HANDBOOK ON INTEGRATED WASTEWATER AND SEPTAGE MANAGEMENT FOR URBAN LOCAL BODIES IN TELANGANA

Commissioner and Director of Municipal Administration
Government of Telangana

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FOREWORD

Dr T K Sreedevi, IAS

Government of India, through its flagship Mission on '**Swachh Bharat**' has emphasised the importance of sanitation and Government of Telangana has launched "**SwachhTelangana Mission**" with a goal of achieving "Open defecation free cities" by 2019 in line with the SBM's vision. Having gained significant ground in the enormous challenge of providing universal access to toilets to all citizens, now the state is faced with the imminent challenge of management of the wastewater beyond the point of generation. In pursuance to the Telangana State Sanitation Strategy, the State envisages to address the sanitation challenges in a holistic and integrated manner.

With the Mission Bhagirtha the ULBs would receive 135 LPCD of water, which further increase the wastewater flows. It becomes important for cities to effectively capture the entire wastewater (grey water + black water) generated from all sources within the city limits and scientifically treat the entire quantum to protect and preserve public and environmental health.In this context, this handbook on integrated waste water and septage management, sets the direction for urban local bodies in Telangana to systematically address the wastewater issues and achieve the objectives of Telangana State Sanitation Strategy.

The handbook promotes the conjunctive use of conventional and non-conventional systems to address the sanitation needs in a city in an incremental manner. The handbook highlights a set of six 'guiding principles' to assist the decision makers to formulate appropriate sanitation plans that is equitable, sustainable and economically viable. The step wise processes of planning, design, implementation, technical criteria for selection of technologies and operation and maintenance refered in CPHEEO Manual on Sewerage and Sewerage Treatment. It also provides an overview of sustainable technologies options in terms of capital cost, O&M cost, energy requirements and advantages and regulatory framework.

I take this opportunity to acknowledge the efforts of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and express gratitude for their continued support in the development of the handbook through a participatory and inclusive processes. The department is committed to improving sanitation in the state and we are proud to present this handbook as a humble effort in this direction.

Dr T.K.Sreedevi, IAS

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ABBREVIATIONS

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
BIS	Bureau of Indian Standards
CAPEX	Capital Expenditure
CDMA	Commissioner and Director of Municipal Administration
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organization
CRZ	Coastal Regulation Zone
DMA	Directorate of Municipal Administration
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EoI	Expression of Interest
GoTS	Government of Telangana State
GoI	Government of India
HH	Household
IHHT	Individual Household Toilet
IEC	Information Education and Communication
IWwSM	Integrated Wastewater and Septage Management
LCS	Least Cost Selection
LSGI	Local Self Government Institutions
MA&UD	Municipal Administration and Urban Development**!**
MDWS	Ministry of Drinking Water and Sanitation
MoUD	Ministry of Urban Development
NGO	Non-Governmental Organisation
NUSP	National Urban Sanitation Policy
O&M	Operation and Maintenance
OSS	Onsite Sanitation
PHMED	Public Health and Municipal Engineering Department
PPP	Public Private Partnership
QCBS	Quality and Cost Based Selection
RfP	Request for Proposal
SBM	Swachh Bharat Mission
SOP	Standard Operating Procedures
SPCB	State Pollution Control Board
STP	Sewage Treatment Plant
TSPCB	Telangana State Pollution Control Board
ULB	Urban Local Body
VGF	Viability Gap Funding
WHO	World Health Organisation

GLOSSARY

BLACKWATER

"Blackwater" is the mixture of urine, faeces and flushwater along with anal cleansing water and/or dry cleansing materials. Blackwater contains the pathogens of faeces and the nutrients of urine that are diluted in the flushwater

References: Compendium of Sanitation systems and Technologies, 2nd Revised Edition

EFFLUENT

"Effluent" is the supernatant liquid that flows out of a treatment system or is discharged from the treatment systems

For the purposes of this document, the treatment system in reference is also an on-site sanitation system or septic tank

FAECAL SLUDGE

"Faecal Sludge" is raw or partially digested, in a slurry or semisolid form, the collection, storage or treatment of combinations of excreta and black water, with or without grey water. It is the solid or settled contents of pit latrines and septic tanks. The physical, chemical and biological qualities of faecal sludge are influenced by the duration of storage, temperature, soil condition, and intrusion of groundwater or surface water in septic tanks or pits, performance of septic tanks, and tank emptying technology and pattern.

Faecal sludge is the solid or settled contents of pit latrines and septic tanks. Faecal sludge (FS) comes from onsite sanitation systems. Examples of onsite technologies include pit latrines, non-sewered public ablution blocks, septic tanks, aqua privies, and dry toilets.

References: National Faecal Sludge and Septage Management Policy

GREYWATER

"Greywater" is the total volume of water generated from washing food, clothes and dishware, as well as from bathing, but not from toilets. It may contain traces of excreta (e.g., from washing diapers) and, therefore, also pathogens. Greywater accounts for approximately 65% of the wastewater produced in households with flush toilets.

References: Compendium of Sanitation systems and Technologies, 2nd Revised Edition

SEPTAGE

"Septage" is the liquid and solid material that is pumped from a septic tank, cesspool, or such onsite treatment facility after it has accumulated over a period of time. Usually, septic tank retains 60% - 70% of the solids, oil, and grease that enter it. The scum accumulates on the top and the sludge settles to the bottom comprising 20% - 50% of the total septic tank volume when pumped. Offensive odour and appearance are the most prominent characteristics of Septage. It is a host of many disease-causing organisms along with the contamination of significant level of grease, grit, hair, and debris.

Septage is the combination of scum, sludge, and liquid that accumulates in septic tanks.

References: National Faecal Sludge and Septage Management Policy

SEWAGE

"Sewage is defined as the wastewater containing human body waste matter (faeces and urine etc.), either dissolved or undissolved, discharged from toilets and other receptacles intended to receive or retain such human body wastes. The effluent coming out of septic tanks or any such facility is also sewage.

WASTEWATER

"Wastewater" consists of domestic blackwater (excreta, urine and faecal sludge) and greywater (kitchen and bathing wastewater) from households and also the effluent from the on-site sanitation systems

CONTEXT

India is witnessing an increase in urbanization with 377 million people projected to be living in 7935 towns as per 2011 census, against 285 million in 5161 towns in 2001. There has been a 31.8% decadal increase in urban population, which in absolute numbers translates to 91 million people added to the urban centres in the last decade and this trend is likely to continue in the future. The urbanization process in India has been characterized by rapid informal growth of cities and towns leading to rising demand for basic services. Although significant initiatives have been undertaken by various state governments as well as the central ministries, there are substantial deficits with respect to urban sanitation and significant measures need to be taken to improve the overall situation.

In urban areas especially, water resources are under significant pressure due to high water-demand patterns. The situation is worsening with rising demand due to increasing urbanisation. Almost 80 percent of water supply to municipalities flows back into the ecosystem as untreated wastewater, which is a critical environmental and health hazard.

Sewerage and sewage treatment is a part of public health and sanitation and according to the Indian Constitution, falls within the purview of the State List. Since this is non-exclusive and essential, the responsibility for providing the services lies within the public domain. The activity being of a local nature is entrusted to the ULBs, which undertake the task of sewerage and sewage treatment service delivery, with its own staff, equipment and funds. In a few cases, part of the said work is contracted out to private enterprises. Cities and towns, which have sewerage and sewage treatment facilities are unable to cope-up with the increased burden of providing such facilities efficiently to the desired level. Issues and constraints that are encountered by the ULBs responsible for providing sewerage and sanitation facilities are compounded due to various reasons.

Urban wastewater treatment has received less attention compared to the supply and treatment of drinking water. Rising costs and growing fresh water-supply challenges make it essential to treat municipal wastewater for reuse and recharge to water bodies. With water scarcity—due to availability, access, or pollution issues—being reported from several parts of the country, planners need to strategize on the utilization of all water resources, including untreated, partially-treated, and fully-treated wastewater, for different productive purposes (Amerasinghe, et al., 2013). Wastewater management has to be regarded from an environmental/ecological viewpoint, and also sociopolitical, microbiological, and hydro-economic perspectives.

While the conventional sewerage may be an effective system for sewage collection and transportation and treatment, it also remains as a highly resource-inefficient technology. Consequentially, high capital cost and continuing significant costs for O&M of this system prohibit its widespread adoption in all sizes of urban areas in the country. There has been no major effort to create community awareness either about the likely perils due to poor sewage management or the simple steps that every citizen can take which will help in reducing sewage generation and promote effective management of its generation and treatment. The degree of community sensitization and public awareness is low. There is no system of segregation of black water (from toilets) and grey water (other liquid wastes) at household level. In most cities and towns no proper service connections have been provided to the toilets connecting to the sewers.

The urban local bodies are missing strategic approaches that address the demand for wastewater management in an integrated manner considering the optimal use of water and wastewater resources, leveraging the existing non-conventional on-site wastewater management systems that provide short-term stability and build upon them to gradually achieve long term goal of 100% universal coverage of wastewater management services.

WASTEWATER MANAGEMENT SCENARIO IN TELANGANA

Telangana is a newly formed southern state in India, declared as 29th state on 2nd June 2014 with the enactment of Andhra Pradesh Reorganization Act 2014 with Hyderabad as capital.

Urbanisation is growing at a faster pace with the urban population of 38.5% Telangana the 5th largest urbanized state in India The urban population of the state is 1,37,24,566 spread across 73 Urban Local Bodies consisting of 6 Corporations, 42 Municipalities of all grades and 25 Nagar Panchayats and 1 Secundrabad Cantonment as per 2011 census. The net increase of urban population between 2001 and 2011 is 38.5% persons. With the increasing urban population, it is imperative to focus on water and sanitation infrastructure in cities.

As per 2011 Census, 91.62 % of urban HHs in Telangana have access to toilets as compared to national figure of 81.4 %. Open Defecation in Urban Local Bodies is 8.38% which is lower than the national average of 12.6 %. Telangana has been the forerunner in implementation of the Swachh Bharat Mission and all the urban areas in state have declared as open defecation free with improved accesses to sanitation services in all the ULBs. In addition to this the state have pioneered the implementation of the Mission Bhagiratha a flagship project which aims to provide 135 LPCD in municipalities and 150 LPCD in corporationsby end of 2018. With 80% of water in ULBs estimated to flow out wastewater, it is imperative to adopt the integrated approach for managing the grey and black water based on technical, financial feasibility of the projects.

The 2011 census indicates that more than50% of the urban households rely on non-conventional sanitation systems such as septic tanks, leach pits.Apart from GHMC, 6 ULBs have the in the state of Telangana have underground sewerage network and 4 ULBs have partial underground drainage networks.The coverage of conventional sewerage system to the extent of about 18.07% of urban households excluding GHMC and about 51.07% including GHMC. Out of the estimated 1884 MLD of and the available capacity of treatment is 685 MLD. The remaining wastewater is let into drains and nalas without any treatment.Thus, there is a large gap between generation and treatment of wastewater in the state. Even the existing treatment capacity is also not effectively utilized due to operation and maintenance problems. Discharge of untreated sewage is single most important cause for pollution of surface and ground water since there is a large gap between generation and treatment of domestic wastewater.

The key issues and challenges faced by the urban local bodies of the state are as listed -

- the sewage treatment facility exists only for the 1/3rd of the waste water generated;
- no established mechanism for Fecal Sludge/ Sepatge management and treatment;
- lack of capacity among the municipal staff and other stakeholders;
- insufficient knowledge/capacity/awareness and public involvement; and
- Faecal Sludge and septage management has been accorded low priority and there is poor awareness about its inherent linkages with public health
- lack of outreach programmes on wastewater and septage management, resulting in unsafe, unsustainable wastewater management.

About the Handbook

The **"Telangana State Sanitation Strategy"**, prepared in line with NUSP, 2008 envisages that "All cities and towns in Telangana to become totally clean, sanitized, healthy and livable, ensuring and sustaining good public health and environmental outcomes for all citizens", with the objectives of 100% safe collection, transportation, treatment and disposal/reuse of human excreta and liquid waste.

To achieve its sanitation vision, goal and objectives, the 'Integrated Wastewater& Septage Management' (IWwSM)approach needs to be adopted by all urban areas to achieve the goal of universal coverage of effective, safe, hygienic and sustainable sanitation management systems. The handbook on 'Integrated Wastewater & Septage Management' is relevant to all urban local bodies and is guided by the following principles -

- It is well understood that conventional sewerage systems may not be feasible for all urban areas and on the other hand onsite systems may not always offer complete solutions, hence Co-existence of different sanitation systems (conventional & non-conventional)
- Safe collection, conveyance, treatment & disposal of all domestic waste-water streams
- Addressing the whole sanitation value chain (collection -> containment -> conveyance -> treatment -> disposal -> reuse -> recycle etc.)
- Stepwise project planning, design and management approach (Project identification -> Feasibility -> Approvals/Clearances -> DPR preparation ->Implementation -> Monitoring)
- A city-wide, holistic & long-term approach (considering all essential dimensions of planning, design & management i.e. technical, financial, institutional& governance, legal &regulatory, O&M, etc.)

The objective of the handbook is to set the direction for urban areas in Telangana to systematically address the sanitation situation and achieve the aforementioned sanitation objectives. The handbook would also serve as a guiding/strategy document for decision-makers, ULB officials, and city planners to evolve an effective solution for a safe and sustainable septage and wastewater management for the city, concurrent to the present context with investment needs-assessment and viability.

Integrated wastewater and Septage management has been defined for this document as a strategy to manage the wastewater

- From domestic sources including homes, commercial establishments and domestic uses in industries, hospitals etc. consisting of black water (excreta, urine and faecal sludge) and grey water (kitchen, washing and bathing wastewater)
- Conveyance to centralized treatment facilities, decentralized treatment facilities and onsite sanitation solutions.
- Treatment of the water in mixed or segregated forms onsite, decentralized or at a central facility.
- Reuse of the treated water for productive uses.

The IWwSM handbook does not cover:

- Storm water and other urban runoff
- Industrial and other contaminated non-domestic wastewater
- Agricultural, horticultural and aquaculture effluent

[1]For the purposes of this document, please refer to the definition presented in the glossary section; with specific mention of the effluent from the non-conventional on-site sanitation systems

The 'primary target groups' for handbook are decision-makers at state and city level, at a strategic level. It further includes the municipal commissioners, PHMED, implementation agencies, planning officers, engineers, planners and architects. These stakeholders are involved in problem identification, planning, design and implementation of sanitation systems;

The 'secondary target groups' are public and private professionals, utility managers and sanitation workers involved in the O&M of wastewater and septage management systems. Additionally, the regional organisations and the private sector that facilitate and participate financially in individual projects also constitute the secondary target group.

A set of six 'guiding principles' that would support decision makers to formulate appropriate sanitation plans that form the backbone of every sanitation strategy that is suitable, affordable, sustainable and economically viable. These include –

CITY-WIDE PLANNING

Adopting a 'city-wide' approach is the foremost principle of an effective sanitation strategy. It empowers the city to create synergies between the entire value chain of sanitation (collection to treatment) and optimize overall finances and operations, deriving mandatory performance improvement

SUSTAINABLE TECHNOLOGIES AND RESOURCE EFFICIENCY

ULBs must promote context specific and efficient sanitation technologies. Further, a closed-loop approach to sanitation planning is prescribed that seeks optimal expenditure on energy and material and enables city governments to systematically recover and re-use nutrients and water.

FINANCIAL SUSTAINABILITY AND PRIVATE SECTOR PARTICIPATION

City planners must focus on creation of revenue-augmentation strategies, robust cost recovery mechanisms to enable long-term financial sustainability of the sanitation facilities. Suitable contracting framework, revenue-sharing mechanisms and engagement models (PPP).

INSTITUTIONAL STRENGTHENING, ACCOUNTABILITY AND TRANSPARENCY

Creating GIS-based MIS databases, standard operating procedures towards achieving greater accountability on service delivery, effective management and monitoring must go hand-in hand with the clear demarcation of roles and responsibilities.

URBAN POOR, INCLUSIVENESS AND EQUITY CONSIDERATIONS

ULBs should devise innovative approaches to extend equitable sanitation services delinking from land tenure and ownership issues and devise differential tariff structure with well-targeted cross-subsidization mechanisms. A strong grievance redressal mechanism should be set up.

PUBLIC OUTREACH AND AWARENESS GENERATION

Efforts must also be made to align the behaviour of people to match what is desirable from the system's perspective through incentives and behaviour change communication and ensuring that the preferences and constraints of the citizens are accommodated while strategizing.

