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UNITED NATIONS CHILDREN'S FUND
WES SECTION

MONITORING MISSION REPORT ON DEEP WELL DRILLING PROJECT IN MIDDLE SHABELLE REGION

PREPARED BY
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Assist Project Officer

Mogadishu September 12, 1995

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I. INTRODUCTION:

On 12th Aug, 95 WES National Project Officer, Mr. Mohamed El-Fattih sent a radio massage to Mr. Ali Haibah who was the Hargaisa WES OIC, requesting to deploy Mr. Hassan Egal for 10 days mission to Rage Eele in Jawhar Region area where UNICEF committed in drilling 2 deep wells through one of UNICEF partner ADRA International NGO based in Mogadishu and have sub-office in Adale District.

The terms of reference of the trip was the following:

1. Inspection and monitoring the on going project.
2. To brief a new employed WES consultant for Mogadishu on the policies & procedure of UNICEF Water and environmental sanitation programme.

On 6th Sept. Mr. Hassan Egal travelled with UNICEF Aircraft from Hargaisa (North-West Zone) to Jawhar (Central Zone), where ADRA implementing the project, One of ADRA staff member were expected to be stand by at the Airport to meet with me, however, no body was spotted there while the aircraft hovered the airport for several rounds; later on it was clarified that they left the airport before the arrival time of the aircraft by the fact that the plane delayed due to the alteration of the aircraft schedule and lack of communication with ADRA. As a result the Aircraft with Mr. Egal preceded to Balli-dogle upon authorization from Nairobi and landed at 16:45 Hrs pm there where UNICEF assistant logistic Officer Mr. Abdullahi Ali Mohamed met the aircraft and escorted me safely to Mogadishu warehouse, we arrived Mogadishu at 07:40 Hrs pm. Being arrived late time in Mogadishu we couldn't succeeded to communicate with ADRA informing them about my presence in Mogadishu, we decided to call them in the next morning from UNICEF Mogadishu Office.

On the morning of September 7th, 1995, Mr. Egal met with Dr. Jeylani M. Dini, OIC Mogadishu. Abdullahi Ali Mohamed made communication with Mohamed El-Fattih, NPO at Nairobi who gave

instruction to Mr. Egal through Abdullahi to proceed to Mogadishu North with UNICEF Mogadishu OIC and other staff members. This was done methodically and efficiently and there was no problem on the way to the destination, at about 10:30 a.m Mr Egal with the other staff members reached ADRA office. A very quick meeting was organized by ADRA and UNICEF staff members informing them about their visit, whereby each of the parties introduced them self to the others, a particular introduction was made to Mr. Hassan Egal as the mission focal person for UNICEF.

II. PREPARATORY ACTIVITIES

After the departure of other UNICEF staff Mr. Egal made his first meeting with ADRA field staff including:

1.	Mr. Sharma	Drilling Engineer
2.	Mr. George	Hydrogeologist
3.	Mr. Matoto	Hydrogeologist
4.	Mr. Macaw	Project Coordinator
5.	Mr. Osman Subkane	Foreman
6.	Mr. Osman M. Sheikh	Logistic Officer
7.	Mr. Abdirahman	Accountant

The theme of the meeting was the progress of project achieved by ADRA in the field works. In this respect there was a long debate on the various activities such as:

Resistivity result and well specifications

a) Surface geophysical study.
b) Well logging results (electrical conductivity).
c) Well design.
d) Physical soil analysis at the project site (Hawaal Dobley).
e) drilling rates.
f) pump testing results.
g) Schedule of overall activities noting each and every

single activity.

After the meeting, ADRA OIC commenced the preparation of the long a waited field visit for UNICEF by facilitating to the staff member to carry on the field inspection and monitoring, preparing all necessary logistical facilities for the trip such as vehicles, fuel and escort.

Mean while an official assignment was given by the NPO to the staff member Mr. Egal through Mogadishu office regarding for further follow up and updating project officer about the project status .

III. FIELD VISIT & OBSERVATIONS:

On the morning of 8th Sept. 95 at about 7:00 a.m Mr. Hassan Egal accompanied with ADRA field staff: Mr. Sharma, Mr. George, Mr. Osman Subkane and Ali Sheikh with their security escort departed from Mogadishu North to the project site through Jawhar. (See the map attached). In effect, the trip took 5 driving hours went smoothly and was no rood constraints involved, therefore the team reached Hawaal Dobley at noon time.

The objective of the trip was to monitor the project progress, particularly the status of the wells and related activities executed by ADRA.

1. The staff member checked the total depth of the well by using deep meter and he found 194 meters of total depth. The well was cased with screen portions as informed by Mr. Sharma and Georgé when enquired about the well design (Annex A).
2. The present water level of the well by using the water level indicator (deep meters) was 168 meters. Therefore, at the time of the visit the depth of well is 26 meters beyond the water level.

3. Inspected and measured the casing type and diameter as PVC pipe 200 mm diameter.
4. Inspected and measure the screen pipe type, diameter and slot size respectively was (screen type = PVC, Diameter=200 mm, Slot size = 3 mm).
5. Checked the gravel packing material in site (remains). In this respect, it was observed that there are two types of gravel of different granulometry but of same lithology. The first was smaller size gravel about 1.00 mm diameter about 95% round and slightly bigger size gravel with various shape (consisting of both angular and sand in almost equal ratio). As of it's lithology, the gravel was mainly sialic i.e quarzitic, feldspatic (ortoclasis and plagioclasic) however there was inclusions of femic particles, darkish in color and very hard basaltic.
6. Checked and measured the electric conductivity of the water by utilizing a cane tied to the end of the deep meter (with the help of the rig crew). In this case, the E.C showed to be 7600 ms/cm (brackish in taste) and there were some contents of drilling mud that made the water polish in color. In this issue, the driller and hydrologist mentioned, after enquiry, that the well development/cleaning was not completed due to the frustration resulted by the observation of reduced well yield.
7. Pumping test result, surface geophysical study (TERRA METER), well logging results, well design, penetration rate were studied and counter with each other (attached as annexes): The finding of those analysis would came in the pump testing paragraph.
8. Conducted other site observations like presence of two drilling rigs, a deep rock type and tone type, however the later had some minor break down and spare parts were ordered. The deep rock maximum drilling depth is 200 m - (marginal) though the

normal capacity is 150 m. Moreover there were surplus casing/screen 200 m and bentonite scales. Besides, all other camping equipment were on site.

9. Examined the soil samples taken in 3 m depth, granulometry and lithology.

IV. OTHER OBSERVATIONS

a) As a result of some clan conflicts and very recent skirmish in the area nearby or better to say at vicinity of Bakad Jeex, where the other site located, so that for security constrains we couldn't proceed for the site survey and monitoring of the selected target by the ADRA hydrogeologist.

b) At about 13 km West of Hawaal dobley, along the road to Rage Eele there is a well called Qoor-dheere, therefore, data collection was made to utilize it for correlation of the total depth of the well, the static water level and the pump setting level. However, the well was not operational at the time of the visit due to submersible pump failure. Moreover there is an old Dautz genset in position. The community members met there, were very enthusiastic of any possible humanitarian assistance extended towards them; particularly in the rehabilitation and reconditioning of their well. In spite of that the UNICEF Officer doesn't made commitments or promise what so ever according to the organization rules and regulation.

c) At Hawaal Dobley, community elders who were the selected WES committee members were met and in the discourse their assistance and co-operation was evident. Besides, their interest and willingness on the success completion of the well was highly observant. Moreover, they expressed their thanks to UNICEF who gave consideration in helping them to recover from their long lasted water crisis.

In that context, it was real shocking to see nomadic people that dwell in the vicinity coming to the sites and collecting drinking water from the drill mud holes.

This, infect, demonstrated the existing water problems in that area.

d) Another important concern was that ADRA had a problem of break down to one of their rigs, the higher capacity rig (japanese made) and at present they were in the search for spare parts from Nairobi (effects to pump test).

e) Water quality showed very brackish because in one hand the water are coming from the gypsiform alluvial/flurial uppermost formation and on the other hand and most conspicuously the poor quality was aggravated by the presence of drill mud, an indication of improper or short time development of the well (foam not used)

V. FOLLOW UP MEETING:

On the evening of September 10 at 19:30 o'clock, after the team returned from Hawaal Dobley, UNICEF Officer responsible of monitoring the operation, requested ADRA staff (particularly the drilling Engineer, Hydrogeologist and Project Coordinator) for a follow up meeting to discuss their joint field observation. In this respect Mr. Egal, the UNICEF Officer aimed at finding out certain issues regarding the executed works since this was the first UNICEF monitoring trip to that project. The meeting was official and hence all discussions and debates would be highlighted in this report. This eventually contribute on clarification of the project background history and it's current status.

Mr. Egal opened the meeting by thanking ADRA s/ms for their good collaboration and sincere, honest and willingness to perform all their responsibilities on the project as of their part according to the bilateral agreement. Above all on their efforts to facilitate, all their best, the mandates of this monitoring mission. Further to that, he requested the to brief him on the project activities since when they have started it.

