CHAPTER 10 SEWERAGE DEVELOPMENT PLAN

10.1 Rehabilitation Works of Existing Facilities

The sewerage development strategy in Chapter 7 emphasises the rehabilitation and further development of sewerage systems. It will be absolutely necessary to further investigate and study on a case by case basis to clearly specify the required sewerage works for each urban sewerage scheme. In this study, only general features are stated based on the operational status and physical conditions of existing facilities, which have been surveyed directly by the Study Team.

(1) Sewers

Rehabilitation of sewers is necessary in all urban centres. The needs vary among the urban centres and it is difficult to establish exactly what is required without a visual inspection and assessment of conditions. Therefore, the sewer rehabilitation projects in each case are priced on the assumption that all trunk sewers need to be cleaned, and that 25% of all small diameters sewers (150 mm) should be replaced with larger diameter pipe, sized to meet the hydraulic requirements for future development.

The decision on which sewers to rehabilitate will require more information and the following actions should be taken:

1) Preparation of a comprehensive sewer inventory,
2) Sewer inspections to determine the physical condition of infrastructure,
3) Assessment of hydraulic capacities to identify bottlenecks, and
4) Ranking of rehabilitation needs in order of priority

More detailed reporting on the rehabilitation works is presented in Supporting Report III.

(2) Treatment Works

Where existing treatment works are inoperative they must be rehabilitated as soon as possible. Treatment works that are overloaded must be expanded to serve existing and future sewered populations. Other treatment works that are operational but do not meet effluent standards should be the subject of an operational review to determine what can be done to optimise treatment levels. In addition, the operational review should establish standard operating procedures and identify the equipment and training required for operators to monitor and control the process.

Rehabilitation at existing treatment works is assumed to consist of the following works:

1) Removing sludge from the anaerobic or primary facultative ponds, and any subsequent ponds if necessary, assuming 0.75 m depth of sludge, and
2) Check embankment stability, and repair, replace or install embankment protection.

In general where treatment facilities already exist, there are three possible alternatives that must be considered in assessing future development:

Alternative 1 : Rehabilitation and expansion of existing facilities at the same time

Alternative 2 : Rehabilitation of existing facilities at first, followed by construction of new treatment works at new site

Alternative 3 : Replacement of existing sewerage works with new one with a larger treatment capacity

The decision to maintain existing facilities in operation should be based on an economic feasibility of the site-specific technical options. This type of detailed evaluation should be carried out when a master plan for the urban centre is developed. For the purpose of establishing programme costs of the sector concerned, it is assumed that it will principally be cost effective to rehabilitate and keep existing facilities in operation (Alternative 2).

Three facilities are in extremely poor condition: Nairobi (Kariobanigi conventional), Mombasa (Kizingo primary sedimentation) and Kakamega (Kiambi waste stabilisation ponds). It is assumed that it would be technically and economically advantageous to abandon these works and divert flows to a new facility with more capacity (Alternative 3).

Based on a survey of existing conditions rehabilitation of sewerage treatment works is required at 15 facilities as shown in the table below:

Facility	Rehabilitation Need
Nairobi – Dundora	Remove sludge from anaerobic ponds and facultative ponds
Kisumu – Conventional	Mechanical/electrical equipment replacement and repair
Kisumu – Nyalenda	Remove sludge and weeds from ponds
Nyeri – Conventional	Repair embankments and erosion protection at maturation ponds
Nyeri – Kijango	Repair pond inlet structure, repair embankments
Kitale – Conventional	Repair inlet works, replace sludge pumps, trickling filter distributor, provide erosion protection at maturation ponds
Kakamega – Sbirere	Provide inlet works, repair and protect embankments, remove sludge and weeds
Thika	Remove sludge, provide new inlet works, cut grass and remove trees from embankment, provide erosion protection and improve inter-pond connections
Naivasha	Replace electrical equipment, repair mechanical equipment, remove sludge from anaerobic and facultative ponds
Webuye	Remove sludge and repair inlet chamber
Busia	Remove sludge
Nanyuki	Remove sludge
Embu	Remove sludge
Isiolo	Remove sludge and provide embankment protection
Homa Bay	Remove sludge, provide new sludge processing equipment and clarifier
Nyahururu	Repair floating aerators, remove sludge, repair embankment protection

Source: The Aftercare Study Team

The removal of sludge from waste stabilisation ponds is considered to be a financially and technically heavy burden for most local authorities because they lack the required pumping equipment and vehicles to haul the wastes to a suitable dumping site. The issue is complicated by the massive size of the operations required at most sites. This type of maintenance should be contracted out to specialised companies and it would probably more cost effective for several local authorities to pool their resources to obtain the required services.

10.2 Extension of Sewer Reticulation and Expansion of Treatment Works

(1) Extension of Sewer Reticulation

The rehabilitation of existing sewers should be the first priority in urban centres where the service coverage is well below the proposed target service ratios and the flows into the treatment plant are well below design capacity. Extensions should follow simplified designs that feed into existing trunk sewers with excess capacity. Where sewers exist in a community, efforts should be made to reinforce the number of individual service connections in order to improve flows into the sewers. Trunk sewers that do not have the required hydraulic capacity should be replaced or augmented before extensions are made in upstream drainage areas.

Sewers should not be extended into areas where individual per capita wastewater flow is less than 75 lpcd. unless there is a corresponding improvement of water supply services. The phasing of sewer reticulation depends on existing water supply conditions and the availability of sewage treatment capacity as shown in the following table:

Sewer Reticulation Extension Concept

Water Supply Condition	Treatment Works Condition	Proposed Measures	Urban Centre Subject
Water supply conditions are probably adequate to support conventional sewerage.	Treatment works is operating at or above design capacity.	Increase treatment capacity before extending sewer network.	Eldoret, Kakamega, Kapsabet, Kisumu, Machakos, Meru, Nairobi, Nanyuki, Nyahururu, Thika
	Treatment works has short term capacity.	Extend sewer reticulation coverage up to treatment works capacity	Athi River, Karatina, Kiambu, Kisii, Muranga, Webuye
Water supply conditions are probably not adequate to support conventional sewerage.	Treatment works has short term capacity .	Improve water supply conditions before extending sewer network.	Bungoma, Isiolo, Kitale, Mombasa, Naivasha, Nakuru, Nyeri
	Treatment works is operating at or above design capacity.	Increase treatment capacity before extending sewer network. Extend sewer network only if water supply conditions improve.	Busia, Embu, Homa Bay, Kericho, Limuru, Ngong, Voi

(2) Expansion of Sewage Treatment Works

Where existing sewerage treatment works are overloaded the first priority should be the expansion of the treatment works even in cases where water supply conditions are inadequate to support sewer reticulation.

The decision to maintain existing facilities in operation should be based on an economic feasibility of the site-specific technical options. The conditions in each urban centre will be different depending on: (a) the need to expand capacity, (b) the condition of the existing works, (c) the availability of land for expansion at the same site, and (d) the cost effectiveness of consolidating all treatment facilities in one location.

The need for sewerage treatment works in urban centres with existing facilities is identified **Table - 10.2.1** and summarised in the table below. More detailed information is seen in Supporting Report III.

Preliminary Sewage Works Development Plan

Treatment Capacity	Proposed Measures	Urban Centre Subjects
Short term (1998 – 2005) more treatment capacity is required because existing facilities are overloaded	Rehabilitate and/or expand existing treatment works	Kisumu (Nyalenda), Kapsabet, Limuru, Kakamega, Nairobi (Dundora), Nanyuki, Nyahururu
	Provide new treatment works	Busia, Eldoret, Embu, Kericho, Homa Bay, Machakos, Meru, Ngong, Thika, Voi
Long term (2005 – 2010) provide more treatment capacity to meet target for 2010	Rehabilitate and/or expand existing treatment works	Bungoma, Isiolo, Kakamega, Karatina, Kisii, Muranga
	Provide new treatment works	Kitake, Kisumu, Mombasa, Nakuru, Naivasha, Nyeri

Source: The Aftercare Study Team

10.3 Preliminary Design Criteria

In Kenya there are currently no planning or design standards. This has lead to a variety of technologies, some inappropriate, resulting in systems that are difficult to operate and maintain.

Since design factors affect long-term maintenance, National design codes and standards should be developed to ensure consistent planning, selection of appropriate technologies and materials that are suitable for conditions encountered in Kenya.

10.3.1 Diameter and Length of Pipe

The size, depth, and length of pipe required to serve the target population is determined to estimate the costs of sewer reticulation. Costs are estimated on the basis of an average length per capita and a distribution of pipe sizes considered to be typical for most urban centres in Kenya.

The assumptions made regarding sewer reticulation quantities are shown in **Table - 10.3.1.** The typical quantities of pipe of different diameters, expressed as a percentage of total length, is based on a review of existing reticulation inventories for Mombasa, and Nakuru (refer to Data Book). The table shows the assumed average depth of buried pipes, the percentage for each diameter of pipe in terms of total installed length, and the length of pipe per capita connected to the sewer system.

The total length of pipe required in each urban centre is calculated by multiplying the incremental population requiring sewer connections in 2010 by the average per capita length of 1.14 meters found from the results of the survey carried out for the Aftercare Study.

10.3.2 Wastewater Treatment Works

Planning is based on the assumption that waste stabilisation ponds will be used in all cases. Pond systems are sized on the basis of formula and design criteria given in the UK Overseas Development Administration publication entitled "Waste Stabilisation Ponds: A Design Manual for Eastern Africa". Typical calculations are shown in Supporting Report IV.

The stabilisation ponds consist of a configuration of anaerobic ponds, facultative ponds, and maturation ponds required to achieve effluent standards. Considering future rehabilitation and expansion, more than two series of pond are planned as shown in **Figure - 10.3.1.**

The size of each pond is determined based on the projected "Dry weather flow 2010" shown in **Table – 10.2.1.** Required capacities of anaerobic ponds, facultative ponds and maturation ponds are calculated by the following formulas.

$$V_A = 2.1X \qquad A_F = 11.2X \qquad A_M = 12.7X$$

where X is design wastewater flow (m^3/day), V_A is capacity of anaerobic pond (m^3), and A_F is area of facultative pond (m^2), A_M is area of maturation pond (m^2). The typical relation between the capacities of ponds and the dry weather flow is shown in **Figure - 10.3.2.**

Capacity at existing treatment works is increased by adding more ponds. Capacity at existing conventional works is also increased by adding stabilisation pond downstream of existing treatment processes. The type of expansion works may be classified into the following 3 groups illustrated in **Figure - 10.3.1.**

1) Provision of one or more additional series of ponds (Type 1)

Expansion is required for anaerobic, facultative and maturation ponds

2) Provision of additional maturation ponds (Type 2)

Expansion is required for facultative ponds

3) Provision of stabilisation pond to other treatment types (Type 3)

10.4 Preliminary Construction Cost Estimate

10.4.1 General Conditions

The general conditions set forth for the urban water supply will also be applicable for the urban sewerage projects.

The construction cost comprises: (i) direct construction cost, (ii) land acquisition and compensation, (iii) engineering services, (iv) administration cost, and (v) contingency. The land acquisition and compensation is estimated on the assessment of sewage treatment process requirement, while the other items remain the same as those of the urban water supply.

It is difficult to determine typical unit costs for any method of sewage disposal; costs vary for example, with location, with ease of excavation, and with topography. The depth and therefore the cost of excavation for sewers, which flow by gravity and must therefore always fall, depends absolutely upon the local topography. The presence of rock or groundwater can enormously increase construction expenditure. Population density is also another important factor; costs generally fall as the density increases. To estimate the costs of sewerage development, an attempt has been made in the Study to establish average unit costs, which are applicable through Kenya. These costs represent typical conditions but do not necessarily apply to any particular project in any particular location.

More detailed information is presented in Supporting Report III.

10.4.2 Extension Works

The quantities of sewer reticulation and size of facilities required for each urban centre are estimated as shown in **Table - 10.4.1**.

(1) Unit Costs

The unit costs for various sewerage works are estimated as follows:

1) Sewer Reticulation

The unit cost for construction of sewer reticulation is given in **Table - 10.4.2.** The construction cost per meter includes those of pre-cast concrete pipes, excavation, and manholes at 50 m intervals.

2) New Treatment Facilities

The construction cost of New Treatment Facilities is estimated by the following formula.

$$Y = 195.6X$$

where,

Y : Construction cost of new treatment facilities, US$
X : Design wastewater flow, m^3/day

The typical relation between the construction costs and design wastewater flow for each type of pond is given in **Figure - 10.4.1**. The unit construction costs used to derive the cost of treatment facilities are summarised in **Table - 10.4.3**.

10.4.3 Rehabilitation Works

The unit costs for various rehabilitation works are given in **Table - 10.4.4**. The unit costs for replacing sewer pipes are assumed to be 1.5 times the cost of new construction, and they include pre-cast concrete pipes, excavation and manholes.

10.4.4 Estimated Investment Requirement

Table - 10.4.5 provides a breakdown of the estimated costs for the planned treatment works and sewer reticulation in each urban centre.

The direct investment required to achieve the long-term urban sewerage development plan, is the sum of the rehabilitation cost of existing projects and expansion works. It is estimated at US$483.0 million for 40 urban centres included in the long-term plan. It consists of US$116.5 million for treatment works, US$231.5 million for sewer reticulation.

10.5 Annual Operation and Maintenance Cost

The cost of operation and maintenance cost (O&M) is basically composed of: (i) equipment maintenance and repair cost and (ii) staff salary cost.

(1) Maintenance and Repair Cost of Equipment

Maintenance and repair cost of equipment is roughly estimated on the basis of proportion to capita cost, which is shown in the table below.

Basis for Annual Operation and Maintenance Cost of Equipment

Item	Economic Life in Years	Annual Maintenance and Repair Costs as a % of Capital Cost
Ponds	40	0.5
Treatment works in masonry or reinforce concrete	30	1
Mass concrete structures e.g. intakes, culverts	40	1
Earth works generally	40	1
Pipes	30	1
Building, Masonry	30	1
Road of access	30	1

Source: Design Manual for Water Supply in Kenya

The cost of operation and repair cost of equipment are estimated referring to the data indicated in **Table - 10.5.1.**

(2) Salary Cost

To ensure a sustainable operation and maintenance, adequate staffing is important. The numbers of the staff are decided by referring to the recent World Bank' study (1983: Notes on the Design and Operation of Waste Stabilisation Ponds in Warm Climates of Developing Countries Washington D.C.). **Table - 10.5.2** indicates the standard numbers of desirable staffing for operation and maintenance of the system and the annual manpower cost.

10.6 Construction Period

The construction time schedule of sewerage projects is assumed as follows:

Construction Period of Sewerage Project

Required Actions	Period Required (Year)
1. Feasibility Study	1
2. Detailed Design and Financial Arrangement	1
3. Pre-construction Stage	1
4. Actual Construction	
Rehabilitation	1
New schemes, large scale	3
small-medium	2

Source: The Aftercare Study Team

Such urban centres as Nairobi and Mombasa are classified as a large scale centre and, for such urban centre, sewage expansion works are planned to be implemented in a couple of phases. Further it is absolutely necessary for some urban centres to implement their sewerage expansion works in parallel with or after realisation of urban water supply projects. These will be stated in Chapter 12. When planning the implementation schedule.

CHAPTER 11 STRENGTHENING PLAN FOR PUBLIC ADMINISTRATION, LEGISLATION AND FINANCIAL ADMINISTRATION

11.1 Improvement in Public Administration

11.1.1 Basic Concepts

As summarised in Section 3.9 of this report, a number of issues concerning the overall organisation of the water and sewage sector need to be resolved if the sector performance is to be improved.