1. CITY-WIDE PLANNING

Approach to IWwSM planning, the scope and the multi-pronged step by step planning process for the achievement of safe and sustainable sanitation necessarily is presented in this section.

1.1 PLANNING - OBJECTIVE AND SCOPE

The 'objective' of planning is to enable the city to capture the wastewater generated from all sources within the city boundaries and treat to the required standardsfor a clean, healthy and sanitized city keeping in considerationthe public and environmental health outcomes.

The 'scope' includes the entire range of citywide sanitation systems and elements therein across the sanitation value chain and the cross-cutting dimensions (technology, finance, institution & governance, legal & regulation, inclusion & public participation). The cross-cutting dimensions influence the sustainability of the design and implementation of safe and hygienic sanitation systems. It is relevant to plan the sanitation value chain in conjunction with the cross-cutting dimensions. The following would be the key considerations for planning:

Figure 1: Sanitation Value Chain and Scope of Planning: *Integrated Wastewater & Septage Management*

User Interface/Acess	Containment/ Collection	Conveyance	Treatment	Disposal Reuse/Recycle
• Private Assets (Kitchen, Individual Toilets) • Community Assets (Community Toilets) • Public Assets (Public Toilet)	• Private (on site sanitation) • Public (Conventional Sewer Networks)	• Non conventional networks, Mobile unit • Conventional Networks	• Treatment System - Liquid and solids components of wastewater	• Reuse for surface water groundwater recharge, Industries, Agriculture, Non-potable uses: contact, non-contact uses • sludge disposal, reuse, recycle

1.2 KEY DETERMINANTS FOR PLANNING

Every city adopts various approaches (conventional and non-conventional) for the choice of sanitation systems and often the choices are not mutually exclusive and a number of hybrid options also emerge as the most viable options that are amenable to local contexts.

Settlement typology and physiography of a region are two key determinants that primarily influence the choice, design and O&M of the sanitation system while the cross cutting dimensions influence the viability and sustainability of the sanitation system thus chosen. The choice exercised by the city aims to optimize efficiencies and associated costs

Population size and density of a settlement determines the wastewater quantities and flows, land availability for sewer network & treatment facilities, road widths & access of desludging vehicles. Participatory planning, regulation and enforcement, O&M responsibilities can be effective with due consideration on aspects of the asset ownership and land tenure. Various physiographical parameters such as soil type, topography, altitude, terrain and groundwater table influence the design of sewers, gradient of network, pumping requirements, technology options, construction techniques and associated costs, etc.

Annexure A-1 provides more details on the impact of the aforementioned factors on the choice of sanitation systems.

1.3 PLANNING APPROACHES

Given the several constraints the cities face in terms of institutional, financial capacities and city's physical characteristic related challenges, the cities must strategize and plan the development in an incremental manner. The development shall be planned both with respect to timeline and spatial context, such that while maintaining short-term stability, cities should still be guided by the goals of long-term vision of establishing safe, hygienic and sustainable sanitation systems. This will allow cities to ensure optimal public health and environmental integrity targets at all times. The following strategic approaches are recommended:

1.3.1 Incremental Development: Temporal Phasing

1. Short-term [5 years from base year]

In the short term, the cities should consider the design of a serviceable interim arrangement until the initiation of the long-term plan, as per the CSP document

2. Medium-term [15 years from base year]

In the medium term, the cities should consider the provision of a combination of short-term measures and initiation of the long-term plan to avoid sporadic adverse impacts on environment and public health arising out of the lack of service delivery

3. Long-term [30 years from the base year]

In the long term, the cities should establish robust wastewater & septage collection, conveyance, treatment, and environmentally sound disposal, recycle and reuse measures for a safe, effective and sustainable sanitation service delivery.

The temporal phasing must be an integrated approach rather than stand-alone planning and implementation action.

1.3.2 Incremental Development: Spatial Phasing

Spatial integration

The cities should undertake spatial planning that helps to visualize the existing levels of sanitation service delivery across the city and helps target attention towards those parts of the city where deficiencies in the sanitation chain are most concentrated. The cities should achieve spatial integration by leveraging the existing levels of improved services in an area to normalize service levels across the adjoining service deficient areas.

The cities should integrate the new added areas to the municipal limits / urban agglomerations & newly developed areas (e.g., due to change in master plan) within the municipal limits, with the proposed system.

Process Integration

In the context of project planning, cities should take into consideration the maturity of the existing sanitation systems w.r.t. process, technology and infrastructure and should explore possibilities of integration of the existing systems, with proposed system, to the extent possible. The cities should plan the integration of advanced processes with existing services that offer simple interface during transitioning.

Based on the findings, it should be evident, if the existing infrastructure needs replacement, refurbishment, retrofitting or can be used in its current condition as part of the proposed system.

1.4 PLANNING STEPS

Step-by-step holistic and integrated planning process, not necessarily a linear process, is needed for all cities to ensure safe, hygienic and sustainable sanitation systems.

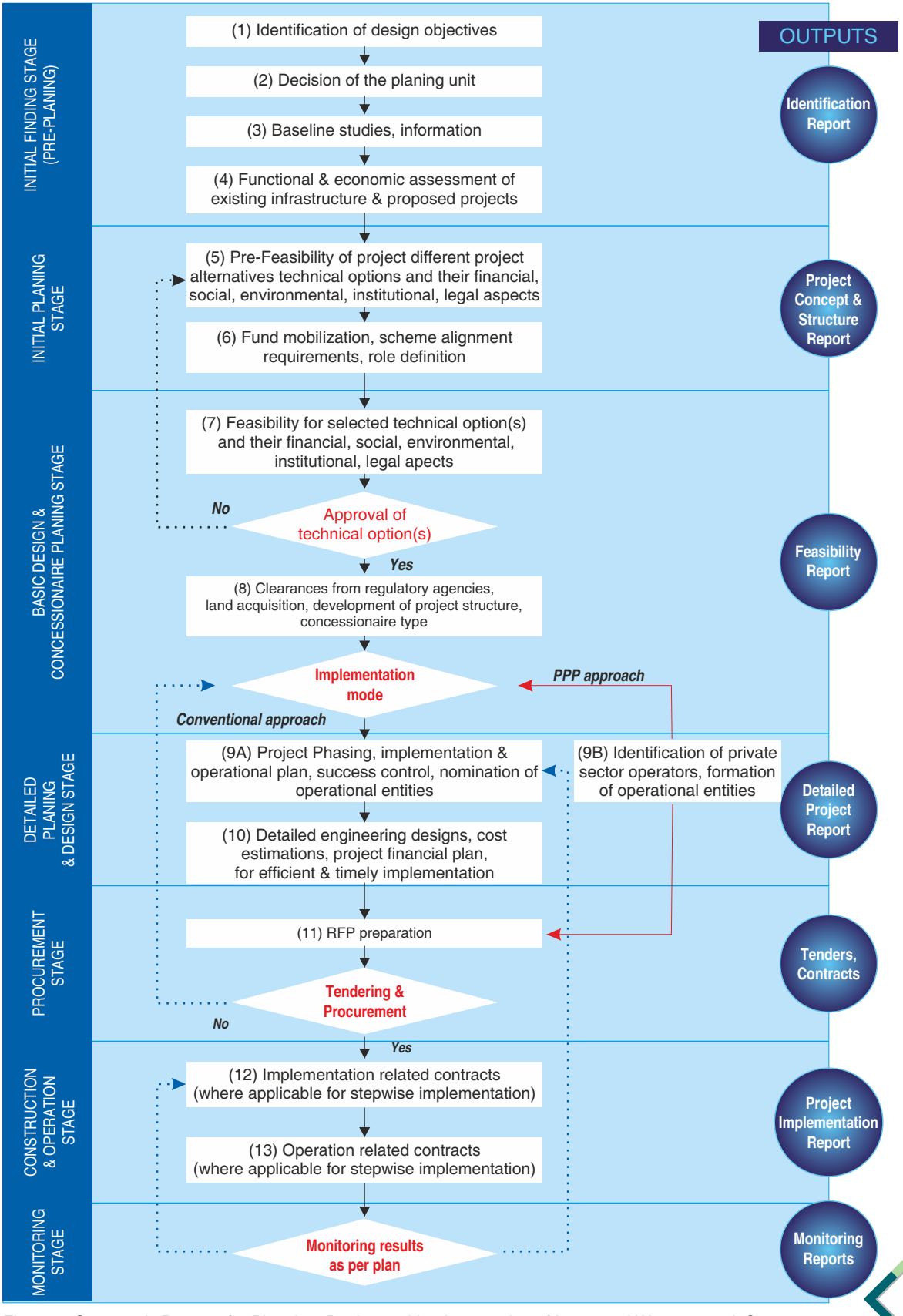


Figure 2: Systematic Process for Planning, Design and Implementation of Integrated Wastewater & Septage Management (IWwSM) Projects

1.4.1 Initial Findings Stage (Steps 1 to 4)

There are 4 key steps involved in this stage, focusing on establishing the evidence around the existing status of the sanitation sector that lead to the identification and definition of the key problem statements, the underlying reasons and the strategic interventions that will address the problems. The output is the '**identification report**' that clarifies the objectives of the project and the **critical decision** requirements at this stage is **city approval** clarifying the need for the project.

Sec 2.13.2 of Part A, CPHEEO Sewerage Manual provides guidance on the typical contents and accompanying assessments to be taken up

Identification of Design Objectives

Depending on the problem to be addressed, typical objectives for the project could individually be the following or in any combination as identified during the visioning exercise:

1. Achieve 100% public health & hygiene protection
2. Best-designated use and management of the water & wastewater resources – resource efficiency, recovery and sustainability
3. Ecological protection, environmental flows & discharge control, natural balance & pollution abatement,adaptation to climate change

Decision on Planning Unit

- Cities should organize the entire city area into a cluster of planning units through careful consideration from multiple perspectives (existing boundaries for services like water supply, wastewater, public sanitation or administrative, revenue or in any combination whatsoever)
- Cities should also best avoid conflicts with existing / on-going projects or ensure interlinkages are clearly marked out for consideration during planning or implementation. Typical inclusion or exclusion parameters could be considered
- Normally, slum areas already considered for separate improvement programs and hence can be excluded from the potential planning units that complicate the design & economics. However, possibilities to synchronize the current & future sanitation solutions require to be examined in case they lie in or near a potential planning unit. It is important to provide for due allowances in the design in lieu of future connections to the system
-

Please refer to Annexure A-2 for planning tool for decision making on planning unit size

Typical Inclusion Criteria	Typical Exclusion Criteria
Areas where non-conventional sanitation systems are more suitable & contextual	Areas that have ongoing and defined projects/interventions to improve sanitation
Areas within the proposed sewer catchments with public land is available for STPSynchronization within the existing Sewerage Master Plan and DPRs	Areas that are unsuitable to be selected as planning unit at city-level
Urgency for short- & mid-term solutions addressing health and environmental issues	Urban poor areas that are already considered under separate flagship programmes

Baseline Studies, Information

In order to develop an integrated wastewater and septage management system, the city should adopt a holistic approach that puts household and neighborhood 'priorities and means' at the center of the planning, design, financing and implementation process, but also involves a wide range of stakeholders from the government, private sector and civil society. Assessment of the current state of sanitation is a pre-requisite to strategically plan an expected performance for the sustainable sanitation services. Please refer to **Annexure A-3** for data collection formats.

1.4.2 Initial Planning Stage (Steps 5 to 6) Section

There are two key steps in this stage that involve the design of a concept (approaches w.r.t. on-site, decentralized, centralized, hybrid) along with the assessment of the different project alternatives based on technical options. Subsequently, role definitions of the critical stakeholders are also achieved. It is very crucial to attain political buy-in at this stage. The output is a 'pre-feasibility report'; Critical decision requirements at this stage is the political buy-in, posing of project to different schemes.

Sec 2.13.2 of Pat A, CPHEEO Sewerage Manual provides guidance on the typical contents and accompanying assessments to be taken up

Pre-Feasibility Assessment

- Guided by the baseline data, the city should understand the demand for the services and the design requirements
- Identify the technology options for a given geography in due consideration of the existing infrastructure governed by the guiding principles (refer to preface).
- Assess the functional efficiency of existing infrastructure and the proposed projects

Fund Mobilization Assessment

- It is imperative that the city understand its financial condition, ability to mobilize internal (own revenues – general & project related) and external sources (grants, loans, flagship missions in sanitation sector, markets), leverage existing assets and align the project requirements. A clear statement on the gap funding required for implementation and its debt servicing ability to respond to external finance and capital markets is needed.

1.4.3 Design & Concessionaire Planning Stage (Step 7 to 8)

There are two key steps in this stage that involves the preliminary planning for different elements of sanitation value chain and estimation of bill of quantities. Accordingly, sources of funding are identified and evaluated for the feasibility of access / investment. This stage also identifies all clearances required to facilitate an effective implementation. The output is a 'feasibility report'. Critical decision requirements at this stage – technical options, clearances, implementation mode

Sec 2.13.2 of Pat A, CPHEEO Sewerage Manual provides guidance on the typical contents and accompanying assessments to be taken up

Feasibility Assessment

- The city should conduct the feasibility assessment of the selected technical options in the previous stage w.r.t financial viability, institutional & governance capability, operational ease, environmental compliances and social & inclusion goals;
- City should define the structure of the project including the operational model, financial model, mode of implementation and the related project partners or concessionaires

Clearances

- The city should outline the land requirements as per the project design and clearly layout the acquisition procedure and protocol and associated clearances required from all stakeholders
- The city should also list out all approvals required during execution by the contractor per the legal and regulatory framework at the national, state and local level (CRZ, EIA notifications, public litigations, encumbrances on land, etc

1.4.4 Detailed Planning & Design Stage (Steps 9 to 10)

There are 2 key steps in this stage that will result in efficient project phasing and implementation plan including the corresponding detailed design and engineering aspects. The output is a '**detailed project report**'.

Detailed engineering designs

- The detailed engineering designs should be developed for the new assets and/or retrofit, rehabilitation of the existing assets, infrastructure, with emphasis on the process design. The designs shall provide the details that include unit capacities/dimensions, context specific material choice for construction and the phase wise design. The financial estimates shall be based on the Telanganaschedule of rates (SoR)
- The operability conditions, the institutional & governance requisites, the legal & regulatory necessities, and the financial sustainability models concerning the detailed engineering designs shall be considered. The financial risks should be clearly set down and delimited to an interval of ± 10%

Section 2.13 of Part A, CPHEEO Sewerage Manual provides guidance on DPR preparation for wastewater projects, MoHUA Advisory Note on Septage Management, 2013 and National Policy on Fecal Sludge and Septage Management. 2017 guides on planning for Septage Management

Project Phasing and Implementation Plan

- The work packages for tender documents should align with the planning units, the synergies with areas with existing levels of services & assets, and the urgency of an area as a function of public health and environmental concerns;
- The work packages shall be structured as financial packages with staggered implementation schedule based on the financial implications and feasibility;

1.4.5 Procurement and Construction & Operation Stage (Steps 11 to 12)·

- A robust expression of interest (EoI), request for proposal (RfP) documents shall be developed and very diligent and efficient bid appraisal mechanisms shall be employed based on the principles of fairness, transparency, integrity, accountability, competence in compliance with the statutory rules.
- The procurement process shall result in the establishment of governance structures and implementation frameworks that will guarantee the safe, sustainable service delivery in the long term

Part B, CPHEEO Sewerage Manual provides guidance on O&M processes for different equipment and processes to be followed; Chapter 2 & 3, Part C, CPHEEO Sewerage Manual provides guidance on legal aspects and institutional building processes; Chapter 4 & 5, Part C, CPHEEO Sewerage Manual provides guidance on budget planning, costing for O&M activities

1.4.6 Monitoring Stage (Step 13)

- As the primary custodian, the city should monitor the efficiency and efficacy of the implementation/service delivery with an objective to control the success.
- The city should also assign responsibilities, besides the government agencies, for beneficiary groups, self-help groups, and for private sector as per the contract. Responsibilities shall include but not limited to monitoring the implementation and service delivery.

Chapter 8 & 9, Part C,CPHEEO Sewerage Manual provides guidance on asset management and linked monitoring processes

2. DESIGN AND IMPLEMENTATION

Integrated Wastewater and Septage Management [IWwSM] entails the management of both the grey and blackwater collected either at the source level or at the level of source collectives (decentralized or in a centralized manner).

