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Government of India

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Greater Visakhapatnam Municipal Corporation

Faecal Sludge and Septage Management Policy and Operational Guidelines

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GVMC

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FOREWARD

Praveen Kumar, IAS
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Safe and sustainable sanitation is a basic requirement for the people living in any city. The Ministry of Urban Development, GoI, have taken steps by way of introducing two major schemes viz; Swachh Bharat Mission Urban (SBM-U) and AMRUT. As per the Swachh Sarvekshan 2017 data, out of 4,041 cities where Ministry of Urban Development (MoUD) is presently focusing, 1012 cities have been declared Open Defecation Free (ODF). Achieving ODF is the first step towards cleaner and safer environment. The cities which have been declared ODF should now take the next step and move towards safer disposal of Faecal Sludge.

The city of Visakhapatnam which has secured the rank of third cleanest city in the 2017 Swachh Sarvekshan is taking the lead in developing the Faecal Sludge and Septage Management Policy. In addition to the policy, GVMC has developed the Operational Guidelines for safe septage disposal at designated sites in the Sewage Treatment Plant. Only 26.9 per cent of the household in Visakhapatnam are connected to centralized sewerage network. Out of this only 16.17 per cent is being treated at the Sewage Treatment Plant (STPs). This policy aims to address the existing gaps and provide for safe collection, transportation, disposal as well as treatment of faecal sludge.

The common norm practiced in the country is that of developing the centralized sewerage system but setting up such huge infrastructure takes time. It is therefore, imperative that, a mix of centralized as well as decentralized treatment approach is taken up to address the current sanitation situation in the city.

It gives me immense pleasure to introduce the City Faecal Sludge and Septage Management Policy along with the Operational Guidelines. It provides direction for managing the fecal sludge in a cost effective manner wherein treatment, resource recovery methods are adopted with focus on efficient management of transportation of septage from source upto the treatment.

I am optimistic that the introduction of this policy will be a paradigm shift in the management of faecal sludge and septage in city as it introduces the best practices which help in achieving the predefined targets set forth.

PREFACE

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Commissioner Greater Visakhapatnam Municipal Corporation

Under the Sustainable Development Goal, India is required to provide safe and healthy environment to its citizens. Safe sanitation practice is extremely necessary in order to ensure healthy lives and promote well-being for all ages. Government providing cleaner cities is not only to meet the promises made at the global and national front but also increases the finances of the individuals through reduced medical expenditure by way of payments to doctors and purchase of medicines for the ailing but also increases the disposable income to cater to other important needs. To achieve this, Ministry of Urban Development, Government of India has come up with two schemes viz; Swachh Bharat Mission Urban (SBM-U) and Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

Since the implementation of the SBM-U programme in October 2014, significant efforts are being made in Visakhapatnam to generate awareness, build capacities of the GVMC officials and create infrastructure by way of up-gradation of existing sanitation facilities, and construction of new toilet structures as per the needs in a given area. The consistent efforts have borne fruits and we take pride in the fact the Visakhapatnam is the third cleanest city in the country. It is no mean achievement and I would like to take the opportunity to thank the immense contribution made by the citizens along with the support extended by the officials from various government departments as well as the non-government organizations who have provided valuable insights from the field. I take pride in reaching the target set up by the GoI and would like to urge all to move ahead and set a benchmark for the others to follow.

In this regard, I would like to tell my fellow citizens that across the country as per the 2011 Census, more than 59 per cent of the population in the city are dependent on the On-Site Sanitation (OSS) system. There has been an increase in the percentage as additional sanitation infrastructure has been created under SBM-U. Greater Visakhapatnam Municipal Corporation (GVMC) aims for 100 percent sewerage coverage for the city in near future, but such gold standard of containing and treating the sewage takes time as it is attributed to various other factors. Till such time, an interim arrangement is put in place to manage the faecal sludge generated by adopting the most cost effective and environment friendly treatment techniques.

In this context, instructions have been issued by the Department of Municipal Administration & Urban Development, Government of Andhra Pradesh on Faecal Sludge and Septage Management (FSSM). Working in this direction, GVMC is launching its City Faecal Sludge and Septage Management Policy and Operational Guidelines which will facilitate implementation of FSSM activities within the city.

I hope that this policy document will throw light and will be a guiding book providing direction to various stakeholders involved in such activities for safe and sustainable management of sanitation in general and faecal sludge and septage management in in particular.

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LIST OF ABBREVIATIONS

BIS	Bureau of Indian Standards
CPHEEO	Central Public Health and Environmental Engineering Organization
CSE	Centre for Science and Environment
CSTFs	City Sanitation Task Forces
FSSM	Faecal Sludge Septage Management
FSM	Faecal Sludge Management
FSTP	Faecal Sewage Treatment Plant
FFD	Faecal Flow Diagram
GVMC	Greater Visakhapatnam Municipal Corporation
GoAP	Government of Andhra Pradesh
GoI	Government of India
IHHT	Individual Household Toilet
MA&UD	Municipal Administration & Urban Development
MLD	Million Liter per Day
NBC	National Building Code
PESTLE	Political Economical Social Technological Legal Environmental
PPE	Personal Protective Equipment
SWOT	Strength Weakness Opportunity
SWM	Solid Waste Management
STP	Sewage Treatment Plant
OSS	Onsite Sanitation
WHO	World Health Organization
VTO	Vacuum Truck Operator

1. TERMINOLOGY

1.1 Faecal Sludge

Faecal sludge comprises all liquid and semi-liquid contents of pits and vaults accumulating in on-site sanitations in-stallations, namely un-sewered public and private latrines or toilets, aqua privies and septic tanks. These liquids are normally several times more concentrated in suspended and dissolved solids than wastewater. The physical, chemical and biological qualities of faecal sludge are influenced by the duration of storage, temperature, soil condition and intrusion of ground water or surface water in septic tanks or pits, performance of septic tanks, and tank emptying technology and pattern.

1.2 On-site Sanitation

On-site sanitation is a system of sanitation whose storage facilities are contained within the plot occupied by a dwelling and its immediate surroundings. For some systems (e. g. double-pit or vault latrines), faecal matter treatment is conducted on site and also by extended in-pit consolidation and storage. With other systems (e. g. septic tanks, single-pit or vault installations), the sludge has to be collected and treated off-site. (WHO, 2006, p. 180)

1.3 Septage

Septage means the liquid and solid material that is pumped from a septic tank, cesspool, or such on site treatment facility after it has accumulated over a period of time. Usually a septic tank retains 60% - 70% of the solids, oil and grease that enter it.

1.4 Septic Tank

Septic Tank means a water-tight receptacle which receives the discharge of a plumbing system or part thereof, and is designed to accomplish the partial removal and digestion of the suspended solid matter in the sewage through a period of detention.

1.5 Sewage

Sewage means water-borne human or animal wastes, excluding oil or oil wastes, removed from residences, buildings, institutions, industrial and commercial establishments together with such ground water, surface water and storm water as may be present.

1.6 Sewerage

Sewerage means and includes, but not limited to, any system or network of pipeline, ditches, channels, or conduits including pumping stations, lift stations, and force mains, service connections, including other constructions, devices and appliances appurtenant thereto, which includes the collection, transport, pumping and treatment of sewage to a point disposal.

1.4 Faecal Sludge and Septage Management (FSSM)

FSS Management (FSSM) deals with on-site sanitation systems, while wastewater management is concerned with sewered sanitation. FS may be treated in separate treatment works or co-treated with sludges produced in wastewater treatment plants. (Strauss et al., 2002)

Faecal Sludge Management (FSM) involves safely collecting, transporting, treating and disposing the faecal sludge from the on-site sanitation systems. A more commonly used term has been septage management, which is "a

historical term to define sludge removed from septic tanks" (Tilley, Ulrich, Lüthi, Reymond, & Zurbrügg, 2014). On-site sanitation systems collect, contain and partially treat the faecal waste and wastewater. The sludge accumulated in these systems need to be periodically removed and treated before being disposed into the environment.

CITY FSSM POLICY

2. Introduction

2.1. Sanitation Status in Visakhapatnam

As per the 2011 Census, Visakhapatnam has a population of 19, 96,523. The city is divided into 8 Zones including Beemili and Ankapalli. The municipality of Visakhapatnam came into existence in the year 1858 to fulfil the basic infrastructure requirements of its residents. It was later declared a corporation in 1979. The city is home to some of the important private and public sector enterprises. Visakhapatnam is one of India's largest seaports, containing the country's oldest shipyard. The city has high in-migration, due to large magnitude of economic opportunities available.

Sewerage remains the gold standard of sanitation services in Visakhapatnam despite major shortfalls in coverage and underutilization of existing capacity. The city is divided into 20 sewerage blocks including 32 merged villages (excluding Bheemili and Anakapalli). Figure 1 shows the current status of completed and on-going sewerage networks in various blocks.

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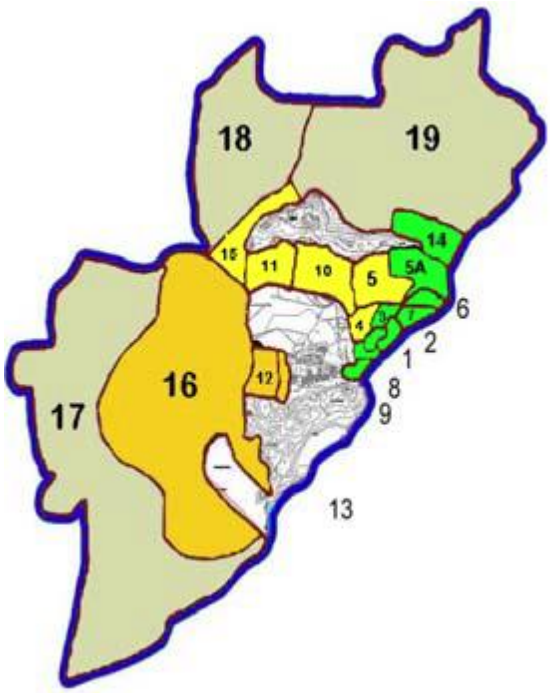


Legend	Status	Sanitation Blocks Covered
	Completed	1, 2, 3, 5A, 6, 7, 8, 9, 14
	In progress under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM)	4, 5, 10, 11, 15
	Designs submitted	12, 13, 16
	Designs under preparation	17, 18, 19

Figure:1 –Sanitation Blocks in Visakapatnam

Based on the 2011 Census, an assessment of the sanitation services was carried out and the resulting data were presented in the faecal flow diagram. The diagram may be seen at Annexure - 1.

Visakhapatnam has a mix of on-site sanitation facility coupled with sewerage system for collection of septage and waste water. The Faecal Flow Diagram (FFD) at Annexure - 1 reveals that nearly 14.7 percent household in the city do not have access to adequate sanitation facilities like an individual toilet within their premises. 85.3 percent population do have access to individual household toilets. It further states that out of 85.3 percent, about 58.8 percent households are not connected to the sewerage network and therefore depend on on-site sanitation facility. 14.7 percent households do not have access to toilet, out of this 2.58 percent population use Community Toilet facility to defecate. If we include the community toilet data, a total of 61.38 percent of the household produce faecal sludge, which is not connected with the underground drainage network (UGD) and it is being disposed in open environment without any treatment. Only 26.9 percent of the households are presently connected to the UGD network out of which only 16.17 percent of it is treated through centralized Sewage Treatment Plant (STP). The study informs that in areas which has sewerage network only 50 percent of the households have access to UDG network. This is evident from the distribution map of the septic tank as shown in the Figure - 2.

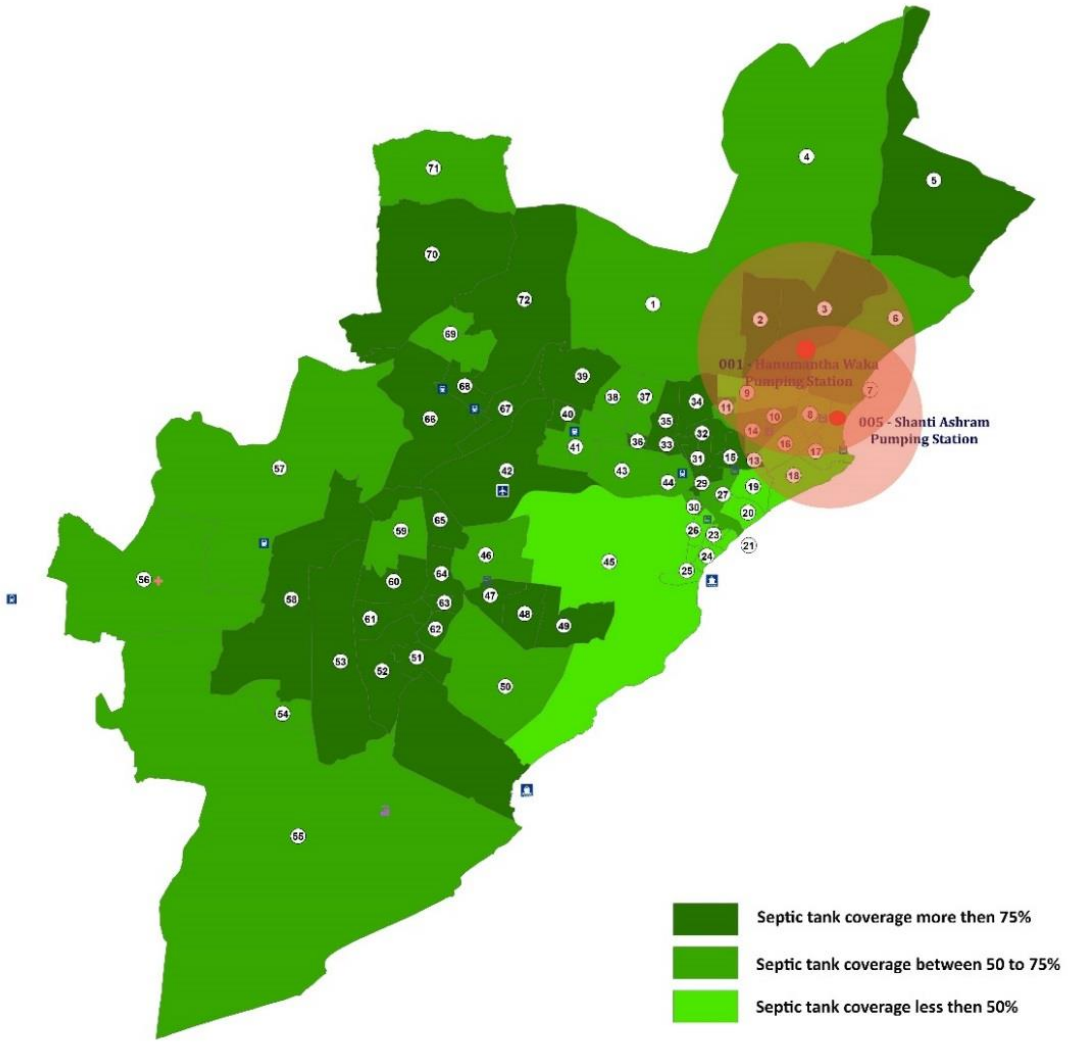


Figure:2 – Showing Toilet Coverage

As the city in not well connected with the Underground Drainage Network, the sewage treatment plants in the city are not running with full capacity. GVMC's effort in providing access to the onsite sanitation to its citizens by constructing Individual Household Toilets (IHHT) and up-grading the existing Public and Community Toilet facilities under SBM-U has resulted in making Visakhapatnam Open Defecation Free (ODF). It has increased the toilet coverage significantly in the city, which will be subsequently visible in the results on the census data survey to be undertaken by the Government of India. A graphical representation of the status on urban sanitation in Visakhapatnam is shown in the Figure 3.

