PUBLIC WORKS DEPARTMENT
THE GOVERNMENT OF GOA
THE REPUBLIC OF INDIA

No.

STUDY ON AUGMENTATION OF WATER SUPPLY AND SANITATION FOR THE GOA STATE IN THE REPUBLIC OF INDIA

Volume III
Main Report: Feasibility Study

November 2006

JAPAN INTERNATIONAL COOPERATION AGENCY

NIHON SUIDO CONSULTANTS CO., LTD.
and
NJS CONSULTANTS CO., LTD.

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PREFACE

In response to a request made by the Government of Republic of India, the Government of Japan decided to conduct the Study on Augmentation of Water Supply and Sanitation for the Goa State in the Republic of India and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Mr. Takemasa MAMIYA of Nihon Suido Consultants Co., Ltd. between March 2005 and October 2006. The study team was composed of members from Nihon Suido Consultants Co., Ltd. and NJS Consultants Co., Ltd. JICA also established an Advisory Committee headed by Mr. Yoshiki OMURA, Senior Advisor, Institute for International Cooperation JICA, which, from time to time during the course of the study, provided specialist advice on technical aspects of the study.

The team held discussions with the officials concerned of the Government of the Republic of India and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared present report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of India and Government of Goa for their close cooperation extended to the team.

November, 2006

Ariyuki MATSUMOTO
Vice-President
Japan International Cooperation Agency

November, 2006

Mr. Ariyuki MATSUMOTO
Vice-President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We are pleased to submit to you this Final Report on the Study on Augmentation of Water Supply and Sanitation for the Goa State in the Republic of India. This report incorporates the views and suggestions of the authorities concerned of the Government of Japan, including your Agency. It also includes the comments made on the Draft Final Report by Public Works Department of the Government of Goa and Ministry of Urban Development of the Government of the Republic of India and other government agencies concerned of the Republic of India.

The Final Report comprises a total of six volumes as listed below.

Volume I	: Executive Summary
Volume II	: Main Report: Master Plan
Volume III	: Main Report: Feasibility Study
Volume IV	: Annex for Master Plan
Volume V	: Annex for Feasibility Study
Volume VI	: Drawings

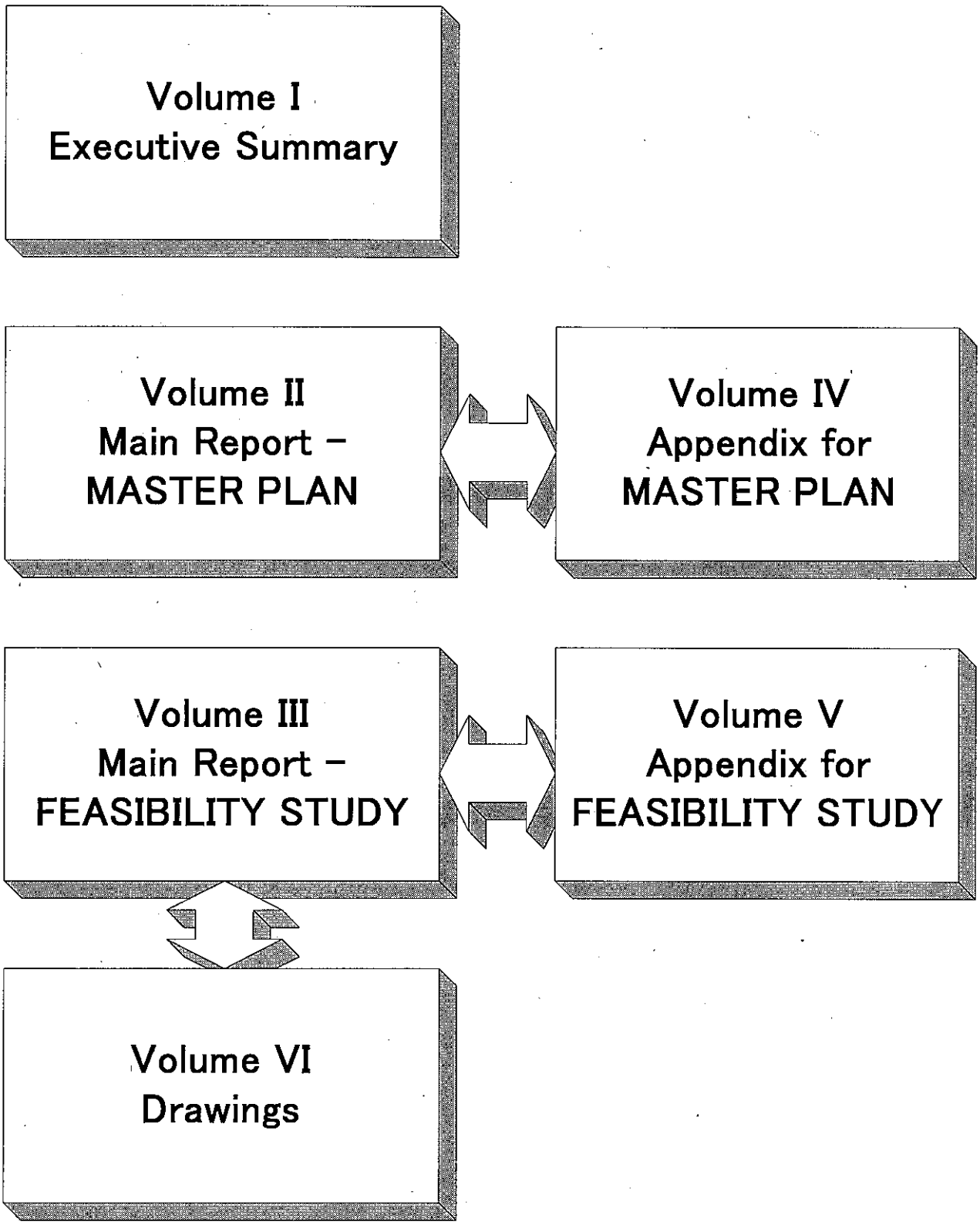
This report contains the Study Team's findings, conclusions and recommendations derived from the three phases of the Study. The main objective of the Phase I was to conducted a reconnaissance survey. That of Phase II was to formulate a long term master plan and to identify priority projects, whilst that of the Phase III was to examine the feasibility of the priority projects which had previously been identified in Master Plan during the course of the Phase II.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Health, Labour and Welfare of the Government of Japan for their valuable advice and suggestions. We would also like to express our deep appreciation to the relevant officers of Public Works Department of the Government of Goa and Ministry of Urban Development of the Government of the Republic of India for their close cooperation and assistance extended to us throughout our Study.

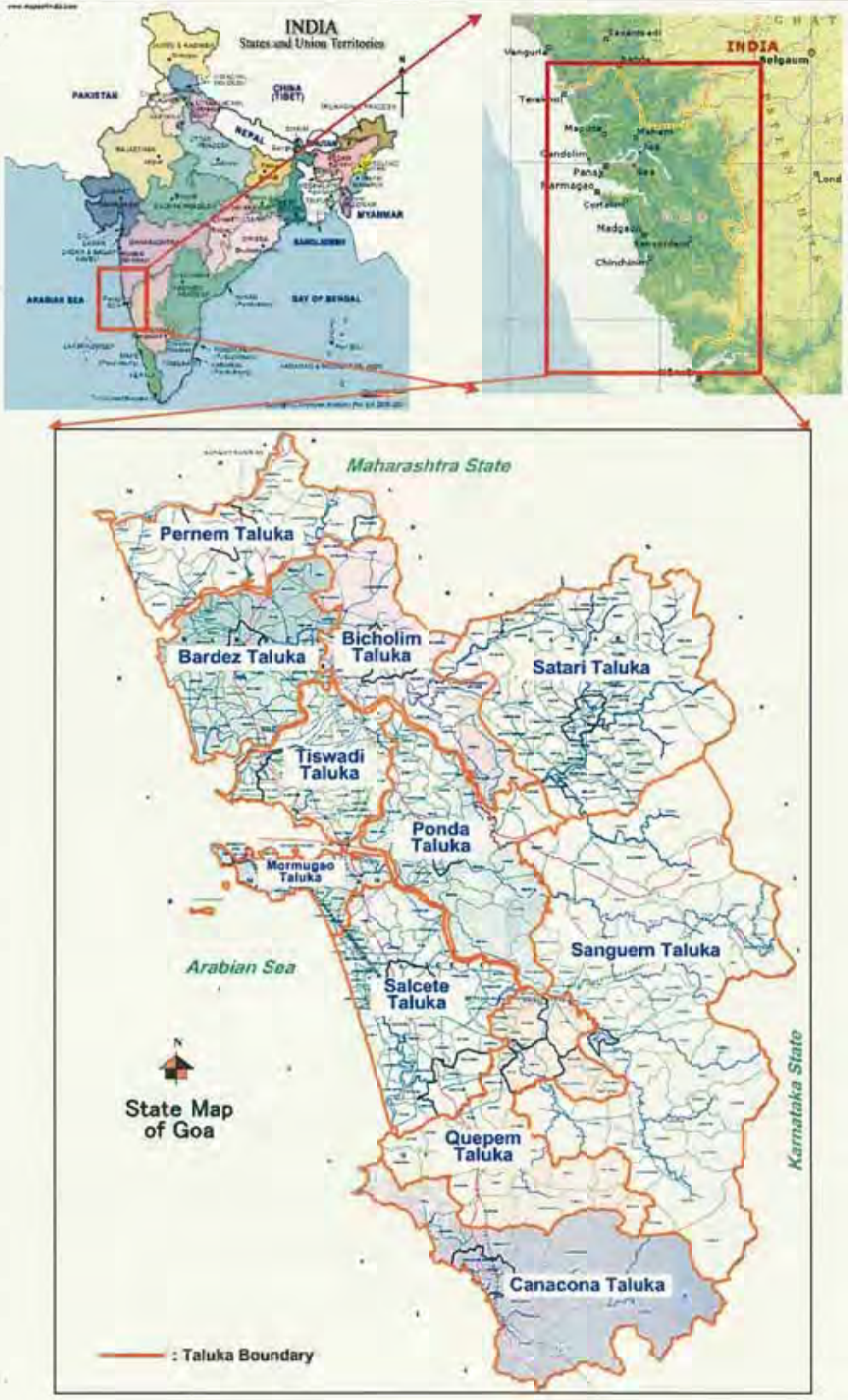
Very truly yours,

Takemasa Mamiya, Team Leader
Study on Augmentation of Water Supply
And Sanitation for Goa State in the
Republic of India

Structure of Report



Location Map



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PUBLIC WORKS DEPARTMENT,
THE GOVERNMENT OF GOA
THE REPUBLIC OF INDIA

STUDY ON
AUGMENTATION OF WATER SUPPLY AND SANITATION
FOR
THE GOA STATE IN THE REPUBLIC OF INDIA

FINAL REPORT

VOLUME III: MAIN REPORT – FEASIBILITY STUDY

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ABBREVIATIONS

ACP	Asbestos Cement Pipe
ADB	Asian Development Bank
ATP	Affordability to Pay
BOD	Biochemical Oxigen Demand
CE	Chief Engineer
CI	Cast Iron
CMMS	Computerised Maintenance Management System
COD	Chemical Oxygen Demand
CPWD	Central Public Works Department
CRZ	Coastal Regulation Zone
CSM	Customer Service Management
D	Diameter
DI	Ductile Cast Iron
DSR	Debt-service Ratio
DST&E	Department of Science, Technology and Environment
EE	Executive Engineer
EIA	Environmental Impact Assessment
FS, F/S	Feasibility Study
GDP	Gross Domestic Product
GI	Galvanised Iron
GIS	Geographical Information System
GLR	Ground Level Reservoir
GOG	Government of Goa
GOI	Government of India
GOJ	Government of Japan
GRDP	Gross Regional Domestic Product
GSDP	Gross State Domestic Product
GVA	Gross Value Added
HDPE	High-density Polyethylene
IEE	Initial Environmental Examination
IS	Information Systems
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KPI	Key Performance Indicator
lpcd	Per Capita Water Demand (liter per capita day)
M&E	Machinery and Electricity
MBR	Master Balancing Reservoir
MIS	Management Information System
MLD	Million Liter per Day
MNF	Minimum Night Flow
MOF	Ministry of Finance
MOUD	Ministry of Urban Development
MP, M/P	Master Plan

ABBREVIATIONS

MS	Mild Steel
NPV	Net Present Value
NRPP	NRW Reduction Pilot Project
NRW	Non Revenue Water
NTU	Nephelometric Turbidity Unit
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
OHR	Over Head Reservoir
PHE	Public Health Engineering
PSC	Prestressed Concrete
PSP	Public Stand Post
PVC	Polyvinyl Chloride
PWD	Public Works Department
RCC	Regional Control Centre
RL	Reduced Level (Height above specified datum level)
SC	Steering Committee
SCM	Supply Chain Management
SE	Superintending Engineer
SS	Suspended Solids
STP	Sewage Treatment Plant
TOR	Terms of Reference
UFW	Unaccounted-for Water
WSS	Water Supply Scheme
WTP	Water Treatment Plant
WTP	Willingness To Pay

SUMMARY

SUMMARY

1 Scope of Priority Projects

1.1 Water Supply System

Expansion and rehabilitation of Salaulim Water Supply Scheme were selected as the priority projects because the scheme has the most serious problem of water shortage from the urgency point of view. The project scale was set based on a careful examination of water demand, supply capacity, raw water availability and the PWD's financial capabilities. The priority projects have been selected from the components of Stage 1 of the Salaulim Scheme. The priority projects are described below:

- Expansion of the Salaulim Treatment Plant 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 a 20,000 m^3 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
- Improvement of Operation and Maintenance such as installation of flow meters, control valves and float valves and improvement of safety standards of WTPs for 7 WSSs
- 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.

1.2 Sewerage System

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.

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 12.1.

Table 12.1 Priority Projects for Sewerage Development

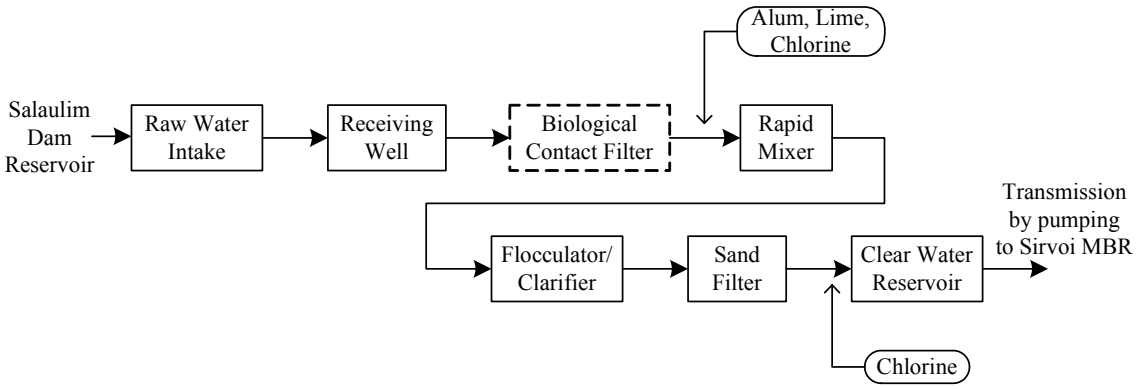
Location	Unit	North Coastal Belt	Margao	Mapusa	Remarks
Expansion Area	ha	398	221	180	
Population in the Expansion Area	Person	22,129	36,779	34,942	
Trunk Sewer Construction	km	6.1	6.0	3.9	
Branch Sewer Construction	km	47.8	44.2	31.5	
Pumping Station Construction	Nos.	1	1	0	
Treatment Plant Capacity	MLD	5.6	(7.5)+6.7	5.4	(Existing)

2 Water Supply System

2.1 Expansion Work

(1) Expansion of Salaulim WTP: 100,000 m^3/day

It is proposed to increase the treatment capacity of Salaulim WTP by 100,000 m^3/day, to cope with future demands in 2018. Therefore, the total capacity will become 260,000 m^3/day. The proposed WTP is recommended the rapid sand filtration system as well as the existing process plus manganese sand filtration process to remove manganese contained in raw water. The proposed treatment process is shown in Figure 21.1.



Note: Biological Contact Filter will be installed if it was judged necessary based on results of continuous water quality monitoring on Ammonia-Nitrogen.

Figure 21.1 Treatment Process of the Proposed Salaulim WTP

(2) Installation of Transmission Mains: 73.65 km

To transmit the treated water from the proposed Salaulim Plant to the existing and proposed reservoirs, via the Sirvoi Master Balancing Reservoir, transmission mains of 73.65 km in total length with diameters of ϕ 150 to ϕ 1400 need to be installed.

(3) Proposed Reservoirs

1) Master Balancing Reservoir at Sirvoi: 20,000 m³

Since the proposed treatment plant is located at lower level of the existing plant, a pumping is required to transmit the treated water to a high altitude reservoir which is a master balancing reservoir and then from the master balancing reservoir the water will be transmitted and distributed to respective distribution reservoirs or service areas under gravity flow. Construction of a master balancing reservoir (MBR) of 20,000 m³ at Sirvoi Rock Hill is proposed.

2) Other Reservoirs: 6 reservoirs

It is proposed to construct the six reservoirs (excluding the Sirvoi MBR) to supply the treated water to the expanded service area.

(4) Pumping Stations: 5 stations

The constructions of five pumping stations are proposed as the priority projects in order to pump transmitted water into the proposed reservoirs for supplying water to the expanded service area.

2.2 Rehabilitation Work

(1) Rehabilitation of Salaulim WTP: 160,000 m³/day

The Salaulim WTP was constructed in 1989 with a production capacity of 160,000 m³/day and is the sole WTP of Salaulim WSS. Therefore deterioration of facilities and equipment have become a significant problem for stable operation of the plant and water supply to the service area. The equipment and facilities in the Salaulim WTP are used for almost 20 years.

According to the site investigations during the study period, the equipment and facilities in the WTP have not been maintained proactively and operated based on written operation and maintenance manual. Therefore, the equipment and facilities have been deteriorated, some equipment are not able to operate properly, and many leaks have been found at piping systems.

In order to secure water supply to the existing service area from the Salaulim WTP, it has been judged that the rehabilitation works for the Salaulim WTP is indispensable and selected as a priority project.

(2) Transmission Main from Margao to Verna: 13.8 km of ϕ 1200

Rehabilitation of the existing transmission mains from the existing Salaulim WTP to Verna Pumping Station which is prestressed concrete (PSC) pipe has been identified as a high priority for securing the sustainable and continuous supply of treated water from both the existing and proposed treatment plants, since pipe break accidents have occurred frequently because of deteriorated quality of the pipes.

The PWD is, therefore, replacing the PSC pipes of a diameter of 1,400 mm, which are laid from the Salaulim WTP to Margao with mild steel (MS) pipes. The PWD has replaced about 10 km PSC pipes with MS pipes as of July 2006. The replacement of the remaining 11.3 km PSC pipes are under implementation and will complete within the year 2007 according to the PWD's information. Therefore, the priority projects include the replacement of the remaining transmission lines of PSC pipes which is about 13.8 km of 1,200 mm from Margao to Verna Pumping Station.

(3) Replacement of Pumping Equipment at Verna Pumping Station: 4 units

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 units of the existing pumping equipment (pumps and motors). 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 28.16 m^3/min × H69m × 456kW × 4 units (pumps and motors). Remaining other 2 units are proposed to be replaced at the Stage II.

2.3 Improvement of Operation and Maintenance

(1) Installations of Flow Meters at Reservoirs and WTPs: 371 meters

The study proposes to install the flow meters 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 as well as float valves 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.