The objectives of a rationalisation of the institutional framework of the sector are to:

1) promote effective and efficient regulation of the water and sewage sector, and clearly segregate regulation from operation of water and sewage schemes;

2) rationalise and clarify the roles and boundaries of responsibility between the main sectoral institutions while reducing MWR's role as service provider;

3) establish a unified body within MWR responsible for providing planning, construction, O&M monitoring and advisory services for the sewage subsector;

4) support longer term public sector reforms by:

   i) enabling schemes to be operated on a commercial basis with a greater degree of autonomy, with the aim of funding future capital investment from scheme revenue, and by
   ii) encouraging and promoting investment from the private sector at the appropriate time;

5) improve the delivery of services to the customer.

To agree and implement a rational development strategy for the water supply and sewerage sector, based on the above objectives, is of key importance in improving overall sector performance.

The objective is to focus on a minimum number of key problem areas and propose action, with donor support where necessary, to resolve them.

(1) Rationalisation and Clarification of Major Institutional Roles

The roles and responsibilities of MWR, NWCPC, MOLA and the LAs, and any other scheme operators, should be rationalised and clearly defined in terms of:

1) policy formulation
2) sector strategy and planning
3) regulation
4) scheme planning and implementation
5) scheme operation.

The revision of responsibilities referred to in the National Water Policy would, in the longer term, concentrate the responsibilities of MWR and other ministries on overall sector policy and strategy, planning, coordination and regulation, while the development, implementation, and operation of schemes would be handled by NWCPC, the municipalities, and other undertakers. This has been accepted by GOK in principles. Specific proposals and modalities appear in outline in the subsection 11.1.2 below.

To achieve such a separation of roles and responsibilities, in addition to the development of a regulatory framework, it will be necessary to:

1) strengthen the management, systems and general resources of existing and potential water undertakers to allow them to take on additional schemes currently managed by MWR and NWCPC;
2) agree the criteria and procedure for allocating schemes.

Also, the poor financial performance in the sector has to be addressed. Existing problems include, generally:

1) under-recovery of capital and even operating costs;
2) inadequate budgets for operating and maintaining schemes, and severely under-funded budgets;
3) hidden cross-subsidisation between schemes,

these appear to be due to inadequate tariff levels, constraints from the central planning and budgeting system, and poor operation, maintenance and financial control by existing water undertakers. Proposals for dealing with some of the major current problems appear in Section 11.3 below.

(2) Scheme Allocation Criteria

A logical basis, which can be agreed by those involved, must be established for the allocation of water and sewage schemes among the main actors. Such criteria could include:

1) financial viability;
2) size of scheme (water volume or population served);
3) type of scheme (bulk water/pipeline supply; distribution to consumer);
4) municipal/urban/rural scheme;
5) geographical location (e.g. by catchment area, basin, or administrative unit);

6) the need to combine water supply and sewage disposal schemes under one water and sewerage manager, as in the municipalities.

(3) Framework for Regulating Schemes and Undertakers

A regulatory framework should be set up to monitor the operational, environmental, and financial performance of undertakers and schemes to ensure that:

1) adequate service levels are provided for consumers;
2) tariff levels allow the undertaker to meet reasonable and agreed financial targets, but are fair to each category of consumer;
3) services are extended to supply changing demand, when necessary;
4) new projects are sensible and are planned and carried out efficiently and effectively;
5) performance is regulated using specific criteria and operating licences are controlled.

The framework, within which all undertakers (including Nairobi City Council W&S Department) would have to operate, would allow undertakers to function without political interference but would make sure they understand their responsibilities for delivering performance. This arrangement is also needed for regulating privatised or franchised water and sewage schemes in the interests of customers and investors. Specific proposals appear in the subsection 11.1.2 hereof.

11.1.2 Proposed Restructuring of Institutions

(1) Ministry of Water Resources

MWR should be responsible overall for policy making, strategy, planning, coordination, and regulation of the water supply and sewerage sector and should retain its current functions, at least in the short term. Some changes are, however, necessary (see **Figure - 11.1.1, Figure - 11.1.2, Figure - 11.1.3 and Figure - 11.1.4**).

First, two areas should be strengthened to emphasise their growing importance:

1) planning, design and construction, and overall supervision of sewerage schemes and their operation and maintenance;

2) central regulation of:

   i) water abstraction, water pollution and water quality, and
   ii) water undertakers and sewage providers, including tariffs.

Although sewerage facilities are currently the responsibility of municipalities and some urban centres and are therefore under the jurisdiction of MOLA, it is important that MWR has full technical responsibility for and control over this subsector. The linkage between sewerage and water supply should be strengthened. To fulfil this responsibility properly, the present functions

relating to sewerage, currently dispersed in several MWR units, should be brought together in one division under a deputy director reporting to Director, WDD - who should be designated Director, W&SDD.

An additional section dedicated to sewerage may be required in the Special Water Programmes Division. On site sanitation should remain under the overall control of MOLA assisted by MOH.

Regulation of water abstraction, water pollution, and water quality should be grouped together with surface water and groundwater management in one department reporting to the Permanent Secretary, to detach regulatory functions from the mainstream work of the Ministry, and be given a higher profile. This department would support the Water Apportionment Board, the Catchment Boards and the District Water Boards in their decisions and recommendations regarding the conservation and management of water resources. MWR must ensure that this regulatory organisation is adequately funded, in which case Boards can meet far more frequently. Also, Catchment Boards should be given powers to approve the less significant permit applications without involving the WAB.

In the longer term, MWR should relinquish most of its direct water undertaking activity, beginning with the handover of municipal and urban schemes to local authorities when these are ready for the task. This handover would take a number of years to accomplish fully (see (3) below).

In addition, suitable rural water supply schemes should continue to be handed over to selected communities under the SIDA-funded Community Management of Water Supplies Project, thereby reducing MWR's direct involvement in service delivery. The procedures and documentation developed should allow this divestment to continue with the help of the District Technical Committee (DTT) led by the DWE in his expanded role. This leaves MWR to look after policy and regulatory functions after handover plus the advisory role described immediately below.

In parallel with the above, MWR should retain its increasing role in the rural areas, both by acting as undertaker of the smaller less profitable or loss-making schemes, and by advising local communities and actively helping them from local offices to set up and manage their schemes. All community schemes should be registered with the Ministry.

The formation and successful operation of financially autonomous water and sanitation companies by LAs will attract potential water undertakers, both urban and rural. MWR (until the formation of a separate regulator), assisted by MOLA, should develop minimum quality and performance standards and monitor undertaker performance.

Concerning MWR's Head Office, it is additionally recommended that:

1) Activities in the Construction Division, Water Resources Development Branch, should be increasingly opened up to the private sector to reduce the MWR direct

involvement. Where MWR is directly involved, on a reducing basis, its services should be offered at commercial rates.

2) The Applied Water Research Branch should devote more of its resources to research in the sewerage subsector.

3) Staffing of the Operations and Maintenance Division should be constantly reviewed for potential reductions as water supply schemes are handed over to other undertakers.

4) The potential for merging sections in the Water Resources Management and Water Resources Development Branches should be investigated.

Concerning Provincial Offices, it is recommended that staff should be reduced to the minimum required for advisory and monitoring activities, and, if so decided, the calculation and dissemination of water supply and sewerage tariffs, and decisions on adjustments to revenue to be returned to District Offices.

The present development programmes for the Kenya Water Institute (KEWI) should be pursued as planned. KEWI's increased autonomy and size should be recognised by having it report to the Permanent secretary, MWR rather than Director, WDD. Courses needed for the Study implementation schedule concern:

1) meter reading;
2) meter repair and calibration;
3) billing and revenue collection;
4) bookkeeping and accounting, with special reference to the billing and collection system;
5) leakage control and the reduction of UFW;
6) supervisory courses for the above;
7) sewage treatment for operators and supervision;
8) personal computing using spreadsheet and database software.

The Action Plan prepared by the Kenya-France Task Force says that only one of those courses is presently available. Unfortunately the Action Plan does not say, if courses needed by the Study are not currently available, when they will be. The proposed O&M improvement programme requires that all courses should be available by the beginning of the 1999/2000 financial year.

(2) Community Water Supply Schemes

Water supply schemes run by community groups are increasingly important because of their coverage of the population, potential for disease and as providers of small scale irrigation. However, information on the total number and location of community schemes is incomplete. Generally, the schemes are simple gravity schemes which are facing many operational and

financial problems. Yet they appear united in their wish not to be interfered with by GOK although they would accept help without strings attached.

Development options would appear to be:

1) Metered bulk supply from MWR. Scheme members would pay bulk charges and manage their own distribution system.

2) Coexistence of MWR scheme (supplying treated water for domestic purposes) and the community scheme (supplying untreated water for irrigation and other purposes). The MWR supply could be in bulk as in 1) above.

3) MWR and community schemes to supply mutually exclusive areas.

Option 2) would seem to be most suitable as a model given: the increasing danger to public health of consuming untreated water; the need to conserve treated water; and the communities' wish to remain, as far as possible, independent of GOK.

Actions required to improve the current situation include:

1) Undertake a national survey of all community schemes;

2) GOK water quality sampling and testing at all community water supplies, including those MWR schemes already handed over to community groups;

3) MWR to provide advice in technical and management matters from District or Division Water Offices;

4) MWR and MCSS to provide advice on legal and organisational matters;

5) where new or extended MWR schemes are being considered near community schemes, the above options for development should be assessed and the most appropriate one selected.

(3) National Water Conservation and Pipeline Corporation

In the opinion of the Study Team, simple mutually exclusive divisions between the functions and areas of jurisdiction of NWCPC and those of MWR or the LAs, although desirable, are not yet feasible. A further review of NWCPC focusing solely on the development and supply of water in bulk to undertakers showed significant disadvantages including:

1) operational and billing/collection problems at the interface between bulk supplier and undertaker or distributor;

2) NWCPC could find it hard to recover the capital cost of major schemes at current or potential bulk supply tariff rates even if their financial performance was dramatically improved;

3) the difficulty of neatly separating bulk supply from water undertaking activity in many schemes.

However, the following can be recommended:

1) Of the five areas in 11.1.1(1) above, NWCPC should undertake scheme planning and implementation, and scheme operation. It should have no responsibility for policy (MWR), sector strategy and planning (MWR) or regulation (MWR or agency), although it could advise on the first two areas.

2) Where NWCPC is a water undertaker in a local authority which is ready to become one under the UWASAM local authority development project, its responsibilities should be handed over to the LA.

3) NWCPC should have no responsibility for developing or operating sewerage schemes.

4) NWCPC should continue to develop and operate bulk supply and pipeline schemes within or between catchment areas where these are required by strategic development plans.

5) NWCPC should continue to operate as a water undertaker where its schemes cannot be transferred to a suitable LA, other water undertaker which is likely to deliver a superior performance, or well prepared community group.

6) Scheme allocation criteria as those outlined above (see 11.1.1(2)) should be agreed and applied to all current NWCPC and MWR water supply schemes to decide which should be transferred to NWCPC, and which to MWR. The majority of transfers should be from MWR to NWCPC to reduce MWR's responsibility for service delivery.

7) Major efforts must be made to improve NWCPC's operational and financial performance if it is to become commercially viable and deliver an adequate water supply service. NWCPC schemes taken over from MWR have shown little, if any, improvement since the transfer. Much more capacity building and reform is needed before commercial operation is possible.

Because of the lack of up-to-date information available, the Study Team could not propose specific action to resolve the foregoing other than broadly delegating more authority to regions and repositioning the PIU for the Mombasa and Coastal Water Supply Project in Development Services Department. A further comprehensive review of NWCPC is probably needed therefore,

to propose improvements where required for the benefit of the water supply system as a whole as well as NWCPC.

If it proves impossible to commercialise NWCPC as presently structured, one option would be to break it up into autonomous regional units under the general jurisdiction of MWR, leaving the Coastal Region with its large development programme under a much reduced and renamed NWCPC.

NWCPC's continuing role developing and providing water in bulk should not duplicate but complement the work of the River and Lake Basin Development Authorities (RLBDAs). The RLBDAs should focus on specific industrial and commercial development within their catchment areas and, where needed, the development and provision of water specifically for such projects. They should also monitor water abstraction and use. This is confirmed by the Act (Cap 442) establishing the Lake Basin Development Authority.

(4) Municipalities and the Ministry of Local Authorities

In line with GOK's current policy of decentralisation and local empowerment, the responsibility for management and delivery of combined water and sanitation services to users should be devolved to the lowest feasible level.

Thus, the commercialisation of water supply and sewage disposal currently being implemented by municipalities (with GTZ technical assistance) should continue until all ten water undertaking municipalities (including Nairobi) have municipally owned water and sanitation companies operating commercially. In addition, non-water undertaking municipalities ultimately suitable for appointment as water undertakers (i.e. that will eventually meet certain criteria) should be progressively upgraded through the GTZ programme to allow them to be appointed as such. At this point these municipalities would begin the commercialisation process, ending with the establishment and operation of autonomous water and sanitation companies.

W&S companies would be registered under the Companies Act to ensure the necessary autonomy in financial and personnel matters. This implies separate financial accounts and accountability, retention of water and sewage revenue, and regular auditing.

There would be a longer term possibility of private equity participation when the operating and financial performance of the W&S companies has improved sufficiently.

One of the major constraints to the separation of water supply and sewerage from the rest of LA activity has been the reliance of LAs on a substantial proportion of water sector revenue to fund other services. Both the Local Government Reform Programme and the UWASAM project are helping LAs to develop other revenue sources so that they can operate satisfactorily without water sector revenue.

The Study Team recommends that this GTZ project continues without interruption until the necessary reforms are fully implemented and sustainable. According to the findings of

UWASAM, some 15 municipalities (including Nairobi) would be suitable candidates for separate W&S companies. This programme will require ongoing donor assistance to support UWASAM until completion, i.e. until the 15 currently eligible municipalities have been commercialised.

The foregoing model for providing urban water and sanitation services should be extended to apply to towns, once all municipalities have been covered, provided they can meet the stipulated conditions.

MOLA's present water and sanitation support role should be clarified with MWR to eliminate the present duplication and omissions, and ensure that all development and operation and maintenance tasks are adequately covered. Ideally, all technical development and support responsibilities should be in the hands of MWR. However, a small MOLA water and sewerage technical unit may be useful to assist MWR and liase between LAs and MWR.

11.1.3 Commercialisation and Privatisation

Structural commercialisation has already begun in the water supply and sewerage sector with the recent establishment of three water and sanitation companies under the GTZ UWASAM Project (see 3.3.4). The aim of this corporatisation is to increase autonomy in the management of these bodies thereby improving efficiency and effectiveness, and to retain water and sewage revenue for use solely within the sector. Results to date indicate that, so far, the process is delivering improved performance. The increased autonomy has to be subject to regulation (without interference in the management process) where competition is absent, i.e. in a natural monopoly such as water supply and sewage disposal, and this is proposed in (6) below.

Privatisation represents a further stage in detaching operations or enterprises from the public sector, and generally results in improved performance, operationally and financially, as much experience in Latin America, Africa and Asia as well as in the industrialised countries has shown[1]. It is also GOK policy as expressed in the National Water Policy. In Kenya (as in other emerging economies) private sector funds from domestic and international sources will be vital to help meet the massive investment required in water supply and sanitation development. Furthermore, to attract private money there must be opportunity for profit without unreasonable risk; public management must therefore create an environment that lowers risk and offers a high probability of a reasonable return on investment. Again, because of the natural monopoly and greater autonomy enjoyed, the regulatory framework is even more necessary than for the commercial operation of a public company.

Once it has been decided to involve the private sector, as Kenya has, the types of participation have to be chosen. These are, in ascending order of complexity and contract period:

1) Service Contracts, where a private firm provides specific services such as meter installation and repair, meter reading, billing and collection, or system operation.

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1 Private Sector Participation in the Water Supply and Wastewater Sector: Lessons from Six Developing Countries, Daniel Rivera 1996, The World Bank

2) Management Contracts, where a private firm assumes overall responsibility for operating and maintaining the water supply or sanitation system, with freedom to make day-to-day decisions.

3) Lease Contracts, where a private firm leases facilities from a public authority and assumes responsibility for: operation and maintenance; for financing working capital; and replacing working capital and replacing capital components with a limited economic life.

