CHAPTER 7

OPERATION AND MAINTENANCE

CHAPTER 7 OPERATION AND MAINTENANCE

7.1 O&M Strategy Development

Effective operation and maintenance of water and wastewater assets requires the development and implementation of strategies that ensure that asset performance is optimised bearing in mind the whole life cycle cost of the assets. It is also crucial to ensure that assets are maintained and operated in accordance with best operating practice employing safe systems of work. This will enhance plant operability, service delivery and the health, safety and welfare of staff, contractors, customers and the general public.

7.1.1 Primary Objective

The Public Health Engineering (PHE) Division's primary objective is to supply drinking water and dispose of wastewater.

To do this, PHE will need to manage their processes effectively. PHE recognise that one of their 'core' processes is the 'Operations and Maintenance' process and that effectively managing the O&M process is crucial to business success.

Managing processes as opposed to functions (departments), focuses efforts on all activities associated with a process regardless of the fact that activities may be performed by various functional departments within or across processes.

The process model approach requires the assignment of 'ownership' for each core process to ensure continual review and optimisation of that process. PHE should consider assigning a 'process owner' for O&M activities as well as for other business critical processes in accordance with the model below:

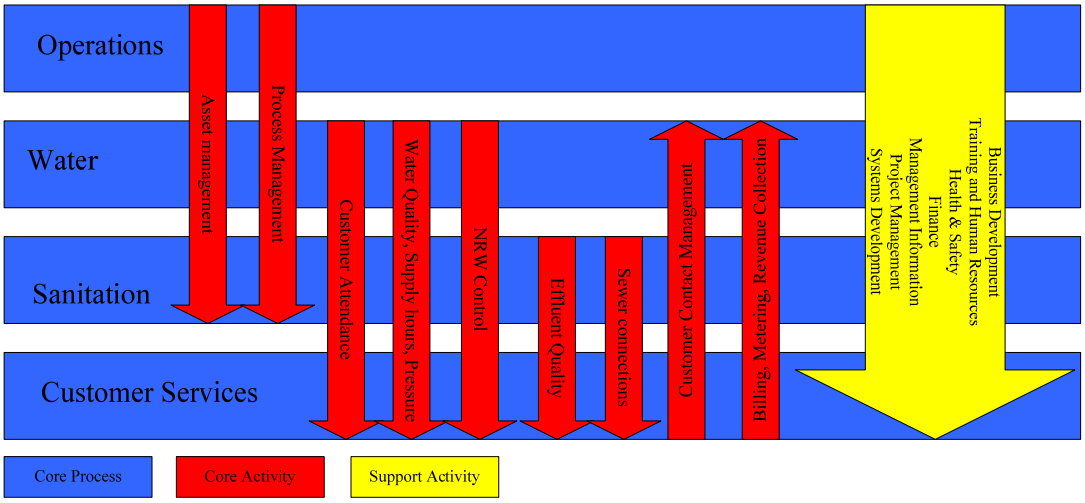


Figure 71.1 Process Management Model

Each of the above processes should come under the managerial control of a 'Senior Manager'. The process owners together with the PWD Chief Engineer would form the leadership team.

7.1.2 Operations

Operations are the "doing" part of the organisation. It is responsible for the 'source to tap' process, which includes water resources, transmission, dams, reservoirs, production, supply, non-revenue water and operations and maintenance. It is also responsible for the 'drain to river' process, which includes wastewater collection, sewerage network operation and wastewater treatment and disposal.

Appropriate systems will need to be introduced to aid the management, operation, control and maintenance of water and sanitation operations. Such systems might include; 'job management system' (JMS), 'geographical information system' (GIS), 'computerised maintenance management system' (CMMS), Supervisory Control and Data Acquisition (SCADA).

Appropriate procedures will need to be introduced in accordance with an in-house or internationally recognised quality system to cover the following activities:

- Asset Management (asset planning, asset acquisition/new schemes/project management, asset optimisation)
- Network Management (operations, control and maintenance: valve operations, pressure/flow management, flushing, leak detection/fixing leaks, rehabilitation of service connections and networks, new connections, meter exchanges/maintenance/calibration)
- Pumping Station Management (operation, control and maintenance of water and wastewater assets)

- Well Stations Management (operation, control and maintenance)
- Tanks/Service Reservoirs (operation, control and maintenance)
- Maintenance Management (breakdown maintenance, planned preventative maintenance, asset optimisation)
- Treatment Plant Management (operation, control and maintenance of water treatment facilities)
- Process Management (process control/optimisation, water quality compliance, continuous process improvements)
- Wastewater Collection & Disposal (operation, control and maintenance of sewerage networks and wastewater treatment facilities)

7.1.3 O&M Management Practices

PHE will need to adopt an holistic view of O&M practices in line with the 'O&M model' below to ensure that operational, maintenance and management strategies 'fit' and complement overall corporate objectives and strategic intent:

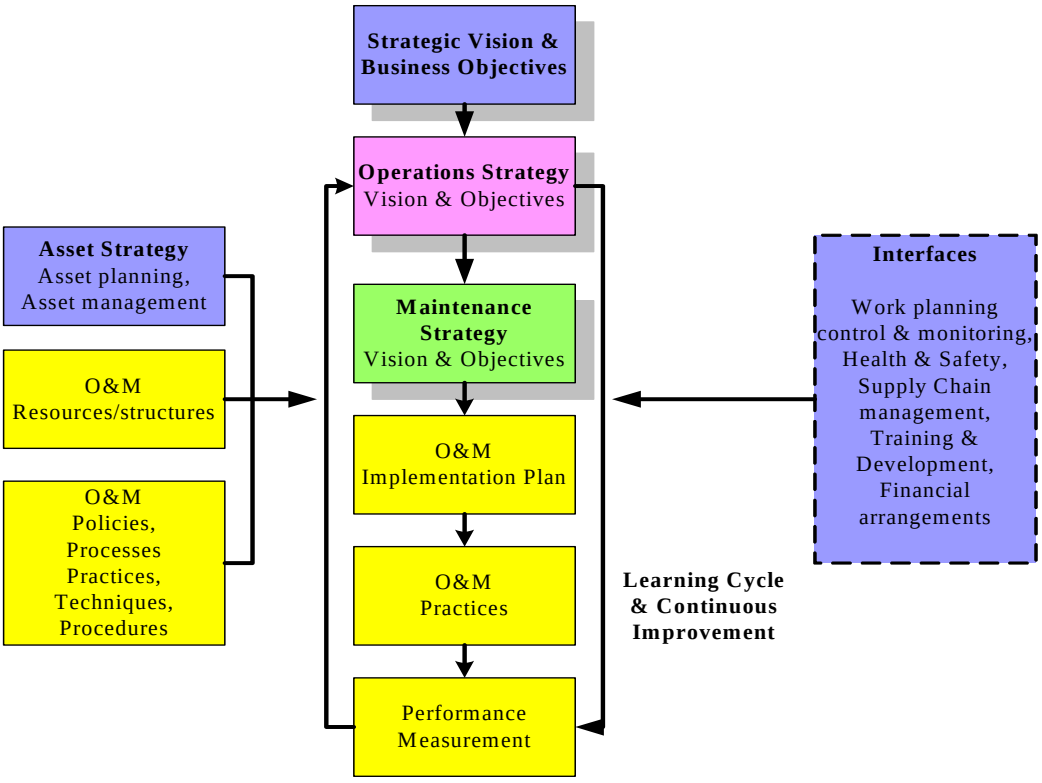


Figure 71.2 O&M Model

7.1.4 Operations Strategy

The operations strategy forms an integral part of the O&M Model shown above. The objectives

of the ‘operations strategy’ are to ensure efficient operations on a continuous basis through providing local ‘operational managers’ with accurate up to date information and guidance on systems, policies and procedures, as well as ‘key performance measures’, in order to:

- Provide the services required to satisfy the demands of customers, GOG and GOI
- Comply with the contractual and statutory requirements for the supply of potable water and meet environmental obligations for disposal of wastewater
- Minimize the risk of failure due to human error or plant failure to ensure compliance with statutory, legal and service requirements
- Ensure that, if failures do occur, they are detected, action is taken to minimise the consequences and the operating system is reviewed and amended to reduce the risk of recurrence
- Ensure that, in all areas of operations, efficiencies are constantly monitored against best industry practices and processes are modified accordingly where necessary

In order to meet the objectives of the operations strategy, PHE should consider adopting the ‘operations management’ model below in order to ensure a holistic and integrated approach to management of operations through established and effective ‘Business Systems’, encompassing ‘processes’, ‘assets’, ‘people’ and ‘information systems’:

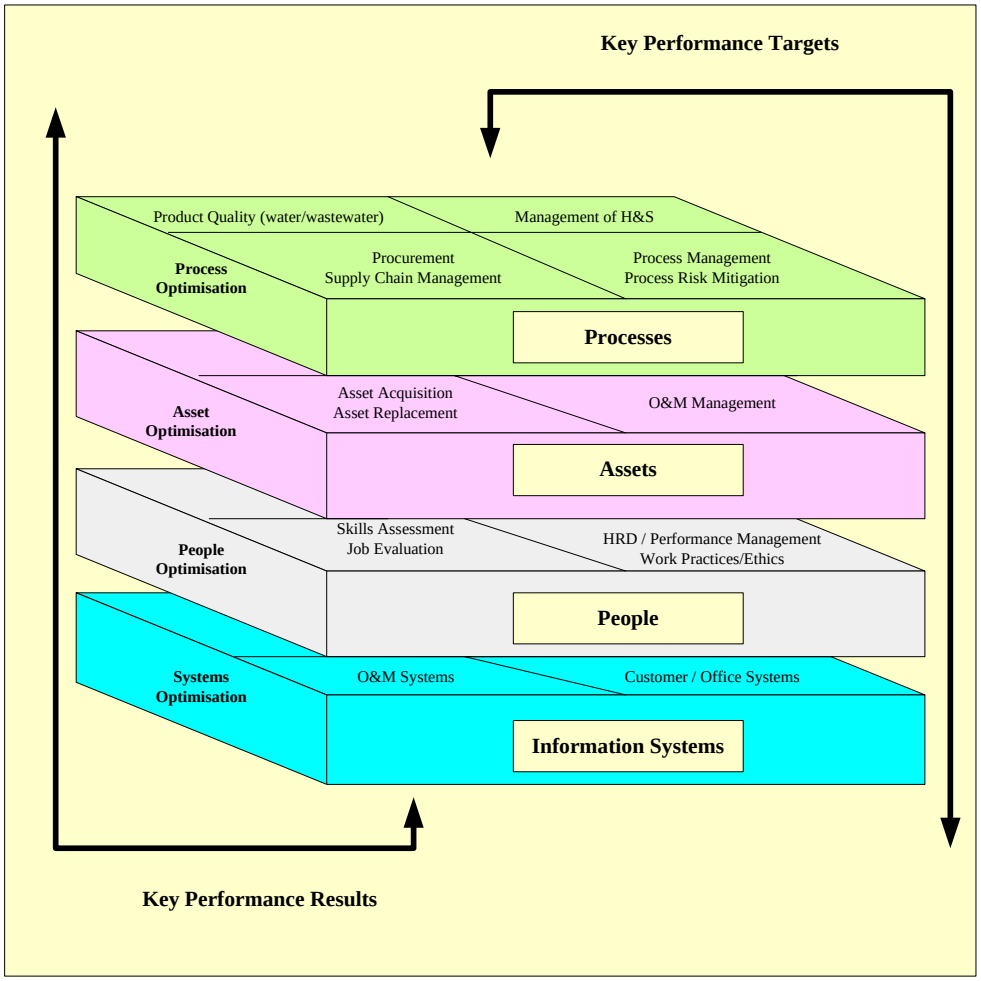


Figure 71.3 Operations Management Model

Adopting this model will require that PHE places equal focus on each of the key areas shown, thus ensuring that:

- Processes are clearly defined in accordance with national or internationally recognised quality standards and regularly reviewed for continuous process improvement
- Hazards, risks and output targets are clearly documented and managed
- Hazards, risks and output targets are understood by all involved with operations
- Risks to service delivery are identified and proactively managed
- Clear, simple and concise systems and procedures are in place to ensure process risks and operational efficiency are managed in a visible and auditable manner
- Clear and visible measures of efficiency are in place to monitor and control Key Performance Indicators (KPI's), especially in relation to power/chemicals/consumables/manpower, etc.
- All involved within operations take ownership and responsibility for efficient operation of the process, systems, plant and equipment

- Unplanned service failures are managed and rectified quickly and effectively
- Operating costs and resources are managed effectively
- Risk are assessed and managed through regular review, for example:
- Plant operability – HAZOP
- Health & Safety – H&S Risk Assessment
- Alarms are categorised and plant criticality assessed according to relative process importance
- Clear process and plant condition targets are identified to develop understanding/ownership
- Routine condition checks assessing health of process and plant against action 'triggers' are conducted on a routine day to day basis
- Plant and process condition data is used for management information for the purposes of continuous improvement
- Clear/concise operating procedures are documented to ensure that systems, plant and equipment are operated consistently and efficiently

7.1.5 Maintenance Strategy

The maintenance strategy forms an integral part of the O&M Model shown above. Refer to Figure 71.2. Effective maintenance practices will add value by providing improvements to the efficiency, cost effectiveness and reliability of assets and enhance operational performance. In developing a maintenance strategy, PHE should consider the following two drivers:

(a) Internal drivers

- Corporate and operations objectives
- Equipment age, reliability and maintainability
- Cost of maintenance and potential added value
- Skill levels and competencies of maintenance staff
- Systems, processes and procedures
- Availability of spares, materials and equipment
- Health and safety legislation and practices

(b) External drivers

- Legal, statutory and regulatory requirements
- Revenue and available working capital
- Political influences/interference
- Customer expectations
- Available technology

(1) Maintenance Strategy Objectives

PHE's should ensure that their maintenance objectives include the following:

- To provide an efficient maintenance service with optimum use of available resources and allocation based on operational priorities
- To minimize asset life costs through the application of cost effective planned preventative maintenance procedures and working practices
- To improve maintenance financial management and budget control. This will include the provision of better financial information to improve decision making
- To improve the knowledge and skills of maintenance staff by identifying and rectifying skill gaps, introducing individual development plans and providing cost effective training focused on meeting the needs of the business
- To optimize stock holding of materials and spare parts through the development of a spares policy and by identifying inventory requirements
- To develop a disciplined and professional approach towards health and safety and maintenance work practices. This includes the use of safe systems of work and lock-out/tag-out procedures

The maintenance objectives should be continuously reviewed and refined to ensure they remain aligned to the overall business strategy and responsive to internal and external business drivers.

(2) Planned Preventative Maintenance

PHE will need to provide greater emphasis on maintenance of assets by introducing a 'planned preventative maintenance' system as opposed to the current 'corrective maintenance' approach.

PHE should therefore consider adoption of the following planned maintenance approach:

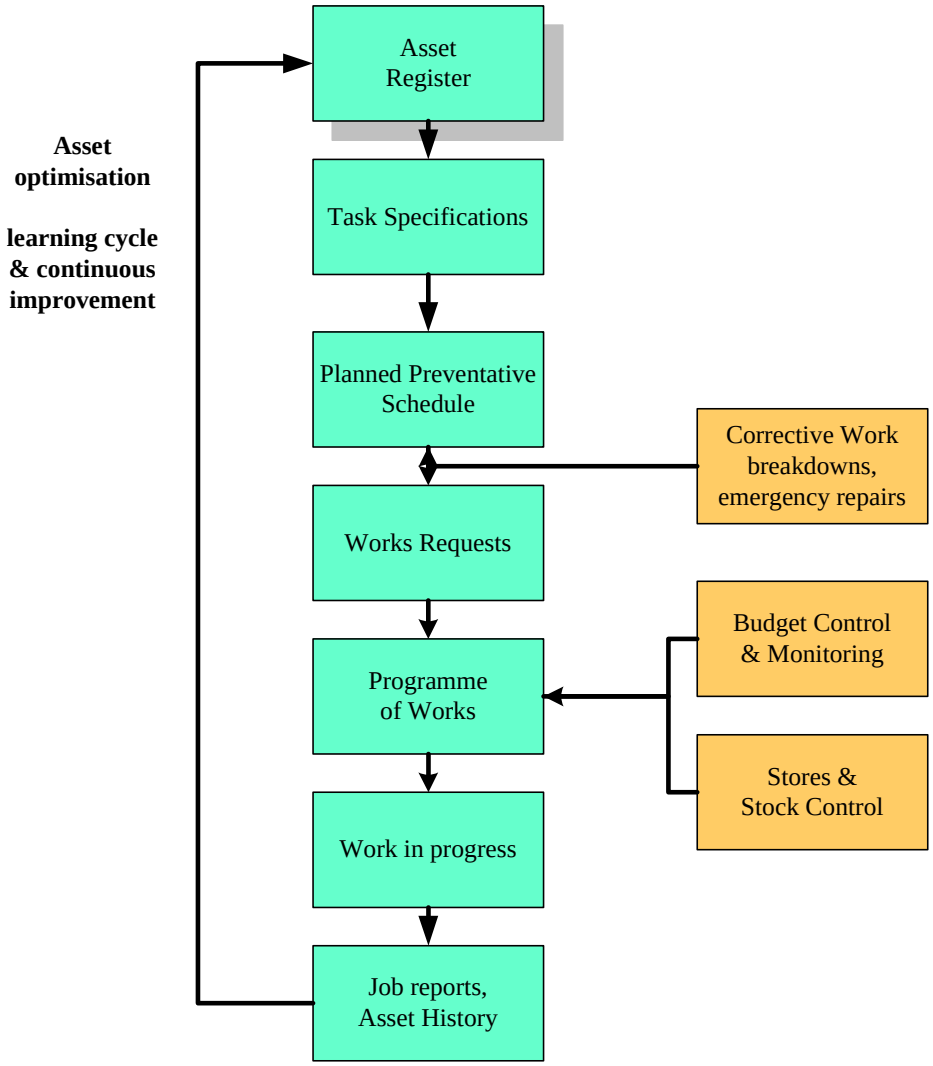


Figure 71.4 Planned Preventative Maintenance Process

The benefits of this approach will include:

- Fewer occurrences of in-service breakdowns resulting in better utilization of assets and reduced asset down-time
- Improvements in asset performance and increased asset life
- Lower operating and maintenance costs in the long-term resulting from improved efficiency
- Reduction in the 'whole life cost' of assets

The current reactive approach can often increase delays in resolving maintenance problems. Adopting a more proactive stance will initially require an increase in the volume of planned work to be carried out. This will in turn require an increase in the resources available for maintenance, more effective utilization of available resources and changes to the way resources are organized and managed.

Achieving this type of proactive preventative maintenance will require greater emphasis on getting the basics right. Accordingly, PHE will need to put in place the following key 'building blocks':

- An 'asset strategy' which determines the appropriate level of planned work required for each asset. The core focus of this strategy would be plant criticality and resolving common causes of failure
- Implementation of an adequate resource structure, process and system for organizing and controlling maintenance work
- Financial budgets, spares and materials availability along with a holistic approach to 'supply chain management' as opposed to the current system of procurement and stock management

Adoption of the approaches detailed above will be crucial to the long term viability and sustainability of all schemes being introduced as well as optimising the performance of the existing schemes. PHE should therefore consider the following:

- Continue to manage their O&M activities by geographic regions and will need to put in place appropriate policies and standard operating procedures in accordance with best practice. This includes agreeing and setting targets (key performance indicators) to meet corporate goals and a system to ensure that performance is measured against those targets
- Agree a strategy for 'Supply Chain Management' (SCM) which will ensure that the O&M team are able to operate and maintain assets effectively by ensuring that appropriate levels of chemicals, materials and spares are available in accordance with agreed maintenance regimes. PHE will therefore need to consider the development and implementation of an appropriate SCM strategy
- Review all key O&M processes on a regular basis to ensure a cycle of continuous learning and process improvements
- Centralise responsibility for the measurement, detection, reduction and management of leakage and NRW. The distribution networks design and set-up as well as management practices will need to be realigned and geared to these activities. For example, the various networks should be 'remodelled' and installation of equipment such as flow and pressure measuring devices as well as basic equipment such as 'zonal' meters, isolation or pressure control valves to aid leakage detection, measurement and control will need to take place
- Introduce a system of proactive communications including the reporting of key management information
- Introduce O&M Manuals to internationally recognised quality standards to be used as a key source of information for training purposes to ensure consistent operation and maintenance

of major plant and equipment. The O&M Manuals should be subject to constant review, as will O&M practices, to ensure development and sharing of best practice across all activities. In this way, PHE will ensure that operational plant is operated and maintained in an efficient and cost-effective manner. The O&M Manuals should contain the following key elements as a minimum:

- Operating and maintenance policy statement
- Organisation structures at local and corporate levels and organisational arrangements and management responsibilities
- Job descriptions for all the members of the O&M team
- General description of the facilities to be operated and maintained
- Detailed operating procedures for all installations, facilities, plant and equipment including control and monitoring systems
- Detailed emergency procedures and contingency plans
- Detailed maintenance procedures for all installations, facilities, plant and equipment including control and monitoring systems. These include procedures and systems for preventative and predictive maintenance
- Testing and laboratory procedures
- Calibration of measuring equipment
- Safety procedures including 'safe systems of work'

7.2 H&S Strategy Development

7.2.1 Duty of Care

PHE recognise the importance of establishing safe systems of work to ensure that they protect their staff and the general public and to ensure compliance with the relevant H&S legislation in force.

To achieve this, PHE will need to introduce and maintain good health and safety practices and provide the necessary documentation, equipment, systems and training to ensure that they meet their H&S responsibilities effectively.

7.2.2 Organization and Arrangements for Health & Safety

PHE should consider assigning 'ownership' for all health, safety, welfare and security matters to an 'H&S process owner' who will take responsibility for ensuring that PHE complies with its H&S obligations. The process owner will support line managers to meet all H&S obligations within their regions.

Supported by the H&S process owner, PHE should consider adoption of an 'integrated safety management system' as depicted below:

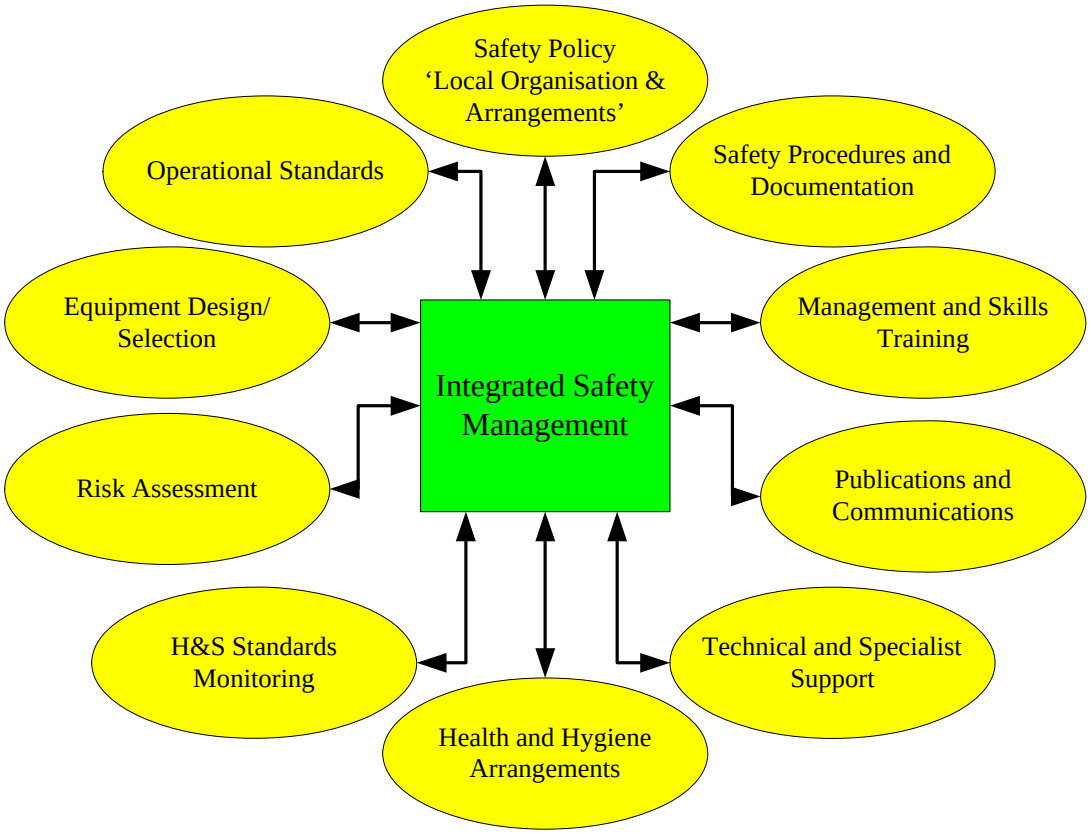


Figure 72.1 Integrated Safety Management System

In adopting this approach, PHE will need to introduce the necessary standards and documentation required for each of the areas above including the following:

- The management of Health and Safety (Process owner, assign responsibilities, resources, trained safety representatives, safety inspections, record keeping)
- Health and Safety organisational arrangements (safety reps/committee, regular meetings and inspections, H&S awareness training/refresher courses, introduction/review of safety standards/procedures/safe systems of work)
- The safe management of Chlorine (training, safe systems of work/equipment)
- Safety in Mechanical Maintenance (training, safe systems of work/equipment)
- Safety in Electrical Maintenance (training, safe systems of work/equipment)
- Accident statistics and reporting procedures (first aid/accident/near-misses reporting and investigation)
- Management and control of confined spaces (designing-out confined space working, staff

training, work permits/safety equipment and procedures)

- Lifting tackle and lifting operations (inspections, records, safe handling procedures, staff training, storage of lifting tackle)
- Emergency/contingency planning (emergency procedures, emergency drills, staff training, community and emergency services liaison, disaster/recovery plans)
- Site incident procedures (site inspections, accident investigation/problem rectification)
- Fire safety procedures (inspections, extinguisher maintenance/records/testing, fire drills)
- Safe working practices/safe systems of work (safety inspections, control of premises/contractors, work permits[hot work, plant isolation/maintenance, confined spaces entry])

- PHE should also:
- Introduce a Health & Safety Policy that will include a 'policy statement' that makes clear who takes responsibility for what and the procedures for compliance.
- Introduce a Local Organisation and Arrangements Document (LOAD). This document identifies responsibilities and roles for each member of staff and details specific Health and safety responsibilities and duties to be managed or performed. This document will be site specific and will relate to the hazards associated with the site for which the document is intended. Refer to Volume IV Appendix M71 Local Organisation and Arrangements Document (LOAD).
- Consider 'appointment' of a "Controller of Premises" for each PHE site, including treatment plants, reservoirs, depots, Regional and District office complexes etc. The 'controller' will take overall responsibility for the control of health and safety matters on that site.
- Consider 'appointment' of health and safety representatives to coordinate health and safety activities such as audits and inspections and to help raise the profile of health and safety generally.
- Consider forming a H&S committee that will meet regularly to raise the profile of health and safety awareness and to help improve safety standards and practices generally.
- Provide training for all engineers and managers from junior to senior level in H&S matters specifically with regard to statutory requirements, safe systems of work (work permits, lock-off procedures, etc.) and best practise.
- Consider introducing mobile communications (radio or mobile telephones) to improve safety for 'mobile' staff working on public highways or in remote or lone conditions.
- Regularly review operational practices to ensure that they continually meet and improve safety requirements and standards.
- Provide personal protective equipment such as gloves, helmets, safety shoes, breathing

apparatus etc. and ensure that staff are trained in their proper use and maintenance.

- Ensure that all necessary safety equipment such as lifting tackle, harnesses, tripods, etc. are logged, maintained, calibrated, stored and used in accordance with best practice.
- Must employ a safe system of work for the handling and use of chlorine and other chemicals.
- Regularly review their Health, Safety, Welfare and Security measures, practices, procedures and documentation for adequacy to ensure that thy meet their H&S obligations as a professional and responsible organisation.
- Ensure a safe system of work for working on public highways to ensure the safety of staff, contractors and road users.
- Ensure a safe system of work on all premises relating to fire safety. This will include the need to appoint 'fire marshals', provide fire extinguishers and training for their use, provide evacuation procedures and fire drills, etc.

7.3 Performance Management Strategy Development

There are currently no clearly defined mechanisms in place for 'performance managing' the business. Whilst some information is collated within regions and other information is collated centrally, for example, project progress, requests for funds/materials, as well as commercial and financial information, these are collated via paper systems and not used for purposes of 'performance managing' the business, decision making, or for comparing inter- departmental performance.

PHE does not have:

- A system in place for performance management that establishes goals and measures for individuals, teams, departments or the authority as a whole
- An established set of Key Performance Indicators (KPI's) that are agreed, understood, 'owned' or shared throughout the organisation. These would be used to improve processes, service provision etc. through the collection, sharing and acting on relevant management information
- A system in place for performance management that uses internal or external benchmarking activities in order to compare/improve inter-departmental performance as well as overall PHE performance with industry best standards

PHE generates 'annual accounts', annual administrative reports' and 'annual budget estimates' but these are not widely distributed or shared amongst the staff. These appear to be the main reports or source of information that could be used by the GOG to 'regulate' PHE's activities. However, there appears to be little regulation or sanction placed on PHE regarding compliance

with water quality standards, wastewater standards, abstraction, or the level of business performance generally.

PHE will need to develop appropriate 'corporate systems' to ensure effective management and control across all aspects of the business and documented procedures should be produced in accordance with an appropriate in-house or internationally recognised quality standard to cover the following activities:

- Establishing processes for setting, measuring, charting, reviewing and improving performance
- Collating and issuing appropriate performance information at all levels of the organisation (Management Information)
- Continuous review of key processes such as business, financial, customer, commercial HRD, O&M, water resources planning etc.

(1) Taking a balanced approach

Currently, PHE does not have a system of sharing or measuring corporate objectives against agreed performance indicators.

PHE should take a 'balanced' approach to performance managing the business and consider the development and introduction of a 'Balanced Scorecard'. Refer to Figure 73.1 Example Balanced Scorecard. This is a process whereby the vision, strategic objectives and critical success factors are translated into performance measures and specific targets across the key business areas such as Customers, Finance, Human Resources and Business Processes. The process itself can be helpful in bringing clarity and focus to what needs to be done to achieve success even before the benefits from measurement and performance monitoring begin to appear.

Ideally a balanced scorecard should concentrate equally on hard and soft measures. However, for an initial period of say one year, it is recommended that the scorecard is based on hard physical performance data - because it is easier to collect and use to improve performance 'on the ground'.

Balanced scorecards should be prepared for each department to improve 'ownership', compare performance and to determine and share best practice.

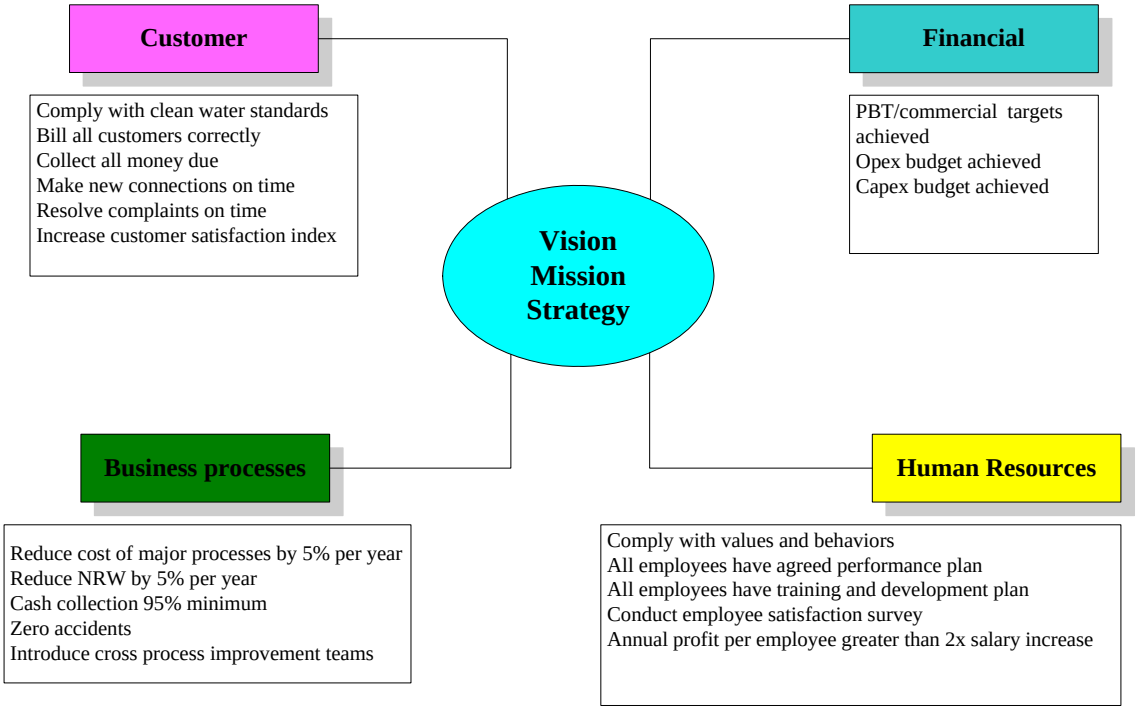


Figure 73.1 Example Balanced Scorecard

7.4 O&M of Water and Sanitation Schemes – Organizational Development

It is currently assumed that PHE would continue to take responsibility for the day to day operation and maintenance of all schemes. Based on discussions with Panchayats and Municipalities it is evident that Councils and Panchayats do not have any plans in the short, medium or long term to take on responsibility for O&M of water and sanitation schemes within their area of control or to develop further schemes in accordance with their mandate as stipulated by the 9th and 10th Plans as well as the 73rd and 74th Constitutional Amendments. The development of O&M strategies and practices described throughout the body of this report will be applicable whether PHE continue to operate as at present or changes over time to a 'market based service provider'.

Operating Philosophy

The Operations Department should aim to become a centre of service excellence, in line with international best practice, with responsibility for operating, maintaining, developing and extending the water and sanitation systems. The aim will be to undertake these responsibilities, together with meeting customer expectations, in an efficient, effective and economical manner providing a reliable and high quality service. Appropriate methods will therefore need to be put in place to make this happen.

Operations has a key role in the future success of PHE through reduction of non revenue water, ensuring a positive supply/demand balance, development and extension of water and sanitation systems and connection of new customers for increased revenue.

In undertaking their duties all activities of Operations will need to be managed and reported in full compliance with Indian legal/statutory requirements and PHE policies. Local processes and procedures, especially value added processes, will need to be put in place to ensure effective management and control of the water and sanitation function.

Currently very little exists in the way of either good operating practice or standard operating procedures. In the short term therefore efforts will need to be concentrated in putting the necessary 'building blocks' in place to ensure that work practices are captured and that a process is established to ensure continuous improvement through the setting, measuring and monitoring of performance data. Refer to Section 7.3

Similarly, the robustness and accuracy of asset and historical data on water and sanitation systems is limited. Effort in the short term will therefore need to concentrate in capturing this data in order to define and understand the 'base position' with the aim of bringing clarity and focus to the scale and scope of what needs to be done to improve asset performance now and in the future.

For performance measurement purposes, balanced scorecards should be developed and introduced in the short term by Division and Region to improve 'ownership' and to facilitate continuous process and performance improvement. Refer to Figure 73.1 Example Balanced Scorecard. The regulatory performance targets for Operations will need to be developed. PHE may consider introducing 'progressive' targets in line with the suggestions shown. These should be introduced in the short term and modified as appropriate over the medium and long term as performance improves over time. The Operations Department will need to be committed to achieving all published performance targets and with need to foster good relations with the 'Regulator'.

A key element affecting the success of Operations relates to the capital expenditure required for NRW measurement and control and rehabilitation and augmentation of water and sanitation systems. These requirements will need to be set out in an 'Asset Strategy' that will need developing accordingly.

7.5 Water and Sanitation Schemes Control Philosophy

7.5.1 Water Supply Schemes

(1) Short term

Based on current skill levels, in the short term, PHE should continue to operate clean water facilities manually with limited use of technology. Facilities would need to continue to be manned on a 24 hour basis by on-site personnel. However, there are a number of basic but essential improvements that would need to be implemented to improve operational and commercial performance.

This would include the need to:

- Install pressure and flow measuring devices
- Implement best operating practices and manuals
- Implement safe systems of work
- Improve safety standards especially for chlorine use
- Adopt 'Active Leakage' practices and equipment
- Measure the performance of assets and staff
- Record process and asset data and maintain asset records
- Act on process, asset and management information
- Implement proactive maintenance practices
- Enhance skills through training
- Improve water quality sampling throughout networks and customer taps and additional responsibility for the Tonca laboratory to set sampling and quality procedures for the whole of Goa and to ensure testing for those parameters currently not tested by contracting out to government or private labs.
- Introduce standby generation at critical plants

(2) Medium term

In the medium term, PHE should introduce a level of sophistication to improve performance of existing and future plant and reduce operational expenditure. In addition to the above, this would include the need to:

- Introduce process control measures for water quality and process parameters (statistical process control techniques)
- Introduce plant control measures such as electrically or phneumatically actuated valves
- Introduce automated flow controls in and out of reservoirs
- Reorganise around processes
- Introduce Regional Control Centres for water supply systems including complaints handling
- Centralise responsibility for water quality sampling, testing and reporting
- Introduction of a central laboratory to ensure compliance with water quality standards at plants and throughout the networks. The laboratory will need to be fully equiped and resourced to enable sampling and analysis of all parameters stated within the Indian Drinking Water Quality Standards. The Tonca laboratory may not be sufficiently spacious to accommodate the expansion required at that time. This should be fully investigated as part of the feasibility phase
- Telemetry of pressure and flow measuring devices
- Introduce DMA's for leakage and UFW reduction
- Introduce computer systems to record process, asset, performance and management information
- Introduce planned preventative maintenance practices
- Introduce mobile maintenance teams for smaller sites
- Train or buy in key skills such as IS, computer, instrumentation skills

(3) Long term

- In the long term, PHE should consider the following in addition to the above:
- Process automation (Power Line Communications (PLC)/Supervisory Control and Data Acquisition (SCADA) systems)
- Plant automation (PLC/SCADA systems)
- Remote network control (Telemetry/SCADA)
- Telemetred DMA's back to the regional control centre
- Computerised Asset Management System including job management, asset records, procurement of materials and inventory management
- Computerised Maintenance Management system (CMMS)
- Computerised water Quality analysis, recording and reporting system
- Network Modelling

Network modelling is a useful tool in understand the characteristics and performance of networks in order to optimise network operation. The use of network modelling supplemented

with field verification to assess and check the effects of proposed changes to a network prior to implementation can avoid expensive mistakes, abortive detailed planning and possible future operational supply problems.

7.5.2 Maintaining Water Quality

(1) Water Treatment Plants

Water quality is monitored in water treatment plants to assess drinking water quality and to assess the treatment process. Drinking water quality parameters will need to be measured at a central laboratory and the process monitoring parameters will continue to be measured in on-site laboratories at each water treatment plant.

The drinking water quality parameters are shown in Volume IV Appendix M72 Water & Sanitation Quality Monitoring. These parameters comply with the recommended guidelines in India. Currently all drinking water quality parameters are not measured. As part of the master plan, a central laboratory that can measure all the required parameters should be established. The central laboratory would be responsible for drinking water quality at all the water treatment plants. Samples would be taken monthly. In the short term the central laboratory would analyse only those parameters that are classified in the Indian guidelines that are also listed in the WHO guidelines as 'Health Significant Aspects'. In the long term all parameters in the Indian guidelines would be measured. Until the central laboratory is established, the parameters that cannot be measured in the existing Tonca laboratory should be measured at private laboratories.

The central laboratory would monitor drinking water quality and treated sewage water quality for all schemes. The role of the central laboratory is shown in Figure 75.1 below. The central laboratory will conduct monthly analysis of treated water, daily analysis of distributed water, and monthly analysis of treated sewerage.

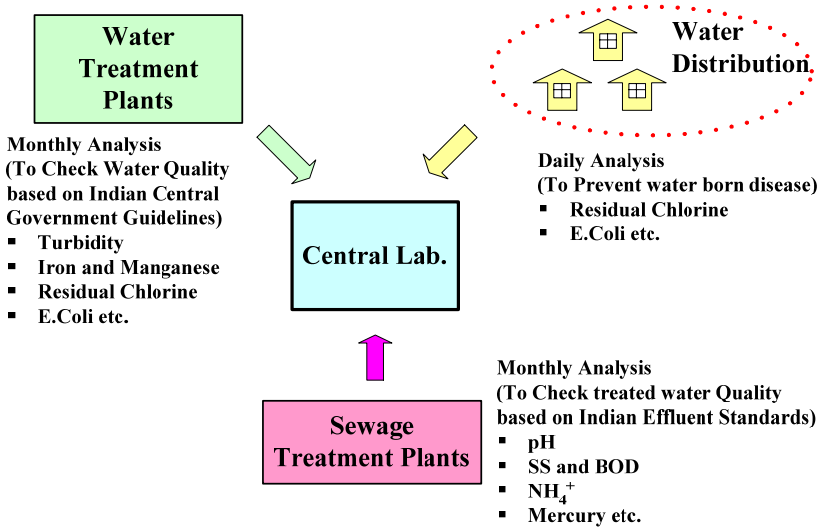


Figure 75.1 Role of the Central Laboratory

7.5.3 Water Supply Schemes Control

It is envisaged that in the medium and long term, once the concept of 'process working' has been embraced, Regional Control Centres (RCC's) would be established for effective control of Water Supply Systems; refer to Section 7.5 'Water and Sanitation Systems Control Philosophy'.

The treatment plants, networks and reservoirs within each region would be monitored and controlled from the RCC's. The RCC's would have a communications link with the PWD HQ for monitoring and control purposes. The Information Systems (IS) network would also serve as a communications link within and between centres for purposes of providing management information, operating various software applications such as Computerised Maintenance Management System (CMMS), Billing & Revenue systems, Geographical Information System (GIS) etc., as well as provide the communications 'backbone' for telemetry of critical assets and control points. Refer to Section 7.6.

7.5.4 Sanitation Schemes

(1) Short term

Based on current skill levels, in the short term, PHE should continue to operate the existing sanitation facilities manually with limited use of technology with the exception of Panjim STP. This should be used as a proving ground for future STP's. Facilities would need to continue to be manned on a 24 hour basis by on-site personnel. However, there are a number of basic but essential improvements that would need to be implemented to improve operational and commercial performance.

This would include the need to:

- Implement best operating practices and manuals
- Implement safe systems of work
- Impove safety standards at sewage pumping stations (SPS's), sewage treatment plants (STP's) and the sewerage networks
- Upgrade electrical instalations at STP's and SPS's to comply with safety regulations in force
- Provide tools for effective maintenance of SPS's, STP's and the sewerage networks
- Measure the performance of assets and staff
- Record process and asset data and maintain asset records
- Act on process, asset and management information
- Implement proactive maintenance practices
- Enhance skills through training
- Equip Margao STP with an on-site process laboratory to ensure self sufficiency in complying with the relevant efflent discharge standards in force from time to time

(2) Medium term

In the medium term, PHE should introduce a level of sophistication to improve performance of existing and future plant and reduce operational expenditure. In addition to the above, this would include the need to:

- Introduce process control measures for effluent and process parameters
- Introduce plant control measures such as electrically or phneumatically actuated valves
- Introduce automated flow controls in and out of (SPS's)
- Reorganise around processes
- Introduce Regional Control Centres for sewerage systems
- Telemetry of SPS's back to the regional control centres
- Introduce computer systems to record process, asset, performance and management information
- Introduce planned preventative maintenance practices
- Introduce mobile maintenance teams for smaller SPS's
- Train or buy in key skills
- Centralise responsibility for effluent quality sampling,measurement and reporting

(3) Long term

- In the long term, PHE should consider the following in addition to the above:
- Process automation (PLC/SCADA systems)

- Plant automation (PLC/SCADA systems)
- Remote SPS control (Telemetry/SCADA)
- Computerised Asset Management System including job management, asset records, procurement of materials and inventory management
- Computerised Maintenance Management system (CMMS)

7.5.5 Maintaining Effluent Quality

Responsibility should be assigned to an 'effluent quality process owner' for ensuring that control parameters are set and measured to ensure compliance with the appropriate effluent quality standards in force from time to time across the state.

Parameters that require special equipment or analysis should be agreed, sampled and analysed at a central laboratory that is fully equipped to ensure compliance with the appropriate standards in force from time to time. The central laboratory should take responsibility for setting sampling procedures, transport of samples for central analysis, record keeping and reporting to PWD and other government agencies as required. For sanitation system monitoring parameters refer to Volume IV Appendix M72 Water & Sanitation Quality Monitoring.

7.5.6 Sanitation Systems Control

It is envisaged that in the medium and long term, once the concept of 'process working' has been embraced, Regional Control Centres (RCC) will be established for effective control of Sanitation Systems. The treatment plants, pumping stations and sewerage networks within each region would be monitored and controlled from the RCC's. The RCC's would have a communications link with the PWD HQ for monitoring and control purposes. The IS network would provide the communications 'backbone for' for purposes of providing management information and telemetry of critical assets and control points such as the SPS's.

7.6 Water and Sanitation Control Systems

In the medium and long term, it is envisaged that the RCC's would be capable of monitoring and control of all water and sanitation systems within the regions as the responsibility for both water and sanitation would fall under the same person. Refer to Section 7.1 'O&M Strategy Development'.

Adopting the control philosophy as detailed above would require the development and implementation of a typical 'communications infrastructure' as follows:

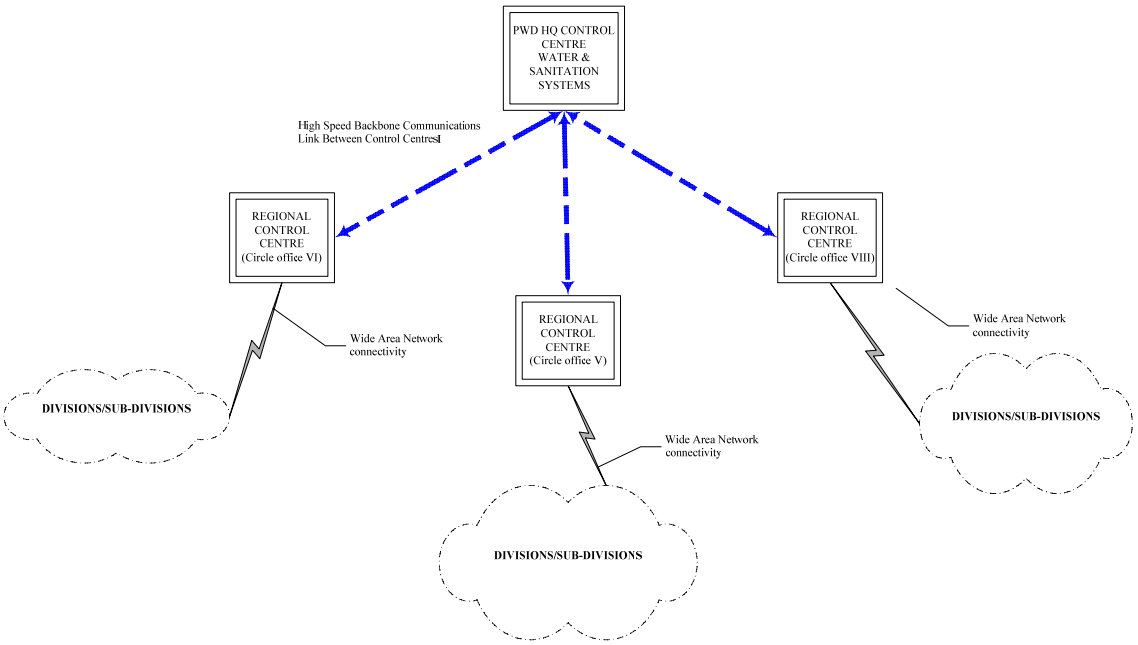


Figure 76.1 Suggested Typical Future Communications Infrastructure

Adopting the control philosophy and communications infrastructure as detailed above would require development and implementation of a typical ‘IS architecture’ as follows:

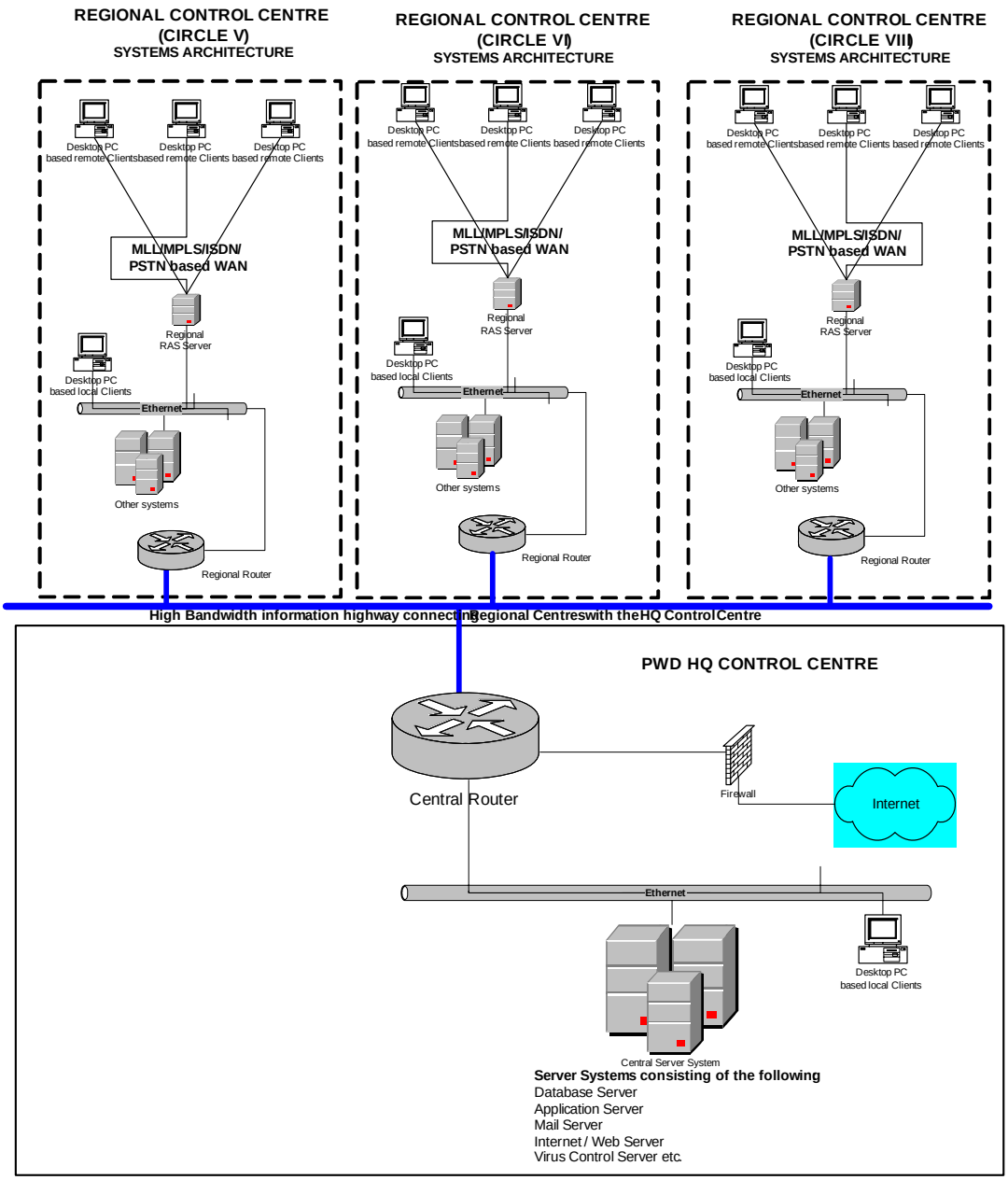


Figure 76.2 Suggested Typical Future IS Architecture

Based on discussions with the Goa Director of IT, it is envisaged that the communications 'backbone will be provided by the IT directorate (high bandwidth fibre optic cable) within the next 12 months. This negates the need for PWD to provide a dedicated communications network. This also provides the opportunity for PWD as well as all other government offices to utilise the facilities of a State Central Data Centre where by the IT Directorate would 'host' PWD applications. The provision of high bandwidth connectivity will enable PWD to operate central database applications as opposed to distributed databases thus reducing the cost of software licenses etc. Should this be the case, in the diagram above, the PWD HQ Control

Centre would be hosted at the Directorate of IT State Data Centre.

7.7 Asset Management

Following discussions with PWD a desire has been expressed to place high priority on registering assets. Based on these discussions it is recommended that PWD considers the following approach to Asset Management.

7.7.1 Managing Assets

Asset management can be described as the process of guiding the acquisition, use and disposal of assets to make the most of their service delivery potential and manage the risks and costs over their entire life. The benefit of adopting an 'asset management process' is that it will allow PWD to meet its service delivery obligations efficiently and effectively. Effective asset management will potentially deliver the following business benefits for PWD:

- Makes the most of the service potential of assets by ensuring that they are operated correctly, optimized and maintained
- Reduces the demand for new assets and saves money through optimizing existing assets and seek non-asset service delivery options
- Achieves greater value for money through economic evaluation of options that take into account whole life cycle and full costs, and value management techniques
- Reduces unnecessary acquisition of assets by making PWD management aware of the full costs of holding and using assets
- Management focuses attention on results by clearly assigning responsibility, accountability and reporting requirements

Asset Management is probably the single most powerful tool a water utility business can use in the pursuit of asset stewardship, sustainability, customer service excellence and efficiency.

