C: DEMOCRATIC REPUBLIC OF THE CONGO

C.1 INTRODUCTION

As part of the compilation process for the SADC Map and Atlas, Mr. Jan Van Hooydonck of SRK Consulting carried out the Democratic Republic of Congo (DRC) country visit between 2 and 9 June 2002. The status with regard to data acquisition, management and hydrogeological mapping in the DRC was analysed according to a series of interviews conducted with the major stakeholders involved in groundwater studies.

All interviews took place in Kinshasa, limiting the information obtained from institutions with headquarters located in Lubumbashi (GECAMINES) and Mbudji-Mayi (MIBA).

C.2 BACKGROUND

The background information is summarised from the:

- DRC Country Report: submitted as part of the "Development of Code of Practice for Groundwater Development in the SADC Region" by Groundwater Consultants Bee Pee (Pty) Ltd (200); and
- Zaire Country Report: Evaluation hidrogéologique de l'Afrique Subsaharienne, Pays de la CEPGL (Communauté Economique des Pays des Grands Lacs) Louis Berger International (1993)

C.2.1 Physiography and Climate

The DRC covers an area of 2.4 Mkm^2 and constitutes the largest and most northern member state of the SADC. The country extends across the Congo river basin, which is part of the large central depression that opens in the west towards the Atlantic Ocean. The highest elevations (~5000 mamsl) are reached in the east of the country, along the Virunga and Ruwenzori volcanic mountains that form the western boundary of the Rift Valley.

The DRC has an equatorial climate, with high average annual temperatures and a high precipitation rate (~2000 mmpa). In the south-east, rainfall occurs only in the wet season and amounts to (~1250 mmpa). In the eastern mountain ranges, rainfall varies between 1500 mmpa to 2500 mmpa, increasing with altitude.

C.2.2 Water Resources

With an average flow rate of 39000 m^3/sec (minimum: 23000 m^3/sec, maximum: 80000 m^3/sec) the Congo River constitutes the largest surface water flow in the world. The total volume of groundwater resources has not been documented but, considering the high precipitation rate and the extent of sedimentary rock formations, the resource is considered the largest in the SADC region.

C.2.3 Overall Institutional Framework of the Water Sector

Within the DRC, one central unit that controls water resources does not exist. Instead, responsibilities are shared between various ministries and government institutions, based on the practical application of the resource. These ministries and institutions are:

- Ministry of Energy: responsible for water supply to urban communities, ranging from potable water to the provision of hydro-electric power. Water supply is controlled and managed via REGIDESO (state owned water supply company);
- Ministry of Environment: responsible for water resource management and forestry;
- Ministry of Health: responsible for water sanitation;
- Ministry of Agriculture and Rural Development: responsible for water supply to rural communities through the institute of SNHR (Service Nationale de l'Hydraulique Rurale);
- Ministry of Planning: responsible for the water distribution infrastructure;
- Ministry of Mining: responsible for water resource management in and around the mining centres located in the southern region of DRC via the state owned mining company GECAMINES;
- Ministry of Education and Scientific Research: responsible for the research and analysis of groundwater through the institute of CRGM (Centre de Recherches Géologiques et Minières).

Within each ministry, responsibilities are further shared at provincial level, leading to a highly de-centralised organisation of the water sector. In order to improve communication at national level, the CNAEA (Comite Nationale d'Actions de l'Eau et de l'Assainissement) is responsible for the development and co-ordination of all water related activities. The CNAEA is strongly supported by REGIDESO.

C.2.4 Role of Groundwater

The total population is estimated at 46 million (2000), of which 33% are living in urban centres. Kinshasa is the largest city with an estimated 6 million inhabitants.

Water resources are mainly used for the generation of electricity (hydro-electric dams), industrial purposes and drinking water. In agriculture, irrigation is generally not required due to the relatively high precipitation rate. Although groundwater development through boreholes and spring captivation takes place across the country, it only contributes 25% to the total urban water supply. The Ministry of Energy (pers. comm. Exc. Buse Falay) is dedicated to increasing the contribution of groundwater to the urban water supply network, thereby releasing more surface water for economical exploitation (such as industry, electricity, etc.).

