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Pasadena
Aug. 10, 83
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Africa Resettlement
Services and Facilities
Project No.698-0502

Inception Report
for the
Gedaref, Sudan
Water Supply Project

prepared for
United States of America
Agency for International Development

under

Indefinite Quantity Contract
No. OTR-1406-I-04-1132-00
Work Order No. (04)

10 August, 1983

James M. Montgomery, Consulting Engineers, Inc.
Pasadena, California



JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

555 East Walnut Street, Pasadena, California 91101 (213) 796-0141 - (213) 681-4255

Cable Address: Montgomery Pasadena California Telex: 67-5420

August 10, 1983

Mr. Lynn Sheldon, Sudan Engineering Officer
United States Agency for International Development
49th Street, New Extension
Khartoum
Sudan

Re: Inception Report for
Gedaref Water Supply and
Solid Waste Disposal

Dear Mr. Sheldon:

In accordance with Article III B.5.2. of the 18 July, 1983 Agreement between USAID and James M. Montgomery, Consulting Engineers, Inc., we are pleased to submit herewith four (4) copies of our Inception Report relative to preparation of final designs and construction documents and assistance in project paper preparation for the referred project.

Respectfully submitted,

Edward H. Shamieh
Project Manager

Section 1

Introduction

A. General

This Inception Report is in partial fulfillment of the terms of the Agreement dated July 18, 1983 between US Agency for International Development (USAID) and James M. Montgomery, Consulting Engineers, Inc. (JMM) for the preparation of final designs and construction documents and to assist in project paper preparation for the Gedaref, Sudan water supply project. The scope and description of this project are contained in the Gedaref Water Supply and Solid Waste Disposal Feasibility Study - Sudan, Final Report, July 1983 prepared by JMM.

B. Report Organization

The main purpose of the Inception Report is to provide with sufficient description of the JMM's staff mobilization, problems encountered or foreseen and projected program of work for design development and completion of the construction documents. Accordingly, the report is organized into the following sections:

- Section 1 - Introduction
- Section 2 - Staff Mobilization
- Section 3 - Progress to Date
- Section 4 - Problems Encountered or Foreseen
- Section 5 - Project Work Schedule
- Section 6 - Design Development Priorities
- Section 7 - USAID Review and Approval Requirements
- Section 8 - Construction Documents Development Sequence

Section 2

Staff Mobilization

A. Personnel

To date, the three long-term and one short-term project team members have arrived in Sudan. The following tabulation presents the actual or anticipated arrival dates of all team members.

Project Team Arrival Dates

| <u>Name</u> | <u>Assignment</u> | <u>Arrival Date</u> |
|-------------|--------------------------|---------------------|
| E. Shamieh | Project Manager | 22 July |
| J. Sproat | Project Engineer | 29 July |
| K. Wiebe | Principal Hydrogeologist | 28 July |
| R. Turner | Project Hydrogeologist | 24 July |
| M. Santos | Electrical Engineer | 1 October |
| L. Ramage | Surveyor | 20 August |
| N. Hixson | Institutional/Training | 20 August |
| D. Shoup | Economics/Financial | 20 August |
| D. Bird | Engineering Advisor | 20 August |

B. Accommodations and Office Facilities

JMM entered into a Sub-contract agreement with a local Sudanese firm to provide the logistical services for the design team while in Sudan. Suitable furnished accommodation and office facilities have been arranged in Gedaref where the team will maintain residency. Vehicles as well as secretarial services have also been secured. Periodic visits on a weekly or bi-weekly basis will be made to Khartoum by one or more of the design team members, and as required, to meet with AID staff and other governmental agencies.

While in Khartoum, JMM design team have used and intend to use the telex facilities at the Meridian Hotel to maintain contact with the home office. Skypack courier service has also been established between the design team

and the home office for expeditious and safe communication.

C. Equipment and Supplies

Hydrogeological equipment, test kits, and other engineering instruments have been brought in by the JMM team members for their use in the field.

D. Miscellaneous

1. Photographic License

All design team personnel have obtained the permit necessary to allow photographing work-related subjects.

2. Visas and Residency Permits

Design team members possess visas permitting a 3-month stay within Sudan. These will have to be extended at a later date and departure permits will be required.

Residing permits may be applied for, with assistance from the National Administration for Water (NAW), but these are not required.

3. Health and Welfare

Design team personnel have received copies of the U.S. Embassy information packet which provides details on health care, emergency medical attention and a generalized evacuation plan. Design team members have all registered at the U.S. Embassy.

4. General Amenities

The U.S. Commissory privileges have been extended to team members.

5. JMM's local bank is El-Nilien Bank, Khartoum, which is Bank of American's associate in Sudan. Funds in US. dollars will be transferred to the account periodically for logistics and miscellaneous expenditures by the staff in Sudan.

Section 3

Progress to Date

A. General

Since the arrival of the JMM Project Manager 22 July much ground has been covered both in Khartoum and the Project area in preparation for commencement of the project work tasks. Numerous meetings have been held with AID officials, well drilling contractors, NAW officials in Khartoum, Gedaref and Showak, UNHCR, and Commission for Refugees both in Gedaref and Khartoum. All parties contacted have been most gracious and cooperative to the design team.

B. Engineering Aspects

Cursory field visits have been made to the Abu Naga well field and the Showak treatment plant, for the purpose of familiarization with their general features.

C. Hydrogeological Aspects

Members of the ground water team, the Senior Hydrogeologist and the Project Hydrogeologist mobilized in Khartoum during the last week in July 1983, and met with USAID, UNHCR, NAW, and with representatives of four well drilling firms. Two trips were also made to Gedaref, Showak, and Abu Naga to review field conditions and meet with water-oriented groups in the Kassala Region.

As a result of recent activities by NAW and the UNHCR, the work plan was modified to include additional exploratory drilling and production testing at Showak. Subsequently, a contract amendment was submitted to USAID on July 31, 1983 defining those changes. Detailed plans and specifications

were then prepared for submission to USAID and to qualified drilling contractors in Sudan. Plans, activities and a proposed schedule of drilling and testing have also been presented to USAID in the "Detailed Work Plan" for the drilling and aquifer testing program (Contract Item ARTICLE III, B., 2.c. paragraph 2).

Well construction, subsurface exploration and production well testing at Showak, logging and observations at Tawawa, and detailed aquifer and well field testing at Abu Naga are tentatively scheduled to begin during the last week in August, 1983. The specifications call for the Contractor to complete all drilling and testing by October 20, 1983. If favorable results are forthcoming, well field designs will be initiated immediately upon completion of testing and completed by the first week in November, 1983.

