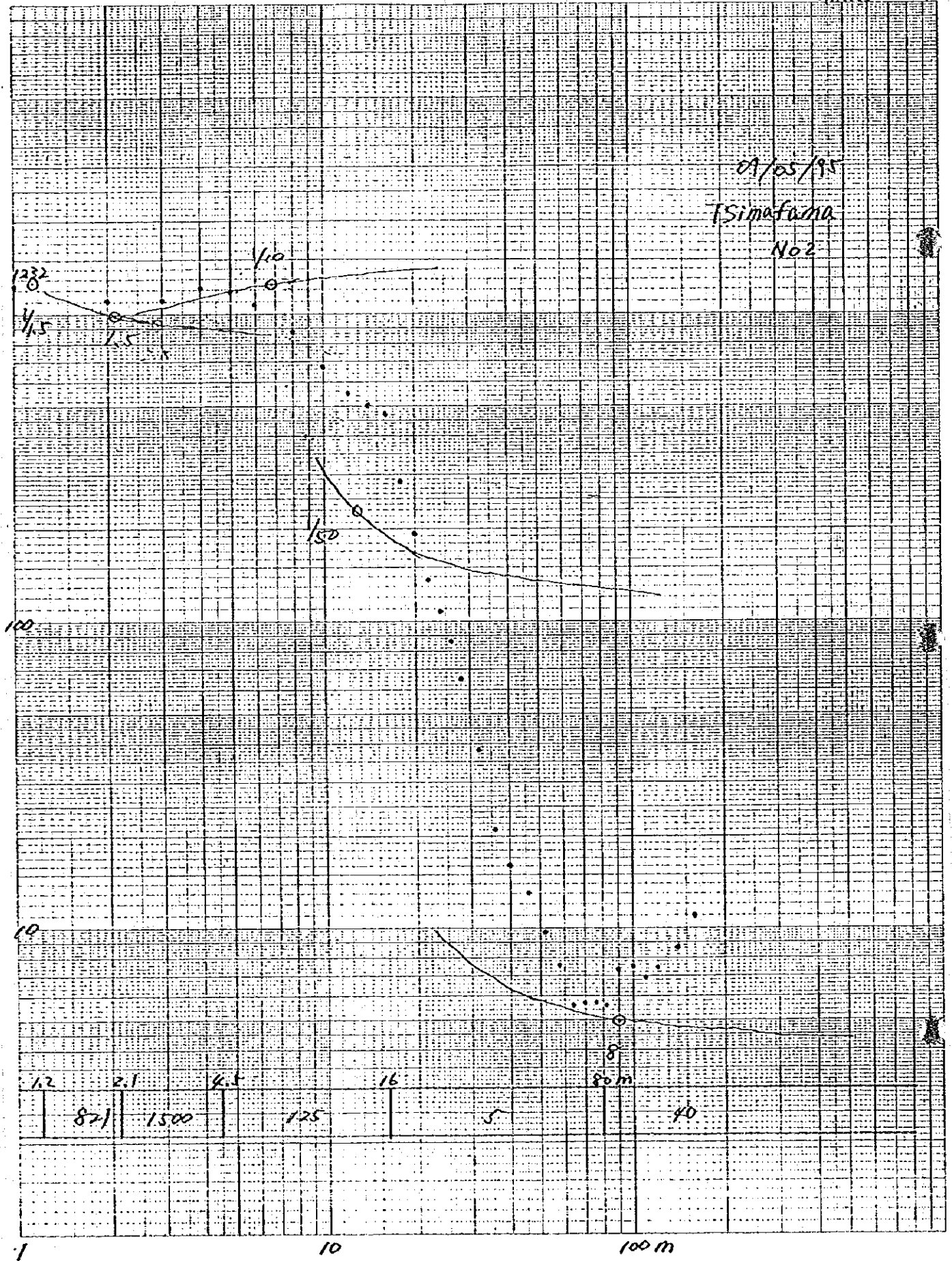


Timafama

MISS ON 圖式樣式 5

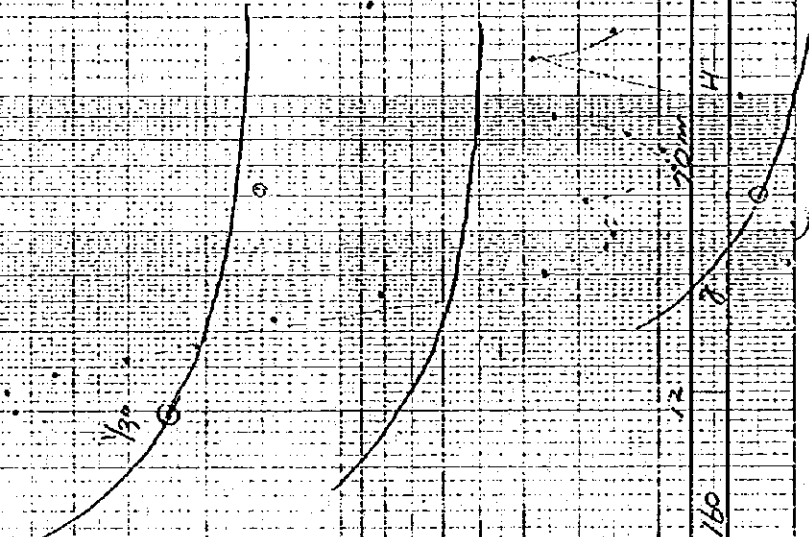
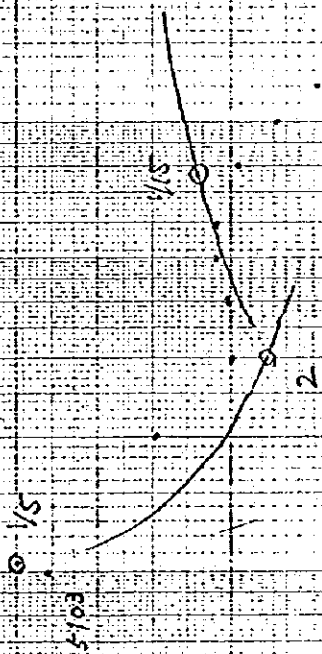
01/05/95

Timafama
No 2

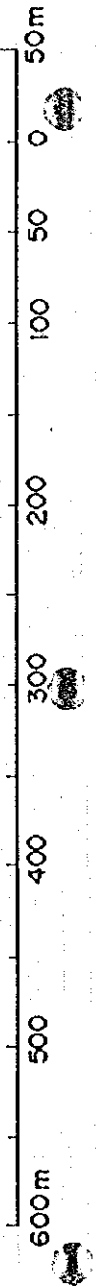
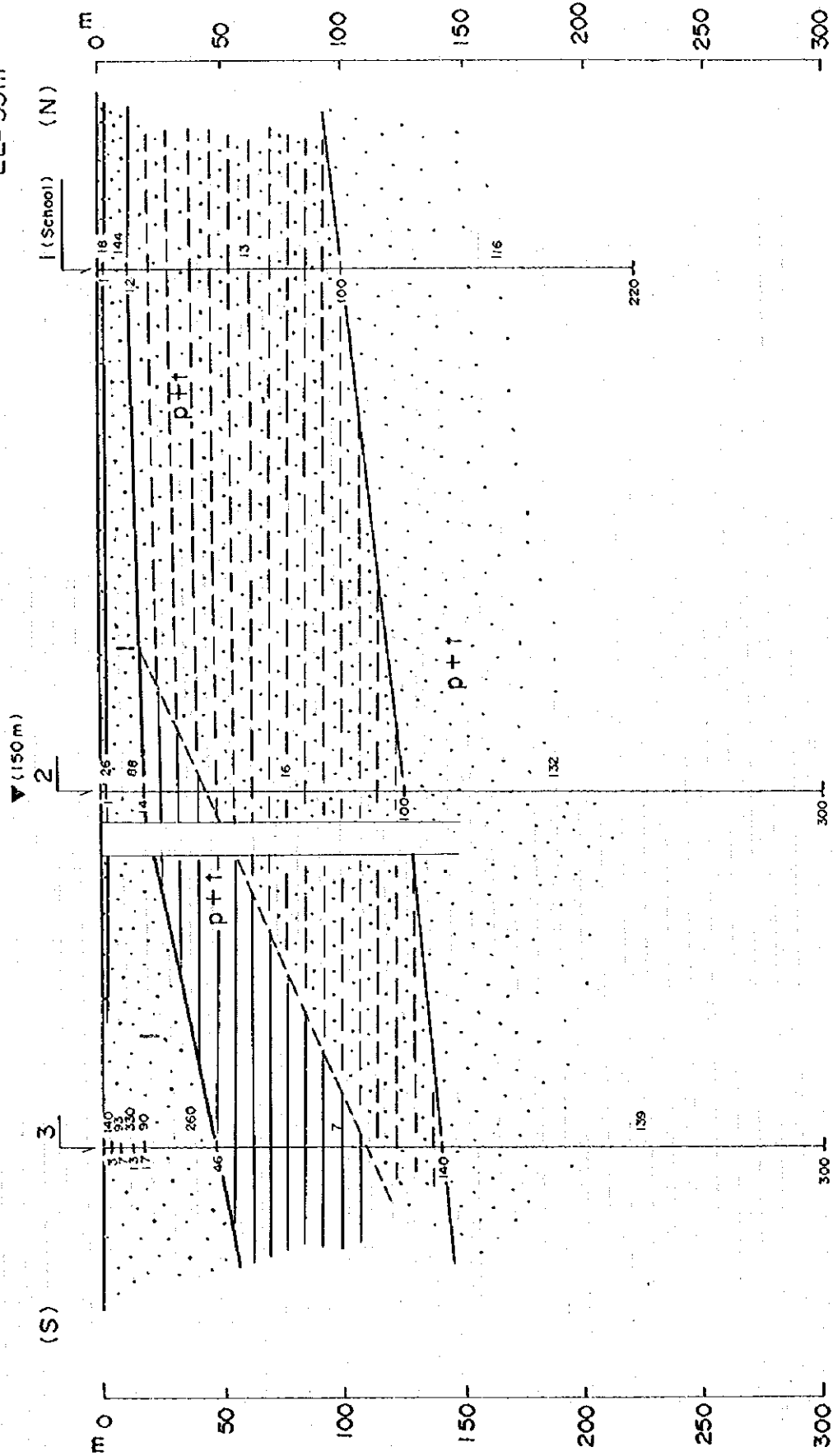