4) Concession Arrangements (Build, Operate, Transfer (BOT), or Build, Operate, Own (BOO), or Build, Lease, Transfer (BLT)), where a private firm finances fixed assets as well as working capital and assumes complete operational responsibility as under a lease contract. It owns the assets for the period of the concession (say 10-30 years) and transfers them back to the public authority at the end of this period. For the BOO contract, assets would be retained by the firm.

5) Divestiture, where a private firm takes complete control by purchasing public assets (as in the UK water industry). Even with divestiture, the public sector (via the regulatory framework) is still responsible for seeing that services are of the stipulated quality and delivered at a reasonable cost.

Before beginning a privatisation arrangement or programme, four basic questions should be asked and answered:

1) What do we want the private sector to do for us? An infusion of technical expertise or major new investment?

2) What will the service improvements we want mean for tariffs?

3) Does the existing regulatory framework provide sufficient support for the private sector, so that it will willingly take on commercial risk?

4) Do the key stakeholders (employees, consumers, environmentalists) support private sector involvement?

Answers will help appropriate privatisation methods and preparatory work as well as targets to be more confidently identified.

To undertake this task, a separate regulatory agency should be set up with the necessary statutory powers.

Reporting initially to the MWR Minister to emphasise its independence, the agency would regulate water undertakers and sewerage providers in order to monitor their operational, environmental and financial performance without managerial or political intervention. (A similar

agency, also reporting to the relevant Minister, was recently set up for the power sector in Kenya.) The agency would:

1) set performance targets,
2) monitor operational and financial performance,
3) enforce service standards,
4) approve tariffs, and
5) license undertakers.

There are precedents in other African countries for such regulators and they are essential components of the corporatised water and sewage sector, for example, in France or England and Wales.

11.1.4 Personnel Administration

(1) Recruitment, Promotion and Transfer of Senior Officers

To help to remedy the current problems in recruiting, promoting and transferring senior officers, an assessment of the functions, methods and value of the PSC is recommended, with a view to increasing the relative authority of Department heads, LAs and District offices in decisions affecting their staff, and possibly abolishing the PSC altogether and replacing it with an appeal body to hear staff complaints.

(2) Remuneration

Of concern to both water and sewage subsectors is the major issue of inadequate pay and conditions which is prevalent throughout the Civil Service and the wider public sector.

It is, therefore, recommended that a consulting assignment be undertaken to establish a pay policy for the Civil Service. This is in recognition of severe skill shortages in managerial, technical and professional positions, the anticipated large differentials between private sector salaries and allowances and those in the Civil Service, and the low performance delivered by the majority of public service employees at all levels, among other issues. A culture of under achievement currently exists and is largely related to low pay.

The pay policy assignment, which could be completed in about 6 weeks by an experienced remuneration consultant, would investigate, as a minimum:

1) Civil Service and public service pay and allowance structures and how they are implemented; trends in pay relative to inflation;
2) Briefly, external private sector pay and allowances;
3) Analysis of staff establishments/vacancies by grade/agency;
4) Existing job evaluation, performance appraisal systems, and how they are operated;
5) Employer/trade union relations;

6) GOK's current and potential financial performance, relating to employment cost, revenue and revenue improvement programmes and projects;

and would produce a pay policy document, to be agreed by GOK and trade unions, which would state:

1) phased targets for enhancement of pay relative to the private sector;
2) the need for and mechanisms to achieve productivity improvements and revenue increases;
3) possible improvements to job evaluation, performance appraisal and pay systems;
4) possible application of special salary enhancement for critical posts;
5) possible improvements in recruitment and training;
6) responsibility for policy implementation.

11.2 Proposed Amendments to Legislation

Measures to address both the current poor implementation and enforcement of the law as well as the need for amendments, are proposed below. The Study Team recommends that both the Water Act revisions and the Environmental Management and Coordination Bill 1996 should be enacted without further delay.

(1) Short Term Recommendations

The following amendments should be made to the Water Act at once, to resolve the above issues:

1) Exclude defunct bodies from Act and reassign functions and powers;

2) Establish new bodies such as District Water Boards; strengthen powers of Water Apportionment Board to issue, alter, revoke various permits and make by-laws; strengthen powers of Catchment Boards to approve certain categories of permit without WAB involvement;

3) The Water Act should apply to all water undertakers, including registered community water groups;

4) Section 50 should be extended so that surface and groundwater abstractions are treated alike; action required on salt water pollution of wells should be extended to all pollution of wells;

5) Standards for disposal of industrial effluent into a body of water should be prescribed, together with the charges for exceeding permitted pollutant levels; all charges and penalties should be updated using inflation as a guide to correct present values.

6) The Act should establish the Kenya Water Institute with responsibility for HRD training in the whole water sector.

Municipal by-laws, where still needed, should be brought up-to-date for both water supply and sewerage.

(2) Long-Term Recommendations

Long-term recommendations include: the reduction of enforcement agencies to one; and the drafting of a single comprehensive Water Act, consolidating all other water sector legislation. The Environmental Management and Coordination Bill 1996 could ultimately provide the framework for a single enforcement agency and a further consolidation of water and environmental legislation.

(3) Recommendations to Assist Implementation of the Law

The following measures are required to improve implementation and enforcement of the law:

1) Law enforcement should be handled at the district level, coordinated, if needed, by the District Water Board. Issues unresolved at this level should be referred progressively up to the district courts via the Catchment Boards and the Water Apportionment Board;

2) Officials (water bailiffs, health inspectors etc) responsible for enforcement should be thoroughly trained in the law and its application, and be committed to enforcement. Responsibility for law enforcement should appear on all relevant managers' job descriptions, from the PS down to Section Head;

3) A PR campaign should be launched to educate and inform the public about the water laws, the need for them, and why enforcement is necessary to benefit both individual and community.

11.3 Improvement in Financial Administration

11.3.1 Budgeting and Funds Allocation

Reference is made to the frequent large disparity between budgeted recurrent expenditure and the funds allocated. It is recommended that the Ministries of Finance and Planning, and the Office of the President take urgent steps to ensure that budgets and available funds coincide to a greater extent than at present. If necessary, an external review of the planning, budgeting and funds management process should be undertaken. It is vital that the funds budgeted are made available at District level, so that management of District operations may proceed rationally and the requisite quality and quantity of water supplied can be maintained.

It is understood that revenue generated by Districts is currently adjusted by MWR in Nairobi to between 65% and more than 100%, to balance the needs of rich and poor areas, before it is returned to districts. It is recommended that this balancing and adjustment should be performed at provincial offices in future, in support of GOK's policy of decentralisation and local empowerment.

11.3.2 Improved Investment Method

Investment in development projects in the past has too often been done without policy guidelines on, for example, appropriate technology, or a sectoral planning framework.

It is essential that such policy guidelines and a planning framework are developed for both water supply and sewerage subsectors and used as a basis for determining investment priorities. The procedure for identifying projects should include the use of standard algorithms and selection criteria for water supply and sewage treatment and disposal. These criteria should be as far as possible identical for both subsectors.

For larger projects, economic and financial evaluations should be routinely used to provide additional information for investment decisions.

Projects should only be approved for implementation if they are fully funded. This would avoid the present unsatisfactory arrangement where many more projects than can be properly funded are started and take far longer to complete than planned. Frequent interruptions to development or construction programmes result in low productivity and excess costs. This approach is more difficult to explain to would-be beneficiaries, but must be adopted in the interest of more effective development.

MWR would be responsible for planning and project selection in the water sector, working through District Development Committees and in collaboration with MOLA.

11.3.3 Proposed Amendment to Tariff System

As stated in 3.6.1 it is national policy that water beneficiaries should share, according to the benefits received, the entire capital and operating cost of the relevant public facilities, and this must be an objective of any future tariff system.

(1) Water Supply

It is recommended, in accordance with the findings of the 1995 NWCPC Tariff Study, that a progressive rising block tariff is best suited to Kenya's needs because it:

1) provides an incentive for conservation;
2) can be structured to achieve social objectives (such as a basic needs block);
3) obviates the need for more complex "industry specific" tariffs;
4) is in current use, and familiar to both customers and billing staff.

The size of the "basic needs" block should be 10 m^3 metres per month and there should be five consumption blocks with the following band widths:

1) < 10 m^3 metres per month,
2) 10 to 20 m^3 metres per month,
3) 20 to 50 m^3 metres per month,
4) 50 to 100 m^3 metres per month, and
5) > 100 m^3 metres per month.

There should be an increase in tariff value of at least 700% from the bottom to top blocks.

Tariff rates should be set to satisfy an attainable revenue target, such as to cover operating and maintenance costs or to cover O&M costs plus depreciation plus a contribution to reserves at an agreed percentage rate (10% has been suggested) of the cost of new capital works. This is equivalent to establishing a target for the return on the value of the new assets (ROA). Once set to realistic levels, real tariff values should then be maintained by applying annual corrections for inflation.

In 3.6.1, current water tariffs were reviewed for seven municipalities and compared with the MWR and NWCPC basic rate. Considerable disparities in most schemes were noted both in values and in the tariff structure.

Those tariffs departing significantly from the above model should be examined and revised, and the values recalculated to raise the target revenues originally specified. These targets should be at least sufficient to cover O&M costs.

Generally, government/institutional and commercial/industrial consumers should be charged at higher rates than domestic consumers. Studies by industrial concerns analysing costs of abstracting their own water have shown that it costs much less from the municipality, perhaps as little as 30% of the in-house cost. So there should be plenty of room to increase tariffs to industrial and commercial firms before they could produce their own water more cheaply.

Where adequate bulk supplies are available at or near the current price of Kshs 10/m^3, these should be used by the water undertaker in the interest of economy. It is estimated that this rate is considerably less than the cost of own production by the undertaker even where low cost resources are available.

Finally, prices of water sold by kiosks to the poorer citizens, the sole source of water for many people, must be controlled effectively at official rates. To assist implementation, kiosks should be leased to agents who have to sell at the official price. To help ensure that this happens, agents should be drawn from the local community.

As the principle of local tariff setting has been accepted for municipalities and agrees with the theme of the National Water Policy, it would be logical to extend it to either basins/catchment areas, provinces, or districts, whichever is administratively most feasible. This suggests that tariff

setting should be based at either provinces or districts (probably the former) and the necessary administrative support put in place.

(2) Sewerage

It is recommended that actual sewerage O&M costs and water flows at each municipality should be used as a basis for calculating tariffs. The resulting tariff value (in terms of water volume) to generate the necessary funds to meet the desired target recovery could then be expressed as a percentage of the water tariff and collected by the same billing arrangements as are now used.

11.3.4 Improvement in Billing and Collection

In 3.6.1 it was reported that the serious weaknesses in the revenue collection system are largely due to lack of meters and meter repair activity, and substandard water supply. However, other problems relating to ineffective and inefficient meter reading, billing, bill distribution and collection should be addressed. This should be done by training where needed, of meter readers, billing clerks and their supervisors, and, particularly, by providing management support and feedback to supervision, both from District management and from Head Office in Nairobi. However, some of these shortcomings will be due to the general deterioration of the whole metering and water supply system. When improvements are made to the overall system as recommended under this project, it will be easier to obtain better performance in billing and collection.

Since operating revenue for sewerage is for sewerage is based on water consumption it is imperative that recommended improvements for water supply systems be implemented.

CHAPTER 12 IMPLEMENTATION PROGRAMME OF PROPOSED PLAN

12.1 Implementation Programme of Strengthening Plan for Public Administration, Legislation and Financial Administration

12.1.1 Proposed Measures

In the previous Chapter 11, an institutional strengthening plan was proposed aiming at sustainable development in water supply and sewerage sectors, which includes improvement in public administration, amendment to legislation and improvement in financial administration. The proposed measures are:

(1) Improvement in Public Administration

The measures for improvement in public administration are listed as follows:

1) MWR

i) Establish Sewerage Division,
ii) Establish Water Resources Management and Regulation Department
iii) Hand over water supply schemes to upgraded LAs,
iv) Select community groups to receive water supply schemes and hand over when ready,
v) Strengthen support for rural and community water supply schemes, and
vi) Set up independent central regulator for water undertakers and sewerage providers.

2) Community Water Supply Schemes

i) National survey of community schemes,
ii) Water quality test for community water supply schemes, and
iii) Assessment of development options for new and extension schemes and selection of optimum plan.

3) Local Authorities and MOLA

i) Commercialise the remaining seven municipal water and sewerage departments (6 under GTZ assistance and Nairobi City) and supervise pilot water and sewerage company
ii) Upgrade additional five municipalities which are non-water undertakers and appoint as water undertakers, and
iii) Commercialise five municipal water and sewerage departments.

4) NWCPC

i) Hand over water supply schemes to upgraded LAs,
ii) Apply scheme allocation criteria to receive/hand over water supply schemes from/to MWR, and
iii) Organisational, operational, and financial review of NWCPC's performance.

5) Personnel administration

i) Review of Public Service Commission, and
ii) Establish pay policy for Civil Services.

(2) Amendment to Legislation

As amendment to legislation, the following is proposed.

1) Short-term measures

i) Amendment of Water Act,
ii) Changes to other water related legislation, and
iii) Enforce Environmental Management and Coordination Bill.

2) Long-term measures

i) Draft comprehensive Water Act,
ii) Prepare single water and environment law, and
iii) Establish a single enforcement agency for water and environment law.

3) Enforcement of the Law

i) Train provincial and district staffs, and
ii) Conduct PR campaign regarding water legislation in districts.

(3) Improvement in Financial Administration

For improvement in financial administration, the following is proposed.

1) Improve budgeting and fund allocation,
2) Improve investment method,
3) Revise tariff structure and rates for water supply and sewerage schemes in NWR, NWCPC and MOLA, and
4) Improve enforcement of billing and collection.

12.1.2 Implementation Schedule

The implementation schedule of the strengthening plan for public administration , legislation and financial administration is given in **Figure - 12.1.1.** All the proposed measures except those requiring on-going actions are scheduled to be completed by the year 2005 since they should be as early as possible before implementation of the proposed structural measures.

The proposals for the improvement in public administration is scheduled to be complete by the end of year 2002, except for those requiring on-going actions.

For the amendment to legislation, the short term measures should be complete by the end of year 2000. More comprehensive changes to the Water Act would require a further year to accomplish. The long term measures are scheduled for completion in the end of year 2005.

In the financial improvement plan, the proposals for improving budgeting and fund allocation, revising of tariff structure and rates, and improving enforcement of billing and collection should be completed by the end of year 2001. While, on-going action is required for improvement of investment method.

12.2 Implementation Programme of Improvement Plans of Operation and Maintenance Systems for Water Supply and Sewerage

12.2.1 Proposed Measures

Improvement of operation and maintenance of water supply and sewerage schemes is essential to secure sustainability of the schemes. The improvement plans for operation and maintenance of water supply and sewerage schemes are presented in Chapter 6 and 7, respectively. The proposed measures are as follows:

1) Water supply schemes

   i) Establish functional metering system,
   ii) Leakage control,
   iii) Customer registration,
   iv) Other O&M staff training,
   v) Procure water tankers (2 vehicles per province), and
   vi) Technical assistance at district level for implementing the proposed projects.

2) Sewerage schemes

   i) Increase operating revenue in each scheme (obtain funds due from water undertakers),
   ii) Upgrade staff levels and skills,
   iii) Procure required facilities, equipment and tools in each facilities,
   iv) Establish preventive maintenance and standard operating procedures

v) Implement industrial wastewater pre-treatment programme, and
vi) Technical assistance at each facilities for implementing the proposed projects.

12.2.2 Implementation Schedule

The schedule for implementing the proposals in the operation and maintenance (O&M) system strengthening plan is given in **Figure - 12.2.1**. The O&M strengthening plan for water supply scheme is scheduled for completion by the end of 2006, except for the projects requiring on-going action. While, the O&M strengthening plan for sewerage scheme is scheduled for completion by the end of 2004.

