A 17.2 (ANG MANASAN SANG MANASANAN SANG MANGSAKANAN SANG MANGSAKANAN SANGANAN SANANAN SANANAN SANANAN SANANAN

THE LANGUER LICENTIFICATION OF THE PROPERTY OF

Hydrologic observation systems.

THE WATER ROLLING WEEKS

M

ZIMINA).

MARCH, 1992

PANEZANI INTIDETBANZATITADINAD, LEXDROPETERVATORDIA ZALEFERICAY

Chite)

REPUBLIC OF ZAMBIA MINISTRY OF ENERGY AND WATER DEVELOPMENT

A STATE

FINAL REPORT SUMMARY

THE MASTER PLAN STUDY
ON
HYDROLOGIC OBSERVATION SYSTEMS
OF
THE MAJOR RIVER BASINS
IN
ZAMBIA

LIBRARY 1096904(6)

27647

MARCH, 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

SSS CR(3) 92-030(1/4)





Preface

 $(\)$

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a Master Plan Study on Hydrologic Observation Systems of the Major River Basins in Zambia, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zambia a study team headed by Mr. Yoshio Nakagawa, Yachiyo Engineering Co., Ltd., five times between December 1989 and March 1992.

The team held discussions with the officials concerned of the Government of Zambia, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the Project and to the enhancement of the friendly relations between our two countries.

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

Tokyo, March 1992

Kensuke Yanagiya President

Japan International Cooperation Agency

Kenenka Ganas

THE MASTER PLAN STUDY ON HYDROLOGIC OBSERVATION SYSTEMS OF THE MAJOR RIVER BASINS IN ZAMBIA

FINAL REPORT S U M M A R Y

11	COMOTTITI	TTON O	כי שו	TAT. D	יויסממים	~ <

- (1) SUMMARY
- (2) MAIN
- (3) SUPPORTING
- (4) DATA BOOK

CONTENTS OF MAIN REPORT

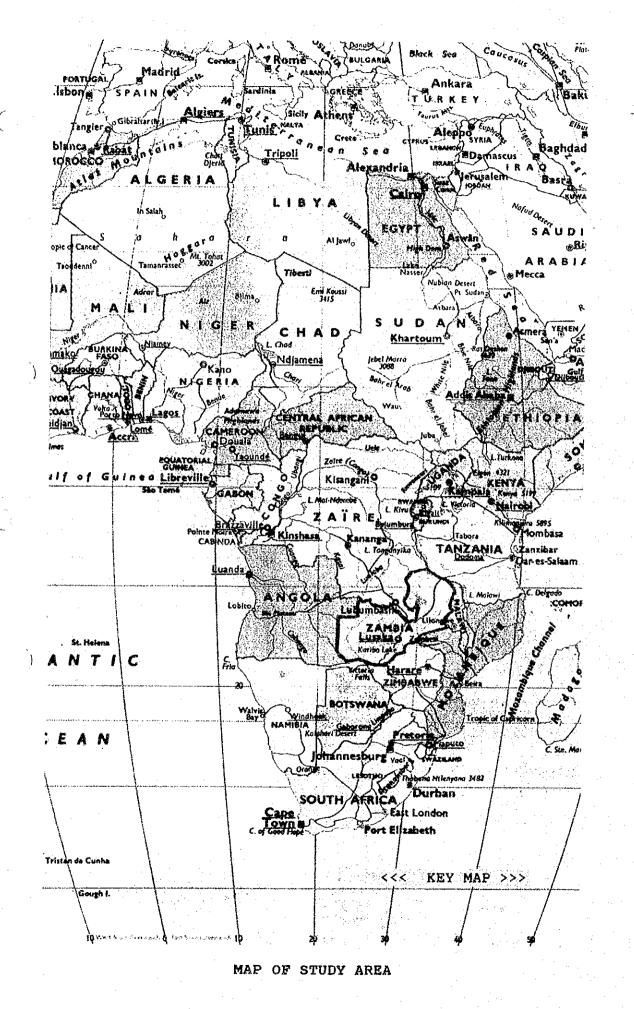
	LIST OF FIGURES AND TABLES	$\ldots (\bar{2})$
1	OUTLINE OF STUDY	
2	HYDROLOGIC OBSERVATION	.(201) .(201)
3	WELL OBSERVATION	.(301) .(301)
4	WATER QUALITY INVESTIGATION. 4.1 Water Sampling	.(401) .(401)
	HYDROLOGIC ANALYSIS. 5.1 Hydrologic Database. 5.2 Discharge Rating Curve. 5.3 Reservoir Water Balance. 5.4 River Flow Analysis 5.5 Characteristics of River Flow 5.6 Consideration on Analysis Results	. (501) . (503) . (504) . (508) . (510)
6	HYDROLOGIC OBSERVATION PLAN 6.1 General 6.2 Activities 6.3 Organization and Responsibilities 6.4 Frequency of Observation 6.5 Classification of Hydrometric Stations	. (601) . (601) . (604) . (607)
7	Recommendation	. (701)

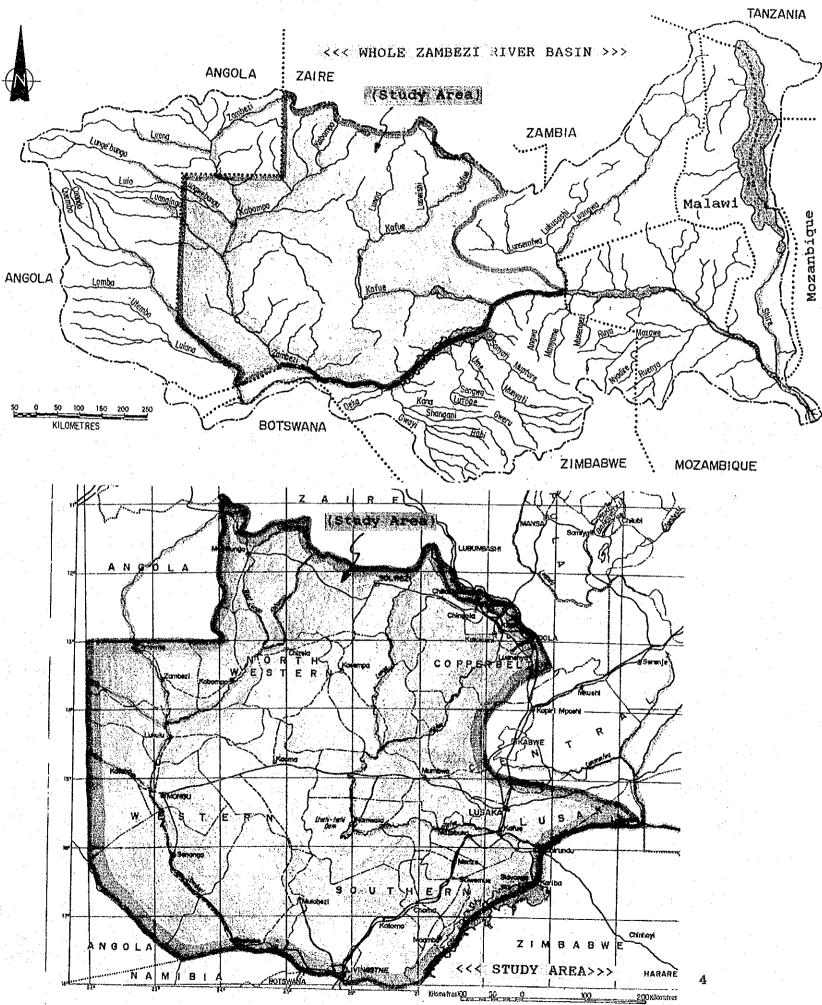
THE MASTER PLAN STUDY ON HYDROLOGIC OBSERVATION SYSTEMS OF THE MAJOR RIVER BASINS IN ZAMBIA

