AGENCY FOR INTERNATIONAL DEVELOPMENT

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A. Initial FY 84 — B. Quarter 4 — C. Final FY 84

8. COSTS ($000 OR EQUIVALENT $1 = zaires 37)

A. FUNDING SOURCE	FIRST FY 85 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	800		800	2250		2250
(Grant)	(800)	( )	(800)	(2250)	( )	(2250
(Loan)	( )	( )	( )	( )	( )	(
Other U.S. 1.						
Other U.S. 2.						
Host Country		400	400		1800	1800
Other Donor(s)						
TOTALS	800	400	1200	2250	1800	4050

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) RP	500	545				2250		2250	
(2)									
(3)									
(4)									
TOTALS						2250		2250	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)

11. SECONDARY PURPOSE CO

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	BRW	BSW	PVON				
B. Amount							

13. PROJECT PURPOSE (maximum 480 characters)

To improve the water supply system of the refugee area of Southwestern Shaba.

14. SCHEDULED EVALUATIONS
Interim MM 09 YY 86 — MM 09 YY 87 — Final MM 09 YY 90

15. SOURCE/ORIGIN OF GOODS AND SERVICES
[X] 000 [X] 941 [ ] Local [ ] Other (Specify) 935

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

17. APPROVED BY — Signature: Arthur S. Lahr — Title: Acting Director USAID/Zaire — Date Signed MM 09 DD 13 YY 84

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PD-BAS 741

SHABA REFUGEE WATER SUPPLY PROJECT

660-0116

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Shaba Refugee Water Supply Project

660-0116

INTRODUCTION

This project has been designed to conform with policy and program guidelines for refugee, returnee, and displaced person activities under the Africa Resettlement Services and Facilities Project (698-0502). That project envisages the use of refugee support funds to move beyond simple relief to development assistance that can help refugees become self-supporting.

The project described herein focuses on the reconstruction of an area where half the population is either in returnee or refugee status, and where virtually all have suffered at least some displacement during the last seven years. The project will rehabilitate and improve the rural water infrastructure of the Lualaba Sub-Region of Southwestern Shaba. It will complement and facilitate the medium-term phase out of UNHCR and USAID relief programs that address the immediate basic needs of newly arrived refugees.

USAID experience in Zaire has demonstrated that water supply improvement has an important positive impact on the quality of life in rural villages. Since water for domestic use is normally supplied in rural Lualaba Sub-Region by women and girls carrying buckets of water up to two kilometers from springs and streams, and since women are also responsible for most agricultural work, improvements in water supply can rapidly allow a significant increase in productive agricultural labor investment. By rebuilding and expanding the water supply infrastructure of the refugee and returnee area, this project will also encourage the population to participate fully in regional and national development by discouraging rural exodus among the younger and most economically active portions of the community.

The Shaba Refugee Water Supply Project is in full conformance with the USAID Country Development Strategy Statement for Zaire, which recognizes and addresses the basic constraint to increased agricultural production and

improved quality of life in rural areas posed by the deteriorated state of the rural infrastructure. Shaba is a priority region for USAID. The support infrastructure in place and planned for other activities in the Region will minimize the additional management burden imposed by this and the two related proposed refugee assistance projects (Health Infrastructure in Shaba, 660-0114, and Roads in Shaba, 660-0115).

I. Project Summary

The Shaba Refugee Water Supply Project will make significant improvements in water supply facilities in Lualaba Sub-Region by rehabilitating or constructing water systems in 500 area villages with a total population of over 200,000. A secondary benefit will be the training of personnel from the village communities to carry out routine maintenance of water supply facilities in the future under local initiative.

This project work is doubly justified. In the first instance, the western two-thirds or more of the area was profoundly affected by the 80-Day War of 1977 during which rebel forces occupied the rural areas for almost three months before retreating back into their Angolan base areas; the urbanized area of Kolwezi at the far east of Lualaba Sub-Region was in turn occupied for a brief period in 1978. Secondly, the civil wars in Angola over the past decade have repeatedly pushed Angolan refugees across the frontier into Zairian territory. This movement has recently increased because of greater Union for the Total Independence of Angola (UNITA) military activity in Angola's northeastern provinces. In one way or another, almost the entire population of Lualaba Sub-Region has experienced displacement, whether they crossed national borders or not. Most recent United Nations High Commission for Refugees (UNHCR) estimates place the total number of refugees and returnees in the three project zones at 190,000. This represents more than half the subregion's population.

The water supply infrastructure of Lualaba Sub-Region has long suffered from neglect. During the colonial period, the Fund for the Well-Being of

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Natives (Fonds du Bien-être Indigène--FBI) carried out numerous water supply improvements in Lualaba Sub-Region with its funding based on certain specified taxes. Signs are still commonly seen along the roads which point to springs improved or wells dug with FBI funding; unfortunately the improved water supplies have not proved as durable as many of the signs. Pumps available thirty or more years ago proved fragile, and pump handles and mechanisms were occasionally broken. The FBI's program was also paternalistic and did not associate members of the village community in construction and maintenance; once the local colonial administration disappeared, maintenance of gaskets and other expendable items ceased. Finally, the population dislocations of the ensuing years meant that many former villages were largely abandoned and new village locations were created while other villages took on new demographic importance. The result has been a markedly less developed water supply system within Lualaba Sub-Region than three decades ago. Always time-consuming, village water supply becomes a difficult problem during the dry season (May through September). Village young people who have received an education, whether within the secondary schools of the sub-region or high school training in urban centers, are reluctant to return to their home communities in part because of the lack of convenient and safe water supplies.

Improvements in the water supply infrastructure within Lualaba Sub-Region will help accomplish several major objectives. First, they will contribute to national and regional economic development by promoting the contribution to the country's economy by the population of Lualaba Sub-Region. Second, they will help work toward the resolution of the refugee problem by encouraging permanent settlement for returning Zairian refugees as well as for Angolan refugees who may remain permanently in Zaire. Third, improvements in Lualaba Sub-Region will help relieve the critical shortage of agricultural produce in the industrialized copperbelt of southeastern Shaba by lessening the burdens of water supply and water-borne diseases on the agricultural labor supply.

II. Project Rationale and Location

All of Lualaba Sub-Region forms a part of the large Lunda plateau, extending from the highlands of western Angola to the mountainous areas of central/eastern Shaba intercut by the western branches of the African Rift Valley System. This plateau forms the watershed between the Zaire basin to the north and the Zambezi basin to the south; further west, it also feeds streams flowing toward the Atlantic Ocean and to the Okavango swamps. It is basically a zone of savanna with areas of clear woodland, with heavy forests occurring primarily as remnant strands along the rivers, which flow in parallel off the sloping sides of the plateau. Communications along this east-west belt have always been relatively easy by foot, as linguistic study of parallel changes in the various Bantu language subgroups on the plateau has shown, but the largely unnavigable rivers, with their important seasonal fluctuations typical of the tropics, present significant barriers for mechanized transport. The important seasonal fluctuations in rainfall also create serious problems of water supply. Inhabitable land is limited by the year-round availability of water.

The sub-region presents a considerable degree of cultural uniformity despite differences of language and ethnic group. In recent centuries, the entire area was part of the Lunda system with its heartland in present-day Kapanga zone of Shaba; as a result, the various ethnic groups share a great deal of general culture and specifically political culture among themselves and with their neighbors in Zambia and Angola, despite underlying differences in linguistic/cultural origins before the Lunda conquest. Because of this widespread homogeneity and the fact that present national borders are culturally artificial, there has historically been considerable movement of people across the current national boundaries. This posed one of the first administrative problems for the colonial government. While the Ruund of the Kapanga area had erected a sophisticated state system in the 17th and 18th centuries by conquest and diplomacy, new socio-economic forces in the 19th century led to its decline and the advent of the Chokwe, Lwena, and Minungu groups tied to the ivory, slave, and rubber trades working inland from the Angolan coast. The colonial administration eventually settled on a policy of using Ruund chiefs over mixed populations, with a few token (but densely

populated) areas in the south under chiefs from the incoming ethnic groups. People continued to stream into Belgian territory in the early colonial period because of pacification campaigns by the Portuguese in eastern Angola and because of perceived differences in colonial regimes and economic opportunities. Inter-ethnic tensions came to the surface in the late 1950s and early 1960s, particularly in Dilolo and Sandoa zones.

The current refugee problems stem from more recent political crises in Zaire and Angola. In 1977 forces of the FNLC (Congolese National Liberation Front) occupied Kapanga, Sandoa, and Dilolo zones and advanced east past Mutshatsha toward Kolwezi before the onset of a long stalemate. When the FNLC eventually retreated into Angola, the civilian population dispersed. Some, particularly youth of military age, were forced or recruited into FNLC forces. Others, for fear of reprisals, simply fled across the border into Angola or into the large uninhabited areas within Lualaba Sub-Region. The short but bloody occupation of Kolwezi by the FNLC in 1978 provoked a similar exodus, primarily toward Zambia . Those who had merely fled into the bush or to stay with relatives in remote villages returned to their homes relatively quickly but still with major disruption of their lives; the major part of the surviving cross-border refugees returned after the Zairian Government declared an amnesty for returnees in 1978.

The wars had a devastating impact on the occupied areas. Vehicles were immediately conscripted. Institutions lost equipment during the war or through looting during the period of insecurity and uncertainty afterwards. Equally important, personnel resources were scattered or permanently lost through death and evacuation. Postal service and telecommunications were not reestablished until the 1980s. Local social structures remain seriously weakened. In part, this is due to the demoralization accompanying the economic effects of the war. In part, it is also due to the divisions created within communities and within families between those who fled for relatively long periods (and who often suffered greater hardships) and those refugees within Zaire who returned more quickly and thus took advantage of the property left behind by those crossing international boundaries.

The second contemporary refugee problem concerns refugees from the People's Republic of Angola who have crossed into Zaire at various periods to escape fighting between the rival nationalist factions following the Portuguese withdrawal from Angola in 1975. These Angolan refugees fall into two categories. Some have fled to relatives and acquaintances of their own ethnic groups directly across the border and are sufficiently dispersed not to be obvious. Others, especially members of the Mbundu (kiMbundu-speaking) ethnic group who have settled in the Dilolo and Kisenge areas, form refugee communities distinct from local Zairian residents.

The major problems facing both the local refugees and the returning refugees (and thus the population as a whole) have been in restoring health among refugees arriving in poor physical condition, tiding them over the short term until gardens are established and begin to produce, and rebuilding the economic and social infrastructure. Lualaba Sub-Region does not have a high population density by Zairian standards; the subsistence agricultural tradition of all the ethnic groups involved is basically the same. Land for resettlement is not then a critical problem, although some parts of Dilolo Zone are much more crowded than other areas. The population movements do require readjustments in social patterns and also technological and resource allocation adaptations where population densities are markedly increased in comparison with former residence areas.

UNHCR operated a major relief program in the area from 19[illegible] through 1982 in partnership with the United Methodist Church, the proposed overall implementing agency for the Shaba Refugee Health Infrastructure Project, a companion project to the Water Supply Project. The UNHCR program, however, was aimed at immediate refugee needs and at the returning refugee component of the population only; it was not designed to improve community infrastructure or to reestablish the foundations for socio-economic development. Currently UNHCR is operating on a much smaller scale to monitor the Angolan refugee situation in Dilolo Zone; it has supplied used clothing and blankets through the Roman Catholic mission at Dilolo Post and plans food shipments in the near future. Such relief work, while necessary in the short-term, can easily create dependency and foster segregation if poorly timed or continued too long.

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Results of the 1984 Zairian census will not be available for some time. Given the traumatic events of the late 1970s, the following figures from the 1970 census may not be indicative of current population distribution and numbers:

	Population	Area (km^2)
Kapanga Zone	67,016	24,476
Sandoa Zone	87,469	29,608
Dilolo Zone	233,395	25,330

UNHCR estimated the number of Angolan refugees in Dilolo Zone in July 1984 as 11,200 around Dilolo and a further 1,275 around Kisenge. The population continues to increase, although the rate is difficult to determine as there is also movement of refugees into new areas farther from the border and the overcrowded, immediate area of Dilolo Post. The Zairian authorities for Lualaba Sub-Region reported 16,000 and 3,500 for the two concentrations respectively, in late July 1984. UNHCR estimates the repatriate population at 175,000. Thus the total refugee and repatriate communities represent 50% or more of the area's population.

III. Project Description

A. General

The availability of water supply is often the primary criterion for choice of village locations in Lualaba Sub-Region. Traditionally, the population relied on springs in the valleys for water supply, but villages were traditionally built on the plateau where insect infestation (and thus insect-born disease) problems were less severe and where soils were more suitable for agriculture. Such a pattern, while avoiding certain problems, increased the labor burden for water supply by requiring transportation over considerable distances (up to 1.5 kilometers or more) and at times up steep slopes. In certain areas, more particularly in the more level areas where the water table is closer to the surface, the colonial administration introduced dug wells with bucket-and-pulley or hand pumping systems. Missions were able to devote sufficient resources to construct piped water systems for their own facilities, based on pumps driven by internal combustion engines, hydraulic rams, or, in one case, windmills. REGIDESO (the government urban water supply parastatal) facilities were constructed at Sandoa (formerly the regional administrative center for what is now Lualaba Sub-Region) and Dilolo Post (the port-of-entry from Angola on the Benguela Railroad). For further details, see Annex 2, "Description of the Present Situation", and Annex 3, "Field Report".

At a time when the Rural Hydraulics Division of the Department of Agriculture is carrying out a program of rural water supply infrastructure projects in other regions under UNICEF funding but lacks sufficient trained personnel as well as funding to meet national needs, this project presents an opportunity for major improvements in the water supply system of Lualaba Sub-Region over a time period much shorter than could be envisaged otherwise. This will include both mechanized well-boring and rehabilitation of existing but non-functional facilities. It will also create new capabilities within the Rural Hydraulics Division through the training and equipment of three local brigades and of a specialized well-drilling brigade.

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B. Goal and Purpose

The goal of the project is to reintegrate the Lualaba Sub-Region repatriates and refugees into regional socio-economic development. The purpose is to improve the water supply system of the refugee area of Southwestern Shaba. The problem will be addressed by improving both water quality and access to adequate supplies for drinking, sanitation, and economic activity (manioc processing in particular). The project will benefit the major portion of the population directly through improved water supply from renovated wells and capped springs and from piped water systems in several large centers. The entire population of the project area will benefit indirectly through improvements in water supply to common institutions such as hospitals, health centers, and schools. It will benefit refugee populations in particular in the sense that those refugees from outside the project area who are in temporary, provisional residence do not benefit from traditional local experience and generally suffer from unusually poor sanitary and water supply arrangements pending more adequate long-term arrangements by trial and error. It will also enhance the possibilities for a positive resolution of the refugee problem both through improving the possibilities for independent and productive lives for refugees during temporary dislocation and through providing opportunities for possible permanent resettlement. Finally, but by no means of least importance, the project will make a significant contribution to the capability of the of Rural Hydraulics Division (RHD) of the Zairian government to conduct such projects on its own through the equipping and training of a specialized well-drilling brigade--non-existent until now--and through field training of management and technical personnel in Shaba for spring capping, well repair, gravity piping system installation, and other common water supply operations which already are programmed for other parts of Zaire under other auspices.

Specific project objectives oriented toward achieving the goal and purpose are as follows:

1. Reopen wells which have been partially filled with rubbish or which were too shallow to be sufficiently productive during the dry season.

2. Drill boreholes in stable villages of significant size where existing wells cannot supply sufficient water for drinking purposes.

3. Install simple but sturdy hand pumps of UNICEF design which can be maintained by local personnel to be trained during the project and, to the greatest possible degree, with spare parts to be produced in Zaire.

4. Cap springs near each village as water supply points for washing and soaking of cassava, and in case of pump failures.

5. Provide separate facilities in villages for bathing/laundry and for manioc leaching to avoid contamination of drinking water.

6. Improve existing water supply systems for medical and school centers to increase operating efficiency and decrease operational costs.

7. Provide piped water systems in major rural population centers currently not enjoying REGIDESO systems.

8. Install pilot village water systems where there is also existing medical infrastructure.

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C. End of Project Status

The conditions expected at the end of this project are the following:

- The rehabilitation and improvement of existing wells in 140 villages, and the installation of 430 new village wells.

- The capping of springs and provision of separate facilities for drinking water, bathing/laundry, and manioc leaching in 500 villages.

- Rehabilitation and improvement of existing piped water supply systems in eight Secondary Reference Medical Centers.

- Village committees formed capable of levying fees for regular maintenance and upkeep of pumps.

- Installation of piped water systems for two major rural centers and for one major village with a Secondary Reference Medical Center.

- Experienced maintenance personnel within village groups capable of routine maintenance of wells and pumps.

- Experienced water supply crews, including one well drilling brigade with two qualified drilling directors and three brigades for well rehabilitation, spring capping, and piping systems.

D. Work plan and schedule.

To realize the above RHD will assign six brigades to the Sub-Region. Each brigade will be manned by one hydraulic engineer and six to eight workers. The center of operations for all six brigades

will be Sandoa. Three brigades will be responsible for spring capping (which is more time consuming than well work), one for drilling new wells, one for rehabilitating dug wells and one for special projects (hydraulic ram, gravity and solar systems).

The following table gives the planned work schedule by type of supply system for the life of project[1]:

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Tubewells	40	80	100	110	100	430
Dug wells	20	30	30	30	30	140
Pumps[2]	60	110	130	140	130	570
Springs capped	60	80	100	120	140	500
Gravity system	6km	10km	-	-	-	16km
Solar systems	3	-	2	-	-	5
Hydraulic rams	1	1	1	2	-	5

[1] Figures are indicative only and based on AIDR experience elsewhere. A final report, to be completed in October, 1984, will determine exact work schedule.

[2] The pumps are for both the dug and drilled wells.

Further details on the work plan and sites are given in Annex 4, Detailed Technical Analysis.

E. Other donor activity

UNHCR is presently the major donor active in the project area, with a six month, $500,000, emergency relief program that is aimed at addressing the immediate basic needs of the recently arrived Angolan refugees. This program is scheduled to end in late 1984. A two year, follow on program is being planned by UNHCR with initial funding proposed for early 1985. This program, if approved and funded, will address longer-term refugee needs. Belgian aid provides small grants to missionaries in the Sub-Region for education, health, and road maintenance activities. The FAO is considering the possibility of funding a small agricultural project in Kapanga, the Sub-Region's northernmost zone. Finally, the World Bank is planning a major agricultural project in the Luiza Zone of Western Kasai, immediately to the north of the Lualaba Sub-Region. All such correlative undertakings would be complemented and supported by the project proposed herein.

In the sub-sector of water supply, UNICEF has a $500,000 to $700,000 per year national program to develop the capacity of the Rural Hydraulics Division to install rural water systems. In addition, a joint UNICEF-UNID effort in the Kivu Region has created on indigeneous capacity for the production of spare parts from local materials for Mark II pumps.

IV. Project Analyses

A. Social Analysis

1. Background and Summary

This project addresses the need to help existing refugees and returning refugees regain self-reliance and become more productive. In particular, the Shaba Refugee Water Supply Project addresses the severe deficiencies which currently exist in the Lualaba Sub-Region water supply system and which constitute a major negative factor in the quality of rural life. It addresses the economic needs of both refugee and non-refugee components of the population and thus avoids further exacerbating tensions within the community that set the refugee groups apart. The various water supply sub-projects to be implemented through a non-profit contractor and the Rural Hydraulics Division will include a mix of repair and construction activities. These project component activities may be considered as a unit for purposes of the social analysis as they are all to be carried out by employees of the Rural Hydraulics Division and with the PVO providing the supervisory, technical, and training functions. All activities will produce a common output, improved water supply. The social analysis indicates that the types of interventions to be included are soundly designed in that they are appropriate to the social, economic, and historical context; they address critical needs; they are socially feasible; and they will have significant beneficial impact on a large portion of the population in Lualaba Sub-Region.

2. Beneficiaries

The Project will benefit the community as a single demographic reality, including "refugees" from Angola, "returning refugees" of Zairian origin, and "residents" who have not left their communities for significant periods in the last decade but who have been affected by the social disruptions. The demographic make-up of the three communities is similar; the three component groups are all drawn from within the same cultural area and thus share similar ways of life as subsistence agriculturalists. Since the project is an

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infrastructural program which addresses the needs of the population through removing obstacles to useful economic activity and good health, the entire population of the Sub-Region can be expected to benefit. The water supplies will be open to all potential users, but those living in proximity to medical or school centers and those living in larger population centers will profit the most in the short term. In the medium term (3-5 years), labor used in water transport should decrease, allowing increased labor inputs in economically productive activity. Water-borne diseases should decline and hospital services will improve also resulting in increased productivity.