12.3 Institutional Support

To progress the programme properly, a high level Implementation Committee (IMCO) with executive powers should be set up with the specific remit to ensure implementation of the agreed projects according to the agreed timetable. IMCO would have the same remit at supervisory level for the agreed water supply and sewerage projects described elsewhere in this Report. Members would include a senior representative from Office of the President, MWR, MOLA, MOF and NWCPC, and would meet monthly.

A Project Implementation Unit (PIU) should be established in MWR to manage the implementation of the projects emerging from the Study. These would include all facilities development and refurbishment projects, and organisation and maintenance improvement projects in water supply and sewerage. The PIU should work closely with, and probably draw staff from, the Special Water Programmes Division of MWR, while reporting to Director, WDD rather than Deputy Director, SWPD, in view of the scope, number and interdepartmental nature of the projects involved. MOLA staff should also be co-opted to the PIU, one at least to be at senior level.

For the PIU to be effective, responsibility for all projects and sub-projects should be assigned to specific team leaders, and there should be adequate planning and costing expertise available to team leaders and the PIU.

The proposed programme of institutional and operational change will demand in addition to the above, strong, well publicised and sustained support from the highest levels of Government.

12.4 Implementation Programme of Urban Water Supply Development Plan

12.4.1 Criteria for Priority Ranking among Urban Centres

The long-term water supply plan has been established for 139 selected urban centres as reported in Chapter 6, and total investment requirement is estimated at US$ 1,667.6 million to achieve the proposed plan. The need and urgency or implementation of the proposed plan are greatly

different among the 139 urban centres, as are demonstrated by the water balance analysis. On the other hand in view of financial aspects, it will hardly be possible to implement the entire plan in a short period. Therefore, in due consideration of such maters, it is necessary to establish rational and efficient implementation programme, and for this purpose, priority ranking among the urban centres is considered to be most rational.

It is considered appropriate to introduce five socioeconomic factors for priority ranking. They are: (i) service coverage by water supply schemes, (ii) water supply condition, (iii) health conditions, (iv) contribution to industrial and commercial development, (v) contribution to tourism, (vi) willingness and affordability of households, and (vii) cost effectiveness.

(1) Percentage of Served Population to Total Population

This implies the service coverage in the supply area. This coverage ratio may suggest needs of expansion and augmentation of the UWS.

(2) Water Supply Conditions in the Supply Areas

Many urban centres, are suffering from serious water shortage due mainly to significant gaps between the production capacity and the water requirements. Percentage of the production capacity to the 1995 estimated water demand, as considered appropriate, is selected as the factor.

(3) Health Conditions

A provision of safe and clean water will significantly improve the living environment and accordingly public health as seen in many developing countries. The household survey indicates that almost all households despite poor or rich, are suffering from water related diseases. District data on population case of vomit/diarrhoea and fever/malaria are utilised.

(4) Contribution to Industrial and Commercial Development

Industrial development is one of the most important goal to create job opportunities to the growing number of the working forces. For the ranking, it is assumed that each district centre has more room for the development than the others.

(5) Contribution to Tourism

Tourism is one of the most important industries in Kenya. The Tourism Master Plan indicates that development of reliable, safe and potable water supply is in a urgent need for acceleration of tourism industry.

(6) Willingness and Affordability of Households

According to the Household Survey, people's willingness to pay for water is rather high. Hence, income levels of average households in each district are focused on whether they are affordable against monthly payment or water bill. The following equation is utilised for evaluation.

Monthly Ave. Household Income × 3% > Monthly Water Consumption × Water Tariff

(7) Cost Effectiveness

Unit production cost of the planned schemes is selected as a factor for the cost effectiveness.

A numerical rating system is determined to be adopted to complete the priority ranking rationally. Allocation of score is set out as shown in the table below.

Rating System for Priority Ranking

Evaluation Item	Evaluation Index	Allocation of Score
Percentage of served population	- More than 50%	1
	- 50% or less	2
Water supply conditions (Supply/demand)	- Less than 25%	4
	- 25 – 50%	3
	- 51 – 75%	2
	- More than 75%	1
Health condition (Case of vomit/diarrhoea, fever/malaria)	- Less than 25%	1
	- 25 – 50%	2
	- 51 – 75%	3
	- More than 75%	4
Contribution to industry and commerce	- District centre	2
	- Others	1
Contribution to tourism	- Nairobi, Malind, Lamu, Marsabit, Kericho, Makuru	2
	- Others	1
Willingness to pay and affordability	- More than Kshs 7,700	2
	- Kshs 7,700 or less	1
Cost effectiveness (Unit production cost)	- More than Kshs 1,000/m^3	1
	- Kshs 1,000/m^3 or less	2

Source: The Aftercare Study Team

12.4.2 Priority Orders of Urban Centres

Result of the numerical rating is given in **Tables - 12.4.1.** Depending on score gained, 139 urban centres evaluated are grouped into three priority groups as follows.

Ranking of Urban Centres by Group

Ranking Groups	Score Gained	Urban Centres
A	15 or more	Karuri, Msambweni, Lamu, Garsen, Hola, Kangundo/Tala, Marsabit, Mwingi Mitto Andei, Garissa, Elwak, Rhamu, Bute, Eldas, Wajir, Ahero, Kisumu, Homabay, Migori, Nyamira, Narok, Lemok, Simat, Kilgoris, Cheptais, Malakisi, Luanda, Mbale, Vihiga (29 UC)
B	13 - 14	Githunguri, Kiambu, Ndumberi, Ruiru, Kerugoya/Kutus, Muranga, Nyahururu, Ol Kalou, Majengo, Malindi, Watamu, Kwale, Lunga Lunga, Modo Gashe, Kitui, Machakos, Matuu, Kargi, Korr, Moyale, North Horr, Meru, Nkubu, Maua, Kibwezi, Liboi, Mandera, Kisii, Muhoroni, Asiro, Siaya, Kendu Bay, Mbita, Oyugis, Awendo, Kenhacha, Nyabikaye, Keroka, Kericho, Kipkelion, Londiani, Sotik, Nyanyuki, Rumuruti, Kitale, Eldoret, Moi's Bridge, Kabarnet, Wamba, Kakuma T.C., Kalokol, Lodwar, Lokitaung, Kepenguria, Makutano, Bungoma, Kimilili, Webuye, Busia, Malaba Town, Butere, Kakamega, Mumias (63 UC)
C	12 or less	Kikuyu, Thika, Wanguru, Mukuyu, Maragua, Endarasha, Karatina, Nyeri, Othaya, Kilifi, Mambrui, Mariakani, Makowe, Taveta, Voi, Wundayani, Embu, Runyenjes, Isiolo, Merti, Athi River, Sololo, Chuka, Maseno, Rongo, Kajiado, Magadi, Namanga, Ngong, Loitokitok, Ongata-Longai, Elburgon, Gilgil, Molo, Naivasha, Nakuru, Njoro, Burnt Forest, Turbo, Elda Ravine, Mazi Mazuri, Marigat, Mogotio, Iten, Kapsabet, Maralal, Nambale (47 UC)

Source: The Aftercare Study Team

Among 139 urban centres, 29, 63, and 47 centres are evaluated as Ranks A, B and C, respectively.

12.4.3 Implementation Schedule

On the basis of the assumed construction period presented in Chapter 8 and the results of the priority ranking among the urban centres, implementation schedule is worked out for the respective urban centre. Detailed implementation schedule is given in Supporting Report Part II.

Figure - 12.4.1 shows the summarised implementation schedule of the urban water supply development plan.

12.5 Implementation Programme of Rural Water Supply Development Plan

12.5.1 Criteria for Priority Raking among Districts

Criteria for project ranking for the RWS is basically similar to that of UWS.

Majority of rural population do not have any access to safe water. To provide people with safe and potable water, water supply system development is urgently required particularly in the arid and semi-arid areas. Severity of water shortage during dry seasons, service coverage, health conditions, contribution to tourism people's willingness and affordability to pay for water, and cost effectiveness of the planned schemes are considered as key determinant factors for ranking the rural areas. Instead, contribution to industrial and commercial development is disregarded as

any significant difference in the commercial and industrial activities are not observed in the rural areas.

(1) Percentage of Served Population to the Total Population

This is a most fundamental factor that represents the water supply condition in the districts. Although many water schemes are developed throughout the country, service coverage ratio ranges widely between districts. Accordingly, the 1995 service coverage ratios in the districts are selected for the evaluation.

(2) Water Shortage during Dry Season

Many population are suffering from serious water shortage during the dry season. People who are dependent on river water in ASAL areas are most miserable. They, spending several hours to collect water and it is very often that they cannot access any water in a severe dry season. Early provision of safe and clean water by construction of RWS may save these people from shortage. Time spent for collecting water by these population is considered as most representative factor for this situation.

(3) Health Conditions

A provision of safe and clean water will significantly benefit to improvement of living environment and accordingly public health as seen in many developing countries. Same parameter as in the UWS is utilised for the ranking.

(4) Contribution to Tourism

Same parameter as in the UWS is utilised for the ranking.

A numerical rating system is also applicable to priority ranking among the rural areas (districts), and allocation of score is set out as summarised below.

Rating System for Priority Ranking

Evaluation Item	Evaluation Index	Allocation of Score
Percentage of served population (Pop. served/district pop.)	Less than 25%	4
	25% - 50%	3
	51% - 75%	2
	More than 75%	1
Water shortage during dry season (Time spent/maximum time)	Less than 25%	4
	25% - 50%	3
	51% - 75%	2
	More than 75%	1
Health condition	Less than 25%	2
	25% or more	1
Contribution to industry and commerce	District Centre	2
	Other Urban Centres	1
Contribution to tourism	Nairobi, Malindi, Mombasa, Lamu, Marsabit, Kericho, Nakuru	2
	Other Urban Centres	1
Willingness to pay and affordability	More than 7,700 Kshs	2
	7,700 Kshs or less	1
Cost effectiveness (Unit production cost)	More than 1,000 Ksbs/m^3	1
	1,000 Kshs/m^3 or less	2

Source: The Aftercare Study Team

12.5.2 Priority Orders of Districts

Results of the numerical rating is given in **Table - 12.5.1.**

As the same as the urban centres, rural areas are grouped into three priority groups depending on scores gained. The rural areas by priority group is as summarised in the table below.

Priority Ranking of Rural Water Supply Development

Ranking Groups	Score Gained	District
A	14 - 15	Kilifi, Kwale, Tana River, Kitui, Makueni, Mandera, Wajir, Migori, Kipsigis, Narok, Transmara (11 districts)
B	12 - 13	Lamu, Masaku, Marsabit, Mwingi, Garissa, Gusii, Siaya, Homa Bay, Nyamira, Kajiado, Laikipia, Trans Nzoia, Uasin Gishu, Baringo, Elgeyo Marakwet, Nandi, West Pokot, Bungoma, Kakamega, Vihiga (20 districts)
C	11 or less	Kiambu, Kirinyaga, Muranga, Nyandarua, Nyeri, Mombasa, Taita, Embu, Isiolo, Meru, Nyambene, Tharaka Nith, Kisumu, Nakuru, Bomet, Samburu, Turkana, Busia (18 districts)

Note: Nairobi is excluded.
Source: The Aftercare Study Team

In all of 11 districts ranked A, on-going projects are not sufficient to meet the estimated 2010 water demand even by completion of on-going projects. They are Kilifi, Kwale, Tana River, Kitui, Makueni, Mandera, Wajir, Migori, Kipsigis, Narok and Transmara districts. These districts are further assessed to select priority districts in Chapter 7.

Of all the districts ranked B and C, only five districts have sufficient scale of the on-going projects. They are Marsabit and Uasin Gishu (2 districts as Rank B) and Taita, Isiolo and Meru (3 districts as Rank C).

12.5.3 Implementation Schedule

The implementation schedule of rural water supply development is worked out on a basis of district in due consideration of the assumed construction period and priority ranking of the rural areas as shown in **Figure - 12.5.1** and **12.5.2.** More detailed implementation schedule is presented in Supporting Report H.

12.6 Implementation Programme of Livestock Water Supply Development Plan

12.6.1 Criteria for Priority Ranking among Districts

The livestock water supply schemes are planned to be realised on a basis of district unit and their priority order is proposed to be examined simply based on the number of livestock unit and amount of the annual rainfall in the district concerned. Out of the 50 districts under study, only 6 districts have the livestock units more than 300,000 heads.

As the same as the urban and rural water supply and sewerage schemes, a numerical rating system is introduced for evaluation and score allocation is determined as follows:

Rating System for Priority Ranking

Evaluation Item	Evaluation Index	Allocation of Score
Number of livestock unit	More than 300,000 heads	2
	Less than 300,000 heads	1
Annual rainfall	Less than 500 mm	4
	500 - 900 mm	3
	900 - 1,500 mm	2
	More than 1,500 mm	1

Source: The Aftercare Study Team

12.6.2 Priority Order among Districts

Table - 12.6.1 presents the processing data and scores allocated to the respective district.

As an overall evaluation, 50 districts are classified into three groups, high, medium and low, on the basis of score gained. The districts by this classification are summarised below:

Priority Ranking of Livestock Water Supply Development

Group	Score Gained	Districts
A	5 or more	Makueni, Garissa, Mandera, Wajir, Narok, Baringo (6 districts)
B	4	Taita, Tana River, Isiolo, Kitui, Marsabit, Kajiado, Laikipia, Nakuru, Uasin Gishu, Turkana, West Pokot (11 districts)
C	3 or less	Nairobi, Kiambu, Kirinyaga, Muranga, Nyandaura, Nyeri, Kilifi, Kwale, Lamu, Mombasa, Embu, Masaku, Meru, Nyambene, Tharaka Nithi, Mwingi, Gusii, Kisumu, Siaya, Homa Bay, Migori, Nyamira, Kipsigis, Trans Nzoia, Bomet, Transmara, Elgeyo Marakwet, Nandi, Samburu, Bungoma, Busia, Kakamega, Vihiga (33 districts)

Source: The Aftercare Study Team

12.6.3 Implementation Schedule

The implementation schedule of the livestock water supply is shown in **Figure - 12.6.1**. This is prepared on assumption that there is any financial constraint in implementation and the required water demand is to be fully met within the planing horizon.

12.7 Implementation Programme of Sewerage Development Plan

12.7.1 Criteria for Priority Ranking among Urban Centres

Sewerage development is proposed for 40 urban centres as stated in Chapter 7 of this report. Preliminary design an cost estimate were made as reported in Chapter 10. It may not be possible to implement all the identified projects in the immediate short period (2010), because the identified constraints, especially insufficient investment funds, will likely persist or some time before they can be overcome. Therefore, to establish an appropriate implementation schedule, the following scheme is proposed for ranking priorities among urban centres:

Evaluation Criteria for Priority Ranking of Sewerage Schemes

Ratio of Population with Piped Water Supply but No Sewer Connection	Population Requiring Services by 2010	Potential Health & Environmental Impact	Industrial Growth Potential	Tourism Potential	Rating
< 25%	P < 20,000	Nil	Nil	Nil	0
25 to 50%	20,000 < P < 100,000	Minor impact on water environment	Low	Low	1
50 to 75%	100,000 < P < 300,000	Serious impact on sensitive ecosystem	Medium	Medium	2
> 75%	P > 300,000	Contamination of drinking water source	High	High	3

Source: The Aftercare Study Team

The evaluation criteria are explained as follows:

(1) Percentage of Population with Piped Water but No Sewage Connection

This is a direct indication of how urgently sewerage services in an urban centre are required. Where a large percentage of the population have piped water but no sewer connection the disposal of sullage will likely be in large enough quantities to find it's way to surface drainage causing a serious threat to the health of all residents, especially in larger, more densely populated areas.

(2) Number of People Requiring Services by 2010

This is also a measure of the urgency and the need for services. This factor compares the number of people now connected to sewers to the number of people that would be connected in the future to achieve the proposed target by the year 2010.

