第５章　工事費・工程・維持管理

第5章　工事費・工程・維持管理

5－1　工事費の概算

前項の施設計画に基づき、現在価格（1981年 8月）における概算工事費を算出し次頁以下に表・5－1－1～表・5－1－3としてまとめた。

工事費の内訳としては建設資機材および労務費に分け更に外貨分、内貨分の項目に分けた。

外貨分の主なものとしては、井戸材料としてのケーシング、スクリーン、動力設備としての変圧器、ケーブル、揚水設備としてのポンプ類、配水設備としての管類およびさく井機械（予備品含む）である。

内貨分については、資機材のうち原材料に属する。セメント、骨材、砕石、木材等であり、労務費、海上、内陸輸送費もすべて内貨分として計上した。

全体工事費は表・5－1－3に示すとおり1,926百万円であり、日本国負担分が43%の830百万円を占め、ビルマ国負担分は57%の1096百万円である。

表・5－1－1　Magweの概算工事費

施設	工種	数量	単位	工事費（千円）			
				資機材		労務費	合計
				外貨	内貨	内貨	
取水施設	1-01 生産井築造工事	17	本	52,853	10,744	833	64,430
	1-02 調査井　〃	13	〃	6,462	7,501	559	14,522
	1-03 観測井　〃	33	〃	5,378	13,200	1,254	19,832
	1-04 取水ポンプ設備工事	17	基	26,816	1,700	510	29,026
	1-05　〃　室建設工事	17	棟	－	3,740	850	4,590
	1-06 動力架線設置工事	1	式	19,292	3,940	950	24,182
	小計			110,801	40,825	4,956	156,582
2 導水施設	2-01 導水管布設工事	8,700	m	63,463	－	10,920	74,563
	小計	1		63,463	－	10,920	74,563
3 貯水施設	3-01 貯水槽築造工事	3	池	－	104,200	26,000	130,200
	小計			－	104,200	26,000	130,200
4 配水施設	4-01 補助タンク築造工事	1	基	－	900	225	1,125
	4-02 配水管布設工事	17,700	m	110,684	－	19,212	129,896
	小計			110,684	900	19,437	131,021
直接工事費計		1	式	285,128	145,925	61,313	492,366
諸経費		1	式	－	－	123,091	123,091
さく井機械一式		1	式	234,360	－	－	234,360
海上・内陸運送費		1	式	－	50,183	－	50,183
合計				519,488	196,108	184,404	900,000
				715,596			

Table 5.1.1 Construction Cost of Magwe

Fiscal year. / Facilities				82/83 ~ 84/85 (Total construction cost)				82/83				83/84				84/85			
Facilities	Type of construction	Q'ty	Unit	Construction cost				Construction cost				Construction cost				Construction cost			
				Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total
				Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local	
Intake facilities	1-01 Construction of production wells	17	Ea	52,853 (1,762)	10,744 (358)	833 (28)	64,430 (2,148)	52,853 (1,762)	-	-	52,853 (1,762)	-	5,372 (179)	417 (14)	5,789 (193)	-	5,372 (179)	416 (14)	5,788
	1-02 Construction of exploration wells	13	"	6,462 (215)	7,501 (250)	559 (19)	14,522 (484)	6,462 (215)	-	-	6,462 (215)	-	3,751 (125)	280 (9)	4,031 (134)	-	3,750 (125)	279 (9)	4,029
	1-03 Construction of observation wells	33	"	5,378 (179)	13,200 (440)	1,254 (42)	19,832 (661)	5,378 (179)	-	-	5,378 (179)	-	6,600 (220)	627 (21)	7,227 (291)	-	6,600 (220)	627 (21)	7,227
	1-04 Construction of in-take pump facilities	17	"	26,816 (894)	1,700 (37)	510 (17)	29,026 (968)	26,816 (894)	-	-	26,816 (894)	-	850 (28)	255 (9)	1,105 (39)	-	850 (28)	255 (9)	1,105
	1-05 Construction of intake pump rooms	17	"	-	3,740 (125)	850 (28)	4,590 (153)	-	-	-	-	-	1,870 (62)	425 (14)	2,295 (77)	-	1,870 (62)	425 (14)	2,295
	1-06 Installation of suspended electric power wires	1	Job	19,292 (643)	3,940 (131)	950 (32)	24,182 (806)	19,292 (643)	-	-	19,292 (643)	-	1,970 (66)	475 (16)	2,445 (82)	-	1,970 (66)	475 (16)	2,445
	Subtotal			110,801 (3,693)	40,825 (1,360)	4,956 (165)	156,582 (5,219)	110,801 (3,693)	-	-	110,801 (3,693)	-	20,413 (680)	2,479 (83)	22,892 (763)	-	20,412 (680)	2,477 (83)	22,889
Conduit facilities	2-01 Installation of conduits	8,700	m	63,463 (2,115)	-	10,920 (364)	74,563 (2,485)	63,463 (2,115)	-	-	63,463 (2,115)	-	-	5,460 (182)	5,460 (182)	-	-	5,460 (182)	5,460
	Subtotal			63,463 (2,115)	-	10,920 (364)	74,563 (2,485)	63,463 (2,115)	-	-	63,463 (2,115)	-	-	5,460 (182)	5,460 (182)	-	-	5,460 (182)	5,460
Water storage facilities	3-01 Construction of reservoirs	3	pond	-	104,200 (3,473)	26,000 (867)	130,000 (4,340)	-	-	-	-	-	52,100 (1,737)	13,000 (433)	65,100 (2,170)	-	52,100 (1,737)	13,000 (433)	65,100
	Subtotal			-	104,200 (3,473)	26,000 (867)	130,200 (4,340)	-	-	-	-	-	52,100 (1,737)	13,000 (433)	65,100 (2,170)	-	52,100 (1,737)	13,000 (433)	65,100
Distribution facilities	4-01 Construction of auxiliary tanks	1	Ea	-	900 (30)	225 (9)	1,125 (38)	-	-	-	-	-	450 (15)	123 (4)	573 (19)	-	450 (15)	122 (4)	572
	4-02 Installation of distribution pipes	17,700	m	110,684 (3,689)	-	19,212 (640)	129,896 (4,330)	-	-	-	-	36,844 (1,229)	-	6,404 (213)	43,288 (1,443)	73,800 (2,460)	-	12,808 (427)	86,608
	Subtotal			110,684 (3,689)	900 (30)	19,437 (648)	131,021 (4,367)	110,684 (3,689)	-	-	110,684 (3,689)	36,884 (1,229)	450 (15)	6,527 (217)	43,861 (1,462)	73,800 (2,460)	450 (15)	12,930 (431)	87,180
Total direct construction cost		1	Job	285,128 (9,504)	145,925 (4,864)	61,313 (2,044)	492,366 (16,412)	174,444 (9,504)	-	-	174,444 (9,504)	36,884 (1,229)	72,963 (2,432)	27,466 (916)	137,313 (4,577)	73,800 (2,460)	72,962 (2,432)	33,867 (1,129)	180,629
Miscellaneous expenses		1	"	-	-	123,091 (4,103)	123,091 (4,103)	-	-	50,000 (1,667)	50,000 (1,667)	-	-	23,091 (770)	23,091 (770)	-	-	50,000 (1,667)	50,000
Boring machinery		1	"	234,360 (7,812)	-	-	234,360 (7,812)	234,360 (7,812)	-	-	234,360 (7,812)	-	-	-	-	-	-	-	-
Maritime and overland transport cost		1	"	-	50,183 (1,673)	-	50,183 (1,673)	-	50,183 (1,673)	-	50,183 (1,673)	-	-	-	-	-	-	-	-
Total				519,488 (1,732)	196,108 (6,537)	184,404 (6,147)	900,000 (30,000)	408,804 (13,627)	50,183 (1,673)	50,000 (1,667)	508,987 (16,966)	36,884 (1,229)	72,963 (2,432)	50,557 (1,685)	160,404 (5,347)	73,800 (2,460)	72,962 (2,432)	83,867 (2,800)	230,629 (7,688)
				715,596 (2,385)				458,987 (15,300)				109,847 (3,662)				146,762 (4,892)			

Note: Yen in thousands
(Kyats in thousands)

As of August 1981
1 Kyat ≒ 30 yen

表・5－1－2 Promeの概算工事費

施設	工種	数量	単位	工事費（千円）			
				資機材		労務費	合計
				外貨	内貨	内貨	
取水施設	1−01 生産井築造工事	15	本	54,237	9,765	750	64,752
	1−02 調査井 〃	11	〃	6,839	6,776	495	14,110
	1−03 観測井 〃	29	〃	5,738	12,180	1,160	19,078
	1−04 取水ポンプ設備工事	15	基	32,166	1,500	450	34,116
	1−05 〃 室建設工事	15	棟	−	3,300	750	4,050
	1−06 動力架線設置工事	1	式	18,486	3,600	900	22,986
	小計			117,466	37,121	4,505	159,092
2 導水施設	2−01 導水管布設工事	7,750	*m*	69,370	−	11,707	81,077
	小計			69,370	−	11,707	81,077
3 貯水施設	3−01 貯水池築造工事	3	池	−	109,900	27,500	137,400
	小計			−	109,900	27,500	137,400
4 配水施設	4−01 補助タンク築造工事	−	−	−	−	−	−
	4−02 配水管布設工事	30,900	*m*	182,379	−	32,232	214,611
	小計			182,379	−	32,232	214,611
直接工事費計		1	式	369,215	147,021	75,944	592,180
諸経費		1	式	−	−	148,045	148,045
さく井機械一式		1	式	234,360	−	−	234,360
海上・内陸輸送費		1	式	−	51,415	−	51,415
合計				603,575	198,436	223,989	1,026,000
				802,011			

Table 5.1.2 Construction Cost of Prome

Fiscal year Facilities	82/83 ∿ 84/85 (Total construction cost)							82/83				83/84				84/85			
Facilities	Type of construction	Q'ty	Unit	Construction cost				Construction cost				Construction cost				Construction cost			
				Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and material		Labour cost	Total
				Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local	
Intake facilities	1-01 Construction of production wells	15	Ea	54,236 (181)	9,765 (326)	750 (25)	64,752 (2,158)	54,237 (181)	-	-	54,237 (181)	-	4,883 (163)	375 (13)	5,258 (175)	-	4,882 (163)	375 (13)	5,257 (175)
	1-02 Construction of exploration wells	11	"	6,839 (228)	6,776 (226)	495 (17)	14,100 (470)	6,839 (228)	-	-	6,839 (228)	-	3,388 (113)	248 (8)	3,636 (121)	-	3,388 (113)	247 (8)	3,635 (121)
	1-03 Construction of observation wells	29	"	5,738 (191)	12,180 (406)	1,160 (39)	19,078 (636)	5,738 (191)	-	-	5,738 (191)	-	6,090 (203)	580 (19)	6,670 (222)	-	6,090 (203)	580 (19)	6,670 (222)
	1-04 Construction of intake pump facilities	15	"	32,166 (1,072)	1,500 (50)	450 (15)	34,116 (1,137)	32,166 (1,072)	-	-	32,166 (1,072)	-	750 (25)	225 (8)	975 (33)	-	750 (25)	225 (8)	975 (33)
	1-05 Construction of intake pump rooms	15	"	-	3,300 (11)	750 (25)	4,050 (1,352)	-	-	-	-	-	1,650 (55)	375 (13)	2,025 (168)	-	1,650 (55)	375 (13)	2,025 (68)
	1-06 Installation of suspended electric power wires	1	Job	18,486 (616)	3,600 (120)	900 (30)	22,986 (766)	18,486 (616)	-	-	18,486 (616)	-	1,800 (60)	450 (15)	2,250 (75)	-	1,800 (60)	450 (15)	2,250 (75)
	Subtotal			117,466 (3,916)	37,121 (1,237)	4,505 (150)	159,092 (5,303)	117,466 (3,916)	-	-	117,466 (3,916)	-	18,561 (619)	2,253 (175)	20,814 (694)	-	18,560 (619)	2,252 (75)	20,812 (694)
Conduit facilities	2-01 Installation of conduits	2,750	m	69,370 (2,312)	-	11,707 (290)	81,077 (270)	69,370 (2,312)	-	-	69,370 (2,312)	-	-	5,854 (195)	5,854 (195)	-	-	5,853 (195)	5,853 (195)
	Subtotal			69,370 (2,312)	-	11,707 (290)	81,077 (270)	69,370 (2,312)	-	-	69,370 (2,312)	-	-	5,854 (195)	5,854 (195)	-	-	5,853 (195)	5,853 (195)
Water storage facilities	3-01 Construction of reservoirs	3	Pond	-	109,900 (3,663)	27,500 (917)	137,400 (4,580)	-	-	-	-	-	54,950 (1,832)	13,750 (458)	68,700 (2,290)	-	54,950 (1,832)	13,750 (458)	68,700 (2,290)
	Subtotal			-	109,900 (366)	27,500 (917)	137,400 (4,580)	-	-	-	-	-	54,950 (1,832)	13,750 (458)	68,700 (2,290)	-	54,950 (1,832)	13,750 (458)	68,700 (2,290)
Distribution facilities	4-01 Construction of auxiliary tanks			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-02 Installation of distribution pipes	30,900	m	182,379 (6,079)	-	32,232 (1,094)	214,611 (7,154)	-	-	-	-	60,793 (2,026)	-	10,744 (358)	71,537 (2,385)	121,586 (4,053)	-	21,488 (716)	143,074 (4,769)
	Subtotal			182,379 (6,079)	-	32,232 (1,074)	214,611 (7,154)	-	-	-	-	60,793 (2,026)	-	10,744 (358)	71,537 (2,385)	121,586 (4,053)	-	21,488 (1,716)	143,074 (4,769)
Total direct construction cost		1	Job	369,215 (12,307)	147,021 (4,901)	75,944 (2,531)	592,180	186,836 (6,228)	-	-	186,836 (6,228)	60,793 (2,026)	73,511 (2,450)	32,601 (1,087)	166,905 (5,564)	121,586 (4,053)	73,510 (2,450)	43,343 (1,445)	238,439 (7,948)
Miscellaneous expenses		1	"			148,045 (4,935)	148,045 (4,935)	-	-	50,000 (1,667)	50,000 (1,667)	-	-	48,045 (1,602)	48,045 (1,602)	-	-	50,000 (1,667)	50,000 (1,667)
Boring machinery		1	"	234,360 (7,812)	-	-	234,360 (7,812)	234,360 (7,812)	-	-	234,360 (7,812)	-	-	-	-	-	-	-	-
Maritime and overland transport cost		1	"	-	51,415 (1,715)	-	51,415 1,715)	-	51,415 (1,715)	-	51,415 (1,715)	-	-	-	-	-	-	-	-
Total				603,575 (20,119)	198,436 (6,615)	223,989 (7,466)	1,026,000 (34,200)	421,196 (14,040)	51,415 (1,715)	50,000 (1,667)	522,611 (17,420)	60,793 (2,020)	73,511 (2,450)	80,646 (2,688)	214,950 (7,165)	121,586 (4,653)	73,510 (2,450)	93,343 (3,111)	288,439 (9,615)
				802,011 (26,734)				472,611 (15,754)											