C.3 GEOLOGICAL AND HYDROGEOLOGICAL FRAMEWORK

C.3.1 Geology and Hydrogeology

The DRC forms part of the Congo craton, which, together with the Kalahari craton, comprised the Gondwana Continent. The DRC territory is therefore underlain by Pre-Cambrian metamorphosed sedimentary formations. Uplift, associated with the Cretaceous Rift Valley tectonics and volcanism, resulted in the formation of a closed, in-land lake and the subsequent deposition of alluvial and lacustrine sediments. Recent volcanic deposits are associated with the eastern mountains of Virunga and Ruwenzori.

The groundwater resources can be classified according to three main aquifer systems, namely:

- Crystalline basement aquifers (Pre-Cambrian) that occur mainly in the high relief zone in the east where fractures and fissures dominate groundwater flow;
- Sedimentary aquifers (Cretaceous) encountered in the south of the central basin where groundwater flow is dominated by both primary and secondary permeability (karst features);
- Non-consolidated alluvial aquifers (Recent), comprising sands and gravels that line the rivers and tributaries.

C.3.2 Natural Groundwater Quality

Groundwater quality is generally acceptable for potable use although, in mountainous areas (east highland region), high EC values are associated with elevated levels of groundwater mineralisation. Isolated cases of high nitrate and fluoride occur.

C.4 DATA ACQUISITION

C.4.1 Institutional Framework for Data Collection

The institutions and personnel contacted as part of this project are summarised in Table 1. They include all the major stakeholders from both the government and the NGO sectors that are involved in groundwater studies.

Table 1: Institutions and Personnel contacted in DRC

COMPONENT	INSTITUTION	PERSONNEL
Water resource information	Ministry of Energy	Exc. G. Buse Falay Mr. C. Mbuyi wa Mpoyi
Water resource information	Ministry of Mining	Mr. Ngandu
Legal Framework	Ministry of Planning	Mr. André Ambele
Legal Framework	CNAEA	Mr. G. Kazad Matand
GW drilling Information	GECAMINES	Mr. T. Bulanza Esi
Mapping Information	Institut du Bâtiment et des Travaux Publics	Prof. Mangombi
Mapping Information	Institut Géographique du Congo	Mr. Mbuyi Mucici Pax
Meteorological Data General GW information	METTELSAT	Mr. C. Tanania Kabobo
GW drilling information	MIBA	Mr. Abaya
GW drilling information	AIDR	Mr.D.Nsiku Dia Tamba
GW drilling Information	CRGM	Prof. V. Kanda Nkula
Water resource information	REGIDESO	Mr. P. Muntu Tchimoa Kanda Mr. B. Lokula Lotika
GW drilling information	SNHR	Mr. Luzayadio Kanda

Although the CNAEA is responsible for the co-ordination of the water sector on a national level, a centralised organisation for the management of water resources does not exist. The responsibilities associated with each institution are as follows:

- CNAEA: Centre Nationale de l'Action de l'Eau et de l'Assainissement, created in 1981, is responsible for regional strategy with regard to drinking water and sanitation. The strategy is based on a "General Plan" that encompasses (a) a prioritisation of water resource studies, (b) project funding and (c) capacity building;
- REGIDESO: is the state-owned water supply company that distributes water in the urban centres. It is the main user of groundwater which is abstracted via shallow to deep boreholes and spring captivation systems. Its data mainly relate to Kinshasa and Katanga Provinces;
- CRGM: Centre de Recherches Géologiques et Minières, and its predecessor, the Geological Survey (created in 1936), investigates and controls exploitation of natural resources. The institute carries out ground-prospecting (including geology, mineralogy, mining, etc) and borehole installation projects, capturing data with regard to hydrogeology, water quality, etc;
- SNHR: Service National de l'Hydraulique Rurale is responsible for the rural development of groundwater resources. It constructs shallow and deep boreholes for the abstraction of

groundwater. In mountainous areas, most groundwater is obtained via spring captivation. Although operative across the country, most of the records relate to the south-west (province of Bas-Congo).

