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Republic of the Sudan / Kingdom of the Netherlands

# Nyala and El Geneina water supply project

Phase 3: Upgrading, extension and consolidation



September 1989

Government of the Republic  
of the Sudan

Ministry of Energy  
and Mining

National Urban Water  
Corporation

Government of the Kingdom  
of the Netherlands

Ministry of Foreign  
Affairs

Directorate General of  
Development Cooperation

NYALA AND EL GENEINA WATER SUPPLY PROJECT

PHASE 3

Upgrading, extension and consolidation

**Project Proposal**

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Euroconsult,  
Arnhem, The Netherlands

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## ABBREVIATIONS

NUWC	- National Urban Water Corporation
mwc	- meter water column head
m <sup>3</sup> /h	- cubic metres per hour
m <sup>3</sup> /d	- cubic metres per day
V	- Volt
A	- Ampere
kW	- kilowatt
kVA	- kilo volt-ampere
(10)"	- (ten) inch
dia	- diameter (of pipe)

## 1 INTRODUCTION

### 1.1 Background

The towns of Nyala and El Geneina are located in the Darfur Region, in the Western Sudan (Figure 1).

Nyala is the main commercial, industrial and administrative centre of Southern Darfur. The town is linked with Khartoum by a single-track railway line which was completed in 1958. Rail transport to Nyala presently is at low frequency and poor efficiency, however. Road transport from Khartoum over sand tracks across the semi-desert to Nyala takes about six days for trucks, but in the wet season the tracks often become impassable. Nyala is at an altitude of 650m above mean sea level. The Jebel Nyala hill east of the town is the only significant topographical relief feature in the vicinity. Annual rainfall amounts to 465 mm on average, but varies considerably from year to year. Some 90% of the rainfall occurs in the period from June to September.

In recent years Nyala has been receiving a continuous and considerable inflow of people from the region and beyond who fled for reasons of drought conditions, political disturbances or tribal unrest. These refugees took occupation of various areas on the outskirts of Nyala town and have formed settlements there. As a result, the town's total population has greatly grown to presently an estimated 275 000 inhabitants. Initially, most of the dwellings in the outskirts settlements were temporary shelters mainly traditional mud huts with grass roofing. However, in the last few years more houses of brickwork and similar materials have been built and the fringe settlements have gradually assumed a more permanent character.

In the central town area of Nyala, north of the Wadi Nyala, governmental institutions and municipal offices are grouped together. Military compounds are situated to the west, the railway station and industrial areas to the east. The present Nyala airport is located at a flat strip north of Jebel Nyala; there are advanced plans to develop a new airport at a greater distance from the town at a location east of Jebel Nyala.

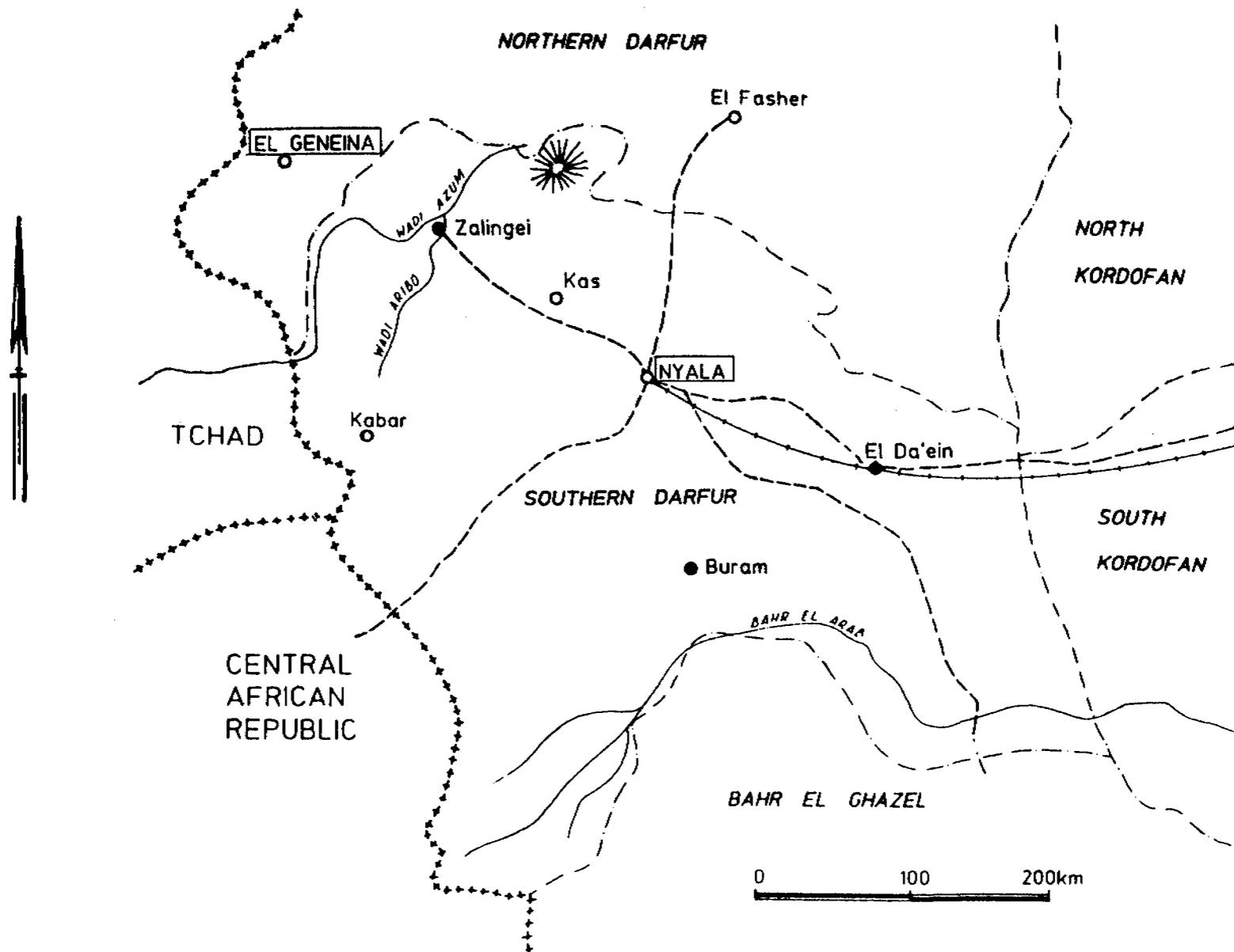
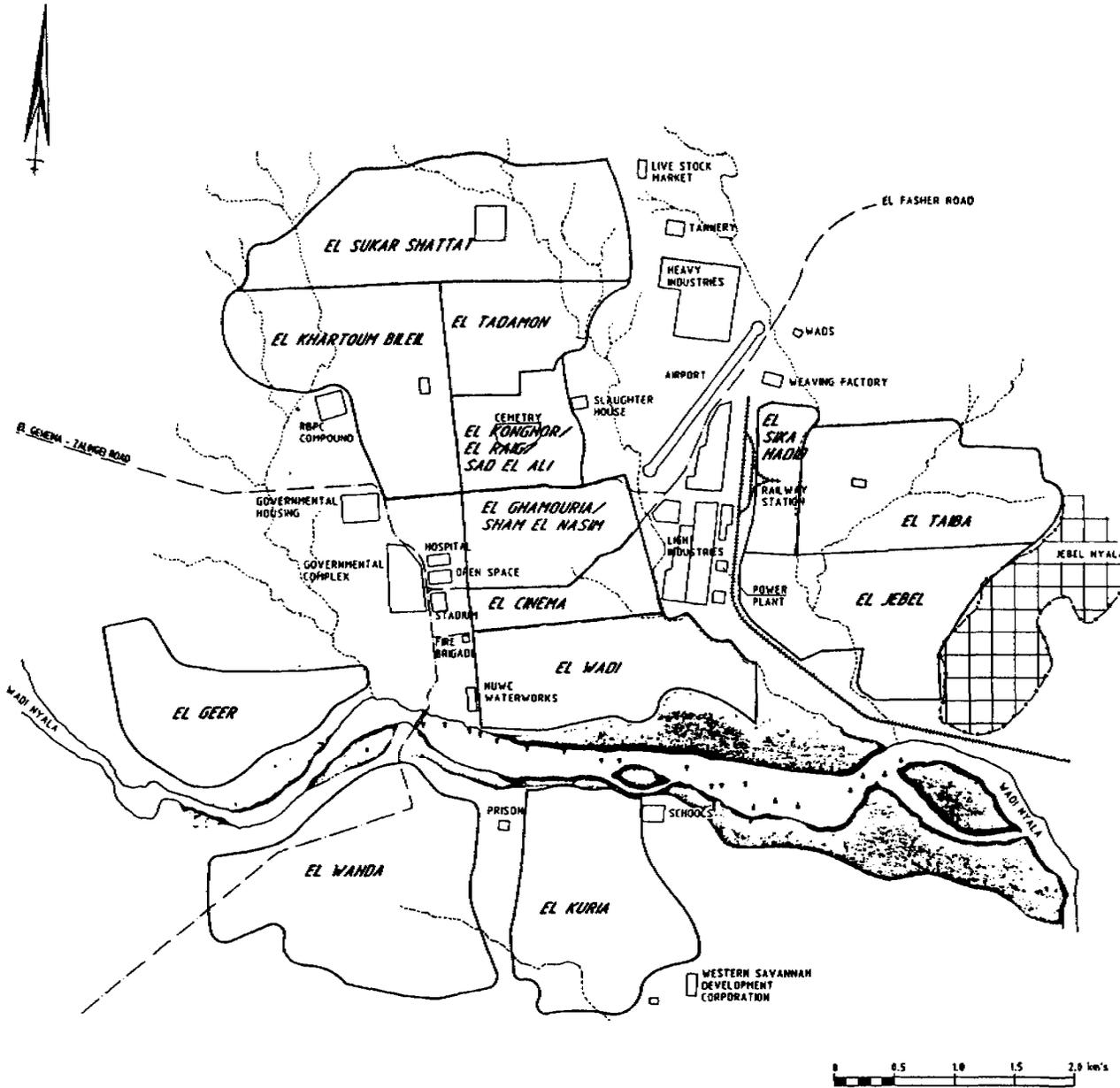


FIG. 1 GENERAL MAP OF DARFUR REGION

FIGURE 2 NYALA - GENERAL PLAN AND TOWN QUARTERS



**LEGEND**

- RAILWAY
- ROAD
- - - SURFACE DRAIN (KHORI)
- QUARTER BOUNDARY
- ▽ EXISTING BOREHOLE
- ▲ PLANNED BOREHOLE

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 WATER SUPPLY PROJECT

NYALA  
 GENERAL PLAN & TOWN QUARTERS



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Residential areas with the better-class housing are generally concentrated to the east of the commercial area in the central town district. The outskirts settlements of newly arrived people and refugees are located to the north (e.i. Sukar Shattat, El Konghor), to the east on the lower slopes of Jebel Nyala (El Taiba, El Jebel), to the south across Wadi Nyala (e.g. El Wahda), and to the west along the wadi (El Geer).

See Figure 2.

Rain-fed agriculture and animal husbandry are the main economic activities of the region. Nyala provides the market functions for agricultural produce and livestock trading. There is also considerable light industry including a weaving factory, tannery, and a number of groundnut processing and soap factories. Nyala being the main distribution centre of Southern Darfur, it has a substantial service sector providing transport, communication, banking and technical services (e.g. mechanical workshops, servicing of vehicles). The town also has a number of schools and educational institutes, a hospital and some medical centres.

El Geneina is located in the extreme west of Darfur Region, near the border with Chad. The distance by road to Nyala is 360 km including gravel road sections from El Geneina to Zalingei (with a passing across the wide Wadi Azum) and the tarred road Zalingei-Nyala.

The central part of El Geneina town and most of its outskirts settlements are situated north of Wadi Kaja. See Figure 3.

There has been and continues to be a steady flow to El Geneina of people escaping the effects of droughts, political disturbances and tribal unrest. Displaced people and refugees have come to El Geneina in search for shelter and food, from the drought-stricken north-west of the Sudan, from across the Chad border, and some from southern areas. Part of this drift is caused by the severe droughts in the Sahelian region.

Considerable numbers of these people have settled in the outskirts of El Geneina town (e.g. El Riyadh, El Shati, El Nassim, and the Ardamatta A and B settlements). As a result, the population in and around El Geneina has greatly expanded and is now estimated to be over 100 000 inhabitants.



The surrounding area of El Geneina is semi-arid with an average annual rainfall of 530 mm occurring mainly in the months of July and August. The altitude is about 800m above mean sea level, but there are several low hills (jebels) rising higher at both sides of Wadi Kaja.