2.1 DECISION MAKING FOR APPROACHES OF CITY-WIDE IWWSM SYSTEMS

The selection of the two main approaches that are applied while choosing different sanitation management options is discussed below andthe decision flow capturing interaction between input influencing factors and related sanitation outcomes is presented as **Annexure B-1.**

2.1.1 Conventional Approach

The cities shall adopt conventional approach at zone level and city level especially in high density areas. In centralized systems within conventional approach, both grey and black water are connected into sewer at household level, the transport options are the traditional sewers with pumping stations and treatment is at centralized STPs.

2.1.2 Non-Conventional Approach

The cities shall adopt non-conventional approaches at household, community and ward level customized with a suitable transport and treatment option in consideration of the local context. Grey water and black water shall be collected and treated separately.The transport options are alternative systems such as simplified sewers, small bore sewers, vacuum-sewers,vacuum trucks, other mobile transport options, etc. Treatment is at decentralized level, ranging from on-site sanitation (e.g. septic tanks) to community sanitation (e.g community septic tanks etc.) to decentralized STPs. Recycle and reuse of treated wastewater can be taken up in consideration of the local demand.

2.2 DECISION MAKING FOR APPROPRIATE TECHNOLOGIES OF CITY-WIDE IWWSM SYSTEMS

2.2.1 Objectives and General Criteria for Selection of Technologies

The cities shall consider the following design objectives for the strategic planning and design of the sanitation systems, either conventional or non-conventional –

1. Achieve 100% public health & hygiene protection
2. Environmental protection, environmental flows & discharge control, ecological balance & pollution abatement; applicable and efficient in the context of the catchment area
3. Best-designated conjunctive use and management of the water & wastewater resources – resource efficiency, recovery and sustainability

The cities shall also consider the following general criteria –

1. A technology should have technical performance and reliability under variable wastewater flows, compositions and operational problems and be energy efficient
2. The city should have institutional capacity with respect to planning, design, construction, operation and maintenance capacity including local availability of skilled human resources w.r.t. the selected technology and processes
3. The technology should warrant affordable investment and O&M costs and affordable to those who pay for the services
4. The technology should be in compliance to existing policies and regulations

2.2.2 Technical Criteria for Selection of Technologies – Containment

In the case of conventional sanitation approaches, the wastewater is directly discharged into sewers and the collection / containment in the case of conventional sanitation systems is hence covered under conveyance link of the sanitation value chain. While in the context of non-conventional sanitation approaches, the containment is either an on-site sanitation system or a decentralized off-site system in the close vicinity of the households at community or ward level. This section covers the containment options for the on-site sanitation systems that include twin-pit latrines, conventional septic tanks and improved septic tanks.

Public Health and Environmental Protection Considerations

The cities/citizens/planners should select an appropriate containment method, in a manner that it preserves the water quality environment in receiving water bodies and environment and reduces the pollution risk of ground water and water sources, which has an impact on public and environment health. Please refer **Chapter 9 On site sanitation systems , CPHEEO Manual on Sewerage and Sewage Treatment, 2013.**

Efficiency Considerations

The cities/citizens/planners should investigate natural conditions like weather that includes temperature changes and precipitation, geographical features, groundwater levels, sub-soil conditions, distance to nearest water bodies, wastewater and septage characteristics prior to its decision making with respect to the containment method, selection of materials for the containment structures all of which have a bearing on the efficient functioning of the containment method in the local context of an area. Please refer **Chapter 9, CPHEEO Manual on Sewerage and Sewage Treatment, 2013.**

Technology Options

The choice of technology option for the cities shall be foremost driven by the requirement of the local conditions (soil conditions, groundwater table, settlement densities, etc.) besides the compliance to the legal and regulatory provisions. The efficiency and sustainability considerations for the selection of technologies is reflective within energy efficiency, most favorable land foot print requirement, and the cost optimizations that may be achieved both with respect to capital expenditure and operational expenditure.

Please refer to **Chapter 9, CPHEEO Manual on Sewerage and Sewage Treatment, 2013that presents the details on the selection, planning, design and management of the on-site sanitation systems.**

2.2.3 Technical Criteria for Selection of Technologies – Conveyance

Public Health and Environmental Protection Considerations

In both cases of conventional or non-conventional approaches of sanitation systems, wherever sewer networksare applicable, the choice of technology for conveyance system should be such that it prevents any direct or indirect contact with humans (for e.g. avoiding open drains for conveyance systems) and also avoids any environment contamination by overflows, leakages, etc.

Therefore, the choice is based on the water tightness, simplicity of assembly, physical strength, resistance to acids, alkalies, gases, solvents, etc., resistance to scour and durability such that there are no system leakages resulting in adverse health impacts or pollution in the environment.

In the non-conventional sanitation systems scenario where, septic tanks or similar containment structures are part of the systems, mobile transportation trucks should be designed or selected based on the similar factors as above that guarantee public health and environmental protection

Efficiency Considerations

Factors influencing the selection of materials for sewers are flow characteristics, level and quality of groundwater, wastewater characteristics, terrain characteristics, adequate bearing capacity, availability in the sizes required including fittings and ease of handling and installation.

Factors influencing the selection of trucks should be based on adequate size vis-à-vis the quantity of septage, optimal number of trips, road characteristics.

Technology Options

No single material will meet all the conditions that may be encountered in sewer design. Selection should be based on the application and different materials may be selected for parts of a single project. The determination of the suitability in all respects of the pipes and specials for any work is a matter of decision by the engineer concerned based on requirements for the scheme. Please refer **Annexure B-2** or more details.

2.2.4 Technical Criteria for Selection of Technologies –Treatment

Public Health and Environmental Protection Considerations

The cities shall select the technologies in a manner that the reduction of contaminants in wastewater and septage is achieved to the discharge standards as prescribed in CPCB, TSPCB standards for wastewater and Advisory on Septage Management (MoHUA) and National Faecal Sludge and Septage Management Policy for Septage. Please refer**Annexure D-2** for all aforementioned relevant standards and the Directions.

Reuse and Recycle Considerations

Cities shall prioritize the recycle and reuse of wastewater and septage as a resource in order to reduce the burden on the fresh water resources. The appropriate treatment for wastewater and septage shall be determined based on the specific applications through which water supply costs can be controlled and the costs for improved wastewater treatment technologies delayed until they are balanced by the benefits. Please refer to **Annexure D-3** for the recycle and reuse guidelines and standards.

[3]Realizing that rivers and water bodies have been polluted and to prevent further deterioration of surface and sub-surface water resources, CPCB has notified the revised discharge standards, 2016 that will be applicable in case of disposal of effluents, either from the conventional (STPs) or non-conventional treatment systems (septic tanks), on land or river or any water body including coastal water/creek or a drain, and it is mandated that the treated effluents shall meet the suggested standards as annexed to the notification. Through the issuance of the directions under Section 18(1)(b) of the Water (Prevention and Control of Pollution) Act, 1974 regarding treatment and utilization of sewage, CPCB has directed the Telangana State Pollution Control Board (SPCB) shall notify the standards and issue directions to all municipalities and other concerned authorities in the State responsible for treatment and disposal of sewage to the following effect. http://cpcb.nic.in/Telangana_swg_18(1)(b)_2015.pdf

The cities shall select the most appropriate technology from a range of treatment options that are available such that any level of water quality or quality of byproducts can be achieved depending upon the use of the reclaimed water for land application, groundwater recharge, agricultural & irrigation, landscaping, industrial use and use of treated septage/sludge for agricultural purposes.

Technology Options

Based on the principles, general criteria and the technical criteria mentioned above, technology options have been compiled in **Annexure B-3**. The choice of technology option is foremost driven by the requirement of the local conditions (soil conditions, groundwater table, settlement densities, etc.) besides the compliance to the legal and regulatory provisions. The efficiency and sustainability considerations for the selection of technologies is reflective within energy efficiency, most favorable land foot print requirement, and the cost optimizations that may be achieved both with respect to capital expenditure and operational expenditure.

2.3 Design of Integrated Wastewater and Septage Management [IWwSM] Systems

The cities shall refer to the adequate guidance on all aspects of the planning, design, and construction across the sanitation value chain, which is clearly established primarily in Part A: Engineering, in the Sewerage Manual, CPHEEO, 2013. Table 1below presents all references from the CPHEEO Manual, MoHUA's Advisory Note on 'Septage Management in Urban India, 2013' and MoHUA's 'National Policy on Fecal Sludge and Septage Management', 2017,National Building Code, 2016 and IS 2470 Part I:

Table 1 : Guidance on Design of Integrated Wastewater & Septage Management Systems

Containment	Conveyance	Treatment	Disposal/ Recycle & Reuse
Conventional Systems			
	Chapter 3, Design and Construction of Sewers, CPHEEO Manual, Part A Chapter 4, Design and Construction of Sewage Pumping Mains and Pumping Stations, CPHEEO Manual, Part A	Chapter 5, Design and Construction of Sewage Treatment Facilities, CPHEEO Manual, Part A Chapter 6 Design and Construction of Sludge Treatment Facilities, CPHEEO Manual, Part A	Chapter 7, Recycling and Reuse of Sewage, CPHEEO Manual, Part A
Non-Conventional Systems			
Chapter 9, Onsite Sanitation, CPHEEO Manual, Part A, National Building Code, 2016, IS 2470 Part I	Chapter 8, Decentralized Sewerage System, CPHEEO Manual, Part A, IS 2470 Part I	MoHUA's Advisory Note on 'Septage Management in Urban India, 2013' MDWS' Technological options for Solid & Liquid Waste Management, 2015. NBC, 2016 IS 2470 Part I	Chapter 7, Recycling and Reuse of Sewage, CPHEEO Manual, Part A MoHUA's Advisory Note on 'Septage Management in Urban India, 2013' MoHUA's 'National Policy on Fecal Sludge and Septage Management', 2017, IS 2470 Part I NBC, 2016

3. OPERATION AND MAINTENANCE

Operation &Maintenance (O&M) and rehabilitation of the wastewater and septage management systems across the entire sanitation value chain with focus on the processes that help reduce or eliminate the risk of failure of systems is presented in this section.

National Urban Sanitation Policy (NUSP) 2008, recommends that the proper operation and maintenance (O&M) and rehabilitation of all sanitary installations requires proper usage, regular upkeep, maintenance of household, community and public sanitation facilities and adequate monitoring and evaluation including third party monitoring; it also requires strengthening ULBs to provide or enforce sustainable sanitation services delivery. O&M of the integrated systems warrants intense coordination on the various engineering, physical, chemical and biological processes between the two systems

Figure 2 : Framework for an Effective and Sustainable Operations & Maintenance Strategy

OUTLINE OF OPERATION & MAINTENANCE	(1) Broad Overview	*Chapter 1. Part B of CPHEEO Manual*
	(2) Regulatory Considerations	*The Greater Hyderabad Municipal Corporation Act 1955: The Andhra Pradesh Municipal Conporation Act. 1994: The Hyderabad Metro Waste Supply and Sewerage Act. 1989: The Andhra Pradesh Municipalities Act. 1965*
	(3) Environment Considerations	*EPA Act 1986: Water Act 1974; Chapter 8, Part B of CPHEEO Mannual*
	(4) Management Strategies (Asset Management)	*Chapter 9, Part B of CPHEEO Mannual*
	(5) Master O&M Schedule	*Chapter 9, Part B of CPHEEO Mannual*
ORGANIZATION OF OPERATION & MAINTENANCE	(6) Description of O&M	*Part B of CPHEEO Mannual*
	(7) Database for effective O&M (Ledgers & records for monitoring)	*Indicators per NUSP, SLB, Swachh Survekshan: Appendix 1,2, Part B of CPHEEO Manual; To integrate with e-governance platforms of the state & City*
	(8) Deployment of Manpower	*Chapter 9, Part B of CPHEEO Manual*
	(9) Training Master plan & Schedule	*To sync with state & national level training institute like NIUA, ASCI, EPTRI ESCI etc: leverage online training courses both national & international*
	(10) IT Enabled Monitoring	*Appendix 1,2 & Chapter 6, Part B of CPHEEO Manual to converge with egovernance platform fo state & city level governement*
FINANCIAL MANAGEMENT	(11) Budget Estimation	*Chapter 5, Part C of CPHEEO Manual*
RISK MANAGEMENT	(12) Consolidated Record (O&M related issues w.r.t. Risk of Failure)	*Appendix 1,3 Part B of CPHEEO Manual*
	(13) Consolidated Record (Disasters that Warrant Special O&M)	*To sync with the climate change action plan & disaster management plan of the state and record the fore seeable disasters*
	(14) Mitigation Strategy to Address Regular & Special Circumstances	*Based on the O&M description schedule role of the citizen required defining identification of resident welfare associations/community based organisations*
PUBLIC PARTICIPATION	(15) IEC (Do's & Don't for Community)	*Based on the O&M description schedule role of the citizen required defining identification of resident welfare association/community based organisations*
	(16) Grievance Redressal	*To integrate with e-governance platform of state & city level govenment*

[4]Pursuant to the Andhra Pradesh Reorganization Act, 2014; for all acts made before the appointed day, in relation to the State of Andhra Pradesh or the State of Telangana, construe the law in such manner, without affecting the substance, as may be necessary or proper in regard to the matter, as in the case of acts like Andhra Pradesh Municipalities Act, 1965 and Andhra Pradesh Municipal Corporation Act, 1994.

The cities shall develop a comprehensive O&M strategy and action plan that covers the the entire sanitation value chain. While the guiding principles of O&M for both conventional and non-conventional systems remain the same, the approach and the implementation for each system shall be adopted based on the specific needs and context. The following sections present the O&M details for the conventional and non-conventional systems –

3.1 OPERATION & MAINTENANCE OF CONVENTIONAL SANITATION SYSTEM

Part B: Operation and Maintenance in the CPHEEO Manual provides the details on the O&M of the conventional sanitation systems across the sanitation value chain. Chapter 3 provides details on the O&M of the pumping stations for collection; Chapter 2 provides detail son the O&M of the sewer systems for conveyance/transportation and Chapter 4 details the O&M of the sewage treatment facilities for treatment.

3.2 OPERATION AND MAINTENANCE OF NON-CONVENTIONAL SYSTEMS

Chapter 10 of Part B of CPHEEO Manual on Operation & Maintenance provides details, National Building Code, 2016 and IS 2470, Part II present details on O&M for collection through on-site storage, tranisition infrastructure and pumping, The details include the precautions for non-entry of soaps, deteregents, oily substances, disinfectants, latex, sanitary napkins, etc into the onsite sanitation system to prevent the interference with efficiency of microbial culture towards decomposition of waste. The details further describe the requirement on regular desludging, periodic replacement of filter media, removal of blockages at inlet and outlet, refurbishment of the system to be carried out for effective biological activity in the system.

Chapter 10, Part B: Operation and Maintenance in the CPHEEO Manual, provides details on the O&M of the conveyance system that includes routine flushing of the sewers to remove silting and to ensure against blockage, periodic visual checking, structural maintenance, repair and replacement of the components of the conveyance system. Advisory note on Septage Management provides details on the O&M of the septage desludging trucks for conveyance of the septage.

Part B: Operation and Maintenance in the CPHEEO Manual, Chapter 5 and 10, NBC, Advisory Note on Septage Management in India provide details on the O&M of the treatment facilities. Please refer to **Annexure C-1** for proposed SOP for desludging and conveyance, **Annexure C-2** presents sample collection and conveyance record.

The cities shall carry out regular inspection of carrying capacity of the sewer network, the detection and assessment of blockages & infiltration and the periodic procedures to address the issues that are posed due to aging and corrosion of the pipes.

3.3 REHABILITATION OF INFRASTRUCTURE

Section 2.4 of CPHEEO manual on Sewerage and Sewage Treatment Part B: Operation and Maintenance elaborates the rehabilitation steps for various sewer appurtenances. The manual also illustrates the rehabilitation steps for the electrical and instrumentation facilities in the section 6.10.4. of Chapter 6. The US EPA handbook on Sewer System Infrastructure Analysis and Rehabilitation examines contemporary methods. It further provides guidance on the situations where each method is applicable and provides general description of each rehabilitation technique, the procedures, equipment and cost estimates.

4. INSTITUTIONAL, GOVERNANCE AND REGULATORY FRAMEWORK

An overview of the institutional and governance structures responsible and accountable for IWwSM, and an updated summary of existing standards and regulations along with recommendations for guidelines wherever they do not exist in the context are presented in this section.

