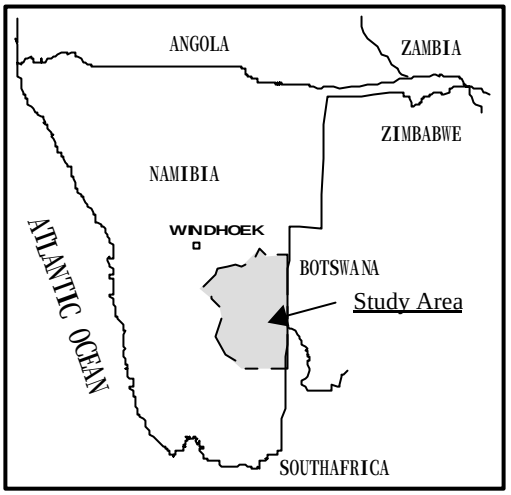
SUMMARY

1. INTRODUCTION

1-1 Background of the Study

The Southeast Kalahari (Stampriet) Artesian Basin (hereinafter referred to as "the basin" or "the study area") is situated in the southeastern part of Namibia. This basin is the largest groundwater basin in the country, which extends eastwards into Botswana and South Africa.

Groundwater extraction within the basin is maintained by the regulations prescribed in the Water Act. Extensive groundwater extraction by commercial farmers occurs in the central area of the western side of the basin. According to some monitoring wells installed during 1978, groundwater levels have been declining continuously since 1980



<Fig.1-1 Location Map of the Study Area >

Consequently, a Hydrocensus was carried out by the Department of Water Affairs (DWA) during 1986 to 1988 in order to define the impact due to extraction of the groundwater. Since then, no further study has been done, although, groundwater use has steadily increased to nearly twofold of 1988.

DWA (Department of Water Affairs) needs to understand the nature of the entire aquifer system in order to manage the excessive extraction. Accordingly, the Government of Namibia requested the Government of Japan to carry out an investigation of the groundwater flow and recharge mechanism of the basin, and furthermore, to formulate a groundwater management plan for sustainable groundwater development. This study was carried out from June 1999 to January 2002.

1-2 Objectives of the Study

The objectives of the study are:

- To investigate the groundwater flow regime and recharge mechanism within the Southeast Kalahari Artesian Basin;
- To evaluate the groundwater potential to support sustainable development within the

Southeast Kalahari Artesian Basin.

- To formulate a groundwater management plan within the Southeast Kalahari Artesian Basin.
- To achieve technology transfer to counterpart personnel during the course of the study.

1-3 Study Area

The study area covers the Southeast Kalahari Artesian Basin (approximately 71,000km^2) as shown in the figure at the beginning of the report.

