CHAPTERS

CHAPTER 1: INTRODUCTION

Perhaps we need to be reminded what Mahatma Gandhi said ***"For India, Sanitation is more important than independence".***

1.1 PREAMBLE

Over the years, there has been a continuous migration of people from rural and semi-urban areas to cities and towns. The proportion of population residing in urban areas has increased from 27.8% in 2001 to 31.2 % in 2011. The number of towns has increased from 5,161 in 2001 to 7,935 in 2011. The uncontrolled growth in urban areas has left many Indian cities deficient in infrastructure services as water supply, sewerage, storm water drainage and solid waste management.

Most of the urban areas inhabited by slums in the country are plagued by acute problems related to indiscriminate disposal of sewage. It is due to the deficient services of the town / city authorities that sewage and its management has become a tenacious problem, even though a large part of the municipal expenditure is allotted to it. It is not uncommon to find that a large portion of resources is being utilized on manning sewerage system by Urban Local Bodies (ULBs) for their operation and maintenance (O&M). Despite this, there has been a decline in the standard of services with respect to collection, transportation, treatment and safe disposal of treated sewage as well as measures for ensuring safeguard of public health, hygiene and environment. In many cities and towns in India, major portion of sewage remains unattended leading to insanitary conditions in densely populated slums. This in turn results in an increase in morbidity especially due to pathogens and parasitic infections and infestations in all segments of population, particularly the urban slum dwellers.

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. The main cause of water pollution is the unintended disposal of untreated, partly treated and non-point sources of sewage and more important is its effect on human health and environment.

The reasons for the above cited position are:

1. Almost all local bodies not being financially resourceful to self-generate the required capital funds and looking up to the State and Central Governments for outright grant assistance
2. Lack of institutional arrangements and capacity building to conceive planning, implementation, procurement of materials, operate and maintain the sewerage system and sewage treatment plants (STP) at the desired level of efficiency

3. The fact that the collected sewage terminates far away beyond the boundaries of the ULB and is an “out of sight, out of mind” syndrome

4. The high cost of infrastructure investment, continual replacement and on-going O&M costs of centralized sewerage system (CSS) facilities take these systems beyond the financial grasp of almost any ULB in the country

5. It is also necessary to recognize that the practice of piped sewer collection is an inheritance from advanced countries with high water usages, which permit adequate flushing velocities. Due to their high per capita water supply rates, the night-soil does not settle in pipes and hence no choking and no sulphide gas generation. Whereas, in the Indian scenario, the per capita water supply is low and inequitable in many cities and that too intermittent and this results in settling down of night-soil in the sewers, choking, gasification, etc., which necessitates very often the extreme remedies of cutting open the roads to access and break open the pipes for rectification and so on.

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.

1.1.1 Need for Safe Sanitation System

Sanitation can be perceived as the conditions and processes relating to people’s health, especially the systems that supply water and deal with the human waste. Such a task would logically cover other matters such as solid wastes, industrial and other special / hazardous wastes and storm water drainage. However, the most potent of these pollutants is the sewage.

When untreated sewage accumulates and is allowed to become septic, the decomposition of its organic matter leads to nuisance conditions including the production of malodorous gases. In addition, untreated sewage contains numerous pathogens that dwell in the human intestine tract. Sewage also contains nutrients, which can stimulate the growth of aquatic plants and may contain toxic compounds or compounds that are potentially mutagenic or carcinogenic.

For these reasons, the immediate and nuisance-free removal of sewage from its sources of generation followed by treatment, reuse or dispersal into the environment in an eco-friendly manner is necessary to protect public health and environment.

1.1.2 Present Scenario of Urban Sanitation in India

The problem of sanitation is much worse in urban areas due to increasing congestion and density in cities. Indeed, the environmental and health implications of the very poor sanitary conditions are a major cause for concern. The study of Water and Sanitation Programme (WSP) of the World Bank observes that when mortality impact is excluded, the economic impact for the weaker section of the society accounting to 20 % of the households is the highest. The National Urban Sanitation Policy (NUSP) of 2008 has laid down the framework for addressing the challenges of city sanitation. The NUSP emphasizes the need for spreading awareness about sanitation through an integrated city-wide approach, assigning institutional responsibilities and due regard for demand and supply considerations, with special focus on the urban poor.

As per the 2011 Census, 81.4% households have toilet facilities within their premises. This includes 70.9% households having water closets; 8.8% households having pit latrines; 1.7% households having other toilets (connected to open drains, night soil removed by human etc., which are unsafe). Out of the 70.9% households, 32.7% households have water closets connected to sewer system and 38.2% households are having water closets with septic tank.

The remaining 18.6% households do not have toilet facilities within their premises. This includes 6.0% households using public toilets and 12.6% households defecating in the open. As per the 2011 census, the status of toilets in urban households in India is shown in Figure 1.1.