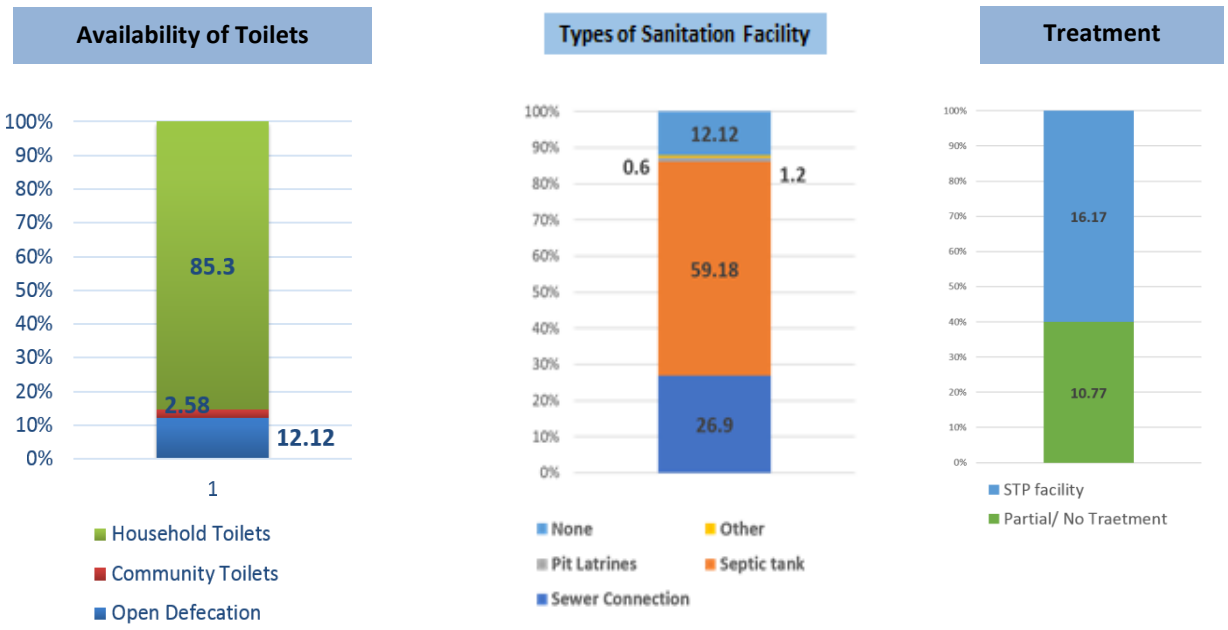


Figure 3: Picture Status of Urban Sanitation in Visakhapatnam

2.2. Need for City FSSM Policy

Looking at the current baseline, it is important that departments responsible for managing the portfolio of public health, may undertake necessary precautionary measures, so that its citizen are not adversely affected . Bearing this in mind, GVMC's earnest effort has been to contain the ill effect of the disposal of faecal matter directly into the environment. There is need to take necessary steps and it is with this view this that the FSSM policy is being conceived and prepared.

Currently there are 8 STPs in GVMC area, which are under operation and are at various stages of construction, as shown in Table 1. These STPs aggregate to a total of 189 MLD installed capacities for the entire city but is running at a total of 51 MLD current operating capacity. Out of the189 MLD installed capacity, only 54 MLD is under trial run while the remaining 54 MLD is under various stages of construction. As per Census 2011, 61.38 percent of the total households in GVMC area are using IHHT and CT. With the implementation Swachh Bharat Misssion programme, th percentage of users has increased are more IHHTs are sanctioned to the householders, who earlier

did not have access to such a facility. Thus, while the containment of human waste will be largely achieved under SBM, but its treatment still poses a huge challenge.

While the design standards and guidelines for construction of toilets, septic tanks have already been given and published by the Bureau of Indian Standards (BIS), attention in terms of treatment is the most important issue that needs to be addressed in the present scenario. The Central Public Health and Environmental Engineering Organization has come up with latest guidelines for treatment of septage and faecal sludge with its latest publication. In the last two years of implementation of the SBM programme, considerable steps have been taken towards creating awareness, building capacities of the officials and developing infrastructure to achieve ODF. It is important to sustain the status achieved which has not only led to the improvement of the health of the common man but has also added to their self-esteem., Holistic approach by taking necessary cost effective steps for treatment of the faecal sludge for entire GVMC is the way forward.

This policy document not only talks about the treatment methods but also outlines the measures taken towards preparedness to handle the sanitation value chain. GVMC has conducted training programmes, organized capacity building workshops, drafted monitoring and evaluation plan as well as sustainable financial plan towards cost recovery and construction.

Table 1 – Visakhapatnam city wide STPs with capacities

Sl. No.	City/Town	STP Location	Status	Installed Capacity (MLD)	Current Operating Capacity (MLD)
1	Visakhapatnam	Ward - 1	Operation	13	6
2	Visakhapatnam	Ward - 5	Operation	1	1
3	Visakhapatnam	Ward - 6	Operation	1	1
4	Visakhapatnam	Ward - 7	Operation	25	20
5	Visakhapatnam	Ward - 25	Operation	38	20
6	Visakhapatnam	Ward - 55	Operation	2	2
7	Visakhapatnam	Ward - 56	54 Trial run + 54 Under Construction	108	54 (Trial Run)
8	Visakhapatnam	Ward 71	Operation	1	1

2.3. Gaps and Issues in the area sanitation within Visakhapatnam

While onsite sanitation is prevalent in the city, there are major gaps in its implementation across the sanitation service chain. The gaps and consequences on lack of access to toilets are well reported, but the issues pertaining to septage collection, conveyance and treatment remain largely unknown and unaddressed. Apart from a series of technical challenges associated with faecal sludge emptying, haulage and treatment, the inadequate political, organisational and regulatory context are the main causes for the appalling sanitation situation in the urban context in Visakhapatnam. To understand the situation in the city it is important to do a SWOT and PESTLE analysis for urban sanitation. PESTLE is understanding the Political, Economic, Social, Technological, Legal and Environmental aspects of any idea to assess the gravity of the problem which might surface during

implementation. There is urgent need to take appropriate measures to address these issues so that successful implementation is carried out and the goal is achieved.

2.3.1. Inadequate legal and regulatory framework

Due to paucity of regulatory acts, ordinances and administrative rules on Faecal Sludge management people not adhere to the best practices. Currently GVMC does not have any such rules in practice under faecal sludge for its disposal in the most scientific manner. In the past, institutional responsibilities were often perceived and/or not performed, or else, responsibilities were assigned to several agencies which often led to overlapping leading to institutional interference and paralysis in implementation of the programme. Since formal attribution of responsibilities to the private sector is generally missing, clarity regarding the distribution of tasks between the public and private sector is also lacking. One of the consequences of the informal character of the private sector is the lack of rules regarding, for example, emptying of pit, Faecal Sludge haulage and disposal. This can lead to abuse (e. g. cartelisation, increase in emptying fees etc.).

Due to lack of incentives and clear directions regarding sanctioning procedures, the different actors involved in FS management do not have the necessary motivation to comply with the existing regulations, and the local governments usually do not have the means either to control or enforce them. In most cases, there is also no provision of land for faecal sludge disposal or treatment.

2.3.2. Inadequate financial capacity

GVMC is often faced with financial difficulties, which impair their ability to ensure services to the population. However there have been constant strive by the authority to push sanitation at top of its agenda by allocation funds from various sources.

2.3.3. Lack of concerted action between stakeholders

Responsibilities of the different stakeholders are not clearly defined and coordination/communication mechanisms between the different actors are nonexistent. Also, the responsibilities between city and zone authorities are not clearly formulated.

2.3.4. Poor Awareness

Faecal Sludge and septage management has been accorded low priority and there is poor awareness about its inherent linkages with public health.

2.3.5. Lack of an Integrated City-wide Approach

Faecal Sludge and septage management investments are currently planned in a piece-meal manner and do not take into account the full cycle of safe confinement, treatment and safe disposal.

2.3.6. Limited Technology Choices

Technologies have been focussed and the disposal techniques are not environmental friendly, no cost-effective and sustainable investments for safe management and disposal have been thought off on a large scale.

2.3.7. Reaching the Un-served and Poor

Urban poor communities as well as other residents of informal settlements have been constrained by lack of tenure, space or economic constraints, in obtaining affordable access to safe Faecal Sludge and Septage Management. In this context, the issues of whether services to the poor should be individualised and whether community services should be provided in non-notified slum should be addressed. The issues of subsidies inadvertently reaching the poor should be addressed by identifying different categories of urban poor.

2.3.8. Lack of Demand Responsiveness

Faecal Sludge and Septage Management has been provided by private agencies in a supply driven manner, with little regard to environmental and health concerns and by applying short cut methods.

3. Objectives of the city FSSM policy

3.1. Vision

All the inhabitants of the GVMC areas will live in a city that is free from health hazards, environment pollution and adopt the best practices in sanitation with regard to improved onsite sanitation services together with faecal sludge and septage management for greatest benefit of their own health with special focus on the urban poor.

3.2. Objectives

The key objective of the city urban FSSM Policy is to set the context, priorities, and direction for, and to facilitate, citywide implementation of FSSM services in all the areas of GVMC such that safe and sustainable sanitation becomes a reality for all in each and every household. More specifically, the Policy will:

- Mainstream FSSM in the city by the year 2019, and ensure that all benefits of wide access to safe sanitation accrue to all citizens across the sanitation value chain with containment, extraction, transportation, treatment, and disposal / re-use of all faecal sludge, septage and other liquid waste and their by-products and end-products.

- Suggest and identify ways and means, including the methods and resources, towards creation of an enabling environment for realising safe and sustainable FSSM in the City.

- Define the roles and responsibilities of various government entities and agencies, and of other key stakeholders such as the private sector, civil society organisations and citizens for effective implementation of FSSM services throughout the country.

- Enable and support synergies among relevant Central Government/State Government programs such as SBM, AMRUT and the Smart Cities Mission to realise safe and sustainable sanitation for all at the earliest, possibly by the year 2019.

- While not compromising the eventual compliance to the strict environmental discharge standards already set, recognising the constraints in achieving these standards, adopt an appropriate, affordable and incremental approach towards achieving these standards.

- Mitigate gender-based sanitation insecurity directly related to FSSM, reducing the experience of health burdens, structural violence, and promote involvement of both genders in the planning for and design of sanitation infrastructure.

3.3. Scope

- This policy shall apply to all areas within GVMC, whether public or private, residential, commercial, institutional, industrial or residential, proposed/planned or existing.

4. Legislative and Regulatory Contexts

4.1. Central Laws and Rules

The legal context for FSSM includes municipal building byelaws, environment laws, laws for the legal rehabilitation of "manual scavenging" and institutional laws that provide for the establishment, powers and functions of local authorities. The first category, which includes the Municipal Law, the Environment (Protection) Act, 1986 and the Water (Prevention and Control of Pollution) Act, 1974 provide a framework for control of effluent, sewage and septage discharge. Further, the Solid Waste Management (SWM) Rules, 2016 under the Environment (Protection) Act apply to the final and safe disposal of post-processed residual faecal sludge and septage to prevent contamination of ground water, surface water and ambient air. Further, the SWM Rules 2016 will also apply for disposal and treatment of faecal sludge and septage, before or after processing, at landfills and for use as compost. The provisions of the National Building Code of India published by the Bureau of Indian Standards (BIS) as applicable for Septic tanks soak pits, cess pools, leach pits, drainage fields etc. also need to be examined and taken into account while framing the FSSM policy. The Model Building Bye-Laws (MBBLs), 2016 framed by the Town and Country Planning Organisation can also be referred.

The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993 put a ban on dry latrines, i.e., latrines with no water-seal or flushing mechanism, and the employment of persons for manually carrying human excreta. This was supplemented in 2013 with the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 by which "hazardous cleaning" in relation to sewers and septic tanks was also banned. The law now provides that manual cleaning of sewers and septic tanks, if necessary, may be carried out only in highly controlled situations, with adequate safety precautions, and in accordance with specific rules and protocols for the purpose.

All the public and private sector staffs should adhere to safety norms as provided in the Manual on Sewerage and sewage treatment published by Ministry of Urban Development and such other safeguards under the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 and that the GVMC may provide under its own rules. For Disposal of Septage GVMC need to follow the standard set out in the Environmental (protection) Act, 1986 and MSW Rule 2016 depending on the mode of disposal.

4.2. State Laws, Rules and Regulations

All the stakeholders involved in FSS Management in the sanitation value chain of the should adhere to the State Laws, Rules and Regulations that are enacted time to time as deemed by the Department of Municipal Administration and Urban Development, (MA & UD) Government of Andhra Pradesh (GoAP).

4.3. Formation of Rules and Regulation at GVMC level

GVMC will formulate rules and regulation in the form of septage bye-laws separately as well as planning and implementation framework, operative guidelines for Vacuum Trucks Operators (VTOs) registration and licensing for faecal sludge and septage management in this document. This should be supplemented with building regulations to ensure proper construction of adequate onsite facilities for anticipated loads and for ensuring safe disposal. Site selection for sludge application by GVMC and by other parties (like residential layouts) would need prior consent to operate from the competent authority (like State Pollution Control Board).

Rules, Regulations and Operative guidelines for Faecal Sludge and Septage Management should address;

- Delineation of private (Individual houses, Group Housing, Institutions etc.) and public responsibilities (Urban Local Bodies and local authorities) in relation to faecal sludge and septage management.
- Detail of the planning and implementation process for carrying out safe and sustainable management of all faecal sludge and septage. This may be integrated with over all city land use planning, with a time based plan of holistically addressing waste water management via onsite, decentralized and centralized systems.
- Design of septic tank, pits etc. (adopted to local condition) including siting and method of approval of building plan or retrofitting existing installations to comply with rules.
- Special provisions for medium and large format real estate developments.
- Periodicity of desludging and O & M of installations and the responsibilities of households (owner/occupant)
- Operating procedure for desluding including Occupational H & S procedures.
- Licensing, record keeping, monitoring and reporting arrangements for faecal sludge and septage service providers.
- Methods and location of transport (conveyance), treatment and safe disposal.
- Tariff or cess/tax etc. for septage management in the city.
- Penalty clauses for untreated discharge for households as well as desludging agents.
- Regular monitoring and evaluation of the entire process of FSSM.
- Training, accreditation, education and awareness programs.

5. Roles and Responsibilities

Lead roles at GVMC level

- Design, develop, plan and implement ULB level FSSM strategy
- Set up and ensure operation of systems for 100% safe and sustainable collection, transport, treatment and disposal of faecal sludge & septage
- Develop expertise, in-house and outsourced, to provide safe and effective FSSM services
- Awareness and behaviour change campaign to engage diverse stakeholders
- Develop training programmes for masons to build requisite skills in construction of quality septic tanks as per BIS / NBC norms
- Set up systems to ensure financial sustainability in provision of FSSM services
- Achieve objectives of FSSM Policy in a time-bound manner
- Design and implement plans to eliminate manual scavenging and rehabilitate manual scavengers
- Funding through specific schemes and plans
- Monitor and evaluate FSSM strategy and implementation plan

- Implement Municipal Byelaws and Septage Byelaws

Supportive Roles at GVMC level

- Create enabling environment for NGOs and private initiatives to achieve safe and sustainable FSSM

Lead roles at Household level

- Timely and regular cleaning of septic tanks through approved entities
- Regular maintenance and monitoring of septic tanks
- Timely payment of user fee and/or charges, if any, towards FSSM services
- Practice Building Byelaws for construction of OSS
- Practice of Septage Byelaws as issued by GVMC

Supportive roles at Household level

- Engage with decision-makers at GVMC level to ensure that they receive good quality FSSM services

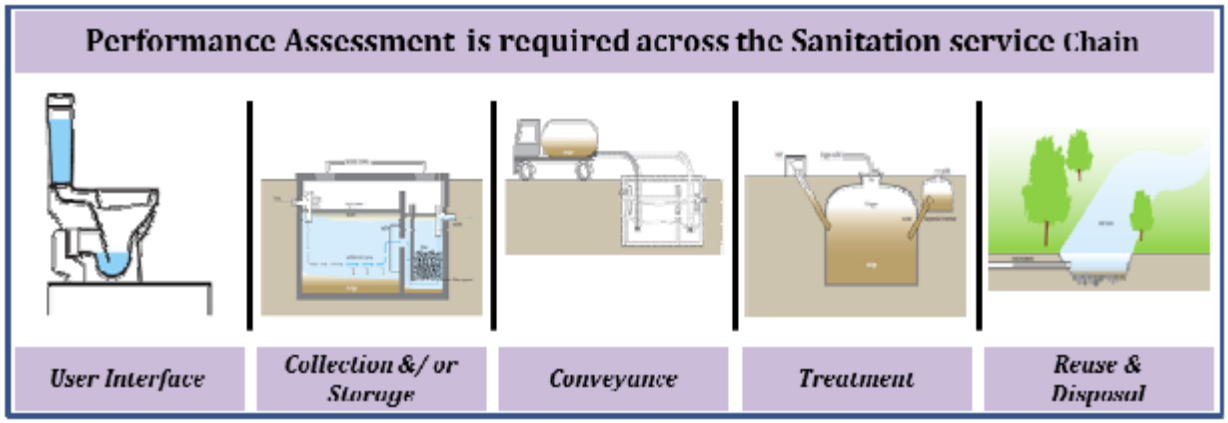
6. Implementation Strategy and Guidelines

Faecal Sludge and Septage Management (FSSM) for the local bodies includes both residential and non-residential/commercial waste (though not industrial waste). Implementation guidelines are most important which gives direction, with knowledge, procedure and facilities for efficient management of FSSM practices. In particular, City Sanitation Task Forces (CSTFs) should take up an active planning and advisory role in cooperation with municipal councils in order to dedicate appropriate resources and attention to the challenges of faecal sludge management.

