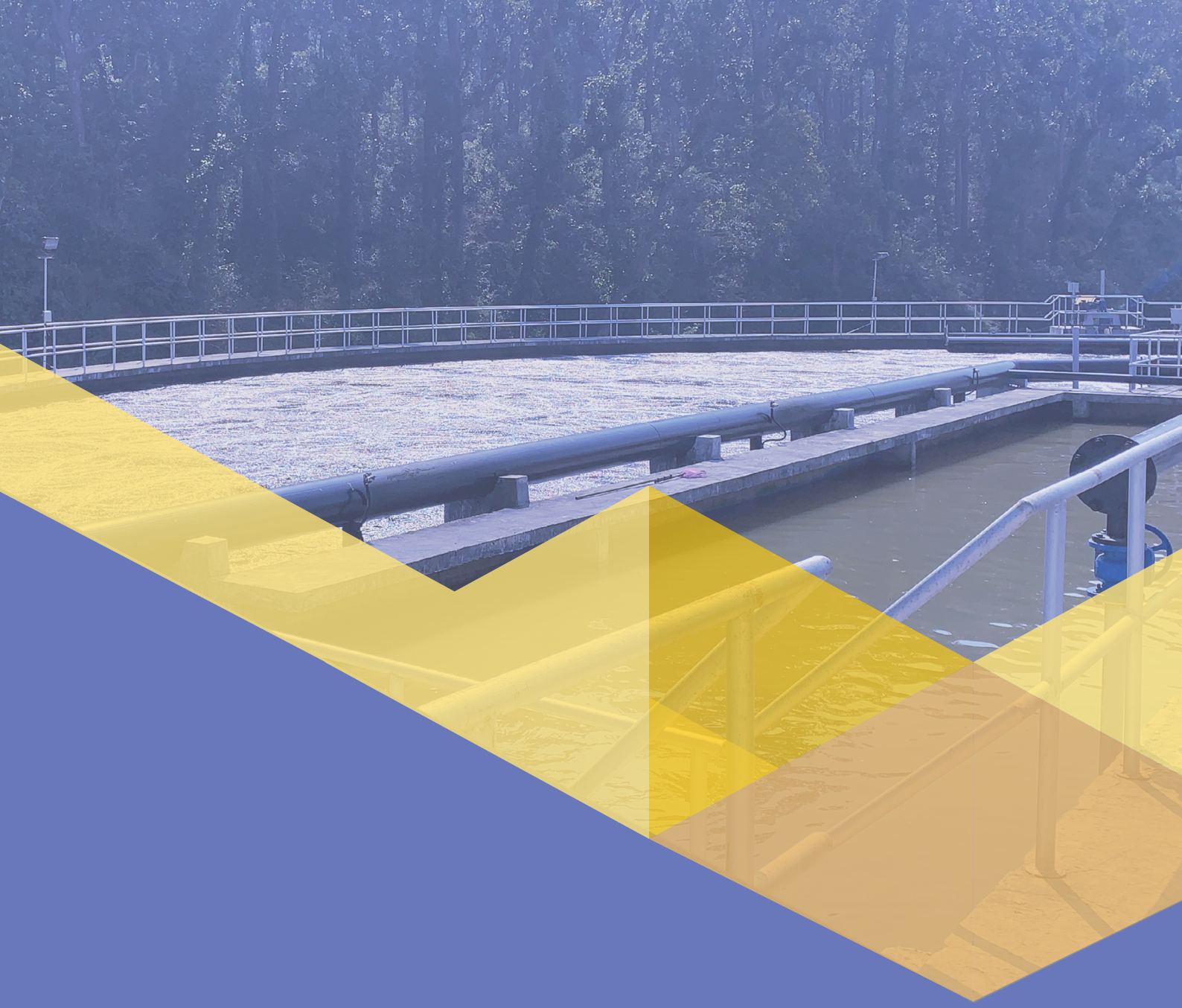

INTEGRATED WASTEWATER AND SEPTAGE MANAGEMENT PLANNING MODULE

PART C: WORKBOOK

National Institute of Urban Affairs

NFSSM Alliance

ecosan SERVICES FOUNDATION

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Integrated Wastewater and Septage Management - Planning Module (Part: C Workbook)

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INTEGRATED WASTEWATER AND SEPTAGE MANAGEMENT-PLANNING MODULE

PART: C WORKBOOK

Collaborative Effort Under Training Module Review Committee (TMRC)

National Institute of Urban Affairs

NFSSM Alliance

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Foreword

Acknowledgement

About National Faecal Sludge and Septage Management Alliance (NFSSMA)

The 'NFSSM Alliance' was formed with a vision to "Create an enabling environment which amplifies scaling of safe, sustainable and inclusive FSSM through knowledge, partnerships and innovative solutions by 2024".

Convened by Bill and Melinda Gates Foundation in 2016, the Alliance is a voluntary body that aims to:

- Build consensus and drive the discourse on FSSM at a policy level, and
- Promote peer learning among members to achieve synergies for scaled implementation and reduce duplication of efforts.

The Alliance currently comprises 28 organizations across the country working towards solutions for Indian states and cities. The Alliance works in close collaboration with the Ministry of Housing and Urban Affairs (MoHUA) and several state and city governments through its members to support the progress and derive actions towards mainstreaming of FSSM at state and national level. The NFSSM Alliance works on all aspects of city sanitation plans to regulatory and institutional frameworks across the sanitation value chain. The NFSSM Alliance working in collaboration with the Ministry of Housing and Urban Affairs has been instrumental in the passage of India's First Policy on FSSM launched in 2017. This resulted in 19 out of 36 states adopting guidelines and policies for FSSM in India.

The strength of the Alliance lies in its diverse membership, which includes research institutes, academic institutions, think-tanks, quasi-government bodies, implementing organizations data experts, consultants and intermediaries. This enabled a multi-disciplinary view of urban sanitation, with members building on each other's expertise. The alliance has had enormous success in championing FSSM as a viable solution to the Government of India by broadly focussing on:

1. Influencing and informing policy.
2. Demonstrating success through innovation and pilots.
3. Building capacities of key stakeholders across the value chain.

The collaborative continues to work towards promoting the FSSM agenda through policy recommendations and sharing best practices which are inclusive, comprehensive, and have buy-in from several stakeholders in the sector.

NFSSM Alliance

- ASCI
- Athena Infonomics
- BBC Media Action
- BMGF
- Borda
- CEPT University
- CSTEP
- CDD
- CPR
- CFAR
- CSE
- Dasra
- EY
- GIZ
- IIHS
- ISC
- IWMI
- KPMG
- NIUA
- PSI
- RTI International
- Tide Technocrafts
- UMC
- UNICEF
- USAID
- WASHi
- Water Aid
- World Bank Group

About Training Module Review Committee (TMRC)

To ensure quality control in content and delivery of trainings and capacity building efforts, a Training Module Review Committee (TMRC) was formed with the collaborative effort of all Alliance partners. TMRC which is anchored by National Institute of Urban Affairs (NIUA), has the following broad objectives:

- Identification of priority stakeholders and accordingly training modules for Capacity Building
- Development of a Normative Framework – For Capacity Building at State Level.
- Standardization of priority training modules – appropriate standardization of content with flexibility for customization based on State context.
- Quality Control of Trainings – criteria for ensuring minimum quality of training content and delivery.
- Strategy for measuring impact of trainings and capacity building efforts.

About the Training Module

Title	Integrated Wastewater and Septage Management - Planning Module (Part A: Presentation Slides)
Purpose	The module introduces a city/town perspective of an integrated planning approach to managing wastewater and septage including methods and technological options for treatment. With the announcement of SBM-U 2.0 and AMRUT 2.0, continuation of NMCG and the recommendations of the 15th Finance Commission, this course provides participants a holistic understanding of wastewater and septage management approaches, which is a key component in these national missions.
Target Audience	Decision-makers, technical and planning officials from state governments and ULBs with a basic understanding and professional experience in wastewater and septage management.
Learning Objectives	1. Gain in depth knowledge of wastewater and septage management principles and approaches 2. Understanding of different sanitation systems and technologies with a focus on wastewater and septage conveyance technologies 3. Gain knowledge about the different treatment principles and technologies available for wastewater and septage management
Format of the Module	The training module is based on case methodology where the sessions are combined with exercises based on real-life cases. This helps the trainee to apply the knowledge grasped during the session and reinforce it further. The module is divided into three parts: Part A: This contains the slides used during the session in the presentation format. Part B: This is a comprehensive compilation of the all the session briefs and further reading material which helps to strengthen the learning. **Part C: This contains the exercise developed for training based on the real-life cases.**
Duration	In a face to face training format, this training is conceptualized for 3 days without site visits and can be adopted for including the site visits depending upon the city where it is being conducted.

