THE STUDY ON WATER SUPPLY FOR
SEVEN TOWNS IN EASTER PROVINCE
IN THE REPUBLIC OF KENYA

APPENDIX B

SOCIO-ECONOMY

APPENDIX B SOCIO-ECONOMY

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1. GENERAL

To visualize socio-economic aspects of the study area , efforts are made to obtain data and information through interviews with the officials concerned in the district offices, municipalities, etc. When deemed necessary, direct contact and interviews with residents are also carried out. Description in Section 5 (Women Participation) is particularly based on interviews made during the series of the field surveys for "Monitoring of Communal Water Points" and "Public Awareness Survey on Potable Water and Sanitary Education".

2. ADMINISTRATION

All the supply areas are located in Eastern Province which, in terms of both area and population, is the second largest of Kenya's eight Provinces.

Eastern Province has its Provincial Headquarters in Embu and is divided into eight Districts. Meru and Nkubu are located in Meru District with the District Headquarters in Meru. Isiolo is the District Headquarters for Isiolo District, Chuka and Chogoria lie in Tharaka Nithi District, with the newly formed headquarters located at Chuka and, Maua and Tigania are located in Nyambeni District, with the District Headquarters located just north of Maua.

District Development Plans are prepared at District level and it is significant to note that all current plans place a high priority on the improvement of water supplies.

3 POPULATION

Baseline population levels and current growth rates were obtained from an analysis of past population census results, as summarised below:

Table B3-1 1989 Scheme Populations, And 1969-1989 Inter-Census Growth Rates For Identified Supply Areas

Project	Kenya	Eastern Province	Meru	Nkubu	Isiolo	Chuka (1)	Chogoria	Maua (2)	Tigania
1989 population	21,443,636	3,768,677	125,191	6,881	18,658	62,784	25,148	3,223	51,826
1969–1989annual growth rate	3.40%	3.65%	3.60%	3.50%	4.20%	2.70%	3.40%	3.40%	2.40%
1997 population	28,000,000	5,020,000	165,980	9,471	25,679	81,034	32,134	5,537	63,891

Notes *(1) Chuka population includes for additional area outside supply area, for which water will be delivered from the proposed treatment plant.*

(2) Maua supply area is limited to the urban areas within Amwathi sub-location. A higher growth rate than that for the full sub-location has therefore been applied.

These figures indicate that population growth rates during the twenty years between 1969 and 1989 were among the highest in the world. Since the 1989 census, there has been no similar widescale and detailed population survey, although a number of local population estimates have been made. These however do not give sufficient justification for adopting alternative growth characteristics. Therefore, the above current (1997) population levels have been estimated using the average 1969-1989 annual growth rates. The exception being Maua where, due to raw water source constraints, the supply area is limited to the urban areas of Amwathi sub-location only. Since the growth characteristics of urban areas is different from rural areas, the growth rate for the whole sub-location can not be applied in this instance. A higher growth rate has been assumed in this case to allow for the higher level of urbanisation and also due to the location of the new District Offices close to the supply area.

4. LAND USE AND ECONOMIC ACTIVITIES

4.1 Land Use

Land is the principal factor of production, therefore access to land and control over land has a critical impact on the family's socio-economic status. A tabel below shows general patterns of the land use seen in each town of the Study Area..

Table B4-1 Land Use in Study Area

TOWN	Land Classification	Land Use
Isiolo	Low potential	Livestock, National Parks
Meru	High potential	Agriculture, Forestry, National Parks
Chogoria	High potential	Agriculture, Forestry, Livestock
Chuka	High potential	Agriculture, Livestock
Nkubu	High potential	Agriculture, Livestock
Maua	High potential	Agriculture, Forestry, Livestock
Tigania	Medium potential	Agriculture, Livestock

(1) Meru District

Soils in Meru district are moderately to highly fertile loams in general. According to the information obtanined fromthe District Agricultural Office Meru, more than one third of Meru district is either gathered forest reserrve or National Park. Forest reserve cover 843 km2. Meru National Paark occupies 870 km2 while Mt. Kenya occupies 380km2. Arable land occupies 1586km2. The medium and high potential areas represent 35% of the toral land available, and produces the highest output in the whole country. Large sacale farming is around Timau, occupying 1,000 ha while small scale farms occupy 80,000 ha. Potential irrigatable land acounts for 8,000 ha.

Land in Meru is held under three tenure systems, close holdings, individual small scale holdings and large scale farms.

According to the Meru traditional land tenure system, access to land was open to all family lineage, while control over land was veted in the clan. Therefore clan elders play a major role in decision making and form part of implementing organization in any community based projects. Customarily, women do not inherit land or property. A son is considered to be the heir to the family name and property.

(2) Isiolo District

Land in Isiolo district is vast (totals to 25,605 km2), it is classified as low potential due to the drought conditions which prevail in the district. It is trustee land administrated by Isiolo County Council. The soils are sandy, with patches of black cotton and red loamy soils.

Livestock rearing is the main stay in the district. The nomadic population continuously move their livestock around the district in search of pasture and water.

Land use for agriculture is very limited. According to the DDP (1994-1996), the total

agricultural land available is 2,600ha, of which 5% can be used for crop production.

A land area comprising of 537,000 km2 has been kept as animal game reserves, with Shabe game reserve comprising of 256 km2, Buffalo springs 131 km2 and Bisanad 150 km2. Plans are under way to gazette three forests with an area of 9,894 ha.

(3) Tharaka Nithi District

Tharaka Nithi District covers an area of 2,136 km2 of which 1,765 km2 is arable land. Of the remaining, forest and swamps occupy 114 km2.

Wide ranges of soil types are found in the district. In the upper zones, the soils are well formed, mainly very deep clay and clay loams of moderate to high fertility, while in the lower zone the soils are shallow sandy clays and sandy loams of moderate fertility.

30% of the land area under agriculture is used for livestock production.

4.2 Economic Activities and Income Sources

As described above, the land is mainly utilized for agriculture, livestock and forestry. The cash crops grown include coffee, tea, miraa, maize, horticulture, cotton, and sunflower. The food crops include Irish potatoes, beans, sorghum, millet, cow peas, cassava and sweet potatoes. The main economic activity in Isiolo is livestock rearing. Other sources of income include trade, commerce, tourism, informal sector and employment mostly in the public sector.

The area is well known as one of the prodution center of tea and coffee in Kenya. In Meru town, a number of factories, depending on these agricultural products, process milk, cheese, flour, textile, bread, etc. for internal and external markets. There are no industries in Isiolo (one livestock factory is currently under construction). The industries found in the rest of the study area are mainly coffee and tea estates.

Table B4-2 Major Industry in the Study Area

TOWN	INDUSTRIES
Chuka	Coffee Factories, Cotton Ginning, Saw Mills
Chogoria	Coffee and Tea Factories
Isiolo	No Industries
Meru	Coffee & Tea Factories, Honey & Milk Processing, Animal Feed, Timber, Tannery, Flour Milling & Bakery
Nkubu	Coffee and Tea Factories
Maua	Coffee and Tea Factories, Oil Press, Wine Processing
Tigania	Coffee and Tea Factories, Fruit Processing and Vegetable Oil Processing

Source: Development Plan 1994 - 96 for Meru, Tharaka Nithi and Isiolo.

5. SOCIAL INFRASTRUCTURE

5.1 Roads

The social infrastructure in the survey area is fairly developed. As regards the development of roads, the topography and terrain of most of the towns in the study area makes it difficult and costly to develop roads. However, in Meru, Tharaka Nithi and Nyambene, there is a complex and well developed network of both classified and unclassified roads. One major problem is the inaccessibility of the rural access roads especially during rainy seasons. The road network in Isiolo is poor with only one tarmac road; Meru-Isiolo road. Due to disparity in population distribution and nomadic way of life, it is unconomical and difficult to develop infrastructure throughout the District.

Although the towns in the study area are served by electricity and telephone, electricity is mostly used for commercial purposes. Institutions served by electricity include hospitals, schools, coffee and tea factories. Every town in the study area (except Tigania) is served by banking facilities.

5.2 Education

Access to education varies from one area to another. In Isiolo, due to nomadism, enrolment is very low. Unequal access to education implies unequal access to knowledge and opportunities. The level of education has an impact on the use of improved water facilities. The more the people are educated, the better they will understand the benefits accruing from the use of improved water and sanitary facilities.

Table B5-1 Education Status of Each Town

Town	Primary	Enrolment	Secondary	Enrolment	Technical	Enrolment
Chogoria	9	2700	4	1400	1	45
Chuka	5	2500	3	1200	2	120
Isiolo	6	1500	2	700	2	75
Maua	3	1800	2	750	1	78
Meru	20	4500	10	2800	4	1050
Nkubu	5	1500	1	450	1	65
Tigania	11	3850	4	1850	4	812

Source: Data collected from interviews in Meru, Nyambene and Tharaka Nithi Districts; September, 1996

5.3 Sanitary Conditions

Health facilities are poorly distributed in Isiolo and Tigania. Other areas are fairly covered with health facilities provided by the Government and private agencies. Table below gives a breakdown of health facilities per town.

Table B5-2 Health Facilities in the Study Area

Town	Health Facilities	No. of beds	Out-Patient per day
Chogoria	1 hospital 2 health centres 5 private clinics	312	1,500
Chuka	1 district hospital 1 private hospital 4 private clinics	63 56	850
Isiolo	1 district hospital 2 dispensaries 2 clinics	112	500
Maua	1 sub-district hospital 1 private hospital 1 dispensary 12 private clinics	70	1,000
Meru	1 district hospital 6 health centres 26 dispensaries 64 clinics	251	28,000
Nkubu	1 Mission hospital 2 health centres 4 private clinics 1 dispensary	270	1,200

Source: Public Health Office Meru, Chuka, Isiolo and Maua.

Traditional beliefs about the use and acceptance of latrines is more pronounced in Isiolo than the other towns. All ethnic groups in the study area do not accept sharing sanitary facilities. For example, a daughter in-law and a father-in-law are not allowed to use the same sanitary facility. These beliefs and taboos have negative impact on the construction and use of latrines.

Traditional beliefs are also extended to water use and practices. Many communities believe that spring and river water tastes better than tap water, hence the tendency to use river water. Traditional practice has also implications for the spread of disease. Among the Meru, circumcision is commonly practised among boys and girls. Female circumcision spreads disease as the circumciser uses only one knife for the whole group. Socio-cultural beliefs and taboos practised in the study area have an impact on the spread of diseases.

The most common disease affecting households in the study area is malaria. Other diseases include respiratory diseases, intestinal diseases, pneumonia, amoebisis, diarrhoea, dysentry, skin diseases and AIDS.

6. WOMEN PARTICIPATION (WID)

The traditional tasks in water supply and waste disposal for family well-being, economic resources and health, make women the main potential contributors to and beneficiaries of water and sanitation projects.

The importance and advantages of involving women in water and sanitation activities can not be over-emphasised. Besides women being responsible for family subsistence production, they are the major providers of food to the family. The nutritional status of the family especially children depend on the women. The family's health greatly depends on the mother. In this case, thererfore, food hygiene through improved faecal and waste disposal is the responsibility of the women. Collecting and carrying water is also the work of women.

Improved water supply may have considerable effect to the lives of the women. Reduction in times spent collecting water would allow women to engage in income generating activities and child care.