GVMC has planned to address the city and ward wide FSSM issues by looking at the sanitation value chain of FSSM practices in a manner that address the technical, financial, institutional, regulatory dimension and social dimensions to the best possible manner to the greatest benefit of the inhabitants of the city. It has comprehensive plan for faecal sludge and septage management with objectives in each step in the value chain. Idea of conceiving a separate cell called Septage Management Cell (SMC) is being considered under the Department of Public Health, which will look in the all the modality of the FSSM starting from awareness creation to capture and reuse. A Septage Management Committee is being proposed under this policy which will be convened by the Chief Medical Officer Health under the chairmanship of the Commissioner with representative from various line departments to monitor the city-wide implementation programme.

6.1. Step by Step Approach: Operationalizing Faecal Sludge and Septage Management

Assessing service performance across the sanitation value chain through a city level assessment is the first step in planning process. It is an important exercise, which provides an initial sense of the state of FSSM facility in the city, help in understanding the context and identifying gaps in key services.



Detail assessment of services will need to be done across each link in the chain through appropriate field assessments. As policies and regulations already exist for ensuring toilet access, the operative guidelines focus on the last four stages of the value chain, i.e. containment, emptying and conveyance, treatment, disposal or reuse will be developed.

6.2. Objectives and Strategy in Sanitation Value Chain

Citizens:

The service level benchmark suggested by CPHEEO and for that matter which is also applicable to the new sanitation benchmark should at least be 80% to consider it a success. It is therefore important that citizen FSM related complaints are been addressed in timely manner by suitable technological means such as through a separate APP, that is inclusive for its entire citizen especially focusing at the urban poor.

Containment:

The first step is that GVMC will take necessary steps to create a database of the all the onsite sanitation facility that are currently been used in the city. Although the Indian standard provides comprehensive guidelines for construction of septic tank, it is important to know whether they have been constructed with the best available knowledge in the GVMC area. It is with this view GVMC will undertake survey of containment system or on-site sanitation system to understand it's adequacy and will address the inadequacy through an action plan. It will further strengthen the permitting and inspection process by including the septic tank as a vital requirement in the building plan approval for sanctioning of new houses construction. Group housing will be dealt with provision of having proper onsite sanitation facility within the complex.

The following steps will be followed for creation of database and determining the adequacy of onsite sanitation system;

- City level assessment for coverage of toilet and on-site sanitation facility using the existing database (like property tax module) or based on recent survey carried out under Swachh Bharat Mission (SBM).
- In case of not availability of database, a database will be created for the toilets and containment units. Information will be collected related to toilet availability, type of toilet, containment typology (septic tank, pit latrine, soak pit, etc.), and its connection with waste water outlet. This information should be linked with property tax databases on e-governance platform.
- GVMC will keep updated database related to toilet availability and onsite sanitation through property tax assessment survey carried out from time to time.

- GVMC shall evaluate existing containment units and other storage / treatment systems and will issue order to modify (in case of variation) based on design mentioned in the Annexure 2.
- Notice should be issues to all property owners whose containment facilities do not meet the standard septic tank design. National/State aid may be sought in order to financially support the conversation of improper containment units into sanitary toilets.
- Identification of insanitary toilets and convert them to sanitary latrines for safe collection and disposal of waste as per norms set out in Annexure 3.
- All existing containment facilities should have access covers for each chamber, so that they can be easily opened during emptying process. Where such covers are not available, it should be made compulsory for all property owners to provide proper covers.
- Pursuant to the previous four steps, municipalities must take efforts to build the capacity of masons and builders to teach them how to construct proper toilets and refurbish improper already-built containment units. Details regarding the codes that must be followed are included in the next item.
- When new containment facilities need to be built, they should be built as septic tanks designed and constructed as per instructed in the National Building Code, 2005 and CPHEEO Manual, 2013 which takes reference of design norms from IS: 2470 on Code of practice for installation of septic tanks - Part 1: Design and Construction and Part 2: Secondary treatment and disposal of septic tank effluent 1985 (Reaffirmed 1996). The design norms CPHEEO Manual, 2013 is compiled in Annexure 2.

Emptying and Conveyance:

Conveyance describes the movement of sludge across the service chain from individual septic tanks and latrines to municipal or regional treatment facilities. Currently, these services are largely unregulated across the city of Visakhapatnam. Immediately two steps will be undertaken: **first**, GVMC must regulate operators by establishing a system of licensing, and will facilitate the enforcement of health and safety standards and the prevention of open dumping; **second**, it must design a plan to conduct a system of scheduled emptying in which every containment facility is emptied at least every three years (with more frequent emptying for public accommodations, community/public toilets, and the like). This scheduled emptying will be contingent on having completed a detailed survey of individual containment facilities (as referred to in containment section).

GVMC shall take following steps for emptying and conveyance (some are also required in containment section, but at listed here for clarity);

- Determine how many households use on-site containment systems and ascertain how much sludge they can contain in order to determine the amount of sludge that will be emptied every year (presuming a three-year emptying cycle for individual households and more accelerated cycles on an as-assessed basis for public and commercial facilities).
- Determine how many septic tanks /pits are emptied annually and what volume of sludge is disposed of at present by looking at actual on-ground practices.
- Determine the average price per emptying (and accounting for how it may differ based on volume and containment facility location) that operators are charging.
- Use the above data to determine as to how many trucks would be needed if septic tanks were emptied on a three-year basis and design a database for maintaining a register of containment facilities that are emptied.
- Create a registration system for private truck operators which permit them to legally empty septic tanks within the ULB. However, these permits will require that they adhere to safety and hygiene standards both in emptying and disposal (detailed below), establish certain regulated tariffs for emptying septic tanks and latrines, and require the use of receipts to track emptying and disposal. The permits and

receipts required for this system are included in Annexures 4, 5, and 6. Pursuant to this, GVMC will establish a system for penalizing trucks that operate without valid permits/licenses.

- GVMC will mobilize enough vehicles, either through public or private means, to support a three- year emptying system. This should be done in line with the growth in demand for emptying services, so that trucks are not left underutilized.

As point five mentioned previously, truck operators must take the following measures with use of septage vehicle that meets the approved standard as mentioned in the Annexure 8 while desludging:

- The septic tanks should not be fully emptied; small amount of sludge of around 1 to 2 inches should be left in the septic tank to facilitate decomposing of incoming faecal waste.
- No fire or flame should be used near the septic tanks as there may be inflammable gases inside septic tanks.
- Proper safety gear (including uniform, tools, and well-maintained vehicles) or personal protective equipment (PPE) as per specification mentioned in Annexure 8 must be used by the operator while desludging/emptying the septic tanks/Pits. The rules under the Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 provide for a comprehensive list of safety gear that should be used while providing these services.
- Operators should clean their surroundings before leaving and after desludging; residents should not find their homes or surroundings dirtier.

To achieve this;

A rapid assessment of emptying and conveyance market will be undertaken to figure out the demand and supply for desluding. Possibility of Public Private Partnership(PPP) venture will be looked at for carrying out the emptying activities after the finalization of disposal sites with the help of private Vacuum Truck Operators (VTOs). It is therefore essential that GVMC put in place a proper monitoring and evaluation mechanism for such contract and provide necessary support for training to the operators through standard operating procedures (SOPs) and health and safety (H & S) guidelines. Option of providing individual license could also be worked out through guidelines for regularization and registration. To make this service more affordable, a emptying and conveyance business plan will be prepared for the VTOs or the private contractors, doing a SWOT analysis and after looking at the CAPEX and OPEX involved in the cleaning process.

It is essential that the households clean their septic tank in every 3 years period, and to achieve this Behavior and Communication Change (BCC) campaign will be conducted by consumer profiling and further adopting segmentation, targeting and positioning as per consumer behavior. Proper marketing mix will be adopted to scale up and to make it a profitable business which will be appealing for the private sector to invest in this segment.

Disposal, Treatment and Reuse:

For treatment GVMC will assess the load of septage and assess the requirement of capacity for treatment plant. ULBs should first try and assess the possibility of setting up faecal sludge treatment facilities at the solid waste treatment/disposal site or treating at sewage treatment plants within the city by utilizing co-treatment, depending on the advice and recommendations of the appropriate engineering authorities. It is understood that the State FSSM policy recommends co-locating purpose-built infrastructure, i.e. building faecal sludge treatment plants next to either sewage treatment plants or solid waste management plants, in order to gain advantage from synergies in operation and maintenance (effluent from FSTP can go to STP, or output of FSTP can be co-composted with solid waste, etc.).

Reuse/disposal refers to the methods in which products are ultimately returned to the environment, as either useful resources or reduced-risk materials. The treated septage can be used as a soil enricher or as filling material at construction sites. ULB should carry out primary assessment for availability of market and demand for reuse.

GVMC will take following steps in order to properly treat faecal sludge;

- Operators shall be forbidden by regulation to dispose off sludge collected from the septic tanks or pits into fields, rivers, nalas, forests, etc. These regulations shall be enforced and violation shall be subject to advertised financial and/or legal penalties or even cancellation of licenses. These penalties should come into force as soon as there is a sanitary location for dumping faecal sludge.
- GVMC will first assess the possibility of sludge treatment at existing STP in the city or STP of nearby city through appropriate agreements with STP operators. A list of STPs present in the city is given in Table 1. Proper tests and assessment should be carried out by STP operators before receiving faecal sludge/septage.
- If it is not possible to co-treat the faecal sludge in the STP, construction faecal sludge treatment plant will be taken in to consideration. Such a new faecal sludge treatment plant should be designed to cater to expected volumes of septage generated within the city and if faecal waste is expected from nearby rural areas the same to be considered.
- Input quality of the collected septage should be tested at the treatment facility for checking presence of any metal or traces of industrial waste.
- The faecal sludge treatment plant should be operational during working hours only and a responsible person should be appointed in the facility to ensure that no industrial waste is unloaded in these facilities.
- Septage should be reused/disposed of only after it meets the parameters in Annexure 7.

To achieve this,

GVMC will identify suitable location within the city or in it's outskirt for disposal of faecal sludge. Possibility of co-treatment with existing sewage treatment plant (STP) will also be looked at considering small amount of investment involved through CAPEX and OPEX. Where such co-treatment facility is not possible, feasibility of decentralized Feacal Sludge Treatment Plant (FSTP) will be considered. Although it is essential that the services to wards sanitation is a one of the basic and foremost duty of the ULB, nevertheless it is important that the investment put in to such services should give some amount of return in terms of offsetting its operating cost and also marginally catering to the capital cost. It is with this idea, the reuse market will be surveyed and GVMC will be dealing with Fertilizer Association of India and other authority that deals with such byproduct for sell to the farmer. Sensitization amongst the farmers will also be taken up to use the sludge as manure for farming. Not to mention that there is a tremendous potential in the GVMC area for the demand of the treated effluent which can be used by various private and public sector organization involved in mineral processing and manufacturing in the city. Possibility of carbon credit will also be looked by reducing emission of greenhouse gas and capturing high calorific valued methane gas for power generation. Sustainability is only possible with efficient and robust recovery of not only the resources but also the finances.

Measures to be taken while planning for Faecal Sludge Treatment Plant

Identification of Faecal sludge and septage treatment site is crucial for effective implementation of septage management plan. Following parameters to be taken into consideration before finalization of treatment sites:

Distance of treatment site: Distance from emptying to delivering and accessibility of the treatment site are major issues. The transport of relatively small faecal sludge volumes on congested roads over long distances in large

urban areas is financially unfeasible. A site that is too far away implies fewer trips per day, less revenue and more fuel costs to private operators.

Reliability of electricity: It is also important to assess the availability and reliability of electricity if treatment technology has mechanical operated parts; as in case of fluctuations it will increase treatment time and will affect optimal utilization of treatment capacity.

Neighbourhood: A treatment site may generate objectionable odours. For this reason, it should be located at an appropriate distance from the residential areas and communities should be consulted during the process of designating land for a treatment plant.

Land availability: Projects are often delayed because of non-availability or high price of land. GVMC will identify the land bank for treatment facility. GVMC will also explore the possibility of developing faecal sludge and septage treatment facilities near solid waste dumping sites or already existing sewage treatment plants in order to streamline disposal processes: effluent from FSTPs may be treated at an STP, and the treated sludge may be cocomposted with solid waste.

Geological Parameters: Assessment of existing geological conditions on site including groundwater table, type of soil, flooding risk is always recommended to ensure that the structure can be safely constructed and sludge will not enter the environment through either porous soil or frequent floods.

6.3. City and Ward FSSM Plan

City and ward level FSSM plan will be developed to identify the gaps through sanitation benchmark as prescribed by National FSSM policy document. This will be implemented through the ward sanitation committee with the help of community based organization or NGOs and will further be integrated to the City FSSM plan. The development plan for the ward and the city will be considered after finding the gaps, and through a step wise approach by addressing the low level benchmark first and then further to intermediate level and lastly to the high level. It will be the earnest effort of GVMC to provide 100% sewerage coverage and 100% sewage connection facility for its citizen in the following years to come. Recovery of cost one of the most important benchmark as suggested by the CPHEEO which is having base line of at least 20% will be tried to achieve through various marketing mix as narrated earlier.

It is important to understand the performance of the Sewage Treatment Plant (STP) which is if at all considered for co-treatment. Therefore the operation and monitoring of the plant will be taken up on pilot basis for a month time to understand its effect on the plant output parameter, managing sludge lines and addressing the breakdown of the pumps, motors and valves.

GVMC at its level will look in to the intervention tools that are required for successful implementation of such FSSM plan in the city. Some of the important intervention tools that will be considered are as below;

Tool	Purpose	Examples / Information
Capital Investment	Provide new / renewed hardware capacity	Investment can be in upgrading, rehabilitating or new infrastructure (e.g. treatment facilities, IT network, etc.) and / or equipment.
Regulation	Ensure public safety and fairness	Regulations are a 'stick' that should be applied only in extreme circumstances when all other 'carrots' have been tried and not proven to be effective enough. For instance, if behaviour change campaigns (BCC) educating and encouraging households to empty their OSS once every 3 years do not result in improved behaviour, scheduled emptying regulations can be introduced, along with investment in the necessary IT infrastructure and BCC campaigns. Regulation could also be introduced to regulate price of emptying, however similarly it is preferably to influence the market (e.g. invest in more disposal points, improve competition, etc.), as enforcement of prices is notoriously difficult.
Experimentation	Trial of innovative approach that may either succeed or fail	Research, design, trial, learning and iteration / or failure of innovative approaches. Experimentation can be undertaken along with any of the other intervention tools. Monitoring, evaluation and learning is a crucial part of experimentation. Failure of the innovation is a possibility that should be expected, however failure due to poor learning from previous mistakes should not be accepted.
Institutional Evolution	Trial of innovative approach that may either succeed or fail	Redesign of institutional structure and / or incentives to address new challenges. First, citizens' needs as it relates to FSS management need to be assessed. Based on these needs, institutional structures and / or incentives should be re-evaluated and if necessary redesigned to ensure they are responsive.
Information	Improve effectiveness of response to citizen needs	Data on existing sanitation systems, services or citizens' needs is necessary to design solutions. Some information may already be available and needs to be used. Information that is not available needs to be collected (either one-time or regular collection, depending on needs).
Behaviour Change and Communication	Inform, motivate, and sustain changes in citizen behaviour	Regular emptying of septic tanks is necessary, even before it starts overflowing. Citizens need be aware and motivated to regularly empty through behaviour change and communication campaigns (BCC), and the behaviour needs to be sustained through regular reminders (e.g. vacuum tanker operators send targeted reminders 3 years after emptying is complete).
Licensing	Ensure safety of public and operators, ensure competitive market	Licensing is a way for public authorities to ensure service providers (i) have been trained on safe and appropriate ways of service delivery to ensure health and safety of the public and the operators, (ii) are regularly up to date on their training, (iii) their

equipment is appropriate and safe, (iv) privileges can be revoked if public health and safety is jeopardized, (v) provide a competitive market – e.g. limited licenses can be provided to avoid over-saturation of market with VTOs.