(2) Installations of Flow Meters and Flow Control Valves at Transmission Mains: 30 locations

As the priority projects, the flow meters are proposed to be installed at major points of the existing and proposed 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.

(3) Improvement of Safety Standards at 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.

(4) 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 “Ambient 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.

2.4 Summary of the Priority Projects

In conclusion Table 24.1 shows a summary of the priority projects.

Table 24.1 Summary of the Priority Projects

Work Component		Description
1. Expansion Works (for Salaulim WSS)		
	Salaulim WTP	100 MLD
	Transmission Mains	73.65 km, 150 – 1,400 mm
	Reservoirs	Sirvoi MBR, 20,000 m^3
		6 reservoirs, 100 – 800 m^3
	Pumping Stations	5 stations
2. Rehabilitation Works (for Salaulim WSS)		
	Salaulim WTP	160 MLD
	Transmission Mains,	Margao to Verna, 13.8 km, 1,200 mm
	Pumping Equipment	4 units of Pumping Equipment at Verna Pumping Station
3. Improvement of Operation and Maintenance (for all 7 WSSs)		
	Installation of Flow Meters	23 nos at WTPs
		348 nos at reservoirs with float valve
		30 nos at transmission mains with flow control valve
	Safety Standards for WTPs	Chlorination Facility and others
	Central Laboratory	established at Tonca, Panaji

3 NRW Reduction Roll-out Plan

The 'NRW reduction roll-out plan' has been formulated based on the experiences gained from the 'NRW reduction pilot project' conducted by the joint PWD/JICA Study Team during April/May 2006 and the review of current PWD NRW performance and practices during the first and second phases of the study. During the pilot project, not only leakages but also illegal or unregistered connections were found. The premise on which the plan is based is as follows:

- NRW is at an unacceptable level and will need to be reduced by adopting a more proactive approach to NRW reduction
- The NRW reduction pilot project was a success in demonstrating the benefits to be gained in reducing NRW by taking and 'active' approach and PWD are keen to build on the transfer of knowledge and technology gained during the project
- PWD would benefit from gaining additional assistance in developing and delivering the roll-out plan to ensure it's success and to maximise benefits and sustainability
- A number of actions, resources and investments are required to bring NRW under control and to sustain it at economic levels. This may include the need to let external contracts as well as to enhance in-house efforts
- NRW reduction activities will need to become 'a way of life' as opposed to a series of adhoc or one-off exercises

3.1 Actions to be Addressed by the NRW Reduction Roll-out Plan

A successful NRW reduction roll-out plan will need:

Leadership – From the top of the organisation, there must be a "Champion" to ensure that the whole organisation concentrates upon the basics of increasing income and reducing the physical leakage

Commitment – Throughout the organisation there must be a determination to follow through the processes that reduce NRW.

Resources – Significant resources are required to make the step change necessary to reduce NRW. Once NRW is under control and efficient and effective processes are in place then the resource can be reduced to a lower level. It must be recognised that NRW control is an ongoing operation.

Based on the experience gained from the NRW reduction pilot project, the following actions will need to be addressed:

- Improve network management practices
- Agree standards for new connections and repairs including standard specifications for materials, fittings, meters, layout, non-return valves, sealing, testing, calibration etc
- Introduce leakage policy and improved methods
- Replace all defective (leaking) house connections
- Repair all existing visible leaks
- Introduce metering policy and improved practices
- Replace all defective meters
- Conduct enabling works and leakage control measures
- Set up Active Leakage Teams within each Division or Region with appropriate tools to find and fix leaks. It may also be prudent to establish a 'centrol coordinating' role to collate and share Regional performance across the State
- Institutionalise NRW management measures and tackle 'apparent' as well as 'real' losses
- Ensure 100% billing and improve revenue collection practices

It should be noted that the premis on which the feasibility study for water supply is based, emphasises the provision of 24 × 7 supplies in future. This brings with it the challenges of ensuring that leakage control measures are put in place to keep leakage 'in-check', as potentially, increasing the hours of supply could increase the level of water lost as a result of leaks if the current 'passive' approach to leakage management is not changed.

3.2 Strategies for Setting up and Running NRW Reduction Activities

There are a number of options available to PWD in tackling the current levels of NRW and for putting measures in place to firstly bring it within acceptable limits and then to maintain it at economic levels.

External Technical Assistance Approach

Even with the enthusiasm generated from the success of the NRW reduction pilot project, it will be difficult to get the roll-out programme 'off the ground' by using entirely PWD staff with out additional external technical assistance. External technical assistance will provide the expertise and 'driving force' to formulate and initiate roll-out so that PWD can implement the plan successful following a thorough planning phase. In short, external technical assistance would:

- Help PWD in planning a successful roll-out program
- Help PWD in developing capacity to implement the programme
- Help start-up of the State wide roll-out programme
- Support PWD during implementation of the programme
- Support PWD in analysing the benefits of the programme

Based on the number and complexity of water supply schemes, it would be preferable to seek external technical assistance by means of including a part of the priority projects.

3.3 Priority of Implementation

Implementation of NRW reduction measures will need to be prioritized regardless of whether the approach to tackling NRW is conducted in-house or by a combination of the three approaches described above. PWD will need to consider prioritization based on the following:

Areas wise: Areas suffering severe water shortages/intermittent supplies should be tackled as a priority as savings in water resulting from NRW reduction measures will make more water available to existing customers and provide supplies to those that currently do not receive a supply. This will improve supply coverage, increase revenues and improve service delivery and public image.

Scheme wise: The water supply schemes that provide the largest volume of water or supply the largest amount of customers or contributes the largest amount of revenue should be tackled as a priority as these will return the greatest benefits in the short term. However, it should be noted that the larger schemes will present the biggest challenges as these are likely to contain longer transmission/piped distribution lines and more reservoirs. The current lack of reservoir level control and flow measuring devices will need to be rectified accordingly.

4 Sewerage System

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.

According to the result of comparison study to select the priority projects, three (3) projects, namely North Coastal Belt (new), Margao (expansion) and Mapusa (new) were selected as priority projects. The summary of basic values of sewerage system in the Feasibility Study is

shown in Table 40.1. 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.

In North Coastal Belt STP, a part of treated effluent is further treated by sand filters for reuse as gardening water. The remaining treated effluent is also treated to reduce the suspended solids because it is discharged near to the world famous beach resorts.

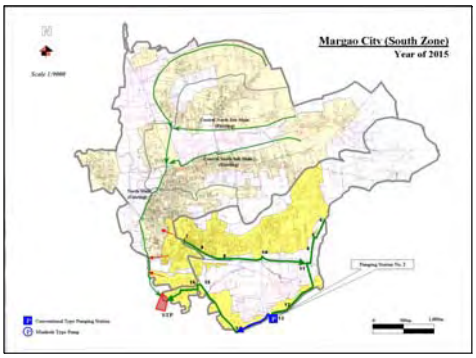
Table 40.1 Summary of Basic Values of Sewerage System in Stage I

Location	Unit	Margao		Mapusa		North Coastal Belt Calangute & Candolim	
Stage		Stage I	M/P	Stage I	M/P	Stage I	M/P
Target year		2015	2025	2015	2025	2015	2025
Covered population	Person	80,680	118,193	34,260	68,255	19,772	39,358
Sewage flow	m³/day	13,678	20,861	5,354	10,782	5,090	11,172
Sewage treatment plant							
Capacity (New)	m³/day	6,700	13,400	5,400	10,800	5,600	11,200
(Existing)	m³/day	7,500	7,500	-	-	-	-
(Total)	m³/day	14,200	20,900	5,400	10,800	5,600	11,200
Treatment method		Activated sludge method					
		Conventional + (Sand filtration)		OD + (Sand filtration)		OD + Sand filtration	
Location		Margao		Mapusa		Calangute	
Discharge river		Sal River		Tributary of Mandovi R.		Baga River	
Sewage quality		In	Out	In	Out	In	Out
BOD	mg/ℓ	300	30	300	30	240	10
SS	mg/ℓ	250	100/50	250	100/50	200	100/50(10)

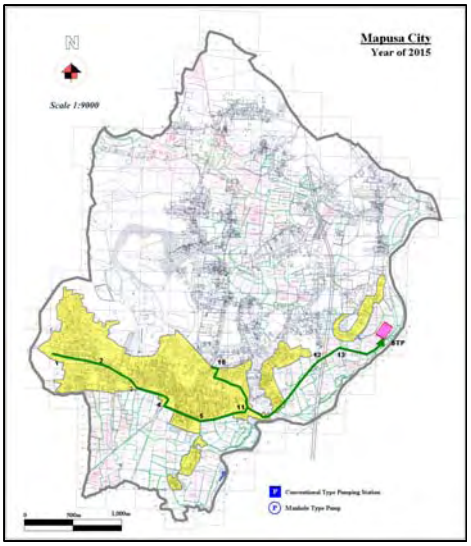
Notes: (Sand filtration) Sand filtration is a future plan for Margao and Mapusa
Sewage quality of SS out: Effluent quality standard/ expected effluent quality (with sand filtration)

The general Layout plans of sewerage system of Margao, Mapusa and North Coastal Belt are presented below.

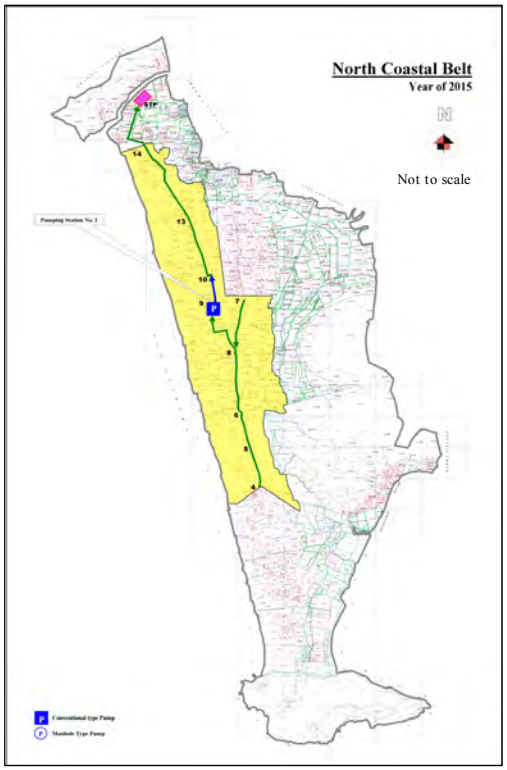
Margao



Mapusa



North Coastal Belt



5 Operations & Maintenance Improvement Plan

This O&M improvement plan has been formulated based on the knowledge gained primarily from discussions with PWD during the three phases of the study and is based on the review of current PWD O&M performance and practices. The assumptions related to water and wastewater schemes are as follows:

For water supply schemes, the premise on which this plan is based is as follows:

- The feasibility study for enhancement and augmentation of existing water production facilities emphasises the use of familiar technologies (in-line with existing installations)
- Improved methods of process control will be employed including the testing and analysis of process water and final water delivered to the customer's tap

- Improved network designs will be employed and include devices for the measurement and control of pressures and flows in order to 'balance' the networks and to aid the management and control of NRW
- Improved operations management practices will be employed including the need to collect and act on asset and process data
- Improved maintenance management practices will be employed including the need to employ a more 'proactive' approach to maintenance such as the use of planned preventative maintenance practices to ensure efficient plant availability and operability
- Improved safety standards will be employed to ensure safe installation, maintenance and operation of disinfection and chlorine handling facilities

For sanitation schemes, the premise on which this plan is based is as follows:

- The feasibility study for enhancement and augmentation of existing sewage treatment facilities emphasises the use of familiar technologies (in-line with existing installations) as well as the 'oxidation ditch' method of treatment
- Improved methods of process control will be employed including the testing and analysis of effluents prior to discharge into public water bodies to ensure compliance with environmental legislation in force. This includes the safe disposal of screenings, grit and sludge generated at plants as a result of the sewage treatment process
- Improved operations management practices will be employed including the need to collect and act on asset and process data
- Improved maintenance management practices will be employed including the need to employ a more 'proactive' approach to maintenance such as the use of planned preventative maintenance practices to ensure efficient plant availability and operability
- Improved sewerage network designs will be employed to ensure efficient flows to ensure self cleaning properties to minimise deposits
- Modern techniques and tools will be employed to ensure that the sewerage networks are regularly cleaned and maintained to prevent sewer blockages and sewage flooding
- Improved safety standards will be employed to ensure safe installation, maintenance and operation of equipment in potentially explosive atmospheres

5.1 Actions to be Addressed by the O&M Improvement Plan

As well as being based on the assumptions mentioned above, the O&M improvement Plan builds on the suggestions and strategies formulated in the Master Plan. The Plan addresses the shortfalls identified in the review of current O&M performance and practices and the need for:

- Policy formulation, setting of departmental targets and objectives
- Asset management plans and for asset information to be recorded
- O&M manuals that clearly states the parameters, procedures, schedules and responsibilities for effective plant operation
- 'Planned preventative maintenance' practices to be adopted
- Installation of devices for measuring inflow and outflow to accurately determine the volume of water into supply. Additionally, installation of good quality revenue meters to accurately determine consumption
- H&S policy/manuals and contingency/emergency plans; to raise H&S awareness and to improve the level of installation, operation and maintenance of chlorine facilities
- Statistical process control techniques and to act on process data to optimise water quality and wastewater effluent standards
- Providing and acting on meaninful and timely management information
- Improved maintenance and H&S practices at water treatment plants (WTP's), sewage treatment plants (STP's), pumping stations and when working in highways and in sewers
- Improved sewer cleaning, sludge management and trade-effluent compliance
- Improved housekeeping standards and computerisation of O&M administrative activities
- The setting up of 'pilot offices' to develop best practice
- Institutionalising the O&M improvement measures within each region by use of best practices developed within the pilot offices

5.2 Strategies for Setting up and Running O&M Improvement Activities

There are a number of options available to PWD in tackling the current levels of O&M performance related to water treatment facilities, water distribution networks, wastewater treatment and sewerage networks and for putting measures in place to improve management capability, plant performance and availability, service standards and service delivery.

Given the number of offices and staff responsible for the operation and maintenance of the water and sanitation schemes throughout the State, it will be difficult to get the O&M improvement plan 'off the ground' by using entirely PWD staff with out additional external technical assistance. Implementing improvements requires not only the need to develop improved methods of working but also **'change management'** skills to ensure that the improved methods are successfully adopted and applied in practice. External technical assistance will provide the expertise and 'driving force' to formulate and initiate improvements as well as a 'Change Management Plan' so that PWD can implement improvements successfully. In short, external technical assistance would:

- Help PWD in planning a successful O&M Improvement Plan including the need for a 'Change Management Plan'
- Help PWD in developing capacity to implement the O&M Improvement
- Help start-up of the State wide pilot office improvement teams and priorities tangible and achievable improvements
- Support PWD during implementation of the programme
- Support PWD in analysing the benefits of the programme

Based on the number of functional skill requirements needed to bring about changes in the management of O&M activities, it would be preferable to seek external technical assistance by means of including as part of the priority projects.

6 Institutional Development Plan

6.1 Capacity Building Agenda

Based on the earlier assessments of strengths and weaknesses of PHE, a detailed Capacity Building Plan is presented in the following Table 56.1. It has been agreed with PHE that, to successfully implement the plan, an external technical capacity building support project during 2007-2012.

The technical assistance will include the provision of advisory services to PHE, provision of software, augmentation of computer hardware. A budget, in the order of about US 6.2 M for the 6-year period (2007-2012) has been developed. This is about 4% of the proposed capital investment project.

6.2 Restructuring Agenda

Following assessment of internal institutional arrangements, a scheme-based structure is recommended.

- Service area is defined by the presence of facilities; implies that the service area responsibility of each water or sewerage system will be expanding in the future.
- Responsibility for expansion of services to un-served areas will be with the Technical Services Office – not with the system managers.
- Operation and maintenance of small village services will, for practical reasons, have to be managed by the "nearest" system manager.
- Revenue and cost performance will be tracked by scheme; and consolidated at the Department level.

The Study recommended a detailed description of the functions and responsibility of each work group, including proposed staffing levels up to the year 2012. The staff productivity ratio is envisaged to be improved from the current 16.1 staff per thousand connections to 14. This may be achieved by intensified campaign for new connections over the period, from about 194,000 in 2005 to 236,500 in 2012, while retaining, more or less, the current number of staff. The Study proposes that PHE:

1. Review proposed restructuring of PHE
2. Seek authorization and approval of new organization structure.
3. Implement new PHE structure.
4. Introduce a system and methodology for regular review of organization structure and staff competency mix in each of the working groups in the future.

6.3 Policy Agenda

In addition to the broader legislation suggested in the Master Plan, additional policy decisions are needed for this institutional development plan to proceed, as follows:

- Authorize reorganization of PHE.
- Authorize use of an independent accounting system which will be implemented parallel with the existing financial reporting system now implemented by PHE.
- Enable PHE to retain revenues generated, plus a state subsidy indexed on revenue generated (or other performance targets) to support water and sewerage services.

- Authorize PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc). Guarantee security of tenure of staff who may be adversely affected by these changes.
- Create mechanisms for regular dialogue with consumers and consumer groups.
- Consider a state policy requiring mandatory connection to the sewerage system within a fixed time to achieve viability of investments.

7 Cost Estimate and Implementation Schedule

7.1 Introduction

The construction period of the priority projects is expected to be three years. Structural component of water and sewage treatment plants will be constructed in the first two years, while the M&E works and the test operation will be carried out in the last year. Rehabilitation of the existing water treatment plant will be carried out in parallel to the expansion works.

About other transmission mains, trunk sewers, branch sewers, reservoirs and pumping stations, there are no restrictions, so the works can be carried out at any convenient time within a period of two and a half years.

7.2 Water Supply

A summary of the water supply annual costs is presented in Table 72.1.

Table 72.1 Annual Cost Estimate for Water Supply Components

Item	Amount (Rs. In Million)					
	Total	2008	2009	2010	2011	2012
1.Construction Cost	3,519.38			737.91	1,906.20	875.27
1) Expansion Project	2,256.72			451.39	1,280.29	525.04
(1) Water Treatment Plant	738.01			147.61	369.01	221.39
(2) Transmission Main	1,395.20			279.07	837.16	278.97
(3) Reservoir	114.75			22.95	68.85	22.95
(4) Pumping Station	8.76			1.76	5.27	1.73
2) Rehabilitation Works	955.30			191.22	536.91	227.17
(1) Water Treatment Plant	362.80			72.71	181.40	108.69
(2) Transmission Main	537.86			107.58	322.72	107.56
(3) Pumping Station	54.64			10.93	32.79	10.92
3) Water Quality Control	17.50			0.00	17.50	0.000
4) O&M Improvement	289.86			95.30	71.50	123.06
(1) Water Supply System O&M	266.06			71.50	71.50	123.06
(2) NRW Reduction Improvements	23.80			23.80	0.00	0.00
2. Engineering Cost	351.94	70.00	130.00	43.79	70.62	37.53
3. Administration Cost	193.57	3.50	6.50	39.09	98.84	45.64
4. Land Acquisition	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical Contingency	387.13	7.00	13.00	78.17	197.68	91.28
6. Price Contingency	1,240.57	5.15	19.78	184.71	645.11	385.82
Total excluding Price Contingency	4,452.02	80.50	149.50	898.96	2,273.34	1,049.72
Total	5,692.59	85.65	169.28	1,083.67	2,918.45	1,435.54
Total In Million US$ (in Million US$1.00=Rs.45.24)	125.82	1.89	3.74	23.95	64.51	31.73

Notes: 1) Improvement and rehabilitation of distribution system and installation of house connections should be conducted as routine work of the PWD. Therefore, costs for these portions are not included in table above. However, these costs are taken into account for following economic/financial analysis.