One constraint to area development is the low population density. Excepting the urban center of Kolwezi proper, the overall density in 1970 was 4.19 persons per square kilometer (although this may have increased in the intervening period). The problem is somewhat alleviated by uneven distribution of the population, with large areas away from the roads being effectively uninhabited. Giving priority to investment in water supply in larger population pockets is, however, not only a response to existing population distribution, but also an instrument favored by the Government of Zaire to encourage rural populations to regroup in larger units which will facilitate provision of other services such as rural electrification and health infrastructure.

When water supply infrastructure was better maintained during the colonial period, local economic conditions were much more dynamic and the population as a whole enjoyed much better living and health conditions. In other parts of Shaba Region, as in the Upemba Basin of adjoining Upper Lomami Sub-Region to the east, poor water supply has resulted in major health problems including the spread of endemic cholera during the 1970s and 1980s. It is thus reasonable to expect an improvement in the well-being of the entire population of the Lualaba Sub-Region and the avoidance of significant risks of major decline in health standards as a result of the improvements envisaged.

3. Participation of Beneficiaries

Early in the life of the project and before installation development begins, a study will be undertaken to develop an appropriate project structure to ensure essential local participation in all aspects of installation and maintenance of each village water system. It is expected that each brigade will have as a team member at least one local sociologist, sensitive to the tribal and administrative structure of the area, who will precede the brigade, organize the village for project activities, and follow up regularly after the system has been installed. USAID intends to solicit the advice and assistance of WASH technicians experienced in the planning and implementation of rural village water systems, in the field development of the project. WASH participation in scheduled evaluations, also would be useful in guiding project implementation.

Initial involvement will include the identification of water supply points currently exploited and in the evaluation of potential sites for improvements. The nature of improvements and the technology to be used at each site will depend on technical considerations and the nature of the demand for water. The beneficiaries must be deeply involved in the execution of the project once the technical decisions have been made, for maintenance will be the primary responsibility of the beneficiaries in each instance. This involvement will include the hiring of limited amounts of labor, furnishing of burned bricks and building stone, and the creation of local water committees to oversee the water supplies after the initial improvements have been carried out. The village committees will be administered by local traditional leaders and will receive technical and management assistance periodically, beginning before the village water systems are installed and continuing thereafter as required. Several possibilities are being considered to ensure that village committees effectively maintain the systems. A promising solution is to assign a trained rural sociologist from the sub-region to each brigade to precede the brigades and assist villagers to create committees. A fee structure will be developed

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early in the project by the technical assistance team and the sociologists. Care will be taken to arrange for skilled individuals in each village group to provide routine technical maintenance.

4. Socio-Cultural Feasibility

No appreciable socio-cultural problems are foreseen. Water supply is a traditional concern of community authorities and is the most common criterion for choosing village location in Lualaba Sub-Region. Local taxes have commonly been assessed for the use of water systems. Local beneficiary direct participation in the project will be similar to traditional self-help strategies where the technology involved is relatively simple. Where the technology is new to the area, as in the case of boreholes, the involvement of the local community will be more limited during the construction phase. In all cases, the technology is appropriate and has already been in use in the project area or, in the case of boreholes, within Shaba Region at earlier periods. The project takes due care to avoid the major errors of the earlier water supply program of the colonial period: not creating a pool of local maintenance expertise and installing a variety of different pumps without sources of spare parts within Zaire.

5. Impact

The impact of the project will be great. It builds on previously existing water supply infrastructure where possible. The fact that traditional population distribution is predominately determined by water supply availability indicates the capital role improved water supply will play in facilitating improvements in living conditions and in community infrastructure.

For example, lack of adequate water supplies has been a significant constraint on hygiene for medical facilities within the area. The inconveniences of not having a water supply within the town or village are often cited as motives for rural exodus and for the unwillingness of highly-skilled individuals of local origin to return to their home areas after specialized training elsewhere. The elimination of serious health risks is a very real if unquantifiable benefit.

Institutions within Lualaba Sub-Region existing within large population concentrations will benefit most immediately. These would include in the sub-region's administrative center (currently without a public water supply), churches, business firms, and schools. Because of the importance of adequate supplies of pure water to rural medical centers, they will receive priority in the choice of sites and in the implementation schedule.

B. Institutional Analysis

The implementing agency for this project is AIDR (Association Internationale de Développement Rural), a PVO with a long history of water supply implementation in Zaire and elsewhere in Central Africa. Its history in Zaire began in 1947 as FBI (Fonds du Bien-être Indigène, or Native Well-Being Fund), a Belgian colonial government agency created to address the new interest in broad-based development programs for colonial populations after World War II. Water supply was one of its four major preoccupations at that time, along with medical centers, schools, and rural public buildings; as mentioned elsewhere in this PP, Lualaba and rural Mutshatsha Sub-Regions have a large infrastructure of wells and springs improved by FBI during the colonial period but which has been neglected in recent decades and requires renovation before it can again serve the population. In 1964 AIDR was created as a private non-profit technical agency to take over the programs of FBI remaining after the independence of the three former Belgian colonies in Central Africa. It is officially recognized by the Zairian government as a PVO with a resident office in Kinshasa. The decree granting AIDR indigenous PVO status in Zaire is attached as Annex 11.

Water supply has continued to be a major portion of its program, both under direct Belgian governmental financing through 1974 and under contract to a variety of organisms (UNICEF, World Bank, African governments, African PVOs, and Belgian government agencies). Major programs in the past five years have improved water supply for more than 2 million people each in Burundi and Rwanda. In Zaire a number of boreholes were drilled in the Sandoa area in 1974 as part of an integrated rural development plan under Belgian financing. AIDR places great importance today on the formation of local community

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structures and skills to ensure future maintenance and management of all water supply improvements. AIDR is currently in contact with several Zairian government agencies with water-related rural development proposals, and is responsible for a mjaor water supply and resettlement program in Haut Zaire for Ugandan Refugees.

AIDR, working with USAID under a cooperative agreement, will assist the Rural Hydraulics Division of the GOZ Department of Agriculture to strengthen its capabilities in rural water supply development. With funding from UNICEF, RHD has set up nine brigades in Zaire: three in Kivu, three in East Kasai, one in Lower Zaire, and one in Equator regions. Progress since their creation has not lived up to initial projections; the lack of activity of certain brigades has been discouraging. Despite well-trained leadership at some levels, including competent national management, RHD is in serious need of well-trained and effective operational personnel.

The present proposal represents an important contribution to RHD activity in Zaire. First, the current UNICEF program is restricted to the regions currently covered, and activity in the immediate future will possibly be concentrated within a portion of this area to facilitate coordination by UNICEF's single field representative. Shaba would not otherwise have a possibility of a funded RHD program in the immediate future. Secondly, the Shaba Refugee Water Supply Project will result in the formation of several new trained brigades, including RHD's first borehole drilling team and two technicians for it. The latter group and its equipment, capable of drilling approximately 100 boreholes in an average year, will be able to expand RHD's program in other geographical areas at the end of the project.

In light of the current state of RHD's development and the great need in Zaire for its services, the proposed institutional structure for the project, with management and training functions borne by AIDR, is realistic and will contribute concretely to the future capabilities of RHD as well as ensuring realization of the projected water supply improvements and the formation of local community structures to maintain them.

Other institutions that will participate in the implementation of the project are the local PVOs that have existing water supply systems to be improved (schools, hospitals, medical centers) and community water supply committees to be created to insure adequate management and maintenance after the construction and renovation phase has finished. Lualaba Sub-Region in general has strong and cohesive rural community structures, especially in the northern portion, and water supply management has been a traditional concern of village authorities.

C. Technical Analysis

1. 500 springs will be capped to provide water for washing and cassava soaking.

2. 140 dug wells in villages where springs have been capped will be rehabilitated and provided with pumps. The wells will provide water for drinking and cooking.

3. 430 tube wells will be drilled in villages where springs have been capped and either a) there is no dug well that can be refurbished; or b) the drinking and cooking water requirements of the village exceed the capacity of one well.

4. At the end of the project 500 villages will have capped springs. Of these 430 will have one dug or drilled well and 70 will have two.

5. In most of the project area the daily yield of wells is limited to 2 to 5 cubic meters a day by the low permeability of the gneiss, quartzite and granite bedrock. The separation of drinking and cooking water from washing and soaking water is therefore technically as well as socially sound.

6. Five solar-powered and five hydraulic ram systems will be provided to missionary-run medical and educational complexes. The hydraulic rams will be maintained by experienced local PVO technicians, and will provide piped water in sufficient quantities to social centers. The operation of the solar installations will be monitored to determine their appropriateness for rural water supply systems in Zaire.

7. One large rural town, Musumba, will be provided with a gravity system piped sixteen kilometers.

8. Villages in the project area vary in size from 300 to 500 people. The wells and the springs will provide approximately 30 litres per day per person. The total population served numbers 210,500. The total amount of water available per day will be 6,655 m^3.

9. The construction of tube wells, rehabilitation of dug wells, spring capping, and special projects (rams solar, gravity) will be carried out by 6 Rural Hydraulics brigades. These brigades are staffed by one hydraulic technician and six to eight workers. The technical assistance team will oversee the work.

10. The estimated time for the completion of the project is based on the experience of A.I.D.R. in Zaire and elsewhere in Africa, and on the RHD brigades' record elsewhere in Zaire.

11. The equipment cost estimates have been prepared using current prices C.I.F. Lubumbashi. Local cost estimates are based on construction material costs and on current Rural Hydraulics salary schedules. These local costs, to be funded out the GOZ's regular budget as well as from counterpart funds generated by USAID-funded commodity imports are within the projected availability of funds under the project.

The technical design and equipment requirements for carrying out the proposed work are appopriate for the objectives to be accomplished, are practical, and are in accordance with sound engineering practice. The cost estimates are realistic. The technical assistance personnel will complement the skills already available in the Rural Hydraulics Division. Assuming prompt initiation of project implementation, no technical constraints to the satisfactory completion of the project on schedule are foreseen.

D. Financial Analysis

1. Sustainability.

Sustainability and expansion of the Lualaba Sub-Region water supply infrastructure after the project has ended will be ensured in three ways. First, village water committees will impose a small user fee to ensure a supply of spare parts for simple manual pumps from local missions and from Lubumbashi and to pay a small retainer to a local craftsman who will be trained by AIDR and RHD. The village committees will be anchored to the strong traditional leadership structures that have managed for centuries to levy taxes and maintain rudimentary infrastracture in the area. Second, local expertise and a regular supply of spare parts will develop in the area since the project will standardize on a single type of pump for the sub-region. The local missions will also be in a position to provide a backup supply of inexpensive gaskets and other basic spare parts in the event of supply disruption. Third, RHD will continue to field two and perhaps three brigades in the Sub-Region. Hence it can be expected that more new tubewells and other installations can be built and serviced. If, on the other hand, RHD should have to move its trained personnel to other areas, the critical mass of standard simple pumps and trained villagers should ensure a continued supply of potable water to the Lualaba Sub-Region for the foreseeable future. Local missions that benefit from the project will be provided with the basic tool kit (tripod and hoist, etc.) to perform regular pump maintenance services that surpass the capacity of the local trained artisans. The existing UNICEF-funded RHD program in other regions of Zaire has already foreseen local fabrication in Zaire of expendable parts for the same standardized pump.

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2. Cost estimates

Table 1: Summary Cost Estimate and Financial Plan

$000 or local currency equivalent in $000					
Source	AID		GOZ		TOTAL
	FX	LC	FX	LC	
1. Commodities	797	-	-	1,298	2,095
Household furnishings	21	-	-	76	
Survey materials	6	-	-	-	
Vehicles	412	-	-	-	
POL	-	-	-	632	
Tools	6	-	-	10	
Tubewells (430 units)	-	-	-	174	
Well construction material (140 units)	1	-	-	19	
Pumps (570 units)	200	-	-	-	
Spring capping (500 units)	-	-	-	135	
Gravity, ram and solar systems (1, 5, 5 resp.)	152	-	-	252	
2. Travel	84	-	-	18	102
3. Technical Assistance	1,088	-	-	-	1,088
Long term	953	-	-	-	
Short term	135	-	-	-	
4. Salaries	-	-	-	28	28
5. Maintenance and Overhead	19	-	-	70	89
6. Training	14	-	-	154	168
7. Miscellaneous	3	-	-	-	3
TOTAL	2,005			1,568	3,573
Inflation (12%)	245			232	477
GRAND TOTAL	2,250			1,800	4,050

Table 2: Projection of USAID-funded costs by fiscal year by major line item

	1985	1986	1987	1988	1989	TOTAL
TOOLS AND FURNISHINGS	33	-	-	-	-	33
PUMPS	21	39	46	49	45	200
SPECIAL PROJECTS	50	35	42	25	-	152
TRAVEL	24.4	24.3	7.7	13	14.6	84
TECHNICAL ASSISTANCE (Short term 15 p/m) (Long term 13 p/y)	242.7 (28) (214.7)	242.7 (28) (214.7)	242.5 (27.8) (214.7)	180.1 (25.6) (154.5)	180 (25.6) (154.4)	1,088 (152) (152)
MAINTENANCE	0.1	3.7	4.5	5.1	5 .6	19
TRAINING	14	-	-	-	-	14
VEHICLES + DRILL	412	-	-	-	-	412
MISCELLANEOUS	1.6	1.1	0.3	-	-	3
TOTAL	798.8	345.8	342.9	272.3	245.2	2,005
INFLATION (12%)						245
GRAND TOTAL						2,250

C. Detailed cost estimates for AID and GOZ funding are presented in Annex 5.

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E. Economic Analysis

1. Background

In the project area the sources of water for various uses are, in many cases, distant from users, of questionable safety, costly to use, insufficient, or accessible only by means of equipment and structures that are in need of rehabilitation. The difficulty of getting enough good water in rural areas is one of the main complaints of the residents. Even more than the lack of electricity, it typifies in their minds the state of backwardness of their communities as compared with some of the better-off urban areas.

Not only is access to water presently costly in time, effort, and, in some cases, fuel, but the lack of water and the pollution caused by lack of care with its sources and handling reduce sanitation and increase morbidity.

2. The Project

The project would improve the quantity of water available, improve the quality of that water, make it available at more convenient locations, reduce costs of pumping it, promote a limited capacity of the Department of Agriculture's Rural Hydraulics Division to continue to improve infrastructure, and help organize communities to manage their water supplies. For the various types of water users and situations, different measures would be used: for example, drilling new boreholes, rehabilitating existing shallow dug wells, capping springs, or installing pumps.

3. Economic Feasibility

Although some benefits from the project can be given preliminary evaluation, as reported in the annex (number 6) on economic analysis, we do not have the means to evaluate some of the main benefits of the project. For example, so far as is known, there does not exist anywhere good information on a basic benefit: reduced incidence of water-borne

diseases. Experts feel that, under present conditions in any areas, increased availability of water at lower cost (in time and effort, primarily) would lead to improvements in personal, household, and community sanitation that would substantially reduce morbidity. More care of water sources could also result in less polluted water that would transmit less disease. However, the assumptions that this analysis might make to measure and to value these expected benefits would be too arbitrary to guide project selection or design.

Other benefits that would be difficult to measure are similarly discussed in annex 6. Overall, five general categories of benefits are distinguished in that analysis:

a. Time saved drawing water;
b. Improved health;
c. Improved care at health centers;
d. Post-project work by governmental teams trained and equipped by the project; and
e. Prevention of misallocation of labor to urban areas.

Given the overall cost of the project, $4 million benefits valued at, for example, nearly $1 million per year over years three through ten of the project would be necessary to justify the project's expense. Those benefits of which preliminary evaluations are possible do not approach that figure. Thus, formal economic feasibility can not be demonstrated ex ante.

During mid-term and final evaluations of the project, economists will attempt to learn more about quantities and values of benefits from the project both to better assess the merits of this investment and to facilitate selection and design of future projects.

V. Implementation Plan

A. Administrative Arrangements

USAID will sign a Cooperative Agreement with AIDR, which is registered with the GOZ as a PVO, to provide technical, administrative and procurement Services for the implementation of the project. AIDR, in turn, will enter into an agreement with the Rural Hydraulics Division (RHD) of the Department of Agriculture and Rural Development of the Government of Zaire. RHD has been created to assume primary responsibility for rural water supply in Zaire, but sufficient qualified management and technical personnel are not yet available to field teams in all Zaire's eight rural regions.

AIDR's office in Kinshasa will be the contracting entity, and will serve liaison functions with USAID. AIDR will appoint a Project Coordinator in Brussels to oversee the program with annual one-month visits to the field to ensure satisfactory implementation. The Project Leader will be the AIDR field representative, who will be in liaison with his RHD counterpart, the Director of RHD. The Project Coordinator at AIDR central offices will be responsible for backstopping project procurement. AIDR technical field personnel will and forward specific engineering plans to USAID. USAID's engineering office will provide technical backstop to the project. AIDR central offices will also supply specialized consultants, estimated at two months per year. USAID will approve all short-term consultancies and long-term appointments of AIDR personnel.

The Project Leader will be responsible for general management of the project in the field: studies, construction, training, and other programs. He will be responsible also for financial management and logistic support services, although it is anticipated that AIDR may contract for local procurement services in Lubumbashi and Kinshasa.

AIDR will assign a senior project water and sanitation engineer, a well drilling supervisor, and a master mechanic from its professional technical staff. In addition to these full-time, long-term AIDR personnel, an administrative assistant, to be hired locally, will complete the core TA team (see Annex 5 for the TA team profile).

To manage this project effectively, USAID will assign a Project Officer to Shaba whose responsibilities will include:

1. Monitoring and evaluation of project activities to ensure that the management of AID resources is satisfactory;
2. assisting in the preparation of project implementation documents, particularly those relating to procurement;
3. the maintenance of liaison with the relevant host country officials;
4. assisting in the maintenance of project reporting and record keeping, including financial management information and project performance tracking.

The officer based in Shaba will have a USAID backstop who will be responsible for liaison with AIDR and AID/Washington on all project matters.

B. Implementation Schedule

The general schedule for the implementation of project activities from the date of approval until project completion is presented below. A detailed work plan will be prepared by the contractor in the first 3 months of project implementation.

Activities schedule

Project paper approved by A.I.D.	September 1984
Project grant agreement signed	September 1984
Commodities list finalized	November 1984
Initial conditions precedent met	November 1984
Detailed project work and maintenance plan completed	December 1984
Commodities order placed	January 1985
Technical assistance team arrives	May 1985

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Zairian work crews on site	May 1985
Commodities on site	July 1985
Water supply work commences	July 1985
Technical services completed	June 1990
Project completion date	September 1990

C. Evaluation Plan

Three evaluations are slated for this project: one in September of 1986 one in 1987, and one in 1990. The first will be a start-up evaluation, the the second a mid-point, and the third a final.

All evaluations will coincide with, and take into account, evaluations of the Roads in Shaba (660-0114) and the Health Infrastructure in Shaba (660-0115) companion refugee projects.

The first evaluation will have as its principal purpose to review project objectives, assess the degree to which project design is leading towards purpose achievement, review and confirm the validity of assumptions, assure that all participants are properly carrying out the responsibilities envisaged and assigned, and make recommendations for improving project implementation.

The evaluation team will be led by a sanitary engineer with expertise in rural water supply and will include a public health specialist and an economist with experience of local revenue generating programs. The team leader will assess the quality of the water supply improvements proposed for the area against appropriate standards for similar geographical and hydrological environments. The public health expert will assess the impact of the water supply improvements on health standards among the refugee, returnee, and resident portions of the local population. The economist will review the provisions for local water committees to manage the improved water supplies and ensure reasonable longevity for each element of the infrastructure and repair or replacement when necessary. He will also develop the criteria for monitoring the economic impact of the project. The mid-term evaluation will update initial evaluation findings with recommendations appropriate at that

point. It will specifically review what mechanisms have been established or planned for recurrent costs and other aspects of sustainability. It will also make an initial estimate of the economic impact of the project components. Results of this evaluation will be incorporated into USAID Planning for water and sanitation activities slated for 1987 and beyond.

The final evaluation will be conducted following the completion of all water supply infrastructure construction under the project, and will provide a comprehensive assessment of the project's impact on Lualaba Sub-Region. The team will be constituted similarly to those of the earlier evaluations. Health and economic analyses will determine the extent to which the population has benefitted through improved access to drinking water and improved water quality. The evaluation team should also address the impact of improved water supply on consolidation of hamlets into larger villages more readily benefitted by various forms of infrastructure improvement. In addition, an assessment will be made of the cumulative impact of the three refugee projects on the populace of the sub-region.

D. Procurement

This project is to be authorized in accordance with the Migration and Refugee Assistance Act of 1962.

Because the authorization for this project does not come from the Foreign Assistance Act, the provisions of that Act relating to the procurement of goods and services do not apply as a matter of law and accordingly this PP reflects greater flexibility than usually assumed in AID regarding procurement requirements.