Note: Yen in thousands (Kyats in thousands)

As of August 1981

1 Kyat ≒ 30 yen

表・5－1－3　全体概算工事費

施設	工種	数量	単位	工事費（千円）			
				資機材		労務費	合計
				外貨	内貨	内貨	
取水施設	1-01 生産井築造工事	32	本	107,090	20,509	1,583	129,182
	1-02 調査井　〃	24	〃	13,300	14,277	1,054	28,631
	1-03 観測井　〃	62	〃	11,116	25,380	2,414	38,910
	1-04 取水ポンプ設備工事	32	基	58,982	3,200	960	63,142
	1-05　〃　室建設工事	32	棟	−	7,040	1,600	8,640
	1-06 動力架線設置工事	2	式	37,778	7,540	1,850	47,168
	小計			228,267	77,946	9,461	315,674
2 導水施設	2-01 導水管布設工事	16,450	m	133,013	−	22,727	155,640
	小計			133,013	−	22,627	155,640
3 貯水施設	3-01 貯水槽築造工事	6	槽	−	214,100	53,500	267,600
	小計			−	214,100	53,500	267,600
4 配水施設	4-01 補助タンク築造工事	1	基	−	900	225	1,125
	4-02 配水管布設工事	48,600	m	293,063	−	51,444	344,507
	小計			293,063	900	51,669	345,632
直接工事費計		2	式	654,343	292,946	137,257	1,084,546
諸経費		2	〃	−	−	271,136	271,136
さく井機械一式		2	〃	468,720	−	−	468,720
海上・内陸輸送費		2	〃	−	101,598	−	101,598
合計				1,123,063	394,544	408,393	1,926,000
				1,517,607			

Table 5.1.3 Overall Construction Cost

Fiscal year / Facilities	82/83 ∿ 84/85 (Overall construction cost)							82/83				83/84				84/85			
Facilities	Type of construction	Q'ty	Unit	Construction cost				Construction cost				Construction cost				Construction cost			
				Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total	Equipment and materials		Labour cost	Total
				Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local		Foreign	Local	Local	
	1-01 Construction of production wells	32	Ea	*107,090 (3,636)	20,509 (684)	1,583 (53)	129,182 (4,306)	*107,090 (3,636)	-	-	107,090 (3,636)	-	10,255 (342)	792 (26)	11,047 (368)	-	10,254 (342)	791 (26)	11,045 (368)
	1-02 Construction of exploration wells	24	"	*13,300 (443)	14,277 (476)	1,054 (25)	28,631 (954)	*13,300 (443)	-	-	13,300 (443)	-	7,139 (238)	527 (18)	7,667 (256)	-	7,138 (238)	526 (18)	7,664 (256)
	1-03 Construction of observation wells	62	"	*11,116 (371)	25,380 (846)	2,414 (80)	38,910 (1,297)	*11,116 (371)	-	-	11,116 (371)	-	12,690 (423)	1,207 (40)	13,897 (463)	-	12,690 (423)	1,207 (40)	13,891 (403)
Intake facilities	1-04 Construction of intake pump facilities	32	"	*58,982 (1,966)	3,200 (107)	960 (32)	63,142 (210)	*58,982 (1,966)	-	-	58,982 (1,966)	-	1,600 (53)	480 (16)	2,080 (69)	-	1,600 (53)	480 (16)	2,080 (69)
	1-05 Construction of intake pump rooms	32	"	-	7,040 (235)	1,600 (53)	8,640 (288)	-	-	-	-	-	3,520 (117)	800 (27)	4,320 (144)	-	3,520 (117)	800 (27)	4,320 (144)
	1-06 Installation of suspended electric power wires	2	Job	*37,778 (1,260)	7,540 (251)	1,850 (62)	47,168 (1,572)	*37,778 (1,260)	-	-	37,778 (1,260)	-	3,770 (126)	925 (31)	4,695 (157)	-	3,770 (126)	925 (31)	4,695 (157)
	Subtotal		.	*228,267 (7,609)	77,946 (2,598)	9,461 (315)	315,674 (10,522)	*228,267 (7,609)	-	-	228,267 (7,609)	-	38,974 (1,299)	4,732 (158)	43,706 (1,457)	-	38,972 (1,299)	4,729 (158)	43,701 (1,457)
Conduit facilities	2-01 Installation of conduits	16,450	m	*133,013 (4,434)	-	22,627 (754)	155,640 (5,188)	*133,013 (4,434)	-	-	133,013 (4,434)	-	-	11,314 (377)	11,314 (377)	-	-	113,133 (377)	113,133 (377)
	Subtotal			*133,013 (4,434)	-	22,627 (754)	155,640 (5,188)	*133,013 (4,434)	-	-	133,013 (4,434)	-	-	11,314 (377)	11,314 (377)	-	-	113,133 (377)	113,133 (377)
Water storage facilities	3-01 Construction of reservoirs	6	Ea	-	214,100 (7,137)	53,500 (1,783)	267,600 (8,920)	-	-	-	-	-	107,050 (3,568)	26,750 (892)	133,800 (4,460)	-	107,050 (3,568)	26,750 (892)	133,800 (4,460)
	Subtotal			-	214,100 (7,137)	35,500 (1,783)	267,600 (8,920)	-	-	-	-	-	107,050 (3,568)	26,750 (892)	133,800 (4,460)	-	107,050 (3,568)	26,750 (892)	133,800 (4,460)
	4-01 Construction of auxiliary tanks	1	Ea	-	900 (30)	225 (8)	1,125 (38)	-	-	-	-	-	450 (15)	123 (4)	573 (19)	-	450 (15)	122 (4)	572 (19)
Distribution facilities	4-02 Installation of distribution pipes	48,600	m	293,063 (9,769)	-	51,444 (1,715)	344,507 (11,484)	-	-	-	-	97,677 (3,256)	-	17,148 (572)	114,825 (3,828)	195,386 (6,513)	-	34,296	229,682 (7,656)
	Subtotal			293,063 (9,769)	900 (30)	51,669 (1,715)	345,632 (11,521)	-	-	-	-	97,677 (3,256)	450 (15)	17,223 (574)	115,350 (3,845)	195,386 (6,513)	450 (15)	34,446 (1,148)	230,282 (768)
Total direct construction cost		2	Job	654,343 (21,811)	292,946 (9,765)	137,257 (4,575)	1,084,546 (36,152)	*361,280 (12,043)	-	-	361,280 (12,043)	97,677 (3,256)	146,474 (4,882)	60,019 (2,000)	304,170 (10,139)	195,386 (6,513)	146,472 (4,882)	77,238 (2,575)	419,096 (13,970)
Miscellaneous expenses		2	"	-	-	271,136 (9,038)	271,136 (9,038)	-	-	100,000 (3,333)	100,000 (3,333)	-	-	71,136 (2,371)	71,136 (2,371)	-	-	100,000 (3,333)	100,000 (3,333)
Boring machinery		2	"	*468,720 (15,624)	-	-	468,720 (15,624)	*468,720 (15,624)	-	-	468,720 (15,624)	-	-	-	-	-	-	-	-
Maritime and overland transport cost		2	"	-	101,598 (3,387)	-	101,598 (3,387)	-	101 598 (3,387)	-	101,598 (3,387)	-	-	-	-	-	-	-	
Total				1,123,063 (37,435)	394,544 (13,151)	408,393 (13,613)	1,926,000 (64,200)	*830,000 (27,667)	101,598 (3,387)	100,000 (3,333)	1,031,598 (34,387)	97,677 (3,256)	146,474 (4,882)	131,203 (4,373)	375,354 (12,512)	195,386 (6,513)	146,472 (4,882)	177,238 (5,908)	519,096 (17,303)
				1,517,607 (50,587)				931,598 (31,053)				244,151 (8,138)				341,858 (11,395)			

Note: Yen in thousands
(Kyats in thousands)

As of August 1981
1 Kyat ≒ 30 yen
* Japan Grant Aid

5－2　建設工程

本計画の建設工程を表・5－2－1に示した。

ビルマ政府側で作成する発注のための仕様書の作成はE/N(1981年10月30日)交換後3ヶ月間を予定、それに続く6ヶ月間で発注がなされ、製作をへて7ヶ月後に輸送が行なわれるものである。

資機材の現地到着後、建設準備のための期間を2.5ヶ月間設けた。この後さく井作業に入ることとなるが、さく井作業進行途中において一井当り実揚水量、井戸の本数および位置が確定されると予測されることから、さく井作業開始後4ヶ月後から約3ヶ月、施設計画の詳細設計が行われる。

また現地の気象条件からさく井作業は年間実稼働月数を8ヶ月とした。

建設工事は、ビルマ政府側実施期間の予算獲得の状況にもよるが、R.C.D.C.から提示された基本方針では本計画の終了期限を2～3年としていることから、入札手続から始まり、工事完了までの全期間を3ヶ年とした。

5－3　工事実施体制

このプロジェクト即ちMagwe・Prome 新水道施設工事実施に当っては地区開発委員会に於て行う水道施設建設方式として通常行われる建設公社に委託する方式を取らず、新に発足する予定のMagwe・Prome水道開発統合事務所（仮称）に於て実施する予定である。現在総務局及びR.C.D.C 等の関係部局に於て進められている構想は、総務局傘下の3部のもとにあるR.C.D.C，M.C.D.Cと並列して新たに上記事務所を置きこれを総務局が統轄するというものである。

この統合事務所は両地区を統合して建設工事に当るものであるが、しかしMagwe とProme の距離は150Km余離れ、また建設に当っての事情も全く異るのでこれを統合して事業を行うに際しては、両地区に夫々可なりの権限を持つ地区管理者を置き事業を推進していかなければならない。何となればこの水道施設建設事業においては調査井を先行させその調査結果に基き生産井の配置を定めて詳細設計を行い、その後建設工事実施に当らなければならないので調査設計及び工事の一貫体制をとることが必要で、Magwe 及びProme に夫々管理責任者を置く必要がある所以である。