Section 4
Problems
Encountered or Expected

A. General

After meetings with certain responsible personnel and visits to the Project Area, it became evident that certain actions has been conducted by NAW and UNHCR subsequent to preparation of the feasibility study which will have some bearing on the final design work by JMM. These actions will have to be investigated from the aspect of integrating this work into the final design.

B. Engineering Aspects

Since the departure of the feasibility study team in December 1982, the National Administration for Water has been actively making changes or improvements to their facilities at Cedaref and Showak.

1. Abu Naga Well Field

One reason the Abu Naga well field was inoperative was due to leakage and breakage in the 10" (250mm) AC discharge main from the well field. NAW has abandoned that line and installed an 8" (200mm) PVC discharge main. New wells have been drilled, old wells have been rehabilitated, and four wells have been equipped with new pumps: all discharging into the new 8" main.

The design objective is to develop Abu Naga to produce a minimum of some 45 lps flow. This flow produces about 11 meters/Km headloss in the 200mm pipe, whereas if 250mm pipe had been used the headloss would be about 4 meters/Km. Therefore, rather than just designing new

wells and pumps, as was the original intent, JMM will now have to determine the well field potential, the appropriateness of the existing pumps, and then attempt to design, making possible use of these pumps. Hopefully, pumps curves are available.

The booster station has been refurbished to some degree both with regard to mechanical and electrical improvements. These changes will be considered and may be integrated into the final design.

2. Showak Treatment Plant

A large portable diesel generator set has been set up and connected to the Showak facility. The future usefulness of this equipment will have to be determined.

3. Proposed Booster Station

The feasibility study team reviewed for AID on 20 December 1982 a proposal from NAW to UNHCR which included, among other items, the conceptual design for an intermediate booster station on the 20" (500mm) Showak-Gedaref transmission main. That team raised numerous questions about the design of this station and the appropriateness of using dry-running submersible well pumps as booster pumps.

This item is apparently still alive, but it is not known to what degree. The design team will have to work closely with UNHCR and NAW personnel to resolve this matter and perhaps determine a better application for the pumps which have been requisitioned.

4. Transmission Main Accessibility

Due to the seasonal rains, a "windshield survey" of the 500mm transmission main - which is deemed necessary to determine the condition of its ancillary devices - may prove quite difficult. This survey is also considered necessary to optimize the location of the new in-line booster station, as called for in the Feasibility Study. The design team will try to cope with this problem with its best resources on hand.

C. Hydrogeological Aspects

It is inevitable that some problems may arise in developing countries such as Sudan which can affect prescribed scheduling. The following items are noted in order to identify potential problem areas which have been anticipated by the Project Team.

1. Heavy rains in August and early September may limit ingress and egress to the well drilling sites by the Contractor. High river levels at Atbara may also slow progress during the initial phase of drilling, construction and aquifer testing.
2. Competition for qualified drilling contractors may result in a delay in mobilization of the selected contractor. At this time, these problems are not anticipated to comprise more than a two weeks' delay in the scheduled mobilization for late August, 1983.
3. During past drilling and construction programs, land ownership along the Atbara River has been in dispute. During our field visit, the Project Team endeavored to have all interested and responsible parties walk the proposed drilling and testing sites near Showak. It was determined

that sites selected by Montgomery were, in fact, owned by or accessible to the Government. However, in light of historical perspective, future land ownership disputes may be anticipated; these could delay the project completion schedule.

Section 5

Project Work Schedule

A. Project Objective

The objective of this project is to provide final engineering designs, plans, specifications, tender documents and other services for the preparation of documents leading to the construction by others of a reliable water supply system for the Gedaref, Showak and Tawawa areas.

The achievement of this objective requires that the contractor, JMM to perform certain work tasks in a systematic method within the allocated time period.

B. Proposed Task Scheduling

The project work tasks are divided into the following categories:

1. Water well drilling, testing and design
2. Preparation of construction plans, specifications and tender documents
3. Project Paper preparation assistance
4. Preparation of inception, progress and design reports

Table 5-A graphically presents the proposed schedule for completion of these tasks, based upon known constraints at this time.

C. Proposed Staff Scheduling

The project Staff consists of the following:

- 3 long term staff (over 30 days in Sudan)
- 3 short term staff visiting Sudan for approximately 2 weeks each
- 3 specialists for the Project Paper assistance program, and
- home office support and design teams

Table 5-B presents the proposed scheduling of both on-site and home office personnel affiliated with this project.

Section 6

Design Development Priorities

A. General

Priorities for sequencing design tasks are predicated upon such factors as the availability of data, well drilling crews and equipment, and project team staff members. Therefore, ideal priorities must be tempered with the conditions found in the field.

B. Well Drilling

The entire project is dependent upon the verification of adequate ground water sources adjacent to the Atbara River at Showak and at Abu Naja and Tawawa to meet the projected demand. Therefore prompt contractual negotiations with well drillers and mobilization of their equipment claims top priority in the design development.

It appears likely, however, that no drilling can begin before 1 September at Showak due to prior commitments by all acceptable drillers. This delay has been factored into the design schedule.

Drilling of the Tawawa well will begin in August under the auspices of UNHCR. JMM will log that well and ascertain the design to be optimal for the conditions found.

C. Well Testing

As the NAW has done some remedial work in the Abu Naga well field, it may be possible to conduct some preliminary, but meaningful, testing these

before the contracted driller can conduct more extensive drawdown and specific capacity tests for this source. Some preliminary design improvements for this source therefore claims second priority.

D. Engineering Field Work

Engineering field work will begin immediately, both in conjunction with the hydrological efforts and in a broader scope.

Elevations will be established or confirmed at all critical locations throughout the Gedaref, Tawawa and Showak systems as well as at pertinent locations along the 500mm transmission main.

Pressure testing will be conducted to better determine appropriate friction factors for major transmission lines which will be retained in service.

Design sketches will be made of all physical features which will be modified as a part of the new design.

This work is considered as the third priority in design development

E. Data Analysis

The fourth priority level will be analysis of the field data to determine the best use, if any, of existing facilities such as well pumps, pipelines, etc.

F. Final Design and Drafting

As pertinent field data and analyses are generated in the Gedaref project office, they will be sent posthaste to JMM home office for final design and drafting of the construction plans.

