Appendix M64:

Required Land Area for New Sewage Treatment Plants

Contents for Appendix M64

Appendix M64.1 Calculation of Required Land Area for STP

(1) Required Land Area for St. Cruz STP

(1)Basic conditions

- Daily average flow = 2,500 m3/day
- Peak flow = 7,500 m3/day (Daily average×3.00)
- Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	300	30	90.0
SS(mg/l)	250	100	60.0

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	3.47	m2
Unit number	:	2	unit(s)
Width	:	0.6	m/unit
Length	:	2.89	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	1,563	m3/day
Depth	:	3.0	m
Unit number	:	2	basin(s)
Width	:	4.0	m
Length	:	65.1	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	2	basin(s)
Required area	:	83.3	m2/basin
Depth	:	4.0	m
Diameter	:	10.3	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	12.5	m2
Unit number	:	2	basin(s)
Width	:	3.0	m
Length	:	2.1	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	26.0	m3
Width	:	1.0	m
Depth	:	1.0	m

	Pass : 6 m Length : 4.3 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 2 basin(s) Sludge content : 375.0 kgDS/day Required area : 6.25 m2/basin Depth : 3.0 m Diameter : 2.8 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 0.38 ton/day Sludge moisture : 97.0 % Sludge volume : 12.5 m3/day Sludge retention : 14.0 day Required volume : 175.0 m3 Basin number : 1 basin Depth : 6.0 m Diameter : 6.1 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 375.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 12.5 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 1.6 m3/hr
(3)Required surface area	① Grit Chamber : 3.5 m2 ② Oxidation ditch : 520.8 m2 ③ Sedimentation Basin : 166.7 m2 ④ Sand Filtration Tank : 12.5 m2 ⑤ Disinfection Tank : 26.0 m2 ⑥ Sludge Thickening Tank : 12.5 m2 ⑦ Sludge Digestion Tank : 29.2 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 871.2 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 3,920.3 ≒ 4,000 m2

(2) Required Land Area for Porvorim STP

(1)Basic conditions

・Daily average flow = 7,600 m3/day
・Peak flow = 19,000 m3/day (Daily average×2.50)
・Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	300	30	90.0
SS(mg/l)	250	100	60.0

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	8.80	m2
Unit number	:	2	unit(s)
Width	:	0.9	m/unit
Length	:	4.89	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	4,750	m3/day
Depth	:	3.0	m
Unit number	:	2	basin(s)
Width	:	4.0	m
Length	:	197.9	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	2	basin(s)
Required area	:	253.3	m2/basin
Depth	:	4.0	m
Diameter	:	18.0	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	38.0	m2
Unit number	:	2	basin(s)
Width	:	5.0	m
Length	:	3.8	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	79.2	m3
Width	:	1.2	m
Depth	:	1.0	m

	Pass : 8 m Length : 8.2 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 2 basin(s) Sludge content : 1,140.0 kgDS/day Required area : 19.00 m2/basin Depth : 3.0 m Diameter : 4.9 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 1.14 ton/day Sludge moisture : 97.0 % Sludge volume : 38.0 m3/day Sludge retention : 14.0 day Required volume : 532.0 m3 Basin number : 1 basin Depth : 6.0 m Diameter : 10.6 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 1,140.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 38.0 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 4.8 m3/hr
(3)Required surface area	① Grit Chamber : 8.8 m2 ② Oxidation ditch : 1,583.3 m2 ③ Sedimentation Basin : 506.7 m2 ④ Sand Filtration Tank : 38.0 m2 ⑤ Disinfection Tank : 79.2 m2 ⑥ Sludge Thickening Tank : 38.0 m2 ⑦ Sludge Digestion Tank : 88.7 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 2,442.6 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 10,991.8 ≒ 11,000 m2

(3) Required Land Area for Ponda STP

(1)Basic conditions

- Daily average flow = 3,500 m3/day
- Peak flow = 10,500 m3/day (Daily average×3.00)
- Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	280	30	89.3
SS(mg/l)	240	100	58.3

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	4.86	m2
Unit number	:	2	unit(s)
Width	:	0.7	m/unit
Length	:	3.47	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	2,188	m3/day
Depth	:	3.0	m
Unit number	:	2	basin(s)
Width	:	4.0	m
Length	:	91.1	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	2	basin(s)
Required area	:	116.7	m2/basin
Depth	:	4.0	m
Diameter	:	12.2	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	17.5	m2
Unit number	:	2	basin(s)
Width	:	3.0	m
Length	:	2.9	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	36.5	m3
Width	:	1.0	m
Depth	:	1.0	m

	Pass : 8 m Length : 4.6 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 2 basin(s) Sludge content : 490.0 kgDS/day Required area : 8.17 m2/basin Depth : 3.0 m Diameter : 3.2 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 0.49 ton/day Sludge moisture : 97.0 % Sludge volume : 16.3 m3/day Sludge retention : 14.0 day Required volume : 228.7 m3 Basin number : 1 basin Depth : 6.0 m Diameter : 7.0 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 490.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 16.3 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 2.0 m3/hr
(3)Required surface area	① Grit Chamber : 4.9 m2 ② Oxidation ditch : 729.2 m2 ③ Sedimentation Basin : 233.3 m2 ④ Sand Filtration Tank : 17.5 m2 ⑤ Disinfection Tank : 36.5 m2 ⑥ Sludge Thickening Tank : 16.3 m2 ⑦ Sludge Digestion Tank : 38.1 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 1,175.8 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 5,290.9 ≒ 5,300 m2

(4) Required Land Area for Mapusa STP

(1)Basic conditions

- Daily average flow = 10,800 m3/day
- Peak flow = 24,300 m3/day (Daily average×2.25)
- Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	300	30	90.0
SS(mg/l)	250	100	60.0

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	11.25	m2
Unit number	:	2	unit(s)
Width	:	1.6	m/unit
Length	:	3.52	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	6,750	m3/day
Depth	:	3.0	m
Unit number	:	4	basin(s)
Width	:	4.0	m
Length	:	140.6	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	4	basin(s)
Required area	:	180.0	m2/basin
Depth	:	4.0	m
Diameter	:	15.1	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	54.0	m2
Unit number	:	2	basin(s)
Width	:	5.0	m
Length	:	5.4	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	112.5	m3
Width	:	2.0	m
Depth	:	1.0	m

	Pass : 6 m Length : 9.4 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 2 basin(s) Sludge content : 1,620.0 kgDS/day Required area : 27.00 m2/basin Depth : 3.0 m Diameter : 5.9 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 1.62 ton/day Sludge moisture : 97.0 % Sludge volume : 54.0 m3/day Sludge retention : 14.0 day Required volume : 756.0 m3 Basin number : 2 basin Depth : 6.0 m Diameter : 9.0 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 1,620.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 54.0 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 6.8 m3/hr
(3)Required surface area	① Grit Chamber : 11.3 m2 ② Oxidation ditch : 2,250.0 m2 ③ Sedimentation Basin : 720.0 m2 ④ Sand Filtration Tank : 54.0 m2 ⑤ Disinfection Tank : 112.5 m2 ⑥ Sludge Thickening Tank : 54.0 m2 ⑦ Sludge Digestion Tank : 126.0 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 3,427.8 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 15,424.9 ≒ **15,500** m2

(5) Required Land Area for Colva STP

(1)Basic conditions

- Daily average flow = 2,200 m3/day
- Peak flow = 6,600 m3/day (Daily average×3.00)
- Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	220	30	86.4
SS(mg/l)	190	100	47.4

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	3.06	m2
Unit number	:	2	unit(s)
Width	:	0.6	m/unit
Length	:	2.55	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	1,375	m3/day
Depth	:	3.0	m
Unit number	:	2	basin(s)
Width	:	4.0	m
Length	:	57.3	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	2	basin(s)
Required area	:	73.3	m2/basin
Depth	:	4.0	m
Diameter	:	9.7	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	11.0	m2
Unit number	:	2	basin(s)
Width	:	4.0	m
Length	:	1.4	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	22.9	m3
Width	:	1.0	m
Depth	:	1.0	m

	Pass : 6 m Length : 3.8 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 1 basin(s) Sludge content : 198.0 kgDS/day Required area : 6.60 m2/basin Depth : 3.0 m Diameter : 2.9 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 0.20 ton/day Sludge moisture : 97.0 % Sludge volume : 6.6 m3/day Sludge retention : 14.0 day Required volume : 92.4 m3 Basin number : 1 basin Depth : 6.0 m Diameter : 4.4 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 198.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 6.6 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 0.8 m3/hr
(3)Required surface area	① Grit Chamber : 3.1 m2 ② Oxidation ditch : 458.3 m2 ③ Sedimentation Basin : 146.7 m2 ④ Sand Filtration Tank : 11.0 m2 ⑤ Disinfection Tank : 22.9 m2 ⑥ Sludge Thickening Tank : 6.6 m2 ⑦ Sludge Digestion Tank : 15.4 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 764.0 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 3,437.9 ≒ 3,500 m2

(6) Required Land Area for Baga STP

(1)Basic conditions

- Daily average flow = 11,200 m3/day
- Peak flow = 28,000 m3/day (Daily average×2.50)
- Design water quality

Item	Influent	Effluent	Removal Rate(%)
BOD(mg/l)	240	30	87.5
SS(mg/l)	200	100	50.0

(2)Outline of major facilities

① Grit Chamber

Type	:	Parallel flow rectangular	
Surface load	:	2,160	m3/m2/day
Required area	:	12.96	m2
Unit number	:	2	unit(s)
Width	:	1.9	m/unit
Length	:	3.41	m
Depth	:	0.3	m

② Oxidation Ditch

Type	:	Endless ditch flow type	
Hydraulic retention time	:	15.0	hours
Required volume	:	7,000	m3/day
Depth	:	3.0	m
Unit number	:	4	basin(s)
Width	:	4.0	m
Length	:	145.8	m

③ Sedimentation Basin

Type	:	Circular tank with sludge collector	
Sueface load	:	15.0	m3/m2/day
Unit number	:	4	basin(s)
Required area	:	186.7	m2/basin
Depth	:	4.0	m
Diameter	:	15.4	m/basin

④ Sand Filtration Tank

Type	:	Gravity Upflow Filter Type	
Filtration rate	:	200	m/day
Required area	:	56.0	m2
Unit number	:	2	basin(s)
Width	:	5.0	m
Length	:	5.6	m

⑤ Disinfection Tank

Type	:	Chlorination type	
Retention time	:	15.0	min
Required volume	:	116.7	m3
Width	:	2.0	m
Depth	:	1.0	m

	Pass : 6 m Length : 9.7 m ⑥ Sludge Thickening Tank Type : Circular tank with sludge collector Dry solid load : 30.0 kgDS/m2/day Unit number : 2 basin(s) Sludge content : 1,120.0 kgDS/day Required area : 18.67 m2/basin Depth : 3.0 m Diameter : 4.9 m ⑦ Sludge Digestion Tank Type : Anaerobic type Solid weight : 1.12 ton/day Sludge moisture : 97.0 % Sludge volume : 37.3 m3/day Sludge retention : 14.0 day Required volume : 522.7 m3 Basin number : 1 basin Depth : 6.0 m Diameter : 10.5 m ⑧ Sludge Dewatering Type : Centrifugal type Sludge content : 1,120.0 kgDS/day Sludge moisture rate : 97.0 % (Digested sludge) Sludge volume : 37.3 m3/day Unit number : 2 unit(s) (including 1 stand-by) Operation time : 8.0 hr/day Required capacity : 4.7 m3/hr
(3)Required surface area	① Grit Chamber : 13.0 m2 ② Oxidation ditch : 2,333.3 m2 ③ Sedimentation Basin : 746.7 m2 ④ Sand Filtration Tank : 56.0 m2 ⑤ Disinfection Tank : 116.7 m2 ⑥ Sludge Thickening Tank : 37.3 m2 ⑦ Sludge Digestion Tank : 87.1 m2 ⑧ Sludge Dewatering : 100.0 m2 (as building) 3,490.1 m2
(4)Required area	Required area = Required surface area × 4.5 (for maintenance space) Approximately : 15,705.3 ≒ **15,800** m2

APPENDIX M7

This appendix is reference to and supporting data of

Volume 2 Main Report – Master Plan

Chapter 7 Operation and Maintenance

M71	Local Organization and Arrangements Document
M72	Water & Sanitation Quality Monitoring
M73	Asset Management Process

Appendix M71:

Local Organization and Arrangements Document

(LOAD)

Contents for Appendix M71

Appendix M71.1 Local Organisation and Arrangements Document (LOAD)

(1) Chief Engineer I PWD

In addition to the duties outlined in the Health and Safety Policy, the Chief Engineer I PWD should take responsibility for:

- Ensuring that senior managers produce Divisional/Regional Health & Safety Policy statements and establish LOAD's for carrying out the policy
- Annually reviewing performance against the responsibilities assigned under the Divisional/Regional Health and Safety Policy Statements and LOAD's
- Ensuring that within the financial and manpower resources allocated, adequate provision is made for health and safety measures
- Bringing the Health & Safety Policy statement and provisions for health, safety, security and welfare to the attention of all employees including contract staff as well as contractors and the general public where necessary
- Ensuring that relevant health and safety information is communicated to the workforce as and when necessary
- Ensuring that PHE complies with all current and future health and safety requirements

(2) Managers

Managers should take responsibility for:

- Ensuring that health and safety is given a high profile and that sufficient resources are made available for dealing with all health, safety, security and welfare issues/matters
- Ensuring that plans and budgets take into account health and safety standards and that they are adequately resourced
- Reporting on health, safety, security and welfare matters, raising any shortfalls or concerns
- Ensuring adequate liaison with other managers across PHE, agents, contractors, suppliers and others
- Exercising a general duty of care for the health, safety and welfare of employees and the general public
- Ensuring that safe systems of work are established and adhered to, taking into account known and potential hazards
- Ensuring that arrangements are made for employees to obtain the necessary skills and training to safeguard their health and safety and that of others who may be affected by potentially hazardous operations
- Ensuring that all necessary safety equipment and protective clothing is provided and used correctly

- Identifying the particular hazards of plant, vehicles and machinery under their control ensuring that all standards and statutory regulations are met
- Establishing and implementing as far as is reasonably practicable, procedures to ensure that the operations of agents and contractors do not put employees of PHE, the general public or themselves at risk.
- Identifying any safety training needs within their area of responsibility
- Ensuring that a tidy and orderly workplace is maintained
- Resolving any health, safety, security and welfare issues/problems quickly and for referring any unresolved problems to their Line Manager
- Continually monitoring systems of work, periodically inspecting the workplace and, when necessary, reporting hazards and any matters beyond the Manager's authority to the Senior Management team/Managing Director
- Undertaking a formal audit of the workplace on a quarterly basis
- Immediately on becoming aware of any situation that could endanger themselves, employees, or others, take immediate action to rectify the hazard
- Ensuring that when using contractors, 'day workers', or any other agent, to carry out work they do so in a safe and proper manner and that they follow all applicable health and safety procedures, regulations and directives

(3) Employees

Employees should take responsibility for:

- Taking reasonable care for ensuring the health and safety of himself and of any other persons who may be affected by his acts or omissions at work
- Understanding that if legal requirements are not fulfilled, disciplinary or legal action may be taken against the individual
- Ensuring that when carrying out their duties, they do so in a safe manner, use safe working practices, do not take any unnecessary risks or intentionally or recklessly interfere or misuse anything provided in the interests of health, safety or welfare in pursuance of their duties, paying particular attention to any relevant statutory provisions
- Ensuring that should they observe any unsafe areas, practices, equipment, cables, plant, machinery, building, or processes being carried out, they will report it immediately to their Line Manager

(4) Health & Safety Process Owner

The 'H&S Process Owner should take responsibility for:

- Monitoring that PHE complies with all health, safety, security and welfare obligations.

This involves the provision of safety advise, safety auditing, safety training, fire and security advise, occupational health and hygiene advice and process hazards and risk assessments.

- Ensuring that 'Local H&S Advisors' or 'Champions' are trained within each Division/Region to give help and advise to ensure that all relevant standards and activities within the Divisions/Regions are complied with
- Ensuring that a Central as well as Regional H&S Committees are formed, representatives are trained and meetings are held regularly to discuss and resolve relevant health, safety, welfare and security issues quickly and professionally
- Co-ordination of PHE-wide First Aid provisions, welfare facilities, cleaning and security arrangements and for ensuring that sufficient numbers of staff are trained and certified to provide first aid throughout the Regions
- Ensuring compliance with electrical testing and tagging of portable equipment
- Ensuring Fire Certificate compliance and that local managers have adequate fire extinguishers, have staff trained in their correct use, conduct fire drills and maintain appropriate records.

Table M71.1.1 Schedule of duties and responsibilities

DUTY	RESPONSIBLE PERSON	COMMENTS
Electricity		
Electrical wiring repairs and/or alterations	Local manager supported by Regional SE and H&S Process Owner	To be carried out in accordance with appropriate regulations.
Electrical supply, distribution boards and wiring testing	Local manager supported by Regional SE and H&S Process Owner	To be carried out in accordance with appropriate regulations.
Portable electrical equipment maintenance	Local manager supported by Regional SE and H&S Process Owner	To be carried out in accordance with appropriate regulations.
Chlorine Gas and associated equipment		
Gas supply and associated equipment maintenance	Local manager supported by Regional SE and H&S Process Owner	To be carried out in accordance with appropriate regulations and maintenance best practice document
Use of Chlorine gas	Local manager supported by Regional SE and H&S Process Owner	To be used in conjunction with written best practice procedure

DUTY	RESPONSIBLE PERSON	COMMENTS
Building Maintenance		
Any repair or alterations to the fabric of the buildings or associated utilities and services	Local manager supported by Regional SE and H&S Process Owner	To be carried out in accordance with appropriate regulations.
Fire Safety		
Obtain Fire Certificate and seek approval from relevant Authority for any proposed internal changes.	Regional SE and H&S Process Owner	Fire Certificate to be held in central file by H&S Process Owner
Fire alarm tests to be undertaken weekly	Local responsible Manager.	Records kept by Local responsible Manager.
Maintenance of Fire Alarm systems	Local manager supported by Regional SE and H&S Process Owner	Records to be kept by Local responsible manager.
Maintenance of smoke detectors	Local manager supported by Regional SE and H&S Process Owner	Records to be kept by Local responsible manager.
Maintenance of fire extinguishers	Local manager supported by Regional SE and H&S Process Owner	Use of approved dealer/contractor.
Extinguisher, Door signs, Fire exits and Gangways check	Local Manager	Weekly visual check.
Fire Drill	Local Manager	To be held at frequency stipulated in the Fire Certificate, but not less than every six months
Allocation of assembly points and floor fire officers.	Local manager supported by Regional SE and H&S Process Owner	As and when required.
Maintenance of fire drill check list and roll call check at assembly points	Local Site Manager or nominated floor fire officer.	As and when required
Training of new starters	Local Site Manager in conjunction with Training Manager.	Induction course for new starters includes H&S training, including what to do in a fire situation

DUTY	RESPONSIBLE PERSON	COMMENTS
First Aid		
Ensure adequate provision made at each location	Regional SE co-ordinates with local Manager	As required to meet legal and other requirements.
Appoint First Aiders; provide training and relevant record keeping.	Regional SE co-ordinates with local Manager and Training Manager	As required to meet legal and other requirements.
Provision of equipment, First Aid rooms, signing etc.	Local Manager	As required to meet legal and other requirements.
Accident reporting	All staff	Follow procedure specified and in line with H&S induction training
Appoint Safety Reps. And arrangements for joint consultation	Local manager supported by Regional SE and H&S Process Owner	Meet every 2 months.
Safety Management/Administration		
Accident investigation	Relevant Line Manager	All accidents to be investigated and recorded with the aim of preventing re-occurrence
Upkeep of Company Health and Safety Manual	H&S Process Owner and all Manual holders	Circulation of updates from H&S Process Owner.
Display of Employers Liability Insurance	H&S Process Owner	To be displayed in a prominent position at each site office.
Display of Statutory and Company health and safety information	H&S Process Owner co-ordinates with local Manager.	To be displayed in a prominent position at each site office.
Assessment of chemicals and substances	Local manager supported by Regional SE and H&S Process Owner	Assessments held centrally by H&S Process Owner. Product data safety sheets held by H&S Process Owner
Supervision and control of contractors, day workers, visitors, etc.	Local site Manager.	All contractors, day workers, visitors, etc. to be briefed on site safety requirements

DUTY	RESPONSIBLE PERSON	COMMENTS
Updating Local Organisation and Arrangements Health and safety Statements	Local manager supported by Regional SE and H&S Process Owner	Copy to be held at each site office.
Completion of safety inspection forms	All site Managers.	Copy to be held at each site office, and copy sent to H&S Process Owner who keeps central file
Provision of protective clothing as appropriate to the job in hand as and when required	Appropriate Line Manager with advise from the local Health and Safety Adviser	Relevant stocks to be maintained of approved 'safety issues' at each site location warehouse.
Induction safety training for new starters and transfers from elsewhere. Relevant record keeping	Line Manager in conjunction with Training Manager	On the first day, the Line Manager must provide training on fire, first aid, and all welfare arrangements. The Training Manager will provide formal safety training
Provision of specialist safety training	Line Manager in conjunction with Training Manager and H&S Process Owner	The Training Manager will provide formal safety training
Monitor and arrange noise assessments if necessary	Appropriate Line Manager with advise from the H&S Process Owner	Records to be kept by Line Manager and H&S Process Owner
Safe receipt and storage of materials and chemicals	Appropriate Line / site manager	Standard procedure in place as appropriate.
Confined space procedures	H&S Process Owner co-ordinates with Regional SE and relevant Line Manager to ensure safety compliance or engineer out all confined spaces	Only authorised and trained persons to enter a confined space under supervision of relevant line Manager
Testing and servicing of all mobile and fixed plant and equipment	Contractors appointed by Regional SE	Plant maintenance schedule to be agreed by Regional CE with Line Manager
Needle Stick Injury	Line Manager in conjunction with H&S Process Owner	Appropriate protective gloves to be stocked, provision of a sharps box as required and issued as appropriate. Urgent medical advice sought on injury and accident reported

DUTY	RESPONSIBLE PERSON	COMMENTS
Animal Bites and stings	Line Manage	All animal bites and serious stings referred to doctor/ hospital.
Use of appropriate signs and barriers	H&S Process Owner stipulates standards. Line Manager to comply with Standard	Appropriate signs and barriers kept in stock at each site warehouse as appropriate and as directed by the H&S Process Owner
Lone workers	H&S Process Owner stipulates standards. Line Manager to comply with Standard	Line Manager to ensure adequate training
Company vehicles	Line Manager to ensure that vehicles are only used by those qualified to do so. It is the drivers responsibility to check that the vehicle is safe and/or road worthy prior to using it	Maintenance of vehicles is the responsibility of the Regional CE, but co-ordinated with the Line Manager.

Appendix M72:

Water & Sanitation Quality Monitoring

Contents for Appendix M72

Appendix M72.1 Water & Sanitation Quality Monitoring

Table M72.1.1 Drinking Water Quality Parameters and Frequency of Analysis to be conducted by the Central Laboratory

	Parameter	Recommended Guidelines* (mg/L)		WHO Guidelines**** (mg/L)	Frequency of analysis			
		Acceptable**	Cause for Rejection***		Recommended	Present	Short Term	Long Term
Health Significance Aspects	**1. Microbial aspects**							
	E.coli or Thermotolerant coliform bacteria	0 in 100ml sample		Must not be detectable in any 100ml sample	Monthly	Monthly	Monthly	Monthly
	2. Naturally occurring chemicals							
	Arsenic (As)	0.01	0.05	0.01	Monthly		Monthly	Monthly
	Barium (Ba)	-	-	0.7				
	Boron (B)	-	-	0.5				
	Chromium (Cr^{6+})	0.05	0.05	0.05	Monthly		Monthly	Monthly
	Fluoride (F)	1	1.5	1.5	Monthly	Monthly	Monthly	Monthly
	Manganese (Mn)	0.05	0.5	0.4	Monthly	Monthly	Monthly	Monthly
	Molybdenum (Mo)	-	-	0.07				
	Selenium (Se)	0.01	0.01	0.01	Monthly		Monthly	Monthly
	Uranium (U)	-	-	0.009				
	3. Chemicals from industrial sources and human dwellings							
	Inorganics							
	Cadmium (Cd)	0.01	0.05	0.003	Monthly		Monthly	Monthly
	Cyanide (CN)	0.05	0.05	0.07	Monthly		Monthly	Monthly
	Mercury (Hg)	0.001	0.001	0.001	Monthly		Monthly	Monthly
	Organics							
	Benzene	-	-	0.01				
	Carbon tetrachloride	-	-	0.004				
	Di(2-ethylhexyl)phthalate	-	-	0.008				
	Dichlorobenzene, 1,2-	-	-	1				
	Dichlorobenzene, 1,4-	-	-	0.3				
	Dichloroethane, 1,2-	-	-	0.03				
	Dichloroethene, 1,1-	-	-	0.03				
	Dichloroethene, 1,2-	-	-	0.05				
	Dichloromethane	-	-	0.02				
	Edetic acid (EDTA)	-	-	0.6				
	Ethylbenzene	-	-	0.3				
	Hexachlorobutadiene	-	-	0.0006				
	Nitrilotriacetic acid (NTA)	-	-	0.2				
	Pentachlorophenol	-	-	0.009				
	Styrene	-	-	0.02				
	Tetrachloroethene	-	-	0.04				
	Toluene	-	-	0.7				
	Trichloroethene	-	-	0.07				
	Xylenes	-	-	0.5				

*Source: The Government of India, Manual on Water Supply and Treatment Third Edition.

**The figures indicated under the column 'Acceptable' are the limits up to which water is generally acceptable to consumers.

***The figures which exceed 'Acceptable' but are less than 'Cause for Rejection' may be tolerated in the absence of an alternative and better source.

****Source: Guidelines for Drinking-water Quality Third Edition, WHO 2004

	Parameter	Recommended Guidelines* (mg/L)		WHO Guidelines**** (mg/L)	Frequency of analysis			
		Acceptable**	Cause for Rejection***		Recommended	Present	Short Term	Long Term
Health Significance Aspects	**4. Chemicals from agricultural activities**							
	Non-pesticides							
	Nitrate (NO3)	45	45	50	Monthly	Monthly	Monthly	Monthly
	Nitrite (NO2) (long term)	-	-	3				
	Nitrite (NO2) (short term)	-	-	0.2				
	Pesticides used in agriculture							
	Alachlor	-	-	0.02				
	Aldicarb	-	-	0.01				
	Aldrin and dieldrin	-	-	0.00003				
	Atrazine	-	-	0.002				
	Carbofuran	-	-	0.007				
	Chlordane	-	-	0.0002				
	Chlorotoluron	-	-	0.03				
	Cyanazine	-	-	0.0006				
	2,4-D (2,4-dichlorophenoxyacetic acid)	-	-	0.03				
	2,4-DB	-	-	0.09				
	1,2-Dibromo-3-chloropropane	-	-	0.001				
	1,2-Dibromoethane	-	-	0.0004				
	1,2-Dichloropropane (1,2-DCP)	-	-	0.04				
	1,3-Dichloropropene	-	-	0.02				
	Dichlorprop	-	-	0.1				
	Dimethoate	-	-	0.006				
	Endrin	-	-	0.0006				
	Fenoprop	-	-	0.009				
	Isoproturon	-	-	0.009				
	Lindane	-	-	0.002				
	MCPA	-	-	0.002				
	Mecoprop	-	-	0.01				
	Methoxychlor	-	-	0.02				
	Metolachlor	-	-	0.01				
	Molinate	-	-	0.006				
	Pendimethalin	-	-	0.02				
	Simazine	-	-	0.002				
	2,4,5-T	-	-	0.009				
	Terbuthylazine	-	-	0.007				
	Trifluralin	-	-	0.02				

	Parameter	Recommended Guidelines* (mg/L)		WHO Guidelines**** (mg/L)	Frequency of analysis			
		Acceptable**	Cause for Rejection***		Recommended	Present	Short Term	Long Term
Health Significance Aspects	**5. Chemicals used in water treatment or materials in contact with drinking-water**							
	Disinfectants							
	Chlorine (as OCL^-)	-	-	5				
	Monochloramine	-	-	3				
	Disinfection by-products							
	Bromate	-	-	0.01				
	Bromodichloromethane	-	-	0.06				
	Bromoform	-	-	0.1				
	Chloral hydrate (trichloroacetaldehyde)	-	-	0.01				
	Chlorate	-	-	0.7				
	Chlorite	-	-	0.7				
	Chloroform	-	-	0.2				
	Cyanogen chloride	-	-	0.07				
	Dibromoacetonitrile	-	-	0.07				
	Dibromochloromethane	-	-	0.1				
	Dichloroacetate	-	-	0.05				
	Dichloroacetonitrile	-	-	0.02				
	Formaldehyde	-	-	0.9				
	Monochloroacetate	-	-	0.02				
	Trichloroacetate	-	-	0.2				
	Trichlorophenol, 2,4,6-	-	-	0.2				
	Trihalomethanes	-	-	0.001				
	Contaminants from treatment chemicals							
	Acrylamide	-	-	0.0005				
	Epichlorohydrin	-	-	0.0004				
	Contaminants from pipes and fittings							
	Antimony (Sb)	-	-	0.02				
	Benzo[a]pyrene	-	-	0.0007				
	Copper (Cu)	0.05	1.5	2	Monthly		Monthly	Monthly
	Lead (Pb)	0.05	0.05	0.01	Monthly		Monthly	Monthly
	Nickel (Ni)	-	-	0.02				
	Vinyl chloride	-	-	0.0003				
	6. Cyanotoxins							
	Microcystin-LR	-	-	0.001				

	Parameter	Recommended Guidelines* (mg/L)		WHO Guidelines**** (mg/L)	Frequency of analysis			
		Acceptable**	Cause for Rejection***		Recommended	Present	Short Term	Long Term
Acceptability Aspects	**7. Acceptability aspects**							
	Alkalinity	200	600		Monthly	Monthly	Monthly	Monthly
	Aluminium (Al)	0.03	0.2	0.1	Monthly	Monthly	Monthly	Monthly
	Ammonia	-	-	1.5				
	Anionic detergent	0.2	1	-	Monthly			Monthly
	Calcium (Ca)	75	200	-	Monthly	Monthly	Monthly	Monthly
	Chloride (Cl)	200	1000	200-300	Monthly	Monthly	Monthly	Monthly
	Chlorine (as OCL^-)	-	-	0.6 - 1.0				
	Chlorophenols	-	-	0.0001-0.002				
	Color	5 Pt/Co Scale	25 Pt/Co	15 TCU	Monthly	Monthly	Monthly	Monthly
	Copper (Cu)	0.05	1.5	5	Monthly		Monthly	Monthly
	Dichlorobenzenes	-	-	0.002-0.03				
	Ethylbenzene	-	-	0.002-0.13				
	Gross Alpha activity (Bq/L)	0.1	0.1	-				
	Gross Beta activity (Bq/L)	1	1	-				
	Hardness	200	600	100-300	Monthly	Monthly	Monthly	Monthly
	Hydrogen sulfide (H_2S)	200	400	0.05-0.1				
	Iron (Fe)	0.1	1	0.3	Monthly	Monthly	Monthly	Monthly
	Magnesium (Mg)	30	150	-				
	Manganese (Mn)	0.05	0.5	0.1	Monthly	Monthly	Monthly	Monthly
	Mineral Oil	0.01	0.03	-	Monthly			Monthly
	Monochloramine	-	-	0.3				
	Monochlorobenzene	-	-	0.01-0.02				
	Odor	Objectable	Objectable	acceptable	Monthly	Monthly	Monthly	Monthly
	Petroleum oils	-	-	-				
	pH	7.0 to 8.5	<6.5 or >9.2	6.5 - 8.5	Monthly	Monthly	Monthly	Monthly
	Phenol	0.001	0.002	-				
	Polynuclear aromatic hydrocarbon (PAH)	0.0002	0.0002	-				
	Sodium (Na)	-	-	200				
	Styrene	-	-	0.004-2.6				
	Sulfate (SO4)	200	400	250	Monthly	Monthly	Monthly	Monthly
	Synthetic detergents	-	-	-				
	Taste	Objectable	Objectable	acceptable	Monthly	Monthly	Monthly	Monthly
	Toluene	-	-	0.04-0.17				
	Total dissolved solid (TDS)	500	2000	600-1000	Monthly	Monthly	Monthly	Monthly
	Trichlorobenzenes	-	-	0.005-0.05				
	Turbidity	1NTU	10NTU	5 NTU	Monthly	Monthly	Monthly	Monthly
	Xylenes	-	-	0.3				
	Zinc (Zn)	5	15	3-5	Monthly			Monthly

The water treatment process monitoring parameters are shown in Table72.1.2. These parameters will be measured in on-site laboratories at the water treatment plants except for Trihalomethane formation potentials which will be measured in the central laboratory.

Table M72.1.2 Parameters and Frequency of Analysis for Monitoring Water Treatment Plant Processes

Monitoring Place (Lab.)	Parameters	Frequency of Analysis			
		Recommended	Present	Short Term	Long Term
Water Treatment Plant (Each WTP Lab.)	Turbidity	Daily	Daily	Daily	Daily
	Colour	Daily		Daily	Daily
	pH	Daily	Daily	Daily	Daily
	Odour	Daily		Daily	Daily
	Alkalinity	Daily	Daily	Daily	Daily
	Residual chlorine	Daily	Daily	Daily	Daily
	Iron	Daily	Daily	Daily	Daily
	Manganese	Daily	Daily	Daily	Daily
	Ammonia-Nitrogen	Daily		Daily	Daily
	Trihalomethane formation potential	Monthly or Quarterly			Monthly or Quarterly
	Hardness		Daily	Daily	Daily
	DO		Daily	Daily	Daily

(2) Transmission and Distribution System

Water quality in the transmission and distribution system must be sufficient to ensure public safety because once the water is released from this system people will be accessing the water. The parameters used to check the water quality in the transmission and distribution system were selected to allow monitoring of issues related to public health and customer perceptions. The parameters used to monitor the transmission and distribution system are shown in Table72.1.3. These parameters will be measured daily in the central laboratory. In the longer term, Trihalomethanes will be measured to ensure further drinking water quality improvements in India.

Table M72.1.3 Parameters and Frequency of Analysis for Monitoring Water Quality in the Transmission and Distribution System

Monitoring Place (Lab.)	Parameters	Frequency of Analysis			
		Recommended	Present	Short Term	Long Term
Transmission & Distribution (Central Lab.)	Residual chlorine	Daily	Daily	Daily	Daily
	pH	Daily	Daily	Daily	Daily
	Conductivity	Daily		Daily	Daily
	Odour	Daily	Daily	Daily	Daily
	Taste	Daily	Daily	Daily	Daily
	Colour	Daily	Daily	Daily	Daily
	Turbidity	Daily	Daily	Daily	Daily
	Lead	Monthly			Monthly
	Iron	Monthly		Monthly	Monthly
	Manganese	Monthly		Monthly	Monthly
	Zinc	Monthly			Monthly
	E.coli	Daily	Daily	Daily	Daily
	Standard plate count bacteria	Daily	Daily	Daily	Daily
	Nitrate as N and Nitrite as N	Monthly			Monthly
	Chloride ion (Cl-)	Monthly			Monthly
	COD Oxygen consumed by $KMnO_4$	Monthly			Monthly
	Trihalomethanes	Monthly or Quarterly			Monthly or Quarterly
	Chloroform	Monthly or Quarterly			Monthly or Quarterly
	Bromodichloromethane	Monthly or Quarterly			Monthly or Quarterly
	Dibromochloromethane	Monthly or Quarterly			Monthly or Quarterly
	Bromoform	Monthly or Quarterly			Monthly or Quarterly
	Dichloroacetic acid	Monthly or Quarterly			Monthly or Quarterly
	Trichloroacetic acid	Monthly or Quarterly			Monthly or Quarterly
	Chloral hydrate	Monthly or Quarterly			Monthly or Quarterly

Table M72.1.4 Monitoring Parameters on Sanitation System

	Parameters	Indian Standards	Operation Purpose	Frequency			Place of Analysis		Sample*
				Present in Panaji	Proposed		STP	Central Labo.	
					Short Term	Long Term			
1	Colour	○	○	Alternate days	Daily		○	-	1,2,3
2	Odour	○	○	-	Daily		○	-	1,2,3
3	Suspended Solids (SS)	○	○	Alternate days		Daily	○	○	1,2,3
4	Particle size of Suspended solid	○	○	-	Once a year		-	○	2
5	pH	○	○	Alternate days	Daily		△	○	1,2,3
6	Temperature	○	○	Alternate days	Daily		○	-	1,2,3
7	Oil and grease	○	○	Monthly			-	○	1,2
8	Residual Chlorine	○	○	Daily			△	○	2
9	Ammonical Nitrogen (NH_4-N)	○	○	Weekly			-	○	1,2
10	Total Kjeldahl Nitrogen	○	○	Weekly			-	○	1,2,4
11	B.O.D.	○	○	Alternate days		Daily	-	○	1,2
12	C.O.D (Cr)	○	○	Alternate days		Daily	-	○	1,2
13	Arsenic as As	○		-	Frequency stipulated in the statute		-	○	2,4
14	Mercury as Hg	○		-	Frequency stipulated in the statute		-	○	2,4
15	Lead as Pb	○		-	Frequency stipulated in the statute		-	○	2,4
16	Cadmium as Cd	○		-	Frequency stipulated in the statute		-	○	2,4
17	Chromium as Cr^{6+}	○		-	Frequency stipulated in the statute		-	○	2,4
18	Total Chromium (Cr)	○		-	Frequency stipulated in the statute		-	○	2,4
19	Copper as Cu	○		-	Frequency stipulated in the statute		-	○	2,4
20	Zinc as Zn	○		-	Frequency stipulated in the statute		-	○	2,4
21	Selenium as Se	○		-	Frequency stipulated in the statute		-	○	2,4
22	Nickel (Ni)	○		-	Frequency stipulated in the statute		-	○	2,4
23	Cyanide as CN	○		-	Frequency stipulated in the statute		-	○	2,4
24	Fluorides as F	○		-	Frequency stipulated in the statute		-	○	2,4
25	Dissolved phosphates (P)	○	○	Weekly			-	○	1,2,4
26	Sulphide (S)	○		-	Frequency stipulated in the statute		-	○	2,4
27	Phenolic compound as C_6H_5OH	○		-	Frequency stipulated in the statute		-	○	2,4
28	Gross Alpha activity	○		-	Frequency stipulated in the statute		-	○	2,4
29	Gross Beta activity	○		-	Frequency stipulated in the statute		-	○	2,4
30	Bio-assay Test	○		-	Frequency stipulated in the statute		-	○	2,4
31	Managanese as Mn	○		-	Frequency stipulated in the statute		-	○	2,4
32	Iron as Fe	○		-	Frequency stipulated in the statute		-	○	2,4
33	Nitrate as N	○	○	Weekly			-	○	1,2
34	E.Coli		○	Weekly			-	○	1,2
35	Total Coliforms		○	Weekly			-	○	1,2
36	Total Soloids		○	Alternate days		Weekly	-	○	1,2
37	Dissolved Substance		○	Alternate days		Weekly	-	○	1,2
38	Coliform Bacteria		○	Weekly			-	○	1,2
39	Dissolved Oxygen (DO)		○	-	Daily		△	-	3
40	Volatile Solids(VS)		○	-	Daily		-	○	1,2,4
41	Sludge Volume(SV)		○	-	Daily		○	-	3

Note: ○ Examined by stipulated in the statute
△ Simple Test
* Sample 1: Raw sewage
2: Discharging point
3: Reactor tank
4: Slugde

Appendix M73:

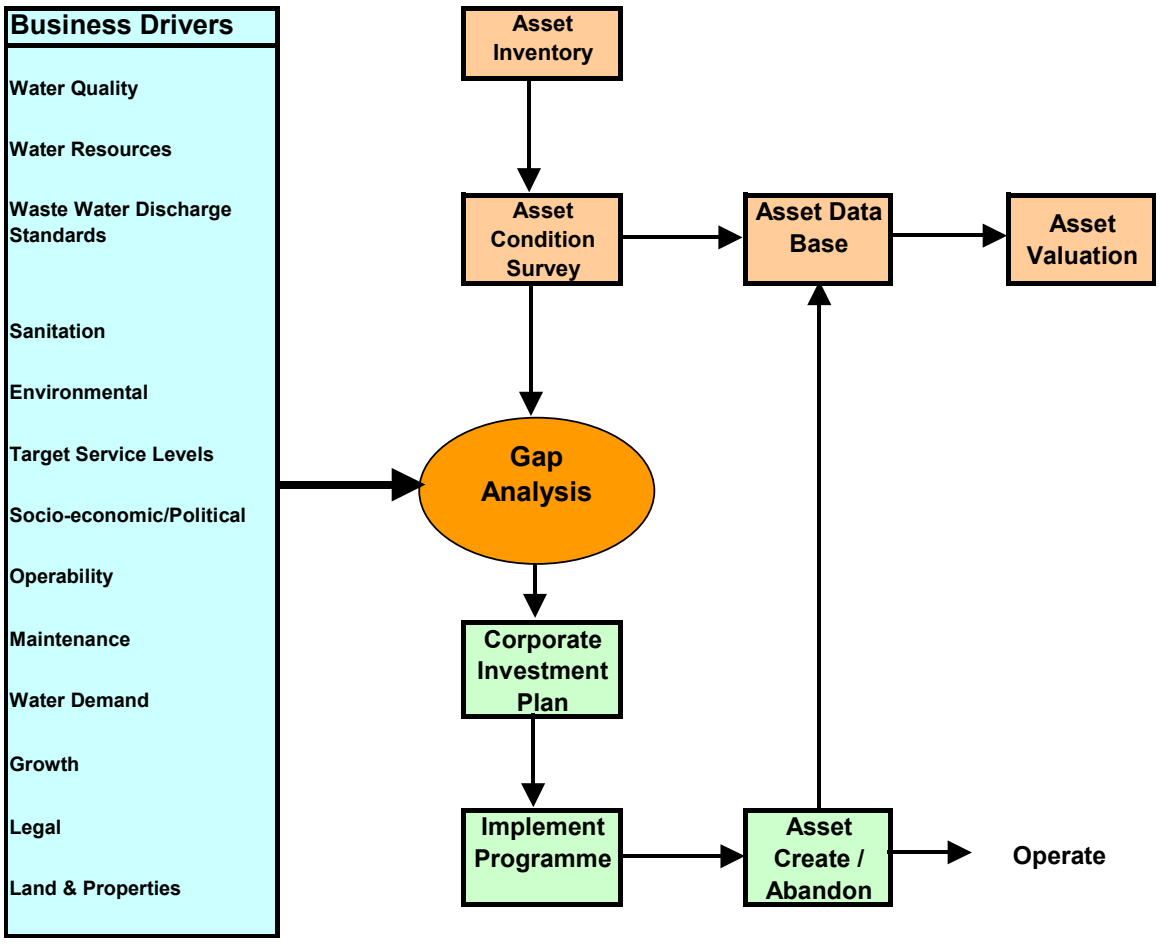
Asset Management Process

Contents for Appendix M73

Appendix M73.1 Asset Management Process

ASSET MANAGEMENT

PROCESS OVERVIEW



(1) Asset Inventory

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

By way of example, typical data capture forms associated with a 'generic' rapid gravity filter is shown below for reference:

Field Asset Data Capture Form **Surface Water Treatment**

Process Driver - Water Treatment **7**

1/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	

Process Attribute				
Attribute	**Value**	**Units**		**Confidence**
Number of filters		#		
Total Design Filtration Capacity		cu.m	cu.ft.	
Designed Filtration Rate		Mg/d	Ml/d	

Process Attribute - Performance Indicator			
Attribute	**Value**	**Units**	**Confidence**
Start Date		Year	
End Date		Year	
Frequency of Backwash		# / day # / hr	
Maximum Filter Run		#	
Minimum Filter Run		#	
Trigger Value For Filtrate Turbidity			
Number of Exceedance of Trigger Value		#	

Process Comments

Sign:…… Team Leader:

Date:……

Field Asset Data Capture Form **Surface Water Treatment**

Process Driver - Water Treatment **7**

2/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	

Asset Component Condition				
Asset	**Value**	**Units**		**Confidence**
Filter Structure				
Installation Date		year		
Construction Material		Text		
Access Walkway		yes	no	
Media Depth		metres	feet	
Building				
Date Constructed		year		
Height		metres	feet	
Length		metres	feet	
Width		metres	feet	
Construction Material		Text		
Number of Windows		#		
Ventilation		yes	no	
Galleries		yes	no	

Process Comments

Sign:…… Team Leader:

Date:……

Field Asset Data Capture Form **Surface Water Treatment**

Process Driver - Water Treatment **7**

3/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	

Asset Component Condition				
Asset	**Value**	**Units**		**Confidence**
Valves				
Installation Date		year		
Valve Type		Text		
Valve Diameter		mm	inch	
Actuator		yes	no	
Air Compressor		yes	no	
Electrical Actuator		yes	no	
Flow Meter				
Bulk meter		yes	no	
Individual Filter Meters		yes	no	
Pressure Gauge				
Pressure Monitors		yes	no	
Filter Level Monitor		yes	no	
Air Compressor (Backwash Air)				
Installation Date		year		
Manufacturer		Text		
Filter Type		Text		
Filter Size		mm	inch	
Compressor Air Reservoir				
Pressure Rating		Psi		
Air Compressor (Valve Actuation)				
Installation Date		year		
Manufacturer		Text		
Filter Type		Text		
Filter Size		mm	inch	
Compressor Air Reservoir				
Pressure Rating		Psi		

Process Comments

Sign:…… Team Leader:

Date:……

Field Asset Data Capture Form

Surface Water Treatment

Process Driver - Water Treatment

7

4/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	

Asset Component - Condition				
Asset	**Value**	**Units**		**Condition**
Pipe Work				
Construction Material		Text		
Diameter		mm	inch	
Design Capacity		Ml	Mg	
Actual Capacity		Ml	Mg	
Number of Valves		#		
Filter Floor				
Installation Date		Year		
Type of flooring		Text		
Filter Nozzle Type		Text		
Nozzle Material		Text		
Backwash Holding Tank				
Capacity		cu.m	cu.ft	
Construction Material		Text		
Number of Tanks		#		
Filter Media				
Date of Replacement		Year		
Media Type		Text		
Media Source		Text		
Media Grading				

Process Comments

Sign:…… Team Leader:

Date:……

Field Asset Data Capture Form

Surface Water Treatment

Process Driver - Raw Water Pumping Station

7

5/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	
Takes From:	
Source Supplied	

Asset Component Attributes				
Attribute	**Value**	**Units**		**Confidence**
Pump No.1				
Year Installed		Year		
Model Number		#		
Type Number		#		
Manufacturer		Text		
Flow		l/sec.	g/min	
Head Design		metre	feet	
Speed		RPM		
Size		mm	inch	
Sealing Gland Type		Text		
Coupling Type		Text		
Pump Depth		metre	feet	
Drive Shaft (hollow / Solid)		Text		
Motor No.1				
Year Installed		Year		
Serial Number		#		
Volts		V		
Current		Amps		
Frequency		Hz		
Power		HP		
Motor Shaft (Type)		Text		

Process Comments

Sign:…… Team Leader

Date:……

Field Asset Data Capture Form **Surface Water Treatment**

Process Driver - Raw Water Pumping Station **7**

6/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	
Takes From:	
Source Supplied	

Component Attributes					
Attribute	**Value**		**Units**		**Confidence**
Backwash Sequencer					
Instrumentation			Yes	no	
Hardwired			Yes	no	
Software			Yes	no	
Backwash Pipe Work					
Pipe material			Text		
Dimension			mm	inch	
Support Structure (type)			Text		
Control Panel	**Backwash Seq.**	**Air Compressor**			
Year Installed			year		
Manufacturer			Text		
Power Requirement (Electrical)			HP	kW	
Enclosure Material			Text		
Height			metre	feet	
Width			metre	feet	
Operational			yes	no	

Process Comments

Sign:…… Team Leader

Date:……

Field Asset Data Capture Form

Surface Water Treatment

Process Driver - Raw Water Pumping Station

7

7/7

Location Purpose:	Clean Water Supply System
Clean Water Supply System Name:	
Functional Element:	Water Treatment Plant
Process Unit:	Rapid Gravity Filters
Name:	
Takes From:	
Source Supplied	

Component Attribute				
Attribute	**Value**	**Units**		**Confidence**
Distribution Board / Panel				
Year Installed		Year		
Manufacturer		Text		
Main Breaker Amperage				
Number of Circuit Breakers		#		
Lock / Safety Device		yes	no	
Enclosure Material		Text		
Height		metre	feet	
Width		metre	feet	
Power Supply				
Voltage		V		
Phase		#		
Monitoring Systems				
Electrical		yes	no	
Pressure		yes	no	
Motor Saver		yes	no	
Phase		yes	no	
Overloading		yes	no	
Other		Text		

Summary Condition Grade				
Asset Component				
Type	Condition	Year Installed	Conditions	Reason for Deficiency
CIV / BUILD.				
MECH.				
ELE.				
ICA				

Note: ***For any further comments please use back of form***

Sing:…… Team Leader:

Date:……

(2) Asset Condition Surveys

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

(3) Asset valuation

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

(4) Asset Database

The asset database will need to be structured to ensure that each asset along with its corresponding components is assigned unique identification numbers. These should be compatible with other current or future systems such as GIS, CMMS etc. The database should be accessible and simple to use and be capable of being uploaded or updated with asset information from various departments and users as assets are maintained or created. The data hierarchy should follow a standard 'parent-child' approach. This approach ensures that any item of plant at any level, within the hierarchy is associated with its parents. For example, a pump is associated with a particular pump set i.e. surplus sludge pump set. The pump set is in turn is the child of the surplus sludge pumping station. The sludge pumping station is in turn is the child of the waste water treatment works and so on.

73.2 Scope of work for Asset registering

PWD will need to decide if the registering of assets should be done in-house or contracted out. The activities required would need to include the following:

Activity
1. Develop a logic structure for data collection (asset hierarchy structure)
2. Develop an 'ACCESS' database or use a proprietary software database
3. Collect asset data on standardised collection forms in 'EXCEL' or equivalent

4. Migrate asset inventory to Access database or proprietary software database to produce Asset Inventory
5. Assess asset condition for above and below ground assets and assign grades
6. Assess asset valuation for above and below ground assets
7. Assess asset criticality, performance and serviceability and assign performance and confidence grades
8. Complete the asset database and generate reports to support investment/replacement decisions

Should PWD contract out the work for an Asset Management System (AMS), the 'Functional Specification' should include the following:

(1) The Asset Management System

The AMS should be based on an Asset Inventory Database which will record the existence of all PWD above and below ground assets. Each asset record will have associated physical attribute data. Condition and performance data should be recorded against each asset.

(2) Principal Functions

The Asset Inventory Database should provide the following functions in order to facilitate the data collection phase of the AMS.

- Production of blank paper questionnaires for subsequent completion during the site inspections
- Multi-user entry and validation of the collected data
- A single repository for all above ground asset attribute data
- Maintenance of a unique ID for each asset

(3) Feature List

An entity is a fixed physical item owned or under the responsibility of PWD. All entities should be included in the Asset Inventory Database. The entities should be categorised and the term 'feature' should be used to describe a category of entities. The features should be divided into:

- Water supply features, which relate to the collection, treatment, and distribution of clean water
- Wastewater features, which relate to the collection, treatment and disposal of waste water
- Supporting features, which relate to administrative offices and other facilities not wholly dedicated to one of the above two functions

The features should be related in a hierarchical structure as follows:

Location	The site of the assets
Functional elements	Groups of assets performing a function such as water treatment, water pumping, storage, etc. on a single location.
Asset units	Units which together form the functional element, e.g. the pump house and the pumps belonging to a pumping facility.
Component	The component of each asset unit, usually civil, mechanical and electrical components.

(4) Attributes

Features should be defined by a list of associated attributes. The format of each attribute listing should include the following:

Name: The title for the attribute, e.g. Power.

Description: An enlarged description of the Name, e.g. Rated Power of a pump.

Data Type: The type of data, e.g. integer, decimal, date, text, etc.

Unit: The units of a numerical value, where appropriate.

Value range: The valid range for a numerical value.