4.1 INSTITUTIONAL & GOVERNANCE FRAMEWORK – THE EFFECTIVE FACILITATION

Table 2: Agencies – Responsibility and Accountability for Various Services

Sector	Planning & Construction	Service Delivery	Policy Making	Tariff Fixation	Regulation
Water Supply	PHMED	ULBs	MA&UD	ULBs	ULBs
Sewage Management	PHMED	ULBs	MA&UD	ULBs	ULBs/ TSPCB
On-site Sanitation	ULBs	ULBs	MA&UD	ULBs	DTCP/ULBs
Solid Waste Management	ULBs	ULBs	MA&UD	ULBs	ULBs
Septage Management	PHMED/ ULB	ULB/ Private Sector	MA&UD	ULBs	ULBs/ TSPCB

Figure 3: Stakeholder Group:
Roles and Responsibilities for a Safe and Sustainable Integrated Wastewater & Septage Management

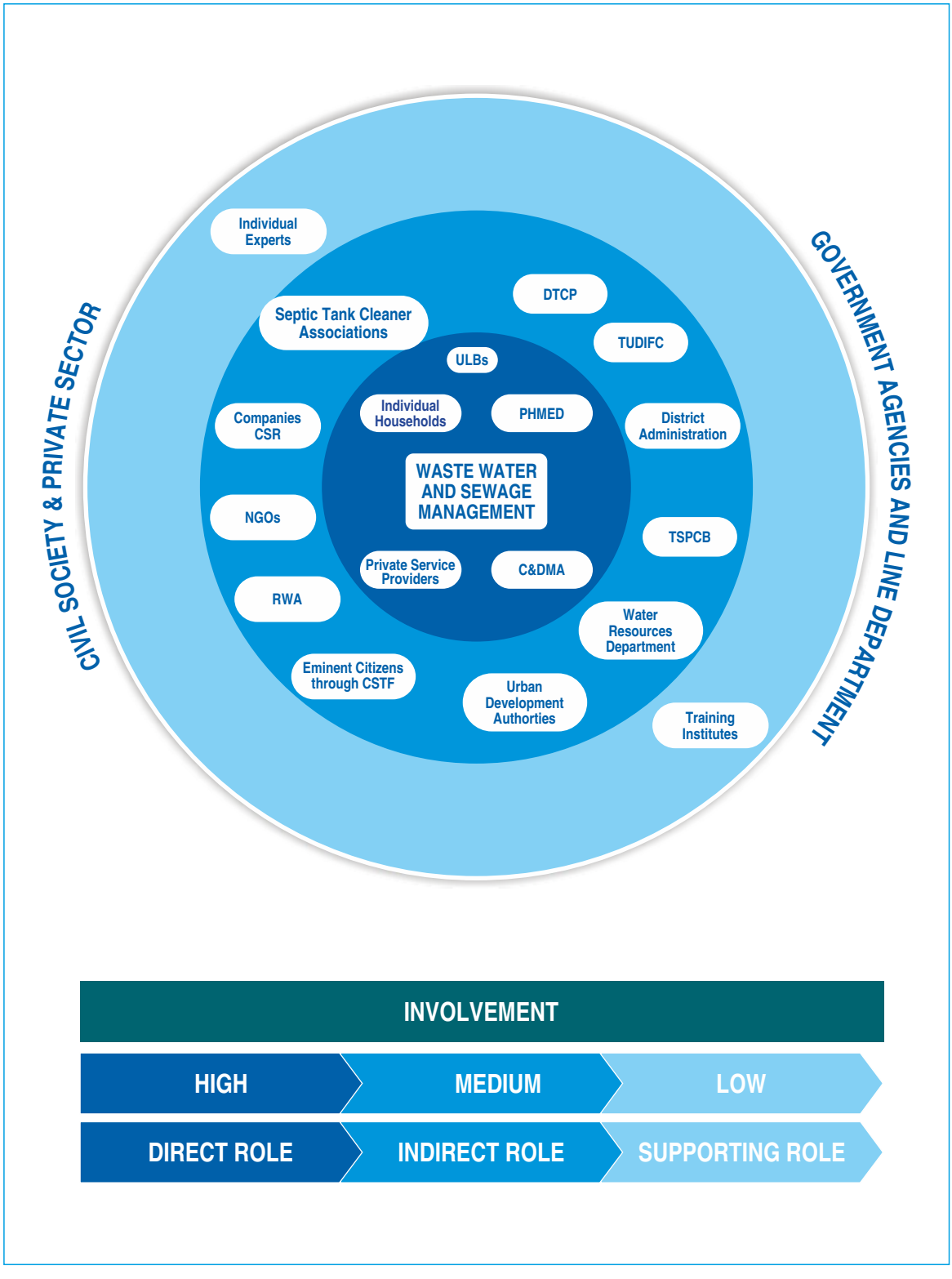


Table 3: Roles and Responsibilities for a Safe and Sustainable Integrated Wastewater & Septage Management

Stakeholders	Asset ownership	Function		
		Planning and Construction Phase	Operation & Maintenance Phase	Regulatory
Households / Users	• IHHTs, OSS units like septic tanks, twin pits etc. • Connection for grey water from HH to the trunk - sewer	• Express needs for the services • Nominate representative to the Beneficiary • Group/Committee Electing Ward committee members	• Correct usage • Tariff payment • Reporting faults	• Reporting malpractices during collection, conveyance and disposal at House hold level
City Council Steering Committee (SC)		• Participation in zone selection • Consultation and support on request • Approval of major policy decisions including tariff setting • Approval of Ward selection • Approval of benchmarks decision	• Support in all activities (on request) • Receiving information on performance of the system, but no active role in O&M	• Recommend the regulations to be adapted at the ULB level, in the septage bylaw.
ULB	• Conveyance vehicles • Grey water collection and treatment infrastructure • Centralised treatment facilities	• Establish sanitation unit including suitable staff • Planning and management (monitoring, supervision etc.) of all activities dependent on capacities	• Monitoring and supervision propose amendments if required • Technical support on request to service providers • Organize meetings of stakeholders, IEC& awareness generation activities and facilitate operation and maintenance • Tariff setting for users and private operators	• Setting tariffs/user fees at the ULB level • Formulation of septage byelaws • Empanelment of private service providers for collection of fecal sludge / sepatge • Monitoring the private operators regarding the compliance of the bylaws. • Collection of tariff
Parastatal Department		• Facilitate project implementation • Approvals and clearances • Progress reporting (to donor agency, if any) • Supervision	• Facilities/support project partner in its role and responsibilities to achieve sustainable O&M system • Provide required capacity building • Coordination • Advise for complementary activities.	• State level monitoring for all the ULBs • Project monitoring • Suggesting corrective measures, wherever necessary
Consultants		• Carry out project design including technology options, detailed planning, supervision etc. according to ToR • Supervision	• Prepare O&M schedule & manuals • Provide technical Assistance & trainings • Participate in monitoring of system.	
State Government		• Approvals of projects • Compliance to Legal framework • Financial support	• Technical support to ULBs • Secure proper O&M • Encourage replication • Provide access to funding for replication	• Enable regulatory bodies to carry out the performance monitoring

4.2 IEC AND CAPACITY BUILDING FRAMEWORK

Capacity building and awareness activities should be undertaken on a regular basis for users, government bodies or private entrepreneur on various attributes of IWwSM including appropriate design and technology, de-sludging of septic tanks, collection mechanism, transportation, disposal and the treatment of septage and wastewater.

In addition to above regular handholding of the different levels of ULBs staff should be undertaken on aspects of safe collection, treatment and disposal. Standard septic tank design, periodic inspection and de-sludging of sewage, design of a decant facility, tender details for engaging licensed transporters, safety standards etc.

It is important to undertake IEC activities for users and civil society organisations/representative like RWAs, community organizers, self-help groups and the general public on matters related to health hazards associated with improper collection and treatment of waste, and the ill-effects of sewage discharge into fresh water/storm water drains etc. Local bodies should also be involved in the IEC and capacity building activities of private vendors on aspects which of safety norms for proper collection and transportation of sewage including vehicle design, process of de-sludging, safety gears and safe disposal at the nearest treatment facility. Please refer to **Annexure D-1** for an awareness generation strategy.

4.3 REGULATORY FRAMEWORK

For an enabling environment both state and local governments have a major role to play to ensure a policy and regulatory environment to enable sustainable planning and management for IWwSM for improvements in public and environmental health.

At the national levels, there are several key acts, rules and standards like Water (Prevention and Control of Pollution) Act, 1974, Environment (Protection) Rules, 1986, Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013, Indian Standard, BIS 2470 (Part I), 1985 and MoHUA Service Level Benchmarks that safeguard environment and public health while ensuring provision of adequate service delivery of sanitation services.

The Water (Prevention and Control of Pollution) Act of 1974 restricts discharges of pollutants towater bodies and created MoHUA Central and State Pollution Control Boards with authority to set

standards and enforce water pollution rules. The Water (Prevention and Control of Pollution)

Cess Act of 1977 established a levy on industries using water, using the funds thus generated to augment the resources of the Central and State Pollution Control Boards.

The Environment (Protection) Act of 1986 is an umbrella act on all issues related to environmental protection and provides for the audit of all facilities that require permits under water pollution, air pollution and hazardous waste rules. The CPCB is the main authority that sets pollutant discharge standards while the State Pollution Control Boards (SPCBs) have the mandate to monitor performance and take enforcement action. The CPCB has developed General Discharge Standards that apply to all discharges including those from STPs.

Discharge standards have been developed for 33 parameters under four categories: discharges to inland surface waters, in marine coastal areas, to public sewers, and on land for irrigation

The ULBs may further formulate their own bye-laws for implementation of the above stated rules. In addition, the state and appropriate development authorities would need to review the building regulations to ensure proper construction of adequate on-site sanitation facilities, which in turn need to be disseminated to the construction industry. The bye laws and rules shall address design, construction, operation & maintenance of sanitation systems along the entire sanitation value chain; methods of approval of building plans, or retro-fitting existing installations, tariffs for sanitation management, penalty clauses for violation of rules, laws, regulations, issuance of permit/licenses to private operators providing services.

Please refer to **Annexures D-4** to **D-7** for regulations, sample permits, applications for permits and management resolutions at city-level for an effective septage management service delivery.

5. FINANCIAL FRAMEWORK

An overview of the financial & procurement frameworks which presents the several instruments and processes that ensure the viability, efficiency and sustainability of the sanitation service delivery is presented in this section.

5.1 FINANCIAL FRAMEWORK – THE VIABILITY AND SUSTAINABILITY INSTRUMENT

The financing framework goes hand-in-hand with the procurement framework, wherein both should take into account the sustainability of the wastewater management project for all stakeholder. The framework is set by the detailed assessment of three critical and interrelated aspects:

Risk assessment and management – A detailed risk assessment is critical to define the financial and procurement framework. The risk assessment and thereby its management should lay the foundation of the responsibility sharing between stakeholders involved. Please refer to PPP TOOLKIT for improving PPP decision making processes, Ministry of Finance, Government of India for more details on risk assessment and management

Investment costs and financial structure – Wastewater projects incur a huge capital investment that should be contributed by all the stakeholders in order to ensure the sustainable burden on all. Detailed financial modelling and sensitivities shall be carried out to see the impact of various financial structures on the affordability of the tariffs that shall be the most defining parameter for the financial structuring of the projects. Before arriving at investment cost and financial structure for the project, detailed assessment of the following parameters shall be done

- Initial CAPEX - Investment for infrastructure establishment, plant and machinery, vehicles etc. is the key component of investments costs and is used as baseline cost or initial CAPEX for financial structuring. Initial CAPEX further constitutes of ULB's share and Private Operator share. ULBs share is generally a grant to the project as viability gap funding from state government or central government or external aid on behalf of the ULBs or concessional loan from state government or any state financial intermediary, which the ULBs transfer as grants to the project and Private operator's share constitutes an equity contribution and a loan component taken on the Initial CAPEX.
- Replacement Investment – Investments made for replacement of plant and machinery, vehicles etc. at the end of their economic lives. These aren't loaded on the initial CAPEX but are generally considered as O&M expense of the private operator.
- Incremental Investments – Investments made in setting up infrastructure, plant & machinery, vehicles etc. due to increased demand over the project life. These are considered as incremental investments over the project life and hence have no bearing on the initial CAPEX.

Recovery of O&M Cost – While ULBs are obligated to provide quality services to the users, the modality of providing services – by themselves or through PPP will have an impact on the O&M cost incurred by the ULBs. For the recovery of O&M cost – payment of tariffs to private operator, the principle of "water user pays" and "polluter pays" shall be conformed to.

Cost Recovery Mechanisms

Full public funding of septage management will lead to severe stress on the state and local governments. This will also engender a lack of accountability and responsibility among the ULBs to generate revenue for septage/sewage management. Thus, it is important that the beneficiaries also share the responsibility of septage management following the 'Polluters Pay Principle'. This is possible through increased taxation and private participation. Apart from levying direct user charges on citizens for wastewater management services, sanitation tax/charge as surcharge on property tax under the Municipalities Act could also be levied. Periodic revisions of taxes, sale of treated septage for agriculture or other purposes are some ways of mobilizing adequate fund for the O&M.

Investment Options for Infrastructure

Traditionally, sanitation improvements are generally dependent on a mix of government funding, external assistance and increased user charges to meet the capital as well as O&M expenditure. One of the major sources for public funding of the sanitation programme is various state and central programs which could be used for creation of database for toilets and septic tanks, procurement of suction emptier trucks and construction of septage treatment facilities and such other components. Further, funds are available to the ULBs for planning & preparation of feasibility reports/DPRs, etc., and conducting IEC activities under various central govt. schemes such as SBM, AMRUT etc.

There is a need to ring-fence the usage of funds, ensure scalability in fund usage and leverage on additional source of funds, to ensure good accountability and transparency of fund usage to finally provide quality services to the citizens and eventually the achievement of service level benchmarks of GoI. Please refer to **Annexure E-1** for strategies that shall be followed to fill gap between investments and quality of services

Considering the current situation, most ULBs cannot develop and operate capital-intensive conventional, engineered waste water projects on suo-moto basis as they lack the technical knowhow, financial resources and human resources required to implement these projects. Therefore, engaging a private operator via any outsourcing model is viable option to leverage on their technical capacity and financial capability.

5.2 PROCUREMENT FRAMEWORK – THE EFFICIENCY AND SUSTAINABILITY INSTRUMENT

To address the gap between the current and optimum levels of wastewater and sanitation management services, various procurement strategies can be adopted. These procurement strategies shall be framed from meeting the ultimate objective of providing quality, sustainable and economical urban services to citizens. Please refer to **Annexure E-2** for key factors that affect the decision on procurement strategy

1. Conventional approach - This has been the traditional method followed by ULBs of procuring the equipment, machinery, vehicles by themselves. However, wastewater and sanitation management being a technology and O&M intensive business, ULBs lack the technical and operational capacity and hence fail to provide quality services on a day to day basis, resulting in a loss of initial investments made.

2. Functional Privatization - Most prevalent PPPs fall under this structure. In this, a private operator is engaged through a permutation of any of the key responsibilities – design, build, finance, operate, and own; for certain period with the transfer of assets to government happening at the end of the concession period. Please refer to Annexure E-3

Key Procurement Considerations –

1. Concession Period – This should be based on the economic lives of the infrastructure, technology, vehicles etc. The choice of concession period should ensure that the economic lives of infrastructure, technology, or vehicles is almost over to ensure that these have been utilized for their complete economic lives and that there is no legacy transfer of facilities to ULB or private operator, in-case a new private operator is engaged for provision of wastewater management services.

2. Selection Criteria – The generally practiced bidding criteria include

a. Quality and Cost Based Selection (QCBS) wherein a great consideration is given to the technology and technical part of the private operator's bid. The bidding parameter is based on the mix of scores in technical bid and financial bids based on a stated formula in RfP. The private operator with the highest score is awarded the project even when his financial bid isn't the lowest. This model is generally applied to technology-intensive projects.

b. Least Cost Selection (LCS) wherein a consideration is given to the price discovery and no consideration is given to the technology and technical part of the bid. This model is generally applied in projects where technology & processes are quite standardized and cost recovery is the only objective – for instance,in wastewater transportation. Private operator with the minimum financial bid wins the project.

c. Hybrid LCS wherein a key consideration is given to both technology and price recovery. A minimum bar in terms of scoring on technology and technical bid is kept and only those bids that meet the minimum score are considered for competing on financial bids. At this stage, the private operator with the minimum financial bid is awarded the project.

3. Bidding Parameter - The choice of bidding parameter is depended on two key factors – CAPEX/O&M nature of the project and then on whether the demand risk is transferred to the private operator or not.

a. Traditionally VGF has been used as bidding parameter in PPP projects but considering the O&M intensive and long-term nature of waste water projects, VGF as bidding parameter fails to serve the purpose. VGF is apt as a bidding parameter for Road sector or civil infrastructure construction which are CAPEX intensive and minimal O&M. Hence, a performance based bidding parameter should be used for wastewater projects.

b. Further, the choice between the annuity model (annual payment) or a quantity linked model is dependent on demand risk transfer between private operator and ULB.