Section 7
USAID Review and Approval
Requirements

A. General

It is expected that frequent meetings with AID in Khartoum will result in agreement of all project activities so that technical services by JMM be provided smoothly and quickly. Monthly program reports will also be submitted to update AID on JMM's ongoing progress and design activities. It is recognized, however, that certain actions by JMM will require more formal review and approval by AID prior to initiation of these actions.

B. Actions Requiring AID Review and Approval

1. Should JMM desire the services of a subcontractor, prior approval of the subcontractor and all elements of the subcontract will be required.
2. Deviation from the functional designs of the Feasibility Report for detail design shall be agreed upon in writing by AID/Sudan.
3. Recommendations for alternate methods of work involving procurement and installation of equipment shall be made for review and approval.
4. Final construction plans, specifications and tender documents shall be approved prior to start of construction by others.
5. Assistance rendered by JMM personnel during preparation of the AID Project Paper is subject to editing and revision by AID.

Section 8
Construction Documents
Development Sequence

A. General

Due to the limited time available to complete preparation of the construction documents, it is necessary that this phase of the project be conducted expeditiously. It should be recognized that the completion of the design tasks as prioritized in Section 6 will have a major bearing in completing the construction documents on a timely manner.

B. Development Sequence

1. Specification and tender documents for all material items such as water meters, chlorinators, pumps, etc. are being prepared in JMM home office concurrent with the field work. Only required sizes, capacities, etc. will be completed after pertinent field data has been obtained.
2. Construction drawings will be prepared in JMM home office as field notes and sketches are forwarded via courier service on a routine basis. Whenever possible, check prints of the drawings will be returned to the project office for field review.
3. It is expected that the foregoing procedures will result in completion of the construction documents on schedule to the mutual satisfaction of AID, JMM and concerned local government entities.

Pasadena
Aug. 21, 83

Africa resettlement
Services and facilities
Project No. 698-0502

RECEIVED
AUG 21 1983
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
PASADENA

Progress Report No. 1
for the
Gedaref, Sudan
Water Supply Project

Prepared for
United States of America
Agency for International Development

under

Indefinite Quantity Contract
No. OTR-1406-I-04-1132-00
Work Order No. (04)

20 August, 1983

James M. Montgomery, Consulting Engineers, Inc.
Pasadena, California

-15-

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

250 North Madison Avenue, Pasadena, California 91101 / (213) 786-9141 or 681-4255

Cable Address: Montgomery Pasadena California Telex: 67-5420

20 August, 1983

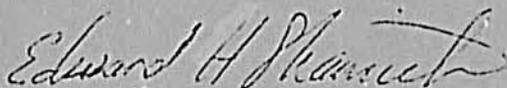
Mr. Lynn Sheldon, Sudan Engineering Officer
United States Agency for International Development
49th Street, New Extension
Khartoum
Sudan

Re: Gedaref Water Supply and
Solid Waste Disposal
Progress Report No. 1

Dear Mr. Sheldon:

In accordance with Article III B. 5. b. of the 18 July 1983 Agreement between USAID and James M. Montgomery, Consulting Engineers, Inc., We are pleased to submit herewith four (4) copies of Progress Report No. 1 of the referred project.

Respectfully submitted,



Edward H. Shamieh
Project Manager

EHS/

Encl.

SECTION I

WORK PERFORMED

18 JULY 1983 TO 20 AUGUST 1983

A. GENERAL

During this first reporting period, there was general mobilization of the JMM project team members; numerous meetings were held with USAID officials, well drilling contractors, NAW officials in Khartoum, Gedaref and Showak, UNHCR and Commission for Refugees both in Gedaref and Khartoum; a project office has been established in Gedaref; and certain field work has commenced.

The mobilization activities and other matters pertinent to the project have previously been described in the Inception Report submitted to USAID on 10 August 1983 by JMM.

B. HYDROGEOLOGICAL

I. Well Site Selection

- a. Showak / Atbara River - At this location, sites have been selected for Test Well JMM - T1, with adjacent piezometres (observation wells) JMM - o1 to o4 -- just south of the existing water treatment plant -- and Test Well JMM - T2, some 4500' (1400 metres) south of T1 near the Atbara River.
- b. Abu Naga Wellfield - Due to work done by NAW subsequent to preparation of the 1982 feasibility study, no test wells will be drilled at this site during this design program, however drawdown tests will be conducted utilizing existing wells.
- c. Tawawa - The National Administration for Water (NAW) unilaterally selected a production well site in Tawawa which was contracted out by UNHCR for drilling, by Geosource - Spig. After drilling 680 ft. of basalt and 40 ft. of mudstone, on 15 August 1983 the UNHCR and the Sudanese Commissioner for Refugees considered relocating the well to another site which more closely approximates the location recommended in the JMM feasibility Study.

Since this work is being financed by UNHCR, JMM has no authority to direct the operation, but will observe the drilling, describe the drill cuttings, and determine the possible need for additional wells.

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2. Well Drilling

The hydrogeological team had meetings with four local drilling firms which had the potential of executing the well drilling scope of work. However it was soon determined that only two firms, Geosource - Spig and Water Drilling & Engineering Co. LTD., were capable and willing to do the necessary work x within the contract time limits.

Well drilling specifications and bid documents were then prepared by JMM and given to the above firms on 8 August; with an additional copy submitted simultaneously to USAID for review and approval. Subsequent discussions with the firms indicated that, due to the time constraints and lack of required supplies and equipment, neither firm could unilaterally carry out the complete scope of work. It was therefore necessary to receive inter-dependent quotations from the two firms which would permit completion of the work on schedule. These bids were received 11 August 1983. The bid quotations and JMM evaluation were submitted to USAID 14 August 1983.

Due largely to the lack of local competition, as well as the scarcity of adequate equipment and supplies, the combined bids were much higher than previous JMM estimates. Reference may be made to the JMM bid evaluation dated 14 August 1983.

3. Well Development and Testing

No work has been started on this item to date.

4. Well field Design

No work has been started on this item to date.

C. Engineering

1. Surveying

Some preliminary data relative to benchmarks, well identification, base lines, etc. have been determined for later use.

2. Preliminary Design

Data regarding existing well pumps at Abu Naga is being reviewed to determine the possible future use of these pumps.