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01

City Profile

1 Introduction

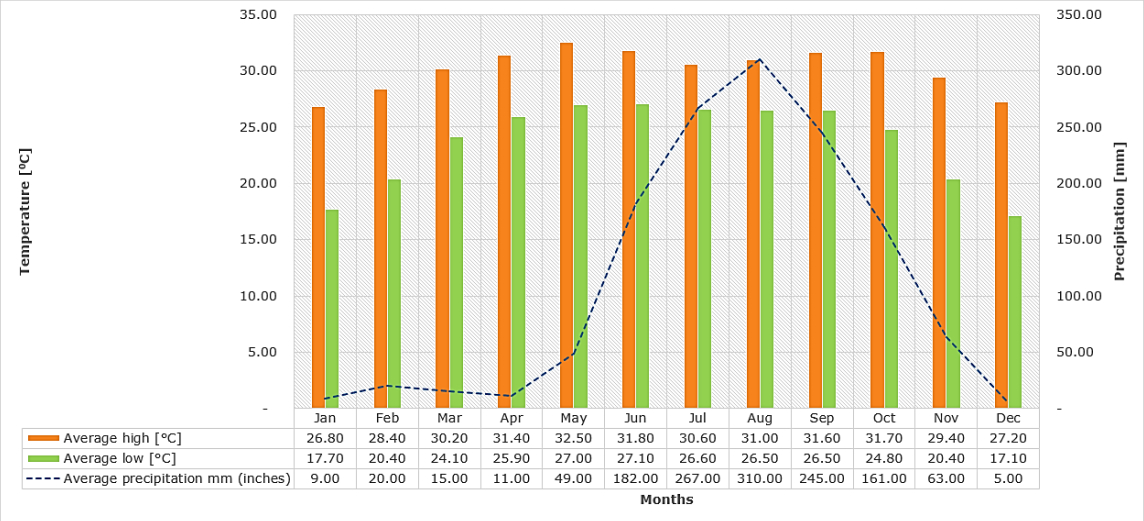
The city in consideration is a coastal city located in the delta region of a river. The total area of the city is 16.80 km^2. It has been divided into 32 administrative wards. In 2001, the city's population was recorded as 1,57,837. The decadal population growth is approximately 30%.

1.1 Demography

According to the Census of 2011, the city's population was recorded as 2,00,564 and the total number of households was 41,140. There are 24 notified informal settlements in the city and about 32% of the population resided in these settlements.

1.2 Climatic data

As a coastal town, the city is characterised by high humidity. This also results in high rainfall during monsoon season. The average rainfall received per annum is 1,337 inches. The annual average high and low temperature is recorded as 30.20 ^{0}C and 23.70 ^{0}C, respectively.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average high [°C]	26.80	28.40	30.20	31.40	32.50	31.80	30.60	31.00	31.60	31.70	29.40	27.20
Average low [°C]	17.70	20.40	24.10	25.90	27.00	27.10	26.60	26.50	26.50	24.80	20.40	17.10
Average precipitation mm (inches)	9.00	20.00	15.00	11.00	49.00	182.00	267.00	310.00	245.00	161.00	63.00	5.00

FIGURE 1: INFORMATION PERTAINING TO CLIMATIC CONDITIONS PREVALENT IN THE CITY

1.3 Water supply

The main source of water in the city is groundwater, which can be found at a depth of 5m in many parts of the city. After conducting a hydro-geological survey, the Urban Local Body (ULB) developed a piped water supply scheme to tap the groundwater to serve the city. The total water demand (including losses) is estimated to be 31 MLD. The current water supply is approximately 27 MLD (including losses). Out of 32 wards, 28 wards have 100% piped water

supply. The total service connections are approximately 18,639. The ULB claims to provide 119 LPCD as water supply to the population. The Non-Revenue Water (NRW) is recorded to be significantly high at 55%, mainly due to the high proportion of the population residing in informal settlements across the city.

1.4 Sanitation

During the 2011 Census, following data was captured pertaining to user interface and containment units.

TABLE 1: CENSUS DATA ON USER INTERFACE AND CONTAINMENT UNIT AS IN 2011

Description	Value
Households practising open defecation	**19%**
Individual Household Toilet (IHHT) coverage	**58%**
Community toilet coverage	**23%**
Number of community toilet blocks	**9**
Number of public toilet blocks	**15**
IHHT connected to septic tank	**43%**

Following is the data recorded regarding conveyance and treatment of wastewater.

TABLE 2: CENSUS DATA ON CONVEYANCE AND TREATMENT AS IN 2011

Description	Value
Sewerage connections	**57%**
Area covered by pucca drains	**81%**
Wastewater generated	**12 MLD**
STP design capacity	**15 MLD**
Water flowing through stormwater drains	**10 MLD**

The treated wastewater from the STP is disposed off in stormwater drains which are connected to the river.

Section

02

Decentralized Wastewater Management

2 Residential Property

Lake View Residency is a residential project located adjacent to a prominent lake in this city. The project is located in a newly added area within the municipal administrative limits. Details of this residential project are provided in Table 3.

TABLE 3: DETAILS OF LAKE VIEW RESIDENCY PROJECT

Number of buildings	2	no.
Number of floors	5	per building
Apartments	4	per floor
Total number of apartments	_____	no.
Number of persons per apartment[1]	5	no.
Total population	_____	no.

2.1 Water consumption

Provision of water through a piped supply system has been initiated by the municipal body. It is planned to supply 90 LPCD of piped water to this residential project.

Considering the water supply for the project, do you think that the project is eligible to get a sewerage connection? If "NO", give a rationale.

What is the total wastewater generation assuming that the amount of wastewater is equivalent to 80% of the water consumed?

[1] The average persons per apartment is 4. However, it is recommended to assume one additional person per apartment. This accounts for any increase in population in any given year.

However, it should be kept in mind that such residential projects use groundwater as an alternate source of water. A borewell is installed within the project premises and groundwater is supplied to the users in addition to the piped water supply.

Details of alternate water source for the proposed project:

Groundwater extracted[2]	15	KLD
Groundwater consumed	_____	LPCD
Total water consumption	_____	LPCD

Based on the total water consumption per person, do you think that the project is eligible to get a sewerage connection? If "YES", then explain your answer?

What is the total water consumption on a daily basis for the project?

$$Total\ water\ consumption\ [KLD] = Total\ population\ [no.] \times Water\ consumption\ [LPCD]$$

Total water consumption = _____ KLD

What is the total wastewater generation assuming that the amount of wastewater is equivalent to 80% of the water consumed?

$$Total\ wastewater\ generation\ [KLD] = Total\ water\ consumption\ [KLD] \times 0.80$$

Total wastewater generation = _____ KLD

[2] The quantum of ground water extracted can be calculated based on the flow rate of the pump and the operational hours of the pump in a day.

The municipal body has passed a bylaw stating that all projects having more than or equal to 80 apartments should treat their own wastewater and reuse atleast 20% of this treated wastewater. The project developer has reached out to you for support in wastewater management in this project.

During the site visit, you carry out sample survey and make observations on water consumptions for various purposes in a household.

Following are the details of average water consumption[3] (in LPCD) in a household.

Purpose	Quantity	Unit
Drinking	5	LPCD
Cooking	5	LPCD
Flushing of WC	25	LPCD
Bathing	60	LPCD
Washing of clothes	25	LPCD
Washing of utensils	15	LPCD
Cleaning of house	15	LPCD
Gardening etc	15	LPCD

2.2 Wastewater quantification

Identify activities resulting in blackwater generation and calculate the total blackwater generation in litres per capita per day.

List of purposes contributing to generation of blackwater:

Blackwater generation = _____ LPCD

Similarly, identify activities which lead to greywater generation and calculate the total greywater generation in litres per capita per day.

