

**MANUAL ON  
SEWERAGE AND SEWAGE TREATMENT**

**PART C : MANAGEMENT**

**FINAL DRAFT**

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NEW DELHI**

**IN COLLABORATION WITH**



**JAPAN INTERNATIONAL COOPERATION AGENCY**



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### **ABBREVIATIONS**

AA	Aguas Argentinas
AAI	Airports Authority of India
ABACUS	Advanced Billing and Collection Utility System
ADB	Asian Development Bank
AE	Assistant Engineer
AM	Alandur Municipality
AM	Infrastructure Asset Management
ASEM	Advisory Services in Environmental Management
ASP	Alandur Sewerage Project
ASR	Average Survival Ratio
AU	Anna University
AWS	Automatic Weather Station
BCP	Business Continuity Plan
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BOO	Build Own Operate
BOOT	Build Own Operate Transfer
BOQ	Bill of Quantities
BOT	Build Operate Transfer
BSNL	Bharat Sanchar Nigam Limited
BTO	Build Transfer Operate
BWSSB	Bangalore Water Supply and Sewerage Board
CA	Constitutional Amendment
CAA	Constitutional Amendment Act
CAD	Computer-Aided Design
CBO	Community-based Organizations
CCS	Centre for Civil Society
CCTV	Closed Circuit Television
CD	Compact Disc
CE	Chief Engineer
CETP	Common Effluent Treatment Plant
CFC	Central Finance Commission
CI	Cast Iron
CI	Context Information
CII	Confederation of Indian Industry
CMWSSB	Chennai Metropolitan Water Supply and Sewerage Board
CPCB	Central Pollution Control Board
CPCL	Chennai Petroleum Corporation Limited
CPHEEO	Central Public Health and Environmental Engineering Organization
CPL	Community Participation Law
CRZ	Coastal Regulation Zone Notification
CSER	Corporate Social and Environmental Responsibility
CSO	Central Statistical Organization
CSR	Corporate Social Responsibility
DAF	Dissolved Air Flootation
DANIDA	Danish International Development Agency
DCB	Demand Collection Balance
DEA	Double Entry Accounting
DFID	British Department for International Development

DG	Diesel Generator
DI	Ductile Iron
DMHQ	Disaster Management Head Quarter
DMF	Dual Media Filters
DMP	Disaster Management Plan
DPC	District Planning Committee
DPR	Detailed Project Report
EAM	Enterprise Asset Management
EC	Equivalent Cost
EE	Executive Engineer
EIA	Environmental Impact Assessment
EPA	Environment Protect Agency
EPC	Engineering Procurement and Construction
ERP	Enterprise Resource Planning
ESR	Electron Spin Resonance
FI	Funding Institution
FIDIC	International Federation of Consulting Engineers
FIRE	Financial Institutions Reform and Expansion
FRC	French Water Club
GDP	Gross Domestic Product
GIS	Geographic Information System
GOI	Government of India
GOTN	Government of Tamil Nadu
GSM	Global System for Mobile Communications
HDA	Haldia Development Authority
HPEC	High Powered Expert Committee
HPP	High Pressure Pump
HRD	Human Resources Development
HT	High Tension
HUDCO	Housing and Urban Development
HUF	Hindu Undivided Family
IEC	Information, Education and Communication
IIPA	Indian Institute of Public Administration
IIT	Indian Institute of Technology
IL&FS	Infrastructure Leasing & Financial Services Limited
IP	Internet Protocol
IS	Indian Standard
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISRO	Indian Space Research Organization
IT	Information Technology
ITI	Industrial Training Institutes
ITN	International Training Network
ITV	Industrial Television
IWA	International Water Association
JE	Junior Engineer
JICA	Japan International Cooperation Agency
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
JS	Japan Sewage Works Agency
JSWA	Japan Sewage Works Association
KAPS	Knowledge, Attitude, Practice, Study
KIADB	Karnataka Industrial Areas Development Board
KMDA	Kolkata Municipal Development Authority



KWA	Kerala Water Authority
LAN	Local Area Network
LBFL	Local Bodies Finance List
LCD	Liquid Crystal Display
LIC	Life Insurance Corporation
LoC	Letter of Credit
LT	Low Tension
MBBR	Moving Bed Biofilm Reactor
MCGM	Municipal Corporation of Greater Mumbai
MDG	Millennium Development Goals
MFL	Maximum Flood Level
MIS	Management Information System
MLD	Million Litres per Day
MLIT	Ministry of Land, Infrastructure, Transport and Tourism
MMRDA	Mumbai Metropolitan Region Development Authority
MMSD	Milwaukee Metropolitan Sewerage District
MOEF	Ministry of Environment and Forests
MOF	Ministry of Finance
MOHA	Ministry of Home Affair, India
MOUD	Ministry of Urban Development
MOUD&PA	Ministry of Urban Development and Poverty Alleviation
MP	Member of Parliament
MPC	Metropolitan Planning Committee
MPLADS	Member of Parliament Local Area Development Scheme
MPN	Most Probable Number
MSWM	Municipal Solid Waste Management
MWCI	Manila Water Company
MWSI	Manila Water Services
MWSS	Manila Metropolitan Waterworks and Sewerage Services
M&E	Monitoring and Evaluation
NABARD	National Bank for Agriculture and Rural Development
NCB-W2	World Bank's Contract for National Competitive Bidding
NCC	National Cadet Corps
NDITA	Nabadiganta Industrial Township Authority
NEERI	National Environmental Engineering Research Institute
NGO	Non-Governmental Organization
NIC	National Informatics Centre
NICNET	Nation-wide Informatics Network
NILIM	National Institute for Land and Infrastructure Management, Japan
NITIE	National Institute for Training in Industrial Engineering
NOF	Net Owned Fund
NRCD	National River Conservation Directorate
NRCP	National River Conservation Plan
NRSA	National Remote Sensing Agency
NSKFDC	National Safai Karamachari Finance and Development Corporation
NSS	National Social Service
NTADCL	New Tirupur Area Development Corporation Ltd.
NURM	National Urban Renewal Mission
NUSP	National Urban Sanitation Policy
O&M	Operation and Maintenance
OHP	Overhead Projector
OSN	Dirección Nacional de Obras Sanitarias de la Nación

PA	Poverty Alleviation
PC	Personal Computer
PCB	Pollution Control Board
PCOM	Per Capita O&M Costs
PDCA	Plan-Do-Check-Act
PF	Power Factor
PHE	Public Health Engineering
PHED	Public Health Engineering Department
PI	Performance Indicator
PIL	Public Interest Litigations
PLC	Programmable Logic Controller
PMC	Pune Municipal Corporation
PPP	Public Private Partnership
PPPP	People Public Private Partnership
PSP	Private Sector Participation
PWD	Public Works Department
R&D	Research and Development
RBI	Reserve Bank of India
RCC	Reinforced Cement Concrete
RDBMS	Relational Database Management System
RIF	Rural Innovation Fund
SCADA	Supervisory Control and Data Acquisition
SCS	Survival Curve using Survey
SDE	Spatial Database Engine
SDES	State Directorates of Economics and Statistics
SE	Superintending Engineer
SECAP	System Evaluation and Capacity Assurance Plans
SEMIS	Sewerage Mapping and Information System
SFC	State Finance Commission
SHG	Self-Help Group
SLB	Service Level Benchmark
SMC	Surat Municipal Corporation
SMS	Short Message Services
SOQ	Standards of Quality
SPC	Special Purpose Company
SPCB	State Pollution Control Board
SPS	Sewage Pumping Station
STP	Sewage Treatment Plant
SWM	Solid Waste Management
SWMD	Sewerage and Wastewater Management Department, Japan
SXF	Secure eXchange Format file
TACID	Tamil Nadu Corporation for Industrial Infrastructure Development Limited
TAIMS	Tokyo Advanced Information Management System
TCPO	Town and Country Planning Organization
TDS	Total Dissolved Solids
TEA	Tirupur Exporters Association
TNUDF	Tamil Nadu Urban Development Fund
TNUIFSL	Tamil Nadu Urban Infrastructure Financial Services Limited
TUFIDCO	Tamil Nadu Urban Finance and Infrastructure Development Corporation Limited
TV	Television
TWAD	Tamil Nadu Water Supply and Drainage Board

TWICL	Tamil Nadu Water Infrastructure Company Limited
UA	Urban Agglomeration
UF	Ultra Filtration
UFW	Unaccounted for Water
UGD	Underground Drainage
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
ULB	Urban Local Body
UNEP	United Nations Environment Programme
UNHABITAT	United Nations Human Settlements Programme
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
UWSS	Urban Water Supply and Sanitation Sector
VGf	Viability Gap Funding
VSNL	Videsh Sanchar Nigam Limited
WAN	Wide Area Network
WB	World Bank
WHO	World Health Organization
WSP	Water and Sanitation Program
WSS	Water Supply and Sanitation
WTP	Water Treatment Plant



## CHAPTER 1 INTRODUCTION

Management in all business and organizational activities is the act of getting people together to accomplish desired goals and objectives using available resources efficiently and effectively. Management comprises planning, organizing, staffing, leading or directing, and controlling an organization (a group of one or more people or entities) or effort for the purpose of accomplishing a goal.

The Millennium Development Goals comprise targets to be achieved for the betterment of the human society. The MDGs include eight goals to be achieved by 2015 that respond to the world's main development challenges. Health constitutes the prime focus of the MDGs. One of the MDG goals is to ensure environmental sustainability, which is directly related to development, operation and maintenance and management of sewerage and sanitation services.

### 1.1 GOI POLICIES

The Ministry of Urban Development, Government of India proposed a very ambitious program on urban sanitation for which the Ministry has prepared a Report on "National Urban Sanitation Policy" and published in October 2008.

- **Concepts of Totally Sanitized Cities**

A totally Sanitized City will be one that has achieved the outputs or milestones specified in the National Urban Sanitation Policy.

- **The Salient Features of Urban Sanitation Policy**

The salient features of Urban Sanitation Policy are as follows:

- 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 of fully and safely
- f) Services to the poor and systems for sustaining results
- g) Improved public health outcomes and environmental standards.

- **Vision and Key Policy Issues**

In order to achieve the above Vision, key policy issues such as i) Lack of Awareness, ii) Social and occupational Aspects of Sanitation, iii) Fragmented Institutional Roles and Responsibilities, iv) Lack of an Integrated City-wide Approach, v) Limited Technology Choices, vi) Reaching the Un-served Poor, and vii) Lack of Demand Responsiveness, need to be addressed and translated on the field for long term sustainability of the project.

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

40 The Ministry of Urban Development 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 the hygiene and clean environment and thereafter bring about behaviour.

- **National Sanitation Policy Goals**

45 The overall goals of this policy are to transform Urban India into community-driven, totally sanitized, healthy, and liveable cities and towns.

- **Service Level Benchmarking on Sewage Management (Sewerage and Sewage Treatment)**

50 As already mentioned, 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 without 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. Ministry formulated the set of  
55 Standardized Service Level Benchmarks for UWSS as per International Best Practice and brought out a “Handbook on Service Level Benchmarking” on water supply and sanitation sector in the year 2008. The Service Level Benchmarks (SLB) on Sewage Management (Sewerage and Sewage management) are given in Table 1.1 which are required to be achieved within a specified timeframe.

60 Table 1.1 Sewage management (Sewerage and Sanitation)

S. 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

## 1.2 MANAGEMENT NEEDS

65 It is clearly stated in Chapter 1, opening paragraph of Part A of this Manual that “the main cause of water pollution is the unintended disposal of untreated, partly treated and nonpoint sources of sewage and more important is its effect on human health and environment.” Seven reasons have also been identified in the same chapter. These reasons are spread over engineering aspects, O&M aspects and management aspects. Part A deals with the engineering aspects, while Part B deals with the O&M aspects. Out of the seven reasons identified in the introduction chapter of Part A, two reasons extracted are as given below.

- 70 a) Almost all local bodies are not financially resourceful to self-generate the required capital funds and look up to the State and Central Governments for outright grant assistance.
- 75 b) Institutional arrangement and capacity building are inadequate to conceive planning, implementation, procurement of materials, and to operate and maintain the sewerage system and sewage treatment plants with the desired level of efficiency.

It is thus a combination of inadequate finances and inadequate institutional arrangements which fall under the aspects of management. These two reasons are related to two other major reasons namely:

- 80 a) How sustainable are the sewerage projects financially for the public? The proposals should (i) technically solve the basic cause of sewage stagnating at various locations without collection and without treatment, and (ii) the capital and O&M costs should be met with from the taxes and monthly bills to be paid by the public.
- 85 b) The public should also realize that a service cannot be provided free by the Government and if it is to be provided, it should again come from taxes only. The Government cannot find the finances all by itself.

90 A situation involving a three-way relationship comes into play among the public, the local body and the Government. The National Urban Sanitation Policy (NUSP) of 2008 has laid down the framework for addressing the challenges of city sanitation. The Policy emphasizes the need for spreading awareness for sanitation through an integrated citywide approach, assigning institutional responsibilities and due regard for demand and supply considerations with special focus on the urban poor.

95 Thus, it is necessary to recognize the managerial issues which govern this three way relationship. These are (a) legal framework and policies, (b) institutional framework, and capacity building, (c) financing and financial management, (d) budget estimates for operation and management (e) public private partnership, (f) community awareness and participation, (g) asset management, (h) management information systems, and (i) potential disasters in sewerage and their management and ability of the local body to meet the challenges of natural calamities which can cause unforeseen disasters and still operate and maintain the sewerage system.

### 100 1.3 STAKEHOLDERS

The stakeholders for implementing management are many and all have their own rules and regulations besides having their own limitations.

#### a) Government of India

105 The Government of India will support clear assignment of roles and responsibilities, resources and capacities and institutional incentives in relation to setting standards, planning and financing, implementation, knowledge development, capacity building and training, monitoring and evaluation (M&E), and regulatory arrangements.

#### b) State Governments

110 The State Governments must ensure clear ULB responsibility as envisaged in the 74th Constitutional Amendment (CA). Where this is partial or incomplete, states will need to make concerted efforts to devolve powers, roles and responsibilities along with financial and personnel resources necessary for ULBs to discharge their functions. The States will also have to give ULBs wide-ranging powers over agencies that currently carry out sanitation related activities in the city but are not directly accountable to them, such as parastatal agencies and PHEDs.

#### c) Urban Local Bodies (ULB)

120 Under decentralized governance (74th Amendment), the ULB has some power to form bylaws in conformity with the State and Central Government policies and the Environment Protection Act. The ULB on its part has to frame policies for cost recovery, levying sanitation tax, promoting PPP and private sector participation, providing sewerage and sanitation services in slums, allotting appropriate funds, developing human resources, setting up mechanism for

grievance redressal, enforcing awareness for public participation, and constructing and maintaining drains.

d) Jal Boards, PHEDs

125 Fulfil the role of subcontractors to the State Government for implementing the infrastructure services from finances allocated by the State and Central Governments.

e) Non-Government Organisations (NGOs)

130 Independently set up voluntary groups which are accorded recognition by State and Central Governments to receive grant money and conduct programmes mainly in capacity building among the people to take up micro level management functions on behalf of State Governments.

f) Regulatory Bodies

Statutorily set up authorities mainly for independently monitoring the works of other agencies, NGOs and ULBs, etc., for complying with announced set of rules and regulations by State Governments like the Pollution Control Boards.

135 g) Citizen/Communities

140 The population has so far been referred to as beneficiaries of services rendered by the above agencies. It has now been recognized that the population should instead be stakeholders and have a say before the implementation of infrastructure services in respect of the financial liabilities which the population has to bear for availing of services to each household and the charges for its O&M by the ULBs.

#### 1.4 STRUCTURE OF MANUAL

- Chapter 1 is a general introduction.
- Chapter 2 Legal Framework and Policies – covering articles, constitutional amendments, acts, designated best-use, general standards, discharge standards, notifications and policies relevant to the sewerage sector within which the management functions are to be optimized.
- Chapter 3 Institutional Aspects and Capacity Building – covering organizational setup and administration of sewerage services at the central, state and ULB levels, need for capacity building and various kinds of training programmes for personnel, responsibilities of managerial staff, and so on.
- Chapter 4 Financing and Financial Management – which provides possible options to identify the ways and means of achieving total sewerage sanitation by a judicious blend of location specific technologies and managing finances diligently by devising newer models of project delivery mechanisms, and touches briefly on sources of funding, revenue and expenditure, and technical and financial appraisals.
- Chapter 5 Budget Estimates for Operation and Maintenance – which covers the need and how to make budget estimates, various components of O&M costs, cost recovery and so on.
- Chapter 6 Public Private Partnership – which is being promoted as a mechanism for generating funds and increasing efficiency in public services through cooperation with the private sector, covering needs, advantages, challenges and issues, success stories, potential PPP models, stakeholders, and so on.



- 165 • Chapter 7 Community Awareness and Participation – describes the need for community awareness and participation for sewage collection and treatment systems maintained by the local body, and also covers various aspects that need to be considered to improve the community awareness and participation by involving individuals or voluntary organizations, and government agencies.
- 170 • Chapter 8 Asset Management – which is a systematic process of operating, maintaining, upgrading, and disposing of assets cost-effectively, covers the need for asset management for sewage treatment plant, pumping station, sewer and gives a model for Indian scenario. This is an area where true appreciation is needed especially as many assets are not utilized effectively and in fact even the records are not adequate specifically in “as constructed” drawings.
- 175 • Chapter 9 Management Information System – which is a formal system of making available to the management accurate, timely, sufficient, and relevant information to facilitate the decision making process, covers topics such as need for MIS at the central, state and ULB levels, MIS in sewerage system, management indicators and applications of MIS, and use of MIS for enhancing efficiency.
- 180 • Chapter 10 Potential Disasters in Sewerage and Management – which covers the various disasters that can affect a sewerage system, plans and measures to prevent and mitigate such disasters if they occur, and lessons learnt from them.

### 1.5 RELATIONSHIP BETWEEN PART – A (ENGINEERING), PART – B (OPERATION AND MAINTENANCE), AND PART – C (MANAGEMENT) OF MANUAL

185

The present Manual is presented in three sections, as under, which are interdependent:

- i) Part – A on ‘Engineering’
- ii) Part – B on ‘Operation and Maintenance’, and
- iii) Part – C on ‘Management’

190 Part – A on ‘Engineering’ addresses the core technologies and updated approaches towards the incremental sanitation from onsite 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 choice of approaches to remedy the situation. In addition it also includes recent  
 195 advances in sewage treatment, sludge and septage management to achieve betterment of receiving environment. By no means, this is a text book nor it should be. It is a simple to understand guideline for the field engineer.

200 Part – B on ‘Operation and Maintenance’ addresses the issues of standardizing the human resources and financial resources that are needed to sustain a system created at huge costs without it slipping into an edifice for want of codified requirements of these so that it becomes possible to address these in the estimate stage itself and seek a comprehensive approval of fund allocations and human resources besides ushering in the era of public private partnership to make the projects self-sustaining. It is a simple to understand guidance for the resource seeker and resource allocating authorities.

205 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

210 budget that remain unutilized and get surrendered in end of fiscal year with no use to anyone. It is a straightforward approach to a mundane approach over the decades.

**It is very important to mention here in the beginning of this Part C of the Manual that Trade names and technology nomenclatures, etc., are cited only for familiarity of explanations and not a standalone endorsement of these.**

## 215 CHAPTER 2 LEGAL FRAMEWORK AND POLICIES

### 2.1 INTRODUCTION

220 This chapter covers the legal framework for the sewerage and related sectors in India and should be updated from time to time to reflect new statutes that are enacted. Articles, constitutional amendments, acts, designated best-use, general standards, discharge standards, notifications and policies relevant to the sewerage sector are covered briefly in this chapter, and references to the relevant topics are given for the reader requiring more details on specific topics.

#### *Note for Reader*

225 *The contents of this Chapter will have to undergo reviews by the Workshop and the public review based on the draft put up in MoUD website before all the views are taken up and synthesized with the help of a competent legal luminary who will be co-opted for this Chapter alone in the editorial committee.*

### 2.2 THE EASEMENTS ACT, 1882

230 The Easements Act is perhaps the most important act for public services. Any vacant space of the ULB lying vacant for more than the specified period shall not be alienated by the ULB to any individual unless it is enacted by the state legislature under the act. If such a land has been earmarked for a specific purpose at the time of town planning the same shall not be questioned by the public once the public has set foot over the town planning boundary.

### 2.3 74TH CONSTITUTIONAL AMENDMENT

235 The 74<sup>th</sup> Constitutional Amendment, enacted by the Parliament in 1993, mandates the State Government to transfer responsibility of water supply and sanitation (WSS) services to the urban local bodies (ULBs) such as Nagar Panchayat (City council), Nagar Palika (Municipality) and Nagar Nigam (Municipal Corporation) in the ascending order of magnitude. This amendment is aimed to strengthen ULBs through devolution of power toward decentralization.

240 The Twelfth Schedule, which has been added to the 74<sup>th</sup> Constitutional Amendment, includes the following 18 functions in accordance with Article 243W:

- i) Urban planning including town planning
- ii) Regulation of land-use and construction of buildings
- iii) Planning for economic and social development
- iv) Roads and bridges
- 245 v) Water supply for domestic, industrial and commercial purposes
- vi) Public health, sanitation conservancy and solid waste management
- vii) Fire services
- viii) Urban forestry, protection of the environment and promotion of ecological aspects
- ix) Safeguarding the interests of weaker sections of society, including the handicapped  
250 and mentally retarded
- x) Slum improvement and upgradation
- xi) Urban poverty alleviation

- xii) Provision of urban amenities and facilities such as parks, gardens, playgrounds
- xiii) Promotion of cultural, educational and aesthetic aspects
- 255 xiv) Burials and burial grounds; cremations, cremation grounds and electric crematoriums.
- xv) Cattle pounds; prevention of cruelty to animals.
- xvi) Vital statistics including registration of births and deaths
- 260 xvii) Public amenities including street lighting, parking lots, bus stops and public conveniences
- xviii) Regulation of slaughter houses and tanneries.

In this context, the Ministry of Urban Development prepared and circulated the ‘Model Municipal Law’ with the objective of facilitating implementation of the 74<sup>th</sup> amendment which among other features cites the following:

#### 265 **Urban Environmental Infrastructure and Services**

- a) Participation of private sector, NGOs, and CBOs in delivery of services
- b) Service charges to reflect O&M and capital costs
- c) Provision to meet the Hazardous and Bio-medical Waste Handling Rules of MOEF, GOI
- 270 d) Provision to meet the Solid Waste Handling Rules of MOEF, GOI
- e) State-level regulatory commission on municipal services.

The issue of relevance here is the listing in item b) above, which aims at levy and collection of service charges to reflect O&M and capital costs.

275 The objective of the amendment has not been realized in practically all the centres in the country because the receipts are inadequate to varying degrees. This is the thrust area to focus on. It has been reported that there are administrations where even the deposits are stated to be foreclosed to disburse salaries with no hope of meeting the actual O&M charges and the capital costs. Unless this issue is overcome and the said item b) above is achieved, the sewerage services will show no improvement, and will possibly start deteriorating in adequacy and efficiency. The simple requirement is the firmness on the part of the local body to levy realistic charges and the willingness of the user population to pay for it.

#### **2.4 BIS DISCHARGE STANDARDS, 1973**

285 The BIS discharge standards were issued as IS: 4764 in 1973 by BIS. Currently national discharge standards, issued by CPCB and SPCB, are being adopted widely. Refer to Table 5.20 for the recommended discharge guidelines in Chapter 5 of Part A. Also, refer to twin drains after septic tank described in Section 3.13, Chapter 3, Part A.

#### **2.5 WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974, AND ITS AMENDMENTS**

290 The purpose of this Act is “to provide for the prevention and control of water pollution and the maintenance or restoring wholesomeness of water for the establishment, with a view to carrying out the purpose aforesaid by Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for

matters connected therewith.” This is the Act that established the Central and a State Board and also the authority and power to constitute as many committees as it feels essential to carry out specific functions. The Act specifically prohibits ‘any poisonous, noxious or polluting matter’ into any stream or well. Consent from the State Board is required for any type of new discharge into any new stream or well. It also includes consent for “temperature” discharges as done by cooling tower users. In general, this means that a State consent or permit is required for all types of intake and/or discharge of any type of liquid or water either from a running stream or well. Under these rules, “effluent standards to be complied with by persons while causing discharge of sewage or sullage or both” have been specified. Standards for small scale industries have been specified separately. Penalties for non-compliance with the permit or polluting in any way are imprisonment for three months and fine of Rs. 10,000 or fine up to Rs. 5,000 per day of violation or both plus any expenses incurred by the Board for sampling, analysis, inspection etc. Penalties for contravention are specified. Any “director, manager, secretary or other officer of the company may also be deemed to be guilty” if proved that the offense occurred with their “consent or connivance.” In case of the government, department head could be held liable.

(A) Functions of the Central Board: Subject to the provisions of this Act, the main functions of the Central Board shall be -- (1) to promote cleanliness of streams and wells in different areas of the States. (2) In particular and without prejudice to the generality of the foregoing function, the Central Board may perform all or any of the following functions, namely, advise the Central Government on any matter concerning the prevention and control of water pollution;

(B) Functions of the State Board: Subject to the provisions of this Act, the functions of a State Board shall be -- (a) to plan a comprehensive programme for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof; (b) to advise the State Government on any matter concerning the prevention, control or abatement of water pollution; (c) to collect and disseminate information relating to water pollution and the prevention, control or abatement thereof; (d) to encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control.

(C) Powers to Give Directions: In the performance of its functions under this Act -- (a) The Central Board shall be bound by such directions in writing the Central Government may give to it; and (b) Every State Board shall be bound by such directions in writing as the Central Government or the State Government may give to it: Provided that where a direction given by the State Government is inconsistent with the direction given by the Central Board, the matter shall be referred to the Central Government for its decision.

## **2.6 DESIGNATED-BEST-USE BY CENTRAL POLLUTION CONTROL BOARD, 1981**

The Central Pollution Control Board (CPCB) has developed the concept of “designated best use”. According to this concept, out of several uses a particular water body is put to, the use which demands the highest quality of water is called its “designated best use”, and the water body is designated accordingly.

For each of the five defined “designated best uses”, the CPCB has identified water quality requirements in terms of few water quality criteria. The “designated best uses” along with respective water quality criteria is given in Table 5.2, Chapter 5, Part A.

This classification helps the water quality managers and planners to set water quality targets and identify needs and priority for water quality restoration programmes for various water bodies in the Country.

## **2.7 ENVIRONMENT (PROTECTION) ACT, 1986**

The provisions of this Act, passed in 1986, have strengthened the enforcement of the Water Act,

340 1974. The Act was enacted to “provide for the protection and improvement of environment and  
for matters connected therewith.” This act defined environment which includes “water, air, and  
land and the inter-relationship which exists among and between “water, air and land, and human  
beings, other living creatures, plants, micro-organisms and property.” It also defined a  
345 hazardous substance as “any substance or preparation which, by reason of its chemical or  
physics-chemical properties, or handling, is liable to cause harm to human beings, other living  
creatures, plants, microorganisms, property or the environment.” This law enlists general  
powers of the central government which included “all such measures as it deems necessary or  
expedient for the purpose of protecting and improving the quality of the environment and  
preventing, controlling and abating environmental pollution.” The law also included “the  
350 standards of quality of air, water, or soil for various areas and purposes, the maximum allowable  
limits of concentration of various environmental pollutants, procedures and safeguards for the  
handling of hazardous substances.”

Important points of the Act that are more relevant to sewerage and sanitation are as follows:

- 355 a) The Act empowers the Centre to take all such measures as it deems necessary or  
expedient for the purpose of protecting and improving the quality of the  
environment and preventing, controlling and abating environmental pollution.
- b) The Central Government has the power of entry for examination, testing of  
equipment and other purpose and power to take samples of air, water, soil or any  
other substance from any place for analysis to ensure compliance with the Act.
- 360 c) The Act explicitly prohibits discharge of pollutants in excess of prescribed  
standards and prohibits handling of hazardous substances except in compliance  
with regulatory procedures and discharges.
- d) Persons responsible for discharges of pollutants in excess of prescribed standards  
must prevent or mitigate the pollution and must report the discharge to government  
365 authorities.
- e) The Act empowers the central government to establish standards for the quality of  
the environment in its various aspects, including maximum allowable concentration  
of various environmental pollutants (including noise) for different areas. These  
standards could be based on ambient levels of pollutants sufficient low to protect  
370 the public health and welfare.

Penalties for contravention are specified.

## **2.8 GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS UNDER THE ENVIRONMENTAL PROTECTION RULES, 1989**

375 Under the Environment (protection) Rules, the following standards have been stipulated.

- a) Industry specific standards for emission/effluent discharge (Schedule I)
- b) General standards for discharge of environmental pollutants (Schedule VI)
- c) Ambient air quality standards (Schedule III)
- 380 d) Standards for emission of smoke, vapour, etc., from motor vehicles prescribed in  
Schedule IV.

Schedule VI of the Environment (Protection) Rules, 1986 contains the General Standards for  
Discharge of Environmental Pollutants, refer to Table 5.3, Chapter 5 in Part A. The State Boards

may specify more stringent standards for the relevant parameters with respect to specific industry or locations after recording the reasons in writing.

385 Refer to Table 5.20 for the recommended discharge guidelines in Chapter 5 of Part A. Also refer to twin drains after septic tank described in Section 8.5.4, Chapter 8, Part A.

## **2.9 HAZARDOUS WASTE (MANAGEMENT AND HANDLING) RULES, 1989**

390 The Ministry of Environment and Forests came out with Wastes (Management and Handling) Rules, July 1989 under the Environment (Protection) Act, 1986. The main purpose for promulgation of these Rules was for management and handling of hazardous substances.

These rules may apply to the conduct of the business of sewerage and sewage treatment if and only if any of its component activities result in hazardous residues as decided by the respective court of law and not arbitrarily by any ULB or other statutory agency.

## **395 2.10 THE PUBLIC LIABILITY INSURANCE ACT, 1991**

The purpose of this Act is “to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.

400 The Act defines an “accident” as involving a fortuitous, sudden or unintentional occurrence while handling any hazardous substance resulting in continuous damage to any property but does not include an accident by reason only of war or radioactivity. Penalty for not taking insurance coverage has also been mentioned in this act.

The applicability is contingent on the activity being hazardous.

## **2.11 MANUAL SCAVENGING ACT 1993**

405 Manual scavenging refers to the removal of animal or human waste/excreta (night soil) using brooms, tin plates and baskets from dry latrine and carrying it to disposal grounds some distance away. Manual scavenging still survives in parts of India without proper sewerage systems.

410 The practice of carrying night-soil on the heads from dry latrines by scavengers has been in existence for centuries in India. The Central Government has formulated the following schemes for the elimination of dry latrines and rehabilitation of manual scavengers in March 2008:

- i) Integrated Low Cost Sanitation Scheme - for conversion of dry/insanitary latrines in urban areas
- ii) Nirmal Bharat Abhiyan (formerly Total Sanitation Campaign) – for construction of sanitary latrines in rural areas
- 415 iii) Pre-matric Scholarships – for children of those engaged in ‘unclean’ occupations including manual scavengers
- iv) Post-matric Scholarships for Scheduled Caste and Other Backward Class Students (manual scavengers belonging to one of these two categories may avail benefit of these schemes)
- 420 v) Concessional loans for self-employment through the National Safai Karamachari Finance and Development Corporation (NSKFDC)
- vi) National Scheme of Liberation and Rehabilitation of Scavengers and their Dependents during 1992-2005, followed by Self-employment Scheme for

Rehabilitation of Manual Scavengers from 2007.

425 Additionally, the Government of India formulated a draft bill in May 2012 for sanitation  
workers applicable to the whole of India and which when passed would be called “Sanitation  
Workers (Regulation of Employment and Conditions of Service) Act, 2012.” This Bill gives  
430 details of formation of Central and State Advisory and Expert Committees, state welfare board  
for sanitation workers, registration of sanitation workers, engagement of sanitation workers,  
hours of work, welfare measures, etc., safety and health, and common provisions regarding  
safety, health and working conditions of sanitation workers, and special provisions regarding  
working conditions of workers employed in hazardous sanitation work, inspecting staff,  
prohibition of hazardous cleaning of sewers and septic tanks, and so on.

435 At the time of this writing, the Prohibition of Employment as Manual Scavengers and their  
Rehabilitation Bill, 2012, had been introduced in the Parliament on September 3, 2012. This Bill  
defines and prohibits hazardous manual cleaning of sewers and septic tanks, and aims to  
eliminate manual scavenging and insanitary latrines, and also provides for rehabilitation of  
identified manual scavengers in alternative occupations. It is meant to reduce risk to the health  
and safety of such workers, as far as possible.

#### 440 **2.12 NATIONAL ENVIRONMENTAL TRIBUNALS ACT OF 1995**

The National Environmental Tribunal Act of 1995 was enacted to provide for strict liability for  
damages arising out of any accident occurring while handling any hazardous substance and for  
the establishment of a National Environment Tribunal for effective and expeditious disposal of  
cases arising from such accidents, with a view to giving relief and compensation for damages to  
445 persons, property and the environment and for matters connected therewith or incidental thereto.

#### **2.13 WATER (PREVENTION AND CONTROL OF POLLUTION) CESS ACT, 2003**

This law provides for the levy and collection of a cess on water consumed by persons carrying  
on certain industries and by local authorities, with a view to augment the resources of the  
450 Central and State Boards for the prevention and control of water pollution constituted under the  
Water (Prevention and Control of Pollution) Act, 1974. Industries are specified in Schedule I.  
They are: 1. Ferrous: Metallurgical industry, 2. Non-Ferrous: Metallurgical industry, 3. Mining  
industry, 4. Ore processing industry, 5. Petroleum industry, 6. Petro-chemical industry, 7.  
Chemical industry, 8. Ceramic industry, 9. Cement industry, 10. Textile industry, 11. Paper  
455 industry, 12. Fertilizer industry, 13. Coal (including coke) industry, 14. Power (thermal and  
diesel) generating industry, 15. Processing of animal or vegetable products industry. Collection  
of cess was based on the quantity of water consumed. The State government had the authority to  
collect the cess from the industry.

460 The definition of “industry” in the earlier Act of 1997 has been amended to read as "industry  
includes any operation or process, or treatment and disposal system, which consumes water or  
gives rise to sewage effluent or trade effluent, but does not include any hydel power unit” and  
levy of cess for water used for domestic purpose has been duly authorized.

#### **2.14 COASTAL REGULATION ZONE NOTIFICATION, 2011**

465 The Coastal Regulation Zone Notification, 2011 (herein after referred as CRZ Notification  
2011) came into force on 6th January 2011. The 2011 notification is based on three objectives:  
the need to protect the livelihood of seven million fishermen families, protect the ecology of the  
coastal area and the ecological infrastructure, and to generate economic activities in the coastal  
area. The Notification tries to ensure:

- Livelihood security to the fisher communities and other local communities, living



- 470 in the coastal areas, to conserve and protect coastal stretches
- Development through sustainable manner based on scientific principles taking into account the dangers of natural hazards in the coastal areas, sea level rise due to global warming
- 475
- Declaration of the coastal stretches of the country and the water area up to its territorial water limit
  - Restricting the setting up and expansion of any industry, operations or processes and manufacture or handling or storage or disposal of hazardous substances.

Box: Example on delay in obtaining clearance related to STP construction in coastal areas (Nagore).

The Nagapattinam Municipality, Nagapattinam proposed the construction of sewage treatment plants at Nagore and Nagapattinam together with outfall pipelines.

The project involves the construction of following facilities:

Construction of STP one each at Nagore and Nagapattinam, sewer system to a length of about 1200 m, Pumping station, Pumping main of size 600 mm dia. D1 pipes for 300 m, Elevated pipe carrying bridge, Outfall pipe line from STP @ Nagai of size 500 mm dia. RCC Pipes for 370 m, Outfall pipe line from STP @ Nagore of size 400 mm dia. and RCC Pipes for 300 m. Total project cost is Rs.48.95 crores and the project area is falling in CRZ-I(ii) , CRZ – II and C RZ III areas.

The Tamil Nadu State Coastal Zone Management Authority held a meeting on 29.01.2010 and the Authority resolved the matter as follows:

“Regarding the Construction of Sewage treatment plants at Nagore and Nagapattinam together with outfall pipelines, the Authority is of the opinion that the treated water should not be let out into the rivers and the Authority recommended to re-utilize the treated water for gardening, cultivation etc. Hence the Authority resolved to request the applicant to revise the proposals accordingly and re-submit the proposals.

The discharge of water, if any, proposed to dispose into the rivers, then the details such as quantity of discharge of water, its quality, the impacts on the river due to the discharge etc., with detailed study reports and baseline data should be provided. Detailed EIA studies based on the hydraulics of the river and the details of river flow and contents, quality, species present therein, etc., with adequate base line data should be provided.”

The TWAD Board, Urban Division, Thanjavur proposed in writing to supply the treated water from 2.96 MLD capacity Nagore STP to M/s. CPCL, Narimanam. Further they also proposed to discharge 6.97 MLD treated water from Nagapattinam STP into river Devanathi out of the expected quantity of 7.87 MLD and the balance quantity of 0.9 MLD would be re-utilized for gardening. A study report based on the river hydraulics, furnished by the TWAD board was submitted.

As per para 3 (2) (ii) of the CRZ Notification 1991, the above activity required clearance from the Ministry of Environment and Forests, Government of India. Further as per para 3 (2) (v) of CRZ Notification 1991, the above activity also required clearance from the Ministry of Environment and Forests, GOI as the project cost was more than five crores.

The Authority would consider the case based on the data submitted.

480 Source: <http://www.environment.tn.nic.in/doc/56thsczma%20meeting.doc>

## 2.15 POLICIES

### 2.15.1 Central Government

485 The Ministry of Urban Development, Government of India prepared a Report on “National Urban Sanitation Policy” (NUSP) and published it in October 2008. The overall goals of this policy are to transform urban India into community-driven, totally sanitized, healthy, and liveable cities and towns.

To achieve this, the Government of India shall support the following components:

#### a) Awareness generation

490 A countrywide Information, Education and Communication (IEC) Strategy will be designed and implemented for raising awareness on the public health and environmental importance of sanitation. The socio-cultural biases against sanitation and sanitary work need to be targeted, and dignity and humane approach has to be promoted in the elevation of priority to sanitation in public affairs. Further, the public-good nature of urban sanitation necessitating collective action needs to be highlighted in the minds of all stakeholders. In connection with this, the Model communication participation law aiming institutionalize community participation platforms/systems has been developed. Refer to Section 7.5.

#### b) Institutional roles

500 The Government of India will support clear assignment of roles and responsibilities, resources and capacities and institutional incentives in relation to setting standards, planning and financing, implementation, knowledge development, capacity building and training, Monitoring and Evaluation (M&E), and regulatory arrangements. The government will help states and cities in ensuring sanitation as a core responsibility of Urban Local Bodies as envisaged in the Constitutional (Seventy fourth) Amendment Act, 1993. The special roles of NGOs and Community Based Organisations (CBOs) will be recognized in mobilizing communities, raising awareness and in working with poor communities to assist them in finding affordable, community-managed solutions to sanitation.

#### c) Reaching the un-served and poor households

510 The national policy will help urban areas adopt a city-wide, demand-based participatory approach to individual (resolving tenure, space and affordability constraints), and community sanitation where individual sanitation facilities are not feasible. Special slum and community sanitation plans will be formulated as a part of the City Sanitation Plan. Provision of public sanitation facilities will also be supported.

#### d) Knowledge development

515 The policy recognizes the importance of developing and disseminating knowledge on institutional development, technology choices and management regimes, planning new developments and upgradation, and sustainability issues.

#### e) Capacity building

520 The Government of India will help formulate and implement a national level strategy on capacity building and training to support states and cities to build their personnel capacities and organizational systems for delivery of sanitation services.

#### f) Financing

The Government of India, wherever possible, will explore possibilities of providing assistance for funding projects proposed as part of City Sanitation Plans through its schemes like

525 JNNURM, UIDSSMT, Lump Sum Provision for the Projects/Schemes for the Benefit of North Eastern Region including Sikkim, Satellite Township Scheme, etc. However, the emphasis will be on improving the efficiency of existing sanitation infrastructure and service delivery.

**g) National monitoring and evaluation**

At the national level, the Government of India will support periodic rating of cities by independent agencies. A National Annual Award will be instituted on the basis of the rating.

530 **h) Coordination at the national level**

National investments in urban infrastructure and housing shall accord high priority to sanitation. Towards this, sanitation will be mainstreamed into all relevant programmes of all the relevant sectoral ministries.

**i) Service level benchmarking on sewage management**

535 As already mentioned, 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 without improved sanitation, and providing proper sanitation facilities in public places to make cities and towns open defecation free. The Ministry has proposed to shift focus on infrastructure in urban water supply and sanitation sector (UWSS) to improve service delivery. The Ministry has formulated the set of Standardized Service Level Benchmarks for UWSS as per International Best Practice and brought out a “Handbook on Service Level Benchmarking” on water supply and sanitation sector in the year 2008. The Service Level Benchmarks (SLB) on Sewage Management (Sewerage and Sewage Treatment) which are required to be achieved within a specified timeframe, preferably matching with the MDGs deadlines are given in Table 2.1. These deadlines as mentioned above, aim to extend access to improved sanitation to at least half the urban population by 2015 and to 100% access by 2025.

Table 2.1 Service level benchmarks for sewage management (Sewerage and Sanitation)

S. 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

550 **2.15.2 State Government**

State strategies are recommended to detail out the following generic headings or areas requiring attention similar to the national policy,:

**a) Clear assignment of institutional responsibility, resources and capacities**

555 State Urban Sanitation Strategies must ensure clear ULB responsibility as envisaged in the 74th Constitutional Amendment (CA). Where this is partial or incomplete, states will need to make concerted efforts to devolve powers, roles and responsibilities along with financial and personnel resources necessary for ULBs to discharge their functions. The ULBs will also have to be accorded wide-ranging powers over agencies that currently carry out sanitation related

560 activities in the city but are not directly accountable to them, such as parastatal agencies and PHEDs.

**b) Setting standards at the State level (within the overall frame of national standards)**

- 565 • Environment outcomes (for example, State Pollution Control Board standards on effluent parameters, diminishing water resources, impact of climate change, use of low energy intensive onsite/decentralised sewage treatment technologies, distributed utilities, etc.)
- Public health outcomes (for example, State health departments)
- Processes (for example, safe disposal of on-site septage) and infrastructure (for example, design standards) (PHEDs/Parastatal) and coverage of the informal sector activities like disposal of sewage, solid waste, etc.
- 570 • Service delivery standards (for example, by urban development departments)
- Manpower issues such as adequate remuneration, hazardous nature of work, employment on transparent terms and conditions, use of modern and safe technologies, provision of adequate safety equipment such as gloves, boots, masks, regular health check-ups, medical and accident insurance cover, etc.
- 575 • States are recommended to not just emulate but 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.

**c) Planning and financing at the State level**

580 ULBs will need to be made responsible for planning (including preparation of “City Sanitation Plan”) and financing public infrastructure, and leveraging such private investments as may be required for achieving outcomes (as stated in their State Strategies). The problem of shortage of funds needs to be factored in. In this regard, States will need to devolve adequate and predictable resources to ULBs including setting tariffs, inter-governmental fiscal transfers and devising targeting of subsidies to the poorest of the poor households. The issue of recovery of O&M cost through the introduction of usage charges and collection of dues needs to be emphasised as a means of ensuring accountability as well as financial sustainability. In doing so, State Government’s support to ULBs will need to be increasingly reoriented to reward the achievement of outcomes (moving way from input, process and hardware funding per se). State governments should also be encouraged to launch awards for best performing cities to bring about a competitive spirit in achieving total sanitation by cities. Considerable coordination will also be required across other government agencies and institutions, private and community institutions - to highlight the priority to sanitation, as well as in planning and implementation of programs.

**d) Reaching the un-served populations and the urban poor at the State level**

595 States will need to resolve tenure, space and affordability constraints to providing individual sanitation facilities preferentially, and community facilities where individual provision is not feasible. The provisioning of basic sanitation should be de-linked from the issues of land tenure. Every urban dweller should be provided with minimum levels of sanitation, irrespective of the legal status of the land in which he/she is dwelling, possession of identity proof or status of migration. However, the provision of basic services would not entitle the dweller to any legal right to the land on which he/she is residing. At least 20% of the funds under the sanitation sector should be earmarked for the urban poor. The issues of cross subsidy to the urban poor and their involvement in the collection of O&M charges should be considered. States will need to

600

605 issue guidelines to support cities in adopting participatory approaches to community sanitation, and rational planning for appropriate and adequate sanitation for floating population, institutions and public place workers, with explicit recognition of cost recovery for sustainable management, service delivery and repairs and maintenance. Special role of NGOs and CBOs needs to be recognized in this respect, especially for community sanitation facilities.

**e) Service delivery in cities**

610 ULBs will need to be responsible for asset creation and managing systems including service delivery. In this context, the ULB may bring in public, private and community agencies/groups to provide services on its behalf. But the final accountability with regard to performance in sanitation will have to be that of the ULB. Departments and parastatals currently carrying out these responsibilities should be accountable to the respective ULBs (including for example, 615 financing through the ULBs). The State governments will need to make explicit directions in this regard, including roles for NGOs and CBOs and the urban poor.

**f) Regulation of cities and regulation within cities**

620 State strategies will need to dwell on this issue carefully - strengthening existing state level institutions that are charged with ensuring compliance of ULBs to environmental standards (e.g. State Pollution Control Boards), health outcomes (e.g. Health Departments), and Service Delivery Standards (e.g. State Urban Departments). Wherever these responsibilities or action on deviance are not spelt out clearly, the state strategy will need to make these clear. The strategy will also have to identify the ULB as having the key regulatory limit over all properties and agencies/households in the city in respect of outcomes and process standards stipulated by it.

**g) Monitoring & evaluation at the state and city levels**

630 The State government will be responsible for M&E of its cities' performance, and hence needs to devise data collection and reportage systems using outcome indicators. ULBs in turn need to track compliance of households (establishments, etc.) with outcomes and process standards that it has adopted. Introducing citizens' report cards, citizens' monitoring committees, self-assessment system, inter-city competitions, etc., will be considered. NGOs and CBOs will also play key roles in M&E.

**h) Capacity building & training**

635 The state strategy needs to identify agencies that will train its state level ULB personnel and orientation of elected representatives. These agencies could be specialist agencies of the State government, and/or NGOs and private sector organizations. It will also need to focus on capacity building, i.e., not just training but also developing systems and capacities of ULBs in sanitation, in line with the Urban Sector Reforms that the State may be implementing. ULBs will need to provide training on sanitation to their own staff, using State level resource agencies. They will need to utilize Government of India and State Government Schemes for training and 640 capacity building in order to achieve this.

**2.15.3 Urban Local Bodies**

Under decentralized governance (74<sup>th</sup> Amendment), the ULBs have some power to form bylaws in conformity with the State and Central Government policies and the Environment Protection Act.

645 The Urban Local Bodies on their part may frame their policies as under:

**a) Cost recovery**

The local bodies must frame a policy and make serious efforts to initiate cost recovery for the

sewerage and sanitation services being provided to the households and for the provision of special services to commercial and industrial units.

650 **b) Levy of sanitation tax**

The ULB should impose adequate sanitation tax to cover the cost of sewerage and sanitation services. Whereas efforts should be made for cost recovery from the beneficiaries who get doorstep service, the shortfall in funds should be made good from general sanitation tax, which should be adequately imposed as a matter of policy by the ULBs.

655 **c) Public private partnership**

660 There is a need to promote a healthy competition in the sewerage and sanitation services being provided by the urban local bodies and the private sector. The manpower cost is rising steeply in the local bodies and efficiency levels are falling. There is, therefore, a need to induct private sector to provide sewerage and sanitation services in un-served and under-served areas in a cost effective and efficient manner. This will reduce the costs and promote an element of healthy competition between public and private sector.

**d) Private sector participation**

665 The ULBs may promote private sector participation. As a policy, they may decide to set up treatment facilities with private sector participation on suitable terms and conditions for which standard concession agreements/formats may be drawn up with legal assistance to ensure protection of ULB interest.

**e) Provision of sewerage and sanitation services in slums**

670 The local bodies should frame a policy of providing sewerage and sanitation services for the slums to ensure sanitary conditions in the slums irrespective of their legal or illegal status in the city to maintain overall public health and sanitation in the urban areas. The local body may also prohibit open defecation and provide adequate toilet facilities to slum dwellers either on “pay and use” basis or through the provision of low cost sanitation facilities in the slums.

**f) Allotment of adequate funds for capital and revenue expenditure**

675 The local body should give priority to management of sewerage and sanitation services and provide adequate funds in the annual budget for capital investment as well as day to day operation and maintenance of sewerage and sanitation services. Appropriate percentage of the budget of the local body should be earmarked for efficient management of sewerage and sanitation services.

**g) Human resources development**

680 The local body as a policy should provide adequate training to the staff engaged in the management of sewerage and sanitation services and arrange for short term and refresher courses for updating the knowledge of the supervisory staff to maintain the high standards of service. All components of these services, including the workshop, should be under one umbrella to ensure effective supervision and control.

685 **h) Public grievance redressal mechanism**

The local bodies should draw up a citizen’s charter and create a system to register public grievances in all the wards and set up a mechanism for expeditious redressal of grievances through decentralized municipal administration.

**i) Enforcement**

690 While all efforts may be made to build awareness among the community for public participation in management of sewerage and sanitation services in the urban areas, a mechanism for enforcement should be simultaneously created to instil discipline in the citizens who do not adhere to the directions of the urban local bodies.

#### **j) Obligations of Municipal Bodies to Provide Drains**

695 The Municipal Act of India casts a duty on the municipalities to construct and maintain “drains” on the sides of the road. The act also states that “drain” includes a sewer. Thus, the historical trend in India of houses discharging their wastewater from the houses into the drains holds good even now. The underground sewerage costs are prohibitive and nearly 70% of the cost is for the underground sewers. It is further compounded by the fact that it takes a minimum of five years  
700 to complete a sewerage scheme in the field. Considering all these, there is a need to implement the incremental sewerage system as detailed in Part A of the Manual. The twin drain system can be considered as a right choice in this situation. The stagnation of sewage can be avoided. It can also be treated and reused for tree growing, farm forestry, median watering, etc. In as much as drains are mandatory, it may not cost much to add one more drain for sewerage before the  
705 full-fledged underground sewerage takes shape. Such a policy can achieve great progress in sewerage with minimum financial outlay and minimum time in the initial stages of sewerage both in existing as well as new habitations.

### **2.16 SUMMARY**

710 The 74th Constitutional Development includes 18 functions aimed at strengthening ULBs through devolution of power. The Water (Prevention and Control of Pollution) Act and its Amendments aims to prevent and control water pollution and ensure wholesomeness of water. The Water (Prevention and Control of Pollution) Cess Act provides for the levy and collection of cess on water consumed by consumers. The Environment (Protection) Act provides for the protection and improvement of the environment. The National Environmental Tribunals Act  
715 provides for liability for damages arising out of any accident while handling any hazardous substance for effective and expeditious disposal of cases arising out of such accidents. The Hazardous Waste (management and handling) Rules are mainly meant for management and handling of hazardous substances. According to the concept of “designated best use” developed by the CPCB, out of several uses a particular water body is put to, the use which demands the highest quality of water is called its “designated best use”, and the water body is designated accordingly. The General Standards for Discharge of Environmental Pollutants under the Environmental Protection Rules stipulate specific standards for emission and effluent discharge, general standards for discharge of environmental pollutants, ambient air quality standards, and standards for emission from motor vehicles. The BIS Discharge Standards have been withdrawn  
720 as at the time of this writing because national discharge standards are being adopted widely. A new bill called the Prohibition of Employment as Manual Scavengers and their Rehabilitation Bill, 2012, has been introduced in the Parliament and is likely to become a law in the near future. This bill prohibits manual cleaning of sewers and septic tanks, aims to eliminate insanitary latrines, and rehabilitate identified manual scavengers in alternative occupations. The Coastal Regulation Zone Notification aims to protect the livelihood of fishermen families, protect the coastal area ecology and generate economic activities in coastal areas. The Central and State Government and the ULBs have announced various policies to transform the nation to sanitized,  
725 730 healthy and liveable cities, towns and villages.





## 735 **CHAPTER 3 INSTITUTIONAL ASPECTS AND CAPACITY BUILDING**

### **3.1 INTRODUCTION**

740 With the increased awareness towards improved living environment, development of sewerage  
and sanitation infrastructure has been accelerating in last few decades. Even after establishment  
of sewerage (conventional and decentralized) and onsite facilities, if the system is not operated,  
745 maintained and managed properly, it may fail to provide the desired level of services on a  
sustainable basis. An efficient organization is very important for planning, design, and  
sustainable operation and maintenance of sewerage systems. Therefore, measures must be taken  
for institutional strengthening and internal capacity building so that the efforts made can be  
750 sustained over a period of time and the system put in place can be well managed. Institutional  
strengthening can be done by adequately decentralizing the administration, delegating adequate  
powers at the decentralized level inducting professionals into the administration and providing  
adequate training to the existing staff. This Chapter considers institutional aspects of  
management of sewerage and onsite systems and describes in detail about strengthening the  
capacity of relevant staff-members through training.

### **3.2 ORGANIZATION SETUP**

755 Sewerage services have been historically under the control of public health engineering  
departments governing the entire State for capital works and local bodies like corporations,  
municipalities, townships and Panchayats for O&M. In recent decades, separate Boards/Nigams  
have been created in major cities like Bangalore, Hyderabad, Chennai and Lucknow that are  
responsible for both capital works as well as O&M of systems.

760 In a large country like India, the sewerage management can be performed effectively if  
administration is adequately decentralised. Decentralisation can be at the City level, the Zone  
level, and the Ward level. Sewerage services would get focussed attention if all functions of the  
city administration are decentralised at Zone/Division levels and senior officers are placed  
in-charge of each Zone/Division functioning independently with adequately delegated powers.  
The 74<sup>th</sup> Constitutional Amendment envisages formation of Ward Committees in each city that  
have population above 300,000. These Ward Committees, as and when formed, may be very  
profitably involved in improving sewerage and sanitation services at the Ward level.

#### **765 3.2.1 Central Government**

The role of the Central Government is to administer uniformity in the features by bringing out  
manuals and advisories and disbursing grant funds under various Central Programmes.

770 Broad policies on sector development of water supply and sanitation in urban and rural areas are  
formulated and circulated to State Governments and Union Territories as guidelines. Technical  
manuals are drafted and published for use by the water and sewage authorities. General progress  
in providing these services in the urban and rural areas is monitored. External aid is also  
procured through the GOI for major projects fulfilling certain norms. Apart from offering  
specific in-service training programmes for the employees of sewerage authorities in the States,  
775 financial assistance for specific in-service training programmes of the States is also offered.  
Assistance from financial institutions and other bodies like HUDCO, LIC, etc., are available.

#### **3.2.2 State Government**

The State Governments offer to assist the local bodies in planning and implementation of  
sewage collection, treatment and proper disposal schemes of individual or a group of local

bodies. Financial assistance is also given for these schemes in the form of grant-in-aid and loan, etc., for capital investment. In special circumstances, the State Governments assist the local bodies in operating and maintaining their sewerage schemes through their own departments or through statutory boards. Trained engineers and skilled workmen are sometimes deputed to local bodies on request, to plan, implement and operate the systems. The State Governments monitor general progress of schemes of local bodies in respect of planning, implementation, operation and maintenance.

### 3.2.3 Parastatal Agency

These Agencies/Boards are devices by which State Government would be able to establish corporate public entities to construct, manage and operate water and sanitary services on a fully commercial basis in large metropolitan areas as well as in smaller urban communities. These Agencies/Boards should be empowered and equipped to raise such capital from local resources and open market borrowings to supplement the resources provided by the Government at the State and Central level. Such Agencies/Boards may have the advantage of:

- a) increased efficiency resulting from financial autonomy
- b) improved ability to raise capital with confidence
- 795 c) affording better opportunities for small municipalities grouped together to finance and operate their schemes as a business proposition
- d) the economies implicit in a common authority which may be made to serve several undertakings
- 800 e) a better and full realization of taxes/cess when this duty is divorced from local politics
- f) the economies possible by pooling technical and administrative staff to serve a number of municipalities
- g) opportunities for equalizing the rates in every region.

A statutory Water and Sanitation Board may be set up at the State level with regional boards if and to the extent necessary within the State, to provide water and sanitation services and to collect revenues to meet such services, to raise the capital needed to provide the facilities and to exercise all other corporate powers necessary to act on behalf of the local bodies within their jurisdiction. Normally, such boards would encompass all activities including production, conveyance and distribution of water within their statutory areas and also the collection, treatment and disposal of sewage from that area as well as other sanitation services. It is, however, possible that some local bodies may prefer to purchase water in bulk from the statutory boards and arrange for the internal distribution themselves and may also prefer to have the statutory board take over sewage in bulk from the local area and arrange for its treatment and disposal. This should be avoided as far as possible as the supply and distribution of water as also collection and disposal of sewage are two interdependent functions and the divisions of such functions amongst two independent agencies might lead to inefficiency and unavoidable difficulties for both parties. Any local body managing its systems satisfactorily need not necessarily come under such a Board.

### 3.2.4 Urban Local Bodies

820 It is obligatory for every local body (Municipal corporation, Municipality, Nagar Panchayat, etc.) to collect, transport and properly dispose of sewage produced in the area under their respective jurisdictions. Depending upon the financial status of each local body, the

825 State/Central Governments come to the help of these local bodies to meet a part/whole of their capital investment cost on schemes in the form of grant-in-aid and/or loan. The expenditures on annual operation and maintenance of these schemes however, have to be met by the urban local body out of its own revenue generated from taxes. As per the respective acts, local bodies have been empowered to levy and recover tax from the community to whom sewerage services is provided by the local bodies.

### 3.2.4.1 Types of ULBs

830 According to the Article 243Q of 74<sup>th</sup> Constitutional Amendment Act (CAA), the ULBs have been classified into the following three categories:

- a) Municipal Corporation (Nagar Nigam) - for larger urban areas
- b) Municipal Council or Municipality (Nagar Palika) - for smaller urban areas
- c) City Council (Nagar Panchayat) - for transitional areas

835 No quantitative dimension for area or population has been specified for their identification. However, the 74<sup>th</sup> CAA lists five criteria for constituting the ULBs: Population, density, revenue generated per annum, percentage of employment in non-agricultural activities, and economic importance of the local body. In addition, several states have specified their own criteria for the purpose with the state legislatures setting up the criteria while amending their Acts.

840 The area under a Municipal corporation is further divided into wards. Individual wards or collections of wards within a corporation sometimes have their own administrative body known as ward committees.

Municipalities are also divided into wards, which may be grouped together into ward councils. One or more representatives are elected to represent each ward.

## 845 3.3 NEED FOR CAPACITY BUILDING

Proper sewage collection and treatment form a sound basis for improvement in community health. Maximum health benefits will be achieved only when the sewerage and sanitation facilities operate continuously and to full capacity in conformity with the acceptable standards of quantity and quality. If the sewerage tasks are to be carried out effectively and efficiently 850 capabilities should be strengthened as under:

- Institutional capacity building
- Human resources capacity building by training

855 Also, many ULBs in the country do not have adequate Environmental Engineers/Public Health Engineers and other professionals for planning, design of sewerage systems, implementation and O&M. It is, therefore, necessary to induct such expertise by either in-house or from a central pool under the State depending on the needs of different classes of towns.

Sample job requirements are described in Section 3.14.

### 3.3.1 Institutional Capacity Building

860 Funds may be available in a given institution such as a municipality, but the institution by itself may not be able to discover within itself a way of rendering the services more efficiently and profitably without unnecessarily levying impractical tariff on users. This requires (a) the ability of a dedicated municipal information unit in the country to collect, collate and analyse comparable data on municipal services and finances on an annual basis from across the country and bring out a concise set of successful models and (b) developing a performance assessment

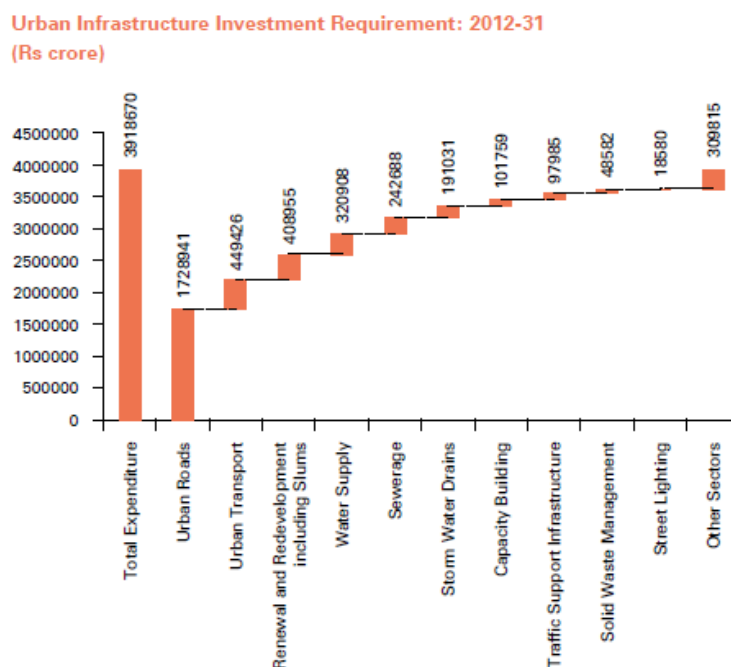
865 system for evaluating and recognizing the institutions which perform the best so as to confer a  
recognition on a rotational three yearly basis in various categories of corporations,  
municipalities, townships, Panchayats and parastatals.

### 3.3.2 Human Resources Capacity Building

870 Here also, funds may be available in a given institution as a municipality but there may not be  
persons who have innovative thoughts, the ability to envision newer project deliveries, to  
enhance revenue collection, etc. Further there must be a guarantee that once an officer has  
initiated a newer line of deliverables, the officer should be allowed to continue for a reasonable  
period. At the same time, the officer needs training and visits to other such agencies to see and  
learn how others are doing these. This can be implemented by a continual training. The Chennai  
875 Metropolitan Water Supply and Sewerage Board was formed by members from the water and  
sewerage services from the various agencies in the area. A programme was instituted whereby a  
set of training courses were designed and an in-house training centre was constructed and for  
the first few years it was ensured that at a given time, 10% of the staff would be on training, if  
necessary by repeat training also. The stability of this agency even today after 34 years is largely  
880 due to this initial orientation of the staff. The training goes on even today but not as intensively  
as in the initial stage.

### 3.3.3 Inadequate Fund Allocation for Capacity Building

Capacity building for both the institutions and human resources is a continual task and not a  
one-time affair. Therefore, a portion of the budget is to be set aside for these. The High Powered  
885 Expert Committee set up for estimating the Investment Requirements for Urban Infrastructure  
Services for the period 2012 to 2031 has given a forecast as in Figure 3.1 and identifies a  
separate head of expenditure for capacity building. It may be seen that the funds needed would  
be about Rs 101,759 crores.



890 Source: HPEC, MOUD, 2011

Figure 3.1 Urban infrastructure investment requirement 2012-31

### 3.4 TRAINING NEEDS ASSESSMENT

895 Training is a planned process to modify attitude, knowledge or skill through learning experience to achieve effective performance in activity and to develop abilities of the individuals to satisfy the current and future needs of the organization.

900 The personnel who are already available or chosen to carry out the actions contained in the O&M programme may have to be trained through special courses or by “on the job training” to ensure that these personnel are thoroughly trained to carry out the actions listed in the plan of maintenance. This training is essential to prevent experimentation by operating personnel with equipment since often these operating personnel may not have the capability to take up the required maintenance. On the job training is preferred to classroom training. The supervisors can be trained initially; and later they can train the operators.

A systematic plan of action of any training program includes:

- Identification and assessment of the need for planned training
- 905 • Defined training objectives
- Appropriate strategy for training
- Provision for assessing effectiveness of training.

#### **Objective of training needs identification**

- To identify a profile of the training needs and interests of the employees
- 910 • To gather information on the climate, culture and communication links of the work place
- To make recommendations for a training initiative that would be the basis for a strategic plan for employee development.

#### **Process of identification of training needs**

915 This involves the following steps:

- Determine what is required or expected in the job.
- Determine the degree to which this requirement is being met.
- Determine whether training can bridge the gap between what is required in the job and the present knowledge, skills, attitudes or behaviour of the employees.

#### **920 Data collection on training needs**

Data on the assessment of training needs can be collected in the following ways:

- Discussions with officials and employees, supervisors and top management
- Observing the employees, their work, work flow and relationships.

925 Review of records and reports, particularly the reports if any which provide the reaction of the consumers to the services provided by the utility, organization structure, organization policies, records of past trainings, etc.

#### **Analysis of data**

The analysis of the data is carried out with a view to make the assessment of training needs for

various levels as below:

- 930
- Needs for the organization as a whole - corporate needs
  - Needs for departments/teams within the organization - group needs
  - Needs for individual employees - individual needs

There is a need for i) Job analysis and ii) individual analysis for carrying out a training need analysis.

935 **Job analysis**

Information is obtained on the following aspects:

- 940
- Problems faced by job holders in learning basic skills and applying them successfully in work
  - Weakness in performance of existing job holders due to gap in knowledge, lack of skills or motivation
  - Areas where competence levels are not up to required standards
  - Areas where future changes in work process or methods or job responsibilities indicate training needs
  - How training is carried out at present.

945 A job analysis work sheet is shown below in Table 3.1.

Table 3.1 Job analysis worksheet

What is to be done?	Why?	How?	How well?
To .....	In order to ..... ...	With whom? Where? Process or procedure? What equipment or facilities	Quantity? Output required? Results needed? Quality?

Source: CPHEEO, 2005

**Individual analysis**

Information obtained from individual analysis includes:

- 950
- Details of job holders with adequate knowledge and skill for the job
  - Effectiveness of a person in putting her/his work to practice
  - Behavioural changes and work efficiency of job holders after attending training program
  - Level of job satisfaction.

955 The individual analysis worksheet is shown below (Table 3.2).

Table 3.2 Individual analysis worksheet

Individual particulars	Detailed information		
	Essential	Useful	Not necessary
Educational/Training/Experience			
Sex, Age			

Individual particulars	Detailed information		
	Essential	Useful	Not necessary
Occupation			
Affiliation/Special Interests/Aptitudes			
Languages			
Attitudes, beliefs			
Knowledge of subject			
Authority			

Source: CPHEEO, 2005

### Results of the training needs analysis

960 From the training need analysis described above; the present knowledge and skill of job holders of the organization can be arrived at. The results of training needs are shown below in Table 3.3.

Table 3.3 Results of training needs (CPHEEO, 2005)

Job requirement	Trainee's current knowledge & skills				
	Excellent	Good	Fair	Poor	Nil
1.					
2.					
3.					
4.					
Etc.					

Source: CPHEEO, 2005

Training needs are identified from the above information. Considering the identified training needs as indicators, training objectives can be listed out to arrange the training.

### 965 3.4.1 Short-Term Training Needs

Short-term training needs for the existing staff of the organization are likely to be met by short courses or other similar interventions.

- Specific training needs identified can be met by appropriate short-term training programs.
- 970 • This improves competence of employees.

Proper job analysis and training analysis can identify short-term training needs. Short-term training needs can mostly be attended by means of in-house training programs.

### 3.4.2 Long-Term Training Needs

975 Long-term training needs should largely be addressed by deputing staff to undergo formal educational programs in sewerage and sanitation (regular/distance learning) as well as specifying recruitment criteria for new entrants.

Universities, Technical Colleges, Public/Private Sector institutes offer formal programs leading to certification or degree/diploma in sewerage works.

- 980 • Evaluations of short-term training programs should lead to assessment of long-term training needs.
- Existing staff of organization can undergo formal programs by distant learning.
- Long-term training needs addresses the future demands of the organization.

**3.4.3 Managerial Training Needs**

985 The managers of sewerage work deal with planning, organization and finance in sewerage works. They should also be required to formulate programs and implement activities aimed at improving the effectiveness of operation and maintenance practices. Sewerage works need appropriate strategy for decision making based on information, engineering and management. Appropriate strategy influences the efficiency of management.

990 The staff should know the procedures for routine tasks to be performed by them and supervision and inspection managers should know the checks and inspections to be carried out by them at specified intervals to monitor and evaluate the status of activities. The supervision or inspection officers have to ensure that the operation and maintenance staff perform their assigned duties promptly and properly.

