# CHAPTER 2: PROJECT PLANNING

## 2.1 VISION

The vision for urban sanitation in India as mentioned in the NUSP (2008) of GOI is:

“All Indian cities and towns become totally sanitized, healthy and liveable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women”.

## 2.2 OBJECTIVES

The objective of a sewage collection, treatment and disposal system is to ensure that sewage discharged from communities is properly collected, transported and treated to the required degree in short, medium and long-term planning and disposed-off/reused without causing any health or environmental problems.

Short term: Implies the immediate provision of on-site system. It is an interim arrangement until the implementation of the long-term plan. Short-term plans should be formulated for a target up to 5 years from the base year.

Medium term: Implies the provision of a decentralized (non-conventional) system of collection for rapid implementation of collection, transportation, treatment and disposal/local reuse to avoid sporadic sewage discharges into the environment and where conventional sewerage system is not feasible. Medium-term plans should have a target of 15 years from the base year.

Long term: Implies conventional sewage collection, transportation, treatment, and environmentally sound disposal/reuse. It encompasses the short term and medium term. Long-term plans should be formulated for a target of 30 years from the base year.

## 2.3 NEED FOR PROJECT PLANNING

The City sanitation plan is the pre-requisite for sewerage projects. The decision tree in selecting the appropriate technical option whether it is on-site, decentralised or conventional system as in Figure 10.2 shall be followed. While preparing the plan, the data similar to Figure 10.1, has to be first enumerated specific to the classification therein. Only after having assessed the above status, the plan for the city can be conceived in accordance with the NUSP. While doing so the real time total sanitation model shown in Figure 1.2 shall also be taken into consideration.

The city sanitation plan should include

1. Provision of individual and community toilets to prohibit open defecation
2. Conversion of insanitary toilets such as dry or bahao toilets (directly connected to open drain), single pit toilets, etc to sanitary toilets
3. Replacement of existing septic tanks, which are not as per the specifications and further improvements

4. Decentralised sewerage system including treatment and non-conventional sewers such as settled or simplified sewers / small bore sewers, twin drains where water is scarce
5. Septage management including desludging of septic tanks, transportation, treatment and its disposal
6. Mechanization or cleaning of sewers, septic tanks and safety devices for sanitation workers
7. Conventional sewerage system where per capita supply is more than 135 lpcd or augmentation of water supply in contemplated with 135 lpcd
8. Recycling and reuse of treated sewage
9. Provision for public toilets

However, while preparing the CSP, solid waste management and storm water drainage components should also be considered as envisaged under NUSP.

Sewage collection, treatment and disposal systems can be either short-term, medium-term or long-term. To keep overall costs down, most urban systems today are planned as an optimum mix of the three types depending on various factors.

Planning is required at different levels: national, state, regional, local and community. Though the responsibility of various organizations in charge of planning sewage collection, treatment and disposal systems is different in each case, they still have to function within the priorities fixed by the national and state governments and keep in view the overall requirements of the area.

## 2.4 BASIC DESIGN CONSIDERATIONS

2.4.1 Engineering considerations

2.4.2 Institutional aspects

2.4.3 Environmental considerations

2.4.4 Treatment process

2.4.5 Financial aspects

2.4.6 Legal issues

2.4.7 Community awareness

2.4.8 Inter and Intra departmental coordination

2.4.9 Geographical information systems

2.4.10 City master plan

2.4.11 City sanitation plan

### 2.4.1 Engineering Considerations

Topographical, engineering and other considerations, which figure prominently in project design, are mentioned below:

a) Design period, stage wise population to be served, expected sewage volume, sewage quality and fluctuation with respect to time

b) Topography of the general area to be served, its slope and terrain and geological considerations. Tentative sites available for STP, sewage pumping station (SPS) and disposal works, considering flooding conditions

c) Available hydraulic head in the system up to high flood level in case of disposal to a nearby river or high tide level in case of coastal discharge or the level of the irrigation area to be commanded in case of land disposal

d) Depth of groundwater table and its seasonal fluctuation affecting construction, sewer infiltration & structural design (uplift considerations)

e) Soil bearing capacity and type of strata expected to be met with in construction

f) On-site disposal facilities, including the possibilities of segregating the sullage water and sewage and reuse or recycle sullage water within the households

g) Existing water supply, sewerage and sanitation conditions

h) Water reliability, augmentation steps, drought conditions

i) Reuse in agriculture, farm forestry, non-potable urban usages and industries

j) Decentralized sewerage and progressive coverage

### 2.4.2 Institutional Aspects

a) Capability of existing local authority

b) Revenue collection and reliability

c) Capacity building needs

d) Public Private Partnership

### 2.4.3 Environmental Considerations

The following aspects should be considered during design:

a) Surface Water Hydrology and Quality

Hydrological considerations affect the location of outfalls to rivers with regard to protection of nearby water supply intake points either upstream or downstream, especially at low flow conditions in the river. Hydrological considerations also help determine expected dilutions downstream, frequency of floods and drought conditions, flow velocities, travel times to downstream points of interest, navigation, etc.

Surface water quality considerations include compliance with treated effluent standards at the discharge point with respect to parameters like BOD, suspended and floating solids, oil & grease, nutrients, coliforms, etc. Special consideration may be given to the presence of public bathing ghats downstream. The aquatic ecosystem (including fish) may also need protection in case of rivers through minimum dissolved oxygen (DO) downstream, ammonia concentrations in the water, uptake of refractory and persistent substances in the food chain, and protection of other legitimate uses to which the river waters may be put to.

b) Ground Water Quality

Another environmental consideration is the potential for ground water pollution presented by the STP proposed to be built. For example, in certain soils, special precautions may be needed to intercept seepage of sewage from lagoons and ponds. Land irrigation would also present a potential for ground water pollution especially from nitrates. In case of low cost sanitation involving on-site disposal of excreta and sullage, ground water pollution may need special attention if the ground water table is high and if the top soil is relatively porous.

c) Coastal Water Quality

Shoreline discharges of sewage effluents, though treated, could lead to bacterial and viral pollution and affect bathing water quality of beaches. Discharges have to be made offshore and at sufficient depth through marine outfall to benefit from dilution and natural die-away of organisms before they are washed back to the shoreline by currents. The presence of nutrients could also promote algal growth in coastal waters, especially in bays where natural circulation patterns might keep the nutrients trapped in the water body.

d) Odour and Mosquito Nuisance

Odour and mosquito nuisance in the vicinity of STP, particularly in the downwind direction of prevailing winds, can have adverse impacts on land values, public health and environment and general utility of amenities may be threatened. These factors have to be considered in the selection of technologies and sites for location of STP and the use of treated sewage for irrigation.

e) Public Health

Public health considerations pervade through all aspects of design and operation of sewage treatment and disposal projects. Some aspects have already been referred to in earlier part of this section. Public health concepts are built into various bye-laws, regulations and codes of practice, which must be observed, such as:

i) Effluent discharge standards including the permissible microbial and helminthic quality requirements

ii) Standards for control of toxic and accumulative substances in the food chain

iii) Potential for nitrate and microbial pollution of ground waters

iv) Deterioration of drinking water resources including wells

v) Deterioration of bathing water quality

vi) Control measures for health and safety of sewage plant operators and sewage farm workers, and nearby residents, who are exposed to bio-aerosols or handle raw and/or treated sewage.

f) Landscaping

The STP structures need not be ugly and unsightly. At no real extra cost, some architectural concepts can be used and the buildings designed to suit the main climates (humid or dry) generally met within India.

Apart from the usual development of a small garden near the plants office or laboratory, some considerations need to be given to sites for disposal of screenings and grit in a harmless manner, general sanitation in the plant area and provision of a green belt around the STP. Green belt around the STP shall be preferably of plants with shallow roots in order to avoid deep and spread roots from trees accessing the water retaining structures and damaging their construction by ingress to the moist zones.

g) Status of pollution of surface waters, ground waters and coastal waters

h) Remediation needs and realistic solutions to mitigation of pollution

i) Solid wastes disposal and leachates as affecting the likely siting of STPs

j) Condition of sludge generated in STPs and potential to go in for vermicomposting

k) Clean Development Mechanism by biomethanation and energy recovery from STPs

l) Vital statistics and frequency of waterborne and vector borne diseases

### 2.4.4 Treatment Process

The process considerations involve factors, which affect the choice of treatment method, its design criteria and related requirements such as the following:

a) Sewage Flow and Characteristics

This constitutes the primary data required for process design. The various parameters to be determined are described in other sections of the manual.

b) Degree of Treatment Required

In case of domestic or municipal sewage, this is considered, for example, in terms of removal of BOD, nutrients (nitrogen and phosphorous), coliforms, helminths etc. Land disposal generally has to meet less stringent discharge standards than disposal to surface waters. Land disposal also has the advantage of avoiding nutrient removal in STP and is preferred wherever feasible. It is often not enough to aim only at BOD removal and let other items be left to unspecified, incidental removal, whatever may occur. The selection of a treatment process thus, depends on the extent of removal efficiency required for all the important parameters and the need to prevent nuisance conditions.

c) Performance Characteristics

The dependability of performance of a process in spite of fluctuations in influent quality and quantity are very useful attributes in ensuring a stable effluent quality. Similarly, the ability to withstand power and operational failures, also form important considerations in the choice of treatment process. The more high-rated treatment process, the more sensitive it is in operation. Other processes like digesters, lagoons and ponds may be sensitive to extreme temperature range. The choice has to match with the discharge standards to be met in a specific case. The performance characteristics for some methods of sewage treatment are indicated in Appendix A.2.1.

d) Other Process Requirements

Various other factors affecting the choice of a process include requirements in terms of -:

- Land
- Power and its dependability
- Operating (and control) equipment requirement and its indigenous availability
- Skilled staff
- Nature of maintenance problems
- Extent of sludge production and its disposal requirements
- Loss of head through plant in relation to available head (to avoid pumping as far as possible)
- Adoption of modular system

Between the land and power requirements, a trade-off is often possible, based on the actual costs. This could well be exploited to get an optimum solution for ensuring treatment requirements and giving a dependable performance.