Services will be provided by AIDR, which is registered in Zaire as a PVO, and which has over 20 years of experience in Water Supply in Central Africa. As described above, the major responsibility for all procurement lies with AIDR, the cooperating PVO which has long experience with water supply improvements, particularly in Zaire. Procedures to be followed by AIDR in procurement and possible criteria to be applied to justify any non-US procurement are included in Annex 12. USAID will review and approve all requests for procurements which do not have their source or origin in the United States.

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REPUBLIQUE DU ZAIRE
MOUVEMENT POPULAIRE DE LA REVOLUTION

REGION DU SHABA
CABINET DU PRESIDENT REGIONAL DU MPR
GOUVERNEUR DE REGION

Lubumbashi, le 16 AOUT 1984

N° 10/ 000685 CAB/PR-MPR/GR/SH/8.4

OBJET :
Projet routes et santé
Sous-Région de Lualaba.

A Monsieur le Directeur
de l'U.S.A.I.D. - Zaïre
à KINSHASA

Monsieur le Directeur,

J'ai l'honneur de vous confirmer les différents entretiens que j'ai eus avec vous au sujet de la priorité que la Région du Shaba accorde aux problèmes d'assistance aux réfugiés d'Angola et de réintégration des rapatriés zaïrois qui ne cessent d'affluer dans la Sous-Région de Lualaba.

A cet effet, la Région appuie le projet d'amélioration des routes de desserte agricole et celui de santé communautaire que l'USAID et les Nations-Unies ont élaborés pour la Sous-Région de Lualaba.

Ces projets visent essentiellement :

1. l'amélioration des routes de desserte agricole dans la Sous-Région de Lualaba, projet n°660-0115.
   Cela pour faciliter l'écoulement des produits agricoles vers les centres de consommation.
   Le coût estimé de ce projet serait de 7.500.000 US$.
   L'Office des Routes en assurerait la réalisation.

2. le système de santé dans la Sous-Région, projet n°660-0114. Le but de ce projet est de permettre à la population de la Sous-Région de Lualaba de bénéficier des soins médicaux.
   Le coût estimé du projet serait de 1.750.000 US$.
   L'Eglise Méthodiste Unie assurera la réalisation de ce projet.

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3. la fourniture d'eau potable dans la Sous-Région de Lualaba, projet n°660-116. Le but du projet est de faire bénéficier la population de cette Sous-Région d'eau potable.
Le coût estimé du projet serait de 2.250.000 US$.

Tout en vous remerciant d'avance de l'appui que vous apportez aux projets ci-dessus qui ont un caractère prioritaire pour la Région du Shaba, je vous prie d'agréer, Monsieur le Directeur, l'assurance de ma considération distinguée.

LE PRESIDENT REGIONAL DU MPR,

MANDUNGU BULA NYATI
GOUVERNEUR DE REGION.

REGION DU SHABA
CABINET DU GOUVERNEUR

ANNEX 2

ANALYSIS OF THE PRESENT WATER SUPPLY SITUATION

1. INTRODUCTION

Considering rural water supply, the three zones of Dilolo, Sandoa, and Kapanga are characterized by the fact that no water supply/distribution equipment is in operating condition except for several major rural centers where United Methodist, Roman Catholic, or Garenganze missions are located. Twenty years ago, dug wells with reinforced concrete liners were set up with hand pumps, but all are now unusable for various reasons following the events of the last ten years in the area.

For this reason, the village population draws water for drinking and cooking from the rivers and streams and at the heads of their saturated valleys at the closest possible sites to the village. No particular improvements have been made to supply points, whether to springs or to water holes. Note that no boreholes have been drilled, and no gravity-flow piped systems exist.

2. LARGER RURAL CENTERS

Potable water supply infrastructure exists and functions in those major rural centers where religious missions are located. These administer and finance significant medical institutions: hospitals, maternities, leprosariums, dispensaries. The most important of these are:

Kasaji-Chisengama
Kasaji-Lueo
Sandoa Poste
Kafakumba-Kimpuki
Dilolo Poste
Katoka
Musumb
Ntit
Kalamb

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All these installations are based on the principle of pumping water up to a reservoir with a gravity-flow distribution system. The supply systems are of two types:

1. Hydraulic rams of various brands (Blake Hydram, Vulcam, Rife-Ram, Carvens and Alto) are installed at Kasaji-Chisengama, Kasaji-Lueo, Katoka, Dilolo Poste, Kafakumba-Kimpuki, and Kalamb (medical facilities not presently supplied).

2. Motor-driven pumps are used for the United Methodist hospital at Musumb (gasoline) and the Roman Catholic dispensary-maternity at Ntit (diesel).

Water is pumped up to steel reservoirs of the Braithwaithe type. Supply piping is of galvanized steel.

In general, even this infrastructure and its associated equipment do not function at their maximum efficiency and are not sufficient for present needs. All these water supply systems date from several decades back and suffer from a lack of periodic maintenance. No technical studies or blueprints were done before the construction of this infrastructure and the installation of its associated equipment. Thus marked improvements can be expected through both planning and implementation of future construction in order to obtain maximum efficiency from the existing infrastructure and increase the volume of water pumped up to the reservoirs and thus the quantity of water available for daily use.

In order to avoid corrosion of the existing galvanized steel supply piping, settling basins should be installed before the head chambers of the hydraulic rams in order to ensure longevity. Moreover, improvements can be made to the various structures feeding the hydraulic rams in order to avoid water losses. This is especially a matter of improving the impermeability of the dam, intake, supply canal, and supply chamber.

3. Rural villages

Wells have earlier been constructed in a large number of rural villages, particularly around Sandoa. These wells, 0.8 meters in diameter, were lined with concrete rings, varied in depth from 8 to 15 meters depending upon the location, and were equipped with hand pumps (wheel or lever action). They are about 20 years old. For various reasons, stemming from the events of the last ten years, these wells are now unuseable. The pumps have either been removed or destroyed. The concrete platforms are still present, as well as certain pump bases, but their condition is poor. In most cases the top of the well is not covered by a protective slab, and all sorts of debris can be found at the bottom. Two wells equipped with windmills, but also out of use, were set up at the Garenganze hospital complex at Kasaji.

Because it is impossible to use these wells, the village populations have had to turn to other natural water sources: rivers, streams and springs at valley heads. According to the use to which the water is to be put, one can distinguish several different points for drawing water. These are as follows:

- A spring, kept more or less cleared by the villagers where water appears naturally and at a single point.

- One or more water holes (of 0.50 m diameter and 0.60 m depth), according to the size of the village, dug by the villagers in the alluvial deposits at the heads of stream valleys. The system is a rudimentary well with tree trunks placed in front of the hole and serving as a firm base on which to put the water containers; the water at these supply points is used only for drinking and cooking.

- If one of the two systems above is not present, water is drawn directly from a stream or river.

- A series of basins of diverse types used only for the soaking of manioc tubers and corn.

- A seperate basin or place for the washing of clothes.

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Water required for drinking or cooking is fetched by children and women. A large calabash is used to raise the water, which is then poured into either a plastic jug or a metal basin that varies in size according to the physical capacity of the bearer. These recipients are then carried full on one's head back to the village, a distance varying from 800 m to 1.5 km. The difference in altitude between the two points may range according to the area from 20 to 50 meters. The slope may be steep or gradual, according to the local topography. The expenditure of human energy and the time required to transport water are important, particularly because water drawing is commonly performed twice a day.

It should also be noted that the villagers dig their own wells to make bricks during the dry season. The water thus tapped is used only to wet the clay. In certain cases the top of the well is made of half a metal barrel 40 cm high, sometimes capped with a metal cover. In the best of these the junction of the barrel and the well is formed of packed dirt with bricks placed in it. The diameter of such wells varies between .6 and .8 meters and the depth averages about 10 meters. Most villages have one or more such wells.

A three-pronged program is planned:

- the capping of springs and construction of a water drawing area
- the rehabilitation of existing open wells
- the drilling of tube wells

Annex 3 gives an inventory of water points in the villages surveyed by the technical design team.

ANNEX 3

FIELD STUDY

This annex is based largely on findings obtained by the project paper team during on-site visits to the proposed project area. The primary purpose of the following study was to assess the needs of the target population with respect to safe and convenient water supplies. The following report identifies those needs, and has aided in the formulation of the proposals presented elsewhere in this document. It is important to note, however, that the limited funding available to the project has required that the design team make certain choices. These choices are presented in the body of the PP and in the Technical Analysis. The needs of the area in water greatly outweigh the possibilities of this project, and thus the following reports should not be confused with planned project outputs.

1. Generalities.

The principal objective of this AIDR study mission, composed of Messrs. Jean-Paul BARTIER (Sanitary Engineer) and Yves FAUGERE (Hydrologist) and Citizens SEDZABO Seke (Rural Engineer), LOMA Djesa (Rural Engineer) and LUVULLA Agnen-a-Mbati (Sanitary Technician) for the National Rural Hydraulics Division was to define a program of action and to identify a series of projects in the field of rural drinking water supply in Lualaba Sub-Region in Shaba.

This sub-region has a total surface area of 79,414 km² distributed as follows:

DILOLO	25,330 km²
SANDOA	29,608 km²
KAPANGA	24,476 km²

Due to the insufficient time available for field trips (3 weeks), it was impossible to cover all 3 zones thoroughly nor to make a systematic inventory of the hydrological potential of each village. Furthermore, in the course of the survey it became apparent that some areas are currently inaccessible for lack of road infrastructure, e.g. the Kapanga-Katapakish axis where a bridge at the Rushish River is under construction and the Chimbalang-Sakapele area where it is impossible to cross the Lulua at Bumba, for lack of a ferry.

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Upon examination of the administrative map, it appears that the population is dispersed along the principal and secondary road axes. Taking into account the spread of population in villages along these axes, we chose villages representative of the different natural regions crossed alongside the principal axes, namely:

KASAJI - NANSONI - SANDOA (direction S-NW)
SANDOA - SAPINDJI - KAFAKUMBA (direction W-E)
SANDOA - CHIBAMB - KAPANGA (direction S-N)
KAPANGA - KAZOMB (direction S-N)
KAPANGA - RUBWIZ (direction E-W)
SANDOA - DILOLO (direction N-S)

Along these roads, existing hydraulic infrastructure (simple dug wells, wells with concrete liners, the scattered springs, places to draw water from the streams) are concentrated in the biggest villages.

On the other hand, a systematic inventory village by village was taken along the axes -

SANDOA - KAFAKUMBA
KAPANGA - KAZOMB

All the information gathered in the field was marked onto summary tables.

Particular attention was paid to the large rural centers such as

KASAJI
KAFAKUMBA
KAFAKUMBA LAKE
DILOLO POST
KAPANGA

The sub-regional centers supplied by REGIDESO, such as Sandoa and Dilolo, were not included in the present study.

The following information was gathered for each site visited:

- the state of existing wells, depth, state of repair of the pump
- the difference in altitude between the village and the potable water source (using pocket barometric altimeter).
- the distance from the water source to the village.
- the pH of the water.

This preliminary information allowed us to define water pumping requirements (pump head) and to determine water treatment needs (acid vs. alkaline).

2. FIELD SURVEY CALENDAR.

The calendar of field visits was the following

18-08-84	Lubumbashi-Kolwezi
19-08-84	Kolwezi-Kasaji
20-08-84	Kasaji - Malonga - Kasaji
21-08-84	Kasaji
	Kasaji - Sandoa
22-08-84	Sandoa - Kafakumba Lake
23-08-84	Kafakumba Lake - Kafakumba Post
Kafakumba-Kimpuki - Sandoa	
24-08-84	Sandoa - Chibamb - Kapanga
25-08-84	Kapanga
26-08-84	Kapanga
27-08-84	Kapanga - Mpand a Mwil - Kazomb - Kapanga
28-08-84	Kapanga - Rubwiz - Kapanga
29-08-84	Kapanga - Sandoa
30-08-84	Sandoa - Dilolo Post - Dilolo Gare - Dilolo Post
31-08-84	Dilolo Post - Sandoa
01-09-84	Sandoa
02-09-84	Sandoa - Luena (small plane)
03-09-84	Luena - Lubumbashi - Kinshasa (plane)

24X

3. CONCLUSIONS.

From the examination of information gathered in the field and written up in the form of summary tables below, it appears that in rural areas:

1. Wells equipped with various types of manual pumps were dug about years ago.

2. At the present time these wells are unusable (pumping system destroyed or taken away; bottoms of wells filled in).

3. In every village the population draws water for drinking and for cooking purposes either at natural springs or at holes dug for the purpose in the alluvial deposits at the heads of tributary valleys of the major rivers. These water points are not developed.

4. In some cases water is drawn directly from the stream or river.

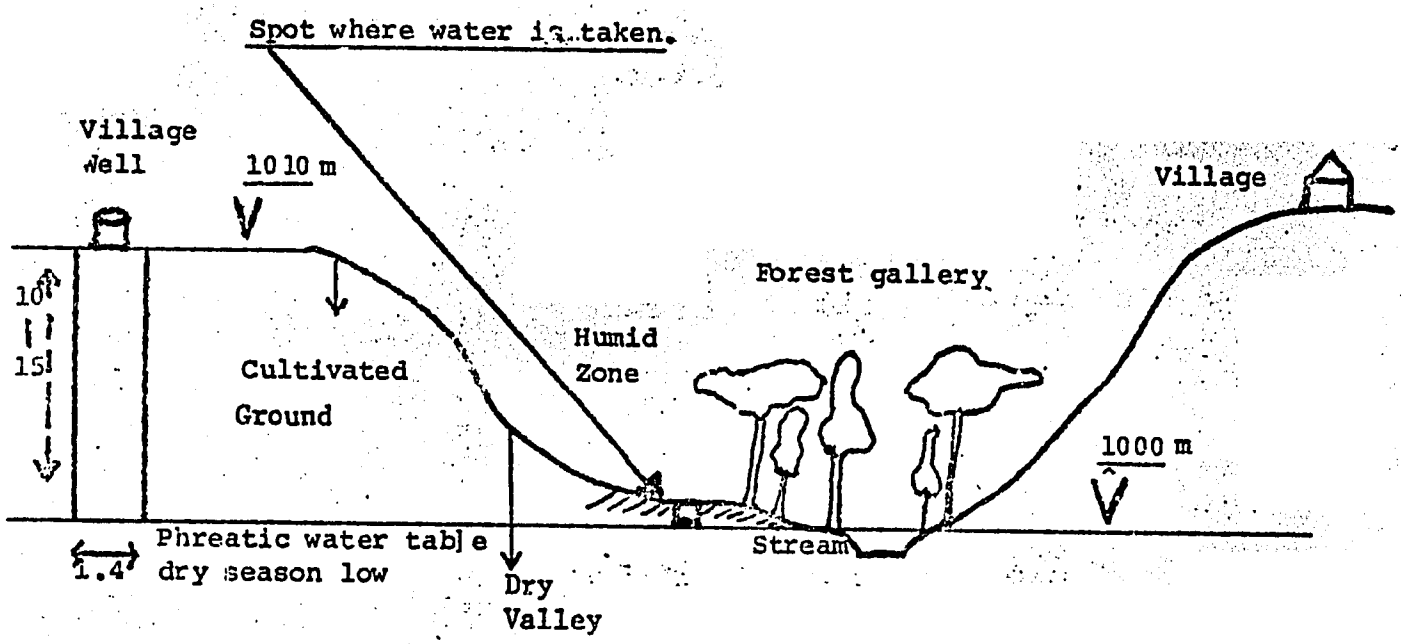
5. For brick-making, the villagers dig wells on-site.

In the much larger villages where religious communities are established, (United Methodist, Roman Catholic, or Garenganze) there does exist more complex hydraulic infrastructure, either hydraulic rams or generator-pumps which deliver water into metal storage reservoirs. The medical complexes are then gravity-fed. The installations do not function at maximum capacity and are not properly maintained. It should be noted that two wells equipped with windmill-driven pumps are out of use at Kasaji and Chisengama. The blades are still in good condition.

ANNEX 3.A

Kasaji - Nasoni Road.

Villages, varying in size from 50 to 300 inhabitants are spread out along the north-south road axis linking Kasaji to Nansoni. The region is characterised by a succession of plateaus and valleys. The villages are established on the plateaus. For the most part, the valleys are very flat valley heads, through which run streams bordered by arborescent vegetation forming a forest gallery.



Village	Altitude	Well O	h	pH	Valley/alt.	Dist. to Riv.
Madidi	1025	dried up	15.20	5.5	1000	+ 1 km
Mulindi	1010		10	5.5	1000	+ 800 m
Chimbayeke	1010	1.40	10	6	1000	+ 1.5 km
Kasangula		1.20	12			+ 1 km
Lumbidi	990					

75X

It appears:

1) That the population has dug wells whose depth varies from 10 to 15 m. Water is murky and has a pH level varying from 5.5 to 6. The villages use this water for all purposes except drinking water, which is taken on the banks or in the river. According to the depth of the well and the general topography, the river's water table is tapped just beside the village. Wells are dug without basic hydraulic infrastructure, filters for example, and are unprotected: no well liners either in brick (locally made) or in concrete. The drainage platform is either nonexistent or formed out of half a metal drum, (drum 0.60 m); in the first case the well opening is partially blocked, leaving just room for a bucket to pass. When the head is made out of a drum, the latter is imbedded into a concrete slab and can be covered with a metal cover which provides a hermetic seal. In both cases, water is drawn manually by means of a bucket attached to a cord made of strips of rubber cut from old tires. The choice of the well-digging site s random but near the houses. In certain cases the latrines are only 10 or 15 m. distant from the well. The wells are dug manually with locally-made shovels; the number of wells per village varies.

2) Because of the murky appearance of the water the villagers have the habit of taking water either from the river, when the water is running and clear, or on the edge of the forest in the humid zone. In this case, an excavation 0.50 m deep serves as a water-hole. Owing to the nature of the soil at the surface (generally alluvial sands), the water is clear and cool (pH 1.6). The distance from the water hole to the village is about one km.

3) In conclusion: improvement in drinking water supply to village populations could be effected by:

- introducing an appropriate technology to place straining filters.
- construction of a fully-equipped well head permitting easier and more rapid drawing of water.
- use of filters of local materials, (sand, gravel, charcoal).

ANNEX 3.B

SANDOA - KAFAKUMBA ROAD

Traveling along the road linking these points from west to east, the countryside is characterised by a succession of plateaus and valleys. Note that the valleys are wider than those along the Sandoa - Kasaji Road. They are formed of a wide flood plain where papyrus grows and a narrow bed where water runs during the dry season.

The secondary hydrographic networks of the Kalala, Lukongolo, Chilunda, Lufuta, and Sachila streams, which all flow into the Kashileshi River, one of the main tributaries of the Lulua River, are likewise east-west in orientation. The heads of these valleys are thus situated parallel to the axes of the plateaus where the principal villages lie. These valley-heads are mantled with forest galleries, with flourishing arborescent vegetation. In general, they are situated from 0.6 to 2.0 km from the villages.

As regards water supply, the populations provide for their needs in two different ways. These vary according to the distance separating the village either from the main streams (Kalala, Lukongolo, Tshilunda, Lufuta, and Sachila) or from the valley heads in these rivers' tributary networks. The flow of water in these galleries is permanent and can take the form either of separate springs (in the case of Kamwenda, Kaswawata and Kaneji springs or of a seepage line. In this case (as at Musumbo, Kawuma, Kasima, Kakoji, and Kawanda) the population has dug a series of small water holes all along the seepage line, in the form of circular holes 0.5 m in diameter and from 0.40 to 0.60 in. deep. Water is drawn in calabashes.

The isolated springs are found adjacent to the lateritic outcrops at the change of slope of the hill. The flow is of the order of 0.5 litres/second. Note that no water catchment, properly speaking, has been created, and the local people have simply cleared a few metres of the surface to catch the permanent trickle of water. Note that a receiving dam 5 m. high has been constructed in cemented stone masonry at the Kamodende spring, the water-supply for the village of Kajimakaji. A pH level of 5.5 to 6 is typical of these waters which, as a function of the hydrological profile, are for the most part clear, limpid, and have no pronounced taste. The distance from

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and wells to the villages varies from 0.6 to 2 km. The difference in altitude between the water sources and the village varies from 10 to 30 m, according to the topographical conditions.

Certain villages have wells dug in the years 1965-68 by AIDR or earlier by the FBI (Fonds du Bien-être Indigène) and constructed in accordance with a common plan. Either the liner is made of concrete rings 0.8m in diameter, or the well is simply dug in the soil. The liner extends 0.8m above ground level. The platform is stabilized with concrete; the depth of these wells varies from 7 to 15 m. The population no longer draws water from these wells, which were equipped with lever-action pumps. As they are no longer protected by covers, they have filled up with various debris.

For brick-making, the population digs holes from 0.6 to 0.8 m in diameter and with an average depth of 10m. The pH level of this water is around 5.5. According to the nature of the sub-soil, the water is more or less limpid and clear. This water is not used for drinking or cooking. These wells are mostly equipped with a half-drum and a cover. Water is drawn by bucket and rubber cord.