7.7.2 Consequences of Poor Asset Management

In absence of a fully effective Asset Management Programme, the risk of asset failure increases as the assets age resulting in:

- A mismatch between customer expectations, asset capabilities and regulatory standards
- Unacceptable variances in asset performance between customers or locations
- Inadequate investment and/or O&M expense level
- Missed income opportunities
- Sub-optimal resource utilization & asset performance
- Regulatory/PR issues for failure to comply with Regulatory Standards
- Bad press, penalties and compensation claims due to injuries and environmental damage

- Health and Safety or Public Health concerns
- Increasing operating costs attributable to poor investment targeting

Based on the above, it is recommended that PWD formalise their 'Asset Management processes' inline with the Asset Management Model detailed below:

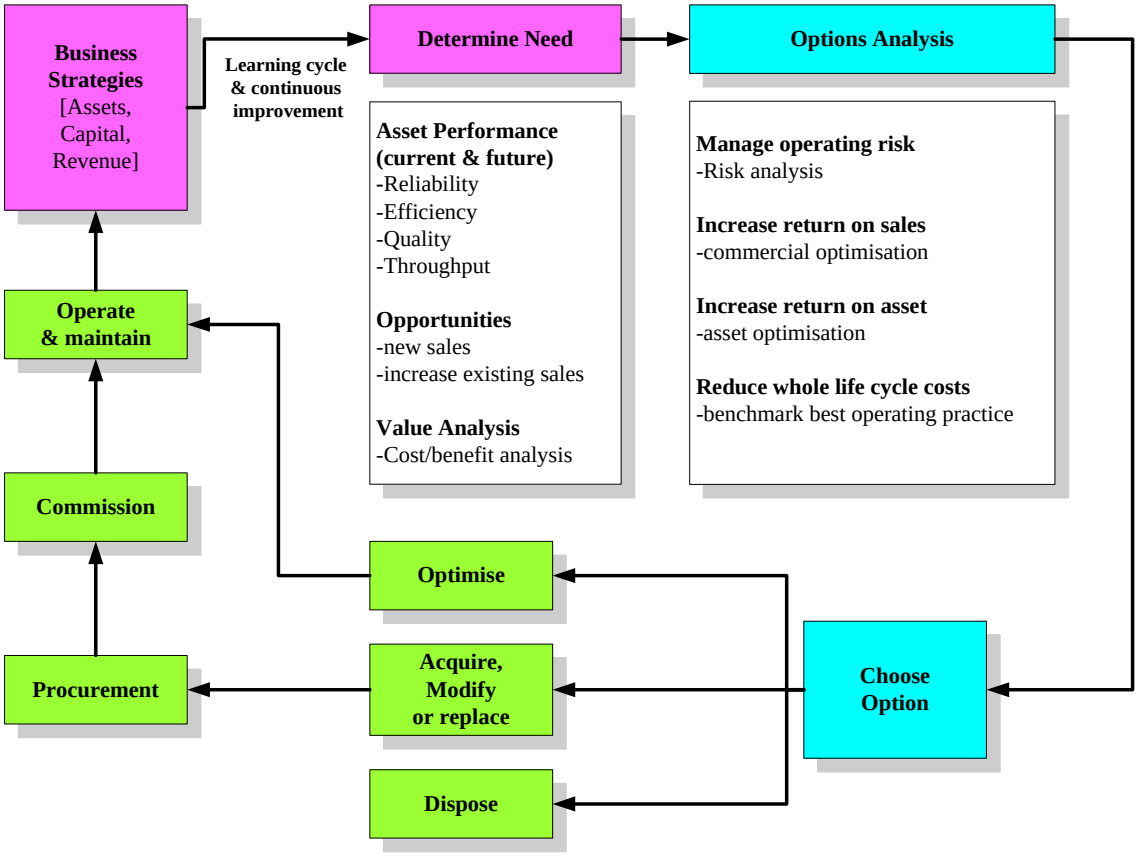


Figure 77.1 Asset Management model

Adoption of this model will enable PWD to ensure:

- Serviceability of the assets are maintained
- Assets are capable of meeting increased future demands such as quantity, quality standards and other regulatory requirements
- Maximum revenue generation
- Support to all business areas, for example, operations, customer services, information systems, etc.
- Improved operating efficiency of assets
- Capital expenditure plans meet the strategic intent of the business through agreed action plans or CAPEX plans

- Integration of capital expenditure, income and operating expenditure within Business Plans for SE's within the Regions
- Control of budgets through business plans and on individual capital projects through appropriate authorization thresholds and financial systems
- Adherence to procedures or guidelines for capital expenditure, planning, control, and approval processes
- All asset expenditure is subject to an investment appraisal process, which considers alternative options and highlights the impact on company profitability and key financial measures.

Asset Management should be developed as a Corporate Business Process with clear definitions of role and responsibilities assigned to an 'Asset Manager'.

Asset Strategy-based investment will enable PWD to make informed decisions regarding the development, operation & maintenance of water & wastewater assets.

Assets in turn should be managed to meet agreed operational objectives for meeting corporate performance objectives such as water into supply targets, compliance with quality standards, levels of service etc.

The Asset Management strategy should take into consideration the interaction of various business strategies and processes such as business planning which will provide operational targets and the O&M strategy which will provide an integrated policy for effective and efficient asset acquisition, operation, repair and replacement, in compliance with the requirements of quality management objectives and target levels of service, based upon asset 'whole life cycle' costs and performance.

Based on the above PWD should consider adoption of a generic Asset Management Process. Refer to Volume IV Appendix M73 Asset Management Process.

CHAPTER 8

INSTITUTIONAL DEVELOPMENT

CHAPTER 8 INSTITUTIONAL DEVELOPMENT

This Chapter lays out a broad strategy and development framework, principles and concepts guiding the preparation of the institutional development master plan. Much of the institutional assessments and analysis of the external policy environment were presented in the earlier chapters. This institutional development master plan envisages a legislative/policy agenda, an internal restructuring agenda and a capacity building agenda focused on supporting the development needs of the adopted institutional arrangements. The institutional development strategy will focus on assisting PHE plan and implement the internal organizational changes needed to support the sector reform objectives through effective management of assets, processes, systems and people. The Plan includes a wide range of proposed interventions – management systems, training, policy adjustments - designed to transform PHE into a viable and efficient water and sanitation public enterprise.

Overall, this Plan seeks to transform the PHE from an engineering-oriented operation into an accountable service provider. It will help strengthen the business orientation and customer orientation of the organization. It will work in partnership and contribute to the reforms in sector policy and legislation. The key policy pre-requisites for institutional strengthening include: increased financial autonomy, clear public accountability and performance incentives.

Implementation is envisaged to follow the proposed phasing delineated in the facilities improvement plan.

8.1 Bases for the Institutional Development Plan

8.1.1 Water Sector Reforms

The preparation of this Master Plan comes at an exciting time in the life of the sector in Goa as the state embarks on an ambitious program to reorganize and rationalize the sector. Water Sector Reform began in 2003. Several reform recommendations have been put before the Cabinet Committee. This Institutional Development Master Plan and the current water sector reform initiatives are very closely linked and interdependent. This Master Plan will focus on developing internal capacity within the new sector institutions following the policy innovations introduced with the sector reform.

Sector reform consists of a “5-Point Agenda” intended to improve the provision of water supply

service throughout the State. The reform envisages a clear separation of roles at three levels: a policy level; a water supply authority level, and a service provision level. It examined various options for facilitating the contribution and increasing the role of the various local bodies. Various options for organizing the service delivery functions (operation and maintenance, customer services, capital development) were examined. Institutional arrangements for sector performance monitoring and oversight were assessed. And finally, sector reform considered effective approaches for strengthening customer voice and participation.

Role separation is intended to clearly identify responsibilities for various aspects of sector management and actual delivery of the service.

Table 81.1 Role Separation, as envisaged in the Water Sector Reform initiative

	Areas of responsibility
Policy level	▪ Policy framework, Policy goals ▪ Water & Sanitation Law ▪ State norms & Technical standards, WRM, EPA & DWQ trade-offs ▪ Setting Tariff structure & Tariff policy ▪ Tariff approval ▪ Sector Targets, framework for fiscal transfers ▪ Oversight of content & process of agreement ▪ Audit of investment plan ▪ Overall monitoring & oversight
Water supply authority level	▪ Sector management & planning ▪ Capital development (project investment), including Master Plans & Project Plans; Planning and Sourcing of capital investments, and Project implementation & monitoring ▪ Operations support services (for example, training services, water and wastewater quality testing services ▪ Operations monitoring (benchmarking); Compliance with approved standards. ▪ Tariff and tariff structure recommendations ▪ Coordination with consumer groups and local bodies
Service provision level	▪ Services provision as per service delivery agreement (i.e., coverage & supply as per guidelines / norms) ▪ Operations & maintenance of assets (water production & treatment; water transmission & distribution; sewage collection; sewage treatment & disposal) ▪ Customer services (billing, collection, service requests, complaints, etc) ▪ Asset creation (investment plan implementation, procurement of capital works) ▪ Business plan development.

An 18-month rollout period is anticipated as soon as a firm decision is arrived at by the policymakers. The first stage of this Institutional Development Master Plan will likely coincide with and be coordinated with the implementation of the roll-out plan. It will assist PWD in its transition and transformation from a construction-oriented engineering organization to a viable public utility enterprise following the concepts espoused under the Water Sector Reform initiative. This Master Plan will respond to the challenges posed by the impending policy decision. If the reform recommendations are fully accepted, this Plan will certainly be more

challenging. The scope and scale of the Plan will be tailored to suit the policy decision made.

8.1.2 Institutional Assessment

The Study has reported on the assessment of PHE institutional performance in Chapter 3. Financial performance and operation and maintenance performance assessments are found in the appropriate sections of the same chapter. This assessment also provides a firm base for this institutional development plan.

8.2 Legislation and Sector Policy Agenda

During the assessment stages, this Study concluded that from an operational point of view, sufficient legislation and policy statements are already in place.

Chief Officer and panch can play a more supportive role in enhancing PHE activities at the local level. This constitutes a missed opportunity for PHE.

Much of the current legislation tends to be "over-specific" – even "good engineering practice" is legislated. Thus brings up some difficulties in updating practices as new technologies & methods become available.

A draft "Bye Law for Sewerage Work" has been under consideration for several months now and seems to have fallen out of the legislative priorities. The draft was reviewed during the Study. Essentially, it was drafted for the purpose of "…regulating the construction, maintenance and control of drains, sewers, drainage and sewerage works…", both public and private. The draft discusses a broad range of important aspects of sewerage and drainage. The "missed opportunities" which could be strengthened in the draft include the following aspects: inadequate coordination arrangements between PHE and local officials; public information and consultation requirements; mandatory sewer connection for all new houses and structures; and, inadequacy of provisions for the protection of facilities.

Consolidation of current laws (and pending drafts) into a major policy legislation (a water and sanitation law) will help in clarifying the need for PHE to operate under a more autonomous and commercially-oriented e.g., capital and O&M financing, institutional arrangements, sector regulation, the "tariff or subsidy" mix, incentives, accountability for results, etc. This law should lay the basis for reorganizing the sector following reform recommendations. It should clearly state the roles, responsibilities and working relationships among the various stakeholders. Specific sector policy/legislative actions are needed, among others, to:

- Authorize PHE to use of commercial accounting systems;
- Provide guidelines for the proper treatment of depreciation;
- Introduce external audit and other safeguards;
- Enable PHE to retain revenues generated (plus a state subsidy indexed on revenue generated (or other performance targets) to support water and sewerage services);
- Clarify debt service obligation as a state responsibility;
- Authorize PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc);
- Guarantee security of staff to be affected by the reforms; and
- Create mechanisms for regular dialogue with consumers and consumer groups.

The Study also noted that the Water Sector Reform initiatives similarly suggest consideration of new sector policy legislation. The Strategy will be to coordinate with the legislative agenda of ongoing sector reform.

Soon after policy level decisions are taken, various key management policies need to be reviewed and enhanced, including such internal management concerns as:

- Budgeting and financial planning processes
- Performance agreement structure
- Treatment of depreciation; what constitutes capital investment, major maintenance & minor maintenance cost?
- Customer rights & responsibilities
- Staffing issues

8.3 Organizational Restructuring Agenda

A sound organization structure is needed to ensure that all the responsibilities are covered and the working relationship among the various work groups is clearly established.

It was pointed out in the assessments that the existing basis for sizing the Subdivisions is equity in work load and financial responsibility. It does not consider as much the interdependence of inputs, possible efficiencies and economies of scale and lumping of similar activities. Thus, there are situations where: three different sub-divisions are maintaining different sections of the same transmission pipeline; WTP handled by 2 SD's – one for civil works, the other for electrical-mechanical works. Although, the Chief Engineer and the Executive Engineers are ultimately responsible for this, the manner of structuring also leads to difficulty in attributing

results (or lack thereof) to lower responsible parties and difficulties in monitoring actual unit operating costs.

A new PHE organization structure following the principles and framework described below is recommended in the FS.

8.3.1 A Framework for Organizational Growth

It is useful to visualize how organizations develop over time. A widely-accepted concept[1] suggests that institutions typically go through a series of recognizable cycles of growth and crises. Organizations experience a period of stable growth, followed by crises when the accumulating deficiencies and inadequacies of the prior growth period rise to the surface. Many changes, both minor and major, are introduced to address the crises. A management approach that seems ideal for an organization at a certain phase in its growth may be inappropriate when applied in another phase. The process is "dialectic", i.e., every phase and management style sows the seeds of its own destruction. What is at first appropriate, ultimately proves inadequate in the face of new and more demanding organizational needs arising from both internal (historical) and external forces.

Such managerial adaptation may occur gradually, but more typically, a period of sustained and stable growth is followed by a relatively short period of managerial crisis and change, characterized by self-examination, structural reorganization and the adoption of new managerial systems and practices. The principal phases thus far identified are:

- **Growth through Creativity**. During this period, the ideas, motivation and creativity of individuals are the driving forces. A simple entrepreneurial structure is appropriate. Eventually the organization is unable cope and a crisis of leadership leads to a need for direction.
- **Growth through Direction**. At this period, more formal systems and procedures provide direction through a functional structure. However, these procedures eventually stifle creativity, which leads to a crisis of autonomy. Systems cannot cope with individuality; the way out of the crisis is through delegation and decentralization.
- **Growth through Delegation**. Decentralized decision making gives more autonomy. People can use their own initiative to make and take decisions quickly. But when decision-makers in each unit go their own way, the result is a crisis of control which leads to fragmentation. If they are brought into line through "re-centralization", this only exacerbates the problem

[1] The basic concept first presented by Dr. Larry Greiner, in "Evolution and Revolution as Organizations Grow," *Harvard Business Review,* 1972. Various adaptations have since been suggested.

back to growth through direction.

- **Growth through Coordination**. Coordination and monitoring from the center of the organization (through the formal structure) allow decision-makers to operate freely while the center maintains overall control. Eventually these co-ordination methods accumulate and create a crisis of "red tape", i.e., cumbersome bureaucratic procedures.
- **Growth through Collaboration.** Growth through collaboration means working together in small teams to accomplish tasks. A matrix structure may be appropriate. Other crises may occur, psychological saturation for example. The process (and model) is still evolving.

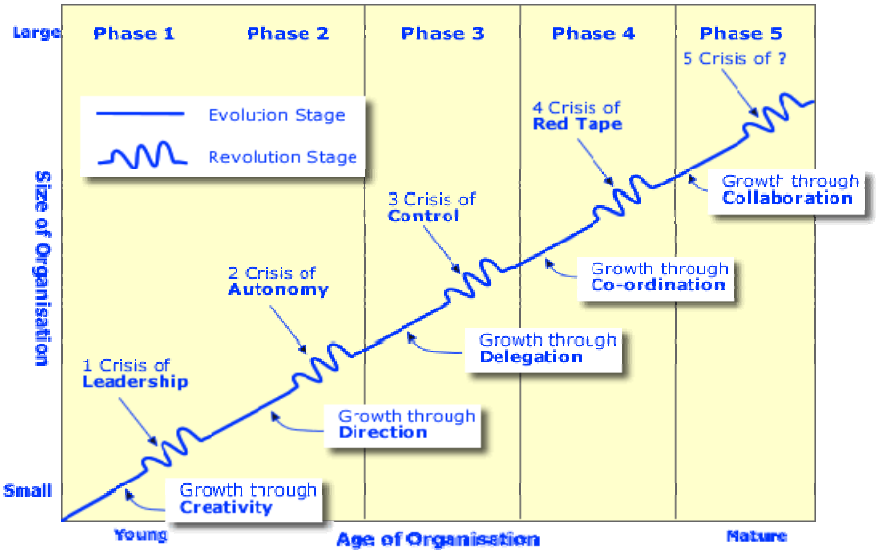


Figure 83.1 Phases of Organizational Growth

In spite of it many years of existence, PHE is still clearly identifiable in the early phases of this typology. PHE is operating under centrally-prescribed guidelines and structures to drive the organization's daily operations. Interestingly, the management style today can be fairly described as creative in trying to implement new ways of doing things without upsetting the old policy prescriptions and directives. It is most often in a "coping" mode – trying to keep up with the short-term demands and long-term aspirations of the State. The sector reforms provide a unique opportunity to move on to the next stage but it will have to shed many of its current ways of doing things and boldly face the new challenges and opportunities offered by the sector reforms.

With continued effort and adequate preparation, perhaps it can avoid the crisis of leadership that would otherwise mark its transition to the next stage. In the meantime, PHE needs to continue its efforts to renew its internal management systems, develop its administrative policies and systematize its operating procedures. These are the focal elements of the Institutional

Development Plan, whose central themes are sharpening organizational **direction**, strengthening management **systems** and, looking ahead, promoting more **delegation** of duties and responsibilities.

The following Table presents, in broad terms, the organization structure goals to be attained (or the shifts needed) up to 2020.

Table 83.1 Institutional Development Priorities

Priorities to be accomplished/facilitated by the structure & key changes envisaged	
2007-2012	Priority themes include: • Sharpening of organizational directions; • Strengthening of management systems; and • Promotion of delegation of duties, accountability and responsibility for results.
2012-2018	Priority themes include: • Sharpening of coordination and interaction among work units. • Re-emphasis on evaluation and control systems
2019-2025	Priority themes include: • Strengthening collaboration and consolidation.

8.3.2 Management Levels

At this point in its development, standardizing the PHE structure at three (3) basic management levels is recommended: a senior management level; a middle management level; and an operational management level. Generally, each of these levels of management can be defined based on broad level of scope and responsibility and differences in area of discretion and authority.

As an initial step to organizational restructuring, it is useful to define and categories the various detailed responsibilities. This framework below may be useful in reviewing and balancing the current responsibilities and job descriptions and developing the performance indicators for the various managerial and supervisory positions in PHE.

Table 83.2 Distribution of Management Responsibilities by levels

Management levels	Management function related to:			
	PHE objectives	**Formulation of PHE strategies**	**PHE strategic programming**	**PHE strategic & operational budget**
Senior management (including Chief Engineer, Department Managers	• Objectives for provision of services • Types of services to be provided • Efficiency in personnel administration • Targets for quality, quantity, continuity, cost and price • Interaction with external agencies.	• Situation diagnosis • Ensuring best use of equipment & installations • Improving availability of services • Design and construction criteria, appropriate technology improving quality control • Selection of tenders for procurement of goods and services • Improving productivity of personnel • Ensuring safe work procedures • Management of water resources • Quality control of wastewater • Consolidation of programs formulated by middle & operational management • Feasibility studies • Long-term O&M plan	• Approval of long-term program • Allocation of resources • Monitoring, evaluation, adjustments	• Approval of annual budget for each program and its projects • Encouragement of research, innovative approaches, special projects
Middle management (including Section Managers, Plant Managers and other similar positions)	• Objectives by type of service provided • Definition of increase in output in terms of capacity for treatment, storage and distribution of water and capacity for collection, treatment and disposal of wastewater	• Formulation, evaluation & supervision of medium-term program • Expansion of coverage • Best use of resources • Improvement of quality of services • Reduction of NRW • Rehabilitation • Improvement of cost-productivity ratio • Control of production and quality • Pollution control of water sources and receiving bodies • Education of users	• Evaluation of long-term plan for O&M • Determining priorities • Establishing methodology for implementting long-term plan	• Setting program targets • Calculating need for financial resources and proposing budget allocation
Operational management (including Shift Supervisors, Unit Supervisors, Team Leaders and other positions with supervisory responsibilities)		• Proposal of medium-term programs	• Evaluation of feasibility of medium-term investment and operational plans	• Studies, designs for expansion • Construction of new works • Rehabilitation • Macro-metering • Network survey • Leakage control • Technical mapping • Improvement of house connections • Inventory of technical information • Improvement of processes for production and quality control • Updating maintenance procedures • Definition of short-term objectives, targets, programs & projects • Definition of responsibilities for project formulation, implementation, follow-up, monitoring & evaluation. • Improvement of raw water quality and pollution control • Efficiency improve, cost reduction, productivity increase

8.4 Capacity Building Agenda

8.4.1 Framework and Approach for Capacity Building

This section presents the overall strategy and framework for the strengthening of the PHE institutional systems over the Master Plan. To establish a comprehensive and integrated approach for strengthening of PHE, it is useful to view the strengths and weaknesses in the wider context of an organization consisting of parts or systems, as follows:

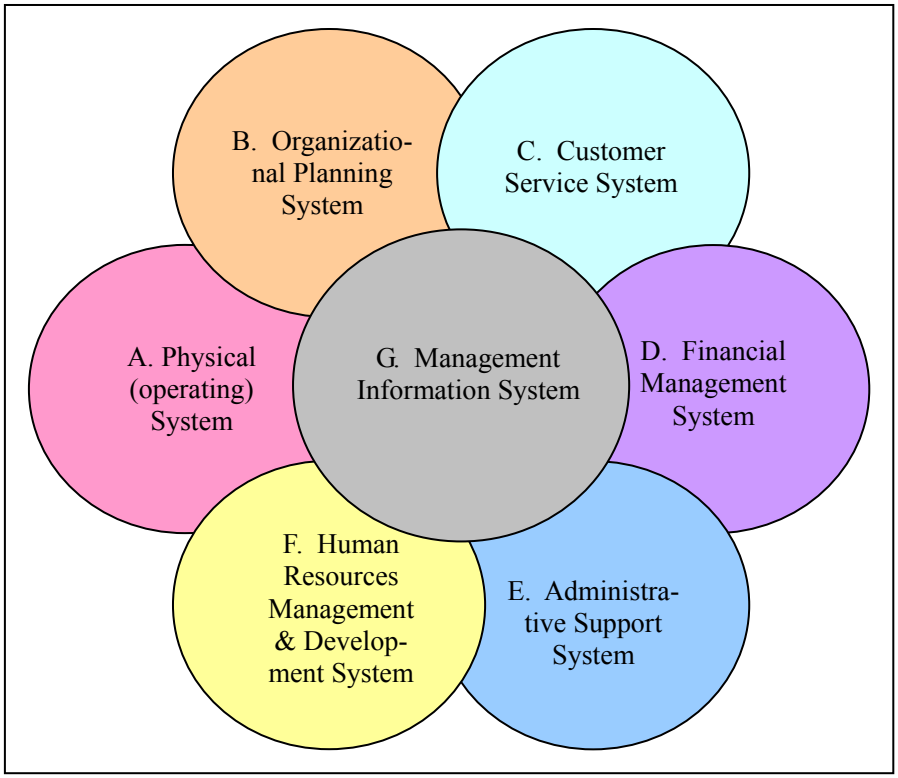


Figure 84.1 Institutional Strengthening Framework

A. Physical system – Operation, Maintenance and Expansion

The operating system (physical) of PHE includes all the resources and activities needed for the preparation of technical plans and designs, implementation of construction, the operation of water supply facilities and the maintenance of installations and equipment. The operational system functions through its subsystems for design and construction management, water operation, and installations and equipment. This is the core function of PHE at present.

The assessment mentions that O&M systems and procedures are only partially documented and written and that major maintenance competencies in production and distribution are still largely untested since most of the facilities are still new.

B. Organizational Planning Processes

This system begins with analysis of the problems and solutions by comparing PHE's current services with targets set according to social, economic, environmental and regulatory policies under which it must function.

Using this frame of reference, the planning system must aim to effectively achieve the objectives of PHE in the long-, medium- and short-term. The planning system must make sure all parts of PHE work efficiently to meet targets so that PHE delivers the services (safe drinking water and sewerage) required by the State. This system generates physical expansion and institutional development programs. Supported by the management information system, the planning system establishes feasibility of the objectives, plans and programs and controls their implementation.

The assessments indicate that the planning is very centralized and may benefit from more participation of managers and staff – and even local officials and consumers. This input will help reflect more objectively the service conditions and expectations of the customers. Wider participation in the planning process will also increase the sense of ownership of the plan by all stakeholders.

C. Customer Service System

The commercial system is a strategic element for attaining the objectives of PHE (meeting drinking water and wastewater service demands within regulatory requirements). It is a tool for the promotion and sale of services and for recovery of the cost of delivering those services to the users. This enables PHE to be financially self-sufficient. PHE performs its function according to policies, standards and plans established in the light of consumer demands and official regulations. The commercial system includes subsystems related to consumption measurement (for water supply), billing and collection, consumer registration and marketing.

At present, the assessments indicate a high level of customer complaints on hours of supply, meter reading complaints, inequitable policies on use of public taps. PHE assessment also refers to a lack of response to customer feedback. Tariff structuring, which is not exclusively a commercial system issue, may also need to be addressed.

D. Financial Management System

This includes all policies and standards established by PHE to carry out its financial tasks, together with the procedures used for recording and evaluating financial operations and reporting on

their results. These activities are found in the financial administration and accounting subsystems.

The assessments indicate that the current financial management and control system is not suited for PHE operating as an enterprise. Current systems are geared towards financial planning and control of capital investment activities or project management. Financial monitoring of key inputs and outputs for a water and sewerage services is not systematically and regularly done.

E. Administrative Support System

The administration support system includes three (3) sub-systems – for supplies administration, for asset management and for social communication. Each of these is a virtual system within itself and is made up of a variety of smaller parts.

The *supplies administration subsystem* is PHE's set of policies, standards and procedures, together with goods and services, for the construction, operation and maintenance of the water and sewerage system. It functions through stock management and control, procurement administration, and storage and distribution of materials (tools, spares, chemicals, etc.).

The *asset management subsystem* takes care of the inventory, custody and control of the property assets of PHE. A detailed discussion on the asset management framework is in the succeeding section.

The *social communication subsystem* comprises PHE's activities at different levels aimed at giving the community an appropriate image of PHE in line with senior management policy. External activities include enlisting the support and participation of the community in the preparation and execution of PHE's plans, while internal activities include maintaining good relations with and between the employees. Important aspects of the communication subsystem include its influence on decision-makers and on the general public. Decision-makers and politicians need to be aware of the importance of supporting financially the operation and maintenance of drinking-water supply. Many employees of PHE interact directly or indirectly with the public so they are also responsible for the public image of PHE. The professionalism, behavior and effectiveness of its staff shape the public perception of PHE. The public also needs to recognize PHE's vital role in environment, public health and the State economy, in general

F. Human Resources Management & Development Systems

This comprises all policies, standards and procedures which ensure that PHE has the personnel

it needs at the right time and that the personnel are appropriately trained. To this end, a plan of human resources demand and supply should be drawn up. This system carries out several key functions and responsibilities, including: job design, classification and grading, staff selection and recruitment, deployment of staff, training; administrative control of staff; and human relations activities through social welfare and benefits, work safety and workers' health. PHE basically follows the centrally-prescribed personnel management policies and systems of CHPEEO. A broader framework for human resources development and training is presented in the FS.

G. Management Information System

The management information system defines the flow of information within the organization to support the planning and decision-making processes of PHE, as illustrated in the figure below. Each of earlier systems produce financial and operating information and data which are fed into and processed by the MIS for management planning and decision making, as shown in the following figure. The assessment indicates that PHE performance can improve with better and systematic information management that cuts across the department lines. This improvement will take the form of introducing a computerized management information system capable of supporting the planning and decision making functions.

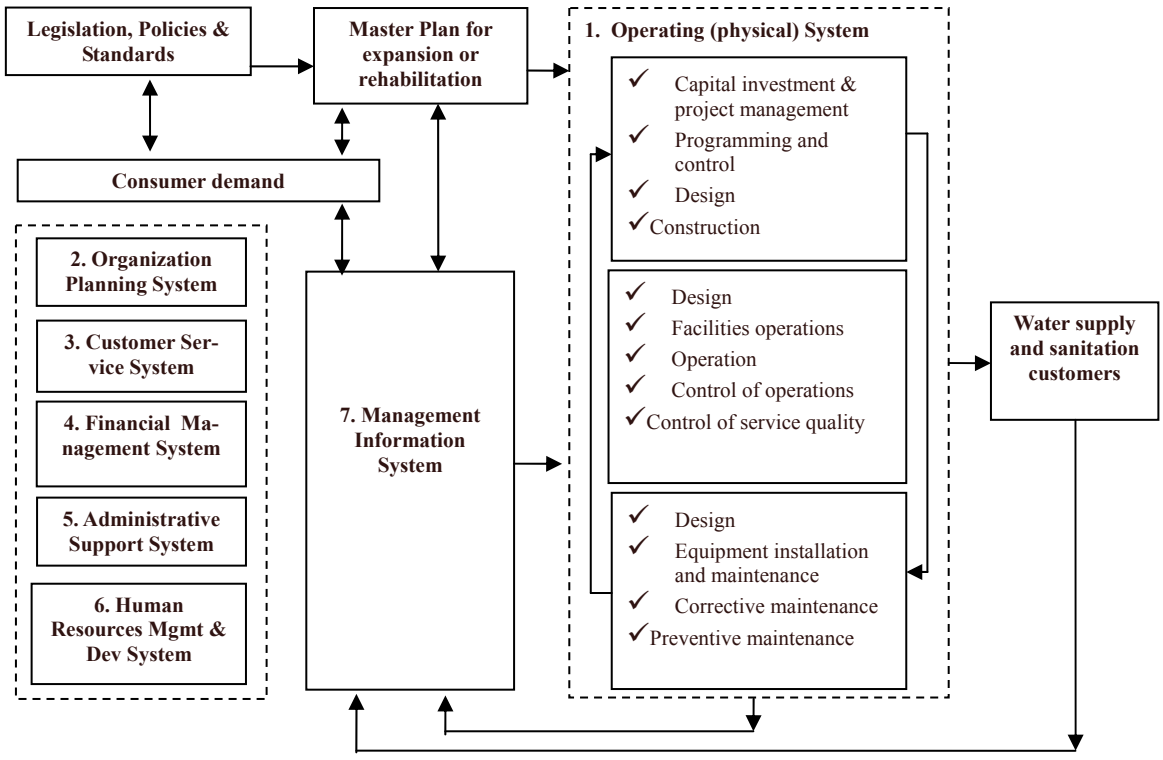


Figure 84.2 Integration through the Management Information System

8.4.2 Framework for Human Resources Management

PHE should aim to develop a skilled and committed workforce and recognize that its employees are its greatest asset. The continued success and growth of PHE is dependent upon the continued success and development of its employees.

The organization design deals with the identification of the tasks, which are allocated to the departments/sections and jobs. The human resource planning goes one step further and determines the number of staff types required, inventories the available manpower, and plans for actions to resolve the imbalances.

The job design/description and job performance appraisal serve as a necessary inputs to training need assessments, by comparing the required and the actual capability of the various staff types. The gap between the required and actual capability represent the basis for training plans and programs. But, job performance not only depends on the staff ability, but on the motivation as well. Staff motivation can be enhanced through a range of incentives, such as extra pay, career opportunities etc.

PHE should aim to:

- Encourage employees to use their own initiative in order to develop the business and to overcome the challenges that face the organisation
- Promote an environment which is open in style with good communications across all levels of the organisation to promote employee commitment, teamwork and a sense of belonging to a progressive and forward looking organisation
- Develop staff structures where clear roles and responsibilities are defined in order for employees to understand their role within the organisation, their working relationship with others and the duties that they are asked to perform
- Operate an environment where all employees play a key role in the development of their own careers through providing training and other opportunities for self-development
- Develop Human Resources (HR) management skills as this has an important role to play in assisting the organisation to achieve its purpose by focusing on organisation design and development and fostering a highly committed work force. This requires a coherent HR organisation framework, policies and procedures to help make the best use of the work force
- Assign responsibility for the management of HR to a central process owner who takes 'ownership' for all HRD & training activities. It would be the process owner's responsibility to ensure that a HR strategy is put in place and to ensure that each element of the strategy:

Human Resources Policies

PHE should keep employees informed of all policies and procedures affecting their terms and conditions of employment and should therefore consider publication and distribution of an 'Employees Handbook' which could also detail PHE 'values and behaviors' as well as other terms and conditions of employment.

Human Resource Planning

The primary objectives of planning are to meet PHE's demand for labor adequately and to promote efficiency in the use of human resources. Human resource planning involves the planning for the right numbers and kinds of staff to perform the tasks of the organization. It generally involves three main types of activities:

- the assessment of the human resource requirements;
- the inventory of the human resources;
- the planning of interventions to come to an adequate staffing situation.

The determination of staffing requirements for the management, operation and maintenance should ideally be based on detailed job analysis. It should take the technologies employed, e.g. extent of mechanization, technical processes tools and equipment used, institutional arrangement (outsourcing), into account. Key senior staff of the various sub-divisions should be consulted on manpower requirements.

Although desirable to determine staffing requirements based on detailed job analysis, it may be difficult and too time consuming to estimate staffing requirements in the initial instance in this way. It is therefore suggested that the initial assessment of the human resources is made, using comparable staffing ratios (by function).

The staffing ratios for the various types of functions within the companies can be related to:

- specific quantifiable indicators for workload such as the number of connections/customers (currently in use on a total aggregate basis) or the length of the networks;
- the number and location of the facilities to be managed, particularly in view of the new facilities to be brought online in the coming years (for example, no of WTP operators per production line), or number of pipe technicians per km of pipeline, or per km^2 of distribution network area);
- the service provided and technology employed; and
- the contracting arrangements. Some tasks may, for efficiency reasons, be outsourced. Towards this end, it would also be useful for PHE to adopt a clear outsourcing policy (when

to outsource, how to outsource, etc.)

This method can be supplemented with interviews of the key senior staff to ensure that local conditions in the service area are properly reflected. The results should also be included, for example, in the detailed Operation and Maintenance Guidelines (OMG).

The Plan envisages that a staffing ratio is maintained at about 10 staff per thousand connections. The staffing estimates up to the year 2012 will be prepared in the FS.

Human Resources Development

Following the job descriptions and the job analyses conducted, a framework for the technical training for PHE engineers, technical staff and operators is presented in the FS. This framework will ensure that all aspects of management training (including finance and customer service), operation and maintenance training and engineering training are dealt with in a systematic manner. The training approach envisages a wide mix of approaches and methods – from on-job program to formal training sessions; from in-country to overseas programs; and, from short-courses to long term scholarship programs. It is further envisaged that these training activities will be led by a new PHE Training Center supplemented by on-job training. PHE should also consider formulating a 'HRD & Training Manual' containing policies, procedures and guidelines to ensure efficient HR practices.

Performance Appraisal and Motivation

Training alone will not be sufficient to improve staff performance. The implementation of an incentive scheme, linked to performance, is an important factor to motivate staff. This aspect includes the approach for performance appraisal and motivation concepts – factors which affect job performance.

Job performance assessment aims to determine whether the amount and quality of staff efforts meet the standards laid down in some prior analysis of their work. It tries to answer the question whether the amount of work effort put in by the staff is adequate or satisfactorily in relation to the established performance standards.

It can be used to assess the staff incentives, but equally as important to assess training needs. When used, one should recognize that there are many other causes for poor job performance, including shortage of staff, lack of skills, lack of knowledge, lack of staff motivation, inadequate procedures, inadequate task division, lack of guidance/control, lack of equipment & tools,

lack of materials, lack of transport, etc. Evidently, only performance deficiencies due to a lack of skills or knowledge can be remedied by training. Other performance constraints will have to be addressed by other means, in order to improve results.

The term 'incentive' here refers **not** to basic wage or salary, but to extra benefits for extra effort or contribution. To get the employees to do more or to contribute more, it may be necessary to offer appropriate incentives over basic wages or salaries.

It is important to develop and implement a simple and practical job performance appraisal system (i.e. using performance indicators easy to measure and understand by managers and staff). The system should also make performance appraisal more transparent. The system can also be used to assess individual training needs in addition to the determination of the incentives. The implementation of performance related incentives requires three types of action:

- the identification of the tasks to be performed, together with the criteria to be used to measure performance;
- the measurement of the job performance;
- the determination of the amount of incentive to be given;

In the design of the system, a balance should be pursued between group indicators to promote the co-operation and teamwork among staff within the sections and job specific criteria, allowing for individual differences in job performance among group members. Group indicators can also be justified in case results are not readily identifiable or measurable to the achievements of an individual. The group performance indicators can be derived from company performance indicators provided that indicators are attributable to staff efforts. Job specific indicators can be derived from the job descriptions as well as from an evaluation of general performance indicators commonly used in job performance appraisal.

In this framework for managing human resources, major attention shall be given to the following objectives:

- Establishing PHE job descriptions for all positions, including the skill and competency requirements. Job descriptions serve as the necessary reference material for staff recruitment and staff appraisal;
- Staff planning and staff recruitment and deployment, which are, on the one hand, meant to attract the right people and on the other hand, to re-train and re-deploy staff;
- Introduction of a regular in-company training delivery system to improve the basic skills necessary for proper execution of PHE activities;

- Further improvement of staff incentives to obtain and retain adequate number of suitably qualified people, and to encourage better performance.

8.4.3 A Framework for Asset Management

Asset management is a systematic process of effectively maintaining, upgrading and operating assets, combining engineering principles with sound business practice and economic rationale, and providing the tools to facilitate a more organized and flexible approach to making decisions necessary to achieve the public's expectations. It is a comprehensive and structured approach to the long term management of assets as tools for the efficient and effective delivery of services emphasizing that assets are a means to an end, not an end in themselves.

The PHE asset management system will include:

- identification of need for the asset, in the light of service requirements
- provision of the asset, including its ongoing maintenance and rehabilitation to suit continuing needs
- operation of the asset
- disposal of the asset when the need no longer exists or it is no longer appropriate for the asset to be retained

Asset Inventory

A high level view should be taken initially to ensure that data is captured in a format that is easily maintained and understood. The Sector Status Study completed by 'Feedback Ventures' includes a register of 'above ground' assets; this is a good starting point and includes an initial assessment of asset condition. In this Study, a more detailed list of facilities is provided.

Asset Condition Surveys

Each major asset will need to be visited, documented and assessed in accordance with an agreed methodology and against standard agreed criteria. Each asset will be classified in terms of criticality, operability, maintainability, serviceability etc.

Asset valuation

The accuracy of the asset valuation will depend on the available data on unit costs, the depreciation and the asset conditions. It is generally accepted that 'top down' approach is adopted in first instance and as more reliable asset data information becomes available through improved data capture, condition surveys and records, the process can be refined. Condition surveys together with local knowledge of asset performance in terms of mains fracture/bursts,

repairs, particular problems with particular materials etc can generally give a good indication the residual life of assets.

Asset Database

The asset database will need to be structured to ensure that each asset along with its corresponding components is assigned unique identification numbers. These should be compatible with the larger information system to be adopted by PHE. The database should be accessible and simple to use and be capable of being uploaded or updated with asset information from various departments and users as assets are maintained or created. The data hierarchy should follow a standard 'parent-child' approach. This approach ensures that any item of plant at any level, within the facilities hierarchy is associated with its "parents". For example, a pump is associated with a particular pump set, i.e., sludge pump set. The pump set is in turn is the "child" of the surplus sludge pumping station. The sludge pumping station is in turn is the "child" of the waste water treatment works and so on. The asset management framework and process if shown in the following Figure. A more detailed description, including sample forms, is found in Volume IV Appendix 73 Asset Management Process.

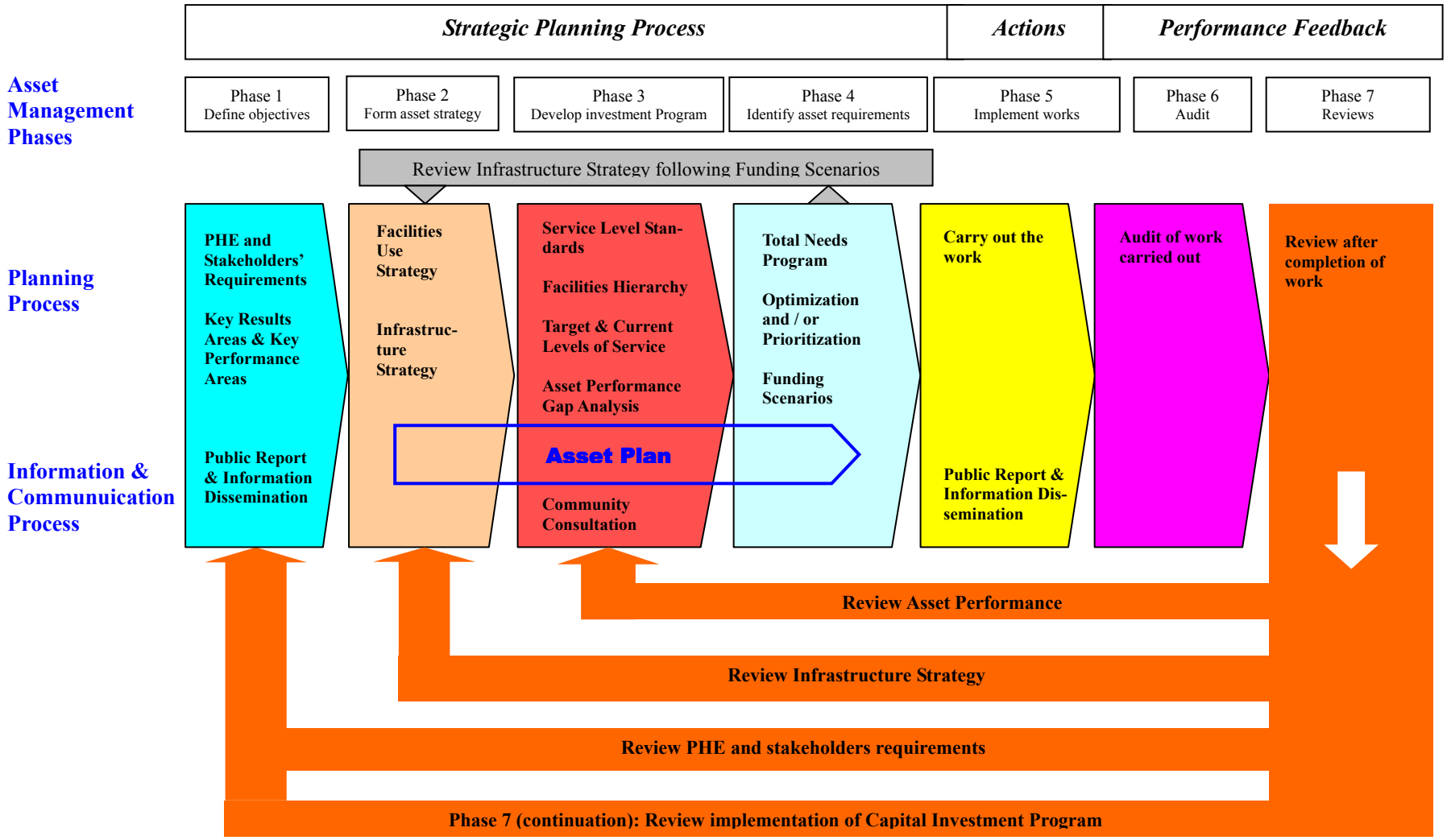


Figure 84.3 Asset Management Framework for PHE

8.4.4 Customer Services Strategy Development

Provision and Management of Customer Services

PHE should recognize the importance of efficient customer services, customer billing, and collection of revenue. Control of the revenue stream is vital to long-term financial sustainability. Proper control of revenue through accurate metering and billing followed by responsive collection will ensure that PHE's financial position is sufficiently healthy to sustain growth and investment. In addition, timely response to customer service enquiries and requests is essential in building public confidence and support of the utility's management.

In order to highlight the importance of customer services and ensure that it receives the highest priority across the Business, PHE should implement a 'Customer Focus Program'. The program should focus on the key functions of customer contact management, billing and revenue collection, meter reading and meter management, and customer and community relations.

This program would include a series of service standards built around customer needs and values, and integrates with other functional and process areas as shown below:

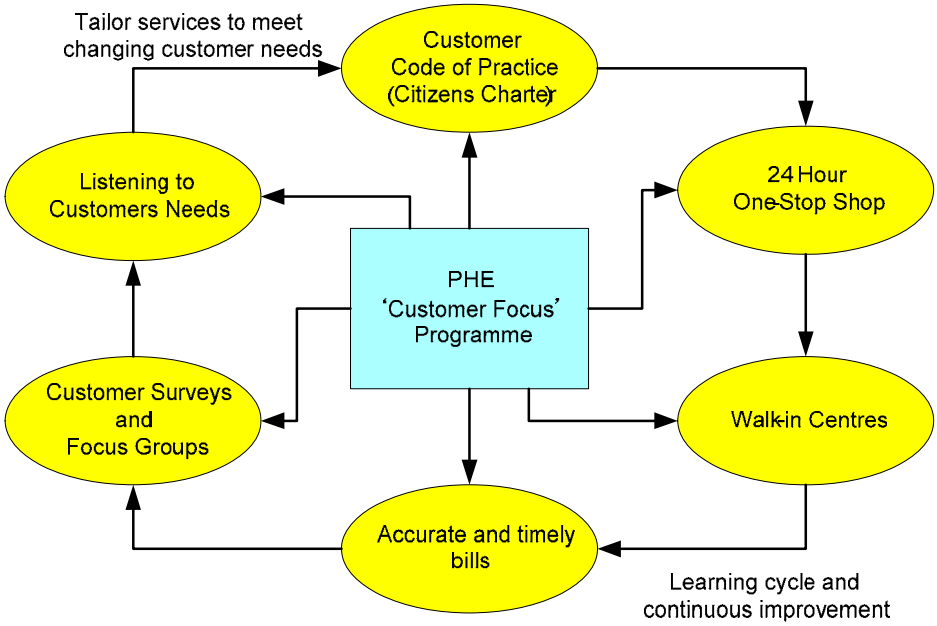


Figure 84.4 Integrated Customer Service Approach

A fundamental part of this approach involves consulting with customers to ensure they are provided with opportunities for feedback and criticism. As part of the consultative approach, PHE should consider establishing Citizens Advisory Councils to provide customers with an opportunity to be a part of the decision-making process.

PHE should publish and maintain a 'Customer Code of Practice', which will define the services offered and provide a standard for measuring delivery performance. Results of PHE performance should be published and included with the bill and in documents such as an annual Consumer Confidence Report so that customers can see the improvements in service delivery achieved over time.

8.4.5 Framework for Management Information Systems Development

To enable PHE to deliver a good level of service to customers and other stakeholders and to improve business, commercial and operational performance, they will need to invest in skilled, competent and professional individuals as well as deploy proven, leading edge technology where these offer 'Business' benefit. Management information systems with an appropriate infrastructure will be required to support:

- **Business functions:** covering financial management, budgeting/control of expenditure, employee information, payroll, projects management, management information etc.
- **Customer services:** covering meter reading, billing, revenue/debt collection, contact management etc.
- **Operations:** covering asset data, process automation, plant operation, telemetry, Supervisory Control And Data Acquisition (SCADA), computerised maintenance management (CMMS) etc.

PHE will need to implement a phased approach to investing in appropriate information systems and technology to meet the future needs of the 'business' and stakeholders alike. This involves the following tasks:

- Carry out a 'business needs analysis', 'information needs analysis' and 'user needs analysis' to identify business, customer and operational requirements
- Carry out a detailed review of available integrated information systems software to meet the above needs and scope the chosen systems for implementation.
- Set up an MIS office with agreed roles and responsibilities to develop and implement systems or outsource this activity
- Carry out detailed development of systems requirements and specifications, tendering, procurement, SLA's for systems development, maintenance and support
- Development of detailed project plan for each system, including timescales for implementation
- Establish future linkages with the current State-wide efforts led by the Goa Directorate for Information Technology to establish state-wide information system.

A core objective of the 'Systems Strategy' will be to provide communications connectivity for various sites for purposes of providing business and operational critical data, including process

data, contact data, reports, comparisons, trends, graphs etc.

PHE may want to consider development of an information system infrastructure along the following lines:

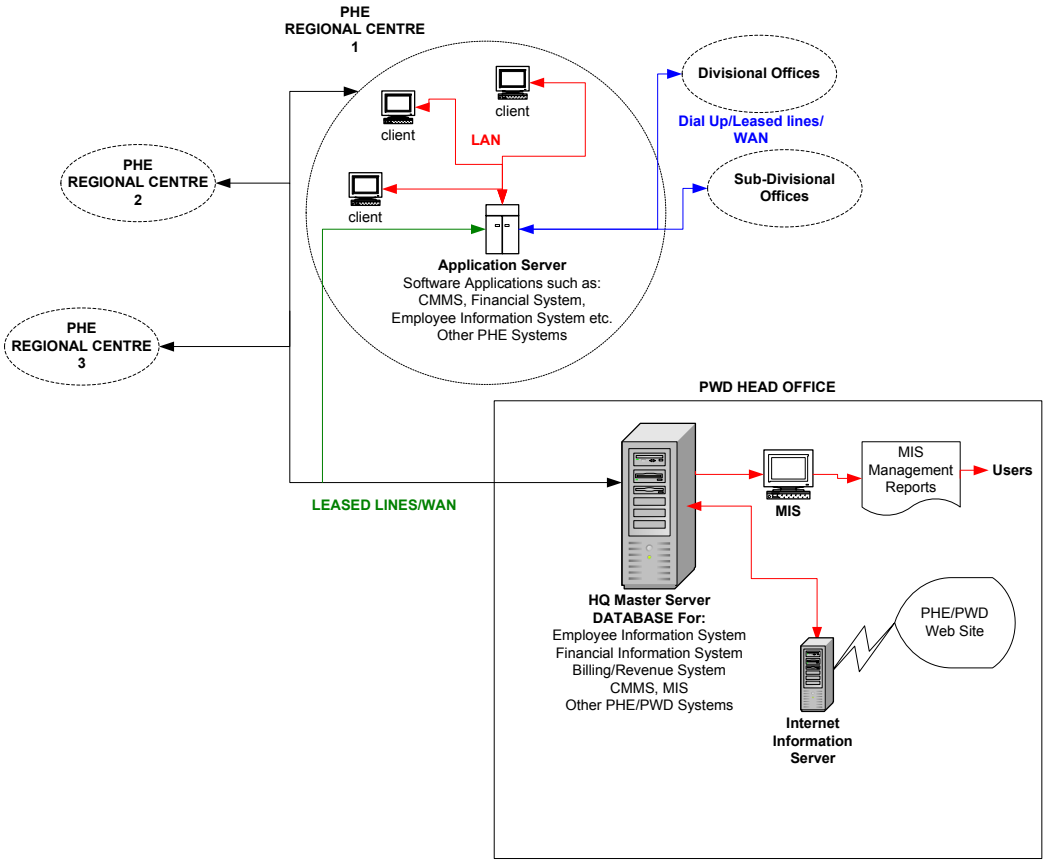


Figure 84.5 Suggested IS Architecture

PHE's information system strategy would underpin key business processes and should be based on the following principles:

- Single point of contact for information system delivery and management
- Common standards for hardware and other peripherals
- Development and consolidation of existing systems to offer enhanced functionality
- Continued development, updating and introduction of new information technology with justifiable business benefits
- Deliver tried and tested solutions and implement application software that is world-class, easy to use and meets local needs
- Administering of security centrally to protect data quality, access and process

- Support to the respective 'business units'; technical, financial, HR etc., in defining, implementing and delivering 'business systems' to ensure efficient and professional operation of their assigned responsibilities
- Development of PHE staff competencies in information technology through training and skill upgrading
- Supporting PHE managers by delivering systems capable of providing appropriate, timely and accurate management information for informed decision making
- Promotion of efficient and timely communication amongst staff, for example via electronic mail, calendaring, knowledge sharing etc.
- Supporting reliability and efficiency across all PHE activities by providing the 'tools' to optimize performance and aid continuous business and process improvements

Communications

Effective internal communication and management of information is essential to the success of PHE. Staff needs to be able to communicate with each other effectively and ensure that key information is made available in the appropriate format to those that need it in order to fulfil their roles efficiently. PHE will therefore need to develop a communications strategy that will enhance employee satisfaction, provide a common understanding of business performance, and enable the sharing of knowledge across all functions. The development of an internal communication strategy will support and provide appropriate channels for the sharing of knowledge between individuals and departments.

In order for PHE to provide world-class service and performance they will need to consider investing in the following areas:

Intranet. An Intranet will act as a catalyst for improving interdepartmental communications. PHE should consider the introduction of an Intranet to provide and control access to core applications, provide news bulletins to employees, advertise new employment opportunities, book meetings, etc. This will help PHE improve the exchange of information and enhance electronic communication between key departments, for example by use of email.

Information technology infrastructure. Based on discussions with the Goa Director of IT, it is envisaged that the communications 'backbone will be provided by the IT directorate (high bandwidth fiber optic cable) within the next 12 months. This negates the need for PWD to provide its own communications network. This also provides the opportunity for PWD to utilize the facilities of a State Central Data Centre where by the IT Directorate would 'host' PWD

applications. The provision of high bandwidth connectivity will enable PWD to operate central database applications as opposed to distributed databases thus reducing the cost of software licenses etc. Should this be the case, in the previous diagram, the PWD HQ Control Centre would be hosted at the Directorate of IT State Data Centre.

Knowledge Management. PHE should regards knowledge as an asset of the business and therefore promote knowledge management behaviors such as the sharing of information and best practice. PHE will therefore need to ensure that the work culture encourages the creation, sharing and utilization of knowledge. IT will facilitate this.

'Best Practice' documents should be developed to ensure consistency of practice and approach State-wide, for example, in areas such as, plant operation, maintenance practices, UFW reduction, customer service delivery, collection of asset and management information etc.

Systems Integration

Efficiencies can be achieved through integration of application systems which will lead to enhanced quality of work and productivity. Selection of new application systems should therefore be subject to rigorous evaluation to ensure integration and ability to share data across applications. This will improve the quality and availability of management information.

8.5 Improvement of Financial Management and Control

8.5.1 Introduction of Financial Self-sufficiency

(1) Achieving Financial Self-sufficiency

Financial Self-sufficiency means that revenues received (mainly from water and sanitation services sales) are able to cover the direct and indirect operating expenses, indirect costs, debt service and capital expenditures. Major construction of water supply and sanitation facilities requires large investments which financed through loans from government or banks. Loan repayments for water supply investments are recovered by revenues of the enterprise. For sanitation investments, however, tariff revenues are generally not sufficient to cover the costs. Consequently, public funds (subsidies) are often needed, particularly in the sanitation service.

It is recommended that PHE adopt a policy to achieve financial self-sufficiency in the future, so as to realize the sustainable financial management fundamentally based on the advantages mentioned below. Financial self-sufficiency should be the target of PHE in the future and the introduction of independent accounting system, Section 8.5.2 Planning and Design of

Independent Accounting System, is applied in the transition period before commencement of the financial self-sufficiency.

Financial self-sufficiency means the independence of PHE only in the aspects of financial and accounting system. Introduction of the system does not directly lead to the organizational independence either to privatization which shall be owned and operated by private. PHE is able to be one of the authorities in the State Government even under the financial self-sufficiency. In the future, corporatization of PHE invested by State Government should be considered as a target after the introduction of financial self sufficiency, so as to improve the management efficiency further with more freedom for financial management. Even the corporatization is realized, State government has to play the important role as 'Regulator', regarding tariff, service level, water quality, and so on. Board will be organized consisting of delegates of State Government, firms, and customers. It is necessary for the Board of Director to keep the power of final decision.

(2) Advantages of financial self sufficiency

PHE shall have the following major advantages after the successful implementation of the system.

a) Presently, State Government has been responsible for overall financial management. Under the financial self sufficiency, PHE shall have the full responsibility of financial management of water supply and sanitation. PHE will have more discretion to decide how to use the annual budget at its own risk within the amount of financial capacity. PHE will improve the financial management ability gradually.
b) Lead to improvement of the overall performance of water supply and sanitation enterprise management through saving of costs and increase of revenues based on the sense of responsibility and the awareness of financial condition, since PHE can utilize the profit if it is originated.
c) Provide the incentive for customer service improvement for profit generation and for non revenue water reduction.