The main problems facing women in the study area are:

Illiteracy

Illiteracy is high among women, therefore they find it difficult to understand issues pertaining to clean water and health. They also earn less income which is not enough to sustain them.

Inheritance system:

Women are not allowed to inherit property especially land. As a result, it is difficult for women to acquire credit as they lack collaterals.

Division of labour:

Women do most of the work in the family, but they do not make decisions concerning expenditure of income earned by the family. This affects the ability to pay for water and sanitation facilities.

The Government recognises the important role played by Women in development, and as a result in 1985 a Women's Bureau was set up in order to articulate women's needs. With the support given by the Bureau, women have undertaken income generating activities. They have participated in community development programmes and have been the major beneficiaries of the Adult Literacy Programmes.

In the study area, women groups have been involved in managing water kiosks (Isiolo), and soil conservation activities in the rest of the study area.

If encouraged to participate in water and sanitation activities, women can assist in the planning of new facilities by giving their advice on the location of facilities. As users and promoters of change in behaviour, women should be the main recipients of health education, and they should also assist to manage and maintain improved water facilities.

APPENDIX C

EXISTING WATER SUPPLY FACILITIES IN MERU

APPENDIX C SURVEY OF EXISTING WATER SUPPLY FACILITIES IN MERU TOWN

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1. GENERAL

To identify problems of the existing water supply system in Meru Town, a field survey was carried out in the period from 1st September and 25th October. This includes 'Inventory Survey at the intake, the treatment works and the distribution mains', 'Pressure and Flow Rate Measurement' and 'UFW Survey' at a selected pilot area. The following sections descirbe the major results of the surveys.

2. INVENTORY SURVEY ON THE EXISTING WATER SUPPLY FACILITIES

2.1 Overview

The present water supply for Meru Town is operated and maintained by the Ministry of Land Reclamation, Regional and Water Development. The system was first built in 1952 with an intake on Gatabora Stream. The Treatment Works were located in Milimani area and comprised of a sedimentation unit and a composite treatment unit with a total capacity of 450 m3/day. Two filtration units (capacity 1,992 m3/day) were added in 1978. A second intake on Kathita River was constructed in 1988 to supply raw water to Treatment Works by gravity. Two composite treatment units (capacity 960 m3/day each) were built in 1995. Presently only the filtration units and the new composite treatment units are in use. These have a total capacity of 3,912 m3/day.

In addition to above, two 150m3 capacity ground level masonry tanks were built in Kaithe in 1978 to supply water to the high level zone of Meru Township. These tanks were fed by pumping water from the Treatment Works in Milimani. However, pumping was discontinued sometime in 1988 when the tanks were supplied by gravity from the intake at Gatabora Springs.

The Distribution Network is divided into the High Level and Low Level Zones. The High Level Tanks supply the high level area which comprises three distribution zones;

i) Kaithe Zone
ii) Milimani (H.L.) Zone
iii) Kaaga Zone

The low level zone is supplied from the Treatment Works comprising the following zones:

i) Milimani (L.L.) Zone
ii) Town Zone

iii) Nubian Zone
iv) Kooje Zone
v) Gakoromone Zone
vi) Maize Control Zone
vii) Thimangiri Zone
viii) Kaaga Zone

Kaaga Zone is supplied by both High Level and Low Level Zones.

2.2 Source, Intake and Raw Water Mains

As stated above, Meru Water Supply extracts raw water from three water sources. They are the Kathita River, the Gatabora Stream and the Gatabora Springs. Out of them, the Gatabora Stream is the smallest in capacity and being utilized as a standby source when the raw water of the Kathita River is turbid.

Major intake facilities are weirs constructed on the Kathita River and the Gatabora Stream, raw water mains installed therefrom to the treatment works, a concrete weir and a collecting chamber at the Gatabora Springs and its raw water main. Technical dimensions and the present status of these facilities are summarized in a table below.

	Component	Evaluation
IR - 1	**Intake on Kathita River** 15.3 m wide concrete weir 0.65m high at elevation of 1759.4m AOD constructed in 1988.	Good structural condition. Valve chamber is flooded. Coarse screen partly broken. Intake Chamber silted.
IR - 2	**Raw Water Main** 300 mm dia uPVC pipe with some parts having 200 mm dia. uPVC pipe. Total length 3150m (Supplying to Treatment Works). Laid in 1988/89.	Generally good condition. All air valves and sluice valves needs to be cleaned and serviced.
IR - 3	**Intake on Gatabora Stream** Masonry intake built on River Ganging Station 4E6 in 1956.	In good structural condition. Inlet chamber silted.
IR - 4	**Raw Water Main** 150 mm dia. uPVC main with some length in 200 mm dia. uPVC pipe. Total length approximately 1500m. Laid in 1956. (Supplying to Treatment Works). Old 100 mm dia. GI and 75 mm dia. GI pipe presently not in use.	Generally good condition. Pipeline exposed (5m length) in steep embankment.
IR - 5	**Intake at Gatabora Springs** Concrete weir, 10 m wide 2.5 high with concrete inlet chambers. Built in 1989.	Water in reservoir to 0.4 m depth only. Chicken mesh on fine screens vandalized. Coarse screens timber frame broken.
IR - 6	**Raw Water Main** 200 mm dia. uPVC pipe appx. 1000m laid in 1989. (Supplying to high level tanks).	Good condition. The sluice valve for one washout is rusted.

In general, they are in good structural condition. It is however observed that some metal and wooden works are broken and need to be repaired. The intake chambers at the Kathita River and the Gatabora Stream are silted and left without maintenance. This may lower the intake rate and cause high turbid water. It is recommended to clean under periodical surveillance by DWO.

2.3 Treatment Works

(1) Component and Evaluation

The Treatment Works are located in Milimani Area, supplying the treated water to the low level distribution zones. ***Figure C2-1*** shows a general plan of the Treatment Works and a table below outlines the component facilities and the present conditions with our evaluation.

	COMPONENT	EVALUATION
TW - 1	**Sedimentation Unit** Capacity 225 m3/day circular horizontal flow sedimentation Unit built in 1952.	In fair structural condition. Silted up. Presently not in use.
	Circular filtration unit for sedimentation unit built in 1952.	Not in use for more than 10 years.
	Circular composite treatment unit capacity 225 m3/d. Built in 1956.	In fair structural condition. Presently not in use.
TW - 2	**Filtration Units** Capacity 1,992 m3/day. Two units of surface area 8.3 m2 each. Built in 1978.	In good structural condition. Operating under overloaded condition as Raw Water is filled to the top of unit 1 and overflows to unit 2.
	(Backwashing for both filters done simultaneously on daily basis).	Surplus overflow from unit 2 measured as 2,700 m3/d.
	Inlet chamber for line from Kathita:	3 Nos. 150 mm dia. sluice valves leaking . No covers.
	Inlet chamber for line from Gatabora.	1 No. 150 mm dia. sluice valve. leaking .
	Inlets to filter units:	150 mm dia. GI pipe supported partly over steel covers for valve channel. 4 Nos. 150 mm dia. Sluice Valves leaking. uPVC underdrainage pipes for unit 2 partly broken.
	Outlet chambers:	1 chamber broken. 4 Nos. 150 mm dia. sluice valves leaking.
BT - 1	**Backwash tank 1** (for 'Old' Treatment Units) Pressed steel elevated tank of capacity 13 m3. Built in 1956.	In good structural condition presently not in use. 50 mm dia. sluice valve on inlet leaking. Backwash pipe has burst. There is no ball float valve.
BT - 2	**Backwash tank 2** (for filters and 'new' treatment units). Pressed steel elevated tank of capacity 77m3. Built in 1980.	Tank has leak in one bottom panel, otherwise in good structural condition. 300mm dia. sluice valve on outlet is leaking. There is no ball float valve. Scour pipe is broken at threaded end and is not supported. 75mm dia. sluice valve on scour pipe is not working.

	COMPONENT	EVALUATION
TW - 3	**Composite Treatment Unit I** with horizontal flow sedimentation chambers and a central rapid sand filter. Capacity 40m3/hr. Built in 1995. Backwashing done daily.	In good condition. Operation under overloaded condition with decanting pipe submerged.
	Components:	
	i) Inlet valves masonry chamber 2.0m x 2.0m	Chamber is unplastered.
	ii) Inlet and mixing chamber 1.6m x 0.6m masonry.	In good condition. 'V' notch used as dosing point of Alum. No measurements of flow.
	iii) Alum mixing concrete chamber 0.7m x 0.6m x 0.9m deep concrete	Mixing dose using sticks. Chamber has no scour pipe. Dosing pipe has no valve.
	iv) Alum doser - FRN type gravity doser.	Not in good condition.
	v) Outlet chamber 2.4m x 1.6m x 2.1m deep masonry	Unplatered chamber. 1 no. 150mm dia. sluice valve leaking.
	vi) Chlorination arrangement Masonry platform with common mixing tank and two FRN dosers, one for each unit.	Mixing in 1.2m x 0.5m x 0.6m uPVC tank, using sticks. FRN doser not in good working condition.
	vii) Scour chamber - 3 nos.	Unplastered masonry chambers
	viii) Washout chamber	Unplastered masonry chambers
TW - 4	**Composite Treatment Unit II** with horizontal flow sedimentation chambers and a central rapid sand filter. Capacity 40m3/hr. Built in 1995. Backwashing done daily.	Good structural condition. Operating under overloaded conditions with decanting pipe submerged.
	Components:	
	i) Inlet valve chamber	Common chamber with Unit 1
	ii) Inlet and mixing chamber 1.6m x 0.6m into masonry.	In good condition. Concrete 'V' notch is dosing point.
	iii) Alum dosing chamber 0.65m x 0.45m x 1.0m deep concrete	Mixing done using sticks. No water pipe for mixing. No valve at outlet. No scour.
	iv) Alum doser - FRN type gravity doser	Not in good working condition
	v) Outlet valve chamber 2.4m x 1.6m x 2.1m deep masonry	Unplastered masonry chamber with only one step iron,
	vi) Chlorination arrangement Common mixing chamber as for Unit I and FRN doser	FRN doser not in good working condition
	vii) Scour chamber - 3 nos.	Unplastered masonry chambers. 1 No. sluice valve completely rusted.
	viii) Washout chamber is common as above scour chamber	Sluice valve and fittings in good condition.

