No. 4

THE BASIC DESIGN STUDY REPORT
ON
LUSAKA CITY WATERWORKS TREATMENT PLANT IMPROVEMENT PROJECT
IN
THE REPUBLIC OF ZAMBIA

JUNE, 1986

Japan International Cooperation Agency

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PREFACE

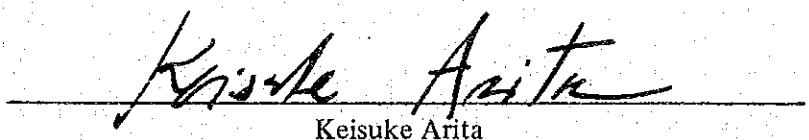
In response to the request of the Government of the Republic of Zambia, the Government of Japan decided to conduct a basic design study on the Lusaka City Waterworks Treatment Plant Improvement Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Zambia a study team headed by Mikio Nakamura, Deputy Division Chief, First Basic Design Study Division, Grant Aid Planning and Survey Department, JICA, from March 9 to 31, 1986.

The team had discussions on the Project with the officials concerned of the Government of Zambia and conducted a field survey in Lusaka City area. After the team returned to Japan, further studies were made and the present report has been prepared.

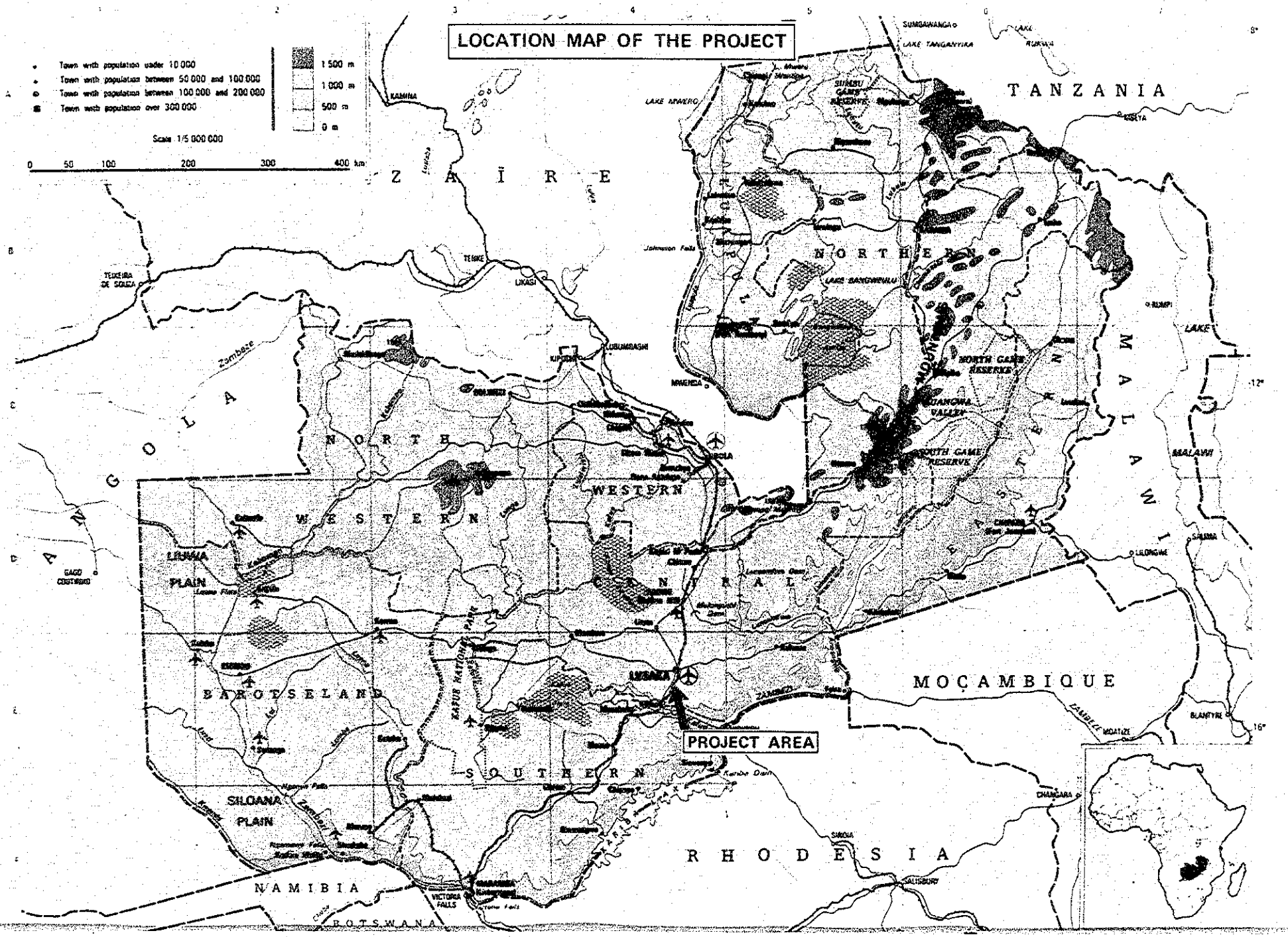
I hope that this report will serve for the development of the project and contribute to the promotion of friendly relations between our countries.

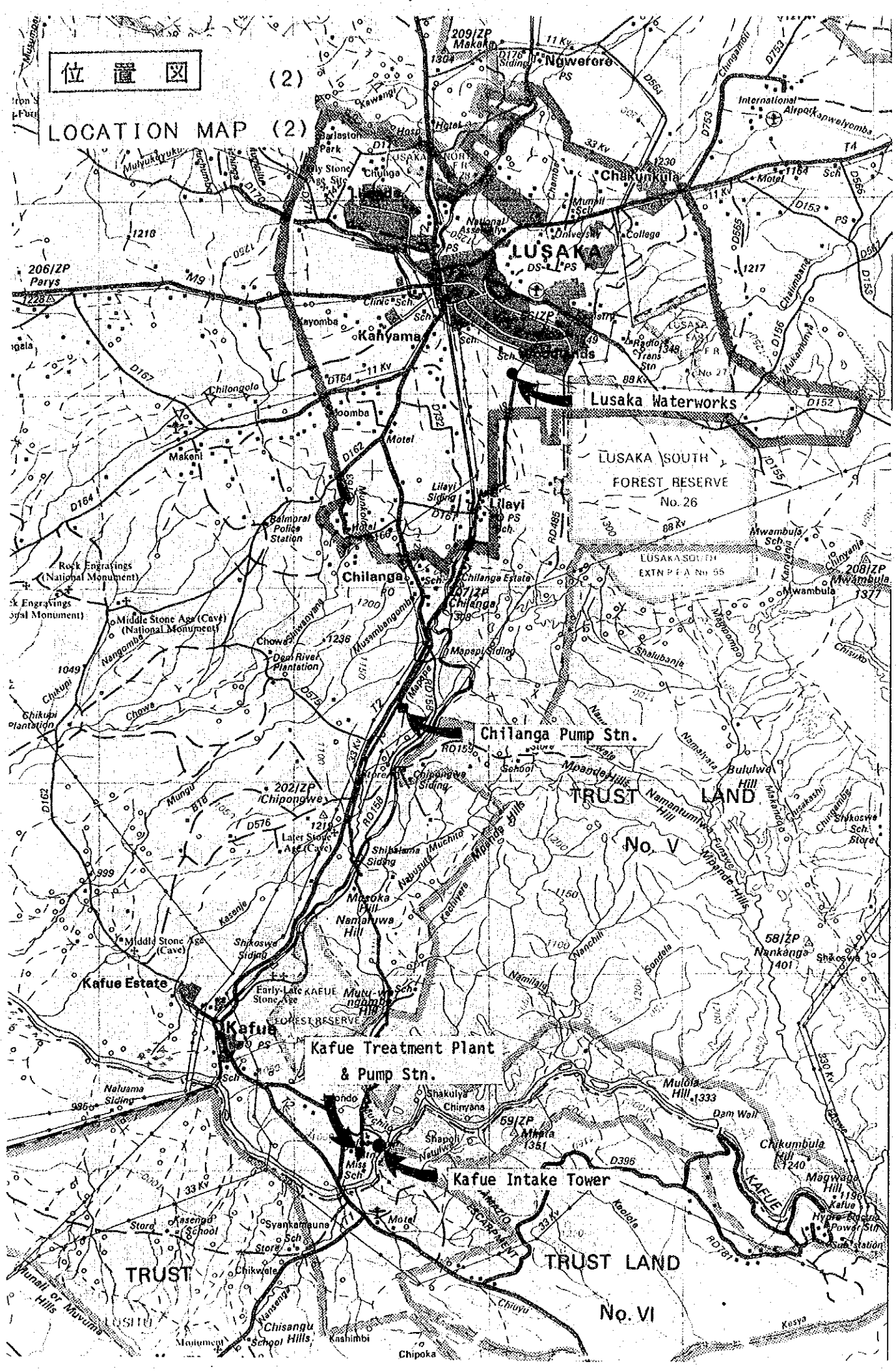
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Zambia for their close cooperation extended to the team.