For centuries, El Geneina was an important commercial trading centre on the caravan route from West Africa to the north. This function has lost its importance and animal husbandry now is the main economic activity of the area. There is very little industrial or artisan activity. Groundnut growing is practiced for cash crop production and gardening along the wadi banks provides fruit and vegetables for local consumption.

The main commercial and residential areas of El Geneina are in the town centre near the Jebel Sultan. The military area, the police compounds, and the air strip are situated in the Ardamatta A settlement some 5 km north of the town. To the north of El Geneina along the road to Ardamatta fairly large settlements of newly arrived people are located. A camp for refugees from Chad is situated on the east bank of the wadi in Umm Duein. Large groups of nomads each year stay around the town for one or two months when the local water sources in their normal grazing areas dry up at the end of the dry season.

El Geneina is considered to be the capital of the large and influential Masalite tribe. The Sultan of the Masalites resides in a palace on Jebel Sultan which overlooks the town.

## 1.2 Project history

Phase 1 of the Nyala/El Geneina Water Supply Project for upgrading and extension of the water supply systems of these two towns, was approved by the Sudanese Government and the Netherlands Government authorities in July 1986. Actual execution of the Phase 1 project began in September 1986. Originally, completion of Phase 1 was scheduled for early 1988 but more time was necessary because the works proved to be more elaborate and time-consuming than envisaged. There also were several delays in the supply of materials and equipment. Extension of Phase 1 to October 1988 was approved by the project authorities and accordingly executed.

The National Urban Water Corporation (NUWC) is the project executing agency with principal responsibility for the management of the project and for its planning, design and construction work. From the start, NUWC posted one of its engineers as Resident Engineer, stationed in Nyala, to supervise all project activities both in Nyala and El Geneina. NUWC also made available an engineer as Assistant Resident Engineer in El Geneina, a mechanical engineer particularly charged with the installation of pumping equipment and electrotechnical plant, several construction supervisors, and supporting staff such as a project administrator and store keepers, and a number of specialized personnel such as pipe fitters. Skilled and unskilled labour were made available from the personnel of the NUWC-organizations in Nyala and El Geneina, or recruited locally as casual labour.

To provide the required technical assistance and logistical support, Euroconsult of the Netherlands were appointed project consultant. Euroconsult fielded an expert as Project Adviser, based in Nyala, and arranged for the necessary short-term missions of experts for specific aspects of the project. The logistical support involving customs clearance and arrangements for inland transport of imported materials and equipment for the project, radio and other communications, and liaison with the project authorities in Khartoum, were provided by Euroconsult's Project Support Office in Khartoum.

In their consultations on bilateral cooperation in December 1987, the Sudanese Government and Netherlands Government authorities agreed that the Nyala/El Geneina project should continue in a Phase 2 to start in 1988 directly after Phase 1. Earlier, Euroconsult had been instructed to carry out the necessary technical surveys and studies in cooperation with NUWC in order to prepare the preliminary design, work programme and cost estimates. This work was completed in February 1988 and the results were presented to the project authorities in the Technical Report Phase 2. Following further consultations and discussions, it was decided that the project in its Phase 2 should be mainly concentrated on upgrading and rehabilitation of the water supply systems in Nyala and El Geneina. The work programme of Phase 2 was developed in close cooperation between NUWC and Euroconsult, and approved by the Sudanese Government and Netherlands Government authorities in their bilateral consultation of July 1988.

After making the necessary arrangements, execution of the Phase 2 project began in November 1988. NUWC secured the continuation in the project, of the Resident Engineer, the Assistant Resident Engineer (El Geneina), the Mechanical Engineer, the supervisory staff and the supporting personnel. In addition, NUWC agreed to post an additional engineer as Assistant Resident Engineer in Nyala. The directors at NUWC Head Office, Khartoum, and the NUWC Regional Manager for Darfur Region, El Fasher, continued to direct and support the project for its execution.

Euroconsult carried through with the technical assistance and logistical support, and fielded an additional expert as Assistant Project Adviser, stationed in El Geneina. Short-term missions for expert contributions to the execution of the Phase 2 project were arranged in accordance with the agreed work programme. The necessary logistical support, radio and other communications, and liaison with the project authorities, were continued by Euroconsult's Project Support Office in Khartoum.

In May 1989, the Sudanese Government and Netherlands Government authorities during their bilateral consultation on development cooperation, agreed that the Nyala/El Geneina project should proceed into a Phase 3 directly after the end of Phase 2. The project authorities specified that Phase 3 of the project should be designed to cover two years, from January 1990 to December 1991. The requested project continuation was formally confirmed on behalf of the Sudanese Government and agreed upon by the Netherlands Government authorities.

In July 1989, Euroconsult was instructed to assist NUWC with the preparation of the project proposal to present the work programme, staffing and cost estimates for the Phase 3 period. The present proposal is based on all available data, updated planning of the project, current surveying and design work (e.g. Design Drawings Phase 2 and 3, April 1989), the results of recent short-term missions by experts, and regular consultations with the project authorities.

### 1.3 Contents of project proposal

The progress achieved so far in the Nyala/El Geneina project Phase 1 and 2, is briefly described in Chapter 2. The approach developed on the basis of the experience obtained in the project is summarized in Chapter 3. The proposed work programme for Phase 3 follows in Chapter 4, with details of the works and activities to be implemented.

The project organization is discussed in Chapter 5, and the scheduling of the project and its staffing in Chapter 6.

Cost estimates and the proposed project budget are presented in Chapter 7.

## 2 PREVIOUS PROJECT PROGRESS

### 2.1 General

Progress made in developing the water supply systems of Nyala and El Geneina during Phase 1 and 2 of the project, includes:

- distribution mains and branch lines  
(trenching, trimming, pipelaying and fitting)
- on-the-job training of pipe fitters
- erection of new elevated tanks
- repair of existing elevated tanks
- construction of water kiosks, complete with branch connections to mains
- testing and cleaning-out of existing boreholes
- drilling of new boreholes
- testing of existing borehole pumps
- installation of new borehole pumps
- construction of discharge lines for borehole pumps
- supply and lining-out of new booster pumps (Nyala booster pump station)
- preliminary rehabilitation of electrical connections and switchgear
- overhead power lines (with support poles on improved foundations)
- testing and temporary provisions for existing electro-generator sets  
(El Geneina)
- installation of new electro-generator sets (El Geneina)
- testing and commissioning of new components of water supply systems
- on-the-job training of staff of NUWC-organizations in Nyala and El Geneina, and preliminary improvements to the organizational structure and working procedures
- pilot system of revenue collection.

It is estimated that the water supply improvements effected in Phase 1 and 2 are benefitting, either directly or indirectly, some 90 000 people in Nyala and some 50 000 in El Geneina. However, the conditions of project execution are far from easy and there is a continuing influx of people both in Nyala and El Geneina. Thus, it is true that much remains to be done. Large segments of the population in both towns still lack access to an adequate and convenient supply of water. Most of these people as yet relay on water vendors for their water requirements. The vendors draw water from open unprotected sources and the bacteriological quality of this water is poor. Furthermore, the water is sold by the vendors at excessive prices.

The low-income sections of population cannot afford to take more than very limited quantities of water daily (as little as 8-12 litres per head) and have to use it sparingly and not sufficient for personal and domestic hygiene. The cost of water from vendors is 15-20 times higher per unit than the water from the piped supply system.

Incidence of hygiene- and water-related diseases in Nyala and El Geneina is still high, especially among the under-privileged sections of population most of which live in the outskirt settlements of the two towns. The progress made with increasing the water production from boreholes, pipelaying of mains and branch lines, and construction of water kiosks, needs to be extended and consolidated so as to provide these people particularly, and the other parts of the town's population also, with an adequate and reliable supply of water for hygiene and improved health conditions at affordable cost.

## 2.2 Nyala

Progress made in project implementation in Nyala includes (Figure 4):

- water supply service to outskirt settlements Sukar Shattat, El Khartoum Bileil, and El Wahda which were totally unserved when the project began
- Sukar Shattat/El Konghor distribution main with branch line to El Khartoum Bileil
- distribution main to Hai El Wahda (partly with push-off-resistant joints)
- construction of more than 20 new water kiosks and re-connection of 4 existing water kiosks
- erection of 3 new elevated tanks
- construction of valve chambers with heavy covers of reinforced concrete
- on-the-job training in installation of valves
- installation of sectional valves and air valves
- rehabilitation of selected service connections to the water supply system
- branch lines and connections to elevated tanks
- on-the-job training of pipe fitters
- selection of locations for bulk water meters
- selected repair of water meters in residential connections
- on-the-job training in installation of water meters

FIGURE 4 NYALA - PRESENT WATER SUPPLY SYSTEM



**LEGEND**

- RAILWAY
- ROAD
- SURFACE DRAIN (BOHRI)
- EXISTING BOREHOLE
- PLANNED BOREHOLE
- EXISTING PIPELINE
- ELEVATED TANK
- WATER KIOSK

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 WATER SUPPLY PROJECT

**NYALA**  
 EXISTING WATER SUPPLY SYSTEM



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- drilling of 4 new boreholes
- laying of discharge lines for borehole pumps (partly with tension-resistant joints)
- supply and installation of 5 new borehole pumps
- placement of support poles for overhead power lines
- wiring of overhead power lines and connection to power off-take at the booster pump station
- preliminary improvement of electrical circuit and switchgear in booster pump station
- supply and lining-out of 2 new booster pump/motor sets (each rated 100 m<sup>3</sup>/h at 60m head)
- repair of existing elevated balancing tanks at NUWC compound, including the sealing of leaking plate and bottom joints
- provision of expert advice in mechanical and electrotechnical works (i.e. power distribution switchboard, power control panels for borehole pumps, pump installation and power connections)
- installation of new borehole heads with non-return valve and isolating (gate) valve
- on-the-job training of staff of the NUWC-organization in Nyala, in water supply engineering and design, and in supervision of construction work.

In the old water distribution network of Nyala which was constructed some fifteen years ago with asbestos-cement pipes and fittings (of imperial not metric sizes), major rehabilitation will be required to reduce water leakages by renovation of defective pipe sections and joints. Almost all of the sectional and other valves are badly leaking and many are inoperative (of some valves the gate is missing altogether). There are some 9 000 house connections, some fitted with a water meter, but most in a very poor condition and leaking. In the present state, the distribution network cannot maintain the working pressure required to serve the higher-lying parts of the service area and these are, therefore, without water supply most of the time. In the design of the Nyala water supply system as developed by the project, account has been taken of this situation and a limited supply pressure (30 mwc) is foreseen for this part of the distribution system. Even so, extensive provisions for rehabilitation of the old distribution network will be required in the Phase 3 project period to secure the suitability of the network.

The NUWC staff and personnel deployed in the execution of the project Phase 1 and 2 (some only part of the time) are listed in Table 1.

Table 1 - NUWC staff and personnel deployed in Nyala during project Phase 1 and 2

Category	Number
Resident Engineer	1
Assistant Resident Engineer	1*
Mechanical Engineer	1*
Construction Supervisor	-
Superintendent/Commander	1
Foreman	1
Pipe fitters (experienced)	5**
Pipe fitters (unexperienced)	3
Skilled labour	6**
Unskilled labour	50

\* Available during Phase 2 only

\*\* Engaged in the project part of the time

### 2.3 El Geneina

Progress achieved in project implementation in El Geneina includes (Figure 5):

- water supply service by water kiosks to parts of the outskirts settlements which were totally unserved when the project began
- BH 13 distribution main with branch line
- Disa distribution line (DI 200mm dia)
- distribution line from borehole BH 14
- distribution lines in Ardamatta area
- construction of 14 new water kiosks
- on-the-job training of pipe fitters
- construction of valve chambers complete with concrete covers
- installation of sectional (gate) valves
- on-the-job training in installation of valves
- site location for erection of 3 new elevated tanks
- repair of elevated tank at Disa water yard
- temporary repair of elevated tanks at Kaja water yard
- laying of connecting line between borehole BH 14 and elevated tank at Hospital compound

FIGURE 5 EL GENEINA - PRESENT WATER SUPPLY SYSTEM



- service lines from distribution mains to newly constructed water kiosks
- rehabilitation of service lines of selected house connections
- installation of new water meters in selected house connections
- basic provisions in house connections with defective water meters
- drilling of 2 new boreholes (BH 13 and BH 14)
- installation of 2 new borehole pumps
- trenching and pipelaying for discharge line of borehole GP 06 to Disa water yard
- temporary provisions at BH 13 station for direct pumping of water into BH 13 main
- installation of new electro-generator set at BH 13 station, complete with power cabling
- overhead power line connecting GP 06 borehole pump with electro-generator set at Disa water yard
- preliminary rehabilitation of existing electrical connections and switchgear
- construction of new generator house at BH 13 station
- cleaning-out of borehole GP 02 at Ardamatta water yard
- basic repair of existing small elevated tank at Ardamatta water yard
- construction of new generator house at Ardamatta water yard
- installation of new electro-generator set at Ardamatta water yard
- preparations for removal of old reciprocating pumps (SBS type) from boreholes at Kaja and Disa water yards
- provision of expert advice in mechanical and electrotechnical works (i.e. pump installation and power connections, power control panels and switchgear)
- on-the-job training of staff of the NUWC-organization in El Geneina, in water supply engineering and design, and in supervision of construction work.