Following that Mr. Sharma, the project drilling engineer thanked back to Mr. Egal and showed their happiness to receive this opportunity for the mission to supervise their activities and have access to demonstrate their work to UNICEF. Finally he gave the word to Mr. George to present the briefing, which for convenience is summarized as follows:

- As of normal the operation started with drilling equipment and crew mobilization and transportation of material to site and setting up the camp.
- On 23rd Aug,95 started surface geophysical survey and conducted geoelectric profiles with TERRA METER in 3 sites at Hawaal Dobley.
- On 24th Aug. executed similar operations at Bakad Jeex where they did profiles for 3 sites.
- On 25th Aug.95 tried to make resistivity data interpretation, however faced difficulties in processing data due to the diskette disorder. In this case, made rough interpretation with reference to a previous one that they did in Rage Eele..
- Debate on the issue revealed that the event was not reported to UNICEF Offices; neither Mogadishu nor Nairobi.
  Above all, that would have facilitated inter-office consultation and work relationship. It has, also, it's magnitude of consideration as a line item of the project agreement. On the other hand UNICEF would have made their own

decision on the affair; That would have served as point of reference for ADRA, the project counterpart or implementing organization.

- On 28th Aug.95 started drilling operation with tone rig and went down to 27 meters. At that point mud pump leaking was observed on the mud line, then shifted the Deep Rock to site on 30th Aug. 95, where it started drilling from 27 meters and on down.
- 2nd September 95, completed drilling with 12.25 inch bore to a depth of 202m.
- 2-3rd September 95, waited UNICEF Representative Officer to check and advice on the progress.
- 2-3rd Sept 95, conducted electrical logging down the well up to 196m; being worried of sand caving, started lowering the casing pipes and screen on 4th September due to lack of feedbacks from UNICEF. The UNICEF Officer raised a question in this regard on whether ADRA reported to UNICEF on the issue however the answer was negative.
- 4-5th Sept. 95, performed development/cleaning of the well with the help of air compressor and water.
- 5th Sept. 95, conducted pump testing with grunfoss submersible pump, yield 15.5 cum/hour (pump testing results attached)
- 6th Sept. 95, ADRA team waited the arrival of UNICEF Office and were stand by at the airport up to 3:30.
- Together with the survey ADRA obtained resistivity data from Rage Eel and Ado U1 and hence made Comparison of data from Rage Eele and the current one.
- Had no data from Qoor Dheere which is the nearest and most reliable well.

VI. ANALYSIS

According to the site observation done during the field trip, all available data obtained by ADRA before and after drilling, other references made to existing well nearby from old text's and verbal information compiled from Qoor dheere village genset attendant and previous experience to the strategy of the area the following analysis were made.

VI. 1. LITHOSTRATOGRAPHIC CORRELATION

Hawaal Dobley lies on the alluvial deposits of the Shabelle valley. That formation mainly constitute of sand dunes, sandy clay, fine sand and silt with occasional small gravel. The nearest well locating about 15 km west of Hawaal Dobley is at Qoor-Dheere (see map); The altitude of Qoor-dheere is 140m above see level. The well total depth is 226m and the pump setting depth is 196 bgl. Though the well is not operational at present it is reported to have soft good quality water which is believed, as informed by the well operator Mr. Hariir met at the village, that the lowest rock samples from the well resembled limestone formations.

a) On the other hand, the well at Rage Eele, being maintained by ADRA 40 km East of Hawaal Dobley is 155m deep with a water level at 21m; however the water quality is very poor (8000m/cm). The altitude at Rage Eele is 30m above the sea level.

b) In Aqab duco the well depth is 115m bgl where the altitude is 65 m abgl.

c) In Wardhagax 20 km North-West of Qoor-dheere , the bore well is 160m below ground level.

The underground hydraulic cross section from Jawhar to Rage Eele is

attached. Therefore, as indicative measurement of drilling depth to a potential aquifer limestone .

VI. 2. LOGGING DATA INTERPRETATION

VI. 2. 1. SOIL LOGGING:

As been informed by the hydrologist as well on site a physical lithological and granulometric study of the reserved drilling samples at 3m depth intervals, the following summary was obtained:

0-12m	Pale whitish alluvial medium to coarse sand.
12-40	Light brown fine sand with traces of whitish (soft) calcareous traces.
40-68	Whitish to reddish fine grained sandstone
68-118m	Brownish to reddish, fine to medium, sand
118-122m	Whitish fairly calcareous unconsolidated sensation.
122-133m	Fine, reddish sandstone; lightly calcareous lenses.
133-152	Fine to medium brown reddish to reddish brown unconsolidated sands.
152-184m	Fine, brown to reddish brown consolidated sand
152-184m	Fine pale whitish calcareous sand.
184-198m	Fine reddish brown sand
198-202m	Fine pale, whitish calcareous for consolidated sand

The above stostrategraphic column could indicate the intercalation of marine sand with terrestrial sand and sandstone. This virtual stratification is probably

a) Due to deposition of transgression and regression.
b) Alluvial deposits from Yasooman sandstone during and marine eolic deposits with the ritmic monsoons.

The attached pump testing record produced by ADRA (Annex...) clearly shown water level measurements and relative time scale which could even be orifice method. What-so-ever, the yield or discharge data illustration would have been much better for optimum comprehension. According to the record contents the total draw down is 79.95m in 40 minutes time, therefore the average DD/m is calculated to be 2. The pump used in the operation has been inspected in the site and is 15.5 cm/hr equivalent to 4.3 lt/sec. Therefore the water column (86 to 194 m = 108 m) having a volume of 3.39 cum would deeplite in 75.6 minutes.

Despite the rapid draw down during the first 20 minutes of pumping test, the DD reduces and approaches to zero at the final stages (40th minutes = 0.1 m) could indicate tendency to the equilibrium state, therefore pumping test results would have been more reliable if pump setting level is lowered or even pumping continuous (in a concerned question the team mentioned that water flow stopped at 40 minutes time despite the water level being 17 m above the pump setting level). This could indicate pump failure or similar problem but not depletion of well water.

As a result of that uncertainty, a recommendation related to the issue would be included.

DRAW DOWN CHART

TIME/PERIOD	DD (M) *	REMARKS
1	8.77	
2	4.30	AV.DD 2M/MIN
3	6.70	
4	6.30	
5	5.30	
6	5.20	
7	5.33	
8	5.17	
9	5.29	
10	4.04	
12	2.58	
14	10.14	
16	2.70	* DD very high in first 20 min and drasticaly reduces in the next 20 min.
18	3.40	
20	1.88	
25	1.65	
30	0.85	
35	0.45	
40	0.10	
Total	79.15	

Another concern is the back fill of about 8 meters after clearing the bore hole. However this happened, this would have been easily solved with the use of bailer, nevertheless the

event is vague. On the other hand this could indicate the presence of underground movement in a loose incoherent and unconsolidated aquifer that needed emergency casing (see Annex 1). This hypothesis is clearly justified by the resistivity log chart bottom portion.

VI. 2. 5. PENETRATION RATE

In the basis of information prepared by ADRA, some analysis was also made to the penetration logging sheet for the drilling operation. The data interpretation shows a very low rate of penetration that indicates the softness of the ground stratus which in effect is a symbol of drilling through unconsolidated soil. This determines conforming to the soil analysis made in the extracted samples (see lithostratography column) that are mainly unconsolidated sandstone, fine and medium size sand with presence of traces of salt.

On the other hand, the penetration rate analysis verify that the drilling is above the limestone formation containing the relatively good quality water which apparently would present more high penetration rate.

VII. RECOMMENDATIONS

VII. 1. GENERAL RECOMMENDATIONS

- Based on discussions with the elders of the concerned area that proved the existing scarcities of drinking water, it is important to give maximum consideration to the successful completion of the project.
- To establish constant follow up channel of the project, it is inevitable to increase the frequency of monitoring and supervision trips from UNICEF side. The presence of UNICEF of qualified engineer is important in peak times

such as well setting, logging and pump testing if not all drilling operations.

- In order to improve the UNICEF - ADRA communication on the field operations, it is suggested to decrease reporting period from one month to biweekly. Moreover, to state official written queries on the status and condition of the drilling operation (or on each phase of the contract terms).
- For the smooth project implementations, it is worth advising ADRA not to treat the possible unforeseen event or accidents related to the implementations internal, but report accordingly and was as soon as possible to UNICEF officers.