1 010 0 0 1 mm 50 001 0 0 1 1

09/05/84
Tsimafana
No-3



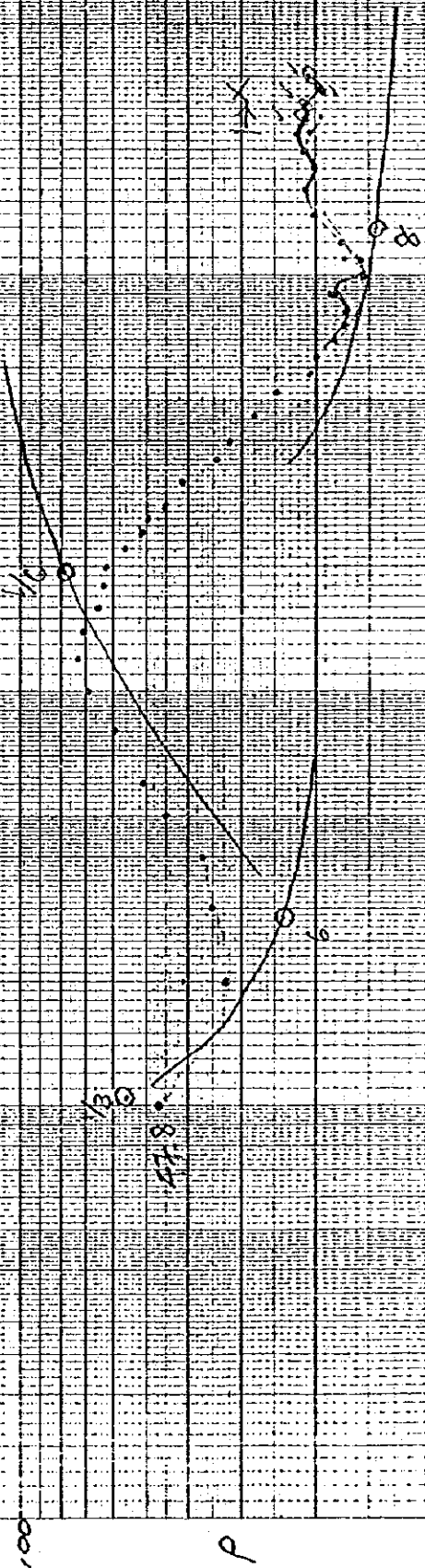
Ambatolahy (114)
EL= 95m



05/10/71

Ambulatory
No. 1

26.5m



25/05/90

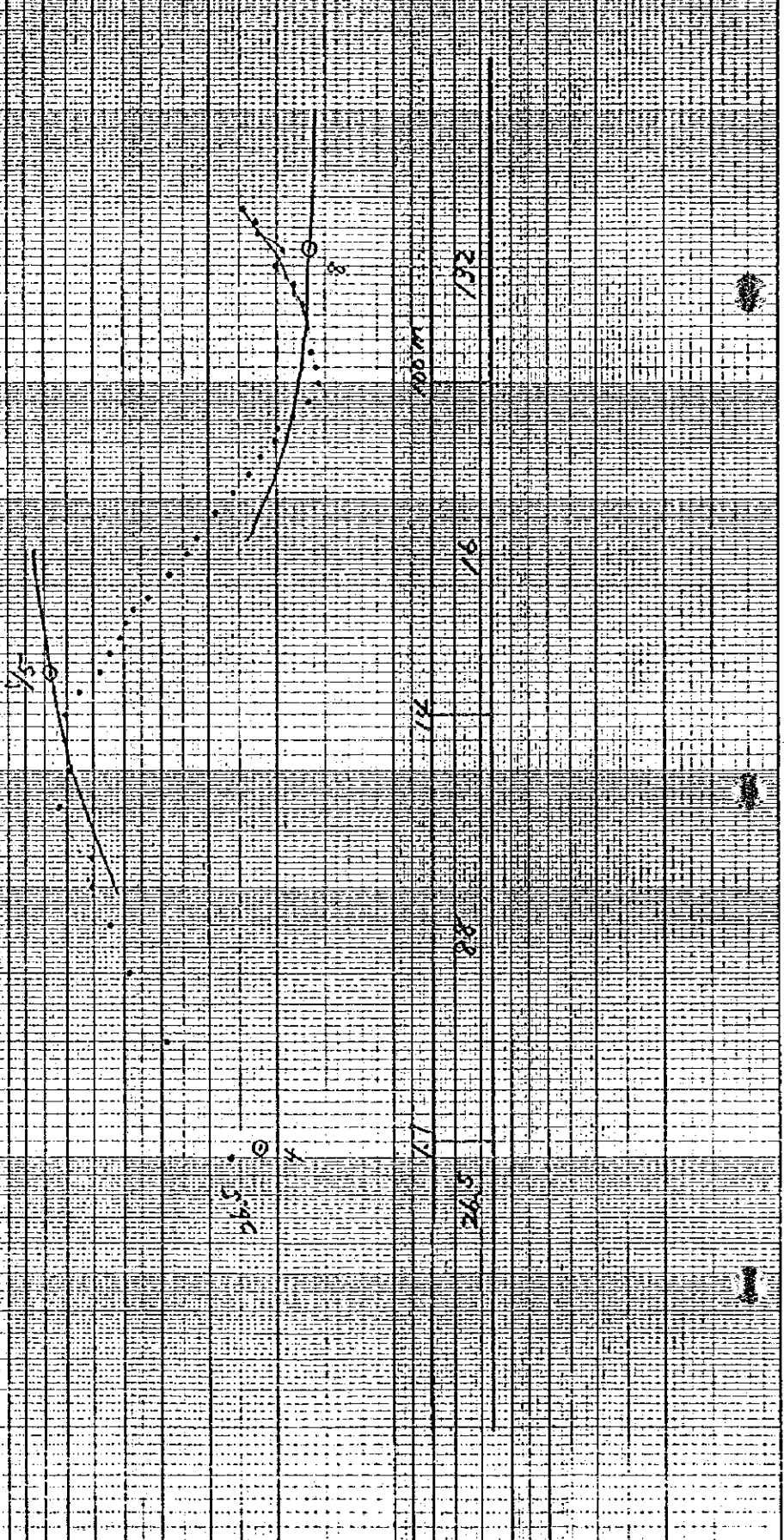
Ambratolony

No. 2

100

P

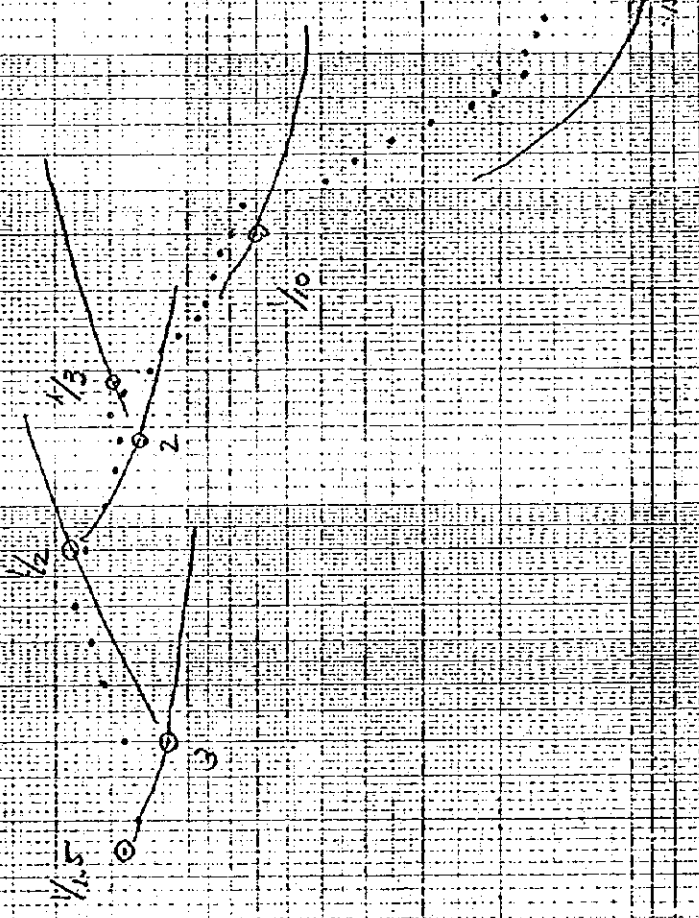
10



25/05/95

Ambatohy

No. 3



136

140	2.5	7	13	17	46	140 m
140	93	200	90	260	139	

100 m

10

P

El. 85-60 M
26/05/95
Ankotrofotsy
No. 1

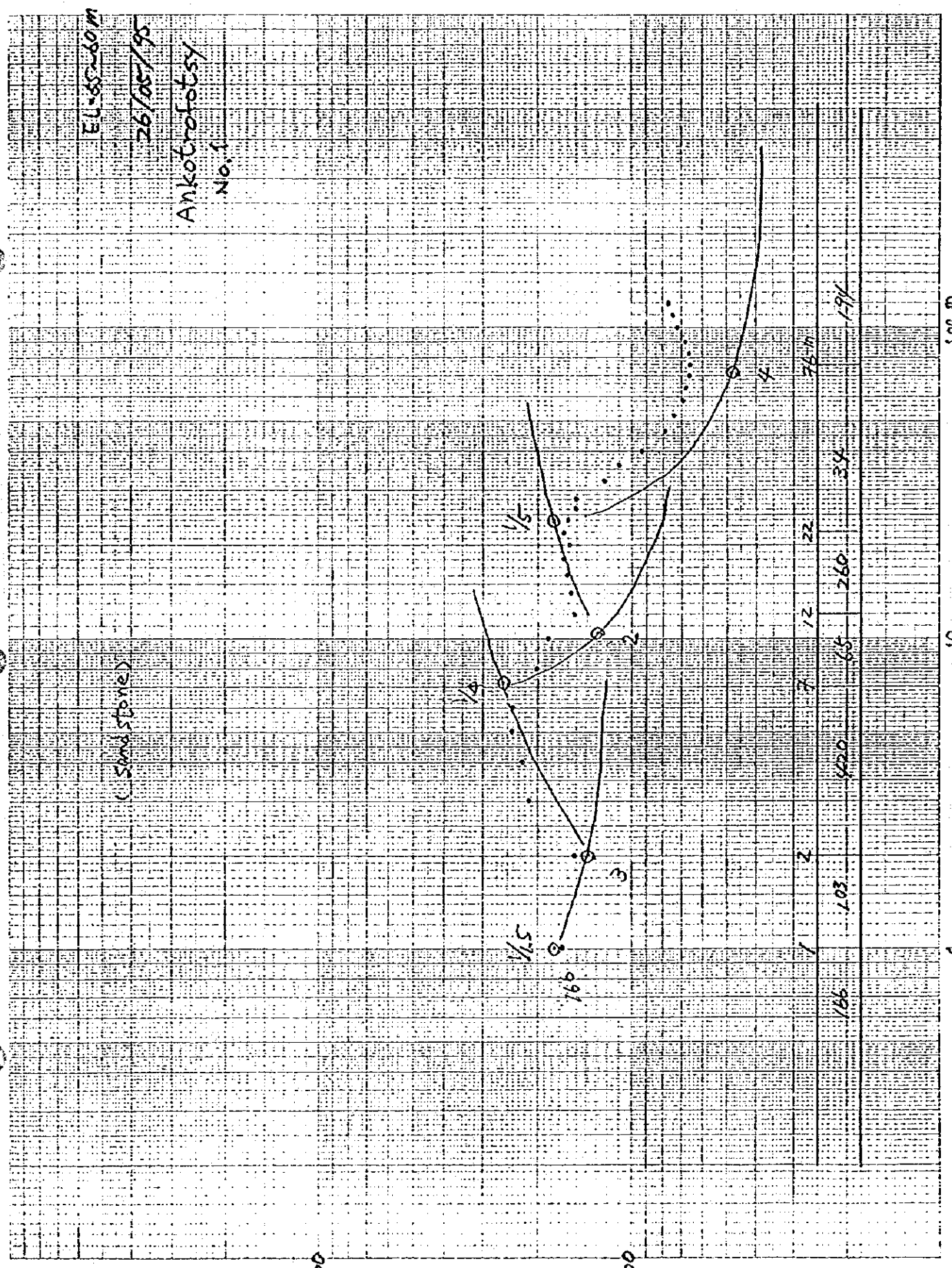
(Sandstone)

1000

P

-185-

100



10

100 M

Manamby

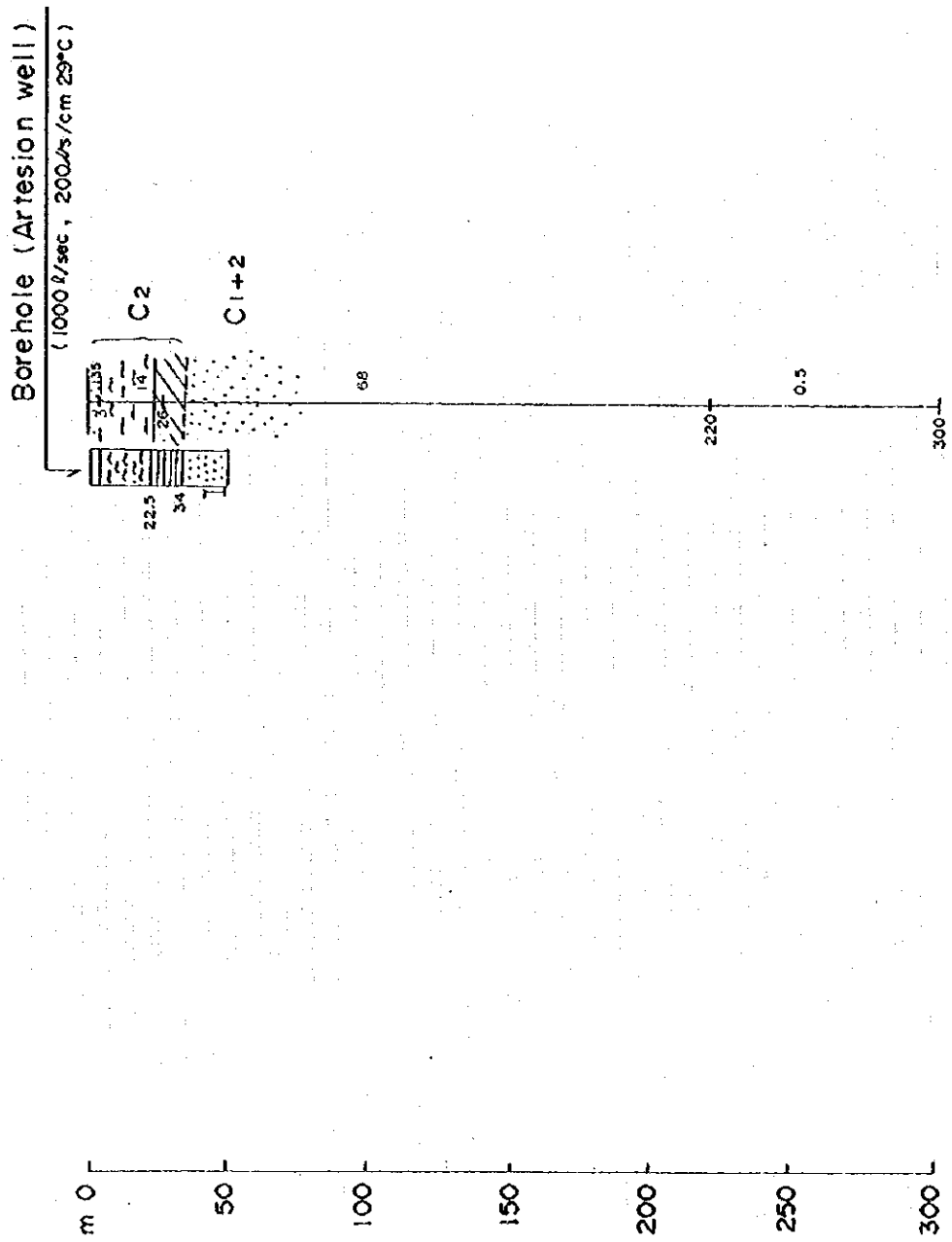
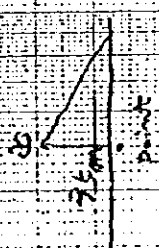


Fig. Lithological Section of Existing Borehole in Manamby

08/05/95
Artisan well

well depth (3)



110
1354

220 m

95

68

26

3

105

100

10 m

1



5. Method and Result of VLF E-M Survey

HOW WADI FINDS WATER

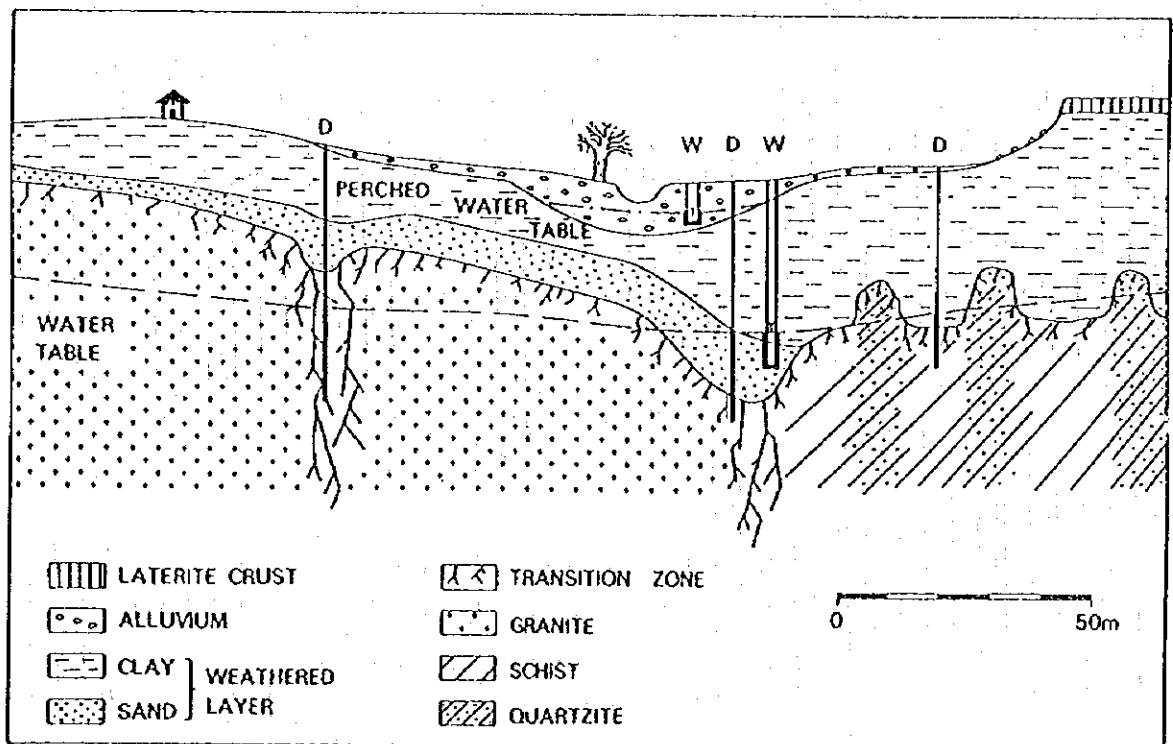
Good drinking water can be obtained from hard rock. But drilling without previous site investigation seldom yields water in useful quantities. Effective water development programs must include carefully conducted geological and geophysical investigations. WADI finds structures where useful quantities of underground water may be trapped in rock fractures and cavities, thus enabling drillers to select the most promising sites for their wells.

WADI combines state-of-the-art geophysics with ingenious simplicity. WADI results are

easy to understand and convincingly consistent. Unlike most geophysical instruments, WADI presents your answer on site without requiring complicated interpretation.

However, WADI simply finds physical structures. It cannot guarantee that they contain water (such structure might comprise an orebody for example). Nonetheless, the VLF principle on which WADI is based has an excellent track record when it comes to finding useful quantities of water in hard rock.

The fracture zones shown in this picture appear as electrical conductors in the bedrock. Such structures are ideal targets for WADI operators.



Schematic section of Precambrian geology and hydrogeological conditions in Burkina Faso. Perched water table sinks and rises depending on season. Economic aquifers are associated with fracture zones in granites and more easily weathered lithologies, such as schists, in the volcano-sedimentary sequences. Low-yielding shallow wells (W) are dug; productive wells in hard rock (D) must be drilled. (after Palacky, Ritsema, de Jong: Electromagnetic prospecting for groundwater in Precambrian terrains in the republic of Upper Volta, Geoph. Prospecting vol. 29, p. 932 - 955, 1981)

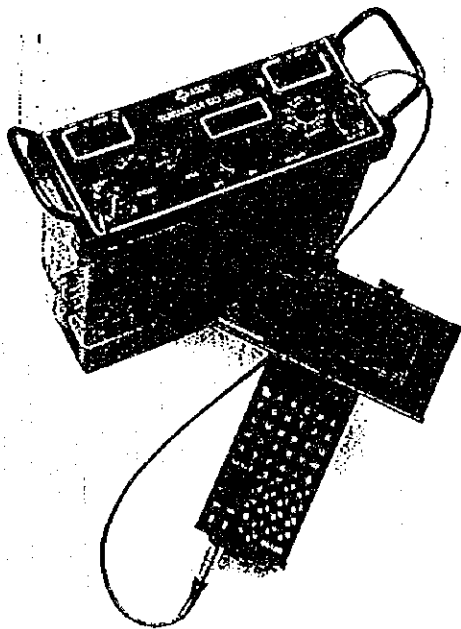
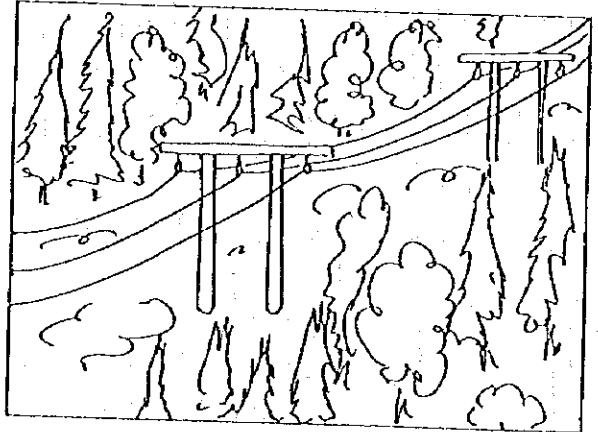
FINDS PIPES, CABLES AND OREBODIES

Blessing or nuisance?

Since WADI reacts to the high electrical conductivity of fracture zones in the rock, it also reacts to other types of high-conductivity anomalies such as electrical cables (underground or overhead), buried metallic pipes and certain types of orebodies.

Because of the many buried man-made objects, surveys conducted in urban areas are seldom successful. However, WADI can be used (under favourable conditions) to locate hard-to-find pipes and cables.

WADI is based on the well-known, time-tested VLF mineral prospecting method. It can be re-programmed (with a few simple key-strokes) to display the familiar in-phase and quadrature magnetic field tilt angle components used by most geophysicists for interpretation.



ABEM Terrameter SAS 300C with the Geomac III field computer / data logger.

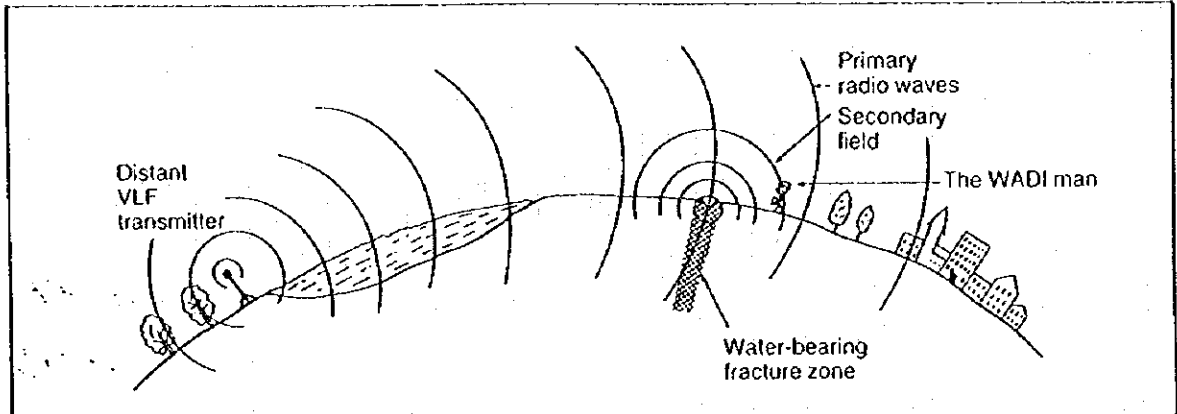
Where to be careful using WADI

There are certain areas where WADI or other VLF instruments cannot be expected to work well:

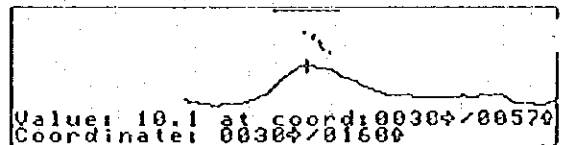
In areas having horizontal layers of soil and rocks and very few fracture systems (often encountered in young sedimentary rock). Here, water can be expected to form aquifer at a certain depth, and since you are interested primarily in determining the depth to the water and the thickness of the water-bearing layer, you should use ABEM TERRAMETER SAS 300 which is based on the resistivity method.

If the topsoil is electrically conductive, it will be difficult to obtain information from structures in the rock below. Such areas are moist (sometimes even saline) or covered by clays and saltplanes. Here too, ABEM TERRAMETER SAS 300 (see illustration) is preferable.

THE VLF PRINCIPLE



WADI utilizes the magnetic components of the electromagnetic field generated by long-distance radio transmitters in the VLF (Very Low Frequency) band. These transmitters are used for long-distance communication (see map), and they operate at 10-30 kHz. Conductive structures on the surface or underground, even when covered with thick overburden, affect locally the direction and strength of the field generated by the transmitted radio signal. WADI measures the radio signal distortion and presents the result directly on a display screen.