2) Components of 3) Water Quality Control and 4) O&M Improvement are derived from improvement of O&M improvement plan, therefore, these components are not listed as priority projects for water supply as shown on Table 52.1.

7.3 Sewerage

A summary of the sewerage annual costs is presented in Table 73.1.

Table 73.1 Annual Cost Estimate for Sanitation Components

Item	Amount (Rs. In Million)					
	Total	2008	2009	2010	2011	2012
1.Construction Cost	881.20			262.92	314.34	303.94
1) Margao	344.97			98.91	123.03	123.03
(1) Trunk Sewer	108.18			36.06	36.06	36.06
(2) Branch Sewer	132.15			44.05	44.05	44.05
(3) Pump	10.84			0.00	5.42	5.42
(4) Sewage Treatment Plant	93.80			18.80	37.50	37.50
2) Mapusa	234.56			68.12	85.22	81.22
(1) Trunk Sewer	77.73			25.91	25.91	25.91
(2) Branch Sewer	75.33			25.11	25.11	25.11
(3) Pump	0.00			0.00	0.00	0.00
(4) Sewage Treatment Plant	81.50			17.10	34.20	30.20
3) North Coastal Belt	286.67			80.89	106.09	99.69
(1) Trunk Sewer	79.23			26.41	26.41	26.41
(2) Branch Sewer	103.44			34.48	34.48	34.48
(3) Pump	10.40			0.00	5.20	5.20
(4) Sewage Treatment Plant	93.60			20.00	40.00	33.60
4) O&M Improvement	15.00			15.00	0.000	0.00
2. Engineering Cost	105.74	20.00	40.00	11.55	17.72	16.47
3. Administration Cost	49.34	1.00	2.00	13.72	16.60	16.02
4. Land Acquisition	18.20	9.10	9.10	0.00	0.00	0.00
5. Physical Contingency	100.52	2.91	4.91	27.45	33.21	32.04
6. Price Contingency	318.16	2.11	7.40	64.86	108.36	135.43
Total excluding Price Contingency	1,155.00	33.01	56.01	315.64	381.87	368.47
Total	1,473.16	35.12	63.41	380.50	490.23	503.90
Total In Million US$ (in Million US$1.00=Rs.45.24)	32.57	0.78	1.40	8.41	10.84	11.14

7.4 Capacity Building, Institutional/Organizational Improvement

A summary of the capacity building, institutional/organizational improvement annual costs is presented in Table 74.1.

Table 74.1 Annual Cost Estimate for Capacity Building, Institutional/ Organizational Improvement

	Amount (Rs. In Million)						
	2007	2008	2009	2010	2011	2012	Total
1. Institutional/Organizational Improvement Cost	48.99	49.34	49.58	49.39	44.41	42.47	284.18
2. Engineering Cost	5.01	5.05	5.07	5.06	4.55	4.35	29.09
3. Administration Cost	2.70	2.72	2.73	2.72	2.45	2.34	15.66
4. Physical Contingency	5.40	5.44	5.47	5.45	4.90	4.68	31.34
5. Price Contingency	0.00	4.00	8.31	12.87	15.98	19.79	60.95
Total minus Price Contingency	62.10	62.55	62.85	62.62	56.31	53.84	360.27
Total	62.10	66.55	71.16	75.49	72.29	73.63	421.22
Total (in Million US$1.00=Rs.45.24)	1.37	1.47	1.57	1.67	1.60	1.63	9.31

7.5 Implementation Schedule

Construction period for water supply and sewerage systems is scheduled to be for three years from year 2010 to 2012. A consultancy service for the capacity development is scheduled to be implemented at the same time.

7.6 Schedule of Pre-construction Stage

Before award of contracts for contractors, there are several procedures or stages are required such as detailed design, pre-qualification of contractors, bidding, and bid evaluation as pre-construction stage.

Schedule of the pre-construction stage is prepared as shown on Figure 76.1 to be able to commence the constructions or services for capacity development from the year 2010. As shown on this schedule, it is recommended to complete budgetary arrangements by the end of fiscal year 2007.

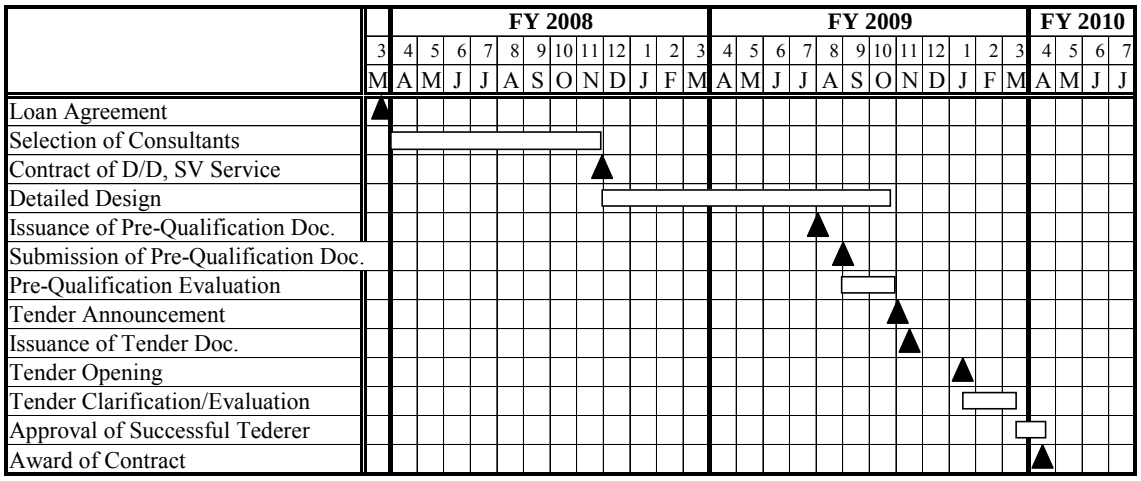


Figure 76.1 Schedule of Pre-construction Stage

8 Economic and Financial Analysis

Economic and financial analyses were conducted applying same method as master plan.

8.1 Priority Projects for Water Supply

The EIRR of the proposed priority projects was estimated at 16.3%, which exceeds the opportunity cost of capital at 12%. This indicates that the projects are economically viable. The NPV, and B/C ratio was Rs.1,064 million and 1.35, respectively.

The results of sensitivity analysis indicated that the priority projects for water supply are still

economically viable with more than 12% EIRR, even under the fluctuations of costs and benefits within the range of plus minus 10%, as shown in the Figure 81.1.

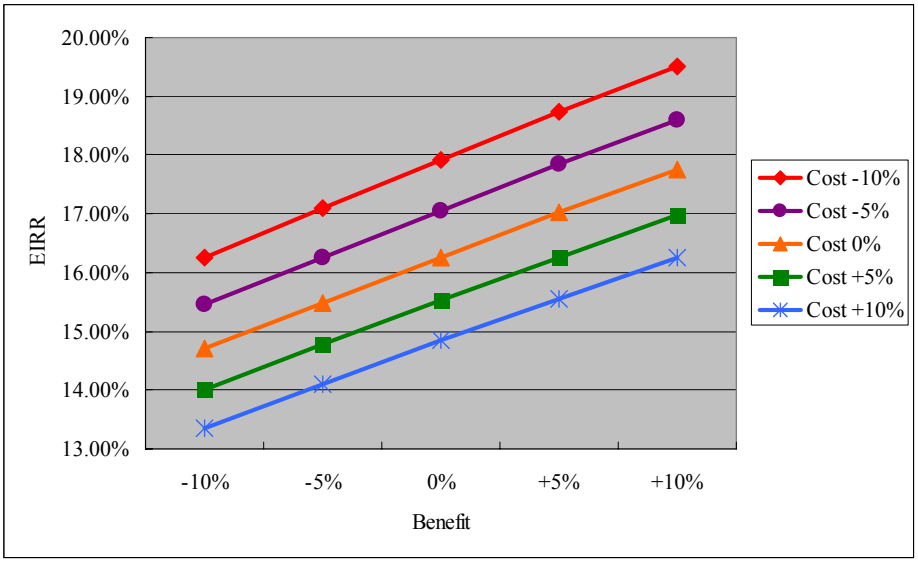


Figure 81.1 Sensitivity Analysis of EIRR of Priority Projects for Water Supply

Feasibility of the priority projects for water supply was analyzed, assuming the following tariff increases applied each year until the year 2025. The FIRRs were as follows:

Table 81.1 FIRR estimation for each case of tariff increase

Case	Tariff increase per annum				FIRR
Case 1	Domestic	0 %	Non-domestic	0 %	N.A.
Case 2	Domestic	3.00%	Non-domestic	1.50%	4.50%
Case 3	Domestic	3.50%	Non-domestic	2.00%	5.20%
Case 4	Domestic	4.00%	Non-domestic	2.50%	5.88%

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

Water tariff in the year 2025 by applying annual 3.50% increase is estimated at 2.04% of the average household income, assuming continuous economic growth of Goa State. The percentage is under the household's willingness to pay (2.48%) and is below the household's affordability to pay (3.5%). The project is deemed to financially feasible when the annual tariff increase of 3.5% and 2.0% is implemented for domestic and non-domestic sectors respectively, since the FIRR exceeds the discount rate at 5.15%.

Sensitivity analysis was conducted for the Case 3 of Table 81.1. Shaded areas in Table 81.2 are the combinations of cost and benefit changes that make the priority projects not to be

financially feasible. Basically, when the cost increases, benefit must be raised at the same percentage of cost increase in order to be the projects feasible. On the other hands, by reducing the total costs of projects including O&M costs, PHE is able to restrain the increase of the benefit, in other words, necessary tariff revenues.

Table 81.2 Sensitivity Analysis of FIRR of Priority Projects for Water Supply

%		Benefit				
		-10%	-5%	0%	5%	10%
Cost	-10%	5.20%	5.71%	6.20%	6.66%	7.12%
	-5%	4.69%	5.20%	5.68%	6.14%	6.59%
	0%	4.21%	4.71%	5.20%	5.66%	6.10%
	5%	3.76%	4.26%	4.74%	5.20%	5.64%
	10%	3.33%	3.83%	4.30%	4.76%	5.20%

8.2 Priority Projects for Sewerage

The economic evaluation indicated that EIRR was 12.7%. NPV, and B/C ratio was Rs.47 million and 1.06, respectively. The project is economically viable because the EIRR exceeds the opportunity cost of capital at 12%.

Sensitivity analysis was conducted for EIRR of sewerage priority projects. Shaded areas in Table 82.1 are the sets of cost and benefit changes that make the priority projects not to be economically viable. It must be careful that the projects may not become economically viable if the project costs increase more than 10% without benefits increase.

Table 82.1 Sensitivity Analysis of EIRR of Priority Projects for Sewerage

%		Benefit				
		-10%	-5%	0%	5%	10%
Cost	-10%	12.74%	13.40%	14.05%	14.68%	15.29%
	-5%	12.09%	12.74%	13.37%	13.98%	14.58%
	0%	11.48%	12.12%	12.74%	13.34%	13.92%
	5%	10.92%	11.55%	12.15%	12.74%	13.31%
	10%	10.39%	11.01%	11.60%	12.18%	12.74%

The FIRR was not available for the proposed sewerage priority projects. The benefit cost ratio (B/C) was found to be only 0.13, which indicates the present value of benefits is only 13% of the present value of costs. NPV was minus Rs.1,075 million. Sensitivity analysis indicated that sewerage priority projects are financially not feasible even under the any combination of costs and benefits changes within the range of plus minus 10%.

Generally, it is not easy to recover the full costs of sewerage project including capital expenditure, since sewerage charge is usually not high enough to recover the full cost. On the other hands, benefits of sewerage are not limited to the users but also to the others. Therefore, it is recommended for sanitation services to aim the cost recovery for operation and maintenance in the long run and provision of public fund as subsidy.

Financial plan was compiled regarding sanitation service of PHE covering all the existing and expansion facilities with sanitation master plan. Annual tariff raise until 2025 was calculated at 7.5% for domestic and 6.0% for non-domestic at constant price to secure the cost recovery of the operation and maintenance costs excluding depreciation costs and interest expenses.

Sewerage charge in 2025 raised at 7.5% per annum at constant price will be less than the ceiling of ATP and WTP for sanitation under the assumption of 3% annual growth of average household income at constant price.

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 shown in Table 82.2 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 82.2 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.

9 Social Consideration and Environmental Impact Assessment

9.1 Public Consultation

It is important to consult with the stakeholders to generate support for the priority projects. The main component of the third stage of public consultation was a 3rd stakeholder meeting. The 3rd stakeholder meeting was held by the PWD in cooperation with the JICA Study Team on 18 July 2006. Results from the Rapid-EIA study were presented to the stakeholders at this meeting. These results could include the impact of the priority projects, analysis of alternative project options, recommended mitigation measures, and environmental monitoring programs. The need for the PWD to provide better daily customer services was highlighted in the discussion as well as second stakeholder meeting.

9.2 Implementation of Rapid-EIA

In practice, any water supply and sewerage projects are not included targeted sectors for EIA requirement in National level. However, environmental clearance is necessary in relation to any development projects within Goa State. However, the proponent needs to prepare the "Rapid-EIA" to gain official approval from the Goa State Pollution Control Board and DST&E and to satisfy requirement of international donor agencies. Accordingly, the Rapid-EIA report must submit to the Impact Assessment Wing as soon as practicable to obtain the permission of environmental and social consideration clearance. The Study Team assisted the PWD to conduct the Rapid-EIA for the selected priority projects. The Rapid -EIA report wasprepared in accordance with JICA's Environmental and Social Consideration Guidelines.

9.3 Results of Rapid-EIA and Recommended Mitigation Measures

The Rapid-EIA study was undertaken to identify any potential negative or positive impacts on the social and natural environment, resulting from the Feasibility Study for the priority projects. A full evaluation of potential significant anticipated impacts both environmental and social aspects, and the recommendation of mitigation measures are provided in the Rapid-EIA report (see Volume V Appendix Feasibility Study). It is recommended that a Rapid-EIA report that prepared by the project proponent (PWD) must submit to the DST&E without delay.

Several mitigation measures for avoiding anticipated negative impacts were also considered in the Rapid-EIA report. Before implementation of the priority projects, PWD must formulate the Environmental Management Plan in detail to present both domestic and international agencies as part of an environmental clearance procedure. It is also essential to involve the

staff who will be responsible for the execution of the Environmental Management Plan as well as to train the staff in practising the mitigation actions.

10 Emergency Measures To be Taken by the PWD/PHE

10.1 Water Supply System

Preparation of Asset Drawings

The PHE is recommended to prepare the drawings of its assets 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.

Collection of Operation and Maintenance Data

The PHE is recommended to collect and maintain operation and maintenance 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.

Cleaning up the Facilities

The PHE is recommended to clean up at all facilities and to keep clean not only for appearance and keeping chemicals of good condition and quality but also for as safety measures.

Repair of Visible Leaks

There are many visible leaks at the WTPs and at the air and scour valves located along the transmission and distribution mains. It is recommended to repair all visible leaks as soon as possible.

Implementation of On-going Projects without Delay

The PHE is implementing the projects such as Dobose, Canacona, Assonora, pipe installation to Panaji and replacement of existing transmission from Salaulim WTP at present. For preparation of the master plan and feasibility study, these projects are taken into account. The PHE is recommended to execute/complete these projects without any delays or suspensions.

Ganjem and Maisal Schemes

The PHE has plans of implementation of the Ganjem (25 MLD) and Maisal (10 MLD) Schemes for securing the water supply to Panjim as emergency measures. General plans on these schemes have prepared respectively according to the request and information from the PHE and the results are attached to Volume IV Appendix for Master Plan. It is, however, recommended

that the PHE 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.

Development of Distribution Network

It should be noted that since the priority projects cover only transmission pipelines upto the reservoirs, the PHE should develop distribution network systems from the reservoirs depending on the expansion of the service area for the Salaulim WSS and install the distribution pipelines and house connections every year as the routine works.

NRW Reduction Roll-out Plan

PWD will need to consider implementation of the NRW Reduction Roll-out Plan and in doing so will need to progressively implement the detailed NRW mitigation measures in order to bring NRW under control now and into the future. The scale of the tasks involved in tackling NRW reduction should not be underestimated and PWD will therefore need to decide on the best strategic approach in bringing NRW under control as well as maintaining it within acceptable and economic levels in future bearing in mind the desire to augment schemes and to provide 24 hour supply capability.

10.2 Sewerage System

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.

Sewer Cleaning

The blockage of sewers causes serious problems for sewerage systems. Blockages not only generate odor, 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, to prepare a cleaning schedule, to procure cleaning equipment, to secure appropriate personnel, and to prepare a budget.

Ambient Water Quality Monitoring

Water quality data analyzed by PWD or agencies concerned are not adequately accumulated and it is difficult to utilize these data for evaluation of environmental conditions. The PWD is recommended to monitor surface and groundwater quality, 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 and Central Laboratory which will be established under the priority project. It is recommended that water quality monitoring data be shared between the related organizations and agencies.

10.3 Capacity Building

Physical System

PHE can immediately take the following steps prior to the implementation of the capacity building plan with respect to the management of the physical water and sewerage systems.

- Prepare an initial list of areas where operation and maintenance guidelines should be developed. There are areas suggested in the O&M assessments.
- Draft a standard format for how each guideline should look like;
- Gather and centralize all existing written equipment manuals and "as-built" drawings;
- Implement the expanded NRW Reduction Program based on the pilot study to other key areas and,
- Identify and agree on other areas of current operations which could be outsourced for public private partnerships.

Organization Planning System

On the organization planning system, much of the improvements will have to be initiated during the period of external technical assistance itself. Many of the improvements needed are founded on a new set of corporate values and processes which need to be understood.

Customer Service System

The following steps can be initiated by PHE with respect to the customer service system improvements.

- Review and update its present "Citizens Charter" with a view towards challenging its own ability to provide high quality services to the consumers.
- Continue holding regular consultations with the public on current issues, similar to those Stakeholders Meetings initiated during the Study period.
- Clean up and verify customer database using independent house-to-house surveys in

preparation for the implementation of a computerized system.

- Organize and implement the concept of Citizens Advisory Councils to advise PHE management on how to proceed.

Administrative System

To facilitate the introduction of an asset management system and an improved inventory control system, PHE can immediately take up the following tasks.

- Initiate a simple registry of available existing assets, including the current condition of the asset.
- Prepare a unified process map starting from the requisition, procurement, store-keeping, issuance and reporting of all supplies and commonly-used spare parts.

Human Resources Management and Development System

In preparation for the human resources management system improvements, PHE should:

- Conduct a detailed review of the existing available job description in the CPWD Manuals and prepare additional annotations and remarks about other tasks which the incumbents are currently doing or are responsible for.
- Implement the health and safety improvement recommendations indicated in the O&M improvement plans.
- Organize, on an interim basis, a training committee to start planning and implementing basic training programs; identify local resources in the State who may be tapped to provide the training services. Trainers or speakers may be invited to make presentations as part of the regular management staff meetings of PHE.

Management Information System

In the immediate future, PHE should continue to keep abreast of the current initiatives to set up the MIS of the PWD (which currently focuses on capital investment monitoring for roads projects). It should take advantage of the training programs currently underway. The expanded MIS for PHE will seek to be integrated into (and be part of) the broader MIS of PWD.

- Attend the basic MIS training programs currently being organized for PWD staff.