I. In annuity model, a fixed payment is given to the private operator and the ULB takes the demand risk

ii. In quantity linked bidding parameter (such as tipping fee) can be linked to either input quantity of waste water or output quantity of treated waste water.

Generally, quantity linked bidding and payment parameter brings in more transparency and accountability on behalf of private operator and also allows the private operators to leverage on their O&M strength as well as focus on sustainable technological solutions. Please refer to **Annexure E-3** for factors influencing the procurement strategy.

ANNEXURES

ANNEXURE A
PLANNING

ANNEXURE A-1
KEY-DETERMINANTS INFLUENCING THE CHOICE OF SEWERAGE TREATMENT SYSTEMS

Key Determinants	Defining Elements	Aspects to Consider / Implications to Factor in
Settlement Based	Population size, density	• The per-capita cost of underground sewerage systems tends to reduce with increased housing and population density while that of on-site options remains roughly constant. On-site sanitation may therefore be feasible for lower density areas (population density of less than approx. 160 persons per hectare) and peri-urban areas. • Wastewater quantities and flows • Land availability for sewer network & treatment facilities • Road-widths & access for desludging vehicles
	Water resource	• A conventional underground sewerage system requires sufficient water to transport waste through sewers (per capita water supply more than 135 lpcd approx.). If sufficient water is not available, the conventional sewerage system would not function well. • Water supply rate influences wastewater generation Protection of water resources
	Asset ownershipp, Land Tenure	• Participatory planning • Regulation & enforcement • O&M responsibility
Physiography Based	Soil type / Geology	• Laying conventional sewers in rocky topography / geology is technically challenging and adds to significant escalation in construction costs. • Permeability influences technology & infrastructure choices • Impact on groundwater pollution • Influences design of sewers and gradient of network • Influences pumping requirements
	Topography – altitude, terrain	• Influences construction techniques & costs • Influences technology options due to altitude, temperatures
	Groundwater table	• If the depth of ground water table is less than the design depth of sewers, then laying of sewers is very challenging and also adds to significant escalation in construction costs. On-site alternatives that rely on soil absorption (e.g. soak pits) are only feasible: • if the depth of ground water table is more than 5 m (If the water supply is through local abstraction of groundwater i.e., from wells or boreholes) • if the depth of ground water table is more than 2 m (If the water supply is through piped supply) • For depth of ground water table lesser than above values, the risk of ground water contamination is very high necessitating off-site secondary treatment systems. • Influences sewer network, septic tank, infrastructure construction & functional, structural efficiency

[1]Sharon Hophmayer – Tokich, "Wastewater Management Strategy: centralised v. decentralised technologies for small communities", The Center for Clean Technology and Environmental Policy, University of Twente.
[2]For details, please refer to 'Manual on Sewerage and Sewage Treatment Systems,' 2013, CPHEEO, MoHUA(GoI)
[3]Thomas Loetscher & Jürg Keller, "A decision support system for selecting sanitation systems in developing countries," Socio-Economic Planning Sciences, 36 (2002), 267-290.

ANNEXURE A-2: PLANNING TOOL FOR DECISION MAKING ON PLANNING UNIT SIZE

The purpose of wastewater management in cities is multi-pronged in nature – prevention of public health risks; protection of surface / ground water bodies / land; conservation and reuse of resources and protection of local amenity from odour, dust, etc.

Cities planning for sewerage management are often divided into various drainage zones and sub-drainage zones (referred to as planning units in these guidelines) based on certain zoning criteria / constraints to help arrive at most economical and practical conveyance of wastewater and its safe treatment. Indicatively, the criteria could be a combination of – topography to help gravity flow; administrative boundaries; natural or artificial barriers (like rivers, canals, national highways & railways); habitation pattern & future wastewater generation from catchment; subsoil conditions; location of other services (position, depth, size) in the vicinity; land availability for (conveyance/pumping/treatment) infrastructure; utilization & integration with existing sewerage infrastructure, if any and local bye-laws [Source: Chapter 8 of Sewerage Master Plan for Delhi 2031; Chapter 2 & 3 of Part A CPHEEO Manual 2013].

International planning literature also considers additional evaluation factors and analytical criteria to arrive at the optimal catchment size. Some of them are the volume of water supply at household level as well as distance of water intake points; type of developments / densification (concentrated / moderately spread out / sparsely distributed); committed / proposed developments; social and/or environmental benefits quantification; number of discharging points; environmental analytical parameters (like pollution production load / reduction of pollution load / pollution load reduction cost), etc. [Source: Guidelines for Developers Vol.1 Sewerage Policy for new developments in Part C Sewerage Catchment Planning Manual of Malaysia].

While the above criteria are indicative, there are clear metrics that determine or advice which criteria takes precedence and to what extent they influence the planning unit size. This often leaves a decision-making on planning unit size very subjective, for want of reliable large data or information sets (for ex. Irrespective of the size of catchment in water supply planning, output specifications explicitly require a min. residual pressure at ferrule points to be 7 to 17m depending on number of building storeys; staging height of service reservoirs at 15 to 20m; hydraulic gradient in the pipe to normally be 1 to 4 per 1000 at peak flow, etc.). This necessitates development of specific guidelines in case non-conventional systems like small bore sewers, shallow sewers, vacuum sewers etc. requires to be planned for.

ANNEXURE A-3: SURVEY FORMAT FOR WASTEWATER MANGEMENT

A clear understanding of the current status is critical to the overall project as it sets the stage to strategically plan the expected performance of sanitation services. The accompanying data and information serves as a starting point, including:

- A GIS based MIS system to accurately comprehend the specific sanitation context
- Field surveys for populating the GIS & MIS on the lines suggested in table below

Indicative Data Collection Formats for Sanitation across the value chain,

4

MIS is indicative of both quantitative and qualitative data; the asset conditions, the service delivery quality assessment integrate with the SLB, Swachh Survekshan formats, indicators; MIS should also capture the age of the assets, the O&M schedule and the rehabilitation details wherever necessary; MIS should also capture economics related data along with functional aspects.MIS will also assist with an effective implementation, operation and maintenance while enabling efficient monitoring and evaluation.

PART A - GENERAL

1	Name of the Surveyor; Date/Time of Survey
2	Name / No. of Ward
3	Name of the Street
4	Address of the Household GPS coordinates of the household
5	Name/ Detailed Address of the Owner
6	Occupation of the Owner
7	Description/ Type of the House (No. of floors, etc.)
8	Number of Households
9	Number of Permanent Residents in the House
10	Number of Non-Permanent Residents in the House

PART B – SANITARY INSTALLATIONS

B-1 INSIDE BUILDING

1	Water Supply
	Water grid (pipe):
	Public stand post:
	Public well:
	Private (neighbour):
	Canal:
	other:
2	Storage Tank for Water Supply
	No / Yes:
	If yes Volume (litres):
3	Duration of Public Water Supply (hrs/day)y
4	Greywater Installations
	Sink:
	Washing machine:
	Bathtub:
	Shower:
	Wash hand basin:
5	Type and Number of Toilets
	Western
	Indian
	Other
6	Access to Toilets
	Private (no. of users)
	Sharing (no. of users)
	Community (no. of users)
7	Location of the Toilets
	Inside the house
	Separate building
	External
8	Type of Toilet Flushing
	Cistern
	Pour flush

B2-PIPES

1	Is greywater & blackwater discharged separately (Yes or No)	
	No / Yes:	
2	Greywater Pipe System is drained directly to	Blackwater Pipe System is drained directly to
	Drain:	Drain:
	Minor canal:	Minor canal:
	Soak pit:	Soak pit:
	Soil (infiltration):	Soil (infiltration):
3	Greywater pipe system is connected to a septic tank with connection to:	Greywater pipe system is connected to a septic tank with connection to:
	Drain:	Drain:
	Minor canal:	Minor canal:
	Soak pit:	Soak pit:
	Soil (infiltration):	Soil (infiltration):
	If No,	
4	Greywater and blackwater pipe system is directly drained to:	
	Drain:	
	Minor canal:	
	Soak pit:	
	Soil (infiltration):	
5	Greywater and blackwater pipe system is connected to a septic tank with connection to:	
	Drain:	
	Minor canal:	
	Soak pit:	
	Soil (infiltration):	
6	Year of construction of the pipe system and applied material	
7	Points of discharge of wastewater	
8	Observation at discharge points	
	Stagnant	
	Swampy	
	Flies	
	Bad Smell	
9	Quantification of black water litres/day from toilets:	
10	Quantification of grey water litres/day kitchen and bathroom:	
11	Other general observations (any point/ non-point source of discharge to drains?)	

B3-TANKS

1	Year of construction of the septic tank and applied material
2	Dimensions of the septic tank
	Volume (m3)
	Width (m)
3	Dimensions of the soak pit
	Volume (m3)
	Width (m)
4	Visual conditions of the septic tank
	Proper:
	non proper:
	root intrusion:
	:
5	Desludging mechanism and frequency
	Vacuum:
	Manually
	Volume per desludging m3
6	Costs incurred in maintenance (desludging, etc.)
7	Brief on the overflow of septic tank)
8	Levels at:
	Plinth of house
	Outlet pipe at septic tank
	Discharge pipe at drain
	Plinth of drain
9	Dimension of Drain
	Width (m)
	Depth (m)
10	Other General Observations

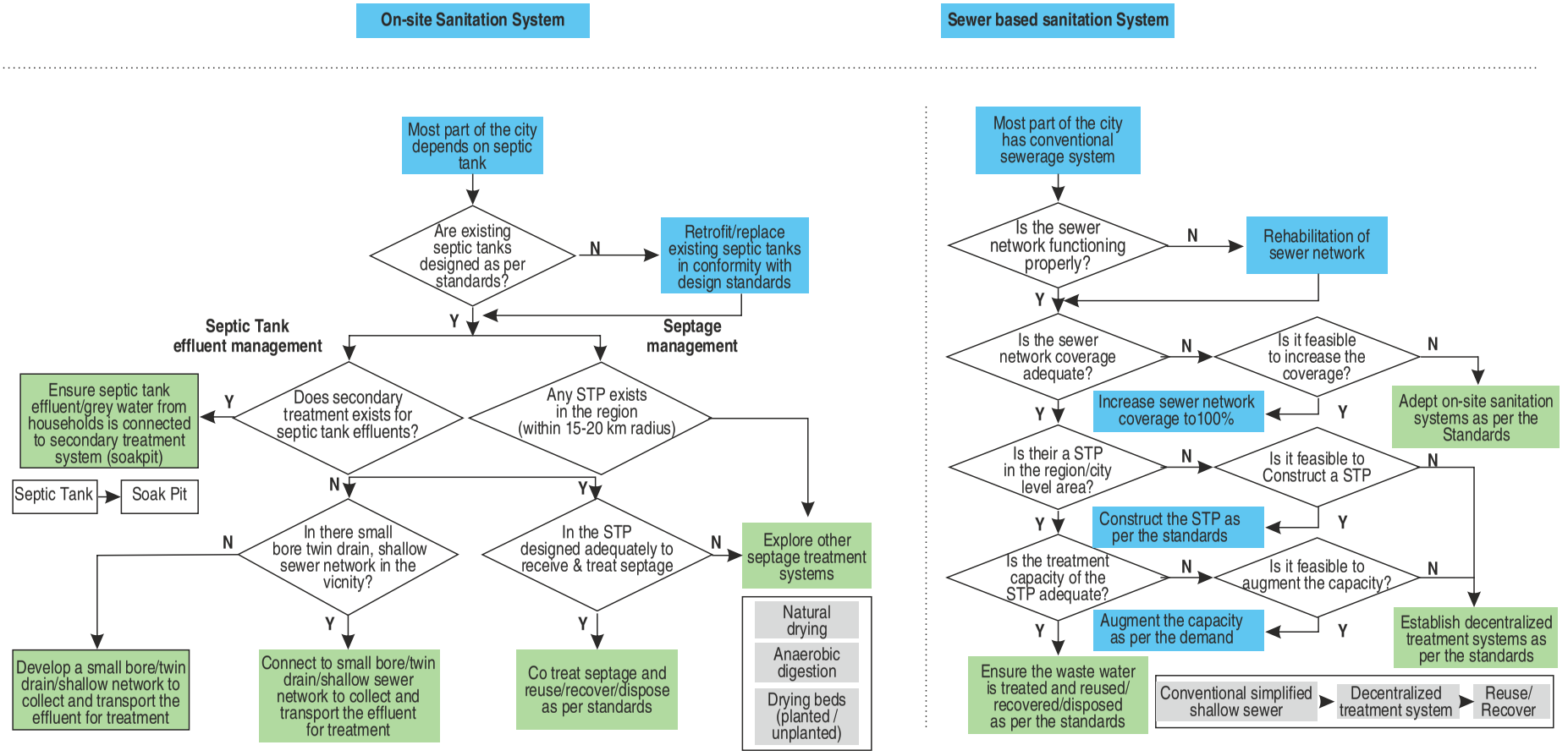
PART C – CUSTOMER PERCEPTION

1	Willingness to pay for a proper sanitation system

HANDBOOK ONINTEGRATED WASTEWATER AND SEPTAGE MANAGEMENT FOR TELANGANA

ANNEXURE B
DESIGN AND IMPLEMENTATION

ANNEXURE B-1
DECISION MAKING FOR APPROACHES OF CITY-WIDE IWwSM SYSTEMS



ANNEXURE B-2
TECHNOLOGY OPTIONS, MATERIAL CHOICE FOR CONVEYANCE SYSTEMS

S.No.	Option	Advantages	Dis-Advantages	Suitable For
1	Concrete	• Ease with which strength can be provided. • Can adopt wide range of pipe sizes. • Rapidity of backfilling the trench.	• Crown corrosion due to sulphide gas. • Mid depth water line corrosion. • Outside corrosion due to sulphates in soil and water.	• Can be manufactured using sulphate resistant cement. • High alumina coating on inside. • Non pressure pipes for gravity flow. • Pressure pipes for force mains, submerged outfalls, inverted siphons.
2	Pre-Cast Concrete			
3	Cast-in-situ Reinforced Concrete	• Economic design, • Easy to construct and maintain, • Has good hydraulic characteristics	• The distance for cutting concrete shall be kept to a minimum to avoid segregation and the vibrating of concrete done by approved mechanical vibrators. • Air entraining cement or plasticizing agents may be used to improve workability and ensure a denser concrete.	• When non-standard sections are required. • When the headroom and working space are limited
4	Cast Iron	• Long laying lengths, • Tight joints, • Withstand high internal pressure and external loads and • Corrosion resistance in most natural soils.	• Susceptible to corrosion by acids or highly septic sewage and acidic soils	• Pressure sewers, sewers above ground surface, • Piping in sewage treatment plants and occasionally on gravity sewers.
5	Steel	• Can withstand internal pressure, impact load and vibrations, • More ductile and withstand water hammer efficiently.	• Cannot withstand high external load, • Fails when subjected to negative pressure, • Susceptible to corrosion	• Pressure sewer mains, under water river crossings, bridge crossings, • Connections for pumping stations, self-supporting spans, railway
6	Ductile Iron (DI) Pipes	• Creates a high pH at the pipe wall and ultimately by providing a physical and chemical barrier to the water, • Higher machinability, impact resistance, high wear and tear resistance, high tensile strength and ductility and corrosion resistance, • 30 % lighter than conventional cast iron pipes.	• Leakages • Complex engineering installations	• Suitable for use in locations where high stress concentration are anticipated and can be produced with reduced thickness of metal
7	UPVC Pipe	• Resistance to corrosion, light weight for transportation, toughness, rigidity, economical in laying, jointing, and maintenance and easy to fabricate. • Smooth interior surfaces, • Highest resistance to corrosion, • Longer life cycle when laid in straight gradients without humps	• Limitation is pressure and temperature due to expansion and contraction. • Cutting and threading limits its use in high pressure and temperature application	• Where nonpressure unplasticized polyvinylchloride (PVC) is required for use in underground sewerage system. • Where single wall corrugated pipes for drainage are required
8	Glass Fibre Reinforced Plastic Pipes (GRP)	• Resists external and internal corrosion.	• Composite materials tend to be more brittle • Limited shelf life • Repairs is a complex process	• Where corrosion resistant pipes are required at reasonable costs • Used as a lining material for conventional pipes which are subject to corrosion

[5]Adapted from CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

ANNEXURE B-3
TECHNOLOGY FACT SHEETS, WASTEWATER, SEPTIC TANK EFFLUENT AND SEPTAGE TREATMENT

This annexure presents the technologies commonly used in the wastewater and septage management sector with a summary in terms of cost assessment, and footprint requirement for selecting its suitability in Indian climate. Based on the wastewater /septage influent characteristics and the required effluent discharge standards, cities may decide on the choice of technologies either on stand-alone basis or in conjunction with others, as applicable.