List of activities contributing to generation of greywater:

Greywater generation = _____ LPCD

[3] It is recommended to check details of water fixtures to calculate the water consumption for various purposes instead of depending on the percentages mentioned in the literature. At a decentralized scale, these percentages do not apply and can lead to wrong estimation.

Calculate total blackwater and greywater generation. Also, determine blackwater and greywater generation as percent of total water consumption for the project.

$$Wastewater\ generation\ [KLD] = Total\ population\ [no.] \times Wastewater\ generation\ [LPCD]$$

$$Wastewater\ generation\ [\%] = \frac{Wastewater\ generation\ [KLD]}{Total\ water\ consumption\ [KLD]} \times 100$$

Calculation for blackwater generation

Total blackwater generation = _____ KLD and _____ %

Calculation for greywater generation

Total greywater generation = _____ KLD and _____ %

Calculation for wastewater generation

$$Total\ wastewater\ generation\ [KLD] = Blackwater\ generation\ [KLD] + Greywater\ generation\ [KLD]$$

Total wastewater generation = _____ KLD and _____ %

Write the learnings from this exercise in brief.

2.3 Diurnal curve

A diurnal curve is a plot of wastewater generation per hour with respect to time of the day. A typical diurnal curve for a residential property such as Lake View Residency is shown in Figure 2. It can be clearly observed that wastewater generated in a day is not evenly spread across a 24-hour time period.

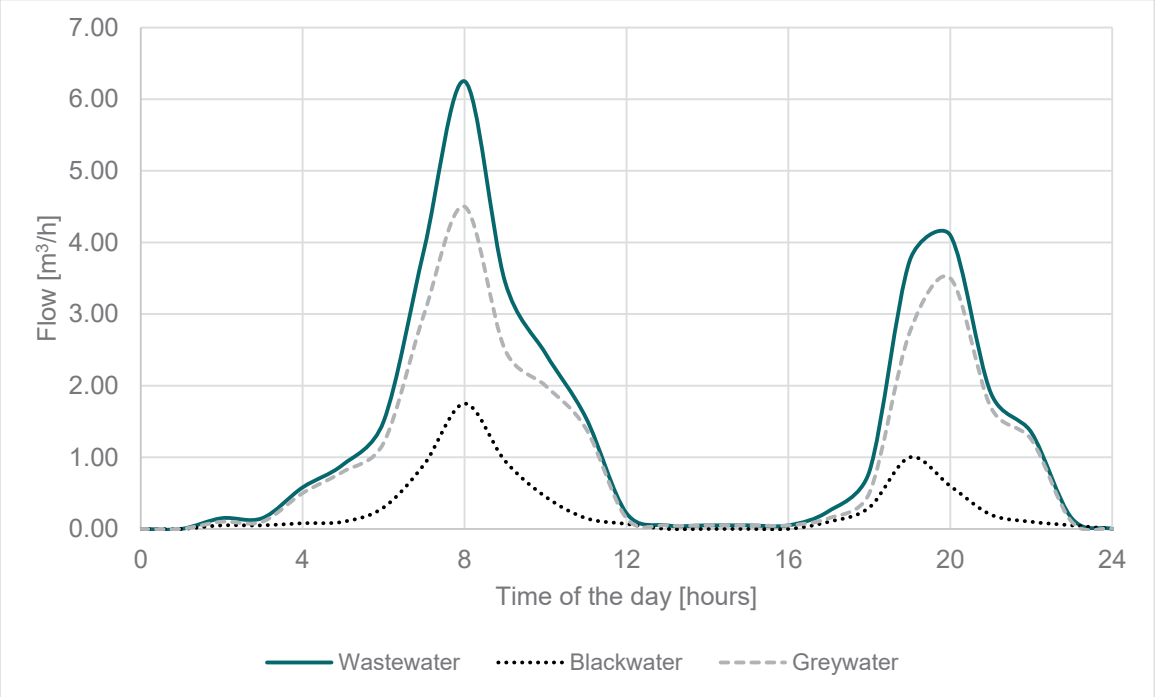


FIGURE 2: A TYPICAL DIURNAL CURVE FOR WASTEWATER GENERATION IN A RESIDENTIAL PROJECT

In a typical diurnal curve, it can be observed that around 80% of daily wastewater generation is spread over 8 hours i.e. 4 hours each in the morning and evening, respectively. The flow of wastewater during these time periods are known as peak flow of wastewater and hours during which it is generated is known as the peak flow hours.

Any wastewater treatment system should be designed to cater to these peak flows. In a decentralized wastewater treatment system (DWTS)[4], it needs to be designed considering the peak flow. Designing a non-mechanized treatment system at peak flow results in a large foot-print area. However, there are no major electro-mechanical equipment like pumps required to operate the treatment plant. Hence, the overall operation and maintenance (O&M) costs for such a treatment system are found to be low.

[4] DWTS refers to a non-mechanized wastewater treatment system based on treatment modules such as anaerobic settler, anaerobic baffled reactor, and constructed wetlands.

However, fitting DWTS into any residential project requires careful planning. In cases where application of DWTS is not possible, other mechanized wastewater treatment systems[5] can be considered. Generally, any mechanized wastewater treatment system is provided with an equalization tank as the receiving unit. Equalization tank helps absorb the variation in the hydraulic load and provides a homogeneous flow of wastewater to the subsequent units of the treatment system. The wastewater is pumped using a solid handling pump from equalization tank to subsequent units at a constant rate of over 8 hours. Additionally, these treatment systems are designed for 20 hours of operation in a day. Since the operating hours are long, 3 sets of pump are provided with the equalization tank and they operate in a '2 working + 1 standby' protocol.

2.4 Wastewater characterization

Wastewater characterization can be done through a planned sampling and wastewater analysis. As a thorough analysis of wastewater is found to be too expensive, consultants rely on characterisation given in the literature. Figure 3 gives the domestic wastewater characteristics mentioned in the CPHEEO Manual of Sewerage and Sewage Treatment (2013).

Item	Per capita contribution (g / c /d)	water supply (L / c / d)	Sewage Generation 80 % of (3)	Concen-tration (mg/L)
(1)	(2)	(3)	(4)	(5)
BOD	27.0	135	108	250.0
COD	45.9	135	108	425.0
TSS	40.5	135	108	375.0
VSS	28.4	135	108	262.5
Total Nitrogen	5.4	135	108	50.0
Organic Nitrogen	1.4	135	108	12.5
Ammonia Nitrogen	3.5	135	108	32.5
Nitrate Nitrogen	0.5	135	108	5.0
Total Phosphorus	0.8	135	108	7.1
Ortho Phosphorous	0.5	135	108	5.0

FIGURE 3: WASTEWATER CHARACTERISTICS FROM THE CPHEEO MANUAL ON SEWERAGE AND SEWAGE TREATMENT (2013)

It can be seen that the concentration of various parameters depends on the water supply (or water consumption to be more specific). Thus, in cases where the water supply is not equal

[5] Mechanized wastewater treatment systems refer to technologies based on activated sludge process such as sequential batch reactor (SBR), moving bed bio-reactor (MBBR), membrane bio-reactor (MBR).

to 135 LPCD or where wastewater generation is not equal to 80% of water supplied (or water consumed), the concentration of these parameters will differ.

The calculation of concentration for each parameter is done using the following formula:

$$Parameter\ \left[\frac{mg}{L}\right] = \frac{Per\ capita\ contribution\ \left(\frac{g}{d}\right)\ \times\ Water\ supply\ (LPCD)}{80\%\ \times\ Water\ supply\ (LPCD)}$$

It is recommended to conduct wastewater sampling and analysis prior to designing a wastewater treatment system. This ensures that the design is based on the actual **organic loading**.

Per capita contribution of various organic and inorganic constituents gives a reliable value for wastewater parameters. After performing wastewater quantification, the per capita contribution can be used to estimate actual wastewater characteristics. Figure 4 gives per capita contributions of various constituents in the Indian context.