VII.2. TECHNICAL RECOMMENDATIONS

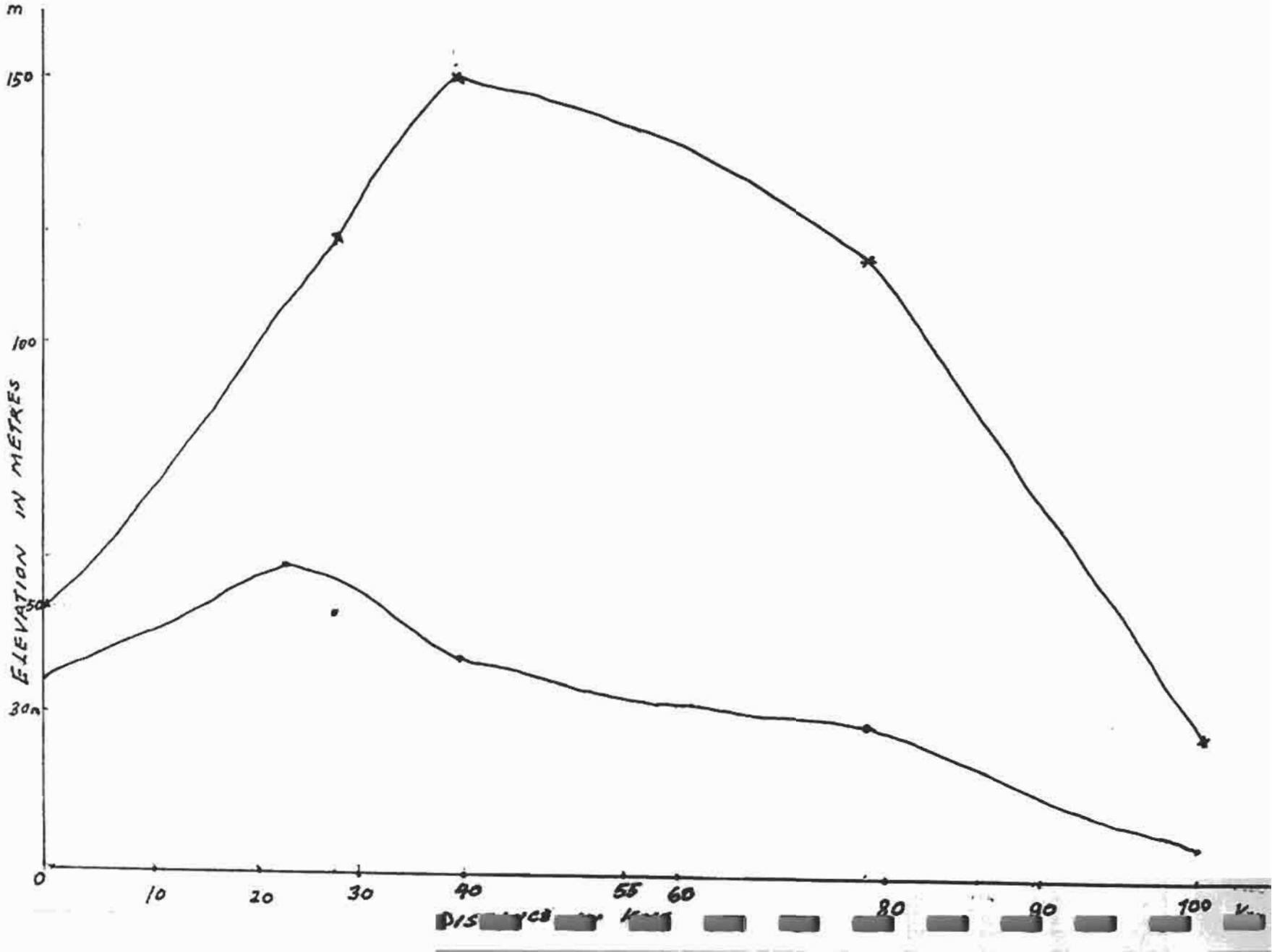
- On the basis of data obtained, during the field monitoring mission, on the soil analysis log bore hole electric logging and pumping test, it is recommended that the Hawaal Dobley well present depth be increased.
- References to data of the existing deep - wells around Hawaal Dobley, highlight the presence of potential deep aquifer with relatively soft to marginal waters (stratigraphy, well depth, static water levels), a good example of which is Qoor-dheere well locating 15 kms West of Hawaal Dobley it is proposed that the well should be drilled to 240 m. This is justified, apart from others; by referring the difference in elevation of Rage Eele, Qoor-dheere and Jawhar and their relative water levels (or total bore hole depths).
- Upon consent of the above (no.3), the present well design could be improved, in condition also to prior accurate electric down hole logging, by taking either of the

following two options:

- To extract the recently installed PVC casing and screen by gravel-wash method (if possible) and after that drill the well with same diameter bore; This of course requires higher skills during fishing and great attention to drill mud (bentonite) concentration.
- To start drilling the well with a 7.78 inch diameter peak from its present depth, leaving the 8 inch casing screen in position. In this options, the final well design would either be telescopic by casing screening bottom portion with 6 inch or would be double cased by casing screening the total depth quality and quantity of water contents. If incase the bottom part acquires acceptable transmissivity and yield it would be better to put 6 inch although to prevent capillary saline water from upper aquifers.

For pump testing certinity and accuracy a test unit is recommended for the site.

HYDRAULIC & ALTITUDE CROSS SECTION JOWHAR RAAGE EEL



T`: ADRA - SOMALIA FROM: AQUA PLAN CONSULT
L..TE: 26/08/95
SUBJECT: INTERIM REPORT ON GEOPHYSICAL/GROUNDWATER INVESTIGATIONS AT HAWALE DUBILE AND BAKAD JEEX IN CENTRAL SOMALIA REGION.

1 INTRODUCTION

Adventists Development and Relief Agency (ADRA) - Somalia commissioned Aqua Plan Consult (APC) to undertake hydrogeological and geophysical investigations at two different sites namely; Hawale Dubile and Bakad Jeex. Both sites are located in an area commonly referred to as the Middle Shabelle Region. The sites are situated about 120 kilometres northeast of Mogadishu Town.

The objective of the investigations was to establish the optimum locations for drilling of boreholes at the above mentioned sites. The boreholes are required to supply water mainly for domestic and livestock purposes. Presently water sources are located several kilometres away and the people and livestock have to walk for hours or days between grazing areas and watering points.

The project areas are characterised by a gentle micro-relief with sand cover. The general gradient is to the east sloping gently to sea level. The drainage pattern is towards the southeast into the Indian Ocean. The Shabelle river emanates from the Ethiopian Highlands and flows perennially through Central Somalia into the sea.

The climate of the project area can be described as arid to semi-arid with a mean annual rainfall of about 400 mm. The rainfall pattern is very irregular, and some areas may receive much more than the mean annual rainfall while neighbouring areas may receive much less. The main rainy season is from April to June while the minor season is from October to December.

Geologically the study areas fall within what has been described as the Shabelle Dhexe alluvial plain comprising Recent - Pleistocene sandy clays, gypsiferous sandy clays, sands and fine gravel.

In as far as groundwater is concerned at the two sites, there are two main controlling factors other than the rainfall and geology; the Shabelle river and the fault running along the coastline from northeast to southwest. Most recharge of the groundwater at these sites is derived from the Shabelle river which flows from north to south about 40 kilometres west of the project area. Water table maps show that groundwater flows from the river towards the sea. The alluvial sands and the coastal deposits have a high permeability allowing large areas between the Shabelle river and the coastline to be recharged by good quality water from the river.

The geophysical investigations conducted applied mainly the resistivity method and all the data will be presented in the final report after the final interpretations.

2 CONCLUSIONS AND RECOMMENDATIONS

2.1 Hawale Dubile

This site located about 24 kilometres NNW of Raga Ele market is found about 5 - 10 kms south of the NE-SW fault and some 150 kms east of the Shabelle river. Boreholes drilled in the vicinity of this site have all encountered water at intermediate depth between 100 and 150 metres below ground level (m bgl). The waters encountered have been of moderate quality by Somalia standards with electrical conductivity (EC) values ranging between 5000 and 8,000 micro mhos/cm.

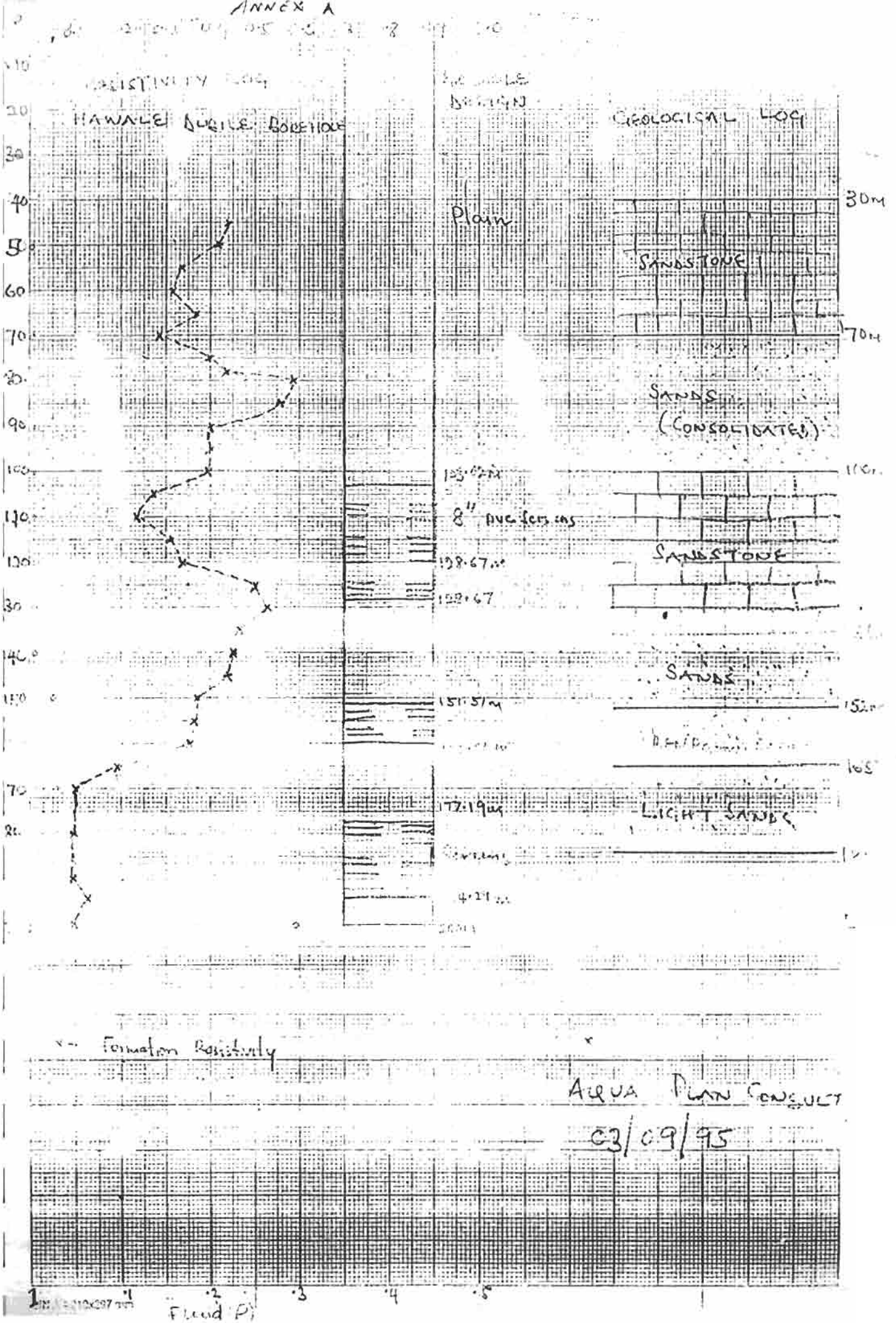
From the geophysical and hydrogeological data, it is recommended that a borehole is drilled at this site to a depth of 200 m bgl. If the shallow aquifers encountered are of very poor quality, they should be sealed off and water tapped only from the intermediate aquifers of moderate quality. Groundwater recharge at this site is derived from the Shabelle river and is also influenced by the proximity of the fault. Groundwater of moderate quality (EC = 5,000 micromhos/cm) is expected.