Preparatory Activities for Internal Re-structuring Agenda

PHE management should undertake a detailed review and plan to implement the proposed restructuring, including the movement of staff and transfer of responsibilities. The initial set of the activities involve securing the needed approvals for the restructuring.

Preparatory Activities for the Policy and Legislative Agenda

Much of the needed institutional and managerial improvements will need to be initiated by PHE itself. With respect to the legislative and policy agenda, the Study recommends that PHE an initial paper be put together for discussion first among the PHE management team and for consideration of PWD and State officials. As presented in the Study, the key recommendations involve:

- Authorization of PHE to undertake internal restructuring;
- Authorization of PHE to use of independent financial accounting systems and other financial management guidelines, such as proper treatment of depreciation and use of external auditors 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);
- Authorization of PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc) based on ;
- 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. It is envisaged that all these policy recommendations will be taken up as a single policy reform action.

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.

10.4 Improvement of Financial Management

Planning and design of independent accounting systems

The compilation of independent accounting system tailored for water supply and sanitation services shall be strongly recommended. The intent is to make available to PHE and PWD managers, timely and vital financial information affecting their internal operations as a business. The introduction of this system helps to bring PHE performances more transparent; and help sector policymakers and concerned State officials make informed decisions about tariff and service levels.

Meter Reading and Bill Collection Procedure

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 Chapter 7 of Volume III. 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.

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. 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. Initial burden on an applicant is one of the major constraints for PHE to increase the customers of public sewer system, since the initial construction cost to connect sewer in their own land is approximately as much as three to four times of average household income. It is necessary that state government shall establish the legal framework which obligates residents to connect to the public sewer system. Even after the development of the legal system, the initial construction cost is still heavy burden on the residents. Therefore, it is recommended to implement the installment plan for initial cost of public sewer.

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 generate 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.

11 Need for Project Implementation

11.1 Project Components

The feasibility study assesses three key components of the target priority projects. The first component is the development of the water supply system. The second component is the development of the sewerage system. These two components require facility improvement and include construction work. These components can be categorized as hardware improvements. The third component is capacity building of the PWD/PHE, including reduction of NRW and asset management. This component is a fundamental part of the first and the second components because it will help to secure the sustainability of the water supply and sanitation systems.

The policy, strategy and action plan for capacity building is discussed in the feasibility study. These items are not only for discussion in the feasibility study but also represent key actions that need to be implemented to support the facility improvement.

The feasibility study recommends actions that would build the capacity of the PWD/PHE. External assistance would be required to implement these actions. A contracted management consultant would provide this assistance. The contractor would develop a detailed action plan for presentation to the PWD/PHE. The action plan would be based on the capacity building plan described in the feasibility study. The contractor would work with the PWD/PHE to assist them implement the action plan. This component would include various kinds of training (including on-the-job-training), and asset inventory surveys to help with asset management.

Utilization of JICA Expert Scheme might be one of alternative external assistances instead of contracting management consultant as part of the priority projects.

The technical, financial, and environmental feasibility of the three components of the priority projects have been analyzed in previous chapters. Financial feasibility is confirmed under the condition of full O/M cost recovery. This does not currently occur in India. For the water supply project to be financially feasible not only would full O/M cost recovery be required, but part of the capital investment cost would also need to be recovered.

Increases to the water and sewage tariff would be required to recover these costs. The proposed tariff increase plan is presented in the feasibility study. The proposed tariff increases have been carefully set so as not to exceed the customers' willingness to pay and affordability to pay during the design life of the project (through to 2025). The proposed rate for increasing

tariffs does not to exceed the historical rate of increases.

In this context, it can be concluded that the project is feasible and that sustainable management of the water supply and sewerage system can be strengthened by undertaking capacity building (which is the third component of the project).

11.2 Need for Project Implementation

1) Reducing water shortages and improving environmental conservation

Water demand has been increasing as a result of population growth, improved living standards, industrial development and the increased number of tourist visiting Goa. The demand now exceeds the supply capacity and water shortages are expected in the near future. To reduce the likelihood of water shortages the development of the water supply system is required as soon as possible. Increased water usage increases wastewater generation from domestic and non-domestic customers.

Goa is a world famous beach resort. Approximately 1.8 million tourists visited Goa during 2005. The number of tourists is expected to increase to 4 million by 2025. Tourism is one of the most important industries in Goa. Improving the water supply and sanitation situation is fundamental to supporting the development of the industry. Improvements to the sewerage system will help to prevent further contamination of the beautiful natural environment in Goa.

NRW reduction is one of the main components of the capacity building program. NRW reduction will also help to avoid water shortages. JICA Expert Scheme might be applicable for NRW reduction introducing Japanese experiences of leakage and NRW reductions.

2) Delivering a Continuous Water Supply (24 hours a day, 7 days a week)

Goa's water is currently supplied intermittently, meaning people can only access water several hours each day. The water supply master plan was developed to help move the system from providing intermittent supply to providing a continuous water supply. Currently, no water supply authority in India supplies water continuously. The measures that are needed to provide for a continuous water supply are described in the previous section. As the previous section indicates, to achieve a continuous water supply both technical changes and capacity building are required.

3) Internal Structural Reform and Independent Accounting System

To transform the PWD/PHE into a more customer oriented, accountable, and effective

organization, the feasibility study proposes internal structural reform. The capacity building required for this reform will be undertaken with external assistance.

Currently, the PWD does not undertake financial management because all of the tariff revenue is transferred to the state government. Also, the annual PWD budget is provided by the state government. This situation means there are no strong incentives for the PWD to generate revenue or to reduce expenditure. Therefore, in the long term, it is recommended that the PWD operates to be financially self sufficient. The feasibility study recommends that an independent accounting system be introduced during the transition period. Introduction of an independent account system does not need any changes to the existing legislative framework. The independent accounting system will allow the PWD to improve its financial management ability gradually. As the PWD becomes aware of and responsible for its financial situation cost savings and increases in revenue will result.

These structural reforms and the introduction of an independent accounting system are recommended for implementation as part of the capacity building project.

4) Poverty Alleviation

There are very few "notified slums" in Goa, however Margao and Vasco have some small scale slums. These slum areas are covered by the priority water supply project. According to the Government of Goa's policy, new water connections to low income groups in "notified slums" will be provided by the government but the monthly tariff should be paid by the consumer.

5) Using this Project as an Example of Best Practice in India

Development indices for Goa state (such as socio-economic levels, living standard, infrastructure, culture and education) are higher than the average figures for India. Therefore Goa has significant potential capability to establish a sustainable, accountable, customer oriented, and reliable public service provider. The priority projects proposed in the feasibility study include aspects of best practice such as providing continuous water supply, capacity building including NRW reduction, asset management, cost recovery, an independent accounting system, and institutional reform. These practices have proven very difficult for India in the past. If these best practices are implemented in Goa, other states in India can learn from Goa's experiences. This will make it easier to implement similar practices in the other states in the future.

These practices can be implemented in the short and medium term without changing the existing

legislative framework or the status of the PWD/PHE as a public service provider. Although the PWD/PHE will remain a public authority, outsourcing some of the services, such as meter reading/billing, operation and maintenance of plant, and sewer cleaning, should be considered as a means of improving the service efficiency.

11.3 Actions for Project Implementation

1) Vigorous Approaches of the Government of Goa

To implement proposed projects and to attract external financial sources, the Indian side understood the importance of vigorous approaches of the Government of Goa to central government or international lending agencies.

2) Establishment of Project Implementation Unit

To implement to project smoothly, the PWD/PHU should establish the Project Implementation Unit (PIU). Roll and formation of the PIU is described in Volume III Chapter 7. The PIU shall be central control center of entire project implementation from budgetary arrangements for project implementation to handing over the facilities to PHE department concerned.

3) Reserving Land Space Required for the Projects

According to the consultation with the Government of Goa, land spaces required for the projects are owned by government or communities, therefore, land acquisition will not be required. However, to reserve the land spaces as planned in the feasibility study, coordination with other departments which have jurisdiction of the land and with communities is indispensable and such coordination should be started as soon as possible.

4) Arrangements of Organization for Operation & Maintenance of the New Facilities

Several new facilities are planned to be constructed under the projects. Organization with adequate staffing should be arranged for susutainable operation and maintenance. Details of arrangements required for the new facilities are described in Volume III Chapter 7.

5) Necessity of Detailed Design

After budgetary arrangements are completed, detailed design should be conducted before starting bidding procedures. The preliminary design conducted during the feasibility study stage of this project was based on a preliminary topographic survey and preliminary geotechnical investigations. The preliminary design was undertaken to identify possible locations and land area requirements for the proposed facilities, and potential pipe alignments. The preliminary design was also used to estimate the project costs used in the

economic/financial analysis and to provide basic information for international lending agencies. The preliminary design is not suitable to inform construction work.

Construction work should be based on detailed design drawings, not the preliminary design drawings. The detailed design drawings will be prepared as part of the next stage of the project. The detailed design drawings will be based on more detailed topographic survey and further geotechnical investigations. A more detailed topographic survey may provide more accurate information about land ownership which would facilitate the land acquisition process. Further geotechnical investigations are required to locate any underground utilities such as telephone and electric cables. Depending on the location of these utilities the location of the proposed facilities, the pipe alignments, or the foundation types may need to be revised from those proposed in the preliminary design.

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Goa is India's smallest state (with an area of 3,702 km^2) and as of the year 2001 had a population of approximately 1.3 million. Goa is located south of Mumbai and plays an important role as a hub connecting the northern and southern parts of India. Goa State is rich in natural mineral resources, such as Iron and Manganese, which are mined and exported to Japan. Socio-economic indicators such as the literacy rate and gross domestic product (GDP) are higher for Goa than the national averages. Land use in Goa includes a mixture of industrial, rural, urban and tourism uses. The topography includes elevated hilly areas and lower flat areas, which are used as paddy fields.

Goa has a monsoonal climate, with an average annual precipitation in excess of 2,000 mm. There are seven existing surface water supply schemes in Goa (e.g. the Salaulim Scheme which sources water from Salaulim Dam) and approximately 15 existing groundwater supply schemes. Water supply service is limited to several hours each day even in the capital city Pananji.

Water demand is continuously increasing (due to population growth and economic development) and is approaching the capacity of the existing water supply system. This is beginning to constrain socio-economic development in Goa.

Only the cities of Panaji, Vasco, and part of Margao are serviced by conventional sewerage systems. The average coverage ratio is only 5 %, which is lower than the national average. Even where sewer pipelines are installed, the connection ratios remain low (e.g. 7 % in Margao and 19% in Vasco in year 2004). People who are not connected to the sewerage system mainly use on-site sanitation (e.g. pit latrines), however 30% of the rural population does not have adequate sanitation facilities and therefore depends on open defecation.

During the peak tourism season (i.e. the dry season) the populations in coastal areas double and therefore the volume of sewage generated increases. The existing sewage systems do not have sufficient capacity to accommodate the higher loads and therefore inadequately treated sewage is discharged into the sea. The Government of Goa is eager to develop a range of industries and believes that tourism could be a key growth industry, due to Goa's beautiful coastal resources. However, an increase in tourism could increase the amount of inadequately treated sewage being discharged to the sea. During the rainy season many septic tanks overflow due to rises in the groundwater table. The inadequate capacity of the sewage systems within Goa is

a concern because the overflows and discharges pollute the coastal areas.

There is a clear need for additional water supply and sewage system capacity in Goa, especially for cities, industrial estates and tourism resorts in the southern districts. Therefore, during 2002, the Government of India (GOI) requested an assistance of the Government of Japan (GOJ) concerning the augmentation of water supply and sanitation for Goa. The GOJ has agreed to undertake the study. Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of technical cooperation programs for the GOJ, is responsible for the study.

During September 2004, JICA dispatched a Preparatory Study Team to India to undertake a preliminary investigation to define the purpose and scope of the study. The purpose and scope of the study was agreed between GOI and the JICA.

In March 2005, the JICA Study Team was dispatched to India/Goa to hold inception meeting with Indian side such as Ministry of Urban Development (MOUD), Government of Goa, and Public Work Department (PWD) Goa. The JICA Study Team explained the study purpose, study area, scope of work, work schedule, work assignments, personnel schedule, reporting requirements and role of the GOI which were described in Inception Report.

Indian side and the JICA Study Team agreed contents of the Inception report and signed Minutes of Meeting on the Inception Report. During the Inception meeting, the Indian side requested to extend the target year from 2020 to 2025 and the JICA agreed the extension. This agreement is also described in the Minutes of Meeting.

1.2 Milestones of the Study Work

The Study was conducted in three phases as shown below.

1st Phase: Reconnaissance Survey, from March to September 2005
2nd Phase: Preparation of Master Plan, from October 2005 to March 2006
3rd Phase: Feasibility Study, from April 2006 to November 2006

As an output of each phase, the Study Team prepared and submitted several reports. Report submissions and milestones of the Study are as follows.

September 22, 2004	Signing agreement on Scope of Work for Study
September 22, 2004	Signing Minutes of Meeting on Preparation of Scope of Work
March 2, 2005	Submission of Inception Report
March 4, 2005	Meeting on the Inception Report with MOUD in Delhi
March 7, 2005	Meeting on the Inception Report with PWD Goa
March 11, 2005	Signing Minutes of Meeting on the Inception Report at MOUD in Delhi
April 17, 2005	Commencement of 1st Phase Study Work in India
August 22, 2005	1st Steering Committee Meeting
August 23, 2005	1st Workshop and 1st Stakeholder Meeting
October 16, 2005	Commencement of 2nd Phase Study Work in India
October 17, 2005	Submission of Progress Report to MOUD in Delhi
October 19, 2005	Submission of Progress Report to PWD Goa
November 9, 2005	Meeting on Progress Report
December 1, 2005	Signing Minutes of Meeting on the Progress Report at PWD Goa
December 23, 2005	2nd Stakeholder Meeting
January 5, 2006	2nd Steering Committee Meeting
January 6, 2006	2nd Workshop
April 4, 2006	Commencement of 3rd Phase Study Work in India
April 5, 2006	Submission of Interim Report to MOUD in Delhi
April 10, 2006	Submission of Interim Report to PWD Goa
April 27, 2006	3rd Steering Committee Meeting on the Interim Report
Jun 29 , 2006	Signing Minutes of Meeting on the Interim Report
July 18, 2006	3rd Stakeholder Meeting
July 25, 2006	3rd Workshop
July 27, 2006	4th Steering Committee Meeting
September 26, 2006	Submission of Draft Final Report to MOUD in Delhi
September 28, 2006	Submission of Draft Final Report to PWD Goa
September 29, 2006	5th Steering Committee Meeting
October 4, 2006	Signing Minute of Meeting on the Draft Final Report

Respective minutes of meeting of meetings shown above are included in Volume IV M11 Minutes of Meetings.

CHAPTER 2

SUMMARY OF THE MASTER PLAN AND FRAMEWORK OF FEASIBILITY STUDY

CHAPTER 2 SUMMARY OF THE MASTER PLAN AND FRAMEWORK OF FEASIBILITY STUDY

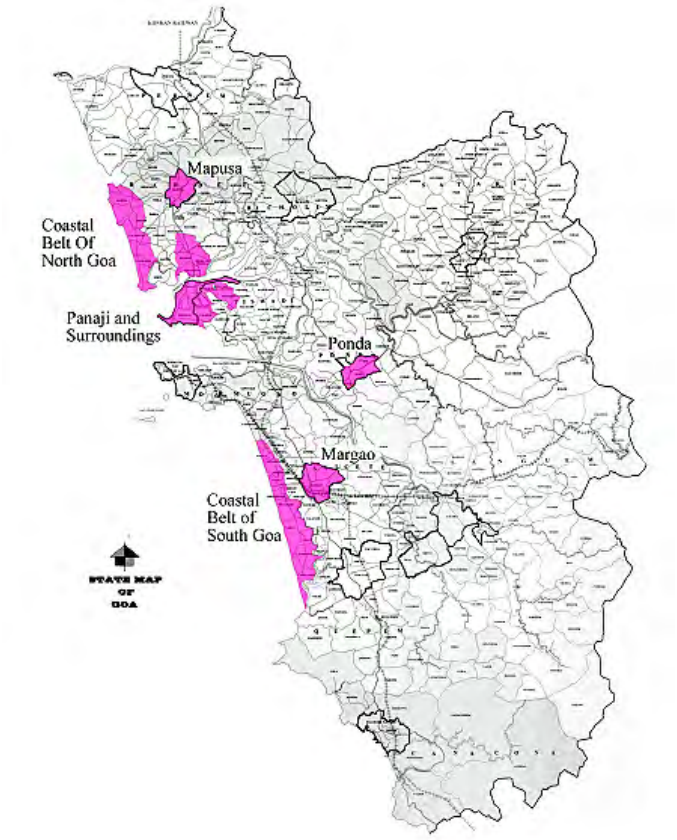
2.1 Objectives of the Study

The objectives of the Study are to:

1) formulate a master plan for augmentation of water supply and sanitation in Goa State. The target year of the master plan is 2025;
2) conduct a feasibility study for priority project(s) which will be selected from the master plan; and
3) pursue technology transfer to the counterpart personnel in the course of the study.

2.2 Study Area

The water supply study area covers all of Goa.



The sanitation study area covers the following areas as shown on Figure 22.1.

- Margao Municipality;
- Ponda Municipality;
- Mapusa Municipality;
- Coastal belt of south Goa;
- Coastal belt of north Goa; and
- Panaji Municipality and its surrounding area (Provorim, Taleigao, Dona Paula, Caranzalem, St. Cruz, Merces, Ribandar).

Figure 22.1 Study Area for Sanitation

2.3 EXISTING CONDITION OF THE WATER SUPPLY AND SANITATION / SEWERAGE SYSTEMS

2.3.1 Water Supply System

There are seven existing regional water supply schemes in Goa. These are listed in Table 23.1 and shown on Figure 23.1.

Table 23.1 List of Surface Water Supply Schemes in Goa

Water supply scheme		Water treatment plant		Trans. mains	Reservoirs	Distr. pipelines	Dom. house Connections	Name of Taluka mainly supplied by the scheme
		No. of Plants	Total Capacity	m	nos. & capacity	m	nos.	
1	Salaulim	1	160 MLD	276,586	91 53,000m³	1,424,990	74,930	Mormugao, Salcete, Quepem, Sanguem
2	Opa	4	112 MLD	183,567	91 36,000 m³	704,003	45,118	Ponda, Tiswadi
3	Chandel	1	15 MLD	101,704	33 6,180 m³	328,628	6,346	Pernem
4	Assonora	2	42 MLD	213,940	95 46,225 m³	724,140	43,151	Bardez
5	Sanquelim	3	52 MLD	151,666	30 16,950 m³	159,900	11,643	Bicholim
6	Dabose	1	5 MLD	65,150	26 6,400 m³	183,000	5,886	Satari
7	Canacona	1	5 MLD	60,273	15 3,700 m³	48,085	3,411	Canacona
Total		12	391 MLD	1,052,886	381 168,455 m³	3,573,246	190,485	

Source: Sector Status Study – WSS Goa, 2004, (Data was confirmed to the PWD in 2005-2006)

Goa's 11 talukas are served by 7 regional water supply schemes. Areas that are not served by these 7 schemes are served by rural water supply schemes. The rural water supply schemes mainly source their water from groundwater or springs.

The PWD is currently facing a number of technical problems across Goa's water supply schemes, extending from the water source to service connections. The assessment completed as part of this study identified the following key problems:

(1) Raw Water Quality

Manganese and iron was present in the raw water for almost all the plants in Goa.