In conclusion

1) Permanent springs in the valley heads could be piped, and water sources could be developed there.
2) Existing wells could be restored to working order and equipped with pumps whose type remains to be defined.
3) The population could be trained in the excavation of new wells, including techniques for lining and pump installation.
4) According to the population density and the various existing local infrastructures, (school, dispensary, place of worship), a general principle of drawing water from the main river beds can be envisaged. Along these lines, a pilot project could be implemented in Mdjimi village:

- Difference of 20 m in altitude between the river and the village.
- Distance of 1.5 km from river to village.
- Easy all-season access from Sandoa 60 Km away
- Concentrated population, and developed social infrastructure
- Numerous local wells.

SANDOA-KAFAKUMBA LAKE ROAD

VILLAGE	WELL			WATER SUPPLY POINTS			
	FBI or AIDR	Local work		River			
	Depth (m)	Depth (m)	pH	Name	Dist. (Km)	Head (m)	Name
KASHITA	-	-	-	KALALA	2.1	20	
NAUNGU	-	9	5.5-6	LUKONGOLO	0.7	20	MUSOMBO
LUKONGOLO	-	-	-	BALONGO	0.9	15	
ZANDA	-	-	-	-	-	-	KASWAWAT
SAKATOTA	7	-	-	-	-	-	
MWASHITU	-	10	5.5-6	NDUMBA	1.3	20	
TSIVUNDA	-	9	Dried up	-	-	-	KAMENGI (
SAPINDJI	12	(5)11	5.5	-	-	-	KAOUWA (1
							KASIMA (1
SACHIZEMBE	-	-	-	KATANGE	1.6	30	
NDJIMI		(4) 9	6	KATANGEJI	1.2	20	
				CHILUNDA	1.7	20	
CHITALA		-		RUTANDWEJ	1.3	10	
NGANDU	10	-	5	RUTANDWEJ	1.5	10	

SANDOA-KAFAKUMBA LAKE ROAD

VILLAGE	WELL			WATER SUPPLY POINTS			
	F.B.I. A.I.D.R. Depth (m)	Local Depth (m)	pH	River Name	Dist. (Km)	Head (m)	Name
SACHIBANGA	10	1.2	5.5	SACHILA	1.7	30	KAKOJI (LUFUT
TSHIHUTA	-	-	-	SACHILA	1.2	15	
SACHAKOJI	-	-	-	SACHILA	0.9	10	
KASONDO	-	-	-	SACHILA	1.0	20	
KAJIMAKAJI	15	-	dried up	-	-	-	KAMUDI (pipe
SAWENGO	-	10	-	-	-	-	KAMUDI
MBWAMBWA	-	-	-	KANGOWA	0.8	-	
KANGONGO (SAKATANGA)	-	-	-	MWANDA	1.2	15	
KAMIKA	(1)14	-	-	MWAMBA	1	15	
SAKUNDUNDU	(1) 8	(5) 7	6	KAMUWANYA	1.1	15	KAWAN
SANDUMBA	-	-	-	KANYUNGWA	0.8	20	
SANASERA	12	-	Dried up	KULA	0.7	20	
KAJILA	-	-	-	KAYENGA	0.5	-	
SAMULENG	-	-	-	WONGO	1.2	10	

ANNEX 3.C

SANDOA KAPANGA ROAD

The villages along this axis are distinctive in that eight wells were excavated and equipped with lever hand pumps (FBI type) in Kapanga Zone. These pumps are out of service at the present time. They are situated in the following villages:

MUSUMB-KAKES
MUSENG
MULAMBU
MWANAKAJ
KAMEJ
MUSHAD
CHAL
RUCHACH

The population, as in the other regions, draws its drinking water from springs and water-holes (see table below) in the heads of the principal tributary valleys of the Lulua River. The water is 500 to 1000 m from the village, but in this latter case the difference in height between the village and water-source is up to 30 m maximum. It should be noted that two sites suitable for the installation of hydraulic rams were identified.

The first is found on the Kamuzangalal stream, a tributary of the Rov River, just 900 m from the village of Mwin Kapend. The site permits erecting and bracing a retaining dam on a granite slab. The water head is estimated at 25 m, and the flow is sufficient. The village population is 227 inhabitants, with 126 adults. Besides the fact that the general topography of the site is favorable to this type of hydrological work, the region offers the possibility of fabricating good quality bricks. A detailed study should be undertaken at the beginning of this project.

The second site favorable for a hydraulic ram is situated on the Randu stream above the bridge on the Sandoa-Kapanga road. The water head is of the

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A special study should also be undertaken of a very favorable site for installation of a water supply for the villages of Sangubu and Mbumb.

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SANDOA - KAPANGA ROAD

VILLAGES			F.B.I. WELLS			RIVERS	LOCAL WELLS	
Name	Pop.	Alt.(m)	Number	Depth	Remarks	Name	Distance(m)	S R
RUMANG	1450	885				Ibumbur	1600	s
KABWAT	427	950				-		
KAJIMBU	423	1000				-		
MAZAU	547	1000				Mwangal	350	s
SAYILEKA	151	1020				-		
MWIN KAPENDA	188	950				Kabamb	250	s
KAMWILA	234	995				Kapang		
KALAL	220	1070				Kazeng	600	a
MBINDAKAL	430	1080				Ruvulej	800	a
SATSHINEY	1350	1060				Kamuzeng	600	
KASAMBUJAND	537	1060				Mbul a Mbaw	550	a
CHIMBUNGU	1530	1090				Mudil a Nzundu	400	a
			1	12	Pk			
			2	6	P			
			1	13	P			

ANNEX 3.D MUSUMB/KAPANGA POSTE/NTIT COMPLEX

This complex includes several urbanized locations along the Kapanga Poste - Musumb road plus nearby centers such as the Catholic mission at Ntit and the leprosarium at Kabaj. Most of the complex has some type of previous infrastructure, although the public system for Musumb and Kapanga Poste has not been operational for a decade owing to the inability to buy sufficient fuel to operate the diesel-driven pumping system. Operational systems exist at Samuteb Memorial Hospital for the United Methodist mission and at the Catholic mission at Ntit. Both mission systems are very expensive to maintain because of their reliance on internal combustion engines rather than gravity-flow or hydraulic ram systems; the field study supports the empirical judgments of the missionaries that the available water sources do not have sufficient dry season flow and are located too far below the level of the inhabited areas to allow any solution other than pumped systems. Solar-powered pumps would be far more advantageous for such an isolated location far from the railroad and oil company facilities. (See Annex 4, "Detailed Technical Analysis".)

ANNEX 3.F KAPANGA - RUBWIZ ROAD

For the area situated to the west of Kapanga, a survey was carried out in the villages of Chibang and Rubwiz, situated in the watershed of the Kaongesh River. The first is located at the break in the slope of the valley and the second at the summit of the ridge. No well, traditional nor of the type adopted by the FBI, has been excavated in this region.

At the village of Chibang, the population has dug small waterholes in the alluvial deposits of the Kapasech stream, a tributary of the Kaongesh. The distance from village to waterhole varies from 500 to 800 m. The difference in altitude is of the order of 25 m.

For the village of Rubwiz, the water needed for all activities of the village community is drawn from two natural springs. The first, 700 m away on the north face and called Kej, appears at two points in a calcareous mass. The pH is 5.5, and it is 40 m below the site of the village.

The second, called Mpasej, on the south face at 800m, emerges from granite (alt. 40 m, pH 6).

ANNEX 3.F

KAPANGA - KAZOMB ROAD

The north-south road linking Kapanga to Kazomb follows the ridge line dividing the watersheds of two large rivers, the Lulua to the east and the Rumpan to the West. The tributary networks of these rivers arise in different valley heads adjacent to the plateaux on which the various villages are located.

From a general topographical point of view, this axis presents two different aspects. The first, between the villages of Chamb and Chiubu, has very little relief with a gentle slope, whereas the second, situated between Sayambu and Kazomb, has a much more broken and variegated topography. In this second section, the valleys slope steeply, and the change of elevation between plateau and valley head is around 50 m over a distance of 500 to 800m.

Because of the profile of the first area, simple wells with a depth of about 17m were dug in the past (as in Chamb and Mpand a Mwil villages). These water supplies were equipped with manual wheel-action pumps. The cylinders/casings of these pumps are still in existence.

The population does not traditionally excavate wells. Water is drawn either in the valley head or in the stream nearest to the village. According to geological characteristics, natural springs occasionally exist, and in that case are used only for drinking water. Holes, dug in the alluvial deposits of streams serve either for bathing and washing clothes or for soaking cassava and for fermenting maize for alcohol.

Note that the current dry season (August 1984) is drier than previous years. For example:

- the forests are unusually severely burned by brush fires.
- the population has had to dig new water holes nearer to minor stream beds and have to take water directly from the streams.
- at the Lulua River ferry next to the village of Chabul, the water level is 53 cm lower than last year at the same time according to the the ferryman).

We can conclude that the current dry season is outside usual norms.

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KAPANGA - KAZOMB ROAD

VILLAGE NAME	Depth	pH	WATER SUPPLY POINT Number	Name	pH	Head (m)	Dist. (km)	Remarks
CHAMB	17 (2)	blocked	4	Nkand (E) (Rov stream	5.5	30	0.8	
MPAND A MWIL	15 (1)	blocked	7	Rov (s)	6	20	2.1	granite, clay, kaolin
TSHIRUNDU			3	Rov (s)	5.5	30	1.5	
TSHIHUBU			2	Rayind (E)	5.5	25	1.2	
SAYAMB			4	Kakung (E)	5.5	40	1.1	
TSHISONG			4	Chip (S)	6	60	1.2	granite, clay, kaolin
NAMBUND			4	Nkuzu (S)	6	50	0.5	sandstone
				Kasos (S)			1.5	
				Kabwatu (E)			1.0	
				Rulong (S)	6	40	0,7	sandstone, clay.
DIBUNGU			3	Rid(S)	6	40	0.8	
				Kafuk (E)				
				Chikund				
KAMBANG			3	Mwang (E)	6	40	0.7	
				Rutand (E)	6	30	0.5	
				Kapong (E)	6	50	1.0	
NSHING a NGOMB				Ngam stream			0.5	
MWIN ISEK			1	Sawang				
MUTEMB				Rach str.		30	0.8	
TSIKENK			3	Mbumb (S)	6	30	0.5	
CHIBANU			3	Katip'tip	5.5	50	1	clay, lateritic gravel
KAZOMB			3	Kakung (E)	6	40	0.9	

ANNEX 3.G

KAPANGA - NGIMIK - KALOMB ROAD

We were unable to visit any point on this road. The bridge over the river Rushish is under construction, and this prevented us from pursuing our investigations in this direction.

According to information given by the Roman Catholic Mission at Ntit, the following villages have been equipped with wells by FBI:

Twin Ijidij
Kamwang
Ntanimb a Mbwand
Mwin Iswin
Changul
Tshinan
Kapaku
Kasar
Tshiying

for a total of nine pumps.

These wells are out of service, and we recommend that they be restored to working condition.

ANNEX 3.H

KAFAKUMBA-KIMPUKI

(KAFAKUMBA CATHOLIC MISSION)

The water supply for the medical complex, the convent and its mission annexes, and the rectory and its mission annexes comes from three hydraulic rams, of which two are in operating order. Given the size of the medical complex and the schools, it would be useful to undertake the following renovations:

-the retaining wall should be resurfaced, raised a half meter, and lengthened 30 meters to make an overall height of 1.5 meters and length of 200 meters. The additional length would serve to brace the extremities of the retaining wall.

-the lateral intake should be made of durable materials in order to give a greater retaining capacity in the artificial lake.

-the intake at the dam which supplies the head chamber should be redone.

-a new head chamber should be constructed which would include a settling tank and be protected by a concrete slab.

-protective housing should be built for the rams.

-the bed of the Wongo river, which feeds the artificial lake, should be rectified over 1.3 kilometers.

The main goal of these improvements would be to restore the operation of the third ram and prepare for the installation of a fourth. It would also be advantageous at this point to plan for new underground PVC delivery pipes and distribution network of about three kilometers. A raised steel Braithwaithe reservoir should be added. A specific technical study would determine any need for peripheral work. Note that two concrete wells (depth 15 m, diameter 1.2 m, pH 6), equipped with hand-operated pumps, are still operational at the convent. In addition, two unlined wells (depth 10 m, diameter 80 cm, pH 7) have been recently dug in the hospital courtyard. A brick curb equipped with a pulley facilitates the drawing of water.

Overall needs will be calculated based on the following information:

Boys' dormitory.....100 beds
Girls' dormitory.....100 beds
Medical Center wards..100 beds
Maternity.....50 beds
Hospice.....50 beds
Dispensary.....350 visits/day
Convent.....7 rooms
Rectory.....7 rooms
Primary school.....800 pupils/day
Secondary school.....400 pupils/day.

ANNEX 3.I

DILOLO POSTE
(DILOLO CATHOLIC MISSION)

1. There are three hydraulic rams installed at Dilolo Poste which supply respectively:

- the hospital
- -the convent and its mission annexes
- -the rectory and its mission annexes

Currently the ram for the hospital is broken.

2. There is a replacement ram in storage, but the diameter of the delivery pipe fitting on the ram is not the same as the diameter of the delivery pipe itself. The delivery pipe should be put underground. The ram housing should have a protective covering. The head pipe of 12 m length should be replaced and anchored to concrete supporting blocks. The head chamber of 0.5 m^3 capacity should be surfaced and sealed on the inside (4 m^2) and covered with a concrete slab. The junction between the bypass channel and the head chamber should be restudied and constructed out of brick. Necessary improvements should be undertaken on the 200m bypass channel so as to prevent any water loss. A solid retaining wall of 50 m length and 1 m height should be constructed.

3. Situated in the same valley, the Blake no. 4 Hydram hydraulic ram that supplies the Catholic rectory and its mission annexes is found 800 meters above the lake that feeds the hospital. The water that this ram does not deliver to the rectory and mission flows down to the ram for the hospital. For more efficient water consumption, it would be useful to build a 800 m channel of durable materials leading from the mission ram down to the hospital ram. Over the mission ram, protective housing should be built in which there would be a collection chamber for all unused water. The 100 meter-long retaining wall, through which water is drawn by pipe to the ram, should be raised a half-meter and made watertight. The same should be done for the entire perimeter of the artificial lake. In addition, drainpipes should be installed underground on the right bank to catch any ground water.

4. There is an old fish pond with a sluice-gate that is fed directly by the Dilolo River 500 meters above the retaining wall in the same valley. The valley's water system suffers considerable water loss through seepage. This in turn hinders the efficient functioning of the rams. A general technical study of the valley from its source to the hospital ram should be made as to the feasibility of placing three hydraulic rams parallel to each other to serve the surrounding population, including roughly 2000 refugees camped around the hospital, the hospital itself (300 beds), and the dispensary (300 visits/day).

5. The convent and its associated facilities (school, etc.) also gets its water from an artificial lake formed by a dike feeding water into a Vulcam-Ram 4L hydraulic ram. In this case, the entire infrastructure is in good condition and functions normally. Further improvements in water collection on the Kakuzenze stream and the raising of the retaining wall by one meter would increase the water capacity of the lake and permit the installation of a second ram. The 1.3 km of delivery pipes should be replaced and put underground.

The existing metal tanks should be repainted and made watertight. In this way, the convent and its mission facilities would be supplied with water individually and permanently. Here again a technical study will have to be made in order to estimate the amount of work to be done.

ANNEX 3.J

SAPINDJI - MAZAU ROAD

The organization of this visit was based on a 1956 map, which located the different villages. At the end of our survey, it became apparent that many villages (such as Samuyinga, Sakaseshi, Liyi, Mwandoji) were either destroyed during the war or have been abandoned in accordance with Chokwe custom on the death of the chief. The villages still in existence--Chingungu, Sahundu, Kaboka, and Dilombe--are very small. The population is around 50 per village which are spread out along the whole length of the road.

The data relevant to the survey are the following:

NAME OF VILLAGE	POPULATION	NAME OF RIVER	Alt (m)	pH	Dist. (km)
CHINGUNGU	57	Chilefu	10	6	1.8
SAHUNDU	15	Kasumbo	15	5.5	1.2
KABOLA	30	Luiyi	20	5	1.8
DILOMBE	63	Popi	10	6	1.2

For all these water supplies, the population seeks its water in holes dug along the edge of the river bed in the alluvial layer. The water hole may be moved if the hole dries up in dry season. In general, one watering-place suffices to supply a group of approximately 60 people.

The survey indicates that a general project should be prepared for the acquisition of the latest aerial or satellite photos and these in both black-and-white and infrared, so as to verify the actual distribution of the rural habitation.

ANNEX 3.K

KAFAKUMBA LAKE

Because of the location of the United Methodist medical complex and other facilities at Kafakumba Lake, the only possible water supply is the lake itself, where the population goes daily to draw its water.

A project based on the lake is conceivable, seeing that the difference in altitude between lake level (measured in August 1984, a year considered exceptionally dry) and the highest point on which construction has taken place, is a mere 20 m. Walking distance from the lake to the highest point is 900 m.

We suggest the following:

an intake in the lake at a distance of 25 m from the shore, to pipe water from a depth beyond human and animal pollution.
a sump in which would be placed a submerged electric pump powered by solar panels; this sump would have first a settling and filtering compartment and then another compartment for actual pumping.
a delivery pipe feeding a storage reservoir situated on the highest point, with a gravity distribution network supplying the different medical, educational, and residential complexes.

ANNEX 3-L

KASAJI-CHISENGAMA HOSPITAL (GARENGANZE MISSION)

A Blake Hydram No. 4 hydraulic ram has been installed below the hospital at a distance of 1 km. Water from Kamaninga stream is stocked in an artificial lake. The retaining dyke is 70 m long and 1.5 m high. Its integrity leaves much to be desired, with considerable seepage. The canal leading to the head chamber, 80 m long x 1.5m wide x 0.5 m high, needs repair and cleaning. The lateral intake from the dike to the canal must be constructed in permanent materials and fitted with a sluice gate. The head chamber, constructed in brickwork, 3m wide x 5m long x 1m deep, has two compartments of 1 m x 2 m.

From a hydrological point of view, the junction of the canal at the chamber needs to be restudied. The delivery pipe, in 3 1/2 inch steel, is 20 m long and there is 3 m difference in level between ram and head-chamber. This pipe needs replacing.

The head between the ram and the reservoir is 25 m. The reservoir's capacity is 10 m^3. Water is not supplied to the hospital because no delivery piping exists.

Above the dike, at 500m distance, is a former fish pond supplied by natural seepage. This seepage could easily be piped, the fishpond could be restored and the stream course between the pond and the holding basin should be cleaned up and restored.

The main purpose of the works would be to store a maximum of water to feed the ram; installation of a second ram would also be possible. The storage reservoirs should be restored to like-new condition, and the overall distribution system overhauled.

A general study defining the various work needed should be undertaken for the whole of the medical complex. Near the leprosarium is a 15 m deep, concrete well equipped with a windmill (Stewards and Lloyd brand) but with the pump mechanism broken. The blades turn, and the linkage functions. At the hospital entrance is a second well in the same condition. These two wells should be rehabilitated, as should a 12 m deep concrete well equipped with a lever-action pump (also Stewarts and Lloyd brand) which is out of service.

ANNEX 3.M

KASAJI-LUEO

The Roman Catholic Mission complex at Kasaji is fed by two rams in parallel, both in working order. The installation is classic: retaining wall, bypass channel, head-chamber. The difference in height is 3.5 m.

In order to improve the water quality, the following work should be undertaken:

- sealing and restoring the dike
- repairing and sealing the head-chamber
- calibrating and restoring the bypass channel
- construction of a proper lateral intake at the dam.

Once these improvements are completed, it would be possible to install two more rams, supplying two new reservoirs, one for the future public health training center and the second for the tuberculosis wards. The two existing steel reservoirs are in good condition.

A decent-sized spring situated below the dam and to its right (its flow is of the order of 1 litre a second) could also be developed as a water source for the population living alongside the dam. There are also four wells within the hospital grounds which should be equipped with pump systems.

A technical study defining all work needed should be made, taking into consideration:

Dispensary:	170 beds
	350 visits/day
Maternity Annex:	60 beds
Tuberculosis wards:	120 beds
	300 visits/day
Hospice:	10 beds
Training Centre:	
Guest House:	20 beds
Boarding School:	100 beds
Houses:	2 units

ANNEX 3.N

KASAJI GARE (TOWN)

Several wells have been excavated at Kasaji. Their average depth is 9 m. Water is drawn by bucket and cord. The water's appearance is murky, its pH 5.5. The wells' diameter is 1 m, and the top of the well is generally fitted with a half-drum protected by a metal cover. These wells could be improved by being deepened and having filters and pumps installed.