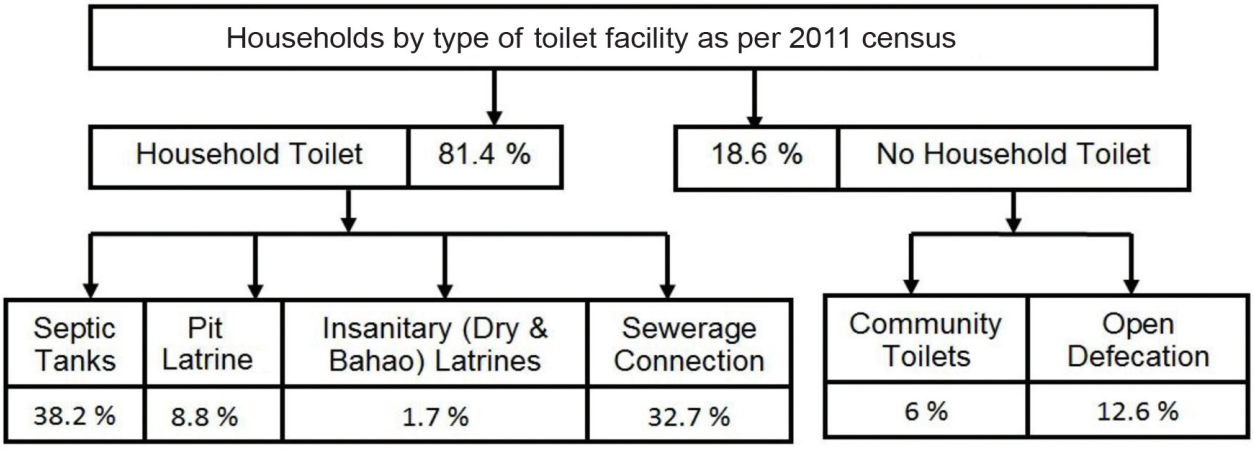

Figure 1.1 Status of Toilets in Urban Households in India

According to the report on the Status of Wastewater Generation and Treatment in Class-I Cities and Class-II towns of India, December 2009, published by Central Pollution Control Board (CPCB), the estimated sewage generation from 498 Class-I cities and 410 Class-II towns (Population estimated for 2008 based on 2001 census) together is 38,524 MLD. Out of this, only 11,787 MLD (31%) is being treated with a capacity gap of 26,737 MLD.

Sewer networks for collection and transportation of sewage from households in cities and towns are too inadequate to carry it to the STP. The STP capacities are inadequate due to many reasons.

These are poor planning and implementation of sewerage and STP and other appropriate sanitation facilities by ULBs due to inadequate financial resources and lack of adequate capacity of ULBs in the country.

This imposes significant public health and environmental costs to urban areas, that contribute more than 60% of the country's GDP. Impacts due to poor sanitation are especially significant for the urban poor (22% of total urban population), women, children and the elderly. The loss due to diseases caused by poor sanitation for children under 14 years alone in urban areas amounts to Rs. 500 crores at 2001 prices (Planning Commission-United Nations International Children Emergency Fund UNICEF, 2006). Inadequate discharge of untreated domestic / municipal sewage has resulted in contamination of more than 75 % of all surface waters across India.

1.1.3 Basic Philosophy of Sewage Treatment

Sewage when collected from communities can be perceived as a "water conveyor belt". Its treatment can be perceived as "unloading the conveyor belt" to make the belt useable again. The crucial issue is water in the conveyor belt. Hence, the treated sewage must ultimately return to the receiving water body or to the land or it could be reused for specific applications after appropriate treatment.

The complex question faced by the design engineers and the practicing engineers are :

What is the level of treatment that must be achieved in a given type of treatment beyond those prescribed by the discharge standards to ensure protection of the health of the community and the environment?

The answer to this question requires detailed analyses of local conditions and needs, application of scientific knowledge, engineering judgment based on past experience & consideration of central, state and local regulations. In some cases, a detailed assessment is required. The reuse and disposal of sludge are vexing problems for some ULBs and requires careful consideration.

1.1.4 Sewerage and Sewage Treatment Technology

Sewerage and Sewage treatment technology is the branch of environmental engineering. The basic principles of engineering are applied to solve the issues associated with collection. The basic principes of biochemistry are applied to the treatment and environmental issues in the disposal and reuse of treated sewage. The ultimate goal is the protection of public health in a manner commensurate with environmental, economic, social and political concerns. To protect public health and environment, it is necessary to have knowledge of:

1. Constituents of concern in sewage
2. Impacts of these constituents when sewage is dispersed into the environment
3. The transformation and long-term fate of these constituents in treatment processes
4. Treatment methods which can be used to remove or modify the constituents found in sewage
5. Methods for beneficial use or disposal of solids generated by the treatment systems

To provide an initial perspective in the field of sewerage and sewage treatment technology, a common terminology is first defined followed by:

1. A discussion of the issues that need to be addressed in the planning and design of sewerage management systems, and
2. The current status and new directions in sewerage and sewage treatment technology

1.1.5 Efforts of Concerned Agencies in Retrospect

Sewerage and sanitation were not accorded the due priority by the ULBs till the late seventies. The impetus of the International Drinking Water Supply and Sanitation Decade (IDWSSD), 1981 to 1990 had produced considerable efforts in urban areas in the country to improve health by investment in water supply and sanitation programmes. These comprise the sewerage and sanitation sub-sector the construction of sewers & on-site sanitation facilities using various types of toilets. Under certain hydrological conditions, unsewered sanitation can cause severe groundwater contamination by pathogens and nitrate, which may largely negate the expected health benefits of such programmes. In some circumstances, therefore, the low-cost-technologies may be incompatible.