The description presented in the factsheets is adapted from CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013 and the Compendium of Sanitation Systems and Technologies, 2nd Revised Edition; the land requirement and energy requirement data is adapted from CPCB report 2013, while the effluent quality represents the actual operational data sourced from the ongoing projects across India, wherever data is available.

All costs presented in the facts sheets are indicative. The costs are based on CPCB report 2013 and corrected for escalation along with adjustments made in correspondence to the market rates prevailing in 2017, wherever data is available. The O&M costs include the costs for power (energy), chemicals, manpower and routine maintenance while replacement and major repair related costs are not included. Wherever data is applicable, operational data is also referenced.

TECHNOLOGY OPTIONS

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
1	**Activated Sludge Process (ASP)**	The conventional ASP typically consists of a concrete aeration tank followed by a concrete clarifier. Sewage and return activated sludge (RAS) enter together or separately into the aeration tank and leave as mixed liquor. This mixed liquor flows into the clarifier where it is allowed to settle and the treated effluent separates from the activated sludge. The clear, treated sewage from the process flows over the clarifier weirs. The settled activated sludge is recycled to the aeration tank and a portion is wasted out of the system as waste activated sludge
a)	Land Requirement	0.1 to 0.15 hectares / MLD installed capacity
b)	Energy Requirement	180 to 225 Kwh/ML treated
c)	Capital Cost**	Rs 8 to 17 million/MLD capacity
d)	O & M Cost**	Rs 1.0 to 2.0 million/year/MLD Installed capacity
e)	Effluent Quality	BOD: 10-20 mg/L Suspended solids (SS): 20 to 50 mg/l
f)	Distinct Advantage	• Land requirement is very less and performance is not affected by normal variation in waste water characteristic • Very Good cleaning performance, if process is operated properly and technically correct
g)	Distinct Disadvantage	• Large Hydraulic fluctuations might have negative impact (sludge overflow) • High level of knowledge is necessary to operate this process (incl. regular maintenance) • High investment & operational costs
h)	O & M	• Start-up – The equipment manufacturer should be present to be sure that any equipment breakdowns are not caused by improper start-up procedures • Equipment – The whole unit should be thoroughly inspected once a year, including replacement of worn out parts and painting with anti-corrosive paints to achieve the desired efficiency of the plant. A record of operations should be maintained. • Abnormal Operation –Activity of the organisms is varied based on seasonal temperature variations which requires the operator to gradually adjust aeration rates, return sludge rates and wasting rates. • Counter Measures - ASP is a biological process and may require from three days to a week or longer to show any response to corrective action. Allow seven or more days for the process to stabilize after making a change in the treatment process • Records – Activated sludge operation should include recording of flow rates of sewage and return sludge, DO, MLSS, MLVSS, biota, SRT (sludge age), air, BOD, COD (Chemical Oxygen Demand). Refer Part B, CPHEEO Manual – Section 4.7.2 for more details

***Higher cost is for treatment plant including sludge treatment like anaerobic digestion, or for small capacity plants without sludge treatment*

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
2	**Extended Aeration Technology EAT)**	This is a modification of the activated-sludge process using long aeration periods to promote aerobic digestion of the biological mass by endogenous respiration. The process includes stabilization of organic matter under aerobic conditions and disposal of the gaseous end products into the air. The plant effluent has finely divided suspended solids and soluble matter.
a)	Land Requirement	0.15 to 0.25 hectares / MLD installed capacity
b)	Energy Requirement	180 to 225 Kwh/ML treated
c)	Capital Cost**	Rs 2 to 4 million/MLD capacity
d)	O & M Cost**	Rs 0.3 to 0.5 million/year/MLD Installed capacity
e)	Effluent Quality	BOD: 10-20 mg/L Suspended solids (SS): 20 to 50 mg/l
f)	Distinct Advantage	• Good cleaning performance, if process is operated proper and technically correct
g)	Distinct Disadvantage	• Increased oxygen input for treatment process necessary • Increased energy consumption compared to ASP • No gas yield from primary sludge • Hydraulic fluctuations have negative impact (sludge overflow) • High level of knowledge is necessary to operate this process (incl. regular maintenance) • High Investment & operational costs
h)	O & M	• Operation of Aeration Equipment – Aeration equipment should be operated continuously 24x7, non-stop. The operator can judge how well the aeration equipment is working by appearance of the water on the settling compartment and the effluent that goes over the weir. The air supplied or aeration rate should be increased slightly each day until the water is clear in the settling compartment. • Normal Operation – Should be checked visually every day. • Abnormal Operation – As the temperature changes from season to season, activity of the organisms speeds or slows down. This requires the operator to gradually adjust aeration rates, return sludge rates and wasting rates. • Counter Measures - Extended Aeration is a biological process and may require seven to fifteen days or longer to show any response to corrective action. Allow seven or more days for the process to stabilize after making a change in the treatment process. • Maintenance – Equipment in extended aeration plants should follow the manufacturer's instructions. Items requiring attention include – plant cleanliness, aeration equipment, air lift pumps, scum skimmer, etc. Refer Part B, CPHEEO Manual, Chapter 4 – Section 4.7.3 for more details.

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
3	**Moving Bed Bio Film Reactor (MBBR)**	It's a combination of activated sludge process (suspended growth) and attached growth process (media). Moving Bed Biofilm Bioreactor (MBBR) process uses the whole tank volume for biomass growth. It uses simple floating media, which are carriers for attached growth of biofilms. Biofilm carrier movement is caused by the agitation of air bubbles. This compact treatment system is effective in removal of BOD as well as nitrogen and phosphorus while facilitating effective solids separation.
a)	Land Requirement	0.04 – 0.05 hectares / MLD installed capacity
b)	Energy Requirement	200 – 250 kWh/ML treated
c)	Capital Cost**	Rs 17 million/MLD capacity (approximately)
d)	O & M Cost**	Rs 2.5 million/year/MLD Installed capacity (approximately)
e)	Effluent Quality	BOD: < 10 mg/L COD: < 50 mg/L TSS: < 20 mg/L
f)	Distinct Advantage	• Smaller foot print compared to conventional treatment • Up-gradation and mobility. • Flexibility to adapt fluctuating hydraulic & organic loads.
g)	Distinct Disadvantage	• Change of media after some time. • Higher running cost.
h)	O & M	• Start-up – The equipment manufacturer should be present to be sure that any equipment breakdowns are not caused by improper start-up procedures. • Equipment – The electro-mechanical components such as blowers, aerators and pumps need to be checked on weekly basis. The overhauling of the needs to be done on annual basis for detailed check up to avoid major break down. The biofilm carriers (media) need to be replaced after few years in order to maintain the specific surface area requirement of the reactor. • Records – operation should include recording of flow rates of sewage and return sludge, DO, MLSS, BOD, COD (Chemical Oxygen Demand).

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
4	**Sequencing Batch Reactor (SBR)**	In SBR operations, the processes of Fill-react, React, Settle and Decant are carried out in the same tank and are controlled by time intervals to achieve the objectives of the operation. Each process is associated with particular reactor conditions (turbulent/quiescent, aerobic/anaerobic) that promote selected changes in the chemical and physical nature of the sewage. These changes lead ultimately to a fully treated effluent.
a)	Land Requirement	0.05 to 0.1 hectare/MLD Installed capacity
b)	Energy Requirement	150 to 200 KWh/ML treated
c)	Capital Cost**	Rs. 8.0 to 20.0 million/MLD capacity
d)	O & M Cost**	Rs. 1.0 to 2.0 million/year/MLD installed capacity
e)	Effluent Quality	BOD 10 – 20mg/L Total Suspended solids (TSS): 20 mg/L
f)	Distinct Advantage	• Smaller area requirement compared to ASP • The process is time controlled and flexible
g)	Distinct Disadvantage	• High level of knowledge is necessary to operate this process (incl. regular maintenance) • Needs significant automation for proper operation • High investment & operational costs
h)	O & M	• Operation of Equipment – The manual given by the equipment supplier should be followed. • Back-up power is required at least for the decanter mechanism. • Process Control – Can adjust the cycle times to manage hydraulic peaks. • Records – The limited parameters as per the design requirements and the flow rate and cycle times. • Refer Part B, CPHEEO Manual – Section 4.7.4 for more details.

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
5	**Membrane Bio Reactor (MBR)**	Membrane Bio Reactor (MBR) are treatment processes, which integrate a perm selective or semi permeable with a biological process. It is the combination of a membrane process like micro-filtration or ultra-filtration with a suspended growth bioreactor, and is now widely used for municipal and industrial wastewater treatment. Due to it being a very technical solution; it needs expert design and skilled workers. Though it is a costlier than conventional treatment providing equivalent quality, the area requirement is at least 40% less, which is a major advantage for urban location. With the MBR technology, it is also possible to upgrade old wastewater plants for capacity as well as effluent quality.
a)	Land Requirement	0.03 – 0.05 hectares / MLD installed capacity without sludge treatment, 0.02 hectares / MLD additional area with anaerobic digestion sludge treatment.
b)	Energy Requirement	300 – 1300 kWh/ML treated, higher unit power consumption for small capacity plants
c)	Capital Cost**	Rs 30 – 50 million/MLD capacity, higher unit cost for small capacity plants
d)	O & M Cost**	Rs 5 – 7 million/year/MLD Installed capacity
e)	Effluent Quality	BOD: < 3 mg/L COD: < 30 mg/L TSS: < 1 mg/L
f)	Distinct Advantage	• Performance is not affected by normal variation in waste water characteristic. • Secondary clarifiers and tertiary filtration processes are eliminated, thereby reducing plant footprint. • High loading rate capability • Very Good cleaning performance
g)	Distinct Disadvantage	• High level of knowledge is necessary to operate this process (incl. regular maintenance) • Membrane complexity and fouling • Membrane replacement after about 10 years • Energy costs • High Investment & operational costs
h)	O & M	• Start up – The membrane equipment manufacturer should be present to set up the automatic operation of the membrane filtration process. This helps to prevent any equipment breakdowns that may occur due to improper start-up procedures. Inoculation / seeding is needed at the start • Equipment – Membrane needs chemical cleaning once a week and recovery cleaning once or twice a year. The whole unit should be thoroughly inspected once a year, including plugging of damaged fibers for hollow fiber membranes, and replacement of worn out parts to achieve the desired efficiency of the plant. A record of operations should be maintained. • Records – operation should include recording of flow rates of sewage and return sludge, DO, MLSS, BOD, COD (Chemical Oxygen Demand).

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
6	**Waste Stabilisation Ponds (WSP)**	Waste stabilization ponds are open, flow-through earthen basins specifically designed and constructed to treat sewage. They provide comparatively long detention periods extending from a few days to several days. There are three principal types of WSP – anaerobic, facultative, and maturation ponds. These three types of WSP can also be arranged in a series – first an anaerobic pond, then a facultative pond, and finally (if needed to achieve the required faecal coliform removal) followed by one or more maturation ponds.
a)	Land Requirement	0.8 to 2.3 hectares/MLD installed capacity
b)	Energy Requirement	Energy required for the operation of screen and grit chamber negligible as compared to ASP
c)	Capital Cost**	Rs. 3.0 to 6.0 million/MLD capacity
d)	O & M Cost**	Rs. 0.06 to 0.1 million/year/MLD installed capacity
e)	Effluent Quality	• BOD: 30-50 mg/L • Suspended solids (SS): 75-125 mg/L • The colour of the water is greenish
f)	Distinct Advantage	Very easy operation and maintenance
g)	Distinct Disadvantage	• Limited control possibilities of process • Large area required for operation • Cleaning performance is moderate • High hydraulic fluctuations have negative impacts • Contamination of groundwater is possible (especially if monitoring is neglected)
h)	O & M	• Start up Procedures – Pond systems should preferably be commissioned at the beginning of the hot season so as to establish as quickly as possible the necessary microbial populations to effect waste stabilization. • Routine Maintenance – The maintenance requirements of ponds are very simple, but they must be carried out regularly. Otherwise, there will be serious odour, fly and mosquito nuisance. • Desludging - In general after 10 years or when the BOD removal is getting reduced drastically or when black sludge is constantly overflowing in the treated sewage from the pond. • Process Control – Ensure the sludge accumulation does not exceed 30% of the total liquid depth or the design depth of sludge. • Records – Daily tests of Flow, SS and monthly tests of DO. Refer Part B, CPHEEO Manual, Chapter 4 – Section 4.13 for more details

TECHNOLOGY OPTIONS

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
7	**Rotating Biological Contactor (RBC)**	They are also called rotating biological filters, are fixed-bed reactors consisting of stacks of rotating disks mounted on a horizontal shaft. They are partially submerged and rotated as wastewater flows through. They are used in conventional wastewater treatment plants as secondary treatment after primary sedimentation of domestic grey or blackwater, or any other biodegradable effluent. The microbial community is alternately exposed to the atmosphere and the wastewater, allowing both aeration and assimilation of dissolved organic pollutants and nutrients for their degradation.
a)	Land Requirement	0.05 to 0.1 hectares/MLD installed capacity
b)	Energy Requirement	100 - 150 kWh/ML treated wastewater
c)	Capital Cost**	Rs 8 to 17 million/MLD capacity
d)	O & M Cost**	Rs 0.5 – 1.0 million/year/MLD Installed capacity
e)	Effluent Quality	BOD: 20-30 mg/L Suspended solids (SS): 20 to 50 mg/l
f)	Distinct Advantage	• Ease of installation and commissioning. • Simple to operate and maintain
g)	Distinct Disadvantage	• Strong odour emissions are possible, in certain regions spare parts are not available (rotating growth bodies)
h)	O & M	• On a daily basis, there is little need for operation and maintenance, but there can be problems with breakage of the shaft and the mechanism that turns the discs.

Adapted from CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
8	**Fluidised Bed Reactors and Fixed Film Reactors – Packaged Decentralized Wastewater Treatment System**	This system is addressed to isolated habitations, where there is a need for non-mechanized and self-operating treatment technology given the premise that adequate land area is available and at reasonable distance from the habitation itself. Another aspect will be to group the toilets or at least bring the sewage from the various centers
a)	Land Requirement	0.18-0.25 hectare/MLD installed capacity
b)	Energy Requirement	Almost negligible
c)	Capital Cost**	2-4 million/MLD
d)	O & M Cost**	• Daily maintenance is negligible. • Once in year or two years Desludging is practiced the O&M cost is Rs. 0.15 Million/MLD
e)	Effluent Quality	• BOD < 10mg/L • Total Suspended solids (TSS): <10mg/L. • Very superior qualities also possible
f)	Distinct Advantage	• Technically complex • The process is time controlled and flexible • Sludge handling is minimal.
g)	Distinct Disadvantage	• Can absorb hydraulic and organic shock loading
h)	O & M	• The packaged treatment plants like this have to be maintained as per the vendors of these systems. Refer Part B, CPHEEO Manual – Section 4.19 for more details

TECHNOLOGY OPTIONS

Wastewater Treatment (Grey + Black Water; Septic Tank Effluent), **Secondary Treatment**		
9	**Upflow Anaerobic Sludge Blanket Reactor (UASB)**	The Upflow Anaerobic Sludge Blanket reactor (UASB) maintains a high concentration of biomass through formation of highly settleable microbial aggregates. The sewage flows upwards through a layer of sludge. Separation between gas-solid-liquid takes place at the top of the reactor phase. Any biomass leaving the reaction zone is directly recirculated from the settling zone. The process is suitable for both soluble wastes and those containing particulate matter. The process has been used for treatment of municipal sewage at few locations and hence performance data and experience available presently are limited.
a)	Land Requirement	0.2 to 0.3 hectares/MLD installed capacity`
b)	Energy Requirement	10-15 KWh/ML sewage treated
c)	Capital Cost**	Rs.5 – 10 million/MLD Installed capacity
d)	O & M Cost**	Rs 0.08 to 0.17 million/year/MLD installed capacity
e)	Effluent Quality	BOD: 30-40 mg/L Suspended solids (SS): 75-100 mg/L
f)	Distinct Advantage	• Can absorb hydraulic and organic shock loading. • Sludge handling is minimal
g)	Distinct Disadvantage	• Further treatment is necessary (linked to increasing investments costs due to additional treatment steps and thus also more space) • High level of monitoring is needed • Economic design needs high level of wastewater specification
h)	O & M	• Daily O & M – Cleaning of Effluent Gutters, unclogging feeder pipes, removal of floating mat, check leakage of biogas, etc. • Routine Maintenance – Quarterly maintenance of valves. Annual – equipments and structures should be checked. • Operational Cautions – Once you reach the walking platform at top, check the H2S by the handheld meter, do not carry any ignitable matters, etc. • Refer Part B – Section 4.12 for more details.