(2) Lack of Flow Measurement and Flow Control Systems

The flow rates of intake and transmission are not directly measured using flow meters. Lack of flow measurement means accurate chemical dosage is not possible. Also, the transmission flow rates along the transmission mains are not measured. This means flow control cannot be carried out properly.

(3) Ineffective Coagulation, Sedimentation and Filtration

The sedimentation basins do not remove the majority of turbidity because coagulation and sedimentation might be ineffective. Therefore the turbidity of the water entering the filtration basin is large, which means the filters need to be backwashed more frequently. The field investigation indicated that the backwashing is not sufficient because the duration of the backwashing process is not long enough or there is a structural problem of the filter basin.

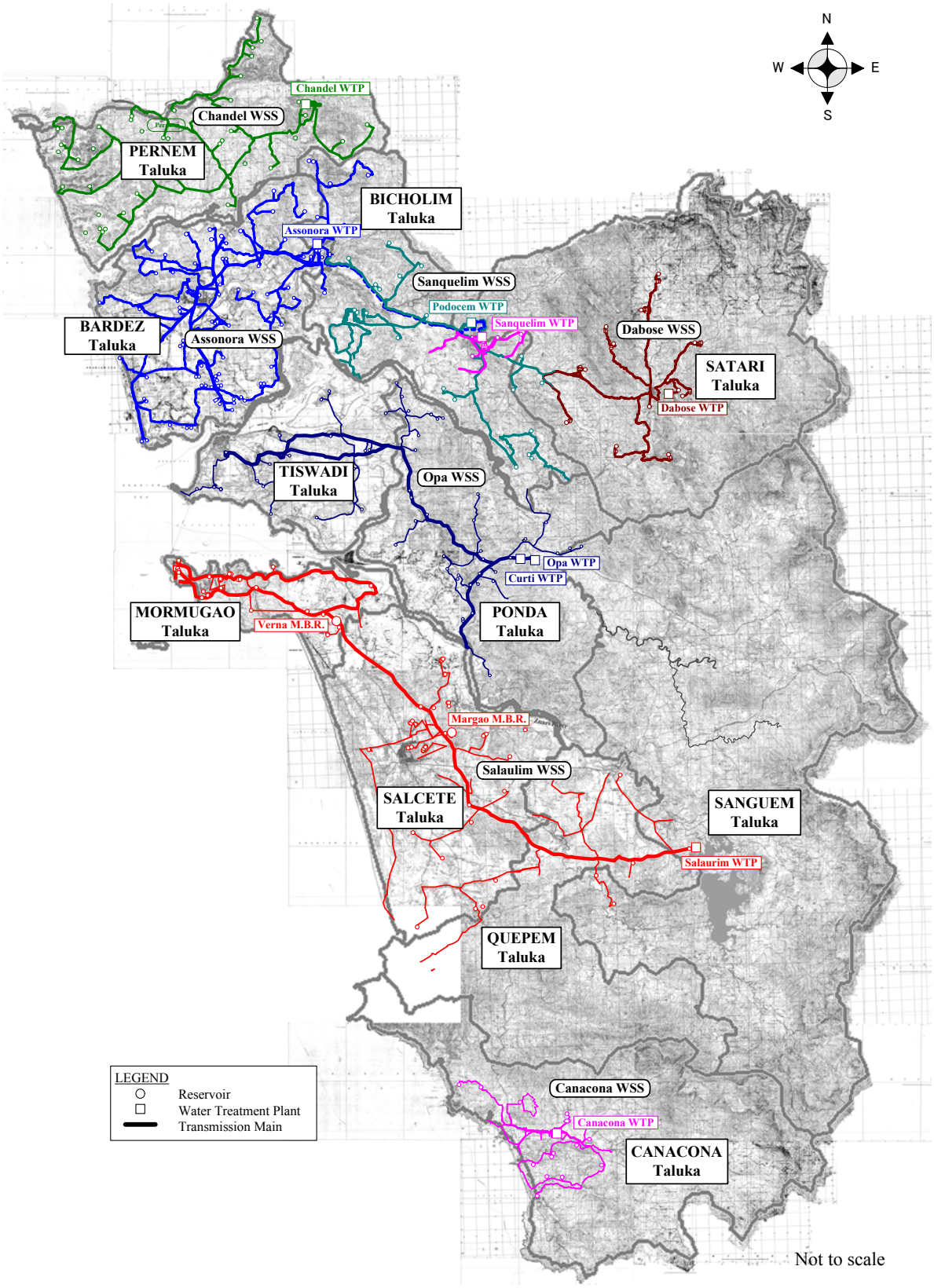


Figure 23.1 Regional Water Supply Schemes in Goa

(4) Safety Provision

Safety related to the chlorination systems at all the WTPs does not exist. For example, there are no facilities for adequately detecting or containing gas leaks, personal breathing apparatus is available in the laboratories at some WTPs but is not used or maintained, and combinations of small bore PVC and flexible plastic hoses are used to connect the cylinders to the chlorinators, instead of copper pipes.

(5) Electric Power Outages

Power failure means the water supply stops and the water supply facilities can be damaged.

(6) Visible leaks along the transmission mains

There are many visible leaks at the air and scour valves located along the transmission mains.

(7) Lack 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.

(8) Lack of asset drawings, asset data and process data

The PWD does not have updated drawings of the water supply facilities or maps that cover all the water supply areas. Also, records and data for the operation and maintenance of the schemes are not maintained. Some drawings and data are maintained by individuals, but this is not available for management of the system as a whole.

2.3.2 Sanitation System

According to the Census 2001, 51.8% of the rural population and 30.8% of the urban population had no latrine despite the continuous efforts of the State Government in the last 20 years to increase sanitation coverage as shown in Table 23.2.

Table 23.2 Coverage Ratio by Sanitary Toilet Type

Item	Urban Area (%)			Rural Area (%)		
	Pit latrine	Water Closet latrine	No latrine	Pit latrine	Water Closet latrine	No latrine
Goa State	18.7	38.9	30.8	18.9	20.8	51.8

The present water quality of Mandovi and Zuari rivers ranges 3 - 6 mg/L BOD and North and South Coastal Area ranges 7 - 9 mg/L BOD. They exceed water quality standard of 3 mg/L BOD. Some pollutants may be derived from human activities. To improve water quality,

countermeasures including sewerage are recommended.

An appropriate sewerage system is essential for improving public health and quality of life in urban areas and for attracting tourism development. Most of Goa does not have sewerage system. According to the Census in India, only 13 % of Goa's urban population is served by sewerage system, much lower than the all India average of 28%. In the principal municipalities in Goa, Panaji, Vasco and Margao have sewerage system.

(1) Panaji Sewerage System

The sewage network and treatment plant for Panaji was installed in 1960's, this being the first sewerage project in the State of Goa. The old STP was designed to cater for a population of 30,000 with a capacity of 5.68 MLD. The old STP was constructed about 40 years ago and its facility which was adopted the trickling filter treatment process is not operated now because of its deteriorated condition. With the above conditions, PWD started the sewerage expansion project to increase treatment capacity and to improve the water quality in 2001.

Sewer Network

The sewerage service area of Panaji City is divided into 12 sewerage zones and the total service area is 434.9 ha. Population of the service area is estimated to be 58,785 in year 2001. The general description of sewers and general sewerage plan are shown in Table 23.3 and Figure 23.2.

Table 23.3 Sewers of Panaji Sewerage System

Item	Main sewers	Sub main sewers	Branch sewers	Total
Diameter (mm)	150 – 700	150 - 350	150 - 300	-
Length (m)	4,110	7,700	27,270	39,080

Pumping Station

There are eight pumping stations in Panaji City as shown in Figure 23.2. Submersible pumps are installed in only one pumping station, dry well pumps are installed for the other stations.

Sewage Treatment Plant

Instead of old trickling filter facility, new treatment facility with capacity of 12,500 m^3/day started operating in April 2005. The treatment process used is SBR (Sequencing batch reactor) method.

Figure 23.2 General Plan of Panaji Sewerage System

(2) Margao Sewerage System

Sewer Network

For the sewerage system, the municipality has been divided into three zones, namely North, Central and South as shown in Figure 23.3. The North and Central zones of the municipality have sewerage system. Main sewer namely North Main was installed in 1990's. Sub main sewers namely Central North Sub Main and Central South Sub Main and branch sewers in North Zone and Central Zone have been laid from 1990's to date. Some branch sewers in North and Central Zones are still under construction. The general description of sewers and general sewerage plan are shown in Table 23.4 and Figure 23.3.

Table 23.4 Sewers of Margao Sewerage System

Zone	Area (ha)	Diameter (mm)	Branch Sewer length (m)	Main and sub main length (m)	Total (m)	Sewer density (m/ha)
North Zone	259	150-1200	13,410	5,430	18,840	73
Central Zone	307		20,140	5,580	25,720	84
South Zone	-		-	-	-	
Total	566		33,550	11,010	44,560	79

Source: Under Ground Scheme to Margao Town

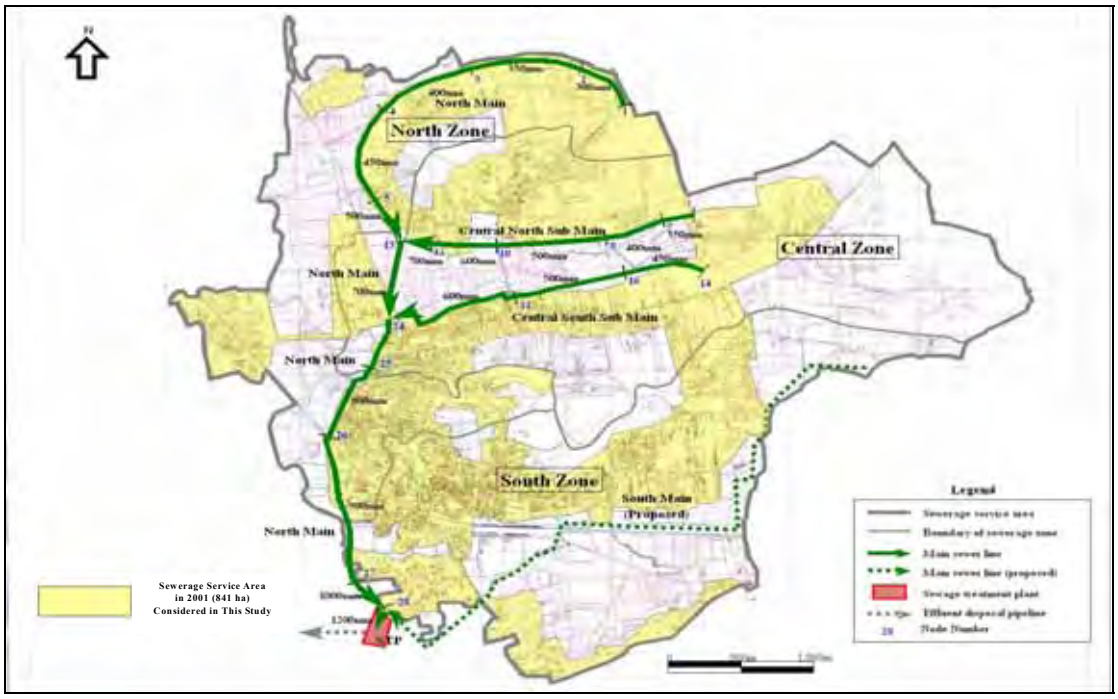


Figure 23.3 General Plan of Margao Sewerage System

Sewage Treatment Plant

The Margao sewage treatment plant is located in the south west of the municipality and sewage treatment plant of 7.5 MLD capacity has been commissioned in May 2000 to cater for North and Central zones.

(3) On-site Treatment System

In order to improve the hygienic conditions and to provide sanitation facilities, total 72,165 single seat low cost pour latrines have been constructed by the "Sulabh International Social Service Organization" since 1985. During the reconnaissance survey, on-site treatment facilities in hotel, factory and college school are inspected. These surveyed on-site treatment facilities are properly operated and treated effluents from treatment facility are used for gardening on the premises.

(4) Summary of Existing Problems Identified

The following problems about the present sanitary conditions are identified during the reconnaissance survey.

- Low service coverage of sanitary toilets
- Lack of asset drawings, calculation sheets, data and records in the PWD
- Weak crude sewage (low pollution load) in the Margao STP
- Lack of implementation plan and equipment for sewer cleaning

- Frequent electrical power outages in the pumping stations and STPs
- Lack of flow measurement device in the pumping station
- Lack of screenings and scum removal in the pumping station
- Deterioration of pump equipment
- Lack of disinfection process in the Margao STP

2.3.3 Operation and Maintenance

Based on the review of current operation and maintenance practices it is evident that PHE faces a number of significant challenges in the delivery of its functions. These include severe funding problems, organisational issues and administrative/management constraints placed on them. The Study Team believes that PHE on the whole have shown considerable dedication and resourcefulness in working within this underlying framework of constraints, however, much could still be achieved to improve operational and commercial performance through increased focus on institutional strengthening and capacity building elements.

PHE's business and operational practices which have remained unchanged for many years espouse an organisation that provides essential services for the enhancement of public heath rather than a commercial entity seeking to make a return on investment. As such, the use of tariff or pricing mechanisms to regulate water usage is not actively or readily applied (PHE need to get GOG approval for price adjustments in any case) as the cost of services is highly politicised. For example, public taps (stand posts) are installed by PHE but all the water consumed is not charged. This contributes substantially to NRW (approximately 13% of water into supply) as well as O&M expenditure without financial return.

PHE currently use the Indian Standard ISI 91(revised 1991) adopted by the Bureau of India Standards and is based on acceptable world standards for drinking water quality. However, due to the lack of computerised management and laboratory information systems it is difficult to determine the extent to which PHE comply with the relevant standards in force throughout the various stages of the water production/supply/customer process.

Currently PHE is effectively 'self-regulating' for purposes of meeting water quality standards as a result of insufficient independent control measures. Whilst the GOG Public Health laboratory does take periodic water and wastewater samples and send the analyses to PHE, it is understood that the State Health Department do not impose or 'police' the required standards.

PHE does not have a strategy in place for the recruitment of trainees, graduates, or staff with

new skills to satisfy future organisational needs. This will limit PHE's ability to embrace new technologies in future not only related to O&M activities.

The management approach and hence the policies, systems and procedures have been geared to the hierarchical structure. This has created many layers of management and supervision, whereby even minor decisions or sanction are often referred to the highest level in the organisation. As a result, O&M staff are often faced with having to find ways to 'workaround' operational and maintenance problems.

The current set-up does not encourage communication and as a result the sharing of ideas and learning is limited. This is having a detrimental impact on O&M performance as little is known or shared regarding best practice within or between Regions.

Due to the need for Systems and Process improvements, the O&M stance is 'reactive' in nature with little time to assume a more 'pro-active' approach.

PHE's low level of computerisation has led to labour intensive manual practices involving a large number of employees performing clerical, administrative or menial tasks compared to those performing skilled or technical/managerial tasks. Any O&M information currently kept is manually maintained and therefore provides little value for decision making.

Due to the lack of appropriate measuring devices at treatment plants or along the transmission/distribution network, it is not possible to accurately measure NRW, UFW or leakage generally. The distribution networks design and set-up as well as management practices have not been geared to reducing or managing leakage or UFW. For example, the various networks are not adequately modeled or set-up by discrete supply zones with adequate ability to measure network performance. The networks are lacking 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. Additionally, leakage detection equipment and active leakage detection techniques are not practiced centrally or regionally. As a consequence it is not currently possible for PHE to accurately measure water losses throughout the supply process from source to customer taps or accurately measure other customer and commercial components that make up the other elements of NRW.

PHE places overall responsibility for all of the various functional activities such as projects, O&M, commercial, financial and administration under the departmental head, headed by Chief

Engineer (PHE) assisted by geographical head (Superintending Engineer (SE)) who manages the 'Circle' office supported by a 'Divisional' and 'Sub-Divisional' office set-up. This can lead to dilution of effort or lack of focus in key areas associated within each functional activity. For example, a commercial drive or focus to improve customer services, billing and cash collection could conflict with or dilute efforts to maximise water production, distribution or project implementation bearing in mind that 'geographical heads' have to balance budgets, priorities and resource in functional areas that require different and specialist core skills.

Asset management plans are not in existence and asset information is not recorded.

On the whole, PHE operate and maintain their assets, including leakage repairs, although in some areas, management contracts have been awarded for O&M of new schemes. Generally, anything other than 'running maintenance' is contracted out to third parties including breakdown, plant repairs, overhauls, leakage repairs, new connections, sewer cleaning etc.

H&S policy/manuals and contingency/emergency plans are not in existence and H&S and security practices appear to be ad hoc and at the 'discretion' of individual managers within regions. H&S appears to be of low priority at all levels of operation of plants, street works activities etc. The lack of appreciation for the hazards associated with the O&M of these facilities poses a serious threat to the safety of staff and in some cases local residents.

Statistical process control techniques are not practiced; however various logs are kept at each plant showing power use, run hours, chemical parameters, chemical use, breakdowns etc.

Little management information is recorded or reported. There is no formal (written) reporting upwards of plant performance such as treatment volumes/costs/labour/plant breakdowns/power failures/treatment bypassing/quality parameters etc. Performance is not reported against targets and on the whole process and business reviews do not take place.

Most water treatment plants (WTP's) appear to be deficient good maintenance and H&S practices although security and housekeeping standards are good. Sanitation schemes appear to be deficient good maintenance, housekeeping, H&S and security standards.

Most offices appear to be deficient good housekeeping standards. Under investment is apparent. Little or no computerisation of activities is evident even where computers have been provided.

2.3.4 Sector Legislation, Policy Regulations and Institutional Arrangements

(1) Sector Legislation and Policy

A legislation and policy review was done to establish extent of the mandate of PHE as the lead sector institution and the presence of basic policies which guide the provision of water and sewerage services in the State. In the context of this MP/FS Study, the purpose of the legislative study was to understand the legal framework under which PHE is mandated to deliver the water and sewerage service and to implement the proposed capital improvements.

The Study reviewed the relevant sections of the following key documents: 73rd & 74th Constitutional amendments; the Goa Municipalities Act, 1968; Goa Panchayat Raj Act, 1994; Goa Public Health Act, 1985 & Rules (1086); Goa State Water Policy – 2002; Goa Groundwater Regulation Act (2002) & Rules; Water supply bylaws (Portaria 6802); Goa Water (Prevention of Pollution) Rules, 1988; and the Goa Town and Country Planning Act and the Goa Command Area Development Act, 1997. In addition various state-level planning documents were reviewed: Draft Regional Plan Goa – Perspective 2011; the Goa 10th Five-Year Plan (2002/07) and a draft Annual Plan (2004/05).

Findings

- Overall, sufficient legislation and policy statements are in place. The motivation, financing resources and institutional capacity to carry out can be strengthened.
- The local Chief Officer and the panch can play a more significant role in supporting PHE activities. At this point, this represents a missed opportunity for PHE since the level of interaction and coordination with local bodies can still be improved.
- It would be useful to consolidate various policy statements. The Water Sector Reform initiative is also suggesting consideration of new sector legislation.
- Current laws mandate connection to sewerage only for public health or nuisance reasons. There is no state policy requiring mandatory connection to the sewerage system within a fixed time to achieve viability of investments.

(2) Institutional Arrangements

The Study reviewed the Central Public Works Department manuals to understand the key internal management and institutional arrangements in PHE.