Although the targets fixed for sewerage and sanitation coverage during the decade at the beginning of the IDWSSD were laudable, but could not be achieved due to resource constraints and other prevailing reasons. Due to these reasons, the condition of sanitation has worsened.

1.2 LOSS TO THE NATION DUE TO POOR SANITATION

1.2.1 Time and Money Loss in terms of DALYs

The Disability-Adjusted-Life-Years (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill health, disability or early death. Originally developed by the World Health Organization (WHO), it is becoming increasingly used in the field of public health and health impact assessment (HIA). It extends the concept of potential years of life lost due to premature death to include equivalent years of 'healthy' life lost by virtue of being in states of poor health or disability. In doing so, mortality and morbidity are combined into a single common-matrix.

As per the WHO report, 80 % of the diseases in human beings are water-borne and water-related. It is mainly due to water pollution or water contamination and water logging. Though water logging may be location and weather specific, water pollution and contamination is a common phenomenon which can occur at any place at any point of time if the community is not careful about adverse impact of indiscriminate disposal of sewage. The indiscriminate disposal of human excreta or sewage from habitations may contain hazardous micro-organisms (pathogens) for water pollution and harbouring vectors which act as carriers of pathogens.

The names of diseases mentioned in Table 1.1 (overleaf) might appear to be conventional which occur in many parts of the country. The occurrence of such diseases depends upon various factors relating to illiteracy, personal hygiene, standard of living, malnutrition, adulteration of food items, lack of community awareness among all stakeholders and other factors related to environmental pollution.

Table 1.1 Burden of water related diseases in India, 1990

(In millions of DALYs)

Diseases	Female	Male	Total
Diarrheal Diseases	14.39	13.64	28.03
Intestinal Helminths	1.00	1.06	2.06
Trachoma	0.07	0.04	0.11
Hepatitis	0.17	0.14	0.31
Total – water-borne and water-related Diseases	15.63	14.88	30.51

Source: World Bank, 1993

There is no doubt that these factors play an important role in the occurrence of diseases but unsafe disposal of untreated or partially treated sewage plays a vital role in aggravating the chances of occurrence of these communicable diseases.

If we merely consider the economic value of life years at the average per capita income of $ 300 per year, the annual loss of 30.51 million DALYs is worth of 30.51×300 = $ 9.153 billion (Exchange rate during 1993, $1 = Rs 40). Improvements in water supply and sanitation including management of municipal solid waste can substantially reduce the incidences and severity of these diseases, as well as infant mortality associated with diarrhoea as shown in the following box:

Reduction in morbidity from better water supply and sanitation including safe disposal of municipal solid waste is estimated to be 26 % for diarrhoea, 27 % for trachoma, 29 % for ascaris, 77 % for schistosomiasis and 78 % for dracunculiasis. Mean reduction in diarrhoea-specific mortality can be 65 %, while overall child mortality can be reduced by 55 %.

Source: Esrey et. al., 1991

From the above statements and Table 1.1, it is evident that environmental pollution by liquid and solid wastes adversely affects the environment and human health directly or indirectly resulting in loss of life and heavy financial burden on exchequers.

1.2.2 Poor Sanitation Costs India $54 Billion

It has been reported from “The Economic Impact of Inadequate Sanitation in India” a report released by the Water and Sanitation Programme (WSP), states that inadequate sanitation costs India almost $54 billion or 6.4% of the country’s Gross Domestic Product (GDP) in 2006. Over 70% of this economic impact or about $38.5 billion was health-related with diarrhoea followed by acute lower respiratory infections accounting for 12% of the health-related impacts.

It is the poorest who bear the greatest cost due to inadequate sanitation. The poorest fifth of the urban population bears the highest per capita economic impact of $ 37.75, much more than the national average per capita loss due to inadequate sanitation, which is $ 21.35.

Health impacts, accounting for the bulk of the economic impacts, are followed by the economic losses due to the time spent in obtaining piped water supply and sanitation facilities, about $15 billion, and about $0.5 billion of potential tourism revenue loss due to India's reputation for poor sanitation, the report says. Table 1.2 gives a glimpse of 'How much we lose'.