Parameters		Range			
1	Biochemical oxygen demand, BOD	45-54			
2	Chemical oxygen demand, COD	1.6-1.9 times BOD			
3	Total organic carbon, TOC	0.6-1.0 times BOD			
4	Total solids, TS	170-220			
5	Suspended solids, SS	70-145			
6	Grit (inorganic,0.2 mm and above)	5-15			
7	Grease	10-30			
8	Alkalinity as calcium carbonate ($CaCO_3$)	20-30			
9	Chlorides	4-8			
10	Total nitrogen N	6-12			
11	Organic nitrogen	~0.4 total N			
12	Free ammonia	~0.6 total N			
13	Nitrate	~0.0-0.5 total N			
14	Total phosphorus	~0.6-4.5			
15	Organic phosphorus	~0.3 total P			
16	Inorganic(ortho- and poly-phosphates)	~0.7 total P			
17	Potassium(as potassium oxide K_2O)	2.0-6.0			
Microorganisms in 100 ml of sewage					
18	Total bacteria	10^9-10^{10}	22	Protozoan cysts	Up to 10^3
19	Coliforms	10^9-10^{10}	23	Helminthic eggs	Up to 10^3
20	Faecal streptococci	10^5-10^6	24	Virus (plaque forming units)	10^2-10^4
21	Salmonella Typhosa	10^1-10^4			

FIGURE 4: PER CAPITA CONTRIBUTION OF ORGANIC AND IN ORGANIC CONSTITUENTS IN WASTEWATER. SOURCE- ARCEIVALA (2000)

Section

03

Sanitation in Informal Settlements

3 Sanitation in Informal Settlements

The city has a notified informal settlement in Tridev Nagar area of the city. Recently, a new development took place in this settlement where approximately 80-100 households were built. Due to administrative and practical constraints, it is not possible to provide Individual Household Toilet (IHHT) for these households. The existing sanitation blocks are situated far away from these households. Under the Swachh Bharat Mission (SBM), the ULB has awarded a Build, Operate and Transfer (BOT) contract for a sanitation block to a Non-Government Organization (NGO) in the city.

The NGO conducted a sample survey, and existing sanitation blocks were also surveyed for their design and operation. It was observed that no health faucets were provided either with the water closet or in the bathroom. But a common tap or a tank was provided which supplied water to the user. This served two purposes:

1. Limiting the scope for overuse of water, thereby reducing its wastage.
2. Reducing the operation and maintenance (O&M) costs by providing a common tap or tank.

Results of the sample survey are given in Table 4.

TABLE 4: RESULTS OF THE SAMPLE SURVEY CONDUCTED BY NGO IN TRIDEV NAGAR SETTLEMENT

Description	Number	Unit
Population	400	no.
Households	80	no.
Men	232	no.
Women	168	no.
Water use in water closet (WC)[6]	8	L/user
Water consumption in bath[7]	40	L/user
Water consumption in wash area	60	L/HH
Water required for cleaning of blocks	10%	
Population using WC twice a day	30%	
Population taking bath twice a day	10%	

Observations

[6] Depends on capacity of cistern flush in the WC or should be equivalent to two small buckets.
[7] Usually, taken as capacity of one large bucket per use.

A plot of land has been designated for setting up of a community sanitation block in the settlement. This plot is accessible to most of the households. There is a 3.2 m wide approach road to this piece of land. The stormwater drain running adjacent to this plot carries wastewater from the non-sewered areas.

Additionally, the settlement has a small-scale dairy business run by a Community-Based Organization (CBO). Cattle owners supply milk to this dairy. With regards to dealing with the cattle dung, the families practice disposal into a natural pit. This pit is located within the boundary of the plot designated for the proposed community sanitation block. As a result, there is an issue of odour as well as overflow of cow-dung into the stormwater drain flowing along the plot. In fact, the issue is further aggravated during monsoon, when the surface run-off carries all the waste through this stormwater drain.

3.1 Sanitation requirement

You are a freelance expert in the field of solid and liquid waste management. The NGO has requested your services in planning of sanitation infrastructure for this new pocket of the settlement.

The first step is to understand sanitation infrastructure required on the basis of information gathered in Table 4.

To calculate the number of water closets (WCs), baths, urinals and wash area required for the community sanitation block, refer to the SBM (Urban) Guidelines issued by the Ministry of Housing and Urban Affairs (MoHUA) in 2014.

Toilet Seats	Bath units	Urinal units	Clothes washing Area
One seat for 35 men	One unit per 50 users	One unit per 200 – 300 users	4 to 5 sq. meters per 10 toilet seats; Min. 1.5 m x 1.2 m
One seat for 25 women			

Description	Optimum (mm)	Minimum* (mm)
Toilet cubicles	900 x 1200	750 x 900
Bath rooms	1050 x 1200	900 x 1050
Urinals (divided into units by partition walls)	575 x 675	500 x 600
Washing area	1750 x 1500	1200 x 1500

*Note: *In case of space constraint the minimum sizes may be adopted. However, it has been observed that the minimum dimensions, which are found acceptable for individual household toilet units, are sometimes not being accepted for community toilet cubicles, because while a user is willing to bear the discomfort in his own premises in exchange of other conveniences, he or she is not willing to use a confined space in a community toilet due to odour and hygiene issues and thus is susceptible to reverting to defecating in the open.*

FIGURE 5: GUIDELINES FOR DESIGNING A COMMUNITY SANITATION BLOCK BASED ON SANITATION REQUIREMENT. (SOURCE: SBM (URBAN) GUIDELINES (2014))

Sanitation requirement

Type of unit	Men	Women	Unit
WC			**no.**
Bath			**no.**
Urinals			**no.**
Wash Area			**m^2**

3.2 Wastewater quantification

In this case, wastewater generation will be equal to water consumption for the sanitation block.

Calculate number of users

Use information given in Table 4 and calculate number of users for each type of unit in the sanitation block.

Assume, each household uses the wash area once a day to wash clothes.

$$Number\ of\ users\ [no.] = Population\ [no.] + (1 + Population\ using\ the\ unit\ twice)$$

WC users

Bath users

Wash area users

Total number of users = _____

Type of unit	Users	Unit
WC		**no.**
Bath		**no.**
Wash area		**no.**

Calculate water consumption

Use information given in Table 4 and calculate water consumption for each type of unit in the sanitation block.

$$Water\ consumption\ [KLD] = Total\ users\ [no.] \times water\ consumption\ [L/use]$$

Water Closet

Bathroom

Wash area

$$Water\ consumption\ [KLD]$$
$$= Water\ consumed\ in\ WC + Water\ consumed\ in\ Bathroom$$
$$+ Water\ consumed\ in\ Wash\ area$$

$$Total\ water\ consumption\ [KLD]$$
$$= \ Water\ consumption\ [KLD] \times (1 + Water\ required\ for\ cleaning\ of\ block)$$

Total water consumption = _____ KLD

Calculate wastewater generation

Considering the amount of wastewater generated equal to amount of water consumed, estimate the generation of blackwater and greywater in the sanitation block.

Total blackwater generation = _____ KLD

Total greywater generation = _____ KLD

Wastewater generation

$$Total\ wastewater\ generation\ [KLD] = Blackwater\ generation\ [KLD] + Greywater\ generation\ [KLD]$$

Total wastewater generation = _____ KLD

3.3 Diurnal curve

Plot a diurnal curve for community sanitation block.

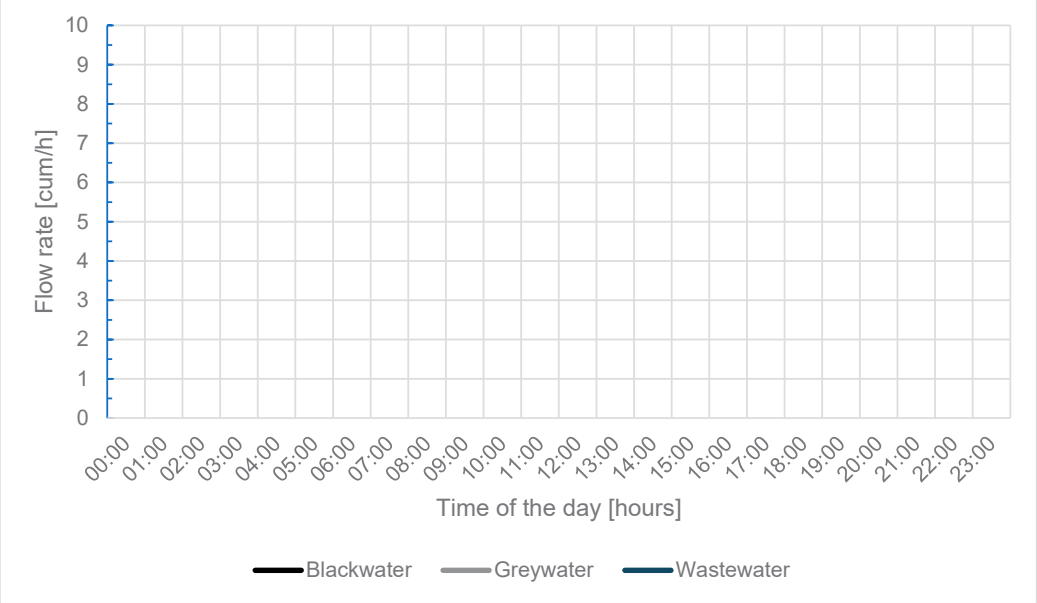


FIGURE 6: DIURNAL CURVE FOR COMMUNITY SANITATION BLOCK

3.4 Recommendations

As a solid and liquid waste management expert, what are your recommendations for managing the waste generated at the project site? Can you think of some innovative and holistic solution that will safely manage wastewater as well as cow dung which requires proper disposal? Write down your solution in brief and analyse it further to document its pros and cons.