(5) User requirements

The user requirements for the Asset Inventory Database should include the following:

- The system must be multi-user (multiple simultaneous update access)
- User name/password access to the system
- Ability to create new entities
- Ability to add new attributes to any entity
- Ability to define validation rules for any entity attribute
- Ability to enter data for all attributes of any instance of an entity
- Ability to record performance data against any instance of any entity
- Ability to browse (read only) attributes for an instance of any entity
- Ability to produce a summary report of instances of entities associated with a given site
- Ability to produce a paper copy of all attributes for a given entity
- The system must utilise a recognised ODBC data source
- The forms for data entry must not be hard coded to attribute names
- The developer of the software should provide training to all PWD users

APPENDIX M9

This appendix is reference to and supporting data of

Volume 2 Main Report – Master Plan

Chapter 9 Preliminary Cost Estimates and Implementation Schedule

M91	Calculation basis of Water Supply Cost for Master Plan
M92	Breakdown of Water Supply Cost
M93	Breakdown of Sanitation Cost

Appendix M91

Preliminary Cost Estimates and Implementation Schedule

Contents for Appendix M91

M91.1 Calculation basis of Water Supply Cost for Master Plan

Description	Detail	Quantity	Unit	Unit Cost (Rs.)	Amount (Rs. In Million)
1 Salaulim Water Supply Scheme					
1.1 Rehabilitation/Improvement Works					
1.1.1 Salaulim W.T.P.					
1.1.1.1 Raw Water Intake					
(1)M & E	Phase1 410*6= 2,460 kW	2,460	kW	30,000	73.800
	Phase2 850*2= 1,700 kW	1,700	kW	30,000	51.000
(2)Raw Water Transmission Line (Raising Main)	Zero Velocity Valve	1	L.S.	500,000	0.500
	Flow Meter	1	L.S.	500,000	0.500
	By-pass Pipe with Valve	1	L.S.	500,000	0.500
1.1.1.2 Water Treatment					
(1) Water Treatment Facility		160	MLD	1,800,000	288.000
1.1.2 Transmission main					
(1)Rehabilitation I	MS 1,200	14,199	m	37,880	537.860
(2) Rehabilitation II	DIP 900	3,024	m	17,820	53.890
	600	1,206	m	9,320	11.240
(3)Rehabilitation III	DIP 350	8,200	m	4,310	35.340
	300	16,460	m	3,470	57.120
	250	24,000	m	2,800	67.200
	200	9,590	m	2,170	20.810
	150	13,560	m	1,710	23.190
1.1.3 Resorvoir					
(1) Rehabilitation	800*5+600*2+400+300*6+200+150*2+100= 8,000 m3	8,000	m3	5,100	40.800
1.1.4 Pumping Station					
(1) Rehabilitation I	Margao MBR 214.2*3= 643 kW	643	kW	30,000	19.280
	Verna MBR 455.3*4= 1,821 kW	1,821	kW	30,000	54.640
	Verna MBR 455.3*2= 911 kW	911	kW	30,000	27.320
(1) Rehabilitation II	31.3*3+5.9*3+16.5*3+2.3*2+10.4*3+3.2*3+2.0*3+3.7*3+15.7*3+2.6*3+16.9*3+2.8*3+3.4*3+14.0*3 389.8 kW	390	kW	30,000	11.700
1.1.5 Distribution Pipe					
(1) Rehabilitation	PVC 100-250	541,496	m	800	433.200
1.1.6 House Connection					
(1) Rehabilitation		228,858	Nos.	2,400	549.260
1.2 Proposed					
1.2.1 Raw Water Intake Facility					
(1) Raw Water Intake & Pumping House		1	L.S.	10,000,000	10.000
(2) M & E (1st Stage)	280*4= 1,120 kW	1,120	kW	48,000	53.760
(3) M & E (2nd Stage)	280*4= 1,120 kW	1,120	kW	48,000	53.760
1.2.2 Raw Water Transmission Main					
(1) 1st Stage	MS 1,600	1,000	m	52,750	52.750
(2) 2nd Stage		1	L.S.	0	5.280
1.2.3 Treatment Facility					
(1) 1st Stage		100	MLD	5,000,000	500.000
(2) 2nd Stage		100	MLD	5,000,000	500.000
1.2.4 Transmission Pump Facility					
(1)Resorvoir (1sr Stage)	5,000 m3	5,000	m3	5,100	25.500
(2)Resorvoir (2nd Stage)	5,000 m3	5,000	m3	5,100	25.500
(3) M & E (1st Stage)	500*4= 2,000 kW	2,000	kW	48,000	96.000
(4) M & E (2nd Stage)	500*4= 2,000 kW	2,000	kW	48,000	96.000
1.2.5 Transmission Main					
(1) Proposed I	MS 1,400	7,500	m	44,700	335.250
	Pipe Bridge D1400 L= 20+20= 40 m	40	m	150,000	6.000
	MS 1,400	19,200	m	44,700	858.240
	Pipe Bridge D1400 L= 100+20+20*2+20= 180 m	180	m	150,000	27.000
	Railway Crossing D140L= 20*3= 60 m	60	m	447,000	26.820
	DIP 900	850	m	17,820	15.150
(2) Proposed II	DIP 450	2,700	m	6,100	16.470
	DIP 400	3,900	m	5,150	20.090
	DIP 300	2,900	m	3,470	10.060
	DIP 250	8,800	m	2,800	24.640
	DIP 200	14,300	m	2,170	31.030
	DIP 150	14,300	m	1,710	24.450
(3) Proposed III	DIP 500	13,500	m	7,070	95.450
(4) Proposed IV	DIP 900	5,400	m	17,820	96.230
	DIP 400	800	m	5,150	4.120
	DIP 300	4,300	m	3,470	14.920
	DIP 250	5,000	m	2,800	14.000
	DIP 150	1,300	m	1,710	2.220
1.2.6 Resorvoir					
(1) Proposed I	20000+800*2+300*2+200+100= 22,500 m3	22,500	m3	5,100	114.750
(2) Proposed II	20000+5000= 25,000 m3	25,000	m3	5,100	127.500
1.2.7 Pumping Station					
(1) Proposed I Pumping Pit & Pump House	100+300+300+100+100= 900 m3	900	m3	5,100	4.590
(2)Proposed I M & E	2.6*3+4.3*3+28.6*3+9.3*3+1.5*3= 139 kW	139	kW	30,000	4.170
(3) Proposed II Pumping Pit & Pump House	800= 800 m3	800	m3	5,100	4.080
(4)Proposed II M & E	121.*3= 363 kW	363	kW	48,000	17.420
1.2.8 Distribution Pipe					
(1) Proposed	PVC 100-250	960,634	m	800	768.510
1.2.9 House Connection					
(1) Proposed		67,652	Nos.	2,400	162.370

2 Opa Water Supply Scheme						
2.1 Rehabilitation/Improvement Works						
2.1.1 Opa W.T.P. (8MLD)						
2.1.1.1 Raw Water Intake						
(1) M & E	Phase1 37*3=	111 kW	111	kW	30,000	3.330
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
2.1.1.2 Water Treatment						
(1) Water Treatment Facility			8	MLD	1,800,000	14.400
2.1.2 Opa W.T.P. (12MLD)						
2.1.2.1 Raw Water Intake						
(1) M & E	Phase1 75*1+75*2=	225 kW	225	kW	30,000	6.750
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
2.1.2.2 Water Treatment						
(1) Water Treatment Facility			12	MLD	1,800,000	21.600
2.1.3 Curti W.T.P. (72MLD)						
2.1.3.1 Raw Water Intake						
(1) M & E	Phase1 475*1+475=	950 kW	950	kW	30,000	28.500
	Phase2 550*2+550*2=	2,200 kW	2,200	kW	30,000	66.000
(2)Raw Water Transmission Line (Raising Main)	Zero Velocity Valve		1	L.S.	500,000	0.500
	Flow Meter		1	L.S.	500,000	0.500
2.1.3.2 Water Treatment						
(1) Water Treatment Facility			72	MLD	1,800,000	129.600
2.1.4 Curti W.T.P. (40MLD)						
2.1.4.1 Raw Water Intake						
(1) M & E	875*3=	2,625 kW	2,625	kW	30,000	78.750
(3)Raw Water Transmission Line (Raising Main)	Zero Velocity Valve		1	L.S.	500,000	0.500
	Flow Meter		1	L.S.	500,000	0.500
2.1.4.2 Water Treatment						
(1) Water Treatment Facility			40	MLD	1,800,000	72.000
2.1.5 Transmission main						
(1)Rehabilitation I	DIP 350		1,800	m	4,310	7.760
	DIP 250		11,000	m	2,800	30.800
	DIP 150		4,140	m	1,710	7.080
	DIP 100		760	m	1,220	0.930
(2)Rehabilitation II	DIP 750		10,578	m	13,310	140.790
	DIP 600		3,150	m	9,230	29.070
(3)Rehabilitation III	DIP 500		3,294	m	7,070	23.290
	DIP 400		8,664	m	5,150	44.620
	DIP 350		240	m	4,310	1.030
	DIP 250		5,070	m	2,800	14.200
	DIP 200		990	m	2,170	2.150
2.1.6 Resorvoir						
(1) Rehabilitation	800*6+650+300*7+200+150*2+100*2=	8,250 m3	8,250	m3	5,100	42.080
2.1.7 Pumping Station						
(1) Rehabilitation	13.1*3+1.5*2+2.1*3+5.1*3+5.4*3+4.9*3+1.5*2=	98 kW	98	kW	30,000	2.930
2.1.8 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		267,521	m	800	214.020
2.1.9 House Connection						
(1) Rehabilitation			129,086	Nos.	2,400	309.810
2.2 Proposed						
2.2.1 Ganjen to Curti						
2.2.1.1 Raw Water Intake Facility (Ganjem to Curti)						
(1)Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2)M&E	315*4=	1,260 kW	1,260	kW	48,000	60.480
(3)Raw Water Transmission Main	DIP 700		12,300	m	11,870	146.000
2.2.2 Ganjem W.T.P. (25MLD)						
2.2.2.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2) M & E	440*3=	1,320 kW	1,320	kW	48,000	63.360
2.2.2.2 Raw Water Transmission Main						
(1) Proposed	DIP 500		3,900	m	7,070	27.570
2.2.2.3 Treatment Facility						
(1) Proposed			25	MLD	5,000,000	125.000
2.2.3 Maisal W.T.P. (10MLD)						
2.2.3.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2) M & E	144*3=	432 kW	432	kW	48,000	20.740
2.2.3.2 Raw Water Transmission Main						
(1) Proposed	DIP 400		2,700	m	5,150	13.910
2.2.3.3 Treatment Facility						

3 Chandel Water Supply Scheme						
3.1 Rehabilitation/Improvement Works						
3.1.1 Chandel W.T.P.						
3.1.1.1 Raw Water Intake						
(1) M & E	45*4=	180 kW	180	kW	30,000	5.400
(3)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
3.1.1.2 Water Treatment						
(1) Water Treatment Facility			15	MLD	2,100,000	31.500
3.1.2 Resorvoir						
(1) Rehabilitation	300*1+100*3+50*3=	750 m3	750	m3	5,100	3.830
3.1.3 Pumping Station						
(1) Rehabilitation	13.7*3=	41 kW	41	kW	30,000	1.230
3.1.4 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		124,879	m	800	99.900
3.1.5 House Connection						
(1) Rehabilitation			25,926	Nos.	2,400	62.220
3.2 Proposed						
3.2.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2) M & E (1st Stage)	180kW/150MLD*150MLD=	180 kW	180	kW	48,000	8.640
3.2.2 Raw Water Transmission Main						
(1) Proposed			1	L.S.	5,000,000	5.000
3.2.3 Treatment Facility						
(1) Proposed			15	MLD	6,000,000	90.000
3.2.4 Transmission Main						
(1) Proposed	DIP 400		2,900	m	5,150	14.940
	DIP 250		4,150	m	2,800	11.620
	DIP 200		11,420	m	2,170	24.780
	DIP 150		8,260	m	1,710	14.120
	DIP 100		8,850	m	1,220	10.800
3.2.5 Resorvoir						
(1) Proposed	1600+1000+800+400*3+300*5+150*2+100=	6,500 m3	6,500	m3	5,100	33.150
3.2.6 Pumping Station						
(1) Pumping Pit & Pump House		100 m3	100	m3	5,100	0.510
(2) M & E	13.7*3=	41 kW	41	kW	48,000	1.970
3.2.7 Distribution Pipe						
(1) Proposed	PVC 100-250		66,740	m	800	53.390
3.2.8 House Connection						
(1) Proposed			4,680	Nos.	2,400	11.230

4 Assonora Water Supply Scheme						
4.1 Rehabilitation/Improvement Works						
4.1.1 Assonora W.T.P. (12MLD)						
4.1.1.1 Raw Water Intake						
(1) M & E	55*3=	165 kW	165	kW	15,000	2.480
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		3	L.S.	250,000	0.750
4.1.1.2 Water Treatment						
(1) Water Treatment Facility			12	MLD	900,000	10.800
4.1.2 Assinora W.T.P. (30MLD)						
4.1.2.1 Raw Water Intake						
(1) M & E	700*2=	1,400 kW	1,400	kW	30,000	42.000
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
4.1.2.2 Water Treatment						
(1) Water Treatment Facility			30	MLD	1,800,000	54.000
4.1.3 Transmission main						
(1) Rehabilitation	DIP 350		1,320	m	4,310	5.690
	DIP 250		660	m	2,800	1.850
	DIP 200		2,490	m	2,170	5.400
	DIP 150		1,485	m	1,710	2.540
4.1.4 Resorvoir						
(1) Rehabilitation	800*4+300*5+150*8=	5,900 m3	5,900	m3	5,100	30.090
4.1.5 Pumping Station						
(1) Rehabilitation	5.9*3+4.7*3+2.3*3+5.0*3+10.3*3+33.4*3=	185 kW	185	kW	30,000	5.540
4.1.6 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		275,173	m	800	220.140
4.1.7 House Connection						
(1) Rehabilitation			116,526	Nos.	2,400	279.660
4.2 Proposed						
4.2.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2) M & E	1400kW/30MLD*50MLD=	2,333 kW	2,333	kW	48,000	112.000
4.2.2 Raw Water Transmission Main						
(1) Proposed			1	L.S.	5,000,000	5.000
4.2.3 Treatment Facility						
(1) Proposed			50	MLD	5,000,000	250.000
4.2.4 Transmission Main						
(1) Proposed	DIP 500		5,000	m	7,070	35.350
	DIP 400		4,000	m	5,150	20.600
	DIP 250		7,200	m	2,800	20.160
	DIP 200		6,050	m	2,170	13.130
	DIP 150		10,500	m	1,710	17.960
	DIP 100		900	m	1,220	1.100
4.2.5 Resorvoir						
(1) Proposed	10000+800*5+650*2+300*4+150*1=	16,650 m3	16,650	m3	5,100	84.920
4.2.6 Distribution Pipe						
(1) Proposed	PVC 100-250		377,055	m	800	301.640
4.2.7 House Connection						
(1) Proposed			26,442	Nos.	2,400	63.460

5 Sanquelim Water Supply Scheme						
5.1 Rehabilitation/Improvement Works						
5.1.1 Sanquerim W.T.P. (5 & 7MLD)						
5.1.1.1 Raw Water Intake						
(1) M & E	75+100*2+110=	385 kW	385	kW	30,000	11.550
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		2	L.S.	500,000	1.000
	By-pass Pipe with Valve		1	L.S.	500,000	0.500
5.1.1.2 Water Treatment						
(1) Water Treatment Facility			12	MLD	1,800,000	21.600
5.1.2 Podocem W.T.P. (40MLD)						
5.1.2.1 Raw Water Intake						
(1) M & E	456*3=	1,368 kW	1,368	kW	30,000	41.040
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
5.1.2.2 Water Treatment						
(1) Water Treatment Facility			40	MLD	1,800,000	72.000
5.1.3 Transmission main						
(1) Rehabilitation	DIP 250		2,500	m	2,800	7.000
	DIP 200		1,700	m	2,170	3.690
5.1.4 Resorvoir						
(1) Rehabilitation	800*2+300*2+150*1=	2,350 m3	2,350	m3	5,100	11.990
5.1.5 Pumping Station						
(1) Lamgao	16.2*3=	49 kW	49	kW	30,000	1.460
(2) Sanquelim	13.3*3=	40 kW	40	kW	30,000	1.200
(3) Vlgem	3.6*3=	11 kW	11	kW	30,000	0.320
5.1.6 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		60,762	m	800	48.610
5.1.7 House Connection						
(1) Rehabilitation			37,330	Nos.	2,400	89.590
5.2 Proposed						
5.2.1 Transmission Main						
(1) Proposed	DIP 250		4,400	m	3,000	13.200
	DIP 100		3,000	m	1,220	3.660
5.2.2 Pumping Station						
(1) Pumping Pit & Pump House	100+300=	400 m3	400	m3	5,100	2.040
(2) M & E	1.9*3+24.7*3=	80 kW	80	kW	48,000	3.830
5.2.4 Distribution Pipe						
(1) Proposed	PVC 100-250		99,189	m	800	79.350
5.2.5 House Connection						
(1) Proposed			6,956	Nos.	2,400	16.690

6 Dabose Water Supply Scheme						
6.1 Rehabilitation/Improvement Works						
6.1.1 Dabose W.T.P. (5MLD)						
6.1.1.1 Raw Water Intake						
(1) M & E	Phase1 45*2=	90 kW	90	kW	30,000	2.700
	Phase2 20*1=	20 kW	20	kW	30,000	0.600
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		1	L.S.	500,000	0.500
6.1.1.2 Water Treatment						
(1) Water Treatment Facility			5	MLD	2,100,000	10.500
6.1.3 Transmission main						
(1) Rehabilitation	DIP 200		10,600	m	2,170	23.000
	DIP 150		3,400	m	1,710	5.810
6.1.4 Resorvoir						
(1) Rehabilitation	800*2+300*2+150*1=	2,350 m3	2,350	m3	5,100	11.990
6.1.5 Pumping Station						
(1) Rehabilitation	3.4*3+3.4*2+2.4*2+1.7*2+11.0*3+2.7*2+5.8*3+3.7*3+22.9*3+4.9*3+3.8*2+	196 kW	196	kW	30,000	5.870
6.1.6 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		69,730	m	800	55.780
6.1.7 House Connection						
(1) Rehabilitation			16,461	Nos.	2,400	39.510
6.2 Proposed						
6.2.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	10,000,000	10.000
(2) M & E	(90+20)/5MLD*10MLD=	220 kW	220	kW	48,000	10.560
6.2.2 Raw Water Transmission Main						
(1) Proposed			1	L.S.	2,500,000	2.500
6.2.3 Treatment Facility						
(1) Proposed			10	MLD	6,000,000	60.000
6.2.4 Transmission Main						
(1) Proposed	DIP 250		6,300	m	2,800	17.640
	DIP 200		6,000	m	2,170	13.020
	DIP 150		22,400	m	1,710	38.300
	DIP 100		15,300	m	1,220	18.670
6.2.5 Resorvoir						
(1) Proposed	150*1+100*3=	450 m3	450	m3	5,100	2.300
6.2.6 Pumping Station						
(1) Pumping Pit & Pump House		100 m3	100	m3	5,100	0.510
(2) M & E	1.6*2=	3 kW	3	kW	48,000	0.150
6.2.7 Distribution Pipe						
(1) Proposed	PVC 100-250		88,167	m	800	70.530
6.2.8 House Connection						
(1) Proposed			6,183	Nos.	2,400	14.840

7 Canacona Water Supply Scheme						
7.1 Rehabilitation/Improvement Works						
7.1.1 Canacona W.T.P. (5MLD)						
7.1.1.1 Raw Water Intake						
(1) M & E	Phase1 75*3=	225 kW	225	kW	30,000	6.750
	Phase2 45*3=	135 kW	135	kW	30,000	4.050
(2)Raw Water Transmission Line (Raising Main)	Flow Meter		2	L.S.	500,000	1.000
7.1.1.2 Water Treatment						
(1) Water Treatment Facility			5	MLD	2,100,000	10.500
7.1.3 Transmission main						
(1) Rehabilitation	DIP 100		1,850	m	1,310	2.420
7.1.4 Resorvoir						
(1) Rehabilitation	100*2=	200 m3	200	m3	5,100	1.020
	50*1=	50 m3	50	m4	5,100	0.260
7.1.5 Pumping Station						
(1) Canacona	3.3*3=	10 kW	10	kW	30,000	0.300
(2) Shristhal	1.2*2=	2 kW	2	kW	30,000	0.070
(3) Hottipal	4.7*3=	14 kW	14	kW	30,000	0.420
7.1.6 Distribution Pipe						
(1) Rehabilitation	PVC 100-250		18,272	m	800	14.620
7.1.7 House Connection						
(1) Rehabilitation			12,767	Nos.	2,400	30.640
7.2 Proposed						
7.2.1 Raw Water Intake Facility						
(1) Raw Water Intake & Pumping House			1	L.S.	5,000,000	5.000
(2) M & E	(225+135)/5MLD*10MLD=	720 kW	720	kW	48,000	34.560
7.2.2 Raw Water Transmission Main						
(1) Proposed			1	L.S.	5,000,000	5.000
7.2.3 Treatment Facility						
(1) Proposed			10	MLD	6,000,000	60.000
7.2.4 Transmission Main						
(1) Proposed	DIP 250		2,950	m	2,800	8.260
	DIP 200		2,700	m	2,170	5.860
	DIP 150		25,050	m	1,710	42.840
	DIP 100		4,600	m	1,220	5.610
7.2.5 Resorvoir						
(1) Proposed	400*1+300*1+150*1+100*4=	1,250 m3	1,250	m3	5,100	6.380
7.2.6 Pumping Station						
(1) Hospital Pumping Pit & Pump House		100 m3	100	m3	5,100	0.510
(2) Hospital M & E	6.7*3=	20 kW	20	kW	48,000	0.960
(1) N2 Pumping Pit & Pump House		50 m3	50	m3	5,100	0.260
(2) N2 M & E	3.0*3=	9 kW	9	kW	48,000	0.430
(1) N6 Pumping Pit & Pump House		50 m3	50	m3	5,100	0.260
(2) N6 M & E	2.4*3=	7 kW	7	kW	48,000	0.350
(1) Saleri Pumping Pit & Pump House		100 m3	100	m3	5,100	0.510
(2) Saleri M & E	5.9*3=	18 kW	18	kW	48,000	0.850
7.2.7 Distribution Pipe						
(1) Proposed	PVC 100-250		74,894	m	800	59.920
7.2.8 House Connection						
(1) Proposed			5,252	Nos.	2,400	12.610

M91.2 Breakdown of Water Supply Cost

			Amount (Rs. In Million)																			
			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
1 Salaulim	Rehabilitation/Improvement Works	WTP				72.710	181.400	108.690					0.250	0.250			25.500	25.500				414.300
		Transmission Main				107.580	322.720	107.560	26.910	26.910	26.910	26.910	26.910	26.910	26.910	26.910	26.910	26.600				806.650
		Resorvoir							4.080	4.080	4.080				4.080	4.080	4.080	4.080	4.080	4.080	4.080	40.800
		Pumping Station	0.620	0.620	0.620	11.550	33.410	11.540	0.620	0.620	0.620	9.950	28.590	9.920	0.620	0.620	0.620	0.620	0.620	0.620	0.540	112.940
		Distribution Pipe	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	22.800	433.200
		House Connection	25.370	25.370	25.370	25.370	25.370	25.370	25.370	25.370	25.370	25.370	32.310	32.440	32.570	32.700	32.820	32.960	33.110	33.270	33.380	549.260
		Sub Total	48.790	48.790	48.790	240.010	585.700	275.960	79.780	79.780	79.780	85.030	110.860	92.320	86.980	87.110	112.730	112.560	60.610	60.770	60.800	2,357.150
	Proposed	WTP				147.610	369.010	221.390				136.120	340.270	204.150								1,418.550
		Transmission Main				279.070	837.160	278.970				45.410	136.190	45.340								1,622.140
		Resorvoir				22.950	68.850	22.950				25.500	76.500	25.500								242.250
		Pumping Station				1.760	5.270	1.730				4.310	12.910	4.280								30.260
		Distribution Pipe	32.990	33.630	34.230	34.880	35.410	36.110	36.810	37.550	38.290	39.030	39.810	41.770	44.300	45.170	45.940	46.800	47.690	48.580	49.520	768.510
		House Connection	6.940	7.070	7.200	7.340	7.450	7.600	7.740	7.900	8.060	8.210	8.380	9.470	9.320	9.500	9.670	9.850	10.030	10.220	10.420	162.370
		Sub Total	39.930	40.700	41.430	493.610	1,323.150	568.750	44.550	45.450	46.350	258.580	614.060	330.510	53.620	54.670	55.610	56.650	57.720	58.800	59.940	4,244.080
	Total		88.720	89.490	90.220	733.620	1,908.850	844.710	124.330	125.230	126.130	343.610	724.920	422.830	140.600	141.780	168.340	169.210	118.330	119.570	120.740	6,601.230
2 Opa	Rehabilitation/Improvement Works	WTP	23.550	23.530	35.920	83.650	47.730					33.000	33.000		71.780	71.770						423.930
		Transmission Main	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.920	15.860	15.220	301.720
		Resorvoir	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.220	2.120	42.080
		Pumping Station				0.590	1.760	0.580														2.930
		Distribution Pipe	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.260	11.340	214.020
		House Connection	14.380	14.380	14.380	14.380	14.380	14.380	14.380	14.380	14.380	14.380	18.440	18.470	18.480	18.500	18.390	18.410	18.430	18.450	18.440	309.810
		Sub Total	67.330	67.310	79.700	128.020	93.270	44.360	43.780	43.780	43.780	76.780	80.840	47.870	119.660	119.670	47.790	47.810	47.830	47.790	47.120	1,294.490
	Proposed	WTP	197.800	197.780		64.950	86.600	64.930														612.060
		Transmission Main	65.400	65.340		2.780	8.340	2.770				3.130	9.360	3.090								160.210
		Resorvoir																				
		Pumping Station																				
		Distribution Pipe	19.340	19.440	19.510	19.580	19.070	19.160	19.290	19.370	19.500	19.120	19.270	18.290	16.740	16.950	17.040	17.270	17.500	17.760	18.010	352.210
		House Connection	4.070	4.090	4.100	4.120	4.010	4.030	4.060	4.080	4.100	4.020	4.050	3.160	3.520	3.570	3.590	3.630	3.680	3.740	3.790	73.410
		Sub Total	286.610	286.650	23.610	91.430	118.020	90.890	23.350	23.450	23.600	26.270	32.680	24.540	20.260	20.520	20.630	20.900	21.180	21.500	21.800	1,197.890
	Total		353.940	353.960	103.310	219.450	211.290	135.250	67.130	67.230	67.380	103.050	113.520	72.410	139.920	140.190	68.420	68.710	69.010	69.290	68.920	2,492.380
3 Chandel	Rehabilitation/Improvement Works	WTP			7.880	8.120	0.250						10.580	10.570								37.400
		Transmission Main																				
		Resorvoir										0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.320	3.830
		Pumping Station																			1.230	1.230
		Distribution Pipe	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.260	5.220	99.900
		House Connection	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.550	3.560	3.560	3.560	3.580	3.590	3.590	3.600	3.630	62.220
		Sub Total	8.260	8.260	16.140	16.380	8.510	8.260	8.260	8.260	8.260	8.650	19.780	19.780	9.210	9.210	9.230	9.240	9.240	9.250	10.400	204.580
	Proposed	WTP		9.000	9.000						19.130	57.390	19.120									113.640
		Transmission Main			7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.650	7.410								76.260
		Resorvoir			3.320	3.320	3.320	3.320	3.320	3.320	3.320	3.320	3.320	3.270								33.150
		Pumping Station			1.250	1.230																2.480
		Distribution Pipe	2.600	2.620	2.650	2.660	2.740	2.770	2.780	2.810	2.820	2.790	2.820	2.840	2.860	2.880	2.900	2.930	2.950	2.970	3.000	53.390
		House Connection	0.550	0.550	0.560	0.560	0.580	0.580	0.590	0.590	0.590	0.590	0.590	0.600	0.600	0.610	0.610	0.620	0.620	0.630	0.610	11.230
		Sub Total	3.150	12.170	24.430	15.420	14.290	14.320	14.340	14.370	33.510	71.740	33.500	14.120	3.460	3.490	3.510	3.550	3.570	3.600	3.610	290.150
	Total		11.410	20.430	40.570	31.800	22.800	22.580	22.600	22.630	41.770	80.390	53.280	33.900	12.670	12.700	12.740	12.790	12.810	12.850	14.010	494.730
4 Assonora	Rehabilitation/Improvement Works	WTP	7.020	7.010	19.300	48.250	28.950															110.530
		Transmission Main							1.550	1.550	1.550	1.550	1.550	1.550	1.550	1.550	1.550	1.530				15.480
		Resorvoir							3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.010	3.000				30.090
		Pumping Station									1.110	1.110	1.110	1.110	1.100							5.540
		Distribution Pipe	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.590	11.520	220.140
		House Connection	13.290	13.290	13.290	13.290	13.290	13.290	13.290	13.290	13.290	13.290	16.090	16.140	16.190	16.250	16.310	16.360	16.430	16.490	16.500	279.660
		Sub Total	31.900	31.890	44.180	73.130	53.830	24.880	29.440	29.440	30.550	30.550	33.350	33.400	33.440	32.400	32.460	32.480	28.020	28.080	28.020	661.440
	Proposed	WTP				75.400	226.200	75.400														377.000
		Transmission Main				21.680	64.990	21.630														108.300
		Resorvoir				16.990	50.960	16.970														84.920
		Pumping Station																				
		Distribution Pipe	13.320	13.550	13.830	14.090	14.370	14.630	14.930	15.240	15.530	15.840	16.180	16.510	16.850	17.190	17.180	17.540	17.910	18.270	18.680	301.640
		House Connection	2.800	2.850	2.910	2.960	3.020	3.080	3.140	3.210	3.270	3.330	3.400	3.470	3.550	3.620	3.610	3.690	3.770	3.840	3.940	63.460
		Sub Total	16.120	16.400	16.740	131.120	359.540	131.710	18.070	18.450	18.800	19.170	19.580	19.980	20.400	20.810	20.790	21.230	21.680	22.110	22.620	935.320
	Total		48.020	48.290	60.920	204.250	413.370	156.590	47.510	47.890	49.350	49.720	52.930	53.380	53.840	53.210	53.250	53.710	49.700	50.190	50.640	1,596.760

5 Sanquelim	Rehabilitation/Improvement Works	WTP			19.360	19.360	9.020	9.010						45.720	45.720							148.190
		Transmission Main										1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.060	10.690
		Resorvoir										1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.190	11.990
		Pumping Station													1.200			1.460			0.320	2.980
		Distribution Pipe	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.560	2.530	48.610
		House Connection	4.320	4.320	4.320	4.320	4.320	4.320	4.320	4.320	4.320	4.320	5.120	5.130	5.140	5.150	5.150	5.160	5.170	5.180	5.190	89.590
		Sub Total	6.880	6.880	26.240	26.240	15.900	15.890	6.880	6.880	6.880	9.150	9.950	55.680	56.890	9.980	9.980	11.450	10.000	10.010	10.290	312.050
	Proposed	WTP																				
		Transmission Main							3.380	10.120	3.360											16.860
		Resorvoir																				
		Pumping Station										1.180	3.530	1.160								5.870
		Distribution Pipe	3.820	3.850	3.910	3.940	3.970	4.000	4.050	4.100	4.160	4.140	4.190	4.250	4.290	4.340	4.370	4.410	4.470	4.520	4.570	79.350
		House Connection	0.800	0.810	0.820	0.830	0.840	0.840	0.850	0.860	0.880	0.870	0.880	0.890	0.900	0.910	0.920	0.930	0.940	0.950	0.970	16.690
		Sub Total	4.620	4.660	4.730	4.770	4.810	4.840	8.280	15.080	8.400	6.190	8.600	6.300	5.190	5.250	5.290	5.340	5.410	5.470	5.540	118.770
	Total		11.500	11.540	30.970	31.010	20.710	20.730	15.160	21.960	15.280	15.340	18.550	61.980	62.080	15.230	15.270	16.790	15.410	15.480	15.830	430.820
6 Dabose	Rehabilitation/Improvement Works	WTP			2.740	6.850	4.410	0.300														14.300
		Transmission Main										2.880	2.880	2.880	2.880	2.880	2.880	2.880	2.880	2.880	2.890	28.810
		Resorvoir										1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.190	11.990
		Pumping Station										0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.590	0.560	5.870
		Distribution Pipe	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.940	2.860	55.780
		House Connection	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	1.750	2.380	2.400	2.420	2.430	2.450	2.460	2.480	2.500	2.490	39.510
		Sub Total	4.690	4.690	7.430	11.540	9.100	4.990	4.690	4.690	4.690	9.360	9.990	10.010	10.030	10.040	10.060	10.070	10.090	10.110	9.990	156.260
	Proposed	WTP	41.530	41.530																		83.060
		Transmission Main					17.540	17.540	17.540	17.540	17.470											87.630
		Resorvoir							0.460	1.380	0.460											2.300
		Pumping Station							0.140	0.400	0.120											0.660
		Distribution Pipe	3.030	3.100	3.190	3.260	3.330	3.400	3.490	3.550	3.640	3.710	3.800	3.870	3.940	4.020	4.100	4.170	4.230	4.310	4.390	70.530
		House Connection	0.640	0.650	0.670	0.690	0.700	0.720	0.730	0.750	0.770	0.780	0.800	0.810	0.830	0.850	0.860	0.880	0.890	0.910	0.910	14.840
		Sub Total	45.200	45.280	3.860	3.950	21.570	21.660	22.360	23.620	22.460	4.490	4.600	4.680	4.770	4.870	4.960	5.050	5.120	5.220	5.300	259.020
	Total		49.890	49.970	11.290	15.490	30.670	26.650	27.050	28.310	27.150	13.850	14.590	14.690	14.800	14.910	15.020	15.120	15.210	15.330	15.290	415.280
7 Canacona	Rehabilitation/Improvement Works	WTP			2.300	5.750	3.450	3.380	3.370					2.030	2.020							22.300
		Transmission Main								1.210	1.210											2.420
		Resorvoir								0.260	0.260				0.130	0.130				0.260	0.240	1.280
		Pumping Station						0.210	0.210	0.040	0.030	0.150	0.150									0.790
		Distribution Pipe	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.770	0.760	14.620
		House Connection	1.310	1.310	1.310	1.310	1.310	1.310	1.310	1.310	1.310	1.310	1.940	1.940	1.950	1.950	1.950	1.960	1.960	1.970	1.920	30.640
		Sub Total	2.080	2.080	4.380	7.830	5.530	5.670	5.660	3.590	3.580	2.230	2.860	4.740	4.870	2.850	2.720	2.730	2.730	3.000	2.920	72.050
	Proposed	WTP	104.560																			104.560
		Transmission Main			12.510	12.510	12.510	12.510	12.530													62.570
		Resorvoir			1.280	1.280	1.280	1.280	1.260													6.380
		Pumping Station			0.310	0.890	0.620	1.340	0.970													4.130
		Distribution Pipe	3.000	3.020	3.050	3.060	3.090	3.100	3.120	3.140	3.150	3.100	3.130	3.150	3.180	3.200	3.230	3.260	3.280	3.310	3.350	59.920
		House Connection	0.630	0.640	0.640	0.640	0.650	0.650	0.660	0.660	0.660	0.650	0.660	0.660	0.670	0.670	0.680	0.690	0.690	0.700	0.710	12.610
		Sub Total	108.190	3.660	17.790	18.380	18.150	18.880	18.540	3.800	3.810	3.750	3.790	3.810	3.850	3.870	3.910	3.950	3.970	4.010	4.060	250.170
	Total		110.270	5.740	22.170	26.210	23.680	24.550	24.200	7.390	7.390	5.980	6.650	8.550	8.720	6.720	6.630	6.680	6.700	7.010	6.980	322.220
Ground Total	Rehabilitation/Improvement Works	WTP	30.570	30.540	87.500	244.690	275.210	121.380	3.370			33.000	43.830	58.570	119.520	71.770	25.500	25.500				1,170.950
		Transmission Main	15.920	15.920	15.920	123.500	338.640	123.480	44.380	45.590	45.590	48.330	48.330	48.330	48.330	48.330	48.330	48.000	19.870	19.810	19.170	1,165.770
		Resorvoir	2.220	2.220	2.220	2.220	2.220	2.220	9.310	9.570	9.570	8.020	8.020	8.020	12.230	12.230	12.100	12.090	9.090	9.350	9.140	142.060
		Pumping Station	0.620	0.620	0.620	12.140	35.170	12.330	0.830	0.660	1.760	11.800	30.440	11.620	3.510	1.210	1.210	2.670	1.210	1.210	2.650	132.280
		Distribution Pipe	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.180	57.030	1,086.270
		House Connection	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	63.420	79.830	80.080	80.310	80.540	80.650	80.900	81.170	81.460	81.550	1,360.690
		Sub Total	169.930	169.900	226.860	503.150	771.840	380.010	178.490	176.420	177.520	221.750	267.630	263.800	321.080	271.260	224.970	226.340	168.520	169.010	169.540	5,058.020
	Proposed	WTP	343.890	248.310	9.000	287.960	681.810	361.720			19.130	193.510	359.390	204.150								2,708.870
		Transmission Main	65.400	65.340	20.160	323.690	948.190	341.070	41.100	35.310	28.480	56.190	153.200	55.840								2,133.970
		Resorvoir			4.600	44.540	124.410	44.520	5.040	4.700	3.780	28.820	79.820	28.770								369.000
		Pumping Station			1.560	3.880	5.890	3.070	1.110	0.400	0.120	5.490	16.440	5.440								43.400
		Distribution Pipe	78.100	79.210	80.370	81.470	81.980	83.170	84.470	85.760	87.090	87.730	89.200	90.680	92.160	93.750	94.760	96.380	98.030	99.720	101.520	1,685.550
		House Connection	16.430	16.660	16.900	17.140	17.250	17.500	17.770	18.050	18.330	18.450	18.760	19.060	19.390	19.730	19.940	20.290	20.620	20.990	21.350	354.610
		Sub Total	503.820	409.520	132.590	758.680	1,859.530	851.050	149.490	144.220	156.930	390.190	716.810	403.940	111.550	113.480	114.700	116.670	118.650	120.710	122.870	7,295.400
	Total		673.750	579.420	359.450	1,261.830	2,631.370	1,231.060	327.980	320.640	334.450	611.940	984.440	667.740	432.630	384.740	339.670	343.010	287.170	289.720	292.410	12,353.420

M91.3 Breakdown of Sanitation Cost

		Amount (Rs. In Million)																			
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Panaji	Trunk Sewer	0.000	0.000	0.000	0.000	0.000	0.000	13.590	13.590	13.590	0.000	15.970	15.970	15.970	0.000	0.000	0.000	0.000	0.000	0.000	88.680
	Branch Sewer	0.000	0.000	0.000	0.000	0.000	0.000	8.740	8.740	8.740	10.850	10.850	10.850	10.850	10.850	10.850	10.850	10.850	10.850	10.850	134.720
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.410	2.410	0.000	0.000	2.010	2.010	0.000	0.000	0.000	0.000	0.000	0.000	8.840
	STP										18.690	31.150	12.460			18.690	31.150	12.460			124.600
	Total	0.000	0.000	0.000	0.000	0.000	0.000	22.330	24.740	24.740	29.540	57.970	41.290	28.830	10.850	29.540	42.000	23.310	10.850	10.850	356.840
Saint Crus	Trunk Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9.650	9.660	9.660	0.000	0.000	0.000	0.000	0.000	0.000	0.000	28.970
	Branch Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.860	3.860	3.860	3.860	3.860	3.860	3.860	3.860	3.860	3.860	38.600
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.260	2.260	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.520
	STP										5.460	9.100	3.640		5.460	9.100	3.640				36.400
	Total	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	18.970	24.880	19.420	3.860	9.320	12.960	7.500	3.860	3.860	3.860	108.490
Provorim	Trunk Sewer	0.000	0.000	0.000	0.000	0.000	0.000	11.550	11.550	11.550	0.000	0.000	16.410	16.410	16.410	0.000	0.000	0.000	0.000	0.000	83.880
	Branch Sewer	0.000	0.000	0.000	0.000	0.000	0.000	14.090	14.090	14.090	13.040	13.040	13.040	13.040	13.040	13.040	13.040	13.040	13.040	13.040	172.670
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.090	4.090	0.000	0.000	0.000	2.520	2.520	0.000	0.000	0.000	0.000	0.000	13.220
	STP							16.170	26.950	10.780			16.170	26.950	10.780						107.800
	Total	0.000	0.000	0.000	0.000	0.000	0.000	41.810	56.680	40.510	13.040	13.040	45.620	58.920	42.750	13.040	13.040	13.040	13.040	13.040	377.570
Margao	Trunk Sewer	0.000	0.000	0.000	36.060	36.060	36.060	0.000	0.000	0.000	0.000	0.000	0.000	4.760	4.760	4.760	0.000	0.000	0.000	0.000	122.460
	Branch Sewer	0.000	0.000	0.000	44.050	44.050	44.050	0.000	0.000	0.000	1.660	1.660	1.660	1.660	1.660	1.660	1.660	1.660	1.660	1.660	148.750
	Pump	0.000	0.000	0.000	0.000	5.420	5.420	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.100	2.100	0.000	0.000	0.000	0.000	15.040
	STP				18.800	37.500	37.500							18.800	37.500	37.500					187.600
	Total	0.000	0.000	0.000	98.910	123.030	123.030	0.000	0.000	0.000	1.660	1.660	1.660	25.220	46.020	46.020	1.660	1.660	1.660	1.660	473.850
Ponda	Trunk Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8.930	8.930	8.930	0.000	0.000	0.000	0.000	0.000	0.000	0.000	26.790
	Branch Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	6.700	6.700	6.700	6.700	6.700	6.700	6.700	6.700	6.700	6.700	67.000
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.820	1.820	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.640
	STP										7.350	12.250	4.900		7.350	12.250	4.900				49.000
	Total	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	22.980	29.700	22.350	6.700	14.050	18.950	11.600	6.700	6.700	6.700	146.430
Mapusa	Trunk Sewer	0.000	0.000	0.000	25.910	25.910	25.910	0.000	0.000	0.000	0.000	11.140	11.140	11.140	0.000	0.000	0.000	0.000	0.000	0.000	111.150
	Branch Sewer	0.000	0.000	0.000	25.110	25.110	25.110	0.000	0.000	0.000	5.100	5.100	5.100	5.100	5.100	5.100	5.100	5.100	5.100	5.100	126.330
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.460	2.470	0.000	0.000	0.000	0.000	0.000	0.000	4.930
	STP				17.100	34.200	30.200					7.600	15.100	15.100		7.600	15.100	15.100			157.100
	Total	0.000	0.000	0.000	68.120	85.220	81.220	0.000	0.000	0.000	5.100	23.840	33.800	33.810	5.100	12.700	20.200	20.200	5.100	5.100	399.510
South Coastal Belt	Trunk Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	13.590	13.590	13.590	0.000	0.000	0.000	0.000	0.000	0.000	0.000	40.770
	Branch Sewer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.830	3.830	3.830	3.830	3.830	3.830	3.830	3.830	3.830	3.830	38.300
	Pump	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.100	2.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.200
	STP										4.950	8.250	3.300		4.950	8.250	3.300				33.000
	Total	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	22.370	27.770	22.820	3.830	8.780	12.080	7.130	3.830	3.830	3.830	116.270
North Coastal Belt	Trunk Sewer	0.000	0.000	0.000	26.410	26.410	26.410	0.000	0.000	0.000	0.000	17.120	17.120	17.130	0.000	0.000	0.000	0.000	0.000	0.000	130.600
	Branch Sewer	0.000	0.000	0.000	34.480	34.480	34.480	0.000	0.000	0.000	5.570	5.570	5.570	5.570	5.570	5.570	5.570	5.570	5.570	5.570	159.140
	Pump	0.000	0.000	0.000	0.000	5.200	5.200	0.000	0.000	0.000	0.000	0.000	2.790	2.790	0.000	0.000	0.000	0.000	0.000	0.000	15.980
	STP				20.000	40.000	33.600					8.400	16.800	16.800		8.400	16.800	16.800			177.600
	Total	0.000	0.000	0.000	80.890	106.090	99.690	0.000	0.000	0.000	5.570	31.090	42.280	42.290	5.570	13.970	22.370	22.370	5.570	5.570	483.320
Ground Total	Trunk Sewer	0.000	0.000	0.000	88.380	88.380	88.380	25.140	25.140	25.140	32.170	76.410	92.820	65.410	21.170	4.760	0.000	0.000	0.000	0.000	633.300
	Branch Sewer	0.000	0.000	0.000	103.640	103.640	103.640	22.830	22.830	22.830	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610	50.610	885.510
	Pump	0.000	0.000	0.000	0.000	10.620	10.620	0.000	6.500	6.500	0.000	6.180	13.440	9.790	4.620	2.100	0.000	0.000	0.000	0.000	70.370
	STP	0.000	0.000	0.000	55.900	111.700	101.300	16.170	26.950	10.780	36.450	76.750	72.370	77.650	66.040	101.790	74.890	44.360	0.000	0.000	873.100
	Total	0.000	0.000	0.000	247.920	314.340	303.940	64.140	81.420	65.250	119.230	209.950	229.240	203.460	142.440	159.260	125.500	94.970	50.610	50.610	2,462.280

APPENDIX M10

This appendix is reference to and supporting data of

Volume 2 Main Report – Master Plan

Chapter 10 Economic and Financial Evaluation

M101	Methodology of Economic and Financial Evaluation
M102	Economic and Financial Evaluation of Master Plan for Water Supply
M103	Economic and Financial Evaluation of Master Plan for Sanitation
M104	Financial Plan of PHE with the Master Plan for Water Supply and Sanitation

Appendix M101

Methodology of Economic and Financial Evaluation

Contents for Appendix M101

Appendix M101 Methodology of Economic and Financial Evaluation

Table M101.1.1 Calculation of Shadow Exchange Rate

(Rs. In billion)

Item	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average
(1) Import Amount *1	1,226.7	1,389.1	1,541.7	1,783.3	2,152.3	2,308.7	2,451.9	2,972.0	3,591.0	4,810.6	2,422.7
(2) Export Amount *1	1,063.5	1,188.1	1,301.0	1,397.5	1,595.6	2,035.7	2,090.1	2,551.3	2,933.6	3,560.6	1,971.7
(3) Import Tax *2	357.5	428.5	401.9	406.6	484.1	475.4	402.6	448.5	493.5	542.5	444.1
(4) Export Tax *2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(5) Export Subsidies *2	4.3	5.6	5.7	7.4	7.0	8.3	9.1	9.2	10.6	11.3	7.9
(6) = (1)+(2)	2,290.2	2,577.2	2,842.7	3,180.8	3,747.9	4,344.4	4,542.0	5,523.3	6,524.6	8,371.2	4,394.4
(7) = (1)+(2)+(3)-(4)+(5)	2,652.0	3,011.3	3,250.3	3,594.8	4,239.0	4,828.1	4,953.7	5,981.0	7,028.7	8,925.0	4,846.4
Shadow Exchange Factor =(7)/(6)	**1.158**	**1.168**	**1.143**	**1.130**	**1.131**	**1.111**	**1.091**	**1.083**	**1.077**	**1.066**	**1.103**

Source: *1: Handbook of Statistics on Indian Economy, Reserve Bank of India,
*2: Indian Public Finance Statistics 2004-2005, Ministry of Finance, Department of Economic Affairs, Economic Division

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

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

Appendix M102

Economic and Financial Evaluation of Master Plan for Water Supply

Contents for Appendix M102

Appendix M102.1 Economic and Financial Evaluation of Master Plan for Water Supply

Table M102.1.1 Excess water demand for existing capacity and incremental number of connections served by M/P project for each supply scheme

Chandel Water Supply (Pernem Taluka only) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**448**	**972**
% of Domestic	96.1%	96.0%	96.0%	96.0%	96.0%	95.9%	95.9%	95.8%	95.8%	95.7%	95.7%	95.6%	95.5%	95.4%	95.3%	95.2%	95.1%	95.0%	94.8%	94.7%	94.5%
Domestic Day Max.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	424	918
Day Ave.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	759
% of Tourism	0.6%	0.6%	0.6%	0.6%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%
Tourism	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	6
% of Other Non-Domestic	3.3%	3.4%	3.4%	3.5%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.8%	3.9%	4.0%	4.1%	4.2%	4.3%	4.4%	4.5%	4.6%	4.8%	4.9%
Other Non-Domestic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	48
Non-Domestic Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	54
Excess demand served by M/P (Day Ave.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	374	813
Incremental number of connections																					
Domestic	0	226	228	230	232	233	240	243	244	246	247	244	247	249	251	253	255	257	259	261	262
Non-Domestic	0	12	12	12	12	12	13	13	13	13	13	13	13	13	13	13	13	14	14	14	14

Assonora & Sanquelim Water Supply Scheme (Bardez and Bicholim Taluka) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9,749**	**11,942**	**14,178**	**16,456**	**18,773**	**21,144**	**23,566**	**26,039**	**28,569**	**30,992**	**33,477**	**36,030**	**38,649**	**41,345**
% of Domestic	94.4%	94.2%	94.1%	94.0%	93.8%	93.7%	93.5%	93.3%	93.2%	93.0%	92.8%	92.5%	92.3%	92.1%	91.8%	91.6%	91.3%	91.0%	90.7%	90.3%	90.0%
Domestic Day Max.	0	0	0	0	0	0	0	9,099	11,124	13,180	15,265	17,374	19,522	21,703	23,916	26,165	28,296	30,463	32,671	34,915	37,204
Day Ave.	0	0	0	0	0	0	0	7,520	9,193	10,893	12,615	14,359	16,134	17,936	19,765	21,624	23,385	25,176	27,001	28,856	30,747
% of Tourism	3.2%	3.3%	3.3%	3.4%	3.5%	3.5%	3.6%	3.6%	3.7%	3.7%	3.8%	3.8%	3.9%	4.0%	4.0%	4.1%	4.1%	4.2%	4.3%	4.3%	4.4%
Tourism	0	0	0	0	0	0	0	353	439	529	623	722	825	933	1,047	1,165	1,285	1,410	1,542	1,680	1,825
% of Other Non-Domestic	2.4%	2.5%	2.5%	2.6%	2.7%	2.8%	2.9%	3.1%	3.2%	3.3%	3.5%	3.6%	3.8%	3.9%	4.1%	4.3%	4.6%	4.8%	5.0%	5.3%	5.6%
Other Non-Domestic	0	0	0	0	0	0	0	297	379	469	568	677	797	930	1,076	1,238	1,412	1,604	1,817	2,053	2,316
Non-Domestic Total	0	0	0	0	0	0	0	650	818	998	1,191	1,399	1,622	1,863	2,123	2,404	2,696	3,014	3,359	3,734	4,141
Excess demand served by M/P (Day Ave.)	0	0	0	0	0	0	0	8,170	10,011	11,891	13,807	15,758	17,756	19,799	21,888	24,028	26,081	28,190	30,360	32,589	34,888
Incremental number of connections																					
Domestic	0	1,372	1,396	1,418	1,444	1,469	1,496	1,520	1,548	1,578	1,605	1,635	1,666	1,698	1,730	1,762	1,759	1,793	1,829	1,863	1,900
Non-Domestic	0	72	73	75	76	77	79	80	81	83	84	86	88	89	91	93	93	94	96	98	100

Opa Water Supply Scheme (Tiswadi and Ponda Taluka) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
% of Domestic	85.4%	85.1%	84.7%	84.4%	83.9%	83.5%	83.1%	82.6%	82.0%	81.5%	80.9%	80.3%	79.6%	78.9%	78.1%	77.4%	76.6%	75.7%	74.8%	73.9%	72.9%
Domestic Day Max.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Day Ave.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Tourism	6.0%	6.0%	6.1%	6.1%	6.2%	6.2%	6.3%	6.3%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%	6.7%	6.7%	6.8%	6.8%	6.9%	6.9%	6.9%
Tourism	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Other Non-Domestic	8.6%	8.9%	9.2%	9.5%	9.9%	10.3%	10.7%	11.1%	11.6%	12.1%	12.6%	13.2%	13.8%	14.5%	15.2%	15.9%	16.7%	17.5%	18.3%	19.2%	20.2%
Other Non-Domestic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Domestic Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Excess demand served by M/P (Day Ave.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental number of connections																					
Domestic	0	1,561	1,563	1,569	1,572	1,574	1,523	1,528	1,536	1,541	1,549	1,507	1,518	1,530	1,543	1,557	1,560	1,574	1,589	1,605	1,622
Non-Domestic	0	82	82	83	83	83	80	80	81	81	82	79	80	81	81	82	82	83	84	84	85

Table M102.1.2 Excess water demand for existing capacity and incremental number of connections served by M/P project for each supply scheme (continued)

Dabose Water Supply Scheme (Satari Taluka only) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**795**	**1,033**	**1,281**	**1,535**	**1,800**	**2,069**	**2,347**	**2,632**	**2,927**	**3,228**	**3,540**	**3,858**	**4,188**	**4,524**	**4,868**	**5,222**	**5,586**	**5,956**	**6,336**	**6,726**	**7,125**
% of Domestic	98.3%	98.3%	98.2%	98.2%	98.1%	98.0%	97.9%	97.9%	97.8%	97.7%	97.6%	97.5%	97.4%	97.3%	97.2%	97.0%	96.9%	96.8%	96.6%	96.5%	96.3%
Domestic Day Max.	782	1,015	1,258	1,507	1,766	2,028	2,299	2,576	2,863	3,154	3,455	3,762	4,079	4,401	4,730	5,068	5,414	5,764	6,122	6,489	6,862
Day Ave.	646	839	1,040	1,245	1,459	1,676	1,900	2,129	2,366	2,606	2,856	3,109	3,371	3,637	3,909	4,188	4,474	4,764	5,060	5,362	5,671
% of Tourism	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Tourism	1	1	1	1	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6	6	7
% of Other Non-Domestic	1.5%	1.6%	1.7%	1.8%	1.8%	1.9%	2.0%	2.0%	2.1%	2.2%	2.3%	2.4%	2.5%	2.6%	2.7%	2.8%	3.0%	3.1%	3.3%	3.4%	3.6%
Other Non-Domestic	12	17	22	27	32	39	46	54	62	71	81	92	105	118	133	149	167	186	208	231	256
Non-Domestic Total	13	18	23	28	34	41	48	56	64	74	85	96	109	123	138	154	172	192	214	237	263
Excess demand served by M/P (Day Ave.)	659	857	1,063	1,274	1,494	1,717	1,948	2,185	2,430	2,681	2,940	3,205	3,480	3,760	4,047	4,342	4,646	4,956	5,273	5,600	5,934
Incremental number of connections																					
Domestic	0	344	353	362	372	381	390	399	409	418	429	437	448	457	466	476	485	494	502	511	520
Non-Domestic	0	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	26	27	27

Salaulim Water Supply Scheme (Mormugao, Salcete, Quepem, and Sanguem taluka) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**0**	**0**	**66**	**5,765**	**11,686**	**17,851**	**24,234**	**30,881**	**37,798**	**45,010**	**52,520**	**60,335**	**68,481**	**91,543**	**100,959**	**110,791**	**121,035**	**131,736**	**142,916**	**154,599**	**166,816**
% of Domestic	67.6%	67.0%	66.4%	65.8%	65.2%	64.6%	64.0%	63.4%	62.7%	62.1%	61.4%	60.8%	60.1%	59.4%	58.8%	58.1%	57.4%	56.7%	56.0%	55.3%	54.6%
Domestic Day Max.	0	0	44	3,795	7,622	11,533	15,506	19,565	23,706	27,941	32,263	36,668	41,165	54,415	59,331	64,356	69,475	74,706	80,047	85,502	91,075
Day Ave.	0	0	36	3,136	6,299	9,532	12,815	16,169	19,592	23,092	26,663	30,304	34,020	44,971	49,034	53,187	57,417	61,740	66,155	70,663	75,268
% of Tourism	2.6%	2.6%	2.6%	2.6%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%
Tourism	0	0	2	153	311	478	652	835	1,026	1,226	1,435	1,654	1,882	2,521	2,786	3,062	3,350	3,649	3,962	4,287	4,626
% of Other Non-Domestic	29.8%	30.4%	30.9%	31.5%	32.1%	32.7%	33.3%	33.9%	34.6%	35.2%	35.8%	36.5%	37.1%	37.8%	38.5%	39.1%	39.8%	40.5%	41.2%	41.9%	42.6%
Other Non-Domestic	0	0	20	1,817	3,753	5,840	8,076	10,482	13,066	15,843	18,822	22,014	25,435	34,607	38,842	43,373	48,210	53,381	58,907	64,809	71,115
Non-Domestic Total	0	0	22	1,970	4,064	6,318	8,728	11,316	14,092	17,069	20,257	23,667	27,316	37,128	41,628	46,435	51,560	57,030	62,869	69,097	75,741
Excess demand served by M/P (Day Ave.)	0	0	58	5,106	10,363	15,849	21,543	27,485	33,684	40,161	46,921	53,971	61,337	82,099	90,662	99,622	108,977	118,771	129,024	139,760	151,010
Incremental number of connections																					
Domestic	0	2,990	3,043	3,101	3,157	3,217	3,266	3,330	3,393	3,461	3,528	3,595	3,666	3,737	3,811	3,891	3,966	4,047	4,128	4,211	4,296
Non-Domestic	0	157	160	163	166	169	172	175	179	182	186	189	193	197	201	205	209	213	217	222	226

Canacona Water Supply Scheme (Canacona taluka) (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	**0**	**0**	**0**	**0**	**228**	**496**	**770**	**1,049**	**1,334**	**1,626**	**1,920**	**2,210**	**2,504**	**2,805**	**3,112**	**3,424**	**3,742**	**4,066**	**4,394**	**4,732**	**5,073**
% of Domestic	95.1%	95.1%	95.1%	95.1%	95.0%	95.0%	95.0%	95.0%	95.0%	94.9%	94.9%	94.9%	94.8%	94.8%	94.7%	94.7%	94.6%	94.5%	94.5%	94.4%	94.3%
Domestic Day Max.	0	0	0	0	217	471	732	997	1,267	1,543	1,822	2,097	2,375	2,658	2,948	3,241	3,540	3,844	4,151	4,467	4,784
Day Ave.	0	0	0	0	179	390	605	824	1,047	1,276	1,506	1,733	1,963	2,197	2,437	2,679	2,926	3,177	3,431	3,691	3,954
% of Tourism	1.5%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%	1.3%
Tourism	0	0	0	0	3	7	10	14	18	21	25	29	33	36	40	44	48	53	57	61	66
% of Other Non-Domestic	3.5%	3.5%	3.5%	3.5%	3.6%	3.6%	3.6%	3.7%	3.7%	3.7%	3.8%	3.8%	3.9%	3.9%	4.0%	4.0%	4.1%	4.2%	4.2%	4.3%	4.4%
Other Non-Domestic	0	0	0	0	8	18	28	38	49	61	72	84	97	110	124	138	153	169	186	204	222
Non-Domestic Total	0	0	0	0	11	25	38	52	67	82	98	113	129	146	164	182	202	222	243	265	288
Excess demand served by M/P (Day Ave.)	0	0	0	0	191	414	643	876	1,114	1,358	1,604	1,846	2,092	2,343	2,601	2,861	3,128	3,399	3,674	3,957	4,243
Incremental number of connections																					
Domestic	0	262	263	265	267	269	270	272	274	275	276	272	274	276	279	281	283	286	287	290	292
Non-Domestic	0	14	14	14	14	14	14	14	14	14	15	14	14	15	15	15	15	15	15	15	15

Table M102.1.3 Total of excess water demand for existing capacity, total of incremental number of connections served by M/P and expanded supply capacity by Ganjem and Maisal emergency scheme

Grand Total (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Excess demand for existing capacity	795	1,033	1,347	7,300	13,714	20,416	27,351	44,311	54,001	64,042	74,436	85,176	96,317	122,438	134,978	148,006	161,355	175,235	189,676	205,154	221,331
Domestic Day Max.	**782**	**1,015**	**1,302**	**5,302**	**9,605**	**14,033**	**18,537**	**32,236**	**38,960**	**45,818**	**52,805**	**59,901**	**67,141**	**83,177**	**90,926**	**98,831**	**106,725**	**114,777**	**122,992**	**131,797**	**140,843**
Day Ave.	646	839	1,076	4,382	7,938	11,597	15,320	26,641	32,198	37,866	43,640	49,505	55,488	68,742	75,145	81,678	88,202	94,857	101,646	108,923	116,399
Tourism	**1**	**1**	**3**	**154**	**316**	**487**	**665**	**1,204**	**1,485**	**1,779**	**2,087**	**2,408**	**2,743**	**3,496**	**3,878**	**4,277**	**4,688**	**5,118**	**5,567**	**6,038**	**6,530**
Other Non-Domestic	12	17	42	1,844	3,793	5,896	8,150	10,871	13,556	16,444	19,544	22,867	26,433	35,765	40,175	44,898	49,942	55,340	61,118	67,319	73,958
Non-Domestic Total	**13**	**18**	**45**	**1,998**	**4,110**	**6,383**	**8,815**	**12,075**	**15,041**	**18,223**	**21,631**	**25,275**	**29,177**	**39,260**	**44,052**	**49,175**	**54,630**	**60,458**	**66,684**	**73,357**	**80,488**
Excess demand served by M/P (Day Ave.)	659	857	1,121	6,380	12,047	17,981	24,134	38,717	47,240	56,090	65,271	74,780	84,665	108,002	119,198	130,853	142,833	155,315	168,330	182,280	196,887
Incremental number of connections (for Expansion facilities)																					
Domestic	**0**	**344**	**3,396**	**3,463**	**3,796**	**3,867**	**3,926**	**5,521**	**5,624**	**5,732**	**5,838**	**5,939**	**6,054**	**6,168**	**6,286**	**6,410**	**6,493**	**6,620**	**6,746**	**7,136**	**7,270**
Non-Domestic	**0**	**18**	**179**	**182**	**200**	**203**	**207**	**290**	**296**	**301**	**308**	**312**	**319**	**325**	**332**	**338**	**343**	**348**	**354**	**376**	**382**
Incremental no. of connections (for Existing Facilities)																					
Domestic	0	6,411	3,450	3,482	3,248	3,276	3,259	1,771	1,780	1,787	1,796	1,751	1,765	1,779	1,794	1,810	1,815	1,831	1,848	1,605	1,622
Non-Domestic	0	337	181	184	171	172	172	93	94	94	95	92	93	94	94	95	95	97	98	84	85
Incremental no. of connections (total)																					
Domestic	0	6,755	6,846	6,945	7,044	7,143	7,185	7,292	7,404	7,519	7,634	7,690	7,819	7,947	8,080	8,220	8,308	8,451	8,594	8,741	8,892
Non-Domestic	0	355	360	366	371	375	379	383	390	395	403	404	412	419	426	433	438	445	452	460	467
Total no. of connections (for Expansion Facilities)																					
Domestic	0	344	3,740	7,203	10,999	14,866	18,792	24,313	29,937	35,669	41,507	47,446	53,500	59,668	65,954	72,364	78,857	85,477	92,223	99,359	106,629
Non-Domestic	0	18	197	379	579	782	989	1,279	1,575	1,876	2,184	2,496	2,815	3,140	3,472	3,810	4,153	4,501	4,855	5,231	5,613
Total no. of connections (for Existing Facilities)																					
Domestic	250,581	256,992	260,442	263,924	267,172	270,448	273,707	275,478	277,258	279,045	280,841	282,592	284,357	286,136	287,930	289,740	291,555	293,386	295,234	296,839	298,461
Non-Domestic	13,188	13,525	13,706	13,890	14,061	14,233	14,405	14,498	14,592	14,686	14,781	14,873	14,966	15,060	15,154	15,249	15,344	15,441	15,539	15,623	15,708

Ganjem and Maisal Emergency Water Supply Scheme (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Expanded Supply Capacity	**0**	**0**	**0**	**0**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**	**35,000**
% of Domestic	85.4%	85.1%	84.7%	84.4%	83.9%	83.5%	83.1%	82.6%	82.0%	81.5%	80.9%	80.3%	79.6%	78.9%	78.1%	77.4%	76.6%	75.7%	74.8%	73.9%	72.9%
Domestic Day Max.	0	0	0	0	29,382	29,233	29,068	28,894	28,711	28,518	28,315	28,091	27,855	27,609	27,350	27,079	26,794	26,496	26,185	25,861	25,522
Day Ave.	0	0	0	0	24,283	24,160	24,023	23,880	23,728	23,568	23,401	23,216	23,021	22,817	22,603	22,379	22,144	21,898	21,641	21,372	21,093
% of Tourism	6.0%	6.0%	6.1%	6.1%	6.2%	6.2%	6.3%	6.3%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%	6.7%	6.7%	6.8%	6.8%	6.9%	6.9%	6.9%
Tourism	0	0	0	0	2,155	2,171	2,191	2,209	2,227	2,245	2,262	2,283	2,302	2,321	2,339	2,356	2,371	2,386	2,399	2,411	2,422
% of Other Non-Domestic	8.6%	8.9%	9.2%	9.5%	9.9%	10.3%	10.7%	11.1%	11.6%	12.1%	12.6%	13.2%	13.8%	14.5%	15.2%	15.9%	16.7%	17.5%	18.3%	19.2%	20.2%
Other Non-Domestic	0	0	0	0	3,463	3,595	3,741	3,896	4,061	4,237	4,423	4,626	4,842	5,070	5,311	5,566	5,834	6,118	6,415	6,728	7,056
Non-Domestic Total	0	0	0	0	5,618	5,767	5,932	6,106	6,289	6,482	6,685	6,909	7,145	7,391	7,650	7,921	8,206	8,504	8,815	9,139	9,478

Note: Ganjem and Maisal emergency schemes, which are planned to supply 25MLD and 10MLD respectively, are considered as one of the benefits of M/P project, since the investment cost of them are included in the cost of M/P.