Magwe 及びProme 地区に置く地区管理事務所（仮称）には管理者の下に技術者（オフィサー）及びその他ランク者を置き工事実施に当る。

技術者等の人員配置は総務局所属機関の技術者、地元の地区開発委員会所属技術者その他

表・5－2－1　全建設工程は次のとおりである。

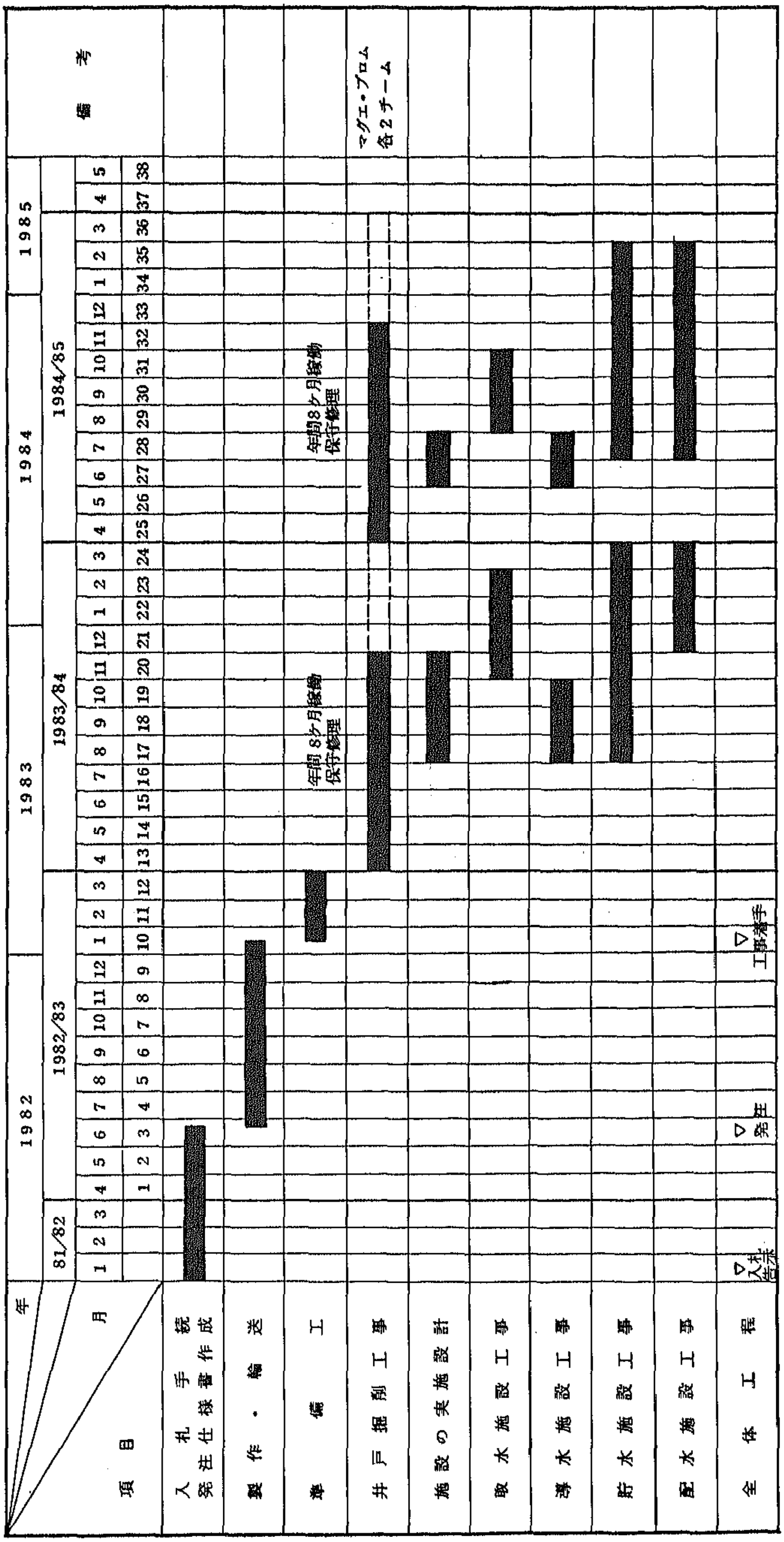
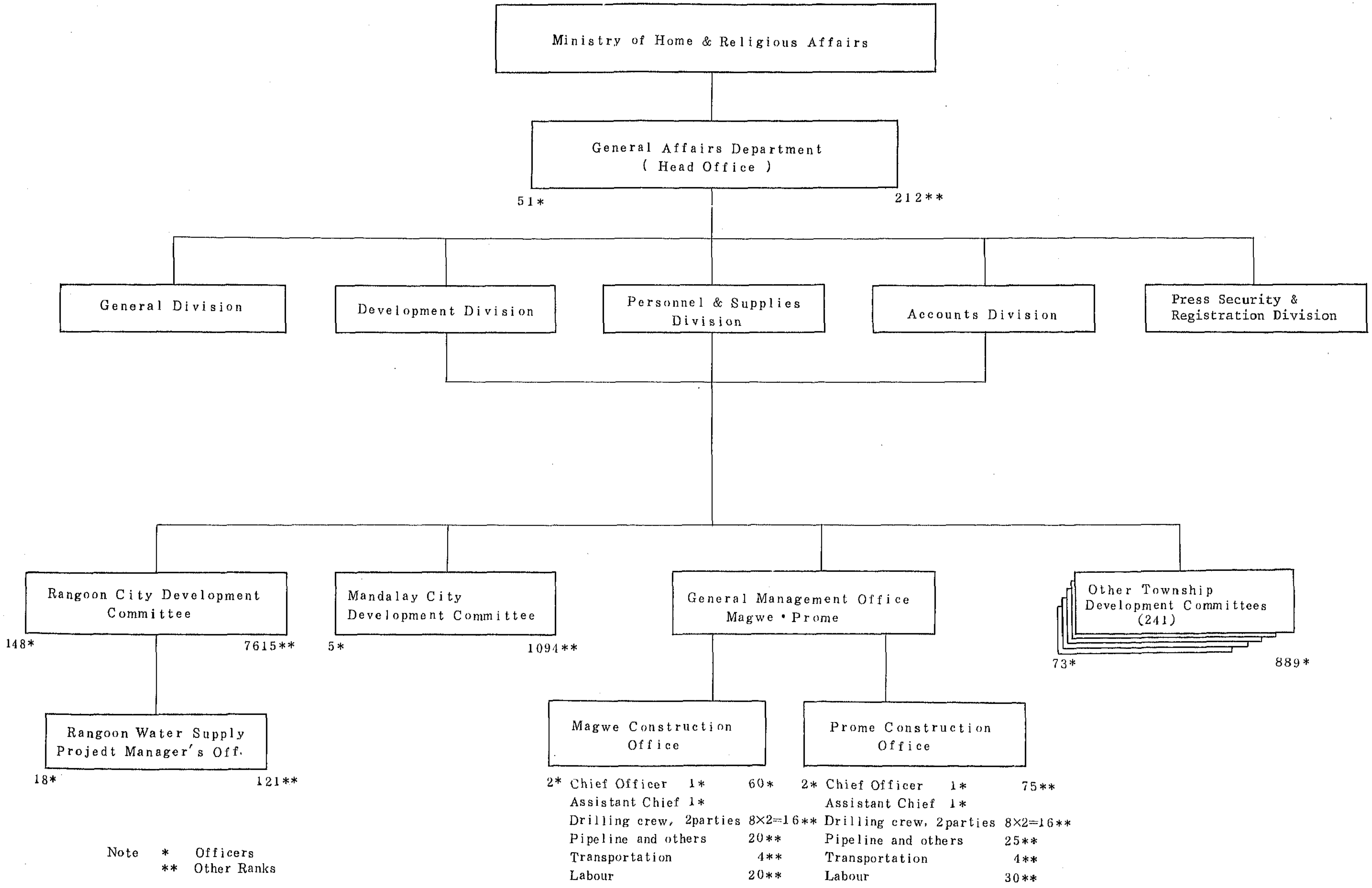


Fig. 5—3—1 Organizational Chart of the General Affairs Department and General Management Office, Magwe• Prome



を配備する計画である。Magwe地区においては技術者（Officers）2人、その他（Other Ranks）60人を、Prome地区は技術者2人その他70人を予定している。

また建設費の財政負担は総務局の斡旋によりMyanma Economic Bank（国立銀行）からの借入金により行うもので工事完成後の借入金の返済は、水道税及び水道料金収入をこれに当てるものである。

5－4 維持管理

本プロジェクトにより、MagweおよびPromeは、既設水道施設を含めて全域に水道が布設されることになるので、常に住民が安心して飲料水の恩恵を享受できるようこれを維持管理していくことが必要である。

維持管理に当っては、次の項目を整備する。

- 組織
- 業務
- サービス

[illegible] now

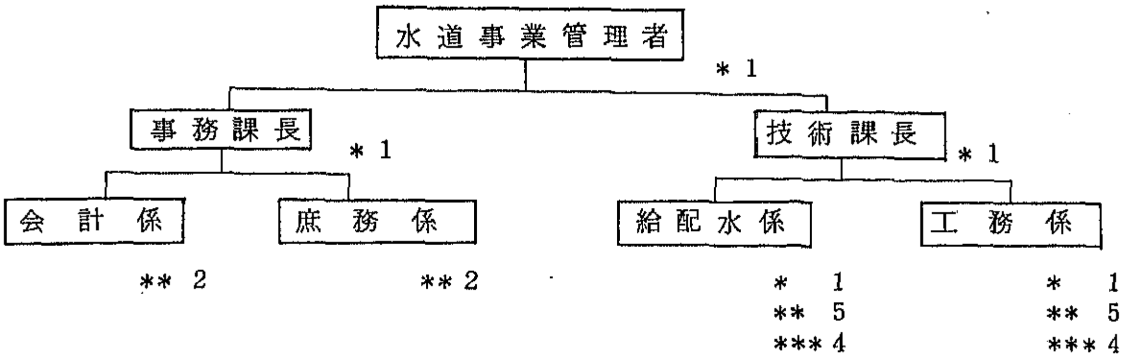
1）組織

水道施設の維持管理は、地区開発委員会（地方自治体）が総ての責任を負っており、本プロジェクトも地区開発委員会のもとに以下の体制で維持管理を実施させる必要がある。

ⅰ）水道事業の総括を行う水道事業管理者を置く。

ⅱ）水道事業管理者のもとに、技術面の維持管理責任者として技術課長を置き、その下に、工務係および給配水係を置く、工務係は水源から貯水槽までを、給配水係は主管、枝管および給水栓までの維持管理をそれぞれ担当させる。また事務面の担当課長を置き、その下に庶務係および会計係を置き、維持管理に伴う事務を担当させる。

水道事業の組織および人員配置は次の通りである。



＊　高級職員
＊＊　一般職員
＊＊＊雇員

備考：水道事業管理者は地区開発委員会委員長が兼任する場合もある。

2）業務

業務は、技術面と事務面に分けるが、事務面については省略する。

技術面は、技術管理者の下に次の項目についての維持管理を行う。

a）水源およびその付帯設備

水源の維持管理は、報告書別刷ガイドラインに記載してあるので省略する。

?

b）浄水場および貯水槽

浄水場および貯水槽は常に最良の状態で運転を行わなければならない。

また年1回はこれらの施設を点検し、必要に応じて修理を行う。

c）配水施設

配水管をへて給水栓に至る間は市街地を通過するので、配水管の損傷による漏水または汚水の流入を防ぐようにし、漏水調査を実施し損傷箇所を早期に発見し手当てを行う。

How ?

3）サービス

水道施設は地域住民に対する公共サービスであるから、特に都市飲料水を対象とする本プロジェクトにおいては、その給水が一時的であっても中断することのないように、常時その維持管理に努めなければならない。

4）維持管理費

維持管理費は地区開発委員会が水道料金収入によりこれを賄うことが原則である。

このためには維持管理費およびその他経費の算定を行いこれに基き水道料金体制

守け?

（水使用税、水道使用料）を定めなければならない。Magwe及びPromeにおける1井当りおよび全井戸の年間維持管理費の概算は次の通りである。（1981年8月、算定基準1 kyat ≒ 30円）

Magwe

a） Energy Cost：15kW×18hrs×365days×0.25k/kW= 24637.5 kyats/year

Operating and Security ：4320.0 kyats

Total Operation Cost ：28957.5 kyats/well/year

b） Maintenance Cost ：

Maintenance ：3,000.0 kyats

Electrical Component ：1,000.0 kyats

Total maintenance Cost：4,000 kyats/well/year

c） Overall Cost：32,937.5 kyats/well/year.

d） Magwe 17 wells Cost：559,937.5 kyats/year

Prome

a） Energy Cost

Operating and Security：30kW×18hrs×365days×0.25 k/kW= 49275 kyats/year

Total Openation Cost：4320 kyats

b） Maintenance Cost：53595.0 kyats/well/year

Maintenance ：3,000.0 kyats

Electnical Component：1500.0 kyats

Total Maintenance Cost：4,500.0 kyats/well/year

c） Overall Cost：58095 kyats/well/year

d） Prome 15 wells Cost：871,425 kyats/year

井戸の年間維持管理費は、Magwe：560,000 kyats/year（17,000千円/年）Prome：872,000 kyats/year（26,000千円/年）である。

給配水関係の維持管理の人件費は、従事者の構成及び年間経費は管理者を除き両地区とも略々同様で次の通りである。

職種	人数	年間経費	合計経費（kyats）
Sub Assistant Engineer(課長)	1	6,300	6,300
Junior Engineer（係長）	2	5,040	10,080
Engineer Grade (1)（係員）	2	3,600	7,200
〃 (2)（〃）	4	3,360	13,440
〃 (3)（〃）	4	2,520	10,080
Labour（雇員）	8	2,160	17,280
	21人		≑ 65,000 kyats. （1,950千円/年）

給配水関係の維持管理費は、管理者の人件費、上記21人の人件費と共に、維持管理資機材費、消耗品、事務費等の積算が年間の経費となるものである。

上記の水源井および給配水関係費用の他に、その他経費を加算したものが、年間の維持管理費の総額となるもので、年間約80,000 kyats（2,400千円）と算定される。

Magwe における維持管理費の総額の概算は640,000 kyats（19,200千円）

Prome においては約950,000 kyats（28,500千円）である。

[illegible] 円

第６章　プロジェクトと無償資金協力

第6章　プロジェクト無償資金協力

6－1　無償資金協力の対象

本プロジェクトを実施するために必要な外貨部分は資機材を中心とするもので、その全体概算工事費の区分表を表・6－1－1に示す。

表・6－1－1　全体概算工事費区分表

単位：千円

	資機材		労務費	合計	全体工事費に対する%
	外貨	内貨	内貨		
日本	830,000	－	－	830,000	43
ビルマ	293,063	394,544	408,393	1,096,000	57
合計	1,123,063	394,544	408,393	1,926,000	100
全体工事費に対する%	58.3	20.5	21.2	100	

（1981年8月算定）

全工事費1,926,000$^{\text{千円}}$のうちビルマ国負担分は1,096,000$^{\text{千円}}$となりその比率は約57%である。

ビルマ国側はこれら資機材を用いて3年以内にMagweおよびPromeの都市水道施設を完成させるものである。

これら資機材を選定するに当っては現地調査時、1981年8月12日に交換したミニッツの議事録を中心に、ビルマ側の優先順位および日本側の無償資金協力の各種制約条件を考慮して以下のプライオリテイを以て選定に当ることとした。

1）さく井機械および付属品

2）ポンプ等の井戸設備

3）地上設備機材

4）導水施設用材料

以上に基く日本側負担区分を表・6－1－2に示した。

表・6－1－2　日本側負担分区分表

単位：千円

項　　　目	Magwe	Prome	合　計
さく井機械および付属品	234,360	234,360	468,720
井戸設備費及び地上設備機材費	110,801	117,466	228,267
導水施設用材料	63,643	69,370	133,013
合　　　計	408,804	421,196	830,000

この無償供与資機材を用いて事業を実施するに当っては、ミニッツの議事録に基きビルマ政府は次の事項を行う必要がある。

i）水道建設事業実施詳細設計を行うこと

ii）水道施設に必要な土地の確保を行うこと

iii）このプロジェクトのビルマ国内工事に必要なすべての費用に関する予算措置を講ずること。

本プロジェクトは、Magweにおいては旧水道施設を吸収した形で、またPromeにおいては旧水道施設を本プロジェクトとは別に補修拡張した形で行う計画であるが、新施設との間にアンバランスとならないような措置が必要である。特にMagweにおいては表流水と地下水が混合して配水されるので既存施設の改良工事をビルマ国側において予算措置を講じて早急にこれを実施に移すことが必要である。

