Advantages of Decentralized Sewerage

1. In general, prediction of sewage volumes is far easier in decentralized sewerage micro collection areas and to that extent the design becomes realistic.
2. Flows in a decentralized sewerage are relatively smaller than conventional sewerage and this implies that environmental damages from any mishaps are also minimal.
3. Given the smaller flows, the sewer sizes are also smaller and the depths of cut are also less thus, making it easy to construct and maintain.
4. Additions of new service areas which are independent of the existing system and the need to augment or enlarge the existing sewers and STPs are avoided.
5. The STPs are smaller and it is easier to find the reuse prospects nearby as compared to all the sewage being treated in one far corner.
6. It is also easier to layout return lines of treated sewage for use in medians, industrial supplies, flushing far flung head manholes, etc.
7. The ecology of rivers, streams and receiving waters are better managed by smaller volumes of discharges of treated sewage at multiple locations than one massive volume in a single location and also if the single STP is out of order, the entire stretch of the water course is polluted.

8.4 TECHNOLOGIES OF DECENTRALIZED SEWERAGE

8.4.1 Simplified Sewerage

Simplified sewerage is a technology widely known in Latin America, but much less known in Africa and Asia. It has been successfully demonstrated in the Orangi habitation of Pakistan (having a population of about 7.50 lakh, where per capita water supply is about 27 lpd) and since adopted there in situations similar to the status in the preamble here. Duncan Mara defines simplified sewerage as “An off-site sanitation technology that removes all wastewater from the household environment.” Conceptually it is the same as conventional sewerage, but with conscious efforts made to eliminate unnecessarily conservative design features and to match design standards to the local situation. The simplified sewerage approach is now widely used. Figure 8.4 is one such example at Brazil as an in-block system rather than – as with conventional sewerage – an in-road system.

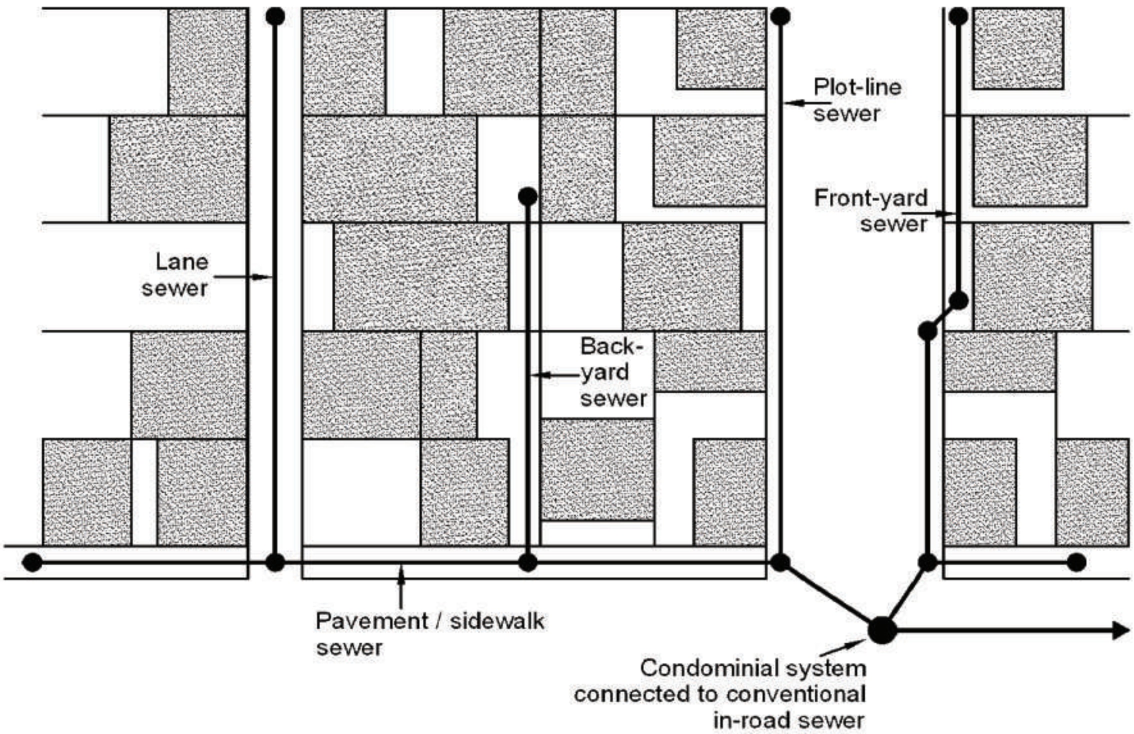


Figure 8.4 Simplified sewerage as avoiding public roads unless actually required

The key feature of an in-block system is that sewers are routed in private land, through either back or front yards. This in-block or back-yard system of simplified sewerage is often termed condominial sewerage in recognition of the fact that tertiary sewers are located in private or semi-private space within the boundaries of the ‘condominium’. These simplified sewers are laid at shallow depths, often with covers of 400 mm or less. The minimum allowable sewer diameter is 100 mm, rather than the 150 mm or more that is normally required for conventional sewerage.

