

JAPAN INTERNATIONAL COOPERATION AGENCY
MINISTRY OF LOCAL GOVERNMENT,
RURAL AND URBAN DEVELOPMENT
REPUBLIC OF ZIMBABWE

THE STUDY
ON
WATER POLLUTION CONTROL
IN
THE UPPER MANYAME RIVER BASIN
IN
THE REPUBLIC OF ZIMBABWE

VOLUME 3
SUPPORTING REPORT

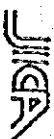
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**WATER POLLUTION CONTROL MASTER PLAN
FOR
THE UPPER MANYAME RIVER BASIN**

**VOLUME 3
SUPPORTING REPORT**

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PART I

**WATER POLLUTION MASTER PLAN
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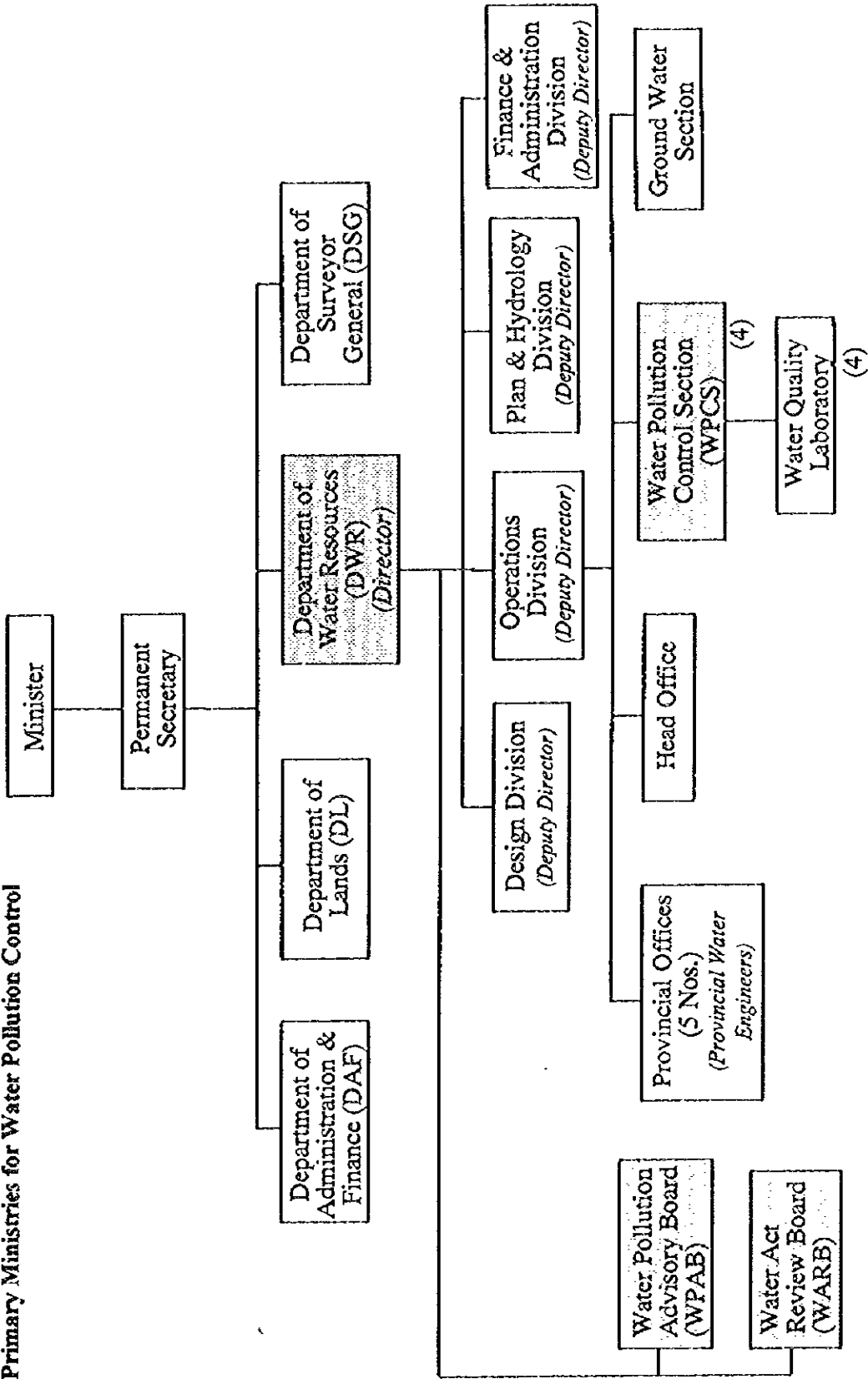
CHAPTER 2

Water Pollution Control Master Plan for the Upper Manyame River Basin

CHAPTER 2 WATER POLLUTION CONTROL MASTER PLAN FOR THE UPPER MANYAME RIVER BASIN
 SECTION 3 ENVIRONMENTAL MANAGEMENT AND WATER POLLUTION STATUS

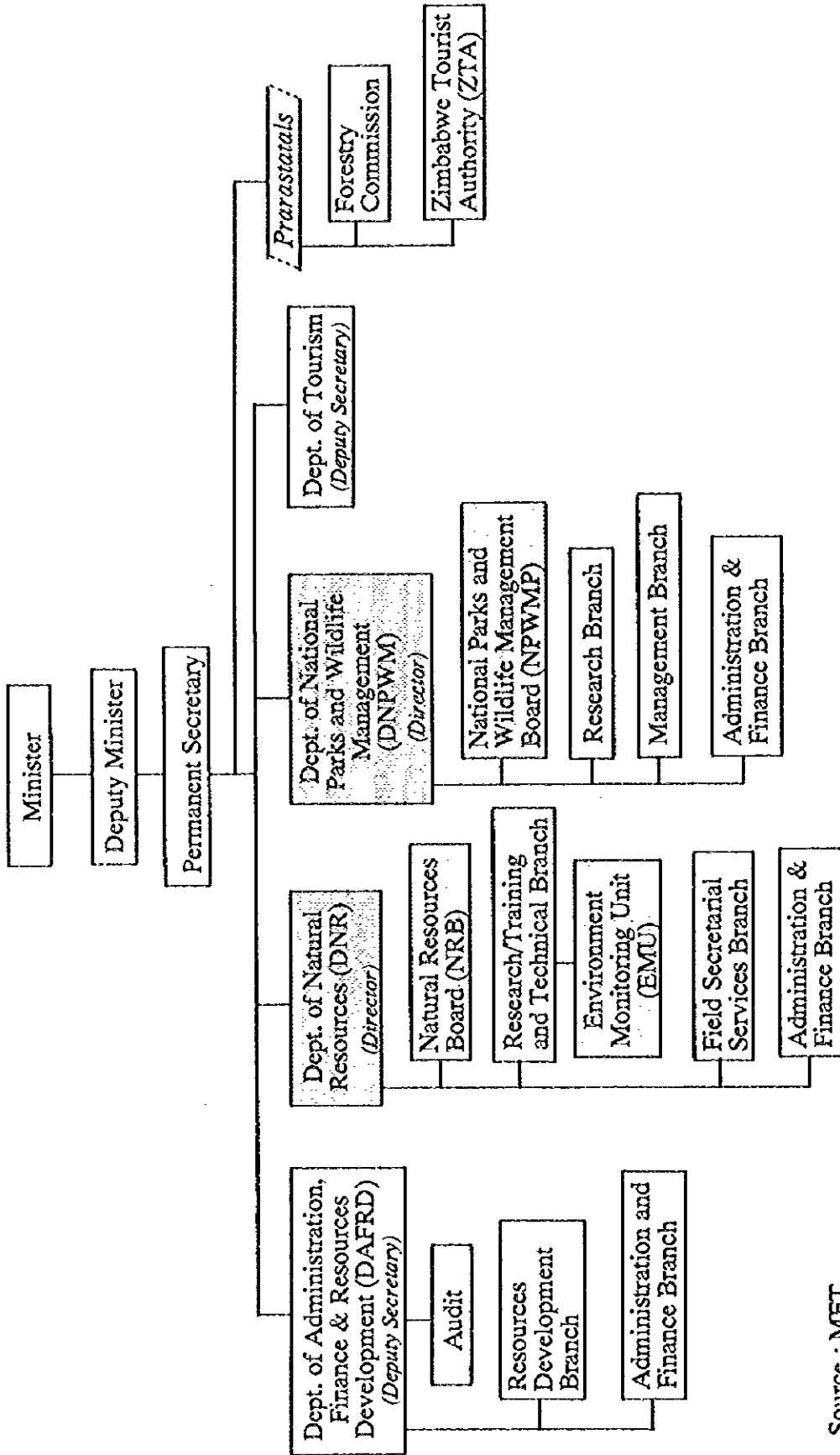
3.1 Present Institutions for Water Pollution Control and Environmental Management

3.1.2 Primary Ministries for Water Pollution Control



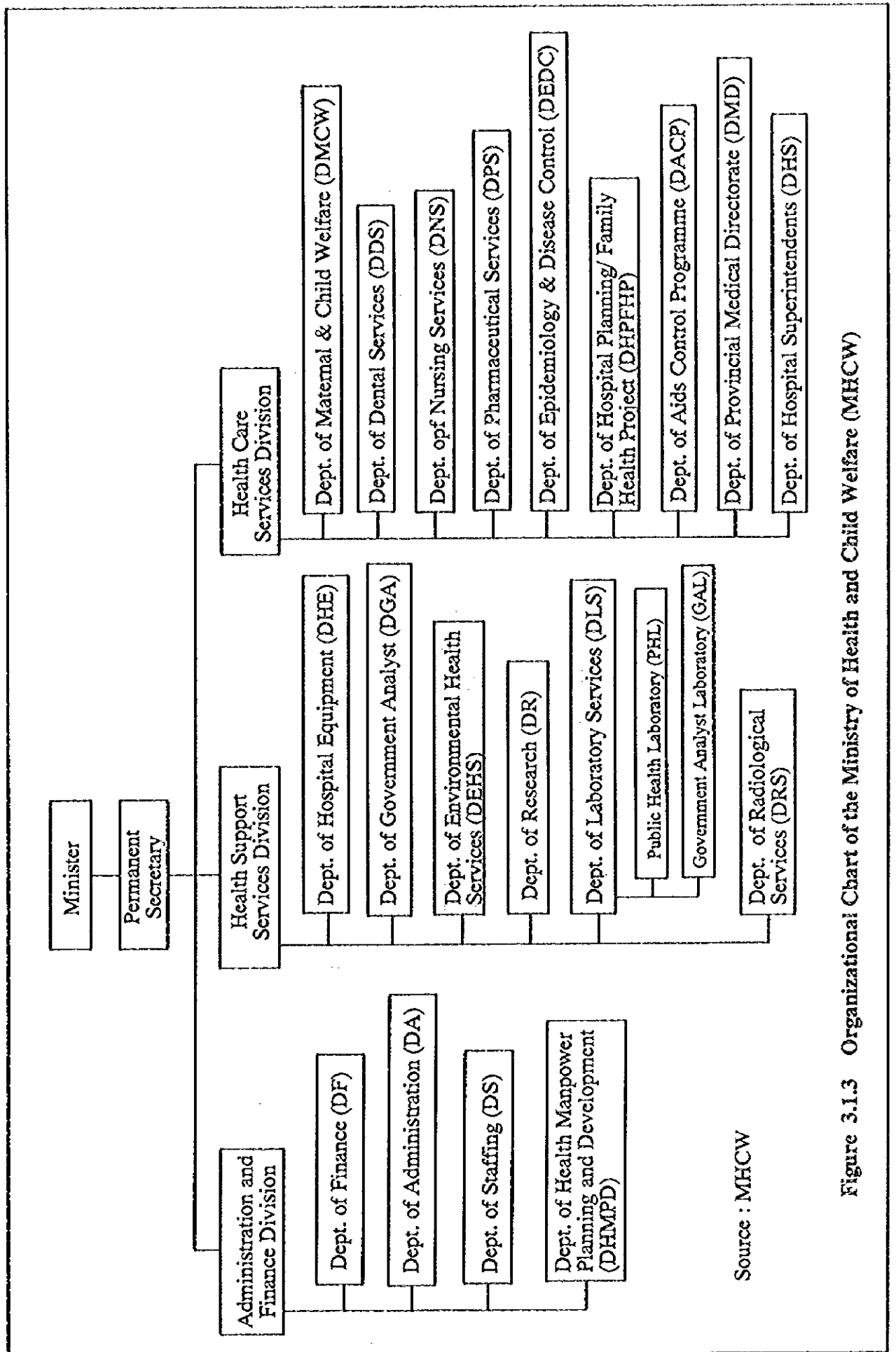
Source : MLWR

Figure 3.1.1 Organizational Chart of the Ministry of Lands and Water Resources (MLWR)