6－2　無償資金協力対象資機材

6－2－1　資機材の選択方針

資機材の選択は下記の方針に従い選定した。

1）個々の資機材の選定基準に合致すること。

2）ビルマ国の国状に適応していること。

3）日本国内におけるこの種の製品は、信用あるメーカー品であること。

4）機能的に優れたものであること。

5）堅牢かつコンパクトなこと。

6）取扱が簡単で特殊な熟練を要しないものであること。

7）耐久性に優れていること。

8）保守、維持管理が容易であること。

6－2－2　さく井用資機材

6－2－2－1　さく井機

1）選定基準

選定は次の基準に従った。

ⅰ）ダイレクトサーキュレーション工法により大孔径（300～400㎜）で掘さく可能なこと。

ⅱ）高能率で、保守、点検、修理がビルマ国内で十分可能なこと。

ⅲ）ビルマにおいて最も一般的に使用されているさく井機と同形式のものであること。

ⅳ）地域間、井戸間の移動が簡単なコンパクトタイプであること。

ⅴ）ビットその他付属品は、掘さくの能率を促進し、かつ経済的であること。

2）仕様および数量

ⅰ）選定基準に従いさく井機の基本方式は機械的動力伝達機構を有するロータリーテーブルタイプとし、簡便な輸送および、移動を考慮し、全輪駆動形トラック塔載方式を採用する。また、メインテイナンス箇所の削減を計るため、さく井用原動機はトラックエンジンと共用するものとする。本計画には、生産井、調査井及び観測井の3種類の井戸掘さくが必要であるが、各井戸の計画掘さく深度、孔径など異るため、補助機器を取りつけることにより、総ての井戸が掘さく可能となるような機能のあるさく井機とする。このことはまた維持管理の簡素化につながるものである。

ビットは地層から判断し、掘さく能率が高く経済的なトリコンビットを主とし、口切り及び軟弱層用のウイングビットを選定する。

ⅱ）さく井機の台数は、3－4－6および4－4－6の項に示す作業工程により、2ケ年以内に生産井を2地域で完成させるためには、生産井および調査井を同一さく井機で兼ねて行うことは不可能であるため、夫々専用機を必要とし、各地域にそれぞれ2台、計4台のさく井機が必要である。

ⅲ）付属品は生産井、調査井、観測井に相互に用いられるものとする。

6－2－2－2　エアコンプレッサー

1）選定基準

ⅰ）生産井（深度110～150m）の井戸掘削後の孔内洗滌に適したものであること。

ⅱ）調査井（深度150～250m）の孔内洗滌およびエアリフト揚水試験用に適したものであること

ⅲ）移動に便利であること

2）仕様及び数量

ⅰ）トレーラー搭載形のものを選定し、生産井用は低圧で空気量大のもの､調査井は高圧のものとする。

生産井用：7 Kg/㎠、10.53 ㎥/min

調査井用：10.5Kg/㎠、8.5 /㎥/min

ⅱ）作業能率増進のため、さく井機1台につき、エアコンプレッサー1台を配置するものとし、計4台

6－2－2－3　車輌関係

1）選択基準

ⅰ）重量貨物輸送車

ⅱ）軽量貨物輸送車

ⅲ）作業用水供給車

2）仕様および数量

ⅰ）重量物の積上げ積下し用とし、能力7m、3500Kgのクレーン付カーゴタイプを選定し、トラックはさく井機と同一社製を採用する。Magwe，Promeに各1台計2台

ⅱ）軽量貨物の積上げ積下し用とし、クレーン付カーゴタイプとし、各地区2台計4台

ⅲ）積載水量約8,000ℓのタンクローリー車を採用し、トラックはさく井機と同社製のものとし、Magwe，Promeに各1台、計2台

6－2－2－4　電気検層機

1）選定基準

ⅰ）測定に簡便であり、自動記録型であること。

ⅱ）測定項目は、地下水調査に適した項目であること。

2）仕様および数量

ⅰ）自動記録型電気検層機のうち、小型車輛に積み運搬可能であり、また測定項目として、電気比抵抗、自然電位、γ検層および水温の測定可能な機種とする。

ⅱ）数量は、MagweおよびPromeに各1台、計2台

6－2－2－5　その他さく井関連機器

その他さく井関連機器は、資機材の選択方針に従い、調査地区に適応し、またさく

井を能率も良く、安全に、また経済性に富んだものをその関連機器として選択する。その仕様と数量は次のとおりである。

1）水位計

ⅰ）揚水試験水位観測用としては簡便なタイプのものを採用する。

数量は、本井、観測井、各1個計2個、2地区分計4個

ⅱ）水位観測用、４５日自動巻とし、1地区3ヶ所、2地区分計6台

2）溶接器

ⅰ）トローリー塔載型の現場溶接作業に適した仕様とする。2地区に各1台計2台

3）水質試験器

揚水試験時に、簡易に水質試験を行うもので、試験項目はpH、電気伝導度、鉄、cℓ等を測定仕様とし、2地区に各1台、計2台

6－2－2－6　スペアパーツ

スペアパーツは、さく井機本体、トラックエンジン、掘削用付属品等を中心に2年間の工事期間に必要なものを挙げ、その仕様数量とした、これら部品の概略目標数量は本体の約１５～２０％である。

6－2－3　井戸用資機材

井戸用資機材は井戸材料、スクリーン、揚水ポンプ、受配電設備およびそれらの補給部品とする。

6－2－3－1　井戸側管

井戸側管は掘削時の地表部の崩壊防止のため一時的に設置する口元管及び井戸側管とする。側管の仕様はＪＩＳ（Japanese Industrial Standard）によるため、特に選定の基準は設けず、また詳細な仕様および数量もこれを省略した。

1）口元管

掘削時の地表部の崩壊を防ぐためのもので、掘削終了後抜管する。

仕様：ソケット付炭素鋼鋼管（ガス管）ネジ付　ＪＩＳ　Ｇ３４５２

口径：３５０*m/m*　，１８０*m/m*

2）ケーシングパイプ（生産井用）

生産井用ケーシングパイプの材質は井戸寿命に直接かかわるため、高級材質のパイプを使用する。

仕様：短ネジケーシング、カップリング付、　ＡＰＩ規格Ｊ－５５

口径：２５０m/m，200m/m

3）ケーシングパイプ（調査井用・観測井用）

調査井用および観測井用のケーシングパイプは、殆どの井戸において一時的に使用するもののため普通の鋼管を使用し、接続はネジソケット付とした。

仕様：ネジソケット付　ＪＩＳ　Ｇ３４５２

口径：１００m/m（調査井・水位観測井）、５０m/m（観測井）

６－２－３－２　スクリーン

1）選定規準

スクリーンサイズは帯水層サンプルの篩分け分析データにより決定されるが、調査地域の地質を勘案して、砂層に対して一般に使用される１㎜スリットを採用した。

2）仕様および数量

仕様　ⅰ）管径：２００m/m

ⅱ）Ｖ形連続スロット、スロットサイズ１㎜

ⅲ）ステンレススチール製

数量　　スクリーン長、各井２０m

６－２－３－３　揚水ポンプ

1）揚水ポンプは、ビルマ国においては種々なポンプが使用されているが、次の理由により水中モーターポンプを選定することとした。

ⅰ）Magwe，Promeには電力の供給がなされ、変圧設備も本プロジェクトに組入れられている。

ⅱ）揚水に伴う水位降下も予想され、水中モーターポンプは最もよくそれに対応しうる。

ⅲ）機種の選定に従い、揚程を自由にとることができる。

ⅳ）保守点検が容易で耐久性がある。

ⅴ）水位の観測が容易である。

2）仕様および数量

	揚水量 ℓ/min	揚程 m	kW	台数	対象地域
ⅰ）	６５０	８０	１５	１７	Magwe
ⅱ）	９５０	９０	３０	１３	Prome
ⅲ）	９５０	５０	１５	２	Prome

6－2－4　変圧器及び送電線

1）変圧器は、生産井の位置ならびに使用する水中モーターポンプの容量により電圧降下を考慮に入れて選定する。計画地域に11,000Vで送電されたものを、水中モーターポンプ入力400Vに変圧する。変圧器の設置地域、容量等の仕様、数量は次表6－2－4－1の通りである。

表・6－2－4－1　Specifications of Transformers

地域名	使用井戸番号	変圧器設置場所	変圧器容量	1次電圧	2次電圧	数量
Magwe	号 1～6号	3号井を基点	300kVA	11,000V	460V 440V 420V 400V	1
	7～17号	13号井を基点	500kVA	11,000V	460V 440V 420V 400V	1
	7，11号	13号井を基点	10kVA			2
Prome	1～7号	4号井を基点	600kVA	11,000V	480V 460V 440V 420V 400V	1
	8～13号	13号井を基点	600kVA	1,000V	460V 440V 420V 400V	1
	14～15号		100kVA	11,000V	440V 420V 400V	1

2）送電線

送電線は、第2次電圧を各モーター位置まで送電し、400Vに電圧降下させるに適したものとし、3芯、22mm^2を使用する。

送電線延長：Magwe　11,700 *m*

Prome　9,300 *m*

6.3 SPECIFICATION AND QUANTITY OF GRANT AID EQUIPMENT AND MATERIALS

Description of Equipment and Materials Supplied through the Grant Aid

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	TECHNICAL SPECIFICATIONS		
A.	WATER WELL DRILLING RIGS & SUPPORTING EQUIPMENT		485,900
1.	Truck Mounted Water Well Drilling Rig, Rotary Table Type, Complete with Accessory Equipment for Production Well	2 Units	166,000
1.1	Truck Mounted Water Well Drilling Rig	2 Units	45,000 90,000

General: The rig shall be truck mounted rotary table type, driven by truck engine P.T.O. and cable of drilling 250 to 450mm up to 200 to 300 metres deep with 2-7/8" drill pipes.

Rotary Table: The rotary table, having 133mm (5-1/4") opening dia. with hydraulic retraction of clearance for running 16" casing, driven through 4 forward and 1 reverse speed transmission and spiral bevel gears.

Pull Down: Hydraulically actuated wire rope pull down of minimum stroke of 7 meters. The rig shall be equipped with holding back system for moving the pull down swivel and kelly back into the mast, away from the centre line of the hole to give clearance of minimum 350mm.

Drawworks: Single drum type with air actuated disc clutch, having spooling capacity of minimum 85m with 25mm wireline and single line pull of 4,500kg.

Sand Reel: Single drum type with air actuated disc clutch, having spooling capacity of minimum 500m with 9mm wireline and single line pull of 3,000kg.

Mast: Ladder type electrically welded steel tubular construction, having total gross capacity of 20,000kg and hook load capacity of 10,000 hydraulically raised and lowered.

Mud Pump: 5" × 5-1/8" duplex reciprocating type, having maximum delivery capacity of 600ℓ/min. and maximum pressure of $25kg/cm^2$., driven from main compound case of the rig.

Compound Case: Chain drive, fully enclosed, oil bath lubricated.

Oil Cooler: The rig shall be equipped with radiator type air cooling system for hydraulic system.

Rig Frame: Fabricated steel construction, covered with non-slip plates and safety guards where necessary. A pipe rack of handling approx. 15 pcs. of 2-7/8" × 6m drill pipes shall be equipped.

Controls: All controls, except for those not used for drilling operation, shall be located at driller's position on one side of the rig.

Tubing Tongs: Built-in tubing tongs used with the hydraulic breakout cylinder for breakout power. The hydraulic breakout cylinder shall be mounted inside the mast.

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	Trucks: One, first class maker and 4 × 4 left hand steering type with cab of latest model, tyre size of 11.00 - 20 - 14 PR. The engine of the truck shall be 4 cycle, vertical 6 cylinders in line, having maximum output of 140 HP at 2,500 rpm. The truck shall be serviceable in Burma. Levelling Jacks: Four hydraulic levelling jacks with safety clevis shall be fitted. Lighting: The current source for the night operation lighting shall be obtained through truck engine battery.		
1.2	Standard Accessories Standard accessories for drilling rig, such as disassembling tools, 50mm × 10m long high pressure delivery hose, 100mm × 4.5m long suction hose, wire ropes, drill pipe elevator, 305mm single sheave travelling block, 3" × 26' kelly bar, drill pipe spider, screen for gravel packing, sampling sieve, etc.	2 Sets	6,340 12,680
1.3	Operating Tools Operating tools, including 2-7/8" × 6m long drill pipes, 7" × 3m long drill collars, bit stabilizers for 12-1/4" and 10-5/8" drill holes, 14-3/4" three wing bits for starting, 12-1/4" and 10-5/8" three wing bits, 14-3/4" to 10-5/8" three cutter rock roller bits, various bit subs, casing handling tools, such as casing elevators, elevator links, etc. and other necessary fishing tools.	2 Sets	11,270 22,540

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
1.4	Miscellaneous Tools	2 Sets	390 780
	450mm to 1,200mm pipe wrenches, super tongs, other necessary engineering tools, etc.		
1.5	Supplies for Standard Accessories and Operating Tools	1 Lot	30,000
	Supplies for standard accessories and operating tools, including spare parts for swivel, hoisting and sand reel wire ropes, 2-7/8" × 6m long drill pipes, 7" × 3m long drill collars, bit stabilizers for 12-1/4" and 10-5/8" holes, 13" and 12-1/4" three wing bits, 14-3/4" to 10-5/8" three cutter rock roller bits, bit subs, hoses, miscellaneous tools, etc.		
1.6	Air List and Test Pumping Equipment	2 Sets	5,000 10,000
1.6.1	Operating Accessories for Air-Lift	2 Sets	700 1,400
	Operating accessories for air-lift, such as 3" × 5.5m water pipes with coupling, 3" × 3m and 3" × 1.5m long water pipes with coupling, 1" air pipes, 1" air hoses, 3" manifold assembly, 8" × 6m dart valve bailer, and other handling tools for air-lift.		
1.6.2	Test Pumping Equipment	2 Units	4,300 8,600
1.6.2.1	Electrical submersible multistage turbine pump capacity 950ℓ/min., T.D.H. 50m, 4 nos. of stage, 8" well diameter, 2,850 rpm. revolution speed, required power of 15KW, complete with pipe clamp, discharge pipes, electric starter, electrode and other necessary accessories	2 Sets	1,250 2,500

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
1.6.2.2	Diesel engine generator, having rated output of 20KVA, 3 phase, rated speed of 1,500 rpm., driven by diesel engine, having displacement of 2,530 litres, brake horsepower of 26 HP rated engine speed of 1,500 rpm., electrically started, complete with non-vibrating system, anchor bolts and all necessary accessories.	2 Units	3,050 6,100
2.	Truck Mounted Water Well Drilling Rig, Complete with Drilling Accessory Equipment	2 Units	168,000
2.1	Truck Mounted Water Well Drilling Rig	2 Units	45,000 90,000
	<u>General</u>: The rig shall be truck mounted rotary table type, driven by truck engine P.T.O. and capable of drilling 200mm hole up to 300 metres deep with 2-7/8" drill pipes.		
	<u>Rotary Table</u>: The rotary table, having 133mm (5-1/4") opening dia. with hydraulic retraction of clearance for running 16" casing, driven through 4 forward and 1 reverse speed transmission and spiral bevel gears.		
	<u>Pull Down</u>: Hydraulically actuated wire rope pull down of minimum stroke of 7 metres. The rig shall be equipped with holding back system for moving the pull down swivel and kelly back into the mast, away from the center line of the hole, to give clearance of minimum 350mm.		
	<u>Drawworks</u>: Single drum type with air actuated disc clutch, having spooling capacity of minimum 85m with 25mm wireline and single line pull of 4,500kg.		