Findings

- Little or no accountability for results by lower levels of management

- Highly centralized decision making
- Too many management tiers
- Little attention to organization "health" (renewal) and capacity; often in "coping" mode
- Little focus on strategic issues. Managers continue to be burdened by details
- Organization structure does not reflect all "core processes"
- Higher priority on achieving balanced work load distribution

(3) Institutional Capacity Assessments: Strengths and Weaknesses

The assessment (and subsequent planning) of institutional plan followed a frame briefly explained below. 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:

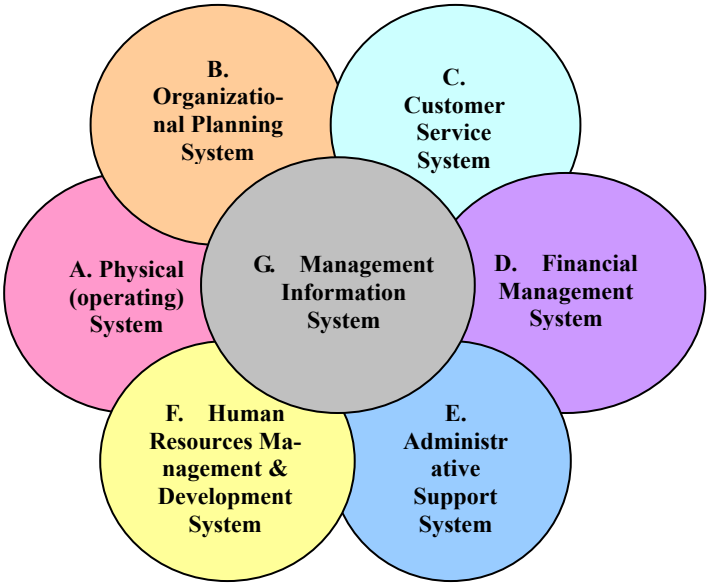


Figure 23.4 Institutional Strengthening Framework

In the succeeding sections, system components are briefly described and the major strengths and weaknesses of each is presented using a SWOT matrix.

(a) Physical System

The **physical (or operating) system** 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.

Strengths	Weaknesses
• PHE technical staff is experienced in construction and rehabilitation work and capital improvements, i.e., locally-financed and relatively small.	• O&M deficiencies • Not all O&M procedures and standards written, documented and readily available for both water supply and sewerage. • Limited operation and maintenance skills and equipment. • Deteriorating asset condition; • Low service levels; intermittent supplies; • Lack of sewer optimisation; • Water supply system monitoring • Difficulty in quickly assessing impact of pressure-flow variations in the water system along transmission lines and network.
Opportunities	**Threats**
• Pilot exercise has demonstrated benefits of an NRW program; staff trained; equipment available.	• NRW is high due to various reasons. • Poor work practices and safety practices and conditions. • No experience in management and supervision of large capital investments, particularly those supported or funded externally.

In addition to the immediate specific actions needed to improve the current operating conditions, the assessments pointed to the need for operation and maintenance management systems and tools to reduce the incidence of "crisis" situations in the future.

(b) Organization Planning System

This **organizational planning 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.

Strengths	Weaknesses
• PHE has undertaken a comprehensive water sector reform initiative; clear proposals are on the table to improve current sector management, including planning • Budget-conscious planning.	• Goa State's annual development plans are not translated into a PHE corporate or business plan. • Minimal participation of managers and supervisors, and possibly other stakeholders, in planning. • No "big picture". • Planned operation & maintenance.
Opportunities	**Threats**
• Many similar reform experiences done in the other States from which to learn from.	• Inadequate participation of lower-level managers and staff in planning process. • Minimal direct input or participation from customers and local bodies.

(c) Customer Service System

The **customer service system** is a strategic element for attaining the objectives of PHE. 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 system includes subsystems related to consumption measurement (for water supply), billing and collection, consumer registration and marketing.

Strengths	Weaknesses
• Good experience with outsourcing of bill preparation function. • PHE has piloted a system of direct payment through banks with selected customers. • High collection efficiency.	• Low customer service orientation among PHE staff. • Lack of customer confidence in PHE. • No formal customer service standards • Variation / differences in meter reading-billing cycle periods among SD's (difficulties in consumption analysis and to customer complaints. • Differences among division and sub-division offices in customer data availability. • No marketing / public information plan.
Opportunities	**Threats**
• Few people are connected to the sewer system; low connection rates.	• Lack of customer participation and interest in PHE affairs.

(d) Financial Management System

The **financial management system** 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 management and accounting subsystems.

Strengths	Weaknesses
• Concern for cost reduction and cost efficiency is relatively higher among staff and officers. • Current data and reports more suited to an asset creation (or project) organization.	• Difficult to assess financial performance of PHE as a public utility due to absence of readily-available data. • Non-uniform billing and collection system leads to difficulty in customer consumption analysis. • Inadequate billing & collection data reporting system for management use. • Less concern about revenue generation among Division and Sub-Divisions. • CPWD Account Codes are not for water supply and sanitation only, therefore, important cost details on WSS operations - electricity, chemicals, raw water cost, etc. - are not routinely kept and reported.
Opportunities	**Threats**
• Balance sheets, income statements are "not required" in the present system.	• Depreciation is not calculated for capital expenditures. • PHE is not able to assess the impact of tariff structure adjustments on the overall revenue. • Apparently minimal cost consideration / cost analysis in tariff revision decisions.

(e) Administrative Support System

The **administration support system** includes three (3) sub-systems – for supplies administration, for asset management and for social communication.

Strengths	Weaknesses
• High priority on office records keeping and maintenance system.	• No formal system to guide decision-making on asset acquisition and maintenance matters, i.e., not based on data about serviceability, demand, risk analysis, value analysis and other 'life cycle' parameters • No analysis of maintenance expenditures. • Inventory and spare parts system needs to be better planned and controlled.
Opportunities	**Threats**
• PWD is installing an asset management system, initially with the roads sector.	• Low priority given to administrative support systems – asset management, security, general upkeep of office facilities, etc.

(f) Human Resources Management & Development System

The **human resources management & development system** 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.

Strengths	Weaknesses
• Very formal and rigid personnel systems. • High technical competencies.	• Low staff productivity (16.1 staff/1,000 connections). • Insufficient job descriptions and qualification standards for all job titles • No method for determining staffing requirements and skill specifications • Inadequate performance evaluation and incentive system. • Unsafe working conditions, particularly in the chlorination facilities, along the major roads and streets and in confined-space facilities. • Financial analysis skills limited. • Narrow "competencies" among technician-level staff. • Personnel systems administered directly from PWD HQ
Opportunities	**Threats**
• Lack of long-term human resources development plan.	• Limited opportunities for staff development and training. • Over-specified procedures tend to remove or reduce responsibilities for results. • Worker safety & health issues.

(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.

Strengths	Weaknesses
• Each EE has his own system for data management.	• Link between operational performance and financial performance not evident; costing (& pricing) for services not streamlined. • Data and record keeping not standardized; "individualized" information systems. • Minimal sharing ("consolidation") of information among working units.
Opportunities	**Threats**
• Plans are underway for establishing an MIS system for PWD, initially focusing on its roads operations.	• Limited familiarity with information systems and information technology

2.3.5 Financial System

The PWD, a State Government department, receives a budget from the Government of Goa, and returns all of its revenue (gained from its activities) to the Government of Goa. Approximately, 50% of the total PWD budget was expended on water supply and sanitation through the PHE.

The PWD follows the accounting method specified in the manual called "Central Public Works

Account Code". The manual does not require the preparation of balance sheets nor income statements that include the depreciation costs. The accounting system following the manual is applied not only to the water supply and sanitation services, but also to all of the Government's activities. Therefore, the information requirements are general, meaning the Division offices are not requested to provide information that is important for the water supply and sanitation sector, such as the cost of electricity, chemicals, and raw water.

The tariff system in Goa classifies users into major four categories or small seven categories and applies a volumetric charge based on the readings from water meters that are installed at each individual house connection. The tariff system subsidizes domestic users by setting a higher unit price for non domestic users. In Goa, industrial users pay 6.9 times more than domestic users to buy 1 m^3 water. The cross subsidy is more of a burden to the non-domestic users in Goa than in other Asian countries.

The results of the Public Awareness Survey by the JICA Study Team show that the percentage of current water supply and sewerage charge in average household income in Goa is 2.4%. It is lower (almost half) than the affordability limits at 5% estimated by the international organizations. However, WTP for the services is 3.6%, which is also not high. Based on the affordability limits there are some opportunities to increase tariffs, however customers are not willing to spend much more than they currently do for the services.

Meter reading, billing and collection are undertaken by four divisional offices: Division III, Division IX, Division XVII, and Division XX. Meter reading is carried out once every 30 to 60 days, depending on the capabilities of each sub-division. Even in the same sub-division, the cycle of the meter reading varies throughout the year. This variation in the cycle of meter reading makes it difficult for management to accurately understand customer service information such as: collection efficiency, water consumption per connection, water charges per connection, and unit price of water.

As part of this study, profit-loss statements for the last five years for the water supply and sanitation sector of Goa were prepared. Division IX, which covers the cities of Margao and Vasco, is the largest source of revenue for the PHE. Division IX is responsible for approximately 60% of the total revenue. More than half of the revenue from Division IX is collected from just 15 industries which include a shipyard and hotel resorts.

Table 23.5 Profit Loss Statement for the PHE over the last 5 years

(Unit: Rs. million)

	2000-01	2001-02	2002-03	2003-04	2004-05
I. Revenue					
Total	448.1	543.4	566.9	555.4	552.7
II. Expenditure					
1 Operation & Maintenance cost	736.1	796.0	933.7	729.7	779.7
2 Administration cost	67.5	74.1	73.7	75.6	96.2
3 Other expenses	25.5	34.0	10.9	1.6	12.4
4 Depreciation	20.2	29.1	34.7	45.1	59.0
Total	849.3	933.2	1,053.0	852.0	947.3
III. Income from Operation	**-401.2**	**-389.8**	**-486.1**	**-296.6**	**-394.6**
IV. Interest expenses	**0.0**	**32.8**	**208.3**	**312.8**	**313.2**
V. Net profit	**-401.2**	**-422.6**	**-694.4**	**-609.4**	**-707.8**

Source: Prepared by the JICA Study Team based on data provided by PHE

If it is assumed that the PHE is funded only by revenue generated from water supply and sanitation services, the PHE has experienced a large deficit over the last five years. As shown in Table 23.5, the PHE made a net loss of approximately Rs.700 million during 2004-2005. Presently, this loss is compensated for by funding from the State Government.

Table 23.6 Profitability, Efficiency and Productivity of the PHE

Item	Unit	2004-2005
Profitability		
Unit Production Cost	Rs/m^3	12.38
Unit Price	Rs/m^3	8.66
Efficiency		
Non Revenue Water Ratio	%	50.6%
Productivity		
Staff per 1,000 Connections		16.1

Source: Data from Division Offices and Bill Printing Company

Performance indicators as shown in Table 23.6 were used to understand and evaluate the financial situation of the PHE. One of the structural problems for non profitable condition of PHE is clearly observed in the relationship between Unit Production cost and Unit Price. Unit Production Cost (Rs.12.38/m^3) exceeds the Unit Price (Rs.8.66/m^3). Under the present tariff and operation and maintenance systems, the PHE continues to make a loss through its operating activity. The Efficiency of the PHE was analyzed using the Non Revenue Water ratio. The ratio of 50.6% shows one of the major factors which cause massive deficits. According to the Asian Development Bank's "Water in Asian Cities, Utilities' Performance and Civil Society Views" (2004), the average ratio for NRW for 18 Asian major cities was 34%. Productivity of the PHE was assessed using the Staff per 1,000 connections indicator. Staff per 1,000

connections in Goa is 16.1. This is higher than the average (11.8) for the 18 cities. The productivity of the PHE is lower than for the other countries.

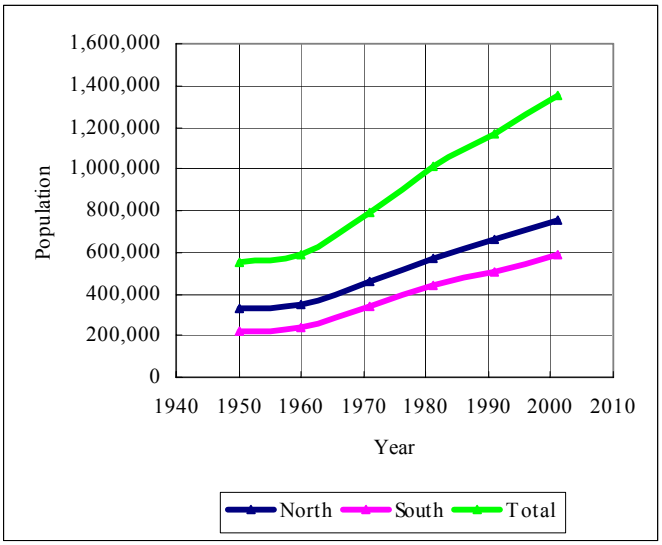
2.4 MASTER PLAN

2.4.1 Future Population and Water Demand

(1) Future Population

Past Trend of Population Growth

The Government of India has undertaken population census from 1950 to 2001. These census were used to assess population trends which is shown in Figure 24.1. As shown in the above figure, Goa's population has more than doubled since the 1950s and 1960s.



Source: Directorate of Census Operations, Goa

Figure 24.1 Population Census Data for Goa State

(2) Future Population

The future population was estimated for each unit using the five statistical equations. Historical census data (1971, 1981, 1991, and 2001) was used to predict the population size for all years up until 2025 which is the master plan target year. Figure 24.2 shows the results of future population projections.

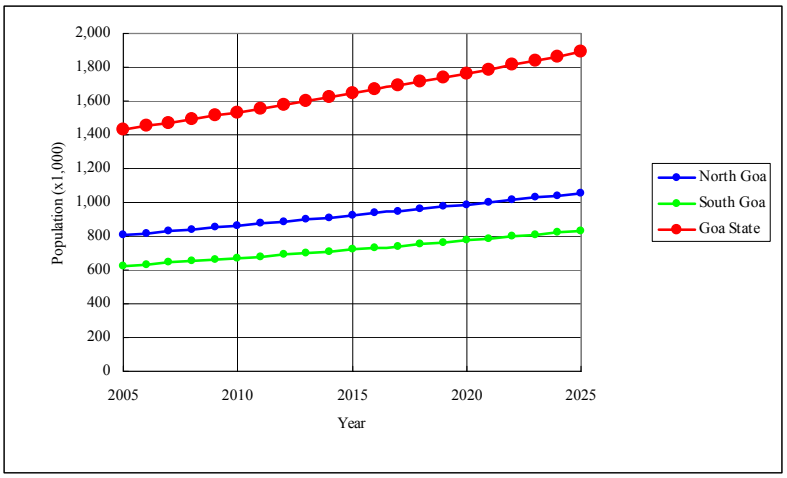


Figure 24.2 Future Population Projection (for each District)

(3) Water Demand

Basis of the Future Water Demand Forecast

Future water demand was estimated based on the population predictions and the number of tourists. The following conditions were assumed for the calculations:

1) Service Ratio

Area	Service Ratio in 2025
Urban	Gradually increased from current service ratio to 100 % in 2025
Rural (for Tiswadi, Mormugao, and Salcete talukas)	Gradually increased from current service ratio to 100% in 2025
Rural (for Pernem, Bardez, Bicholim, Satari, Ponda, Quepem, Sanguem, and Canacona talukas)	Gradually increased from current service ratio to 90 % in 2025

2） Domestic Per Capita Consumption

Domestic per capita consumption (liter per capita per day: lpcd) is an important design factor for estimating future domestic water demand. This study considered the following three per capita consumption rates:

- Case 1:Urban=135 lpcd, Rural=70 lpcd
- Case 2: Urban=150 lpcd, Rural=100 lpcd
- Case 3: Urban=200 lpcd, Rural=200 lpcd

Case 1: This per capita consumption rate is the standard recommended in the CPHEEO manual. However, as discussed in the previous section, current per capita consumption for urban and rural areas already exceeds these levels.

Case 2: The current average per capita consumption for urban areas is currently 144 lpcd and for rural areas is 88 lpcd. Case 2 increased these consumption rates in accordance with predicted improvements in living standards.

Case 3: This case assumes a more rapid increase of per capita consumption in urban areas and in rural area.

Through the discussion with PWD Goa, the Case 2 was adopted for future facility planning since the Case 2 was judged as realistic from current per capita water consumption level.

3) UFW Ratio

Based on other reports and the data that is available, the UFW ratio was assumed to be 35%. It was assumed that these efforts will reduce the UFW ratio to 15 % during the next 30 years (i.e. by 2035). Therefore, the UFW ratio in 2025 was estimated to be 21.7 %.

Total Water Consumption

Figure 24.3 presents the future domestic and non-domestic water consumptions. These consumptions are net consumptions which do not include UFW.

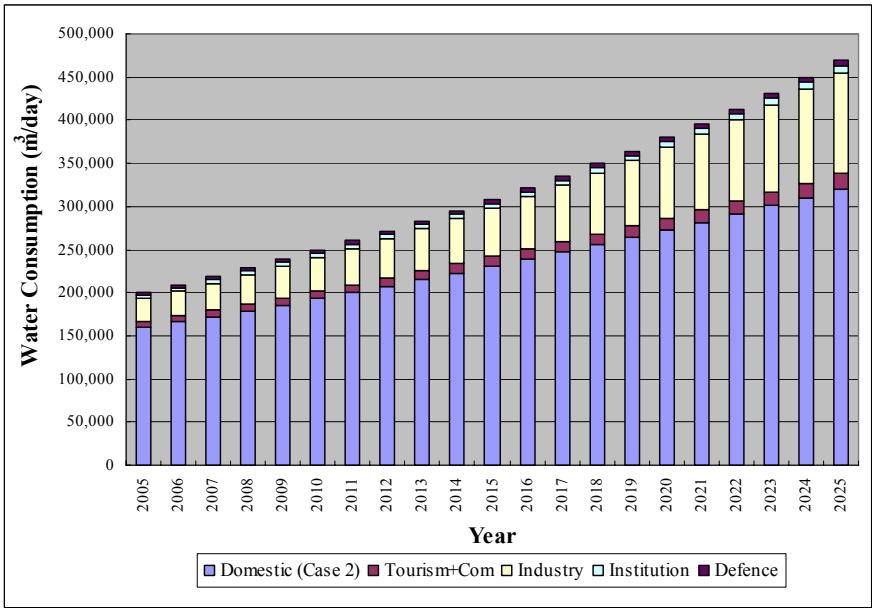


Figure 24.3 Domestic and Non-Domestic Water Consumption (without UFW)

The total future water consumption that was calculated from net water consumption shown on Figure 24.3 taking into account the future UFW ratio and peak factor.

"Consumption" shown on the Figure 24.4 is calculation results of future water consumption. Quantity of water consumption in year 2005 is calculated from existing actual water consumption and adding a balance of the maximum and average water consumption.

"Potential Demand" shown on the Figure 24.4 is the potential water demand. The potential water demand is calculated applying ultimate service ratio and ultimate per capita water consumption. Hence, in year 2025, water consumption and potential water demand become same quantity.