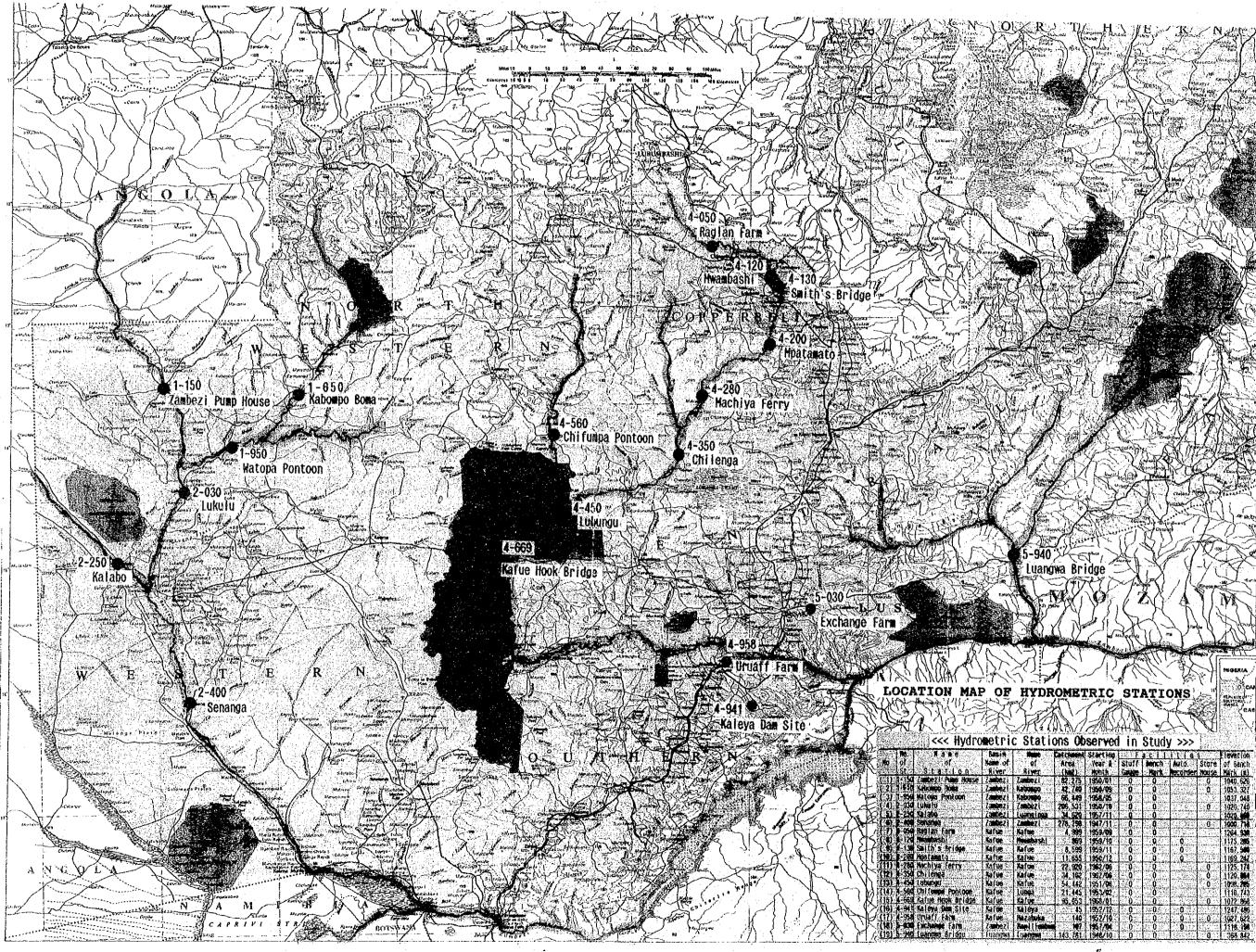
FINAL REPORT S U M M A R Y

	LIST OF FIGURES AND TABLES	+1 1
		Page
	[Chapter 1]	1 1
Fig 1.1	Flowchart of Study	. (104)
Table-1.1	Work Schedule of Study	. (105)
Fig 1.2	Organization of Study	.(106)
r19 1.2	or gamera cross or breast	
	[Chapter 2]	2
mahia 0 1	Hydrometric Stations Selected and Installed	
Table-2.1	in Study	(201)
**** O 1	Location of Selected Hydrometric Stations	(202)
Fig 2.1	Result of Leveling Survey	(203)
Table-2.2	Number of Flow Measurement Data	(204)
Table-2.3	Middle of From Measurement para	
		and the second
1 3 A 4	[Chapter 3] List of Observation Wells	(301)
Table-3.1	List of Opservation Wells	(303)
Fig 3.1	Location Map of Observation Wells	(302)
Table-3.2	Monthly River Water Level and Well Water Level	(205)
Fig 3.2	Correlation Pattern between River Water Level .	. (303)
	and Well Water Level	(206)
Table-3.3	Well Water Level Fluctuation	(300)
Fig 3.3(1)	Monthly River W/L and Well W/L Fluctuation	. (302)
. N. S	(Linked Type A: No.9 Kabalanda)	10001
Fig 3.3(2)	Monthly River W/L and Well W/L Fluctuation	. (308)
	(Delayed Type B: No.8 Mwambashi)	(000)
Fig 3.3(3)	Monthly River W/L and Well W/L Fluctuation	. (309)
1000	(Preceding Type C: No.15 Kafue Hook Bridge)	(040)
Fig 3.3(4)	Monthly River W/L and Well W/L Fluctuation	. (310)
	(A/B Combination Type D1: No.14 Lupemba)	
Fig 3.3(5)	Monthly River W/L and Well W/L Fluctuation	. (311)
and the	(B/C COmbination Type D2: No.4-1 Luanchama)	v 4:
		- 1 20
and the second second	[Chapter 4]	
Table-4.1	Test Items for Water Quality	. (401)
Fig 4.1	Sampling Points of Water Quality Test	. (402)
Table-4.2	Test Results of General Items	. (404)
Table-4.3	Test Results of Special Items	. (404)
Table-4.4	Water Quality Standard for Material Contained	. (406)
	in Mining Waste Water	Reading of
Fig 4.2	Variation of Turbidity along Kafue River	. (407)
Ť.		
	[Chapter 5]	Note: 1
Table-5.1	[Chapter 5] Hydrologic Database System	. (501)
Fig 5.1	Hydrologic Database System	. (502)
Table-5.2	Discharge Rating Curve	. (503)
Table-5.3	Summary of Reservoir Water Balance	. (504)
Fig = 5.2	Summary of Reservoir Water Balance	. (504)