Sand Reel: Single drum type with air actuated disc clutch, having spooling capacity of minimum 500m with 9mm wireline and single line pull of 3,000kg.

Mast: Ladder type electrically welded steel tubular construction, having total gross capacity of 20,000kg and hook load capacity of 10,000, hydraulically raised and lowered.

Mud Pump: 5" × 5-1/8" duplex reciprocating type, having maximum delivery capacity of 600ℓ/min. and maximum pressure of 25kg/cm^2, driven from main compound case of the rig.

Compound Case: Chain drive, fully enclosed, oil bath lubricated.

Oil Cooler: The rig shall be equipped with radiator type air cooling system for hydraulic system.

Rig Frame: Fabricated steel construction, covered with non-slip plates and safety guards where necessary. A pipe rack of handling approx. 15 pcs. of 2-7/8" × 6m drill pipes shall be equipped.

Controls: All controls except for those not used for drilling operation shall be located at driller's position on one side of the rig.

Tubing Tongs: Built-in tubing tongs used with the hydraulic breakout cylinder for breakout power. The hydraulic breakout cylinder shall be mounted inside the mast.

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	Trucks: First class maker's one and 4 × 4 left hand steering type with cab of latest model, tyre size of 11.00 - 20 - 14 PR. The engine of the truck shall be 4 cycle, vertical 6 cylinders in line, having maximum output of 140 HP at 2,500 rpm. The truck shall be serviceable in Burma.		
	Levelling Jacks: Four hydraulic levelling jacks with safety clevis shall be fitted.		
	Lighting: The current source for the night operation lighting shall be obtained through truck engine battery.		
2.2	Standard Accessories	2 Sets	6,340 12,680
	Standard accessories for the drilling rig, including disassembling tools, 50mm × 10m high pressure delivery hose, 50mm intermediate hose, mixing and return hose, 100mm × 4.5m suction hose, hoisting and sand reel wire ropes, 2-7/8" drill pipe elevator, 305mm single sheave travelling block, 3" × 26' kelly bar, 2-7/8" drill pipe spider and other necessary lowering and lifting equipment.		
2.3	Operating Tools	2 Sets	11,270 22,540
	Operating tools, including 2-7/8" × 6m long drill pipes, 5" × 3m long drill collars, bit stabilizers for 5-1/4" hole, 115mm × 3m long wing type guide rods, 8-1/2" three wing bits for starting, 6-1/4" and 4-3/4" three wing		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	bits and three cutter rock roller bits, various bit subs, casing handling tools such as casing elevators, elevator links, etc. and fishing tools.		
2.4	Miscellaneous Tools	2 Sets	390 780
	1,200mm to 450mm pipe wrenches, super tong, engineering tools, etc.		
2.5	Supplies for Standard Accessories and Operating Tools	1 Lot	40,000
	Including spare parts for swivel, hoisting and sand reel wire ropes, 2-7/8" × 6m long drill pipes, 5" × 3m long drill collars, bit stabilizers for 6-1/4" hole, 115m × 3m long wing type guide rods, 8-1/2" three wing bits for starting, 6-1/4" and 4-3/4" three wing bits and three cutter rock roller bits, various subs, high pressure delivery hoses, suction hoses and other necessary hoses, miscellaneous tools, etc.		
2.6	Air-lift Equipment	2 Sets	1,000 2,000
2.6.1	Operating Accessories for Air-lift	2 Sets	
	Operating accessories for air-lift, such as 3" × 5.5m, 3m and 1.5m long water pipes with coupling, 1" × 5.5m, 3m, 1.5m long air pipes with coupling, 1" air hoses, 3" manifold assembly, 6" × 6m dart valve bailers, and other necessary handling tools for air-lift.		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
3.	Trailer Mounted Portable Air Compressor	2 Units	15,000
3.1	Air compressor, rotary sliding vane type, single-stage, portable engine compressor with tyre wheels, working pressure of 7kg/cm^2, actual free air delivery of 10.5m^3/min., rated speed of 1,800 rpm., driven by a water-cooled diesel engine of 110 PS at 1,800 rpm., complete with 0.315m^3 capacity separator receiver.	2 Units	3,500 7,000
3.2	Air compressor, screw type, single stage, portable engine compressor with tyre wheels, working pressure of 10.50kg/cm^2, actual free air delivery of 8.5m^3, rated speed of 1,500 rpm., driven by a water-cooled diesel engine of 110 PS at 1,800 rpm., complete with 0.315m^3 capacity separated receiver.	8 Units	4,000 8,000
4.	Cargo Type Heavy and Light Truck with Crane, and Tank Lorry	8 Units	54,000
4.1	Cargo Type Heavy Truck with Crane	2 Units	10,000 20,000
	The truck shall be of same as rig carrier truck. The truck shall be standard cargo type, left hand drive, 4 × 4, having G.V.W. rating of 13,700kg, max. speed of 83kg/h., max. gradeability of 46.9%, min. turning radius of approx. 9,700mm. The truck shall be driven by a diesel engine of 4 cycle, vertical 6 cylinders, in-line, valve-in-head, water-cooled, max. output of 140 HP at 2,500 rpm., precombustion chamber type combustion system. The truck shall be equipped with hydraulically controlled dry single plate with damper spring		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	type clutch, five-speed transmission, two-speed constant mesh with herical gearings transfer, full-floating single-reduction single speed rear axle of 9,200kg axle capacity, 4,550kg capacity front axle, 11.00 - 20 - 14 PR tyres, 115 litres single fuel tank, welded all steel construction cab, necessary electrical equipment. The crane of truck shall be HIAB type with double telescoping hydraulic extension boom, lifting capacity of 3,500kg at 7m, hydraulic standard reach of 5.0m and hydraulic extension boom travel of 1.6m.		
4.2	Cargo Type Light Truck with Crane The truck shall be standard cargo type, left hand drive, more than 2,000 litre diesel engine of cycle, vertical 4 cylinder.	4 units	3,500 14,000
4.3	Tank Lorry for Water The truck shall be of same as rig carrier truck. The truck shall be standard cargo type, left hand drive, 4 × 4, having G.V.W. rating of 13,700kg, maximum speed of 83kg/h., maximum gradeability of 46.9% minimum turning radius of approx. 9,700mm. The truck shall be driven by a diesel engine of 4 cycle, vertical 6 cylinders, in-line, valve-in-head, water-cooled, maximum output of 140 HP at 2,500rpm., precombustion chamber type combustion system. The truck shall be equipped with hydraulically controlled dry single plate with damer spring type clutch, five-speed transmission, two-speed constant mesh with herical gearings transfer, full-floating single-reduction single speed rear	2 Units	10,000 20,000

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	axle of 9,200kg axle capacity, 4,550kg capacity front axle, 11.00 - 20 - 14 PR tyres, 115 litres single fuel tank, welded all steel construction cab, necessary electrical equipment. The water tank mounted on the truck shall be ellipse sectional cylindrical type, protected against axidation, tank volume of 8,054 litres, maximum loading capacity of 7,500 litres, inside length of 4,160mm, inside major axis of 2,200mm, inside minor axis of 1,150mm, thickness of shell of 3.2mm. The truck also shall be equipped with self-priming pump, driven by transmission P.T.O., having capacity of 300 liters min. at 3,600rpm. and pressure of 3.0kg/cm^2.		
5.	Water Testing Equipment	1 Unit	12,900
5.1	Well Logging Equipment The well logging equipment shall be light weight and compact enable to log S.P. caliper, temperature, and natural gamma-ray. Each logging shall be performed by replacing measuring module and sonde with applicable combination, complete with necessary accessories to maximum depth of 300 metres.	2 Units	4,000 8,000
5.2	Portable Water Analysis Laboratory Kit	2 Units	900 1,800
5.3	Water Level Indicator with Self Recording System The instrument shall detect changes in water level of ground water in the well and shall record them on a strip chart by co-axial 2 pens for a long period, having accuracy of	6 Sets	500 3,000

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
	0.1% of maximum measuring depth, 2 pen recording system, feeding speed of 18mm/h for 45 days or 6mm/h for 100 days selectable by gear sliding, input shaft of 1m per 1 rotation, circumference of 1 metres co-axial pulley, power source from 1 pc. of UM-2 dry cell, complete with float and wire.		
5.4	Portable Water Level Indicator	4 Sets	25 100
	The instrument shall take an accurate measurement of the water level in the well and shall never work when the electrode touch the well casing or drips of water from the upper strainer while lowering it into the well, having measuring depth of 100m, accuracy of 1mm, operating range of 0 - 300KΩ of earthing resistance, power source from 2 pcs. of UM-3 dry cell, complete with an electrode and ground cord.		
6.	Other Supporting Equipment	1 Lot	5,000
6.1	Welding Equipment	2 Units	500 1,000
	The welding equipment shall be trolly mounted diesel engine drive D.C. arc welder and A.C. power, having non-load voltage of 60 - 80V, arc voltage of 25V, duty cycle of 40%, current range of 50 - 200A for D.C. welder and rated of 100 - 200V, single phase, 100% power factor, rated speed of 3,000 rpm. The unit shall be driven by 11 PS at 3,000 rpm. water-cooled diesel engine, complete with necessary accessories.		
6.2	Other Suppoting Eguipment	1 Lot	4,000

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
7.	Spare Parts and Supplies (Approx. 15%)	1 Lot	65,000
7.1	Spare Parts for Drill Rig	1 Lot	45,000
7.1.1	Spare Parts for Drill Unit (for 4 sets)	1 Lot	15,380
7.1.2	Spare Parts for Mud Pump (for 4 sets)	1 Lot	13,580
7.1.3	Spare Parts for Truck (for 8 sets)	1 Lot	16,000
7.1.4	Spare Parts for Lighting Set (for 4 sets)	1 Lot	40
7.2	Spare Parts for Air-Compressor, Rotary Type (for 2 sets)	1 Lot	1,400
7.3	Spare Parts for Air-Compressor, Screw Type (for 2 sets)	1 Lot	1,600
7.4	Spare Parts for Submersible Pump and Diesel Generator	1 Lot	1,680
7.4.1	Spare Parts for Submersible Motor Pump (for 2 sets)	1 Lot	480
7.4.2	Spare Parts for Diesel Generator (for 2 sets)	1 Lot	1,200
7.5	Spare Parts for Welder (for 2 sets)	1 Lot	200
7.6	Spare Parts for Electric Logging Equipment	1 Lot	600
7.7	Spare Parts for Water Level Indicator with Self Recording System	1 Lot	450
7.8	Spare Parts for Portable Water Level Indicator	1 Lot	120
7.9	Spare Parts for Electric Submersible Pump for Production Wells	1 Lot	8,000
7.10	Spare Parts for Transformer (for 4 Sets)	1 Lot	1,950

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
B.	WATER WELL MATERIALS		228,267
1.	Well Casings		75,827
1.1	350mm temporary casing with screw and socket, JIS 3452 SGP for production wells	40 Metres	20 800
1.2	175mm temporary casing with screw and socket, JIS 3452 SGP for exploratory and observation wells	40 Metres	7.8 312.0
1.3	10-3/4" API casing pipe with coupling, 273mm O.D., 8.89mm thickness, 255.2mm I.D., J-55	1,280 Metres	17.9 22,912.0
1.4	8-5/8" API casing pipe with coupling, 219.1mm O.D., 772mm thickness, 203.7mm O.D., J-55	2,200 Metres	12.59 27,698.0
1.5	100mm casing pipe with screw and socket, 114.3mm O.D., 4.5mm thickness, 105.3mm I.D., JIS 3452 SGP	3,670 Metres	2.47 9,064.9
1.6	100mm strainer pipe with screw and socket, 114.3mm O.D., 4.5mm thickness, 105.3mm I.D., JIS 3452 SGP, opening area, approx. 4% slot size 1.5mm	480 Metres	8.5 4,080.0
1.7	50mm casing pipe with screw and socket, 60,5mm O.D., 3.8mm thickness 52.9mm I.D., JIS 3452 SGP	7,810 Metres	0.8 6,248.0
1.8	50mm strainer pipe with screw and socket, 60.5mm O.D., 3.8mm thickness, 52.9mm I.D., JIS 3452 SGP, opening are approx. 4% slot size 1.5mm	1,240 Metres	3.8 4,712.0