(3) Necessary tasks to be taken for adopting financial self-sufficiency

Major requirements are considered as follows for the introduction of financial self-sufficiency;

a) To understand and to clear any legal impediments for PHE to introduce the financial self-sufficiency;
b) To negotiate with related agencies concerning the introduction of financial self sufficiency, if necessary, amendment of regulations, bylaws, or internal regulations;

c) Decision of the cost allocation to PHE financial statements from common items among PWD, such as administration cost of PWD headquarters
d) To negotiate with State Government regarding the provision of public funds (subsidy). Terms and period of subsidy shall be predetermined in detail. For example, at least;
   (a) Water supply service: Subsidy will cover the capital costs not covered by loan until the year 2025, and the part of operation and maintenance (O&M) costs until the year 2025. The level of O&M subsidy shall be reducing over time.
   (b) Sanitation service: Subsidy will be required for all of the construction costs, and the part of O&M costs. Major part of O&M costs shall be covered by sewerage tariff revenue after the year 2025.
   (c) Construction costs for water supply after 2025 and other deficits for water supply after 2025 will be covered by loan or be self sufficient.

   Note: (a), (b), (c) are the samples in simple version. The conditions should be discussed in detail between State Government and PHE.
e) Disclosure of financial and accounting information to State Government and to customers by PHE
f) Introduction of accounting audit by a third party in the future

8.5.2 Planning and Design of Independent Accounting System

(1) Purpose of Independent Accounting System

Presently, the accounting system of PHE, which engages water supply and sanitation services, is combined to the accounting system of PWD. PWD compiles the current Budget estimates and the actual Budget consumption for making future budget requests to the State Government. There are no independent accounting systems for PHE to understand its own financial condition precisely.

In order to maintain the existing water supply and sanitation facilities appropriately by allocating relevant operation and maintenance fund, and to prepare the sustainable investment plan and to provide the data for tariff revision, it is indispensable to understand the latest financial condition of the water supply and sanitation service. For example, the detailed data of costs for operation and maintenance, such as electricity cost, chemical cost, and raw water cost, is not clearly stated in the actual Budget report of the PWD, as water supply and sanitation services are one of the other services conducted by PWD. Depreciation cost, which is also important cost item for securing the appropriate amount of fund to the future expansion projects of existing facilities, is not calculated in the PWD.

The provision of water and sanitation services has both socio-economic and financial dimensions. These are vital services which all citizens, regardless of social and financial standing, need. However, in order to sustain the availability and access to these services, the public utility needs to have the consciousness of financial sustainability. With the introduction and use of this independent accounting system, PHE will be poised to provide better and sustainable services for all of the people. The compilation of independent accounting system tailored for water supply and sanitation services shall be strongly recommended.

The introduction of an independent accounting system is not intended to replace, but rather, strengthen the existing accounting system of the PWD. The intent is to make available to PHE and PWD managers, timely and vital financial information affecting their internal operations as a business (or as a cost-revenue center). PHE will continue to provide the financial information and reports required by the larger financial reporting system of PWD. The introduction of this system helps to bring PHE operations more transparent; and help sector policymakers and concerned State officials make informed decisions about tariff, service levels and so on.

Change of accounting procedure shall be introduced in the transition period from existing system to the Financial Self-sufficiency of PHE. After realizing the Financial Self-sufficiency, PHE will be able to complete the independent accounting system whose numerical value will precisely correspond to the actual amount of profit or loss.

(2) Necessary Major Accounting Documents / Financial Indicators

The basic financial statements and accounting documents is explained as follows for the compilation of the independent accounting system. Financial statement is composed of three major documents: Balance Sheet, Income Statement, and Cash Flow Statement. Basic concept of these three financial statements is briefly described as follows.

Detailed explanation of accounting documents, implementation plan, work allocation, and so on, is described in the Chapter 7 on Volume III, Main Report: Feasibility Study.

(a) Balance Sheet

It shows the composition of assets, liabilities, and equity at a certain point of time; at the beginning of the fiscal year, or at the end of the fiscal year. Amount of assets shall be put on the left hand side of the Balance sheet. Liabilities and equity are put on the right side of the Balance sheet. Total amount of the both side should be exactly the same figure, in other word, ‘balanced’. Assets in the balance sheet include firm’s economic resources at a particular time.

Definitions of assets in the balance sheet are; (1) it must arise out of past transactions or events, (2) it must have probable future economic benefits, and (3) it must be owned or controlled by the entity. Liabilities and equity are also listed at the beginning and end of the fiscal year. Liabilities are divided into 'current liabilities' and 'long term liabilities'. Liabilities within 1 year repayment period are current liabilities. Equity includes capital stock and retained earnings. By means of the double-entry bookkeeping, assets side and liabilities and equity side are equated. Table 85.1 shows the sample balance sheet for the water supply and sanitation enterprise.

Table 85.1 Sample of Balance Sheet

As of 31 March 200X

Assets	Liabilities, Equity
Current assets	Liabilities
Cash & Bank Account	Current liabilities
Inventory	Short term loan
Debtors	Account payable
Account receivables	Customer Deposits
Allowance for doubtful account	
Advances	Long term liabilities
Total current assets	Long term loan
Fixed assets	Total Liabilities
Land	
Building, plant & equipment	Equity
Less depreciation	Capital
Work in progress	Accumulated profit / loss
Total fixed assets	Total Equity
TOTAL ASSETS	**TOTAL LIABILITIES & EQUITY**

(b) Income Statement

The income statement shows the summary of financial activity through the financial year. It summarizes revenues and expenditures during the fiscal year. When revenues exceed expenses in the income statement, the entity is regarded to originate the profit. When expenses exceed revenues, the entity is regarded to be suffered from loss. Therefore, income statement is also called Profit and Loss Statement. It describes the financial performance of the entity during the fiscal period from the view point of revenue and expenditure. In terms of water supply and sanitation services, operating revenues mainly come from water supply & sewerage tariff, meter rent charge, and connection charge. Operating expenses, originated from operation and maintenance, shall be deducted from these tariff revenues. Operation and maintenance cost should have the category of electricity cost, raw water cost, chemical cost, repair cost, administration cost, and depreciation cost, etc. The result from operating revenues and operating expenses is operating profit or loss. Other incomes and expenditures and interest

payments shall be deducted from operating profit (loss). The residual is the 'Net profit (loss) before tax'. Table 85.2 shows the sample Income Statement for the water supply and sanitation enterprise.

Table 85.2 Sample of Income Statement

1 April 200X to 31 March 200Y

Items	Amount
1. Operating Revenue	
Water sales	
Meter rent charge	
Water supply connection charge	
Sewerage charge	
Sewerage connection charge	
2. Operating Expenditure	
Electricity cost	
Chemical cost	
Maintenance cost	
Personnel cost	
Office and administration	
Depreciation cost	
3. Operating profit / loss	
Other revenue & expenditure	
Interest payments	
4. Net profit / loss before tax	
Tax payments / revenue from government subsidy	
5. Net profit / loss	

When the construction (expansion) project is implemented and the large amount of money is consumed in the year, the total construction cost of the year shall be added to the item of 'Building, plant & equipment' of the Fixed assets in the Balance sheet. Only the annual depreciation cost of the year shall be deducted from revenue in the Income statement. By this procedure, budget for future renovation of the facilities shall be accumulated in the entity as depreciation cost which is not actual consumption of the money but procedure in the accounting document. One of the other benefit of depreciation is that annual expenditure of the Income statement is able to avoid large fluctuation of each year by construction cost, which shall make it difficult (or even impossible) to conduct financial analysis of the year. In Japan, many water supply enterprises raised the depreciation cost as much as 20% to 40% of the total expenditure. It is recommended that PHE shall also estimate and accumulate the annual depreciation cost for future renovation or rehabilitation of the facilities.

(c) Cash flow Statement

Cash flow statement shows the manner in which the entity obtains and uses the cash. The purpose of cash flow statement is to understand the changes in the entity's cash position during a certain period. In other words, it shows from what sources cash has come into the work and on what the cash has been spent. The statement contains the items of 'Cash flows from operating activities', 'Cash flows from investing activities', and 'Cash flows from financial activities'. Cash flows from operating activities are calculated from the net profit of the last period, and increase or decrease of account receivable, inventory, advance payment, depreciation, account payable, etc. Cash flows from investing activities shall be expressed as negative number for the purchase of property, facilities, and equipment, and so on. Cash flows from financial activities shall increase as the entity increase the amount of debt or issuing of the capital stock. Table 85.3 shows the sample cash flow statement for the water supply and sanitation enterprise.

Table 85.3 Sample of Cash Flow Statement

1 April 200X to 31 March 200Y

Items	Amount
1. Cash flow from operating activities	
Net profit / loss	
Depreciation	
Decrease of accounts receivable	
Decrease of inventory	
Decrease of advance payment	
Increase of accounts payable	
Net cash flow of operating activities	
2. Cash flow from investing activities	
Increase in fixed assets	
Increase in plant	
Increase in equipment	
Net cash flow of investing activities	
3. Cash flow from financial activities	
Increase in loans	
Interest payments	
Issuing of capital	
Net cash flow of investing activities	

(d) Audit of Accounts

Internally compiled financial statement has the limitations and uncertainties for preciseness, therefore, it is recommended to receive the audit of accounts by external independent accounting firms or authority. The audit by the third party shall secure the quality and credibility of the financial documents of the entity.

(e) Financial Indicator

One of the major purpose of compiling the financial statements, Balance Sheet, Income Statement, and Cash Flow Statement, is to assess the financial condition of the entity. Financial analysis shall be conducted by keep watching the Financial Indicators of the entity. Financial Indicators are calculated from the information on the financial statements and show the relationship between various components of the entity's financial statements. There are many financial indicators which are categorized to the several view points such as; Liquidity, Profitability, Solvency, Efficiency, Productivity, Current asset management capability. Entity is able to investigate its financial situation by comparing the numbers of indicators to those of the other countries, or by tracking the movement of the number of entity's indicators for several years. Followings are the major financial indicators including managerial indicators for water supply and sanitation enterprise.

- *Liquidity*

Current ratio – This indicator is to measure the entity's ability to meet short term debt obligations. Current ratio = (Current assets) divided by (Current liabilities). The higher the current ratio, the more assurance that current liability can be paid.

- *Profitability*

Operating ratio – This indicator expresses the level of total operating expenditure necessary to generate one unit of operating revenue. Operating ratio = (Total annual operating expenses) divided by (Total annual operating revenue) x 100.

Return on assets – This is to measure the productivity of fixed assets in use, expressing the relationship between net operating income and net value of fixed assets in operation. Return on assets = (Net income) divided by (Total fixed assets).

Unit production cost – This indicator expresses the cost incurred to produce $1m^3$ of billed water. Unit production cost = (Total annual operation and maintenance cost for water supply + annual administration cost for water supply) divided by (Total annual billed consumption).

Unit price – This indicator expresses the average amount of revenue produced by supplying $1m^3$ of billed water. Unit price = (total annual revenue from water supply) divided by (total annual consumption that is billed).

- *Solvency*

Debt to equity ratio – This indicator is to measure the relative dependence of the entity on debt and its ability to use additional credit without worsening the risk bearing ability. Debt to equity ratio = (Total liabilities) divided by (Total equity). The higher the ratio, the larger the risk of

financial difficulty to meet the debt obligations is.

- *Current asset management capability*

Collection efficiency – This indicates that the percentage of collected amount of money to the total billed amount of money. This is defined as: Collection efficiency = (Collected amount) divided by (Billed amount).

Account receivable turnover ratio – This is to measure speed of recovery of payment of credit sales, which is the total billed amount of tariff for water supply and sanitation services. Account receivable turnover ratio = (Total billed amount of money) divided by (Average account receivables) x 100. The higher the ratio, the better and faster the recovery of billed amount of money is.

- *Debt management capability*

Debt service coverage ratio – This indicator is used to measure the extent that annual funds flow covers debt service requirements. Debt service coverage ratio = (Net profit excluding depreciation, interest, and other non cash charges) divided by (Total debt service).

Gearing ratio – This is to measure the relationship between the long term debt and capital investment. Gearing ratio = (Long term liabilities) divided by (Long term liabilities + Equity). Lower number of this ratio indicates that the capital investment is conducted by the entity's own capital.

- *Efficiency*

Non revenue water ratio – Non Revenue Water (NRW) is defined as the water which does not generate any revenue for the water supply enterprise. This indicator expresses the proportion of volume of water which does not generate any revenues in the total amount of water production volume. Revenue water includes billed metered consumption and billed unmetered consumption. NRW includes: unbilled authorized consumption (e.g. free water from public stand posts and water tankers etc), unbilled unauthorized consumption (e.g. illegal connections), metering inaccuracy, and leakage. The formula for this indicator is: NRW ratio = [(total annual production volume - annual consumption volume billed) divided by (total annual production volume)] x 100.

Ratio of facility utilization – This is to measure the level of utilization of water treatment plant. Ratio of facility utilization = (Average water supply volume per day) divided by (Water production volume per day) x 100

- *Productivity*

Staff per 1,000 connections – This is a commonly used indicator to measure staff productivity. Staff per 1,000 connections = (Total number of staff) divided by (Number of connections) x 1000. The lower the ratio, the higher the productivity is.

Accounted for water volume per staff – This is to check the relationship between the level of accounted for water and number of staff. Accounted for water per staff = (Annual accounted for water volume) divided by (Number of staff).

(f) Publication

Publication of financial statements and these financial indicators internally or externally shall contribute to the transparency as the public nature of water supply and sanitation services, in addition to helping the understanding of the present difficult management condition by customers. Inter-net or annual report shall be the media of the publication. Breakdowns of operation and maintenance costs should be comprehended and be opened to the public. Breakdown of O&M costs shall include personnel cost, repair cost, electricity cost, etc. Regarding sanitation service, it is better to disclose the percentages of subsidy from State Government and sewerage tariff revenue within the total operation and maintenance costs. In terms of water supply services, percentages of usage of water tariff per 1m^3 tap water, for example, depreciation cost, interest payment, water treatment cost, distribution cost, shall be informed to the public for public relations.

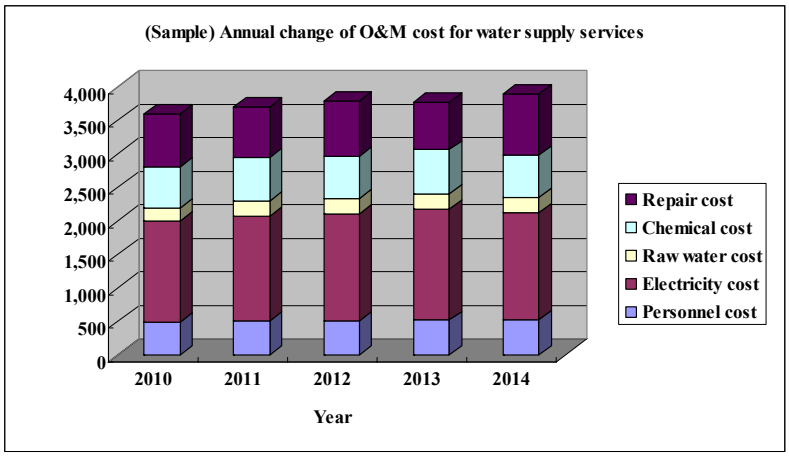


Figure 85.1 Sample of Publication – 1

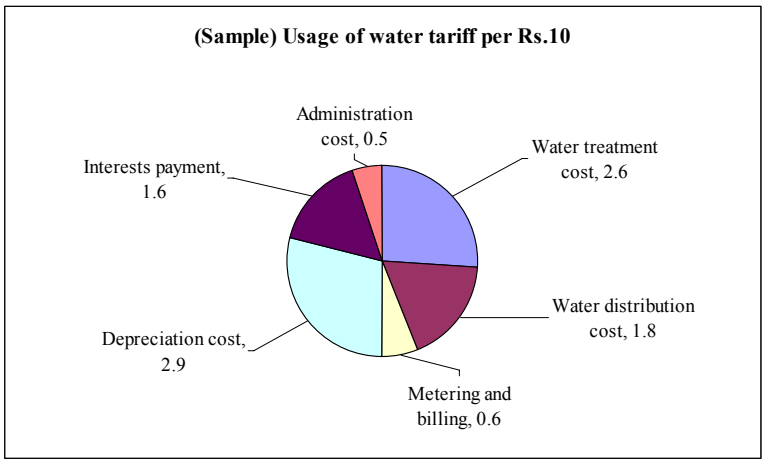


Figure 85.2 Sample of Publication - 2

(3) Accounting System Improvement Plan

In order to make the accounting system of water supply and sanitation sector (PHE) independent from the whole accounting system of PWD, PWD must negotiate with and obtain approval of State Government. For the first several years, it is recommended that PHE tries to prepare financial statements by corporate accounting system, with keeping the present accounting system as a transition period. Even in that case, PHE has more merits to do it than present system, since PHE is able to comprehend the annual profit and loss and general management condition of water supply and sanitation services. After successful implementation of new corporate accounting system, PHE shall negotiate with PWD and other related governmental department concerning the withdrawal from present accounting system. Steps for independent accounting system of PHE from PWD are shown in the Figure 85.3 and described below the Figure;

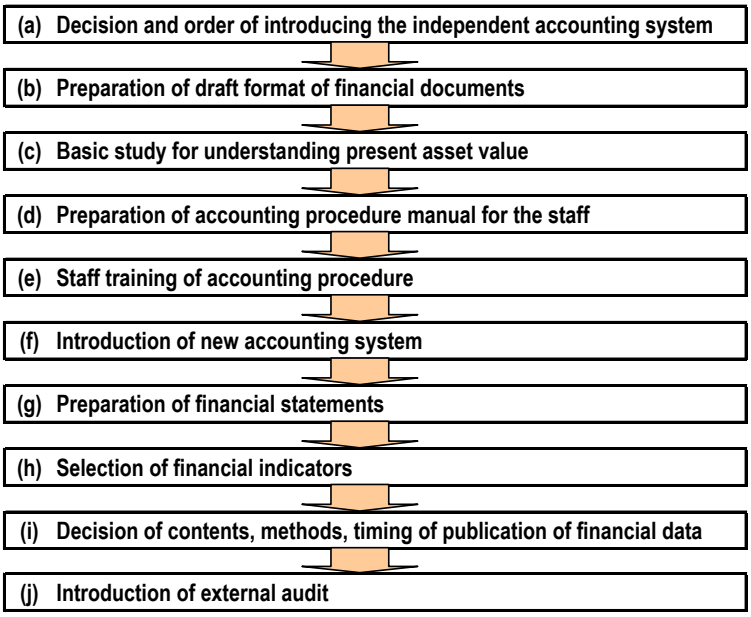


Figure 85.3 Flow of the introduction of independent accounting system

(a) Decision and order of introducing the independent accounting system

Decision by CEO should be passed and order should be given to the whole PHE regarding the introduction of independent accounting system. Target year of the start of the system shall also be mentioned in the order. Introduction of the system require the full cooperation of all the divisions and sub-divisions. Order from the top of the organization is indispensable for the smooth implementation.

(b) Basic study for understanding present asset value

Preparation of Balance Sheet requires the understanding of present value of fixed assets including land, building, plant, equipment, and work in progress. Investigation of these information shall require great effort and enough time. This work must be conducted before all of the following tasks along with the implementation of Asset Management of the Institutional Development.

(c) Preparation of draft format of financial documents

Draft formats of financial statements shall be prepared by deciding the major account titles of the statements. Formats of account ledgers for compiling the financial statements have also to be considered and prepared. Journal book, general ledger, and trial balance shall be included in the account ledgers.

(d) Preparation of accounting procedure manual for the staff

Introduction of double entry book-keeping is necessary for compilation of financial statements. This procedure should be mastered by every accounting staff of sub-division offices. For the purpose of staff training, easy to understand and specific manual for accounting staff should be newly prepared with the attachment of necessary formats of financial statements.

(e) Staff training of accounting procedure

Lectures and workshops shall be conducted to the accounting staff of sub-division offices for training of double entry book-keeping system. Actual past data for buying / selling transaction shall be considered and lectured in the workshop.

(f) Introduction of new accounting system

It is recommended to introduce the new accounting system firstly in several sub-division offices as the trial. After solving the problems occurred in these trial cases, accounting manual shall be revised and informed to the accounting staff of all the sub-divisions. Formal introduction of the system shall be started at the same time for all of the sub-divisions.

(g) Preparation of financial statements

Results of the accounting documents for the last month shall be sent early next month to headquarter of PHE, and is compiled for the whole sub-divisions every month. At the early next fiscal year, balance sheet, Income statement, and cash flow statement for 1 year period shall be compiled as soon as possible. It is recommended to compile income statement each month or quarterly for the whole sub-divisions at headquarter.

(h) Selection of financial indicators

Necessary financial indicator shall be selected by management class of headquarter to evaluate the financial / managerial condition of the water supply and sanitation services from the aspects of profitability, liquidity, efficiency, productivity, and so on. Selected indicators shall be added and deducted by the time passing and by accumulating the experiences.

(i) Decision of contents, methods, timing of publication of financial condition

After experiencing and succeeding the cycle of accounting procedure in one fiscal year, plan of publication of financial data shall be prepared. Plan of publication includes contents of information, method of information transmission, and timing of the first disclosure. Data, which shall be publicized, does not have to include all of the detailed data, but summarized and easy to understand data with the graphs and figures.

(j) Introduction of external audit

If the water supply and sanitation service sector obtains complete financial self sufficiency, it is recommended to introduce the system of external audit of the third party. It assures the quality of accounting system and documents of the organization and helps to keep the better quality of accounting system & staff.

8.5.3 Other Improvement Plan for Enterprise Management

(1) Tariff Structure

The basis for healthy management of water supply and sanitation services is to balance revenues and expenditures and to have sufficient income to provide enough operation and maintenance costs of the services. It is reasonable that the beneficiaries of the services bear the cost of them. Based on this beneficiary pay principle, the necessary cost shall be recovered by beneficiary of the service. On the other hand, the benefits of sewerage are not limited to the users. Eliminating water pollution significantly improves sanitary conditions in urban areas in the region and, if including the sewage treatment, downstream basin will benefit in many ways in improved sanitation and enhanced tourism and fishery.

Following the above consideration, it is recommended for water supply service to aim the full cost recovery, including loan repayment of construction, O&M cost (including personnel & administration cost), by user charges in the long run. It is also recommended for sanitation services to aim the cost recovery for operation and maintenance (including personnel & administration cost) in the long run.

The other point to bear in mind in setting tariff is that the monthly rate should not exceed the affordability of the user to pay. Enough attention is to be paid for the unit charge of the minimum consumption volume of the lowest income group in preparing the tariff structure. In the future, nevertheless, it is recommended that consideration for the lowest income group shall be shifted to one of the social welfare program by the State Government, since water supply and sanitation services have the responsibility to keep providing better quality of services continuously with the healthy financial condition by commercial oriented management.

(a) Basic methodology of tariff setting

Estimation of necessary tariff raise for water supply and sanitation service in Goa is conducted in the Volume IV Appendix 102 Economic and Financial Evaluation of Master Plan for Water Supply. On the other hand, in this Section, the basic orientation of tariff revision is described based on the full cost recovery for water supply service. It is recommended that the PHE shall

follow this basic methodology for tariff setting.

The first step of tariff setting is to calculate total necessary amount of tariff income for a certain period. Total necessary amount of tariff income must cover the total expenditure including operating expenses and capital expenses for the same period. Operating expenditure includes personnel cost, administration cost, electricity cost, chemical cost, raw water cost, depreciation cost, and replacement cost. Capital expenditure includes repayment of loan and investment cost for necessary expansion. Once the total necessary amount of tariff income is determined, divide this by the amount of water which is possible to sell during the period and ascertain the average unit revenue or Unit price.

The second step for tariff setting is to prepare the tariff structure which shows the burden on each user group of the total necessary amount of tariff income. In other words, total necessary amount of tariff income shall be allocated for each user group. Total necessary amount of tariff is composed of fixed cost, which is required for water supply without relating to the supply volume, and variable cost depending on the supply volume. Preferably, fixed cost shall be covered by basic charge or minimum charge of the tariff and variable cost shall be covered by volumetric charge of the tariff. In terms of volumetric charge, progressive or increasing block system is utilized for fostering awareness for water saving. Attention shall be paid for domestic users to have access to the minimum necessary volume of water for lower prices by relevant cross subsidy from non-domestic to domestic. When setting the tariff for domestic user, the affordability or ability of the household should be considered in detailed. Figure 85.4 shows the general outline of the tariff setting procedure.

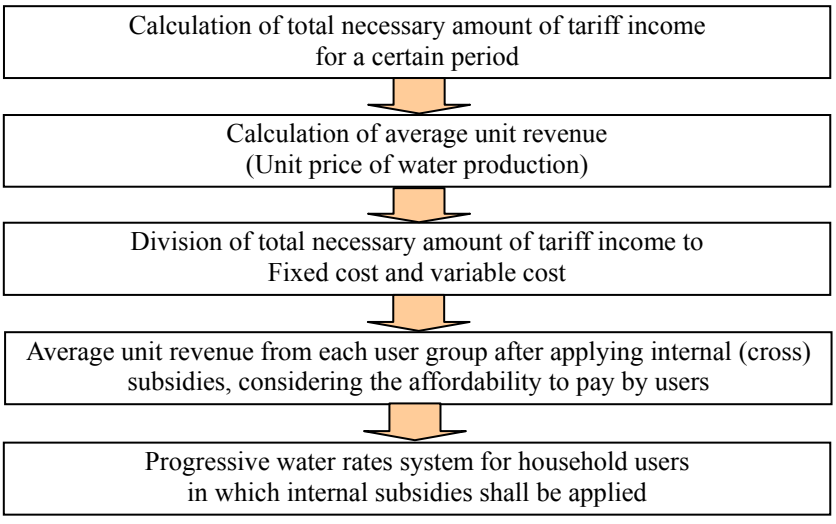


Figure 85.4 General Outline of the Tariff Setting Procedure

On the other hand, too heavy burden for non-domestic user shall cause the possibility of financial instability of service provider, since it gains much of the tariff revenue from the several huge consumers. Withdrawal of huge consumer shall directly lead to the deterioration of the financial situation of service provider. In case of Goa, the unit price gap between domestic and non-domestic is 6.9 times for 1m^3 consumption as described in volume II Chapter 3 5 Financial System. This figure belongs to the large part of the group of unit price gap, comparing to the other Asian cities. It is recommended that the tariff raise for non-domestic group should be slower than that for domestic group, in order to narrow down the unit price gap between these two categories.

(2) Meter Reading and Bill Collection Procedure

Presently, the period of meter reading varies according to capability of each sub division. This variation makes it difficult for PHE to understand the management condition including total water consumption per month, water consumption per connection per month, collection efficiency, etc. It is strongly recommended that PHE shall uniform the period of meter reading for all of the sub-divisions. In case of shortage of capability for conducting meter reading, data input, bill preparation, bill delivery for one month, sub-division is able to conduct only meter reading once in two month and preparing bill every month as shown in Figure 85.5.

In Figure 85.5, meter reading is conducted once in June and July and bill is prepared once every month. Billed amount in June is predicted at water consumption data at May. On the other hands, billed amount in July is calculated by subtracting billed amount in June from actual read amount for June & July. By utilizing the procedure, PHE is able to reduce the workload and cost for meter reading with the slight disadvantage from prediction of user consumption once in two months.

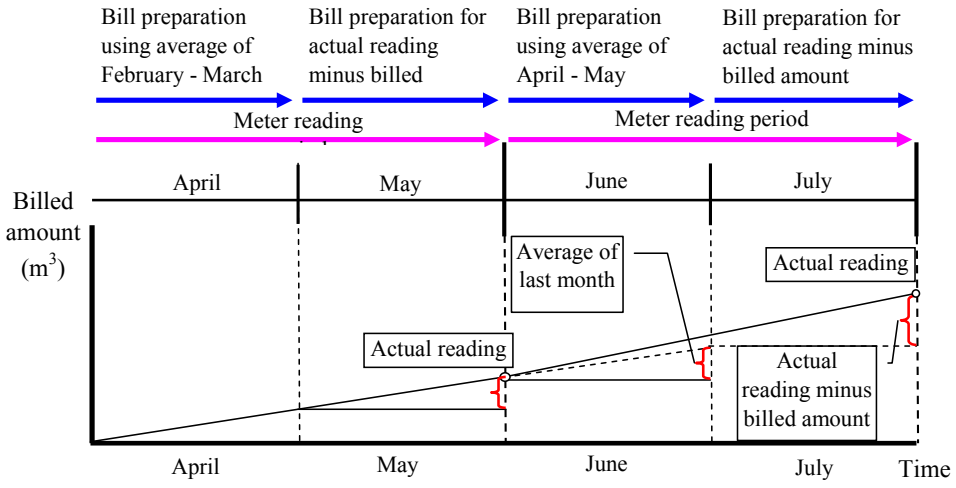


Figure 85.5 Sample of meter reading and bill preparation

Divisions or sub-divisions, are able to employ private computer companies for data processing and bill preparation in case of overload for existing staff, as it is presently conducted in Division IX, XXI, XX, and some sub-divisions in Division XVII. By unifying the meter reading & billing period, PHE is able to find the malfunction of water meter of the user in addition to obtaining the useful management / financial information. It is also recommended that PHE shall transmit the data of meter reading and billing, collected amount between headquarter and divisions / sub-divisions through the MIS described in Section 8.4.5 Framework for Management Information Systems Development

(3) Promotion of connection to the public sewer system

In Margao, the number of housing units benefited by public sewer was 1,074 on December 2004, 1,972 on December 2005, and 2,576 on May 2006. The number of housing units has been steadily increasing for the last two years. The increase in the year 2005 and 2006 owed to the 'Subsidized Connection Scheme' by State Government, which State Government paid other necessary cost for connection to the public sewer than the burden by the applicant at Rs.3,000. Without the scheme, general customers have to pay several times of household income for the construction of sewer pipe and fittings inside their own lands in addition to the connection charge at Rs.200 or Rs.350 for domestic. For example, by 'One Time Subsidized Sewerage Connection Scheme' that was implemented during April to August 2005, 1,508 customers were newly connected to the public sewer system. On the other hands, Rs. 3 crores public funds were required as the total cost for all the connections. As a result, it is calculated that on average Rs.19,894 was required for the sewer connection per customer. This initial burden by an applicant is one of the major constraints for PHE to increase the customers of public sanitation system, since the initial cost is approximately as much as three times of average household income.

It is recommended to implement the installment plan for initial cost of public sewer. Installment plan shall be realized by borrowing the certain amount of money from private bank or preferably public lending organization with lower interest rate. PHE, or division office, receives the applicants without full amount of money to invest for connection. PHE makes loan agreement with the applicant which mentions the terms and period of loan repayment. PHE utilizes the fund from borrowed money from bank and construct the connections to the public sewer for applicants. New customers shall pay the installment payment every month including the interests in addition to the tariff to the PHE. PHE shall make loan repayments to the bank by the installment payments from the customers.

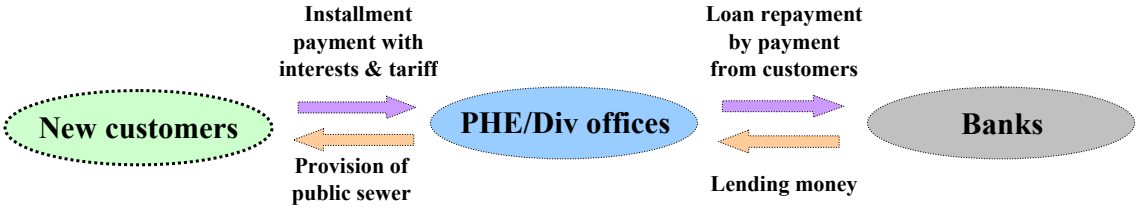


Figure 85.6 Stream of service and fund of the initial cost installment plan

For the purpose of reference, repayment schedule of the customer are shown in the Table 85.4 and Table 85.5, with the interests of 11% (supposing private bank) and 7% (supposing public lending organization) respectively for the repayment period of 10 years. Loan amount of the reference is assumed at Rs.13,000, which equals to the general necessary cost (Rs.16,000) minus initial payments by the applicant (Rs.3,000).

Table 85.4 Repayment schedule of the customer (fund from private bank)

(unit: Rs.)

Year	Loan amount	Interest rate	Interest of the year	Repayment per year	Balance at the end	Repayment per month
1	13,000	11%	1,430	2,208	12,222	184
2	12,222	11%	1,344	2,208	11,358	184
3	11,358	11%	1,249	2,208	10,400	184
4	10,400	11%	1,144	2,208	9,336	184
5	9,336	11%	1,027	2,208	8,155	184
6	8,155	11%	897	2,208	6,844	184
7	6,844	11%	753	2,208	5,389	184
8	5,389	11%	593	2,208	3,773	184
9	3,773	11%	415	2,208	1,980	184
10	1,980	11%	218	2,198	0	183

Table 85.5 Repayment schedule of the customer (fund from public lending organization)

(unit: Rs.)

Year	Loan amount	Interest rate	Interest of the year	Repayment per year	Balance at the end	Repayment per month
1	13,000	7%	910	1,851	12,059	154
2	12,059	7%	844	1,851	11,052	154
3	11,052	7%	774	1,851	9,975	154
4	9,975	7%	698	1,851	8,822	154
5	8,822	7%	618	1,851	7,589	154
6	7,589	7%	531	1,851	6,269	154
7	6,269	7%	439	1,851	4,857	154
8	4,857	7%	340	1,851	3,346	154
9	3,346	7%	234	1,851	1,729	154
10	1,729	7%	121	1,850	0	154

(4) Reduction of Public Stand Post by promoting the house connection

Presently, PHE has a lot of Public Stand Post (PSP) mainly in Division XVII and in Division XX. PWD is promoting the reduction of PSP and application to the house connection. Consumption of water from PSP is usually not billed and does not originate revenue. Unbilled PSP is one of the major causes for the high NRW rate in Goa. Promotion of the reduction of PSP by PHE is appreciated in the aspect of financial management. Introduction of installment payment described in '(3) Promotion of connection to the public sanitation system' is also useful to promote the application to house connection, in case the initial investment cost is the hurdle for new customers.

8.6 Overall Framework for Institutional Development Master Plan

This section describes the organizational transformation over the Master Plan period. The organization changes proposed mainly consider the overall growth strategy described in this Master Plan (facilities, customers, etc) and the progressive shifts in organizational focus and priorities described in this chapter. This discussions assume that the core function of PHE as the water supply and sanitation utility for Goa. Clearly, changes to this proposal may be required as other future decisions are taken about PHE's mission. Following the assessment framework, the Institutional Development Master Plan is envisaged to consist of various interventions into the seven (7) key elements of the PHE organization, as outlined in the Figure below.

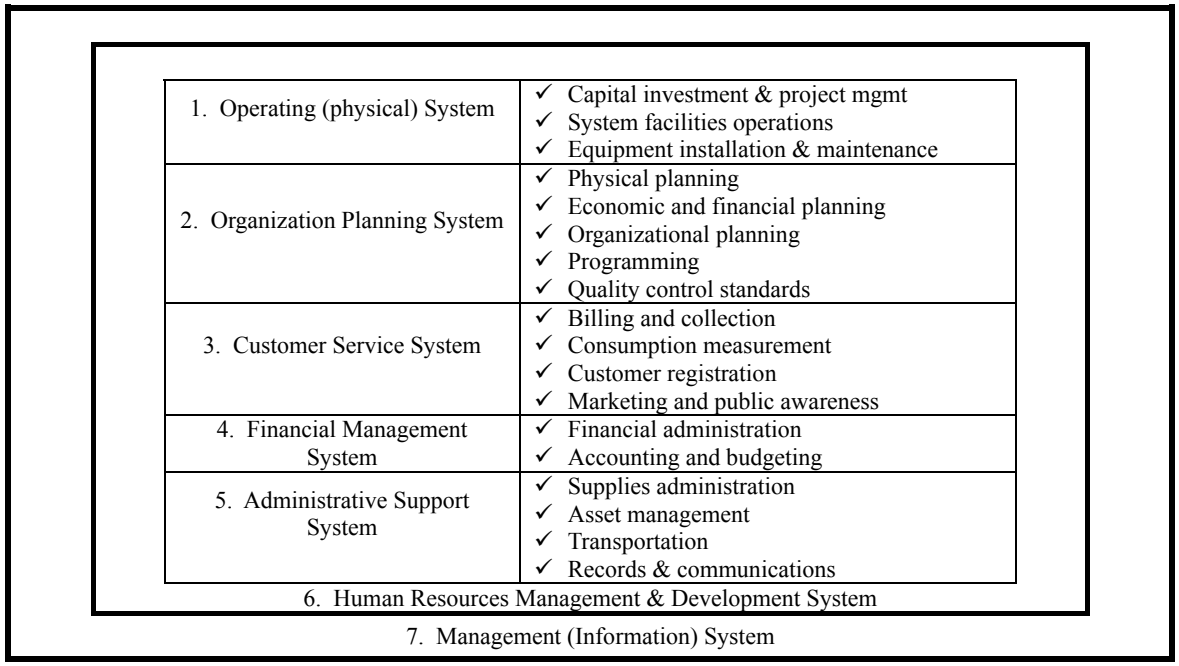


Figure 86.1 Framework for the Institutional Development Master Plan

8.6.1 Elements of the Institutional Development Strategy in First Phase

Based on the current discussions, the initial stage of the Institutional Development Plan, in addition to the legislative and reorganization agenda, will consists of the following seven (7) elements to strengthen the internal operations and management of PHE:

Table 86.1 Synopsis of Institutional Development Plan

General	• Support for policy studies & recommendations • Internal restructuring (work distribution and staff re-deployment) • Development of support programs,
1. Physical System	• O&M Improvement Plan (management of maintenance; work practices, health & safety) • Project management (externally-supported projects)
2. Organization Planning System	• Introduction of the PHE/service provider Business Model and clear core and support functions (or processes). Corporate planning and performance monitoring processes. • Introduction of business planning process (annual corporate plans)
3. Customer Service System	• Introduction of customer service system (part of MIS)
4. Financial Management & Control System	• Introduction of financial accounting system (part of MIS) • Adoption of commercial practices.
5. Administrative Support System	• Introduction of an asset management system (part of MIS) • Introduction of supplies and inventory management (part of MIS) • Build up public information and education programs
6. Human Resources Management And Development System	• Improvements in personnel management system (job descriptions, manpower projections, performance indicators, etc) • Comprehensive training program for all staff.
7. Management Information System	• Introduction of Management Information System (MIS) (including information and benchmarking systems, planning and control systems, asset management systems etc.)

8.6.2 General Support

Policy Studies and Recommendations

This activity will support the policy and legislative agenda proposed in this Study as well as further policy studies to support the policy decision on sector reform.

Internal re-structuring

The Plan, based on the assessments, envisages the need to undertake work (or responsibility) re-distribution & resource allocation. Balancing of management responsibilities and work load may have to be done. Work processes will need to be optimization (re-engineering through learning & continuous process review) leading to changes in work practices. The function description of each operating work group will be reviewed and revised; job description and qualification requirements for all positions will be formulated.

Development of support program

Finally, the assessment pointed to some specific support programs which need to be implemented if PHE is to succeed in achieving it mission. Principally, this involves the issue of how to increase the connection rate for sewerage. This requires a meticulous study into the issue and the consideration of new approaches, including the feasibility of implementing a Revolving fund for to promote household toilet improvements, including sewer connections. Secondly, in-depth programs need to be introduced aimed at enhancing and transforming the organization values and "culture" within PHE. The Plan will assist in formulating and implementing a program to address these and other priority issues which may arise as PHE progresses.

8.6.3 Physical Systems Improvements: Operation and Maintenance & Capital Investments

The operation and maintenance assessments made about seventy-four (74) key recommendations to improve current practices. Many of the urgent improvements can be implemented by PHE management. This has been detailed in the preceding chapter. Some external support (and new thinking) needs to be inputted with respect to:

- O&M strategy development & improved practices
- NRW strategy development & improved practices
- Organisation development & capacity building for O&M
- Information system development and control systems
- Process and asset optimisation
- Water, sanitation & NRW improvement plans
- Health and Safety Improvements

Similarly, PHE's does not have experience in managing externally-supported investment projects. Much of its current experience is in the implementation of locally-financed expansion or rehabilitation works.

8.6.4 Planning System Improvements: Introduction of the PHE Business Model

The Plan will introduce the implementation of a business planning model similar to the figure above which clearly indicate the market conditions, the sources and uses of funds and the key internal business management processes.

The introduction of corporate planning and review processes will involve:

- Development of strategic intent and business priorities based on internal & external factors.
- Development & sharing corporate strategies.
- Agreement on corporate objectives (based on strategic intent).
- Agreement on key performance indicators.
- Agreement on departmental, team & individual objectives.
- Agreement on performance indicators and method of evaluation.

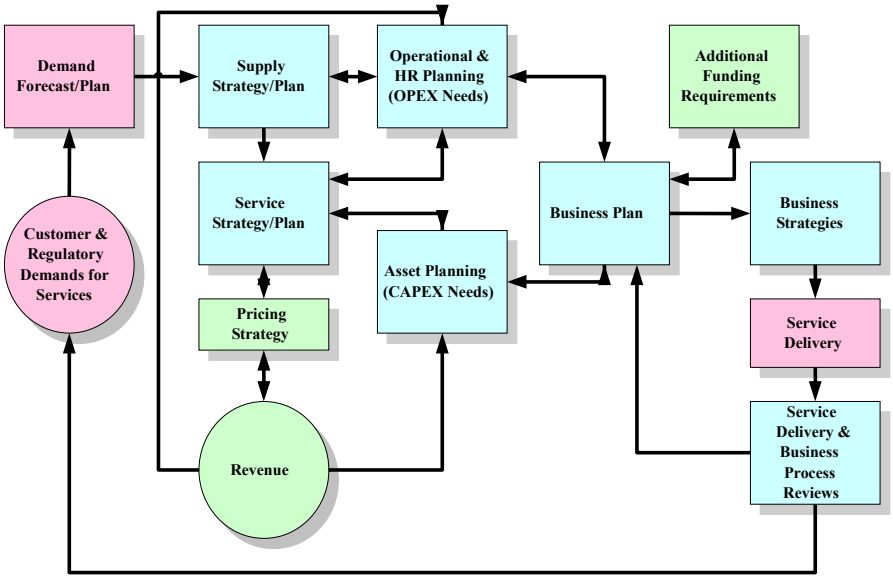


Figure 86.2 Proposed Business Planning Model for PHE

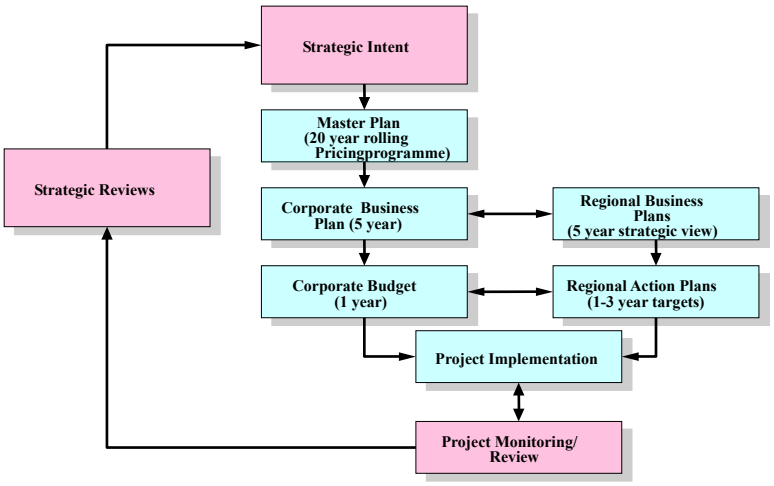


Figure 86.3 Hierarchy and relationship of PHE plans

8.6.5 Customer Service System: Introducing Customer Service Management

The Plan will establish a Customer Service Management (CSM) system for PHE. This principally includes a customer database system and a customer feedback/dialogue system. A public information & education program and a public relations and marketing program will be designed and implemented. A revolving fund project to assist residents in gaining access to the sewerage system has been described in the previous section. The proposal, funding source and implementation arrangements need to be identified.

8.6.6 Financial Management & Control System

The Plan will develop the capacity of PHE to produce and evaluate the basic financial reports, including balance sheet, income statement and cash flow projections, including the basic information system to produce these vital reports. New budgeting procedures and formats will be introduced. Commercial accounting procedures will be adopted. An asset revaluation exercise will have to be undertaken to establish the list and value of the current assets of PHE. Thereafter, guidelines and procedures for succeeding asset revaluation exercises will be developed. Intensive staff training will be required to raise the level of financial management and control throughout all levels of the organization, including technical, field and accounting staff. The Plan will also assist PHE in initial selection for the independent external audit of accounts. Use of relevant financial performance indicators will be introduced to monitor the performance of the water service providers. The Study also recommended the regular publication of the utilities financial condition. The Plan will assist PHE in implementing this recommendation. The Plan will also recommend a rational procedure for determining needed tariff.

8.6.7 Administrative Support System: Introducing Asset Management System

The Plan, will assist PHE in designing and putting in place an asset register and an asset management system (as part of the MIS) to help plan and keep track of the status, disposition and maintenance requirements of its assets. Secondly, an online system will be introduced to keep track of supplies and inventories of spares. Finally, public information and education programs will be designed and implemented.

8.6.8 Staff Training & Development Programs

The Plan will assist PHE in managing staff resources and organizing an in-house training operations. It will assist in making more detailed needs assessment, design, test and pilot new workshops and courses. It is envisaged that local training resources will be tapped to assist training implementation. The immediate training priorities are as follows:

Management Development	Focus on middle managers & supervisors. Management of sections and even smaller work teams and crews; communications, leadership, motivation and working relationships. Includes MIS & computer training.
Financial Management	Basic accounting. Preparation of Financial Reports.
Customer Services	Customer management systems.
Operation & Maintenance	Development of local O&M specialists, for such areas as pipes and appurtenances, treatment processes, electro-mechanical & telemetry equipment, etc)
Project Management and Development	Project financing. Financial/economic analysis. Development of more local specialists, such as designers (hydraulics, treatment, electro-mechanical, etc), construction specialists and inspectors, socio-economists and financial analysts for future feasibility study, design and construction activities. Include computer training.

8.6.9 Management Information Systems

The management information system for PHE is envisaged to be a fully computerized system which is fully integrated with a new commercially-oriented accounting system and a benchmarking program. It will support the planning, decision-making and assessment of operations of the service providers. It will also support official reporting and auditing requirements. The Plan will assist in evaluating and selecting, procuring and customizing the MIS software. It is envisaged that a commercially-available software will have to be customized to suit the specific management information requirements of the PHE.

Based on the assessment, the components or modules of the integrated management information system which has to be installed follows, as prioritized:

1. Financial Accounting and Control module
2. Asset Management module
3. Customer Relationship Management module
4. Inventory & Supplies Management module
5. Project Management module
6. Human Resources Management module

CHAPTER 9

PRELIMINARY COST ESTIMATES AND IMPLEMENTATION SCHEDULE

CHAPTER 9 PRELIMINARY COST ESTIMATES AND IMPLEMENTATION SCHEDULE

9.1 Conditions of the Cost Estimates

9.1.1 General

Preliminarily costs have been estimated based on the analysis presented in the previous chapters. All costs mentioned in this chapter are in Indian Rupees as of 2007, together with converted amount in US$ for reference. Taxes and duties vary depending on the type of equipment or material and were included in the corresponding unit costs. The estimated costs were based on staged implementation of the projects, which correspond to the priorities and timeframes discussed in the previous chapters. The operation and maintenance improvement costs are described in Chapter 7. Institutional and organizational improvement costs were estimated to be 4% of the direct construction costs.

9.1.2 Construction Costs for Improvement of Water Supply and Sanitation

The construction costs were estimated based on information obtained from the following reports:

- The unit prices of PWD (PWD Goa, 2004)
- Actual cost of Chandel WTP (PWD Goa, 2002)
- Actual cost of Dabose WTP (PWD Goa, 1992)
- Actual cost of Canacona WTP (PWD Goa, 1983)
- Actual cost of Opa-Curti WTP (PWD Goa, 2004)
- Actual cost of Assonora WTP (PWD Goa, 1992)
- Actual cost of Salaulim WTP (PWD Goa, 1989)
- Cost estimation of Dabose WTP (PWD Goa)
- Cost estimation of Salaulim WTP (PWD Goa)
- Cost estimation of Canacona WTP (PWD Goa)
- Cost Estimation of Kerala Water Supply Projects (KWA, Kerala, 2006)
- Detailed Project Report on Sewerage for Ponda (PWD Goa)
- Detailed Project Report on Sewerage for Margao (PWD Goa)
- The Study on Water Quality Management Plan for Ganga River (JICA, 2005)

9.1.3 Other Costs Related to the Project

The total cost of the master plan includes the following items besides the direct construction costs.

(1) Engineering Costs

The engineering services costs include detailed design, assistance for tendering/tender evaluation to the contract awards, and construction supervision. The engineering costs are estimated to be 10 % for water supply and 12 % for sanitation of the direct construction costs including costs for operation and maintenance improvements and for capacity building.

(2) Administrative Costs

The administrative cost was estimated to be 5 % of the direct construction costs not including costs for operation and maintenance improvement or for institutional development.

(3) Contingencies

The physical contingency is estimated to be 10 % of the sum of the construction and engineering costs. The price contingency is calculated from the sum of the construction, administration and engineering costs multiplying annual inflation rate 7%.

9.2 Results of Cost Estimates

9.2.1 Water Supply

A summary of the costs for the water supply component is presented in Table 92.1.

Table 92.1 Cost Estimate for Water Supply Components

Item	Amount	
	(In Million Rs.)	(In Million US$)
1.Construction Cost	12,679.560	280.27
1) Expansion Project	7,295.400	161.26
(1) Water Treatment Plant	2,708.870	59.88
(2) Transmission Main	2,133.970	47.17
(3) Reservoir	369.000	8.16
(4) Pumping Station	43.400	0.96
(5) Distribution Pipe	1,685.550	37.26
(6) House Connection	354.610	7.84
2) Rehabilitation Works	5,058.020	111.80
(1) Water Treatment Plant	1,170.950	25.88
(2) Transmission Main	1,165.770	25.77
(3) Reservoir	142.060	3.14
(4) Pumping Station	132.280	2.92
(5) Distribution Pipe	1,086.270	24.01
(6) House Connection	1,360.690	30.08
3) Water Quality Control	25.500	0.56
4) O&M Improvement	300.640	6.65
(1) Water Supply System O&M	276.840	6.12
(2) NRW Reduction Improvements	23.800	0.53
2. Engineering Cost	1,267.940	28.03
3. Administration Cost	697.380	15.42
4. Land Acquisition	26.280	0.58
5. Physical Contingency	1,397.370	30.89
6. Price Contingency	10,012.880	221.33
Total excluding Price Contingency	16,068.530	355.18
Total	26,081.410	576.51

Note: US$1.00 = Rs.45.24
Costs for (2) NRW Reduction Improvements includes only costs for leakage detection equipment. Other costs required are included in “Rehabilitation Works” and Table 46.3.

9.2.2 Sanitation

Summary of the costs for sewerage is presented in Table 92.2. Regarding treatment method, new sewage treatment plants including St. Cruz, Porvorim, Ponda, Mapusa, Colva and Calangute & Candolim are estimated based on adopting OD method. On the other hand, existing plant expansion are estimated as the same method as existing plant, SBR for Panaji and conventional activated sludge method for Margao. Table 92.3 shows the cost estimates for decentralized and on-site system.

Table 92.2 Cost Estimate for Sanitation Components

Item	Amount	
	(In Million Rs.)	(In Million US$)
1.Construction Cost	2,647.730	58.53
1) Expansion Project	2,462.280	54.43
(1) Trunk Sewer	633.300	14.00
(2) Branch Sewer*	885.510	19.57
(3) Pump	70.370	1.56
(4) Sewage Treatment Plant	873.100	19.30
2) Rehabilitation Works	143.450	3.17
3) O&M Improvement	42.000	0.93
2. Engineering Cost	317.730	7.02
3. Administration Cost	148.270	3.28
4. Land Acquisition	24.800	0.55
5. Physical Contingency	299.040	6.61
6. Price Contingency	2,900.970	64.12
Total excluding Price Contingency	3,437.570	75.99
Total	6,338.540	140.11

Note: * Branch sewer cost includes house connection 144.11 Mill Rs

US$1.00 = Rs.45.24

Treatment Method OD: St. Cruz, Porvorim, Ponda, Mapusa, Colva and Calangute & Candolim
SBR: Panaji, Conventional Activated Sludge Method: Margao

Table 92.3 Cost Estimate for Decentralized and On-site System

Item	Amount (In Million Rs.)	Amount (In Million US$)	Remarks (Population in person)
Decentralized System	31.0	0.68	5,900
On-site System	223.2	4.93	40,500
Total	254.2	5.61	

Note: US$1.00 = Rs.45.24

9.2.3 Institutional/Organizational Improvement

A summary of the costs for the institutional/organizational improvement is presented in Table 92.4.

Table 92.4 Cost Estimate for Institutional/Organizational Improvement

Item	Amount (In Million Rs.)	Amount (In Million US$)
1. Institutional /Organizational Improvement Cost	578.16	12.78
2. Engineering Cost	59.84	1.32
3. Administration Cost	31.93	0.71
4. Physical Contingency	63.81	1.41
5. Price Continhency	480.24	10.62
Total excluding Price Contingency	733.74	16.22
Total	1213.98	26.83

Note: US$1.00 = Rs.45.24

9.3 Implementation Schedule

9.3.1 Water Supply Scheme

The implementation schedule for the water supply scheme is shown in Figure 93.1. The corresponding annual investment plan is presented in Table 93.1. The implementation schedule does not include the installation of the proposed distribution pipelines and house connections nor the rehabilitation and replacement of the existing distribution pipelines and house connections, because these works should be implemented every year as routine work.