The relatively shallow depth allows small access chambers to be used rather than large expensive manholes as in Figure 8-5, Figure 8.6 and Figure 8.7 overleaf.

Source: Mara et al.

Figure 8.5 Pavement (sidewalk) simplified sewerage being installed in the high-income area of Lago Sul in Brasília in 1999

Figure 8.6 Simplified sewerage in the footpath and main road free of manholes in French Puducherry - early 20th century

Source:Mara et al., 2001

Figure 8.7 Junction chamber for simplified sewerage using larger diameter concrete pipes, used in Guatemala

8.4.1.1 Design Criteria

In regard to design, the basic procedures are the same as any hydraulics. For example, for serving 500 people with a water consumption of 80 lpcd and using a return factor of 0.85, the average daily sewage flow will be 0.85 × 500 × 80 / 24 / 3600 = 0.4 lps.

Depending on the peak factor as given in Chapter 3, the design flow will be its multiplication and the design will be as per Manning's formula as in Chapter 3. The design guidelines are available in *http://www.efm.leeds.ac.uk/CIVE/Sewerage/manual/pdf/simplified_sewerage_manual_full.pdf.*

The long-term sustainability of simplified sewer systems can be ensured by a good partnership between the community served by simplified sewerage and the sewerage authority along with the following key factors:

1. Good design
2. Good construction
3. Good maintenance
4. An adequate, but affordable, tariff structure.

It is in item 4 that the success of the system resides and requires a public hearing and acceptance, instead of taking the public acceptance for granted. Eventually, when the habitation becomes fully developed, of course the conventional sewerage can still be incorporated in lieu of the simplified sewerage.

8.4.2 Small Bore Sewer System

Small bore sewer system is designed to collect and transport only the liquid portion of the domestic sewage for off-site treatment and disposal. The solids are separated from the sewage in septic tanks or aqua privies installed upstream of every connection to the small bore sewers. Where conventional sewers would be inappropriate or infeasible, this system provides an alternative. This system also provides an economical way to upgrade the existing on-site sanitation facilities to a level of service comparable to conventional sewers. Since the small bore sewer collects only settled sewage, it needs reduced water requirements and reduced velocities of flow. This in turn reduces the cost of excavation, material and treatment. This is also called as settled sewerage.

8.4.2.1 Components of the System

The small bore sewer systems consist of house connections, interceptor tanks, sewers, cleanouts and manholes, vents and in some cases lift stations.

8.4.2.2 Suitability of the System

This system is suitable under the following conditions, where

1. Effluent from pour-flush toilets and household sullage cannot be disposed off on-site
2. Installation of new schemes is taken up, especially for fringe areas

3. A planned sequence of incremental sanitation improvements with small bore sewers as a first stage is contemplated

4. Existing septic tank systems have failed or where there are a number of septic tanks requiring the effluent to be discharged, but soil and ground water conditions do not permit such a discharge.

8.4.2.3 Design Criteria

Each house sewer is usually connected to an interceptor tank, which is designed as a septic tank. The optimum number of house sewers to be connected to an interceptor tank can be worked out for each case. The effluent from the tank is discharged into the small bore sewer system, where flow occurs by gravity utilizing the head resulting from the difference in elevation of its upstream and downstream ends. The sewer should be set deep enough to carry these flows.

The diameter of sewer pipe shall be designed for incremental flows between successive sections. First consider the available ground slope and choose a minimum of 100 mm sewer pipe and use Manning’s formula for pipes flowing full and find out the flow carrying capacity. If this is lesser than the actual flow in that section, increase the pipe diameter in that section as needed. Velocity is not a criterion.

Design decisions regarding the location, depth, size and gradient of the sewer must be carefully made to hold hydraulic losses within the limits of available head. Minimum pipe diameter of 100 mm is recommended. Maintenance of strict sewer gradients to ensure minimum self-cleansing velocities is not necessary. The sewer may be constructed with any profile as long as the hydraulic gradient remains below all interceptor tank outlet inverts. Ventilation is not necessary for small bore sewers, if they are laid on a falling gradient. A vent cleanout to release air may be provided at every hump. Profiles are shown in Figure 8.8 (overleaf). An example on design calculation is also presented in Appendix A.8.1.

8.4.3 Shallow Sewers

8.4.3.1 System Description

Shallow sewers are designed to receive domestic sewage for off-site treatment and disposal. They are a modification of the surface drain with covers and consist of a network of pipes laid at flat gradients in locations away from heavy imposed loads (usually in backyards, sidewalks and lanes of planned and unplanned settlements). They are usually laid at a minimum depth of 0.4 m. Where vehicular loading is present and the invert depth of sewer is less than 0.8 m, a concrete encasement is provided for the sewer.