- GECAMINES: is the state-owned, copper producer, operating a series of underground mines in the south-east. The institute collects basic groundwater data as part of the mining operations located mainly in south-east (Lubumbashi, Katanga, Luena);
- MIBA: Minieres de Bakwanga is a diamond mine operator based in Mbuji-Mayi. As part of the mining operations, the company maintains basic groundwater records for the Kasai-Oriental province.

In order to obtain background information with regard to the management of water resources, additional institutions were visited, namely:

- Institut du Bâtiment et des Travaux Publics: responsible for civil infrastructure, including the water distribution network;
- Institut Géographique du Congo: responsible for the management of geographic information and the production of maps.
- METTELSAT: Agence Nationale de Météorologie et de Télédétection par satellite is responsible for the collection, management and interpretation of climatic data. Based on satellite imagery, geological information and groundwater drilling records, during the mid 1990's, personnel have compiled groundwater resource maps for the various provinces. This institute forms the DRC representative for the SADC based HYCOS programme.

In the NGO sector, AIDR (Association d'Intervention en Développement Rural au Congo) was interviewed since it is one of the longest operating organisations in DRC involved in groundwater development, with experience dating back to 1946.

Currently, the private sector is not involved in groundwater studies. In the early 1990's, however, several consultants were active, including Louis Burger International, Tractebel and SOGREAH. No interviews were carried out but work archived by CNAEA was reviewed as part of the country visit.

C.5 GROUNDWATER INFORMATION SYSTEMS

C.5.1 Hardware and Software

There is no systematic groundwater management and information infrastructure. Due to the highly de-centralised organisation of the water sector and the lack of financial support, each organisation maintains data on a project-by-project basis. These data are stored in paper copies and report format. Poor co-ordination between the various agencies prevents the application of common standards and practices.

Only recently, REGIDESO has started to build an Excel database to record borehole drilling information. As shown in Table 2, all other institutions maintain paper copies and reports which cannot be easily integrated into a regional hydrogeological map.

Table 2: Summary of Groundwater Information Systems

Database / Source	In Use	No. of Records	Format	Useable [1]	Comments
AIDR	Yes	~800	paper	No	<1985: data stored in Belgium (musée de Tervuren, Brussels) 1985-2002: data covers the south-west (Kinshasa, Equateur, Kasaii).
CRGM	Yes	Not provided	paper	No	1950-1990: the data mainly covers the west and Bas-Congo province
REGIDESO	Yes	210	Excel	Yes	1952-1992: the data covers the entire DRC but with the majority located in Kasaii-Oriental province
SNHR	Yes	838	paper	No	1988-2002: the data covers the south, with the majority located in Bas-Congo and Katanga provinces.

[1] Easily useable for regional hydrogeological map.

As part of the HYCOS hydrological network, METTELSAT maintains a digital database of ~20 meteorological stations, predominantly located in the south. All data, covering a period of 1960 to recent, is managed in MS Access and DAK (Data Automation Kit, compatible with Arcview). In addition, specialised monitoring software (Sistad, Climcom, Climbas) is used for data interpretation and statistics. The institute does not store any groundwater related data.

C.5.2 Data Saved

Groundwater data are only collected during drilling or the installation of boreholes and spring captivation systems. The data are saved on paper and classified on a project to project basis. Due to the lack of coordination between all the institutes involved in groundwater studies, integration or centralisation of the results in not practised.

Although CNAEA was created in 1981 to centralise data management and co-ordinate groundwater studies nationally, it is only under recent management of the new permanent General Secretary (Mr. Kazad Matand) that efforts are being made to structure REGIDESO as a central information gathering institute.