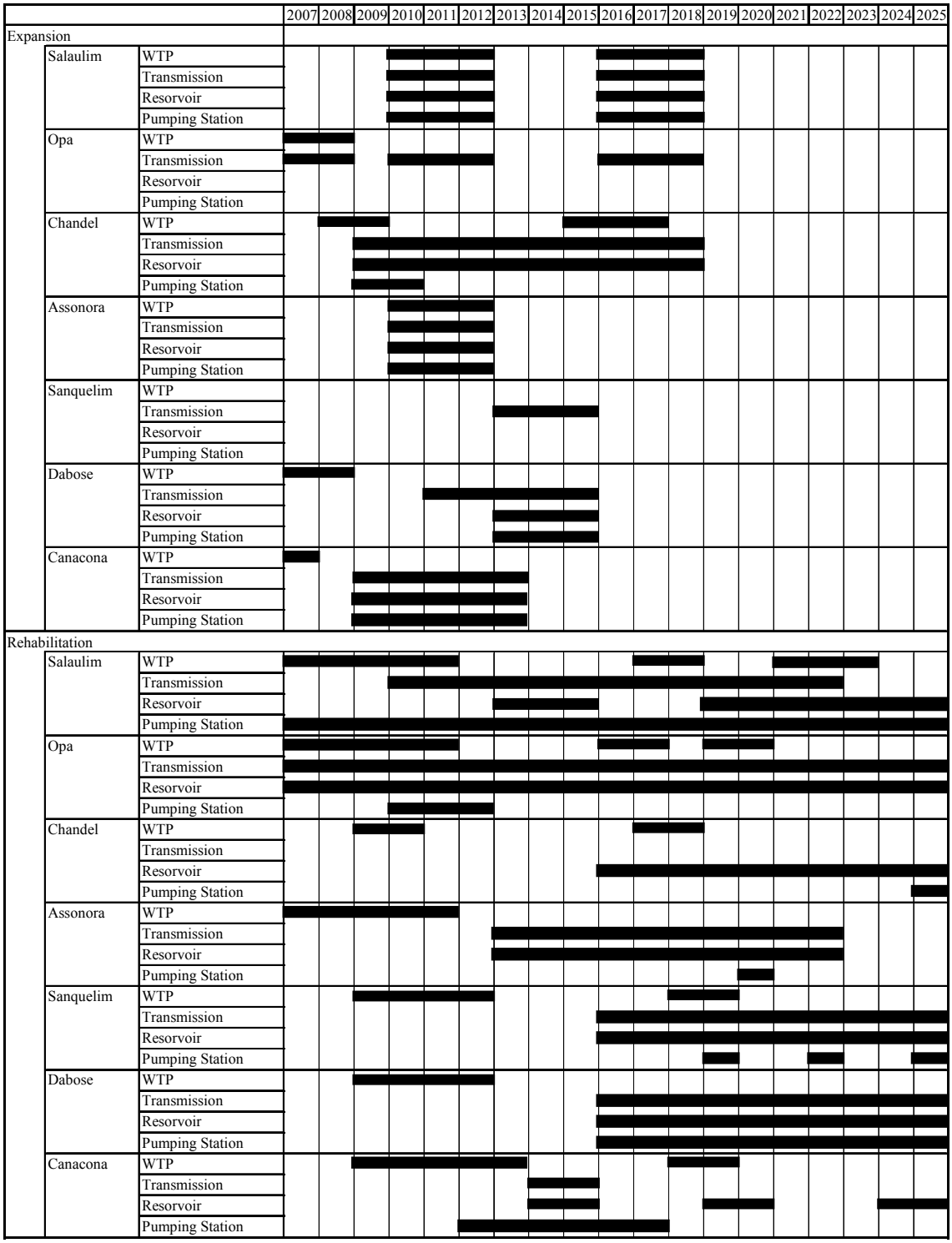


Figure 93.1 Implementation Schedule for the Water Supply Scheme

Table 93.1 Annual Investment Plan for Water Supply Scheme

Item	Amount (Rs. In Million)																			
	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1.Construction Cost	12,679.560	678.370	582.500	362.530	1,357.130	2,720.370	1,354.120	327.980	320.640	334.450	611.940	992.440	667.740	432.630	384.740	339.670	343.010	287.170	289.720	292.410
1) Expansion Project	7,295.400	503.820	409.520	132.590	758.680	1,859.530	851.050	149.490	144.220	156.930	390.190	716.810	403.940	111.550	113.480	114.700	116.670	118.650	120.710	122.870
(1) Water Treatment Plant	2,708.870	343.890	248.310	9.000	287.960	681.810	361.720	0.000	0.000	19.130	193.510	359.390	204.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(2) Transmission Main	2,133.970	65.400	65.340	20.160	323.690	948.190	341.070	41.100	35.310	28.480	56.190	153.200	55.840	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(3) Reservoir	369.000	0.000	0.000	4.600	44.540	124.410	44.520	5.040	4.700	3.780	28.820	79.820	28.770	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(4) Pumping Station	43.400	0.000	0.000	1.560	3.880	5.890	3.070	1.110	0.400	0.120	5.490	16.440	5.440	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(5) Distribution Pipe	1,685.550	78.100	79.210	80.370	81.470	81.980	83.170	84.470	85.760	87.090	87.730	89.200	90.680	92.160	93.750	94.760	96.380	98.030	99.720	101.520
(6) House Connection	354.610	16.430	16.660	16.900	17.140	17.250	17.500	17.770	18.050	18.330	18.450	18.760	19.060	19.390	19.730	19.940	20.290	20.620	20.990	21.350
2) Rehabilitation Works	5,058.020	169.930	169.900	226.860	503.150	771.840	380.010	178.490	176.420	177.520	221.750	267.630	263.800	321.080	271.260	224.970	226.340	168.520	169.010	169.540
(1) Water Treatment Plant	1,170.950	30.570	30.540	87.500	244.690	275.210	121.380	3.370	0.000	0.000	33.000	43.830	58.570	119.520	71.770	25.500	25.500	0.000	0.000	0.000
(2) Transmission Main	1,165.770	15.920	15.920	15.920	123.500	338.640	123.480	44.380	45.590	45.590	48.330	48.330	48.330	48.330	48.330	48.330	48.000	19.870	19.810	19.170
(3) Reservoir	142.060	2.220	2.220	2.220	2.220	2.220	2.220	9.310	9.570	9.570	8.020	8.020	8.020	12.230	12.230	12.100	12.090	9.090	9.350	9.140
(4) Pumping Station	132.280	0.620	0.620	0.620	12.140	35.170	12.330	0.830	0.660	1.760	11.800	30.440	11.620	3.510	1.210	1.210	2.670	1.210	1.210	2.650
(5) Distribution Pipe	1,086.270	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.030
(6) House Connection	1,360.690	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	79.830	80.080	80.310	80.540	80.650	80.900	81.170	81.460	81.550
3) Water Quality Control	25.500	0.000	0.000	0.000	0.000	17.500	0.000	0.000	0.000	0.000	0.000	8.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4) O&M Improvement	300.640	4.620	3.080	3.080	95.300	71.500	123.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(1) Water Supply System O&M	276.840	4.620	3.080	3.080	71.500	71.500	123.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
(2) NRW Reduction Improvements	23.800	0.000	0.000	0.000	23.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2. Engineering Cost	1,267.940	67.840	128.250	166.250	105.710	152.040	85.410	32.800	32.060	33.450	61.190	99.240	66.770	43.260	38.470	33.970	34.300	28.720	28.970	29.240
3. Administration Cost	697.380	37.310	35.540	26.440	73.140	143.620	71.980	18.040	17.640	18.400	33.660	54.580	36.730	23.790	21.160	18.680	18.870	15.790	15.930	16.080
4. Land Acquisition	26.280	8.760	8.760	8.760	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5. Physical Contingency	1,397.370	75.500	71.950	53.750	146.280	287.240	143.950	36.080	35.270	36.790	67.310	109.170	73.450	47.590	42.320	37.360	37.730	31.590	31.870	32.170
6. Price Contingency	10,012.880	0.000	52.850	81.720	345.660	937.370	608.460	189.690	224.350	277.440	592.610	1,108.610	852.110	625.700	626.490	619.290	696.890	647.490	722.380	803.770
Total excluding Price Contingency	16,068.530	867.780	827.000	617.730	1,682.260	3,303.270	1,655.460	414.900	405.610	423.090	774.100	1,255.430	844.690	547.270	486.690	429.680	433.910	363.270	366.490	369.900
Total (in Million Rs.)	26,081.410	867.780	879.850	699.450	2,027.920	4,240.640	2,263.920	604.590	629.960	700.530	1,366.710	2,364.040	1,696.800	1,172.970	1,113.180	1,048.970	1,130.800	1,010.760	1,088.870	1,173.670
Total (in Million US$1.00=Rs.45.24)	576.52	19.18	19.45	15.46	44.83	93.74	50.04	13.36	13.92	15.48	30.21	52.26	37.51	25.93	24.61	23.19	25.00	22.34	24.07	25.94

9.3.2 Sanitation Scheme

The implementation schedule for the sanitation scheme is shown in Figure 93.2. The annual investment plan is presented in Table 93.2.

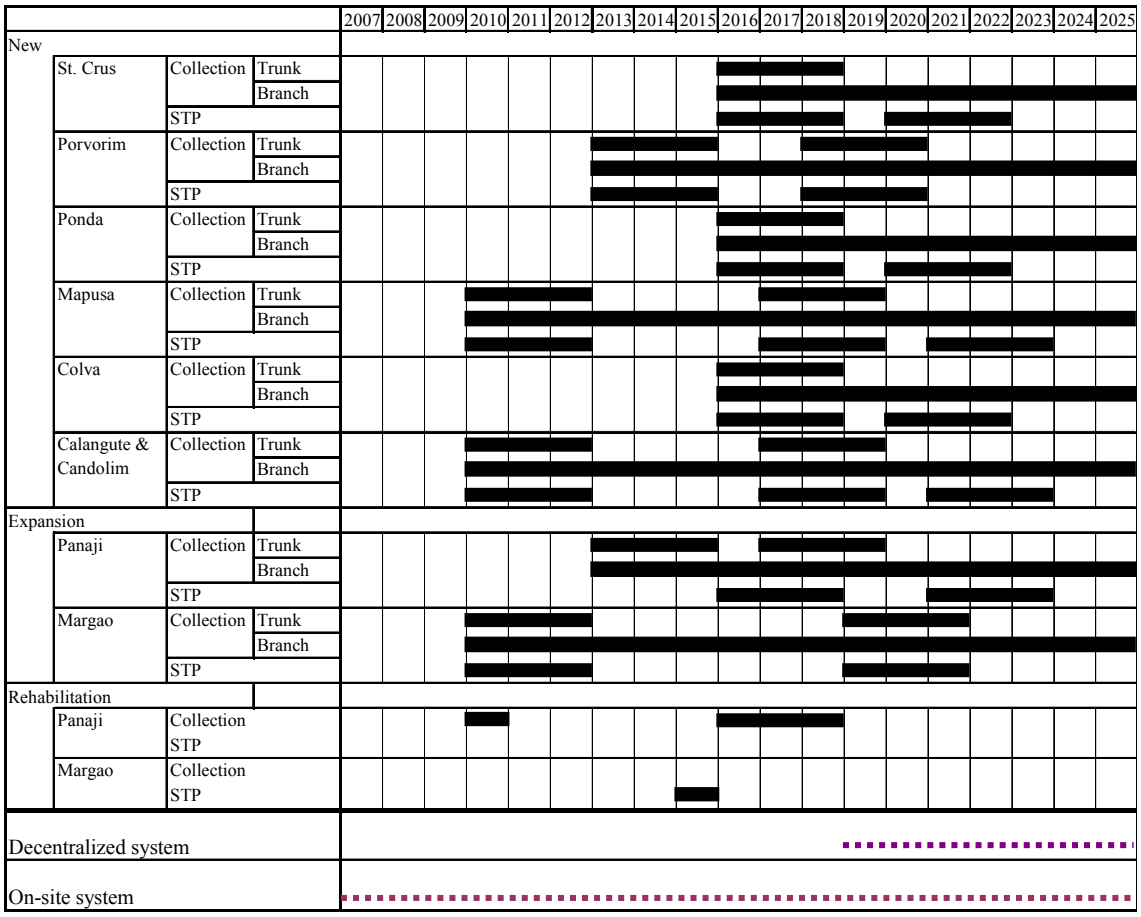


Figure 93.2 Implementation Schedule for the Sanitation Scheme

9.3.3 Capacity Building, Institutional/Organizational Improvement Cost

The institutional/organizational improvement cost is shown in Table 93.3.

9.3.4 Operation and Maintenance Cost

The operation and maintenance costs for water supply and sanitation are shown in Tables 93.4 and 93.5.

Regarding sanitation scheme, decentralized and on-site system will be controlled by municipality/panchayat under the technical and financial assistance of PWD. It is recommended PWD to bear a part of the operation maintenance cost, estimated 2.53 million Rs./year for decentralized system and 30.16 million Rs./year for on-site system.

Table 93.2 Annual Investment Plan for Sewerage Scheme

Item	Amount (Rs. In Million)																			
	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1.Construction Cost	2,647.730	6.500	6.500	6.500	278.530	314.340	303.940	64.140	81.420	94.130	136.700	219.920	239.210	203.460	203.690	159.260	125.500	94.970	50.610	58.410
1) Expantion Project	2,462.280	0.000	0.000	0.000	247.920	314.340	303.940	64.140	81.420	65.250	119.230	209.950	229.240	203.460	142.440	159.260	125.500	94.970	50.610	50.610
(1) Trunk Sewer	633.300	0.000	0.000	0.000	88.380	88.380	88.380	25.140	25.140	25.140	32.170	76.410	92.820	65.410	21.170	4.760	0.000	0.000	0.000	0.000
(2) Branch Sewer	885.510	0.000	0.000	0.000	103.640	103.640	103.640	22.830	22.830	22.830	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610
(3) Pump	70.370	0.000	0.000	0.000	0.000	10.620	10.620	0.000	6.500	6.500	0.000	6.180	13.440	9.790	4.620	2.100	0.000	0.000	0.000	0.000
(4) Sewage Treatment Plant	873.100	0.000	0.000	0.000	55.900	111.700	101.300	16.170	26.950	10.780	36.450	76.750	72.370	77.650	66.040	101.790	74.890	44.360	0.000	0.000
2) Rehabilitation Works	143.450	0.000	0.000	0.000	15.610	0.000	0.000	0.000	0.000	28.880	9.970	9.970	9.970	0.000	61.250	0.000	0.000	0.000	0.000	7.800
3) O&M Improvement	42.000	6.500	6.500	6.500	15.000	0.000	0.000	0.000	0.000	0.000	7.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2. Engineering Cost	317.730	0.780	20.780	40.780	13.420	17.720	16.470	7.700	9.770	11.300	16.400	26.390	28.710	24.420	24.440	19.110	15.060	11.400	6.070	7.010
3. Administration Cost	148.270	0.360	1.360	2.360	14.600	16.600	16.020	3.590	4.560	5.270	7.660	12.320	13.400	11.390	11.410	8.920	7.030	5.320	2.830	3.270
4. Land Acqisition	24.800	0.000	9.100	9.100	0.000	1.500	1.500	0.000	1.800	1.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5. Physical Contingency	299.040	0.730	3.640	5.640	29.200	33.360	32.190	7.180	9.300	10.720	15.310	24.630	26.790	22.790	22.810	17.840	14.060	10.640	5.670	6.540
6. Price Continhency	2,900.970	0.000	2.640	8.510	68.990	108.830	136.030	37.770	59.090	80.800	134.790	250.130	310.820	299.610	337.710	295.640	259.620	218.040	128.470	163.480
Total minus Price Contingency	3,437.570	8.370	41.380	64.380	335.750	383.520	370.120	82.610	106.850	123.220	176.070	283.260	308.110	262.060	262.350	205.130	161.650	122.330	65.180	75.230
Total	6,338.540	8.370	44.020	72.890	404.740	492.350	506.150	120.380	165.940	204.020	310.860	533.390	618.930	561.670	600.060	500.770	421.270	340.370	193.650	238.710
Total (in Million US$1.00=Rs.45.24)	140.110	0.19	0.97	1.61	8.95	10.88	11.19	2.66	3.67	4.51	6.87	11.79	13.68	12.42	13.26	11.07	9.31	7.52	4.28	5.28

Notes: Treatment Method Adopted
OD: St. Cruz, Porvorim, Ponda, Mapusa, Colva and Calangute & Candolim
SBR: Panaji, Conventional Activated Sludge Method: Margao

Table 93.3 Institutional/Organizational Improvement Cost

	Amount (Rs. In Million)																			
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
1. Institutional /Organizational Improvement Cost	48.990	49.340	49.580	49.390	44.410	42.470	27.320	27.320	27.320	27.320	27.320	27.320	18.580	18.580	18.580	18.580	18.580	18.580	18.580	578.160
2. Engineering Cost	5.010	5.050	5.070	5.060	4.550	4.350	2.850	2.850	2.850	2.850	2.850	2.850	1.950	1.950	1.950	1.950	1.950	1.950	1.950	59.840
3. Administration Cost	2.700	2.720	2.730	2.720	2.450	2.340	1.510	1.510	1.510	1.510	1.510	1.510	1.030	1.030	1.030	1.030	1.030	1.030	1.030	31.930
4. Physical Contingency	5.400	5.440	5.470	5.450	4.900	4.680	3.020	3.020	3.020	3.020	3.020	3.020	2.050	2.050	2.050	2.050	2.050	2.050	2.050	63.810
5. Price Continhency	0.000	4.000	8.310	12.870	15.980	19.790	15.860	19.190	22.750	26.560	30.640	35.000	27.000	30.400	34.030	37.920	42.090	46.540	51.310	480.240
Total excluding Price Contingency	62.100	62.550	62.850	62.620	56.310	53.840	34.700	34.700	34.700	34.700	34.700	34.700	23.610	23.610	23.610	23.610	23.610	23.610	23.610	733.740
Total	62.100	66.550	71.160	75.490	72.290	73.630	50.560	53.890	57.450	61.260	65.340	69.700	50.610	54.010	57.640	61.530	65.700	70.150	74.920	1,213.980
Total (in Million US$1.00=Rs.45.24)	1.370	1.470	1.570	1.670	1.600	1.630	1.120	1.190	1.270	1.350	1.440	1.540	1.120	1.190	1.270	1.360	1.450	1.550	1.660	26.820

phase1:2007-2012 from Chaptor 8
4% of the direct construction cost of each phase and arocated every year,,phase2:2013-2018 phase3:2019-2035
Engineering Cost: Weighted mean method of constraction cost, Water Supply 10%, Sanitation 12%

Table 93.4 Operation and Maintenance Costs for the Water Supply Scheme

Item		Amount (Rs. In Million)																		
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Electricity	W.T.P.	0.000	1.410	4.020	5.170	5.430	26.260	68.840	71.240	73.720	76.280	78.960	107.450	111.330	115.380	119.510	123.810	128.300	132.990	137.820
	Others	0.020	0.020	0.020	0.020	0.020	0.020	1.140	1.210	1.270	1.340	1.410	1.490	5.810	6.090	6.360	6.650	6.940	7.250	7.570
	Sub Total	0.020	1.430	4.040	5.190	5.450	26.280	69.980	72.450	74.990	77.620	80.370	108.940	117.140	121.470	125.870	130.460	135.240	140.240	145.390
Chemical		0.000	0.120	0.200	0.220	0.230	1.870	5.440	5.630	5.820	6.030	6.240	8.330	8.630	8.950	9.280	9.600	9.950	10.320	10.690
Personnel Expenses		0.000	7.050	14.100	14.100	14.100	19.750	52.450	52.450	52.450	52.450	52.450	57.700	57.700	57.700	57.700	57.700	57.700	57.700	57.700
Maintenance		0.000	2.150	4.590	4.880	5.350	12.380	32.370	33.030	33.710	34.430	36.170	45.150	47.270	48.440	49.610	50.860	52.130	53.480	54.850
Administration		0.000	0.322	0.688	0.731	0.742	1.796	4.795	4.895	4.997	5.103	5.215	6.562	6.881	7.055	7.232	7.417	7.610	7.810	8.017
Total (in Million Rs.)		0.020	11.072	23.618	25.121	25.872	62.076	165.035	168.455	171.967	175.633	180.445	226.682	237.621	243.615	249.692	256.037	262.630	269.550	276.647
Total (in Million US$) (US$=Rs.45.24)		0.00	0.24	0.52	0.56	0.57	1.37	3.65	3.72	3.80	3.88	3.99	5.01	5.25	5.38	5.52	5.66	5.81	5.96	6.12

Table 93.5 Operation and Maintenance Costs for Sewerage Scheme

Item		Amount (Rs. In Million)																		
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Electricity	S.T.P.	0.000	0.000	0.000	0.000	0.000	0.000	7.524	8.746	9.317	10.516	11.557	12.449	16.414	18.264	20.354	24.389	26.933	30.862	33.452
	Others	0.000	0.000	0.000	0.000	0.000	0.000	0.393	0.434	0.474	0.759	0.863	0.967	1.159	1.912	2.611	3.269	3.913	4.557	5.201
	Sub Total	0.000	0.000	0.000	0.000	0.000	0.000	7.917	9.179	9.792	11.275	12.420	13.416	17.573	20.177	22.965	27.658	30.846	35.419	38.653
Chemical		0.000	0.000	0.000	0.000	0.000	0.000	1.859	2.160	2.301	2.597	2.855	3.075	4.054	4.511	5.027	6.024	6.653	7.623	8.263
Personnel Expenses	S.T.P.	0.000	0.000	0.000	0.000	0.000	0.000	1.929	2.242	2.388	2.696	2.963	3.191	4.208	4.682	5.218	6.252	6.904	7.911	8.575
	Others	0.000	0.000	0.000	0.000	0.000	0.000	0.700	0.700	0.700	1.400	1.400	1.400	2.450	3.500	4.200	4.550	4.550	4.550	4.550
	Sub Total	0.000	0.000	0.000	0.000	0.000	0.000	2.629	2.942	3.088	4.096	4.363	4.591	6.658	8.182	9.418	10.802	11.454	12.461	13.125
Maintenance		0.000	0.000	0.000	0.000	0.000	0.000	1.861	2.142	2.277	2.695	2.946	3.162	4.243	4.931	5.612	6.673	7.343	8.325	9.006
Sewer Cleaning		0.000	0.000	0.000	0.000	0.000	0.000	1.031	1.207	1.288	1.649	1.893	2.136	2.543	2.860	3.203	3.798	4.220	4.653	5.079
Administration		0.000	0.000	0.000	0.000	0.000	0.000	0.459	0.529	0.562	0.669	0.734	0.791	1.052	1.220	1.387	1.649	1.815	2.054	2.224
Total		0.000	0.000	0.000	0.000	0.000	0.000	15.755	18.160	19.310	22.981	25.210	27.172	36.123	41.880	47.612	56.603	62.332	70.536	76.350
Total (in Million US$) (US$=Rs.45.24)		0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.40	0.43	0.51	0.56	0.60	0.80	0.93	1.05	1.25	1.38	1.56	1.69

CHAPTER 10

ECONOMIC AND FINANCIAL EVALUATION

CHAPTER 10 ECONOMIC AND FINANCIAL EVALUATION

10.1 Methodology of Economic and Financial Evaluation

10.1.1 Methodology of Economic Evaluation

(1) Indicators of Economic Evaluation

The economic and financial viability of a capital investment project is analyzed on the basis of discounted cash flow method that is essentially aiming to clarify whether the anticipated net cash flows (cash inflows or project benefits less cash outflows or project costs) from the project are reasonably attractive for the investor to risk his funds. In terms of economic analysis, the discount rate is theoretically the opportunity cost of the capital of the country. In order to judge whether the project is economically viable or not, three indicators are used. These are the Economic Internal Rate of Return (EIRR), Net Present Value (NPV), and Benefit Cost Ratio (B/C). Followings are the general explanation of the three indicators.

1) Net present value (NPV)

Net Present Value (NPV) is the total of net cash flows of the project changed in the present time for the whole project period. Cash inflow and outflow of the project of each year are transferred to the present value by using the discount rate. For the NPV, the basic decision criterion is that project is acceptable if the NPV of the net cash flows equals or exceeds zero. In such a case, project shall originate the positive value to the national economy after subtracting the economic cost of the project. In order to calculate this indicator, one must estimate the discount rate, the economic life, and the amount of economic benefit and economic cost in each year through the evaluation period.

2) Benefit cost ratio (B/C)

The Benefit Cost ratio (B/C) expresses the comparative size of the present value of the economic benefit and economic cost, calculated through dividing the present value of benefit by the present value of cost. B/C calculation requires discount rate, project life, economic benefit and economic cost in monetary term. The project shall originate the positive NPV, if the present value of the benefit is more than the present value of cost. Therefore, if the B/C ratio is more than 1, the project is viable in economic term.

3) Economic internal rate of return (EIRR)

The economic internal rate of return (EIRR) computation finds the rate of return that equates the present value of the benefit and present value of cost. If the actual discount rate, or the

opportunity cost of capital of the country, is less than EIRR, the present value of the benefit must be more than the present value of the cost, since costs are usually originated in the earlier stage of the project life and benefit shall be originated later. Therefore when the actual discount rate is less than EIRR, the project is said to be economically viable.

EIRR is set as the most important indicator of the three indicators, NPV, B/C, EIRR, to judge the economic viability.

(2) Assumptions for Economic Evaluation

Regarding the economic evaluation of the master plan, followings are considered as the major conditions and assumptions for this study.

(a)	Base year	: Year 2007 (Start of the project)
(b)	Project life	: 2013 – 2042 (30 years from start of the services)
(c)	Evaluation period	: 2007 – 2042
(d)	Price level	: Year 2007
(e)	Exchange rate	: 45.24 Indian Rupees per US$1.00 and 116.35 Japanese Yen per US$1.00 at December 19, 2005
(f)	Opportunity cost of capital	: 12 % per annum (set up by ADB)

(3) Conversion from Financial Value to Economic Value

The purpose of the Economic Evaluation is to judge whether to implement the project or not in view of the priorities of many projects for the national economy. At first, project cost and benefit of the project are identified and quantified in monetary terms all through the evaluation period. Total cost of the M/P project was described in Chapter 9 Preliminary Cost Estimates and Implementation Schedule. The total cost in Chapter 9 is enumerated in terms of market price, or in other words, 'financial value'. For the purpose of economic evaluation, this financial value must be converted into economic value, since economic evaluation is conducted to see the relationship between benefit and cost from the view point of national economy. On the other hands, financial evaluation is conducted to see the feasibility of the project from the view point of implementation agency, the PHE in this study.

Following points were considered, in order to convert the financial cost into economic cost.

- Exclusion of transfer payment: Tax, interest, subsidy are considered as the transfer payment from/to the government, and not as the true consumption of the resources for the project.
- Adjustment of the exchange rate distortion: Avoid the price distortion of the foreign

exchange rate of the country, which are originated from the import tax, export duty, export subsidy, etc. In this analysis, domestic price level is applied to the whole items of cost and the cost is expressed in local currency (Indian Rupee). Prices of imported goods/materials must be adjusted to avoid the exchange rate distortion through multiplying the Shadow Exchange Rate, Rs.49.90/US$, in the Table 101.1. Detailed calculation method is included in the Volume IV Appendix M101 Methodology of Economic and Financial Evaluation.

Table 101.1 Calculation of Shadow Exchange Rate

Item	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average
Shadow Exchange Factor	1.158	1.168	1.143	1.130	1.131	1.111	1.091	1.083	1.077	1.066	1.103

Rupee per US Dollar: 45.24
Japanese Yen per US Dollar: 116.35
Source: International Monetary Fund, at the rate of December 19, 2005

Shadow Exchange Rate (SER) = Shadow Exchange Factor x Official Exchange Rate
SER = 1.103 x 45.240 = **49.900**

- Consideration of opportunity cost: Costs of labor and land are calculated by opportunity cost, not by market price. In this analysis, opportunity cost of unskilled labor is assumed to be 70% (= Shadow Wage Rate) of market price, and 100% of market price for skilled labor. Regarding the land value, percentage of land acquisition cost in water supply master plan is less than 1% of the total investment costs, therefore, market price is recognized as economic value in this analysis.

(4) Limitation of Economic Evaluation

Economic evaluation is conducted based on the many preconditions and assumptions for the analysis. If there are some changes for these preconditions and assumptions, the results of the EIRR, NPV, and B/C may also be changed. For example, unexpected price hike of electricity will make bad influence on the result of economic analysis. Slow down of the economic growth will lead to the decrease of industrial water demand and will cause the deterioration of EIRR through the reduction of economic benefit of industrial water supply. Economic benefits of the projects will be reduced by the cost reduction and technical improvement of the alternative water supply or individual sanitation facilities. Change of exchange rate will also influence on the economic evaluation results.

On the other hands, calculation of EIRR, NPV, and B/C ratio includes the tangible economic benefit only. If it is possible to calculate the intangible economic benefits, the result of economic evaluation would be much better.

The figure of EIRR is changeable depending on the changes of the circumstances of the project

implementation. Viable number of EIRR may become not viable in case of remarkable change of the preconditions and assumptions. It is important to observe the preconditions and assumptions of economic evaluation and recalculate it when the preconditions or assumptions are changed.

10.1.2 Methodology for Financial Evaluation

(1) Methodology for Financial Evaluation

Financial evaluation is conducted to check the feasibility of the project from the view point of implementation agency, PHE. All of the costs in the market price, which are accrued to the project, have to be included in the total cost of financial evaluation. On the other hands, the benefit of the project for financial evaluation must be the actual revenues into the PHE originated from the expansion of the water supply or sanitation by the master plan project.

In order to judge whether the project is financially feasible or not, three indicators are used almost same as the economic evaluation. These are the Financial Internal Rate of Return (FIRR), Net Present Value (NPV), and Benefit Cost Ratio (B/C), general explanations are referred to "10.1.1 Methodology of Economic Evaluation". The major difference between those in economic evaluation and financial evaluation is the discount rate for NPV and B/C. Discount rate for economic evaluation is the opportunity cost of capital, on the other hands, that for financial evaluation is the general interest rate of the loan for the project.

Among the above three, FIRR is set as the most important indicator due mainly to needlessness of establishing discount rate and easiness in comparing with interest rates and rate of return with which every decision maker is familiar to. In the evaluation of the master plan project, however, the three indicators are computed in order to analyze the financial feasibility from the wider scope.

(2) Assumptions for Financial Evaluation

Regarding the financial evaluation of the master plan, followings are considered as the major conditions and assumptions for this study. In the financial analysis, 3.1% discount rate is applied for the computation of NPV and B/C, which is obtained from Interest rate of official creditors of '9. Average Terms of New Commitments' in the data book of "Global Development Finance, Mobilizing Finance and Managing Vulnerability" published by the World Bank in 2005.

(a)	Base year	: Year 2007 (Start of the project)
(b)	Project life	: 2013 – 2042 (30 years from start of the services)
(c)	Evaluation period	: 2007 – 2042
(d)	Price level	: Year 2007
(e)	Exchange rate	: 45.24 Indian Rupees per US$1.00 and 116.35 Japanese Yen per US$1.00 at December 19, 2006
(f)	Discount rate	: 3.1 % per annum*1

Note: *1; Discount rate is set by 3.1% average of interest rate of India from Official creditors during 1999 – 2003

(3) Limitation of Financial Evaluation

Financial evaluation is conducted based on the many preconditions and assumptions for the analysis. If there are some changes for these preconditions and assumptions, the results of FIRR, NPV, and B/C may also be changed. For example, unexpected price hike of electricity will make bad influence on the number of FIRR, NPV, and B/C. In case that the NRW reduction is not improved as planned, FIRR, NPV, and B/C will certainly be deteriorated. Less the number of new customers for public sewer than expected, smaller the number of FIRR. Slow down of the economic growth will lead to the decrease of industrial water demand and will cause the deterioration of FIRR through the reduction of non-domestic tariff revenue. Change of exchange rate will also influence on the financial evaluation results.

The figure of EIRR is changeable depending on the changes of the circumstances of the project implementation. Viable number of FIRR may become not viable in case of remarkable change of the preconditions and assumptions. It is important to observe the preconditions and assumptions of financial evaluation and recalculate it when the preconditions or assumptions are changed.

10.2 Economic and Financial Evaluation of Master Plan for Water Supply

10.2.1 Economic Evaluation of Master Plan for Water Supply

(1) Economic Benefits of Proposed Projects

Water supply project has the many quantifiable and unquantifiable economic benefits to India and also to the State of Goa. The following table describes these benefits of the water supply master plan.

The benefits of the project are divided into two categories, quantifiable/tangible benefits and unquantifiable/intangible benefits. Economic evaluation includes all the quantifiable benefits

as economic benefits of the master plan. In this study, 2-1, 2-2, 2-3, 3-1, and 3-2 of the Table 102.1 are selected as quantifiable benefits.

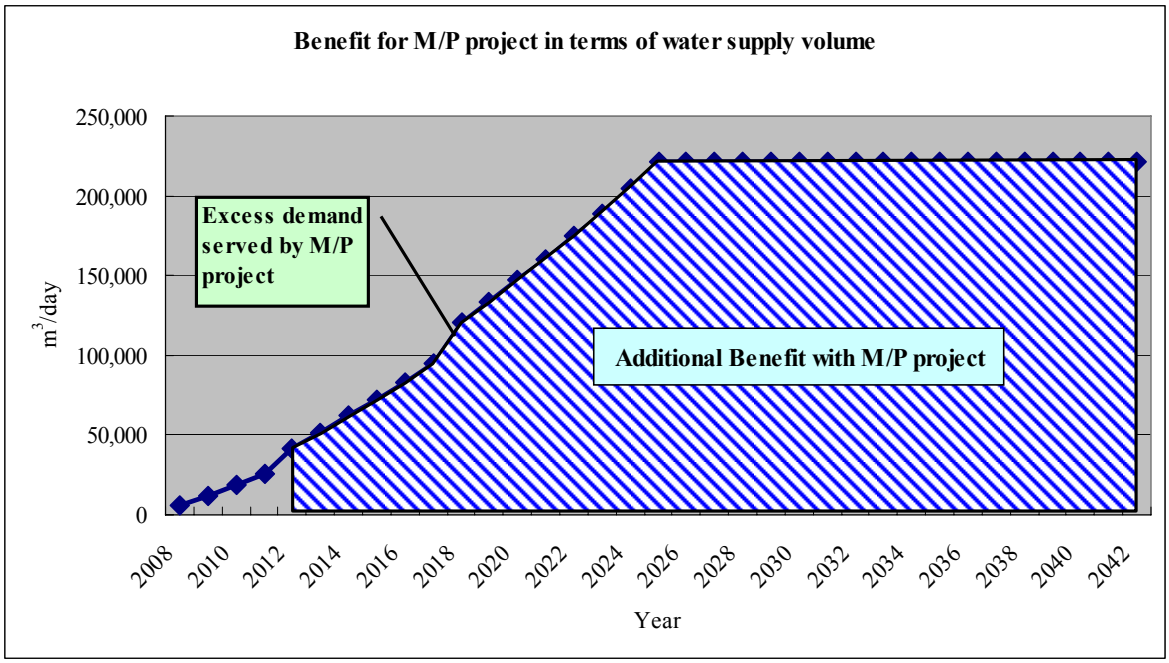
Table 102.1 Economic Benefits of the water supply master plan

1	Improvement of amenity	1-1	Improvement of quality of life of domestic customers	Intangible
2	Cost reduction effects	2-1	Saving of alternative water procurement cost other than public water supply	Tangible
		2-2	Saving of incurred costs by public water supply stoppages	Tangible
		2-3	Saving cost for purchasing bottled water	Tangible
3	Improvement of public hygiene	3-1	Saving of medical expenditures by decrease of waterborne diseases	Tangible
		3-2	Reduction of absence from work caused by waterborne diseases	Tangible
4	Economy stimulation effects	4-1	Stimulation of regional economy by project investment	Intangible
		4-2	Stimulation of tourism	Intangible
		4-3	Increase of land value	Intangible
5	Environment preservation effects	5-1	Efficient use of water resource (by NRW reduction)	Intangible
		5-2	Preservation of underground water source (by constraining increase of wells)	Intangible

Economic benefits of the master plan project are calculated by subtracting benefit without project case from the total benefit with the project case. Figure 102.1 describes these additional benefits in terms of water supply volume, which calculated by summing up the additional water supply volume by the project for all of the 7 water supply schemes. For each of the water supply scheme, additional water supply volume is calculated by subtracting water supply volume without project from the total water supply volume with the project, since some of the schemes will face water shortage soon and some of the schemes have enough supply capacity for a long period. Blue shaded area of the Figure 102.1 delineates the additional benefit of master plan in terms of water supply volume, since water supply capacity expansion in the master plan always covers the excess water demand of blue dot line other than before the year 2012. The line is constant after the year 2025, because the target year of facility design of the project is set at 2025. Excess demand curve in Figure 102.1 has two times remarkable increase in the year 2012 and 2018. First large increase is caused by the abolishment of old Assonora water treatment plant (WTP) whose demand shall be covered by newly expanded

WTP. Second large increase in 2018 is caused by increase of coverage area and water demand of Salaulim scheme. This additional benefit in terms of water supply volume is utilized for calculating economic benefit and financial benefit of the master plan project after adjustment from day maximum to day average for domestic water demand.

PWD decided to implement the Ganjem and Maisal emergency water supply scheme, which are planed to have 25 MLD and 10 MLD water supply capacities respectively in the coverage area of Opa water supply scheme. Investment expenditures for these capacity expansions are included in the cost component of the M/P project. Therefore, these expanded capacities (35 MLD) are also considered as additional benefits with the project case and are included in the financial and economic benefits from the start of services in 2009, though they are not the part of excess demand curve in Figure 102.1.



Source: calculation based on the water demand projection of JICA Study Team

Figure 102.1 Benefit of Master Plan for Water Supply

1) Estimation of economic benefit by cost reduction effects

(a) Saving of alternative water procurement cost other than public water supply: Domestic user

Assumed without the Project case, public water supply system will not be able to cover the increasing water demand in the future. Therefore, increased amount of water demand shall be satisfied with alternative water supply systems as follows;

a. Open well
b. Tube well with hand pump
c. Tube well with submersible pump
d. Private Water Tanker
e. Spring, River, Pond

The percentage of the usage by household of the above 5 water sources is estimated as follows, based on the information of "Census 2001."

Table 102.2 Composition of Alternative water acquisition methods

Type of Water Supply	% of number of household for each alternative water acquisition methods
Hand Pump	1.9%
Tube well	1.6%
Open well	84.2%
Pond, lake	1.9%
River, Canal	2.3%
Spring	6.5%
Any other	1.6%
TOTAL	100.0%

Source: Census 2001

Annualized construction cost by applying Capital Recovery Factor, plus operation and maintenance costs of each alternative water supply system is calculated and described in Table 102.3 for Hand pump, Tube well, and Open well, respectively. Detailed calculation method is attached in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

Table 102.3 Annual cost of construction, O&M of Alternative Water Supply System

Item	Unit	Domestic			Non-Domestic
		Open well	Hand pump	Tube well*1	Tube well*1
1 Equipment cost					
1) Excavation	Rs./L.S.	12,000	55,000	55,000	55,000
2) Pumping equipment	Rs./L.S.	-	17,000	20,400	34,500
3) Pipes in yard	Rs./L.S.	-	-	-	-
4) Miscellaneous	Rs./L.S.	8,000	134,800	145,350	152,100
Total	Rs./L.S.	20,000	206,800	220,750	241,600
2 Annualized Equipment Cost	Rs./year	2,201	25,970	27,722	30,340
3 Operation & Maintenance cost					
1) Electricity	Rs./year	-	-	225	3,150
2) Maintenance	Rs./year	500	3,125	5,900	8,338
3) Miscellaneous	Rs./year	0	0	0	0
Total	Rs./year	500	3,125	6,125	11,488
4 Household labour for Fetching water	Rs./year	-	-	-	-
4 Total cost for water procurement (2. + 3.)	Rs./year	2,701	29,095	33,847	41,828

Note: *1: 'Tube well' means 'Tube well with submersible pump'.
Detailed cost breakdown and specification of open well, tube well with hand pump, and tube well with submersible pump are shown in the appendix.

Combining the data regarding numbers of facilities per household, which is estimated in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply, and the annual cost of construction, operation, and maintenance of each alternative water supply system, annual cost for each facilities per household are calculated as shown in Table 102.4.

Table 102.4 Annual cost for water acquisition per household

Type of Water Supply	Number of Facilities per household	Annual cost for Construction, O&M	Annual cost for water acquisition / household
Hand Pump	0.53	29,095	**15,420**
Tube well	0.53	33,847	**17,939**
Open well	0.57	2,701	**1,540**

Based on the data of average hours of fetching water and of minimum wage in Goa, the opportunity (economic) cost for fetching water is calculated at Rs.3,772/household per year, as is explained in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply. As a result, unit cost for alternative water acquisition methods other than public water supply shall be listed in the Table 102.5.

Table 102.5 Unit cost for each water acquisition methods

Type of Water Supply	Cost for water acquisition (Rs./household per year)	Average size of household in Goa (persons/household)	Average water consumption (liter/capita per day)*1	Unit cost for water acquisition (Rs./m^3)
Hand Pump	15,420	4.580	116	79.5
Tube well	17,939	4.580	116	92.5
Open well	1,540	4.580	116	7.9
Pond, lake	3,772	4.580	116	19.4
River, Canal	3,772	4.580	116	19.4
Spring	3,772	4.580	116	19.4
Any other *2	3,772	4.580	116	19.4

Note: *1; Domestic per capita water consumption is the average in Goa calculated by JICA Study Team.
*2; 'Any other' is considered as fetching water from other sources

In other words, alternative water acquisition costs shall be saved by incremental water supply by M/P. The amount of saved cost is one of the economic benefits of the M/P. Economic benefit of each year shall be calculated by multiplying the 'Unit Cost for water acquisition' in Table 102.6 to each percentage of additional water supply volume by M/P project.

Table 102.6 Composition and Unit cost of alternative water acquisition methods

Type of Water Supply	Unit cost for water acquisition (Rs./m^3)	% of each alternative water acquisition methods	
Hand Pump	**79.5**	1.9%	
Tube well	**92.5**	1.6%	
Open well	**7.9**	84.2%	
Pond, lake	**19.4**	1.9%	12.3%
River, Canal	**19.4**	2.3%	
Spring	**19.4**	6.5%	
Any other	**19.4**	1.6%	

(b) Saving of alternative water procurement cost other than public water supply: Non Domestic

Regarding the hotels, the percentage of usage for alternative water supply system was obtained from the “Public Awareness Survey”. On the other hand, regarding industries, there are a lot of varieties of existing water supply system from tube well to rain collection system, or small water treatment plant with dam. For simplification, non domestic users other than hotels are assumed to utilize Tube well with submersible pump, in order to satisfy their scarcity of water,

without the Project case in our analysis.

a) Hotels

The percentage of usage of alternative water acquisition methods by hotels is as shown in Table 102.7.

Table 102.7 Composition of alternative water acquisition methods

Type of Water Supply	% of volume of water from each alternative water acquisition methods
Own well	56.9%
Private Water Vendor	43.1%

Note: % of volume of water from each alternative water acquisition methods is calculated as follows;
e.x.; Own well 29% / 51% x 100% = 56.9%
Source: "Public Awareness Survey" by JICA Study Team

According to "Tourist Statistics 2004", total number of hotels in Goa State is 2,027. Total water demand of the Tourism is estimated as 6,686 m^3/day. Therefore, the average water demand for the Tourism per hotel shall be 1,203.9 m^3/year. For the necessity of continuous supply and safety of water quality, 'Own well' is assumed as tube well with submersible pump. Annual cost of construction by applying the Capital Recovery Factor, and operation and maintenance of tube well with submersible pump is calculated at Rs.41,828 as shown in Table 102.8. Detailed calculation is attached in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply. Annual unit cost for alternative water supply system for tourism is described in Table 102.8.

Table 102.8 Unit cost of alternative water acquisition methods

Type of Water Supply	Annual cost for construction, O&M	Annual water demand of Tourism per hotel (m^3/year per hotel)	Unit cost for water acquisition (Rs./m^3)
Tube well with Submersible Pump	41,828	1,203.9	**34.7**
Private Water Vendor			**50.0**

Alternative water acquisition costs shall be saved by incremental supply of M/P project. The amount of saved costs is one of the economic benefits of the project. Economic benefit of each year shall be calculated by multiplying the 'Unit cost for water acquisition' to each percentage of additional water supply volume by the project.

Table 102.9 Composition and Unit cost of alternative water acquisition methods

Type of Water Supply	Unit cost for water acquisition (Rs./m^3)	% of volume of water from each alternative water acquisition methods
Own well	**34.7**	56.9%
Private Water Vendor	**50.0**	43.1%

b) Other Non Domestic

The number of connections for Non-Domestic without Tourism is calculated at 11,162. Total water demand of Non-Domestic without Tourism in 2005 is 34,100m^3/day. Therefore, the average water demand for Non-Domestic without Tourism shall be 1,115.1m^3/year. As was mentioned previously, it is assumed that they shall utilize tube well with submersible pump as alternative water supply system for the necessity of continuous supply and safety of water quality. Annual unit cost for alternative water supply system for Non-Domestic without Tourism is described as follows;

Table 102.10 Unit cost of alternative water acquisition methods

Type of Water Supply	Annual cost for construction, O&M	Annual water demand of Non-Domestic without Tourism (m^3/year per user)	Unit cost for water acquisition (Rs./m^3)
Tube well with Submersible Pump	41,828	1,115.1	**37.5**

(c) Saving of incurred costs by public water supply stoppages

According to the "Public Awareness Survey" conducted by JICA Study Team, 69% of the household in the total number of house connection users have the ground water tank and pump facilities. 79% of the household in the total number of house connection users have the water tank on upper floors. The Project is planned to secure 24 hours water supply to the users. After the completion of the project, existing water tank users do not have to invest for the renovation and construction of water tank. It is the economic benefit by solving water supply stoppage.

Table 102.11 Usage of water storage facilities by domestic users

Facility	% of users in the total number of customers
Ground Water Tank & Pump	69%
Overhead Tank	79%

Source: Public Awareness Survey

By applying Capital Recovery Factor, annualized cost for water storage facilities (construction and O&M cost) per household is calculated as shown in Table 102.12. Detailed calculation is included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

Table 102.12 Annual cost for water storage facilities

Type of Water Supply	Annual cost for facilities (Rs./year per household)
Ground Water Tank & Pump	1,231
Overhead Tank	382

Percentages of users in the total number of customers, which are 69% for ground water tank & pump, 79% for overhead tank shows that some of the customers are using both of the tanks. It is natural that ground water tank user has to pump up the water to the top of the roof and accumulating it in overhead tank.

Number of connections for domestic users is estimated by population projection by JICA Study Team. By utilizing the data, economic benefit from solving water supply stoppage shall be estimated until the year 2025. Digest of the estimation is shown in Table 102.13. Detailed information is included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

Table 102.13 Total economic benefit of saving water tank cost

Year	Number of served household	Total Water Tank Cost (Rs./year)			% of reduction of tank users	Total Economic Benefit of Saving Water Tanks (Rs./year)
		Ground Water Tank & Pump	Overhead Tank	TOTAL		
2012	299,306	254,227,523	90,324,565	344,552,088	5%	17,227,604
2013	306,662	260,475,636	92,544,458	353,020,094	10%	35,302,009
2014	314,130	266,818,881	94,798,151	361,617,032	15%	54,242,555
2015	321,709	273,256,408	97,085,342	370,341,750	20%	74,068,350
2020	361,121	306,732,566	108,979,095	415,711,661	45%	187,070,247
2025	403,658	342,863,069	121,815,911	464,678,980	50%	232,339,490

Source: JICA Study Team

'Total Water Tank Cost' in Table 102.13 is the sum of the annualized construction and O&M costs for all of the water tank users. Therefore, total amount will be counted as economic benefit every year, if all the customers stop using the water tank forever. For the calculation of

this project, it is assumed that 5% of the total households shall stop using the facility additionally for 10 years from 2012 to 2021. For modesty on economic benefit estimation, it is assumed that 50% of the users shall continue using the water tank, therefore, 50% of the benefit is estimated for economic evaluation after 2021.

(d) Saving cost for purchasing bottled water

According to the Public Awareness Survey by JICA Study Team, 20% of total households having individual house connection answers that they buy the bottled water. With the project case, the number of bottled water bought by household shall be decreased because of the improvement of the water quality of public water supply. If it is assumed that only the direct drinking water is covered by bottled water, total cost for the purchasing bottled water in the year 2005 is calculated and shown in Table 102.14.

Table 102.14 Total cost for purchasing bottled water

Total number of household served by PWD (Year 2005)	% of household buying bottled water	Average consumption per household (bottle/day)	Unit price of bottled water (Rs./bottle)	Total cost for bottled water (Rs./year)
250,341	20%	4	12	877,194,864

With the project case, it is assumed that 50% of the above cost for buying bottled water shall be decreased by water quality improvement. Beneficiaries by saving the bottled water cost also include future population. The total economic benefit by saving bottled water cost is described partially in the Table 102.15. The benefits all through the evaluation period are included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

Table 102.15 Total economic benefit with the project by saving cost for bottled water

Year	Total served population	Number of household served by PWD	Total cost for bottled water (Rs.x1,000)	Total saved amount with the project (Rs.x1,000)
2012	1,370,822	299,306	1,048,768	524,384
2015	1,473,426	321,709	1,127,268	563,634
2020	1,653,936	361,121	1,265,368	632,684
2025	1,848,753	403,658	1,414,418	707,209

2) Estimation of economic benefit by improvement of public hygiene

(a) Saving of medical expenditures by decrease of waterborne diseases

With the project case, public hygiene condition shall be improved through the increase of public water supply coverage ratio with better quality. It is one of the major economic benefits for the Goa State to save the medical expenditure by decrease of waterborne disease. The precise data of existing in-patients and out-patients in Goa is not available, therefore, it is estimated based on the information from Department of Health and the hospitals in Panaji. Table 102.16 shows the estimation of number and percentage of waterborne diseases, including Diarrhea, Typhoid, Hepatitis, and Malaria in the year 2005.

Table 102.16 Estimation of total number of patients in Goa (2005)

Unit		Diarrhea	Typhoid	Hepatitis	Malaria
Out-patients	(patients/year)	53,518	182	1,456	92,604
	% in total population	3.74%	0.01%	0.10%	6.48%
In-patients	(patients/year)	15,031	1,638	1,456	39,684
	% in total population	1.05%	0.11%	0.10%	2.78%

Table 102.17 also includes the standard medical costs and average days for treatment for each waterborne disease which is estimated by the information from the hospitals.

Table 102.17 Average cost and days for medical treatment (2005)

	Unit	Diarrhea	Typhoid	Hepatitis	Malaria
Ave. cost of out-patient treatment	Rs./case	200	200	200	200
Ave. cost of in-patient treatment	Rs./case	2000	5000	2000	2000
% of subsidy for medical cost	%	0	0	0	0
Ave. days of in-patient treatment *1	Days/case	3.2	8.3	15	4.5
Ave. cost of transportation to hospital	Rs./return	30	30	30	30

Note; *1: Ave. days of out-patient treatment is considered half of those of in-patient treatment, based on the information from hospitals

With the project case, it is assumed that the percentage of patients in total population for each disease will reduce by 30%. Total economic benefit of saving of medical expenditures by decrease of waterborne diseases is included in Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply through the evaluation period.

(b) Reduction of absence from work caused by waterborne diseases

Water supply improvement with the project also contributes to increase the production capability of the people through reduction of the patients of waterborne diseases. In this

Analysis, it is assumed that 30% decrease of the percentage of waterborne diseases in total population shall be realized by the implementation of water supply master plan. Economic benefit of each year shall be included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply for each waterborne disease from the start of water supply by M/P project until the year 2025.

Total amount of economic benefits during the evaluation period is shown in the Table 102.18.

Table 102.18 Economic Benefit Stream of Proposed Water Supply Project

Year		Incremental supply above existing supply capacity				Benefit (Rs.1,000)							
						Alternative water supply				Saving water tank cost	Saving bottled water cost	Saving from reduction of water borne disease	Grand Total
		Domestic (m^3/day)	Tourism (m^3/day)	Non-domestic except Tourism (m^3/day)	Total (m^3/day)	Domestic	Tourism	Non-domestic except Tourism	Total				
-5	2007	0	0	0	0	0	0	0	0	0	0	0	0
-4	2008	0	0	0	0	0	0	0	0	0	0	0	0
-3	2009	24,283	2,155	3,463	29,901	106,612	32,481	47,400	186,493	0	0	0	186,493
-2	2010	24,160	2,171	3,595	29,926	106,072	32,722	49,207	188,001	0	0	0	188,001
-1	2011	24,023	2,191	3,741	29,955	105,471	33,024	51,205	189,699	0	0	0	189,699
0	2012	50,521	3,413	14,768	68,702	221,808	51,442	202,137	475,387	17,228	524,384	63,116	1,080,115
1	2013	55,926	3,712	17,618	77,256	245,538	55,949	241,146	542,633	35,302	537,272	63,996	1,179,203
2	2014	61,435	4,024	20,681	86,140	269,724	60,651	283,071	613,447	54,243	550,356	64,877	1,282,923
3	2015	67,041	4,349	23,967	95,357	294,337	65,550	328,048	687,935	74,068	563,634	65,797	1,391,434
4	2016	72,720	4,691	27,494	104,905	319,270	70,705	376,324	766,299	94,781	577,000	66,718	1,504,798
5	2017	78,509	5,046	31,275	114,830	344,686	76,055	428,077	848,818	116,415	590,584	67,638	1,623,455
6	2018	91,559	5,817	40,835	138,211	401,981	87,676	558,929	1,048,586	138,992	604,389	68,599	1,860,566
7	2019	97,749	6,216	45,486	149,451	429,157	93,690	622,590	1,145,437	162,536	618,419	69,599	1,995,991
8	2020	104,058	6,633	50,463	161,154	456,857	99,975	690,712	1,247,544	187,070	632,684	70,520	2,137,818
9	2021	110,346	7,060	55,776	173,182	484,463	106,411	763,434	1,354,309	212,591	647,098	71,520	2,285,518
10	2022	116,755	7,504	61,457	185,716	512,601	113,103	841,193	1,466,898	217,405	661,752	72,521	2,418,576
11	2023	123,287	7,966	67,533	198,786	541,280	120,067	924,358	1,585,704	222,300	676,651	73,561	2,558,216
12	2024	130,296	8,449	74,047	212,792	572,052	127,347	1,013,518	1,712,917	227,277	691,800	74,602	2,706,596
13	2025	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
14	2026	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
15	2027	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
16	2028	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
17	2029	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
18	2030	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
19	2031	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
20	2032	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
21	2033	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
22	2034	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
23	2035	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
24	2036	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
25	2037	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
26	2038	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
27	2039	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
28	2040	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
29	2041	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644
30	2042	137,492	8,952	81,014	227,458	603,645	134,928	1,108,879	1,847,453	232,339	707,209	75,643	2,862,644

(2) Economic Costs of Proposed Projects

Construction cost includes all of the expansion projects to cover the excess water demand over the existing supply capacity by the year 2025, in addition to the rehabilitation works for the existing water supply facilities. Major parts of the financial cost and economic cost are listed in the Table 102.19. Methodology for conversion from financial cost to economic cost is mentioned in Section 10.1 Methodology of Economic and Financial Evaluation. Annual

disbursement is described in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

Total economic cost of the project is Rs. 15,524.19 million. Replacement costs of expanded facilities are also considered as one of the necessary costs, but are not included in the Table 102.19. They are included in the Cost Benefit Stream for the calculation of EIRR (refer to the Table 102.20). Residual values of replaced equipments are not deducted from the cost in the last evaluated year, since the values are negligible.