8.4.3.2 Components of the System

The shallow sewer system, like the conventional sewer system consists of house connections, inspection chambers, laterals, street collector sewers, pumping stations where necessary and treatment plants. Low volume pour flush or cistern-flush water seal toilets are connected to the inspection chamber by means of a 75 mm diameter sewer.

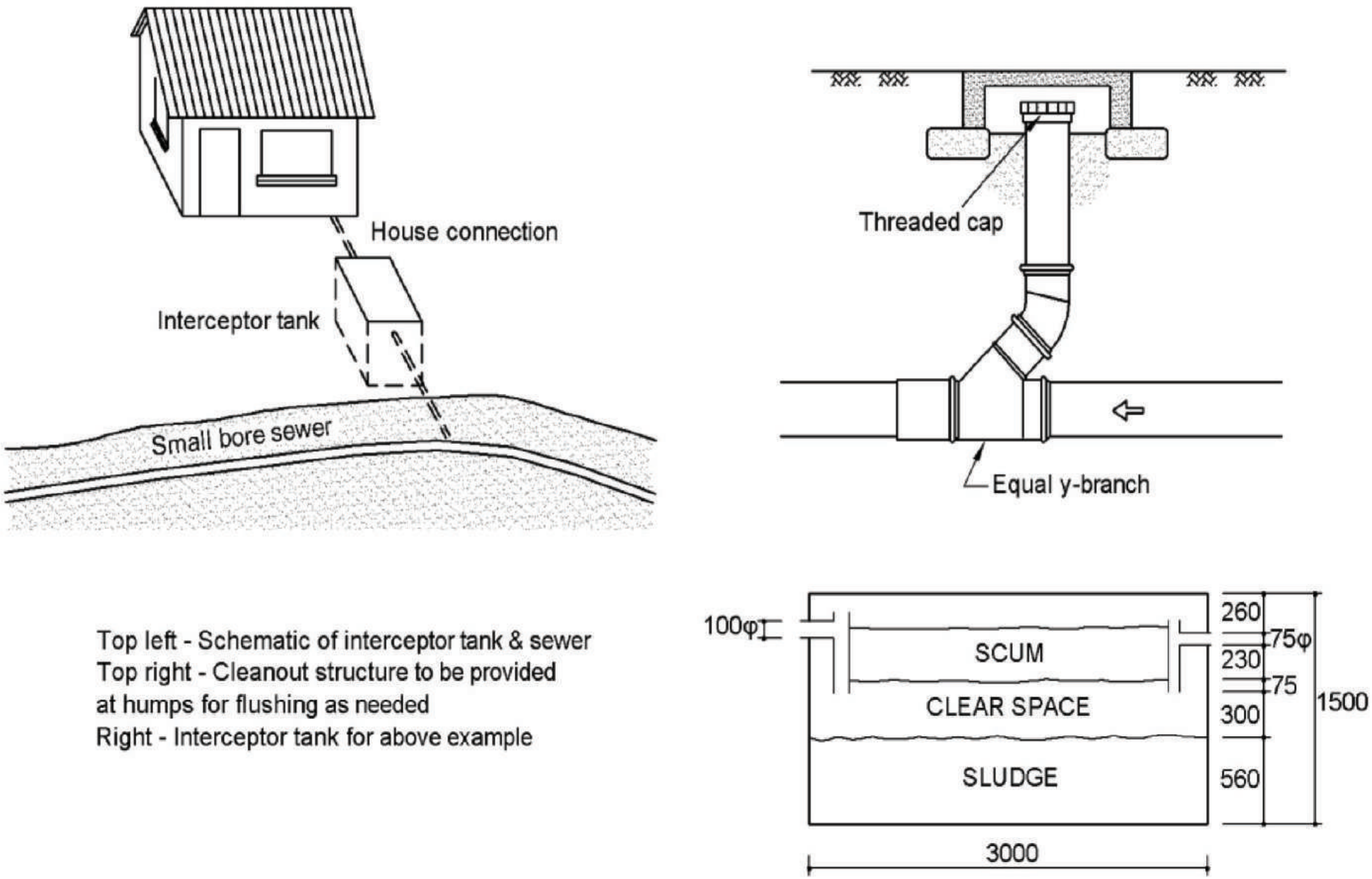


Figure 8.8 Schematics of small bore sewer system

A vertical ventilation column of the same diameter is provided on the house connection. The sullage water generated in the house is also connected to the inspection chamber directly when water consumption is more than 75 lpcd. Where the water consumption is lesser and where grit is used for cleaning purpose, it is connected through a grit/grease trap. Inspection chambers are provided along the street collector sewers and along the length of the laterals at intervals not exceeding 40 m. Usually one chamber is provided for each house. However two or more houses may share a single inspection chamber. The chamber is provided with a tight-fitting RCC cover. The laterals are of small diameter (minimum 100 mm) and of stoneware or concrete, which are buried in a shallow trench. The minimum depth of pipe invert is 0.4 m. In general, they have a straight alignment between inspection chambers and are suitably aligned around existing buildings. They may even pass under property boundary walls and also under future building areas. The inspection chamber however, is located is an open area. The street collector sewer has a usual minimum diameter of 150 mm, however, 100 mm sewers may also be used if hydraulic capacities permit. Where community septic tanks are provided at the exit of the lateral sewers, the street sewers should be designed as small-bore sewers. The pumping stations should, as far as possible, be avoided in such cases.

8.4.3.3 Design

The design procedure is as much the same as that of gravity sewer design in Chapter 3.

8.4.3.4 Applicability

Shallow sewers are suitable where

1. high density, weaker sections, squatter settlements (100 to 160 persons per hectare) exist
2. adverse ground conditions exist and on-site disposal is not possible
3. sludge also has to be disposed off and where the minimum water consumption rate is 25 lpcd.

8.4.3.5 Limitations

Shallow sewerage system is suitable where adequate ground slopes are available. Since these sewers are laid at flat gradients the solids are likely to get deposited unless flushed at peak flow conditions. Otherwise, these sewers may get clogged and require frequent cleaning.