C.5.3 Quality of Data

Although the various institutions carry out data capturing and storage independently, the quality of the data is relatively uniform. QA/QC procedures are not followed but the high level of training (university educated) and the use of standard report formats guarantees a consistent product.

C.5.4 Resources Available for Maintenance

The CNAEA has recognised the urgent need for a comprehensive compilation of groundwater data. However, apart from the funds to operate CNAEA itself, a budget is not available to establish structured communication between the different role players. Instead, the CNAEA is primarily involved in optimising and improving the data storage and capturing system in REGIDESO. It is hoped that this "leading by example" principle will encourage data storage improvements within the other institutes.

The main resource in all government institutes, i.e. CNAEA, REGIDESO, SNHR, CRGM is the availability of highly trained, university educated personnel, which would be made available to assist in the production of the SADC map and atlas. METTELSAT, although mainly involved in

meteorological monitoring, is the best equipped institute (hardware, software) and would be willing to assist technically. However, due to the uncertain time scale of the project at the time of interview, no firm commitment could be provided.

In return to a firm commitment with regard to personnel, all institutions expect significant financial support for up-grading of outdated hardware, software and monitoring equipment currently used.

In the NGO sector, payment for contribution would be required.

C.6 GROUNDWATER MONITORING

Routine groundwater monitoring is not carried out. All hydrogeological data are collected during drilling or immediately following borehole completion. It is subsequently stored on a project-by-project basis. Table 3 summarises the borehole distribution network.

In 1986, during a period of one year, the Kinshasa East Wellfield was monitored by REGIDESO on a quarterly basis for water level fluctuations and changes in chemistry (temperature, pH and EC). The monitoring programme was discontinued in January 1987.

Table 3: Borehole / Captivated Spring Distribution Network

Institute	Region / Province	Boreholes in Operation	Monitoring Frequency
AIDR	Kinshasa, Equateur, Kasaii	~800	When drilling
CRGM	Bas-Congo	Not provided	When drilling
REGIDESO	Kinshasa East	54 (*)	1986-1987: Quarterly Monitoring
REGIDESO	Bas Congo	27	When drilling
	Kinshasa	8	When drilling
	Equateur	21	When drilling
	Gbadolite	22	When drilling
	Katanga	26	When drilling
	Kasaii Oriental	42	When drilling
	Kasaii Occidental	14	When drilling
	Bandundu	29	When drilling
	Orientale	21	When drilling
REGIDESO	Nationally	3946 springs	Monitored when captivated
SNHR	Bas Congo	143	When drilling
	Bandundu	3	When drilling
	Equateur	29	When drilling
	Katanga	133	When drilling
	Kinshasa	27	When drilling
	Kasaii Occidental	5	When drilling
	Kasaii Oriental	8	When drilling
	Not defined	490	When drilling

(*) Separate borehole network for monitoring purposes only. Not included in borehole supply network as drilled by REGIDESO between 1952 and 1992.

C.6.1 Monitoring Network and Frequency

Apart from a short period in 1986, when 54 boreholes in Kinshasa East were monitored for groundwater level and basic chemistry (temperature, pH and EC) by REGIDESO, monitoring is only carried out as part of the drilling and borehole installation procedures. The following information is collected:

- **Drilling Information**: data of construction, location (generally a basic map without co-ordinates), method, drilling diameter and depth;
- **Geological Information**: brief description of the lithological properties;
- **Groundwater Information**: rest water level, flow rate (based on 3-day pump test), basic chemistry for potability analysis
- **Borehole Construction Information**: casing diameter, basic pump specifications, borehole number.

C.6.2 Quality of Monitoring Data and QA/QC

Formal quality assurance and quality control (QA/QC) procedures are not carried out by any of the institutions involved in groundwater resources. The quality of the data remains highly dependent on the personal training received by the respective staff members and the type of equipment available.