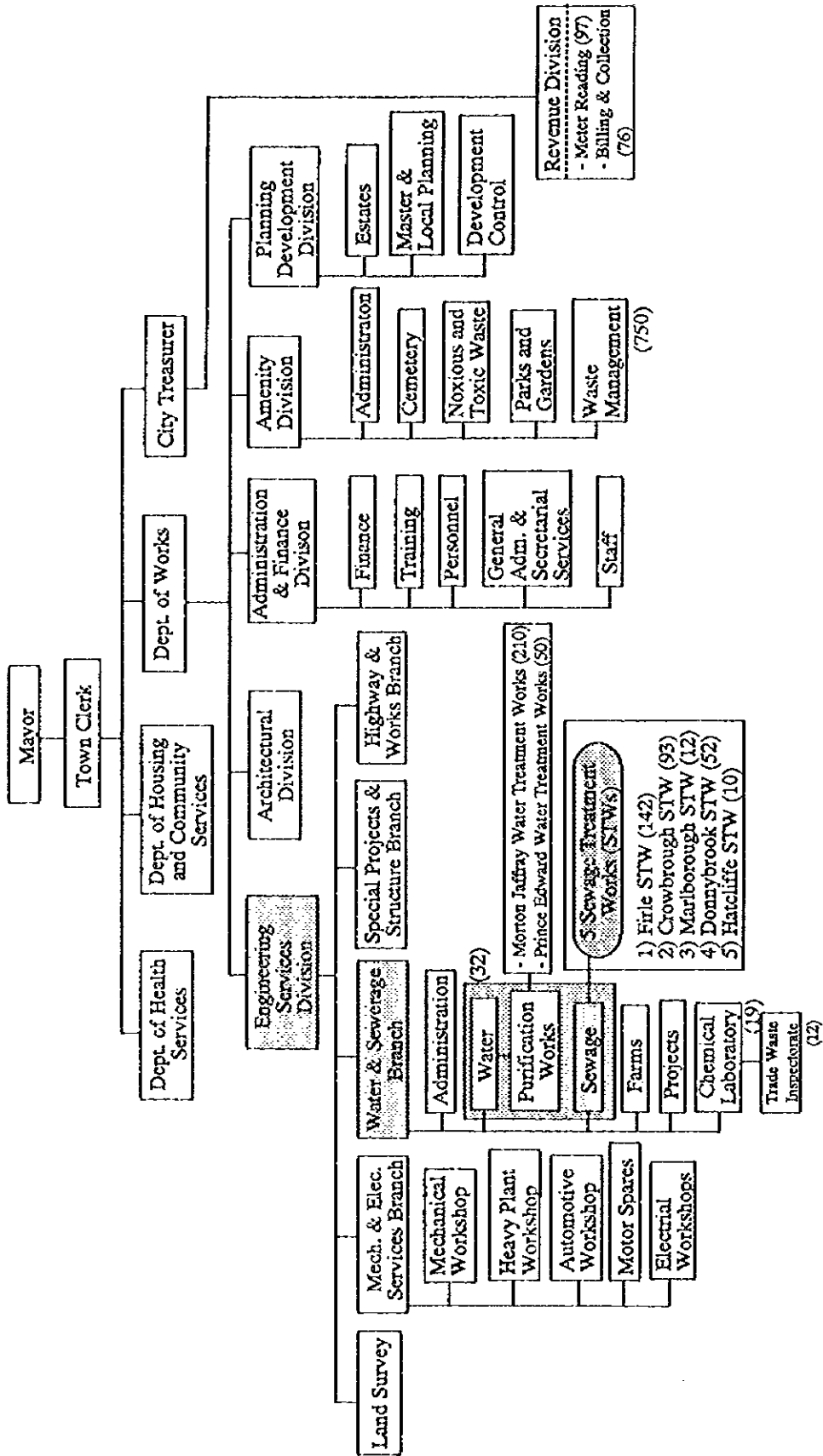
Source : MET

Figure 3.1.2 Organizational Chart of the Ministry of Environment and Tourism (MET)



Source : MHCW

Figure 3.1.3 Organizational Chart of the Ministry of Health and Child Welfare (MHCW)



Notes : Figures in parentheses () indicate the number of staff in the existing Sewage Treatment Works (as of July 1996).
 Total number of the permanent staff : 11,116 (as of July 1996).

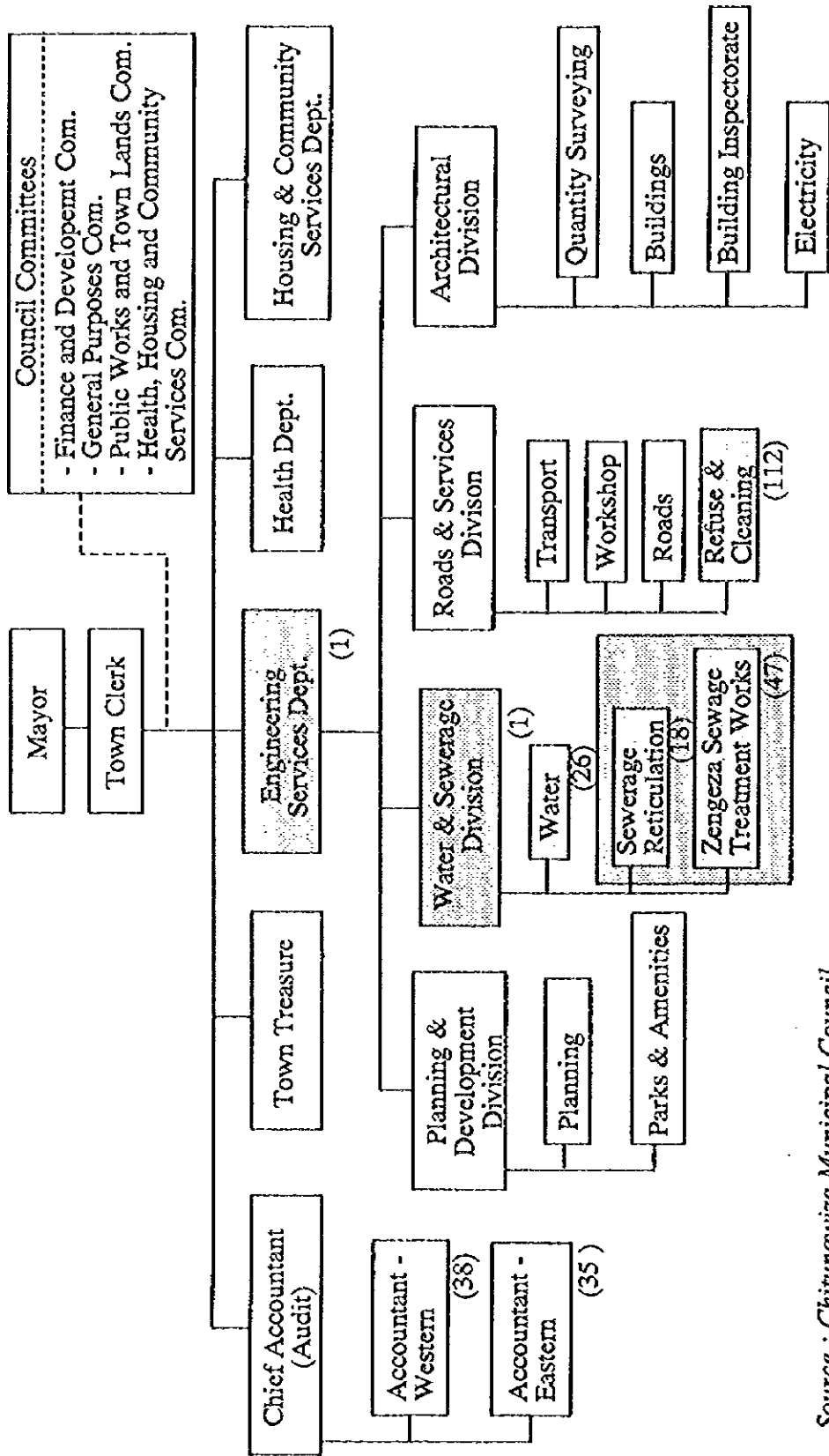
Source : Department of Works (DW), City of Harare

Figure 3.1.4 Organizational Chart of the Harare City Council

**Table 3.1.1 Water and Waste Water Sampling Points and Frequency
in the City of Harare**

Sampling Points	Number	Frequency of Sampling
1. Water Works (Morton Jaffray)		4 times per week
Raw water	3	
Filtered water	3	
Treated water	2	
Inlet into clarifiers	7	
Outlet into sand filters	18	
Sub-total	33	
2. Water Works (Prince Edward)		4 times per week
Raw water	1	
Filtered water	1	
Treated water	1	
Inlet	1	
Outlet	4	
Sub-total	8	
3. Warren in Warren out	1 1	4 times per week
Sub-total	2	
4. Treated water samples around Town	24	5 times per month
5. Dams & lakes		1 time per month
Harava dam	1	
Seke dam	1	
Lake Chivero	1	
Lake Manyame	1	
6. Rivers	10	1 time per month
7. Storm water (canals)	9	1 time per month
Grand-Total	86	

Source : Chemical Laboratory of the City of Harare

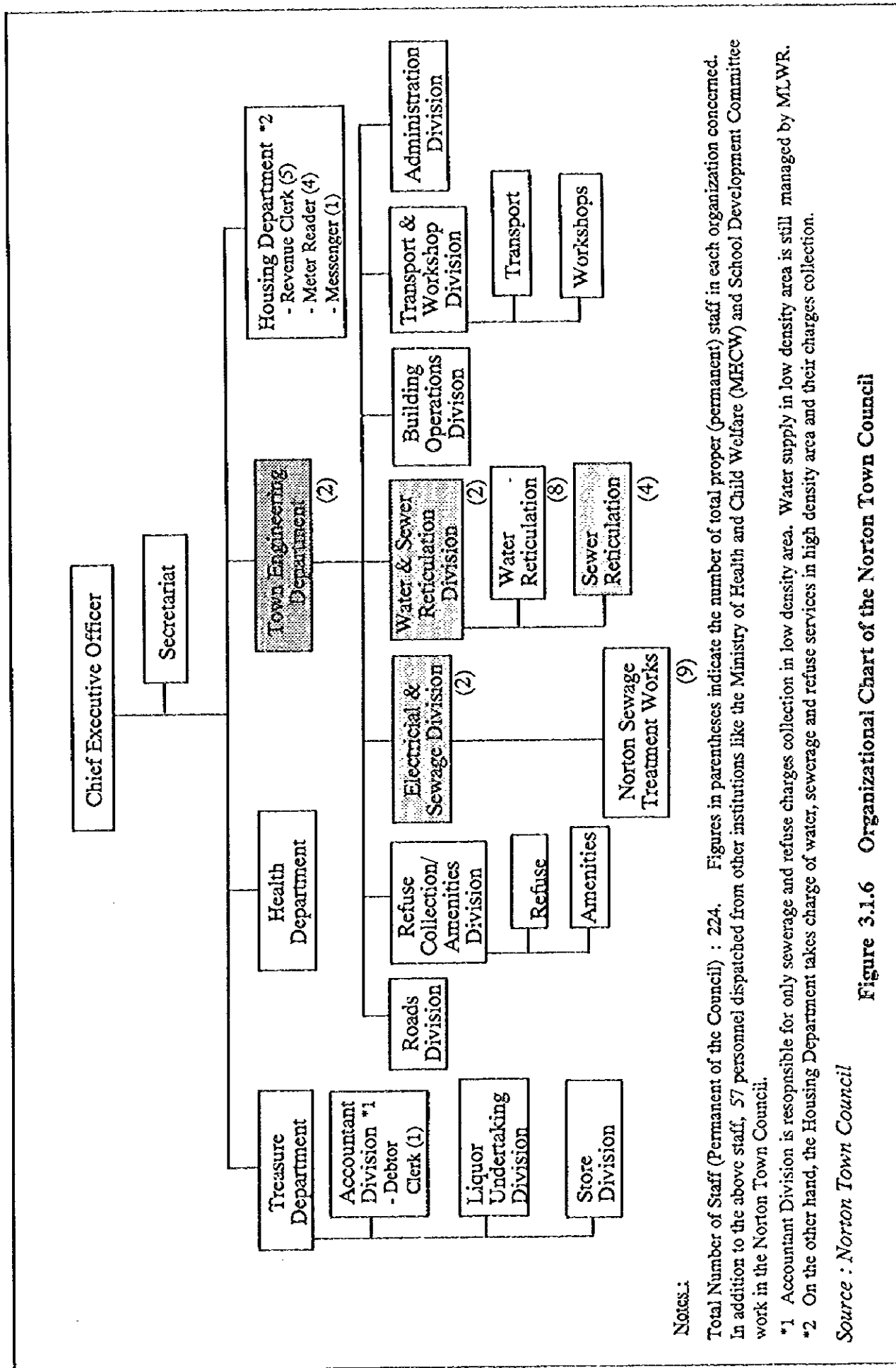


Source : Chitungwiza Municipal Council

Notes : Total Number of Staff (permanent of the Council) : 1,633

Figures in parentheses indicate the number of total proper (permanent) staff in the organizations concerned.