The operating equipment and its ancillary control equipment should be easy to operate and maintain (with indigenously available spare parts) as far as possible. It is to be noted that, methane gas collection, scrubbing to remove hydrogen sulphide wherever necessary and its conversion to electricity, should be effectively done. The option of gas collection and supply to a nearby industry or area should be favoured during the site selection stage wherever possible.

The related issues are –

e) To be affordable by the ULB for its O&M

f) Trade-offs between portions to be treated for industrial uses and portions to be discharged

g) Possibility of upgrading with respect to incrementing flows over time

h) Dependency on proprietary spares to be avoided or in built into the O&M contract itself

i) Local skills to comprehend and implement monitoring

### 2.4.5 Financial Aspects

Finally, from among the few selected options, the overall costs (capital and operating) and financial sustainability have to be determined in order to arrive at the optimum solution.

a) Capital costs include all initial costs incurred up to plant start-up, such as:

- Civil construction, equipment supply and erection costs
- Land purchase costs including legal fees, if any
- Engineering design and supervision charges
- Interest charge on loan during construction period

b) Operating costs after start-up of plant include direct operating costs and fixed costs, such as:

- Amortisation and interest charges on capital borrowing
- Direct operation and maintenance costs on
  - Salary & Wages
  - Chemicals
  - Energy
  - Transport
  - Maintenance and repairs
  - Tools and Plants
  - Insurance
  - Overheads

c) Financial sustainability

- Levy of appropriate sewerage charges
- Capacity & Willingness to pay by the users.
- Willingness to charge
- Efficient sewerage charge collection
- Supplementary budget from alternate sources
- Revenue generation potential of the concerned local body, water boards, PHED's / Jal Nigams, Parastatal organizations, as the case may be
- Actual recovery generated

### 2.4.6 Legal Issues

In general, legalities do not affect sewerage projects except land acquisition issues, which require tact, patience and perseverance.

### 2.4.7 Community Awareness

In general, the decision-making on sewerage system management is carried out without involving the public at large and this has to change by appropriate web-based messages, hand-outs, public hearings and documenting the outcomes and taking the population along.

### 2.4.8 Inter- and Intra-departmental Coordination

a) Co-ordination between ULB and water boards/PHEDs/Jal Nigams/as the case may be

b) Co-ordination among water boards / PHEDs / Jal Nigams / ULB as the case may be and the elected representatives

c) Intra-departmental coordination

### 2.4.9 Geographical Information Systems

Geographical Information Systems (GIS) should be an integral part of sewage collection system. It allows developing city master plans (CMP), including CSP rapidly and in a precise manner and can be related precisely to its position in the ground.

The spatial modelling capabilities of GIS can be used to estimate current and future sewage flows, evaluate the capacity of the sewers and estimate the condition of the sewers.

### 2.4.10 City Master Plan

The CMP shall be prepared clearly indicating the various aspects as this will form a basis for the project. The CSP shall also mandatorily form part of the CMP. The various aspects to be considered are in Chapter 10. Any proposal submitted for funding shall mandatorily include the CMP and CSP. It is very important and pertinent to include and account for the mandatory provision of adequate and proper sanitation facilities in every school in the country thus complying with the directive of the GOI.

The planning period to be adopted for the preparation of the master plan shall be 30 years. In order to bring the master plan projections on the same time line for comparison and funding, the Town & Country planning authority would also be required to increase their planning period, from the present 20 years to 30 years for the reasons mentioned earlier.

### 2.4.11 City Sanitation Plan

The CSP should be a part of CMP and it should be prepared in accordance with the NUSP. The planning design period for on-site, decentralised and centralised systems shall be 5 years, 5 to 15 years and 30 years respectively.

## 2.5 DESIGN PERIOD

The project components may be designed for the periods mentioned in Table 2-1 overleaf.

Table 2.1 Design period of sewerage components

| Sl. No | Component | Design Period, Years (from base year) |
|---|---|---|
| 1 | Land Acquisition | 30 years or more |
| 2 | Conventional sewers (A) | 30 |
| 3 | Non-conventional sewers (B) | 15 |
| 4 | Pumping mains | 30 |
| 5 | Pumping Stations-Civil Work | 30 |
| 6 | Pumping Machinery | 15 |
| 7 | Sewage Treatment Plants | 15 |
| 8 | Effluent disposal | 30 |
| 9 | Effluent Utilization | 15 or as the case may be |
| (A) Typical underground sewers with manholes laid in the roads<br>(B) All types such as small bore, shallow sewers, pressure sewers, vacuum sewers | | |

Source: CPHEEO, 1993

## 2.6 POPULATION FORECAST

### 2.6.1 General Considerations

The design population should be estimated by paying attention to all the factors governing the future growth and development of the project area in the industrial, commercial, educational, social, and administration spheres. Special factors causing sudden immigration or influx of population should also be predicted as far as possible.

A judgement based on these factors would help in selecting the most suitable method of deriving the probable trend of the population growth in the area or areas of the project from the following mathematical methods, graphically interpreted where necessary:

a) Demographic method of population projection

The population change can occur in three ways: by birth (population gain), by death (population loss), or by migration (population loss or gain depending on whether movement-out or movement -in occurs in excess). Annexation of area may be considered a special form of migration. Population forecasts are frequently made by preparing and summing up separate but related projections of natural increases and of net migration, and are expressed below.

The net effect of births and deaths on population is called natural increase (natural decrease, if deaths exceed births).

The migration also affects the number of births and deaths in an area, and hence, projections of net migration are prepared before projections for natural increase.

This method thus takes into account the prevailing and anticipated birth rates and death rates of the region or city for the period under consideration.

An estimate is also made of the emigration from and immigration to the community, its area-wise growth and the net increase of population is calculated accordingly considering all these factors by arithmetical balancing.

b) Arithmetic increase method

This method is generally applicable to large and old cities. In this method, the average increase of population per decade is calculated from the past records and added to the present population to estimate population in the next decade. This method gives a low value and is suitable for well-settled and established communities.

c) Incremental increase method

In this method, the increment in arithmetical increase is determined from the past decades and the average of that increment is added to the average increase. This method gives increased values compared to the figures obtained by the arithmetical increase method.

d) Geometrical increase method

In this method, the percentage increase is assumed as the rate of growth and the average of the percentage increase is used to determine the increment in future population. This method gives a much higher value and is applicable to growing towns and cities having a vast scope of expansion.

e) Decreasing rate of growth

In this method, it is assumed that the rate of percentage increase decreases, and the average decrease in the rate of growth is calculated. The percentage increase is modified by deducting the decrease in the rate of growth. This method is applicable only to those cases where the rate of growth of population shows a downward trend.

f) Graphical method

There are two methods: in the first method, only the city in question is considered; and in the second method, other similar cities are taken into account.

i) Graphical method based on single city

In this method, the population curve of the city (i.e., the population vs. past decades) is smoothly extended for obtaining values for the future. The curve should be extended carefully; this requires vast experience and good judgement. The line of best fit may be obtained by the method of least squares.

ii) Graphical method based on cities with similar growth pattern

In this method, the city in question is compared with other cities that have already undergone the same phases of development, which the city in question is likely to undergo. Based on this comparison, a graph of populations versus decades is plotted and extrapolated.

g) Logistic method

The S shaped logistic curve for any city gives the complete trend of growth for the city right from beginning to the saturation limit of population of the city. This method is applicable to very large cities with adequate demographic data.

h) Method of density

In this approach, the trend in rate of increase in population density for each sector of a city is determined and population is forecast for each sector based on the above approach. Addition of population sector-wise, gives the population of the city.

### 2.6.2 Final Forecast

While the forecast of the population of a project area at any given time during the design period can be derived by any one of the foregoing methods appropriate to each case, the density and distribution of such population in several areas, zones or districts will again have to be estimated based on the relative probabilities of expansion in each zone or district, according to the nature of development and based on existing and contemplated town planning regulations. Wherever population growth forecast or master plans prepared by town planning authorities or other appropriate authorities are available, the design population should take these figures into account.

Floating population should also be considered which includes number of persons visiting the project area for tourism, pilgrimage or for working. The numbers should be decided in consultation with the tourism departments and specified for water supply and sewerage.

The worked out examples for estimation of future population by some of the methods are given in Appendix A.2.2.

## 2.7 PROJECT AREA

The factors that influence the determination of project area include natural topography, layout of buildings, political boundaries, economic factors, CMP, etc. For larger drainage areas, though it is desirable that the sewer capacities are designed for the total project area, sometimes the political boundaries and legal restrictions prevent construction of sewers beyond the limits of the local authority. However, when designing sewers for larger areas, there is usually an economic advantage in providing adequate capacity initially for a certain period of time and constructing additional sewers, when the pattern of growth becomes established. The need to finance projects within the available resources necessitates the design to be restricted to political boundaries. The project area under consideration should be marked on a key plan so that the area can be measured from the map.