6.4. Timelines

A.	**CITIZENS**	
○	A1. Upgrade **GVMC mobile app** to include VTO requisition feature and FSSM-related complaints	19th Sept' 2017
B.	**CONTAINMENT**	
○	B1. Assess **adequacy of on-site sanitation systems** (OSS) – disseminate learning (GVMC/state/nat'l/int'l)	30th Sept 2017
○	B2. Preparation of **action plan to address existing inadequacies** if appropriate, & incorporation into FSSM plans	15th Oct 2017
○	B3. Prepare and implement plan to strengthen **permitting / inspection process**	18th Aug 2017
C.	**EMPTYING & CONVEYANCE**	
●	C1. Rapid **assessment of emptying market** (supply and demand)	30th Sept 2017
○	C2. Prepare **VTO licensing programme** (incl. training & enforcement) to improve quality of services (part of C7)	15th Sept 2017
○	C3. Launch licensing programme for VTOs (coordinate with C6 and D2)	20th Sept 2017
○	C4. Monitor effectiveness of implementation of licensing prog – disseminate learning (GVMC/state/national/int'l)	20th Dec 2017
○	C5. Pilot **FSSM mobile application** to improve access to data – disseminate learning (GVMC/state/national/int'l)	15th Aug 2017
○	C6. Prepare **Emptying and Conveyance Business Plan (ECBP)** to increase demand and affordability of services	15th Sept 2017
○	C7. Launch ECBP (including training, BCC campaigns, contracts, etc.)	20th Sept 2017
○	C8. Monitor effectiveness of implementation of ECBP – disseminate learning (GVMC/state/national/int'l)	20th Dec 2017
D.	**DISPOSAL, TREATMENT AND REUSE**	
◖	D1. 1st Phase of Disposal Sites (DS) – Assess **feasibility of existing DS**, prepare	Completed

	investment plan & upgrade	
◖	D2. 1st Phase of DS – Prepare SoPs, H&S plan, and monitoring plan; train DSOs and VTOs (coordinate with C3)	Partially completed
○	D3. 1st Phase of DS – Design plan for and monitor effectiveness of upgrades – disseminate learning	18th Dec 2017
○	D4. **Assessment Reuse Market**: assess production of and demand for treated FSS – disseminate learning	18th Sept, 2017
E.	**CITY & WARD FSSM PLANS**	
◖	E1. Prepare city and ward-level Faecal Flow Diagrams (FFDs)	Completed
○	E2. Prepare City and Ward FSSM Plans through consultative process (coordinate with E3)	30th Nov 2017
○	E3. 2nd Phase of DS – assess feasibility of upgrading new DS as per request from wards (coordinate with E2)	15th Feb, 2017
○	E4. Launch City and Ward FSSM Plan	1st Jan 2018
○	E5. Support GVMC in implementing, monitoring, and regularly updating FSSM Plans	1st Dec 2017
○	E6. Disseminate learning on implementation of FSSM Plan within GVMC, state-level, nationally and internationally	15th March 2018
○	E7. 3rd Phase of DS – if necessary, prepare plans to invest in new DPs	28th Feb 2018

7. Technological options for treatment

This section presents an overview of the mechanisms on which faecal sludge (FS) treatment processes are based, and highlights those on which the treatment technologies discussed in subsequent sections rely. Many FS treatment technologies are based on those developed for wastewater and wastewater sludge treatment, but it is important to remember that these technologies cannot be directly transferred. FS characteristics differ greatly from wastewater, and have a direct impact on the efficiency of treatment mechanisms (Spellman, 1997; Kopp and Dichtl, 2001). Important properties of the sludge to consider include stabilisation, organic load, particle size and density, dissolved oxygen, temperature, pH, water content and viscosity. The current understanding of physical, biological and chemical mechanisms in FS management (FSM) is limited and has been acquired via empirical observations over the years.

Physical Mechanism

Physical mechanisms include dewatering, drying and volume reduction. One of the most important treatment mechanisms in FSM is dewatering. FS is mainly comprised of water, the proportion of which is dependent on the type of onsite technology. Water is heavy and expensive to transport, and discharging this polluted water to the environment has significant negative impacts. Dewatering is also necessary prior to resource recovery for applications such as composting, or combustion as a fuel and is mostly based on physical processes such as evaporation, evapotranspiration, filtration, gravity, surface charge attraction, centrifugal force and pressure.

Biological Mechanism

In FSM, biology is essential in the achievement of treatment objectives through transformation of organic matter and nutrients. Biology is also important in understanding mechanisms of pathogen reduction. Biological mechanisms allow the removal and transformation of organic constituents, nutrients and pathogens via the activity of microorganisms. Biological treatment harnesses the metabolism and growth rate of microorganisms in naturally occurring processes, and employs them in controlled situations to optimise the desired outcomes. As the microbes grow, they are dynamically altering the system, by modifying forms of organic matter, and releasing and binding up nutrients. They also release gases and other by products that can affect the environment.

Chemical Mechanism

Chemical mechanisms involve employing additives to optimise and control desired reactions, and are mainly used for disinfection and enhanced dewatering. Chemicals can be mixed with FS to improve the performance of other physical mechanisms (e.g. addition of a cationic polymer to increase the flocculation and the settling efficiency), or to inactivate pathogens and stabilise FS. The addition of chemicals can represent a significant increase in the overall cost of treatment, and the benefits therefore need to be carefully weighed.

There are different treatment facilities that are available but each technology has different fields of application. They can be used for the treatment or co-treatment of undigested FS (e.g. from public toilets), or digested or pre-treated FS. Given the high content of coarse wastes such as plastics, tissues and paper in the FS discharged by collection and transport trucks, a preliminary screening is needed for most treatment technologies. Also, the characteristics of FS collected at industrial and commercial facilities should be checked as they can be contaminated with metals, have high concentrations of fats, oil and grease, or other concerns. That should be segregated and treated separately. After treatment, three types of end products can be distinguished:

- Screenings;
- Treated sludge; and
- Liquid effluents.

Selection of the technologies, or combinations thereof, should be done taking into account the local context, existing regulations and the end use goals. Treatment will be comprised of combinations of:

- The treatment of FS directly transported from the onsite sanitation systems - this treatment can be done in one or several steps, and produces solid and liquid end products; and
- The further treatment of the resulting end products (either the solid part of the treatment end products (treated FS) or liquid effluents) before end use or final disposal.

It is important to realise that for the conversion of FS into a product that is safe for end use or disposal, several processes need to take place. FS typically contains large volumes of water and hence needs to be dewatered, which can be achieved on its own, or in combination with solid / liquid separation. Depending on the end goal, further treatment needs could include converting organic matter into a stabilised form and/or pathogen reduction.

7.1. Established Faecal Sludge Treatment Technologies

7.1.1. Co-composting of faecal sludge

Composting is a biological process that involves microorganisms that decompose organic matter under controlled predominantly aerobic conditions. The resulting end product is stabilised organic matter that can be used as a soil conditioner. It also contains nutrients which can have a benefit as a long-term organic fertiliser. There are two types of composting systems, open and closed, of which open systems are lower in capital and operating costs but typically require more space. In an open composting system, raw organic matter is piled up into heaps (called windrows) and left for aerobic decomposition. To increase space efficiency, the heaps of waste can also put into walled enclosures which are called box composting. If untreated waste feedstock is placed in a closed container this is called in-vessel or closed drum composting and is considered in the category of closed systems.

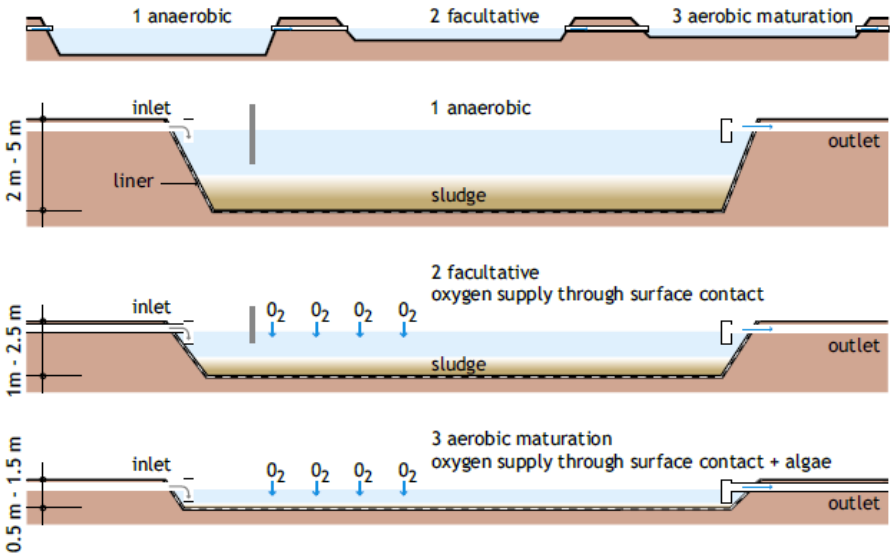
Potential advantages and constraints of co-composting

The main advantage of co-composting is formed by the thermophilic conditions and the resulting pathogen inactivation. The output of co-composting is a good soil conditioner which provides potential for income generation depending on the demand for compost. However, operating a co-composting plant and generating a safe product with value requires technical and managerial skills, which can be limiting if not available.

7.1.2. Co-treatment in waste stabilisation ponds

Waste stabilisation ponds (WSPs) are widely used for the treatment of municipal wastewater. The mechanisms for stabilisation are based on natural processes that occur in aquatic ecosystems. WSPs are considered to be good options for wastewater treatment in low-income countries when adequate land is available, particularly in tropical climates. WSPs consist of several ponds having different depths and retention times. A combination of three types of ponds in series is frequently implemented in wastewater treatment:

a) Anaerobic ponds that are two to four meters deep are used for settling of suspended solids and subsequent anaerobic digestion. The effluent flows to the facultative pond.
b) Facultative ponds that are 1 to 1.8m deep allow for remaining suspended solids to settle. In the top layer of the pond dissolved organic pollution is aerobically digested, while anaerobic conditions are prevalent at the bottom.
c) Maturation ponds that are 1 to 1.5 m deep allow for pathogen reduction and stabilisation. The ponds are mainly aerobic. Oxygen is supplied through algae and diffusion from the air. Pathogen reduction occurs via UV rays from the sun.
   Figure – Design and principles of the three types of ponds constituting waste stabilisation ponds



Potential advantages and constraints of waste stabilisation ponds

WSPs are simple to build and require relatively low O&M requirements. The technology is appropriate for tropical climates, and achieves relatively high pathogen removal in the effluent. Constraints include land availability, high rate of solids accumulation if preliminary solids separation is not performed, and potential inhibition due to high salt and ammonia concentrations. The removal of sludge that accumulates in the anaerobic ponds may require heavy mechanical equipment

7.1.3. Deep row entrenchment

Deep row entrenchment is a technology that can be considered as both a treatment and end use option. Deep row entrenchment consists of digging deep trenches, filling them with sludge and covering them with soil. Trees are then planted on top, which benefit from the organic matter and nutrients that are slowly released from the FS. In areas where there is adequate land available, deep row entrenchment can present a solution that is simple, low cost, has limited O&M issues and produces no visible or olfactory nuisances. Benefits are also gained from the increased production of trees. However, the availability of land is a major constraint with deep row entrenchment, as is the distance/depth to clean groundwater bodies. Deep row entrenchment is considered most feasible in areas where the water supply is not directly obtained from the groundwater source and where sufficient land is available, which means the sludge would have to be transportable to rural and peri-urban areas.

Potential advantages and constraints of deep row entrenchment

The main advantage of deep row entrenchment is that very little is needed for it: no expensive infrastructure or pumps that are very susceptible to poor maintenance. In addition, growing trees has many benefits such as extra CO2 fixation, erosion protection, or potential economic benefits. Constraints are that sufficient land has to be available in an area with a low enough groundwater table and, moreover, legislation still needs to catch up in many countries to allow for this technology.

7.2. Transferred Sludge Treatment Technologies

Activated sludge wastewater treatment produces waste sludge that needs treatment. Technologies that are typically applied there may be transferable to application in FSM. The benefit of these technologies is that they have generally been applied for many years and much knowledge is present regarding design, operation and maintenance. The difficulty is however that the application of these technologies to FS has not been researched in much detail yet, which is key for successful long-term implementation.

7.2.1. Anaerobic digestion

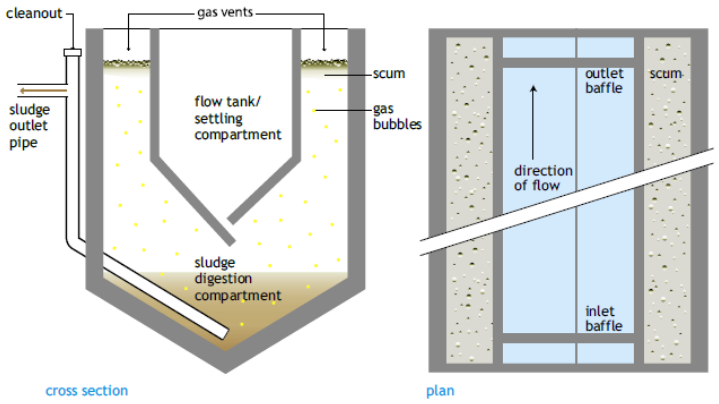
During anaerobic digestion, organic matter is converted into biogas and the remaining sludge is referred to as slurry or digestate. Biogas is a mixture of mainly methane and carbon dioxide and the digestate is relatively biologically stable and can be used as a soil conditioner. Anaerobic digestion treats organic waste in airtight chambers to ensure anaerobic conditions. Anaerobic digestion has been widely applied in centralised wastewater treatment facilities for the digestion of primary sludge and waste activated sludge, typically with plug flow (PFR) or continuously stirred reactors (CSTRs). Anaerobic treatment technologies also include up flow anaerobic sludge blanket (UASB) reactors, anaerobic baffled reactors (ABRs) and anaerobic filters. Anaerobic treatment is also well known and developed for industrial wastes and highly loaded wastewater treatment plants.

Potential advantages and constraints of anaerobic digestion for faecal sludge management

Anaerobic digestion has the potential to produce biogas while stabilising FS, reducing sludge volume and odours. However, operation and maintenance (O&M) of anaerobic digesters requires a relatively high level of skilled operation. Inhibition of digestion needs to be considered due to the inconsistent nature of FS, and also detergents and heavy metals should be addressed at the household level. A constraint of anaerobic digestion as a technology for FS treatment is that, despite the vast amount of knowledge on anaerobic digestion, it has not yet been proven for FS alone in semi-centralised to centralised treatment in urban areas. Hence, further research is needed, and pilot scale facilities need to be installed prior to full scale implementation in order to learn more about the safe and sustainable application of this technology.

7.2.2. Imhoff tank

An Imhoff tank is a compact sized tank that combines the effect of a settler and an anaerobic digestion system in one. It is a compact system which is well-known for wastewater treatment. Imhoff tanks are most often used as a primary treatment technology in wastewater treatment where it serves as a solid-liquid separation system including partial digestion for the settled sludge. The same considerations for sludge characteristics that were described under anaerobic digestion apply here.



Potential advantages and constraints of Imhoff tanks

The main advantages of Imhoff tanks compared to settling-thickening tanks are the small land requirement, the possibility of operating only one tank, and the physical separation between the settled sludge and the liquid fraction. The main constraints compared to settling thickening tanks are the increased operational complexity, slightly higher costs as the Imhoff tanks require an additional elevation to accommodate the inclined baffles, and the risk of damage to the sludge draw-off pipe in case of an inadequate draw-off frequency. Operation and maintenance of an Imhoff system is not as complex as some technologies, but it requires skilled operators. Cleaning of flow paths, the sides of the tank as well as the removal of scum is very important

7.2.3. Sludge incineration

Incineration of sludge is a form of disposal which involves the burning of sludge at temperatures between 850-900°C. It does not typically take advantage of the potential for resource recovery; however, energy can be captured from the incineration of sludge. The ash that is produced from incineration could potentially be used, for example as a cover material for urine diversion dry toilets or in construction, or it can be disposed of in landfill sites. Depending on the source of sludge, the ash may contain high concentrations of heavy metals. Sludge needs to be dewatered prior to combustion, but stabilisation treatment is not necessary as it decreases the volatile content of the sludge. Commonly used incineration systems are multiple-hearth incineration, fluidised-bed incineration and co-incineration with municipal solid waste.

Potential advantages and constraints of sludge incineration

Disadvantages include: the potential emission of pollutants; the need for highly skilled operating and maintenance staff, high capital and O&M costs; and residual ashes. Advantages are that the sludge volume is substantially reduced and all pathogens are removed.

7.2.4. Mechanical sludge treatment

Mechanical dewatering or thickening can be carried out prior to, or following other treatment steps. Dewatering and thickening are important for reducing the volume of sludge that needs to be further treated or managed. After the sludge thickening process, additional reduction of the water content is often necessary and this can be done either naturally or by machine processes such as centrifugation or pressing. Four technologies that are widely used for dewatering WWTP sludge are the belt filter, the centrifuge, the frame filter press, and the screw press. Only few examples are available in the literature for the implementation of these technologies to FS, but theoretically the technology is transferable.

Potential advantages and constraints of mechanical sludge treatment

The main constraints of these technologies in comparison to non-mechanical options are the investment costs, the O&M requirement, the need to add flocculants and the dependency on electricity. The general advantages are the compactness, and the speed of the process. To transfer these types of technologies to treat FS, information from manufacturers, laboratories, and pilot-scale tests is necessary.

7.2.5. Lime addition

Lime is used for wastewater sludge treatment to achieve the reduction of pathogens, odours, degradable organic matter, and also as sludge conditioner to precipitate metals and phosphorus. The process of pathogen reduction

during alkaline stabilisation is based on an increase of pH, temperature (through exothermic oxidation reactions) and ammonia concentration. Its effect is enhanced by a longer contact time and higher dosing amount. An added benefit of lime is that heavy metals can precipitate with the lime. However, the pathogen removing effect of lime also affects desired microbial processes such as composting and other soil processes. Moreover, safety is very important: as lime is corrosive to the skin, eyes and lungs and proper personal protection equipment (PPE) is crucial. Furthermore, protection from fire and moisture must be ensured.