3. Review of UNHCR Proposals

The JMM project team, in close coordination with the UNHCR staff, held meetings with the Commissioner's Office for Refugees in Khartoum to discuss the work that the Commission proposes to initiate as a relief and temporary measures to improve the Showak water supply facilities. UNHCR has allocated approximately \$ 500,000 for these improvements.

The purpose of the JMM review was to evaluate the technical soundness of the UNHCR proposal and its compatibility with JMM's long-term design. This review and coordination with UNHCR was timely as the contract to provide the improvements has not yet been signed by UNHCR.

D. Project Paper Assistance

No work has been started on this item to date.

SECTION II

PERSONNEL

18 JULY 1983 TO 30 AUGUST 1983

A. ARRIVALS DURING PERIOD

The following members of the Project Team arrived in Khartoum:

| | | | |
|-----------|---|-------------|--------------------------|
| 22 July | - | E. Shavich, | Project Manager |
| 24 July | - | R. Turner, | Project Hydrogeologist |
| 28 July | - | K. Wiebe, | Principal Hydrogeologist |
| 29 July | - | J. Sprout, | Project Engineer |
| 20 August | - | D. Bird, | Engineering Advisor |

The project staff as of 30 August consisted of the three long-term team members and one short-term member plus three local employees.

B. DEPARTURES DURING PERIOD

The following members of the Project team departed Khartoum:

11 August - K. Wiebe ; to JMM home office

C. SCHEDULED ARRIVALS

During the next reporting period, the following arrivals are scheduled:

| | | | |
|-----------|---|------------|--------------------------|
| 20 August | - | D. Shoup, | Economics / Financial |
| 22 August | - | L. Ramare, | Surveyor |
| 27 August | - | N. Hixon, | Institutional / Training |

D. SCHEDULED DEPARTURES

During next reporting period, the following departures are scheduled:

| | | | |
|--------------|---|------------|--------------------|
| 5 September | - | L. Ramare; | to JMM home office |
| 5 September | - | D. Bird; | to JMM home office |
| 13 September | - | D. Shoup; | to JMM home office |
| 16 September | - | N. Hixon; | to JMM home office |

E. MANPOWER EXPANDED ON SITE

| JMM EXPATRIATE STAFF | | | | |
|--|--------------------------|----------------------|------------------------|-------------------|
| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
| 1. E. Shamieh Project Manager | 25 | 25 | 88 | 28.4% |
| 2. J.Sproat Project Engineer | 19 | 19 | 82 | 23.2% |
| 3. R. Turner Project Hydrogeologist | 24 | 24 | 88 | 27.3% |
| 4. K. Wiebe Principal Hydrogeologist | 10 | 10 | 10 | 100% |
| 5. M. Santos Electrical Engineer | 0 | 0 | 13 | 0 |
| 6. L. Ramage Surveyor | 0 | 0 | 13 | 0 |
| 7. N. Hixson Institutional / Training | 0 | 0 | 20 | 0 |
| 8. D. Shoup Economics / Financial | 0 | 0 | 20 | 0 |
| 9. D. Bird Technical Analyst | 1 | 1 | 15 | 6.7% |
| TOTALS | 79 | 79 | 294 | 26.9% |

| LOCAL SUPPORT STAFF | | | | |
|--|--------------------------|----------------------|------------------------|-------------------|
| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
| 1. Alem Ghebremariam Secretary / Typist | 8 | 8 | 71 | 11.3% |
| 2. Maaruf Abdu Driver | 8 | 8 | 71 | 11.3% |
| 3. Hassen Driver | 7 | 7 | 70 | 10 % |

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SECTION III

MEETINGS

18 July 1983 TO AUGUST 1983

During the reporting period, numerous introductory and coordination meetings were held between the Project team and concerned parties:

USAID - SUDAN

Keith Sherper Deputy Mission Director
Lynn Sheldon, Sudan Engineering Officer
Jerry Weaver, Refugee Officer
Peter Kranstover, Operations Officer

COMMISSIONER FOR REFUGEES - SUDAN

Hassan Atiyeh, Deputy Commissioner - Khartoum
Ismail Ibrahim, Deputy Commissioner - Gedaref

REFUGEE SETTLEMENTS ADMINISTRATION - SHOWAK

Hassan M. Othman Project Manager
Al Tiraifi Younis, Deputy Project Manager

NATIONAL ADMINISTRATION FOR WATER

Dr. Khair Alla Mahjoub, Director General

REGIONAL GOVERNMENT

H.E. Hannid Ali, Shash, Governor, Eastern Region
H.E. Solaiman Fuqairi, Deputy Governor, Eastern Region

GEDAREF LOCAL GOVERNMENT

Ahmad Soghair, Commissioner
Izzidin Mohamad Ahmad, Executive Director, Gedaref Area Councils

RURAL WATER ADMINISTRATION

Mohamad Hussein, Executive Director Gedaref / Kassala

22

UN HIGH COMMISSIONER FOR REFUGEES

Robert J. Muller
Staffan Bodemar,
Uwi Winters,
Karen Abu-Zeid,

Representative, Khartoum
Deputy Representative, Khartoum
Engineer
Khartoum

CARE

Bob Chaples,

Assistant Director

INTERNATIONAL RESCUE TEAM

Tom Fellows,

Director - Gedaref

UNIVERSITY OF KHARTOUM

Dr. Badr El Din Khalil,
Dr. Yasin A. Salam Haggaz,

Head, Geology Dept.
Professor, Geology Dept.

SECTION IV

CORRESPONDENCE

18 JULY 1983 TO 20 AUGUST 1983

During the reporting period, certain significant correspondence relative to the project has been written by the Project Team in Sudan:

| DATE | WRITTEN TO | WRITTEN BY | SUBJECT |
|-----------|---------------------|-------------------------|---|
| 31 July | P. Kranstover - AID | E. Shamieh | Request to amend contract to provide budget for secretarial services for Project Paper Assistance Team. |
| 31 July | P. Kranstover - AID | K. Wiebe/ E. Shamieh | Contract modifications to reflect changes made by NAW subsequent to the Feasibility Study. |
| 8 August | P. Kranstover - AID | K. Wiebe/ E. Shamieh | Well drilling Specifications and bid documents. |
| 8 August | P. Kranstover - AID | E. Shamieh | Draft contract with NASH - for Logistic services. |
| 9 August | L. Sheldon - AID | E. Shamieh | Transmittal of work plan and Design for Well Drilling and Testing Program. |
| 10 August | L. Sheldon - AID | E. Shamieh | Transmittal of Inception Report. |
| 14 August | L. Sheldon - AID | K. Wiebe/ E. Shamieh | Receipt and Evaluation of Bids for Ground Water Program. |

SECTION V

PROBLEM AREAS

18 JULY 1983 TO 20 AUGUST 1983

A. GENERAL

Due to activities of NAK and UNECR subsequent to preparation of the Feasibility Study, and also due to certain environmental and climatic conditions there are certain heretofore unforeseen aspects which will have some effect on the final design work,

B. HYDROGEOLOGICAL

1. The well drilling bids which were received were much higher than the budget estimate within the JMK contract. This will require revision to the ODC's budget by USAID, which will delay signing of the well drilling subcontract with the drilling firm (s). This may, in turn, cause delay in the execution of the drilling scope of work.
2. Seasonal rains may still hamper access to the well drilling sites at Showak.