## 2.8 REUSE AND DISPOSAL

The reuse of treated sewage should be given preference over disposal and the various options are discussed in Chapter 7 of this manual.

## 2.9 LAYOUT AND ARRANGEMENT OF SEWERAGE

The layout of collection systems shall resist the tendency to go in for underground sewerage flat out even in habitations that are only sparsely developed. The options of either time-deferred underground sewerage or incremental sewerage commensurate with the pace of development by such options as small bore, shallow sewers, twin drains, etc., to start with and eventual underground sewerage when habitations have been populated to a certain level where the revenue will be able to sustain the O&M.

The layouts by small communities shall be mandated to include the small bore sewer system / twin drain in both sides of roads, whereby the house side drain will receive the septic tank effluent and the road side drain will receive the storm water runoff. In metropolitan urban centres, decentralized sewerage shall be confined to institutional boundaries only and not culled out of habitations itself and zoning of sewerage with STPs fanning out radially outwards is to be encouraged.

A flat out choice of underground sewerage with sewers in middle of roads shall be discouraged and incremental sanitation as settled sewers, small-bore sewers, twin drain for septic tank effluents and sewers on shoulders of wide roads are to be evaluated as detailed in Chapter 3 of this manual.

## 2.10 LEGISLATION AND REGULATIONS

a. Water (Prevention and Control) Act, 1974

In this Act, it is necessary to obtain a consent to establish (CTE) from the Pollution Control Board (PCB) before starting the work of STP. Similarly, it is necessary to obtain the consent to operate (CTO) after completion of the construction and before actual operation. The CTE is based on whether the proposed STP design meets the discharge standards for treated sewage and the CTO is based on whether all the units originally committed are actually built and to the same size. Starting the construction without the CTE and starting the operation without CTO are punishable as an offence.

b. Environment (Protection) Act, 1986

The discharge standards for treated sewage, the noise standards governing the STP, the air emission standards governing the STP are prescribed in this act and are binding without exception. The PCB is empowered to tighten these standards wherever it is needed.

c. Municipal Bye-laws

Most municipal bye-laws stipulate that the owner of any property shall dispose of sewage in a proper manner without causing any nuisance to others. Wherever municipal sewers exist within a specified distance as per the respective bye-laws, it is obligatory that the sewage of the property be discharged into it. The bye-laws provide for action against defaulting owners.

d. Environment Impact Assessment

According to the Environment Impact Assessment (EIA) notification issued in 2006 by MoEF, this is not needed for sewerage projects. However, the concerned agencies are advised to maintain all the necessary facts and figures related to the total sanitation programme in the form of an effective and efficient Management Information Systems (MIS) which might be required in future under NUSP.

e. Indian Standards

The Bureau of Indian Standards (BIS) lays down quality levels of bought out items and construction quality and these shall not be diluted under any account. Wherever BIS are not available, internationally accepted standards may be used.

f. Town and Country Planning Act

The Town & Country Planning Act shall be mandatorily followed. Wherever there is a possibility, storm water drains on both sides of the road shall be built mandatorily.

## 2.11 GUIDELINES ON HOUSE SEWER CONNECTIONS

a) There is a compelling need to amend the bye-laws to make it compulsory for the population to avail house sevice sewer connection wherever public sewer is provided and if this is not forthcoming, the local authority shall effect the house sewer connection and institute revenue recovery proceedings.

b) Include house-service sewer connections as part of the sewerage project itself

c) Float Equated monthly instalments (EMI) schemes for repayment of house service sewer connection costs.

## 2.12 SURVEY AND INVESTIGATION

The survey and investigation are both pre-requisites for framing of the preliminary report and the preparation of a detailed project report (DPR) for any sewerage project. The engineering and policy decisions taken are dependent on the correctness and reliability of the data collected and its proper evaluation for preparing DPR to ensure success of the programme on long-term sustainable basis.

### 2.12.1 Basic Information

Broad knowledge of the problems likely to be faced during the various phases of the implementation of the project is essential for performing investigations effectively. Information on physical, fiscal, developmental and other aspects have to be collected.

The philosophy of survey is to rule out simple initial mistakes, which will make the entire project a blunder eventually. The entire geographical coverage of the project area relies very seriously on gravity transmission and eligible pathways, affordability by users, etc. The initial survey will chalk out the aspects to be considered and the aspects which have to be time deferred and the aspects which need to be relegated in each case.

#### 2.12.1.1 Physical Aspects

These would necessitate the collection of information related to:

a) Topography or elevation difference needed for design of sewers and location of STP, outfall and disposal works

b) Subsoil conditions, such as types of strata likely to be encountered, depth of groundwater table and its fluctuations. In the absence of any records, preliminary data should be collected by carrying out at least 3 trial bores or 3 trial pits per hectare

c) Underground structures like storm drains and appurtenances, city survey stones, utility services like house connections for water supply & sewerage, electric & telephone cables and gas lines

d) Location of streets and adjoining areas likely to be merged or annexed

e) Contour map of the area to be superimposed on the village/town/city maps

f) Survey of India maps

g) Groundwater table and its fluctuations from local enquiries and past records

h) Underground utility services and Survey of India bench marks

i) Land use maps, density and trends of population growth and demographic studies

j) Type and number of industries for potential reuse and discharge of sewage

k) Existing drainage and sewerage facilities and data related to these facilities

l) Flow in sewers and sewers of similar areas to assess the flow characteristics

m) Historical and socio-economic data

n) Problems of maintenance of existing sewers

o) Effluent disposal sites and their availability

p) Earthquake

The possible sources of information are existing maps and plans showing streets from revenue or town surveys or the Survey of India maps.

Other sources are the topographical maps of survey of India if available with existing spot-levels, aerial photographs, photographs of complex surfaces for supplementing the existing instrumental surveys by concerned authorities like Municipalities and Roads Departments.

#### 2.12.1.2 Survey of Natural Conditions

a) Societal preferences and local habits

b) Present status of the governmental, semi-governmental or municipal authority sponsoring the project, its capacity, adequacy, effectiveness and the desirability of its modification or necessity of a new organization to satisfactorily implement and maintain the project.

#### 2.12.1.3 Survey on Related Plans

a) Sewerage master plan

b) Other related sewerage plans

c) Long-term comprehensive development plans for cities and towns

d) Urban planning

e) City planning area, urbanization zone, and urbanization control area

f) Land use plan

g) Road plan

h) Urban development as rezoning, residential estates, and industrial complexes

i) Design longitudinal section, transverse section

j) Design flood level and corresponding flood flow

k) Design low flood level and corresponding flow

l) Other plans.

#### 2.12.1.4 Survey on Pollution Loads and Receiving Bodies

a) Survey on generated pollution load

b) Existing conditions and future plans related to water supply

c) Existing conditions and future plans related to industrial uses

d) Population, industrial production, agriculture, forestry and animal husbandry

e) Data on quality and quantity of sewage from large factories, offices, etc.

f) Data on sewage generated from sightseeing sources

g) Data on wells

h) Data on standard unit pollution loads from different sources

i) Survey to gather information on receiving water bodies

j) Data on existing water quality and flow in water bodies at the time of sampling

k) Data on environmental standards for water quality

l) Utilization of existing water bodies and future plans related to uses.

#### 2.12.1.5 Survey on Existing Facilities

a) Underground installations

b) Existing sewerage and on-site sanitation facilities

c) Existing conditions of disposal of human waste

d) Existing conditions and alignment of road

e) Cultural assets and historic relics

f) Other existing facilities.

#### 2.12.1.6 Survey on Resources of Sewerage System and its Utilization

a) Utilization of space in STP and SPS

b) The open space on top of STP structures or SPS is precious especially in highly populated cities and can be used for terrace garden, green houses.

c) Utilization of space in large sewers as conduits for optical fibre cables.

#### 2.12.1.7 Survey on Treated Sewage, Sludge and Biogas Utilization

a) Reuse of treated sewage should be taken up after discussions between ULB, water boards, PHEDs / Jal Nigams and the public, as the case may be. Various possible reuse methods such as farm forestry, greenbelt development and lawns in road medians

b) Utilization of sludge in public areas is not possible due to issues of public acceptance and hence it is best to focus on farm forestry

c) Utilization of alternative energy, like in plant energy to be harnessed from biomethanation and to evaluate the ambient temperature suitability or heating of sludge vs. economics

d) Reuse of treated sewage to a minimum extent of 20 % by volume shall be mandatorily explored and the proposed use for achieving this 20 % target shall mandatorily form part of the CSP

e) Utilization of sludge as a construction material (as porous pavements, bricks, etc.).

#### 2.12.1.8 Project Surveys

It should include the overall survey of the population, their historical outlook, their willingness for a change, acceptance of the concept to pay for the services, responsibility of local body under the national law of the land and above all, a public hearing on these issues.

#### 2.12.1.9 Preliminary Project Surveys

This is concerned with the broad aspects of the project. Data on aspects such as capacity required, basic arrangement and size, physical features affecting general layout and design, availability of effluent disposal facilities, probable cost and possible methods of financing, shall be collected to prepare an engineering report describing the scope and cost of the project with reasonable accuracy. In framing such estimates, due consideration must be given to the escalation of prices of basic materials and their availability. While extreme precision and detail are not required in this phase, all the basic data obtained must be reliable.