8.4.4 Twin Drain System

This is an integral twin drain on both sides of the road. The drain on house side receives the sewage. The drain on road side is the storm water drain. It is in use in coastal areas of Tamilnadu particularly in Tsunami affected habitations. The advantage is that even if the per capita sewage falls to low quantities, say 28 lpcd as is still there in some cases, where water is scarce like in coastal fishermen communities this can be adopted. The design of the drain with removable cover slabs permits the daily scraping forward of sediments progressively by each house owner in the portion of the drain before his premises to the destination treatment site, something that the other options do not permit that easily.

8.4.4.1 Installation at Kolachel, Tamil Nadu

This is a decentralized sewerage and sewage treatment for Tsunami Rehabilitation for a population of 2,000 and 350 dwellings and it is in use since July 2007 at Kolachel which is located near the backwaters of Bay of Bengal in Tamilnadu. A schematic drawing of the self-contained system is shown in Figure 8.9. The photographs are in Figure 8.10 and Figure 8.11

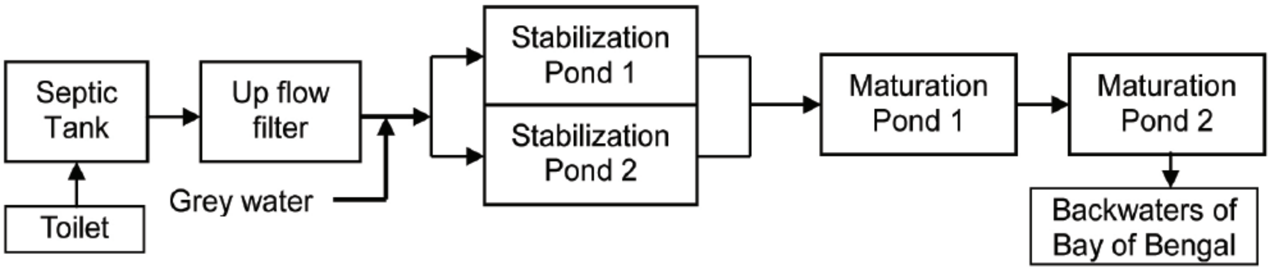


Figure 8.9 Schematic of the twin drain decentralized sewerage

8.4.4.2 Design Adopted for the System

1) The daily flow is 1,89,000 litres (350 houses – 6 persons per dwelling – 90 litres per head).
2) The septic tank was sized at 2 m × 0.9 m × 1.4 m liquid depth for cleaning at 3 year interval.
3) The up flow filter was sized at 0.7 m × 0.9 m × with floor depressed by 0.5 m.
4) The ablution water is about 6 litres/person/day.
5) The drains were designed for a velocity of 0.3 m/s to conserve depth of excavation.
6) The loading for oxidation pond design was 275 kg BOD/hectare/day.
7) The pond was designed for liquid depth of 1.5 m and sludge accumulation of 0.5 m.
8) The detention in maturation ponds was 3 days and was 1.5 m deep.
9) The facultative ponds were provided in two parallel modules of each 50% capacity.
10) The maturation ponds were provided in series with two modules of each 50% capacity.
11) The pond bottom was dense clay for 1.5 m and hence, lining was not needed.
12) The treated sewage was flowing out into the backwaters of the Bay of Bengal.

8.4.4.3 Performance of the System

The biochemical parameters of performance are given in Table 8-1.