When the surveyor passes over a conductive structure, WADI displays a peak on a normally straight line. By pressing a key, WADI will indicate the depth to the conductive zone and its dip.

VLF stations that can be used with WADI include:

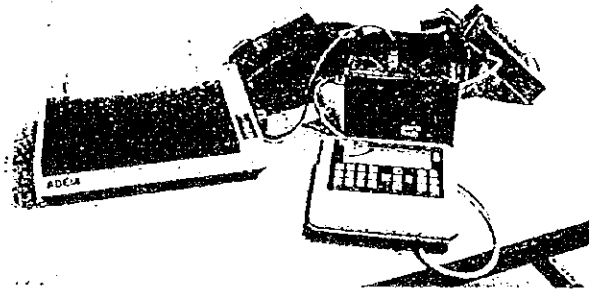
	Frequency (kHz)	Power (kW)		
Bordeaux, France (FUO)	15.1	500	Annapolis, USA (NSS)	21.4 400
Rugby, Great Britain (GBR)	16.0	750	Northwest Cape, Australia (NWC)	22.3 1000
Hegeland, Norway (JXZ)	16.4	350	Burlage, Germany (DHO)	23.4
Gorkl, CIS (ROR)	17.0	315	Laulualei, Hawaii, USA (NPM)	23.4 600
Moscow, CIS (UMS)	17.1	1000	Cutler, Maine, USA (NAA)	24.0 1000
Yosamal, Japan (NDT)	17.4	500	Seattle, Washington, USA (NLK)	24.8 125
Murmansk, CIS (UPP)	18.1		Aguada, Puerto Rico (NAU)	28.5 100
Oxford, Great Britain (GBZ)	19.6	550		



WADI tunes in automatically on the most suitable transmitter located roughly perpendicular to your survey line. You will see the frequency on the display. If a local transmitter (not listed above) is in operation, WADI tunes in on it if it is suitably located. It's also possible to set WADI to a specific frequency from the keyboard. In the case where no suitable transmitter can be heard, Geonics portable VLF transmitter TX-27, operating at 18.6 kHz, can be supplied.

OUTPUT, PRINT-OUT AND COMMUNICATION

There are three output options. The screen content or the entire curve can be sent to a dot matrix printer with serial interface; the data can also be sent to a computer.



- PRINT F0 - Prints out the screen content
- PRINT F1 - Prints out the full curve with coordinates
- SEND DATA F2 - Sends data to a computer

THE SECTOR SOFTWARE

ABEM SECTOR is a MS-DOS oriented program that greatly enhances the performance of WADI.

SECTOR has all these features:

Transfer data

From the memory of WADI to your PC, PC/XT, PC/AT, PS/2, laptop, notebook or compatible computer

Create library

For convenient data handling and storage

Plot original data

Gives a plot of measured real and imaginary components

Plot filtered data

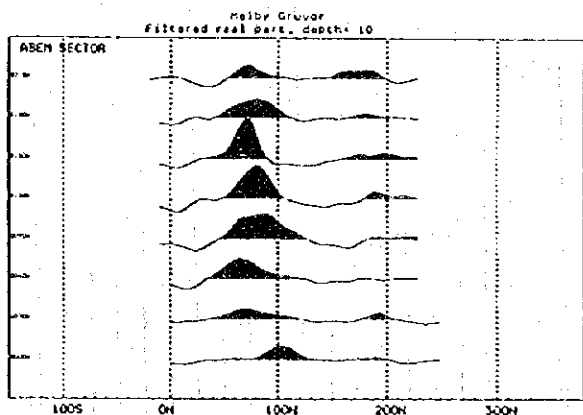
This mode gives a plot of the filtered real and imaginary WADI display curves

Multi-profile plot

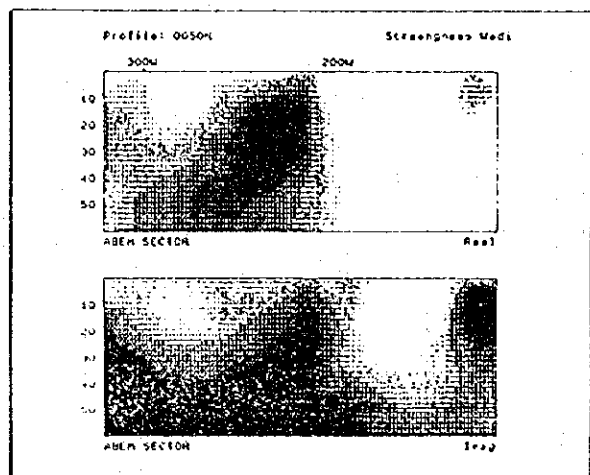
This option gives an overview of all measured profiles and helps determine strike and extent of the structures.

Vertical cross section

By plotting the equivalent current density versus depth along the profile, you will get an impressive picture of the approximate shape of underground conductors.



Multi-profile plot showing two parallel structures



Vertical cross section. Main feature is a fault zone, dipping west. The anomaly at coordinate 130W is caused by a shallow water pipe.

Filtered real part, depth= 10

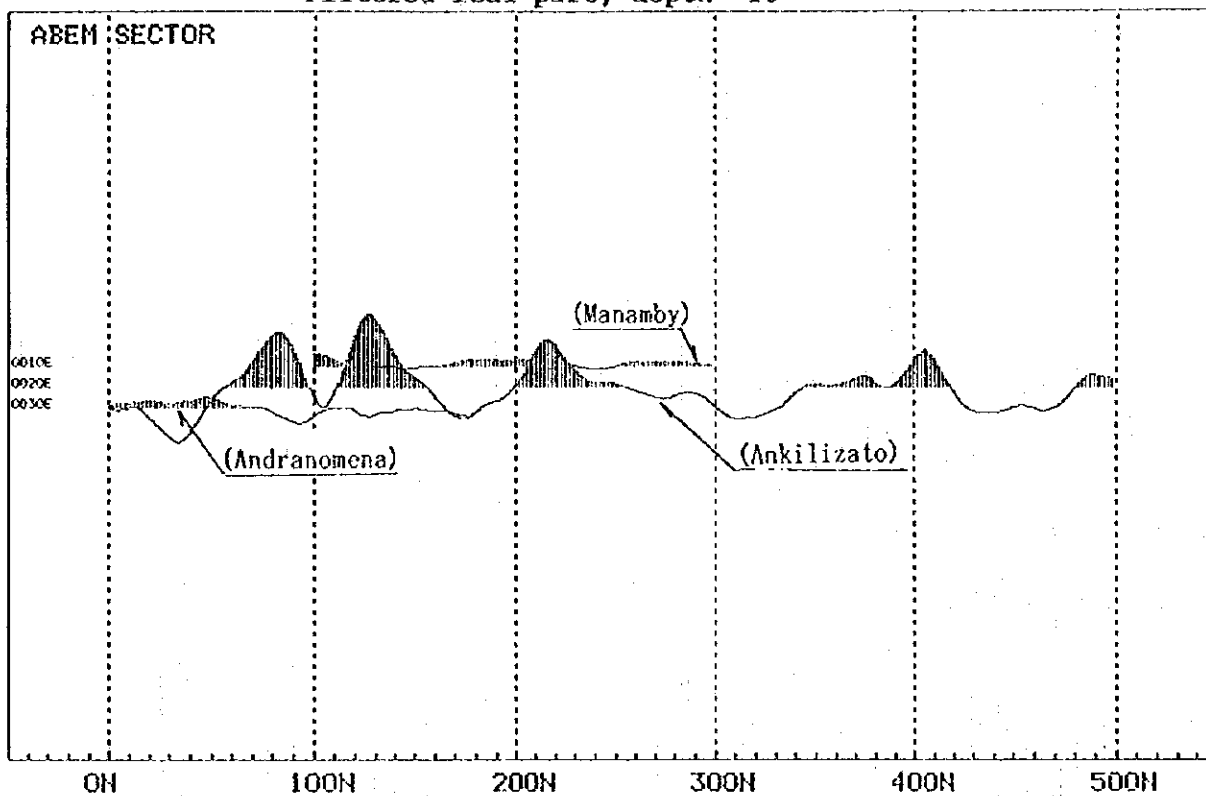


Fig. Result of WADI VLF Magneto-telluric survey

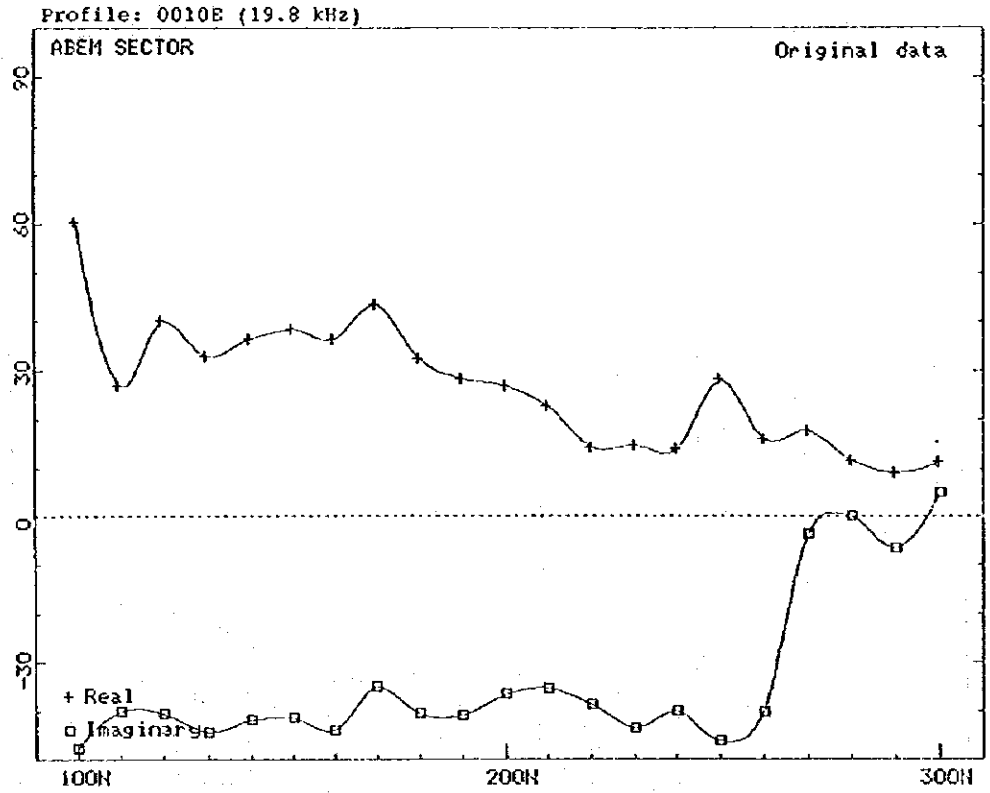


Fig. Result of WADI VLF Magneto-telluric survey(Manamby)

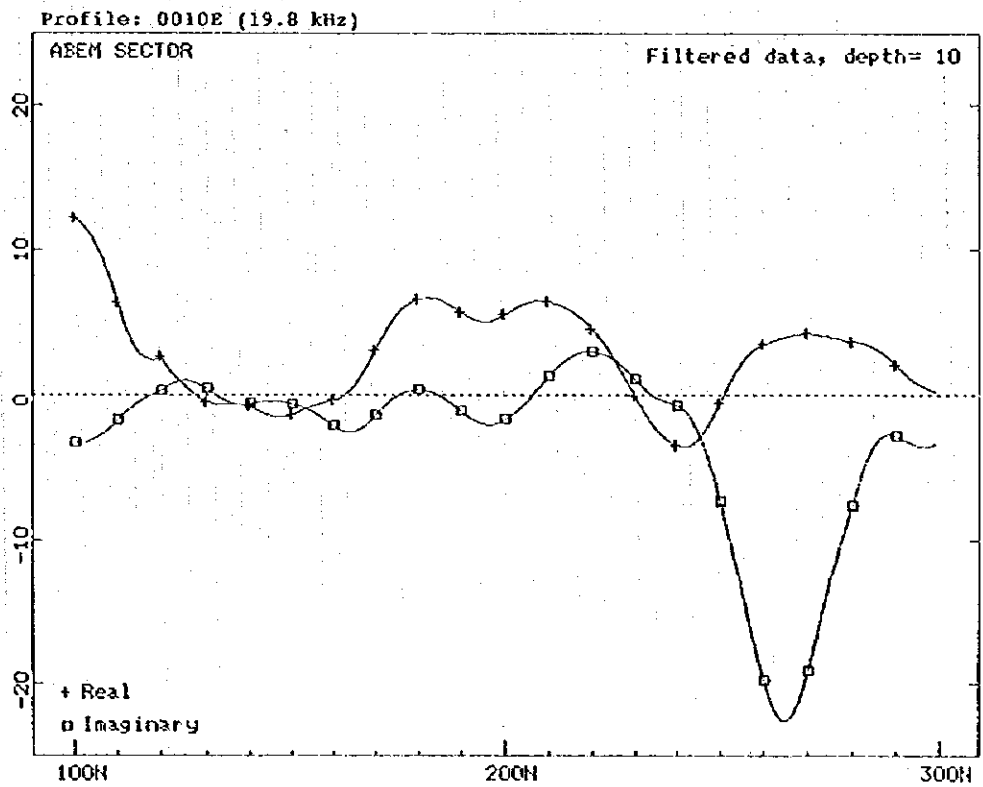


Fig. Result of WADI VLF Magneto-telluric survey(Manamby)

Profile: 0010E

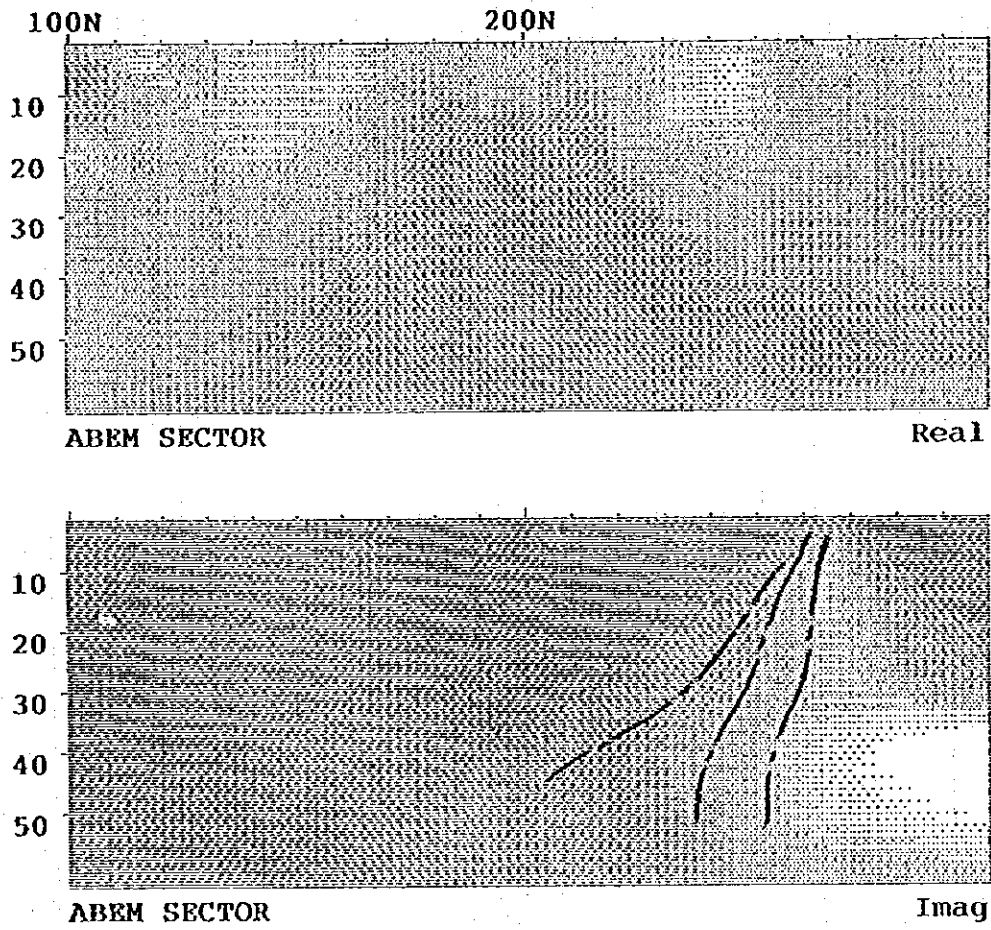


Fig. Vertical cross section from data in WADI-VLF (Manamby)

Profile: 0020E (28.7 kHz)

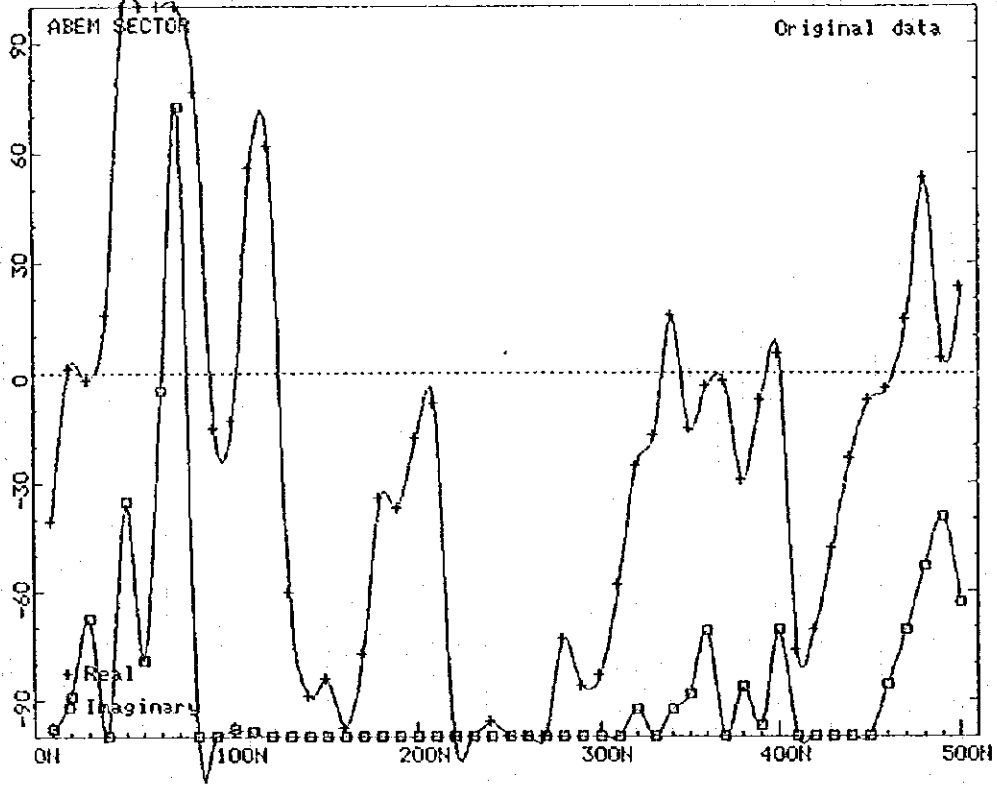


Fig. Result of WADI VLF Magneto-telluric survey(Ankilizato)