	Component	Evaluation
ST - 1	**Storage Tank 1** Underground masonry tank capacity 265m3. Filtered water from **TW-2** and **TW-4** are stored. i) 2 Nos. inlet chambers (No chamber or sluice valve for third inlet). ii) 1 No. outlet chamber iii) Scour pipe iv) Overflow pipe 150mm dia 0.5m from soffit of tank.	Tank is in good structural condition. There are no ball float valves for 3 Nos. inlets. 1 No. 150mm dia sluice valve is tight to operate. Covers for both chambers are missing. 1 No. 150mm dia. sluice valve is leaking Not provided. Overflowing continuously during period of observation.
ST - 2	**Storage Tank 2** Underground masonry tank capacity 91m3. Filtered water from **TW-2** are stored. i) 3 Nos. inlets ii) 3 Nos. outlets iii) Scour **Storage Tank 3** Underground masonry tank capacity 455m3. Filtered water from **TW-2 and TW-3** are stored. i) 4 Nos. inlet chambers (2 Nos. inlet presently not in use) ii) 3 Nos. outlet chamber iii) Scour and overflow **Office and Laboratory** One masonry building with 2 rooms Chemical store masonry building 3.8m x 2.8m internal. **Site Works** 1) The site is fenced with barbed wire on cedar posts and hedge grown in parts. ii) Gates provided at entrance and exit to site iii) Internal drains iv) Security lighting	Tank in good structural condition. Only 1 presently in use. Cover for chamber missing 150mm dia. No ball float valve. Sluice valve condition. 1 No. 150mm dia. sluice valve rusty and 1 No. leaking. 1 No. 75mm dia. sluice valve broken. 1 No. 75mmdia. sluice valve broken Tank walls have cracks and leaks over a half perimeter of tank. No ball float valves 1 No. 150mm dia. sluice valve is rusted. 1 No. 150mm dia. sluice valve is rusted. 2 Nos. 75mm dia. sluice valves are rusted. Office has basic furniture. Laboratory has negligible equipment.Tests done only for Residual Chlorine and pH. Building is in poor state. Storage of up to 100 bags alum and 60 bags chlorine. Fence is not in straight lines between corners. 30m fence broken. Gates are in good condition. Inadequate. Part of of drive way is eroded due to lack of drainage. In poor state.

(2) Repair and Rehabilitation Proposed

All facilities constructed at the treatment works except the sedimentation units built in 1952 are in operation. Measuring devices such as flow meters installed, however, are all broken because of an absence of the proper maintenance. Repair or rehabilitation are required at the following facilities and equipment.

- **Filtration Units**
  4 nos of inlet valves, 150mm in diameter, shall be replaced
  4 nos of outlet valves, 150mm in diameter, shall be replaced
- **Storage Tank 1**
  One outlet valve with a diameter of 150mm to be replaced
- **Storage Tank 2**
  Two outlet valves with a diameter of 75 and 150mm to be replaced
- **Storage Tank 3**
  Leak repair of tank walls
- **Flow meters to be replaced or newly installed**

Type	Diameter (mm)	No.	Location
Mechanical	200	1	Outlet 200mm uPVC
ditto	150	1	Outlet 150mm AC
ditto	**75**	1	Outlet 75mm AC
ditto	**50**	1	Outlet 50mm GI

2.4 High Level Tanks

The high level tanks constructed in 1978 are to supply the Gatabora spring water to the high level Kaithe zone, newly developed area of Meru town. They are located 3 km northwest of the Milimani Treatment Works. Two units of storage tanks are constructed. The inflow rate was measured at 112 m3/hour. After chlorination at the tank inlet, the spring water are supplied to about 400 customers in the high level zone.

All facilities are in a working condition. No repair other than installation of the manhole covers is required.

	Component	Evaluation
HLT - 1	**Hlgh level tanks** 2 nos. masonry tanks of capacity 150m3 each.	Structurally in good condition
	i) Inlet chamber and fittings (common) masonry chamber 1.53m x 1.06m external	Cover for chamber manhole is missing. 200mm dia. sluice valve is rusted.
	ii) Outlet chamber and fittings (common) masonry chamber 1.76m x 1.44m internal, without cover slab.	Chamber and fittings are in good condition.
	iii) Washout chamber located on Raw Water Main. Masonry chamber 1.87m x 1.55m external.	Cover for chamber manhole missing 0.53m x 0.53m. Chamber and fittings in good condition.
	iv)Chlorination arrangement on roof of tank. 1.2m high platform with fibre glass mixing tank 1.2m x 1.2m x 0.6m.	Mixing done with sticks. There are no dosers, dosing is done directly from tank.
	v) Meter chamber. Masonry chamber 0.8m x 0.8m internal	150m m dia.meter operational but leaking. Chamber in good condition.
	vi) Reflux valve chamber. Masonry chamber 1.0m x 1.0m internal.	Non-return valve in working condition. Sluice valves rusty.
	vii) Washout The washout has not been used to supply water to the elevated tanks at the Treatment Works through a 150mm dia. uPVC pipe.	No chambers are provided. 1 No. sluice valve 150mm dia. is leaking.
	viii) Water level measurement	Not operational
	Site Works i) Stuffing house with a soakaway and a pit latrine	

2.5 Distribution Pipe Network

(1) Evaluation of Pipe Network

The distribution network comprises of two supply zones; the high level distribution zones and the low level distribution zones as shown in ***Figure C2-2***. In the low level distribution zone, there are two parallel networks of lines laid in 1956 and those laid in 1978. Details of the pipelines and their appurtenances are given below:

	Component	Evaluation
HLZ	**Distribution to High Level Zones**	
HLZ - 1	**Kaithe Zone**	
	Distribution Mains:	
	150mm uPVC main 790m (laid in 1978)	The pipes are laid to a good depth and
	100mm uPVC main 800m (laid in 1978)	are generally in good condition.
	75mm uPVC main 1930m (laid in 1978)	
	50mm uPVC main 1100m (laid in 1978)	
	Appurtenances:	
	10 Nos. Sluice valves	1 No. chamber is broken.
	2 Nos. Air valves	2 Nos. marker posts need to be painted.
		5 Nos. 150mm dia., 1 No. 75mm dia. and 1 No. 50mm dia. sluice valve need to be rehabilitated.
	Areas of Water Shortages:	
	Kaithe Academy, Herry Kinywa Estate.	No visible leaks on pipes. Amount of water at source is generally low. Frequency of shortages-once a week
HLZ - 2	**Milimani Zone**	
	Distribution Mains:	
	150mm uPVC main 395m (laid in 1978)	
	100mm uPVC main 240m (laid in 1978)	
	75mm uPVC main 1130m (laid in 1978)	
	50mm uPVC main 430m (laid in 1978)	
	Appurtenances:	
	7 Nos. Sluice valves	3 Nos. chambers have no covers.
	4 Nos. Fire Hydrants	3 Nos. 75mm dia. sluice valve need to be rehabilitated.
	1 No. Air valve	1 No. markerpost for fire hydrants is missing.
		1 No. markerpost for sluice valve needs to be painted.
	Areas of Water Shortages:	
	near Tuntu Estate.	No visible leaks on pipes. Amount of water at source is generally low.
HLZ - 3	**Kaaga Zone**	Frequency of shortages - 3 days a week.
	Distribution Mains:	
	75mm uPVC mains 1030m (laid in 1978)	
	50mm uPVC mains 1250m (laid in 1978)	
	50mm uPVC mains 1380m (laid in 1978)	
	Appurtenances:	
	2 Nos. Sluice valves	1 No. Chamber cover broken.
	1 No. Fire Hydrant	2 Nos. sluice valves needs to be repaired.
	Areas of Shortage:	No visible leaks on pipes. Amount of
	Mafuko industries, Kaaga Girls Secondary School	water from source is generally low. Frequency of shortage-twice a week

	Component	Evaluation
LLZ	**Distribution to Low Level Zones**	
LLZ - 1	**Milimani Zone**	
	Distribution Mains:	
	200mm uPVC main 560m (laid in 1978)	The pipes are laid to a good depth and are
	150mm uPVC main 380m (laid in 1978)	generally in good condition.
	100mm uPVC main 850m (laid in 1978)	
	100mm uPVC main 980m (laid in 1956)	
	75mm uPVC main 380m (laid in 1978)	
	75mm uPVC main 610m (laid in 1956)	
	50mm uPVC main 440m (laid in 1978)	
	50mm uPVC main 1145m (laid in 1956)	
	Appurtenances:	3 Nos. appurtenances have no chambers.
	11 Nos. Sluice valves	3. Nos. chambers are partly broken.
	5 Nos. Fire Hydrants	6 Nos. covers are missing.
	1 No. Air valve	6 Nos. markerposts are missing.
	1 No. Washout	2 Nos. markerposts are broken.
	2 Nos. Break Pressure Tanks	1 No.markerpost needs to be painted.
		1 No. fire hydrant, not connected to main line.
		2 Nos. fire hydrants need to be cleaned.
		2 Nos. 50mm dia. slice valves are broken.
		3 Nos. 200mm dia., 1 No. 150mm dia., 1 No. 100mm dia. and 2 Nos. 75 mm dia. sluice valves need to be rehabilitated.
		1 No. 200mm dia. bulk meter and 2 Nos. 100 mm dia. bulk meters not working.
		1 No. BPT has no float valve - 50mm dia. BPT overflowing at rate of 100 l/min.
	Areas of Water Shortages:	None reported.
LLZ - 2	**Town Zone**	
	Distribution mains:	The uPVC pipes are laid to good depth and are
	100mm uPVC mains 1000m(1978)	generally in Good condition. The AC and GI
	100mm AC mains 460m (laid in 1956)	pipes are laid to shallow depths in many places
	50mm uPVC mains 900m (laid in 1978)	and are prone to damage. AC pipes are
	50mm GI mains 810m (laid in 1956)	repaired with GI pipes.
	Appurtenances:	
	10 Nos. Sluice Valves	2 Nos. markerposts for sluice valves are missing.
		4Nos. chambers have no covers.
		2 Nos.100mm dia. 1 No. 75mm dia. and 1 No. 50mm dia. sluice valves need rehabilitation.
		1 No. fire hydrants needs rehabilitation.
	3 Nos. Fire Hydrants	1 No. break pressure tank has no ball float
	2 Nos. Break Pressure Tanks	valves -75 mm dia.
		1 No. break pressure tank - inlet valve has broken chamber and no cover.
	Area of water shortages	None reported.

	Component	Evaluation
LLZ -3	**Nubian Zone**	
	Distribution mains:	The uPVC mains are laid to good depth and are generally in good condition. The GI pipes are laid to shallow depths in some places and are prone to damage.
	150mm uPVC mains 630m (laid in 1978)	
	100mm uPVC mains 105m (laid in 1978)	
	75mm uPVC mains 130m (laid in 1978)	
	50mm UPVC mains 595m (laid in 1978)	
	50mm GI mains 480m (laid in 1956)	
	Appurtenances:	
	4 Nos. Sluice Valves	1 No. appurtenance has no cover. 3 Nos. covers are missing. 1 No. fire hydrants need to be cleaned. 3 Nos. markerposts for appurtenances are missing.
	1 No. Fire Hydrants	1 No. break pressure tank has no ball float valve 75 mm dia. inlet chamber for BPT has no cover.
	1 No. Break Pressure Tank	
	Areas of Water Shortages:	None reported.
LLZ - 4	**Kooje Zone**	
	Distribution mains:	The pipes are laid to good depth and are generally in good condition.
	75mm uPVC mains 215m (laid in 1978)	
	50mm uPVC mains 1705m (laid in 1978)	
	Appurtenances:	5 Nos. markerposts are missing.
	3 Nos. Sluice Valves	3 Nos. appurtenances have no chambers.
	4 Nos. Fire Hydrants	1 No. fire hydrants needs to cleaned. 1 No. single air valve is missing.
	1 No. Air Valves	
	Area of water shortages	Generally no shortages are reported.
LLZ - 5	**Gakoromone Zone**	
	Distribution basins:	The pipes are laid to a good depths and are generalluy in good condition.
	50mm UPVC mains 2830m (laid in 1978)	
	Appurtenances:	
	4 Nos. Sluice Valves	2 Nos. appurtenances have no chambers.
	2 Nos. Fire Hydrants	4 Nos. appurtenances have no markerposts. 2 Nos. 50mm dia. sluice valves not working. 2 Nos. 50mm dia. sluice valves need to repair. 1 No. appurtenances have no cover.
	Areas of Shortages	Generally no shortages have been reported.
LLZ - 6	**Maize Control Zone**	
	Distribution mains:	Pipes are laid to good depth and are generally in good condition.
	100mm uPVC mains 150m (laid in 1990)	
	75mm uPVC mains 470m (laid in 1990)	
	50mm uPVC mains 565m (laid in 1978/1990)	
	Appurtenances:	
	2 Nos.Sluice Valves	100 dia. sluice valve has no chamber.
	Areas of Water Shortages: Majengo	Reported once a month on average.