Grand Total including Ganjem and Maisal Emergency Water Supply Scheme (Unit: m^3/day)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Domestic Day Max.	**0**	**0**	**0**	**0**	**29,382**	**29,233**	**29,068**	**61,130**	**67,671**	**74,336**	**81,120**	**87,992**	**94,996**	**110,786**	**118,276**	**125,910**	**133,519**	**141,273**	**149,177**	**157,658**	**166,365**
Day Ave.	0	0	0	0	24,283	24,160	24,023	50,521	55,927	61,435	67,041	72,720	78,509	91,559	97,749	104,058	110,346	116,755	123,287	130,296	137,492
Tourism	**0**	**0**	**0**	**0**	**2,155**	**2,171**	**2,191**	**3,413**	**3,712**	**4,024**	**4,349**	**4,691**	**5,046**	**5,817**	**6,216**	**6,633**	**7,060**	**7,504**	**7,966**	**8,449**	**8,952**
Other Non-Domestic	0	0	0	0	3,463	3,595	3,741	14,768	17,618	20,681	23,967	27,494	31,275	40,835	45,486	50,463	55,776	61,457	67,533	74,047	81,014
Non-Domestic Total	**0**	**0**	**0**	**0**	**5,618**	**5,767**	**5,932**	**18,181**	**21,330**	**24,706**	**28,316**	**32,184**	**36,321**	**46,652**	**51,702**	**57,096**	**62,836**	**68,962**	**75,499**	**82,496**	**89,966**
Water volume served by M/P (Day Ave.)	0	0	0	0	29,901	29,926	29,955	68,702	77,257	86,140	95,357	104,905	114,831	138,210	149,451	161,154	173,182	185,716	198,786	212,792	227,458

Note: Until 2012, when the service of the priority projects start, only the water volume of Ganjem and Maisal scheme is considered as financial and economic benefit in terms of water volume, because only those scheme start servicing at 2009.

Table M102.1.4 Total Served Population

Total Served Population (x 1,000)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Pernem	58.77	59.89	61.01	62.14	63.28	64.43	65.61	66.80	68.01	69.22	70.43	71.64	72.85	74.08	75.31	76.56	77.81	79.07	80.35	81.63	82.92
Bardez	225.95	230.84	235.83	240.91	246.10	251.38	256.78	262.29	267.91	273.65	279.50	285.49	291.60	297.85	304.23	310.74	317.28	323.96	330.80	337.77	344.91
Tiswadi	150.15	152.62	155.11	157.63	160.19	162.77	165.35	167.97	170.62	173.32	176.06	178.80	181.59	184.43	187.34	190.32	193.38	196.49	199.68	202.93	206.26
Bicholim	83.36	84.68	86.01	87.34	88.69	90.04	91.40	92.76	94.14	95.52	96.91	98.31	99.72	101.13	102.55	103.98	105.37	106.77	108.17	109.59	111.01
Satari	45.46	47.03	48.64	50.29	51.99	53.73	55.50	57.32	59.18	61.07	63.02	65.00	67.03	69.09	71.20	73.34	75.53	77.75	80.00	82.29	84.62
Ponda	110.45	115.27	120.07	124.86	129.63	134.39	138.90	143.39	147.88	152.36	156.81	161.07	165.33	169.58	173.83	178.07	182.25	186.42	190.60	194.77	198.94
Mormugao	109.42	113.92	118.53	123.25	128.08	133.02	138.04	143.19	148.48	153.91	159.49	165.22	171.11	177.17	183.41	189.83	196.45	203.26	210.30	217.55	225.04
Salcete	251.59	256.90	262.30	267.79	273.38	279.08	284.87	290.76	296.76	302.87	309.08	315.40	321.83	328.36	335.00	341.76	348.61	355.58	362.65	369.82	377.10
Quepem	68.86	69.98	71.08	72.20	73.32	74.44	75.58	76.71	77.85	79.00	80.15	81.29	82.43	83.58	84.74	85.91	87.08	88.26	89.44	90.64	91.84
Sanguem	18.87	21.33	23.83	26.38	28.96	31.58	34.25	36.96	39.71	42.50	45.34	48.22	51.14	54.10	57.10	60.14	63.22	66.34	69.49	72.69	75.91
Canacona	23.67	24.93	26.20	27.47	28.76	30.05	31.35	32.66	33.98	35.30	36.64	37.94	39.26	40.59	41.93	43.29	44.65	46.02	47.40	48.80	50.21
TOTAL	1,146.56	1,177.38	1,208.60	1,240.27	1,272.37	1,304.91	1,337.63	1,370.82	1,404.51	1,438.71	1,473.43	1,508.37	1,543.88	1,579.97	1,616.64	1,653.94	1,691.61	1,729.92	1,768.87	1,808.47	1,848.75

Table M102.1.5 The percentage of usage by household of the public water supply system and alternative 5 water sources

Type of Water Supply	Composition of water acquisition methods
Public tap (House connection & public stand post)	69.0%
Hand Pump	0.6%
Tube well	0.5%
Open well	26.1%
Pond, lake	0.6%
River, Canal	0.7%
Spring	2.0%
Any other	0.5%
TOTAL	100.0%

Source: Census 2001

69% of the household receive the water supply by PWD. Other 31% obtain the water from alternative water source other than house connection / public stand post. Without the Project case, in order to satisfy the increased water demand, household has to rely on the alternative water system only. Therefore, the percentage of usage of alternative water supply methods for excess water demand above existing supply capacity shall be estimated as follows;

Table M102.1.6 The percentage of number of household for each alternative water acquisition methods

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

Note: % of number of household for each alternative water acquisition methods is calculated as follows;
e.x.; Hand Pump 0.6% / 31% x 100% = 1.9%

On the other hand, according to the Census 2001, number of households for each water acquisition methods 'Within Premises', 'Near Premises', or 'Away' is shown in Table M102.1.5.

Table M102.1.7 Number of household of each Hand Pump, Tube well, & Open well

Type of Water Supply	Within Premises (% in the same type)		Near Premises & Away (% in the same type)		Total Number of Household (% in the same type)	
Hand Pump	672	37.4%	1,123	62.6%	1,795	100.0%
Tube well	574	46.4%	664	53.6%	1,238	100.0%
Open well	30,826	42.3%	42,111	57.7%	72,937	100.0%

Source: Census 2001

In this Analysis, it is assumed that the number of household 'Within Premises' has their own water source for Hand Pump, Tube well, Open well, and the households 'Near Premises' and 'Away' share 1 water source by some of the households. For simplification, it is assumed in this analysis that 1 unit of hand pump & open well is shared by 4 households respectively, and 1 unit of tube well is shared by 8 household.

Table M102.1.8 Number of Hand Pump, Tube well, & Open well

Type of Water Supply	No. of facilities within Premises (% in the same type)		No. of facilities of near Premises & Away (% in the same type)		Total Number of Facilities (% in the same type)	
Hand Pump	672	70.5%	281	29.5%	953	100.0%
Tube well	574	87.4%	83	12.6%	657	100.0%
Open well	30,826	74.5%	10,528	25.5%	41,354	100.0%

Based on the above two tables, average number of water supply facilities for each household is calculated in Table M102.1.8.

Table M102.1.9 Number of Hand Pump, Tube well, & Open well for each household

Type of Water Supply	Total Number of Household	Total Number of Facilities	Number of Facilities / Household
Hand Pump	1,795	953	0.53
Tube well	1,238	657	0.53
Open well	72,937	41,354	0.57

Table M102.1.10 Specification and cost information of hand pump for economic analysis of water supply M/P

Specification		Depth: 100 m Diameter: 150mm Pipe: Galvanized Iron Pipe (Dia.2 inches) Type: Hand Pump Assumption: 80% of the Depth of well requires casing		
Construction cost				
1	Survey	Rs.	0	
2	Mobilization cost	Rs.	2000	
3	Drilling cost	Rs.	55000	(=Rs.550x100m)
4	Flushing cost	Rs.	3600	
5	Casing cost	Rs.	96000	(=Rs.1200x100mx80%)
6	Galvanized pipe cost	Rs.	33200	
7	Hand pump & Platform, etc.	Rs.	17000	
	TOTAL	Rs.	206,800	
O&M cost				
	Removal of blockage, etc.	Rs.	12500	/ each 4 years

Table M102.1.11 Specification and cost information of tube well with submersible pump (Domestic) for economic analysis of water supply M/P

Specification			Depth: 100 m Diameter: 150mm Pipe: Galvanized Iron Pipe (Dia.2 inches) Type: Submersible Pump (2HP) Assumption: 80% of the Depth of well requires casing	
Construction cost				
1	Survey	Rs.	5000	
2	Mobilization cost	Rs.	2000	
3	Drilling cost	Rs.	55000	(=Rs.550x100m)
4	Flushing cost	Rs.	3600	
5	Casing cost	Rs.	96000	(=Rs.1200x100mx80%)
6	Galvanized pipe cost	Rs.	33200	
7	Well cap	Rs.	300	
8	Submersible pump	Rs.	20400	
9	Water tank	Rs.	2250	(=Rs.4.50x500liter)
10	Electricity panel	Rs.	3000	
	TOTAL	Rs.	220,750	
	TOTAL without Pump	Rs.	200,350	
O&M cost				
	Removal of blockage, etc	Rs.	12500	/ each 4 years
	Submersible pump replacement	Rs.	20400	/each 8 years

The opportunity cost of fetching water

According to the Public Awareness Survey, the sampled households fetching water from public stand posts, well, etc. carry water a day taking 1.9 hours on average. The minimum wage in Goa is Rs.87 per day on "Official Gazette", by Government of Goa. Therefore, the opportunity (economic) cost for fetching water is calculated by using the 50% of minimum wage as assumed opportunity cost of the fetching hour.

The opportunity cost of fetching water = 1.9 hours x 30 days x Rs.87/day x 50% / 8 hours

= 310 Rs./household per month

= 3,772 Rs./household per year

Table M102.1.12 Specification and cost information of tube well with submersible pump (Non-domestic) for economic analysis of water supply M/P

Specification			Depth: 100 m Diameter: 150mm Pipe: Galvanized Iron Pipe (Dia.2 inches) Type: Submersible Pump (165liter/min, 10HP) Assumption: 80% of the Depth of well requires casing	
Construction cost				
1	Survey	Rs.	5000	
2	Mobilization cost	Rs.	2000	
3	Drilling cost	Rs.	55000	(=Rs.550x100m)
4	Flushing cost	Rs.	3600	
5	Casing cost	Rs.	96000	(=Rs.1200x100mx80%)
6	Galvanized pipe cost	Rs.	33200	
7	Well cap	Rs.	300	
8	Submersible pump	Rs.	34500	
9	Water tank	Rs.	9000	(=Rs.4.50x1000literx2units)
10	Electricity panel	Rs.	3000	
	TOTAL	Rs.	241,600	
	TOTAL without Pump	Rs.	207,100	
O&M cost				
	Removal of blockage, etc	Rs.	12500	/ each 4 years
	Submersible pump replacement	Rs.	34500	/each 8 years

Table M102.1.13 Calculation of annualized construction cost, O&M cost for alternative water acquisition methods

	Interest rate *1				Interest rate *1		Economic period		Capital Recovery Factor	Annualized construction cost	Present Value				Annualized construction cost	O&M cost /year	**Annual Construction + O&M cost**
CRF	=	**r**	**/(1 -**	**1 /(**	**1 +**	**r**	**) ^**	**n)**		**Pn**	=	**So**	**x**	**CRF**			
Capital Recovery Factor	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	10)	=	0.16980	**Overhead tank**		2,250	x	0.1698	=	382	0	**382**
	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	10)	=	0.16980	**Ground Water Tank & Pump** *2		7,250	x	0.1698	=	1,231	0	**1,231**
	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	70)	=	0.11007	**Open well**		20,000	x	0.11007	=	2,201	500 *3	**2,701**
	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	20)	=	0.12558	**Hand pump**		206,800	x	0.12558	=	25,970	3,125 *4	**29,095**
	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	20)	=	0.12558	**Tube well & Submersible pump 1**		220,750	x	0.12558	=	27,722	6,125 *5	**33,847**
	11.0%	/(1 -	1 /(	1 +	11.0%	) ^	20)	=	0.12558	**Tube well & Submersible pump 2**		241,600	x	0.12558	=	30,340	11,488 *6	**41,828**

Notes: *1; Interest rate of commercial bank for lending purpose is calculated based on the following data.
"Minimum rate general", of the Table 70 : Structure of Interest Rates, p.125, Handbook of Statistics on Indian Economy, Reserve Bank of India.

Year	Interest rate	Average rate
2000-01	11.00 - 12.00	11.50
2001-02	11.00 - 12.00	11.50
2002-03	10.75 - 11.50	11.13
2003-04	10.25 - 11.00	10.63
2004-05	10.25 - 10.75	10.50

Average rate in the last 5 years

11.05 %

Table M102.1.14 Calculation of annualized construction cost, O&M cost for alternative water acquisition methods (continued)

*2; If underground tank is utilized, the water must be pumped up at the top of the roof. Therefore, the cost of a tank (Rs.2,250) and a pump (Rs.5,000) are included in the total cost.

*3; Operation & Maintenance cost of Open well is assumed as Rs.500/year, for replacing pulleys and cleaning of well inside and surroundings

Rs. 500

*4; Operation & Maintenance cost of Hand pump is calculated as follows;

1. Removal of blockage, and cleaning of pipe in the tube well is conducted once in 3 to 5 years @Rs.10,000 - Rs.15,000.
   Annual O&M cost shall be; (Rs.10,000 + Rs.15,000) / 2 / (3 years + 5 years)/2 Rs. 3,125

*5; Operation & Maintenance cost of Tube pump / Submersible Pump is calculated as follows;

1. Removal of blockage, and cleaning of pipe in the tube well is conducted once in 3 to 5 years @Rs.10,000 - Rs.15,000.
   Annual O&M cost shall be; (Rs.10,000 + Rs.15,000) / 2 / (3 years + 5 years)/2 Rs. 3,125
2. Replacement of Submersible pump (Rs.20,400) is conducted once in 8 years
   Annual O&M cost shall be; Rs.20,400 / 8 years Rs. 2,550
3. Replacement of Water tank (Rs.2,250) is conducted once in 10 years
   Annual O&M cost shall be; Rs.2,250 / 10 years Rs. 225
4. Electricity cost is assumed on average; Rs. 225
   (1.00m3 per household per day/ 0.04m3/minute x 30days/60minutes x 1.5kW x Rs.1.00/kWH per month x 12months)

Total annual O&M cost shall be; **TOTAL** **Rs. 6,125**

*6; Operation & Maintenance cost of Tube pump / Submersible Pump is calculated as follows;

1. Removal of blockage, and cleaning of pipe in the tube well is conducted once in 3 to 5 years @Rs.10,000 - Rs.15,000.
   Annual O&M cost shall be; (Rs.10,000 + Rs.15,000) / 2 / (3 years + 5 years)/2 Rs. 3,125
2. Replacement of Submersible pump (Rs.34,500) is conducted once in 8 years
   Annual O&M cost shall be; Rs.34,500 / 8 years Rs. 4,313
3. Replacement of Water tank (Rs.9,000) is conducted once in 10 years
   Annual O&M cost shall be; Rs.9,000 / 10 years Rs. 900
4. Electricity cost is assumed on average; Rs. 3150
   (3.3m^3 per household per day/ 0.165m^3/minute x 30days/60minutes x 7.5kW x Rs.3.5/kWH per month x 12months)

Total annual O&M cost shall be; **TOTAL** **Rs. 11,488**

Table M102.1.15 The percentage of usage of the public water supply system and other water sources by hotels for economic analysis

Type of Water Supply	Composition of water acquisition methods
Public Piped Water Supply	49.0%
Own well	29.0%
Private Water Vendor	22.0%
TOTAL	100.0%

Source: Public Awareness Survey

49% of the water consumption is supplied by PWD. Other 51% consumed water is obtained from the alternative water sources. Without the Project case, in order to satisfy the increased water demand, hotels must utilize the alternative water system only. Therefore, the percentage of usage of alternative water supply system for increased water demand shall be estimated as follows;

Table M102.1.16 The percentage of volume of water from each alternative acquisition methods by hotels for economic analysis

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

Note: % of volume of water from each alternative water acquisition methods is calculated as follows;
e.x.; Own well 29% / 51% x 100% = 56.9%

Table M102.1.17 Number of connections of Non-Domestic other than Tourism in the year 2005

Number of conections of Non-Domestic in 2005

	Number of connections
Pernem	635
Bardez	2,678
Tiswadi	1,743
Bicholim	893
Satari	454
Ponda	1,221
Mormugao	1,285
Salcete	3,022
Quepem	786
Sanguem	213
Canacoa	259
TOTAL	**13,189**

Number of hotels as a tourism is 2,027, according to the

Number of connection of Non-Domestic users other than Tourism

11,162

Table M102.1.18 Total economic benefit of saving water tank cost

Year	Number of served household	% of users in the total number of customers		Annual cost for facilities (Rs./year per household)		Total Water Tank Cost (Rs./year)			% of reduction of tank users	Total Economic Benefit of Saving Water Tanks (Rs./year)
		Ground Water Tank & Pump	Overhead Tank	Ground Water Tank & Pump	Overhead Tank	Ground Water Tank & Pump	Overhead Tank	TOTAL		
2012	299,306	69.0%	79.0%	1,231	382	254,227,523	90,324,565	344,552,088	5%	17,227,604
2013	306,662	69.0%	79.0%	1,231	382	260,475,636	92,544,458	353,020,094	10%	35,302,009
2014	314,130	69.0%	79.0%	1,231	382	266,818,881	94,798,151	361,617,032	15%	54,242,555
2015	321,709	69.0%	79.0%	1,231	382	273,256,408	97,085,342	370,341,750	20%	74,068,350
2016	329,338	69.0%	79.0%	1,231	382	279,736,404	99,387,622	379,124,026	25%	94,781,007
2017	337,091	69.0%	79.0%	1,231	382	286,321,724	101,727,322	388,049,046	30%	116,414,714
2018	344,971	69.0%	79.0%	1,231	382	293,014,918	104,105,348	397,120,266	35%	138,992,093
2019	352,979	69.0%	79.0%	1,231	382	299,816,833	106,522,003	406,338,836	40%	162,535,534
2020	361,121	69.0%	79.0%	1,231	382	306,732,566	108,979,095	415,711,661	45%	187,070,247
2021	369,348	69.0%	79.0%	1,231	382	313,720,498	111,461,839	425,182,337	50%	212,591,169
2022	377,712	69.0%	79.0%	1,231	382	320,824,796	113,985,927	434,810,723	50%	217,405,362
2023	386,216	69.0%	79.0%	1,231	382	328,048,008	116,552,264	444,600,272	50%	222,300,136
2024	394,863	69.0%	79.0%	1,231	382	335,392,684	119,161,756	454,554,440	50%	227,277,220
2025	403,658	69.0%	79.0%	1,231	382	342,863,069	121,815,911	464,678,980	50%	232,339,490

Table M102.1.19 Total economic benefit with the water supply M/P by saving cost for bottled water

Year	Total served population	Number of household	Total cost for bottled water (Rs.x1,000)	Total saved amount with the project (Rs.x1,000)
2012	1,370,822	299,306	1,048,768	524,384
2013	1,404,514	306,662	1,074,544	537,272
2014	1,438,714	314,130	1,100,712	550,356
2015	1,473,426	321,709	1,127,268	563,634
2016	1,508,366	329,338	1,154,000	577,000
2017	1,543,878	337,091	1,181,167	590,584
2018	1,579,966	344,971	1,208,778	604,389
2019	1,616,642	352,979	1,236,838	618,419
2020	1,653,936	361,121	1,265,368	632,684
2021	1,691,613	369,348	1,294,195	647,098
2022	1,729,920	377,712	1,323,503	661,752
2023	1,768,868	386,216	1,353,301	676,651
2024	1,808,473	394,863	1,383,600	691,800
2025	1,848,753	403,658	1,414,418	707,209

Table M102.1.20 Information regarding waterborne disease for economic analysis of water supply M/P

I. Information of waterborne disease

1. Number of patients of waterborne diseases

1) Average in hospital (2005)*1

	Unit	Diarrhea	Typhoid	Hepatitis	Malaria
(1) Out-patients	patients/year	205.8	0.7	5.6	356.1
(2) In-patients	patients/year	57.8	6.3	5.6	152.6

*1: Hospital with around 20 beds

2) Estimation of total number of patients in Goa (2005)

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

2. Average cost and days for medical treatment (2005)

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

3. Population of the Project beneficiaries in Domestic Uses

No. of Incrememental Beneficiaries 30% decrease of existing % in total population

II. Saving of decrease of medical cost in Goa (year 2005)

	In-patient treatment	Out-patient treatment	
(1) Diarrhea	9,153,879	3,692,742	
(2) Typhoid	2,471,742	12,558	
(3) Hepatitis	886,704	100,464	
(4) Malaria	24,167,556	6,389,676	
Sub-Total	36,679,881	10,195,440	
TOTAL			46,875,321 Rs./year

III. Annual savings due to reduction of absence from working

1. Annual absence days from working

	Unit	In-patient	Out-patient	
(1) Diarrhea	Person days	48,099	85,629	
(2) Typhoid	Person days	13,595	755	
(3) Hepatitis	Person days	21,840	10,920	
(4) Malaria	Person days	178,578	208,359	
Sub-Total	Person days	262,112	305,663	
			TOTAL	567,775 days/year

2. Annual saving due to reduction of absence from working

Absence days	Minimum wage	SWR *1		
170,333	87	70%	TOTAL	10,373,249 Rs./year

Note: *1; SWR is Shadow Wage Rate.

Table M102.1.21 Economic benefit from reduction of waterborne diseases

Year			2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
Population (x 1,000)			1577	1599	1621	1644	1667	1690	1714	1738	1762	1787	1812	1838	1864	1890	1890
Saving of decrease of medical cost in Goa (Rs.1,000)																	
	% in total population	Cost/case															
Dairrhea (out-patients)	3.74%	230	4,070	4,126	4,183	4,243	4,302	4,361	4,423	4,485	4,547	4,612	4,676	4,743	4,810	4,877	4,877
Dairrhea (in-patients)	1.05%	2,030	10,084	10,225	10,365	10,513	10,660	10,807	10,960	11,114	11,267	11,427	11,587	11,753	11,919	12,086	12,086
Typhoid (out-patients)	0.01%	230	11	11	11	11	12	12	12	12	12	12	13	13	13	13	13
Typhoid (in-patients)	0.11%	5,030	2,618	2,654	2,691	2,729	2,767	2,805	2,845	2,885	2,925	2,966	3,008	3,051	3,094	3,137	3,137
Hepatitis (out-patients)	0.10%	230	109	110	112	113	115	117	118	120	122	123	125	127	129	130	130
Hepatitis (in-patients)	0.10%	2,030	960	974	987	1,001	1,015	1,029	1,044	1,058	1,073	1,088	1,104	1,119	1,135	1,151	1,151
Malaria (out-patients)	6.48%	230	7,051	7,149	7,248	7,351	7,453	7,556	7,664	7,771	7,878	7,990	8,102	8,218	8,334	8,451	8,451
Malaria (in-patients)	2.78%	2,030	26,699	27,071	27,444	27,833	28,223	28,612	29,018	29,425	29,831	30,254	30,678	31,118	31,558	31,998	31,998
Sub-total			51,601	52,321	53,041	53,794	54,546	55,299	56,084	56,870	57,655	58,473	59,291	60,142	60,993	61,843	61,843
Savings due to reduction of absence from working (Rs.1,000)																	
	absence days	Min. wage															
Dairrhea (out-patients)	1.6	87	1,724	1,748	1,772	1,797	1,822	1,848	1,874	1,900	1,926	1,954	1,981	2,009	2,038	2,066	2,066
Dairrhea (in-patients)	3.2	87	968	982	995	1,009	1,023	1,037	1,052	1,067	1,082	1,097	1,112	1,128	1,144	1,160	1,160
Typhoid (out-patients)	4.2	87	12	12	12	13	13	13	13	13	14	14	14	14	14	15	15
Typhoid (in-patients)	8.3	87	263	267	270	274	278	282	286	290	294	298	302	307	311	315	315
Hepatitis (out-patients)	7.5	87	216	219	222	225	228	232	235	238	241	245	248	252	255	259	259
Hepatitis (in-patients)	15.0	87	432	438	444	451	457	463	470	476	483	490	497	504	511	518	518
Malaria (out-patients)	2.3	87	4,294	4,354	4,414	4,477	4,539	4,602	4,667	4,733	4,798	4,866	4,934	5,005	5,076	5,146	5,146
Malaria (in-patients)	4.5	87	3,604	3,655	3,705	3,757	3,810	3,863	3,917	3,972	4,027	4,084	4,141	4,201	4,260	4,320	4,320
Sub-total			11,514	11,675	11,835	12,003	12,171	12,339	12,514	12,690	12,865	13,047	13,230	13,420	13,610	13,799	13,799
TOTAL			63,116	63,996	64,877	65,797	66,718	67,638	68,599	69,559	70,520	71,520	72,521	73,561	74,602	75,643	75,643

Note: For example, economic benefit of 'Saving of decrease of medical cost in Goa' is calculated for diarrhea as follows;
Diarrhea, Out-patient: Saved amount = Population x 3.74% x (Ave. cost of out-patient treatment + Ave. cost of transportation to hospital) x 30%
Diarrhea, In-patient: Saved amount = Population x 1.05% x (Ave. cost of in-patient treatment + Ave. cost of transportation to hospital) x 30%
For example, economic benefit of 'Savings due to reduction of absence from working' is calculated as follows;
Diarrhea, Out-patient: Saved amount = Population x 3.74% x 3.2(Ave. days of out-patient treatment) x 30% x 87(minimum wage) x 0.7(shadow wage rate)
Diarrhea, In-patient: Saved amount = Population x 1.05% x 1.6(Ave. days of in-patient treatment) x 30% x 87(minimum wage) x 0.7(shadow wage rate)

Table M102.1.22 Financial Costs of Initial Investment, Water Supply Project

(Unit: Rs. In million)

Item	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Construction cost																				
1) Expansion project																				
(1) Water Treatment Plant	2,708.87	343.89	248.31	9.00	287.96	681.81	361.72	0.00	0.00	19.13	193.51	359.39	204.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(2) Transmission Main	2,133.97	65.40	65.34	20.16	323.69	948.19	341.07	41.10	35.31	28.48	56.19	153.20	55.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3) Reservoir	369.00	0.00	0.00	4.60	44.54	124.41	44.52	5.04	4.70	3.78	28.82	79.82	28.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(4) Pumping Station	43.40	0.00	0.00	1.56	3.88	5.89	3.07	1.11	0.40	0.12	5.49	16.44	5.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(5) Distribution Pipe	1,685.55	78.10	79.21	80.37	81.47	81.98	83.17	84.47	85.76	87.09	87.73	89.20	90.68	92.16	93.75	94.76	96.38	98.03	99.72	101.52
(6) House Connection	354.61	16.43	16.66	16.90	17.14	17.25	17.50	17.77	18.05	18.33	18.45	18.76	19.06	19.39	19.73	19.94	20.29	20.62	20.99	21.35
Sub total	7,295.40	503.82	409.52	132.59	758.68	1,859.53	851.05	149.49	144.22	156.93	390.19	716.81	403.94	111.55	113.48	114.70	116.67	118.65	120.71	122.87
2) Rehabilitation works																				
(1) Water Treatment Plant	1,170.95	30.57	30.54	87.50	244.69	275.21	121.38	3.37	0.00	0.00	33.00	43.83	58.57	119.52	71.77	25.50	25.50	0.00	0.00	0.00
(2) Transmission Main	1,165.77	15.92	15.92	15.92	123.50	338.64	123.48	44.38	45.59	45.59	48.33	48.33	48.33	48.33	48.33	48.33	48.00	19.87	19.81	19.17
(3) Reservoir	142.06	2.22	2.22	2.22	2.22	2.22	2.22	9.31	9.57	9.57	8.02	8.02	8.02	12.23	12.23	12.10	12.09	9.09	9.35	9.14
(4) Pumping Station	132.28	0.62	0.62	0.62	12.14	35.17	12.33	0.83	0.66	1.76	11.80	30.44	11.62	3.51	1.21	1.21	2.67	1.21	1.21	2.65
(5) Distribution Pipe	1,086.27	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.18	57.03
(6) House Connection	1,360.69	63.42	63.42	63.42	63.42	63.42	63.42	63.42	63.42	63.42	63.42	79.83	80.08	80.31	80.54	80.65	80.90	81.17	81.46	81.55
Sub total	5,058.02	169.93	169.90	226.86	503.15	771.84	380.01	178.49	176.42	177.52	221.75	267.63	263.80	321.08	271.26	224.97	226.34	168.52	169.01	169.54
3) Water Quality Control	25.50	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	25.50	0.00	0.00	0.00	0.00	17.50	0.00	0.00	0.00	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4) O&M Improvement																				
(1) Water supply system O&M Improvement	276.84	4.62	3.08	3.08	71.50	71.50	123.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(2) NRW reduction improvements	23.80	0.00	0.00	0.00	23.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	300.64	4.62	3.08	3.08	95.3	71.5	123.06	0	0	0	0	0	0	0	0	0	0	0	0	0
5) Institutional/organizational improvement *1	475.77	44.12	44.44	44.66	44.48	40.00	38.25	20.84	20.84	20.84	20.84	20.84	20.84	13.54	13.54	13.54	13.54	13.54	13.54	13.54
Sub total	475.77	44.12	44.44	44.66	44.48	40.00	38.25	20.84	20.84	20.84	20.84	20.84	20.84	13.54	13.54	13.54	13.54	13.54	13.54	13.54
Total	13,155.33	722.49	626.94	407.19	1,401.61	2,760.37	1,392.37	348.82	341.48	355.29	632.78	1,013.28	688.58	446.17	398.28	353.21	356.55	300.71	303.26	305.95
2. Engineering cost *2	1,366.09	76.82	137.31	175.37	117.22	166.27	96.88	37.14	36.40	37.79	63.10	97.51	67.47	46.10	41.31	36.81	37.14	31.56	31.81	32.08
3. Administration cost *3	749.89	42.17	40.44	31.36	78.16	148.34	76.38	20.34	19.94	20.70	35.84	56.58	38.84	25.29	22.66	20.18	20.37	17.29	17.43	17.58
4. Land acquisition cost *4	26.28	8.76	8.76	8.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical contingency *5	1,502.48	85.22	81.75	63.59	158.76	302.72	156.38	40.70	39.89	41.41	69.26	107.11	74.06	50.59	45.32	40.36	40.73	34.59	34.87	35.17
6. Price contingency (7%) *6	10,650.89	0.00	60.05	96.70	375.14	987.94	661.05	213.89	253.63	312.16	609.60	1,087.49	858.99	665.02	670.77	668.85	752.13	708.79	790.18	878.51
TOTAL minus Price contingency	16,800.07	935.46	895.20	686.27	1,755.75	3,377.70	1,722.01	447.00	437.71	455.19	800.98	1,274.48	868.95	568.15	507.57	450.56	454.79	384.15	387.37	390.78
TOTAL minus Price contingency (in million US$)	371.33	20.68	19.79	15.17	38.81	74.66	38.06	9.88	9.68	10.06	17.71	28.17	19.21	12.56	11.21	9.95	10.05	8.49	8.56	8.63
TOTAL	27,450.96	935.46	955.25	782.97	2,130.89	4,365.64	2,383.06	660.89	691.34	767.35	1,410.58	2,361.97	1,727.94	1,233.17	1,178.34	1,119.41	1,206.92	1,092.94	1,177.55	1,269.29
TOTAL (in million US$)	606.80	20.68	21.12	17.31	47.10	96.50	52.68	14.61	15.28	16.96	31.18	52.21	38.19	27.26	26.05	24.74	26.68	24.16	26.03	28.06

Notes: *1; 3% of the total direct construction cost. Total amount for each three phase is calculated and allocated equally to every year. Phase 1: 2007-2012, Phase 2: 2013-2018, Phase 3: 2019-2025

*2; 10% of the total construction cost

*3; 5% of the total construction cost and engineering cost

*4; 0.5% of the total of Water Treatment Plant, Transmission Main, Reservior, and Pumping Station.

*5; 10% of Construction cost and Engineering cost.

*6; Excluding minor equipment, construction cost is to be procured in India.

Table M102.1.23 Economic Costs of Initial Investment, Water Supply Project

(Unit: Rs. In million)

Item	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Construction cost *1																				
1) Expansion project																				
(1) Water Treatment Plant	2,537.68	322.16	232.62	8.43	269.76	638.72	338.86	0.00	0.00	17.92	181.28	336.68	191.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(2) Transmission Main	1,999.10	61.27	61.21	18.89	303.23	888.26	319.51	38.50	33.08	26.68	52.64	143.52	52.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(3) Reservoir	345.69	0.00	0.00	4.31	41.73	116.55	41.71	4.72	4.40	3.54	27.00	74.78	26.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(4) Pumping Station	40.65	0.00	0.00	1.46	3.63	5.52	2.88	1.04	0.37	0.11	5.14	15.40	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(5) Distribution Pipe	1,579.02	73.16	74.20	75.29	76.32	76.80	77.91	79.13	80.34	81.59	82.19	83.56	84.95	86.34	87.83	88.77	90.29	91.83	93.42	95.10
(6) House Connection	332.19	15.39	15.61	15.83	16.06	16.16	16.39	16.65	16.91	17.17	17.28	17.57	17.86	18.16	18.48	18.68	19.01	19.32	19.66	20.00
Sub total	6,834.33	471.98	383.64	124.21	710.73	1,742.01	797.26	140.04	135.10	147.01	365.53	671.51	378.42	104.50	106.31	107.45	109.30	111.15	113.08	115.10
2) Rehabilitation works																				
(1) Water Treatment Plant	1,096.96	28.64	28.61	81.97	229.23	257.82	113.71	3.16	0.00	0.00	30.91	41.06	54.87	111.97	67.23	23.89	23.89	0.00	0.00	0.00
(2) Transmission Main	1,092.12	14.91	14.91	14.91	115.69	317.24	115.68	41.58	42.71	42.71	45.28	45.28	45.28	45.28	45.28	45.28	44.97	18.61	18.56	17.96
(3) Reservoir	133.10	2.08	2.08	2.08	2.08	2.08	2.08	8.72	8.97	8.97	7.51	7.51	7.51	11.46	11.46	11.34	11.33	8.52	8.76	8.56
(4) Pumping Station	123.91	0.58	0.58	0.58	11.37	32.95	11.55	0.78	0.62	1.65	11.05	28.52	10.89	3.29	1.13	1.13	2.50	1.13	1.13	2.48
(5) Distribution Pipe	1,017.69	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.57	53.43
(6) House Connection	1,274.67	59.41	59.41	59.41	59.41	59.41	59.41	59.41	59.41	59.41	59.41	74.78	75.02	75.23	75.45	75.55	75.79	76.04	76.31	76.40
Sub total	4,738.45	159.19	159.16	212.52	471.35	723.07	356.00	167.22	165.28	166.31	207.73	250.72	247.14	300.80	254.12	210.76	212.05	157.87	158.33	158.83
3) Water Quality Control	23.88	0.00	0.00	0.00	0.00	16.39	0.00	0.00	0.00	0.00	0.00	7.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	23.88	0.00	0.00	0.00	0.00	16.39	0.00	0.00	0.00	0.00	0.00	7.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4) O&M Improvement																				
(1) Water supply system O&M Improvement	267.55	5.15	3.71	3.71	67.80	67.80	116.10	0.82	0.82	0.82	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(2) NRW reduction improvements	22.30	0.00	0.00	0.00	22.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	289.85	5.15	3.71	3.71	90.10	67.80	116.10	0.82	0.82	0.82	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5) Institutional/organizational improvement	409.00	41.33	41.63	37.60	37.45	33.68	32.21	17.55	17.55	17.55	17.55	17.55	17.55	11.40	11.40	11.40	11.40	11.40	11.40	11.40
Sub total	409.00	41.33	41.63	37.60	37.45	33.68	32.21	17.55	17.55	17.55	17.55	17.55	17.55	11.40	11.40	11.40	11.40	11.40	11.40	11.40
Total	12,295.51	677.65	588.14	378.04	1,309.63	2,582.95	1,301.57	325.63	318.75	331.69	591.63	947.27	643.11	416.70	371.83	329.61	332.75	280.42	282.81	285.33
2. Engineering cost *2	1,352.44	76.05	135.94	173.62	116.05	164.61	95.91	36.77	36.04	37.41	62.47	96.53	66.80	45.64	40.90	36.44	36.77	31.24	31.49	31.76
3. Administration cost *3	558.11	31.51	30.22	23.43	58.40	110.84	57.07	15.20	14.90	15.47	26.78	42.28	29.02	18.90	16.93	15.08	15.22	12.92	11.92	12.02
4. Land acquisition cost	26.28	8.76	8.76	8.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical contingency	1,364.81	75.37	72.41	55.17	142.57	274.76	139.75	36.24	35.48	36.91	65.41	104.38	70.99	46.23	41.27	36.61	36.95	31.17	31.43	31.71
TOTAL	15,597.15	869.34	835.47	639.02	1,626.65	3,133.16	1,594.30	413.84	405.17	421.48	746.29	1,190.46	809.92	527.47	470.93	417.74	421.69	355.75	357.65	360.82
TOTAL (in million US$)	344.79	19.22	18.47	14.13	35.96	69.26	35.24	9.15	8.96	9.32	16.50	26.31	17.90	11.66	10.41	9.23	9.32	7.86	7.91	7.98

Notes: *1; 20% of each each portion of the project is assumed to be labour cost. 80% of the labour is assumed to be unskilled labours

*2; It is assumed that 10% of the engineering cost is paid to local engineers.

Personel Income tax 10%

Shadow Exchange Rate 49.90 Rs./US$ (Exchange rate 45.24 Rs./US$)

Shadow Wage Rate for unskilled labour 70% of market price

Shadow Wage Rate for skilled labour 100% of market price

Opportunity cost of land 100% of market price

*3; It is assumed that 80% of the staff are unskilled labour.

Table M102.1.24 Financial and Economic Costs of Operation and Maintenance, Water Supply Project

Financial Costs

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Electricity																			
WTP	0.00	1.41	4.02	5.17	5.43	26.26	68.84	71.24	73.72	76.28	78.96	107.45	111.33	115.38	119.51	123.81	128.30	132.99	137.82
Others	0.02	0.02	0.02	0.02	0.02	0.02	1.14	1.21	1.27	1.34	1.41	1.49	5.81	6.09	6.36	6.65	6.94	7.25	7.57
Sub-total	0.02	1.43	4.04	5.19	5.45	26.28	69.98	72.45	74.99	77.62	80.37	108.94	117.14	121.47	125.87	130.46	135.24	140.24	145.39
2. Chemical cost	0.00	0.12	0.20	0.22	0.23	1.87	5.44	5.63	5.82	6.03	6.24	8.33	8.63	8.95	9.28	9.60	9.95	10.32	10.69
3. Personnel cost	0.00	7.05	14.10	14.10	14.10	19.75	52.45	52.45	52.45	52.45	52.45	57.70	57.70	57.70	57.70	57.70	57.70	57.70	57.70
4. Maintenance	0.00	2.15	4.59	4.88	5.35	12.38	32.37	33.03	33.71	34.43	36.17	45.15	47.27	48.44	49.61	50.86	52.13	53.48	54.85
5. Administration	0.00	0.32	0.69	0.73	0.74	1.80	4.80	4.90	5.00	5.10	5.22	6.56	6.88	7.06	7.23	7.42	7.61	7.81	8.02
TOTAL	0.02	11.07	23.62	25.12	25.87	62.08	165.04	168.46	171.97	175.63	180.45	226.68	237.62	243.62	249.69	256.04	262.63	269.55	276.65

Economic Costs

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Electricity																			
WTP	0.00	1.41	4.02	5.17	5.43	26.26	68.84	71.24	73.72	76.28	78.96	107.45	111.33	115.38	119.51	123.81	128.30	132.99	137.82
Others	0.02	0.02	0.02	0.02	0.02	0.02	1.14	1.21	1.27	1.34	1.41	1.49	5.81	6.09	6.36	6.65	6.94	7.25	7.57
Sub-total	0.02	1.43	4.04	5.19	5.45	26.28	69.98	72.45	74.99	77.62	80.37	108.94	117.14	121.47	125.87	130.46	135.24	140.24	145.39
2. Chemical cost	0.00	0.12	0.20	0.22	0.23	1.87	5.44	5.63	5.82	6.03	6.24	8.33	8.63	8.95	9.28	9.60	9.95	10.32	10.69
3. Personnel cost *1	0.00	4.82	9.64	9.64	9.64	13.51	35.88	35.88	35.88	35.88	35.88	39.47	39.47	39.47	39.47	39.47	39.47	39.47	39.47
4. Maintenance	0.00	2.15	4.59	4.88	5.35	12.38	32.37	33.03	33.71	34.43	36.17	45.15	47.27	48.44	49.61	50.86	52.13	53.48	54.85
5. Administration *1	0.00	0.24	0.51	0.55	0.55	1.34	3.58	3.66	3.73	3.81	3.90	4.90	5.14	5.27	5.40	5.54	5.69	5.84	5.99
TOTAL	0.02	8.76	18.98	20.48	21.22	55.38	147.25	150.65	154.13	157.77	162.56	206.79	217.65	223.60	229.63	235.93	242.48	249.35	256.39

Notes: *1; 80% of labour is assumed to be unskilled labours

Personel Income tax	10%	
Shadow Exchange Rate	49.90	Rs./US$
Shadow Wage Rate for unskilled labour	70%	of market price
Shadow Wage Rate for skilled labour	100%	of market price

Table M102.1.25 Unit Price of Water and Basic Data for Calculation

PHE **Water Charge** **TOTAL**

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Unit Price of Water (Rs./m^3)	
I	Domestic	186,351	4,253,224	22.82	**4.1**	**4.12**
II	Non-domestic	302	199,135	659.39	**14.8**	
III	Non-domestic	754	317,343	420.88	**22.4**	**25.69**
IV	Non-domestic	3,047	644,581	211.55	**30.7**	
	TOTAL	190,454	5,414,283	1,315	**0.0**	

Note: Because of the limitation of the existing data, unit price is estimated from the one month data regarding the Division III and Division XVII.

Division III Sub Division I Tiswadi Apr-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	27,527	603,708	21.93	0
II	Non-domestic	14	28,389	2,027.79	0
III	Non-domestic	0	0	0	0
IV	Non-domestic	587	77,102	131.35	0
	TOTAL	28,128	709,199	2,181.07	0

Division III Sub Division IV Ponda Jul-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	16,587	481,608	29.04	180,966
II	Non-domestic	0	0	0	0
III	Non-domestic	403	81,593	202.46	6,174
IV	Non-domestic	0	0	0	0
	TOTAL	16,990	563,201	231.50	187,140

Division III **TOTAL**

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	44,114	1,085,316	24.60	180,966
II	Non-domestic	14	28,389	2,027.79	0
III	Non-domestic	403	81,593	202.46	6,174
IV	Non-domestic	587	77,102	131.35	0
	TOTAL	45,118	1,272,400	2,386	

Division IX Sub Division I Vasco year 2004

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	15,541	442,968	28.50	
II	Non-domestic	75	12,554	167.39	
III	Non-domestic	45	3,198	71.07	
IV	Non-domestic	477	52,754	110.60	
	TOTAL	16,138	511,474	378	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Table M102.1.26 Unit Price of Water and Basic Data for Calculation (continued)

Division IX Sub Division II

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	11,477	421,434	36.72	
II	Non-domestic	67	4,990	74.48	
III	Non-domestic	44	4,298	97.68	
IV	Non-domestic	460	22,489	48.89	
	TOTAL	12,048	453,211	258	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division IX Sub Division III

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	21,327	441,191	20.69	
II	Non-domestic	57	56,929	998.75	
III	Non-domestic	35	75,748	2,164.23	
IV	Non-domestic	118	7,419	62.87	
	TOTAL	21,537	581,287	3,247	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division IX Sub Division IV

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	10,163	229,992	22.63	
II	Non-domestic	7	141	20.14	
III	Non-domestic	20	18,621	931.05	
IV	Non-domestic	138	11,182	81.03	
	TOTAL	10,328	259,936	1,055	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division IX 15 Bulk Consumers directly billed & collected by Div. IX Jun-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	0	0	0	
II	Non-domestic	4	94,345	23,586.25	1,560
III	Non-domestic	8	104,961	13,120.13	4,049
IV	Non-domestic	3	408,040	136,013.33	2,599
	TOTAL	15	607,346	172,720	8,208

Note:

Division IX **TOTAL**

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	58,508	1,535,585	26.25	454,621
II	Non-domestic	210	168,959	804.57	4,361
III	Non-domestic	152	206,826	1,360.70	8,464
IV	Non-domestic	1,196	501,884	419.64	14,647
	TOTAL	60,066	2,413,254	2,611	482,093

Table M102.1.27 Unit Price of Water and Basic Data for Calculation (continued)

Division XVII Sub Division I Bicholim Jun-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	11,364	305,572	26.89	109,497
II	Non-domestic	0	0	0.00	0
III	Non-domestic	9	6,955	772.78	174
IV	Non-domestic	270	10,998	40.73	2,664
	TOTAL	11,643	323,525	840	112,335

Division XVII Sub Division II Pernem Jun-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	8,000	103,987	13.00	72,024
II	Non-domestic				
III	Non-domestic				
IV	Non-domestic	55	770	14.00	598
	TOTAL	8,055	104,757	27	72,622

Division XVII Sub Division III Mapusa, Sub Division V Porvorim Jun-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	42,390	851,648	20.09	345,269
II	Non-domestic	0	0	0	0
III	Non-domestic	17	14,449	849.94	545
IV	Non-domestic	744	48,476	65.16	5,768
	TOTAL	43,151	914,573	935	351,582

Division XVII Sub Division IV Valpoi Jun-05

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	5,764	31,603	5.48	18,595
II	Non-domestic	0	0	0	0
III	Non-domestic	122	2,170	17.79	530
IV	Non-domestic	0	0	0	0
	TOTAL	5,886	33,773	23	19,125

Division XVII **TOTAL**

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	67,518	1,292,810	19.15	545,385
II	Non-domestic	0	0	0.00	0
III	Non-domestic	148	23,574	159.28	1,249
IV	Non-domestic	1,069	60,244	56.36	9,030
	TOTAL	68,735	1,376,628	235	555,664

Table M102.1.28 Unit Price of Water and Basic Data for Calculation (continued)

Division XX Sub Division I

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	5,155	103,062	19.99	
II	Non-domestic	11	244	22.18	
III	Non-domestic	25	965	38.60	
IV	Non-domestic	102	2,399	23.52	
	TOTAL	5,293	106,670	104	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division XX Sub Division II

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	2,553	52,146	20.43	
II	Non-domestic	6	147	24.50	
III	Non-domestic	6	265	44.17	
IV	Non-domestic	11	496	45.09	
	TOTAL	2,576	53,054	134	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division XX Sub Division III Quepem

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	5,281	114,842	21.75	
II	Non-domestic	17	396	23.29	
III	Non-domestic	6	3,689	614.83	
IV	Non-domestic	30	681	22.70	
	TOTAL	5,334	119,608	683	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division XX Sub Division IV

No.	Category	Number of Connection*2	Water Volume Billed*3	Water volume billed / connection	Meter rent Charge
I	Domestic	3,222	69,463	21.56	
II	Non-domestic	44	1,000	22.73	
III	Non-domestic	14	431	30.79	
IV	Non-domestic	52	1,775	34.13	
	TOTAL	3,332	72,669	109	

Note: *2; Number of customer is on the average of 2004. *3; Average of the year 2004.