Profile: 0020E (28.7 kHz)

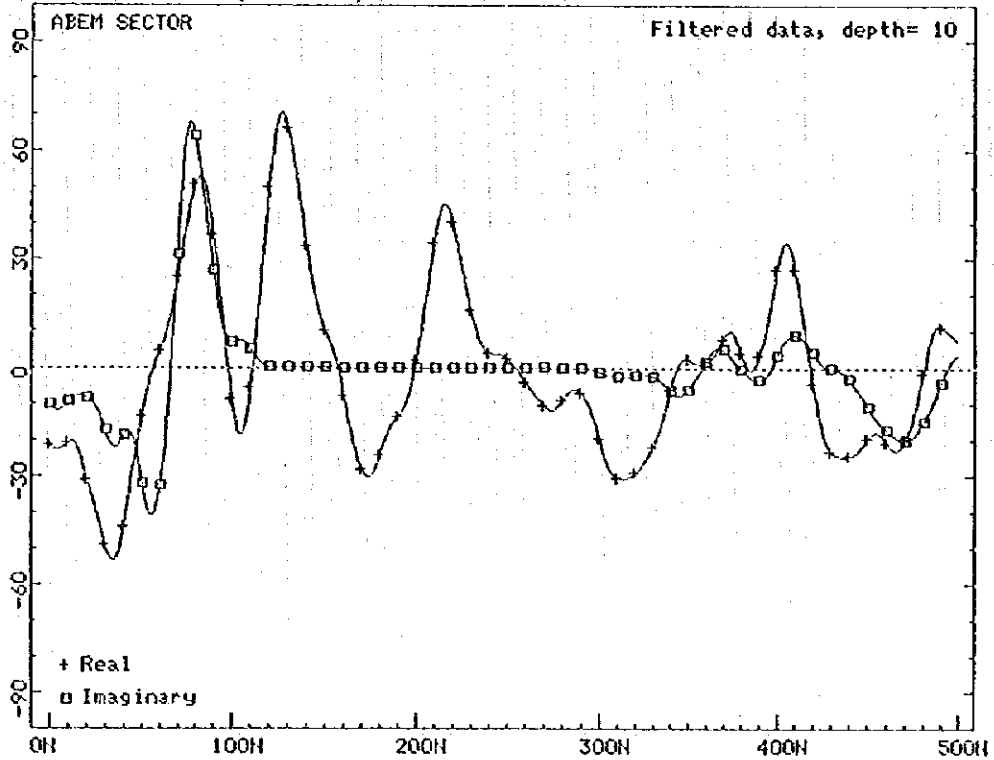


Fig. Result of WADI VLF Magneto-telluric survey(Ankilizato)

Profile: 0020E

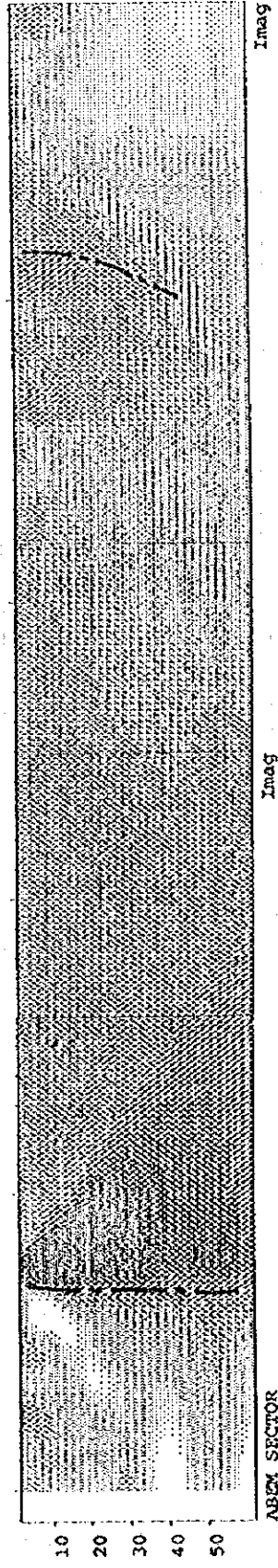
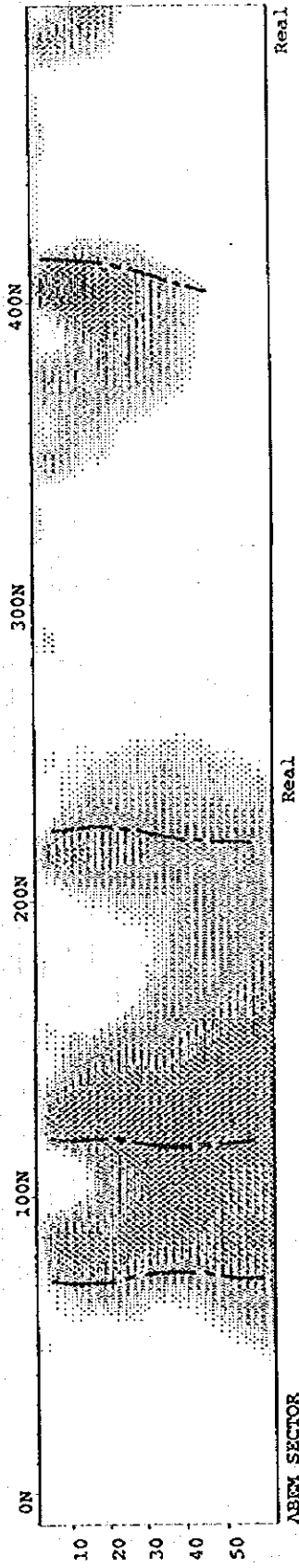


Fig. Vertical cross section from data in WADI-VLF (Ankilizato)

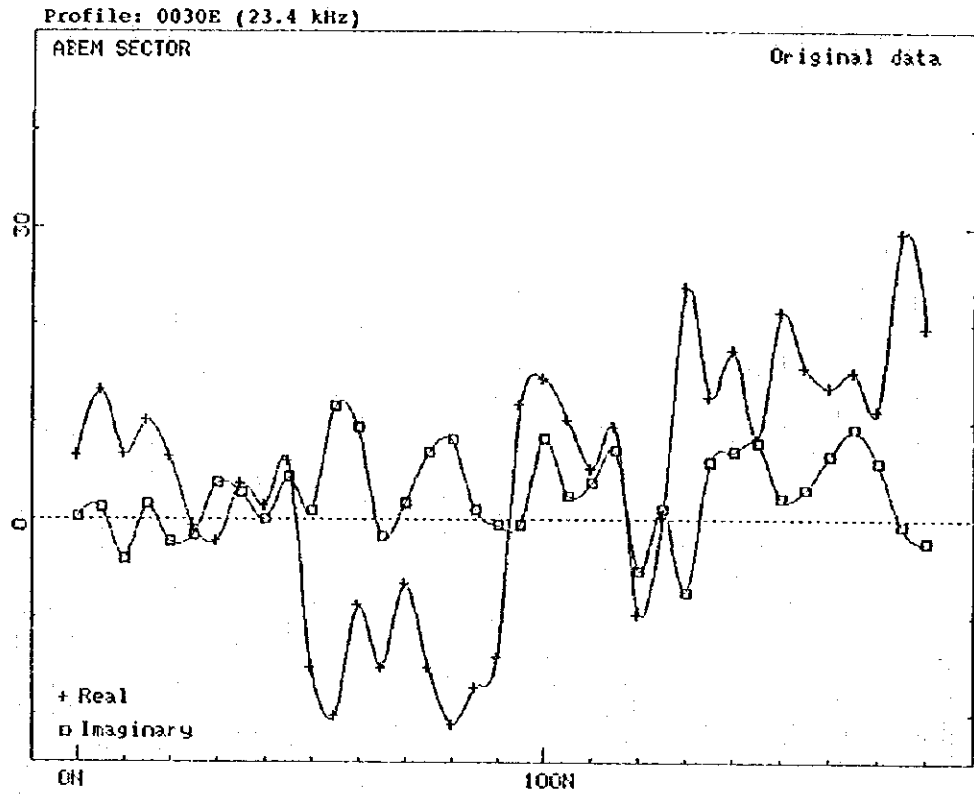


Fig. Result of WADI VLF Magneto-telluric survey(Andranomena)

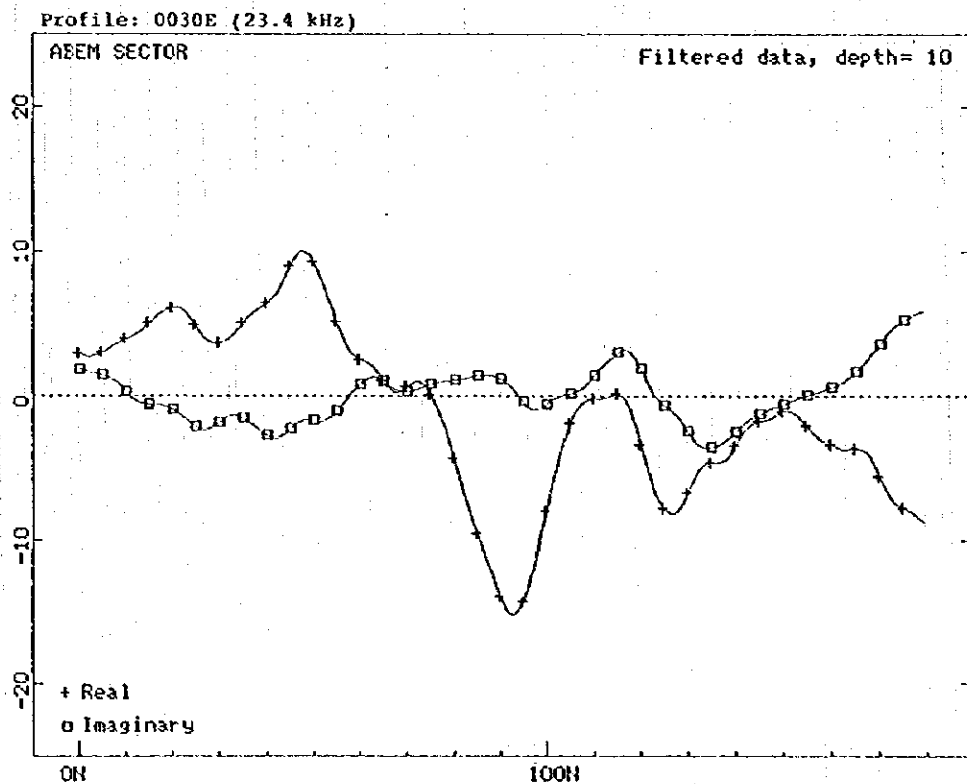


Fig. Result of WADI VLF Magneto-telluric survey(Andranomena)

Profile: 0030E

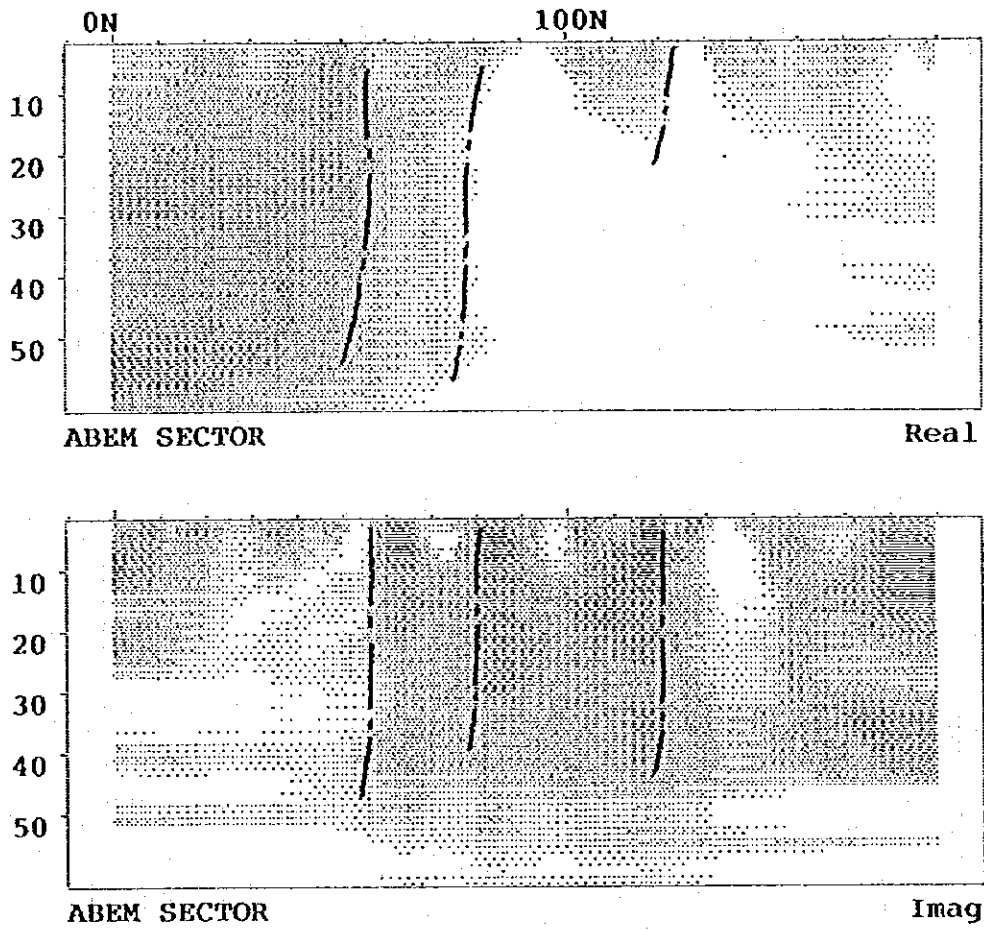
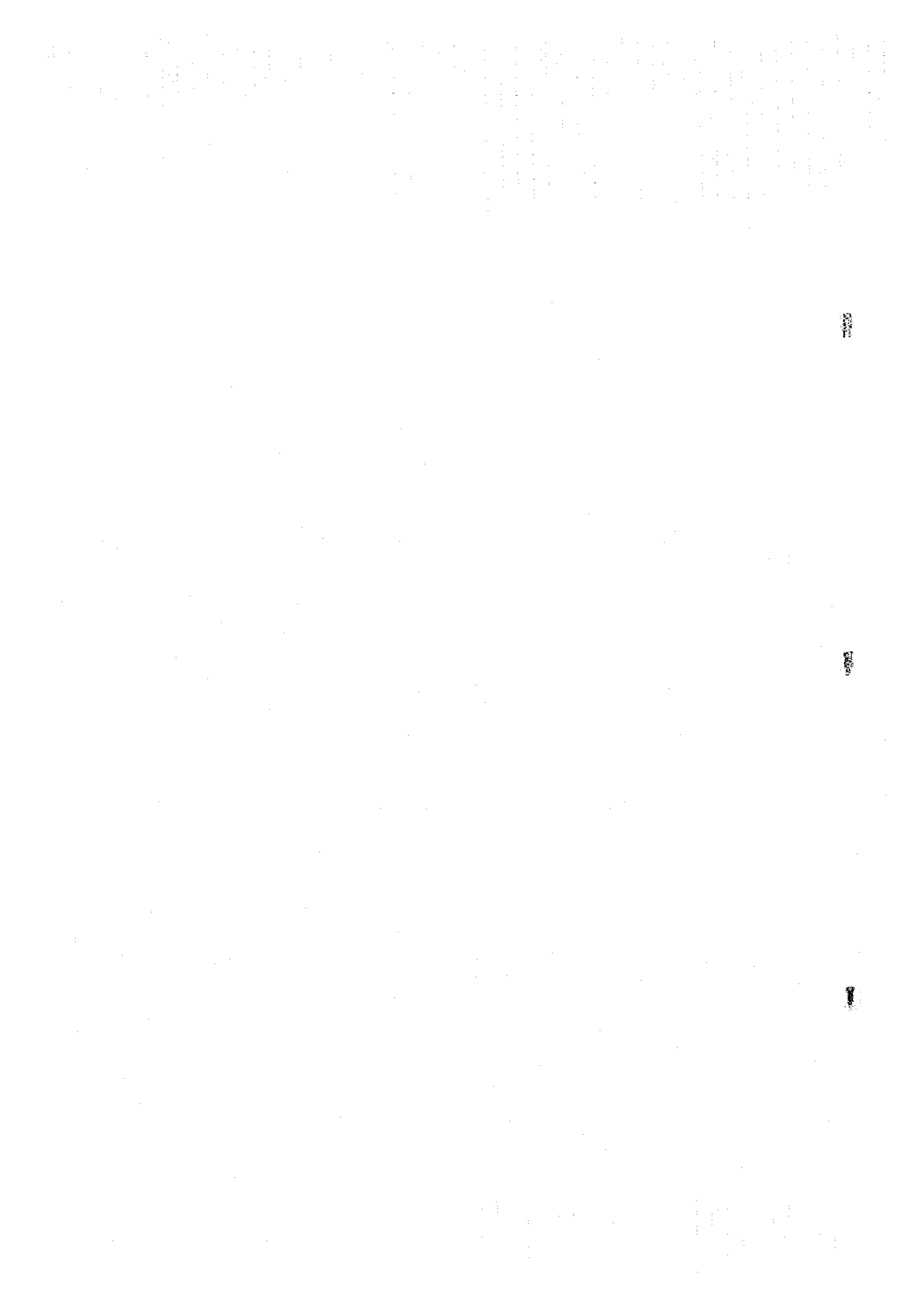