Adapted from CPHEEO Manual on Sewerage and Sewage Treatment Systems, 2013

Septage Treatment		
10	**Anaerobic Digestion**	Anaerobic biogas digesters are reactors used for the conversion of the organic fraction of large volumes of slurries and sludge into biogas by anaerobic digestion. Biogas is recovered and used either directly for heating the reactors or transformed into combined power and heat and fed into the grid. It can also be upgraded to natural gas quality. Typical substrates are excess sludge from wastewater treatment plants or waste slurries from agriculture (manure) or (diary) industry. Energy crops may also be added in order to increase the gas yield. Large-scale anaerobic digesters have been mainly developed in industrialised countries and many different designs and types are available - most of them are rather high-tech and require expert construction, operation and maintenance skills. Biogas is a green energy and has the potential to reduce greenhouse emission. Due to increasing fuel prices and climate change, biogas generation from wastes and energy crops at large-scale is gaining interest also in developing countries.
a)	Land Requirement	Low
b)	Energy Requirement	High
c)	Capital Cost**	High capital cost
d)	O & M Cost**	High operation costs.
e)	Performance	High volume reduction of wastes; Relatively high pathogen removal; Nutrient remain in the sludge; SRT of some weeks
f)	Distinct Advantage	• Combined treatment of different organic waste and wastewaters • High reduction of the volume of waste • Generation of a renewable energy (biogas) • Potential for greenhouse gas emission reduction (collection of methane; green energy production) • Remaining sludge could be used as fertiliser • Low space requirements
g)	Distinct Disadvantage	• Experts are required for the design, construction, operation and maintenance • High technical and organisational complexity (complexity normally rises with scale) • Reuse of produced energy (e.g. transformation into, fire/light, heat and power) needs to be established • High sensitivity of methanogenic bacteria to a large number of chemical compounds • Requires seeding (start-up can be long due to the low growth yield of anaerobic bacteria)
h)	O & M	• Temperature should be controlled between 20-35oC for mesophilic digestion. • Neutral pH should be maintained. • Total solid content of the feed should be less than 20% for optimum digestion. • Mechanical mixing is to be done regularly. • Digested sludge removal needs to be frequently to maintain F:M ratio. • The electro-mechanical components should be checked frequently and repaired and replaced if needed.

ANNEXURE C
OPERATION AND MAINTENANCE

ANNEXURE C-1
STANDARD OPERATING PROCEDURES[SOP] FOR SEPTAGE DESLUDGING AND CONVEYANCE

While desludging the following norms should be followed:

- 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 gears should be used by the operator while desludging / emptying the septic tanks

Septage transportation vehicle operators (whether from ULB or private sector) should be well trained and equipped with protective safety gears, uniforms, tools and proper vacuum trucks, to ensure safe handling of sewage/septage. 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.

Operating septage pumping equipment is dangerous. Operators are responsible for their personal safety as well as safety on the road. Septage is infectious material. It can cause disease if ingested or if it comes in contact with broken skin. Hands must always be washed immediately after contacting septage or tools and equipment that may have contacted septage, and always before eating or drinking. Septage workers should be immunized for tetanus, hepatitis A, and hepatitis B.

Smoking must be prohibited while operating septage equipment. Septic tanks may generate methane, an explosive gas. Smoking also promotes the hand-to-mouth route of infection. Caution must be used around septic tanks and septic tanks must never be entered. People are killed every year in septic tanks, because tanks are confined spaces that may contain toxic or oxygen-limited atmospheres. Septic tanks also may collapse or break if excessive weight is place on the lid or manhole cover.

Specific procedures for pumping, and the transportation activities

The Septage Program Managers should prepare a Manual of Practice by first reviewing the operations procedures for specific equipment and then documenting all aspects of the day-to-day procedures. These procedures include:

- Scheduling and routing for trucks
- Customer service protocols
- Locating tanks and cleanouts
- Probing tanks to determine sludge levels
- Proper pumping equipment operation and worker safety
- Site control, including post-pumping clean-up
- Transportation requirements, including rules of the road
- Disposal procedures at the treatment facility
- Routine service of equipment – greasing and oiling, minor repairs
- Record keeping for all tanks pumped and wastes discharged at the disposal facility.

Train new employees on standard practices, share best practices with other local governments or service providers. Employees must wear proper safety equipment.

Septage Tanks and Septage Management.

Always secure septic tank lids with safety screws or locks. Keep children safe by keeping septic tank lids secure. Operators should never enter septic tanks for sludge removal or cleaning activities. All service activities must be performed from the ground surface.

Operating the Vacuum Truck Equipment

Operators should become familiar with the proper operation of the equipment in use for each operation. This includes the physical operation of the truck, all valves, piping, power take-offs and ancillary equipment for the vacuum equipment (including the tank, valves, hoses, and fittings). Check to see if inlet pipe and sanitary tee are in place. Check tank construction to the extent possible. Look for cracks in the concrete and tank settling. Use of a mirror on a long pole can help to inspect the interior of the tank. Number of compartments, if more than one, locate and remove lids from all compartments. Each compartment will require pumping.

[6]Source: Adapted from Part B, CPHEEO Manual on Sewerage and Sewage Treatment Systems

Use caution when pumping tanks during high groundwater conditions as unsecured tanks may float. Ask for local knowledge of the area to obtain this information. Position the truck and prepare the truck for pumping. Place safety cones around truck. Chock the wheels. Set parking breaks and removes the hoses and fittings required to complete pumping from the toolbox. Probe the tank with the last length of hose. This will provide an indication on the volume of sludge to pump. To probe the tank, slowly lower the hose into the tank. As it passes down the water column, the resistance increases when the sludge layer is encountered. The sludge layer exists from the depth at which resistance is first encountered to the bottom of the tank.

Connect the hose to the truck tank.

Screw or clamp fittings should be used in case back-pressure is required to break up sludge masses. Friction fittings may come apart during the pump back operation, thus exposing workers to a safety hazard.

Engage the pump or vacuum equipment.

The operator will make sure there is suction and that the pump is operating. Volume in the tank should start decreasing rapidly. Use the hose to break up sludge and scum masses to the greatest extent possible. As pumping commences, the operator will monitor the level gauge on the septage tank. Always ensure there is adequate volume in the septage tank to accommodate the load. If only a partial load can be pumped, monitor levels closely. Monitor the septic tank as pumping progresses. Look for water flowing back from the outlet pipe or inlet pipe back to the tank as the water level decreases. Such flows may indicate problems with the disposal field or clogs in outlet lines.

After pumping is complete, check the tank for remaining sludge. If there are accumulated solids remaining, initiate the pump-back procedure, which is to send the pumped septage under pressure back into the tank and direct this flow toward the sludge mass. When pump-back is complete, pump out the tank again (suction). Repeat the above steps as needed. It is okay to leave as much as 100 to 200 liters of septage in the tank after cleaning. Never pump out the entire contents of a tank during periods of high groundwater. If the groundwater is higher than the bottom of the tank, the tank may float out of the ground. In such conditions, leave enough contents in the tank to serve as ballast. When pumping is complete, wash the hoses with water while directing the water stream back into the tank. Replace the clean hoses back in the truck toolbox. Replace the tank lids and secure. Clean up any spills and disinfect with lime or bleach solution.

Operation and Maintenance of the Facility

The operation and maintenance of a stand-alone septage treatment and disposal facility is mostly similar to a typical conventional wastewater treatment plants. The O&M concern is mainly related to the fact that septage is a highly concentrated waste as compared to sewage. Septage characteristics dictate greater attention to the operation of screening and grit and grease removal facilities at the septage receipt module and primary treatment systems. Here the hydraulic and organic overloads of septage should be avoided. The maintenance program should follow certain simple rules, that include:

- Good housekeeping and maintenance for a clean, neat, and orderly facility
- Establish a routine service and maintenance schedule for each piece of equipment
- Maintain O&M records of each equipment and module with emphasis on lubrication frequencies
- Observe good safety procedures
- Control the increased sludge and scum production in the primary treatment process by process control, maintenance of clarifier equipment, pumps, and transport equipment, etc.

ANNEXURE C-2
SAMPLE COLLECTION AND CONVEYANCE

Sample Collection and Conveyance Records
(including schedules for septic tank emptying services).
(to be filled by Operator / Transporter of Septage)

I. Identification of Waste:

a) Volume :
b) Type : (1) Septic Tank (2) Others
c) Source : (1) Residential (2) Commercial (3) Restaurant (4) Public or Community Toilet (5) Others

II. Details of Waste Generator

a) Name :
b) Phone Number:
c) Address :
d) Pin :

The undersigned being duly authorized does hereby certify to the accuracy of the source and type of wastewater collected and transported.

Date: _____ Signature: _____

III. Details of Transporter / Operator

a) Company Name :
b) Permit No :
c) Vehicle Registration #:
d) Driver's name :
e) Pump out date :

The above described wastewater/ septage was picked up and hauled by me to the disposal facility name below and was discharged. I certify that the foregoing is true and correct:

IV. Signature of Authorized Agent and Title:

The above transporter delivered the described wastewater to this disposal facility and it was accepted.

Disposal date:_____Amount Collected from Transporter: _____

Signature of authorized signatory and title: _____

NOTE: SUBJECT TO THE TERMS AND CONDITIONS OF _____MUNICIPALITY.

Vacuum truck drivers are responsible for all rules of the road

- Take the most expedient route to the disposal site considering traffic flows
- Plan the trips to arrive at the disposal site within the specified disposal site operating hours
- In the event of an accident or moving violation (citation), cooperate with local authorities.
- Be prepared to show driver's license, vehicle registration, and insurance if requested.
- A complete report will be required and all incidents should be investigated.

[7]Source: Adapted from the Operative guidelines for septage management for urban and rural local bodies in Tamilnadu. (2014)

ANNEXURE D

INSTITUTIONAL, GOVERNANCE AND REGULATORY

ANNEXURE D-1
AWARENESS GENERATION STRATEGY

While the proposed methodology for preparing the national communications strategy for sanitation awareness in urban areas (as mentioned in the previous section of this document) would lead to the development of a comprehensive, evidence based communications strategy, the strategy per se would need to fit into a framework that is easy for policy makers and those involved in the implementation of the strategy to follow. This section of the document presents such a prescriptive framework.

The framework highlights the issues / communication needs of "target audiences" or "consumers" of the communication activities / efforts and indicates a set of possible communication activities to address the communication needs of the target audiences.

It must be noted that the identification of communication needs and possible communication activities / efforts are not exhaustive in nature but is purely indicative and presented to give a flavour of the range of communication efforts / activities required to address the needs. Table below provides the indicative strategic framework to raise sanitation awareness in urban areas.

Issue / Communication Needs	Target Audiences	Communication Thrust / Objective	Possible Set of Communication Activities / Efforts
Improving urban sanitation is not top priority for state and city level institutions and officials Perspectives and awareness on strategies such as need for universal coverage, city wide approaches, mainstreaming the poor, need for developing localized need based solutions, need for proper O& M of sanitation facilities, etc differ among policy makers and city managers	• Officials of state level institutions involved in urban development • Officials of ULBs and parastatal agencies • Elected representatives (MPs, MLAs and Ward Councilors)	• Strengthen programmatic awareness on urban sanitation and related policies / programmes / schemes, etc. in order to ensure uptake and effective implementation • Strategic communications/ advocacy to push sanitation higher-up on the agenda of these institutions and to build support for strategies such as city-wide approaches, mainstreaming the poor, local needs-based technological options, proper Operations and Maintenance off sanitary installations etc. The communication inputs should be aimed at honing perspectives of officials and staff on the above-mentioned themes/ strategies. • Strengthening communication mechanisms between institutions at the national, state and local level in order to ensure regular and effective flow of information / knowledge on urban sanitation between institutions involved in sanitation service delivery at different levels. • Bring "sanitation" to the forefront of the political debate at the national, state and local level and for ensuring that states / cities prioritize urban sanitation.	• Attractive multimedia presentations on urban sanitation • Specially designed information materials including briefing kits (fact sheets, talking points and Q&As on urban sanitation) and multimedia presentations with details of policies and programmes. • Personalized communication by the Minister of Urban Development • Special advocacy events - national round tables, regional workshops and consultations on the following themes - understanding sanitation, mainstreaming the poor, city wide approaches, understanding sanitation, financing sanitation need for localized need based solutions, financing sanitation etc. • Creation of a dedicated web-site and virtual information hub on urban sanitation • Briefing meetings with relevant parliamentary sub committees, ministers responsible for portfolios linked to sanitation (health, education and environment)
Low priority accorded to sanitation Limited awareness of programmes and schemes as well as rights and duties as citizens vis-à-vis sanitation	• Urban households	Provide information and raise awareness on the following issues: • What is sanitation – its holistic definition; • Importance of sanitation; • Linkages of sanitation with health, economic well being and the environment; • Information on schemes and programmes aimed at ensuring sanitation facilities; and • Whom to approach for further information	• Branded multi-media and multi-channel communications campaign including, but not restricted to: • Radio campaign – spots and jingles • TV spots / programmes • Information materials • Theme based media campaign • Strategic placement of sanitation awareness messages in popular TV serials and radio shows

Issue / Communication Needs	Target Audiences	Communication Thrust / Objective	Possible Set of Communication Activities / Efforts
Limited and disinterested media coverage of sanitation issues	• Media – print, audio, audio-visual and internet based media	• Create a buy-in for sanitation and sanitation related issues	• Specially designed information materials including briefing kits (fact sheets, talking points and Q&As on urban sanitation) and multimedia presentations with details of policies and programmes • One-on-one briefing meetings with editors, journalists and beat reporters • National / state level workshops or round-tables with editors and journalists • Media exposure tours for journalists and beat reporters • Special sanitation scholarship / fellowship scheme for journalists and beat reporters
Lack of interest / sporadic interest and involvement of industry bodies, citizens associations and bodies on sanitation related issues	• Industry and tradespersons associations • Voluntary associations like the Rotary Clubs, Lions Clubs, Young Men / Women's Christian Associations, etc.	• Create avenues / opportunities for active engagement of these stakeholders on sanitation related issues	• Research to identify best fit corporate / industry associations / voluntary associations to partner with national / state / ULB level institutions for raising sanitation awareness • Organization of meetings / special events with identified corporate bodies / industry associations / voluntary associations to raise sanitation awareness • Co-branding of special events, programmes

ANNEXURE D-2
DISCHARGE STANDARDS

National Level: MoHUA Advisory Note on Septage Management in Urban

For dewatered septage/sludge use as fertilizer in agriculture application, it should satisfy the following criteria of Class A Bio-solids of US EPA:

- A fecal 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.

India, 2013
National Level: CPCB, 2016

Industry	Parameter	Standard (applicable for all modes of disposal) Concentration values are in mg per liter except pH & Fecal Coliform
Sewage Treatment Plants (STPs)	pH	6.5-8.5
	Bio-Chemical Oxygen Demand (BOD)	10
	Chemical Oxygen Demand (COD)	50
	Total Suspended Solids (TSS)	10
	Ammonical Nitrogen (NH4-N)	5
	Total Nitrogen (N-total)	10
	Fecal Coliform (MPN/100 ml)	<230
	Phosphate (PO4-P)	2

Note:

(I) New STPs planned after date of notification shall be designed to meet the specified standards. Existing STPS shall meet the specified standards within 02 years from date of notification.

(ii) The standards for Fecal Coliform shall not be applicable for use of treated sewage in industrial purposes.

(iii) Any housing / residential complex and any other establishment generating sewage and if such area is sewered with sewer terminating to STP such complexes / establishment shall meet the prescribed standards of General Standards for discharge of Environmental Pollutants for sewer. In case of standalone complexes / establishments either not having sewer or terminal STP, shall be requiring to meet these standards.

ANNEXURE D-3
RECYCLE AND REUSE STANDARDS

Please refer to Chapter 7, CPHEEO Manual on Sewerage and Sewage Treatment Systems 2013 for guiding principles in recycle and reuse of treated wastewater for various categories.