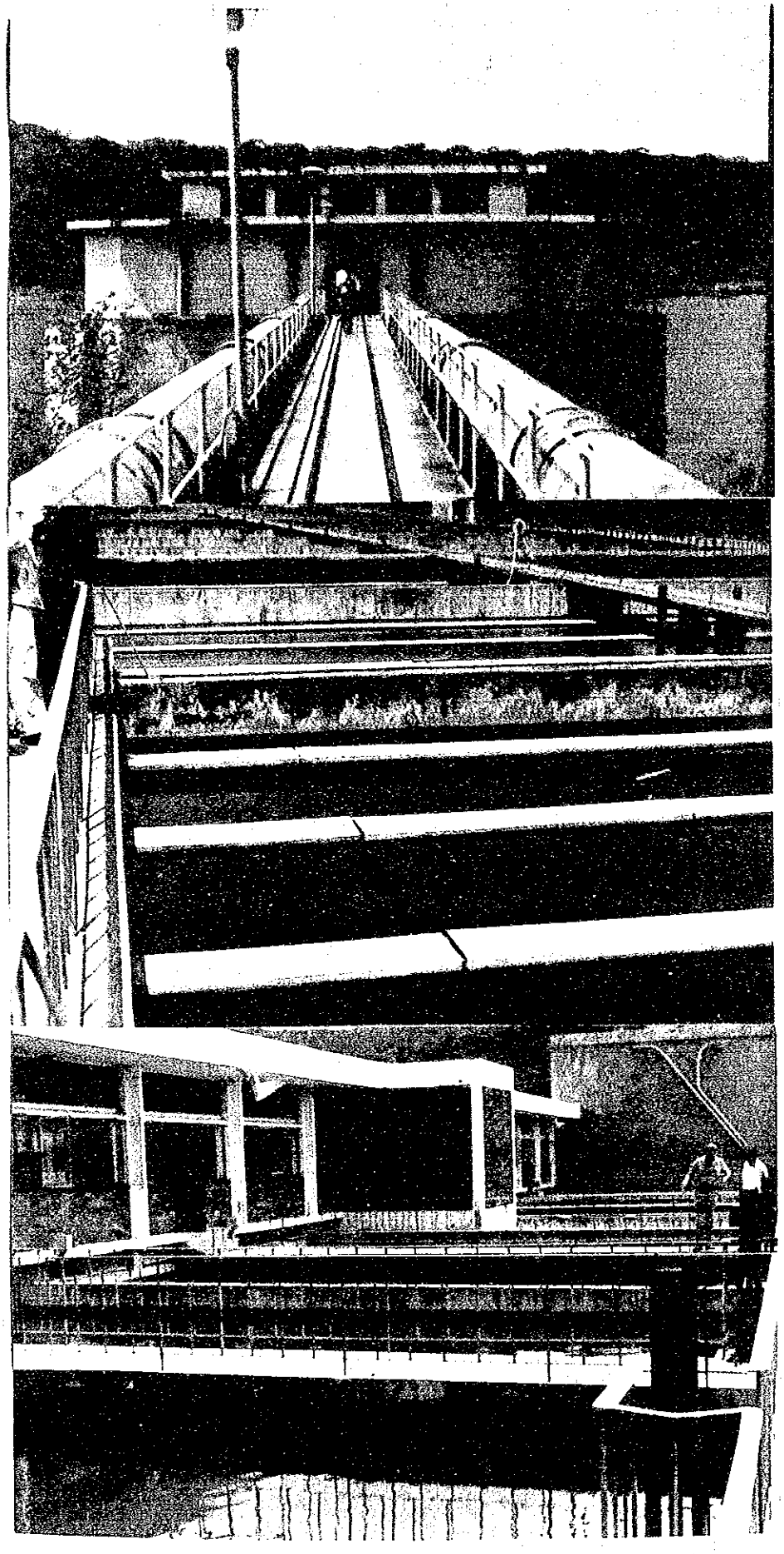
June, 1986



Keisuke Arita
President
JAPAN INTERNATIONAL COOPERATION AGENCY


LOCATION MAP OF THE PROJECT
Town with population under 10 000
Town with population between 50 000 and 100 000
Town with population between 100 000 and 200 000
Town with population over 300 000
1 500 m
1 000 m
500 m
0 m
Scale 1/5 000 000
0 50 100 200 300 400 km
TANZANIA
ZAIRE
ANGOLA
NAMIBIA
BOTSWANA
RHODESIA
MOÇAMBIQUE
MALAWI
NORTHERN
NORTH WESTERN
WESTERN
CENTRAL
EASTERN
SOUTHERN
BAROTSELAND
KAFUE NATIONAL PARK
KAFUE FLATS
LUSAKA PLAIN
SILOANA PLAIN
LUSAKA
PROJECT AREA
LAKE TANGANYIKA
LAKE MWERU
LAKE BANGWEULU
LUANGWA VALLEY
NORTH GAME RESERVE
SOUTH GAME RESERVE
KAMINA
TENKE
LIKASI
TEIXEIRA DE SOUSA
LUBUMBASHI
MWERU
KIPUSHI
SUMBAWANGA
KASAMA
MPIKA
CHIPATA
LILONGWE
BLANTYRE
CHAMBARA
SALISBURY
VICTORIA FALLS
MOATIZE
Zambeze
Kafue
Luapula
Johnson Falls

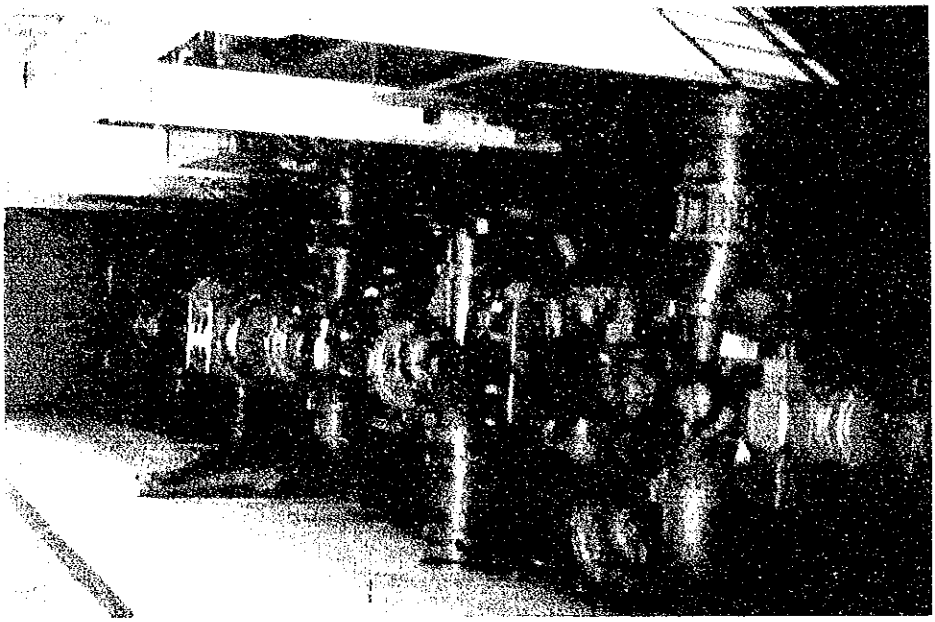

位置図 (2)
LOCATION MAP (2)
LUSAKA
Ngwerere
Chakunkula
Kanyama
Lusaka Waterworks
LUSAKA SOUTH FOREST RESERVE No. 26
LUSAKA SOUTH EXTN P F A No. 55
Ilayi
Chilanga
Chilanga Pump Stn.
TRUST LAND No. V
Kafue Estate
Kafue
Kafue Treatment Plant & Pump Stn.
Kafue Intake Tower
TRUST LAND No. VI
TRUST
KAFUE FOREST RESERVE
International Airport
Rock Engravings (National Monument)
Middle Stone Age (Cave) (National Monument)
Middle Stone Age (Cave)
Later Stone Age (Cave)
Early-Late Stone Age
Dam Wall
Kafue Hydro-Electric Power Station
206/ZP Parys
209/ZP Makeni
202/ZP Chipongwe
207/ZP Chilanga
208/ZP Mwambula
58/ZP Nankanga
59/ZP Mbala
Mpande Hills
Mulola Hill 1333
Chikumbula Hill 1240
Magwaga Hill 1196
Nanjahuwa Hill
Mwambula 1377
Nankanga 1401
Mbala (351)
Balmoral Police Station
Dam River Plantation
Chikuni Plantation
Mapepi Siding
Chipongwe Siding
Shibalama Siding
Shikoswe Siding
Naluama Siding
Lilayi Siding
Kafue Gorge
Kafue Gorge Lower
Kafue Gorge Upper
330 Kv
88 Kv
33 Kv
11 Kv



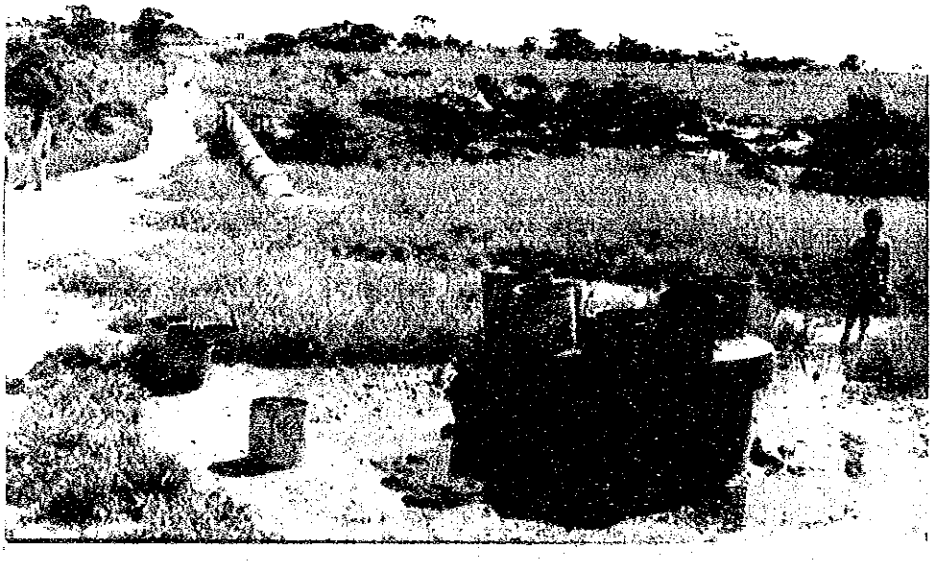
Kafue Intake Site
カフェ取水場

Sedimentation Basin at Kafue Treatment Plant
沈でん池（カフェ浄水場）

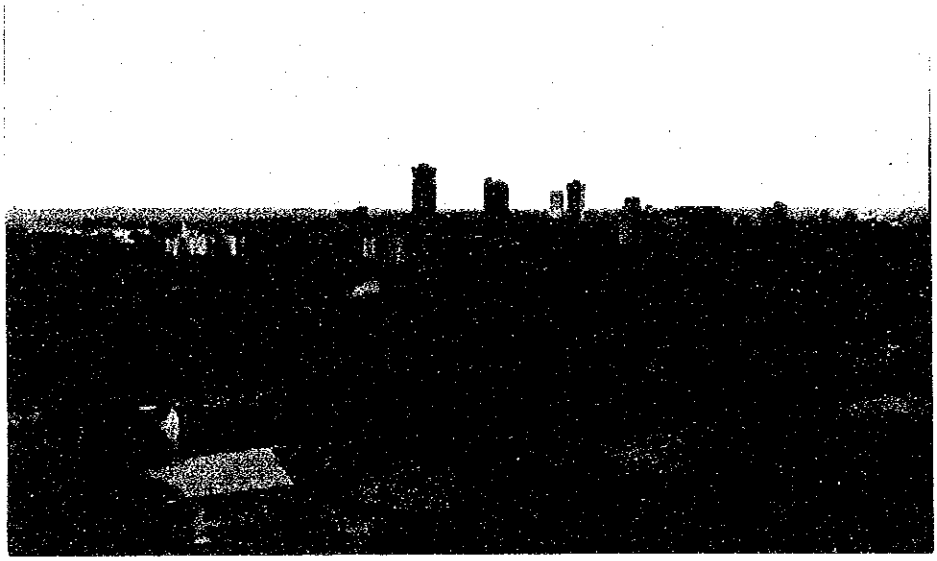
Rapid Gravity Filter at Kafue Treatment Plant
ろ過池（カフェ浄水場）



Pumping Station at Kafue Treatment Plant
カフェポンプ場



Transmission Line between Kafue and Lusaka
カフェ～ルサカ間の送水管



Lusaka City
ルサカ市

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SUMMARY

SUMMARY

The population of Zambia has increased rapidly since its independence in 1964, i.e., from approximately 3,490,000 in 1963 to 5,660,000 in 1980. The ratio of urban population also increased from 20% to 50%. During this period, many people had access to safe water in the ratios of 46% in the country and 70% in the 10 Large Urban Areas as of 1980. Nevertheless, service levels are not so satisfactory. For example, only 48% of dwellings have individual taps within their plots even in the 10 Large Urban Areas. In addition to the increase in urban population, such factors as higher living-standards, industrial development, etc. have caused increased water demand, particularly in urban areas. However, since the water supply system was not developed adequately to keep up with the demand, water shortage problems have continually been one of the main topics throughout the country which has a high rate of epidemics.