C. ENGINEERING

1. At the present time, neither Abu Naga nor Showak are producing water on a reliable basis and Gedaref is without water and electricity. Uncertainty as to future pumping schedules may hinder hydraulic testing and analyses of existing transmission mains.
2. Due to seasonal rains, a " windshield survey " of the 500 mm. transmission main may prove quite difficult due to inaccessibility. This survey is considered important to optimize the location of the new booster pumps station and to determine the condition of the pipeline accessories.

SECTION VI

PROGRAM FOR NEXT PERIOD

21 AUGUST 1983 TO 20 SEPTEMBER 1983

During the next reporting period, numerous actions will be implemented during a continuation of the project. At this time only the problems noted in Section V are expected to cause any effect in the project schedule from that given in the Agreement.

Actions to be implemented by JMM include:

1. Completion of all field surveys.
2. Monitoring of Tawawa well drilling by UNHCR.
3. Start of well drilling program at Showak.
4. Continuation of field engineering work.
5. Assistance in Project Paper preparation.
6. Participate in Coordination meetings with USAID as necessary.
7. Commence home office support for final design and drafting tasks.

Africa Resettlement
Services and Facilities
Project No. 698-0502

PASADENA
REGISTERED
SEP 20 1983
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
INTERNATIONAL

Progress Report No. 2
for the
Gedaref, Sudan
Water Supply Project

Prepared for
United States of America
Agency for International Development

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No. OTR-1406-I-04-1132-00
Work Order No. (04)
20 September, 1983

James M. Montgomery, Consulting Engineers, Inc.
Pasadena, California

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250 North Madison Avenue, Pasadena, California 91101 / (213) 796-9141 or 681-4255

Cable Address: Montgomery Pasadena California Telex: 67-5420

20 September, 1983

Mr. Lynn Sheldon, Sudan Engineering Officer
United States Agency for International Development
49th Street, New Extension
Khartoum
SUDAN

Re: Gedaref Water Supply and
Solid Waste Disposal
Progress Report No. 2

Dear Mr. Sheldon:

In accordance with Article III E. 5. b. of the 18 July 1983 Agreement between USAID and James M. Montgomery, Consulting Engineers, Inc., we are pleased to submit herewith four (4) copies of Progress Report No. 2 of the referred project.

Respectfully submitted,



Edward H. Shamieh
Project Manager

EHS/
Encl.

SECTION I

WORK PERFORMED

21 AUGUST 1983 TO 20 SEPTEMBER 1983

A. GENERAL

During the second reporting period, field work by the JMM project team continued, well drilling contracts were awarded, the Project Paper assistance team conducted their particular scope of work, and coordination meetings were held with USAID officials, NAW officials, and UNHCR and COR personnel.

B. HYDROGEOLOGICAL

1. Well Site Selection

- a. Tawawa Well - Around 15 August Geosource - Epig, the UNHCR drilling contractor relocated to a well site 1.0 km west of the westerly corner of Tawawa village. Static water level was 110' below ground surface and the well drilled to a depth of 600 feet.

Due to funding of this well by UNHCR, JMM had no authority to direct any of the operation, however the drilling work was observed and the drill cuttings were logged by JMM's Project Hydrogeologist. Pump test data was also analyzed and long-term well output evaluated.

- b. Other Well Sites - No change from the previous progress report with regard to the Showak / Atbara River well sites.

2. Well Drilling

Contracts were signed, after review and approval by USAID, between JMM and Geosource - Epig and Water Drilling & Engineering Co. Ltd. for the drilling development and testing of test and observation wells at Showak.

Geosource moved on site 6 September and Water Drilling & Engineering moved on site 10 September. Progress to date includes:

*page 1 will be retyped
to include progress in
drilling work.*

3. Well Development and Testing

No work has been started on this item by the JMM drilling subcontractors. The Tawawa well funded by UNHCR was developed and tested at about 100 USGPM. In our opinion the well was not adequately developed and further development could increase the well efficiency and yield.

4. Well field Design

Testing of the Tawawa well indicated that the single new well is not capable of supplying the design demand of 600 m³/day. It will be proposed that another well be drilled approximately 1 - 2 km northwesterly of the new well, such that both new wells together should be adequate for the demand with a reasonable pumping schedule and drawdown.

C. ENGINEERING

1. Surveying

At this time all basic field surveying is considered as being complete. This includes a survey of the existing Abu Naga wellfield and booster station, the Gedaref booster station, the Tawawa wells, location of the Showak test wells, measurement of the existing Showak facilities, and survey of the tentative booster station site (at Rawashda) on the Showak - Gedaref transmission main.

2. Preliminary Design

Hydraulic calculation have been started with regard to the Abu Naga wellfield, booster station and transmission main. Conceptual design have been done for the Rawashda booster station.

The efforts of UNHCR at Tawawa and Abu Naga are being considered and will be incorporated as much as possible in the JMM design scheme. See further comments in Section V.B.

D. PROJECT PAPER ASSISTANCE

The three - man Project Paper assistance team arrived and departed during this reporting period. A final draft of the project paper was finalized prior to their departure.