Division XX **TOTAL**

No.	Category	Number of Connection	Water Volume Billed	Water volume billed / connection	Meter rent Charge
I	Domestic	16,211	339,513	20.94	101,634
II	Non-domestic	78	1,787	22.91	257
III	Non-domestic	51	5,350	104.90	382
IV	Non-domestic	195	5,351	27.44	1,219
	TOTAL	16,535	352,001	176	103,491

Table M102.1.29 Detailed information of water charge, meter rent charge of bulk consumers

Month: June 2005

No.	Name of Consumer	Category	Days	Water Volume Billed	Water Volume Billed / Month	Water Charge	Water Charge / Month	Meter rent Charge	Installation Bill	Sewerage Charges	Unit Price of water supply	Meter rent / month	Category in Tariff
1	The Asst. Engineer Elect S.D. II (EHV) Verna	Govt.	34	473	423	2,310	2,067	68			4.9	60	2
2	The Garrison Engineer N.O.F.R.A.	Defence	34	74,750	66,872	747,500	668,719	397			10.0	350	2
3	The Garrison Engineer, Varunapuri	Defence	34	28,060	25,103	280,600	251,027	1,133		140,300	10.0	1,000	2
4	The Garrison Engineer, Coast Guard	Defence	34	2,177	1,948	21,770	19,476	170			10.0	150	2
	Sub-Total Category 2			**105,460**	**94,345**	**1,052,180**	**941,288**	**1,768**	**0**	**140,300**	**10.0**	**1,560**	
1	The Regional Manager G.D.D.I.D.C. Electronic City Verna	IN	34	35,225	31,513	704,500	630,251	1,133			20.0	1,000	3
2	The Industrial Estate Sancoale Goa	IN	34	9,377	8,389	187,540	167,775	1,133			20.0	1,000	3
3	The Industrial Development Corp. A/C Meta Strips Ltd.	IN	34	5,750	5,144	115,000	102,880	397			20.0	350	3
4	The Reliance Energy Ltd.	IN	34	37,040	33,136	740,800	662,725	1,133			20.0	1,000	3
5	The Western India Shipyard Ltd.	IN	34	3,400	3,042	68,000	60,833	170			20.0	150	3
6	Select Holiday Resorts Pvt. Ltd.	Hotel reosrt	34	3,941	3,526	78,820	70,513	170			20.0	150	3
7	Park Plaza Resorts	Hotel reosrt	34	4,193	3,751	83,860	75,022	170			20.0	150	3
8	Morepen Hotels Ltd.	Hotel reosrt	34	18,400	16,461	368,000	329,216	283			20.0	250	3
	Sub-Total Category 3			**117,326**	**104,961**	**2,346,520**	**2,099,215**	**4,589**	**0**	**0**	**20.0**	**4,049**	
1	Zuari Industries Ltd.	IN	34	408,000	365,000	11,992,245	10,728,356	1,699			29.4	1,499	4
2	Advani Hotels & Resorts India Ltd. Flight	Hotel reosrt	34	2,040	1,825	61,200	54,750	113			30.0	100	4
3	The Mormugao Port Trust Steamer Tank	Port Trust	34	46,070	41,215	1,382,100	1,236,438	1,133			30.0	1,000	4
	Sub-Total Category 4			**456,110**	**408,040**	**13,435,545**	**12,019,544**	**2,945**	**0**	**0**	**29.5**	**2,599**	
	TOTAL			**678,896**	**607,346**	**16,834,245**	**15,060,048**	**9,302**	**0**	**140,300**	**24.8**	**8,208**	

Table M102.1.30 Average Installation Charge and Meter Rent Charge and Basic Data

Proportion of number of customers for each meter size — **Average Installation Charge**

No.	Category	Size of connection	Amount per connection (Rs.)	No. of existing connection *1	% of No. of connection	Weghted average (Rs./connection)
1	Domestic & Small hotels	Upto 20mm	500	159,090	100.0%	500
2		Above 20mm	1,000	0	0.0%	0
	Sub-Total Domestic			159,090	100.0%	**500**
3	Non-Domestic / Comercial	Upto 20mm	2,000	2,659	82.2%	1,643
4		Above 20mm upto 25mm	5,000	403	12.5%	623
5		Above 25mm	10,000	174	5.4%	538
	Sub-Total Non-Domestic			3,236	100.0%	**2,804**
	TOTAL			162,326		

Installation bill per costomer : Domestic 500 Non-domestic 2,804

Note: Because of data limitation for meter rent charge, number of connection of Sub-division I, Division III, is not included in the existing connection

Proportion of number of customers for each meter size — **Average Meter Rent Charge**

No.	Category	Indicted size of connection	Number of connection	New unit of meter rent charge / month	% of No. of connection	Weghted average (Rs./connection month)
1	Domestic & Small hotels	15mm	142,503	15	89.6%	13.44
2		20mm	16,587	20	10.4%	2.09
	Sub-Total Domestic		159,090		100.0%	**15.53**
3	Non-Domestic / Comercial	15mm	1,463	15	45.2%	6.78
4		20mm	1,196	20	37.0%	7.39
5		25mm	403	25	12.5%	3.11
6		50mm	152	150	4.7%	7.05
7		100mm	22	250	0.7%	1.70
	Sub-Total Non-Domestic		3,236		100.0%	**26.03**
	TOTAL		162,326			

Meter rent charge per costomer : Domestic 15.53 Non-domestic 26.03

Note: Because of the data limitation, unit price is estimated from the one month data regarding the Division III and Division XVII.
Meter rent charge and Installation bill is estimated based on the data of total number of connections of only the Sub-divisions which include Meter rent charge / Installation bill.
Unit Price of Installation bill of each domestic and non-domestic is set by each unit price of meter rent and existing tariff table.

Division III — Sub Division IV — Ponda — Jul-05

No.	Category	Number of Customer	Meter rent Charge	Meter rent charge / customer	Indicated size of connection*1
I	Domestic & Small Hotels	16,587	180,966	10.9	20 mm
II	Non-domestic	0	0		
III	Non-domestic	403	6,174	15.3	25mm
IV	Non-domestic	0	0		
	TOTAL	16,990	187,140	11.0	

Note: *1: Size of connection is induced from the calculated meter rent charge/customer and mater rent charge setting of the tariff table.

Division IX — **TOTAL**

No.	Category	Number of Customer	Meter rent Charge	Meter rent charge / customer*1	Indicated size of connection
I	Domestic & Small Hotels	58,696	454,621	7.7	15 mm
II	Non-domestic	22	4,361	198.2	100 mm
III	Non-domestic	152	8,464	55.7	50 mm
IV	Non-domestic	1,196	14,647	12.2	20 mm
	TOTAL	60,066	482,093	8.0	

Note: *1: Size of connection is induced from the calculated meter rent charge/customer and mater rent charge setting of the tariff table.

Division XVII — **TOTAL**

No.	Category	Number of Customer	Meter rent Charge	Meter rent charge / customer*1	Indicated size of connection
I	Domestic & Small Hotels	67,518	545,385	8.1	15 mm
II	Non-domestic	0	0		
III	Non-domestic	148	1,249	8.4	15 mm
IV	Non-domestic	1,069	9,030	8.4	15 mm
	TOTAL	68,735	555,664	8.1	

Note: *1: Size of connection is induced from the calculated meter rent charge/customer and mater rent charge setting of the tariff table.

Division XX — **TOTAL**

No.	Category	Number of Customer	Meter rent Charge*1	Meter rent charge / customer*1	Indicated size of connection
I	Domestic & Small Hotels	16,289	101,890	6.3	15 mm
II	Non-domestic	0	0		
III	Non-domestic	51	382	7.5	15 mm
IV	Non-domestic	195	1,219	6.2	15 mm
	TOTAL	16,535	103,491	6.3	

Note: *1: Size of connection is induced from the calculated meter rent charge/customer and mater rent charge setting of the tariff table.

Table M102.1.31 Financial Benefit of Water Supply Project

Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	29,382	29,233	29,068	61,130	67,671	74,336	81,120	87,992	94,996	110,786	118,276	125,910	133,519	141,273	149,177	157,658	166,365	166,365
Water supply volume (m^3/day): Day Av	0	0	24,283	24,160	24,023	50,521	55,927	61,435	67,041	72,720	78,509	91,559	97,749	104,058	110,346	116,755	123,287	130,296	137,492	137,492
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	16,440	16,501	16,576	35,213	39,317	43,619	48,068	52,577	57,312	67,479	72,628	78,044	83,532	89,084	94,931	101,240	107,656	107,656
(4) Unit Price *1	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41	4.41
(5) Total water charge billed per year	0.00	0.00	26.46	26.56	26.68	56.68	63.29	70.21	77.37	84.63	92.25	108.62	116.91	125.62	134.46	143.39	152.81	162.96	173.29	173.29
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	25.35	25.47	25.61	54.47	60.88	67.61	74.58	81.67	89.11	105.04	113.17	121.73	130.43	139.23	148.53	158.56	168.78	168.78
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	18,792	5,521	5,624	5,732	5,838	5,939	6,054	6,168	6,286	6,410	6,493	6,620	6,746	7,136	7,270	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	9.40	2.76	2.81	2.87	2.92	2.97	3.03	3.08	3.14	3.21	3.25	3.31	3.37	3.57	3.64	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	18,792	24,313	29,937	35,669	41,507	47,446	53,500	59,668	65,954	72,364	78,857	85,477	92,223	99,359	106,629	106,629
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	3.50	4.53	5.58	6.65	7.74	8.84	9.97	11.12	12.29	13.49	14.70	15.93	17.19	18.52	19.87	19.87
TOTAL REVENUE	0.00	0.00	25.35	25.47	38.51	61.76	69.27	77.13	85.24	93.48	102.11	119.24	128.60	138.43	148.38	158.47	169.09	180.65	192.29	188.65

Note: *1 Unit price:Rs.4.41/m^3 per month
*2 Weighted average installation cost: Rs.500/case
*3 Weighted average meter rent charge: Rs.15.53/case per month

Non-Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	5,618	5,767	5,932	18,181	21,330	24,706	28,316	32,184	36,321	46,652	51,702	57,096	62,836	68,962	75,499	82,496	89,966	89,966
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	3,803	3,939	4,093	12,672	14,995	17,541	20,303	23,269	26,514	34,383	38,415	42,822	47,567	52,618	58,134	64,099	70,443	70,443
(4) Unit Price *1	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49	27.49
(5) Total water charge billed	0.00	0.00	38.16	39.52	41.07	127.15	150.46	176.00	203.72	233.48	266.04	344.99	385.45	429.67	477.28	527.96	583.31	643.16	706.81	706.81
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	36.56	37.90	39.43	122.19	144.74	169.49	196.39	225.31	256.99	333.61	373.12	416.35	462.96	512.65	566.98	625.79	688.43	688.43
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	989	290	296	301	308	312	319	325	332	338	343	348	354	376	382	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	2.77	0.81	0.83	0.84	0.86	0.87	0.89	0.91	0.93	0.95	0.96	0.98	0.99	1.05	1.07	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	989	1,279	1,575	1,876	2,184	2,496	2,815	3,140	3,472	3,810	4,153	4,501	4,855	5,231	5,613	5,613
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	0.31	0.40	0.49	0.59	0.68	0.78	0.88	0.98	1.08	1.19	1.30	1.41	1.52	1.63	1.75	1.75
TOTAL REVENUE	0.00	0.00	36.56	37.90	42.51	123.40	146.06	170.92	197.93	226.96	258.76	335.50	375.13	418.49	465.22	515.04	569.49	628.47	691.25	690.18

Note: *1 Unit price:Rs.27.49/m^3 per month
*2 Weighted average installation cost: Rs.2,804/case
*3 Weighted average meter rent charge: Rs.26.03/case per month

Table M102.1.32 Cost Benefit Stream of M/P for water supply: Case 2

Annual tariff increase at: 3.0% for Domestic *1
Annual tariff increase at: 1.5% for Non-Domestic *1

(Unit: Rs.in million)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-5	2007	935.46	0.02		935.48	0.00	0.00	0.00	-935.48
-4	2008	895.20	11.07		906.27	0.00	0.00	0.00	-906.27
-3	2009	686.27	23.62		709.89	26.90	37.66	64.56	-645.33
-2	2010	1,755.75	25.12		1,780.87	27.84	39.63	67.47	-1,713.40
-1	2011	3,377.70	25.87		3,403.57	41.71	44.92	86.63	-3,316.94
0	2012	1,722.01	62.08		1,784.09	70.41	132.82	203.23	-1,580.86
1	2013	447.00	165.04		612.04	81.00	159.54	240.54	-371.50
2	2014	437.71	168.46		606.17	92.62	189.48	282.10	-324.07
3	2015	455.19	171.97		627.16	105.04	222.71	327.75	-299.41
4	2016	800.98	175.63		976.61	118.30	259.17	377.47	-599.14
5	2017	1,274.48	180.45		1,454.93	132.63	299.90	432.53	-1,022.40
6	2018	868.95	226.68		1,095.63	159.48	394.72	554.20	-541.43
7	2019	568.15	237.62		805.77	176.58	448.02	624.60	-181.17
8	2020	507.57	243.62		751.19	195.29	507.24	702.53	-48.66
9	2021	450.56	249.69		700.25	214.92	572.33	787.25	87.00
10	2022	454.79	256.04		710.83	235.83	643.15	878.98	168.15
11	2023	384.15	262.63		646.78	258.67	721.91	980.58	333.80
12	2024	387.37	269.55		656.92	283.84	808.54	1,092.38	435.46
13	2025	390.78	276.65		667.43	310.56	902.62	1,213.18	545.75
14	2026		276.65	143.99	420.64	306.92	901.55	1,208.47	787.83
15	2027		276.65	340.91	617.56	306.92	901.55	1,208.47	590.91
16	2028		276.65	180.87	457.52	306.92	901.55	1,208.47	750.95
17	2029		276.65		276.65	306.92	901.55	1,208.47	931.82
18	2030		276.65	9.57	286.22	306.92	901.55	1,208.47	922.25
19	2031		276.65	96.76	373.41	306.92	901.55	1,208.47	835.06
20	2032		276.65	179.70	456.35	306.92	901.55	1,208.47	752.12
21	2033		276.65	102.08	378.73	306.92	901.55	1,208.47	829.74
22	2034		276.65		276.65	306.92	901.55	1,208.47	931.82
23	2035		276.65		276.65	306.92	901.55	1,208.47	931.82
24	2036		276.65		276.65	306.92	901.55	1,208.47	931.82
25	2037		276.65		276.65	306.92	901.55	1,208.47	931.82
26	2038		276.65		276.65	306.92	901.55	1,208.47	931.82
27	2039		276.65		276.65	306.92	901.55	1,208.47	931.82
28	2040		276.65		276.65	306.92	901.55	1,208.47	931.82
29	2041		276.65	143.99	420.64	306.92	901.55	1,208.47	787.83
30	2042		276.65	340.91	617.56	306.92	901.55	1,208.47	590.91

FIRR: 1.14% NPV: -3,473 million Rs. B/C: 0.808

Note: *1: Increase ratio excludes the inflation rate.

Table M102.1.33 Financial Benefit of M/P for water supply: Case 2

Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	29,382	29,233	29,068	61,130	67,671	74,336	81,120	87,992	94,996	110,786	118,276	125,910	133,519	141,273	149,177	157,658	166,365	166,365
Water supply volume (m^3/day): Day Av	0	0	24,283	24,160	24,023	50,521	55,927	61,435	67,041	72,720	78,509	91,559	97,749	104,058	110,346	116,755	123,287	130,296	137,492	137,492
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	16,440	16,501	16,576	35,213	39,317	43,619	48,068	52,577	57,312	67,479	72,628	78,044	83,532	89,084	94,931	101,240	107,656	107,656
(4) Unit Price *1	4.41	4.54	4.68	4.82	4.96	5.11	5.26	5.42	5.58	5.75	5.92	6.10	6.28	6.47	6.66	6.86	7.07	7.28	7.50	7.50
(5) Total water charge billed per year	0.00	0.00	28.08	29.03	30.01	65.68	75.48	86.29	97.90	110.35	123.84	150.24	166.48	184.30	203.06	223.06	244.97	269.01	294.71	294.71
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	26.90	27.84	28.81	63.12	72.61	83.10	94.38	106.49	119.63	145.28	161.15	178.59	196.97	216.59	238.11	261.75	287.05	287.05
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	18,792	5,521	5,624	5,732	5,838	5,939	6,054	6,168	6,286	6,410	6,493	6,620	6,746	7,136	7,270	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	9.40	2.76	2.81	2.87	2.92	2.97	3.03	3.08	3.14	3.21	3.25	3.31	3.37	3.57	3.64	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	18,792	24,313	29,937	35,669	41,507	47,446	53,500	59,668	65,954	72,364	78,857	85,477	92,223	99,359	106,629	106,629
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	3.50	4.53	5.58	6.65	7.74	8.84	9.97	11.12	12.29	13.49	14.70	15.93	17.19	18.52	19.87	19.87
TOTAL REVENUE	0.00	0.00	26.90	27.84	41.71	70.41	81.00	92.62	105.04	118.30	132.63	159.48	176.58	195.29	214.92	235.83	258.67	283.84	310.56	306.92

Note: *1 Unit price:Rs.4.41/m^3 per month Tariff is assumed to be raised at 3.00% annually over the inflation rate.
*2 Weighted average installation cost: Rs.500/case
*3 Weighted average meter rent charge: Rs.15.53/case per month

Non-Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	5,618	5,767	5,932	18,181	21,330	24,706	28,316	32,184	36,321	46,652	51,702	57,096	62,836	68,962	75,499	82,496	89,966	89,966
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	3,803	3,939	4,093	12,672	14,995	17,541	20,303	23,269	26,514	34,383	38,415	42,822	47,567	52,618	58,134	64,099	70,443	70,443
(4) Unit Price *1	27.49	27.90	28.32	28.74	29.17	29.61	30.05	30.50	30.96	31.42	31.89	32.37	32.86	33.35	33.85	34.36	34.88	35.40	35.93	35.93
(5) Total water charge billed	0.00	0.00	39.31	41.32	43.58	136.95	164.47	195.28	229.43	266.86	308.62	406.24	460.75	521.26	587.70	659.90	740.12	828.22	923.82	923.82
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	37.66	39.63	41.84	131.61	158.22	188.05	221.17	257.52	298.13	392.83	446.01	505.10	570.07	640.76	719.40	805.86	899.80	899.80
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	989	290	296	301	308	312	319	325	332	338	343	348	354	376	382	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	2.77	0.81	0.83	0.84	0.86	0.87	0.89	0.91	0.93	0.95	0.96	0.98	0.99	1.05	1.07	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	989	1,279	1,575	1,876	2,184	2,496	2,815	3,140	3,472	3,810	4,153	4,501	4,855	5,231	5,613	5,613
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	0.31	0.40	0.49	0.59	0.68	0.78	0.88	0.98	1.08	1.19	1.30	1.41	1.52	1.63	1.75	1.75
TOTAL REVENUE	0.00	0.00	37.66	39.63	44.92	132.82	159.54	189.48	222.71	259.17	299.90	394.72	448.02	507.24	572.33	643.15	721.91	808.54	902.62	901.55

Note: *1 Unit price:Rs.27.49/m^3 per month Tariff is assumed to be raised at 1.50% annually over the inflation rate.
*2 Weighted average installation cost: Rs.2,804/case
*3 Weighted average meter rent charge: Rs.26.03/case per month

Table M102.1.34 Cost Benefit Stream of M/P for water supply: Case 3

Annual tariff increase at: 4.0% for Domestic *1
Annual tariff increase at: 2.5% for Non-Domestic *1

(Unit: Rs.in million)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-5	2007	935.46	0.02		935.48	0.00	0.00	0.00	-935.48
-4	2008	895.20	11.07		906.27	0.00	0.00	0.00	-906.27
-3	2009	686.27	23.62		709.89	27.42	38.41	65.83	-644.06
-2	2010	1,755.75	25.12		1,780.87	28.65	40.82	69.47	-1,711.40
-1	2011	3,377.70	25.87		3,403.57	42.87	46.60	89.47	-3,314.10
0	2012	1,722.01	62.08		1,784.09	73.62	139.45	213.07	-1,571.02
1	2013	447.00	165.04		612.04	85.43	169.17	254.60	-357.44
2	2014	437.71	168.46		606.17	98.44	202.92	301.36	-304.81
3	2015	455.19	171.97		627.16	112.65	240.85	353.50	-273.66
4	2016	800.98	175.63		976.61	127.93	283.10	411.03	-565.58
5	2017	1,274.48	180.45		1,454.93	144.75	330.84	475.59	-979.34
6	2018	868.95	226.68		1,095.63	175.68	439.75	615.43	-480.20
7	2019	568.15	237.62		805.77	196.34	503.93	700.27	-105.50
8	2020	507.57	243.62		751.19	219.03	576.16	795.19	44.00
9	2021	450.56	249.69		700.25	243.31	656.53	899.84	199.59
10	2022	454.79	256.04		710.83	269.29	744.98	1,014.27	303.44
11	2023	384.15	262.63		646.78	298.08	844.42	1,142.50	495.72
12	2024	387.37	269.55		656.92	330.22	955.14	1,285.36	628.44
13	2025	390.78	276.65		667.43	364.52	1,076.92	1,441.44	774.01
14	2026		276.65	143.99	420.64	360.88	1,075.85	1,436.73	1,016.09
15	2027		276.65	340.91	617.56	360.88	1,075.85	1,436.73	819.17
16	2028		276.65	180.87	457.52	360.88	1,075.85	1,436.73	979.21
17	2029		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
18	2030		276.65	9.57	286.22	360.88	1,075.85	1,436.73	1,150.51
19	2031		276.65	96.76	373.41	360.88	1,075.85	1,436.73	1,063.32
20	2032		276.65	179.70	456.35	360.88	1,075.85	1,436.73	980.38
21	2033		276.65	102.08	378.73	360.88	1,075.85	1,436.73	1,058.00
22	2034		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
23	2035		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
24	2036		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
25	2037		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
26	2038		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
27	2039		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
28	2040		276.65		276.65	360.88	1,075.85	1,436.73	1,160.08
29	2041		276.65	143.99	420.64	360.88	1,075.85	1,436.73	1,016.09
30	2042		276.65	340.91	617.56	360.88	1,075.85	1,436.73	819.17

FIRR: 2.56% NPV: -1,045 million Rs. B/C: 0.942

Note: *1: Increase ratio excludes the inflation rate.

Table M102.1.35 Financial Benefit of M/P for water supply: Case 3

Domestic

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	29,382	29,233	29,068	61,130	67,671	74,336	81,120	87,992	94,996	110,786	118,276	125,910	133,519	141,273	149,177	157,658	166,365	166,365
Water supply volume (m^3/day): Day Av	0	0	24,283	24,160	24,023	50,521	55,927	61,435	67,041	72,720	78,509	91,559	97,749	104,058	110,346	116,755	123,287	130,296	137,492	137,492
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	16,440	16,501	16,576	35,213	39,317	43,619	48,068	52,577	57,312	67,479	72,628	78,044	83,532	89,084	94,931	101,240	107,656	107,656
(4) Unit Price *1	4.41	4.59	4.77	4.96	5.16	5.37	5.58	5.80	6.03	6.27	6.52	6.78	7.05	7.33	7.62	7.92	8.24	8.57	8.91	8.91
(5) Total water charge billed per year	0.00	0.00	28.62	29.87	31.22	69.02	80.08	92.34	105.80	120.33	136.39	166.99	186.89	208.80	232.33	257.52	285.51	316.68	350.11	350.11
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	27.42	28.65	29.97	66.33	77.04	88.92	101.99	116.12	131.75	161.48	180.91	202.33	225.36	250.05	277.52	308.13	341.01	341.01
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	18,792	5,521	5,624	5,732	5,838	5,939	6,054	6,168	6,286	6,410	6,493	6,620	6,746	7,136	7,270	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	9.40	2.76	2.81	2.87	2.92	2.97	3.03	3.08	3.14	3.21	3.25	3.31	3.37	3.57	3.64	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	18,792	24,313	29,937	35,669	41,507	47,446	53,500	59,668	65,954	72,364	78,857	85,477	92,223	99,359	106,629	106,629
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	3.50	4.53	5.58	6.65	7.74	8.84	9.97	11.12	12.29	13.49	14.70	15.93	17.19	18.52	19.87	19.87
TOTAL REVENUE	0.00	0.00	27.42	28.65	42.87	73.62	85.43	98.44	112.65	127.93	144.75	175.68	196.34	219.03	243.31	269.29	298.08	330.22	364.52	360.88

Note: *1 Unit price:Rs.4.41/m^3 per month Tariff is assumed to be raised at 4.00% annually over the inflation rate.
*2 Weighted average installation cost: Rs.500/case
*3 Weighted average meter rent charge: Rs.15.53/case per month

Non-Domestic

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	5,618	5,767	5,932	18,181	21,330	24,706	28,316	32,184	36,321	46,652	51,702	57,096	62,836	68,962	75,499	82,496	89,966	89,966
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	3,803	3,939	4,093	12,672	14,995	17,541	20,303	23,269	26,514	34,383	38,415	42,822	47,567	52,618	58,134	64,099	70,443	70,443
(4) Unit Price *1	27.49	28.18	28.88	29.60	30.34	31.10	31.88	32.68	33.50	34.34	35.20	36.08	36.98	37.90	38.85	39.82	40.82	41.84	42.89	42.89
(5) Total water charge billed	0.00	0.00	40.09	42.56	45.33	143.85	174.48	209.23	248.25	291.66	340.65	452.80	518.51	592.38	674.51	764.77	866.16	978.89	1,102.77	1,102.77
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	38.41	40.82	43.52	138.24	167.85	201.49	239.31	281.45	329.07	437.86	501.92	574.02	654.27	742.59	841.91	952.46	1,074.10	1,074.10
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	989	290	296	301	308	312	319	325	332	338	343	348	354	376	382	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	2.77	0.81	0.83	0.84	0.86	0.87	0.89	0.91	0.93	0.95	0.96	0.98	0.99	1.05	1.07	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	989	1,279	1,575	1,876	2,184	2,496	2,815	3,140	3,472	3,810	4,153	4,501	4,855	5,231	5,613	5,613
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	0.31	0.40	0.49	0.59	0.68	0.78	0.88	0.98	1.08	1.19	1.30	1.41	1.52	1.63	1.75	1.75
TOTAL REVENUE	0.00	0.00	38.41	40.82	46.60	139.45	169.17	202.92	240.85	283.10	330.84	439.75	503.93	576.16	656.53	744.98	844.42	955.14	1,076.92	1,075.85

Note: *1 Unit price:Rs.27.49/m^3 per month Tariff is assumed to be raised at 2.50% annually over the inflation rate.
*2 Weighted average installation cost: Rs.2,804/case
*3 Weighted average meter rent charge: Rs.26.03/case per month

Table M102.1.36 Cost Benefit Stream of M/P for water supply: Case 4

Annual tariff increase at: 4.5% for Domestic *1
Annual tariff increase at: 3.0% for Non-Domestic *1

(Unit: Rs.in million)

Year		Cost				Benefit			Balance
		Const-ruction	O&M	Replace-ment	Total	Domestic	Non-domestic	Total	
-5	2007	935.46	0.02		935.48	0.00	0.00	0.00	-935.48
-4	2008	895.20	11.07		906.27	0.00	0.00	0.00	-906.27
-3	2009	686.27	23.62		709.89	27.71	38.78	66.49	-643.40
-2	2010	1,755.75	25.12		1,780.87	29.12	41.41	70.53	-1,710.34
-1	2011	3,377.70	25.87		3,403.57	43.50	47.44	90.94	-3,312.63
0	2012	1,722.01	62.08		1,784.09	75.35	142.82	218.17	-1,565.92
1	2013	447.00	165.04		612.04	87.91	174.12	262.03	-350.01
2	2014	437.71	168.46		606.17	101.81	209.82	311.63	-294.54
3	2015	455.19	171.97		627.16	117.05	250.21	367.26	-259.90
4	2016	800.98	175.63		976.61	133.48	295.47	428.95	-547.66
5	2017	1,274.48	180.45		1,454.93	151.82	347.01	498.83	-956.10
6	2018	868.95	226.68		1,095.63	185.20	463.53	648.73	-446.90
7	2019	568.15	237.62		805.77	207.89	533.79	741.68	-64.09
8	2020	507.57	243.62		751.19	233.11	613.41	846.52	95.33
9	2021	450.56	249.69		700.25	260.17	702.35	962.52	262.27
10	2022	454.79	256.04		710.83	289.50	800.92	1,090.42	379.59
11	2023	384.15	262.63		646.78	322.00	912.06	1,234.06	587.28
12	2024	387.37	269.55		656.92	358.27	1,036.64	1,394.91	737.99
13	2025	390.78	276.65		667.43	397.44	1,174.34	1,571.78	904.35
14	2026		276.65	143.99	420.64	393.80	1,173.27	1,567.07	1,146.43
15	2027		276.65	340.91	617.56	393.80	1,173.27	1,567.07	949.51
16	2028		276.65	180.87	457.52	393.80	1,173.27	1,567.07	1,109.55
17	2029		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
18	2030		276.65	9.57	286.22	393.80	1,173.27	1,567.07	1,280.85
19	2031		276.65	96.76	373.41	393.80	1,173.27	1,567.07	1,193.66
20	2032		276.65	179.70	456.35	393.80	1,173.27	1,567.07	1,110.72
21	2033		276.65	102.08	378.73	393.80	1,173.27	1,567.07	1,188.34
22	2034		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
23	2035		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
24	2036		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
25	2037		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
26	2038		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
27	2039		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
28	2040		276.65		276.65	393.80	1,173.27	1,567.07	1,290.42
29	2041		276.65	143.99	420.64	393.80	1,173.27	1,567.07	1,146.43
30	2042		276.65	340.91	617.56	393.80	1,173.27	1,567.07	949.51

FIRR: 3.26% NPV: 331 million Rs. B/C: 1.018

Note: *1: Increase ratio excludes the inflation rate.

Table M102.1.37 Financial Benefit of M/P for water supply: Case 4

Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	29,382	29,233	29,068	61,130	67,671	74,336	81,120	87,992	94,996	110,786	118,276	125,910	133,519	141,273	149,177	157,658	166,365	166,365
Water supply volume (m^3/day): Day Av	0	0	24,283	24,160	24,023	50,521	55,927	61,435	67,041	72,720	78,509	91,559	97,749	104,058	110,346	116,755	123,287	130,296	137,492	137,492
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	16,440	16,501	16,576	35,213	39,317	43,619	48,068	52,577	57,312	67,479	72,628	78,044	83,532	89,084	94,931	101,240	107,656	107,656
(4) Unit Price *1	4.41	4.61	4.82	5.04	5.27	5.51	5.76	6.02	6.29	6.57	6.87	7.18	7.50	7.84	8.19	8.56	8.95	9.35	9.77	9.77
(5) Total water charge billed per year	0.00	0.00	28.92	30.36	31.88	70.82	82.66	95.84	110.36	126.08	143.71	176.84	198.82	223.33	249.71	278.33	310.12	345.51	383.91	383.91
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	27.71	29.12	30.60	68.06	79.52	92.29	106.39	121.67	138.82	171.00	192.46	216.41	242.22	270.26	301.44	336.18	373.93	373.93
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	18,792	5,521	5,624	5,732	5,838	5,939	6,054	6,168	6,286	6,410	6,493	6,620	6,746	7,136	7,270	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	9.40	2.76	2.81	2.87	2.92	2.97	3.03	3.08	3.14	3.21	3.25	3.31	3.37	3.57	3.64	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	18,792	24,313	29,937	35,669	41,507	47,446	53,500	59,668	65,954	72,364	78,857	85,477	92,223	99,359	106,629	106,629
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	3.50	4.53	5.58	6.65	7.74	8.84	9.97	11.12	12.29	13.49	14.70	15.93	17.19	18.52	19.87	19.87
TOTAL REVENUE	0.00	0.00	27.71	29.12	43.50	75.35	87.91	101.81	117.05	133.48	151.82	185.20	207.89	233.11	260.17	289.50	322.00	358.27	397.44	393.80

Note: *1 Unit price:Rs.4.41/m^3 per month. Tariff is assumed to be raised at 4.50% annually over the inflation rate.
*2 Weighted average installation cost: Rs.500/case
*3 Weighted average meter rent charge: Rs.15.53/case per month

Non-Domestic (Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	After 2025
1. Water Charge																				
(1) Water supply volume (m^3/day)	0	0	5,618	5,767	5,932	18,181	21,330	24,706	28,316	32,184	36,321	46,652	51,702	57,096	62,836	68,962	75,499	82,496	89,966	89,966
(2) UFW ratio	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%	24.3%	23.7%	23.0%	22.3%	21.7%	21.7%
(3) Billed water volume (m^3/day)	0	0	3,803	3,939	4,093	12,672	14,995	17,541	20,303	23,269	26,514	34,383	38,415	42,822	47,567	52,618	58,134	64,099	70,443	70,443
(4) Unit Price *1	27.49	28.31	29.16	30.03	30.93	31.86	32.82	33.80	34.81	35.85	36.93	38.04	39.18	40.36	41.57	42.82	44.10	45.42	46.78	46.78
(5) Total water charge billed	0.00	0.00	40.48	43.18	46.21	147.36	179.63	216.40	257.96	304.48	357.39	477.39	549.36	630.83	721.74	822.38	935.75	1,062.65	1,202.79	1,202.79
(6) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.4%
(7) Total Water Revenue	0.00	0.00	38.78	41.41	44.36	141.61	172.80	208.39	248.67	293.82	345.24	461.64	531.78	611.27	700.09	798.53	909.55	1,033.96	1,171.52	1,171.52
2. Installation Charge																				
(1) Number of new customer	0	0	0	0	989	290	296	301	308	312	319	325	332	338	343	348	354	376	382	0
(2) Total Installation Revenue *2	0.00	0.00	0.00	0.00	2.77	0.81	0.83	0.84	0.86	0.87	0.89	0.91	0.93	0.95	0.96	0.98	0.99	1.05	1.07	0.00
3. Meter Rent Charge																				
(1) Number of customer	0	0	0	0	989	1,279	1,575	1,876	2,184	2,496	2,815	3,140	3,472	3,810	4,153	4,501	4,855	5,231	5,613	5,613
(2) Total Meter Rent Revenue *3	0.00	0.00	0.00	0.00	0.31	0.40	0.49	0.59	0.68	0.78	0.88	0.98	1.08	1.19	1.30	1.41	1.52	1.63	1.75	1.75
TOTAL REVENUE	0.00	0.00	38.78	41.41	47.44	142.82	174.12	209.82	250.21	295.47	347.01	463.53	533.79	613.41	702.35	800.92	912.06	1,036.64	1,174.34	1,173.27

Note: *1 Unit price:Rs.27.49/m^3 per month Tariff is assumed to be raised at 3.00% annually over the inflation rate.
*2 Weighted average installation cost: Rs.2,804/case
*3 Weighted average meter rent charge: Rs.26.03/case per month

Appendix M103

Economic and Financial Evaluation of Master Plan for Sanitation

Contents for Appendix M103

Appendix M103.1 Economic and Financial Evaluation of Master Plan for Sanitation

Table M103.1.1 Excess sewage flow from connected customers over the existing treatment capacity (2007 - 2025)

(m^3/day)

Year			2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Panaji	Sewage Flow	Average	6,582	6,591	6,599	6,608	6,697	6,786	7,002	7,348	7,800	8,342	8,920	9,510	10,147	10,759	11,424	12,103	12,796	13,504	14,226
	Capacity		12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	16,950	16,950	16,950	16,950	16,950	16,950	21,400	21,400
	Ex. sewage flow		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	296	1,004	1,726
St.Cruz	Sewage Flow	Average	0	0	0	0	0	0	0	0	0	0	0	0	259	583	971	1,269	1,541	1,774	2,008
	Capacity		0	0	0	0	0	0	0	0	0	0	0	0	1,300	1,300	1,300	1,300	2,600	2,600	2,600
	Ex. sewage flow		0	0	0	0	0	0	0	0	0	0	0	0	259	583	971	1,269	1,541	1,774	2,008
Porvorim	Sewage Flow	Average	0	0	0	0	0	0	0	0	0	571	1,284	2,139	2,795	3,394	3,908	4,421	4,934	5,448	5,961
	Capacity		0	0	0	0	0	0	0	0	0	3,850	3,850	3,850	3,850	3,850	7,700	7,700	7,700	7,700	7,700
	Ex. sewage flow		0	0	0	0	0	0	0	0	0	571	1,284	2,139	2,795	3,394	3,908	4,421	4,934	5,448	5,961
Margao	Sewage Flow	Average	2,067	2,811	3,582	4,545	5,707	6,678	7,732	8,835	9,955	10,684	11,415	12,149	12,885	13,625	14,367	15,112	15,860	16,612	17,366
	Capacity		7,500	7,500	7,500	7,500	7,500	7,500	14,200	14,200	14,200	14,200	14,200	14,200	14,200	14,200	20,900	20,900	20,900	20,900	20,900
	Ex. sewage flow		0	0	0	0	0	0	232	1,335	2,455	3,184	3,915	4,649	5,385	6,125	6,867	7,612	8,360	9,112	9,866
Ponda	Sewage Flow	Average	0	0	0	0	0	0	0	0	0	0	0	0	320	720	1,200	1,568	1,905	2,193	2,481
	Capacity		0	0	0	0	0	0	0	0	0	0	0	0	1,750	1,750	1,750	1,750	3,500	3,500	3,500
	Ex. sewage flow		0	0	0	0	0	0	0	0	0	0	0	0	320	720	1,200	1,568	1,905	2,193	2,481
Mapsa	Sewage Flow	Average	0	0	0	0	0	0	661	1,488	2,479	3,240	3,934	4,528	5,123	5,718	6,313	6,908	7,503	8,098	8,693
	Capacity		0	0	0	0	0	0	5,400	5,400	5,400	5,400	5,400	5,400	5,400	8,100	8,100	8,100	8,100	10,800	10,800
	Ex. sewage flow		0	0	0	0	0	0	661	1,488	2,479	3,240	3,934	4,528	5,123	5,718	6,313	6,908	7,503	8,098	8,693
Colva	Sewage Flow	Average	0	0	0	0	0	0	0	0	0	0	0	0	153	345	574	750	911	1,049	1,187
	Capacity		0	0	0	0	0	0	0	0	0	0	0	0	1,100	1,100	1,100	1,100	2,200	2,200	2,200
	Ex. sewage flow		0	0	0	0	0	0	0	0	0	0	0	0	153	345	574	750	911	1,049	1,187
Calangute &	Sewage Flow	Average	0	0	0	0	0	0	546	1,229	2,048	2,676	3,249	3,741	4,232	4,724	5,215	5,707	6,198	6,690	7,181
Candolim	Capacity		0	0	0	0	0	0	5,600	5,600	5,600	5,600	5,600	5,600	5,600	8,400	8,400	8,400	8,400	11,400	11,400
	Ex. sewage flow		0	0	0	0	0	0	546	1,229	2,048	2,676	3,249	3,741	4,232	4,724	5,215	5,707	6,198	6,690	7,181
TOTAL	Sewage Flow	Average	8,649	9,401	10,181	11,152	12,404	13,464	15,941	18,900	22,283	25,512	28,802	32,067	35,916	39,868	43,973	47,839	51,649	55,367	59,102
	Capacity	Existing	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
	Ex. sewage flow		**0**	**0**	**0**	**0**	**0**	**0**	**1,439**	**4,051**	**6,982**	**9,670**	**12,382**	**15,058**	**18,269**	**21,609**	**25,049**	**28,236**	**31,649**	**35,367**	**39,102**
	Capacity	Expansion	0	0	0	0	0	0	17,700	17,700	17,700	21,550	21,550	26,000	30,150	35,650	46,200	46,200	50,350	60,500	60,500
	Additional served population		0	0	0	960	1,920	2,880	10,490	12,863	15,044	16,570	16,918	16,829	19,734	20,415	20,912	19,444	19,026	18,396	18,396
	Additional served connections		0	0	0	210	419	629	2,290	2,809	3,285	3,618	3,694	3,674	4,309	4,457	4,566	4,245	4,154	4,017	4,017

Note: Ex. sewage flow' indicates the excess sewage flow from only the customers who are expected to connect over present capacity, which will be treated by master plan for sanitation

Table M103.1.2 Excess sewage flow from connected customers over the existing treatment capacity (2026 - 2042)

(m^3/day)

Year			2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
Panaji	Sewage Flow	Average	14,755	15,137	15,372	15,460	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628	16,628
	Capacity		21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400	21,400
	Ex. sewage flow		2,255	2,637	2,872	2,960	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128	4,128
St.Cruz	Sewage Flow	Average	2,241	2,409	2,513	2,552	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589
	Capacity		2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600	2,600
	Ex. sewage flow		2,241	2,409	2,513	2,552	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589	2,589
Porvorim	Sewage Flow	Average	6,475	6,845	7,073	7,159	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416
	Capacity		7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
	Ex. sewage flow		6,475	6,845	7,073	7,159	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416	7,416
Margao	Sewage Flow	Average	18,927	19,354	19,617	19,715	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211	20,211
	Capacity		20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900	20,900
	Ex. sewage flow		11,427	11,854	12,117	12,215	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711	12,711
Ponda	Sewage Flow	Average	2,769	2,977	3,105	3,153	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201
	Capacity		3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
	Ex. sewage flow		2,769	2,977	3,105	3,153	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201	3,201
Mapsa	Sewage Flow	Average	9,288	9,717	9,982	10,081	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580
	Capacity		10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800
	Ex. sewage flow		9,288	9,717	9,982	10,081	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580	10,580
Colva	Sewage Flow	Average	1,324	1,424	1,485	1,508	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531
	Capacity		2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
	Ex. sewage flow		1,324	1,424	1,485	1,508	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531	1,531
Calangute & Candolim	Sewage Flow	Average	7,673	8,028	8,246	8,328	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737
	Capacity		11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400	11,400
	Ex. sewage flow		7,673	8,028	8,246	8,328	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737	8,737
TOTAL	Sewage Flow	Average	63,451	65,892	67,393	67,957	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893	70,893
	Capacity	Existing	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
	Ex. sewage flow		**43,101**	**45,884**	**48,389**	**50,059**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**	**50,893**
	Capacity	Expansion	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500	60,500
	Additional served population		18,396	13,286	8,176	3,066	1,021	0	0	0	0	0	0	0	0	0	0	0	0
	Additional served connections		4,017	2,901	1,785	669	223	0	0	0	0	0	0	0	0	0	0	0	0

Note: Ex. sewage flow' indicates the excess sewage flow from only the customers who are expected to connect over present capacity, which will be treated by master plan for sanitation

Table M103.1.3 Sewage flow for each category of customer treated by M/P for sanitation

(Unit: m^3/day)

Year			2010	%	2011	%	2012	%	2013	%	2014	%	2015	%	2016	%	2017	%	2018	%	2019	%	2020	%
Excess Sewerage Flow Treated by Proposed Project	Sewage Flow TOTAL	Total	0	100.0%	0	100.0%	0	100.0%	1,439	100.0%	4,051	100.0%	6,982	100.0%	9,670	100.0%	12,382	100.0%	15,058	100.0%	18,269	100.0%	21,609	100.0%
		D&I	0	77.6%	0	77.1%	0	76.7%	1,097.7	76.3%	3,073.9	75.9%	5,270.3	75.5%	7,254.7	75.0%	9,236.4	74.6%	11,169.0	74.2%	13,476.8	73.8%	15,854.2	73.4%
		T	0	19.2%	0	19.7%	0	20.0%	293.8	20.4%	841.4	20.8%	1,473.9	21.1%	2,079.8	21.5%	2,710.6	21.9%	3,351.1	22.3%	4,129.3	22.6%	4,955.6	22.9%
		I&D	0	3.2%	0	3.2%	0	3.3%	47.5	3.3%	135.7	3.3%	237.8	3.4%	335.5	3.5%	435.1	3.5%	537.9	3.6%	662.9	3.6%	799.2	3.7%
	Sewage Flow Panaji	Total	0	100.0%	0	100.0%	0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%	0.0	100.0%
		D&I	0	77.6%	0	77.1%	0	76.7%	0.0	76.3%	0.0	75.9%	0.0	75.5%	0.0	75.0%	0.0	74.6%	0.0	74.2%	0.0	73.8%	0.0	73.4%
		T	0	19.2%	0	19.7%	0	20.0%	0.0	20.4%	0.0	20.8%	0.0	21.1%	0.0	21.5%	0.0	21.9%	0.0	22.3%	0.0	22.6%	0.0	22.9%
		I&D	0	3.2%	0	3.2%	0	3.3%	0.0	3.3%	0.0	3.3%	0.0	3.4%	0.0	3.5%	0.0	3.5%	0.0	3.6%	0.0	3.6%	0.0	3.7%
	Sewage Flow Others	Total	0	100.0%	0	100.0%	0	100.0%	1,439	100.0%	4,051	100.0%	6,982	100.0%	9,670	100.0%	12,382	100.0%	15,058	100.0%	18,269	100.0%	21,609	100.0%
		D&I	0	77.6%	0	77.1%	0	76.7%	1,097.7	76.3%	3,073.9	75.9%	5,270.3	75.5%	7,254.7	75.0%	9,236.4	74.6%	11,169.0	74.2%	13,476.8	73.8%	15,854.2	73.4%
		T	0	19.2%	0	19.7%	0	20.0%	293.8	20.4%	841.4	20.8%	1,473.9	21.1%	2,079.8	21.5%	2,710.6	21.9%	3,351.1	22.3%	4,129.3	22.6%	4,955.6	22.9%
		I&D	0	3.2%	0	3.2%	0	3.3%	47.5	3.3%	135.7	3.3%	237.8	3.4%	335.5	3.5%	435.1	3.5%	537.9	3.6%	662.9	3.6%	799.2	3.7%
	Number of new connections	Total	210		419		629		2,290		2,809		3,285		3,618		3,694		3,674		4,309		4,457	
		Domestic	200	95.0%	398	95.0%	598	95.0%	2,176	95.0%	2,669	95.0%	3,121	95.0%	3,437	95.0%	3,509	95.0%	3,490	95.0%	4,094	95.0%	4,234	95.0%
		Non-Dom	10	5.0%	21	5.0%	31	5.0%	115	5.0%	140	5.0%	164	5.0%	181	5.0%	185	5.0%	184	5.0%	215	5.0%	223	5.0%

(Unit: m^3/day)

Year			2021	%	2022	%	2023	%	2024	%	2025	%	2026	%	2027	%	2028	%	2029	%	2030	%	After 2030	%
Excess Sewerage Flow Treated by Proposed Project	Sewage Flow TOTAL	Total	25,049	100.0%	28,236	100.0%	31,649	100.0%	35,367	100.0%	39,102	100.0%	43,101	100.0%	45,884	100.0%	48,389	100.0%	50,059	100.0%	50,893	100.0%	50,893	100.0%
		D&I	18,293.1	73.0%	20,483.9	72.5%	22,813.3	72.1%	25,336.4	71.6%	27,789.0	71.1%	30,631.1	71.1%	32,608.9	71.1%	34,389.1	71.1%	35,576.0	71.1%	36,168.7	71.1%	36,168.7	71.1%
		T	5,804.6	23.2%	6,655.3	23.6%	7,580.0	24.0%	8,599.2	24.3%	9,703.9	24.8%	10,696.3	24.8%	11,386.9	24.8%	12,008.6	24.8%	12,423.0	24.8%	12,630.0	24.8%	12,630.0	24.8%
		I&D	951.3	3.8%	1,096.8	3.9%	1,255.7	4.0%	1,431.4	4.0%	1,609.1	4.1%	1,773.6	4.1%	1,888.2	4.1%	1,991.2	4.1%	2,060.0	4.1%	2,094.3	4.1%	2,094.3	4.1%
	Sewage Flow Panaji	Total	0.0	100.0%	0.0	100.0%	296.0	100.0%	1,004.0	100.0%	1,726.0	100.0%	2,255.0	100.0%	2,637.0	100.0%	2,872.0	100.0%	2,960.0	100.0%	4,128.0	100.0%	4,128.0	100.0%
		D&I	0.0	73.0%	0.0	72.5%	213.4	72.1%	719.3	71.6%	1,226.6	71.1%	1,602.6	71.1%	1,874.1	71.1%	2,041.1	71.1%	2,103.6	71.1%	2,933.7	71.1%	2,933.7	71.1%
		T	0.0	23.2%	0.0	23.6%	70.9	24.0%	244.1	24.3%	428.3	24.8%	559.6	24.8%	654.4	24.8%	712.7	24.8%	734.6	24.8%	1,024.4	24.8%	1,024.4	24.8%
		I&D	0.0	3.8%	0.0	3.9%	11.7	4.0%	40.6	4.0%	71.0	4.1%	92.8	4.1%	108.5	4.1%	118.2	4.1%	121.8	4.1%	169.9	4.1%	169.9	4.1%
	Sewage Flow Others	Total	25,049	100.0%	28,236	100.0%	31,353	100.0%	34,363	100.0%	37,376	100.0%	40,846	100.0%	43,247	100.0%	45,517	100.0%	47,099	100.0%	46,765	100.0%	46,765	100.0%
		D&I	18,293.1	73.0%	20,483.9	72.5%	22,599.9	72.1%	24,617.2	71.6%	26,562.4	71.1%	29,028.5	71.1%	30,734.8	71.1%	32,348.1	71.1%	33,472.4	71.1%	33,235.0	71.1%	33,235.0	71.1%
		T	5,804.6	23.2%	6,655.3	23.6%	7,509.1	24.0%	8,355.1	24.3%	9,275.5	24.8%	10,136.7	24.8%	10,732.5	24.8%	11,295.9	24.8%	11,688.5	24.8%	11,605.6	24.8%	11,605.6	24.8%
		I&D	951.3	3.8%	1,096.8	3.9%	1,244.0	4.0%	1,390.7	4.0%	1,538.1	4.1%	1,680.8	4.1%	1,779.7	4.1%	1,873.1	4.1%	1,938.2	4.1%	1,924.4	4.1%	1,924.4	4.1%
	Number of new connections	Total	4,566		4,245		4,154		4,017		4,017		4,017		2,901		1,785		669		223		0	
		Domestic	4,338	95.0%	4,033	95.0%	3,946	95.0%	3,816	95.0%	3,816	95.0%	3,816	95.0%	2,756	95.0%	1,696	95.0%	636	95.0%	212	95.0%	0	95.0%
		Non-Dom	228	5.0%	212	5.0%	208	5.0%	201	5.0%	201	5.0%	201	5.0%	145	5.0%	89	5.0%	33	5.0%	11	5.0%	0	5.0%

Table M103.1.4 Calculation of annualized construction cost, O&M cost for alternative sanitation

	Interest rate *1				Interest rate *1		Economic period		Capital Recovery Factor	Annualized construction cost	Present Value					Annualized construction cost	O&M cost /year	**Annual Construction + O&M cost**
CRF	**=**	**r**	**/(**	**1 -**	**1 /(** | **1 +** | **r** | **) ^**	**n**	**)**			**Pn**	**=**	**So**	**x**	**CRF**			
Capital Recovery Factor	11.0%	/(	1 -	1 /(| 1 + | 11.0% |) ^	5	)	=	0.27057		**Pit Latrine**		4,000	x	0.27057	=	1,082	*3 400	**1,482**
	11.0%	/(	1 -	1 /(| 1 + | 11.0% |) ^	50	)	=	0.11060		**Septic Tank & Soak Pit**		21,200	x	0.1106	=	2,345	*2 2,150	**4,495**
	11.0%	/(	1 -	1 /(| 1 + | 11.0% |) ^	9	)	=	0.18060		**Pour-Flush Latrine without Septic Tank**		6,200	x	0.1806	=	1,120	*3 400	**1,520**
	11.0%	/(	1 -	1 /(| 1 + | 11.0% |) ^	20	)	=	0.12558		**Double Pit Pour - Flush Latrine**		13,300	x	0.12558	=	1,670	*3 400	**2,070**

Interest rate of commercial bank for lending purpose is calculated based on the following data.

Notes: *1; "Minimum rate general", of the Table 70 : Structure of Interest Rates, p.125, Handbook of Statistics on Indian Economy, Reserve Bank of India.

Year	Interest rate	Average rate
2000-01	11.00 - 12.00	11.50
2001-02	11.00 - 12.00	11.50
2002-03	10.75 - 11.50	11.13
2003-04	10.25 - 11.00	10.63
2004-05	10.25 - 10.75	10.50

⇒ Average rate in the last 5 years: **11.05** %

*2; Maintenance cost of Septic Tank & Soak Pit is calculated as follows;

1. Removal of sludge in the Septic Tank is conducted once in 10 to 15 years @Rs.5,000.			
Annual O&M cost shall be;	Rs.5,000 / (10 years + 15 years)/2		Rs. 400
2. Replacement of Soak Pit is conducted once in 3 to 5 years @Rs.5,000.			
Annual O&M cost shall be;	Rs.5,000 / (3 years + 5 years)/2		Rs. 1,250
3. Checking of blockage of the sewer pipes	Rs.200-300/time x 2 times/year		Rs. 500
Total annual O&M cost shall be;		**TOTAL**	**Rs. 2,150**

*3; Maintenance cost of Simple Pit Latrine, Pour Flash Latrine w/o Septic TankDouble Pit Pour Flash Latrine is as follows;

1. Repair of building structure and cleaning of inside and surrounding.	Rs. 400

Table M103.1.5 Number of tourists staying in the sanitation M/P project area and amount of economic benefit

Average number of tourists staying in sewerage project areas

(Person:x1,000)

		% of staying tourists	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total number of Tourists in Goa	Domestic		1650	1721	1795	1873	1954	2038	2127	2219	2315	2415	2519	2628	2742	2860	2984	3113	3247	3388
	Foreign		398	413	428	442	457	472	487	502	517	532	547	561	576	591	606	621	636	651
Panaji	Domestic	*1 10.3%	169	177	184	192	200	209	218	228	238	248	258	270	281	293	306	319	333	348
	Foreign	*1 4.3%	17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	26	27	28
St.Cruz	Domestic	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Foreign	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porvorim	Domestic	1.2%	20	21	22	22	23	24	26	27	28	29	30	32	33	34	36	37	39	41
	Foreign	2.1%	8	9	9	9	10	10	10	11	11	11	11	12	12	12	13	13	13	14
Margao	Domestic	*1 1.2%	20	21	22	23	24	25	26	27	28	30	31	32	34	35	37	38	40	42
	Foreign	*1 1.9%	8	8	8	8	9	9	9	10	10	10	11	11	11	11	12	12	12	12
Ponda	Domestic	2.4%	40	41	43	45	47	49	51	53	56	58	60	63	66	69	72	75	78	81
	Foreign	0.1%	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mapsa	Domestic	1.2%	20	21	22	22	23	24	26	27	28	29	30	32	33	34	36	37	39	41
	Foreign	2.2%	9	9	9	10	10	10	11	11	11	12	12	12	13	13	13	14	14	14
Colva, South Coastal	Domestic	4.0%	66	69	72	75	78	82	85	89	93	97	101	105	110	114	119	125	130	136
	Foreign	6.1%	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40
Calangute & Candolim, North Coastal	Domestic	14.5%	239	250	260	272	283	296	308	322	336	350	365	381	398	415	433	451	471	491
	Foreign	26.5%	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165	169	173
Total	**Domestic**	**34.8%**	**574**	**600**	**625**	**651**	**678**	**709**	**740**	**773**	**807**	**841**	**875**	**915**	**955**	**994**	**1,039**	**1,082**	**1,130**	**1,180**
	Foreign	**43.2%**	**171**	**178**	**183**	**190**	**198**	**204**	**211**	**218**	**224**	**230**	**236**	**243**	**250**	**255**	**263**	**269**	**275**	**282**

Note: *1; Regarding Panaji and Margao, it is assumed that tourists in new sewerage service area is 30% of the total tourists staying in each of the city.