Figure 3.1.5 Organizational Chart of the Chitungwiza Municipal Council



Notes:

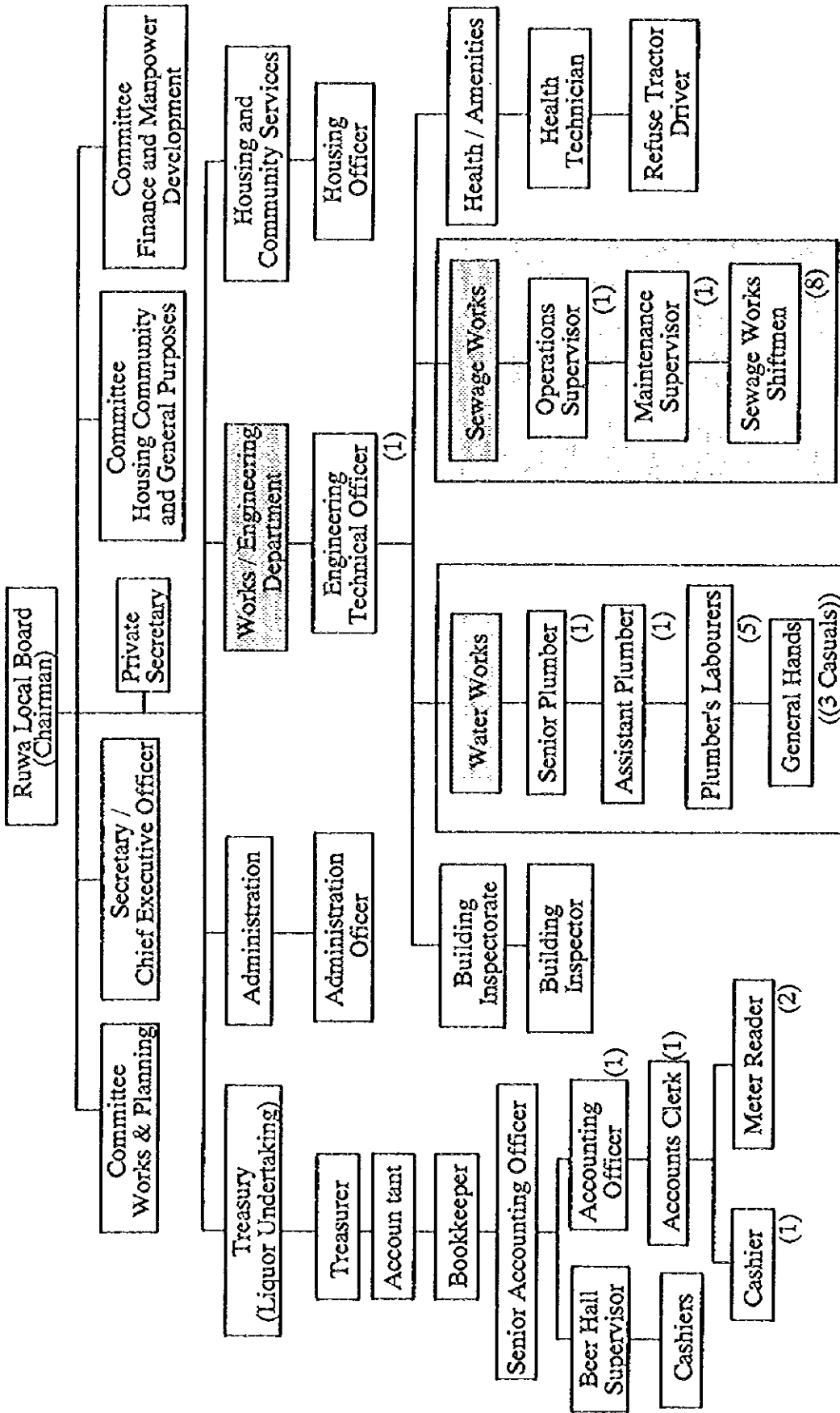
Total Number of Staff (Permanent of the Council) : 224. Figures in parentheses indicate the number of total proper (permanent) staff in each organization concerned. In addition to the above staff, 57 personnel dispatched from other institutions like the Ministry of Health and Child Welfare (MHCW) and School Development Committee work in the Norton Town Council.

*1 Accountant Division is responsible for only sewerage and refuse charges collection in low density area. Water supply in low density area is still managed by MLWR.

*2 On the other hand, the Housing Department takes charge of water, sewerage and refuse services in high density area and their charges collection.

Source : Norton Town Council

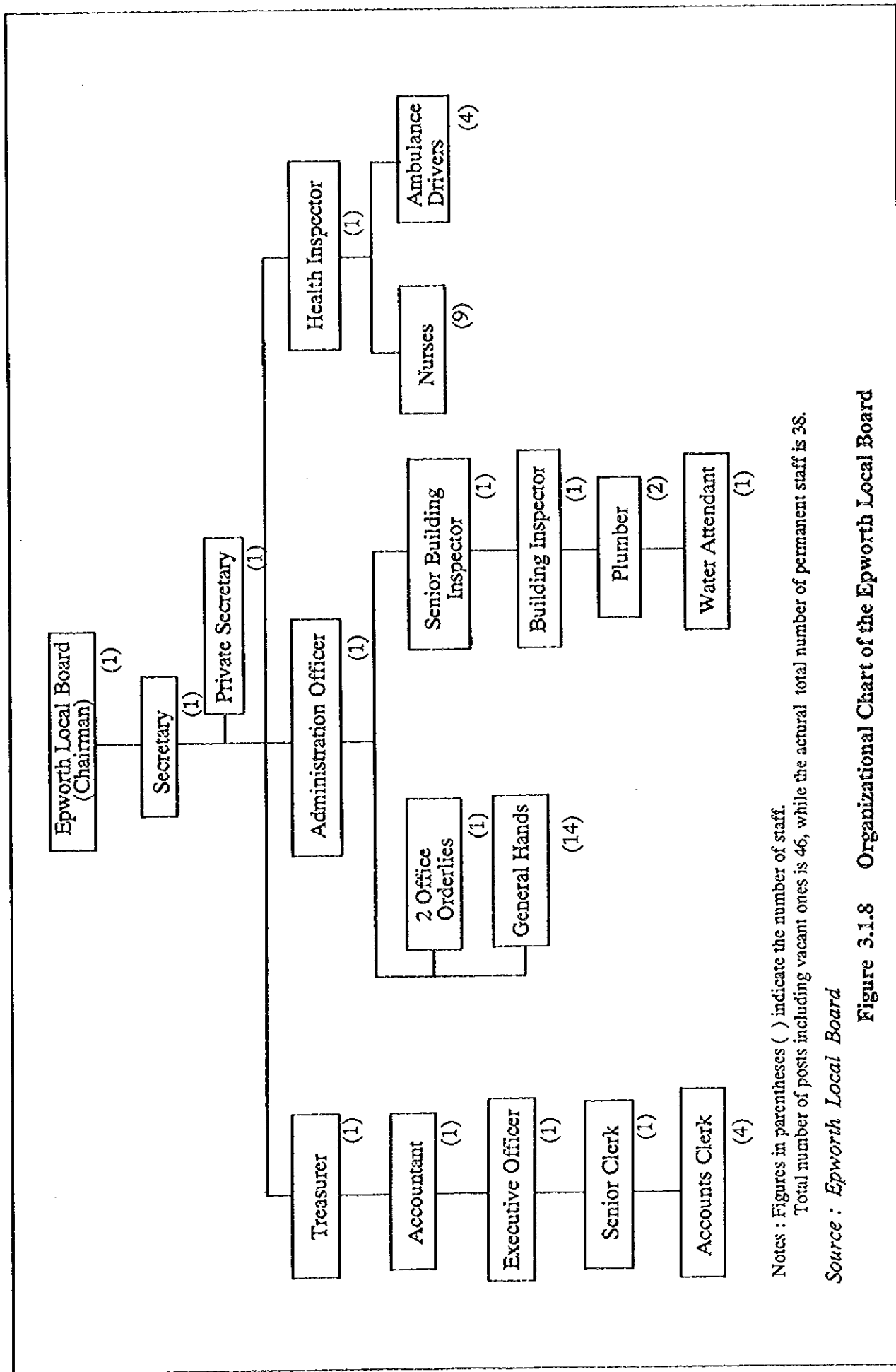
Figure 3.1.6 Organizational Chart of the Norton Town Council



Note : Total Number of the Permanent Staff : 75 (as of July 1996)

Source : Ruwa Local Board

Figure 3.1.7 Organizational Chart of the Ruwa Local Board



Notes : Figures in parentheses () indicate the number of staff.
 Total number of posts including vacant ones is 46, while the actual total number of permanent staff is 38.

Source : Epworth Local Board
 Figure 3.1.8 Organizational Chart of the Epworth Local Board

Table 3.1.2 Problems and Constraints Reported in the Sewage Treatment Works Concerned

Problems & Constraints Sewage Treatment Works	Interviewed Problem Areas	
	Organization and Personnel	Facilities & Equipment
City of Harare		
1) Fife STW	<ul style="list-style-type: none"> - Lack of qualified and experienced personnel - Bad working environment and occurrence of workers' diseases - Poor training 	<ul style="list-style-type: none"> - Frequent power failures resulting in spillages to river - Repeated breakdowns of plant & machinery due to age - Repair of machinery takes too long due to poor procurement system of spares
2) Crowborough STW	<ul style="list-style-type: none"> - Lack of qualified staff to maintain and control water pollution - Poor training 	<ul style="list-style-type: none"> - Frequent electrical and mechanical breakdowns - Delayed repair due to poor procurement system - Illegal discharge of untreated industrial wastewater during the nights and early mornings
3) Marlborough STW	<ul style="list-style-type: none"> - Insufficient qualified staff - Little occasion of training 	<ul style="list-style-type: none"> - Overloaded ponds and complaints about the odour - Frequent breakdowns of the submersible pumps
4) Donnybrook STW	<ul style="list-style-type: none"> - Lack of qualified staff - No sufficient training to improve the O&M 	<ul style="list-style-type: none"> - Overloaded ponds and complaints about the smell
Chitungoza Municipality		
1) Zengeza STW	<ul style="list-style-type: none"> - Manpower shortage - Lack of specialized training for each staff 	<ul style="list-style-type: none"> - Overloaded and aged facilities to meet actual demand - Lack of funds to upgrade/ expand the operating capacity
Norton Town		
1) Norton STW	<ul style="list-style-type: none"> - Lack of qualified staff - No training for staff 	<ul style="list-style-type: none"> - Frequent breakdowns of pumps because of age - Malfunction of flow meter recorders and trickling filters
Ruwa Local Board		
1) Ruwa STW	<ul style="list-style-type: none"> - Manpower shortage to maintain the treatment ponds and speed up the purchasing 	<ul style="list-style-type: none"> - Delayed purchasing system - Lack of pollution monitoring equipment (due to financial and operational constraints)

Source : Interview and Questionnaire Surveys conducted in July 1996 by JICA Team.

Table 3.1.3 Staff Complements for Crowborough Sewage Treatment Works

Design Capacity (TF) :	36,000	m3 / day
Design Capacity (BNR) :	18,000	m3 / day

Occupation Title	No. of Personnel (as of July 1995)	No. of Personnel (Actual)
Superintendent	1	1
Assistant Superintendent	1	1
Sewerage Works Attendant	5	5
Assist. Sewerage Works Attendant	6	6
Senior Operator	14	5
Operator	22	23
General Laborer	23	52
Total Staff Complement	72	93

Table 3.1.4 Staff Complements for Firle Sewage Treatment Works

Design Capacity (TF) :	36,000	m3 / day
Design Capacity (BNR) :	36,000	m3 / day

Occupation Title	No. of Personnel (as of July 1995)	No. of Personnel (Actual)
Superintendent	1	1
Assistant Superintendent	1	1
Sewerage Works Attendant	6	6
Assist. Sewerage Works Attendant	5	5
Skilled Worker Class	1	1
Senior Operator	1	1
Light Vehicle Driver	1	1
Operator	45	32
Assistant Works Operators	39	94
Total Staff Complement	100	142

Note : Actual = Data as of July 1996.

Source : Harare City Council

Table 3.1.5 Staff Complements for Donnybrook Sewage Treatment Works

Design Capacity (WSP) :	5,500	m3 / day (Total)
Occupation Title	No. of Personnel (as of July 1995) .	No. of Personnel (Actual)
Superintendent	0	1
Operations Supervisor	1	1
Sewerage Works Attendant	0	0
Shift Foreman	1	2
Light Vehicle Driver	1	1
Senior Operator	2	17
Operator	18	15
General Laborer	16	15
Total Staff Complement	39	52

Table 3.1.6 Staff Complements for Marlborough Sewage Treatment Works

Design Capacity (WSP) :	2,000	m3 / day
Occupation Title	No. of Personnel (as of July 1995)	No. of Personnel (Actual)
Senior Operator	1	1
Operator	1	1
Assistant Operators	0	7
General Labourer	3	4
Total Staff Complement	5	13

Note : Actual = Data as of July 1996.

Source : Harare City Council

Table 3.1.7 Staff Complements for Zengeza Sewage Treatment Works

Design Capacity (TF) :		20,400	m ³ / day
Occupation Title	No. of Personnel (Budgeted)	Actual	Vacant
Superintendent	1	1	0
Assistant Superintendent	1	0	1
Clerk Typist	1	1	0
Sewerage Foreman	1	0	1
Works Attendants	2	1	1
Pump Operator	27	27	0
Plumber Class I	1	0	1
Plumber Class II	2	0	2
Trade Waste Inspector	1	0	1
Assistance Foreman	2	2	0
Charge Hands	5	5	0
Pond Operators	30	17	13
Senior Drainlayers	2	2	0
Assistant Drainlayers	6	2	4
Sewer Rodmen	18	7	11
General Hands	10	0	10
Total Staff Complement	110	65*	45

Notes : Data as of July 1996.