E. MANPOWER EXPENDED ON SITE

JMM EXPATRIATE STAFF

| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
|---|--------------------------|----------------------|------------------------|-------------------|
| 1. E. Shamieh Project Manager | 27 | 52 | 88 | 59.1 % |
| 2. J. Sproat Project Engineer | 27 | 46 | 82 | 56.1 % |
| 3. R. Turner Project Hydrogeologist | 27 | 51 | 88 | 58.0 % |
| 4. K. Wiebe Principal Hydrogeologist | - 0 - | 10 | 10 | 100 % |
| 5. M. Santos Electrical Engineer | - 0 - | - 0 - | 13 | - 0 - |
| 6. L. Ramage Surveyor | 11 | 11 | 13 | 100 % |
| 7. N. Hixson Institutional/Training | 14 | 14 | 20 | 100 % |
| 8. D. Ghoup Economics/Financial | 12 | 12 | 20 | 100 % |
| 9. D. Bird Technical Analyst | 20 | 20 | 15 | 100 % |
| TOTALS | 138 | 216 | 349 | |

LOCAL SUPPORT STAFF

| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
|--|--------------------------|----------------------|------------------------|-------------------|
| 1. Alem Ghebremariam Secretary/Typist | 27 | 35 | 71 | 49.3 % |
| 2. Maaruf Abdu Driver | 27 | 35 | 71 | 49.3 % |
| 3. Hassen Ahmed Driver | 27 | 34 | 70 | 48.6 % |

SECTION II

PERDONNRL

21 AUGUST 1983 TO 20 SEPTEMBER 1983

A. ARRIVALS DURING PERIOD

The following members of the Project Team arrived in Khartoum:

22 August - L. Ramage, Surveyor
23 August - D. Shoup, Economics/ Financial
29 August - N. Hixson, Institutional/ Training

The project staff as of 20 September consisted of the three long-term team members plus three local employees.

B. DEPARTURES DURING PERIOD

The following members of the Project team completed their assignment and departed Khartoum:

3 September - L. Ramage,
9 September - D. Shoup,
15 September - D. Bird,
16 September - N. Hixson.

C. SCHEDULED ARRIVALS

During the next reporting period, the following arrival is scheduled:

1 October - M. Santos, Electrical Engineer

D. SCHEDULED DEPARTURES

During the next reporting period, the following departure is scheduled:

15 October - M. Santos

SECTION III

MEETINGS

21 AUGUST 1983 TO 20 SEPTEMBER 1983

During the reporting period, numerous briefing and coordination meetings were held between the Project Team and AID as well as other concerned parties:

- Meetings with AID staff were primarily related to the drilling Subcontracts: Scope of work of the drilling program, budget, and approval of the Subcontracts which included most of the pertinent AID general provisions.
- Frequent meetings were held with the subcontractors. Water Drilling and Engineering Co. and Geosource - Epig Services Ltd., to review, finalize and eventual signing of the subcontracts on September 1, 1983.
- Field visits and meetings were held with the NAW staff in Gedaref and Showak to gather information about the existing facilities for incorporation in the final design.
- A number of meetings were held with representatives of COR, NAW, UNHCR and AID to resolve the question of implementing the Showak pump station and booster pump station proposed by COR.
- Periodic meetings were held with COR staff in Gedaref and Showak to advise them of JMM activities and design scope of work.

SECTION IV

CORRESPONDENCE

21 AUGUST 1983 TO 20 SEPTEMBER 1983

During the reporting period, certain significant correspondence relative to the project has been written by the Project Team in Sudan:

| DATE | WRITTEN TO | WRITTEN BY | SUBJECT |
|-------------|--------------------|------------|---|
| 24 August | L. Sheldon - USAID | E. Shamieh | Review of well drilling subcontract proposals. |
| 28 August | L. Sheldon - USAID | E. Shamieh | Highlights of 22 August meeting held by COR/UNHCR/NAW to review their proposal for Showak and booster pumping stations. |
| 30 August | L. Sheldon - USAID | E. Shamieh | Procurement of well Casing and Screen via USAID from NAW. |
| 31 August | L. Sheldon - USAID | E. Shamieh | Transmittal of draft well drilling subcontracts for approval. |
| 31 August | L. Sheldon - USAID | E. Shamieh | Summary of well drilling program and budget. |
| 7 September | L. Sheldon - USAID | E. Shamieh | Transmittal of copies of executed well drilling subcontracts. |
| 7 September | E. Nesbitt | E. Shamieh | Notice to Proceed for Geosource - Epig. |
| 7 September | K. Panten | E. Shamieh | Notice to Proceed for Water Drilling & Engineering Co. |

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SECTION V
PROBLEM AREAS

21 AUGUST 1983 TO 20 SEPTEMBER 1983

A. HYDROGEOLOGICAL

1. Difficulties have been experienced in locating the specified capacity pump which can be installed in one of the existing wells for testing the Abu Naga Well field. The pumps that the drilling subcontracts have locally in stock ^{were} either not large enough to meet the capacity - head required (350 USGPH at 300 ft. of head), or too large physically to fit into the existing 8 in. I.D. Casing. Procuring the pump from Europe or the USA proved to be costly and time consuming. Efforts by JMM and the subcontractors to borrow pumps locally were not successful either. A submersible pump was finally located through a local pump representative which can be delivered within 3 weeks at the cost Ls 23,285. The pump has a capacity of 265 USGPM at 300 ft. of head, which is adequate for testing purposes. However, as explained in item 2 below, funds may not be available to procure the pump and the well testing may have to be deleted altogether or conducted with the existing pumps at Abu Naga.
2. Every effort is being made by the JMM staff to stay within the budgeted amount of \$ 308,850; for the test well drilling program. The present contract prices are marginally close to this amount, therefore, the drilling program will have to be reduced by deletion of at least one observation well, in order to stay within the budget amount.

B. ENGINEERING

UNHCR has a continuous program of various sorts underway or imminent within the project area. (Drilling of the Tawawa well is an example.) Interfacing JMM final design with UNHCR should be given careful consideration, especially as the UNHCR program is in a state of flux depending on budget availability and immediate needs of the project area. JMM is attempting to coordinate with and design around the UNHCR proposals as much as possible, however it must be recognized that last minute changes may be required to best utilize and incorporate the efforts of UNHCR in the long term improvements being funded by USAID.

SECTION VI

PROGRAM FOR NEXT PERIOD

21 SEPTEMBER 1983 TO 20 OCTOBER 1983

During the next reporting period, numerous actions will be implemented during the continuation of the project. At this time only the hydrogeological problems noted in Section V are expected to cause any effect in the project schedule from that given in the Work Order.

Actions to be implemented by JMM include:

1. Continuation of well drilling program at Showak.
2. Continuation of field engineering work.
3. Participate in coordination meetings with USAID as necessary.
4. Continuation of home office support for final design and drafting tasks.
5. Initiate joint briefing meetings with representatives of NAW, COR, UNHCR, etc. to see that all mutual goals are addressed during the design work.