2.2 Bakad Jeex

This site located some 20 kilometres west of Raga Ele has a good groundwater potential. The site seems to fall close to the boundary of the good quality water zone that surrounds Mogadishu and the moderate quaility zone north of Raga Ele. Geophysical and hydrogeological data indicate that sufficient groundwater will be encountered at moderate depth at this site. It is recommended that a borehole of 180 - 200 m bgl be drilled at this site.

At both sites it is necessary to log the electrical conductivity of the drilling mud during drilling to monitor the variation of water quality with depth.

ANNEX A



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03/09/95

ANNG B

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ANNX B

SELECTED SITE

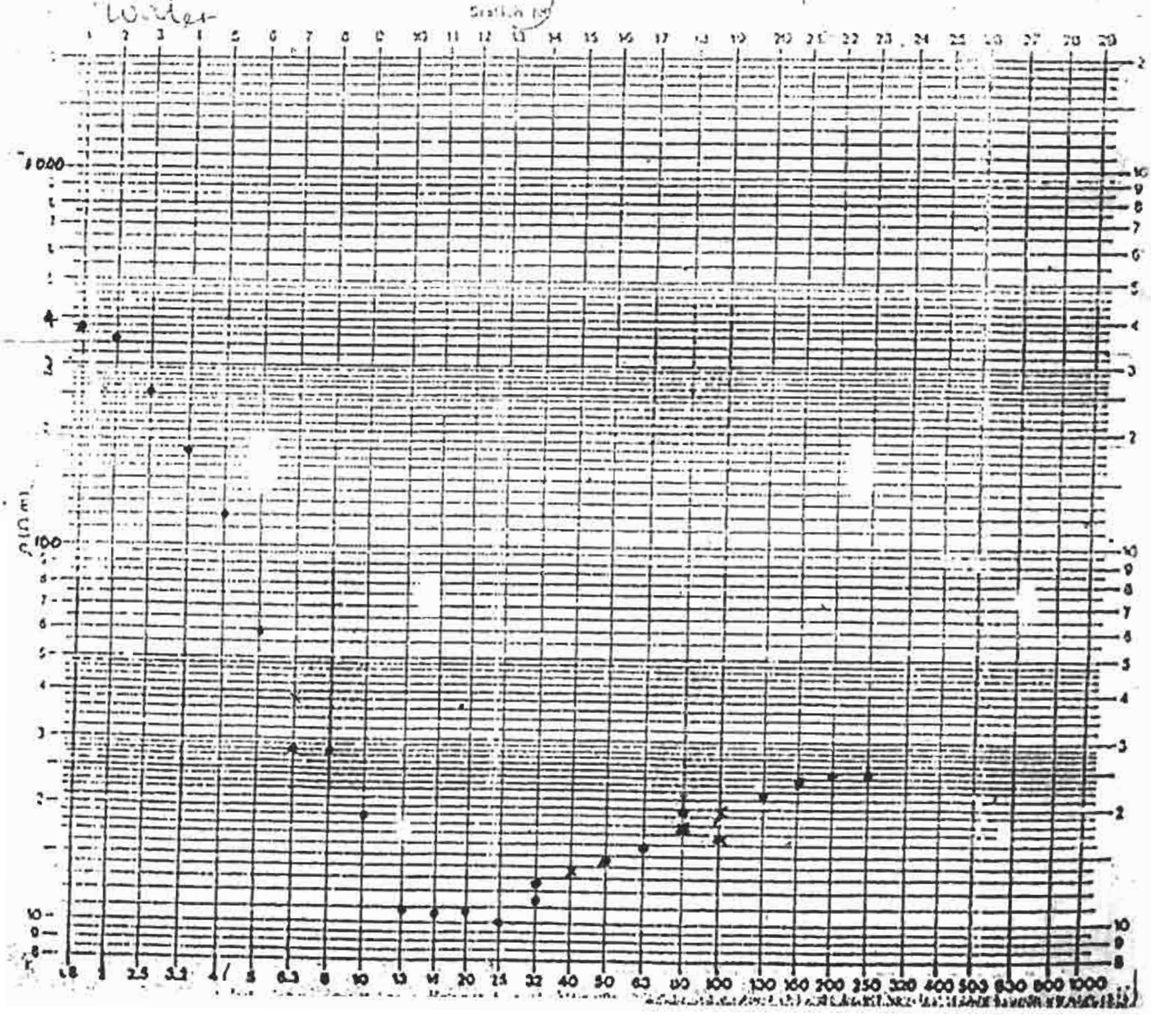
Location: HAWALE NUBI & ________ Date: 23/08/95

Mapsheet: ________ Coord. X: ______ Y: ______ Azimuth: 320°

VES/Profile NO: 1 ________ Station interval: ________ m Operator: ________

MN/2	AB/2	K	ΔV / I	ρ	MN/2	AB/2	K	ΔV / I	ρ	MN/2	AB/2	K	ΔV / I	ρ
.5	1.6	7.26	52.6	382		32	3220				400	10000		
	2	11.8	30.2	356	10	32	145	0.0866	12.6		500	15700		
	2.5	18.8	13.34	251		40	236	0.0726		50	250	1880		
	3.2	31.4	5.60	176		50	377	0.0381	14.4		320	3160		
	4	49.5	2.45	121	20m	65	[illegible]	0.0559	15.7		400	4950		
	5	77.8	0.76	59.4		80	[illegible]	0.0423	19.9	7.16	500	7780		
	6.3	124	0.236	3.5	754	100	1560	0.9	20.4	5	16	72.6	0.1461	10.6
.0889	8	200	0.1416	3	50	130	600	0.036	21.6		20	118	.0916	10.8
	10	313	0.0604	19		160	942	0.0245	23.6		25	188	0.0530	10.0
	13	530	0.0204	19		200	1507	0.0165	24.8		32	314	0.0365	11.4
	15	703	0.01			250	2388	0.0103	24.5	25	80	362	0.0462	16.8
	20	1260			250	250	3890				100	589	0.0261	15.4
	35	1960				320	6370				130	1070		