Page Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.4 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Dam (507) Fig 5.8 Reservoir Water Balance of Kafue Dam (508) Fig 5.7 River Flow of Upper Area (511) Fig 5.8 River Flow of Upper Area (512) Fig 5.9 1 Rydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 2 Rydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 3 Rydrometric St. (1-150 / Watepa Pontoon) (514) Fig 5.9 3 Rydrometric St. (1-200 / Lukulu) (516) Fig 5.9 6 Hydrometric St. (2-200 / Lukulu) (516) Fig 5.9 6 Hydrometric St. (2-200 / Lukulu) (517) Fig 5.9 6 Hydrometric St. (2-200 / Kalabo) (517) Fig 5.9 6 Hydrometric St. (2-200 / Raglam Farm) (519) Fig 5.9 6 Hydrometric St. (4-200 / Sanamga) (518) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (620) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (620) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (620) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (620) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (622) Fig 5.9 6 Hydrometric St. (4-200 / Machawashi) (622) Fig 5.9 6 Hydrometric St. (4-400 / Lubungu) (622) Fig 5.9 6 Hydrometric St. (4-460 / Lubungu) (622) Fig 5.9 6 Hydrometric St. (4-460 / Lubungu) (622) Fig 5.9 6 Hydrometric St. (4-460 / Kutungu) (622) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (621) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (621) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (622) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (622) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (622) Fig 5.9 16 Hydrometric St. (4-460 / Katue Hook Bridge (622) Fig.				•	
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.4 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Discharge (510) Fig 5.7 River Flow of Upper Area (511) Fig 5.7 River Flow of Upper Area (511) Fig 5.9 (1) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (3) Hydrometric St. (1-150 / Zambezi P/H) (514) Fig 5.9 (5) Hydrometric St. (1-150 / Zambezi P/H) (514) Fig 5.9 (5) Hydrometric St. (1-150 / Zambezi P/H) (515) Fig 5.9 (6) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (7) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (8) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (10) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (11) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (12) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (13) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (13) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (14) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (15) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15)					
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.4 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Discharge (510) Fig 5.7 River Flow of Upper Area (511) Fig 5.7 River Flow of Upper Area (511) Fig 5.9 (1) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Mydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (3) Hydrometric St. (1-150 / Zambezi P/H) (514) Fig 5.9 (5) Hydrometric St. (1-150 / Zambezi P/H) (514) Fig 5.9 (5) Hydrometric St. (1-150 / Zambezi P/H) (515) Fig 5.9 (6) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (7) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (8) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (516) Fig 5.9 (10) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (11) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (12) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (13) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (13) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (14) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (15) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambezi P/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15) Fig 5.9 (16) Hydrometric St. (1-150 / Zambez D/H) (1-15)		·		•	
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.4 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-6.4 Characteristics of Discharge (510) Fig 5.7 River Flow of Upper Area (511) Fig 5.8 River Flow of Upper Area (511) Fig 5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Hydrometric St. (1-150 / Zambezi P/H) (513) Fig 5.9 (2) Hydrometric St. (1-600 / Kabompo Boma) (514) Fig 5.9 (3) Hydrometric St. (1-500 / Watepa Pontoon) (515) Fig 5.9 (4) Hydrometric St. (1-200 / Dukulu) (516) Fig 5.9 (5) Hydrometric St. (2-200 / Eukulu) (516) Fig 5.9 (6) Hydrometric St. (2-200 / Kalabo) (517) Fig 5.9 (6) Hydrometric St. (2-200 / Kalabo) (517) Fig 5.9 (7) Hydrometric St. (4-200 / Senanga) (514) Fig 5.9 (9) Hydrometric St. (4-200 / Mwambashi) (520) Fig 5.9 (10) Hydrometric St. (4-100 / Mwambashi) (520) Fig 5.9 (11) Hydrometric St. (4-200 / Myatamato) (522) Fig 5.9 (11) Hydrometric St. (4-200 / Myatamato) (522) Fig 5.9 (12) Hydrometric St. (4-200 / Myatamato) (522) Fig 5.9 (13) Hydrometric St. (4-200 / Myatamato) (523) Fig 5.9 (13) Hydrometric St. (4-200 / Myatamato) (523) Fig 5.9 (13) Hydrometric St. (4-300 / Chilenga) (524) Fig 5.9 (13) Hydrometric St. (4-300 / Chilenga) (524) Fig 5.9 (13) Hydrometric St. (4-300 / Chilenga) (524) Fig 5.9 (14) Hydrometric St. (4-450 / Chilenga) (524) Fig 5.9 (16) Hydrometric St. (4-450 / Chilenga) (527) Fig 5.9 (16) Hydrometric St. (4-500 / Chilenga) (527) Fig 5.9 (16) Hydrometric St. (4-500 / Chilenga) (527) Fig 5.9 (16) Hydrometric St. (4-500 / Chilenga) (527) Fig 5.9 (16) Hydrometric St. (5-940 / Lubungu) (520) Fig 5.9 (16) Hydrometric St. (5-940 / Lubungu) (520) Fig 5.9 (16) Hydrometric St. (5-940 / Lubungu) (520) Fig 5.9 (16) Hydrometric St. (5-940 / Lubungu) (520) Fig 5.9 (16) Hydrometric St. (5-940 / Lubungu) (520) Fig 5.9 (16) Hydromet		· · · ·			
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.4 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Discharge (510) Fig 5.7 River Flow of Upper Area (511) Fig 5.8 River Flow of Upper Area (511) Fig 5.9 (1) Hydrometric St (1-150 / Zambezi F/H) (513) Fig 5.9 (2) Hydrometric St (1-650 / Kabompo Boma) (514) Fig 5.9 (2) Hydrometric St (1-650 / Kabompo Boma) (514) Fig 5.9 (3) Hydrometric St (1-650 / Kabompo Boma) (514) Fig 5.9 (4) Hydrometric St (1-200 / Watepa Pontoon) (515) Fig 5.9 (5) Hydrometric St (2-230 / Lükulu) (516) Fig 5.9 (6) Hydrometric St (2-200 / Kalabo) (517) Fig 6.9 (6) Hydrometric St (2-200 / Kalabo) (517) Fig 6.9 (7) Hydrometric St (4-500 / Raglam Farm) (519) Fig 6.9 (8) Hydrometric St (4-500 / Raglam Farm) (519) Fig 6.9 (10) Hydrometric St (4-120 / Mwambashi) (520) Fig 6.9 (11) Hydrometric St (4-200 / Myatamato) (522) Fig 6.9 (11) Hydrometric St (4-200 / Myatamato) (522) Fig 6.9 (13) Hydrometric St (4-200 / Myatamato) (523) Fig 6.9 (13) Hydrometric St (4-200 / Myatamato) (523) Fig 6.9 (13) Hydrometric St (4-200 / Myatamato) (523) Fig 6.9 (13) Hydrometric St (4-300 / Chilenga) (524) Fig 6.9 (13) Hydrometric St (4-300 / Chilenga) (524) Fig 6.9 (13) Hydrometric St (4-300 / Chilenga) (524) Fig 6.9 (14) Hydrometric St (4-300 / Water Balance On Kongu Ferry) (523) Fig 6.9 (16) Hydrometric St (4-300 / Water Balance On Kongu Ferry) (523) Fig 6.9 (16) Hydrometric St (4-500 / Chilenga) (524) Fig 6.9 (17) Hydrometric St (5-940 / Lubungu) (525) Fig 6.9 (18) Hydrometric St (5-940 / Lubungu) (520) Fig 6.9 (19) Hydrometric St (5-940 / Lubungu) (520) Fig 6.9 (10) Hydrometric St (5-940 / Lubungu) (520) Fig 6.9 (10) Hydrometric St (5-940 / Lubungu) (520) Fig 6.9 (10) Hydrometric St (6-940 / Lubungu) (520) Fig 6.9 (10) Hydrometric St (6-940 / Lubungu) (600) Fi					
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Dischange (510) Fig 5.7 River Flow of Upper Area (611) Fig 5.8 River Flow of Upper Area (611) Fig 5.9 (1) Hydrometric St (1-180 / Zembezi F/H) (513) Fig 5.9 (2) Hydrometric St (1-180 / Zembezi F/H) (513) Fig 5.9 (3) Hydrometric St (1-850 / Kabompo Bona) (514) Fig 5.9 (3) Hydrometric St (1-850 / Kabompo Bona) (514) Fig 5.9 (4) Hydrometric St (2-230 / Iukulu) (516) Fig 5.9 (5) Hydrometric St (2-200 / Iukulu) (516) Fig 5.9 (6) Hydrometric St (2-200 / Iukulu) (517) Fig 5.9 (6) Hydrometric St (2-400 / Senanga) (518) Fig 5.9 (7) Hydrometric St (4-500 / Raglam Ferm) (519) Fig 5.9 (8) Hydrometric St (4-300 / Senanga) (518) Fig 5.9 (9) Hydrometric St (4-300 / Smith's Bridge) (521) Fig 5.9 (10) Hydrometric St (4-200 / Myatamato) (522) Fig 5.9 (11) Hydrometric St (4-200 / Myatamato) (522) Fig 5.9 (11) Hydrometric St (4-200 / Myatamato) (523) Fig 5.9 (12) Hydrometric St (4-280 / Machiya Ferry) (523) Fig 5.9 (13) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (15) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (527) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (527) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (530) Fig 5.10 Specific Discharge (5-34) Fig 6.9 (12) Hydrometric St (6-308) Fig 6.12 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig 6.11 River Chamel and Flooding Area (534) Fig 6.12 Runoff Coefficient of	•	* .		•	
Fig 5.3 Reservoir Water Balance of Itezhi-tezhi Dam (505) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.5 Reservoir Water Balance of Kafue Gorge Dam (506) Fig 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Dischange (510) Fig 5.7 River Flow of Upper Area (611) Fig 5.8 River Flow of Upper Area (611) Fig 5.9 (1) Hydrometric St (1-180 / Zembezi F/H) (513) Fig 5.9 (2) Hydrometric St (1-180 / Zembezi F/H) (513) Fig 5.9 (3) Hydrometric St (1-850 / Kabompo Bona) (514) Fig 5.9 (3) Hydrometric St (1-850 / Kabompo Bona) (514) Fig 5.9 (4) Hydrometric St (2-230 / Iukulu) (516) Fig 5.9 (5) Hydrometric St (2-200 / Iukulu) (516) Fig 5.9 (6) Hydrometric St (2-200 / Iukulu) (517) Fig 5.9 (6) Hydrometric St (2-400 / Senanga) (518) Fig 5.9 (7) Hydrometric St (4-500 / Raglam Ferm) (519) Fig 5.9 (8) Hydrometric St (4-300 / Senanga) (518) Fig 5.9 (9) Hydrometric St (4-300 / Smith's Bridge) (521) Fig 5.9 (10) Hydrometric St (4-200 / Myatamato) (522) Fig 5.9 (11) Hydrometric St (4-200 / Myatamato) (522) Fig 5.9 (11) Hydrometric St (4-200 / Myatamato) (523) Fig 5.9 (12) Hydrometric St (4-280 / Machiya Ferry) (523) Fig 5.9 (13) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (15) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (524) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (527) Fig 5.9 (16) Hydrometric St (4-350 / Chilenga) (527) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (525) Fig 5.9 (16) Hydrometric St (5-340 / Lubungu) (530) Fig 5.10 Specific Discharge (5-34) Fig 6.9 (12) Hydrometric St (6-308) Fig 6.12 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig 6.11 River Chamel and Flooding Area (534) Fig 6.12 Runoff Coefficient of					
Fig 5.4 Reservoir Water Balance of Kartha Dam. (506) Fig 5.6 Reservoir Water Balance of Kartha Dam. (507) Fig 5.6 Division of Area for River Flow Simulation (509) Table-6.4 Characteristics of Discharge					Page
Fig 5.4 Reservoir Water Balance of Kartha Dam. (506) Fig 5.6 Reservoir Water Balance of Kartha Dam. (507) Fig 5.6 Division of Area for River Flow Simulation (509) Table-6.4 Characteristics of Discharge			• •		
Fig. 5.4 Reservoir Water Balance of Kartho Dam. (506) Fig. 5.6 Division of Area for River Flow Simulation (509) Table-5.4 Characteristics of Discharge. (510) Fig. 5.7 River Flow of Upper Area (511) Fig. 5.8 River Flow of Upper Area (512) Fig. 6.9(1) Hydrometric St. (1-130 / Zambezi P/H) (513) Fig. 6.9(2) Hydrometric St. (1-130 / Zambezi P/H) (513) Fig. 5.9(3) Rydrometric St. (1-860 / Kabompo Boma) (514) Fig. 5.9(3) Rydrometric St. (1-850 / Kabompo Boma) (514) Fig. 5.9(5) Rydrometric St. (1-800 / Matopa Fontoon) (515) Fig. 5.9(4) Hydrometric St. (2-200 / Lukulu) (516) Fig. 5.9(5) Hydrometric St. (2-200 / Kalabo) (517) Fig. 5.9(6) Hydrometric St. (2-200 / Kalabo) (517) Fig. 5.9(6) Hydrometric St. (4-120 / Myanbashi) (520) Fig. 5.9(9) Hydrometric St. (4-120 / Myanbashi) (520) Fig. 5.9(10) Hydrometric St. (4-120 / Myanbashi) (520) Fig. 5.9(11) Hydrometric St. (4-200 / Mpatamato) (522) Fig. 5.9(12) Hydrometric St. (4-200 / Mpatamato) (522) Fig. 5.9(13) Hydrometric St. (4-200 / Mpatamato) (523) Fig. 5.9(13) Hydrometric St. (4-305 / Chilenga) (524) Fig. 5.9(13) Hydrometric St. (4-306 / Chilenga) (524) Fig. 5.9(14) Hydrometric St. (4-306 / Chilenga) (524) Fig. 5.9(15) Hydrometric St. (4-306 / Chilenga) (525) Fig. 5.9(16) Hydrometric St. (4-306 / Chilenga) (527) Fig. 5.9(16) Hydrometric St. (4-306 / Chilenga) (528) Fig. 5.9(16) Hydrometric St. (4-306 / Chilenga) (529) Fig. 5.9(16) Hydrometric St. (4-306 / Chilenga) (520) Fig. 5.9(16) Hyd	Fig 5.3	Reservoir Water	Balance of 1	(tezhi-tezhi Dam	(505)
Fig. 5.5 Reservoir Water Balance of Kariba Dam (507)					
Table-5.6 Division of Area for River Flow Simulation (509) Table-5.7 Characteristics of Discharge (510) Fig5.7 River Flow of Upper Area (511) Fig5.8 River Flow of Upper Area (512) Fig5.9 River Flow of Whole Area (512) Fig5.9 Hydrometric St. (1-50 / Zambezi P/H) (513) Fig5.9 St. (2) Hydrometric St. (1-50 / Kabompo Boma) (514) Fig5.9 Hydrometric St. (1-60 / Kabompo Boma) (514) Fig5.9 Hydrometric St. (2-203 / Watopa Pontoon) (516) Fig5.9 Hydrometric St. (2-203 / Kalabo) (517) Fig5.9 Hydrometric St. (2-203 / Kalabo) (517) Fig5.9 Hydrometric St. (2-200 / Kalabo) (517) Fig5.9 Hydrometric St. (4-400 / Senanga) (518) Fig5.9 Hydrometric St. (4-400 / Raglam Farm) (519) Fig5.9 Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9 Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9 Hydrometric St. (4-200 / Machiya Ferry) (523) Fig5.9 Hydrometric St. (4-200 / Machiya Ferry) (523) Fig5.9 Hydrometric St. (4-200 / Machiya Ferry) (523) Fig5.9 Hydrometric St. (4-450 / Chifumpa Pontoon) (526) Fig5.9 Hydrometric St. (4-450 / Chifumpa Pontoon) (526) Fig5.9 Hydrometric St. (4-450 / Chifumpa Pontoon) (526) Fig5.9 Hydrometric St. (4-50 / Chifumpa Pontoon) (526) Fig5.9 Hydrometric St. (4-94 / Kaleya Dam Site) (528) Fig5.9 Hydrometric St. (5-30) / Exchange Farm) (530) Fig5.9 Hydrometric St. (5-30 / Exchange Farm) (530) Fig5.9 Hydrometric St. (5-30 / Exchange Farm) (530) Fig5.9 Hydrometric St. (5-30 / Exchange Farm) (530) Fig5					
Table-5.4 Characteristics of Discharge (510) Fig5.8 River Flow of Upper Area (511) Fig5.8 River Flow of Whole Area (512) Fig5.9 (1) Hydrometric St. (1-150 / Zambezi P/H) (513) Fig5.9 (2) Hydrometric St. (1-150 / Kabompo Boma) (514) Fig5.9 (3) Hydrometric St. (1-950 / Watopa Pontoon) (515) Fig5.9 (4) Hydrometric St. (2-203 / Lukulu) (516) Fig5.9 (5) Hydrometric St. (2-203 / Lukulu) (516) Fig5.9 (6) Hydrometric St. (2-204 / Kalabo) (517) Fig5.9 (6) Hydrometric St. (2-204 / Kalabo) (517) Fig5.9 (7) Hydrometric St. (2-204 / Kalabo) (518) Fig5.9 (1) Hydrometric St. (4-120 / Mambashi) (520) Fig5.9 (8) Hydrometric St. (4-120 / Mambashi) (520) Fig5.9 (9) Hydrometric St. (4-120 / Mambashi) (522) Fig5.9 (11) Hydrometric St. (4-200 / Mpatamato) (522) Fig5.9 (12) Hydrometric St. (4-200 / Mpatamato) (523) Fig5.9 (13) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9 (13) Hydrometric St. (4-350 / Chilenga) (524) Fig5.9 (15) Hydrometric St. (4-350 / Chilenga) (525) Fig5.9 (16) Hydrometric St. (4-360 / Lubungu) (525) Fig5.9 (17) Hydrometric St. (4-360 / Lubungu) (526) Fig5.9 (18) Hydrometric St. (4-360 / Unbungu) (528) Fig5.9 (19) Hydrometric St. (4-360 / Unbungu) (529) Fig5.9 (19) Hydrometric St. (4-360 / Unbungu) (529) Fig5.9 (18) Hydrometric St. (4-360 / Unbungu) (529) Fig5.9 (18) Hydrometric St. (4-360 / Unbungu) (529) Fig5.9 (18) Hydrometric St. (4-360 / Unbungu) (528) Fig5.9 (18) Hydrometric St. (4-		Division of Area	for River F	Flow Simulation	(509)