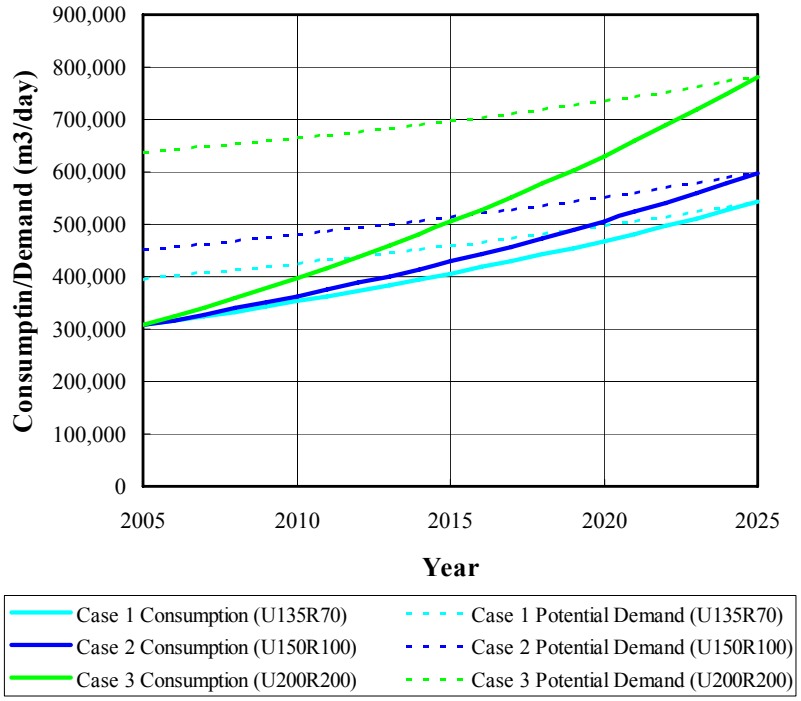


Figure 24.4 Future Water Consumption and Potential Water Demand

2.4.2 Water Supply System

The Water Supply Master Plan covers seven regional water supply schemes (WSSs). The master plan was developed to solve existing problems, which the PWD and people of Goa currently experience. It was also developed to increase the water supply capacity and to provide an adequate transmission system. The existing supply capacity is not sufficient to meet potential water demand.

The master plan will enable the PWD to meet future water demands and realize continuous and equal water supply services for customers by 2025. To help achieve continuous water supply, the master plan includes improvement plans for water supply facilities, operation and maintenance, institutional and capacity building, unaccounted-for water (UFW) and non revenue water (NRW) reduction, tariff strategies to restrain excessive consumption and wastage, and public relations with regards to wise water use.

To meet the increases in future water demand and to secure the existing water supply system, the master plan provides a facility improvement plan for each scheme as shown in Figure 24.5 and listed in Table 24.1.

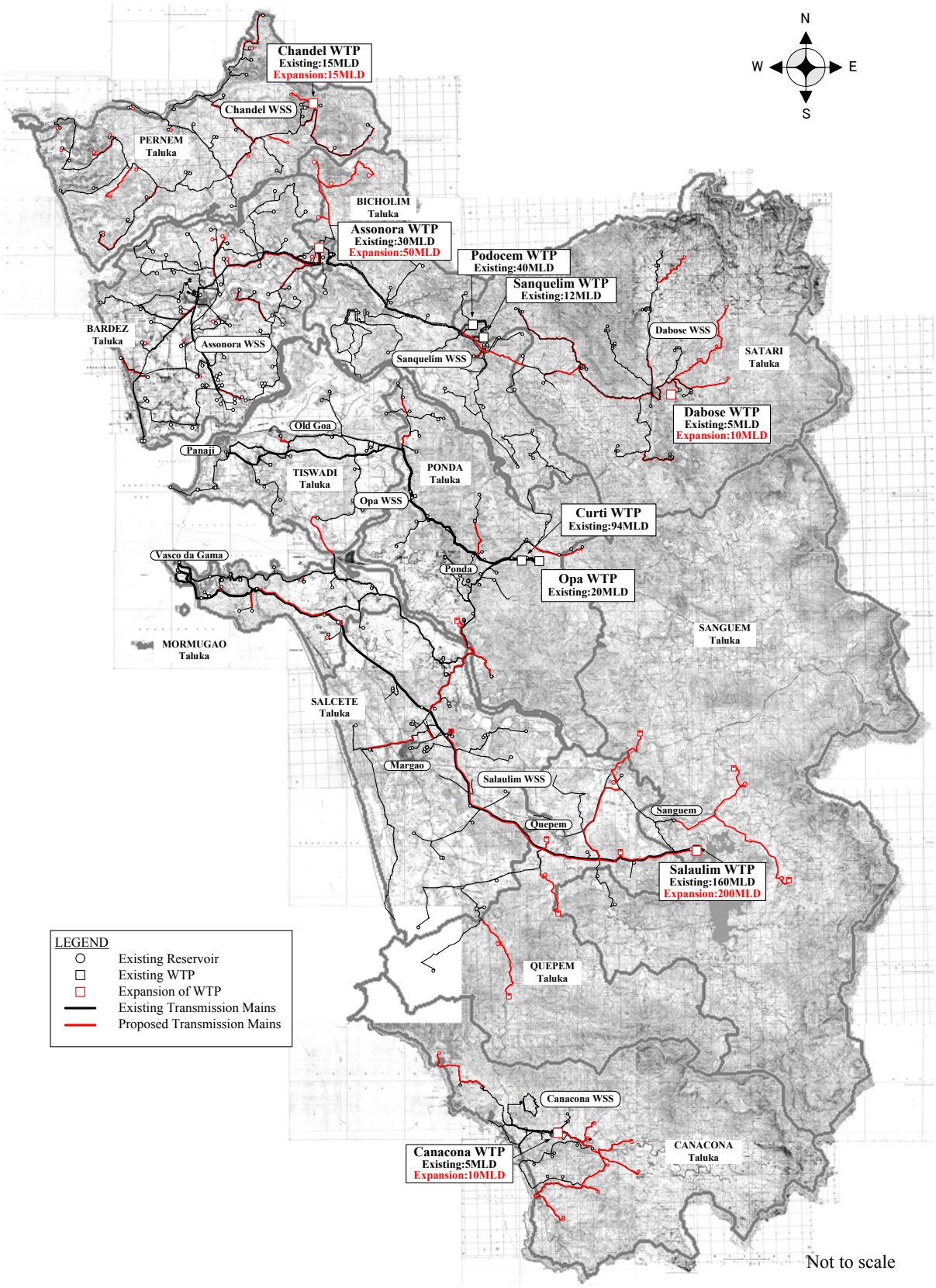


Figure 24.5 Proposed Water Supply System in 2025

Table 24.1 Summary of Components for the Water Supply Master Plan until 2025

Component	Water Supply Scheme (WSS)						
	Salaulim	Opa	Chandel	Assonora	Sanquelim	Dabose	Canacona
Proposed System (additionally required facilities)							
Water Treatment Plant (m^3/day)	200,000	-	15,000	50,000	-	10,000	10,000
Transmission Main	108 km	14 km	36 km	41 km	7 km	48 km	35 km
Reservoir	7	-	14	16	-	4	7
Pumping Station	7	-	1	1	2	1	3
Distribution Pipeline	965 km	436 km	67 km	377 km	99 km	88 km	75 km
House Connection	68,000	30,600	4,680	26,500	7,000	6,200	5,300
Rehabilitation/Improvement of the Existing System							
Water Treatment Plant (m^3/day)	160,000	114,000	15,000	30,000	52,000	5,000	5,000
Transmission Main	83 km	50 km	-	6 km	4 km	11 km	2 km
Reservoir	18	19	7	14	5	5	3
Pumping Station	16	4	-	2	3	10	3
Distribution Pipeline	540 km	268 km	125 km	275 km	61 km	70 km	18 km
House Connection	229,000	129,000	25,900	116,500	18,000	16,500	12,800

2.4.3 Sanitation System

The most appropriate sanitation system (either on-site, decentralized, or sewerage systems) was selected for each area based on the demographic, geological and economic situations. The groundwater table level and the long-term infiltration rate of the soil were also taken into account when assessing the infiltration ability. Also, a comparative study of the construction costs for on-site systems and sewerage systems was conducted to ensure the most appropriate system.

As a result of these comparative assessments and technical studies, a decentralized system is proposed for small cities from which less than 1,000 m³ / day of sewage flow is generated. The decision tree is explained in Figure 24.6. The population density is the criteria for selection of sanitation system and it was set as 41 person/ha. This figure was obtained from comparison of construction costs for onsite, sewerage, and decentralized systems.

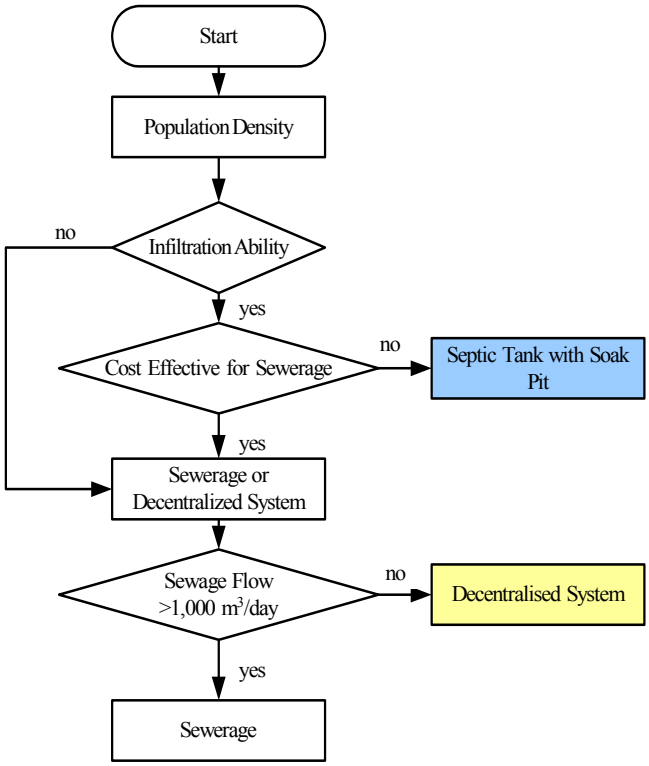


Figure 24.6 Sanitation System Selection

Introducing these sewerage projects, sewage originated from 370,000 residents and 70,000 tourists can be treated in 2025, discharging BOD load will be reduced up to 20 % of present one despite of population increase in the proposed sewerage areas. Regarding the whole study area, 35 % of discharging BOD load will be reduced against present one comprised with sewerage, de-centralized system and septic tank development.

The existing sewage collection systems in Panaji and Margao use a separate collection system. The separate sewage collection system is also proposed for the rest of the sewerage areas taking into account the above mentioned reason and the water pollution control in the rainy season. On the other hand, the combined sewage collection system suffers from several disadvantages such as sluggish flow during non stormy days, leading to deposition of sewage solids causing foul odours and increased cost of sewers, sewage treatment plant and pumping station costs.

The separate sewage collection system is also proposed for the rest of the sewerage areas taking into account the above mentioned reason and the water pollution control in the rainy season.

The quantity of sewage was calculated based on the residential and tourist population size and the per capita water demand. The sewage return ratio and groundwater infiltration ratio were taken from the CPHEEO manual.

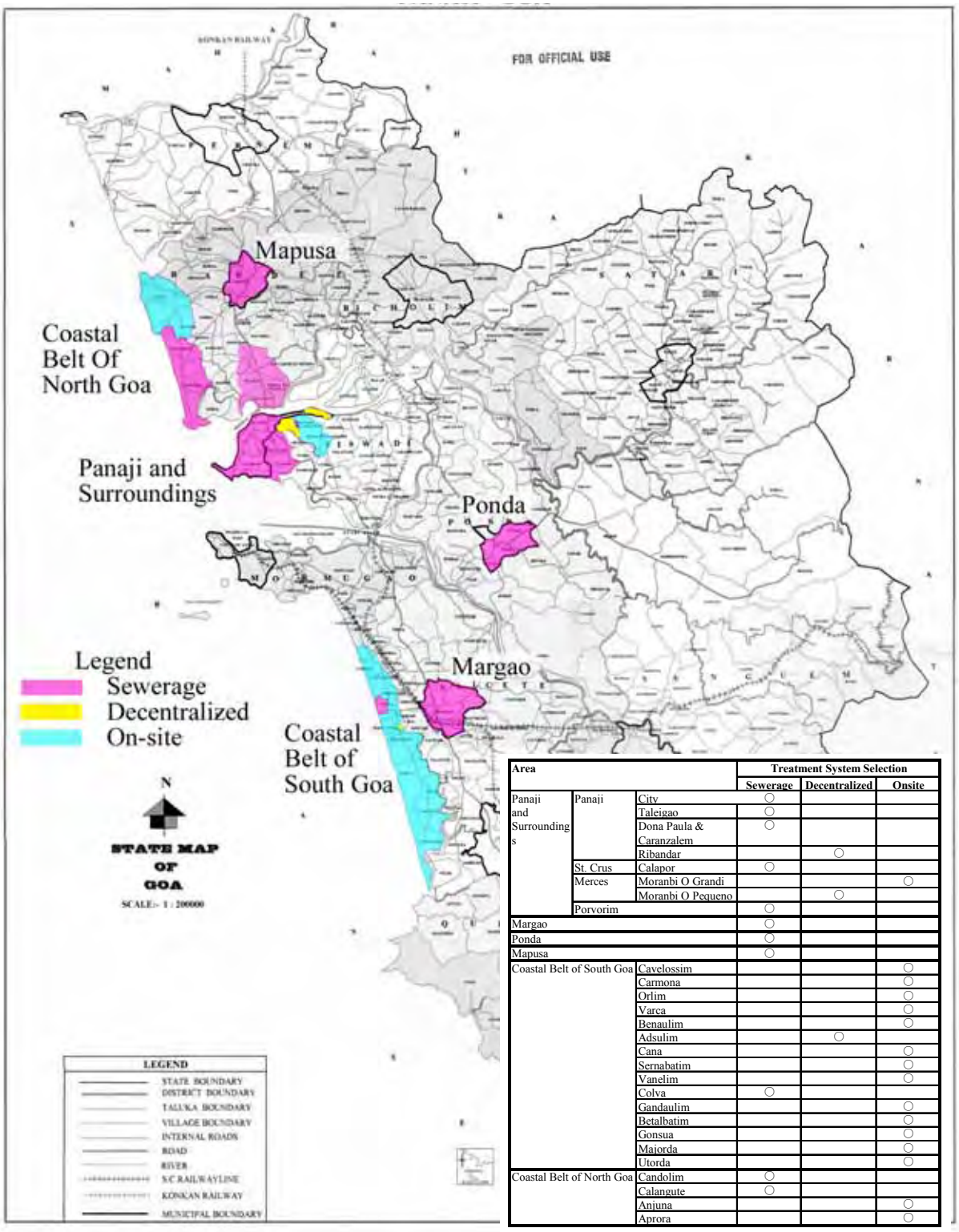
The sewage quality was estimated from the pollution load divided by the sewage flow rate. The per capita pollution load of BOD was assumed to be 45 g/capita/day (as defined in the CPHEEO manual). The quality of the treated effluent must comply with the Indian standards for sewage discharge.

In general, gravity collection systems and biological treatment processes are proposed. The sewerage facilities (including sewer network, pumping stations and treatment plants) will be designed in accordance with the CPHEEO manual. The treatment plant sites were selected based on the topography, ease in land acquisition, and environmental and social considerations.

Figure 24.7 shows the selected sanitation system and Table 24.2 shows a summary of the proposed sewerage system.

Table 24.2 Summary of Sewerage System

Location	Unit	Panaji including Taleigao, Dona Paula & Caranzalem	St. Cruz	Porvorim	Margao	Ponda	Mapusa	Colva (South Coastal Belt)	North Coastal Belt
Target Year		2025							
Collection System		Separate System							
Covered Population	Persons	56,557	16,918	47,848	118,193	19,401	68,255	5,279	39,358
Tourist	Persons	33,576	-	1,653	5,429	2,097	1,703	5,231	20,261
Per Capita Sewage Flow	L/capita/day	150							
Return Ratio	%	100%	80%						
Groundwater Infiltration	%	20%							
Sewage Flow	m^3/day	21,390	2,538	7,608	20,859	3,455	10,781	2,152	11,172
Sewage Quality (BOD)	mg/L	210	300	300	300	280	300	220	240
(SS)	mg/L	180	250	250	250	240	250	190	200
Treated Effluent (BOD)	mg/L	30							
(SS)	mg/L	100							
Capacity (Proposed)	m^3/day	8,900	2,600	7,700	13,400	3,500	10,800	2,200	11,200
(Existing)	m^3/day	12,500	-	-	7,500	-	-	-	-
Treatment Method		Biological Process							



Area			Treatment System Selection		
			Sewerage	Decentralized	Onsite
Panaji and Surroundings	Panaji	City	○		
		Taleigao	○		
		Dona Paula & Caranzalem	○		
		Ribandar		○	
	St. Crus	Calapor	○		
	Merces	Moranbi O Grandi			○
		Moranbi O Pequeno		○	
	Porvorim		○		
Margao			○		
Ponda			○		
Mapusa			○		
Coastal Belt of South Goa	Cavelossim				○
	Carmona				○
	Orlim				○
	Varca				○
	Benaulim				○
	Adsulim			○	
	Cana				○
	Sernabatim				○
	Vanelim				○
	Colva		○		
	Gandaulim				○
	Betalbatim				○
	Gonsua				○
	Majorda				○
	Utorda				○
Coastal Belt of North Goa	Candolim		○		
	Calangute		○		
	Anjuna				○
	Aprora				○

Figure 24.7 Selected Sanitation Systems for the Study Area

2.4.4 Operation and Maintenance

(1) Operation and Maintenance of Water and Sanitation Schemes

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.

Operations are the "doing" part of the organisation. It is responsible for the 'source to tap' process, which includes water resources, dams, reservoirs, production, transmission, 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 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)

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. Effective maintenance practices will add value by providing improvements to the efficiency, cost effectiveness and reliability of assets and enhance operational performance. PHE will need to develop their maintenance practices to:

- Provide an efficient maintenance service with optimum use of available resources and allocation based on operational priorities
- Minimize asset life costs through the application of cost effective planned preventative maintenance procedures and working practices
- Improve maintenance financial management and budget control. This will include the provision of better financial information to improve decision making
- 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
- Optimize stock holding of materials and spare parts through the development of a spares policy and by identifying inventory requirements
- 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

(2) NRW Reduction Planning

An 'active' approach to NRW reduction will need to be institutionalised for best results. PHE operate a "Passive" approach to leakage reduction whereby leak detection and repairs are managed on a reactive basis such that only visible leaks are dealt with. Due to low pressures it is likely that many leaks will not appear above ground and therefore go unnoticed. Many of the leaks will be as a result of poor materials, installations or repairs. Leaks can cause water quality issues due to back-siphonage as well as causing commercial losses. The current emphasis is to tackle physical or 'real' losses with little or no emphasis on tackling commercial

or ‘apparent’ losses.

PHE aims to progressively implement enhanced services. Where this includes the provision of 24 hour supply systems, PHE will need to ensure that water supply networks are managed effectively to maintain NRW at an economic level. It is well proven that a focus on reducing NRW will produce a positive financial return based upon operational savings and capital deferment.

The aim of a NRW Reduction Strategy will be to:

- Maximise the use of available water resources
- Improve the efficiency of water supply systems
- Improve services to customers
- Defer capital investment
- Reduce operating costs through water savings
- Increase revenue through water savings

A successful NRW Reduction Strategy will require:

- **Leadership** – from the top of the organisation, there must be a “Champion” to ensure that the whole organisation concentrates upon the basics of increasing income and reducing the physical leakage.
- **Commitment** – throughout the organisation there must be a determination to follow through the processes that reduce NRW.
- **Resources** – significant resources are required to make the step change necessary to reduce NRW. Once NRW is under control and efficient and effective processes are in place then the resource can be reduced to a lower level. It must be recognised that NRW control is an ongoing operation.