995 It is necessary to understand analysis methods for organizational state and cutting-edge management systems by training.

- Cutting-edge management system – Asset Management, Management Information System, PPP, Project Management, Disaster Management, New tender system, etc.
- Enhancement of Capacity Building for manager - Problem–solution training, Leadership training, Communication training.

**1000 3.4.4 Technical Training Needs**

1005 Sewage works need many fields of technology – civil engineering, architecture, mechanical engineering, electrical engineering and chemistry. Each technology interacts with others, so basic knowledge of technology is essential for employees. Sewerage technology evolves very rapidly. There are many dangerous equipment and chemicals involved. Integration of these technologies makes sewerage systems work well. In order to enhance the capacity, periodical training is essential.

- Newly deployed employees – Basic knowledge of sewage treatment, technical issues for daily operation of facilities
- New technology - Sewer renewal, sewer cleaning equipment, advanced treatment
- 1010 • Safety measures – Hydrogen sulphide, lack of oxygen, chloride, electricity, etc.

**3.5 TRAINING FOR ENHANCEMENT/REFRESHING SKILLS**

1015 The purpose of any training program is to provide individuals with skills necessary for them to perform their assigned duties effectively and efficiently. It has to be decided as to whether training to enhance the skills or training to refreshing the skills is to be arranged after ascertaining the skills of the job holders.

a) Employees creative model:

Organizations provide training for enhancement of skills to encourage personal advancement.

b) Organizational strategy model:

1020 Basic skills are identified as a critical component in achieving corporate goals for refreshing the skills of work for increasing production and efficiency.

c) Problem cantered model:



The need for basic skills training is identified as a specific issue or difficulty faced by the organization.

### 1025 3.6 TRAINING OF TRAINERS

1030 Training of trainers plays a key role in how effectively a trainer can operate to satisfy the needs of the trainees. Trainer's training is a specific program set out to enable new trainers to learn the basic techniques and approaches of training or to enable existing trainers to develop the training skills they already possess. Some of the specific objectives of trainer's training in sewerage sector are:

- To explain the necessity and objectives of training in sewerage works, operation and maintenance
- To practice participatory learning activities
- To carry out systematic training needs identification or training needs assessment
- 1035 • To demonstrate appropriate technology for urban sewerage
- To prepare and review curriculum for various categories of trainees
- To select and use appropriate audio visual aids in training programmes.

With new or improved skills of trainers, the trainers can arrange training programs to enable other trainees to develop skills, knowledge and attitudes.

1040 An example of a document for Trainer's Guide & Trainers Textbook for Training Programme on O&M of Sewage Treatment Plants has been developed by the Tamil Nadu Pollution Control Board and DANIDA and is specifically made for the type and facilities affordable for Indian conditions. There is also a similar set of a 3 volume publication by Canadian Ontario Water Resources Commission, specifically meant for sewerage works operators and published as early as 1969 (Ontario Water Resources Commission, 1968 and 1969). More such publications in not only English but also in regional languages are needed so that the operators can really understand their roles easily and increase their confidence.

Example of specific training curriculum for employees is given in Section 3.15.

### 3.7 ON-THE-JOB TRAINING

1050 Depending on the place or location where training takes place, training can be called on-the-job training if the trainee gets training while working on the assigned job. The trainee in the physical and social environment of the work place is simultaneously involved in the process of acquiring knowledge.

- 1055 • The trainee requires little specialized attention in terms of extra equipment and manpower.
- It helps to develop and practice specific managerial/technical/administrative skills needed in operation and maintenance of sewerage works.
- The trainee works, learns and develops expertise at the same time and concepts and theories are put into practice immediately.
- 1060 • Gives guidance to supervisors and instructs new employees in performing their tasks.
- It is considered to be an acceptable means to train officials in new developments

and new systems when they are introduced.

1065 For example, a mechanic/plumber may be given field experience in pump houses and small sewerage works schemes to operate and maintain them. This helps in:

- Skill Development: Learns how to do it
- Practical knowledge: Learns when to do it
- Education: Learns what to do
- Hands-on experience: Knows the impact.

### 1070 **3.8 QUANTIFICATION OF TRAINING**

Training programs can be quantified in terms of category of staff being trained, the number of staff members who can be accommodated in a training program, how often this training has to be given (frequency) and the duration of each course.

#### **Category of trainees**

- 1075
- Executive officers
  - Supervisory staff
  - Administration and establishment staff
  - Operators
  - Training for grass root level personnel.

#### 1080 **Category of the training course**

- Technical/Public Health Engineering
  - General Management
  - Finance
  - Operation and Maintenance
- 1085
- Industrial/Personal Relations
  - Computer Applications/IT.

#### **Number, Frequency and Duration**

The number of trainees in a particular training course, how frequently that course is offered and duration of the course are key components used to quantify the training programs.

### 1090 **3.9 INCENTIVES FOR EFFICIENT PERFORMANCE**

There is a need to provide for incentives and awards to recognize and encourage those employees whose performance has been found to be exceptionally efficient. This should enthruse other employees also to strive to improve their work efficiency. The HRD budget should provide for the incentives and awards.

### 1095 **3.10 TRAINING SCHEDULE AND YEARLY PROGRAMME**

The change from a crisis type of O&M to a planned O&M can be undertaken gradually or in a

1100 relatively short period of time depending on the resources available. The change should be planned and coordinated with a training schedule. The training schedule should ensure that each staff member gets training periodically and training should be made mandatory for all the staff members of the utility.

A tentative action plan for the year can be prepared in advance. Every staff member should get training periodically and it should be made mandatory. This action plan would give the yearly programme of various training courses. It includes the following:

- Course group, title
- 1105 • Category and number of participants
- Duration (including date on which training is to be held).

### 3.11 TRAINING INSTITUTIONS

1110 External training facilities for a substantial proportion of the staff and personnel engaged in design and R&D of sewerage facilities are available at both the national and local levels. Such training facilities are being used by many of the sewerage authorities.

Off-the-job training can take place in institutions outside the organization, which are specially equipped and staffed for training.

- 1115 • It is the best way to acquire knowledge on advanced or latest office procedures, planning and monitoring, project implementations methods, quality assurance methods and proper maintenance of schemes.
- Use of systematic training techniques, special equipment and trained trainers
- Basic skills and knowledge can be acquired quickly and often economically.
- Training courses cover standard theory and practice which are easily translated from general to particular.
- 1120 • Useful to implant highly specialized knowledge and advanced skills.

#### 3.11.1 National Education/Training Facilities

##### 3.11.1.1 Post Graduate Courses in Public Health/Environmental Engineering

1125 The Government of India has from time to time launched various programmes for increasing the provision of sewerage and sanitation facilities. The infrastructure which is being developed by various ULBs/State Departments for drinking water supply, sewerage, sanitation, drainage, solid waste management, etc., will need more qualified and trained manpower for better designing and speedy implementation of all the schemes in economical manner and also for proper operation and maintenance of old and new projects and infrastructure development. In order to achieve that, the CPHEEO organizes several training programs. The PHE training program is

1130 being implemented by the Ministry since 1956 with the objective of providing training to in-service engineers and para-engineering staff of the various State Public Health Engineering Departments, Water Supply and Sewerage Boards, Urban Local Bodies, etc. The details are as follows:

Some of the institutions offering these training programmes are:

- 1135 i) All India Institute of Hygiene and Public Health, Kolkata
- ii) Veermata Jeejabai Technological Institute, Mumbai

- 1140
- iii) Anna University, Chennai
  - iv) Visvesvaraya National Institute of Technology, Nagpur
  - v) Motilal Nehru National Institute of Technology, Allahabad
  - vi) Shri Jayachamarajendra College of Engineering, Mysore
  - vii) Shri Govindram Seksaria Institute of Technology & Science, Indore
  - viii) Indian Institute of Technology Bombay, Maharashtra
  - ix) Malviya National Institute of Technology, Jaipur
  - x) Indian Institute of Technology Kharagpur, West Bengal
  - 1145 xi) Indian Institute of Technology Delhi, New Delhi
  - xii) Jawaharlal Nehru Technological University, Hyderabad

The duration of the Post Graduate Course is 24 months.

### 3.11.1.2 Management Education at Degree/Diploma Level

Management Courses are offered inter-alia, at the following five management Institutes:

- 1150
- i) Indian Institute of Management, Ahmedabad
  - ii) Indian Institute of Management, Bangalore
  - iii) Indian Institute of Management, Kolkata
  - iv) Indian Institute of Foreign Trade, New Delhi
  - v) International Management Institute, Delhi
  - 1155 vi) Administrative Staff College of India, Hyderabad

### 3.11.1.3 National Institute for Training in Industrial Engineering (NITIE)

- 1160 Short term non-residential and residential courses are held by the National Institute for Training in Industrial Engineering (NITIE). The courses are from five days to two weeks' duration and are held at five centres. Courses held in Mumbai are residential. Courses held in Bangalore, Delhi, Hyderabad and Madras are non-residential.

### 3.11.1.4 Refresher Courses Conducted by CPHEEO

Refresher Courses are conducted by various recognized institutes under the sponsorship of the CPHEEO, by the Ministry of Urban Development under the Public Health Engineering Training Programme. The courses being offered are given in Appendix 3.1.

### 1165 3.11.1.5 National Environmental Engineering Research Institute (NEERI), Nagpur

NEERI is a research institute primarily engaged in research and development work in the field of public health and environmental engineering. Training and consultancy services are offered by this institute in the following areas:

- 1170
- i) Water Treatment and Supply
  - ii) Sewage Treatment and Disposal
  - iii) Industrial Waste Treatment

- iv) Stream Sanitation
- v) Industrial Hygiene and Air Pollution
- vi) Rural Sanitation.

### 1175 3.11.1.6 Training in Outside Institution (International Training Network)

There exist a number of institutions coming under an International Training Network (ITN) established for the implementation of HRD activities. In India the following institutions are in the network:

- i) All India Institute of Hygiene & Public Health, Kolkata (ITN Centre)
- 1180 ii) Gujarat Jalseva Training Institute, Gandhinagar
- iii) Environmental Sanitation Institute, Ahmedabad
- iv) S.J. College of Engineering, Mysore
- v) Gandhigram Rural Institute, Gandhigram
- vi) Institute of Engineering & Rural Technology, Allahabad
- 1185 vii) Motilal Nehru National Institute of Technology, Allahabad.

## 3.12 CAREER ADVANCEMENT

An important question is: how does an employee benefit even after being well trained and having proven one's application to duty? In the present system, the employee will merely receive a promotion which is entirely by seniority and may receive a good remark in the performance appraisal note. This unfortunately does not serve to encourage staff members. There are cases where an entry level engineer remains in the same level for decades. Similarly, sewage works operators remain and retire as sewage works operators. However, people who have had the opportunity to enter the All India Civil Services, rise rapidly in stature and salaries and by the time a sewage works operator retires in her/his initial cadre, these officers becomes heads of Government services. These anomalies do not enthuse the staff in O&M and should be corrected. Within the framework of administrative machinery, the incentives below should be considered and promoted.

### 3.12.1 Higher Professional Qualifications

For the O&M staff members who possess a basic qualification such as diploma, there is an opportunity to appear for examinations of the Institution of Engineers, India, and qualify to receive a certification as an associate member which is recognized as equal to a degree in engineering. Similarly, there are opportunities whereby the staff can pursue such qualifications from local universities by part time courses. But the issue is there are no such avenues for the sewage works operators who are the core staff members of the sewerage system in the field but who may not have the money or time to sit and study. It is strongly recommended that a set of grades be introduced for the operators and the staffing for various sized plants should be compulsorily manned by these categories of operators naturally with higher pay scales for the higher categories. A recommended simple structure is proposed in Table 3.4.

1210

Table 3.4 Recommended categories of sewage works operators

Category	Basis of Offering the Grade
A	After 10 years of service in B
B	After 10 years of service in C
C	After 5 years of service in D
D	Entry level

A recommended compulsory staffing pattern for sewerage works is given in Table 3.5.

Table 3.5 Recommended staffing for sewerage

	Range and Volume of public water supply in MLD	Category			
		A	B	C	D
1	Up to 1				All shifts plus one
2	Between 1 and 5		General shift	All shifts plus one	All shifts plus one
3	Between 5 and 10	General shift	All shifts plus one	All shifts plus one	All shifts plus one
4	Above 10	All shifts plus one	All shifts plus one	All shifts plus one	All shifts plus one

Note: The number of each category in each range will depend on local geographic area of the concerned local agency.

1215 It should be made compulsory for the local agency to have such staff in its employment roster in respective categories to qualify for receipt of grant funds under various Central Programmes.

### 3.13 NEEDS FOR TRAINING BUDGET

It is preferable to have a separate budget for HRD for each utility. While preparing budget for training, one should plan and budget for the following items:

- 1220
- Professional/registration fee
  - Honorarium and travel expenses for the trainer/faculty
  - Accommodation for trainer(s)
  - Ground transportation for trainer(s)
  - Training rooms
- 1225
- Library facilities
  - Audio-visual equipment (OHP, LCD, etc.)
  - Snacks and tea (refreshment)
  - Travel expenses for trainees for field visit
  - Stationery articles

- 1230
- Computer time, stationery, etc., for computer aided training courses
  - Incentives and awards for improvement in work efficiency.

A typical worksheet for developing a training budget is given in Table 3.6.

Table 3.6 Worksheet for developing training budget

Questions to consider	Cost	Comments
<b>Event fees:</b>		
Is there a registration fee, course fee, or tuition fee for the event?		
Trainer or consultant fees		
What is the trainer's or consultant's hourly, daily, or weekly fee?		
Does the trainer or consultant charge for preparation time? If so, how much?		
<b>Materials:</b>		
Are there course materials associated with the training? How much do they cost? Does each trainee need a copy, or can they share?		
Will the training require printing or photocopying of materials? If so, how much will these services cost? Are they included in the trainer's fees?		
Will the trainer need audio or visual aids (such as overhead projector and slides, TV)? How much will it cost to purchase or rent these items?		
Are other assorted materials (such as name tags, paper and pens, files, or computer stationery) required to be purchased? If so, what will they cost?		
How much will refreshments cost? How will you pay for them?		
<b>Space:</b>		
Where will you hold the training? What will the space renting cost?		
Will you provide on-site care? Are necessary spaces and resources available? What will this cost?		
<b>Travel:</b>		
Will the training require staff to travel? Will they need to stay over? How much will this cost, including mileage, per diem, and lodging?		
If the trainers are from out of town, what is the total of their travel, lodging, and per diem expenses? Are their travel costs covered separately or included in the contract?		
If volunteers are included in the learning event, will they incur transportation or parking expenses? Are they eligible for reimbursement?		
<b>Staff Time/Substitutes:</b>		
Do some employees involved in the training need to be replaced by substitute staff? How much will the substitutes cost?		
If follow-up training or assistance will be needed, what will this cost?		
<b>Other:</b>		
Accommodation for the out station trainees		

Source: CPHEEO, 2005

- 1235 Budget for training is frequently expressed as a percentage of the total payroll. On an average 2 to 2.5% is preferred, out of which 75% can be spent for in-house training and rest can be utilized for training in external institutions.

**3.14 JOB REQUIREMENTS****3.14.1 Responsibility of Senior Management Personnel**

- 1240 a) The senior management personnel should define the role of the agency and set out strategies for long term objectives. They should be in close contact with other agencies involved in infrastructure services and work for coordination with government and private agencies in design, construction, O&M, monitoring and evaluation of the functioning of the agency.
- 1245 Their responsibilities are to:
- Establish mechanisms and type and level of service for sewerage system (including centralized, decentralized, and onsite systems) for the population in their service area, determine priorities and define areas for expansion of coverage
  - Determine and administer staffing structure, service conditions, job descriptions, salary levels, performance standards, staff training and promotions
  - Ensure efficient use of funds and control construction and O&M costs
  - Set targets for achieving excellence in quality, quantity, continuity, cost, and set tariff levels keeping in view the social equity and agency's need for financial self-sufficiency
  - Promote dissemination of information and seek support and acceptance of the agency's programmes and plans by public and private bodies
  - Initiate actions for conservation of water environment
  - Promote reuse of effluent and sewage sludge
  - Consider use of gas produced in digester
  - Carry out a situation analysis of technological capacity, government policies, and sources of funding which affect the O&M
  - Prepare an inventory of the installations and equipment
  - Adopt appropriate technologies to minimise O&M costs
  - Ensure quality control in the purchase and installation of materials and equipment and thus ensure prolonged useful life of materials and equipment through preventive maintenance
  - Raise the productivity of the workforce
  - Monitor plans for prevention and control of pollution
  - Consolidate programmes formulated by middle and operational management levels and prepare a long term plan for O&M with targets set for each unit for the coverage, output, productivity and cost
- 1270 b) Determine the technical, economic and organisational feasibility of the O&M plan, make adjustments where necessary, and carry out cost benefit analysis or undertake socioeconomic studies or other studies if deemed necessary
- 1275 c) Arrange for dissemination of O&M plan with other agencies, authorities and public



- d) Approve the long term plan, prepare programmes for investment and implementation of long term plan for O&M, set targets for implementation of long term plan for O&M, allocate resources according to priorities, set targets, and monitor and re-allocate resources where necessary to ensure that the targets set in the plan are achieved
- 1280 e) Encourage programmes of a strategic nature which have potential for research and development, and encourage adaptation of new technologies and approaches
- f) Create enabling environment for adaptation by the agency for technical, regulatory and political changes
- g) Prepare contingency plans for continued service delivery in emergency situations.
- 1285 **3.14.2 Responsibility of Middle Management Personnel**
- a) Middle management personnel should contribute in the formulation of a long term plan for O&M and also contribute in preparing projects for expanding and making the facilities work effectively. For achieving this they should:
- 1290 i) update system data, select design criteria and decide how to meet the technical standards and social needs in the most cost effective way,
- ii) formulate and implement programmes for increasing productivity,
- iii) formulate and implement programmes for reuse of the effluent, sludge, and gas and provide data to senior management for formulation and implementation of pollution control programmes.
- 1295 b) Middle management personnel should be responsible for defining the type of service and coverage and formulate medium-term programmes for O&M. These programmes should aim at:
- i) Expanding coverage of service
- ii) Making best use of existing physical, financial and human resources
- 1300 iii) Improving quality of services provided
- iv) Rehabilitation (as part of preventive maintenance) of component parts of sewerage installations and equipment with a view to extend their useful life
- v) Reducing costs and raising productivity in the agency's O&M programmes
- vi) Supervising the O&M of sewerage system
- 1305 vii) Monitoring environmental conditions
- viii) Promoting awareness of and educating users about the proper use of sewerage services.
- c) Middle management personnel should determine the technical, economic and organisational feasibility of the O&M plan. They should determine priorities and set targets for implementation of long term plan for O&M.
- 1310 d) Middle management personnel should consolidate all the short term O&M plans prepared by the operational management level and submit it to senior management to ensure that it is compatible with the long term plan. They should monitor and re-allocate resources where necessary to ensure that the targets set in the plan are achieved.

**1315 3.14.3 Responsibility of Operational Management Personnel**

Operational management personnel are primarily responsible for short term planning and also participate in formulating medium term and long term O&M plans. Operational management personnel have responsibilities in the planning, design and construction work as well as O&M of the agency's equipment. They also propose medium term activities to operate and maintain the sewerage system and participate with middle management personnel in defining objectives, strategies and resources both to extend and to ensure full use of the coverage of services. They should also evaluate the feasibility of medium term investments for O&M. In line with long term and medium term programmes for O&M, they should formulate short term objectives, targets and programmes. They should assess the resources required and allocate them, monitor and evaluate the performance in the following areas:

- 1325 i) Studies and designs needed for rehabilitation of the installations or for expansion of the services
- ii) Maintain the units under operation so that they work efficiently and last as long as possible
- 1330 iii) Measurement of sewage flow rates, water quality test for maintenance
- iv) Update the ledger data
- v) Processes for improvements of house connections and domestic plumbing
- vi) Processes for treatment and quality control of water.

**3.14.4 Job Description**

1335 Work details regarding O& M duties and designations are shown in Table 3.7 and Table 3.8, respectively. The management of sewage works is headed by a chief engineer (CE) or Superintending Engineer (SE) at the senior management level and supported by Executive Engineer (EE) or Assistant Engineer (AE) at the middle management level and Assistant Engineer (AE) or Junior Engineer (JE) at the operational level depending on the plant size. The engineers are assisted by chemists, electricians, mechanics and operators. The chemist and the chemist's assistants collect sewage samples from influents and effluents at least once a day for assessing wastewater quality.

Table 3.7 Job description

No	Duty	Description
1	Execution of general affairs related to sewage	General affairs, Personnel, Salary, Welfare, Dissemination
2	Budget Execution	a) Procurement of materials and administration (Fuel, chemicals, consumables) b) Contract of construction c) Contract of outsourcing
3	Asset Management	Administration of fixed assets, maintenance and repair
4	Coordination of Service Charges	User survey, user charges, collection of user charges, survey of uncollected sewerage charges
5	Guidance for house connections	Check and inspection of house connections

No	Duty	Description
6	Monitoring and guidance on industrial effluent	Check, inspection and guidance on pretreatment facilities and effluent quality
7	O&M of sewers	a) Planning, preparing detail plans and supervising implementation of inspection and survey of sewers b) Planning, preparing detail plans and supervising implementation of cleaning and desludging of sewers c) Planning, preparing detail plans and supervising implementation of rehabilitation and replacement works d) Protection of sewers e) Approval and authorization of sewer related matters
8	O&M of pumping station, and treatment plant	(1) Operation a) Planning of sewage treatment and sludge treatment b) Planning operation of facilities of pumping station & STP c) O&M of pumping stations and STP d) Disposal plan for grit, screenings, and sludge, Preparation of plan and implementation of transport and disposal e) Planning and implementation of cleaning of buildings and garden maintenance f) Recording data on O&M of pumping stations and STPs (Daily, Monthly, Annual) g) Direction for operation during abnormal and emergency periods  (2) Maintenance and Inspection a) Establishment of guidelines, and preparation of maintenance and inspection plan for machine and electrical equipment b) Preparing detailed plans and implementation of outsourcing the above activities  (3) Rehabilitation and Replacement a) Preparing detailed plan, design, and implementation of rehabilitation
9	Water quality control	a) Planning of water quality tests b) Execution of sludge quality test c) Execution of water quality test for industrial effluent d) Execution of survey and research e) Data compilation, analysis and report preparation f) Making decisions for the O&M manual g) Countermeasures in case of any abnormal situation h) Adjustment of water quality analysis equipment i) Close check of data
10	Ledger management	a) Preparation and keeping ledger b) Revising and reading ledger c) Maintenance of drawings and literature (Plan, profile, sewerage map, electrical system drawings, sewer networks drawings, etc.)
11	Environment conservation	a) Plan and execution of measures for air pollution b) Plan and execution of measures for noise and vibration c) Plan and execution of measures for odour d) Plan and execution for discharge of treated effluent to river

No	Duty	Description
12	Others	a) Report to authority b) Understanding the status and improvement on safety and sanitation c) Guide to visitors d) Dissemination of knowledge and public awareness e) Training of staff and operators

Source: JSWA, 2003 Guidelines on Sewage Works Operation and Maintenance Guideline, Japan Sewage Works Association

1345

Table 3.8 Designation and responsibilities

No	Level of Management	Designation	Functional Responsibilities
1	Senior management	Chief Engineer	Strategies of long term objectives
			Determination of O&M
			Arrange for dissemination of O&M
			Approval of long term plan
		Superintending Engineer	Preparation of contingency plan
2	Middle management	Superintending Engineer	Formulation of long term plan
			Formulation of medium term plan
			Feasibility of O&M
		Executive Engineer	Consolidation of short term plan
3	Operational Management	Assistant/Executive Engineer	Operation of sewer and STP
		Junior Engineer	Water quality control
			Ledger management
4	Others	Plant Operator	Operations of the plant
		Electricians	Working on the electrical motors and systems
		Mechanics	Small repairs
		Civil	Small repairs of sewer & STP
		Chemist	Test of quality of sewage
		Sewerage Workers	Cleaning of screens, removal of grit, cleaning of aeration tanks and other units of plants.

### 3.15 TRAINING NEEDS SUBJECTS/PERFORMANCE AREAS IDENTIFIED FOR ORGANIZING TRAINING INPUTS

- 1350 a) Chief Engineer
- i) Corporate policy and management, personnel
  - ii) Management Information System – Automation
  - iii) Personnel management - Organisational development - Management of Urban utilities
- 1355 iv) Bilateral/Multilateral funding and management
- v) Financial management - commercial pattern
  - vi) Project management

- vii) Systems Engineering
- viii) Contracts - application of specifications
- 1360 ix) Quality engineering
- x) Material planning and control
- xi) Construction management
- xii) Environmental impact assessment.
- b) Superintending Engineer
- 1365 i) Corporate planning
- ii) Organisational behaviour
- iii) Industrial relations
- iv) Personnel management and industrial relations
- v) Management information system – applications
- 1370 vi) Human resource development
- vii) Project planning & control – computer applications
- viii) Computer aided designing
- ix) Standardisation of designs
- x) Quality circles
- 1375 xi) Material planning and control techniques
- xii) Preparation of manual on servicing and repair and testing of electrical and mechanical equipment
- xiii) Analysis of industrial effluents
- xiv) Construction management
- 1380 xv) Rehabilitation of structures
- xvi) Leakage rectification and cleaning of pipelines
- xvii) Programme planning and budgeting systems
- xviii) Bilateral/Multilateral funding – issues and problems
- xix) Import procedures
- 1385 xx) Commercial accounting
- xxi) Basic financial management.
- c) Other Engineers
- i) Construction management
- ii) Project preparation – feasibility studies

- 
- |      |         |   |
|------|---------|---|
| 1390 | iii)    | Project report writing  |
|      | iv)     | Updating of codes and standards   |
|      | v)      | Construction quality control  |
|      | vi)     | Laying, jointing, testing and commissioning of sewers                       |
|      | vii)    | Sewer network planning  |
| 1395 | viii)   | Tooling for operations, maintenance and repair                              |
|      | ix)     | Civil structures – maintenance management                                   |
|      | x)      | Pollution – detection, prevention and control – techniques and applications |
|      | xi)     | Maintenance management  |
|      | xii)    | Energy audit  |
| 1400 | xiii)   | Basic instrumentation   |
|      | xiv)    | Project estimates – preparation and documentation                           |
|      | xv)     | Systems engineering - simulation/modelling                                  |
|      | xvi)    | Material testing and certification  |
|      | xvii)   | Total station survey – computerised analysis and mapping of survey data     |
| 1405 | xviii)  | GIS methods: Preparation and updating maps                                  |
|      | xix)    | Cleaning of sewers  |
|      | xx)     | Rehabilitation of structures  |
|      | xxi)    | Office management – automation  |
|      | xxii)   | Industrial relations  |
| 1410 | xxiii)  | Fire fighting and first aid   |
|      | xxiv)   | Material (stock accounting)   |
|      | xxv)    | MS office – Computer applications in office management                      |
|      | xxvi)   | Human resource development  |
|      | xxvii)  | Management Information Systems (MIS) in urban utilities                     |
| 1415 | xxviii) | Basic financial management  |
|      | xxix)   | Commercial accounting – accounting in public utilities                      |
|      | xxx)    | Planning and monitoring of metering and billing for water                   |
|      | xxxi)   | Basic business accounting   |
|      | xxxii)  | Financial analysis – techniques   |
| 1420 | xxxiii) | Budgeting – Principles and applications                                     |
|      | xxxiv)  | Management accounting   |

- xxxv) Stores accounting
- xxxvi) Costing, budgeting and accounting
- xxxvii) Financial ratio analysis.
- 1425 d) All technical and non-technical office staff members (other than engineers)
  - i) Introduction to MIS – (Application to respective functions)
  - ii) Maintenance manuals – updating
  - iii) Engineering drawing
  - iv) Work execution – measurement recording and billing
- 1430 v) Water quality testing and control
  - vi) Preparation of estimates
  - vii) Sewer cleaning techniques
  - viii) Scouring and cleaning techniques
  - ix) Data collection and statistical analysis
- 1435 x) Computer applications
  - xi) Personnel management
  - xii) Labour laws and industrial relations
  - xiii) General management – introduction
  - xiv) Office management – automation
- 1440 xv) Metering, billing and customer services
  - xvi) Commercial accounting – procedures
  - xvii) Budgeting and audit – procedures
  - xviii) Capital budgeting – procedures
  - xix) Costing, cash flow and credit management – procedures
- 1445 xx) Stores accounting – procedures
  - xxi) Book keeping and accounts
  - xxii) Preparation of budgets
  - xxiii) Materials (stock) accounting
  - xxiv) Management accounting
- 1450 xxv) Costing, budgeting and accounting
- e) Specific Training Course
  - i) Planning and design of sewer systems
    - Basic plan of sewerage facilities

- Fundamentals of stormwater discharge
- 1455 – Hydraulics of sewerage facilities
- Design of sewer
- Fundamentals and practice surveying
- Design exercises.
- ii) Planning and design of treatment plants and pumping stations
- 1460 – Basic plan of sewage treatment and pumping facilities
- Principle of sewage treatment
- Design of the sewage treatment plant and pumping station
- Hydraulics of sewerage facilities
- Design exercises
- 1465 iii) Planning of mechanical and electrical equipment
- Basic plan of sewerage facilities
- Principle of sewage treatment
- Machines for sewage treatment
- Electrical equipment for sewage treatment
- 1470 – Pumping station
- Equipment supervision
- Design exercises
- iv) Construction Supervision
- Principles of sewage treatment
- 1475 – Fundamentals and practice of surveying
- Construction plan
- Construction management
- Quality control
- Inspection
- 1480 v) Fundamentals of operation and maintenance
- Principle of sewage treatment (basic)
- Operation control of sewerage facilities (basic)
- Practice implementing operation control of the pumping station
- Machine operation control for sewage treatment (basic) exercises



- 1485
- Operation of electrical equipment and appliances for sewage treatment (basic) exercises
  - Field exercises
  - Safety rules
- vi) Operation and maintenance (advanced)
- 1490
- Principle of sewage treatment (advanced)
  - Operation control of the sewage treatment facilities (advanced)
  - Machine operation control for sewage treatment (advanced) exercises
  - Operation control of electrical equipment and appliances for sewage treatment (advanced) exercises
- 1495
- Water quality control (data control)
  - Field exercises
- vii) Water quality analysis (basic)
- Principle of sewage treatment (basic)
  - Outline of water quality analysis (basic)
- 1500
- Water quality analysis (basic) exercises
  - Effluent standard exercises
- viii) Water quality analysis (advanced)
- Principle of sewage treatment (advanced)
  - Outline of water quality analysis (advanced)
- 1505
- Water quality analysis (advanced) exercises
  - Biology of sewage treatment
  - Water quality control
- ix) Management of sewerage
- Outline of sewerage facilities
- 1510
- Laws and codes for sewerage
  - Outline of economics
  - Costs for operation control of sewerage facilities
  - Financial administration of sewerage
  - Sewer charge collection procedure
- 1515
- x) Water quality control
- Chemistry of water supply and sewer

- Necessary supplies of sewage treatment technology
- Sewage treatment facilities inspection and inspection standards
- Effluent surveys
- 1520 – Discharge permission procedure
- Field exercises

### 3.16 NEED FOR APPLIED R&D IN SPECIFIC ASPECTS

1525 There exist technologies and systems for any given problem. The solution has to be sustainable, appropriate and in specific cases data either in the short term or long term are not readily available. This situation needs to be addressed and specific focus in terms of applied R&D is required. Applied R&D is different from fundamental R&D in that its aims and objectives are specific to given situation and local practices for upgrading the management skills. Given this definition, the projects listed in Appendix 3.2 are considered as the crucial need for our Country at this time to fill the knowledge gaps in areas of day to day practices in sewerage in India.

### 1530 3.17 SUMMARY

Brief description has been made about institutional aspects and capacity building through training of staff-members of relevant agency/organization. For sustainable development and operation and management of sewerage and sanitation facilities, it is essential to lay emphasis on capacity development of relevant staff-members to update them on improved and more effective methods of O&M, recent advances in technology and management in sector, etc. 1535 Therefore, planning of training programmes on a regular basis and allocating required funds for training, field trips, visits to other countries, at the planning stage of the project is indispensable. Evaluating the impact of the training on the participants and efficiency of the management of system itself is recommended; and if required, modifications should be made in training 1540 procedures. The approach should be such that the trained staff remain in the organization after receiving training for providing their services and do not leave the organization as soon as a better opportunity is available. This of course is not easy unless time bound promotions are guaranteed and services akin to IAS are created to these personnel.

## 1545 **CHAPTER 4 FINANCING AND FINANCIAL MANAGEMENT**

### **4.1 INTRODUCTION**

The age old perception has been drinking water given by the local body is a free service. Slowly, this has changed at least in the urban sector and people are becoming aware of their obligation to pay for the service received. However, even now, there is no change in the rural sector. 1550 Similarly, the awareness to avoid open air defecation also has been realized in the urban sector but not so in the rural sector. It has been ascertained that even in the urban sector, open defecation continues to be practised by about 12.6% of the population. Recognizing the importance of millennium development goals for water and sanitation, it is imperative to eradicate open defecation but the obstacle is the paucity of required capital and O&M funds for 1555 sewerage and sanitation. The difficulty is compounded by the unwillingness of the public to pay their dues, except in some urban areas. Even in the urban sector, the revenues of many local bodies do not meet the actual expenditures of sewerage leave alone saving towards a corpus fund for development in the future. Thus it is a challenge to identify the ways and means of achieving the physical objective of total sanitation by a judicious blend of location specific 1560 technologies and managing finances diligently by devising newer models of project delivery mechanisms. This Chapter presents possible options.

Subsidies for latrines have long been announced by the Governments both State and Centre. Yet, the conveying of the message to the likely beneficiaries and getting the concept into practice has not been happening as expected. One of the notable schemes is the news item (The 1565 HINDU-March-20-2011) which reports that Dakshina Kannada and Shimoga districts have earned the distinction of being the “cleanest” districts of Karnataka, having won the annual sanitation award of the state as a part of an effort to encourage sustainable sanitation. A subsidy of Rs. 3,000 is given to below poverty line families who want to build toilets in their houses, but some districts are yet to come out of the “mindset” that toilets are unnecessary. In Tamil Nadu, 1570 the subsidy has been increased to Rs 4700 (Source The HINDU, March-20-2011 and June-14-2012).

### **4.2 CAPITAL AND REVENUE**

The financial needs are mainly the capital which is meant for creation and upkeep of the infrastructure and O&M on a day to day basis. This is a symbiotic exercise and both aspects are 1575 equally important. Usually, the finances for the capital works come from the Government sector but the funds for O&M have to be met by the population which should pay taxes and charges for services. Herein lies the basic problem. The funds for capital also indirectly come from the taxes to be paid by the population for other services as well. Thus, as long as the revenues earned by the Government are not compatible with the totality of the provision and upkeep of the various 1580 services, the exercise within the Government is prioritization of allocations to the various services from limited funds. As long as this cycle goes on, it is simple to understand that the objectives stated above can never be achieved. Thus, it is essential to devise changes in the physical and financial contents of sewerage services in such a way that it is still possible to bridge the gap.

### **1585 4.3 SOURCES OF FUNDING**

#### **4.3.1 Central Assistance (Grant in Aid, Loan)**

The GOI disburses funds to the States as grant in aid under the Central Programmes based on its own assessment of the financial stability of the States to handle the grants effectively and the human resources available with the concerned local bodies.

### 1590 4.3.2 State Funding

State Budget, which is the official annual announcement by the Government on funds for various sectors like, transport, roads, sewage, education, and so on, is a source of funding.

1595 Some projects are subsidized by central governments, namely, the Ministry of Urban Development and the Ministry of Environment and Forests. Their subsidies vary from 35% to 100% depending on the date of approval of projects and population size. The rest of the budget has to be prepared by the states and ULB. Financing of projects would be as given in Table 4.1.

Table 4.1 Example of financing pattern

Category of Cities /Town/UAs (Urban Agglomerations)	Grant		ULB or Para-Statal Share/Loan from Financial Institutions
	Centre	State	
Cities/UAs with 4 million plus population as per 2001 census	35%	15%	50%
Cities/UAs with million plus but less than 4 million population as per 2001 census	50%	20%	30%
Cities/towns/UAs in North Eastern States and Jammu & Kashmir	90%	10%	-
Cities/UAs other than those mentioned above	80%	10%	10%
For setting up de-salination plants within 20 Kms. from sea-shore and other urban areas predominantly facing water scarcity due to brackish water and non-availability of surface source.	80%	10%	10%

Source: Guidelines for Jawaharlal Nehru National Urban Renewal Mission (JNNURM) December, 2005, Government of India, Ministry of Urban Development, New Delhi

### 1600 4.3.3 Institution Funding

These are loans from standing financial institutions such as banks, HUDCO, LIC, NABARD, IL&FS, etc. The outline of funding implemented currently by these institutions is summarized in Table 4.2.

### 4.3.4 International and Bilateral Funding

1605 Financial assistance is provided by international bilateral and multilateral donor agencies like the World Bank (WB), Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), Advisory Services in Environmental Management of Germany (ASEM), British Department for International Development (DFID), Danish International Development Agency (DANIDA), French Water Club (FRC), and similar agencies. Some of these are grants for the

1610 report preparation for a new project or evaluation of an on-going project, while others are soft loans for capital works. However, these Agencies do not fund the O&M costs. There is also the bilateral funding between one country to another as grants of funds for the receiving country to import technical expertise from the donor country. An example is the twinning arrangement between the British and Indian governments between 1984 and 1989 to send British sewerage

1615 experts to reside and guide the Chennai Metropolitan Water Supply and Sewerage Board. That exercise made a very positive change by introducing for the first time in the country the practice of submersible sewage pumps and today these have become the standard practice all over the country. There are many other such instances of bilateral assistance at other locations in the country such as the Delhi Jal Board, Indore and Varanasi STPs, etc.

1620

Table 4.2 Outline of funding implemented currently by funding institutions

Institution	Area/Field	Loan Applicant/Joint Venture Partners	Loan Terms & Conditions	Case Studies
National Bank for Agriculture and Rural Development (NABARD)  Rural Innovation Fund (RIF)	NABARD is a refinancing agency that has instituted this fund for financial assistance made available in the form of grants and/or loans to support innovative, risk friendly, unconventional experiments in farm, non-Farm (including design of economic and efficient water harvesting structures, innovative rain harvesting for rural dwellings, rural sanitation and waste disposal, and so on) and micro-Finance sectors with the potential to promote livelihood opportunities and employment in rural areas.	Individuals, NGOs, Community Based Organisations, Self-Help Groups (SHGs), Farmer's Club, Panchayati Raj Institutions and corporates with expertise and willingness to implement innovative ideas for improving the quality of life in rural areas.	1) Assistance given is limited to a maximum of 95% of the total project outlay. 2) The Fund will be utilised in a span of 5 years, with an extension period of two years subject to conditions. 3) Support in the form of loan / grant/ incubation fund support, or a mix of all the three components. 4) Support decided on a case-by-case basis.	Sanitation Scheme based on the model successfully implemented by Gram Vikas, a renowned NGO in Orissa for a twin structure of toilet and bathing room costing about Rs. 8600/- per unit.
Life Corporation of India ( LIC) LIC Infrastructure Bond	Life Insurance Corporation of India (LIC) is the largest insurance group and investment company in India. It is a state-owned in which the Government of India has 100% stake. LIC endeavours to provide security to as many people as possible and to channelize the savings mobilised for the welfare of the people. LIC has been promoting social welfare through investments in infrastructure and social sector which includes: * Projects/Schemes for generation and transmission of power, * Housing sector,	(a) Central and State Governments (b) Banks and financial institutions (c) Subsidiaries (d) Companies (e) (f) Municipalities (f) State Electricity Boards (g) State Road Transport Corporation (h) Co-operative Industrial Estates (i) Sugar Co-operatives (j) Housing Co-op Societies Ref: LIC Annual Report 2011	As of 2012 LIC Infrastructure Bonds: •Term: 10 years •Minimum lock in period: 5 years •Loan on Bond: After 5 years •Interest Rate: 7.85%-7.95% after tax. •Exit options: Buy back or through Demat account •Open for Individual or HUF.	website : <a href="http://indiabudget.nic.in">http://indiabudget.nic.in</a> Fund requirement for water supply and sanitation in the Tenth Plan LIC 2,500 (Rs. in crore)

Institution	Area/Field	Loan Applicant/Joint Venture Partners	Loan Terms & Conditions	Case Studies
	* Water supply and sewerage projects/schemes, * Development of roads, bridges & road transport ..., <a href="http://www.licindia.in/">http://www.licindia.in/</a> (LIC Annual Report 2011)			
Infrastructure Leasing & Financial Services Limited (IL&FS)	IL&FS is an infrastructure development and finance company. Rather than disbursing loans, it participates and promotes development projects from concept to execution in joint ventures with various organizations. IL&FS has the requisite capabilities to take infrastructure projects from concept to commissioning in various sectors, such as transportation, power, finance, ports, water and waste water, urban infrastructure, and so on.	IL&FS has participated in various projects in joint ventures such as: Special Economic Zone, Public-Private Partnerships, JNNURM & UIDSSMT Schemes, Indian Power Sector, Tourism Infrastructure, Urban Public Transport Project, Hydro Power Development, Developing Sustainable Strategies to Finance Urbanisation, Indian Water Market, Integrated Development & Project Development Approach, Inland Water Transport Projects and so on.		Tirupur Water Supply and Sanitation In case of Tirupur Water Supply and Sanitation scheme, a Memorandum of Understanding was signed on 25th August 1994, between Government of India, TACID, TEA and IL&FS. The Concessionaire contract (Build-Own-Operate-Transfer) for a period of 30 years, has been granted jointly by the Government of Tamil Nadu and the Tirupur Municipality to the New Tirupur Area Development Corporation Ltd (NTADCL)
Housing & Urban Development Corporation Ltd (HUDCO)	HUDCO is a public sector company fully owned by the Government of India for financing housing and urban infrastructure activities in India. HUDCO's major activities include implementation of a variety of schemes -including low cost sanitation schemes; water supply; and sewerage and drainage- for	Loan Eligible borrowers are: i) State level financing institutions / corporations ii) Water supply and sewerage boards iii) Development authorities iv) State functional borrowers for housing &	1) Extent of finance for Govt. Borrowers and Private Sector Borrowers is – Govt. Borrower -The loan amount for a project may be up to 90% of the project cost subject to maximum of 15% of Net Owned Fund (NOF) of HUDCO; and Private Sector Borrower - Loan amount may be up to	Under its core infrastructure portfolio, HUDCO has financed a total of 430 water supply projects, 71 sewerage projects, and 22 drainage projects with cumulative project cost of Rs. 84067.85 cr and loan amount of 27542.77 cr in different towns of the Country. During the

Institution	Area/Field	Loan Applicant/Joint Venture Partners	Loan Terms & Conditions	Case Studies
	providing shelter and services. Categories of projects under Housing Finance include all types of Housing projects including Community Toilets, Slum Upgradation, etc. Eligible projects for HUDCO finance in Infrastructure Sector include construction, augmentation, and improvement of Water Supply Projects, Sewerage and Drainage, Solid Waste Management, Low Cost Sanitation, etc.	urban development v) New town development borrowers vi) Regional planning boards vii) Improvement trusts viii) Municipal corporations / councils ix) Joint sector companies x) Cooperative societies / trusts xi) NGOs xii) Private companies/borrowers including BOT operators, concessionaires	66% of project cost subject to maximum of 15% of NOF of HUDCO for a project/ SPC and up to 25% of NOF of HUDCO to group companies. 2) Tenure of HUDCO loan a) Minimum: 5 years. b) Maximum: 10 years (for private projects) and 15 years (for Govt. projects) including construction period/moratorium period.	financial year 2011-12, HUDCO sanctioned a total loan of Rs. 5451.76 cr for 12 water supply projects, 6 sewerage projects, and 2 drainage projects. The important projects for which HUDCO has sanctioned loans in the recent past include Godavari Drinking Water Supply Project Hyderabad, Urban Drinking Water Supply Scheme Ranchi, Water Supply Scheme Dhanbad, Comprehensive Underground Sewerage System Nellore, New Sewerage Scheme for Aurangabad, and Integrated Storm Water Drainage System Jabalpur.

## References:

- 1625 1) <http://mofpi.nic.in/images/File/FICCI%20Data/INSTITUTIONS/NABARD.pdf>  
2) [http://www.nabard.org/nonfarm\\_sector/rif\\_faqs.asp#question\\_9](http://www.nabard.org/nonfarm_sector/rif_faqs.asp#question_9)  
3) [http://www.nabard.org/nonfarm\\_sector/pdf/chapter%204.pdf](http://www.nabard.org/nonfarm_sector/pdf/chapter%204.pdf)  
4) <http://www.licindia.in/>  
5) LICAnnual\_Report\_2011  
1630 6) <http://www.ilfsindia.com/Index.aspx>  
7) <http://www.ielrc.org/content/w0801.pdf>  
8) <http://www.hudco.org/Site/FormTemplate/frmTemp1PLargeTC1C.aspx?MnId=27&ParentID=23>  
9) <http://www.hudco.org/writereaddata/finpat.pdf>

### 1635 4.3.5 Community Funding

There are mechanisms whereby the population to be benefitted by a sewerage project agrees to meet the capital costs of a sewerage project. Sewered area will be improved in form of sanitary condition, convenience and comforts compared to unsewered area. Eventually, the value of the land in sewerage area will increase. It is considered fair that beneficiary pay the costs of the project within the parity of the benefit. Table 4.3 below shows the example of proposed or implemented community funding schemes.

Table 4.3 Example of proposed or implemented community funding schemes

S. No	Project	Form of projects	Situation of plan or implementation
1	Alandur sewerage in Chennai	PPP	A part of capital cost was funded through public contribution. Collection of sewerage fee from the public (on a graded structure amounting to a weighted average of Rs. 75 per connection per month) amounts to Rs. 2 crores per month and covers both debt repayment and O&M costs of the AM
2	Community Managed Sewerage Scheme in Gwalior	Public Participation Scheme	Before implementation of this scheme, the proposal was discussed in the stakeholder's consultation with the residents of the slum conglomerate. It was decided that out of the total cost for the laying of sewer lines within the locality, a sum of Rs. 500 in five equal instalments of Rs. 100 per month will be collected from 2500 households, which the community agreed to contribute. The remaining amount was provided by District Administration under public participation scheme of the Government of Madhya Pradesh.

Source: 1. Ministry of Finance (2010). *Public Private Partnership Projects in India, Compendium of Case Studies*, p.24

1645 2. Gwalior Municipal Corporation. UNHABITAT, *Community Managed Sewerage Scheme in Gwalior*

### 4.3.6 Corporate Social Responsibility

Corporate Social Responsibility (CSR), is understood as the responsibility of “haves” to allocate a portion of their revenues to upgrade the living of the “have nots” and the habitation by and large. Historically, it has been implemented by the erstwhile rulers towards, charity and philanthropy. With independence, the appeal by Gandhi of “*I desire to end capitalism almost, if not quite, as much as the most advanced socialist. But our methods differ. My theory of trusteeship is no make-shift, certainly no camouflage. I am confident that it will survive all other theories.*” This influenced business houses to establish trusts for schools and colleges and also helped in setting up training and scientific institutions.

The crucial phase of CSR is between 1960 and 1980 when the concept of public sector enterprises was pursued and private sector was driven almost to backseat. However, the public sector was effective only to a certain limited extent and in mid 60's reconciliation was initiated to more clearly implement the CSR towards the public. This has steadily grown to bring about a change in the current social situation in India in order to have an effective and lasting solution to the social woes. Partnerships between companies, NGOs and the government are in vogue to facilitate a combination of their expertise, strategic thinking, manpower and money to initiate extensive social forward change on a fast track.



1665 In order to assist the businesses to adopt responsible governance practices, the Ministry of  
Corporate Affairs has prepared the Corporate Social Responsibility Voluntary Guidelines 2009,  
which indicated some of the core elements and implementation guidance that businesses need to  
focus on while conducting their affairs. One of the core elements is that companies should  
1670 undertake activities for economic and social development of communities and geographical  
areas, particularly in the vicinity of their operations depending on their core competency and  
business interest. These could include: education, skill building for livelihood of people, health,  
cultural and social welfare, etc. In addition, one kind of implementation guidance indicates that  
companies should allocate a specific amount in their budgets for corporate social responsibility  
(CSR) activities. This amount may be linked to profits after tax, cost of planned CSR activities  
1675 or any other suitable parameter. According to these guidelines, companies could undertake to  
fulfil their CSR commitment by funding activities related to sanitation and sewerage services in  
the communities (Ministry of Corporate Affairs, Corporate Social Responsibility Voluntary  
Guidelines, 2009).

The Companies Bill 2011, clause 135(1) states that “Every company having net worth of rupees  
five hundred crore or more, or turnover of rupees one thousand crore or more or a net profit of  
1680 rupees five crore or more during any financial year shall constitute a Corporate Social  
Responsibility Committee of the Board consisting of three or more directors, out of which at  
least one director shall be an independent director. The Companies Bill 2011 in Clause 135(5)  
states “The Board of every company referred to in sub-section (1), shall make every endeavour  
to ensure that the company spends, in every financial year, at least two per cent of the average  
1685 net profits of the company made during the three immediately preceding financial years, in  
pursuance of its Corporate Social Responsibility Policy: provided that if the company fails to  
spend such amount, the Board shall, in its report made under clause (o) of sub-section (3) of  
section 134, specify the reasons for not spending the amount”.

1690 In specific reference to sewerage and sewage treatment, an initiative by industries to come  
forward to adopt decentralized sewerage systems in the region by incremental sewerage and in  
turn benefit from the “ownership” and use of the sewage for industrial uses is needed to attain  
the twin objectives of fulfilling the CSR by the industry and also fulfilling the resolution of  
challenges of environmental sanitation upgrades needed in the peri-urban and rural habitations.

#### **4.3.7 Member of Parliament Local Area Development Fund**

1695 The Member of Parliament Local Area Development Division under the Ministry of Statistics  
and Programme Implementation is entrusted with the responsibility of implementation, progress  
review and monitoring of Member of Parliament Local Area Development Scheme (MPLADS).  
The objective of the scheme is to enable MPs to recommend works of developmental nature  
with emphasis on the creation of durable community assets based on the locally felt needs to be  
1700 taken up in their constituencies. Right from inception of the Scheme, durable assets of national  
priorities namely, drinking water, primary education, public health, sanitation and roads, etc.,  
are being created.

Under the scheme, each MP has the choice to suggest to the District Collector for works to the  
tune of Rs.5 crores per annum to be taken up in their constituency. Elected Members of the  
1705 Rajya Sabha can recommend works for implementation in one or more districts as they may  
choose in the State of their election. The nominated members of the Lok Sabha and the Rajya  
Sabha can recommend works for implementation in one or more districts anywhere in the  
country. MPs may choose some works for creation of durable assets of national priorities  
namely drinking water, education, public health, sanitation, and roads under the Scheme.

1710 The Department has issued guidelines on scheme concept, implementation, and monitoring. The  
Department has initiated all necessary steps to ensure that the Scheme is successfully  
implemented in the field. The progress of the works being implemented under the Scheme is

monitored on a regular basis.

### 4.3.8 Public Private Partnership

- 1715 Even during the pre-independence and the immediate post-independence periods the infrastructure created by the Governments has been handed over to private parties to invest the money required to keep the services up to date and levy their own fee and maintain the services. Examples are many in the electricity sector where even the power generation was under the control of such players. The recent Public Private Partnership (PPP) is thus nothing new. The major difference however is that the PPP model includes investing of money by the private player to develop the infrastructure also and its O&M for a number of years agreed to beforehand. The repayment is by the Government by way of billing and collection from the public. Details on PPP are provided in Chapter 5.

### 4.3.9 Other Financial Revenues (Bonds)

- 1725 These are floated by the Government not for a specific project but as a whole for the State. These generally carry better credibility for the safety of the invested money as the Government itself is the borrower from the public. The Government is of course required to guarantee the repayments on pre-agreed terms whether the bonds are encashed after their term or foreclosure.

## 4.4 REVENUE AND EXPENDITURE

- 1730 These are two categories, namely planned and emergency. The planned category of revenue and expenditure is shown in Table 4.4.

Table 4.4 Planned category of revenue and expenditure for local bodies

Revenues		Expenditures	
1	Property Tax	1	Power
2	Water and sewage charges	2	Chemicals
3	Sale of secondary treated sewage	3	Establishment
4	Surcharge for special events	4	Repairs and Renewals
5	Fines for delayed payment of tax and charge	5	Free services of water and sanitation
6	Interest on bank deposits if any	6	Water cess
7	Consultancy charges if undertaken	7	Depreciation on equipment
8	Loans from banks, institutions	8	Repayment of loans
9	Grant from state / central governments	9	Public announcements, websites, etc.
		10	Manpower

- 1735 The emergency expenditures occur in case of occurrence of natural calamities like earthquake, epidemics, acts of war, fire, electrical faults, etc. Sometimes, it may become necessary for the local body to override public opinion and provide an entirely new facility, and that too on a war footing.

- 1740 For example, we can recall the (in)famous case of the “Broad street pump” (now named Broadwick Street) in UK. The cholera epidemic of 1854 (which eventually claimed the lives of 616 people) was traced to the groundwater pumped by hand pump from this street. At that time, the fact that cholera is spread by drinking water contaminated with faecal matter of an infected person was not known. Though there were hand pumps in other streets, the people were drawing their drinking water from this well only apparently because they found the taste was possibly more appealing. The pioneers John Snow and Reverend Henry Whitehead proved by circumstantial evidence that there was a sewage cesspool nearby and its foul matter was seeping into this tube well. There was nothing on record or otherwise for the local authority to deactivate this popular drinking water source. However, the fact remains that the local body decided and boldly deactivated this tube well. It was subsequently established that this tube well water was the cause of the epidemic. This event showed the whole world what is water borne

1750 epidemic of cholera. In later day acknowledgement of the same, the monument of the pump still stands there as in Figure 4.1 reminding the whole world of the trade-off between what the consumers may insist and what the Government must resist. The population could be saved from subsequent cholera epidemics as in Figure 4.2 by the lesson of this pump.



1755 Source: [http://en.wikipedia.org/wiki/1854\\_Broad\\_Street\\_cholera\\_outbreak](http://en.wikipedia.org/wiki/1854_Broad_Street_cholera_outbreak)

Figure 4.1 The monument of 1854 Broad Street pump of Soho, England



Photograph of cholera inoculation by the doctors in British India. This was possible mainly by the discovery of water borne transmission of cholera established by the forcible deactivation of the pump and the subsequent decline of cholera in the Broad Street episode and the discovery of cholera vaccine.

Source: Life Magazine - 1894

Figure 4.2 The file photo of cholera inoculation by the doctors in British India

1760 Clearly, in the cases of Figure 4.1 and Figure 4.2, the lesson is that local Governments may not blindly venture into a particular type of infrastructure facility merely because it is desired by the public. There is an obligation to educate the public and get a safer option installed. Thus revenue and expenditure can be a tricky procedure in some cases like these and other emergencies, such expenditures may be solicited through voluntary contributions from those  
1765 who can afford to help.

#### 4.4.1 Billing and Collection

1770 Revenue management is an important aspect of any sewerage and sanitation system as it governs the financial aspect. Fixing a tariff structure, and billing and collection of revenue plays important roles in financial sustainability of the system as a whole. Sewerage tariff is normally clubbed with the water use charges.

##### 4.4.1.1 Tariff Fixation

The charges to be fixed by the utility take into account the ability of the system to meet the following:

- Operating cost (excluding establishment cost)
- 1775 • Establishment cost
- Depreciation
- Debt services (both capital repayment and interest)
- Asset replacement fund
- Capital development

1780 Tariff structure should be fixed and revised periodically. Automatic increase of tariff periodically on an index basis can also be adopted. In many cases, the same authority also provides water supply services, and the charges for sewerage are included as a percentage of the water charges. In setting tariffs, the first consideration must be a consistent transparent tariff policy endorsed by the Government. Demand management through higher rates for high consumption and a lifeline rate where there are urban poor should be considered in the tariff structure.

1785

##### 4.4.1.2 User Categories

The users may be categorized as:

- a) Domestic
- 1790 b) Commercial (business entities, hotels, industries, etc.)
- c) Government authorities
- d) Partly commercial
- e) Bulk consumers

##### 4.4.1.3 Methods of Charging

1795 The methods of levying charges can be any one or more of the following:

- a) Metered system: Based on water consumption charges (with minimum fixed charge)
- b) Non-metered system:
  - Fixed charge per house per month
  - 1800 • Fixed charge per family per month
  - Fixed charge per tap per month

- Percentage of rateable value of the property.

1805 As of 2012, in many cases, sewerage charges/cess are levied as some percentage of the water bill, or as percentage of property tax. In addition, users also need to pay one time connection charge at the time of connection. In areas where water meter is not available or not working, flat charges per household/connection may be adopted.

1810 While the advantage of flat charges is that it requires no expense for installing and reading meters, the disadvantage of flat charges is that all customers pay either too much or too little for what they use and is not based on use. It may promote high water consumption. Therefore, if the system is not metered or water meter is not working, it is strongly recommended to promote installing meters or considering a plan for replacement of the meters. Also, for any water utility to be financially self-sustainable the tariffs should be reasonably fixed and levied. The charges should be collected and accounted as accurately as possible.

#### 4.4.1.4 Billing Process

1815 The billing for sewerage is mostly included in the water bills. Various stages in the water billing process are:

- a) Data gathering (meter reading in case of metered billing)
- b) Preparation of bill based on collected data
- c) Distribution of bill to consumer
- 1820 d) Payment of the bill by the consumer
- e) Sending the receipt details to billing section
- f) Related accounting.

1825 The frequency of billing depends mainly on the type of system used. For non-metered system the billing frequency could be quarterly and for the metered system the billing frequency could be bi-monthly. But in both cases all non-domestic, industrial, bulk consumers must be billed monthly. The only other factor which can be considered in this respect is the availability of manpower for billing process and the cost of issuing bills in one complete billing cycle.

1830 In many large cities, Water Supply and Sewerage Boards are responsible for billing and collection of water supply and sewerage charges. In medium scale cities, Public Health Engineering Department (PHED), Municipal Corporation/Council, Development Authority, etc., are responsible for raising the bills and collecting the revenue.

The payments of bills by consumers can be accepted at any one or more of the following:

- Counters at various offices of the Board/Corporation/Utility
- Various branches of bank/banks authorized for accepting payments
- 1835 • Door to door/on the spot recovery by concerned person/team
- Electronic fund transfer through various banks offering such option/directly
- By cheque through post or drop boxes
- Through societies authorised by government, such as cooperative societies
- On line payments

- 1840           •     Automatic kiosk.

#### 4.4.1.5 Japanese System

In Japan, the sewerage charges are normally based on water consumption. The following methods are adopted for calculating sewage charges:

- Volume of water consumed
- 1845           •     Land size: When the sewerage system is started, the beneficiary is required to pay the services charge one time which is estimated based on land/property size.

The volume of consumed water is based on meter (if available) otherwise estimated. The methods of computing volume of consumed water for different cases are as follows:

- When tap water is used:                 By reading water meter
- 1850           •     When groundwater is used:             Calculated using per capita consumption
- Tap water + groundwater used:        Meter reading + calculation based on per capita consumption

The sewerage charge is calculated as certain percentage (say 50-150%) of the total water charges. The sewage charges are added up along with the water use charges in the bills.

- 1855     The billing is done usually once every two months. To reduce the cost, private agencies are hired for meter reading and billing. In future, it is also planned to transfer data through wireless system or to use same reader for reading meters related to gas, electricity and water consumption in order to further reduce the cost.

- 1860     Upon receiving the bills, the user can opt for either of the following modes to make payment against their raised bills:

- Counter of financial institutions and ULBs (e.g., Banks, Post office, Agricultural cooperatives, etc.)
  - Electronic bank transfer
  - Convenient store
- 1865           •     Credit cards, etc.

#### 4.4.2 Self Sustainability

Two issues related to self-sustainability need to be considered:

- a)    the extent to which the system can sustain itself without external support
  - b)    the fraction of time in which the system is self-sustaining
- 1870     Ideally, both these should be satisfied all the time. This is a question of balancing the revenues and expenditure. The expenditure cannot be curtailed to match shortage of revenue. The classical documents on this subject are the report by the High Powered Expert Committee (HPEC) for Estimating the Investment Requirements for Urban Infrastructure Services and the report of the sub-committee of the High Level Committee on Financing Urban Infrastructure in the 12th plan. The following extracts from these reports will bring out the situation analysis to enable decision making on remediation approaches.
- 1875

- a)    The rate of development is clearly related to the rate of urbanization.

- b) In the year 2009-10, GOI invested about Rs. 75,000 crores for the rural sector, while its disbursement under Central Programmes was about Rs. 8000 crores.
- 1880 c) This makes it evident that the urban sector continues to suffer neglect over the years, with policy and resources directed mainly towards the rural sector.
- d) This neglect has now created a huge infrastructure challenge of having to cater both to the new population and the backlog of the past.
- 1885 e) Given the current level of ULB finances and the traditional low viability of projects related to the water supply, sewerage sector and quality public transport, the private sector has stayed away from investment in the urban infrastructure sector.
- f) A sanitation rating of 423 class-I cities done in 2009-10 by Ministry of Urban Development, GOI revealed that only 39 cities qualified on three basic water quality parameters of turbidity, residual chlorine and thermo-tolerant coliform bacteria.
- 1890 g) With nearly 70% of the GDP contribution from the urban areas, and the recent population projections indicating well over 40% urbanization in the coming decade, there is a clear need to focus attention towards the urban sector and to provide adequate financing for urban infrastructure.
- 1895 h) However, given the multiplicity of institutions involved and the challenges of capacity availability and governance, it may be difficult to expect immediate results, unless conscious efforts are made to bring about all round improvement in urban infrastructure and services, besides improvement in local governance.
- 1900 i) A study of municipal finances by the RBI in 2007 also revealed that the total revenue of Municipalities is growing at a lower rate compared to the growth of combined Central and State Government revenues. This is in contrast to the situation in advanced countries, where local bodies normally account for 20-35 per cent of the total government expenditure and the principle of 'subsidy' is regarded as a cornerstone of fiscal federalism.
- 1905 j) The service backlog in sewerage is assessed as in Table 4.5.

Table 4.5 Service backlog in sewerage in stated categories of population

Class	Population	Network (%)	Treatment (%)
Ia	> 5 million	53	53
Ib	1 to 5 million	44	53
Ic	100,000 – 1,000,000	64	77
II	50,000 – 100,000	84	88
III	20,000 – 50,000	90	96
IV	< 20,000	100	100

Note: Network backlog % is estimated assuming underground sewerage network for all city size classes and 100 per cent collection and treatment of sewage.

1910 Source: High Level Committee on Financing Infrastructure, MOUD, 2012. Report of the Sub-committee on Financing Urban Infrastructure in the 12th plan.

- k) The per capita investment cost and per capita O&M cost has been assessed as Rs.4,704 and Rs. 286 respectively at as recent as 2009-2010 prices.
- l) The projected expenditure on sewerage for capital and O&M for the 12<sup>th</sup> plan is given in Table 4.6.

1915

Table 4.6 Projected capital and O&M expenditure for sewerage and all sectors in 12<sup>th</sup> plan

	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	Total
<b>Sewerage</b>						
Capital expenditure, Rs Crores	3,931	4,411	4,915	5,543	6,213	25,013
O&M expenditure, Rs Crores	4,299	4,675	5,097	5,569	6,098	25,738
Total	8,230	9,086	10,012	11,112	12,311	50,751
<b>All Sectors</b>						
Capital expenditure, Rs Crores	58,604	67,342	77,383	88,920	102,178	394,428
O&M expenditure, Rs Crores	70,328	75,919	82,150	89,094	96,830	414,320
Total	128,932	143,261	159,533	178,014	199,008	808,748

Source: High Level Committee on Financing Infrastructure, MOUD, 2012. Report of the Sub-committee on Financing Urban Infrastructure in the 12th plan.

Self-sustainability in Asset Management is described in Section 8.9.

#### 1920 4.4.3 Financial Planning

The requirement of funds for sewerage in the 12<sup>th</sup> plan is proposed by HPEC for the next plan period as given in Table 4.7 and has been accepted by the steering committee on urbanization set up by the Planning Commission.

1925

Table 4.7 Investment over the next Plan period as projected by HPEC for next 20 years with backlog covered in 5 years

(Figures in % of GDP at current prices)					
Item	2012-13	2013-14	2014-15	2015-16	2016-17
Total revenue	1.19	1.23	1.26	1.32	1.34
Own revenue	0.74	0.83	0.89	1.03	1.05
Exclusive taxes	0.33	0.33	0.34	0.34	0.35
Revenue-shared taxes	0.23	0.31	0.36	0.49	0.50
Non-tax revenue	0.19	0.19	0.20	0.20	0.21
Other revenue	0.46	0.41	0.37	0.29	0.29
Transfers from SFC	0.10	0.10	0.10	0.10	0.10
Grants-in-aid from State Governments	0.06	0.06	0.06	0.06	0.06
Transfers from CFC	0.08	0.08	0.08	0.08	0.08
Grants-in-aid from GOI	0.05	0.05	0.05	0.05	0.05
Revenues of entities other than municipalities	0.17	0.12	0.08	0.00	0.00
Total revenue expenditure	0.90	0.90	0.91	0.93	0.96



Item	2012-13	2013-14	2014-15	2015-16	2016-17
Annuity payments	0.00	0.00	0.01	0.02	0.04
Debt repayment	0.01	0.01	0.02	0.02	0.03
Reduction in revenues on the account of PPP	0.00	0.00	0.00	0.00	0.01
Investible surplus of municipalities	0.29	0.32	0.32	0.34	0.31
Capital expenditure	0.78	0.87	0.97	1.08	1.21
Deficit (-)/Surplus (+)	-0.50	-0.55	-0.66	-0.75	-0.90
PPP	0.02	0.03	0.05	0.07	0.09
Annuity	0.04	0.08	0.12	0.17	0.23
Borrowing	0.03	0.03	0.03	0.03	0.03
Land based instruments	0.07	0.07	0.12	0.16	0.16
Unfunded deficit (-)	-0.35	-0.35	-0.34	-0.33	-0.38

Source: High Level Committee on Financing Infrastructure, MOUD, 2012. Report of the Sub-committee on Financing Urban Infrastructure in the 12th plan.

1930 The Financing Framework envisioned by HPEC is as given below. For realizing the shortfalls and potential impracticability in harnessing revenues, the HPEC has suggested a multipronged strategy covering the following:

#### 4.4.3.1 Simulation of Municipal Own Sources

This should cover the following:

- a) Efficient application of revenue instruments
- 1935 b) Use of fiscal monitoring and control innovations.

#### 4.4.3.2 Taking Citizens into Confidence

It is also necessary to take the citizens into confidence in relation to determining the levels of user charges by increasing property taxes, land monetization, enhancing floor space index, etc.

#### 4.4.3.3 Devolution of Fiscal Powers and Funds

1940 A significant share of the revenues for the Municipalities would come from a constitutionally mandated revenue sharing arrangement as recommended by the HPEC and adopted by the Working Group.

#### 4.4.3.4 Scaling up the PPP

1945 Some interesting examples may be mentioned in respect of the sources financing the investment needs for urban infrastructure. One such instance is the re-development of airports. While the Kolkata and Lucknow Airport re-development projects have been undertaken by the Airports Authority of India (AAI), at a cost in the order of Rs. 2,000 crores each, a similar project for Delhi has been implemented with not only at zero cost to the Government, but the project even gives sustained revenue returns to the Government in the revenue-sharing arrangement built in the model.

1950

#### 4.4.3.5 Annuity Model

1955 The infrastructure projects in urban subsectors to be implemented in PPP should be encouraged for annuity models too. This is necessary because some such projects, particularly in smaller cities, may not be financially viable by themselves and would need yearly financial payments from the sponsoring municipality.

#### 4.4.3.6 Double Entry Accounting (DEA)

States have to push accounting sector reforms through DEA for necessary provisions/approvals to apply at the ULB level so as to build transparency and borrowing capacity among Municipalities.

#### 1960 4.4.3.7 Budget Rationalization

Budgeting needs to be rationalized for normative performance oriented, participatory budget, which is implemented throughout the year in a fixed manner.