Fig5.7 River Flow of Upper Area (511) Fig5.8 River Flow of Whole Area (512) Fig5.9(1) Hydrometric St. (1-150 / Zambezi P/H) (513) Fig5.9(2) Hydrometric St. (1-650 / Kabompo Bona) (514) Fig5.9(3) Hydrometric St. (1-950 / Watopa Pontoon) (515) Fig5.9(4) Hydrometric St. (1-950 / Watopa Pontoon) (516) Fig5.9(5) Hydrometric St. (2-250 / Kalabo) (517) Fig5.9(6) Hydrometric St. (2-250 / Kalabo) (517) Fig5.9(7) Hydrometric St. (2-250 / Kalabo) (517) Fig5.9(8) Hydrometric St. (4-050 / Raglam Farm) (519) Fig5.9(8) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9(9) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9(10) Hydrometric St. (4-120 / Machiya Ferry) (523) Fig5.9(11) Hydrometric St. (4-200 / Machiya Ferry) (523) Fig5.9(12) Hydrometric St. (4-200 / Machiya Ferry) (523) Fig5.9(13) Hydrometric St. (4-250 / Chifumpa Pontoon) (526) Fig5.9(14) Hydrometric St. (4-450 / Lubungu) (525) Fig5.9(15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9(16) Hydrometric St. (4-968 / Watue Hook Bridge) (527) Fig5.9(17) Hydrometric St. (4-968 / Uruaff Farm) (529) Fig5.9(18) Hydrometric St. (5-030 / Exchange Farm) (530) Fig5.9(18) Hydrometric St. (5-040 / Luangwa Bridge) (531) Fig5.9(18) Hydrometric St. (5-040 / Luangwa Bridge) (531) Fig5.9(18) Hydrometric St. (5-040 / Luangwa Bridge) (531) Fig5.9(18) Hydrometric St. (5-040 / Exchange Farm) (530) Fig5.9(18) Hydrometric St. (5-040 / Exchange Farm) (530) Fig5.17 Rutor Flow Balance on Mongu Floading Area (534) Fig5.18 Floading Model in Mongu Flain (535) Table-5.6 Floading Water Level and Discharge (534) Fig5.13 Floading Model in Mongu Plain (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation Coefficient of Kafue River Basin (538) Fig5.17 General Organization (536) Fig5.17 General Organization (536) Fig5.17 General Organization (540) Fig5.17 General Organization (540) Fig5.17 General Organization (540) Fig5.18 General Organization (540) Fig					
Fig5.8 River Flow of Whole Area (512) Fig5.9 (1) Hydrometric St. (1-160 / Zambezi P/H) (513) Fig5.9 (2) Hydrometric St. (1-960 / Kabompo Bona) (514) Fig5.9 (3) Hydrometric St. (1-960 / Watopa Pontoon) (515) Fig5.9 (4) Hydrometric St. (2-200 / Lukulu) (516) Fig5.9 (5) Hydrometric St. (2-200 / Lukulu) (516) Fig5.9 (6) Hydrometric St. (2-200 / Sananga) (518) Fig5.9 (7) Hydrometric St. (2-200 / Sananga) (518) Fig5.9 (8) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9 (9) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9 (10) Hydrometric St. (4-120 / Mwambashi) (522) Fig5.9 (11) Hydrometric St. (4-280 / Machlya Ferry) (523) Fig5.9 (12) Hydrometric St. (4-280 / Machlya Ferry) (523) Fig5.9 (13) Hydrometric St. (4-450 / Chilenga) (524) Fig5.9 (14) Hydrometric St. (4-450 / Chilenga) (525) Fig5.9 (14) Hydrometric St. (4-450 / Chilenga) (527) Fig5.9 (15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9 (16) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9 (18) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9 (18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.9 (18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.9 (18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (534) Fig5.13 Flooding Model in Mongu Flain (538) Fig5.15 Fluctuation Coefficient of Kafue River Basin (538) Fig5.15 Fluctuation Coefficient of Safue River Basin (538) Fig5.15 Fluctuation Coefficient of Safue River Basin (538) Fig5.17 Repombashilities of Organization (605) Fig5.17 Repombashilities of Organization and Staff (606) Fig5.17 General Organization (607) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608)					
Fig5.9(1) Hydrometric St. (1-150 / Zambezi P/H) (513) Fig5.9(2) Hydrometric St. (1-650 / Kabompo Boma) (514) Fig5.9(3) Hydrometric St. (1-950 / Watopa Pontoon) (515) Fig5.9(4) Hydrometric St. (2-200 / Lukulu) (516) Fig5.9(5) Hydrometric St. (2-200 / Lukulu) (516) Fig5.9(6) Hydrometric St. (2-200 / Sananga) (518) Fig5.9(7) Hydrometric St. (2-200 / Sananga) (518) Fig5.9(8) Hydrometric St. (4-050 / Raglam Farm) (519) Fig5.9(8) Hydrometric St. (4-050 / Raglam Farm) (519) Fig5.9(9) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9(9) Hydrometric St. (4-120 / Myatomata) (521) Fig5.9(10) Hydrometric St. (4-120 / Myatomata) (522) Fig5.9(11) Hydrometric St. (4-200 / Myatomata) (523) Fig5.9(12) Hydrometric St. (4-200 / Myatomata) (524) Fig5.9(13) Hydrometric St. (4-350 / Chilenga) (524) Fig5.9(14) Hydrometric St. (4-350 / Chilenga) (527) Fig5.9(16) Hydrometric St. (4-450 / Lubungu) (526) Fig5.9(16) Hydrometric St. (4-650 / Kafue Hook Bridge) (527) Fig5.9(17) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(18) Hydrometric St. (4-954 / Vunaff Farm) (529) Fig5.9(18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge		River Flow of Wh	ole Area		(512)
Fig5.9(2) Hydrometric St. (1-650 / Kabompo Boma) . (514) Fig5.9 (3) Hydrometric St. (1-950 / Watopa Pontoon) . (515) Fig5.9 (4) Hydrometric St. (2-030 / Lukulu) . (516) Fig5.9 (5) Hydrometric St. (2-250 / Kalabo) . (517) Fig5.9 (6) Hydrometric St. (2-250 / Kalabo) . (517) Fig5.9 (7) Hydrometric St. (2-250 / Kalabo) . (518) Fig5.9 (8) Hydrometric St. (4-050 / Raglam Farm) . (519) Fig5.9 (8) Hydrometric St. (4-102 / Mwambashi) . (520) Fig5.9 (9) Hydrometric St. (4-102 / Mwambashi) . (520) Fig5.9 (10) Hydrometric St. (4-100 / Smith's Bridge) . (521) Fig5.9 (11) Hydrometric St. (4-200 / Mpatamato) . (522) Fig5.9 (12) Hydrometric St. (4-200 / Mpatamato) . (522) Fig5.9 (13) Hydrometric St. (4-260 / Chilenga) . (524) Fig5.9 (13) Hydrometric St. (4-450 / Chilenga) . (524) Fig5.9 (14) Hydrometric St. (4-450 / Chilenga) . (525) Fig5.9 (15) Hydrometric St. (4-450 / Chilenga) . (526) Fig5.9 (17) Hydrometric St. (4-450 / Chilenga) . (527) Fig6.9 (18) Hydrometric St. (4-450 / Kafue Hook Bridge) . (527) Fig6.9 (18) Hydrometric St. (4-941 / Kaleya Dam Site) . (528) Fig5.9 (17) Hydrometric St. (4-941 / Kaleya Dam Site) . (528) Fig5.9 (18) Hydrometric St. (4-940 / Luangwa Bridge) . (531) Fig5.10 Specific Discharge					
Fig5.9(3) Hydrometric St. (2-950 / Matopa Pontoon) (515) Fig5.9(4) Hydrometric St. (2-250 / Kalabo) (517) Fig5.9(5) Hydrometric St. (2-250 / Kalabo) (517) Fig5.9(6) Hydrometric St. (2-250 / Kalabo) (518) Fig5.9(7) Hydrometric St. (2-400 / Senanga) (518) Fig5.9(8) Hydrometric St. (4-405 / Raglam Farm) (519) Fig5.9(8) Hydrometric St. (4-120 / Mwambashi) (620) Fig5.9(9) Hydrometric St. (4-120 / Mwambashi) (520) Fig5.9(10) Hydrometric St. (4-200 / Mpatamato) (522) Fig5.9(11) Hydrometric St. (4-200 / Mpatamato) (522) Fig5.9(12) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9(12) Hydrometric St. (4-260 / Minma Pontoon) (524) Fig5.9(13) Hydrometric St. (4-450 / Chilenga) (524) Fig5.9(14) Hydrometric St. (4-450 / Chilenga) (527) Fig5.9(16) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9(16) Hydrometric St. (4-958 / Uruaff Farm) (528) Fig5.9(17) Hydrometric St. (4-958 / Uruaff Farm) (529) Fig5.9(18) Hydrometric St. (5-930 / Exchange Farm) (530) Fig5.10 Specific Discharge (532) Table-5.5 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Mater Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.15 Fluctuation Ocefficient of Fairer Basin (538) Fig5.16 Fluctuation Ocefficient of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig6.1 Responsibilities of Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608)					
Fig5.9(4) Hydrometric St. (2-030 / Lukulu)					
Fig5.9(5) Hydrometric St. (2-250 / Kalabo)			•		
Fig5.9(6) Hydrometric St. (2-400 / Senanga)		and the contract of the contra		and the second s	
Fig5.9(7) Hydrometric St. (4-050 / Raglam Farm) (519) Fig5.9(8) Hydrometric St. (4-120 / Myambashi) (520) Fig5.9(9) Hydrometric St. (4-130 / Smith's Bridge) (521) Fig5.9(10) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9(11) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9(12) Hydrometric St. (4-450 / Lubungu) (524) Fig5.9(13) Hydrometric St. (4-450 / Lubungu) (525) Fig5.9(14) Hydrometric St. (4-450 / Chilenga) (524) Fig5.9(15) Hydrometric St. (4-450 / Chilenga) (527) Fig5.9(15) Hydrometric St. (4-460 / Chifumpa Pontoon) (526) Fig5.9(15) Hydrometric St. (4-940 / Kafue Hook Bridge) (527) Fig5.9(15) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(17) Hydrometric St. (4-940 / Luangwa Bridge) (528) Fig5.9(18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.9(18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.5 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (536) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Fig5.17 Flooding Model in Mongu Plain (538) Fig5.18 Flooding Model in Mongu Plain (538) Fig5.16 Fluctuation of Annual Rainfall and Discharge (539) Fig5.17 Flooding Model in Mongu Plain (538) Fig5.18 Hydrologic Water Balance of Kafue River Basin (538) Fig5.16 Fluctuation of Annual Rainfall and Discharge (539) Fig5.17 Flooding Model in Mongu Flooding Area (536) Fig5.18 Flooding Model in Mongu Flooding Area (536) Fig5.19 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (540) Fig6.1 General Organization (606) Fig6.1 Responsibilities of Organization and Staff (606) Fig.					
Fig5.9(8) Hydrometric St. (4-120 / Mwambashi)					
Fig5.9(9) Hydrometric St. (4-130 / Smith's Bridge)					
Fig5.9(10) Hydrometric St. (4-200 / Mpatamato) (522) Fig5.9(11) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9(12) Hydrometric St. (4-350 / Chilenga) (524) Fig5.9(13) Hydrometric St. (4-450 / Lubungu) (525) Fig5.9(14) Hydrometric St. (4-660 / Chifumpa Pontoon) (526) Fig5.9(15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9(16) Hydrometric St. (4-968 / Wrunaff Farm) (528) Fig5.9(17) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(18) Hydrometric St. (5-930 / Exchange Farm) (530) Fig5.9(19) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.6 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Runoff Coefficient of Kafue River Basin (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (534) Fig5.13 Flooding Model in Mongu Plain (536) Fig5.13 Flooding Model in Mongu Plain (536) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig6.1 General Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (608)					
Fig5.9(11) Hydrometric St. (4-280 / Machiya Ferry) (523) Fig5.9(12) Hydrometric St. (4-350 / Chilenga) (524) Fig5.9(13) Hydrometric St. (4-450 / Lubungu) (526) Fig5.9(14) Hydrometric St. (4-450 / Chifumpa Pontoon) (526) Fig5.9(15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9(16) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(17) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(18) Hydrometric St. (4-945 / Uruaff Farm) (529) Fig5.9(18) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.9(19) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.5 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig6.1 General Organization (605) for Hydrological Observation Table-6.1 Responsibilities of Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (609)					
Fig5.9(12) Hydrometric St. (4-350 / Chilenga)					
Fig5.9(14) Hydrometric St. (4-450 / Lubungu)					
Fig5.9(14) Hydrometric St. (4-660 / Chifumpa Pontoon) (526) Fig5.9(15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig5.9(16) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(17) Hydrometric St. (4-958 / Urusaff Farm) (529) Fig5.9(18) Hydrometric St. (5-030 / Exchange Farm) (530) Fig5.9(19) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.6 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (536) Table-5.8 Hydrologic Water Balance of Kafue River Basin (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig6.1 General Organization (605) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (608)					
Fig5.9(15) Hydrometric St. (4-669 / Kafue Hook Bridge) (527) Fig6.9(16) Hydrometric St. (4-941 / Kaleya Dam Site) (528) Fig5.9(17) Hydrometric St. (4-958 / Uruaff Farm) (529) Fig5.9(18) Hydrometric St. (5-030 / Exchange Farm) (530) Fig5.9(19) Hydrometric St. (5-940 / Luangwa Bridge) (531) Fig5.10 Specific Discharge (532) Table-5.5 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (536) Table-5.8 Hydrologic Water Balance of Kafue River Basin (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig 6.1 Responsibilities of Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (608)	the state of the s				
Fig6.9(16)	——————————————————————————————————————				
Fig5.9(17)					
Fig5.9(18)		the contract of the contract o			
Fig5.9(19) Hydrometric St.(5-940 / Luangwa Bridge)					
Fig5.10 Specific Discharge					
Table-5.5 Runoff Coefficient of Kafue River Basin (533) Table-5.6 Flooding Water Level and Discharge (534) Fig5.11 River Channel and Flooding Area (534) Fig5.12 Ratio of Hydropower Generation (535) Table-5.7 River Flow Balance on Mongu Flooding Area (536) Fig5.13 Flooding Model in Mongu Plain (536) Table-5.8 Hydrologic Water Balance of Kafue River Basin (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig 6.1 General Organization (605) for Hydrological Observation Table-6.1 Responsibilities of Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (609)	51 17 H				
Table-5.6 Flooding Water Level and Discharge					
Fig5.11 River Channel and Flooding Area					
Fig5.12 Ratio of Hydropower Generation					
Table-5.7 River Flow Balance on Mongu Flooding Area					
Fig5.13 Flooding Model in Mongu Plain					
Table-5.8 Hydrologic Water Balance of Kafue River Basin (538) Fig5.14 Hydrologic Water Balance of Kafue River Basin (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water (540) Fig5.17 Development Potential of River Water (541) at Main Points [Chapter 6] Fig 6.1 General Organization (605) for Hydrological Observation Table-6.1 Responsibilities of Organization and Staff (606) Table-6.2 Frequency of Flow Measurement (607) Table-6.3 Classification of Hydrometric Stations (608) Table-6.4 Number of Hydrometric Stations (609)					
Fig5.14 Hydrologic Water Balance of Kafue River Basin . (538) Fig5.15 Fluctuation of Annual Rainfall and Discharge . (539) Fig5.16 Fluctuation Coefficient of (539) Annual Mean Discharge Table-5.9 Development Potential of River Water					
Fig5.15 Fluctuation of Annual Rainfall and Discharge	the second secon				
Fig5.16 Fluctuation Coefficient of					
Annual Mean Discharge Table-5.9 Development Potential of River Water		and the second of the second o			
Table-5.9 Development Potential of River Water	rig5.10		SERVICE CONTRACTOR CON		(003)
Fig5.17 Development Potential of River Water	Tabla_E Ω	and the control of th		iam Watan	(640)
at Main Points [Chapter 6] Fig 6.1 General Organization					
[Chapter 6] Fig 6.1 General Organization	F195.11		nergy or way	er water	(041)
Fig. 6.1 General Organization		ac Main Follics	1 %		*
Fig. 6.1 General Organization		[Obombon 6]		and the second second	e de la companya de l
for Hydrological Observation Table-6.1 Responsibilities of Organization and Staff(606) Table-6.2 Frequency of Flow Measurement(607) Table-6.3 Classification of Hydrometric Stations(608) Table-6.4 Number of Hydrometric Stations(609)	73.4 0.4	Conapter o	tion		. IENE!
Table-6.1 Responsibilities of Organization and Staff(606) Table-6.2 Frequency of Flow Measurement(607) Table-6.3 Classification of Hydrometric Stations(608) Table-6.4 Number of Hydrometric Stations(609)	rig 6.1				(600)
Table-6.2 Frequency of Flow Measurement	man and a second				ICACI
Table-6.3 Classification of Hydrometric Stations(608) Table-6.4 Number of Hydrometric Stations(609)	The state of the s				
Table-6.4 Number of Hydrometric Stations(609)					
	Table-6.4	number of Hydrom	etric Static	мѕ	(609)
			3		and the second second
en de la companya de La companya de la co					
				•	
	i kasali ta ji Bilik Tek dalam seba				