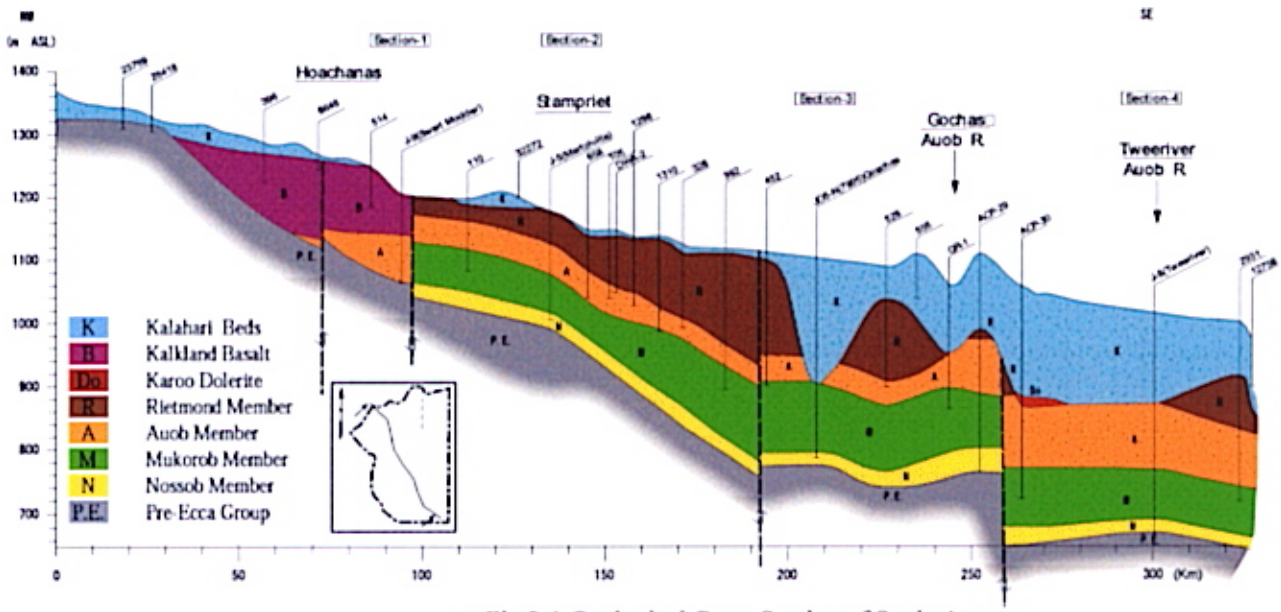
2. GENERAL DESCRIPTION OF STUDY AREA

2-1 Geomorphology

In general, the topography of the study area is flat, and the gradient is 2/1000 in average. The elevation of the study area decreases towards the southeast from 1,500m to 950m. Most of the areas where Kalahari calcretes crop out are significantly flat. Sand dunes developed in the northern and central part of the study area are typically in a NW-SE direction (as shapes by the prevailing winds) and are of varying sizes. Two types of drainage are imminent, one being an external drainage of surface streams and the other of an internal drainage of "Pans" developed from sinkholes in the distribution area of the Kalahari Beds. They show almost circular or ellipse shapes with varing sizes.

2-2 Geology

The Pre-Ecca Group; Damara Sequence, the Nama Group and the Dwyka Group, can be regarded as the hydrogeological basement rocks of the study area. The Nossob and the Auob Members are the major aquifers in the study area, and are included in the Prince Albert Formation that consists mainly of non-marine sediments deposited in the early Permian Period (280 million years ago). Faults and dolerite dykes or sills occurre in the Prince Albert Formation. The Kalkrand Basalt was formed in an extensive area to the north of Mariental. The Kalahari Beds, which age is of late Cretaceous to Recent, were deposited on an erosional landscape known as the "African Surface" or "Pre-Kalahari Valley".



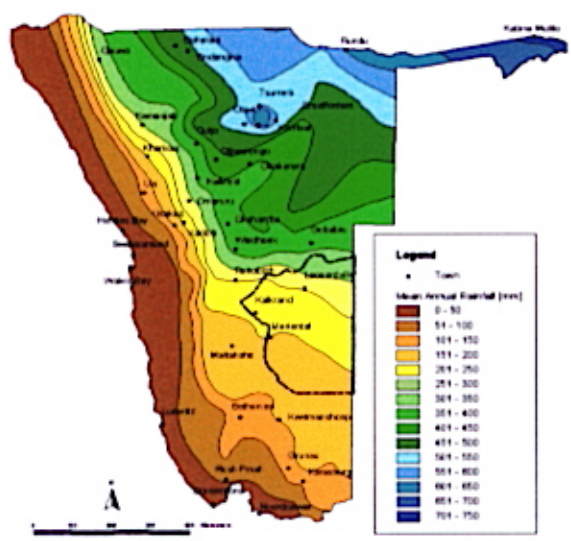
< Fig.2-1 Geological Cross Section of Study Area >

2-3 Meteorology and Hydrology

(1) Meteorology

Namibia is classified as a subtropical country with an arid to semi-arid climate. The annual rainfall varies from 50mm to 700mm. Most of the rainfall occurs from the end of December to the middle of April. The average temperature is 25 °C, the maximum may rise up to 40 °C in the summer months and the lowest could be below freezing point during the winter.

The isohyets of annual average rainfall in the study area are presented in the Fig.2-2. The approximate range is within 150 – 300 mm.