Table 1.2 Poor sanitation cost to India

No.	Impact	Loss ($ billion)
1.	Health	38.5
2.	Access time (safe WSS)	15.0
3.	Tourism	0.5
	Total	54.0

Source: World Bank, 2006

The challenge of sanitation in Indian cities is acute. With very poor sewerage networks, a large number of urban poor still depend on public toilets. Many public and community toilets have no water supply while the outlets of many other toilets with water carriage systems are not connected to city's sewerage system. As per the estimate, over 50 million people in urban India defecate in the open every day. The cost in terms of Disability Adjusted Life Years (DALY) of diarrhoeal diseases for children from poor sanitation is estimated at Rs. 500 crores. The cost per DALY per person due to poor sanitation is estimated at Rs. 5,400 and due to poor hygiene practices at Rs. 900. A study by the WSP using data for 2006 shows that the per capita economic cost of inadequate sanitation including mortality rate in India is Rs. 2,180.

As mentioned above, the impacts of poor sanitation on human health are significant. Unsafe disposal of human excreta facilities are responsible for the transmission of oral-faecal diseases, including diarrhoea and a range of intestinal worm infections such as hookworm and roundworm. Diarrhoea accounts for almost one-fifth of all deaths (or nearly 535,000 annually) among Indian children who are under 5 years. In addition, rampant worm infestation and repeated diarrhoea episodes result in widespread childhood malnutrition. Moreover, India is losing millions of rupees each year because of poor sanitation. Illnesses are costly to families and to the economy as a whole in terms of productivity losses and expenditure on medicines, health care, etc. The economic toll is also apparent in terms of water treatment costs, losses in fisheries production, tourism, welfare impacts such as reduced school attendance, inconvenience, wasted time, lack of privacy & security for women. On the other hand, ecologically sustainable sanitation can have significant economic benefits that accrue from recycling nutrients and using biogas as an energy source.

1.3 SECTOR ORGANIZATION

Water supply and sanitation is treated as a state subject as per the Federal Constitution of India and, therefore, the States are vested with the constitutional right on planning, implementation, operation and maintenance and cost recovery of water supply and sanitation projects.

At the local level, the responsibility is entrusted by legislation to the local bodies like Municipal Corporation, Municipality, Municipal Council and Notified Area Committee/Authority for towns or on a State/Regional basis to specialized agencies. The economic and social programme of the country is formulated through five-year plans.

The Public Health Engineering Department (PHED) is the principal agency at State level for planning and implementation of water supply and sanitation programmes. In a number of States, statutory Water Supply and Sanitation Boards (WSSBs) have taken over the functions of the PHEDs. The basic objectives for creation of WSSBs have been to bring in the concept of commercialization of the water supply and sanitation sector management and more accountability. Such boards have been set up in Assam, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Uttar Pradesh and Tamil Nadu. The metropolitan cities of Bangalore, Hyderabad and Chennai have separate statutory Boards. The water supply and sanitation services in the cities of Ahmedabad, Delhi, Kolkata, Mumbai, Pune and few other cities are under the Municipal Corporations.

The Ministry of Urban Development (MoUD), Government of India (GOI) formulates policy guidelines in respect of Urban Water Supply and Sanitation Sector and provides technical assistance to the States and ULBs wherever needed. The expenditure on water supply and sanitation is met out of block loans and grants disbursed as Plan assistance to the States, and out of loans from financial institution like Life Insurance Corporation of India (LIC) and Housing and Urban Development Corporation (HUDCO). The Central Government acts as an intermediary in mobilizing external assistance in water supply and sanitation sector and routes the assistance via the State plans. It also provides direct grant assistance to some extent to water supply and sanitation projects in urban areas under the various programmes of GOI.

1.4 INITIATIVES OF GOVERNMENT OF INDIA

Government of India has taken number of initiatives during the last two decades by implementing number of reforms aimed at improving the working efficiency of ULBs in India. These reforms have been implemented in the form of Act (Amendment) and all the State Governments have been advised to implement these reforms by suitably modifying ULB's bye-laws so as to achieve the objectives of these reforms for the development of urban sector in the country. Few of the reforms such as institutional, financial, legal, etc., are in vogue. The reforms mainly relating to sewerage and sanitation are briefly described as under.

1.4.1 Initiative on Reforms – 74th Constitution Amendment Act, 1992

Quite often, multiplicity of agencies and overlapping of responsibilities are the reasons for ineffective and poor operation and maintenance of the assets created by civic bodies. In the light of 74th Amendment under the 12th Schedule of the Constitution, the role and responsibility of the ULBs have increased significantly in providing these basic facilities to the community on a sustainable basis. The new Amendment has enabled ULBs to become financially viable and technically sound to provide basic amenities to the community.