CHAPTER - 1 OUTLINE OF STUDY

(1) Outset of Study

Zambia has been dependent on copper production since the discovof copper ore deposits. The country, however, now faces a difficulties due to a significant nationwide economic prices in international markets since 1975. this situation, the country is seeking to diversify its industries and has chosen agriculture to be the center of a national development plan. On the other hand, the population growth rate, more than three (3) percent per annum, is high and increasing rapidly. This growth rate is among the highest in the world. Such population increase will cause further serious shorturban and rural water. This situation requires urgent of development of water resources. Existing plans of water resource development have emphasized single purpose which has been limited in scope, such as hydraulic power generation, urban water supply An overall scheme for developing water irrigation. sources, taking into account differences in river basing, has never been produced. Regarding the hydrological observation collect, process and archive the hydrological data for the base water resources development plan of Zambia, the installation of hydrometric stations was started mainly from 1950's in technical cooperation with the foreign agencies led by the England. At the moment, more than 240 hydrometric stations are registered in In fact, basic hydrologic data, essential to an overall Zambia. scheme for water resource development, has not been sufficiently collected and analyzed, especially in a recent decade.

With this as a background, Zambia sought technical cooperation from Japan in February of 1987, to study the water resources potential in the major rivers and to prepare a master plan for developing these resources. In response to the Zambia's request, the Japan International Cooperation Agency (JICA) sent the preliminary study team to Zambia in November of 1988 to perform a preliminary survey, and the scope of work (S/W) of this study was discussed and agreed upon by the two countries. In December 1989, JICA dispatched the study team for "The Master Plan Study on Hydrologic Observation Systems of the Major River Basins in Zambia" (Study Team and Study respectively) according to the scope of work, and commenced the Study in conjunction with the counterpart agency, Department of Water Affairs (DWA), Ministry of Water, Lands and Natural Resources (present Ministry of Energy and Water Development).

(2) Objectives of Study

The Study, the first step in preparation of the overall plan for water resources development in Zambia, is designed to achieve the following objectives.

1) To strengthen the hydrologic observation systems in Study Area to utilize the data for future planning of water resources development.

2) To make a rough estimation of water resources potential through the study of river flow based on existing and new hydrologic data.

In addition, this study is also designed to transfer technology to the Zambian counterparts through the execution of study.

(3) Study Area

The areas covered by Study (Study Area) are the western parts of Zambia. The total catchment area of Study Area amounts about 340,000 km2 consisting of:

- 1) Catchment area of some 787,000 km2 along the mainstream of the Zambezi River (Area of 602,000 km2 is out of Zambia, this area is out of scope) as far as the confluence point with one of its tributaries, the Luangwa River, and
- 2) Catchment area of some 155,000 km2 along the Kafue River, another tributary of the Zambezi River.

Zambezi River originates at the northwest corner of the county and, after passing through Angolian territory, flows southward in the western part of the Zambia. After forming a great flooding area (190 km in length and 40 km in average width), it reaches the boundary with Namibia. It then turns east, giving the great valley and Victoria falls (utilized for generating hydraulic power of 108 MW), flows into the Kariba Lake (big artificial lake with a total volume of 160 billion cubic meters and formed by the construction of Kariba Dam which generates as much as 1266 MW of electric power in Zasmbia and Zimbabwe and joins with its tributary, Kafue River, at Kafue Gorge. At Luangwa it accompanies another tributary, Luangwa River which originates at the country's east boundary with Tanzania and after passing through Mozanbique, flows into the Indian Ocean. The Zambezi River is an international river and its total catchis about 1.2 million km2. Other countries: Angola, ment area Botswana, Zimbabwe and Mozanbique all contain parts of Namibia, the Zambezi River basin.

The Kafue River, originating from the copper belt on the boundary with Zaire, flows through the middle west portion of the and has a total area of about 155,000 km2 and a total length of about 1,200 km. Its whole area is contained within Zambian territory. Its catchment area contains political, economic cultural centers of the country. One third of the whole populais concentrated in this area. The Kafue river has dams (the Itezhi-tezhi Dam in the middle and the Kafue Gorge Dam on its lower course) to utilize the river's water resources for hydroelectric power generation. The Itezhi-tezhi Dam is a regulation reservoir for Kafue Gorge Dam. The Kafue Gorge Dam can generate 900 MW of electric power which is distributed to the Lusaka, or cities in the Copperbelt to operate urban capital, facilities.

(4) Scope and Contents of Study

The scope of this study includes systemizing and reinforcing a hydrologic observation network throughout the Study Area and clarifying the water resources potential of the Study Area.

The Study is divided into three (3) phases comprising each phase's targets as shown below. Refer to Fig. - 1.1.

<< Phase 1 >>> Period : Dec. 1989 - Mar. 1990

1) To establish the hydrometric reference points and hydrologic observation network.

2) To repair and/or install observation stations covered by the network. After putting facilities into place, actual observation should be made using those facilities.

3) To prepare a hydrologic database to be used for planning water resource development in the future, and feed it the necessary data.

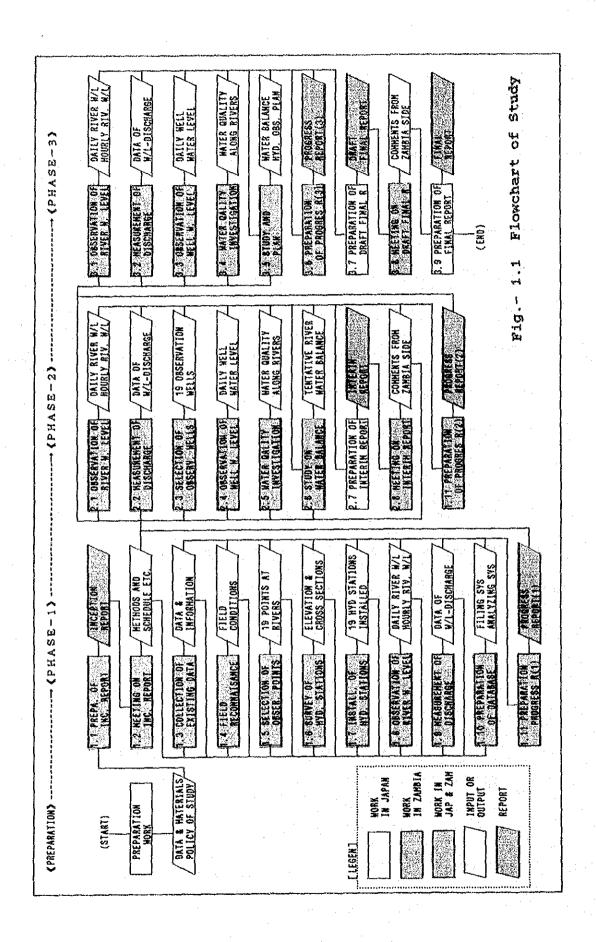
4) To prepare a progress report (1)

<<< Phase 2 >>> Period : May 1990 - Mar. 1991

- To continue hydrologic observations and to transfer hydrologic techniques to Zambian counterparts. (training level)
- 2) To investigate water quality.
- 3) To analyze existing materials and observation data to comprehend the flow regime at each reference point and to study water balance of existing reservoirs.
- 4) To prepare an interim report summarizing the interim results, and discuss with the Zambian side.
- 5) To prepare a progress report (2)

<< Phase 3 >>>
Period: May 1991 - Mar. 1992

- To continue hydrologic observations and work to transfer hydrologic techniques to Zambian counterparts (mastery level).
- 2) To analyze the existing materials and observation data to reveal river flow classified by different basins so that potential water resources can be roughly estimated.
- 3) To prepare a master plan for hydrologic observation systems.
- 4) To prepare Draft Final Report summarizing the above results, and discuss Study results with Zambian side.
- 5) To prepare Final Report after receiving the comments on the report from the Zambian side and submit it to Zambia.



(5) Work Schedule

The Study was carried out as shown in Table- 1.1.