8.4.4.4 Financial Aspects of the System

By way of comparison, the cost of the collection system starting from septic tank and up to the ponds was only 38% of what would have been the cost for a conventional underground sewer system. In respect of the O&M costs, the twin drain system is only 8% of that for the conventional system. This illustrates the relative sustainability of this system.

Top: Septic tank up flow filter under construction in brickwork and as completed
Middle: Terminal chamber & twin drain under construction and as completed
Bottom: Stabilization pond and maturation pond and safe walkway all-round.

Source: M/s Kottar Social Service Society, Nagercoil and M/s Caritas India and M/s Caritas Germany

Figure 8.10 Twin drain system

Twin Drain with top perforated cover slabs for storm drain, Salt pan totally spoiled by Tsunami waves overflowing on it and since reclaimed to accommodate the STP pond system.

Source:M/s Kottar Social Service Society, Nagercoil and M/s Caritas Swiss

Figure 8.11 Another set up of twin drain system at Kodimunai

Table 8.1 Physico-chemical characteristics of the Kolachel System (Mean values)

No	Location	BOD	COD	SS	TKN	Total P
1	Septic Tank entry	1294	2565	4142	170	30
2	Up flow filter entry	702	1509	1450	111	24
3	Up flow filter outlet	399	1003	628	88	14
4	Grey water	362	615	359	28	16
5	Stabilization pond inlet	51	212	57	14	11
6	Stabilization pond outlet	31	144	42	10	8
7	Maturation pond 1 outlet	32	144	42	10	8
8	Maturation pond 2 outlet	23	124	38	7	6

8.4.4.5 Applicability

In most of new layouts the septic tank and open drains on road sides for storm water are a matter of routine and invariably the septic tank effluent is discharged into the drain which complicates the environmental hazard in rainy seasons. The twin drain system can stall the pollution by containing the septic tank effluents, which can be collected and provided with treatment. For new layouts, it will be useful if the bye-laws can be strengthened to mandate the twin drain instead of the roads drain alone, which is anyway mandated by the Town and Country planning act.