(3) Potential Health and Environmental Impact

Several urban centres will have a profound impact on the environment. Other urban centres pollute water that will be used downstream as an important source of potable water supply. In some districts access to safe water is very low and many people rely on surface water for domestic use. Urban centres in these districts have a very high potential for contaminating surface water used by rural residents in downstream reaches especially if the district is densely populated and urbanised.

(4) Industrial Growth Potential

Industrial potential is a measure of several factors that can influence the need for sewerage development:

1) these towns will likely grow at a much faster rate in the near future given the Government's policy to increase industrial output;
2) the influx of more people and industrial development will increase the consumption of water and exert a greater demand for wastewater infrastructure; and
3) control of industrial effluents and wastewater treatment will be important in these industrialised urban centres to safeguard the environment.

(5) Tourism Potential

Tourism industry is one of Kenya's most important sources of revenue. The sanitary conditions in important tourism centres must be improved to maintain tourism as a viable industry as identified in the National Tourism Master Plan.

12.7.2 Priority Orders of Urban Centres

Each urban centre is evaluated and given a total score on the basis of the rating received for each factor. Higher priority is given to urban centres with a larger score. A ranking of priorities among urban centres is presented in **Table - 12.7.1** and summarised below:

Priority Ranking of Urban Sewerage Development

Priority	Urban Centre	Score
1	Mombasa	14
2	Nairobi	13
3	Kisumu	12
4	Machakos, Meru, Nakuru	11
5	Narok, Malindi, Kitale	10
6	Kisii, Naivasha	9
7	Maragua, Ruiru, Wajir, Thika, Kericho, Nanyuki	8
8	Garissa, Ongata, Kilifi, Nyahururu, Webuye, Voi, Eldoret, Nyeri	7
9	Mandera, Kabarnet, Muranga, Bungoma, Busia, Isiolo	6
10	Kapsabet, Homa Bay, Karatina, Embu, Kakamega	5
11	Ngong, Athi River	4
12	Kiambu	3
13	Limuru	2

Source: The Aftercare Study Team

As noted during discussions with MWR the remaining urban centres (approximately 175) have not been included in the sewerage development plan. These urban centres have small populations therefore it is anticipated that on-site sanitation systems can be successfully implemented as long as recommendations to formalise installations are implemented.

12.7.3 Strategy for Project Scheduling and Phasing

The scheduling of sewerage development projects should follow the relative order of priorities established by the ranking of urban centres to meet the target service coverage ratio set for 2010. The timing of a sewerage project will depend on the funding available and on the timing of water supply improvements where low unit consumption does not support waterborne sewerage. Sewerage development can proceed before water supply improvements in locations where water supply is sufficient to support waterborne sewerage.

The sequence of constructing the treatment works and sewer network components in each urban centres will also depend on prevailing water supply conditions and the availability of spare treatment works capacity. The strategy for phasing of sewerage development for each urban centre is shown in the following table:

Basic Stage-wise Implementation Plan

Urban Centre	Stage 1	Stage 2	Stage 3
Bungoma, Isiolo, Mombasa Condition A	Improve water supply	Extend Sewer Network	Expand sewage treatment works and/or build new
Kitale, Naivasha, Nyeri Condition B	Rehabilitate treatment works	Improve water supply	Expand sewage treatment works and sewer network
Kisii, Muranga, Nakuru, Webuye Condition C	Extend Sewer Network	Provide new sewage treatment works and/or expand existing	
Athi River, Kiambu Condition D	Extend Sewer Network		
Busia, Kericho, Homa Bay Condition E	Provide new sewage treatment works and/or expand existing	Improve water supply	Extend Sewer Network
Eldoret, Kapsabet, Kisumu, Kakamega, Machakos, Meru, Nairobi, Nanyuki, Nyahururu, Thika Condition F	Provide new sewage treatment works and/or expand existing	Extend Sewer Network	
Garissa, Kilifi, Kabarnet, Malindi, Mandera, Maragua, Narok, Ongata, Ruiru, Wajir, Voi Condition G	Improve water supply	Provide Sewerage System	

Note: Improving water supply system is a constraint that must be resolve before the next stage can be implemented.

Condition A : Sewer network extensions are not possible due to low unit water consumption.
Condition B : Existing treatment works can be rehabilitated but sewer network extensions are not possible due to low unit water consumption
Condition C : Treatment works have capacity for more flow but will need expansion before 2010.
Condition D : Treatment works have capacity for more flow but will not need expansion before 2010.
Condition E : Treatment plants are overloaded and should be expanded. Sewer network extensions are not possible due to low unit water consumption.
Condition F : Treatment plants are overloaded and should be expanded before extending sewers.
Condition G : No existing sewer systems.

12.7.4 Implementation Schedule

Based on the assumed construction period, priority order, and strategy of scheme scheduling and phasing, overall implementation schedule of the proposed sewerage development plan was worked out as shown in **Figure - 12.7.1**.

This schedule is prepared aiming at fully attaining targets set for the year 2010, provided that all institutional, legislative and financial constraints are resolved prior to or in parallel with implementation arrangement of the proposed sewerage development plan.

12.8 Investment Schedule

12.8.1 Annual Investment Schedule

The preliminary cost estimate and implementation schedule have been worked out for the long term development plans of the urban and rural water supplies and livestock water supply as reported herein above. In order to successfully accomplish even long term development plans, a huge amount of investment, approximately US$2,149 million is estimated to be funded during the planning horizon.

Based on the proposed project implementation schedule and the estimated project costs, the annual investment schedules are worked out for the respective project component and presented in **Figures - 12.1.1** and **12.2.1** and **Table - 12.8.1** and **12.8.2**

The summary of annual investment schedule is as given below:

Summary of Investment Schedule

(Unit: US$ 10^6)

Year	Water Supply			Livestock	Sewerage	Total
	UWS	LSRWS	SSRWS			
1999	17.8	13.1	3.7	0.5	6.2	41.3
2000	28.6	13.6	3.7	0.5	7.2	53.6
2001	53.3	14.0	9.7	3.0	27.5	107.5
Sub-Total	99.7	40.6	17.1	4.0	40.9	202.4
2002	89.5	23.3	10.2	3.2	60.6	186.6
2003	164.0	26.8	10.2	3.2	36.0	240.2
2004	155.0	17.1	14.5	1.1	30.9	218.7
2005	187.3	23.5	18.0	1.3	44.1	274.2
2006	231.0	19.5	15.2	1.2	42.6	309.7
Sub-Total	826.9	110.2	68.1	10.0	214.2	1229.1
2007	143.8	23.5	16.1	1.1	76.1	260.7
2008	102.2	31.1	10.8	1.1	59.6	204.8
2009	102.2	15.8	4.1	1.0	48.3	171.5
2010	47.5	15.8	3.5	1.0	43.9	111.8
2011						
Sub-Total	395.6	86.3	34.5	4.2	227.9	748.7
Total	1,322.2	237.1	119.7	18.2	483.0	2,180.2

Source: The Aftercare Study Team

12.8.2 Comparison between Investment Cost and Available Fund

(1) Estimate of Future Development Fund

For each water supply and sewerage sector, the annual development fund up to the year 2011 was estimated with the assumptions and then summarised in the table below. The year 2011 is assumed to be end of 10th National Development Plan.

Total national public expenditure of the central government was estimated in proportion to GDP, whose applied rate was 51.9%. Regarding development expenditure, it accounts for 21.5% of the total national public expenditure.

10.6% of the total development expenditure was allocated for water supply sector, and 2.3% for sewerage sector, totally accounting for 12.8% of the total development expenditure budgeted for both water supply and sewerage sector.

Estimated Development Fund for Water Supply & sewerage Sector in Kenya, 1997/98 – 2011/12

(Unit: US$ million)

	8th National Development Plan (1997/1998 – 2001/2002)			5-Year National Development Plan (2002/2003 – 2006/2007)					5-Year National Development Plan (2007/2008 – 2011/2012)				
	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012
GDP	8,428.225	8,917.065	9,443.172	10,038.092	10,710.644	11,428.257	12,193.950	13,010.945	13,895.689	15,035.136	16,268.017	17,618.262	19,098.196
Annual GDP Growth Rate	5.8%	5.8%	5.9%	6.3%	6.7%	6.7%	6.7%	6.7%	6.8%	8.2%	8.2%	8.3%	8.4%
Total National Public Expenditure	4,374.250	4,627.957	4,901.006	5,209.770	5,558.824	5,931.265	6,328.660	6,752.680	7,211.863	7,803.235	8,443.101	9,143.878	9,911.964
Total National Development Expenditure	940.464	995.011	1,053.716	1,120.100	1,195.147	1,275.222	1,360.662	1,451.826	1,550.550	1,677.696	1,815.267	1,965.934	2,131.072
Capital Expenditure	362.414	383.434	406.056	431.638	460.558	491.415	524.340	559.471	597.515	646.511	699.525	757.585	821.222
Gross Fixed Capital Formation (GFCF)	(328.709)	(347.774)	(368.293)	(391.496)	(417.726)	(445.713)	(475.576)	(507.440)	(541.946)	(586.385)	(634.469)	(687.330)	(744.849)
Total Fund for Water Supply an Sewerage													
Annual Fund	121.320	128.356	135.929	144.493	154.174	164.504	175.525	187.286	200.021	216.423	234.169	253.605	274.908
Total 5-Year Fund	385.606			825.982					1,179.127				
(A) Total Fund for Water Supply Sector													
Annual Fund	99.689	105.471	111.694	118.731	126.686	135.174	144.230	153.894	164.358	177.836	192.418	208.389	225.894
Total 5-Year Fund	316.854			678.714					968.895				
(B) Total Fund for Sewerage Sector													
Annual Fund	21.631	22.885	24.235	25.762	27.488	29.330	31.295	33.392	35.663	38.587	41.751	45.216	49.015
Total 5-Year Fund	68.751			147.268					210.232				

Source: The JICA Study Team

Note: Annual GDP growth rate applied to estimate the future GDP was obtained from "Sessional Paper No. 2 of 1996 on Industrial Transformation on the Year 2020".

(2) Comparison between Investment Cost and Available Fund

The required investment costs for implementing the long term plans of urban water supply, rural water supply, livestock water supply and sewerage development are summarised as follows:

(Unit: US$ million)

Long Term Plan	Investment Cost
Urban Water Supply	1,322
Rural Water Supply	357
Livestock Water Supply	18
Sub-total	1,689
Sewerage	483
Total	2,172

On the other hand, the future development fund, estimated based on historical development expenditure, is shown below.

(Unit: US$ million)

Sector	Estimated Future Development Fund (1997/1998 – 2011/2012)	Government Portion	Foreign Assistance Portion
Water Supply Sector	1,965	714	1,251 (64 %)
Sewerage Sector	426	103	326 (76 %)
Total	2,391	817	1,577 (66 %)

As seen in the above table, the ratio of expected foreign assistance amount to the future development fund is more than 60%.

Comparing the required investment cost to the future development fund expected, the long term plans toward 2010 proposed in the present Study may be implementable provided that the foreign assistance continues as expected. However, as the ratio of foreign assistance is high, the continued foreign assistance is essential for the successful development of water supply and sewerage sectors to meet the planned objectives for 2010.

(3) Development Scenarios

Considering those financial constraint, the following three scenarios were studied.

Scenario A : Full development
Scenario B : Development with Kenyan own fund only
Scenario C : Development with Kenyan own fund and 50% of the expected foreign assistance amount.

The development fund amounts of respective scenarios are given below:

(Unit: million US$)

Scenario	Sector	Government Fund	Foreign Assistance	Total Fund
A	Water Supply	714	983	1,697
	Sewerage	103	380	483
	Total	817	1,363	2,180
B	Water Supply	714	0	714
	Sewerage	103	0	103
	Total	817	0	817
C	Water Supply	714	627	1,341
	Sewerage	103	161	264
	Total	817	788	1,605

For the above expected funds, the scale of implementation programme are reviewed by scenario based on the following criteria.

1) Allocation of the fund between water supply and sewerage sectors is to be unchanged.

2) Priority of implementation is given as follows:

   i) Urban centres and districts ranked A (or high) have a priority and are followed by those ranked B (or medium) and C (or low) in order.
   ii) In the same ranking group, the urban centres and districts with larger requirement have a priority.
   ii) Among the urban, rural and livestock water supplies, the rural water supply has a priority and is followed by the urban water supply and livestock water supply in order.

As a result, the numbers of urban centres and districts of each scenario are summarised as given below.

Scenario	Urban Water Supply (nos. of U.C.)	Rural Water Supply (nos. of districts)	Livestock Water Supply (nos. of districts)	Sewerage (nos. of U.C.)
A	139 (A29,B63,C47)	49 (A11,B20,C18)	49 (A6,B11,C33)	40
B	34 (A29,B5)	31 (A11,B20)	6 (A6)	3
C	93 (A29,B63,C1)	49 (A11,B20,C18)	17 (A6,B11)	27

Note: U.C. Urban Centre.

Besides the above analysis from financial constraint, it should be noted that the social, institutional and legislative constraints also affect the implementation programme although it is difficult to reflect those constraints to the implementation schedule.

CHAPTER 13 PRELIMINARY STUDY ON PRIORITY PROJECTS

13.1 Priority Urban Water Supply Projects

13.1.1 Approach to Selection of Priority Project

In Chapter 12 it is concluded that, it is most preferable to implement the water supply project of 29 urban centres in the initial stage. These 29 urban centres are nominated through a preliminary ranking analysis. This preliminary analysis is universal to be suitable to treat a large number of samples with reasonable accuracy.

It will be evident that there are differences in degree of urgency and need of project implementation among the nominated 29 urban centres when looked into more in detail. It is, therefore, necessary to examine in more detail the natures, urgenc, and need of the project among the 29 urban centres so that their order for implementation could be formulated. In this second screening firstly the following general approach is taken into consideration:

(1) The long-term development plan comprises such structure measures as rehabilitation of existing facilities, completion of ongoing projects and implementation of planned/designed and newly proposed projects. Thus, they are simply grouped into the rehabilitation works and the expansion works (ongoing, planned/designed and newly proposed projects) and their ranking will be determined accordingly.

(2) Among the 29 urban centres, 2 urban centres have no existing and ongoing projects (under construction). They are Lemok (4,405 pop. in 1995) and Simat (7,717 pop.) in Uasin Gishu District.

(3) Cheptais (3,361 pop.) operates its own water supply schemes which have sufficient production capacity at present to meet the estimated 2010 water requirements.

(4) Other urban centres ranked A, which have no ongoing projects (under construction) and not sufficient production capacity, include Karuri (18,716 pop.), Msambweni (7,247 pop.), Garsen (4,232 pop.), Hola (12,583 pop.), Tala+Kangundo (14,656 pop.), Mwingi (5,469 pop.), Mtito Andei (4,938 pop.), Bute (2,543 pop.), Eldas (2,242 pop.), Wajir (26,239 pop.), Ahero (11,661 pop., Kisumu (231,327 pop.), Homa Bay (30,995 pop.), Migori (14,913 pop.), Nyamira (7,130 pop.), Narok (19,859 pop.), Kilgoris (7,665 pop.), Mawalie+Malakasi (3,119 pop.), Luanda (4,246 pop.), Mbale (3,672 pop.), and Vihiga/Majengo (5,274 pop.) (21 urban centres in total).

(5) Remaining urban centres ranked A, which have the ongoing projects, are 5 (Lamu, Marsabit, Elwak, Garissa, and Rhamu). Out of them, Elwak (8,087 pop.) and Rhamu (5,144 pop.) are assessed that production capacities of their ongoing projects are less than 50% of the estimated water deficit expected in 2010 (2 urban centres).

The priority projects will therefore be selected from the above 25 urban centres (2 + 21 + 2), especially in view of the expansion works.