Benefit of water environment preservation perceived of the staying tourists

		Unit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total number of staying tourists	Domestic	persons x 1,000	574	600	625	651	678	709	740	773	807	841	875	915	955	994	1,039	1,082	1,130	1,180
	Foreign		171	178	183	190	198	204	211	218	224	230	236	243	250	255	263	269	275	282
Total benefit of tourists expressed by WTP	Domestic	Rs.x1,000	0	0	0	0	0	31,905	33,300	34,785	36,315	37,845	39,375	41,175	42,975	44,730	46,755	48,690	50,850	53,100
	Foreign		0	0	0	0	0	220,320	227,880	235,440	241,920	248,400	254,880	262,440	270,000	275,400	284,040	290,520	297,000	304,560

Table M103.1.6 Number of tourists to Salcete taluka & Bardez taluka and amount of economic benefit derived from day trip tourists

(Unit: x1,000)

Year	Domestic	Foreign	Total	Salcete		Bardez		Benefit of water environment preservation of the day trip tourists (Rs.x1,000)		
				Domestic	Foreign	Domestic	Foreign	Domestic	Foreign	Total
2005	1,453	353	1,806	369	138	302	135	0	0	0
2006	1,516	368	1,884	385	144	315	141	0	0	0
2007	1,581	383	1,964	402	150	329	146	0	0	0
2008	1,650	398	2,048	419	156	343	152	0	0	0
2009	1,721	413	2,134	437	162	358	158	0	0	0
2010	1,795	428	2,223	456	168	373	163	0	0	0
2011	1,873	442	2,315	476	173	390	169	0	0	0
2012	1,954	457	2,411	496	179	406	175	0	0	0
2013	2,038	472	2,510	518	185	424	180	848	4,380	5,228
2014	2,127	487	2,614	540	191	442	186	884	4,524	5,408
2015	2,219	502	2,721	564	197	462	192	923	4,668	5,591
2016	2,315	517	2,832	588	203	482	197	963	4,800	5,763
2017	2,415	532	2,947	613	209	502	203	1,004	4,944	5,948
2018	2,519	547	3,066	640	214	524	209	1,048	5,076	6,124
2019	2,628	561	3,189	668	220	547	214	1,094	5,208	6,302
2020	2,742	576	3,318	696	226	570	220	1,139	5,352	6,491
2021	2,860	591	3,451	726	232	595	226	1,189	5,496	6,685
2022	2,984	606	3,590	758	238	621	231	1,241	5,628	6,869
2023	3,113	621	3,734	791	243	648	237	1,295	5,760	7,055
2024	3,247	636	3,883	825	249	675	243	1,350	5,904	7,254
2025	3,388	651	4,039	861	255	705	249	1,409	6,048	7,457

Source: Number of tourist is from the water demand projection by JICA Study Team

Table M103.1.7 Financial Costs of Initial Investment, Sanitation Project

Financial Costs

(Unit: Rs. In milion)

Item	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Construction cost																				
Expansion projects																				
(1) Trunk Sewer	633.30	0.00	0.00	0.00	88.38	88.38	88.38	25.14	25.14	25.14	32.17	76.41	92.82	65.41	21.17	4.76	0.00	0.00	0.00	0.00
(2) Branch Sewer	885.51	0.00	0.00	0.00	103.64	103.64	103.64	22.83	22.83	22.83	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61	50.61
(3) Pump	70.37	0.00	0.00	0.00	0.00	10.62	10.62	0.00	6.50	6.50	0.00	6.18	13.44	9.79	4.62	2.10	0.00	0.00	0.00	0.00
(4) Sewage Treatment Plant	873.10	0.00	0.00	0.00	55.90	111.70	101.30	16.17	26.95	10.78	36.45	76.75	72.37	77.65	66.04	101.79	74.89	44.36	0.00	0.00
Sub total	2,462.28	0.00	0.00	0.00	247.92	314.34	303.94	64.14	81.42	65.25	119.23	209.95	229.24	203.46	142.44	159.26	125.50	94.97	50.61	50.61
Rehabilitation works																				
(1) Rehabilitation	143.45	0.00	0.00	0.00	15.61	0.00	0.00	0.00	0.00	28.88	9.97	9.97	9.97	0.00	61.25	0.00	0.00	0.00	0.00	7.80
Sub total	143.45	0.00	0.00	0.00	15.61	0.00	0.00	0.00	0.00	28.88	9.97	9.97	9.97	0.00	61.25	0.00	0.00	0.00	0.00	7.80
O&M Improvement																				
(1) Sanitation systems O&M Improvement	42.00	6.50	6.50	6.50	15.00	0.00	0.00	0.00	0.00	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	42.00	6.50	6.50	6.50	15.00	0.00	0.00	0.00	0.00	0.00	7.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Institutional/organizational improvement *1	96.45	4.87	4.90	4.92	4.91	4.41	4.22	6.19	6.19	6.19	6.19	6.19	6.19	4.44	4.44	4.44	4.44	4.44	4.44	4.44
Sub total	96.45	4.87	4.90	4.92	4.91	4.41	4.22	6.19	6.19	6.19	6.19	6.19	6.19	4.44	4.44	4.44	4.44	4.44	4.44	4.44
Total	2,744.18	11.37	11.40	11.42	283.44	318.75	308.16	70.33	87.61	100.32	142.89	226.11	245.40	207.90	208.13	163.70	129.94	99.41	55.05	62.85
2. Engineering cost *2	327.80	1.28	21.28	41.28	13.92	18.17	16.90	8.35	10.42	11.95	17.05	27.04	29.36	24.89	24.91	19.58	15.53	11.87	6.54	7.48
3. Administration cost *3	153.61	0.63	1.63	2.63	14.87	16.84	16.25	3.93	4.90	5.61	8.00	12.66	13.74	11.64	11.66	9.17	7.28	5.57	3.08	3.52
4. Land Acquisition	24.80	0.00	9.10	9.10	0.00	1.50	1.50	0.00	1.80	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical contingency *4	309.67	1.27	4.18	6.18	29.74	33.85	32.66	7.86	9.98	11.40	15.99	25.31	27.47	23.28	23.30	18.33	14.55	11.13	6.16	7.03
6. Price contingency (7%) *5	3,005.35	0.00	3.04	9.33	70.27	110.42	138.00	41.36	63.44	85.95	140.81	257.07	318.75	306.06	344.97	303.77	268.68	228.10	139.59	175.74
TOTAL minus Price contingency	3,560.06	14.55	47.59	70.61	341.97	389.11	375.47	90.47	114.71	131.08	183.93	291.12	315.97	267.71	268.00	210.78	167.30	127.98	70.83	80.88
TOTAL minus Price contingency (in million US$)	78.69	0.32	1.05	1.56	7.56	8.60	8.30	2.00	2.54	2.90	4.07	6.44	6.98	5.92	5.92	4.66	3.70	2.83	1.57	1.79
TOTAL	6,565.41	14.55	50.63	79.94	412.24	499.53	513.47	131.83	178.15	217.03	324.74	548.19	634.72	573.77	612.97	514.55	435.98	356.08	210.42	256.62
TOTAL (in million US$)	145.12	0.32	1.12	1.77	9.11	11.04	11.35	2.91	3.94	4.80	7.18	12.12	14.03	12.68	13.55	11.37	9.64	7.87	4.65	5.67

Notes: *1; 3% of the total direct construction cost. Total amount for each three phase is calculated and allocated equally to every year. Phase 1: 2007-2012, Phase 2: 2013-2018, Phase 3: 2019-2025

*2; 12% of the total construction cost

*3; 5% of the total direct construction cost

*4; 10% of Construction cost and Engineering cost.

*5; Excluding minor equipment, construction cost is expected to be procured by India.

Exchange rate between Rupee per US Dollar is Rs. 45.24/US$.

Table M103.1.8 Economic Costs of Initial Investment, Sanitation Project

Economic Costs

(Unit: Rs. In million)

Item	Total	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1. Construction cost																				
Expansion projects																				
(1) Trunk Sewer	593.26	0.00	0.00	0.00	82.79	82.79	82.79	23.55	23.55	23.55	30.14	71.58	86.95	61.28	19.83	4.46	0.00	0.00	0.00	0.00
(2) Branch Sewer	829.54	0.00	0.00	0.00	97.09	97.09	97.09	21.39	21.39	21.39	47.41	47.41	47.41	47.41	47.41	47.41	47.41	47.41	47.41	47.41
(3) Pump	65.93	0.00	0.00	0.00	0.00	9.95	9.95	0.00	6.09	6.09	0.00	5.79	12.59	9.17	4.33	1.97	0.00	0.00	0.00	0.00
(4) Sewage Treatment Plant	817.95	0.00	0.00	0.00	52.37	104.64	94.90	15.15	25.25	10.10	34.15	71.90	67.80	72.74	61.87	95.36	70.16	41.56	0.00	0.00
Sub total	2,306.68	0.00	0.00	0.00	232.25	294.47	284.73	60.09	76.28	61.13	111.70	196.68	214.75	190.60	133.44	149.20	117.57	88.97	47.41	47.41
Rehabilitation works																				
(1) Rehabilitation	134.38	0.00	0.00	0.00	14.62	0.00	0.00	0.00	0.00	27.05	9.34	9.34	9.34	0.00	57.38	0.00	0.00	0.00	0.00	7.31
Sub total	134.38	0.00	0.00	0.00	14.62	0.00	0.00	0.00	0.00	27.05	9.34	9.34	9.34	0.00	57.38	0.00	0.00	0.00	0.00	7.31
O&M Improvement																				
(1) Sanitation systems O&M Improvement	39.35	6.09	6.09	6.09	14.05	0.00	0.00	0.00	0.00	0.00	7.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub total	39.35	6.09	6.09	6.09	14.05	0.00	0.00	0.00	0.00	0.00	7.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Institutional/organizational improvement *1	90.36	4.56	4.59	4.61	4.60	4.13	3.95	5.80	5.80	5.80	5.80	5.80	5.80	4.16	4.16	4.16	4.16	4.16	4.16	4.16
Sub total	90.36	4.56	4.59	4.61	4.60	4.13	3.95	5.80	5.80	5.80	5.80	5.80	5.80	4.16	4.16	4.16	4.16	4.16	4.16	4.16
Total	2,570.77	10.65	10.68	10.70	265.52	298.60	288.68	65.89	82.08	93.98	133.87	211.82	229.89	194.76	194.98	153.36	121.73	93.13	51.57	58.88
2. Engineering cost *2	324.53	1.27	21.07	40.87	13.78	17.99	16.73	8.27	10.32	11.83	16.88	26.77	29.07	24.64	24.66	19.38	15.37	11.75	6.47	7.41
3. Administration cost *3	114.78	0.47	1.22	1.97	11.11	12.58	12.14	2.94	3.66	4.19	5.98	9.46	10.27	8.70	8.71	6.85	5.44	4.16	2.30	2.63
4. Land Acquisition *4	24.80	0.00	9.10	9.10	0.00	1.50	1.50	0.00	1.80	1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical contingency	289.54	1.19	3.18	5.16	27.93	31.66	30.54	7.42	9.24	10.58	15.08	23.86	25.9	21.94	21.96	17.27	13.71	10.49	5.8	6.63
TOTAL	3,324.42	13.58	45.25	67.80	318.34	362.33	349.59	84.52	107.10	122.38	171.81	271.91	295.13	250.04	250.31	196.86	156.25	119.53	66.14	75.55
TOTAL (in million US$)	73.48	0.30	1.00	1.50	7.04	8.01	7.73	1.87	2.37	2.71	3.80	6.01	6.52	5.53	5.53	4.35	3.45	2.64	1.46	1.67

Notes: *1; 20% of each each portion of the project is assumed to be labour cost. 80% of the labour is assumed to be unskilled labours

*2; It is assumed that 10% of the engineering cost is paid to local engineers.

Personel Income tax	10%
Shadow Exchange Rate	50.081 Rs./US$ (Exchange rate 45.24 Rs./US$)
Shadow Wage Rate for unskilled labour	70% of market price
Shadow Wage Rate for skilled labour	100% of market price
Opportunity cost of land	100% of market price

*3; It is assumed that 80% of the staff are unskilled labour.

*4; Market price is recognized as economic value, since land acquisition cost os less than 1% of the total project cost.

Table M103.1.9 Financial and Economic Costs of Operation and Maintenance, Sanitation Project

Financial Costs

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	After 2030
1. Electricity																									
(1) STP	0.00	0.00	0.00	0.00	0.00	0.00	7.52	8.75	9.32	10.52	11.56	12.45	16.41	18.26	20.35	24.39	26.93	30.86	33.45	35.86	37.17	37.88	38.83	40.53	40.53
(2) Others	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.43	0.47	0.76	0.86	0.97	1.16	1.91	2.61	3.27	3.91	4.56	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Sub total	0.00	0.00	0.00	0.00	0.00	0.00	7.91	9.18	9.79	11.28	12.42	13.42	17.57	20.17	22.96	27.66	30.84	35.42	38.65	41.06	42.37	43.08	44.03	45.73	45.73
2. Chemical cost	0.00	0.00	0.00	0.00	0.00	0.00	1.86	2.16	2.30	2.60	2.85	3.07	4.05	4.51	5.03	6.02	6.65	7.62	8.26	8.86	9.18	9.36	9.59	10.01	10.01
3. Personnel expenses																									
(1) STP	0.00	0.00	0.00	0.00	0.00	0.00	1.93	2.24	2.39	2.70	2.96	3.19	4.21	4.68	5.22	6.25	6.90	7.91	8.58	9.19	9.53	9.71	9.96	10.39	10.39
(2) Others	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.70	0.70	1.40	1.40	1.40	2.45	3.50	4.20	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Sub total	0.00	0.00	0.00	0.00	0.00	0.00	2.63	2.94	3.09	4.10	4.36	4.59	6.66	8.18	9.42	10.80	11.45	12.46	13.13	13.74	14.08	14.26	14.51	14.94	14.94
4. Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	1.86	2.14	2.28	2.70	2.95	3.16	4.24	4.93	5.61	6.67	7.34	8.33	9.01	9.55	9.84	10.00	10.22	10.60	10.60
5. Sewer Cleaning	0.00	0.00	0.00	0.00	0.00	0.00	1.03	1.21	1.29	1.65	1.89	2.14	2.54	2.86	3.20	3.80	4.22	4.65	5.08	5.46	5.69	5.82	5.98	6.29	6.29
6 Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.53	0.56	0.67	0.73	0.79	1.05	1.22	1.39	1.65	1.82	2.05	2.22	2.36	2.43	2.48	2.53	2.63	2.63
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	15.75	18.16	19.31	23.00	25.20	27.17	36.11	41.87	47.61	56.60	62.32	70.53	76.35	81.03	83.59	85.00	86.86	90.20	90.20

Economic Costs

(Unit: Rs. In million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
1. Electricity																									
(1) STP	0.00	0.00	0.00	0.00	0.00	0.00	7.52	8.75	9.32	10.52	11.56	12.45	16.41	18.26	20.35	24.39	26.93	30.86	33.45	35.86	37.17	37.88	38.83	40.53	40.53
(2) Others	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.43	0.47	0.76	0.86	0.97	1.16	1.91	2.61	3.27	3.91	4.56	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Sub total	0.00	0.00	0.00	0.00	0.00	0.00	7.91	9.18	9.79	11.28	12.42	13.42	17.57	20.17	22.96	27.66	30.84	35.42	38.65	41.06	42.37	43.08	44.03	45.73	45.73
2. Chemical cost	0.00	0.00	0.00	0.00	0.00	0.00	1.86	2.16	2.30	2.60	2.85	3.07	4.05	4.51	5.03	6.02	6.65	7.62	8.26	8.86	9.18	9.36	9.59	10.01	10.01
3. Personnel expenses																									
(1) STP	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.53	1.63	1.85	2.02	2.18	2.88	3.20	3.57	4.28	4.72	5.41	5.87	6.29	6.52	6.64	6.81	7.11	7.11
(2) Others	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.48	0.48	0.96	0.96	0.96	1.68	2.39	2.87	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11	3.11
Sub total	0.00	0.00	0.00	0.00	0.00	0.00	1.80	2.01	2.11	2.81	2.98	3.14	4.56	5.59	6.44	7.39	7.83	8.52	8.98	9.40	9.63	9.75	9.92	10.22	10.22
4. Maintenance	0.00	0.00	0.00	0.00	0.00	0.00	1.86	2.14	2.28	2.70	2.95	3.16	4.24	4.93	5.61	6.67	7.34	8.33	9.01	9.55	9.84	10.00	10.22	10.60	10.60
5. Sewer Cleaning	0.00	0.00	0.00	0.00	0.00	0.00	1.03	1.21	1.29	1.65	1.89	2.14	2.54	2.86	3.20	3.80	4.22	4.65	5.08	5.46	5.69	5.82	5.98	6.29	6.29
6. Administration	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.40	0.42	0.50	0.55	0.59	0.78	0.91	1.04	1.23	1.36	1.53	1.66	1.76	1.82	1.85	1.89	1.97	1.97
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	14.80	17.10	18.19	21.54	23.64	25.52	33.74	38.97	44.28	52.77	58.24	66.07	71.64	76.09	78.53	79.86	81.63	84.82	84.82

Notes: *1; 80% of labour is assumed to be paid unskilled labours

Personel Income tax	10%
Shadow Exchange Rate	50.081 Rs./US$
Shadow Wage Rate for unskilled labour	70% of market price
Shadow Wage Rate for skilled labour	100% of market price

Table M103.1.10 Unit price of sewerage treatment

TOTAL of All the Sub-Divisions in Sewerage Study Area

No.	Category	Number of Connection	Water Volume Billed (m^3)	Water volume billed /connection (m^3/connection)	Water Charge /connection (Rs./connection)	Unit Price of Water Charge (Rs./m^3)	Unit Price of Sewerage (Rs./m^3)	
I	Domestic	145,012	3,472,549	23.9	100	4.2	**1.05**	**1.05**
II	Non-domestic	224	197,348	881.0	13,065	14.8	**3.70**	
III	Non-domestic	572	302,868	529.5	11,799	22.3	**5.58**	**6.40**
IV	Non-domestic	2,527	627,462	248.3	7,599	30.6	**7.65**	
	TOTAL	148,335	4,600,227					

Note: Because of the limitation of the existing data, unit price is estimated from the one month data regarding the Division III.

Installation Charge **Domestic** **215** **Non-Domestic Commercial** **520**

* Regarding the sewerage connections, they are assumed that 90% of them are upto 150 mm and 10% of them are above 150mm in diameter.

Division III **TOTAL**

No.	Category	Number of Connection	Water Volume Billed (m^3)	Water volume billed /connection (m^3/connection)	Water Charge /connection (Rs./connection)	Unit Price of Water Charge (Rs./m^3)	Unit Price of Sewerage (Rs./m^3) *1
I	Domestic	44,114	1,085,316	24.6	120	4.9	1.23
II	Non-domestic	14	28,389	2,027.8	30,267	14.9	3.73
III	Non-domestic	403	81,593	202.5	4,604	22.7	5.68
IV	Non-domestic	587	77,102	131.3	4,090	31.1	7.78
	TOTAL	45,118	1,272,400				

Note: *1: Sewerage Charge is calculated by 25% of water charges, following the Tariff Table.

Division IX **TOTAL**

No.	Category	Number of Connection	Water Volume Billed (m^3)	Water volume billed /connection (m^3/connection)	Water Charge /connection (Rs./connection)	Unit Price of Water Charge (Rs./m^3)	Unit Price of Sewerage (Rs./m^3) *1
I	Domestic	58,508	1,535,585	26.2	129	4.9	1.23
II	Non-domestic	210	168,959	804.6	11,919	14.8	3.70
III	Non-domestic	152	206,826	1,360.7	30,085	22.1	5.53
IV	Non-domestic	1,196	501,884	419.6	12,739	30.4	7.60
	TOTAL	60,066	2,413,254		54,872	0.0	

Note: *1: Sewerage Charge is calculated by 25% of water charges, following the Tariff Table.

Division XVII Sub Division III Mapusa Sub Division V Porvorim Jun-05

No.	Category	Number of Connection	Water Volume Billed (m^3)	Water volume billed /connection (m^3/connection)	Water Charge /connection (Rs./connection)	Unit Price of Water Charge (Rs./m^3)	Unit Price of Sewerage (Rs./m^3) *1
I	Domestic	42,390	851,648	20.1	95	4.7	1.18
II	Non-domestic	0	0		0		
III	Non-domestic	17	14,449	849.9	18,849	22.2	5.55
IV	Non-domestic	744	48,476	65.2	2,105	32.3	8.08
	TOTAL	43,151	914,573		21,049	0.0	

Note: *1: Sewerage Charge is calculated by 25% of water charges, following the Tariff Table.
Regarding the Division XVII, the unit price of Sewerage Charge is the predicted value.

Table 103.1.11 Financial Benefit of Sanitation Project

Domestic

(Unit: Rs in Million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	After 2030
1. Wastewater Charge																									
(1) Billed water volume (m^3/day) *1	0.0	0.0	0.0	0.0	0.0	0	1,372.1	3,842.4	6,587.9	9,068.4	11,545.5	13,961.3	16,846.0	19,817.8	22,866.4	25,604.9	28,463.3	31,490.7	34,429.6	37,888.2	40,292.6	42,476.1	43,944.1	44,477.5	44,477.5
(2) Unit Price *2	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
(3) Total sewerage charge billed	0.000	0.000	0.000	0.000	0.000	0.000	0.561	1.571	2.693	3.707	4.720	5.707	6.887	8.102	9.348	10.467	11.636	12.873	14.075	15.489	16.472	17.364	17.964	18.182	18.182
(4) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.5%	97.6%	97.7%	97.8%	97.9%	97.9%
(5) Total Sewerage Revenue	0.000	0.000	0.000	0.000	0.000	0.000	0.540	1.513	2.596	3.577	4.560	5.519	6.667	7.851	9.068	10.163	11.310	12.525	13.709	15.102	16.077	16.965	17.569	17.800	17.800
2. Installation Charge																									
(1) Number of customer	0	0	0	200	398	598	2,176	2,669	3,121	3,437	3,509	3,490	4,094	4,234	4,338	4,033	3,946	3,816	3,816	3,816	2,756	1,696	636	212	0
(2) Total Installation Revenue *3	0.000	0.000	0.000	0.043	0.086	0.129	0.468	0.574	0.671	0.739	0.754	0.750	0.880	0.910	0.933	0.867	0.848	0.820	0.820	0.820	0.593	0.365	0.137	0.046	0.000
TOTAL	0.000	0.000	0.000	0.043	0.086	0.129	1.008	2.087	3.267	4.316	5.314	6.269	7.547	8.761	10.001	11.030	12.158	13.345	14.529	15.922	16.670	17.330	17.706	17.846	17.800

Note: *1 Billed water volume is assumed as 100% of sewerage treated volume in Panaji, and 125% of sewerage treated volume in other project areas.

*2 Unit price:Rs.1.12/m^3 per month

*3 Weighted average installation cost: Rs.215/case

Non-Domestic

(Unit: Rs in Million)

Item	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	After 2030
1. Wastewater Charge																									
(1) Billed water volume (m^3/day) *1	0.0	0.0	0.0	0.0	0.0	0	426.6	1,221.4	2,139.6	3,019.1	3,932.1	4,861.3	5,990.3	7,193.5	8,444.9	9,690.1	11,024.0	12,467.1	14,016.4	15,424.3	16,403.2	17,292.0	17,889.7	18,106.8	18,106.8
(2) Unit Price *2	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85	6.85
(3) Total sewerage charge billed	0.000	0.000	0.000	0.000	0.000	0.000	1.067	3.054	5.350	7.549	9.831	12.154	14.977	17.986	21.114	24.228	27.563	31.171	35.045	38.565	41.012	43.234	44.729	45.272	45.272
(4) Collection Efficiency	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%	97.0%	97.1%	97.2%	97.3%	97.4%	97.5%	97.6%	97.7%	97.8%	97.9%	97.9%
(5) Total Sewerage Revenue	0.000	0.000	0.000	0.000	0.000	0.000	1.026	2.941	5.157	7.285	9.497	11.753	14.498	17.428	20.481	23.525	26.791	30.329	34.134	37.601	40.028	42.240	43.745	44.321	44.321
2. Installation Charge																									
(1) Number of customer	0	0	0	10	21	31	115	140	164	181	185	184	215	223	228	212	208	201	201	201	145	89	33	11	0
(2) Total Installation Revenue *3	0.000	0.000	0.000	0.005	0.011	0.016	0.060	0.073	0.085	0.094	0.096	0.096	0.112	0.116	0.119	0.110	0.108	0.105	0.105	0.105	0.075	0.046	0.017	0.006	0.000
TOTAL	0.000	0.000	0.000	0.005	0.011	0.016	1.086	3.014	5.242	7.379	9.593	11.849	14.610	17.544	20.600	23.635	26.899	30.434	34.239	37.706	40.103	42.286	43.762	44.327	44.321

Note: *1 Billed water volume is assumed as 100% of sewerage treated volume in Panaji, and 125% of sewerage treated volume in other project areas.

*2 Unit price:Rs.6.85/m^3 per month

*3 Weighted average installation cost: Rs.520/case

Appendix M104

Financial Plan of PHE with the Master Plan For Water Supply and Sanitation

Contents for Appendix M104

Appendix M104.1 Financial Plan of PHE with the Master Plan for Water Supply and Sanitation

Table M104.1.1 Water supply volume by existing facilities

(m^3/day)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total demand	306,765	317,356	328,270	339,545	351,184	363,196	375,472	388,143	401,256	414,821	428,858	443,192	458,046	473,446	489,425	506,017	523,063	540,789	559,230	578,434	598,442
Existing capacity	393,000	393,000	393,000	393,000	393,000	393,000	393,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000	381,000
Excess demand for existing capacity	795	1,033	1,347	7,300	13,714	20,416	27,351	44,311	54,001	64,042	74,436	85,176	96,317	122,438	134,978	148,006	161,355	175,235	189,676	205,154	221,331
Water supply volume by existing facilities	305,970	316,323	326,923	332,245	337,469	342,780	348,121	343,832	347,255	350,779	354,422	358,016	361,729	351,009	354,447	358,011	361,708	365,554	369,554	373,280	377,111

Table M104.1.2 Profit loss statement of PHE for water supply : 2004/05 – 2023/24

(Unit: Rs. million)

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
I. Revenue																				
Water supply	543	604	638	673	717	749	796	864	1,025	1,116	1,216	1,326	1,443	1,573	1,736	1,889	2,058	2,242	2,440	2,660
Total	543	604	638	673	717	749	796	864	1,025	1,116	1,216	1,326	1,443	1,573	1,736	1,889	2,058	2,242	2,440	2,660
II. Expenditure																				
1 Operation & Maintenance cost	686	686	709	733	748	766	779	791	811	886	897	910	921	933	949	968	981	996	1,011	1,026
Water supply	686	686	709	733	748	766	779	791	811	886	897	910	921	933	949	968	981	996	1,011	1,026
2 Administration cost	90	90	93	96	105	114	116	117	123	159	160	161	162	163	168	169	170	171	173	175
Water supply	90	90	93	96	105	114	116	117	123	159	160	161	162	163	168	169	170	171	173	175
3 Other expenses	12	12	12	13	13	13	14	14	14	14	15	15	15	16	16	16	16	17	17	17
4 Depreciation	59	59	59	79	96	107	145	224	261	270	279	289	308	338	358	371	382	392	403	412
Total	847	847	874	921	962	1,000	1,053	1,146	1,209	1,329	1,351	1,375	1,406	1,450	1,491	1,524	1,549	1,576	1,603	1,630
III. Income from Operation	**-304**	**-243**	**-235**	**-248**	**-245**	**-251**	**-257**	**-281**	**-184**	**-213**	**-135**	**-48**	**37**	**123**	**245**	**365**	**508**	**666**	**836**	**1,030**
IV. Interest expenses	313	313	313	313	315	320	344	404	433	440	447	454	466	486	503	519	565	668	718	729
V. Net profit	**-617**	**-556**	**-548**	**-561**	**-560**	**-571**	**-601**	**-685**	**-617**	**-653**	**-582**	**-502**	**-429**	**-363**	**-258**	**-154**	**-57**	**-1**	**119**	**301**
VI. Accumulated profit / loss	**-617**	**-1,173**	**-1,721**	**-2,282**	**-2,842**	**-3,413**	**-4,014**	**-4,699**	**-5,316**	**-5,969**	**-6,551**	**-7,053**	**-7,482**	**-7,845**	**-8,103**	**-8,257**	**-8,314**	**-8,315**	**-8,196**	**-7,895**

Table M104.1.3 Profit loss statement of PHE for water supply : 2024/25 – 2042/43

(Unit: Rs. million)

	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43
I. Revenue																			
Water supply	2,899	3,156	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152
Total	2,899	3,156	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152
II. Expenditure																			
1 Operation & Maintenance cost	1,040	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057
Water supply	1,040	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057
2 Administration cost	176	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
Water supply	176	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
3 Other expenses	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
4 Depreciation	421	430	444	465	478	484	490	500	512	522	471	479	486	473	462	457	425	360	344
Total	1,655	1,682	1,696	1,717	1,730	1,736	1,742	1,752	1,764	1,774	1,723	1,731	1,738	1,725	1,714	1,709	1,677	1,612	1,596
III. Income from Operation	**1,244**	**1,474**	**1,456**	**1,435**	**1,422**	**1,416**	**1,410**	**1,400**	**1,388**	**1,378**	**1,429**	**1,421**	**1,414**	**1,427**	**1,438**	**1,443**	**1,475**	**1,540**	**1,556**
IV. Interest expenses	426	437	464	510	538	549	559	570	584	594	601	606	625	655	667	664	628	541	525
V. Net profit	**818**	**1,037**	**992**	**925**	**884**	**867**	**852**	**830**	**804**	**784**	**829**	**815**	**789**	**772**	**771**	**779**	**847**	**1,000**	**1,031**
VI. Accumulated profit / loss	**-7,077**	**-6,040**	**-5,048**	**-4,123**	**-3,239**	**-2,372**	**-1,520**	**-690**	**114**	**898**	**1,727**	**2,542**	**3,331**	**4,103**	**4,874**	**5,653**	**6,500**	**7,500**	**8,531**

Table M104.1.4 Subsidy from state government budget for water supply : 2007 – 2024

(Unit: Rs. In million)

Year	TOTAL	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1 Total project cost	16,800	935	895	686	1,756	3,378	1,722	447	438	455	801	1,274	869	568	508	451	455	384	387
1) Water supply		935	895	686	1,756	3,378	1,722	447	438	455	801	1,274	869	568	508	451	455	384	387
2 Borrowed amount	7,588	5	74	133	773	1,946	942	224	219	228	400	637	434	284	254	225	227	192	194
1) Water supply		5	74	133	773	1,946	942	224	219	228	400	637	434	284	254	225	227	192	194
2 Accumulated borrowed amount		5	79	212	985	2,931	3,873	4,097	4,316	4,544	4,944	5,581	6,015	6,295	6,538	6,714	6,794	6,793	6,782
3 Interest rate		0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount		0	2	7	31	91	120	127	134	141	153	173	186	195	203	208	211	211	210
5 Loan repayment		0	2	7	31	91	120	127	134	141	153	173	190	206	252	355	405	416	426
Interest payments		0	2	7	31	91	120	127	134	141	153	173	186	195	203	208	211	211	210
Principle payments		0	0	0	0	0	0	0	0	0	0	0	4	11	49	147	194	205	216
Total debt		5	79	212	985	2,931	3,873	4,097	4,316	4,544	4,944	5,581	6,011	6,284	6,489	6,567	6,601	6,588	6,566
Subsidy from State Government	15,808	**1,491**	**1,381**	**1,124**	**1,583**	**2,117**	**1,397**	**876**	**801**	**730**	**830**	**1,001**	**693**	**438**	**310**	**227**	**228**	**192**	**193**
1 Preparation works	1,753	930	821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply		930	821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	7,464	0	0	553	983	1,432	780	223	219	227	401	637	435	284	254	226	228	192	193
1) Water supply		0	0	553	983	1,432	780	223	219	227	401	637	435	284	254	226	228	192	193
3 Annual Net loss at the end of FY	6,597	561	560	571	601	685	617	653	582	502	429	363	258	154	57	1	0	0	0
1) Water supply		561	560	571	601	685	617	653	582	502	429	363	258	154	57	1	0	0	0

Table M104.1.5 Subsidy from state government budget for water supply : 2025 – 2042

(Unit: Rs. In million)

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
1 Total project cost	391	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
1) Water supply	391	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
2 Borrowed amount	195	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
1) Water supply	195	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
2 Accumulated borrowed amount	6,761	7,015	7,461	7,638	7,551	7,460	7,460	7,537	7,533	7,447	7,328	7,175	6,999	6,775	6,533	6,286	6,066	6,407
3 Interest rate	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount	210	217	231	237	234	231	231	234	234	231	227	222	217	210	203	195	188	199
5 Loan repayment	437	464	510	538	549	559	570	584	594	601	606	625	655	667	664	628	541	525
Interest payments	210	217	231	237	234	231	231	234	234	231	227	222	217	210	203	195	188	199
Principle payments	227	247	279	301	315	328	339	350	360	370	379	403	438	457	461	433	353	326
Total debt	6,534	6,768	7,182	7,337	7,236	7,132	7,121	7,187	7,173	7,078	6,948	6,772	6,561	6,319	6,072	5,852	5,714	6,080
Subsidy from State Government	**196**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
1 Preparation works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply	196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Annual Net loss at the end of FY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table M104.1.6 Profit loss statement of PHE for sanitation : 2004/05 – 2023/24

(Unit: Rs. million)

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
I. Revenue																				
Sanitation	10	5	7	7	9	10	13	15	18	24	31	39	48	58	70	84	101	119	140	163
Total	10	5	7	7	9	10	13	15	18	24	31	39	48	58	70	84	101	119	140	163
II. Expenditure																				
1 Operation & Maintenance cost	94	94	94	94	94	94	94	94	94	107	108	109	113	114	115	123	127	131	139	143
Sanitation	94	94	94	94	94	94	94	94	94	107	108	109	113	114	115	123	127	131	139	143
2 Administration cost	6	6	7	8	8	9	10	11	12	17	17	17	19	19	21	23	25	27	30	31
Sanitation	6	6	7	8	8	9	10	11	12	17	17	17	19	19	21	23	25	27	30	31
3 Other expenses	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
4 Depreciation	0	0	0	0	0	0	7	16	25	27	29	32	36	42	49	55	61	66	70	73
Total	101	101	102	103	103	104	112	122	132	152	156	160	170	177	187	204	215	226	242	249
III. Income from Operation	**-91**	**-95**	**-95**	**-95**	**-95**	**-94**	**-100**	**-107**	**-115**	**-129**	**-125**	**-121**	**-122**	**-119**	**-117**	**-119**	**-115**	**-107**	**-102**	**-86**
IV. Interest expenses	0	0	0	0	1	3	11	22	31	33	35	37	39	44	51	58	75	95	112	115
V. Net profit	**-91**	**-95**	**-95**	**-95**	**-96**	**-97**	**-111**	**-129**	**-146**	**-162**	**-160**	**-158**	**-161**	**-163**	**-168**	**-177**	**-190**	**-201**	**-214**	**-201**
VI. Accumulated profit / loss	**-91**	**-186**	**-281**	**-376**	**-472**	**-569**	**-680**	**-809**	**-955**	**-1,117**	**-1,277**	**-1,435**	**-1,596**	**-1,759**	**-1,927**	**-2,104**	**-2,294**	**-2,495**	**-2,709**	**-2,910**

Note: Tariff raise are assumed at 7.5% per annum for domestic customers and 6.0% per annum for non-domestic, both excluding inflation adjustment.

Table M104.1.7 Profit loss statement of PHE for sanitation : 2024/25 – 2042/43

(Unit: Rs. million)

	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43
I. Revenue																			
Sanitation	187	216	231	241	250	257	259	259	259	259	259	259	259	259	259	259	259	259	259
Total	187	216	231	241	250	257	259	259	259	259	259	259	259	259	259	259	259	259	259
II. Expenditure																			
1 Operation & Maintenance cost	150	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155
Sanitation	150	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155
2 Administration cost	32	33	34	34	34	36	36	36	36	36	36	36	36	36	36	36	36	36	36
Sanitation	32	33	34	34	34	36	36	36	36	36	36	36	36	36	36	36	36	36	36
3 Other expenses	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4 Depreciation	75	77	77	80	80	80	81	81	81	82	83	84	85	86	87	87	80	71	65
Total	259	267	268	271	271	273	274	274	274	275	276	277	278	279	280	280	273	264	258
III. Income from Operation	**-72**	**-51**	**-37**	**-30**	**-21**	**-16**	**-15**	**-15**	**-15**	**-16**	**-17**	**-18**	**-19**	**-20**	**-21**	**-21**	**-14**	**-5**	**1**
IV. Interest expenses	117	120	123	129	135	140	143	146	147	148	147	146	143	142	137	131	115	96	79
V. Net profit	**-189**	**-171**	**-160**	**-159**	**-156**	**-156**	**-158**	**-161**	**-162**	**-164**	**-164**	**-164**	**-162**	**-162**	**-158**	**-153**	**-129**	**-101**	**-78**
VI. Accumulated profit / loss	**-3,099**	**-3,270**	**-3,430**	**-3,589**	**-3,745**	**-3,901**	**-4,059**	**-4,220**	**-4,382**	**-4,546**	**-4,710**	**-4,874**	**-5,036**	**-5,198**	**-5,356**	**-5,509**	**-5,638**	**-5,739**	**-5,817**

Note: *1; Straight-line depreciation by 30 year-life, with salvage value at 10% of original price

Table M104.1.8 Subsidy from state government budget for sanitation : 2007 – 2024

(Unit: Rs. In million)

Year	TOTAL	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1 Total project cost	3,561	15	48	71	342	389	375	90	115	131	184	291	316	268	268	211	167	128	71
1) Sanitation		15	48	71	342	389	375	90	115	131	184	291	316	268	268	211	167	128	71
2 Borrowed amount	2,178	5	33	53	274	329	318	45	58	66	92	146	158	134	134	106	84	64	36
1) Sanitation		5	33	53	274	329	318	45	58	66	92	146	158	134	134	106	84	64	36
2 Accumulated borrowed amount		5	38	91	365	694	1,012	1,057	1,115	1,181	1,273	1,419	1,577	1,709	1,838	1,926	1,975	1,989	1,972
3 Interest rate		0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount		0	1	3	11	22	31	33	35	37	39	44	49	53	57	60	61	62	61
5 Loan repayment		0	1	3	11	22	31	33	35	37	39	44	51	58	75	95	112	115	117
Interest payments		0	1	3	11	22	31	33	35	37	39	44	49	53	57	60	61	62	61
Principle payments		0	0	0	0	0	0	0	0	0	0	0	2	5	18	35	51	53	56
Total debt		5	38	91	365	694	1,012	1,057	1,115	1,181	1,273	1,419	1,575	1,704	1,820	1,891	1,925	1,936	1,916
Subsidy from State Government	4,372	**105**	**111**	**115**	**179**	**189**	**203**	**207**	**217**	**223**	**253**	**308**	**326**	**311**	**324**	**306**	**297**	**265**	**224**
1 Preparation works	26	10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Sanitation		10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	1,362	0	0	18	68	60	57	45	57	65	92	145	158	134	134	105	83	64	35
1) Sanitation		0	0	18	68	60	57	45	57	65	92	145	158	134	134	105	83	64	35
3 Annual Net loss at the end of FY	2,990	95	96	97	111	129	146	162	160	158	161	163	168	177	190	201	214	201	189
1) Sanitation		95	96	97	111	129	146	162	160	158	161	163	168	177	190	201	214	201	189

Table M104.1.9 Subsidy from state government budget for sanitation : 2025 – 2042

(Unit: Rs. In million)

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
1 Total project cost	81	0	84	0	0	21	0	0	41	29	18	30	18	43	0	0	0	84
1) Sanitation	81	0	84	0	0	21	0	0	41	29	18	30	18	43	0	0	0	84
2 Borrowed amount	41	0	42	0	0	11	0	0	21	15	9	15	9	22	0	0	0	42
1) Sanitation	41	0	42	0	0	11	0	0	21	15	9	15	9	22	0	0	0	42
2 Accumulated borrowed amount	1,957	1,898	1,876	1,806	1,727	1,652	1,560	1,462	1,382	1,292	1,194	1,100	1,000	912	803	696	603	568
3 Interest rate	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount	61	59	58	56	54	51	48	45	43	40	37	34	31	28	25	22	19	18
5 Loan repayment	120	123	129	135	140	143	146	147	148	147	146	143	142	137	131	115	96	79
Interest payments	61	59	58	56	54	51	48	45	43	40	37	34	31	28	25	22	19	18
Principle payments	59	64	71	79	86	92	98	102	105	107	109	109	111	109	106	93	77	61
Total debt	1,898	1,834	1,806	1,727	1,641	1,560	1,462	1,361	1,277	1,185	1,085	991	890	803	696	603	526	507
Subsidy from State Government	**211**	**160**	**201**	**156**	**156**	**168**	**161**	**162**	**184**	**178**	**173**	**177**	**171**	**179**	**153**	**129**	**101**	**120**
1 Preparation works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Sanitation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	40	0	42	0	0	10	0	0	20	14	9	15	9	21	0	0	0	42
1) Sanitation	40	0	42	0	0	10	0	0	20	14	9	15	9	21	0	0	0	42
3 Annual Net loss at the end of FY	171	160	159	156	156	158	161	162	164	164	164	162	162	158	153	129	101	78
1) Sanitation	171	160	159	156	156	158	161	162	164	164	164	162	162	158	153	129	101	78

Table M104.1.10 Profit loss statement of PHE for water supply and sanitation : 2004/05 – 2023/24

(Unit: Rs. million)

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
I. Revenue																				
Water supply	543	604	638	673	717	749	796	864	1,025	1,116	1,216	1,326	1,443	1,573	1,736	1,889	2,058	2,242	2,440	2,660
Sanitation	10	5	7	7	9	10	13	15	18	24	31	39	48	58	70	84	101	119	140	163
Total	553	610	645	681	726	760	809	880	1,043	1,140	1,247	1,366	1,491	1,631	1,805	1,973	2,159	2,362	2,579	2,823
II. Expenditure																				
1 Operation & Maintenance cost	780	780	803	827	842	860	873	885	905	993	1,005	1,019	1,034	1,047	1,064	1,091	1,108	1,127	1,150	1,169
Water supply	686	686	709	733	748	766	779	791	811	886	897	910	921	933	949	968	981	996	1,011	1,026
Sanitation	94	94	94	94	94	94	94	94	94	107	108	109	113	114	115	123	127	131	139	143
2 Administration cost	96	96	100	104	113	123	126	128	135	176	177	179	181	183	189	193	195	198	203	205
Water supply	90	90	93	96	105	114	116	117	123	159	160	161	162	163	168	169	170	171	173	175
Sanitation	6	6	7	8	8	9	10	11	12	17	17	17	19	19	21	23	25	27	30	31
3 Other expenses	13	13	13	14	14	14	15	15	16	16	16	17	17	17	18	18	19	19	19	20
Water supply	12	12	12	13	13	13	14	14	14	14	15	15	15	16	16	16	16	17	17	17
Sanitation	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
4 Depreciation	59	59	59	79	96	107	152	240	286	297	308	321	344	380	407	426	443	458	473	485
Water supply	59	59	59	79	96	107	145	224	261	270	279	289	308	338	358	371	382	392	403	412
Sanitation	0	0	0	0	0	0	7	16	25	27	29	32	36	42	49	55	61	66	70	73
Total	948	948	976	1,023	1,065	1,104	1,165	1,268	1,342	1,482	1,507	1,535	1,576	1,627	1,678	1,728	1,765	1,802	1,845	1,879
III. Income from Operation	**-395**	**-338**	**-331**	**-343**	**-339**	**-345**	**-356**	**-388**	**-298**	**-341**	**-260**	**-169**	**-85**	**4**	**127**	**246**	**394**	**560**	**734**	**944**
IV. Interest expenses	313	313	313	313	316	323	355	426	464	473	482	491	505	531	554	576	641	762	829	844
V. Net profit	**-708**	**-651**	**-644**	**-656**	**-655**	**-668**	**-711**	**-814**	**-762**	**-814**	**-742**	**-660**	**-590**	**-527**	**-426**	**-331**	**-247**	**-203**	**-95**	**100**
VI. Accumulated profit / loss	**-708**	**-1,359**	**-2,003**	**-2,659**	**-3,314**	**-3,982**	**-4,693**	**-5,507**	**-6,269**	**-7,083**	**-7,825**	**-8,485**	**-9,075**	**-9,602**	**-10,028**	**-10,359**	**-10,606**	**-10,809**	**-10,904**	**-10,804**

Table M104.1.11 Profit loss statement of PHE for water supply and sanitation : 2024/25 – 2042/43

(Unit: Rs. million)

	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33	2033-34	2034-35	2035-36	2036-37	2037-38	2038-39	2039-40	2040-41	2041-42	2042-43
I. Revenue																			
Water supply	2,899	3,156	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152	3,152
Sanitation	187	216	231	241	250	257	259	259	259	259	259	259	259	259	259	259	259	259	259
Total	3,086	3,372	3,383	3,393	3,402	3,409	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411	3,411
II. Expenditure																			
1 Operation & Maintenance cost	1,190	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212	1,212
Water supply	1,040	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057	1,057
Sanitation	150	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155
2 Administration cost	207	209	210	210	210	212	212	212	212	212	212	212	212	212	212	212	212	212	212
Water supply	176	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
Sanitation	32	33	34	34	34	36	36	36	36	36	36	36	36	36	36	36	36	36	36
3 Other expenses	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Water supply	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
Sanitation	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
4 Depreciation	496	507	521	545	558	564	571	581	593	604	554	563	571	559	549	544	505	431	409
Water supply	421	430	444	465	478	484	490	500	512	522	471	479	486	473	462	457	425	360	344
Sanitation	75	77	77	80	80	80	81	81	81	82	83	84	85	86	87	87	80	71	65
Total	1,913	1,949	1,964	1,988	2,001	2,009	2,016	2,026	2,038	2,049	1,999	2,008	2,016	2,004	1,994	1,989	1,950	1,876	1,854
III. Income from Operation	**1,172**	**1,423**	**1,419**	**1,405**	**1,401**	**1,400**	**1,395**	**1,385**	**1,373**	**1,362**	**1,412**	**1,403**	**1,395**	**1,407**	**1,417**	**1,422**	**1,461**	**1,535**	**1,557**
IV. Interest expenses	543	557	587	639	673	689	702	715	731	742	747	752	768	796	804	795	744	636	604
V. Net profit	**629**	**866**	**832**	**766**	**728**	**712**	**693**	**670**	**642**	**620**	**665**	**651**	**627**	**611**	**613**	**627**	**717**	**899**	**953**
VI. Accumulated profit / loss	**-10,175**	**-9,309**	**-8,477**	**-7,711**	**-6,983**	**-6,271**	**-5,578**	**-4,908**	**-4,266**	**-3,646**	**-2,981**	**-2,330**	**-1,703**	**-1,092**	**-479**	**148**	**865**	**1,764**	**2,717**

Table M104.1.12 Subsidy from state government budget for water supply and sanitation : 2007 – 2024

(Unit: Rs. In million)

Year	TOTAL	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1 Total project cost	20,361	950	943	757	2,098	3,767	2,097	537	553	586	985	1,565	1,185	836	776	662	622	512	458
1) Water supply	16,800	935	895	686	1,756	3,378	1,722	447	438	455	801	1,274	869	568	508	451	455	384	387
2) Sanitation	3,561	15	48	71	342	389	375	90	115	131	184	291	316	268	268	211	167	128	71
2 Borrowed amount	9,764	10	107	186	1,047	2,275	1,260	269	277	294	492	783	592	418	388	331	311	256	230
1) Water supply	7,586	5	74	133	773	1,946	942	224	219	228	400	637	434	284	254	225	227	192	194
2) Sanitation	2,176	5	33	53	274	329	318	45	58	66	92	146	158	134	134	106	84	64	36
2 Accumulated borrowed amount		10	117	303	1,350	3,625	4,885	5,154	5,431	5,725	6,217	7,000	7,592	8,004	8,377	8,640	8,770	8,782	8,754
1) Water supply		5	79	212	985	2,931	3,873	4,097	4,316	4,544	4,944	5,581	6,015	6,295	6,538	6,714	6,794	6,793	6,782
2) Sanitation		5	38	91	365	694	1,012	1,057	1,115	1,181	1,273	1,419	1,577	1,709	1,838	1,926	1,975	1,989	1,972
3 Interest rate		0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount		0	3	10	42	113	151	160	169	178	192	217	235	248	260	268	272	273	271
1) Water supply		0	2	7	31	91	120	127	134	141	153	173	186	195	203	208	211	211	210
2) Sanitation		0	1	3	11	22	31	33	35	37	39	44	49	53	57	60	61	62	61
5 Loan repayment		0	3	10	42	113	151	160	169	178	192	218	241	263	328	449	516	531	543
Interest payments		0	3	10	42	113	151	160	169	178	192	217	235	248	260	268	272	273	271
Principle payments		0	0	0	0	0	0	0	0	0	0	1	6	15	68	181	244	258	272
Total debt		10	117	303	1,350	3,625	4,885	5,154	5,431	5,725	6,217	7,000	7,586	7,989	8,309	8,459	8,526	8,524	8,482
Subsidy from State Government	20,181	**1,596**	**1,492**	**1,239**	**1,762**	**2,306**	**1,600**	**1,082**	**1,018**	**953**	**1,083**	**1,309**	**1,019**	**749**	**634**	**533**	**524**	**457**	**417**
1 Preparation works	1,778	940	836	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply	1,752	930	821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2) Sanitation	25	10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	8,824	0	0	571	1,051	1,492	837	268	276	292	493	782	593	418	388	331	311	256	228
1) Water supply	7,462	0	0	553	983	1,432	780	223	219	227	401	637	435	284	254	226	228	192	193
2) Sanitation	1,360	0	0	18	68	60	57	45	57	65	92	145	158	134	134	105	83	64	35
3 Annual Net loss at the end of FY		656	655	668	711	814	762	814	742	660	590	527	426	331	247	203	214	201	189
1) Water supply		561	560	571	601	685	617	653	582	502	429	363	258	154	57	1	0	0	0
2) Sanitation		95	96	97	111	129	146	162	160	158	161	163	168	177	190	201	214	201	189

Table M104.1.13 Subsidy from state government budget for water supply and sanitation: 2025 – 2042

(Unit: Rs. In million)

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042
1 Total project cost	472	481	777	456	214	245	328	416	387	303	268	257	245	257	214	214	214	777
1) Water supply	391	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
2) Sanitation	81	0	84	0	0	21	0	0	41	29	18	30	18	43	0	0	0	84
2 Borrowed amount	236	481	735	456	214	235	328	416	367	289	259	242	236	236	214	214	214	735
1) Water supply	195	481	693	456	214	224	328	416	346	274	250	227	227	214	214	214	214	693
2) Sanitation	41	0	42	0	0	11	0	0	21	15	9	15	9	22	0	0	0	42
2 Accumulated borrowed amount	8,718	8,913	9,337	9,443	9,278	9,112	9,020	9,000	8,915	8,739	8,522	8,276	7,999	7,687	7,335	6,982	6,669	6,975
1) Water supply	6,761	7,015	7,461	7,638	7,551	7,460	7,460	7,537	7,533	7,447	7,328	7,175	6,999	6,775	6,533	6,286	6,066	6,407
2) Sanitation	1,957	1,898	1,876	1,806	1,727	1,652	1,560	1,462	1,382	1,292	1,194	1,100	1,000	912	803	696	603	568
3 Interest rate	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
4 Intrest amount	271	276	289	293	288	282	279	279	277	271	264	256	248	238	228	217	207	217
1) Water supply	210	217	231	237	234	231	231	234	234	231	227	222	217	210	203	195	188	199
2) Sanitation	61	59	58	56	54	51	48	45	43	40	37	34	31	28	25	22	19	18
5 Loan repayment	557	587	639	673	689	702	715	731	742	747	752	768	796	804	795	744	636	604
Interest payments	271	276	289	293	288	282	279	279	277	271	264	256	248	238	228	217	207	217
Principle payments	286	311	350	380	401	420	436	452	465	476	488	512	548	566	567	527	429	387
Total debt	8,432	8,602	8,987	9,064	8,877	8,692	8,584	8,548	8,450	8,263	8,034	7,763	7,451	7,121	6,768	6,455	6,240	6,588
Subsidy from State Government	**407**	**160**	**201**	**156**	**156**	**168**	**161**	**162**	**184**	**178**	**173**	**177**	**171**	**179**	**153**	**129**	**101**	**120**
1 Preparation works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1) Water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2) Sanitation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Burden for M/P	236	0	42	0	0	10	0	0	20	14	9	15	9	21	0	0	0	42
1) Water supply	196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2) Sanitation	40	0	42	0	0	10	0	0	20	14	9	15	9	21	0	0	0	42
3 Annual Net loss at the end of FY	171	160	159	156	156	158	161	162	164	164	164	162	162	158	153	129	101	78
1) Water supply	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2) Sanitation	171	160	159	156	156	158	161	162	164	164	164	162	162	158	153	129	101	78

Table M104.14 Calculation of Unit Cost for Water Service and Unit Price at the Year 2025

Unit Production Cost = $\frac{\text{annual O\&M cost (Rs.)}}{\text{total annual consumption billed (m}^3\text{)}}$

Existing & Proposed annual O&M cost (Rs.) = 1,251 Rs. In million (O&M, Administration, Other costs)