* Actual number of staff (65) includes the personnel of two Sections : Sewage Treatment Works (47) and Sewerage Reticulation (18). Some staff hold concurrently the responsibilities/ tasks in two Sections.
(refer to Figure 3.1.7)

Source : Chitungwiza Municipal Council

Table 3.1.8 Staff Complements for Norton Sewage Treatment Works

Design Capacity (TF) :	3,400	m ³ / day
Occupation Title	No. of Personnel (Actual)	Remarks
Superintendent	1*	* holds concurrently the position of Electrician II
Assistant Superintendent	-	
Clerk Typist	-	
Operations Supervisor	-	
Works Attendants	-	
Pump Operator	-	
Maintenance Supervisor	1	
Maintenance Mechanic	-	
Electrician	(1)*	
Assistance Foreman	-	
Laborer	9	
Others	-	Urgently needed a qualified fitter/ artisan
Total Staff Complement	11	

Note : Data as of July 1996.
 Source : Norton Town Council

Table 3.1.9 Staff Complements for Ruwa Sewage Treatment Works

Design Capacity (WSP) :	5,300	m³ / day	
Occupation Title	No. of Personnel (Budgeted)	Actual	Vacant
Operations Supervisor	1	1	0
Maintenance Supervisor	1	1	0
Sewage Works Shiftmen	9	8	1
Total Staff Complement	11	10	1

Note : Data as of July 1996.
Source : Ruwa Local Board



3.2 Present Politics and Countermeasures for Water Pollution Control

Table 3.2.1 Main Figures of the Second Five-Year National Development Plan, 1991 - 1995

No.	Sector	GDP Annual Growth (%) (at constant 1990 prices)		Investment (GFCF) (Z\$ million, 1990 prices)			Employment (in 1,000) *2		Exports *3 (US\$ million)	
		1980-1990	1990-1995	Total		Public 1991-95	1990	1995	1990	1995
				1991-95	(%)					
1.	Agriculture	2.0	3.5	2,076	(12.1)	1,000	286.3	300.9	670	900
2.	Mining	1.0	5.0	1,389	(8.1)	52	52.1	57.5	480	645
3.	Manufacturing	3.2	6.0	3,482	(20.3)	137	196.0	227.0	610	930
4.	Electricity & Water	8.3	5.5	2,401	(14.0)	1,350	8.5	9.9	-	-
5.	Construction	-4.7	9.7	652	(3.8)	50	74.4	84.8	3	14
6.	Finance, Insurance & Estate	3.7	4.8	2,401	(14.0)	1,250	17.2	20.0	2	4
7.	Transport & Communications	2.2	5.1	2,367	(13.8)	1,717	52.3	60.7	56	84
8.	Distributin & Tourism	2.1	5.0	1,115	(6.5)	50	93.0	107.8	110	226
9.	Public Administration	3.9	0.0	137	(0.8)	137	91.9	75.9	-	-
10.	Education	9.7	4.0	515	(3.0)	400	107.9	119.1	1	2
11.	Health	5.0	3.5	343	(2.0)	243	24.0	26.5	-	-
12.	Domestic Services	-1.1	1.2	-	-	-	102.0	108.3	-	-
13.	Other Services & Activities	4.1	5.1	87	(0.5)	37	72.6	88.3	11	20
Total		3.2	4.6	17,153	(100.0)	6,611	1,178.2	1,286.7	1,943	2,825

Notes : *1 excludes non-GFCF investment such as purchasing of land for resettlement, financial investment, research projects and exploration.

*2 employees in the formal sector only.

*3 in current US Dollars

Source : Second Five-Year National Development Plan, 1991-1995, December 1991

Table 3.2.2 Public Sector Investment Programme by Industrial Sector, 1991/92 - 1995/96

(Unit: ZS million)

No.	Sector	Budget Allocation in Five-Year Plan					Total	(%)
		Budget 1991/92 (%)	1992/93	1993/94	1994/95	1995/96		
1.	Agriculture	427 (17.4)	475	525	600	675	2,702	(22.1)
2.	Mining	10 (0.4)	15	20	25	30	100	(0.8)
3.	Manufacturing	10 (0.4)	30	50	75	100	265	(2.2)
4.	Electricity & Water	405 (16.5)	450	440	480	580	2,355	(19.2)
5.	Transport & Communication	634 (25.9)	600	650	700	710	3,294	(26.9)
6.	Housing & Urban Dev.	368 (15.0)	270	255	230	210	1,333	(10.9)
7.	Education	100 (4.1)	130	165	180	215	790	(6.4)
8.	Health	48 (2.0)	65	85	100	120	418	(3.4)
9.	Public Administration	90 (3.7)	65	50	40	20	265	(2.2)
10.	Defence	178 (7.3)	80	60	40	20	378	(3.1)
11.	Other Sectors	182 (7.4)	70	50	30	20	352	(2.9)
Total		2,452 (100.0)	2,250	2,350	2,500	2,700	12,252	(100.0)

Source : Second Five-Year National Development Plan, 1991-1995, December 1991

3.3 Laws and Regulations Relevant to Water Pollution Control and Environmental Management

3.3.1 Relevant Regulations

Public Health (Effluent) Regulations, 1972

Rhodesia Government Notice No. 638 of 1972

Chap 167

Public Health (Effluent) Regulations 1972

It is hereby notified that Minister of Health has in terms of section 112 of the Public Health, Act [Chapter 167] made the following regulations : -

1. These regulations may be cited as the Public Health (Effluent) Regulations, 1972.
2. In these regulations -
 - “approval” means written approval by a health authority given in terms of these regulations;
 - “council” means any municipal council, town council or rural council;
 - “effluent liquid” means any liquid discharged from sewage treatment works or oxidation ponds,
 - “health authority” means -
 - (a) in the case of an application for approval in respect of land within the jurisdiction of a council, the council; and
 - (b) in the case of an application for approval in respect of land outside the jurisdiction of a council, the chief health officer;
 - “oxidation ponds” include aerated oxidation ponds, passover channels and their variations;
 - “Sewage” means any liquid containing waste matter of excremental, domestic or industrial origin;
 - “Sewage treatment works” means any works, installation, process or method used for the treatment of sewage, but does not include oxidation ponds.
3. No person may -
 - (a) discharge any effluent liquid on to; or
 - (b) use any effluent liquid for the irrigation of;any land without having first applied for and received the approval of the appropriate health authority.
4. (1) Any person requiring the approval mentioned in section 3 shall apply to the health authority and give full details of his proposed use or discharge of the effluent liquid, and any other information reasonably required by the health authority.
 - (2) In considering an application made in terms of subsection (1) the health authority shall take into account, *inter alia*, the quantity and nature of the effluent, liquid in relation, to the area and type of land on to which it is to be discharged, or where it is to be used.
 - (3) The approval mentioned in section 3 may be made subject to all or any of the following conditions -
 - (a) that reticulation system is provided for the effluent liquid entirely separate from any system for the reticulation of potable water;
 - (b) that all piping, equipment and installation for use in the storage and reticulation of the effluent liquid, above or below ground, are

distinctively and indelibly marked so as to be immediately distinguishable from any system for the reticulation of potable water;

- (c) that all pipe connections are below the ground;
 - (d) that adequate warning notices are erected in appropriate languages indicating that effluent liquid is being used; and
 - (e) any other conditions deemed necessary by the health authority to protect the health of the public.
- (4) In giving the approval mentioned in section 3, the health authority shall prescribe standards of purity which shall not be lower, but may be higher, than those specified in the schedule for the effluent liquid.
- (5) Notwithstanding the provisions of sub-section (4), the appropriate health may, for a stated period and for good and sufficient reason, grant exemption in writing from compliance with the standards of purity specified in the Schedule:

Provided that if a council grants such an exemption it shall notify the Chief Health Officer in writing immediately of its reasons for doing so and shall provide details of any lower standards it may lay down.

- (6) A health authority may, by notice in writing -
- (a) revoke its approval or any conditions to which the approval was subject; or
 - (b) amend or add to any conditions to which the approval was subject; or
 - (c) withdraw any exemption granted in terms of sub-section (5).
5. Where any effluent liquid from sewage-treatment works or oxidation ponds which are the property of a council is to be used for the irrigation of land, the council shall comply with the standards of purity prescribed in terms of section 4.
6. No person may use any effluent liquid for the irrigation of any land on which salad crops, vegetable crops, vegetable crops berry fruits or any crops intended for human consumption in an uncooked state, are growing.
7. No person may use, for the irrigation of any within 200 meters of any occupied dwelling or 50 meters of any public road by sprinklers, any effluent liquid unless such liquid complies with the minimum standards prescribed in the Schedule for use in relation to public amenities.
8. (1) No person may, without having first applied for and received approval, use -
- (a) any digested sludge for agricultural purposes; or
 - (b) any raw or undigested sludge for any composting process:

Provided that no approval shall be granted for the use of digested sludge for agricultural purposes without at least a fifty *per centum* in volatile matter in the digestion process.

- (2) The health authority may make approval granted in terms of subsection (1) subject to any conditions it deems necessary to protect the public health.

9. No person may use any raw or undigested sludge or sewage for agricultural purposes.
- 10 The Public Health (Effluent) Regulations, 1970, published in Rhodesia Government Notice No. 662 of 1970 and the Public Health (Effluent) (Amendment) Regulations, 1971 (No.1) published in Rhodesia Government, Notice No. 133 of 1971 are repealed.

**Water (Effluent and Waste Water Standards)
Regulations, 1977**

Rhodesia Government Notice No. 687 of 1977

ACT41/76

Water (Effluent and Waste Water Standards) Regulations 1977

It is hereby notified that the Minister of Water Development has in terms of section 135 of the Water Act, 1976, made the following regulations.

Title

1. These regulations may be cited as the Water (Effluent and Waste Standards) Regulations, 1977.

Interpretation

2. In these regulations -
"heavy metals" means a metal having a specific gravity greater than 5.0;
"Zone I catchment area" means a zone I catchment area specified in the First Schedule;
"Zone II catchment area" means a Zone II catchment area specified in the First Schedule.

Prescribed standard of quality for effluent and waste water

3. The standards of quality, prescribed for the purposes of paragraph (a) of subsection (2) of section 101 of the Act, to which effluent or waste which has been produced by, or results from, the use for any purpose, and which is discharged or disposed of into a public stream, private water, public water or underground water, whether directly or through drainage or seepage, shall conform, shall be as set out in the Second Schedule.

Sampling Procedure

4. The following requirements shall be complied with in respect of any sample which may be taken or required to be taken of effluent or water for the purposes of Part IX of the Act -

- (a) a composite sample for the purpose of analysis for all tests, other than these for temperature, pH and dissolved oxygen, shall be taken by combining individual samples so that not less than five hundred milliliters each of the effluent or waste water shall be taken, at the point of discharge, at approximately equal intervals of time over a minimum period of approximately four hours within any twenty-four hour period;
- (b) temperature, pH and dissolved oxygen readings shall be taken on individual samples at the time of sampling, all the samples shall comply with the standards specified in respect of temperature, pH and dissolved oxygen in the First Schedule;
- (c) where full laboratory facilities do not exist on the site for the determination of dissolved oxygen, the oxygen, in the sample may be fixed at the time of sampling by adding the sulfuric acid, the permanganate, the oxalate, the manganous sulphate and the alkaline iodine only:

Provided that -

- (i) the stopper of the sample container shall be replaced and the solution shall be well mixed,
- (ii) the remaining steps shall be carried out in the laboratory.

Repeals

- 5. The Water Pollution Control (Water and Effluent Water Standards) Regulations, 1971, published in Rhodesia Government Notice No. 609 of 1971, are repealed.

First Schedule (Section 2)

ZONES I AND II CATCHMENT AREAS

Zone I catchment areas	Locality
The river catchment area of -	
(a) the Gairezi River and its tributaries	Inyanga district
(b) the Pungwe River and its tributaries	Inyanga district
(c) the Hondi river and its tributaries	Inyanga district
(d) the Nyamkwarara River and its tributaries	Inyanga district
(e) the Inhangombe River and its tributaries of its confluence with the Nyajezi River	nyanga and Makoni districts
(f) the Nyajezi River and its tributaries to its confluence with the Odzani River	Inyanga district
(h) the Odzani River and its tributaries to its confluence with the Odzi River	Inyanga district
(I) the Mazonwe River and its tributaries	Umtali district
(j) the Muvumvumvu River and its tributaries to its confluence with the Nyambewa River	Melsetter district
(k) the Nyambewa River and its tributaries to its confluence with the Muvumvumvu River	Melsetter district
(l) the Nyanyadzi River and its tributaries to its confluence with the Ririwiri River	Melsetter district
(m) the Ririwiri River and its tributaries to its confluence with the Nyanyadzi River	Melsetter district
(n) the Lusitu River and its tributaries	Melsetter district
(o) the Busi River and its tributaries	Chipinga district

Zone II catchment areas

All river catchment areas other than those specified under Zone I.