13.1.2 Criteria for Selection of the Priority Projects

In accordance with grouping of the structure measures, criteria are established for the respective group as follows:

(1) Criteria for Rehabilitation Woks

Project ranking made in Chapter 12 does not reflect the operational status of the existing schemes. The efficiency of the existing schemes is focussing on in order to select the priority projects for the rehabilitation works. The following factors are selected;

1) Metered Connection (related to accounted-for water ratio)

Depending on metered or not, subscribers are likely to change their attitudes for water use, according to the previous and current studies. In general, percentage of metered connections to the total connections well represents an efficiency of the water supply, or accounted-for-water ratio.

2) Operational hour (related to production efficiency)

Many treatment works supply water intermittently. They are usually in operation less than 16 hours a day. It is a basic requirement to operate treatment facilities on continuous basis so that water production would increase significantly.

3) Chlorine dosage (related to quality control)

The Household Survey indicates that majority of the people are not satisfied with the present water supply services. Major reasons for this are low pressure (less water available), poor quality of supplied water, and poor management. As assumed from these replies, all water supply schemes are not always dosing chemicals (or chlorine) on daily basis. Many schemes, particularly small scale schemes, are supplying water without proper treatment.

A numerical rating system is applied to rationally analyse relative merits among the pre-selected 25 urban centres. Rating is set out as tabulated below:

Rating System for Priority Ranking for Rehabilitation Works

Evaluation Item	Evaluation Index	Score Allocated
Metered Connection	More than 75%	1
	50 - 75%	2
	50% and less	3
Operation Hour	More than 20 hours	1
	15 - 20 hours	2
	15 hours and less	3
Chlorine Dosage	Daily dosage	1
	Not daily	2

Source: The Aftercare Study Team

(2) Criteria for Expansion Works

Project ranking in Chapters 12 is based on social and technical factors. Due to a lack of data on scheme basis, social factor evaluation is made utilising district data. Factors selected for the project ranking, therefore, may not be comprehensive and proper. More in-depth and thorough studies based on reliable and accurate data are required. To minimise such deviation of the project ranking, the selected urgent schemes are further discussed from the following viewpoints;

1) Development status of the scheme

Status of the urban centre with the ongoing projects is an important aspect to identify priority projects.

2) Water production to be expanded

Magnitude of the project scale in terms of production capacity is not considered in the project ranking. Depending on schemes, shortage of water production varies significantly.

3) PIP projects

The Government has prepared PIP, which include priority water supply projects. For the present prioritisation, such selected schemes are taken into account.

4) Impacts on Environment

Development of water supply systems may sometimes entail environmental problems. Particularly construction of the intake and dam and water abstraction from the limited water sources might be influential to the fauna and flora at the construction site and to the other water users downstream.

13.1.3 Selected Priority Projects for Rehabilitation Works

An unit rehabilitation cost (cost per m^3 of incremental water) should not exceed unit construction cost of a new scheme. Keeping this in mind, evaluation is made for the 25 urban centres. For

evaluation technical data obtained from the Water Supply Sector Survey and the Survey on Needs of Rehabilitation by MWR are used.

Results are given in **Table - 13.1.1.** The following 20 schemes are recommended for urgent rehabilitation. Their locations are shown in **Figure - 13.1.1.**

Prioritised Scheme for Rehabilitation Works

District	Code	Name of Urban Scheme
Kiambu	U-3	Karuri
Kwale	U-46	Msambweni
Lamu	U-47	Lamu
Tana River	U-58	Garsen
	U-59	Hola
Masaku	U-77	Kangundo
Mwingi	U-91	Mwingi
Garissa	U-104	Garissa
	U-110	Rhamu
Wajir	U-113	Bute
	U-114	Eldas
	U-116	Wajir
Kisumu	U-119	Ahero
Migori	U-136	Migori
Kajiado	U-141	Kajiado
Transmara	U-174	Kilgoris
Bungoma	U-200	Cheptais
Vihiga	U-213	Maseno/Luanda
	U-214	Mbale
	U-215	Vihiga/Majengo

Source: The Aftercare Study Team

As will be discussed in Subsection 13.1.4, six schemes of the above 20 (Msambweni, Kangundo, Wajir, Kilgoris, Maseno/Luanda, Mable) are also selected for urgent expansion and rehabilitation. Accordingly, these six schemes are excluded from the further discussion to avoid duplication.

13.1.4 Selected Priority Projects for Expansion Works

Twenty five eligible urban centres were thoroughly graded according to the evaluation criteria to prioritise their order of development. **Table - 13.1.2** presents the process and result of the evaluation. The 25 urban centres are sorted into "High", "Medium", and "Low" in terms of overall evaluation. The urban centres by classification are as follows:

Urban Centres by Priority Classification

Classification	Urban Centre
A (High)	Msambweni, Tala+Kangundo, Wajir, Kisumu, Howa Bay, Narok, Luanda, Mbale (8 centres)
B (Medium)	Karuri, Garsen, Hola, Mtito Andei, Elwak, Rhamu, Zldas, Migori, Nyamira, Lemok, Simat, Kilgoris, Malakisi, Vihiga (14 centres)
C (Low)	Mwingi, Bute, Aboro (3 centres)

Source: The Aftercare Study Team

The evaluation as given in **Table - 13.1.2** recommends 8 out of 25 projects for urgent rehabilitation and augmentation as parallel works. Present status of the eight (8) water supply schemes are briefed below:

(1) Msambweni

Msambweni urban centre has 7,247 population in 1995. The existing water supply scheme operated by MWR has a production capacity, 624 m^3/day, not sufficient to meet the present water demand, 1,704 m^3/day. The existing scheme extracts groundwater from the two boreholes. Chlorine is dosed daily for domestic use. No other treatment than chlorination is practised. Due to population growth, water demand is forecast to be more than 3 times the present value.

(2) Tala+Kangundo

Tala/Kangundo is located in Masaku district. It had a population of 14,656 in 1995. There are no ongoing projects. The existing scheme operated by town council depends on two boreholes as water sources. Extracted groundwater, pumped up to the storage tank, then boosted to hill tank and are gravitated to the customer. Rapid population growth in the coming 15 years will result in water deficit, 7,490 m^3/day in 2010.

(3) Wajir

Wajir is a district centre in Wajir district. MWR is a responsible agency for operating the existing schemes, which extracts groundwater from shallow wells. Its yield is very limited, 48 m^3/day, not sufficient to meet the present water demand. Major customers of this scheme are government offices and small number of houses.

(4) Kisumu

JICA Study on developing the existing water supply scheme is currently on going. Its operational body is municipal council. It has two waterworks, Kajulu and L. Victoria waterworks. The supply capacity of these treatment works is merely one third of the estimated water demand in 1995. Since the present water source is the Lake Victoria, it applies conventional treatment process. Several water sources for future expansion are assessed in the JICA Study.

(5) Homa Bay

Homa Bay has a urban water supply scheme operated by MWR, with a production capacity of 1,500 m^3/day. The treatment process applied is conventional type, consisting of coagulation, sedimentation, filtration and disinfection. The existing intake on Lake Victoria is choked with water 'hyacinth' causing problems in the supply of water. The existing pumps are also not adequate with no standby arrangements. There is no project underway around the area.

(6) Narok

The Narok river and spring are water sources of Narok Urban Water Supply Scheme. It produces 1,315 m^3/day. The treatment process applied is also conventional type, consisting of coagulation, sedimentation, filtration and disinfection. Service area has a population of approximately 30,000. Due to recent heavy rains, the scheme has been heavily damaged. Distribution mains are washed away and intake chamber are clogged. Rehabilitation and augmentation of the scheme are urgently required.

(7) Luanda/Maseno

Maseno water supply was constructed in 1957 and expanded in 1978 and 1987. This scheme, operated by MWR, serves Luanda/Maseno urban centre and its surrounding rural areas. It takes raw water from the existing open furrow. After full treatment, it supplies to approximately 68,400 people. The scheme has been heavily affected by the recent heavy rains with section of the furrow washed away and filters clogged. Some section of distribution system has also been washed away. The estimated water shortage in 2010 is 23,000 m^3/day.

(8) Mbale

Mbale water supply was commissioned in 1975. Conventional treatment process is applied to clarify the turbid river water. It has production capacity of 960 m^3/day, servicing 20,000 people. Approximately 450,000 people reside in its supply area. Despite its large supply area, Mbale urban centre is small with 3,800 people in 1995. To meet the rapidly growing water demand, it is considered urgent to implement the project.

Their locations are shown in **Figure - 13.1.1**.

13.1.5 Preliminary Scope of the Proposed Projects

(1) Rehabilitation Works

Urgent rehabilitation is recommended for 20 urban centres and their preliminary nature of work is proposed as follows:

Summary of Rehabilitation Works

Code	Name of Urban Scheme	Production Capacity (m^3/day)	Scope of Rehabilitation Works						Estimated Rehabilitation Cost (US$1,000)
			(1)	(2)	(3)	(4)	(5)	(6)	
U-3	Karuri	624			X		X	X	88
U-46	Msambweni	624			X	X	X	X	142
U-47	Lamu	575			X	X	X	X	117
U-58	Garsen	100	X	X	X	X	X		57
U-59	Hola	228	X	X	X	X	X	X	105
U-77	Kangundo	441			X	X	X	X	95
U-91	Mwingi	300	X	X	X	X	X	X	145
U-104	Garissa	1,440	X	X	X	X	X	X	353
U-110	Rhamu	140			X	X	X	X	46
U-113	Bute	202			X	X	X		54
U-114	Eldas	65			X	X	X		36
U-116	Wajir	48			X	X	X		38
U-119	Ahero	23				X	X		33
U-136	Migori	960			X	X	X	X	184
U-141	Kajiado	2,000		X	X	X	X	X	533
U-174	Kilgoris	864	X	X	X	X	X	X	249
U-200	Cheptais	2,400	X	X	X	X	X	X	505
U-213	Maseno/Luanda	1,192	X	X	X	X	X	X	309
U-214	Mbale	960			X	X	X	X	114
U-215	Vihiga/Majengo	63			X	X	X	X	41
Total		10,080							3,244

Note: (1) Intake facilities, (2) Treatment works, (3) Storage tanks, (4) Pipeline, (5) Master meters, and (6) Chlorine dosing equipment.
Source: The Aftercare Study Team

(2) Expansion Works

The expansion works comprise the completion of the ongoing projects and the implementation of the planned/designed and newly proposed projects. The project features of the ongoing and planned/designed projects have been documented by the government executing agencies concerned, and those of the newly proposed projects are summarised in **Table - 8.3.1.**

The project list of the selected eight urban centres is presented in **Table - 13.1.3** together with construction cost of each project involved.

Summary of Expansion for UWS

Scheme Name	Production Cap. of the Existing (m^3)	Production Cap. to be Expanded	Water Source	Treatment Process	Storage Tank Cap. (m^3)	Length of Distribution Pipes (km)	Estimated Costs (US$ 1,000)	
							Reh.	Exp.
Msambweni	624	4,937	S	F	2,600	37	142	3,796
Kangundo/Tala	441	6,885	S	F	3,500	51	95	5,309
Wajir	48	9,088	G	C	4,700	68	38	9,608
Kisumu	14,565	60,750	D	F	30,200	436	1,172	77,257
Homa Bay	1,500	11,524	S	F	6,000	87	363	8,257
Narok	1,315	9,558	D	F	4,700	69	249	27,242
Maseno/Luanda	1,192	23,174	S	F	11,700	170	309	15,331
Mbale	960	0	S	F	0	0	114	34
Total	20,645	125,915			63,400	918	2,481	146,834

Note: S... surface water, G...groundwater, D...impounded dam, F... full treatment, C... chlorination

Source: JICA Study, 1998

13.1.6 Project Evaluation

The economic viability of the eight priority urban water supply projects was undertaken by means of Economic Internal Rate of Return (EIRR). Calculation of EIRR was made on the basis of the estimated investment costs, O&M costs, and the quantifiable economic benefits identified.

Based on the data and information collected in the field survey, the major economic benefits of the urban water supply projects are identified as follows:

1) The increased quantity of available water for consumption will alleviate shortage of water and water rationing, particularly during the dry season,
2) Cost saving for water vendor will be realised for the people who are currently dependent on fairly expensive vending water compared to the water tariffs of the public water supply systems, and
3) The improved quality water will contribute to preventing the people from catching waterborne diseases through taking unsanitary water.

Among the economic benefits identified, the benefits obtained from (i) increased water and (ii) cost saving were quantifiable benefits.

(1) Estimate of Quantifiable Benefit

1) Increased Water

The first major benefit is the net increase of water gained through improvement of rehabilitation and expansion of the water supply system. The net increase of water was, therefore, valued at the marginal production cost of water by calculating an average

incremental cost of the water production value per cubic meter. This is termed the Average Incremental Costs (AIC).

2) Cost Saving

Cost saving by not purchasing vending water of a jerry can is considered as another major benefit of the projects. Cost saving benefit is then valued by estimating the difference between the economic value of a jerry can and the marginal production cost of water. Both were valued at per cubic meter. For the sake of the analysis, one jerry can (20 litters) was assumed to cost at one Kenya Shilling

(2) Economic Cash Flow Analysis

The economic cash flow for each priority project was prepared on an annual basis. In addition to EIRR, Net Present Value (NPV) and Cost-Benefit Ratio (CBR) were also applied as alternative evaluation measures to further verify the economic viability of the projects.

The following procedures were adopted for the economic cash flow analysis.

1) The economic cash flows were prepared on the basis of the estimated economic benefits and economic investment costs,
2) The investment costs and economic benefits of the projects are estimated on an incremental basis,
3) Local portion of the financial investment costs were converted to economic investment costs by applying a conversion factor of 0.9,
4) The economic benefits were estimated on the basis of "with and without project principle," as stated in the estimate of quantifiable benefit,
5) The opportunity cost of capital was assumed to be 10%, discounting the costs of the projects and benefits, and
6) The quantifiable benefits of increased water and cost saving were included in the calculation.

(3) Calculated EIRR, NPV, and CBR

The economic cash flow analysis was conducted and its results are summarised in the table below.

Summary of Economic Evaluation for Priority Urban Water Supply Projects

Urban Centre	EIRR	NPV (US$10^3)	CBR
Msambweni	16.6%	1,833	1.63
Tala+Kangundo	16.7%	2,423	1.61
Wajir	12.4%	1,426	1.21
Kisumu	9.8%	▲852	0.98
Homa Bay	17.4%	4,595	1.72
Narok	1.2%	▲10,748	0.45
Luanda	18.6%	9,915	1.86
Mbale	24.7%	2,792	1.95

Source: The Aftercare Study Team

All the projects were found to be economically viable with the fairly acceptable EIRR ratios, being more than the opportunity cost of capital of 10% assumed in the analysis. In addition, the alternative evaluation measures of NPV and CBR also indicate that all the projects were able to attain the positive values.

(4) Sensitivity Analysis

Having done cash flow analysis in the previous section, a sensitivity analysis was conducted in order to verify if the projects would remain economically viable under the uncertain conditions such as the change of investment and O&M costs in the future.

The following three different conditions were set out for sensitivity analysis.

1) Case I: Investment costs increased by 20%
2) Case II: O&M costs increased by 20%
3) Case III: Both investment and O&M costs increased by 20%

The results of the analysis are given in the table below.