Existing facilities total annual consumption billed (m^3 = 235,311 m^3/day x 365 days

= 85,888,521 m^3/year

Proposed facilities total annual consumption billed (m^3 = 178,099 m^3/day x 365 days

= 65,006,135 m^3/year

Existing & Proposed total annual consumption billed (m^3 = 150,894,656 m^3/year

Unit Production Cost at the year 2025 = $\frac{\text{annual O\&M cost (Rs.)}}{\text{total annual consumption billed (m}^3\text{)}}$ = $\frac{1,251,000,000}{150,894,656}$ = 8.29 Rs/m^3

Unit price at the year 2025 = $\frac{\text{Water revenue (Rs.)}}{\text{total annual production billed (m}^3\text{)}}$ = $\frac{3,156,000,000}{150,894,656}$ = 20.92 Rs/m^3

Table M104.1.15 Comparison of estimated maximum budget of PHE and current budget of State Government, PWD, and PHE

(Unit: Rs. In million)

	State Government	PWD	PHE
Budget (fiscal year 2004-05)	22,237	3,509	1,666
Max. subsidy for water supply & sanitation	2,300	2,300	2,300
Water supply & sanitation revenue (fiscal year 2004-05)	553	553	553
PHE Max.Budget including reimbursed costs (Max. subsidy plus revenues)	2,853	2,853	2,853
% of PHE max. Budget in each Budget	12.8%	81.3%	171.2%

Table M104.1.16 Profit loss statement of PHE for water supply service with the tariff raise: 3% for domestic and 2% for non-domestic over the inflation rate

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
I. Revenue															
Water supply other than M/P	316,323	326,923	332,245	302,469	307,780	313,121	308,832	312,255	315,779	319,422	323,016	326,729	316,009	319,447	323,011
% of domestic	78.4%	78.0%	77.8%	77.5%	77.3%	77.1%	76.3%	75.9%	75.6%	75.2%	74.7%	74.3%	73.6%	73.2%	72.7%
Water supply volume (domestic)	247,906	254,867	258,349	234,534	237,953	241,327	235,644	237,101	238,576	240,079	241,447	242,828	232,737	233,832	234,940
Day Average	204,881	210,634	213,512	193,830	196,655	199,444	194,747	195,951	197,170	198,412	199,543	200,684	192,345	193,250	194,165
Unit price	**4.41**	**4.41**	**4.54**	**4.68**	**4.82**	**4.96**	**5.11**	**5.26**	**5.42**	**5.58**	**5.75**	**5.92**	**6.10**	**6.28**	**6.47**
Water supply volume (non-domestic)	68,417	72,056	73,896	67,935	69,827	71,794	73,188	75,154	77,203	79,343	81,569	83,901	83,272	85,615	88,071
Unit price	**27.49**	**27.49**	**28.04**	**28.60**	**29.17**	**29.75**	**30.35**	**30.96**	**31.58**	**32.21**	**32.85**	**33.51**	**34.18**	**34.86**	**35.56**
UFW ratio	34.3%	33.7%	33.0%	32.3%	31.7%	31.0%	30.3%	29.7%	29.0%	28.3%	27.7%	27.0%	26.3%	25.7%	25.0%
Installation charge	4.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Meter rent charge	52.0	53.0	53.0	54.0	55.0	55.0	56.0	56.0	56.0	57.0	57.0	58.0	58.0	58.0	59.0
No. of domestic connections	256,992	260,442	263,924	267,172	270,448	273,707	275,478	277,258	279,045	280,841	282,592	284,357	286,136	287,930	289,740
No. of non-dome. Connections	13,525	13,706	13,890	14,061	14,233	14,405	14,498	14,592	14,686	14,781	14,873	14,966	15,060	15,154	15,249
Collection efficiency	95.6%	95.6%	95.7%	95.8%	95.9%	96.0%	96.1%	96.2%	96.3%	96.4%	96.5%	96.6%	96.7%	96.8%	96.9%
Water supply Revenue (existing)	638	673	712	675	714	756	786	829	875	924	975	1,029	1,046	1,102	1,164
Water supply Revenue (Expansion)	0	0	0	65	68	87	206	244	288	336	388	446	574	649	733
Water supply	638	673	712	740	782	843	992	1,073	1,163	1,260	1,363	1,475	1,620	1,751	1,897
Total	**638**	**673**	**712**	**740**	**782**	**843**	**992**	**1,073**	**1,163**	**1,260**	**1,363**	**1,475**	**1,620**	**1,751**	**1,897**
II. Expenditure															
1 Operation & Maintenance cost	709	733	748	766	779	791	811	886	897	910	921	933	949	968	981
Water supply	709	733	748	766	779	791	811	886	897	910	921	933	949	968	981
2 Administration cost	93	96	105	114	116	117	123	159	160	161	162	163	168	169	170
Water supply	93	96	105	114	116	117	123	159	160	161	162	163	168	169	170
3 Other expenses	12	13	13	13	14	14	14	14	15	15	15	16	16	16	16
O&M, Administration, and Other expenses	**815**	**842**	**866**	**893**	**908**	**922**	**948**	**1,059**	**1,072**	**1,086**	**1,098**	**1,112**	**1,133**	**1,153**	**1,167**
4 Depreciation	59	79	96	107	145	224	261	270	279	289	308	338	358	371	382
IV. Interest expenses	313	313	315	320	344	404	433	440	447	454	466	486	503	519	565
V. Net profit	**-548**	**-561**	**-565**	**-580**	**-615**	**-707**	**-650**	**-696**	**-635**	**-569**	**-510**	**-461**	**-374**	**-292**	**-218**

Table M104.1.17 Tax revenue estimation and number of tourists staying in sanitation M/P target areas

(Person:x1,000)

		% of tourists	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total number of Tourists in Goa	Domestic	100%	1650	1721	1795	1873	1954	2038	2127	2219	2315	2415	2519	2628	2742	2860	2984	3113	3247	3388
	Foreign	100%	398	413	428	442	457	472	487	502	517	532	547	561	576	591	606	621	636	651
Panaji	Domestic	10.3%	169	177	184	192	200	209	218	228	238	248	258	270	281	293	306	319	333	348
	Foreign	4.3%	17	18	18	19	19	20	21	21	22	23	23	24	25	25	26	26	27	28
St.Cruz	Domestic	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Foreign	0.0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porvorim	Domestic	1.2%	20	21	22	22	23	24	26	27	28	29	30	32	33	34	36	37	39	41
	Foreign	2.1%	8	9	9	9	10	10	10	11	11	11	11	12	12	12	13	13	13	14
Margao	Domestic	1.2%	20	21	22	23	24	25	26	27	28	30	31	32	34	35	37	38	40	42
	Foreign	1.9%	8	8	8	8	9	9	9	10	10	10	11	11	11	11	12	12	12	12
Ponda	Domestic	2.4%	40	41	43	45	47	49	51	53	56	58	60	63	66	69	72	75	78	81
	Foreign	0.1%	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mapsa	Domestic	1.2%	20	21	22	22	23	24	26	27	28	29	30	32	33	34	36	37	39	41
	Foreign	2.2%	9	9	9	10	10	10	11	11	11	12	12	12	13	13	13	14	14	14
Colva, South Coastal	Domestic	4.0%	66	69	72	75	78	82	85	89	93	97	101	105	110	114	119	125	130	136
	Foreign	6.1%	24	25	26	27	28	29	30	31	32	32	33	34	35	36	37	38	39	40
Calangute & Candolim, North Coastal	Domestic	14.5%	239	250	260	272	283	296	308	322	336	350	365	381	398	415	433	451	471	491
	Foreign	26.5%	105	109	113	117	121	125	129	133	137	141	145	149	153	157	161	165	169	173
Total number of staying tourists	Domestic	**34.8%**	574	600	625	651	678	709	740	773	807	841	875	915	955	994	1,039	1,082	1,130	1,180
	Foreign	**43.2%**	171	178	183	190	198	204	211	218	224	230	236	243	250	255	263	269	275	282
Tax amount for tourists (Rs. In million)	Domestic		0	0	0	0	0	21	22	23	24	25	26	27	29	30	31	32	34	35
	Foreign		0	0	0	0	0	147	152	157	161	166	170	175	180	184	189	194	198	203
Total tax revenue (Rs. In million)	Domestic & Foreign		0	0	0	0	0	168	174	180	185	191	196	202	209	214	220	226	232	238

APPENDIX M11

This appendix is reference to and supporting data of

Volume 2 Main Report – Master Plan
Chapter 11 Social Considerations and Initial Environmental Examination

M111 Public Consultation
M112 Environmental and Social Considerations for Implementation
M113 Initial Environmental Examination

Appendix M111:

Public Consultation

Contents for Appendix M111

Appendix M111.1 Note of Discussion from and Attendance Sheet of the First Workshop and Stakeholder Meeting

M111.1 First Stakeholder Meeting

The PWD and the JICA Study Team agreed that a stakeholder meeting to discuss the environmental and social considerations should be held at the end of the Reconnaissance Study. The first stakeholder meeting was held jointly with a technical workshop on 23 August 2005. The aims of the stakeholder meeting were to improve the scoping of the IEE and to consult with the public. Table 111.1.1 lists the attendees at the first stakeholder meeting and workshop.

Table M111.1.1 Number of Attendees at the First Stakeholder Meeting and Workshop

Type of Stakeholder	Number	Type of Stakeholder	Number
PWD	37	Chief Officer of Municipality	1
JICA Official	3	Goa State	1
JICA Study Team	10	Mnisitory of Urban Development	1
NGO	3	Engineering Consultants, IT services, Industry and Municipal Engineer of BMC	4
Journalist	3	Unidentified	5
Academic	4	**Total**	**77**
Chairperson and Deputy Chairperson of Municipal Council and Panch of Panchyat	5		

The following general environmental and social concerns about the water supply and sewerage projects were identified through the draft environmental scoping. These were explained to the stakeholders at the first meeting:

1) Suitable Site Selection for STPs
2) Treated Wastewater Discharge from STPs
3) Odour from STPs
4) Difficulties of Supplying Water to Rural Areas
5) Difficulties of Providing Sanitation/Sewerage to Low Income Group

The methods that were going to be used to predict the levels of impacts and the mitigation measures were also explained to the stakeholders. The stakeholders' opinions were then sought. Also, the stakeholders were encouraged to identify other concerns that they thought

should be included in the environmental scoping. Before starting the discussion, it was clearly explained to the stakeholders that the results of the discussion would be used to develop a suitable water supply and sanitation/sewerage master plan. The stakeholders were also told that there would be another subsequent stakeholder meeting where they would receive feedback on how the results of their discussions have been used.

The record of discussions from the first stakeholder meeting is provided in Appendix M111.1.1 Note of Discussion from and Attendance Sheet of the First Workshop and Stakeholder Meeting. The following is the summary of the main remarks made in the discussion:

1) Stakeholders suggested the possibility of applying eco-sanitation. Rather than viewing sewage as a waste, eco-sanitation recommends beneficial reuse for purposes such as fertilizers and fuel. This would be a new approach for Goa.
2) Stakeholders requested that water supply be provided to the local population before providing water to tourists.
3) There was active discussion regarding the willingness to connect to the sewerage system and the appropriate associated sewerage charges. The PWD explained the need to evaluate the willingness of the population to connect to the sewerage system before the sewerage projects can be developed. The JICA Study Team explained that the willingness to pay to connect to the sewerage system would be assessed based on the results of the public awareness survey. The stakeholders explained that it could be possible to raise the willingness to pay by promoting public awareness of the services.
4) Stakeholders pointed out the need to assess the positive impacts of water supply and sanitation on health.
5) A stakeholder pointed out the importance of appropriate site selection. If a STP is not suitably located, farmers cultivating the surrounding area and the population living near the STP could be affected by the discharge. This risk increases during power cuts or system malfunctions.
6) A stakeholder suggested that the STPs should be located where residential development cannot occur. This would avoid future problems that would result if residential development were allowed to approach the STP.
7) The stakeholders requested that the PWD provide them with brochures about the proposals prior to the next meeting so that they are better informed and can better participate in constructive discussions. The JICA Study Team agreed to assist the PWD with the preparation of the brochures for the next meeting.

During the development of the Master Plan, the JICA Study Team helped the PWD incorporate these stakeholders' opinions into the TOR for the IEE.

The first stakeholder meeting for environmental and social considerations was held jointly with the first workshop for technology transfer. Stakeholders were invited both to the workshop and stakeholder meeting. Stakeholders had discussion on technical matters mainly in the morning session for workshop and also had discussion on environmental and social considerations mainly in the afternoon session for the environmental scoping. The following records of discussion include stakeholders' remarks in both workshop and stakeholder meeting. The attendance sheet of the workshop and stakeholder meeting is also attached to this document.

1. Workshop

The following discussion was held after the presentations prepared by the Study Team.

Q (Question): Government Engineering College, GOA – In terms of water demand, you said that in March the demand is 1.2 times more. Is it the demand or supply? Is it just 1.2 because in May we have power fluctuations and break down hence the capacity to send water or to supply water reduces? So you have projected less demand in May which is supposed to be one of the worst and highest in March.

You also said that in 2008 there is going to be a short fall. Which is more essential, treatment capacity enhancement or storage capacity enhancement required?

You also said that we consume 142 and 83 lpcd in urban and rural where as norms says 135 is more than sufficient. Does this include losses? Or is it the billing charges which are being worked out?

A: JICA Study Team – I am not going to explain you in detail calculation at this moment. You can find our calculation in the report after October or November. If you still have interest that you can come to us and we will discuss again.

Q: Government Engineering College, GOA – Whether you have identify storage has to be increased or treatment has to be increased?

A: JICA Study Team – That is the comparison with supply capacity. So definitely treatment

plant capacity is required. Production capacity is required. According to the information from PWD, Salaulim Dam still has the space for additional water supply. So this is not a big problem as I understand but production capacity is really not enough.

A: JICA Study Team – As for per capita water consumption, you feel that 135 is still high level?

C (Comment): MOUD – It is the normal that everybody uses 135 lcpd? Does it include leakage? I think you included leakage.

A: JICA Study Team – The figures 135, 150 or 200 lcpd don't include leakage. This figure is from the manual on water supply prepared by Government of India and this is target per capita water demand in urban areas. As for Mega city over big city like Delhi or big city with sewerage system, the manual says per capita water consumption will be 150.

We are talking about future plan. So if we target lower per capita consumption it's not so realistic. Most probably this figure may be 150 or more.

Q: Former PWD Official – It cannot be 142. It is not correct because you have not taken the tourist population into consideration. If you take the tourist population actually, per capita consumption is much less. It cannot be that much compare to metro city. Tourist population is almost the double to the population. How it can be 142?

A: JICA Study Team –We have a very good database from the south of Goa state. There, PWD is outsourcing their billing and calculation to a private company and we received their water quantity data which has categories of domestic, tourist, industries, commercial, institution . Based on the data, we obtained current per capita.

C: Former PWD Official – Tourist are staying in houses and not only in hotels. Their consumption is a lot.

C: PWD – Mentioned tourist population is recorded tourist population. There is much unrecorded tourist population which stays in houses and some temples. Unrecorded and unnoticed tourist population is also tourist floating population.

Q: PWD – I have two points. When you are planning for a master plan, you must be

planning for 24 x 7? Do you plan for 24 x 7? If that is so and if you see the supply pattern today and if you make a picture of whole Goa, somewhere you will supply 30 lpcd, somewhere 150, somewhere 200, somewhere say 50 or 100. This sort of pattern will come up. So if water supply is constant, 24 x 7, at 150 lpcd people will be dam happy but I assume you will never give 24 hours immediately. So instead of that, you have plan properly that you give 80 lpcd say for 4 hrs then slightly increase that level to 6 hrs, then 7 hrs ultimately 24 hours. Are you are doing this way?

Have you conducted any studies for time and pressure management with existing supplies?

A: JICA Study Team – That is a very good point. We will consider it for the preparation of master plan. We will take your point into consideration.

C: Sulabh International – Here in Goa what has been happening since liberation is that all planning for water supply and sewerage has been turning toxic turbid because of higher growth than what has been assumed while designing the projects. All the earlier projects were designed for 30 years but these were being utilized fully within 5 to 8 years. In fact earlier projects were based on the previous experience as well as your study. Now your figures show that the urbanization rate is coming down. It may be so but the tourist population is about 2 times more than the original population of Goa. In Panaji at certain times in the year the number of tourist will be 5 times as much as the local population. So this growth has to be properly assessed and provided for.

Second, when you consider the consumption per day, it is not to be considered on the basis of total supply divided by number of people or number of connection. Each metered daily consumption has to be obtained and exactly how much they are consuming has to be found out. This kind of exercise was done earlier and again it has to be done now, which will show that it is not 135c or 140 but hardly 60 or 70 liters. Thank you.

A: JICA Study Team – Thank you.

Q: Government Engineering College, GOA – What policy is going to affect the industry vs. domestic pricing which is about 6.9 times in Goa? I am surprised of what your opinion is. Should it be more leveled? Which is going to affect the common man finally? The common man's view point is that the user is too much subsidized. But if you think it is not right, then your policy is going to have effect on everyone. If industry has finally put it down on the

consumer, the common man has to pay from his pocket. So what is your opinion on this?

A: JICA Study Team – That is also a good point but I am really sorry that I cannot comment on this point at this moment. But we realized that ratio of domestic and industry pricing differs very much comparing with another countries. Whether the industry pricing is too high or whether domestic is too low will be studied in the master plan stage.

C: Former PWD Official – Basically when any water supply scheme is prepared, availability of sustainable water sources has to be studied at first. I think in your study this aspect has not been considered most importantly and you have to do the detail engineering as well as the hydrological analysis. First, you have to study the availability of sustainable water and water requirement for 2025.

A: JICA Study Team – Thank you very much and this is the comment about water resources. At this moment in this study phase, we have not yet discussed about water resources fully. But in the second phase we will discuss more about water resources.

C: Sulabh International – Many of the villagers are already covered and many of them are covered from the integrated water supply scheme from a treatment plant. There are some schemes where a local source has also been exploited and from it with or without treatment it is supplied fortunately for us. Here the ground water level is quite high and in most of the places except those villages, which are located on the plateau, ground water is available. In fact most of the villages used to draw drinking water from the wells only. Especially in low lying areas or nearer to the rivers and the sea, the water level is within 2 meters of ground level and therefore these sources also can be very well exploited. In most of the places and cases you will find, the water is almost that of the drinking water standard with minimal treatment. It is possible to maintain for drinking water standard and to supply to the local areas. Although the yield is limited, this will be cheaper alternative and plus village community itself can manage it. They would have the satisfaction that they have their own water supply scheme which they are using.

A: JICA Study Team – Thank you very much. We have difficulty to find ground water level data. Do you know where the data is available?

C: Sulabh International – The Central Ground Water Board, which has got office in Bangalore and Nagpur. They have done lot of studies and there is one geologist in the Water

Resources Department, Mr. Soma Sundaram.

A: JICA Study Team – I think we have already had contact with the Water Resources Department. Could you tell me his name again, please?

C: Sulabh International – Mr. Soma Sundaram in Water Resources Department or Ground Water Board in Belgum. I can give you the address, Bangalore or Nagpur. Bangalore office is in charge of Goa and they have been continuously monitoring the water level in open wells and tube wells for a number of years now or at lest a decade.

C: PWD – I think the data on Manganese and Iron contents in Opa Water Treatment Plant is giving some error. Manganese and Iron in Salaulim is more than Opa.

A: JICA Study Team – We will check the data again for Opa. Thank you.

C: PWD – Regarding water supply to rural areas, first of all, we get lot of rainfall in rural areas on the foot of Western Ghats, but the rainfall immediately passes to this Arabian Sea. In the end of season, say March, April and May, we are not having water. Last year there has been a series of bandharas on Kalomna River at Canacona which were taken by Water Resources Department. Some of them are completed and some of them are half the way. But wherever they have been completed, there has been better level of water retaining along the river from bank of the river and periphery of river. It may proven quite beneficial for the water supply project like this type of things all over Sanguem taluka which are situated in the foot of the hill. Ultimately the water which is available quickly passes.

Mining activity has penetrated much below our river levels, well levels, and even much below our bore wells. Now we are not getting much water into the bore wells and existing bore wells are getting dried off. Extensive survey requires to be made in those mining belt where water levels have drastically lowered.

Third point is feasibility of interconnection of 6 to 7 or 8 schemes. If the water supply is short, then you should be able to draw water from the other scheme by interconnecting somewhere in some scheme. The feasibility on the interconnectivity of all the schemes is to be studied, with regard to your planning for 2025.

A: JICA Study Team – Thank you very much. Good point! Any other comments?

C: Sulabh International – I will just add to what Mr. Dhone had said. What he has basically said is rain water harvesting. The bandharas store water in the upstream side. There will be good recharge of ground water and wells nearby will start getting water if there is standing water in summer. Also, this can be applied anywhere. In fact, in some cities in Tamil Nadu etc. they have made it compulsory that the ground water recharge has to be done and all the construction should have arrangements for rain water harvesting. Now rain water harvesting is beneficial in two ways.

One is that it will recharge the ground water and increases the ground water availability. And, what happens because of this development is the increased or doubled runoff which results in floods like Bombay' floods. Too much of paving will reduce the absorption capacity of the ground and all the water has to flow on the ground. In Goa state, rivers are dry today because of various reasons. In the mining what happening is there are going very deep in 20 to 30 meters below mean sea level and then they pump out the ground water. If rain water harvesting and recharge of ground water are done for wells, tube wells and open wells .Definitely we can continue to get water from theses sources which may be in limited quantity.

C: PWD – So my dear colleagues. Today we were having brain storming, thoughtfully holding workshop and very nice presentation from these JICA fellows.

2. STAKEHOLDER MEETING

1) General Discussion on the Study and Stakeholders Meeting

Q (Question): Government Engineering College, Goa – What is your experience in this practice?

A (Answer): JICA Study Team – We are specialists for water supply and sewerage having a lot of experiences in South East Asia, Africa and Central America.

Q: Goa State Consumer Protection Council– Who are the stakeholders here?

A: PWD – We have invited some of the panchayats and municipal representatives, ministers, NGOs, academics, journalists and private consultants and so on.

Q: Goa State Consumer Protection Council – I would like to know whether JICA is doing this study with an understanding that Japanese companies will be involved in the eventual

construction work.

A: JICA Official – The role of JICA is very clear at this moment. JICA is a technical cooperation agency and it is not a financial agency. So the role of JICA is only to prepare the Master Plan and Feasibility Study. Now the entire property belongs to Government of Goa and Government of India. They can take the report of this study to any agencies such as the World Bank, ILFC, Planning Commission and Local Banks.

Q: Goa State Consumer Protection Council – I would have liked to come prepared to contribute to this discussion because I think you have raised valid and very important points. So stakeholders need to have a brochure on JICA and this Study prior to stakeholder meetings. If you want a good/participation or if you want people to agree to have Sewage Treatment Plants, proper information has to be given to the people.

A: JICA Study Team – JICA Study Team will support PWD for the next stakeholder meeting regarding to sending a brochure on JICA and this Study beforehand so that we can have more positive and fruitful discussion.

2) Presentation on Environmental and Social Considerations

- Approaches for Environmental and Social Consideration
- Measures of Public Consultation
- Five Main Concerns Identified in the Environmental Scoping

3) Discussion on Stakeholders' Concerns

C (Comment): Former Chair Person of Ponda Municipal Council – I am very happy to see that Ponda has finally come into a focus area. It is one of the areas that have been considered for sewage disposal and management. In fact this is one of the very pressing problems because Ponda has a town that is developing such a rapid rate. The worst thing is sewage problem. We use septic tanks but high laterite content of soil makes problems.

It needs to be noted that priority should be to the local population. The local population should not be made to suffer in the seasonal demand increase due to tourists. The water has to be provided to the local residents before providing water for tourists.

C: PWD – Eco- Sanitation, which looks at the waste as a source of some nutrients and energy, could be applicable to Goa as a new approach.

Q: PWD – How do you evaluate how many people are willing to take a connection and how much money they can bear?

A: JICA Study Team – In our public awareness survey we have included questions about willingness to pay to connect sewerage and to have improved water supply. We are now analyzing the data by income wise and area wise.

C: Former Chair Person of Ponda Municipal Council – In another seminar, it was discussed that as long as the people are given efficient service and properly explained about the scheme and its benefits, they are always ready to pay for the services. In Ponda, it was found that the people were ready and willing to pay for the maintenance and operation of required facilities. If the service was efficient and if it is 24 x 7 they may be ready to share the cost or may bear a substantial portion of the cost in this kind of facilities that would be provided.

Q: State Epidemiologist – The most important aspect of water and sanitation is the positive impact on the health. Will the positive impacts on health be assessed in the past and future contexts? Is any improvement on the health expected? Whether there is any reduction in occurrence of certain water bone diseases? Whether any such studies will be conducted?

A: JICA Study Team – Our public awareness surveys includes questions about the occurrences of waterborne diseases in households and the perception on whether they feel they are having less health problems after connecting to sewer. We are going to analyze the results of public awareness surveys for economic analysis of this project so we can predict the benefits of this project including positive impacts on public health.

C: JICA Official – If a STP is not located at suitable site, farmers and rural population living near the STP could be affected by the discharge from the STP. For example, if there is a power cuts, the wastewater could come discharged without treatment affecting farmers who cultivate sounding area.

C: Sulabh International – A suitable site for STPs have to be necessarily away from the population as no body would like to have a STP by the side of his residence generally. What happens is that by the time STP comes up the town will have grown up to the site. To avoid this it is also necessary that where STP is to be proposed is located at certain areas where development can not be taken place.

If we are providing a tertiary treatment and if the parameters are as specified within the limits effluent discharge, the treated wastewater discharge off course will not be a problem and probably most of them can be used for irrigation.

As for the sanitation and sewerage for low income people, I consider this low income group mostly as villagers because in Goa we don't have many slums unlike in cities in other states where slum is a very big problem.

In villages the houses are detached and they are far off mainly in the coconut gardens. Therefore, the sewerage option will be very expensive and at the same time the maintenance cost is very high. Villagers will not be able to sustain it and so the best option will be on site treatment and disposal. Goa Government and PWD have constructed pour flush water seal double leach latrines for 73,500 households.

They have to use a small receptacle and 0.5 to 2 liters of water per flush. The entire human waste can be absorbed in the ground but as the depth of facilities is limited to less than a meter it generally will not pollute the underground aquifers. However, in water logged areas these are not constructed because of malfunction.

Now there is an ambitious program in which almost 100% of the rural households are being provided sanitation by PWD. Probably another 10 to 15 thousands household toilets will be required to cover 100% of rural households. No other personal sanitation will be required apart from what remains in urban areas.

The urban areas have a big problem because these toilets cannot be provided in urban areas where space availability is very limited. Then, the only solution in those areas could be sewerage which is no doubt a very costly both for maintenance and construction. If the sewage is collected at one place, handling large quantity of wastewater becomes more problematic. If you can treat it in a smaller quantity it will be definitely helpful. In fact in some cases it has been proved that if a number of smaller plants are proposed instead of a large treatment plant for one city. It will be cheaper and easier to handle.

A: JICA Study Team – Thank you very much for your detailed explanation of current situations of sanitation and valuable suggestion. We are going to consider your comments in the formulation of master plan.

C: JICA Study Team －Based on the concerns identified in the environmental scoping and your comments, Initial Environmental Examination and Environmental Impact Assessment will be conducted by PWD with support form JICA Study Team for the future project. How the results of this discussion will have been considered in the formulation of master plan will be explain to the stakeholders in the next stage of public consultation.

Attendance Sheet

Name of the meeting : Workshop &
Stake Holder Meeting

Place : International Center
Date : 23 August 2005

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
1	Ramnath Pai Raikar	Reporter, The Navhind Times	
2	Newman Fernandes	St. Xavier's College Margao	
3	Hiromi SAWADA	JICA	
4	KURAUCHI, Takeshi	JICA India Office	
5	Subrata Talukdar	JICA India Offic	
6	S.R. Paranjape	Executive Engineer W.P. XII P.W.D. Sanguem.	
7	ERNESTO PINTO	Engineering Consultant Antiviegas Bldg. Na Parte Margao	
8	Dilip Khandi	T.A., P.W.D	
9	H. Donald	J.E. Service Verna	
10	DR. S.R. IMAM	Chairman Salcete Jan Seva Sangh	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
11	BHASKAR G. NAYAK	GOVT. COLLEGE OF ARTS, SCIENCE & COMMERCE, Kepem. and SAPANA VALLEY Housing Society, Porvorim.	BGNayak
12	R.G. Deo	Sulabh International	RG Deo.
13	Luna Furtado	Porvorim Parish	Furtado
14	Cdr. H. Azevedo IN(R.td)	St. Inez Parish	H. Azevedo
15	MRS. M. Azevedo	St. Inez	M. Azevedo
16	~~V. T. THOMA~~	~~PORVORIM~~	
17	~~MRS. ELIZABETH THOMA~~	~~PO~~	
18			
19	V. J. BHENDE	P. W. D. IX, MARGAO	
20	Kunimasa IZUMI	JICA Study Team	K. Izumi
21	DAIZO IWATA	Economics & Financial Analyst JICA STUDY TEAM	岩田
22	Willie Barreiro	JICA Study Team	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
23	TONY DESETA	JICA Study Team.	
24	Takemasa Maniya	JICA Study Team	
25	Tetsuo WADA	JICA Study Team	
26	Hirofumi SANO	〃	
27	Shozo Mori	JICA Study Team	
28	Eiichi ISHII	〃	
29	Vinod. Majali	〃	
30	Raghuram P.C.	PWD	
31	H.S. Prasanna Kumar	Lecturer in Civil Engg. Govt. Engg. College, Goa.	
32	DR. RAJENDRA TAMBA	STATE EPIDEMIOLOGIST Dir. of Health Services, Panaji-Goa.	
33	Jose Philip	8 Palmyra Colva	
34	Sharad V. Naik	A.S.O / circle VIII	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
35	A.M. Wachasundar	C.E PWD	
36	V.N. AMBIKAR	Retd SE (PHE)	
37	Srikanth.V.	Verna industries	
38	C. Dias	Tech Asst SD II / UD IX	
39	Rev. Dn. KURIYAKOSE. ST. MARY'S ORTHODOX CHURCH, RAIBANDAR GOA	ORTHODOX CHURCH RAIBANDAR, GOA	
40	V. K. Kaul	Addl Chief Engineer PWD Goa	
41	Udaykumar. S.M	AE I, WD IX, PWD (PHE) Vasco	
42	Mrs. Doris J Teixeira	Chairperson M.M.C	Teixeira
43	G M N PARRIKAR	E E XVII	
44	A. S. Gaonkar	AE II WD XX	
45	Adv. Vinoj Daniel	Govt. Counsel	
46	Radhika S. Nayak	Lecturer in Economics (Researcher) Carmel College for Women Nuvem, Goa	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
47	K R Shrikant	WD III PWD, Exec. Engr	
48	Y. SAMTHANAM	EE WD XXI Sanguem PWD	
49	P. KARUNAKARAN	EE WD IX. Margao	
50	S.S. Wagmare	PWD Goa	
51	K. P Raghava	PWD. Asst Engr	
52	P. S. Varur.	AE I / PWD.	
53	Prakash Bhangle	JE SD IV WD XX Canacona	
54	Bruno Rodrigues	Panch (Majorda Panchayat)	
55	V. P. Mafatsi	JE, P.W.D, Ponda	
56	A.P. PARSEKAR	JE PWD PONDA	
57	E. P. PASTE	JE PWD PONDA.	
58	L.S.R. PEREIRA	C.O. Bicholim Municipal Council	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
59	S.P. JADHAV	Asst. Eng. PWD Div III PHE	
60	D. M. Dhavalikar	Asst. Eng P.W.D Div- III	
61	U.S. Shirodkar	Environ Engineer Eng, Smat	
62	H.S. MUZAWAR	municipal engineer D.M.C	
63	Avit Bage	Commandale	
64	Kailas Naik	Comandak (PHE)	
65	P.S. Yarnaik	Sanguem PHE	
66	S.Y. Gaude	Canchem PHE	
67	V.S.S. Karmalker	Quepem XX PHE	
68	M.B. Hajgaya	Quepem XX PHE	
69	S.G. Malvekar	PWD Quepem	
70	Rama A. Honavar	Chairperson Vasco Municipal Council	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
71	Anand V. Sardesai	SDII/WDXX/PHE PWD, Quepem	
72	Vinayak Shet	SDII/WDXX/PHE PWD Quepem	
73	G.C. Bidaluli	SDII/XEN PWD Tonca	
74	SAVITUR PRASAD	Director Ministry of Urban Development	
75	Alexo Xavier	Chairperson. S.G Zilla. Panchayat	
76	Ramesh V.	deputy chairperson Kirlapal Panchayat	
77	Easwara Prasad	Dabol Goa	
78	Girish Prabhu	Dabal goa	
79	K.P. NAMBIAR	P.W.D.	
80	Subhash Parab	A.E., Opa Water work	
81	S.M. Dhond	EE WDXX PWD Margao	
82	K.H. Kamalakannan	AE SDII PHE Margao	

Please fill in your name, title and organization in this sheet.

No	Name in Print	Title / Organization	Signature
83	A A Patil	EE / PWD	
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Appendix M111.2 Note of Discussion From and Attendance Sheet of the Second Stakeholder Meeting

M111.2 Second Stakeholder Meeting

The main component of the second stage of public consultation was a second stakeholder meeting. The agenda, participants and timing of the second stakeholder meeting were jointly decided by the PWD and the JICA Study Team during the development of the master plan.

Objectives of the second stakeholder meeting were to:

- Present the outline of the proposed master plan.
- Show how the results of the first stakeholder meeting had been considered in the formulation of the master plan.
- Discuss site specific issues (e.g. the construction of sewage treatment plants) regarding the environmental and social considerations identified through the IEE.

The second stakeholder meeting was held by the PWD in cooperation with the JICA Study Team on 23 December 2005. More than 100 stakeholders were invited and around half of the invitees attended (54 attendants / 107 invitees). Table 111.2.1 shows the numbers of invitees and attendants for each stakeholder group. A detailed list of the invitees and attendants is provided in Volume IV Appendix M111.2 Note of Discussion From and Attendance Sheet of the Second Stakeholder Meeting.

Table M111.2.1 Number of Invitees and Attendants at the Second Stakeholder Meeting

Type of Stakeholder	Number of Invitees	Number of Attendants
MOUD	1	1
Goa Sate	6	1
JICA Official	1	1
PWD	19	13
JICA Study Team	13	13
Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	16	7
Chairperson, Vice Chairpersion, Councillor, Sarpanch, etc.	30	6
Journalists	4	2
NGO	5	4
College	7	2
Pvt. Engineer Consultant	2	1
Others (Port Trust and Military)	3	3
Total	107	54

The invitation to the second stakeholder meeting was distributed by the PWD. These were accompanied by a brochure outlining the master plan and the environmental and social considerations (see M111.3), a pamphlet about JICA, and a newsletter from the JICA Indian Office. The brochure was prepared specially for the second stakeholder meeting by the PWD with support from the JICA Study Team.

The most important purpose of the second stakeholder meeting was to discuss site specific issues (e.g. the construction of sewage treatment plants) regarding the environmental and social considerations identified through the IEE with the local stakeholders. Therefore, the invitations and the other documents were directly distributed by hand to the 16 most prominent stakeholders living/working around the proposed sites for the STPs, WTPs, etc. The locations of proposed sites and types of projects were briefly explained by the PWD staff to those representatives when the invitations were handed to them. Identification of these prominent stakeholders was based on recommendations made by local people.

In the second stakeholder meeting, the following five presentations were given to the stakeholders by the PWD, with support from the JICA Study Team, before discussions were initiated.

Two Main Presentations:

- Outlines of the Study and Public Participation (including answers to the comments given during the first Stakeholder meeting)
- Explanation of the Proposed Projects and the likely Environmental and Social Impacts

Three Additional Presentations:

- Answers to the comments given in the first Workshop
- Institutional Development and Capacity Building
- Outcomes of the Financial Analysis

Although some of the presentations explained the potential negative environmental impacts of the proposed STPs, the stakeholders seemed unexpectedly unconcerned about these issues. Rather, most of the topics raised were related to the current discontent of the public toward the PWD with regards to its water supply services. The need for the PWD to provide better daily customer services was highlighted in the discussion.

The main topics raised in the discussion section were:

1) Financial Implications of the Project
2) Goa's Good Historical Performance
3) Consumers' Complaints
4) Who Should Pay the Cost?
5) Reduction of Corruption
6) NRW Reduction and Organizational Improvement
7) Continuous Water Supply (24hrs a day, 7 days a week)
8) Sewage entering Water Supply Pipes
9) Coordination with Other Projects
10) Contents of the JICA Study
11) Unequal Water Supply among Different Regions
12) High Turbidity of Water Supply during the Wet Season
13) Necessity of Sewerage
14) Future Population and Demand Forecast
15) Sewers Sinking into the Sandy Soil
16) Industrial Water Demand based on the Regional Plan
17) Preservation of Wells and Decentralization of Water Supply

18) Map of Pipelines for Panchayats and Municipalities
19) Rain Water Harvesting
20) Need for Qualified Chemists and Laboratory Networks

The topic wise records of the discussion are shown as flows.

< Financial Implications of the Project >

Q (Question): Mr. Roland Martins, NGO – I would like to make some initial remarks. While this stakeholders meeting was going on last time I specifically asked to the person representing JICA in Delhi "What are the financial implications of this project?" He answered that there is no money for project implementation involved in this study and that it is left to the Indian and Goa Government to do with finance. I think first the financial implications of the project should be discussed.

A (Answer): Director (W.S), MOUD - About the financial implications of the loan let me tell you the Study is the 100 % grant from the courtesy JICA and loan is not yet sanctioned and I don't promise also. Based on our national priorities and Goa is a one of the state we may sanction or we may not sanction.

< Goa's Good Background for the Project >

C (Comment): CE I, PWD – Although there are still problems in Goa, please let me tell you that Goa is No 1 state all over in India as far as water supply system and provisions are concerned. Because Goa is the only state which has supplied all the villages potable water supply with piped system through regional and rural water supply schemes. We are here with the understanding that yes we are No.1 but still we have got the scope for improvement. With that understanding we are doing all these studies considering future requirements as well as current requirements. We are not totally useless and totally sort of unaccountable.

< Consumers' Complaints >

Q: Mr. Roland Martins, NGO – Here it has been mentioned that a sample survey has been conducted about 700 people. I want to ask how many people who are interviewed of the 700 sample who filled a direct complaint in consumer court against PWD, whom PWD had paid compensation or whom PWD has to pay heavily for the things they have done.

A: CE I, PWD - We have already developed helpline which is a computerized system where the complaints are registered. The registered complaints are sorted out in a stipulated time period

and if complaint is not sorted in stipulated time it goes to secretary. We agree that some complaints are not solved but measure to deal with the complaints has been created.

< Who Should Pay the Cost? >

Q: Mr. Roland Martins, NGO – I can see the system are being concerned I would like to suggest that Mr. Balav of World Bank came and we had shown him 100 illegal connections in Diwar village by the staff of PWD. You say that people are ready to pay the water supply and sewerage charges. I am having a summary of the affidavits for new connections saying that I will make alternative arrangements if PWD water supply is not available such affidavits are taken form the new consumers. The officers are taking statements from consumers that I will always pay my bill I will never complaint even if I do not get the water. This is the present consumer response you had from the department. If you are going to give 1000 crores what is the burden on the consumers. Which five star hotels are being asked to set up a desalination plant? Who is going to pay the interest?

Q: Mr. Joe D'Souza, Journalists – JICA says that the financial things should be on the consumer but see what Goa government is doing. The ferry services which are there in Goa and which are free and costing about Rs. 8 crores annually. This should be stopped. You want water supply to be paid by the consumers. But why are the ferry services free? Ferry services in entire Goa are free. On one side you say that the PHE department has to be self sustaining and the consumer has to pay here. This very government is giving free ferry services. The water losses from transmission pipes are not the transmission losses but the water politician give for free to some people. We say the corporate pay higher taxes but they are not but the common man who pays.

< Reduction of Corruption >

Q: Mr. Roland Martins, NGO – I am concerned about the corruption factor which does not seem to come any where in this. There is large corruption factor in PWD. Not a single line is there about your staff and corruption that's the only point I am saying. You put in your report.

A: Mr. Alban Couto, Advisor from the Goa State - In financial analysis it had been shown there. How subsidiary is there and how we have to improve is all shown in that. And all the points are being considered in the financial analysis.

A: CE I, PWD - One thing is that here we have stated into the reports. Also it is shown that the

accountabilities will be generated. I understand that increased accountabilities will control on corruption and other things automatically.

A: CE I, PWD - Second thing is that our tariff in Goa is practically least on an average, compared to other parts of India. It indicates how the PWD system is functioning. If corruption would have been there then our tariffs would have been fantastically high. But the tariff is less and the water quality is best as confirmed by some independent agencies. If water quality is good and tariffs are low. It once again confirms that department is functioning properly.

< NRW Reduction and Organizational Improvement >

Q: Mr. Roland Martins, NGO – The NRW, the leakages you talk about are basically the part and parcel of PWD's problem. When you say that 50 % of the money is not recovered for water supply what steps has been taken to hold the officers responsible?

A: Mr. Alban Couto, Advisor from the Goa State - Non revenue water include not only leakages of the pipes, but also non revenue meter water supply and public taps for which no charges are made.

Q: Mr. Roland Martins, NGO – Doesn't PWD have a manual? It does not have a test report? Why should I, the consumer, pay that amount? You have to be credible if you are a service provider. You should be credible, putting procedures in place? Tell me which staff held responsible for the loss of revenue in last one year.

A: Director (W.S.), MOUD - The organization restructuring or regeneration plan should be there. He has brought issues which have significant implications. Restriction, system of the feedback and reporting to bring about the improvement in the organization can also be possible within the frame work. Some drastic steps have to be taken at some point of time to bring NRW down. If state Government, PWD department, are not able to bring about the reforms, we will not sanction any loan to anybody. That's clear. They have to take reforms. They have to come out with increase in revenue and reduction in losses. They have to be a transparent and responsible department. This is not an optional but a mandatory dictate from the Central Government.

A: CE I, PWD - As for an unaccounted flow of water, we have taken up mass scale change of water meters and replacement of non working water meters. And our revenues are increased by 20% even in present system without increase in tariffs and that indirectly means that our non

revenue water is reduced by at least 7 to 10 % so that way we are going ahead.

A: CE I, PWD - As regards to public taps we have taken on mass scale reduction of public taps. We consider the reduction of public taps from 16,000 to 12,000 and further we have reduced to 8,000 public taps in Goa. We are aware that public taps are misused for gardening and other purposes. Therefore, we have developed a scheme wherein we are giving free water connection to the needy person who cannot afford to the charges of water connection. We have taken it on a large scale. Whenever we are giving free connection, we are making mandatory that some public taps are reduced. Is there any other state other than Goa where the entire state is having metered water supply. There may be some towns. But Goa is the only state where we are charging in both rural and urban areas. We are giving piped water supply and tariff may be showing less than the O & M cost. But at least with all this we are getting 85 to 90% O&M cost from the revenue collection. With respect to this Goa is no.1 state in India.

< 24 x 7 Water Supply >

Q: Mr. Joe D'Souza, Journalists – The last PWD secretary promised 24 x 7 water supply in Panaji and he said 24 x 7 is economical because changes happen in people's behavior. People tend to use more water when water comes only for limited time because when water supply resume next day they throw away the water stored.

<Sewage into Water Supply Pipes>

Q: Mr. Joe D'Souza, Journalists – When there is not water supply in pipe line the sewage goes into the pipelines. In Panaji there is more sewage coming out. Your 47 % transmission losses are much more because what we get is 20 to 30 % sewage which enters into the pipeline. The amount of water which you are getting is not water but it is sewage what we are getting.

A: CE I, PWD - As regarding to sewerage, it is a havoc making statement to say 30 % sewerage is going into the water pipelines and all that. Such statements are not proper. Let me tell you that we have an inbuilt system of everyday water quality check. We are already having testing facilities & laboratories. We are checking each and everyday. The reports come to Chief Engineer and report goes to the Secretary also. We are confirming that there are free from E.coli. At one place somebody said rightly that on pipeline some gutter may be going. You have to remember that gutters are constructed by gram panchayat, village panchayat and all that. Therefore we are having meetings with them. We have tried to make coordination for improvement and now panchayats are required to take NOC or concurrences from PWD while constructing gutters and all that.

< Map of Pipelines for Panchayats and Municipalities >

Q: Mrs Lorna B. Fernandes, NGO - I have a suggestion about the pipeline that a map of all the pipeline should be given to the local panchayat and municipalities and also want to say that I did requested from PWD engineer he said you could be terrorist and so I can't give it to you. I will just give a suggestion that the sewage lines don't go on the top of the water pipe lines because if these maps are displayed in local panchayat then it will help.

A: Director (W.S.), MOUD –They should have the maps. Local panchayat and whom so ever is concerned should have it.

< Coordination with Other Projects >

Q: Mr. Joe D'Souza, Journalists – Then the minister states that Tillari water can be used for domestic purposes. Then we have the Mopa airport. Is it supposed to come? Then there is a food park which is going to come. When is Goa going to become havoc in different directions? Are we going to have growth in different directions?

A: Mr. Alban Couto, Advisor from the Goa State - Augmentation of Dabose and other things are based on Tillari and Mopa airport. They had gone through their reports so that all these factors are taken into account. We are trying to bring in measures and procedures. Mr Vaidhya is doing all that. Please help us to have a positive constructive approach. We will build the plan considering all your concerns and worries. That's why JICA has come and we will build it into professional constructive approach.

< Contents of the JICA Study >

Q: Mr. Joe D'Souza, Journalists – The previous government had called so many companies and they had prepared so many reports but those are not reflected in the inflation rate.

A: Director (W.S.), MOUD - JICA has studied in all parts and their study is based on ground factors and not interested to help any company in any parts. Different studies which has taken at different point of times. JICA are studying many things including, future population growth, required power consumption, gravity flow system, soil conditions for sanitation such as absorption capacity, discharge capacity, cost, etc. The system also has placed very interactive stake holders meeting. The issues which have been brought out must be addressed.

< Unequal Water Supply among Different Regions >

Q: Defense - I am from the defense establishment at Vasco. Vasco is the fag end of Salaulim

dam and when there is any breakdown we are the last recipient of water. Are supply failures caused by the situation where there are no generators standby at the pump houses?

A: CE I, PWD - Presently there is unequal water supply distribution. But they are likely to be improved in long term.

A: CE I, PWD - Second thing there is absolute lack of awareness among the public and we blame ourselves for that. PWD have to generate awareness to the public by making action and interaction. Therefore as our director from MOUD stated, we can approve the proposal wherein the average water supply is 150 lpcd and our water cost per cubic meter is Rs. 10. But considering that it is an essential commodity and considering that the poorest or the poor should avail the water supply facility, water should not be wasted because the tariffs are less. Based on these considerations we are giving up to 100 litters per day per capita at rate of Rs. 2.5 for cubic meter for poor people by giving 75% subsidiary. When the consumption increases, up to 250 liters we charge Rs 5.5 per cubic mater. We have introduced a third slap of consumption above 250 liters, which will be charged Rs. 10 to 12 per cubic meter. With these slaps people will not use water more lavishly and less consumption will be there. Also the tail end users will not suffer from water shortage.

A: CE I, PWD - We are constructing the zonal reservoirs so that the water will be served even to tail end users from zonal reservoirs all the night, and the difficulty of water stoppage will be reduced on an average in Goa. PWD supply 82 lpcd on average in rural areas and we are much ahead.

Q: Mr. Snowkon Gowsalves, Sarpanch of Calangute - Major pipeline is running from Calangute to other village Saligao, Anjuna etc. Calangute village was not getting water though we are termed as a tourist destination. When we couldn't get any water, we marched to the office to a PWD engineer and we took the engineer to Mapusa and from Mapusa we took the engineer to the valve which was operating. Then we literally operated that valve and then the water was coming. These things are happening most of the times. The Junior Engineers were supposed to be at the place. They are looking after 5 or 6 villages wherein they are having additional charge.

A: CE I, PWD - Calangute also comes to the tail end and we have to generate awareness. The starting places of treatment plants get more water. Suppose the junior engineer goes and controls the unequal distribution the locals representative shouts. The second issue is about

funding. These fellows (JICA Study Team) also state that if any big schemes are to be taken then the systems accountability and sustainability has to be seen for.

Q: Marmugao Port Trust - Vasco is the tail end and we are always getting late water plus when breakdown takes place. It takes 3 days to reach Vasco. Improvement has to be done on this. Earlier the demand given was 3000 m^3 per day. We used to get 1500 to 1800 earlier 4 years. Now it has restricted to 1000 m^3 and we are having quarters of about 1400 employees plus administration and other bungalows. Those quarters I am not able to fulfill the requirements and I am restricting to one hour and giving water. Forget about the ships. Earlier we used to give water to ships. Port is the major and Goa Government is also beneficiaries. Now we are not able to give the water to the ships as well as port and we were supplying tankers. My request is to keep an eye on the port trust and to think as international port and major port and development of Goa state. Please increase the capacity as well as our requirements. Recently we had given spare land also to lay the pipeline of 600mm dia which is crossing in our area. So with the hope we will get more water which is assured to us by chief engineer.

< High Turbidity of Water Supply during the Rain Season >

Q: Defense -Supplied water turbidity during the last rainy season was high. So a lot of your filter beds got clogged and there was shortage of water.

A: CE I, PWD -Regarding turbidity as far as first rain comes we have experience that more turbidity comes and accordingly we have to wash the filter beds very often which intern results in lowering the output (total quality of treated water) therefore in Salaulim we have recently taken over for augmentation of filtering capacity 20Mld. These are things we are taking up.

< Necessity of Sewerage >

Q: Mr. Snowkon Gowsalves, Sarpanch of Calangute -As for sewerage system, the PWD and the Central Government are helping us. But no one is bothered to take care of the Calangute belt for sewerage system.

Q: Mr. Snowkon Gowsalves, Sarpanch of Calangute - I had heard for the last 18 years that a sewage treatment plant is going to come in Calangute. Using one tanker to the sewage treatment plant costs me Rs. 500 and I have to charge public Rs. 1200 now if these things are happening.

A: CE I, PWD - Now Calangute is added in the JICA Study.

Q: Mr. Snowkon Gowsalves, Sarpanch of Calangute - They have constructed sewage

corporation. They were calling tenders and things had been shown in high court, but those tenders have not yet commissioned.

Q: Mr. Roland Martins, NGO - How much is the tourism department going to pay? Because ultimately it should not be on the tax payers. Sewerage contributes to Tourism, so let tourism Dept. also contributes to this process.

A: CE I, PWD - If we take it to appropriate forum they will accordingly decide the tariffs. As you suggested, tourist should be charged.

Q: Mr. Snowkon Gowsalves, Sarpanch of Calangute – Let's take in a constructive way. JICA is doing their study. Let the State Government take their decision and the Union Government provide us sufficient funds. As a Sarpanch I have not seen a treatment plant for the last 18 years in Calangute, but let's see that I can see it in the next 5 years.

Q: Mr. Abdul Samad, Household living around Panaji STP - Regarding to sanitation, it is better not to further load the existing sewerage system which are in Panaji. Let other areas go for zoning in order to develop a sewerage scheme for Calangute. You should have a separate scheme. You should have a separate scheme in Candolim because if you go for combining all these schemes, sanitation will not function properly. You have to give the proper slope to the sewer lines because sewer lines cannot be given more slope also because of the scouring effect. For that reason, I am suggesting to have the zoning system which has a small units functioning efficiently. I am requesting you to go for zoning of small areas and implement it.

< Future Population and Demand Forecast >

Q: Mr. Abdul Samad, Household living around Panaji STP - I would like to tell you about the future population forecasted for 25 years considering that Government policies, industrialization, urbanization and all. The population growth is going to be very fast particularly in rural areas, which are becoming like urban areas. People want more and more water supply facilities.

Sir has told us to restrict to 150 lpcd, but what has happened in Delhi in some areas? We require water for 400 lpcd to make the Goa a beautiful state. Why can't we go for population forecast for 3 decades. The future population was projected to be 18.49 lakhs here in 30 years. I think that figure has to be seen in the positive direction to revise. These figures will not be appropriate now the plans are under proposal. The plan will take 4 to 5 years to be implemented,

by the time this population would have reached above that. Particularly urbanization is linked with the political party. Industrialization is linked with the parties which are in power. Therefore every party has to go over their own manifesto and growth should be in right direction. For example, today you see what has happened to Verna IDC, where the city is developing in all directions. So considering these things you have to revise the forecasted population again.

A: Director (W.S.), MOUD – The present population is 11 lakhs in Goa and it may become more than 19 lakhs in 25 years. But the population forecast can never be precise because Goa is the tourist destination.

Q: Commissioner, C.C.C. Panaji - I would also like to comment on the capacities which are shown for the STP's as well as WTP's. For example, I was observing the figures in Calangute. They have projected the capacity of 11000 m^3 per day. On what basis is this 11000 fixed in 2025?.

The required gestation periods for the study itself, securing funds, actual commencement of the project and actual execution of the project has to be taken into consideration.

On that day of execution it might be even 2025. I think 2025 is a very close. Any such plan has to come for 2050 if you want to make a proper plan. For example of Panaji, because we have setup a system in 1969 or 1965 it is over used and over exhausted. They have gone for the augmentation for that capacity. It has also to be looked into land acquisition for the augmentation up to 2050. Whether in 2050 these plans will be augmented, I think a futuristic vision has to be projected.

< Sewers Sinking in to the Sand Soil >

Q: Commissioner, C.C.C. Panaji - As he said definitely in STP the topographical conditions has to be seen. We have seen in coastal areas in relation to Calangute and Candolim. We have to see whether the sewer lines will be sustainable in the sandy soil. We are in Panaji where we have a small beach area in Miramar where the sewer line is sinking every year at the circle. Chief engineer would justify every year after the monsoon the sewer chamber goes down due to the sandy soil strata. Whether such long lines in coastal areas are feasible to take the sewer water to Baga? Whether, the engineer said, these have to be decentralized treatment plant in Candolim, Calangute and Baga itself? This should be taken care off. Because in Panaji itself the chamber sinks in Miramar area, what will happen in other areas also in terms of augmentation and additional requirements? I think the study has to be more elaborated and precise.

A: CE I, PWD - Basically we know that the old pipeline which is laid in 1960s is sinking due to sandy strata and therefore latest technologies are being considered during this generation. HDPE pipelines and all that will be taken into account and that thing will be taken care off. As regards to the decision regarding quantum of the treatment plant which area to be covered is to be decided by the economics scale.

< Industrial Water Demand based on the Regional Plan >

Q: Commissioner, C.C.C. Panaji - I would also like to bring to the notice of JICA team that there is a regional plan for Goa and these stakeholders grievances are coming because that projection of stakeholders has not come. If MPT requires x amount of water from the Salaulim dam from the project it is not indicated in the project report. If the MPT increases 10 berths tomorrow so more ships will come. These types of projections like Verna. If the regional plan has an industrial estate there in 2025 they have to take into consideration that regional plan and these industrial estates will be 100 % functional. Have they taken this into account? Has this capacity shown in the plan? Has the regional settlement area which will come in 2025 is it commensurate to the regional plans? This has to be very well taken into account otherwise the figures will not match with the regional plans and growth sectors. So what STP's and WTP's are projecting should be linked to the regional plans and areas in the regional plan, industrial areas, settlement areas and otherwise.