ANNEX 3-O

BUNINGE AGRICULTURAL INSTITUTE

This agricultural institute is in Chanika village 5 km north of Kasaji on the road to Sandoa. The institute is no longer supplied with water, although the infrastructure still exists for two hydraulic rams, one of which is still in place although out of service.

The work required includes:

- restoration and raising by 0.5 m of the dam
- rebuilding of the 2 km bypass channel
- construction of a lateral intake at the dam, fitted with sluice gates
- construction of a head chamber
- repair of the existing ram and installation of a second
- installation of 700 m of delivery pipe to the existing steel reservoir, which needs restoration
- distribution system

Following this work on the hydraulic infrastructure, a third ram could be envisaged. A technical study of this project should also be undertaken, so as to specify the amount of work to be done.

ANNEX 3.P

MALONGA TOWN

This large center on the Dilolo-Kasaji road, a former administrative post for Lualaba Sub-Region, has no water supply infrastructure. The population takes its water from the Lukoshi River 1.2 km away. The difference in altitude between the river and Malonga is 40 m. A program of deep boreholes should be undertaken for this center.

ANNEX 3-Q

KASAJI-SANDOA ROAD

An inventory was taken for some villages situated along this road.

VILLAGE NAME	WELL		WATER SUPPLY POINT.			
	Depth	pH	RIVER	Head (m)	Distance (km)	pH
MADIDI	17	dried up	Valley			
			Kampemba	25	1.2	5.5
MULUNDI	10	-	Kajileshi	20	1.3	-
CHIMBAYEKE	10	6	Kajileshi	15	1.5	-
KASENGULA (3)	12	-	Nzala	-	1.0	-
LUMBIDI	-	-	Lufubu	25	0.9	-

As in the other sites visited, drinking water is taken from holes dug in the alluvium of the nearest river. Local wells around 10 m deep are dug for brick-making.

A program of wells and boreholes equipped with manual pumps should be envisaged for the villages along this road.

ANNEX 3.R

KATOKA

The Garenganze (Plymouth Brethren) mission at Katoka had not yet been visited at the time the preliminary reports were submitted. The mission consists of two modern houses and a number of national staff dwellings, a large maternity, in-patient wards, a tuberculosis camp, primary and secondary schools, and various associated minor projects. A second, state-operated secondary school is located nearby. The existing water system consists of two artificial streams on the Katoka stream, both stocked with fish, with the upper lake being protected by diversion channels from surface runoff and feeding a Blake Hydram hydraulic ram. A reservoir is located in the medical center complex. The system is functional, although water no longer reaches all the medical center facilities; in August 1984 water had been temporarily cut off short of the reservoir because of recent damage to the supply pipe where it crosses under the Dilolo-Kasaji road.

ANNEX 4

DETAILED TECHNICAL ANALYSIS

Introductory Note: The field survey is currently in process, and all results for the Sub-Region are yet not available. Certain figures below are simply extrapolations of the data collected in the two administrative zones. These figures will be refined in the final AIDR report. Provisional figures are given in parentheses.

A. INTRODUCTION

1. The purpose of this project is to improve the water supply system of the refugee area of Southwestern Shaba.

2. Lualaba Sub-Region forms the western part of Shaba Region. Bordered on the west and south by Angola, it extends in length more or less 400 kms from north to south and about 200-250 kms in width.

3. The sub-region is subdivided into three administrative zones: Kasanga to the north, Sandoa in the center, and Dilolo in the south.

Scientific surveys during the fourth quarter of 1983 revealed the following:

ZONE	km^2	POPULATION	DENSITY PER KM^2
Kapanga	24,476	75,692	3.1
Sandoa	29,608	106,780	3.6
Dilolo	25,330	212,925	8.4
Lualaba	79,414	395,397	5.0

4. In addition to the resident Zairian population, there are a number of Angolan refugees who have been fleeing their country for more than 20 years

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but especially in the last year; they have settled in Zaire for an undefinate period. At the present they have settled in two camps, one in Dilolo with 15-18,000 and the other in Kisange with 2-3,000 according to information from UNHCR, Zairian authorities, and religious missions. It appears that the refugees continue to immigrate despite the disastrous conditions they face in Zaire; in particular, they do not have access to potable water.

5. In the past, few installations (wells with hand pumps, gravity flow systems, diesel pumps or other systems) provided potable water to the populace regrouped in villages in the entire Sub-Region. At present water supply installations in working order are rare. With the exception of the piped systems in the towns of Sandoa and Dilolo that are managed by Regideso, the only functioning systems are those under the direct responsibility of missions. The result is that in August 1984 almost 400,000 inhabitants of the sub-region plus some 20,000 Angolan refugees did not regularly have access to potable water, other than when they went to a hospital, a mission or a privileged site such as Sandoa or Dilolo.

6. In fact, following the deterioriation of former installations (through lack of maintenance and repair and the 80 Day War in 1977) the people had three remaining possible supply sources:

- Rivers, ponds, swamps
- Slightly-improved springs at the heads of valleys and water holes in alluvial zones
- Local wells of 8 to 20 meters without lining, cover, or bucket in well.

The three supply sources provide a poor quality of water due to the fact that they are not protected from flooding and surface contamination.

7. Personnel responsible for the Sub-Region's hospitals and medical centers insist that there has been considerable increase in water-borne diseases, contributing along with other causes of diseases (malnutrition, mosquitoes, bacteria, etc.) ; treatment being more and more complex and considerably weakening the patients, particularly young infants.

8. In addition, the condition of women has deterioriated. They have to walk long distances to reach a water supply which is always located at a lower elevation (normally 800-1500 meters one way and 20-50 meters downhill). Women and children are those who must bear the burden of fetching water.

9. The sub-region is considerably under-populated: normally only 5 persons per km^2. Large portions of the region remain uninhabited, with most of the population concentrations (from tens to hundreds of residents) situated along the roads. "Villages" are the important centers, according to the number of residents. The rest of the population live in hamlets of some tens of residents.

The following preliminary analysis summarizes the population distribution:

Administrative Unit		Districts		Villages		Hamlets
	Residents	Nb	Residents	Nb	Residents	Residents
Kapanga Zone	75,692	4	21,325	28	25,000	29,367
Sandoa Zone	106,780	3	4,842	77	51,000	50,938
Dilolo Zone	212,925	4	(26,000)	(150)	(100,000)	(86,925)
Lualaba S-R.	395,397	11	(52,167)	(255)	(176,000)	(167,230)

* Numbers in parentheses are provisional and will be corrected in final report.

The potable water supply program will concentrate on towns and villages, first because these are the most stable inhabited sites, and secondly because these villages will in the long run become consolidation points for surrounding hamlets.

B. SCIENTIFIC DATA

Annual precipitation (torrential rains from September through April, 5-6 months of dry season from April to September Rainfall somewhat less abundant in the south)	1200-1500 mm
Normal temperatures: May, June, July ave. minimum	20°
September, October ave. minimum	24°
Average annual insolation	2,500 hours

C. AQUIFER RESOURCES

1. Interfluvial aquifers:

This is the table reached by the wells dug (by FBI, AIDR, or villagers) on the plateaus. The table overflows at the seepage level at the head and along the sides of the valleys which surround the plateaux. For the most part, the quality of the water supply is poor: low permeability of the aquifer, low flow, and high seasonal variation. However, one should not dismiss it completely so far as it is possible to sink wells at the consuming location and where water is obtained at shallow depth (an average of 10 to 30 m.; deeper in the north). In certain instances these tables may be of better quality, when the aquifer is formed of geologically recent sand deposits or of sandstone.

Many wells have previously been dug to reach these layers. They are lined with cement culverts (800 mm in diameter). The pumps are beyond repair, but it is estimated that 120 to 150 are repairable.

Planning should also foresee exploiting springs at the head and along the sides of the valleys.

2. Alluvial aquifers:

Alluvial or colluvial aquifers, these are more or less associated with

the previous deposits and are sometimes fed by the rivers. Here there is the possiblity of tapping the aquifer with long trenches which can drain off larger flows for use than from the interfluvial aquifers above. The problem is that these sites are at a distance from the villages, which presents problems of pumping or of carrying distance.

3. Surface Water

It is plentiful, but its use requires water treatment. This water source also has the same problem as the preceding one of pumping or travel distance for users.

Conclusion

Throughout Lualaba Sub-Region water availability is not a problem. The difficulties are rather a question of rational techniques to make use of the available water supplies.

II. WATER NEEDS AND MEANS OF SUPPLY

At the present time, water consumption in the area is very low because of transportation: a few liters a day per person. Bathing and laundry are normally done at the water source which a few hundred meters from the houses.

The calculation of water supply needs which will be satisfied by implementation of the present project has been based on the following factors:

1. In the rural areas, potable water supply for villages and hamlets will be ensured in part through wells with hand pumps located within the village itself and, for the rest, through capped springs below the villagess and located 200-1000 m from the houses. The daily productivity of wells is low: about 3-4 m^3. (In regions with sandy soils or sandstone bedrock, the productivity is much higher, but these regions seem to be the least populated.) Therefore, we suggest that well water be reserved for cooking and that laundry and bathing continue to be done at the springs, appropriately improved for this.

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In this case, the daily needs of the population can be divided as follows:

Wells:	10 l./day/person
Springs:	20 l./day/person
Total:	30 l./day/person

In this case, a well can supply 300 persons per day and a spring 200-500 according to its location. When new wells are necessary, 8" or 12 1/4" boreholes are preferable, using PVC lining; these can reach the bedrock aquifers and thus increase the useful flow to the well.

2. In towns or points of polarization with medical, social, educational, or administrative facilities, potable water supply has been studied case by case. Various techniques can be used: gravity-flow piped systems, piped systems with pumps (solar, hydraulic ram, or diesel), dug wells, springs, boreholes.

Water supply needs have been calculated as in the following table:

Type of water source	Unit type	User	Need (l/day)
Public tap	Residential area	Resident	20
Well (dug or bored)	" "	"	10
Spring	" "	"	20
Interior faucet	Hospital, dispensary	Bed patient	100
" "	" "	Visitor	20
" "	School dormitory	Boarder	50
" "	Modern house	Family	100

III. PROPOSED IMPROVEMENTS

A. KAPANGA ZONE

1. Traditional villages and hamlets

The 28 largest villages have a population of 25,000; 13 among them have or will have a local rural heal center with qualified medical personnel.

Another 29,000 people are located in hamlets of lesser size. We propose the following improvements in considering that the 28 large villages have priority and that potable water supply for today's dispersed hamlets should be done is such a way so as to encourage consolidation of several of them.

		Phase 1 28 villages	Phase 2 Hamlets
Residents		25,000	29,000
Daily water needs (m^3)		750	870
Rehabilitation of old wells and of equipment (hand pumps)	Number	20	5
	Usable daily volume (1)	60 l.	15 l.
New boreholes with PVC liners and hand pumps	Number	40	55
	Usable daily volume (2)	200 l.	275 l.
Spring capping	Number	65	75
	Usable daily volume (3)	520 l.	600 l.
Total usable daily volume:		780 l.	890 l.

(1) at the rate of $3m^3$ per day

(2) at the rate of $5m^3$ per day, considering the techniques used

(3) depending on the output of the capped source. An average source output is considered to be that which can supply 400 persons per day with 20 liters of water, or $8m^3$ per day.

In other terms:

Phase 1: 20 rehabilitated wells
40 new boreholes
65 new capped springs
for 780 m^3/day and 2600 potential users

Phase 2: 5 rehabilitated wells
55 new boreholes
for 890 m^3/day and

40X

A third phase should be planned to take into account population growth in the zone.2.

TOWNS

Kalamba:

An important educational center with dispensaries and missions at the northeast corner of the zone. Kalamba was inaccessible from Kapanga during our tour because of a bridge under reconstruction over the Rushish River.

Musev

A polarization point at the northwestern edge of the zone because of its role as a stopover point in the diamond trade out of neighboring Angola.

Kapanga Poste-Ntit-Musumb complex

An urbanized complex in the west-central part of the zone over a distance of over 10 kilometers. The seats of both central and traditional government are found here, as well as two hospitals, several primary and secondary schools, and the missions. The potable water supply of these three areas will have to be made the object of specific additional studies. We have identified the daily needs and the improvements necessary to meet these needs for the Kapanga Poste-Ntit-Musumb complex, to which was added the leprosarium at nearby Kabaj.

2.1

DAILY NEEDS

Name	Structure	Consumers	Number	Rate l/day	Needs m^3/day
Mwin Kapang	village	residents	400	30	12
Kapanga Poste	residences	families	20	500	10
DATSCO	factory	workers	-	-	-
Kaleng	village	residents	800	30	24
Ntit	hospital	beds patients	250	100	25
		companions and visitors	250	20	5
	school	proposed boarders	(200)	(50)	(10)
	apprenticeship	day students			
	cathechist school	boarders	100	50	5
Samuteb Memorial	hospital	beds	224+20*	100	25
		visitors	125	20	2.5
		families	10	500	5
Musumb (taps)	town	residents	15,000	30	450
Musumb (private houses)	residences	families	80	500	40
Kabaj	leprosarium	patients and families	200	50	10

Total daily needs for all of Kapanga-Musumb: 623.5

* planned for 1985

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2.2 PRESENT WATER SUPPLY INSTALLATIONS

DATSCO Piped Water System

Cotton gin which is expected to reopen in 1985.
The existing water system is out of order:

- pump in the alluvial deposit of Nkat stream;
- electric pumping station, pumping to a Braitwaithe reservoir (3 X 2 X 1 = 8.5 m^3)
- distribution system for the factory, management and worker housing, and one public water supply point.

The factory owner plans to rehabilitate the piped water system in 1985.

Kapanga Poste/Musumb Piped Water System

The old water system that functioned in the 1960s and 1970s has been out of order for many years:

- Water intake constructed by FBI in the alluvial deposit of the Raz; to be rebuilt;
- :oncrete storage and pumping reservoir (15m^3); to be rehabilitated;
- ›umping station in pieces; to be completely rebuilt;
- :eservoir supply pipe of galvanized steel, above ground, 2.7 km for 60 m ›f rise; to be checked.
- ıping to a Braithwaithe reservoir (6x5x3=145m^3) raised 9 m off the ›und. It is in good shape but needs to be repainted.
- ıtribution to: Musumb (5 public taps and to a few modern houses)
  Ntit (supplying the school)
  Kapanga Poste (4 public taps)

The pipes are underground, the public taps are in a deteriorated state, and the entire system needs to be checked.

Ntit Medical Center Piped Water System

- There are two wells in a small dry valley to the south of the hospital, each with a depth of 6 m that give very little water in the dry season (1.2 m^3/day).
- Pumping station: diesel motor pump.
- Delivery to a metal water tower elevated 8 m with a capacity of 6 m^3.
- Distribution to the hospital.

Here the problem is not the network itself, which is in good condition; it is the availability of water. The intakes must be made larger and deeper. The use of solar panels powering an electric engine is suggested so that fuel shortages will not affect the quantity of water supplied.

Ntit Catholic Mission Piped Water System

The water supply is of the same type as the preceding:

- wells in a dry valley to the north of the mission
- electric pumping station
- delivery to a raised reservoir.

The installation works. The missionaries plan to install a ram on the Raz stream for the convent in 1985.

Samuteb Memorial Hospital Piped Water System

This supply system is still in service:

Dr. Piper's spring at the head of the valley from a tributary of the Raz stream. The spring is not protected and delivers 0.5 l/s of water at the height of the 1984 dry season. Water collection could be increased and made more efficient; water output could be doubled. A protective perimeter is of the utmost importance.

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- ground-level circular reservoir (25 m^3) without protective covering.

- pumping station: gasoline motor pump (5 m^3/h)

- delivery system: 510 meters of 2" galvanized pipes above ground; this needs to be protected

-Braithwaithe water tower (3x3x2=28m^3 capacity); water head of 40 m

As in the case of Ntit Medical Center and for the same reasons, photovoltaic equipment would suit the needs of this hospital.

Palace Piped Water System

The old supply system is totally destroyed. Only the Braithwaithe reservoir raised four meters off the ground on fieldstone walls at what is now the police station is recuperable.

Other Installations

Three FBI wells:

-one at the Catholic mission in Musumb (30 m?)
-one at the Catechist Training Center at Ntit (30 m?)
-one at the Catholic mission in Kapanga Poste (18 m).

The well at the Kapanga Poste mission works, but only in the rainy season. The other two do not work anymore.

Conclusion: Present Water Supply

Kapanga, Kaleng, Musumb and Kabaj residents have been forced to draw their water from sources in the surrounding valleys. This water cannot be considered as potable. The medical center at Ntit receives 2 m^3 of higher quality water per day. The Samateb Memorial Hospital's water supply is currently limited by a fuel shortage. When fuel supply is not a problem, the hospital receives 15 m^3 of water per day--less than a third of needs, considering the number of beds and other water users (dormitories, houses) on the piped system.

2.3. PROPOSED IMPROVEMENTS

Besides well rehabilitation, new boreholes and spring capping, three possible solutions have been studied:

- restoration and expansion of existing facilities
- survey of gravity-feed, hydraulic ram, and pumping sites
- exploitation of the Rushish falls 16 kilometers from Musumb.

Considering the large amount of current water needs (close to 625 m^3/day), all possible solutions should be developed, but the investment costs make it beyond the scope of the present project to finish all the necessary work. It is for this reason that we now define two phases:

- the first consisting of all work capable of being accomplished in the scope of the present project; and

- the second consisting of all work not capable of being accomplished in this project and for which financing from other sources will have to be found.

Phase 1

1.	Capping of 12 springs	96 m^3
2.	Rehabilitation of 3 wells	9 m^3
3.	Execution of 3 drillings	15 m^3
4.	Improvements to pumping station and on water collection at Samuteb Memorial Hospital	35 m^3
5.	Improvements to pumping station and on water collection at Ntit medical center	30 m^3
6.	Capping of Raz stream springs (2.5l/s at low water point)and delivery by gravity to existing reservoir; distribution within Musumb (40 houses, 20 faucets)	216 m^3
	TOTAL	401 m^3

Beneficiaries: - 2 hospitals
-40 modern houses
-10,500 users of public taps

Phase 2

A full comparative study is necessary among the possible solutions which we have identified above:

Rehabilitation of the intakes and pumping station at the Raz stream (note that installation of a ram is planned for 1985 to supply the Roman Catholic mission and the trade school at Ntit.

Tapping water supplies from the Nkat stream and in the Lulua River flood plains with pumping station to supply Kapanga Poste and Kaleng.

Tapping the water supply of the Rushish in conjunction with a small hydroelectric plant supplying the entire Kapanga-Musumb complex by gravity.

The choice will be made in terms of the evolution of demand, technology, and costs between now and the date of such a study.

3. TABULAR SUMMARY: KAPANGA ZONE

Location		Phase 1	Phase 2	Phase 3
Traditional village	Proposed works	20 rehabilitated dug wells 40 bored wells 65 capped springs	5 rehabilitated dug wells 55 bored wells 75 capped springs	According to the evolution of demand
	m^3/day	780	890	
	Users	26,000	30,000	
Towns	Studies	Kalamb, Musev, Musumb 1st & 2nd phases	According to demand	
	Proposed works	Musumb 1st phase: 12 capped springs 3 dug wells 3 drilled wells	Kalamb, Musev, Musumb 2nd phase	Musumb 3rd phase
	m^3/day	400	415	
	Users	10,500	8,200	
Kapanga Zone (Total)	m^3/day	1,180	1,305	
	Users	36,500	38,200	

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B. SANDOA ZONE

1. TRADITIONAL VILLAGES

A total of 77 villages, ranging from 250 to more than 1500 inhabitants, were counted, for a total of approximately 50,000 inhabitants. Sixteen among them currently have or in the immediate future (1984-1985) will have rural dispensaries. Another 46,000 people are scattered in hamlets of smaller size.

The following works are suggested, taking into account that the 77 villages have priority and that drinking water supply to the dispersed hamlets should be carried out so as to favor consolidation of these hamlets into new central villages:

		77 Villages	Hamlets
Residents Population		50,000	46,000
Daily needs (m^3)		1,680	1,380
Restoration of old dug wells (rehabilitation of hand pumps, other equipment)	Number	50	10
	Available capacity:	150 m^3/day	30 m^3/day
New boreholes with PVC tubing, hand pumps	Number:	85	85
	Available capacity:	425 m^3/day	425 m^3/day
Spring capping		140	120
	Available	1,120 m3/day	960 m3/day
TOTAL AVAILABLE CAPACITY (m^3/day)		1,695	1,415

or in other terms:

First phase: 50 dug wells rehabilitated 85 new boreholes 140 newly capped springs	For a total of 1695 m^3/day and 56,500 users
Second phase: 10 dug wells rehabilitated 85 new boreholes 120 newly capped springs	For a total of 1615 m^3/day and 47,000 users

2. TOWNS

Here it a question of the following points of polarization:

Sandoa: administrative seat of the Zone, hospital, Catholic mission, important commercial center. Sandoa is supplied by REGIDESO through a gravity system; drinking water supply of this town is not, in principle, the responsibility of this project.