Lusaka City, the objective area of this project, has been developed as the capital of Zambia. It is the center of the nation in terms of politics, economy, culture, transportation, etc., and one of the most developed cities on the African Continent. Its population, which was only about 120,000 in 1963 has increased at a faster rate than that of the country, reaching 670,000 in 1985. Its water supply system is meant to service all inhabitants for an estimated demand of 272,000 m3/day in 1985. However, its water supply capacity was 220,000 m3/day, consisting of a surface water supply system (Kafue system; using the Kafue river) of 110,000 m3/day and of a groundwater supply system (49 boreholes) of 110,000 m3/day, resulting in a water shortage of 52,000 m3/day. Furthermore, the supply capacity of the Kafue system decreased to 84,000 m3/day due to the breakdown of the worn-out facilities, increasing the deficit amount to 78,000 m3/day.

In order to cope with this continuing water deficit problem, the Lusaka Urban District Council has since 1974 undertaken several studies including a comprehensive master plan, long-term plan, short-term plan,

immediate improvement plan etc., assisted by many donor agencies such as the African Development Bank and the Government of West Germany. The main points of the conclusion of these studies were the need for the improvement/rehabilitation of the Kafue system, groundwater development, improvement of the reticulation system, improvement of administrative structure etc.

The Government of Zambia requested of the Government of Japan financial assistance for the improvement/ rehabilitation of the treatment and transmission facilities, the most crucial part of the Kafue system. In response, the Government of Japan dispatched a basic design study team to Zambia from March 9 to March 31, 1986, through the Japan International Cooperation Agency, the official agency of technical cooperation of the Government of Japan.

The basic design study team discussed the terms of referrence with the officials of both the Lusaka Urban District Council and the Government of Zambia. The team also conducted field investigations and collected information and documents on the water supply situation, water supply facilities, water sources, water qualities, equipment and materials etc. As a result, it was found that the water shortage was wide spread, a problem which people are struggling to rectify by means of storing water in buckets, digging individual wells etc. Hence, the immediate implementation of measures is considered to be fully justified.

Following further consideration in Japan, it has been decided to undertake measures to alleviate the serious water deficit by means of the improvement of facilities for water supply and water quality, along with the on-going strengthening of the administrative organization. Therefore, the measures described below for the improvement of the Kafue system which constitutes half of the water source for Lusaka city are included in the project. This project, upon completion, will decrease the water deficit amount from 78,000 m3/day to 52,000 m3/day .

(1) Treatment Facilities

Name of Facility	Number	Equipment to be Improved.
Alum Feeding Equipment	1 lot	Solution Tanks, Mixers in SolutionTanks, Circulation Pumps, Dosing Pumps, Pipes, Valves etc.
Mixing Basin	2 basins	Flash Mixer
Sedimentation Basin	30 basins	Sludge Cones, Pipes, Valves etc.
Rapid Sand Filter	20 basins	Supplemental Filter Media, Sand Washing Equipment, Underdrain Equipment, Drain Troughs, Flow Control Valves, Air Wash Blowers, Upwash Pumps etc.
Lime Feeding Equipment	1 lot	Solution Tanks, Mixers in Solution Tanks, Dosing Pump, Pipes, Valves etc.

(2) Transmission Facilities

Name of Facility	Number	Equipment to be Improved.
Kafue Pump Station	1 lot	Substation, Power Supply System, Monitoring Equipment, Wireless Telephone Equipment
Chilanga Pump Station	1 lot	Ditto.
Electric Cable	1,200 m	Electric Cable
Lusaka Water Works	1 lot	Wireless Telephone Equipment

(3) Electrical, Instrumental and Communication Facilities

Name of Facility	Number	Equipment to be Improved.
Kafue Pump Station	4	Pumps, Motors, Delivery Valves, Ventilation Duct, Floor Drain Pumps, Pipes etc.
Chilanga Pump Station	4	Ditto.
Chilanga Surge Tank	2	Surge Tanks (RC), newly provided.

(4) Vehicles

One truck of 3-ton maximum loading capacity and two four-wheeled wagons.

The Japanese side will undertake the supply and installation of the above-mentioned equipment and materials, including shipment from Japan to Tanzania and inland transportation from Tanzania to Zambia. The Zambian side will undertake the installation of substations and cables, costing 18,000 kwacha.

The time period provided for designing, manufacturing and installing the equipment and materials will be 27.5 months after the signing of the Exchange of Notes. Included in that period will be 21.5 months for designing and manufacturing. The responsible agency of the Government of Zambia is the Ministry of Decentralization and the executing agency of the project is the Water and Sewerage Department of the Lusaka Urban District Council.

The direct benefit to be realized by the execution of this project is to improve the serious water deficit by steadily supplying Kafue river water with improved quality. Besides the above-mentioned direct benefit, technology transfer through this project is expected to be a boost to the overall technological progress of the technical staff of the Water and Sewerage Department, and also contribute greatly to the improvement of citizens' living standards. Thus, this project is considered to be fully justifiable for implementation as a Grant-Aid Programme of the Government of Japan.

Structural change and an increase in the operation and maintenance staff of the Water and Sewerage Department of the Lusaka Urban District Council, which is responsible for the operation and maintenance for the water supply system of Lusaka, will not be necessary because this Project is not expansion but rather improvement/rehabilitation of existing facilities. Further, it is expected that the facilities will be more properly operated and maintained as a result of the

improvement/rehabilitation, since the work is to be done with the emphasis on ease of operation, e.g., manual operation. Towards this objective, training for operators is also being considered. In terms of the prospective financial situation resulting from this project, sound management will continue, based on fair collection of water tariffs, since the increase in revenues will exceed the increase in expenditures for operation and maintenance.

When this project is completed, other items of the "Immediate Improvement Projects", particularly those dealing with distribution facilities, need to be undertaken immediately, in order to complete the immediate improvement programme for the water supply system of Lusaka. It should be noted that, since the population is expected to increase with the rise in living-standards, water demand is also expected to increase, resulting in serious water shortages in the future. Consequently, it is necessary to establish a long-term plan and start implementation as soon as practicable in order to eusure an adequate water supply system in the years to come.

Chapter 1 INTRODUCTION

CHAPTER 1. INTRODUCTION

The British protectorate of Northern Rhodesia gained independence in 1964 under the name of the Republic of Zambia. Since then, Dr. Kenneth D. Kaunda has been the president as well as the commander-in-chief of the military forces and the leader of the United National Independence Party, the single political party of Zambia.

Economic independence has been the most important policy of Zambia since its political independence. Its basic policy has been, therefore, to diversify industrial development other than the copper industry already developed. As a result of the prosperous development of the copper sector and increased government expenditure, agricultural, manufacturing and construction sectors which rely on domestic demand, made good progress until the oil crisis in late 1974. Since then copper prices have decreased due to the world depression brought on by the oil crisis, and the economy of Zambia has been stagnant, resulting in a substantial decrease in foreign exchange reserves.

In the meantime, urban population increased and the City of Lusaka was no exception. Its population was only some 200,000 at the time of the independence of Zambia but it was over 700,000 in 1985. This population increase also increased water demand. The water source of Lusaka consists of the Kafue river, running 50 kms south of the City, and groundwater (47 boreholes and 2 springs from quarries). Although the Kafue river is a stable water source, its supply system does not function well and supply decreased to 84,000 m3/day at present from the rated capacity of 110,000 m3/day, as facilities including treatment plant, pumping station, Chilanga booster pumping station etc. have not been properly maintained and therefore have severely deteriorated. The supply of groundwater is not stable, as it was 115,000 m3/day during the rainy season of 1985 while it was 108,000 m3/day in the dry season, 10% less. Thus total supply capacity of Lusaka is estimated to be 192,000 - 199,000 m3/day, which is far less than the estimated water demand of 272,000 m3/day, resulting in a continuous water shortage in Lusaka.

In order to solve the problem it is nessary to improve/rehabilitate the existing facilities and simultaneously to construct new facilities. The Lusaka Urban District Council undertook the "Immediate Improvement Projects" in 1985, with the aim at first of improving the existing facilities considering the deteriorated financial situation. Among the proposed facilities, a treatment plant and pumping stations, which are the key parts of the Kafue system, were requested of the Government of Japan as a grant in aid.

In response to this request, the basic design study team headed by Mikio Nakamura, deputy head of the First Basic Design Study Division, Grant Aid Planning and Survey Department, Japan International Cooperation Agency, was dispatched to Lusaka from March 9 to March 31, 1986. The basic design study team held discussions on the contents of the requested assistance with the officials of the Lusaka Urban District Council and the Government of Zambia. The team also collected data on and made field investigations of the water supply facilities, water sources, water quality, water supply situation, equipment and materials.

As a result, the basic matters agreed upon by the officers of the Lusaka Urban District Council and the Government of Zambia and the team were recorded in the "Minutes of the Discussion" and signed by both sides. The "Minutes of the Discussion" and such items as a list of the members of the study team, schedule of the field survey, list of the interviewees and list of documents collected are attached in the appendices.

This report is compiled regarding the basic design of the Kafue water supply system and the most appropriate size and composition of the facilities for it on the basis of an analysis of the field investigations, collected data and information, and the various discussions conducted in Japan.

Chapter 2 BACKGROUND OF THE PROJECT

CHAPTER 2. BACKGROUND OF THE PROJECT

2.1. General Conditions in the Republic of Zambia

Zambia is located in central-southern Africa, and extends from 8 to 18 south latitude and from 22 to 34 east longitude. It is an inland country, surrounded by 8 other countries, i.e., Tanzania and Zaire in the north, Malawi and Mozambique in the east, Zimbabwe and Botswana in the south, and Namibia and Angola in the west.

All of the country (total area of 752,614 sq. km) is a mild plateau, ranging from 900 to 1,500 meters in altitude, except for a highland area of about 2,000 meters elevation in the north bordering on Tanzania. The vegetation of the plateau is made up of grassland, sparsely wooded, which is called savanna. The Zambezi river, flowing from west to east through the southern border and into the Indian Ocean through Mozambique, together with its tributaries, the Kafue river and the Luangwa river, and the lakes, has created fertile land and contributes greatly to agricultural activities in Zambia.

Zambia has a cool, comfortable climate throughout the tropical area. Equatorial prevailing westerlies, bringing rain between November and April, have a favorable influence on its agriculture, as rich rainfall brings good harvests contributing to the national economy, while poor rainfall results in poor harvests and drought.

Gross domestic product (GDP) of Zambia was 4.7 billion kwacha in 1984 with GDP per capita of 765 kwacha, amounts of which are equivalent to 700 million US dollars and 120 US dollars respectively, using the conversion rate of 6.5 kwacha per US dollar. Although the Zambian government has been diversifying its economic activities, the mining and quarrying sector is high with 30 % of the national GDP. The shares of agriculture and industry are still only 10 % respectively. As a result, the national economy is greatly influenced by the price of copper. Due to low copper prices associated with the recession in the world economy,

exports are declining in contrast to the increase in imports, and therefore Zambia is faced with severe economic hardships.

Modernized industries, represented by the mining and quarrying sector, are located along the railway lines, from Copperbelt Province in the north through Lusaka, the capital city, to Livingstone in the south, giving rise to sizable cities along the railway lines, and agriculture is developed outside of these areas. The earning imbalance between mining, quarrying and industry on the one hand, and the agriculture sector on the other hand has induced rural-urban migration. Consequently, the 20.5 % of the total population who were urban dwellers in 1963 increased to 43.0 % in 1980 and reached 50.0 % in 1985. According to the latest statistics available, in 1980 the population of Zambia was 5.66 million with a population density 8 persons per sq. km.