#### 4.4.3.8 Innovative Asset Management

1965 Innovative asset management, which includes listing, classification, valuation and finally assessment of each asset for optimum utilization of its revenue potential, needs to be practised.

#### 4.4.3.9 Local Bodies Finance List (LBFL)

1970 Local bodies finance list along the lines of the Union and State Lists aims to empower Municipalities to exclusively levy property tax, urban infra cess along with property tax, profession tax, entertainment tax, and advertisement tax and retain the whole of their proceeds (hereinafter referred to as 'exclusive taxes').

#### 4.4.3.10 Sharing of Revenues

Sharing of a pre-specified percentage of revenues from all taxes on goods and services which are levied by States to enable municipalities to meet their functional responsibilities assigned to them by the 74<sup>th</sup> Amendment (hereinafter collectively referred to as 'revenue-shared taxes').

#### 1975 4.4.3.11 Specific Actions

A set of specific actions that can be taken are presented in Table 4.8.

Table 4.8 Exclusive actions suggested by HPEC for Municipalities

Area	Actions
Accounting	<ul style="list-style-type: none"> <li>• Introduce double entry accounting</li> <li>• State to prepare accounting standard and coding</li> <li>• Develop financial statements and ratio analysis</li> </ul>
Budgeting	<ul style="list-style-type: none"> <li>• Introduce budget cycle, apply innovative performance budgeting, apply participatory funding</li> </ul>
Asset Management	<ul style="list-style-type: none"> <li>• Listing and classification, assessment of revenue and potential</li> </ul>
Procurement	<ul style="list-style-type: none"> <li>• Standardisation of procurement system, E-procurement of services and goods</li> </ul>
Auditing	<ul style="list-style-type: none"> <li>• Timely audit, private/concurrent audit, social audit, effective internal audit, energy audit, citizens charter</li> </ul>
Information System and Feedback Mechanism	<ul style="list-style-type: none"> <li>• Performance monitoring and service level benchmarking as per GOI/norms/indicators, complete automation, initiate GIS application</li> </ul>
Billing and Collection	<ul style="list-style-type: none"> <li>• Timely billing, use of IT &amp; advertisements, prepare DCB statements, ABC analysis of arrears, innovative collection</li> </ul>
Grievance Redressal	<ul style="list-style-type: none"> <li>• Decentralised system of grievance redressal, promote downward accountability - social audit, area Sabha, citizens charter, promote E-Sewa Kendra, initiate one window approach</li> </ul>
Capacity Building	<ul style="list-style-type: none"> <li>• Three Tier Training - awareness, class rooms, hand holding/on job training, documentation and dissemination of best practices, incentive system for good performance, suitable material (Manual, checklist, guidelines) exchange/study visits, city to city cooperation,</li> </ul>

Area	Actions
	budget allocation for capacity building and in house capacity building

Source : K. K. Pandey, Stimulating Revenue Base of Municipalities, IIPA, 2011

#### 4.4.3.12 Why PPP is not Taking off in Sewerage

- 1980 There are barriers for private sector investments in urban infrastructure in India, more so in the critical water supply and sewerage subsectors. A quick review of the relevant literature indicates a number of reasons for the reluctance on the part of the private sector to assume commercial risks in a majority of the urban subsectors. These are mainly: (a) Most of the urban sector investments involve third tier of governments, which increase the perceived risks for private
- 1985 sector investments and (b) Historically, water supply and sanitation services have been seen as “public goods” that need to be provided at affordable prices (meaning nominal low costs). Also see Chapter 5 for details on PPP.

#### 4.4.3.13 Municipal Bonds

- 1990 Municipal Bonds form nearly 10% of the debt market in the US. By contrast, in India, just 1% of the total ULB contribution is funded by municipal bonds. Hence, municipal bonds have played a limited role as a source of finance for funding ULB contribution for urban infrastructure projects. A number of regulatory, supply and demand side constraints exist which need to be tackled in order to promote municipal borrowing as a significant source of funding local bodies. However, it is relevant to note that development of Municipal Bond Markets have
- 1995 taken about 100 years even in USA.

#### 4.4.3.14 Repayment Tenure

- The tenure of the term loans for urban infrastructure too needs to be reviewed. As most such projects have life of 20 to 30 years, and the user charges would be able to generate only small surplus, if at all, after paying up the O&M expenses, it would be necessary to extend the loan
- 2000 repayment period for the term loans availed by the developer/concessionaire of such projects.

#### 4.4.3.15 Empowering Municipalities

- 2005 Fundamental to the framework is the need for Municipalities to increase their own sources of revenue. Failure to do so will put at risk the ability to use other financing instruments like PPPs or borrowings. A weak revenue scenario, with borrowing or PPPs being ruled out, will put further strain on the Government of India to support the State governments and Municipalities in urban infrastructure financing. Accordingly, the design of the New and Improved Central Programmes should be such that it creates an environment for Municipalities to increase revenues through better service delivery, which will push up user charges and other revenue streams.

#### 2010 4.4.3.16 Need of the Hour

- The urgency to deploy more investment through these sources is necessitated because of the precarious position of the resource generation (own revenue) capacity of our cities. The need to utilize the avenues of funding through these sources has to be explored in the 12<sup>th</sup> Plan. Any lag or slippage in this regard would put a lot of stress on the ability of cities to deliver services
- 2015 effectively and reduce economic activity also. This view needs to be revisited because urban areas will increasingly accommodate a greater portion of the total population of the country. Financing for urban infrastructure needs to be stepped up to the level of 1.5 percent of GDP in the next plan and it should increase to 2.0 percent by 2021-22 and 2.2 percent by 2031-32.

#### 4.4.3.17 MOUD Recommendations

- 2020 The MOUD in its advisory note on Recent Trends in Technologies in Sewerage System has concluded that “As the current sewage tariff levels are too low across ULBs in India and do not reflect the true economic cost of providing sewage collection, treatment and disposal services, increasing tariffs to a level that ensures the sewerage system generate sufficient revenues to meet its capital and O&M costs and become self-sustainable may not be possible in one stroke.
- 2025 This could be achieved by increasing tariffs gradually over a period of time”.

#### 4.4.3.18 Willingness to Charge

- 2030 There is growing evidence that many urban and rural communities are willing to pay more than the prevailing rates for water and sanitation, if they are convinced of more reliable service. However, governments seem unwilling to match this with a willingness to charge consumers for these services and the result is a continuing cycle of low revenues, high costs, unsatisfactory services and financial crisis.

Policy makers frequently refrain from raising tariff rates fearing that the people will not want to pay. If policy makers can establish what households are willing to pay, they should be able to:

- Revise tariffs to capture this willingness to pay;
- 2035 • Plan future investment keeping in mind what consumers really want; and
- Move towards financial sustainability and independence.

#### 4.4.3.18.1 Political Will towards Tariff Revision

- 2040 In the matter of electricity, the levy of tariff is guided in that sector in compliance with section 3 of the Electricity Act 2003. The guiding principles therein state that the tariff should “encourage competition, efficiency, economical use of resources, good performance and optimum investment” and “progressively reflect cost of supply of electricity” and also “reduce cross subsidies”. Such a guideline is not traceable in the management of the water sector. Of course a practical view of the physical aspects of the two services brings about the inherent difficulty in the water sector. This is due to the fact that whereas the electrical supply cannot be polluted, the water supply can be polluted by ever so many factors which are not entirely in the control of the water authority. Moreover, levy of tariff for sewage is to be related to the quantity of sewage but this cannot be measured from each user because meters will get choked and plugged and hence, tariff based on volume of sewage is linked to tariff based on water supplied to the user. As such, it is water and sewerage tariff as an integrated methodology. This being so, running a water authority on a self-equated basis of revenue vs. expenditure is not all that easy because the supply of drinking water is not an entirely commercial proposition in India. All the same, the levy of tariff even if it is to be incremented in small measures becomes a matter of political overtones as well. This is specifically compounded by the fact that supply of water “drinkable from the tap” is neither financially feasible not physically worthwhile in the mixed types of economically weaker segments, physical damages to infrastructure by other agencies and above all the capital cost of such a facility. Thus it is an issue which does not have a single countrywide answer but localized answers to evolve as unique strategies for given locations.
- 2055

#### 4.4.3.19 Case of Alandur Sewerage through Community Funding

- 2060 This is one of its kinds of PPP initiated as early as in 1996 for a population of 165,000 with nearly 25% in economically weak sections. The town did not have an underground sewerage system. A sewerage scheme for 12-MLD intermediate capacity and 24-MLD ultimate capacity with underground sewers and a mechanized sewage treatment plant was formulated and sanctioned in 1999. The funding pattern was conceived as in Table 4.9.

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Table 4.9 Funding pattern (in Rs. Crores) proposed for the Alandur PPP sewerage project

No.	Source	Amount	Interest
1	Grant from TNUIFSL	3.00	
2	Grant from TUFIDCO	16.00	
3	Loan from TNUIFSL	6.11	15 years at 16%
4	Loan from TUFIDCO	1.00	8 years at 5%
5	Public contribution	12.40	
6	Interest on deposits	2.46	
7	Total	40.86	

Source: Ministry of Finance (2010). *Public Private Partnership Projects in India, Compendium of Case Studies*, p.17

2070

The municipality targeted to provide about 22,000 connections both for domestic and non-domestic categories of users by end 2004-2005 at the one-time charge as shown in Table 4.10.

Table 4.10 One-time sewer connection charges (in Rs.) proposed by the local body

No	Category	One-time deposit
1	Domestic	5,000 per connection
2	Commercial	10,000 per connection
3	Industrial	10,000 per connection

Source: NUS, 2009

2075

It was anticipated to generate nearly Rs. 13 crores to be put into a revolving fund for repayment of loans to the lenders. In addition to the above, it was also decided by the municipality to collect sewer maintenance charges as shown in Table 4.11.

Table 4.11 Monthly sewer charges proposed to be levied by the local body

No	Category	Monthly charge	Yearly increase	Upper Limit in Rs.
1	Domestic	150	5%	180
2	Commercial	350	6%	540
3	Industrial	750	6%	900

Source: 1. ASCI, Public Private Community Participation in Implementation of Underground drainage system in Alandur Municipality

2080

2. ICLEI, 2012

3. GOTN, 2007

As of 2005, the monthly charge and one-time deposit have been reported to have been adopted on a graded pattern for the domestic, commercial and industrial sectors based on the area of the premises as in Table 4.12.

2085

Table 4.12 Graded tariff structure for UGD (Sewer) connections

No	Area (ft <sup>2</sup> )	Domestic connection		Commercial and Industrial connection	
		Monthly charge (Rs.)	Deposit (Rs.)	Monthly charge (Rs.)	Deposit (Rs.)
1	< 500	60	6,000	200	13,000
2	500 to 1500	80	7,500	400	16,000
3	1500 to 3000	100	10,000	600	20,000
4	> 3000	120	20,000		
5	3000 to 5000			800	30,000
6	> 5000			1000	1,00,000

Source: City Corporate cum Business Plan-Alandur Municipality, Final Report, September 2007, GOTN-TNUDF.

#### 4.4.3.19.1 Assessment of the Value for Money

2090 This exercise has brought out the following as in Table 4.13.

Table 4.13 Difference made by the project in terms of value for money

No	Parameter	Situation prevailing before the project	Situation which would prevail after the project
1	Urban Service	No sewerage system	Sewerage system
2	Urban Service	Septic tank & Sullage collection	Full-fledged Sewerage
3	Urban Service	Sewage entering storm water drains	Entry to storm water drains stopped
4	Environment & Health	Storm drains in turn polluting environment	Storm drains are clear of sewage flows
5	Environment & Health	Contamination of groundwater and soil	Contamination would be stopped
6	Public Participation	No participation	Mutually agreed participation
7	Payments by Public	No payment	Average of Rs. 75/ month per connection

Source: DEA, MOF, 2010

#### 4.4.3.19.2 Beneficiary Participatory Approach

2095 People's participation in the project, including the fact that almost 29% of the project cost was garnered from public contributions, was the most outstanding aspect and learning from the ASP. The project established that mobilizing people's participation for infrastructure projects is possible through collective efforts and transparent procedures. The success of the project from the outset depended highly on effective collection of connection charges and monthly sewer fees as also public acceptance of engaging a private BOT participant. Community awareness, support and on-going cooperation were therefore, critical. The aggressive public outreach campaign conducted by the municipality and GoTN and the engagement of stakeholders was essential to assure the lending agencies and city officials that repayment provisions would be met.

#### 4.4.3.19.3 Stakeholder Involvement and Interdepartmental Coordination

2105 Continued involvement of stakeholders throughout the project ensured timely completion of the project and addressing of issues even as they arise. To maintain support for the project, a citizen's committee was formed and it met frequently to review the status of the project, monitor performance of the BOT contractor and provide a forum in which citizens could air their

2110 concerns. The ASP established that close involvement of all stakeholders/departments at the key decision-making stages of the project, as also for review and monitoring, is critical to ensuring that the project stays on-track.

#### **4.4.3.19.4 Political Will and Strong Decision Making, Especially at the Grass-root Level**

2115 The ASP demonstrated that ‘political will and quick decisions make projects happen.’ The political leadership and strong advocacy for the project provided by the chairman and council of the municipality proved to be the critical element of the success. While strong support for the sewerage system within Alandur existed, political will was essential to convince the customers and citizens to pay a significant share of the cost and accept the entry of the private sector, throughout the project decision making stages.

#### **4.4.3.19.5 Acceptance of Fiscal Discipline**

2120 The term lenders, TNUIFSL and TUFIDCO, placed strict lending conditions on the municipality, requiring the municipality to accept and implement strong fiscal discipline measures. TNUIFSL required the municipality to establish a separate sewer account distinct from the general budget of the municipality, forcing discipline and transparency on the officials managing the system. The municipality was also required to limit new debts to a certain percentage (typically 30%) of their revenue. GoTN, which provided loan guarantee, stipulated that any payment made to these entities on account of default by the municipality would be recovered from the annual transfer of payments from the municipality to the State government. Similarly the contractual obligations between the municipality and the BOT operator forced the municipal government to ensure timely payment for management and sewage treatment services. Thus, the loan as well as contractual obligations ensured strong fiscal discipline by the municipal body, by making it take difficult decisions on capital priorities, closely oversee the sewerage system management, and ensure budgeting of sufficient funds to meet payment schedules.

#### **4.4.3.19.6 Implementing an Effective Fee System**

2135 Despite the willingness-to-pay survey that indicated that public willingness was far below the tariff requirement to meet the capital and operational cost of the project, the municipal council, through its rigorous public outreach measures, managed to impose reasonable levels of connection charges and sewer fee on the public. The municipality also managed to collect the connection charges fairly well in time to pre-empt the need for the TNUIFSL loan. A large part of the success of the municipality in this aspect sprung from the fact that they provided sympathetic measures that addressed the concern of the public. For example, the connection deposits were collected in two instalments as per the convenience of the consumers; the local branch of the Punjab National Bank also offered financial support to the citizens of Alandur by creating a scheme for lending the connection deposit amount to them.

#### **4.4.3.19.7 Assurances on Payment to the Private Sector Participant**

2145 The municipality agreed to provide the BOT operator a minimum level of income by accepting the ‘take or pay’ condition in the Agreement. Thus, the municipality assumed the risk of minimum payment to the operator while the private partner assumed all other responsibilities and risks of financing, constructing and operating the STP for a period of 14 years.

#### **4.4.3.19.8 Access to Finance for the Municipality**

2150 An important aspect of the success of the project stemmed from concession financing and subsidies from the Government and public-private entities, established specifically to meet the credit needs of the municipalities without access to private capital, due to a low or non-existent credit rating. Though almost 30% of the capital was generated by the municipality from connection fees, grants from GoTN and loans from TUFIDCO were crucial. The loan agreement

2155 from TNUIFSL, while proving to be unnecessary in the end, was imperative for participation in  
the finance package by all the parties.

#### 4.4.3.19.9 Technical and Financial Assistance

2160 The expertise needed to plan and manage the technical and financial aspects of the project far  
exceeded the capacity of the municipality. Assistance from the other government bodies in the  
state, the Chennai Corporation, and sources, such as the USAID's FIRE project, was critical.  
TNUIFSL and FIRE played a substantial role in structuring the project, managing the feasibility  
studies, and preparing the bid and contract documents crucial to project success. The review and  
approval of the engineering reports by the management committee, consisting of senior officials  
of the AM, the Tamil Nadu Water Supply and Sewerage Board, Chennai Metropolitan Water  
2165 Supply and Sewerage Board, and TNUIFSL, were essential for successful project management.

#### 4.4.3.19.10 Transparency in Bidding and Contracting Procedures

2170 The transparent approach to the project, right from inception to selection of contractor/operator  
and implementation, was critical to providing the necessary assurance to the private sector  
bidders on the professional approach of the municipality. This included strict application of  
World Bank and FIDIC processes, oversight and approval of the process by the World Bank.  
Public participation in the deliberations of the management committee overseeing the tendering  
process execution was also important.

#### 4.4.3.19.11 In Retrospect

2175 The project might not have materialized in the financial model as originally foreseen. This is  
because of the payment of sewer charges by the population which had to be reduced after  
implementing the project according to the wishes of the people and also made up by subsidy by  
the local Government. But the fact remains that the project is the first of its kind in the country  
and has set a trend in implementing sewerage projects by the local body and the population  
without looking up to the Government completely. The sewerage system component of the  
2180 project was financed through several sources and the STP on the other hand was financed  
entirely by the contractor.

#### 4.4.4 Methods of Raising Revenue

2185 Each local body is an entity by itself. The successful model of one local body may not be  
successful in another. This depends on many local factors. For example, reuse of treated sewage  
for agriculture and farm forestry may be fine in desert areas of Rajasthan, but may not be  
appropriate in a water rich municipality in Kerala with no industrial activity. Similarly, artificial  
recharge of advanced treated sewage to stop sea water intrusion may be suitable for locations in  
coastal Puducherry where there are no storage reservoirs and the entire public and agricultural  
water is almost entirely being drawn from groundwater and in coastal Gujarat locations where  
2190 sea water intrusion is occurring and industrial activity is high. However, this may not suit a  
location like the Kolkata estuaries. Methods of raising revenue from such uses are almost  
entirely dependent on the local situation.

#### 4.4.5 Willingness to Pay

2195 This is a confidence building process. It can be compared to the famous chicken and egg  
syndrome. Unless the people see the benefits, they will not be willing to pay. Unless they pay,  
the local body will not be in a position to improve the services. A method of solving this issue is  
to fix the initial price of a new service with a buffer which can be developed as financial asset  
and used when needed.

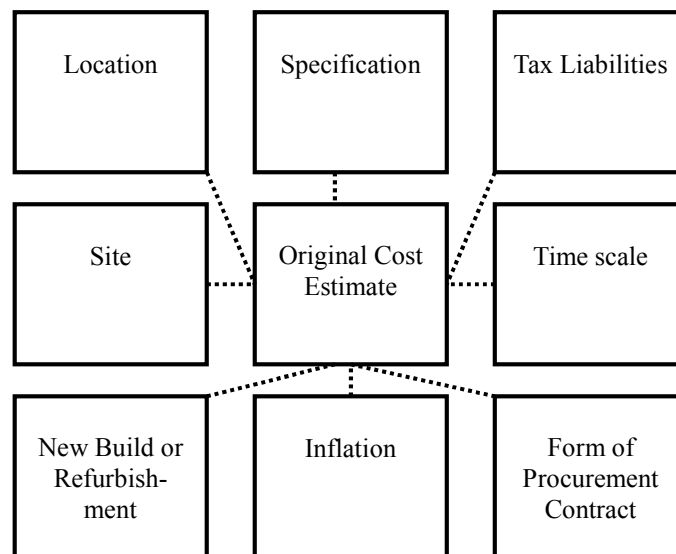


#### 4.4.6 Computerised Billing Systems in Sewerage

2200 Unlike a water supply system, it is not possible to meter and measure the volume of sewage  
 discharged by a household. This is difficult in practice as the meter will immediately get choked  
 with biological growth. The simpler method will be to link it to the volume of water used and  
 measured by a meter. In cities where a flat system of billing is being practised, the costing must  
 2205 be based on real time expenditure and a corpus fund and this of course will need powers to levy  
 by the local body. Such powers will however be only of academic interest because it is the  
 political will and State-wide approach of the Government in place.

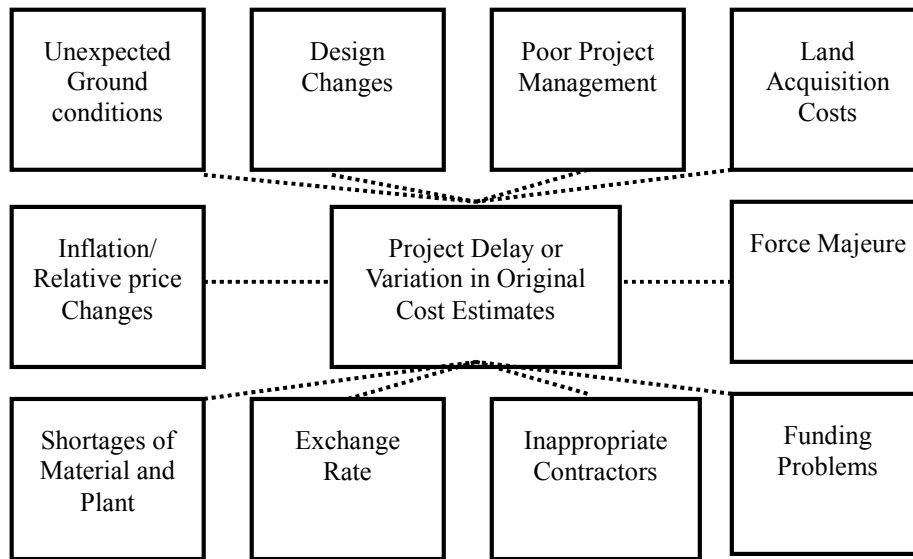
#### 4.4.7 Monitoring and Accounting the Expenditure

Simple monitoring of expenditure is a routine task. It accounts for each expenditure in its  
 appropriate head like machinery repairs, payment to contractors, disbursements of salaries, etc.  
 2210 It is needed to verify that the allocation is not exceeded. Given the objective of this whole  
 chapter, such routine monitoring of expenditure is of no use. It will only show the gap between  
 the revenue and expenditure, but not the method by which the expenditures could be restricted.  
 This is again a multi-disciplinary exercise and cannot be ascertained by the financial manager  
 alone. It requires a joint brain storming of engineering, administrative, finance and public  
 2215 representation. Even if this is carried out periodically, still there is no guarantee that projects can  
 be completed in time and within the allocations of money. Figure 4.3 and Figure 4.4 show the  
 intangibles that slowly creep in.



2220 Source: [http://ec.europa.eu/regional\\_policy/sources/docgener/evaluation/pdf/5\\_full\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/5_full_en.pdf)

Figure 4.3 Key determinants of costs in a project implemented as planned initially



2225

Source: [http://ec.europa.eu/regional\\_policy/sources/docgener/evaluation/pdf/5\\_full\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/5_full_en.pdf)

Figure 4.4 Cost changing factors in a project with time

It can be easily understood that Figure 4.4 is a reality in almost all sewerage projects. Some of the drivers to this eventual state of affairs are as follows:

2230

- a) Lack of planning and coordination
- b) Poor communication between members of the project team and the project sponsor
- c) Failure to identify problems and institute necessary design and programming changes
- d) Lack of control over time and cost inputs.

2235

These are easier to say than control in the real sense. The potential impacts on key project components can be as shown in Table 4.14.

Table 4.14 Effect of major and minor cost changing events on project costs

Cost Estimates	Cost-changing Factors					
	Design costs	Land Acquisition Problems	Poor Project Management	Unexpected Ground Conditions	Inflation/Relative Price Rise	Difficulties with Contractors
Planning / Design Fees	1		1		2	
Land Purchase	2	1	2		2	
Site Preparation	2		2	1	2	2
Building & Construction	1		1	2	1	1
Plant & Machinery	1		2		1	2

1 denotes relatively major effect – potentially 20% change for affected cost elements

2 denotes relatively minor effect – typically 5% change or less for each cost element affected.

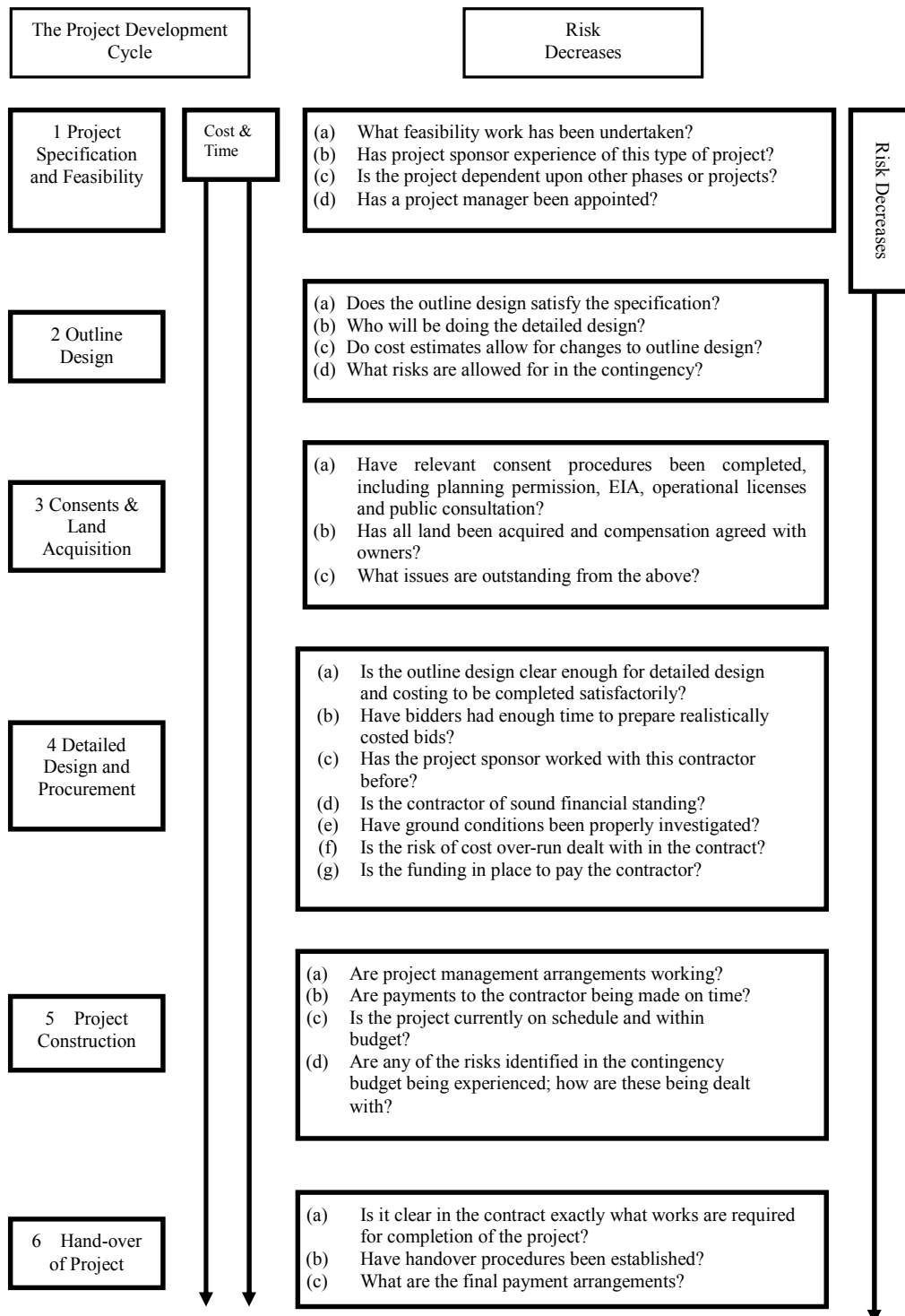
2240 “Site Preparation” is identified as a separate element of Building and Construction costs because it is here that the main effect of unexpected ground conditions is experienced.

Source: [http://ec.europa.eu/regional\\_policy/sources/docgener/evaluation/pdf/5\\_full\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/5_full_en.pdf)

2245 It is not possible evidently to formulate in advance these issues and the extent of their impacts. But then, a good Management Information System (MIS) should be able to present the indications by way of comparison of the historical events of other projects in the same local body jurisdiction because the required information is readily available. An example can be the costs of laying sewer in dense old cities and new development areas. The costs as well as time overruns in both these cases will be vastly different due to many reasons. The most potent reasons will be excavations adjacent to old structures and narrow streets in the old cities and most often land acquisition issues in new development areas. If the MIS has a database of such issues and factored into the costs, it will be a warning system enabling anticipation of higher expenses on the components of a project, and will accordingly enable planning for meeting the eventuality of increased expenditures which have to be overcome. A national network of such an MIS developed on a few issues as above can serve to facilitate the monitoring of finances in a project and account for increased expenditures as the case may be. It will also be useful to go into the following drivers of a project during the launch of the project, recognize them and their future impacts on expenditures and build a cushion in the MIS.

- 2255
- a) Where is the project being undertaken?
  - b) What exactly does the project comprise?
  - 2260 c) Why is the project being undertaken – what is the demand?
  - d) What phases have been undertaken and what phases are now included?
  - e) Is this project directly dependent upon any other projects?
  - f) Who is undertaking the project and over what time period?

2265 For example, phase I of a sewerage project must have been in the old city and phase II may be in the developing city. Both fall under the same sewerage project, but they will respond differently. It is possible to do this exercise stage by stage as the project proceeds as shown in Figure 4.5.



2270 Source: [http://ec.europa.eu/regional\\_policy/sources/docgener/evaluation/pdf/5\\_full\\_en.pdf](http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/5_full_en.pdf)

Figure 4.5 Project development stages and risk factors related to financial management

It may be seen that for each stage, parallel groups of project interrogation questions are also included. These groups of questions are discussed in the following text as “Risk Issues”. Some questions are relevant at more than one stage. When interrogating a project, desk officers should first establish the stage of development of a project and then use the relevant questions. The

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figure also shows graphically how risk (of cost and time over-run) decreases as a project progresses. The formulation of such models and incorporating these into the MIS is a strong felt need if the expenditures are to be justified and accounted for promptly. This will avoid the projects from being held up for want of approvals for deviations, and which in turn again pushes up the expenditures.

This type of MIS will ultimately be in the interest of the country as a whole in the quicker implementation of sewerage projects which run into many years in their present trend. The quickening will be because increased expenditures can be foreseen, justified and accounted for without wasting months of paper work and committees. This will also ensure that funds may not have to divert from one project to another because a contingency fund will be available at the beginning of the project itself which will not be used in the routine expenditure and which will come to the immediate rescue when the above events shape up. Even now in the estimates prepared by Government projects there is a provision under the head “unforeseen” and is a very meagre amount which is otherwise calculated to round off the project cost. Instead, the effort should be to provide for this as “foreseen” and realistically based on information of similar projects locally and elsewhere. Even with all these, this may not totally eliminate some eventualities as “compensations”, “deviations”, “arbitrations”, etc., but these will at least reduce these incidences drastically.

#### 4.5 TECHNICAL AND FINANCIAL APPRAISAL

These are to be carried out after the Detailed Project Report (DPR) has been completed and before deciding the allocation of funds for the project. The idea is to make sure that the following are not allowed:

a) The project as completed is not readily acceptable by the public.

The investment does not result in a completed project which is not acceptable by the public in physical shape and financial payments by them. Most often, sewerage schemes are launched straightaway without consulting the public and consist of the ultimate stage of underground sewers straightaway. The sewage treatment plant is of course a standalone component. After implementation, the public do not come forward to avail of the house service connection and the local bodies are unable to enforce it mainly due to lack of political support. Moreover, the technology of incremental sewage starting from the twin drain concept as detailed in Part A of the Manual in Section 8.5.4 limiting the immediate investment on collection system to possibly only about 10% of what is needed for underground sewerage might not have been considered. If such a staging of the project is taken up, the public may not resist paying their dues because the cost will be very much less and they also know that sewage will not stagnate on the streets. When the public do not come forward to avail of the house connections, the completed project is physically a non-starter.

b) The completed project does not generate the revenue for repayment of loans, etc.

The situation as in the paragraph above results in a position where there is no generation of revenue and the repayments by the local body to lender banks, institutions, etc., are not possible. Sometimes, even the bills of contractors remain unpaid for a long period. Once the local body loses its credibility, other future schemes and projects will also suffer because the banks and institutions will not come forward to invest.

This exercise is carried out by a two stage appraisal namely, technical and financial.

##### 4.5.1 Technical Appraisal

In the technical appraisal, the issues which need to be reviewed are given in Table 4.15.

Table 4.15 Scope of technical appraisal of a sewerage project proposal

No	Components	Significance
1	Project Objectives	Is the project postulate a priority at this time amongst other objectives and is the chosen objective a priority?
2	Assumptions of Growth	Not only population growth but the direction of growth on land so that the sewage treatment volumes & locations are correct?
3	Methodology of Project Preparation	Whether local data have been analysed and used or merely copied from elsewhere or from other reports
4	Dependability of the chosen system	Whether alternative technologies have been duly evaluated for ultimate economy and proven dependability
5	Review of Work Plan	Whether it is proven in the region and whether it has taken note of lessons of earlier work plans
6	Proposed Organizational Structure	Whether competent persons are available and if not what is the proposal to get their services in place
7	Arraying of collection systems	Whether the incremental sewerage evaluated with the type of area development and the repayment capacity of the wards
8	Cost Estimates	Whether Government approved rates are used and how the project cost compares with other projects in the region
9	Willingness of public to accept the project	Whether the population is willing to pay for population 30 years from now and whether more economical systems are required

#### 4.5.2 Financial Appraisal

2325 The idea here is to ensure that the project becomes readily acceptable to the public within their payment capacity and the issues which will be reviewed will be as in Table 4.16.

Table 4.16 Scope of financial appraisal of a sewerage project proposal

No	Components	Significance
1	Proposed financing	Whether letters of commitment are obtained from lending institutions and whether the liabilities have been made public
2	Investments in first time technologies	If the technology chosen is a first timer, what securities are modelled for the safety of the public money?
3	Financial investments needed	Clarity of real-time cost resources of the local body and justification for ability of repayments of capital and interest
4	Liabilities to local body	Whether the public will take house connections immediately and if not how the local body will do the repayments
5	Financial sustainability	Whether corpus fund generation is included to be able to meet emergencies if any in future

2330 In actual practice, these are two exercises carried out simultaneously. The experts carrying out these appraisals are different groups. Once these two appraisals find that the project proposals are acceptable for a safe investment of public funds, the next step will be to evaluate the social and environmental aspects of the same.

#### 4.5.3 Social and Environmental Appraisal

2335 Basically, sewerage is an Environmental Enhancement affair. If at all environmental negative aspects arise it is only from residues of the project and that too when there are human failures. As such it is only the social appraisal which is relevant to predict the acceptability by the users. The purpose of the social appraisal is to ensure that proposed project components are socially

sound and sustainable and that adverse social consequences of the project are recognized at early stage and taken into account in the project planning and design.

The major objectives of carrying out social appraisal are:

- 2340
  - To establish baseline data on social conditions of the project area
  - To predict the impacts on relevant social attributes due to the construction and operation of the proposed project
  - To suggest appropriate and adequate mitigation measures to minimize/reduce adverse impacts, and
- 2345
  - To prepare mitigation and monitoring plan.

Various considerations to be made for undertaking social and environmental assessment include the following main items:

- 2350
  - Impact of project must be assessed and examined from the earliest planning stage. Alternatives or minimization measures to prevent or reduce adverse impact must be examined and incorporated into the project plan.
- 2355
  - Social concerns shall include: involuntary resettlement of the affected population, local economy such as employment and livelihood, the indigenous people, equality of benefits and losses and equality in the development process, cultural heritage, landscape, gender, children's rights, local conflicts of interest, working conditions including occupational health, etc.
- 2360
  - Projects must comply with laws, ordinances and standards, policies and plans related to social and environmental considerations established by the governments that have jurisdiction over project site (including Central and State governments).
  - Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the locality in which the project is planned. Appropriate consideration must be given to vulnerable social groups, who are susceptible to social impact.
  - Information disclosure and accountability also need to be addressed.

2365 Financial appraisals are evaluated as acceptable. The reason is this may lead to entirely wrong conclusions in cost-benefit. For example, let us consider a project proposal with various collection systems in various parts of the local body like twin drain in newly developing localities, underground sewerage in recently developed well-laid layouts almost fully occupied and private on-site system backed up by sullage removal services by the local body. Financially this proposal can be explained and the population satisfied, but the various sections which do not have the underground sewerage immediately will not have the same benefits as the section with underground sewerage. Clearly, quantifying the benefits of these into monetary values is at best a guessing game.

2370

2375 A case study of how this cost-benefit becomes a fraud in the decades to come can be the UNEP test model format which was applied by the UNEP, Anna University (AU) and the Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) to evaluate and justify investments on mechanized STPs in huge grass farms fed by raw sewage and the grass sold to cattle in the city during the 1980's. The social issues were listed out in that exercise as in Table 4.17.

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Table 4.17 Social issues considered in appraising the changeover to mechanized STPs at Chennai

No.	Social Issues	Relevance to the Social Cost Benefit Issues
1	Closing of the grass farms	Grass farms were the state of the art in almost all cities having a sewer system in those days. At the same time, feeding the cattle in the city started creating problems. The shed owners washed away cow dung into sewers during non-peak times causing immediate sewer blocks. It generated sulphide and methane. People were not permitting ventilating shafts and these gases started to leak through manholes on streets. Automobile engines plying over the manholes were exposed to inflammable methane. Actually the answer lay in the complaints by the people about these gases coming out of manholes in roads. It was easy to convince them to accept the project of (a) moving cattle away to an organized co-operative, (b) erecting a mechanized STP and (c) using the treated sewage to grow grass in the new location. Finally, as real estate was so expensive the relocation of cattle into a co-operative did not take place. The cattle got dispersed in small numbers to outlying class 3 habitations. Clearly, the benefit here is only social and not financial because huge revenue by sale of grass was lost. Also higher costs were needed for the STP and its O&M.
2	Retrieving the surrounding real estate	It was agreed that once the sewage farm is taken out, the value of real estate will go up and the local body will realize more income from development charges for new layouts. But the time frame by which this will happen cannot be foreseen.
3	Health of the population near the grass farms	Once the grass farms are removed, the propagation of insect vectors spreading from the farms could be practically eliminated. The impact can be quantified into man days that could be saved from people falling sick and instead earning their livelihood. But the problem is there is no organized information on how many man-days were lost, its seasonal variation etc.
4	Improvement of final marine coastal outfall zone	Once the mechanized STPs are provided, the final discharged sewage will not be raw sewage. It will be treated sewage with almost 99.9 % of water borne pathogenic organisms having been inactivated. This in turn will stop the ground water in the discharge location getting polluted by these pathogenic organisms. But the problem is there is no organized information of pathogen occurrence in the ground water in this zone.
5	Sale value of treated sewage	Once sewage is treated to secondary standards, it gains a quality which can be used by industries for non-human contact cooling purposes. Its cost can be just a token value as compared to commercial tariff for fresh water; Moreover, it will be a mistake to waste freshwater for such purposes. Thus, there is a social benefit. But then, putting a monetary benefit to this is not possible especially by way of time related development as there may be many factors such as willingness of the industries nearby, the validation of the technology and the completion period for its implementation. This is a case where the social benefit can be readily agreed to, but the benefit cannot be readily quantified.

Source: UNEP, 1985

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With all these uncertainties, a compilation was made by the said UNEP-AU-CMWSSB study to quantify the cost benefits as shown in Appendix 4.1. The social benefits as listed in that report in respect of health (Annex IV, e) siting of fisheries harbour (Annex-IV, f), treated sewage at four places earning revenue from industries (Annex IV, g) never really occurred even after 30 years. Out of the calculated benefit of Rs. 49.949 lakhs per annum, the amount of the benefits of



2390 the three items cited above is Rs. 35.723 lakhs per annum. Thus the actual benefit is only  
 (49.949-35.723) / 49.949 = 28%. At that time, the benefit and cost was shown as almost 1  
 (Annex V). Actually, if the benefit is only 0.28, the benefit cost ratio becomes 0.28 and that  
 project would not have been sanctioned at all. But we should not stop sewerage and STPs. The  
 real problem in doing a benefit-cost analysis of sewerage is the fact that there are no reliable  
 models for quantifying health benefits. This is because information on vital statistics is not up to  
 date and information is missing in many places. Thus, it is strongly felt that the social value of  
 2395 sewerage can be easily understood and does not need a benefit-cost ratio.

2400 It is to be thus seen that the value of sewerage as a socially benefitting occurrence has to be  
 considered and does not require carrying out social cost benefit appraisal. If carried out, this will  
 be full of guesswork and finally the real occurrence may be totally different. The fact that the  
 sewerage and STP are also removed from the list of projects requiring EIA reinforces this. Thus  
 social cost-benefit analysis should be scrapped from project proposals for sewerage and instead  
 reliance be placed on technical and economic appraisal.

#### 4.6 SUMMARY

The financial problems of ULBs are directly traceable to a few straightforward issues as listed below:

- 2405 a) Initiatives are absent in many ULBs because there are no incentives for achievement.
- b) ULBs do not take efforts to boost revenues as levies are more a political affair.
- c) Institutional capacity for forward financial planning is mostly historical.
- d) Public think that water is a product of nature and it should be supplied free of cost.
- 2410 e) Public think sewerage is also an obligation by the ULB and is included within the taxes they pay.
- f) But the taxes are not sufficient for the upkeep of the ULB commitments.
- g) User charges are not fixed realistically for the services rendered.
- h) ULB revenue expenditure does not provide for depreciation and financial charges.
- 2415 i) The State Government controls the local body to revise their tariff and taxes.
- j) The ULBs are always on the lookout for grants from Government.
- k) If the grants dry up, most ULBs will be in the “lockout” stage.
- l) The ULBs are also taking it for granted that loans will be closed as grants some time.
- 2420 m) Double entry system of book keeping is not in vogue.
- n) Cost accounting is simply ignored in most of the ULBs.
- o) Budgeting is a mere annual ritual than a professional exercise in forward planning.
- p) Cost control measures are not attempted due to lack of cost consciousness.
- 2425 q) Energy audit, maintenance audit, system audit, asset management etc., are not carried out.

There are practically the positions in most ULBs except where there are high profile industrial

clusters and the revenues are consistently high for the ULBs. These cannot be however allowed to escalate. The following realities are to be recognized and fresh initiatives taken.

- 2430 a) Historically, funding of sewerage projects were entirely out of grant funding from GOI and allocation of budget money by state Governments.
- b) As both these sources in turn depend on taxes and charges in various sectors, the funding could never be met fully and projects were dragging on towards instalments.
- 2435 c) Local bodies are not able to take up sewerage projects on their own because the per capita costs of sewerage projects are not affordable for the public. The main reason for this is that the underground sewerage collection system costs as much as 70% of the sewerage costs. Also the long project completion periods running into more than 5 years sometimes due to problems of land acquisition, traffic diversions, narrow roads in old cities etc., add to the inconveniences faced by the public.
- 2440 d) The concept of incremental sewerage permits many options towards deferred completion of sewerage projects in various segments within a given local body and examples like twin drains in newly developing areas, on-site systems backed up by sullage management by the local body are to be taken on board.
- 2445 e) It is necessary to have public consultation on the likely costs to be paid by the public under various types of sewerage and build in their choices in project formulation.
- 2450 f) The requirement of technical appraisal and financial appraisal could be made with reasonable precision in sewerage project proposals. However quantifying the social cost benefits can be misleading and it will be enough if the benefits are described in the project proposal.
- g) The use of land owned by the local body for generation of funds and approving a master plan in outlying areas to enable the growth of real estate, permitting increased FSI in main corridors of transport are to be exploited to generate revenue.
- 2455 h) Once the proposals are firmed up, the technical and financial appraisals should be carried out to justify the extent of funds sought for the projects.
- i) However, the so-called social appraisal or cost-benefit appraisals should be scrapped altogether in respect of sewerage schemes because a sewerage scheme is on any day an environment enhancement measure and the benefits of health cannot be quantified. The example of the Chennai city STPs cost-benefit study of 1980's and how that has now proved a misconception at this point in time after three decades should be an eye opener in this respect.
- 2460 j) The PCBs insisting on EIA for STPs even after the contract has been awarded is to be set aside especially as in most cases, locations for STPs are either grave yards or cemeteries or solid waste dumping yards and if EIA is insisted upon, there will be no place for STPs.
- 2465 k) Once appraisals are completed, shortfalls in financial closure can be made up by floating municipal bonds underwritten by state Governments.
- 2470 l) Implementation sequence should be wisely chosen to commission various sections of the local body in stages and generating revenues from completed portions instead of waiting for the entire project to be completed especially the collection system.

## CHAPTER 5 BUDGET ESTIMATES FOR OPERATION AND MAINTENANCE

### 5.1 INTRODUCTION

2475 As a result of sharp economic growth and urbanization, the environment in India has deteriorated. There is serious concern about the negative impact on public health and urban living environment. Under such circumstances, Government of India has instituted the National River Conservation Plan (NRCP) and entrusted the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) to tackle the environment degradation issue because of water pollution.

2480 The purpose is to improve water and the sewerage system by reducing water pollution and environmental pollution. To ensure improvement in the water environment, not only construction of STPs but also proper operation and maintenance (O&M) of STP is essential. However, experience on management and O&M of STP is meagre in many cities.

2485 According to the “Report on Indian Urban Infrastructure and Services (March 2011)” by a high power expert committee, the challenge of sanitation in Indian cities is huge. With very poor sewerage networks, a large number of the urban poor still depend on public toilets. A study by the Water and Sanitation Program (WSP, 2010) of the World Bank using data for 2006 showed that the per capita economic cost of inadequate sanitation including mortality impact in India was quite high. In a City Sanitation Study conducted by the Ministry of Urban Development,

2490 none of the 423 cities was found to be ‘healthy’ and ‘clean’. Of the 79 sewage treatment plants under state ownership reviewed in 2007, 46 STPs were operating under very poor conditions.

The assumptions used in preparing the estimates for investment in sewerage for the 20-year period, 2012-2031, as well as the associated O&M expenditure for existing and new assets is presented here.

2495 In this chapter, need for realistic budget estimate to cover O&M activities and approaches to calculation of O&M costs, O&M budget and cost recovery, per capita O&M costs for sewerage, and recommendations are explained. Especially, for the convenience of readers, the calculation for O&M costs is illustrated as reference.

### 5.2 NEED FOR BUDGET ESTIMATE

2500 For budget estimation, technical, managerial, administrative, personnel, financial & social aspects need to be considered. The most important problem is there are no norms for getting proper budget funds for O&M. The only norm is historical. Simply because some decades ago funds were allotted as an ad hoc procedure, the same will be followed every year with an escalation. Newer schemes sanctioned for construction also follow the same approach. Since

2505 O&M of sewage works consists of a lot of activities, the example of norms for a proper budget for O&M is proposed in this chapter.

### 5.3 O&M ACTIVITIES

2510 O&M is conducted through many activities by many sewage employees. O&M consists of activities such as execution of general affairs related to sewage, budget execution, asset management, coordination of service charges, guidance for house connections, monitoring and guidance on industrial effluent, O&M of sewers, O&M of pumping station, and treatment plant, water quality control, ledger management, environment conservation and others. Refer to Table 3.7 in Chapter 3.

## 5.4 CALCULATION OF O&M COSTS

2515 The calculation of O&M costs is a sum of the following:

- (a) Establishment cost
- (b) Energy cost
- (c) Consumables and fuel
- (d) Laboratory analysis
- 2520 (e) Landscaping
- (f) Repairs, renewals and minor replacement of infrastructures
- (g) Depreciation cost
- (h) Seed capital
- (i) Debt servicing
- 2525 (j) Cess
- (k) Taxes and duties
- (l) Unforeseen costs

The probable assessment of these is discussed hereunder.

### 5.4.1 Establishment Costs

2530 The present practice is to arrive at the establishment cost as a percentage of the project cost as per the age old practice of PWD, where the establishment charges are taken as anywhere between 12 to 15%. The fallacy here is this approach was adopted in the past era when the works were mostly civil works like dams, buildings, bridges, canals, roads etc., and which probably reflected the actual position because the number of staff required was also in  
2535 proportion to the volume of work involved. There are no guidelines for establishment costs for sewerage and almost the same PWD method is being followed. Naturally, some local bodies have developed a slightly different approach. However, in the actual case this is not the position in sewerage. An illustration of the establishment costs for sewers, sewage pumping stations and sewage treatment plants is illustrated in Table 5.1 to Table 5.3. Table 5.1 illustrates the approach  
2540 for assessing the establishment cost per km of sewers. Table 5.2 illustrates the approach for assessing the establishment cost per kW of pumping stations. Table 5.3 illustrates the approach for assessing the establishment cost per MLD of STPs

The table as shown in this chapter will also be made available in MS Excel format in the CD version of the manual and can be easily downloaded. The entries in respect of the numbers of  
2545 each category of staff and the fraction of time they will be needed (for the rest of the time, they will be on other duty in the sewerage system) can be varied as also the monthly salary, leave salary, retirement gratuity, etc.

A graphical relationship between the monthly establishment costs versus the km of sewers, kW of pump stations and MLD of STP is presented in Figure 5.1. It may be seen that the cost tapers  
2550 down rather steeply when the size of the system increases and it is very high in the case of

2555 smaller systems. In effect, the cost of an infrastructure increases in proportion to the size or length or volume of a project. Thus, for example, if we consider a STP of say 50 MLD and another of 300 MLD, the cost of the latter will be 6 times maximum and about 4 times minimum. If we go by the conventional method of calculating the establishment costs as a fixed percentage of the cost of the work, the establishment cost to project cost will be a fixed percentage and the curve in Figure 5.1 should be a straight line. But in reality, it is not so. This method of computing can be adopted with suitable changes in the number of staff.

2560

Table 5.1 Establishment cost calculation for illustrative capacities of sewer systems

1	Establishment Cost Calculation for Illustrative Capacities of Sewer Systems										
2	The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4	A	B	C	D	E	F	G	H	I	J	
5	Length of sewers in km	5	10	20	50	100	150	200	250	300	Monthly pay
6	Executive Engineer					1	2	3	3	4	80000
7	Portion of time charged for STP					1	0.75	0.75	1	1	
8	Assistant Executive Engineer			1	2	2	4	6	6	8	60000
9	Portion of time charged for STP			1	1	1	1	1	1	1	
10	Assistant Engineer	1	2	2	2	2	3	3	4	4	40000
11	Portion of time charged for STP	1	1	1	1	1	1	1	1	1	
12	Junior Engineer	2	2								30000
13	Portion of time charged for STP	1	1								
14	ITI qualified plumber	1	1	2	2	3	4	5	6	8	15000
15	semi-skilled labourers	2	2	2	2	3	4	5	6	8	12000
16	unskilled labourers	2	2	4	6	8	10	12	16	20	10000
17	Watchman & security	3	3	3	3	3	3	3	3	3	10000
18	Office assistant	1	1	1	1	1	1	1	1	1	15000
19	Office computer operator	1	1	1	1	1	1	1	1	1	20000
20	Office driver						1	1	1	1	15000
21	Tapal messenger	1	1	1	1	1	1	1	1	1	10000
22	Monthly salary in lakhs of rupees	2.34	1.4	1.4	2	2.8	4.8	6.6	7.6	9.6	
23	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	

1	Establishment Cost Calculation for Illustrative Capacities of Sewer Systems										
2	The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4	A	B	C	D	E	F	G	H	I	J	
5	Length of sewers in km	5	10	20	50	100	150	200	250	300	Monthly pay
24	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
25	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
26	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
27	Monthly salary in Rs lakhs	3.28	1.96	1.96	2.80	3.92	6.72	9.24	10.64	13.44	
28	Monthly salary in Rs Lakhs per km	0.66	0.20	0.10	0.06	0.04	0.04	0.05	0.04	0.04	

The above is computed in Excel and the same will be available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which will be real and meet the actual expenditures appropriately.

Table 5.2 Establishment cost calculation for illustrative capacities of sewage pumping stations

1	Establishment Cost Calculation for Illustrative Capacities of Sewage Pumping Stations										
2	The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4		A	B	C	D	E	F	G	H	I	J
5	Installed kW of pump sets	50	100	150	200	400	600	800	1000	1300	Monthly pay
6	Executive Engineer					1	1	1	1	1	80000
7	Portion of time charged for STP					0.25	0.25	0.5	0.5	1	
8	Assistant Executive Engineer			1	2	2	2	2	3	4	60000
9	Portion of time charged for STP			1	1	1	1	1	1	1	
10	Assistant Engineer	1	2	2	2	2	2	2	2	2	40000
11	Portion of time charged for STP	1	1	1	1	1	1	1	1	1	

1	Establishment Cost Calculation for Illustrative Capacities of Sewage Pumping Stations										
2	The numbers in the cells bound by columns B to J and rows from 5 to 26 are considered reasonable										
3	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
4		A	B	C	D	E	F	G	H	I	J
5	Installed kW of pump sets	50	100	150	200	400	600	800	1000	1300	Monthly pay
12	Junior Engineer	2	2								30000
13	Portion of time charged for STP	1	1								
14	ITI qualified plumber	1	2	4	6	6	6	6	6	6	15000
15	Semi-skilled labourers	2	2	2	2	2	2	2	2	2	12000
16	Unskilled labourers	2	2	2	2	4	4	4	4	4	10000
17	Watchman & security	3	3	3	3	3	3	3	3	3	10000
18	Office assistant	1	1	1	1	1	1	1	1	1	15000
19	Office computer operator	1	1	1	1	1	1	1	1	1	20000
20	Office driver						1	1	1	1	15000
21	Tapal messenger	1	1	1	1	1	1	1	1	1	10000
22	Monthly salary in lakhs of rupees	2.34	1.4	1.4	2	2.2	2.2	2.4	3	4	
23	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
24	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
25	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
26	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
27	Monthly salary in Rs lakhs	3.28	1.96	1.96	2.80	3.08	3.08	3.36	4.20	5.60	
28	Monthly salary in Rs Lakhs per 1000kW	65.52	19.60	13.07	14.00	7.70	5.13	4.20	4.20	4.31	

2565 The above is computed in Excel and the same will be available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which can be real and meet the actual expenditures appropriately.



2570

Table 5.3 Establishment cost calculation for illustrative capacities of mechanized STPs

1	The numbers in the cells bound by columns B to J and rows from 5 to 31 are considered reasonable										
2	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
3	A	B	C	D	E	F	G	H	I	J	
4	Operating MLD of STP	5	10	20	60	100	150	200	250	300	Monthly pay
5	Executive Engineer					1	1	1	1	1	80000
6	Portion of time charged for STP					0.25	0.5	0.75	1	1	
7	Assistant Executive Engineer			1	1	1	2	3	3	3	60000
8	Portion of time charged for STP			0.5	1	1	1	1	1	1	
9	Assistant Engineer			3	3	2	2	3	3	3	40000
10	Portion of time charged for STP			0.5	1	0.25	0.5	0.75	1	1	
12	Junior Engineer	2	2								30000
13	Portion of time charged for STP	1	1								
14	Diploma qualified electrician			1	1	3	3	3	3	3	20000
15	ITI qualified electrician	1	2	2	2						15000
16	ITI qualified plumber	1	1	1	1	1	2	2	2	2	15000
17	Semi-skilled labourers	1	2	2	2	2	2	3	3	4	12000
18	Unskilled labourers	2	2	2	4	4	6	6	9	9	10000
19	Watchman & security	3	3	3	3	3	3	3	3	3	10000
20	Office assistant	1	1	1	1	1	1	1	1	1	15000
21	Office computer operator	1	1	1	1	1	1	1	1	1	20000
22	Office driver						1	1	1	1	15000
23	Chemist	1	1	1	1	2	2	2	2	2	25000
24	Microbiologist								1	1	25000
25	Lab assistant	1	1	1	2	2	2	2	2	2	12000
26	Tapal messenger	1	1	1	1	1	1	1	1	1	10000
27	Monthly salary in lakhs of rupees	2.34	2.61	3.11	4.33	3.88	5.38	6.8	7.85	7.97	

1	The numbers in the cells bound by columns B to J and rows from 5 to 31 are considered reasonable										
2	The fraction of time charged is to utilize the services more effectively in other sectors in the remaining time										
3	A	B	C	D	E	F	G	H	I	J	
4	Operating MLD of STP	5	10	20	60	100	150	200	250	300	Monthly pay
28	Leave salary allowances as %	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	
29	Administrative overheads as %	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
30	Margin for emergencies at %	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
31	Margin for retirement & gratuity	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	
32	Monthly salary in Rs lakhs	3.28	3.65	4.35	6.06	5.43	7.53	9.52	10.99	11.16	
33	Monthly salary in Rs Lakhs per MLD	0.66	0.37	0.22	0.10	0.05	0.05	0.05	0.04	0.04	

The above is computed in Excel and the same will be available in the CD version of the manual. The users can easily change the entries as per their local situation and arrive at a cost which can be real and meet the actual expenditures appropriately.

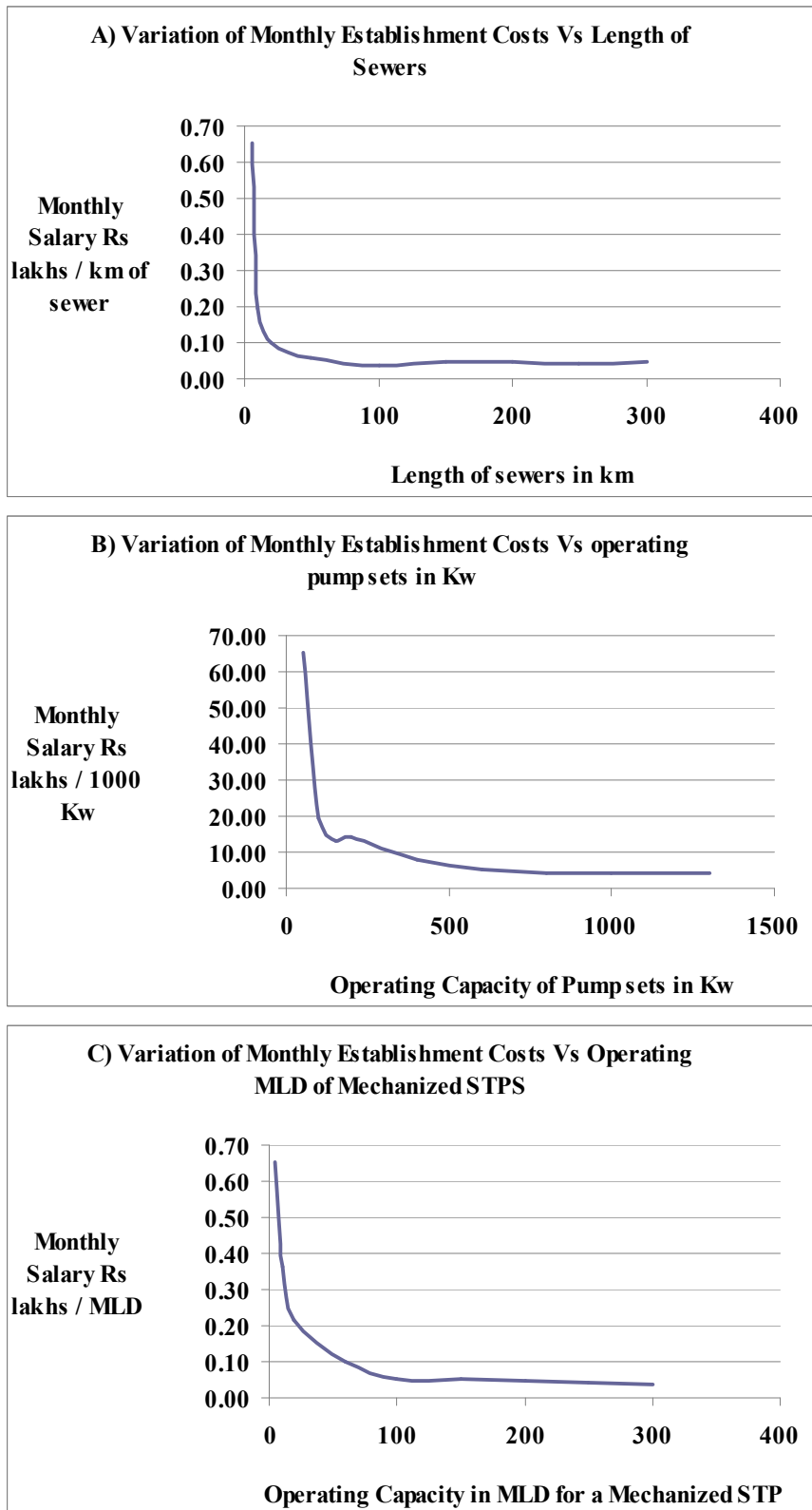


Figure 5.1 Illustration of relationship of establishment costs to the scale of sewers, SPS and STP

2580

### 5.4.2 Energy Costs

2585 The energy costs are straightforward calculation based on the running kW, numbers, and hours of electrical equipment. Usually these cannot be worked out in great detail at the stage of project proposal. A rule of thumb can be arrived at based on similar reported STPs. A sample illustration of this calculation is presented in Table 5.4. The Excel version will be available in the CD version.

2590

Table 5.4 Illustration of calculation of electrical energy for an STP with DAF-Nitrification-denitrification and dual media filters

No	Equipment	kW Rating	Efficiency	Load factor	working	PF at full load	Operating Load in kW	Running Hours	kWh
1	Raw Sewage pump for wet weather	90	0.85	0.85	1	0.88	76.50	8	612.00
2	Raw Sewage pump for dry weather	55	0.85	0.85	1	0.87	46.75	24	1122.00
3	Mechanical coarse bar screen	1.1	0.77	0.85	1	0.81	0.94	24	22.44
4	Mechanical fine bar screen	1.1	0.77	0.85	1	0.81	0.94	24	22.44
5	Conveyor for coarse screenings	1.5	0.75	0.85	1	0.81	1.28	24	30.60
6	Grit Remover	0.75	0.75	0.85	2	0.77	1.28	24	30.60
7	Classifier for grit chamber	1.5	0.75	0.85	2	0.77	2.55	24	61.20
8	Organic Pump for Grit chamber	0.75	0.75	0.85	2	0.77	1.28	24	30.60
9	Air Compressor for DAF	5.5	0.85	0.85	1	0.82	4.68	24	112.20
10	Dosing Pump for DAF	2.2	0.7	0.85	4	0.9	7.48	24	179.52
11	Agitator for DAF dosing tank	3.7	0.75	0.85	8	0.9	25.16	24	603.84
12	Pump for DAF (HPP)	37	0.92	0.85	1	0.9	31.45	24	754.80
13	DAF Unit	1.5	0.75	0.85	2	0.81	2.55	24	61.20
14	DAF Clarified Water Transfer Pump	30	0.85	0.85	2	0.83	51.00	24	1224.00
15	Agitator for pH correction tank	0.37	0.77	0.85	1	0.81	0.31	20	6.29
16	Primary Clarifiers	1.5	0.75	0.85	2	0.77	2.55	24	61.2
17	Primary sludge pump sets	10	0.5	0.85	2	0.77	17	6	102
18	Agitator for Nutrient Dosing Tank	11	0.8	0.85	2	0.83	18.70	24	448.80
19	Agitator for anoxic tank	3.7	0.8	0.85	2	0.83	6.29	24	150.96
20	Internal return pump	37	0.95	0.85	2	0.88	62.90	24	1509.60
21	Air Compressor for aeration tank	110	0.95	0.85	4	0.88	374.00	24	8976.00
22	Return and excess sludge pump	37	0.92	0.85	2	0.9	62.90	24	1509.60
23	Agitator for ferric chloride dosing tank	1.1	0.77	0.85	1	0.81	0.94	24	22.44
24	Secondary Clarifiers	1.5	0.75	0.85	2	0.77	2.55	24	61.2

No	Equipment	kW Rating	Efficiency	Load factor	working	PF at full load	Operating Load in kW	Running Hours	kWh
25	Thickener mechanism	1.1	0.75	0.85	2	0.77	1.87	24	44.88
26	Dilution Water Pumps	20	0.9	0.8	2	0.9	32.00	24	768.00
27	Digester feed pumps	30	0.5	0.85	2	0.9	51.00	24	1224.00
28	Digester mixers	60	0.85	0.85	1	0.87	51.00	24	1224.00
29	Centrifuge feed pump	0.75	0.7	0.85	2	0.72	1.28	24	30.60
30	Poly dosing pump for centrifuge	0.37	0.75	0.85	1	0.77	0.31	24	7.55
31	Centrifuge	7.5	0.75	0.85	1	0.83	6.38	24	153.00
32	Filtrate transfer pumps	10	0.85	0.85	2	0.83	17.00	24	408.00
33	Air Compressor for Instruments	7.5	0.83	0.85	1	0.84	6.38	20	127.50
34	DMF feed pump	75	0.938	0.85	2	0.87	127.50	20	2550.00
35	DMF backwash pump	30	0.92	0.85	2	0.9	51.00	4	204.00
36	DMF air blower	11	0.884	0.85	2	0.87	18.70	4	74.80
37	Single Phase Receptacles& Exhaust	22.5	0.9	0.8	2	0.9	36.00	24	864.00
38	Treated water transfer pump	45	0.925	0.85	1	0.9	38.25	20	765.00
39	Lighting Load	55	0.9	0.8	1	0.9	44.00	15	660.00
40	Total						1285		26821

Based on the above value of 26821 kWh consumed for the applicable unit charges and KVA charges can be easily arrived at.

2595 **5.4.3 Consumables and Fuel**

Chemical consumption in respect of biological STPs will be mainly for the final chlorine consumption and addition of sodium carbonate if adequate bicarbonate alkalinity is not available in the raw sewage to the extent of at least eight times the ammonia to be nitrified. This is easily calculated in respect of chlorine but it cannot be easily calculated when a new STP is being planned for. However, generally sewage has the required bicarbonate alkalinity. Costs on other consumables and fuel should be also calculated as the occasion demands. The best method is to mention in the DPR that this will be met as per actuals at site when the STP is commissioned.

2600 **5.4.4 Repairs and Renewals**

As stated earlier, the prevailing practice is to take repairs and renewals as at about 2% of the STP or SPS cost. This is where most of the problems of inadequate funding of O&M starts. The civil works in a sewage contract cannot go on for 30 years as is the case of normal civil structures as per PWD norms. It is necessary to consider a period of only 25 years for civil tanks of aerobic reactors and 20 years for anaerobic tanks. It is not that the tanks are to be demolished after this period. It only means that there is a need to look into the state of the civil works and carry out rectifications of masonry or concrete or roof protection items. It is difficult to predict this value while preparing the DPR. Hence, it is to be taken as occurring at that time but provide a head of account of 10% of civil works cost under the head “unforeseen items” of future works and deposit the money in a security where it will be needed only after 20 years. By that time the value appreciation and inflation will normally even out. For equipment, it is suggested to consider that mechanical equipment will need replacement in 10 years and electrical equipment will need renewal in 15 years. Here again, repairs and renewals are usually provided for as a percentage of the cost of the plant, but this is not going to help the already prevailing shortfall in the O&M needs in many local bodies. A better method will be to assess the cost of the civil, mechanical and electrical parts of a similar sized plant which has been commissioned recently.

The better approach will be to assume a compounding rate for the coming years and arrive at the cost of these portions at the renewal year. Thereafter the equivalent cost can be calculated and added together for the total renewal cost to be provided for in the DPR stage.

The formula for compounding factor is  $S = (1 + r)^n$

2625 Where S is compounding factor, n is the number of years and r is the interest rate as a numeral.

The formula for equivalent cost is  $EC = (1) / ((1 + r)^n)$

Where EC is the equivalent cost in zero year, n and r as mentioned above

A worked out example is illustrated in Table 5.5. The cells marked as “enter” are the cells where the values can be inserted as desired by the designer in the cell to its right. It may be seen that if a project plant is to be provided now at Rs 200 lakhs, the additional money required at the zero year is Rs. 47.25 lakhs or nearly 23%. Strictly speaking if this amount is deposited in the bank at the zero year itself and if the rate of interest entered in Table 5.5, there should be no difficulty in prompt renewals of the plant at the corresponding year as provided for in Table 5.5. The table will be available in MS Excel in the CD which will be provided with the manual. Hence it will be easy to find out how much money is to be set aside in the zero year itself and invested at as high an interest accrual as possible.