Mwajinga: United Methodist mission center, central dispensary with maternity, technical secondary school, teacher-training secondary school (1000 boarding students).

Chibamb: Administrative center of a collectivité, at the extreme northern limit of the Zone; small Catholic mission without) resident priest), dispensary, schools, polarization point for the left bank of the Lulua River.

Kafakumba: Medical, social, school, and religious center in the eastern part of the Zone but with three discrete centers at 15 km intervals along east-west road (Kafakumba-Kimpuki for the Catholic mission, Kafakumba Poste for shops, administration, and schools; and Kafakumba Lake for the United Methodist mission with medical and pastor-training programs).

2.1. WATER SUPPLY NEEDS

Location	Unit type	Consumers	Number	Volume (l/day)	Needs (m^3/day)
MWAJINGA	Village	Residents	300	30	9
	Mission	Families	20	500	10
	Dispensary, Maternity	Beds	50	100	5
	Secondary schools*	Boarders	1000	30	30
TOTAL:					54
CHIBAMB	Village	Residents	1012	30	30
	Dispensary	Visitors	250	20	5
TOTAL:					35
KAFAKUMBA-KIMFUKI	Hospital, dispensary	Beds	200	100	20
		Visitors	350	20	7
	Secondary schools	Boarders	200	50	10
	Mission	Houses	2	500	1
TOTAL:					38
KAFAKUMBA LAKE	Maternity, dispensary	Beds	100	100	10
		Visitors	150	20	3
	Pastors School	Boarders	100	50	5
	Mission	Houses	4	500	2
TOTAL:					20

*The boarders are housed in traditional huts.

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2.2. PRESENT WATER SUPPLY INSTALLATIONS

Mwajinga:

- Changombe spring capped with a hand pump.

- Kayunyakana stream dammed. Intakes need rebuilding, pumping station destroyed; 850 m of main pipe to a Braithwaithe water tower (3x2x2 or 19 m^3 capacity) plus a cistern (8 m^3), both at 7 m elevation and both reparable; distribution system to all houses and major points.

- Several reparable wells (10-12 m depth) but with old pumps destroyed.

Chibamb:

- One dug well (14 m) in the center of the town; it is unused, and the residents carry water from the Lulua River.

Kafaoumba-Kimpuki:

- Piped water system by 2 hydraulic rams, but with supply channel and piping system to water tower needing improvements to avoid large water losses.

2.3. PROPOSED IMPROVEMENTS (see detailed description in annex):

Mwajinga:

- Rehabilitation of existing system with study for a solar pumping system
- Intake of 1 l/s
- Storage reservoir
- Pumping of 55 m^3/day
- Repairs to distribution system

Chibamb:

- Rehabilitation of dug wells:	3 m^3
- Capping of 3 springs:	24 m^3
- 3 new boreholes:	15 m^3

Kafakumba-Kimpuki:

- Rehabilitation of existing system	
- Addition of 2 additional ~~rams~~:	32 m^3
- Rehabilitation of 2 dug wells at hospital	6 m^3

Kafakumba Lake:

- Intake from lake	
- Pumping station with solar power	15 m^3
- Water tower or other storage	
- Distribution	

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3. TABULAR SUMMARY FOR SANDOA ZONE

		Phase 1	Phase 2
Traditional villages	Works	50 rehabilitated dug wells 85 boreholes 140 capped springs	10 rehabilitated dug wells 85 boreholes 120 capped springs
	m^3/day	1,695	1,415
	Users	56,500	47,000
Towns	Studies	Mwajinga Kafakumba-Kimpuki Kafakumba Lake Pilot projects at dispensaries	
	Works	3 dug wells 3 boreholes 3 capped springs 3 distribution systems	
	m^3/day	150	
	Users	1,450	
Sandoa Zone Total)	m^3/day	1,845	1,415
	Users	57,950	47,000

C. DIDLO ZONE

Introductory Note: The field survey is currently in process, and all results for this zone are yet not available. Certain figures below are simply extrapolations of the data collected in the other two administrative zones. These figures will be refined in the final AIDR report. Provisional figures are given in parentheses.

1. TRADITIONAL VILLAGES

We estimate that (150) villages group about (100,000) inhabitants, of which (30) villages have or will soon have a rural dispensary. (Note by design team: 15-20 seems a more reasonable figure for rural dispensaries on the basis of data for the related Shaba Refugee Health Infrastructure Project). Another (70,000) inhabitants are dispersed in hamlets of smaller size. We propose the following works with the idea that such a proposal should favor consolidation of these hamlets into new central villages.

	First Phase	Second Phase
Residents Villages	(150) villages	Numerous hamlets
Population	100,000	70,000
Daily needs (m^3)	3,000	2,100
Recuperation No of former wells	58	20
m^3/day	175	60
Boreholes Number	185	130
m^3/day	925	650
Capped springs Number	260	180
m^3/day	2,080	1,440
Total available water volume - m^3/day	3,180	2,150

or, in other terms:

First phase: 58 dug wells rehabilitated:
185 new boreholes:
260 capped springs

For a total of 3120 m^3/day and 106,000 potential users

48X

Second phase:	20 dug wells rehabilitated: 130 new boreholes 180 capped springs	For a total of 2150 m^3/day and 71,500 potential users

2. TOWNS

Here it is a question of the following points of polarization:

- Lilolo Gare. This modern town, the rail and road port-of-entry from Angola along the Benguela Railroad and the administrative and commercial center of the Zone, has an existing REGIDESO water supply and thus its drinking water supply does not enter into the present study's frame of reference.

- Dilolo Poste. The former administrative center still houses the Roman Catholic mission and a small commercial zone. The Catholic medical center is currently overwhelmed with Angolan refugees, housing several times its normal full capacity.

- Kasaji-Chisengama. A Garenganze mission is located adjacent to the administrative center of Chisengama collectivité, including a hospital and primary and secondary schools.

- Katoka. A Garenganze mission is located between Kahundu station and the large village of Sambembe. It consists of a large medical center, with maternity, inpatient wards, tuberculosis sanitarium, and secondary schools.

- Kasaji-Lueo. Roman Catholic mission, including a large medical center.

- Kasaji Gare. Large town around the railway station at an important road junction; currently the administrative seat for the entire Lualaba Sub-Region; completely without satisfactory drinking water supply.

Finally, we note the existence near Dilolo of a large camp of Angolan refugees (appriximately 17,000) completely lacking safe drinking water supply. An urgent need exists for action, with UNHCR willing to provide financing.

2.1. WATER SUPPLY NEEDS

Location	Unit type	Consumers	Number	Volume (l/day)	Needs (m^3/day)
Dilolo Poste	Hospital	Beds	200	100	20
		Visitors	200	20	4
		Refugees	1000	10	10
	Village	Residents	500	30	15
TOTAL					49
Kasaji-Chisengama	Hospital	Beds	(250)	100	25
		Visitors	(200)	20	4
	Schools	Boarders	(400)	50	20
	Village	Residents	1000	30	30
TOTAL					79
Kasaji-Lueo		Beds	120	100	12
		Visitors	150	20	3
	Mission	Houses	4	500	2
	Village	Residents	300	30	9
TOTAL					26
Kasaji Gare		Residents	(8000)	30	240
Buninge Agri-cultural Institute	Secondary school	Boarders	(500)	50	30
	Houses	Families	10	500	5
TOTAL					

49X

2.2. CURRENT WATER SUPPLY INSTALLATIONS

Dilolo Poste:

- One functioning hydraulic ram operating with fair efficiency only; the stream intake, supply pipe and supply chamber for the ram are in poor condition.

- One hydraulic ram site with former ram recently removed in inoperable condition; other accessory installations as above

Kasaji-Chisengama:

- Nothing functioning at this time

Kasaji-Lueo:

- Two hydraulic ras currently in service

Kasaji Gare:

- No modern installation of any kind

Bunincge Agricultural Institute:

- No modern installation of any kind

2.3. PROPOSED IMPROVEMENTS

Dilolo Poste:

- Rehabilitation of existing infrastructure
- Addition of additional hydraulic rams

Kasaji-Chisengama:

- Spring capping
- Rehabilitation of former infrastructure
- Rehabilitation of two windmills — 6 m^3
- New supply piping to water towers — 60 m^3
- New distribution piping

Kasaji-Lueo:

- Rehabilitation of 4 wells — 12 m^3
- Rehabilitation and extension of existing distribution system — 30 m^3

Kasaji Gare:

- Drilling 16 boreholes:
- Capping 20 springs: — For a total of 240 m^3

- Installation of hydraulic rams, supply piping, water tower, distribution system: — 40 m^3

3. TABULAR SUMMARY FOR DILOLO ZONE

Location		Phase 1	Phase 2
Traditional villages	Works	260 capped springs 58 rehabilitated dug wells 185 boreholes	180 capped springs 20 rehabilitated dug wells 130 boreholes
	m^3/day	3,180	2,150
	Users	106,000	71,500
Towns	Studies	Dilolo Poste Kasaji-Chisengama Kasaji-Lueo Buninge Ag. Institute	
	works	6 dug wells, 16 boreholes, 20 capped springs 4 piped water systems	
	m^3/day	450	
	Users	10,100	
	m^3/day....	3,630	2,150
	Users	116,100	71,500

D. TABULAR SUMMARY FOR LUALABA SUB-REGION

Location		Phase 1	Phase 2
Traditional villages	Works	465 capped springs 128 rehabilited dug wells 310 boreholes	375 capped springs 35 rehabilitated dug wells 270 boreholes
		5,655	4,455
	Users	188,500	148,500
Towns	Studies	Musumb, Kalamb, Misev, Mwajinga, Kafakumba (2), Dilolo Poste, Kasaji (2) Buninge Agricultural Inst. Pilot projects with rural health centers	
	works	35 capped springs, 12 dug wells, 22 boreholes, 10 piped water systems	3 piped water systems + ?
	m^3/day	1,000	415
	Users	22,050	8,200
Total	m^3/day	6,655	4,870
	Users	210,5	156,700

51X

This project proposes to undertake Phase 1 as its first priority. According to the funding availability, it may be possible to undertake Phase 2 as well. For the moment, proposals are based on complete implementation of Phase 1.

Some 210,550 residents will be supplied at public distribution points at an overall rate of 30 liters per person per day. They will also benefit from medical, social, administrative, and educational facilities improved through adequate water supply.

ANNEX 5

DETAILED FINANCIAL ANALYSIS

1. General Issues

For each project component, the budgets for investment, upkeep, maintenance and operating costs are estimated both in sum totals and by year.

The cost estimates are conservative and expressed partially in US dollars and partially in zaires.

The rate of exchange applied is $US1 = Z37. Annual costs are presented in constant dollars, based on prices in effect in October, 1984.

2. Technical Assistance

General considerations that define the role of the technical assistance staff are the subject of Annex 8. In summary, a team of three experienced expatriate staff members will be made available for five years for a total of 156 person-months of service. In addition, 15 months of short-term technical assistance is programmed.

For the financial estimates, provision has been made for each expatriate staff member to live in the town of Sandoa in a house provided by Zairian government authorities. After a ten month period, each staff member will be eligible for fifteen days of local leave. After twenty months in Zaire, the consultant and his family will be allowed to return to Europe for two months overseas leave, with the expenses for air travel and excess baggage charged to the project.

Expenses for air travel and per diem have also been planned for the consultant's assignments. The short-term advisors will spend two months in the field, with the remaining month set aside for general management of the project and for the finalization of particular project studies (years one, two and three). For years four and five, a one and one half month assignment is foreseen. The basis for the cost estimates for the technical assistance is the subject of Table 1.

Summary Table 1 shows detailed estimates of all the budgetary posts that can be summarized totally as follows:

	$US	Z
1. Expatriate staff members' services	1,068,150	
2. International travel	53,100	
3. Domestic air travel		354,000
4. Excess baggage	30,750	307,500
5. Consultant's per diem	19,200	
Total	1,171,200	661,500

Table 1

TECHNICAL ASSISTANCE COST ESTIMATE ANALYSIS

1. SERVICES

1.1 Duration of service

Project Chief:	5 years, starting from year 1
Driller:	5 years, starting from year 1
Mechanic:	3 years, starting from year 1
Consultants:	3 months, a year, during the 5 years of the project

1.2

Project Chief:	12 months x $US 7,150 = $US 85,800
Driller:	12 months x $US 5,720 = $US 68,640
Mechanic:	12 months x $US 5,000 = $US 60,000
Consultant:	3 months x $US 7,730 = $US 23,190

2. Family composition for expatriate manager:
   2 Adults and 2 Children

3. Unit costs of international air travel

One way	adult:	$US 900
	child:	$US 450
Round trip	adult:	$US 1,800
	child:	$US 900

4. Number of international trips

Year 1. One way: 9 Trips: 3 Managers and families
Round trip: 2 Trips: Consultants

Year 2. Round trip: 9 Trips: 3 Managers and families for annual leave
Round trip: 2 Trips: Consultants

53X

Year 3. One way: 3 Trips: Mechanic and family
Round trip: 1 Trip: Consultant

Year 4. Round trip: 5 Trips: 2 Managers and families
Round trip: 1 Trip: Consultant

Year 5. One way: 5 Trips: 2 Managers and families
Round trip: 1 Trip: Consultant

5. Unit costs of international air travel

Kinshasa - Lubumbashi or vice versa:
adult Z 6,000
child Z 3,000
Kinshasa - Lubumbashi - Kinshasa
adult Z 12,000
child Z 6,000

6. Number of International Air Trips

Same as the number of trips cited in Part 4.

7. Unit cost for extra baggage allowance

- 300 kg per family on arrival and departure
- 25 kg per person or 100 kg per family for Europe-Lubumbashi one-way trips

Unit cost:
Europe - Kinshasa $US 10 per kg
Kinshasa - Lubumbashi Z 100 per kg

8. Number of kilograms of excess baggage:

Year 1. Europe - Kinshasa 1250 kg
Kinshasa -Lubumbashi 1250 kg

Year 2.	Europe - Kinshasa	450 kg
	Kinshasa - Lubumbashi	450 kg
Year 3.	Kinshasa - Europe	350 kg
	Lubumbashi - Kinshasa	350 kg
Year 4.	Kinshasa - Europe	250 kg
	Kinshasa - Lubumbashi	250 kg
Year 5.	Kinshasa - Europe	850 kg
	Lubumbashi - Kinshasa	850 kg

9. Per diem of the consultants

30 days x $US 80/day = $US 2,400 per month

3. Installation Expenses

The project's base camp will be set up in Sandoa. The buildings (office and garage) and the houses which will be made available to the project must be rehabilitated, restored and equipped. The infrastructure will include:

*One house transformed into an office (secretary's office, design room, two work offices and one guest room),

*Three houses for the expatriate staff,

*Eight houses for two counterparts, an administrative agent, and 6 members responsible for the work crews, and

*A garage with storeroom and workshop.

The necessary investment for rehabilitating housing and for furnishing various equipment is estimated at US$18,800 plus Z2,800,000. These expenses will be incurred during the first year of the project. The annual maintenance costs for the 5 year period are US$9,600 and Z462,000. In estimating these costs we took into consideration the following estimates of maintenance costs in terms of total investment.

Dwellings: 10%
Office and garage: 10% for infrastructure maintenance
20% for equipment

Detailed estimates are given in Tables 2 and 3 in the Annexes.

Table 2

Estimates of Unit Costs for Installation Expense

No.	Headings	Totals $US	Z
1.	Investments		
1.1	Staff Dwellings		
	Rehabilitation		80,000
	Furnishings		100,000
	Refrigerator	500	
	Deep freezer	600	
	Gas stove	200	
	Solar panels and electricity	600	20,000
	Totals	1,900	200,000
1.2	Counterpart Dwellings		
	Rehabilitation		50,000
	Furnishings		100,000
	Refrigerator	500	
	Solar panels and electricity	500	10,000
	Totals	1,000	160,000
1.3	Office		
	Rehabilitation		50,000
	Furnishings		100,000
	Secretarial and office equipment	350	40,000
	Solar panels and electricity	600	10,000
	Totals	950	230,000
1.4	Garage		
	Transformation into dwelling		
	Rehabilitation; theft protection,, development of the section, etc.		300,000
	Workshop equipment, electric generator, welding set, mechanical and electric tools	6,000	320,000
	Totals	6,000	620,000
2.	Annual Maintenance Costs		
2.1	Staff Dwellings	190	2,000
2.2	Counterpart Dwellings	100	1,600
2.3	Office	130	2,700
2.4	Garage	1,200	94,000

55X

Table 3

Global Estimate of Installation Costs

No.			Unit Costs $US	Unit Costs Z	Qty. No.	Total Costs $US	Total Costs Z
1.		Investment Budget					
	1.1	Staff Dwellings	1,900	200,000	3	5,700	600,000
	1.2	Counterpart Dwellings	1,000	160,000	8	8,000	1,280,000
	1.3	Office	950	300,000	1	950	300,000
	1.4	Garage	6,000	620,000	1	6,000	620,000
		Investment Total				20,650	2,800,000
2.		Annual Maintenance Budget					
	2.1	Staff Dwellings	190	2,000	3	570	6,000
	2.2	Counterpart Dwellings	100	1,600	8	800	12,800
	2.3	Office	130	2,700	1	130	2,700
	2.4	Garage	1,200	94,000	1	1,200	94,000
		Total Maintenance Costs				2,700	115,500

4. Logistic Means

4.1. Study Material

The costs of scientific material needed to conduct different field studies amount to $US 6090 CIF Lubumbashi. The list of material and is costs is given in Table 4. The sum of US$ 100 is foreseen annually for repair and eventual replacement of the apparatus.

4.2. Vehicles

For implementation of its studies and field work, the project will be equipped with the following vehicles during its first year:

- 6 four-wheel drive vehicles, one each for the Project Leader, Administrative Agent, Driller, 3 spring-capping crews
- 1 truck for drilling crew, fitted with drill and compressor
- 1 truck for transport of materials from Lubumbashi
- 1 pickup for the well crew, with a roof rack, a detachable derrick, and a trailer
- 1 pickup for the spring-capping crew

Each vehicle and truck will be fitted with a tool kit and repair accessories (cable, jerry cans, pump, etc.).

The total investment anticipated for the vehicle fleet amounts to US$ 412,200. Details are given in Table 5 in annex.

For the annual operating costs of these vehicles, including the drivers' wages, lubricants, fuel, repairs, spare parts, and depreciation, the rate per kilometer is fixed contractually at:

50 Z/km for the trucks
40 Z/km for the pickups
25 Z/km for the 4-wheel drive vehicles

The monthly number of kilometers covered is estimated at:

1000 km for a four-wheel drive vehicle
400 km for the drilling truck
2000 km for the truck
1500 km for a pickup

Annual operating costs are estimated at 4,680,000 Z, divided as follows:

For the four-wheel drive vehicles:	
6 x 12 months x 1000 km/mo. x 25 Z/km	1,800,000 Z
For the drilling truck:	
1 x 12 months x 400 km/mo. x 50 Z/km	240,000 Z
For the truck:	
1 x 12 months x 2000 km/mo. x 50 Z/km	1,200,000 Z
For the pickups:	
2 x 12 months x 1500 km/mo. x 40 Z/km	1,440,000 Z
TOTAL	4,680,000 Z

4.3. Miscellaneous tools

In order to carry out the program of boreholes, dug well rehabilitation, spring capping, and of town water supply, the various work crews will have to be equipped with suitable equipment adapted to the jobs they each have (plumbing, carpentry, masonry, cementing, well-casing, etc.).

The necessary investment for the first year is estimated as follows:

1 tube well crew	2,000 $US and 150,000Z
3 spring crews	1,500 $US and 60,000 Z
1 well crew	1,000 $US and 50,000 Z
1 piping crew	2,000 $US and 100,000 Z
	6,500 $US and 360,000 Z

For the maintenance of the tool kits and replacement of various items, we have estamated the annual costs at 5% of the total sum, namely 325 $US and 18,000 Z.

5. The implementation program

5.1 Program for drilling and rehabilitation of existing wells

This program's objective is to perform the following work over five years:

- 330 tube wells including sealed well and material (piping of PVC) requiring the use of cement, sand and gravel.
- The rehabilitation of 140 wells and the installation of pumps, requiring the use of local materials (cement, sand, gravel).
- The placement of 330 pumps on the tube wells.

The cost of a: tube well is estimated at 15,000 Z;
rehabilitation of a well is estimated at 5,000 Z and $ 350;
Placement of one pump is estimated at $350.

The total cost of the investments is estimated at $164,500 and 5,650,000 Z over the five year life of project. The annual breakdown of costs is given in Table Six.

The unit costs of maintenance or the wells begin two years after installation and are as follows:

tube well with pump	1,500
open well with pump	2,000

Thus, post-project maintenance costs are 775,000 zaires.