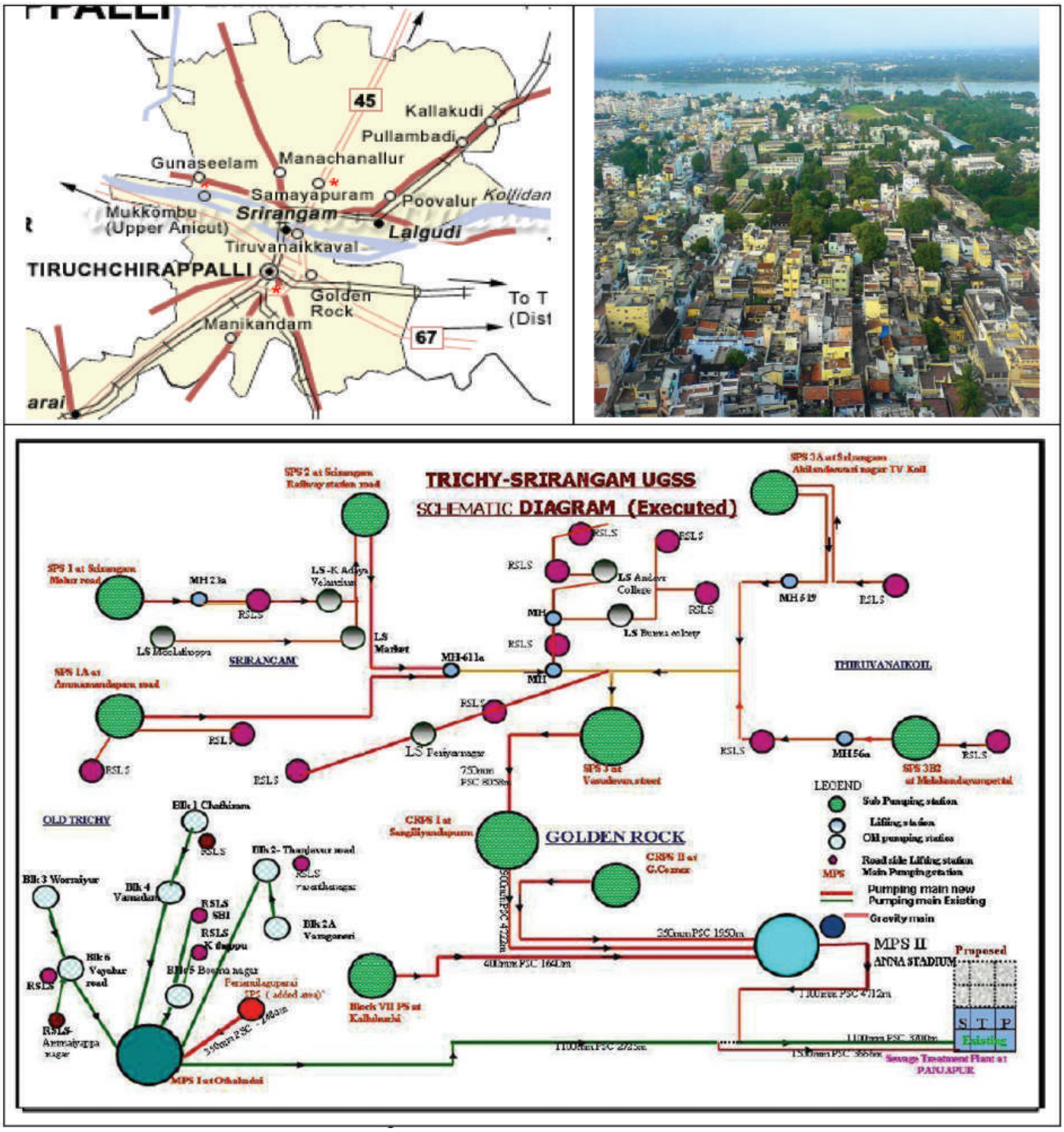
8.5 APPLICATION OF DECENTRALIZED SEWERAGE IN URBAN AREAS

It is not as though the decentralized sewerage is meant for peri-urban and rural settings alone. In fact, it is as much applicable to even metropolitan centres as in the case of our major State capitals like Chennai, Bangalore, Delhi, Ahmedabad, etc. except that the treatment is decentralized, but the sewerage is conventional sewerage. This is understandable in these locations, but Trichy for example where over the decades, a decentralized sewerage could have been evolved, but it has been a case of the entire sewage going down to one far corner and the sewage from one side of the river Cauvery being pumped to the other side 330 m across. While apparently this may appear paradoxical, it is not so because the tiny Srirangam habitation from where the sewage is pumped across the major river, is a highly revered and very densely populated religious centre and positioning a STP at Srirangam was ruled out from public acceptance point of view. Hence, it has not been possible to decentralize as shown in Figure 8.12 (overleaf).

The Cauvery and Coleroon (Kollidam) are, perhaps, the biggest rivers in South India.

Trichy (Tiruchirapalli) is situated on the banks of river Cauvery and the STP of the city is located on the South Eastern corner of the city.

The sewage of the entire habitation between Cauvery and Coleroon rivers could have been routed towards Coleroon river.



Top left - Trichy town of 150 km^2 area lying on both sides of the perennial river Cauvery

Top right - Panorama of the town illustrating the efficacy of decentralized sewerage

Bottom - Paradox of centralized sewerage over a century

Source: TWAD Board webpage

Figure 8.12 Historical sewerage system of an Indian city

However, the sanctity of the Srirangam town in this location is revered by the followers so highly that STP was not acceptable by the public and hence, the entire sewage is pumped across the Cauvery river to the existing STP. This is a case where decentralized sewerage, though technically justifiable has to give way to public acceptance.

8.6 PUBLIC TOILETS AS DECENTRALIZED SEWERAGE

In effect public toilets are a further decentralization within decentralized sewerage in that it answers the needs of the floating population in locations as market places, bus terminals and super markets. These are a compelling necessity as the user is a stranger to the location, who may be passing through it and may not know what to do and is unable to control the urge to relieve him or herself.

8.6.1 Norms for Public Toilet facilities with focus on attention to gender issues

Provision of public toilet facilities to meet the demands of opposite genders entering a toilet which is not designated for the accompanying child should be given importance while designing these kinds of facilities. Mostly the child caring facilities are provided in Women's toilet section and not generally in Men's toilets section. Absence of such facility would put the men with difficulties, when they required caring for the accompanying children and kids. Provision of dedicated toilets for differently abled persons and transgender is also need to be taken care of while designing the public toilet facilities. The General Norms for Public Toilets and norms for provision of sanitary facilities as recommended by the Town and Country Planning Organisation (TCPO) in the Model Building Bye-laws are given in Table 8-2 and Table 8-3 respectively.

Table 8.2 Norms for Toilets in Public spaces

Public Toilet	On roads and for open areas @every 1 km, including in parks, plazas, open air theatre, swimming area, car parks, fuel stations. Toilets shall be disabled-friendly and in 50-50 ratio (M/F). Provision may be made as for Public Rooms (Table 8.3).
Signage	Signboards on main streets shall give directions and mention the distance to reach the nearest public convenience. Toilets shall have multi-lingual signage for the convenience of visitors. Helpline number shall be pasted on all toilets for complaints/queries.
Modes	Pay & use or free. In pay and use toilets entry is allowed on payment to the attendant or by inserting coin and user gets 15 minutes.
Maintenance/ Cleaning	The toilet should have both men and women attendants. Alternatively automatic cleaning cycle covering flush, toilet bowl, seat, hand wash basin, disinfecting of floor and complete drying after each use can be adopted, which takes 40 seconds. Public toilet shall be open 24 hours.