The old water distribution network of El Geneina which was constructed some fifteen years ago with asbestos-cement pipes and fittings, is subject to considerable water losses by leakage. Many of its pipe joints are apparently leaking and most of the sectional valves inoperative. There are about 800 house connections most of which in a poor state of repair. Some are equipped with water meters which virtually all are out of operation.

Although the works executed in the project Phase 1 and 2 have provided tens of thousand people in the outskirts settlements, and also in the central town areas, with improved water supply from kiosks there remain large sections of population that are dependent on water vendors for their water requirements. The vendors sell water at excessive prices and of poor bacteriological quality because it is drawn from unprotected sources. Much work remains to be done to extend piped water supply service to the under-privileged groups of population who so far lack it. Low-income groups take very little water from the vendors (according to a survey the water usage is as low as 8-10 litres per head daily). The water is used very sparingly, not sufficient for personal and domestic hygiene. Hygiene- and water-related diseases occur widely under the population of El Geneina, especially among the low-income population and refugees in the fringe settlements.

The public power supply of El Geneina presently is very unreliable and subject to frequent breakdown. The power supply to the BH 14 borehole pump is from the town's power-generating plant. It is often interrupted so that the pump cannot be operated regularly.

The NUWC staff and personnel deployed in the execution of the project Phase 1 and 2 are listed in Table 2.

Table 2 - NUWC staff and personnel deployed in El Geneina during project Phase 1 and 2

Category	Number
Assistant Resident Engineer	1
Mechanical Engineer	-*
Construction Supervisor	-
Superintendent/Commander	1
Foreman	1
Pipe fitters (experienced)	4**
Pipe fitters (unexperienced)	3**
Skilled labour	3**
Unskilled labour	60

\* Based in Nyala, worked most of the time there

\*\* Available only part of the time

#### 2.4 Logistical support

The logistical support provided by Euroconsult's Project Support Office, Khartoum, to the Nyala/El Geneina project, involved:

- making arrangements for customs clearance at Port Sudan of imported materials and equipment ordered for the project; this requires regular visits of Euroconsult staff from Khartoum to Port Sudan to follow up on the formalities and clearing procedures
- arrangements for inland transport of the imported materials and equipment, with Sudan Railways or for truck transport as appropriate
- daily radio communications with the project staff in Nyala and, if necessary, also directly with El Geneina; mail delivery of project documents and correspondence using Sudan Airways flights if possible or otherwise private charter flights
- procurement and delivery of materials and equipment from suppliers within the Sudan
- liaison with the project authorities in Khartoum (i.e. NUWC Head Office, Ministry of Finance and Economic Planning, Royal Netherlands Embassy)
- travel arrangements, visa and inland travel permits both for resident project staff and experts on short-term missions to the project.

This logistical support is truly essential for the project's execution. It should definitely be continued during the Phase 3 period.

### 3 CURRENT APPROACH

#### 3.1 General

The objective of the project in its Phase 3 is the same as in the Phases 1 and 2, that is, to provide better living and health conditions for the populations of Nyala and El Geneina, especially the under-privileged sections of population in the outskirts settlements of these towns. The project pursues this objective by making systematic improvements to the water supply systems of Nyala and El Geneina. The aim is to provide all groups of population in these two towns with a supply of water that is sufficient for hygiene and domestic needs, adequate in terms of convenience, and reliable for continuous operation year-round.

Considering the works and facilities brought about by Phase 1 and 2 of the project, it has been decided that the emphasis of the Phase 3 should be on upgrading, extension and consolidation of the Nyala and El Geneina water supply systems. Upgrading includes essential and urgently needed rehabilitation work and replacement of defective components (i.e. leaking pipe sections of the old water distribution networks, inoperative pumping equipment, unsuitable power supply facilities, electrical connections and switchgear that are in a poor condition). Extension refers to the needed expansion and operational requirements of the water pumping and distribution systems so as to provide water supply service to more of the populations of Nyala and El Geneina. The term consolidation covers the required integration of the works and facilities installed under project Phase 1 and 2, with the existing water supply infrastructure after upgrading, and with the further extension works programmed for Phase 3. Consolidation also relates to the programme of technical training foreseen for the staff and personnel of the NUWC-organizations in Nyala and El Geneina who are to take charge of the operation and maintenance of the water supply systems. This is closely connected with the Pilot Project for institutional development and organizational strengthening which has been approved for execution. The Phase 3 project must be fully integrated with the Pilot Project.

### 3.2 Target benefits and community participation

Improved water supply service for all or most of the populations in Nyala and El Geneina is the main target benefit of the project. In particular, the under-privileged sections of population in the outskirts settlements of the two towns will be benefitting greatly by the adequate and reliable water supply from the water kiosks. At the kiosks they can obtain their daily water requirements with less effort, in quantities sufficient for hygiene and domestic use, and at much reduced cost per unit of quantity (e.g. tin).

The construction of water kiosks also makes it possible to promote the participation of the women in the operation and use of the water supply systems. In many respects, women and their children are the principal users of water and thus the main beneficiaries of improved water supply. By providing reliable water delivery points in the vicinity, the project supports the women in their traditional task of catering for the family's water requirements. Less effort, time and cost will be involved. This will promote adequate use of water for food preparation and cooking, and for cleaning of utensils, so that hygiene and cleanliness can be better maintained. Each water kiosk is to have a user committee of 4-5 members (preferably at least 2 women) selected from the population living in the service area of the kiosk. These user committees will be looking after the operation, use and hygienic conditions of the kiosks.

In addition, to strengthen the involvement of the populations of Nyala and El Geneina in the management of the town water supply systems, in each of the two towns the establishment of a Water Committee is foreseen which should advise the local authorities on all matters pertaining to the water supply especially the water rates charged.

### 3.3 Integration of water supply with hygiene education and promotion of sanitation

There is a close relation between water supply, environmental hygiene and sanitation. Improved water supply alone cannot be expected to produce lasting effects in hygiene or in health and living conditions.

Sanitary provisions for hygiene and disposal of excreta are needed to reinforce the effects of improved water supply. The project will be instrumental in giving essential support to the local authorities and health officials in the promotion of hygiene education and sanitation. This line of activity will be further supported by the Pilot Project.

Water-borne disposal of excreta and domestic wastewater is no realistic option for major parts of Nyala and El Geneina. The cost of sewerage systems would be prohibitive and in several parts of these towns such systems would not even be technically feasible because of topography, soil conditions and rock outcrops. Fortunately, low-cost technical options of sanitation are available and suitable to provide the desired hygienic benefits and convenience of use. These options include: ventilated improved latrines, toilets connected to septic tanks or double-vault soakaway pits, and aqua privies (with the limitation that these require watertight construction). Adequate disposal of garbage and other solid wastes also is an integral part of environmental hygiene. In Nyala and El Geneina it mainly concerns the disposal of kitchen garbage, household refuse and stove ashes. Under the Pilot Project, awareness will be promoted under the local populations of the serious health hazards caused by unsanitary disposal of solid wastes.

#### 3.4 Institutional and organizational development

The institutional framework embodied in the NUWC-organizations in Nyala and El Geneina, the NUWC Regional Office for Darfur Region, the NUWC Head Office in Khartoum, and the local and national authorities concerned, is considered to be generally adequate for the requirements of the Phase 3 project.

Technical assistance and expert consulting services are foreseen under the Pilot Project for:

- clearer designation of functions and tasks within the NUWC-organizations in Nyala and El Geneina
- improved work planning for staff and personnel
- scheduled operation and maintenance work
- upgrading of skills of supervisory staff
- improved internal communications between management, supervisory staff and work force.

Full integration with the Pilot Project will be needed for the Phase 3 project in the area of revenue collection and financial management. No water supply system can be successfully operated and maintained unless its revenue collection, financial management and administration are sound. Cost recovery, at least at the level of full coverage of the recurrent costs of operation and maintenance, is mandatory for the financial sustainability of the water supply systems.

### 3.5 Technical training programme

Key constraints to the effective functioning of the NUWC-organizations in Nyala and El Geneina are the weaknesses in staffing and level of skills. The technical training programme incorporated in the Phase 3 project, is focused on the provision of technical skills and know-how.

Upgrading of the level of skills of the technical personnel deployed for construction and installation work, and for operation and maintenance, is absolutely needed. The programme of technical training has been designed by a short-term expert mission in March 1989 (Technical Report Nyala/El Geneina Project - Technical Training Programme). Arrangements for suitable training activities have already been developed under the project Phase 2 and will be continued and intensified in Phase 3.

### 3.6 Design strategy

In the technical designs prepared for the Phase 3 project the utmost attention has been given to facilitate operation and maintenance as much as possible. This concerns the various system components, such as, mains and branch lines, borehole heads, pumping equipment, power connections and switchgear, and electro-generator sets.

The supply pressures to be applied on the old parts of the water distribution networks in Nyala and El Geneina have been kept limited to allow for the weak condition of these networks.

Placement of bulk meters is foreseen in those distribution mains that supply town sectors where house connections are mostly unmetered or where existing water meters are not working. This will permit adequate monitoring of supply flows to these sectors so as to control water delivery and identify leakages or un-authorized connections.

The objective of the technical provisions incorporated in the prepared designs, is to provide water supply systems that can be best managed and operated by the NUWC-organizations in Nyala and El Geneina.

### 3.7 Maintenance support

Regular inspection of operating equipment and maintenance schedules will be used to upgrade maintenance work and to prevent breakdowns. This relates particularly to pumps, power control, switchgear and instrumentation.

Operator's manuals and checklists for operation and maintenance will be provided using documentation from suppliers of equipment or from other sources. Translation of key sections of these manuals and checklists into Arabic will be promoted. Parts' lists need to be available and used particularly when ordering replacement parts.

### 3.8 Workshops and stores

Adequate workshop facilities are essential for the NUWC-organizations both in Nyala and in El Geneina. The Phase 3 project will be fully integrated with the Pilot Project under which provisions have been made for the supply of tools, equipment and materials for the workshops.

In Nyala, space for a mechanical/electrotechnical workshop is expected to become available on the NUWC compound. In El Geneina a site has already been selected, with the approval of the regional and local authorities, for construction of a workshop annex to the new NUWC office.

Stores management will be improved by introduction of simplified stock control and issuing procedures for materials, spare parts and equipment.

### 3.9 Fuel supply and storage

The timely supply of diesel fuel for the operation of the water supply systems is a matter of continuous concern, especially for El Geneina. Bulk storage of diesel and fuel to cover at least three months' requirement during the wet season is essential for continuous water supply pumping operations.

### 3.10 Transport

For both Nyala and El Geneina the availability of sufficient transport facilities is a continuing concern. Construction and installation work under the Phase 3 project will impose considerable transport needs. Operation and maintenance work also regularly requires the transport of materials, equipment and personnel to the working sites.

### 3.11 Radio communication

Radio equipment allowing daily communications between Nyala, El Geneina, El Fasher and Khartoum, has already been provided under the project's Phase 2. Arrangement haven been made for the installation of the radio equipment in these places. The Ministry of Communications has granted a permit and assigned a frequency for use by the project.

## 4 WORK PROGRAMME PHASE 3

4.1 General

The work programme for Phase 3 covers the works and activities required for the upgrading, extension and consolidation of the water supply systems of Nyala and El Geneina. The work programme includes a number of works and activities that are expected to be not fully completed at the end of Phase 2.

4.2 Nyala design base

The design base for the Nyala water supply system is summarized in Table 3.