2640 Table 5.5 Illustration of compounding and equivalent costs in Lakhs of Rupees for repairs and renewals

No	Components for Calculation		Rs Lakhs
1	Present assessed cost of a plant	Enter	200
2	Percent of civil costs	Enter	0.40
3	Percent of mechanical costs	Enter	0.35
4	Percent of electrical costs		0.25
5	Cost of civil works		80
6	Cost of mechanical works		70
7	Cost of electrical works		50
8	Life of civil works before renewal in years		25
9	Life of mechanical works before renewal, in years		15
10	Life of electrical works before renewal, in years		10
11	Interest rate in percent	Enter	9
12	Compounding factor for civil works		8.62
13	Compounding factor for mechanical works		3.64
14	Compounding factor for electrical works		2.37
15	Percent of civil cost for repairs	Enter	10
16	Percent of mechanical costs for renewal	Enter	60
17	Percent of electrical costs for renewal	Enter	40
18	Compounded value of civil works at renewal year		68.98
19	Compounded value of mechanical works at renewal year		152.98
20	Compounded value of electrical works at renewal year		47.35
21	Rate of interest for equivalent cost factor	Enter	12.00
22	Equivalent cost factor for civil renewals		0.06
23	Equivalent cost factor for mechanical renewals		0.18
24	Equivalent cost factor for electrical renewals		0.32
25	Equivalent cost at zero year for civil works renewal		4.06
26	Equivalent cost at zero year for mechanical works renewal		27.95
27	Equivalent cost at zero year for electrical works renewal		15.24
28	Total equivalent cost at zero year for all renewals later		47.25

The table is available in MS Excel in the CD version of the manual and can be used easily.

#### 5.4.5 Depreciation Cost

2645 Depreciation can be understood as an expense that reduces the utility of an asset by its wear and tear and its age as number of years. Equipments are to be recognized for depreciation and must be replaced once the end of their useful life is reached. There are several accounting methods that are used in order to calculate the depreciation cost over the period of its useful life. Accounting for it and treating the equipment as practically of no value at the end of its life term



2650 helps in reducing the revenues by off-setting depreciation and thus permits a free cash flow for expenditures. Among the many methods of arguing how much is depreciated, the two useful ones are as given below. If we assume that the equipment will have only a scrap value at the end of its service life, the annual depreciation is calculated as:

$$\text{Annual depreciation} = (\text{Cost at zero year} - \text{Cost of the scrap value}) / \text{life years}$$

2655 The difficulty in using this method in sewerage infrastructure is the fixing of the scrap value after the life years. This is also not practically applicable in sewerage infrastructure because the equipment cannot be replaced completely after its service life years since it can be renewed and operate for some more years. Also there will be criticism from the auditors that whereas the equipment could have been serviced and used for some more time, it was deliberately thrown out to pave the way for a totally new purchase.

2660 The other method of calculating the depreciation is by the formula:

$$D = [r] / ((1+r)^{\text{power } L}) - 1$$

Where D is the depreciation, L is the life years, and r is the interest rate as a numeral

2665 The same example in Table 5.5 when calculated by this formula will result in depreciation over the life years of both mechanical and electrical equipment as in Table 5.6. It may be seen from Table 5.5 that the total equivalent costs at zero year by following the compounding and equivalent value method is Rs 47.25 lakhs. It may be seen that by following the depreciation formula method, the net accrual will be Rs. 50 lakhs at the end of the 15th year. By following this method, the written off money would have been invested as savings over the 15-year period as follows:

2670 For first 10 years at Rs 3.73 lakhs per annum and yielding Rs 72 lakhs and then at Rs 1.18 lakhs up to the 15th year yielding Rs 8 lakhs. The reinvesting of Rs 72 lakhs for 5 years will yield Rs. 130 lakhs. This will yield a revenue of Rs 8 + 30 = Rs 138 lakhs in year 16. However the cost of renewals will be as follows as shown in Table 5.5:

	Renewal of electrical equipment at the 11th year	Rs 47.35 lakhs
2675	Renewal of mechanical equipment at the 16th year	Rs 152.98 lakhs
	Total cost at the 16th year	Rs. 200.33 lakhs.

2680 Though this example will tend to prove that the compounding and equivalent cost method is safer for renewals of equipments, the percent of interests assumed will dictate the relative gains. There are also fluctuations in market lending rates. It appears better to use the best ascertained interest rates and calculate for both these methods, and then use the method that will result in the higher monetary value at the 16th year. The money for repair of civil works is a minor component and can be adjusted in the annual budgets spread over a two- to three-year period.

Table 5.6 Depreciation of mechanical and electrical equipment of the plant in Table 5.5

No	Components for Calculation		Lakhs of Rupees
1	Present assessed cost of a plant	Enter	200
2	Percent of civil costs	Enter	0.40
3	Percent of mechanical costs	Enter	0.35
4	Percent of electrical costs		0.25
5	Cost of civil works		80
6	Cost of mechanical works		70
7	Cost of electrical works		50

No	Components for Calculation		Lakhs of Rupees
8	Life of civil works before renewal in years		25
9	Life of mechanical works before renewal, in years		15
10	Life of electrical works before renewal, in years		10
11	Interest rate in percent	Enter	9
12	Interest true value, r		0.09
13	1+r		1.09
14	(1+r) power L for mechanical works		0.04
15	(1+r) power L for electrical works		0.02
16	Annual depreciation for mechanical works		2.55
17	Annual depreciation for electrical works		1.18
18	Annual depreciation of equipments		3.73
19	Total depreciation for first common years		37.33
20	Total depreciation for balance years		12.75
21	Net depreciation		50.08

2685 The table will be available in MS Excel in the CD version of the manual. The user can download the same and use it easily.

### 5.5 BUNDLING THE ESTABLISHMENT COSTS OF SPSS AND STPS

2690 The financial burden of allocating dedicated establishment for scattered and small SPSSs and STPs need to be recognized in Figure 5.1. If these smaller facilities can be bunched together for purpose of establishment, the initial steep portion of the curves can be virtually eliminated and the costs can be practically made into a straight line parallel to the x axis. In actual practice, the allocated establishment in these SPSSs and STPs are not having a continuous work in the O&M except for random checking of the status of machineries. This can be easily done by keeping the establishment moving between a grouped numbers of SPSSs and STPs. In fact this will also help in keeping the establishment getting involved with the work and avoid the staleness of being forced to be idling for most time when handling a small SPSS or STP where there is nothing much to do daily. In some cases the bundling of these SPSSs and STPs may bring in geographical issues and jurisdictions. These can be easily got over. Whether the O&M is by contractors or by ULBs, the functional responsibility of the contractor/ULB staff will be to the respective ULBs and the administrative control can be under the concerned revenue official with integrated jurisdiction on the ULBs concerned. This is similar to the functioning of the law & order system in our country.

### 5.6 O&M BUDGET AND COST RECOVERY

The preparation of O&M budget is an exercise for performing all the above calculations and also providing for the other components listed in Section 5.4 as:

- 2705 • Consumables and fuel
- Seed capital
- Debt servicing
- Cess
- Taxes and duties

2710 The seed capital is a provision that would serve to take up system improvements and unforeseen

expenditures. There are no hard and fast rules for its value. It depends on whether there is revenue surplus in the first place. The rest of the components of debt servicing, cess and taxes and duties are components as become available. A good budget exercise is one which has iterations. Firstly, the expenses are worked out and then revenues are verified based on levies. The rate of levies can be varied to result in a revenue surplus budget. The final decision will rest with the consumers and if they do not come forward to pay for services availed by them (or) if they question the cross subsidies policy, there can be difficulties.

2715

Table 5.7 Per capita O&amp;M Costs (PCOM) for sewerage at 2009-2020 prices

No	City size and class	PCOM / year
1	Class IA	414
2	Class IB	373
3	Class IC	290
4	Class II	290
5	Class III	207
6	Class IV+	145

Source: HPEC, MOUD. 2011.

## 2720 5.7 RECOMMENDATIONS

The O&M costs can be calculated by appropriately using the Excel versions of Table 5.1 to Table 5.6. Thereafter the other expenditures as in the para above should be added. The extent of the surplus, however marginal, has to be verified. Once the figures have been arrived at, the PCOM equivalent can be decided by dividing the expenditures by the population and the resulting value compared with Table 5.7. If the resulting value is less than the value given in Table 5.7, once again the exercise has to be repeated to ensure no item is left out. If it is higher, the same must be maintained. If the Government policies do not empower the local bodies to levy a workable levy, it has to be taken up with the Government and discussed.

2725

## 5.8 SUMMARY

O&M of sewerage works in India is not in any great shape. One of the reasons is the inadequate O&M budget. This in turn is traceable to the absence of a structured approach to forecast O&M fund requirements as also human resources needs. In this chapter, these are analysed and examples of calculation methods of necessary costs are proposed. In addition, a CD of Excel spreadsheets is included. In order to customize the Excel sheet to specific ULB, accumulation of data and periodical assessment are necessary. The recommendation shows some precaution for application to specific ULB. This is only a genesis and needs progressive refining.

2735



## CHAPTER 6 PUBLIC PRIVATE PARTNERSHIP (PPP)

### 6.1 INTRODUCTION

2740 The schemes in which a government service or private business venture funded and operated  
through a partnership of government and one or more private sector companies are sometimes  
referred to as PPP, P3 or P<sup>3</sup>. Recently, another P has been added to the PPP framework, i.e.  
People, and is now described as People, Public, Private Partnership and the new concept of  
2745 PPPP, P4 or P<sup>4</sup>, being applied. In the PPPP concept, people are involved actively in investments  
and infrastructure development aiming at increase in sense of ownership and enhancing  
sustainability of services.

PPP involves a contract between a public sector authority and a private party, in which the private  
party provides a public service or project and assumes substantial financial, technical and  
operational risk in the project. In some types of PPP, the cost of using the service is borne  
2750 exclusively by the users of the service and not by the taxpayer. In other types (notably the private  
finance initiative), capital investment is made by the private sector on the strength of a contract  
with government to provide agreed services and the cost of providing the service is borne wholly  
or in part by the government. Government contributions to a PPP may also be in kind (notably the  
transfer of existing assets). In projects that are aimed at creating public goods like in the  
2755 infrastructure sector, the government may provide a capital subsidy in the form of a one-time  
grant, so as to make the project more attractive to the private investors. In some other cases, the  
government may support the project by providing revenue subsidies, including tax breaks or by  
providing guaranteed annual revenues for a fixed period.

Typically, a private sector consortium forms a special company called a “special purpose  
2760 company (SPC)” to develop, build, maintain and operate the asset for the contracted period. In  
cases where the government has invested in the project, it is typically (but not always) allotted an  
equity share in the SPC. The consortium is usually made up of a building contractor, a  
maintenance company and bank lender(s). It is the SPC that signs the contract with the  
government and with subcontractors to build the facility and then maintain it. In the infrastructure  
2765 sector, complex arrangements and contracts that guarantee and secure the cash flows make PPP  
projects prime candidates for project financing. A typical PPP example would be a hospital  
building financed and constructed by a private developer and then leased to the hospital authority.  
The private developer then acts as landlord, providing housekeeping and other non-medical  
services while the hospital itself provides medical services.

2770 The Government of India defines a P3 as “a partnership between a public sector entity  
(sponsoring authority) and a private sector entity (a legal entity in which 51% or more of equity is  
with the private partner/s) for the creation and/or management of infrastructure for public purpose  
for a specified period of time (concession period) on commercial terms and in which the private  
partner has been procured through a transparent and open procurement system.”

2775 In PPPP, people could contribute towards both the capital and O&M investments, and can be  
actively involved in the development and O&M of infrastructure leading to an enhanced sense  
of ownership and sustainability of the project. This move needs to be supported by the  
Governance structure that involves greater people participation and hence promote greater  
accountability and transparency.

2780 In this Chapter, the need for PPP in sewerage and sanitation services, various aspects that need  
to be considered to promote PPP, efforts encouraging PPP, potential PPP models, sustainability  
of PPP contract, addressing the concerns of stakeholders and funding institutions/banks etc., are  
discussed.

## 6.2 NEED FOR PPP

### 2785 6.2.1 PPP in Sewerage and Sanitation Services

The aim of PPP is to increase fund flow and efficiency and to improve the quality of service delivery by leveraging the expertise of the private sector and raising the level of satisfaction among users.

2790 Sewerage and sanitation service is an obligatory function of urban local bodies in the country. The local bodies are therefore, required to provide adequate services for sewage collection, treatment, and disposal.

2795 Currently sewage treatment plant projects are bid out on Engineering Procurement and Construction (EPC) basis and have a limited role for the EPC contractor in operation and maintenance of assets. In many instances, the assets so created are of relatively poor quality, inadequately maintained and do not comply with the required effluent treatment norms stipulated by the Pollution Control Boards. In order to ensure optimum utilization of funds deployed and proper creation and maintenance of assets, it is desirable to explore the option of PPP contracts wherein the long-term commitment of the Private Sector Participants would be ensured due to continued deployment of their own funds.

2800 Sewerage and sanitation services need huge capital investment, high cost for operation and maintenance of facilities and considerable human resources; so this service is becoming more and more expensive. Besides, the efficiency of the labour force employed in the urban local bodies is far from satisfactory. High wage structure and inefficiency of the work force results in steep rise in the cost of service and yet the people at large are not satisfied with the level of service being provided by the urban local bodies. It is, therefore, necessary that the local bodies seriously consider private sector participation in sewerage and sanitation services.

2810 There are various technology options available for treating sewage like Activated Sludge Process, Sequential Batch Reactor, etc. The technology option as well as the project cost would be outlined in the Detailed Project Report prepared for implementing the project. Irrespective of the technology chosen, STP projects could be developed on a long term commitment from the Private Sector Partner on PPP basis.

2815 In recent years, public private partnerships in sewerage facilities are on the rise. Local governments now are more aware of the benefits of privatisation, and private companies are eager to enter the market. Currently, the policy environment is not very conducive to private sector participation in sewerage.

2820 In addition, getting and retaining qualified staff, challenges in complying with ever-stricter regulations and catering to the need for financing, designing and building a new or expanded system. Non-compliance regulatory pressures, rising public awareness, and Public Interest Litigations (PIL) often strengthen the reasons for privatisation. However, public private partnerships are not the cure-all. When a municipality does decide to privatise, it is imperative to do so in a competitive environment where it seeks partners that are financially stable, experienced and have the ability to deliver the services. The contractual conditions that the municipality identifies should clearly define the measurable service deliverables and penalties for non-performance.

2825 Uninterrupted and safe collection, treatment and disposal of sewage are essential basic services to be rendered by a civic body interested in ensuring the quality of life of its residents. Predominant problems in sewerage services are:

- a. Inadequate coverage of efficient sewerage system
- 2830 b. Inadequate operation and maintenance
- c. Lack of public awareness
- d. High level of fiscal dependence
- e. Inefficient and inequitable utilization of resources (capital and human)
- f. Low responsiveness to user needs and preferences
- 2835 g. Partial recovery of O&M cost and with no scope for capital investment
- h. Manual cleaning of sewers and septic tanks
- i. Poor septage management
- j. High seepage losses and transmission losses
- k. Contamination of sewage network by storm water and effluent from industries
- 2840 l. Inefficiency in intermediate pumping stages
- m. No provisions for standby power arrangements

2845 A priority issue for most towns and cities will be to improve the management and accountability of sewerage collection and treatment systems through PPP to make the services market oriented, efficient and demand responsive. Investment in other areas should then be determined by the private operator who should have financial incentives for meeting the desired service standards at the least cost, ensuring that low cost rehabilitation, efficiency enhancement and demand management measures precede capital intensive sewers, treatment plants or pumping stations.

### 6.2.2 Project Types

Sewage treatment projects can be of two types:

#### 2850 a) Treatment for Disposal

The basic objective of this type of project is sewage collection, treatment and disposal to meet the norms of the Pollution Control Board (PCB). This type of project can be developed either on PPP/BOOT basis or EPC with long term O&M obligations for the contractor.

#### b) Treatment for Reuse

2855 In cities with large number of industrial establishments and scarcity of water, sewage treatment projects for reuse can be developed for supply of industrial/non-potable water for industries. This type of project can be developed with the private sector on PPP basis. The private sector partner will implement the project, treatment plant, conveyance system and bill and collect on behalf of the ULB from the end consumer industries. The ULB will pay annuity to the private  
2860 sector partner on take or pay basis.

### 6.2.3 Present Method of Financing

2865 In the current scheme of things, varied sources of financing are employed towards the sanitation sector. The programmes undertaken by central government agencies, like JnNURM and NGRBA, form the sources of funding from central agencies. State governments and the revenue base of the local governments form the primary source of O&M. Bilateral and multilateral donor agencies have also contributed significantly to the development of the sector. Other financial sources include the user charges collected from domestic/industrial/others users of

treated water, connection charges, etc.

2870 In most cases, the government provides financial assistance to the municipalities for improving the sanitation and sewerage system. Due to paucity of funds, the municipalities are often faced with high indebtedness and money has been a major constraint on the municipalities for improving/providing these basic services. A clear assessment of the time frame required for the local bodies with their meagre budgetary provisions to improve the basic services of sewerage system reflects the need for alternative options which can ensure sustainable services in much shorter times. As an alternative to traditional management and funding, the most suitable option is to bring in private management and finance to improve the provision and development of basic urban services including sanitation and sewerage systems. Under the PPP structure, the private sector partner who invests in the project assets and recovers it over a project life cycle of say 15-20 years, is likely to ensure better management of project assets and delivery of committed service level parameters during the project term.

2885 Going forward under the PPP structure, JnNURM has helped kick-start PPPs in the urban sector. One of the innovative aspects of the JnNURM model of infrastructure finance is that it encourages the use of government funding as a catalyst for private investment. PPPs in the urban sector often require higher grant support than the 40% grant provided by the Viability Gap Funding (VGF) scheme sponsored by Ministry of Finance (MOF). JnNURM has filled this gap and encouraged PPP transactions that would have not been viable in the absence of a dedicated centrally sponsored scheme. States and Urban Local Bodies (ULBs) have creatively used JnNURM grants as viability gap funds to finance economically sound but financially unviable projects on a PPP basis.

2890 The remaining of the project cost may be funded by PSP who will also operate and maintain the plant over the Concession Period, for which the PSP will be paid annuity over the concession period. The Annuity payable to the PSP will include the following:

2895 **Fixed Charges:** These charges will be for recovery of capital expenditure for creating the project. This will include fixed costs such as interest, depreciation, investment returns and fixed O&M costs including manpower.

**Variable Charges:** These charges shall include all variable costs including, but not limited to consumables, chemicals, power, etc., and will be subject to indexation to reflect the change in prices.

2900 The fixed charges component of the annuity will be paid out of the various Grants of the Central and State Government. The payment of variable charges component of the annuity will be the responsibility of the Urban Local Body implementing the project.

2905 As the current tariff levels are too low across ULBs in India and do not reflect the true economic cost of providing sewage treatment and disposal service, increasing tariffs to a level to ensure that the sewerage system generates sufficient revenues to meet its fixed and variable expenses and become self-sustainable may not be possible all at once. This could be achieved by increasing tariffs gradually over a period of time.

In the initial years, tariff should be set to ensure that it recovers at least the variable costs of the sewage system. Once operational efficiency is demonstrated, the ULBs can increase the tariff to recover the fixed costs in addition to the variable costs.

### 2910 **6.3 ADVANTAGES OF PPP**

Massive investments are required towards infrastructure creation, capacity building, and operation and maintenance of the assets to improve the coverage and service levels of sewerage and sanitation services. This makes PPPs an important strategy in improving the service levels



of sewerage and sanitation services.

- 2915 Promotion of PPP has some advantages that are listed below.
- a. Investments by private firms may be quick and prompt and wait time is shorter compared to traditional government funding, thus ensuring early completion of construction or improvements in sewerage system.
  - 2920 b. Through increased investment and greater focus on customer services, the private firm will be able to ensure adequate sewerage facilities and better services.
  - c. With enormous potential for expansion of the facilities, the private firm can enhance the efficiency of services.
  - d. Users are kept informed by the publication of performance data.
  - e. Private firms are more flexible in their approach to solve related problems.
  - 2925 f. The private firm does not have the constraint of working within yearly budgetary allocations which is usually seen in public sector funding and can borrow money as required, which can be spent efficiently and in a timely manner.
  - g. There could be a gradual change in work culture of the employees resulting in a more flexible structure that allows individuals to show more initiative.

#### 2930 **6.4 CHALLENGES AND ISSUES**

PPP has some constraints listed as follows:

- a. In the process of private partnership, there may be a natural aversion to changes from the people themselves or from public representatives.
- 2935 b. The utility and the consumers/users may have fears that they will have no control over the pricing of the services to be provided by the private firm.
- c. There will always be some members of the less privileged society in the served area for whom sewerage and sanitation service is either free or heavily subsidised by government, and hence some persons may object to private partnership.
- 2940 d. The employees may have fears in respect of their existing benefits as government employees like pension rights, retrenchment, salary cuts and more importantly, the loss of identity of a government servant or civic employee.
- 2945 e. The taking over of part of a public service by the private sector will require a well-defined contract in order to safeguard all parties, including government, but primarily the user, who would be the main beneficiary. The hand-over process at the end of a private sector arrangement needs to be defined, at least in outline, when the initial deal is made.

Some of the main issues in PPP are listed below.

- 2950 a. Since the utilities depend on the governments for provision of funds for improving the sewerage services, the responsibility for providing this basic service has shifted from government to utility. This is a vital issue since the 74th Constitutional Amendment which empowers the ULBs to manage their affairs and hence places the responsibility for provision of these services on the local body.
- b. The utility should give sufficient thought to all aspects and properly assess how it is doing the job of providing the water supply and sewerage services and how soon

- 2955 it can improve the services with available/government funds.
- c. The utility can also weigh the advantages and drawbacks of entrusting these services to a private firm as against management by the utility and then decide accordingly.
- 2960 d. The utility and government should dispel the fears of the employees in respect of their existing benefits like pension rights, retrenchment, salary cuts and more importantly the loss of the identity of a government servant or civic employee.
- e. From the perspective of the private sector, the following risks need to be addressed in the Model Concession Agreement from the bankability point of view and for successful private participation.
- 2965 i) Source risk:
- The major input for any wastewater reuse projects is continuous supply of sewage/effluent. The source of sewage/effluent is usually identified by the Government Agencies with diligence after getting necessary in-principle approvals from the concerned authorities. High cost infrastructure has to be put in place for water/effluent treatment, which cannot be redeployed and are inextricably linked to the source. Since the source is identified by the Government agencies, it is essential that they also provide guarantee on the source.
- 2970
- ii) Credit risk:
- In case of PSP, the investment is made upfront by the private sector player. The return on investment to the private party is either by direct collection of revenues from users and/or annuity payment by the Government Agencies. The public sector counterpart could be usually a State Government, Urban Local Body or Water/Sewerage Boards, etc. The repayment capacity of each Government body would vary and would be dependent on the financial strength and the powers vested to the public agency. To ensure the bankability of a project and also to avail of lower interest rates from the lenders, the following are to be addressed:
- 2975
- The credit rating of the public party to be at investor grade
  - In case of parastatal agencies/boards, the State Government should provide:
    - Certification of the payment capacity of the boards
    - 2985 – Guarantee to bridge the gap in case of shortfalls due to change in law or lapses by public party where the public party is also responsible for routing the grant funds from Central/State Government
    - Insistence on ULB/Government agency to open escrow account wherein it will escrow its identified revenue streams and mark a lien on the account in favour of the private sector player
    - 2990 – Mortgaging rights to the private sector for assets created
    - Insistence to provide a revolving Letter of Credit (LoC) for at least six months of annuity payments with a provision that the letter of credit will be replenished every time the concessionaire draws the LoC.
- 2995 iii) Contract structure risk:
- The following clauses are to be incorporated in the agreement for any project to be

taken up by the private party

- 3000 • Step in rights to lenders: Step-in rights are the rights given to lenders to step in to the project company's position in the contract to take control of the infrastructure project when the project company is not performing. The concession agreement should provide provisions for lenders to step in through a substitution agreement for lenders.
- 3005 • Termination Payments: The termination payments should be acceptable to both the equity investors and the lenders.
  - In case of termination due to Concessionaire Event of Default, the termination payments payable by the Client/Municipal Corporation/Government Agency shall be the entire senior and subordinate debt/mezzanine debt deployed in the project.
  - 3010 – In case of termination due to Client/Municipal Corporation/Government Agency Event of Default and termination due to various Force Majeure events, the termination payments payable by Client/Municipal Corporation/Government Agency shall be the entire equity along with desired returns, entire senior and subordinate/mezzanine debt deployed in the project.

## 3015 **6.5 ENABLING ENVIRONMENT AND NEED FOR REFORMS**

### **6.5.1 Enabling Environment**

3020 The Government of India is committed to improving the level and the quality of economic and social infrastructure services across the country. In pursuance of this goal, the Government envisages a substantive role for Public Private Partnership (PPPs) as a means for harnessing private sector investment and operational efficiencies in the provision of public assets and services.

3025 The Government of India has set up Public Private Partnership Appraisal Committee to streamline appraisal and approval of projects. Transparent and competitive bidding processes have been established. To provide a broader cross-sectoral fillip to PPPs, extensive support has been extended through project development funds, viability gap funding, user charge reforms, provision of long tenure financing and refinancing as well as institutional and individual capacity building.

3030 Sewerage services are one such area where private sector has still not found much interest. Private sector must, therefore, be given some incentives by way of long term contracts, lease of land at nominal lease rent, and so on, for attracting it to this field.

- a. The Ministry of Urban Development and Poverty Alleviation (MoUD&PA) identified the need for Guidelines for Sector Reform and Successful Public-Private Partnerships in late 2001, recognizing:
  - 3035 – the enormous potential benefits of a bigger role for the private sector in improving urban water supply and sanitation services; and
  - the inherent risks of executing poorly designed private transactions in this sector.

3040 The Guidelines are designed to sensitize State Governments and Urban Local Bodies to the policy and procedural issues that need to be addressed as they reform urban water supply and sewerage services. They also seek to:

- embed an evolving role for the private sector into this broader sector reform;
  - facilitate a systematic assessment of the issues and options for successful private sector participation; and
  - prevent improperly designed and executed PSP transactions.
- 3045      b.      Contracts may be given for cleaning sewer or sewerage facilities for a period of not less than 3 years so that the contractor may be in a position to invest money for buying equipment. The contractors will have no interest in short-term contract, as investment made may become redundant if the contract is not subsequently renewed.
- 3050      c.      Private sector may be offered land for sewerage facilities at a nominal rent for not less than 15 years for setting up sewage treatment plants, pumping stations, etc. The terms for obtaining royalties from the private sector can be worked out by local bodies through mutual negotiations. There may be situations where urban local bodies may not have adequate land for sewage treatment and/or disposal or local bodies may find it difficult to manage the same departmentally. In such situations, they may consider private sector providing sewage treatment and disposal facilities on its own land or on municipal land and local body may pay tipping fees for the treatment and disposal of their sewage by private entrepreneurs. However, cost benefit analysis should be carefully carried out by the local body before concluding such an agreement.
- 3055
- 3060      d.      Private sector participation may be encouraged in such a way that it does not affect the interests of the existing labour force, does not violate the provisions of the Contract Labour (Regulation and Abolition) Act 1970 of the Government of India, and does not exploit private labour, yet reduces the burden of the urban local body for new establishment. This will substantially help in improving the quality of service of the urban local bodies, reduce the expenditure and also provide opportunity to the private sector to enter the sewerage services market.
- 3065
- 3070      e.      An arrangement of BOO (Build, Own and Operate), BOOT (Build, Own, Operate and Transfer) or any other arrangement which may be transparent and beneficial to the local body may be made keeping in view the above observations.

## 6.5.2 Need for Reforms

### 6.5.2.1 Need for Sector Reforms and the Status of Reforms

3075      The functions of the administration are divided mainly into three kinds, namely “policy making”, “administration/regulation of policy” and “execution of public works”. Sector reforms imply that the framework of “execution of public works” may be rearranged in order that “execution of public works” is entrusted to the private sector from the public sector based on the market principle.

3080      There is need for a radical reform of the urban infrastructure sector, particularly in sewerage services to ensure that the quality of services in the urban areas, particularly to the urban poor is improved. Traditional mechanisms, relying on unreliable flows of insufficient public funds to finance piecemeal projects cannot fill the urban infrastructure gap. Hence, reform of the urban sewerage sector is particularly urgent because without such reform, fiscal resources will continue to be used sub-optimally and urban population will continue to spend significant portions of their time and income in coping with the costs of poor service, depriving themselves of their full economic and civic potential. The situation is also complex because:

3085

- Sewerage is an essential service.

- Sewage management is a local issue with local solution, but failure to tackle them successfully can have regional and national implications.
- There is a need to introduce the reform agenda.
- 3090 • The private sector can play a positive and long-lasting role.
- Reforms must be properly sequenced and managed, based on key lessons learned from application of reforms in other sectors.

3095 While recognizing that urban reforms are State subjects, the Government of India (GOI) through the Ministry of Urban Development and the Ministry of Housing and Urban Poverty Alleviation is facilitating these reforms, including designing and disseminating among others, a model Municipal Act, important guidelines for public private partnership in sewerage services and overall framework for GOI support. Within the framework, the ministry has proposed the “Urban Challenge Fund” and the “Pooled Finance Mechanism” to catalyse urban change through an active partnership with the States and their towns and cities by a combination of strategic engagements, capacity and regulatory support, and fiscal incentives. These will be further complemented by the “Urban Reform Incentive Fund” under the Ministry of Finance (GOI).

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#### 6.5.2.2 Key Principles for Policy Framework

3105 A publicly endorsed policy framework would give decision makers the mandate for systematic reform and private partnership. Various initiatives are required for creating an enabling environment among all the stakeholders for private partnership as a viable alternative. To create such an environment, there is a need to assure the underprivileged and weaker sections of society the continued government support (subsidies) and dispel the fears of retrenchment and salary cuts of the present employees even if the sewerage and sanitation services are provided and managed by the private sector. The key principles for such a reform policy framework are to:

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- Introduce public service obligations, prudent financial constraints and accountability obligations for urban local bodies/service providers/sewerage utilities.
- 3115 • Commercialise service providers under transparent governance structures - professional management, insulation from political influence, revenue adequacy and suitable auditable accounts and performance measures.
- Establish an autonomous and competent economic regulator when there is a clear demand for its services and the political will for its empowerment.
- 3120 • Put in place specific incentives and regulations to improve services for the poor.
- Create a flexible demand-responsive industry structure.
- Encourage Public Private Partnership, prioritising distribution system management, operation, maintenance and planning.
- Set service charges that reflect costs with better targeted public subsidies.
- 3125 • Create an enabling legal, regulatory and institutional environment; delineate the roles of state and local regulatory agencies and establish an empowered Sector Reform Team to facilitate the reforms.
- Urban Local Bodies/Sewerage Utilities would restructure the service providers,

3130 assess costs, tariff and subsidy requirements for better services, prepare for and execute the envisaged form of Public Private Partnership and manage the Public Private Partnership contract (with support from State institutions).

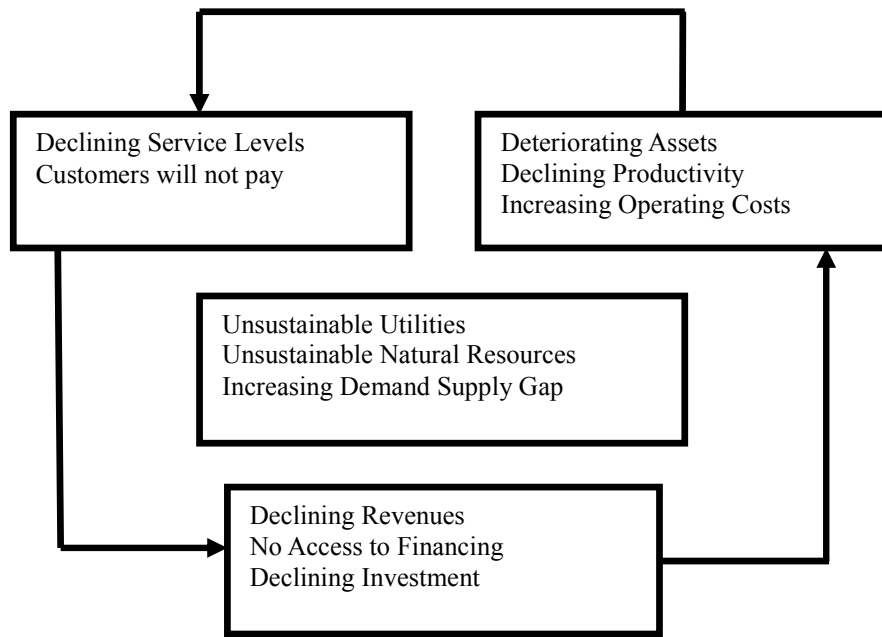
### 6.5.2.3 Apprehension by Bankers/Lenders

Some of the key issues and challenges faced by Bankers/Lenders while appraising urban infrastructure projects under PPP include the following:

- 3135 a) Structuring of the PPP projects in urban infrastructure is not up to the expectation of the various stake holders on account of the following reasons:
- 3140 i) The project documents (bid, concession agreement, etc.) are not standardized at the State and Central level unlike the case of road or power sector leading considerable scope for negotiation between Concessing Authorities and bidders during development, execution and operations. This leads to delay in project development and execution having residual risks.
  - 3145 ii) Lender's interests are to be adequately and appropriately protected in the Concession Agreements like in the model concession agreement of transportation or power sector.
  - 3150 iii) Urban Infrastructure sector is today at the same stage where the road sector was about 15 years back – the route adopted and lessons learnt in the privatization process of the road sector should be put to use to an optimum level for successful privatization of urban infrastructure projects.
  - 3155 iv) The “User pay” principle is not yet established for urban infrastructure services – leaving the private sector to manage the show on behalf of the government with respect to user charges collection.
  - v) For the payment of annuity, appropriate escrow account would have to be created as the Urban Local Bodies (Municipalities) lack financial credibility because of their weak finances.

### 3155 6.5.2.4 Unsustainable to Sustainable

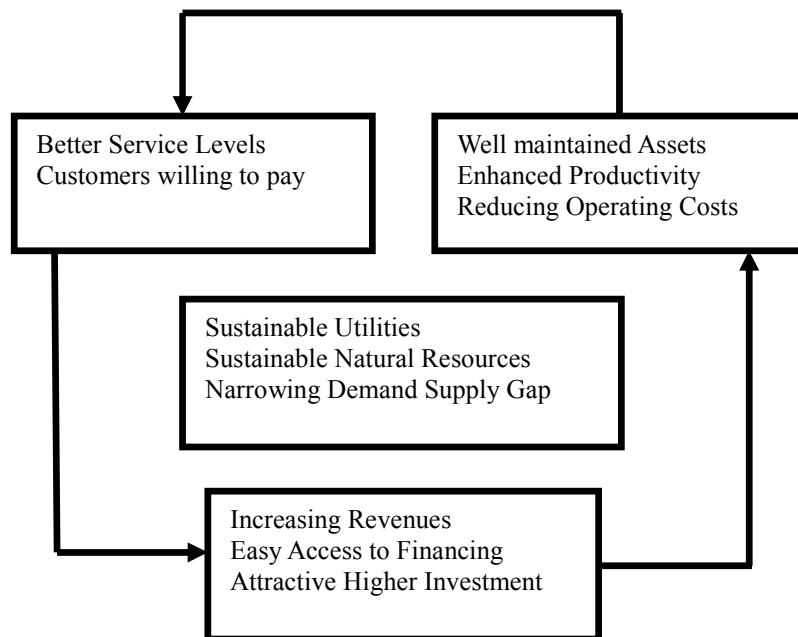
The HPEC has graphically portrayed the situation of unsustainable to sustainable. This is shown in Figure 6.1 and Figure 6.2.



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Source: High Level Committee on Financing Infrastructure, MOUD. Report of the Sub-committee on Financing Urban Infrastructure in the 12<sup>th</sup> Plan, 2012, p.43-44.

Figure 6.1 Portrayal of unsustainable nature of PPP in urban sector infrastructure



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Source: High Level Committee on Financing Infrastructure, MOUD. Report of the Sub-committee on Financing Urban Infrastructure in the 12<sup>th</sup> Plan, 2012, p.43-44.

Figure 6.2 Portrayal of sustainable nature of PPP in urban sector infrastructure

3170 There is scope for expanding PPP in urban sector especially in water, sanitation and waste to energy. While there are established Models and a sizable number of projects in certain sectors, the number of PPP projects in urban social infrastructure (water supply, sanitation and SWM)

are limited. PPP Projects in water sector for loss reduction, introducing 24x7, 100% metering and billing are to be encouraged in the form of Management contracts in the States. A few states have taken the initiative, which needs to be replicated in the country. Some of the key issues and challenges faced by Bankers/Lenders while appraising urban infrastructure projects under PPP include the following:

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1. Structuring of the PPP projects in urban infrastructure is not up to the expectation of the various stake holders on account of the following reasons:

3180

- a. The project documents (bid, concession agreement, etc.) are not standardized at the state and central level unlike in the case of Road or Power sector leading to lot of scope for negotiation between Concessioneing Authorities and bidders during development, execution and operations. This leads to delay in project development and execution having residual risks

3185

- b. Lender's interests are to be adequately and appropriately protected in the Concession Agreements like in the model concession agreement of transportation or power sector.

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- c. Urban Infrastructure sector is today at the same stage where the road sector was about 15 years back – the route adopted and learning's in the privatization process of the road sector should be put to use to an optimum level for successful privatization of urban infra projects.

- d. The "User pay" principle is not yet established for urban infra services – leaving the private sector to manage the show on behalf of the government with respect to collection of user charges.

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- i. The Urban Infra sector needs to be handled with soft gloves, like in case of the transportation sector where after the initial debacle of the toll road projects; the concept of annuity was brought in successfully. Similarly for the Urban Infra sector projects policy should graduate slowly from Government run to Private with the initial route of annuity before switching over completely to user pay principle basis.

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- ii. For the payment of annuity appropriate escrow account would have to be created as the Urban Local Bodies (Municipalities) lack financial credibility on account of their weak finances.

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2. Proper Quality of Service and upkeep of the existing urban infra assets is not being done, leading to poor service quality which does not enthuse the end user to pay service charges for the urban facilities being used and leading to the user pay principle not being established. The Un-sustainable cycle depicted above needs to be broken and converted into a seamless cycle of sustainability as depicted below.

#### 6.5.2.5 Land Based Financing

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The HPEC cites the case of sales from MMRDA land auctions in just one complex (Bandra-Kurla complex) in January 2006 which was a staggering Rs. 23.0 billion, two times more than the total infrastructure investment made by the Mumbai Municipal Corporation, during 2004-05 (which was only Rs.10.4 billion) and four times more than MMRDA's own infrastructure investment in 2004-05 which was a mere Rs.5.4 billion. However, there are several other questions which would be worth examining: Are the proceeds from land lease/sales used to finance "related" infrastructure, such as access roads, water and sewerage systems to service the development to take place on the land that is sold? Or is a significant part of the proceeds used for more general infrastructure purposes? What procedures are followed in

3215



allocating funds, how fully defined is the process, and how much public disclosure takes place?

3220 A news item on Aug-2-2012 reports that “The Indian Prime Minister's Office Thursday partially lifted curbs on the transfer of government land for infrastructure projects, a move that the government claims will reduce the time needed to build roads, railway lines, airports and ports”. A similar model for sewerage projects, which are held up for “right of way” to lay sewers and locate STPs by the PPP route, is to be explored.

## 6.6 EFFORTS ENCOURAGING PPP

3225 Some examples of success stories of PPP project in the water and sewerage sector in India are summarised below. Some international examples of success stories of PPP project in water and sewerage sector are also summarised below.

### 6.6.1 National Projects

#### 6.6.1.1 Alandur Sewerage Project

##### 3230 a. Project Description

The Alandur Sewerage Project (ASP) was initiated in the year 1996 by the Chairman of the Alandur Municipality (AM). The AM, located adjacent to Chennai, forms a part of the Chennai Metropolitan Area. With a population of around 165,000, the municipality is a residential suburb of Chennai with predominantly residential and commercial activities. Approximately 3235 one-fourth of its population lives in slums.

The proposed sewerage system was to be designed for the estimated population of about 300,000 in 2027 and was planned to be completed within a five-year period from its inception date. The project components included:

- 3240 • A sewerage network consisting of the main sewer line, branch sewer line and manholes;
- Construction of a sewage pumping station;
- A sewage treatment plant; and
- Low cost sanitation

3245 In the initial phase the plant was to treat 12 million litres per day (mld) of sewage supplied to it by the municipality. The ultimate capacity was to be 24 mld.

To plan this complex and politically challenging project, the AM worked in partnership with the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL), the state asset management company and with USAID's Financial Institution Reform and Expansion (FIRE) Project.

3250 The ASP was the first project in the municipal water sector to be taken through the Public Private Partnership route in India. The construction of the underground sewerage system in Alandur town, involving the laying of pipes, construction of pumping station, etc., was done on a BOQ (Bill of Quantities) basis, and the sewerage treatment plant (STP) on a BOT (Build, Operate and Transfer) basis. Besides the construction responsibility, the contractor was also 3255 required to undertake the operation and maintenance of the sewerage system for a period of five years from the date of completion of the construction, on a fixed fee basis. The collection of tariff and provision of new connections during the O&M phase was to be undertaken by the municipality directly.

Accordingly, the PPP structure of this complex project was governed by three contracting

- 3260 mechanisms awarded to one engineering procurement and construction (EPC) contractor selected through a competitive bidding process:
- A *Works Contract* for construction of the sewage network, using the World Bank's Contract for National Competitive Bidding (NCB-W2) as the template;
  - 3265 • An *Operations and Management Contract*, also using NCB-W2. The selected contractor would operate and maintain the underground sewerage system for a period of five years on a fixed fee basis.
  - 3270 • A *Lease Contract* (in the nature of a BOT Agreement) for the STP, using guidelines from the International Federation of Consulting Engineers (FIDIC). Through this Agreement, the contractor would finance, build and operate the STP for a period as proposed in the contractor's successful bid. The contractor would be required to recover the investment on the STP on the basis of a per unit rate payment from the municipality for treatment of sewage delivered. The municipality agreed to provide a minimum payment level per annum regardless of the volume of sewage actually delivered. It was designed to cover the company's minimum fixed operating cost and capital investment. Accordingly, the PPP structure was
  - 3275 technically in the nature of BOT-Annuity.

Alandur sewerage project is summarised in Table 6.1.

Table 6.1 Alandur sewerage project

Sector	PPP Project structure	State and Year PPP Contract Signed	Government / Public Sector Entity / Entities	Private Sector Promoter / Sponsor / Consortium Members	Project Cost	Concession Period
Sewerage	Construction Contract (Underground Sewerage System)  O&M Contract (Underground Sewerage System)  Build-Operate-Transfer (BOT) Annuity (Sewage Treatment Plant)	Tamil Nadu 2000	Alandur Municipality and the Tamil Nadu Urban Infrastructure Financial Services Limited (TNUIFSL)	IVRCL Infrastructures and Projects Ltd. and Va Tech Wabag Technologies Ltd.	Rs. 34.6 crores (Sewerage Network) Rs. 6.68 crores (Sewage Treatment Plant)	O&M Contract – 5 years BOT Annuity – 14 years

3280 Source: Ministry of Finance (2010). *Public Private Partnership Projects in India, Compendium of Case Studies*, p.2

### b. Key Learning and Observations

A brief on the difference made by the ASP, as captured below, illustrates that the 'value for money' brought in by the project far exceeded any monetary consideration:

Table 6.2 Brief on the difference 'before' and 'after' PPP intervention

Sr. No.	Parameter	Situation before PPP intervention	Situation after PPP intervention
1.	Urban service	No sewerage system for a population of 165,000	120 km of underground sewerage system, pumping stations and an STP of 24 MLD
2.	Urban service	Water borne sanitation facilities, septic/holding tanks for disposal of night soil	Underground sewerage system with direct connection to each household
3.	Urban service	Unregulated disposal of sewerage in storm water drainage and low lying areas	Modern sewerage treatment plant designed to international standards.

Sr. No.	Parameter	Situation before PPP intervention	Situation after PPP intervention
4.	Environment and health	Open storm water drains stagnating in outer areas of town – environmental and health hazard	Underground sewerage system has eliminated risk of mosquitoes and related diseases for the citizens of Alandur and surrounding areas.
5.	Environment and health	Contamination of underground water sources due to open drains	Almost 100% eradication of ground water contamination through underground sewerage system and waste water treatment plant.
6.	Public participation	-	Rs. 12 crores out of the capital cost was through public contribution

3285 Source: Ministry of Finance (2010). *Public Private Partnership Projects in India, Compendium of Case Studies*, p.24

### 6.6.1.2 Salt Lake Water Supply and Sewage Disposal System

#### a. Project Description

3290 The Kolkata Municipal Development Authority (KMDA) along with the Nabadiganta Industrial Township Authority (NDITA) planned a combined water supply-cum-sewerage project. This project was planned to be implemented under the Built-Operate-Transfer (BOT) PPP arrangement. The project was developed with financial assistance under the central government scheme of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM).

3295 The PPP contract for the project is a Concession Agreement for the development of the project on a BOT basis. The contract involves the following parties, viz., KMDA, NDITA and the consortium of private developers. As per the Concession Agreement, the private developer is required to undertake the development, design, engineering, financing, procurement, construction, completion, commissioning, implementation, management, administration, operation and maintenance of the water supply network, sewerage network and the sewage treatment plant (STP) at the site. Against the capital investment made, the private developer is permitted to charge the consumers a water supply-cum-sewerage tariff. The Concession Agreement requires the private developer to operate and manage the water supply and sewerage system for a time period of 30 years.

3305 As part of the pre-implementation activities, the private developer was required to prepare a Detailed Project Report for the project to be implemented. The detailed design of the capital works to be undertaken was to be provided by the private developer and, subject to approval from KMDA and NDITA; the works were to be implemented by the private developer. The grant under the JNNURM scheme is subject to approval of the DPR by the Ministry of Urban Development (MoUD). The tariff to be levied and the structure of the same will be determined by the private developer in consultation with KMDA, NDITA and the concerned stakeholders which include the representatives of the offices located in the project area.

3315 After completion of the construction phase, the private developer is required to purchase the treated water from NDITA and supply water to all the connected units and collect sewage; the sewage then has to be disposed of following treatment. Further, the generation of bills and its collection is to be managed by the private developer. The private developer will retain the user charges so collected from the consumers. For undertaking the construction works, and for setting up the STP, the private developer will be provided the required land area free of cost. Additionally, the private developer is also not required to make any type of licensee fee payment or annuity payment to the KMDA or NDITA during the period of the contract.

3320 At the end of the tenure of the contract, the water supply and sewerage network has to be handed back to NDITA for future operations and maintenance.

Project of Salt Lake Water Supply and Sewage Disposal System is summarised in the Table 6.3.

Table 6.3 Project of Salt Lake water supply and sewage disposal system

Sector	PPP Project structure	State and Year PPP Contract Signed	Government / Public Sector Entity / Entities	Private Sector Promoter / Sponsor / Consortium Members	Project Cost	Concession Period
Water & Sewage	BOT (includes Design and Finance)	West Bengal 2007	Kolkata Metropolitan Development Authority (KMDA) and Nabadiganta Industrial Township Authority (NDITA)	Jamshedpur Utilities and Services Company Limited and Voltas Limited	Rs.70.09 crores	30 years

Source: Ministry of Finance (2010). *Public Private Partnership Projects in India, Compendium of Case Studies*, p.2

3325

### b. Key Learning and Observations

- Pre-project assessment and feasibility studies are critical: Before tendering out the project, it is important that the government undertakes a first level assessment of the project area. This assessment should be able to indicate the status of the physical infrastructure and the service delivery gaps. On the basis of the assessment, it should ascertain the nature of infrastructure required and the investment needed. Such an assessment would give a realistic picture of the on ground situation to the government and the private developer. Additionally, a detailed feasibility study should also be undertaken especially in the case of a greenfield project to determine the commercial viability of the proposed project.
- Effective facilitation of project implementation by the government: KMDA and NDITA played a critical role in providing key concessions to the private developer to arrive at a rational water-plus-sewerage tariff. KMDA had several rounds of discussions with the stakeholders, that is, the IT firms to ascertain the acceptable tariff.
- Government needs to provide full cooperation to the private developer at various stages: The private developer needs to be provided with maximum cooperation for the implementation of the project. There were delays in handing over of land free of cost to the private developer which resulted in delays in commencement of the construction work. It is important for the government agencies to avoid such delays. However, in all other areas, the private developer has received substantial assistance from KMDA and NDITA to ensure smooth implementation of the project.

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## 6.6.2 International Projects

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### 6.6.2.1 Manila Water Supply Project (Philippines)

#### a. Project Description

Manila Metropolitan Waterworks and Sewerage Services (MWSS) have been operating the water supply and sewerage services for metro Manila since 1971. Its performance was so poor, (with water supply coverage of 68%, unaccounted for water ratio of 44%, unpaid charges and illegal connections) that half of the population had access to water for only half a day every day.

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In 1995, the MWSS was privatised, following the example of Buenos Aires. With competition

3360 introduced to a local monopoly environment, the city of Manila was split into eastern and western areas to invite private bids for services in separate areas, to prevent cessation in the water supply citywide even in the event a privatised business should go bankrupt. As a result, the Maynilad Water Services (MWSI) won a 25-year concession to operate the services for the west area while the Manila Water Company (MWCI) was successful for the east area.

3365 The biggest achievement of the MWSI and the MWCI was expansion of their areas of coverage. Five years after inauguration of the service, the number of connections soared by about 30%. The daily average water availability duration increased to 17-21 hours. However, the performance of their sewerage services remains far short of the goal. The unaccounted for water (UFW) ratio still remains the same with no reduction.

3370 Introduction of private capital led to service expansion. But it cannot be said to have completely improved the financial position. In the wake of the 1997 Southeast Asian economic crisis and slumping currency in the Philippines, the cumulative debts in Philippine peso swelled by 60%. This was partly because a large portion of the debts of the MWSI for the western district was in foreign currencies. In March 2001, the annual debt repayment in the west area became equal to the fees charged. The MWSI was obliged to raise the tariff. The tariff increases were approved by the government in October 2001 and in July 2002 the financial position finally improved. Later, the government declared a freeze on water tariff hikes. In response, the MWSI informed the government it planned to relinquish its operational rights on the grounds that the contractual terms for tariff revisions were violated.

3380 In the east district, the MWCI increased operational efficiency to achieve profitability. It has yet to remove the entire governmental financial burden. Not all fiscal burdens for future investment plans including water source development have been eased. The east-west disparity in performance is partly attributable to differences between the two areas. The east has well-developed infrastructure and a business district while the west lacks infrastructure and has many poverty zones.

The Manila Water Supply Project is summarised in the Table 6.4.

Table 6.4 Manila water supply project

Sector	PPP Project structure	State and Year PPP Contract Signed	Government / Public Sector Entity / Entities	Private Sector Promoter / Sponsor / Consortium Members	Project Cost	Concession Period
Water & Sewage	Concession Contract (Water Treatment, Distribution, Tariff Collection, Facility Improvement, Overall Management)	Manila, Philippines 1997	Manila Metropolitan Waterworks and Sewerage System (MWSS)	Maynilad Water Services, Inc.  Manila Water Company, Inc.	About 30 billion pesos (1.2 billion dollars in 1997) over the concession period	Concession Contract – 25 years

3385 Source: UTCE Ltd., Japan PFI Association, 2003

### b. Key Learning and Observations

The key learning from the privatization of MWSS and the experience of Manila Water are as follows:

- 3390 • To ensure successful implementation of privatization, the Government must have clear objectives, firm political will, focused execution of its action plans and programs, and unwavering support from the private sector.
- The close link and unique relationship between MWSS and the “Regulatory Office” would require experienced regulators to manage, considering that the regulators do not have complete independence.
- 3395 • Concessionaires need a strong balance sheet and cash flows to address “regulatory lag” and survive liquidity problems resulting from external factors (for example, currency devaluation as a result of the Asian financial crisis).
- MWSS privatization showed success initially, but establishing a credible regulatory structure requires more time and effort. Changes in policy and contract will present new challenges and opportunities to all stakeholders, particularly MWSS and its concessionaires.
- 3400 • To ensure the success and sustainability of the MWSS privatization, both MWSS and its concessionaires should strengthen existing partnerships to ensure that the latter remains efficient in the delivery of service to its customers, especially the urban poor.
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#### 6.6.2.2 PPP Water Project in Buenos Aires (Argentina)

3410 The water supply and sewerage services in the Buenos Aires Metropolitan Region had been operated by OSN (Dirección Nacional de Obras Sanitarias de la Nación), a state-run sanitation public corporation, since 1912. Prior to the privatization project, its performance was very poor with a coverage ratio of 70%, an UFW ratio of 45%, water meter coverage ratio of 20% and a sewerage coverage ratio of 58%. Rehabilitation of the business was an urgent issue.

3415 In 1993, privatization of water services was approved as part of a program for privatizing state-run companies with the help of the World Bank, to correct economic mismanagement. Under a 30-year concession agreement, the international joint venture called Aguas Argentinas (AA) took over the responsibility for operating the water services.

3420 After the privatization, amount equal to US\$600 million was invested. The project was reported to be a success, with tariffs lowered by 27% and a water supply volume increased by 37%. However, when Argentina devalued its currency in the wake of its economic crisis in 2002, the AA experienced a two-thirds fall in revenues, and encountered serious financial difficulties. The concession agreement had a provision for renegotiation, including that based on foreign exchange risks. However, the government froze the reassessment and no tariff increase has taken place. AA’s largest shareholder, Suez, suffered a loss of Euro 500 million in FY2002.

### 6.7 POTENTIAL PPP MODELS

There are several business schemes of PPP as described below.

- 3425 a. Service contract

3430 Service contract is a system in which the administration entrusts its specific and restrictive works to the private sector. This includes work such as cleaning of facilities or security services. The administration assumes total responsibility and private sector assumes management responsibility of employees. The service contract form includes a contract for one or multiple services to a private sector (outsourcing). The duration of contract is usually one to two years.

b. Management contract

3435 A management contract is a system in which the administration entrusts management (operation and maintenance, etc.) of a complete facility which the administration owns to a private sector. The private sector does not take financial risks such as financing, and the administrative side provides the private sector (trustee) with funds for operation or investment. A private sector always acts on behalf of the administration (truster). The administration has the ultimate responsibility to the public services that the trustee provides. The contract duration in this case is 3 to 5 years.

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c. Lease contract (Property rental contract)

3445 A lease contract is a system in which the administration leases an institution to a private sector for a fixed period so that the private sector may perform operation and maintenance of a public facility. The administration collects investments by collecting a rental fee from the private sector over a long period of time. The private sector performs operation and maintenance of facilities. When additional investment or renewal of facilities becomes necessary, the administration pays for these expenses. The contract duration in this case is usually 8 to 15 years.

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d. Concession contract (Business right contract)

3450 A concession contract is a system in which administration entrusts management of public works to a private sector that has acquired a business license (managerial right), and this contract is called a business right contract. The private sector, which acquires a business license, performs business management including operation and maintenance of facilities and investment for business expansion. Although the facilities are publicly owned, management is entrusted to the business license holder during the duration of the contract. The facilities are transferred and received by the administration from the private sector upon completion of duration of the contract. In this case the duration is usually continued for 25 to 30 years in order to recover the investment.

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e. BOOT (Build-Own-Operate-Transfer) contract

3460 A BOOT (Build-Own-Operate-Transfer) contract is a system in which a private sector raises funds by itself for building a new facility or acquiring equipment, and builds, owns, and operates the facility. Upon completion of the contract, the facilities and equipment are transferred to the administration. The duration of contract should be long enough to redeem the long term debt and distribute dividend to investors. Although the scale and term of contract are influenced by the scale of debt, the duration of the contract in this case is usually 20 to 30 years.

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Contracts such as BOO, BOT, and BTO are basically modifications of the BOOT contract.

– BOO (Build-Own-Operate)

3470 In this system, ownership of the facility is not transferred from a private sector to the administration after the private sector builds the facility. The private sector owns it and carries out operation and maintenance of the facilities continuously.

– BOT (Build-Operate-Transfer)

3475 In this system, a private sector builds the facility, operates and maintains it, and transfers the ownership to the administration after the end of the contractual period.

– BTO (Build-Transfer-Operate)

3480 In this system, a private sector builds the facility and transfers the ownership to the administration immediately after completion of construction of the facility. The private sector performs operation and maintenance of the facility continuously during the contractual period.

The burden sharing between the administration and private sector in the business scheme of the PPP is summarized in Table 6.5.

Table 6.5 Burden sharing in the business scheme of PPP

Business Schemes of PPP	Owner of Assets	Operation & Maintenance	Investor	Business Risk	Contract Term
Service contract*	Public	Private/Public	Public	Public	1-2 years
Management contract	Public	Private	Public	Public	3-5 years
Lease contract	Public	Private	Public	Share	8-15 years
Concession contract	Public	Private	Private	Private	25-30 years
BOT/BOO contract	Private/Public	Private	Private	Private	20-30 years

3485 \* Private Sector Participation (PSP)

Source: World Bank, 1997

### 6.7.1 Sample PPP

3490 A sample draft concession agreement of the Shimla Water supply and Sewerage System Project to build, refurbish, operate and maintain the Water supply and Sewerage System of Shimla City, Himachal Pradesh (India) on PPP Mode is in Appendix 6.1.

## 6.8 SUITABILITY OF PPP CONTRACT

3495 Benefits from PPP will grow, as increasing responsibility and risks are transferred to the private partner. Hence, simple service management contracts generate less benefits compared to performance based management contracts, leases, concessions and divestitures. Concession contracts may be suited for most urban areas as they mobilize capital and high quality human resources but may be unfeasible until market conditions are better developed. However, management contracts can be expedient and cost effective if used as leverage for a deeper form of public private partnership. Hence, the private partners in such contacts should have sufficient rights and responsibilities to improve services and prepare for a deeper form of PPP.

3500 Any form of PPP should contain a clear obligation to improve services to the poor. PPP transactions should be executed in a transparent and competent manner, with the assistance of qualified transaction advisers. Maximizing competition from qualified bidders is one of the ideal methods of assuring the best outcome to the consumers. Capacity should be continually strengthened at the local and State levels so that utility performance is monitored effectively and  
3505 the PPP contracts are managed efficiently to ensure quality of economic regulation.

## 6.9 LEGAL FRAMEWORK

3510 An act with legal provisions is required for creation of an authority for approval of public private partnership projects, with specific authority to negotiate, accept or reject the PPP proposals submitted by the bidders. Any act shall also include provision for creation of a regulatory authority independent of private sector participants and the Government, not only for regulating the tariffs but also for ensuring that the private sector participants are discharging their obligations as per their contracts. This is also required to ensure expansion and up-gradation of facility in future.



## 6.10 SUBSIDIES TO THE POOR

3515 Sewerage charges in India generally form part of the water supply charges. The economically  
disadvantaged consumers may not be able to pay the full cost of the water and sewage.  
Therefore it is important to consider issues such as: the minimum quantity required for  
sustaining, amount spent for providing this quantity, the least amount that the poor/low use  
3520 consumer will be able to pay, and the costs that can be mobilised from the poorest and amount  
which can be shared by those who can afford to pay. There is a need for coming out with the  
policy for continuation of subsidies to the underprivileged sections of society who require the  
support of the Government for availing drinking water supply and sanitation services even if the  
service is managed by private firm.

## 6.11 COMPETITIVE BIDDING

3525 Often a lot of time and effort are spent on finding finances from international financial lending  
institutions due to the complex procedural formalities. Since funding is not focused on  
privatisation, the grant processes are generally too slow to meet the requirements of fast track  
projects involving water supply/sewerage services. Regulatory authority can compare the  
alternatives available for implementation of a project. If any utility desires to take up  
3530 improvements in its service to achieve increased coverage and better service levels, it has two  
alternatives, namely traditional funding or private financing.

### 6.11.1 Tariff Charges for Traditional Funding

Any utility can approach the government for funds by plan provisions and/or procure loans from  
national, international and bilateral funding agencies. Due to limited availability of such funds,  
3535 the investment for improvement projects may spill over longer periods, i.e., about 5 to 7 years.  
Accordingly, the technical estimates and financial projections will be prepared for O&M costs  
and probable tariff charges to be recovered by the utility from users can be worked out to meet  
the O&M costs, debt servicing and depreciation plus some capital reserve for extension of  
services.

### 6.11.2 Tariffs for Private Financing

3540 As an alternative to traditional funding, a suitable option is to bring in private finance for  
provision and development of sewerage systems. The utility can accept without bidding and by  
negotiation, the proposals submitted by private firms if their tariffs are comparable with those of  
the alternative under traditional funding.

## 6.12 ADDRESSING THE CONCERNS OF STAKEHOLDERS

3545 PPP is not a one stop solution for all the issues of the sewerage sector. There are concerns of  
stakeholders which have been frankly brought out by the Infrastructure Development  
Corporation of Karnataka as in Table 6.6.

3550

Table 6.6 Key concerns of stakeholders

Government and Civic Society	Private Developers
<ul style="list-style-type: none"> <li>• Look at private sector for capital infusion</li> <li>• Concern about loss of control</li> <li>• Resistance to levy or increase user charges</li> <li>• Condition of assets during handback</li> <li>• Civic society - Tariff implications</li> <li>• General acceptance by the community</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of reliable baseline information               <ul style="list-style-type: none"> <li>• Haste in bidding projects to avail funds under schemes</li> <li>• Inadequate technical studies undertaken while preparing DPRs</li> <li>• Has impacted the due diligence exercise prior to bidding</li> <li>• Landed cost much higher than the cost estimated by government agency</li> </ul> </li> <li>• Technology being prescribed by the government agency</li> <li>• Payment guarantee</li> <li>• No business case</li> <li>• Obtaining applicable permits</li> </ul>

Source: Infrastructure Development Corporation (Karnataka) Ltd., 2012

3555 It needs to be recognized that these concerns are legitimate from the respective points of view. Consequently, it is clear that each PPP has to have its own “rules of the game” and it is not possible to create a uniform model for all PPP.

3560 For example, if we consider a new technology to be implemented for the first time in the country for a sewage treatment plant, the whole complexion of PPP changes. To start with, the most crucial parameter of target setting is the raw sewage BOD itself. There is no sewerage system in the first place and it is not possible for the local agency to specify this BOD. The same is the position for the investor. Thus, the project, from a commercial and bankable sense is a non-starter. Given this position, how to get started is a unique solution to the habitation, the life style of people, the trading, the tourism, the academic centres of excellence, etc., are all involved. If the habitation is essentially a trading centre, the cooperation of the population to be willing to pay is suspect and would be dependent on their market fortunes. Similarly if the habitation is essentially agriculture related, the monsoon patterns will influence the willingness to pay. If the habitation is essentially a centre of excellence in learning, a better understanding by the habitation can be expected. There are many such dimensions. Each situation needs to be appraised. Blindly copying the model from elsewhere will not work. Coming back to the raw sewage BOD, a realistic way will be to have a flexible PPP for various ranges of raw sewage BOD as it occurs.

3575 A classical case study is the venture to implement the zero liquid discharge of industrial effluent treatment of textile dyeing industries at Tripura. Among the many Common Effluent Treatment Plants (CETPs), some of them chose the PPP model with the Tamil Nadu Water Infrastructure Company Limited (TWICL) initiative and some of them chose the EPC model by investing from loans secured from banks. The project is still being refined in its technical infrastructure as constructed even after nearly 8 years, even though it was to be completed in 4 years. The reason

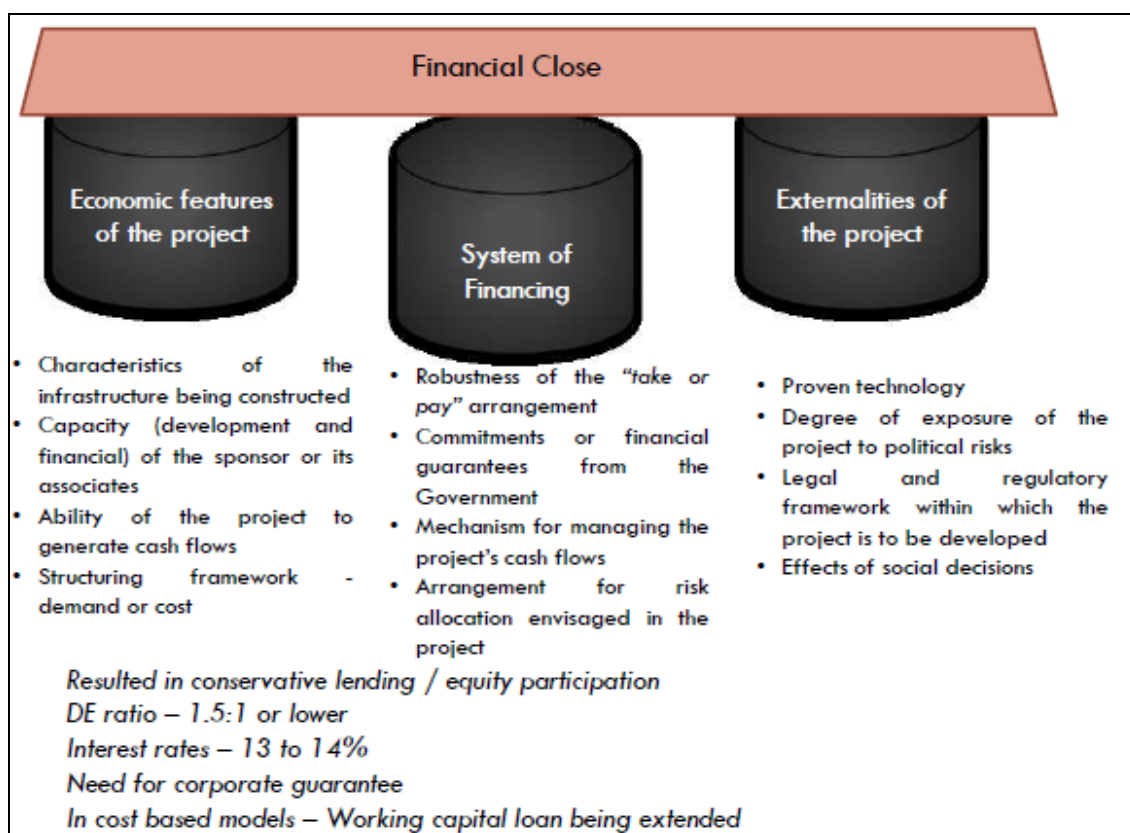
3580 here is not that the raw BOD was unknown. The raw effluent was very much there. The issue  
was the absence of proven technology. With no uniform technology, each contractor and CETP  
combine chose its own technology and discovered a few areas of need to refine the technology  
itself and reinstall different equipment. Obviously, contentious issues between the contractor  
and the CETPs have arisen and a resolution is pending; at the same time, the revisions are being  
3585 physically pursued. The key lessons in this case could have been (a) piloting instead of  
embarking based on surmises and assumptions or (b) at least erecting a parallel pilot plant to  
validate continually over a period of time. All the same, the fact remains that initiative and effort  
have to be recognized and complimented.

3590 Another successful case study is the PPP model seawater desalination plant at Chennai where a  
private party invested his funds for building India's first plant for supplying the drinking water  
to the Chennai city and the local agency has contracted to pay the contractor on a formula of  
fixed cost and variable cost and is working well. Though this is the first of its kind in India, the  
project is on stream from day one except of course some issues of seawater intake refinements  
which are fully understandable. The reason behind this success is that the technology of  
treatment is the same everywhere in the world for the chosen treatment process and there is a  
3595 compulsion for the local agency to buy and distribute the water to the public to sustain the  
public water supply.

### **6.13 ADDRESSING THE CONCERNS OF FUNDING INSTITUTIONS (FIS)/BANKS**

3600 Here again, it is not that PPP is a one stop solution for all the issues of sewerage sector. There  
are concerns of FIS/Banks which have been rather frankly brought out by the Infrastructure  
Development Corporation of Karnataka as in Table 6.7.