Table-1.1 Work Schedule of Study

W O A K 1 E H S D F M A M J J A S D N D J F N A H J J A S D N D N D J F N A H J J A S D N D J A D J A D J N D J A D J A D J N D J A D J N D J A D J J J J J J J J J J J J J J J J	[89]90 [91									1 92																				
P. H. A. S. E 1	HOOK TIENS					-1			īΠ	1	٨	k	h		b			Įį.	4	ų.	li	1	K	E 7	h]	ī	<u> </u>			4
1. Inception Report JUZ 2. Heeting on Inc. Report Z 3. Collection of Z/Z/Z/Z/Z 4. Field Reconnaisance Z/Z 5. Selection of Z/Z 6. Observation Points Z/Z/Z/Z/Z 8. Survey of Z/Z/Z/Z/Z 9. Hydrometric Stations 1. Installation of Z/Z/Z/Z/Z Hydrometric Stations Z/Z/Z/Z/Z 1. Observation of Z/Z/Z/Z/Z River Water Level Z/Z/Z/Z/Z 1. Oregaration of Z/Z/Z/Z/Z 1. Oregaration of Z/Z/Z/Z/Z 2. Interim Report Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z/Z							+	╗	-	_	`_	۲-	<u> </u>	 ` -	۷	<u>'</u>	-		-	<u>'</u>	۲	۲-	۲-	۷	٧	-	-	-	+	SWC4
1.2 Heeting on Inc. Report Z. 1.3 Collection of ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ			3	-			十	-	-	_		-	-		-			-		 	-	}-	\vdash						7	
1.3 Collection of Existing Data 1.4 Field Reconnaisance 7.2 1.5 Selection of Observation Points 1.6 Survey of Hydrometric Stations 7.7 1.7 Installation of Hydrometric Stations 1.8 Observation of Private Mater Level 7.7 1.9 Flow Measurement 7.7 1.10 Preparation of 7.7 1.10 Preparation of 7.7 1.11 Progress Report(1) 7.7 1.12 Progress Report(1) 7.7 1.14 S. I 2 2.1 Observation of 7.7 1.15 Selection of 7.7 1.15 Observation of 7.7 1.15 Progress Report(1) 7.7 1.16 Preparation of 7.7 1.17 Progress Report(1) 7.7 1.18 S. I 2 1.19 Flow Measurement 7.7 1.19 Flow Measurement 7.7 1.10 Preparation of 7.7 1.1		۲×	7	-	\vdash	-1		1			Н				-	-	-	-	-	┢	-	-	-	-	Н		Н			_~-
Existing Data 1.4 Field Reconnaisance 1.5 Selection of Observation Points 1.6 Survey of Hydrometric Stations 1.7 Installation of ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ		†-	77	77	77	77	-	7	-		-	-	-			-	 		-	-	-	-	-	-	-			1		
1.5 Selection of Observation Points 1.6 Survey of Phydrometric Stations 1.7 Installation of Phydrometric Stations 1.8 Observation of Private Phydrometric Stations 1.8 Observation of Private Phydrometric Stations 1.8 Observation of Private Phydrometric Stations 1.9 Flow Heasurement Private Phydrometric Stations 1.10 Preparation of Private Phydrometric Phydrometric Stations 1.11 Progress Report(1) Phydrometric Phydromet							Ì					١.		١.,	ļ						Ī	l								
1.5 Selection of Observation Points 1.6 Survey of Pydrometric Stations 1.7 Installation of PZZZZZZZZ Hydrometric Stations 1.8 Observation of PZZZZZZZZ Hydrometric Stations 1.9 Flow Heasurement PZZZZZZZZ Hydrometric Stations 1.10 Preparation of PZZZZZZZZ Hydrometric Stations 1.11 Progress Report(1) PZZ Hydrometric Stations 1.11 Progress Report(1) PZZ Hydrometric Station of PZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ		1-	77	-	\vdash		-	7	-		-	-		┢		Ė	\vdash	-	-	\vdash	-		-	-				一十		
Observation Points 1.6 Survey of Y2727272				 -	 		-	1	-			-			-		-	-	\vdash	-	T		-	-	-		-		_	
1.6 Survey of Hydrometric Stations 1.7 Installation of YZZZZZZZ Hydrometric Stations 1.8 Observation of ZZZZZZZZ River Water Level 1.9 Flow Measurement ZZZZZZZZZ Hydrometric Stations 1.10 Preparation of ZZZZZZZZ Hydrometric Stations 1.11 Progress Report(1) YZ Hydrometric Station of River Hater Level 2.1 Observation of River Hater Level 2.2 Flow Measurement ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ			-	1				١	ĺ													ĺ							.	
Hydrometric Stations 1.7 Installation of Hydrometic Stations 1.8 Observation of River Water Level 1.9 Flow Heasurement ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ		1-	7	77	77	77	-1	7	\neg		-	-		-	-	-	 	-		-	<u> </u>		-	-					\Box	
1.7 Installation of Hydrometic Stations 1.8 Observation of River Water Level 1.9 Flow Measurement VZZZZZZZ 1.10 Preparation of ZZZZZZZZZ Batabase 1.11 Progress Report(1) P H A S E - 2 2.1 Observation of River Water Level 2.2 Flow Measurement VZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ			1	-	[]		- {		-			"				İ			:											
Hydrometic Stations 1.8 Observation of River Mater Level 1.9 Flow Heasurement ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ		1	77	77	77	77	-t	7	_		-	_		-	-		-	<u> </u>	-	t	 		 	_	-					
1.8 Observation of River Mater Level Image: River Mater River M		1	[<u>ר</u>			-					ĺ	Ì,			١.		ĺ			ľ	İ							I	
River Water Level 1.9 Flow Measurement 77777777 1.10 Preparation of Database 1.11 Progress Report(1) P H A S E - 2 2.1 Observation of River Water Level 2.2 Flow Measurement 2.3 Selection of Observation of Well Water Level 2.4 Observation of Well Water Level 2.5 Mater Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Measurement 777777777 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 77777777 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Flnal Report 3.8 Meeting on D/F/Report 3.8 Meeting on D/F/Report 3.9 Flnal Report 3.1 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Flnal Report 2.1 Jujujujujujujujujujujujujujujujujujujuj		十	77	77	77	77		٦			<u> </u>	-		-	-	\vdash	┞		-	1		Г	-						\Box	
1.9 Flow Measurement			["	Γ-			- 1	- [(ĺ				ļ	ļ							. (٠.
1.10 Preparation of Database 1.11 Progress Report(1) P H A S E - 2 2.1 Observation of River Mater Level 2.2 Flow Measurement 2.3 Selection of Observation of Well Mater Level 2.4 Observation of Well Mater Level 2.5 Mater Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Mater Level 3.2 Flow Measurement 3.3 Observation of Well Mater Level 3.4 Mater Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on DyJJJJ 3.8 Meeting on DyJ/F/Report 3.9 Progress Report(3) 3.7 Draft Final Report		†	77	77	77	77		7				-		_	_	T				 	-	Ī		-						
Database							一	7	_	-				_	Г		Ι-				\vdash			_					\Box	_
1,11 Progress Report(1)		١.	Γ	-	[]	-	. }		١	. : :		1			ĺ							}	-			,			ıl	
P H A S E - 2 2.1 Observation of		1	T			77	寸	7	Tį						T		T				Γ	T	Ι-					П		
2.1 Observation of River Mater Level 2.2 Flow Measurement 2.3 Selection of Observation Mells 2.4 Observation of Hell Water Level 2.5 Mater Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2)		†	┪	 	$\vdash \vdash$		***	_	**	**	**	**	* *	**	**	**	**	**	_	_	 	T	1	_		_	_			
River Mater Level 2.2 Flow Heasurement 2.3 Selection of Observation Wells 2.4 Observation of Well Water Level 2.5 Hater Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Heeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Weeting on D/F/Report 3.9 Final Report		T	1		\Box	7	1	٦	/7	77	77	77	77	77	77	77	77	77			Γ		_	i -	_			П	П	
2.2 Flow Heasurement 2.3 Selection of Observation Wells 2.4 Observation of Wells 2.5 Mater Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Heeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Hell Hater Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Heeting on D/F/Report 3.8 Heeting on D/F/Report 3.9 Final Report		1	{	-			ļ					[-		[-	Γ"		Γ-	Γ-		1		ļ .				100		į Į	۱ ۱	
2.3 Selection of Observation Wells 2.4 Observation of Well Nater Level 2.5 Water Quality Investigation 2.6 Hydrologic Analysis		1	1	1			1		77	77	77	77	77	77	77	7 7	77	ZZ	Γ						1					
Observation Wells 2. 4 Observation of Well Nater Level 2. 5 Mater Quality Investigation 2. 6 Hydrologic Analysis ZZZZZZJJJ 2. 7 Interim Report 2. 8 Meeting on Int. Report 2. 9 Progress Report(2) ZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZZ		1	Г	Ī									_						Г			Γ	Γ	Γ					П	
2.4 Observation of Hell Water Level 2.5 Water Quality					۱ ۱	1	- 1	١				1			l			١.			-	-			١,		١.	\	_	l
Well Water Level 2.5 Water Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) PHASE-3 3.1 Observation of River Water Level 3.2 Flow Measurement 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		1	Γ	Γ			1	_	77	77	77	ZZ	22	7.7	27	77	27	7.7					Γ	Γ	Γ			[]		
2.5 Water Quality Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Measurement 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report				Ì			ı	-								_	L	L	_			_								
Investigation 2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Mater Level 3.2 Flow Measurement 3.3 Observation of Well Mater Level 3.4 Mater Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		Τ			П		1		ZZ	ŽΖ		Γ			Γ		Γ		Γ					Γ	Γ	Γ				
2.6 Hydrologic Analysis 2.7 Interim Report 2.8 Heeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		1		١		_		_ []			L				_			<u> </u>		L					L				
2.7 Interim Report 2.8 Meeting on Int. Report 2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		T			\Box				77.	77	77	IJ								L							L			
2.8 Meeting on Int. Report 2.9 Progress Report(2) PHASE-3 3.1 Observation of River Water Level 3.2 Flow Measurement 3.3 Observation of Reli Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		1											IJ				L		L			L		L		L				
2.9 Progress Report(2) P H A S E - 3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Relation of	2.8 Meeting on Int. Report	Τ												2.2		Γ									L	L				
PHASE-3 3.1 Observation of River Water Level 3.2 Flow Heasurement 3.3 Observation of Pull Water Level 3.4 Water Quality Progress Report (3) 3.5 Analysis and Plan 3.6 Progress Report (3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report																		ZZ			<u>l</u> .				L					
River Water Level 3. 2 flow Heasurement 3. 3 Observation of	PHASE-3	Γ			7															L	*	**	**	**	**	**	**	**	**	**
3.2 Flow Measurement 3.3 Observation of	3.1 Observation of)	1	1	1 1	٠	l	į	1				١.							Ì] Z	27	7.7	22	7.7	22		Ì	l i	
3.3 Observation of Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Heeting on D/F/Report 3.9 Final Report	River Water Level	1_		L					_		L	L	L	_	L	Ŀ	<u>_</u>	_	_		L		L	L		L	L			<u> </u>
Well Water Level 3.4 Water Quality Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		1_	L	L	Ц			_			_	<u> </u>	_	L	<u> </u>	L.	L	L	L	ļ								L	L	ļ
3.4 Water Quality			Ì	ļ			-													1	1	2.2	72	[77	77	7.7				
Investigation 3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		L	L	L							Ĺ	<u> </u>	_	_	L	Ŀ	ļ		_		Ĺ		L	L		L	_	1_	_	<u> </u>
3.5 Analysis and Plan 3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Heeting on D/F/Report 3.9 Final Report			-		{	ı. İ								١							[7.2	2.7				\ .	"	
3.6 Progress Report(3) 3.7 Draft Final Report 3.8 Heeting on D/F/Report 3.9 Final Report				L			\sqcup		:		L.	ļ	L.	_	 _	_	L	L	<u> </u>	L	L	L	L	L	1	L	L	1	L	<u> </u>
3.7 Draft Final Report 3.8 Meeting on D/F/Report 3.9 Final Report		L	L	_			\sqcup			L	<u>L</u>		L		<u> </u>	1_	1_	L	L	1	17	7.7	7	L	μJ	Ŋ.	_	1_	L	<u> </u>
3.8 Meeting on D/F/Report Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z		_	_	<u> </u>							L	_	L	_	<u> </u>	L.	1_	1	1_	<u> </u>	$oldsymbol{\perp}$	1_	<u>Z</u>	1	1	↓_	ļ.,	1_	<u> </u>	<u> </u>
3.9 Final Report		_		_	Ц					L	ļ		<u> </u>	_	L	_	L	_	<u> </u>		<u> </u> _	Ļ	L	1_	L	Ļ	μ.	ŲĴ	7	_
		\perp	L	L	oxdot						ļ	L	ļ	L.	L	_	1	_	_	_	<u> </u>	L	<u> </u>	1	1	1	_	1	₽	Ļ
<pre><note></note></pre>		辶	<u>L</u>		Ш			لـــا		_	_	_	<u> </u>	_	<u>L</u>	L	L	Ļ	<u></u>	L	L	_	ــِـل	L	L	1	1	L	L	<u>u</u>
	<note></note>	2	JJ	IJ	:	0 P	k i	Ŋ	J	ap	an			<i>L1</i>	LZ	: 1	01	,K	I į	1 2	as	M.	i a	ŧ						

(6) Organization of Study

The organization of Study is as shown in Fig.-1.2.