Table 102.19 Economic and Financial Costs of Proposed Water Supply Project

(Unit: In million)

Item	Financial Cost		Economic Cost	
	Rs.	US$	Rs.	US$
1. Construction cost	13,155.33	290.79	12,295.51	271.78
2. Engineering cost	1,366.09	30.20	1,352.44	29.89
3. Administration cost	749.89	16.58	558.11	12.34
4. Land acquisition cost	26.28	0.58	26.28	0.58
5. Physical contingency	1,502.48	33.21	1,364.81	30.17
TOTAL	16,800.07	371.36	15,597.15	344.76

Note; Price contingency is excluded for financial analysis, since the inflation is not considered in financial benefit, either.
Exchange rate between Rupee per US Dollar is Rs. 45.24/US$.

(3) Economic Evaluation

Economic cost and benefit stream during evaluation period is shown in the Table 102.20. As a result of the economic analysis of the water supply master plan, EIRR is calculated as 13.2%, NPV as Rs.730 million, and B/C as 1.09. Comparing the opportunity cost of capital, 12%, EIRR is over the figure, therefore, water supply master plan is said to be economically viable. Also under the discounted rate of 12%, the project obtained the positive Net Present Value of Rs.730 million, and present value of Benefit is 1.09 times larger than the present value of Cost.

Table 102.20 Economic Cost and Benefit Stream of Proposed Water Supply Project

(Unit: Rs. in million)

Year		Cost				Benefit	Balance
		Const-ruction	O&M	Replace-ment	Total	Total	
-5	2007	869.34	0.02		869.36	0.00	-869.36
-4	2008	835.47	8.76		844.23	0.00	-844.23
-3	2009	639.02	18.98		658.00	186.49	-471.51
-2	2010	1,626.65	20.48		1,647.13	188.00	-1,459.13
-1	2011	3,133.16	21.22		3,154.38	189.70	-2,964.68
0	2012	1,594.30	55.38		1,649.68	1,080.13	-569.55
1	2013	413.84	147.25		561.09	1,179.20	618.11
2	2014	405.17	150.65		555.82	1,282.92	727.10
3	2015	421.48	154.13		575.61	1,391.43	815.82
4	2016	746.29	157.77		904.06	1,504.80	600.74
5	2017	1,190.46	162.56		1,353.02	1,623.46	270.44
6	2018	809.92	206.79		1,016.71	1,860.57	843.86
7	2019	527.47	217.65		745.12	1,995.99	1,250.87
8	2020	470.93	223.60		694.53	2,137.82	1,443.29
9	2021	417.74	229.63		647.37	2,285.52	1,638.15
10	2022	421.69	235.93		657.62	2,418.58	1,760.96
11	2023	355.75	242.48		598.23	2,558.22	1,959.99
12	2024	357.65	249.35		607.00	2,706.60	2,099.60
13	2025	360.82	256.39		617.21	2,862.64	2,245.43
14	2026		256.39	134.89	391.28	2,862.64	2,471.36
15	2027		256.39	319.36	575.75	2,862.64	2,286.89
16	2028		256.39	169.44	425.83	2,862.64	2,436.81
17	2029		256.39		256.39	2,862.64	2,606.25
18	2030		256.39	8.97	265.36	2,862.64	2,597.28
19	2031		256.39	90.64	347.03	2,862.64	2,515.61
20	2032		256.39	168.34	424.73	2,862.64	2,437.91
21	2033		256.39	95.63	352.02	2,862.64	2,510.62
22	2034		256.39		256.39	2,862.64	2,606.25
23	2035		256.39		256.39	2,862.64	2,606.25
24	2036		256.39		256.39	2,862.64	2,606.25
25	2037		256.39		256.39	2,862.64	2,606.25
26	2038		256.39		256.39	2,862.64	2,606.25
27	2039		256.39		256.39	2,862.64	2,606.25
28	2040		256.39		256.39	2,862.64	2,606.25
29	2041		256.39	134.89	391.28	2,862.64	2,471.36
30	2042		256.39	319.36	575.75	2,862.64	2,286.89

EIRR: 13.2% NPV: 730 million Rs. B/C: 1.09

10.2.2 Financial Evaluation of Master Plan for Water Supply

(1) Revenue from Proposed Projects

Financial revenue of the proposed project is originated from the tariff revenue from the customers for the portion of incremental water supply volume and number of customers. Tariff revenue of the customer is composed of water charge, installation charge, and meter rent charge. Regarding water charge, incremental water supply volume is divided to domestic and non-domestic to apply distinct unit prices for computerizing total water charge billed. Incremental water supply volume, shown in the Figure 102.1, is the sum of the excess water demands over the existing supply capacity for all of the seven water supply schemes that is planned to be satisfied by the master plan project. For domestic users, unit price of water charge is calculated at Rs.4.41/m^3 for the year 2007, based on the water consumption per connection and tariff table in 2006, reflecting inflation adjustment until the year 2007. For non-domestic users, unit price of water charge is calculated at Rs.27.49/m^3 for the year 2007, through the same procedure. The basic information for the calculation of unit price is included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply. Non revenue water ratio is deducted from the incremental water supply volume, and collection efficiency is also considered for calculating the water revenue. Unit prices for installation charge for each domestic and non-domestic are Rs.500/case and Rs.2,804/case, respectively. Unit prices for meter rent charge for each domestic and non-domestic are Rs.15.53/case and Rs.26.03/case, respectively. The total financial benefit and breakdown of the water supply master plan are included in the Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply for each year through the evaluation period. Table 102.21 is the digest of the total financial benefit from the master plan for water supply.

Table 102.21 Total Financial Benefit from the Master Plan for Water Supply

(Unit: Rs. In million)

Item	2012	2015	2020	2025	After 2025
Domestic					
1. Total Water Revenue	54.47	74.58	121.73	168.78	168.78
2. Total Installation Revenue	2.76	2.92	3.21	3.64	0.00
3. Total Meter Rent Revenue	4.53	7.74	13.49	19.87	19.87
TOTAL REVENUE	61.76	85.24	138.43	192.29	188.65
Non-Domestic					
1. Total Water Revenue	122.19	196.39	416.35	688.43	688.43
2. Total Installation Revenue	0.81	0.86	0.95	1.07	0.00
3. Total Meter Rent Revenue	0.40	0.68	1.19	1.75	1.75
TOTAL REVENUE	123.40	197.93	418.49	691.25	690.18
GRAND TOTAL	185.16	283.17	556.92	883.54	878.83

(2) Costs for Proposed Projects

Financial cost of the proposed projects consists of Initial investment cost, replacement cost, and operation and maintenance (O&M) cost.

Initial investment cost at the price level of 2007 is composed of construction cost, administration cost, engineering cost, physical contingency, and price contingency. Price contingency is calculated until 2025, nevertheless, not included in the financial analysis, because inflation is not considered in the financial revenue either. Construction cost covers the mainly expansion works and rehabilitation works for the existing facilities. Construction cost also includes the cost for water quality control system establishment, operation and maintenance improvement, and institutional/organizational improvement. Replacement cost covers replacement of machinery and equipments for expanded facilities of the proposed project. O&M cost consists of electricity cost, chemical cost, personnel cost, maintenance cost and administration cost. Each item of O&M cost covers only for the expanded facilities, since financial revenue is also limited to incremental water supply only. Estimation of the costs for proposed water supply master plan is described in Volume IV Appendix M102 Economic and Financial Evaluation of Master Plan for Water Supply.

(3) Financial Evaluation

Cost and benefit stream of proposed water supply project during the evaluation period is shown in the Table 102.22. In case without unit price increase of water supply in constant price, financial internal rate of return (FIRR) is not calculated as benefit is smaller than cost. NPV is minus 7,056 million Rupees. Benefit cost ratio is 0.610. As a result, proposed water supply master plan is not financially feasible.

(4) Case Study of Financial Analysis

Based on the existing unit price of water charge, proposed water supply master plan is not financially feasible. Four tariff increase patterns are set to see feasibility of proposed project under the condition that tariff increase is conducted regularly by the year 2025. Following cases are set and FIRR, NPV, and B/C are computerized for each case. It should be noted that percentage of tariff increase in each case shows real term (constant price), excluding inflation rate. Actually, inflation rate shall be added to the following tariff increase at the revision of tariff setting.

On the other hands, annual tariff increase rate for non-domestic user is always set lower than that of domestic, in order to eliminate the large unit price gap between non-domestic and

domestic.

Table 102.22 Cost and Benefit Stream of Proposed Water Supply Project

(Unit: Rs.in million)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-5	2007	935.46	0.02		935.48	0.00	0.00	0.00	-935.48
-4	2008	895.20	11.07		906.27	0.00	0.00	0.00	-906.27
-3	2009	686.27	23.62		709.89	25.35	36.56	61.91	-647.98
-2	2010	1,755.75	25.12		1,780.87	25.47	37.90	63.37	-1,717.50
-1	2011	3,377.70	25.87		3,403.57	38.51	42.51	81.02	-3,322.55
0	2012	1,722.01	62.08		1,784.09	61.76	123.40	185.16	-1,598.93
1	2013	447.00	165.04		612.04	69.27	146.06	215.33	-396.71
2	2014	437.71	168.46		606.17	77.13	170.92	248.05	-358.12
3	2015	455.19	171.97		627.16	85.24	197.93	283.17	-343.99
4	2016	800.98	175.63		976.61	93.48	226.96	320.44	-656.17
5	2017	1,274.48	180.45		1,454.93	102.11	258.76	360.87	-1,094.06
6	2018	868.95	226.68		1,095.63	119.24	335.50	454.74	-640.89
7	2019	568.15	237.62		805.77	128.60	375.13	503.73	-302.04
8	2020	507.57	243.62		751.19	138.43	418.49	556.92	-194.27
9	2021	450.56	249.69		700.25	148.38	465.22	613.60	-86.65
10	2022	454.79	256.04		710.83	158.47	515.04	673.51	-37.32
11	2023	384.15	262.63		646.78	169.09	569.49	738.58	91.80
12	2024	387.37	269.55		656.92	180.65	628.47	809.12	152.20
13	2025	390.78	276.65		667.43	192.29	691.25	883.54	216.11
14	2026		276.65	143.99	420.64	188.65	690.18	878.83	458.19
15	2027		276.65	340.91	617.56	188.65	690.18	878.83	261.27
16	2028		276.65	180.87	457.52	188.65	690.18	878.83	421.31
17	2029		276.65		276.65	188.65	690.18	878.83	602.18
18	2030		276.65	9.57	286.22	188.65	690.18	878.83	592.61
19	2031		276.65	96.76	373.41	188.65	690.18	878.83	505.42
20	2032		276.65	179.70	456.35	188.65	690.18	878.83	422.48
21	2033		276.65	102.08	378.73	188.65	690.18	878.83	500.10
22	2034		276.65		276.65	188.65	690.18	878.83	602.18
23	2035		276.65		276.65	188.65	690.18	878.83	602.18
24	2036		276.65		276.65	188.65	690.18	878.83	602.18
25	2037		276.65		276.65	188.65	690.18	878.83	602.18
26	2038		276.65		276.65	188.65	690.18	878.83	602.18
27	2039		276.65		276.65	188.65	690.18	878.83	602.18
28	2040		276.65		276.65	188.65	690.18	878.83	602.18
29	2041		276.65	143.99	420.64	188.65	690.18	878.83	458.19
30	2042		276.65	340.91	617.56	188.65	690.18	878.83	261.27

FIRR: N.A. NPV: -7,056 million Rs. B/C: 0.610

Table 102.23 Results of Financial Evaluation for 4 Cases

Case	Tariff increase per annum *1		FIRR	NPV(Million Rs.)	B/C
Case 1	Domestic	0%	N.A.	-7,056	0.610
	Non-domestic	0%			
Case 2	Domestic	3.00%	1.14%	-3,473	0.808
	Non-domestic	1.50%			
Case 3	Domestic	4.00%	2.56%	-1,045	0.942
	Non-domestic	2.50%			
Case 4	Domestic	4.50%	3.26%	331	1.018
	Non-domestic	3.00%			

Note: *1; Rate of tariff increase excludes the inflation adjustment.

When the interest rate of the borrowed money for the project implementation is lower than the FIRR, the project is financially feasible. From the above table, the project is feasible under the conditions of Case 3, if the interest rate of lender is lower than 2.56%. If PHE can realize the tariff increase in the Case 4 continuously until 2025, proposed water supply master plan is said to be feasible.

Table 102.24 Past trend of Per Capita Net State Domestic Product Increase

Per Capita Net State Domestic Product at Current Price

Year	1980-81	1990-91	1993-94	1996-97	2000-01	2001-02	2002-03
Goa (Rs.)	3,200	8,952	16,558	26,418	48,582	49,084	52,277

Source: Economic Survey 2002-03 & 2004-05

Average ratio of increase: 13.54% /year from 1980/81 to 2002/03 (22 years)

Per Capita Net State Domestic Product at Constant Price

Year	1993-94	1996-97	2000-01	2001-02	2002-03
Goa (Rs.)	16,558	20,686	26,730	27,603	28,071

Source: Economic Survey 2004-05

Average ratio of increase: **6.04%** /year from 1993-94 to 2002-03 (9 years)

Trend of per capita Net State Domestic Product (NSDP) is investigated, in order to see the possibility of annual 4.00% domestic tariff increase. Data of per capita NSDP is compiled in the "Economic Survey", by Directorate of Planning, Statistics and Evaluation, Government of Goa.

As shown in Table 102.24, per capita NSDP had been grown at 13.54% annually including inflation rate. From the fiscal year 1993/94 to 2002/03, 'Economic Survey' describes the growth rate of per capita NSDP at 6.04% without inflation rate. Considering the inflation rate at around 7% from the latter half of the 1990s, per capita NSDP has been grown at approximately 6% without inflation rate for the last 20 years. It can be assumed, in this analysis, that household income will be growing at 3% per annum at constant price for the next 20 years, which is half of the past trend of per capita NSDP increase.

On the other hands, Willingness to Pay (WTP) and average income of household was investigated in the Public Awareness Survey in 2005 by JICA Study Team. For adequate pressure, improved water quality, and 24 hour continuous supply, average of WTP of household was Rs.127/month. With the result of average household income (Rs.5,127/month), the percentage of WTP in household income was 2.48% in the year 2005. Setting the assumption that household income will be grown at 3.00% annually, percentage of monthly water charge in the average household income for $20m^3$ of water consumption will be estimated as follows.

Table 102.25 Estimation of water charge & household income

Year	Ave. Income (3% increase)	Water charge ($20m^3$) (4% increase)	% of water charge in Income
2005	Rs.5,127	Rs.95	1.85%
2015	Rs.6,890	Rs.141	2.04%
2025	Rs.9,260	Rs.208	2.25%

Note: Ave. income in 2005 is obtained from Public Awareness Survey

Percentage of water charge in household income in the year 2025 will be 2.25%, if the water charge is raised 4% every year, which is still lower than the percentage of WTP in household income (2.48%). The IBRD estimates the limit for household affordability to pay as 4% of household income for the water supply services, and 1% for sewerage services. The Pan American Health Organization also recommends that the total water supply and sewerage charge should be less than 5% of the household income, consisting of 3.5% for water supply and 1.5% for sewerage. Estimation of water charge in household income in Table 102.25 is lower than these ceilings. The following Table 102.26 describes the estimation of the percentage of water charge in household income for low & very low income group. Average household income is the average of income for low income group (Rs.2,868/month) and for very low income group (Rs.2,150/month) obtained from the Public Awareness Survey.

Table 102.26 Estimation of water charge & household income for lower & very low income group

Year	Ave. Income (3% increase)	Water charge ($15m^3$) (4% increase)	% of water charge in Income
2005	Rs. 2,500	Rs. 68	2.72%
2015	Rs. 3,360	Rs. 100	2.97%
2025	Rs. 4,515	Rs. 148	3.28%

Year	Ave. Income (3% increase)	Water charge ($10m^3$) (3.5% increase)	% of water charge in Income
2005	Rs. 2,500	Rs. 55	2.20%
2015	Rs. 3,360	Rs. 78	2.31%
2025	Rs. 4,515	Rs. 109	2.42%

If the minimum required volume for low income & very low income household is set as $15m^3$/month, constant water charge increase at 4% will result in the 3.28% consumption for water charge in the household income in the year 2025. The percentage is much over the percentage of WTP and is close to the ceiling of affordability to pay estimated by Pan American Health Organization. It seems to be difficult for PHE to obtain the understanding of the low income customers. From this analysis, it is obvious that annual water charge increase (4%) is very difficult condition. Second table in Table 102.26 shows the assumption that household receive $10m^3$ water consumption per month with the 3.5% annual increase of water charge. In this case, the percentage of water charge in household income is 2.42% in 2025, which is almost same as percentage of WTP and lower than affordability to pay. When the water charge increase will be planned, minimum water consumption volume of low income group should be carefully investigated and growth rate should be lower than 4% per annum.

With the condition that annual 4% water charge increase are realized continuously until 2025, proposed water supply master plan will be financially feasible. It should be noted that continuous 4% water charge increase plus inflation rate is not easy for PHE to realize and to obtain the understanding of the customers. PHE should make more effort to make efficient the operation and maintenance and to improve the service quality for customers continuously.

10.3 Economic and Financial Evaluation of Master Plan for Sanitation

10.3.1 Economic Evaluation of Master Plan for Sanitation

(1) Economic Benefits of Proposed Projects

Sanitation project has the many quantifiable and unquantifiable economic benefits to India and also to the State of Goa. The following table describes these benefits of the master plan for sanitation.

Table 103.1 Economic Benefits of the Sanitation Master Plan

1	Improvement of amenity	1-1	Improvement of sanitary condition of town	Intangible
		1-2	Preventing sewage overflow	Intangible
2	Cost reduction effects	2-1	Saving cost for alternative sanitation facilities for present and future sewage flow over existing capacity	Tangible
3	Improvement of productivity	3-1	Improvement of productivity of fishery	Intangible
4	Economy stimulation effects	4-1	Stimulation of regional economy by project investment	Intangible
		4-2	Increase of land value	Intangible
5	Environment preservation effects	5-1	Preservation of water environment expressed by willingness to pay of tourists	Tangible
		5-2	Preservation of underground water source	Intangible

The benefits of the project are divided into two categories, quantifiable/tangible benefits and unquantifiable/intangible benefits. Economic evaluation includes all the quantifiable benefits as economic benefits of the master plan. In this study, 2-1, and 5-1 of the Table 103.1 are selected as quantifiable benefits.

Economic benefits of the master plan project are calculated by subtracting quantifiable benefit without project case from the total quantifiable benefit with the project case. Figure 103.1 shows additional benefits in terms of sewage flow per day, which are calculated by summing up the excess sewage flows of all the project areas. Excess sewage flow of each area is computed by subtracting the existing treatment capacity from the future sewage flow prediction of each project areas. Green shaded area of the Figure 103.1 delineates the additional benefit of master plan in terms of sewage flow, since sewage treatment capacity expansion in the master plan always covers the sewage flow of orange dot line. The line is constant after the year 2030, because the connection of the served population to public sewer is considered to be delayed after target year of facility design of the project at 2025. This additional benefit in terms of

sewage flow is utilized for calculating economic benefit and financial benefit of the master plan project.

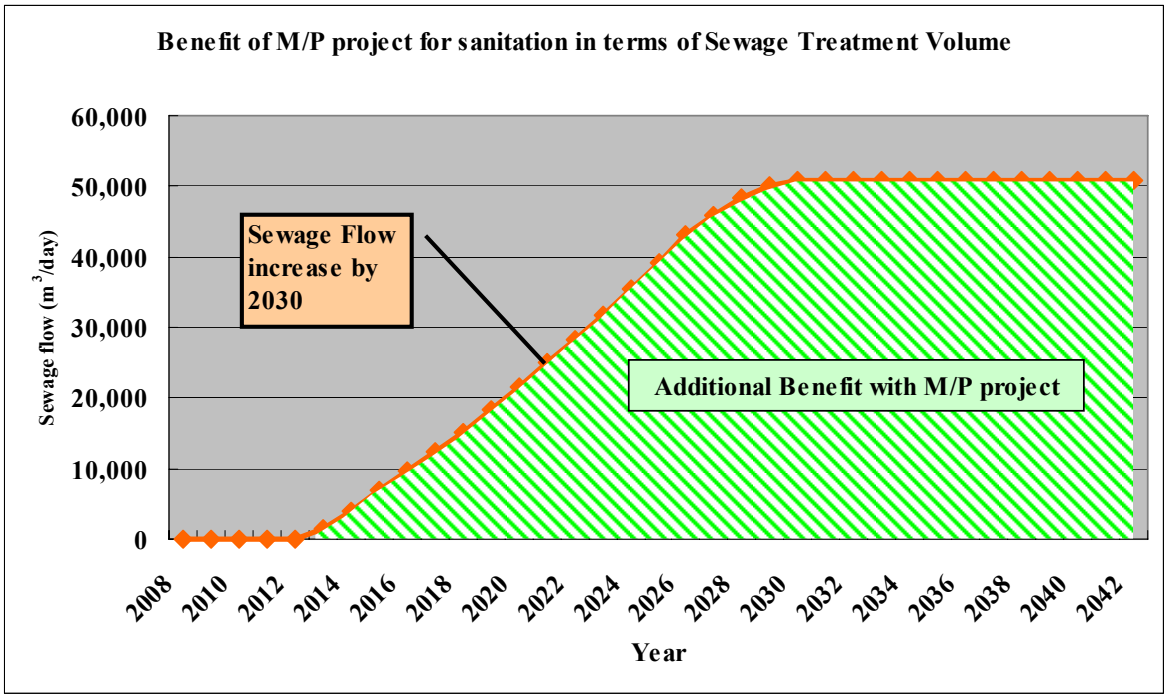


Figure 103.1 Benefit of master plan for sanitation

1) Estimation of economic benefit by cost reduction effects

(a) Saving cost for alternative sanitation facilities: Domestic user

Assumed without project case, public sanitation system in Panaji and Margao will not be able to cover the excess sewage flow over the existing treatment capacity in the future. Also in the other M/P project area at St. Cruz, Porvorim, Ponda, Mapsa, North Coastal, and South Coastal area, present and future sewage flow must be treated by private sanitation system, since there are no public sewer systems presently. As a result, total sewage flow shown in Figure 103.1 must be disposed/treated by alternative on-site sanitation systems as follows;

a. Simple Pit Latrine
b. Pour-Flush Latrine without Septic Tank
c. Double Pit Pour-Flush Latrine
d. Septic Tank connected to Soak Pit
e. Others

The percentage of usage by household of the above 5 sanitation system in the public sanitation unserved area in the study area is shown in Table 103.2, based on the information of 'Public

Awareness Survey'.

Table 103.2 Composition of sanitation methods of household

Type of Sanitation System	Composition of sanitation methods
Simple Pit Latrine	9.0%
Pour-Flush Latrine without Septic Tank	8.0%
Double Pit Pour-Flush Latrine	19.0%
Septic Tank connected to drain	5.0%
Septic Tank connected to Soak Pit	54.0%
Others	5.0%

On the other hand, annualized construction cost by applying Capital Recovery Factor, plus operation and maintenance cost of each alternative sanitation system is estimated. Annual costs for Simple Pit Latrine, Pour-Flash Latrine without Septic Tank, and Double Pit Pour-Flush Latrine, Septic Tank connected to Soak Pit per household are shown in Table 103.3. Detailed calculation method is attached in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation.

Table 103.3 Annual cost of construction, O&M of alternative sanitation methods

Item	Unit	Simple Pit Latrine	Pour-Flush Latrine without Septic Tank	Double Pit Pour-Flush Latrine	Septic Tank connected to Soak Pit
1 Equipment cost					
1) Excavation	Rs./L.S.	1,000	1,200	-	3,000
2) Equipment	Rs./L.S.	1,800	3,800	-	17,000
3) Pipes in yard	Rs./L.S.	900	900	-	900
4) Miscellaneous	Rs./L.S.	300	300	-	300
Total	Rs./L.S.	4,000	6,200	13,300	21,200
2 Annualized Equipment Cost	Rs./year	1,082	1,120	1,670	2,345
3 Operation & Maintenance cost					
1) Maintenance	Rs./year	400	400	400	1,250
2) Sludge withdrawal	Rs./year	0	0	0	400
3) Miscellaneous	Rs./year	0	0	0	500
Total	Rs./year	400	400	400	2,150
4 Total cost for water procurement (2. and 3.)	Rs./year	1,482	1,520	2,070	4,495

Septic Tank connected to drain is not legally permitted as it should be connected to soak pit. In this analysis, it is assumed that the percentage of user for Septic Tank connected to drain in existing condition shall be covered by other facilities in the future by the percentages of their

coverage ratio. Others (13%) is also assumed to be covered by other sanitation systems by the percentage of their coverage ratio for simplification. As a result, coverage ratio for alternative sanitation methods other than public sewerage system shall be listed in the following Table 103.4.

Table 103.4 Cost and composition of alternative sanitation methods

Type of Water Supply	Cost for sanitation per household (Rs./household per year)	% of number of household for each alternative sanitation methods
Simple Pit Latrine	1,482	10.0%
Pour-Flush Latrine without Septic Tank	1,520	8.9%
Double Pit Pour-Flush Latrine	2,070	21.1%
Septic Tank connected to drain	0	0.0%
Septic Tank connected to Soak Pit	4,495	60.0%
Others	0	0.0%

Note: % of number of household for each alternative sanitation methods is calculated as follows;
Simple Pit Latrine: 9% / (100% - (5% + 5%)) x 100% = 10.0%

Considering the data of per capita sewage flow (150 lpcd) and average size of household (4.58) from the water supply and sanitation planning, unit cost for alternative sanitation methods are calculated as follows;

Table 103.5 Unit cost for alternative sanitation methods

Type of Water Supply	Cost for sanitation per household (Rs./household per year)	Sewage flow per household (m^3/household per day)	Unit Cost for Sanitation (Rs./m^3)
Simple Pit Latrine	1,482	0.687	**5.9**
Pour-Flush Latrine without Septic Tank	1,520	0.687	**6.1**
Double Pit Pour-Flush Latrine	2,070	0.687	**8.3**
Septic Tank connected to Soak Pit	4,495	0.687	**17.9**

In other words, alternative sanitation cost shall be saved by incremental sewage volume treated by M/P. The amount of saved cost is one of the economic benefits of the sanitation M/P. Economic benefit of each year shall be calculated by multiplying the 'Unit Cost for Sanitation' to each percentage of treated sewage flow by M/P.

Table 103.6 Unit cost and composition for alternative sanitation methods

Type of Water Supply	Unit Cost for Sanitation (Rs./m^3)	% of each alternative sanitation method
Simple Pit Latrine	**5.9**	**10.0%**
Pour-Flush Latrine without Septic Tank	**6.1**	**8.9%**
Double Pit Pour-Flush Latrine	**8.3**	**21.1%**
Septic Tank connected to Soak Pit	**17.9**	**60.0%**

(b) Saving cost for alternative sanitation facilities: Non-domestic user

Assumed without the Project case, increased amount of sewage flow shall be covered by alternative sanitation methods. For simplification purpose, non-domestic users are assumed to utilize Septic Tank connected to Soak Pit, in order to cover their sewage, without the Project case in this analysis. Annual unit cost for sanitation for non-domestic including tourism is described in Table 103.7.

Table 103.7 Unit cost for alternative sanitation for non-domestic

Type of Water Supply	Unit Cost for Sanitation (Rs./m^3)
Septic Tank connected to Soak Pit	**17.9**

2) Estimation of economic benefit by environment preservation effects

(a) Preservation of water environment expressed by willingness to pay of tourists

Without the project case, sewage flow over the existing sewerage treatment capacity will be received by on-site sanitation methods. With the project case, the sewage flow will be treated by wastewater treatment plant and treated water will be discharged into the river and sea. Therefore, with the project case, water environment, including river and sea, shall be preserved in better condition regarding water quality and odor, comparing to that without project case. It is usually very difficult to quantify this economic benefit in monetary term. In this analysis, contingent valuation method is introduced to calculate the benefit of water environment preservation. Stakeholder Interview for Tourists in the Public Awareness Survey by JICA Study Team obtained the result of the willingness to pay (WTP) of the tourists regarding the following question;

Increasing Wastewater and Need for Sewerage

Following the future increase of water demand due to the development of tourism, the amount of water supply is planned to be increased in Goa. The more water is supplied, the more wastewater will be generated resulting in water pollution of rivers and beaches. Therefore, sewerage projects are also being planned to reduce the pollution of rivers and seaside for tourism as well as to avoid any waterborne diseases. However, the construction and maintenance of sewerage facilities will require large amount of money.

Question: How much are you willing to pay per day as your contribution (tourist tax) to the cost of running sewerage facilities which will keep the value of tourism in Goa by preserving the water and ecosystem in rivers and costal areas?

According to the Stake holder interview, the average of the WTP of tourists for water and ecosystem preservation was as follow;

Domestic Tourist: 18 Rs./day

Foreign Tourist: 240 Rs./day

According to the "Tourist Statistics 2004", Department of Tourism, Government of Goa, average length of stay of tourists were 9 days for foreign tourists, and 5 days for domestic tourists. Therefore, the annual average amount of WTP per tourist is estimated as follows;

Domestic Tourist: 90 Rs./year

Foreign Tourist: 2,160 Rs./year

For the modest estimation of the economic benefit, 50% of the above amounts of WTP were used for the calculation of the economic benefit.

Number of tourists who stay in the project area and amount of accrued economic benefit are briefly shown in the Table 103.8. Detailed data for the whole evaluation period is included in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation. Numbers of tourists are estimated by analyzing the data for number of hotels and beds in addition to the actual number tourists for each taluka, based on the "Tourist Statistics 2004", Department of Tourism, Government of Goa.

Table 103.8 Number of tourists staying in the sanitation M/P project area and amount of economic benefit

		Unit	2013	2014	2015	2020	2025
Total number of staying tourists	Domestic	persons × 1,000	709	740	773	955	1,180
	Foreign		204	211	218	250	282
Total benefit of tourists expressed by WTP	Domestic	Rs.×1,000	31,905	33,300	34,785	42,975	53,100
	Foreign		220,320	227,880	235,440	270,000	304,560

Number of tourists who visit Calangute (North Coastal Area) and Colva (South Coastal Area) by staying the other places should be also included in the number of beneficiaries as one day tourist, in addition to the tourists staying in the project areas. According to the "Tourist Master Plan of Goa", these places are introduced as 'Calangute: … It is Goa's most crowded beach, with all kind of eating joints from beach snacks to restaurants' and also for 'Colva: ... This is the most crowded beach of South Goa with the number of beach snacks and restaurants along its shores.' According to the report, 66% of domestic tourists and 60% of foreign tourists in Goa prefer to visit seaside for the sightseeing place. In this analysis, it can be assumed that 10% of total numbers of tourists who stay in Bardez taluka go to Calangute beach for day trip and 10% of total numbers of tourists who stay in Salcete taluka go to Colva beach for day trip. This is not overestimation, since Tiswadi taluka, Mormugao taluka, and Ponda taluka are located within the day trip distance for Calangute beach and/or Colva Beach, nevertheless, they are not included in the number of day trip tourists for Calangute and/or Colva for the modest estimation. Results and calculation of the economic benefit for day trip tourists are shown in Table 103.9 for several years. Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation includes the data whole through the evaluation period.

Table 103.9 Number of tourists to Salcete taluka & Bardez taluka and amount of economic benefit derived from day trip tourists

(Unit: ×1,000)

Year	Domestic	Foreign	Total	Salcete		Bardez		Benefit of water environment preservation of the day trip tourists (Rs.×1,000)		
				Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Total
2013	2,038	472	2,510	518	185	424	180	848	4,380	5,228
2014	2,127	487	2,614	540	191	442	186	884	4,524	5,408
2015	2,219	502	2,721	564	197	462	192	923	4,668	5,591
2020	2,742	576	3,318	696	226	570	220	1,139	5,352	6,491
2025	3,388	651	4,039	861	255	705	249	1,409	6,048	7,457

Total amount of economic benefit accrued from sanitation master plan during the evaluation period is shown in the Table 103.10.

Table 103.10 Economic Benefit Stream of Proposed Sanitation Project

Year		Sewage volume to be treated by M/P (m^3/day)			Benefit (Rs.1,000)						Grand Total
					Saving of alternative sanitation cost			Benefit of water environment preservation (WTP of Tourist)			
		Domestic	Non-domestic	Total	Domestic	Non-domestic	Total	Domestic	Foreign	Total	
-5	2007	0	0	0	0	0	0	0	0	0	0
-4	2008	0	0	0	0	0	0	0	0	0	0
-3	2009	0	0	0	0	0	0	0	0	0	0
-2	2010	0	0	0	0	0	0	0	0	0	0
-1	2011	0	0	0	0	0	0	0	0	0	0
0	2012	0	0	0	0	0	0	0	0	0	0
1	2013	1,097	341	1,438	5,455	2,228	7,683	32,753	224,700	257,453	265,136
2	2014	3,074	977	4,051	15,286	6,383	21,669	34,184	232,404	266,588	288,257
3	2015	5,270	1,712	6,982	26,207	11,185	37,392	35,708	240,108	275,816	313,208
4	2016	7,255	2,415	9,670	36,078	15,778	51,856	37,278	246,720	283,998	335,854
5	2017	9,236	3,146	12,382	45,929	20,554	66,483	38,849	253,344	292,193	358,676
6	2018	11,169	3,889	15,058	55,542	25,409	80,951	42,223	259,956	302,179	383,130
7	2019	13,477	4,792	18,269	67,019	31,309	98,328	42,269	267,648	309,917	408,245
8	2020	15,854	5,755	21,609	78,839	37,600	116,439	44,114	275,352	319,466	435,905
9	2021	18,293	6,756	25,049	90,968	44,140	135,108	45,919	280,896	326,815	461,923
10	2022	20,484	7,752	28,236	101,864	50,648	152,512	47,996	289,668	337,664	490,176
11	2023	22,813	8,836	31,649	113,445	57,730	171,175	49,985	296,280	346,265	517,440
12	2024	25,336	10,031	35,367	125,992	65,538	191,530	52,200	302,904	355,104	546,634
13	2025	27,789	11,313	39,102	138,190	73,913	212,103	54,509	310,608	365,117	577,220
14	2026	30,631	12,470	43,101	152,323	81,473	233,796	54,509	310,608	365,117	598,913
15	2027	32,609	13,275	45,884	162,159	86,732	248,891	54,509	310,608	365,117	614,008
16	2028	34,389	14,000	48,389	171,011	91,469	262,480	54,509	310,608	365,117	627,597
17	2029	35,576	14,483	50,059	176,914	94,625	271,539	54,509	310,608	365,117	636,656
18	2030	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
19	2031	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
20	2032	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
21	2033	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
22	2034	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
23	2035	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
24	2036	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
25	2037	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
26	2038	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
27	2039	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
28	2040	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
29	2041	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178
30	2042	36,169	14,724	50,893	179,862	96,199	276,061	54,509	310,608	365,117	641,178

(2) Economic Costs of Proposed Projects

Construction cost includes all of the expansion projects to cover the excess sewage flow over the existing treatment capacity by the year 2025, in addition to the rehabilitation works for the existing sanitation facilities. Major parts of the financial cost and economic cost are listed in the Table 103.11. Methodology for conversion from financial cost to economic cost is mentioned in 10.1 Methodology of Economic and Financial Evaluation. Annual disbursement is described in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation.

Total economic cost of the project is Rs.3,310.54 million. Replacement costs of expanded facilities are also considered as one of the necessary costs, but are not included in the Table. They are included in the Cost Benefit Stream for the calculation of EIRR (refer to the Table 103.12). Residual values of replaced equipments are not deducted from the cost in the last evaluated year, since the values are negligible.

Table 103.11 Economic and Financial Costs of Proposed Sanitation Project

(Unit: In million)

Item	Financial Cost		Economic Cost	
	Rs.	US$	Rs.	US$
1. Construction cost	2,744.18	60.66	2,570.77	56.83
2. Engineering cost	327.80	7.25	324.53	7.17
3. Administration cost	153.61	3.40	114.78	2.54
4. Land acquisition cost	24.80	0.55	24.80	0.55
5. Physical contingency	309.67	6.85	289.54	6.40
TOTAL	3,560.06	78.69	3,324.42	73.48

Note; Price contingency is excluded for financial analysis, since the inflation is not considered in financial benefit, either.
Exchange rate between Rupee per US Dollar is Rs. 45.24/US$.

(3) Economic Evaluation

Economic cost and benefit stream during evaluation period is shown in the Table 103.12. As a result of the economic analysis of the sanitation master plan, EIRR is calculated as 15.6%, NPV as Rs.338 million, and B/C as 1.24. Comparing the opportunity cost of capital, 12%, EIRR is over the figure, therefore, sanitation master plan is said to be economically viable. Also under the discounted rate of 12%, the project obtained the positive Net Present Value of Rs.338 million, and present value of Benefit is 1.24 times larger than the present value of Cost.

Table 103.12 Cost and Benefit Stream of Proposed Sanitation Project

(Unit: Rs. In million)

Year		Cost				Benefit	Balance
		Const-ruction	O&M	Replace-ment	Total	Total	
-5	2007	13.58	0.00		13.58	0.00	-13.58
-4	2008	45.25	0.00		45.25	0.00	-45.25
-3	2009	67.80	0.00		67.80	0.00	-67.80
-2	2010	318.34	0.00		318.34	0.00	-318.34
-1	2011	362.33	0.00		362.33	0.00	-362.33
0	2012	349.59	0.00		349.59	0.00	-349.59
1	2013	84.52	14.80		99.32	265.14	165.82
2	2014	107.10	17.10		124.20	288.26	164.06
3	2015	122.38	18.19		140.57	313.21	172.64
4	2016	171.81	21.54		193.35	335.85	142.50
5	2017	271.91	23.64		295.55	358.68	63.13
6	2018	295.13	25.52		320.65	383.13	62.48
7	2019	250.04	33.74		283.78	408.25	124.47
8	2020	250.31	38.97		289.28	435.91	146.63
9	2021	196.86	44.28		241.14	461.92	220.78
10	2022	156.25	52.77		209.02	490.18	281.16
11	2023	119.53	58.24		177.77	517.44	339.67
12	2024	66.14	66.07		132.21	546.63	414.42
13	2025	75.55	71.64		147.19	577.22	430.03
14	2026		76.09		76.09	598.91	522.82
15	2027		78.53	78.66	157.19	614.01	456.82
16	2028		79.86		79.86	627.60	547.74
17	2029		81.63		81.63	636.66	555.03
18	2030		84.82	19.72	104.54	641.18	536.64
19	2031		84.82		84.82	641.18	556.36
20	2032		84.82		84.82	641.18	556.36
21	2033		84.82	38.49	123.31	641.18	517.87
22	2034		84.82	27.52	112.34	641.18	528.84
23	2035		84.82	16.92	101.74	641.18	539.44
24	2036		84.82	27.82	112.64	641.18	528.54
25	2037		84.82	16.64	101.46	641.18	539.72
26	2038		84.82	39.93	124.75	641.18	516.43
27	2039		84.82		84.82	641.18	556.36
28	2040		84.82		84.82	641.18	556.36
29	2041		84.82		84.82	641.18	556.36
30	2042		84.82	78.66	163.48	641.18	477.70

EIRR: 15.6% NPV: 338 million Rs. B/C: 1.24

10.3.2 Financial Evaluation of Master Plan for Sanitation

(1) Revenue from Proposed Projects

Financial revenue of the proposed project is originated from the tariff revenue from the customers for the portion of incremental water supply volume and number of customers, since sewerage charge is the 25% of the water consumption charges. Tariff revenue of the customer is composed of sewerage charge and installation charge. Regarding sewerage charge, distinct unit prices are set for domestic and non-domestic, to computerizing total charge billed. Water supply volume for calculating sewerage charge is assumed as 100% of the sewerage flow in Panaji and 125% of the sewerage flow in other project areas which is shown in the Figure 103.1, the sum of sewage flows that are planned to be satisfied by the master plan project. For domestic users, unit price of sewerage charge is calculated at Rs.1.12/m^3 for the year 2007, based on the water consumption per connection and tariff table in 2005, reflecting inflation adjustment until the year 2007. For non-domestic users, unit price of sewerage charge is calculated at Rs.6.85/m^3 for the year 2007, through the same procedure. The basic information for the calculation of unit price is included in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation. Collection efficiency is considered for calculating the sewerage revenue. Unit prices for installation charge for each domestic and non-domestic are Rs.215/case and Rs.520/case, respectively. The total financial benefit and breakdown of the sanitation master plan are included in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation for each year through the evaluation period. Table 103.13 is the digest of the total financial benefit from the master plan for sanitation.

Table 103.13 Total Financial Benefit from the Master Plan for Sanitation

(Unit: Rs in Million)

Item	2013	2015	2020	2025	2030	fter 2030
Domestic						
1. Total Sewerage Revenue	0.540	2.596	7.851	13.709	17.800	17.800
2. Total Installation Revenue	0.468	0.671	0.910	0.820	0.046	0.000
TOTAL REVENUE (from 1. to 2.)	1.008	3.267	8.761	14.529	17.846	17.800
Non-Domestic						
3. Total Sewerage Revenue	1.026	5.157	17.428	34.134	44.321	44.321
4. Total Installation Revenue	0.060	0.085	0.116	0.105	0.006	0.000
TOTAL REVENUE (from 3. to 4.)	1.086	5.242	17.544	34.239	44.327	44.321
GRAND TOTAL (from 1. to 4.)	**2.094**	**8.509**	**26.305**	**48.768**	**62.173**	**62.121**

(2) Costs for Proposed Projects

Financial cost of the proposed projects consists of Initial investment cost, replacement cost, and

operation and maintenance (O&M) cost.

Initial investment cost at the price level of 2007 is composed of construction cost, administration cost, engineering cost, physical contingency, and price contingency. Price contingency is calculated until 2025, nevertheless, not included in the financial analysis, because inflation is not considered in the financial revenue either. Construction cost covers mainly the expansion works and rehabilitation works for the existing facilities. Construction cost also includes the cost for operation and maintenance improvement, and institutional/organizational improvement. Replacement cost covers replacement of machinery and equipments for expanded facilities of the proposed project. O&M cost consists of electricity cost, chemical cost, personnel cost, maintenance cost, sewer cleaning cost, and administration cost. Each item of O&M cost covers only for the expanded facilities, since financial revenue does not include the revenue from existing facilities either. Estimation of the costs for proposed sanitation master plan is described in the Volume IV Appendix M103 Economic and Financial Evaluation of Master Plan for Sanitation.

(3) Financial Evaluation

Cost and benefit stream of proposed sanitation project during the evaluation period is shown in the Table 103.14. In case without unit price increase in constant price, financial internal rate of return (FIRR) is not obtained, since project benefit is much smaller than project cost. NPV is minus 3,147 million Rupees. Benefit cost ratio is 0.17. As a result, proposed sanitation master plan is not financially feasible.

In the next section, financial plan for PHE is presented including every revenues and costs of water supply and sanitation services. Financial plan is prepared under the condition to aim the cost recovery for operation and maintenance (including personnel & administration cost) in the long run, as it was recommended in the “8.6 Improvement of Financial Management and Control”. Necessary amounts of sanitation tariff increase are calculated in the analysis to cover the operation and maintenance costs. Necessary amount of subsidy from state government is also computed.

Table 103.14 Cost and Benefit Stream of Proposed Sanitation Project

(Unit: Rs. In million)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-5	2007	14.55	0.00		14.55	0.00	0.00	0.00	-14.55
-4	2008	47.59	0.00		47.59	0.00	0.00	0.00	-47.59
-3	2009	70.61	0.00		70.61	0.00	0.00	0.00	-70.61
-2	2010	341.97	0.00		341.97	0.04	0.01	0.05	-341.92
-1	2011	389.11	0.00		389.11	0.09	0.01	0.10	-389.01
0	2012	375.47	0.00		375.47	0.13	0.02	0.15	-375.32
1	2013	90.47	15.75		106.22	1.01	1.09	2.10	-104.12
2	2014	114.71	18.16		132.87	2.09	3.01	5.10	-127.77
3	2015	131.08	19.31		150.39	3.27	5.24	8.51	-141.88
4	2016	183.93	23.00		206.93	4.32	7.38	11.70	-195.23
5	2017	291.12	25.20		316.32	5.00	9.59	14.59	-301.73
6	2018	315.97	27.17		343.14	6.00	11.85	17.85	-325.29
7	2019	267.71	36.11		303.82	8.00	14.61	22.61	-281.21
8	2020	268.00	41.87		309.87	8.76	17.54	26.30	-283.57
9	2021	210.78	47.61		258.39	10.00	20.60	30.60	-227.79
10	2022	167.30	56.60		223.90	11.03	23.64	34.67	-189.23
11	2023	127.98	62.32		190.30	12.16	26.90	39.06	-151.24
12	2024	70.83	70.53		141.36	13.35	30.43	43.78	-97.58
13	2025	80.88	76.35		157.23	14.53	34.24	48.77	-108.46
14	2026		81.03		81.03	15.92	37.71	53.63	-27.40
15	2027		83.59	83.97	167.56	16.67	40.10	56.77	-110.79
16	2028		85.00		85.00	17.33	42.29	59.62	-25.38
17	2029		86.86		86.86	17.71	43.76	61.47	-25.39
18	2030		90.20	21.05	111.25	17.85	44.33	62.18	-49.07
19	2031		90.20		90.20	17.80	44.32	62.12	-28.08
20	2032		90.20		90.20	17.80	44.32	62.12	-28.08
21	2033		90.20	41.09	131.29	17.80	44.32	62.12	-69.17
22	2034		90.20	29.38	119.58	17.80	44.32	62.12	-57.46
23	2035		90.20	18.06	108.26	17.80	44.32	62.12	-46.14
24	2036		90.20	29.70	119.90	17.80	44.32	62.12	-57.78
25	2037		90.20	17.76	107.96	17.80	44.32	62.12	-45.84
26	2038		90.20	42.62	132.82	17.80	44.32	62.12	-70.70
27	2039		90.20		90.20	17.80	44.32	62.12	-28.08
28	2040		90.20		90.20	17.80	44.32	62.12	-28.08
29	2041		90.20		90.20	17.80	44.32	62.12	-28.08
30	2042		90.20	83.97	174.17	17.80	44.32	62.12	-112.05

FIRR: N.A. NPV: -3,147 million Rs. B/C: 0.17

10.4 Financial plan of PHE with the Master Plan for Water Supply and Sanitation

10.4.1 Purposes and Assumptions for Financial Plan

Financial Plan for PHE with the M/P project is prepared for the purposes of; 1) checking the amount of annual subsidy for each water supply and sanitation services, 2) grasp the trend of net profit/loss and the accumulated profit/loss with the master plan project, 3) how much tariff increase are necessary for sanitation service to cover the annual O&M cost. The amount of 'Subsidy' in this analysis equals to the total of annual net loss and construction and related cost excluding loan provision for master plan project. Financial plan is composed of Profit Loss statement between the year 2007 and 2042, evaluation period of financial/economic analysis, and table which describes annual necessary subsidy for each water supply and sanitation service for the same period. Followings are the assumptions and conditions of financial plan.

1) Projection period: From the year 2007 to2042
2) Price escalation: For both revenue and expenditure, inflation is not reflected for simplification.
3) Loan amount: 85% of the total investment costs of priority projects until 2012, and 50% of the total investment costs from 2012 to 2025, including construction cost, administration cost, engineering cost, and physical contingency are assumed as expected loan amount.
4) Condition of loan: Interest rate for loan is set at 3.10% per annum, prevailing to the whole loan amount, same as the discount rate of FIRR of M/P. Total period of loan repayment is 30 years including 10 years grace period. It is assumed that originated interest amount in a year is paid at the same year and that principal is paid at same amount every year.
5) Water charge: Unit charges are the same as those in financial analysis for sanitation M/P. Unit price for domestic is set at Rs.4.41/m^3 in 2007 and raised at 4% every year in real term. Unit price for non-domestic is set at Rs.27.49/m^3 in 2007 and raised at 2.5% every year in real term.
6) Sewerage charge: Unit charges are the same as those in financial analysis for sanitation M/P. Unit price for domestic is set at Rs.1.12/m^3 in 2007. Unit price for non-domestic is set at Rs.6.85/m^3 in 2007. Annual percentage of tariff raise is calculated and explained later.
7) Water supply volume: Water supply volume for water revenue is based on the water

demand projection by JICA Study Team. Water supply volume for sanitation revenue is computed by 100% of sewage flow in Panaji and by 125% of sewage flow in other project areas of sanitation M/P.

8) Depreciation: Fixed assets for water supply and sanitation facilities expanded by M/P project are depreciated using Straight-Line method over 30 years after deducting the residual value at 10% of original cost. Rehabilitation costs of facilities are also depreciated in this study using the same procedure, since PHE has not counted depreciation cost for the future renovation for the existing facilities.

10.4.2 Financial Plan of PHE

Figure 104.1 to 104.6 describes the results of the financial plan under the above assumptions and conditions. Detailed information for preparing these Figures are included in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation.

- Figure 104.1 shows the profit and loss of PHE for water supply service.
- Figure 104.2 shows the necessary subsidy from State Government for water supply service.
- Figure 104.3 shows the profit and loss of PHE for sanitation service.
- Figure 104.4 shows the necessary subsidy from State Government for sanitation service.
- Figure 104.5 shows the profit and loss of PHE for water supply and sanitation.
- Figure 104.6 shows the necessary subsidy from State Government for both of water supply and sanitation services.

'Accumulated profit / loss' in Figure 104.1, 104.3, 104.5 is the total of the annual net profit / loss which might be accumulated in PHE in case it is considered as the independent firm. Under the present budget system, annual net loss is actually subsidized by the State Government. Therefore, accumulated loss indicates the actual accumulated loss for the State Government, and net loss each year is included in the amount of necessary budgetary input (subsidy) from the State Government.

'Preparation works' in the Figure 104.2, 104.4, 104.6 indicate the necessary investment for implementing master plan, which is the part of initial investment cost, before the loan provision.

'Burden for M/P' in the Figure 104.2, 104.4, 104.6 indicates the total project cost minus loan provision that should be covered by the budget of State Government or any other sources.

‘Annual net loss at the end of financial year’ in the Figure 104.2, 104.4, 104.6 should be covered by the budget of State Government or any other sources before the realization of enough tariff raise.

‘Total annual subsidy’ is the total of the ‘Preparation works’, the ‘Burden for M/P’, and the ‘Annual net loss at the end of financial year’. The amount is the necessary amount of external budgetary input each year to the water supply and/or sewerage enterprise in order to secure the sufficient funds for operation and maintenance costs, administration costs, depreciation costs, interest expenses, and other expenses.