Table 8.3 may well ipso facto apply for transit stations like bus stations, markets and most importantly road side users. The determination of the numbers for roadside toilet users can be computed by considering the number of people transiting that road in the day time and providing the toilets at strategic locations.

Toilets for transgenders can also be appropriately allocated as stand alone without clubbing with gender based toilets and the doors opening directly into the vastness of the hall instead of a narrow passage. Toilets for differently abled person's are easily constructed and identified and will almost invariably have a western toilet, guide rails on both walls, water faucet for ablution and wash basins at chair level.

Table 8.3 Norms for sanitary facilities in Public Toilets

No.	Sanitary Unit	For Male	For Female (A)
1.	Water Closet	One per 100 persons up to 400 persons; for over 400 add at the rate of one per 250 persons or part thereof.	Two for 100 persons up to 200 persons; over 200 add at the rate of one per 100 persons or part thereof.
2.	Ablution Taps	One in each W.C.	One in each W.C.
3.	Urinals	One for 50 persons or part thereof.	Nil
4.	Wash Basins	One per W.C. and urinal provided	One per W.C. provided

Note:

i) It may be assumed that two-thirds of the number are males and one- third females

ii) One water tap with drainage arrangements shall be provided for every 50 persons or part thereof in the vicinity of water closet and urinals.

* At least 50% of female WCs may be Indian pan and 50% EWC

8.6.2 Off-Site Treatment

As these locations are amidst habitation, it should be possible to connect them to the existing collection system, whether it is conventional sewerage or a decentralized sewerage or in its absence, provide a collection tank duly covered and transfer the contents by a sewer lorry to the existing disposal site/sites. In any case, on-site disposal of these public toilets shall be totally banned.

8.6.3 One-way See through Public Toilets

A key issue of public toilets amidst downtowns especially for women in software firms, etc. brings up the security concerns which may be possible to be got over by the pay and use type and see through mirror wall toilets reported to be in use abroad as in Figure 8.13 (overleaf). It shows the view of the roadside from inside the toilet, thereby facilitating a much needed security for the lone user in metros at odd hours.

8.7 COMMUNITY TOILETS AS DECENTRALIZED SEWERAGE

The community toilet is to be defined as a facility to be continuously used day in and day out by a fixed number of users at public locations or residential locations, and where a reasonable control over the number of users is possible.

Examples are those in economically weaker sections, educational institutions, sites of religious centres situated away from the main habitation, whether used daily or seasonally or for clusters of dwellings far away from sewerage and most important meeting locations, which are used in high numbers by the population though infrequently.

Source: http://www.toxel.com/tech/2009/05/27/transparent-public-toilets-from-switzerland/

Figure 8.13 A toilet reportedly in Switzerland affording security to the user to be aware of the surroundings through the one way mirror viewable from inside only

8.7.1 Norms

The norms for the number of seats, wash basins, etc., can be appropriated from the nearest category as in the NBC for railway stations, hostels, educational institutions, which border on community facilities. In respect of economically weaker sections, the design approach in Chapter 3 shall be followed to assess the volume of sewage. The issues already discussed under public toilets in respect to gender related and differently abled persons shall be considered here also. The designs for community toilets, which also include a washing section and bathing section have been developed for easy utility by the variety of users in common domain by the National Institute of Design and needs to be considered for suitable adoption. Their designs of pre-fabricated toilets and their networking, both in horizontal plane and vertical plane are worthy of adoption. The problem arises in assessing the needs for fairs, festivals and public meetings in locations where large number of people congregate though infrequently, like for example the foregrounds of Ana Sagar in Ajmer. The Norms for Toilet facilities for infrequent events is given in Table 8.4 herein.

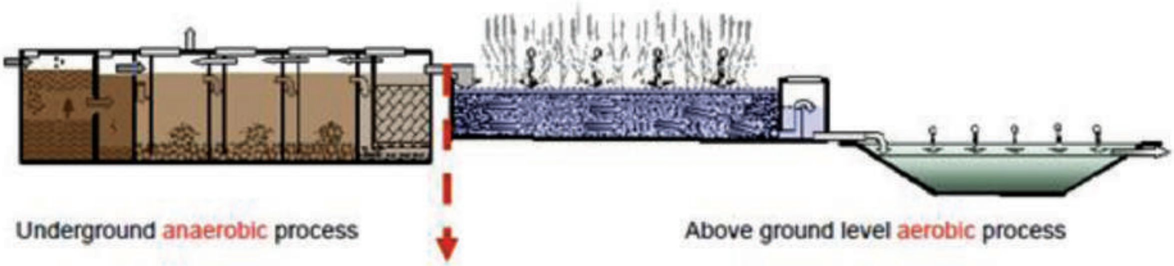
Table 8.4 Norms for Toilet facilities for infrequent events