In order to implement a successful NRW reduction strategy, PHE will need to:

- Get the basics right now to control and reduce the current levels of NRW such as capturing accurate data required to monitor and control physical and commercial losses
- Implement ‘Active Leakage’ control techniques to reduce the current levels of UFW
- Develop staff and systems for progressive and sustained improvements in NRW
- Minimise future leakage by raising standards of installation and repair
- Minimise future commercial losses by raising standards of metering, billing and revenue collection
- Undertake ‘enabling works’ to monitor and control UFW in future. PHE will need to

consider contracting out the enabling works and the 'primary UFW reduction' to an agreed target level. Following this period, PHE would need to take responsibility for ongoing UFW control

2.4.5 Institutional Development

(1) Framework for Institutional Development Master Plan

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.

In each of the three (3) institutional development stages, the priorities are expected to shift. A thorough review of the institutional situation at the end of each stage will be needed to confirm or adjust the priority themes for the succeeding stages. The emerging strategy for the initial stage consists of:

- Strengthening business orientation and customer orientation (transformation of organizational "culture")
- Transforming PHE (Circles/Divisions) from an engineering company into an accountable service provider.
- 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.
- Collaborate and contribute to the reforms in sector policy and legislation.

During the first stage, a 3-pronged agenda will be formulated consisting of a policy agenda, a restructuring agenda and a capacity building agenda will be needed.

(2) Policy Agenda

The priority objectives of policy decisions for PHE institutional development are envisaged to promote:

- increased financial autonomy for PHE to make the link between performance and resources transparent;
- clear performance accountability at all levels of PHE management; and
- performance incentives to effective work teams and staff.

(3) Restructuring Agenda

The core functions of PHE consist of the following:

- Services provision as per service delivery agreement
    - 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 planning and development

With this restructuring agenda, PHE is envisaged to be better able to:

- Lay the foundation for increased delegation of responsibilities and authority to lower levels;
- Prepare itself for implementation and operation of major, externally-supported capital investments;
- Set service and performance targets and standards by work groups; and
- Establish a flexible & responsive organization

These can be achieved through:

- A more process-focused, business-oriented and customer-friendly structure;
- Clear accountability for results on specific managers / teams;
- Mechanisms for internal review and improvement ("renewal");
- More adaptable and flexible for future organization reforms;
- Balanced responsibilities with resources and authority; and
- A policy & system for regular review and updating of departmental and office responsibilities, functions and structure.

(4) Capacity Building Agenda/Directions

Following the assessment framework, specific development objectives and interventions will be introduced into each of the systems. This is fully described in the feasibility study. In addition, a technical assistance project to support Capacity Building in PHE has been formulated as part of the Priority Project.

2.4.6 Preliminary Cost Estimates

(1) Introduction

Preliminarily costs have been estimated based on the analysis presented in the previous chapter. All costs mentioned in this chapter are based on the value of Indian Rupees in 2007. Taxes and duties vary depending on the type of equipment or material and were included in the corresponding unit costs. The estimated investment cost was based on a staged implementation of the project, which corresponds to the priorities and timeframes discussed in the Report. 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.

(2) Water Supply

A summary of the water supply component costs is presented in Table 24.3.

Table 24.3 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.

(3) Sanitation

A summary of the sanitation component costs is presented in Table 24.4.

Table 24.4 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

In addition to costs shown above, the costs required for decentralized and onsite system will be 254 million Rs. (equivalent to 5.6 million US$)

(4) Capacity Building, Institutional/Organizational Improvement

A summary of the capacity building, institutional/organizational improvement costs is presented in Table 24.5.

Table 24.5 Cost Estimate for Capacity Building, 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

2.4.7 Economic and Financial Analysis

Economic evaluation, as well as financial evaluation, was conducted utilizing the discounted cash flow method. Economic Internal Rate of Return (EIRR), NPV, and B/C ratio were selected as indicators for economic evaluation. Among the above three, EIRR was set as the most important indicator. Regarding the financial evaluation, the financial internal rate of return (FIRR), NPV, and B/C ratio were selected as indicators for financial evaluation. Among the above three, FIRR was set as the most important indicator. These indicators for economic and financial evaluation are computerized based on many preconditions and assumptions mentioned in the Volume II: Master Plan. In case the preconditions and assumptions are changed, evaluation results would be also changed. It should be noted that there are these kinds of limitations in economic and financial evaluation.

(1) Water Supply Master Plan

Following benefits in Table 24.6 were deemed and enumerated as the tangible economic benefit for the water supply master plan. Economic costs were converted from financial cost.

Table 24.6 Economic Benefit of Water Supply Master Plan

1	Cost reduction effects	1-1	Saving of alternative water procurement cost
		1-2	Saving of incurred costs by public water supply stoppages
		1-3	Saving cost for purchasing bottled water
2	Improvement of public hygiene	2-1	Saving of medical expenditures by decrease of waterborne diseases
		2-2	Reduction of absence from work caused by waterborne diseases

The EIRR of the proposed projects was 13.2%, which exceeds the opportunity cost of capital at 12%. This indicates that the projects are economically viable. For the reference, NPV, and B/C ratio was Rs.730 million and 1.09, respectively.

When conducting the financial evaluation, FIRR was not available for the present tariff. NPV, and B/C ratio was minus Rs.7,056 million and 0.610, respectively. Full cost recovery is not realized under the present tariff. Assuming that the tariff increases in Table 47.2 were applied each year, the FIRR were calculated as follows. Since the present cross subsidy from non-domestic to domestic is higher than those of other countries, four cases are set by constraining the annual tariff raise for non-domestic lower.

Table 24.7 FIRR Estimation for Each Case of Tariff Increase

Case	Tariff increase per annum				FIRR
Case 1	Domestic	0 %	Non-domestic	0 %	N.A.
Case 2	Domestic	3.00%	Non-domestic	1.50%	1.14%
Case 3	Domestic	4.00%	Non-domestic	2.50%	2.56%
Case 4	Domestic	4.50%	Non-domestic	3.00%	3.26%

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

Water tariff in the year 2025 by applying annual 4.00% increase is estimated at 2.25% of the average household income, assuming continuous economic growth of Goa State. The percentage is under the household's willingness to pay (2.48%) and is below the household's affordability to pay (3.5%). The project is deemed to financially feasible when the loan interest rate is less than 2.56%, and if the annual tariff increase of 4% and 2.5% is implemented for domestic and non-domestic sectors respectively. In this case, full cost recovery will be realized for the construction and maintenance of expanded facilities under water supply M/P until the end of the evaluation period.

(2) Sanitation Master Plan

Following benefits in Table 24.8 were selected and enumerated as tangible economic benefits of

the M/P for sanitation. Economic costs were converted from financial cost.

Table 24.8 Economic Benefit of Sanitation Master Plan

1	Cost reduction effects	1-1	Saving cost for alternative sanitation facilities
2	Environment preservation effects	2-1	Preservation of water environment expressed by willingness to pay of tourists

The economic evaluation indicated that EIRR was 15.9%. NPV, and B/C ratio was Rs.355 million and 1.26, respectively. The project is economically viable because the EIRR exceeds the opportunity cost of capital at 12%.

The FIRR was not available for the proposed sanitation projects. The benefit cost ratio (B/C) was found to be only 0.17, which indicates the present value of benefits is only 17% of the present value of costs. NPV was minus Rs.3,084 million. Input of subsidy from State Government is indispensable for PHE to implement proposed projects in the M/P for sanitation and to maintain the service. Necessary amount of subsidy and tariff increase for sanitation were estimated in the Financial Plan.

(3) PHE Financial Plan for the Water Supply and Sanitation Master Plan

1) Necessary tariff increases and subsidy for sanitation services

The financial plan consists of income statements and necessary subsidy amounts for water supply and sanitation through the project evaluation period. If only the operation and maintenance costs (including administration costs and other costs) need to be covered the sewerage charge increase in Table 24.9 would be required.

Table 24.9 Necessary Tariff Raise for Sanitation to Recover the O&M Cost

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

Water tariff in the year 2025 by applying annual 7.50% increase is estimated at 1.03% of the average household income, assuming continuous economic growth of Goa State. The percentage is under the household's willingness to pay (1.29%) and is below the household's affordability to pay (1.5%). The tariff increases above will significantly impact on customers. However, if the tariff raises are not implemented, the expansion of the sanitation service would result in a continuous deficit for the PHE sanitation service. It is therefore recommended that

the PHE carefully considers the expansion of the sanitation service. The PHE will need to provide better service and will need to implement public relation activities to obtain support and understanding from customers.

Following chart shows the estimated necessary amount of subsidy for sewerage enterprise with the tariff raise at 7.5% per annum for domestic and at 6.0% per annum for non-domestic, in order to keep providing the sewerage service continuously. Without this annual subsidy for sewerage enterprise, it is impossible to keep providing the project benefits perpetually.

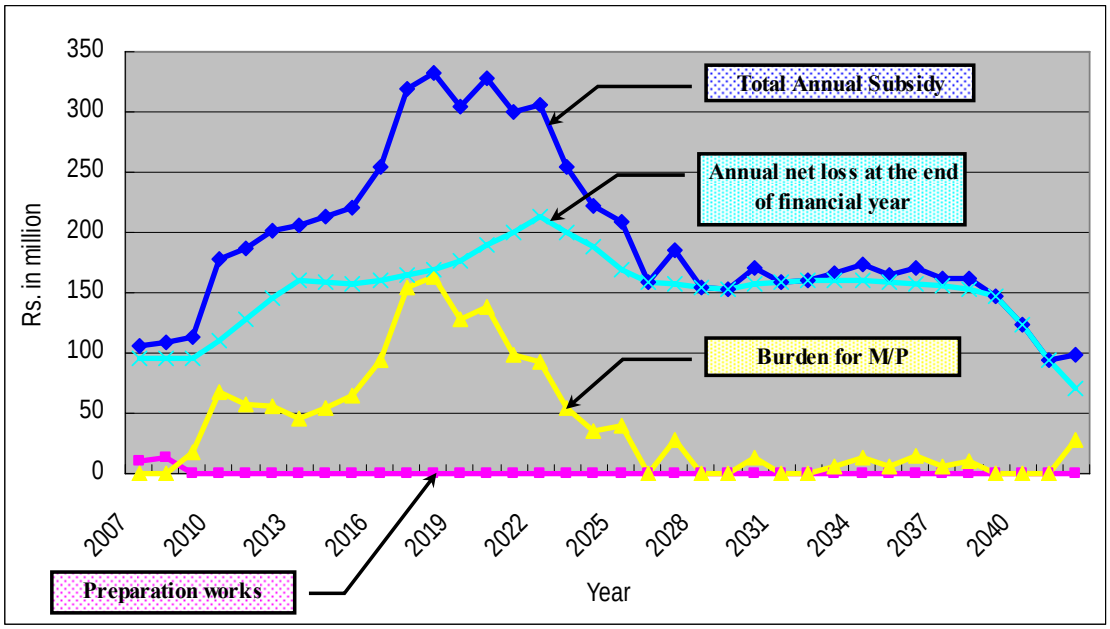


Figure 24.8 Annual Necessary Subsidy for Sanitation Service

Water and sewerage tariff in the year 2025 by applying annual 4.00% increase for water supply and annual 7.50% increase for sewerage is estimated at 3.28% of the average household income, assuming continuous economic growth of Goa State. The percentage is under the household's willingness to pay (3.77%) and is below the household's affordability to pay (5.00%).

2) Necessary subsidy for water supply services

If the tariff increases at a rate of 4% per annum at constant price, the necessary subsidy will decrease from 2013 to 2025, and will be zero after 2026. For the period between 2007 and 2017, the necessary subsidy from the State Government will reach as much as Rs.2,200 million. This large subsidy between 2007 and 2017 is the result of an annual net loss during the early stage of project and the burden for project implementation.

3) Net profit/loss and the accumulated profit/loss trends

The annual net loss during the early stage of the evaluation period will become a profit by 2023/24 and the net profit will continue after that right through to the end of the evaluation period. Due to the net losses during the early stage, the accumulated loss will increase up until the year 2022/23 and will reduce after 2023/24. An important point to note is that 'Revenue' begins to exceed 'Expenditure'. This increase in annual revenue is mainly a result of the 4% (for domestic) and 2.5% (for non-domestic) annual water tariff increases. Without this tariff raise, accumulated loss for PHE cannot reduce. The sanitation tariff increase also contributes to the reduction in the PHE's annual loss.

2.4.8 Initial Environmental Examination

(1) Public Consultation

Stakeholder participation has been incorporated into the project from an early stage. The public consultation has focused on the consideration of a wide range of environmental and social impacts. The stakeholder meeting (SHM) was carried out in each stage inline with the three phases of the Study. The 1st SHM was held to explain the public consultation approach that was being adopted. During the development of the Master Plan, the Study Team assisted the PWD incorporate these stakeholders' opinions into the TOR for the Initial Environmental Examination (IEE). The 2nd SHM was held by the PWD in cooperation with the Study Team. The important purpose of the meeting was to discuss site specific issues regarding the environmental and social considerations identified through the IEE with the local stakeholders.

(2) Implementation of IEE

The Study Team assisted the PWD to conduct the IEE for the Master Plan and prepared the draft environmental scoping and draft TOR for the EIA. When the PWD executed the IEE that was undertaken in conjunction with the formulation of the Master Plan, there were no reasons for changing the classification from Category "B" which were identified during preliminary Study stage.

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. For water supply and sewerage projects are not listed on the Schedule I. This means an EIA report does not require submitting to the Central Government. However, the proponent needs to prepare the "rapid EIA" to gain official approval from the Goa State Pollution Control Board and DST&E and to satisfy requirement of international donor agencies.

(3) Results of IEE and Recommended Mitigation Measures

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. A full evaluation of potential significant impacts and the recommendation of mitigation measures are provided in the IEE Report (see Volume IV Appendix M). Environmental scoping for the EIA was conducted in the context of the IEE.

In conclusion, it is strongly recommended that a rapid-EIA document be prepared by the proponent (PWD) to submit to the DST&E without delay. The baseline survey for the rapid-EIA should be initiated at the same time as the Feasibility Study, at the latest.

2.4.9 Priority Projects and Emergency Measures

(1) Water Supply System

Priority Projects

Expansion and rehabilitation of Salaulim Water Supply Scheme were selected as the priority projects because the scheme has the most serious problem of water shortage from the urgency point of view. The project scale was set based on a careful examination of water demand, supply capacity, raw water availability and the PWD's financial capabilities. The priority projects have been selected from the components of Stage 1 of the Salaulim Scheme. The priority projects are described below:

- Expansion of the Salaulim Treatment Plant 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 a 20,000 m^3 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
- Improvement of Operation and Maintenance such as installation of flow meters, control valves and float valves and improvement of safety standards of WTPs for 7 WSSs
- 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.

Emergency Measures to be Taken by PWD/PHE

As the emergency measures, the PWD is recommended to conduct the following activities as soon as possible.

- Preparation of Asset Drawings
- Collection of Operation and Maintenance Data
- Preparation of Operation and Maintenance Manuals and Plans
- Cleaning up the Facilities
- Repair of Visible Leaks
- Implementation of On-going Projects without any Delay
- Ganjem and Maisal Schemes

(2) Sanitation

Priority Projects

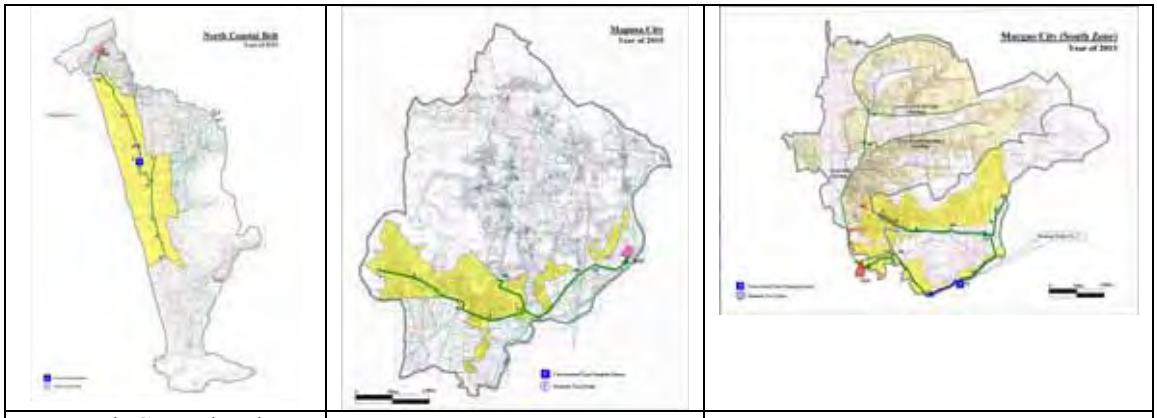
The following factors were considered when the priority projects were being selected: number of beneficiaries, cost effectiveness, positive impacts, and urgency. The results are shown in Table 24.10. Three (3) projects, namely North Coastal Belt, Margao, and Mapusa were selected as the priority projects. A summary of the priority projects is provided in Table 24.11 and Figure 24.9. 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 24.10 Selection of Sewerage Priority Projects

		Panaji	St. Cruz	Porvorim	Margao	Ponda	Mapusa	Colva (South Coastal Belt)	North Coastal Belt
Point	Beneficiary	4.1	1.2	3.9	4.8	1.9	5.4	1.7	7.9
	Cost Effects	7.5	4.3	4.6	9.5	6.9	7.5	0.0	7.3
	Positive Impacts	3.3	1.0	2.9	5.0	1.3	4.0	0.8	4.2
	Urgency	1.2	1.5	2.2	1.2	0.4	2.7	0.5	3.5
	Total	16.1	8.0	13.6	20.5	10.5	19.6	3.0	22.9
Rank		4	7	5	2	6	3	8	1
Priority Project					★		★		★

Table 24.11 Summary of Priority Projects

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)



North Coastal Belt | Mapusa | Margao

Figure 24.9 Priority Project Area

Emergency Measures to be Taken by PWD/PHE

- Implement measures upgrading sewerage connection rate including public relationship improvement, legislation setup, technical and financial assistance for the people in the coverage area.
- Undertake periodic sewer cleaning to prevent blockages and/or reduction in the sewer capacity resulting from accumulation of sand, soil and other materials.
- Survey sewer conditions, prepare cleaning schedules, procure cleaning equipment, and secure appropriate personnel and budgets.
- Prepare and maintain written records and data for assets and activities. This is very important for water supply and sewerage management.
- Replace the decayed pump facilities to secure enough capacity including stand-by pumps for peak flow and alternative operation.
- Improve sanitation in areas that will not have access to the sewerage service. This should be done by providing technical and financial assistance to the residents in terms of construction and maintenance of on-site and decentralized treatment facilities.
- Improve public relations with regards to sanitation.

- Establish a long-term renewal plan for old and deteriorated facilities. This plan should consider the installation date and the design life of each equipment/facility.
- Monitor the surface and groundwater quality to assess/improve the water environment. An effective monitoring system should include relevant organizations/agencies (e.g. the pollution control board, the health department, and the water resource department).

(3) Institutional Development and Capacity Building

Following the assessment framework, specific development objectives and interventions will be introduced into each of the systems. This is fully described in the feasibility study. A technical assistance project to support Capacity Building in PHE has been formulated as part of the Priority Projects.

In the FS, 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.

(4) Improvement of Accounting System

Introduction of the independent accounting system shall be initiated by PHE and PWD with the assistance of management consultant planned in the priority projects for capacity building. Management consultant shall help the implementation of the improvement of accounting system of PWD/PHE. 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.

(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.