As per the 74th Constitution Amendment Act, 1992, the ULBs have been delegated with sets of responsibilities and functions; however, they are not supplemented with adequate financial resources. As a result, they are not able to perform their assigned functions in an efficient and effective manner. They are also not able to fix the rates of user charges and are heavily dependent upon the higher levels of Government grants. Consequent to the 74th Constitutional Amendment Act (74th CAA), the States are expected to devolve responsibility, powers and resources upon ULBs as envisaged in the 12th Schedule of the Constitution. The 74th CAA has substantially broadened the range of functions to be performed by the elected ULBs. The 12th Schedule brings into the municipal domain among others such as urban and town planning, regulation of land-use, planning for economic & social development and safeguarding the interests of weaker sections of the society.

The Constitution thus envisages ULBs as being totally responsible for all aspects of development, civic services and environment in the cities going far beyond the traditional role. The focus should not only be on the investment requirements to augment supplies or install additional systems in sanitation and water supply. Instead, greater attention must be paid to the critical issues of institutional restructuring, managerial improvement, better and more equitable service to citizens who must have a greater degree of participation. The 74th CAA also focuses on achieving sustainability of the sector through the adoption of adequate measures in O&M, the financial health of the utilities through efficiency of operations and levy of user charges, and conservation & augmentation of the water sources.

1.4.2 THE PROHIBITION OF EMPLOYMENT AS MANUAL SCAVENGERS AND THEIR REHABILITATION ACT, 2013

The Government of India has enacted The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 in September 2013 to remove certain anomalies in the erstwhile legislation of The Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993.

The 1993 Act served as a primary instrument to eradicate practice of manual scavenging, but the House listing data from Census, 2011 showed the existence of manual scavenging in many of the States. The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013, provides for the following distinction very clearly to end this dehumanizing practice of manual scavenging and also to eliminate the hazardous cleaning of septic tanks and sewers by the sanitary workers.

- Prohibits insanitary latrines.
- Prohibits hazardous manual cleaning of sewers and septic tanks.
- Offences committed under the law is cognizable and non-bailable.
- Appropriate governments shall confer powers on local authority and district magistrates.
- Vigilance and Monitoring committee to be set up at the level of sub-division, District, State and Central to monitor the implementation of the Act.
- The responsibility of the local authorities under the Act is mandatory.

The Centrally sponsored scheme of Integrated Low Cost Sanitation scheme implemented by the Ministry of Housing and Urban Poverty Alleviation (MoHUPA) for liberation of the scavengers was started in year 1980-81. It is now being operated through MoHUPA.

As per the scheme's revised guidelines 2008, the objectives of the scheme are

- To convert / construct low cost sanitation units through sanitary two pit pour flush latrines with superstructures and appropriate variations to suit local conditions and
- To Construct new latrines where the economically weaker section (EWS) households have no latrines and
- To avoid the inhuman practice of defecating in the open in urban areas.

This would improve the overall sanitation in towns. The manual scavengers thus liberated if any or their dependents would have to be rehabilitated under the scheme by the State Governments simultaneously with the help of funds provided by the Ministry of Social Justice and Empowerment (MoSJE).

As per the Gazette of India dated October 2013, the Act shall come into force from December 6, 2013. The text of the Act as in the Gazette is in Appendix A 1.1. The time frame specified under the Act for the fulfilment of responsibilities and carrying out certain activities are mentioned in Appendix A 1.2.

1.5 NATIONAL URBAN SANITATION POLICY (NUSP), 2008

The NUSP adopted by the MoUD in 2008, envisions that "All Indian cities and towns become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens, with a special focus on hygenic and affordable sanitation facilities for the urban poor and women"

According to the NUSP ''Sanitation is defined as safe management of human excreta, including its safe confinement treatment, disposal and associated hygiene-related practices''.

1.5.1 Key Sanitation Policy Issues

In order to achieve the above vision, following key policy issues must be addressed

- Poor Awareness: Sanitation has been accorded low priority and there is poor awareness about its inherent linkages with public health.
- Social and Occupational aspects of Sanitation: Despite the appropriate legal framework, progress towards the elimination of manual scavenging has shown limited success, Little or no attention has been paid towards the occupational hazard faced by sanitation workers daily.
- Fragmented Institutional Roles and Responsibilities: There are considerable gaps and overlaps in institutional roles and responsibilities at the national, state, and city levels.

- Lack of an Integrated City-wide Approach: Sanitation investments are currently planned in a piece-meal manner and do not take into account the full cycle of safe confinement, treatment and safe disposal.
- Limited Technology Choices: Technologies have been focussed on limited options that have not been cost-effective and sustainability of investments has been in question.
- Reaching the Un-served and Poor: Urban poor communities as well other residents of informal settlements have been constrained by lack of tenure, space or economic constraints, in obtaining affordable access to safe sanitation. In this context, the issues of whether services to the poor should be individualized and whether community services should be provided in non-notified slums should be addressed. However provision of individual toilets should be prioritized. In relation to “Pay and Use” toilets, the issue of subsidies inadvertently reaching the non-poor should be addressed by identifying different categories of urban poor.
- Lack of Demand Responsiveness: Sanitation has been provided by public agencies in a supply driven manner, with little regard for demands and preferences of households as customers of sanitation services.