Potential advantages and constraints of lime treatment

The main disadvantages of this technique are the requirement of consumables (lime), and a dry storage area. Pathogen regrowth is also a concern. Lime is an alkaline material which reacts strongly with moisture and high risks of hazard to the eyes, skin and respiratory system are observed. Therefore, skilled staff is required who must follow health and safety procedures and make use of good protective equipment.

7.3. Innovative Technologies for Faecal Sludge Treatment

There is currently a great deal of research being conducted on innovative FS treatment technologies.

7.3.1. Vermicomposting

Earthworms are a member of the oligochaetes sub-class and they appear to be very effective in organic waste reduction. An example is the “vermi-filter”, which treats diluted domestic wastewater sludge in a system inoculated with earthworms. Interestingly, the earthworms seemed to function in synergy with bacterial communities within the filter. Worms cannot survive in fresh faeces and need some kind of support in the form of layers of soil and vermi-compost. Vermicomposting is not a reliable method to ensure adequate pathogen removal. However, when carried out under proper conditions the technology of vermicomposting can lead to a complete removal of coliforms.

Potential advantages and constraints of vermicomposting

In general, the advantages and constraints for vermicomposting are similar to the points for composting. However, vermicomposting cannot be carried out at the thermophilic temperatures of co-composting. Therefore, if adequate pathogen reduction is not achieved during treatment, further treatment steps are required. Constraints are that the technology is still in development; the worms can be quite susceptible to toxic components (or higher concentrations in general), and the time span until matured compost is reached can be longer than for thermal composting. The production of worms can be beneficial provided there is a market for them.

7.3.2. Ammonia treatment

Ammonia treatment can be applied for pathogen reduction. Pathogen inactivation by uncharged ammonia (NH_3) has been reported for several types of microorganisms, bacteria, viruses and parasites. The principle of pathogen reduction with ammonia is based on the fact that ammonia (NH_3) enters cells, takes up intracellular protons for the formation of ammonium (NH_4^+) and as a charged ion disturbs the functioning of organisms. Ammonia addition to sludge has been applied for wastewater sludge, where it is commonly referred to as alkaline stabilisation. More recently, investigations have been conducted on using the ammonia from excreta for pathogen reduction in Faecal Sludge. This can be done by collecting urine separately, and then mixing it with FS, as urine has a high ammonia concentration. For sludge with low ammonia concentration, additional ammonia in the form of the synthetic urea can be added to enhance the treatment.

Potential advantages and constraints of ammonia treatment

In comparison to lime treatment, ammonia requires less stringent storage conditions. It seems particularly applicable in areas with urine diverting dehydrating toilets (UDDTs). In the cases where synthetic urea needs to be applied, the costs become higher, which may limit the economic feasibility and sustainability of the technology. Another constraint is the stability of nitrogen in treatment End products, and whether the full nutrient benefit can be achieved.

7.3.3. Thermal drying and pelletising

Thermal drying allows the removal of all types of liquids from FS. It has been applied in the management of wastewater sludge for many years, and the technology has been taken up and improved from its original application in other industries (e.g. paper industry). Several types of technologies exist, all based on the ability of evaporating water with heat. The end products are stable and in a granular form allowing easier storage or transport.

Potential advantages and constraints of thermal drying

Thermal drying results in a significant reduction in volume as well as pathogen content. Dried sludge is easy to handle and to market, and can be used in agriculture. The main constraints are the expense, high energy requirements, the potential risks of fire or explosion due to the gas and dust in the system, and the high maintenance requirements. Pelletising combines mechanical dewatering and thermal drying technologies. The dried pellets can then be used as an energy source or soil conditioner, and are relatively easy to transport.

7.3.4. Solar drying

A special form of drying is applied in solar sludge driers. They also have been used on a large scale since the nineteenth century in Europe and USA for the treatment of wastewater sludge. This technology is generally constructed in greenhouse structures with transparent covers, concrete basins and walls. Sludge is disposed into these basins and processed for about 10 to 20 days. Options exist for batch or continuous operation, with devices to control the conditions in the greenhouses (e.g. ventilation, air mixing, temperature). The main factors influencing the evaporation efficiency in these systems are the solar variation, the air temperature and the ventilation rate, with initial dry solid content of the sludge and air mixing also influencing the process

Potential advantages and constraints of solar drying

The main advantages of this option are the low energy requirements, the limited complexity of the technology and low investment costs, and the high potential dewatering efficiency. The main constraints are the space requirements and the need for mechanical means to turn the sludge, as well as to ventilate the greenhouses. Although pilot tests are being carried out, for the moment no information is available on the use of this technology for the treatment of FS in low-income countries or on design and operating parameters that need to be considered for this purpose.

8. Co-treatment with Sewage treatment plant (STP) with PPP engagement in Visakhapatnam

A sewage treatment plant (STP) is often a convenient and environmentally sound location for septage disposal. The city is having four major STPs that cater to the need of treating the daily sewage generated. These plants can be modified to receive and treat septage effectively along with sewage. Septage addition, however, can have a

significant impact on plant operations or performance if receiving facilities are not properly designed or not having adequate reserve capacity to take extra load. Septage handling increases plant operation and maintenance (O & M) costs in proportion to the amount of septage received. However, if effectively designed and operated they perform as expected, during the planning stage of the plant without causing any affect to the plant operation.

8.1. Estimating Plant Capacity

Determining the ability of a plant to handle septage and estimating the amount of material that can be effectively handled are complex processes. The lists the potential impacts of septage addition to a STP are as below.

Impact of Septage addition in STP

- Increased volume of screenings and grit requiring disposal
- Increased order emissions from head works
- Scum accumulation in clarifiers
- Increased organic loadings to the biological process
- Potential order and foaming problem in aerated basins
- Increased loading to sludge handling process
- Increased sludge volume requiring final disposal
- Increased housekeeping requirements

Figure 4 provides a method to estimate the allowable rates of septage addition, assuming that a holding tank is provided and that septage is added to the sewage flow on a semi-continuous basis. This chart takes into account the current loadings to the plant compared with its design loadings. Package plants or other activated sludge processes that do not employ primary treatment are the least amenable to septage handling. Allowable septage volumes may be reduced due to septage characteristics, treatment plant operations, and sewage flow patterns. A factor of safety should be included in establishing allowable septage volumes.

If septage is added to the solids handling train, allowable loadings must be estimated based on site-specific information and will vary depending on both the existing solids handling processes used at the plant and their design *ca*pacity. First, information on current versus design hydraulic and solids loadings must be compiled for those processes that will be employed to cotreat septage-sludge mixtures. Such processes may include thickening, aerobic or anaerobic digestion, dewatering, chemical stabilization and composting. Then, conservative estimates of the volumes of septage that could be processed without exceeding the design capacity of each unit process can be developed.

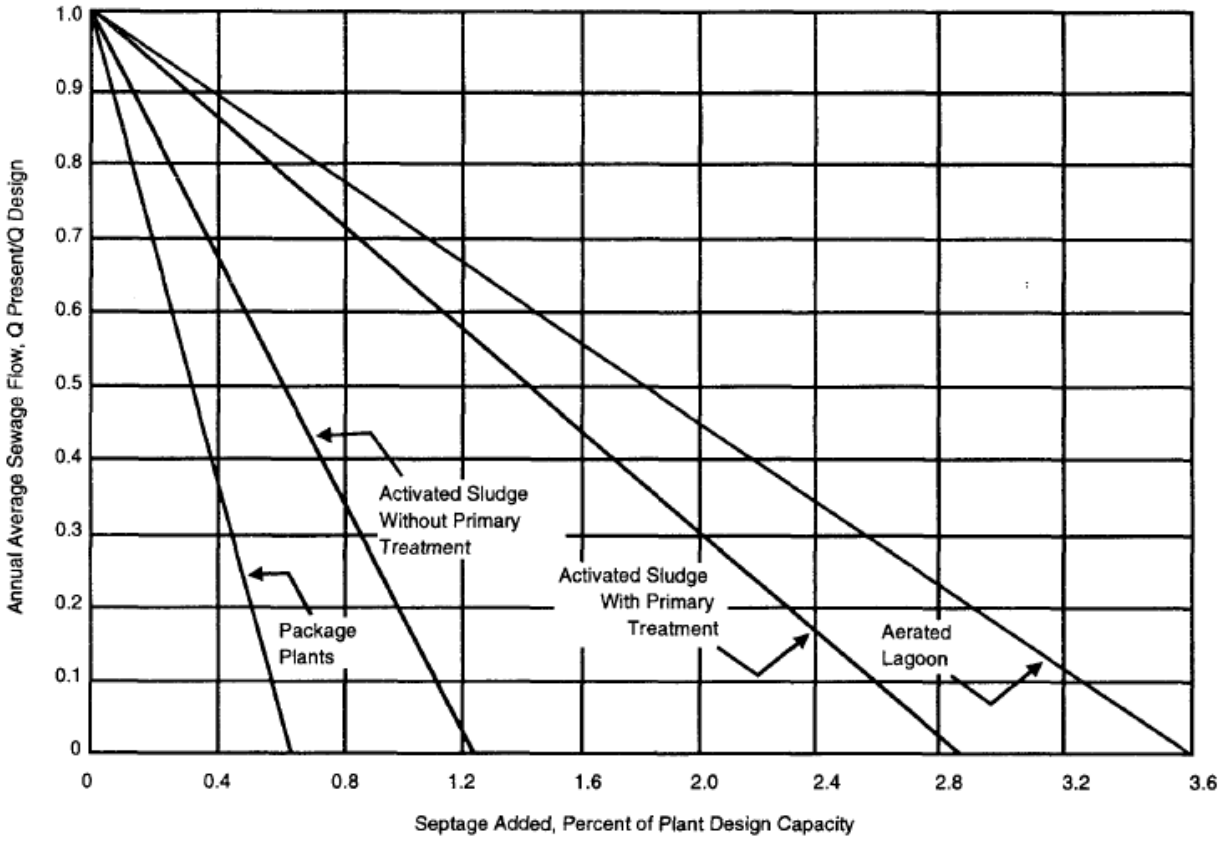


Figure: 4 Allowable septage loadings to a sewage treatment plant having a septage holding tank (1).

8.2. Present Proposal

The present study is to scientifically dispose the faecal sludge generated from household level in the city to the existing sewage treatment plant. Considering that GVMC is planning for construction of UGD network in the coming future for the whole city, it is important that until such services are in operation, an alternative arrangement is in well in place. GVMC will undertake technical feasibility study of the all STPs in the city and will identify their ability to take septage load. In this context, a guiding document called Technical Feasibility Guideline will be prepared by GVMC, which will consists of general guidelines as well as a Field and Desk survey form. Data of the existing STPs will be collected and the septage load will be calculated with use of the graph shown in Figure 4. Based on the density of the septic tank in particular area the nearest pumping station will be designated for disposal for septage coming from that area first b however if needed some septage may be allowed to dispose from the neighboring area also.

With these available information, a Detailed Project Report will be prepared, which will discuss the demand estimation, CAPEX, OPEX, recovery of O & M cost, VTO market size and implementation framework to carry out the the up-gradation work at selected Sewage Treatment Plant (STP) for disposal of septage.

8.3. Public Private Partnership (PPP) Engagement

The city of Visakhapatnam is having 58 vacuum trucks owned by private sector operators to address to the need of the residents. They are currently being operated informally and are unregulated. To leverage the private sector capability in providing on time services a framework will be chalked out in consultation with the association of the vacuum truck operators' association. GVMC will monitor the activities of the VTO with the help of septage bye-laws and will provide training to the operator's time to time. GVMC will further look in to the occupational health and safety requirements of the VTOs by all means of doing welfare not only for the person involved in desludging process but also for their family as well.

GVMC will advocate the banker's association and other financial organization present in the city to provide short term finance at low interest rate for purchase of new vehicle or for modernization, repair and maintenance of the existing vacuum trucks. The private sector operator will be engaged with GVMC under a licensing procedure to carryout necessary work for septage desluding. Option of providing individual license could also be worked out through guidelines, for regularization and registration. To make this service more affordable, a emptying and conveyance business plan will be prepared for the VTOs or the private contractors.

It is essential that the households clean their septic tank in every three years period, and to achieve this Behavior and Communication Change (BCC) campaign will be conducted by consumer profiling and further adopting segmentation, targeting and positioning as per consumer behavior. Proper marketing mix will be adopted to scale up and to make it a profitable business, which will be appealing for the private sector to invest in this segment.

To achieve this foot, GVMC will support in coming out with proper form of contract identifying performance level and further to encourage in doing ethical practices in sludge disposal, suitable incentives will be added for the private sector operators.

9. Operation and Maintenance

There are several important factors that are to be considered when planning co-treatment of faecal sludge with the existing sewage treatment plant or by having a new Faecal Sludge Treatment Plant (FSTP) which has direct impact on O & M and monitoring. Since O & M aspects are important for overall long-term success of the programme, O & M planning, including the financial provision of funds should be included in the terms of references (TOR) for the design such facilities. Furthermore O & M should be reviewed and approved along with engineering designs and specifications by including operation and maintenance cost. The following points to be kept in mind for having such facility;

- Location of disposal sites and its proximity to residential areas.
- Volume and schedule of FS collection.
- Degree of mechanization of technologies.
- Final end use or disposal of end product.
- Recovering the money by the way of user charges.
- Running it on PPP mechanism and charging the household with a septage tax or on number of trips made by vacuum trucks.

10. Financial Planning

While Faecal Sludge and Septage Management treatment options are significantly most cost effective than conventional sewerage options, they still require capital costs that some municipalities cannot bear. Financing of projects in GVMC area will be taken up with the help of ongoing urban development schemes and programs such as AMRUT, SBM or SMART City initiative. The allocation of funds through 14th Finance Commission in AMRUT can specifically be used for taking up such activities. However, emphasis will be on improving the efficiency of existing sanitation infrastructure and service delivery. GVMC will improve its financial capability through introduction of 4 T's in sustainable finance management that is tax, tariff, transfer and trade to meet its CAPEX and OPEX involved in FSSM practices. Tax in terms of property, water charges and sewerage fees are common in practice. Possibility of private sectors involvement in construction or operation, maintenance and desludging of faecal sludge will be looked at considering private sectors robust financial capability and operational efficiency in dealing with similar projects.

Some of the steps that can be taken up to boost up private sector participation are by the means of;

Tax Incentive and Ease of Doing Business: Business line in sanitation sector especially in faecal sludge management is new in India although the same has been practiced in Western countries and some of the South East Asian countries. Ease of doing business with proper tax incentive to the private operator can increase the possibility of venturing in to doing in sanitation sector. One stop clearances and active facilitation to the private operators without being propelled them to a problematic situation can create a win-win situation for both.

Financing at Low Interest Rate: GVMC will co-ordinate with the Bankers Association of India particularly focusing at Visakhapatnam to come up with loan available at low interest rate particularly for projects in sanitation sector focusing to urban poor. Further funding from bilateral and multilateral agencies in the form of transfer could also be used for financing such projects.

Citizen having onsite sanitation also be considered for the following option to push the business opportunity and thereby helping them benefitted from such scheme;

- All the individual households of the RWAs will treat their sludge in a decentralized manner where the system is not connected by sewer will get property tax rebate of 10%.
- All the new apartments which will be constructed and are not having the sewer lines connection will have to design their own sludge management system and will use the recycled water in their premises. In doing so they will get a rebate of 10% of the construction permit fee or Rs. 2,00,000/- (Two Lakhs) whichever is less.
- All the new malls, big hotels, industries, clubs, colleges, universities, hospital, sports stadium etc. which will be constructed and are not having a sewer lines connection will have to design their own sludge management system and will use the recycled water in their premises. In doing so they will get a rebate of 10% of the construction permit fee or Rs. 2,00,000/- (Two Lakhs) whichever is less.
- A separate tax called septage tax will be created which may be levied in the property tax or water charges for operation and maintenance of septage.

Various funding options in summary:

Private Funding Options

- Desludging fee paid by user to the desludging service provider
- Fine for faulty containment system construction and illegal disposal of faecal sludge.

- Sale of end products (For Eg. Dried faecal sludge, water).
- Property tax or septage tax designated for FSSM.

State and Municipal Funding Options
As per the Andhra Pradesh Municipal Corporation Act, 1955 – conservancy tax can be levied on all the properties by the Corporation where city undertakes the collection, removal and disposal of excrementitiously and polluted matter from privies, urinals and cesspools. Periodic revisions for the taxes/ charges to be effected based on revisions in costs involved to the extent possible, revenues should be generated from sale of treated septage for agriculture or other purposes.

Additional Funding Options
GVMC may utilize the funds from **14th Finance Commission** to implement the various components related to septage management plan. Creation of database for toilets and septic tanks, procurement of suction emptier trucks and construction of septage treatment facilities are the permissible components to utilize the 14th FC funds. The funds would also be provided as preparatory activity like preparing detailed project report and prefeasibility report for septage management.