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
2.	Well screen, size 8-5/8" with coupling stainless with V-shaped continuous slot. Opening area shall be approx. 20% and slot size shall be 1mm.		640 Metres	87 55,680
3.	Electrical Submersible Multistage Turbine Pump		32 Units	51,482.1
3.1	Capacity 650ℓ/min., T.D.H. 80m		17 Units	1,342.1 22,815.7
	(Specifications)			
A)	Pump Specifications			
	Type:	Submersible motor pump shall have built-in thrust bearing which can stand up to double expected load.		
	No. of stages:	8		
	Well diameter (I.D.):	10"ϕ (250mm)		
	Discharge bore size:	65mm		
	Discharge capacity:	650ℓ/min.		
	Total dynamic head:	70m		
	Revolution speed:	2,850 rpm.		
	Red. power:	15KW		
	Liquid pumped:	Water		
B)	Material Construction of Pump Main Parts			
	Casing:	Cast iron		
	Impeller:	Bronze		
	Shaft:	Stainless steel		
	Sleeves:	Bronze		
	Bearings (Bush):	Bronze		

単位 千円
上段 単価
下段 合計

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY
C)	Submersible Motor	
	Type: Wet type water filled submersible motor.	
	Voltage × phase × cycle: 400V × 3ph. × 50Hz	
	No. of poles: 2	
	Insulation class: E	
	Starting method: Star-delta starting	
	Submersible electrical cable :2 nos. (Cores × 3.5mm sq. 85m length)	
D)	Accessories (per pump)	
	Pipe clamp w/90° bend pipe	1 set
	Discharge pipe	80 pcs.
	Electric starter	1 set
	Wall-mounting type, indoor use star-delta starting	
	Equipped with following;	
	Magnetic contacts (Thermal relay, overload, single phase protection)	
	Low voltage protection	
	Ammeter, pilot lamp, push button switch (on off)	
	Water level relay, control panel.	
	Electrode for stopping the pump at low water level	1 set
	Slide valve	1 pc.
	Check valve	1 pc.
	Compound gauge (w/cock)	1 pc.
	Cable clamp (5.5 length)	1 pc.

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
3.2	Capacity, 950ℓ/min., T.D.H. 90mm		13 Units	2,0128 26,1664
	(Specifications)			
A)	Pump Specification			
	Type:	Submersible motor pump shall have built-in thrust bearing which can stand up to double expected load.		
	Number of stages:	4		
	Well diameter:	10"φ (250mm)		
	Discharge bore size:	100mm		
	Discharge capacity:	950ℓ/min.		
	Total dynamic head:	90m		
	Revolution speed:	2,850 rpm.		
	Req. power:	30KW		
	Liquid pumped:	Water		
B)	Materials Construction of Pump Main Parts			
	Casing:	Cast iron		
	Impeller:	Bronze		
	Shaft:	Stainless steel		
	Sleeves:	Bronze		
	Wearing ring:	Bronze		
	Bearing (Bush)	Bronze		
C)	Submersible Motor			
	Type:	Wet type water filled submersible motor.		
	Voltage × phase × cycle:	400V × 3ph. × 50Hz		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
	No. of poles:	2		
	Insulation class:	E		
	Starting method:	Star-delta starting		
	Submersible electrical cable: (Cores × 8mm sq. × 3 phase 95m)	2 nos.		
D)	Accessories			
	Pipe clamp w/90° bend pipe	1 set		
	Discharge pipe	90 pcs.		
	Electric starter	1 set		
	Well-mounting type, indoor use Star-delta starting			
	Equipped with following;			
	Magnetic contactors (Thermal relay, overload, single phase protection)			
	Low voltage protection			
	Ammeter, pilot lamp, push button switch (on off)			
	Water level relay, control panel			
	Electrode for stopping the pump at low water level	1 set		
	Slide valve	1 pc.		
	Check valve	1 pc.		
	Compound gauge (w/cock)	1 pc.		
	Cable clamp (5.5 length)	1 pc.		
3.3	Capacity 950ℓ/min., T.D.H. 50m		2 Units	1,250 2,500
	(Specifications)			
A)	Pump Specifications			
	Type:	Submersible motor pump shall have built-in thrust bearing		

単位 千円
上段 単価
下段 合計

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY
		which can stand up to double expected load.	
	No. of stages:	6	
	Well diameter:	10"ϕ (250mm)	
	Discharge bore size:	100mm	
	Discharge capacity:	950ℓ/min.	
	Total dynamic head:	50m	
	Revolution speed:	2,850 rpm.	
	Req. power:	15KW	
	Liquid pumped:	Water	
B)	Materials Construction of Pump Main Parts		
	Casing:	Cast iron	
	Impeller:	Bronze	
	Shaft:	Stainless steel	
	Sleeves:	Bronze	
	Wearing ring:	Bronze	
	Bearing (Bush):	Bronze	
C)	Submersible Motor		
	Type:	Canned type, water filled submersible motor.	
	Voltage × phase × cycle:	400V × 3ph. × 50Hz	
	Number of poles:	2	
	Insulation class:	E	
	Starting method:	Star-delta starting	
	Submersible electrical cable: (Cores × 5.5mm sq. × 3 phase:	2 numbers 55m)	

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位千円 上段単価 下段合計
D)	Accessories		
	Pipe clamp, w/90° bend pipe	1 set	
	Discharge pipe	50 m	
	Electric starter	1 set	
	Wall-mounting type, indoor use star-delt starting		
	Equipped with following;		
	Magnetic contactors (Thermel relay, overload, single phase protection)		
	Low voltage protection		
	Ammeter, pilot lamp, push button switch (on off)		
	Water level relay, control panel		
	Electrode for stopping the pump at low water level	1 set	
	Slide valve	1 pc.	
	Check valve	1 pc.	
	Compound gauge (w/cock)	1 pc.	
	Cable clamp (5.5 length)	1 pc.	
4.	Delivery Pipes and Fittings, etc.	1 Set	7,500
5.	Transformer and Electric Wire	7 Units	37,778
5.1	Capacity 300KVA for No. 16 Wells in Magwe	1 Unit	3,200

General:	Standard on transformer shall be according to JEC-204 (1978)
Type:	Oil bath, lubricated.
Rated capacity:	300KVA
Number of phases:	3
Frequency:	50Hz
Coiling:	First coil: Delta Second coil: Star

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
	Insulation:	Type E		
	Input voltage:	11,000V		
	Output voltage:	460V, 440V, 420V, 400V		
	Dimensions:	(H) 1,635 × (W) 1,520 × (L) 985mm		
	Approx. weight:	2,440kg		
5.2	Capacity 500KVA for No. 7-17 Wells in Magwe		1 Unit	3,700
	General:	Standard on transformer shall be according to JEC-204 (1978)		
	Type:	Oil bath, lubricated		
	Rated capacity:	500KVA		
	Number of phases:	3		
	Frequency:	50Hz		
	Coiling:	First coil; Star Second coil; Delta		
	Insulation:	Type A		
	Input voltage:	11,800V		
	Output voltage:	460V, 440V, 420V, 400V		
	Dimensions:	(H) 1,785 × (W) 1,520 × (L) 1,115mm		
	Approx. weight:	2,980kg		
5.3	Capacity 10KVA for No. 7 & 11 Wells in Magwe for Raising the Voltage		2 Units	692
	General:	Standard on transformer shall be according to JEC-204 (1978)		
	Type:	Oil bath, lubricated		
	Rated capacity:	100KVA		
	Number of phases:	3		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
	Frequency:	50Hz		
	Coiling:	First coil; Star Second coil; Delta		
	Insulation:	Type A		
	Dimensions:	(H) 680 × (W) 550 × (L) 460mm		
	Approx. Weight:	160kg		
5.4	Electric Wire, Beare conductor Wire and Insulaters 3 core, 22mm^2 for Magwe		11,700 Meters	11,700
5.5	Capacity 600KVA for No. 1 ∿ 17 Wells in Prome		1 Unit	4,000
	General:	Standard on transformer shall be according to JEC-204 (1978)		
	Type:	Oil bath, lubricated		
	Rated capacity:	600KVA		
	Number of phases:	3		
	Frequency:	50Hz		
	Coiling:	First coil; Star Second coil; Delta		
	Insulation:	Type A		
	Input voltage:	11,000V		
	Output voltage:	480V, 460V, 440V, 420V, 400V		
	Dimensions:	(H) 1,785 × (W) 1,560 × (L) 1,205mm		
	Approx. weight:	3,160kg		
5.6	Capacity 600KVA for No. 8 ∿ 13 Wells in Prome		1 Unit	4,000
	General:	Standard on transformer shall be according to JEC-2041 (1978)		
	Type:	Oil bath, lubricated		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS		Q'TY	単位 千円 上段 単価 下段 合計
	Rated capacity:	600KVA		
	Number of phases:	3		
	Frequency:	50Hz		
	Coiling:	First coil; Star Second coil; Delta		
	Insulation:	Type A		
	Input voltage:	11,000V		
	Output voltage:	460V, 440V, 420V, 400V		
	Dimensions:	(H) 1,785 × (W) 1,560 × (L) 1,205		
	Approx. weight:	3,160kg		
5.7	Capacity 100KVA for No. 14 ∿ 15 in Prome		1 Unit	1,186
	General:	Standard on transformer shall be according to JEC-204 (1978)		
	Type:	Oil bath, lubricated		
	Rated capacity:	100KVA		
	Number of phases:	3		
	Frequency:	50Hz		
	Coiling:	First coil; Star Second coil; Delta		
	Insulation:	Type A		
	Input voltage:	11,000V		
	Output voltage:	440V, 420V, 400V		
	Dimensions:	(H) 1,385 × (W) 890 × (L) 1,165mm		
	Approx. weight:	1,280KVA		

ITEM NO.	DESCRIPTION OF EQUIPMENT AND MATERIALS	Q'TY	単位 千円 上段 単価 下段 合計
5.8	Electric Wire, Bear Copper Conductor Wire and Insulater 3 Core, 22mm^2 for Prome	9,300 Metres	9,300
C.	Water Distribution System	1 Lot	115,833
1.	Ductile Iron Pipe		
1.1	ϕ150mm TYPE A-1	3,200 Metres	
1.2	ϕ200mm "	6,750 Metres	
1.3	ϕ250mm "	4,150 Metres	
1.4	ϕ300mm "	2,250 Metres	
1.5	ϕ350mm "	100 Metres	
2.	Air Valve ϕ13	20 Units	
3.	Sluice Valve		
3.1	ϕ150mm	17 Units	
3.2	ϕ200mm	15 Units	
3.3	ϕ250mm	2 Units	
3.4	ϕ350mm	2 Units	
4.	Specials (Reducer, Tee, Bend, and Others)	1 Set	

A	WATER WELL DRILLING RIGS & SUPPORTING EQUIPMENT	485,900
B	WATER WELL MATERIALS	228,267
C	WATER DISTRIBUTION SYSTEM	115,833
	Total	830,000

第7章　本プロジェクトの効果

第7章　本プロジェクトの効果

1) このプロジェクトによりMagweで約61,000人、Promeで約67,000人が水道によって毎日十分な飲料水を供給されることになる。またその給水量は1人1日当りは以前の数10ℓ/dから、計画による給水量は195ℓ/dとなり給水内容は格段と向上する。

2) 都市飲料水の不足は都市開発を阻む大きな隘路となっているが、先鞭をつけたこのパイロットプロジェクトは他の多くの都市に飲料水対策の方向づけを与えることができる。

3) 日本政府無償資金協力による資機材は、このプロジェクトのみならず、更に多くの都市飲料水開発に資する可能性も十分考えられる。

4) MagweおよびPromeの既設水道は住民の水需要を満すには程遠く、多くの住民は飲料水を買水に頼っている。この買水の多くはIrrawaddy河表流水をドラム缶に汲んで牛車(Bullock carts)に引かせた売水業者から買うもので、価格は1ドラム缶(181.8ℓ入)当り水源に近い場所で2〜3kyats、遠隔地では6kyatsである。これを1kyat当りの購買量に直すと河に近い場所で90.9ℓ/kyat 遠隔地では30.3ℓ/kyatである。ここでRangoon市における水道料金は4.5㎥で4kyatsであるから1kyat当り購買量は1125ℓ/kyatとなる。この数値を比較すると次のとおりである。

Prom[illegible]?