	Component	Evaluation
LLZ - 7	**Thimangiri Zone** Distribution mains: 50mm uPVC mains 1210m (laid in 1978) Appurtenances: 2 Nos. Sluice Valves (1 No. Storage Tank on 40 mm dia. line)	Pipes are generally in good condition. 2 Nos. sluice valves have no chambers. (Masonry tank capacity 25m3. No ball float valves. No chamber for inlet valves).

(2) Total Length

The distribution mains of PVC and GI are generally in good condition. Some AC and GI pipes laid in Town Zone are found in a shallow depth, which are prone to damage. Most AC pipes laid earlier are difficult to locate. Table below summarizes total length of the distribution and raw water transmission mains installed to date.

SECTION	PIPE SIZE (mm)	PIPE MATERIALS	APPX. LEGTH (m)	REMARKS
Raw Water Mains	300	uPVC	3,150	Part of the line is in 200mm uPVC pipe.
	200	uPVC	1,000	
	150	uPVC	1,500	Part of the line is in 200mm uPVC pipe.
High Level Distribution Zones	150	uPVC	1,185	Part of the lines in Kaaga zone are for low level distribution and are not included here.
	100	uPVC	1,040	
	75	uPVC	2,790	
	50	uPVC	2,270	
Low Level Distribution Zones	200	uPVC	560	Part of lines for Kaaga are included.
	150	uPVC	1,010	
	100	uPVC	2,105	
	100	AC	1,440	
	75	uPVC	1,495	
	75	AC	610	
	50	uPVC	8,755	
	50	GI	2,435	
Total			**31,345**	

(3) Rehabilitation

Our survey indicated that the visible leaks are taking place at the broken sluice valves. They are recommended to be replaced at an early stage of project development. This rehabilitation will benefit on significant water loss reduction at the distribution network.

Area	Scope of Rehabilitation
a. Milimani Zone	5 Nos. 150mm dia., 1 No. 75mm dia. and 1 No. 50mm dia. sluice valve need to be rehabilitated.
b. Town Zone	2 Nos.100mm dia. 1 No. 75mm dia. and 1 No. 50mm dia. sluice valves need rehabilitation.
c Gakoromone Zone	2 Nos. 50mm dia. sluice valves need to repair.

3 WATER FLOW AND PRESSURE MEASUREMENT

3.1 Bulk Flow Measurement

Bulk flow measurements were carried out at various locations within the water supply system as shown in ***Figure C3-1***. Locations finally determined are:

- Gatabora Spring Intake
- Kathita River Intake
- High Level Tanks
- Treatment Works

The flow meter used for the measurements were the UFW 600P (ultrasonic flow meter). The two sets of flow meters brought by JICA Study Team from Japan did not work due to misconnection with high voltage current.

Total losses during transmission and at treatment works were estimated at around 270m3/h, equivalent to 51% of the intake rates. Out of these losses, the overflow at the treatment works were particularly large, recording 130m3/h, or 27%. As the system flows by gravity and no equipment is installed for flow control, it is difficult to minimize the overflow. ***Figure C3-1*** also presents inflow and outflow rates and water losses during transmission and at the treatment works.

3.2 Pressure Measurement

The pressure measurements were carried out at several points of the distribution network as shown in ***Figure C3-2***. To this end, pressure gauges capable of measuring from 0 to 34 bars were used. Pressure readings were recorded at 8:00, 10:00, 12:00, 16:00, 18:00 and at 24:00. The results suggest that;

- Pressure distribution varies from a high of 5.2 bars to 0.2 bars depending on distance from the treatment works, pipeline length and diameter, and altitude.

- Low pressures were recorded at the eastern fringe of the service area, in a range of between 0.2 to 1.0 bars,

- The high level zone at the northern west of the town center, is suffering from the extreme low water pressure, less than 0.5 bar consistently.

- Due to insufficiency of the pipe diameter, water pressure is likely to fluctuate particularly at the fringe areas, depending on the magnitude of the water consumption at the town center.

4. WATER LOSS SURVEY

To identify the patterns and magnitude of water losses from the distribution system, a water loss survey has been carried out for a selected pilot area containing 330 households. The pilot area selected is shown in ***Figure C4-1***.

The pilot area is located in the Kooje zone of the distribution network. This zone has been selected because of the following:

- the zone is representative of the network system consisting of various diameters of old and new pipelines installed,
- the zone can be isolated by closing valves,
- there is regular supply to the zone,
- the zone had 330 households/subscribers,
- the zone can be subdivided into 3 sub zones by closing isolating valves, and
- water pressures are reasonably high in the zone and consistent.

In order to assess the water consumption in the pilot area the following has been carried out.

- Consumer survey to determine the number of consumers in the pilot area, the zone is representative of the network system consisting of various diameters of old and new pipelines installed,
- Water consumption patterns in two service blocks. Service Block 1 contained 9 metered connections and Service Block 2 contained 10 unmetered connections.

The minimum night use, UFW and leakage levels in the area have been assessed by carrying out flow and pressure measurement within the pilot area. Step down tests were also carried out to determine the UFW in the pilot area.

4.1 Customer Survey

(1) Status of Customers

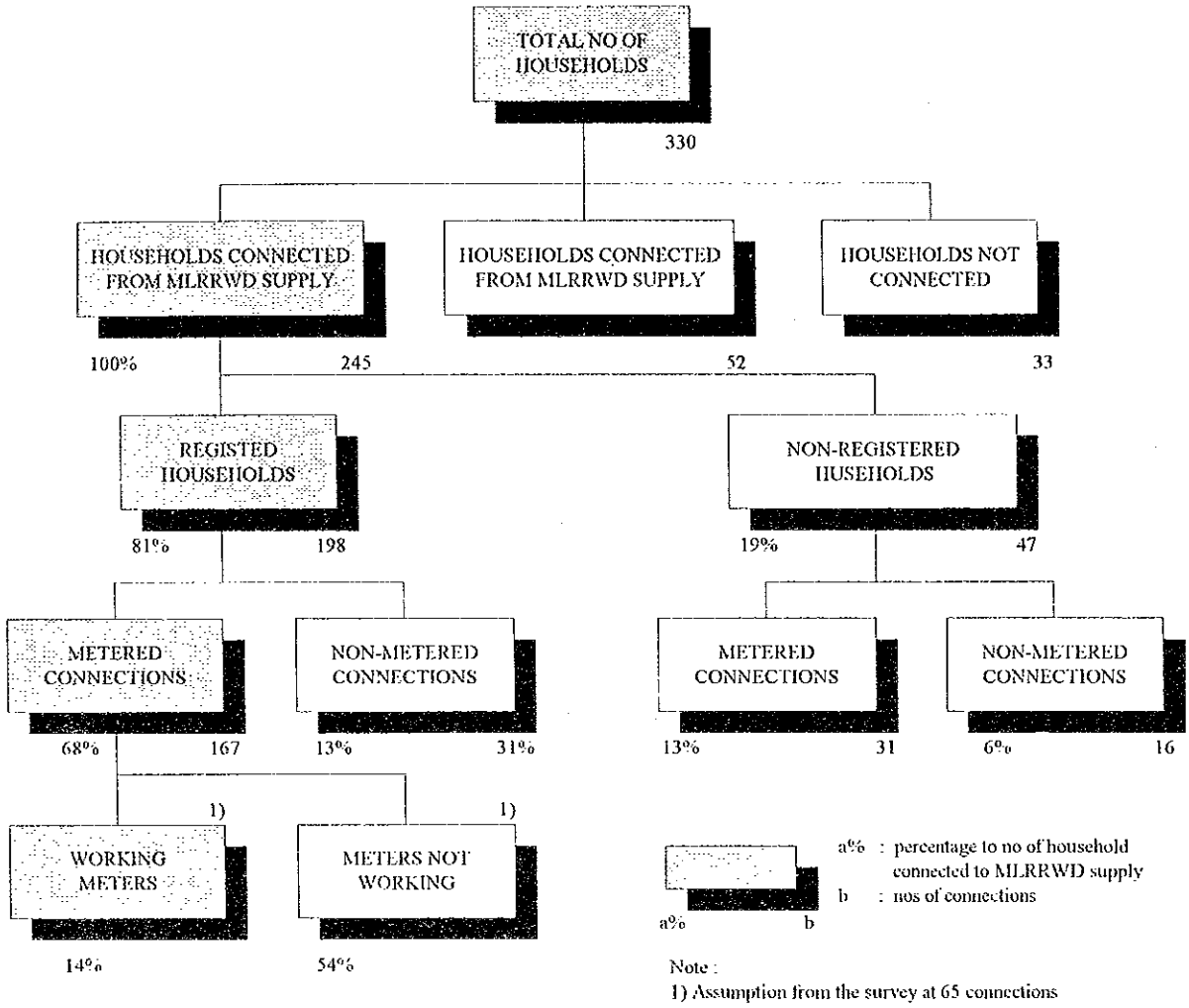
The aim of the customer survey was to primarily determine the average number of consumers, status of supply-metered or unmetered and condition of connections. This information has enabled the consumption pattern of the households to be determined. In turn the level of UFW and leakage can be assessed.

The required information has been collected using the questionnaire. The questionnaire covered 100% of the selected pilot area (330 households). The results of the survey are summarized below:

- Total population of the pilot area : 1,633 persons.
- The average number of persons per household : 5
- 74% of the households are customers of the Ministry Water Supply
- Out of them, 81% of the customers are registered, and 19% non-registered.
- Metered connections accounts for 66% of the customers, with 13% with working meters and 53% with meters not working.

They are also schematically portrayed in the diagram below:

SUMMARY OF CONNECTIONS
AT PILOT AREA – KOOJE ZONE



(2) Consumption Patterns

Attempts were made to determine and compare the water consumption at customers who have individual connections with working meters and customers who are charged on a flat rate tariff basis. A block containing 69 connections was selected from the pilot area. Out of them, 67 connections were metered and 2 were disconnected. One (1) connection was a flat rate connection. Serial meters purchased in Kenya by the JICA Study Team were installed for 9 metered connections over a period of 4.5 days. It was assumed that consumers with non working meters were billed as being on the flat rate. In this case 53 connections had faulty or non working meters. The flow for these consumers has been calculated as the balance of the incoming flow less consumption recorded for metered connections using serial meters. The following results were obtained from the exercise:

- Bulk supply into the Block - 717m3 over 4.5 days

- The 9 metered consumers consumed 21m3 over 4.5 days

Based on the above,

Total incoming flow	:	159.0 m3/day
Total consumption by 13 metered consumers	:	6.8m3/day or 0.52m3/day per con. or 104 lpcd
Total consumption by 53 flat rate consumers	:	152.2m3/day or 2.87m3/day per con. or 574 lpcd

Per capita consumption for the metered customers is within the generally acceptable design values adopted for low to medium class housing for urban consumers. To the contrast, flat rate consumers use much water over 5 times larger than the metered customers. This is attributable to the following:

- The water charges are fixed and not based on actual consumption, the consumers do not have any reason to conserve water.
- As a result of the above consumers are known to leave taps open at night and also irrigate their vegetable gardens. This was obvious from the small scale vegetable gardening which is predominant in the area, despite the current dry season.