1.5.2 National Urban Sanitation Policy Goals (NUSP)

The overall goal of this policy is to transform urban India into community-driven, totally sanitized, healthy, and liveable cities and towns. The specific goals are:

a. Awareness generation and behaviour change

b. Open defecation free cities

c. Integrated city-wide sanitation

1.5.3 Concepts of Totally Sanitized Cities

A totally sanitized city will be one that has achieved the outputs or milestones specified in the NUSP, the salient features are given below.

a. Cities must be open defecation free.

b. Must eliminate the practice of manual scavenging and provide adequate personnel protection equipment that addresses the safety of sanitation workers.

c. Municipal sewage and storm water drainage must be safely managed.

d. Recycle and reuse of treated sewage for non-potable applications should be implemented wherever possible.

e. Solid waste collected and disposed off fully and safely.

f. Services to the poor and systems for sustaining the results.

g. Improved public health outcomes and environmental standards.

1.6 SANITATION PROMOTION

In order to rapidly promote sanitation in urban areas of the country (as provided for in the NUSP and Goals 2008), and to recognize excellent performance in this area, the GOI intends to institute an annual rating award scheme for cities (NUSP 2008).

The MoUD is also promising a National Communication Campaign to generate awareness on sanitation both at the household level and at the service provider level. The aim of this exercise is to generate awareness of the benefits of hygiene and clean environment and thereafter bring about behaviour. The suggested real time Total Sanitation Model is given in Figure 1.2 .