Table 3 - Nyala: Population estimates and water demand projection

Town sector	Population estimates		Water demand (m <sup>3</sup> /d)	
	1990	1995	1990	1995
<u>Central</u>				
El Wadi	22 000	24 000	1 390	1 550
El Cinema	4 800	5 000	410	430
Ghamouria & Sham El Nasim	11 800	12 000	750	780
<u>Eastern</u>				
El Jebel	20 000	21 000	670	745
El Taiba	28 000	36 000	730	970
Sika Hadid	15 000	16 000	500	570
<u>Northern</u>				
Konghor, Raig & Sad El Ali	7 400	8 000	250	285
El Tadamon	20 000	26 000	550	790
Sukar Shattat	41 000	52 000	980	1 400
Khartoum Bileil	35 000	44 000	960	1 330
<u>Western</u>				
El Geer	14 000	17 000	380	510
<u>Southern</u>				
El Wahda	40 000	51 000	1 110	1 540
El Kuria	26 000	33 000	840	1 150
<b>TOTAL</b>	<b>285 000</b>	<b>345 000</b>	<b>9 520</b>	<b>12 050</b>

The estimated water demands for institutional and commercial use, industrial purposes, and for livestock watering, are presented in Table 4.

Table 4 - Nyala: Projection of non-residential water demand

Category	Water demand (m <sup>3</sup> /d)	
	1990	1995
Institutional	210	240
Commercial	150	210
Industrial	300	420
Railway station	50	80
Livestock watering & slaughter house	220	350
<b>Total</b>	<b>930</b>	<b>1 300</b>

The total water demand to be supplied by the Nyala water supply system thus is as follows, allowing for some variation due to uncertainties (Table 5).

Table 5 - Nyala: Total water demand projection

Year	Total water demand (m <sup>3</sup> /d)	
1990	10 450	(10 000 - 11 000)
1995	13 350	(12 500 - 14 000)

#### Water sources

Various groundwater surveys have been carried out to assess the assured yield capacity of the alluvium in the Wadi Nyala bed. The WAPS-2 survey conducted in 1984-1985 conservatively estimated the assured yield at 3.5 - 4 million m<sup>3</sup> per year, or an average 9 500 - 11 000 m<sup>3</sup>/d. Additional investigations and the results of pumping tests indicate that the assured yield of the wadi aquifer is somewhat greater, 13 500 - 15 500 m<sup>3</sup>/d. Verification of the yield capacity of the wadi aquifer will be needed.

The present water abstraction from the wadi alluvium is mainly concentrated in the western and middle well fields. It is estimated to be about 6 500 m<sup>3</sup>/d if all existing borehole and well pumps are operated.

The operating experience with these boreholes generally confirms the findings of the WAPS-2 survey and indicates that the western well field is pumped close to its maximum allowable yield. The additional boreholes required for the Nyala water supply, therefore, must be sited in the eastern well field. If more water would be pumped from the western well field than the present abstraction rate, over-pumping and excessive drawdowns are to be expected.

Table 6 - Nyala: Estimated water production (m<sup>3</sup>/d)

Stage	Western well field	Middle well field	Eastern well field	Total
<u>Present situation</u>				
incl. extensions by project Phase 1				
Operating boreholes	7	3	4	14
Yield capacity	2500-2800	1700-1800	2000-21000	6200-6700
<u>Short term situation</u>				
incl. extensions by project Phase 2 and 3				
Operating boreholes	7	3	8	18
Yield capacity	2400-2600	1700-1800	4400-4800	8500-9200
<u>Future development</u>				
incl. additional boreholes				
Operating boreholes	8	2	15*	25
Yield capacity	3200-3500	1100-1200	8700-9300	13000-14000

\* including boreholes to be sited downstream (east) of eastern well field

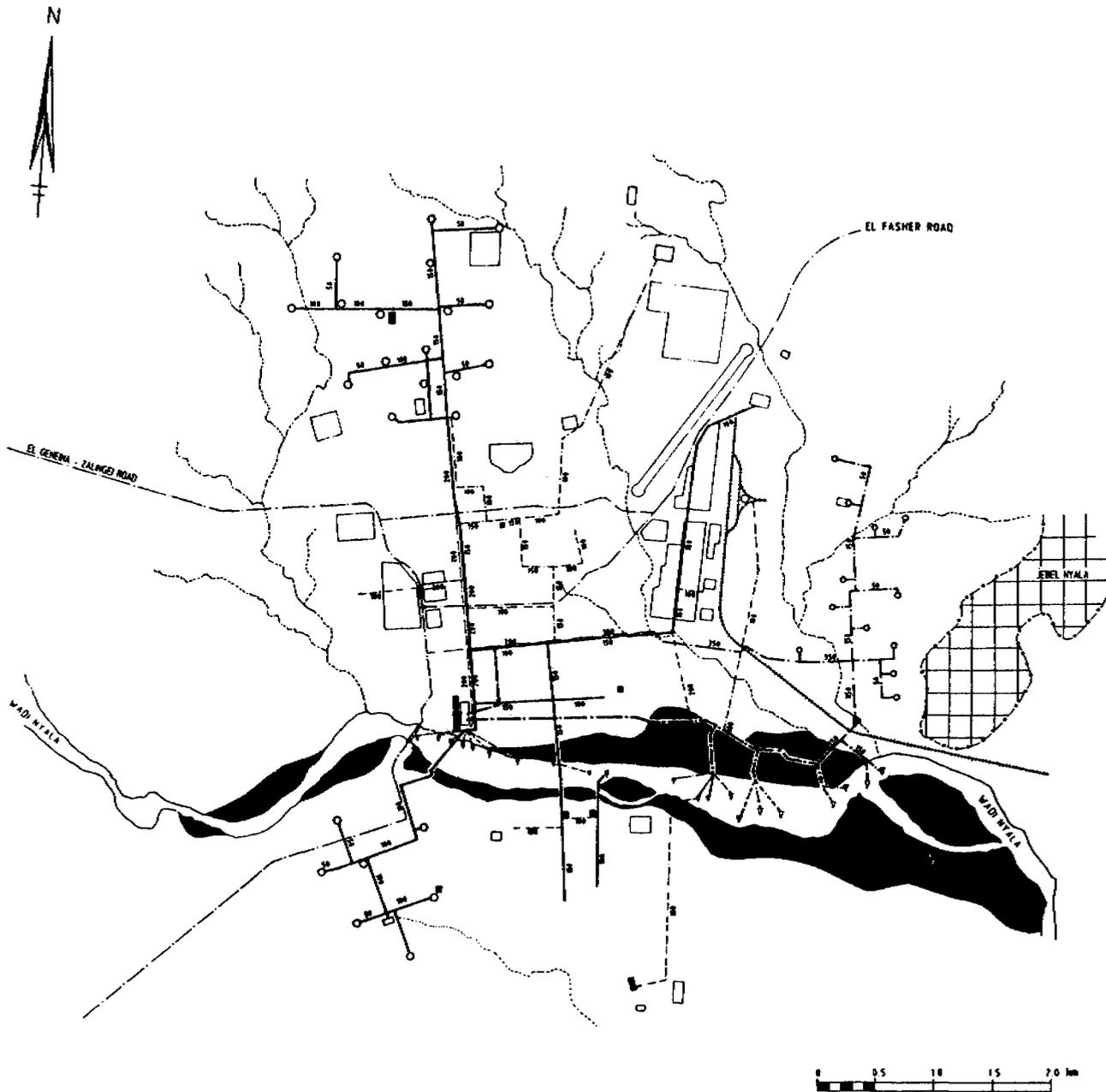
#### 4.3 Nyala work programme Phase 3

The Phase 3 work programme for Nyala includes the following works and installations (Figure 6):

##### Boreholes and borehole pumps

- drilling of 7 new boreholes (i.e. eastern well field)
- installation of 7 new borehole pumps in these boreholes
- discharge lines for pumps in new boreholes

FIGURE 6 NYALA - EXTENSION WORKS PHASE 3



**LEGEND**

- RAILWAY
- ROAD
- - - SURFACE DRAIN (KHORI)
- ▽ EXISTING BOREHOLE
- ▽ PLANNED BOREHOLE
- EXISTING PIPELINE
- - - PLANNED PIPELINE
- ELEVATED TANK
- WATER KIOSK

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NYALA  
 EXTENSION WORKS, PHASE II & PHASE III



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- replacement of 3-4 borehole pumps in western well field by installation of new pumps
- construction of collector line for eastern well field with connection of discharge lines
- fitting out of all borehole heads as per standard design (i.e. non-return valve, gate valve, air valve, pressure gauge, water level control instrumentation).

#### Power supply of borehole pumps

- upgrading of existing overhead power lines (incl. fixing of support poles on steel pipe sections drilled 6m deep into wadi bed)
- overhead power lines to new borehole pumps in eastern well field
- wiring, switchgear and power control for all pumps in eastern well field
- upgrading of overhead power lines to borehole pumps in western well field
- installation of new power distribution panel and switchboard at booster pump station
- rehabilitation of overhead power lines for middle well field
- complete renovation of power connections and switchgear for middle well field (including protective housing).

#### Supply main

- construction of supply main running from eastern well field to balancing reservoir at NUWC compound.

#### Elevated balancing tanks at NUWC compound

- installation of float valves
- level indicators for the operational control of the borehole pumps discharging into the tanks
- installation of level switches for the operational control of the booster pumps
- upgrading of inlet and outlet piping of the tanks

#### Ground-level balancing reservoir

- mound scaping for foundation of reservoir
- construction of reservoir consisting of bolted steel sectional plates, complete with inlet piping connected to elevated tanks, pipework including bypass lines, float valve, and outlet piping connected to feeder pipe of booster pumps.

#### Booster pump station

- re-arrangement of feeder and discharge lines of booster pumps according to new configuration

- removal of several existing old pump/motor sets
- supply and installation of additional 2 booster pumps (for low-pressure duty of 30 mwc)
- installation of existing pump No. 1 for standby duty
- renovation of electrical connections and switchgear for booster pumps
- upgrading of pipework and valves (i.e. inlet suction, valves, discharge valves, and non-return valves to reduce pressure surges in discharge line and outlet pipe of booster pump station).

#### Water distribution system

- construction of trunk distribution main running from booster pump station in eastern direction, complete with sectional valves, air and scour valves, and other appurtenances
- construction of valve chambers with concrete covers
- upgrading of mains and connections of old distribution network (asbestos-cement)
- replacement of inoperative valves in old distribution network (using standard design for pipe configuration and valve chamber)
- construction of branch line to El Jebel/El Taiba area; cross-connection to trunk main at arrow point
- construction of branch line to Hai El Sukka Hadid area (industrial zone)
- construction of 12 new water kiosks in El Jebel/El Taiba area
- construction of extension line to Government Tannery
- construction of branch line from Sukar Shattat main to Hai El Geer area
- installation of bulk water meters at selected locations in the water distribution system
- rehabilitation of selected service lines
- installation of water meters in larger-size non-residential connections
- selective installation of water meters in house connections.

#### Training programme

- on-the-job training in operation and maintenance of pumping equipment and electrotechnical installations
- on-the-job training of pipelaying and fitting work
- on-the-job training in installation of valves, bulk water meters, and service connections
- training in control of water supply operations including selection of pumps and operation of valves to adjust the supply flow to the demand for water.

Engineering & design

- preparation of working drawings for pipelaying, civil engineering and electrotechnical works
- preparation of bills of quantities and tender documents, as required
- specification of equipment and plant to be procured
- preparation of procurement lists

Logistical support

- clearing and inland transport of imported materials and equipment
- liaison with the project authorities in Khartoum
- radio and other communications
- procurement of supplies to project that are obtainable within the Sudan
- applications for official permits, licences and other required documents.

4.4 El Geneina design base

The design base for the El Geneina water supply system is summarized in Table 7.

The projection of water demand for non-residential uses is as follows (Table 8).

The total water demand to be supplied by the El Geneina water supply system thus is as follows, allowing for some variation due to uncertainties (Table 9).

For the Ardamatta area a separate water supply system has been designed for implementation during the Phase 3 project. The estimated water demand in the Ardamatta service area is:

1990 - 380 m<sup>3</sup>/d  
 1995 - 550 m<sup>3</sup>/d.