Details are provided in Annex 6.

A bonus will be provided to the Zairian personnel working on the project according to the following scale:

Z500 per tubewell drilled
Z1,000 per open well reconstructed.

The total cost of these bonuses is as follows:

Table 5

Estimates of Logistic Means

Headings	Unit Price $US	No.	Total Price $US
4-wheel drive vehicle	23,000	6	138,000
Drilling truck and compressor	172,000	1	72,000
Pick-up	16,000	1	16,000
Truck	40,000	1	40,000
Pick-up roofrack + derrick + tank	43,000	1	43,000
Tool kit for car	50	6	300
Tool kit for truck	100	4	400
Breakdown accesories	250	10	2,500
Sub-total			412,200

Table Six

DRILLING AND WELL REHABILITATION PROGRAM

I. INVESTMENTS								
Annual number of drillings	(40)	(80)	(100)	(110)	(100)	-	-	(430)
Drilling and construction material	600,000	1,200,000	1,500,000	1,650,000	1,500,000	-	-	5,450,000
Number of wells redone and provided with pump	(40)	(30)	(30)	(30)	(30)	-	-	(140)
Digging and provision of pumps for wells								
Z5,000/wells	100,000	150,000	150,000	150,000	150,000			700,000
$ 350/pump	(7,000)	(150,000)	(150,000)	(150,000)	(150,000)			(49,000)
of pumps	(40)	(80)	(100)	(110)	(100)			(430)
(350)/pump	(14,000)	(8,000)	(35,000)	(38,500)	(35,000)			(150,500)
TOTAL In Zaires	700,000	1,350,000	1,650,000	1,800,000	1,650,000			7,150,000
In dollars	(21,000)	(38,500)	(45,500)	(49,000)	(45,500)			154,000

X65

5.2 Spring Capping Program

The object of this program is to cap and outfit 500 water points in 5 years. The sum total of anticipated investments is 5,000,000Z or a unit cost of 10,000Z per spring. Annual maintenance costs are estimated at 1,000Z per spring, starting after one year in service. Once the project is established, annual expenses are estimated at 500,000Z.

All the construction materials and divers other material involved in the capping of a well will be purchased including a premium of 1,000Z per spring capped which will be awarded to the crew.

The annual allocation of investments, maintenance costs and premiums is given in Table 7.

5.3 Particular Works

In addition to the well drilling and rehabilitation program, and the spring capping program, particular studies and works will be carried out in the centers of KASAJI, KAFAKUMBA, DILOLOL, MUZUMBA and BUNINGE. The planning for the studies and their implementation is established as follows:

VILLAGE	STUDY		IMPLEMENTATION	
	YEAR	DURATION	YEAR	DURATION
MWAYINGA	3	2	3	3
KASAJI-CHJISENGAMA	2	2	2	4
KASAJI-LUWENO	2	2	4	3
DILOLO POST	1	1	1	3
KAFAKUMBA LAKE	2	1	3	3
KAFAKUMBA POST	2	3	3	4
MUZUMBA	1	3	1-2	8
PILOT PROJECT	1	4	1	4
I. A. BUMINGE	2	4	4	5

Table 8 gives for each case the annual estimates of .

Costs of the studies
Costs of implementation
Costs of maintenance

which can be summarised as follows:

TABLE 1. COST ESTIMATE FOR TECHNICAL ASSISTANCE[1]

HEADINGS	UNIT COST Unit	US $	Z	YEAR OF PROJECT 1 NO.	US $	Z	2 NO.	US $	Z	3 NO.	US $	Z	4 NO.	US $	Z	5 NO.	US $	Z	TOTAL NO.	US$	Z
1. SERVICES																					
Project leader	Mo.	7150	-	12	85800	-	12	85800	-	12	85800	-	12	85800	-	12	85800	-	60	429000	-
Driller	Mo.	5720	-	12	68640	-	12	68640	-	12	68640	-	12	68640	-	12	68640	-	60	343200	-
Mechanic	Mo.	5000	-	12	60000	-	12	60000	-	12	60000	-	-	-	-	-	-	-	36	180000	-
Consultants	Mo.	7730	-	3	23190	-	3	23190	-	3	23190	-	3	23190	-	3	23190	-	15	115950	-
TOTAL POSTS	-	-	-	39	237630	-	39	237630	-	39	237630	-	27	177630	-	27	177630	-	171	1068150	-
2. INTERNATIONAL TRAVEL																					
One way	unit	900	-	9	8100	-	-	-	-	3	2700	-	-	-	-	5	4500	-	17	15300	-
Round trip	unit	1800	-	2	3600	-	11	19800	-	2	1800	-	6	10800	-	1	1800	-	21	37800	-
TOTAL POST 2	-	-	-	-	11700	-	-	19800	-	-	4500	-	-	10800	-	-	6300	-	-	53100	
3. DOMESTIC TRAVEL																					
One way	unit	-	6000	9	-	5400	-	-	-	3	-	18000	-	-	-	5	-	30000	17	-	102000
Round trip	Unit	-	12000	2	-	24000	11	-	132000	1	-	12000	6	-	72000	1	-	12000	21	-	252000
TOTAL POST 3	-	-	-	-	-	78000	-	-	132000		-	30000	-	-	72000	-	-	42000	-	-	354000
4. EXCESS BAGGAGE																					
Europe/Kinshasa	Kg	10	-	1250	12500	-	450	4500	-	325	3250	-	225	2250	-	825	8250	-	3075	30750	-
Zaire	Kg	-	100	1250	-	12500	450	-	45000	325	-	32500	225	-	22500	825	-	82500	3075	-	307500
TOTAL POST 4	-	-	-	-	12500	12500	-	4500	45000	-	3250	32500	-	22500	22500	-	8250	82500	-	30750	307500
5. OTHER																					
Per Diem	Mo.	2400	-	2	4800	-	2	4800	-	2	4800	-	1	2400	-	1	2400	-	8	19200	-
GENERAL TOTAL	-	-	-	-	266630	203000	-	266730	17700	-	250180	62500	-	193080	94500	-	194580	124500	-	1171200	661500

[1] Travel and baggage are included here but listed separately in the PP body

Table 7

SPRING CAPPING PROGRAM

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Total
I. Investment								
Number of springs	60	80	100	120	140	--	--	500
Cost at 10,000 Z per spring	600,000	800,000	1,000,000	1,200,000	1,400,000	--	--	5,000,000
II. Annual Maintenance Cost								
Number of springs		60	140	240	360	500	500	--
Cost at 1,000 Z per spring	--	60,000	140,000	240,000	360,000	500,000	500,000	--
III. Bonuses to RHD staff								
1,000 Z per spring capped	60,000	80,000	100,000	120,000	140,000	--	--	--

KASAJI, KAFAKUMBA, DILOLO, MUSUMB, and OTHER CENTERS

The study and implementation plan is as follows:

VILLAGE	STUDY		IMPLEMENTATION	
	YEAR	DURATION	YEAR	DURATION
MWAJINGA	3	2	3	3
KASAJI-CHISENGAMA	2	2	2	4
KASAJI-LUEO	2	2	4	3
DILOLO POSTE	1	1	1	3
KAFAKUMBA LAKE	2	1	3	3
KAFAKUMBA-KIMPUKI	2	3	3	4
MUSUMB (+ HOSPITAL)	1	3	1-2	8
PILOT PROJECTS	1	4	1	4
BUNINGE AG. INST.	2	4	4	5

Annex table 8 gives in each of the above cases annual estimates for
- costs of the studies
- costs of implementation
- costs of maintenance.

A summary of these costs follows:

VILLAGE	STUDY		IMPLEMENTATION		ANNUAL MAINTENANCE	
	FX($)	LC($eqv)	FX($)	LC($eqv)	FX($)	LC($eqv)
MWAJINGA	260	-	26,000	5,405	260	54
KASAJI-CHISENGAMA	300	-	15,000	18,919	300	378
KASAJI-LUEO	200	-	10,000	10,811	200	216
DILOLO POST	300	-	15,000	18,919	300	378
KAFAKUMBA LAKE	60	-	6,000	8,108	60	81
KAFAKUMBA KIMPUKI	200	-	10,000	13,514	200	270
MUSUMB (+ HOSPITAL)	1,100	-	37,000	137,838	370	1,378
PILOT PROJECTS	180	-	18,000	16,216	180	162
BUNINGE AG. INST.	300	-	15,000	21,622	300	216
TOTAL	2,910	-	152,000	251,352	2,910	3,133

The dollar costs of studies are for the publication and reproduction of the plans. Annual maintenance costs have been estimated as a percentage of purchase price of the various systems as follows:

gravity flow	1 %
hydraulic rams	2 %
solar power	1 %

Tables 8 and 9 in annex give a detailed breakdown by investment and maintenance costs.

A total of 160,000 zaires will be paid as bonuses to the brigades for the good and rapid implementation of the studies and supply systems as follows:

Year 1	45,000
Year 2	40,000
Year 3	35,000
Year 4	40,000

Once the project work is complete, annual maintenance costs are estimated at $2,200 and Z126,000.

TABLE 8 INVESTMENT BUDGET BY SUB-PROJECT: STUDY AND IMPLEMENTATION COSTS

SITE		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		TOTAL	
		US$	zaires	US$	zaires	US$	zaires	US$	zaires	US$	zaires	US$	zaires
MWAJINGA	STUDY:	-	-	-	-	260	-	-	-	-	-	260	-
	IMPLEMENT:	-	-	-	-	26,000	200,000	-	-	-	-	26,000	200,000
KASAJI	STUDY:	-		300	-		-	-	-	-	-	300	-
	IMPLEMENT:	-	-	15,000	700,000			-	-	-	-	15,000	700,000
KASAJI-LUEO	STUDY:	-		200	-		-	-	-	-	-	200	-
	IMPLEMENT:	-	-					10,000	400,000	-	-	10,000	400,000
DILOLO	STUDY:	300			-		-	-	-	-	-	300	-
	IMPLEMENT:	15,000	700,000							-	-	15,000	700,000
KAFAKUMBA LAKE	STUDY:		60		-		-	-	-	-	-	60	-
	IMPLEMENT:					6,000	300,000			-	-	6,000	300,000
KAFAKUMBA-KIMPUKI	STUDY:			200	-		-	-	-	-	-	200	-
	IMPLEMENT:					10,000	500,000			-	-	10,000	500,000
MUSUMB	STUDY:	1,100			-		-	-	-	-	-	1,110	-
	IMPLEMENT:	17,000	2,100,000	20,000	3,000,000					-	-	37,000	5,100,000
PILOT PROJECTS	STUDY:	180			-		-	-	-	-	-	180	-
	IMPLEMENT:	18,000	600,000							-	-	18,000	600,000
BUNINGE AG. INST.	STUDY:			300	-		-	-	-	-	-	300	-
	IMPLEMENT:							15,000	800,000	-	-	15,000	800,000
TOTAL		51,590	3,400,000	36,060	3,700,000	42,260	1,000,000	25,000	1,200,000			154,910	9,300,000

TABLE 9

SPECIAL PROJECTS (STUDIES AND IMPLEMENTATION)

HEADINGS	1		2		3		4		5		6	
	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z
II. Maintenance Costs												
MWAJINGA	-	-	-	-	-	-	260	2 000	260	2 000	260	2 000
KASAJI	-	-	-	-	300	14 000	300	14 000	300	14 000	300	14 000
KASAJI-LUEO	-	-	-	-	-	-	-	-	200	8 000	200	8 000
DILOLO POSTE	-	-	300	14 000	300	14 000	300	14 000	300	14 000	300	14 000
KAFAKUMBA LAKE	-	-	-	-	-	-	60	3 000	60	3 000	60	3 000
KAFAKUMBA-KIMPUKI	-	-	-	-	-	-	200	10 000	200	10 000	200	10 000
MUSUMB (+ HOSPITAL)	-	-	-	-	370	51 000	370	51 000	370	51 000	370	51 000
BUNINGE AG. INST.	-	-	-	-	-	-	-	-	300	8 000	300	8 000
PILOT PROJECTS	-	-	300	16 000	300	16 000	300	16 000	300	16 000	300	16 000
TOTAL II	-	-	600	30 000	1 270	95 000	1 790	110 000	2 290	126 000	2 290	126 000

TABLE 10

SUMMARY OF INVESTMENT COST

YEAR	1		2		3		4		5		TOTAL	
HEADINGS	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z
1. T.A.	266,630	203,000	266,630	177,000	250,180	62,500	193,080	94,500	194,580	124,500	1,171,200	661,500
2. Construction	20,650	2,800,000	-	-	-	-	-	-	-	-	20,300	2,800,000
3. Logistics												
3.1 Study material	6,090	-	-	-	-	-	-	-	-	-	6,090	-
3.2 Vehicles	412,200	-	-	-	-	-	-	-	-	-	412,200	-
3.3 Tools	6,500	360,000	-	-	-	-	-	-	-	-	6,500	360,000
4. Work crews												
4.1 Drilling+Well	21,000	700,000	38,500	1,350,000	445,500	1,650,000	449,000	1,800,000	45,500	1,650,000	199,500	7,150,000
4.2 Springs	-	600,000	-	800,000	-	1,000,000	-	1,200,000	-	1,400,000	-	5,000,000
4.3 Piped supply	751,590	3,400,000	336,060	3,700,000	342,260	1,000,000	225,000	1,200,000	-	-	154,910	3,300,000
5. Training	13,800	1,136,900	-	1,136,900	-	1,136,900	-	1,136,900	-	1,136,900	13,800	5,684,500
TOTAL	798,460	9,199,900	341,290	7,263,900	337,940	4,849,400	267,080	5,431,400	240,080	4,311,400	1,984,850	30,956,000
Total (in US$)	798,460	248,646	341,290	193,619	337,940	131,067	267,080	146,795	240,080	116,524	1,984,850	836.651
Total (US$)	1,047,106		534,909		469,007		413,875		256,604		2,821,501	

TABLE 11

SUMMARY OF OPERATING AND MAINTENANCE COSTS

YEAR	1		2		3		4		5		6	
HEADINGS	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z	US$	Z
1. T.A.	-	-	-	-	-	-	-	-	-	-	-	-
2. Construction	-	-	2,700	115,500	2,700	115,500	2,700	115,500	2,700	115,500	10,800	462,000
3. Logistics												
3.1 Scient. Mat.	100	-	100	-	100	-	100	-	100	-	500	-
3.2 Vehicles	-	4,680,000	-	4,680,000	-	4,680,000	-	4,680,000	-	4,680,000	-	23,400,000
3.3 Tools	-	-	325	18,000	325	18,000	325	18,000	325	18,000	1,300	72,000
4. Work crews												
4.1 Drilling+well	-	-	-	-	-	100,000	-	280,000	-	490,000	-	870,000
4.2 Spring	-	-	-	60,000	-	140,000	-	240,000	-	360,000	-	800,000
4.3 Piped supply	-	-	600	80,000	1,270	95,000	1,770	110,000	2,290	126,000	5,930	411,000
5. Training	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	100	4,680,000	3,725	4,953,500	4,395	5,148,500	4,895	5,443,500	5,415	5,789,500	18,530	26,015,000
Total (in US$)	100	126,486	3,725	133,878	4,395	139,149	4,895	147,122	5,415	156,473	18,530	703.108
Total (US$)	126,586		137,603		143,544		152,017		161,888		721,638	

TABLE 12

SUMMARY OF BONUSES FOR ZAIRIAN STAFF

HEADING	1	2	3	4	5	TOTAL
1. Drilling crew	20,000	40,000	50,000	55,000	50,000	215,000
2. Well rehab, crew	20,000	30,000	30,000	30,000	30,000	140,000
3. Spring-capping crew	60,000	80,000	100,000	120,000	140,000	500,000
4. Special projects	45,000	40,000	35,000	40,000	-	160,000
TOTAL	145,000	190,000	215,000	245,000	220,000	1,015,000

TABLE 13

Year	1	2	3	4	5	TOTAL
Item						
Investment	I,047,106	534,909	469,007	413,875	356,604	2,821,501
Maintenance	126,586	137,603	143,544	152,017	161,888	721,638
Bonuses	3,919	5,135	5,811	6,622	5,946	27,433
TOTAL	I,177,611	677,647	618,362	572,514	524,438	3,570,572

ANNEX 6

Detailed Economic Analysis

Five general categories of benefits are distinguished in this analysis:

a. Time saved fetching drinking water;
b. Improved health;
c. Improved care at health centers;
d. Post-project work by governmental teams trained and equipped by the project; and
e. Prevention of misallocation of labor to urban areas.

A. Time Saved Fetching Drinking Water

The project would bring drinking water virtually to the residences of 188,000 rural and 30,000 urban dwellers. The following assumptions are made about the impact of this development:

i. Each person uses ten liters of drinking and cooking water per day;
ii. One person's round trip to fetch water yields ten liters;
iii. The average distance of such trips is reduced by two kilometers, from over two kilometers to less than one kilometer;
iv. Trips are made at a speed of two kilometers per hour;
v. The value of the time saved for those who fetch water ranges between Z. 1 and Z. 5 per hour.

On these assumptions, the total value of time saved would be in the range between Z. 218,000 and Z. 1,090,000, or roughly $6,000 to $ $24,000, per year. The most difficult assumption is that regarding the value of time. The ends of the range chosen each represent an actual wage rate paid to unskilled labor in the region where the project takes place. However, there are many problems with using such an estimator. To give just one example, such wages

are paid to adult men for full-time contracts, while the labor freed by reducing time needed to fetch water would be that mainly of women and children who otherwise work mainly in domestic agriculture, marketing, and household tasks. In any case, the upper end of the range amounts to about one dollar per day, which is in the common range for agricultural labor in some parts of the developing world, while the lower end of the range is much too low to support a person, although it might be acceptable as a supplement to the income of a family with other sources of income.

The other assumptions about rates and quantities are also rather heroic.

B. Improved Health

The parameters needed to evaluate improvements in health resulting from access to more and better water are not known well enough to compute a figure. Three types of benefits derive from improved health: a higher quality of life, increased labor supply, and decreased cost of medical care sought (*ceteris paribus*). In each case, valuation would require knowledge of, at least, the reduction in incidence of disease due to the improvement in water supply, and the change in duration of disease among those who would still be stricken. Values of well-being, or labor-time, and of medical services would then be needed for each type of benefit. The analysis lacks the basic parameters concerning incidence of disease and the effects on health of the type of improvements in the supply of potable water to be brought about by the project. The values of medical services, labor-time, and well-being would be very difficult to assign in any case.

Therefore, the analysis does not attempt to value this group of benefits.

C. Improved Health Services

Three major health centers are presently equipped with gasoline- or diesel-powered generators of electricity. Photo-voltaic equipment to be supplied by the project would supplant the fossil-fuel generators powering water systems, at a saving of $5,000 per year in operating cost at each facility, totalling $15,000 per year.

Increased supply of water to hospitals is very important. At present, they are able to acquire only about one third of their needs for sanitation, toilettes, and so forth. Lack of water is considered one of the most serious constraints on the quality of medical care. The three hospitals have about 300 beds each, with an average occupancy rate of 75%. The value of the hospitals' services is estimated to average $15 per bed-day at present. If that value is raised by $1 by providing for adequate water supplies, the total value of the improvement in health care in hospitals would be almost $250,000 per year.

Four secondary centers would also receive greatly increased supplies of safe water. The centers have altogether about five hundred beds, seventy-five percent occupied on the average. If the improvements in water supply raise the quality of service from an assumed $7.50 per bed-day at present by an assumed $0.50, the total value of the benefit would be about $70,000 per year.

D. Operations of the Department of Rural Hydraulics

The project would train and equip teams of the Rural Hydraulics Division to continue the project's work of drilling new wells. However, the capacity of much of the equipment will be considerably diminished by the end of the project. Furthermore, it is unlikely that the government would be able to finance operations at full capacity.

If the value of the benefits from the project's outputs were given, one could attempt an evaluation of replication of these benefits by the Division's extension of the project's work by assuming that certain fractions of the project's chief outputs would be added in the years after completion of AID's funding. However, as explained above, the benefits to be replicated cannot yet be evaluated.

E. Improved Allocation of Labor

One of the principal reasons cited by young people leaving rural areas is

the lack of water supplies. The necessity of long trips to fetch drinking water is an aspect of rural life that characterizes the areas' backwardness in the people's minds.

It is possible that residents of rural areas would be willing to emigrate to cities with more amenities even if emigration implied abandonment of superior income-producing assets or opportunities in the rural areas. Better access to drinking water might therefore result in net gains in the value of overall output, as superior opportunities in rural areas would be exploited rather than abandoned.

However, for lack of any idea of the orders of magnitude of emigration averted or net gains in value of output per resident retained, no attempt is made to evaluate this expected benefit.