IEC & Capacity building funds: IEC funds under SBM can be utilized for various awareness generating activities. This applies to GVMC for using funds to implement septage management plan, and to include funding for capacity building activities for GVMC staff, septage transporters, treatment plant operators, and city residents.

Convergence with existing schemes/activity: GVMC can ask for funds under the existing state and national schemes such as Smart City Mission and AMRUT.

Corporate Social Responsibility: GVMC can also raise funding through Corporate Social Responsibility.

11. Record-keeping, Reporting, Monitoring and Evaluation

Record keeping and manifest forms should be an integral part of a comprehensive septage management program. Recordkeeping requirements should be codified into the law governing the program. A sample manifest form is detailed out in Annexure 6.

- The completed document or documents with signatures of the household/property, suction truck operator, and treatment plant operator should be submitted to the local government for their records. These documents would validate that the sludge collected from households is disposed of at proper treatment facilities.
- A database system such as the one discussed in access and collection will need to be developed and maintained.
- Where possible, GIS should be used to be plan the route of suction emptier trucks and track emptying trucks for regular record keeping.
- Consumer grievance redressal system for faecal sludge management should also be set up as a part of urban local body record keeping systems and helpline numbers to be shared with residents as a part of monitoring and record keeping systems for faecal sludge management.

At the ULB level, the GVMC is adopting Sanitation Benchmark framework of revised service level benchmarks for sanitation that assess performance of citywide sanitation, capturing on-site sanitation systems and sewage management. Sanitation Benchmark framework for revised Service Level Benchmarks for Sanitation is as below;

Current SLB indicators (Sewerage System)	Proposed Sanitation Benchmark (Sewerage + Onsite systems)
1. Coverage of sewerage network services	**1. Coverage of adequate sanitation system**
Total number of properties with individual connections to sewerage network as a percentage of total number of properties in the city.	Percentage of households with individual or group toilets connected with adequate sanitation systems (sewer network/ septic tank / double pit system) to total households in the city.
2. Collection efficiency of sewerage network	**2. Collection efficiency of sanitation system**
Quantum of sewage collected at the intake of the treatment plant to the quantity of sewage generated (as per CPHEEO, 80% of water consumed is generated as sewage).	Weighted average of collection efficiency of each sanitation system, weighted by share of households dependent on each sanitation system.
3. Adequacy of sewage treatment capacity	**3. Adequacy of treatment capacity of Sanitation System**
Adequacy is expressed as secondary treatment capacity available as a percentage of normative wastewater generation.	Weighted average of adequacy of treatment plant capacity available for each sanitation system, weighted by share of household's dependent on each sanitation system.
4. Quality of sewage treatment	**4. Quality of treatment of sanitation system**
Quality of treatment is measured as a percentage of WW samples that pass the specified secondary treatment standards, that is, treated water samples from the outlet of STPs are equal to or better than the standards lay down by the GoI agencies for secondary treatment of sewage.	Weighted average of quality of treatment of each sanitation system, weighted by share of household's dependent on each sanitation system.
5. Extent of reuse and recycling of sewage	**5. Extent of reuse and recycling in sanitation system**
Quantity of sewage that is recycled or reused after secondary treatment as a percentage of quantity of sewage received at the treatment plant.	Weighted average of extent of reuse of treated wastewater and sludge after adequate treatment as a percentage of sewage and sludge received at the treatment plant, weighted by share of household dependent on each sanitation system.

GVMC will develop database, registry of certified on-site sanitation system, robust reporting format to track compliance of households (establishments, etc.) with outcomes and process standards. These sanitation benchmark will further will be linked to the Service Level Improvement Plan (SLIP) to address the gaps and creating new investment projects.

All these activities will be performed by the Septage Management Cell (SMC) under the direct supervision of the head of the Department of Public Health before going to the commissioner for approval. The cell will be created by funds from external agency or from funds of 14th Finance Commission or through State/GVMC budget. As per City FSSM plan a database will be developed by the city for all such properties having the septic tank in different categories of properties i.e. residential, commercial, industrial, institutional etc. will be monitored on daily basis at GVMC level and will be monitored in such a way that necessary cleaning is done in every 3 years. A Management Information System (MIS) will be developed accordingly to monitor the progress.

12. Community Engagement and Stakeholder Involvement

FSSM practice which is particularly designed keeping community at the center is incomplete without their active participation in conceptualizing projects and subsequent involvement in development and implementation stage through Participatory Learning Action (PLA) and Participatory Urban Appraisal (PUA) process for an inclusive growth that creates employment opportunity and helps in reducing poverty.

It is therefore important that all the stakeholders involved in an integrated coordinated approach for a successful implementation FSSM programme. GVMC will take necessary steps by involving community, Self Help Groups (SHGs), NGOs and CBOs in implementing such sanitation program. Particularly the management of decentralized FSTP in terms of construction, operation and management with community participation creates a sense of ownership amongst each individual benefitted from the community.

13. Awareness Generation, Capacity Building and Training

GVMC with the support of State Government of Andhra Pradesh will formulate a strategy on capacity building and training on FSSM to support City to build their personnel capacities and organizational systems for delivery of sanitation services. It will identify agencies that will train its ULB personnel and orientation of elected representatives on aspects related to FSSM. GVMC will set up and develop strategies for citizen engagement through city sanitation task forces. These agencies could be specialist agencies of the State Government, academic institutions and private sector organizations. This will also need to focus on capacity building, i.e. not just training but also development of systems and capacities of GVMC in sanitation, in line with the Urban Sector Reforms that the city may be implementing under AMRUT, SMART city and SBM. GVMC will need to provide training on sanitation to it's own staff using the specialized agency selected by State Government of Andhra Pradesh. They will need to utilize ongoing Govt. of India and State Government Schemes for training and capacity building in order to achieve this. Training will also need to be imparted to private sector players and NGOs to help them engage and deliver effectively in the provision of FSSM services.

Awareness generation activities need to be taken up for successful implementation of faecal sludge management plan. Wherever possible, these activities should be led by City Sanitation Task Forces, or a sub- committee including members of CSTFs and other interested parties.

Awareness generation for residents: Members of Resident Welfare Associations, community organizers, self-help groups and the general public should be sensitized periodically regarding the need for a safe faecal sludge management system including a 3- year cycle. The health hazards associated with improper collection and treatment of waste, and the ill-effects of sewage discharge into fresh water/storm water drains should be explained to the residents. Awareness generation activities should be carried out at the beginning of introducing a scheduled service in all wards and then repeated periodically over the three-year cycle.

Capacity building for municipal staff: Municipal Commissioners, Engineers, Health Officers, Sanitary Inspectors, and Sanitary Workers should be well trained in safe septage management and its best practices. This involves regular training sessions on safe collection, treatment and disposal. Information regarding standard septic tank design, the need for periodic inspection and desludging of septage, design of a treatment facility, tender details for engaging licensed transporters, etc. should be disseminated widely to achieve a safe faecal sludge management system. Training should also be provided on safety standards.

Capacity building for septage transporters/private vendors: Local Bodies should ensure all safety norms are clearly explained to the septage transporters. Private Operators and Transporters should be well trained in safe

collection and transportation of sewage including vehicle design, process of desludging, safety gears and safe disposal at the nearest treatment facility.

Gender Inclusivity: It is crucial that municipalities look at faecal sludge management through a lens considering gender, particularly concerning the empowerment of women and girls. Women should be equitably involved in the planning of feacal sludge management activities or the formation of local regulations, and any CSTF or sub-committee that discusses faecal sludge management should have a membership consisting of at least one third women, at minimum.

14. Private sector participations for septage management

For effective operationalize of scheduled septic tank emptying service and treatment facilities, GVMC will also explore the option for private sector participation. Following points to be taken into consideration by ULB:

- Explore private sector participation for various activities like procurement, operations and maintenance of the suction emptier trucks, construction and operations of septage treatment facility and possible re-users of treated septage within the city as well as in nearby cities.
- Develop performance based contracts such that payment is linked to the performance of private sector for providing the services.

15. Expected Outcomes

As this Policy is implemented across the city, it is expected to yield significant benefits in terms of improved public health indicators, reduced pollution of water bodies and groundwater from human waste, and resource recovery leading to reuse of treated waste and other end products. Some key projected outcomes are;

- Safe containment, collection and conveyance of 100% human waste to treatment and disposal sites.
- Cost effective solution for management of human waste through integrated network sewerage and faecal sludge septage management.
- Clarity among different stakeholders on identifying and implementing best and economically viable sanitation solutions.
- Improve in technical capability among ULB staff to effectively implement city FSSM.
- Scheduled emptying of septic tanks or other containment systems at an interval of 3 years as recommended by CPHEEO Sewerage and Sewage Treatment Manual and the MoUD Advisory on Septage Management (2013).
- Safe disposal of all collected faecal sludge and septage at designated sites. (Sewage Treatment Plants, Faecal sludge Treatment Facilities for safe and scientific disposal, etc.)
- Continuous improvements in efficiency and effectiveness in the entire FSSM chain: containment, collection, conveyance, treatment and disposal.
- Contamination of water bodies and groundwater from human waste (Faecal matter) reduced to zero levels in all the towns and cities.
- Nuisance from faecal sludge reduced to minimum levels, resulting in nuisance-free living space in city.
- Maximum reuse of treated sludge as fertilizer in farmlands, parks, gardens and other such venues, reuse of treated sewage, as source of energy where feasible, and any other productive uses.
- Drastic reduction in incidences of diseases due to safe and sustainable FSSM services.

16. Policy Evaluation

- Policy may be reviewed as and when required for assessing its effectiveness and making changes if necessary.
- This Policy shall come in to force from the date of issue of this resolution.

17. Power of GVMC

- Notwithstanding anything contained in the foregoing paragraphs of the Greater Visakhapatnam Municipal Corporation Faecal Sludge & Septage Management Policy and Operative Guidelines, 2017 the ULB by issuance of notification in the official gazette may amend or withdraw any of the provisions and / or the schemes mentioned herein above.
- Interpretation – Should any doubt arise as to the interpretation of any of the provisions of these Rules, the matter shall be referred to the Greater Visakhapatnam Municipal Corporation (GVMC), whose decision thereon shall be final.

OPERATIONAL GUIDELINES

1 Operative Guidelines for Septage Management

These operative guidelines are framed by GVMC drawing from provisions and specifications related to septage management of the National Building Code, 2005, revised CPHEEO Manual on Sewage and Sewerage Treatment 2012, Advisory Note on Septage Management in Urban India, 2013 and National FSSM Policy 2017.

The objective of these guidelines is to promote a comprehensive and integrated approach to septage management covering collection, storage, desludging, transportation, treatment, disposal and reuse and ensure compliance with various national level guidelines and regulations.

The guidelines cover the following key elements of septage management.

- Design and construction of septic tanks
- Conversion of insanitary latrines into sanitary latrines
- Septic tank pumping and de-sludging
- Septage transportation
- Treatment, disposal and reuse of septage
- Information, education and communication
- Training programs
- Record keeping and reporting (MIS)
- Help line for septage management

The operative guidelines for each of these key elements are as follows.

1.1 Design and Construction of Septic Tanks

The household are encouraged to adopt the improved version of the designs of septic tanks as prescribed by the NBC and IS Code 2470 and CPHEEO manual. GVMC shall adopt regulations on septic tank designs and construction methods as part of building plan regulations.

The town planning department of the municipal corporation shall ensure that the septic tank designs conform to the guidelines at the time of approval of building plan. The town planning department and/or sanitation department shall inspect the septic tanks during their construction to ensure that there are no deviations from the approved design. The existing guidelines for septic tanks and suggested designs to be adopted by households are provided in Annexure 2.

1.2 Conversion of Insanitary Latrines into Sanitary Latrines

The public health department of the Corporation shall undertake a survey to identify the insanitary latrines and improperly constructed septic tanks. All households with insanitary latrines shall be given notices to convert them into septic tanks and twin pits as per the provisions of the Manual Scavenging Act 2013 and Septage Bye-laws of GVMC. Households with improper septic tanks shall be educated to retrofit them as per the approved designs. For slums and informal settlements twin pits may be permitted as per guidelines in Annexure 3.

1.3 Pumping and Desludging

The households, institutions, commercial entities etc., shall undertake desludging of the septic tanks and pits once in every three years or when they get filled-up whichever is earlier as per the NBC code and CPHEEO guidelines. The operators shall obtain licenses for collection and transportation operations as per the formats provided in

Annexures 4 and 5 of these guidelines. The licenses shall be valid for a period of five years from the date of issue and shall be revised as per due process.

The households are required to engage the licensed operators for collection and transportation to desludge the septic tanks and pay the user charges as per the markets rates or rate/tax as prescribed by the GVMC. The GVMC reserves the right to regulate and fix the user charges in case the market rates are observed to be high and unaffordable to households.

The licensed operators shall have trained workers equipped with uniforms, safety gear, tools and vacuum trucks as defined in the Manual Scavenging Act 2013. The operator, drivers and workers shall have adequate training in septage desludging and transportation. The licensed operators are required to adopt approved standards and procedures for pumping and desludging. Desludging workers shall wear appropriate personal protective equipment, including rubber gloves, rubber boots, a face mask, and eye protection. The operator shall ensure the availability of protective gear for workers and materials for cleaning on a daily basis. After desludging, workers should follow proper hygiene practices such as washing hands with soap. The workers should avoid entering into septic tank and it should be done in exceptional cases with proper care and safety equipment. After each desludging operation, the area shall be properly cleaned and disinfected with relevant cleaning agents such as bleaching powder and lime.

1.4 Septage Transportation

Service providers shall deploy septage vehicles that meet the approved standards as mentioned in the Annexure 8 for desludging and transportation. The septage vehicles shall be fitted with Global Position System (GPS) and the details of GPS shall be shared with GVMC for monitoring purpose.

The driver and service providers shall be responsible for safe operation of the vehicle and equipment at all times and only drivers and workers with adequate training shall be deployed. Transportation shall be undertaken on pre-designed routes avoiding busy roads and peak traffic.In the event of accidental spillage of sludge/septage, the operator shall immediately take action to contain the sludge/septage, minimize the environmental impact, and begin clean-up procedures.The operator shall notify the concerned officials about the spillage and the nature of remedial action within 24 hours. Penalties may be imposed on the operators who shall not comply with the guidelines.

1.5 Septage Treatment, Disposal and Reuse

The GVMC shall facilitate construction and operation of a septage disposal sites in the existing sewage treatment plant. GVMC may adopt appropriate financing model including Public Private Partnership (PPP) for construction and O&M of faecal sludge/septage treatment plant and shall levy user charges as appropriate for meeting capital and O&M expenditure.

The operator of the sewage treatment plant in case of co-treatment and the septage treatment plant shall implement a comprehensive environmental management plan to ensure compliance with environmental and social standards. The septage treatment plant shall adopt appropriate technology for treating septage and the disposed sludge and waste water after treatment shall strictly comply with the norms as per the relevant legislations.

It is the responsibility of the operator of the treatment plant to ensure the compliance with treatment and discharge norms as per APSPCB guidelines. The reuse of treated waste shall be permitted as per the standards and norms. It shall be mandatory for all licensed operators for collection and transportation of septage to dispose the septage only at the plant or any such place as designated by GVMC. The de-sludging service providers are

prohibited to dispose the septage at any other location and would attract penalties for the same. GVMC will notify penalty structure as framed in the septage bye-law and may revise the same from time to time.

The guidelines in this section 1.5 shall become effective only after identification and construction of disposal sites. The GVMC reserves the right to suggest the septage disposal locations and the operators of collection and transportation shall comply with the same.

1.6 Information, Education and Communication (IEC)

The GVMC shall develop appropriate IEC materials and undertake IEC campaigns through print and electronic media, outdoor medium and consultations and workshops targeting the residents to promote adoption of proper toilet designs, construction methods, periodic desludging and safe sanitation practices.

The builders, masons and suppliers of the septic tanks and pits shall be exposed to better designs and better methods of construction. The operators of collection and transportation shall be provided information on standard operating procedures. Non-government Organization (NGOs), Community Based Organizations (CBOs), women's groups and school children shall be extensively involved in undertaking IEC campaigns. Operators and other involved parties shall also develop IEC material and educate communities on safe management of septage.

1.7 Training Programs

GVMC shall support capacity building of various stakeholders including its own staff through appropriate institutions of repute namely Department of Civil Engineering (Andhra University), Indian Institute of Technology, Tirupati, and National Institute of Technology, Tadepalligudem etc. GVMC shall engage these agencies to undertake training needs assessment, design training modules and deliver the training programs.

1.8 Record keeping and MIS

GVMC shall create a computerized MIS platform for monitoring and evaluation (M&E) for baseline data and progress on implementation of septage management guidelines through a separate cell formed under the health department as Septage Management Cell.