### 2.12.1.10 Detailed Project Surveys

The surveys for this phase form the basis for the engineering design, as well as, for the preparation of plans and specifications for incorporation in the DPR. In contrast to preliminary survey, this survey must be precise and contain contours of all the areas to be served giving all the details that will facilitate the designer to prepare design and construction of plans suiting the field conditions. It should include, inter-alia, network of benchmarks and traverse surveys to identify the nature as well as extent of the existing underground structures requiring displacement, negotiation or clearance. Such detailed surveys are necessary to establish rights-of-way, minimize utility relocation costs, obtain better bids and prevent changing and rerouting of lines.

### 2.12.1.11 Construction Surveys

All control points such as base lines and benchmarks for sewer alignment and grade should be established by the engineer along the route of the proposed construction. All these points should be referred adequately to permanent objects.

a) Preliminary Layouts

Before starting the work, right-of-ways, work areas, clearing limits and pavement cuts should be laid out clearly to ensure that the work proceeds smoothly. Approach roads, detours, by-passes and protective fencing should also be laid out and constructed prior to undertaking sewer construction work. All layout work must be completed and checked before construction begins.

b) Setting Line and Grade

The transfer of line and grade from control points, established by the engineers, to the construction work should be the responsibility of the executing agency until work is completed. The methods generally used for setting the line and grade of the sewers are discussed in Chapter 3 of this manual. The procedures for establishing line and grade where tunnels are to be employed in sewer system are also discussed in Chapter 3 of this manual.

### 2.12.1.12 Developmental Aspects

The following should be taken into account:

a) Types of land use, such as commercial, industrial, residential and recreational uses; extent of areas to be served

b) Density of population, trends of population growth and demographic studies

c) Type and number of industries for determining quantity and nature of wastes, and locations of their discharge points

d) Existing drainage and sewerage facilities and data related to these facilities

e) Flow in existing sewers and sewers of similar areas to assess the flow characteristics

f) Historical and socio-economic data

g) Basis of design and information on the maintenance of existing sewers

h) Effluent disposal sites and their availability

Possible sources of information are census records, town and metropolitan master plans, city development plans, regional planning records, land use plan, flow gauging records, stream flow records, meteorological data and data from pollution control boards.

#### 2.12.1.13 Fiscal Aspects

The various factors that will have an important bearing are:

a) Existing policies or commitments/obligations which may affect the financing of the project

b) Outstanding loan amounts and instalments of repayments

c) Availability of Central and State Government loans, grant-in-aid, loans from other financing bodies such as Life Insurance Corporation, Industrial Development Corporation, HUDCO, International Bank for Reconstruction and Development and other Banks and Institutions

d) Present water rates, sewer-tax and revenue realized from the service, size of property plots and land holding, the economic condition of community with respect to their tax-paying capacity

e) Factors affecting the cost of construction, operation and maintenance (O&M); some of the information can be obtained from the records related to Municipal and State Tax Levies, Acts and Rules governing loans, procedures for financing projects and registers and records of the authorities maintaining water supply and sewerage systems.

#### 2.12.1.14 Other Aspects

The considerations that are likely to influence the planning of sewerage system are:

a) Changes in political boundaries by physical acquisition or merger of adjacent communities or by possible extension of limits

b) Feasibility of multi-regional or multi-municipal systems

c) Prevailing water pollution prevention statutes, other rules and regulations related to discharge of industrial and domestic wastes

d) Present status of the governmental, semi-governmental or municipal authority sponsoring the project, its capacity, adequacy, effectiveness and the desirability of its modification or necessity of a new organization to satisfactorily implement and maintain the project

e) Inconveniences likely to be caused to the community during execution and the feasibility of minimizing them by suitable alignment or location of the components of the sewerage system

Possible sources of information are National Acts, State and Municipal Laws and Bye-laws, minutes of the past meetings of the municipal or other governing bodies and discussions with officials, municipal councillors and other local leaders.

## 2.13 DETAILED PROJECT REPORT (DPR)

### 2.13.1 General

All projects have to follow distinct stages between the period they are conceived and completed. The various stages are:

- Pre-investment planning
  - Identification of a project
  - Survey and Investigation as described in clause 2.12
  - Preparation of project report
- Appraisal and sanction
- Construction of facilities and carrying out support activities
- Operation and maintenance
- Monitoring and feed back

#### 2.13.1.1 Project Reports

Project reports deal with all aspects of pre-investment planning and establish the need as well as the feasibility of projects technically, financially, socially, culturally, environmentally, legally and institutionally. For big projects, economic feasibility may also have to be examined. Project reports should be prepared in three stages viz. (i) identification report (ii) pre-feasibility report and (iii) feasibility report. Projects for small towns or those forming parts of a programme may not require preparation of feasibility reports. Detailed engineering and preparation of technical specification and tender documents are not necessary for taking investment decisions, since these activities can be carried out during the implementation phase of projects. For small projects, however, it may be convenient to include detailed engineering in the project report, if standard design and drawing can be adopted.

Since project preparation is quite expensive and time consuming, all projects should normally proceed through three stages and at the end of each stage, a decision should be taken whether to proceed to the next planning stage and commit the necessary manpower and financial resources for the next stage. Report at the end of each stage should include a timetable and cost estimate for undertaking the next stage activity and a realistic schedule for all future stages of project development. It should be taken into consideration the time required for review and approval of the report, providing funding for the next stage, mobilizing personnel or fixing agency (for the next stage of project preparation) data gathering, physical surveys, site investigations, etc.

The basic design of a project is influenced by the authorities/organizations who are involved in approving, implementing, operating and maintaining the project. Therefore, the institutional arrangements, through which a project will be brought into operation, must be considered at the project preparation stage. Similarly responsibility for project preparation may change at various stages. Arrangements in this respect should be finalized for each stage of project preparation.

Sometimes, more than one organization may have a role to play in the various stages of preparation of a project. It is therefore necessary to identify a single entity to be responsible for overall management and coordination of each stage of project preparation. It is desirable that the implementing authority is identified and those responsible for operations of a project are consulted at the project preparation stage.

### 2.13.2 Identification Report

Identification report is basically a desk study, to be carried out relying primarily on the existing information. It can be prepared reasonably quickly by those who are familiar with the project area and needs of project components. This report is essentially meant for establishing the need for a project indicating likely alternatives, which would meet the requirements. It also provides an idea of the magnitude of cost estimates of a project to facilitate bringing the project in the planning and budgetary cycle and makes out a case for obtaining sanction to incur expenditure for carrying out the next stages of project preparation. The report should be brief and include the following information:

a) Identification of the project area and its physical environment

b) Commercial industrial, educational, cultural and religious importance and activities in and around the project area (also point out special activities or establishments like defence or others of national importance)

c) Existing population, physical distribution and socioeconomic analysis

d) Present sewage collection, treatment and disposal arrangements in the project area, pointing out deficiencies, if any, in system of collection and treatment

e) Population projection for the planning period, according to existing and future land use plans or master plans, if any

f) Establish the need for taking up a project in the light of existing and future deficiencies in sewage collection, treatment and disposal services, pointing out adverse impacts of non-implementation of the project, on a time scale

g) Bring out, how the project would fit in with the national / regional / sectoral strategies and with the general overall development in the project area

h) Identify a strategic plan for long-term development of sewage collection, treatment and disposal services in the project area, in the context of existing regional development plans and such other reports, indicating phases of development

i) State the objectives of the short-term project under consideration, in terms of population to be served and the impact of the project after completion, clearly indicating the design period

j) Identify project components, with alternatives if any; both physical facilities and supporting activities

k) Preliminary estimates of costs (component-wise) of construction of physical facilities and supporting activities, cost of operation and maintenance

l) Identify source for financing capital works and operation and maintenance, work out annual burden (debt servicing + operational expenditure)

m) Indicate institutions responsible for project approval, financing, implementation, operation and maintenance (e.g., Central Government, State Government, Zilla Parishad, Local Body, Water Supply Boards)

n) Indicate organization responsible for preparing the project report (pre-feasibility report, feasibility report), cost estimates for preparing project report and sources of funds to finance preparation of project reports

o) Indicate time table for carrying out all future stages of the project and the earliest date by which the project might be operational

p) Indicate personnel strength required and training needs for implementation of the project. Indicate if any particular/peculiar difficulties of policy or other nature that are likely to be encountered for implementing the project and how these could be resolved

q) Recommend actions to be taken to proceed further.

The following plans may be enclosed with the report:

i) An index plan to a scale of 1 cm = 2 km showing the project area, existing works, proposed works and location of community/township or institution to be served

ii) A schematic diagram showing the salient levels of project component

### 2.13.3 Pre-feasibility Report

After clearance is received, based on the identification report from the concerned authority and / or owner of the project and commitments are made to finance further studies, the preparation work on pre-feasibility report should be undertaken by an appropriate agency. This may be a central planning and design cell of the department dealing with the water and sewerage board, ULB, Jal Nigam or professional consultants working in the water supply, sanitation and environmental areas. In the latter case, terms of reference for the study and its scope should be carefully set out. Pre-feasibility study may be a separate and discrete stage of project preparation or it may be the first stage of a comprehensive feasibility study. In either case, it is necessary that it precedes taking up of a feasibility study because the pre-feasibility study is essentially carried out for screening and ranking of all project alternatives, and to select an appropriate alternative for carrying out the detailed feasibility study. The pre-feasibility study helps in selecting a short-term project, which will fit in the long-term strategy for improving services in the context of overall perspective plan for development of the project area.