2.2 National Development Plan

Zambia established its First National Development Plan (1966-1970) to follow the Emergency Plan (1964) and the Transitional Plan (1965-1966), which were implemented after independence in 1964. The First National Development Plan was designed to promote self-reliance and self-sustained growth, including Zambianization of manpower and to diversify its economic activities away from an economy monopolized by copper, with the aim of adjusting the earning imbalance between the urban and rural populations. The economic growth rate during the First Plan was 10.6 percent per annum.

The Second National Development Plan (1972-1976) with the same objectives as the First National Plan was launched in 1972, one year later than scheduled. Attainment of the objectives was difficult due to the border closure by Rhodesia (now, Zimbabwe), the oil crisis, the consequent collapse in copper prices and the lack of skilled manpower (due to Zambianization).

The Third National Development Plan was scheduled to be launched

after the end of the Second Plan. However, it was postponed due to the subsequent economic depression and the deteriorated trade imbalance, and was actually launched in January 1980, covering five years up to December 1984. Its basic policies were not different from the previous Plans, emphasizing regional development, particularly in agriculture. The main objectives were as follows:

1) Promoting economic development along socialist lines in conformity with the National Philosophy of Humanism.

2) Provision of gainful employment opportunities to the local labour force by adopting labour-intensive technology.

3) Diversification of the economy, reducing its heavy dependence on copper.

4) Regional development and agricultural development.

5) Setting up of village and small-scale industries, utilising domestic materials.

6) Exploitation of minerals other than copper.

7) Reducing income imbalance.

8) Promotion of Zambianization.

9) Improvement of educational and training facilities with the aim of manpower development.

10) Stabilization of commodity prices.

The Fourth National Development Plan which was to commence in January 1985 will be announced in early 1987.

The objective of the water supply sector which was a common point in all plans from the Emergency to the Third, was to provide safe potable water to as many people as possible. Attainment of the objectives was, however, incomplete due to economic depression caused by low copper

prices, and to the greater emphasis on the rural sector with less emphasis on the urban sector.

2.3 Institution of Water Supply

2.3.1 Administrative Organization

The Government is unifying the nation and the tribes, of which there are 73, divided according to language, customs, etc., with the national slogan of "One Zambia One Nation". However, its centralized system has brought on adverse effects to some degree so that the Local Decentralization Act was amended in 1980 with the aim of strengthening local administration. In line with this amendment, the Ministry of Provincial and Local Government changed its name and function to the Ministry of Decentralization. Its organizational chart is shown in Fig. 2.1.

Local government - 57 district councils - is theoretically responsible for the development, coordination, construction, operation and maintenance of the public water supply system both in urban and rural areas, and the District Councils are under the control of the Ministry of Decentralization. However, in reality, the Department of Water Affairs in the Ministry of Agriculture and Water Development is assisting the District Councils financially and technically in the planning, implementation, operation and maintenance of water supply schemes in many rural areas due to the lack of qualified personnel on the District Councils. Even the relatively well-established Water Affairs Department (See Fig. 2.2) in the government which is empowered by the Water Act of 1964 to control water rights, has also been faced with difficulty in filling its posts with qualified personnel. The legally established professional positions in the Department were never filled, in particular the posts of water engineers. As of January 1983, eight professional slots were not filled out of the regular total of 22 posts. Due to the development of the country, major amendments of the Water Act were required. A new draft

図 2.1 地方分散省組織図

Fig.2.1 Organization Chart

Ministry of Decentralization

Proposed in 1985

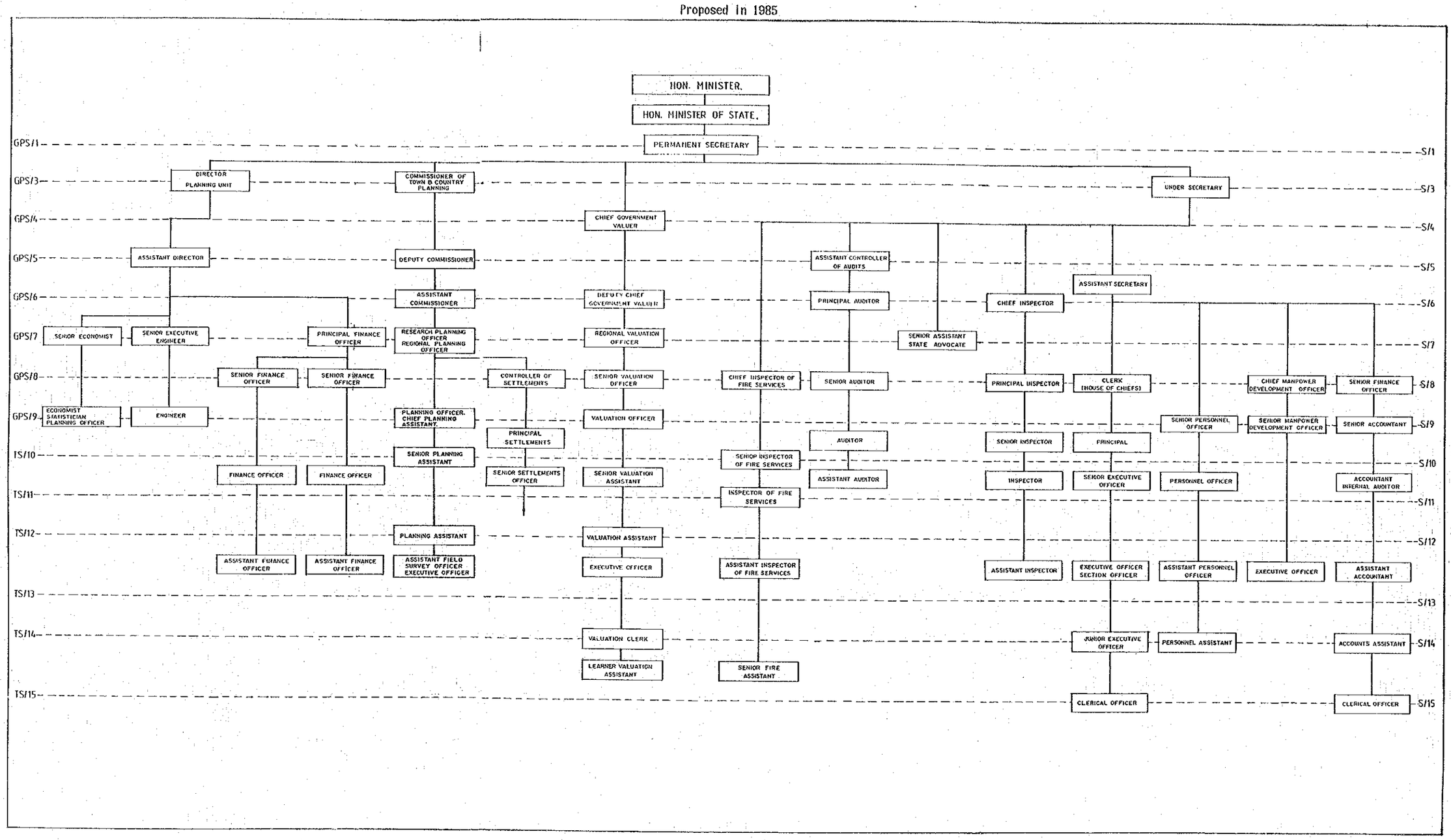
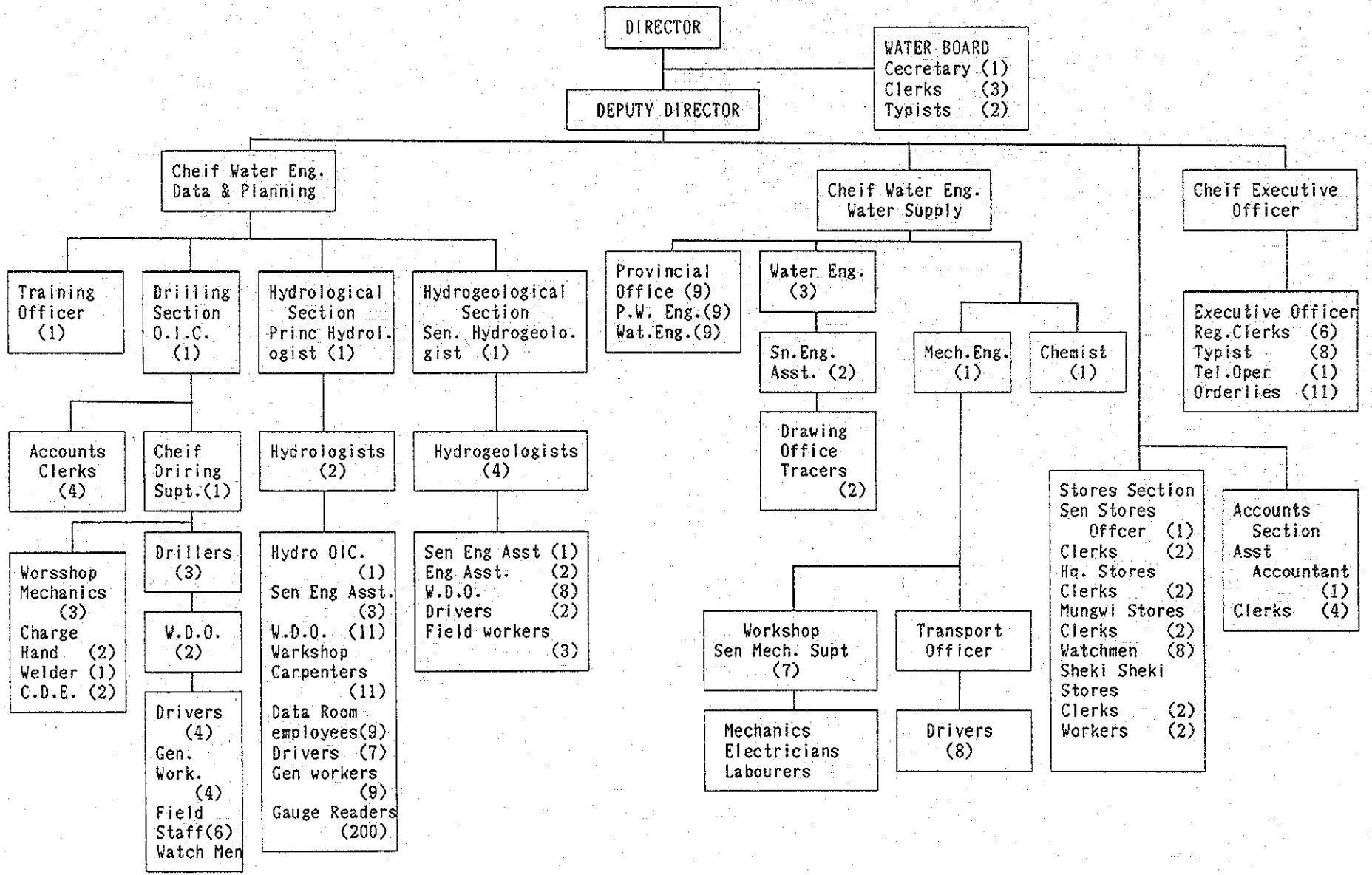