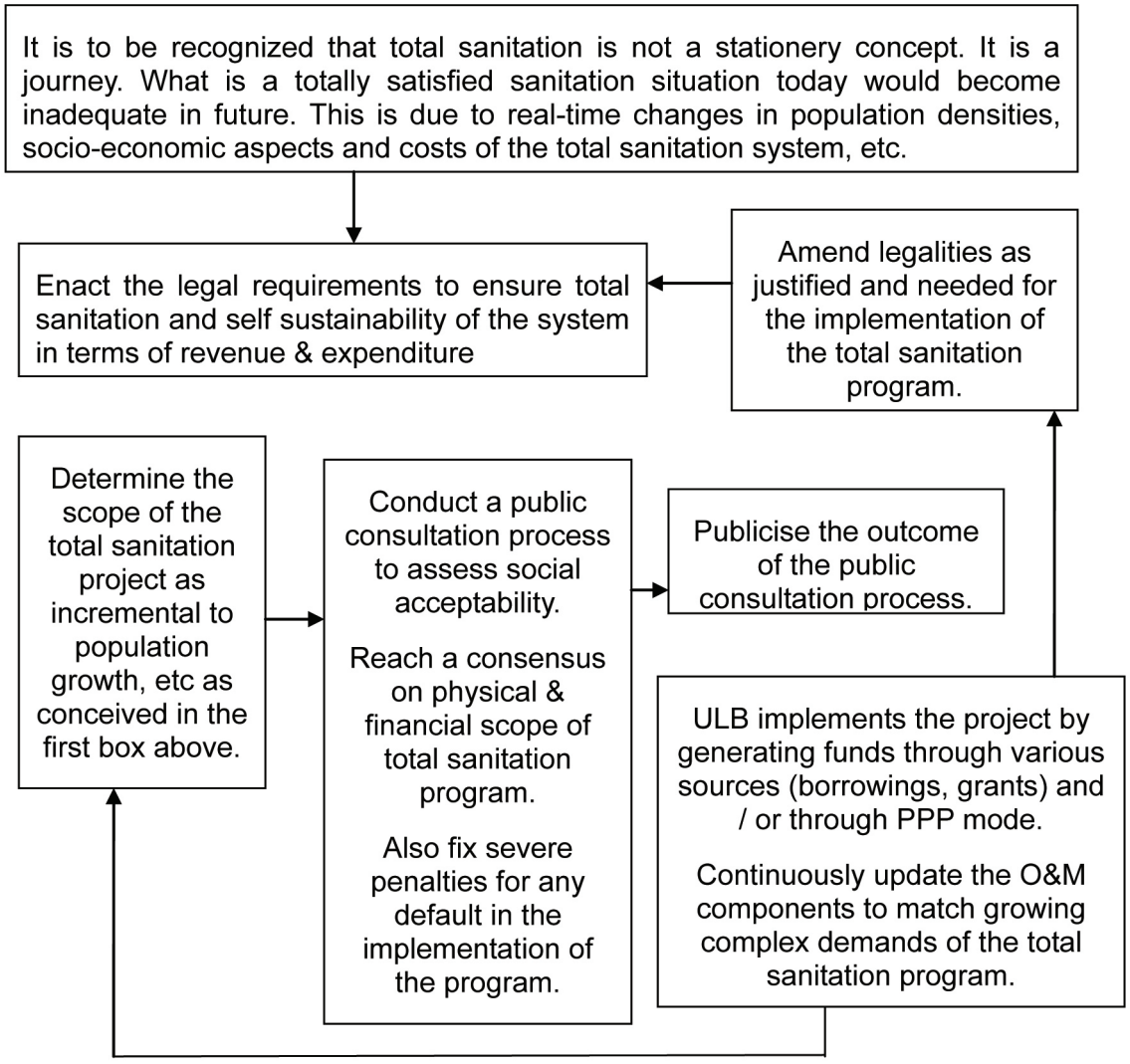

Figure 1.2 Suggested Real Time Total Sanitation Model

1.7 SERVICE LEVEL BENCHMARKING ON SEWAGE MANAGEMENT (SEWERAGE AND SEWAGE TREATMENT)

The Millennium Development Goals (MDGs) enjoins upon the signatory nations to extend access to improved sanitation to at least half the urban population by 2015, and 100% access by 2025.

This implies extending coverage to households with improved sanitation and providing proper sanitation facilities in public places to make cities and towns open-defecation free. The Ministry proposed to shift focus on infrastructure in urban water supply and sanitation sector (UWSS) to improve service delivery.

The Ministry formulated a set of Standardized Service Level Benchmarks (SLB) for UWSS as per International Best Practice and brought out a “Handbook on Service Level Benchmarking” on water supply and sanitation sector during the year 2008.

The SLB on Sewage Management (Sewerage and Sewage management) are given in Table 1.3 which are required to be achieved within a specified time frame.

Table 1.3 Sewage Management (Sewerage and Sanitation)

No.	Proposed Indicator	Benchmark
1.	Coverage of toilets	100%
2.	Coverage of sewage network services	100%
3.	Collection efficiency of sewage network	100%
4.	Adequacy of sewage treatment capacity	100%
5.	Quality of sewage treatment	100%
6.	Extent of reuse and recycling of sewage	20%
7.	Efficiency of redressal of customer complaints	80%
8.	Extent of cost recovery in sewage treatment	100%
9.	Efficiency in collection of sewage charges	90%

Source: MoUD, 2011

1.8 EMERGING TRENDS AND TECHNOLOGIES OF SEWERAGE AND SEWAGE TREATMENT

1.8.1 Recent Trend - Centralized vis-a-vis Decentralized Sewerage Systems

While the conventional sewerage may be a comprehensive system for sewage collection and transport, it also remains as a highly resource-intensive technology. Consequently, high capital cost and significant O&M cost of this system inhibits its widespread adoption in all sizes of urban areas.

The implementation of Centralized Wastewater Management System (CWMS) should not be considered as the only option available for collection, transportation and treatment of sewage. There are certain factors which govern the selection of options between CWMS and Decentralized Wastewater Management System (DWMS). These have been elaborately discussed in the relevant chapter of this Manual.

The DWMS may be designed as the collection, treatment, and disposal/reuse of sewage from individual houses, cluster of houses, isolated communities, industries or institutional facilities as well as from portion of existing communities at or near the point of generation of sewage.

The DWMS maintains both the solids and liquid fraction, although the liquid portion and any residual solids can be transported to a centralized point for further treatment and reuse.

Recognizing the many applications and benefits of sewage reuse, some important points may be kept in view such as

i. Review of the impact of the population growth rate

ii. Review of potential water reuse applications and water quality requirements

iii. Review of appropriate technologies for sewage treatment and reuse

iv. Considering the type of management structure that will be required in the future and

v. Identification of issues that must be solved to bring about water reuse for sustainable development on a broad scale.

It has been emphasized that, if the sewage from the urban and semi urban areas were reused for a variety of non-potable uses, the demand on the potable water supply would be reduced.

The choice of appropriate technology will also depend on several factors such as composition of sewage, availability of land, availability of funds and expertise. Different operation and maintenance options will have to be considered with respect to sustainable plant operation, the use of local resources, knowledge and manpower.

1.9 NEED FOR REVISION AND UPDATING OF THE EXISTING MANUAL ON SEWERAGE AND SEWAGE TREATMENT (1993)

Ever since the publication of the Manual on sewerage and sewage treatment in 1993 a number of new developments and changes have occurred in the complete range of technologies of collection, transportation, treatment and reuse of treated sewage and sludge for various usages during the last two decades. Broad approaches adopted for the need of revision and updating of the manual on sewerage and sewage treatment are as mentioned below:

i. A greater fundamental understanding of the mechanisms of the biological treatment.

ii. The application of advanced treatment methods for the removal of specific constituents.

iii. The increased emphasis on the management of sewerage and sewage treatment in general and management of sludge resulting from the treatment of sewage, and

iv. The issuance of more comprehensive and restrictive permit requirements for the discharge and reuse of treated sewage.

Even though the sewerage and sewage treatment practices have continued to evolve and grow during last two decades, no time period in the past can equal this intervening period in terms of technological development. In addition, awareness of the environmental issues among the national urban communities has reached a level not experienced before. This active awareness is a driving force for the agencies responsible for sewerage and sewage treatment to achieve the level of performance far beyond those envisioned even during the last two decades.