SOLUTION

Section

04

Public Sanitation

4 Public Sanitation

The city has a beach which is visited by the local population on a daily basis. A concerned stretch of coastline is called 'Golden Sand Beach' which runs for 2 km. The ULB needs to install public sanitation blocks on this stretch and wishes to achieve this under the guidelines of Swachh Bharat Mission (SBM). The School of Architecture and Urban Planning has been assigned the task of developing a plan for installation of public sanitation blocks by the ULB. You have been appointed as the project coordinator for this task.

As a first step, you have taken help of students for data collection. Following table summarizes the data collected over a period of 2 weeks.

TABLE 5: RESULTS OF SAMPLE SURVEY CONDUCTED BY THE SCHOOL OF ARCHITECTURE AND URBAN PLANNING

Description	Number	Unit
Number of visitors	1200	no.
Men	60	%
Women	40	%
Visitors (both gender) expressed the need to use WC for defecation	6	%
Women who expressed the need to use WC for urination	40	%
Men who expressed the need to use urinals	70	%
Visitors who will wash the hands after using facilities	100	%

4.1 Sanitation requirement

Based on the data collected and the CPHEEO Manual on Sewerage and Sewage Treatment (2013), calculate sanitation requirements for installing public toilet blocks in this area. The guidelines for designing a public sanitation block are given below.

NO	Sanitary Unit	For Male	For Female
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% European WC*

FIGURE 7: GUIDELINES FOR DESIGNING A PUBLIC SANITATION BLOCK

(SOURCE: CPHEEO MANUAL ON SEWERAGE AND SEWAGE TREATMENT (2013))

Sanitation requirement

Type of unit	Men	Women	Unit
WC			**no.**
Urinals			**no.**
Wash Basins			**no.**

4.2 Number of public sanitation blocks

Along the 2 km length, the Golden Sand Beach has several entry points. However, there is one main entrance that also has a parking facility. You must decide the number of public sanitation blocks you need to install and its location. The location should be chosen in such a way that the blocks are easily accessible to the visitors.

Table 6 gives the detail about sanitation infrastructure and facilities required for various categories of toilets.

TABLE 6: INFRASTRUCTURE AND FACILITIES REQUIRED IN VARIOUS CATEGORIES OF TOILETS (SOURCE: CPHEEO MANUAL ON SEWERAGE AND SEWAGE TREATMENT (2013))

Type of toilet	Men					Women					Differently abled unit (refer footnote)	Transgender unit (refer footnote)	Caretaker /storage room	Waiting circulating space	Washing area
	Indian WC	Western WC	Urinal	Hand-wash + Mirror	Bath	Indian WC	Western WC	Hand-wash + Mirror	Child care wash + changing room	Bath					
Type 1 Transit Area toilets	Mandatory	Mandatory	Mandatory	Mandatory	Recommended	Mandatory	Mandatory	Mandatory	Recommended	Recommended	Mandatory	Recommended	Mandatory	Recommended	-
Type 2 Institutional Area toilets	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Mandatory	Mandatory	Mandatory	Optional	Optional	Mandatory	Optional	Mandatory	Optional	-
Type 3 Public Space toilets	Recommended	Mandatory	Mandatory	Mandatory	-	Recommended	Mandatory	Mandatory	-	-	Mandatory	Optional	Mandatory	Optional	-
Type 4 Community toilets	Mandatory	Mandatory	Optional	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Mandatory	Recommended	Recommended	Recommended	Recommended	Mandatory
Type 5 Event linked toilets	Optional	Mandatory	Mandatory	Mandatory	-	Optional	Mandatory	Mandatory	-	Optional	Recommended	Optional	-	Optional	-

Foot note:

1. *Mandatory- Defined as per norms and guidelines already available in CPHEEO Manual / URDPFI Guidelines / IS Codes.*
2. *Recommended- To be provided based on demand and space availability, but guidelines are not available.*
3. *Optional- To be provided based on local conditions / demand for such facilities/infrastructure.*
4. *Blank cells- Facility or service not required.*
5. *Differently abled unit- Unisex / separate for men or women as per local conditions. Whether to be integrated into the main toilet unit design or separately provided to be decided based on local conditions and space availability.*
6. *Transgender unit- Subject to local conditions and demand*
7. *Single toilet units (like E-toilets) are covered under Type 1 & 3 toilets above. Suitable guidelines / norms to be adapted if this is the preferred option over a toilet facility.*
8. *Standalone Urinal facilities as an option are covered under Type 1, 2, 3, 5 toilets above. Suitable guidelines / norms to be adapted if this is the preferred option over a toilet facility.*

The total sanitation requirement (WCs, urinals and wash basins) should be such that it is accessible to users at three different locations. Assuming that one of these sanitation blocks will be located near the main entrance to the beach, it should have the highest number of sanitation facilities. The other two will be of a smaller size and will be located at either ends of the beach. **Give details of the sanitary units at each location.**

Public Sanitation Block 1: Location		
Sanitary unit	**Number**	**Unit**
WC		no.
Ablution taps		no.
Urinals		no.
Wash basins		no.

Public Sanitation Block 2: Location		
Sanitary unit	**Number**	**Unit**
WC		no.
Ablution taps		no.
Urinals		no.
Wash basins		no.

Public Sanitation Block 3: Location		
Sanitary unit	**Number**	**Unit**
WC		no.
Ablution taps		no.
Urinals		no.
Wash basins		no.

4.3 Wastewater quantification

Calculate number of users

In order to estimate the number of users, we will use the information collected through the sample survey (Table 5) and guidelines provided in From *CPHEEO Manual on Sewerage and Sewage Treatment (2013)* the guidelines, it can be inferred that:

1. One WC serves up to 100 men and 50 women.
2. One urinal serves up to 50 men.

It can be inferred that of the 100 men and 50 women, 6% of them will use the WC for defecation. And of the 50 women, 40% will be using the WC for urination. Furthermore, 70% of the 100 men will use the urinals.

Table 7 provides the detail of the users per unit and the water consumption per use.

TABLE 7: NUMBER OF USERS PER SANITATION UNIT AND CORRESPONDING WATER CONSUMPTION FOR EACH UNIT

Type of unit	Users/unit		Water consumption [L/use]
	Men	Women	
WC	6	3 + 20[8]	12
Urinals	35	-	0.3
Wash basins	41	23	6

Using the solution from section 4.2 and information from Table 7, find total number of users for each type of sanitary unit.

$$Total\ users\ [no.] = Number\ of\ sanitary\ unit\ [no.] \times Number\ of\ users\ [\frac{users}{unit}]$$

Example: For 2 number of WCs, the total users in case of men will be 2 x 6 = 12 users.

Total number of users for each sanitary unit in each public sanitation block will be:

Public Sanitation Block 1			
Type of unit	Users		Total users
	Men	Women	
WC			
Urinals		-	
Wash basins			

[8] Women using WC for urination.