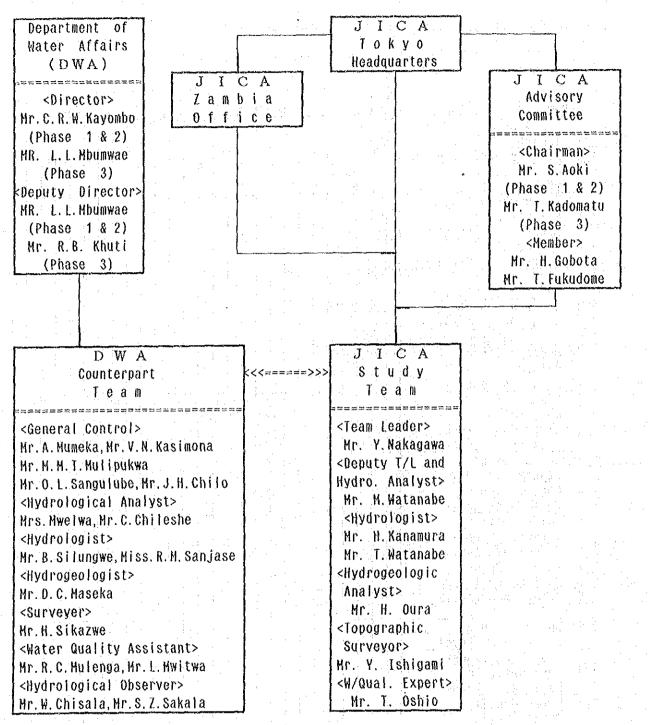


Fig.-1.2 Organization of Study

CHAPTER - 2 HYDROLOGIC OBSERVATION

2.1 Installation of Hydrometric Stations

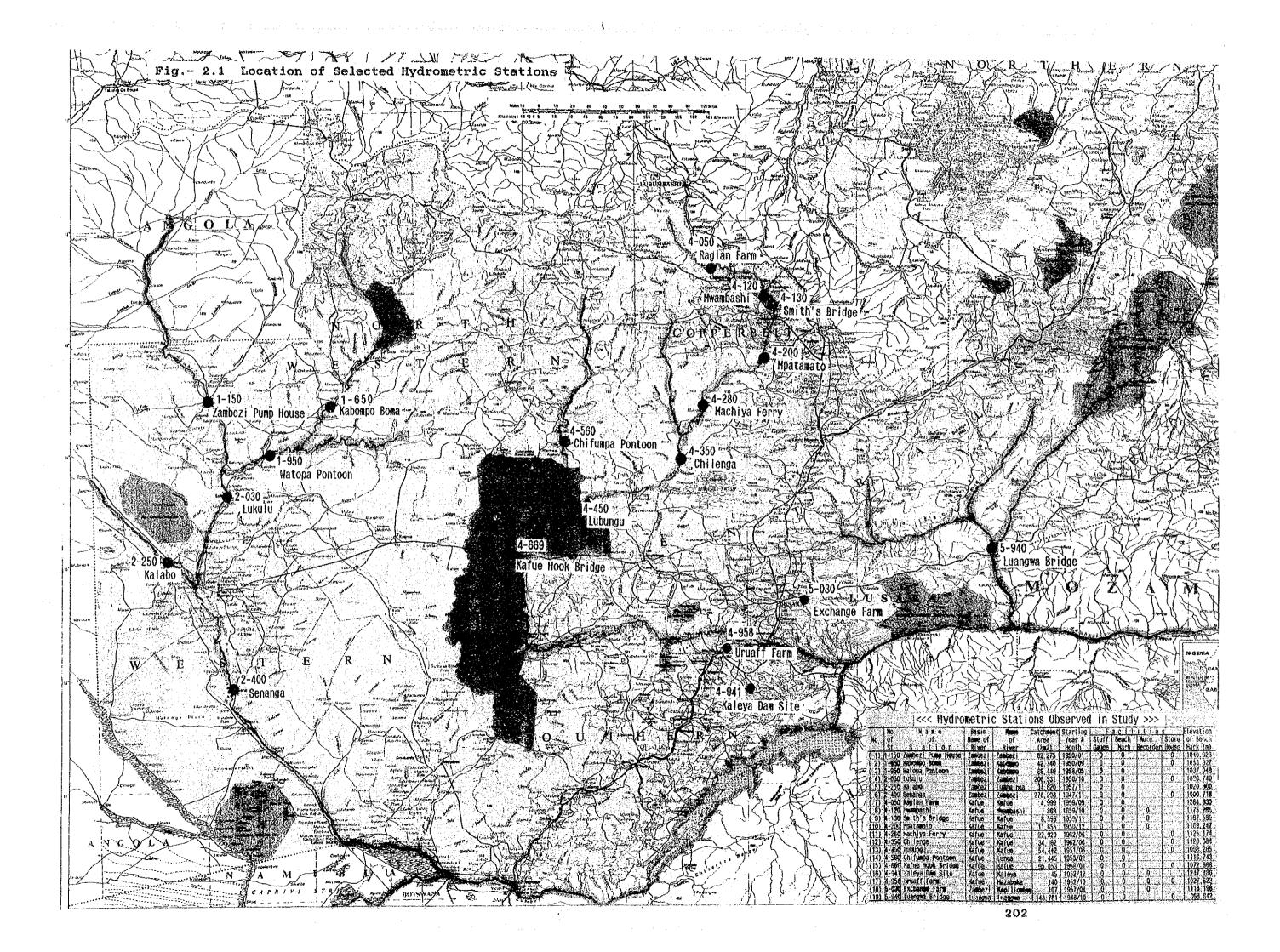
(1) Selection of Hydrometric Observation Points

The Study Team and DWA selected the 19 hydrometric stations to be observed in this Study as shown in Table- 2.1. and Fig.- 2.1. The main points of selection criteria are as follows.

- 1) The stations are well located so as to comprehend uniformly the river flow pattern throughout Study Area, also the stations have long term observation data so that the long term flow pattern is estimated.
- 2) Kariba Dam, Itezhi-tezhi Dam, Kafue Gorge Dam, Sesheke, Victoria Falls and Luangwa should be reference points. However, no observation will be done at these points in the Study. This is because periodic data such as reservoir water level and gate operation etc. are recorded at each dam, and at the other three points flow measurement is difficult due to the reason that the international boundary lies on the river.
- 3) Water level recorders should be set at promising exploitation points having small catchment area, .
- 4) To estimate the discharge at the confluence (Zambezi and Luangwa River), observation will be carried out at St. Luangwa Bridge, though it is out of the Study Area.

Table-2.1 Hydrometric Stations Selected and Installed in Study

Hydrometric	Catchment	Starting	Fac.	ilities	s Set in S	Study
	Area	Year &	Stuff	Bench	W/Level	Store
Stations	(km2)	Month	Gauge	Mark	Recorder	House
	=======		====	=====	======	=====
1-150 Zambezi P/H	82,275	1950/01	0	0		0
1-650 Kabompo B.	42,740	50/09	0	0		0
1-950 Watopa Pon.	66,449	158/05	0	. 0	ļ ·	
2-030 Lukulu	206,531	50/10	0	0	,	0
2-250 Kalabo	34,620	57/11	0	0		
2-400 Senanga	278,298	47/11	0	0	1	0 -
4-050 Raglam Farm	4,999	159/09	0	0)	
4-120 Mwambwashi	869	59/10	0	0	0	l :
4-130 Smith's Br.	8,599	150/08	. 0	0	0	
4-200 Mpatamato	11,655	50/12	0	0	0	
4-280 Machiya F.	22,920	162/06	0	0	1	0
4-350 Chilenga	29,008	62/06	.0	0	•	0
4-450 Lubungu	54,442	51/06	0	0		0
4-560 Chifumpa P.	21,445	53/02	0	0	1	1
4-669 Kafue H/B	95,053	68/01	. 0	0	}	j o
4-941 Kaleya D/S	45	52/12	0	0	0	
4-958 Uruaff Farm	140	152/10	0	0	0	0
5-030 Exchange F.	67	157/04	0	0	0	
5-940 Luangwa Br.	143,781	'48/10	0	0		j 0
	a=a=		**====	2225E3	e e: = = = = = = = = = = = = = = = = = =	



(2) Installation of Hydrometric Stations

The selected 19 stations installed by the Study Team and the following facilities were constructed. Refer to Table-2.1

- 1) Automatic water level recording station 6 Stations
- 2) Water Level Gauge and bench bark..... 19 Stations
- 3) Store house 10 Stations

(3) Topographic Survey

The topographic survey for the selected 19 stations was carried out. The survey includes the following:

- 1) Leveling Survey for Establishment of Bench Mark
- 2) Cross Sectional Survey of River

zo tu likulia harraskiji bili je potabl

- 3) Relative Position Survey between Bench Mark & Base Point
- 4) Leveling Survey for Water Level Gauge

The results of leveling survey between the national Bench Mark and the new bench mark installed at each station are summarized as shown in Table- 2.2. The cross sections of the selected 19 hydrometric stations are shown in Fig.-5.9 in Chapter 5. The item 3) and 4) above were done during the construction of stations.

Table- 2.2 Result of Leveling Survey

Hydrometric	National I	Bench Mark	Length of Leveling	Elevation of River Bench
Stations	Name	Elev.(m)	(km)	Mark (m)
1-150 Zambezi P/H	T=P6	1056.230	J ·	1040.626
1-650 Kabompo B.	T=TP28	1128.980		1053.327
1-950 Watopa Pon.	T=TP30	1110.380		1037.048
2-030 Lukulu	T=P7	1032.430		1026.740
2-250 Kalabo	B=H89	1046.000		1020.800
2-400 Senanga	B=17F7	1009.392	0.1	1000.718
4-050 Raglam Farm	B=14M30	1321.953	18.1	1264.930
4-120 Mwambwashi	B=KITWE	1205.831	12.0	1175.285
4-130 Smith's Br.	B=RM88CL	1200.269	5.0	1167.580
4-200 Mpatamato	B=E7M165	1208.594	28.0	1169.247
4-280 Machiya F.	B=E7M120	1196.963	28.0	1125.174
4-350 Chilenga	B=E7M75	1161.896	21.0	1120.684
4-450 Lubungu	B=12M120	1120.492	0.4	1098.285
4-560 Chifumpa P.	B=43M81A	1079.549	0.8	1116.743
4-669 Kafue H/B	B=19/19	1147.963	36.0	1072.868
4-941 Kaleya D/S	B=19F1	1136.021	13.8	1247.486
4-958 Uruaff Farm	B=9/19	1125.102	0.3	1027.622
5-030 Exchange F.	B=12/63	1097.606	0.1	1118.198
5-940 Luangwa Br.	B=TS289	944.570	12.0	368.289

2.2 Observation and Flow Measurement

(1) Observation Team

To collect data at the 19 stations, the following three observation teams for the Study were established: 1) Mongu Team to cover the western part of the Study Area 2) Kitwe Team to cover the northern part 3) Lusaka Team to cover the southern part.

(2) Water Level Observation and Discharge Measurement

The daily water level observation was carried out at every stations by the employed observer. The gauge reading was made twice a day, every morning (6:00) and evening (18:00). The continuous water level data was recorded at the six (6) recording stations during rainy seasons. In this Study all the flow measurement were done with the current meter method. Flow measurement with current meter was done by wading or from bridge or from boat.

(3) Observation and Measurement Data

The Study Team executed successfully the hydrologic observation mentioned above and obtained the daily water level data of 19 stations and the recording water level data of 6 recording stations. These data was converted into discharge using the rating curves established in the Study. Flow measurement data obtained in this Study is summarized as shown in Table-2.3.

Table-2.3 Number of Flow Measurement Data

	~=======	=====	====			====	=====	=======
Station		re <			dy P	erio	d>	Team in
			1.0	1990/91			Total	Charge
		====			====	=== :	=====	======
1-150 Zambezi P		1 .	5	7		2	14	Mongu
1-650 Kabompo Bo	oma j O		5	7	T at the	2	14	Mongu
1-950 Watopa Por	ntoon 173	, j e	7	7	İ.	2	16	Mongu
2-030 Lukulu	. 0	r leje	5	7 %	The second	2	14	Mongu
2-250 Kalabo	45	į	5	6	1	1	12	Mongu
2-400 Senanga	2		4	8		2	14	Mongu
4-050 Raglam Far	rm 127		2	8	i :	2	12	Kitwe
4-120 Mwambashi	186	1 1	4	8		2	14	Kitwe
4-130 Smith's Br	ridge 226		3	8.	is a si	2	13	Kitwe
4-200 Mpatamato	368		3	8	1	2	13	Kitwe
4-280 Machiya Fe	erry 261	1	3	7	į :	2 .j.	12	Kitwe
4-350 Chilenga	220		2	6	1 :	2	10	Kitwe
4-450 Lubungu	216		3	7	į į	2 j	12	Lusaka
4-560 Chifumpa F	7.		3	5	:	2	10	Lusaka
4-669 Kafue Hook	,		3	7	1 2	} j	12	Lusaka
4-941 Kaleya Dam	n/S 15		2	5		2	9	Lusaka
4-958 Uruaff Far	rm 11		1	4	j.	} : · j	7	Lusaka
5-030 Exchange F	Farm 22	1	2	7 5 1 m	1	2 j	9	Lusaka
5-940 Luangwa Br	ridge 133		3	7	1 :	3 j.:	12	Lusaka
		-	-					
< Total >	2134	6	35	127	37		229	

CHAPTER - 3 WELL OBSERVATION

3.1 Selection of Observation Wells

To clarify the relationship between the river water level and shallow groundwater level, 19 observation wells shown in Table-3.1 were selected near the hydrometric stations.

One well was designated near hydrometric station, but around 2 hydrometric stations: St. Lubungu and St. Luangwa Bridge, there is no available well. The locations of wells are shown in Fig.-3.1.