図 2.2　水資源局組織図

Fig.2.2　GENERAL ADMINISTRATION CHART, DEPARTMENT OF WATER AFFAIRS



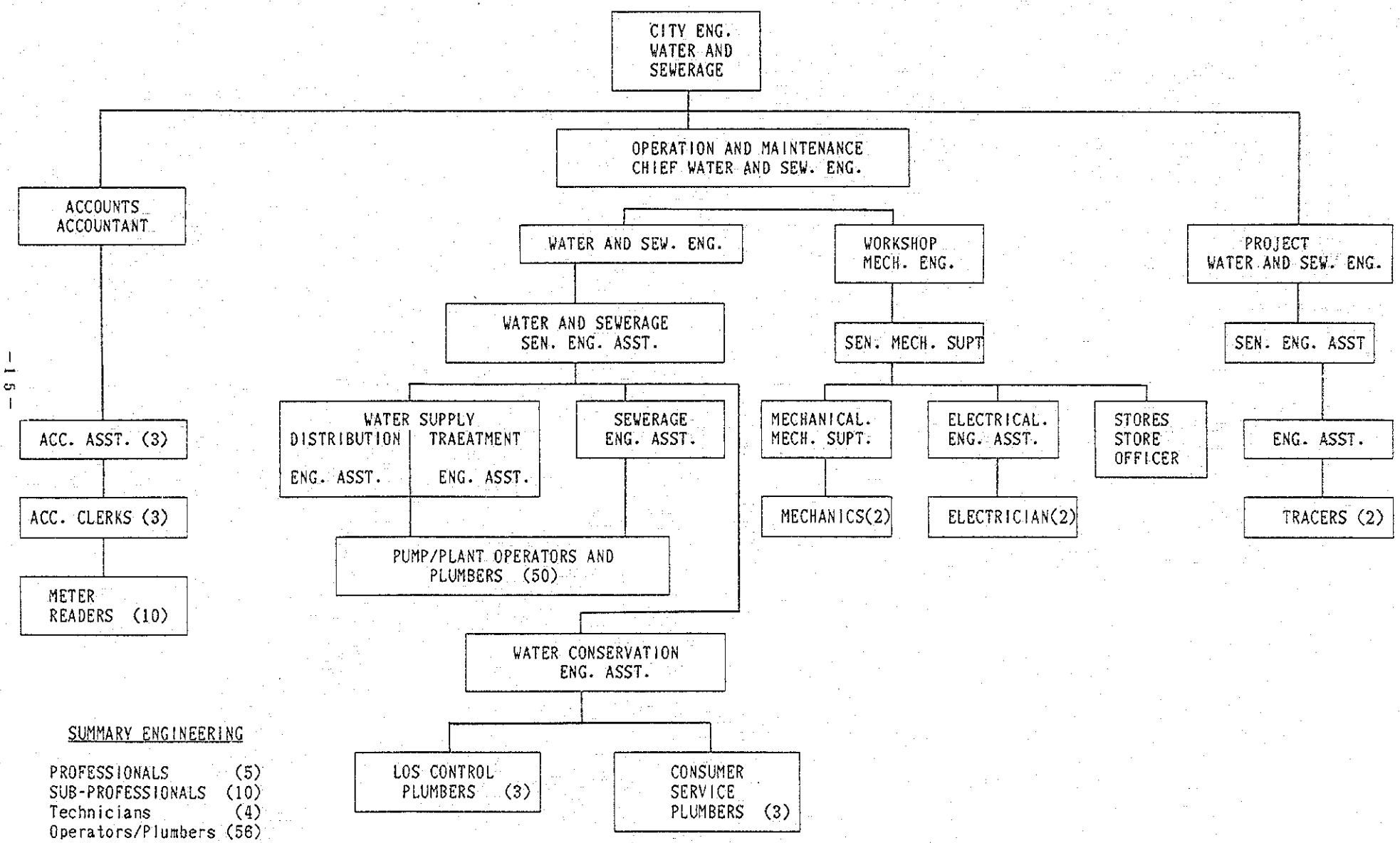
was submitted to the Cabinet in 1981 in order to clearly define the DWA's responsibilities, for example, approving all contracts and designs for public water supply schemes and acting as technical adivisor to local governments on water supply schemes.

The ten-year plan for water supply can only be put into practice if, among other things, skilled manpower is employed. For that purpose, the strengthening of local governments, namely District Councils, is designated in the ten year Plan. Figs. 2.3 to 2.4 show the proposed organizational charts of the District Councils. The Organization of Water and Sewerage Departments in Large Urban Areas as shown in Fig. 2.3 constitutes project, accounts and operation/maintenance. The number of staff to be required in 10 LUAs by 1990 is estimated to be 65 professionals, 180 sub-professionals or technicians, and 700 skilled labourers, assuming that the number of department staff is proportional to the population based on the staff number of LUAs of 150,000 population of Fig. 2.3. It is proposed that the departments in the 47 district councils as shown in Fig. 2.4, located in rural areas are to emphasize operations and maintenance, different from those in LUAs. The responsibility for Small Urban Townships (water source is mainly surface water) and for rural areas (water source is groundwater and point supply is the predominant distributing system) is clearly divided among 47 district councils.

2.3.2 Responsible Institution

Among the total of 57 district councils, ten large district councils, called ten Large Urban Areas (LUAs), constituting 33 % of the population of Zambia, are responsible for water supply in the respective 10 LUAs (Refer to Table 2.1 and Fig. 2.6). The remaining 47 district councils are further divided into 75 Small Urban Townships (SUTs) and rural areas. Population in the former amounts to 7%, while in the latter, population is 60% and the area covers almost all of the country.

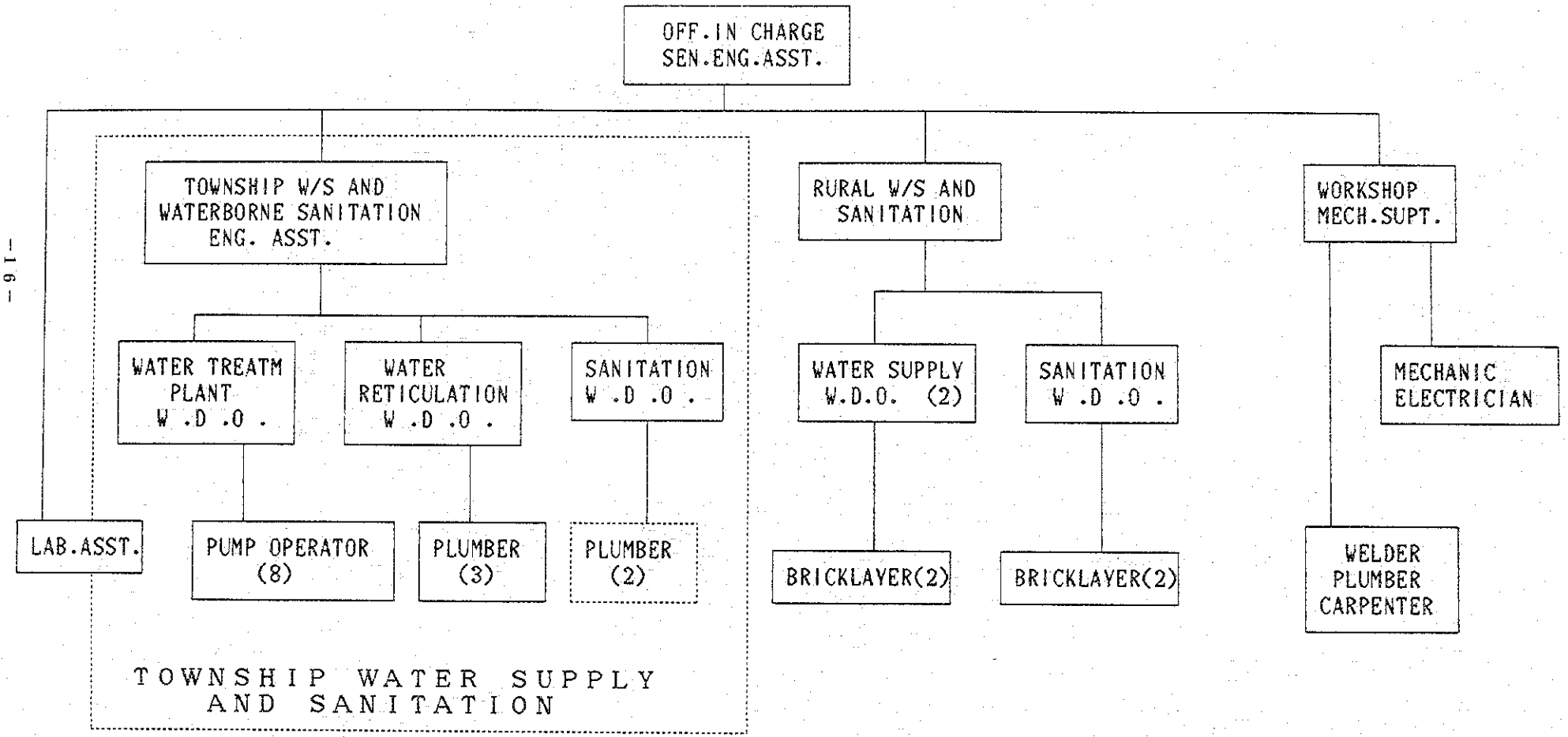
図 2.3　ＬＵＡｓの上下水道局組織図（案）
Fig. 2.3　PROPOSED ADMINISTRATION OF WATER AND SEWERAGE SECTION OF A TYPICAL LARGE URBAN AREA



SUMMARY ENGINEERING

PROFESSIONALS	(5)
SUB-PROFESSIONALS	(10)
Technicians	(4)
Operators/Plumbers	(56)

図 2.4　District Council（LUAsを除く）の上下水道局組織図（案）
Fig.2.4　Proposed Administration of Water and Sewerage Section for a Typical District Council



POPULATION BY PROVINCES AND URBAN AND RURAL AREAS

	1980 census	1974 Sample Census Final Results	1969 Census	1963 Census	1969-1980 Average annual growth rate (%)	1969-1974 Average annual growth rate (%)	1963-1969 Average annual growth rate (%)
Total Zambia	5,661,801	4,677,000	4,056,995	3,490,170*	3.1	2.9	2.5
Provinces:							
Central	511,905	397,000	358,655	309,407	3.3	2.1	2.5
Copperbelt	1,251,178	1,046,000	816,309	543,465	3.9	5.1	7.0
Eastern	650,902	570,000	509,515	479,866	2.3	2.3	1.0
Luapula	420,966	321,000	335,584	357,018	1.9	−0.9	−1.0
Lusaka	691,054	522,000	353,975	195,757	6.3	8.1	10.4
Northern	674,750	584,000	545,096	563,995	2.0	1.4	−0.6
North-Western ...	302,668	242,000	231,733	211,189	2.4	0.8	1.6
Southern	671,923	534,000	496,041	466,327	3.0	1.5	1.0
Western	486,455	460,000	410,087	362,480	1.6	2.3	2.1
Large Urban Areas:							
1 Chilllabombwe ...	61,928	56,000	44,862	34,165	3.0	4.7	4.6
2 Chingola	145,869	134,000	103,292	59,517	3.2	5.3	9.6
3 Kabwe	143,635	99,000	65,974	39,522	7.3	8.4	8.9
4 Kalulushi	59,213	41,000	32,272	21,303	5.7	4.7	7.2
5 Kitwe	314,794	251,000	199,798	123,027	4.2	4.6	8.4
6 Livingstone	71,987	58,000	45,243	33,026	4.3	5.0	5.4
7 Luanshya	132,164	121,000	96,282	75,332	2.9	4.6	4.2
8 Lusaka	538,469	401,000	262,425	123,146	6.8	8.9	13.4
9 Mufulira	149,778	136,000	107,802	80,609	3.0	4.7	5.0
10 Ndola	282,439	229,000	159,786	92,691	5.3	7.4	9.5
Total Urban (including small urban areas) ...	2,258,519	1,663,000	1,192,116	715,020	6.7	6.9	8.9
Total Rural	3,403,282	3,014,000	2,864,879	2,774,484	1.1	1.0	0.5
Percentage Urban ...	39.9	35.6	29.4	20.5			

*Includes 666 railway travellers.