Public Sanitation Block 2			
Type of unit	Users		Total users
	Men	Women	
WC			
Urinals		-	
Wash basins			

Public Sanitation Block 3			
Type of unit	Users		Total users
	Men	Women	
WC			
Urinals		-	
Wash basins			

Calculate wastewater generation

$$Wastewater\ generation\ [\frac{L}{d}] = Total\ users\ [no.] \times Water\ consumed\ [\frac{L}{use}]$$

Public Sanitation Block 1			
Type of unit	Total users [no.]	Water consumption [L/use]	Wastewater generation [L/d]
WC			
Urinals			
Wash basins			

Public Sanitation Block 2			
Type of unit	Total users [no.]	Water consumption [L/use]	Wastewater generation [L/d]
WC			
Urinals			
Wash basins			

Public Sanitation Block 2			
Type of unit	Users		Total users
	Men	Women	
WC			
Urinals		-	
Wash basins			

4.4 Diurnal curve

Plot a diurnal curve for the public sanitation block.

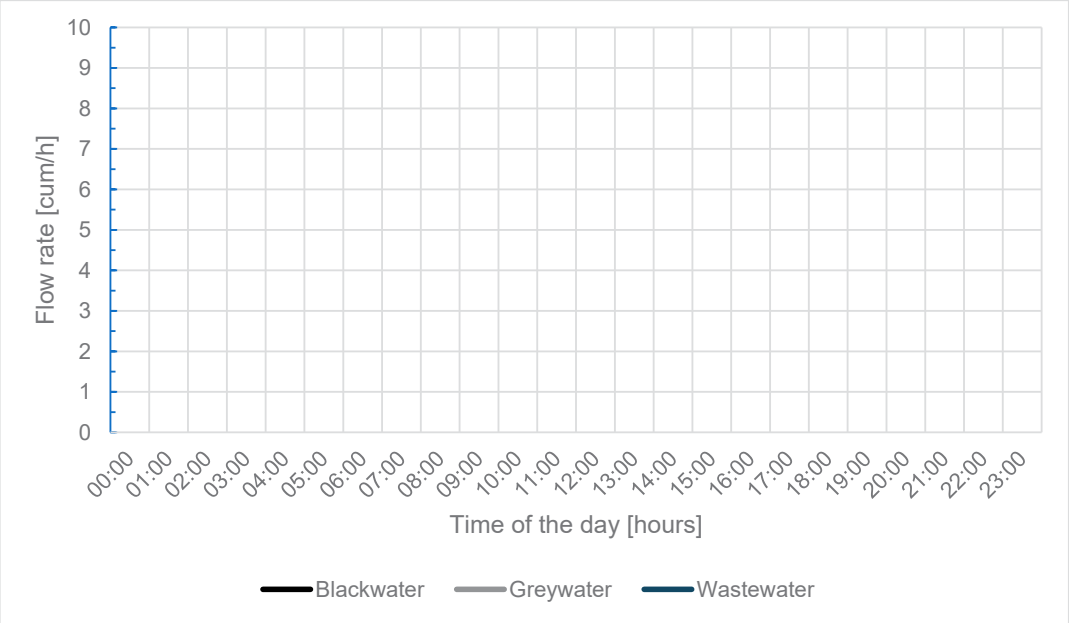


FIGURE 8: DIURNAL CURVE FOR PUBLIC SANITATION BLOCK

4.5 Recommendations

The location for public sanitation blocks have been identified. However, following are some of the factors that need to be considered:

1. There is no sewerage network nearby.
2. Ground water table is high and the underlying sandy soil strata is completely saturated with water.
3. Electrical and water supply is available.

As the project coordinator, what is the type of wastewater management system that you suggest for the public sanitation blocks? Provide a flow diagram of the wastewater management system.

Solution

In order to ensure the functionality of these public sanitation blocks and sustainability of the infrastructure, what solution do you recommend?

Solution

Section

05

FSSM Planning

5 FSSM Planning

A technical support unit has been set up at the state level. You are appointed as a project manager who has been assigned the task of planning FSSM for this city. As a first step, you conducted a consultation with key stakeholders such as ULB officials, desludging operators and certain households dependent on on-site sanitation systems such as septic tanks. The data was captured through stakeholder consultations and inferences from it are provided in Table 8. The amendment in the Open Defecation Free (ODF) Protocol by MoHUA (2020) mandates that an onsite sanitation system such as septic tank should have a desludging frequency of 3 years.

TABLE 8: INFERENCES DRAWN FROM STAKEHOLDER CONSULTATIONS FOR PLANNING OF FSSM

Description	Number	Unit
Persons per household	5	No.
Households connected to septic tank	58%	
Number of community toilet (2020)	16	
Number of public toilets (2020)	21	

Assumption:
Number of working days in a year = 290



SIZE OF SEPTIC TANKS		
Households	3	KL
Community Toilet Blocks	7	KL
Public Toilet Blocks	4	KL

DESLUDGING FREQUENCY		
Households	3	years
Community Toilet Blocks	3	months
Public Toilet Blocks	6	months

TRUCK SIZES AVAILABLE		
3000 L and 8000 L		
TRIPS PER DAY		
3000 L	3	no.
8000 L	1	no.

5.1 Foundation

After completing data analysis, the next step is to plan for emptying and conveyance of waste material from the containment units. It is important to prepare a strong foundation for the planning of these services. For this, we assume a base year[9] for the project as 2021. Calculate population in the base year using the information given in section 1. In case of emptying and

[9] Base year is the year when the implementation of the project will finish and the infrastructure will be commissioned.

conveyance, planning is done for the base year. As the population grows, additional desludging equipment such as vacuum trucks can be introduced when necessary.

Base year population

$$Future\ population = Past\ population\ \times (1 + R)^n$$

Base year population = _____ no. of persons

Base year household

$$Number\ of\ households = \frac{Population}{No.of\ persons\ per\ household}$$

Base year households = _____ no. of households

Households having septic tank

$$Households\ having\ septic\ tank\ [no.] = Number\ of\ households\ [no.] \times Percent\ of\ households\ connected\ to\ septic\ tank\ [\%]$$

Households having septic tank = _____ no. of households

5.2 Planning for emptying of containment units

Next, we calculate the containment units to be serviced. It can be observed from Table 8 that the containment units connected to residential properties are emptied every 3 years. On the other hand, the containment units connected to community toilets (CTs) and public toilets

(PTs) are emptied frequently. It is assumed that total number of working days[10] in a year are 290.

In case of residential properties, we calculate the number of households (HHs) to be serviced per day.

$$HHs\ to\ be\ serviced\ per\ day = \frac{No.\ of\ HHs\ with\ septic\ tank}{Desludging\ frequency \times No.\ of\ working\ days\ in\ a\ year}$$

HHs to be serviced per day = _____ no. of households

Community toilets (CTs) and public toilets (PTs) to be serviced

Assume, number of weeks per month as 4 and the CTs and PTs are connected to septic tanks. Since the number of CTs and PTs are low, we will calculate the toilets to be serviced per week.

$$CT\ or\ PT\ to\ be\ serviced\ per\ week = \frac{No.\ of\ CT\ or\ PT\ with\ sepic\ tank}{desludging\ frequency\ x\ no.\ of\ weeks\ in\ a\ month}$$

CTs to be serviced per week [no.] = _____ no. of CTs

PTs to be serviced per week [no.] = _____ no. of PTs

Total CTs and PTs to be serviced per week [no.] = _____ no. of toilets

[10] Working days are calculated by deducting 52 Sundays and 23 additional public holidays from total number of days in a year.

5.3 Planning for conveyance of waste from containment units

After planning for emptying of containment units, the next step is to plan for conveyance of the waste material. Here, we calculate the number of trucks required for providing desludging services to various properties. Refer to Table 8 and carefully choose the capacity of truck to provide desludging services.

Calculate number of trips required for servicing HHs

$$No.\ of\ trips\ required\ per\ day = \frac{No.\ of\ HHs\ to\ be\ serviced\ per\ day\ x\ Capacity\ of\ septic\ tank}{Capacity\ of\ a\ truck}$$

No. of trips required = _____ no. of trips

Calculate number of trucks required for servicing HHs

$$Number\ of\ trucks\ required = \frac{No.\ of\ trips\ required}{No.\ of\ trips\ per\ day\ for\ truck}$$

No. of trucks required = _____ no. of trucks

The containment units connected to CTs and PTs have a higher depth due to constraints in land area. Also, there are situations when the location of these sanitation blocks is not adjacent to an access road. Hence, to desludge such containment units, a higher capacity of vacuum pump is required. The larger capacity trucks can carry such higher capacity vacuum pumps for operation.

Conveyance of sludge using higher capacity trucks as compared to doing multiple trips while using lower capacity trucks is economical and highly recommended.