Fig. Vertical cross section from data in WADI-VLF (Andranomena)



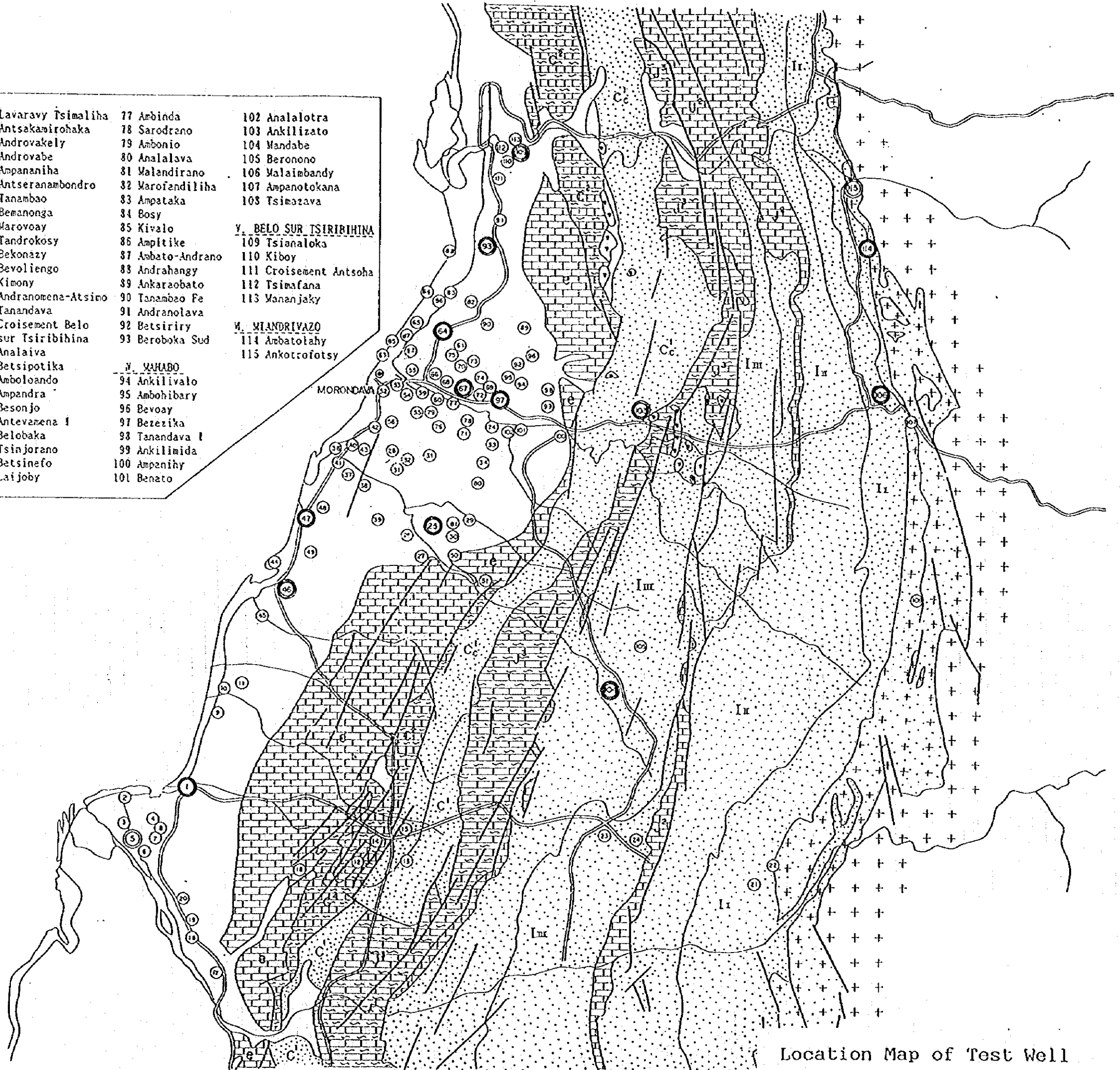
6. Well Logs and Pumping Test Results (Test Well Construction)

I. MANJA		II. WORONDAVA		51 Lavaravy Tsimaliha	77 Ambinda	102 Analalotra
1 Andranopasy I	25 Befasy	26 Antevamena	52 Antsakamirohaka	78 Sarodrano	103 Ankilizato	104 Mandaba
2 Andranopasy I	27 Mitsitiky	28 Andranovorisosotra	53 Androvakely	79 Ambonio	105 Beronono	106 Malaimbandy
3 Antaly	29 Ankitatamahavelo	29 Ankitatamahavelo	54 Androvabe	80 Analalava	107 Ampanotokana	108 Tsimazava
4 Darika	30 Bekininy Soarano	30 Bekininy Soarano	55 Ampananiha	81 Malandirano		
5 Befamanty	31 Beleo	31 Beleo	56 Antseranambondro	82 Marofandiliha		
6 Ambatobe	32 Anadabo	32 Anadabo	57 Tanambao	83 Ampataka		
7 Nositonga	33 Misokotsa	33 Misokotsa	58 Bemanonga	84 Bosy		
8 Nosibe	34 Croisement Besetroka	34 Croisement Besetroka	59 Marovoay	85 Kivalo		
9 Ankoba	35 Amanga	35 Amanga	60 Tandrokosy	86 Ampitike	Y. BELO SUR TSIRIBIHINA	
10 Antseranandaka-Nord	36 Namakia	36 Namakia	61 Bekonazy	87 Ambato-Andrano	109 Tsianaloka	
11 Tzarmandroso	37 Voloe	37 Voloe	62 Bevoliengo	88 Andrahangy	110 Kiboy	
12 Songary	38 Benasy	38 Benasy	63 Kimony	89 Ankarabato	111 Croisement Antsoha	
13 Piste de Bedo	39 Antsamake	39 Antsamake	64 Andranomena-Atsimo	90 Tanambo Fe	112 Tsimafana	
14 Tanambahiny	40 Manomentinay	40 Manomentinay	65 Tanandava	91 Andranolava	113 Mananjaky	
15 Miary	41 Faratny	41 Faratny	66 Croisement Belo sur Tsiribihina	92 Betsiriry		
16 Ambivy I	42 Ianadabo	42 Ianadabo	67 Analaiva	93 Beroboka Sud	W. MIANDRIVAZO	
17 Ambivy I	43 Andrananja	43 Andrananja	68 Betsipotika		114 Ambatolahy	
18 Ambahia	44 Belo sur Mer	44 Belo sur Mer	69 Amboloando	V. MAHABO	115 Ankotrofotsy	
19 Besatrohaka	45 Ankilifolo	45 Ankilifolo	70 Ampandra	94 Ankilivalo		
20 Marolafika	46 Marofihitsa	46 Marofihitsa	71 Besonjo	95 Ambohibary		
	47 Ambararata	47 Ambararata	72 Antevamena I	96 Bevoay		
I. BEROROHIA	48 Ankevo	48 Ankevo	73 Belobaka	97 Bezezika		
21 Ambalavato Nord	49 Ambivy	49 Ambivy	74 Tsinjorano	98 Tanandava I		
22 Andranomena	50 Bevantaza	50 Bevantaza	75 Betsinefo	99 Ankilimida		
23 Marerano			76 Laijoby	100 Ampanihy		
24 Ambondrobe				101 Benato		

Result of Electrical Prospecting

Village No	Name	Village No	Name
1	Andranopasy-1	64	Andranomena
3	Antaly	67	Analaiva
4	Darika	68	Betsipotika
5	Befamanty	70	Ampandra
6	Ambatobe	72	Antevamena
8	Nosibe	74	Tsinjorano
15	Miary	80	Analalava
16	Ambivy	82	Marofandilia
17	Ambivy-2	83	Ampataka
18	Ambahia	93	Beroboka Atm.
19	Besatrohaka	94	Ankilivalo
20	Marolafika	97	Bezezika
23	Marerano	99	Ankilimida
25	Befasy	103	Ankilizato
33	Misokotsa	104	Mandaba
40	Manomentinay	106	Malaimbandy
41	Faratenina	107	Ampanotoka
46	Marofihitsa	109	Tsianaloka
47	Ambararata	110	Kiboy
48	Ankevo	112	Tsimafana
52	Antsakamirohaka	114	Ambatolahy
53	Androvakery	115	Ankotrofotsy
58	Bemanonga		
59	Marovoay		

Total 46 Village



Well Log and Corelation with Resistivity Section

	Well Log	Pumping Test
Andranopasy	6 - 2	6 - 31
Befasy	6 - 4	6 - 34
Marofihitsa	6 - 6	6 - 39
Ambararata	6 - 9	6 - 43
Andranomena	6 - 11	6 - 46
Analaiva	6 - 13	6 - 48
Beroboka Sud	6 - 15	6 - 51
Bezezika	6 - 17	6 - 55
Anlilizato	6 - 19	6 - 60
Mandabe	6 - 21	6 - 67
Malaimbandy	6 - 23	—
Tsianaloka	6 - 26	6 - 74
Ambatolahy	6 - 29	6 - 77

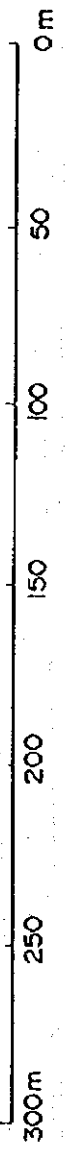
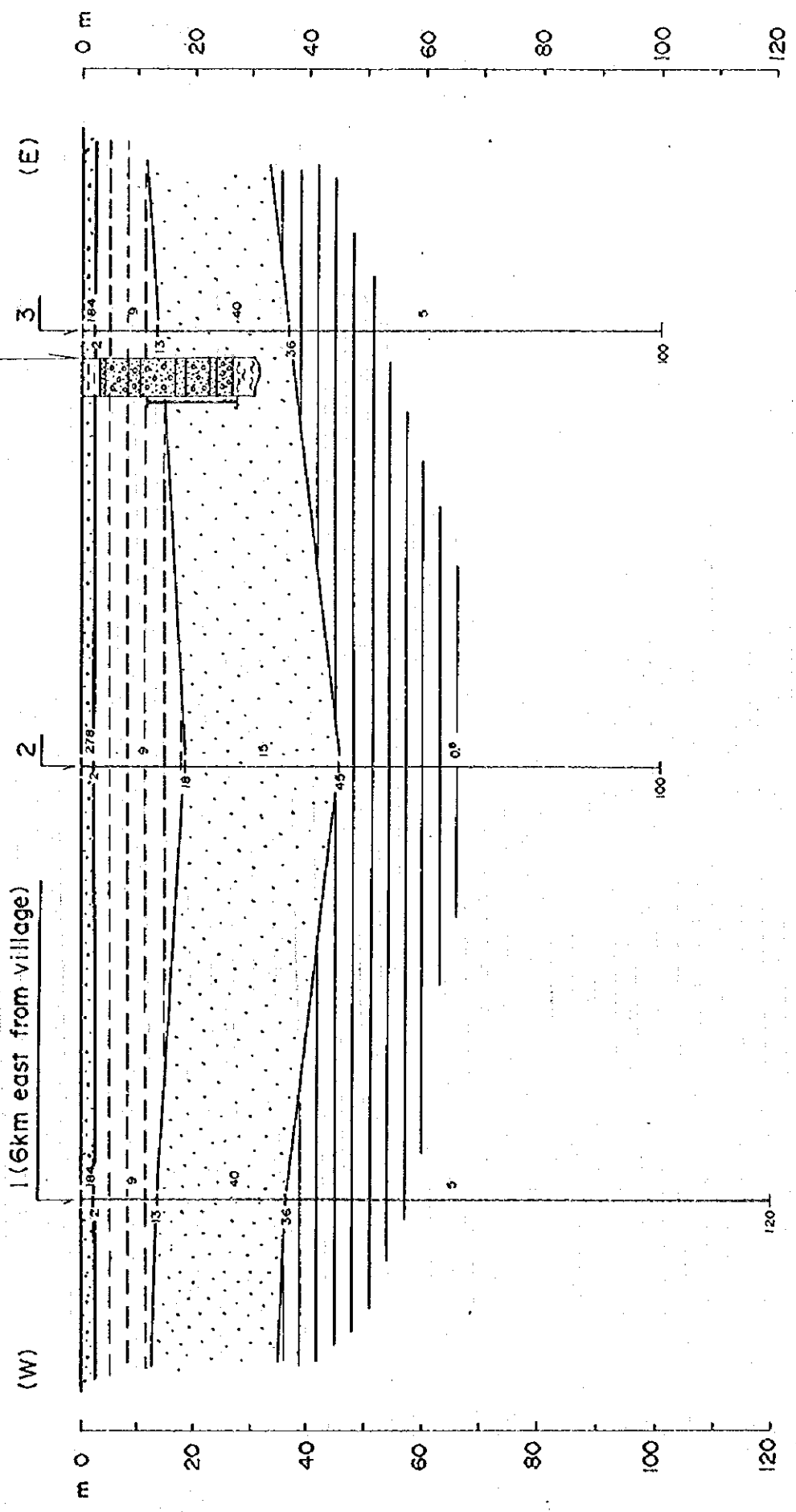
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <i>Andramopasy</i>		(Elevation: _____ m)	Well No. _____
Well Depth: <i>170.0</i> m	Pumping Rate: <i>197</i> m ³ /D	<i>2.28</i> l/s	Water Temp. <i>28.3</i> °C
Static Water Level: <i>7.160</i> m	Drilling Rig: <i>KOKEN</i>		EC(25°C): <i>2000</i> µs/cm
Dynamic Water Level: <i>12.485</i> m	Drilling Started: <i>16 - November - 95</i>		PH: <i>7.0</i>
Specific Capacity: <i>37</i> l/day/m	Well Completed: <i>16 - November - 95</i>		Taste: _____

Drilling and Caslog Program		Depth (m)	Water Level (m)	Lithology Data		Obsv	(ohm-m)	(cps)	
Bit Size	Caslog and Screen Size			Log	Description of Lithology				
PVC 4" SCREEN	PVC 4" SCREEN		Ec(25)		Reddish brown silty clay				
			1511		Reddish brown silty clay with gravel (2-4%)				
			1854		Reddish brown sandy gravel (2-4%, porous limestone)				
			1787		Brown sandy gravel (2-3%, porlate sandstone)				
			1788		Reddish brown porous gravel (3-6% porous limestone)				
			1665						
			1628						
			1466						
			1455			Reddish brown sandy gravel (2%, coarse sandstone)			
			1484			Brown sandy gravel (2-4%, quartzite, chert, basalt)			
			1486						
			1115			Brown fine-medium sand			
			1387			Light brown gravel (2-4%, quartzite, chert, basalt)			
			1485			Light brown marl			
			1521			Brown marly clay			

Andranopasy (I)

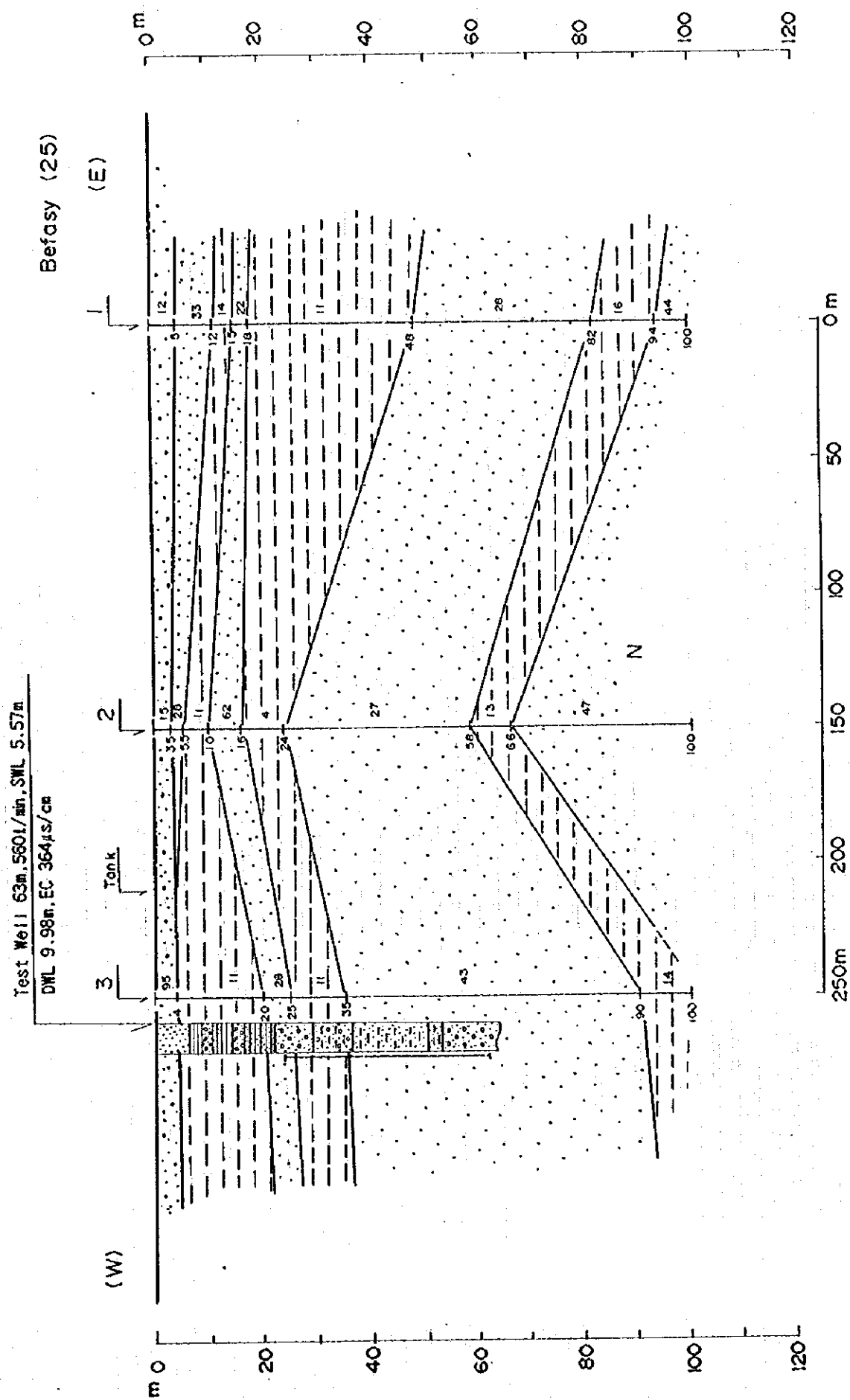
Test Well 30m, 1371/mh
 SWL 7.16m, DWL 12.48m, EC 2.000µs/cm



WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: Befasy		(Elevation: m)	
Well Depth: 63.0 m	Pumping Rate: 206 m ³ /D	2.33 l/s	Well No.
Static Water Level: 5.57 m	Drilling Rig: TOP-200		Water Temp. 27.7 °C
Dynamic Water Level: 9.98 m	Drilling Started: 29-oct.-75		EC(25C): 364 µs/cm
Specific Capacity: 182.8 l/day/m	Well Completed: 26-oct.-75		PH: 7.0
			Taste: good

Drilling and Casing Program	Depth (m)	Water Level	Lithology Data	00uv	(ohm-m)	(eps)
Bit Size			Description of Lithology			
PVC 4"	63.0	5.57	Reddish brown fine-medium sand			
	5	830	Brown fine-medium sand with gravel (φ 2%)			
PVC 4" screen	10	1925	Light brown silty mud			
	10	1908	Light brown gravel (φ 2-5%/m)			
		1902	Brownish grey silty mud ~ clay			
		1754				
	15	1787	Light brown-white brown sand and gravel (φ 2-10%, chert, quartzite)			
		1795	Light brownish gray, fine sand and clay			
	20	1696				
		1692				
	25	1592	Light brown sandy gravel (φ 2-20%, chert, quartzite, basalt)			
		1589				
	1441					
30	1551	Light brown silty sand with gravel (φ 2-4% (36-38m: gravel))				
	1526					
35	1485	Light brown silt and sandy gravel (φ 2-15%)				
	1478					
40	1536					
	1412					
45	1310	Reddish brown silty mud with sand and gravel (φ 2%/m)				
	1126					
50	1006	Brown silty sand with gravel (φ 2-3%)				
	1172					
55	1260	Light brown fine conglomerate (φ 2-20%, chert, quartzite, basalt)				
	1204					
	1114					
60	1157					
	1128					
	1073					
	65					
	70					
	75					



WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location:	Marofihitso (I)	(Elevation: m)	Well No. 46
Well Depth:	72.5 m	Pumping Rate: 692 m ³ /D 8.0 l/s	Water Temp. °C
Static Water Level:	4.50 m	Drilling Rig: TOP-200	EC(25°C): 18890 µs/cm
Dynamic Water Level:	m	Drilling Started: 1- November-95	pH: 7.0
Specific Capacity:	m/day/m	Well Completed: 2- November-95	Taste: Salty

Drilling and Casing Program		Depth (m)	Lithology Data		00m	[cm-m]	(cps)
Bit Size	Casing and Screen Size		Water Level (m)	Description of Lithology			
	PVC 4" Screen	0	1423	Reddish brown silty clay			
		5	1460	Grayish brown marl with limestone gravel			
		10	1507	Grayish brown medium-very coarse sand			
		15	1542	Grayish brown marly sandy silt			
		20	1578	Reddish brown silty sand			
		25	1620	Light brown silty sand			
		30	1666	Reddish brown silty clay			
		35	1722	Brown medium-very coarse sand with gravel (φ 1-4 mm)			
		40	1776	Reddish brown silty clay			
		45	1822	Reddish brown coarse sand			
		50	1886	Reddish brown fine sandy silt			
		55	1927	Light brown gravelly sand (φ 1-5 mm)			
		60	1970	Reddish brown sandy silt			
		65	2011	Reddish brown coarse sand			
		70	2054	Reddish brown fine sandy silt			
		75	2097	Light brown gravelly sand (φ 1-5 mm)			
		80	2140	Reddish brown silty sand			
		85	2182	Reddish brown coarse sand			
		90	2225	Reddish brown fine sandy silt			
		95	2268	Light brown gravelly sand (φ 1-5 mm)			
		100	2311	Reddish brown sandy silt			
		105	2354	Light brown gravelly sand (φ 1-5 mm)			
		110	2397	Reddish brown silty sand			
		115	2440	Reddish brown coarse sand			
		120	2483	Reddish brown fine sandy silt			
		125	2526	Light brown gravelly sand (φ 1-5 mm)			
		130	2569	Reddish brown silty sand			
		135	2612	Reddish brown coarse sand			
		140	2655	Reddish brown fine sandy silt			
		145	2698	Light brown gravelly sand (φ 1-5 mm)			
		150	2741	Reddish brown sandy silt			
		155	2784	Light brown gravelly sand (φ 1-5 mm)			
		160	2827	Reddish brown silty sand			
		165	2870	Reddish brown coarse sand			
		170	2913	Reddish brown fine sandy silt			
		175	2956	Light brown gravelly sand (φ 1-5 mm)			
		180	2999	Reddish brown silty sand			
		185	3042	Reddish brown coarse sand			
		190	3085	Reddish brown fine sandy silt			
		195	3128	Light brown gravelly sand (φ 1-5 mm)			
		200	3171	Reddish brown sandy silt			
		205	3214	Light brown gravelly sand (φ 1-5 mm)			
		210	3257	Reddish brown silty clay			

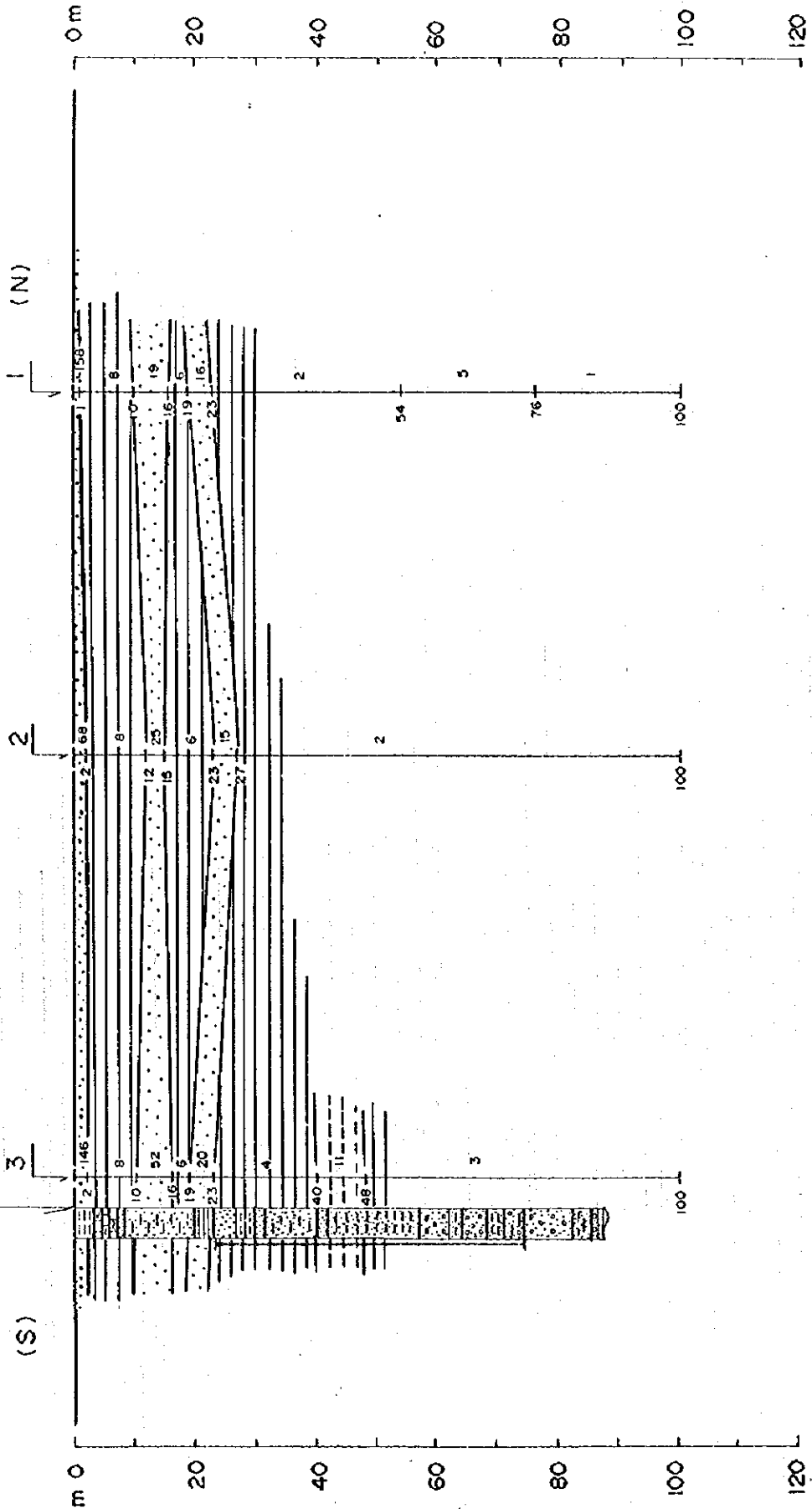
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <i>Maro-fihitsa (II)</i>		Elevation: _____ m	Well No. <i>26</i>
Well Depth: <i>37.2</i> m	Pumping Rate: <i>755</i> m ³ /D <i>8.74</i> l/s	Water Temp. <i>28.6</i> °C	
Static Water Level: <i>4.12</i> m	Drilling Rig: <i>TOP-200</i>	EC(25°C): <i>6840</i> µs/cm	
Dynamic Water Level: <i>4.98</i> m	Drilling Started: <i>9 - november - 95</i>	PH: <i>7.0</i>	
Specific Capacity: <i>2097</i> l/day/m	Well Completed: <i>9 - november - 95</i>	Taste: <i>salty</i>	

Drilling and Casing Program		Depth (m)	Lithology Data		00uv	(cm-m)	(cps)
Bit Size	Casing and Screen Size		Water Level	Log			
	PVC 4" Screen	4'	101	Reddish brown silty fine sand			
		5	103	Brown silty sand			
		10	104	Light brown sandy gravel (φ 2-3 mm)			
		10	105	Light brown medium-very coarse sand			
		15	106	Light brown sandy gravel (φ 2 mm)			
		15	107	Brown silty fine sand			
		15	108	Reddish brown medium coarse sand			
		20	109	Reddish brown medium coarse sand with silt			
		20	110	Reddish brown medium coarse sand			
		25	111	Brown gravelly sand			
		25	112	Light brown sandy gravel (φ 2 mm)			
		30	113	Brown gravel (φ 2 mm)			
		30	114	Brown silty fine sand			
		35	115	Brown conglomerate (φ 2-3 mm, chert, gneiss, basalt)			
		35	116	Reddish brown silty clay			
		40	117				
		45					
		50					
		55					
		60					
		65					
		70					
		75					

Test Well 87m, 480l/m, SWL 4.12m
 DWL 4.48m, EC 6.840-18.890t/s/cm

Marofihitsa (46)
 EL = m



WELL LOG

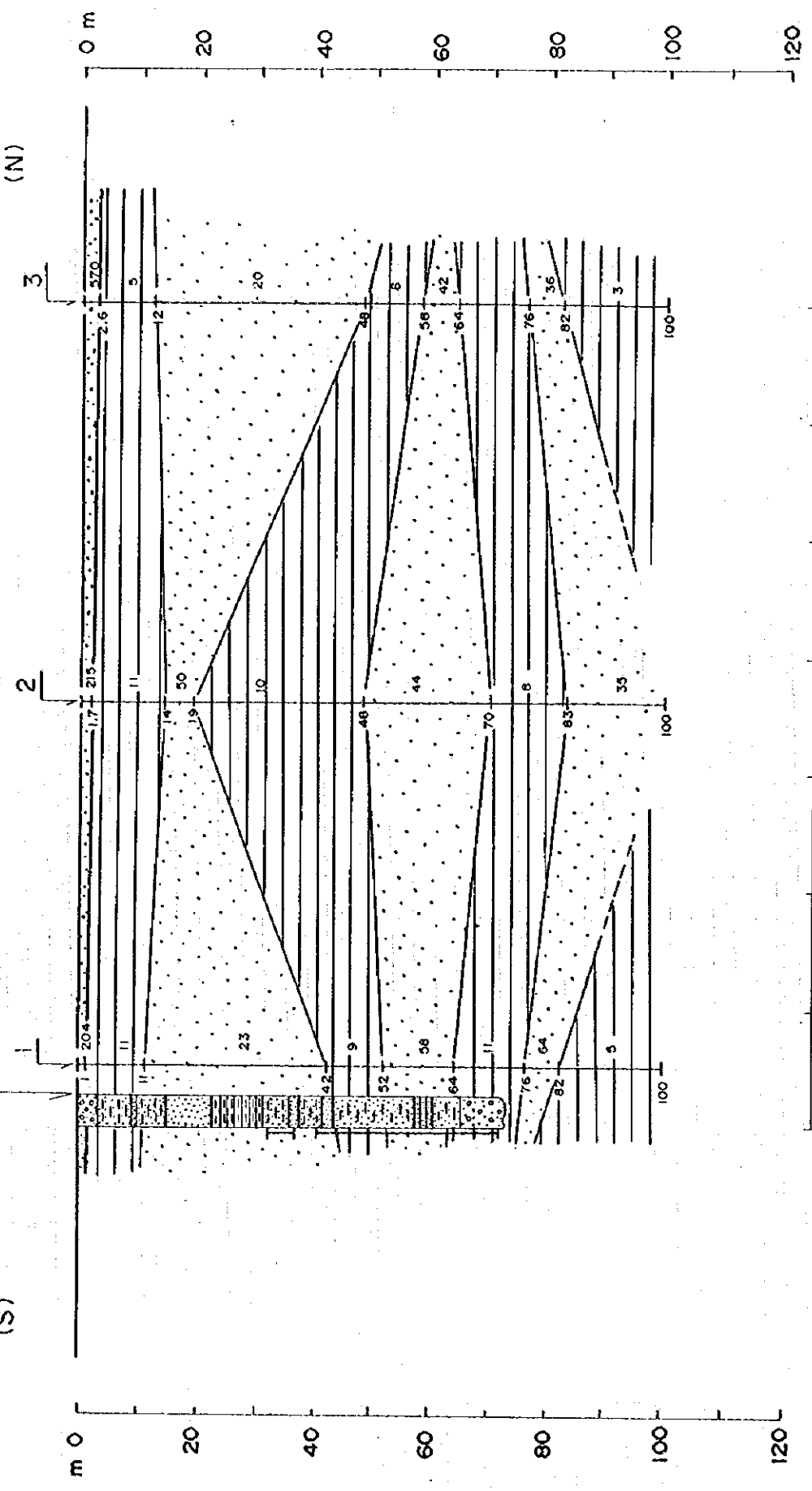
PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location:	Ambararata	(Elevation: m)	Well No. 47
Well Depth:	72.0 m	Pumping Rate: 1105 m ³ /D 12.29 l/s	Water Temp. 26.5 °C
Static Water Level:	2.75 m	Drilling Rig: KOKEN	EC(25°C): 751 µs/cm
Dynamic Water Level:	5.21 m	Drilling Started: 29-Oct.-85	PH: 6.5
Specific Capacity:	489 m ³ /day/m	Well Completed: 31-Oct.-85	Taste: good

Drilling and Casing Program		Depth (m)	Water Level (m)	Log	Lithology Data	00mv	(ohm-m)	(cps)
Bit Size	Casing and Screen Size							
	PVC 4"		Ec(25) 751µs/cm		Reddish brown gravelly sand			
		5	1191		Light brown silty sand with marl			
		10	1125		Light brown fine-medium sand Light brown silty sand with marl			
		15	1082		Light brown fine sand			
		20	1025		Brown medium-very coarse sand			
		25	1062		Brown silty clay			
		30	1070		Reddish brown silty clay			
		32.5	1206		Brown silty sand			
		35	1080		Brown coarse-very coarse sand			
		40	1070		Brown silty fine sand			
		45	1027		Brown sandy gravel (43-10% chert, granite)			
		50	1117		Brown - reddish brown silty sand			
		55	1124					
		55	1122					
		60	1166		Brown silty clay with fine sand			
		65	1093		Brown silty sand			
		65	1061		Brown sandy silt			
		70	928		Brown medium-very coarse sand with gravel (43-8% chert, quartzite, basalt)			
		70	919					
		75						

Test Well 73m. 767l/min. SWL 2.95m
 DWL 5.2m. EC 751µs/cm

Ambararata (47)
 EL = m (N)

(S)