Second Schedule (Section 3)

PREScribed STANDARD OF EFFLUENT WASTEWATER

1. The water shall not contain any color or have any odor or taste capable of causing pollution.
2. The Water shall not contain any radioactive substances capable of causing pollution.
3. The pH of the Water shall be, where discharged or disposed of-
 - (a) in a Zone I catchment area, between 6.0 and 7.5;
 - (b) in a Zone II catchment area, between 6.0 and 9.0.
4. The temperature of the Water at the point of discharge shall not exceed-
 - (a) in a Zone I catchment area, 25oC;
 - (b) in a Zone II catchment area, 35oC.
5. The water shall dissolved oxygen to the extent of at least, where discharge or disposed of-
 - (a) in a Zone I catchment area, 75 per centum saturation,
 - (b) in a Zone II catchment area, 60 per centum saturation.
6. The chemical oxygen demand of the water, after applying chloride correction, shall not exceed, where discharged or disposed of-
 - (a) in a Zone I catchment area, 30 milligrams per liter,
 - (b) in a Zone II catchment area, 60 milligrams per liter.
7. The oxygen absorbed by the water shall not exceed, where discharged or disposed of-
 - (a) in a Zone I catchment area, 5 milligrams per liter,
 - (b) in a Zone II catchment area, 10 milligrams per liter.
8. The total undissolved solids content of the water at the point of discharge shall not be greater than-
 - (a) in a Zone I catchment area 10 milligrams per liter,
 - (b) in a Zone II catchment area, 25 milligrams per liter.
9. The total dissolved solids content of the water at the point of discharge shall not-
 - (a) in a Zone I catchment area, increase the total dissolved solids content to the receiving water by more than 100 per milligrams per liter,
 - (b) in a Zone II catchment area, exceed 500 milligrams per liter.
10. The water shall not contain soap, oil or grease in quantities greater than, where discharged or disposed of-
 - (a) in a Zone I catchment area, nil,
 - (b) in a Zone II catchment area, 2.5 milligrams per liter.
11. The maximum permissible concentrations of chemical consistence permissible in the water is discharged or disposed of in a Zone I or II catchment area shall specified in the following table.

The water shall not contain any detectable quantities of pesticide, herbicide or insecticide, nor shall it contain any other substances not referred to elsewhere in these standards, in concentrations, which are poisonous or injurious to human, animal, vegetable or aquatic life.

**MAXIMUM PERMISSIBLE CONCENTRATIONS OF CERTAIN
CHEMICALS CONSTITUENTS**

Constituent	Maximum concentration in milligrams per liter	
	Zone I Catchment area	Zone II catchment area
Ammonia free (as N).....	0.5	0.5
Arsenic (as As).....	0.05	0.05
Barium (as Ba)	0.1	0.5
Boron (as B)	0.5	0.5
Sodium (as Cd)	0.01	0.01
Chlorine (as Cl)	50	100
Chlorine residual (as free chlorine) ...	Nil	0.1
Chromium (as Cr)	0.05	0.05
Copper (as Cu)	0.02	0.5
Cyanides and related compounds (as Cn)	0.02	0.5
Detergents (as manoxol - OT)	0.2	0.2
Fluoride (as F)	1.0	1.0
Iron (as Fe)	0.3	0.3
Lead (as Pb)	0.05	0.05
Manganese (as Mn)	0.1	0.1
Mercury (as Hg)	0.5	0.5
Nickel (as Ni)	0.3	0.3
Oxygen total (as N)	10.0	10.0
Phenolic compounds (as phenol)	0.01	0.1
Phosphates total (as p)	1.0	1.0
Sulphate (as SO)	50	200
Sulphides as (S)	0.05	0.2
Zinc (as Zn)	0.3	1.0
Total heavy metals	1.0	2.0

Schedule (Section 4)

1. EFFLUENT FROM SEWAGE TREATMENT WORKS

<i>Type of usage crop</i>	<i>Minimum standards of purity of effluent</i>	<i>Method of irrigation</i>	<i>Other requirements</i>
A. (a) Grain crops; and	(1) Biochemical oxygen demand not exceeding 70 parts per million; and	Surface only	No grazing to be permitted within 24 hours of application if effluent, and drinking troughs of potable water to be provided for stock No fruit wind falls to be marketed
(b) Crops grown for industrial processing such as oil-seeds, fiber, etc., which are not for direct human consumption, but excluding crops grown for dehydration, canning or preserving; and	(2) Stability as measured by the methylene blue test not less than 36 hours	Surface only	
(c) Crops grown solely for seed-production for sale to registered seed merchants but not human consumption; and			
(d) Nursery production, excluding cut flowers grown for sale; and			
(e) Fodder crops for harvesting; and			
(f) Pastures for slaughter stock; and			
(g) Deciduous and citrus orchards, trellised vines, plantation and tree crops			
B. As in A (a), (b), (c), (d), (e) and (f)	(1) Biochemical oxygen demand not exceeding 30 parts per million; and	Surface or Sprinkler	As for A.
	(2) Stability as measure by the methylene blue test not less than 10 days.		

<i>Type of usage crop</i>	<i>Minimum standards of purity of effluent</i>	<i>Method of irrigation</i>	<i>Other requirements</i>
C. (a) As in A; and (b) Pastures for dairy stock; and (c) Cut flowers grown for sale.	<ul style="list-style-type: none"> (1) Biochemical oxygen demands not exceeding 10 parts per million; and (2) Stability as measured by the methylene blue test not less than 21 days; and (3) E. Coil (type 1) not exceeding 1000 per 100 milliliters. 	Surface or sprinkler	As for A (f) and (g)
D. Public amenities, e.g. sports field, public parks golf courses, etc., but not swimming pool surrounds.	<ul style="list-style-type: none"> (1) Biochemical oxygen demand not exceeding 10 parts per million; and (2) Stability as measured by the by the methylene blue test not less than 21 days; and (3) E Coil (type 1) not exceeding 1000 per 100 milliliters; and (4) Residual chlorine not less than 0.3 parts per million after 30 minutes contact in samples taken at the sewage treatment works. 	Surface or sprinkler	

2. EFFLUENT FROM OXIDATION PONDS.

<i>Type of usage or crop</i>	<i>Minimum standards of purity of effluent</i>	<i>Method of irrigation</i>	<i>Other requirements</i>
A. (a) Grain crops; and	<p>The effluent shall at no time contain less dissolved oxygen than 1.0 milligram per liter in a sample taken from the outlet of the pond or from surface of the pond as near the outlet as possible, and in any case not deeper than 25 millimeters below the surface: the determination of the oxygen content shall be carried out by the Winkler test, the addition of the manganese sulphate or manganese chloride followed by the alkaline potassium and the determination completed in the laboratory.</p>	Surface only	
(b) Crops grown for industrial processing, such as oil-seeds, fiber, etc., which are not for direct human consumption, but excluding crops grown for dehydration, canning or preserving; and			
(c) Crops grown solely for seed-production for sale to registered seed merchants but not human consumption; and			
(d) Nursery production, excluding cut flowers grown for sale; and			
(e) Fodder crops for harvesting; and			
(f) Pastures for slaughter; and			
(g) Deciduous and citrus orchards, trellised vines, plantation and tree crops.			<p>No grazing to be permitted within 24 hours of application of effluent. and drinking troughs of potable water to be provided for stock.</p> <p>No fruit windfalls to be marketed.</p>
B. As in A (a), (b), (c), (d), (e), and (f).		Surface or Sprinkler	As for A.

Other requirements

Method of irrigation

Minimum standards of purity of effluent:

Type of usage crop

As for A (f) and (g)

Surface or sprinkler

(1) The effluent shall at no time contain less dissolved oxygen 1.0 milligram per liter in a sample taken at any time of the day or night from the outlet of the pond or from the surface of the pond as near the outlet as possible, and in any case not deeper than 25 millimeters below the surface: the determination of the oxygen content shall be carried out by means of a dissolved oxygen meter or by the Winkler test, the oxygen being "fixed" on site by the addition of the manganese sulphate or manganese chloride followed by the alkaline potassium and the determination completed in the laboratory; and

(2) E. Coli (type 1) not exceeding 1000 per 100 milliliters.

- C. (a) As in A, and
- (b) Pastures for daily stock; and
- (c) Cut flower grown for sale.

<i>Type of usage crop</i>	<i>Minimum standards of purity of effluent</i>	<i>Method of irrigation</i>	<i>Other requirements</i>
D. Public amenities, e.g. sports fields, public parks golf courses, etc., but not swimming pool surrounds.	<p>(1) The effluent shall at no time contain less dissolved oxygen 1.0 milligram per liter in a sample taken at any time of the day or night from the outlet of the pond or from the surface of the pond as near the outlet as possible, and in any case not deeper than 25 millimeters below the surface the determination of the oxygen content shall be carried out by means of a dissolved oxygen meter or by the Winkler test, the oxygen being fixed on site by the addition of the manganese sulphate or manganese chloride followed by the alkaline potassium iodide and the determination completed in the laboratory; and</p> <p>(2) E. Coli (type 1) not exceeding 1000 per 100 milliliters; and</p> <p>(3) Residual chlorine not less than 0.3 parts per million after 30 minutes contact in samples taken at the oxidation ponds.</p>	Surface or sprinkler	

3.3.2 Trade Effluent Control Standards

City of Harare

Department of Works

TRADE EFFLUENT CONTROL

Application of the Urban Councils Act (1995) in Controlling Trade Effluents from Industries

1) Protection of Public Sewers and Public Drains

In terms of Section 180 (1) (c), (d) and (e) of the Urban Councils Act (1995), no person shall, except with the consent of the Council and subject to such conditions it may impose:-

i) discharge or put into or permit to enter a public drain any solid, liquid or gaseous substance which the Council by notice in writing to the person concerned, has prohibited from being discharged into that sewer or drain on the ground that it is likely to injure or damage that sewer or drain, interfere with the free flow of sewage or stormwater or cause a nuisance or involve danger to the health of persons entering that sewer or drain or employed at the sewage works or to endanger, destroy or be injurious to the structure of any public sewer, public drain, sewage works or land or to the processes used therein or thereon; or

ii) discharge or put into or permit to enter a public sewer any stormwater; or

iii) discharge or put into or permit to enter a public stormwater drain any sewage.

In terms of (i) above, Council has set the following limits on effluents which are discharged into the Municipal sewage system. Council may also impose limits on any other substances which are not listed below as it deems necessary for the protection of public sewers or drains.

pH	6.8 - 9.0
Settleable Solids (cm ³ /litre)	less than 10.0
Fats (mg/l)	less than 400.0
Mineral Oils	Nil
Organic Solvents	Nil
Individual Heavy Metals (mg/l)	less than 50.0
Calcium Carbide	Nil

Bitumen.....	Nil
Cyanides	Nil
Temperature (°C).....	less than 60

With respect to (ii) stormwater is prohibited from entering the Municipal sewerage system from any source within the premises including : -

- a) Unroofed structures including washbays etc
- b) broken or low sewer inlet gullys
- c) broken sewer manhole covers
- d) broken sewer pipes etc

With respect to (iii) any waste water that arises from any process or activity carried out in the factory or premises is considered as sewage and must not be allowed to enter the public stormwater drains. All such water should enter the sewerage system.

2) Pretreatment of Industrial Effluents

In terms of Section 173 (4), the Council may, by notice in writing, require the owner or occupier of any premises from which trade effluent is discharged, to subject that effluent to such treatment as the Council may determine and to discharge it into a public sewer and the owner or occupier of the premises shall comply therewith within such reasonable time, being not less than thirty days, as is specified in the notice for the compliance therewith.

3) Right of Access to Premises

Under Section 220 (1) (b) (iv) and (v) Council shall, through its employees or contractors, together with any assistants and advisors that may be necessary, have access to or over any property by the shortest and most practicable route reasonable in the circumstances for the purposes of : -

- iv) ascertaining whether : -
 - a) there exists any nuisance; or
 - b) there is or has been a contravention of the provisions of this Act or any other law, responsibility for the administration of which is vested in the Council;
- v) ensuring compliance with the provisions of this Act or any other law, responsibility for the administration of which is vested in the Council.

4) Penalties

In terms of Section 320 (1) (a) and (b); Any person who is guilty of an offence in terms of this Act, where no penalty is expressly provided therefor, or of any regulation or by-law made under this Act shall be liable for each such offence:

- a) to a fine not exceeding five thousand dollars or;
- b) in the case of a continuing offence, to a fine not exceeding five thousand dollars or, if the offence has continued for more than fifty days, to a fine not exceeding 100 dollars for each day during which the offence has continued.

Section 320 (2) also states that : -

A conviction for an offence referred to in subsection (1) shall not be a bar to further prosecution or prosecutions for a continuation of the offence.