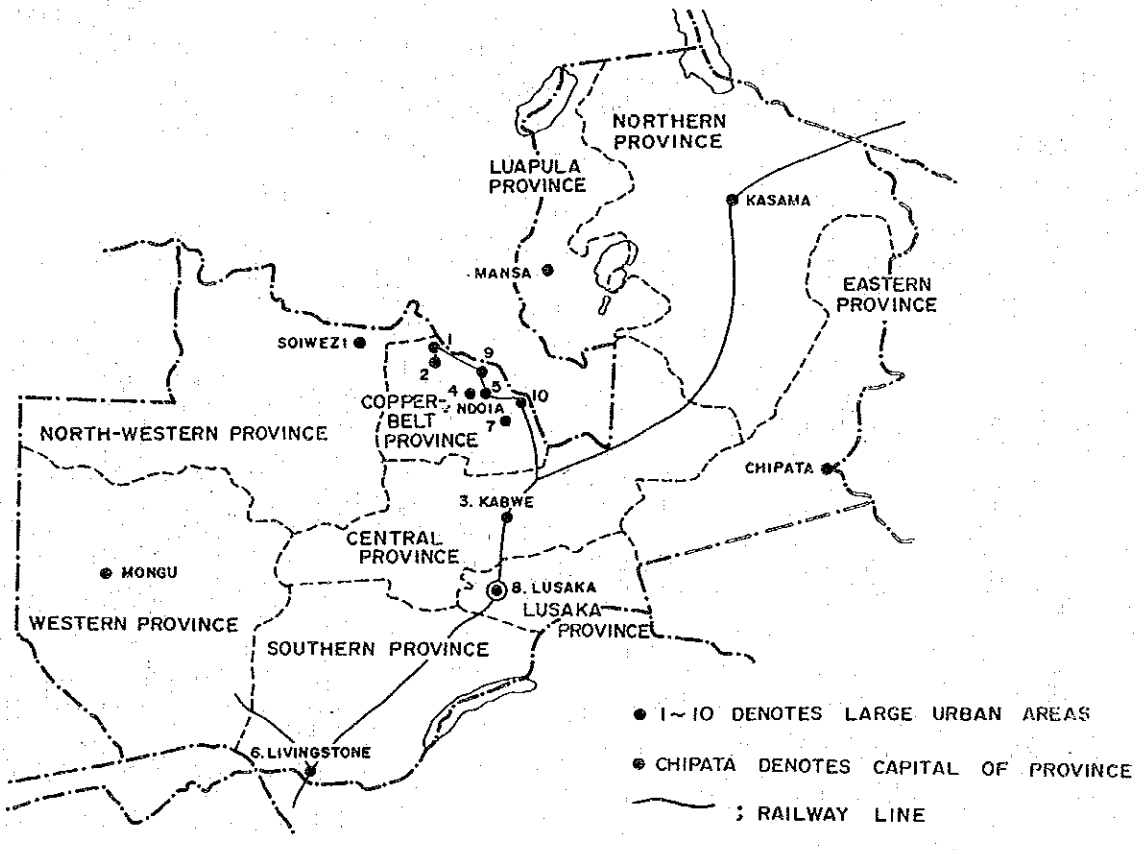
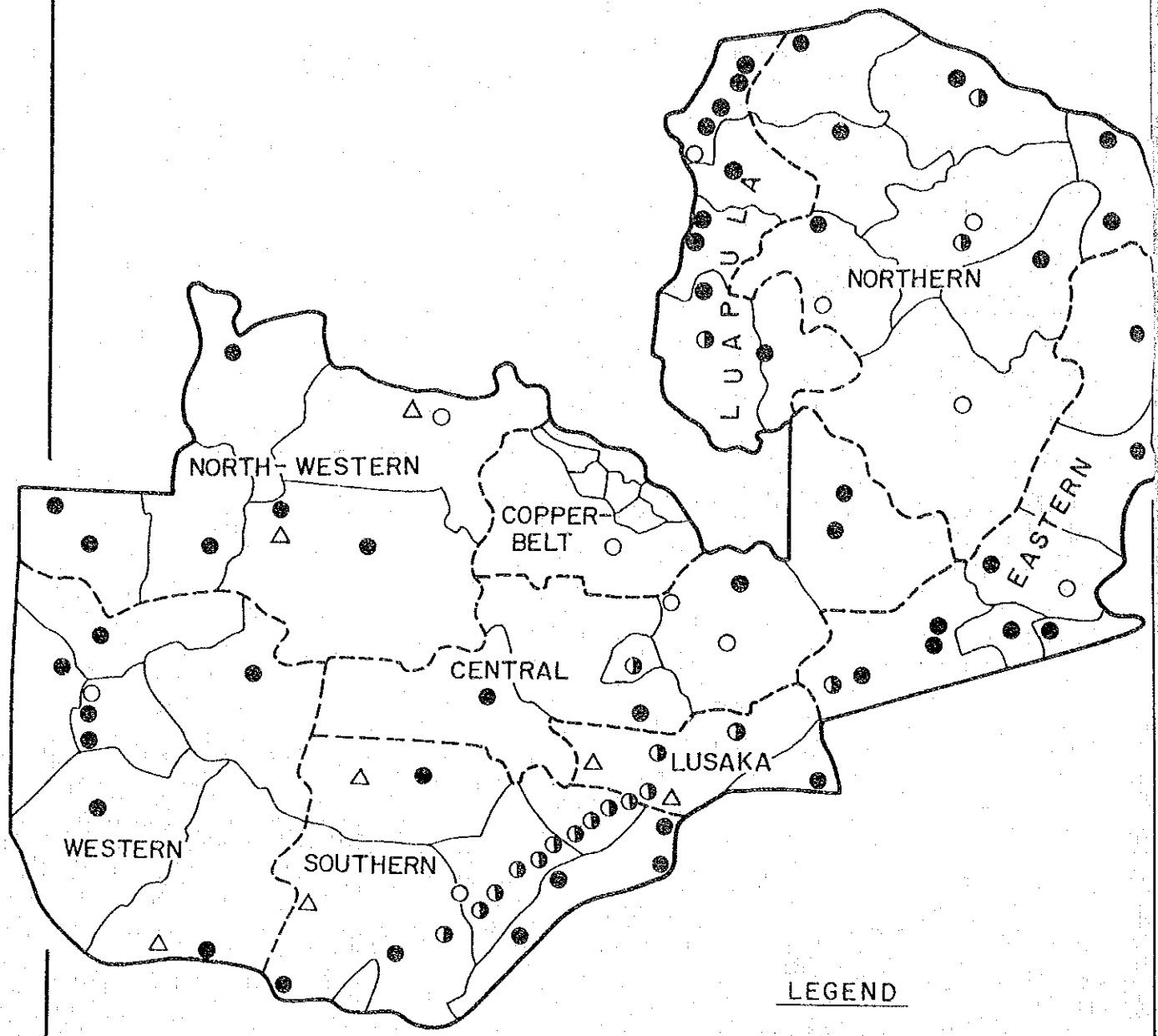


図 2.5 LUAs位置図

Fig.2.5 Location of LUAs



LEGEND

○ ..... COUNCIL SCHEMES OPERATED, CONSTRUCTED OR TO BE UNDER DWA (水資源局)

● ..... SCHEMES COMPLETELY UNDER DWA (水資源局)

◑ ..... SCHEMES COMPLETELY UNDER DISTRICT COUNCILS

△ ..... SCHEMES UNDER PARASTATALS (公益法人) OR MINING COMPANIES (鉱山会社)

——— NATIONAL BOUNDARY 国境

— — — DISTRICT BOUNDARY 市、郡境

— — — PROVINCIAL BOUNDARY 州境

図 2.6 水道事業主体

Fig. 2.6 Water Supply Undertakings

この図には示していないが
10の LARGE URBAN AREAS の水道事業は
DISTRICT COUNCILS ◑ が行なっている。

[SOURCE : DECADE REPORT, 1983]

Table 2.1 Water Supply Responsibilities

Type of Supply / Category	No.	Major Piped Scheme	Small Piped Scheme		Point Supply (Well)	
		C & O/M	C	O/M	C	O/M
Large Urban Areas	10	DC	-	-	-	-
Small Urban Townships	75	DC(19) Mines or Parastatals(7) DWA(49)	-	-	DWA	DC
Rural Area	-	-	DWA	DC or DWA	DWA	DC

C: Construction
O/M: Operation and Maintenance

DC: District Council
DWA: Department of Water Affairs

[Source: Decade Report, 1983]

The responsible institutions for water supply in these 75 SUTs are different. The district councils are responsible in 19 SUTs and companies on mining and parastatals are in 7 SUTs. The remaining 49 SUTs cannot take responsibility due to lack of qualified manpower and insufficient budgets, and the Water Affairs Department assumes responsibility instead of the district councils. Construction of water supply systems in rural areas outside of the SUTs is done by the Water Affairs Department, and district councils are responsible for its operation and maintenance.

2.4. Conditions of Distribution and Water Supply Facilities

Water resources in Zambia consist of surface water and groundwater. Most of the surface water comes from the Zambezi river system because most of the national territory belongs to the catchment of the major tributaries of the Zambezi; namely, the Kafue and the Luangwa. Unfortunately, there is a constraint in using the surface water as pumps

are necessary to extract water, since cities located on the plateau are higher than the river bed generally by approximately 300 m. and are a long way off. In the case of LUAs with many users of the water supply, it is necessary to construct, operate and maintain high-lift pumps and long-pipelines but LUAs can manage them financially and technically. On the contrary, it is difficult for district councils in rural areas to manage them, and instead, they tend to rely on unstable and unsanitary sources like nearby streams and shallow groundwater. The groundwater is widely distributed throughout the country with some exceptions in the areas where limestone is predominant like the Lusaka zone, where the yield of groundwater is generally small. Nevertheless, it is adequate as the water source for rural areas with a small number of users.

Of the total population in the country, 46 percent were provided with an acceptable water supply in 1980 as shown in Table 2.2. The ratio of the water served population is high in the cities and low in rural areas --- 70 percent in LUAs, 45 percent in SUTs and 32 percent in rural areas.

Table 2.2 Water Served Ratio and Water Source, 1980

Category	No.	Population (thousand)	Population Served (thousand)	(%)	Water Source(%) Surface	Ground-water
LUAs	10	1,900	1,330	70	90	10
SUTs	75	540	240	45	75	25
Rural Area		3,240	1,040	32	22*	78
Total		5,680	2,610	46		

LUAs: Large Urban Areas
SUTs: Small Urban Townships
* : Small Piped Supply System
[Source: Decade Report, 1983]

Water treatment plants with sedimentation, rapid sand filter, chlorine disinfection etc. are provided for the water supply systems of LUAs where water demand is large, and, therefore, water sources are mostly surface water. In these LUAs, about 48 percent of the population has private taps on the premises while only about a quarter -- 27 percent in SUTs. On the other hand, inhabitants in rural areas are obliged to carry supplied water to their plots from 100 to more than 1,000 meters distance because rural water supplies are made up of point supplies.