National Level: CPCB, Primary Water Quality Criteria for designated Best Use

Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml	50 or less
		pH	6.5-8.5
		Dissolved Oxygen	6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C	2mg/l or less
Outdoor bathing (Organised	B	Total Coliforms Organism MPN/100ml	500 or less
		pH	6.5-8.5
		Dissolved Oxygen	5mg/l or more
		Biochemical Oxygen Demand 5 days 20°C	3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml	5000 or less
		pH	6-9
		Dissolved Oxygen	4mg/l or more
		Biochemical Oxygen Demand 5 days 20°C	3mg/l or less
Propagation of Wild life and Fisheries	D	pH	6.5-8.5
		Dissolved Oxygen	4mg/l or more
		Free Ammonia (asN)	1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH	6-8.5
		Electrical Conductivity at 25°C micro mhos/cm	Max. 26
		Sodium absorption Ratio	1.2 mg/l or less
		Boron	Max. 2mg/l

ANNEXURE D-4
REGULATIONS, WASTEWATER & SEPTAGE MANAGEMENT, TELANGANA

No	Description	State Level/ City Level	Remarks
1	Water (Prevention & Control of Pollution) Act,1974	State Level	As per A.P. Re-organization Act, 2014, Andhra Pradesh Pollution Control Board was bifurcated and Telangana State Pollution Control Board was constituted under Sec.4 of Water (Prevention & Control of Pollution) Act,1974 and Section 5 of Air (Prevention & Control of Pollution) Act,1981, on 07-07-2014. The following Environmental Acts and Rules are being implemented by the Board
2	Water (Prevention & Control of Pollution) Cess Act,1977	State Level	
3	Environment (Protection) Act, 1986.	State Level	
4	General Standards for Discharge of Environmental Pollutants	State Level	http://tspcb.cgg.gov.in/Environment/General%20Standards%20For%20Discharge%20Of%20Environmental%20Pollutants.pdf
5	Hyderabad Metro Sewerage Rules under the provision of the Hyderabad Metro Water Supply & Sewerage Act, 1989.	GHMC	https://www.hyderabadwater.gov.in/en/files/1114/3297/4989/Sewerage_Rules_1990.pdf
6	Regulations for water supply & sewerage, 1992	GHMC	https://www.hyderabadwater.gov.in/en/files/4314/3297/5019/Water_Supply__Sewerage_Regulation_1992.pdf In exercise of powers conferred by Sections 50 and 75 of the Hyderabad Metropolitan Water Supply & Sewerage Act, 1989 (Act No. 15 of 1989) , the Hyderabad Metropolitan Water Supply and Sewerage Board with the Previous approval of the Government hereby makes the following Regulations
7	Operative Guidelines for Septage Management	City-Level	http://www.gwmc.gov.in/attachments/Operative_guidelines_for_septage_management.pdf
8	Building Rules	City-Level	As per A.P. Re-organization Act, 2014, AP Building Rules 2012 are applicable to State of Telangana as well

ANNEXURE D-5
SAMPLE PERMIT FOR PRIVATE CONTRACTORS, SEPTAGE MANAGEMENT

SEPTAGE TRANSPORTER PERMIT FOR ..... MUNICIPALITY

(to be filled by the private contractors)

In accordance with all the terms and conditions of the current ..... Municipality's Rates, Rules and Regulations, the special permit conditions accompanying this permit, and all applicable rules, laws and regulations of Government of Telangana, permission is hereby granted to:

NAME OF PERMITTEE:_____

ADDRESS:_____

For the disposal of septage from domestic septic tank or commercial holding tank at the

_____ STP.

This Permit is based on information provided in the Septage Transporter Permit application which constitutes the Septage Management Permit.

This Permit is effective for the period set forth below, may be suspended or revoked for Permit Condition Non Compliance and is not transferable. The original permit shall be kept on file in the Permittee's office. A copy of this Permit shall be carried in every registered vehicle used by the permittee.

EFFECTIVE DATE: _____

EXPIRATION DATE: _____

Permit is liable to be cancelled in case of violations of any Acts, Rules and Regulations relating to the operation of Septage System or in cases of safety protocols not being adhered to or in case of non-permitted disposals.

ANNEXURE D-6
APPLICATION FORM FOR THE LICENSE TO COLLECT, TRANSPORT AND DISPOSE SEPTAGE

APPLICANT DETAILS		
Full Name of Applicant (registered vehicle owner or provide a copy of lease agreement):		
Contact Details of the Applicant:	Telephone:	
	Mobile:	
	E-Mail:	
Registered Address:		
Postal Address (for correspondence):		
VEHICLE DETAILS Garage Location (regular garaging address for vehicle):		
Vehicle Make and Model:	Registration Number:	
Body Type:	Net Carrying Capacity (tonnes):	Year of Manufacture:
Additional Equipment (e.g., GPS, Vacuum/Suction arrangement etc) Details:		
Vehicle Inspection Certificate: (Emissions & Safety)	Validity:	
DECLARATION-Your application will not be accepted unless the declaration is completed and signed		
I hereby declare that the information provided in this application is true and correct		
I also declare that the vehicle, registration number_____, is fit for the purpose of transporting the prescribed wastes specified in this permit application		
Signature* (1) _____ (2) _____Date: _ _/_ _/_ _ _ _ Second signature only required if the applicant is a partnership		
* If a company, a person of authority must sign and date and complete the following:		

CHECKLIST — to be completed by the applicant	Tick ☑
Declaration (above) read and signed	
List of types of waste to be transported	
Appropriate insurance policy is maintained for the vehicle	
Three photographs of the vehicle (front, side and rear view) in JPG format	

Do not send a fee with this application – permit fee will be determined on receipt of the application

ANNEXURE D-7
SEPTAGE MANAGEMENT RESOLUTION – [Name of ULB]

AN EXAMPLE OF SEPTAGE MANAGEMENT RESOLUTION FOR GUIDANCE OF ULBs.

Septage Management Resolution

MUNICIPAL CORPORATIONOF [Name of ULB}

Resolution No:

Introduced by: ……

A RESOLUTION TO REGULARISE THE PROCESS OF SEPTAGE COLLECTION AND CONVEYANCE AND DISPOSAL INTO TREATMENT FACILITY FOR MUNICIPAL CORPORATION OF [Name of ULB] FOR ALL SEPTAGE GENERATED IN THE (Name of ULB)PURSUANT TO THE POWER AND AUTHORITY CONTAINED IN ……

By the Council: DD/MM/YYYY

Introduced, read the first time, and order posted,
……
……

Byorder

RESOLUTION NO: ……

A Resolution To Regularize The Process Of Septage Collection, Conveyance And Disposal Into Treatment Facilityfor Municipal Corporation Of [Name of ULB] For All Septage Generated Inthe [Name of ULB] Pursuant To The Power And Authority Contained In ……

WHEREAS, said Septage Management Plan is necessary for the protection of health and hygienic conditions of the public, water bodies and environment of ULB area;and

WHEREAS, in order to protect the health and hygienic conditions of the public, water bodies and environment, [Name of ULB] is required to adopt a plan for collection, conveyance and disposal of Septage generated in ULB; and

WHEREAS, currently the practices of unscientific collection, conveyance and disposal must be controlled/ended and proper Septage management plan needs to be implemented in [Name of ULB]; and

WHEREAS, the Septage Management Plan has been prepared in compliance with the guidelines laid by CPHEEO under MoHUA, Government of India.

YOU, THEREFORE, be it is resolved by the [Name of ULB] asfollows;SECTION 1: The [Name of ULB]has resolved to issue the following guidelines for Collection and conveyance of Septage generated in the ULB limits and disposal into the Septage Treatment Plant at …….. as given below:

Be it further resolved that this Resolution shall take effect immediately upon its date of passage.

GUIDELINES FOR SEPTAGE COLLECTION, CONVEYANCE AND DISPOSAL

1. The [Name of ULB] has decided to regularize the process of collection and conveyance of the Septage generated in the Corporation area and disposal into the Septage Treatment Plant at …….. through licensed septic tank cleaning service providers.
2. The [Name of ULB] has decided to authorize …… to issue license/ permit for the tankers to collect and conveyance of septage with in the corporation limits
3. Accordingly, all septic tank cleaning service providers must be registered with the ……., and obtain license on an annual basis. The license or permit will be issued to the private septage collection operators/owners by the ----- after evaluating the condition of the septage collection vehicles (vacuum tankers) in their possession. A fitness certificate shall also be obtained for all the registered vehicles by the owners, from the Transport Authority.
4. The vacuum tankers of different capacities such as 2000, 3000, 4000, 5000, 6000 and 8000 liters shall be used by the operators for the collection of septage. The vacuum tankers shall be LCV chassis mounted machines with suction unit capable of de-sludging the septage from the septic tanks. The contents of the sludge tank can then be transported to any desired destination for disposal and emptied by means of hydraulic tipping of the tank. The vacuum tankers shall be painted brown color to differentiate from the water supply tankers and shall also have the rear end connected with a 4 inch pipe for disposal into the septage receiving tank at the treatment facility. For higher capacity tankers fitted with 6, 8 or 12 inch pipes, a reducer shall be made available with the tanker for easy disposal into the treatment facility.

LCV Chassis Mounted Vacuum Tanker

Hoses, clamps and fittings used to connect the main hose to the tanker and hoses to each other are critical for proper suction and pressure operations. Clamp style fittings shown in fig: ensure a tight, leak-proof connection.

5. All the tankers shall be fitted with a GPS based tracking system to monitor the movement of the collection tankers to avoid illegal dumping. Vehicles with GPS based tracking system will only be issued valid license.

6. Municipal Corporation will set limits for the amount, by liter, of septic waste allowable per disposal from a septic waste disposal vehicle. If the amount of septic waste contained in the septic waste disposal vehicle exceeds the limits set by Corporation through policy, the waste water treatment plant has the right to refuse that septic waste disposal vehicle's disposal in total or in part. Provision shall be made for the septic waste disposal company/vehicle owner for fixing up the booking at the Septage Treatment Plant for the disposal of septage collection carried out in a day, so that the situation of excess truck loads coming to the plant can be avoided.

7. The Corporation will determine the days and hours during which septic waste maybe disposed of at the waste water treatment plant, preferably the night hours from 10.00pm to 4.00 am.

8. Any licensed operator who fails to carry out the collection, conveyance and disposal of septage in the manner set out by the (Name of ULB) and _____on the first failure to comply will receive a temporary suspension of 30 days of their license and receive a temporary suspension of 90 days of their license on the second failure to comply.

9. All the septic waste originating from the Name of ULB) is to be disposed at the designated Septage Treatment Plants in (Name of ULB)_____. Any person discharging or causing to be discharged septic waste into a wastewater treatment plant shall only dispose domestic septic waste from a private septic waste system to the septage treatment plant, and the septic waste shall not contain any hazardous substances which may cause harm to the treatment process.

10. Any household or other premise situated in any area which is not connected to a public sewerage system and with sufficient onsite sanitation systems for effective disposal of sewage, shall dispose of the septage, every 2-3 years, only through the licensed septic waste disposal service providers of (Name of ULB)and not through any other means, failing which a heavy penalty of INR …… shall be levied by the (Name of ULB). If the licensed septic waste disposal service providersdispose the septage collected to any other location other than the designated Septage Treatment Plant/ designated facility, a heavy penalty of INR ……/- shall be imposed and the license of the company/driver shall be cancelled.

ANNEXURE E
FINANCIAL

ANNEXURE E-1
STRATEGIES TO FILL THE GAP BETWEEN INVESTMENTS AND QUALITY OF SERVICES

STRATEGY	DESCRIPTION
Service Specific Escrow Accounts	Escrow Accounts are ringfenced accounts with defined usage. The grants for wastewater from various sources shall be pooled in these escrow accounts, preventing its misuse. Further, the fund disbursal from these escrow accounts should be linked to the institutional reforms, financial sustainability of various deployment options and necessary output such as Key Performance Indicators to keep a check on the fund usage
Private funding	PPP fill the financing gap by bringing its own source of funding as debt/equity as mentioned above
Scale in fund usage	Fund usage indirectly follows the economics of scale provided by economics of scale in large projects and hence rather than following a piece-meal input driven approach in fund usage, a holistic output driven approach shall be followed

Please refer to PPP Tool Kit, Ministry of Finance, & Department of Economic Affairs for more details; https://www.pppinindia.gov.in/toolkit/; https://www.pppinindia.gov.in/

ANNEXURE E-2: VARIOUS CONTRACTUAL MODALITIES – FUNCTIONAL PRIVATIZATION

CONTRACTUAL MODALITY	DESCRIPTION
Service / outsourcing Contracts	These involve engaging private operator for operations and maintenance of discreet activities with limited scope of work across the value chain in key urban services. In this modality, the private operator is generally engaged for a short time span – two to three years, and does not face any revenue risks while the ULBs suffer from quality services risk
Management Contracts	These involve a range of modalities from engaging technical experts to outsourcing the management of a significant part of operations and maintenance operations across the value chain in key urban services. However, the private operator faces very little commercial risks and hence a low risk option for private operators. These contracts don't pass on the design, technology and operational risks to the private operator and suffer from poor design as well as lack of innovations and hence fail to meet the objective of providing quality services
Affermage / Leasing Contracts	Though similar to management contracts, these involve engaging a private operator who brings in the working capital required for various operations with no capital investments for infrastructure expansion or rehabilitation. The private operator further takes on the partial/complete commercial risks from user charge collection from citizens, without taking the designing/financing/implementation risks, for provisioning of urban services. This modality of contracts is more relevant for ULBs wherein the population growth is constant and hence the demand for urban services does not increase, requiring no further capital investment. However, considering the population growth in ULBs across Telangana, and lack of a strong regulatory system that sets the tariffs for wastewater services, this option is not a very efficient one to meet the objective of providing quality services.
BOT (Build Operate Transfer) Contracts	These involves the private operators designing the system, operating it (without owning the assets) and transferring to the cities after completion of Concession Period. Thus, the private operator, takes on the designing risk, technology risks and operational risks till transfer the assets. In these, the Key Performance Indicators are identified w.r.t the output from the projects and hence incentivize or penalize the private operator for meeting or missing the performance standards. However, this model doesn't bring any financing from the private operator and hence can only be applied to only cash-rich ULBs
BTO (Build Transfer Operate) Contracts	These involves the private operators designing the system, and handing it over to the cities once it is operational while operating it for a certain period of time. Therefore, the private operator passes on the design risk and technology risk to the Authority once the project is operational while retaining the operational risks for the contracted period.
BOOT (Build own operate and Transfer)	BOOT model is similar to BOT but in this case private operator takes the financing risks and hence brings a part/full investment for the project. The projects are designed, built, financed, and owned by private operator for the concession period and transferred to the cities at end of concession period. These contracts follow an annuity model (annual payment) or a quantity (input/output) linked model depending on who takes the demand risk. Generally, in such contracts, a part fixed and part variable fee model/ take or pay mechanisms are introduced to spread the demand risk among stakeholders
Term Contracts	These involve transferring the ownership of existing projects to a private operator and the private operator finances, refurbishes, expands and operates the projects before transferring it to the government at the end of Concession Period. These contracts are majorly applied to brown field water/waste water projects

[9]Please refer to PPP Tool Kit, Ministry of Finance, &Department of Economic Affairs for more details; https://www.pppinindia.gov.in/toolkit/; https://www.pppinindia.gov.in/

ANNEXURE E-3
FACTORS[11] INFLUENCING THE CHOICE OF PROCUREMENT STRATEGY

FACTORS	IMPACT DESCRIPTION
Differential from Service Standards	The procurement strategy will depend on the current level of services level w.r.t service standards (service level benchmarks) in the ULBs. A city with higher differential from service level benchmarks will need larger investment, technological innovations, and manpower deployment to achieve the objectives than a city with a lower differential. Further, smaller cities fail to attract any private operator due to lack of scale in operations, hence "Cluster Based" Procurement strategy shall be adopted.
Differential from Service Standards	Technology/Design intensity of the process needed for wastewater and septage management will define the procurement strategy to be adopted to fill the gap. For example – for collection process of wastewater basic service contracts or manpower outsourcing can be done but for the outsourcing needs to transfer the technology risks as well as have performance standards & penalties for various activities.
Affordability of the cities	The financials of the ULB and hence the paying capacity will have a key impact of the alternative strategy for filling the service gap leading to adopting a piece-meal or hybrid of various procurement strategies
Current modality and allowed modalities of the providing services	The current modality of provision of services will drive the procurement models for gap filling. For example - if the cities have a large number of manpower on permanent contracts then removing them will cause social unrest and hence they need to be absorbed into the system or deputed to private operator, leading to a requirement of a management contract rather than plain service contracts

[10]Please refer to PPP Tool Kit, Department of Economic Affairs for more details; https://www.pppinindia.gov.in/

ANNEXURE F
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