(3) Peak Flow Factor

From the 24 hour flow measurement at the same block, the peak flow factor has been calculated at 1.26 (= peak flow rate / mean flow rate). Peak flow, 144.78 l/min, was observed between 7:00 am to 9:00 am. Mean flow rate was computed at 114.37 l/min for the 67 connections. The variation in flow during the peak and off-peak periods is not very distinctive because of high consumption during the night as a result of leakage, irrigation.

4.2 Water Loss Survey

4.2.1 Step Down Test

The UFW within the system has been ascertained using the step down test in the Pilot Area. The pilot area has been divided into 3 sub zones which were isolated using boundary valves. The sub zones and the location of the boundary valves are shown in ***Figure C3-3***. The step down test was carried out over a 14 hour period between 8:00pm and 10:00am. The follwong procedure was carried out:

- From 8:00pm to 9:30pm, normal flow was maintained in the sub zone and measured using a 40 mm Kent PSM meter with logging apparatus.

- At 9:30pm sub zone I was isolated by closing BV1, BV2 and BV3. The flow was measured for this period.

- At 5:05am sub zone II was isolaed by closing SV3. GV3 was not closed since the flow on line A was being monitored.

- The isolating valves were opened between 7:45am and 8:00am.

From the field results, the following can be concluded:

• There was a marked reduction in flow after colsing the isolating valves for sub zone I. The flow reduced from 293.94 l/min to 194.92 l/min. The average flow into the sub zone was 99.02 l/min during that period.

• The night flow into sub zones II and III was constant at 187.9 l/min.

• The flow into sub zone II between 4:00am and 5:30am was 80 l/min.

• The flow into sub zone III between 4:00am and 5:30am was 177.24 l/min.

The assessment of water loss due to leakage cannot be conclusively estimated using the step down test because of the rather high night flow recorded. This high night flow is attributed to the consumers leaving their taps open to fill storage tanks and use of water for irrigation of vegetable gardens.

4.2.2 Unaccounted for Water - Pilot Area

The bulk flow into the pilot area was measured using a 40mm Kent PSM meter which is equipped with a pulsing unit. An average flow of 292 l/min, equivalent to 12,614.3 m3/month was recorded.

The following results were obtained from the Customer Survey.

• Total number of consumers in the pilot area: 330
• Total number of diconnections: 20
• Average monthly billing per connection: Kshs. 124
(Based on 200 concuemrs who were able to bive billing details)

Base on the above,

i) Total flow into the pilot area: 12614.3 m3/month
ii) Total numbe of active consumers: 310
iii) Monthly consumption per con.: 12614.3/310 = 40.69m3

The average monthly billing of Kshs. 124 per connection is equivalent to approximately 13 m3/month/connection, based on present tariff structure.

UFW for the pilot area is estimated at 27.69m3 (= 40.69-13.0), or 68%.

4.3 Recommendations for Future Studies

(1) Bulk metering of complete distribution system

It is recommended that bulk meters be installed on all trunk mains serving the main distribution zones. This will help to ascertain the actual supply against consumption and revenue earned from each zone. Also this correlation will enable determination of UFW due to leakage, illegal connections and administrative losses.

(2) Flat rate consumption

Results from field studies have shown that consumption by flat rate consumers is very high. It is recommended that metering of 10 or more flat rate connections be carried out without consumers knowledge in order to assess actual consumption. This exercise may have to be carried out over a period of time especially during the dry season in order to determine the consumption due to irrgation.

(3) Status of meters

It has been established that 80% of the meters are not working. It is recommended that the meters be checked to identify the cause of malfunctioning. The malfunctioning of the meters may be due to vandalism, faulty meters, blockages, age, etc.

(4) Serial metering - individual connections

Serial metering to be carried out in a number of distribution zones to assess the accuracy of the existing meters which are working.

(5) Customer survey

Customer survey shall be carried out for the whole supply area in order to prepare a register of consumers. A comparison of this register with MLRRWD registered consumers will enable the illegal connections to be identified.

(6) UFW - raw water main

Raw water main from Kathita intake to Treatment Works at Milimani shall be investigated to identify leaks or illegal connections to account for the large UFW.

(7) Night flow / consumption patterns - pilot study

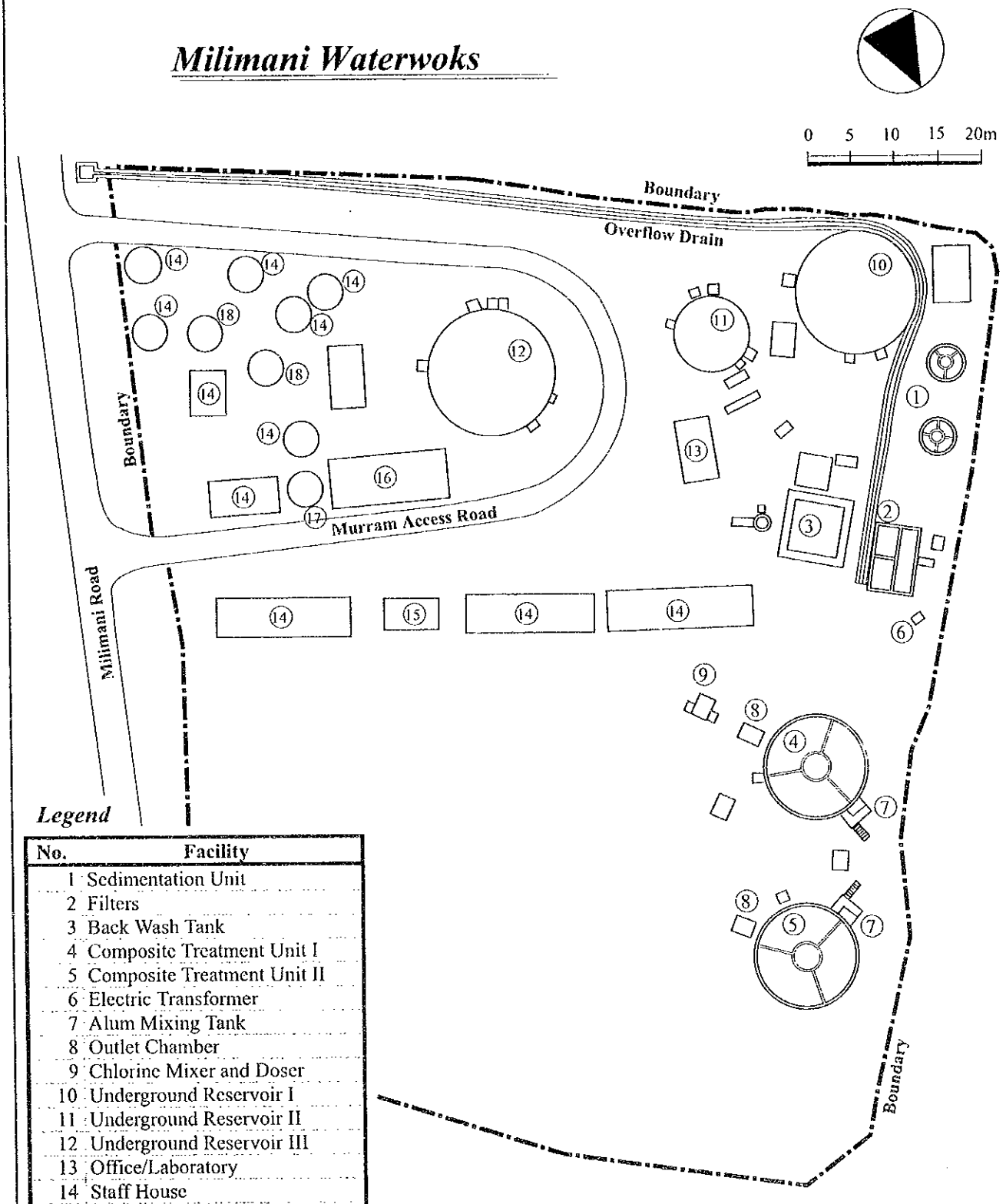
Flow shall be measured in two different pilot areas over a period of several days to ascertain night flows and patterns of consumption.

(8) Interconnections

It has been established that the network within the distribution zones comprises of pipes mostly 50mm dia. and below. The spot survey which was carried out, allowed for picking details for pipes 80mm dia. and above. It is recommended that in order to have an inventory of the complete system a detailed survey shall be carried out for pipes of 50mm dia. and below to identify interconnections and extent of the pipework within the distribution zones.