Since CTs and PTs are assets owned by the ULB, desludging activity can be scheduled by the ULB for these toilets.

Calculate number of trips required for servicing CTs and PTs

$$No.\ of\ trips\ required\ per\ day = \frac{Total\ units\ to\ be\ serviced\ per\ week}{Number\ of\ working\ days\ in\ a\ week}$$

No. of trips required = _____ no. of trips

Calculate number of trucks required for servicing CTs and PTs

$$Number\ of\ trucks\ required = \frac{No.\ of\ trips\ required}{No.\ of\ trips\ per\ day\ for\ truck}$$

No. of trucks required = _____ no. of trucks

In some cases, the CTs might not be accessible to the trucks. It is advisable to use a vacutug to empty faecal sludge from such containment units and transfer it to a truck parked on the nearest access road.

5.4 Quantification of waste material

Waste material emptied from the containment units can be classified as faecal sludge or septage, depending on the time period for which the waste material was contained in the unit. In case of a 3-year desludging frequency, the waste from containment units will be classified as septage. On the other hand, the waste coming from CTs and PTs is classified as faecal sludge. The next step is to find the quantum of faecal sludge and septage (FSS) to be handled at a treatment plant on a daily basis.

$$Quantity\ of\ faecal\ sludge/septage\ to\ be\ handled\ [KLD]$$
$$= Total\ no.\ of\ trips\ x\ Capacity\ of\ the\ truck$$

Quantity of septage to be handled = _____ KLD

Quantity of faecal sludge to be handled = _____ KLD

It is important to understand that there is a variation in the quantum of FSS to be handled on a daily basis. This helps to decide the type of treatment units to be considered in a treatment plant. If the amount of faecal sludge is low, it can be blended with septage and co-treated at a faecal sludge and septage treatment plant (FSSTP). On the other hand, a higher quantum of faecal sludge (or sewage sludge) that needs to be handled, an anaerobic digester is recommended as one of the treatment units. While there are several benefits of installing an anaerobic digester, it is important to note that this unit will result in increase of capital as well as operational expenses of treatment.

Alternatively, desludging of the containment units connected to public properties with CTs and PTs can be scheduled so as to optimise the quantity of the faecal sludge to be handled. This could allow for the elimination of providing an anaerobic digester at the treatment plant.

5.5 Faecal Sludge and Septage Management (FSSM) approach

Depending on the quantity of FSS to be handled and the existing infrastructure available with the ULB, the following decision making diagram can be used to decide the approach for FSSM.

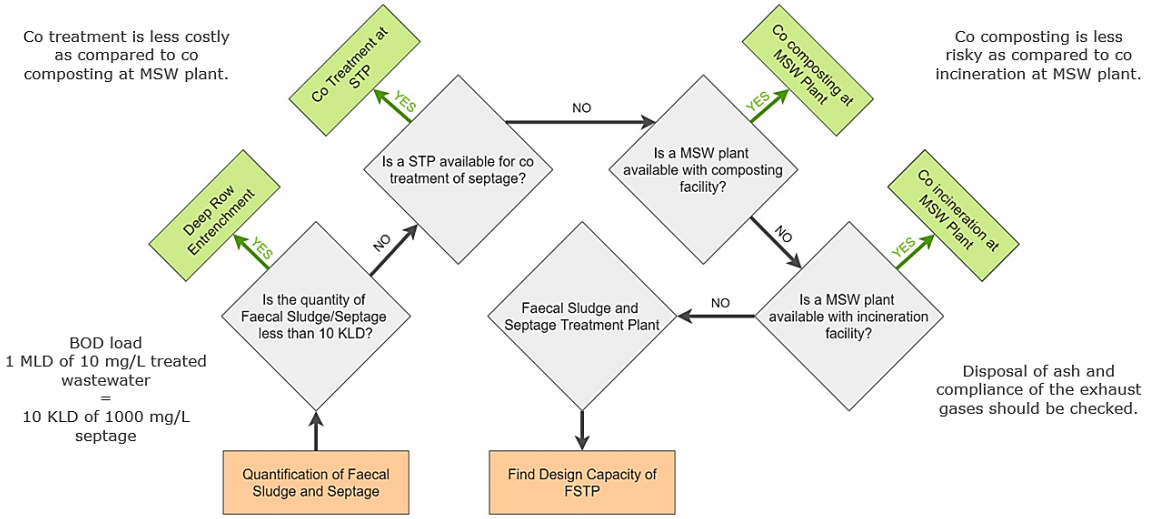


FIGURE 9: DECISION MAKING DIAGRAM FOR SELECTING THE FAECAL SLUDGE AND SEPTAGE MANAGEMENT APPROACH

To know more about how to use this decision making diagram, a separate module has been developed titled **"Co-treatment of faecal sludge and septage with sewage in sewage treatment plant".** In order to understand the design of an FSSTP, you may refer to the advanced module titled **"Faecal Sludge and Septage Management"** on the Sanitation Capacity Building Platform online portal.

From the preliminary information provided in section 1.4, what are the logical steps you suggest for an appropriate FSSM approach?

Solution:

Section

06

O&M Cost of FSSM

6 Operation and Maintenance (O&M) Cost of FSSM

After completing the planning of emptying and conveyance stage of FSSM, you have to select an appropriate treatment scheme that will cater to the quantum of FSS generated in the project. The capital cost for this treatment plant will also require a careful estimation as the ULB will cater to it from the funds received through the state government. However, the O&M cost of the complete system needs to be borne by the ULB. Hence, you will now calculate the O&M expenses for implementing FSSM in this project.

6.1 Emptying and conveyance

As the project manager, you conducted a stakeholder consultation with private desludging service providers in the city. Table 9 provides important inferences from this consultation.

TABLE 9: INFERENCES DRAWN FROM STAKEHOLDER CONSULTATIONS FOR ESTIMATING THE O&M COST OF EMPTYING AND CONVEYANCE STAGE

Average Distance 18 km per trip	Mileage of Truck 4 km per Litre	Human Resource 2 persons per truck	Protective Equipment INR 15,000 per person-year
Fuel Price INR 72 per Litre	O&M Equipment INR 6500 per month	Salary INR 15,000 per person-month	Overheads 10% Total O&M cost

Calculate cost of fuel

$$Fuel\ cost\ [\frac{INR}{trip}] = \frac{Average\ Distance\ [km]\ x\ Fuel\ cost\ [\frac{INR}{L}]}{Mileage\ [\frac{km}{L}]}$$

$$Fuel\ cost\left[\frac{INR}{annum}\right] = Fuel\ cost\ \left[\frac{INR}{trip}\right] \times\ No.\ of\ trips\ \left[\frac{no.}{day}\right] \times\ No.of\ working\ days\ [\frac{days}{annum}]$$

Fuel cost = _____ INR per annum

Calculate O&M cost of equipment

$$Equipment\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost\ of\ equipment\ \left[\frac{INR}{month}\right] \times\ No.\ of\ trucks\ [no.]$$

O&M cost of equipment = _____ INR per annum

Calculate cost of human resources

$$HR\ cost\ \left[\frac{INR}{annum}\right]$$
$$= No.\ of\ trucks\ [no.]\ \times\ Human\ resource\ \left[\frac{persons}{truck}\right] \times\ Salary\ \left[\frac{INR}{person.month}\right]$$
$$\times 12\ [\frac{months}{annum}]$$

Human resources cost = _____ INR per annum

Calculate cost for protective equipment

$$PE\ cost\ \left[\frac{INR}{annum}\right] = No.\ of\ trucks\ [no.]\ \times\ Human\ resource\ \left[\frac{persons}{truck}\right] \times\ PE\ cost\ [\frac{INR}{person.annum}]$$

Protective equipment cost = _____ INR per annum

Calculate O&M cost

$$O\&M\ cost\ \left[\frac{INR}{annum}\right] = Fuel\ cost + Equipment\ O\&M\ cost + \ HR\ cost + PE\ cost$$

O&M cost = _____ INR per annum

Calculate overhead cost

$$Overhead\ cost\ \left[\frac{INR}{annum}\right] = Overheads\ [\%]\ \times\ O\&M\ cost\ [\frac{INR}{annum}]$$

Overhead cost = _____ INR per annum

Calculate total O&M cost of emptying and conveyance

$$Total\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost + Overhead\ cost$$

Total O&M cost = _____ INR per annum

Calculate the percentage contribution under different heads to total O&M cost. Document your critical observations.

$$Percent\ contribution\ [\%] = \frac{Individual\ cost\ \left[\frac{INR}{annum}\right]}{Total\ O\&M\ cost\ [\frac{INR}{annum}]} \times 100$$

Type of cost	Cost [INR/annum]	Contribution [%]
Fuel cost		
Equipment O&M cost		
Human resource cost		
Protective equipment cost		

Observations:

6.2 Treatment

After calculating the cost of emptying and conveyance services of FSSM, the next step is to calculate cost of treatment system. The treatment system selected here is a non-mechanized treatment scheme.