DIRECTOR OF WORKS

Table 3.3.1 Setting and Enforcement of the Standards & Regulations for Water Pollution Control in the Local Authorities Concerned

Standards & Regulations Urban Councils	Effluent Standards* in Rivers (Lakes & Dams) (PH / BOD / SS)	Effluent Standards (Trade Effluent)	Discharge Water Quality Standards at STWs	Solide Waste Control** (Waste Manag. By-Laws)	Regulations on Septic Tank Installation***	Livestock Pollution Regulations
City of Harare	○ ◎	○ ◎	○ ◎	○ ◎	○ ◎	×
Chitungwiza	○ △	○ △	○ △	○ △	○ ▼	×
Norton Town	○ △	○ △	○ △	○ ▼	○ ▼	×
Ruwa Local Board	○ ▼	○ ▼	○ △	○ ▼	○ ▼	×

Notes : ○ Existence × Non Existence ◎ Good enforcement △ Partial enforcement ▼ No enforcement

* This consists of two sets of regulations :

1) Water (Effluent and Wastewater Standards) Regulations (GN 6S7/77), issued under the Water Act (1976)

** Solid waste management in the Urban Councils should comply with the "Waste Management By-laws (1979)".

*** Installation of septic tanks should comply with the "Model Building (Amendment) By-laws (1981).

Source : Local Authorities Concerned

Table 3.4.1 Consolidated Income Statement (City of Harare)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
1 Rate				
Revenue	190,551,606	232,801,109	341,174,980	307,959,451
Expenditures	184,137,591	243,797,100	375,458,819	369,404,681
Balance	6,414,015	(10,995,991)	(34,283,839)	(61,445,230)
2 Sewerage				
Revenue	24,541,789	29,196,360	46,198,260	60,363,219
Expenditures	24,249,664	32,038,629	39,372,882	43,198,657
Balance	292,125	(2,842,269)	6,825,378	17,164,562
3 Water				
Revenue	58,001,383	68,981,553	149,504,212	240,675,870
Expenditures	67,851,492	88,189,093	126,481,347	144,009,164
Balance	(9,850,109)	(19,207,540)	23,022,865	96,666,706
4 Waste Management				
Revenue	11,117,929	15,989,947	28,251,524	39,303,245
Expenditures	13,168,228	21,230,012	28,296,353	33,741,078
Balance	(2,050,299)	(5,240,065)	(44,829)	5,562,167
5 Housing				
Revenue	20,318,337	23,836,098	34,198,488	37,654,768
Expenditures	21,700,614	29,206,710	35,644,719	37,262,962
Balance	(1,382,277)	(5,370,612)	(1,446,231)	391,806
6 Others				
Revenue	21,685,016	23,449,926	26,677,139	28,716,839
Expenditures	22,029,677	20,253,061	24,318,195	32,975,278
Balance	(344,661)	3,196,865	2,358,944	(4,258,439)
7 Total				
Revenue	326,216,060	394,254,993	626,004,603	714,673,392
Expenditures	333,137,266	434,714,605	629,572,315	660,591,820
Balance	(6,921,206)	(40,459,612)	(3,567,712)	54,081,572

Source: City Treasurer's Report, City of Harare.

Table 3.4.2 Consolidated Balance Sheet (City of Harare)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
Assets				
<u>Fixed assets</u>				
Capital outlay	593,980,502	736,814,007	877,300,775	1,199,947,733
Lands for sale	14,538,550	18,798,044	21,715,714	26,951,973
Stores and materials	52,329,603	56,299,400	60,382,975	62,310,477
Work in progress	8,795,330	4,258,947	16,519,398	3,236,544
Sub total	669,643,985	816,170,398	975,918,862	1,292,446,727
<u>Current assets</u>				
Investment to funds	100,440,347	105,004,796	79,736,704	80,637,804
Deferred charges	4,675,796	3,836,842	11,221,921	27,941,813
Advance	19,943,170	18,340,879	16,243,160	15,233,813
Sundry debtors	107,355,244	164,212,293	277,749,046	386,893,193
Deferred expenditures	4,645,532	1,065,172	375,663	478,336
Cash imprest	48,446	33,749	27,867	34,867
Sub-total	237,108,535	292,493,731	385,354,361	511,219,826
Total	906,752,520	1,108,664,129	1,361,273,223	1,803,666,553
Liabilities and Capitals				
<u>Long-term liabilities</u>	408,208,387	496,383,991	623,706,426	794,242,533
<u>Short-term liabilities</u>				
Accumulated funds	159,430,636	173,867,586	182,210,667	240,987,513
Sundry creditors	93,192,091	102,562,225	102,878,877	164,839,226
Sub-total	252,622,727	276,429,811	285,089,544	405,826,739
<u>Capitals</u>				
Contribution/Loan redemption	231,266,113	278,141,343	348,729,291	388,159,188
Reserves/Provisions	25,222,555	59,161,032	148,307,030	160,291,903
Others	18,273,863	64,558,483	32,513,975	168,569,880
Revenue balance	(28,841,125)	(66,010,471)	(77,073,043)	(113,423,690)
Sub-total	245,921,406	335,850,387	452,477,253	603,597,281
Total	906,752,520	1,108,664,189	1,361,273,223	1,803,666,553

Source: City's Treasurer's Report, City of Harare.

Remarks: The original form of balance sheet is transformed into an international standard.

Table 3.4.3 Consolidated Income Statement (Chitungwiza Municipality)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
1 Rates				
Revenue	16,635,095	14,847,608	21,999,885	39,478,057
Expenditures	10,189,976	16,809,346	20,072,088	26,488,865
Balance	6,445,119	(1,961,738)	1,927,797	12,989,192
2 Sewerage				
Revenue	2,629,075	2,821,481	3,845,255	5,062,897
Expenditures	2,408,632	3,589,683	2,656,651	4,724,713
Balance	220,443	(768,202)	1,188,604	338,184
3 Water				
Revenue	8,541,072	9,383,183	24,066,411	31,308,789
Expenditures	6,022,304	7,786,363	9,473,459	23,361,436
Balance	2,518,768	1,596,820	14,592,952	7,947,353
4 Housing				
Revenue	2,808,819	3,944,529	4,032,961	6,986,375
Expenditures	9,508,832	10,880,750	12,183,866	8,787,241
Balance	(6,700,013)	(6,936,221)	(8,150,905)	(1,800,866)
5 Health				
Revenue	7,308,408	5,268,643	5,401,813	7,969,107
Expenditures	8,002,296	9,128,607	12,569,404	15,188,707
Balance	(693,888)	(3,859,964)	(7,167,591)	(7,219,600)
6 Education				
Revenue	518,283	559,637	839,469	2,146,527
Expenditure	486,482	407,319	530,852	356,160
Balance	31,801	152,318	308,617	1,790,367
7 Welfare				
Revenue	1,720,493	1,355,548	1,796,373	1,646,018
Expenditures	1,813,046	2,181,316	2,951,578	3,836,696
Balance	(92,553)	(825,768)	(1,155,205)	(2,190,678)
8 Liquor				
Revenue	28,375,335	30,830,659	31,782,819	39,739,916
Expenditures	26,075,676	30,984,254	33,570,394	42,619,763
Balance	2,299,659	(153,595)	(1,787,575)	(2,879,847)
9 Butcheries				
Revenue	1,836,177	1,716,382	1,538,089	2,301,000
Expenditure	2,031,971	2,092,269	1,702,954	2,381,248
Balance	(195,794)	(375,887)	(164,865)	(80,248)
10 Staff Canteen				
Revenue	61,478	95,060	71,799	91,845
Expenditures	71,828	106,632	77,286	108,643
Balance	(10,350)	(11,572)	(5,487)	(16,798)
11 Refuse				
Revenue	2,085,757	2,198,581	3,337,584	4,656,489
Expenditures	1,221,073	1,535,909	1,696,697	2,272,679
Balance	864,684	662,672	1,640,887	2,383,810
12 TOTAL				
Revenue	72,519,992	73,021,311	98,712,458	141,387,020
Expenditures	67,832,116	85,502,448	97,485,229	130,126,151
Balance	4,687,876	(12,481,137)	1,227,229	11,260,869

Source: Auditor's Report, Chitungwiza Municipality

Table 3.4.4 Consolidated Balance Sheet (Chitungwiza Municipality)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
Assets				
<u>Fixed Assets</u>				
Capital Outlay	41,440,132	45,035,718	43,493,966	68,910,649
Lands for Sale	19,227,042	17,838,889	17,805,326	19,367,413
Sub-total	60,667,174	62,874,607	61,299,292	88,278,062
<u>Current Assets</u>				
Revenue Assets	19,320,560	13,229,048	23,358,976	37,389,307
Special fund Assets	7,334,776	8,003,217	9,525,341	10,669,713
Sub-total	26,655,336	21,232,265	32,884,317	48,059,020
Total	87,322,510	84,106,872	94,183,609	136,337,082
Liabilities and Capitals				
<u>Long-term liabilities</u>	50,692,071	53,035,482	51,641,301	70,913,078
<u>Short-term liabilities</u>	55,205,618	60,124,869	67,066,177	65,036,852
<u>Capitals</u>				
Revenue contribution	205,291	215,735	222,716	2,187,928
Grants	7,670,634	7,963,290	8,088,787	8,815,617
Loans redeemed	5,186,167	6,132,387	5,756,600	7,226,833
Carry over of prior funds	715,318	715,318	715,318	715,318
Revenue balance	(35,885,058)	(46,895,821)	(43,707,201)	(27,647,545)
Sub-total	(18,575,179)	(29,053,479)	(24,523,868)	(387,152)
Total	87,322,510	84,106,872	94,183,609	136,337,082

Source: Auditing Report, Chitungwiza Municipality

Remarks: The original balance sheet is transformed to an international standard form.

Table 3.4.5 Consolidated Income Statement (Norton Town)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
1 Administration				
Revenue	580,964	1,356,913	1,639,745	1,481,225
Expenditures	1,054,703	1,033,846	1,316,189	1,981,244
Balance	(473,739)	323,067	323,556	(500,019)
2 Town Board				
Revenue	1,905,685	2,644,035	2,067,479	3,324,049
Expenditure	1,883,606	3,112,114	2,736,930	3,734,192
Balance	22,079	(468,079)	(669,451)	(410,143)
3 Clinic & Hospital				
Revenue	410,105	1,150,381	1,180,666	1,410,132
Expenditure	431,555	1,205,103	1,288,240	1,515,939
Balance	(21,450)	(54,722)	(107,574)	(105,807)
4 Education				
Revenue	356,637	646,324	627,933	648,975
Expenditure	206,457	546,282	607,758	581,429
Balance	65,180	100,042	20,175	67,546
5 Welfare				
Revenue	46,145	65,396	61,193	85,359
Expenditure	82,633	100,699	107,278	184,443
Balance	(36,488)	(35,303)	(46,085)	(99,054)
6 Housing				
Revenue	789,239	988,096	1,163,433	1,793,030
Expenditure	610,058	807,976	989,823	1,063,936
Balance	178,181	150,120	173,610	729,094
7 Beerhall				
Revenue	980,999	1,012,954	1,061,438	1,727,839
Expenditure	480,194	900,700	1,094,690	1,104,990
Balance	500,805	112,254	(33,252)	622,049
8 TOTAL				
Revenue	5,064,774	7,864,099	7,801,887	10,470,609
Expenditures	4,829,206	7,706,700	8,140,908	10,166,143
Balance	235,568	157,399	(339,021)	304,466

Source: Auditors Report

Table 3.4.6 Consolidated Balance Sheet (Norton Town)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
Assets				
<u>Fixed Assets</u>				
Main account	3,381,144	3,895,588	4,198,209	5,027,686
Housing account	1,618,314	1,597,399	1,618,977	1,728,359
Sub-total	4,999,658	5,492,987	5,767,186	6,756,045
<u>Current Assets</u>				
Revenue assets	1,618,719	2,370,690	2,814,333	281,572
Special funds assets	810,745	1,707,624	2,075,941	4,236,457
Advanced to Development funds	1,718,301	1,754,952	5,004,952	5,079,249
Sub-total	4,147,765	5,833,266	9,895,226	12,177,278
Total	9,147,423	11,326,253	15,662,412	18,933,323
Liabilities and Capitals				
<u>Long-term liabilities (loans)</u>	3,771,443	4,562,522	8,717,449	11,834,928
<u>Short-term liabilities</u>	4,353,550	4,814,191	5,109,542	6,008,812
<u>Capitals</u>				
Revenue contribution	870,783	1,179,488	1,309,241	1,309,241
Grants	1,294,251	1,515,525	1,167,546	1,167,546
Loans redeemed	1,140,281	1,248,285	1,231,851	1,344,343
Revenue balance	(2,734,832)	(2,443,501)	(2,295,209)	(3,147,240)
Sub-total	1,022,430	1,949,540	1,835,421	1,089,583
Total	9,147,423	11,326,253	15,662,412	18,933,323

Source: Auditor's Report, Norton Town Council

Remarks: The original balance sheet is transformed to an international Standard form.

Table 3.4.7 Consolidated Income Statement (Ruwa Local Board)

Unit: Z\$

Accounts	91/92	92/93	93/94
1 Rate			
Revenue		638,889	1,413,442
Expenditures		267,849	472,304
Balance		371,040	941,138
2 Water			
Revenue		83,835	243,259
Expenditures		45,295	143,972
Balance		38,540	99,287
3 Works			
Revenue		418,135	524,999
Expenditures		112,848	380,309
Balance		305,287	144,690
4 Housing			
Revenue		76,984	241,196
Expenditures		48,484	69,359
Balance		28,500	171,837
5 Total			
Revenue	575,300	1,217,843	2,422,896
Expenditures	353,219	474,476	1,065,944
Balance	222,081	743,367	1,356,952

Source: Auditor's Report, Ruwa Local Board

- Remarks: (1) Sewerage and refuse works are included in Works Account.
 (2) The Auditor's Report of 1994/1995 is not published yet.
 (3) The income statement of the year 1991/92 is not presented by account.

Table 3.4.8 Consolidated Balance Sheet (Ruwa Local Board)

Unit: Z\$

Accounts	91/92	92/93	93/94	94/95
Assets				
<u>Fixed Assets</u>	150,804	1,054,941	2,552,598	
<u>Current Assets</u>				
Revenue Assets	350,300	307,246	2,281,151	
Advance to revenue			9,086	
Advance to investments		419,894	410,808	
Sub-total	350,300	727,140	2,701,045	
Total	501,104	1,782,081	5,253,643	
Liabilities and Capitals				
<u>Long-term liabilities</u>		438,578	1,331,844	
<u>Short-term liabilities</u>	51,035	512,987	1,727,597	
<u>Capitals</u>				
Revenue contribution	150,804	614,941	1,212,598	
Loan redeemed		1,422	8,156	
Revenue balance	299,265	214,153	973,448	
Sub-total	450,069	830,516	2,194,202	
Total	501,104	1,782,081	5,253,643	

Source: Auditor's Report, Ruwa Local Board

Remarks: The Auditor's Report of the year 1994/95 is not published yet.