FIGURES

Milimani Waterwoks

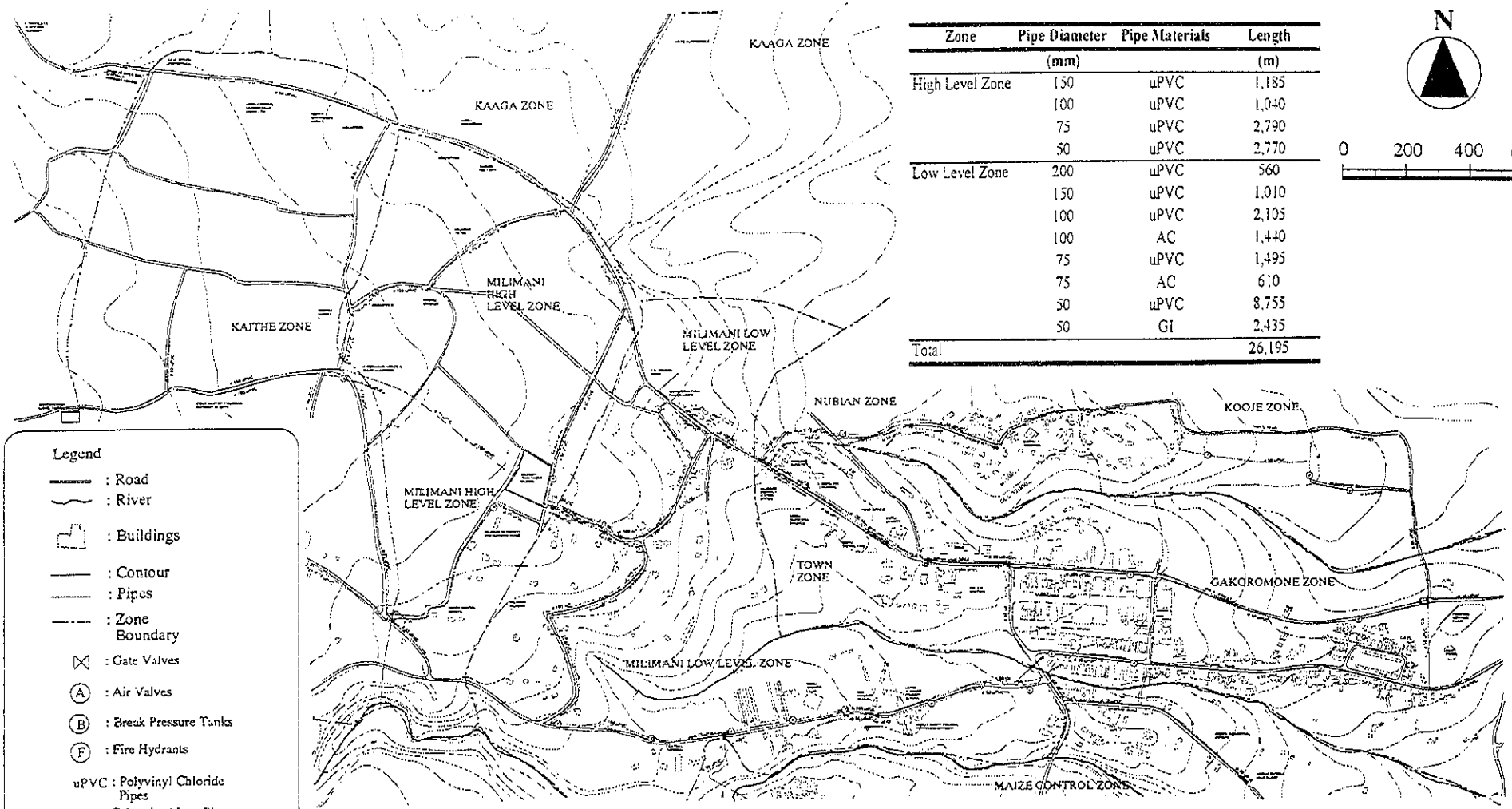


Legend

No.	Facility
1	Sedimentation Unit
2	Filters
3	Back Wash Tank
4	Composite Treatment Unit I
5	Composite Treatment Unit II
6	Electric Transformer
7	Alum Mixing Tank
8	Outlet Chamber
9	Chlorine Mixer and Doser
10	Underground Reservoir I
11	Underground Reservoir II
12	Underground Reservoir III
13	Office/Laboratory
14	Staff House
15	Mechanical Store
16	Store for pipes and fittings
17	Chemical Store
18	Hydrological Store

Source: JICA Study Team

THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA JAPAN INTERNATIONAL COOPERATION AGENCY	**Figure C2-1** **General Plan of** **Milimani Waterworks**



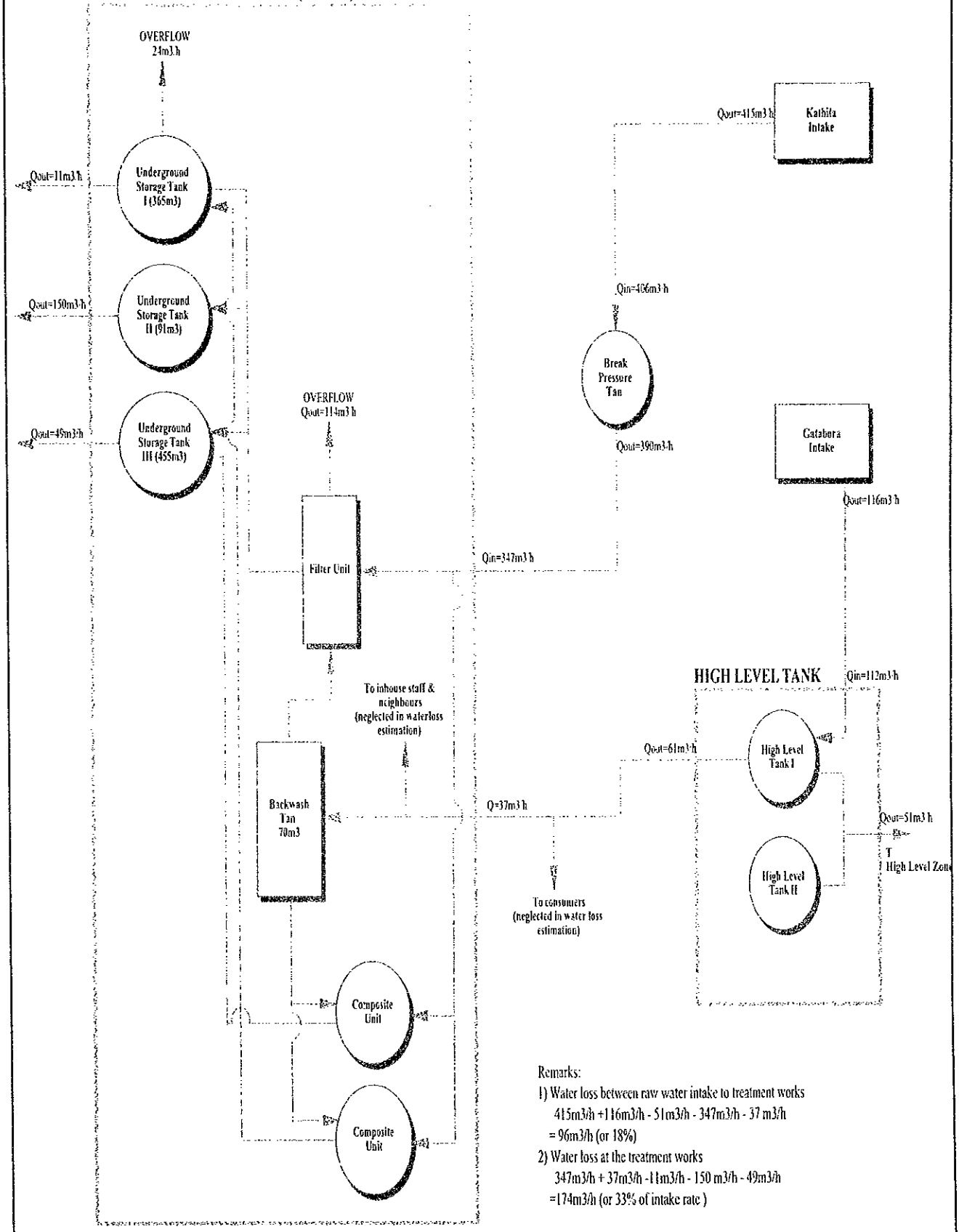
Zone	Pipe Diameter (mm)	Pipe Materials	Length (m)
High Level Zone	150	uPVC	1,185
	100	uPVC	1,040
	75	uPVC	2,790
	50	uPVC	2,770
Low Level Zone	200	uPVC	560
	150	uPVC	1,010
	100	uPVC	2,105
	100	AC	1,440
	75	uPVC	1,495
	75	AC	610
	50	uPVC	8,755
	50	GI	2,435
Total			26,195

Note:

1) This figure shows all distribution pipelines with a diameter of 50mm or larger, installed in Meru Township.
2) Contour lines are shown with an interval of 10m.

Prepared by JICA Study Team, 1977

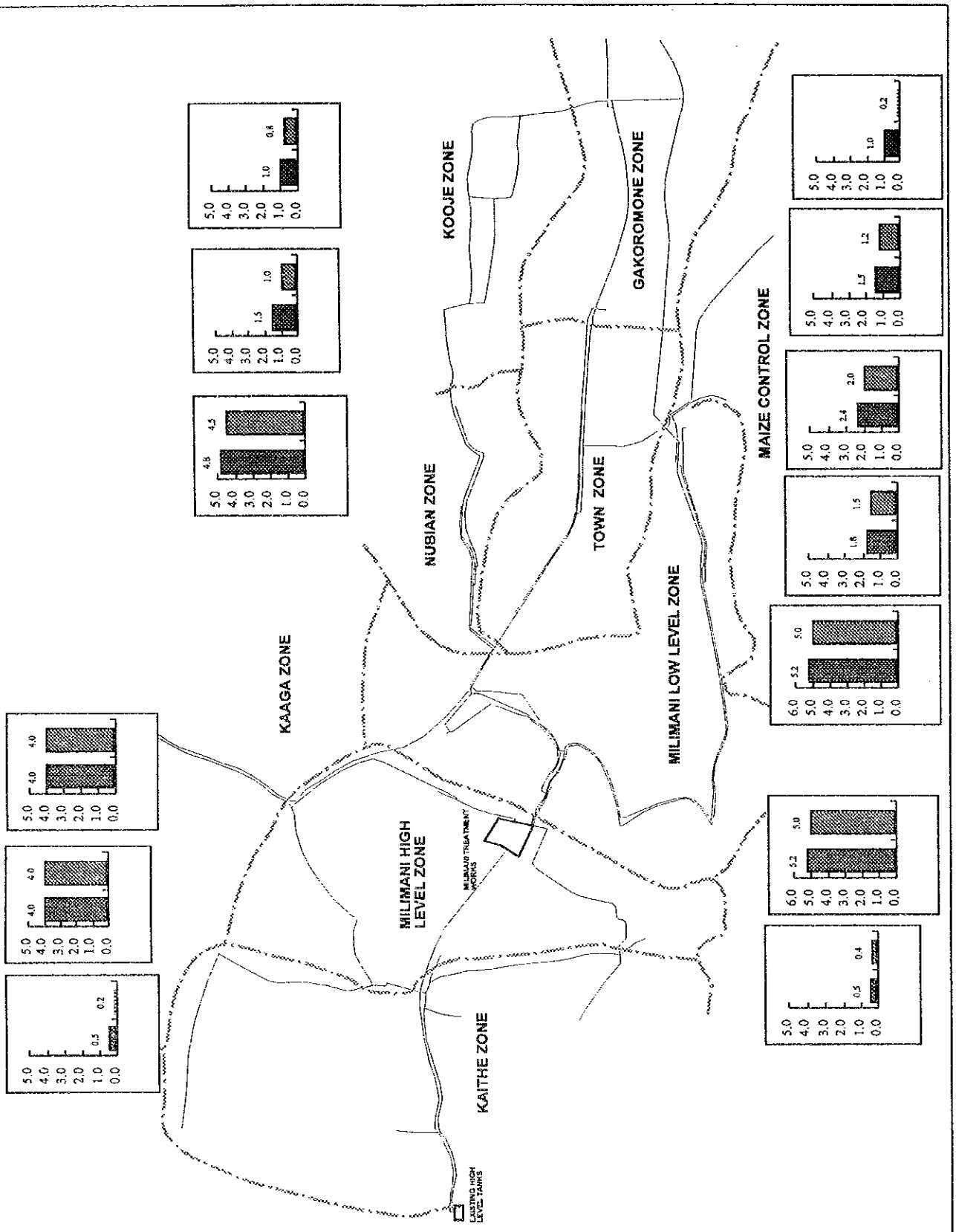
THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA	**Figure C2-2** **Existing Distribution Pipe Network**
JAPAN INTERNATIONALCOOPPERATION AGENCY	