Table 7 - El Geneina: Population estimates and water demand projections

Town sector	Population estimates		Water demand projections	
	1990	1995	1990	1995
<u>Central area</u>				
Najlis	2 800	3 000	220	235
Kefah	9 000	10 000	580	660
Nahda	6 500	7 000	430	460
<u>Eastern</u>				
Zhour	4 700	5 000	165	180
<u>Northern</u>				
Riyadh	3 500	5 000	120	140
Salam	7 500	8 000	260	290
Em Tedad	10 500	14 000	290	430
Shati	18 500	23 000	510	700
Nassim	9 500	12 000	240	330
<u>Western</u>				
Mardaris	6 000	8 000	180	245
<u>Southern</u>				
Jebel	4 500	6 000	115	160
Tadamon	8 000	10 000	230	305
Thoura	7 000	9 000	190	265
Total	98 000	120 000	3 530	4 400
<u>Separate settlements</u>				
Ardamatta	15 500	20 000	380	550
Umm Duein	16 500	20 000	450	590
Total	32 000	40 000	830	1 140
Grand total	130 000	160 000	4 360	5 540

Table 8 - El Geneina: Projection of non-residential water demand

Category	Water demand (m <sup>3</sup> /d)	
	1990	1995
Institutional	90	110
Commercial	50	80
Livestock watering & slaughter house	140	180
Total	280	370

Table 9 - El Geneina: Total water demand projection

Year	Total water demand (m <sup>3</sup> /d)	
1990	4640	(4500-5000)
1995	5910	(5500-6500)

### Water sources

Several groundwater surveys have been carried out in the El Geneina and Ardamatta areas. The WAPS-2 groundwater survey of 1984-1985 concluded that the total assured yield from the Disa sandstone aquifer should be at least 2.5 million m<sup>3</sup>/year, or about 7 000 m<sup>3</sup>/d. The yields obtainable from the Wadi Kaja bed (alluvium) were shown to be fairly limited. Additional water production for the water supply of El Geneina must thus be developed by drilling more boreholes into the Disa sandstone aquifer. For technical reasons and to facilitate operation and maintenance this should be done in the vicinity of the BH 13 station.

The water resources for the water supply of Ardamatta are to be planned separately. The WAPS-2 survey of 1984-1985 was supplemented by further groundwater investigations in late 1987. It appeared that there is no major recharge of the aquifer in that area. The storage volume of the aquifer underlying Ardamatta B was estimated to be about 6.5 million m<sup>3</sup>. If this assessment is correct, water supply pumping would gradually deplete the groundwater resource. However, the resource would suffice for 40-45 years at the planned abstraction rates. In addition, recharge of the aquifer could very well be induced by the drawdown effected by water pumping. It is, therefore, certainly justifiable to develop the Ardamatta water supply as planned, using boreholes GP 02 and GP X. Monitoring of groundwater levels and drawdowns in the boreholes will be required for responsible operation and assessment of the aquifer's response to pumping.

#### 4.5 El Geneina work programme Phase 3

The Phase 3 work programme for El Geneina includes the following works and installations (Figures 7 and 8):

##### Boreholes and borehole pumps

- drilling of 2 No. new boreholes in the vicinity of BH 13 station (WAPS borehole design and specification, 10 5/8"-casing)

FIGURE 7 EL GENEINA - EXTENSION WORKS PHASE 3



- LEGEND**
- ROAD
  - - - - - PRESENT TOWN BOUNDARY
  - BOREHOLE NEW
  - ◐ BOREHOLE EXISTING
  - ELEVATED TANK NEW
  - ◑ ELEVATED TANK 15 m<sup>3</sup>
  - WATERMOSK
  - PIPELINE EXISTING
  - - - - - PIPELINE PHASE III

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 EXTENSION WORKS PHASE II & III



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- pumping test on existing and new boreholes to establish safe yield and drawdown characteristics
- installation of pump in borehole GP 06 (pump 610/15, transferred from BH 13)
- construction of discharge line of GP 06 pump, from borehole to tank at Disa water yard
- installation of new borehole GP 12 at Disa water yard (with temporary provision for throttled operation)
- installation of new pump in borehole GP 02 (Ardamatta)
- laying of discharge lines from new boreholes to BH 13 station
- connection of discharge lines and other pipework to elevated tank and ground-level reservoir at BH 13 station
- installation of new borehole pump (610/9) in BH 13 borehole to replace transferred pump
- installation of non-return valves, gate valves, pressure gauges, and water level control instrumentation.

#### Ground-level reservoir (at BH 13 station)

- ground leveling for foundation of reservoir
- construction of foundation
- bolted steel pressed plate tank, complete with inlet piping, bypass, valves, level indicator, and float valve.

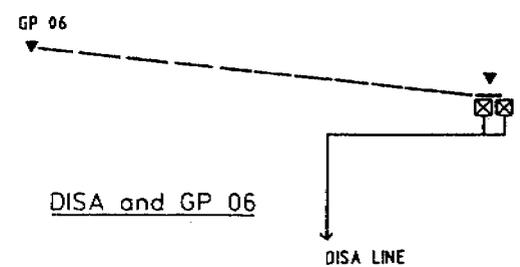
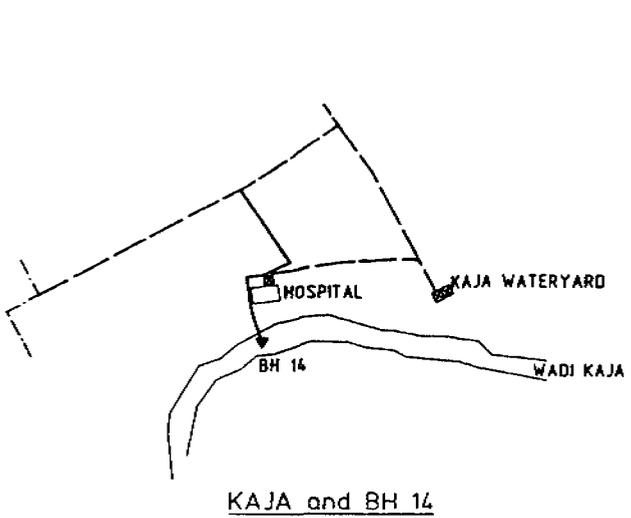
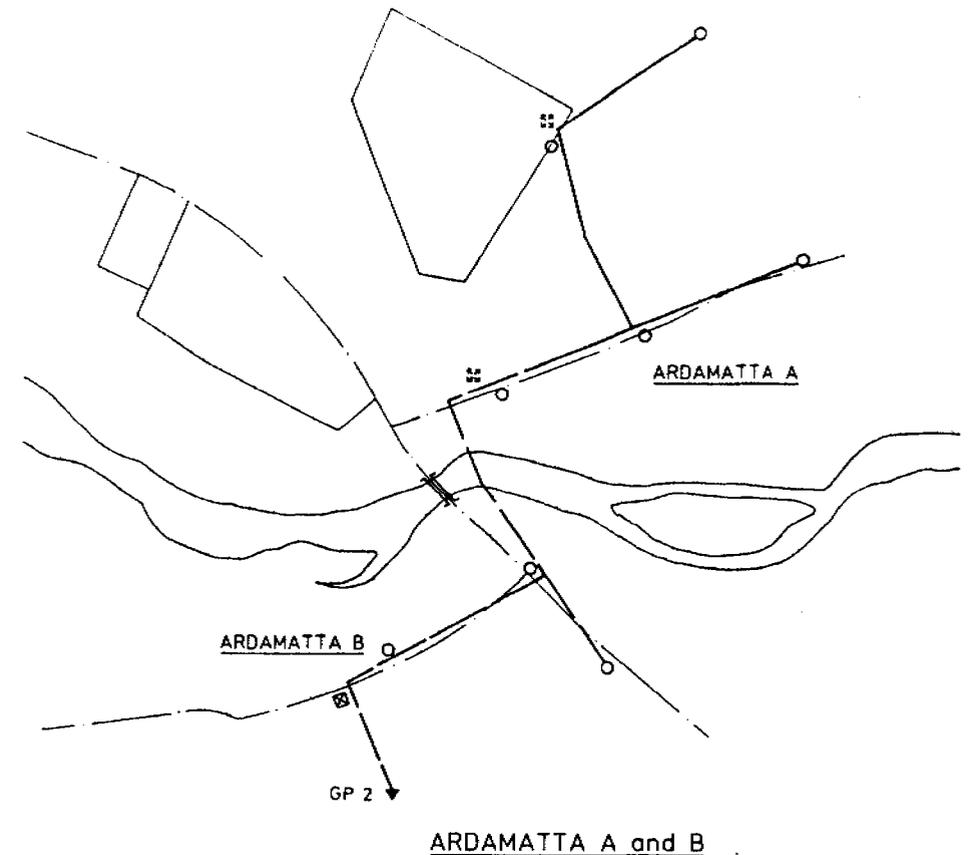
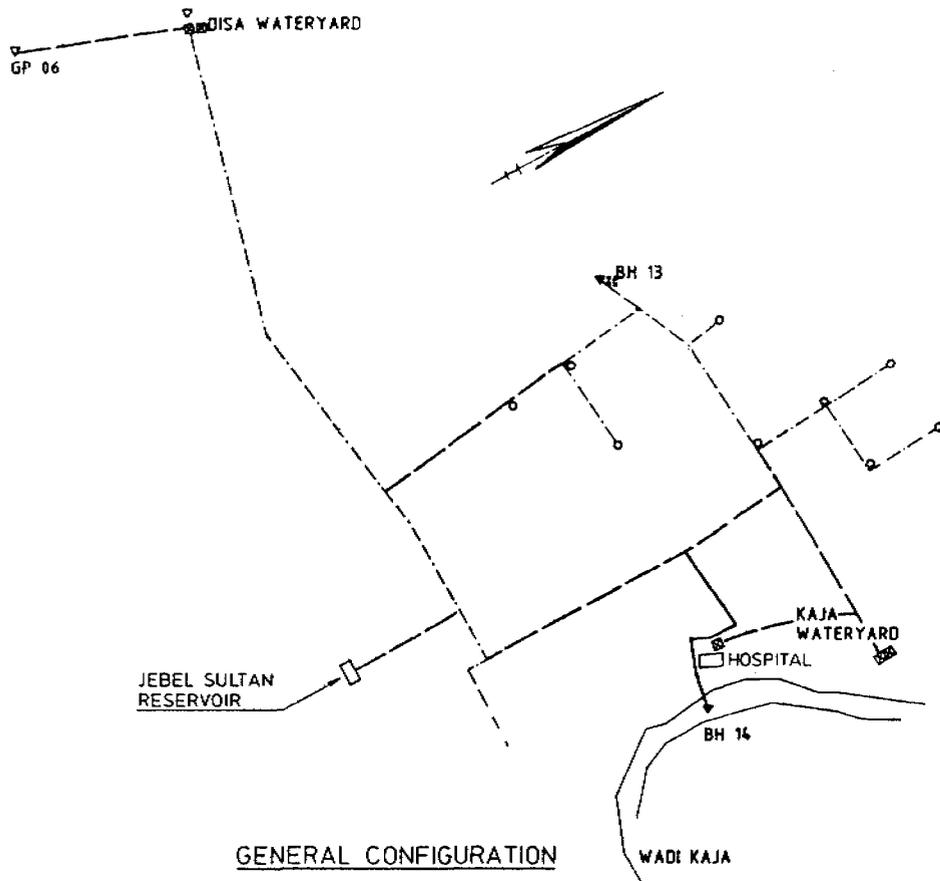
#### Elevated tanks

- painting of elevated tank at Disa water yard
- repair of leaking joints of elevated tanks at Kaja water yard (to keep tanks in use as a temporary provision)
- rehabilitation of tank at Hospital compound
- repair of small tank at Ardamatta water yard, with improvements to the inlet and outlet piping (1½" and 2" GS)
- installation of new elevated tanks at the selected sites in Ardamatta area

#### Power supply to borehole pumps

- removal of the excessively large electro-generator set from Disa water yard
- installation of new electro-generator set
- connection of power lines of borehole pump GP 06 and borehole pump GP 12 with new Disa electro-generator set

FIGURE 8 - DETAILS OF EXTENSION WORKS PHASE 3



**LEGEND**

- ▽ BOREHOLE NEW
- ▼ BOREHOLE EXISTING
- ⊠ ELEVATED TANK NEW
- ⊠ ELEVATED TANK 45 m<sup>3</sup>
- ⊙ WATERKIOSK
- PIPELINE EXISTING
- ==== PIPELINE PHASE II NEW
- PIPELINE PHASE III EXTENSION

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 DETAILS OF WATER SUPPLY  
 EXTENSION WORKS

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- improvement of power supply from town's electro-generator to BH 14 borehole pump (BH 14 pump to have standby function)
- installation of additional new electro-generator set at BH 13 station
- upgrading of power cabling from BH 13 station generator house to BH 13 borehole pump
- installation of power control equipment and switchgear in generator house at Ardamatta water yard
- installation of overhead power line to GP 02 borehole pump.

#### Distribution mains and branch lines

- construction of connection line from BH 13 main to present BH 14 line
- connection of BH 13 main to branch line of tank at Hospital compound
- connection of BH 13 main to existing distribution line from Kaja tanks
- construction of distribution mains and branch lines in Ardamatta area
- construction of new water kiosks in Ardamatta area
- installation of service lines to new water kiosks as well as to those built during project Phase 1 and 2 in Ardamatta area
- installation of bulk meters at selected locations
- rehabilitation of service lines and house connections in old water distribution network
- installation of water meters in larger-size non-residential connections
- selective installation of water meters in house connections.