A pre-feasibility report can be taken to be a Preliminary Project Report, the structure and component of which are as follows:

i) Executive summary

ii) Introduction

iii) The project area and the need for a project

iv) Long term plan for sewage collection, treatment and disposal

v) Proposed sewage collection, treatment and disposal project

vi) Conclusions and recommendations

vii) Tables, figures/maps and annexes

#### 2.13.3.1 Executive Summary

It is a good practice to provide an executive summary at the beginning of the report, giving its essential features, basic strategy, approach adopted in developing the project and the salient features of financial and administrative aspects.

#### 2.13.3.2 Introduction

This section explains the origin and concept of the project, how it was prepared and the scope and status of the report. These subsections may be detailed as under:

a) Project Genesis

i) Describe how the idea of the project originated, agency responsible for promoting the project.

ii) List and explain previous studies and reports on the project, including the project identification report and agencies which prepared them

iii) Describe how the project fits in the regional development plan, long-term sector plan, land use plan, public health care and sewage management programme, etc.

b) How was the Study Organized

i) Explain how the study was carried out, agencies responsible for carrying out the various elements of work and their role in preparing the study

ii) Time table followed for the study

c) Scope and Status of the Report

i) How the pre-feasibility report fits in the overall process of project preparation

ii) Describe data limitation

iii) List interim reports prepared during the study

iv) Explain the pre-feasibility report is intended to be used for obtaining approval for the proposed project

#### 2.13.3.3 Project Area and the Need for the Project

This section establishes the need for the project. It should cover the following main items.

##### 2.13.3.3.1 Project Area

i) Give geographical description of the project area with reference to maps

ii) Describe special features such as topography, climate, culture, religion, migration, etc., which may affect project design, implementation and operation

iii) Map showing administrative and political jurisdiction

iv) Describe any ethnic, cultural or religious aspects of the communities which may have a bearing on the project proposal.

##### 2.13.3.3.2 Population Pattern

i) Estimate population in the project area, indicating the sources of data or the basis for the estimate

ii) Review previous population data, historic growth rates and causes

iii) Estimate future population growth with different methods and indicate the most probable growth rates and compare with past population growth trends

iv) Compare growth trends within the project area, with those for the region, state and the entire country

v) Discuss factors likely to affect population growth rate

vi) Estimate probable densities of population in different parts of the project area at future intervals of time e.g. five, ten and twenty years ahead

vii) Discuss patterns of seasonal migration, if any, within the area

viii) Indicate implication of the estimated growth pattern on housing and other local infrastructure.

##### 2.13.3.3.3 Socio-Economic Aspects

i) Describe present living conditions of the people of different socio-economic and ethnic groups

ii) Identify locations according to income levels or other indications of socio-economic studies

iii) Show on the project area map, location-wise density of population, religion, poverty groups and ethnic concentrations and the present and future land uses (as per development plan)

iv) Information on housing conditions and relative proportions of owners and tenants

v) Provide data and make projection on housing standards and average household occupancy in various parts of the project area

vi) Provide data on education, literacy and unemployment by age and sex

vii) Describe public health status within the project area with particular attention to diseases related to water and sanitary conditions

viii) Provide data on maternal and infant mortality rates and life expectancy

ix) Discuss the status of health care programmes in the area, as well as other projects, which have bearing on improvements in environmental sanitation.

#### 2.13.3.3.4 Sector Institutions

i) Identify the institutions (Government, Semi-Government and Non-Government) which are involved in any of the stages of water supply and sanitation project development in the area (Planning, preparing projects, financing, implementation, O&M and evaluation)

ii) Comment on roles, responsibilities and limitation (territorial or others) of all the identified institutions, in relation to water supply and sanitation (This may be indicated on a diagram).

#### 2.13.3.3.5 Existing Sewage Collection, Treatment and Disposal Systems and Population Served

Describe each of the existing sewage collection, treatment and disposal systems (including conventional, decentralized, and on-site systems) in the project area, indicating the following details mentioned hereunder:

i) Area served, quantity and quality of sewage collected, components of the system such as collection network, SPS, STP, sewage reuse and disposal methods, etc.

ii) Private sewage disposal methods such as septic tanks, on-site toilets, etc.

#### 2.13.3.3.6 Urban Drainage and Solid Wastes

Briefly describe existing systems of storm water drainage and solid waste collection and disposal. This discussion should be focused in terms of their impact on sewerage management and the environment.

#### 2.13.3.3.7 Need for the Project

i) Comment as to why the existing system cannot satisfy the existing and projected demands for services with reference to population to be served

ii) Describe benefits of system improvements (which may include rehabilitation or developing a new system)

iii) Indicate priorities to improvement of existing system, expansion of systems, construction of new system, assessment of the need for consumer education in hygiene and comments on urgency of project preparation and implementation.

### 2.13.3.4 Long Term Plan for Sewage Collection, Treatment and Disposal

a) Sewage collection, treatment and disposal services have to be planned, as a phased development programme and any short-term project should be such that it would fit in the long-term strategy. Such a long-term plan or the strategic plan should be consistent with the future overall development plans for the areas. A long-term plan may be prepared for a period of 30 years and alternative development sequences may be identified to provide target service coverage at affordable costs. From these alternative development sequences, a priority project to be implemented in short term can be selected. It is this project, which then becomes the subject of a comprehensive feasibility study.

b) Alternative development sequences should be identified in the light of the coverage to be achieved during the planning period in phases. This calls for definition of the following:

i) Population to be covered with improved sewage management facility

ii) Target dates by which the above mentioned coverage would be extended within the planning period, in suitable phases

iii) Consistency and coordination to be maintained between projections for both water supply and sanitation services.

c) It must be noted that availability of funds is one of the prime factors which will ultimately decide the scope and scale of a feasible project

d) Selection of a Strategic Plan

Each of the alternative development sequences, which can overcome the existing deficiencies and meet the present and future needs, consist of a series of improvements and expansions to be implemented over the planned period. Since all the needs cannot be satisfied in the immediate future, it is necessary to carefully determine priorities of target groups for improvement in services and stages of development and thus restrict the number of alternatives.

e) Planning for system requirement includes consideration of the following:

i) Possibilities of rehabilitating and/or de-bottlenecking the existing systems

ii) Alternative treatment systems and pumping schemes

f) It may also be necessary to ascertain if supporting activities like health education, staff training and institutional improvements etc., are necessary to be included as essential components of the project. All the physical and supporting input need to be carefully budgeted (capital and operating) after preparing preliminary designs of all facilities identified for each of the development sequences. These may then be evaluated for least cost solution by ‘net present worth’ method, which involves expressing all costs (capital and operating) for each year in economic terms, discounting future costs to present value, selecting the sequence with the lowest present value.

g) As stated earlier, costs are to be expressed in economic terms and not in terms of their financial costs. This is because the various alternatives should reflect resource cost to the economy as a whole at different future dates. Costing of the selected project may however be done in terms of financial costs, duly considering inflation during project implementation.

#### 2.13.3.5 Proposed Sewerage Project

a) Details of the Project

The project to be selected may consist of those components of the least cost alternative of development sequence, which can be implemented during the next 3 to 4 years. Components of the selected project may be as follows:

i) Rehabilitation and de-bottlenecking of the existing facilities

ii) Construction of new facilities for improvement and expansion of existing systems

iii) Support activities like training, consumer education, public motivation, etc.

iv) Equipment and other measures necessary for operation and maintenance of the existing and expanded systems

v) Consultancy services needed (if any) for conducting feasibility study, detailed engineering, construction supervision, socio-economic studies and support activities.

b) Project Components

All project components should be thoroughly described, duly supported by documents such as:

i) Location maps

ii) Technical information for each physical component and economic analysis where necessary

iii) Preliminary engineering designs and drawings in respect of each physical component, such as collection network, SPS, STP and disposal system.

c) Implementation Schedule

A realistic implementation schedule should be presented, taking into consideration time required for all further steps to be taken, such as conducting feasibility study, appraisal of the project, sanction to the project, fund mobilization, implementation, trial and commissioning. In preparing this schedule due consideration should be given to all authorities/groups whose inputs and decisions can affect the project and its timing.

d) Cost Estimates

Cost estimates of each component of the project should be prepared and annual requirement of funds for each year should be worked out, taking into consideration the likely annual progress of each component. Due allowance should be made for physical contingencies and annual inflation. This exercise will result in arriving at total funds required annually for implementation of the project.

e) Pre-feasibility Report

The pre-feasibility report should bring out any major environmental and social impact the project is likely to cause and if these aspects will affect its feasibility (Refer to section 2.13.3 of this manual).

f) Institutional Responsibilities

The pre-feasibility report should identify the various organizations/departments/agencies that would be responsible for further planning and project preparation, approval, sanction, funding, implementation, O&M of the project and indicate the manpower needed to implement and later operate and maintain the project. It should also discuss special problems likely to be encountered during O&M, in respect of availability of skilled and technical staff, funds, transport, chemicals, communication, power, spare parts, etc. Quantitative estimates of all these resources should be made and included in the project report.

g) Financial Aspects

The capital cost of a project is the sum of all expenditure required to be incurred to complete design and detailed engineering of the project, construction of all its components including support activities and conducting special studies. After estimating component-wise costs, they may also be worked out on annual basis throughout the implementation period, taking into consideration construction schedule and allowances for physical contingencies and inflation. Basic item costs to be adopted should be of the current year. Annual cost should be suitably increased to cover escalation during the construction period. Total of such escalated annual costs determines the final cost estimate of the project. Financing plan for the project should then be prepared, identifying all the sources from which funds can be obtained and likely annual contribution from each source, until the project is completed. The possible sources of funds include:

i) Cash reserves available with the project authority

ii) Grant-in-aid from government

iii) Loans from government

iv) Loans from financing institutions like Life Insurance Corporation, Banks, HUDCO, etc.,

v) Open market borrowings

vi) Loans/grants from bilateral/international agencies

vii) Capital contribution from voluntary organization or from consumers

h) Interest on Loan

If the lending authority agrees, interest payable during implementation period can be capitalized and loan amount increased accordingly.

i) Recurring Expenditure

The next step is to prepare recurrent annual costs of the project for the next few years (approximately 10 years) covering O&M expenditure of the entire system (existing and proposed).