Table 6.7 Key concerns of FIs/banks



3605 Source: Infrastructure Development Corporation (Karnataka) Ltd., 2012

Recalling the above example of raw sewage BOD itself being uncertain, the “externalities to the project” being the “proven technology” is interesting. This is similar to the chicken and egg syndrome. Unless a new technology is implemented, there is no way it can be proven. Unless it is proven, there is no way to invest on it. All the same, new technology cannot be ignored. It is here that the PP has immense potential. The MOUD has appropriately brought out in March 2012, a publication titled “Recent Trends in Technologies in Sewerage System” which suggests the following:

3615 *“Other new technologies (listed under section 1.3 at page 4 of the note) which are not proven for municipal wastewater applications under Indian conditions, shall not be considered at large scale under EPC contract as the performance of the plants may not be guaranteed. Before any new technology is considered at large scale under EPC contract, pilot plants/ trial testing / demonstration plants (up to 3 MLD capacity for the technologies listed from Sl. 4 to 8 and up to 1 MLD capacity for the technologies listed at Sl. 9 & 10 under section 4 at Page 4) have to be set up and the same need to be evaluated by the State Govts/ULBs through IITs/NEERI/reputed Govt. Academic Institutions within a period of one year. Any of the aforesaid technologies set up already and functioning in any part of the country may also be considered for performance evaluation. However, based on the performance, STP at larger scale may be proposed under EPC contract/PPP model. In the meantime, if State Govts/ULBs intend to adopt other new technologies (listed from 5-8 under section 1.3 at page 4 of the note) at larger scale, these new technologies which have already been set up at large scale in India or elsewhere in the*

3630 *world and operated successfully may be considered under Build-Own-Operate-Transfer (BOOT) model in view of the fact that the part or full capital cost of construction of the plant based on new technology and its performance is guaranteed by the private firms and the annuity payment is linked with the performance of the plants. In regard to this, adequate provision shall be made in the BOOT agreement by ULBs. While inviting tenders on BOOT basis, all the available technologies may be considered.”*

This shows a way forward to avail of new technologies even under a PPP model to be funded by the FIs/Banks.

### 3635 **6.14 ENABLERS**

The set of enablers brought out by the Infrastructure Development Corporation of Karnataka and reproduced in Table 6.8 is to be duly evaluated for each PPP.

Table 6.8 Enablers to be duly appraised before a PPP is ventured into

<ul style="list-style-type: none"> <li>• <b>Public funding</b> <ul style="list-style-type: none"> <li>◦ Cost based models could be adopted for developing the projects</li> <li>◦ Could ease financing arrangements as the developers would need to raise working capital</li> </ul> </li> <li>• <b>Tariff determination</b> <ul style="list-style-type: none"> <li>◦ Tariff regime ranges from part of property tax / water charges</li> <li>◦ Could be levied separately as the beneficiaries and benefits can be identified</li> </ul> </li> <li>• <b>Setting up of a regulator for water supply and sanitation sector (pricing and service)</b></li> <li>• <b>Adequate project development activities prior to bidding</b></li> <li>• <b>Balanced sharing of risks</b></li> <li>• <b>Payment guarantee mechanism</b></li> <li>• <b>Allowing private partner to implement a technology of its choice</b></li> <li>• <b>Development of model contract documents</b></li> </ul>
--

3640 Source: Infrastructure Development Corporation (Karnataka) Ltd., 2012

### **6.15 KEY LEARNINGS FROM OTHER PPP PROJECTS**

3645 A compendium on Public Private Partnership in Urban Infrastructure -Case Studies- has been brought out by the CII-MOUD, with 7 cases of water supply and sewerage, 7 cases of solid waste management, 8 cases of urban transport, and 4 cases of miscellaneous, which identify the objectives and key learnings as under.

Possible objectives are improving governance, superior project delivery, improving quality of service, investment required, reducing tariffs, and reducing costs to government.

#### **a. Improve quality of supply and reduce cost**

3650 The objective of the SWM projects is to improve quality of supply and reduce costs, therefore there are penal clauses for non-conformance to Standards of Quality (SOQ) and the tipping fee

is the bid parameter.

**b. Achieving operating efficiency and improving service standards**

3655 The objective of PPP can also be achieving operating efficiency and improving service standards. The Latur management contract specified various service quality parameters as well as performance parameters for improvement of operating efficiency.

**c. Leveraging funds**

3660 The increasing urbanization and consequent stress on existing urban infrastructure needs huge investment by local authorities. PPP can be useful for leveraging the funds available with them. Haldia Water Treatment Plant project was envisaged with a need to reduce operating losses, to increase production and to enhance quality of water and services.

**d. Regulatory mechanism**

3665 The regulatory mechanism for the project might also have been prescribed by the concession or license agreements. The contractual agreement in the Chandrapur water supply project specified the water quality measurement system and penal provisions for deficiency in specified water quality parameters.

**e. Commercial viability**

3670 Viability analysis requires technical studies to determine the physical requirements of the project. Traffic or demand analysis is done in parallel so as to determine one component of the revenue stream. To make projects more PPP amenable, certain volume or capacity utilization is being guaranteed by the Government. The Chennai Metropolitan Water Supply & Sewerage Board entered into a Bulk Water Purchase Agreement, specifying 95% of the contracted capacity as the minimum quantity to be taken off.

**f. Tariff determination**

3675 Tariff determination, the other segment of the revenue stream could either be a bid parameter as it is in the water sector, determined ex ante to the bid as it is in the transportation case studies or determined by the Regulator. The tariffs could alternately be market determined and then neither the Regulator nor the Concession Agreement specifies the tariff; it is at the discretion of the Concessionaire in the case of the Commercial complex in Indore.

**g. Viability gap funding**

3680 In case of non-viable projects, the Government might need to pay operating or capital grant. This grant could be a capital grant under the VGF scheme or the JNNURM schemes. Several Water and Solid Waste management projects have availed the JNNURM grant of 35% from GOI. In the KMDA Salt Lake Water & Sewerage Project, the developer was given a capital subsidy of 35% of the project cost from JNNURM funds.

3685 **h. Institutional mechanism (SPC)**

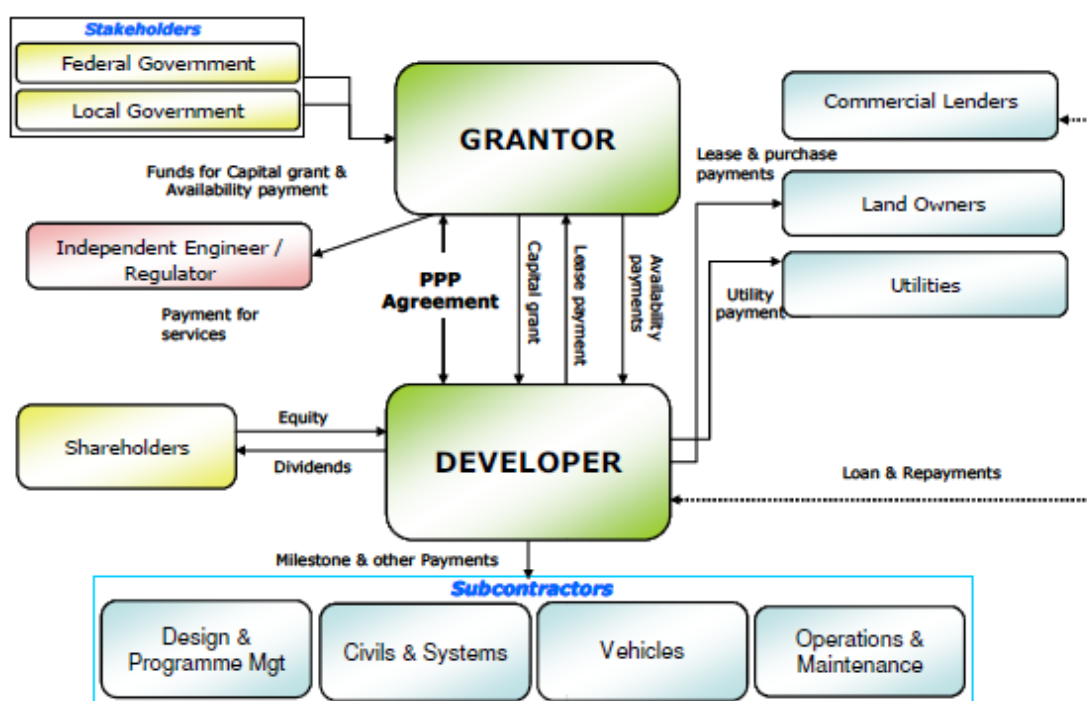
3690 The institutional mechanism for development of projects will be a special purpose company (SPC), either joint venture or non-for-profit organization. The SPC can be jointly formed by government, users and private developers. The SPC for Haldia Waste Management Facility was a joint venture between Haldia Development Authority (HDA) and Ramky Environ Engineers Ltd. The SPC for the Tripura water supply and sewerage project was jointly promoted by Tamil Nadu Water Infrastructure Company (concessionaire) and Tripura Exporters Association (users association).

### i. Capacity building

3695 Development of PPP projects requires capacity building of staff of local bodies. Even though  
 each sector of urban infrastructure will require specific skill set, the general understanding of  
 project structuring, contractual provisions and risk transfer can be utilized in each sector. The  
 Pune Municipal Corporation has started BOT cell for project development. BOT committee  
 takes decision about non-commercial and donation types of projects, while commercial projects  
 3700 are submitted to the appropriate authority (Standing Committee and/or general body of PMC)  
 for approval depending on project cost.

## 6.16 COMPLEXITIES OF FUNDING ARRANGEMENTS

A fairly well compiled depiction of funding arrangements for PPP models has been presented in  
 respect of rail PPP in India as shown in Figure 6.3. It needs to be recognized that funding of  
 3705 PPPs need careful and patient efforts to sustain the initiatives.



Source: Iain Menzies, Cledan Mandri-Perrott, 2009

Figure 6.3 Complexities of funding arrangements in PPP

## 6.17 SUMMARY

3710 The following summary can be made based on the discussion above.

- The decision as to whether private partnership is a viable option or not, or which solution will be the best for a specific utility can only be made on a case by case basis considering the technical, environmental and economic conditions.
- It is important to note that a private firm despite having better resources can function effectively only on a sensible economy of scale.
- A routine customer satisfaction survey may be necessary to reveal whether the majority of customers are willing to pay for improved services and if they want better value for their money.





## CHAPTER 7 COMMUNITY AWARENESS AND PARTICIPATION

3720

### 7.1 INTRODUCTION

According to the census of 2011, 12.6% urban households do not have access to toilets and defecate in the open. Only 300 out of 5,161 cities/towns have a sewerage network installed in the city. Only 21% of the total sewage generated is treated before disposal.

3725 The statistical figures above explain the status of the sanitation and sewerage sector in India, indicating its critical situation. With severe health and environmental impacts witnessed due to low coverage and service levels, the sewerage and sanitation sector in India has a long way to go before achieving the desired coverage and service levels.

3730 Community awareness and participation is the key to success for achieving 100% sanitation and to ensure personal hygiene in the community. A group of people living together with common interests and purpose may be called a community. There are certain common grounds amongst all the members and groups of any given community. These grounds are: locus, cast, creed, religion, customs, traditions, attitudes, gender, age group etc., because of these common interests. The local body can never be successful in urban sanitation without active community awareness and participation, whatever may be the investments made through municipal or

3735 Government funds.

The local bodies such as ward committees of municipality corporations, ward council of municipalities and Nagar Panchayats are the institutions of grass root democracy having elected members representing a small group of electorate. It also has an outreach service at the ward level through which it can easily interact with the people on almost all-important issues. The local body should therefore, seriously consider involving the community in all programmes through a consultative process and variety of other communication approaches dealt with in this chapter later, and adopt strategies which are acceptable to the community.

3740

3745 This chapter discusses the need for community awareness and participation for sanitation and sewerage services provided by the local body. It also covers various aspects that need to be considered to improve the community awareness and participation by involving individuals or voluntary organizations, and government agencies.

### 7.2 NEED FOR COMMUNITY AWARENESS AND PARTICIPATION

3750 The objective of a sanitation and sewerage agency is to provide safe, hygienic sanitation facilities and adequate sewage collection, treatment, and disposal services to improve public health at a reasonable cost. The residents must realize that the quality of life depends on how and what the sewerage utilities serve and that sewage collection and treatment is not a free service but a value added service with cost implications. Unfortunately, these services are most often considered to be free by the residents, and the sanitation and sewerage services providers

3755 do not enjoy the confidence of residents. This in turn fails to acquire a satisfactory level of support and participation from the residents. Hence, attention should be paid to community awareness and participation programmes.

3760 The objective of any community awareness and participation programme is to develop an understanding of the benefits of sewage collection, treatment and disposal, improved sanitary conditions, better user understanding and involvement in terms of time and money, and enhanced acceptability of this concept and organizational credibility.

On the other hand, the community has responsibility for participating willingly in community

3765 awareness and involvement programmes, understanding the significance of sewerage system to achieve sanitized community, and bring about behavioural changes aimed at adoption of healthy sanitation practices.

### 7.3 COMMUNITY AWARENESS PROGRAMME

3770 For the successful implementation of any programme involving the community at large in universal sanitation in urban areas, it is essential to spell out clearly and make known the manner in which the local body proposes to tackle the problem of urban sanitation and the extent to which community participation in urban sanitation is expected to make the city sanitized, healthy and liveable and improve the quality of life in the city.

The scope of the community awareness programme includes the following:

- 3775 a) Enable the community to understand the need for the sewerage system
- b) Enable the community to understand the need for proper sewage treatment and disposal
- c) Enable the community to participate in planning
- d) Enable the community to appreciate that this service is not free because it is valuable and has direct impact on health and living environment
- 3780 e) Enable the community to understand what they get (tangible/intangible, long term/short term benefits) in return
- f) Inform and obtain approval of the community for various improvement measures thus creating a feeling of close participation.

### 7.4 PROCESS OF BUILDING COMMUNITY AWARENESS AND INVOLVEMENT

3785 For developing community awareness and involvement, the appropriate opinion leaders such as community leaders, teachers, and the public at large should be identified. Efforts should also be made to involve the sanitation inspector and other staff of the local government as also the chief health officer. Communication material should preferably be prepared to suit the target audience: house owners, Residents Welfare Associations, Government organizations, 3790 Government aided organizations, Shulabh Sauchalayas, bus stands, railway stations, etc. The communication policy for this purpose should involve the elected civic body, Consumer Action Groups, Residents Welfare Associations, local NGOs, local community workers, and so on. The agency should try new and imaginative ways to involve local communities in its plans and programmes, and thereby provide the public its due pride of belongingness and involvement.

#### 3795 7.4.1 Defining the Concerned Local Community

The following points need to be considered for defining the concerned local community:

- a) Geographic and administrative boundaries
- b) Major media in the concerned locality (newspaper, radio/television, local speakers and town meetings)
- 3800 c) Residents (demographic and economic conditions)
- d) Stakeholders.

**7.4.2 Identifying Existing Local Community Contacts**

The following groups may be considered:

- 3805 a) Elected officials (Joint Council/Sub Committee/Ward Committee members of local body)
- b) Prominent civic leaders
- c) Clubs and associations (Chamber of Commerce, Consumer Service Committee consisting Consumer Association and Consumer Action Groups)
- d) Voluntary organizations, Residents Associations, etc.
- 3810 e) Industrial users
- f) Shopping areas
- g) Schools/Colleges/Institutions
- h) Professional bodies (Doctors, Lawyers, etc.)
- i) NGO, community based organizations.

**3815 7.4.3 Listing out Messages to be Communicated**

The following items may be included in the list of messages to be conveyed:

- a) Health impacts due to lack of sanitation
- b) Prevention of open defecation
- 3820 c) Status and needs of onsite sanitation and sewerage works (including twin-drain systems)
- d) Avail of sewer connection and avoid open air defecation
- e) Accept pay and use principle while using toilets in public places
- f) Change in policy and launching of new schemes (including incremental sewerage)
- 3825 g) Adoption of Citizen's Charter containing objectives, mission statement, facts about the organization, growth profile, achievements, commitments, major schemes to be implemented, service standards, assistance to residents, etc.
- h) Messages related to quality assurance
- i) Rehabilitation and repair works
- 3830 j) Functioning of information and facilitation counters, customer assistance, grievances handling and redressal system, feedback from community, vigilance committee, consumer service committee
- k) Billing and collection procedures/queries, tariff related issues, collection drives and special camps, levy of surcharge, reconciling of accounts
- l) Need for sewage treatment and reuse (Refer Section 7.10)
- 3835 m) Celebrations of national festivals, functions, Environment Day, World Water Day, etc.

- n) Elimination of manual intervention for cleaning of sewers and septic tank
- o) Appropriate septage dealing with according to the Septage Management regulations and guidelines
- 3840 p) Acceptance of payments to local body to sustain a septage management system
- q) Need for community participation for achieving total sanitation
- r) Need for Knowledge, Attitude, Practice, Study (KAPS).

#### 7.4.4 Selection of Communication Methods

3845 A variety of media and communication methods exist, each with its own advantages and disadvantages. The use of a combination of several media at the same time can reinforce the messages. Person to person contact carried out through community members, who are already convinced of the truth of the message, is usually the most effective means of communication. The following are some user friendly measures that could be effectively used in Community Awareness Programme for attaining complete transparency in operations.

##### 3850 a) Use of Print Media

Advertisements may be given in a planned manner to educate the masses and local newspapers can also be requested to insert the given messages on sewerage system at regular intervals. They should also be encouraged to start a regular Suggestion Box from where good ideas can be picked up by the local body.

3855 Newspapers may be especially encouraged to report on successful initiatives that have overcome problems in sewerage systems.

ULBs can also use newspaper delivery services by inserting handbills for readers in a particular locality to announce the start of campaign from time to time.

##### b) Use of TV/Cable TV/Radio/Web Site

3860 These are very powerful media and can be used through local programmes to inform the citizens of new sewage collection systems constructed by the local body as and when they become operational and advise them to participate effectively in the prescribed manner. Contact numbers of the concerned officials for problem solving or reporting of sewerage system grievances may also be publicized. These media may be used to publicize successful efforts in

3865 some localities to motivate other citizens to perform likewise and get similar recognition for their efforts.

##### c) Use of Cinema Halls

Slides in cinema theatres can be displayed to inform and motivate the public.

##### d) Street Plays, Puppet Shows, etc.

3870 Street plays and puppet shows play a significant role in bringing awareness among the people. This method of communication will work well in low-income population; more particularly in slums. Well-designed street plays/puppet shows can convey the messages effectively as such programs are well attended in slums.

##### e) Posters

3875 Attractive posters with good photographs and messages with a very few words, readable from a distance, should be prepared and displayed in various parts of the city where awareness

campaign is being taken up.

**f) Pamphlets**

3880 Pamphlets and hand bills can be printed giving instructions in very simple and understandable language showing photographs in action and circulated in the community requesting public participation.

**g) Use of Hoardings**

3885 Special hoardings may be put up at strategic locations in the city carrying messages seeking public participation. Alternatively, all municipal-licensed hoardings should have a space reserved at the bottom for civic messages. Such messages should be developed and painted by professional agencies. These hoardings should also carry the contact numbers, etc.

**h) Use of Public Transport System**

Brief messages can be painted on the rear of public buses or panels inside the bus. Public and private firms having their own bus fleets may be invited to support such efforts.

3890 **i) Communication through School Children and College Students**

3895 Children and college students are powerful communicators. Parents who do not listen to the advice of others often take their children seriously. Children are idealistic and would like to change their world for better. The ULB should hold regular meetings with principals, teachers and students to explain the need for change, and the usefulness to society of new ways to manage sewage. The message can be reinforced by holding essay, debate or drawing and painting competitions on the subject and publicizing the winning contestants. Social clubs can be encouraged to sponsor such events to keep the topic alive. The leading schools/colleges could be persuaded to work as a role model for other schools/colleges in taking up awareness campaigns in the city through their students, which should be highly publicized and other schools/colleges could be persuaded to follow suit (Figure 7.1).

3900



Source: MOEF

Figure 7.1 School children in public participation and awareness programme

**j) Primary School Curriculum to cover the Subject**

3905 It is an established fact that people form habit at a very young age and habits are hard to change. It is, therefore, necessary to educate young children when they are in primary school to form good habits related to sanitation and managing sewage (Figure 7.2). School curriculum should cover this aspect in the subject of moral science or social studies. Field visits for school children should be organized, with prior attention to safety, to water supply and sewage treatment plants

3910 so as to make them aware of the impacts of such facilities on the health of the human beings and

also for creating better environment. This will go a long way in developing an enlightened community and minimal efforts would be required to discipline the people in managing sewage.



Source: MOEF

3915 Figure 7.2 Shram Dan by school children in Vrindavan

**k) Involvement of National Cadet Corps (NCC), National Social Service (NSS) and Scouts**

In schools and colleges, the students participate in NCC, NSS and scout activities. These students could also be made aware of the public participatory aspect in urban sanitation and as part of their activities; they can be involved in the awareness campaign to bring about a change in public behaviour.

3920

**l) Involvement of Religious Leaders**

Religious leaders play a significant role in bringing about a change in the mind-set of the people. If they advise their devotees/disciples to keep their surroundings sanitized by not defecating in the open anywhere and by managing their sewage as advised by the urban local body, it will go a long way in improving the situation in the urban areas.

3925

**m) Involvement of Medical Practitioners**

Medical practitioners are held in high esteem by the citizens. A word from them to the patients or the community to practice appropriate sewage management at home, offices, shops and establishments would help substantially in bringing compliance with the directions of the urban local body to keep the city clean.

3930

**n) Involvement of Mahila Mandals/Women Associations**

Women are generally found more concerned in maintenance of health and hygiene and they are involved in domestic sewage management on day to day basis. The awareness among the women could be raised through Mahila Mandals/Women Associations who could be given talking points and necessary literature in a very simple understandable language/graphics for creating awareness among women.

3935

**o) Resident Associations**

All citizens want a clean and neat street, but they expect it to be maintained by the local body. The associations can play a vital role towards incremental sewerage being accepted by the population.

3940

**p) Voluntary Organizations/NGO involvement**

Many NGOs are committed to improve sanitation in urban areas to protect the environment and

3945 have been very active in this field. They have also developed good mass-communication skills and education programs for the public. Such NGOs may be persuaded to actively support the new strategies adopted by the local body and associate in public awareness campaigns. Those who wish to conduct programs for sections of the public on the new sewerage management strategies may be encouraged to do so and given necessary support.

**q) Corporate Social and Environmental Responsibility**

3950 Corporates have an obligation to the community to operate their businesses in a socially and environmentally responsible manner. Corporates recognise Corporate Social and Environmental Responsibility (CSER) as the continuing commitment by business to behave ethically and contribute to improving the quality of life of the local community and society. Corporates undertake to fulfil their CSER commitment by community participation in local programmes and funding activities, therefore, the awareness among the community could be effectively raised through the CSER.

**r) Door to Door Contact**

NGOs may be commissioned to do group messaging and door to door contact with special stakeholders like slum-dwellers, etc.

3960 **s) Provide Information over Hot-line**

The key to success of any public-education, awareness and motivation program is to provide as many ways as possible for the public to interact, as promptly and conveniently as possible, with policy-makers, to seek clarification of doubts, share ideas or give suggestions which are constructively followed up. A telephone hot line or post box number for written communications could be one of the ways to have inputs from members of the public. The phone must be attended during working hours by polite, responsive and dynamic persons who are well informed, interested in the subject and available at all stated times.

**7.4.5 Budget for Community Awareness Programme**

3970 The authorities should list out various aspects of public awareness programme as mentioned above and work out the costs for implementing the awareness programme. With proper evaluation and modifications if necessary, the programme can be a success. Further, a form of planning and reporting is needed to monitor and control public awareness activities.

**7.5 ACHIEVING COMMUNITY PARTICIPATION**

**7.5.1 Enabling Environment**

3975 Community participation is essential for making democratic processes effective and for strengthening them. It provides a platform to citizens to influence policy/program development and implementation. While various platforms and systems for citizens' participation have developed organically, there is a need to institutionalize them to make them effective and sustainable. The Model Community Participation Law aims to institutionalize such community participation platforms/systems.

**7.5.2 Community Participation Law**

The steps involved in drafting the CPL are:

3985 a) The State should decide on whether to provide a four-tier (with an intermediary/regional committee) or a three-tier (without the intermediary committee) structure for participation.

- 3990 b) The State should decide whether the provision would be restricted to certain types of ULBs. That is, the structure could depend on the size of the ULB. For example, the legislative provision for a three/four-tier structure could apply to ULBs with population of more than one lakh. The structure could be two-tiered (at city and ward levels) when the ward population is a manageable size.
- 3995 c) The legislation should provide the link between the different tiers, especially between an Area Sabha and a ward committee. This could be through the Area Sabha representatives, who may be either elected by the voters in the area or nominated by the ward councillor.
- 4000 d) The legislation should also specify the manner of selection of the Area Sabha representative and provide the voters the right to recall, if they are dissatisfied with their representative.
- 4005 e) The State should decide on the functions that it would devolve to the different tiers below the municipal level. The legislation should provide an activity mapping of functions under each tier.
- 4005 f) The legislation should provide for the responsibilities (based on the activity mapping) and powers of the different tiers.
- 4005 g) Finally, the legislation should also specify the role of the convener of the different tiers of participation, especially Area Sabha representative, chairperson of ward committee and zonal committee (if present).
- 4010 h) The rules specified under the law should spell out the guidelines for conducting the business of the different tiers specifying the process for arriving at the business agenda and resolutions and also provide for checks and balances for the optimal functioning of the different platforms.
- 4010 The outcomes and related measures are listed below:
- Resolution by the state governments on establishment of a three/four-tier municipal structure (the municipality, the ward committee and the Area Sabha) in the state along the footprint of the electoral polling station
    - Measure: Adherence to the timeline: six months from the signing of MoA.
  - 4015 • Introduction of interim participatory platforms mentioned above that will make way for the formal structures upon passing the law
    - Measure: Number of municipalities in a state with such platforms.
  - Devolution of functions
    - Measure: Number of functions devolved and role of the different tiers with respect to each of them.
  - 4020 • A report documenting the efforts, successes, and failures
    - Measure: Comprehensibility of the document.
  - Enactment of law
    - Measure: Extent of conformity with the spirit of the Model Law.
  - 4025 • Empowerment of the different tiers



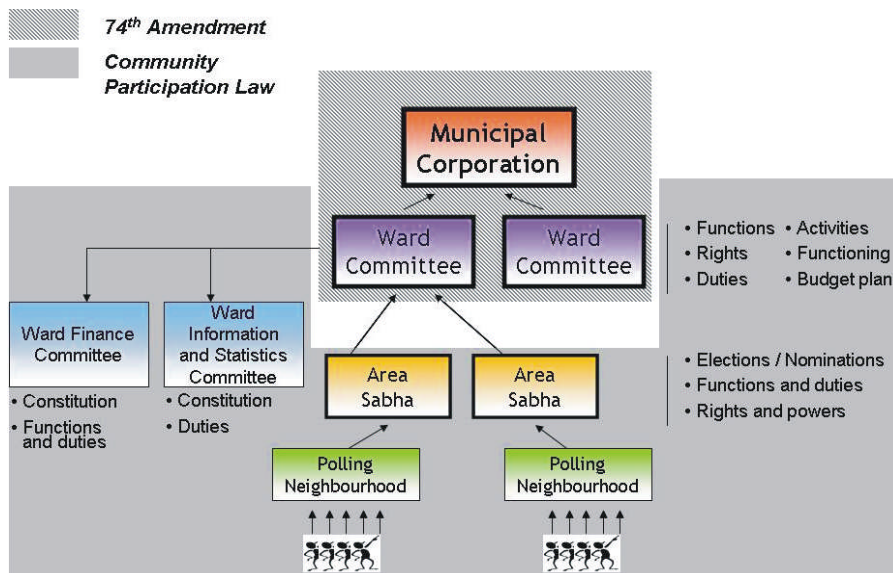
- Measure: Provision of funds and capacity building at the required tier(s).

The Model Community Participation Law (CPL) aims at:

- a) Strengthening municipal governments by:
  - Institutionalizing citizen participation
  - 4030 • Introducing the concept of Area Sabhas (consisting of all registered voters of a polling booth) in urban areas
- b) Involving citizens in municipal functions like setting priorities, budgeting provisions, exerting pressure for compliance of existing regulations, etc.

4035 JNNURM contemplates the creation of another tier of decision-making in the municipality which is below the ward-level, called the Area Sabha. All the Area Sabhas in a ward will be linked to the ward level ward committee through Area Sabha representatives, who will be community representatives. There will thus be a minimum of 3 tiers of decision-making in a municipality, namely, the municipality, the ward committee, and the Area Sabhas. In addition, states may choose to have an intermediary level for administrative reasons, clustering multiple  
4040 wards into a regional structure between the ward and the municipality. Figure 7.3 illustrates the structure of community participation.

The Model CPL is a mandatory reform under the JNNURM and it refers to making appropriate provisions in the state-level municipal statute(s) for the establishment of such a three/four tiered structure. The JNNURM makes it mandatory for States to either enact a separate Model CPL or  
4045 make appropriate amendments to their existing municipal laws. These enactments will need to ensure clear definition of functions, duties and powers of each of these tiers, and provide for appropriate devolution of funds, functions and functionaries to these levels.



Source: Centre for Civil Society, 2007

4050 Figure 7.3 Structure of community participation

If implemented in its true spirit it will have the following advantages:

- a) It will help deepen democracy, facilitate efficiency and sustained socio-economic growth and promote pro-poor initiatives.
- b) It will help in improving urban governance and service delivery.

- 4055 c) It will promote transparency and accountability in governance.
- d) It will improve the quality of the decisions made, as these would be based on knowledge of local realities and requirements.
- 4060 e) It has significance for regional planning structures like the District Planning Committee (DPC) and the Metropolitan Planning Committee (MPC) both of which require citizen participation in planning at the grassroots level.
- f) Citizens will have a say in determining how information is shared, policies are set, resources are used and plans/programs are implemented.

### **7.5.3 Reach the Community**

4065 The local body should formulate a sustainable incremental sewerage system among the various geographical wards of their jurisdiction as judged from the density of population, nature of land use and ability to pay for the O&M. This is a very difficult area of activity and unless this is done meticulously, desired results will not be achieved. The essential steps in this direction is to select representative samples of the community and go through a consultative process to ascertain the perceptions of the people about the services being given to them, their expectations and extent to which they are willing to support and participate in the process. Their choice of technological options available also needs to be ascertained. The consultative process could be taken up as described below.

4070

#### **7.5.3.1 Identification of Problems**

4075 Identification of problems of absence of sewerage through site visits and consultation with local population should be carried out at the time when the community is generally available for interaction. It may either be in early morning or late evening or better still on forenoon of Sundays in a local community hall. A brief hand-out in local language has to be delivered door to door in advance through newspaper distributors. Also brief presentations in local language should be made in local TV channels at prime time on Sundays by repeating two to three times before the above said meeting. The TV show must be more of visuals with voice in the background and not a person delivering a sort of sermon. The areas may be selected by following the method of drawl of representative samples. Situation analysis may be done by the persons who know the subject reasonably well, know the local language and can communicate with local population effectively. Such persons may be Non-Governmental Organizations, Community Based Organizations or knowledgeable individuals. They should try to find out the prevalent situation of sewerage in the area under observation and ascertain the perceptions of the people about the services provided. In this exercise the local councillors, local leaders, NGOs, etc., may be invited to participate.

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#### **7.5.3.2 Finding out Optional Solutions**

4090 Having identified the deficiencies in the system and known the public perceptions, the next essential step is to think of optional solutions to tackle the problems, work out the cost implications and level of public participation needed.

#### **7.5.3.3 Consult Community on Option Available**

4095 Having done this homework, there should be a second round of consultative process where the options worked out may be discussed with the community along with cost implications and their support required. Their suggestions may be sought on each solution proposed. The community may be encouraged to give their views freely. If we ask the people straight away the solutions of the problems, they may not be able to give right kind of suggestions as they have no exposure of various technological options. They must, therefore, be first appraised of the options available

4100 and then asked to give their considered opinion on what will work in their area and how much they are willing to cooperate.

#### 7.5.3.4 Work out the Strategy of Implementation

4105 After the consultative process, strategy for implementation of the system may be worked out and pilot demonstration projects may be taken up in the areas where enthusiasm is high, and the successes demonstrated to other areas and gradually implemented in rest of the areas of the city/town. It is desirable to implement the new program in a few areas to begin with, monitor its success carefully and extend the program to other areas thereafter with suitable modifications wherever necessary.

### 4110 7.6 FORMATION OF PUBLIC RELATIONS UNIT AND PUBLIC REDRESSAL SYSTEM

The following services may be offered under public relations information and facilitation:

- 4115 a) Registration and redressal of public complaints with feedback from complainant with the help of reply cards, and maintenance of suggestion books for residents to record their suggestions/remarks on the work done by the public relations counter and sewerage services provider
- b) Guidance to the residents for new sewer connections and assistance for connections
- c) Guidance to the residents for assessment of new sewer charges, sewer cess, name changes, annual value changes, classification changes and other tax and charge matters
- 4120 d) Guidance to the residents for meeting the concerned officer to make their representations and redressal of their grievances
- e) Supply of pamphlet on procedure related to complaint registration and redressal
- f) Obtaining feedback from residents related to redressal of their complaints/grievances
- 4125 g) Supply of Citizen's Charter to residents to offer knowledge about the service standards of the organization and assurances for adherence to such service standards
- h) Creation of single window system for redressal of grievances
- 4130 i) A separate telephone line should be available round the clock to record complaints and address them.
- j) Define service failure and service recovery measures like guarantee.

### 7.7 COURTEOUS BEHAVIOUR OF PUBLIC RELATIONS STAFF

4135 Since public relation staff and field staff serve as an interface between the community and the sewerage agency, they should be properly trained. Courteous behaviour towards the community by the public relation staff will give a better image of the utility to the community. Since first impressions are very important and last longer, it is necessary to impress the citizen at the very first contact itself. Public relations staff should follow simple guidelines while answering telephone calls from consumers to create a positive image in the minds of citizens.

4140 It would be important to mention here that courteous behaviour of the community towards the public relation staff is also expected to properly communicate their messages to the public

relation staff.

### 7.7.1 Suggested Guidelines for Answering Calls

The following key points should be considered when answering calls:

- 4145 a) The staff attending the telephone should answer the call promptly (by the third or fourth ring).
- b) The person picking up the call should identify himself/herself.
- c) The person taking the call should not conduct conversation on the side and should give full attention to the caller to avoid repetition of names, addresses, etc.
- 4150 d) The person taking the call should not transfer the calls to other concerned officers unless necessary.
- e) A complaint number should be given to every complaint of complainant for easy identification.

### 7.7.2 Answering Consumer Enquiries

The person taking the call at the Public Relations Counter should:

- 4155 a) Be familiar with the services and policies of the utility
- b) Learn to listen and try not to interrupt the caller
- c) Avoid technical jargon/unnecessary high sounding terms while talking to the caller
- d) Summarise the caller's problem and repeat it to the caller for confirmation
- e) Make every effort to take specific action on the caller's complaint.

## 4160 7.8 CONTINUAL INTERACTION WITH THE COMMUNITY

A community participation task is not a one-time task. It is CONTINUAL. It needs to be jointly reviewed in time and appropriate adjustments, both physical and financial, need to be made. The incremental sanitation concept is ideal for implementation in developing countries and especially in India where the population even within the great urban compass is vastly differing in its resources to pay for the services. In most of India, the economically weaker sections consume virtually 30% or a little higher of the resources of services but their ability to pay the real cost is far from affordability. Thus, the underlying factor in community dialogue is to make everybody realize how the cross subsidy system is in place and how the affordable have an obligation to subsidize the less fortunate and also how the less fortunate should not grudge the relatively better services availed by the affordable except in regard to the quality of piped water delivered which should be the same irrespective of affordability. Thus, community participation is not a vehicle to impose the proposals on the community but it is in fact a vehicle which does promote classification of levels of service deliveries with differences in extending it like individual toilets or to share the public toilets. The secret is not to insult the less fortunate but to take them along by proper explanations while at the same time exhibiting a willingness to listen and concede whenever feasible.

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## 7.9 NEED FOR ENFORCEMENT

While all efforts should be made to educate the people to effectively participate in the management of sewage, they also need to be told that they can be punished if they fail to discharge their civic duties. The provision of penalties may be made known to the people and

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details of those punished should be publicized widely to deter others. The enforcement should begin at the public places, market places, etc., and gradually extended to cover residential areas.

### 7.10 CHANGE IN PUBLIC BEHAVIOUR RELATED TO REUSE

4185 Everyone is concerned with the growing problems of wastage of fresh water by a ‘once use and throw away’ type habit. After all fresh water is already becoming scarce. Also indiscriminate discharge of untreated or partly treated sewage in flowing rivers and much less dry river courses is already threatening a serious water pollution of fresh water sources for drinking itself. The fate of the Ganga river basin has been documented in Part A of the Manual in Figure 5.42 and Figure 5.43. The circumstances are alarming. This increases the burden on local bodies to deal with the problem of supplying safe drinking water to the public. The public are forced to pay high costs for bottled water and sometimes such water does not have the minimum needed minerals, etc.

The following measures are therefore proposed to be taken to encourage reuse and recycling of sewage by all concerned:

- 4195 • All industries which have a significant demand of water for non-human contact type of usage such as cooling water, quenching water in steel rolling mills, etc., should come forward to reuse the recovered water from local sewerage scheme
- 4200 • In turn, the local body should permit these industries to discharge their reject waters at about a TDS of 2100 mg/l into the downstream sewers and help the industries.
- The watering of road median lawns, road washing, and public transport chassis washing, etc., should be only by appropriately treated sewage
- 4205 • The development of social forestry in barren lands of local body should be encouraged on a public private partnership model whereby the land is given on long lease and treated sewage is given at a reasonable cost for the private entrepreneur to develop commercially viable forestry and harvest it by himself.

### 7.11 SUMMARY

4210 To achieve 100% sanitation in the community is one such activity where community awareness and participation is the key to success. The local body can never be successful in urban sanitation without active community awareness and participation, whatever may be the investments made through municipal or Government funds.

4215 For the successful implementation of any programme involving community at large in universal sanitation in urban areas, various aspects need to be considered to improve the community awareness and participation by involving individuals or voluntary organizations and government agencies, such as the scope of the community awareness programme, the process of building community awareness and involvement, enabling environment and Model Community Participation Law, formation of public relations unit and public redressal system, and courteous behaviour of public relations staff; these topics have been discussed.

4220 A community awareness and participation task is not a one-time task, and it is continual. It needs to be jointly reviewed from time to time and appropriate adjustments, both physical and financial, need to be made to make it effective and sustainable. The secret is to invoke technologies of scale that are sustainable within the revenues of ULBs and not blindly following inappropriate models.



## 4225 CHAPTER 8 ASSET MANAGEMENT

### 8.1 INTRODUCTION

4230 A water and wastewater utility has certain unique characteristics when compared to other utilities in terms of the size of its asset base and the ‘capital intensity’ of its operations. These utilities are often faced with the problem of ageing pipe networks and the associated increasing costs. Recent studies undertaken in the UK, Australia and USA have shown that water utilities need to make substantial investments in capital maintenance projects, involving renewal of existing assets, to enhance the capabilities of the assets to maintain existing service levels and to meet any new or improved service requirements.

4235 ‘Asset Management’ comes to the fore when making decisions related to asset operations and maintenance in order to provide quality services at low cost to consumers whilst maintaining and protecting the environment. Asset management of water and wastewater networks is an approach which allows the asset base to be managed in a way which ensures that future investments deliver maximum benefit for customers and service providers. Though asset management of these networks is largely concerned with determining capital maintenance investment strategies and achieving the lowest lifecycle cost is one of its key objectives, it is not restricted to just capital maintenance investment planning. Ideally, it also covers the whole of the asset life cycle including design, procurement, operation and reinforcement of assets. Asset management is a way of thinking that considers capital, operations, maintenance, repair, renewal and replacement as investment decisions. Asset management has the ability to

4240 optimally allocate capital and operational expenditure to achieve short-term value and long-term sustainability.

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4250 *“Asset management is a combination of management, financial, economic, engineering and other practices applied to (physical) assets with the objective of maximising the value derived from an asset stock over the whole lifecycle, within the context of delivering appropriate levels of service to customers, communities and the environment and at an acceptable level of risk.”*

The three key elements of asset management are ‘adequate/appropriate service levels’, ‘cost effective’ and ‘risk’. Asset management can be summarised as “the art of balancing performance, cost and risk. Achieving this balance requires support from three pillars of competence: management, engineering and information” (Brown and Humphrey).

4255 Following are the benefits of the asset management as listed by the USEPA ([http://water.epa.gov/infrastructure/sustain/asset\\_management.cfm](http://water.epa.gov/infrastructure/sustain/asset_management.cfm)):

- Prolonging asset life and aiding in rehabilitation, repair and replacement decision through efficient and focused operation and maintenance
- Meeting consumer demands with focus on system sustainability
- 4260 • Setting rates based on sound operational and financial planning
- Budgeting focused on activities critical to sustain
- Meeting service expectations and regulatory requirements
- Improving responses to emergencies
- Improving the security and safety of assets
- 4265 • Reducing excess costs for both operation and capital expenditure

- Maintaining desired level of services

4270 In this chapter the need for AM, basic concept of AM, asset documentation, periodical asset assessment, AM for sewage treatment plants, pumping stations, and sewers is briefly explained. Model to start with for Indian sewerage AM is introduced. In addition, review of practices in Japan is given in Appendix 8.1.

## 8.2 NEED FOR ASSET MANAGEMENT

4275 The underlying infrastructure required to deliver quality water and wastewater services to all are the pipe networks and the supporting treatment and pumping systems. In practice, the physical infrastructure assets created in urban areas have generally been deteriorating due to inadequate attention and/or improper operation and maintenance. Little effort has been made either to manage these assets efficiently. Maintenance activities are typically reactive wherein maintenance is only resorted to when there is a very obvious breakdown in the service. Such a strategy eventually results in even greater infrastructure deterioration and yet more frequent extended breakdowns in the existing poor levels of service.

4280 The fixed assets form the core of the service offer but similarly, little effort has been made to achieve self-sustainability of those services. Water and wastewater utilities in the country cannot generate sufficient revenue from consumers when tariffs are set so far below the operating costs of service provision.

4285 Due to the rapid increase in the urban population the priority of the utility managers has been to increase the service coverage by installing new infrastructure. The fiscal flows to the sector have also laid emphasis only on the creation of new physical assets. Under the existing system, wherein there is already a financial deficit, this need for a large amount of capital would possibly result in further deferred maintenance towards the existing older assets. With the present shortfalls in revenue and the resultant lack of planned maintenance activities, the challenge of maintaining the functional sustainability of the service becomes increasingly difficult.

4290 The performance study carried out by CPCB (2006) on 115 STPs indicated that only 72% of capacity of STPs could be utilised. The performance was also reported to be poor.

As for Sewage Treatment Plants and Pumping Stations, following failures have been reported.

- 4295
- Mechanical and electrical equipment were out of order; mechanical screen, pumps, pre-treatment units, mechanical grit removal system, sludge-handling facilities, flow measuring devices
  - Concrete facilities in some parts, such as digesters were damaged.

4300 Aging pipe defects are also reported which causing cave-ins on roads, Pipe defects are caused due to the following:

- Pipe joints allow water and soil to leak through. The inflow of soil not only causes the sewer to silt but also weakens the pipe bedding due to loss of soil around the pipe.
  - Hydrogen sulphide induced corrosion in sewer crown weakens pipes and causes cracks to develop in the pipes.
  - Bricks of manhole are cracked and groundwater infiltrates into the sewer.
- 4305

To address the goal of maintaining sustainable water and wastewater services, infrastructure asset management has been developed and is being used as a tool for maintaining serviceability



4310 because it promotes the sustainable use of the physical assets and environmental resources by a systematic process (NAMS and IPWEA, 2001).

### 8.3 BASIC CONCEPT OF ASSET MANAGEMENT

4315 A statutory asset management procedure is not seen in the sewerage sector in India and each local administration seems to find its own ways of managing assets. Asset management is the art of balancing performance cost and risk. AM nowadays is a series of organisational strategies, activities and systematic and coordinated practice by which an organisation manages its infrastructure rationally. It requires competencies in three fundamental areas of knowledge: management (financial, economic and organisational), engineering, and information.

In order to implement AM, there are five key questions that need to be answered.

- What are the current conditions of my infrastructure?

4320 The answer requires making an inventory of the existing physical assets and assessing their condition and their current value, taking into account their expected remaining useful life and replacement cost.

- What level of performance can I expect from my infrastructure?

4325 The answer requires an understanding of the performance objectives of each stakeholder, of legal and contractual requirements and of current levels of performance.

- In my current system, what are the most critical components that will safeguard my required performance in a sustainable manner?

4330 This requires analysis including knowing under what circumstances failures occur, how they occur and with what probability. It is also necessary to understand the costs of repair and to assess the consequences of each mode of failure.

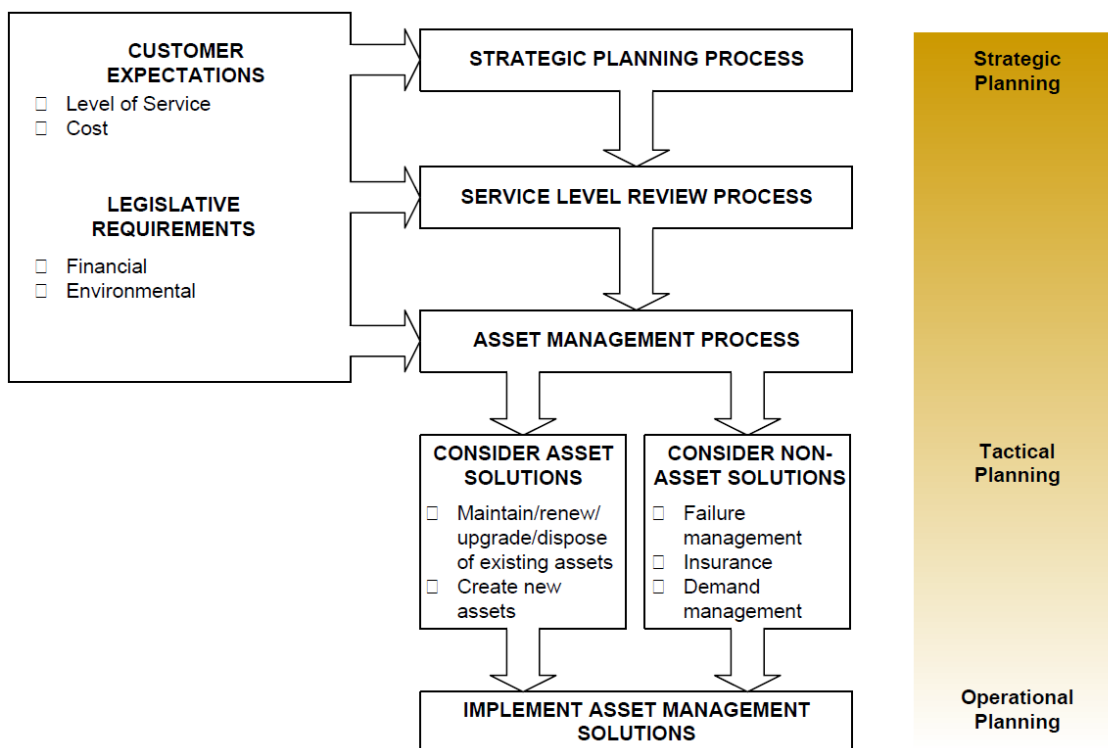
- What are the minimum costs over the lifecycle that I will have to allow for?

4335 It is necessary to identify the main direct and indirect costs to budget for, and to estimate their respective amounts. It must also be borne in mind that operation and maintenance costs may not be constant over the life cycle because the probability of some forms of failure increases with the age of the asset. This AM strategic implementation phase involves identifying current investment, operation and maintenance practices and analysing the most viable alternative management options for the organisation in question.

- What is the best long-term investment strategy to adopt?

4340 Answering this question requires investment planning and identifying how to finance it (Alegre, 2009).

In addition, as shown in Figure 8.1, AM can be an integrated process of decision-making, planning and control over the acquisition, use, safeguarding and disposal of assets to maximise their service delivery potential and benefits in response to community needs, and to minimise their related risks and costs over their entire life.



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Source: Municipal Indaba, 2008

Figure 8.1 Schematic diagram of asset management

#### 8.4 ASSET MANAGEMENT FOR SEWAGE TREATMENT PLANT AND PUMPING STATION

4350 Sewage treatment plants and pumping stations have a large number of assets such as civil structures, electrical and mechanical machinery, which are called above-ground assets because of their location relative to the ground surface. Asset management practices which are brought to bear on above-ground assets are distinct from the asset management practices utilized for underground asset management, mainly because physical inspection of these assets and therefore, assessment of their condition and performance is possible. Not only are above ground assets which are predominantly mechanical and electrical equipment more visible, they are likely to have much shorter asset lives.

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The AM for equipment of STPs and pumping stations proceeds as follows:

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- Preparation of a database on STP equipment, inspection data, repair data and failure data
- Setting the criteria by which plant managers can easily know a suitable time for replacing or improving aging facilities at their STPs. Plant Managers can also refer to Table A8.1-2 and also Figure A8.1-7.
- Making a scenario of repair and replacement of equipment
- 4365 Selecting optimal scenario to decide priority projects so as to minimize risks.
- Drawing up of mid- and long-term financial plans for securing project funds.

## 8.5 ASSET MANAGEMENT FOR SEWER

4370 The underground sewer network constitutes about 70-80% of an average sewerage utility – requiring high initial investment with subsequent network maintenance which are extremely necessary for sustainability of the service.

Asset Management for sewer is as follows:

- a) Preparation of a database on sewers, road sinkhole, and pictures from CCTV cameras to understand the present condition of sewers and compilation of this data
- 4375 b) Drawing up mid- and long-term maintenance plans for deciding priority projects so as to minimize risks.
- c) Drawing up mid- and long-term financial plans for securing project funds.

## 8.6 MODEL TO START WITH FOR INDIAN SEWERAGE AM

To start with, the asset documentation must cover the following:

### a. Asset documentation in Indian sewerage situation

4380 First of all, it is very difficult to ascertain the asset's condition due to the following reasons:

- i) The sewer pipelines are laid underground.
- ii) Assets are generally created or laid over a long period of time.
- iii) The records of the assets may be old, incomplete, inaccurate or missing.
- 4385 iv) Due to the labour intensive O&M, historical knowledge about the assets may be inadequate.

To document the assets, the following steps may be taken:

- i) The staff and officers who were involved in construction and O&M should be interviewed
- ii) The engineering drawings of the assets should be digitized.
- 4390 iii) Physical/visual observations of the “above-ground” and visible assets should be made
- iv) Interview selected long term residents to cross check the maps
- v) Match the on-road manholes with the records to record additions, if any
- vi) Allocate an alpha-numeric code to components to retrieve details on software
- 4395 vii) Interact with ISRO and use GIS to update the computerized data.

### b. Condition of the assets

The condition of the assets should be physically checked and recorded by a separate team. This will specifically tell about how long the equipment can be expected to serve without renewals.

### c. Organizing the asset inventory

4400 There are many options to record the data on asset inventory:

- i) Hand written inventory

- ii) Commercial software for recording asset inventory
- iii) Generic data base software
- iv) Spreadsheets.

4405 The best option is specifically designed asset management software which will be very flexible in recording the asset data and retrieving the reports depending upon the requirements. However, such software is costly. The generic database software is inexpensive but requires time and commitment to set up the database for input of data and generation of reports. The spreadsheet and hand written inventories may be considered temporary solutions.

4410 **d. GIS**

The GIS contains a graphical representation of the location of sewerage assets belonging to a number of sewerage asset classes, especially:

- Sewers
- Manholes

4415 Enterprise asset management (EAM) solutions help utilities improve asset performance and tracking. The asset management component of GIS software gives user-friendly access to tracking, locating, and managing assets. It also creates:

- consolidated view of operations and increases information
- availability across the organization.

4420 Once these are finished, an asset register can be developed with the following:

- i) Cost of construction/purchase cost
- ii) Other details of the asset (if pipeline, the material of the pipe such as CI/DI/Stoneware, etc.)
- iii) Date of commissioning
- iv) Location of the asset
- v) Additions to the asset (Example: Adding one more screen)
- vi) Major repairs of capital nature
- vii) Deletions to the asset (Example: Demolishing unused room, etc.)
- viii) Rate of depreciation (It will vary for each category of asset)

- ix) Year-wise depreciation
- x) Value after depreciation
- xi) Date of disposal
- xii) Value of disposal
- xiii) Scrap value

4435 **e. Capital maintenance cost of the assets**

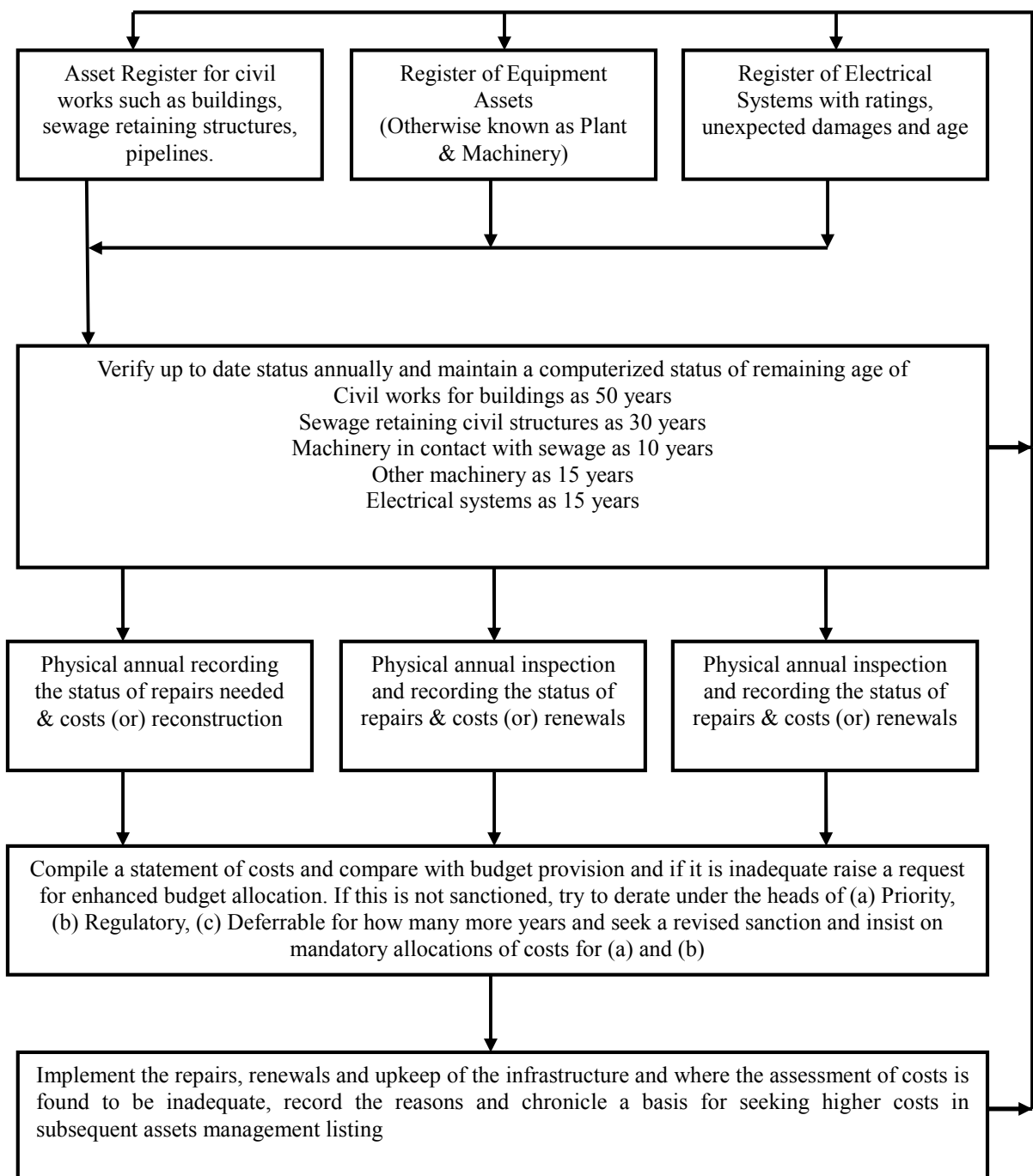
This is perhaps the greatest challenge and has to be compiled essentially from personal enquiries and records and built up step by step.

To estimate the cost of replacement, the following may be adopted:

- 4440
- i) If the utility had recent improvements, such as pipe replacement/renewal/repair, the cost per linear foot of the pipe can be used.
  - ii) The cost obtained from sister organisations may be used for similar projects.
  - iii) The estimates prepared in the recent past for similar projects may also be used.
  - iv) The standard rates may be adopted for preparation of estimates.

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Once these are compiled, the balance sheets for capital works and O&M can be built up step by step as shown in Figure 8.2 and Figure 8.3 which present an elementary model to start the AM documentation to suit Indian sewerage systems.

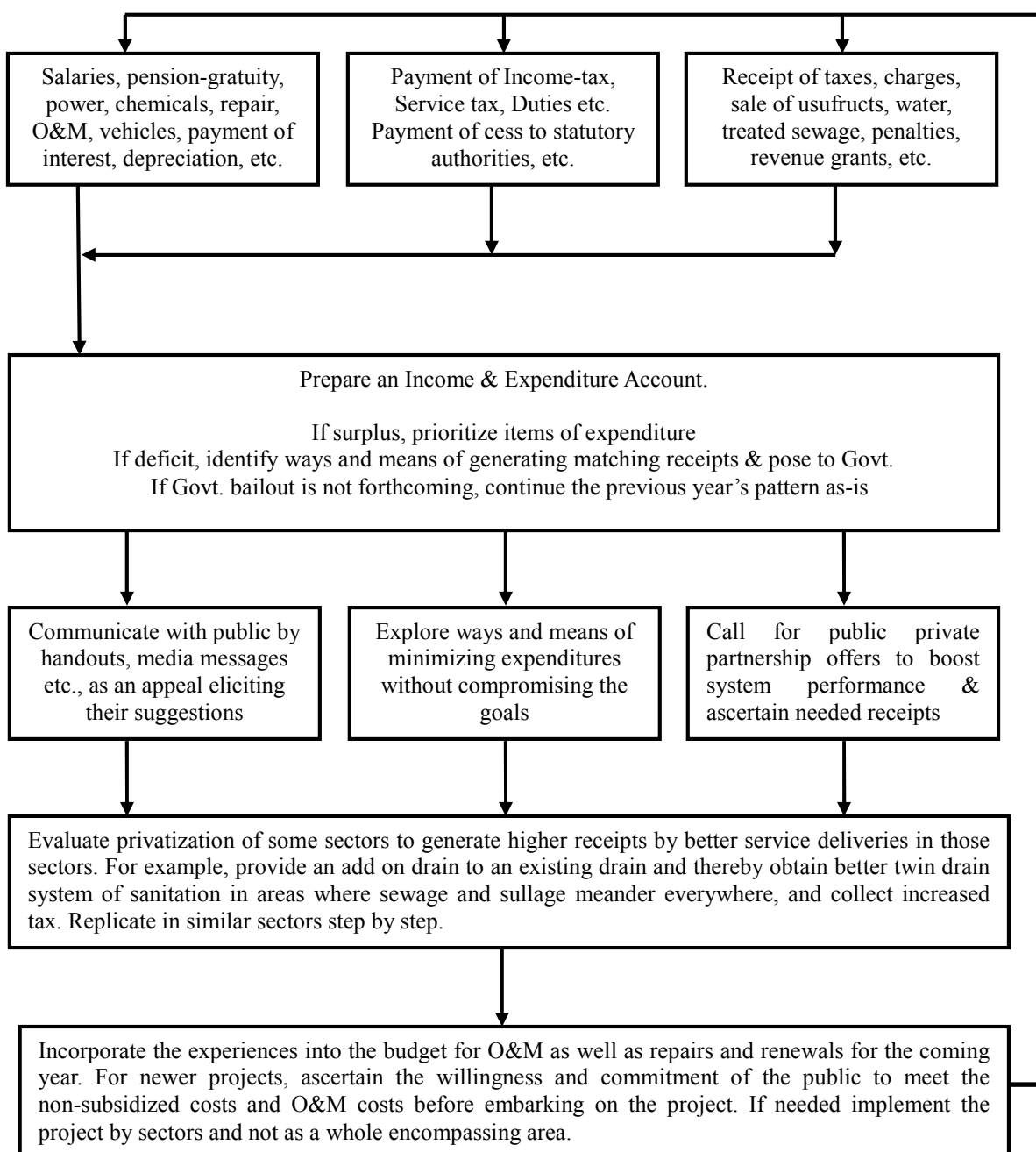


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Note: All departments do maintain their own registers of infrastructure work components but mostly, budget allocations for repairs; renewals, etc., are based on the previous year's allocation. This does not account for the life cycle and the need for increased budget in a given year if the particular infrastructure component is due for renewal by a new one. The above system will help in establishing a realistic claim. It is advisable to renew equipment as whole units. For example, a compressor is better taken as compressor, motor, suction & delivery piping & valves all together.

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Figure 8.2 Simplified sewerage asset management for the infrastructure



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Note: Sometimes, the annual budget is in deficit and even deposits in the banks are foreclosed once in a while to meet expenditures. Due to this the routine maintenance goes to the back bench and only emergency maintenance is done to avoid criticism by public. It is necessary that sub cost centres are identified and user charges revised to cover the expenditure such as salaries, power, chemicals, repairs & maintenance, operation of vehicles, interest and depreciation. The consumers should be made to understand that a healthy public utility organization alone can provide a quality service to the people. For example, a decentralized sewerage and incremental sewerage along with differential tariff of tax and charge for these areas will make the exercise easier to manage and slowly making surplus in revenue.

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Figure 8.3 Simplified sewerage asset management in O&M and seed money

## 8.7 ASSET DOCUMENTATION AND DISCLOSURE

4475 Customers are not only beneficiaries of sewerage services but also main players because they are tariff payers and users of sewer connections. Accountability to local residents needs to be satisfied using stock management method that regards new construction, maintenance and reconstruction and rehabilitation as one process. Therefore, public involvement is needed as follows:

- 4480 • Strategic planning process of AM: When the service level of AM plan such as level of service and cost is decided, customer involvement is necessary. After completing AM, documentation should be disclosed to the public by internet, information bulletin or relevant counter at the city hall.
- Service level review process of AM: When AM plan is assessed, public involvement is necessary. After assessing AM plan, documentation should be disclosed by Internet, information bulletin or relevant counter at the city hall.

4485 For public official, the documentation enables easy communication with the users.

## 8.8 PERIODICAL ASSET ASSESSMENT

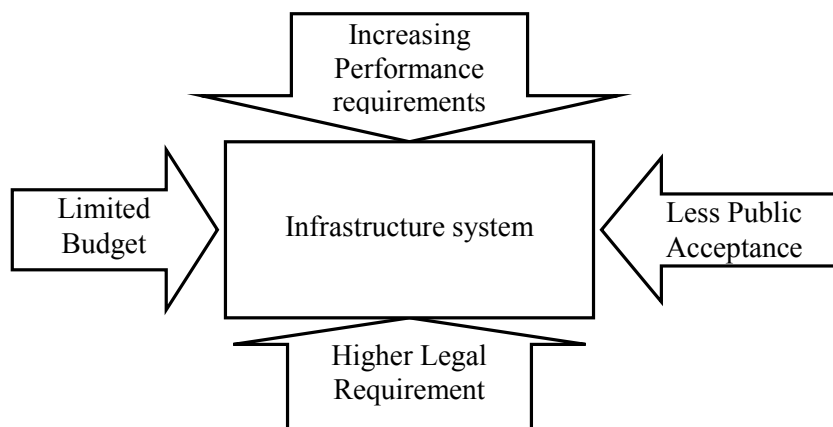
4490 AM is a long (middle) term plan and based on many assumption. It is necessary periodically to check and assess the progress of the plan on the basis of plan-do-check-act principle. If there is some deviation, the AM plan needs to be modified by the cause analysis. In addition, periodical asset assessment is essential to cope with the social needs and changes toward sewage works. Since drawn-up AM plan is based on assumption such as asset risk and estimation of necessary budget, periodical review and fine-tuning of the plan is necessary.

## 8.9 FINANCIAL ASPECT

4495 In the financial sense, asset management is the optimization of finances like stocks, bonds and derivatives in the face of threats from expected risks and expected good from profits. In sewerage, a major part of expenditure is on O&M. The proper operational asset management deals with existing assets of hardware such as pipes, pump sets, civil works, equipment, etc. Thus, maintaining these assets in a trim condition results in efficient functioning of sewerage systems to a level that is satisfactory to the public. If people are satisfied, the tariff can be increased and they will pay willingly. Therefore, asset management in infrastructure must focus on life cycle assessment of equipment, following the preventive maintenance and re-ordering level where needed. The financial asset management shall ensure adequate fund flows at stated times. An easy way to understand the asset management in its financial, human resources, satisfied public and finances is shown in Figure 8.4 and Figure 8.5.

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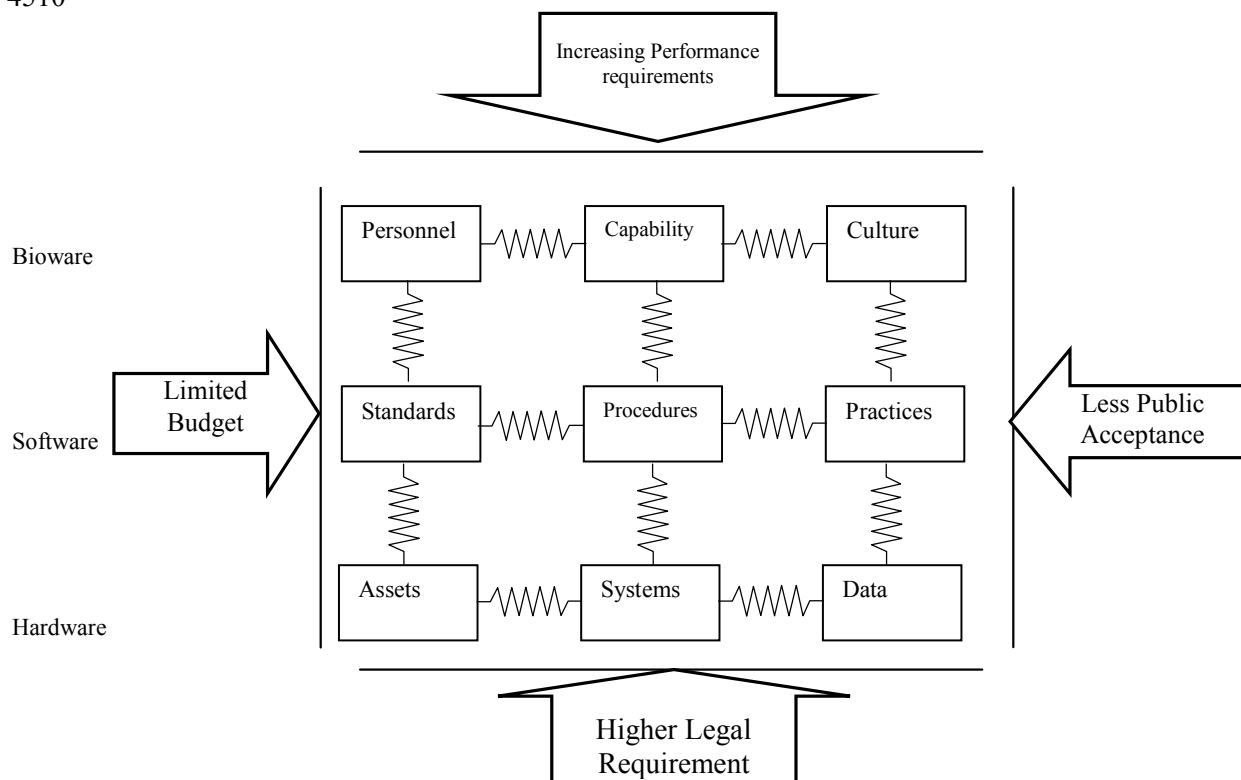




Source: Ype C. Wijnia

Figure 8.4 Depiction of forces acting on infrastructure assets and the directions of their impacts as opposing each other

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Source: Ype C. Wijnia

Figure 8.5 Depiction of mass spring example of response of assets to forces when one or more are altered and final equilibrium

4515 Figure 8.4 illustrates that the infrastructure system which can be conceived as sewerage in this case are always responding to the four-sided compression of (a) limited budget, (b) performance requirements, (c) less public acceptance and (d) higher legal requirements like staff, salaries, etc. If all these act at the same time, the system has to collapse and if one of them increases the pressure, the other three should have the ability to be resilient for the system to remain stable. If  
 4520 this resilience is not there, the shape of the rectangle will be altered and the system may respond

without any control. For simplicity, let us consider a situation described below.