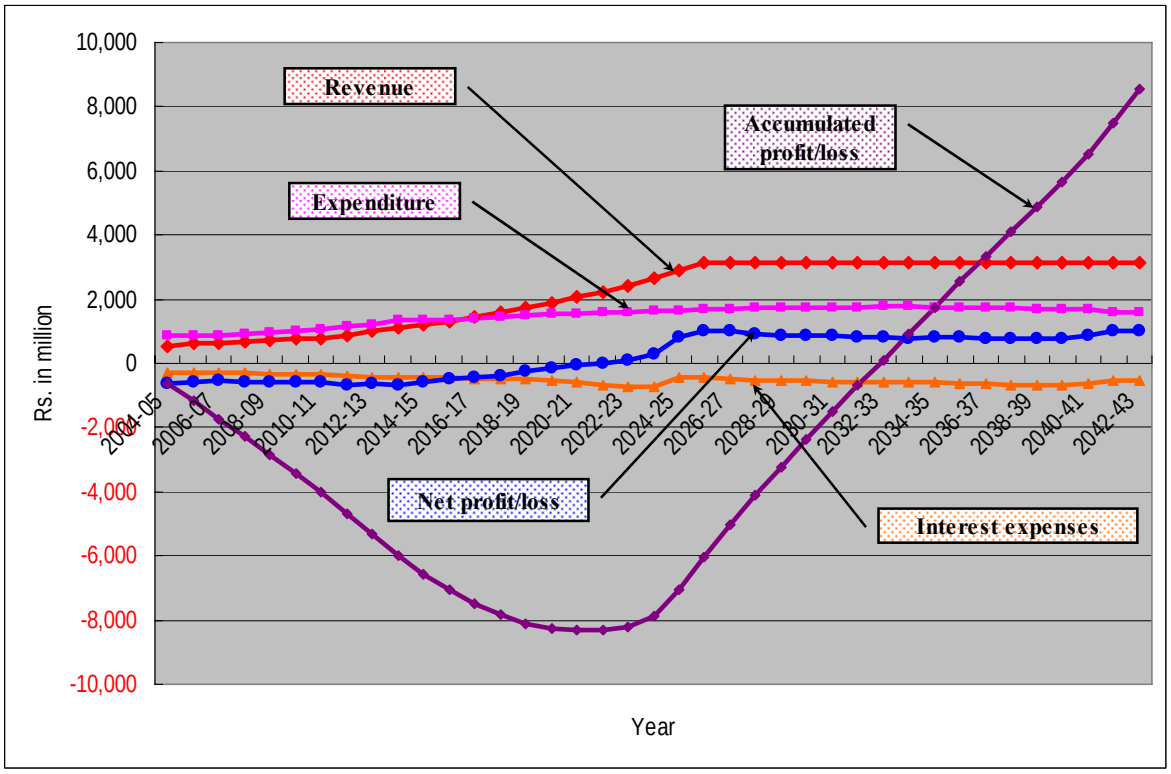


Figure 104.1 **Projection of profit and loss of PHE for water supply**

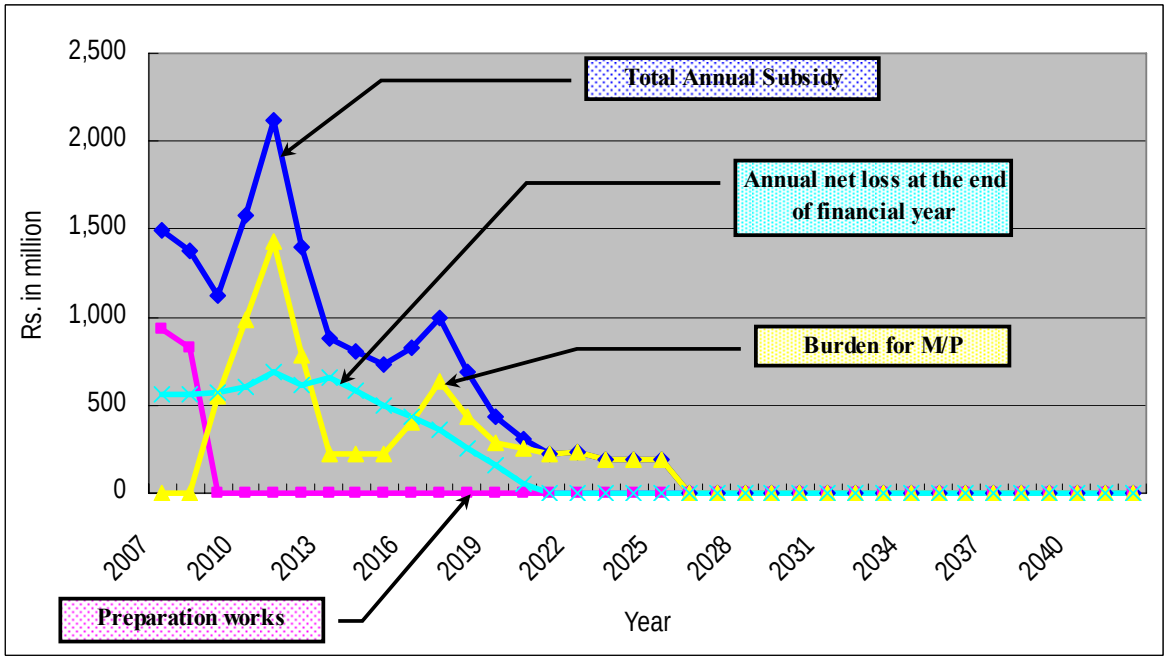


Figure 104.2 **Projection of necessary subsidy from state government for water supply**

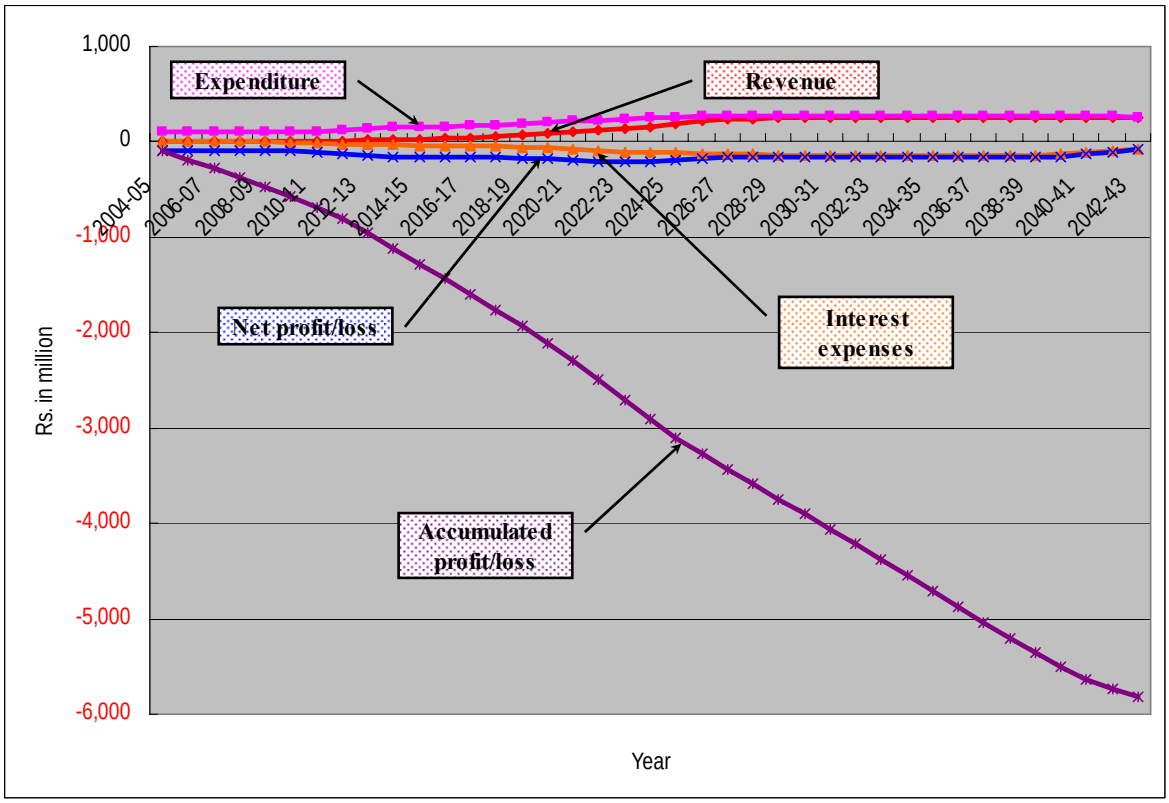


Figure 104.3 Projection of profit and loss of PHE for sanitation

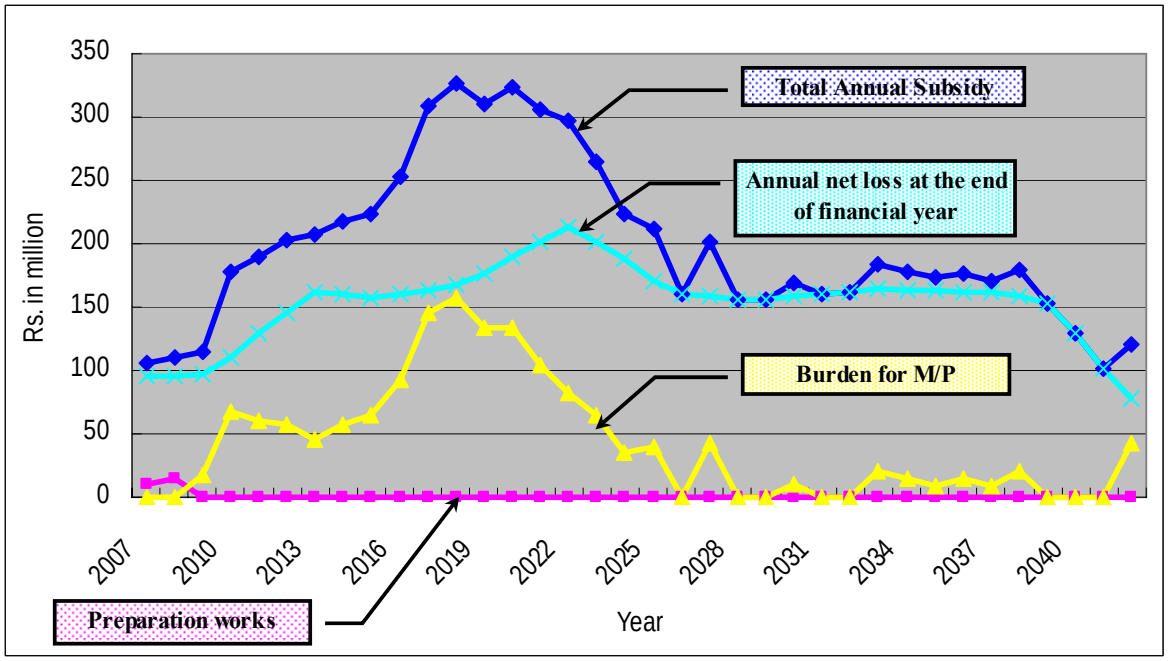


Figure 104.4 Projection of necessary subsidy from state government for sanitation

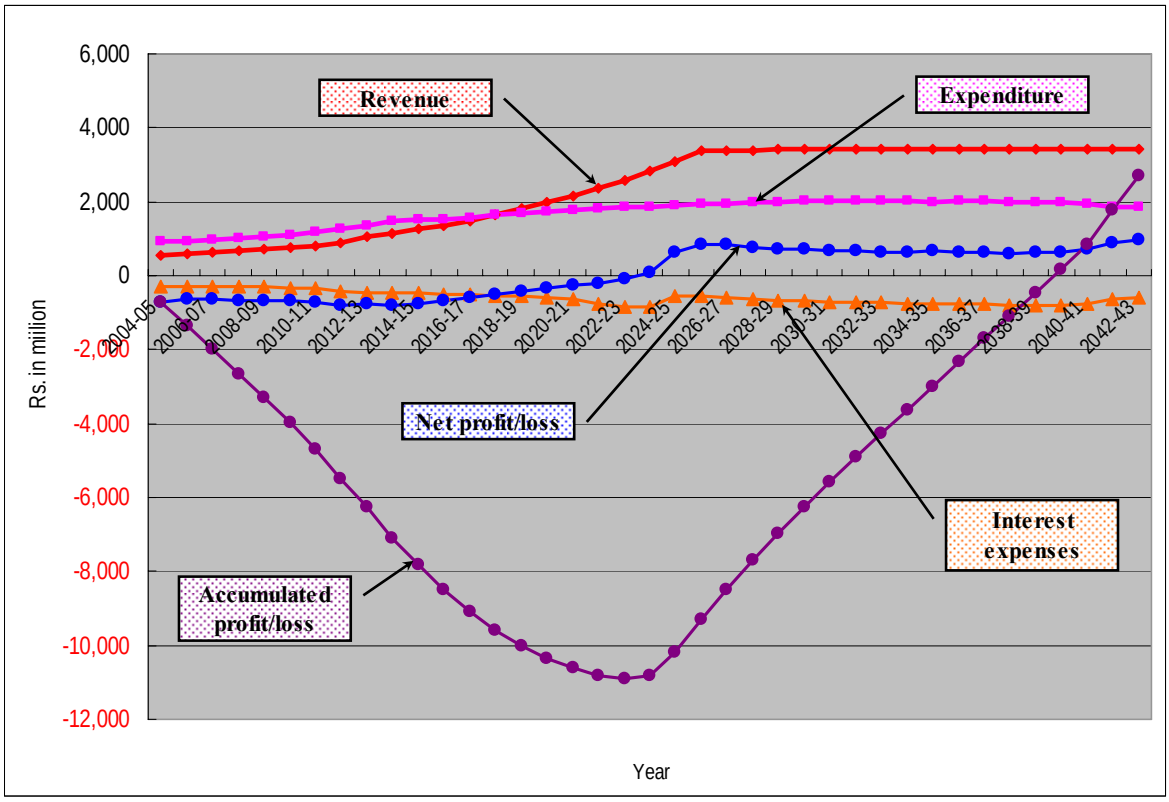


Figure 104.5 Projection of profit and loss of PHE for water supply and sanitation

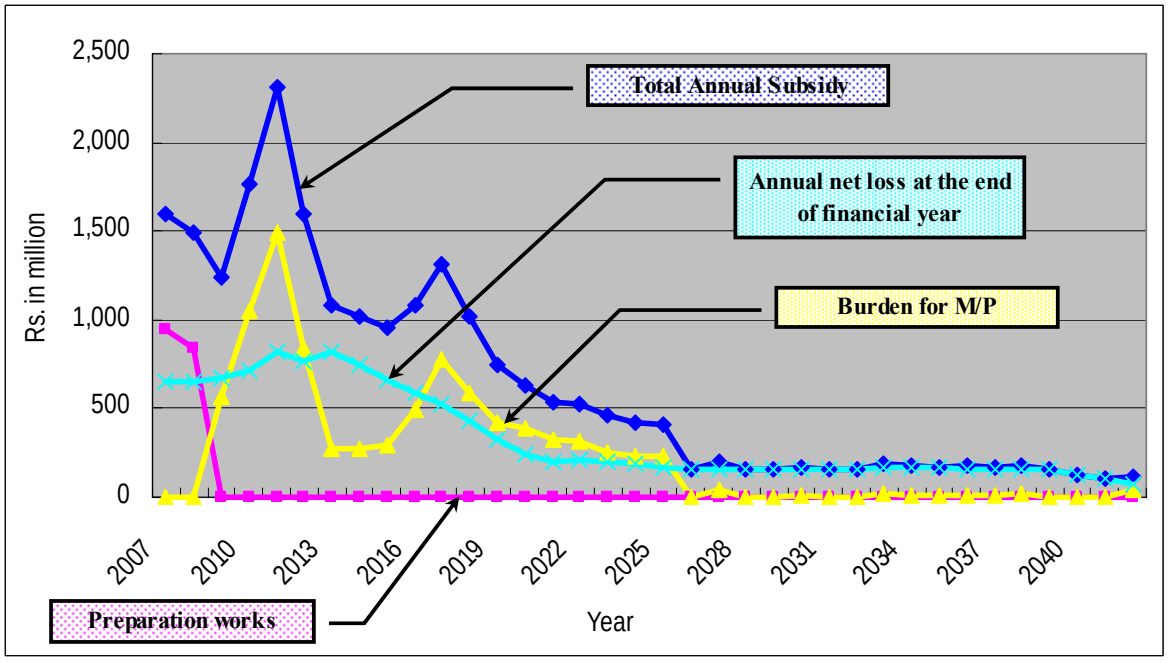


Figure 104.6 Projection of subsidy from state government for water supply and sanitation

10.4.3 Findings from Financial Plan

(1) Necessary tariff increase and subsidy for sanitation service

Figure 104.3 show the change of profit and loss of PHE for sanitation service. In the year 2025/26, target year of the M/P, total of the operation & maintenance cost, administration cost, and other expenses is estimated at Rs.190 million, as shown in the table in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation. Revenue in the same year is calculated at Rs.216 million, to cover the O&M, administration cost, and other expenses of the target year. Revenue includes both of revenue from existing public sanitation facilities and expanded facilities by M/P project. So as to obtain the revenue amount of Rs.216 million, following sewerage charge increase is estimated as required;

Table 104.1 Necessary sewerage charge increase to cover O&M, administration cost

Category	Increase rate	Note
Domestic	7.5% per annum	Without inflation adjustment
Non-domestic	6.0% per annum	Without inflation adjustment

Above increase rate does not include the necessary tariff raise for adjusting the inflation rate. If the price escalation in Goa is 7%, sewerage charge must be increased at 14.5% every year for domestic user. Sewerage tariff raise at 7.5% every year excluding inflation rate will reach at 1.03% for sewerage charge in average household income in 2025 under the condition of 3% annual growth of average household income at constant price. The percentage is less than the ceiling of Affordability to Pay (ATP) at 1.5%, estimated by Pan American Health Organization, and is also less than WTP for sanitation in average household income at 1.29%, as shown in Table 104.2 and Table 104.3.

Table 104.2 Percentage of future sewerage tariff in average household income

(Unit: Rs.)

Year	Ave. Income (3% increase)	Tariff ($20m^3$) (8.0% increase)	% of Tariff in Income	Tariff ($20m^3$) (7.5% increase)	% of Tariff in Income	Tariff ($20m^3$) (7.0% increase)	% of Tariff in Income
2005	5,127	22.4	0.44%	22.4	0.44%	22.4	0.44%
2015	6,890	48.3	0.70%	46.1	0.67%	44.2	0.64%
2025	9,261	104.4	1.13%	95.0	1.03%	86.9	0.94%

Note: Ave. Income in 2005 is obtained from Public Awareness Survey

Table 104.3 Percentage of WTP and ATP for sanitation in average household income

Willingness to Pay (WTP) of household for sanitation:	Rs.66 /month
% of WTP in household income:	1.29% (in Rs.5,127)
Affordability to Pay in household income:	1.5% or 1.0% *1

Note: *1; Estimation of Pan American Health Organization / IBRD

It should be noted that PHE shall be careful about expanding the public sanitation service, since 14.5% tariff raise per year for sewerage including inflation (assumed as 7%) adjustment is not easy for customers to understand with the present service quality. In case that tariff raise is not conducted, expansion of sanitation service will cause continuous deficit to sanitation service of PHE. Under the present budget system, deficit in sanitation may induce the decrease of the budget of water supply service and result in the degradation of both of water supply and sanitation. In the worst scenario, constructed facilities might be abandoned for the scarce of the fund for operation and maintenance. It is recommended that PHE shall be careful about expansion of sanitation service and shall provide better service and public relation activities to obtain the consensus of the existing and expected customers.

On the other hands, provision of better hygiene condition is the social need, which has to be provided even utilizing the public fund or state budget. Figure 104.4 shows the necessary subsidy from State Government budget for sanitation under 7.5% annual tariff increase for domestic and 6.0% annual increase for non-domestic. Subsidy from State Government is estimated at around Rs.100 to 350 million by the year 2025 per annum. Around Rs.200 million State Government subsidy is necessary after the year 2026 per annum. Above tariff raise may cause the strong resistance from customers and PHE may not able to conduct the tariff raise enough to recover the O&M costs. For such a case, the required amounts of subsidy are predicted as follows for sewerage enterprise to keep providing the service for several cases of sewerage tariff raise, which are less than the proposed rate of tariff raise.

Table 104.4 Annual Necessary Subsidy and Accumulated Subsidy for Each Tariff Raise

(Unit: Rs. in million)

Tariff raise	Necessary subsidy/year (constant price)						**Accumulated subsidy by 2042**
	2010	2015	2020	2025	2030	2035	
Domestic:0%, Non-domestic:0%	181	238	380	356	344	348	**10,787**
Domestic:3%, Non-domestic:2%	180	234	364	321	301	305	**9,870**
Domestic:4%, Non-domestic:3%	180	231	356	301	277	282	**9,375**
Domestic:5%, Non-domestic:4%	179	229	347	278	248	253	**8,755**
Domestic:6%, Non-domestic:5%	179	226	336	249	214	219	**8,051**
Domestic:7.5%, Non-domestic:6%	179	223	324	211	168	173	**7,101**

Notes: *1; Excluding inflation adjustment. The table shows the extracts of subsidy for every five years, but actually subsidy inputs is required every year until the year 2042.

Regarding the sewerage enterprise, it is recommended that 7.5% annual tariff raise for domestic and 6.0% annual tariff raise for non-domestic at constant prices, since it is advisable to recover the major O&M costs for sewerage. Nevertheless, in case that the less tariff raise is conducted

actually, it is impossible for the enterprise to keep providing the project benefits continuously without the inputs of above mentioned subsidy to the sewerage enterprise.

Detailed information of State Government subsidy and profit loss statement is described in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation.

(2) Necessary subsidy for water supply service

Figure 104.2 shows the necessary subsidy or budget input from State Government for water supply service. As the expansion of service coverage and tariff raise for water charge at 4% per annum at constant price, necessary amount of subsidy will decrease from 2013 to 2025, result in zero subsidy after 2026. Zero subsidy indicates that tariff revenue are enough to cover the interest payments and depreciation cost for the M/P as well as O&M cost. Accumulated profit shall be utilized for the part of future expansion projects. For the period between 2007 and 2017, necessary subsidy from State Government will climb as high as Rs.2,200 million. On the other hands, past trend of governmental subsidy to the PHE fell in the range of Rs.600 to 1,000 millions for both capital expenditure and deficit of operating activity. Huge subsidy between 2007 and 2012 is originated from the annual net loss for the early stage of project and burden for M/P implementation cost other than coverage of loan. It is recommended that some of the expansion works of the master plan project until 2012 should be extended and be implemented after 2012 through detailed consideration about urgency of the project and possibility of obtaining subsidy from State Government. There is another option that is to seek the additional lender of the part of project cost excepting for loan coverage for priority project, for reducing the whole amount of required subsidy of each year.

Accumulated profit / loss will be maximum at the year 2021/22 and will decrease after that to become positive accumulated profit / loss at the end of evaluation period. Positive accumulated profit / loss indicate that accumulated loss born by State Government will be fully recovered by net profit from water supply under the present budget system. After achieving financial self-sufficiency, accumulated profit shall be utilized for future expansion projects.

For reference, unit cost of supply service of water supply, or unit production cost for water supply, will be Rs.8.3/m^3 at the year 2025. On the other hands, unit price of water supply will be Rs.20.9/ m^3 at the year 2025, based on the water tariff increase.

(3) Necessary subsidy for water supply and sanitation services

Total necessary subsidy to PHE from State Government will be around Rs.2,300 million at the highest in the year 2011. Comparing to the annual budget of PHE, PWD, and State Government, the maximum amount of subsidy (Rs.2,300 million) will be 10.3% of the State budget (Rs.22,237 million, estimation of 2004-05), 65.5% of the PWD's budget (Rs.3,509 million, estimation of 2004-05), and 138% of the budget for PHE (Rs.1,666 million, estimation of 2004-05). It should be noted that the above actual budget amounts of each State Government, PWD, and PHE are partially recovered by tariff revenues of water supply and sanitation. Net expenditures of State Government, PWD, to PHE are less than above mentioned budget amounts. On the other hand, estimated amount of subsidy to PHE (Max. Rs.2,300 million) is net expenditure after deducting reimbursed costs by the tariff revenues. To compare the size of budget and subsidy fairly, reimbursed costs should be added to the amount of subsidy. If the amount of water supply and sanitation revenue at Rs.553 million in the year 2004-05 is assumed to be equal to the reimbursed cost, highest subsidy required including reimbursed cost is Rs.2,853 million. The calculation process is included in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation, and the results of comparison are shown in the Figure 104.7.

At the year 2011, when the maximum subsidy will be necessary, budget of PHE shall be more than 171% of the PHE budget in the fiscal year 2004/05.

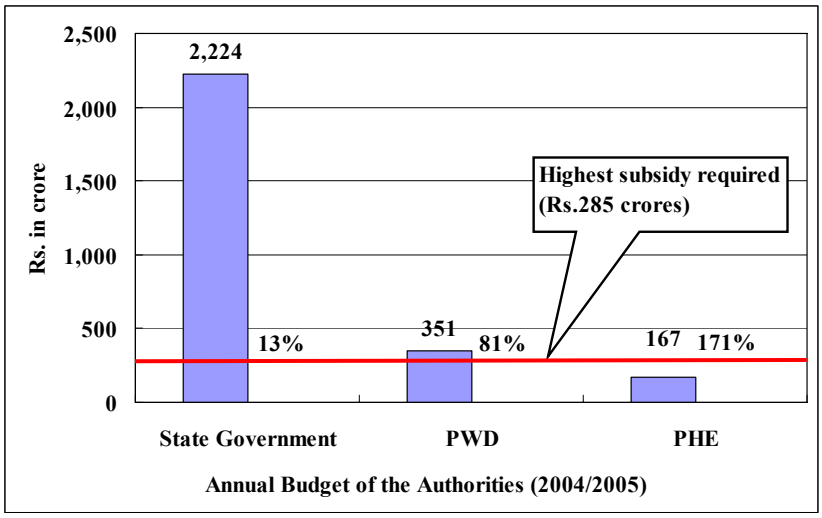


Figure 104.7 Comparison of the expected subsidy and the annual budget of the authorities

(4) Trend of net profit/loss and the accumulated profit/loss with M/P for water supply and sanitation

Figure 104.5 delineates the trend of revenue, expenditure (including O&M cost, Administration cost, Depreciation, etc.), interest expenses, net profit/loss, and accumulated profit/loss. The Figure reflects the additional costs and revenues with M/P projects for water supply and sanitation. Annual net loss in the early stage of the evaluation period will turn to profit at 2023/24 and net profit will continue after that to the end of the period. Because of the net losses in the early stage, accumulated loss will increase by the year 2022/23 and will decrease by the annual net profit after 2023/24.

Important point that is indicated in Figure 104.5 is the overtaking of the 'Revenue' on 'Expenditure'. Presently, expenditure (O&M cost, administration cost, other costs) is not recovered by revenue even in the water supply service. 4% and 2.5% tariff increase of water charge every year for each domestic and non-domestic contributed mainly to make the annual revenue over the annual expenditure. Tariff raise in sanitation charge at 7.5% and 6.0% for each domestic and non-domestic also contributed to decrease the annual loss of PHE. As is explained in the "(1) Necessary sewerage charge increase and subsidy for sanitation service", State Government bears the annual net loss under the present budget system. In this context, annual net loss will not be accumulated in the PHE, but will be recovered by State Budget. On the other hands, net profit after 2024/25 will be accumulated in the State Budget under the present budget system to compensate the excess expenditure before 2023/24.

It should be also noted that 'Expenditure' in the Figure 104.5 of this financial plan includes the depreciation cost. Depreciation cost is not the actual consumption of money or fund, but only an accounting procedure. Therefore, even if the net loss is originated, the amount of net loss is actually less than the amount in profit loss statement for the same amount of depreciation. In the accounting procedure, it is important to keep securing the amount of depreciation for the future renovation of the constructed facilities. Including the depreciation cost in the total cost for tariff setting is the basic of principle of full cost recovery.

(5) Necessary tariff raise to cover the cost for major operation and maintenance cost

Continuous 4% tariff raise per year in constant price for domestic customers for the water supply until 2025 shall lead to the realization of full cost recovery for water supply service including operation and maintenance costs, depreciation costs, and interest expenses for capital expenditure.

Nevertheless, the customers may not ready to understand and to receive the rapid tariff raise estimated by financial plan. In that case, it is recommended that PHE shall aim to realize the cost recovery by tariff revenue for the range of operation and maintenance costs, administration costs, and other expenses, excluding depreciation costs, and interest expenses for capital expenditures. Cost recovery for these major O&M costs (operation and maintenance costs, administration costs, and other expenses) shall be the short term target. Full cost recovery will be the long term target after achieving the cost recovery of major O&M costs. The necessary tariff increase for the cost recovery of major O&M cost is calculated, and the result is shown in the Figure 104.8. The target year of the cost recovery shall be set at 2013, seven years from 2007.

In order to recover the major operation and maintenance costs, excluding depreciation costs and interest expenses, it is required to conduct 3% tariff increase for domestic customers and 2% for non-domestic customers per year over the inflation rate. In the Figure 104.8, tariff revenues for water supply exceed the major O&M costs in the fiscal year 2012-2013 by these tariff raise. It is advisable that PHE would understand the above tariff raise plan shall be the minimum requirement in the aspects of financial management for the sustainable operation and maintenance of water supply facilities constructed by M/P. Profit loss statement projection for Table 104.8 is included in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation.

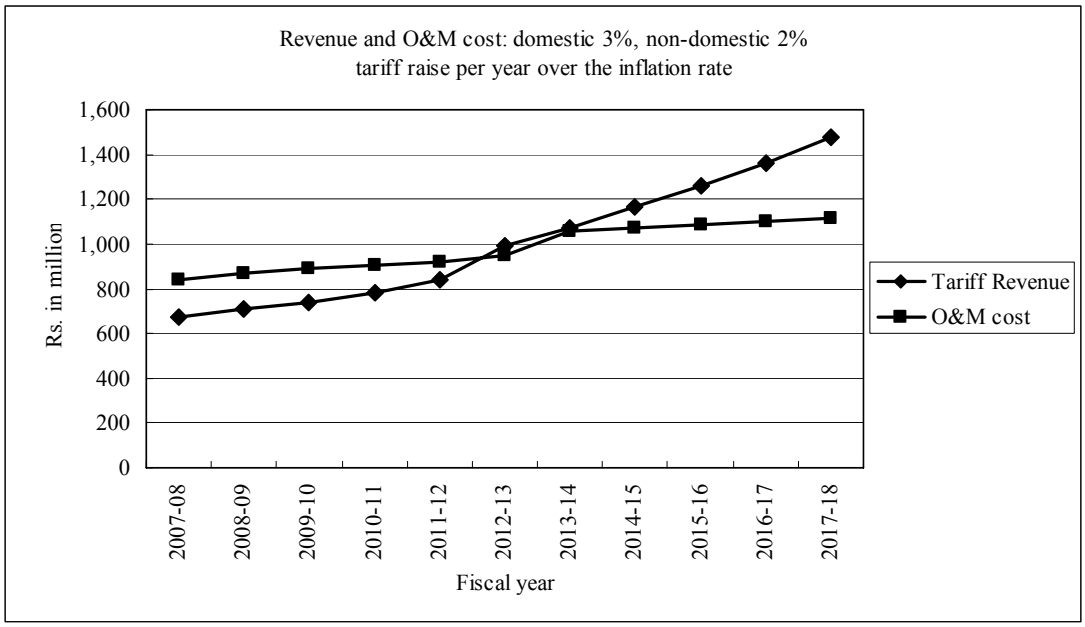


Figure 104.8 Necessary tariff increase for the cost recovery of O&M costs

6) Water and Sewerage Combined Tariff Schedule

Presently, the sewerage charge is billed at certain percentage (25%) of water charge. It may be considered difficult for PHE to raise the tariff at 4% per annum for water supply and at 7.5% per annum for sewerage separately. The tariff raise for water supply was calculated to recover all of the necessary expenditures including capital costs for M/P. On the other hands, the tariff raise for sewerage was calculated in order to recover only the O&M, administration, and other minor costs. The preconditions of this calculation is to separate the accounts of water supply and of sewerage. The separation of water supply account and sewerage account is recommended as it contributes to the transparency of the entity's financial condition.

But if the water supply and sewerage accounts are combined, profit from water supply is consumed for sewerage expenditures. Figure 104.9 shows the projection of profit and loss for PHE including both water supply and sewerage with the tariff raise at 4% for water supply and also for sewerage. In this pattern of tariff raise, it is easy for PHE to change the tariff for water supply and sewerage as they increase at same speed. But in this case, target for the cost recovery for O&M, administration, and other minor costs is not realized for sewerage. As the figure indicates, positive profit will be originated after the year 2023-24, PHE as a whole. The annual loss originated by sewerage service will be covered by the annual profit by water supply service, since the scale of the service is much larger in water supply than that in sewerage. This situation indicates that the sewerage expenditures are cross-subsidized by the water tariff revenues and originating the annual profit as water supply and sewerage enterprise, by means of tariff setting at same percentage of 4% for both water supply and sewerage.

As a result, by raising the tariff at 4% for both water supply and sewerage with combining the accounts for water supply and sewerage, cross-subsidy will be operated and PHE will have annual net profit at the year 2023-24 as a total of water supply and sewerage services.

Nevertheless, it is strongly recommended to separate the accounts of water supply and sewerage and to aim cost recovery of O&M, administration, and other minor costs for sewerage, because of the equal burden for service usage and healthy financial management of sewerage service.

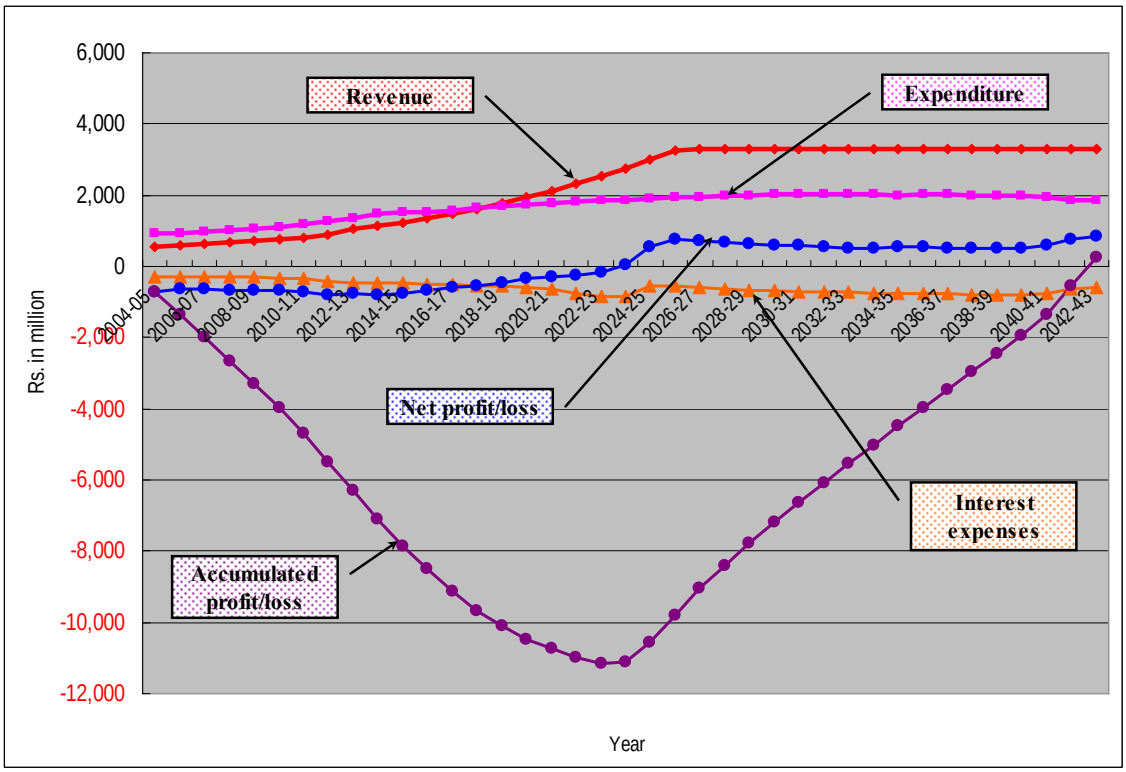


Figure 104.9 Projection of profit and loss of PHE for water supply and sanitation (4.0% tariff raise for both water supply and sewerage)

(7) Proposal for Introduction of environment tax

The benefits of sewerage treatment are not limited to the customers of the service. Downstream basin will benefit in many ways in improved sanitation and enhanced tourism and fishery. Tourism is one of the largest beneficiaries of the water quality preservation of the seashore. Recently, more than two million travelers are visiting Goa per year. Tourism is undoubtedly one of the major industries in the economy of Goa. It is very important to preserve the beautiful nature including seashore for Goa to keep attracting many visitors in the future. Taxation to the tourism for preserving beautiful seashore is reasonably considered as another resource of fund for sanitation service by PHE.

Tax shall be imposed on the tourists and hotels, restaurants, located in the sightseeing place. It is recommended that the budget from tax shall be utilized for the expansion of wastewater treatment plant, sewers, and pumps, and for the replacement of the equipment, so as to replenish the capital expenditures and the part of O&M costs which are not covered by the sewerage tariff revenue.

Detailed study and negotiation among other authorities must be necessary for considering the rate and method of taxation. As one of the possible system, it is considered to impose few percentages on the payment for the hotels and restaurants by tourists.

For the reference, tourists WTP for preserving environmental water quality by sewerage are investigated by Public Awareness Survey by JICA Study Team, which are Rs.18 per night for domestic tourist and Rs.240 per night for foreign tourist. General amount tax revenue is estimated under the following assumptions;

a) tax revenue comes only from the tourists
b) amount of tax is the one third of the WTP for the modest estimation, that is Rs.6/night for domestic tourist and Rs.80/night for foreign tourist
c) average duration of stay for tourists in Goa are 5 days for domestic and 9 days for foreign based on the "Tourist Statistics 2004"
d) tax is levied on the staying tourists, in which is the target area of M/P for sanitation

Simple estimation of the tax revenue is shown in the following figure. More detailed information is included in the Volume IV Appendix M104 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation. The necessary subsidy for Master Plan of sanitation services is calculated at around Rs.150 million to Rs.350 million in the financial plan. Estimated tax revenue falls into Rs.168 million to Rs.238 million in the area of M/P for sanitation. It is understood that not a negligible part of the governmental subsidy for sanitation service may be covered by the expected environment tax. It is recommended that PHE shall start detailed study for the planning of the taxation. Expected tax revenue is not included in the financial evaluation and financial plan of the Master Plan for sanitation project, since the introduction of tax imposition requires detailed study, negotiation with other governmental organization, and political decision with high uncertainty. The results of the financial evaluation and financial plan are certainly to be better, if the budget from tax revenue is utilized completely by PHE for sanitation services.

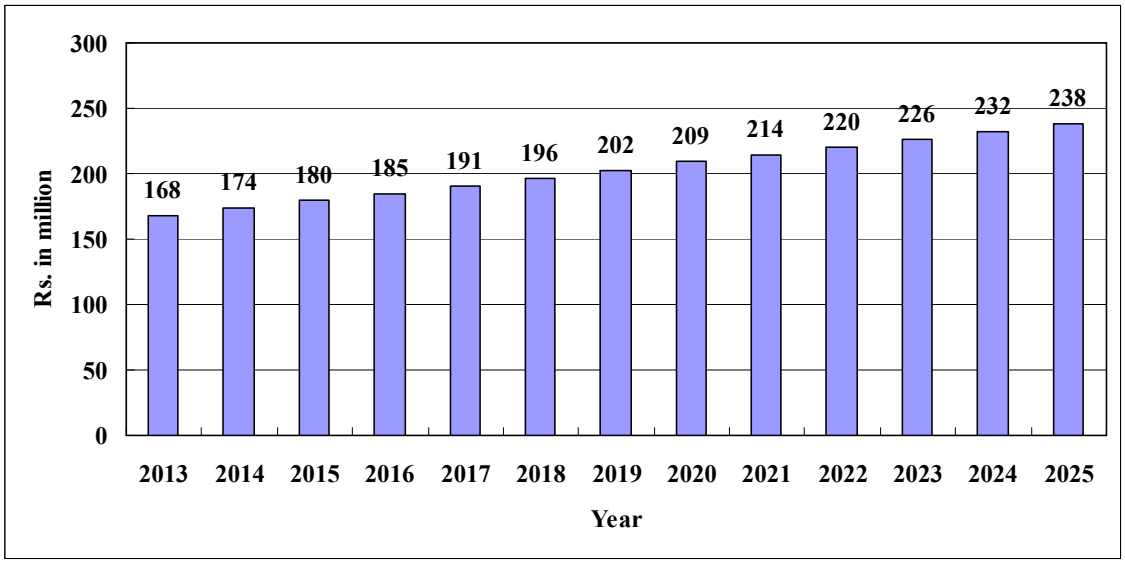


Figure 104.10 Estimation of tax revenue for tourists in sanitation M/P project areas

CHAPTER 11

SOCIAL CONSIDERATIONS AND INITIAL ENVIRONMENTAL EXAMINATION

CHAPTER 11 SOCIAL CONSIDERATIONS AND INITIAL ENVIRONMENTAL EXAMINATION

11.1 Public Consultation

Stakeholder participation has been incorporated into this project from an early stage. The participation has focused on the consideration of a wide range of environmental and social impacts. It is important to consult with the stakeholders to generate support for the projects. Figure 111.1 shows the continuous process of public consultation. The consultation has been carried out in three stages inline with the three phases of the Study by the PWD, in cooperation with the JICA Study Team. This figure was used at the first stakeholder meeting on 23 August 2005 to explain the public consultation approach that was being adopted. As shown in the figure, the consultation process started even before the master plan was developed. A detailed list of the invitees and attendants, record of discussion is provided in Volume IV Appendix M111.1 Note of Discussion from and Attendance Sheet of the First Workshop and Stakeholder Meeting.

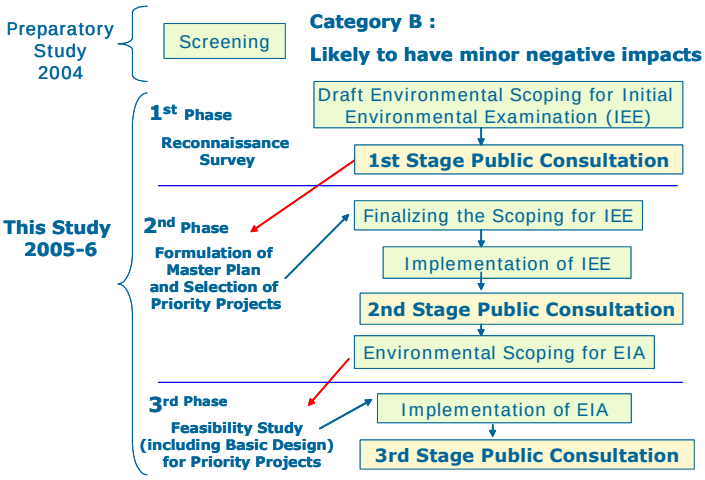


Figure 111.1 Process of Continuous Public Consultation

Figure 111.2 was also used at the stakeholder meeting to explain the each stage of public consultation. The first stage of public consultation included the public awareness surveys (which included the stakeholder interviews with residents living around the existing STPs) and the first stakeholder meeting.

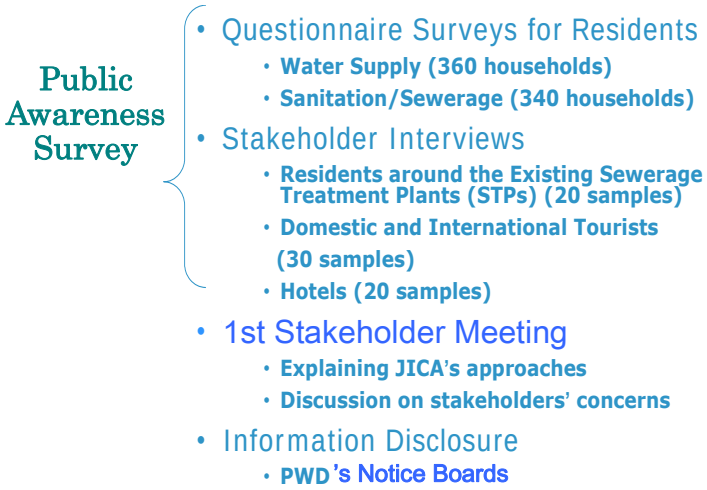


Figure 111.2 Contents of the First Stage of Public Consultation

The results of the public awareness survey were presented in the Chapter 3.6 and were referred to during the preparation of the master plan. Some of the main results were explained directly to the stakeholders during the second stakeholder meeting that was held on 23 December 2005. Also, some of the results from the stakeholder interviews with the residents living near the existing STPs were used to assess the potential negative impacts of the proposed sewerage projects as part of the IEE.

A discussion paper for the first stakeholder meeting was provided to the public by posting it on the notice boards in the PWD's head office and regional offices. The discussion paper is attached in Volume IV Appendix M111.1 Note of Discussion from and Attendance Sheet of the First Workshop and Stakeholder Meeting. Two local newspapers (Herald and Navhind Times) were requested to run advertisements to inform the public that the discussion paper was available on the notice boards.

The second stakeholder meeting was held by the PWD in cooperation with the JICA Study Team on 23 December 2005. More than 100 stakeholders were invited and around half of the invitees attended (54 attendants / 107 invitees). A detailed list of the invitees and attendants, record of discussion is provided in Volume IV Appendix M111.2 Note of Discussion From and Attendance Sheet of the Second Stakeholder Meeting.

11.2 Environmental and Social Considerations

11.2.1 Basic Approaches

The JICA Study Team is assisting the PWD to consider the environmental and social aspects of this project. The role of the JICA Study Team is to:

1) Assist the PWD implement the augmentation of the water supply and sewerage/sanitation systems smoothly, using finance from international donors. Preparing an Initial Environmental Evaluation (IEE) or Environmental Impact Assessment (EIA) is a condition of international funding.
2) Prepare an effective master plan and select priority projects which are not cause significant negative environmental or social impacts.
3) Assist the PWD to consult with stakeholders when preparing the master plan and Feasibility Study to generate support for the projects.

The Study Team assisted the PWD prepare the IEE for the Master Plan. The IEE report has been prepared in accordance with JICA's Environmental and Social Consideration Guidelines. During the Reconnaissance Survey, the Study Team, in conjunction with the PWD, prepared the draft environmental scoping and draft TOR for the IEE. When preparing the Master Plan, the Study Team assisted the PWD with the finalization of the TOR and its implementation. The Study Team has also been assisting the PWD with public consultation. This has included informing the public of the master plan, possible issues, and impacts at the proposed projects. During the Feasibility Study, the Study Team also assisted the PWD undertake the locally required environmental clearance procedure for the priority projects. The environmental clearance documents have to be prepared in consultation with the local government department responsible for reviewing and assessing rapid EIAs.

11.2.2 Implementation Schedule

Figure 112.1 shows the timeline for the work required to assess the environmental and social considerations. Two of the required six environmental and social consideration review reports prepared and were submitted to JICA's Tokyo Office as part of the Reconnaissance Survey. When developing the master plan, two more reports reviewing environmental and social considerations were prepared. These reports (the *Draft Final Report for Master Plan* and *Draft Scoping Report for Feasibility Study*), were submitted at the same time as the Interim Report. As part of the Feasibility Study, the other review reports was prepared and submitted to JICA's Tokyo Office.

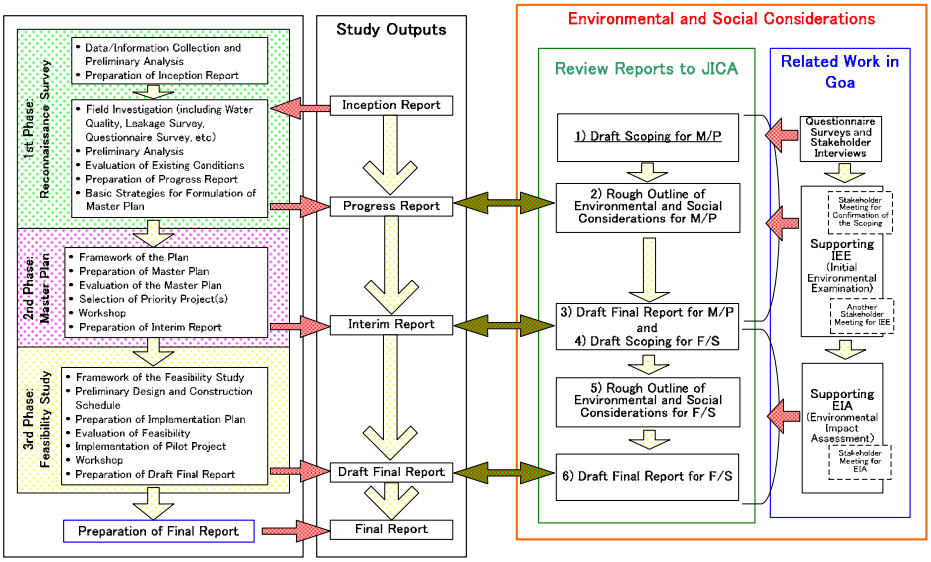


Figure 112.1 Timing for the Environmental and Social Impact Review Reports

11.2.3 JICA Environmental and Social Consideration Guidelines

The Preparatory Study (which was conducted by JICA in 2004) concluded that this study requires considerations of environmental and social assessment. This categorization is in accordance with JICA's Environmental and Social Considerations Guidelines, which were revised during 2004. The Study was classified as "B" because it is expected the construction and operation activities could result in some minor environmental and social impacts in terms of land acquisition, landscaping, water pollution, and odour. The results of the Reconnaissance Survey and the first two environmental and social considerations review reports have not identified any reason to be changed the classification.

11.2.4 EIA-related Regulations in India and Goa State

The *Water (Prevention and Control of Pollution) Act* and the *Environment Protection Act,* passed in 1974 and 1986 respectively, deal with the prevention and control of water pollution. The latter is an umbrella act covering all aspects of the environment. Under this Act the Central Government can take appropriate measures for protecting and improving the quality of the environment, and preventing, controlling and abating environmental pollution.

Pollution Control Boards were established under this Act both at the central government level, and for each state at the state government level. The water supply and sanitation projects for Goa will be executed by Goa's PWD. The PWD will co-ordinate the assessment of the environmental and social issues with the different state government departments (e.g. the Forest Department, the Science, Technology & Environmental Department (DST&E), and the State

Pollution Control Board) at various stages of project implementation and also during the operation phase of the projects.

Since the late 1970s foreign donor agencies have required EIAs to be undertaken. EIAs are legally required under the *Notification under the Environment (Protection) Act, 1986*, which requires certain projects to have environmental clearance from the Central Government's Ministry of Environment and Forests (MoEF). This Ministry is responsible for planning, promotion and co-ordination of environment and forestry programs. Each State Pollution Control Board implements the legislation, issues rules and regulations, and sets effluent standards. Direct responsibility for EIA lies with the "Impact Assessment Division" of the Ministry and its "Impact Assessment Wings" which are the division's decentralized authorities.

The 1994 Notification on Environmental Impact Assessment made it mandatory for EIAs to be undertaken for certain identified activities. Several States have also enacted their own EIA legislation in addition to the national provisions. The Director of the DST&E indicated that the state-owned EIA legislation has not yet been constituted in Goa. The proponent of any development project is personally responsible for undertaking the EIA study. Environmental screening of proposals is carried out by the relevant "Impact Assessment Wing" (e.g. the DST&E). The screening determines whether a rapid or full EIA is required. The scoping of the EIA study is carried out by the Environmental Appraisal Committee (sector-based). This committee liaises with the proponent and the Impact Assessment Wing.

In 1994 the MoEF listed 32 categories of industry which require mandatory EIA studies. These categories are specified in Schedule I of the Environmental Laws Acts (see Volume IV Appendix M112.1 The Notification of Environmental impact assessment and the List of Projects Requiring Environmental Clearance from the Central Government (The Schedule I)) Hand Book. The industries specified in Schedule I include fertilizer, petrochemical, pharmaceutical, dyes and paint, iron and steel manufacturing industries, thermal power plants, mining industries, port and harbour, and river valley projects.

The appraisal committees (consisting of experts, governmental officials and non-government organizations) were set up by the MoEF to assess various EIAs that were prepared for the establishment of such industries and projects. After their assessment the appraisal committees would grant the project an environmental clearance, in consultation with the MoEF.

The projects proposed as part of this Study are not included on the Schedule I "List of Projects

Requiring Environmental Clearance from the Central Government". This means an EIA report does not need to be submitted to the Central Government. However, the PWD needs their EIA (or other documents) to gain official approval from the Goa State Pollution Control Board, DST&E. The EIA approval procedures are shown in Figure 112.2.

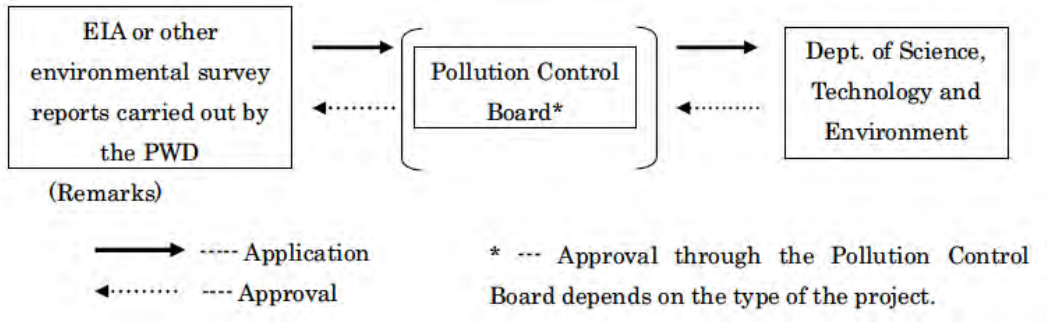


Figure 112.2 EIA Approval Procedures in Goa

After the rapid EIA is undertaken, approval at the national level from the Central Pollution Control Board (CPCB) and the MoEF is not necessary. This is because the water supply and sewerage projects are not included in Schedule I. However, it is necessary for the PWD to submit a report on the rapid EIA to the State Pollution Control Board (SPCB), because the SPCB has jurisdiction over water supply and sewerage schemes.

It is necessary to submit an 'Application Form', which includes the project details, to the SPCB. The application form must describe pollution impacts, such as the predicted air quality effects (as a result of exhaust emission), water quality impacts (as a result of the treated effluent), and characteristics of solid waste generation and disposal. Two separate application forms are required. One is needed before the proposed facilities can be constructed, and the other is needed before the facilities can begin operation. Prior to construction, the proponent must submit an application form seeking consent to establish (under Sections 25 and 26 of the *Water (Prevention and Control of Pollution) Act, 1974*). Another application form must also be submitted seeking consent to start operating the facilities, and for renewal of consent to continue operating existing facilities (such as wastewater treatment and sludge disposal facilities under Section 26 of the *Water Act*). This is one of the environmental clearances that the PWD must obtain before implementing the proposed sewerage projects. Water supply projects are not required to follow the same procedure because water supply projects are not targeted at the state level for environmental clearance.

The Indian Coastal Regulation Zone (CRZ) Notification of 1991 was established to preserve

valuable coastlines and prevent them from deteriorating as a result of haphazard development. The CRZ Notification is a crucial element of the regulatory framework because it has significant implications for project implementation. The CRZ Notification is the principle legislation governing development activities and land use along India's coasts. It applies to areas falling within at least 500 meters of the high tide line and in the inter-tidal zone. Under the notification, all areas within this zone are to be classified as CRZ I (i), I (ii), II, III or IV based on geomorphology and various other criteria, including ecological significance, existing developments and other features. The nature and type of land uses permitted vary according to the specific zone within which an area falls. There are greater restrictions on CRZ-I areas, fewer on CRZ-II areas and variable restrictions in CRZ-III areas. There is also considerable scope for varied interpretation. Generally, the Notification is complex (partly as a result of the 17 amendments that have been made since 1991) and it therefore has been interpreted and applied in different ways by both the central government and the states.

CRZ-I is defined by areas that are ecologically sensitive and important, such as national parks/marine parks, sanctuaries, reserve forests, wildlife habitats, mangroves, corals/coral reefs, areas close to breeding and spawning grounds of fish and other marine life, areas of outstanding natural beauty/historically/heritage areas, areas rich in genetic diversity, areas likely to be inundated due to rise in sea level as a result of global warming, and other areas as may be declared by the Central Government or the relevant State/Union Territory authorities from time to time. CRZ-I also includes areas located between the low tide line and the high tide line.

Within the CRZ-I, no new construction is permitted except (a) Projects relating to the Department of Atomic Energy and (b) Pipelines and conveying systems, including transmission lines and (c) facilities that are essential for activities permissible under CRZ-I. Between the low tide line and high tide line, in areas which are not ecologically sensitive or important, construction of dispensaries, schools, public rain shelters, community toilets, bridges, roads, jetties, ***water supply***, drainage, and ***sewerage*** for requirements of local inhabitants may be permitted. The high tide line refers to the highest point to which the sea water reaches during the spring tide.

The master plan has identified the proposed sites for the STPs and the WTPs. These have all been located outside of the CRZ to minimize their environmental impacts. The STP sites in Colva (South Costal Belt) and Baga (North Costal Belt) are around 1,000m and 700m away from the CRZ, respectively.

11.2.5 Summary of Draft Environmental Scoping

An environmental scoping document was prepared as part of the Preparatory Survey and was improved as a result of the Reconnaissance Survey. The improvements were based on a review of existing documents, site observations, discussions between the PWD and the JICA Study Team, stakeholder meetings, and the public awareness surveys. As part of the Development Study (M/P), a draft environmental scoping for the IEE was presented to the JICA Tokyo Office during September 2005. The scoping consisted of rough outline checklists for environmental and social considerations, prepared for each water supply and sewerage scheme. The submitted report also identified a selection of alternatives and possible mitigation measures for each identified potential impact. This section summarizes the environmental scoping for each of the main potential projects.

Additional environmental scoping was required after the outline of the Master Plan has been developed. There are some of the existing alternative projects (and the 'zero alternative' which is the 'do nothing' option) that were proposed by the PWD, prior to the study, were examined for the draft scoping as part of the Reconnaissance Survey.

(1) Water Supply Schemes

The Salaulim Water Supply Scheme is expected to require large scale expansion because the Salaulim Dam is the major water source that can meet the increasing water demand.

The site that the PWD previously proposed for construction of the new WPT is close to the existing Salaulim WTP and Salaulim Dam. The land has already been acquired by the PWD. There are no nearby residents, except for a small government owned compound which is next to the dam.

(2) Sewerage Scheme

The PWD previously proposed new sewerage schemes and extension of existing sewerage schemes in the following areas: the Northern Coastal Belt, the Southern Coastal Belt, Ponda, Mapusa and Margao. However, due to the low population density in these areas (except for Calangute Beach), improvement of the existing on-site facilities may be sufficient to accommodate the increasing sewerage volumes. Therefore, when developing the Master Plan the Study Team considered the possibility of improving the on-site sanitation facilities as alternatives.