24 km NNW of Raga Ele the present source of water



AQUA PLAN CONSULT

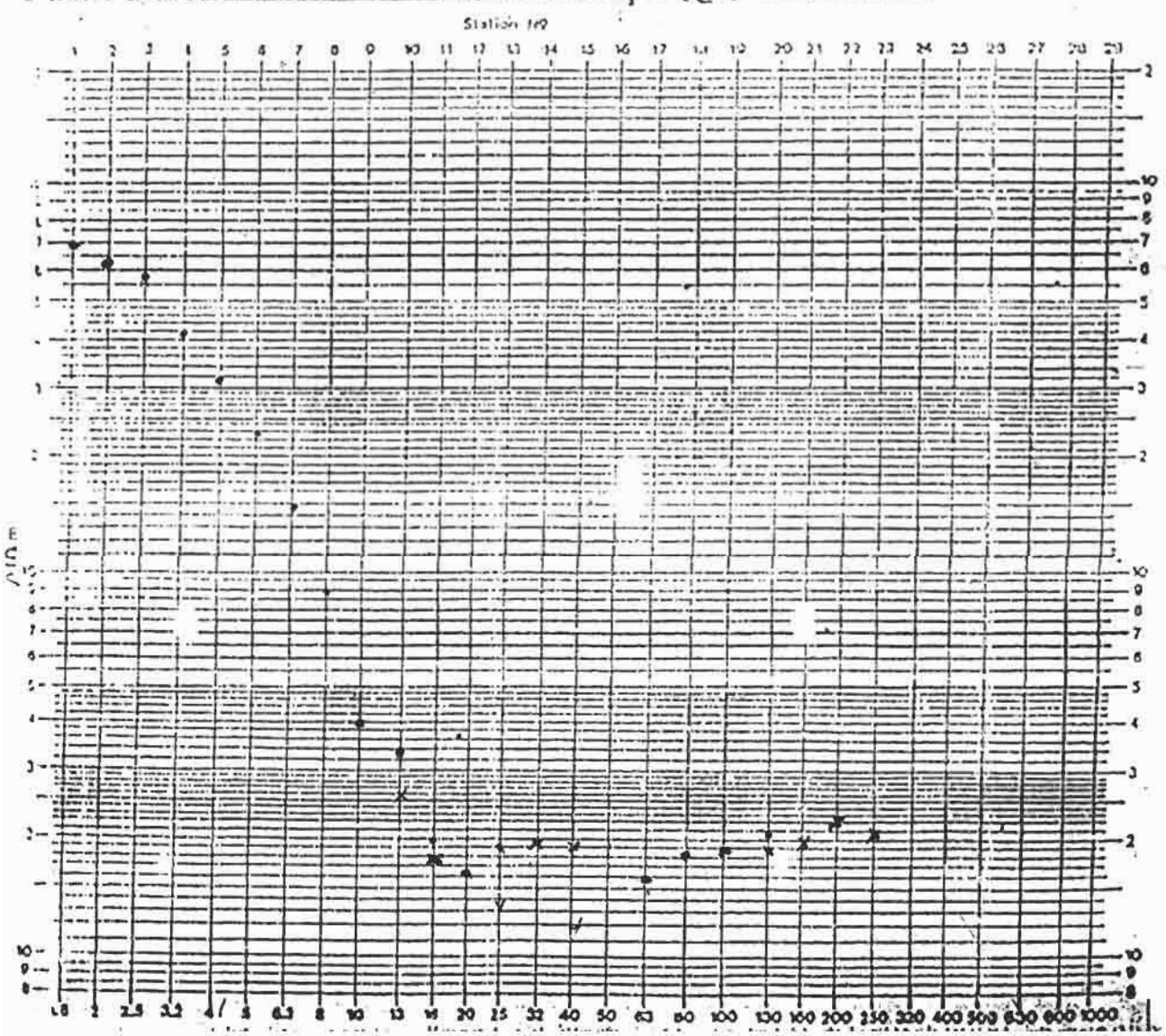
Location: 1 : WALE DUBLE Date: 23/08/95

Mapsheet: Coord. X: Y: Azimuth: EW

VES/~~Profile~~ NO: 2 Station interval: m Operator:

AB/2	K	ΔV / I	ρ	AB/2	K	ΔV / I	ρ	AB/2	K	ΔV / I	ρ
1.6	7.26	95.1	690	32	32.20			400	10000		
2	11.8	53.0	625	32	145	0.1335	19.4	500	15,700		
2.5	18.8	30.5	573	40	236	0.0811	19.1	250	1880		
3.2	31.4	12.95	407	50	377	0.021	?	320	2260		
4	49.5	6.21	307	63	681	0.053	14.8	400	4950		
5	77.2	2.914	225	80	940	0.037	14	500	7720		
6.3	124	1.166	145	100	1580	0.032	13	16	72.6	0.235	17.1
8	200	0.449	89.8	130	2620	0.0201	12	20	119	0.138	16.3
10	313	0.126	39.4	160	4010			25	188	0.103	21.3
13	500	0.064	32.9	200	6270			32	314	0.017	?
16	803	0.025	20.1	250	9800			40	600	0.031	18.8
20	1260			250	3390			160	942	0.0211	20.3
25	1960			320	6370			200	1507	0.0149	22.6

≈ 700m W of VES 1



AQUA PLAN CONSULTS

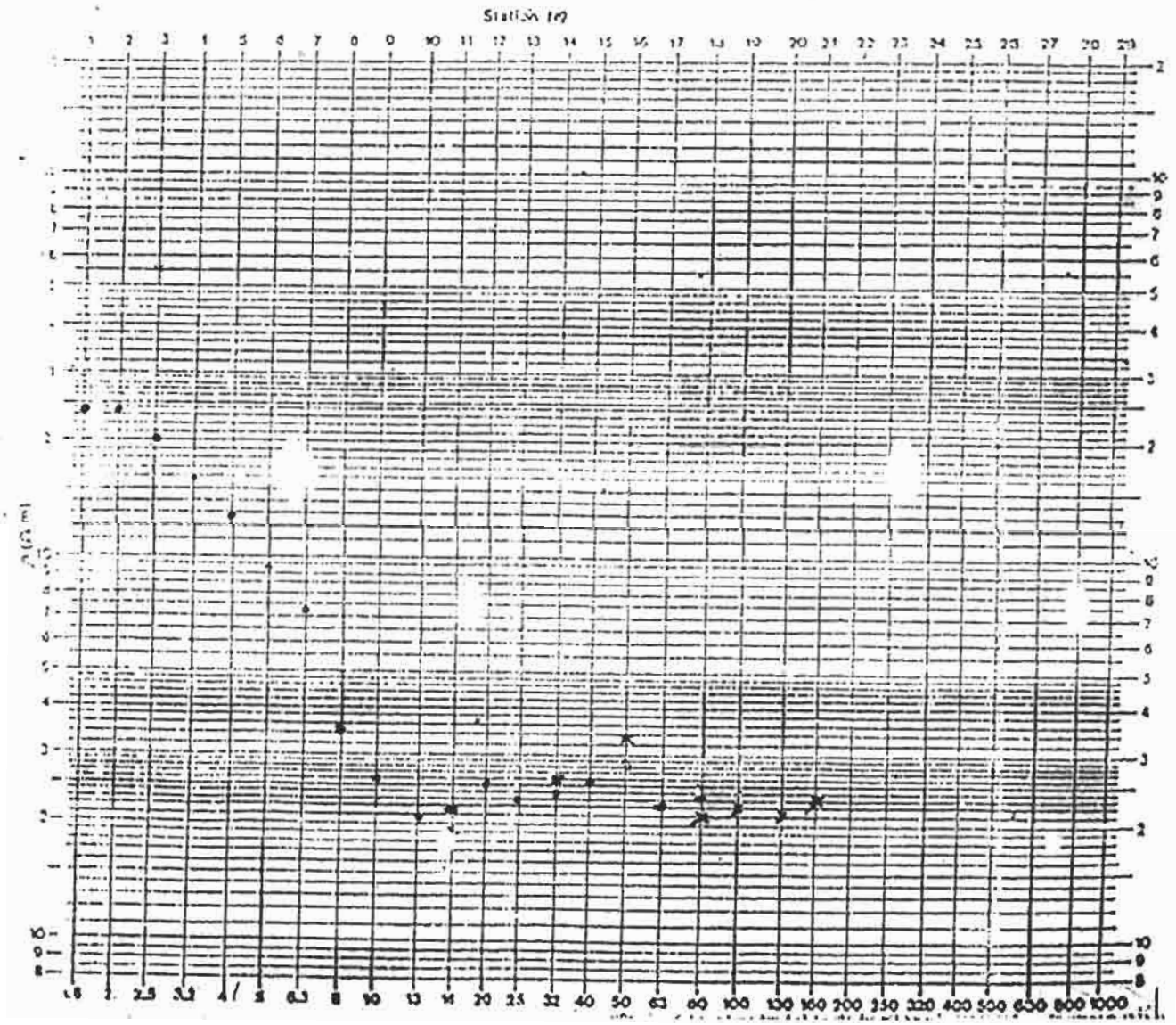
Location: HAWALE NUI LE Date: 22/08/95

Mapsheet: Coord. X: Y: Azimuth: 230

VES/Profile NO: 3 Station interval: m Operator:

AB/2	K	ΔV/I	ρ	AB/2	K	ΔV/I	ρ	AB/2	K	ΔV/I	ρ
1.6	7.36	32.8	238	32	3280			400	10000		
2	11.8	20.1	237	32	145	0.173	26.6	500	15700		
2.5	18.8	10.68	201	40	236	0.0994	23.5	250	1880		
3.2	31.4	5.06	159	50	385	0.203	33.5	320	3440		
4	49.5	2.58	128	65	808	0.0754	21.1	400	4950		
5	77.2	1.198		80	976	0.0497	23.4	500	7780		
6.3	124	0.582		100	1560	0.052		16	72.6	2.6	19.2
8	200	0.178	3	130	2640			20	118	0.98	23.6
10	313	0.083	26	160	4010			25	189	0.15	22.0
13	530	0.039	20	200	6230			32	314	0.0	24
16	803	0.026	20	252	9800			80	363	0.0	21.1
20	1260			250	3390			100	589	0.0	34
25	1960			320	6370			130	1020	0.0209	21.4
								160	1570	0.015	23.5

2 700m NO VES 1



ANNEX C

AQUA PLAN CONSULT

(2)