#### Cause

- A sewage pumping station has worn out pump set and sewage stagnates all the time in sewers and back flows on roads in the mornings.

#### 4525 Responses of the system

- The immediate effect is less public acceptance.
- The next is higher legal requirements as people may go to the court of law.
- The next is increasing performance requirements as directed by the court.
- The limiting factor is the restricted budget; this necessitates temporary repair for the system to go on.

4530

The next time the defect occurs, even the temporary repair may not be possible and replacements will be needed incurring higher expenditure. Figure 8.5 illustrates the situation of the sewerage system in a dynamic state. If there is slack in the springs it will readjust and become stable. In this case, the slack is to be reconciled as the following.

#### 4535 Hardware

- The availability of spare parts, critical spares and if possible, a standby pump set which could be fitted in a short time (or) a standby pump set which can be operated.

#### Software

- The availability of reserve funds and emergency power to operate it and human resources trained to implement these measures. This is referred to as software because they can be “programmed” and people “trained”.

4540

#### Bioware

- The personnel habits, the work culture and capability to respond are matters of intuition and are not fully guided by mathematics or logic or procedural regulations. This is a method by which the system and the human resources act together.

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It may thus be recognized that asset management between financial allocations, training human resources and standardizing the re-order level procurements are all required to act at the same time.

#### 4550 **8.10 SUMMARY**

- Occurrence of asset failures of sewerage system in India is not uncommon. AM is a suitable management system for not only improving performance of a sewerage system but ensuring sustainability of the sanitation service provided. Many utilities in India have very little information about the assets they own and how they are performing. The creation of a database containing information about physical assets and their locations is therefore a fundamental starting point for asset management and gradually building it up with the data regarding asset condition and performance is required for its effective implementation.

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## CHAPTER 9 MANAGEMENT INFORMATION SYSTEM

### 4560 9.1 INTRODUCTION

The efficient and effective performance of an agency depends on a clear relationship between management activities such as planning, organisation, selection and training of staff coordination, direction and control of the functions of the agency. The interaction between the individuals at different management levels, together with use of information in the decision making process, is important to the agency's performance. Each of the management levels has different centres of decision and each of these is supported by an information system.

4565 Management Information System (MIS) is defined as a formal system of making available to the management accurate, timely, sufficient, and relevant information to facilitate the decision making process and to enable the organisation to carry out the specific functions effectively and efficiently in tune with organisation's objectives. Organisations have many information systems serving at different levels and functions within the organisation. The data fed into the MIS initially is internal data and later data from other institutions such as from community and others can also be fed. Each agency has to decide as to which information is relevant and then evolve its own procedures for accurate collection, measurement, recording, storage and retrieval of data.

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4575 The MIS can be developed either by manual data collection or by use of software.

### 9.2 NEED FOR MIS

The Central and State governments are massive organisations with many departments and a very large number of people under their employment. These organisations need to function efficiently through proper communications and should have quick access to accurate information at all times so that decisions can be made quickly and appropriately. A management information system is indispensable for accomplishing these tasks.

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Urban local bodies require a comprehensive information system for planning, management and de-centralised governance in the context of implementation of the 74th Constitution Amendment Act. A management information system will support spatial requirements of urban planning and help the ULBs to develop town level urban databases. The spatial and attribute databases will be useful for preparation of Master/Development plans, detailed town planning schemes, and will also serve as decision support for e-governance.

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### 9.3 MIS IN SEWERAGE SYSTEM

In order to make an effective MIS for sewerage, it is necessary to identify the potential sources of data in every functional area and create reports needed by all users irrespective of their proficiency in data processing. The following are the main/sub systems of a water supply organisation from which the reports for MIS can be generated.

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#### 9.3.1 Financial Management Information System

The system may include information related to Financial Accounting such as:

- 4595
- Payroll
  - Revenue management
  - General ledger
  - Accounting
  - Funds

**4600 9.3.2 Project Management Information System**

This system may include information relevant to Engineering Planning and Design such as:

- Construction
- Contracts and monitoring

**9.3.3 Human Resources Management Information System**

- 4605
- Manpower planning and recruitment
  - Personnel development and training

**9.3.4 Material Management Information System**

- Purchasing
- Inventory control

**4610 9.3.5 Operation and Maintenance Management Information System**

- Operation
- Maintenance

**9.3.6 Marketing Management Information System**

- 4615
- Customer information
  - Demand forecasting
  - Market planning

**9.3.7 Renewal and Repair Alerts System**

- Sewers
  - Pumping stations
- 4620
- Sewage treatment plants

**9.3.8 Violations of Discharge Quality of Sewage onto Public Water Bodies and Land**

The system should include the parameters listed below. It should be updated weekly and be freely accessible to the public.

- 4625
- STP effluent quality
  - Effluent discharge standards

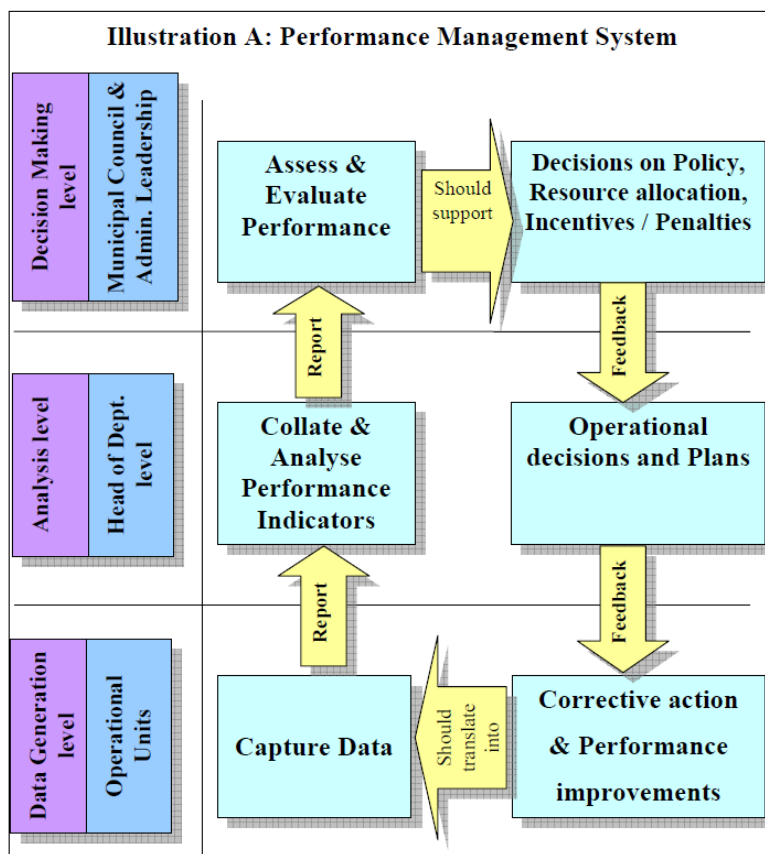
**9.3.9 Financial Health Status of the Local Body**

This system should include the following parameters and need to be updated on weekly basis.

- Revenue
- 4630
- Expenditure

### 9.4 MANAGEMENT INDICATORS

4635 Data captured through the MIS should provide management indicators for decision making. The results of actions by managers at the strategic, tactical and operational level are measured by management/performance indicators. These indicators represent a situation, an event or a change brought about by an action aimed at achieving a target set by the agency. These indicators allow the management to set targets, monitor the O&M, evaluate the performance of the agency and take necessary decisions and corrective actions.



Measuring service levels of civic agencies implies measuring outcomes, and thereby indirectly also reflects on institutional capacity, financial performance and other parameters. Service level parameters can be measured either from a utility manager's / planner's perspective or from a citizen's or consumer's perspective. Further, to facilitate comparison between cities / service delivery jurisdictions, and changes in performance over time, it is important that the performance levels are benchmarked, and monitored against those benchmarks.

Source: MOUD, 2011

4640 Figure 9.1 Performance management system

#### 9.4.1 Overcoming the Limitations

4645 Performance indicators (PIs) can be considered as a management tool to evaluate the degree of an undertaking's efficiency and effectiveness. Efficiency is the extent to which the resources of an undertaking are utilized to provide the services, for instance, maximizing service delivery by the minimum use of available resources. Effectiveness is the extent to which declared or imposed objectives, such as levels of services, are achieved. PIs can also be used for quantitative comparative assessment of performance. This quantitative comparison can be conducted between undertakings, or historically within an undertaking comparing the past and

present or actual performance against predefined targets.

4650 In India, every sector has indicators and the following limitations are observed:

- Different sets of performance indicators have different initiatives
- The definition or the assessment method may vary for the same performance indicator, thus inhibiting inter-city or intra-city comparisons.
- Most measurement exercises have been externally driven by (by agencies external to the agency responsible for delivery against those performance parameters), leading to the key issue of ownership of performance report.
- Most performance measurement initiatives have not been institutionalised, limiting the benefits of monitoring trends in performance over time.
- The process of performance measurement has not been taken forward into performance management (Figure 9.1).

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4660

MOUD issued handbook on Service Level Benchmark. In handbook, indicators of 4 sectors: water supply, sewage, solid waste management, and stormwater drainage, are set with specific definition. These minimum performance parameters are commonly understood and used by all stakeholders. Depending on the specific needs, additional performance parameters can be defined and used. Measuring service level of civic agencies implies measuring outcomes, and indirectly also reflects on institutional capacity, financial performance and other parameters. Service level parameters can be measured either from a utility manager's/planner's perspective or from a citizen's or consumer's perspective. In addition, to facilitate comparison between cities/service delivery jurisdictions, and changes in performance over time, it is important that the performance levels are benchmarked, and monitored against those benchmarks. Performance indicators of MOUD are given in the Appendix 9.1.

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International Water Association (IWA) developed PIs for water supply services and published "Performance Indicators for Water Supply Services" in 2000, and sewerage services namely "Performance Indicators for Wastewater Services" in 2003, respectively. These are presented in the Appendix. The International Organization for Standardization (ISO) developed international standards for activities related to drinking water and sewerage services and published the "Guidelines for the Assessment and for the Improvement of the Service to Users: ISO 24510", the "Guidelines for the Management of Wastewater Utilities and for the Assessment of Wastewater Services: ISO 24511" and the "Guidelines for the Management of Drinking Water Utilities and for the Assessment of Drinking Water Services: ISO 24512" in 2007. ISO24500s are guidelines for evaluation of entire sewerage services, and their aim is to enhance the efficiency of undertakings and services. PIs used for evaluation are key factors.

4685

Performance of an undertaking can be evaluated from various aspects and sewerage services are composed of numerous complicated activities. Therefore, a number of PIs have been developed and made available. Sewerage services in different countries have different histories, and they have different roles. Therefore, selection of proper PIs for each undertaking is most desirable.

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In the Japanese national guideline namely "Guideline for Improving O&M of Wastewater Systems," published in 2007 by the Japan Sewage Works Association, PIs are composed of Context Information (CI) for undertaking, system and district, Performance Indicators (PI) for operation, users, services, management, environment and References. Example of CIs and PIs are shown in Appendix 9.2.

### 9.4.2 Use of Indicators

4695 Performance indicators and the information generated thereon can be the basis for the decision making process involving determining targets, deciding priorities, drafting schedules of O&M, assigning responsibilities and distribution of human, material and financial resources. In the planning process these indicators provide the basis for preparing long-term, medium-term or short-term plans with appropriate finances allocated in the budgets. These performance indicators provide a measure of what has been achieved so that the results can be evaluated and disparities corrected. Based on the results, the targets and indicators need to be changed so as to be nearer to reality. Some of the uses of these indicators are:

- 4700 a) Maintenance information can be used to assess changes in conditions of installations and equipment and to identify potential problems such as weaknesses of structure, reliability of equipment or obsolete equipment and also to determine how long the facilities can function usefully.
- 4705 b) The maintenance activities can be reformulated to achieve maximum yield at minimum cost.
- 4710 c) The data can be used for preparation of the budget. The best justification for the next year's budget is an accurate record of the previous year's activities, costs, workload, growth and production. Similarly, the records on use of spares and materials and performance of equipment can be used to document the importance of the programme and get adequate financial support.
- 4715 d) The trend in the agency's workload can indicate where the workload has increased or where the performance has deteriorated requiring more staff.
- 4720 e) The need for new equipment can also be justified while preparing the budget. Age is not necessarily the only factor for replacing the equipment. Record on production, use and cost of maintenance to keep the equipment operational may also substantiate the need for replacement.
- 4725 f) The review should bring out need for buying new equipment. Additional equipment (including safety equipment) may become necessary from a review of the performance either due to hiring of staff or the need for developing equipment for a specific purpose.
- g) The review should provide an assessment of what spares, and consumables are required for the next year/future.
- h) The review can also bring out the need for economy, for hiring external specialised agency or hiring additional staff for attending to routine or breakdown maintenance or repair work.
- i) The indicators can be used to measure productivity, reduction in breakdowns or frequency of breakdowns linked to productivity levels so as to achieve reasonable level of maintenance with minimum cost.

4730 Each agency has to choose appropriate methods for evaluating effectiveness in achieving the O&M objectives.

### 9.4.3 Information Systems Division

Information system department comprises a group of information specialists, programmers and system analysts.

4735 **9.4.4 Technology**

Appropriate technology with hardware and software is adopted.

**9.4.5 Environment**

The environment includes the external specialists, hardware and software vendors, consultants, competitors and Government.

4740 **9.5 APPLICATION OF MIS IN INDIA**

There has been considerable progress towards use of information technology and electronic media in the dispensation of water and sewerage services and their administration in India. Some of the examples are cited here.

**9.5.1 Case Study of Bangalore**

4745 The Bangalore water supply and sewerage systems have grown enormously since the last four decades. In order to handle such a large system with large volume of geographical information, it was imperative to develop and give decision makers a powerful management and decision making tool.

**a) Objectives**

- 4750
- To provide interactive access to up-to-date network and geographical information for operation and maintenance purpose
  - To provide a planning tool to enable the acquisition of new and replaced mains
  - To provide accurate and comprehensive network information for monitoring, reporting, decision making and data consolidation
- 4755
- To allow the integration of geographical information from different sources and scales, both internal and external
  - To provide a widely available asset management system
  - To set up a pilot repository spatial dataset for the Bangalore Water Supply and Sewerage Board.

4760 **b) Environment**

- (i) Head Office: One Server with 5 PIII workstations, One Plotter, Scanner and A3 Colour Printer, with software such as ArcInfo 8.1, Arc SDE (Spatial Database Engine), ArcView 8.0 ArcPress and Oracle 8i RDBMS
- 4765 (ii) Divisional offices: One Server with 2 PIII workstations and A3 Printer, with software such as Arcview 3.1 and Oracle RDBMS
- (iii) Service Stations: One Desktop PC with Printer

**c) Development of total GIS solution**

- 4770 (i) Total GIS solution developed for Bangalore includes seven applications: Asset management, Water Supply Management, Sewerage Management, Water Quality Management, Consumer Management, Billing System, and Employee Management.
- (ii) Area covered: 290 km<sup>2</sup> (entire jurisdiction area of BWSSB)

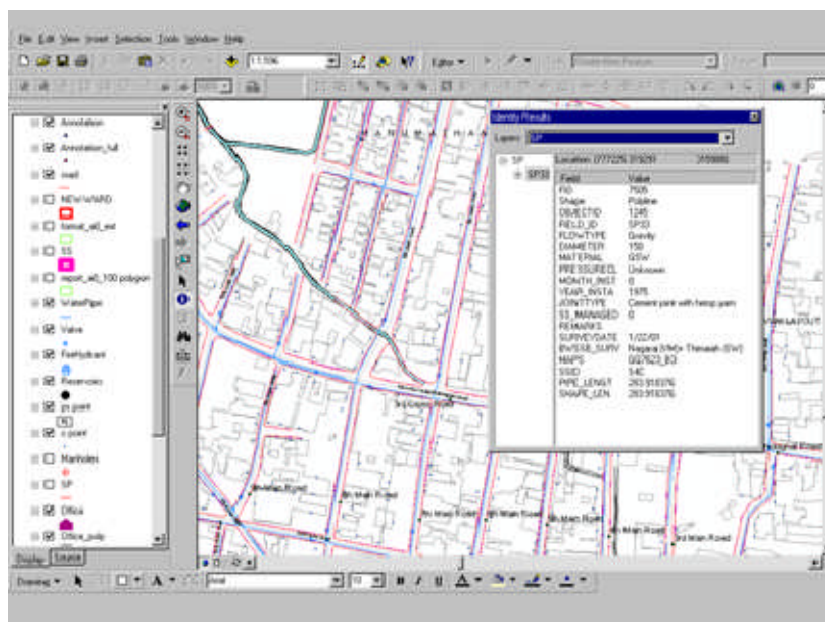


- (iii) Base maps: Digital vector data and maps based on aerial photography provided by Remote Sensing Agency (NRSA), Hyderabad in 1:2000 scale
- 4775 (iv) Road Network and Road Names
- (v) Base map of Buildings, Green area & Landmarks
- (vi) Consumers
- (vii) Location of Service Stations
- (viii) Details of water supply network
- 4780 (ix) Details of sewer network (Figure 9.2)
- (x) Location of BWSSB Offices
- (xi) Attributes of water and sewer networks.

#### d) Facilitating complaint management and maintenance work

4785 The system is designed to cater to the need for addressing complaints related to the water and sewage networks. The output from the system enables:

- Quick identification of location from the digital map
  - Better appreciation of the problem as a holistic view of the network area is available
  - Connectivity with service stations provides speedy implementation of corrective action.
  - A database of all interactions is maintained and this serves as an input for periodic analysis and decision making at the apex level.
- 4790



Source: BWSSB

4795 Figure 9.2 Sewer networks showing detailed attributes of sewers



Source: BWSSB

Figure 9.3 Management indicator panel

4800 The software for service level benchmark on sewerage and sanitation services is available at the MOUD site ([www.urbanindia.nic.in](http://www.urbanindia.nic.in)).

A complaint redressal and monitoring system should be established so that complaints can be registered by several methods such as: Making a toll-free number available for picking up complaints, receiving complaints through SMS, making a Complaint Book available at relevant  
 4805 locations, and/or providing an online web form to receive complaints and making public the link to this web form. This website could be designed to send auto-generated complaint numbers to the complainant's email ID to enable the complainant to check what action has been taken and also the complaint status from time to time. The management should monitor the Complaint Book and the web forms regularly to ensure that the complaints are addressed promptly and  
 4810 appropriately.

### 9.5.2 Use of Enterprise Resource Planning in Chennai

MIS can also be focussed towards user/public friendlier system especially in the most important aspect of billing and collection. The Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB) has successfully deployed such a system by starting a pilot system and since  
 4815 covering its full jurisdiction as follows:

An online billing and collection was taken up initially at one of the ten Area offices and its 19 depot offices and financial accounting section in the Head office and store accounting office. The payments made are immediately updated in the central server at the Head office and the reports could be generated either at Area office, stores or Head office. These areas have been  
 4820 connected through leased telephone lines with the Head office server. All the financial accounting systems were integrated using Oracle Enterprise Resource Planning (ERP) and various stages of bill processing and payments of bills were also integrated through LAN at Head office. Online complaints monitoring system has also been implemented in Head office, Area office and its depot offices. Between Head office and Area office, VSNL and BSNL lines

4825 and between Area office and depot offices ISDN lines were installed. After gaining knowledge  
in the pilot project, the same was replicated in all other 9 Area offices and respective depot  
offices. All the billing and collection records were migrated to the Oracle ERP system.  
Grievances with regard to water tax and charge are also received online from the consumers and  
are redressed immediately. Complaints monitoring system under the Oracle ERP system is  
4830 established to escalate the complaint to the next higher officer automatically if the complaint is  
not addressed within the specified time limit. Hence the senior officers would view the  
complaints. All the stores have been interlinked with the Central Server at Head office using  
Oracle Inventory module which enables them to know the availability of the stock position (age  
wise analysis, ABC analysis, etc.) and purchases can be planned accordingly. All the bill passing  
4835 sections such as supplies, contract and expenses at the Area offices and the Head office have  
been interlinked using the Oracle ERP system-accounts payable module. Apart from this, the  
assets conversion details can be known using Oracle assets module. More importantly, all the  
tender documents, schedules and drawings are uploaded in Government Tender Portal site  
periodically. The prospective suppliers and the contractors can download the tender documents  
4840 from the web site free of cost.

### 9.5.2.1 Governance and Service Delivery Improvements

The following service delivery improvements have been achieved:

- 4845 a) Due to interconnectivity, the consumers can pay at any of the 161 collection points  
or any Area offices, Head office irrespective of the location of the property of the  
consumer.
- b) The outstanding dues of the consumers in respect of water supply charges and taxes  
can be viewed at any place and also on the board's website.
- c) Besides cash, cheque, demand draft, credit cards, VISA/Master cards can be used  
to make payment of water taxes and charges.
- 4850 d) Procedures such as billing, collection, complaints, tendering are simplified and can  
be easily monitored.
- e) More accountability and transparency in operation
- f) Reduced paper work and stage of bill could be monitored at any time.

4855 This is a case which has rendered higher operational efficiency, user friendliness and most  
importantly, transparency. The software used in this system is also being upgraded continually.

### 9.5.3 Use of ABACUS by Kerala Water Authority

The Kerala Water Authority (KWA) jurisdiction is state wide. The KWA together with the  
National Informatics Centre has implemented a comprehensive online application for MIS  
support for billing and revenue applications as well as consumer services called the ABACUS  
4860 (Advanced Billing and Collection Utility System) to develop an effective MIS system for billing  
and revenue collection and to provide consumer services.

The ABACUS utility supports a comprehensive customer database with facilities online  
updating, billing and revenue receipts information, reading sheet prints, centralized billing for  
local bodies, and centralized billing for water tankers, monitoring of meter reading routes,  
4865 disaggregated data on revenue and customer parameters, billing for faulty meters, and consumer  
ledger for revenue receipts. The ABACUS also supports a database on meter replacement,  
service line alteration and consumer category change, disconnection, reconnection, etc.  
Consumers can view and print information related to their transactions.

### 9.5.3.1 Governance and Service Delivery Improvements

4870 The following service delivery improvements have been achieved:

- a) Online tracking of consumer history
- b) Revenue collection enhanced
- c) Effective revenue monitoring and control
- d) Checking of unauthorized consumption
- 4875 e) Mapping of supplied and billed quantity
- f) Improved consumer satisfaction level
- g) To be integrated with e-payment gateway
- h) To be integrated with the Customer Complaint Redressal System module

### 9.5.4 Use of TULANA for Service Level Benchmarking

4880 The Directorate of Municipal Administration, Government of Karnataka, designed and developed the online application software, TULANA, to objectively assess the service level performance of urban local bodies across the State. This application has become an important decision making tool for investments and identification of priority areas. This is implemented as the service level benchmarking tool by way of an information technology web server, application server and database server and software application tool named as TULANA with the objectives of (a) standardized criteria for service level measurement by Urban Local Bodies and (b) decision making on resource allocation to be based on indicator values for service levels.

4890 Standardized systems were not in place to measure the performance of the investments in terms of service improvement. To rationalize decision making on allocation of resources, it was decided to introduce a standard online performance tracking tool for ULB performance. Key sectors covering water supply, wastewater/sanitation, solid waste management, roads and street lights, disease control and development of parks and gardens and finances were covered. 'TULANA' was developed as online application software and monitoring tool for service level benchmarking.

#### 9.5.4.1 Implementation

4900 TULANA was conceptualized as an online application covering key service sectors to rationalize decision making, improve accountability and transparency, allocate resources in an equitable and efficient manner, prioritize investments/development plans and encourage competitive spirit by comparison. The key features included web based application, facility to capture data online from 213 ULBs, inbuilt data validation, generation of MIS reports, inbuilt formula and automated ranking generation based on indicator results.

#### 9.5.4.2 Agency for Implementation

4905 The Centre for Performance Measurement in 2004-5 is housed in the City Managers Association with Advisory & Resource Panel. Indicators were finalized for each sector and criteria for evaluation of performance of a ULB based on a weightage system against each indicator and scoring assigned. Ranking follows from the scoring. This exercise is carried out quarterly and annually.

**9.5.4.3 State Support**

- 4910 a) Support on technical and performance related queries of ULBs
- b) Data collection templates, user manual, technical manual
- c) Pilot testing and development of online application
- d) Protocol for access and authentication of data (user ID and password, authentication system)
- 4915 e) Training on the use of web based application
- f) Provisional report released - modified before final report.

**9.5.4.4 Governance and Service Delivery Improvements**

- a) Enthusiastic participation of all ULBs in service level monitoring
- b) Monitoring of participation of ULBs as well as performance standards
- 4920 c) Data used to make decisions on allocation of resources and performance of investments
- d) Integrates decision maker, database and ULB performance
- e) Standardization of procedures and processes in reporting across ULBs.

**9.5.5 Mobile Phone Technology based MIS in Rajkot**

- 4925 The Rajkot municipal corporation has deployed a mobile phone technology, a fully automatic service which retrieves data from a live server and for Short Messaging Services, in which a GSM MODEM is used. In practice, weekly monitoring of requests and complaints ensured that they would be resolved within 72 hours. On sending an SMS, the citizen receives relevant information on the mobile phone on transactions related to payments, and receives an alert
- 4930 acknowledging the payment. Further officials receive daily income/expenditure statements and are able to monitor service and information requests, complaints, etc.

**9.5.5.1 Governance and Service Delivery Improvements**

- a) Single point communication 24/7
- b) Hassle free complaint registration and status notification
- 4935 c) Lesser response time, reduced search time
- d) Search time for service is reduced
- e) Reduced queuing up - 200 to 20 a day
- f) Elimination of middle men
- g) Equal quality of service regardless of social or economic status
- 4940 h) Cheapest transaction cost (as low as 1 paisa/transaction)

**9.5.6 Other Such Notable Initiatives**

Among the other such initiatives, the following are cited here:

- GIS and Hydraulic Modelling for a Pilot 24/7 Water Supply in Amravati

- Water Supply Distribution & Monitoring System by Nagpur Municipal Corporation
- 4945 • Online Water Quality Monitoring System by Surat Municipal Corporation
- Providing Installing, Integrating and Automation with PLC/SCADA of existing WTP and ESR by Pimpri Chinchwad Municipal Corporation.

## 9.6 APPLICATION OF INFORMATION TECHNOLOGY IN SEWERAGE – THE JAPANESE EXPERIENCE

4950 Advances in information technology are a worldwide trend. This wave of change will involve not only municipalities and companies but also homes. Information technologies have improved surprisingly in recent years. Several factors, such as social demand for advancement and higher incomes, have spurred a global tide of advanced information systems.

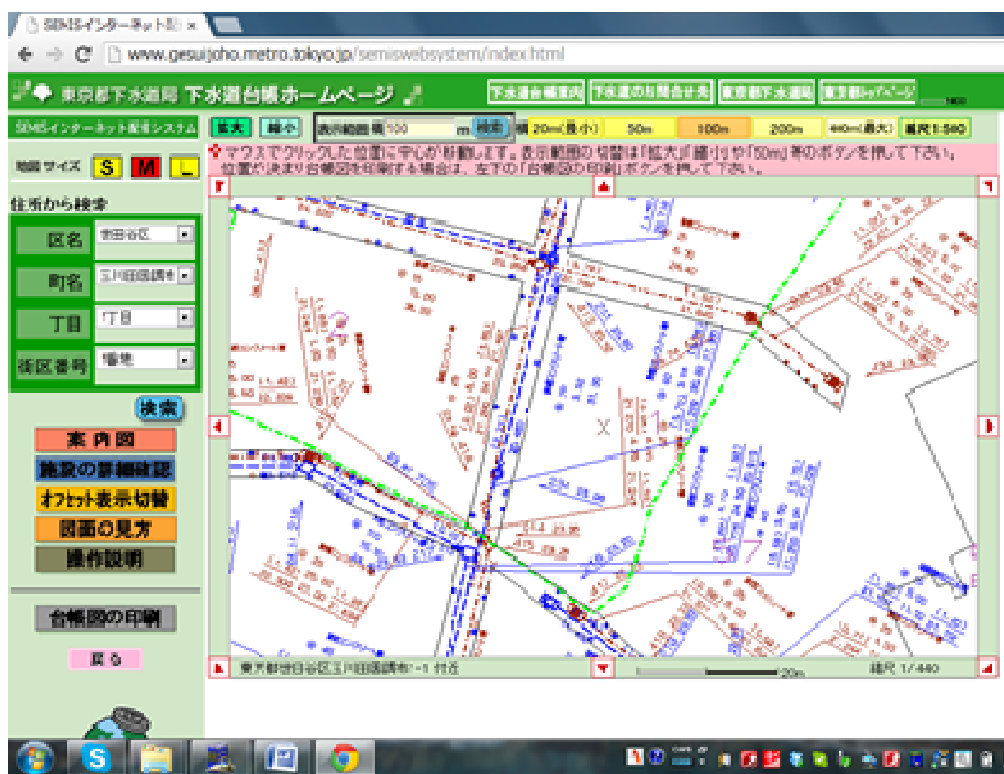
4955 Japan has been employing information technology and many other kinds of advanced technology to facilitate work in the sewage treatment plants, sewers and pumping stations. The salient features of some of technologies are mentioned here briefly.

### 9.6.1 Sewerage Mapping and Information System in Bureau of Sewerage, Tokyo Metropolitan Government

4960 The Tokyo Bureau of Sewerage introduced the Sewerage Mapping and Information System (SEMIS) using information technologies to administer the large number of drawings collected from its growing sewage infrastructure in 1985. The Bureau introduced the Tokyo Advanced Information Management System (TAIMS), a SEMIS-based system in 2009 that allows required personnel to access all sewage pipe information.

4965 SEMIS is a geographic information system (GIS) that brings information from sewage facilities into a unified database for management purposes. The database consists of configuration, attribute and image information. Configuration information consists of facilities data and topographic data, attribute information consists of more than 90 data categories such as pipe diameter, material, year of installation and land manager name, and image information consists of finished drawings and structural drawings for specialized manholes.

4970 A variety of output functions are available to manipulate this information, including configuration search, filing, construction records, standard drawing release, aggregation and SXF data output (a CAD data exchange standard). The configuration search function includes conditional display, upflow/downflow tracking, flow rate measurement, vertical/horizontal view creation and extended area calculation, which has contributed to more efficient planning and  
4975 design. It is therefore a GIS that can aggregate and consolidate all kinds of information.



Source: Bureau of Sewerage, Tokyo Metropolitan Government

4980 (http://www.gesui.metro.tokyo.jp/english/ourprofile/ourprofile13.htm)

Figure 9.4 Sewerage Mapping and Information System (SEMIS)

SEMIS consists of the TAIMS specialized information network. TAIMS is a base for realizing high-level administrative management by cooperative approach and information exchange within and outside the city, and by possessing information that transcends the bounds of the in-house organization. It is a system that offers procedures for collecting, processing and sharing information. Generally, one employee is provided one terminal for work. The functions of SEMIS are given in Table 9.1.

4985

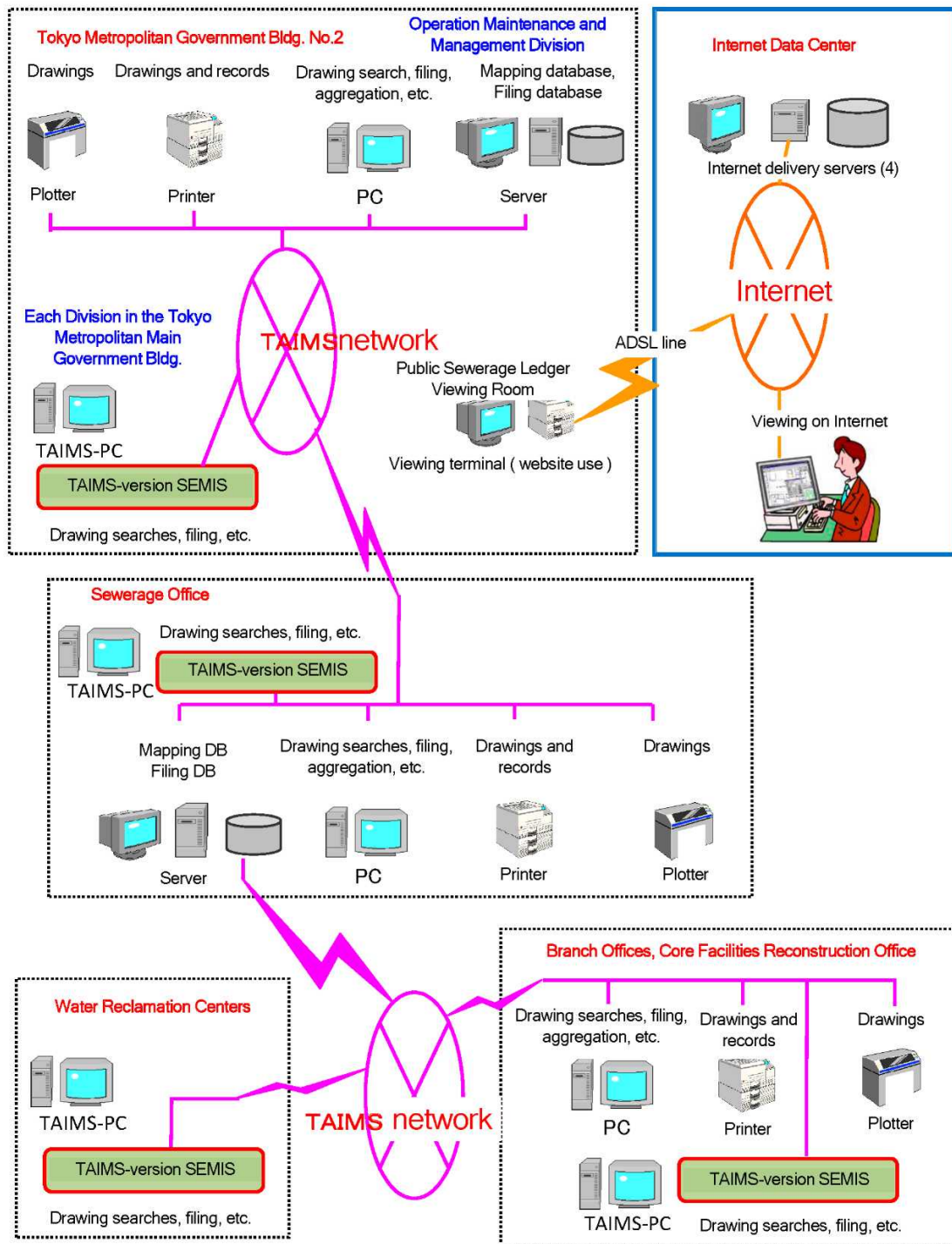
Table 9.1 Functions of SEMIS

Function	Description
Drawing Search	This function can be used to search for objects with parameters such as address, sewerage mapping number, affiliated sewerage facility and manhole number.
Display - Display control - View switching	Switching between configurations and lead line views is easily done with the Display Control function, accessed through the Switch View button on the toolbar.
Attributes	Clicking on the Confirm Attributes tab allows attribute details to be checked.
Sewerage - Upstream/downstream tracking	The Sewage button on the toolbar can be used for upstream/downstream tracking of pipes, flow rate measurements, vertical/horizontal views, etc.
Conditional Search	By using the Search by Condition button on the toolbar and applying pre-registered information, the system can separate out results by color.
Copy to Clipboard	An area selected on a drawing can be copied to the clipboard.
Printing and Output	This function supports printing to laser and inkjet printers and plotters,



Function	Description
- Drawing printout and PDF file creation	PDF file creation and output of SXF data for CAD use.
- SXF data output	

Source: <http://www.asianhumannet.org/db/datas/0912-e/sewage-information.pdf>



4990

Source: Bureau of Sewerage, Tokyo Metropolitan Government

(<http://www.asianhumannet.org/db/datas/0912-e/sewage-information.pdf>)

Figure 9.5 Structure of the Sewerage Mapping and Information System (SEMIS)

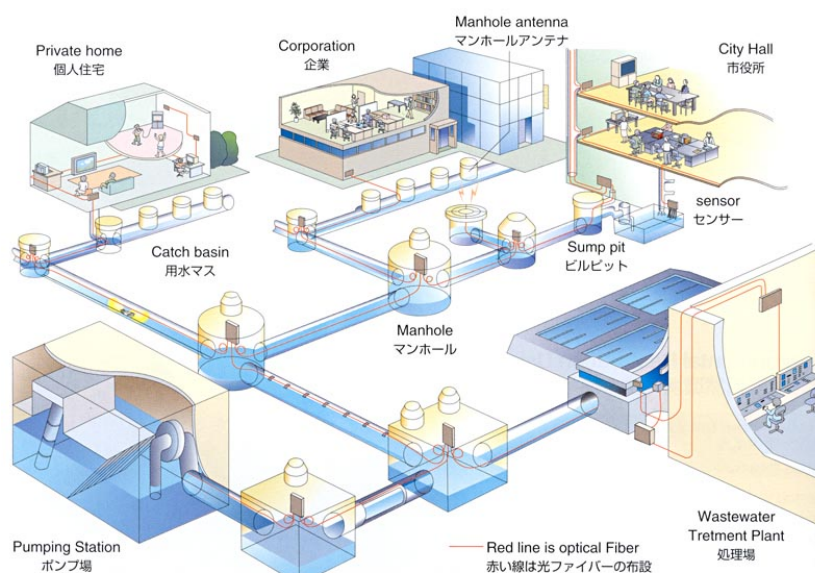


### 9.6.2 An Advanced Information System Using Optical Fibre in Sewers

4995 Although most of the current communication cables are metal cables, they will be replaced by optical fibre cables that enable faster and larger capacity communications. Since optical fibre communication requires no electric current in the cable, the cable can be laid in sewer lines.

5000 The merit of installation in sewers comes from the point that sewers are underground. This means that, compared to aerial wires, underground cables do not ruin urban views. They are also highly resistant to disasters such as earthquakes and fires. Optical fibres installed in sewers can support the ideal image of future cities by providing safe communication in emergencies and by contributing to the realization of comfortable cities.

5005 Optical fibre cable can be used for a wide range of applications. It has now created the possibility of constructing a network not only linking sewerage facilities but also covering homes and offices, so that the use of optical fibre works can progress. Since optical fibre has a large transmission capacity, the benefit/investment ratio will increase, as the range of applications becomes wider. When sewer optical fibre networks are used not only for management of sewerage facilities but also widely for administrative purposes and personal use, sewerage works will truly contribute to the implementation of the advanced information society.



5010

Note: Diagram showing the use of optical fibre cables for sewerage system management in Japan. Optical cables are allowed in Japanese sewer pipes after the Sewerage Law was revised in 1996.

Source: JSWA, 2002

Figure 9.6 Image of optical fibre network

5015 An example of optical fibre installed in a part of the sewer system in Kobe city is given below.

5020 Fibre optic network was installed in a part of the sewer system in Kobe city in 2002. Sewage treatment plants and pumping stations within the city were connected to the fibre optic network. High speed and stable systems for monitoring and controlling data of treatment plants and pumping stations, and other kinds of systems were realized with the objective of enhancing efficiency and improving the management of sewerage systems.

The main routes are trunk lines of the sewerage network constructed in the aftermath of the Great Hanshin Earthquake, and these trunk lines are designed with high earthquake resisting capacity. The main applications are introduced here.

## (1) Controls among sewage treatment plants

5025 The Suzurandai Sewage Treatment Plant (STP) performs advanced treatment of sewage up to a specific influent flow rate; beyond this flow rate, the influent is diverted to the Seibu STP for treatment. To monitor its condition in the Seibu STP, the flow rate of distributed sewage, water level of the grit chamber and ITV images are transmitted using optical fibres installed in the sewers to the Seibu STP from the Suzurandai STP. This is the first time optical fibres have been  
5030 used in sewers in this city.

Sludge is pumped from the Port Island STP to the Higashinada STP. To monitor its condition in the Higashinada STP, data of the pumped sludge quantity and the like, are transmitted using optical fibres installed in the sewers to the Higashinada STP from the Port Island STP.

## (2) Remote monitoring and control of pumping stations

5035 The transmission of remote monitoring and control data for pumping stations located in the sewer route of optical fibre installations was sequentially changed over from dedicated telephone line to optical fibre circuit. Now, the sewer optic network is being used for transmitting ITV images and for remote monitoring and control of pumping stations.

## (3) Optical water level indicator

5040 Optical water level indicators have been installed in sewage trunk lines. There is no need to install transmission equipment at the installed location of the water level indicator on site. The water level can be measured from a remote location. By knowing the water level in a trunk line, the sewage retention status and the influent status can be known beforehand. This enables safe and stable operation of the sewage treatment plant.

## 5045 (4) Sewerage facilities and equipment information system

Sewerage facilities and equipment information systems have been constructed and are in operation. This is a system meant for effective and efficient control and management of an enormous number of machinery, equipment, facilities, drawings, work histories, and so on. Sewer optical fibre network is used for the transmission route of this system. The advantages of  
5050 optical fibres are used effectively to mutually exchange massive volumes of data.

## (5) IP telephones

IP telephone equipment are being operated using sewer optic fibre networks. Since sewer optic fibre network is used in disaster-resistant network trunk lines, it has the important function of transmitting information during a disaster.

## 5055 (6) Rainfall information system

This system consists of radar equipment for monitoring the rainfall status and information terminals installed in various centres. It captures the rainfall status that varies day to day and hour to hour, and is used to establish disaster prevention systems and to support operation of storm water pumps. Initially, information was distributed using dedicated digital lines, but  
5060 gradually the transition is being made to sewer fibre optic networks. This has enabled speedy distribution of information through private networks that can firmly withstand disasters.

## (7) Fibre optic lease business

To effectively utilize the unused parts of sewer fibre optic network, Kobe city has leased the fibre optic network.

## 5065 9.7 PHYSICAL USE OF MIS FOR SYSTEM EFFICIENCY ENHANCEMENT

As the cities extend their boundaries, the complexity of assumptions in sewer design versus reality is a matter of great relevance to understand the validation of design assumptions like the design period of sewers, pumping stations, treatment plants, etc. The population growths and the segments of the cities where growths lead or lag are crucial to optimize investment planning. An example can be cited in the case of the Milwaukee Metropolitan Sewerage District (MMSD) USA which provides wastewater and flood management services for 28 municipalities within its 411 square mile planning area. One of the challenges faced by MMSD was the need to understand the timing and volume of flow contributed by each of these municipalities through their local sewer systems to the MMSD's Metropolitan Interceptor Sewer (MMSD-MIS). The MMSD-MIS is the regional sanitary sewer system operated by MMSD that connects local municipal sanitary sewer systems to the two regional wastewater treatment plants and regional Inline Storage System servicing the Milwaukee metropolitan area. In 2004, MMSD began development of limited satellite municipality System Evaluation and Capacity Assurance Plans (SECAP) for each of the satellite municipalities it serves. The SECAP hydraulic evaluations were limited in that only those portions of the local sanitary sewer systems necessary to provide required information for the 2020 Facilities Plan project were analysed. The 2020 Facilities Plan is the latest generation of facilities planning undertaken by MMSD to determine what MMSD facilities are required to meet the needs of the region through the year 2020. Specifically, the SECAP project intends to: (1) Identify satellite municipality system capacity deficiencies (2) Estimate satellite municipality system bypass volumes and flow rates for selected wet weather events and (3) Summarize peak flows delivered to the MMSD-MIS system for a selection of wet weather events. Such a MIS is indicated for at least the four historical metro cities in India, namely, Chennai, Delhi, Mumbai and Kolkata to start with.

## 5090 9.8 SUMMARY

In India, the National Informatics Centre (NIC) is primarily responsible for providing computing support to various ministries/departments of the government both at the Centre and the state level as well as at the level of district administration throughout the country with the progressive establishment of a nation-wide informatics network (NICNET). These are supplemented with the efforts of the Department of Statistics through the Central Statistical Organization (CSO) and the National Sampling Survey Organisation (NSSO), the State Directorates of Economics and Statistics (SDES), and the statistical units of the central ministries which are partially fulfilling the information requirement and are responsible for coordination of all the statistical activities including development and maintenance of standards. They have liaison with international agencies as well. (Source: [http://www.vikalpa.com/pdf/articles/1996/1996\\_july\\_sep\\_3\\_15.pdf](http://www.vikalpa.com/pdf/articles/1996/1996_july_sep_3_15.pdf)). All these institutions are merely data entry and retrieval centres. These are not MIS centres. It requires a different expertise to develop an MIS. Perhaps the BWSSB model needs to be elaborated and validated.

5105



## CHAPTER 10 POTENTIAL DISASTERS IN SEWERAGE AND MANAGEMENT

### 10.1 INTRODUCTION

5110 The Disaster Management Act, 2005 defines “disaster” as “a catastrophe, mishap, calamity or  
grave occurrence in any area, arising from natural or manmade causes, or by accident or  
negligence which results in substantial loss of life or human suffering or damage to, and  
destruction of, property, or damage to, or degradation of, environment, and is of such a nature or  
magnitude as to be beyond the coping capacity of the community of the affected area.” The Act  
5115 defines “disaster management” as a continuous integrated process of planning, organizing,  
coordinating and implementing measures which are necessary or expedient” for a set of 20  
occurrences. Of these, the major ones are (i) Prevention of danger or threat of any disaster, (ii)  
Mitigation or reduction of risk of any disaster or its severity or consequences and (iii) Capacity  
building. It further warrants that (a) disaster response fund and (b) disaster mitigation fund be  
5120 set up and to be available mutatis mutandis to all departments and emergency procurement  
allowed. A high powered committee made out a schedule of recognizable disasters as given in  
Table 10.1.

Table 10.1 List of various disasters

No	Occurrences	Disaster sectors
1	Water and climate related	1-a) Floods and drainage management 1-b) Cyclones 1-c) Tornadoes and hurricanes 1-d) Hailstorm 1-e) Cloud burst 1-f) Heat wave and cold wave 1-g) Snow avalanches 1-h) Droughts 1-i) Sea erosion 1-j) Thunder and lightening 1-k) Tsunami
2	Geological related disasters	2-a) Landslides and mudflows 2-b) Earthquakes 2-c) Dam failures/Dam bursts 2-d) Minor fires
3	Chemical, industrial & nuclear related disasters	3-a) Chemical and industrial disasters 3-b) Nuclear disasters
4	Accident related disasters	4-a) Forest fires 4-b) Urban fires 4-c) Mine flooding 4-d) Oil spills 4-e) Major building collapse 4-f) Serial bomb blasts 4-g) Festival related disasters 4-h) Electrical disasters and fires 4-i) Air, road and rail accidents 4-j) Boat capsizing 4-k) Village fire
5	Biological related disasters	5-a) Biological disasters and epidemics 5-b) Pest attacks 5-c) Cattle epidemics 5-d) Food poisoning

No	Occurrences	Disaster sectors
6	Anthropogenic (manmade) disaster	6-a) Strike 6-b) Vandalism

Note: Anthropogenic disaster is added to above list by proposal of Expert Committee of CPHEEO

Source: MOHA, 2011

5125 Strike and vandalism are not natural disaster. However, in case of sewage management, operation and maintenance cannot stop. If operation and maintenance stop by man-made hazard and sewage without treatment goes to public bodies, it would be potentially to cause disaster.

5130 There is no mention of a sewerage related disaster. However, if untreated sewage reaches and pollutes a lake, reservoir, rivers or wells which are used as drinking water sources, it is a situation which may become a biological disaster as the entire population would be immediately exposed to possible water borne epidemics of Cholera, Typhoid, Jaundice, Gastroenteritis, etc., transmitted through the water supply and is of great significance to the lives.

5135 In emergency situation, the preparation on the base of lessons from past emergency situations is the most important. In this chapter, Emergency Situation, Preparation of Emergency Plan, Situation of River in India and Disaster Mitigation Plan are explained with illustration of some case studies.

## 10.2 EMERGENCY SITUATIONS

Thus, the damage to sewerage systems which can occur due to disasters in other sectors can be identified as in Table 10.2.

5140 Table 10.2 Potential disasters which can damage the sewerage system

No	Occurrences	Disaster sectors which can damage sewerage	Occurrence which can damage sewerage
1	Water and climate related	1-a) Floods and drainage management 1-b) Cyclones 1-c) Tornadoes and hurricanes 1-d) Hailstorm 1-e) Cloud burst 1-f) Droughts 1-g) Tsunami	Flooding and overland runoff
2	Geological related disasters	2-a) Landslides and mudflows 2-b) Earthquakes 2-c) Dam failures/Dam bursts	Disturbance of infrastructure

Source: MOHA, 2011

Thus the disasters which can damage the sewerage infrastructure can be shortlisted to:

- Earthquake
- Floods
- 5145 • Tsunami

The damage to sewerage brought about by these three disasters and their impacts on public life, are identified as a cause and effect together with the emergency responses and are listed in Table 10.3.

5150

Table 10.3 Causes, effects and emergency response with respect to sewerage during disasters

Occurrence		Damage to the components in the event of disaster caused by		
		Earthquake	Floods	Tsunami
Gravity sewers	Cause	Sewer pipelines get “sheared off”.	Sewers get inundated.	Open manholes and WTP water retaining structures get inundated.
	Effect	Sewage backs up and overflows from upstream chambers and manholes all over the habitation collection system and also overflows into surrounding habitations with lower elevation.	Raw sewage and fresh water get mixed up with water borne disease causing organisms of Cholera, Typhoid, Jaundice, or Gastroenteritis. This in turn flows into drinking water wells and rivers used as drinking water sources and results in potential water borne epidemic.  This is an emergency in the water sector and not in sewerage sector. If protected water supply is not given, epidemic is very likely to occur.	Raw sewage and seawater get mixed up temporarily and the overflowing Tsunami waters are a mixture of seawater and sewage. The water borne disease causing organisms of Cholera, Typhoid, Jaundice, Gastroenteritis etc., die off as they cannot survive in highly saline water. If WTP is affected, there is an emergency.  This is an emergency in the water sector and not in sewerage sector. If protected water supply is not given, epidemic is very likely to occur.
	Emergency Response	Make sure the resulting sewage mixed overflows are diverted from drinking water sources, if necessary by using diesel pumps. Erect flood moderating bunds for diversion by filling up used cement bags with a mixture of earth or sand or clay with 5% volume of cement, dumping them with broad base and minimum 1 m width at the top. Immediately arrange for tankers to ferry drinking water from distant sources and add chlorine at 0.5 mg/l by hypochlorite before the tanker starts the trip and also after completing the trip. Ensure tanker water supplies to the public for drinking and warn them against raw water. Distribute UF linked hand pumps immediately like the famous Orissa flood situation of 1990’s.		If WTP is affected please follow procedures as in the case of earthquake and floods. If WTP is not affected, there is no need to panic or launch management efforts. There are other sectors needing attention.

Occurrence		Damage to the components in the event of disaster caused by		
		Earthquake	Floods	Tsunami
Sewage Pumping Stations (SPS)	Cause	Suction wells may get sheared off and pump sets may get dislocated.	No effect since sumps are constructed with their sidewalls above maximum flood level (MFL).	Open suction wells and WTP water retaining structures get inundated.
	Effect	Gravity sewers cannot discharge into the sumps and sewage backs up and overflows from upstream chambers and manholes all over the habitation collection system and also overflows into surrounding habitations.	No effect	Suction wells in SPS are concerned no effect as the entire mix up is brief and for a few minutes only. The retreating Tsunami wave does not “siphon out” the sewage from the suction wells. If it is the WTP, there is a marginal danger of TDS increase temporarily.
	Emergency Response	Follow as in earthquake	No need	If WTP is affected follow the procedure given for earthquake.
Sewage Treatment Plants	Cause	Sewage retaining structures may get sheared off and pump sets may get dislocated.	No effect since sumps are constructed with their sidewalls above MFL.	As in SPS
	Effect	Already existing sewage in tanks and incoming pumped sewage will overflow into habitations with lower elevation	No effect	As in SPS
	Emergency Response	Follow as in the case of SPS	No need	As in SPS



5155 It may be seen that the real disaster is not in sewerage but in the pollution of the water bodies by untreated sewage as well as washout of open air defecation night soil, animal dung, etc. These result in an emergency situation which is two-fold. The more urgent measure is to ensure protected water supply, while the latter is the resurrection of the damaged sewerage system.

### 10.2.1 Case Studies of Similar Situations Faced in India

There have been instances where similar situations have been encountered and managed successfully in India; these are narrated here.

#### 5160 10.2.1.1 Case of Hosur Town, 2004

This is an important industrial town in Tamil Nadu for many leading industries and has a conventional WTP of clariflocculators, rapid sand filters and chlorination equipment. The water source of this town is the impoundment across the Ponnaiar river, as shown in Figure 10.1.



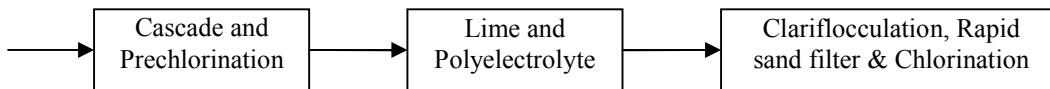
5165 Figure 10.1 Upstream nonpoint sewage infested impoundment at Hosur

In this river, the water flow is limited to July-September and the impounded water is drawn for the whole year. During the summer of 2004, the water flows dwindled and stored water level started going down. However, the sewage flows continued and dead algae densified with foul odour and colour with coliform levels of 40,000 to 80,000/100 ml compared to a maximum limit of 5,000 for raw water for public water supply. The 23.5 MLD capacity WTP was not equipped to handle this situation and the treated water with colour of algae and foul odour was rejected outright by the public. The groundwater availability was at nearly 200 m and the public could not afford drawing it from deep wells on a domestic scale. It almost resulted in an exodus of the population, which had a severe impact on industrial production. The situation was a near emergency with exodus of people and industries coming to a halt. The immediate remedy was to give acceptable drinking water to the public and retain the population. Many technologies were evaluated to equip the WTP to meet the situation but none could remove the organic content, phosphorous and ammonia, which were the causative agents of algae, and their death and decay and it was decided to adopt high lime, ammonia stripping and carbonation and which was successfully tested in the laboratory and which could be retrofitted into the existing WTP. The treatment scheme and pictures are shown in Figure 10.2 to Figure 10.5

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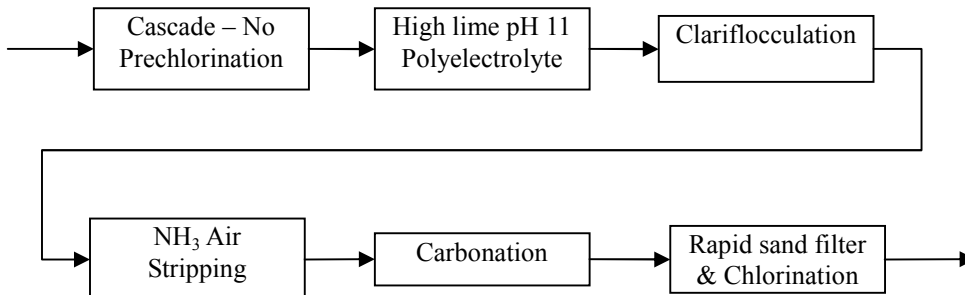
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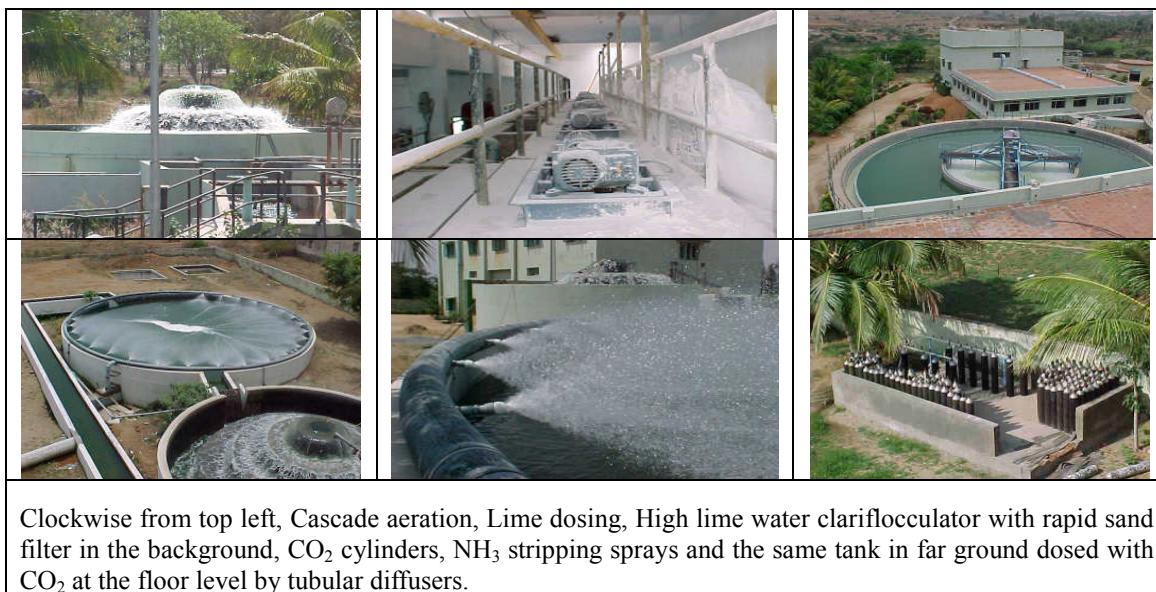
Figure 10.2 The existing treatment process



Source: Saktheeswaran, 2011

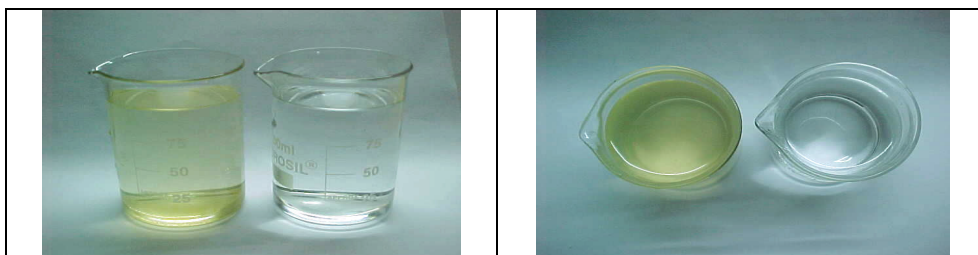
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Figure 10.3 Modified treatment process



Source: Saktheeswaran, 2011

Figure 10.4 Modified WTP



5195 Source: Saktheeswaran, 2011

Figure 10.5 The water supplied by the WTP before (left beaker) and after the modification (right beaker) shown in side view and top view

5200 The situation came under control with the monsoon in June. The disaster part of the case is that even though the remedy of changing the treatment process was available, it was beyond the affordability since there was an increase of 200% in the O&M costs which was borne only for a few months, and could not be borne forever. If the same situation recurs, it will be a real disaster, especially if the situation goes on year after year.

#### 10.2.1.2 Case of Chennai, 1993

5205 Chennai metropolis depends on storing the monsoon rains of the north-east during October-November in reservoirs and using it all through the year for public water supply. During 1992, there was a total failure of the monsoon and the storage in the reservoir was down to only 20% of the normal volume at that time. The next monsoon was only the minor south-east monsoon of July and the situation verged on nearly evacuating the city. Various measures were taken to bring in water from long distances by railway wagons and lorries while

5210 groundwater also was fast depleting. For the first time in its history, piped water supply was shut down and drinking water was rationed door by door by mobile tanker supply. The per capita usage which used to be 100 litres per day came down to about 30 litres per day derived equally from tankered water and groundwater in household bore wells. The impact on sewerage was as under.

5215 Surprisingly, the sewers did not exhibit any great choking or blockages other than what they used to be in normal times and the pumping stations had to work for only half the time than in the normal period. The foul smell from hydrogen sulphide was also nothing abnormal.

5220 But the real problem was in the STPs. The raw sewage BOD suddenly increased from the usual 300 mg/l to alarming values of 500 to 550 mg/l. A major part of the BOD was in soluble/colloidal form and was carried over to the aeration tanks. The aerators in use were surface aerators and augmenting these was not possible as the whole electrical system had to be upgraded. A possibility of recycling the final effluent to the aeration tank to reduce the BOD concentration was hindered by limitations of gravity hydraulics of piping. The secondary clarifier exhibited a blacking sheen. The treated effluent BOD was about 90 mg/l and the

5225 coliforms organisms were also obviously out of control. The discharges from the three STPs were into three water courses across the city in which virtually stagnant water bodies slowly began to stink right through.

5230 Here was the disaster. The well waters in almost all dwellings on both sides of these river courses started smelling foul and nearly caused vomiting if taken directly. Vessels washed with the water started turning black due to the sulphide problem. At that time, there were few bottled water manufacturers in the city. Medical practitioners were also having a tough time controlling gastrointestinal diseases especially infants and older people in economically weaker sections. Thus, the city was heading closer to an epidemic every passing day. There was nothing that could be done and almost all offices started encouraging their staff to go out of the city on long

5235 leave with their families and school children were freely accommodated in schools elsewhere in  
the state. Even then the situation worsened and a survey of well waters showed almost the entire  
groundwater polluted by sulphide and coliforms. Mercifully the July monsoon came down with  
full force and the city escaped just at the nick of time before the sewerage would have turned it  
5240 into an epidemic and wiped out a portion of the population. If the monsoon of July had failed,  
the sewerage situation could have nearly wiped out the Chennai population. In 1993, there was  
no remedy to this disaster.

This is a case where the sewerage by itself was not the disaster but it became a disaster because  
of failure of monsoon. At one point, the entire Chennai city was threatened by a possible water  
borne epidemic. This was not anticipated also. Hence, this was a disaster in its own way.

#### 5245 **10.2.1.3 The Orissa Floods of 1990's**

The 1999 Orissa cyclone, also known as *Cyclone 05B*, and the *Paradip cyclone*, was the  
deadliest tropical cyclone in the Indian Ocean since the 1991 Bangladesh cyclone, and the  
deadliest Indian storm since 1971. On October 29, the cyclone hit Orissa near the city of  
Bhubaneswar. The storm surge was 8 meters and struck the coast of Orissa, travelling up to 20  
5250 km inland damaging 17,110 km<sup>2</sup> of crops and 90 million trees. Approximately 275,000 homes  
were destroyed, leaving 1.67 million people homeless and another 19.5 million people were  
affected to some degree. A total of 9,803 people officially died from the storm, though actual  
figures might have been much higher and 3,312 people injured. The official number of domestic  
5255 animal fatalities was quoted as around 2.5 million whereas actually it might have been double. It  
slowly weakened, maintaining tropical storm strength as it drifted southward. During the relief  
efforts, the main priorities were distribution of packaged food and safe drinking water to the  
people marooned in their houses and lands. The use of mini hand pumps coupled with  
ultra-filtration membranes came to the rescue of the people. They could drink water for free  
5260 taking it from water borne pathogens thanks to the pioneering efforts of the National Chemical  
Laboratory of the GOI Council of Scientific and Industrial Research at Pune. This laboratory  
had evaluated the ultra-filtration membranes for recovering filtered water as suitable and fit for  
drinking from polluted waters after conducting a series of studies in association with the  
National Virological Institute, Pune. This is a case where the floods caused a sewage-originated  
5265 water borne epidemic status and the simple precaution of an assembly of hand pump and  
ultra-filtration contraption, however crude it might have been, saved the population from being  
virtually wiped out by water borne epidemic. This was a grim reminder of the open air  
defecation in the rural and urban peripheral habitations in such cyclonic floods. The relief  
measures could be completed only after two and half years by 2002.

#### **10.2.1.4 Lessons from the Foregoing Case Histories**

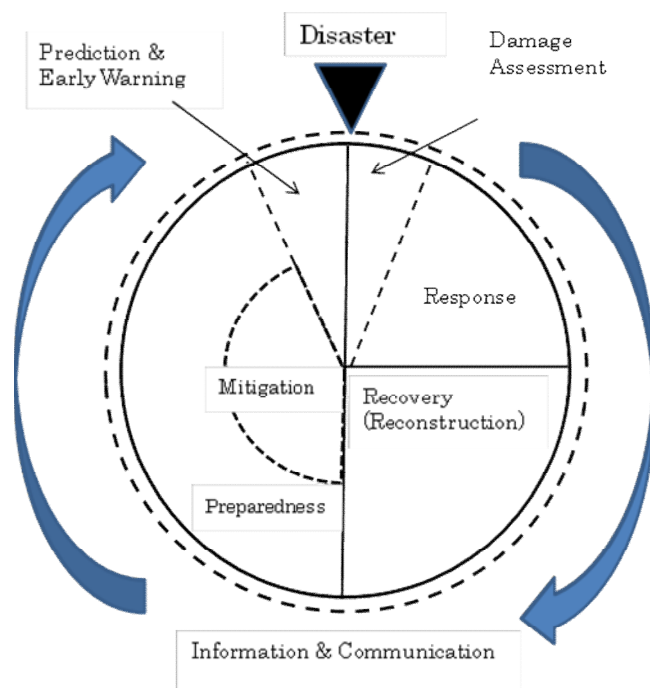
5270 The lessons learnt are to ensure management preparedness to:

- a) Document the emergency operating treatment process and procedures for O&M of  
WTP when raw water is polluted by sewage
- b) List out the persons to be drafted to handle the WTP in such situations and also  
keep rate contracts for direct procurement of needed chemicals
- 5275 c) Give freedom to the persons to invoke provisions of the Disaster Management Act  
and coordinate with the district collector without bias.

### 10.3 PREPARATION OF EMERGENCY PLAN

#### 10.3.1 Disaster Life Cycle

5280



Source: Meguro, K. and O. Maruo, 2008

Figure 10.6 Disaster life cycle

5285 Disaster life cycle is the basic framework for preparing measures for disasters (Figure 10.6). Based on the 'disaster life cycle', the following procedures should be considered to deal with disasters:

- 5290 a) **Mitigation:** At normal times, action should be taken to lessen or limit the adverse impacts of future hazards and related disasters with appropriate technology and finance.
- 5295 b) **Preparedness:** In parallel to mitigation, preparations should be made for reducing damage in case of a disaster exceeding the capacity of mitigation of the urban system, and this is termed as preparedness. It is a supplementary activity which cannot mitigate the damage of the disaster. The examples include stocking of food and water, or the gathering and screening of willing volunteers, etc.
- 5300 c) **Prediction and Early Warning:** If the occurrence of a disaster could be predicted in advance and informed to the affected area well in time, it will serve as a useful measure. Therefore, the prediction and early warning systems may be established. The examples are early warning system for tsunami and earthquake.
- d) **Disaster:** When the hazard level of the event (such as earthquake, flood, tsunami, etc.) is greater than the bearing capacity of urban infrastructures, disaster occurs.
- e) **Damage Assessment:** After disaster, in order to respond to the emergency more appropriately, it is necessary to understand the grade of damage as early as

possible.

- 5305 f) **Response:** Disaster response work includes any action taken in the midst of or immediately following an emergency, including efforts to save lives and to prevent further property damage. The response involves putting already established disaster preparedness plans into motion.
- 5310 g) **Recovery and Reconstruction:** Disaster recovery involves actions to return the affected community to its pre-disaster state or better, and ideally to make the community less vulnerable to future risks. After recovery, the next stage is reconstruction for establishing new urban system, in case the area has experienced significant level of devastation. Reconstruction stage needs a long period ranging from several years to a dozen years depending on the intensity of the disaster. This stage is undertaken for getting life back to normal, and preparing for future disasters.
- 5315 h) **Information and Communication:** In a disaster cycle, information and communication are important parts. The importance of the information and communication is different in each stage.

### 5320 10.3.2 Procedure for Preparing for Emergency Response

To formulate the sewerage disaster management plan, following procedure is required:

- a) To identify, characterize, and assess threats in specific area
- b) To assess the vulnerability of critical assets to specific threats
- c) To identify shortfall and requirements
- 5325 d) To adopt measures for prevention and mitigation of hazards
- e) To reassess the measures.

### 10.3.3 Measures to be Taken for Prevention and Mitigation of Hazards

5330 Risk of destruction and casualties associated with different disasters can substantially be reduced by introducing preventive and mitigation measures. Mitigation is generally categorised into two main types of activities, that is, structural and non-structural. Structural mitigation refers to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant protective structures and infrastructure. Non-structural mitigation refers to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms

5335 and the provision of information, which can reduce risk with related impacts.