The original form of balance sheet is transformed to an international standard.

Table 3.4.9 Water and Sewerage: Revenue and Expenditures (City of Harare)

Unit: Z\$

Account	91/92	92/93	93/94	94/95
1 Water				
Revenue				
Water sales	57,844,094	68,313,515	149,352,082	240,431,733
Connection fees	125,382	99,247	97,105	155,734
Others	31,907	568,791	55,025	88,403
Sub-total	58,001,383	68,981,553	149,504,212	240,675,870
Expenditures				
Morton Jaffray	35,674,099	46,846,134	67,280,745	66,044,313
Connection	8,358,399	10,333,389	14,579,376	19,809,388
Distribution	9,339,816	9,161,794	14,233,027	13,335,522
Water sales	5,640,174	6,691,611	7,402,587	16,992,925
Others	8,839,004	15,156,165	22,985,612	27,827,016
Sub-total	67,851,492	88,189,093	126,481,347	144,009,164
Balance	(9,850,109)	(19,207,540)	23,022,865	96,666,706
2 Sewerage				
Revenue				
Sewerage tariff	20,241,810	23,916,356	38,412,792	50,977,193
Reticulation fees	27,442	30,763	41,205	54,185
Farming operations		5,249,241	7,744,314	9,331,841
Sub-total	24,541,789	29,196,360	46,198,311	60,363,219
Expenditures				
Administration	614,525	418,000	40,500	565,875
Reticulation	9,643,530	12,552,759	13,032,298	15,014,920
Treatment				
Southern	9,718	39,088		
Crowborough	3,310,243	5,271,148	7,764,540	7,405,207
Firle	5,815,090	7,421,701	10,132,814	10,562,413
Donnybrook	947,572	1,264,811	1,840,296	2,455,513
Marlborough	119,929	224,698	540,496	999,401
Hatchliffe	225,785	314,658	569,670	578,950
Farming operation	3,563,272	4,531,739	5,462,268	5,616,378
Sub-total	24,249,664	32,038,602	39,382,882	43,198,657
Balance	292,125	(2,842,242)	6,815,429	17,164,562

Source: City Treasurer's Reports

Table 3.4.10 Water and Sewerage: Investment and Finance (City of Harare)

Unit: Z\$

Account	91/92	94/95	91/92 - 94/95	
1 Water				
<u>Capital Assets</u>			<u>Investment</u>	<u>Disposal</u>
Treatment Works	63,532,149	71,071,974	8,511,975	972,150
Distribution	39,939,051	66,033,002	26,968,768	874,817
Reticulation	27,752,202	55,403,167	28,325,957	674,992
Seke water supply	2,968,191			2,968,191
Harare water supply	76,928,668	198,555,535	121,626,867	
Sub-total	211,120,261	391,063,678	185,433,567	5,490,150
<u>Liabilities</u>			<u>Finance</u>	<u>Repayment/Transfer</u>
Loan	161,947,603	325,658,089	180,231,225	16,520,739
Special funds	3,287,747	3,309,869	1,049,358	1,027,236
Capitals	45,884,921	62,095,720	20,943,906	4,733,107
Sub-total	211,120,271	391,063,678	202,224,489	22,281,082
2 Sewerage				
<u>Fixed Assets</u>			<u>Investment</u>	<u>Disposal</u>
Reticulation	44,749,087	66,494,063	21,931,064	186,088
Treatment				
Southern	1,360,706			1,360,706
Crowborough	7,251,654	9,549,306	2,301,252	3,600
Firle	12,717,488	14,262,756	1,558,048	12,780
Donnybrook	823,023	1,549,674	726,651	
Marlborough	241,329	1,246,235	1,004,906	
Zengeza	3,838,594			3,838,594
Hatcliffe	456,912	1,151,078	694,166	
Firle V		89,410,548	89,410,548	
Irrigations	1,001,952	2,216,733	1,253,221	38,440
Others	6,862	15,022	8,160	
Sub-total	72,447,607	185,895,415	118,888,016	5,440,208
<u>Liabilities and Capitals</u>			<u>Finance</u>	<u>Repayment</u>
Loan	44,270,330	149,089,885	116,473,219	11,653,664
Special funds	759,680	511,533	0	248,147
Capitals	27,417,597	36,293,997	14,664,093	5,787,693
Sub-total	72,447,607	185,895,415	131,137,312	17,689,504

Source: City Treasurer's Reports

**Table 3.4.11 Water and Sewerage: Revenue and Expenditures, Investment and Finance
(Chitungwiza Municipality)**

Unit: Z\$

	92/93	94/95	92/93 - 94/95	
1 Revenue and Expenditure				
Revenue				
Sewerage charges	2,724,578	4,841,090		
Water charges	9,344,298	31,308,789		
Maintenance charges	96,903	221,807		
Others	38,885	1,815,798		
Sub-total	12,204,664	38,187,484		
Expenditures	10,521,530	28,086,149		
Balance	1,683,134	10,101,335		
2 Investments and Finance				
<u>Fixed assets</u>			<u>Investment</u>	<u>Disposal</u>
Building	72,570	206,672	134,242	140
Equipment	40,667	47,516	9,019	2,170
Plant and Machinery	568,888	535,798	43,756	76,846
Vehicles	286,479	272,883	-	13,596
Water and Sewage reticulation	17,910,029	35,131,666	17,314,389	92,752
Sub-total	18,878,633	36,194,535	17,501,406	185,504
<u>Liabilities and Capitals</u>			<u>Finance</u>	<u>Repayment</u>
Loans	17,241,502	32,828,202	17,926,321	2,339,621
Special funds	201,563	1,929,834	1,728,271	
Capitals	1,435,568	1,436,499	931	
Sub-total	18,878,633	36,194,535	19,655,523	2,339,621

Source: Auditor's Reports

Table 3.4.12 Water and Sewerage: Revenue and Expenditures, Capital Expenditures (Norton Town Council)

Unit: Z\$

Account	91/92	92/93	93/94	94/95
1 Revenue and Expenditures				
<u>Revenue</u>				
Sewerage treatment works	367,777	403,775	504,952	983,309
Water and sewer reticulation	292,811	565,396	799,148	1,513,689
Sub-total	660,588	969,171	1,304,100	2,496,998
<u>Expenditures</u>				
Sewage treatment works	199,670	238,839	443,561	450,670
Water and sewer reticulation	190,265	505,654	882,647	1,654,105
Sub-total	389,935	744,523	1,326,208	2,104,775
Balance	270,653	224,648	(22,108)	392,223
2 Investment of Sewer Upgrading			12,306	886,670

Source: financial data collected from the treasury section of Norton Town Council.

Table 3.4.13 Water and Sewerage, Revenue and Expenditure, Investment and Finance (Ruwa Local Board)

Unit: Z\$

	92/93	93/94	92/93 - 93/94
1 Revenue and Expenditure			
<u>Revenue</u>			
Water sales	55,466	97,092	
Water connection fees	28,369	146,167	
Sewerage fees	1,848	25,522	
Sewerage connection fees	15,400	102,523	
Sub-total	101,083	371,304	
<u>Expenditures</u>			
Expenditures for water works	45,295	143,972	
Maintenance of sewerage works	1,586	105,565	
Sub-total	46,881	249,537	
Balance	54,202	121,767	
2 Investments and Finance			
<u>Fixed assets</u>			<u>Investment</u>
Water Woks (Machines and meters)	24,495	77,041	52,546
Sewage Treatment Work		153,923	153,923
Sub-total	24,495	230,964	206,469
<u>Liabilities and Capitals</u>			<u>Finance</u>
Capitals	24,495	230,964	206,469
Sub-total	24,495	230,964	206,469

Source: Auditor's Report Ruwa local Board

Remarks: The revenue and expenditures of sewerage works are included in "The Work Account" of Auditor's Reports. The maintenance cost of sewerage works is only accounted as expenditures of sewerage works, which does not include labour and material costs for operation.

Table 3.4.14 General Data on Charges Collection System of the Urban Councils in the Study Area

Urban Council	Establishment of the Present Urban Status	Distance from the City of Harare (Location)	No. of Households Provided with Water & Sewerage Services (Average Family Size)	Water and Sewerage Collection Rate	Other Charges Collected Together with Sewerage Charges	Time of Application of New Tariffs
City of Harare	April 1980	0 km	80,000 - 90,000 households (7 persons)	85%	Water / Refuse	Water Charges on 1st February Sewerage Charges on 1st October
Chitungwiza Municipality	July 1992	30 km (South)	31,300 households (7 persons)	90%	Refuse (Water charges are collected separately)	1st July
Norton Town	May 1994	40 km (West)	3,400 households in high density (HD) area (6 persons) 680 households in low density (LD) area (6 persons)	87% in HD area 80% in LD area	Water / Refuse Refuse	1st July
Ruwa Local Board	Oct. 1990	25 km (South East)	2,000 households (7 persons)	85%	Water / Refuse	1st July
Epworth Local Board	1986	10 km (South East)	10,000 households (7 persons)	-	-	-

Note : Data derive from the interview and questionnaire surveys conducted in July 1996 to the officers of each local authority concerned.



3.5.1 Water Quality Examination of Public Water Bodies and Major Pollution Sources

The preliminary water pollution analysis for the Upper Manyame River Basin was made fully utilising the existing data on the water quality of the rivers, lakes/dams and on the major pollution sources. During the field work, water quality examination was conducted to supplement the existing data on the water bodies (rivers, lakes and groundwater) and on the major pollution sources (STPs and factories). The examination results of the sewage treatment plants were also used for the calculation of the unit pollution load of domestic sewage.

Water sampling was conducted in the catchment area of the Manyame River and its tributaries from the origin of the Manyame River up to the Manyame Dam, the farms in this area, and the city/municipal area of Harare, Chitungwiza, Norton and Ruwa.

The water quality examination was conducted for 93 samples in terms of the following water quality indices:

Group 1		
Temperature	Hydrogen Ion Potential (pH)	Dissolved Oxygen (DO)
Suspended Solid (SS)	Chloride (Cl)	Electric Conductivity (EC)
Hardness	Total Nitrogen (T-N)	Ammonia Nitrogen (NH ₄ -N)
Nitrite Nitrogen (NO ₂ -N)	Nitrate Nitrogen (NO ₃ -N)	Total Phosphorus (T-P)
Phosphorus Phosphate (PO ₄ -P)	Oil	
Heavy Metals; Aluminum (Al), Copper (Cu), Mercury (Hg), Zinc (Zn), Lead (Pb), Nickel (Ni), Iron (Fe), Arsenic (As), Chromium Hexavalent (Cr ⁶⁺), and Cadmium (Cd)		

Group 2	
Water Quality Indices	Number of Samples
Biochemical Oxygen Demand (BOD ₅)	68
Total Chemical Oxygen Demand (T-COD)	93
Soluble Chemical Oxygen Demand (S-COD)	20

In addition, to the above indices, the following were conducted in Japan:

Group 3	
Water Quality Indices for Agricultural Chemicals	Number of Samples
Atrazine	19
Captan	19
Chlorpyrifos	19

Concerning the selection of the water quality indices for the agricultural chemicals, three indices (atrazine, captan and chlorpyrifos) were selected based on the following items and were examined in Japan:

- must be representative agricultural chemicals in the study area
- must be possible to be examined in Japan
- must fall under existing water quality standard of the WHO guideline for drinking water

The used amount of the agricultural chemicals in the study area is shown in Table 3.5.2.

Table 3.5.3 to Table 3.5.5 summarize the manner of sampling and examination, and the scheduling for each examination group. Figure 3.5.1 presents the water sampling points at rivers, and lakes/dams.