#### Training programme

- on-the-job training in operation and maintenance of borehole pumpmotor sets
- on-the-job training for installation of electrical connections and switchgear
- on-the-job training in operation, maintenance and servicing of electro-generators and diesel engines
- on-the-job training in installation of valves in water distribution system
- on-the-job training in installation of bulk water meters and water meters in non-residential connections and selected house connections.

#### Engineering and design

- preparation of working drawings for pipelaying, civil engineering and electrotechnical works
- preparation of bills of quantities and tender documents, as required
- specification of plant and equipment
- preparation of procurement lists.

Logistical support

- clearing and inland transport of imported materials and equipment for El Geneina
- liaison with the project authorities in Khartoum
- radio and other communications
- procurement of supplies to project that are obtainable within the Sudan
- applications for official permits, licences and other required documents.

## 5 PROJECT SET-UP

### 5.1 Project organization

As in project Phase 1 and 2, the prime responsibility in Phase 3 for the management of the project, and for design and construction work will rest with NUWC. Overall direction and supervision shall be exercised by NUWC Head Office and the NUWC Regional Manager for Darfur Region. NUWC will be responsible for liaison with the Ministry of Finance and Economic Planning and other national government departments concerned, as well as with the Royal Netherlands Embassy. The NUWC Chief Officer in Nyala will have an important counterpart function for the project staff in respect of the day-to-day aspects of project execution.

NUWC will secure the continuation in post of the Resident Engineer, the Assistant Resident Engineers in Nyala and El Geneina, the Mechanical Engineer, the construction supervisors, and the supporting staff (i.e. project administrator, storekeepers). In addition, NUWC will make the necessary arrangements to post two junior engineers in the project. Pipe fitters and mechanics will be assigned to the project in accordance with the requirements of the work programme. Skilled and unskilled labour will, as before, be made available from the personnel of the NUWC-organizations in Nyala and El Geneina, or be recruited locally on a casual basis.

As project consultant, Euroconsult will continue in Phase 3 to provide technical assistance and logistical support. This will require:

- posting of resident experts as Project Adviser, Nyala, and Assistant Project Adviser, El Geneina;
- short-term missions by experts for specific aspects of the project;
- support in design work, preparation of working drawings and specifications;
- assistance in scheduling of project works and in supervision of construction;
- development and conduct of technical training programme;
- promotion of hygiene education and sanitation;
- promotion of the involvement of the local population and authorities;
- services by Euroconsult's project Support Office in Khartoum involving customs clearance of imported materials and equipment for the project, and arrangements for inland transport;

- radio and other communications between Nyala, El Geneina, El Fasher and Khartoum;
- liaison with the project authorities both in the Sudan and in the Netherlands.

The NUWC Chief Officer in Nyala, and the Resident Engineer and Assistant Resident Engineers will be focal points for the day-to-day technical cooperation work with the Consultant's staff.

The regional organization of NUWC in Darfur Region is shown in Figure 9.

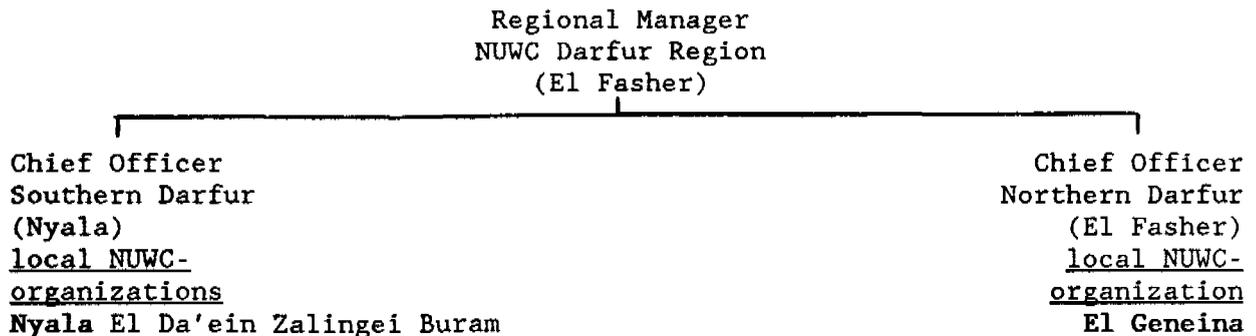


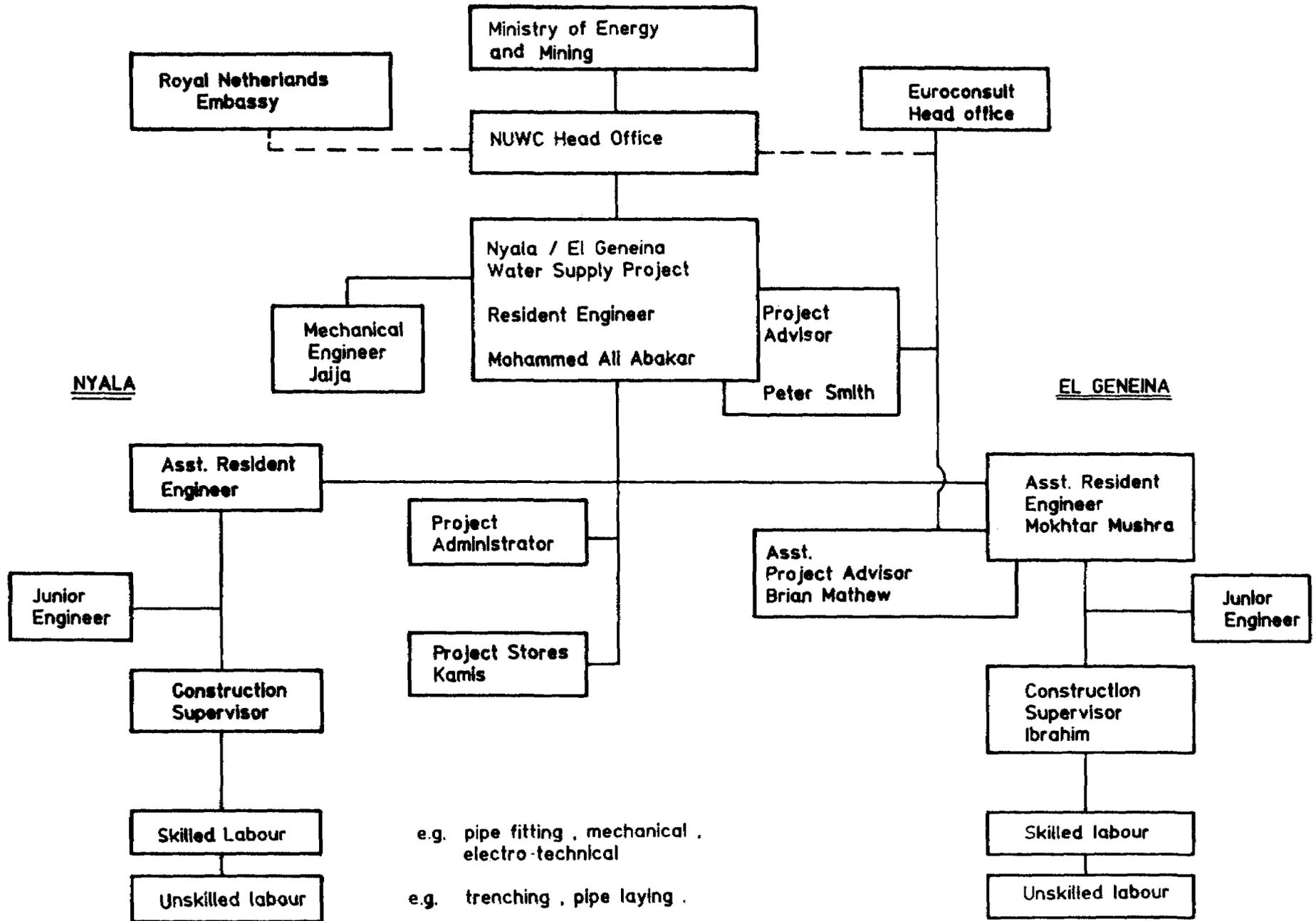
Figure 9 - NUWC regional organization in Darfur Region

The NUWC staff and Consultants' staff assigned to the Phase 3 project shall ensure adequate coordination and regular consultations with:

- NUWC Head Office, Khartoum;
- Royal Netherlands Embassy, Khartoum;
- Governor of Darfur Region, El Fasher;
- Commissioner's Office, Nyala;
- NUWC Regional Office, El Fasher;
- NUWC Nyala Water Corporation, Nyala.

The organizational chart of the Phase 3 project is shown in Figure 10. For technical matters relating to operation and maintenance, the existing situation already is such that the actual responsibility is at the local level, and for financial and administrative matters arrangements are being sought for more operational autonomy at the local level.

Figure 10 - Organizational chart of Phase 3 project



## 5.2 Project monitoring

The Phase 3 project will be carried out under the Sudanese/Netherlands bilateral cooperation programme. Thus, its execution will be monitored by:

### Sudanese authorities

- Ministry of Finance and Economic Planning
- Ministry of Energy and Mining
- National Urban Water Corporation

### Netherlands authorities

- Ministry of Foreign Affairs  
Directorate General of Development Cooperation
- Royal Netherlands Embassy, Khartoum.

## 5.3 Liaison requirements

Organizations and projects with which the Nyala/El Geneina Water Supply Project needs to maintain liaison, include:

- Western Savannah Development Corporation, Nyala;
- Village Water Supply Project, Nyala (previously WADS-project)
- National Corporation for Rural Water Resources Development, Southern Darfur Office, Nyala;
- Lower Saxony (West Germany) - Sudanese Partnership Project, Nyala/EC Fasher;
- Medecins sans Frontières, Nyala;
- GOAL (Irish non-governmental organization) Village Health Care and Refugee Help Project, El Geneina;
- OXFAM, El Geneina;
- UNCHR Office for Help to Refugees, El Geneina.

## 6 PROJECT SCHEDULE, STAFFING AND REPORTING

### 6.1 Project schedule

The Phase 3 project is to follow directly on Phase 2, and will cover a period of two years. Thus, Phase 3 commences in January 1990 and is to continue until December 1991.

The proposed scheduling of the project activities in Phase 3 is shown in the bar chart (Figure 11). Should any major delays occur, then the affected activities may need to be rescheduled. Critical in this respect are the timely release of financial resources committed by the Sudanese authorities in contribution to the project budget, and the time required for customs clearance and inland transport of imported materials and equipment for the project. With early ordering, expeditious sea transport, prompt customs clearance and inland transportation, the first supplies of materials and equipment could arrive on the project sites in Nyala and El Geneina by May-June 1990.

Figure 11 - Phase 3 project activity schedule (1)

ACTIVITIES	1990				1991			
	3	6	9	12	15	18	21	24
<b>A. <u>General</u></b>								
1. Coordination & support	.....							
2. Arrangements for continuation/posting of MUNC staff	.....							
3. Mobilization of expatriate experts	.....							
4. Liaison & consultations wit project authorities	.....							
<b>B. <u>Upgrading of system components &amp; equipment</u></b>								
1. Technical survey of old distr. systems	.....							
2. Early ordering of materials	.....							
3. Preparation of working drawings	.....							
4. Upgrading of existing mains & branch lines	.....							
5. Upgrading of mech. & electrotechn. equipm.	.....							
6. Upgrading of house and non-residential connections	.....							

———— continuous  
 ..... intermittent

Figure 11 - Phase 3 project activity schedule (2)

ACTIVITIES	1990				1991			
	3	6	9	12	15	18	21	24
<b>C Extension works</b>								
1. Ordering of materials and equipment	.....		.....	.....				
2. Preparation of working drawings	.....	.....	.....	.....	.....			
3. Construction of discharge and collector lines		.....	.....	.....				
4. Construction of supply main (Nyala)		.....	.....	.....				
5. Construction of connecting mains (El Geneina)			.....	.....				
6. Ardamatta water distribution system			.....	.....	.....			
7. Branch, extension and service lines		.....	.....	.....	.....	.....	.....	
8. Construction of trunk distr. main (Nyala)			.....	.....	.....	.....		
9. Drilling of boreholes & testing								
. Nyala	.....	.....	.....					
. El Geneina				.....				
10. Installation of								
. borehole pumps			.....	.....	.....			
. booster pumps (add'l)						.....	.....	