As mentioned above, less than 50 percent of the population have nearby water sources. As a result, the rate of disease caused by poor sanitary conditions is high (See Table 2.3).

Table 2.3 Number of Outpatients of Diseases caused by Mal-environmental Conditions
(1980, under 15 yrs old)

Major Cause	Causes Treated	Percent of Total Outpatient Attendance
Upper Respiratory, Tract Infections	1,110,000	18
Diarrhoea	749,000	12
Injuries	584,000	9
Malaria	523,000	8
Diseases of the Eye	337,000	5
Bilharzia	201,000	3
Diseases of the Ear	149,000	2
Scabies	141,000	2
Disease of the Teeth	137,000	2
Ulcers (Skin)	69,000	1
Total	4,000,000	63

[Source: MOH/Bulletin of Health Statistics (Vol.2) 1980]

2.5. National Water Supply Plan

2.5.1 General

Zambia sets the following targets for the improvement of the water supply in the Third National Development Plan (TNDP).

(1) To ensure supplies of permanent water of acceptable quality and quantity to as many users as possible.

(2) Toprovide for effective conservation and pollution control measures.

(3) To regulate water use rights properly so as to satisfactorily meet the water requirements of various groups of users

(4) To establish national and regional water authorities.

The year 1980 marked the start of the International Drinking Water Supply and Sanitation Decade which has been declared by the United Nation General Assembly. In response, the Zambian government established a decade program in 1983, with the aim of providing all people with safe drinking water. The Government developed four alternatives with two parameters of implementation periods (1984-1990 and 1984-2000) and levels of service (high and low). The population of 5,680,000 in 1980 is estimated to increase by 1,780,000 to 7,460,000 in 1990 and again by 2,050,000 to reach 9,510,000 in the year 2000. This increased population plus the unserved population of 3,070,000 in 1980 are to be provided with safe water according to the plan.

The plan also estimated the required costs of four alternatives based on the per capita cost. The total cost as shown in Table 2.4 ranges from 295 to 624 million Kwacha at the pre-auction cost, which is equivalent to 31 to 65 million Kwacha per year. As the expenditures for LUAs, SUTs and rural areas were approximately 16 million Kwacha, two to four times expenditures will be necessary to achieve the plan. Further, it is stressed that manpower development and strengthening of water undertakings will be crucial matters in addition to financial matters.

The objectives of the water supply sector in the annual plan is in

line with the Decade Plan. The objectives in the 1986 annual plan are set as follows;

(1) To improve the supply of acceptable drinking water and raise the standard of sanitation for both urban and rural communities.

(2) To control and manage surface and ground water resources and explore the ground water potential for various developments throughout the country.

Table 2.4 Capital Expenditure for Water Supply

(Unit: million kwacha)

Alterative	1	2	3	4
Service Level	High	Low	High	Low
Implementation Period	1984 ~ 1990	1984 ~ 1990	1984 ~ 2000	1984 ~ 2000
LUAs	131	97	247	200
SUTs	137	103	236	187
Rural Area	122	95	141	111
Total	390	295	624	498
Per Year	65	49	39	31

(Source: Decade Report, 1983)

2.5.2 Water Supply Plan

Water shortages occur throughout the country, particularly in urban areas. The 3.2 percent increase in the national population per year and increased industrial development has not correspondingly been met with an extention of water provision systems although expenditures by local authorities on water and sewerage schemes increased as shown in Table 2.5. This has subsequently resulted in water shortages, especially in the urban areas. To cope with the problems, emphasis is laid on improvement and rehabilitation of the existing water supply facilities which seem effective with relatively small expenditure. According to the 1986 Annual Plan, water supply coverage is planned to reach at least 50 percent by 1990.

Assistance from various donor agencies has enabled the local authorities to implement their water supply projects. Taking an example from the 1986 budget, 24.69 million kwacha or 72 percent of the expenditures of district councils under the Ministry of Decentralization comes from foreign loans (refer to Table 2.6). Nine out of 10 councils are located along the railway line - developed belt - from the Copperbelt Province through Lusaka to the Southern Province. Table 2.7 shows expenditures of district councils assisted by the Water Affairs Department, with the increase of the grant element from foreign aid. 86 percent of 37.58 million kwacha invested by the Water Affairs Department comes from foreign loans and grants.

Table 2.5 Expenditure on Water and Sewerage Scheme
(Unit; Kwacha)

1982	1983	1984	1985	Total
410,000	4,445,588	8,392,555	14,049,000	27,297,143

[Source: Economic Review and Annual Plan, 1986]

表　2.6 District Council の 1986 年度水道事業計画，地方分散省扱い

Table 2.6 General Loans to District Councils from Ministry of Decentralization

[unit: thousand kwacha]

Project Name	District	Province	Total	Zambia	Foreign	Aid Organization
1. Township, Council's Site and Services	7 townships	—	5,590	—	5,590	EEC Loan
2. Kafue Sewerage Treatment Plant	Lusaka Rural	Lusaka	200	50	150	ADB/ADF Loan
3. Ndola Water Supply & Sewerage Services	Ndola Urban	Copperbelt	7,200	1,800	5,400	ADB/ADF Loan
4. Livingstone Water Supply & Sewerage Services	Livingstone	Southern	7,000	1,750	5,250	ADB/ADF Loan
5. Chipata Water Supply	Chipata	Eastern	10	10	—	—
6. Kabwe Underground Water Supply and Sewerage Treatment Plant	Kabwe Urban	Central	1,789	1,789	—	—
7. Choma Water Supply	Choma	Southern	1,500	375	1,125	ADB Loan
8. Kalomo Water Supply	Kalomo	Southern	300	75	225	ADB Loan
9. Monze Water Supply	Monze	Southern	1,000	1,000	—	—
10. Kasama Water Supply	kasama	Southern	100	100	—	—
Total			24,689	6,949	17,740	

(Source: Economic Review and Annual Plan, 1986)

表 2.7　District Council の 1986 年度水道事業計画，農林・水開発省扱い

Table 2.7　Expenditure of Department of Water Affairs for Water Supply Programme

[unit: thousand kwacha]

Project Name	Province	Total	Zambia	Foreign	Aid Organization
1. Provincial Water Works	All	2,190	2,190	—	—
2. Water Supply	Western	7,563	—	7,563	NORAD Grant
3. Township Water Supply Programme	Northern Sector	9,400	2,350	7,050	IDA Loan
4. Township Water Supply Programme	Southern Sector	6,500	—	6,500	EEC Grant
5. Township Water Supply Programme	Northern-Western	8,000	—	8,000	KFW Loan
6. Office and Service Buildings	—	900	900	—	—
7. Canal Development	(Mongu/Kalabo)	1,000	—	1,000	Netherland Grant
8. Public Stand Post Water Supply Project	All	223	—	223	International Reference Centre Grant
9. Water Supply	Central	1,562	—	1,562	KFW Loan
10. Operational Training Course	—	240	—	240	EEC Grant
Total		37,578	5,440	32,138	

(Source: Economic Review and Annual Plan, 1986)

Chapter 3 GENERAL CONDITIONS IN LUSAKA CITY

CHAPTER 3 GENERAL CONDITIONS IN LUSAKA CITY

3.1 General Condition

Lusaka came into existence in 1905 when a railway station was established. At that time Zambia was administered by two separate regions; namely, North-Eastern and North-Western Rhodesia. The two regions were joined in 1911 to become Northern Rhodesia, and Lusaka which is located on a hydrodome, ranging from 1,260 to 1,300 meters in altitude, was selected in 1931 as the suitable site for the capital due to its centrality and the favourable climatic conditions. The dry season extends from April to September while the wet season is from October to March. Mean annual precipitation in Lusaka is about 800 mm. The mean monthly temperature is the lowest from June to July (16°c) and the highest in October(24°c).

The population of Lusaka, which was only 54,793 in 1954 increased to 262,425 in 1969 due to rapid economic development and the resultant rural-to-urban migration since independence of the country in 1964. Subsequently the population has increased and amounted to 526,000, 10 percent of the national population with a population density of 15 persons per hectare in 1980. Considering recent population growth rate, it is assumed to have already reached 700,000 in 1985.

Greater Lusaka was created in 1970 when the area under the jurisdiction of the City Council was extended from 93 sq. kilometers to 360 sq. kilometers. A commercial area is developed near the railway station and an industrial area extends to the west. To the east of the railway station, government offices are located and further east is located a high-cost housing area with less than 40 persons per hectare. A low-cost housing area with high density of more than 100 persons per hectare in the north and south surrounds the high-cost housing area and government offices (refer to Fig.3.1). Housing construction and development did not keep pace with rapid urbanization and raised living standards, resulting in a housing shortage with about 30 percent of dwellings occupied by squatters.

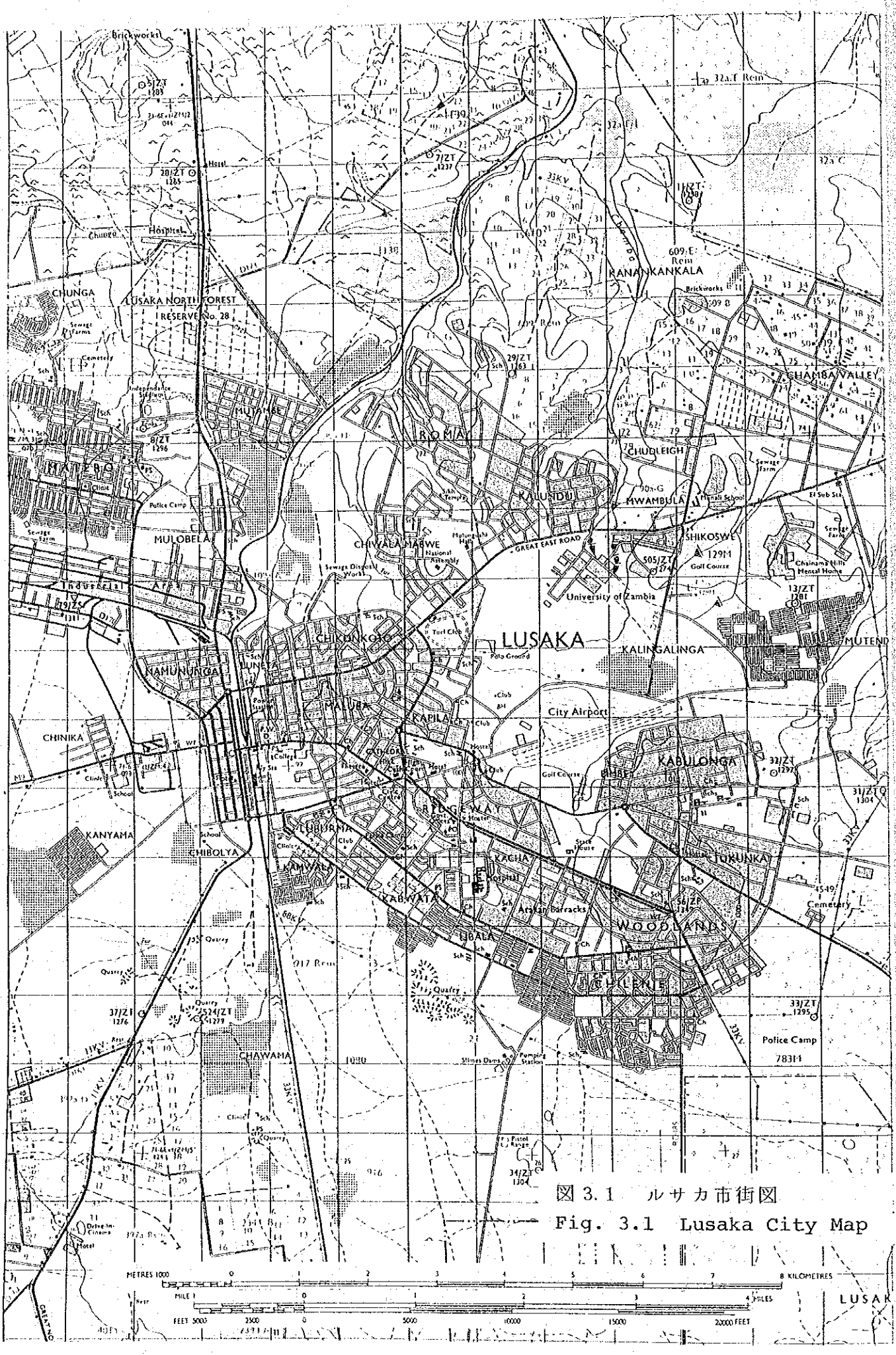


図 3.1　ルサカ市街図

Fig. 3.1　Lusaka City Map

Zambia, including Lusaka, is rich in electricity which is generated by both hydropower and thermal power. Thanks to rich water resources, hydropower electricity generation is greater than that of thermal power, which enables Zambia to export to the neighboring countries.