Sensitivity Analysis by for Priority Urban Water Supply Projects

(Unit for NPV:US$10^3)

Urban Centre	Index	Base Case	Case I	Case II	Case III
Msambweni	EIRR	16.6%	14.4%	16.3%	14.1%
	NPV	1,833	1,345	1,735	1,247
	CBR	1.63	1.39	1.57	1.36
Tala+Kangundo	EIRR	16.5%	14.2%	16.1%	13.9%
	NPV	2,423	1,755	2,291	1,623
	CBR	1.61	1.38	1.55	1.34
Wajir	EIRR	12.4%	10.4%	12.1%	10.1%
	NPV	1,426	235	1,243	52
	CBR	1.21	1.03	1.18	1.01
Kisumu	EIRR	9.8%	7.9%	9.5%	7.7%
	NPV	▲852	▲10,827	▲2,121	▲12,096
	CBR	0.98	0.84	0.96	0.82
Homa Bay	EIRR	17.4%	15.1%	17.1%	14.8%
	NPV	4,595	3,528	4,390	3,322
	CBR	1.72	1.47	1.67	1.44
Narok	EIRR	1.2%	-	0.9%	-
	NPV	▲10,748	▲14,284	▲11,104	▲14,640
	CBR	0.45	0.38	0.44	0.37
Luanda	EIRR	18.6%	16.2%	18.3%	15.9%
	NPV	9,915	7,981	9,536	7,602
	CBR	1.86	1.59	1.80	1.55
Mbale	EIRR	24.7%	22.6%	22.9%	20.9%
	NPV	2,792	2,613	2,385	2,206
	CBR	1.95	1.84	1.71	1.63

Source: The Aftercare Study Team

The economic viability of the projects was found to be sensitive to the increase of both investment and O&M costs (Case III). EIRR and other ratios attained under the Case III were, however, still economically viable, being more than the opportunity cost of capital of 10%. Furthermore, the increase of O&M costs (Case II) was not found to be so sensitive for the economic viability of the projects, staying almost at the same ratios as the base case.

(5) Overall Evaluation

Through the economic evaluation conducted, eight priority urban water supply projects were identified to be economically feasible with fairly acceptable economic returns, even under the uncertain situations of the increase in investment and O&M costs in the future.

13.2 Priority Rural Water Supply Projects

13.2.1 Approach to Selection of Priority Projects

In the same manner as the urban water supply, 11 districts grouped in Rank A are subjected to further screening to determine their order for implementation.

The following general approach are set out to sort out the first priority projects.

(1) The rural water supply system (RWS) comprises LSRWS and SSRWS. At this stage the rehabilitation works are proposed only to LSRWS, since the present physical and operation status of SSRWS are difficult to catch up. Also, very limited information are available for the status of LSRWS.

(2) It is presumed that RWS will be implemented on a basis of district unit, though there are two types of schemes. This means that the rehabilitation and expansion works in the district concerned will be brought forward at the same time.

13.2.2 Selected Priority Rural Water Supply Projects

Although factors are basically same as those for the urban water supply, non-water served population and magnitude of water deficit are considered to be key parameters in case of rural water supply.

The estimated 1995 non-served population of these districts are summarised in the table below, which also gives the estimated water deficits in 2010. It is tentatively supposed that districts where the deficits are large in quantity (more than 10,000 m^3/day) will have a higher priority.

Selection of Priority Rural Water Supply Projects

Province	District	1995 Population Served by RWS	1995 Non-served (x 1,000)	Production Deficit in 2010 (m^3/day)	Overall Assessment
Coastal	Kilifi	300	240	14,018	A
	Kwale	203	252	12,333	A
	Tana River	22	126	974	B
Eastern	Kitui	76	401	5,112	B
	Makueni	145	732	7,892	B
North-eastern	Mandera	54	153	6,358	B
	Wajir	145	63	1,635	B
Nyanza	Migori	29	580	19,571	A
Rift Valley	Kipsigis	209	348	21,151	A
	Narok	77	253	15,941	A
	Transmara	13	164	10,641	A

Note: Non-served population more than 100,000 and production deficit more than 5,000 m^3/day are considered to have higher priority

Source: The Aftercare Study Team

Six districts (Kilifi, Kwale, Migori, Kipsigis, Narok and Transmara) are finally sorted out as the first priority district for rural water supply development. Their locations are shown in **Figure - 13.2.**

13.2.3 Preliminary Scope of the Proposed Projects

As with the urban water supply project, the long-term rural water supply development plan consists of the ongoing projects, the planned/designed projects, the newly proposed projects and the rehabilitation of existing large scale water supply facilities. The first two components have been documented by the government organisations concerned, and for the third component, a preliminary proposal has been discussed in Chapter 8. The rehabilitation of the existing facilities has also been discussed in Chapter 8 and proposed only for LSRWS.

The list of projects of the respective priority district are shown in **Table - 13.2.1.**

13.2.4 Project Evaluation

The economic evaluation of the rural water supply projects was made not by quantitative method, but by qualitative method because the evaluation unit covers wide rural areas in the district where insufficient socioeconomic data are available. Calculation of EIRR or other evaluation measures such as NPV and CBR was not, therefore, undertaken, but some socio-economic impacts of the projects were assessed.

(1) Identification of SocioEconomic Impacts

Based on the data and information collected in the field survey conducted, the following were identified as the socioeconomic impacts of the rural water supply projects.

1) The increased quantity of available water will contribute enhancing the public health conditions of the local residents, thereby decreasing the infection of water-borne diseases,
2) Improved access to water will prevent women from heavy burden of water-carrying for a long distance, resulting in improvement of public welfare such as health conditions and spare time for other social and economic activities, and
3) The increased quantity of available water will ensure the provision of safe water for the local residents in better access.

(2) Assessment of SocioEconomic Impacts

The indicators used for the evaluation are based on the percentages measured by the national average index (national average = 100), in order to show the comparative status or situation of the priority projects.

Socioeconomic Impacts Expected through
Implementation of Priority Rural Water Supply Projects

SocioEconomic Conditions	Kilifi		Kwale		Migori		Kipsigis	
	Rate	Impact Expected	Rate	Impact Expected	Rate	Impact Expected	Rate	Impact Expected
A. Public Health								
Vomit/Diarrhoea Case Population (%)	12.9	●	24.3	●	17.8	●	9.5	●
(National Average Index = 100)	(137)		(259)		(189)		(101)	
Fever/Malaria Case Population (%)	51.8	●	56.1	●	40.5	-	46	-
(National Average Index = 100)	(101)		(109)		(79)		(89)	
B. Access to Safe Water								
Access Ratio (%)	57.4	●	22.5	-	5.5	-	32.0	-
(National Average Index = 100)	(128)		(50)		(12)		(71)	
C. Water Carrying Burden								
More than 2 Hours during Dry Season (%)	19.0	●	20.5	●	9.8	●	4.9	-
(National Average Index = 100)	(345)		(373)		(178)		(89)	
D. Overall Evaluation	-	⊙	-	⊙	-	O	-	O

Symbols:

● = Expected socioeconomic impacts of the project found to be high

⊙ = Overall impacts of the project expected to be significant

O = Overall impacts of the project expected to be high

Source: The Aftercare Study Team

1) Public Health

Impacts on public health were basically assessed by the percentage of population who are suffering from the water-related diseases such as vomiy/diarrhoea and fever/malaria. Of the 6 project areas, Kwale, Migori, Narok, and Transmara were found to have high impacts on public health through implementation of the projects. Particularly, the impacts of Kwale were identified to be significant compared to the others, since Kwale are currently suffering from both vomiy/diarrhoea (24.3% in case population or 259 in national average index) and fever/malaria (56.1% or 109).

2) Access to Safe Water

Regarding access to safe water, the impacts were evaluated by the percentage of households who have access to safe water. All the project areas were found to have high impacts on the access to safe water. Of the 6 project areas, Mandera and Migori would have the significant impacts because only 8.2% and 5.5% of the households, respectively, have the access to safe water at present. These figures were found to be considerably far beyond the national average, accounting for only 18% and 12% of the national average, respectively.

3) Water-Carrying Burden

Women in Kenya basically carry out water carrying, which give them hard burden in terms of health and time. For this evaluation, the impacts were assessed by the percentages of

the households who spend more than 2 hours water fetching during the dry season. All the project areas were found to have high impacts. Of the 6 project areas, the impact of water carrying would be considerably high in Mandera where 44% of the households spend more than 2 hours for water fetching. The national average index of Mandera was then found to be 800 or eight times than the national average.

(3) Overall Evaluation

Overall, Kilifi was found to have significant socioeconomic impacts through the implementation of the projects because all the selected socioeconomic impacts would be expected in Kilifi. For the other project areas, the high impacts would be also expected, as indicated in the table above. The projects were therefore all found to be economically viable in terms of socioeconomic impacts.

13.3 Priority Livestock Water Supply Projects

13.3.1 Selected Priority Livestock Water Supply Projects

All six districts identified in the preliminary screening are proposed to be the first priority project. They are Makueni, Garissa, Mandera, Wajir, Narok and Baringo Districts. Their locations are shown in **Figure - 13.2.1.**

13.3.2 Preliminary Scope of the Proposed Projects

Total estimated project base cost for construction of the livestock water supply is US$9.1 million. Under this project, it is planned that 260 livestock water supply facilities will be constructed.

Summary of Livestock Water Supply

Code	Districts	Nos. of Schemes	Estimated Costs (US$10^3)
4A0	Makueni	79	2,410
510	Garissa	98	2,989
520	Mandera	23	702
530	Wajir	39	1,190
750	Narok	16	488
810	Baringo	44	1,342
Total		260	9,121

Source: The Aftercare Study Team

13.4 Priority Sewerage Projects

13.4.1 Criteria to Selection of Priority Projects

The implementation plan for achieving the proposed target service ratios by 2010 is based on the relative ranking of urban centres discussed in Chapter 12. It is clear that several urban centres are closely ranked as top priorities and share the same timeframe for implementation. These projects will be competing for funding resources. Since funding will likely continue to be a serious constraint it is necessary to assess which projects should proceed on an urgent basis.

The selection of priority projects is made from the short list of the nine urban centres identified in the implementation plan to start in the first year. The relative merits of sewerage development for each of these urban centres is evaluated against the following selection criteria and given an overall rating a shown below:

1) Expected health benefits and improvement to living conditions
2) Importance to the viability of industry/tourism
3) Degree of sewerage development planning already in place
4) The present condition of existing sewerage systems
5) The status of on-going projects

Priority Sewerage Projects Selection

Urban Centre	Studies to Date	Sanitation Conditions	Status of On-going Project	Health & Environment Benefits	Importance to Viability of Tourism	Overall Assess-ment
Mombasa	F/S	Contamination of drinking water supply, impact on reef and beaches	No funding commitment for design and construction	High	High	A
Nairobi	M/P	Good coverage except in slum areas, treatment plants performing well despite overload	World Bank actively involved	Medium	Low	C
Kisumu	F/S	Treatment works polluting Lake Victoria, high level of industrial pollutant.	JICA completing F/S, no funding identified for next phase	High	Medium	A
Machakos	M/P	Treatment works overloaded, polluting surface waters used for drinking.	No funding identified for next stage	High	Low	A
Meru	F/S	Adequate on-site sanitation is available. Existing sewage works is overloaded but capacity can be restored by removing sludge.	On-going water supply project will probably include sanitation improvements	Medium	Low	B
Nakuru	M/P and F/S	Treatment works are operating under design capacity	New treatment works recently completed but sewer reticulation required	High	Medium	C
Narok	nil	Wastewater drainage is affecting surface water used for drinking. On-site sanitation is inadequate.	No funding identified for sewerage development	High	High	A
Kitale	nil	Treatment works are operating under design capacity	GTZ is strengthening water management	Medium	Low	C
Malindi	M/P	On-site sanitation is inadequate.	No funding identified for sewerage development	High	High	A

A = Highest priority, B = intermediate priority, C = lower priority
Source: The Aftercare Study Team

13.4.2 Selected Priority Sewerage Projects

An overall assessment is made using these five criteria to slot urban centres into one of three categories: high, medium, low. In general, lower priority is given to urban centres that have recently been upgraded (e.g. Nakuru) or are already supported by donors (e.g. Kitale, Nairobi).

Five priority urban centres (Rating A) are identified: Mombasa, Kisumu, Machakos, Malindi, Narok. The project requirements for each urban centre are summarised below:

1) Mombasa: proceed to design and construction of facilities following the development programme proposed in feasibility study.
2) Kisumu: proceed to design and construction of facilities following the development programme proposed in feasibility study.
3) Machakos: pre-design review of existing master plan then proceed to design stage.
4) Malindi: proceed with design and construction as identified in master plan.
5) Narok: proceed with master plan and feasibility study to identify sewerage development plan.

Their locations are shown in **Figure - 13.1.1.**

13.4.3 Preliminary Scope of the Proposed Projects

Master planning and feasibility studies are available for each urban centre except Narok. A summary of the proposed sewerage development from each master plan is provided in **Table - 13.4.1.** Drawings of the facilities proposed for each urban centre are shown in Supporting Report III.

(1) Mombasa

Source of information: (Draft feasibility study, Gibb Engineering Report, 1996)

"Currently only 10% of Mombasa's 600,000 population are connected to piped sewerage system. The main industries and hotels are not connected, and none of the Municipality's treatment works are operating. Uncontrolled and untreated sewage is therefore being discharged into Mombasa's marine environment. This environment supports fragile and valuable ecosystems that include the offshore fringing coral reef, and a mangrove forest that exists within the inland creeks. It also supports a local fishing industry and a thriving tourism industry that contributes significantly to the national economy. Current levels of pollution are shown to be a threat to these industries and also to public health."

A new treatment works is currently being completed on the West Mainland. The project included trunk sewers but not secondary sewer reticulation. "Areas were prioritised during the Strategy Study for sewerage in accordance with their potential for reduction of pollution load, early maximisation of revenue, and household ability to pay for both the full costs of both water and sewerage. The resultant priority ranking was:

1) Mombasa Island primary and secondary sewer reticulation
2) The West Mainland secondary sewer reticulation

3) The North Mainland primary and secondary reticulation
4) The South Mainland primary and secondary reticulation

In accordance with these priorities a strategy for phased construction of the sewerage system was derived. The recommended staged construction project for the 2010 horizon is summarised below."

Stage	Period	Proposed Investments
1A	1997-2000	- North Mainland headworks and long sea outfall - Island trunk sewers, priority pumping stations, rising mains, - N. Mainland connecting sewers, M/E work
1B	2000-2010	- Island and W. Mainland secondary sewers and pumping stations

In the feasibility study the system recommended for the Island and North Mainland includes "two main pumping stations on the Island, and a number of secondary pumping stations. Sewage will be collected at one of the main pumping stations, located close to Nyali Bridge and will be pumped across the bridge to a preliminary treatment plant prior to marine treatment and disposal via a long sea outfall. Alternative sewage treatment and disposal methods were evaluated. The proposed solution comprising preliminary treatment was the least cost solution designed to meet the water quality guidelines proposed. This option also presents the least risk in the case of plant or power failure."

Cost estimates taken from the feasibility study have been adjusted for inflation and included in the disbursement schedule for the Study. Total project costs identified in the feasibility study are 3,426 million Kenyan shillings (approximately US$57 million).

(2) Kisumu

Source of information: (Draft Final Report, Kisumu Water Supply & Sewerage Master Plan, JICA, 1998)

Currently approximately 56% of the population in Kisumu is connected to the wastewater system. The central district collects wastewater from the area northwest of the old town by gravity and from low lying areas along Lake Victoria through three pumping stations. All three pumping stations in the collection system are inoperative and wastewater overflows from manholes and pumping station wet wells to Lake Victoria. Flows are conveyed to a conventional treatment works that is overloaded hydraulically and organically. Flows exceed design capacity by more than 150% during dry weather and by more than 200% during the rainy season.

The eastern district collects wastewater from southeast of the old Kisumu town. And conveys flows to a primary facultative pond facility. The treatment works receives less than 20% of its design capacity due to inadequate water supply in this district. As a result, sewers are blocked with sediment.

The master plan identifies that 60% of the wastewater flow from domestic and industrial sources should receive treatment by 2005. That percentage will increase to 83% in 2015.