F. Summary

Relatively few of the project's expected benefits can be evaluated with the information available. Those benefits evaluated total on the order of $360,000 per year at the peak of the project's effectiveness. This sum by itself does not nearly justify project expenses by AID totalling $4 million over five years. (Expenses incurred by the government and by participants are relatively minor.)

Evidently, the project cannot not yet be determined to be economically feasible or infeasible.

The mission's understanding is that there does not exist anywhere in the developing world the information needed, as described above, to inform the selection and design of potable-water projects through use of comparisons of costs and benefits. Nonetheless, potable-water projects will in all probability continue to be funded. This indicates that the present project as designed is justified in including economic investigation in scheduled evaluations, in order to attempt to find information needed to improve future projects.

ANNEX

DEMOGRAPHIC DATA

Population Distribution in Lualaba Sub-Region

I. Kapanga Zone = Mwant Yav Collectivity

Unit	Population (Dec. 1983)	Remarks
Collectivity		
Mwant Yav	73,692	
Towns		
1. Kalamb	2,500	2 dispensaries, secondary schools
2. Musev	3,000	dispensary
3. Musumb/Kapanga Poste/Ntit complex	16,000	hospital, major secondary medical complex, leprosarium, 2 missions, 2 administrative centers, schools
Villages		
1. Chal		dispensary
2. Chamb		dispensary
3. Chibab		dispensary
4. Chibalak		dispensary
5. Chitazu		dispensary, secondary school,
6. Chivund		dispensary
7. Chiying		dispensary
8. Dinying		dispensary, lower secondary school
9. Kaleng		
10. Kambamb		dispensary
11. Kambangu		dispensary
12. Kambundu		
13. Kamwang		dispensary
14. Kaninchin		dispensary
15. Masak		
16. Mpand a Kalend		dispensary
17. Mpand a Mwil		lower secondary school
18. Mukamwish		
19. Mulambu	674	dispensary
20. Musumb-Kakes		
21. Mutombu a Chibangu		
22. Mwant Chinan		
23. Mwin Djidij		
24. Nambaz		
25. Ngung		
26. Nkamb		

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27. Ntembu		dispensary
28. Rubwiz		dispensary
29. Samaband		dispensary
30. Wan a Mutombu		
Total population (towns + villages)	46,325	hospital, major secondary medical center, 16 dispensaries

II. Sandoa Zone

Unit	Population (Dec. 1983)	Remarks
Zone	106,780	
Kayemb Mukur Collectivity	18,083	dispensary, maternity annex, lower secondary school
Villages		
1. Chimikind	360	
2. Dizungwe	269	
3. Kavul a Masamb	346	
4. Kondoluela	775	
5. Mbangu	552	
6. Mpiana Tenge	468	
7. Mvant Kapuku	973	
8. Mwene Ngizi	706	
9. Mwene Ngizi Asangani	468	
10. Nswan Kambur	766	
11. Ulamb	384	
Total	6067	
Rumang Collectivity	26,227	
Towns		
1. Sandoa	3,262	hospital, secondary schools, leprosarium, administrative center
Villages		
1. Chikuru	765	
2. Kabimbu	518	
3. Kamulemb	743	
4. Lukongolo	343	
5. Matang	706	
6. Mvad Tshiwund	445	
7. Mwin Dilombe	280	
8. Mwin Ivund	745	
9. Mwin Mem	836	

Unit	Population (Dec. 1983)	Remarks
10. Mwin Ming	658	
11. Ndolo	641	well
12. Nfumu Ulau	924	
13. Ngang a Mutok	265	well
14. Sangombe	312	
15. Sawamba	318	
16. Sona Mune	376	
17. Zimbola	645	well
Total population	16,292	
Chibamb Collectivity	4,702	
Towns		
1. Chibamb	1,012	well, dispensary, schools
Villages		
1. Chimbung		dispensary
2. Kamapila	420	
3. Mbaku	278	
4. Chirungil	350	dispensary
Total	2,060	
Chipau Collectivity	11,120	
Towns		
1. Kafakumba Poste	1,580	Lower secondary schools
Villages		
1. Chal	424	
2. Chifung	830	
3. Mupwelet	517	
4. Mwin Iyamb	456	
5. Mwin Luweu	613	
6. Ngongo	1,017	
Total	5,996	
Totals for Sandoa Zone		
Zone:	106,700	
Towns:	6,154	
Villages:	5[illegible],126	
Outskirts:	4[illegible],000	

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III. Dilolo Zone

Denomination	Population (Dec. 1982)	Remarks
Zone	212,935	
Provisional Totals		
Towns:	42,000	
Villages: (150)	100,000	
Outskirts:	70,000	

ANNEX 3

PROJECT ADMINISTRATIVE STRUCTURE

The implementation of the studies and work program (boreholes, well rehabilitation, spring capping, water supply development, pilot projects in conjunction with rural health centers, and piped water supplies to certain towns) requires technical assistance for the 5 year duration of the project. This assistance is made up of 3 expatriate staff:

one project leader
one drilling technician
one mechanic

A Zairian counterpart drawn from the Bureau of Rural Hydraulics will be paired with each expatriate team member. After the departure of the expatriate staff, the national staff will take over the continuation of the project in the three zones. A Deputy Project Leader, representing the head of the Bureau of Rural Hydraulics, will at that time take over all administrative and financial tasks. He will also manage all the Zairian staff allocated to the different water supply work crews, garage, and office (secretariate, study office, etc.).

There are 6 different crews, namely:

1 well crew, responsible for renovating existing wells and installing pumps on the boreholes.

1 borehole crew, responsible for the drilling program.

2 spring-capping crews, responsible for improvements to seal and protect springs

1 pump and maintenance crew, responsible for installing pumps and follow-up maintenance

1 special project crew, responsible for piped water supply installations and other special projects.

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Each crew will be led by a Zairian manager with technical training, also drawn from the Bureau of Rural Hydraulics, who will assume responsibility for the work and conduct of the personnel making up the crew. The borehole crew will be directed by the drilling technician who will, during the first term of the project choose two Zairian technicians to receive 3 years' training to become experienced drillers capable of drilling boreholes and maintaining and repairing all the drilling equipment. They will therefore be capable of directing two crews, one or both possibly operating in a different area. The mechanic will likewise train a Zairian mechanic, who must after 3 years be capable of maintaining and repairing the entire vehicle fleet as well as all other equipment, and of managing the garage.

The administrative structure may be sketched as follows:

Project Leader — Rural Hydraulics Director, Kinshasa

Deputy Project Leader — Administrative Assistant (locally funded)

Administrative staff	Borehole crew (1)	Well crew (1)	Spring crews (3)	Piping crew (1)	Garage

From a technical and financial point of view, the responsibility for the project will be incumbent on the Project Leader in Sandoa.

As for administrative and financial questions, these will be dealt with under the joint responsibility of the Project Leader and Deputy Project Leader. All documents bearing on these questions will be signed by both the Project Leader and his deputy. The same will apply to all transfers of funds and bank checks. An account will be opened to this effect at the Banque Commerciale Zairoise at its Lubumbashi office. The right to sign for this account will be granted only to these two managers, with checks drawn only

when signed by both. For payments at Kinshasa for local purchase of materials and equipment, an account will likewise be opened at the Banque Commerciale Zairoise at its Kinshasa office. Two signatures will also be necessary here, those of the head of the Bureau of Rural Hydraulics and of a Kinshasa representative of AIDR.

All purchases and orders will be made only by internal purchase order, countersigned by the Project Leader and the Deputy Project Leader and addressed either to the head of the Bureau of Rural Hydraulics or to a representative of AIDR in Kinshasa. The same principle will apply to all orders to be placed in Europe so that the Project Leader and his deputy will be conversant with all the various orders current or pending.

The European office of AIDR will handle all orders, insurance, and reception of equipment, and dispatch the same to Lubumbashi. AIDR will draw up a monthly report concerning:

the state of pending orders
the expense incurred for the above,
the planned expense for the coming quarter.

In the field, delivery will be overseen by a specialised local agency established in Lubumbashi and approved by USAID. Transportation to Sandoa will be by project trucks. The Deputy Project Leader will then take delivery of the material, inventory it, and place it in stock in the warehouse. Each type of equipment will be entered on a record card. Each crew will similarly hold stock cards for all material received and placed in the field. These cards will be kept up to date by the head of the crew. Annual inventory checks will be done by the Project Leader, with visits to the worksites where the material and equipment has been placed. It will also be his responsibility to carry out random checks. The Deputy Project Leader resident at Sandoa will exercise his powers under delegation from the head of the Bureau of Rural Hydraulics.

Each month the Project Leader and his deputy will transmit to USAID a report on their activity, including the following headings:

the state of work progress, by crew and by job
the list of equipment installed
expenditures and estimates for the following quarter
an account of water supply improvements completed

When a water supply has been improved, it will be placed under the responsibility of the village Water Management Committee. This committee will consist of about ten village residents, users of the water supply. An account describing all equipment provided and installed will be signed by the President of the Water Management Committee and the Deputy Project Leader. All water supply improvements will become property of the local community and not of the Bureau of Rural Hydraulics.

The upkeep of this infrastructure will be assured by the project until Year 5. One member of each Water Management Committee will participate in all local activity so as to be able to continue maintenance in the future.

The Water Management Committee will define the monthly fees to be paid by each family for its water, in function of the number of users and the sum total of the investment made. The money thus collected, from the end of the first year in service, will be the responsibility of the local Water Management Committee. Thus a financial reserve will be created each year, which from year 6 will provide for continuing maintenance, purchase of spare parts, and possible fees for a more highly trained person in the general area responsible for maintenance beyond the capacity of the local Water Management Committee representative trained for routine maintenance by the project.

On termination of the project, all equipment and operating infrastructure (excluding improved water supplies themselves) will be handed

over to the head of the Bureau of Rural Hydraulics. A report, rendered in good and due form, will be drawn up and signed by:

The head of the Bureau of Rural Hydraulics
The Project Leader,
The representative of USAID/Kinshasa.

ANNEX 9

TECHNICAL ASSISTANCE TEAM PROFILE

GENERAL ISSUES

From the project's inception, technical support will be fielded for the management and implementation of various actions. The technical assistance staff will consist of three expatriates who will remain in Sandoa for five years. The expatriate managerial team will consist of:

one project leader (5 years)
one experienced driller (5 years)
one mechanic (3 years)
one administrative assistant (locally-funded in zaires for five years)

Support and coordination missions are scheduled annually for specialized consultants at the rate of three months a year. The total duration of the technical assistance services is set at five years, including consultants' services.

The main tasks of this technical assistance staff will be to:

1. provide the financial and technical management of the project
2. carry out the studies and direct construction in the field
3. direct, advise, and supervise the work of the various hydraulic crews
4. provide all project logistics: auto transport, materials and equipment
5. see to the completion of the programs of all the different phases (studies, procurements, shipments, receiving of materials, execution of work according to norms.)
6. train Zairian counterparts assigned to the expatriate managers

2. DESCRIPTION OF JOB PROFILES AND TECHNICAL ASSISTANCE TASKS

2.1. Project leader

This university-level team member shall have training in hydraulic engineering and be specialized in rural engineering with work experience in LDCs for at least five years. He shall also have experience in management and in the administrative and financial coordination of a development project. Furthermore, he must be willing to adopt "hands-on" approach and be able to live in the field with the operational crews. In terms of linguistic ability, he must have basic knowledge of kiSwahili.

The project leader will be principally responsible for the general management of the project, and for the programs, studies and works; for the financial management of activities; and for the performance of all logistics.

He will also supervise the activities of the various operational crews. He will be responsible to USAID for all equipment and vehicles made available to the project for the completion of the various activities. The duration of his services is estimated to be five years.

2.2 The Driller

The driller should have a basic technical education. He should also have five years minimum experience in well drilling. The driller should have completed several well-boring campaigns in developing countries. He will also have basic knowledge of spoken kiSwahili. Before joining the project, the driller will have a one-month apprenticeship at the factory which will supply the drilling equipment. While in the field, he must also be capable of repairing equipment breakdowns and of providing routine maintenance.

His main task will be to train two Zairian drillers while simultaneously carrying on drilling programs. He will report directly to the project leader. The duration of his services is to be five years.

2.3 Mechanic

This team member should have a diploma in electricity and general mechanics and a knowledge of motors and all types of pumps. He will be in charge of repairs and maintenance of vehicles, various types of pumps, and all other mechanical and electrical equipment (solar panels, batteries, etc.).

He will have at least five years experience in automotive mechanics. He will be capable of managing the spare parts stock for vehicles and all pumps, or carrying out various repairs in the field using his truck-workshop. For the maintenance of the drilling equipment and accessories he will have a two-month apprenticeship at the factory which will provide the drilling equipment.

During the period of his services, set at three years, he will train a Zairian mechanic. He will report directly on all matters to the project leader.

2.4 Administrative Assistant

The Administrative Assistant will support the TA team and the project in all matters of administration and logistics. This will include data collection, files maintenance, communications, reporting, routine liaison with other organizations, materiel management, local procurement support, and provision of clerical services. The Administrative Assistant will be recruited locally.

2.5 Advisory Missions

Each year, three months of consultant services are to be provided by an experienced engineer from the PVO managerial staff, who will be responsible for providing technical assistance to the different project staff members. These services will be carried out both at the PVO home office and in Shaba.

A one-month compulsory supervisory visit to the project areas will be made annually, and on an obligatory basis. The main goals of this visit will be:

- to check inventory and inspect completed work
- to draft a critical report on completed work
- to define the work program for the following year
- to draft and justify the budget for the following year's program
- to resolve all administrative, financial and technical problems encountered during project implementation with USAID and the Bureau of Rural Hydraulics
- to compile an inventory of all the equipment and goods managed by the PVO, accounting for equipment which has been installed during the course of work.

This mission will be planned by USAID and performed on its request. For this purpose, at the time of the presentation of candidacies, the PVO will designate the Project Coordinator at PVO headquarters.

In addition to this annual visit, services can be provided by specialized engineers and permanent members of the PVO field staff for specialized studies. These support missions will be justified and presented beforehand to USAID.

At headquarters, before beginning the work, the PVO's technical services will examine the Project Leader's field studies. These reports will be finalized before being submitted for approval to USAID who will notify the project leader of agreement to perform work. The PVO home office will also have the responsibility to order, receive, and record receipt of equipment and logistical material sent to Lubumbashi. The PVO, which will be responsible for furnishing technical assistance personnel, will present to USAID the detailed curriculum vitae of each candidate. The PVO will also provide professional résumés of consultants sent on annual supervisory, coordinating, and programming missions for field activities. The PVO will furthermore provide follow-up of the project from its home office.

The candidacies of the expatriate coordinator and staff members will be examined by the appropriate USAID officials who will indicate their agreement or refusal of each individual dossier. The PVO will seek to present at least two other candidacies for each rejected name, and USAID will designate the candidate to be retained.

3. PLACE OF ASSIGNMENT OF TECHNICAL ASSISTANCE STAFF

All expatriate staff members will be assigned to the town of SANDOA. This choice is justified in that this town:

- has a central geographic position from which principal roads lead to the towns of Kasaji, Dilolo, and Kapanga.
- has a nearby airstrip allowing urgent delivery of various equipment and other services by light plane.
- has available living accomodations with water provided by REGIDESO.

The following infrastructure necessary for the management of the project will be located in Sandoa:

- a house containing several equipped offices
- a warehouse for storage of logistical equipment and accessories
- a workshop/garage with two pits for checking and maintenance of all vehicle undercarriages.

Electrification of all living quarters and other project buildings will be provided by solar panels. The living quarters of the expatriate staff will be furnished by the project in a reasonable manner, while providing the following essential equipment:

- complete furniture of local fabrication for a family
- refrigerator
- a deep freezer (kerosene-powered)
- a gas stove

C O N V E N T I O N

Vu la constitution, en Juillet 1964, d'une A.S.B.L. intitulée ASSOCIATION INTERNATIONALE DE DEVELOPPEMENT RURAL CUTRE-MER en abrégé A.I.D.R.,

Vu les objectifs poursuivis par cette association "La coopération aux efforts de développement économique, culturel et social et l'amélioration de la santé publique entreprise par les collectivités rurales des pays en voie de développement, dans le cadre des programmes des gouvernements intéressés",

Vu que cette association se propose d'aider à la promotion, au développement économique et social de certaines régions rurales de la République Démocratique du Congo, en collaboration avec toutes les institutions tant officielles qu'internationales privées poursuivant le même but, par [illegible], l'étude et la réalisation d'un ensemble de projets économiques et sociaux dans une perspective de développement communautaire global et harmonisé ;

Il est convenu, dans ces conditions :

Entre : Le Gouvernement de la République Démocratique du Congo représenté par :

- Le Lieutenant-Général Joseph-Désiré MOBUTU, Président de la République,
- Le Général de Brigade Léonard MULAMBA, Premier Ministre,

dénommé ci-après le Gouvernement

et : l'Association Internationale de Développement Rural Outre-Mer (A.I.D.R.), installée, Avenue des Arts, n°20 à Bruxelles représentée par :

- Monsieur Roger DE KINDER, Gouverneur de la Flandre Orientale en Belgique, et Président de l'A.I.D.R.,
- ainsi que par Monsieur WILLOT Hilaire, Administrateur-Délégué de l'A.I.D.R., dûment mandatés,

dénommée ci-après l'Association,

ARTICLE 1.- Le Gouvernement agrée l'Association pour la réalisation des programmes de développement et d'installations hydrauliques au profit des populations rurales suivant les principes énumérés ci-dessous dans l'ensemble de la République Démocratique du Congo.

ARTICLE 2.- Pour être agréés, les programmes généraux et régionaux annuels ainsi confiés à l'Association devront tant pour les études que pour les réalisations, en complet accord avec le Gouvernement, les autorités subordonnées intéressées et l'Association.

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ARTICLE 1.- L'Association s'engage à mener à bonne fin les tâches qui lui seront confiées par le Gouvernement, dans les régions retenues et dans les délais convenus de commun accord et ce, dans la mesure où l'Etat belge, ou des institutions de coopération internationale, s'engageront à mettre à la disposition de l'Association les moyens financiers nécessaires à l'exécution des projets.

ARTICLE 2.- L'Association pourra conclure des accords de coopération avec d'autres organismes pour la réalisation dans la République Démocratique du Congo d'objectifs correspondant à son objet social et qui auront été définis de commun accord avec le Gouvernement.

Les deux parties contractantes conviennent que les Etats ou institutions, qui financent les programmes réalisés par l'Association, peuvent mandater des délégués chargés de contrôler la conformité des travaux avec les programmes retenus.

ARTICLE 5.- Le Premier Ministre du Gouvernement s'engage à désigner un représentant en qualité de coordinateur entre l'Association, le Gouvernement et toutes les autorités subordonnées concernées par les projets.

ARTICLE 6.- Le Gouvernement s'engage à apporter son aide et son appui à la mise au point des programmes généraux et régionaux annuels arrêtés de commun accord avec l'Association.

Les autorités subordonnées apporteront le même appui à l'Association.

Afin de réaliser une véritable coopération, les institutions congolaises et les populations intéressées fixent, pour chaque programme, leur participation à la réalisation de celui-ci.

ARTICLE 7.- Le Gouvernement s'engage à exonérer de tous droits de douanes ou autres tout le matériel, y compris tous moyens de transport, nécessaire à la réalisation des programmes retenus.

ARTICLE 8.- Le Gouvernement s'engage à accorder au personnel de l'Association en matière de douane ou de chancellerie le régime dit de la nation ou de l'organisation internationale la plus favorisée.

ARTICLE 9.- La présente convention est conclue pour une durée indéterminée.

Chacune des parties contractantes peut la dénoncer à tout moment moyennant notification faite à l'autre partie au moins un an à l'avance.

ARTICLE 10.- La présente convention s'applique à l'exécution du plan de développement global communautaire mis en oeuvre au Katanga dont les mesures d'exécution sont déterminées :

- dans la lettre n° 12/132/CAB/P.M. du 24 Mai 1965 du Premier Ministre et Ministre des Affaires Etrangères, dont copie est jointe,

ainsi que

- dans la lettre n° 783 PRE/CONGO/AR/RAT. du 9 Juin 1965 adressée par l'Association au Premier Ministre du Gouvernement

ARTICLE 11.- La présente convention produit ses effets à la date de sa signature.

Fait à Léopoldville, le 18 février 1966
en quatre exemplaires et en langue française.

POUR LE GOUVERNEMENT DE LA REPUBLIQUE DEMOCRATIQUE DU CONGO,

LE PREMIER MINISTRE,

L.MOBOTO
Général de Brigade.

LE PRESIDENT DE LA REPUBLIQUE,

J.D.KASUTU
Lieutenant-Général.

POUR L'ASSOCIATION INTERNATIONALE DE DEVELOPPEMENT RURAL OUTRE-MER (A.I.D.R.O.)

L'ADMINISTRATEUR-DELEGUE,

H.BELLOT.

LE PRESIDENT,

R.DE KINDER.

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