PSD.
oct. 25, 83.

(4)

Africa Resettlement
Services and Facilities
Project No. 698-0502

INTERNATIONAL RECEIVED PASADENA
OCT 31 1983
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

Progress Report No. 3
for the
Gedaref, Sudan
Water Supply Project

Prepared for
United States of America
Agency for International Development

under

Indefinite Quantity Contract
No. OTR-1406-IO4-1132-00
Work Order No. (04)

20 October, 1983

James M. Montgomery, Consulting Engineers, Inc.
Pasadena, California

21

JAMES M. MONTGOMERY, CONSULTING ENGINEERS, INC.

250 North Madison Avenue, Pasadena, California 91101 / (213) 796-9141 or 681-4255

Cable Address: Montgomery Pasadena California Telex: 67-5420

20 October, 1983

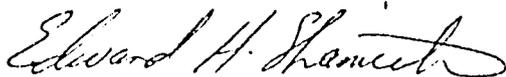
Mr. Lynn Sheldon, Sudan Engineering Officer
United States Agency for International Development
49th Street, New Extension
Khartoum
SUDAN

Re: Gedaref Water Supply and
Solid Waste Disposal
Progress Report No. 3

Dear Mr. Sheldon:

In accordance with Article III B. 5.b. of the 18 July 1983 Agreement between USAID and James M. Montgomery, Consulting Engineers, Inc., we are pleased to submit herewith four (4) copies of Progress Report No. 3 of the referred project.

Respectfully submitted,



Edward H. Shamieh
Project Manager

EHS/
Encl.

SECTION I

WORK PERFORMED

21 SEPTEMBER 1983 TO 20 OCTOBER 1983

A. GENERAL

During the third reporting period, field work and preliminary/conceptual design work by the JMM project team continued, well drilling continued at Showak, and coordination meetings were held with USAID officials, NAW officials, and UNHCR and COR personnel.

B. HYDROGEOLOGICAL

Hydrogeological aspects are covered in the enclosed attachment.

C. ENGINEERING

1. Surveying

Supplemental survey work was done at the Gedaref reservoir and the proposed Gedaref - Tawawa booster pump station site. The existing Tawawa distribution system was field checked with regard to location, pipe sizes and relative condition.

2. Preliminary Design

Conceptual and preliminary designs have been done for the Abu Naga booster station, the Gedaref booster station, the Gedaref reservoir chlorination facilities, the Gedaref - Tawawa booster station, the Tawawa well booster station, and the Showak pump station revisions. The Showak - Gedaref intermediate booster station site has been relocated to the hydraulic midpoint of the transmission main (by calculation only) and redesigned.

Existing electrical facilities have been checked out in all pertinent locations to determine suitability to the proposed designs.

The interests and concepts of NAW have been considered, particularly at Showak, and coordination continues with UNHCR with regards to that agency's interests at Abu Naga and Tawawa.

D. PROJECT PAPER ASSISTANCE

This work was completed during the last reporting period and will not be reported upon further.

E. MANPOWER EXPENDED ON SITE

JMM EXPATRIATE STAFF

| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
|---|--------------------------|----------------------|------------------------|-------------------|
| 1. E. Shamieh Project Manager | 26 | 78 | 88 | 88.6 % |
| 2. J. Sproat Project Engineer | 26 | 72 | 82 | 100 % |
| 3. R. Turner Project Hydrogeologist | 26 | 77 | 88 | 87.5 % |
| 4. K. Wiebe Principal Hydrogeologist | - 0 - | 10 | 10 | 100 % |
| 5. M. Santos Electrical Engineer | 8 | 8 | 13 | 100 % |
| 6. L. Ramage Surveyor | - 0 - | 11 | 13 | 100 % |
| 7. N. Hixson Institutional/Training | - 0 - | 14 | 20 | 100 % |
| 8. D. Shoup Economics/Financial | - 0 - | 12 | 20 | 100 % |
| 9. D. Bird Technical Analyst | - 0 - | 20 | 15 | 100 % |
| TOTALS | 86 | 302 | 349 | |

LOCAL SUPPORT STAFF

| NAME & TITLE | WORK DAYS THIS PERIOD | WORK DAYS TO DATE | WORK DAYS SCHEDULED | % TIME TO DATE |
|---|--------------------------|----------------------|------------------------|-------------------|
| 1. Alem Ghebrmariam Secretary/Typist | 26 | 61 | 71 | 85.9 % |
| 2. Maaruf Abdu Driver | 26 | 61 | 71 | 85.9 % |
| 3. Hassen Ahmed Driver | 26 | 60 | 70 | 85.7 % |

SECTION II

PERSONNEL

21 SEPTEMBER 1983 TO 20 OCTOBER 1983

A. ARRIVALS DURING PERIOD

The following members of the Project Team arrived in Khartoum:

11 October - M. Snatos, Electrical Engineer

The project staff as of 20 October consisted of two of the three long-term team members plus three local employees.

B. DEPARTURES DURING PERIOD

The following members of the Project team completed their assignment and departed Khartoum, to JMM home office:

20 October - M. Santos,

20 October - J. Sproat.

C. SCHEDULED ARRIVALS

During the next month no arrivals are scheduled.

D. SCHEDULED DEPARTURES

During the next month, the following departures are scheduled:

7 November - R. Turner

7 November - E. Shamieh.

The JMM design team will have, by then, completed their assignment in Sudan, and both office and accommodations will be vacated.

SECTION III

MEETINGS

21 SEPTEMBER 1983 TO 20 OCTOBER 1983

During the reporting period, numerous briefing and coordination meetings were held between the Project Team and AID, NAW, as well as other concerned parties.

- Meeting with AID staff were primarily related to the drilling Subcontracts: change in the Scope of work of the drilling program, and budget,
- Frequent meetings were held with the Subcontractors, Water Drilling and Engineering Co. and Geosource - Epig Servies Ltd., to review drilling progress and budget.
- Meeting with NAW staff in Khartoum to keep them advised of the progress of the drilling program and preliminary findings regarding formations and water quality of the shallow and deep aquifers etc.
- Field visits and meetings were held with the NAW staff in Gedaref and Showak to finalize the design of the proposed improvements.
- A number of meetings were held with representatives of COR, UNHCR and Gedaref city Council to advise them of JMM activities and progress of the design work and drilling program.
- Meeting with the Gedaref City Council to brief them of the Project , and JMM's preliminary finding, implementation schedule etc.
- A numerous meetings were held with the Roads and Bridges Public Corporation to learn about commom practices in Sudan, and to find out availability of sand, gravel and fill material in the Gedaref area.
- The first steering committee meeting was held on October 13, 1983, - and was attended by the representatives of COR, UNHCR, Gedaref City Council. The meeting was chaired by the NAW representative.
- The second meeting of the steering committee was held on October 17, 1983 to review the preliminary design by Montgomery.