The project will be in two phases as follows:

Features of Kisumu Sewerage Development

Description	Phase 1	Phase 2
Target Year	2005	2005 - 2015
Major Works	- Rehabilitation of 3 pumping station	- Construction 3 new pumping station
	- Installation of 2.6 km long trunk sewers in central district and 23.1 km in eastern district	- Abandon one existing pump station - Expand existing ponds
	- Rehabilitation of conventional treatment works	- Construction of new treatment works in western district
	- Expansion of conventional treatment works to 2015 design flow	- Provide 23.2 km long trunk sewers in western district
	- Rehabilitation of treatment pond	
Estimated Cost	US$14,234,000	US$23,001,000

Source: Kisumu Water Supply & Sewerage Master Plan, 1998

(3) Machakos

Source of information: (Draft Final Report, Machakos Sewerage Scheme, Master Plan and Preliminary Design Report, Mangat, I.B. Patel & Partners, 1985)

Currently approximately 10% of the population in Machakos is connected to the wastewater system. The existing sewer network was originally installed in 1973. Since then a great deal of development has taken place. Most of this development is unsewered, which means wastewater is discharged untreated to receiving streams. The existing treatment facility is overloaded and is discharging poor quality effluent into the Mitheau river. This situation is creating a significant health risk in the area.

The municipality is divided into two areas north and south. The northern area consists of the northern slopes of the Mua Hills and the Mitaboni plateau. In the 1985 study it was identified as rural and populations studies indicated it would remain so until middle of next century therefore no sewerage was proposed. The southern area is made up of land with the horseshoe ridge of hills. It contains the urban centre of Machakos Town and the relatively flat land that surrounds it. This area is where most of the urban growth has occurred and where the sewerage system needs to be developed most urgently.

Features of Machakos Sewerage Development

Description	Phase 1	Phase 2
Major Works	- Upgrading sewers networks in Drainage Areas 2 & 3 - New gravity trunk sewer lines A and F - New oxidation pond treatment facility at Site 3 (Machakos) and Site 2 (Kiavudimi) - New pumping station at Miwani River	- New sewerage in Drainage - New gravity sewer line B - Expansion of treatment capacity at Sites 2 and 3
Estimated Cost	Kshs 110,295,000 (1985 price)	Kshs 110,054,000 (1985 price)

Source: Machakos Sewerage Scheme, Master Plan and Preliminary Design Report, 1985

The population and land use projections made in the master plan should be compared to existing situation to confirm if Phase 2 works should be implemented with Phase 1.

(4) Malindi

Source of information: (Final Report, Malindi Sanitation and Hygiene Education Feasibility Study, Financed by Federal Republic of Germany, 1994)

Over 60% of the population in Malindi have no sanitation facilities at all. Over 40% of the population has no access to any direct source of water and there is clear evidence of shallow wells with nearby pit latrines. The potential for a major epidemic of cholera or typhoid is great. Malindi is an important tourism centre. Urgent action is necessary to ensure that the sanitation systems in the town are improved to sustain the welfare of the population and ensure further economic development

The feasibility study proposes a sewerage system for densely developed parts of the town, hotels, commercial and industrial areas. The sewerage system consists of collector sewers, 3 pumping stations and a treatment facility all designed to meet the needs until 2005. The study evaluated several treatment site options and recommends the Ganda site. The feasibility study also recommends improving the collection of effluent from on-plot sanitation facilities in order to ensure a healthy living environment.

Total project costs for sewerage is estimated at 580,000,000 Kshs (1994 prices)

(5) Narok

At present, there are no sewer systems in Narok. According to the sewer development strategy, the number of the sewer served population is expected to reach 19,347 by the year 2010. Under the strategy sufficient sewer facilities and reticulation are required to cover Narok's served numbers as follows:

The development strategies of Narok from 1999 to 2011 are:

1) New treatment works: Waste Stabilisation Pond, and
2) New sewer reticulation: 22,055m

The direct costs are:

1) New treatment works: 768,766 US$, and
2) New sewer reticulation: 1,336,694 US$.

13.4.4 Project Evaluation

With the quantifiable benefits identified in the subsequent section, the economic viability of the priority sewerage projects was evaluated. According to the estimated investment costs, O&M costs and the quantifiable economic benefits identified, EIRR was calculated undertaken and the viability of the projects was evaluated.

(1) Identification of Economic Benefits

According to the field survey conducted, the following were identified as the economic benefits of the sewerage projects are:

1) Resource costs saving associated with not having to depend on alternative sanitation facilities such as pit latrines and septic tanks will benefit the households who would be connected to the sewerage system in the "with project" situation, requiring certain costs of investment and O&M for the alternative sanitation facilities.

2) Willingness to pay for an improvement in sewerage service will be realised in terms of the increased service for the urban communities who are currently not connecting to sewerage systems and therefore relying on only alternative sanitation facilities, and

3) The introduction of the proposed sewerage systems will contribute to improving the hygiene, health, and environment conditions of the urban communities.

Of the economic benefits identified, the benefits from (i) resource costs savings and (ii) increased service (willingness-to-pay) were selected as quantifiable benefits.

(2) Estimate of Quantifiable Benefits

1) Resource Costs Savings

The first major benefit is the resource costs savings of not having to depend on the on-site sanitation facilities such as pit latrines and septic tanks. Information on the investment and

O&M costs for pit latrine and septic tank was obtained from another feasibility study done recently in Kenya and used as the assumptions for the analysis.

2) Increased Service (Willingness-To-Pay)

In addition to the resource costs savings, the willingness-to-pay of the urban communities was considered as another major economic benefit of the project and then defined as increased service. For the purpose of the analysis, the increased service of sewerage service was valued at the marginal treatment cost of wastewater by calculating an average incremental cost of the wastewater treatment value per cubic meter. This is defined as the AIC.

(3) Economic Cash Flow Analysis

The economic cash flow was prepared on an annual basis for each priority project. In addition to EIRR, alternative evaluation measures of NPV and CBR were also applied to further verify the economic viability of the projects. It was achieved based on the same procedures as those of the priority urban water supply projects.

(4) Calculated EIRR, NPV and CBR

The economic cash flow, was analized and its results are summarised in the table below.

Summary of Economic Evaluation for Priority Sewerage Projects

Items	Malindi UC	Mombasa UC	Machakos UC	Kisumu UC	Narok UC
EIRR	14.5%	11.8%	22.1%	11.6%	13.1%
NPV (US$10^3)	2,289	4,281	4,440	4,264	1,396
CBR	1.23	1.08	1.82	1.09	1.21

Source: The Aftercare Study Team

According to the results of the analysis, all the projects provided acceptable economic return with the fairly acceptable rates of EIRR, showing the higher rates than the opportunity costs of capital of 10% used in the analysis. Other evaluation measures of NPV and CBR also indicated the economic viability of the projects with the positive values.

(5) Sensitivity Analysis

Having done cash flow analysis, sensitively analysis was conducted to verify if the projects would be economically viable under uncertain conditions such as change of the costs of investment and O&M in the future.

The same conditions as those of the priority urban water supply conditions are set out for sensitivity analysis. The results of the analysis are illustrated in the table below.

Sensitivity Analysis by for Priority Urban Water Supply Projects

(Unit for NPV: US$10³)

Urban Centres	Items	Base Case	Case I	Case II	Case III
Malindi	EIRR	14.5%	12.3%	12.6%	10.5%
	NPV	2,289	1,304	1,281	296
	CBR	1.2	1.1	1.1	1.0
Mombasa	EIRR	11.8%	9.3%	10.0%	7.7%
	NPV	4,281	▲1,824	101	▲6,004
	CBR	1.1	1.0	1.0	0.9
Machakos	EIRR	22.1%	19.4%	21.0%	18.4%
	NPV	4,440	3,855	3,937	3,351
	CBR	1.8	1.6	1.7	1.5
Kisumu	EIRR	11.6%	9.6%	9.9%	8.0%
	NPV	4,264	▲1,331	▲149	▲5,743
	CBR	1.1	1.0	1.0	0.9
Narok	EIRR	13.1%	10.8%	12.3%	10.1%
	NPV	1,396	411	1,024	39
	CBR	1.2	1.1	1.1	1.0

Source: The Aftercare Study Team

According to the above table, the economic viability of the projects was found to be sensitive to the increase of both investment and O&M costs (Case III). Mombasa and Kisumu under Case I and Case III were, however, found to be not economically viable, being less than the opportunity cost of capital of 10%. Even under the Case II, Kisumu was also found to be not viable. These results were mainly caused by the quite high investment and O&M costs of these two projects.

(6) Overall Evaluation

According to the economic evaluation, all the priority sewerage projects were basically found to be economically feasible with fairly acceptable EIRR return. However, the sensitivity analysis indicated that the two projects in Mombasa and Kisumu would not be economically feasible if ever the costs of the investment and O&M were increased by more than 20% in the future.

CHAPTER 14 CONCLUSION AND RECOMMENDATIONS

14.1 Conclusion

The Study Team reviewed the development plans for water supply and sewerage sectors in the National Water Master Plan prepared in 1992 and established new implementation programmes for the target year 2010. Also, the Study Team made recommendations on strengthening of law, organisation and institution for project implementation and improvement of management, operation and maintenance of the projects.

14.1.1 Water Supply Development

(1) The target for water supply development was set as follows:

1) The current 90% service coverage in urban centre will increase to 95% at the year 2010. In the rural area, the present 35% service coverage will increase to 70% and the year 2010. The overall service coverage in the country will attain the 80% from the present 50%.

2) All water supply schemes shall have a certain level of accounted for water ratio (AFW), preferably over 70% by each scheme by the year 2010.

For the above target, water demand is forecasted as 2,010 × 10^3 m^3/day for urban water supply and 1,660 × 10^3/day for rural water supply in 2010. While, the present water supply capacity is estimated at 710 × 10^3 m^3/day for urban water supply and 750 × 10^3 m^3/day for rural water supply. This big gap between water demand and supply capacity indicates the need for further development of both urban and rural water supplies.

(2) To meet the water demand in 2010, a lot of water supply projects have to be completed and require huge amount of investment.

Projects	Urban Water Supply Projects		Rural Water Supply Projects	
	Nos. of projects	Cost (1,000 US$)	Nos. of projects	Cost (1,000 US$)
Rehabilitation Works	120	44,400	295	95,100
On-going Projects	21	7,400	552	67,700
Planned/designed Projects	21	27,400	217	8,800
Newly Proposed Projects	108	1,243,000	51,183	185,400
Total	270	1,322,200	52,247	357,000

The above investment costs may be obtainable provided that foreign assistance continues as expected. However, as the percentage of foreign assistance is more than 60%, it is essential to increase the percentage of own fund and get the continuous foreign assistance for the successful development of water supply and sewerage sectors to meet the planned objectives for 2010.

(3) A review of MWR project status reports suggests that a large percent of the on-going projects are stalled due mainly to a lack of funds. According to the questionnaire surveys, many existing schemes are inoperable due to financial, technical, and managerial problems. Priority should be given to the on-going projects under construction, planning and design. Concurrently with these projects, rehabilitation of the existing schemes shall be undertaken. Augmentation or expansion projects shall be kept to a minimum level and limited to schemes which were evaluated very urgent before completion of on-going projects and rehabilitation works.

(4) However, in the rural areas, much of the population has no access to safe water. In such areas, small scale community water supply schemes which are most cost-effective method to supply safe water should be undertaken. Those schemes may greatly help alleviate the heavy tasks by women and children to fetch water and will improve rural living conditions.

(5) The long-term development plan of water supply was formulated targeting the year 2010. However, considering financial constraints of the GOK priority projects were selected to utilise the limited funds effectively. The priority projects were selected among the projects in the proposed long-term water supply development plan which are ranked as high priority from social and technical viewpoints. However, the priority projects are selected by urban centre unit for urban water supply and district unit for rural water supply. As a result, rehabilitation projects of 20 urban centres and expansion projects of 8 urban centres listed in Section 13.1 were selected as priority project in the urban water supply sector. On the other hand, rehabilitation/expansion projects of 6 districts listed in Section 13.2 were selected as priority project in the rural water supply sector.

14.1.2 Sewerage Development

(1) The service coverage of water supply in the urban centres in Kenya is more than 90% at present, while that of sewerage is 28%. This situation is affecting environment and health conditions; therefore, further sewerage development is required. In the Study, target service ratio of the sewerage development was set as follows:

Urban Population	Target Service Ratio
300,000 or more	50%
300,000 - 100,000	40%
100,000 - 20,000	25%
20,000 or less	15%

The overall service ratio comes to 38%. For this target, wastewater flow in 2010 is estimated at 750×10^3 m^3/day against the present treatment capacity of 240×10^3 m^3/day. The treatment capacity has to be increased by 510×10^3 m^3/day.

(2) To increase the treatment capacity by 510×10^3 m^3/day, the following number of projects have to be implemented:

Projects	Nos. of Projects	Cost (1,000 US$)
Rehabilitation Works	52 (34)	52,100
On-going Projects	18	89,600
Planned/designed Projects	2	31
Newly Proposed Projects	64 (40)	341,400
Total	136 (74)	483,131

Source: Aftercare Survey Group

Funding for these projects may be obtainable by assuming that the past growth rate of budget for the sewerage sector is maintained in the future. However, this is a very ambitious assumption since the appropriation-in-aid occupy more than 70% of the budget for sewerage sector.

(3) Existing old sewer and treatment works are hydraulically and organically overloaded and require urgent rehabilitation. Therefore, in the sewerage development plan rehabilitation of the existing sewerage facilities should have priority in order to recover the original function of sewerage system. Also, extension of sewer reticulation and expansion of treatment works should be implemented and the progress of water supply monitored.

(4) Priority projects were selected by evaluating the projects of 10 urban centres with high priority in the long term sewerage development plan from social and technical viewpoints. As a result, projects of five urban centres listed in Section 13.4 were selected as having the highest priority.

(5) In the evaluation for ranking of sewerage development projects, impact to environment and potential of tourism are adopted as one of the evaluation factors. The tourism is a major industry in Kenya and it depends heavily on the natural environment. The sewerage system can contribute to conservation of the national environment. In the further stage of sewerage development, needs of sewerage development should be confirmed paying attention to the above point.

14.2 Recommendations

(1) The water supply and sewerage development plans were prepared to cope with water demand and wastewater treatment demand in 2010. On the other hand, most existing water supply and sewerage schemes are facing many problems and constraints and are not sustainable. To get out of this situation, it is of vital importance to strengthen the public administration, legislation, and financial administration and also improve the operation and maintenance system. Otherwise, the proposed development plans will not be effective.

(2) To strengthen public administration the following should be done:

1) Restructure organizations related to water supply and sewerage sectors,

1) Restructure organizations related to water supply and sewerage sectors,
2) Improve personnel administration,
3) Regulate water undertakers and sewerage providers,
4) Amend legislation related to water supply and sewerage sectors,
5) Improve law enforcement,
6) Improve disparity between budget and fund available,
7) Improve investment method,
8) Revise tariff structures and rates in water supply and sewerage sectors,
9) Improve tariff billing and collection.

(3) To improve the operation and maintenance system the following should be done:

1) Water supply sector

i) Establish a functional metering system
ii) Implement leakage control
iii) Register all customers
iv) Train operation and maintenance staff
v) Provide water tankers (2 vehicles per province)

2) Sewerage sector

i) Increase operating revenue in each schemes (obtain fund due for operation),
ii) Upgrade staff levels and skills (Recruitment, raining and transfer),
iii) Procure facilities, equipment and tools,
iv) Establish preventive maintenance program and standard operating procedures, and
v) Implement an industrial wastewater pre-treatment program.

(4) The detailed measures for institutional strengthening plan and operation and maintenance improvement plan will be different among the schemes or projects depending on their own problems and constraints. Therefore, the problems and constraints of each scheme or project should be clarified before their implementation. Since some of the measures will require the action at a national level, all the ministries and organizations concerned should implement them cooperatively under the strong leadership of the ministries in-charge.

(5) The financial capability of the Kenyan government is one of the most important factors to achieve the proposed development plans. The estimated government development fund is much too short to accomplish them. Therefore, continuous foreign assistance will be required. However, most donors are recently paying more attention to institutional and operational aspects of the schemes rather than the investment required for the physical facilities. To get the foreign assistance for investment on physical facilities against the recent donor's trend, sustainability of the existing schemes has to be recovered in both water supply and sewerage sectors as precondition for further development by

implementing the proposed institutional strengthening plan and operation and maintenance improvement plan immediately and successively.