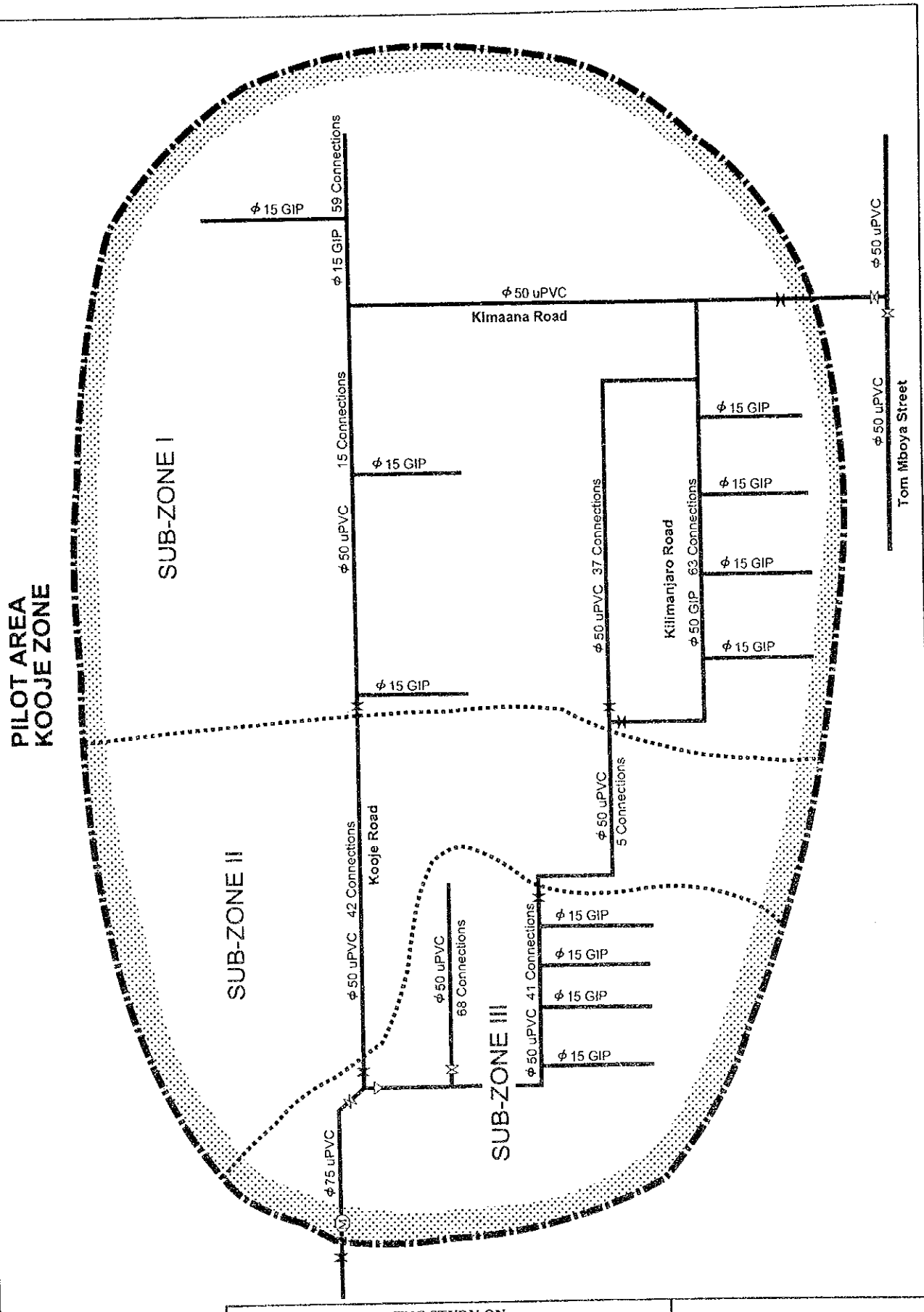
Remarks:

1) Water loss between raw water intake to treatment works
   415m3/h +116m3/h - 51m3/h - 347m3/h - 37 m3/h
   = 96m3/h (or 18%)
2) Water loss at the treatment works
   347m3/h + 37m3/h -11m3/h - 150 m3/h - 49m3/h
   =174m3/h (or 33% of intake rate)

THE STUDY ON THE WATER SUPPLY FOR SEVEN IN EASTERN PROVINCE, THE REPUBLIC OF KENYA JAPAN INTERNATIONAL COOPERATION	**Figure C3-1** **Flow Rate at Water Works**



THE STUDY ON THE WATER SUPPLY FOR SEVEN TOWNS IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA JAPAN INTERNATIONAL COOPERATION AGENCY	Figure C3-2 Water Pressure Distribution



THE STUDY ON THE WATER SUPPLY FOR SEVEN IN EASTERN PROVINCE IN THE REPUBLIC OF KENYA JAPAN INTERNATIONAL COOPERATION AGENCY	Figure C4-1 Pilot Area for Water Loss

APPENDIX D

COMMUNITY WATER SUPPLY

APPENDIX D COMMUNITY WATER SUPPLY

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1. GENERAL

The government of Kenya policy pronouncements are clear that water is a basic need that should be accessible to all Kenyans. Over the last 30 years, Kenya has made substantial progress in improving water supply services in the country. Despite these great improvement, it is evident that the national water supply goals are yet to be fully realised. Rapid population growth has put overwhelming demand on water supply services at a time when government resources are limited to meet the demand. It is for this reason that the private sector, non-governmental organizations, and local communities are being encouraged to develop and run their own water supply schemes.

Many local community based water supply schemes that were initiated in the seventies and eighties are today faced with serious technical, operational and maintenance problems. These problems have become so severe that some of the water supply schemes have actually collapsed. Many of the water supply schemes are poorly designed, their service areas overlap, and their development is neither co-ordinated nor integrated. The water supply schemes are developed and run by different organizations and without proper co-ordination and supervision by the MLRRWD.

A reconnaissance survey in the study area on these communal water schemes was carried out to identify existing situation, main problems they encounter and to propose future development strategy for the community water schemes.

2. INVENTORIES AND OUTLINE FEATURES

Administrative boundaries and supply areas of Community water supplies are shown in ***Figures D2-1 to 5***.

2.1 Meru

The survey of community water supply systems in Meru identified the existence of about 66 projects. Lack of proper records made it difficult to identify all existing projects within the study area. Out of them, 20 of the projects identified were visited and studied in depth whereas the other information was collected by interviewing the committees. This subsection will describe the outline features and major problems of these 20 community water supply schemes in Meru. ***Table D2-1*** gives the summary of each scheme.

2.1.1 Runogone Water Project

(1) Location and Service Area

The water project is located in Kithoka sublocation and supplies water to Runogone and Karegeria villages. This area is on the left-hand side of the Meru-Maua road, 7km from Meru town. The area has occupied by about 500 households and serves over 2000 people. The total service area is approximately
6 km^2.

(2) Organization and Management

The project started in 1973. The project is owned and run by a local community group of over 300 households and is managed by an elected general committee of 21 members, drawn from across the entire service area. There also exists a member executive committee. The entire executive committee is composed of educated men who are either retired or serving public service officers and teachers.

The whole project group meets once every three months and elections are held once in two years. The committee so elected is charged with the responsibility of operating and maintaining the system, revenue collection and fund-raising, and preparation of expansion programmes for the project.

(3) Intake and Distribution

1) The Intake

The intake is located on the Gachiuma river next to Kaaga Girls High School along the Meru-Maua Road. The river flow at the intake is high. The surrounding area is however densely cultivated making the area susceptible to pollution.

The existing side intake is poorly constructed but a new intake has been designed and this is expected to boost water supply.

2) Reticulation System and Storage

The trunk main is a 150mm diameter PVC pipe running over 1.5km to the first storage tank. A parallel 50mm diameter pipe serves the people between the

tank and the intake. The second tank is located 1km below the first tank and is fed by a 100mm diameter pipe. The two tanks have a capacity of 40,000 and 60,000 gallons respectively.

There are in total 10 main distribution lines serving different project area zones, 5 from each tank. The storage capacity is inadequate but the tanks are not covered thus exposing water to pollution.

(4) Finance and Demand

1) Development Finance

The initial capital investment of the project was borne by member contributions that covered construction of the intake and laying down of the pipes. The government assisted the project in the construction of the 40000 gallon tank through the Rural Development Fund (RDF). The total initial investment cost was the tune of ksh.600,000.

In 1995 the project obtained financial assistance worth 30000 Canadian Dollars (ksh.1.2million) which was utilized in extending the pipeline and construction of a second tank.

2) Water Demand

Most of the water from the project is utilized for agriculture (60%) while the rest is mainly for domestic use (30%) and institution use 10%. The project serves 4 churches, 1 primary school and 1 cattle dip. While the water may currently be inadequate for expansion of the service area, current users are adequately provided with water.

3) Operation

Like all other schemes the project is a gravity flow system. Current augmentation programme has strictly adhered to the technical design by the Ministry of Water Development. Inspection of the pipeline and intake is currently being done by 2 paid patrollers in conjunction with the committee. Plans are underway to employ a trained technician.

4) Tariff Structure

Members with individual connections do not pay for water. The system is not

metered. Money to maintain the system is obtained from new members whose contributions cover both registration fees and a labour premium.

(5) Key Problem Areas

Though well planned, the need for expansion of the system to serve the lower side is of immediate concern to the project. The existing intake is partly constructed and shared with the Nyakii coffee factory. The need to improve the intake and expand the trunk main is important. This will ensure that the water rationing will not be necessary.

The tanks need to be covered to protect them from dust and other sources of pollution and there is need to provide basic treatment especially due to the existence of domestic uses.

2.1.2 Lower Chungu Water Project

(1) Location and service area

The project is located in Chungu location and serves areas of Mulathankari, Kaaga and Munithu sublocations. The project area is about 10km from Meru town. The project has a design service population of 16000 persons but currently serves slightly over 6000. The service area is expansive and covers 24km^2.

(2) Organization and Management

The project was started in 1997 and currently has a membership of 344 members. It is managed by an elected committee of 11 members. The main executive committee is composed of educated members. This group is currently undergoing management and leadership problems and elections that should be held every year have not taken place for the last 3 years. Group meetings have been held once every 3 months but attendance has been poor.

None of the officials has been able to obtain any training on management operation and maintenance of water supply schemes.

Development Finance

The initial capital investment cost of the project was borne by member

contributions that covered the construction of the intake and laying down of the pipes. The government assisted the project in the construction of the 40,000 gallon tank through the Rural Development Fund (RDF). The total initial investment cost was to the tune of Kshs.600,000. In 1995, the project obtained financial assistance worth 30,000 Canadian Dollars (KShs.1.2 million) which was utilized in extending the pipeline and construction of a second tank.

(3) Intake and Distribution

1) Intake

The intake is located at the Karumanthi Stream next to Kaaga Boys High School. The intake chamber is properly covered but the adjoining areas upstream and heavily farmed thus pollution is eminent. The production of the spring is currently very low and thus not adequate to supply the area. The source is swampy and accessibility is difficult. A new proposed intake is located on river Nadrima.

2) Reticulation System and Storage

The main trunk line from the intake is a 150m diameter PVC pipe which reduces to 100 mm diameter by the time it reaches the first storage tank located 2 km down stream.

There are in total 3No. storage reservoirs of capacities 40,000, 10,000 and 5000 gallons respectively. The main tank has been cracked and cannot hold water.

Water is supplied to about 32 households before reaching the first reservoir. In total the project has 322 individual connections. The main distribution lines are 75 mm x 50 mm diameter PVC pipes running over a distance of about 6 km. Most of the taps in the supply area are dry because of inadequate pressure head.

(4) Operation and Maintenance

The project is a gravity flow system. The management committee has however been doing very little to maintain the system. Most of the water is lost at the cracked storage tank. Vandalism is also common in the area and some of the pipes have been damaged.

Tariff Structure

Being a non metered system, members do not pay for water. Money for maintenance is raised on ad hoc basis or from new members who have not been entering due to non performance of the system.

(5) Key Problem Issues

The project has an acute management and leadership problem and divisions do exist between members from different region of the supply area. The intake is also insufficient and identification of a new source is necessary.