C.7 HYDROGEOLOGICAL MAPPING

C.7.1 Existing Hydrogeological Maps

Five different hydrogeological maps have been produced:

- Carte Hydrogéologique du Congo Belge, Ruanda et Urundi (1957): produced by J. Snel at scale 1:5,000,000;
- Carte des Ressources en Eau Souterraine: Province Equateur (1987) prepared by METTELSAT at scale 1:1,000,000;
- Carte Hydrogéologique: Schéma d'orientation hydrogéologique, Potentialité en eau souterraine (1990) produced by SOGREAH at scale 1:2,000,000;
- Carte Hydrogéologique: Schéma d'orientation hydrogéologique, Possibilité de captage des sources (1990) produced by SOGREAH at scale 1:2,000,000;
- Carte des provinces hydrogéologiques-Zaire (1991) produced by Louis Berger International at scale 1:3,000,000 (as part of ERTS programme);

All maps are available in paper copy only and are based primarily on the geological and morphological properties of the rock formations. Basic data, such as water level, depth to groundwater, water quality parameters or borehole locations are absent from the maps.

C.7.2 Derivative Maps

Derivative maps are not available.

C.7.3 Classification and Legend of Maps

Although four different hydrogeological maps have been produced, all are primarily based on geological and geomorphological characteristics rather than groundwater flow or chemistry. All maps include topographic and geographic features such as surface water drainage patterns, springs, rivers and lakes.

Table 4 includes an overview of the map features, symbols and colours used in the hydrogeological maps.

Table 4: Legend and Scale: Carte Hydrogéologique du Congo Belge, Ruanda et Urundi (1957)

Map Feature	Symbol	Colour	Description
Topography	Not shown		
Geology	Lines	Black	• Outline of major geological boundaries (contact between hard-rock and sedimentary formations)
Hydrogeology	Lines	Black	• "Limit of the groundwater table" within the sedimentary and hard rock units.
	Shading	Yellow Green Blue Orange	• Indication of permeability (based on geological description of subsurface)
Geography	Lines	Black	• Location of towns and rivers
Scale	Scale bar	black	• 1:5,000,000
Grid. Reference	Not shown		
Derivatives	No derivatives		

Table 5: Legend and Scale: Carte des Ressources en Eau Souterraine: Province Equateur (1987)

Map Feature	Symbol	Colour	Description
Topography	Not shown		
Geology	Shading and Lines	Full colour scheme	• Divisions based on Carte Geologique du Zaire (1:200,000)
Hydrogeology	Shading	Full colour scheme	• 16 hydrogeological zones based on geological (age) and geo-morphology of the subsurface • General classification according to permeability, porosity and storativity.
Geography	Lines	Black	• Stream / surface water drainage network
Scale	Scale bar	Black	• 1:1,000,000
Grid. Reference	Not shown		
Derivatives	No derivatives		

Table 6: Legend and Scale: Carte Hydrogéologique: Schéma d'orientation hydrogéologique, Potentialité en eau souterraine (1990)

Map Feature	Symbol	Colour	Description
Topography	Not shown		
Geology	Infill (lines, shading)	Red	• Six major morpho-structural units, identified by numerals
Hydrogeology	Shading	Full colour scheme	• Identification of four groundwater supply potential divisions (very weak, weak, moderate and good).
Geography	Lines	Blue	• Surface water features (streams, lakes)

Map Feature	Symbol	Colour	Description
		Black, red, yellow	• Road Infrastructure
Scale	Scale bar	black	• 1:2,000,000
Grid. Reference	Not shown		
Derivatives	Inset map 1:10,000,000	Full colour scheme	• Identification of regional groundwater supply potential based on categorisation of pumping rates from deep boreholes (three categories: favourable, moderately favourable and unfavourable)
	Inset Map 1:10,000,000	Coloured dots	• Groundwater recharge according to 4 categories ("assured" 200-350 mm/yr, "generally assured" 150 mm/yr, "incomplete" 100 mm/yr, "precarious often nil" <100 mm/yr)