Table-3.1	List	of	Observation	Wells

<u> </u>	rowerstand was exact.			
Observation Well	Hydrometric Stations	Dia- meter(m) ======	Depth (m)	Distance btw Well & St.
(1) Kanylilaba	1-150 Zambezi	1.30	11.77	8.50 km
(2) Kanyayibma	1-650 Kabompo B	1.30	14.00	6.00 km
(3) Watopa	1-950 Watopa P	1.30	11.79	0.80 km
(4-1) Luanchama	2-030 Lukulu	1.40	3.66	7.00 km
(4-2) Lishawa	2-030 Lukulu	1.30	4.20	30.00 km
(5) Machatanga	2-250 Kalabo	1.40	3.29	4.20 km
(6-1) Milne Farm	2-400 Senanga	1.30	2.21	4.10 km
(6-2) Litoya	2-400 Senanga	1.30	4.35	20.00 km
(7) Kansofu	4-050 Raglam Farm	1.30	7.99	9.10 km
(8) Mwambashi	4-120 Mwambashi	1.00	4.82	0.07 km
(9) Kabulanda	4-130 Smith's B.	1.00	5.36	0.70 km
(10) Mpatamato	4-200 Mpatamato	0.50	1.60	0.54 km
(11) Machiya	4-280 Machiya F	0.98	6.33	0.35 km
(12) Chilenga	4-350 Chilenga	1.30	2.25	1.50 km
(14) Lupemba	4-560 Chifumpa P	1.20	10.81	30.00 km
(15) Kafue H/B	4-669 Kafue F/B	5.15	7.54	0.50 km
(16) U Kaleya Dam	4-941 Kaleya D/S	1.40	10.50	6.50 km
(17) Uruaff Farm	4-958 Uruaff Farm	1.20	4.50	1.60 km
(18) Mutamina	5-030 Exchange F	1.20	3.90	0.60 km

3.2 Observation of Well Water Level

The well water level is measured two times a day, every morning and evening by the observer employed at each observation well. Measurement time in morning is fixed at 6:00 hour and evening at 18:00 hour.

Table-3.2 shows the monthly mean well water level and river water level at the hydrometric station .

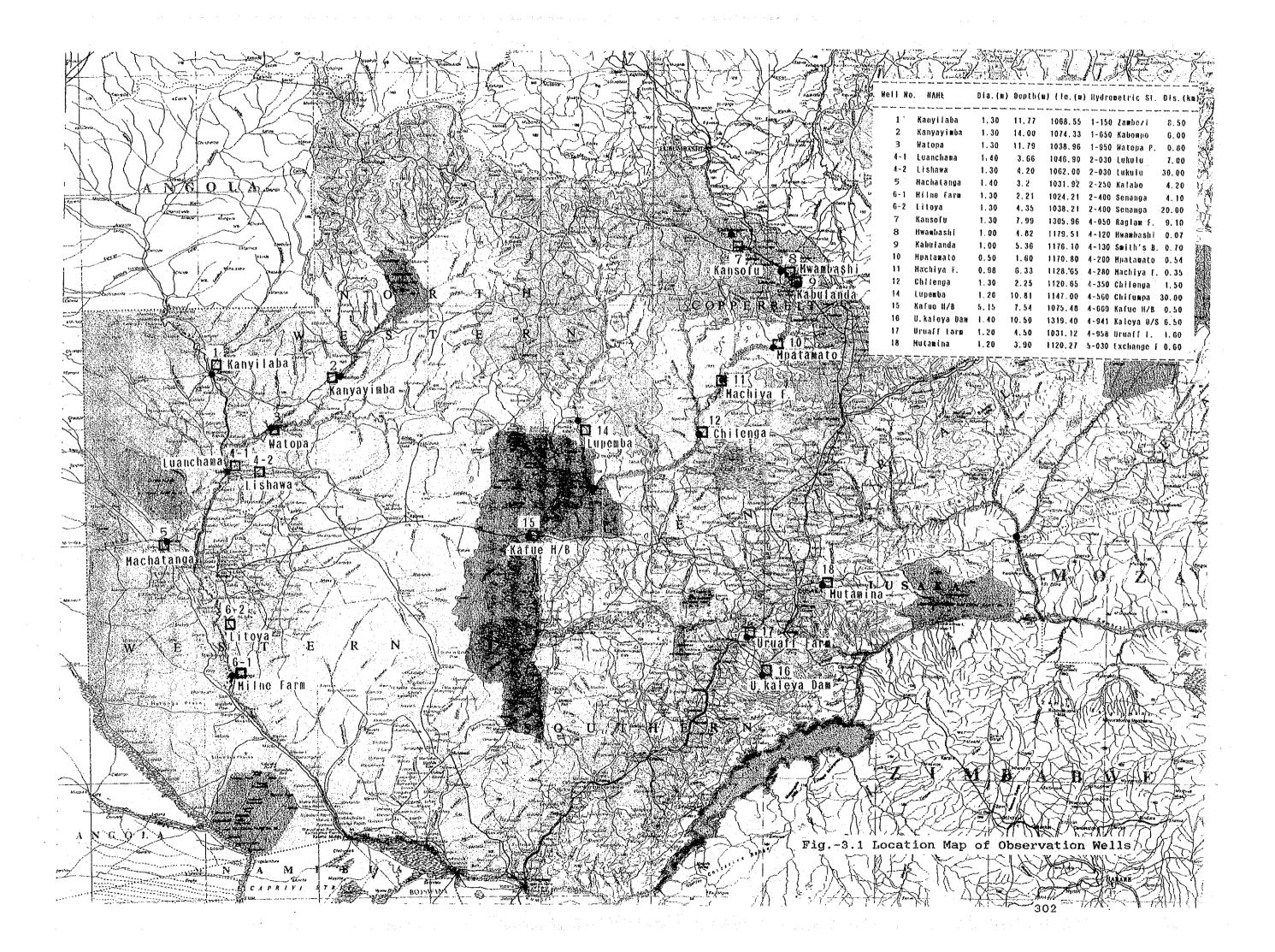


Table-3.2 Monthly River Water Level and Well Water Level

									-											
No.	Stations			JUNI'90	JUL	AUG	SEP	oct	NOV	OFC	JAN'91	FE8	MAR	APR	MAY	JUN	JUL	AUG	SEP	A/AVG
(1)	1-150 Zambezi P/H KANYILABA	River Hell	Horning	4.5			33.54		32,69	32.38		36.17		36.94	36.39	35.80	35.14	34.45	33.91	2.36 34.62
		Hell	Evening	34.79	34.28	33.62	33.89	32.72	32,23	32.05	32,64	36,04	36,78	35.77	35, 19	35.47	34.68	34.04	33.33	34.29
	1-650 Kabonpo Bona	River	Kean	2,01	1.84	1.75	1.63	1.59	1.54	1.88	2.57	3.21	3.16	2.92	2.20	1.99	1.91	1.84	1.70	2.11
(5)	KANYAIMEU		Morning					ibn pe	pson fo	R			15.76						14.78	13,83
		Hell	Evening	15.55	REAU	ing tap	Ε.					15.30	15.57	15.43	15.36	15,13	14.77	14.53	14.10	13.57
(2)	1-950 Watopa Pontoon		4.1	2.22	2.05		1.78		_		3.37		3,99		2.53	2.38	2.27	1.95	1.79	2.51
(3)	HATOPA PONTOCH	Hell Hell	Horning Evening		2.09	1.94	1.74	1.57	1.37	1.21	1.19	1.98	2.33	2.33	2.17	1.96 1.95	1.78 1.77	1.57 1.57	1.37 1.37	1.80 1.79
	4 030 L.L.J.	M	16	6.40	1 05	0.03	0.00	0 60	i	0 00	A 21	1.00		2.00	5 CF	1 (1	0.00	0.71	0.55	4 76
(-1)	2-030 Lukulu LUAYOHMA	Hell	Morning		1.05				0.57 26.55			1 1 1		3.88			100,00	0.71 27.25		1.76 27.31
,	Economic Control of the Control of t	Hell'	Evening																	27.24
1-2)	LISILKA	Nell:																		41.91
		Hell	Evening	41.26	41.15	41.00	40.94	40.76	40.68	41.08	41.79	42.36	12.21	42.10	41.71	41.44	41,40	41.13	41.05	41,38
	2-250 Kalabo	River	Mean	1,91	1.40	1.00	0.77	0.58	0.39	0.39	0.55	1.59	3.04	2.76	2.15	1.70	1.28	0.97	0.69	1.35
(5)	HJCHATAYGA	Hell	Morning															13,50		13.54
	Transfer of the second	Hell	Evening	12,99	13.01	12.95	12.92	12.91	12.87	12.93	13.52	13.93	13.62	13,71	13.22	13.40	12.65	12,95	12,65	13.14
	2-400 Senanga		Mean				1000		17.00		S' 1		10.00		1 2 1		4.1		2.7	1.85
	HILNE FAIM	Hell	forning													7 1 17		100		23.11
	LETOVA	Hell Hell	Evening Horning				1						23.37 36.31							23,10
0-2)	LITOYA	Hell	Evening								- 7		35.97			-				35.26 35.94
	A-050 Prolos Cars	River		1.33	0.89	U 60	0.51	0.42	0.40	0.55	1.37	2 00	2 21	2 62	2.01	1.27	0.63	0.76	0.56	1.31
(7)	4-050 Raglam Farm KWSOFU	Hell	Morning					1.0					1		1 .		. 1		200	41.82
.,		Hell.	-																100	41.77
· .	4-120 Mwambashi	Divec	Hean	1.07	0.91	0.88	0.78	0.59	0.67	0.95	2 22	2 55	2.63	2 13	1.36	1.04	0.97	0.95	0.87	1.30
(8)	HAMBASHI	heli	Homing		6.82			6.19		5.97		8.61	8.45	8.32	11 11	7.61	7.34	7.34	6.76	7.20
		Hell.	Evening	7.14	6.81	6.57	6.38	6,18	6.03	5.93	7.83	8.60	8.45	8.31	7.94	7.81	1.34	7.34	6.16	7.20
	4-130 Smith's Bridge	River	Mean	2.76	1,51	1.24	1.04	0,91	0.88	1.27	3.45	4,81	5.01	4.44	3.13	2.15	1.72	1.45	1.15	2.31
(9)	KABALANDA	Hell	Morning				9.73	9.42					12.32			4.5				10.60
		Hell	Evening	10.28	10.16	9.86	9.69	9.39	9.39	9.87	11.37	12, 17	12.31	12,05	11.10	10.56	10.34	10.07	10.00	10.57
	4-200 Petanato									1.20			4,45	3.74		1.66	1.28		0.76	1.88
(10)	НРАТАНАТО		Horning							5.62			6.62			6.56	6.24	5.55	5.47	6.15
		11211	Evening	3,33	5.55	3.33	2.33	5,33	30.0	5.82	0.02	0.02	0.02	30.0	0.00	0.00	6,01	3.34	5.41	5.11
	4-280 Machiya Ferry												5.89			3.20		2.73		3.48
(11)	MACHIYA FERRY	Nell ⊌-ll	Porning Evening													. 3.84		2.82		2.9
																				
			Mean					1.7							100					2.4
(12)			Horning Evening															5,61		5.80 5.79
								7,750			<u> </u>				 -					
	4-560 Chifumpa Pon.					. 20					5.4	2 2 2 2							-	0.8
(14)	LUPENEA		Morning Evening										34.95 34.97							32.76 32.56
-																				
/ (E)	4-659 Kafue Hook 8.									1 2 .	11.4.1		3.01		2 X 2 2		1.4	1.77		1.8
(15)	KATUE HOOK BRIDGE		Morning Evening			5.00 4.39	4.97						6.16 6.52						4.97 5.61	5.3 5.3
	4 041 Kala - 58	08		A 22	0.20	n ot	0 35	n 21	n or	n 21	0.24	0.22	D 20	0.01	0.31				- :: -	Δ 21
	4-941 Kaleya D/S UPPER KALEYA DAK		Mean Morning										3	4.45	1					0.3 71.8
14)	ALITH SAPPLY PART	Hell																		71.6
	4-958 Urusff Farm	Pium	Mean	וח ח	n n1	וח ק	n 01	חת מ	- n nn		0.07	n no	0.61	n ni	0.01	n ns	ית פ	D 01	n n1	0.0
	URUAFF FARM		Morning	- 1						22				7.					6.20	6.9
,		He11																		7.0
																				0.13
	5-030 Exchange Farm	River	Mean	0.09	0.07	9.08	0.02	0.07		0.05	0.45	0.40	0.26	0.19	0.11	0.89	D.BQ	0.09	0.05	0.1
(18)	5-030 Exchange Farm MITAMINA		Mean Morning				0.02 1.82	1.71	1.68	1 2	0.45 2.01		0.26 1.97		0.11 1.89	1.0	0.09 1.83		0.05 1.73	1.89

Water Level: Height from zero-point at each hydro. station