< Fig.2-2 Mean Annual Rainfall in Namibia >

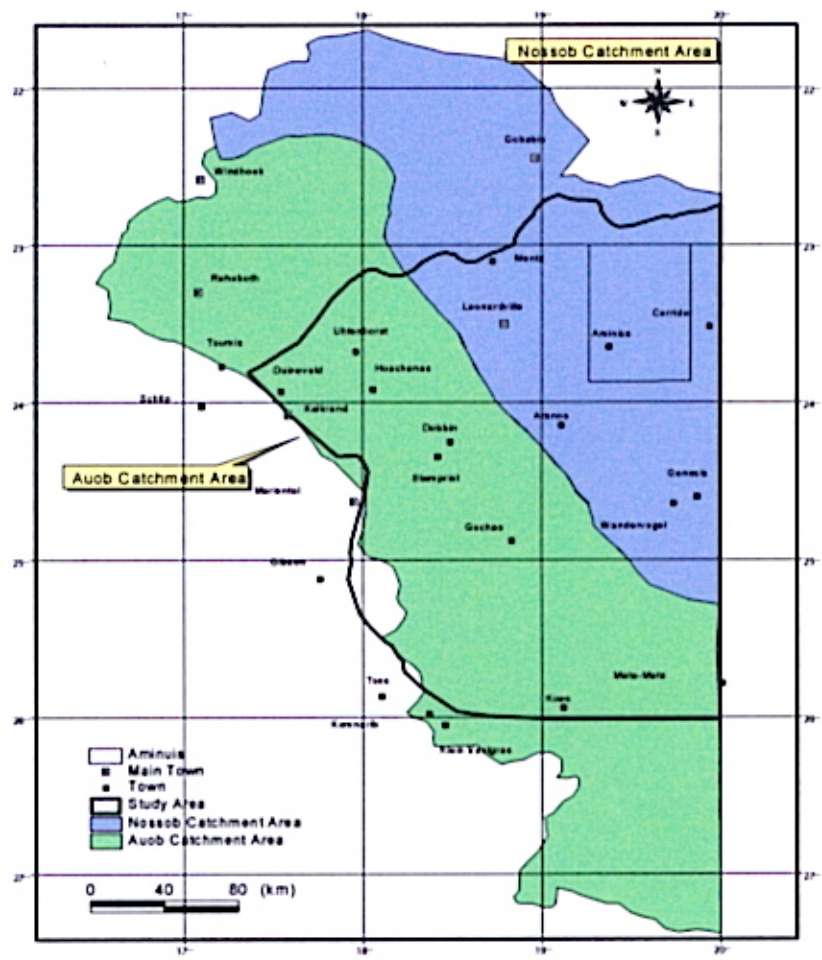
(2) Hydrology

The study area is situated within the catchments of the Nossob and Auob River with catchment area of 50,050km^2 and 74,081km^2 respectively. They are ephemeral and flow only for short periods during the rainy season. The runoff coefficient was calculated for the Nossob and the Auob Rivers as shown in the table below. The coefficients are very low.

< Table 2-1 Runoff Coefficients Calculated in the Study Area >

River	Rainy Season	Month/ Date	Total Observed Runoff (x 10^3 m^3)	Average Rainfall (mm)	Runoff Coefficient
Black Nossob	1985-86	3 - 9 Feb	122.6	36.8	0.00073
Black Nossob	1988-89	28 Jan - 14 Feb	178.4	177.2	0.00022
Auob	1983-84	2 - 12 Dec	141.8	20.0	0.0004
Auob	1983-84	25 Dec - 4 Jan	43,950.0	47.0	0.0487
Auob	1983-84	20 Mar - 21 Apr	4,021.0	65.0	0.0032
Auob	1990-91	1 - 11 Dec	553.7	36.0	0.0008
Auob	1990-91	15 Mar - 25	944.8	49.0	0.0010

During the1999-2000 rainy season, the study area received an intensive rainfall, which caused a huge amount of runoff in the Auob and the Nossob Rivers, and river waters reached the border of South Africa. At Gochas station, 43 million m^3 of discharge was recorded which was approximately 5 times more than the ordinary value.



< Fig.2-2 Catchment Area and Study Area >