Table 7: Legend and Scale: Carte Hydrogéologique: Schéma d'orientation hydrogéologique, Possibilité de captage des sources (1990)

Map Feature	Symbol	Colour	Description
Topography	Not shown		
Geology	Infill (lines, shading)	red	• Six major morpho-structural units, identified by numerals
Hydrogeology	Shading and Dots	Full colour scheme	• Location of springs with general classification according to capturing potential (three categories: weak-moderate- good) and flow rate (three categories: weak-moderate-good)
Geography	Lines	Full colour scheme	• Surface water features (streams, lakes) • Road Infrastructure
Scale	Scale bar	Black	• 1:2,000,000
Grid. Reference	Not shown		
Derivatives	No derivatives		

Table 8: Legend and Scale: Carte des provinces hydrogéologiques-Zaire (1991)

Map Feature	Symbol	Colour	Description
Topography			
Geology	Infill	Green Pink Red	• Division into three dominant geological formations, including alluvial sediments (green), calcareous / karstic formations (pink) and crystalline rocks (red).
Hydrogeology	Infill and numerals	Full colour scheme	• Division of 6 hydrogeological provinces, based on dominant lithology of the subsurface and surface water catchment boundaries;

Map Feature	Symbol	Colour	Description
Geography	Lines	Black	• Surface water catchment boundaries and streams
Scale	Scale bar	Black	• 1:3,000,000
Grid. Reference	Not shown		
Derivatives	No derivatives		

C.7.4 Existing Geological Maps

The CRGM is responsible for the production of geological maps. The list of maps available is detailed below and summarised in Table 9.

- Esquisse Géologique du sous-sol de Léopoldville (1956), scale 1:40,000, Bulletin Service Géologique Congo-Belge, colour sheet;
- Etude Géologique de la Région Matadi-Inga-Monolithe (1957), scale 1:100,000, Service Géologique du Congo-Belge, colour sheet with booklet;
- Carte Géologique du Zaire (1958-1962), scale 1:50,000, Commission de Géologie du Ministère Congo-Belge, 3 provinces complete;
- Carte Géologique du Zaire (1963), scale 1:200,000, Musée Royal de l'Afrique Central, BRGM, 186 coloured sheets with 7 complete to date;
- Carte Géologique du Zaire (1974), scale 1:2,000,000, Musée Royal de l'Afrique Central, BRGM, 2 coloured sheets and handbook;
- Carte Géologique du Zaire (1981), scale 1:200,000, Service Géologique du Zaire, 13 coloured sheets complete to date;
- Notice explicative de la carte des gîtes minéraux du Zaire, Département des Mines, Direction de la Géologie.

In addition, a series of unedited geological maps are available at scales of 1:100,000 to 1:500,000.

Table 9: Existing Geological Maps

MAP	SCALE	DATE	NO. OF MAPS
Esquisse Géologique du sous-sol de Léopoldville	1:40,000	1956	1
Etude Géologique de la Région Matadi-Inga-Monolithe	1:100,000	1957	1
Carte Geologique du Zaire	1:50,000 1:200,000 1:2,000,000 1:200,000	1958 1963 1974 1981	3 provinces 7 2 13

C.7.5 Existing Topographic Maps

The Institut Géographique du Congo is responsible for the production of topographic and hydrographic maps. However, due to limited resources, other institutions such as the University of Kinshasa and METTELSAT commonly use their own digital database to produce the necessary documents for study purposes. This has significantly eroded the authority of the government institute which, officially, has the maps available as listed in Table 10.

Table 10: Existing Topographic Maps

MAP	SCALE	DATE	NO. OF MAPS
Carte Administrative	1:2,000,000	1988	1
Carte Topographique	1:200,000	1952-1983	235
Carte Geographique	1:5,000,000 1:25,000,000	1980's	1 1
Carte Hydrographique	1:3,000,000	1983	1

C.7.6 Aerial Photographs and Satellite Imagery

The most extensive and up-to-date aerial photograph and satellite imagery is maintained by METTELSAT. Table 11 summarises the data available.