比較水源＼購買費		購買量(ℓ/k)	買水量比率	家族7人としての料金k/月	
				30ℓ/d	195ℓ/d
Bullock cartsからの買水(表流水その他)	近距離	90.9	8.1	69	448
	遠距離	30.3	2.7	208	1352
現在のRangoon市水道水		1125.0	100	6	39

また将来1家族で20㎥/月の水を使用したと仮定した場合、その支出は従来の買水によれば200〜600kyats/月であるがRangoon市の水道料金と同率とすれば18kyatsである。従って水道施設が完備した場合Rangoon市の水道料金と同額になると仮定すれば水に要する費用は1/10〜1/30となり、消費者の水に対する支出は大巾に節減される。

5) Irrawaddy河表流水を買水により直接使用してきた人々は、腸炎その他下痢、発疹チフスなど水に原因する罹病率が多く、地下水を水源とする衛生的な水道を使用することにより、この状態は著しく改善されるであろう。

6) 買水は水価が高いため、その使用を制限することによる衛生面への悪影響を取除くこと

ができる。例えば食器の洗浄に十分な水を使い、また手洗を励行することにより胃腸病、眼病その他多くの疾病の予防に著しい効果をあげる。

7) Magwe及びPromeにおいて現在の水道施設における公営投資の採算は次の通りで、そのバランスはプラス便益を出している。

町　名	Magwe	Prome
水道における収益kyats/y	+130,928.00	+408,467.00
水道におけをコストkyats/y	−101,332.00	−221,077.00
純　便　益	+　29,596.00	+187,390.00

このプロジェクトにおける採算は、不確定要素が多くその予測はむづかしいが、プロジェクト完成後は在来の水道事業におけると同様に、将来必ずや公益的便益をもたらすものと考えられる。　誇大にすぎる

8) 産業用水の水需要は現在は殆んど無く、また将来計画にも挙げられていないが、実際に水道水を供給できる体制になった時には、新しく産業の誘致が可能となり、町の発展を促進し、その波及効果が期待される。

9) ビルマの多くの都市では、現在水道施設が不備なために、しばしば火災により町の大半を焼失する事態も起っている。このためにも水道による防火用水の確保と消火栓の設置は都市の防災とともに民生の安定に貢献するものである。

また都市計画の面からみれば、水道布設によって新市街地に旧市街地居住者の移住や、その他の地域からの移転者の定着化を促し、都市計画の遂行に寄与するものである。

10) Magwe及びPromeの水道布設により売水従事者の生活問題がある。この問題の解決には、水道施設建設における直接的および間接的雇用で対処するとともに、水道施設建設後は、維持管理要員としての雇用および転業の斡旋等が必要で、また水道布設に伴う産業の発展、工場誘致などによって転業者を吸収することも可能であろうと考えられる。

第8章　本プロジェクトにおける問題点

第8章　本プロジェクトにおける問題点

本プロジェクトにおける問題点をMagweおよびPromeに分けて列挙すれば次の通りである。

1）地下水開発による水道施設整備計画

ⅰ）Magwe：地下水開発計画においてMagwe地域を生産井地域とその他地域に分け生産井配置計画を立て、それに従って水道施設計画を行った。しかし生産井地域における調査井の試掘結果によっては、生産井の位置に変更のあることも予想され、それに従い水道施設計画も変更されるので、詳細設計に当ってはこれらを勘案しつゝ業務を遂行する必要がある。

ⅱ）Prome：Prome地域の難～不透水層基盤の起伏は激しく、その細部にわたっては電気探査では把握し難いので、Magweと同様に調査井の結果を勘案して計画をそれに合せて行う必要がある。

2）さく井と水道施設

本プロジェクトにおいては、さく井ならびにその関連施設は2ケ年以内に、また貯水槽までの導水施設は3ケ年以内に完了する計画で、それに合せて、すべての水道施設の建設は行われる予定である。しかし、この計画の目標年次は10年後の1991年であるから、そこに7年間のギャップがある。従って場合によっては全く使用しない施設がでてくるという問題が生じてくる。

3）維持管理

適正な維持管理は、施設の耐用年数にも直接影響するので、特に前項のように使用しない施設がある場合に維持管理が問題となる。

4）既存設備に関する問題点

ⅰ）Magwe：Magweの既存設備は水源および一部配管はそのまま新施設に吸収使用されるが、旧水源はIrrawaddy河表流水で、その水処理施設は現在完全ではない。その為一部地区では地下水と表流水の混合配水が行われることになり、折角の地下水による良質水配水のメリットを削減することになる。それ故早急に旧水処理施設を改良して水質基準に適合した施設にする必要がある。

ⅱ）Prome：既存水道施設は、本プロジェクトに合せて改修拡張を行う計画になっていて、この事業は町自身の財政負担で実施される。しかし1991年以降，両施設が完成すると、同一町内

の隣接した地区において配水は別系統となっているが、これは相互に水の融通が可能となるよう配管の連結を行うことが必要である。その為には水質を同一水準にしなければならないのでIrrawaddy河表流水を水源とする旧水道水処理施設を水質基準に適合するよう改善する必要がある。

5) 将来計画における問題点

i) Magwe：町は現在の新市街地の東側に、更に新市街地を計画しているが、この地域は生産井地域と離れているので、Magweプロジェクトの地下水開発状況を勘案し、その水源問題を慎重に検討しなければならない。

ii) Prome：本プロジェクトでの目標年次は１９９１年としているが、それ以降の人口増加のパターンとして、南部地域にかなりの人口集中がなされることが予想される。しかしながら、これらの人口増加に対する給水は南部地域の地下水開発だけでは不充分であることも予想され、水文地質的にみて地下水賦存条件の有利な北部地域の地下水開発を行い、これに当てる必要性が生じてくることも考えられる。

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APPENDIX 1

GENERAL DOCUMENTS

A-1.1

BURMA: URBAN WATER SUPPLY DEVELOPMENT PROJECT

MINUTES OF DISCUSSION

In response to the request by the Government of the Socialist Republic of the Union of Burma (GOB) for the provision of equipment and materials necessary for the Urban Water Supply Development Project (the Project), the Government of Japan (GOJ) has dispatched a Mission, through the Japan International Cooperation Agency (JICA) the official executing agency of the Japanese technical and economic cooperation programs, to carry out a basic design study of the Project (the Study) from 28 July to 12 September 1981.

The Mission visited the Project area and also had a series of discussions with agencies concerned of the GOB including the Foreign Economic Relations Department (FERD) under the Ministry of Planning and Finance, the General Affairs Department (GAD) and the Rangoon City Development Committee under the Ministry of Home and Religious Affairs, the Agricultural Mechanization Department under the Ministry of Agriculture and Forests, the Department of Meteorology and Hydrology under the Ministry of Transport and Communications and the Housing Department and the Construction Corporation under the Ministry of Construction. Both parties agreed with the major points of discussion included as Annex 1 to these Minutes, subject to further review and consideration of their respective Governments toward the realization of the Project.

Rangoon 11 August, 1981.

FOR THE GOVERNMENT OF THE SOCIALIST REPUBLIC OF THE UNION OF BURMA	FOR THE JICA MISSION
U TIN TUT Director-General General Affairs Department Ministry of Home and Religious Affairs	KAZUHISA MATSUOKA Leader JICA Mission

A-1.2 MAIN POINTS OF DISCUSSION

1. JICA will carry out the Study in Prome and Magwe in line with the Inception Report attached to these Minutes as Annex 2.
2. To make the Study successful, the GOB shall provide the Mission with the future land use plan, the proposed 4th Four-Year Plan of the Prome Township Development Committee and also the road and electricity development plan of Prome by 22 August 1981.
3. The GOJ's contribution to the Project after the Study will be to provide major equipment and materials necessary for the implementation of the Project in Prome and Magwe, if the GOJ approves the grant aid to the Project on the basis of the result of the Study.
4. The GOB put the following priorities on equipment and materials which will be provided by the GOJ:-
    1) Equipment for drilling;
    2) Equipment and materials for deep wells; and
    3) Pipes for water distribution system.
5. Equipment and materials will be delivered at a port in Japan.
6. The GOB will take the following measures on condition that the grant aid by the GOJ will be extended to the Project:-
    1) to carry out detailed engineering for the construction of the water distribution system;
    2) to secure lands necessary for the implementation of the Project; and
    3) to make budgetary arrangements necessary for the local expenditure on the Project.
7. The implementing agency of the Project will be the General Affairs Department of the Ministry of Home and Religious Affairs.

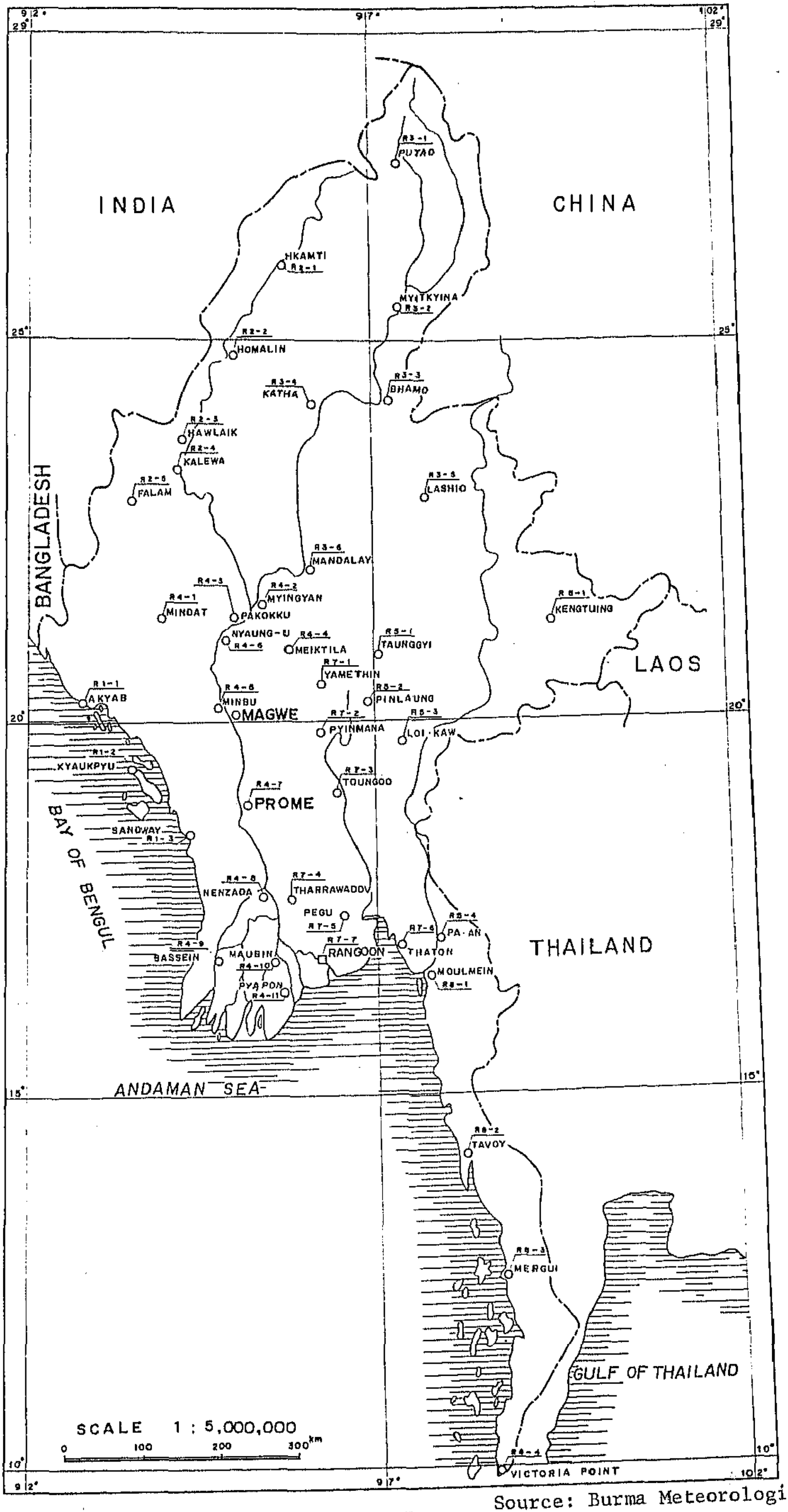
A-1.3 LIST OF MEMBERS OF JICA MISSION

Kazuhisa MATSUOKA 松 岡 和 久	LEADER
Taijiro KONISHI 小 西 泰次郎	TECHNICAL LEADER, HYDROGEOLOGIST
Suenori ISAYAMA 諫 山 末 憲	WATER SUPPLY ENGINEER
Haruo KOBAYASHI 小 林 治 郎	ELECTRIC PROSPECTING SPECIALIST
Takeshi SHIRANE 白 根 武	WATER WELL DRILLING SPECIALIST

A-1.4 LIST OF BURMES STAFFS CONCERNED

U Tin Tut	Director-General, General Affairs Department, Ministry of Home and Religious Affairs
U Seo Myint	Director, General Affairs Department, Ministry of Home and Religious Affairs
U Aung Shwe	Deputy Director, General Affairs Department, Ministry of Home and Religious Affairs
U Tin Hla	Same as above
U Aung Chan Tha	Assistant Director, General Affairs Department, Ministry of Home and Religions Affairs
U Thein Myint	Director-General, Foreign Economic Relations Department, Ministry of Planning & Finance
U Myint Htu	Chief of Section, Foreign Economic Relations Department, Ministry of Planning & Finance
U Aung Ba	Deputy Director, Agriculture Mechanization Department, Ministry of Agriculture and Forests
U Hla Tin	Deputy Director, Meteorology & Hydrology Department, Ministry of Transport and Communications (Water & Sanitation Corporation)
U Aung Kywe	Staff Officer, Ministry of Construction
U Kyaw Thein	Deputy Director, Housing Department, Ministry of Construction
U Hla Pe	Same as above
U Soe Hlaing	Manager, Pugyi Project, Rangoon City Development Committee (R.C.D.C.)
Lt. Colonel Maung Maung	Thone, Chief Executive Officer R.C.D.C
U Percy Lao	Head of Department, Water & Sewerage, R.C.D.C (now in W.H.O Sri Lanka)
U Thein Tan	Head of Department of Water and Sewerage R.C.D.C.
U Thein Naing	Deputy Head of Department of Water and Sewerage, R.C.D.C.