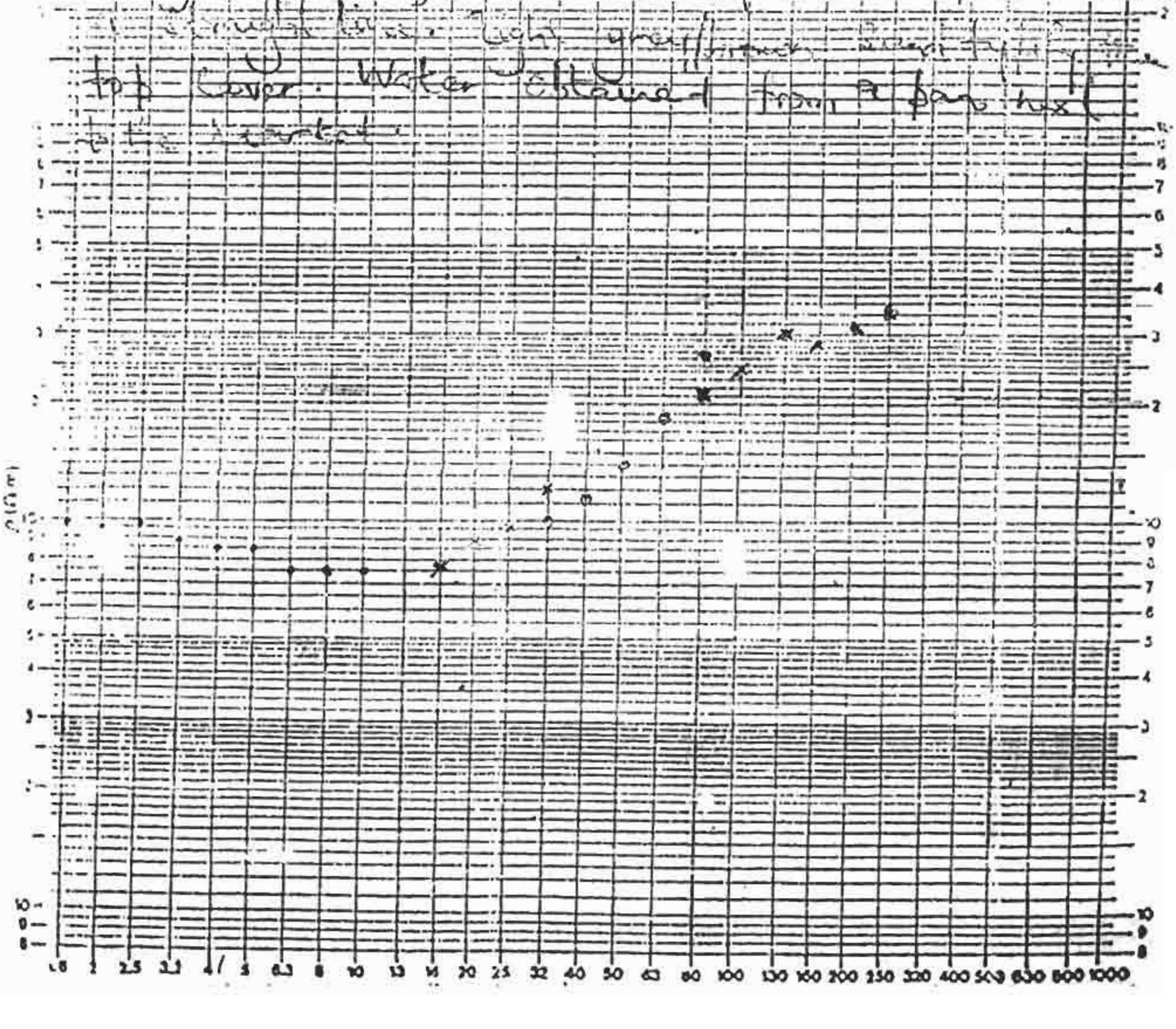
Location: BAKAD JEEX Date: 24/08/95

Mapsheet: ______ Coord. X: ______ Y: ______ Azimuth: 200°

VES/Profile Nº: 1 Station interval: ______ m Operator: ______

MN/2	AB/2	K	ΔV / I	ρ	MN/2	AB/2	K	ΔV / I	ρ	MN/2	AB/2	K	ΔV / I	ρ
.5	1.6	7.36	1.374	9.97		32	3220				400	10000		
	2	11.8	0.803	9.5	10	32	145	0.069	10		500	15700		
	2.5	18.8	0.515	9.70		40	236	0.048	11.3	50	250	1980		
	3.2	32.4	0.279	8.80		50	377	0.037	13.9		320	3140		
	4	49.5	0.1718	8.50		63	608	0.0[illegible]	18.8		400	4950		
	5	77.2	0.1098	8.5		80	980	0.[illegible]	26.7		500	7780		
	6.3	12[illegible]	0.0605	7.5		100	1560			5	16	72.6	0.106	7.70
	8	200	0.0376	7.5		130	2640				20	118	0.0761	9.0
	10	313	0.0238	7.5		160	4010				25	182	0.0507	9.50
	12	530	0.0176	9.3	40	200	1587	0.0[illegible]	31.6		32	314	0.039	12.2
	16	802	0.0148	11.9		253	2980	0.011	34.2	25	80	363	0.059	21.4
	20	1260			25	250	3890				100	589/4	0.083	37.[illegible] ?
	25	1960				320	6370				130	827	0.027	30.
											160	1293	0.022	22.4

BAKAD JEEX is some 33 km west of Raga Ele along the road but probably 20 kms on [illegible] straight line. Light grey/black [illegible] top cover. Water obtained from a pan next to the [illegible]



ADC

AQUA PLAN CONSULT

Location: BAKAU JETTY Date: 24/02/95

Mapsheet: Coord. X: Y: Azimuth:

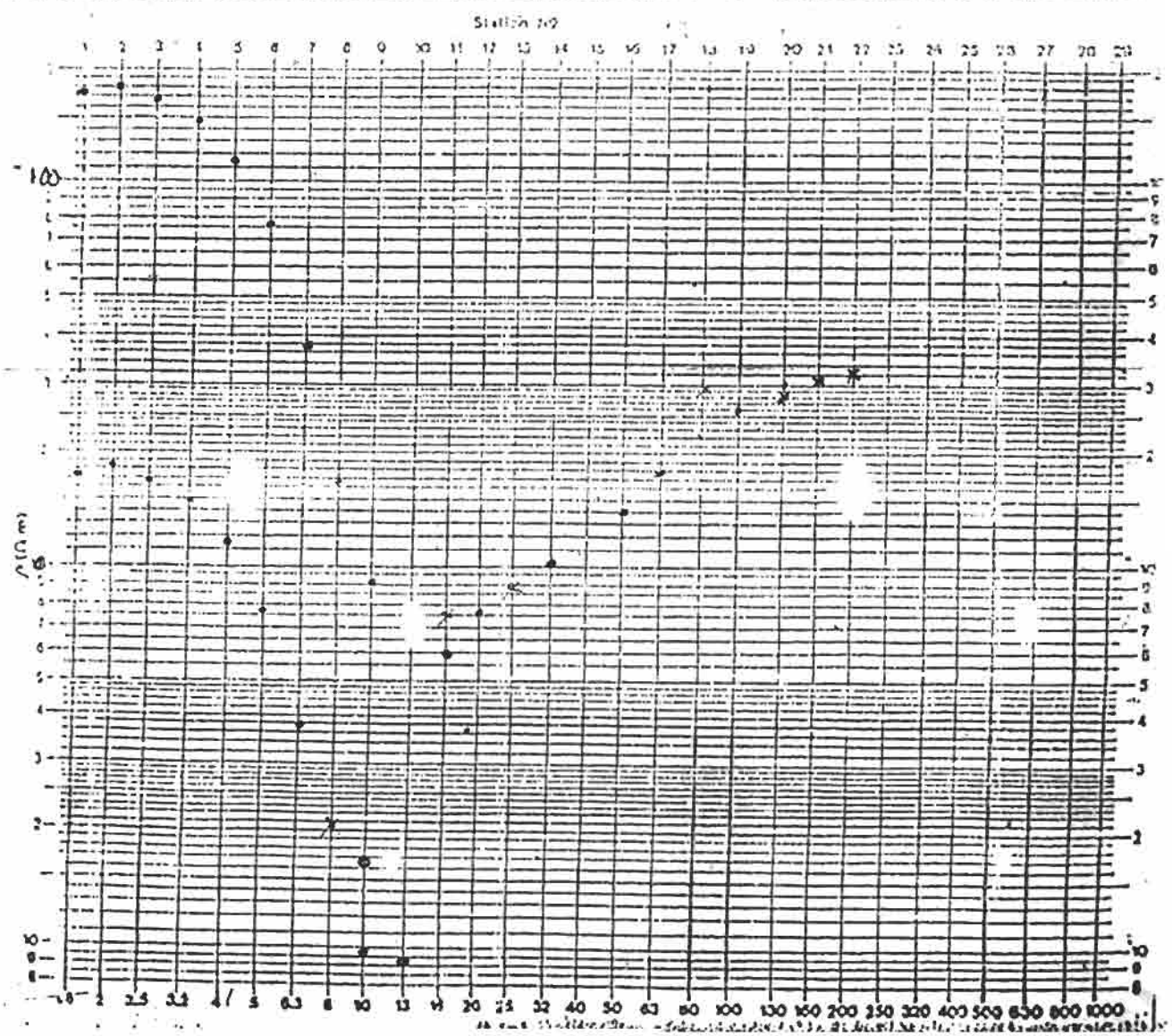
VES/Profile N°: 2 Station interval: m Operator:

AB/2	K	ΔV / I	ρ	AB/2	K	ΔV / I	ρ	AB/2	K	ΔV / I	ρ
1.6	7.26	24.0	174	32	82.20			400	10000		
2	11.8	15.54	183	32	145	0.072	10.4	500	15700		
2.5	18.8	8.90	167	40	236	0.0477	9.8	250	1880		
3.2	31.4	4.73	149	50	320	0.0625	12.8	320	3140		
4	49.5	2.32	115	63	484	0.0487	17.7	400	4950		
5	77.2	0.99	76.2	80	890			500	7720		
6.3	122	0.30	37.2	100	1560			5 16	72.	0.1026	7.40
8	200	0.01		130	6420	0.047	28.2	20	118	0.0501	5.91
10	313	0.031	7.7	160	9420	0.0329	31	25	188	0.0307	5.65
13	530			200	15700	0.0211	31.9	32	314	0.0178	
16	803			250	9800			25 80	363	0.0947	30
20	1260			252	5390			100	589	0.0414	36.3
25	1960			320	6370			130	1020	0.0304	30

12 58.9 283 16.7 2.5

13 102 0.0969.2

16 157



AOC

AQUA PLAN CONSULT

Location: BAKAD Jaex Date: 24.08.95

Mapsheet: Coord X: Y: Azimuth:

VES/Profile NO: 3 Station interval: m Operator:

AB/2	K	ΔV/I	ρ	AB/2	K	ΔV/I	ρ	AB/2	K	ΔV/I	ρ
.5	1.6	7.36	17.62	28	32.2			400	10000		
2	11.8	8.96	106	38	145			500	15700		
2.5	18.8	4.57	85.9	40	236			250	1880		
3.8	31.4	2.01	62.1	50	371			320	3160		
4	49.5	0.736	36.4	63	608			400	4950		
5	78.2	0.320	24	80	996			500	7780		
6.3	124	0.068	7.5	100	1560			5 16	72.6	.07	5.3
8	200		18.9	130	2640			20	118	.08	
10	313		11.8	162	4010			8 25	110	0.080	8.81
13	530			200	6270			32	188		
16	803			256	9800						
20	1260			250	3390						
25	1960			320	6370						

2 6.3 28 1.56 43
8 47.1 0.401
10 75.4 0.157
13 41.3 0.036
16

~ 2 km S. of Bakad Jaex Centre

Station no

readings impossible due to very loose sands

ADVENTIST DEVELOPMENT & RELIEF AGENCY - SOMALIA

ADRA

ANNEX D

DRILLING SECTION:
PUMP TEST RECORD:
(REVISED)

Borehole number ..... Borehole Name HIWAE AYBLE....
Depth ...202m/194m..... Date of test ..05/09/85.....
Test conducted by ..... Water level before test ..87.23..
Depth of pump intake ..185.... Method of measuring discharge .....
..... Method of water level Electric dipper
Average discharge ..... LIM Specific conductivity ..7,000.
... . u/mhos/m3 Temperature ....°C.

CLOC TIME	TIME SINCE PUMP STARTED IN MINS	DEPTH TO WATER (M) (M)	DISC ARGE LPm	REMARKS
	00	87.23	-	Pump on
	01	96		
	02	102.3		
	03	109		
	04	115.3		
	05	120.6		
	06	125.8		
	07	131.13		
	08	135.3		
	09	140.59		
	10	144.63		
	12	147.21		1min 45 secs/20 Lit
	14	157.35		EC= 7400
	16	160.1		
	18	163.84		
	20	165.73		

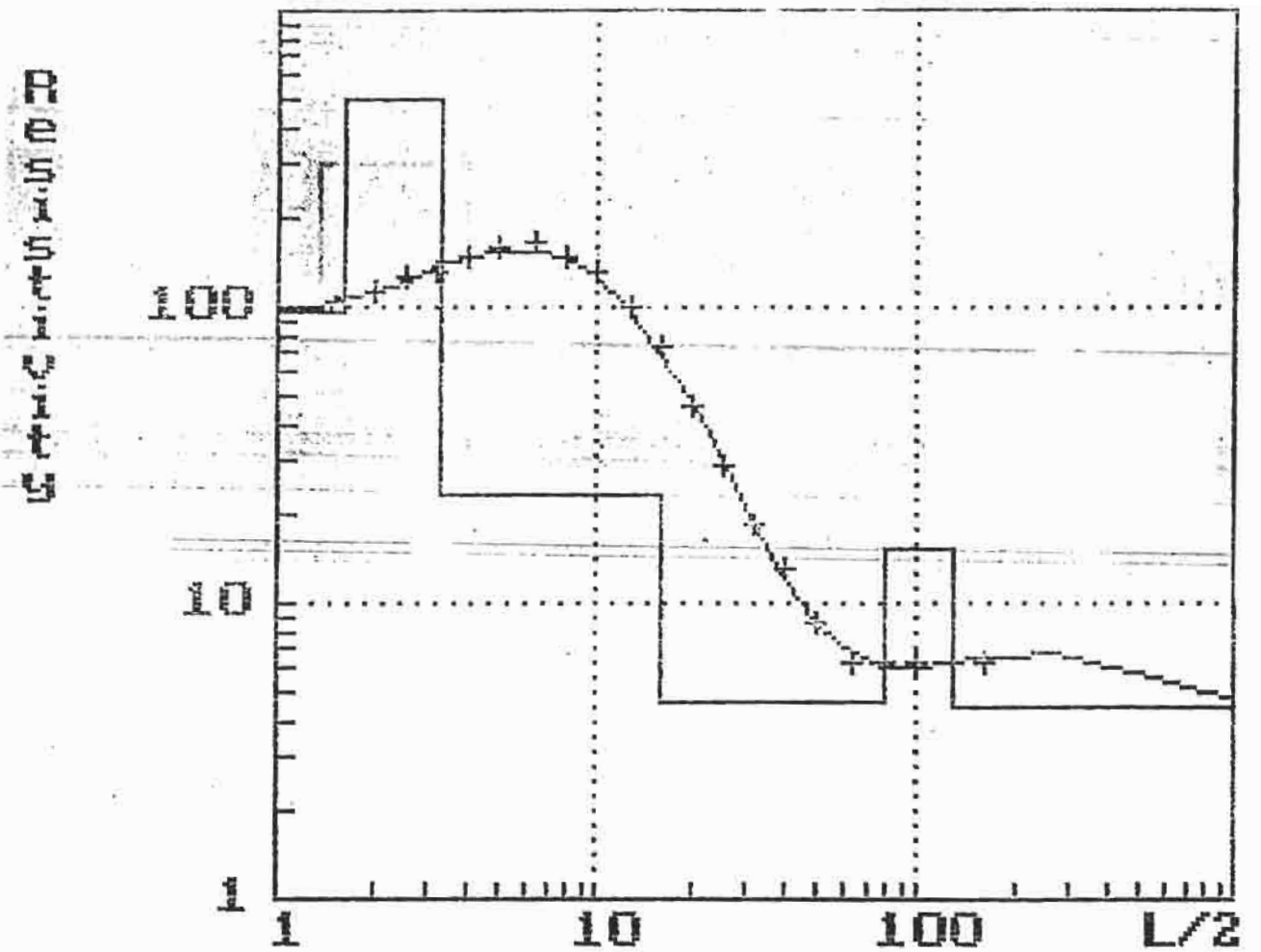
CLOCK TIME	TIME SINCE PUMP STARTED IN MINS	DEPTH TO WATER (M) (M)	DISCHARGE LPM	REMARKS
	25	167.38		
	30	168.27		
	35	168.70		
	40	168.80		
	45			
	50			
	55			
	(1 hr)60			
	70			
	80			
	90			
	100			
	(2 hrs)120			
	150			
	(3 hrs)180			
	210			
	(4hrs) 240			
	(5hrs) 300			
	(6hrs. 360			
	(7 hrs)420			
	(8hrs) 480			
	(9hrs) 540			
	(10hrs)600			
	(11hrs)660			
	(12hrs)720			
	(13hrs)780			
	(14hrs)840			

CLOCK TIME	TIME SINCE PUMP STARTED IN MINS	DEPTH TO WATER (M)	DISCHARGE l/s	REMARKS
	(15hrs) 900			
	(16hrs) 960			
	(17hrs) 1020			
	(18hrs) 1080			
	(20hrs) 1200			
	(22hrs) 1320			
	(24hrs) 1440			