Table 11: Existing Remote Sensing Images

MAP	SCALE	DATE	NO. OF MAPS
Landsat Images and Spot	1:200,000 1:250,000 1:400,000	1970's to 1980's	Not identified

C.8 DATA AVAILABLE FOR THE SADC HYDROGEOLOGICAL MAP

Based on the existing data sets and mapping, Table 12 summarises the data available for specific legend items that may be desirable to portray on a regional hydrogeological map.

Table 12: Hydrogeological Map: Legend Summary

Legend	Source Data	Processed Data
Topography:		
• Contours (mamsl)	Topographic map (1950's)	Hard copy only
Aquifers		
• Aquifer Type and Extent	Carte Hydrogéologique: Potentialité en eau souterraine;	Hard copy only
• Supply characteristics	Carte des provinces hydrogéologiques-Zaire	Hard copy only
Groundwater		
• Groundwater Level	REGIDESO, SNHR, CRGM, AIDR, MIBA, GECAMINES	Hard copies only
• Recharge	Carte Hydrogéologique: Potentialité en eau souterraine;	Inset map (hard copy only)
Boreholes		
• Location	REGIDESO	Excel spreadsheet
• Drilling details	REGIDESO	Excel spreadsheet
Springs		
• Location	Carte Hydrogéologique: Possibilité de captage des sources	Hard copy only
Surface Water		
• Catchment boundaries	Carte des provinces hydrogéologiques-Zaire	Hard copy only
• Streams	Carte Hydrographique	Hard copy only
	Landsat	Hard copy only

Legend	Source Data	Processed Data
Supply Infrastructure		
• Urban Supply	REGIDESO	Hard copies only
• Village Supply	SNHR	Hard copies only

The table clearly indicate the limited amount of data readily available for inclusion in the regional hydrogeological map. Rather than monitored and verified data, the current data set would only allow for a general interpretation of aquifer characteristics based on a geological/geomorphological classification.

C.9 COMMENTS AND CONCERNS

C.9.1 Comments on Contribution on the Regional Mapping Project

According to the DRC, the objectives for the regional SADC hydrogeological map should be the quantification of the water resources. Immediate benefits of this improved understanding would include:

- locally: the development of groundwater resources to compliment or substitute surface water as the main supply source for drinking water in urban areas;
- regionally: the improved planning for the distribution of natural resources and energy on a regional, SADC basis.

Long term benefits are expected in return, including:

- Financial Support: to develop a central organisation to manage the groundwater data and initiate a country-wide hydrogeological monitoring programme. CNAEA, in conjunction with REGIDESO and METTELSAT, could provide the basis for such a central institution;
- Technical Support and capacitation: in the form of information exchange, training and the provision of state-of-the-art technology.

C.9.2 Concerns

The main concern, highlighted by all the institutions and NGO's, is the de-centralised and independent execution of groundwater and sanitation studies with the DRC. In order to contribute meaningfully to a regional hydrogeological map and atlas, the SADC is expected to assist financially in the upgrading of equipment, ranging from hardware, software and monitoring tools. In addition, active support is required in the maintenance and expansion of the CNAEA, which should form the central institute for groundwater development and resource management in the DRC.

C.10 CONCLUDING REMARKS

Although detailed hydrogeological data exist, the total water resource available in the DRC has not been quantified. Due to its potential size, the quantification of the groundwater resource should be a priority in the production of the regional hydrogeological map.

C.11 REFERENCES

- DRC Country Report: submitted as part of the "Development of Code of Practice for Groundwater Development in the SADC Region" by Groundwater Consultants Bee Pee (Pty) Ltd (200); and
- Zaire Country Report: Evaluation hidrogéologique de l'Afrique Subsaharienne, Pays de la CEPGL (Communauté Economique des Pays des Grands Lacs) Louis Berger International (1993)