———— continuous  
 ..... intermittent

Figure 11 - Phase 3 project activity schedule (3)

ACTIVITIES	1990				1991			
	3	6	9	12	15	18	21	24
11. Erection of elevated tanks								
. Nyala					.....			
. El Geneina	.....					.....		
12. Power connections & switchgear	.....		.....		.....			
13. Installation of electrogenerators (El Geneina)			.....					
<b>D Consolidation</b>								
1. Construction of new water kiosks	.....		.....					
2. Connections & water meters			.....		.....		.....	
3. Workshops & stores (constr. & fitting out)			.....		.....			
4. Improved O & M	.....				.....			
5. Stores mangt & stock control			.....		.....			
<b>E Support programmes</b>								
1. Local support to NUMC	.....				.....			
2. Technical training								
. pipelaying & fitting	.....		.....					
. mech. & electrotechn'l			.....			.....		
3. Promotion of hygiene education & sanitation	.....				.....			

———— continuous  
 ..... intermittent

6.2 Staffing

The staffing required for the Phase 3 project is as follows (Table 10).

Table 10 - Staffing for Phase 3 project

Staff	Total time	1990		1991	
		6	12	18	24
<u>NUWC</u>					
Resident Engineer	24				
Asst. Resident Eng. (Nyala)	24				
Asst. Resident Eng. (El Geneina)	24				
Junior Engineer (Nyala)	18				
Junior Engineer (El Geneina)	12				
Constr. Supervisor I (Nyala)	24				
Constr. Supervisor II (Nyala)	12				
Constr. Supervisor (El Geneina)	24				
Project administrator	24				
Store keeper (2No.)	24				
Pipe fitters (4No.)	36				
Skilled labour	est.				
Unskilled labour	est.				
<u>Expatriate</u>					
Project Adviser, Nyala	21,2				
Asst. Proj. Adviser El Geneina	10,6				
Sr Water Supply Eng. & Project Manager	3,2	—	—	—	—
Sr. Mech. Engineer	2,0	—			
Training specialist 1 (pipelaying & fitting)	3,5	—		—	
Training specialist 2 (mechanical & electro- technical works)	3,5		—	—	

### 6.3 Reporting

The following reports, written in English, will be submitted to the project authorities in the course of the Phase 3 project:

- Progress reports (monthly)  
Monthly concise reports to present the progress made in the execution of the project
- Mid-term report (13 months after start of project)  
Comprehensive mid-term report presenting the progress achieved in the execution of the work programme.
- Final report (26 months after start of project).  
Report consolidating information on the design and construction work; accompanied by background information, maps, drawings, etc.
- Technical reports (each short-term mission)  
Separate reports will be prepared by each short-term expert assigned to the Phase 3 project, with a record of the work done and to present the findings, results and recommendations.

## 7 PROPOSED PROJECT BUDGET

7.1 Sudanese contribution

The proposed Sudanese contribution is to cover the following costs:

- all costs of NUWC staff and personnel engaged in the project
- costs of locally recruited casual labour and contractors
- costs of services provided by governmental corporations and agencies other than NUWC
- inland transport of imported materials and equipment, from Port Sudan (sea cargo) or Khartoum (air cargo) to project sites in Nyala and El Geneina
- costs of customs clearance, handling and loading for inland transport
- drilling of boreholes, and supply and installation of casing and screening
- topographical survey work
- trench excavation, bedding and backfilling
- pipe-laying and fitting work
- construction of valve chambers and other small civil structures
- construction of foundation supports for elevated tanks
- supply and erection of elevated tanks
- construction of power control buildings
- supply and placement of power overhead lines (i.e. on firmly founded support poles) and underground cables, as appropriate
- power connections and installation of electrical switchgear
- installation of control instrumentation (i.e. power control, operational control of borehole pumps and booster pumps)
- installation of electro-generator sets and power connections
- installation of borehole pumps and booster pumps
- ground scaping work for foundation of balancing reservoirs
- office accommodation for project staff
- costs of local transportation of project staff and personnel (i.e. fuel, maintenance and servicing of project vehicles)
- costs of locally rented equipment and hired services.

Table 11 - Summary of proposed Sudanese budget contribution  
Nyala/El Geneina Water Supply Project Phase 3

				<u>x LS 1000</u>
Budget item	1990	1991	Amount	
1 NUWC staff and personnel	88 100	131 900	220 000	
2 Contractors, casual labour, and supervision	180 000	160 000	340 000	
3 Inland transportation of materials & equipment	360 000	190 000	550 000	
4 Customs clearance, handling and loading	p.m.	p.m.	p.m.	
5 Drilling of boreholes, incl. casing & screening	510 000	120 000	630 000	
6 Civil structures & works	390 000	135 000	525 000	
7 Supply and erection of elevated tanks	700 000	-	700 000	
8 Supply and placement of power lines and underground cables	140 000	50 000	190 000	
9 Power connections and electro-technical installation work	70 000	40 000	110 000	
10 Installation of control instrumentation incl. wiring	45 000	25 000	70 000	
11 Installation of electro- generator sets	10 000	10 000	20 000	
12 Installation of borehole and booster pumps	40 000	25 000	65 000	
13 Office accommodation	80 000	-	80 000	
14 Local transportation	240 000	310 000	550 000	
15 Miscellaneous & Topographical surveys	135 000	125 000	260 000	
16 Contingencies (5%)	148 900	66 100	215 000	
<b>Totals</b>	<b>3 137 000</b>	<b>1 388 000</b>	<b>4 525 000</b>	

Table 12 - Specification of Sudanese contribution

LS

Description	Rate	Unit	1990	1991	Amount
	<u>Cost adjustment</u>		<u>100</u>	<u>150</u>	
<b>1 <u>NUWC staff &amp; personnel</u></b>					
Resident Engineer	18 000	year	18 000	27 000	45 000
Asst. Resident Engineer (Nyala)	12 600	year	12 600	18 900	31 500
Asst. Resident Engineer (El Geneina)	13 800	year	13 800	20 700	34 500
Mechanical Engineer	9 500	year	9 500	14 000	23 500
Jr. Engineer (Nyala)	8 800	year	8 800	13 200	22 000
Jr. Engineer (El Geneina)	8 800	year	8 800	13 200	22 000
Project accountant	6 600	year	6 600	9 900	16 500
Storekeeper	5 400	year	5 400	13 500	27 000
Asst. storekeeper	4 600	year	4 600	6 900	11 500
<b>2 <u>Contractors, casual labour &amp; supervision</u></b>					
<b>Nyala</b>					
Trench excavation, etc.	15	day	80 000	50 000	130 000
Pipelaying	20	day	20 000	15 000	35 000
Supervisors	25	day	4 000	3 500	7 500
Local serv. & supplies		lump sum	30 000	40 000	70 000
<b>El Geneina</b>					
Trench excavation, etc.	15	day	35 000	40 000	75 000
Pipelaying	20	day	8 000	19 000	17 000
Supervisors	25	day	3 000	2 500	5 500
<b>3 <u>Inland transportation of materials &amp; equipment</u></b>					
To Nyala	1 200	ton	235 000	120 000	355 000
To El Geneina	1 500	ton	125 000	70 000	195 000
<b>4 <u>Drilling of boreholes, incl. casing &amp; screening</u></b>					
<b>Nyala</b>					
7 No. boreholes 10 5/8"	60 000	each	300 000	120 000	420 000
<b>El Geneina</b>					
3 No. boreholes 10 5/8"	70 000	each	210 000	-	210 000
<b>5 <u>Small structures &amp; works</u></b>					
control buildings	45 000	each	135 000	-	135 000
water kiosks (complete)	15 000	each	255 000	135 000	390 000
<b>6 <u>Supply and erection of elevated tanks</u></b>					
3 No. tanks Nyala	140 000	each	420 000	-	420 000
2 No. tanks El Geneina	140 000	each	280 000	-	280 000
		C/F			2 965 000

Table 12 - Specification of Sudanese contribution (cont'd)  
LS

Description	Rate	Unit	1990	1991	Amount
	<u>Cost adjustment</u>		100	150	
			B/F		2 965 000
7 <u>Topographical surveys</u>	lump sum		40 000	15 000	55 000
8 <u>Supply and placement of power lines</u>					
Nyala 2000m	40	metre	60 000	20 000	80 000
El Geneina 2400m	45	metre	80 000	30 000	110 000
9 <u>Power connections &amp; electrotechnical installation work</u>					
Nyala	lump sum		45 000	25 000	70 000
El Geneina	lump sum		25 000	15 000	40 000
10 <u>Installation of control instrumentation incl. wiring</u>					
Nyala	lump sum		25 000	15 000	40 000
El Geneina	lump sum		20 000	10 000	30 000
11 <u>Installation of electro-generator sets</u>					
El Geneina	lump sum		10 000	10 000	20 000
12 <u>Installation of borehole and booster pumps</u>					
Nyala	lump sum		28 000	15 000	43 000
El Geneina	lump sum		12 000	10 000	22 000
13 <u>Office accommodation</u>					
Nyala			p.m.	p.m.	p.m.
El Geneina			80 000	-	80 000
14 <u>Local transportation</u>					
Nyala	12 000	month	145 000	180 000	325 000
El Geneina	8 000	month	95 000	130 000	225 000
15 <u>Miscellaneous</u>					
Rent of equipment	lump sum		65 000	80 000	145 000
Local supplies (i.e. small items, stationary)	lump sum		30 000	30 000	60 000
16 <u>Contingencies</u>		5%	148 900	66 100	215 000
<b>Totals</b>			<b>3 137 000</b>	<b>1 388 000</b>	<b>4 525 000</b>

## 7.2 Netherlands contribution

The proposed Netherlands contribution is to cover the following costs:

### A Technical assistance

- technical assistance
- consulting services

### B Supply of materials and equipment

- pipes and fittings
- appurtenances (i.e. gate valves, flange adaptors, air valves, saddles, push-off resistant couplings, flexible couplings, etc.)
- pipelaying equipment and tools
- borehole pumps
- booster pumps
- electro-technical equipment
- control instrumentation for borehole and booster pumps
- electro-generator sets
- control instrumentation
- prefabricated tanks to build balancing reservoirs
- workshop equipment and tools
- vehicles (i.e. cars, trucks)
- spare parts for existing vehicles
- bulk water meters and house water meters
- supplies of imported small items

### C Support services

- local support to NUWC
- technical training programme
- promotion of hygiene education and sanitation.

### Choice of materials and equipment

Experience with the materials and equipment selected in the project Phase 1 and 2 has been favourable. The suitability of the chosen ductile iron (DI) pipes and fittings, and of the polyethylene (PE) service piping has been clearly confirmed in working practice. The selected pumping equipment and electrotechnical plant also have been found to be very suitable for the requirements of the project.

In view of the merits of standardization, it is considered appropriate to continue using the same pipe materials (i.e. ductile iron ISO 2531-1986 class K9 with inside cement lining and outside bituminous coating suitable for tropical conditions; and polyethylene ISO 4427.2 class B service piping). The DI pipes have stood up very well to harsh conditions of transport with hardly any breakage or deformations, and they have proved to be easy to work with in the field.

Table 13 - Summary of proposed Netherlands contribution\*  
Nyala/El Geneina Water Supply Project Phase 3

DG

Budget item	1990	1990	Amount
<b>A <u>Technical assistance</u></b> specified in Table 14A	912 100	676 500	1 588 600
<b>B <u>Supply of materials &amp; equipment</u></b> (Table 14B)	1 877 300	939 300	2 816 600
1 Pipes and fittings incl. appurtenances & pipelaying equipment			
2 Borehole pumps and booster pumps			
3 Electro-technical equipment & control instrumentation			
4 Electro-generator sets			
5 Prefabricated tanks			
6 Bulk water meters & house water meters			
7 Workshop equipment and tools			
8 Vehicles & spare parts			
9 Other supplies			
10 Sea transport & insurance			
11 Contingencies			
<b>C <u>Support services</u></b> (Table 14C)	142 800	153 700	296 500
1 Local support to NUWC			
2 Technical training			
3 Hygiene education & sanitation promotion			
<b>Totals</b>	<b>2 941 200</b>	<b>1 769 500</b>	<b>4 701 700</b>

\* Exempt of all taxes, charges and levies.