This would include expenditure on staff, chemicals, energy, spare parts and other materials for system operation, transportation, up-keep of the systems and administration. The annual financial burden imposed by a project comprises the annual recurring cost and payment towards loan and interest (debt servicing) less the revenue derived from taxes, tariffs, etc.

j) Financing Plan

Every State Government and the GOI have schemes for financing water supply and sewage collection, treatment and disposal schemes in the urban and rural areas and definite allocations are made for the national plan periods. It will be necessary at this stage to ascertain if and how much finance can be made available for the project under consideration and to estimate the annual availability of funds for the project until its completion. This exercise has to be done in consultation with the concerned department of the Government and the lending institutions, which would see whether the project fits in the sector policies and strategies, and can be brought in an annual planning and budgetary cycle, taking into consideration the commitments already made in the sector and the overall financial resource position. The project may be finally sanctioned for implementation if the financing plan is firmed up.

#### 2.13.3.6 Conclusion and Recommendations

a) Conclusions

This section should present the essential findings and results of the pre-feasibility report. It should include a summary of the following main items:

i) Existing coverage

ii) Review of the need for the project

iii) Long-term development plans considered

iv) Recommended project, and its scope in terms of coverage and components

v) Priorities concerning target-groups and areas to be served by the project

vi) Capital costs and tentative financing plan

vii) Annual recurring costs and debt servicing and projection of operating revenue

viii) Urgency for implementation of the project

ix) Limitation of the data/information used and assumption and acknowledgements made and need for in-depth investigation, survey and revalidation of assumptions and judgments, while carrying out the feasibility study.

The administrative difficulties likely to be met with and risks involved during implementation of the project should also be commented on. These may pertain to boundary of the project area, availability of land for constructing project facilities, coordination with the various agencies, acceptance of service by the beneficiaries, shortage of construction materials, implementation of support activities involving peoples' participation, supply of power, timely availability of funds for implementation of the project and problems of O&M of the facilities.

b) Recommendations

i) This should include all actions required to be taken to complete project preparation and implementation, identifying the agencies responsible for taking these actions. A detailed timetable for actions to be taken should be presented. If found necessary and feasible, taking up works for rehabilitating and/or de-bottlenecking the existing system should be recommended as an immediate action. Such works may be identified and cost be estimated so that detailed proposals can be developed for implementation.

ii) It may also be indicated whether the project authority can go ahead with taking up detailed investigations, data collection, operational studies, without undertaking feasibility study formally.

iii) In respect of small and medium size projects, the pre-feasibility report can be considered sufficient for obtaining investment decision for the project if:

- The results of the pre-feasibility study are based on adequate and reliable data / information. The analysis of the data and situation is carried out fairly intensively,
- No major environmental and social problems are likely to crop up that might jeopardize project implementation, and
- No major technical and engineering problems are envisaged during construction and operation of the facilities.

iv) In that case, the pre-feasibility study with suitable concluding report should be processed for obtaining investment decision for the project. The feasibility study can then be taken up at the beginning of the implementation phase and if results of the study are noticed to be at variance with the earlier ones, suitable modification may be introduced during implementation.

v) In respect of major projects however and particularly those for which assistance from bilateral or international funding agencies is sought for, comprehensive feasibility study may have to be taken up before an investment decision can be taken.

### 2.13.4 Feasibility Report

Feasibility study examines the project selected in the pre-feasibility study as a short-term project in much detail, to check if it is feasible technically, financially, economically, socially, legally, environmentally and institutionally.

Enough additional data/information may have to be collected to examine the above mentioned aspects, though the details necessary for construction of project components may be collected during execution of works.

It is a good practice to keep the authority responsible for taking investment decision, informed of the stage and salient features of the project. If there are good prospects of the project being funded immediately after the feasibility study is completed, detailed engineering of priority components may be planned simultaneously.

The feasibility report may have the following sections:

a) Background

b) Proposed project

c) Institutional and financial aspects

d) Techno Economic Appraisal Procedure

e) Conclusion and recommendations

### 2.13.4.1 Background

This section describes the history of project preparation, how this report is related to other reports and studies carried out earlier, and in particular it's setting in the context of a pre-feasibility report.

It should also bring out if the data/information and assumptions made in the prefeasibility report are valid, and if not, changes in this respect should be highlighted. References to all previous reports and studies should be made.

In respect of the project area, need for a project and strategic plan for the same, only a brief summary of the information covered in pre-feasibility report should be presented, highlighting such additional data/information if any collected for this report.

The summary information should include planning period, project objectives, service coverage, service standards considered and selected for long-term planning and for the project, community preferences and affordability, quantification of future demands for services, alternative strategic plans, their screening and ranking, recommended strategic plan and cost of its implementation.

### 2.13.4.2 Proposed Project

This section describes details of the project recommended for implementation. Information presented here is based on extensive analysis and preliminary engineering designs of all components of the project. The detailing of this section may be done in the following subsections.

a) Objectives

Project objectives may be described in terms of general development objectives such as health improvements, ease in sewerage management, improved environmental conditions, human resources development, institutional improvements and terms of specific objectives such as coverage of various target groups.

b) Project Users

Define number of people by location and institutions who will benefit and/or not benefit from the project area and reasons for the same, users involvement during preparation, implementation and operation of the project.

c) Rehabilitation and De-bottlenecking of the Existing Sewerage System

In fact, rehabilitation, improvements and de-bottlenecking works, if necessary, should be planned for execution prior to that of the proposed project. If so these activities should be mentioned in the feasibility report, if however these works are proposed as components of the proposed project, the necessity of undertaking the rehabilitation / improvement de-bottlenecking works should be explained.

d) Project Description

This may cover the following items in brief:

i) Definition of the project in the context of the recommended development alternative (strategic plan) and explanation for the priority of the project

ii) Brief description of each component of the project, with maps and drawings

iii) Functions, location, design criteria and capacity of each component

iv) Technical specification (dimension, material) and performance specifications

v) Stage of preparation of designs and drawings of each component

vi) Constructing in-house facilities

vii) Method of financing

viii) Existing benchmarks (for relevant indicators mentioned in the “Handbook on Service Level Benchmarking”, MoUD) and benchmarks expected to be achieved after implementation of the project should be mentioned in the report. The indicators included in above reference are given in Table 2-2.

Table 2-2 Service level benchmarks for sewage management

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

Source:MoUD, 2011

e) Support Activities

Need for and description of components such as staff training, improving billing and accounting, consumer education, health education, community participation, etc., and timing of undertaking these components and the agencies involved should be included.

f) Integration of the Proposed Project with the Existing and Future Systems

Describe how various components of the proposed project would be integrated with the existing and future works.

g) Agencies Involved in Project Implementation and Relevant Aspects

i. Designate the lead agency

ii. Identify other agencies including government agencies, who would be involved in project implementation, describing their role, such as granting administrative approval, technical sanction, approval to annual budget provision, sanction of loans, construction of facilities, procurement of materials and equipment, etc.,

iii. Outline arrangements to coordinate the working of all agencies

iv. Designate the operating agency and its role during implementation stage

v. Role of consultants, if necessary, scope of their work, and terms of reference

vi. Regulations and procedures for procuring key materials and equipment, power, and transport problems, if any

vii. Estimate number and type of workers and their availability

viii. Procedures for fixing agencies for works and supplies and the normal time it takes to award contracts

ix. List of imported materials, if required, procedure to be followed for importing them and estimation of delivery period

x. Outline any legislative and administrative approvals required to implement the project, such as those pertaining to environmental clearance, prescribed effluent standards, acquisition of lands, permission to construct across or along roads and railways, high-tension power lines, in forest area and defence or other such restricted areas

xi. Comment on the capabilities of contractors and quality of material and equipment available indigenously

h. Cost Estimates

i. Outline basic assumptions made for unit prices, physical contingencies, price contingencies and escalation

ii. Summary of estimated cost of each component for each year till its completion and work out total annual costs to know annual cash flow requirements

iii. Estimate foreign exchange cost if required to be incurred

v. Work out per capita cost of the project on the basis of design population, cost per unit of sewage treated and disposed and compare these with norms, if any, laid down by government or with those for similar projects

i) Implementation Schedule

Prepare a detailed and realistic implementation schedule for all the project components, taking into consideration stage of preparation of detailed design and drawings; additional field investigations required, if any; time required for preparing tender documents; notice period; processing of tenders; award of works / supply contract; actual construction period; period required for procurement of material and equipment; testing; trials of individual components; and commissioning of the facilities, etc.