Possible risk reduction measures relevant to sewerage systems are described below.

- a) Water related hazard (Monsoon and Cyclone)

5340 In case of torrential rain, collecting information on rainfalls and close contact with river managing authority for gathering information on river are necessary for operation of pumping stations and STPs. As for sewer, daily inspection of inundated area should be made and measures adopted for minimizing disaster. Cyclone is predicable, and preventive measures should be ready beforehand.

- b) Earthquake and tsunami

In order to reduce structural vulnerability, it is better to enforce regulations related to structural

5345 bearing capacity against hazards due to earthquake and tsunami. In case of deficiency of lifelines, STPs and pumping stations need power and water, so preparation of generator and other emergency preparations are necessary. Ledger is important for inspection after the earthquake. Therefore, it is very important to store ledger and printed data such as as-built drawings, specifications, and so on, of facilities in safe custody.

5350 c) Abnormal raw sewage quality

Abnormal quality of raw sewage flowing into STP adversely affects the functions of treatment facilities. Abnormality in raw sewage may be caused due to various reasons. If abnormality is caused by effluent from industrial sectors, the following procedure is necessary: inform related authorities, understand the state and identify cause of the phenomenon, emergency aids (such as oil fence, detoxicating agent, etc.), and investigate the cause and prevent recurrence.

5355 d) Anthropogenic or man-made hazard

Anthropogenic hazards or human-made hazards can come to fruition in the form of a human-made disaster. In this case, “anthropogenic” means threat having an element of human intent, negligence, or error; or involving a failure of a human-made system. It results in loss of life and property. It further affects a person’s mental, physical and social well-being. This is opposed to natural disasters resulting from natural hazards.

5360 Under anthropogenic hazards ‘sociological hazard’ is very common with particular reference to the personnel engaged in sewerage and sewage treatment systems. These hazards could be in the form of strikes by workers, vandalism, or even disruption of services on some pre-text. To deal with such eventualities, management must have a contingency plan.

### 5365 **10.3.4 Guide to Formulating a Disaster Plan**

Disaster management plan usually involves four phases;

- a) Prevention
- b) Preparedness
- 5370 c) Response, and
- d) Recovery.

The following guide to formulating a disaster plan outlines recommended action in all four phases, but prevention is the best protection against natural or man-made disaster.

#### **Phase-1: Prevention**

5375 Identify and minimize the risks posed by the system including building, its equipment and fittings, and natural hazards of the area.

- Carry out a systematic inspection including building inspection and change factors which constitute a potential anthropogenic hazard.
- 5380 • Establish routine housekeeping and maintenance measures to withstand disaster in the system including buildings and surrounding areas.
- Install automatic fire detection and extinguishing systems, and water-sensing alarms.
- Take special precautions during unusual periods of increased risk, such as strikes, vandalism, system renovations, etc.



- 5385
  - Make security copies of vital records such as collection inventories, and store these off-site.
  - Protect computers and data through provision of uninterrupted power supply.
  - Have comprehensive insurance for all the office records, its contents, the cost of salvage operations, and potential replacement, and restoration of damaged materials.
- 5390

### **Phase-2 Preparedness**

Getting ready to cope:

- Develop a written preparedness, response and recovery plan.
- Keep the plan up-to-date, and test it.
- 5395
  - Keep together supplies and equipment required in a disaster and maintain them.
  - Establish and train an in-house disaster response team, imparting training in:
    - i) Disaster response techniques,
    - ii) Identification and making floor-plans and enclosures of irreplaceable and important materials for priority salvage.
- 5400
  - Prepare and keep an up-to-date set of documentation including:
    - i) Building floor-plans with locations of cut-off switches and valves.
    - ii) Inventory of holdings with priorities for salvage marked on floor-plans.
    - iii) List of names, addresses, and home telephone numbers of personnel with emergency responsibilities.
- 5405
  - iv) List of names, addresses, and home telephone numbers of the in-house disaster response team.
  - v) List of names, addresses and home telephone numbers of trained conservators with experience in salvaging water-damaged materials, resource organizations, and other facilities able to offer support in the event of a disaster.
- 5410
  - vi) List of disaster control services, in-house supplies and equipment, and for any central store, the locations and names of contacts with home telephone numbers.
  - vii) List of suppliers of services and sources of additional equipment and supplies, including names of contacts and home telephone numbers.
  - viii) Arrangements made to access freezing facilities.
- 5415
  - ix) Arrangement for funding emergency needs.
  - x) Copies of insurance policies.
  - xi) Salvage procedures.
- Distribute the plan and documentation to appropriate locations on-site and off-site.
- Institute procedures to notify appropriate people of the disaster and to assemble them quickly.
- 5420



**Phase-3: Response**

When disaster strikes:

- Follow established emergency procedures for raising the alarm, evacuating personnel and making the disaster site safe.
- 5425 • Contact the leader of the disaster response team to direct and brief the trained salvage personnel.
- When permission is given to re-enter the site, make a preliminary assessment of the extent of the damage, and equipment, supplies and services required.
- Stabilize the environment to prevent the growth of unwanted vegetation and mould.
- 5430 • Photograph the damaged materials for insurance claim purposes.
- Set up an area for recording and packing material which requires freezing, and an area for air-drying slightly wet material and other minor treatment.
- Transport water-damaged items to the nearest available freezing facility.

**Phase-4: Recovery**

- 5435 Getting back to normal
- Establish a program to restore both the disaster site and damaged materials to a stable and usable condition.
  - Determine priorities for restoration work and seek the advice of an expert as to the best methods and options, and obtain cost estimates.
  - 5440 • Develop a phased conservation program where large quantities of materials are involved.
  - Discard items not worth retaining, and replace or re-bind items not justifying special conservation treatment.
  - Contact the insurer.
  - 5445 • Clean and rehabilitate disaster site.
  - Replace treated material in the refurbished site.
  - Analyse the disaster and improve the plan in the light of experience.

Summing-up

- 5450
- a) Be prepared for any type of anthropogenic or potential disaster. Contact and consult experts on the subject and take their advice on various issues related to the subject.
  - b) Take advantage of training sessions on the subject with particular reference to disaster planning workshops and preparedness exercises.

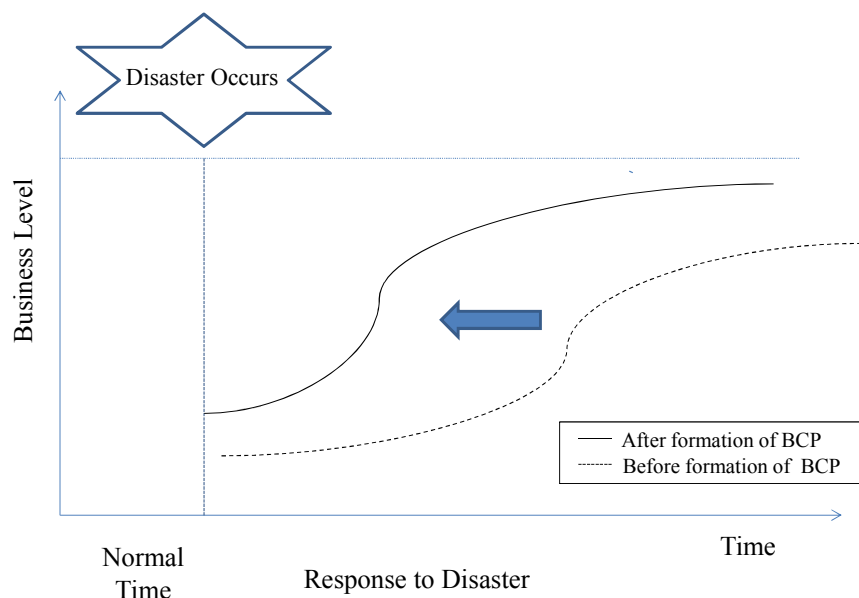
**10.3.5 Earthquake/Tsunami Induced Disaster (Japan)**

- 5455 A devastating tsunami triggered by strong earthquake hit Japan on 11<sup>th</sup> March 2011. Considering the impacts, a new manual was published in March 2012 by the Ministry of Land, Infrastructure, Transport and Tourism, Japan, to manage disaster caused by the occurrence of earthquake and

tsunami. The following parts describe briefly the management of such a disaster.

**a) Business Continuity Plan**

5460 Business Continuity Plan (BCP) is the plan for performing appropriate activities under limitations of resources, such as men, materials, information, life lines and so on, at the time of disaster (Figure 10.7). The plan shall include priority activities for restoring desired level of the business continuity by shortening the start-up time of the business and early recovery of business level just after the disaster.



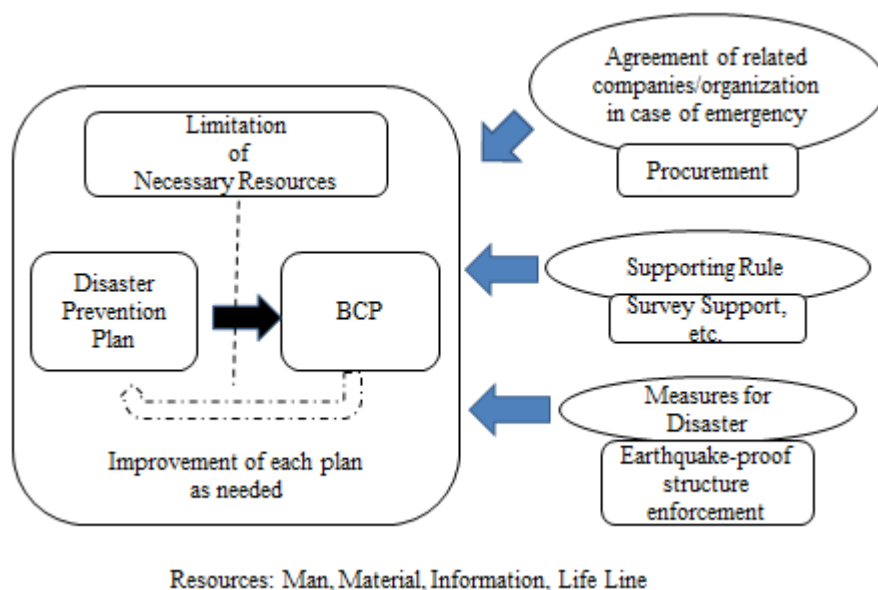
5465

Source: MLIT, 2012

Figure 10.7 Conceptual chart of recovery of business level from disaster

**b) Relationship between BCP and other Project in Municipality**

5470 BCP should be in harmony with Regional Disaster Countermeasures Plan. BCP is effective, when harmonized and incorporated with hard measures such as seismic structure enhancement, rule on support among municipalities, and agreement of related organisations on issues such as procurement of materials, etc. (Figure 10.8).

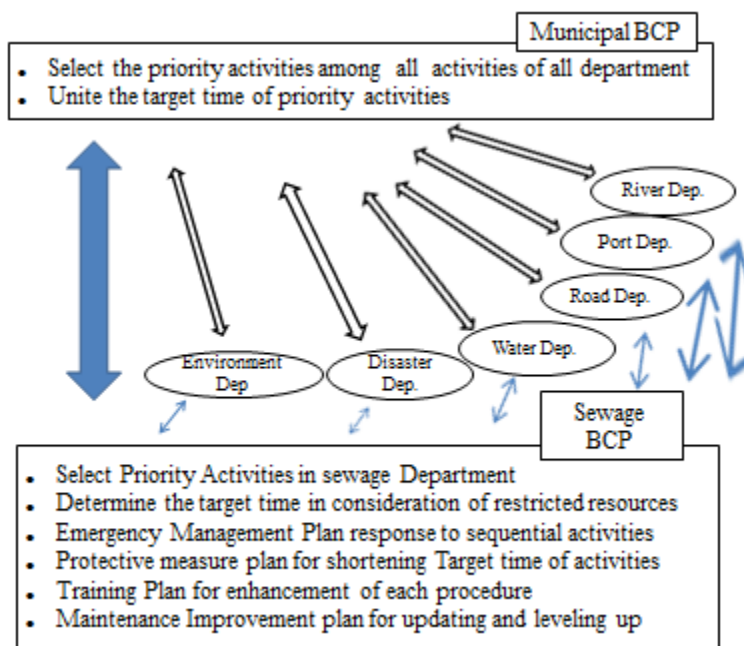


Source: MLIT, 2012

5475 Figure 10.8 Relationship between BCP and other plans

**c) Relationship between sewage BCP and BCP of other sectors**

It is desirable that BCPs of lifeline departments are prepared simultaneously (Figure 10.9).



Source: MLIT, 2012

5480 Figure 10.9 Relationship between municipal BCP and sewage BCP

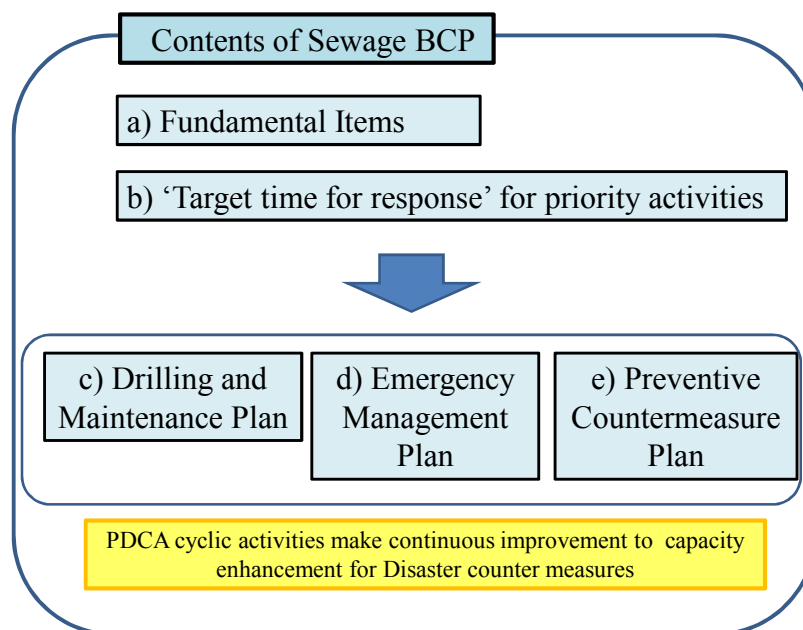
**10.3.5.1 Background/Objectives**

The failure in the sewerage services caused by large scale earthquake/tsunami raises the following main issues:

- 5485
- Environmental and social impacts caused by untreated discharge of sewage into the river, non-availability of toilets, inundation of living environment, etc.
  - Importance of proper steps/activities after disaster for restoring the function of devastated sewerage facilities under limitations of necessary resources for recovery (Employees, Material and Equipment, Life line, etc.).

5490 The main objective of planning sewerage BCP is the prompt restoration of the desired level of sewerage services even under resource limitations after occurrence of disaster.

Figure 10.10 shows a conceptual chart of the contents of Sewage BCP.



Source: MLIT, 2012

Figure 10.10 Conceptual chart of contents of Sewage BCP

### 5495 10.3.5.2 Contents of Sewage BCP

- a) Fundamental items
- Planning organization: Participation of head of related organization/departments
  - Scale of earthquake: Seismic intensity 6 (Japanese standard), Tsunami: maximum scale (2 patterns - working hours and off-time)
  - 5500 • Assumption of damage: Specification of the required activities after the quake (Damage of sewerage facilities as well as stopping of sewerage functions due to power outage)
  - Available resources after the disaster (Failure of electrical facilities and telephone, Availability of employees at work, Availability of material and equipment)
  - 5505 • Objective time: Period for temporary recovery of the sewerage functions
  - Objective Activities: Main activities for sewerage department (Minimizing sewage overflow, recovery of function of STP)

## b) 'Target time for response for prioritised activities

- Selection of prioritised activities
- 5510 – Disaster response and daily (operation) activities
- Determination of 'Target Time' of prioritised activities
  - Understanding of time required for implementing prioritised activities considering the degree of social impact (allowable interruption time)
  - 5515 – Understanding normal time needed to complete the activities considering the limitations of necessary resources
  - Determination of 'target time' considering immediately available proactive measures

Response procedure after the disaster should be listed chronographically.

## c) Drills and maintenance plan

- 5520 • Drills Plan: Examples include safety confirmation drill for employees, information conveying drill among employees
- Maintenance Plan: Examples are periodical check for revising the chain of command due to personnel transfer, comprehensive check by responsible person of sewage BCP

## 5525 d) Emergency management plan

Table 10.4 shows examples of emergency sequence procedure (in case of earthquake, working hours, head office).

## e) Preventive countermeasure plan

- 5530 • Rearrangement of proactive activities for shortening 'target time of response for disaster'
- Rearrangement of development of ledger and its backup
- Securing materials and equipment (for survey and first aid of disaster, for emergency communication, for food and drink)
- 5535 • Connection with related organizations and establishment of cooperation system in an emergency
- Establishment of mutual support rules with other municipalities in an emergency
- Conclusion and revision of agreement with private sectors in an emergency
- Provision of information sharing with citizens and request of cooperation
- Deciding format sheets for survey and response of the disaster.

5540

Table 10.4 Example of emergency response procedure in case of earthquake

No	Priority Activity	Response Target Time	Execution by self or others		Implementation Details	
1	Setting up Sewage DMHQ	hours	Self	Possible, - <del>impossible</del>	Place	City hall (Sewage division / Sewage DMHQ (Disaster Management Head Quarter /Head Office))
			Others	<del>possible</del> , Not possible	Team in charge	Responsible person (Select from gathered persons) However, first person on site should begin setting up Sewage DMHQ in case of night or holidays
					Methods	Confirm power and communications equipment, sending of information to relevant authority
2	Confirmation of safety of staff members	hours	Self	Possible, - <del>impossible</del>	Place	City hall (Sewage division / Sewage DMHQ)
					Team in charge	Contact team
			Others	<del>possible</del> , Not possible	Methods	Telephone during working hours, Use E-mail in case telephone is out-of-service. Use E-mail at night and on holidays
3	Coordination/contact with STP	hours	Self	possible, - <del>Not possible</del>	Place	City hall (Sewage division / Sewage DMHQ)
					Team in charge	Contact team
			Others	<del>possible</del> , Not possible	Methods	Confirm status of damage to STP and gather staff members by phone, use e-mail in case of phone is out of service
4	Coordination with related administrative departments	hours	Self	possible, - <del>Not possible</del>	Place	City hall (Sewage division / Sewage DMHQ)
					Team in charge	Contact team
			Others	<del>possible</del> , Not possible	Methods	Phone or e-mail
5	Emergency Inspection	days	Self	possible, - <del>Not possible</del>	Place	Sewer of cross section of river, down sewer from evacuation places
					Team in charge	Survey team
			Others	possible, - <del>Not possible</del>	Methods	Inspection using own materials and equipment, in case of shortage of the same, request contact team to dispatch private survey company.
6	Request for support	days	Self	possible, - <del>Not possible</del>	Place	City hall (Sewage Division / Sewage DMHQ)
					Team in charge	Sewage DMHQ
			Others	<del>possible</del> , Not possible	Methods	Phone to relevant authorities
7	Collection and sending information on	hours	Self	possible, - <del>Not possible</del>	Place	City Hall (Sewage Division / sewage DMHQ)
					Team in charge	Information Sending Team or Sewage DMHQ
			Other	<del>possible</del> ,	Methods	After collecting information from TV and

No	Priority Activity	Response Target Time	Execution by self or others		Implementation Details	
	disaster damage		s	Not possible		radio, and related sectors through Municipal DMHQ as well as information from the citizens, the information team processes this information and sends it in writing through sewage DMHQ to City DMHQ.
8	Emergency survey	days	Self	possible, - impossible	Place	Important sewers (High priority sewers)
					Team in charge	Survey team
			Others	possible, - impossible	Methods	Execution by municipal staff with their own equipment. In case of shortage of staff and equipment, request contact team to dispatch private survey company, private lease company for support and procurement of materials and equipment.
9	Resolving sewage overflow problems	days	Self	possible, - impossible	Place	Sewage overflow locations
					Team in charge	Disaster recovery team
			Others	others: possible, - impossible	Methods	Response on site by municipal staff with their own equipment. In case of shortage of staff and equipment, request contact team to dispatch private construction companies and private lease companies for support and procurement of materials and equipment.
10	Primary survey	days	Self	possible, - impossible	Place	Whole area (Survey from the high priority areas)
					Team in charge	Survey team
			Others	possible, - impossible	Methods	Execution by municipal staff and support team with their own materials and equipment
11	Emergency rehabilitation	□ days	Self	possible, - impossible	Place	Disaster areas
					Team in charge	Disaster response team
			Others	possible, - impossible	Methods	Design by municipal staff with support team members, and then entrust to construction company or manufacturer, and then implement it.
12	Preventing inundation	—	Self	possible, - impossible	Place	Disaster areas
					Team in charge	Disaster response team
			Others	possible, - impossible	Methods	Design by municipal staff with support team members, and then entrust and execute to construction company or manufacturer, and then implement it.

Source: MLIT, 2012

Table 10.5 shows examples of table of contents of sewage BCP.

Table 10.5 Example of table of contents of sewage BCP

<b><u>Sewage BCP for earthquake/tsunami</u></b>	
Table of contents	
1	Purpose and basic policy of sewage BCP
1.1	Purpose of formulating sewage BCP
1.2	Basic policy
1.3	Scope of work for sewage BCP
1.4	Sewage BCP formulating system and operation system
2	Basic matters for emergency response
2.1	General list of business continuity strategies when disaster occurs
2.2	Response base and location for assembly in an emergency
2.3	Response system and command & order line diagram
2.4	Overview of alternative base for assembly and assembled persons
2.4.1	Agreement document for the use of the alternative base
2.5	Evacuation guidance and safety confirmation
2.5.1	Evacuation guidance method
2.5.2	Safety confirmation method
2.5.3	List of employees
2.6	Grasping the damage situation (check list)
2.7	List of contacts just after the disaster
2.7.1	National and state administrative bureaus
2.7.2	Private enterprises
2.8	Resources held, vendors, alternative vendors
2.9	Emergency stores and rescue equipment
2.9.1	Food stores
2.9.2	Storage of rescue materials such as bars, plastic sheets, etc.
3	Emergency response plan
3.1	Assuming earthquake occurs during working hours
3.2	Assuming earthquake occurs during non-working house such as at night or on a holiday
4	Proactive measures plan
4.1	Time schedule for implementing proactive measures
4.2	Unscheduled implementation of proactive measures
5	Drills, maintenance improvement plan
5.1	Drill program
5.2	Maintenance and improvement plan
5.2.1	Periodical check items of sewage BCP
5.2.2	General items to be checked by person responsible for sewage BCP
5.2.3	Periodic notifications to the employees and concerned persons
6	Investigation, analysis, and study based on plan formulation
6.1	Setting earthquake scale and assumed damage
6.1.1	Setting earthquake scales
6.1.2	Setting tsunami scales
6.1.3	Earthquake resistant and tsunami-resistance of sewerage facilities
6.1.4	Status of safekeeping and backup of important information
6.1.5	Damage assumptions
6.2	Selection of priority activities and deciding target response times
6.2.1	List of degree of influences of candidate priority activities
6.2.2	List of methods of implementing and continuing priority activities
6.3	List of studies on damage to resources required for priority activities and countermeasures

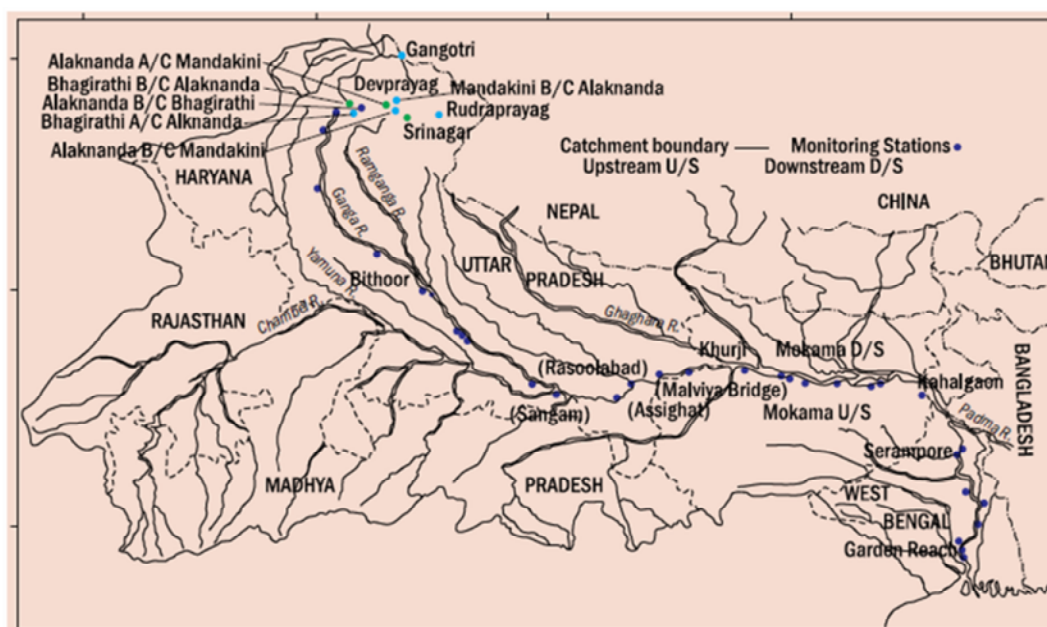
Source: MLIT, 2012



#### 10.4 SITUATION OF RIVERS IN INDIA - IS IT HEADING FOR A POTENTIAL DISASTER?

As discussed earlier, in sewerage, an “emergency” can be happening “silently” to all of a sudden manifest into a major catastrophe of epidemics. The example is the rampant pollution of the water courses by untreated, partly treated, non-point sources and open air defecation subsequently washed into water courses by monsoon rains. Let us consider the most important water course of the river Ganga which supports nearly 40% of our country’s population. The CPCB has instituted water quality sampling stations and monitored the water quality in this river at the sampling stations between 1999 and 2008 as shown in Figure 10.11.

The study reveals that whereas the total Coliforms as MPN should be not more than 5000/100 ml if a water source can be accepted as a raw water for treatment and public water supply, once the river leaves Rishikesh, it is theoretically not meeting the limits and the degree of pollution increases all along the 2.5 km length with faecal coliforms reaching even up to 2,00,000 MPN/100 ml in 2001 itself.



5565

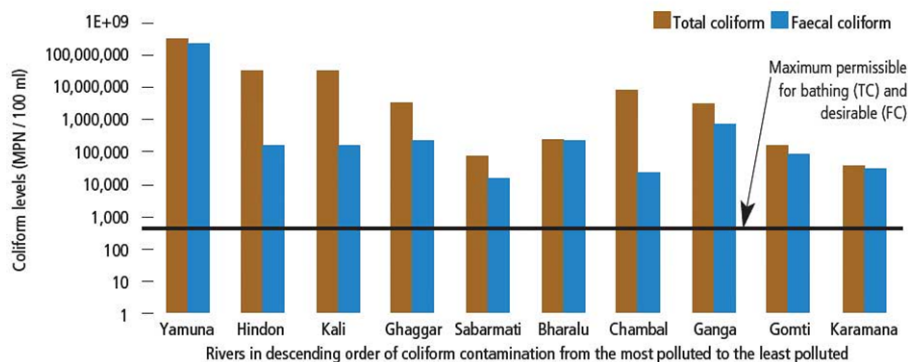
Source: NRCD, MOEF, 2009

Figure 10.11 Stations along Ganga monitored by CPCB between 1999 and 2008

A further recent study by the IITs on the coliforms quality of this river is shown in Figures 5.44 and 5.45 in Part A of this manual shows that the situation is nothing better. Even as of 2009, sewage amounting to 2800 MLD was being discharged into the river and these were not entirely meeting the discharge standards. The position of other rivers too is nothing better as shown in Figure 10.12.

5570

Coliform levels in Indian rivers

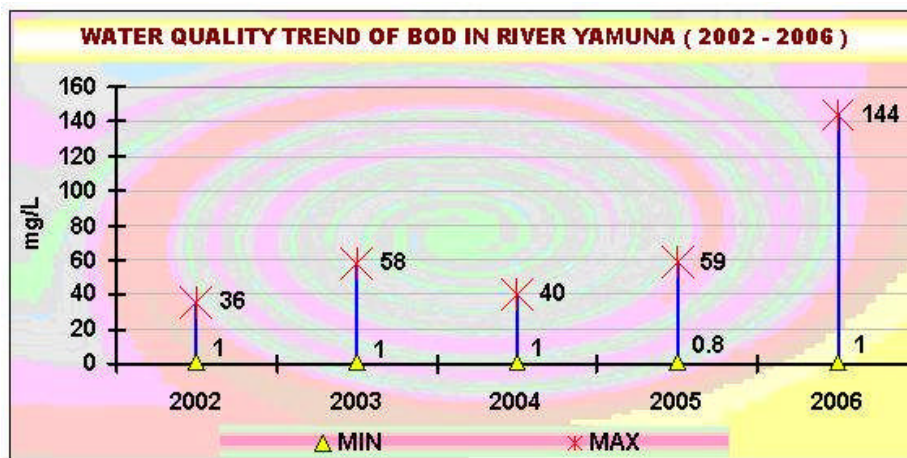


Source: Water Quality Statistics, 2007, CPCB

5575 Source: CPCB, 2007

Figure 10.12 Water quality for Coliforms in major Indian rivers

5580 It may be seen that almost none of these rivers meet the coliforms standard and the heavy pre-chlorination of the raw water at the WTP is able to save the situation. But then, if this keeps on increasing, the question of too much chlorine and decaying organisms in causing Trihalomethanes as carcinogens would be a real disaster. The remedy will be very costly if pre-chlorination is to be avoided. An example is the river Yamuna where the water quality is also affected by BOD as shown in Figure 10.13, though it is reported to have been contained subsequently by commissioning upstream STPs.



5585 Source: <http://www.cpcb.nic.in/water.php#>

Figure 10.13 Status of BOD along River Yamuna as reported by CPCB

5590 The net result is the recent WTP for the Agra city with Yamuna as source, is in effect an STP and not a WTP consisting of Moving Bed Biofilm Reactors like in biological MBBR for not only BOD removal but also for ammonia removal. There is another angle to this. If we consider the livestock which during this river water as it is and the possibility of the bio-geo magnification of pathogens in the animal bovines and again in their meat and milk, it may well be that another Mina Mata type of disaster may manifest itself. The biggest saving grace is that almost everybody takes only bottled water for drinking purpose in urban centres but its affordability in semi urban and rural cities is a question mark. These types of situations cannot be sustained by all local bodies in India. It is also a clear case that the disaster has been developing in the Yamuna river for quite some time and it has not happened overnight.

Thus, it needs to be recognized that disaster arising from sewerage is something which need not be taken too seriously if there is adequate availability of the water even if it is polluted as long as the population can afford bottled water for its drinking and cooking. But the question is what percent of population can afford bottled water?

## **10.5 DISASTER MITIGATION PLAN**

### **10.5.1 The Mumbai Example**

Mumbai experiences a high amount of rainfall during monsoon (June-September), the average monthly rainfall ranging from 550 to 850 mm. Heavy rains during monsoon and cyclone causes rapid increase of flow to sewers and storm water drains. The capacity of sewerage system is not sufficient to handle such events and inundation of roads, basements and houses, etc., may occur. This may also cause a sudden increase in inflow to STP. The occurrence of high tides in sea further complicates the situation. To mitigate the impacts, changes in operation procedures and additional preparations may be needed. Some of these measures are described below.

#### **10.5.1.1 Disaster Management Cell**

The Municipal Corporation of Greater Mumbai (MCGM) has established a Disaster Management Cell to manage disasters. The cell is headed by Chief Officer who is overall in charge of operations of the cell, and is assisted by Deputy Chief Officer. However, in case of a disaster like flood, bomb blast, house collapse, etc., the charge is taken over by the Municipal Commissioner or the Additional Municipal Commissioner in-charge of DMP.

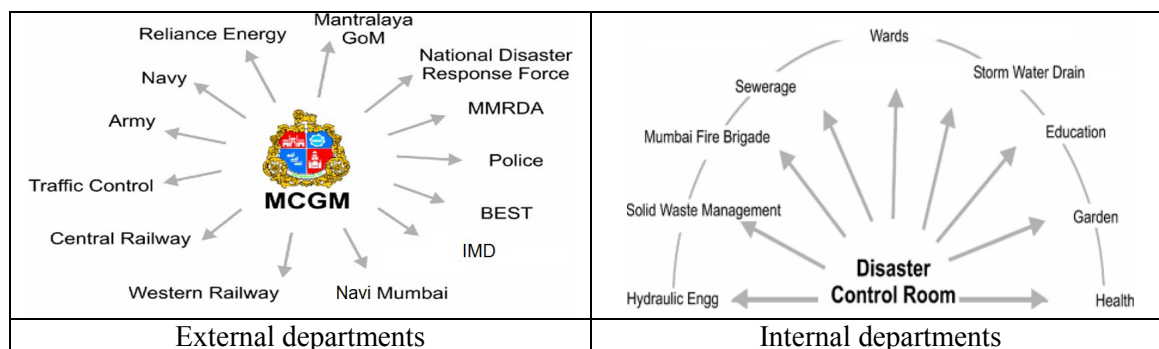
The Disaster Management Cell is well equipped with communication facility, uninterrupted power supply by DG sets and alternate supply, conference hall, pantry and rest rooms with bunker beds, library, etc.

The various communication equipment installed in the Disaster Management Cell includes land lines, hot lines, wireless sets, GSM mobiles, Internet facility, WAN connection to centralized server of MCGM for effective communication between MCGM and stakeholders and to mobilize resources during disaster, and TV sets installed for continuous monitoring of news.

In the monsoon season, nodal officers from various departments are deployed in the Disaster Management Centre. Thirty five (35) Automatic Weather Stations (AWS) are installed in various catchments areas of Mumbai suburbs and city. AWS are used to measure rain, temperature, humidity, wind speed, wind direction, barometric pressure (both inside and outside). All the AWS are interconnected through WAN and live rain data (every 15 minutes) is recorded in Disaster Management Cell. The data collected at the Disaster Management Cell gives a complete picture of isolated downpours in any part of the city or suburbs. It also emits the Early Warning Alarm in case of more than 20 mm of rainfall in 15 minutes. During monsoon an additional communication system namely, HAM Radio is used. All rain data irrespective of monsoon or otherwise is recorded on centralized server which is used for research purpose and further forecasting the rain pattern.

One flow meter is installed at the origin of the Mithi River at Powai which can give the Early Warning in case of rise in water level in the Mithi river, which will help in alerting and evacuating the people in downstream area at Kurla, Kalina, etc. The Disaster Management Cell has provided 2 generators for each ward which will be used basically for illumination of ward control room (established in every monsoon) and ward shelter school in case of power failure.

5640



Source: [http://unisdr-apps.net/confluence/download/attachments/9994389/Mumbai\\_Presentation\\_Sasakawa\\_Award.pdf?version=1](http://unisdr-apps.net/confluence/download/attachments/9994389/Mumbai_Presentation_Sasakawa_Award.pdf?version=1)

Figure 10.14 Coordination with external and internal departments

### 10.5.1.2 Sewerage System Operations for Preparedness against Flooding

- 5645
- To prepare shift schedule for staff of pumping stations and treatment plants for round the clock operation
  - To carry out maintenance of dewatering pumps at pumping stations and keep them in operating condition
- 5650
- To carry out maintenance of all HT/LT breakers, transformers, and other electrical equipment and keep them in operating condition
  - To carry out maintenance of all pumps and motors and keep them in operating condition
  - To raise the existing roads and chambers of the Versova Pumping Station and make storm water drain system for proper disposal of rainwater/floodwater
- 5655
- Solar Energy System has been installed at the Versova Pumping Station
  - To clean all internal drains in advance
  - In order to ensure smooth communication during emergency, walkie-talkie sets will be arranged
  - To arrange emergency lights, candles and match boxes
- 5660
- Proposal for drawing an advance of Rs. 50,000/- will be submitted for making cash available in the office during emergency
  - As per requirement, DG pump sets will be arranged in consultation with Main Sewer section.
- 5665
- To carry out maintenance of screens of all locations and keep them in operating condition
  - To carry out maintenance of all cranes of dry well and keep them in operating condition
  - To carry out maintenance of all sluice gates of pipe lines and keep them in operating condition

- 5670
  - To construct temporary bunds wherever necessary to protect the pumping stations from flooding and to repair existing bund walls in case they are defective
  - To make arrangement of ropes by tightening them to existing trees and poles for easy walking during flooding
  - To make arrangement of first aids at all locations
- 5675
  - To carry out maintenance of internal lightening and keep them in operating condition.

### 10.5.2 Lessons from Disaster Mitigation Plan

5680 The disaster mitigation plan has to draw its lessons from the case studies recounted so far. The simple mitigation plan is to recognize and allocate funds to provide at least the incremental sewerage to all as discussed at length in Part A of the Manual. The funding can also be sought from the head “biological related disasters” in Table 10.1.

5685 Another mitigation plan which needs follow up is from the infamous floods of Orissa in 1990s and the mini hand pump coupled ultra filtration membrane developed by the National Institute of Virology, Pune which saved the population from consuming virus borne waters. This kit needs to be popularized and may be subsidized for households in the rural sector.

Thus there is no need to panic about disaster management plan as long as Gandhiji’s quotation in the beginning of Part A of this manual is realized that is, “For India, sanitation is more important than independence” and at least incremental sewerage is provided on priority to all.

## 10.6 SUMMARY

5690 Introduction explains the definition of disaster and anthropogenic or man-made hazard.

Emergency Situation illustrates cause, effect, and emergency response for earthquake, flood and tsunami respectively. Case studies of water induced disaster such as Hosur Town, 2004, Chennai, 1993, and Orissa Flood 1990, show the influence on potable water due to water pollution caused by malfunction of the sewage system.

5695 Preparation of Emergency Plan explains guide to producing a disaster plan and Japanese case study on how sewage authority has prepared for earthquakes and tsunamis.

Situation of Rivers in India warns of potential biological hazard.

Disaster Mitigation Plan explains the case study of Mumbai Corporation of Greater Mumbai and describes how the sewage facility is protected against cyclones.

5700



# APPENDIX





**APPENDIX 3.1 REFRESHER COURSES BY CPHEEO, MOUD**

Assuming that the scheme of water supply will commence to function from 1986, it is required to estimate the population 30 years hence, i.e. in 2016 and also the intermediate population 15 years after 1986, i.e. in 2001.

Table A3.1-1 List of refresher courses sponsored by the MOUD

Sl. No	Course Category	Name of Course	Level of Participation	Duration
1	WATER	Waterworks Supervisor Course	Junior/Middle Level	4 weeks
2		Waterworks Management	Junior/Middle Level	3 weeks
3		Water Supply System Management	Middle/Senior Level	7-10 days
4		Pipes & Conduits	Junior/Middle Level	9-12 days
5		New Development in Water Treatment	Middle/Senior Level	10 days
6		Structural Design of Water Treatment Plants and Other Related Structures	Middle/Senior Level	1 week
7		Water Treatment Plant Design	Middle/Senior Level	1 week
8		Filter Operation	Junior/Middle Level	10-12 days
9		Care and Use of Chlorinators	Junior/Middle Level	1 week
10		Water Analysis	Junior/Middle Level	4 weeks
11		Chemical Analysis of Water	Junior/Middle Level	7 days
12		Preventive Maintenance and Leak Detection in Water Supply Distribution System	Middle/Senior	7-10 days
13		Cathodic Protection	Junior/Middle Level	1 week
14		Maintenance & Management Related to Municipal Water Works	Middle/Senior Level	1 week
15		Treatment of Arsenic, Iron & Fluoride in Drinking Water	Middle/Senior Level	1 week
16		Water Quality Surveillance	Middle/	12 Days
17		Pumping & Non Pumping Mains for Water Supply System-Design, Operation & Maintenance	Junior/Middle	1 week
18		Water Supply from Ground Water Sources - Quantity/Quality and Ground water Recharge	Junior/Middle	1 week
19		Recent Water Treatment Technology and Quality Surveillance	Middle/Senior	1 week
20		Water Quality Management	Junior/Middle	5 days
21		Testing of Chemicals required for water treatment	Junior/Middle	4 days
22		Recent Development in Water Treatment Technology	Middle/Senior	10 days

Sl. No	Course Category	Name of Course	Level of Participation	Duration
23	SEWERAGE	Waste Stabilization Pond Practices	Junior/Middle Level	1 week
24		Wastewater Analysis	Junior/Middle Level	4 weeks
25		Sewage Works Supervisors	Junior/Middle Level	2 weeks
26		Low Cost Sanitation	Junior/Middle Level	1 week
27		Sewer Cleaning & Maintenance	Junior/Middle Level	9 days
28		Surface drainage in small and medium towns	Middle/Senior Level	1 week
29		Low Cost Techniques for Sanitation, Composting and Wastewater Treatment	Junior/Middle	1 week
30		Chemical Analysis of Sewage	Junior/Middle	7 days
31	COMMON COURSE	Public Health Engineering Structures	Middle/Senior Level	9 days
32		Water & Wastewater Analysis	Junior/Middle Level	4 weeks
33		Corrosion Control	Middle/Senior	1 week
34		Scientific Source Finding	Middle/Senior Level	1 week
35		Laying of Water mains and Sewer Lines	Middle/Senior Level	1 week
36		Operation and Maintenance of Water Supply and Sanitation projects	Middle/Senior Level	10 Days
37		Positive preventive Maintenance of Water Supply and Sewerage system	Junior/Middle	1 week
38		Pumps & Pumping Machinery for Public Health Engineering Job	Junior/Middle	1 week
39	Bacteriological and Biological Examination of Water	Junior/Middle	5 days	
40	WATER CONSERVATION	Rain Water Harvesting	Junior/Middle Level	1 week
41		Ground Water	Middle/Senior Level	1 week
42	MUNICIPAL SOLID WASTE	Solid Waste Management	Junior/Middle Level	7-10 days
43		Solid Waste Management	Middle/Senior	1 week
44	SOFTWARE (INFORMATION TECHNOLOGY)	Computer Aided Design of Pipelines and Pipe Networks for Water Supply and Sewerage Systems	Middle/Senior	1 week
45		Computer Application in PHE Structures Design	Middle/Junior Level	10 days
46		Computer Application for Water Distribution System Management and Water Treatment Plant Design	Junior/Middle Level	9 days
47		Computer Aided Design of Water Supply and Sewerage Network	Junior/Middle Level	10 days
48		Computer Application for Water Distribution System Management	Junior/Middle Level	10 days

Sl. No	Course Category	Name of Course	Level of Participation	Duration
49		Computer Aided Design of Water and Wastewater treatment plants	Junior/Middle Level	1 week
50	MANAGEMENT	Total Quality Management	Middle/Senior	1 week
51		Total Quality Management in Water Supply System	Junior/Middle	1 week
52		Preparation of Water Supply Projects	Junior/Middle	1 week
53		Tenders & Contract	Junior/Middle	1 week
54		Governance of Urban Water Supply & Sanitation	Middle/Senior	1 week

Source: JICA & MOUD, 2011

Table A3.1-2 List of proposed refresher courses in the PHE training programmes

S. No.	Course Name
1	Standard Service Level Benchmarks in respect of Water supply, Sewerage & Sewage Treatment, Solid Waste Management & Storm Water Drainage
2	Preparation of City Sanitation Plan under National Urban Sanitation Policy (NUSP)
3	Septage Management Plan
4	Operation and Maintenance of STPs
5	Decentralized Wastewater Management
6	Rainwater harvesting, water conservation and reuse of wastewater
7	Policy & Regulatory aspects of Water Supply & Wastewater Management
8	Technological options for Municipal Solid Waste Management
9	Emerging technologies in Sewerage & Sewage Treatment
10	GIS Mapping
11	24×7 Water Supply
12	SCADA in Water Supply & Sewerage System
13	Mapping of Infrastructure Networks and Hydraulic Modelling for Water Supply, Sewerage and Storm Water Drainage
14	Demand Side Management of Water Supply through Pricing(Tariff) and Metering, etc.
15	Pressure Management in Water Supply Networks for Diurnal Variations
16	GIS – GPRS based monitoring of MSWM
17	International Quality Standards for Water Supply & Sewage Treatment - Effluent and Re-use Standards
18	Economic Pricing of Water Supply & Sewerage Services
19	Economic Impacts of Lack of Sanitation

20	Desalination Technologies for Water Supply & related Issue
21	Water borne Diseases & Health Effects
22	Maintenance of Conservancy Machinery including Crematoria & Incinerators for Electrical & Mechanical Engineers Environmental Impact Assessment
23	Energy Saving in Public Health Engineering & Related Works for Electrical & Maintenance Engineers
24	Orientation Training Programme for Trainers of WTP Operators
25	National Mission of Sustainable Parameters in a)Water Supply b)Sewerage c)Solid Waste Management and d)Strom Water Drainage
26	Mechanization of cleaning of Sewerage & Drainage & Septic tank systems

Source: CPHEEO, MOUD, 2012

Table A3.1-3 List of some of the institutions that may undertake refresher courses

S. No.	Name of Institutions
1	Motilal Nehru National Institute of Technology (MNNIT), Allahabad, Uttar Pradesh
2	All India Institute of Hygiene and Public Health, Kolkata, West Bengal
3	Centre for Environmental Studies, Anna University, Chennai, Tamil Nadu
4	Sri Jayachamarajendra College of Engineering, Mysore, Karnataka
5	Sri G.S. Institute of Technology and Science, Indore, Madhya Pradesh
6	Gujarat Jalseva Training Institute, Gujarat Water Supply & Sewerage Board, Gandhinagar, Gujarat
7	Visvesvaraya National Institute of Technology, Nagpur, Maharashtra
8	Civil Engineering Department, Indian Institute of Technology, Banaras Hindu University, Varanasi, Uttar Pradesh
9	TWAD Board, Chennai, Tamil Nadu
10	Public Health & Preventive Medicine, Institute of Public Health, Chennai, Tamil Nadu
11	Kerala Water Authority, Thiruvananthapuram, Kerala
12	Institute of Public Health Engineers, Kolkata, West Bengal
13	Research & Training Centre, Maharashtra Jeevan Pradhikaran, Nasik Road, Nasik, Maharashtra
14	All India Institute of Local Self Government, Bhopal, Madhya Pradesh
15	Public Health Department, Government of Orissa, Bhubaneswar, Orissa
16	Rajasthan Institute of Local Self Government, Jaipur, Rajasthan
17	All India Institute of Local Self Government, Mumbai, Maharashtra
18	P.H.E. Department, Government of Rajasthan, Jaipur, Rajasthan
19	Municipal Corporation of Greater Mumbai, Civic Training Institute & Research Centre, Mumbai, Maharashtra

S. No.	Name of Institutions
20	Resource Centre, Metro Water Training Centre, Chennai Metropolitan Water Supply & Board, Chennai, Tamil Nadu
21	All India Institute of Local Self Government, New Delhi

Note: The above list is not exhaustive and yet to be concluded.

Source: CPHEEO, MOUD, 2012

## APPENDIX 3.2 NEED FOR APPLIED R&D IN SPECIFIC ASPECTS

### 1. Time and Motion Study of Sewer Cleaning

Sewer cleaning involves focus on localized preferences of staffing, equipments and affordability. For example, the staffing pattern for sewer cleaning in a given habitation depends on the key factors of

- (a) Type of sewers used being whether they are of vitrified clay, salt glazed stoneware, synthetic materials, composites of concrete, cast iron, ductile iron, etc as in turn dictating the applicability or otherwise of sewer jet rodding and suction machines. With the need to phase out manual entry into sewer systems and thereby improving the mechanized sewer cleaning methods, this becomes all the more challenging. At the same time, the financial aspects of ULBs in regard to revenue from sewerage is extremely limiting in many ULBs that it is becoming difficult to procure and own equipments like the jet rodding and suction machines. This is the paradox in that while everyone accepts there is the compelling need to switch over to these, there are no norms to decide on which capacities of machines and at what numbers are needed. This triggers the infirmity on budgeting for the procurement and O&M of these equipments and more critically the hierarchy of staff needed and their training needs. A crude way of getting over these is to invite tenders for privatized contractors to carry out these sewer cleaning using the machines and accept the lowest evaluated tender as the basis for funding. Here again, if the tender is for the contractor procuring these equipments or for the ULBs to procure them and lease to the contractor. It is obvious that the procedure of the ULB procuring these and leasing to the contractor will be financially much more economical. At the same time, the contractor will not be careful enough in the day to day usage of the machines and this may result in frequent breakdowns and repetitive expenditures. It may appear better to entrust such contracts to the equipment manufacturer himself so that the required supervisory care on a day to day operation and the positioning of operating staff with requisite experience may become available. All the same, there are sewer materials like vitrified clay or salt glazed stoneware in which the sewer jet rodding cum suction machines may not be possible and instead the bucket cleaning machines as also mechanized rodding machines are indicated.
- (b) The depths at which the sewers are laid and the densities of population where the sewers are laid as also the activities like, domestic, commercial or industrial are also vital in deciding on the above issue of machineries. In older cities the required space for positioning equipment itself may not be possible in the narrow roads and the cleaning has to be continued manually only.
- (c) The health condition of the labour who will be getting continually exposed to the atmosphere in the sewers and the cut off deployment time before which the staff needs to be rotated for redeployment in other sectors like water etc are also to be considered.
- (d) There is the associated aspect of accidents and compensations to be paid for in such cases for which financial allocations are called for.

Considering all these, an applied R&D study is urgently needed and which will encompass the above in regard to the nature of the habitation, the densities of habitation, the materials and depths of sewers, staff needs, qualifications etc. The metropolitan cities are reasonably equipped with these machines and such a study would be covering the class I & II cities. The actual work needed during the study will be the compilation and correlation of available data by being resident in the chosen cities for at least two months in a city, talk to operators, staff, public and managers to start with and then to verify these for sustainability with equipment vendors and finally bring out a model that will enable a factual budgeting of these activities.

This study is critically needed to be completed in the coming financial year and the institution to be entrusted with this can be based on availability of the infrastructure in sewerage in the locality. The CMWSSB is the pioneer in these mechanized cleaning having launched in 1980's and has the longest span of experience. There is also the Japanese agencies which have established the norms for that country. Thus, a joint study led by the relevant Japanese organization with the IIT Madras as their counterpart in India could be the optimal entity and if possible to be funded by JICA to that organization directly.

## 2. Disinfection of Secondary Treated Sewage when Discharged to Water Bodies

This is an area crying for attention. Right now, the only authentic study on this is "nil". The only related basis is the report of the Central Pollution Control Board in its publication titled Performance of Sewage Treatment Plants-Coliform Reduction-CUPS / 69 / 2008-CPCB which concludes that "One of the best methods of achieving 100 & faecal microbes removal is coagulation flocculation followed by chlorination after secondary treatment" From a practical point of view, this appears sustainable both physically and financially. However, the lobby on Tri Halo Methane and Total Organic Carbon argues against bringing any form of chlorine in contact with sewage even if treated. The lobby for UV and Ozone are also pitching in with their penchant for sales. There are many forums of debates reaching a crescendo. There is a need to put in a fair amount of effort without getting biased because the discharges reach the aquatic environment and disasters if detected later cannot be reversed that easily and the consequences are shuddering even to think of. Mutations of life forms can also be set in motion over a period of time. The applied R&D in this aspect required the availability of well equipped microbiological laboratories and well trained staff. Clearly, institutions like CPCB with their regional laboratories alone seem equipped and also as continuity to their earlier studies. As far as proving the infrastructure at the site of the STPs, these are to be made available and maintained by the concerned ULBs. Thus, a joint applied R&D by CPCB and selected ULBs are required to take up this study. There is an US-EPA manual itself available on this subject, but then given the status of treated sewages in their STPS Vis a Vis our STPs the reliability of the findings in that manual are to be accepted as not directly applicable and the intuition to endorse the same should be resisted at all costs.

## 3. Fate of Ground Seeded Microbial Pollution in Hilly Regions & Hard rock Areas

Septic tanks are almost the norm of the country for almost all locations where a ready connection to a sewer collection system is not available. The effluent of the septic tank is accepted to be discharged through leach pits, leach dispersion trenches, up flow filters etc before it reaches the soil. There are no standards of measurable parameters for the final treated sewage accessing the soil. This results in a stage where, as long as the soil has the ability to assimilate the organic pollutants, things are under control. But then, the exceptions are hilly regions especially in the North East and the rocky terrain like in Kerala. In the case of North East, the rainfall is severely intense and the hill slopes add to the challenge. The microbial pollutants get almost directly washed down day in and day out into the river courses and these become the sources of potable water supply intakes eventually. IN Kerala where it is more or less hard rock everywhere the organic pollutants can travel through the crevices in the rocks and given the fact that the source of water in those regions scattered among the hills is again the wells driven into these rocky areas, a situation is fast approaching whereby the assimilative self purification capacity of the aquatic body may get exceeded and a variety of dermatic and gastro-intestinal infections may become sporadic to start with and build up to endemicity. There are some studies reported in the country but these are mostly detection of a chosen parameter in its pathway rather than a comprehensive modeling of the fate of ground seeded pathogens as a whole. The CPHEEO manual, 1993 as extracted in the revision of 2013 specifies as follows

### 9.3.3.3.1 Safe Distance from Drinking Water Sources

In dry pits or unsaturated soil conditions, i.e. where the height between the bottom of the pit and the maximum ground water level throughout the year is 2 m and more.

- a. The pits can be located at a minimum distance of 3 m from the water sources such as tube wells and dug wells if the effective size (ES) of the soil is 0.2 mm or less, and
- b. For coarser soils (with ES greater than 0.2 mm) the same distance can be maintained if the bottom of the pit is sealed off by an impervious material such as puddle clay or plastic sheet and 500 mm thick envelope of fine sand of 0.2 mm effective size is provided around the pit.

In wet pit saturated soil conditions, i.e. where the distance between the bottom of the pit and the maximum ground water level during any part of the year is less than 2 m,

- a. The pits can be located at a minimum distance of 10 m from the water sources such as tube wells and dug wells if the ES of the soil is 0.2 mm or less, and
- b. For coarser soils (with ES more than 0.2 mm), minimum distance of 10 m can be maintained if the pit is sealed off by an impervious material such as puddle clay or plastic sheet and 500 mm thick envelope of fine sand of 0.2 mm effective size is provided all round the pit.

#### 9.3.3.3.2 Safe Distance from Water Supply Mains

Lateral distance between the leach pit and the water mains should be at least 3 m provided the water table does not rise during any part of the year above the pit bottom and the inlet of the pipe or drain to the leach pit is below the level of water main. If the water table rises above the bottom of the pit, the safe lateral distance should be kept as 8 m. If this cannot be achieved, the pipes should be completely encased to a length of at least 3 m on either side of the pit.

When the pits are located either under the foot path or under the road, or the water supply main is within a distance of 3 m from the pits, the invert of the inlet pipe should be kept at least 1 m below the ground level. This would ensure that the liquid level in the pits does not reach the level of the water main as the water mains are generally laid at 0.9 m depth.

The water pipe should not cut across the pit, but where this is unavoidable; the water pipe should be completely encased for length of 3 m on either side of the pit including the portion across the pit to prevent infiltration or exfiltration.

A study is reported by National Institute of Technology (NIT), Calicut, Kerala in respect of safe distance in laterite type of soils (An investigation into the safe distance between well and onsite waste disposal systems: A case study from Kerala, India, M. S. Biju, Irfan Khursheed Shahb and George K. Varghese, IJCEES Vol 2(1):11-15, 2011). The study area had houses with either the septic tank-soak pit system or pit latrines, the latter being more common with open wells as the source of water at 1.2 m to 2.4 m below ground in lateritic soil. The horizontal distance between well and the soak pit / pit latrines SWWTS varied from 5 m to 31 m. The MPN of total coliform from nearly 35 wells was studied and it was found that the number of total coliform correlated with the length of a specific parabolic curve connecting the soak pit / pit latrine and the well. This relationship was used to calculate the safe distance between the soak pit / pit latrine and open well so that the total coliform was not exceeding the MoEF classification of class "A" water in the well water and which is "Drinking water source without conventional treatment but after disinfection" at total coliform of not exceeding 50/100 ml and the distance evaluated was 21 m where the water table rises to the level of soak-pit/ pit latrine and the well.

The uncertainty in the foregoing for adoption becomes a matter of concern. Going by the findings of the NIT study, the spacing between a septic tank and abstractable water well needs to be as much as 31 m, which is impossible given the densification of population and real estate costs coupled with security issues when house are that apart in such hilly areas.

Thus, an applied R&D is needed to be instituted to devise technologies which would address the



quelling of water borne pathogenic organisms in septic tank effluents by means of affordable and viable methods. These will be actually pilot plants which are constructed and added as downstream units of existing septic tanks at selected centres and the evaluation of their efficiencies and bringing out a reliable type design. Institutions like NIT, Kerala who have already initiated the study and identifiable institutions in the North East are to be recognized for this.

**APPENDIX 4.1 EXTRACT FROM THE 1985 DOCUMENT OF UNEP TEST  
MODEL FORMAT APPRAISAL OF FUNDING OF 4  
CHENNAI STPS**

Document prepared by United Nations Environment Programme, Bangkok Anna University,  
Chennai and Chennai Metropolitan Water Supply and Sewerage Board

**ENVIRONMENTAL ANALYSIS AND ASSESSMENT OF  
WASTE WATER TREATMENT PLANTS OF  
MADRAS CITY**

*by*

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Vice-Chancellor,  
Perarignar Anna University  
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**Metro water, Madras**

**Dr. M. Swaminathan**

**Corporation of Madras**

**Dr. N. Ramaswamy**

**Agricultural Expert**

## II. Resources Directly Used/Indirectly Affected/ Products and Residues Created

### II (a) RESOURCES USED

#### 1. Directly used/consumed

The following resources, directly used in the project, are economic and measurable.

Description	Quantity	Cost, Million Rs.
Land area for treatment plants	176 hectares	184.8 <sup>1</sup>
Machinery and equipment (including civil works)	5 plants	142.22 <sup>2</sup>
Electrical energy	5 plants	788.28 <sup>3</sup>
Labour		
Maintenance		
Wastewater	222 mld <sup>3</sup>	-

#### 2. Directly affected

These resources may or may not be measurable; the value of the impact of the project on them can only be imputed. It does not have a market price.

Description	Quantity	Cost, Million Rs.
Nil	-	-

1. For calculations, see Appendix IX

2. For details, see Appendix IV.

3. For details, see Appendix II.

### II. (b) PRODUCTS AND RESIDUES CREATED

These are goods and services which confer a benefit or involve a cost.

#### 1) Directly from the development process:

Description	Quantity	Value Million Rs.
a) Treated effluent	222 mld	525.0 <sup>3</sup>
b) Grit and humus	6000 tons/yr	0.75 <sup>2</sup>
c) Digester gas from sludge digestion	22000 m <sup>3</sup> /day	185.0 <sup>3</sup>
d) Improvement in fodder grass yield	12540 tons/yr <sup>4</sup>	43.9

#### 2) Indirectly

Description	Quantity	Value Million Rs.
NIL	-	-

1. Value only from the sale of 40 mld of tertiary effluent from zone II plant. See also Appendices II and III for details.
2. See Appendix III for details.
3. See Appendix II & III for details.
4. See Appendix II and item 5 of appendices III. Improvement is 5 % of grass yield

### III. RESOURCES EXHAUSTED/DEPLETED/DETERIORATED

(By Projects as now implemented)

ITEM	HOW	COST	QUANTUM	VALUE
Nil	Entire project is an environmental enhancement project. No resource is depleted/exhausted/deteriorated	-	-	-

### IV. RESOURCES ENHANCED/1

(By Project now implemented)

ITEM	HOW	COST	QUANTUM	VALUE MILLION RUPEES
1	2	3	4	5
a) Sewage farm raising cattle fodder	Sewage treatment prevents sewage sickness to the soil and improves health of farm workers resulting in 5% increase in production	No extra input except treatment to sewage	Additional 5% of grass production	1.756 p.a.
b) Land adjoining	Treated sewage reduces smell and other unaesthetic conditions for a width of approximately 18 m on either bank of stream concerned. This results in land enhancement.	No extra input except treatment to sewage	5,04,000 m <sup>2</sup>	5.04 m <sup>2</sup>
c) Gas generated in sludge digestion at wastewater treatment plant	.Gas produced can be used as fuel and thus fetch a revenue	No extra input except treatment to sewage	Supply for 19,700 families at Rs. 1/- per family per day	7.4 p.a.
d) Grit and humus produced at sewage treatment plant	The material can be used on land and would fetch a price	No extra input except treatment to sewage	60,000 tons Rs. 5/- ton	0.03 p.a.
e) Health of people in	The sewerage area shows less incidence of	No extra input except	Rs. 840/- per 1,000 persons per	2.643 p.a. <sup>3</sup>

ITEM	HOW	COST	QUANTUM	VALUE MILLION RUPEES
1	2	3	4	5
sewered area	gastro-enteric disease numerically. The benefit associated with this reduction in cases is quantified.	treatment to sewage	year for 3.147 million	
f) Siting of Fisheries Harbour at Madras	The sewage outfall in the sea is relocated further north and this will ensure avoidance of sea pollution. This makes possible siting a fisheries harbour at Kasimode.	Shifting outfall will cost Rs. 6.00 million	Benefit from fish yield in proportion to cost of diversions	12.08 <sup>4</sup> p.a.
g) Treated effluent W.W.T. plant at four places	Reclaimed sewage after tertiary treatment is used for higher quality requirement in industry and fetches Rs. 1.40/- per 1000 litres.	No extra input except sewage treatment	40 mld @ Rs. 1.40 per 1,000 litres	21.0 p.a.

*1 See Appendix VII for detailed calculations*

*2 See also Appendix V for detailed calculations*

*3 See also Appendix VIII for detailed calculations*

*4 See also Appendix VI for detailed calculations*

#### IV. REQUIRED ADDITIONAL PROJECT COMPONENTS – FOR RESOURCE RESTORATION, MAINTENANCE, EXPANSION (POTENTIAL ACTIVITIES)

Suggested Activity Item and Description	HOW	COST	GAINS(+)/LOSSES(-)	
			QUANTUM	VALUE
Not applicable, since there is no resource depletion/deterioration and there is no scope for expansion of sewage farm				

## VI. SUMMARY – DECISION MAKING

Suggested Activity Item and Description	HOW	COST	Value Rs. (Million)
I The Project	Mainly concerning habitat/ settlement with regard to Madras City Total Cost – Over 25 years Products: Fodder grass, methane gas, grit and humus, fish yield, land enhancement, health improvement and treated sewage effluent for industrial purposes.		1115.30 1128.94
II Resources used/affected/ created	Apart from land, machinery and equipment, and electrical energy which are used, raw sewage is also converted to treated sewage for present and potential use. Main residues are gas, treated effluent, grit and humus		1115.30 710.75
III Resources Exhausted/ Depleted/ Deteriorated	Nil		-
IV Resources Enhanced	Increase in fodder crop, improvement in land value adjoining stream carrying excess flow from wastewater treatment plant, gas generation, grit and humus generation, improvement in health of people and increase in fish yield revenue.		418.19
V Required additional Project components for resource restoration	Nil		
VI Decision making	The Environmental cost benefit would be as follows:		

## ENVIRONMENTAL COST/BENEFIT

- A
- 1 The economic cost/benefit on the investment as initially planned is 1115.30:1126.94 i.e. 1:1.01
  - 2 The resource depleted is nil. Accordingly, the result net benefit will be Rs. 1128.94 million.
- B
- 1 The cost of resources enhanced is not separate from the project costs (Rs. 1115.30 million) and hence is not separately stated.
  - 2 Since all the project resources are indigenous, the GDP equivalent is the net benefit from the project (Rs. 1128.94 million)

- C 1 The total cost of project (that is the original economic investment cost plus the cost of resources enhanced) equals Rs. 1115.30 million.  
 2 The total project activities output of the original economic investment plus the result of resources enhanced equal Rs. 1128.94 million
- D 1 Since *the entire project envisages environmental improvement*, the environment cost/benefits is Rs. 1115.30/1128.94, i.e. 1: 1.01  
 2 There is no separate enlarged cost/benefit ratio other than 1:1.01 for this environmental improvement project.

THE COST/BENEFIT ASSESSMENT ON THE PREVIOUS PAGE MAY ALSO BE PRESENTED IN TABULAR FORM  
 AS FOLLOWS

COST BENEFIT PRESENTATION

COSTS			BENEFITS		
Economic Cost /Benefit	a) Original Cost	1115.30	Crude CB 1 : 1.01 Net C/B 1 :1.01	Original Benefit  Less output depleted Net Benefit	1128 94  Nil 1128.94
Environmental Cost/Benefit	No separate cost it attributed for resource enhancement. Since the project itself is for environmental improvement		Environmental C/B 1 : 1.01		
Enlarged Cost Benefit	Total Costs	1115.30	Total CB 1: 1.01	Total Benefit	1128.94



**APPENDIX 6.1 SAMPLE OF DRAFT CONCESSION AGREEMENT ON PPP PROJECT****DRAFT CONCESSION AGREEMENT**

Shimla Water supply and Sewerage System Project

to

Build, refurbish, Operate and Maintain the Water supply and Sewerage System of Shimla City,  
Himachal Pradesh (India)

on Public Private Partnership (PPP) Mode

Shimla Municipal Corporation, Shimla

(<http://shimlamc.gov.in/page/Tenders.aspx>)

**ARTICLE 5 : OBLIGATIONS OF THE CONCESSIONAIRE****5.1 Obligations of the Concessionaire**

- 5.1.1 Subject to and on the terms and conditions of this Agreement, the Concessionaire shall at its cost and expense procure finance for and undertake the design, engineering, procurement, construction, operation and maintenance of the Water Supply and Sewerage System and observe, fulfill, comply with and perform all its obligations set out in this Agreement or arising hereunder.
- 5.1.2 The Concessionaire shall comply with all Applicable Laws and Applicable Permits (including renewals as required) in the performance of its obligations under this Agreement.
- 5.1.3 Subject to Clauses 5.1.1 and 5.1.2, the Concessionaire shall discharge its obligations in accordance with Good Industry Practice and as a reasonable and prudent person.
- 5.1.4 The Concessionaire shall, at its own cost and expense, in addition to and not in derogation of its obligations elsewhere set out in this Agreement:
- (a) make, or cause to be made, necessary applications to the relevant Authority Instrumentalities with such particulars and details, as may be required for obtaining all Applicable Permits (other than those set forth in Clause 4.1.2) and obtain and keep in force and effect such Applicable Permits in conformity with the Applicable Laws;
  - (b) procure, as required, the appropriate proprietary rights, licences, agreements and permissions for materials, methods, processes and systems used or incorporated into the Water Supply and Sewerage System;
  - (c) perform and fulfill its obligations under the Financing Agreements;
  - (d) make reasonable efforts to maintain harmony and good industrial relations among the personnel employed by it or its Contractors in connection with the performance of its obligations under this Agreement;
  - (e) make reasonable efforts to facilitate the acquisition of land required for the purposes of the Agreement;
  - (f) ensure and procure that its Contractors comply with all Applicable Permits and Applicable Laws in the performance by them of any of the Concessionaire's obligations under this Agreement;

- (g) not do or omit to do any act, deed or thing which may in any manner be violative of any of the provisions of this Agreement;
- (h) support, cooperate with and facilitate the Authority in the implementation and operation of the Project in accordance with the provisions of this Agreement; and
- (i) transfer the Water Supply and Sewerage System to the Authority upon Termination of this Agreement, in accordance with the provisions thereof.