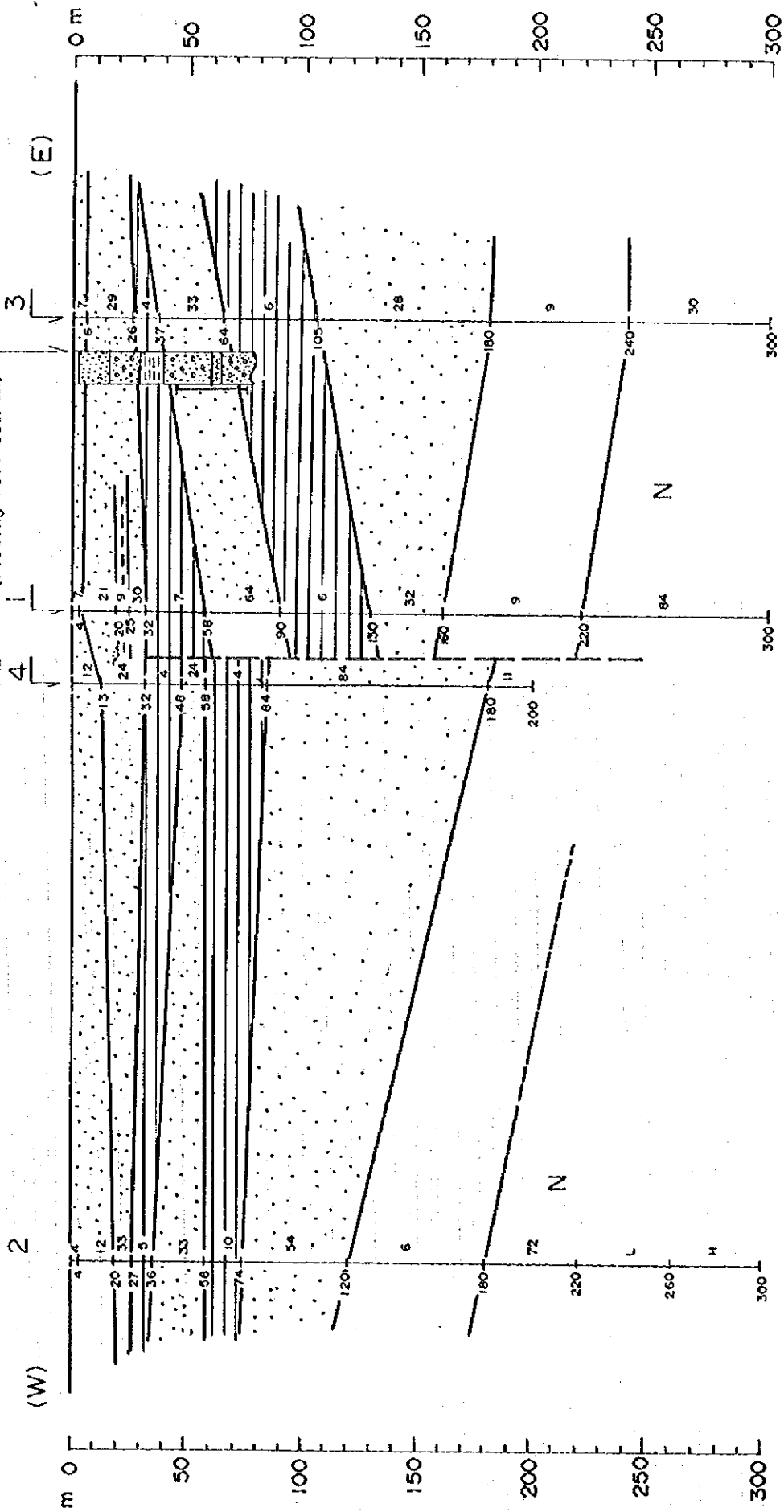
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <i>Andromomena</i>	(Elevation: m)	Well No.	
Well Depth: 79.0 m	Pumping Rate: 580 m ³ /D 6.7 l/s	Water Temp. 28.3 °C	
Static Water Level: + 1.8 m	Drilling Rig: Top-200	EC(25°C): 846 µs/cm	
Dynamic Water Level: 1.53 m	Drilling Started: 11 - Oct. - 95	PH: 6.5	
Specific Capacity: d/day/m	Well Completed: 14 - Oct. - 95	Taste: good	

Drilling and Casing Program		Depth (m)	Lithology Data		Obs	[ohm-m]	(cps)
Bit Size	Casing and Screen Size		Water level	Log			
	PVC 4"	0	6.956m				
		5	1456		Reddish brown silty sand		
		10	1435		Brown fine sand		
			1433		Brown medium - very coarse sand		
					Brown fine sand		
		15			Brown medium - very coarse sand		
			1374		Brown fine sand		
			1402		Brown conglomeratic sand (± 2 - 4% quartzite)		
		20	1255				
			1164				
			1292				
		25	1417		Reddish brown conglomerate (± 30-40% chert, quartzite)		
			1285				
		30	1412		Brown sandy gravel with silt		
			1409				
			1390		Whitish brown sandy gravel and silt		
		35	1426		Reddish brown gravel and sand with silt		
			1285				
		40	1351		Brown conglomerate		
			1382				
			1390		(± 3-10% chert, quartzite, basalt)		
		45	1280				
			1230				
		50	1262				
			1291				
			1244				
		55	1249				
			1270				
		60	1227		silty sand (58-60m)		
			1200				
			1093		silty sand (62-65m)		
		65	1029				
			1104				
		70	1032		Whitish brown medium coarse sand and gravel (± 2-3%)		
			1023		Brown quartzite gravel (± 2-4%)		
			1000				
		75	928				

Andronomena (64)
EL= 15 m

Test Well 78m, 402l/min, SWL±1.80m
DWL 1.53m, EC 846µs/cm
(Flowing well 55l/min)



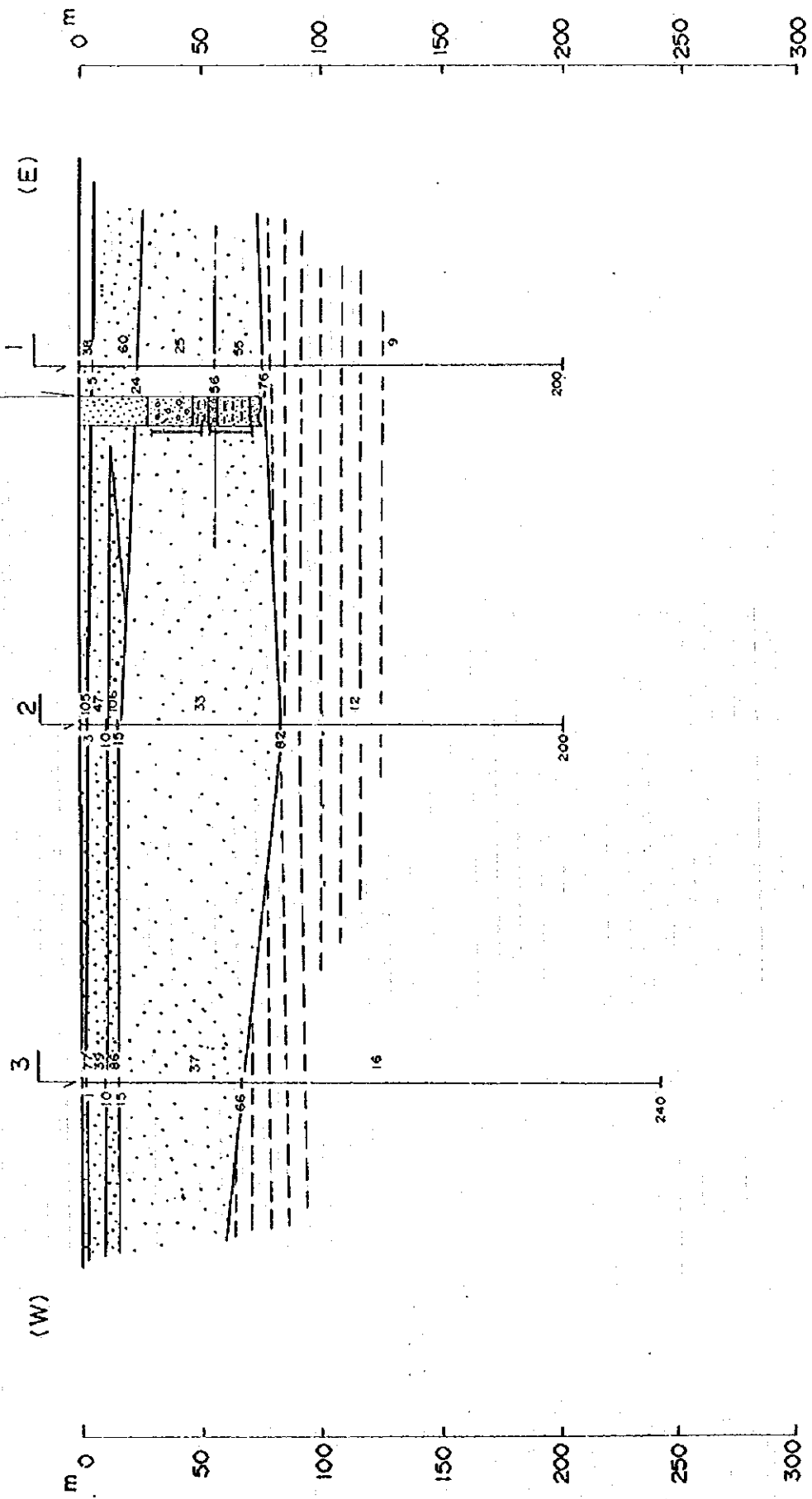
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <u>Analaiva</u>		(Elevation: _____ m) Well No. <u>67</u>	
Well Depth: <u>70.9</u> m	Pumping Rate: <u>1030</u> m ³ /D	<u>11.92</u> l/s	Water Temp. <u>27.8</u> °C
Static Water Level: <u>3.70</u> m	Drilling Rig: <u>KOKEN</u>		EC(25°C): <u>214</u> µs/cm
Dynamic Water Level: <u>4.81</u> m	Drilling Started: <u>18-10-95</u>		FH: <u>6.5</u>
Specific Capacity: <u>928</u> l/day/m	Well Completed: <u>22-10-95</u>		Taste: <u>good</u>

Drilling and Casing Program		Depth (m)	Water Level (m)	Log	Lithology Data Description of lithology	Down	
Bit Size	Casing and Screen Size					(ohm-m)	(cps)
	4" PVC	4	6.47		Reddish brown fine-medium sand		
		5	1110		Light brown fine sand		
		10	1380		Whitish brown coarse sand		
		15	1220		Whitish brown fine sand		
		20	1262				
			1069				
			1124				
		25	1064		Light brown medium-very coarse sand		
			1125				
		30	1095		Light brown fine sand		
			1219		Whitish brown gravelly (coarse) sand		
			1229				
		35	1185				
			1280				
		40	1242		Reddish brown with dark green fine conglomerate (φ 5-6%)		
			1131				
			1135				
		45	1158				
			1163		Light brown silty sand (medium-coarse) with granule (φ 2-3%)		
		50	1158				
			1092				
		55	1083		Light brown coarse sandy gravel (φ 3-5%)		
			1106				
			1025		Light brown medium-very coarse sand with granule (φ 2-3%) & silt		
		60	1078				
			1041		Light brown medium-coarse sand with gravel (φ 2-3%) and silt		
			1002				
		65	999				
			922		Light brown silty sand (medium-coarse)		
		70	986				
			1048		Light brown very coarse sand		
		75					

Test Well 73m, 715l/min, SWL 3.70m
 DWL 4.81m, EC 214µs/cm

Analaiva (67)
 EL=40m



WELL LOG

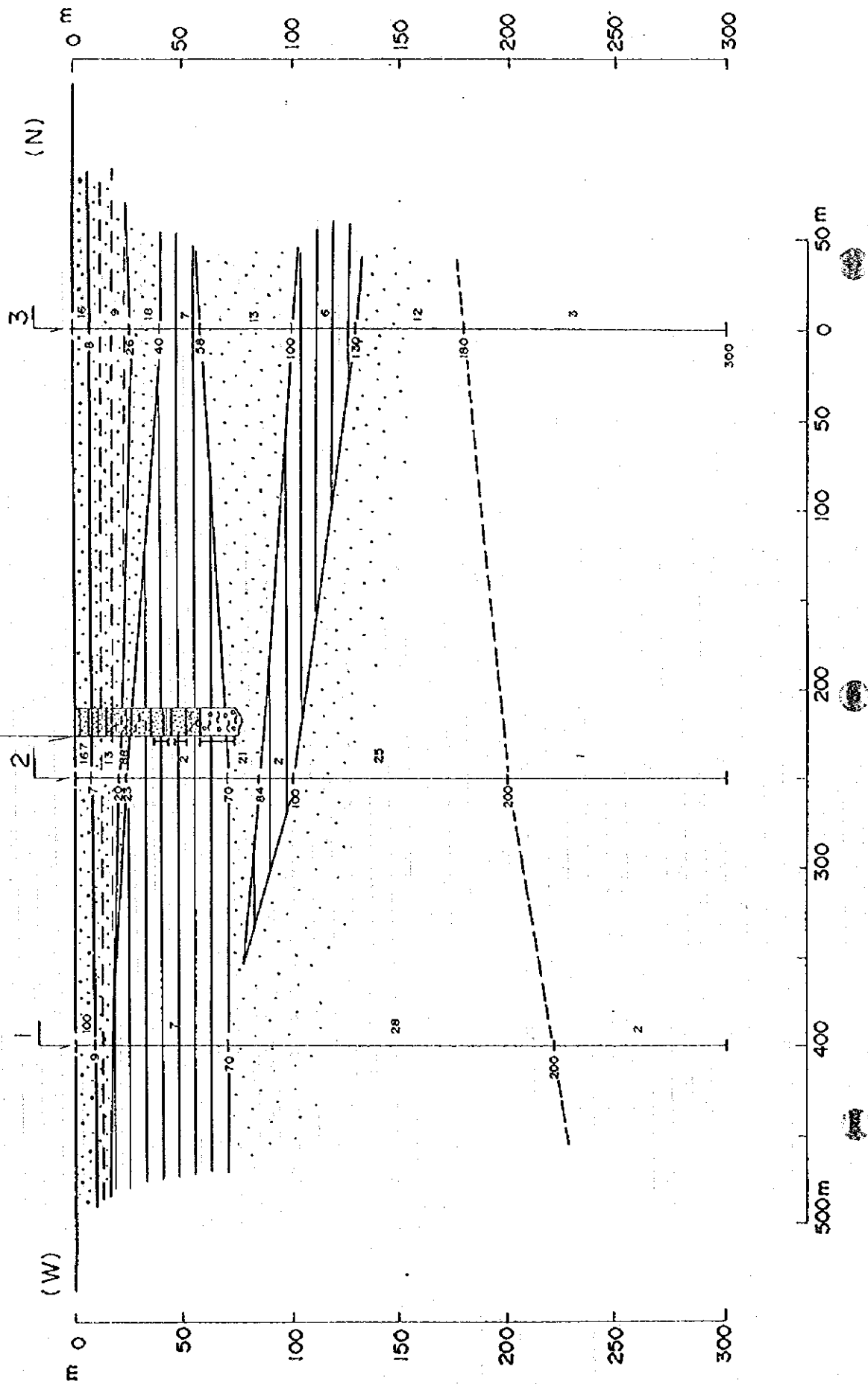
PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <u>Beroboka Sud</u>		(Elevation: <u> </u> m)	
Well Depth: <u>75.0</u> m	Pumping Rate: <u>721</u> m ³ /D	<u>2.34</u> l/s	Well No. <u> </u>
Static Water Level: <u>6.12</u> m	Drilling Rig: <u>TOP-200</u>		Water Temp. <u>28.1</u> °C
Dynamic Water Level: <u>12.23</u> m	Drilling Started: <u>3 - Oct. - 95</u>		EC(25°C): <u>650</u> µs/cm
Specific Capacity: <u>118.0</u> m ³ /day/a	Well Completed: <u>7 - Oct. - 95</u>		PH: <u>6.5</u>
			Taste: <u>good</u>

Drilling and Casing Program		Depth (m)	Water Level	Lithology Data		00m	(cm-m)	(cps)
Bit Size	Casing and Screen Size			Log	Description of Lithology			
	4" PVC		Edm/m		Reddish brown silt			
		5	1535		Reddish brown very coarse sand and gravel (Quartzite)			
					Brown silty sand			
			1180		Reddish brown silt			
		10	1106		Reddish brown quartzite gravel (φ 2-4 mm)			
			1856		Reddish brown silty sand and gravel (φ 2-3 mm)			
			1492		Reddish brown silt			
		15	1405		Reddish brown Conglomerate (φ 2-4 mm)			
			1272		Brown silty sand with gravel (φ 2 mm)			
		20	1276					
			1252					
		25	1199		Light brown sandy gravel (φ 2-4 mm)			
			1172		Brown silty sand with gravel (φ 2-3 mm)			
			1148					
		30	1076		Brown sandy gravel (φ 2-4 mm)			
			1087		Brown silty sand with gravel (φ 2-3 mm)			
		35	1238		Brown sandy gravel (φ 2-3 mm) with silt			
			992		Light brown sandy gravel (φ 2-5 mm)			
			896					
		40	1042		Whitish brown very coarse sand			
			1012		Brown silty sand and mud			
		45	933		Grayish brown silt and mud			
			1179		Brown, quartzose sand and gravel (φ 2-5 mm)			
			1248					
		50	1186					
			1218		Whitish gray, marly sand (medium ~ very coarse)			
			1206					
		55	1259					
			1250					
		60	1242		Gray sandy gravel with marl, (gravel is quartzite (φ 2-4 mm))			
			1226					
			1216					
		65	1190					
			1175					
		70	1213					
			1085					
			930					
		75	926					