The environmental scoping identified some likely significant impacts. The identified key

impacts include:

- wastewater discharge from STPs;
- offensive odor from STPs; and
- resettlement of residents (although this may not be necessary because the land acquisitions proposed for the STPs tends to be vacant).

These impacts mainly depend on the location of the STPs in relation to nearby residential areas and rivers. It is therefore important to select appropriate sites for the STPs when preparing the Master Plan. Site selection should consider the previously proposed sites and investigate more suitable sites, if necessary, in cooperation with the PWD.

The following discussion describes the proposed sites for the STPs in each area.

North/South Coastal Belt Sewerage Schemes

The PWD previously proposed several sites for the STPs along the north/south coastal belt. These sites do not required resettlement of residents. The PWD has indicated that there are many areas called “communidade”. These areas are community land and are supposed to be used for public purposes, such as sewerage treatment plants.

Mapusa/Ponda Sewerage Schemes

The PWD has indicated that overflow of effluent from septic tanks often annoys local residents. The underlying geology at Mapusa and Ponda is a key reason for the overflows. Installation of new sewerage systems in these areas is therefore expected.

The PWD previously proposed one potential site for a STP in Mapusa. The site is far from the populated area of Mapusa and is next to a river, which has a relatively large flow.

The PWD previously proposed two sites for a STP in Ponda. Both of the sites are far from the city of Ponda and are vacant land. The initial site is on privately owned land located next to a stream. Residential development is approaching the site from one side. The second site is unused community land, which is located away from residential areas. The site abuts a large pond which is connected to large tidal creek. Since this site is much further from the city of Ponda it would require longer sewerage pipelines.

Margao Sewerage Scheme

Margao has an existing STP, which is surrounded by paddy fields and some residential areas. The existing STP has enough land to accommodate future expansion within the premises.

The existing inflow of sewerage is well below the plant's capacity because only a small proportion of Margao's population has connected to the sewer.

The existing STP discharges its treated water to the adjacent small stream. The stream passes through a nearby paddy field before joining a larger stream. There is a potential risk of discharging untreated sewage into the small stream if there are power cuts or the facility breaks down. This risk would increase if the volume of sewage being treated rises. Therefore, the need for and feasibility of providing different mitigation measures (e.g. installing a discharge pipe to the larger stream and improvement of continuous facility operation) were considered as part of the IEE.

The need for, and feasibility of, installing odour mitigation measures, in recognition of the nearby residents, were considered as part of the IEE.

The IEE evaluated the potential negative impacts that have been discussed above. The IEE also assessed the impacts on low income earners, such as the imposition of sewerage connection and associated charges.

11.3 Summary of the Revised Environmental Scoping

11.3.1 General

The environmental scoping that was undertaken as part of the Reconnaissance Survey was limited to the alternatives and the proposed sites that were identified by the PWD prior to the Study. The initial environmental scoping also considered the 'do nothing' options. During the development of the mater plan, the initial environmental scoping document was improved and expanded to address the new and more specific project alternatives identified by the JICA Study Team.

The initial environmental scoping found that some of the initially proposed sites were not suitable or ideal in terms of environmental and social considerations. Therefore when developing the Master Plan some new alternative sites were considered, as well as some of the acceptable initial alternatives. The environmental scoping has been continuously revised to take account of the new sets of alternatives that were developed during the implementation of IEE. These alternatives were based on further site observations, discussions between the PWD and the JICA Study Team, and the second stakeholder meeting.

The new alternatives, assessed under the revised environmental scoping, indicate improved environmental and social prospects for the proposed projects. The Final Report on the environmental and social considerations for the master plan also includes a summary of the revised environmental scoping, along with maps and pictures of the alternative project sites that were examined. The IEE report includes detailed results of the environmental scoping (see Volume IV Appendix M114.1 Initial Environmental Examination Report for the Water Supply and Sewerage Master plan in Goa). More detailed environmental scoping was conducted as part of the Feasibility Study for the selected priority projects.

The main points of the revised environmental scoping (for the water supply projects and sewerage projects proposed in the master plan) are presented in the following sub-sections. The proposed mitigation measures are explained in a later subjection (11.4.2 "Results of Impact Evaluation and Recommended Mitigation Measures").

11.3.2 Water Supply Schemes

The following shows the major water supply project components proposed in the master plan. The revision of the environmental scoping for the IEE was limited to the six major facilities that are proposed for the expansion of the four water supply schemes (these are listed under (1).

(1) Project components assess in the revised environmental scoping

- Expansion of the Salaulim Water Supply Scheme (for Mormugao, Salcete, Quepem, Sanguem)
  - ✧ Construction of a new water treatment plant in the vicinity of Salaulim Dam
  - ✧ Construction of a new master balancing reservoir on the hill at Sirvoi
  - ✧ Construction of another transmission pipeline from Salaulim to Margao
- Expansion of Other Water Treatment Plants
  - ✧ Assonora WTP (for Bardez)
  - ✧ Dabose WTP (for Satari)
  - ✧ Canacona WTP (for Canacona)

Before explaining the alternative project sites and their potential negative environmental and social impacts, it is important to understand the expected positive impacts of the proposed projects. These positive impacts are summarized here.

< Expected Positive Impacts >

- Expansion of areas being supplied with water

- Improved water quality
- Continuous water supply
- Reduction of waterborne diseases
- More water availability for tourist facilities
- More water availability for industries
- Improvement of socio-economic conditions
- Effective operation and maintenance
- Reduction of non-revenue water, including water leakage

< Alternative Analysis of Project Sites and Identification of Potential Negative Impacts >

This environmental scoping identified the following issues as likely to have significant impacts as a result of the proposed water supply projects:

- Deforestation for the construction of WTPs and reservoirs.

The right to acquire water for the proposed water supply project was permitted by Goa's Water Resource Department at the end of the development of the master plan.

An analysis of alternatives for each set of proposed project sites was conducted through the environmental scoping process. The purpose was to select the best project components and sites. The following results are for the alternative analyses of the proposed water supply projects.

<u>Expansion of the Salaulim Water Supply Scheme</u>

Only the Salaulim Water Supply Scheme (WSS) is expected to require large scale expansion. This is because Salaulim Dam is the major water source that can meet the increasing water demand in the scheme. Therefore, there is no possible alternative to the expansion of the Salaulim WSS.

The site is considered to have fewer negative social impacts. Since there are only a few scattered households around the area, the boundary of the site could be set to avoid impacting any existing households or archaeological sites. The only main impact would be the deforestation of the site.

Other than constructing the WTP, construction of the transmission pipeline from Salaulim to Margao, and construction of a new master balancing reservoir on the hill at Sirvoi (the largest master balancing reservoir to be constructed) is also proposed. These two additional

components were also examined in the revised environmental scoping.

Neither of these project components have alternative sites. The new transmission pipeline (especially for water supply transmission) will be installed along with the existing transmission lines in the road that is already constructed and owned by the PWD. The road mainly passes through rural areas where households are scattered and where there is sufficient space to install another transmission pipeline in the road shoulder. Therefore, its construction is considered not to have any major environmental and social impacts.

The proposed site for the new master balancing reservoir is located along the road that was constructed for the water transmission pipelines. The site is on the hill at Sirvoi. This is the best and only place that is hydraulically suitable for the new master balancing reservoir. Fortunately there are no residents living on the hill. The only major potential impact of the deforestation of the construction site.

Expansion of the Canacona WTPs

Tenders for the expansion of the existing Canacona WTP have already been let by the PWD. The site for the expansion is located next to the existing water treatment facilities. The site is clear land that is owned by the government. The proposed expansion (only 10,000m^3/d) is much less than that of the proposed new Salaulim WTP. Therefore, only a small parcel of additional land is required, meaning the required deforestation would be minimal.

Expansion of the Dabose WTPs

The expansion of the existing Dabose WTP is about to be put out to tender. The site for the expansion is located next to the existing facilities. The land is privately owned and is on a slope. The facility will be expanded to only 10,000 m^3/d. Therefore, only a small parcel of additional land is required, meaning only small scale deforestation is required. However, some households are located on the top of the slope, therefore special care needs to be taken when carrying out the earth excavation.

Expansion of the Chandel WTPs

The proposed site for expansion of the existing Chandel WTP is located within the current WTP premises. The expansion will take place only if Mopa airport is constructed in the Pernem Taluka. The required for the new facility would be around 2ha. The scale of the facility expansion is 15,000 m^3/d. There is not expected to be any potentially significant social or environmental impacts resulting from the expansion of the Chandel WTP. This is because the

land has already been acquired and leveled by the PWD.

11.3.3 Sewerage Schemes

This section lists the major project components proposed in the sewerage master plan. Revision of the environmental scoping was limited to the expansion of the two existing STPs and the construction of six new STPs.

(1) Project components covered in the revised environmental scoping

- Expansion of the existing STPs
  - ✧ Panaji STP (Surrounding areas of Panaji including Taleigao, Dona Paula and Caranzalem)
  - ✧ Margao STP (South Zone of Margao)
- Consutruction of new STPs.
  - ✧ St. Cruz STP
  - ✧ Provorim STP
  - ✧ Ponda STP
  - ✧ Mapusa STP
  - ✧ Colva STP (in South Coastal Belt)
  - ✧ Baga STP (Calangute and Candolim in North Coastal Belt)

Before explaining the alternative sites for STPs and their possible negative impacts, it is important to understand the expected positive impacts resulting from the proposed projects. These positive impacts are summarized here.

< Expected Positive Impacts >

- Improved water quality in rivers and beaches.
- Improved condition of the natural environment including in gutters and local streams
- Reduced overflows from existing septic tanks
- Improved sanitary conditions in the cities
- Improved environmental conditions in the Costal Belts
- Reduction of the risk of disease and enhancement of human health
- Reuse of nutrient rich sludge from Sewage Treatment Plants for horticulture, etc.
- Improved image of cities and enhancement of the value of the cities
- Improved socio-economic conditions
- Reuse of treated water for sprinkle on the garden, etc.
- Benefits for women, including improving their dignity

< Analysis of Alternative Project Sites and Identification of Potential Negative Impacts >

This environmental scoping identified some likely significant impacts that could result from the proposed sewerage projects. The identified key impacts include:

- Wastewater discharge from STPs;
- Offensive odour from STPs;
- Acquisition of land currently used for agriculture and horticulture; and
- Disposal of sludge.

These impacts mainly depend on the location of the STPs in relation to nearby residential areas and rivers. Therefore, the sites for the STPs were carefully selected based on analysis of a range of sites. The most suitable sites were identified as part of the master planning process. To improve the site selection process new sets of alternative sites were identified during the development of the master plan. These new sites were added to the sites initially proposed by the PWD. The most suitable site for each STP was presented in the second stakeholder meeting along with some of the alternative sites. This presentation was done to confirm that the most suitable site was selected and to identify any potential negative impacts.

A description of the analysis of alternatives is provided below.

Expansion of the Margao STP

Margao's existing STP is surrounded by paddy fields and some residential areas. The existing STP has enough land to accommodate future expansion within the premises. The existing sewage inflows are currently well below the treatment plant's capacity because only a small proportion of Margao's population are connected to the sewers. However, the inflow is expected to significantly increase once the service area is expanded to include the Southern Zone of Margao, and once the number of household connections increases.

The existing STP discharges the treated waste water into the adjacent small stream. The stream passes through a nearby paddy field for about 400m before joining the Sal River. If there were power cuts or the facility breaks down there is a risk that untreated sewage could be discharged into the small stream. This risk would increase if the volume of sewage being treated rises.

The current odour level at the Margao STP is not significant because the raw sewage is significantly diluted by groundwater that infiltrates into the sewers, and because the current inflow is well below the designed inflow quality. However, the planned increase of the inflow

has the potential to cause significant odour problems, especially during the dry season. After construction of the existing STP, a high density residential area was developed to the east of the STP. The boundary of the residential area now extends to the STP. The offensive odour from the STP has presumable significant impact on the residential area.

Expansion of the Panaji STP

The main STP, which is located to the south of Panaji, serves most of Panaji. It is now surrounded by residential areas. The STP has been expanded recently to treat increasing volumes of sewage in Panaji. The existing STP has enough land to accommodate future residential expansion. Further expansion will significantly increase the inflow of sewage into the existing STP.

The existing STP releases its treated wastewater through discharge pipes which deliver the wastewater to a point 50m away at the mouth of Mandovi River. Initially the STP discharged its treated wastewater to the adjacent stream. However, to improve the environmental situation the discharge point was moved to the mouth of the river. The flow of Mandovi River is large, therefore the increased discharge is not expected to cause any significant negative impacts.

The current odour level at the Panaji STP is significantly stronger than at the Margao STP. However, the odour has been significantly reduced by the recent expansion of the treatment facilities. The odour has been reduced as a result of decommissioning of the old trickling filter. Since the STP was first built, residential areas have developed nearby. Therefore, a treatment process that minimizes odour is required if the STP is to be further expanded.

Construction of the Mapusa STP

The results of the public awareness survey and the first stakeholder meeting indicated that the overflow of effluent from septic tanks occurs often, especially in Mapusa and Ponda. The subsurface geology in Mapusa and Ponda is a key reason for the overflows. Installation of new sewerage systems in these areas is therefore required.

The site for the Mapusa STP identified by the PWD is located away from the populated area of Mapusa and is next to a river, which has a relatively large flow. The site is part of a “communidade”, which is community land and is supposed to be used for public purposes such as STPs. Based on the site investigation and the available land use plan, it is considered unlikely that the area surrounding the site could be used for urban development in the future.

Construction of the Ponda STP

The PWD identified two alternative sites for the Ponda STP. One of these sites abuts a large pond which is connected to a large tidal creek. This site is unused community land, and it is located away from residential areas. However, this site is far away from the city of Ponda and it would require long sewerage pipelines. The other site is on privately owned vacant land located next to a stream. Although this site is far from Ponda, residential development is approaching the site from one side. The analysis of alternatives compared these two sites in terms of environmental, social and financial impacts. The analysis indicated that the site near Ponda is the most appropriate.

Construction of the Porvorim STP

The possible sites for the Porvorim STP are located on an elongate private open/wetland at the downstream end of Porvorim in Penha de Franca, adjacent to the Mandovi River. The open land, through which a small creek flows towards the Mandovi River, is partly surrounded by scattered households. The analysis of alternatives compared two sites. The first was located at the upstream end of the open land, and the second was located at the downstream end. The potential environmental and social impacts at these two sites were compared.

The downstream site is located at the mouth of the creek. Therefore, this site would require a large amount of land filling to provide level land for construction. The housing density is greater at the downstream site. Therefore, the upstream site was identified as the most suitable site for the Provorim STP. However, odour from the STP is expected to have a potential negative environmental impact on the limited number of surrounding households.

Construction of the St. Cruz STP

The possible sites for the St. Cruz STP are located at either side of the road at the town of St. Cruz. The sites are located on open land near the wetland on the Mandovi River. On the side next to the wetland, a housing complex is under development. One local political activist opposes the development of this condominium complex because the housing complex may cause environmental impacts on the wetland. There are areas of land near the wetland that could be environmentally sensitive. Therefore, it is recommended that the St. Cruz STP be located on the side of the road furthest from the wetland and the condominium complex and also set away from the expanding town of St.Cruz to avoid future odour problems.

Construction of the Baga (Calangute/Candolim) STP (Northern Coastal Belt)

The PWD previously proposed new sewerage schemes to cover most of the Northern Coastal

Belt and the Southern Coastal Belt. However, population densities in these areas (except for Calangute and Candolim in the north; and Colva in the south) were found to be too low to justify installation of a sewerage system. Therefore, sewerage systems are planned for the three areas of high population density, and the remaining areas will have their existing on-site wastewater treatment facilities improved and decentralized system.

Through previous studies the PWD identified several different sites for the proposed STP in the Northern Coastal Belt. However during the Reconnaissance Study it was found that these sites were not suitable in terms of social impacts on the surrounding areas. Therefore more suitable alternative sites were investigated.

Two alternative sites for the STP servicing Calangute and Candolim were recently identified. These sites were selected based on two alternative sewerage plans (one being a separated system which covers the two areas separately by separate sewerage facilities; and the other being an integrated sewerage system). One site is located at the northern end of Calangute Panchayat (Baga) and the other is at the southern end of Candolim Panchayat.

The site nominated for the integrated sewerage system is a few hundred meters behind Baga Beach. Both sites would be used for the separated sewerage system. From an environmental perspective, the site in Baga is more suitable for a STP. The alternative site in Condolim has limited space, is currently used as paddy fields, and is relatively close to a residential area.

The analysis of alternatives identified the integrated sewage system as the best option for Calangute and Candolim. Therefore, the site in Baga was selected. The selected site is a large area and is located away from residential areas. The STP site is located approximately 1km away from the Coastal Regulation Zone (CRZ). A stream passes near the site and discharges into the right-hand side of Baga Beach.

Construction of the Colva STP (Southern Coastal Belt)

Several alternative sites for the Colva STP have been considered in the Southern Costal Belt. The most suitable land was identified to be at the southern side of the Colva residential areas. The site is located as far from the beach as possible. The STP site is approximately 700m away from the CRZ. The fact that the site is connected to the beach by a small stream is a concern. However, it is planned to discharge the treated wastewater from the STP into the Sal River through a pressured diversion pipeline. This avoids environmental impacts on the beach area.

11.4 Initial Environmental Examination

11.4.1 TOR for the IEE

The IEE mainly evaluates the level of potential key negative impacts that had been identified in the environmental scoping. The IEE also assess the impacts of the proposed projects on low income earners, such as the imposition of sewerage connection and associated charges.

The terms of reference (TOR) for the IEE were finalized by the PWD, with support from the JICA Study Team. The TOR was developed towards the end of the development of the master plan. The contents of the IEE are outlined below:

1) Review of Guidelines, Policy, Legal and Administrative Frameworks
2) Review of the Proposed Projects' Outlines
3) Review of Site Description for Each Proposed Project
4) Review of Environmental Scoping and Analysis of Alternatives
5) Evaluation of the Key Potential Impacts that were identified by the Scoping and Recommendation of Mitigation Measures

The methodology for item (5) "Evaluation of the Key Potential Impacts that were identified by the Scoping and Recommendation of Mitigation Measures" is outlined below:

***a. Data Collection*:** The following issues were analyzed mainly by collection and review of relevant documents and from discussions with relevant PWD officials:

- Land Acquisition and Compensation Procedures.
- Reuse of Sludge and Wastewater.

***b. Field Surveys*:** To supplement information available in existing documents, the following field surveys were undertaken:

- Water quality testing and geological investigation of the water bodies that are receive the treated wastewater from the STPs.
- Observation of the woodlands to be cleared.

c. Analysis of the Public Awareness Survey: The results of the public awareness survey were used to assess the following three aspects:

- Effects of Odour from STPs.
- Difficulties of Water Supply in Rural Areas.

- Difficulties of Sanitation/Sewerage for Low Income Groups.

11.4.2 Results of Impact Assessment and Recommended Mitigation Measures

A full evaluation of potential significant impacts and the recommendation of mitigation measures are provided in the IEE Report (attached in Volume IV Appendix M114.1 Initial Environmental Examination Report for the Water Supply and Sewerage Master plan in Goa). The following sections summarize the results of the IEE that relate to the impact evaluation and recommended mitigation measures.

(1) Land acquisition and compensation procedures

Projects sites have been selected to avoid residential, commercial and industrial areas. Therefore, the selected project sites for the STPs, WTPs, etc. tend to be vacant land, woodlands, wetlands, horticultural lands or paddy fields, which belong to the state government, government agencies, communities (communidade) or private owners. The details of the land identified as the proposed sites are summarized in the following table.

Table 114.1 Land Details for the Proposed Sites

Project Component Requiring Land	Capacity of Facility to be Expanded and Newly Constructed	Area Need to Be Acquired	Types of Ownership	Type of Land Use
Expansion of Salaulim WTP	200,000 m^3/d	8ha+2ha(intake)	Government	Woodland
Master Balancing Reservoir at Sirvoi	40,000 m^3/d	3ha	Government	Woodland
Expansion of Canacona WTP	10,000 m^3/d	About 1 ha	Government	Woodland
Expansion of Dabose WTP	10,000 m^3/d	About 1 ha	Private	Bareness small hill
Expansion of Chandel WTP	15,000 m^3/d	-	Government	Within the premises
Expansion of Panaji STP	8,900 m^3/d	-	Government	Within the premises
Expansion of Margao STP	13,400 m^3/d	-	Government	Within the premises
Mapusa STP	10,800 m^3/d	15,500 m^2	Community-trust	Open land
Ponda STP	3,500 m^3/d	5,300 m^2	Private	Open land
Porvorim STP	7,600 m^3/d	11,000 m^2	Private	Open land/Wetland
St. Cruz STP	2,500 m^3/d	4,000 m^2	Private	Paddy field
Colva STP	2,200 m^3/d	3,500 m^2	Private	Paddy field
Baga (Calangute/ Candolim) STP	11,200 m^3/d	15,800 m^2	Department of Tourism	Open land

Resettlement of residents and removal of valuable structures are not required for acquisition of the identified land. Also, the land types are typical of the surrounding area, therefore it is likely to be relatively easy to provide the original land owners with similar, suitable compensatory land. Therefore, the negative impacts caused by land acquisition are not considered to be significant.

The recommended mitigation measures for land acquisition impacts include the provision of monetary compensation and/or compensatory land. The land acquisition and compensation procedures are described below:

The Land Acquisition Act, 1894 applies to the acquisition of the land from communidade and private owners. According to the Land Acquisition Act, a land acquisition plan must be

submitted to Goa's Collector (either the Northern Goa Collector or the Southern Goa Collector) before the land can be acquired. The Collector then appoints a regional land acquisition officer to facilitate the land acquisition. The PWD has one land acquisition officer in Panaji. The land acquisition officer has indicated that the normal duration for land acquisition is about two years. However, in urgent cases, lands can be acquired within about six months.

The following equation is used to calculate the compensatory money for land acquisition:

Total Compensation (Rs) =

Land Cost (Rs) × (100% + Additional Compansation:12% + Solatium Charges: 30%) + Cost of Trees and Crops (Rs) + Cost of Structures (Rs)

The appointed land acquisition officer evaluates the land cost based on recent sales statistics for land that is located within a 2 km radius from the land to be acquired. The total cost of trees and crops is evaluated by the Zonal Aquiculture Office from the Forest Department. The cost of existing structures is evaluated by the PWD.

Although the *Land Acquisition Act* specifies the compensation procedure, there is no regulation that allows for substitute land to be provided as an alternative to monetary compensation. If substitute land is requested instead of money, an application letter must be submitted by the concerned land owner/user to the Revenue Department. The Minister's Councilor will then make a decision on this matter.

(2) Disposal of Sludge and Treated Water from the STP

Sludge consists of by-products collected from the water and sewage treatment process. Sewage sludge in particular contains compounds of agricultural value (including organic matter, nitrogen, phosphorus and potassium, and to a lesser extent, calcium, sulphur and magnesium), but also pollutants (such as heavy metals, organic pollutants and pathogens). The sludge characteristics depend on the original pollution load of the treated water, and also on the technical characteristics of the wastewater and sludge treatments carried out. Sludge is usually treated before disposal to reduce its water content, its fermentation propensity and the presence of pathogens. Several treatment processes are available e.g. thickening, dewatering, digestion, and thermal drying.

Once treated, sludge can be recycled or disposed of using three main routes: recycling to agriculture (land application), incineration or land filling.

Major developed countries already have their own guidelines for the detection of heavy metals and toxins in sewage sludge. These guidelines require measuring and testing of sludge to ensure allowable maximum levels are not exceeded. Some guidelines require that the land on to which the sludge fertilizer is applied must be approved and monitored to ensure that the specified nitrogen to heavy metal ratio is not exceeded. Therefore, continuous monitoring of those parameters is essential in India.

Currently, the sludge is treated on sludge drying beds in Margao and dewatering in Panaji of each existing STP. The PWD sometimes provides the dried sludge to village farmers around the STPs free of charge. The master plan estimates that approximately 45 m^3/d of wet sludge is generated. In the future, sludge should be sold to farmers and the fertilizer industry in an organized manner.

However, sludge reuse is recommended only if the concentration of heavy metals would not significantly impact on the soil conditions of agricultural lands. It is also recommended to take into account the contents of heavy metals already present in the land and the pH of the soil. In practice, reuse of sludge would face technical and social difficulties. For example, the sludge would need to be stored properly. Storage is required because sludge is produced throughout the year, but the demand for sludge would be limited to one or two seasons each year. Also, as yet there are no accepted guidelines in Goa that control the amount of sludge that can be applied to agricultural land.

Treated water can also be used for the irrigation of forest and farmland. The backwash water from some of the existing WTPs (e.g. Canacona WTP) is already used for irrigation of a nearby plantation during the dry season.

(3) Water quality information and geological investigation of the water bodies that will receive the treated water

The following table shows the discharge points of the proposed STPs in the master plan.

Table 114.2 Proposed Discharge Points for the Treated Effluent

Sewage Treatment Plant	Discharge Point
Panaji (Tonca) STP	Mandovi River
St. Cruz STP	Tributary of Mandovi River
Porvorim STP	Tributary of Mandovi River
Margao STP	Small stream connecting to Sal River
Ponda STP	Tributary of Zuari River
Mapusa STP	Tributary of Mandovi River
Colva (South Coastal Belt) STP	Sal River
Baga (Calangute and Candlim, North Coastal Belt) STP	Baga River

The environmental scoping found that only the Margao STP currently discharges/will continue to discharge its treated water into a small stream. The planned discharged points of the other proposed STPs are rivers which have sufficient flow to significantly dilute the effluent, meaning no significant environmental or social impacts are expected. For the Colva STP, the analysis of alternatives indicated that the treated water should be discharged from the STP into the Sal River through a pressure main, instead of into a nearby small stream that discharges to the beach.

The Study Team carried out visual observations and geological investigations to assess the impacts of the effluent from the Margao STP by walking along the stream from the existing discharge point to the confluence of the stream with the Sal River (which has a larger flow). In the dry season stream flow is almost the same volume as that of the effluent from the STP. However, the stream water quality was good, because the wastewater was well treated before being discharged into the stream. The environment surrounding the stream is high quality paddy fields. That is, the paddy fields are not degraded by the STP effluent. It is assumed that the effluent actually has positive impacts on the paddy fields as it provides nutrients.

The IEE found that the confluence of the small creek with the Sal River is about 400 m away from the discharge point. The environment surrounding the confluence is not actively used for riverside activities. Therefore it is expected that the environmental impacts of the effluent from the Margao STP are not significant and will not be significant even after the proposed expansion of Margao STP. It was also concluded that the installment of a discharge pipe from the STP to the Sal River is not required as a mitigation measure.

The water quality investigation of the existing STPs that was conducted by the Study Team as part of the Reconnaissance Survey showed that the water quality of the treated sewage effluent from the Margao STP meets the effluent Standards (BOD and SS) of India during both the dry and wet seasons, as shown in Table 114.3.

The water quality investigation also indicated that the STP reduces the number of coliform. It is proposed that disinfection process using post-chlorination of treated water is highly effective in reducing the number of coliform. However, continuous water quality monitoring is required to check the functional treatment capability of the sewerage facilities.

It is important that discharge of untreated sewage into the rivers and the sounding environment is avoided even during power cuts. Therefore, installment of an emergency power generator at each proposed STP should be considered as a mitigating measure. Also, a sustainable operation and maintenance plan for the proposed STPs should be prepared and implemented.

Table 114.3 Water Quality of the Effluent and Discharge Points at the Panaji & Margao STPs

STP	Season	Water Quality Parameter	Raw sewage	Water Quality of Effluent		Water Quality of the Stream receiving the Effluent	
				Measured Value	Effluent Standard[1)]	Measured Value	Environment Standard[2)]
Margao	Rainy Season	BOD (mg/L)	6.0 mg/L	3.0	50	2.2	30
		SS (mg/L)	8.0 mg/L	2.0	100	1.5	100
		Coliform (MPN)	4,600,000	46,000	-	110,000	No standard Recommended[3)]
	Dry Season	BOD (mg/L)	30.5 mg/L	13.0	50	22.5	30
		SS (mg/L)	28.0 mg/L	9.5	100	22.0	100
		Coliform (MPN)	11,000,000	460,000	-	240,000	No standard recommended
Panaji	Rainy Season	BOD (mg/L)	82.0 mg/L	5.5	50	4.0	30
		SS (mg/L)	67.0 mg/L	5.0	100	9.5	100
		Coliform (MPN)	4,600,000	1,100,000	-	4,300	No standard recommended
	Dry Season	BOD (mg/L)	53.0 mg/L	7.4	50	6.9	30
		SS (mg/L)	42.0 mg/L	4.5	100	8.0	100
		Coliform (MPN)	46,000,000	1,100,000	-	95,000	No standard recommended

1) Central Pollution Control Board (July 2002), Environmental Standards for Ambient Air, Automobile, Industries and Noise, p55
2) Schedule-VI Part-A, General Standards for discharge of Environmental pollutants in Inland Surface waters, The Environmental Protection Rules, 1986
3) Health Guidelines for Use of Wastewater in Agriculture and Aquaculture, TP No.788. WHO, 1989

(4) Assessment of the woodlands to be cleared

Most of the proposed sites for STPs, WTPs and reservoirs are vacant lots without any buildings. However the sites for the New Salaulim WTP and the Main Balancing Reservoir at Sirvoi are covered by trees. Part of the proposed routes for the new transmission mains also pass through woodland. As a result, clearing is required for the construction of these facilities.

Fortunately, the areas that need to be cleared are not protected by law as national parks nor are they valuable tropical forests which require special consideration. The soil at these sites is hard laterite soil, meaning landslides are not likely to be caused by land clearing.

As a mitigation measure it is recommended that trees are replanted within the premises where the facilities are going to be constructed. However, due to the limited size of the sites, an equal area cannot be replanted. Therefore, some additional trees should be planted in nearby areas.

It is also recommended that some trees are maintained around the construction site to minimize visual impacts and to minimize the size of the land clearing. Therefore, the feasibility study and the detailed design stage should design and layout the facility with consideration of landscaping as well as the required technical aspects.

(5) Odour impacts from the STPs

As part of the Reconnaissance Survey, stakeholder interviews were conducted with 20 residents who live around the existing Panaji and Margao STPs. The purpose of the interviews was to gain an understanding of the environmental and social considerations required for the sewerage projects. The interviewees were asked about their perception on the significance of the odour from the STPs. The results are shown in Table 114.4. This table indicates that about a quarter of the residents surveyed consider that odour from the STP is a serious problem.

Table 114.4 Perception on the significance of odour from the STPs

Level of Seriousness of the Odour	Percentage of Respondents
1. Very serious	25%
2. Serious	37%
3. Not very serious	38%

Margao STP is currently operated far below its treatment capacity and the pollutant concentration is low due to groundwater infiltration into the sewers. Therefore, the current odour level in the Margao STP is usually very low. However, the Panaji STP currently treats large amounts of wastewater. Residential areas were developed around the Panaji STP after its construction. Also, the Panaji STP used to have a wastewater technology which resulted in strong odour, until the wastewater treatment facility was recently replaced as part of the capacity expansion. Judging from these situations, the historical odour problem at the Panaji STP seems to have affected the residents' perception on the significance of the odour from the STP, even though the odour situation has now significantly improved. The future expansions of

these two STPs have the potential to cause increased odour and to affect the residents who already live around the STPs.

Most of the proposed sites for the new STPs are set away from residential areas (except for the Ponda STP). Therefore, odour is not expected to have significant impacts. However, there is an expanding residential area at one side of the proposed Ponda STP site.

Mitigation measures to reduce odour are required for the further expansion of the existing STPs and for the construction of the Ponda STP. The main mitigation measure recommended is the application of appropriate wastewater and sludge treatment technologies e.g. use of biological aerobic treatment process such as the Oxidation Ditch. Also, sealing the wastewater and sludge treatment facilities should be considered. Another mitigation measure would be to design the facility layout so that the odour causing facilities are located as far from the residential areas as possible.

These mitigation measures should be incorporated into the basic design of the wastewater and sludge treatment facilities during the Feasibility Study.

(6) Difficulties of water supply in rural areas

Most of the rural areas will be covered by the expansion of the surface water supply schemes proposed in the master plan, including the expansion of the Salaulim WTP. This expansion may result in a significant financial burden on the new users because they need to pay water charges. This financial burden may discourage the rural population from using the treated water from the expanded schemes.

A possible means of mitigating the financial impact would be to improve the tariff structure with consideration of the rural population. That is, since the rural population tends to have lower incomes than the urban population, a subsidy should be provided for rural users.

(7) Sanitation/sewerage difficulties for low income groups

In general, the lowest income group living in informal residential areas cannot afford to connect their houses to the sewerage system. Therefore, developing the sewerage system may increase the socio-economic gap between the poor and rich (since the poor may not be able to afford to connect to the sewerage system and the rich can).

Fortunately, in many low income residential areas, public toilets have already been installed by

Sulabh International, a local NGO. These public toilets use septic tanks and soak pits. However some of the public toilets do not work properly due to the low infiltration rate of the laterite soil. The new sewerage service areas proposed in the master plan cover the low income residential area in Monte Hill where their public toilets have this infiltration problem.

Therefore, it is recommended that these public toilets are connected to the newly installed sewer network. Also, the budget should be used to improve the sanitary situation of the urban poor and the rural population. For example sewerage should be installed for populated areas, new public toilets should be constructed for the urban poor, and a subsidy for the rural population for the construction of private latrines should be provided. The PWD has been implementing the "Total Sanitation Campaign" since 2005, in the semi-urban and rural areas of Goa. This will have a significant role in the reduction of the gap in sanitation between sewerage users and non-sewerage users.

11.4.3 Level of Required EIA as a Result of the IEE

The IEE study was undertaken to identify any potential negative or positive impacts on the social and natural environment, resulting from the projects proposed under the master plan. JICA's Environmental and Social Consideration Guidelines recommended that an IEE be undertaken. The purpose of the IEE was to clarify the needs and targets for further environmental assessment. This information is then intended to be used to scope any subsequent EIA. The three primary objectives of the IEE were to:

- identify the nature and severity of specific, significant environmental issues associated with the project;
- identify readily applicable mitigation measures for any significant environmental issues. If the IEE indicates that there are no significant environmental issues which need further investigation, then the IEE serves as the rapid EIA Report; and
- develop the terms of reference for the rapid EIA study should more detailed assessment be needed (or any special topic reports which may be required instead of, or in addition to, the rapid EIA).
-

Environmental scoping for the rapid EIA was conducted in the context of the IEE. Initially the projects were screened and found to have potential environmental impacts. An IEE was then undertaken to determine the potential environmental impacts associated with the projects and to determine whether a full-scale EIA would be required as part of the Feasibility Study.

The IEE was undertaken within a limited budget, and was based on existing information, and

the professional judgment of people experienced in this field. The IEE indicated that only a rapid EIA (not a full-scale EIA) is required for the Feasibility Study because the expected negative impacts of the proposed projects were considered to be relatively low (see the IEE report in Volume IV Appendix M114.1 Initial Environmental Examination Report for the Water Supply and Sewerage Master plan in Goa).

In conclusion, a rapid-EIA document prepared by the proponent (PWD) must submit to the DST&E without delay. The baseline survey for the rapid EIA was initiated at the same time as the Feasibility Study. Relevant EIA staff in the PWD carries out the necessary consultations and meetings with the DST&E.

11.4.4 Terms of Reference for the Rapid-EIA Study

(1) Objectives of the Rapid-EIA Study

The objectives of Rapid Environmental Impact Assessment (EIA Study) of the proposed project are;

- to review the existing environmental conditions in the area related to the Priority Project,
- to assess any significant adverse or negative impacts during construction and operation of the proposed facilities in the Priority Projects,
- to propose countermeasures for mitigating impacts and environmental monitoring plan

In the EIA study, the Goa State regulations on EIA shall be applied as well as the JICA Guidelines for Environmental and Social Considerations as a minimum requirement.

(2) Study Area

The Study area shall be limited to the expected development area of Feasibility Study up to the year 2012 in Goa State.

(3) Study Period

The Rapid-EIA Study shall be conducted for the Priority Projects selected in the Master Plan. The exact study period was between middle of June to end of July 2006.

(4) Scope of Work

The Study on Rapid-Environmental Impact Assessment (Rapid-EIA) of the proposed project

shall be carried out by PWD with the technical assistance of JICA study Team.

The followings shall be covered by EIA:

- Review the results of IEE study,
- Describe the relevant aspects of the natural and socio-economic environment,
- Identify and quantify to the extent possible the potential beneficial and adverse impacts during the implementation and operation phases of the project,
- Compare project alternatives in terms of environmental and socio-economic impact,
- Recommend possible mitigation/abatement measures for significant impacts, and
- Formulate a monitoring programme for the significant environmental issues.

Regarding collection and analysis of baseline environmental data, existing sources of information should be used as much as possible in this Study. In addition, a site survey shall be carried out to collect required data and information specific to the site conditions of the water supply and sewerage facilities proposed in the master plan.

11.4.5 Terms of Reference for the Public Consultation of F/S

The main component of the third stage of public consultation is a 3rd stakeholder meeting. The third stakeholder meeting will be held by the PWD in cooperation with the JICA Study Team during the F/S study period. At this stage of public consultation, the stakeholders living just nearby the proposed STP sites that nominated as priority projects were consulted more intensively with regards to the environmental and social considerations.

Figure 114.1 shows a flow chart of the Environmental Clearance procedure which has been explained in the third Stakeholder Meeting. Public consultation needs to be undertaken at the same time as executing the Rapid-EIA.

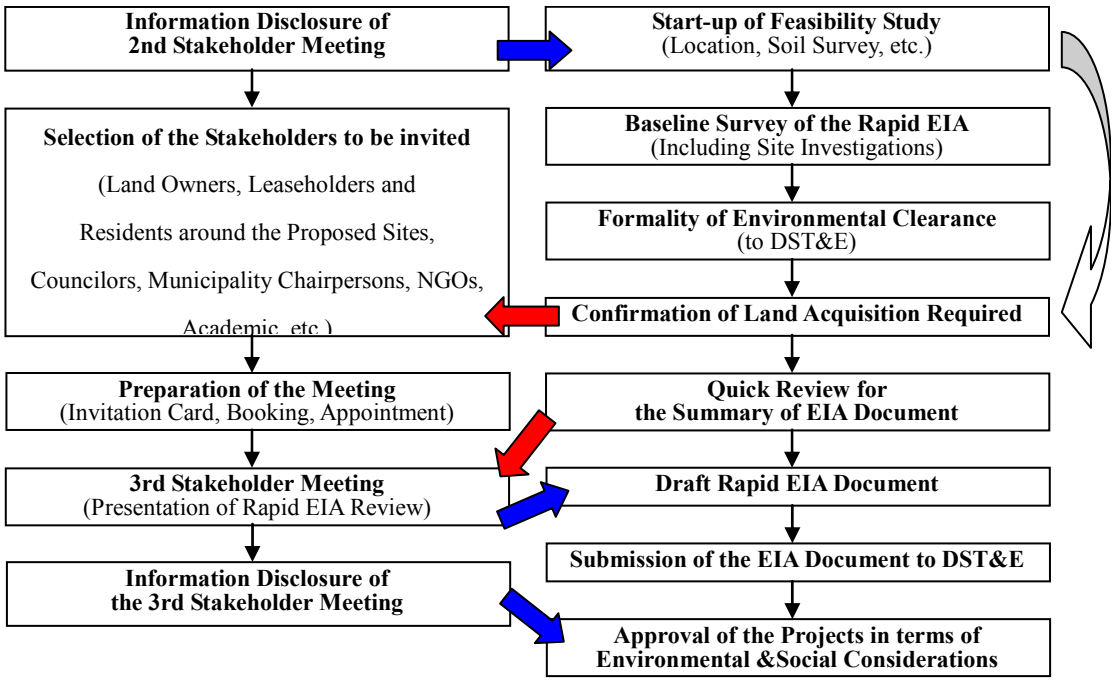


Figure 114.1 Flow Chart of the Third Stakeholder Meeting and the Environmental Clearance Process

In the third stakeholder meeting, the following presentations will be expected to the stakeholders by the PWD, with support from the JICA Study Team.

- Outlines of the Study and Public Participation (Progress of Feasibility Study, a report of second stakeholder meeting)
- Explanation of the Priority Projects for Water Supply & Sewerage and the likely Environmental and Social Impacts
  1) Priority Projects for Water Supply Scheme
  2) Sewerage Scheme in the Feasibility Study
  3) Project Benefits and Likely Impacts as regard to Environmental & Social Considerations

CHAPTER 12

SELECTION OF PRIORITY PROJECTS AND EMERGENCY MEASURES TO BE TAKEN BY PWD

CHAPTER 12 SELECTION OF PRIORITY PROJECTS AND EMERGENCY MEASURES TO BE TAKEN BY PWD

12.1 Water Supply System

12.1.1 Identification of Priority Projects

Among the seven water supply schemes in Goa, the priority projects were identified by considering the following:

- Balance between the daily maximum water demand and the existing supply capacity.
- Magnitude of the predicted water shortage by the target year of 2025.
- Impacts or magnitude of benefits for regional development.

The Assonora, Dabose and Canacona Schemes are being augmented by the PWD. The expanded treatment capacities for these schemes will be sufficient to meet the respective daily maximum water demand in 2025. The Opa, Chandel and Sanquelim Schemes have sufficient existing capacity to meet the current daily maximum water demand. Therefore there is less urgency for augmenting these schemes. The Salaulim Scheme has been judged as the highest priority because:

- The Salaulim Scheme will have the most significant water shortage in 2025 among all seven schemes.
- The daily maximum water demand will exceed supply capacity (treatment capacity of the existing Salaulim WTP) by 2006.
- The Salaulim Scheme supplies treated water to the major municipalities (Margao and Vasco da Gama) and the largest industrial area in Goa (Verna).

Therefore, the augmentation of the Salaulim Water Supply Scheme was selected as the priority projects. As part of the works proposed for the Salaulim Scheme in the master plan, the following Stage I components have been identified as the priority projects:

- Expansion of the Salaulim Treatment Plant, to increase its capacity by 100,000 m^3/day resulting in a total capacity of 260,000 m^3/day
- Rehabilitation and Improvement of the Existing Salaulim Treatment Plant, which has a production capacity of 160,000 m^3/day
- Construction of 20,000 m^3 of a Master Balancing Reservoir (MBR) at Sirvoi rock hill
- Installation of 73.65 km of Transmission Mains, ϕ 150 to ϕ 1400
- Rehabilitation of 13.8 km of the Existing Transmission Mains, ϕ 1200
- Construction of six Reservoirs

- Construction of five Pumping Stations
- Replacement of 4 units of Pumping Equipment at Verna Pumping Station

Figure 121.1 shows the components of the priority projects.

In addition to the system expansion as mentioned above, based on the assessment of the existing conditions of WSSs, the study recommends to implement the following measures as the priority projects of water supply system in the Goa State for improvement of operation and maintenance which are described in Chapter 7.

- Installation of flow meters and control valves at major points of transmission mains
- Installation of flow meters and float valves at all the existing reservoirs and WTPs
- Improvement of safety standards of the existing WTPs
- Establishment of Central Laboratory

In addition to the facility expansion and rehabilitation, reduction of NRW is also major objective of the priority projects. To reduce NRW in Goa State, NRW Reduction Roll-out Plan is recommended. The NRW reduction plan includes rehabilitation of distribution facilities, improvement of quantity measurement system at treatment plants and transmission system, and replacement of defective water meters on house connections. Furthermore, in addition to the facility improvements, organizational improvements such as establishment of NRW Reduction Unit, capacity building for implementation of the NRW reduction plan are proposed in the feasibility study as part of the priority projects.

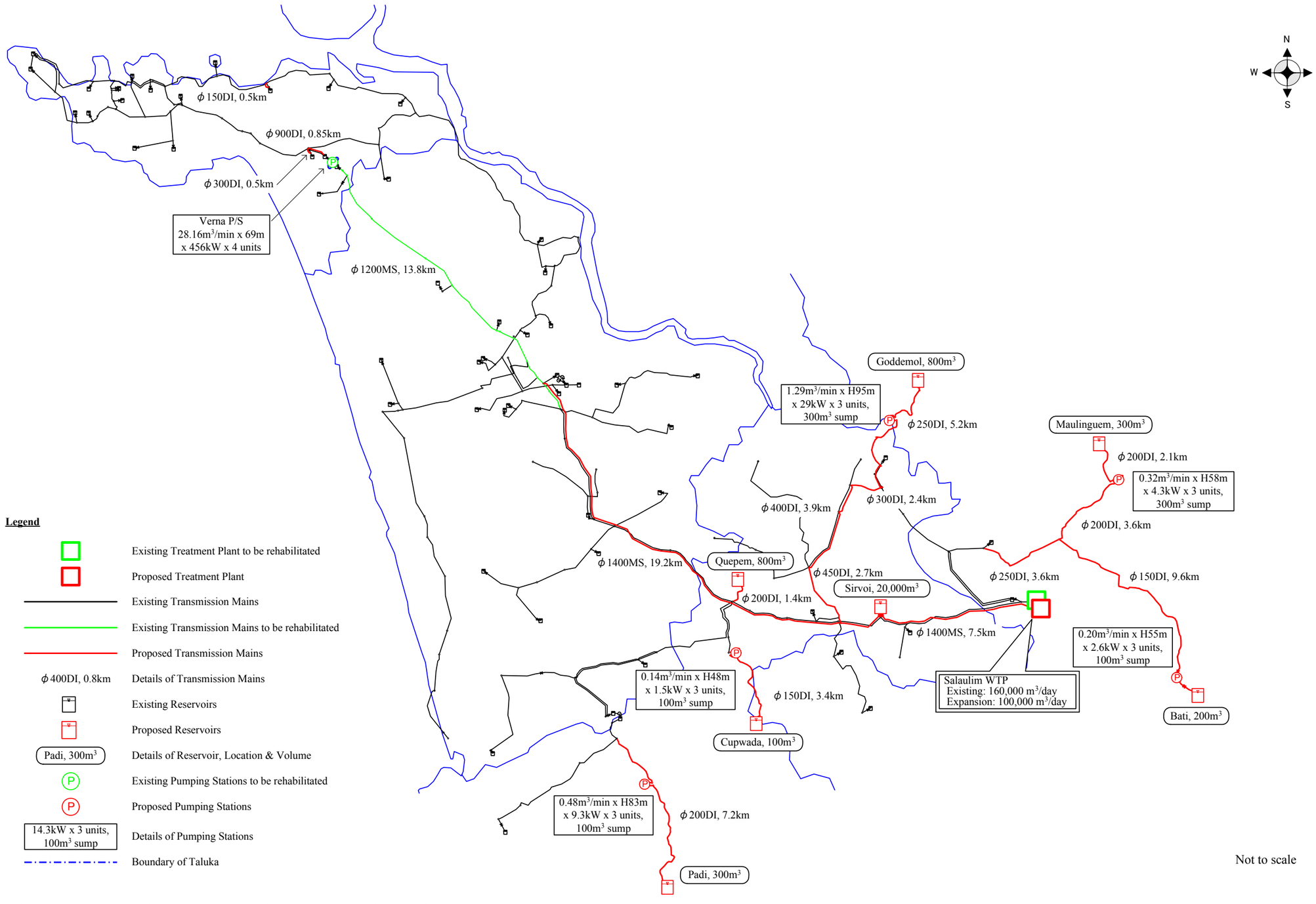


Figure 121.1 Components of the Priority Projects, Salaulim Water Supply Scheme

12.1.2 Components of Priority Projects

(1) Expansion of the Salaulim WTP

The existing WTP has a capacity of 160,000 m^3/day. It is proposed to increase this capacity by 100,000 m^3/day, to cope with future demands. Therefore, the total capacity will become 260,000 m^3/day. The proposed plant has the following facilities:

- Raw water intake facilities including intake and pumping house, pumps and motors.
- Raw water transmission mains from the intake pumping house to the treatment facility.
- Treatment facilities including receiving well, coagulation basin (rapid mixing), flocculator and clarifier, filtration basin and clear water reservoir.
- Chemical feeding facility for alum, lime and chlorine including chemical building and feeding equipment.
- Electrical and instrumentation facilities.
- Transmission facilities including transmission pumping house, pumps and motors.
- Power sub-station including transformer and diesel generator.
- Administration building with laboratory.

Figure 121.2 shows the proposed water treatment process for the expansion of Salaulim WTP.

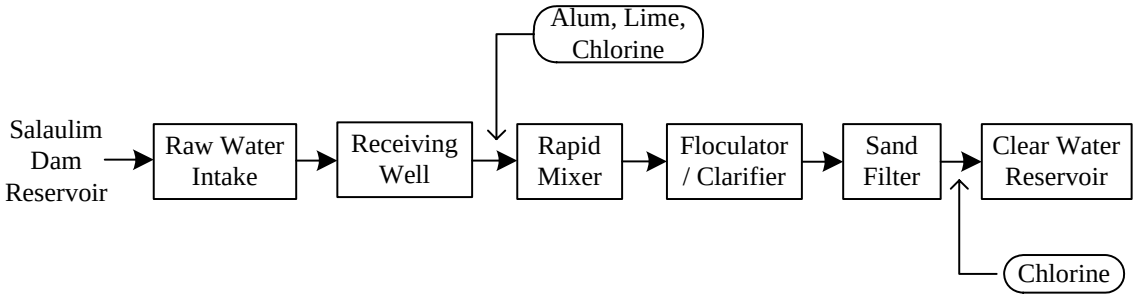


Figure 121.2 Proposed Water Treatment Process at the Salaulim WTP

The location of the proposed WTP is shown on Figure 121.3. This location was selected based on land availability in consultation with the PWD.

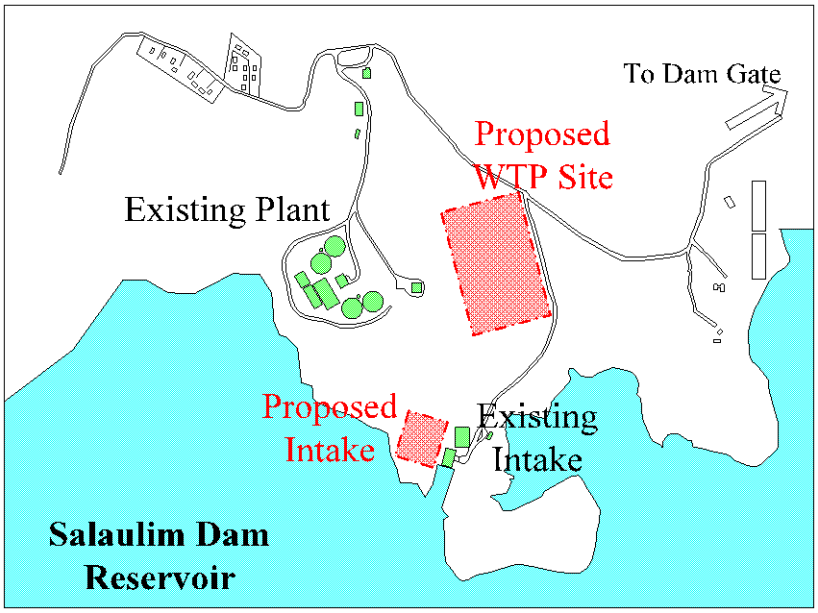


Figure 121.3 Proposed Site for the New Salaulim WTP

(2) Rehabilitation and Improvement of the Existing Salaulim WTP

To secure the supply of water from the existing Salaulim WTP, rehabilitation and improvement works are necessary. These works have been identified as a priority projects. The proposal consists of the rehabilitation and improvement of:

- Raw water intake facility including replacement of pumps, motors and electrical equipment and installation of water level meters in pump suction well.
- Substation facility including replacement of transformers and electrical equipment and installation of a diesel generator.
- Replacement of valves and flow meters of raw water transmission mains
- Treatment facilities including replacement of flush mixers, flocculators, filter sand, backwash pumps and motors, air blowers, filter operation valves and pipings, flow meters, water level meters in the reservoir, electrical equipment and installation of UPS for instrumentation.
- Chemical feeding facilities including replacement of feeding equipment, repair of chemical storage tanks and improvement of safety equipment.
- Transmission facilities including replacement of the flow meter.
- Laboratory facilities including improvement of testing equipment.
- Other repairs such as leakages etc.

(3) Construction of a Master Balancing Reservoir (MBR)

Since the proposed treatment plant is located below the existing plant, a pumping is required to

transmit the treated water to the service area. The pump will deliver water to a high altitude reservoir from where the water will be distributed under gravity flow. Therefore, construction of a master balancing reservoir (of 20,000 m^3 volume) at Sirvoi is proposed.

(4) Installation of 73.65 km of Transmission Mains

To transmit the treated water from the proposed Salaulim Plant to the existing and proposed reservoirs, via the Sirvoi master balancing reservoir, transmission mains (as listed in Table 121.1) need to be installed.

Table 121.1 Proposed Transmission Mains for the Priority Projects

Material	Diameter (mm)	Length (km)
Mild Steel	1,400	26.70
Ductile Iron	900	0.85
	450	2.70
	400	3.90
	300	2.90
	250	8.80
	200	14.30
	150	13.50
Total		73.65

(5) Rehabilitation of the Existing Transmission Mains

Rehabilitation of the existing transmission mains has been identified as a priority project for securing the sustainable and continuous supply of treated water from both the existing and proposed treatment plants. The existing transmission mains to be rehabilitated include the major transmission main from the existing Salaulim Plant to Verna pumping station.

The PWD is replacing the prestressed concrete (PSC) pipes of a diameter of 1,400 mm, which are laid from the Salaulim WTP to Margao with mild steel (MS) pipes, since pipe break accidents have occurred frequently because of deteriorated quality of the pipes. The PWD has replaced about 10 km PSC pipes with MS pipes and the replacement of the remaining 11.3 km PSC pipes are under implementation.

Therefore, the priority projects include the replacement of the remaining lines of PSC pipes which is about 13.8 km of 1,200 mm from Margao to Verna Pumping Station.

(6) Construction of Reservoirs

It is proposed to construct the six reservoirs (excluding the Sirvoi master balancing reservoir) listed in Table 121.2 to supply the treated water to the expanded service area.

Table 121.2 List of Proposed Reservoirs for the Priority Projects

Location	Capacity (m^3)	Remarks
Bati, Sanguem	200	with P/S (3 pump units of 2.6 kW and 100 m^3 sump)
Maulinguem, Sanguem	300	with P/S (3 pump units of 4.3 kW and 300 m^3 sump)
Guddemol, Sanguem	800	with P/S (3 pump units of 29 kW and 300 m^3 sump)
Padi, Quepem	300	with P/S (3 pump units of 9.3 kW and 100 m^3 sump)
Cupwada, Quepem	100	with P/S (3 pump units of 1.5 kW and 100 m^3 sump)
Quepem MCI, Quepem	800	-

(7) Construction of Pumping Stations

The constructions of five pumping stations are proposed as the priority projects in order to pump transmitted water into the proposed reservoirs as listed in Table 121.2.