RECOVERY TEST SHEET

Machai Double

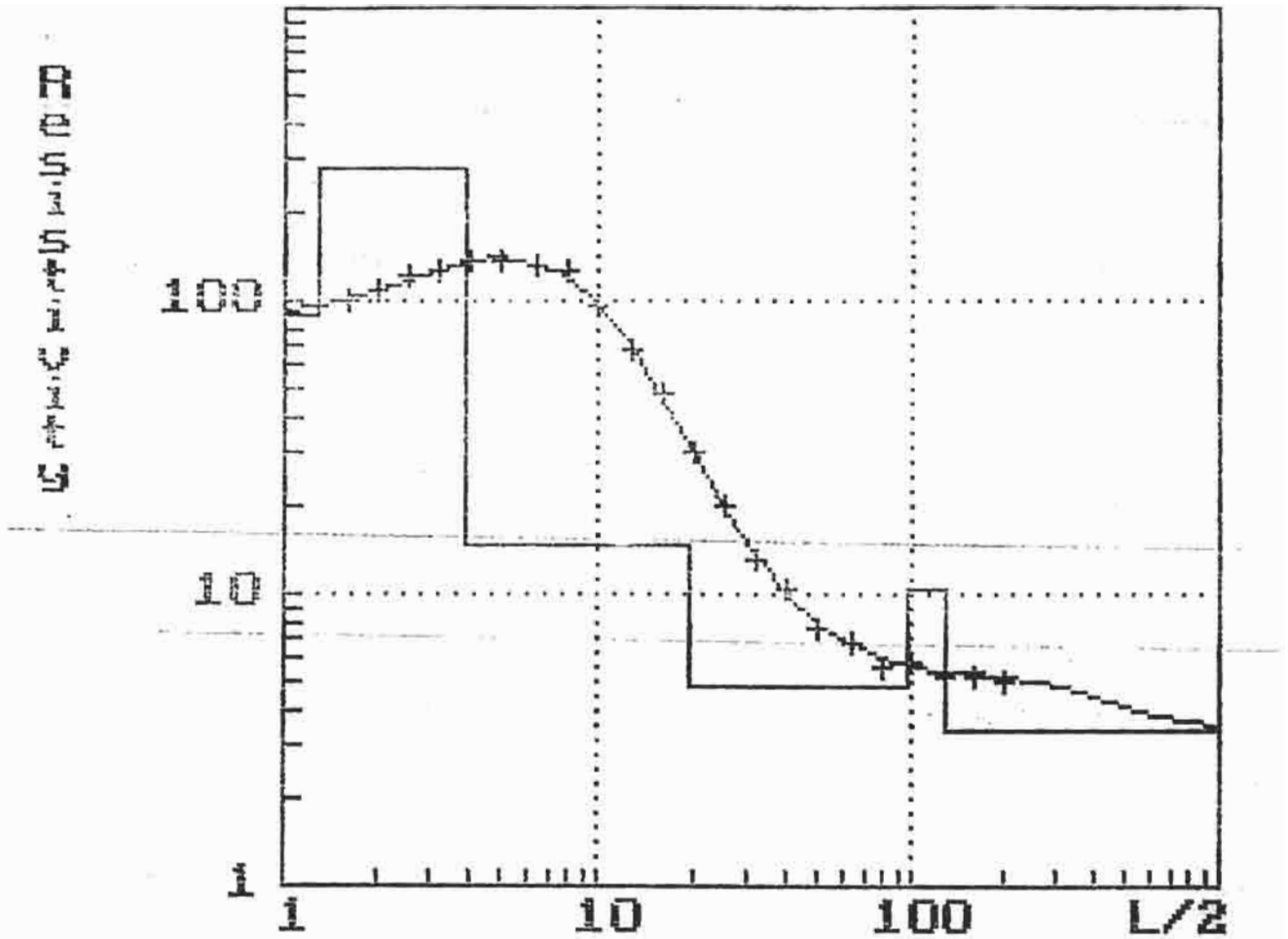
CLOCK TIME	TIME SINCE PUMP STOPPED. IN MINS.	DEPTH TO WATER	CLOCK TIME	TIME SINCE STOPPED IN MINS.	DEPTH TO WATER
	[illegible]			70	
				80	
	2	165		90	
	3	159.7		100	
	4	155.4		120	
	5	152.8		(2hrs) 120	
	6	152.03		150	→ Fast rise to capillary water
	7	152.1		(3hrs) 180	
	8	152.1		210	
	9			(4hrs) 240	
	10			(5hrs) 300	
	12			(6hrs) 360	
	14			(7hrs) 420	
	16			(8hrs) 480	
	18				
	20				
	25				
	30				
	35				
	40				
	45				
	50				
	55				
	(1hr) 60				



Project Name	ADRA-3		Disk RE-1
Location	Raga Elle		File RE-1
Coordinates			Data RE-1
Direction			Name SKN
Date	7-06-93		Date
Near old B/H			Schlumberger

L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)
1.6	107.4	8.0	148.0	40.0	12.9
2.0	112.5	10.0	131.5	50.0	8.6
2.5	126.0	13.0	100.1	63.0	6.4
3.2	130.3	16.0	73.2	80.0	6.2
4.0	146.0	20.0	45.6	100.0	6.2
5.0	155.6	25.0	29.3	130.0	6.2
6.3	162.2	32.0	18.8	160.0	6.2

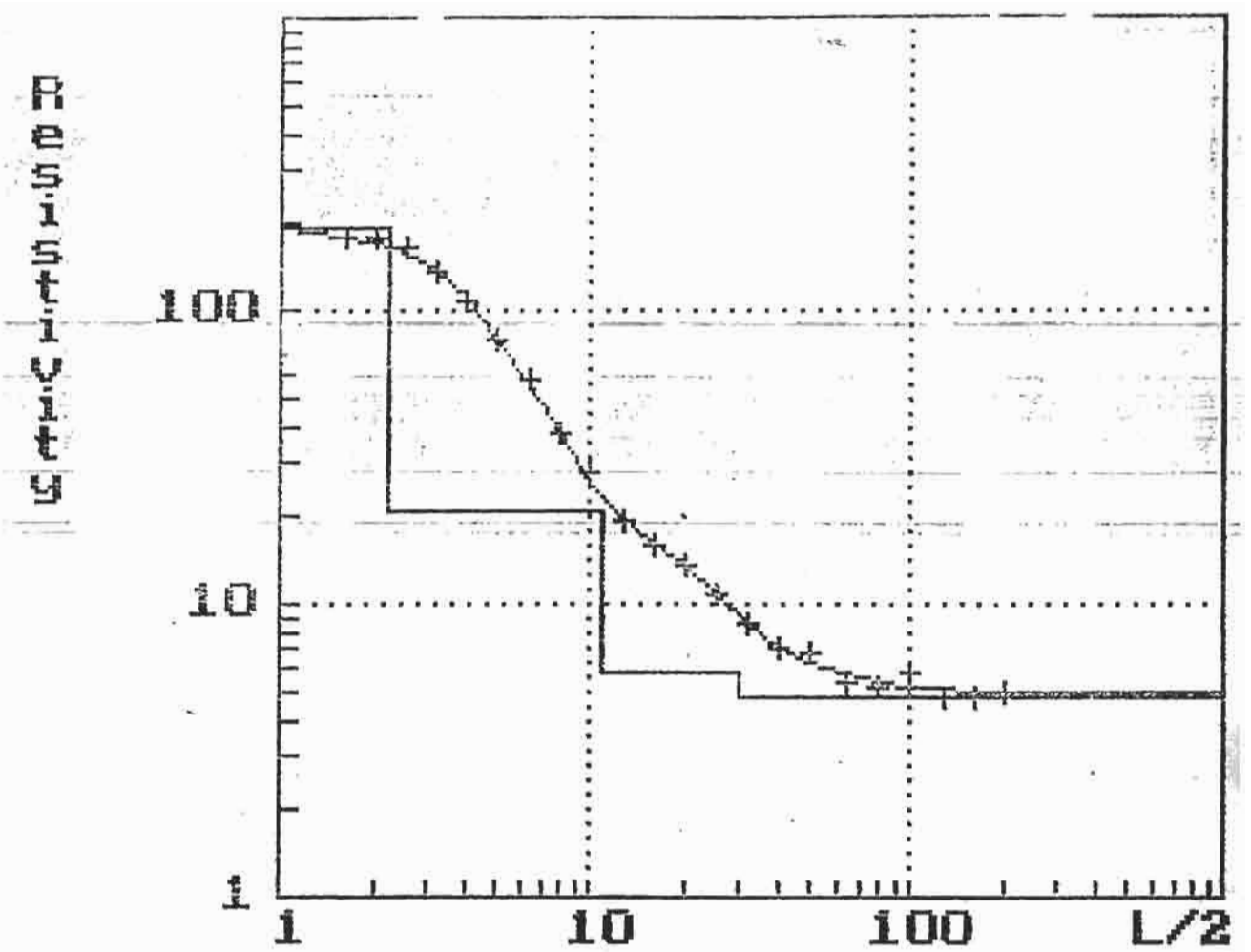
Resistivity (Ohm.m)	Depth (m)
95.0	1.6
500.0	3.3
23.6	16.4
4.7	79.0
15.0	130.0
4.4	



Project Name	ADRA-3		Disk RE-2
Location	Raga Elle		File RE-2
Coordinates			Data RE-2
Direction			Name SKN
Date	7-06-93		Date
			Schlumberger

L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)
1.6	101.8	12.0	97.7	63.0	5.8
2.0	109.6	16.0	67.9	80.0	5.6
2.5	119.2	16.0	48.6	100.0	5.8
3.2	126.9	20.0	30.6	130.0	5.3
4.0	134.2	25.0	19.6	160.0	5.2
5.0	136.3	32.0	12.9	200.0	5.1
6.3	132.9	40.0	10.5		
8.0	128.0	50.0	7.5		

Resistivity (Ohm.m)	Depth (m)
89.0	1.3
278.0	3.8
14.9	19.4
4.9	98.0
10.4	129.0
3.4	



Project Name	ADRA-3		Disk RE-3
Location	Raga Elle		File RE-3
Coordinates			Data RE-3
Direction			Name JNK
Date	7-06-93		Date
			Schlumberger

L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)	L/2 (m)	Rho (Ohm.m)
1.6	177.4	10.0	27.8	63.0	5.4
2.0	177.1	13.0	19.4	80.0	5.3
2.5	162.1	16.0	15.9	100.0	5.9
3.2	136.3	20.0	13.5	130.0	4.9
4.0	107.9	25.0	11.0	160.0	4.9
5.0	80.5	32.0	8.5	200.0	5.1
6.3	58.1	40.0	7.1		
8.0	38.9	50.0	6.7		

Resistivity (Ohm.m)	Depth (m)
207.0	0.3
189.0	2.2
20.5	10.9
5.9	30.0
4.9	