6-15

Beroboka sud (93)
EL = 8 m

Test Well 75m, 500l/min, SWL 6.22m
DWL 12.23m, EC 650µs/cm



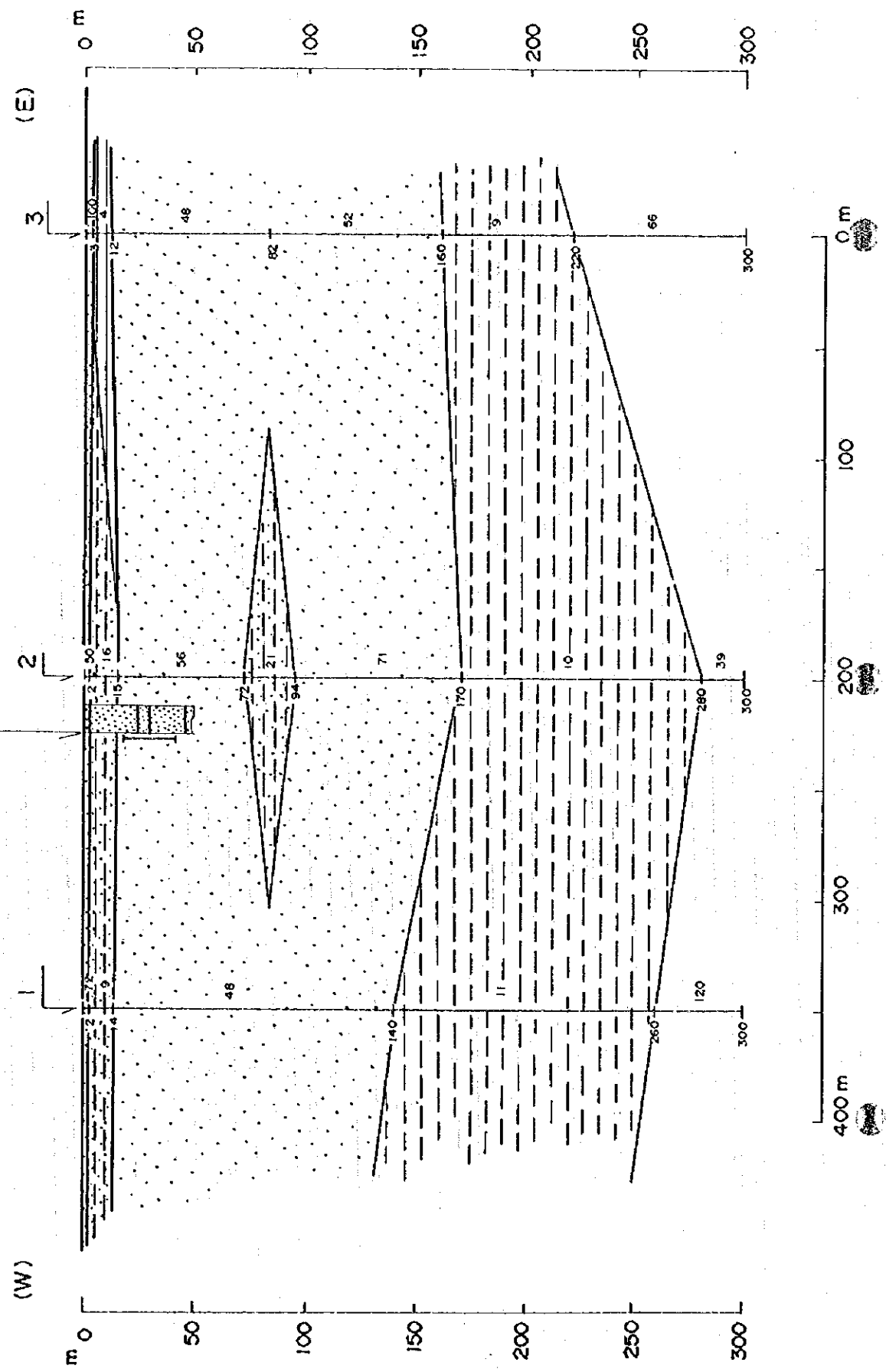
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: BezeziKa		(Elevation: m)	
Well Depth: 91.75 m	Pumping Rate: 1.337 m³/D	15.5 l/s	Well No. 28.7 °C
Static Water Level: 7.902 m	Drilling Rig: KOKEN	EC(25°C): 210-250 µS/cm	
Dynamic Water Level: 8.642 m	Drilling Started: 28 - SEP - 95	PH: 6.5	
Specific Capacity: 1598 m³/day/m	Well Completed: 11 - Oct - 95	Taste: good	

Drilling and Casing Program Bit Size Casing and Screen Size	Depth (m)	Water Level (m)	Lithology Data	Electrical Resistivity			
				00mV	(ohm-m)	(cps)	
PVC 4" Screen 18.05 PVC 4" Screen 71.75	0	7.902	Redish brown medium-very coarse sand				
	5		Light brown medium sand				
	10	822	Whitish brown medium sand				
	15	852	Whitish brown fine sand				
		691	Whitish brown very coarse quartzite sand				
		826	Light brown fine-medium sand				
		901					
		825					
		825					
		25	713	Brown very fine sand			
				Brown medium sand, 27-29m. leakage of artwater, & collapse			
		30	403	Whitish brown coarse sand			
			507				
			295	Brown medium sand			
		35	212				
		1284					
		793					
	40	727					
		740					
	45	474	Brown coarse-very coarse sand				
		498					
	50						

Bezezika (97)
EL = 30 m

Test Well 41.75m, 9301/min
SWL 7.80m, OWL 8.64m, EL 250 ps/cm



WELL LOG

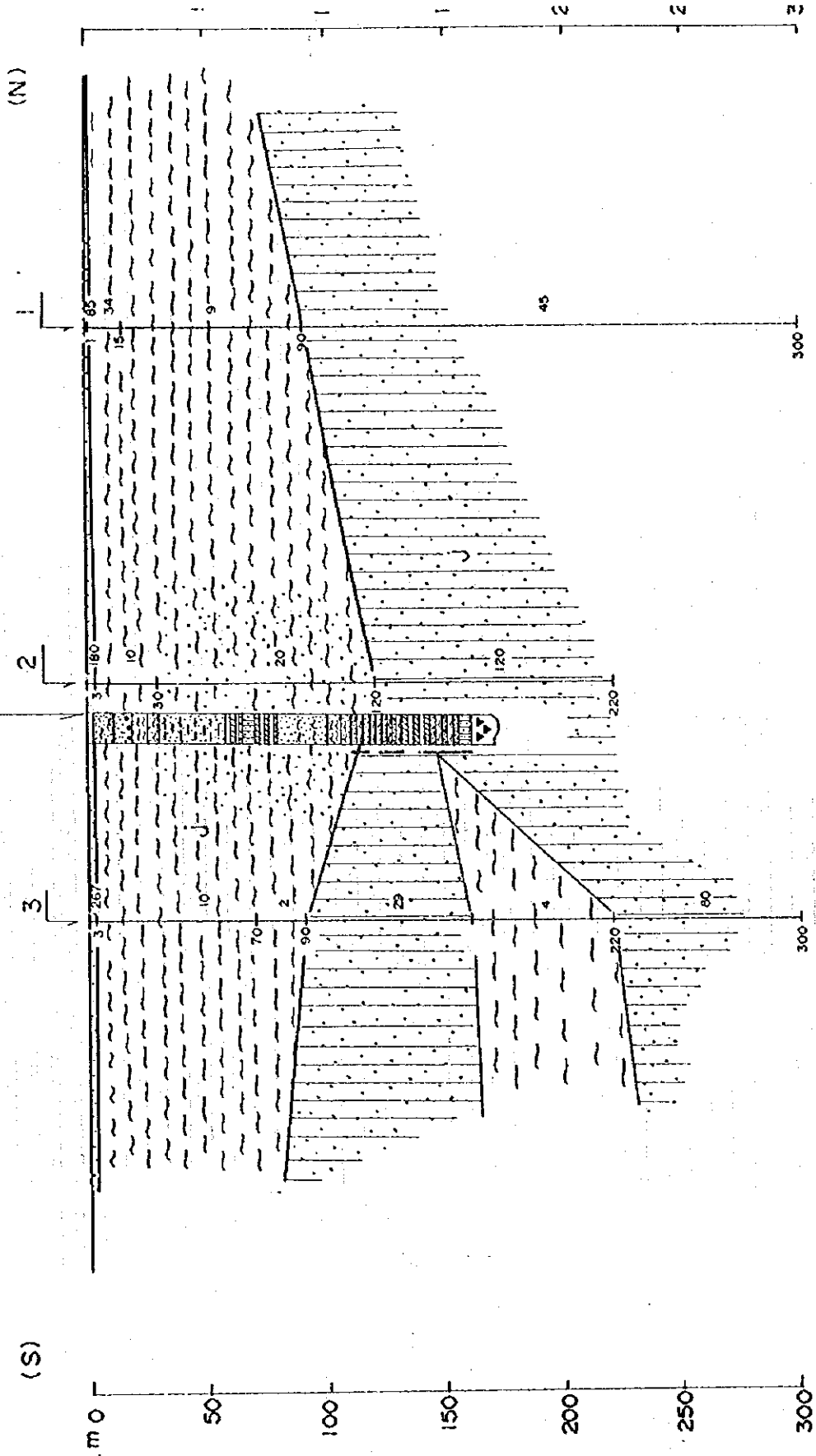
PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and location: Antilizala (Makoba)	(Elevation: 180 m)	Well No.	
Well Depth: 170.00 m	Pumping Rate: 4.302 m ³ /D 5.0 l/s	Water Temp. °C	
Static Water Level: 22.08 m	Drilling Rig: TONE TOP-500	EC(25°C): 22.150 µs/cm	
Dynamic Water Level (airlifting): — m	Drilling Started: 20-09-1995	PH:	
Specific Capacity: — m ³ /day/m	Well Completed: 07-10-1995	Taste:	

Drilling and Casing Program Bit Size Casing and Screen Size	Depth (m)	Water Level (m)	Lithology Data		00m	(ohm-m)	(cps)
			Log	Description of Lithology			
1 3/4"	9.50	21.50		Reddish brown sandy silt.			
	10.00	21.50		Reddish brown-brown sandy marl			
1 3/4"	10.50			(10.00m)			
	11.00			Brown fine to medium sand			
1 3/4"	11.50			(11.00m)			
	12.00			Brown gravelly sand			
1 3/4"	12.50			Brown marl (compact)			
	13.00			(12.50m)			
1 3/4"	13.50			Brown sandy marl			
	14.00			(13.50m)			
1 3/4"	14.50			Grey-dark grey sandy silt			
	15.00			partially clayey			
1 3/4"	15.50			(15.00m)			
	16.00			Grey-dark grey marly mudstone			
1 3/4"	16.50			or mudstone			
	17.00			(16.50m)			
1 3/4"	17.50			Grey marly limestone			
	18.00			(17.50m)			
1 3/4"	18.50			Grey-dark grey marly mudstone			
	19.00			76.50-92.00m sandy marl			
1 3/4"	19.50			(19.00m)			
	20.00			Grey fine sandstone or marly or silty sandstone			
1 3/4"	20.50			(20.00m)			
	21.00			87.70-88.00, 92.00-95.00 and 97.00-98.00m			
1 3/4"	21.50			sandy marl and clayey marl.			
	22.00			(21.50m)			
1 3/4"	22.50			(102.00m)			
	23.00			Brownish grey marl with gravel			
1 3/4"	23.50			(103.00m)			
	24.00			Dark grey-grey marl			
1 3/4"	24.50			(104.00m)			
	25.00			Grey-brownish grey marl with gravelly			
1 3/4"	25.50			(105.00m) sandstone			
	26.00			(106.00m)			
1 3/4"	26.50			Alternation of marl, mudstone and sandstone			
	27.00			(frequent alternation of thin beds)			
1 3/4"	27.50			118.00-127.00m clayey			
	28.00			(112.00m)			
1 3/4"	28.50			(113.00m)			
	29.00			Grey-dark grey marly mudstone			
1 3/4"	29.50			(very clayey)			
	30.00			(114.00m)			
1 3/4"	30.50			Frequent alternation of marl, mudstone			
	31.00			and sandstone			
1 3/4"	31.50			(115.00m)			
	32.00			Grey marly limestone			
1 3/4"	32.50			(116.00m)			
	33.00			Dark black hard gabbro-gabbroic			
1 3/4"	33.50			basalt.			
	34.00			(117.00m)			
1 3/4"	34.50						
	35.00						
1 3/4"	35.50						
	36.00						
1 3/4"	36.50						
	37.00						
1 3/4"	37.50						
	38.00						
1 3/4"	38.50						
	39.00						
1 3/4"	39.50						
	40.00						

6-19

Ankilizato (103)
EL = 180 m

Test Well 170m, 300l/min
SWL 22.08m, EC 2.150µs/cm



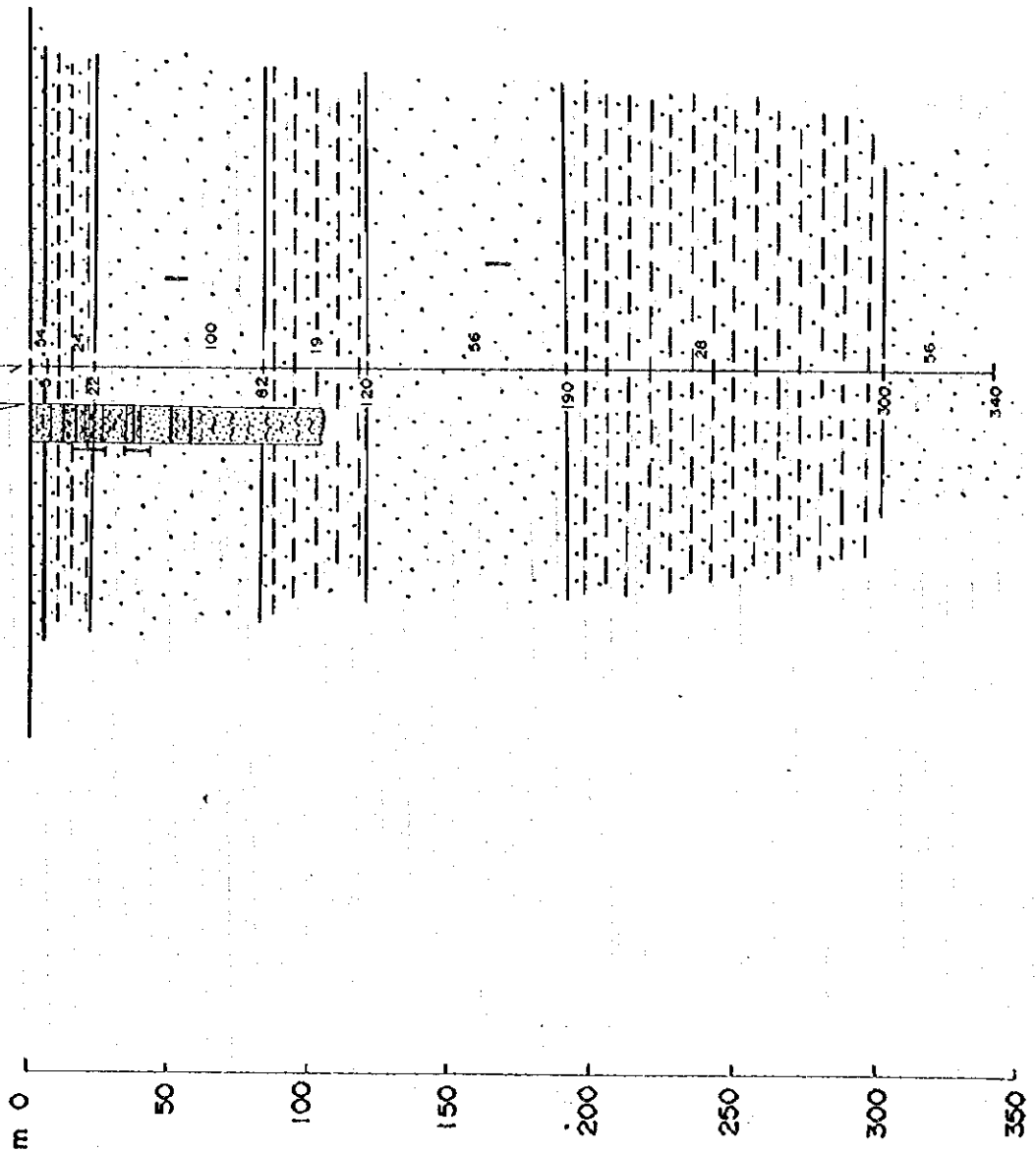
WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <i>Mandabe</i>		(Elevation: _____ m)	
Well Depth: <i>44.00 m</i>	Pumping Rate: <i>460 m³/D</i>	<i>5.33 l/s</i>	Well No. _____
Static Water Level: <i>9.80 m</i>	Drilling Rig: <i>TONF TOP-500</i>		Water Temp. <i>27.8 °C</i>
Dynamic Water Level: <i>12.90 m</i>	Drilling Started: <i>27-10-1995</i>		EC(25t): <i>224 µs/cm</i>
Specific Capacity: <i>110 l/day/m</i>	Well Completed: <i>06-11-1995</i>		PH: <i>6.57</i>
			Taste: <i>Good</i>

Drilling and Casing Program		Depth (m)	Water Level	Lithology Data		GOCv	G	(ohm-m)	(cps)
Bit Size	Casing and Screen Size			Log	Description of Lithology				
<i>2 1/2"</i>	<i>2 1/2"</i>				<i>Reddish brown coarse sand with silt</i>				
		<i>4.00m</i>			<i>Brownish grey sandy siltstone</i>				
		<i>6.00m</i>			<i>Brownish grey coarse sandstone</i>				
		<i>10.00m</i>			<i>Grey gravelly coarse sandstone (fine conglomerate)</i>				
		<i>15.00m</i>			<i>Brownish grey sandy marl</i>				
		<i>18.00m</i>			<i>Grey gravelly coarse sandstone</i>				
		<i>20.00m</i>			<i>Grey sandy marl</i>				
		<i>22.00m</i>			<i>Brownish grey gravelly sandstone (fine conglomerate)</i>				
		<i>24.00m</i>			<i>Grey-white grey sandy marl</i>				
		<i>28.00m</i>			<i>Brownish grey sandy marl</i>				
		<i>34.00m</i>			<i>Brownish grey coarse sandstone</i>				
		<i>36.00m</i>			<i>Grey sandy marl</i>				
		<i>38.00m</i>			<i>White grey clayey marl</i>				
		<i>42.00m</i>			<i>Grey-white grey very hard compact fine sandstone</i>				
		<i>48.00m</i>							
		<i>52.00m</i>			<i>Grey marl with thin and fine sandstone beds</i>				
		<i>57.00m</i>							
		<i>60.00m</i>			<i>Grey hard compact fine sandstone with grey marl</i>				
		<i>65.00m</i>							
		<i>69.00m</i>							

Test Well 103m, 320l/min, SWL 9.80m
DWL 13.90m, EC 324µs/cm

Mandabe (104)



WELL LOG

PROJECT NAME : GROUNDWATER DEVELOPMENT STUDY IN SOUTH-WESTERN REGION OF THE REPUBLIC OF MADAGASCAR (PHASE II)			
Area and Location: <i>Malainbandy (1)</i>		(Elevation: _____ m)	Well No. _____
Well Depth: <i>222 m</i>	Pumping Rate: _____ m ³ /d	0.7/s	Water Temp. _____ °C
Static Water Level: <i>2/10 m</i>	Drilling Rig: <i>TONE TOP-500</i>		EC(25°C): _____ µS/cm
Dynamic Water Level _____ m	Drilling Started: <i>12-11-1995</i>		PH: _____
Specific Capacity: _____ m ³ /day/m	Well Completed: <i>07-12-1995</i>		Taste: _____

Drilling and Casing Program		Depth (m)	Water Level	Lithology Data		00m	(obs-m)	(cps)
Bit Size	Casing and Screen Size			Log	Description of Lithology			
100/16	6"	0						
		10						
		20						
		30						
		40						
		50						
		60						
		70						
		80						
		90						
		100						
		110						
		120						
		130						
		140						
		150						
		160						
		170						
		180						
		190						
		200						

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