If consultant's services are required, the period required for completion of their work should also be estimated. A detailed PERT/CPM network showing implementation schedule for the whole project, as well as those for each component should be prepared, showing linkages and inter-dependence of various activities.

Implementation schedule should also be prepared for support-activities such as training, consumer education, etc., and their linkages with completion of physical components and commissioning of the project should be established.

j) Operation and Maintenance of the Project

Estimate annual operating costs considering staff, chemicals, energy, transport, routine maintenance of civil works, maintenance of electrical/mechanical equipment, including normal cost of replacement of parts and supervision charges. Annual cost estimates should be prepared for a period of 10 years from the probable year of commissioning the project, taking into consideration expected coverage and escalation.

Procedure for monitoring and evaluating the project performance with reference to project objectives should be indicated.

#### 2.13.4.3 Institutional and Financial Aspects

a) Institutional Aspects

It is necessary to examine capabilities of the organizations that would be entrusted with the responsibility of implementing the project and operating the same after it is commissioned. The designated organization(s) must fulfill the requirements in respect of organizational structure, personnel, financial, health and management procedures, so that effective and efficient performance is expected. This can be done by describing the following aspects:

i) History of the organization, its functions, duties and powers, legal basis, organization chart (present and proposed), relationship between different functional groups of the organization and with its regional offices, its relation with government agencies and other organizations involved in sector development

ii) Public relations in general and consumer relations in particular, extension services available to sell new services, facilities for conducting consumer education programme and settling the complaints

iii) Systems for budgeting capital & recurring expenditure, revenue, accounting expenditure & revenue, internal & external audit arrangements and inventory management

iv) Present positions and actual staff, comments on number and quality of staff in each category, ratio of staff proposed for maintenance and operation of the project to the population served, salary ranges of the staff and their comparison with those of other public sector employees

v) Staff requirement (category wise) for operating the project immediately after commissioning, future requirements, policies regarding staff training, facilities available for training

vi) Actual tariffs for the last 5 years, present tariff, tariff proposed after the project is commissioned, its structures, internal and external subsidies, procedure required to be followed to adopt new tariff, expected tariff and revenues in future years, proposal to meet the shortage in revenues

vii) Prepare annual financial statements (income statements, balance sheets and cash flows) for the project operating agency for five years after the project is commissioned; explain all basic assumptions for the financial forecast and the terms and conditions of tapping financial sources; demonstrate ability to cover all operating and maintenance expenditure and loan repayment, workout rate of return on net fixed assets and the internal financial rate of return of the project

b) Financing Plan

Identify all sources of funds for implementation of the project, indicating year-by-year requirements from these sources, to meet expenditure as planned for completing the project as per schedule, state how interest during construction will be paid, or whether it will be capitalized and provided for in the loan, explain the procedures involved in obtaining funds from the various sources.

#### 2.13.4.4 Techno Economic Appraisal Procedure

The decision between technologies of sewerage as well as sewage treatment should be carried out on life cycle analysis of major components. In general, the life cycle of civil works can be taken as 30 years and that of equipment can be taken as 15 years in non-sewage treatment locations and 10 years in sewage treatment locations. The analysis should include:

a) Net Present Value (NPV) of capital costs

b) Equivalent cost of annuity and O&M costs

c) Revenue recoverable if any by way of by-products

d) Land Cost

e) Dependency on Imports for day to day spares

f) Import substitution

g) Time required to achieve the desired project objectives

h) Mitigation of any adverse environmental impacts

i) Long term sustainability by the finances of the ULB

While aspects of a) through d) can be attributed to numerical values, the aspects e) through i) will be subjective and has to be appraised based on higher weightage for most preferred technologies.

Thus, the exercise of techno-economic appraisal is not a fully mathematical approach and has to be tempered as two interdependent aspects, both kept up and reasoned out interactively. The tendency to overly complicate the exercise with undue mathematics shall be resisted.

#### 2.13.4.5 Conclusion and Recommendations

This section should discuss justification of the project, in terms of its objectives, cost effectiveness, affordability, willingness of the beneficiaries to accept the services and effect of not proceeding with the project.

Issues that are likely to adversely affect project implementation and operation should be outlined and ways of tackling the same should be suggested. Effect of changes in the assumptions made for developing the project on project implementation period, benefits, tariff, costs and demand, etc., should be mentioned.

Definite recommendations should be made regarding time-bound actions to be taken by the various agencies, including advance action that may be taken by the lead agency pending approval and financing of the project.

## 2.14 PLANNING OF SEWERAGE SYSTEM

### 2.14.1 Approach

The approach to planning of sewerage shall be governed by optimum utilization of the funds available such that the sewerage system when completed does not become unused for long and at the same time does not become inadequate very soon.

### 2.14.2 Design Population Forecast

This shall be as per the methods in Chapter 3 of this manual and its validation with respect to known growths in recent decades and evolving a reasonable basis by comparing with other similar habitations. There is no hard and fast mathematical basis for this and the methods in Chapter 3 are only a guideline.

### 2.14.3 Estimation of Sewage Flow

This shall be as per the methods in Chapter 3 of this manual and its validation with respect to known growths in recent decades and evolving a reasonable basis. The design population having been established, the judgement of per capita water supply is the key.

### 2.14.4 Sewage Characteristics and Pollution Load

The raw sewage characteristics are a function of the level of water supply and per capita pollution load as shown in Chapter 5 of this manual. Thus, the level of water supply decides the concentration of pollutants.

The pollutant load from a given habitation expressed as kg/day will remain the same but the concentration will vary depending on the level of water supply. Where the actual level of water supply is not foreseeable, the desirable level as in Chapter 3 shall be followed.

### 2.14.5 Planning of Sewer System

The design principles in Chapter 3 of this manual shall be followed. In essence, it stipulates that the options of small bore sewers, shallow sewers, twin drains and underground sewers all have to be relatively evaluated to sub regions of the project site instead of blindly going in for total underground sewer flat out. Incremental sewer shall also be considered based on the phased development of the region instead of directly opting for total underground sewer system.

### 2.14.6 Planning of Pumping Station

The design principles in Chapter 4 of this manual shall be followed. In essence, it stipulates that the options of horizontal foot mounted centrifugal pump sets in a dry well adjacent to wet well has its importance in shallow lift smaller capacity pump stations and submersible pump sets are not a panacea for all applications. In addition, the twin wet well concept for degritting shall be considered.

### 2.14.7 Planning of Sewage Treatment Facilities

The design principles in Chapter 5 of this manual shall be followed. In essence, it stipulates that the choice of conventional systems as also recent emerging trends can also be considered provided the costs of the latter are ascertained from recent contracts in the country and not arbitrarily based on quotes from vendors of these technologies.

## 2.15 PLANNING OF SLUDGE TREATMENT AND UTILIZATION

### 2.15.1 Basic Philosophy of Sludge Treatment

Sludge in STPs generally refers to the biological organisms, which have a tendency to decay and putrefy and as otherwise has its value as soil fillers in agriculture and biomethanation. The philosophy shall be to opt for the biomethanation route and derive electricity by igniting the methane gas in specially designed gas engines.

### 2.15.2 Design Sludge Generation

The design principles in Chapter 6 of this manual shall be followed. In essence, it stipulates the quantity and volatile portion of the sludge solids given by the BOD load. The numerical design guidelines are more easily followed than the theoretical derivations.

### 2.15.3 Planning for Sludge Reuse

Sludge reuse is to be considered for biomethanation and using the methane gas to produce electricity and the digested sludge as soil filler in agriculture or farm forestry. The latter use as soil filler may not be easily possible in metropolitan urban centres for want of the land. Transportation of the sludge outside the limits of the metropolitan area is never easy, as the public there will object to this. Hence, methods such as pellets to marketable soil fillers or composted organic fertilizers shall have to be explored, though this is new to India.

However, the use of treated sewage sludge for land application shall be subject to its compliance to section 6.10.2.1 and section 6.10.2.1.1 of chapter 6 of this manual

### 2.15.4 Common Sludge Treatment Facilities

Common sludge treatment implies that sewage sludge generated in two or more STPs are collected in one STP and treated there. It is an effective method of sludge treatment for urban areas, where the land acquisition for STPs is difficult. However, while planning it is important to consider that transportation / collection of sludge is difficult.

### 2.15.5 Transportation and Disposal of Sludge

The practice of transporting of wet sludge in tankers and spraying onto agriculture fields are reported to be in vogue in developed western countries where such lands are in plenty. However, this practice is not recommended for India because of the fact that in the arid temperatures in most parts of the country this may set off an unintentional cycle of airborne aerosol infection. Thus transportation, if ever to be carried out, shall have to be only in the form of dewatered sludge cake to at least a solid content of about 25%. The disposal shall have to be for eco-friendly purposes as agriculture or farm forestry or pellets for marketing as supplemented organic fertilizers.

However, the use of treated sewage sludge for land application shall be subject to its compliance to section 6.10.2.1 and section 6.10.2.1.1 of chapter 6 of this manual.

## 2.16 PLANNING OF UTILIZATION OF RESOURCES AND SPACE

### 2.16.1 Planning of Utilization of Space in Sewage Pumping Stations and Treatment Plant

The open spaces in STPs and SPS, especially roof-tops, shall be used for horticulture, sports facilities/playgrounds, parks, etc. This will help utilization of such space in densely populated cities.

## 2.17 PLANNING FOR RECONSTRUCTION

The facilities get older with the passage of time and at some stage, they are not able to function at the desired level of performance.