Table 14 - Specification of Netherlands contribution  
A. Technical assistance DG

dgis- code	Description	1990	1991	Amount
	<u>Cost level (1989=100)</u>	<u>102</u>	<u>105</u>	
	<u>Project staff</u>			
211.4	<u>Time in the Netherlands</u> Project Manager & Sr. Water Supply Eng.	23 419	24 108	47 527
211.5	<u>Short-term assignments</u> Project Manager & Sr. Water Supply Eng. Sr. Mechanical Eng. Training expert 1 (pipelaying & fitting) Training expert 2 (mech./electrotechn.)	49 241 41 558 39 780 39 959	50 689 24 446 16 380 41 134	99 930 66 004 56 160 81 093
211.6	<u>Long-term assignments</u> Project Adviser (Nyala) Asst. Project Adviser (El Geneina)	219 494 175 609	225 950 68 216	445 444 243 825
211.7	Sub-total (project staff)	589 060	450 923	1 039 983
	<u>Staff-related costs</u>			
212.2	House furniture	5 100	5 250	10 350
212.5	<u>Air passages</u> (leave & reunion)	12 701 8 670	6 537 4 463	19 238 13 133
213.3	<u>Air passages</u> (missions) Amsterdam/Khartoum - normal fare - special fare	8 670 12 701	4 463 13 075	13 133 25 776
213.5	<u>Excess luggage</u> - long-termers	-	1 890	1 890
215.1	<u>Board &amp; lodging</u> (short-termers) - Khartoum - elsewhere	6 104 9 690	7 461 6 825	13 565 16 515
215.2	<u>Board &amp; lodging</u> (arrival/departure) - Khartoum	5 341	4 712	10 053
215.3	<u>House rent</u> - Nyala 2No. (incl. guesthouse) - El Geneina	13 464 2 570	13 860 662	27 324 3 232
	C/F	674 071	520 121	1 194 192

Table 14 - Specification of Netherlands contribution  
A. Technical assistance (cont'd)

					DG
dgis- code	Description		1990	1991	Amount
		B/F	674 071	520 121	1 194 192
215.4	<u>Living allowances</u> (long-termers)				
	Project Adviser		27 949	28 771	56 720
	Asst. Proj. Adviser		25 873	10 051	35 924
215.5	<u>Board &amp; lodging</u> (out of duty station)				
	- Khartoum		7 630	7 854	15 484
	- elsewhere		1 785	1 838	3 623
216.1	<u>Reporting</u> (printing/binding)		13 770	14 175	27 945
218.2	<u>Local transport</u> - domestic air tickets		4 590	3 938	8 528
	SUB-TOTAL		755 668	586 748	1 342 416
	<u>Equipment</u>				
401	Office equipment & furniture		6 000	1 000	7 000
402	Workshop equipment & tools		12 000	4 000	16 000
403	Field equipment & tools (i.e. survey)		9 000	2 000	11 000
404	Car incl. spare parts		38 500	-	38 500
	SUB-TOTAL		65 500	7 000	72 500
	<u>Operational costs</u>				
501	Office running costs		4 896	5 040	9 936
502	Car maintenance & servicing		37 944	39 060	77 004
503	Air charters (provisional)		19 176	19 740	38 916
504	Truck rental (provisional)		11 016	5 670	16 686
	SUB-TOTAL		73 032	69 510	142 542
800.1	SUM OF SUB-TOTALS		894 200	663 258	1 557 458
800.2	<u>Contingencies</u> 2 percent		17 880	13 262	31 142
800.3	TOTAL A.		912 080	676 520	1 588 600

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GLS CODE	DESCRIPTION	COST-LEVEL	1990		1991		TOTAL NUMBER	TOTAL AMOUNT
			NUMBER	AMOUNT	NUMBER	AMOUNT		
	INFLATION	1989	102		105			
211.4	TIME in the NETHERLANDS Proj.manager	28700 MONTH	0.80	23419	0.80	24108	1.60	47527
211.5	SHORT-TERM ASSIGNMENTS							
	Sr.water eng.	30172 MONTH	1.60	49241	1.60	50689	3.20	99930
	Sr. mech. eng.	29102 MONTH	1.40	41558	0.80	24446	2.20	66004
	Training expert 1	15600 MONTH	2.50	39780	1.00	16380	3.50	56160
	Training expert 2	26117 MONTH	1.50	39959	1.50	41134	3.00	81093
211.6	LONG-TERM ASSIGNMENTS							
	Proj.adviser (Nyala)	20301 MONTH	10.60	219494	10.60	225950	21.20	445444
	Ass.proj.adviser(El Geneina)	16242 MONTH	10.60	175609	4.00	68216	14.60	243825
211.7	SUB-TOTAL		29.00	589060	20.30	450923	49.30	1039983
212.2	HOUSE-FURNITURE	2500 HOUSE	2.00	5100	2.00	5250	4.00	10350
212.5	AIRPASSAGES (LEAVE) Khartoum/Amsterdam v.v.	3113 TICKET	4.00	12701	2.00	6537	6.00	19238
212.6	AIRPASSAGES (REUNION) Khartoum/Amsterdam v.v.	4250 TICKET	2.00	8670	1.00	4463	3.00	13133
213.3	AIRPASSAGES (shorttermers) Amsterdam/Khartoum v.v.							
	-Normal-fare	4250 TICKET	2.00	8670	1.00	4463	3.00	13133
	-Special-fare	3113 TICKET	4.00	12701	4.00	13075	8.00	25776
213.4	EXCESS LUGGAGE -LONG-TERM	45 KG	0.00	0	40.00	1890	40.00	1890
215.1	BOARD and LODGING (shortterm assignments)							
	Khartoum	374 day	16.00	6104	19.00	7461	35.00	13565
	-elsewhere	50 day	190.00	9690	130.00	6825	320.00	16515
215.2	BOARD and LODGING (arrival/departure)							
	Khartoum	374 day	14.00	5341	12.00	4712	26.00	10053
215.3	HOUSE RENT							
	Nyala 2 no.(incl. questh.)	550 MONTH	24.00	13464	24.00	13860	48.00	27324
	El Geneina	210 MONTH	12.00	2570	3.00	662	15.00	3232

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215.4	LIVING(long-term)								
	Smith	2585	MONTH	10.60	27949	10.60	28771	21.20	56720
	Mathew	2393	MONTH	10.60	25873	4.00	10051	14.60	35924
215.5	BOARD and LODGING (out of duty station)								
	Khartoum	374	day	20.00	7630	20.00	7854	40.00	15484
	elsewhere	50	day	35.00	1785	35.00	1838	70.00	3623
216.1	REPORTING printing/binding	4500	REPORT	3.00	13770	3.00	14175	6.00	27945
218.2	LOCAL TRANSPORT -by plane	750	TICKET	6.00	4590	5.00	3938	11.00	8528
400.	INVESTMENTS								
	Office equipm/furniture				6000.00		1000.00		7000.00
	Workshopequipment/tools				12000.00		4000.00		16000.00
	Fieldequipm/tools(survey)				9000.00		2000.00		11000.00
	Car 4w-d.				38500.00		0.00		38500.00
500.	OPERATIONAL COSTS								
	Office running costs	200	month	24.00	4896	24.00	5040	48.00	9936
	Car maint,serv,spareparts	1550	month	24.00	37944	24.00	39060	48.00	77004
	Aircharters(prov.)	4700	charter	4.00	19176	4.00	19740	8.00	38916
	Truck rental(prov.)	2700	trip	4.00	11016	2.00	5670	6.00	16686
	Sundry			0.00	0	0.00	0	0.00	0
800.1	SUB TOTAL				894200		663258		1557458
800.2	UNSPECIFIED COSTS	2%			17884		13265		31149
800.3	TOTAL				912084		676523		1588607

Table 14 - Specification of Netherlands contribution  
B. Supply of materials and equipment

DG

Description/item	Quantity	Unit	Rate	Amount
<b>1 Pipes and fittings</b>				
<u>Pipe (ductile iron)PN 10 with sealing rings</u>				
350 mm dia	--	m	135	--
300 mm dia	2 950	m	95	280 250
250 mm dia	1 050	m	75	78 750
200 mm dia	4 050	m	60	243 000
150 mm dia	8 200	m	45	369 000
100 mm dia	13 400	m	30	372 000
<u>Pipe (polyethylene), with compression fittings</u>				
50 mm dia	5 400	m	6	32 400
<u>Appurtenances</u>				
(sectional valves, flange adaptors, air valves, push-off resistant couplings, flexible couplings, saddles, pipelaying equipment and tools, etc.)				
10 % of pipe & fitting costs				137 500
<b>2 Pumps</b>				
<u>Nyala</u>				
- borehole pump (25 m <sup>3</sup> /h at 40m head)	8	No.	8 500	68 000
- booster pumps (100 m <sup>3</sup> /h at 30m head)	2	No.	20 000	40 000
<u>El Geneina</u>				
- borehole pumps BH13 c.a. (25 m <sup>3</sup> /h at 80m head)	2	No.	12 000	24 000
- borehole pump Ardamatta (30 m <sup>3</sup> /h at 35m head)	1	No.	8 500	8 500
- borehole pump GP12 (15 m <sup>3</sup> /h at 80m head)	1	No.	7 500	7 500
<b>3 Electrotechnical equipment &amp; power control instrumentation</b>				
- electrotechnical equipment & switchgear				40 000
- control instrumentation				
. borehole pumps	14	set	3 500	49 000
. booster pumps	2	set	6 500	13 000
<b>4 Electrogenerator sets</b>				
(El Geneina)				
- electrogenerator 27.5 kVA	3	set	28 000	84 000
- electrogenerator 60 kVA	1	set	45 000	45 000
C/F				1 891 900

Table 14 - Specification of Netherlands contribution  
 B. Supply of materials and equipment (cont'd)  
 DG

Description/item	Quantity	Unit	Rate	Amount
		B/F		1 891 900
<b>5 <u>Prefabricated tanks, complete with pipework</u></b> (to build balancing reservoirs)				
- Nyala 750 m <sup>3</sup>	1	unit	190 000	190 000
- El Geneina 450 m <sup>3</sup>	1	unit	80 000	80 000
<b>6 <u>Water meters</u></b>				
<u>Bulk water meters</u>				
Nyala	7	unit	1 800/1 400	11 200
El Geneina	4	unit	1 400	5 600
<u>House &amp; non-residential water meters</u>				
Nyala	800	unit	240	192 000
El Geneina	200	unit	190	38 000
<b>7 <u>Workshop equipment &amp; tools</u></b> lump sum 35 000				
- Additional special equipment & tools				
<b>8 <u>Vehicles &amp; spare parts</u></b>				
Double-cabin 4WD (incl. spare parts)	1	car	38 000	38 000
Toyota Hilux pick-up (incl. spare parts)	1	car	26 000	26 000
Truck 20-ton (incl. spare parts)	1	truck	p.m.	p.m.
Spare parts for old DAF-truck		lump sum		9 000
<b>9 <u>Other supplies</u></b>				
- pressure gauges, non-return valves, level indicators, level switches, etc.				
- sealant & piping for repair of tanks				
- water taps 2"				
- specials				
- AC pipe & fittings, and sealing rings (for rehabilitation work)				
- equipment & tools for construction work				
		lump sum		45 000
<b>10 <u>Sea transport &amp; insurance</u></b> lump sum 120 000				
<b>11 <u>Contingencies</u></b> 5 percent 134 900				
<b>TOTAL B</b>				<b>2 816 600</b>

Table 14 : Specification of Netherlands contribution  
C. Support services

Description	Quantity	Unit	Rate	Amount
1 <u>Local support to NUWC</u> - logistical services, clearing, transport, liaison, etc.	4.2	month	43 500	182 500
2 <u>Technical training</u> - direct costs of technical training		lump sum		15 000
- fellowships for counterpart staff	2	course	32 000	64 000
3 <u>Hygiene education &amp; sanitation promotion</u>		lump sum		35 000
<b>TOTAL C</b>				<b>296 500</b>

Table 15: Pipe and fitting requirements Phase 3  
Nyala/El Geneina Water Supply Project

Pipe section	diameter						
	ø350 DI	ø300 DI	ø250 DI	ø200 DI	ø150 DI	ø100 DI	ø50 PE
length (m)*							
<b>Nyala</b>							
• discharge pipes (boreholes)						1800	
• collector lines				500	1000		
• supply main		2300	450		650		
• distr. trunk main	1500	1250	750	1150			
• El Jebel/Taiba main & service lines (kiosks)				900	700	500	2400
• Sika Hadid main & service lines (kiosks)					1500		1500
• supply line to Industrial Area					1400		
• extension line to Government Tannery						1800	
• extension line to livestock market & slaughterhouse						500	
• El Geer branch line & service lines (kiosks)						1800	1500
Sub-totals	1500	3550	1200	2550	5250	6400	5400
<b>El Geneina</b>							
• discharge lines (boreholes)					750	3200	
• distribution mains incl. Ardamatta				1800	3500	4100	
• service lines kiosks							1800
• service lines house connections							2400
Sub-totals				1800	4250	7300	4200
TOTALS	1500	3550	1200	4350	9500	13700	9600
Less: Supplied under Phase 2	1500	600	150	300	1300	1300	4200
Requirement Phase 3	-	2950	1050	4050	8200	12400	5400

\* incl. 5% for extra chainage in work

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