## 5.2 Obligations relating to Project Agreements

- 5.2.1 It is expressly agreed that the Concessionaire shall, at all times, be responsible and liable for all its obligations under this Agreement notwithstanding anything contained in the Project Agreements or any other agreement, and no default under any Project Agreement or agreement shall excuse the Concessionaire from its obligations or liability hereunder.
- 5.2.2 The Concessionaire shall submit to the Authority the drafts of all Project Agreements or any amendments or replacements thereto for its review and comments, and the Authority shall have the right but not the obligation to undertake such review and provide its comments, if any, to the Concessionaire within 15 (fifteen) days of the receipt of such drafts. Within 7 (seven) days of execution of any Project Agreement or amendment thereto, the Concessionaire shall submit to the Authority a true copy thereof, duly attested by a Director of the Concessionaire, for its record. For the avoidance of doubt, it is agreed that the review and comments hereunder shall be limited to ensuring compliance with the terms of this Agreement. It is further agreed that any failure or omission of the Authority to review and/ or comment hereunder shall not be construed or deemed as acceptance of any such agreement or document by the Authority. No review and/ or observation of the Authority and/ or its failure to review and/ or convey its observations on any document shall relieve the Concessionaire of its obligations and liabilities under this Agreement in any manner nor shall the Authority be liable for the same in any manner whatsoever.
- 5.2.3 The Concessionaire shall not make any replacement or amendments to any of the Financing Agreements without the prior written consent of the Authority if such replacement or amendment has, or may have, the effect of imposing or increasing any financial liability or obligation on the Authority, and in the event that any replacement or amendment is made without such consent, the Concessionaire shall not enforce such replacement or amendment nor permit enforcement thereof against the Authority. For the avoidance of doubt, the Authority acknowledges and agrees that it shall not unreasonably withhold its consent for restructuring or rescheduling of the Debt Due.
- 5.2.4 The Concessionaire shall procure that each of the Project Agreements contains provisions that entitle the Authority to step into such agreement, in its sole discretion, in substitution of the Concessionaire in the event of Termination or Suspension.
- 5.2.5 Notwithstanding anything to the contrary contained in this Agreement, the Concessionaire agrees and acknowledges that selection or replacement of an O&M Contractor and execution of the O&M Contract shall be subject to the prior approval of the Authority from national security and public interest perspective, the decision of the Authority in this behalf being final, conclusive and binding on the Concessionaire, and undertakes that it shall not give effect to any such selection or contract without prior approval of the Authority. For the avoidance of doubt, it is expressly agreed that approval of the Authority hereunder shall be limited to national security and public interest perspective, and the Authority shall endeavour to convey its decision thereon expeditiously. It is also agreed that the Authority shall not be liable in any manner on account of grant or otherwise of such approval and that such approval or denial thereof shall not in any manner absolve the Concessionaire or its Contractors from any liability or obligation under this Agreement.

### 5.3 Obligations relating to Change in Ownership

5.3.1 The Concessionaire shall not undertake or permit any Change in Ownership, except with the prior written approval of the Authority.

5.3.2 Notwithstanding anything to the contrary contained in this Agreement, the Concessionaire agrees and acknowledges that:

- (i) all acquisitions of Equity by an acquirer, either by himself or with any person acting in concert, directly or indirectly, including by transfer of the direct or indirect legal or beneficial ownership or control of any Equity, in aggregate of not less than 15% (fifteen per cent) of the total Equity of the Concessionaire; or
- (ii) acquisition of any control directly or indirectly of the Board of Directors of the Concessionaire by any person either by himself or together with any person or persons acting in concert with him shall be subject to prior approval of the Authority from national security and public interest perspective, the decision of the Authority in this behalf being final, conclusive and binding on the Concessionaire, and undertakes that it shall not give effect to any such acquisition of Equity or control of the Board of Directors of the Concessionaire without such prior approval of the Authority. For the avoidance of doubt, it is expressly agreed that approval of the Authority hereunder shall be limited to national security and public interest perspective, and the Authority shall endeavour to convey its decision thereon expeditiously. It is also agreed that the Authority shall not be liable in any manner on account of grant or otherwise of such approval and that such approval or denial thereof shall not in any manner absolve the Concessionaire from any liability or obligation under this Agreement.

For the purposes of this Clause 5.3.2:

- (a) the expression "acquirer", "control" and "person acting in concert" shall have the meaning ascribed thereto in the Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeover) Regulations, 1997 or any statutory re-enactment thereof as in force as on the date of acquisition of Equity, or the control of the Board of Directors, as the case may be, of the Concessionaire;
- (b) the indirect transfer or control of legal or beneficial ownership of Equity shall mean transfer of the direct or indirect beneficial ownership or control of any company or companies whether in India or abroad which results in the acquirer acquiring control over the shares or voting rights of shares of the Concessionaire; and
- (c) power to appoint, whether by contract or by virtue of control or acquisition of shares of any company holding directly or through one or more companies (whether situate in India or abroad) the Equity of the Concessionaire, not less than half of the directors on the Board of Directors of the Concessionaire or of
- (d) any company, directly or indirectly whether situate in India or abroad, having ultimate control of not less than 15% (fifteen per cent) of the Equity of the Concessionaire shall constitute acquisition of control, directly or indirectly, of the Board of Directors of the Concessionaire.

### 5.4 Employment of foreign nationals

The Concessionaire acknowledges, agrees and undertakes that employment of foreign personnel by the Concessionaire and/or its contractors and their subcontractors shall be subject to grant of requisite regulatory permits and approvals including employment/residential visas and work permits, if any required, and the obligation to apply for and obtain the same shall and will always be of the Concessionaire and, notwithstanding anything to the contrary contained in this Agreement, refusal of or inability to obtain any such permits and approvals by the

Concessionaire or any of its contractors or sub-contractors shall not constitute Force Majeure Event, and shall not in any manner excuse the Concessionaire from the performance and discharge of its obligations and liabilities under this Agreement.

#### 5.5 Employment of trained personnel

The Concessionaire shall ensure that the personnel engaged by it in the performance of its obligations under this Agreement are at all times properly trained for their respective functions.

#### 5.6 Sole purpose of the Concessionaire

The Concessionaire having been set up for the sole purpose of exercising the rights and observing and performing its obligations and liabilities under this Agreement, the Concessionaire or any of its subsidiaries shall not, except with the previous written consent of the Authority, be or become directly or indirectly engaged, concerned or interested in any business other than as envisaged herein.

### ARTICLE 6 : OBLIGATIONS OF THE AUTHORITY

#### 6.1 Obligations of the Authority

6.1.1 The Authority shall, at its own cost and expense undertake, comply with and perform all its obligations set out in this Agreement or arising hereunder.

6.1.2 The Authority agrees to provide support to the Concessionaire and undertakes to observe, comply with and perform, subject to and in accordance with the provisions of this Agreement and the Applicable Laws, the following:

- (a) upon written request from the Concessionaire, and subject to the Concessionaire complying with Applicable Laws, provide all reasonable support and assistance to the Concessionaire in procuring Applicable Permits required from any Government Instrumentality for implementation and operation of the Project;
- (b) hand over the operation and maintenance of the Project Facilities to the Concessionaire for implementation of the Project;
- (c) undertake that the alignment of the existing pipelines and the location of the Existing Assets and the design thereof are of fundamental importance to the Project and undertakes that it or any Government Agency within its jurisdiction or control or acting on its behalf shall not require the alteration of such alignment and/or location during the Concession Period;
- (d) assist the Concessionaire in procuring Police assistance for ensuring safety of the Project Facilities, removal of trespassers and security on the Water Supply and Sewerage System;
- (e) assign its employees to the Concessionaire to assist the Concessionaire in the discharge of its duties during the Concession Period. However, the Concessionaire shall be required to bear all the costs and expenses i.e. salaries etc of the employees, as assigned by the Authority;;
- (f) support, cooperate with and facilitate the Concessionaire in the implementation and operation of the Project in accordance with the provisions of this Agreement; and
- (g) upon written request from the Concessionaire and subject to the provisions of Clause 5.4, provide reasonable assistance to the Concessionaire and any expatriate personnel of the Concessionaire or its Contractors to obtain applicable visas and work permits for the purposes of discharge by the Concessionaire or its Contractors their obligations under this Agreement and the Project Agreements.

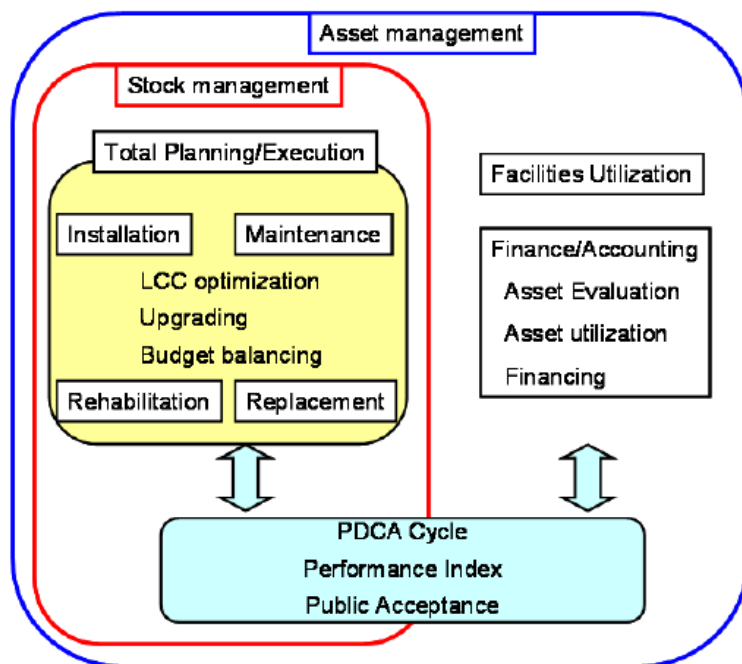
#### 6.2 Maintenance obligations prior to Appointed Date

During the Development Period, the Authority shall maintain the Water Supply and Sewerage

System, at its own cost and expense, so that its operational worthiness and safety are at no time materially inferior as compared to its condition 7 (seven) days prior to the last date for submission of the Bid, and in the event of any material deterioration or damage other than normal wear and tear, undertake repair thereof, or pay to the Concessionaire the cost and expense, as determined by the Independent Engineer, for undertaking such repair after the Appointed Date. For the avoidance of doubt, the Authority shall undertake only routine maintenance during the Development Period, and it shall undertake special repairs only for ensuring safe operation of the Water Supply and Sewerage System, or in the event of excessive deterioration or damage caused due to unforeseen events such as floods or earthquakes.

### APPENDIX 8.1 EXAMPLE OF ASSET MANAGEMENT IN JAPAN

The scope of asset management in sewerage projects is shown in Figure A8.1-1. The Committee (formed by the Ministry of Land, Infrastructure, Transport and Tourism, Japan) lays stress on investigating the basis for developing asset management. Concretely, the Committee aims to “understand the present status of the vast sewerage systems”, “predict mid-to long-term conditions of the systems”, and “maintain the sewerage systems systematically and efficiently” in order to balance the projects and minimize the life cycle costs by considering new construction, maintenance and reconstruction as one process.

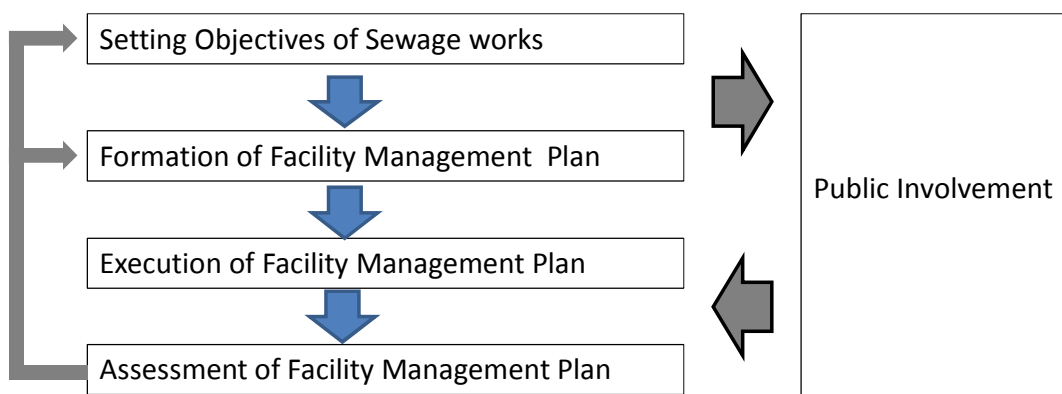


Source: MLIT, 2008a

Figure A8.1-1 Asset management in sewerage project

#### 1. Stock Management and Facility Management Plan

Setting concrete plan based on specific objectives, periodical monitoring of implementation and assessment are necessary in stock management process for AM implementation. When setting and assessing the plan, public involvement is necessary.



Source: MLIT, 2008a

Figure A8.1-2 Components of facility management

### **1.1. Setting Objectives of Sewage Works**

In order to implement sewage works, the administrator should decide the objectives (Objectives A for sewage works, and Objectives B for each facility to fulfil Objectives A) considering regulations, municipal objectives, sewage roles for achieving the objectives of upper-level municipal plans and specific characteristics of sewage facilities. The objectives are decided taking into consideration variation of social conditions and advanced functions for establishing sustainable sewerage system involving public opinion (Table A8.1-1).

Table A8.1-1 Example of objectives of sewage works

Objectives of sewage works (Objective A)				Objectives of sewage works (Objective B)		
Item		Objective	Performance Level	Item		Objective
Ensuring Safety	Reduction of cave-in roads	Road cave-in accident;  0.001 per annum or less	Systematic renewal  Promotion of sewer development	SF	Sewer Reconstruction	Sewer Survey 1000km/year
						Sewer Renewal 30km/year
						Sewer Repair 70km/year
						Trouble shooting rate 100%/year
Ensuring Service Level	Development of sanitary sewer	Coverage of sewer network; 100%	Systematic renewal	SF	Sanitary Sewer	New Development of Sewer 10km/year
				CS/M&E	STP	Working Rate of STP 80%/year
	Sustainable sewage treatment	Level of aging facilities; Reduction of unknown water: 15%→10% Over service-year facility: 10% or less	SF/M&E	Sewer Redevelopment	Inspection of Sewer 100km/year	
					Trouble shooting rate 100%/year	
	Improvement of water quality in public bodies	Water quality of effluent  BOD 20mg/l or less SS 20mg/l or less	Promotion of advanced treatment	CS/M&E	Introduction of advanced treatment	Coverage rate of advanced treatment population 30% or more
						Treated effluent 1000ML/year



Objectives of sewage works (Objective A)				Objectives of sewage works (Objective B)		
Item		Objective	Performance Level	Item		Objective
	Eco-friendly sewage system	Reuse of effluent: 10% or more	Promotion of reuse of effluent	CS/M&E	Development of reuse of effluent	Reused effluent 10MLD/year
			Renewal of Energy efficient equipment		Introduction of high efficient equipment	Electric consumption 20% or more reduction
		Reduction of Carbon foot print: 20% or more	Use of digestion gas & sludge	CS/M&E	Generation of digestion gas	Digestion gas utilization to be optimized
					Use of sludge	Use of sludge rate 10% or more
Minimizing Life Cycle Cost (LCC)	Reduction of LCC	Construction, O&M, Renewal cost:	Introduction of method of cost reduction	SF	Cost reduction of construction and renewal introduction of renewal method, shallow sewer, curved pipe	Cost of construction and renewal 5% or more reduction
				M&E	Cost Reduction of construction , maintenance, renewal	Cost of construction , maintenance, renewal 5% or more reduction
		15 % or more		CS	Cost Reduction of construction and renewal introduction of Lining method	Cost of construction , renewal 5% or more reduction

Legend: SF: Sewer Facility, CS: Civil Structure in STP, M&E: Mechanical and Electrical equipment

Source: MLIT, 2008a

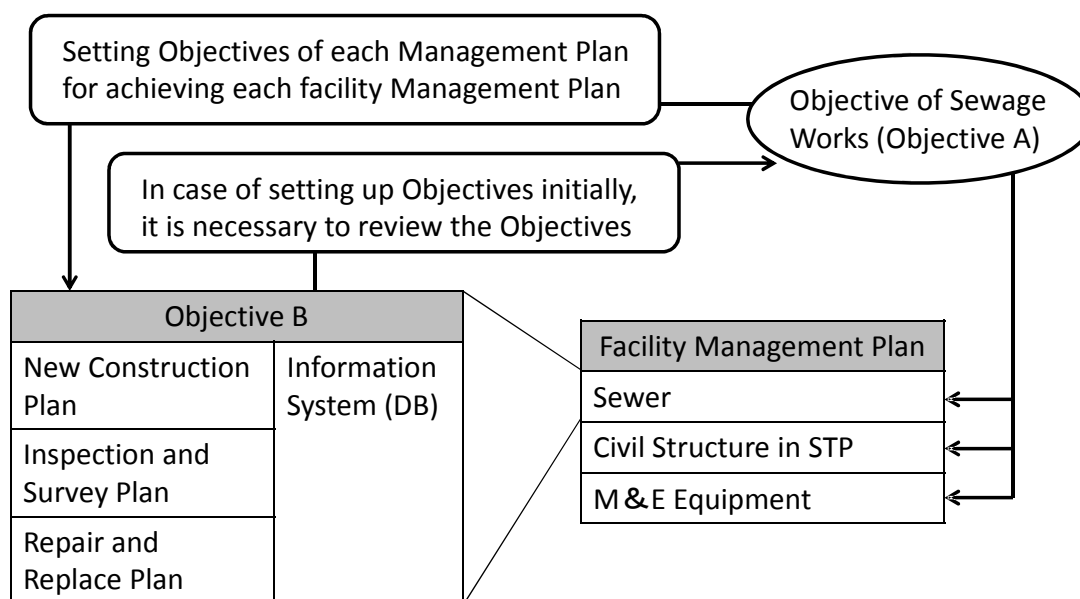
### 1.2. Formation and Implementation of Facility Management Plan

Facility management plan consists of three plans: facility management plan for sewer, facility management plan for civil structures in STP, and facility management plan for M&E equipment in STP. These three facility plans should set objectives (Objective B) and establish “New Construction Plan, “Inspection and Survey Plan” and “Repair and Replacement Plan” for achievement of the objectives. The purposes of ‘Inspection and Survey Plan’, and ‘New Construction Plan’ & ‘Repair and Replacement Plan’ are to understand the conditions of facilities and size of services, respectively. After establishing plans, periodical review is necessary. Furthermore, database is necessary as a tool for optimizing stock management (Figure A8.1-3).

Three categories of Facility Management Plans are for: Sewer, Civil Structure in STP, and M&E equipment in STP.

Each Facility Management Plan includes following: New Construction Plan, Inspection and Survey Plan, and Repair and Replacement Plan.

- New Construction Plan: To plan and implement the expansion plan to increase the coverage of sewage services
- Inspection and Survey Plan: To plan and implement the plan to get information on soundness of the facilities
- Repair and Replacement Plan: To plan and implement the repair and replacement plan to formulate remedy, schedule and cost of repair and replacement of facilities.



Source: MLIT, 2008a

Figure A8.1-3 Components of each facility management (in case of sewer)

Considerations of facility management plan are as follows:

- Facility management plan for sewer network:

Sewer network occupies a major portion of the sewerage capital. It is located largely underground in a complex manner. So, considerable costs and time are required to gather information on conditions of the facility. Traffic load and soil condition affect sewer

failure, which has large impact on the society due to cave-in of roads and groundwater pollution. Therefore considering the impact on living environment, soil conditions, physical features and age of facility, the area should be prioritized and inspection and survey should be conducted systematically in highly prioritized areas.

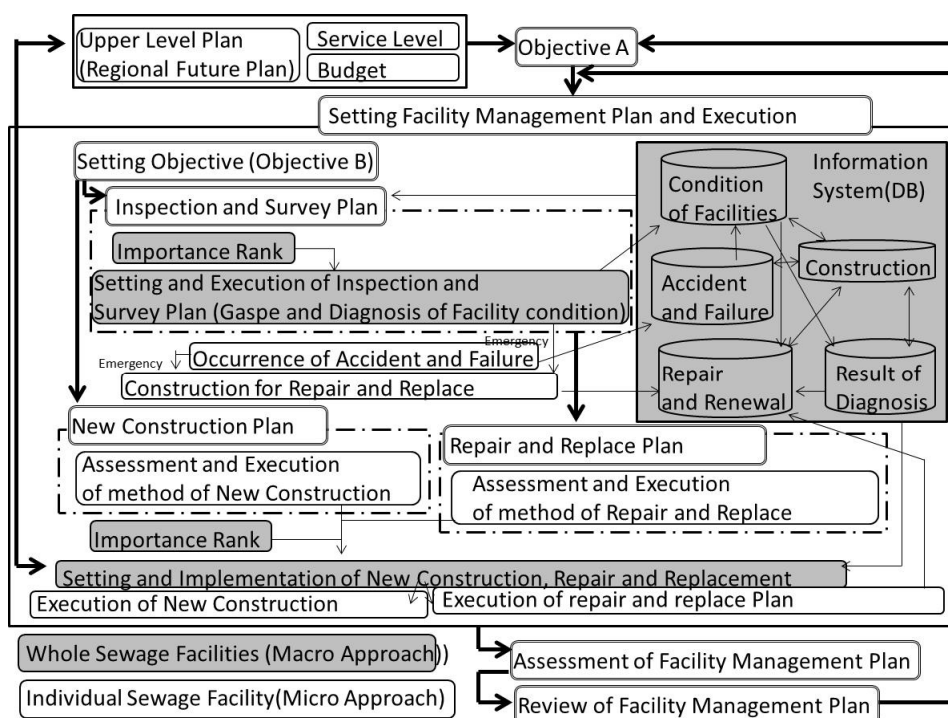
- Facility management plan for civil structures in STP:

Civil structures in STP generally have a long service period. Corrosion of structures in STPs has adverse effect on the concrete and reduces life of the facility. In consideration of social impact by facilities due to corrosion of concrete induced by the hydrogen sulphide gas (H<sub>2</sub>S) and timing of renewal of M&E equipment, priority should be given to facilities and inspection, and surveys of highly prioritized facility should be conducted systematically.

- Facility management plan for M&E equipment in STP

STP has the important function of sewage treatment. In case of failure, effluent may cause the pollution of water bodies. STP consists of many M&E equipment having complicated structures, and their service periods are rather short. So, maintenance of the equipment would be classified as preventive maintenance and corrective maintenance. The required frequency and contents of inspection should be decided according to this classification.

The functions and energy efficiency of M&E equipment should be fully investigated in case of the replacement because of the rapid progress in the R&D of M&E equipment. Figure A8.1-4 shows procedure of facility management plan.



Source: MLIT, 2008a

Figure A8.1-4 Procedure of facility management plan

### 1.3. Assessment and Selection of Method for New Construction Plan

New Construction Plan should be prepared giving attention to selection of the most cost effective method for each facility (Sewer network, civil structures in STP, M&E in STP) considering the social conditions and roles of the sewerage system.

### 1.3.1. Inspection and Survey Plan and their Execution

Inspection and survey are carried out to understand the conditions and diagnose each facility.

a) Understanding of the condition of facility

In this plan, priority should be given to inspection and investigation of the facility by taking into consideration the importance of the facilities. The inspection and survey plan include a list of the target facilities, items and frequency of inspection (Refer to Section 4).

b) Diagnosis

In this case, diagnosis is performed to assess quantitatively to what extent the existing facility is sound (or deteriorated) and to predict when it will fail. In the assessment stage, clear definition of soundness is important so that assessors can clearly assess results.

Clear definition of soundness is also important for recording data which can be used to understand historical changes and for future analysis.

i) Assessment of facility by probability of accident and failure using historical data

- The facilities are assessed by of failure factors and accident factors using data on the conditions of facilities (Refer to criteria described in Sections 4 and 5).
- The failure can be predicted using decay curve by analysing failure factors and accident factors from historical data.

ii) Assessment of probability of accident and failure with no existing historical data

When historical data on conditions of the facility is not available, the soundness of the facilities is decided by age of facilities, materials, environment, construction methods, etc.

Soundness= f (age of facility, materials, environment, construction methods, etc.)

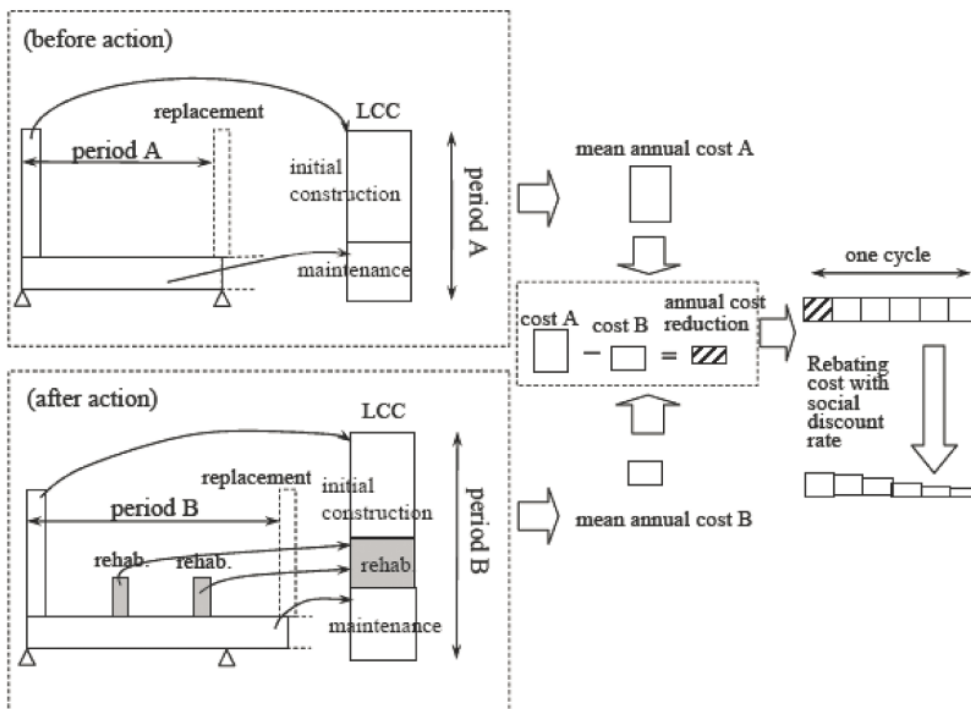
### 1.3.2. Assessment of Repair or Replacement for a Facility

Plan should be drawn up on measures for renewal and rehabilitation based on inspections and surveys on the deterioration of sewerage systems to project prolonged life of facilities, and action should be selected. This assessment aims to prevent accidents and minimize the life cycle cost (Refer to Section 4).

The method of calculating the life cycle cost reduction is shown in Figure A8.1-5.

The procedure is described below:

- a. Decide the assessment periods prior to and after the action.
- b. Calculate the life cycle costs generated within the assessment periods and the mean annual costs before and after the action.
- c. Calculate the cost reduction in each fiscal year by subtracting the mean annual cost before the action from the mean annual cost after action.
- d. Calculate the improved life cycle costs by rebating the improved costs for each year into the time of assessment using social discount rate and summing up.

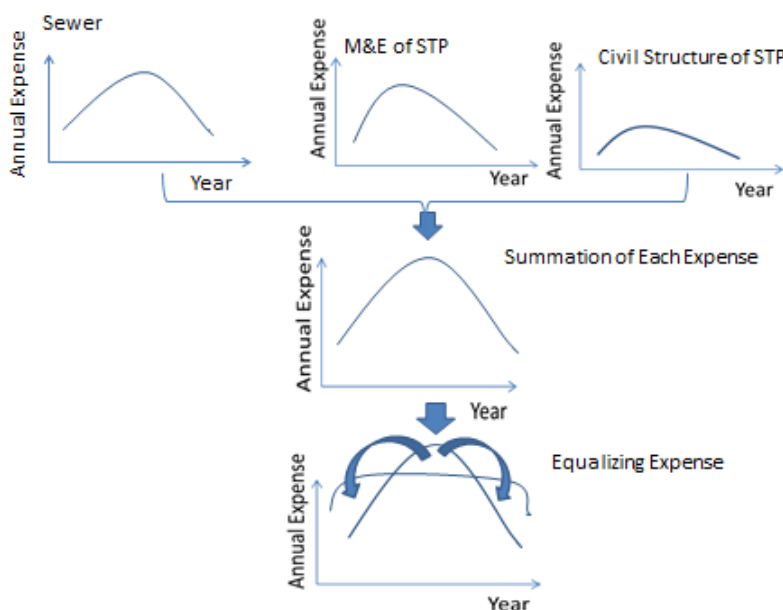


Source: MLIT, 2008b

Figure A8.1-5 Example of method for calculating life cycle cost reduction

**1.3.3. Establishment and Execution of New Construction, Repair and Renewal Plan**

Firstly, the annual budget base of three facility management plans should be calculated considering minimization of life cycle cost and should be summed up. Next, the budget should be reallocated to each plan (Figure A8.1-6) considering in the order of importance the probability of accident and failure and their consequence in the future.



Source: MLIT, 2008a

Figure A8.1-6 Procedure for new construction, O&M and renewal plan

### 1.3.4. Building up Information System and Execution

Sustainable facility management plan requires information on construction, conditions of facilities, results of diagnoses, maintenance and rehabilitation, accidents, failures, and consumer complaint records to be maintained systematically. Setting up of an information system is important for effective use of these data.

### 1.3.5. Organization

It is essential to disseminate the importance and concept of the AM for enhancement of the organization. The concept of the AM may vary from person to person in an organization. Development of human resources is vital for promoting the AM concept.

## 2. Asset Documentation and Disclosure

Users are not only beneficiaries of sewerage services but also the main players because they are tariff payers and users of sewer connections. Accountability to local residents should be fulfilled using the stock management method that regards new construction, maintenance and reconstruction and rehabilitation as one process. Therefore, public involvement is needed as follows:

- Initial stage of AM: When the service level of AM plan is decided, public involvement is necessary. After completing the AM, documentation should be disclosed to the public by Internet, information bulletin or relevant counter at the city hall.
- Assessment stage of AM: When AM plan is assessed, public involvement is necessary. After assessing AM plan, documentation should be disclosed by Internet, information bulletin or relevant counter at the city hall.

For public officials, AM documentation enables easy communication with the users.

## 3. Periodical Asset Assessment

AM is a long or middle term plan and based on many assumption. It is necessary periodically to check and assess the progress of the plan on the basis of plan-do-check-act in principle. If there is some deviation, the AM plan needs to be modified by the cause analysis. In addition, periodical asset assessment is essential to cope with the social needs and changes toward sewage works. Since drawn-up AM plan is based on assumption such as asset risk and estimation of necessary budget, periodical review and fine-tuning of the plan is necessary.

## 4. Asset Management for Sewage Treatment Plant and Pumping Station

### 4.1. Outline of Method of AM for Sewage Treatment Plant and Pumping Station

#### 4.1.1. Civil Structures in STP

- Civil structures in STP are located on the ground surface and hence are visible.
- Concrete structures are damaged by chemical corrosion induced by hydrogen sulphide (H<sub>2</sub>S).
- Hydrogen sulphide is produced from sewage or sludge under anaerobic conditions and eventually could become sulphuric acid and react with concrete and other materials to corrode them.
- Confined places with high hydrogen sulphide need precautions to be taken.
- $D = k \times \sqrt{C \times T}$       D: depth of corrosion (mm), C: Average concentration of Hydrogen sulphide (ppm), T: Service years, k: constant

- Diagnoses in future are based on accumulation of inspection and survey data and soundness of civil structures in the future is predicted. Table A8.1-2 shows example of class of condition of soundness of civil structures.

Table A8.1-2 Example of classification of condition of soundness of civil structures

Grade	State of structure	Action
5	No functional problem when installed first	No measures are needed.
4	State indicates that although the structure is functional, sign of deterioration have appeared.	No measures are needed. (ordinary maintenance is adequate)
3	State indicates that though deterioration has progressed, the structure is functional.	Deterioration has progressed. Recover function of the structure is by repair.
2	State indicates that though deterioration is severe, the structure is functional.	Large scale repairs are needed such as reconstruction or rehabilitation.
1	State indicates the structure is non-functional. (non-functional and cannot withstand long term use )	Reconstruction or rehabilitation is necessary.

Source: MLIT, 2008a

Table A8.1-3 Example of evaluation sheet (civil structure)

Item	Aging Phenomenon		Aging Range		Assessment		Class of Condition
					Aging Phenomenon	Aging Range	
Crack	A	Hair crack	a	10% or less of whole area			
	B	0.2 mm or less	b	10% to 50%			
	C	0.2 mm or over	c	50% or more			
Looseness	A	Confirmed by test hammer	a	10% or less of whole area			
	B	Confirmed visually	b	10% to 50%			
	C	Flaking	c	50% or more			
Water Leakage	A	Bleed	a	0-1 in visual field			
	B	Dripping	b	2-4 in visual field			
	C	Gush	c	More than 5 in visual field			
Rebar Corrosion	A	Spot rust, partially rust fluid	a	Not continuous			
	B	Rust, no loss of cross-section, plenty rust fluid	b	Continuous			
	C	Noticeable rust, loss of cross section, noticeable rust fluid (what is strain??)	c				

Source: MLIT, 2008a

## 4.2. M&E Equipment

Objectives:

- a) Quantitatively understand the conditions of facilities in terms of “soundness” to ensure the safety of the facilities and maintain them in good condition.
- b) Minimize the life cycle costs of the entire facility by keeping it in a good condition to enable rational reconstruction and repair plans to be drawn up.
- c) Draw up project plans in which balancing of expenses and prioritizations are considered to actualize sound management of sewerage projects.

Macro management is a “strategic” level for preparing a long (middle)-term plan of repair and reconstruction in a STP.

Micro management is a “tactical and operational” level of preparing a plan for repair and reconstruction of each facility. Results of micro management should be fed back to macro management.

Criteria: Plant managers can easily know a suitable time of replacing or improving aging facilities at their STPs, thanks to a classification scheme (class 1-5) of conditions of facilities.

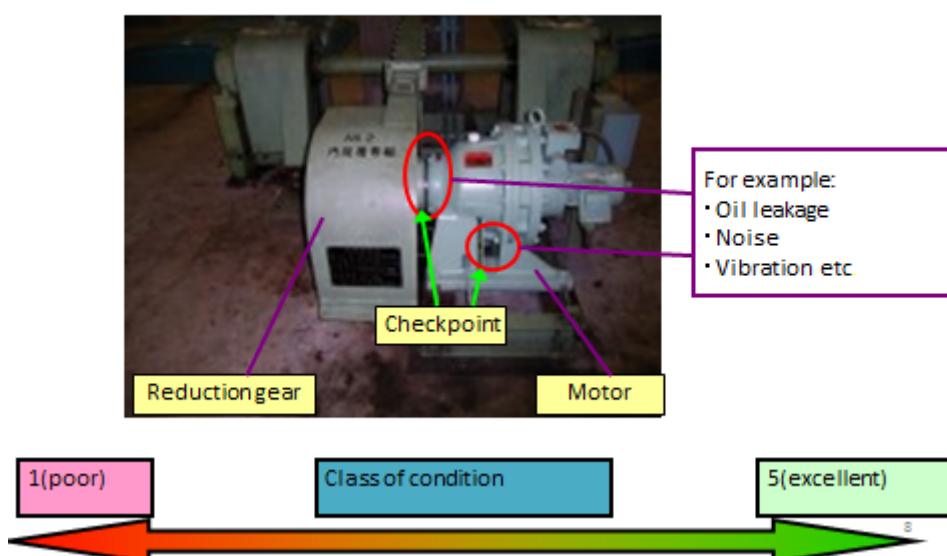
The PDCA Cycle is an essential element of AM. These Plan-Do-Check-Act stages are to be carried out in a cyclic way as follows:

- Plan: Plan an action aimed at improvement
- Do: Check regularly and carry out detailed survey
- Check: Evaluate condition of facilities with data obtained in the Do stage
- Act: Implement measures and improvements

#### 4.2.1. Micro Management

Regular check and detailed survey for each facility at STP is carried out. The level of condition (soundness) is selected from 1 (as poor) to 5 (as excellent), based on oil leakage, noise, vibration, etc. The level of condition is assessed by the prepared evaluation sheet (Figure A8.1-7 and Figure A8.1-8).

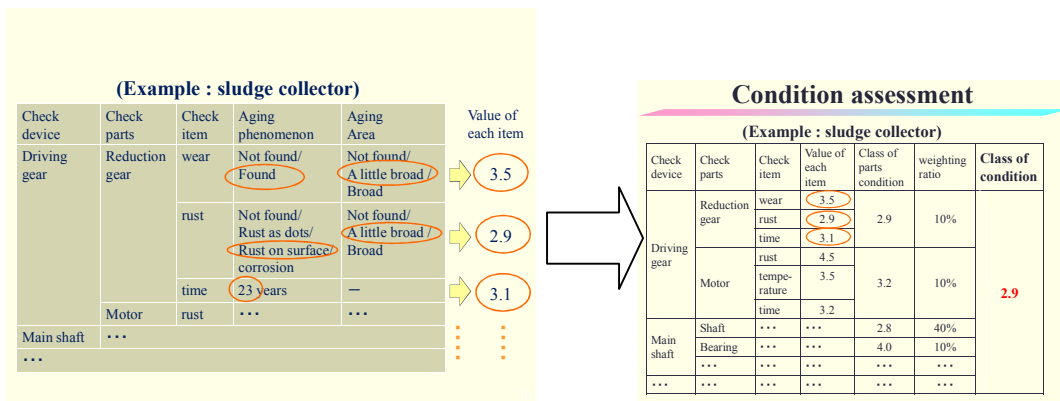
Example : reduction gear and motor of sludge collector)



Source: Matsui, 2009

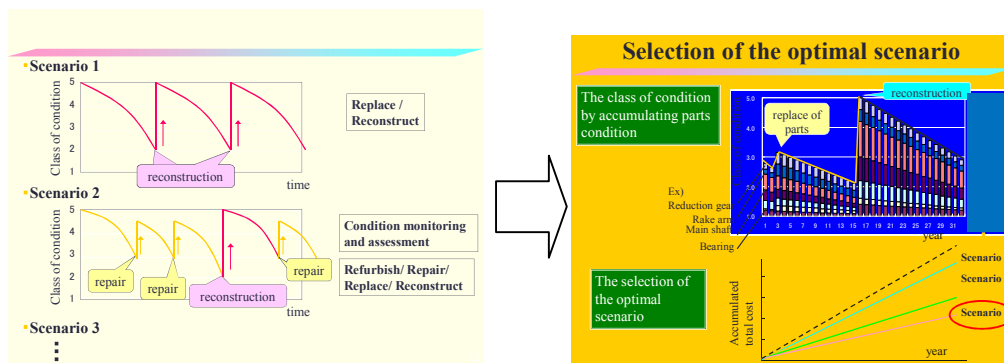


Figure A8.1-7 Survey for condition assessment



Source: Matsui, 2009

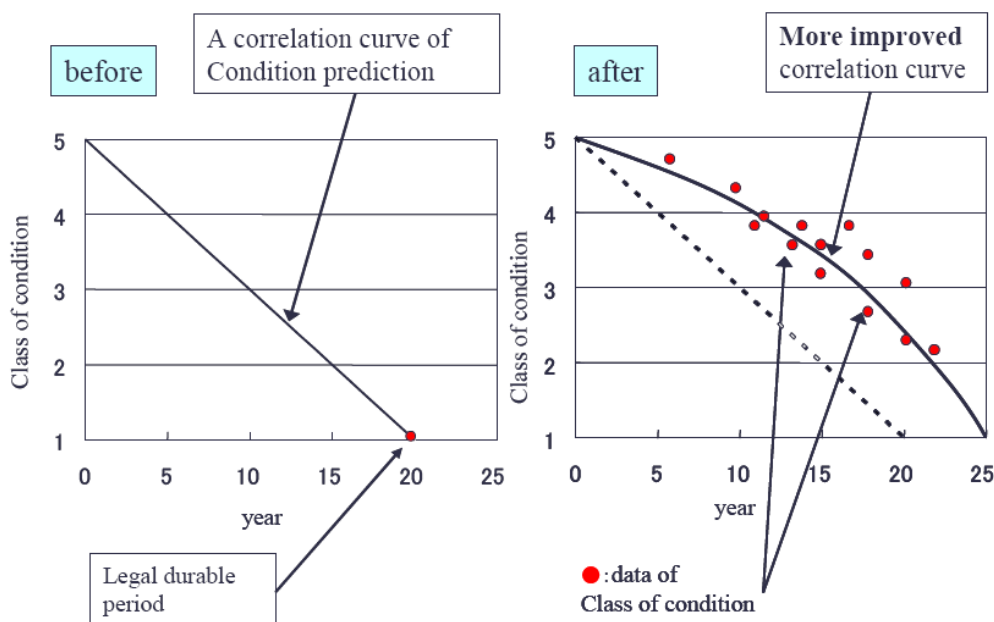
Figure A8.1-8 Example of evaluation sheet



Source: Matsui, 2009

Figure A8.1-9 Examples of scenarios for management

Storing the data of “Class of condition” enables improvement in correlation curves of individual facilities. The more data is obtained, the more accurate the prediction of the future condition of individual facilities (Figure8.1-10). These data are fed to a specific database (DB) system for AM.

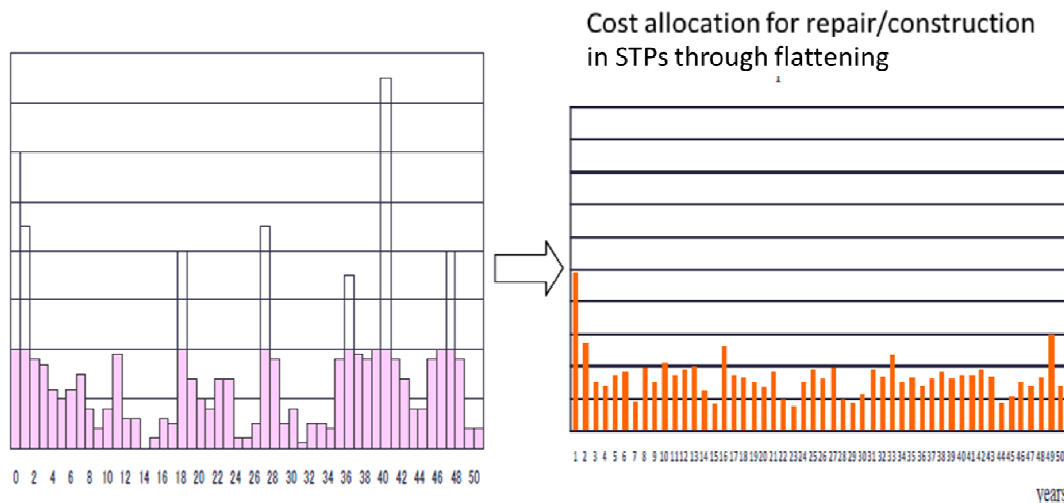


Source: Matsui, 2009

Figure A8.1-10 Prediction of the future condition of individual facilities

**4.2.2. Macro Management**

Macro management is undertaken at the “strategic” level and includes preparation of a long (middle)-term plan of repair and reconstruction in case of a STP. Data related to all facilities will be integrated and used for reviewing budgets of local governments and equalizing budget of repair and reconstruction considering the risk (Figure A8.1-11).



Source: Matsui, 2009

Figure A8.1-11 Benefits of AM in strategic planning

**5. Asset Management for Sewer**

**5.1. Outline of Method of AM for Sewer (Example Practised by NILIM)**

This concept of AM for sewers was developed by the National Institute for Land and Infrastructure Management (NILIM), which is a national research and experimental institute under the Ministry of Land, Infrastructure, Transport, and Tourism, Japan. NILIM performs comprehensive surveys, testing, research, and development concerning the planning and drafting of policies regarding technology for the provision of infrastructure. The results of research enable provision of high quality infrastructure through planning and implementing projects in the relevant sector.

Objectives:

- a) Quantitatively understand the conditions of facilities as “soundness” to ensure the safety of the facilities and maintain them in good condition.
- b) Minimize the life cycle costs of the entire facility by keeping it in a good condition to enable rational reconstruction and repair plans to be drawn up.
- c) Draw up project plans in which balancing of expenses and prioritizations are considered to actualize sound management of sewerage projects.
- d) Fulfil the accountability to local residents using the stock management method that regards new construction, maintenance and reconstruction and rehabilitation as one process.

Methods:

- a) Preparation of a database on sewers, road sinkholes, and pictures from CCTV cameras to understand the present condition of sewers and compilation of data.
- b) Drawing up of mid- and long-term financial plans for securing project funds.
- c) Drawing up of mid- and long-term maintenance plans for deciding priority projects so as to minimize risks.

## 5.2. Macro Management and Micro Management

### 5.2.1. Macro Management Scope

The survival ratio prediction formula to be used for predicting future project costs was investigated as a study topic on financial stock management. The formula should be used for deciding the following items for drawing up plans for future projects:

- How long is the malfunctioning sewer that needs to be reconstructed at that point of time,
- How fast will the length increase,
- What length of sewer will need to be reconstructed or repaired every year?

Grading criteria for sewer span and criteria of sewer condition assessment are shown in Table A8.1-4 and Table A8.1-5. The approximated equation, i.e.,  $y = -0.0108x + 1.0557$  shows that the survival ratio after correction becomes 50% after 51 years of service (Figure A8.1-12). This means that a half of the entire sewer system deteriorates after 51 years of service and requires reconstruction and/or repairing. The approximated slope of minus 0.0108 shows that 1.08% of sewers deteriorates every year, or in other words, 1.08% of sewers require reconstruction and/or repairing every year. Life cycle costs will need to be calculated based on this or similar concept.

Definition of ‘Dead’ sewers for Survival Curve using Survey data (SCS) is given as:

Dead: Emergency I+II because most municipalities rehabilitate Emergency I+II sewers (in Table A8.1-4).

Table A8.1-4 Example of grading criteria for sewer span

Emergency	Category	Criteria of Assessment	Timing of Necessary Action
I	Critical	A dominant	Immediate
II	Bad	Few A & B dominant	Within 5 years after makeshift repair
III	Not well	No A, few B & C dominant	In 5 years or later after makeshift repair

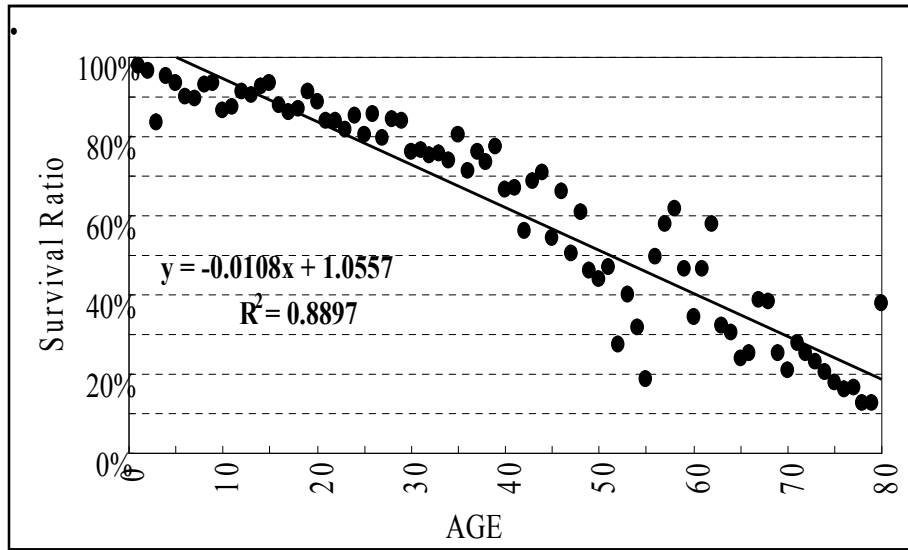
Source: Sakakibara, 2009

Table A8.1-5 Example of criteria of sewer assessment

Mode by Span Basis	A	B	C
Corrosion	Exposed metal bar	Exposed gravel	Rough wall
Sag	Diameter or over	Half diameter or over	Below half diameter

Mode by pipe basis	a	b	c
Fracture	Partially missing or longitudinal crack of 5 mm or over	Longitudinal crack of 2 mm or over	Longitudinal crack of below 2 mm
Crack circumferential	5 mm or over	2 mm or over	Below 2 mm
Joint	Displaced	70 mm or over	Below 70 mm open
Leak	Splashing	Running	Surface stain
Lateral projection	Half diameter over	1/10 diameter or over	Below 1/10 diameter
Root intrusion, grease slime	Half diameter or over blocked	Below half diameter blocked	Na
Mortar	30 % diameter or over blocked	10 % diameter or over blocked	Below 10 % diameter blocked

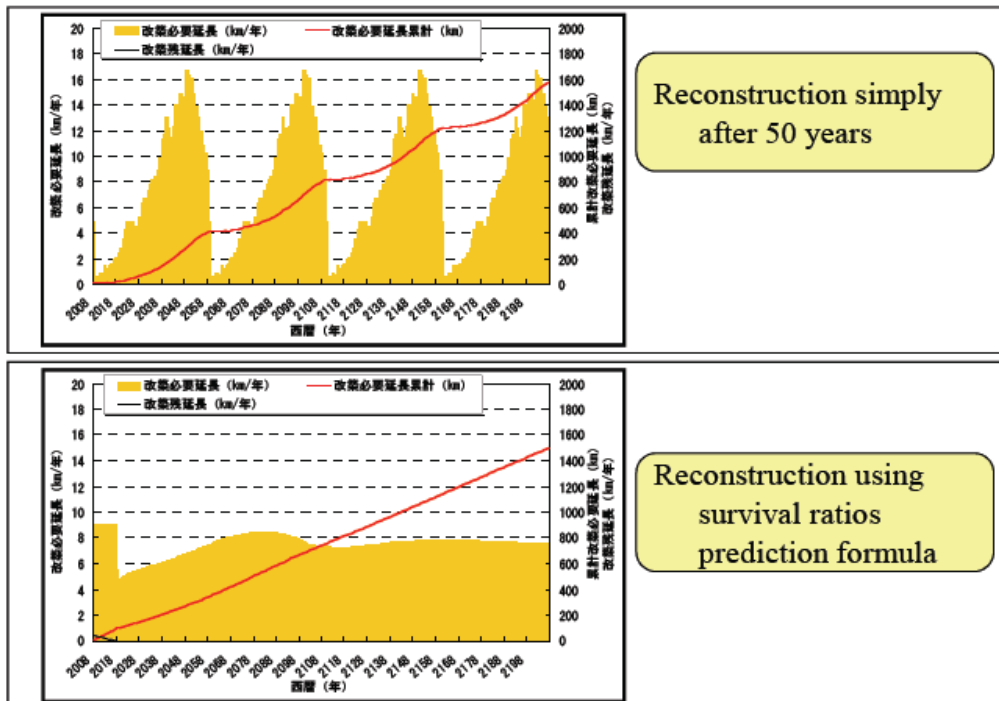
Source: Sakakibara, 2009



Source: Sakakibara, 2009

Figure A8.1-12 Survival ratio prediction formula

The future reconstruction volume in a model city is estimated using ASR formula. The upper chart of Figure A8.1-13 shows simple case of reconstruction of 50-year old sewers. The lower chart shows application of ASR formula (Figure A8.1-13). The lower chart is much flatter than the upper one. The peak reconstruction reduced half from 16 km to 8 km annually.



National Institute for Land and Infrastructure Management

Source: Sakakibara, 2009

Figure A8.1-13 Prediction of future reconstruction volume

### 5.2.2. Micro Management Scope

The tools are to be used for deciding the following items for drawing up plans for deciding project priority to cope with limited funds:

- Where to start surveying, reconstructing and repairing sewers,
- Which sewer is vulnerable to malfunction,
- How large is the damage caused by malfunction such as road sinkhole.

### 5.2.3. Overview of Nationwide Survey on Road Sinkholes

In FY2006, 4,411 cases of road sinkhole occurred in Japan. The frequency of road sinkhole was calculated by using the age of main sewers and the data of sewer length constructed in each fiscal year and by computing the number of sinkhole cases per 100 km of sewer for each causal part. The age of main sewers was limited to 75 years or newer.

The frequencies were in an exponential relationship with the age of the main sewer for all causal parts. Approximation curves for sewers older than 30 years showed large differences among the parts, with an especially high frequency for lateral sewers. This suggested that the frequency of road sinkhole can be predicted for each causal part by the age of the sewers. Combining this method with the assessment of social impact by road sinkhole, will enable comprehensive risk assessment to be made and a priority-based stock management method to be established.

In general the number of damages to sewers by way of cave in type of failures were the highest incidence for lateral sewers and lowest for manhole related.

**APPENDIX 9.1 SERVICE LEVEL BENCHMARKS DESCRIBED IN MOUD HANDBOOK**

Table A9.1-1 Indication of Service Level Benchmark (Sewerage Management)

S. No	Indicator	Method of Calculation	Remark
2.2.1	Coverage of toilets (%)	Coverage of toilets = $[b / a+b]*100$	a) Total number of properties having access to individual toilets or community toilet within individual toilets or community toilet within walking distance in the service area (number) b) Total number of properties without individual toilet or community toilet within walking distance (number)
2.2.2	Coverage of wastewater networks (%)	Coverage of waste water network services = $[b / a]*100$	a) Total number of properties in the service area (number) b) Total number of properties with direct connection to the sewerage network (number)
2.2.3	Efficiency in collection of waste water (%)	Collection efficiency of waste water networks = $[c / ((a+b)*0.8)]$	a) Total water produced (million litres per day (or) month (million litres per day (or) month) b) Estimated water use from other sources (million litres per day (or) month (million litres per day (or) month) c) Wastewater collected (million litres per day (or) month)
2.2.4	Adequacy of treatment capacity (%)	Adequacy of treatment capacity = $[c / ((a+b)*0.8)]$	a) Total water consumed (million litres per day (or) month) b) Estimated water use from other sources (million litres per day (or) month) c) Treatment plant capacity (million litres per day (or) month)
2.2.5	Quality of treatment (%)	Quality of treatment = $[b/a]*100]$	a) Total number of wastewater samples in a month b) Number of samples that pass that specified secondary treatment standards
2.2.6	Extent of recycling or reuse of waste water (%)	Extent of waste water recycled or reused = $[b/a]*100]$	a) Wastewater received at the treatment plants (million litres per day (or) month) b) Wastewater recycled or reused (million litres per day (or) month)
2.2.7	Extent of Cost recovery in waste water management (%)	Cost recovery = $[b/a]*100]$	a) Total annual operating expenses (Rs Crores) b) Total annual operating revenues (Rs Crores)



S. No	Indicator	Method of Calculation	Remark
2.2.8	Efficiency in redressal of complaints (%)	Efficiency in redressal of complaints = $[(b / a) * 100]$	a) Total number of sewerage related complaints (Number per month) b) Total number of complaints redressed with in the month received per month (Number per month)
2.2.9	Efficiency in collection of sewerage charges (%)	Collection Efficiency = $[(a / b) * 100]$	a) Current revenues collected in the given year (Rs. crores per annum) b) Total operating revenues billed during the given year (Rs. crores per annum)

Source: CPHEEO, MOUD, Handbook On Service Level Benchmark

Table A9.1-2 NMSH Indices for Sanitation (sewage part) (distinct from Indicators in SLB framework)

S. No.	Index	Sector of sustainability / Vulnerability reduction	Climate Change Issue	Calculation	Suggested Values for Index			Explanation	Reporting by
					Ideal	Sustainable	Range		
1	Financial sustainability Index in sewage management sector	Overall health of sewage management services	Adaptation & Mitigation	(Revenue from sewage related charges + sale of treated / untreated waste water) / Total O&M cost of sewage management services	>1.00	1.00	1.00 and above	This is a reciprocal of operating ratio but also accounts for revenues from sale of sewage/treated sewage	City
2	Safe Septage Management Index	Vulnerability reduction	Adaptation & Mitigation	(Septage collected & safely treated in a day/month/year)/ (Total Septage sludge cleared/ extracted in a day/month/year)	1.00	0.90	0.90-1.00	Safe septage management mitigates GHG emissions besides reducing disease burden. It is also an adaptive measure for treating human excreta with lesser capital costs than full-fledged water carriage and treatment systems	City
3	Resource recovery Index for sewage		Adaptation & Mitigation	(energy generated from STPs)/ (energy consumed in STPs)	---	---	0.5-1.0	by resource recovery, climate change can be mitigated and also improve financial health of utility	City

S. No.	Index	Sector of sustainability / Vulnerability reduction	Climate Change Issue	Calculation	Suggested Values for Index			Explanation	Reporting by
					Ideal	Sustainable	Range		
4	Energy Efficiency in Sewage Sector	Efficiency in energy utilisation	Mitigation	$\frac{\sum(\text{power factor recorded X connected load at a station...summation of all stations})}{\sum(\text{contracted power factor X connected load at a station...summation of all stations})}$	0.98	0.90	0.9-0.98	Improving energy efficiency has all-round salutary effect-such as reducing GHG emissions; reducing energy costs for utilities; reducing energy shortages and making energy available for more economic activities	City (from power bills)
5	Flood Vulnerability Index for STPs		Adaptation & Mitigation	$\frac{\sum(\text{treatment capacity lower than local HFL line})}{\text{Total Treatment Capacity}}$	---	----	Should show improving trend every year	Treatment facilities are usually built in the lower topography. Hence vulnerable to flooding/ sea water rise in CC scenarios. They have to be built/retrofitted to function fully under such scenarios to prevent disease and protect water supply in downstream areas, besides preventing pollution of water bodies and ground/sea etc.	City
6	School Sanitation Index	Awareness Generation & Behavioural Change		$\frac{\text{(No. of Schools rated for sanitation this year)}}{\text{(No. of Schools rated for sanitation last year)}}$	---	----	Should show improving trend every year	This can indicate the future societal changes that can be brought about by students who are aware & practice good sanitation	City
7	Public Toilet Sanitation Index	Behavioural Change & Citizen Services		$\frac{\text{(No. of Public Toilets rated for sanitation this year)}}{\text{(No. of Public Toilets rated for sanitation last year)}}$	---	----	Should show improving trend every year	This can be a measure of preventing not only open defecation but making the cities friendly to vulnerable sections and tourists etc.	City

S. No.	Index	Sector of sustainability / Vulnerability reduction	Climate Change Issue	Calculation	Suggested Values for Index			Explanation	Reporting by
					Ideal	Sustainable	Range		
8	Training & Capacity Building Index in sewage sector	Capacity Building		(Expenditure incurred in Training & Capacity Building—sewage Sector)/ (Total expenditure in sewage sector or total municipal expenditure)	---	---	0.25% to 0.50%	Climate Change issues can be institutionalized through training and capacity building of personnel engaged in sewage management services	City
9	Awareness Generation Index	Social awareness & citizen responsibility	Adaptation	(Expenditure incurred on IEC etc. on WS issues) / (Total expenditure in Water supply sector or total municipal expenditure)	---	---	0.25% to 0.50%	Developing partnerships with citizens in mitigating effects of climate change	City

Source: CPHEEO, MOUD, Report of the Committee set up to frame National Sustainable Habitat Standards for the Urban Water Supply and Sanitation sector

## **APPENDIX 9.2 PERFORMANCE INDICATORS (PI) FOR ENHANCEMENT OF SEWERAGE SERVICE**

Performance indicators (PIs) can be considered as a management tool to evaluate the degree of undertaking's efficiency and effectiveness. Efficiency is the extent to which the resources of an undertaking are utilized to provide the services, e.g. maximizing services delivery by the minimum use of available resources. Effectiveness is the extent to which declared OI imposed objectives, such as levels of services, are achieved. PIs can also be used for quantitative comparative assessment of performance. This quantitative comparison can be conducted between undertakings, or historically within an undertaking comparing the past and present or actual performance against pre-defined target.

International Water Association (IWA) developed PIs for water- supply services and published "Performance Indicator for Water Supply Services" in 2000. and wastewater services namely "Performance Indicator for Wastewater Services" in 2003, respectively. International Organization for Standardization (ISO) developed international standards regarding activities related to drinking water and wastewater services and published "Guidelines for the Assessment and for the Improvement of the Service to Users: ISO 24510". "Guidelines for the Management of Wastewater Utilities and for the Assessment of Wastewater Services: ISO 24511" and "Guidelines for the Management of Drinking Water Utilities and for the Assessment of Drinking Water Services: ISO 21512" in 2007. ISO 1500s are guidelines for evaluation of entire wastewater services, and their aim is to enhance the efficiency of undertakings and services. PIs used for evaluation are key factors.

Performance of an undertaking can be evaluated from various aspects and wastewater services are composed of numerous complicated activities. Therefore, a number of PIs have been developed and made available. Wastewater services in different countries have different histories, and they have different roles. Therefore, selection of proper PIs for each undertaking is most desirable.

In Japanese national guideline namely "Guideline for Improving O&M of Wastewater Systems", 2007 Japan Sewage Works Association, PIs are composed of Context Information (CI) for undertaking, system and district, Performance Indicators (PI) for operation, users, services, management and environment and References. CIs and PIs of the Japanese guideline are shown in Table A9.1-3.

### **Context Information (CI)**

Context information means background information of a district about legal framework, geological conditions, population, and capacity of facilities, conditions for operation and maintenance and environment, CIs are composed of 25 items and categorized as follows.

- i) Characteristics of an undertaking  
9 items (name of undertaking, application of local public entity law, name of protect, scale of project, number of employee, etc.)
- ii) Characteristics of a project  
12 items (population in administrative district, served population, population density, service ratio, etc.)
- iii) Characteristics of a district

4 items (annual rainfall average temperature future population (100 in 2000), classification of receiving water body, etc.)

### Performance Indicators (PI)

Performance indicator means indicator to evaluate quantitatively results and levels of operation and maintenance service. PIs are composed of 56 items, and categorized as follows.

Table A9.1-3 CIs and PIs

Category	Performance Indicator (PI)	Calculation Formula	Improvement
1. Operation (sewers) (7 Items)			
Op10	Ratio of age of facility (sewer)	Total length of sewers exceeding life time / Total length of sewers maintained × 100	↓
Op20	Ratio of inspected sewer	Total length of inspected sewers / Total length of sewers maintained × 100	↑
Op30	Ratio of repaired sewer	Total length of repaired sewers / Total length of sewers maintained × 100	↑
Op40	Ratio of inspected house connection	Number of inspected house connection / Total number of house connection × 100	↑
Op50	Number of repaired house connection (per 100,000))	Number of repaired house connection / Total number of house connection × 100,000	↑
Op60	Number of collapse per 1 km of sewer	Number of collapse / Total length of sewers maintained	↓
Op70	Maintenance cost per 1 m of sewer	Maintenance cost for sewers / Total length of sewers	↓
2. Operation (wastewater treatment) (12 Items)			
Ot10	Ratio of age of main equipment	Total age of main equipment / Total average life time of mam equipment × 100	↓

Category	Performance Indicator (PI)	Calculation Formula	Improvement
Ot20	Ratio of marginal wastewater treatment capacity'	$(1 - \text{Daily maximum DWF} / \text{Design capacity for DWF}) \times 100$	↑
Ot30	Ratio of emergency power source security	$\text{Number of WWTPs with emergency power source} / \text{Total number of WWTPs} \times 100$	↑
Ot40	Ratio of earthquake- resistant facilities	$\text{Number of earthquake-resistant buildings} / \text{Number of buildings to be earthquake- resistance} \times 100$	↑
Ot50	Compliance with discharge standard (BOD)	$\text{Number of tests complied with standard (BOD)} / \text{Total number of tests (BOD)} \times 100$	↑
Ot60	Compliance with standard (COD)	$\text{Number of tests complied with standard (COD)} / \text{Total number of tests (COD)} \times 100$	↑
Ot70	Compliance with standard (SS)	$\text{Number of tests complied with standard (SS)} / \text{Total number of tests (SS)} \times 100$	↑
Ot80	Compliance with standard (T-N)	$\text{Number of tests complied with standard (T-N)} / \text{Total number of tests (T-N)} \times 100$	↑
Ot90	Compliance with standard (T-P)	$\text{Number of tests complied with standard (T-P)} / \text{Total number of tests (T-P)} \times 100$	↑
Ot100	Compliance with standard of odor	$\text{Number of tests complied with standard of odor} / \text{Total number of tests of odor} \times 100$	↑
Ot110	Unit power consumption (wastewater treatment)	$\text{Power consumed (wastewater treatment)} / \text{Total wastewater treated}$	↓
Ot120	Unit disinfection chemical usage	$\text{Annual consumption of chemical} / \text{Total wastewater treated}$	↓
3.User Service (17Items)			
U10	Provision of storm water drainage	$\text{Area with storm water drainage} / \text{Total planning area} \times 100$	↑

Category	Performance Indicator (PI)	Calculation Formula	Improvement
U20	Compliance with legal water quality standard for water body (BOD)	Number of samples complied with legal standard (BOD) / Total number of legal tests (BOD) $\times$ 100	↑
U30	Compliance with legal water quality standard for water body (COD)	Number of samples complied with legal standard (COD) / Total number of legal tests (COD) $\times$ 100	↑
U40	Compliance with legal water quality standard for water body (SS)	Number of samples complied with legal standard (SS) / Total number of legal tests (SS) $\times$ 100	↑
U50	Compliance with legal water quality standard for water body (T-N)	Number of samples complied with legal standard (T-N) / Total number of legal tests (T-N) $\times$ 100	↑
U60	Compliance with legal water quality standard for water body (T-P)	Number of samples complied with legal standard (T-P) / Total number of legal tests (T-P) $\times$ 100	↑
U70	Compliance with legal water quality standard for water body (E-coli)	Number of samples complied with legal standard (E-coli) / Total number of legal tests (E-coli) $\times$ 100	↑
U80	Sewer Blockages (per 100,000 persons)	Number of sewer blockages / Served population $\times$ 100,000	↓
U90	Third party accidents (per 100,000 persons)	Number of third party accidents Served population $\times$ 100,000	↓
U100	Complaints (per 100,000 persons)	Number of complaints Served population $\times$ 100,000	↓
U110	Response to complaints	Number of complaints responded within one week / Total number of complaints $\times$ 100	↑
U120	Service charge (residential)	According to local government	–
U130	Unit operating cost per person (O&M)	Operating cost (O&M) / Served population	↓
U140	Unit capital cost (capital)	Capital cost (wastewater) / Served population	↓

Category	Performance Indicator (PI)	Calculation Formula	Improvement
U150	Unit cost (O&M + capital)	Cost (wastewater) / Served population	↓
U160	Unit revenue per staff	Revenue / Number of staff	↑
U170	Unit revenue water per staff	Annual volume of revenue water / Number of staff	↑
4. Management (13 items)			
M10	Unit revenue water per person per day	(Annual revenue water / number of days) / Served population	↑
M20	Accounted-for water	Annual accounted-for water / Total treated wastewater × 100	↑
M30	Current balance	Gross earning / Total cost × 100	↑
M40	Transfer ratio (profitable earning)	Transfer / Profitable earning × 100	↓
M50	Transfer ratio (capital earning)	Transfer / Capital earning × 100	↓
M60	Unit revenue	Total revenue / Total accounted-for water	↑
M70	Unit wastewater treatment cost	Wastewater treatment cost / Total accounted-for water	↓
M80	Unit wastewater treatment cost (O&M)	Wastewater treatment cost (O&M) / Total accounted-for water	↓
M90	Unit wastewater treatment cost (capital)	Wastewater treatment cost (capital) / Total accounted-for water	↓



Category	Performance Indicator (PI)	Calculation Formula	Improvement
M100	Cost covering ratio	Service charge revenue / Wastewater treatment cost × 100	↑
M110	Cost covering ratio (O&M)	Service charge revenue / Wastewater treatment cost (O&M) × 100	↑
M120	Cost covering ratio (capital cost)	Service charge revenue / Wastewater treatment cost (capital) × 100	↑
M130	Working accidents (per 1 million m <sup>3</sup> treated wastewater)	Number of accidents which caused 4 days of absence or more / Total wastewater treated × 1,000,000	↓
5. Environment (7 items)			
E10	Pollutant reduction ration in dry weather (BOD)	(1 - Effluent BOD / Inflow BOD) × 100	↑
E20	Wastewater reuse	Wastewater reused / Total wastewater treated by advanced treatment × 100	↑
E30	Sludge recycle ratio	Sludge recycled / Total sludge generated × 100	↑
E40	GHG emission per person	GHG emission by sewerage service in terms of CO <sub>2</sub> / Served population	↓
E50	Compliance with standard for discharge to sewerage	Number of compliance with standard / Total number of samples × 100	↑
E60	Service ratio of advanced treatment for environmental standard	Population served by advanced treatment / Served population × 100	↑
E70	Improvement of combined system	Area for which combined system was unproved (ha) / Total area of combined system (ha) × 100	↑

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References mean indicators which are utilized for determination of higher policy or measure such as fulfilment of environmental policy, and

enhancement of accountability and understanding of customers. References are composed with 34 items and categorized as follows.

i) Indicators for management analysis

8 items (Annual facility improvement ratio, total cost coverage ratio, average depreciation ratio, etc. indicators required when local public entity act is applied)

ii) Indicators for high degree analysis

12 items (Rehabilitation of aged sewer, ratio of earthquake resistant sewers, cost for countermeasures against flooding, etc., indicators for enhancement of various users understanding)

iii) Other indicators

14 items (energy cost, qualification holding ratio, repair cost for wastewater treatment plant, etc. indicators for more detailed management analysis)

Source: Guideline for improving O&M of wastewater systems Japan Sewage Works Association

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