(8) Replacement of Pumping Equipment at Verna Pumping Station

The existing Verna Pumping Station has six pumps which are used to pump water to the Verna Master Balancing Reservoir. The proposal includes replacing four of the existing pumps. This is required because water demand is expected to increase in the Mormugao Taluka (especially domestic demand in the Vasco da Gama Municipality and the industrial demand in the Verna Industrial Area); and because the design life of the existing pumping equipment has been exceeded. The specifications of the new pumps are as follows:

28.16m^3/min x H69m x 456kW x 4 units (pumps and motors)

(9) Installation of Flow Meters and Control Valves at Major Points of Transmission Mains

As the priority projects, the flow meters are proposed to be installed at major points of the existing transmission mains for all the 7 WSSs in order to understand the flow rate through the transmission mains. In addition, the control valves are recommended to be provided upstream or downstream of proposed flow meters for controlling the transmission flow appropriately. Numbers of flow meters and control valves for 7 WSSs are listed in Table 121.3.

Table 121.3 Number of Flow Meters and Control Valves at Transmission Mains

WSS	Flow Meters			Flow Control Valves				
	for small diameter	for large diameter	Total	1400	1200	900	600 and less	Total
Salaulim	0	5	5	2	2	1		5
Opa	0	3	3			3		3
Chandel	0	3	3				3	3
Assonora	3	2	5			2	3	5
Sanquelim	2	1	3			1	2	3
Dabose	4	0	4				4	4
Canacona	7	0	7				7	7
Total	16	14	30	2	2	7	19	30

(10) Installation of Flow Meters at All the Existing Reservoirs and WTPs

The study proposes to install the flow meters and float valves at all existing reservoirs for all the 7 WSSs in order to understand the flow rate into the distribution system belonged to the respective reservoirs and to avoid unnecessary overflow from the reservoirs. Also the installations of flow meters at all WTPs are included in the priority projects to control and understand the flow discharged from the WTPs. Numbers of flow meters are listed in Table 121.3.

Table 121.4 Number of Flow Meters at Reservoirs and WTPs

WSS	for small diameter	for large diameter		Total
		Reservoir	WTP	
Salaulim	81	4	3	88
Opa	80	1	4	85
Chandel	33	0	2	35
Assonora	85	0	7	92
Sanquelim	26	0	5	31
Dabose	26	0	1	27
Canacona	12	0	1	13
Total	343	5	23	371

(11) Improvement of Safety Standards of the Existing WTPs

The existing WTPs are operating and maintaining under the poor safety standards. The priority projects include the following safety improvement works for the operation and

maintenance of all WTPs.

- Improvement of chlorine facilities such as isolation and ventilation of chlorine room, replacement of piping from chlorine gas cylinder to chlorinator with copper pipes, installation of gas detector, etc.
- Improvement of other plant safety such as railing of open channels, guarding of moving equipment/shaft, etc.

(12) Establishment of Central Laboratory

At present the PWD can not measure all the water quality parameters complied with the recommended guidelines in India, "Manual on Water Supply and Treatment, CPHEEO, May 1999" for water supply and "Environmental Standards for Ambient Air, Automobiles, Fuels, Industries and Noise, Central Pollution Control Board, July 2000" for sanitation. The priority projects include the establishment of the central laboratory with adequate testing equipment which can measure all the required parameters.

12.2 Sewerage

12.2.1 Identification of Priority Projects

On the selection of priority projects, sewerage is advantageous comparing to onsite or decentralized system because sewerage shall be constructed in urban areas with large population and benefits spreads widely. Each sewerage project was evaluated from the aspects of number of beneficiary, cost effects, positive impacts and urgency. The evaluation procedures are as follows:

- Resident and tourist population were taken into account as beneficiaries, five (5) points were given for the largest population and points were given proportional to the population, respectively for resident and tourist.
- Unit construction cost and O&M cost per sewage flow were considered as cost effects, five (5) points were given for the lowest value and zero (0) point was given for the highest value, others were calculated proportional to their value.
- The treatment plant capacity was evaluated as a positive impact; five (5) points were given for the largest STP. Points were given proportional to their capacities.
- Urgency was evaluated by the current condition of groundwater contamination (two (2) points), overflow from soak pit (one (1) point) and dependency on well (two (2) points). The service block with the worst current condition received the maximum point.

The evaluation result is shown in the Table 122.1. The result shows that North Coastal Belt

received the highest point, and Margao comes second. The third is Mapusa and its point is very close to Margao.

Regarding the present situation of the sewerage services in the Study Area, the PWD Goa does not have sufficient institutional setup to run their services, resulted in low house connection rates. Under this situation, it is recommended to limit the number of priority project in order to manage and run sewerage systems at an appropriate level.

Considering above aspects, three (3) projects, namely North Coastal Belt (new), Margao (expansion) and Mapusa (new) were selected as priority projects. The Summary of the priority projects are shown Table 122.2 and Figures 122.1 to 3. In addition to the construction of sewerage facilities, sewer cleaning equipment is also proposed to be procured as part of the priority projects to secure an appropriate maintenance of sewers.

Table 122.1 Selection of Priority Project

	Panaji	St. Cruz	Porvorim	Margao	Ponda	Mapusa	Colva	North Coastal Belt	Max Point
Beneficiary:									
Additional Population									
Resident (person)	26,144	16,918	47,848	56,907	19,401	68,255	5,279	39,358	
Point	1.9	1.2	3.5	4.2	1.4	5.0	0.4	2.9	5
Tourist (person)	8,737	0	1,653	2,605	2,097	1,703	5,231	20,261	
Point	2.2	0.0	0.4	0.6	0.5	0.4	1.3	5.0	5
Point for Beneficiary	4.1	1.2	3.9	4.8	1.9	5.4	1.7	7.9	10
Cost Effects									
Cost / Sewage capacity									
Construction cost/Sewage (Thousand Rs/m^3/day)	44.3	44.2	48.1	38.3	40.6	43.4	50.5	44.0	
Point	2.5	2.6	1.0	5.0	4.1	2.9	0.0	2.6	5
OM cost/Sewage (Rs/m^3)	3.9	7.4	5.4	4.5	6.2	4.3	9.2	4.3	
Point	5.0	1.7	3.6	4.5	2.9	4.6	0.0	4.6	5
Point for Cost Effects	7.5	4.3	4.6	9.5	6.9	7.5	0.0	7.3	10
Positive Impacts									
Additional STP Capacity (m^3/day)	8,900	2,600	7,700	13,400	3,500	10,800	2,200	11,200	
Point for Positive Impacts	3.3	1.0	2.9	5.0	1.3	4.0	0.8	4.2	5
Urgency									
Groundwater Contamination	52%	67%	100%	33%	N.A	83%	N.A	63%	
Point	1.0	1.3	2.0	0.7		1.7		1.3	2
Overflow from Soak pit	18%	12%	12%	35%	31%	73%	18%	14%	
Point	0.2	0.2	0.2	0.5	0.4	1.0	0.2	0.2	1
Dependence on Own Well	N. A.	N. A.	N. A.	N. A.	N. A.	N. A.	7%	43%	
Point							0.3	2.0	2
Point for Urgency	1.2	1.5	2.2	1.2	0.4	2.7	0.5	3.5	5
Total Point	16.1	8.0	13.6	20.5	10.5	19.6	3.0	22.9	30
Rank	4	7	5	2	6	3	8	1	
Priority Project				★		★		★	

Table 122.2 Summary of Priority Project

Location	Unit	North Coastal Belt	Margao	Mapusa	Remarks
Expansion Area	ha	354	392	193	
Population in the Expansion Area	Person	19,771	36,781	34,260	
Trunk Sewer Construction	km	5.4	6.4	5.0	
Branch Sewer Construction	km	25.2	36.1	20.7	
Pumping Station Construction	Nos.	1	1	0	
Treatment Plant Capacity	MLD	5.6	(7.5)+6.7	5.4	(Existing)

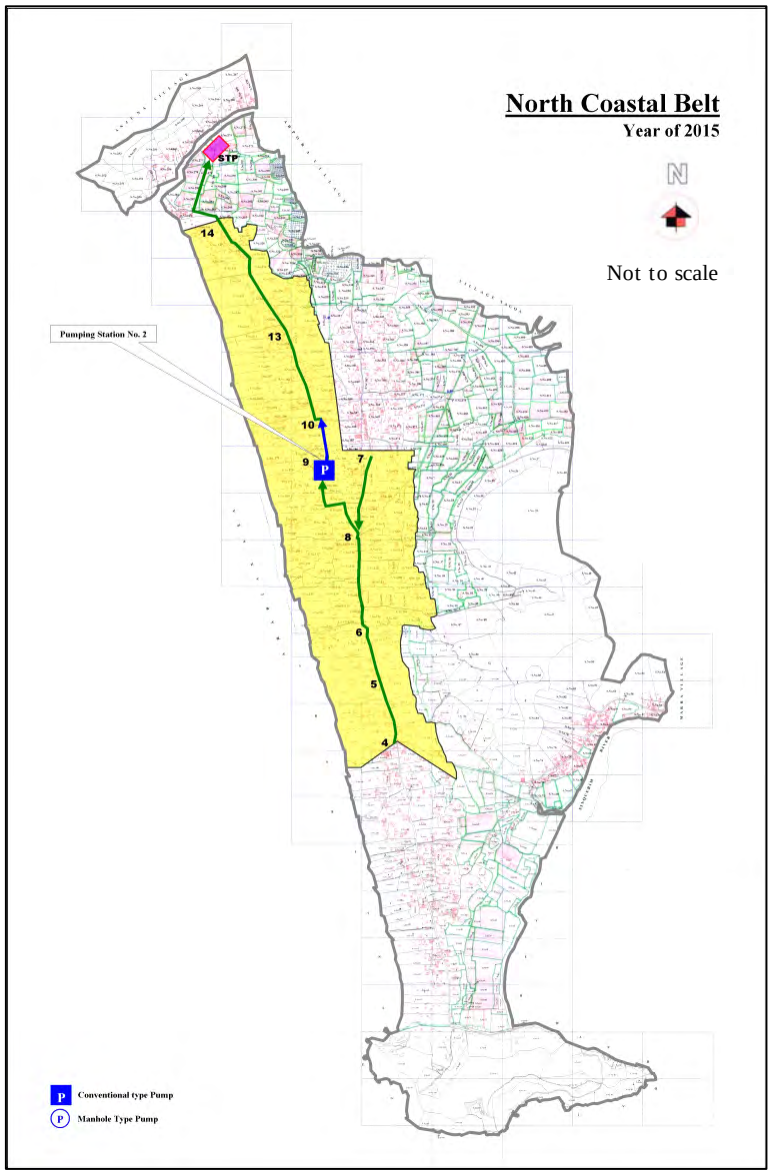


Figure 122.1 Priority Project Area of North Coastal Belt

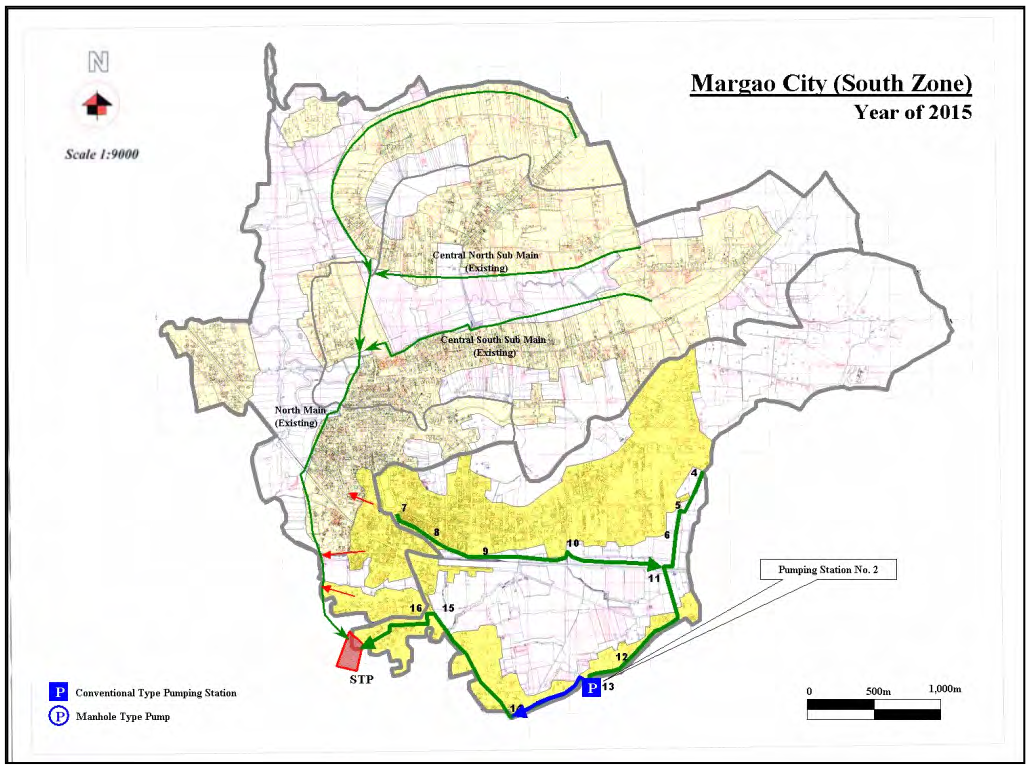


Figure 122.2 Priority Project Area of Margao

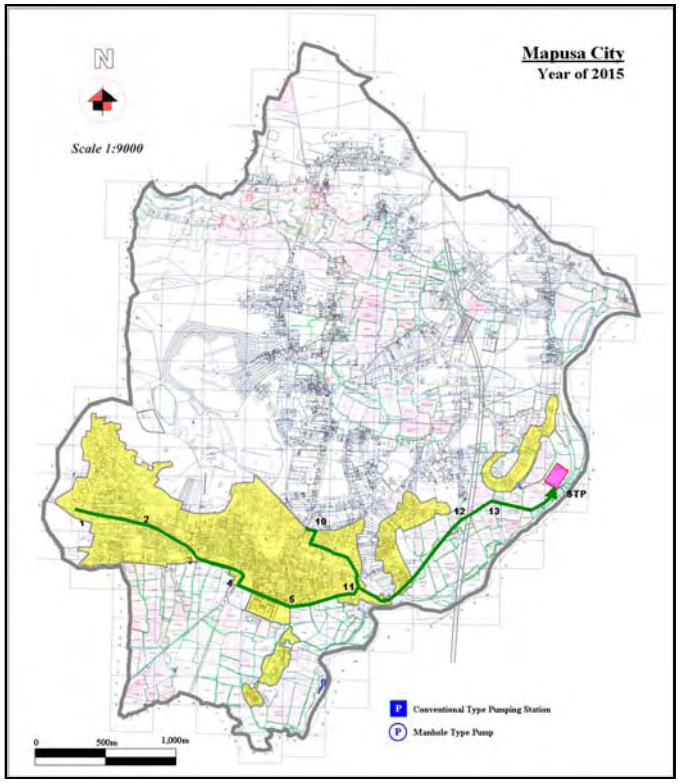


Figure 122.3 Priority Project Area of Mapusa

12.3 Selection of Operations & Maintenance Priority Projects

A number of key improvements from the Water and Sanitation improvement plans considered to be priority based on their relative importance are detailed below. These have been included for consideration in the Feasibility Study phase:

Table 123.1 Key Issues Requiring Intervention –Priority Measures

NO	DESCRIPTION	PRIORITY	COMMENT
WATER TREATMENT FACILITIES AND SUPPLY NETWORKS			
1	Refurbish all out of service plant and equipment such as chemical mixing and dosing equipment at Salaulim	Immediate	Will require investment program based on plant criticality
2	Improve Chlorine facilities	Immediate	Provide standby equipment at all chlorine installations and implement safe systems of work, training and emergency procedures Upgrade all chlorine installations to the appropriate international standards and provide spares Introduce safe systems of work including written procedures for handling and connection of cylinders to chlorinators, maintenance of equipment, including replacement intervals for copper piping etc. Install gas detectors and ensure that immersion tanks are fit for purpose. Ensure forced air breathing apparatus is available, used and properly maintained
3	Replace defective source meters and install meters at ‘intake’ and ‘water into supply’ points	Short term	Use good quality electromagnetic or ultrasonic flow meters that comply with international standards
4	Implement systems for recording asset and maintenance data	Short term	Computerise the capture of asset and maintenance data and implement system of planned preventative maintenance (CMMS). Suggest a contract is let for ‘asset registering system’ including supply of software, unique numbering system, conducting condition surveys and populating the asset database

NO	DESCRIPTION	PRIORITY	COMMENT
SEWAGE TREATMENT PLANTS, SEWAGE PUMPING STATIONS AND SEWERAGE NETWORKS			
1	Provide appropriate tools for cleaning and unblocking sewers	Short term	These can be hand tools as well as power tools such as cleaning rods, swabs, gully suckers etc. Implement program of regular cleaning and maintenance or contract out these services
2	Implement systems for recording asset and maintenance data	Short term	Computerise the capture of asset and maintenance data and implement system of planned preventative maintenance (CMMS). Suggest a contract is let for 'asset registering system' including supply of software, unique numbering system, conducting condition surveys and populating the asset database

12.4 Capacity Development

Necessary measures for capacity development are described in this section from legislative and institutional aspects. These measures or actions should be taken were planed to be implemented as part of the priority projects by introducing external assistances.

12.4.1 Legislative Aspects

Much of the needed institutional and managerial improvements can be facilitated . In several instances, some key policy decisions and legislation are needed to authorize and enable PWD/PHE to implement the changes. Among these are specific sector policy/legislative actions to:

- Authorize PHE to use of commercial accounting systems;
- Provide guidelines for the proper treatment of depreciation;
- Introduce external audit and other safeguards;
- Enable PHE to retain revenues generated (plus a state subsidy indexed on revenue generated (or other performance targets) to support water and sewerage services);
- Clarify debt service obligation as a state responsibility;
- Authorize PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc);
- Guarantee security of staff to be affected by the reforms; and
- Create mechanisms for regular dialogue with consumers and consumer groups.

The Water Sector Reform initiatives also suggest consideration of new sector policy legislation. The recommendations mentioned above are consistent with the intent and spirit of that reform. The Strategy will be to coordinate with the legislative agenda of ongoing sector reform

If the reform recommendations are fully accepted, the Institutional Development Plan will

certainly be more challenging. The scope and scale of the Plan will be tailored to suit the policy decision made.

12.4.2 Institutional Aspects

Internal re-structuring

Immediately after the adoption of the reforms, PHE should undertake detailed assessments with a view towards re-distribution of responsibility & resource reallocation. Balancing of management responsibilities will be important; work processes will need to be optimized.

The function description of each operating work group will be reviewed and revised; job description and qualification requirements for all positions should be developed by PHE.

Management policy

Soon after the policy level decisions are taken, PHE needs to develop various key management policies, decisions and procedures, including such areas as:

- Budgeting and financial planning processes;
- Performance agreement structure;
- Treatment of depreciation;
- Customer rights & responsibilities;
- Staffing issues;
- What constitutes capital investment, major maintenance & minor maintenance cost?

Management information and decision-making

PHE will need to implement a phased approach to investing in appropriate information systems and technology to meet the future needs of the 'business' and stakeholders alike.

The management information system for PHE is envisaged to be a fully computerized system which is fully integrated with a new commercially-oriented accounting system and the benchmarking program. It will support the planning, decision-making and assessment of operations of the service providers. It will also support official reporting and auditing requirements. The Plan will assist in evaluating and selecting, procuring and customizing the MIS software. It is envisaged that a commercially-available software will have to be customized to suit the specific management information requirements of the PHE.

To aid this process, PHE needs to carry out the following:

- Carry out a 'Business needs analysis', 'information system needs analysis' and 'user needs analysis' to identify business, customer and operational requirements
- Carry out a detailed review of available information systems to meet the above needs and scope the chosen systems for implementation.
- Set up an IS department with agreed roles and responsibilities to develop and implement systems or outsource this activity
- Carry out detailed development of systems requirements and specifications, tendering, procurement, SLA's for systems development, maintenance and support
- Development of detailed project plan for each system, including timescales for implementation

Based on the assessment, the priority components or modules of the integrated management information system which has to be installed include the following:

- Financial Accounting and Control module
- Asset Management module
- Customer Relationship Management module
- Project Management module
- Human Resources Management module
- Inventory & Supplies Management module

Customer services management

As part of the consultative approach, PHE should consider establishing Citizens Advisory Councils to provide customers with an opportunity to be a part of the decision-making process.

PHE should publish and maintain a 'Customer Code of Practice', which will define the services offered and provide a standard for measuring delivery performance. Results of PHE performance should be published and included with the bill and in documents such as an annual Consumer Confidence Report so that customers can see the improvements in service delivery achieved over time.

Introduction of the PHE Business Model

PHE should adopt a formal "business model" and formal corporate planning system with due consideration for the market conditions, the sources and uses of funds and the key internal business management processes.

Financial management & control system

The Plan will develop the capacity of PHE to produce and evaluate the basic financial reports,

including balance sheet, income statement and cash flow projections, including the basic information system to produce these vital reports. New budgeting procedures and formats will be introduced. Commercial accounting procedures will be adopted. An asset revaluation exercise will have to be undertaken to establish the list and value of the current assets of PHE. Thereafter, guidelines and procedures for succeeding asset revaluation exercises will be developed. Intensive staff training will be required to raise the level of financial management and control throughout all levels of the organization, including technical, field and accounting staff. The Plan will also assist PHE in initial selection for the independent external audit of accounts. Use of relevant financial performance indicators will be introduced to monitor the performance of the water service providers. The Study also recommended the regular publication of the utilities financial condition. The Plan will assist PHE in implementing this recommendation. The Plan will also recommend a rational procedure for determining needed tariff.

O&M improvement plan

In addition to immediate implementation of the urgent operation and maintenance recommendations, PHE should consider formulation and adoption of improvements in the systems for management of the maintenance function itself, including formal procedures for:

- O&M strategy development & improved practices
- NRW strategy development & improved practices
- Organisation development & capacity building for O&M
- Information system development and control systems
- Process and asset optimisation
- Water, sanitation & NRW improvement plans
- Health and Safety Improvements

Asset Management System

The Plan, will assist PHE in designing and putting in place an asset register and an asset management system (as part of the MIS) to help keep track of the status, disposition and maintenance requirements of its assets.

Human resources management

PHE should aim to encourage employees to use their own initiative in order to develop the business and to overcome the challenges that face the organisation and promote an environment which is open in style with good communications across all levels of the organisation to promote employee commitment, teamwork and a sense of belonging to a progressive and forward looking organisation. Each employee should have a clear role and responsibility within the organisation, including their working relationship with others and the duties that they are asked to perform

In this framework for developing human resources, major attention shall be given to the following objectives:

- Establishing PHE job descriptions for all positions, including the skill and competency requirements. Job descriptions serve as the necessary reference material for staff recruitment and staff appraisal;
- Staff planning and staff recruitment and deployment, which are, on the one hand, meant to attract the right people and on the other hand, to re-train and re-deploy staff;
- Introduction of a regular in-company training delivery system to improve the basic skills necessary for proper execution of PHE activities;
- Further improvement of staff incentives to obtain and retain adequate number of suitably qualified people, and to encourage better performance.

Staff training & development programs

PHE should adopt the needed systems and procedures to be able to offer continuous training opportunities for all Staff. The Study recommends the organization of responsibilities for in-house training operations. Actual delivery of the training programs may be outsourced however, as appropriate. The immediate training priorities are as follows:

- Management Development
- Financial Management Training
- Customer Service Training
- Operation & Maintenance.
- Project Development & Management.

12.5 Improvement of Accounting System

(1) Planning and design of independent accounting systems

Currently there are no independent accounting systems that enable the PHE to accurately understand their financial condition. To properly maintain the existing water supply and

sanitation facilities the PHE must be able to allocate sufficient operation and maintenance funds, and must be able to prepare a sustainable investment plan and a tariff revision plan. It is therefore necessary to understand the current financial condition of the water supply and sanitation service entity. The introduction of an independent accounting system, tailored to water supply and sanitation services, is therefore strongly recommended. The basic financial statements and accounting documents for the independent accounting system are explained below.

A financial statement is composed of three basic documents: balance sheet, income statement and cash flow statement. The balance sheet shows the composition of assets, liabilities and equity at a certain point in time e.g. at the beginning of the fiscal year, or at the end of the fiscal year. The income statement shows a summary of financial activity throughout the financial year. It summarizes revenue and expenditure during the fiscal year. The cash flow statement shows how the entity obtains and uses cash. The purpose of the cash flow statement is to understand the changes in the entity's cash position over a certain period.

After successfully compiled the balance sheet, income statement, and cashflow statement, financial analysis should be conducted by monitoring the financial indicators of the entity. The major financial indicators, including managerial indicators, for water supply and sanitation enterprises are described in the Table 125.1.

Publication of financial statements and financial indicators, either internally or externally, will contribute to the transparency, in addition to helping the understanding of the present management condition. Breakdowns of operation and maintenance cost, which include personnel cost, repair cost, electricity cost, should be comprehended and be opened to the public. Regarding sanitation service, it is better to disclose the percentages of subsidy from State Government and sewerage tariff revenue within the total operation and maintenance cost.

Table 125.1 Major financial and managerial indicators for water supply and sanitation sector

Aspects of capability of entity	Indicators
Liquidity	Current ratio
Profitability	Operating ratio Return on assets Unit production cost Unit price
Solvency	Debt to equity ratio
Current asset management capability	Collection efficiency Accounts receivable turnover ratio
Debt management capability	Debt service coverage ratio Gearing ratio
Efficiency	Non-revenue water ratio Ratio of facility utilization
Productivity	Staff per 1,000 connections Water volume accounted for per staff member

To make the accounting system for the water supply and sanitation sector of the PWD independent from the whole accounting system for the PWD, the PWD needs to negotiate with and obtain the approval from the State Government. If approval is not obtained from the Government, the PHE should prepare the aforementioned financial statements on a trial basis, along with proceeding the present accounting system. There will still be advantages to the PHE i.e. it will be able to better understand the annual profit and loss and the general management condition of water supply and sanitation services.

Steps in implementing an independent accounting system for the water supply and sanitation sectors of the PWD include the following tasks:

(a) Decision and order of introducing the independent accounting system;
(b) Preparation of draft format of financial documents;
(c) Basic study for understanding the present asset value;
(d) Preparation of an accounting procedure manual for staff;
(e) Staff training of accounting procedures;
(f) Introduction of the new accounting systems;
(g) Preparation of financial statements;
(h) Selection of financial indicators;
(i) Decision on content, methods, and timing of publication of financial data; and
(j) Introduction of external audit (after complete financial self sufficiency is realized).

Introduction of the independent accounting system shall be initiated by PHE and PWD with the

assistance of management consultant planned in the capacity development of the priority project. Management consultant shall help the implementation of the item (b), (c), (d), (e), (g), (h) of the above tasks. Counterpart of the independent accounting system development shall be selected from the major accounting staff of PHE. Management consultants will support the preparation works of the accounting system and necessary documents by the counterpart.

12.6 Emergency Measures To be Taken by the PWD

12.6.1 Water Supply System

(1) Preparation of Asset Drawings

The PWD does not have asset drawings of the current water supply facilities or maps that cover all the water supply areas. Therefore the PWD should prepare at least the following drawings and maps with adequate scales, and keep those not only at the headquarters, division offices and sub-division offices but also at the site of each facility.

- General location maps and general layout plans for the facilities
- Intake Facilities
- Treatment Facilities
- Transmission Mains
- Reservoirs and MBRs
- Pumping Stations
- Distribution Networks
- House Connections

(2) Collection of Operation and Maintenance Data

The PWD does not maintained records and data of the operation and maintenance of the schemes in uniformed format. Therefore the PWD should collect and maintain at least the following data and records, and keep those not only at the headquarters, division offices and sub-division offices but also at the site of each facility.

- Water Quality Data such as raw water, treated water and tap water
- Asset Data
- Operational and Maintenance Records

(3) Preparation of Operation and Maintenance Manuals and Plans

There are no standard operation and maintenance manuals or plans for the treatment plants, transmission systems or distribution systems. Therefore the appropriate operation and proactive maintenance is difficult. The PWD should prepare the operation and maintenance

manuals and plans for all facilities and equipment.

(4) Cleaning up the Facilities

Chemical storage conditions are inadequate and poor at almost all WTPs. The PWD is recommended to clean up at all facilities and to keep clean not only for appearance and keeping of good condition and quality but also for safety measures.

(5) Repair of Visible Leaks

There are many visible leaks at the WTPs and at the air and scour valves located along the transmission mains. It is recommended to repair all visible leaks as soon as possible.

(6) Implementation of On-going Projects without any Delay

The PWD is implementing the following projects at present. For preparation of the master plan the study has taken these projects into account. The PWD should execute these projects without any delays or suspensions.

- Augmentation of Dabose WSS, 10MLD WTP
- Augmentation of Canavona WSS, 10MLD WTP
- Augmentation of Assonora WSS, 50MLD WTP
- Installation of ϕ 900DI Pipes to Panjim
- Replacement of ϕ 1400PSC Pipes with MS Pipes from Salaulim to Margao

(7) Ganjem and Maisal Schemes

The PWD has plans on implementation of the Ganjem (25 MLD) and Maisal (10 MLD) Schemes for securing the water supply to Panjim as the emergency measures. General plans on these schemes have prepared respectively according to the request and information from the PWD and the results are attached to Volume IV Appendix M55 Ganjem and Maisal Schemes as the Emergency Measures. It is, however, recommended that the PWD should study in detail the necessary capacity of each scheme based on the demand projection and possibility of supply area from each scheme comparing with costs required.

12.6.2 Sanitation System

(1) Upgrade Sewerage Connection Rate in Margao

Sewerage facilities in Margao do not show expected performance because of the low connection rate to sewerage. The existing sewage treatment plant has a capacity of 7,500 m^3/day and the sewer network has been constructed to collect almost the same sewage flow, however, the present influent is estimated only 2,500 m^3/day. Measures upgrading sewerage connection

rate is recommended to conduct including public relationship improvement, legislation setup, technical and financial assistance for the people in the coverage area. Additionally, BOD concentration of raw sewage in Margao STP is very low, measures to reduce the groundwater infiltration such as sewer network survey and repair are recommended.

(2) Improvement and replacement of facilities

The oldest part of the existing sewerage system in Panaji was constructed in the 1960s. Parts of the existing sewers have decrepit internal conditions and may not have enough capacity to cater for increasing populations in the service area. To ensure proper facility improvement and replacement, it is recommended that the PWD prepare a long-term renewal plan, which considers the construction year and the lifespan of the equipment and facilities.

Also pumping stations in Panaji are very old and decaying. The pump troubles occur so many times that there are not sufficient stand-by pumps for peak flow and alternative operation. It may not only shorten the pump life, but also generate serious problem by the sewage over flow. To replace pump facilities and to conduct proper operation and maintenance is recommended.

(3) Sanitation improvement outside the sewerage area

It is recommended that the PWD undertake sanitation improvement for the areas outside of the sewerage service area. To achieve this, the PWD should provide technical and financial assistance to residents for the construction and maintenance of on-site and decentralized treatment facilities. It is also recommended that the PWD improve its public relations regarding sanitation.

(4) Sewer Cleaning

The blockage of sewers causes serious problems for the sewerage system. Blockages not only generate odour, but can also cause sewage overflow into gutters and contamination of groundwater. Periodic sewer cleaning is necessary to prevent blockages and to prevent a decline in the sewer capacity (caused by the accumulation of sand, soil and other materials). It is therefore recommended to undertake a survey of sewer conditions, prepare a cleaning schedule, procure cleaning equipment (some of them are included in the priority project), secure appropriate personnel, and budgetary arrangement.

(5) Management and utilization of asset data and operation and maintenance records

The PWD does not have a proper management system for their asset data of water supply and sewerage system records. During the study, the Study Team tried to collect the following data

and drawings, but these were not available in a standard and easily accessible format in the PWD office:

- List of assets and their current status;
- Asset drawings and specifications;
- Past records of operation and maintenance.

Therefore it is recommended that the PWD prepare and keep systematic written records and data on their assets and activities. This is very important for water supply and sewerage management.

(6) Ambient water quality monitoring

The PWD should monitor surface and groundwater, in order to assess and improve water quality. An effective monitoring system should involve relevant organizations and agencies, such as the Pollution Control Board, the Health Department, and the Water Resource Department. It is recommended that water quality monitoring data be shared between the related organizations and agencies.

12.6.3 Operations & Maintenance Emergency Measures

A number of key improvements from the Water, Sanitation and NRW Reduction improvement plans considered to be priority based on their relative importance and urgency are detailed below. These are listed for PWD consideration. Those items considered as emergency works should be completed immediately. Those items considered as short term priority should be completed within the next 1 to 3 years:

Table 126.1 Key Issues Requiring Intervention – Emergency Measures

NO	DESCRIPTION	PRIORITY	COMMENT
WATER TREATMENT FACILITIES AND SUPPLY NETWORKS			
1	Improve safety standards	Immediate	Introduce safe systems of work for plant isolation (lock-off/tag-out procedures when working on moving or electrical equipment) Improve plant safety such as railing of open channels, testing of lifting tackle, guarding of moving equipment/shafts etc. Improve safety awareness, staff training and issue PPE

NO	DESCRIPTION	PRIORITY	COMMENT
2	Develop and implement Best Practice Operating Manuals for plants, pumping stations, reservoirs and networks	Short term	Refer to section 7.1.3 'O&M management practice' for suggested contents list of manuals
3	Develop and implement planned maintenance schedules	Short term	Carry out tasks accordingly including lubrication schedules
4	Centralise responsibility for water quality sampling, analysis and reporting at plants, reservoirs, network critical control points and customer taps	Short term	Ensure procedures, equipment and staff training for to collection and analyses of samples in accordance with Indian and WHO standard parameters
NRW REDUCTION			
1	Replace all defective meters	Immediate	Use good quality class 'B' or 'C' meters that comply with international standards
2	Replace all defective (leaking) house connections	Immediate	Use improved materials instead of galvanized pipes and fittings
3	Repair all existing visible leaks	Immediate	Use existing manpower resource or works contracts already in place or introduce new incentivised contracts
4	Agree standards for new connections and pipe repairs, including standard specifications for materials, fittings, meters, layout, non-return valves, sealing, testing, calibration etc.	Short term	Introduce a 'metering policy' that specifies materials and equipment to be used with specified periods for calibration, maintenance, replacement etc. Introduce Leakage policy specifying materials to be used.
5	Audit the billing system to ensure 100% billing	Short term	Conduct surveys to ensure that all who have a connection receive a bill
6	Set up an emergency store in each Division of all appropriate repair materials and equipment and ensure it is available to PHE staff and Contractors	Short term	Ensure that staff and contractors are equipped to get the job done without delay and that H&S issues are taken into account
7	Set up Active Leakage Teams within each Division or Region with appropriate tools to do the job to find and fix leaks	Short term	Introduce targets and monitoring system to ensure that UFW is brought within and maintained at economic levels. For 24 hour systems, teams will need to work at night
8	Set up a dedicated 'leak line' to enable customers to report leaks	Short term	This should be at no cost to the customer (toll-free)
9	Roll-out the NRW Reduction Pilot across the State	Short term	PWD staff involved with the NRW Reduction Pilot should transfer skills and knowledge to all teams within the Regions. C.E to 'champion' NRW reduction efforts, led by SE's within the Regions and sponsored by the Secretary-PWD

NO	DESCRIPTION	PRIORITY	COMMENT
SEWAGE TREATMENT PLANTS, SEWAGE PUMPING STATIONS AND SEWERAGE NETWORKS			
1	Improve safety standards	Immediate	Introduce safe systems of work for plant isolation (lock-off/tag-out procedures when working on moving or electrical equipment) Improve plant safety such as railing of open channels, testing of lifting tackle, guarding of moving equipment/shafts etc. Improve safety awareness, staff training and issue PPE Provide appropriate spark proof tools and flame proof equipment for working in potentially explosive atmospheres at STP's, SPS's and in sewers Provide gas detection equipment and forced air ventilation where necessary such as in SPS's and before entering sewers, wet wells etc. Upgrade all facilities to ensure compliance with relevant regulations in force for electrical installations in potentially explosive atmospheres Provide basic tools for safe working in the highways such as reflective jackets, signage, safety lighting and manhole cover keys Improve security fencing, measures and access control at Panaji STP and all SPS's
2	Develop and implement Best Practice Operating Manuals for plants, pumping stations and networks	Short term	Refer to section 7.1.3 'O&M management practice' for suggested contents list of manuals
3	Develop and implement planned maintenance schedules	Short term	Carry out tasks accordingly including lubrication schedules
4	Replace all defective or missing manhole covers	Short term	Ensure manholes covers meet the required standards and are inspected regularly
5	Ensure trade effluent compliance	Short term	Set up a system for regular visits to all trade effluent companies discharging to sewers. Ensure compliance with effluent standards, installation/cleaning of fat traps etc.

12.6.4 Capacity Building

In the Feasibility Study, technical proposal has been developed which details a broad range of institutional development activities. Some of these activities can be implemented by PHE on its own without much external support. These activities will help to lay the ground work for future improvements in organizational and management systems.

12.6.5 Improvement of Financial Management and Control

(1) Meter Reading and Bill Collection Procedure

Currently, the meter reading period varies according to the capability of each sub-division. This variation makes it difficult for the PHE to understand the management conditions, including water consumption per user per month, collection efficiency, and the average period between billing and collection. It is strongly recommended that the PHE standardize the period of meter reading for all sub-divisions. In cases where there is no enough capacity to conduct monthly meter reading, data input, bill preparation or bill delivery, the sub-division are able to conduct meter reading once every two months as described in the Volume II Chapter 8 Section 8.5 Improvement of Financial Management and Control.

By having consistent meter reading and billing periods across all divisions, the PHE will be able to identify malfunctioning water meters and data input mistakes at bill preparation, in addition to obtaining much useful management and financial information. It is also recommended that the PHE shall make data transmission systems for meter reading and billing, so that information can be transmitted between head office, and divisions or sub-divisions.

Equalization of metering period depends much on the decision and order of PHE with the minor change of the procedures. It is recommended that equalization of meter reading period for all of the sub-divisions shall be conducted as emergency measure taken by PHE.

(2) Promotion of connection to the public sewer system

Especially in Margao, low connection rate to the public sewer is one of the important problems for PHE's enterprise management. Initial burden on an applicant is one of the major constraints for PHE to increase the customers of public sewer system, since the initial cost is approximately as much as three times of average household income. By the 'Subsidized Connection Scheme' by State Government for few months in the year 2005 and 2006, the number of customers had been increased impressively, from 1,074 housing units benefited on December 2004 after 4 years from service commencement, to 1,972 on December 2005, and to 2,576 on May 2006. Subsidized scheme depends on the decision by State Government and, as for now, there is no plan to implement it again.

It is recommended to implement the installment plan for initial cost of public sewer. Installment plan shall be realized by borrowing the certain amount of money from private bank or preferably public lending organization with lower interest rate. PHE receives the applicants without full amount of money to invest for connection. PHE utilizes the fund from borrowed

money from bank and construct the connections to the public sewer for applicants. New customers shall pay the installment payment every month including the interests in addition to the tariff to the PHE. PHE shall make loan repayments to the bank by the installment payments from the customers.

Firstly, installment plan shall be introduced as trial bases, which borrows small amount of money for limited number of applicants. After monitoring the reaction by the applicants such as progress of loan repayment, loan amount and condition shall be considered at the next implementation of installment plan. It is recommended that installment plan for sewerage connection shall be implemented as one of the emergency measures taken by PWD.

(3) Reduction of Public Stand Post by promoting the house connection

Presently, PWD is promoting the reduction of PSP and application to the house connection. Consumption of water from PSP is usually not billed and does not originate revenue. Unbilled PSP is one of the major causes for the high NRW rate in Goa. Promotion of the reduction of PSP by PHE is appreciated in the aspect of financial management. Introduction of installment payment described above is also considered useful to promote the application to house connection, in case the initial investment cost is the hurdle for new customers. It is recommended that installment plan for water connection shall also be implemented as one of the emergency measures.

(4) Improvements for tariff setting

The basis for healthy management of the water supply and sanitation services is to balance revenues and expenditures and to have sufficient income to provide adequate operation and maintenance for the services. It is reasonable to make the beneficiaries of the services bear the costs of those services. Based on this beneficiary pay principle, the necessary cost should be recovered from the users of the service. However, the benefits of sewerage are not limited to the users.

It is recommended that the water supply service aims for full cost recovery, including construction loan repayment and operation and maintenance costs (including personnel and administration costs), by charging users over the long term. It is also recommended that sanitation service aims to recover the costs of operation and maintenance (including personnel and administration costs) over the long term.

The tariff setting procedure, mentioned Volume II Chapter 8 Section 8.5 Improvement of

Financial Management and Control, requires much precise information concerning the financial condition and customer relations. Also the full cost recovery should be introduced gradually with the continuous endeavor of public relations for customer understanding. Therefore, it is recommended that the tariff setting based on full cost recovery shall be introduced after the establishment of MIS database, and not implemented as emergency measure. Before introducing the tariff setting procedure, financial plan of Volume II Chapter 10 Economic and Financial Evaluation, provides the necessary tariff raise for each water supply and sanitation until the year 2025.

CHAPTER 13

EVALUATION OF THE MASTER PLAN

CHAPTER 13 EVALUATION OF THE MASTER PLAN

13.1 Technical Aspects

13.1.1 Water Supply

The significant current problems concerning the water supply system in Goa were identified during the Study. The master plan was prepared to address these problems. The significant issues are:

a. The treatment capacity is not sufficient to meet current and future water demands;
b. There is a lack of data control such as asset data, asset drawings and process control data for many facilities including treatment plants; and
c. The water transmission and distribution systems associated with the existing treatment plants and/or reservoirs are unstable due to insufficient plant and pipeline capacity.

Expansions of the existing plants within the Salaulim, Chandel, Assonora, Dabose and Canacona WSS are proposed, to increase the treatment capacities. The aim is to meet the projected water demand in 2025 (which is the target year of the master plan). As the proposed treatment processes are similar to the existing plants, no special construction, operation or maintenance methods or technologies will be required. It is noted, however, that improved water quantity and quality controls will be required for the operation and maintenance of the existing and proposed plants.

The PWD staff possess an adequate level of capability and knowledge to carry out the related works, assuming that adequate training and capacity building is conducted. It will be important for the PWD to keep written records and data for their assets and activities.

13.1.2 Sanitation

Existing problems in the sanitation sector in Goa were identified in Chapter 3 as listed below. The Master Plan for sanitation was prepared to address these problems.

- Sewerage systems are limited to only two municipalities in the Study Area, namely Panaji and Margao. The other areas have been served by on-site facilities or the practice of open defecation. The majority of the on-site facilities are not operated properly. As a result, they pollute open water bodies and groundwater.
- The existing sewage collection facilities have deteriorated consistently since their construction. Due to inadequate maintenance, they do not function at their full

capacities.

The proposed sanitation systems are expected to be appropriate with regards to demographic, geological, environmental and economic factors in the study area.

The groundwater quality is expected to improve after the proposed sewerage systems are introduced and/or adequate on-site facilities are provided. Decreased overflow from septic tanks will improve residential amenity.

The activated sludge method is the proposed sewage treatment process for the study area. This is expected to be adequate in light of the present technical and institutional capacity of Goa State. The existing sewage collection facilities will also be improved by the proposed renewal plan and by additional sewer cleaning equipment.

The reuse of treated effluent from the STP for watering gardens will conserve water supply resources. The use of the dewatered sludge from the STP for agriculture and/or as garden fertilizer will conserve natural and chemical resources. Consequently, implementation of the project will contribute to ecosystem preservation.

13.2 Social Aspects

(1) Social Benefits of the Master Plan

The proposed water supply and sewerage systems are social infrastructure and will benefit local residents directly and indirectly through environmental improvement.

Positive impacts of the proposed water supply projects are expected to include:

1) An increase in the population served with treated piped water;
2) An improvement in the quality of supplied water;
3) Continuous water supply;
4) A reduction in waterborne diseases;
5) Improvement of the financial situation of the provider due to the reduction of NRW;
6) Greater water supply available to tourist facilities;
7) Greater water supply available to industries.

Currently, many water consumers complain of water shortages, limited and irregular water supply, risks of the water supply being contamination by sewage, and inadequate customer

service. It is expected that these problems will be solved by the implementation of the projects proposed in the master plan, which include the improvement of water supply facilities, operation and maintenance, information management systems, and customer service.

The master plan addresses the increase in water demand necessary for the future development of Goa. At a domestic level, convenience of water supply will be significantly increased once 24 hour / 7 day water supply is implemented in many areas. Large water consumers such as hotels and factories will also be provided with sufficient water. The regional gap in water supply service between towns near the water supply sources and towns at the outskirts of water transmission (such as Vasco) will also be significantly reduced by the increase in water supply.

The expected positive impacts of the proposed sewerage projects include:

1) Reduction of open defecation and unsanitary or malfunctioning individual toilets;
2) Prevention of water quality deterioration of rivers and beaches;
3) Improvement of local environmental condition including gutters and local streams;
4) Reduction overflows from existing septic tanks;
5) Improvement of sanitary conditions and images of towns and coastal areas;
6) Reduction of infectious disease, and enhancement of human health;
7) Improvement of socio-economic conditions, attracting more tourists especially in Calangute, Candolim and Colva;
8) Advancement of women.

Currently, many residents complain about overflows from their septic tanks and an unsanitary living environment due to open defecation. The Master Plan also addresses the importance of enhancing public awareness about sanitation, in order to maximize the effectiveness of the proposed sewerage systems and on-site sanitation facilities. Increased awareness will be achieved using the Total Sanitation Campaign which is subsidized by the central government of India.

(2) Demand Responsiveness and Transparency of the Master Plan

The demand responsiveness and transparency of the mater plan have been evaluated, as they are important social components of the master plan.

In Goa, it was very important for the PWD to build a trusting relationship with stakeholders and to improve customer services. The first stakeholder meeting on environmental and social

considerations and the first technical workshop with the PWD were held jointly during the Reconnaissance Survey. The results of the Reconnaissance Survey were fully explained to the various stakeholders as well as to PWD staff. The stakeholders were also invited to make comments and ask questions in the technical workshop. Therefore, the public was able to make an important contribution to the formulation of the master plan. During the second stakeholder meeting, the invitees again contributed to the finalization of the master plan by discussing various matters concerning water supply, sewerage and sanitation in Goa.

The public awareness survey conducted during the first phase of the study found that more than half of the residents in Goa regarded water pollution in Goa as a serious or very serious issue. About 80% of the residents felt that the water is becoming more polluted in Goa. About 90% of the residents recognized the need to prevent further deterioration of water quality as well as the need to improve their sanitary situation. It was also found that many people who use preliminary on-site sanitation facilities, such as pit latrines, would prefer a sewerage connection over a septic tank upgrade. For these reasons, it can be concluded that the sewerage projects proposed in the master plan address the demands of the residents of Goa.

Overall, the formulation of the master plan demonstrates demand responsiveness and transparency/accountability. It can be evaluated as a positive achievement from a social perspective.

13.3 Economic and Financial Aspects

13.3.1 The Master Plan for Water Supply

According to the economic evaluation, the economic internal rate of return (EIRR) of the proposed project is 13.2%. This indicates that the project is economically viable, as the EIRR exceeds the opportunity cost of capital (12%).

In the financial evaluation, the financial internal rate of return (FIRR) of the project is 2.56%, assuming an annual tariff raise of 4.00% for the domestic sector and 2.50% for the non domestic sector. The annual 4.00% water tariff raise is within the range of ‘willingness to pay’ and within the affordability of customers (assuming annual household income growth is 3% at constant price). Therefore, the project is deemed financially feasible when the loan interest rate is less than 2.56%.

13.3.2 The Master Plan for Sanitation

The economic evaluation shows that the economic internal rate of return (EIRR) of the master plan was 15.6%. Therefore, the project is economically viable because the EIRR exceeds the opportunity cost of capital which is 12%.

In the financial evaluation, the financial internal rate of return (FIRR) is not available for the sanitation master plan. The benefit-cost ratio (B/C) is only 0.17. The necessary tariff increase to cover operation and maintenance costs (including administration costs) and the required amount of subsidy was calculated in the financial plan.

13.3.3 PHE Financial Plan for the Water Supply and Sanitation Master Plan

(1) Necessary tariff increase and subsidy for sanitation services

Table 133.1 shows the estimated increase in sewerage charges required to cover the operation and maintenance costs (including administration costs) by the year 2025.

Table 133.1 Necessary sewerage charge increases to cover O&M and administration costs

Category	Increase rate	Note
Domestic	7.5% per annum	Without inflation adjustment
Non-domestic	6.0% per annum	Without inflation adjustment

The monthly sewerage charge for domestic customers in 2025 through the above tariff raise is slightly less than Willingness to pay for sanitation and is less than household affordability (i.e. less than 1.5% of household income) in 2025.

With these tariff increases, it will be essential for the PHE to obtain a State Government subsidy of around Rs.100 to 350 million per annum by the year 2025. Beyond 2025, a State Government subsidy of Rs.150 to 200 million will be necessary.

Without the sewerage tariff increase, expansion of the sanitation service will result in a continuous large budget deficit to the PHE. Under the present budget system, a deficit in the sanitation sector may result in a decrease in the budget for water supply services, and may result in a decline in both water supply and sanitation services. It is recommended that PHE shall be careful about expansion of sanitation service and shall provide better service and public relations activities to obtain support from existing and future customers.

(2) Necessary subsidy for water supply service

As a result of the expanded service coverage and a tariff raise for water (charged at 4% per annum at fixed price), the necessary subsidy will decrease between 2013 and 2025, resulting in zero subsidy after 2026. For the period between 2007 and 2017, the necessary subsidy from the State Government will climb as high as Rs.2,200 million. The large subsidy between 2007 and 2012 is a result of the annual net loss during the early stage of the project and the costs for master plan exceeding the loan coverage. It is recommended that some of the expansion works planned for execution before 2012 should be delayed until after 2012, based on the detailed consideration of the urgency of the project and the possibility of obtaining subsidies from the State Government. Another option for reducing the amount of subsidies required each year is to seek additional loans for part of the project costs for priority projects.

(3) Proposal for Introduction of environment tax

The benefits of sewerage treatment are not limited to the customers of the service. Downstream basin will benefit in many ways in improved sanitation and enhanced tourism and fishery. Tourism is one of the largest beneficiaries of the water quality preservation of the seashore. Taxation to the tourism for preserving beautiful seashore is reasonably considered as another resource of fund for sanitation service by PHE. It is recommended that the budget from tax shall be utilized for the expansion and replacement of the sewerage treatment facilities, so as to replenish the necessary costs exceeding the sewerage tariff revenue. Not a negligible part of the governmental subsidy for sanitation service may be covered by the expected environment tax, as shown in Chapter 10. It is recommended that PHE shall start detailed study for the planning of the taxation.

13.4 Environmental Aspects

(1) Environmental Benefits and Positive Impacts

The objectives of the water supply and sewerage schemes are to improve public health and hygiene, leading to an improvement in quality of living and promotion of economic growth. The implementation of each scheme will result in the following benefits and positive impacts:

- Transition from intermittent to continuous water supply
- Reduction of waterborne diseases caused by improvement of water quality
- More water supply available to tourist facilities and industries
- Reduction of non-revenue water including water leakage
- The collection and treatment of untreated sewage before it enters rivers will improve water quality in the rivers.
- Proper collection, treatment and disposal of sewage will reduce the risks of parasitic

infections and the incidence of various water-borne diseases.

- A proper sewage handling and disposal arrangement will minimize the risk of contamination of ground and surface water.
- These provisions assist in maintaining ecological balance by reducing damage to flora and fauna.
- Controlled reuse of sewage sludge may enhance agricultural activities and achieve environmental protection.
- Improvement in the existing sewerage system will assist urban drainage, reducing the amount of water in the streets and the road blockages that lead to flooding.
- Nutrient rich treated water and dried sludge can be used for irrigation, or as a material in cement production.

Implementing the sewerage schemes projects in particular could make significant contributions to improving the natural environment and sanitary conditions for populations. Also, the local residents have a right to receive essential public services such as water supply.

(2) Environmental effectiveness with and without the Project

Technical aspects of the water supply scheme and the sanitation/sewerage scheme have been compared, for the scenarios 'with the project' and 'without the project'. Water supply projects can contribute improvement in living standards healthfully. In consequence, residential environment would be drastically upgraded benefit from the projects. If no project will execute in the future, people living in the Goa state is plagued with water shortage and also tourism industry is falling to suffer losses for economical damages.

On the other hand, if the sanitation/sewerage projects are implemented, sewage and night soil, currently discharged to the rivers, will be treated. If the projects are not implemented, no sewage will be treated and all the sewage discharged will find its way to the major rivers which eventually flow into the sea. That is, degraded water quality will result. When an effluent with a high BOD load is discharged into a natural river or stream, the BOD value of the receiving water increases considerably which, in turn, results in a decrease in the DO value in the water. Therefore, the BOD value will increase dramatically if the project is not implemented. Conversely, the BOD value is expected to decrease if the project is implemented.

(3) Minimization of negative environmental impacts

When planning the sewerage system networks factors such as site location, availability of space for treatment plants, treatment start date, initial cost and operation and maintenance costs were

considered. In the former feasibility study conducted by the PWD, the proposed locations of some new sewage treatment plants were close to residential areas. This would create some negative impacts such relocation/land acquisition issues, and urban environmental impacts such as noise, vibration and visual impact. In contrast, the sites proposed in the master plan are located on empty lots which are well separated from residential and commercial areas. As a result of Initial Environmental Examination Study, it would not appear that there were very few significant negative impacts with proposed schemes of Master Plan.

13.5 Necessity of Review of the Master Plan

This Master Plan was prepared based on information available about plans that the Goa Government has for future development, the types of developments, reasons for those developments, existing social and environmental conditions, and the general characteristics of Goa.

Great care was taken when preparing the Master Plan to address and consider the aspects listed above, based on the information available at the time. The Master Plan will need to be amended from time to time to reflect new information, changes in social, economic and environmental conditions, and changes in government policy, as they become evident. It is therefore suggested that an initial review of the Master Plan be undertaken during 2008 when the feasibility study is undertaken for the Stage II projects.

The purpose of the Master Plan is to set an overall vision for the water supply and sanitation situation in Goa and to guide water supply and sanitation improvement works that will help achieve that vision. The Master Plan is a strategic document and therefore does not define all the components of the water supply and sanitation system in detail. This means that some individual water supply / sanitation projects may be required even though they are not identified in the Master Plan. Also, emergency water supply developments may be required from time to time to mitigate severe water shortages that could not be foreseen or planned for in the Master Plan. The PWD should use their own judgment to make decisions to proceed with these small scale and emergency projects. These projects should not be discounted only because they are not included in the Master Plan.