Pressure for environmental compliance today is greater than before. The need for sewerage and sanitation schemes in urban areas and regulatory requirements have, at present, become more forceful. Support from the Central and State Governments for environmental-related programmes are becoming a strong driving force than ever before. Communities are quite aware, well organized, and informed.

The revision and updating of the existing manual (1993) aims to meet some of those needs by providing advice on the selection of technology options for urban sanitation and whether new infrastructure or upgrading of existing services. It is applicable both to small interventions in specific locations and larger programmes that aim to improve sanitation citywide. The selection of technologies with various options for providing techno-economic solutions keeping in view health of the community and safeguarding the environment are listed below to provide a wide range of options to the planners and designers:

i. Decentralized sewerage system
ii. Sludge treatment and septage management
iii. Recent technologies on sewerage and sewage treatment
iv. New pipe materials for construction of sewers
v. Guidelines for recycling and reuse of treated sewage
vi. New guidelines for discharging treated sewage into water bodies used for drinking.

1.9.1 Guidelines for Preparation of City Sanitation Plan (CSP)

One of the most important objectives of revising and updating of this manual is ‘Preparation of City Sanitation Plan,’ which has been amply described in Chapter 10 so as to give proper guidance to decision makers, planners & designers and also suitably involve political initiatives as a tool to envision affordable upgrade of existing sanitation systems and futuristic sanitation systems in a self-sustaining basis.

The algorithm given in Chapter 10 is a very useful approach for decision makers and planners to adopt the most suitable strategy for providing safe sanitation to the urban community within the policy framework of the GOI in the country.

1.10 SETTING-UP OF ENVIRONMENTAL POLLUTION STANDARDS AT THE STATE LEVEL

While planning the citywide sanitation programme, concerned agencies must set-up standards and follow at the State Level (within overall framework of national standards) such as CPHEEO and BIS guidelines values as mentioned below:

a. Environment Outcome (e.g., State Pollution Control Boards standards on effluent parameters, diminishing water resources, impact of climate change, use of low energy intensive on-site/decentralized sewage treatment technologies, distributed utilities, etc.),

b. Public Health Outcomes (e.g., State Health Departments),

c. Processes (e.g., safe disposal of on-site septage) and infrastructure (e.g., design standards) (PHEDs/Parastatals) and coverage of the informal sector activities like disposal of sewage, solid waste, etc.,

d. Service delivery standards (e.g., by the Urban Development Departments),

e. Manpower issues such as adequate remuneration, hazardous nature of work, employment on transparent terms and conditions, use of modern and safe technology, provision of adequate safety equipment such as glove, boots, masks, regular health check-ups, medical and accident insurance, etc.,

f. States are recommended to not just emulate but also set their standards higher than the national standards in order to encourage its institutions and citizens to target higher standards of public health and environment.

1.11 RELATIONSHIP BETWEEN PART-A (ENGINEERING), PART-B (OPERATION AND MAINTENANCE), AND PART-C (MANAGEMENT) OF THIS MANUAL

The present manual is one of a set of three parts and which are interdependent as under:

i. Part – A on ‘Engineering’

ii. Part – B on ‘Operation and Maintenance’

iii. Part – C on ‘Management’

Part – A on ‘Engineering’ addresses the core technologies and updated approaches towards the incremental sanitation from on-site to decentralized or conventional collection, conveyance, treatment and reuse of the misplaced resource of sewage and is simplified to the level of the practicing engineer for day to day guidance in the field in understanding the situation and coming out with a choice of approaches to remedy the situation. In addition, it also includes recent advances in sewage treatment and sludge & septage management to achieve betterment of receiving environment. It is a simple guideline for the field engineer.

Part – B on ‘Operation and Maintenance’ addresses the issues of standardizing the human and financial resources. These are needed to sustain the sewerage and sanitation systems which are created at huge costs without slipping into an edifice of dis-use for want of codified requirements for O&M so that it would be possible to address the related issues. These financial and related issues are to be addressed at the estimate stage itself, thus enabling to seek a comprehensive approval of fund allocations and human resources. This would also usher in the era of public private partnership to make the projects self-sustaining. This also covers aspects such as guidelines for cleaning

of the sewers and septic tanks besides addressing the occupational health hazards and safety measures of the sanitation workers. It is a simple guidance for the resource seeker and resource allocating authorities.

Part – C on ‘Management’ addresses the modern methods of project delivery and project validation and gives a continual model for the administration to foresee the deficits in allocations and usher in newer mechanisms. It is a tool for justifying the chosen project delivery mechanism and optimizing the investments on need based allocations instead of allocations in budget that remain unutilized and get surrendered at the end of the fiscal year with no use of the funds to anyone in that whole year. It is a straight forward refinement of a mundane approach over the decades.

It is important to mention here in the beginning of this Part- A of the Manual that trade names and technology nomenclatures, etc., where cited, are only for familiarity of explanations and not a stand alone endorsement of these.