GVMC shall maintain data base and information related to septage generation from households and commercial establishments, insanitary latrines, location of septic tanks, details of operators responsible for collection of desludge and details of septage treatment plant.

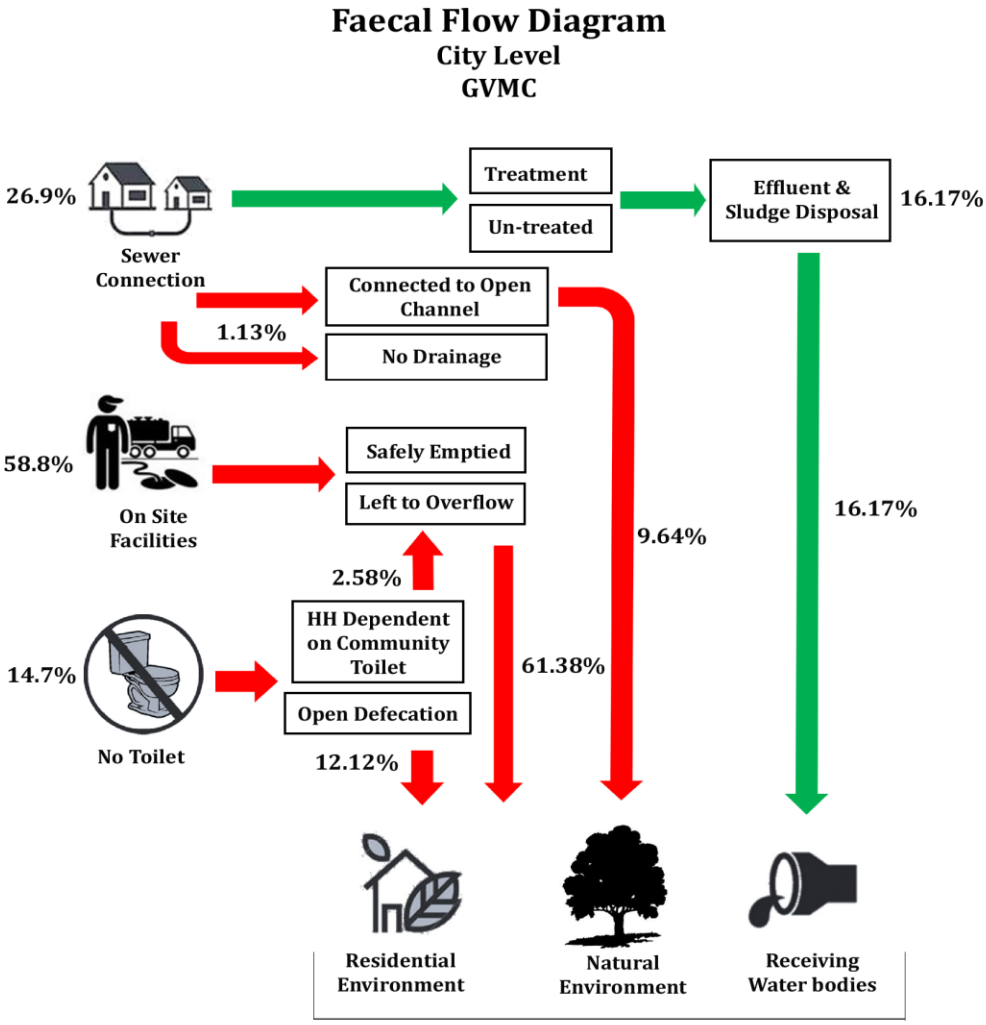
GVMC shall ensure that the operators of collection and transportation and treatment of septage maintain detailed records of their operations as Annexure 6.

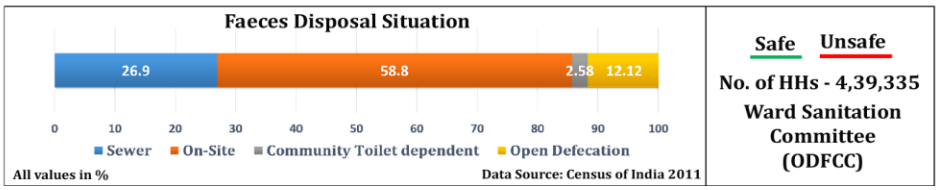
1.9 Help Line for Septage Management

GVMC shall establish a dedicated help line with trained staff for providing support to residents on all aspects of septage management including septic tank designs, approval process, methods of construction, information on masons, and periodicity of desludging, contact details of operators and so on.

Annexure

Annexure 1: Faecal Flow Diagram of GVMC area – City Level





Annexure 2: Septic Tank Specifications, Guidelines, and Designs

Depending on the geography, soil condition, water seepage capacity of the soil the design can be prepared and approved by the Local Bodies. Proper septic tank design considers the following factors:

- Sized properly with appropriate sludge detention time, volume and hydraulic retention time
- Proper inlet and outlet structures
- At least one baffle separating the tank into multiple compartments
- Water tight
- Access port for each compartment that allows for inspection and pumping

Table 2: Recommended Sizes of Septic Tanks as per Number of Users

Number of Users	Length (M)	Breadth (M)	Liquid Depth for Cleaning Interval of 3 Years
5	1.5	0.75	1.05
10	2.00	0.90	1.40
15	2.00	0.90	2.00
20	2.30	1.10	1.80
50	5.00	2.00	1.24
100	7.50	2.65	1.24
150	10.00	3.00	1.24
200	12.00	3.30	1.24
300	15.00	4.00	1.24

(Note; The CPHEEO Manual and NBC code IS 2470 Part I 1985 may be referred for exact calculations)

Notes:

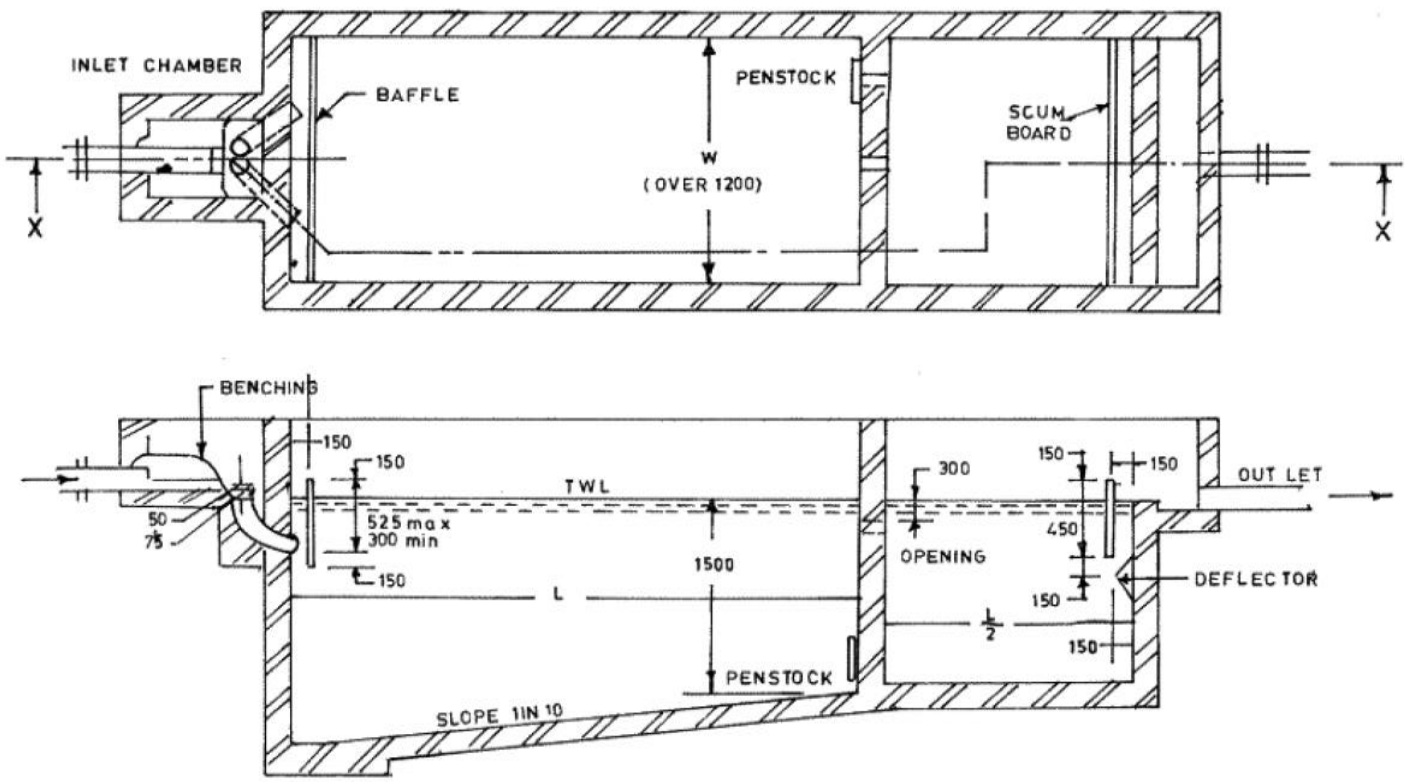
1. A provision of 300 mm should be made for free board.
2. The sizes of septic tank are based on certain assumption on peak discharges, as estimated in IS: 2470 (Part -1) - 1985 and while choosing the size of septic tank exact calculations shall be made.
3. For population over 100, the tank may be divided into independent parallel chambers of maintenance and cleaning.

Construction details:

The inlet and outlet should not be located at such levels where the sludge or scum is formed as otherwise; the force of water entering or leaving the tank will unduly disturb the sludge or scum. Further, to avoid short-circuiting, the inlet and outlet should be located as far away as possible from each other and at different levels. Baffles are generally provided at both inlet and outlet and should dip 25 cm to 30 cm into and project 15 cm above the liquid. The baffles should be placed at a distance of one-fifth of the tank length from the mouth of the straight inlet pipe. The invert of the outlet pipe should be placed at a level 5 to 7 cm below the invert level of inlet pipe. Baffled inlet will distribute the flow more evenly along the width of the tank and similarly a baffled outlet pipe will serve better than a tee-pipe.

For larger capacities, a two-compartment tank constructed with the partition wall at a distance of about two-thirds the length from the inlet gives a better performance than a single compartment tank. The two compartments should be interconnected above the sludge storage level by means of pipes or square openings of diameter or side length respectively of not less than 75 mm. Every septic tank should be provided with ventilation pipes, the top being covered with a suitable mosquito proof wire mesh. The height of the pipe should extend at least 2 m above the top of the highest building within a radius of 20 m. Septic tanks may either be constructed in brick work, stone masonry or concrete cast in situ or pre-cast materials. Pre-cast household tank made of materials such as asbestos cement / HDPE could also be used, provided they are watertight and possess adequate strength in handling and installing and bear the static earth and superimposed loads. All septic tanks shall be provided with watertight covers of adequate strength. Access manholes/covers (minimum two numbers one on opposite ends in the longer direction) of adequate size shall also be provided for purposes of inspection and desludging of tanks. The floor of the tank should be of cement concrete and sloped towards the sludge outlet. Both the floor and side wall shall be plastered with cement mortar to render the surfaces smooth and to make them water tight. A typical two compartment septic tank is shown in figure below;

Source: CPHEEO, 1993



SECTION XX

ALL DIMENSIONS IN mm

TYPICAL SKETCH OF TWO COMPARTMENT SEPTIC TANK FOR POPULATIONS OVER 50 (IS : 2470 (PART 1)-1985)

Structure of a Septic Tank

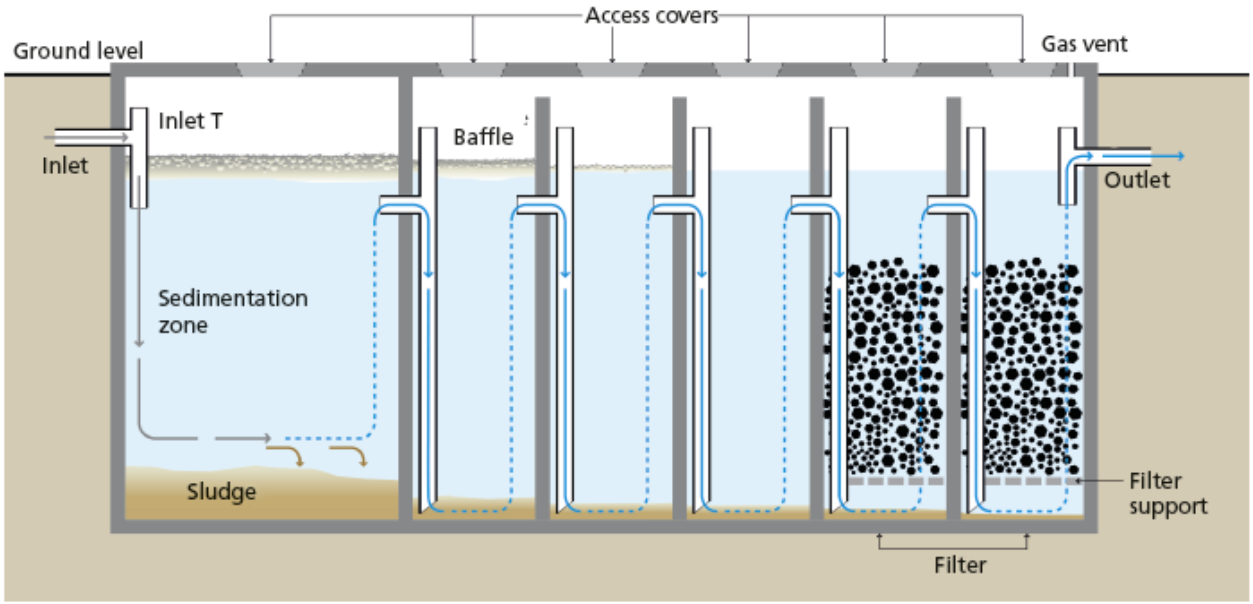
Table 3: Existing guide lines for design and construction of septic tanks

Parameters	Existing Guidelines	Source of Guideline	General Observations
Location	Septic tanks are recommended only for individual homes, small communities and institutions whose contributory population size doesn't exceed 300	**CPHEEO Manual**	While all existing guidelines state that the location of septic tank should be given due consideration, in reality, the location of the septic tanks are practically based on the land availability within the household Vicinity
	A sub soil dispersion system shall not be closer than 18 meters from any source of drinking water, such as well, to mitigate the possibility of bacterial pollution of water supply	**NBC, Part 3: Development Control Rules and General Building Requirements**	
	Septic tank should be located at a place open to sky, as far away as possible from the exterior of the wall of building and should not be located in swampy areas or areas prone to flooding	**IS 2470, Part-1**	
Design and Construction	Septic Tank should have minimum width of 750mm, depth of 1 meter below water level and a minimum water capacity of 1 cubic meter. The length of the tank shall be 2 to 4 times the width. The minimum nominal diameter of the pipe shall be 100 mm. Further at junctions of pipes in manholes, direction of flow from a branch connection shall not make an angle exceeding 45 degrees with the direction of flow in main pipe	**NBC, Part 3: Development Control Rules and General Building Requirement,**	Local masons unaware of the existing design/construction guidelines for construction of septic tanks. The criterion governing the design and construction broadly in the land availability and the funds available with the owner / property builders.
	Every septic tank shall be provided with a ventilation pipe of at least 50mm diameter.	**IS 2470, Part 1**	

The liquid depth should be 1-2 m and the length to depth ratio should be 2-3 to 1.	
The liquid depth of the septic tank should be calculated depending on the cleaning interval of the septic tank (For detail length, breadth and liquid depth for various number of users please refer the Manual)	
A provision of 300 mm should be made for free board. When served for a population above 100, the septic tank may be divided into independent parallel chambers for operation and Maintenance	**CPHEEO, IS 2470, Part 1**
Baffles are provided at inlet and outlet and should dip 25 to 30 cm into and project 15 cm above the liquid. The invert of the outlet pipe should be provided at 5 to 7 cm below the invert level of inlet pipe.	
The height of the ventilation pipe should extend at least 2 m above the height of the highest building within 20 meters radius	
Improved Septic Tank" - the walls of the conventional septic tank can be replaced with baffle walls to have a multi chambered baffled septic tank.	
The paper states "This movement of wastewater inside the tank helps in creating the turbulent flow which causes enhanced mixing of the raw sewage with already existing activated sludge and accelerates the decomposition of the solids because of intensive contact between the activated sludge and fresh influent".	**CSE Policy Paper on Septage Management in India**

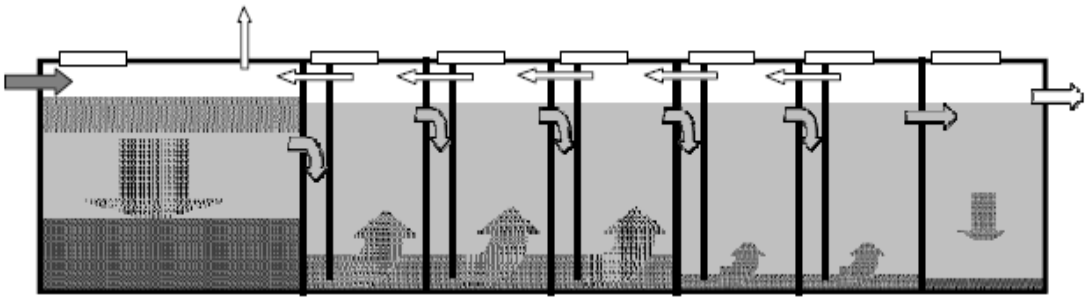
Design for improved septic tank- three chamber with Anaerobic Baffled Reactor (ABR)

An ABR with filter is an improved septic tank (see Figure below: Anaerobic baffled reactor with filter). ABRs incorporate one or more baffles which force the sewage to flow from the bottom to top until it starts to flow into the next chamber. The upflow chambers catalyze the sedimentation of solids and digestion of organic matter.BOD may be reduced by up to 90 per cent, which is far higher a percentage than a conventional septic tank. The filter chambers typically remove 50–80 per cent BOD as sewage flows through them.