3.2 Water Supply System

3.2.1 Administrative Organization

The Water and Sewerage Department of Lusaka Urban District Council (LUDC) is divided into eight sections as shown in Table 3.1 and Fig. 3.2, of which seven sections except the sewerage section involve water works. Kafue Water Works section operates and maintains the Kafue system which extracts water from the Kafue river and consists of such facilities as intake, transmission, and treatment facilities. The established number of the staff of this Section is 129 (See Fig. 3.3), of which 16 staff positions at management levels like assistant superintendent, foreman etc. are left vacant.

The Lusaka Water Works Section operates and maintains borehole pumps while the Distribution Section controls distribution facilities such as reservoirs, pumps and pipes. These three Sections are allocated many staff including operators. Water quality analysis of water sources, treated water and distributed water is the work of a laboratory section. Other Sections concerning water works are administration, finance and development, the functions of which are evident as the names of the sections denote.

Table.3.1 Legally Fixed Number and Presently Employeed Number of Water and Sewerage Department (As of Dec. 13,1985)

Class / Section	Senior Managem.	Middle Managem.	Lower Managem.	Official Clerks.	NJC	Total
Management	3 (3)	—	—	—	—	3 (3)
Development	—	10 (-)	—	3 (-)	—	13 (-)
Kafue Water Works	1 (1)	12 (7)	26 (18)	2 (2)	88 (85)	129(113)
Lusaka Water Works	1 (1)	8 (6)	27 (20)	3 (3)	144(139)	183(169)
Distribution	1 (1)	15 (8)	22 (16)	3 (2)	151(134)	192(161)
Sewerage	1 (1)	6 (6)	30 (22)	6 (6)	279(271)	322(306)
Laboratory	1 (1)	2 (2)	—	4 (1)	—	6 (4)
Finance	2 (1)	8 (2)	32 (24)	59(36)	—	101 (63)
Administration	2 (2)	2 (2)	2 (2)	9 (8)	8 (6)	23 (20)
Total	12(11)	63(33)	139(102)	89(58)	670(635)	973(839)

( ) : staff presently employed

NJC : National Joint Council employee, consisting of mainly artisans and laboures

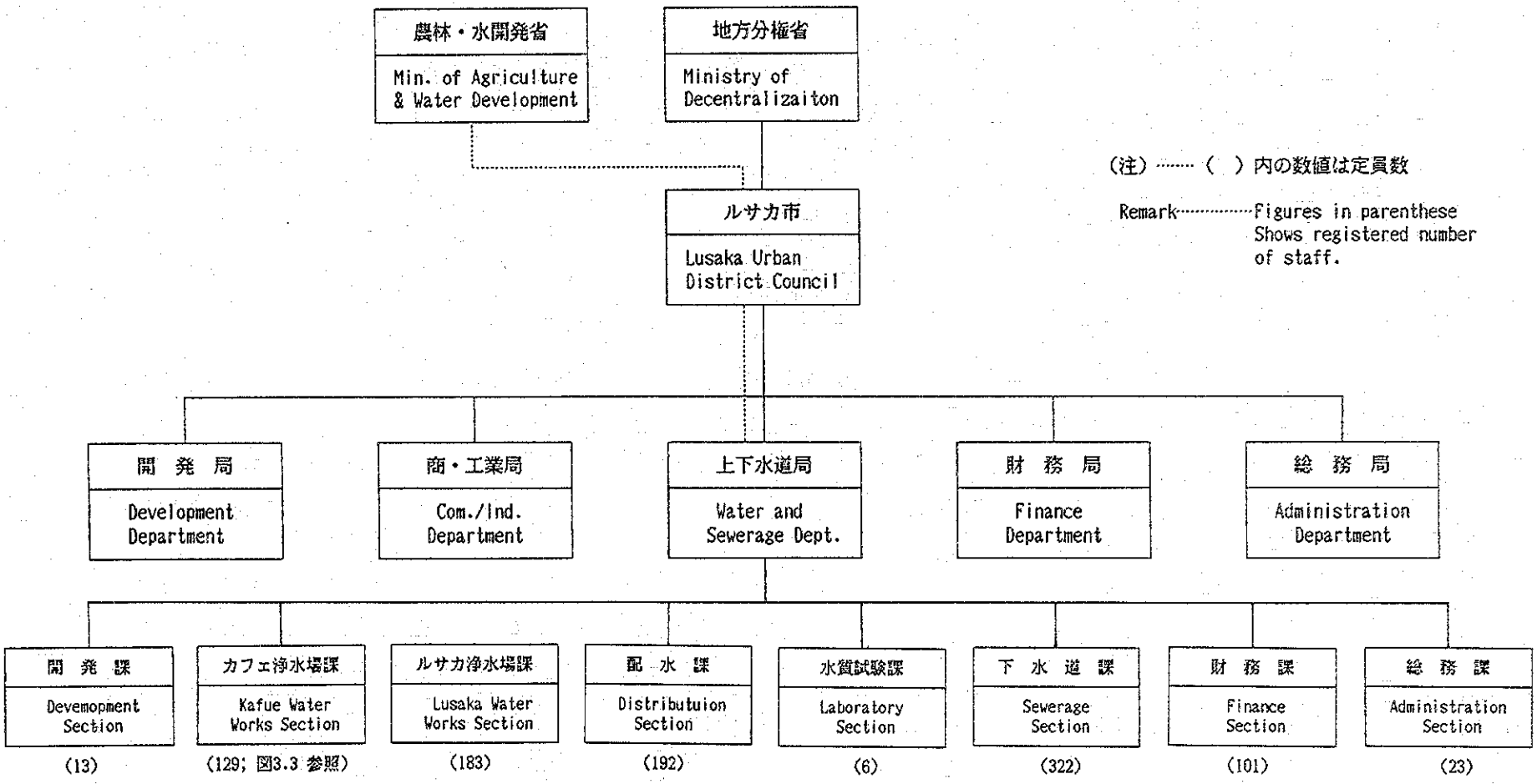


図 3.2　ルサカ市と同市上下水道局の組織図

Fig. 3.2　Organization of Water and Sewerage Department, Lusaka Urban District Council

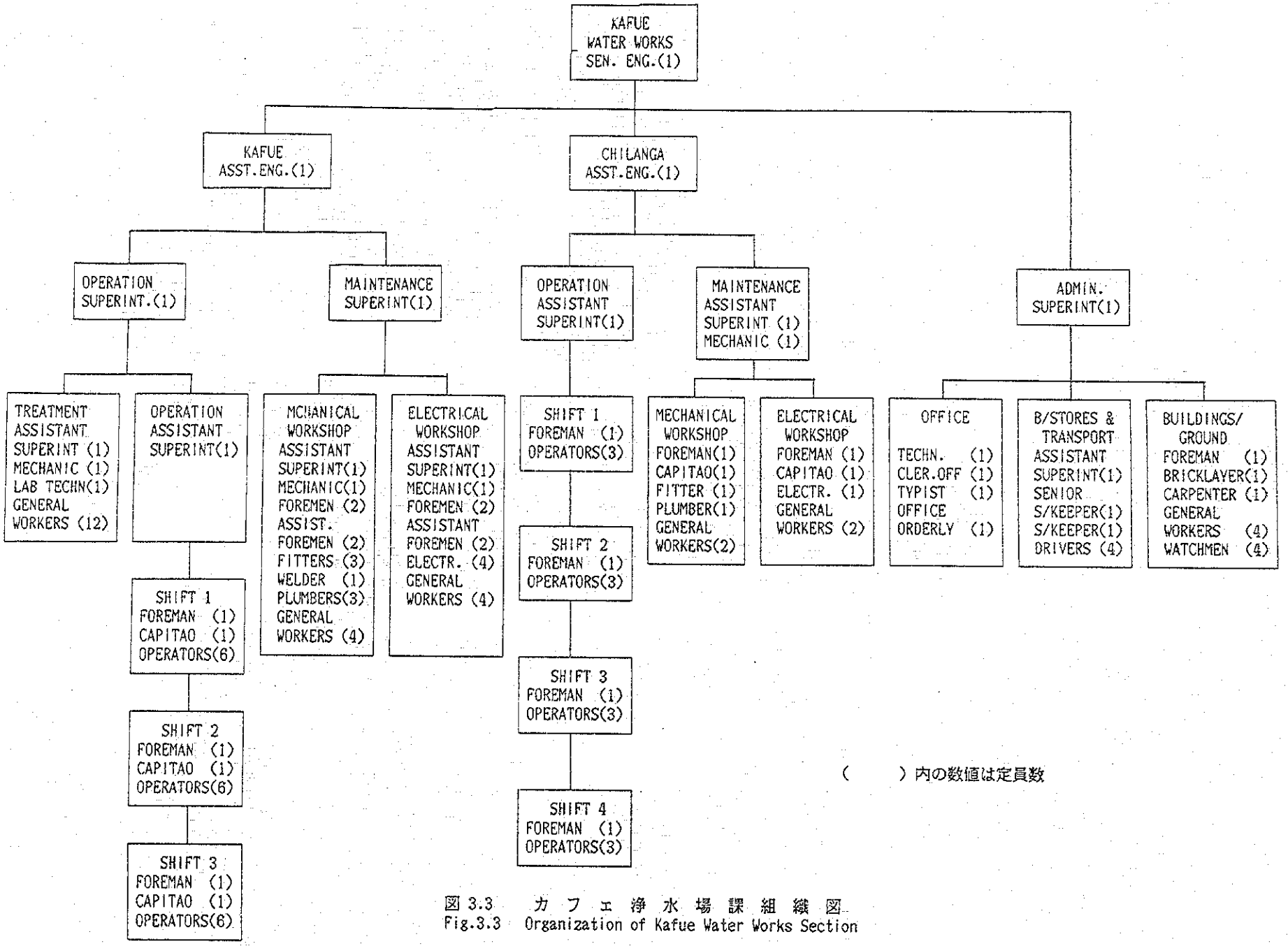


図 3.3　カフェ浄水場課組織図
Fig.3.3　Organization of Kafue Water Works Section