Table 3.5.2 The agricultural Chemicals Commonly used in Study Area

Place	Farm Size (ha)	Herbicide (litre/year)	Insecticide (litre/year)	Fungicide (litre/year)	Comment
Harare	920	Metribuzin 70 Terbutryne 20kg Metalachlor 120 Paraquat 30	Endosulfan 150 Monocrotophos 40	Chlorothalonil 25 Copper oxychloride 250kg Anilazine 25	Includes horticulture
	1,806	Metribuzin 120 Alachlor 490 Metalachlor 320 Terbutryne 40 Glyphosate 25 Captan 120 Atrazine 450	Fenamiphos 70 Monocrotophos 60 Malathion 50kg	Copper oxychloride 30kg Dithane M45 17kg Garbofuran 10kg Benomyl 9kg	
Gwebi	1,600	Atrazine 160 Terbutryne 80 Alachlor 180 Paraquat 20 Glyphosate 30	Garbaryl 100kg Malathion 225kg Endosulfan 200kg Chlorpyrifos 3 Monocrotophos 5 Fenithion 3 Fenvalerate 5	Copper oxychloride 5kg Dithane M45 5kg Anilazine 3kg	
Darwendale	700	Atrazine 400	Butralin 100 Malathion 6kg Chlorpyrifos 20 Fenamiphos 100 Fenvalerate 6	Dithane M45 (-) Anilazine 40kg	Includes livestock
	800	Alachlor 100	Fenvalerate 160 Fenamiphos 160 Butralin 300	Methyl bromide 320kg Copper oxychloride 30kg Anilazine 20kg	
Norton	50	Atrazine (-) Glyphosate (-) Metalachlor 100	Monocrotophos 5 Chlorpyrifos 5 Chlorothalonil 20	Dithane M45 3kg Anilazine 5kg Methyl bromide 225kg	Includes horticulture
Ruwa	197	Haloxypfop ethoxy ethyl 15	Endosulfan (-) Lambda-cyhalothrin (-) Triademinol (-) Dicofol (-)	Dithane M45 (-) Sulphur 1000kg Triforine (-)	Horticulture only
Total	6,073	Atrazine 1,010 Alachlor 770 Metalachlor 540 Metribuzin 190 Terbutryne 140 Captan 120 Glyphosate 55 Paraquat 50 Haloxypfop 15	Butralin 400 Endosulfan 350 Fenamiphos 330 Malathion 281 Fenvalerate 171 Monocrotophos 110 Garbaryl 100 Chlorpyrifos 28 Chlorothalonil 20 Fenithion 3	Sulphur 1,000 Methyl bromide 545 Copper oxychloride 315 Anilazine 93 Chlorothalonil 25 Dithane M45 25 Garbofuran 10 Benomyl 9	

(-) = quantities not available

Table 3.5.3 (1) Water Quality Examination

Investigation Subjects	Sampling Time	No. of Samples	Water Quality Indices	Flow Rate	Remarks
Public Water Bodies	1 time in May	1 sample at each sampling point (Total 9 samples)	Temp., pH, DO, SS, Cl, EC, Hardness, T-N, NH ₄ -N, NO ₂ -N, NO ₃ -N, T-P, PO ₄ -P, Oil, Heavy Metals	To be measured at each sampling point by sampling staff	
	1 time each in May and June	4 samples at each sampling point (Total 20 samples)	Temp., pH, DO, SS, Cl, EC, Hardness, T-N, NH ₄ -N, NO ₂ -N, NO ₃ -N, T-P, PO ₄ -P, Oil, Heavy Metals	Not Applicable	
Major Pollution Sources	3 times/day in May (for influent and effluent)	1 composite sample at each sampling point (Total 14 samples)	Temp., pH, DO, SS, Cl, EC, Hardness, T-N, NH ₄ -N, NO ₂ -N, NO ₃ -N, T-P, PO ₄ -P, Oil, Heavy Metals	To be measured at each sampling point by sampling staff	
	3 times/day during May to June	1 composite sample at each sampling point (Total 45 samples) 15 factories 10 factories 10 factories 5 factories 5 factories	Temp., pH, DO, SS, Cl, EC, Hardness, T-N, NH ₄ -N, NO ₂ -N, NO ₃ -N, T-P, PO ₄ -P, Oil, Heavy Metals	To be measured at each sampling point by sampling staff	Following data to be utilized in further studies will be investigated by using questionnaires & interviews: - consumed water volume - discharged wastewater volume - number of employee - produced goods and production process - production amount - details of wastewater treatment facilities (if exist)
Groundwater	1 time in May	Total 5 samples	Temp., pH, DO, SS, Cl, EC, Hardness, T-N, NH ₄ -N, NO ₂ -N, NO ₃ -N, T-P, PO ₄ -P, Oil, Heavy Metals	Not Applicable	

Table 3.5.4 (1) Water Quality Examination

Investigation Subjects	Sampling Time	No. of Samples	Water Quality Indices	Flow Rate	Remarks
Public Water Bodies	1 time in May	1 sample at each sampling point (Total 9 samples)	BOD, T-COD	To be measured at each sampling point	
	1 time each in May and June	4 samples at each sampling point (Total 20 samples)	T-COD, S-COD	Not Applicable	
	3 times/day in May (for influent and effluent)	1 composite sample at each sampling point (Total 14 samples)	BOD, T-COD	To be measured at each sampling point	
Major Pollution Sources	3 times/day during May to June	1 composite sample at each sampling point (Total 45 samples) 15 factories 10 factories 10 factories 5 factories 5 factories	BOD, T-COD	To be measured at each sampling point	Following data to be utilized in further studies will be investigated by using questionnaires & interviews: - consumed water volume - discharged wastewater volume - number of employee - produced goods and production process - production amount - details of wastewater treatment Facilities (if exist)
	1 time in May	Total 5 samples	T-COD	Not Applicable	
Groundwater	1 time in May	Total 5 samples	T-COD	Not Applicable	

Table 3.5.4 (2) Water Quality Investigation Schedule

Category	Sampling Point	Sampling Time	No. of Sampling	No. of Samples	Indices to be Analyzed		
					BOD	T-COD	S-COD
River	MANYAME R. Main Stream	Upstream	1 no./day	1	0	0	0
	do	New Road Bridge	1 no./day	1	0	0	0
	do	Skyline Bridge	1 no./day	1	0	0	0
	NYATSIME River	Downstream of Zengeza STP	1 no./day	1	0	0	0
	RUWA River	Before confluence to main stream	1 no./day	1	0	0	0
	MAKUVISI River	Before confluence to main stream	1 no./day	1	0	0	0
	MARIMBA River	Before confluence to main stream	1 no./day	1	0	0	0
	MUZURURU River	Before confluence to main stream	1 no./day	1	0	0	0
	GWEBI River	Before confluence to main stream	1 no./day	1	0	0	0
	SEKE Dam	After inflow of Manyame R. (Upper & Lower layer)	May & June	1 no./day	4	0	0
Lake	do	Before outflow to Manyame R. (Up. & Low. layer)	May & June	4	0	0	
	Lake CHIVERO	After inflow of Manyame R. (Up. & Low. layer)	May & June	4	0	0	
	do	After inflow of Marimba R. (Up. & Low. layer)	May & June	4	0	0	
	do	Before outflow to Manyame R. (Up. & Low. layer)	May & June	4	0	0	
Well	Surrounding of Irrigation Area	Up- & Downstream of groundwater flow	1 no./day	5	0	0	
WWTP*2	Fire WWTP	Inlet, Outlet**1	3 no./day	3	0	0	
	Crowborough WWTP	Inlet, Outlet**1	3 no./day	3	0	0	
	Donnybrook WWTP	Inlet, Outlet	3 no./day	2	0	0	
	Zengeza WWTP	Inlet, Outlet	3 no./day	2	0	0	
	Norton WWTP	Inlet, Outlet	3 no./day	2	0	0	
	Ruwa WWTP	Inlet, Outlet	3 no./day	2	0	0	
Factory*2	Fire WWTP Service Area	15 factories	3 no./day	15	0	0	
	Crowborough WWTP S.A.	10 factories	3 no./day	10	0	0	
	Zengeza WWTP S.A.	10 factories	3 no./day	10	0	0	
	Norton WWTP S.A.	5 factories	3 no./day	5	0	0	
	Ruwa WWTP S.A.	5 factories	3 no./day	5	0	0	
Total			93	68	93	20	

*1: Treated water will be taken for each treatment method (Trickling filter and Anaerobic-aerobic).

*2: One composite sample will be made in accordance with the flow amount at each sampling time.

Table 3.5.5 (1) Water Quality Examination

Investigation Subjects	Sampling Time	No. of Samples	Water Quality Indices	Flow Rate	Remarks
Manyame River - Upstream - New Road Bridge - Skyline Bridge Tributaries - Nyatsime River - Ruwa River - Makuvisi River - Marimba River - Muzururu River - Gwebi River Lake - Seke Dam (2 points) - Lake Chivero (3 points)	1 time in May	1 sample at each sampling point (Total 9 samples)	Pesticide (Atrazine, Captan, Chlopyrifos)	To be measured at each sampling point	
Wells - 5 wells around the WWTP effluent irrigation area	1 time in May	Total 5 samples	Pesticide (Atrazine, Captan, Chlopyrifos)	Not Applicable	
Public Water Bodies					
Groundwater					

Table 3.5.5 (2) Water Quality Investigation Schedule

Category	Sampling Point		Sampling Time	No. of Sampling	No. of Samples	Indices to be Analyzed*1		
						Atrazine	Captan	Chlorpyrifos
River	MANYAME R. Main Stream	Upstream	May	1 no./day	1	0	0	0
	do	New Road Bridge	May	1 no./day	1	0	0	0
	do	Skyline Bridge	May	1 no./day	1	0	0	0
	NYATSIME River	Downstream of Zengeza STP	May	1 no./day	1	0	0	0
	RUWA River	Before confluence to main stream	May	1 no./day	1	0	0	0
	MAKUVISI River	Before confluence to main stream	May	1 no./day	1	0	0	0
	MARIMBA River	Before confluence to main stream	May	1 no./day	1	0	0	0
	MUZURURU River	Before confluence to main stream	May	1 no./day	1	0	0	0
	GWEBI River	Before confluence to main stream	May	1 no./day	1	0	0	0
Lake	SEKE Dam	After inflow of Manyame R. (Upper layer)	May	1 no./day	1	0	0	0
	do	Before outflow to Manyame R. (Upper layer)	May	1 no./day	1	0	0	0
	Lake CHIVERO	After inflow of Manyame R. (Upper layer)	May	1 no./day	1	0	0	0
	do	After inflow of Marimba R. (Upper layer)	May	1 no./day	1	0	0	0
	do	Before outflow to Manyame R. (Upper layer)	May	1 no./day	1	0	0	0
Well	Surrounding of Irrigation Area	Up- & Downstream of groundwater flow	May	1 no./day	5	0	0	0
				Total	19	19	19	19

*1: The examination will be done in Japan. Water in upper layer will be sampled at lakes. One sample will be taken at each sampling point.

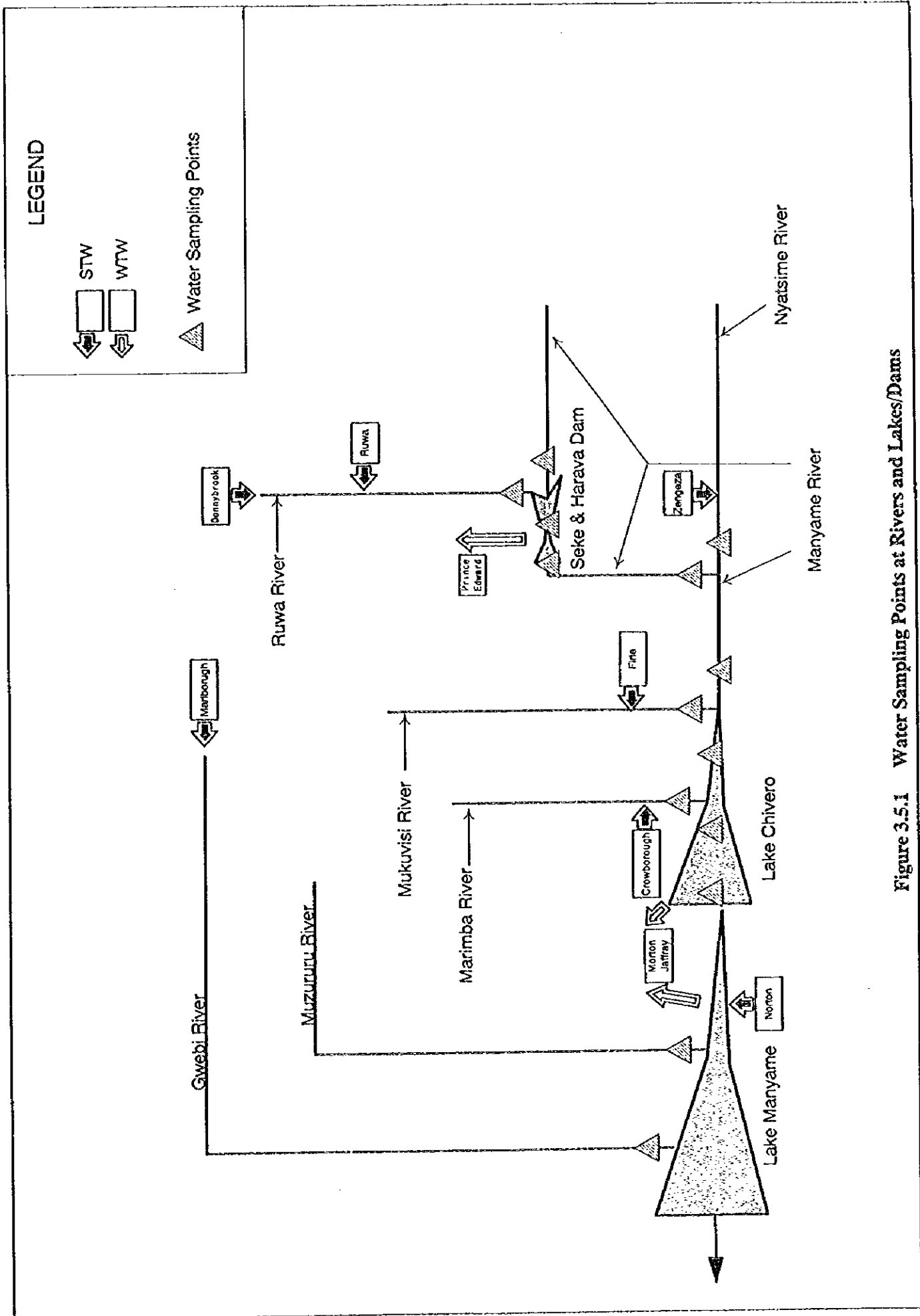


Figure 3.5.1 Water Sampling Points at Rivers and Lakes/Dams