Implementation should also follow the technical designs prepared by the MLRRWD if adequate water supply is to be attained in all the areas.

2.1.3 Gaitune Rutuntune Water Project

(1) Location and Service Area

The Gaitune Rutuntune Water Project is located in Kithoka Sublocation a distance of 8 km from Meru town. The project covers a service are of approximately 5 km^2 and serves the villages of Gaitune and Rutuntune. About 500 households reside within this service areas.

(2) Organization and Management

The project was started in 1985 by members of the local community. Management is done by an elected committee of 7 members majority of whom have attained at least primary level education. There are however no women in the committee. The group meets once every three months and elections are held after every two years.

The committee is responsible for the maintenance of the system and intake, water rationing, and raising funds for the expansion of the project.

Currently, the group has approximately 200 members but about 50 households within the service area are not members.

(3) Intake and Distribution

1) Intake

The intake is located at the Gieto Springs next to Mugene market. The intake

is located within the same spring with the Mwimenyi Water Project and Nkirate-Gieto women water project, Kithoka coffee factory and 3 other privately owned water supply intakes.

Lack of co-ordination in extracting water from the Gieto Spring has led to over exploitation and there is evidence that the spring is drying up. The surrounding area is also heavily farmed and highly susceptible to pollution.

The intake for the project is poorly constructed and lies down-stream all the other intakes. The yield is thus low.

2) Reticulation System and Storage

The trunk main is a 100 mm diameter PVC that reduces to 75 mm diameter PVC, only 50m from the intake and runs for 500m to the storage tank.

The storage tank has a capacity of 40,000 gallons. There are 3 main distribution pipe with a dia of 50mm. There PVC pipeline starting from the tanks, each running for approximately one kilometre. The three lines serve Ciomburu, Gaitune and Rutuntune respectively.

The system has in total 40 individual connections and 2 public standpipes for use by non-connected members. The system however experiences low pressures due to the small size of the main trunk line and the inadequacy of the intake.

(4) Finance and Demand

1) Development Finance

The project started with 15 members who contributed Kshs.1000/= each. This formed the initial investment capital for the project. Other finances for the project have been raised by the members on ad hoc basis and from new members who pay both registration fee and a labour premium for works already done. Money collected is kept in a bank account which has a balance of Kshs.5,000/-.

2) Water Demand

The water is mainly used for domestic purposes (40%) and small scale irrigation (60%). While the project has plans to supply the existing primary school and 2 churches, the current water supply is not adequate.

Rationing of water is therefore done to ensure all areas receive water.

(5) Operation and Maintenance

The project is a gravity flow system. Members of the committee do inspect the line occasionally to detect defects and organises groups to clean the intake once every month.

1) Tariff Structure

The system is not metered and no monthly water charges are paid by the members. Members plan to charge a monthly flat rate but state that this is only possible after successful completion of the project when each member will be connected. It is surprising that even none members who draw water at the public stand pipes do not pay for it.

(6) Key Problem Issues

The implementation of the project has been done in complete disregard of the technical designs from the Ministry of Water resulting in frequent pipe bursts, low pressures.

Secondly, the intake is poorly constructed and the yield unreliable due to competition from other water supply schemes, utilizing the same intake.

2.1.4 Gaitune Mwimenyi Self-Help Water Project

(1) Location and Service Area

The Gaitune - Mwimenyi water project is located in Kithoka sublocation and borders Gaitune Rutuntune water project and Nkirote - Gieto women project to serve Cabuene village.

The project covers a service area of approximately 2.5 km^2 which is inhabited by about 250 households.

(2) Organization and Management

The project was started by members of the local community in 1987 and currently has 60 members. The project is managed by an elected committee of members. No woman its on the committee. All committee members have attained at least primary level education.

Elections are held every 2 years and the group meets at least once every 3 months. The project has clearly laid down rules and regulations that help the committee in undertaking their everyday activities.

(3) Distribution Network

1) Intake

The project has its intake at the Gieto spring. The intake consists of an intake box 2m x 1.5m and 1m high and is well covered. Despite this the upstream area is heavily cultivated and pollution potential is high. The yield at the intake is also low.

2) The Reticulation System

The main trunk line from the intake is a 100m diameter PVC pipe that gradually reduces to 75mm diameter and 50mm diameter within a distance of 1 km before reaching the tank.

The storage tank is made of ferro cement and has a capacity of 40,000 gallons. From the tank there are 4 distribution lines, each line is a 379 mm diameter PVC pipe and serves the areas of Gaitune, Chabuene and Theba. The total length of the distribution lines is about 4 km. Individual connections are done using a 12.5mm diameter PVC pipe. There are also 2 public stand pipes to supply unconnected members.

(4) Finance and Demand

1) Development Finance

Most of the project finance has been raised from members contribution which was pegged at Kshs.2000/= at the start of the project. In 1989 however the project managed to obtain assistance worth Kshs.34,000 from a member of the VSO to construct their water tanks. The initial investment cost for the project was Kshs.80,000/=.

New members joining the project pay a labour premium on top of the registration fee which helps boost the project account. The project keeps a bank account and currently has Kshs.17,000/=.

2) Water Demand

The project intended to utilize most of the water for small scale irrigation and domestic uses. Presently the water available is grossly inadequate and most of it goes to domestic uses (70%). No irrigation is being allowed presently and agricultural uses are mainly to water the livestocks (30%).

(5) Operation and Maintenance

The project employs no technical staff and thus maintenance of the system and intake is coordinated by the committee. They organize line patrols and cleaning of the intake.

Tariff Structure

Unlike many other community schemes the Mwimenyi Water Project charges a flat monthly rate of Kshs.50/- to held in system maintenance. This levy is payable to members irrespective of having a connection or not.

(6) Key Problem Issues

The main problem facing the project is the low pressures that result into inadequate water supply. This has resulted from poor implementation which failed to take into account the requirements of the technical designs prepared by the Ministry of water.

The yield at the intake is also low and their is evidence that the spring is drying up due to over exploitation by other water supply schemes.

2.1.5 Nkirote - Gieto Women Group Water Project

(1) Location and Service Area

This is located in Kithoka sub-location and serves Gieto, Mwanika and Kiruai villages. The scheme borders Gaitume Rutuntune and Mwimenyi Projects, and serves an area of 2km^2. The area is inhabited by 600 - 800 people residing in 110 households.

(2) Organization and Management

The project started as an initiative of the Nkirote - Gieto Women group in 1988 with a membership of 70. During the implementation of the project the ability of the women to actively get involved especially in the provision of adequate capital and labour for the digging of the trenches was found lacking and this led to the incorporation of men in the project.

The project is managed by an elected committee of 7 members that consists of 3 women and 4 men. The group has however not held any elections since inception. Group meetings are held once every month but these are mainly treated as work days.

Apart trem the chair lady, treasurer and secretary, the level of literacy is very low and no clear cut rules and regulations are in place to regulate the running of the project.

(3) Distribution Network

1) The Intake

The intake is located at the Gieto springs next to Mugene market. There are various other intakes at the same spring resulting into lack of coordination and over exploitation. The intake is poorly constructed and the yield is grossly inadequate.

2) Reticulation System

The main trunk line is a 50 mm diameter PVC pipe that runs for 1/2 km to the storage tank. The storage tank is a concrete structure with a capacity of 40,000 gallons. The distribution line is 37.5 mm diameter PVC pipe and supplies water to 17 individual connections. Members who are not connected, draw water from the connected neighbours or from adjacent streams.

The system suffers from low pressures as a result of poor implementation and the utilization of small diameter pipes. No proper technical design was done for the project apart from supervision by public health officials who assisted the project.

(4) Finance and Demand

1) Development Finance

Initial investment costs for the project amounted to Kshs.100,000. This was mainly raised through members contributions. The ministry of health gave material assistance for the construction of the intake and pipes.

No other financial assistance has been obtained from other sources and money to maintain the project and expand the system is raised on ad hoc basis. The group does not have any bank account and has no money currently.

2) Water Demand

The objective to provide water for irrigation and domestic purposes has not been realised. The limited supply available has to be rationed and most of it goes into irrigating small pieces of land for french beans and food crops. Neither institutions nor commercial premises are served by this scheme.

3) Daily Operation of the System

There exists no clearly prepared operation structure. Inspection of the pipeline and intake is only undertaken when no water seems to flow in the system. Maintenance of the project is thus poor and frequent pipe bursts coupled with the low pressures result in insufficient water flows. There is a total lack of technical management to supervise and carry out repairs.

4) Tariff Structure

Members do not pay for water consumed. Their labour input during work days and registration fee is regarded as adequate contribution. This creates problems of finance for maintenance.

(5) Key Problem Issues

The project was implemented with no technical design. Only a pipeline survey to determine gravity flow was done by the Ministry of health officials.

The intake is over exploited and can not adequately supply enough water to the service area.

The management is questionable as no elections have been held since inception

in 1988.

2.1.6 Koiru - Ciomburu Water Project

(1) Location and Service Area

The project is located in Kithoka sublocation and serves only Ciomburu village within a supply area of 1.0 km^2. The area has a resident supply population of 60 households.

(2) Organization and Management

The project started in 1992 as a community initiative and has a current membership of 32 members. The management is done by an elected committee of 9 members a good majority of whom are educated upto primary school. None of the members has obtained any training on water and project management.

There exists no well prepared rules and regulations on the running of the projects. Elections for the committee are held every two years and the group meets once every two months, and these meetings are mainly treated as work days.

(3) Distribution Network

1) Intake

The intake is located downstream the Kioru Spring on a privately owned property. The registered location of the spring intake is on public land but currently there exists a land ownership despite at the lands office between the community and one of the local elders.

Existing intake is poorly constructed and has a very low yield. All surrounding area is mainly cultivated land. Pollution is very eminent.

2) Reticulation System

The main trunk line is 75 mm diameter PVC pipe of 3, lengths of which reduces to 50 mm diameter after 1 km. The rest of the distribution line is 37.5 mm diameter PVC pipe and individual connections are done using a 12.5 mm diameter PVC pipe. The system has no storage tank and water is supplied

directly from the intake. This has created a problem of low pressures.

3) Development Finance

The total initial investment for the project amounting to Kshs.40,000 was raised by the members and no outside funding has been realised to date.

Both expansion of the system and maintenance costs are catered for by registration fee of 1500/= per member, ad hoc contributions and a labour premium charged to new members.

The project does not have any bank account and all funds collected are immediately spent for the purpose they are intended for.

4) Water Demand

The water supplied is utilized mainly for limited agriculture (60%) and the rest for domestic purposes (40%). This is however inadequate for all intended purposes. No irrigation is being done presently because low water pressures cannot utilize the sprinklers. Agricultural uses are mainly to water livestocks.

(4) Operation and maintenance

The inspection of the pipeline and maintenance of the intake is only done when members discover a complete stop in the flow of water at their taps. There also exists technically qualified persons to help undertake the supervision of the system.

Tariff Structure

This system is not metered and no monthly flat rate is charged.

(5) Key Problem Issues

The inability of the project to utilize the Kioru Spring intake, whose 'use-permit' is available to this water project, is responsible for the inadequacy of the water.

The implementation of the project was however done without proper technicians, designs and hence could not provide the water that the community anticipated.

The number of members in the project is also low and it is unlikely that they will be able to raise enough money to construct an adequate intake, storage tanks