A: Director (W.S.), MOUD –Your plan should be synchronized with the regional plan.

A: Mr. Alban Couto, Advisor from the Goa State –He mentioned Verna and I would tell you one important fact which they have taken into account 90% of Goa's industry depend upon potable water because of pharmacy and hotels and Verna. The expansion which will give employment to 40,000 people in pharmacy has been stopped because there is no water. So that has been taken into account plus 15 growth centers and industrial areas all that has been shown in that. As far as Mormugao port trust we had shown as a part of institutional requirement and Salaulim water primarily meet for the airport requirement. In regional plans comments of Mormugao Port Trust has been taken.

A: Director (W.S.), MOUD –Town and country planning they have 40 year or 25 year master plan. Port trust whether they are going in for expansion? Is it going in expansion with new porting facilities? How many more ships will be coming? Will they also require the water? That has to be taken into account. It is very important, including the new airport if they also and their requirement also has to be taken care. So possible future scenario also take any defense

expansion from defense side also.

Q: Defense -As new plans are coming so there will be enhancement of our requirements. New air base is coming.

A: CE I, PWD - We have the experience that many a times the requirements are inflated substantially. When requirement is placed it is not costing anything so I said 10 mld. But when it comes to actual I consume 2 mld. So when the requirement is put for 10 mld and accordingly infrastructure is developed and only 2 mld is consumed then it looses its balance. Therefore, you can send the requirements but it should be on realistic basis

< Preservation of Wells and Decentralization of Water Supply>

Q: Mr. Naryan Vaigankar, NGO - Prior to liberation in Goa we used to have well waters and after liberation this water system of pipeline has come and those wells are already destroyed now that development has taken a place and builders what they are doing they are spoiling all the wells. They are filling all the wells. My suggestion is JICA they should take the initiative of preserving these wells.

A: Director (W.S.), MOUD –This is the thing which municipal bodies or Ground water board has to take care but JICA can't do it. It should be taken care by PWD and water bodies should be preserved.

Q: Mr. Joe D'Souza, Journalist –Because of the centralized water supply system the decentralized water system or ground water is neglected. Goa has 122 inches of rainfall and very good ground water is available and we can decentralized.

A: CE I, PWD -I think Government should take initiative in this. Ground water management is purview of other departments.

< Rain Water Harvesting >

Q: Marmugao Port Trust - Rain water harvesting is not included in this JICA project.

Q: Director (W.S.), MOUD –Goa has a good rainwater. Rain water harvesting is off course definitely I don't know how to again included in the report but rain water harvesting is off course a good suggestion and must be there.

< Need of Qualified Chemist and Laboratory Network>

Q: Mr. Dilip, NGO - There are no qualified chemist in Dabose WTP. There are some employed people who says they are chemist but they are not chemist and they are not qualified. It is the residual chlorine that is required to be maintained at the consumers end so that it will keep pathogenic organisms away. Concentration of residual chlorine will be slightly more on some particular days so controlling at one point that can be taken care.

Q: Director (W.S.), MOUD –JICA Study Team is preparing this master plan and see for setting up of a laboratories network physically. Subsequently in and all these facilities are there to ensure. We have seen the performance of PHE from the discussion which has come to pathogens from sewage point of view or the quality of the water. The water distributors' centers will be there. The offices should have the facility to display the quality of water. So setting up of laboratory should also be a part. Laboratories at whatever level, regional, local, etc. on which level you can feel appropriate that can be added the regional laboratories not for STP and WTP but also from water distribution point of view. Means upto what distance the sample should be tested at that level or sent to main laboratories once in week or once in a month. Whether test has to be done in main laboratory? What will be the network system look like? Entire monitoring system can also be a part of master plan.

A: JICA Study Team - In master plan we are specifying the water quality parameters which should be tested and setting up of laboratory network. Now we are preparing the plan.

Attendance Sheet of the Second Stakeholder Meeting

Please fill in your name, title and organization in Easy-to-Ready Block Letter.

No	Category	Name	Title, Organization / Area	Attendance
1	MOUD	Mr. Savitur Prasad	Director, Ministry of Urban Development	○
2				
3	GOA STATE	Dr. Rajendra Tamba	State Epidemiologist, Dir. of Health Services, Panaji.	
4		Mr. M. Joshi	Pollution Control Board	
5			Director of Tourism	
6		Mr. Arvind Salelkar	Director of Health Service	
7		Dr. N.P.S. Varde	Director/Joint Secretary, Department of Sicence, Technology & Environment	
8		Mr. Daulat Hawaldar	Director of Municipal Administration	○
9				
10	JICA Official	Mr. Ito	Duputy Resident Representative, JICA India Office	○
11				
12	PWD		Chief Secretary	
13		Mr. Santosh D. Vaidya	Secretary	○
14		Mr. Alban Couto	Adviser	○
15		Mr. Nambiar	Pr.Chief Engineer, Panaji	
16		Mr. A. M. Wachasundar	Chief Engineer-I, Panaji	○
17		Mr. U. H. Naik	Chief Engineer-I, Panaji	
18		Mr. S. D. Sayanak (representative)	Chief Engineer, W.R.D	○
19		Mr. T.K. Nambiar	Suptdg. Engineer, Circle V	○
20		Mr. Souza	Suptdg. Engineer, Circle VIII	
21		Mr. Verlekar	Suptdg. Engineer, Circle VI	
22		Mr. Shrikant	Executive Engineer, Div III, Panaji	○
23		Mr. G M Naik Parikar	Executive Engineer, Div XVII, Porvorim	○

24	PWD	Mr. S M Dhond	Executive Engineer, Div XX, Margao	○
25			Executive Engineer, Div XII,Sanguem	
26		Mr. A.A. Patil	Executive Engineer, Div IX, Margao	○
27		Mr. V.Santhanam	Executive Engineer, Div XXI, Margao	○
28		Mr. P. Karunakaran	Jr. Engineer, Co-ordinating Assistant for JICA & PWD	○
29		Mr. Uday Kumar	AE PWD Vasco	○
30		Mr. G H Kedlekar	Jr. Engineer PWD Vasco	○
31				
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33				
34				
35	JICA Study Team	Mr. Mamiya	Team Leader	○
36		Mr. Sano	Team Member	○
37		Mr. Ueno	Team Member	○
38		Mr. Willy	Team Member	○
39		Mr. Izumi	Team Member	○
40		Mr. Ishii	Team Member	○
41		Mir. Oga	Team Member	○
42		Mr. Wada	Team Member	○
43		Mr. Iwata	Team Member	○
44		Mr. Mori	Team Member	○
45		Mr. Jimbo	Team Member	○
46		Mr. Ishihara	Team Member	○
47		Mr. Mapari	Coordinator	○
48				

49	Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	Mr. Peter Carvalho, Dropanchor Bar & Rest Sauntawada Baga beach Ph. 9822483884 & 2497061	North Coastal Belt (Baga): Resident	○
50		Mr. Rocky Fernandes, 3rd ward, Bagdem-Colva Ph. 2788693	South Coastal Belt (Colva): Resident	
51		Mr. Mandar R. Upasani, "Yugantar" Shanti nagar-Ponda Ph. 2319899 9822388924	Ponda: Builder	
52		Mr. Bhanudas Naik, Khadapaband, Ponda-Goa Ph. 2317527	Ponda: Resident	
53		Ms. Radhika S. Nayak, Ramnathkar Apartment Old Bazar, Ponda-Goa Ph. 2315000, 09422439876	Ponda: Builder	
54		Mr. Bhaskar Khandeparkar, Architect, Ponda Ph. 2312430, 9822121457	Ponda : Resident	
55		Mr. Oscar D'Souza e Lenny D'Souza, Heard No.4, Carmarcazana, Mapusa Ph. 2257848, 9423321124	Mapusa: Resident	○
56	Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	Mr. John Edward D'Silva, H. No. 272, Penha-de-France, Manxebhatt-Britona Ph. 98221459999	Porvorim: Resident	
57		Mr. Abdul Samad, Retd. Professor, Govt. Polytechnic, Panaji, UGF004, 'Yashodam Bldg.', Dempo Marg, Caranzalem Post, Panaji Ph. 2463826, 9822139170	Panaji: Resident	○
58		Mr. Dyaneshwar Govekar, Scholar Builder, Caranzalem Ph. 2445215, 9822103560	St. Cruz, Resident & Builder	
59		Mr. Johnson Fernandes, F-1, Silver Glades Bldg. Ph. 2732543, 9822985454	Margao: Resident	
60		Mr. Anil Katkar, Councilor-Vice Chairperson, Volpoi.	Dabose: Resident	
61		Mr. Sundar Dhuri, Proffessor, Chowgule College, Margao Ph. 2375101	Dabose: Resident	○
62		Mr. Taher, Dy. Superintent of archiologist, O/o A-S-1, B-2, Happy Home Apts., St. Inez, Panaji. Ph. 2224703	Archiological Survey of Indeia, St. Inez, Panaji For Salaulim Mahadev Temple	○

63	Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	Mr. S. Rajendra, Engineer- A.S.I.,	Archiological Survey of Indeia, St. Inez, Panaji For Salaulim Mahadev Temple	○
64		Dr. V. Gopaloa Rao	Archiological Survey of Indeia, St. Inez, Panaji For Salaulim Mahadev Temple	○
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74	Chairperson, Vice Chairpersion, Councillor, Sarpanch, etc.	Mr. Sanjit Rodrigues,	Commissioner, C. C. P., Panaji	○
75			Chairperson, Municipality, Margao	
76		Mr. Radha Kavlekar,	Councillor, Margao Municipality. Margao	
77			Chairperson, Municipality,Mapusa	
78			Chairperson, Municipality, Ponda	
79			Chairperson, Municipality, Quepem	
80			Chairperson, Municipality, Canacona	
81			Chairperson, Municipality, Bicholim	
82			Chairperson, Municipality, Curchorem	
83			Chairperson, Municipality, Cuncolim	
84			Chairperson, Municipality, Vasco	
85			Chairperson, Municipality,Pernem	

86	Chairperson, Vice Chairpersion, Councillor, Sarpanch, etc.		Chairperson, Municipality, Volpoi	○
87			Vice Chairperson, Municipality, Margao	
88			Chairperson, Zilla Panchayat North	
89			Chairperson, Zilla Panchayat South	
90		Mr. Rama Honavarkar	Chairperson, Vasco Municipal Council, Vasco	
91			Sarpanch, V.P. Dhabal	
92			Sarpanch, V.P. Collem	
93		Mr. Snowkoni Gowsalves	Sarpanch, Colva	○
94		Mr. Joseph Sequeira, Ph. 9326110855	Sarpanch, Calangute	○
95		Mr. John Rosario	Sarpanch, Taleigao	
96			Sarpanch, Majorda	
97		Mr. William Gonsalves	Sarpanch, St. Cruz	
98	Chairperson, Vice Chairpersion, Councillor, Sarpanch, etc.		Sarpanch, Benaulim	
99			Sarpanch, Betalbatim	
100		Mr. Ramesh V.	Deputy Chairperson, Kirlapal Panchayat	
101		Mr. Rodrigues	Borda Citizen Committee, Margao	
102		Mr. Clotilides Braghnch	V.P Member, Calangute	○
103		Mr. Jose Bragancha	V.P Member, Calangute	○
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109	Journalists		Editor, Navhind	
110		Mr. Joe D'Souza	Editor, Herald	○
111		Mr. Avit Bagle	Reporter, Gomantak	○
112		Mr. Surendra Furtado	Goa Times	
113				
114				
115	NGO	Mr. R. G. Rao	Sulabh International	
116		Mr. Rolant Martins	Co-ordinator GOACAN	○
117		Ms.Lorna B Fernandes	Secretery GOACAN	○
118		Mr. B G Naik	Goa Environmental Ecology Trust	○
119		Mr. Narayan Vaigakar	Goa Environmental Ecology Trust	○
120	College	Mr. Bhaskar G. Nayak	Govt. College of Arts, Commerce, Science, Quepem	
121		Mr. Gupta	Head of Civil Engg Dept., Goa Engg. College, Farmagudi	○
122		Mr. U.G.Sawaikar	Professor, Civil Engg. Dept., Goa Engg. College, Farmagudi.	○
123			H. O. D., Civil Engg. For Govt. Polytechnic	
124			Rosary Collage, Navelim, Margao	
125			Rosary Collage, Navelim, Margao	
126		Dr. I.D. Konikkara	Calicut University, Kerala	
127				
128				
129	Pvt Engineer Consultant	Mr. Veerkumar Sawant	Pvt Engineer Consultant	
130		Mr. H.R.Kulkarni	Consulting Environmnetal Engineer	○

131	Others	Mr. S B Gurav	AE Mormugoa Port Trust	○
132		Maj Uiuay Bahl	GE (NW) Vasco (Defence Establishment)	○
133		Mr. V. L. Charan	Aue Efm (NW) Vasco (Defence Establishment)	○
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Appendix M111.3 Brochure on the Master Plan and Environmental & Social Considerations

Background and Objectives of the Study

There are seven existing surface water supply schemes in Goa (e.g. the Salaulim Scheme which sources water from Salaulim Dam) and existing small scale 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. 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. However the average sewerage coverage ratio in urban areas is still 13% in Goa. Even where sewer pipelines are installed, the connection ratios remain low (e.g. 7 % in Margao and 19% in Vasco). 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 the populations in coastal areas double and therefore the volume of sewage generated increases. During the rainy season many septic tanks overflow due to rises in the groundwater table.

There is a clear need for additional water supply and sewerage system capacity in Goa, especially for cities, industrial estates and tourism resorts. 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. As requested, the JICA Study Team has been currying out its study work on augmentation of water supply and sewerage/sanitation in the study areas shown in Figures 113.1.1 and 113.1.2 since April 2005.

Figure 111.3.1 Water Supply Study Area

Figure 111.3.2 Sewerage/Sanitation Study Areas

Objectives of the Study are to:

- Formulate a master plan for augmentation of water supply and sanitation in Goa State based on requirements up to 2025;
- Conduct a feasibility study for priority project(s) which will be selected from the master plan; and.
- Pursue technology transfer to the counterpart personnel in the course of the study.

Master Plan and 2nd Stakeholder Meeting

The study work consists of three phase of reconnaissance study, formulation of master plan on water supply and sewerage/sanitation, and feasibility study on the priority projects. Since October, 2005 the JICA Study Team has been formulating the master plan for the target year of 2025 considering many aspects including water demand increase in the future, financial feasibility, economical impacts, environmental suitability and inputs from stakeholders on social influences.

In the 1st stakeholder meeting held at the end of reconnaissance study in August 23, 2005, general concerns of the stakeholders (including related government agencies, NGO, representatives of Goa citizens, etc.) regarding to water supply and sewerage/sanitation were discussed. The results of the 1st stakeholder meeting have been utilized to formulating the

master plan. Now after provisionally selecting suitable project sites for the construction of water treatment and sewage treatment plants, the 2nd stakeholder meeting is to be held especially to consult public on social and environmental influences of the proposed master plan. The selection of sites and technological options such as wastewater treatment processes have been conducted based on alternative studies in consideration of environmental and social effects. Those alternatives are also to be presented for stakeholders' information in the second stakeholder meeting.

Objectives of the second stakeholder meeting are to:

- Present the outlines of the proposed master plan
- Present how the results of 1st stakeholder meeting has been considered in the formulation of the Master Plan
- Discuss site specific issues such as the construction of sewage treatment plants with local stakeholders as regard to environmental and social considerations based on IEE study

Water Supply Projects Proposed in the Master Plan

Objectives

The objectives of water supply projects proposed in the Master Plan are to improve water supply situation in Goa,

- Through expanding the existing water supply schemes by constructing new water treatment plants
- Through enhancing the capacities of water transmission and distribution systems of major water supply schemes by rehabilitation of existing facilities, installment of pipelines and construction of reservoirs, etc.
- Thorough the improvement of the operation and maintenance of water supply system.

Major Project Components

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

- ✧ Canacona Water Treatment Plant (for Canacona)

■ Enhancement of Water Transmission and Distribution Capacities of All the Major Schemes
- ✧ Construction of new transmission and distribution pipelines
- ✧ Construction of Reservoirs

■ Rehabilitation of Existing Facilities
- ✧ Replacement of old mechanical and electrical facilities
- ✧ Replacement of old pipes to reduce water leakage

Project Benefits

- ■ Expansion of water supply service areas
- ■ Improvement of water quality
- ■ Continuous water supply
- ■ Reduction of waterborne diseases
- ■ More water supply available to tourist facilities
- ■ More water supply available to industries
- ■ Improvement of socio-economic conditions
- ■ Effective management of operation and maintenance
- ■ Reduction of non-revenue water including water leakage

Presumable Impacts and Possible Mitigation Measures

Major Item	Impact and Mitigation Measures
Water Treatment Plant	
• Resettlement	• New water treatment plant site are selected to avoid resettlement
• Cultural heritage	• New water treatment plant site are selected to avoid relocating cultural heritage
• Deforestation	• Tree Plantation
No major impact of installation of transmission pipes, pumping stations and reservoirs	

Sewerage/Sanitation Projects Proposed in the Master Plan

Objectives

The objectives of sewerage/sanitation projects proposed in the Master Plan are to improve urban sanitation in Goa,

- ■ Through expanding the existing sewerage systems to areas around Panaji and south of Margao.
- ■ Through constructing new sewerage systems in Ponda, Mapusa and part of North Costal

Belt.

- Through improving onsite sanitation facilities in South Costal Belt and other areas of low population density.
- Through enhancement of public awareness on sewerage and on-site sanitation facilities.
- Through the improvement of the operation and maintenance of sewerage and on-site sanitation facilities.

Major Project Components

- Expansion of existing sewerege systems including sewer, pumping station and treatment plants
  - ✧ Panaji: Taleigao, Dona Paula and Caranzalem
  - ✧ Margao: South Zone
- Consutruction of new sewerage system including sewer, puming station and treatment plant
  - ✧ Surrounding areas of Panaji (Provorim, St. Cruz)
  - ✧ Ponda
  - ✧ Mapusa
  - ✧ Coastal Belt of South Goa (Colva)
  - ✧ Coastal Belt of North Goa (Calangute and Candolim)
- Rehabilitation of Panaji Sewerage System
  - ✧ Sewer network rehabilitation
  - ✧ Replacement of pumping station equipment

Project Benefits

- Improvement of water quality in rivers and beaches.
- Improvement of living environment including gutter and local streams.
- Reduction of the overflows from existing septic tanks
- Improvement of sanitary conditions in the cities
- Improvement of environmental conditions of Costal Belts
- Reduction of the risk of disease and enhancement of human health
- Reuse of nutrient rich sludge from Sewage Treatment Plants for horticulture, etc.
- Improvement of the image of the cities and enhancement of the value of the cities
- Improvement of socio-economic conditions
- Benefiting women and improving their dignity

Presumable Impacts and Possible Mitigation Measures

Major Item	Impact and Mitigation Measures
Sewage Treatment Plant	
• Resettlement	• STP sites are selected to avoid resettlement
• Income loss due to land acquisition	• To be compensated by money or alternative land
• Odour	• Wastewater and sludge treatment processes causing less odour
• Sludge disposal	• Reuse of sludge
• Water contamination in receiving body	• Disinfection through chlorination • Ensuring appropriate O&M of sewerage facilities • Setting up of monitoring mechanism
No major impact of installation of pumping stations and trunk sewers	

Appendix M112:

Environmental and Social Considerations for Implementation

Contents for Appendix M112

Appendix M112.1 The Notification of Environmental impact assessment and the List of Projects Requiring Environmental Clearance from the Central Government (The Schedule I)

The notification of EIA was enforced in January 1994 and amended it in May 1997, April 1997, January 2000, December 2000, August 2001, November 2001, June 2002 and July 2004 respectively for conducting Environmental Impact Assessment (EIA) studies which are obligatory for the establishment of certain categories of industries specified in Schedule I. The Schedule I industries include 32 categories as listed below. The appraisal committees comprising experts, Governmental official and non-government organisations (NGOs) were set up by the Ministry of Environment and Forestry (MoEF) to scrutinise various EIAs prepared for the establishment of such industries and projects. The appraisal committees would accord an environmental clearance to the project in consultation with MoEF after scrutinising the EIA report for the proposed project.

1. Nuclear Power and related projects such as Heavy Water Plants, nuclear fuel complex, Rare Earths.
2. River Valley projects including hydro power, major irrigation and their combination including flood control.
3. Ports, Harbours, Airports (except minor ports and harbours).
4. Petroleum Refineries including crude and product pipelines.
5. Chemical Fertilizers (Nitrogenous and Phosphatic other than single superphosphate).
6. Pesticides (Technical).
7. Petrochemical complexes (Both Olefinic and Aromatic) and Petro-chemical intermediates such as DMT, Caprolactam, LAB etc.and production of basic plastics such as LLDPE, HDPE, PP, PVC.
8. Bulk drugs and pharmaceuticals.
9. Exploration for oil and gas and their production, transportation and storage.
10. Synthetic Rubber.
11. Asbestos and Asbestos products.
12. Hydrocyanic acid and its derivatives.
13. (a) Primary metallurgical industries (such as production of Iron and Steel, Aluminium, Copper, Zinc, Lead and Ferro Alloys).
    (b) Electric arc furnaces (Mini Steel Plants).
14. Chlor alkali industry.
15. Integrated paint complex including manufacture of resins and basic raw materials required

in the manufacture of paints.

16. Viscose Staple fibre and filament yarn.
17. Storage batteries integrated with manufacture of oxides of lead and lead antimony alloys.
18. All tourism projects between 200m - 500 metres of High Water Line and at locations with an elevation of more than 1000 metres with investment of more than Rs.5 crores.
19. Thermal Power Plants.
20. Mining projects *(major minerals)* with leases more than 5 hectares.
21. Highway Projects **except projects relating to improvement work including widening and strengthening of roads with marginal land acquisition along the existing alignments provided it does not pass through ecologically sensitive areas such as National Parks, Sanctuaries, Tiger Reserves, Reserve Forests**
22. Tarred Roads in the Himalayas and or Forest areas.
23. Distilleries.
24. Raw Skins and Hides
25. Pulp, paper and newsprint.
26. Dyes.
27. Cement.
28. Foundries (individual)
29. Electroplating
30. Meta amino phenol
31. New construction projects
32. New industrial estates

Water Supply and Sewerage projects are not included in these industries and do not require EIA study according to the Notification.

Appendix M113:

Initial Environmental Examination

Contents for Appendix M113

Appendix 113.1 Initial Environmental Examination Report for the Water Supply and Sewerge Master plan in GOA

The principal objective of an Initial Environmental Examination (IEE) is to reach a decision on whether a full-scale examination of environmental impacts concerning, i.e., an Environmental Impact Assessment (EIA) would be required or not. The purpose of performing the IEE for the *Study for Augmentation of Water Supply and Sanitation for the Goa State* is to identify various environmental factors affected by a total project implementation for the proposed Master Plan Study that selected by the Study. The impact on these environmental factors for selected suitable water and sewerage facilities will be reviewed and carefully examined in the next stage of the rapid EIA.

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

The Pollution Control Board (PCB) was established under this Act both at the Central Government and also at the State Government level for each state. The water supply and sanitation projects for the State of Goa will be executed by the Public Works Department (PWD), Government of Goa. The PWD will co-ordinate in regard to performing Environmental & Social Considerations for the Projects with different state government Departments like Forest Department, Science, Technology & Environmental Department, State Pollution Control Board at various stages of the implementation of the project and also during the operation phase of the project.

1. Environmental Protection

1.1 Institutions and Jurisdictions

(1) Environmental Agencies

1) Ministry of Environment and Forests

Ministry of Environment and Forest (MoEF) is the agency, in the administrative structure of central government, for planning, promotion, co-ordination and overseeing the various environmental protection and forest conservation programmes. The Ministry is responsible for effective implementation of environmental legislation through its various divisions at Central

Government level and also through Central Pollution Control Board, State Departments of Environment and Forests, State Pollution Control Boards and Pollution Control Committees in the Union Territories, which serve as implementing agencies of the Ministry. Besides several legislative measures taken by the ministry to protect the wholesomeness of the environment, a National Conservation Strategy and a policy statement on Environment and Development, 1992, National Forest Policy, 1988 and statement on abatement of pollution, 1992 have also been evolved to tackle the environmental protection issues effectively.

The principal activities undertaken by MoEF consist of conservation & survey of flora, fauna, forests and wildlife, prevention and control of pollution, afforestation & regeneration of degraded areas and protection of environment, in the framework of legislations.

The main tools employed for achieving the above objectives include surveys, impact assessment, control of pollution, regeneration programmes, support to organisations, research and development, collection and dissemination of environmental information and creation of environmental awareness among target groups and stake holders at all levels of the country's population. Realizing the need for authoritative statistical data on environment, the work relating to collection, collation and analysis of environmental data and its depiction has been constantly taken-up through various projects.

The main functions of the ministry are:

- Environmental policy planning
- Effective implementation of legislation
- Monitoring and control of pollution
- Eco-development
- Environmental clearances for industrial and development projects
- Environmental research
- Promotion of environmental education, training and awareness
- Coordination with concerned agencies at the national and international levels
- Forest conservation development and wildlife protection
- Biosphere reserve programmes

(2) Other Agencies Strongly Involved in Environment Management

1) Central Pollution Control Board

The Central Pollution Control Board (CPCB), a statutory organisation, was constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further,

CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

It provides technical services to the MoEF under the provisions of the Environment (Protection) Act, 1986. The principal functions of the CPCB are as given below:

- Advise the central government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air and water.
- Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution;
- Co-ordinate the activities of the State Pollution Control Boards (SPCB) and resolve disputes among them;
- Provide technical assistance and guidance to the SPCB, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement;
- Plan and organise training of persons engaged in programme on the prevention, control or abatement of water and air pollution;
- Organise through mass media, a comprehensive mass awareness programme on the prevention, control or abatement of water and air pollution;
- Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement;
- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
- Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
- Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air; and
- Perform such other function as may be prescribed by the Government of India.

1.2 Legislative and Regulatory Framework

(1) Living Environment

1) Water Quality

The Central Pollution Control Board and the State Boards initiated the implementation of the Water (Prevention & Control of Pollution) Act enacted in late 1974, from the year 1975. The Water Act is applicable to all Union Territories and has been adopted by all the states, by resolution passed on that behalf under clause (I) of Article 252 of the Constitution. Under the provisions of this Act, no discharge of wastewater can be made into the environment without

obtaining prior consent from State Pollution Control Board (from the Central Pollution Control Board, in case of Union Territories). A consent prescribes the volume and quality of wastewater, in terms of concentration of various pollutants, which is permitted for discharge into the environment. The Act allows both the Union Territories and the State Governments and their respective Pollution Control Boards, to make rules implementing the Act. In case of a conflict, however, the Union Government rules prevail.

The standards were stipulated by the Boards for discharge of industrial water depending upon the receiving water body, be it a sewer, nallah, river or other inland surface water body or coastal marine waters. The standards were stipulated also for treated liquid waste disposal on land for irrigation purpose. These standards were updated from time to time.

2) Air Quality

The Air (Prevention and Control of Pollution) Act, 1981 was formulated by the Central Government to regulate air pollution from various sources. Under this Act, the standards for various pollutants namely SO_2, NO_x, Suspended Particulate Matter, CO, hydrocarbons and several other air pollutants were stipulated by CPCB to protect the ambient air quality. The emissions from various stacks and other elevated sources were also simultaneously regulated as per recommended standards by the State Boards under the guidelines given by the Central Pollution Control Board. These standards were granted by the Boards by way of granting consent to establish and to operate the industry. The noise levels were also regulated by stipulating noise for residential areas and industrial areas.

3) Environment Protect Act

After implementation of the above mentioned Acts, the Environment Protection Act, 1986 came into practice. This Act has an overriding effect on the other earlier environment Acts. The Ministry of Environment and Forest (MoEF) was established under this Act. The Director of MoEF is the administrative head of this organisation.

The Act is an Omnibus Act subsuming the various pollution control, wildlife, forest conservation acts. The Act therefore links the pollution control and natural resource conservation issues. The Act empowers the Union Government to make rules providing standards in excess of which environmental pollutants shall not be discharged or emitted into the environment. It also empowers the Union Government to make rules regarding handling, storage, manufacture and import of hazardous substances including wastes. Violation of these rules constitutes a crime which is punishable by imprisonment and/or fine.

(2) Natural Environment

1) Biodiversity

India is a Party to the Convention on Biological Diversity (1992). Recognizing the sovereign rights of States to use their own biological resources, the Convention expects the parties to facilitate access to genetic resources by other Parties subject to national legislation and on mutually agreed upon terms (Article 3 and 15 of CBD). Article 8(j) of the Convention on Biological Diversity recognizes contributions of local and indigenous communities to the conservation and sustainable utilization of biological resources through traditional knowledge, practices and innovations and provides for equitable sharing of benefits with such people arising from the utilization of their knowledge, practices and innovations.

Biodiversity is a multi-disciplinary subject involving diverse activities and actions. The stakeholders in biological diversity include the Central Government, State Governments, institutions of local self-governmental organizations, industry, etc. One of the major challenges before India lies in adopting an instrument, which helps realise the objectives of equitable sharing of benefits enshrined in the Convention on Biological Diversity.

The parameters set out in this report are to assist in the identification of specific areas in different regions of India which could be categorised as ecologically fragile or sensitive. They aim to help in ensuring that they are not subjected to environmentally unacceptable activities. Some fragile or sensitive ecosystems are listed. They include ecosystems: with unique properties; with intrinsically low resilience; with high species richness and biological diversity; susceptible to species loss; linking two or more protected ecosystems; with aquifers and water recharge areas of mountain springs; and those with active geological faults and seismic hazards. The parameters are outlined in sections on various ecosystems: deserts, Himalayas, glaciated areas, seismic zones, landslide zones, and watersheds.

2) Forest Resources

Much before it became concerned about the negative impacts of pollution on the environment, India became concerned about the diminishing natural resource represented by forests. Initially, forests were perceived as a source of revenue, this perception has recently given way to the concept of forests as a vital link in maintaining the environment and halting its degradation.

In response to the former perception, the Forest Act was enacted in 1927 to consolidate all existing laws relating to forests and control trade in timber and other forest produce. The Act

defined “Reserved” and “Protected” forests and laid down the procedure for acquiring land deemed reserved or protected forests under the Land Acquisition Act, 1894. However, measures in this Act proved inadequate to halt the rapid depletion of India’s forests after independence.

This resulted in the Union Government enacting a law, the Forest Conservation Act, in 1980, to control India’s rapid deforestation. It supplements the Forest Act, 1927 by: (1) imposing restrictions on the provision to reserved forests in the Forest Act, 1927; (2) requiring prior approval of the Central Government for diversion of forest areas for non forest purposes; and in case of approval, (3) requiring compensatory afforestation of equivalent area of non forest land. The administrative agency in case of the provisions of the Forest Conservation Act, 1980, is the Union Government. However, as long as it does not involve felling of trees, only limited information needs to be given about the status of the forested area. A compensatory afforestation plan has to be submitted for all activities requiring clearance from the Ministry of Environment and Forests.

(3) Public Participation/Awareness

The public has an important role to play in EIA. The concerned persons will be invited through press advertisement to review information and provide their views on the proposed development requiring environmental clearance.

The related law requires that the public must be informed and consulted on a proposed development after the completion of EIA report. Any one likely to be affected by the proposed project is entitled to have access to the Executive Summary of the EIA. The affected persons may include:

- Bona fide local residents;
- Local associations;
- Environmental groups: active in the area
- Any other person located at the project site / sites of displacement

They are to be given an opportunity to make oral/written suggestions to the State Pollution Control Board as per Schedule IV of the EIA Notification.

1.3 Environmental Policies

(1) Local Environment Policy

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

The Pollution Control Board (PCB) was established under this Act both at the Central Government and at the State Government level for each state. The Water Supply and Sanitation projects for the State of Goa will be executed by the PWD, the Government of Goa. The PWD will co-ordinate in regard to performing environmental and social considerations for the projects with different state government departments such as the Forest Department, the Science, Technology & Environmental Department (DST&E), and the State Pollution Control Board at various stages of the implementation of the projects and also during the operation phase of the projects. In fact, Department of Science, Technology and Environment, Goa State is a responsible and Impact Assessment Agency of Environmental Clearance.

(2) National Environment Policy

The MoEF enforced the notification in January 1994 for conducting Environmental Impact Assessment (EIA) studies which are obligatory for the establishment of certain categories of industries specified in Schedule I. The Schedule I industries include the fertilizer, petrochemical, pharmaceutical, dyes and paint, iron and steel manufacturing industries, thermal power plants, mining industries and also port and harbour and the river valley projects. Water supply and Sewage development projects were not listing in Schedule I.

The appraisal committees comprising experts, Governmental official and non-government organizations (NGOs) were set up by the MoEF to scrutinize various EIAs prepared for the establishment of such industries and projects. The appraisal committees would accord an environmental clearance to the project in consultation with MoEF after scrutinizing the EIA report for the proposed project.

1.4 Environmental Conventions and Criteria

(1) International Conventions

Related International Agreement and Commitment to Environmental Concerns in the

Notification are below:

- Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (2 February 1971), as amended
- Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 12 November 1972)
- Convention on International Trade in Endangered Species in Wild Fauna and Flora (Washington, 3 March 1973)
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (Bonn, 23 June 1979)
- The International Tropical Timber Agreement (Geneva, 18 November 1983)
- International Undertaking on Plant Genetic Resources (Rome, 23 November 1983) as supplemented
- Vienna Convention for the Protection of the Ozone Layer (Vienna, 22 March 1988) and Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 16 September 1987)
- International Convention for the Prevention of Pollution from Ships (London, 2 November 1973), as amended
- International Convention for the Regulation of Whaling (Washington, 2 December 1946), as amended
- United Nations General Assembly Resolution 913 (X) Establishing the Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) (3 December 1955)
- Convention on Early Notification of a Nuclear Accident (hereafter Notification Convention), and Convention on Assistance in the Case of a Nuclear Accident or a Radiological Emergency (hereafter Assistance Convention), (Vienna, 26 September 1986)
- The convention concerning the Protection of Workers against Ionising Radiation (ILO Convention 115, Geneva, 22 June 1960) (hereafter, Radiation Protection Convention, 1960);
- The Convention concerning Protection against Hazards of Poisoning Arising from Benzene (ILO Convention 136, Geneva, 23 June 1971) (hereafter, Benzene Convention, 1971);
- The International Convention on Civil Liability for Oil Pollution Damage, Brussels 1969 (CLC)
- The International Convention on the Establishment of an International Fund for Compensation of Oil Pollution Damage, Brussels 1971 (Fund Convention);

(2) Environmental Standards

1) Water Pollution

In order to protect various water bodies, standards for treated industrial waste / treated domestic waste have been prescribed by the Central Pollution Control Board (CPCB), New Delhi. These standards are different for different types of receiving bodies. Treated effluent / treated sewage to be discharged into any of the following shall meet the relevant standards as prescribed by RPCB:

- into inland surface waters,
- into municipal sewers,
- on land for irrigation,
- into marine coastal waters.

If treated sewage is to be used for irrigation, as is proposed in the sanitation project, upper limits for important parameters will be:

Table M113.1.1 Treated Water Quality for Irrigation

Parameter	Unit	Limits
BOD_5	mg/l	100
Suspended Solids	mg/l	200
Dissolved Solids	mg/l	2100
pH		5.5-9.0
Oil & Grease	mg/l	10
Arsenic	mg/l	0.2
Boron	mg/l	2.0
Cyanide	mg/l	0.2
Chloride	mg/l	600
Sulphate	mg/l	1000

Source: CPCB, Standards for discharge of Industrial/Domestic wastewater

In addition to the standards prescribed by the CPCB, the project proposes to take into account the WHO guidelines for wastewater reuse for irrigation of level B (cereals, industrial and fodder crops, pasture and trees). These guidelines were elaborated by WHO after reviewing epidemiological studies of untreated wastewater reuse. This review led to the conclusion that the danger of infection is:

- high with intestinal nematodes;
- moderate with bacteriological infections and diarrheas;
- minimal with viral infections and diarrheas, and hepatitis A; and

- high to non existent with trematode and cestode infections, schistosomiasis, clonorchiasis, and taenisis, depending on local practices and circumstances.

The WHO guidelines are given in the following table.

Table M113.1.2 Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture

Category	Reuse conditions	Group exposed	Intestinal nematodes (arithmetic mean no of eggs per liter)	Fecal coliforms (geometric mean no. per 100ml))	Wastewater treatment expected to achieve required microbiological quality
A	Irrigation of crops likely to be eaten uncooked; sports fields, public parks.	Workers, consumers, public	≤1	≤ 1,000	Series of stabilization ponds designed to achieve the microbiological quality indicated, or equivalent treatment
B	Irrigation of cereal crops, industrial and fodder crops; and pasture and trees.	Workers	≤ 1	No standard recommended	Retention in stabilization ponds for 8-10 days for equivalent helminth and fecal coliform removal
C	Localized irrigation of crops in category B if exposure of workers and the public does not occur.	None	Not applicable	Not applicable	Pretreatment as required by irrigation technology, but not less than primary sedimentation

Source: Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture. Technical Report No.778. WHO, Geneva. 1989

2) Air Quality

It will be necessary for the project execution agency to maintain air quality within mentioned limits for various parameters. The detailed ambient air quality standards are given in Table M113.1.3

Table M113.1.3 Ambient Air Quality Standards

Pollutant	Time weighted average	Concentration in ambient air as µg/m^3		
		Industrial Areas	Residential and Rural Areas	Sensitive Areas
Sulphur dioxide	Annual average	80	60	15
	24 hours	120	80	30
Oxides of Nitrogen as NO_2	Annual average	80	60	15
	24 hours	120	80	30
Suspended particulate matter (SPM)	Annual average	360	140	70
	24 hours	500	200	100

3) Noise

The noise levels at project sites and residential areas nearby should be as per stipulated standards given in Table M113.1.4

Table M113.1.4 Ambient Noise level standards

Area code	Category of Area	Limits in dB(A)	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Source : Central Pollution Control Board, Delhi, 1981

Day time is considered as 6.00 AM to 9.00 PM.

2. Results and Discussion

2.1 Scope of Environmental Evaluation

(1) Purpose of IEE

The Initial Environmental Examination (IEE) is useful in order to find out the possible negative and positive effects of the Master Plan on the social and natural environment. This IEE is a procedure which is recommended by JICA's Environmental and Social Consideration Guidelines. The purpose of IEE is to clarify the needs and targets for further environmental assessment within the scope of EIA.

The full IEE process includes the evaluation of the initial state of environment conditions and

of the institutional organisation for the protection of environment. The output of the IEE is an evaluation of the main expected orientations and issues to be focused on in the forward EIA study. The IEE is performed below through the review of the project components and potential impact sources, and the screening and ranking of possible negative effects.

(2) Basic Approach of Initial Environmental Examination

In some EIA processes, scoping is conducted in the context of an *initial environmental examination*. After a project has been screened and found to have potentially significant environmental impacts, an IEE is undertaken to determine the probable environmental impacts associated with the project and ascertain whether a full-scale EIA is required. The IEE is usually conducted with a limited budget, and is based on existing information and the professional judgment of people who are knowledgeable about impacts from similar projects. The three primary objectives of the IEE are to:

1. To identify the nature and severity of specific, significant environmental issues associated with the project;
2. To identify easily practicable mitigation or offsetting measures for the significant environmental issues. If the IEE shows there are no significant environmental issues which need further study, then the IEE serves as the final EIA Report; and
3. To develop the TOR for the full-scale EIA study should more detailed assessment be needed, or any special topic reports which may be required instead of, or in addition to, the rapid EIA.

The IEE process involves identifying potentially significant environmental issues, and resolving those issues which are easily mitigated. Conducting an IEE ensures a focused TOR for a full-scale EIA because it identifies the issues requiring resolution and provides background information on them. The objectives of the IEE may be met without extensive financial and human resources, thereby increasing efficiency. The most crucial requirements for IEE execution are excellent judgment and appropriate experience, since evaluations and decisions are based on limited information. Competent EIA practitioners need to be involved in the IEE phase because the decisions made at this stage affect the composition and scope of the EIA performed on a project. A poor IEE report could result in failure to recognize significant environmental impacts, but a good report can result in efficient resolution of significant environmental issues.

2.2 Project Components and Sources of Environmental Impacts

(1) General

In the Reconnaissance Survey, environmental scoping was conducted limitedly to the preliminary alternative projects and their project sites prepared by the PWD prior to the current Study and to the 'zero alternatives' which were the 'do nothing' options. However, during the formulation of Mater Plan, the environmental scoping document prepared in the Reconnaissance Survey was improved considering better project alternatives prepared by the JICA Study Team.

Since some of the proposed sites were found to be not suitable or not ideal in terms of environmental and social considerations in the previous environmental scoping in the Reconnaissance Survey, new alternative sites was considered along with some of the acceptable old alternatives during the formulation of Mater Plan. Then, the environmental scoping has been continuously revised for the new sets of alternatives during the implementation of IEE based on further site observations, discussions between the PWD and the JICA Study Team, and the second stakeholder meeting.

The main points of the revised environmental scoping for water supply projects and sewerage projects proposed in the Master Plan are presented separately in the following sub-sections. The mitigation measures against the identified presumable negative impacts are explained separately from the summery of scoping in a later subjection, Main Report Chapter 11.4.2 Results of Impact Evaluation and Recommended Mitigation Measures.

(2) Water Supply Schemes

The following shows the major project components proposed in the Master Plan regarding to water supply. As for water supply, the revision of environmental scoping for the IEE was limited to the six major facilities to be constructed for the expansion of four water supply schemes, which are listed under 1). The other facilities listed under 2) are relatively small scale and their locations will not be specified until the implementation of the Feasibility Study. Figure M113.1.1 shows water supply scheme area in the Master Plan Study.

Figure M113.1.1 Selected Water Supply Scheme Area in the Master Plan Study

1) Project components covered in the revision of environmental scoping

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

2) Project components to be included in the environmental scoping for the F/S

- Enhancement of Water Transmission and Distribution Capacities of All the Major Schemes

- ✧ Construction of new transmission and distribution pipelines
- ✧ Construction of Reservoirs (including two other master balancing reservoirs)

■ Rehabilitation of Existing Facilities
- ✧ Replacement of old mechanical and electrical facilities
- ✧ Replacement of old pipes to reduce water leakage

Before explaining the alternative project sites and their presumable negative environmental and social impacts, expected positive impacts of the proposed projects are summarized as follows.

< Expected Positive Impacts >

- ■ Expansion of water supply service areas
- ■ Improvement of water quality
- ■ Continuous water supply
- ■ Reduction of waterborne diseases
- ■ More water supply available to tourist facilities
- ■ More water supply available to industries
- ■ Improvement of socio-economic conditions
- ■ Effective management of operation and maintenance
- ■ Reduction of non-revenue water including water leakage

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

This environmental scoping identified the following as a likely significant impact regarding to the proposed water supply projects.

<u>Deforestation for the construction of WTPs and reservoirs</u>

The acquisition of water right for the proposed water supply project was permitted by the Water Resource Department of the Goa state at the end of the formulation of Master Plan.

The alternative analysis for each set of proposed project sites was conducted through the environmental scooping process to select better project components and sites. The following shows the results of alternative analyses regarding to the proposed water supply projects.

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

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

It was already agreed in a written form that the land ownership of 6ha (out of the area around

the existing Salaulim Water Treatment Plan) will be transferred from the Forest Department of the State Government to the PWD for the new WTP after the boundary of the site is finalized.

The site that the PWD previously proposed for the construction of new WTP was close to the lakefront of Salaulim Dam, which is a good condition for water intake. However, during site visits for the preparation of Master Plan, it was found that there was one household living within the trees of that area and that the proposed site was close to an archeological site, Mahadev Temple. The discovery of them was difficult in the Recognizance Survey due to the bad condition of the access road due to the heavy rain. This temple was relocated to this location to avoid being submerged at the bottom of the Dam after construction of the Salaulim Dam. It was also found that a sign board of Archaeological Survey of India at the temple says that within 100 m from the protected limits, no construction work is allowed and prior approval should be obtained from Archaeological Survey of India for construction and excavation work within 200 m from the protected limits. The site previously proposed by the PWD was too close to the archaeological site. It was also found that the site did not have enough flat land space to accommodate the new WTP of 200,000m^3/d.

Therefore, during the formulation of Master Plan, the new alternative sites for the new WTP were sought within the area around the existing Salaulim WTP. By conducting site investigation, it was found that there are other available areas whose sizes are enough to accommodate the new WTP. However, the exact boundary of the new site for the new WTP could not have been finalized during the formulation of Master Plan due to the time constraint. The exact boundary of the new site will be finalized at the binging of the Feasibility Study.

Although its exact boundary is not finalized, the new site is considered to have less negative social impacts. Since there are only very scattered and limited households around the area, the boundary of new site will be set avoiding any households and the vicinity of the archaeological site. Possible major impact of its construction would be only the deforestation at the site.

The other major project components of the expansion of Salaulim WSS are the constructions of another transmission pipeline from Salaulim to Margao and new master balancing reservoir on the hill at Sirvoi (the largest master balancing reservoir to be constructed) which will perform as a relay point between Salaulim and Margao. These two components were also examined in the revised environmental scoping.

Photo M113.1.1 Outer appearance of Sirvoi MBR.

Photo M113.1.2 Proposed Site of Sirvoi MBR.

The both project components don't have alternative sites. The new transmission pipeline will be installed along with the existing transmission lines in the road already constructed and owned by the PWD especially for water supply transmission. The road goes mainly through rural areas where households are very scattered and there is enough space to install another transmission pipeline at its road shoulder. Therefore, its construction is considered not to have any major environmental and social impacts.

The proposed site for the new master balancing reservoir is located along the road constructed for water transmission pipelines and is on the hill at Sirvoi which is the best and only suitable place for the new master balancing reservoir in terms of hydraulic conditions. Fortunately there is no resident living on the hill. Possible major impact of its construction would be only the deforestation for the construction at the site.

In the operational stage of the projects, the water quality of the public water bodies within the service area of Salaulim WSS may decline because the volume of sewage in the area will significantly increase as a result of the water supply project. However, improvements to sewerage facilities are being considered for populated areas within the service area such as Margao as part of the Study. The expansion of sewerage in the populated areas will be carried out along with the increase of on-site sanitation facilities in rural areas.

Expansion of the Other WTPs

The expansion of the existing Canacona WTP is already under its tendering process which is being conducted by the PWD. The site for the expansion is located next to the existing water treatment facilities and is open land owned by the government. The scale of facility expansion is only 10,000m^3/d, which is much smaller than that of the proposed new Salaulim WTP.

Therefore, only small lot of extra land and small scale of its deforestation are required outside of the current boundary of the existing WTP for its expansion.

The expansion of the existing Dabose WTP is about to be put out to tender. The site for the expansion is located next to the existing facilities and is a private land on a slope. The scale of facility expansion is only 10,000m^3/d. Therefore only small lot of extra land and small scale of its deforestation are required outside of the current boundary of the existing WTP for its expansion. However some households are located on the top of the slope, therefore extra consideration is required for suitable earth excavation at the site.

Photo M113.1.3 Proposed site of Dabose WTP-1

Photo M113.1.4 Proposed Site of Dabose WTP-2

The proposed site for the expansion of the existing Chandel WTP is located within the current premises of the WTP. The expansion will take place only if Mopa airport is constructed in Pernem Talka. The required area for the new facilities would be around 2ha. The scale of facility expansion is 15,000m^3/d. There is no presumable significant social or environmental impact regarding to the expansion of Chandel WTP because the land has already acquired and leveled by the PWD.

(3) Sewerage Schemes

The following shows the major project components proposed in the Master Plan regarding to sewerage. The revision of environmental scoping on the proposed sewerage schemes for the IEE is limited to the expansion of two existing STPs and the construction of six new STPs. However, the installation of new sewers and pumping stations and the rehabilitation of Panaji Sewerage System have not been considerted in this envrionmental scoping because their presumable negative impacts are considered to be relatively small comparing to those of the construction of STPs. The negative impacts of the construction of sewers and pumping stations

and the rehabilitation work of Panaji Sewerage System will be examined in the Feasibility Study after their components being more specified in their basic design.

1) Project components covered in the revision of environmental scoping

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

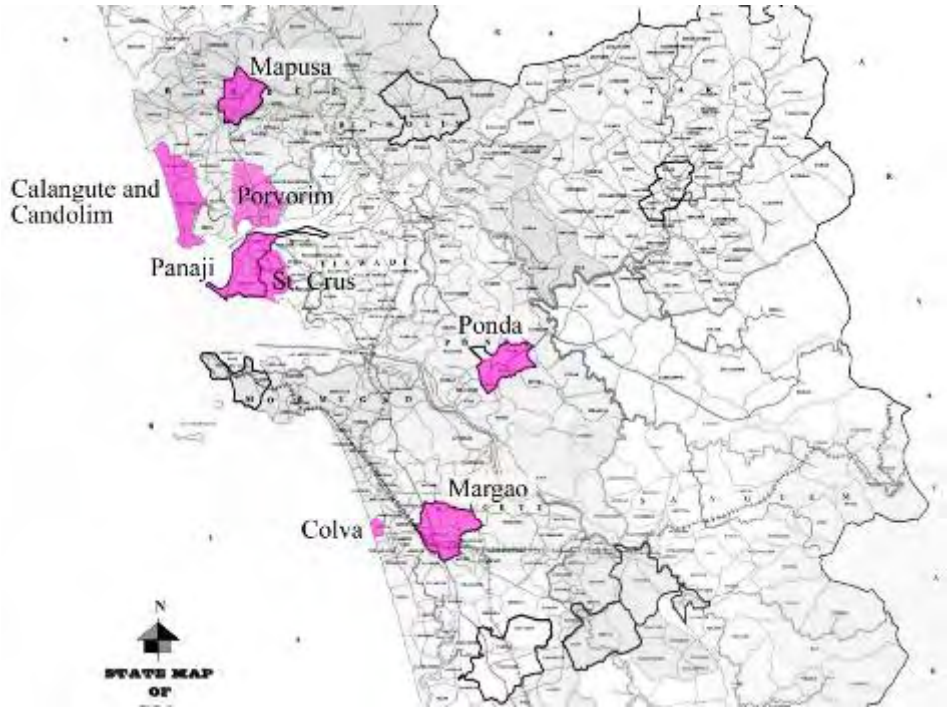

Figure M113.1.2 Selected Sewerage Area in the Master Plan

2) Project components to be included in the environmental scoping for the F/S

- Rehabilitation of Panaji Sewerage System

- ✧ Sewer network rehabilitation
- ✧ Replacement of pumping station equipment

■ Expansion and new installment of sewers and pumping stations.

- ✧ Construction of sewers
- ✧ Construction of pumping stations

Before explaining the alternative sites for STPs and their possible negative impacts, expected positive impacts of the proposed projects are summarized as follows.

< Expected Positive Impacts >

- Improvement of water quality in rivers and beaches.
- Improvement of living environment including gutter and local streams
- Reduction of the overflows from existing septic tanks
- Improvement of sanitary conditions in the cities
- Improvement of environmental conditions of Costal Belts
- Reduction of the risk of disease and enhancement of human health
- Reuse of nutrient rich sludge from Sewage Treatment Plants for horticulture, etc.
- Improvement of the image of the cities and enhancement of the value of the cities
- Improvement of socio-economic conditions
- Benefiting women and improving their dignity

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

This environmental scoping identified some likely significant impacts regarding to proposed sewerage projects. The identified key impacts include:

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

These impacts mainly depend on the location of the STPs in relation to nearby residential areas and rivers. Therefore, appropriate sites for the STPs were well considered through alternative analysis and most suitable sites were identified during preparing the Master Plan. To conduct better alternative analysis, new sets of alternative sites are specified during the formulation of Master Plan, which were added to the sites previously proposed by the PWD. The most suitable site for each STP was presented in the second stakeholder meeting with some of the other alternative sites to confirm the most suitable site and its possible negative impacts.

The following shows the results of alternative analysis on each set of alternative sites for the proposed sewerage projects, which were conducted through the environmental scooping process.

Expansion of Margao STP

Margao has an existing STP, which is surrounded by paddy fields and some residential areas. The existing STP has enough land to accommodate future expansion within the premises. The existing inflow of sewerage is currently well below the treatment plant's capacity because only small proportion of Margao's population have connected to the sewers. However, the inflow is expected to increase significantly after the expansion of its service area to the South Zone of Margao and after the increase of household connections.

The existing STP discharges its treated waste water to the adjacent small stream. The stream passes through nearby paddy field about 400m before joining Sal River. There is a potential risk of discharging untreated sewage into the small stream if there are power cuts or the facility breaks down. This risk would increase if the volume of sewage being treated rises.

Photo M113.1.5 Discharge point of STP

Photo M113.1.6 Site of expansion of Margao STP

Although the current odour level at Margao STP is not significant because its raw sewerage is significantly diluted by ground water intruding into sewers and the current inflow is well below the designed inflow volume of the facilities. However, the planned increase of the inflow has potential to cause significant odour problem especially during the dry season. After the construction of the existing STP, a closely-spaced residential area has been developed at the east side of the STP. The boundary of the residential areas is now reaching the STP. The offensive odour from the STP has presumable significant impact on the residential area.

Expansion of Panaji STP

There are two existing STPs in Panaji including small one for a commercial area. The main STP, which located at the south of Panaji, covers most of Panaji, is now closely surrounded by some residential areas. The STP has been expanded recently to meet increasing sewage in Panaji. The existing STP has enough land to accommodate future expansion to some of the surrounding residential areas of Panaji within the current premises. Therefore, the further expansion will significantly increase the inflow of sewerage into the existing STP.

The existing STP discharges its treated wastewater through discharge pipe lying up to about 50m away out to the mouth of Mandovi River. Initially the STP discharged its treated wastewater to the adjacent stream. However, it has been improved in stages by expanding its discharge pipe to the mouth of the river. Because the flow of Mandovi River is large, the discharge of the increased treated wastewater to its mouth will not presumably cause any significant negative impacts.

The current odour level at Panaji STP is relatively serious comparing to that of Margao STP. However, the odour has been significantly reduced by the recent expansion of the treatment facilities because the operation of its old trickling filter, which had caused serious odour problem, was ended and the operation of new treatment facility started recently. After the first construction of the STP, some residential area has been well developed around the STP. Therefore, a treatment process, which does not cause serious odour, has to be applied for the further expansion of the STP.

Construction of Mapusa STP

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

Photo M113.1.7 Proposed site of Mapusa STP-1

Photo M113.1.8 Proposed Site of Mapusa STP-2

The selected site for Mapusa STP, which was proposed by the PWD, is far from the populated area of Mapusa and is next to a river, which has a relatively large flow. The site is a part of "communidade", which is community land and is supposed to be used for public purposes such as STPs. This community land is currently being temporally rented to locals as paddy fields. Therefore appropriate compensation or substitute paddy fields will need to be considered for the loss of the economic opportunity that the farmers currently enjoy. The possibility that the area surrounding the site could be used for urban development in the future is considered to be low based on the site investigation and available land use plan.