You have consulted with the operator of an STP in the city for understanding the expenses towards various human resources required in a treatment plant. Additionally, some assumptions are also necessary to be made for calculations. Table 10 gives all the data and assumption required for calculating O&M cost of the treatment system.

TABLE 10: DATA AND ASSUMPTIONS MADE FOR CALCULATING O&M COST OF TREATMENT SYSTEM

Energy Cost
INR 12,000
per month

Equipment O&M
INR 8,000
per month

Protective Equipment
INR 8,000
per annum

Overheads
15%
Total O&M cost

Human Resources [no.]	
Operator	1
Chemist	1
Skilled worker	4
Unskilled worker	9
Security guards	2

Salary [INR/month]	
Operator	35,000
Chemist	30,000
Skilled worker	20,000
Unskilled worker	12,000
Security guards	15,000

Calculate cost of energy

$$Energy\ cost\ \left[\frac{INR}{annum}\right] = Energy\ cost\ \left[\frac{INR}{month}\right] \times 12\ \left[\frac{months}{annum}\right]$$

Energy cost = _____ INR per annum

Calculate O&M cost of equipment

$$Equipment\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = Equipment\ O\&M\ cost\ \left[\frac{INR}{month}\right] \times\ 12\ [\frac{months}{annum}]$$

O&M cost of equipment = _____ INR per annum

Calculate cost of protective equipment

$$PE\ cost\ \left[\frac{INR}{annum}\right] = Total\ no.\ of\ human\ resources\ [no.] \times\ PE\ cost\ [\frac{INR}{person.annum}]$$

Protective equipment cost = _____ INR per annum

Calculate cost of human resources

$$Salary\ \left[\frac{INR}{annum}\right] = No.of\ human\ personnel\ \times\ Salary\ \left[\frac{INR}{person.month}\right] x\ 12\ [\frac{months}{annum}]$$

Human Resource	Number	Salary [INR/person-month]	Salary [INR/annum]
Operator	1	35,000	
Chemist	1	30,000	
Skilled worker	4	20,000	
Unskilled worker	9	12,000	
Security guards	2	15,000	

Total cost of human resources = _____ INR per annum

Calculate O&M cost

$$O\&M\ cost\ \left[\frac{INR}{annum}\right] = Energy\ cost + Equipment\ O\&M\ cost + \ HR\ cost + PE\ cost$$

O&M cost = _____ INR per annum

Calculate overhead cost

$$Overhead\ cost\ \left[\frac{INR}{annum}\right] = Overheads\ [\%]\ \times\ O\&M\ cost\ [\frac{INR}{annum}]$$

Overhead cost = _____ INR per annum

Calculate total O&M cost of emptying and conveyance

$$Total\ O\&M\ cost\ \left[\frac{INR}{annum}\right] = O\&M\ cost + Overhead\ cost$$

Total O&M cost = _____ INR per annum

Calculate the percentage contribution under different heads to total O&M cost. Document your critical observations.

$$Percent\ contribution\ [\%] = \frac{Individual\ cost\ \left[\frac{INR}{annum}\right]}{Total\ O\&M\ cost\ [\frac{INR}{annum}]} \times 100$$

Type of cost	Cost [INR/annum]	Contribution [%]
Energy cost		
Equipment O&M cost		
Human resource cost		
Protective equipment cost		

Observations:

6.3 Financial model

The two major financial models used in FSSM are: (a) tax model, and (b) service fee model.

Calculate total cost of O&M for FSSM

$$Total\ O\&M\ cost\ for\ FSSM\ \left[\frac{INR}{annum}\right] = O\&M\ cost\ of\ desludging\ services\ \left[\frac{INR}{annum}\right] + O\&M\ cost\ of\ treatment\ system\ [\frac{INR}{annum}]$$

Total O&M cost of FSSM = _____ INR per annum

Tax model

In case of the tax model, a fixed amount is collected from each registered property as tax for the FSSM services. The desludging service is then provided in a scheduled manner. Here, the desludging frequency is 3 years. In case of scheduled desludging, the ULB will have to adopt tax model and provide regular desludging services to households as well as CTs and PTs. An advantage of the tax model is the improvement in affordability of the services by households. However, for this model to work well it is very important that the ULB builds a good management information system linked to its tax revenue for implementing these services.

Assuming a tax collection efficiency of 62% by the ULB, calculate the FSSM tariff.

$$FSSM\ tariff\ \left[\frac{INR}{household.annum}\right] = \frac{Total\ O\&M\ cost\ of\ FSSM\ [\frac{INR}{annum}]}{Total\ no.\ of\ HHs\ [no.]\ \times\ Tax\ collection\ efficiency\ [\%]}$$

FSSM tariff = _____ INR per annum for each household

Service fee model

In case of the service fee model, a customer will pay a fee upon receiving the service. The service fee model needs to be adopted in case of demand desludging.

$$FSSM\ service\ fee\ \left[\frac{INR}{service}\right] = \frac{Total\ O\&M\ cost\ of\ FSSM\ \left[\frac{INR}{annum}\right]}{Total\ no.\ of\ HHs\ to\ be\ serviced\ \left[\frac{no.}{annum}\right]}$$

FSSM service fee = _____ INR per service

In order to increase the affordability of services for the households, this service fee needs to be capped at a certain price level. This can be achieved by increasing the frequency of desludging. For example, a desludging frequency of 5 years will result in a lower service fee as compared to the service fee calculated for 3 years. Hence, during initial calculations, it is important that you choose a desludging frequency very carefully.

6.4 Summary

- The cost of desludging is significantly impacted by desludging frequency.
- Human resources cost contributes significantly to O&M cost of FSSM.
    - Selection of treatment technology is quite critical as mechanized treatment requires specialized personnel which is often costly.
- Fuel cost is the second highest contributor to O&M cost of desludging services.
    - Treatment plant should be located as close as possible to the city.
- Cost of safety is negligible; however, it is important to consider it to protect the health of human resources involved in service provision.
- Affordability of services determines the demand for desludging services by the households.

Notes:

Notes:

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About NIUA

NIUA is a premier national institute for research, capacity building and dissemination of knowledge in the urban sector, including sanitation. Established in 1976, it is the apex research body for the Ministry of Housing and Urban Affairs (MoHUA), Government of India. NIUA is also the strategic partner of the MoHUA in capacity building for providing single window services to the MoHUA/states/ULBs.

About SCBP

The Sanitation Capacity Building Platform (SCBP) is an initiative of the National Institute of Urban Affairs (NIUA) to address urban sanitation challenges in India. SCBP, supported by Bill & Melinda Gates Foundation (BMGF) is an organic and growing collaboration of credible national and international organisations, universities, training centres, resource centres, non-governmental organisations, academia, consultants and experts. SCBP supports national urban sanitation missions, states and ULBs, by developing and sourcing the best capacity building, policy guidance, technological, institutional, financial and behaviour change advise for FSSM. SCBP provides a unique opportunity for:

- Sharing and cross learning among the partner organisations, to pool in their knowledge resources on all aspects of urban sanitation capacity building;
- Developing training modules, learning and advocacy material including key messages and content, assessment reports and collating knowledge products on FSSM. Through its website (scbp.niua.org), SCBP is striving to create a resource centre on learning and advocacy materials, relevant government reports, policy documents and case studies;
- Dissemination of FSSM research, advocacy and outreach to State governments and ULBs.

Its strength is its ability to bring together partners to contribute towards developing state sanitation policy, training of trainers and training content development, technical and social assessments, training programme delivery, research and documentation.

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Integrated Wastewater and Septage Management- Planning Module

Part C: Workbook