It becomes necessary to carry out rehabilitation or reconstruction work to make them work properly. For this purpose, a reconstruction plan is to be anticipated and developed in the planning stage itself.

### 2.17.1 General Aspects of Reconstruction Planning

By definition, reconstruction arises when the original construction has become either useless or is damaged due to earthquakes or floods. In such situations, the single most important requirement is the records of “as constructed” drawings, which show the approved drawings with endorsements of whatever changes have been carried out in construction. In the absence of these drawings, it is impossible to understand why and how the construction failed. This is most important as the original drawing has been approved based on a set of standards but still it has failed and hence, there are important issues to be understood. Thus, the most important aspect of reconstruction planning is the documentation of “as constructed” drawings and the original design. The next important need is to build a ready reference of past construction failures and the reasons and reconstruction history. Perhaps the more important aspect is to encourage the engineers to be frank of their unintentional lapses and treat this as human error and not to flog even trivial lapses as major flaws.

### 2.17.2 Reconstruction Planning of Sewers

Almost everything written in Section 2.17.1 applies here also. In addition, the following are relevant:

a) A mandatory record of the fate of gases inside major sewers monitored and chronicled for ready reference

b) An ultra-sonic survey of major sewers once a year to maintain a record of the integrity of the sewers and the weakness that may be occurring in some sections

c) A procedure for alternative diversion of sewage flow by temporary submersible pump sets in the upstream manhole of a damaged portion to the downstream manhole, thus permitting the repairs to the damaged section

d) A procedure to plug the manholes on both ends of the damaged sewer using pneumatic plugs similar to football or automobile tubes

e) A standardised schedule of rates for such emergency work

f) A stock of well point system for dewatering the damaged portion

g) The most important plan in facing a failure of a trunk sewer is to realize that ground water may be polluted by seepage of raw sewage. Thus, priority is to route the sewage in another trunk sewer to shut off the incoming raw sewage immediately and divert the same to another destination even if it means overloading the trunk sewer where it is diverted.

h) While designing the sewer system itself, trunk sewers shall be designed to be possible to be used for such diversions by temporarily using the sewer as a pumping line under low pressure. After all, these sewers are laid using long sewer pipes of 6 m length, and the load carrying capacity needs a rating of at least about 4 kg/sq. cm and this is adequate for such low head pumped diversions. Temporary pumping lines of low pressure can be laid above ground along property boundary compound walls by using double-flanged DI pipes which are easy to lay and dismantle.

### 2.17.3 Reconstruction Planning of SPS and STP

The reconstruction plan for SPS and STP has to address the following issues:

a) In both these installations, the reconstruction applies largely to sewage retaining civil works only, because in the case of mechanical and electrical equipment, it is replacement and not reconstruction. Replacement does not require great skill. Reconstruction of sewage holding structures requires very great skills and experience and this includes piping and valves.

b) The importance of record keeping of “as constructed” drawings as stated earlier in Section 2.17.1 is very much important in this case also.

c) The most important plan in facing a failure of a sewage holding civil work as tank is to realize that ground water may be polluted by seepage of raw sewage and thus shut off the incoming raw sewage immediately and divert the same to another destination even if it means overloading the new destination.

d) While designing the sewer system itself, the pumping mains shall be designed to be possible to use for such diversions by temporarily overloading another trunk sewer. After all, these sewers are laid using long sewer pipes of 6 m length, and the load varying capacity needs a rating of at least about 4 kg/sq. cm and this is adequate for such low head pumped diversions. This may not be possible in large metropolitan centres but must be possible in class II and class III cities.

e) In the case of reconstruction of sewage holding structures, the best is to abandon the damaged structure, strengthen its foundation and inscribe a new structure. This may result in a loss of volume by about 10% but that is nothing to be taken seriously.

## 2.18 ENVIRONMENTAL PRESERVATION AND BEAUTIFICATION

### 2.18.1 In Sewer Systems

Most often, the slimy matter taken out of the manholes is left on the road edges itself and this creates a health hazard. In planning stage itself, solutions by way of driving trucks to collect all these to a central facility close to the municipal solid wastes dump-site has to be recognized. Accordingly, in the planning stage itself provisions shall be made in the estimates for procuring a set of mobile trucks that can be deployed in such situations, as no commercial truck will come forward to remove such muck from sewage manholes.

### 2.18.2 In Sewage Treatment Plant and Pumping Stations

Suitable provisions for greening of the premises shall be made in the cost estimation stage itself.

### 2.18.3 Environmental Preservation Measures of Surrounding Area

The fuel and energy available in the treated sewage and sludge in sewerage system can be utilized to contribute to energy conservation in the area. The reduction in energy consumed by the sewerage facilities can indirectly contribute to the prevention of global warming.

In order to preserve the environment of a city and to have positive impact on global environment, it is necessary to use various functions of the sewerage system as described below.

a. Preservation of water quality

In order to plan water quality conservation of a close natural water area, it is necessary to promote introduction of advanced treatment process. It is necessary to promote introduction of efficient advanced processing technology at sustainable cost. Moreover, it is important to plan the public awareness such that the ratio of pollution discharged without treatment is reduced gradually.

b. Use of resurgent water, rain water

Cooling the road and building by resurgent water, rain water, etc., can be planned.

c. Utilization of resources and energy

The practically feasible utilization of resource including treated sewage and sludge can be planned to avoid draining of water and nutrient.

d. Energy conservation measures

The introduction of energy-saving equipment in sewerage facilities can be thought of as the first energy conservation measures. This can be done while updating of apparatus and equipment. It is also important to aim at energy saving by improving the operating method of existing facilities.

e. Reduction of greenhouse gas

A lot of greenhouse gases (e.g., methane, CO2, etc.,) is discharged in sewerage systems. Measures to reduce such emission can be planned.

## 2.19 ENGINEERING PLANS

### 2.19.1 Plans

All plans for sewerage facilities should be in a well-organized format and bear a suitable title showing the name of the municipality, sewer district and organization.

They should show the scale in metric measure, a graphical scale, the north point, date, and the name and signature of the engineer. A space should be provided for signature and / or approval stamp of the appropriate reviewing authority.

The plans should be clear and legible. They should be drawn to a scale, which will permit all necessary information to be plainly shown. Datum used should be indicated. Locations and logs of test borings, when required, should be shown on the plans.

Detail plans should consist of plan views, elevations, sections, and supplementary views, which together with the specifications and general layouts, provide the working information for the contract and construction of the facilities. They should also include dimensions and relative elevations of structures, location, equipment, size of piping, water levels and ground elevations.

### 2.19.2 Specifications

Complete signed technical specifications should be prepared and submitted for the construction of sewers, SPS, STP, and all other appurtenances, and should accompany the plans. The detailed specifications accompanying construction drawings should include, but not be limited to, detailed specifications for the approved procedures for operation during construction, related construction information not shown on the drawings, which is necessary to inform the builder in detail of the design requirements for the quality of materials, workmanship, and fabrication of the project. The specifications should also include: the type, size, strength, operating characteristics, and rating of equipment; allowable infiltration; the complete requirements for all mechanical and electrical equipment, including machinery, valves, piping, and jointing of pipe; electrical apparatus, wiring, instrumentation, and meters; laboratory fixtures and equipment; operating tools, construction materials; special filter materials, such as, stone, sand, gravel, or slag; miscellaneous appurtenances; chemicals when used; instructions for testing materials and equipment as necessary to meet design standards; and performance tests for the completed facilities and component units. It is suggested that these performance tests be conducted at design load conditions wherever practical.

### 2.19.3 Revisions to Approved Plans

In case if the project is prepared and approved and due to some reason, the implementation is not started for a long period (say 5 - 10 years), some of the important factors affecting generated amount of sewage, such as population, water supply coverage, etc. will change. In such cases, revision of the approved plan will be required and approval shall be required again. Moreover, any deviations from approved plans or specifications affecting capacity, flow, operation of units, or point of discharge shall be approved, in writing, before such changes are made. Revised plans or specifications should be submitted well in advance of any construction work, which will be affected by such changes to allow sufficient time for review and approval. Structural revisions or other minor changes not affecting capacities, flows or operation can be permitted during construction without approval. “As built” plans clearly showing such alterations shall be submitted to the reviewing authority at the completion of the work.

## 2.20 CHECKLIST

The MoUD website http://urbanindia.nic.in/programme/uwss/dprs-checklists/sews.pdf contains the checklist for the preparation of DPR for sewerage schemes which require financial assistance. This checklist can be referred to and shall be complied with.

## 2.21 MANDATORY REQUIREMENTS IN SANITATION SECTOR

These shall be as follows

1. Each state government shall mandatorily pass a “Sewerage & Sanitation act” and notify the rules thereunder. The reason for this is to empower the ULB’s to prevail on the property owners/ occupiers to avail house service sewer connections once the sewerage system is developed by the ULB, within 30 m of the premises irrespective of whatever be the mode of existing sewage disposal system.

In case the owner/occupier fails to do so the ULB by virtue of its powers can disconnect essential services like, water supply and electricity after the expiry of the notice period. An example of such a provision can be seen under rule 10(5) of the Goa Sewerage System and sanitation services management rules 2010 enacted under the Goa Sewerage system and services management act 2008 as contained in Appendix C. 2-2 of Part C Management.

2. Similarly, each state government shall mandatorily formulate and notify appropriate act and rules for septage management.