Construction of Ponda STP

Two alternative sites for the STP covering Ponda were proposed by the PWD. One of these sites abuts a large pond which is connected to large tidal creek. This site is unused community land, which is located away from residential areas. However, this site is much further from the city of Ponda and it would require longer sewerage pipelines. The other site is on privately owned vacant land located next to a stream. Although this site is not too far from Ponda, residential development is approaching the site from one side. As the result of the alternative analysis comparing these two sites from different aspects such as environmental, social and financial aspects, the site near Ponda is selected for the STP.

Photo M113.1.9 Proposed site of Ponda STP-1

Photo M113.1.10 Proposed Site of Ponda STP-2

Construction of Porvorim STP

The alternative sites for Porvorim STP are located in an elongate private open/wetland at the down side of Porvorim in Penha de Franca along Mandovi River. The open land, through which a small creek goes into Mandovi River, is partly surrounded by scattered households. For analysis of alternative STP sites, two sites at the upper and down sides of the open land are compared in terms of presumable environmental and social impacts. Because the mouth of the creek is located at the site of down side, the site would require a large amount of land filling for land leveling.

Photo M113.1.11 Proposed site of Porvorim STP-1

Photo M113.1.12 Proposed Site of Porvorim STP-2

Moreover the surrounding households are denser at the down side than at the upper side. For these reasons, the site at the upper side is proposed as most suitable site for Porvorim STP. However, odour from the STP remains as a presumable negative environmental impact to the limited number of surrounding households.

Construction of St. Cruz STP

The alternative sites for St. Cruz STP are located at both sides of the road going through open lands from the town of St. Cruz to the wetland along to Mandovi River. On the right side

toward the wetland, there is a housing complex under development. One local political activist is against the development of this condominium complex because the housing complex may cause environmental impacts on the wetland. Land patches close to the wetland could be environmentally sensitive. Therefore the proposed site for St. Cruz STP was set across the road from the condominium complex and also not close to the wetland. The site is also set apart from the expanding town of St.Cruz as much as possible to avoid the future problem of odour affecting nearby residents.

Photo M113.1.13 Proposed site of St. Cruz STP-1

Photo M113.1.14 Proposed site of St. Cruz STP-2

Construction of a STP in North Coastal Belt

The PWD previously proposed new sewerage schemes covering most of North Coastal Belt and South Coastal Belt. However, population density in these areas except for Calangute and Candolim in the north and Colva in the south were found to be too low to install sewerage system. Therefore, while sewerage systems are planned for the three areas of high population density, the improvement of the existing on-site facilities was considered to be more effective in the other areas to accommodate increasing domestic wastewater.

Several sites were previously proposed for the STP in North Coastal Belt by the PWD in past study reports. However during the Reconnaissance Study it was found that these sites are not suitable in terms of social impacts on the surrounding areas. Therefore more suitable alternative sites are sought by the PWD and the Study Team in collaboration.

Photo M113.1.15 Proposed site of Baga STP-1

Photo M113.1.16 Proposed site of Baga STP-2

Two alternative sites for the STP covering Calangute and Candolim were newly set, for the two alternative sewerage plans of separated and integrated sewerage systems, at the north end of Calangute Panchayat (Baga) and at the south end of Candolim Panchayat.

While only the site few hundreds meters behind Baga Beach is to be used for the integrated sewerage system, both alternative sites are to be used in the separated sewerage system which covers the two areas separately by the separate sewerage facilities. Judging from the environmental point of view, the site in Baga, which is open area used as playground, etc., is more suitable for STP, because the alternative site in Candolim is limited in space, currently used as paddy field, and rather close to a residential area.

As results of the alternative analysis from different aspects, the integrated sewage system is selected for Calangute and Candolim. Accordingly, the site in Baga is selected for the integrated sewerage system. The selected site is a large area apart from residential areas. The selected site is a large area apart from residential areas. The STP site is around 1,000m away from the CRZ. A stream goes nearby the site into the right side of Baga Beach.

<u>Construction of a STP in South Coastal Belt</u>

In South Costal Belt, several alternative sites for Colva STP have been considered. The most suitable land is found at the south side of Colva residential areas. Within the land, the site was set away form the beach side as far as possible. The STP site is around 700m away from the CRZ. It was concerned that the site is connected to the beach side with a small stream. However, it is planned to discharge the treated wastewater form the STP into distant Sal River through a pressured diversion pipeline to avoid environmental impacts on the beach area.

Photo M113.1.17 Proposed site of Colva STP-1

Photo M113.1.18 Proposed Site of Colva STP-2

2.3 Scoping Checklist of Potential Effects in IEE Study

The result of the IEE is summarized in Table M113.1.5 and Table M113.1.6.

Table M113.1.5 Scoping Check List (Water Supply Scheme)

No	Environmental Items	Evaluation	Reason
Socio-Economic Environment			
1	Resettlement	D	Land acquisition is necessary but human settlement is possibly avoidable by selecting no-settlement land.
2	Economic Activities	B	Adversary affects of the living conditions of inhabitants by changes in land use due to the project. Positive impact is also expected such as increase of employment in construction phase.
3	Traffic / public facilities	B	Traffic jam during construction phase may be expected.
4	Split of Communities	D	Since no large-scale construction will be undertaken, the separation of the communities may not occur.
5	Cultural Property	B	The proposed site was close to an archeological site. But the area is out of archaeological properties where protected limits by law.
6	Water rights / Rights of Common	D	Water rights problem is not expected.
7	Public health condition	D	Positive impact is expected.
8	Waste	B	The sludge from treatment plant will be generated. It will be re-used as a material of cement or disposed properly at the final dumping site. During construction, construction waste and excavation material will be generated.
9	Hazard	D	No significant impact. Scale of facilities is small.
Natural Environment			
10	Topography & Geology	D	No significant impact. Scale of facilities is small.
11	Soil Erosion	B	Soil erosion and run-off of top soil will be expected. After the completion of construction activity, top soil is necessary to be replaced and afforestation plan should be done properly.
12	Groundwater	D	No significant impact is expected. Raw water will be intaked from surface water.
13	Hydrological situation	D	No significant impact.
14	Coastal zone	D	No coastal line exists. Major water supply facilities are located in-land
15	Fauna and flora	D	No significant impact.
16	Meteorology	D	No significant impact.
17	Landscape	D	No large scale construction is expected. But master balancing reservoir may be constructed at suburb area and it is important to harmonize the facilities with the surrounding environment.
Environmental Pollution			
18	Air pollution	D	No significant impact
19	Water pollution	D	Back washed water from filtration process will be generated, but the water will be made re-treat ment.
20	Soil contamination	D	No impact is expected
21	Noise and vibration	B	Some noise and vibration during construction period is expected.
22	Land subsidence	D	Since ground water will not be used for the Project, the land subsidence with the Project would not occur.
23	Offensive odor	D	No smell anticipated from the treatment plant

A: Significant impact anticipated, B: Slight impact anticipated, C: Unknown, D: Almost no impact anticipated

Table M113.1.6 Scoping Check List (Sewerage Scheme)

No	Environmental Items	Evaluation	Reason
Socio-Economic Environment			
1	Resettlement	D	Land acquisition is necessary but human settlement is possibly avoidable by selecting no-settlement land.
2	Economic Activities	B	Adversary affects of the living conditions of inhabitants by changes in land use due to the project. Positive impact is also expected such as increase of employment in construction phase.
3	Traffic / public facilities	B	Traffic jam during construction phase may be expected.
4	Split of Communities	D	Since no large-scale construction will be undertaken, the separation of the communities may not occur.
5	Cultural Property	D	No cultural properties are identified in and around the project area.
6	Water rights / Rights of Common	D	Water rights problem is not expected.
7	Public health condition	D	Positive impact is expected.
8	Waste	B	The sewage sludge from treatment plant will be generated. It will be ecologically re-used as fertiliser or disposed properly at the final dumping site. During construction, construction waste and excavation material will be generated.
9	Hazard	D	No significant impact. Scale of facilities is small.
Natural Environment			
10	Topography & Geology	D	No significant impact.
11	Soil Erosion	D	No significant impact. Proposed facilities are situated in flat land area.
12	Groundwater	D	No significant impact is expected.
13	Hydrological situation	B	Treated effluent will be discharged into the nearest Rivers. No significant impact because quantity of effluent is not huge.
14	Coastal zone	D	No significant impact is expected. No proposed site situated in CRZ.
15	Fauna and flora	C	No endangered species or conservation areas confirmed yet.
16	Meteorology	D	No significant impact.
17	Landscape	D	No large scale construction is expected. But sewage treatment plant facilities may be constructed at suburb area and it is important to harmonize the facilities with the surrounding environment.
Environmental Pollution			
18	Air pollution	D	No significant impact
19	Water pollution	B	Treated sewage will be discharged into the nearest Rivers with appropriate treatment.
20	Soil contamination	D	No impact is expected
21	Noise and vibration	B	Some noise and vibration during construction period is expected.
22	Land subsidence	D	Since ground water will not be used for the Project, the land subsidence with the Project would not occur.
23	Offensive odor	B	Some smell anticipated from the treatment plants. But suitable treatment method may be tempered its impact.

A: Significant impact anticipated, B: Slight impact anticipated, C: Unknown, D: Almost no impact anticipated

2.4 Results of Impact Evaluation and Recommended Mitigation Measures

The following summarizes the results of IEE regarding to the impact evaluation and recommended mitigation measures.

(1) Land acquisition and compensation procedures

Projects sites have been selected avoiding residential, commercial and industrial areas.

Therefore, the selected project sites for STPs, WTPs, etc. are vacant lands, woodlands, wetlands, horticultural lands or paddy fields, which belong to the state government, government agencies, communities (communidade) or private owners. The land types of the proposed sites are summarized in the following table.

Table M113.1.7 Land Types of the Proposed Site

Project Component Requiring Land	Capacity of Facility to be Expanded and Newly Constructed	Area Need to Be Acquired	Types of Ownership	Type of Land Use
New Salaulim WTP	20,0000 m^3/d	8ha+2ha(intake)	Government	Woodland
Master Balancing Reservoir at Sirvoi	4,0000 m^3/d	3ha	Government	Woodland
Expansion of Canacona WTP	1,0000 m^3/d	About 1 ha	Government	Woodland
Expansion of Dabose WTP	1,0000 m^3/d	About 1 ha	Private	Bareness small hill
Expansion of Chandel WTP	1,5000 m^3/d	-	Government	Within the premises
Expansion of Panaji STP	8,900 m^3/d	-	Government	Within the premises
Expansion of Margao STP	13,400 m^3/d	-	Government	Within the premises
Mapusa STP	10,800 m^3/d	15,500 m^2	Community-trust	Open land
Ponda STP	3,500 m^3/d	5,300 m^2	Private	Open land
Porvorim STP	7,600 m^3/d	11,000 m^2	Private	Open land/Wetland
St. Cruz STP	2,500 m^3/d	4,000 m^2	Private	Paddy field
Colva STP	2,200 m^3/d	3,500 m^2	Private	Paddy field
Calangute/Candolim STP	11,200 m^3/d	15,800 m^2	Private	Open land

Resettlement of residents and removal of valuable structures are not required for the acquisition of those lands. Moreover, the land types of these sites are not particular in the contexts of surrounding environment, therefore it is unlikely to be difficult to require nearby similar lands by the original land owners of the proposed sites. For these reasons, the level of negative impacts caused by the land acquisitions is considered not to be significant.

The practical and presumable mitigation measures of the impacts caused by the land acquisitions include the provisions of compensation money and substitute land. The following explains the procedures of land acquisition and its compensation.

Land Acquisition Act, 1894 is applied to the acquisition of the lands from communidade and private owners. According to the Land Acquisition Act, a land acquisition plan has to be proposed to the Collector of either North Goa or South Goa to acquire a land in Goa. Then the Collector appoints a land acquisition officer in the region to implement the land acquisition. The PWD have one land acquisition officer in Panaji for their concerned work. According to a

land acquisition officer, the normal duration of land acquisition is within 2 years. However, in the case of emergency lands can be acquired within about 6 months.

The following equation is used to calculate the compensation money for land acquisition.

Total Compensation (Rs) =

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

The appointed land acquisition officer evaluates the land cost based on the recent sells statistics of the lands which are located within 2km in radius from the land to be required. The total cost of trees and crops in the land is evaluated by the Zonal Aquiculture Office of the Forest Department. The cost of existing structures is evaluated by the PWD.

Although the Land Acquisition Act specifies the compensation procedure, there is not regulation for providing substitute land as an alternative of compensation. If substitute land is required instated of providing the compensation money, a proper application letter has to be submitted by the concerned land owner/user to the Revenue Department so that Councilor of Minister can make decision on it.

(2) Disposal of Sludge and Treated Wastewater from STP

Sludge is composed of by-products collected from the water and sewage treatment process. Especially for sewage sludge, it contains both compounds of agricultural value (including organic matter, nitrogen, phosphorus and potassium, and to a lesser extent, calcium, sulphur and magnesium), and pollutants which usually consist of heavy metals, organic pollutants and pathogens. The characteristics of sludge depend on the original pollution load of the treated water, and also on the technical characteristics of the wastewater and sludge treatments carried out. Sludge is usually treated before disposal or recycling in order to reduce its water content, its fermentation propensity or the presence of pathogens. Several treatment processes exist, such as thickening, dewatering, stabilisation and disinfection, and thermal drying.

Once treated, sludge can be recycled or disposed of using three main routes: recycling to agriculture (landspreading), incineration or landfilling. Other, less developed outlets exist, such as silviculture, land reclamation, and other developing combustion technologies including wet oxidation, pyrolysis and gasification.

Landspreading of sludge partially replaces the use of conventional fertilisers, since it contains compounds of agricultural value. It also contains organic matter, although under a form and at a level below that which would have a significant positive impact on soil physical properties. Composted sludge presents a more stable organic matter due to the addition of a vegetal co-product during the process. However, landspreading also involves the application of the pollutants to the soil. These pollutants undergo different transformations or transfer processes. These processes include leaching to groundwater, runoff, microbial transformation, plant uptake and volatilization and enable transfer of the compounds into the air and water, and their subsequent introduction into the food chain. Therefore, suitable sanitary landfilling is surely required to avoid from outflows to the environment.

There are two possibilities in terms of sludge landfilling: mono-deposits, where only sludge is disposed of, and mixed-deposits (most commonly observed), when the landfill is also used for municipal wastes. The inputs of landfilling are the waste and additional resources required for the operation of the landfill site, such as fuel for vehicles, electricity, and additional materials when leachate is treated on-site. Landfill operation, therefore, generates emissions into the air, and into the soil and water at dumpsites (various compounds such as ions, heavy metals, organic compounds and microorganisms in leachate). The operation of a landfill also generates other impacts in terms of noise and dust from the delivery vehicles, as well as odours, land use, disturbance of vegetation and the landscape.

Forestry and silviculture refer to different kinds of tree plantation and use. The term forestry is mainly used when considering amenity forests. On the contrary, silviculture is more specifically used when referring to intensive production. From the both agricultural and environmental point of view, differences exist in terms of the impact of landspreading as compared to the use of sludge in forestry, relating to such factors as the plant species grown, the fauna and flora involved, and the soil types.

When considering the risks to humans associated with the presence of heavy metals in sludge, it is assumed that these are lower than those associated with spreading on agricultural land, as forest products represent only a very small part of the human diet. However, some risks may still exist due to the transfer of heavy metals to game or edible mushroom species, and in a general manner to wild fauna and flora.

There is limited information available on how sewage sludge application can influence soil microbial and bio-chemical characteristics with respect to maintaining soil quality. The effects

of heavy metals on the soil microbial community, with emphasis on specific microbial activities, have been reported. Generally, the application of low metal sludges had beneficial effects on microbial biomass. It has been reported that sewage sludge applications at recommended rates increased microbial activity in soil. The availability of metals in sludge depends upon the concentration of heavy metals present in the sewage sludge and the nature of the sludge itself. More information is needed concerning other routes for sludge recycling, such as land reclamation or use in forestry and silviculture. Research should be carried out to precisely identify the agricultural benefits of sewage sludge spreading and its environmental and sanitary impacts (especially concerning organic pollutants for which no data is currently available).

Major developed countries already have original guidelines set to detect heavy metals and toxins in sewage sludge by measuring and ensuring allowable maximum levels aren't surpassed. Some guidelines require that each field on which sludge fertilizer is to be spread must be approved and monitored to ensure the mandated nitrogen to heavy metal ratio is not exceeded. Accordingly, continuous monitoring of those parameters is essential in India.

On the other hand, the Environmental Protection Agency of United States of America has made a final decision not to regulate dioxins in land-applied sewage sludge. After five years of study, including outside peer review, the Agency has determined that dioxins from this source do not pose a significant risk to human health or the environment. The most highly exposed people, theoretically, are those people who apply sewage sludge as a fertilizer to their crops and animal feed.

Currently, the sludge is treated on sludge drying beds in the existing STP. The PWD sometimes provides the dried sludge to village farmers around the STPs without charge. Based on the prepared Master Plan, the volume of wet sludge to be generated will be around $50m^3/d$. In the future, sludge should be sold to farmers and fertilizer industry in an organized manner.

However, the reuse of sludge is recommended only if the amount of heavy metals contained in the sludge does not depredate the soil conditions of agricultural lands significantly in terms of heavy metal contents. It is also recommended to take into account the contents of heavy metals already present in the land and the pH of the soil. In practice, the recommended reuse of sludge would face some technical and social difficulties. The sludge needs to be stored properly. While the sludge will be produced all year round, but the demand of sludge would be limited to one or two seasons in a year. Furthermore, there are no norms accepted in Goa

yet to control the amount of sludge reuse for each agricultural land.

Treated wastewaters and sludge can also be used for the irrigation of forest and farmland areas for the cultivation of different plant species. The back wash water from some of the existing WTP such as Canacona WTP is already used for the irrigation of nearby plantation during the dry season.

(3) Water quality observation and geological investigation of the water bodies receiving the treated wastewater.

The following table shows the discharge points of the sewerages proposed in the Master Plan.

Table M113.1.8 Proposed Discharge Point of Treated Effluent

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

As a result of the environmental scoping, it was found that only Margao STP currently discharges/will continuously discharges its treated wastewater into a small stream. The planned discharged pints of the other proposed STPs are rivers which have enough flow to significantly dilute the effluent discharged from the STPs so that any occurrence of significant environmental and social impacts of the effluent are not expected. As for Colva STP, it was determined, based on the alternative analysis of possible discharge points, that the treated wastewater will be discharged from the STP into Sal River through a pressured diversion sewer, instead of into a nearby small stream flowing into the beach side.

The Study Team has conducted visual observation and geological investigation to evaluate the impacts of the effluent for Margao STP by walking along the stream from the existing discharge point to the confluence of the stream with Sal River which has lager flow. In the dry season the flow of the stream are almost as much as the volume of the effluent from the STP. However, the water quality of the stream was in good condition because the wastewater was

well treated before being discharged into the stream. The surround environment of the stream is paddy fields of good conditions, which are not degraded by the effluent from the STP. It is also presumed that the effluent have positive impacts on the paddy fields as a provider of nutrients.

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

The earlier water quality investigation at the existing STPs conducted by the Study Team in the Reconnaissance Survey also shows that the water quality of the treated sewage effluent from the Margao STP meets the effluent Standards (BOD and SS) of India in both dry and rainy seasons as shown in Table M113.1.9.

This water quality investigation also indicated that the STP can reduce the number of coliform to meat its water quality standard during both seasons. However, continuous water quality monitoring is indispensable to check the functional treatment capability of the sewerage facilities.

It is also required to continuously operate and maintain the proposed STPs in order to avoid the inflow of untreated sewage into the rivers and sounding environments even during power cuts. As mitigating measures to reduce this risk, the installment of emergency power generator at each proposed STP should be considered in addition to the preparation and implementation of sustainable operation and maintain plan for the proposed STPs.

Table M113.1.9 Water Quality of the Effluent and Discharge Point at Panaji & Margao STP

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

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

(4) Observation of the woodlands to be deforested.

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

Fortunately, those sites and route are neither the lands protected by law such as national parks nor valuable tropical forests for which special considerations are required. It was also observed that the soil type of those sites is hard laterite soil so that land slide is unlikely caused by the impacts of deforestation.

As a mitigation measure of the deforestation, it is recommended to plant trees within the premises of the constructed facilities. However, it would be difficult to completely recover the impacts of deforestation by planting trees in the premises after the construction due to the land limitations. Therefore, it is preferable to try to plant the same amount of trees as that of deforestation in other areas near the sites.

It is also recommended to afforest some trees to surround of the construction area like a protective barrier. This is not only for keeping the spectacle harmonized with surroundings but also for restoring a part of lost forest resources. Therefore, the facility design and layout, which kindly consider the landscape as well as technical aspects, are recommended to consider for the basic design prepared in the Feasibility Study and their detail design.

(5) Effects of odour from STPs.

In the Reconnaissance Survey, stakeholder interviews were conducted to 20 residents around the existing STPs of Panaji and Margao to gain an understanding of the environmental and social considerations required for sewerage projects. In the interviews, perception on the seriousness of the odour from the STPs was asked as a question and its result is shown in the Table M113.1.10. This table indicates that about a quarter of the residents around the existing STPs consider the odour from STP as a serious problem.

Table M113.1.10 Perception on the seriousness of the odour from the STPs

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

Margao STP is currently operated at far below its treatment capacity and the pollution load of the raw wastewater is thin due to groundwater intrusion into sewers. Therefore, the current odour level in Margao STP is usually very low. On the other hand, Panaji STP currently treats large amount of wastewater. Residential areas have been developed around Panaji STP after its construction. Moreover Panaji STP had used a wastewater technology which causes strong odour until the recent replacement of wastewater treatment facilities for treatment capacity

expansion. Judging from these situation, the past odour problem in Panaji STP seems to have effected the residents' perception on the seriousness of the odour from the STP, although the situation of odor around Panji STP have been significantly improved recently. The future expansions of these two existing STPs have potentials to cause more odour and to affect the residents already living around the STPs.

Because most of the proposed sites for the new STPs are set apart from residential areas, except for Ponda STP, the odour seems not to have significant impacts. However, there is an expanding residential area at one side of the proposed site for Ponda STP.

Therefore, mitigation measures to reduce the odour are especially required for the further expansion of the existing STPs and for the construction of Ponda STP. Recommended main mitigation measure is the application of appropriate wastewater and sludge treatment technologies which cause less odour such as Oxidation Ditch. The installment of air sealing cover on wastewater and sludge treatment facilities is also possible mitigation measure. Another mitigation measure is to design the facility layout of STP in the way odour causing facilities are located at the far side of nearby residential areas as possible.

The application of these mitigation measures will be considered in the basic design of the wastewater and sludge treatment facilities in the phase of Feasibility Study.

(6) Difficulties of water supply in rural areas.

In Goa, currently small scale rural water supply schemes, which mainly use open wells as water sources, cover large part of its rural areas for free of charge. Only very limited proportion of the rural areas is left to use natural water sources such as springs without having piped supply system, mostly only in remote or hilly areas. However, the rural water supply schemes distribute water without any water treatment.

Most of the rural areas will be covered by the expansion of surface water supply schemes proposed in the Master Plan, including the construction of New Salaulim WTP. This coverage expansion of treated water supply over the rural areas may cause significant burden on new users in the rural areas because the water charges have to be collected from them unlike current rural water supply schemes. This financial burden may discourage the rural population to use the treated water of the expanded surface water supply schemes.

Possible mitigation measure for the additional financial burden on the rural population are the

improvement of tariff structure considering rural population which has lower earnings comparing to urban population and the installment of subsidy. These mitigation measures may need to be considered in the stage of Feasibility Study.

(7) Difficulties of sanitation/sewerage for low income groups.

House connection to sewerage system is, in general, not affordable for the lowest income group living in informal residential areas. Therefore, the development of sewerage system may increase the gap of livelihood between the poor who cannot have house connection to sewerage and the rich who can have.

Fortunately, in many low income residential areas, public toilets have already been installed by Sulabh International, a local NGO. These public toilets utilize septic tanks and soak pits. However some of the public toilets have the problem of low soakage due to low penetration rate of laterite soil. The new sewerage service areas proposed in the Master Plan covers the low income group residential area in Monte Hill where their public toilets have this problem.

Therefore, it is recommended to consider the connection of these public toilets to the newly installed sewer network. To improve the sanitary situation of the urban poor and rural population, it is also important to properly allocate begets to the development of sewerage in populated areas, the construction of new public toilets for the urban poor, and the subsidy for rural population to construct private latrines. The implementation of the Total Sanitation Campaign being prepared by the PWD since 2005, in the semi-urban and rural areas of Goa, will take a significant role to reduce the gap in sanitary situation between sewerage users and non-sewerage users.

2.5 Public Consultation

(1) Approaches

Stakeholder participation has been incorporated into this project from an early stage. The participation has focus on the consideration of a wide range of environmental and social impacts. It is important to consult with the stakeholders to foster support for the projects. Figure M113.1.3 shows the continuous process of the public consultation, which has three stages through the three phases of the Study. This figure was used at the first stakeholder meeting on 23 August 2003 to explain the public consultation approach being adopted. As shown in the figure, the consultation process was started even before the development of Master Plan. The PWD, in cooperation with the JICA Study Team, also planed to hold stakeholder meetings in each stage of public consultation.

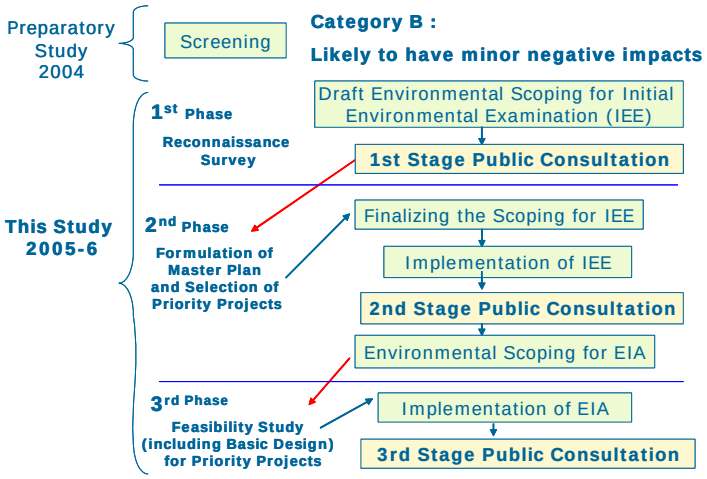

Figure M113.1.3 Flow of the 3rd Stakeholder Meeting Holding & Environmental Clearance

Figure M113.1.4 was also used at the first stakeholder meeting to explain the first stage of public consultation. The first stage of consultation included the public awareness surveys (which included the stakeholder interviews with residents living around the existing STPs), the first stakeholder meeting, and the information disclosure on the results of the first stakeholder meeting.

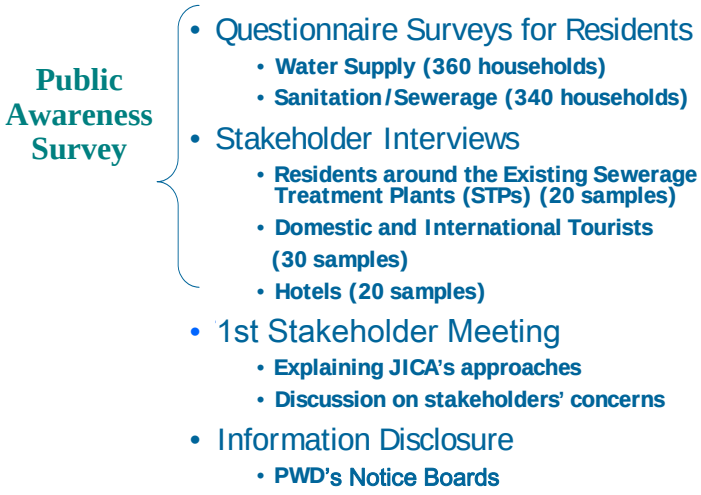

Figure M113.1.4 Contents of the First Stage of Public Consultation

The results of the public awareness survey were shown in the Progress Report and were referred for the preparation of Master Plan. Some of the main results are also explained directly to the stakeholders in the second stakeholder meeting held on 23 December 2006. Moreover, some results of the stakeholder interviews with residents living around the existing

STPs were used to evaluate the presumable negative impacts of the proposed sewerage projects in the IEE.

The note of discussion of the first stakeholder meeting was disclosed to the public through the notice boards of PWD's head quarter and regional offices. The disclosed note of discussion is attacked in A115.1.1. Three local newspaper publishers (Herald, Navhind Times, Gomantak) were asked by the PWD to inform the public that the not of discussion was on the notice boards and two of them put the article in their newspaper before PWD sent the invitations cards of the second stakeholder meeting to selected stakeholders.

The following subsection shows the summary of the first stakeholder meeting. The main components of second and third stages of public consultations are stakeholder meetings, which are explained in (3) and (4), respectively.

(2) First Stakeholder Meeting

The PWD and the JICA Study Team agreed that a stakeholder meeting on environmental and social consideration was required at the end of the Reconnaissance Study. The first stakeholder meeting was held jointly with a technical workshop on 23 August 2005. The aims of the stakeholder meeting were to improve the scooping of the IEE and to consult with the public. Table M113.1.11 lists the attendants at the first stakeholder meeting and work shop.

Table M113.1.11 Number of Attendants at the 1st Stakeholder Meeting and Workshop

Type of Stakeholder	Number	Type of Stakeholder	Number
PWD	37	Chief Officer of Municipality	1
JICA Official	3	Goa State	1
JICA Study Team	10	Mnisitory of Urban Development	1
NGO	3	Engineering Consultants, IT services, Industry and Municipal Engineer of BMC	4
Journalist	3	Unidentified	5
Academic	4	**Total**	**77**
Chairperson and Deputy Chairperson of Municipal Council and Panch of Panchyat	5		

In the stakeholder meeting, the following general environmental and social concerns of water supply and sewerage projects, which were identified through the draft environmental scoping, were explained to the stakeholders at first:

1) Suitable Site Selection for STPs

2) Treated Wastewater Discharge from STPs
3) Odour from STPs
4) Difficulties of Water Supply in Rural Areas
5) Difficulties of Sanitation/Sewerage for Low Income Group

The ways to predict the levels of related impacts and their general mitigation measures were also explained to the stakeholders. The stakeholders' opinions on the identified concerns were then sought in the following discussion. Also, the stakeholders were encouraged to identify other concerns that they thought should be included in the environmental scoping. Before starting the discussion, it was clearly explained to the stakeholders that the results of the discussion would be used to develop a suitable water supply and sanitation/sewerage Master Plan. The stakeholders were also told that there would be another subsequent stakeholder meeting where they would receive feedback regarding how the results of their discussions have been used.

The record of discussions from the first stakeholder meeting is shown in Appendix M111.1. The following is the summary of the main remarks made in the discussion:

1) Stakeholders suggested the possibility of applying eco-sanitation. Rather than viewing sewage as a waste, eco-sanitation recommends beneficial reuse for purposes such as fertilizer and fuel. This would be a new approach for Goa.
2) Stakeholders requested that water supply be provided to the local population before providing water to tourists.
3) There was active discussion regarding the willingness to connect to the sewerage system and the appropriate associated sewerage charges. The PWD explained the need to evaluate the willingness of the population to connect to the sewerage system before the sewerage projects can be developed. The JICA Study Team explained that the willingness to pay to connect to the sewerage system would be assessed based on the results of the public awareness survey. The stakeholders explained that it could be possible to raise the willingness to pay by promoting public awareness of the services.
4) Stakeholders pointed out the need to assess the positive impacts of water supply and sanitation on health.
5) A stakeholder pointed out the importance of appropriate site selection. If a STP is not suitably located, farmers cultivating the surrounding area and the population living near the STP could be affected by the discharge. This risk increases during power cuts or system malfunctions.

6) A stakeholder suggested that the STPs should be located where residential development cannot occur. This would avoid future problems that would result if residential development were allowed to approach the STP.
7) The stakeholders requested that the PWD provide them with brochures about the proposals prior to the next meeting so that they are better informed and can better participate in constructive discussions. The JICA Study Team has agreed to assist the PWD with the preparation of the brochures for the next meeting.

In the phase of the preparation of Master Plan, the JICA Study Team helped the PWD incorporate these stakeholders' opinions into the TOR of IEE.

(3) Second Stakeholder Meeting

The second stakeholder meeting was the main component of the second stage of public consultation. The contents, participants and timing of the second stakeholder meeting were discussed between the PWD and the JICA Study Team during the phase of formulating Master Plan.

Objectives of the second stakeholder meeting were to:

- Present the outlines of the proposed master plan
- Present how the results of 1st stakeholder meeting has been considered in the formulation of the Master Plan
- Discuss site specific issues such as the construction of sewage treatment plants with local stakeholders as regard to environmental and social considerations based on IEE study

The second stakeholder meeting was held by PWD in cooperation with JICA Study Team on 23 December 2005. More than 100 stakeholders were invited and around the half of invitees joined in the meeting. The level of involvement in the second stakeholder meeting was about 50% (54 attendants / 107 invitees). Table M113.1.12 shows the numbers of invitees and attendants from each type of stakeholders. A detailed list of the invitees and attendants is also shown in Appendix M111.2.

Table M113.1.12 Numbers of Invitees and Attendants at the 2nd Stakeholder Meeting

Type of Stakeholder	Number of Invitees	Number of Attendants
MOUD	1	1
Goa Sate	6	1
JICA Official	1	1
PWD	19	13
JICA Study Team	13	13
Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	16	7
Chairperson, Vice Chairpersion, Councillor, Sarpanch, etc.	30	6
Journalists	4	2
NGO	5	4
College	7	2
Pvt. Engineer Consultant	2	1
Others (Port Trust and Military)	3	3
Total	107	54

The invitation cards of the 2nd stakeholder meetings were distributed by PWD to each of the selected stakeholders with the brochure on the outlines of Master Plan and environmental and social considerations (see Appendix M111.3.), a pamphlet of JICA, and a newsletter of JICA Indian Office. The brochure was prepared specially for the second stakeholder meeting by PWD with support of JICA Study Team.

The most important proposes of the second stakeholder meeting was to discuss site specific issues such as the construction of sewage treatment plants with local stakeholders as regard to environmental and social considerations. Therefore, the invitation cards and the other documents were directly distributed by the hand to 16 prominent stakeholders living/working around the proposed sites for STPs, WTPs, etc. The locations of proposed sites and types of projects are briefly explained by PWD stuff to those representatives of stakeholders when the invitation cards were handed to them. The identification of these invitees of the prominent stakeholders around the proposed sites was carried out through the recommendations made by local people.

In the second stakeholder meeting, the following five presentations were given to stakeholders by the PWD with support of JICA Study Team before discussion with the stakeholders.

Two Main Presentations

- Outlines of the Study and Public Participation (including answers to the comments given in the 1st Stakeholder meeting)
- Explanation of Proposed Projects and likely Impacts as regards to Environmental and Social Considerations

Three Additional Presentations

- Answers to the comments given in the 1st Work Shop
- Institutional Development and Capacity Building
- Findings from Financial Analysis

Appendix M111.2 contains topic wise records of the discussions from the second stakeholder meeting. The main topics raised in the discussion section were as follows.

1) Financial Implications of the Project
2) Goa's Good Background for the Project
3) Consumers' Complains
4) Who Should Pay the Cost?
5) Reduction of Corruption
6) NRW Reduction and Organizational Improvement
7) 24 x 7 Water Supply
8) Sewage into Water Supply Pipes
9) Coordination with Other Projects
10) Contents of the JICA Study
11) Unequal Water Supply among Different Regions
12) High Turbidity of Water Supply during the Rain Season
13) Necessity of Sewerage
14) Future Population and Demand Forecast
15) Sewers Sinking in to the Sand Soil
16) Industrial Water Demand based on the Regional Plan
17) Preservation of Wells and Decentralization of Water Supply
18) Map of Pipelines for Panchayats and Municipalities
19) Rain Water Harvesting
20) Need of Qualified Chemist and Laboratory Network

Although some on the presentations explained the presumable negative impacts of the

proposed STPs on the surrounding environments, the remarks about stakeholders' concerns on the proposed sites for STPs and WTPs were unexpectedly limited in the discussion. Many of the raised topics were related to the current discontentment of the public toward the PWD regarding to its water supply services. The needs of better daily customer services by the PWD were highlighted in the discussion.

(4) Description of the Third Stakeholder Meeting

The 3rd stakeholder meeting has been tentatively scheduled on the middle of July, 2006. This meeting will be held after the information disclosure of the note of discussion from the 2nd stakeholder meeting for public notification. In the third stakeholder meeting, the results of Feasibility Study for the selected priority projects will be explained to the stakeholders. In this stage of public consultation, the stakeholders living around the proposed STP and water supply facilities sites included in the priority projects will be consulted more regarding to environmental and social considerations.

Some significant results of the required rapid EIA study, which will include the impact evaluations for the priority projects, alternative analysis of project options, recommendation of mitigation measures, and environmental monitoring programmes, will also be presented to the stakeholders in the third stakeholder meeting. Figure M113.1.5 shows a succession of procedure for Environmental Clearance and the 3rd Stakeholder Meeting. It is necessary to advance the procedure of public consultation at the same time as executing rapid EIA. In a word, it is required to confirm the presence of land acquisition and transmigration according to the implementation of the selected projects at early stage when the Feasibility Study will be executed.

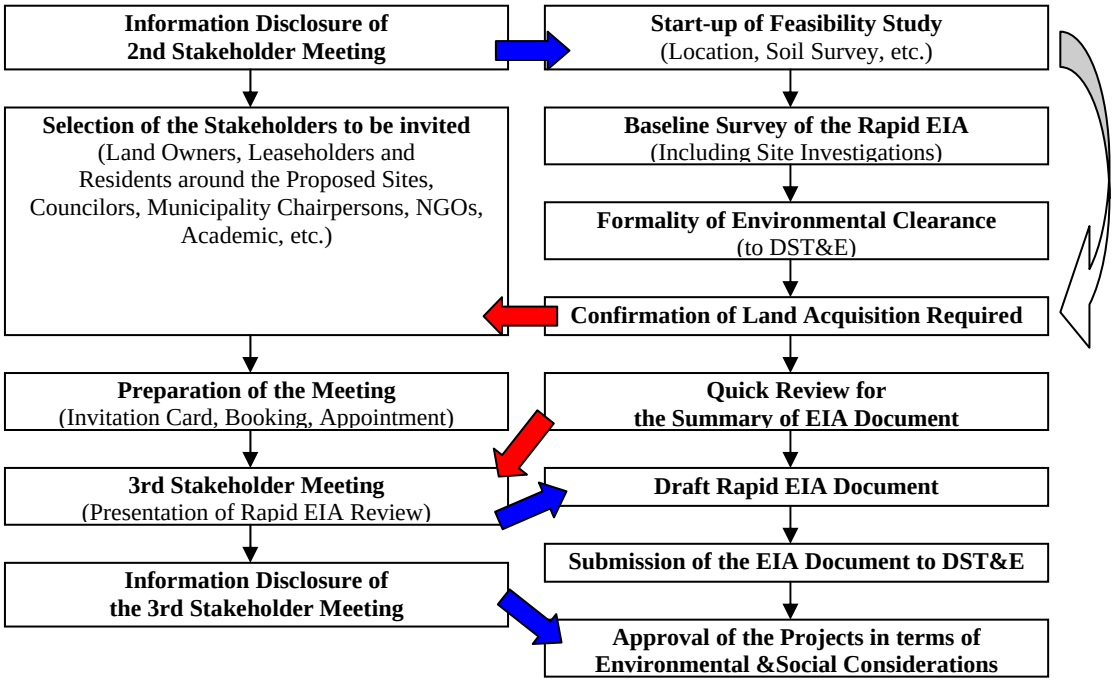

Figure M113.1.5 Flow of the 3rd Stakeholder Meeting Holding & Environmental Clearance

This stakeholder meeting will be the last stakeholder meeting of the Study. When the proposed projects are implemented with the fund from international financial institution or international aid agency, the PWD has to hold additional stakeholder meetings for public consultation in the next stage at the same times of the consents of establishment/construction and operation.

2.6 Requirement of Environmental Impact Assessment

(1) EIA Requirement

EIAs have been carried out since the late 1970s as a requirement of foreign donor agencies. The legal basis for EIA lies under the Notification under the Environment (Protection) Act, 1986, which requires certain projects to have environmental clearance from the Ministry of Environment and Forests. This Ministry is responsible for planning, promotion and co-ordination of environment and forestry programmes. Each State Pollution Board implements the legislation, issues rules and regulations and sets emission standards. Direct responsibility for EIA lies with the "Impact Assessment Division" of the Ministry and its "Impact Assessment Wings" which are the Division's decentralized authorities. The 1994 Notification on Environmental Impact Assessment gives mandatory status for the EIA of certain identified activities. Several States have also enacted their own EIA legislation in addition to the national provisions. The proponent of any development project is responsible itself for carrying out the EIA study. Screening of proposals is carried out by the relevant "Impact Assessment Wing" and may result in rapid EIA or full EIA. Scoping of the EIA study is carried out by the

Environmental Appraisal Committee (sector-based) who also liaises with proponent and the Impact Assessment Wing.

Water Supply and Sewerage Projects like this Study are not included objected Sectors for EIA requirement in National level. That means full EIA study doesn't need a clearance. The regional EIA law of Goa State has not been established yet.

The results of the environmental scoping provided prior to the implementation of EIA shall be reviewed in accordance with the impacts items recommended to be studied for water supply and sewerage schemes in the guidelines for Environmental & Social Considerations of JBIC (Japan Bank for International Cooperation).

Figure M113.1.6 shows flowchart of EIA process in the overleaf.

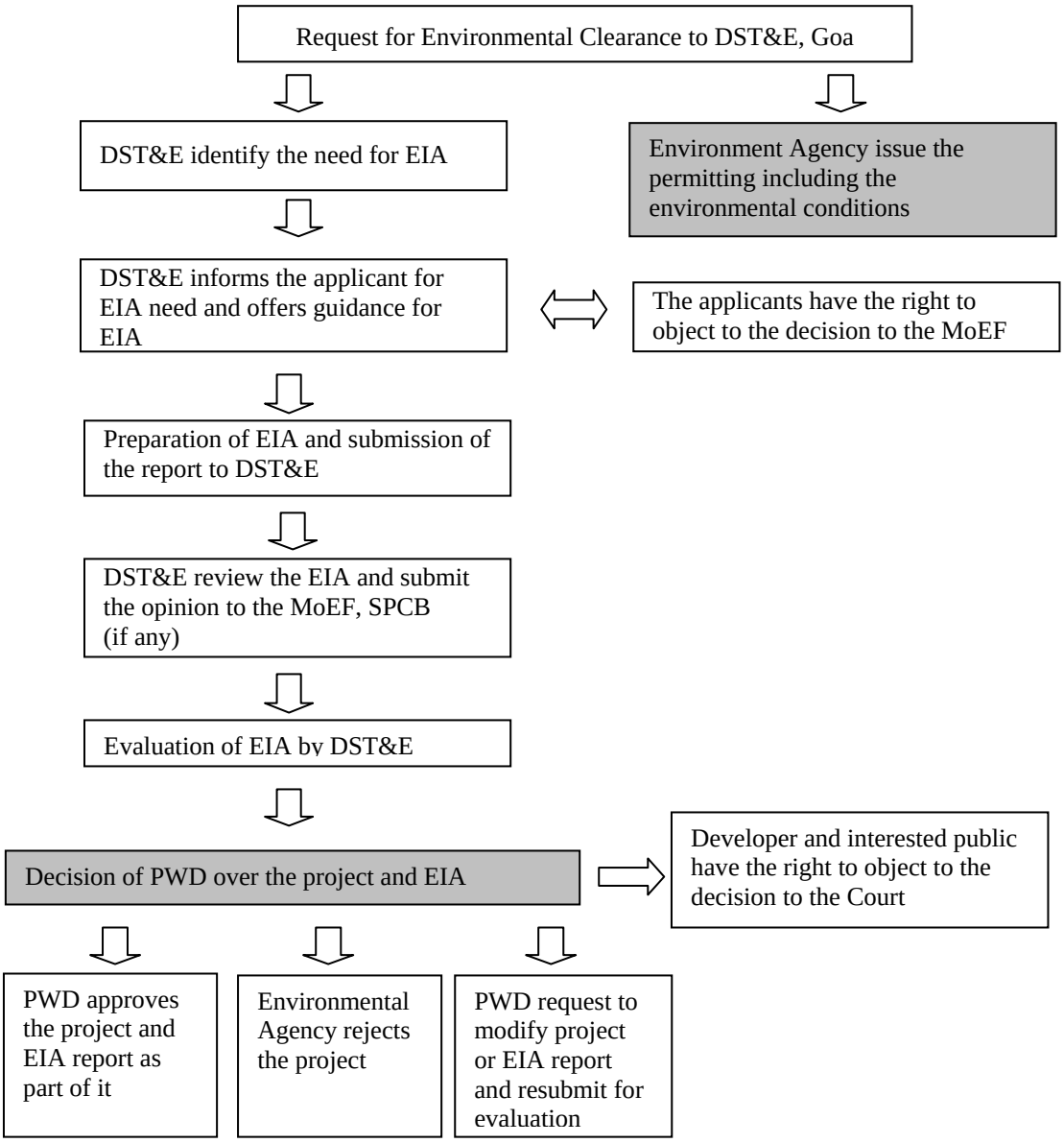

Figure M113.1.6 Flowchart of EIA Process

2.7 GENERIC STURUCTURE OF EIA DOCUMENT

(1) Purpose of the EIA Study

The Master Plan will permit to achieve better public health performances and to upgrade the quality of the living environment. Citizens of Goa State will be blessed with the direct beneficiaries of this plan. The full achievement of such objectives is, however, related to the favourable selection of sites for water supply and sewage facilities, their technical design and their suitable operation and maintenance.

(2) Project Description

Project Description should be included condensed information of those aspects of the project (based upon project Feasibility Study (F/S)), likely to cause environmental effects. Details should be provided to give clear picture of the following:

- Type of Project
- Need for the Project
- Location (maps showing general location, specific location, project boundary & project site layout)
- Size or magnitude of operation (including associated activities required by or for the Project)
- Proposed schedule for approval and implementation
- Technology and/or process description
- Project details, including drawing showing project layout, components of project etc. Schematic representations of the feasibility drawings which give information important for EIA purpose
- Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope)
- Assessment of new and untested technology for the risk of technological failure

(3) Description of the Environment

- Study area, period, components & methodology
- Establishment of baseline for valued environmental components, as identified in the scope
- Base maps of all environmental components

(4) Anticipated Environmental Impacts & Mitigation Measures

- Details of investigated environmental impacts due to project location, possible accidents, project design, project construction, regular operations, final decommissioning or rehabilitation of a completed project
- Measures for minimizing and/or offsetting adverse impacts identified
- Irreversible and irretrievable commitments of environmental components
- Assessment of significance of impacts (Criteria for determining significance, assigning significance)
- Mitigation measures

(5) Analysis of Alternatives (Technology and Site)

- In case, the scoping exercise results in need for alternatives
- Description of each alternatives
- Summary of adverse impacts of each alternatives
- Mitigation measures proposed for each alternatives and
- Selection of alternatives

(6) Environmental Monitoring Program

Technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, frequency, location, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedule)

(7) Additional Study

- Public consultation
- Risk assessment

(8) Project Benefits

- Improvement in the physical infrastructure
- Improvement in the social infrastructure
- Employment potential- skilled; semi-skilled and unskilled
- Other tangible benefits

(9) Environmental Cost Benefit Analysis

If recommended at the Scoping Stage

(10) Environmental Management Plan

Description of administrative aspects of ensuring that mitigation measures are implemented and their effectiveness monitored, after approval of the EIA

(11) Summary & Conclusion

- Overall justification for implementation of the project
- Explanation of how, adverse effects have been mitigated

(12) Disclosure of Consultants Engaged

The names of the consultants engaged with their brief resume and nature of consultancy rendered

3. Evaluation and Conclusion of the IEE Study

3.1 Environmental & Social Benefits and Positive Impacts

(1) Environmental Aspect

Objective of implementation of the water supply and sewerage schemes are to improve the public health and hygiene, lead to improvement in quality of living and gaining economic growth. Therefore, implementation of each scheme will be brought about following benefits and positive impacts:

- The collection and treatment of untreated sewage before entering the rivers will improve water quality of the rivers.
- Proper collection, treatment and disposal system of sewage will reduce the risks of parasitic infections, incident of various water-borne diseases.
- A proper sewage handling and disposal arrangement will minimize the chances of contamination of ground and surface water.
- Such provisions assist to maintain ecological balance by reducing damages to flora and fauna.
- Controlled reuse of sewage sludge may be enhanced agricultural activities and development and also sustenance of environmental protection.
- Improvement in the existing sewerage system will help a function of urban drainage to reduce the nuisance in streets and road blockages that set up floods.
- Nutrient rich treated water and dried sludge can be used for irrigation, as a material of cement.

Especially sewerage schemes, implementation of project can make significant contributions to improve living environment, sanitary conditions for populations and to conserve irreplaceable natural environment. Moreover, the local residents have a right to receive fairly governmental public services, like a water supply as essential utilities.

(2) Social Aspect

The proposed water supply and sewerage systems are social infrastructures and will mainly benefit the local residents directly and indirectly through environmental improvement.

The expected positive impacts of the proposed water supply projects include 1) increase in the population supplied with treated piped water, 2) improvement of supplied water quality, 3) continuous water supply, 4) reduction of waterborne diseases, 5) improvement of financial

situation due to the reduction of NRW, 6) more water supply available to tourist facilities, 7) more water supply available to industries, etc. Currently, many water consumers have complains about water shortage, limited and irregular timing of water supply, risk of water supply to be contaminated by sewage, improper costumer services such as broken water meters. These problems will expectedly solved by the implementation of the Master Plan which include the improvement of water supply facilities, information management system, and costumer services.

The Master Plan covers the increase of water demand necessary for the future development of Goa. At a domestic level, convenience of water supply will be significantly increased after 24 hours-7days water supply starts in many areas. Large water consumers such as hotels and factories will also be provided with sufficient water. From a viewpoint of fairness, the regional gap in water supply service, between towns near WTPs and tail-end towns of water transmission such as Vasco, will also be significantly reduced by the increase of water supply

The expected positive impacts of the proposed sewerage projects include 1) reduction of open defecation and unsanitary/malfunctioning individual toilets, 2) improvement of water quality in rivers and beaches, 3) improvement of living environment including gutter and local streams, 4) reduction of the overflows from existing septic tanks, 5) improvement of the sanitary conditions and images of towns and costal areas, 6) reduction of the risk of disease and enhancement of human health, 7) improvement of socio-economic conditions to attract more tourists especially in Calangute, Candolim and Colva, 8) benefiting women and improving their dignity, etc. Currently, many residents have complains about overflows from their septic tanks, unsanitary living environment due to open defecation, etc. These problems will expectedly be solved by the implementation of the Master Plan which includes a basic plan to improve on-site sanitation facilities as well as development of new sewerage systems. The Master Plan also addresses the importance to enhance the public awareness on sanitation for the effective use of the proposed sewerages and on-site sanitation facilities. The awareness enhancement will be carried out in the Total Sanitation Campaign subsidized by the central government of India.

In the above, the social benefits of the Master Plan are evaluated qualitatively. The expected level of environmental improvement by the sewerage projects is qualitatively evaluated more closely in Main Report, Volume II Chapter 13.4. Moreover, the benefit of saving time and medical cost by the reduction of water-borne diseases and the benefit of water environment preservation for truism are qualitatively evaluated in the economical evaluation of the Master

Plan (see Main Report, Volume II Chapter 10.2 and Chapter 10.3).

3.2 Environmental Effectiveness for With / Without the Project

Technical aspects of with/without project scenarios of the water supply scheme and the sanitation/sewerage scheme are compared in the Main Report, Volume II Chapter 5 and Chapter 6.

If the project are implemented with the scenario, sewage/night soil discharged to the rivers at present will be treated in 2020 while if the project are not implemented without the project scenario), no sewage is treated and all the sewage discharged finds its way to the major rivers which finally flow into the sea degrading its water quality and environment.

When an effluent with high BOD load is discharged in a natural river/stream, the BOD value of receiving water increases considerably which, in turn, results in the fall in DO value in the water. Therefore, it will be shown that the BOD value will be deteriorated dramatically at any water environment without the project in proportion as growth in population. Meanwhile, the BOD value will be expected to decrease with totally covering of the project.

3.3 Minimization Negative Environmental & Social Impacts

(1) Environmental Aspect

In planning network of sewerage system, the points such as site location and space availability for treatment plant, early start of treatment, initial and O&M cost etc. are considered;

In the former F/S study taken by PWD, locations of some new sewage treatment plants (STP) were close to the township. In this plan, there are some negative impacts not only transmigration/land acquisition but also urban environmental nuisance such as noise, vibration and destroy the scenery. However, proposed sites of the Master Plan Study are in the empty lots avoiding from the residential and commercial areas of objective cities.

Moreover, further improving the old plan; it is needed to start operation for treatment as early as possible to improve water quality of the environment. Because, it takes much time to complete for construction of full-scale Master Plan. Destruction of water environment will proceed to the backward.

Proposed site of South Coastal Belt in Colva has been considered for Coastal Regulation Zone (CRZ) Notifications. The CRZ Notification is the principle legislation governing development

activities and land use along India's coasts in the area falling at least 500 meters of the high tide line and in the inter-tidal zone. Any project located in less than 500 m from High Coastal Line, full-scale EIA is required to submit to the Impact Assessment Agency without delay. As a result of this consideration, all proposed sites of new construction for Master Plan Study are selected to get away from the CRZ.

(2) Social Aspect

The minimization of presumable negative social and environmental impacts caused by the proposed projects has been considered through the process of environmental and social considerations while formulating the Master Pan (see Main Report, Chapter 11). The following summarizes the level of negative social impacts after their recommended mitigation measures are appropriately applied (the summary of the evaluation of presumable negative environmental impacts are shown in Main Report, Volume II Chapter 13.4.).

The following two items are identified as presumable negative social impacts of the Mater Plan through the environment scoping of the IEE.

1) The offensive odour from STPs
2) The acquisition of lands currently used for agriculture and horticulture for the proposed new STPs and WTPs

The odour from STPs can be reduced significantly by the appropriate selection of wastewater and sludge treatment technologies. The selection of most suitable technologies for each STP will be conducted in the phase of Feasibility Study along with considering the other mitigation measures recommended in Main Report, Volume II Chapter 11.4.2 (5).

The negative impacts of the land acquisition of agricultural and horticultural lands will be minimized thorough the compensation measure already explained in Main Report, Volume II Chapter 11.4.2 (1). 16 residents living or working around the proposed STP and WTP sites have been already invited to the second stakeholder meeting. In the third stakeholder meeting, the compensation measure will be explained to more residents around the sites to reduce the social impact by early notification.