Patrons	Male						Female			
	Toilets		Urinals		Sinks		Toilets		Sinks	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
<500	1	3	2	8	2	2	6	13	2	2
<1000	2	5	4	10	4	4	9	16	4	4
<2000	4	9	8	15	6	7	12	18	6	7
<3000	6	10	15	20	10	14	18	22	10	18
<5000	8	12	25	30	17	20	30	40	17	20

(a)- Where alcohol is not available; (b)-Where alcohol is available

8.8 DEWATS

This is an abbreviation of Decentralized Wastewater Treatment System (DEWATS) and has been assigned to a typical system of sewage treatment and resource utilization for greening in isolated habitations. The generalized treatment sequence is shown in Figure 8.14.



Source: ISPIRATION webpage

Figure 8.14 Schematic treatment process of DEWATS technology

This system is addressed to isolated habitations, where there is a need for non-mechanized and self-operating treatment technology given the premise that adequate land area is available and at reasonable distance from the habitation itself. Another aspect will be to group the toilets or at least bring the sewage from the various centres to the Dewats facility. The typical treatment units are:

a) Pre-treatment settler: retention time of about 2 hours; BOD reduction by about 30%
b) Anaerobic Baffled Tank Reactor: retention time of about 24 hours; BOD reduction by about 80%
c) Anaerobic filter: retention time of about 8 hours; BOD reduction by about 90%
d) Planted gravel filter: retention time of about 36 hours; BOD reduction by about 90%
e) Polishing pond.

These have been installed and commissioned in quite a few habitations in India and a compilation of the facility at the earthquake ravaged place of Bhuj in Gujarat is shown in Figure 8.15. The treatment process has its advantage of not dependant on mechanized units but requires relatively large areas away from the habitation and vector propagation control in the planted gravel filters and ponds.

Clockwise from top left are the treatment units as listed above	Planted gravel filter and polishing pond of an Ayurvedic resort

Source: ISPIRATION webpage

Figure 8.15 Typical DEWATS treatment plant components

8.9 RECOMMENDATIONS

The decentralization concepts and technologies in sewage management need to be systematically investigated, with focus on its development and practical implementation in India. It may be borne in mind that the approach adopted for decentralized sewage management system (DSMS) is area specific and governed by number of issues and conditions prevailing, and also the methodology adopted and is influenced by (i) technical aspects as covered in this chapter and (ii) financial aspects, (iii) social aspects, (iv) environmental aspects, and (v) legal aspects that will be covered in the part C of the manual. It needs to be realized that this aspect and programme of decentralized sewerage is what the country needs urgently if the MDG is to be achieved especially in the peri-urban, rural and outlying areas and habitations. Accordingly, the following recommendations are brought up in deciding on implementing this.

1) As Incremental Sewerage - Decentralized Sewerage has an enormous significance by way of incremental sewerage and sanitation especially in newly developing peri-urban and rural settings, where conventional sewerage needs time to qualify itself physically and financially.

2) As a Combination of Collection System Options - It is the interim period from start of the layout to such time that underground conventional sewerage will qualify itself that is the bane of all environmental hazards of indiscriminate pollution. Ingenuity of a combination of decentralized collection systems and incremented treatment capacity of the STP are the remediations for the country as a whole.

3) Public Acceptance is the Key - However, with the mindset of the people that sewerage de facto implies only to the underground conventional sewerage, any deviation from a conventional system will require a public acceptance before implementation and as such, decentralized sewerage is not an exception. The Srirangam case study is an ideal example. Any attempt in starting a decentralized treatment there would have never seen the light of the day. This aspect must not be underestimated and hence, the public consultation process shall be announced well in advance in local media and repeated one more time giving notice of at least two weeks and making the venue as local marriage hall or public hall with adequate space and hired chairs and expenses being met by the local body. The technicalities are to be toned down and the benefits and costs alone need to be cited elaborately and the opinion elicited. Understandably, it will not be a full acceptance by all the habitation and there will be various cost recovery models thrown up for example, built-up area based on; number of families based, history of residence in terms of years, economically weaker sections, clusters, non-commercial Vs. commercial occupancies, etc., and these are to be debated to bring the issues on hand to a reasonable level of acceptance. The exercise needs to be repeated for a second time. At the end, if a consensus is reached, the project can be considered forward and if it still eludes, the best is pose a conventional sewerage system to JnNURM and await its turn.

4) Design of Collection System - With regard to design procedures of the collection systems, the Manning’s formula holds good whether it be a circular conduit or a drain.

5) Design of Treatment Plants - With regard to treatment, the guidelines in Chapter 5 will however, apply as it becomes appropriate to each location.