Source: Manual on Sewerage and Sewage Treatment—Part A: Engineering. CPHEEO, 2012

Anaerobic decentralized waste water treatment systems (DEWATs)



Annexure 3: Guidelines for Conversion of Insanitary Latrines into Sanitary Toilets

Table 4: Existing guide lines for leach pits

Parameters	Existing Guidelines	Source
Size (five members)	Dia - 1000mm preferred but 750 mm also permitted where space is a constraint, Depth – 1300mm	CPHEEO
Emptying	Single pit – 6 years, Twin pit – 3 years each	CPHEEO
Shape	Circular is preferred; but rectangular, oval and square also allowed where space is a constraint	CPHEEO
Location	Pits should be placed symmetrically at the back side of the pan. Can be located within premises, under foot pat/road/narrow lane. The distance between foundation and pit should be between 0.2 to 1.3m. A minimum distance of 3 to 10m from water source such as tube wells and 3 to 10m from water mains. Water pipe should not cut across the pit	CPHEEO
Design and Construction	The pits should be lined to avoid collapsing. Bricks joined in 1:6 mortar commonly used for lining. Stones or laterite bricks of cement concrete rings could also be used. Lining brick work 115 mm thick (half brick) with honey combing up to the invert level of size of holes 50mm wide up to the height of brick course pit bottom should be left in natural condition. RCC slab is used for pit cover. Toilet pan is connected to the pit through 1 75-mm brick channel of U shape.	CPHEEO

Annexure 4: Form for Application for the License the Collection, Transportation and Disposal of Septage in GVMC

Paste Self-Attested Recent Passport Size Photograph

1. Name of the applicant: Shri/Ms_____
2. Nationality: Indian_____ Other_____
3. Address: Regd. Office: _____

   Head office: _____
4. Telephone No.: (O)_____ Mobile No._____ Email ID_____
5. Registration No. of Vehicle :_____
6. Pollution certificate of the vehicle valid up to:_____
7. Insurance of the vehicle valid up to:_____
8. Fitness of the vehicle valid up to:_____
9. Vehicle, whether fitted with GPS:_____
10. Details of the vehicles indicating model, type, capacity, leak proof, odour and spill proof having proper vacuum/ suction and discharging arrangement (Document proof of any may be enclosed).
11. Processing fee for license Rs. 1500/- (Non-refundable)
    D.D. No. _____ Date _____ Bank_____

I/We certify that information given by me/us in column 1 to 11 are true to the best of my knowledge and belief. I also certify that I have read and understood the attached terms and conditions 1 to 13 and agree to abide by them. I agree that if any information given by me is found wrong the application for license will be liable for cancellation at any time.

Signature(s) of applicant(s)

No. of document attached: _____ Date: _____

Annexure 5: License for Collection and Transportation of Septage

In accordance with all the terms and conditions of the By-laws/ Regulations, Municipal Corporation Act rules, the special license conditions accompanying this license and applicable rules and laws of Government of Andhra Pradesh, the permission is hereby granted to:

NAME OF LICENSEE……..

ADDRESS……

For the disposal of septage from septic tanks in GVMC

This license is based on information provided in the Septage Collection and Transportation License Application. This license is effective for a period of five years from date of issue, set forth below.

EFFECTIVE DATE

EXPIRATION DATE

The license may be suspended or revoked for Condition of Non Compliance and is not transferable. The original license shall be kept on file in the Licensee's office. A copy of this license shall be carried in every registered vehicle used by the Licensee.

Annexure 6: Collection and Transport Records through Septage Manifest Form (SMF)

Date: **Time of Collection:**

Space for STAMP by VTO, STAMP should contain Name, License Number and Vehicle Registration Number

1)Septage Origin

Origin type:

Residential	☐
Institutional	☐
Commercial	☐
Other	☐

Name (household or unit, mention unit numbers if more than one household)				
Ward No:				
Phone Number				
Volume emptied (in m3), mention separately for each household				

2) Septage Discharge

DSO Name

Designated Disposal Site

Septage Inspection comments:

(Odour / Colour / Solid waste / Soil and grit / FOG scum)

Sample Taken?	Yes	No
Load Accepted?	Yes	No
Load Rejected?	Yes	No

Volume emptied (in m3)

Sign of VTO Signature of the Household Sign of DSO

Date of Discharge: Time of Discharge:

Annexure 7: Safe Reuse and Disposal of Treated Septage[2]

Table 5: Compost Quality as per MSW Rules, 2016

Parameter	Concentration not to exceed (mg/kg dry basis. Except for pH and carbon to nitrogen)
Arsenic	10
Cadmium	5
Chromium	50
Copper	300
Lead	100
Mercury	0.15
Nickel	50
Zinc	1000
C/N ratio	<20
pH	6.5 – 7.5
Moisture percent by weight, maximun	15 – 25
Bulk Density	<1
Total Organic Carbon	12
Total Nitrogen (as N) percent by weight, minimum	0.8
Total Phosphate (as P_2O_5) percent by weight, minimum	0.4
Total potassium (as K_2O) percent by weight, minimum	0.4
Colour	Dark brown to black
Odour	Absence of foul odour
Particle size	Minimum 90% material should pass through 4.0mm IS sieve
Conductivity (as dsm – 1), not more than	4

*Compost (final product) exceeding the above stated concentration limits shall not be used for food crops. However, it may be utilized for purposes other than growing food crops.

For dewatered septage/sludge can be used as fertilizer in agriculture application, it should satisfy the following criteria of Class A Bio-solids of US EPA: A faecal coliform density of less than 1000 MPN/g total dry solids, Salmonella sp. density of less than 3 MPN per 4 g of total dry solids. WHO (2006) suggests Helminth egg concentration of < 1/g total solids and E coli of 1000/g total solids in treated septage for use in agriculture.

MSW Rules (2016) recommended the quality for compost as referred to Table 5 above.

In the absence of any standards, it is recommended that these be adopted until such time standards are notified by the Central Pollution Control Board.

Properly treated sludge can be reused to reclaim parched land by application as soil conditioner, and/or as a fertilizer. Deteriorated land areas, which cannot support the plant vegetation due to lack of nutrients, soil organic matter, low pH and low water holding capacity, can be reclaimed and improved by the application of treated septage. Septage sludge, as a result of lime stabilization has pH buffering capacity that is beneficial for the reclamation of acidic soils. Treated septage contains nutrients in considerable amounts, which supports the growth of a number of plants.

Drip irrigation is the preferred irrigation method for settled septage effluent when irrigation is feasible. Crops which could be safely grown are corn, fodder, cotton, trees including fruit trees, eucalyptus and poplar.

Aquaculture can be practiced for settled septage effluent when freshwater is available to achieve dilution to ensure dissolved oxygen is above 4 mg / l. Fish species of tilapia and carp are preferred since they tolerate low dissolved oxygen. Both drip irrigation and aquaculture need land and are feasible at city outskirts.

2 Source: Advisory note: Septage Management in Urban India, Ministry of Urban Development, Government of India. (2013), SWM Rules - 2016 and Guidelines for septage management in Maharashtra. (2016)

Annexure: 8

TECHNICAL SPECIFICATION OF 3000 LTR. CAPACITY, LCV CHASSIS MOUNTED CESSPOOL EMPTIER (VACUUM TRUCKS)

The complete equipment is mounted on a 7 Ton GVW BS-III Vehicle chassis having minimum wheelbase of 3800 mm.

SLUDGE COLLECTION AND STORAGE TANK

The tank is fabricated from 6 mm thick MS plate confirming to IS – 2062 standard and volumetric capacity of 3000ltr. The tank is designed to withstand conditions prevailing from the operating vacuum and pressure conditions. The tank is mounted on a sub-frame and designed as ready for conversion to tipping at any time in the future.

The tank is of cylindrical design with torri-spherical-dished ends to ensure complete and fast off- loading of the collected material. Mounted on a heavy C-sectioned sub-frame to provide additional structural strength to the chassis frame, the tank is supported at the rear end by two heavy-duty hinge arrangements thus, allowing it to be "ready for conversion to tipping" when required. The forward end of the body is fitted with robust saddle supports, which is securely bolted to the sub-frame. The tank's rear door is fully open able type, and its shell's perimeter is reinforced for structural integrity. Opening and closing operations of the door is affected manually and in a horizontal plane. Locking and sealing of the rear door is done by hand wheel operated swing bolts and located circumferentially on the tank's rear end of the shell.

The sludge compartment is fitted with a level indicator and two nos. 75 mm drain-cum-suction valves. One of the valves is provided with an internal riser to allow discharge of only the water portion of the tank back into the chamber or a nearby storm water drain. This enables the vehicles to move from one application point to the other carrying only the sludge/material waste without transporting the unwanted water portion.

A hollow "D" section type door sealing neoprene rubber gasket is provided to ensure the door to be leak proof.

TECHNICAL DATA

Capacity	: 3000 ltrs.
Max. Operating Pressure	: 1.0 to 1.5 bar
Construction	: Cylindrical shell with torri-spherical dished ends
Material	: 6 mm thick MS plate as per IS 2062 for shell and dished end.

TANK MOUNTING:

The Sludge Collection Tank is mounted on a sub-frame, fabricated from ISMC 150 channel sections.

SUCTION SYSTEM:

Vacuum Pump (Exhauster/ Compressor)

The Equipment is fitted with a Rotary Sliding Vane, positive displacement type Exhauster/Compressor. The pump is fitted with high temperature resistant, asbestos free vanes and has a free airflow capacity of 5300 to 6000 LPM.

The Exhauster/ Compressor is imported origin. The Exhauster/ Compressor is provided with:

a**)** Convection Air **–** Cooling.

b**)** Forced oil Lubrication pump.

c**)** Incorporated Check valve.

d**)** Incorporated 4**-**way valve**.**

Technical Data:

Type	: Rotary sliding vanes
Delivery	: 5300 LPM to 6000 LPM @ 1300 RPM – 1400 RPM Max.
Vacuum	: 92%
Maximum operating	
Pressure (Vacuum)	: 7.00 to 9.00 m
Maximum Pressure	: 1.4 bar (abs)

The 4- way change-over valve will enable the unit to change quickly from the pressure to the suction mode and vice-versa. A pump inlet filter of adequate capacity has been incorporated in the system for the protection of the pump against ant ingress of foreign particles, in both the suction and the overpressure modes of operation

Pressure relief and vacuum relief valves have been mounted to protect the equipment and system from over pressure and excessive vacuum respectively. The valves are factory set to control the operating pressure and vacuum parameters of the system.

The valves are factory set to control the operating pressure and vacuum parameters of the system.

Suction Hose, Hose Connection and Stowage

Ten nos. 3 meters long, heavy duty, PVC flexible suction hoses of 75 mm internal diameter and fitted with quick action couplings/ CAM-Lock couplings.

DRIVE SYSTEM

The vacuum pump/ compressor driven by the factory fitted side PTO of the vehicle through a propeller shaft and a flexible V-belt & pulley configuration .The arrangement allows the operator to stop the pump without necessitating stoppage of the truck's engine. The changeover of the PTO unit for individual drive is from the driver's cabin.

PAINTING/ FINISHING OF THE COMPLETE UNIT

Both, exterior and interior of the tank has been sanded prior to spray painting. The tank exterior is spray-painted with two coats of superior quality anti-corrosive primer and two coats of enamel metal paint. The colour shade is golden yellow. The sludge compartment tank is internally coated with two coats of epoxy paint to resist corrosion

due to weak acids.

ACCESSORIES AND SAFETY FEATURES INCORPORATED IN THE SUCTION SYSTEM

A) **Pressure Relief Valve**: Fitted in a suitable position, this device provides safety to the storage tank as well as the complete system. The valve is of a spring loaded adjustable type and provides continuous relief when the systems pressure exceeds the pre-set limit.

B) **Vacuum Relief Valve**: It is set to function at a desired operating valve and protects the pump and the complete system from operating under high undesired vacuum condition. As the system reaches the set vacuum level, this valve lifts and ventilates the system by virtue of allowing the air outside to enter.

C) **Primary Shut-Off**: The Primary Shut-Off protects the exhauster/ compressor from the harmful effects of an accidental ingress of sludge and other foreign particles caused due to an overflow from the liquid waste tank. Fitted inside the sludge compartment and the tank top, this specially designed device consists of a stainless steel ball which floats on water, rises and seals against a rubber seat at a rubber seat at a rubber seat at that the tank contents do not overflow into the system.

D) **Secondary Shutoff**: Fitted immediately after the primary shut-off. It functions to protect the vacuum blower from any probable carryover of suspended water and sludge particles which may be drawn into the system from the water surface in the sludge compartment due to the high vacuum conditions within the water and sludge particles that accumulate are required to be drained regularly and after each operation through a drain valve provided at the separator's bottom. A ball float shut-off arrangement is incorporated inside the cyclone for the protection of the system from any accident overflow and carryover of material from the sludge tank. In an event of the separator getting filled to a predetermined level, the ball float will rise and seal against the rubber seat provided at the mount of the cyclone outlet, ensuring that the water and sludge particles do not flow into the blower.

E) **Suction Filter**: Incorporated in the airflow circuit between the secondary shut-off and the pump, is a stainless steel, basket type Safety Filter designed to handle the pump's flow rating and filter out solid and semi-solid particulate impurities of size beyond that of the pumps handling capacity.

F) **Exhaust Silencer:** Fitted on the pump's exhaust side of the airflow circuit. This device dampens the airflow with minimum back pressure in the system, thus reducing the operational noise levels considerably.

PROTECTIVE GEARS

Protective gears i.e. helmet, safety goggles, nose mask, hand gloves, acid alkali proof suit and gum boot for three numbers of operating personnel per each cesspool emptier is to be accompanied along with the cesspool emptier for desludging.

SL. NO.	ITEM DESCRIPTION	SPECIFICATIONS
1.	**SAFETY HELMET**	• ISI Mark : IS 2925 • MOC : PVC Safety Helmet • Colour : White / Yellow / Blue • Helmet with Rachet band • Made from chemical resistant HDPE thermoplastic. • Full Adjustable Rachet type head band • Sweat band and nylon chin strap.
2.	**SAFETY GOGGLES**	• EN 166:2001 approved • ANSI Z 87.1 approved • MOC : Impact resistant Polycarbonate • Scratch Resistant (it should have a scratch resistant coating.) • 100 % Polycarbonate Lens and 100 % UV Protection • Adjustable temples. • Anti-scratch and anti-fog lens. • Chemical splash proof i.e. excellent side and front impact protection. • Provide protection against flying particles, dust, spark and glare. • Extremely light weight and soft nose pads. • It should have side shield & brow-bar must fit snugly to forehead for extra application.
3.	**NOSE MASK (RE USABLE)**	• ISI Mark : IS 8522 • Nose mask with elastic head band • Filtering Efficiency: Confirms to EN 149 FFP 1 / FFP 1 S requirement. • Efficiency: filters dust 85 – 90 % up to 3 microns size of dust. • Made of cotton • Filter media should be whole respirator surface. • Head bands: twin head bands having very good elastic retention

		properties with good face seal throughout the usage of life.
4.	**PVC RUBBER HAND GLOVES**	• Acid Alkali Proof Hand Gloves • Propylene rubber hand glove • It should be made of acrylic propylene latex with soft 100 % cotton flock for added comfort which absorbs perspiration & adds insulation. • It should have excellent chemical resistance to heavy hydrocarbons, hydrocarbon derivatives, aromatic solvents, alcohols, oil greases. • Size : 18 inch
5.	**ACID ALKALI PROOF SUIT**	• MOC : PVC • The acid alkali resistant suit should be made of PVC with nylon reinforced laminated material. • It should consists of acid alkali proof coat, pant and full face mask (separately) • The suit should have higher tensile strength & good chemical resistance • It should have full opening from chest for easy wearing & double flap in front to prevent / protect liquid entry splashed on it during use.
6.	**GUM BOOT**	• IS: 12254

17 REFERENCES

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