SECTION IV

CORRESPONDENCE

21 SEPTEMBER 1983 TO 20 OCTOBER 1983

During the reporting period, certain significant correspondence relative to the project has been written by the Project Team in Sudan:

| DATE | WRITTEN TO | WRITTEN TO | SUBJECT |
|--------------|----------------|------------|--|
| 21 September | L. Sheldon | E. Shamieh | Update of well drilling budget. |
| 21 September | E. E. Nesbitt | E. Shamieh | Instruction to delete one observation well from the Scope of Work. |
| 25 September | L. Sheldon | E. Shamieh | Correction to Progress Report No 1 |
| 25 September | K. H. Panten | R. Turner | JMM's concern re. slow progress of drilling at Showak. |
| 28 September | L. Sheldon | E. Shamieh | Transmittal of drilling program progress report. |
| 30 September | Mubarrak Eng'g | E. Shamieh | Order of the Abu Naga test pump. |
| 4 October | L. Sheldon | E. Shamieh | Transmittal of the Draft Design Reports. |
| 5 October | L. Sheldon | E. Shamieh | Transmittal of minutes of the meeting of September 15, 1983. |
| 18 October | L. Sheldon | E. Shamieh | Storage of drilling samples |
| 18 October | L. Sheldon | E. Shamieh | Revised drilling budget and Scope of Work at Showak. |
| 18 October | L. Sheldon | E. Shemih | List of equipment to be left for NAW. |

SECTION V

PROBLEM AREA

21 SEPTEMBER 1983 to 20 OCTOBER 1983

A. HYDROGEOLOGICAL

Major problem areas anticipated are completion of the test/production well at Showak on schedule and arrival of the test pump for Abu Naga as scheduled. This was covered earlier in detail under Section I.B.

B. ENGINEERING

No major problem anticipated.

SECTION VI

PROGRAM FOR FINAL MONTH

21 OCTOBER 1983 TO 15 NOVEMBER 1983

During the final weeks, numerous actions will be implemented towards the conclusion of the project. At this time only the hydrogeological problems noted in Section V are expected to cause any effect in the project schedule from that given in the Work Order.

Actions to be implemented by JMM include:

1. Completion of well drilling program at Showak.
2. Test pumping at Abu Naga.
3. Completion of minor field engineering work.
4. Participate in coordination meetings with USAID as necessary.
5. Continuation of home office support for final design and drafting tasks.
6. Hold final joint briefing meeting with representatives of NAW, COR, UNHCR, etc. to see that all mutual goals were addressed during the design work.

ATTACHMENT

HYDROGEOLOGICAL WORK PERFORMED
21 SEPTEMBER 1983 TO 20 OCTOBER 1983

SECTION I. B.

1. Well Drilling

Since our last progress report dated 9-17-83 drilling of all observation wells at Showak have been completed by Geosource - Epig. Due to budget constraints it was necessary to eliminate one of the deep observation wells from our scope of work. However, Geosource - Epig, drilled an additional shallow observation well at no additional cost. As a result we now have three observation wells in close proximity to the test/production well. Observation well JMM - 01, located approximately 60 feet east of the test/production well, was drilled to a depth of 735 ft. penetrating both the shallow and deep aquifers. Observation well JMM - 02, located approximately 40 ft. south of the test/production well, was drilled to a depth of 60 ft. and penetrates only the shallow gravel aquifer. Observation well JMM - 04, located approximately 60 ft. west of the test/production well was drilled to a depth of 695ft., however, the shallow aquifer was cemented off in order to acquire data solely from the deep aquifer. This, the final observation well drilled, was completed on October 16, 1983. The screened intervals of these three observation wells are as follows:

| <u>JMM - 01</u> | <u>JMM - 02</u> | <u>JMM - 04</u> |
|-----------------|-----------------|-----------------|
| 20 - 60' | 20 - 55' | 400 - 440' |
| 400 - 460' | | 580 - 620' |
| 580 - 680' | | 640 - 680' |

The test/production well, JMM - T1, being drilled to a depth of 700 ft. by Water Drilling and Engineering Company, is still progressing slowly. As of October 16, they had only reached a depth of 180 ft. However, they report that their reverse rotary drilling rig should be on site by October 18. This should hasten their progress considerably. The increase in the depth of this well, which constitutes a change in our scope of work, was made after encountering an aquifer with very good potential between 670 and 680 ft. in observation well JMM - 01.

2. Well Drilling Results

Lithologic samples taken during drilling activities at the test/production well site indicate that the shallow gravel aquifer is approximately 35 ft. thick

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in this area. Nubian sandstone aquifers were encountered from 400 - 420 ft. and 630 - 680 ft. The static water level of the shallow gravel aquifer is approximately 3 ft. below ground surface in this area. Preliminary measurements indicate that the static water level of the deep aquifer may be approximately 60 ft. below the ground surface.

3. Water Quality Results

Preliminary field test indicate the quality of the deep aquifers to be good. Additional analysis of the shallow aquifer were conducted by the Sudan Ministry of Health, are listed below and indicate very hard water with high nitrate levels.

| | <u>Deep Zones</u> | <u>Shallow Zone</u> |
|---|-------------------|---------------------|
| Electical Conductivity μmhos | 1250 | 1240 |
| Total Dissolbed Solids, mg/l | approx. 875 | 800 |
| Temperature, $^{\circ}\text{C}$ | 32 | 29 |
| Chlorides, mg/l | 90 | 45 |
| Hardness (as Ca CO_3), mg/l | 85 | 520 |
| Nitrates (as N), mg/l | 0 | 25 |

Additional analysis will be conducted by the Ministry of Health to verify the the preliminary results of the deep aquifer. In addition the quality of the shallow aquifer at JMM - 03 (1400 meters South of the test/production well) will be tested.

4. Work to be Completed

Within the next 2 - 3 weeks the following tasks will, hopefully, be completed

1. Testing at Abu Naga well field.
2. Completion of drilling, construction and testing of the Showak test/production well.