A — 1 • 5 RAINFALL GAUGING STATION



Source: Burma Meteorological
Department

A-1.6 RAINFALL RECORD IN BURMA (NO. 1)

STATION NO.	LOCATION	ALTITUDE (m)	CO-ORDINATES		AVE. ANNUAL RAINFALL(mm)	MAX. ANNUAL RAINFALL(mm)	MINI. ANNUAL RAINFALL(mm)
			LATITUDE	LONGITUDE			
R1-1	AKYAB	5.49	N20°-08'	E92°-53'	5153 (60 years of record)	8219 (1918)	3064 (1951)
R1-2	KYAUKPYU	4.88	N19°-25'	E93°-33'	4723 (30 ")	5633 (1926)	3005 (1977)
R1-3	SANDWAY	10.97	N18°-28'	E94°-25'	5437 (76 ")	6933 (1918)	4301 (1912)
R2-1	HKAMTI	146.00	N26°-00'	E95°-42'	3939 (13 ")	5096 (1961)	2770 (1972)
R2-2	HOMALIN	131.00	N24°-52'	E94°-55'	2396 (46 ")	3119 (1971)	1015 (1972)
R2-3	MAWLAIN	114.00	N23°-38'	E94°-25'	1851 (10 ")	2363 (1938)	824 (1925)
R2-4	KALEWA	109.00	N23°-12'	E94°-18'	1701 (30 ")	1986 (1973)	1343 (1969)
R2-5	FALAM	1555.00	N22°-55'	E93°-41'	1969 (44 ")	2042 (1973)	1102 (1954)
R3-1	PUTAO	409.00	N27°-20'	E97°-25'	3984 (17 ")	4716 (1971)	3450 (1960)
R3-2	MYITKYINA	145.00	N25°-22'	E97°-24'	2142 (45 ")	3153 (1964)	1284 (1909)
R3-3	BHAMO	111.00	N24°-16'	E97°-12'	1855 (55 ")	2477 (1910)	1276 (1969)
R3-4	KATHA	94.00	N24°-10'	E96°-20'	1517 (53 ")	2176 (1959)	910 (1972)
R3-5	LASHIO	856.00	N22°-56'	E97°-45'	1570 (45 ")	2393 (1927)	1020 (1972)
R3-6	MANDALAY	78.00	N21°-59'	E96°-06'	871 (50 ")	1252 (1973)	493 (1924)

SOURCE: HYDROLOGICAL ANNUAL VO-2 BURMA METEOROLOGICAL DEPARTMENT

A-1.6 RAINFALL RECORD IN BURMA (NO. 2)

STATION NO.	LOCATION	ALTITUDE (m)	CO-ORDINATES		AVE. ANNUAL RAINFALL (mm)	MAX. ANNUAL RAINFALL (mm)	MINI. ANNUAL RAINFALL (mm)
			LATITUDE	LONGITUDE			
R4-1	MINDAT	1395.00	N21°-23'	E93°-57'	1696 (8 years of record)	2298 (1973)	1249 (1972)
R4-2	MYITKYINA	60.00	N21°-28'	E95°-23'	698 (54 ")	1136 (1926)	280 (-)
R4-3	RAKOKKU	57.00	N21°-20'	E95°-05'	617 (52 ")	1174 (1973)	394 (1962)
R4-4	MEIKTILA	214.00	N20°-50'	E95°-50'	896 (51 ")	1406 (1926)	562 (1952)
R4-5	MINBU	51.00	N20°-10'	E94°-35'	886 (45 ")	1406 (1938)	539 (1972)
R4-6	NYAUNG-U	59.00	N21°-12'	E94°-55'	624 (55 ")	924 (1973)	205 (1958)
R4-7	PROME	58.00	N18°-48'	E95°-13'	1207 (71 ")	1749 (1973)	816 (1972)
R4-8	HNZADA	-	N18°-40'	E95°-25'	2161 (70 ")	2844 (1961)	1789 (1957)
R4-9	BASSEIN	9.00	N16°-46'	E94°-46'	2768 (60 ")	3891 (1949)	1868 (1906)
R4-10	MAUBIN	3.00	N16°-44'	E95°-39'	2432 (62 ")	3790 (1953)	1530 (1906)
R4-11	PYPON	2.00	N16°-16'	E95°-40'	2557 (50 ")	3709 (1929)	1906 (1918)
R5-1	TAUNGGYI	1436.00	N20°-47'	E97°-03'	1692 (38 ")	2315 (1907)	1213 (1931)
R5-2	PINLAUNG	259.00	N20°-13'	E96°-47'	2276 (8 ")	2564 (1971)	1962 (1972)
R5-3	LOI-KAW	895.00	N19°-41'	E97°-13'	1169 (35 ")	1936 (1936)	815 (1931)

SOURCE: HYDROLOGICAL ANNUAL VO-2 BURMA METEOROLOGICAL DEPARTMENT

A-1.6 RAINFALL RECORD IN BURMA (NO. 3)

STATION NO.	LOCATION	ALTITUDE (m)	CO-ORDINATES		AVE. ANNUAL RAINFALL(mm)	MAX. ANNUAL RAINFALL(mm)	MINI. ANNUAL RAINFALL(mm)
			LATITUDE	LONGITUDE			
R5-4	PAAN	9.00	N16°-50'	E97°-40'	4490 (30 years of record)	5973 (1961)	3460 (1960)
R6-1	KENGTUNG	827.00	N21°-18'	E99°-37'	1129 (16 ")	1875 (1971)	816 (1962)
R7-1	YAMETHIN	199.00	N20°-25'	E96°-09'	969 (45 ")	1511 (1916)	408 (1954)
R7-2	PYINMANA	95.00	N19°-43'	E96°-13'	1401 (54 ")	1936 (1927)	846 (1958)
R7-3	TOUNGOO	50.00	N18°-55'	E96°-28'	2113 (60 ")	2836 (1907)	1419 (1957)
R7-4	THARRAWADDY	15.00	N17°-38'	E95°-48'	2212 (40 ")	2921 (1914)	1840 (1959)
R7-5	PEGU	10.00	N17°-20'	E96°-30'	3296 (50 ")	4188 (1969)	2085 (1957)
R7-6	THATON	8.00	N16°-55'	E97°-22'	5513 (50 ")	7340 (1961)	4188 (1957)
R7-7	RANGOON	14.00	N16°-46'	E96°-10'	2618 (60 ")	3261 (1974)	1940 (1951)
R8-1	MOULMEIN	24.00	N16°-30'	E97°-37'	4828 (60 ")	6748 (1961)	3567 (1927)
R8-2	TAVOY	16.00	N14°-06'	E98°-13'	5457 (50 ")	7599 (1961)	4446 (1958)
R8-3	MERGUI	37.00	N12°-26'	E98°-36'	4123 (60 ")	4841 (1948)	3216 (1958)
R8-4	VICTORIA POINT	46.00	N09°-58'	E98°-35'	1908 (30 ")	4864 (1917)	3070 (1947)

SOURCE: HYDROLOGICAL ANNUAL VO-2 BURMA METEOROLOGICAL DEPARTMENT

A-1.7 (1) Population of Cities/Towns

Furnished with Water Supply Systems

Sr. No.	State/Division	Sr. No.	City/Town	Population
1	Kachin State	1	Myitkyina	53107
2	Karen State	2	Pa-an	36565
3	Sagaing Division	3	Katha	22513
		4	Monywa	99126
		5	Myinmu	12851
4	Pegu Division	6	Gyobingauk	19542
		7	Zigon	15795
		8	Nyaunlebin	28723
		9	Daik-U	23968
		10	Nattalin	18811
		11	Pegu	149852
		12	Prome	84806
		13	Padaung	10205
		14	Paungde	29439
		15	Minhla	11531
		16	Letpadan	28182
		17	Tharrawaddy	14991
		18	Thonze	22273
		19	Okpo	12474
5	Magwe Division	20	Chauk	56411
		21	Magwe	42708
		22	Minbu	18069
		23	Yenagyaung	69857
		24	Thayet	24112
6	Mandalay Division	25	Kyaukpadaung	26253
		26	Nyaung-U	19305
		27	Taungtha	13951
		28	Mahlaing	14935
		29	Maymyo	70409
		30	Mogok	41490
		31	Meiktila	12919
		32	Mandalay	506846
		33	Myingyan	85990
		34	Yamethin	23721
			- continue -	

SOURCE: MINISTRY OF HOME AND RELIGIOUS AFFAIRS

A-1.7 (2) Population of Cities/Towns Furnished with Water Supply Systems

Sr. No.	State/Division	Sr. No.	City/Town	Population
7	Mon State	35	Moulmein	208615
8	Arakan State	36	Akyab	108735
		37	Pauktaw	10448
		38	Myauk-U	25282
9	Rangoon Division	39	Rangoon	2494665
		40	Syriam	43810
10	Shan State	41	Kalaw	18572
		42	Taungyi	91314
		43	Tachileik	8487
		44	Nanmatu	21314
		45	Loilem	11635
		46	Lashio	84399
11	Irrawaddy Division	47	Kyaiklat	28707
		48	Bassein	152868
		49	Pyapon	44530
		50	Myaungmya	38085
		51	Maubin	45477
		52	Wakema	34544
		53	Henzada	98058

SOURCE: MINISTRY OF HOME AND RELIGIOUS AFFAIRS

A-1.8 Design Criteria for Towns Water Supply

1.	Population Growth rate:-	Based on Burma Census. Overall growth rate in Burma 2.2 to 3%
2.	Water Supply (Consumption)	-(a) House Connection 40 gpcd
3.	Peak day	-1.5 to 2 times average daily consumption
4.	For Fire Fighting	-(a) Duration - 2 hrs. (b) No. of Times - 1 (c) Fire Demand - 20 1 ft sec^{-1} - 0.22 gal sec^{-1}
5.	Population Coverage	(1) 1st Stage 75% (2) 2nd Stage 90%
6.	Design Period	-25 years
7.	Implementation Period	-2 to 3 yrs.
8.	Computation for Distribution main and Pumping mains used Hardy Cross Method.	
9.	Size or Cap. of Public used Street Hydrants	-310 gals
10.	Pipe used.	(a) Distribution Net Work - C.I Class "C" C.I Class "B" Steel Pipe G.I Pipe P.V.C Pipe (b) Tube Wells G.I Pipe Seamless M S Pipe
11.	Size of Tube Wells	- Dia. of Pipes - 12"ϕ Max:
12.	Pumps Used	- (a) Centrifugal Pump - (b) Air Compressor - (c) Submersible Pumps - (d) Vertical Turbine Pump
13.	Size of Fire Hydrants	- 2 1/2" ϕ & 4"ϕ

SOURCE: GENERAL AFFAIRS DEPARTMENT

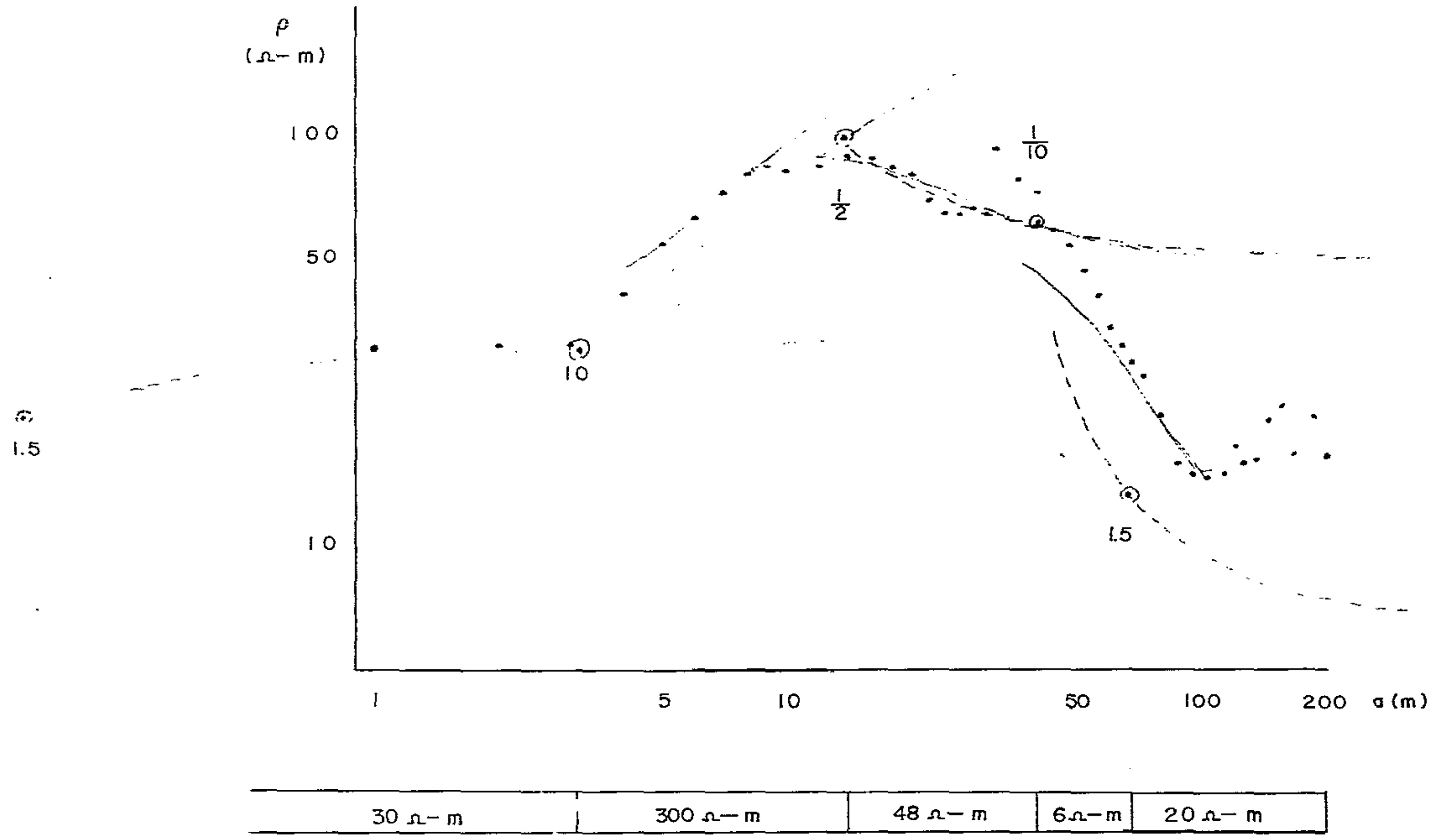
APPENDIX 2

MAGWE PROJECT

ELECTRICAL PROSPECTING RESULT

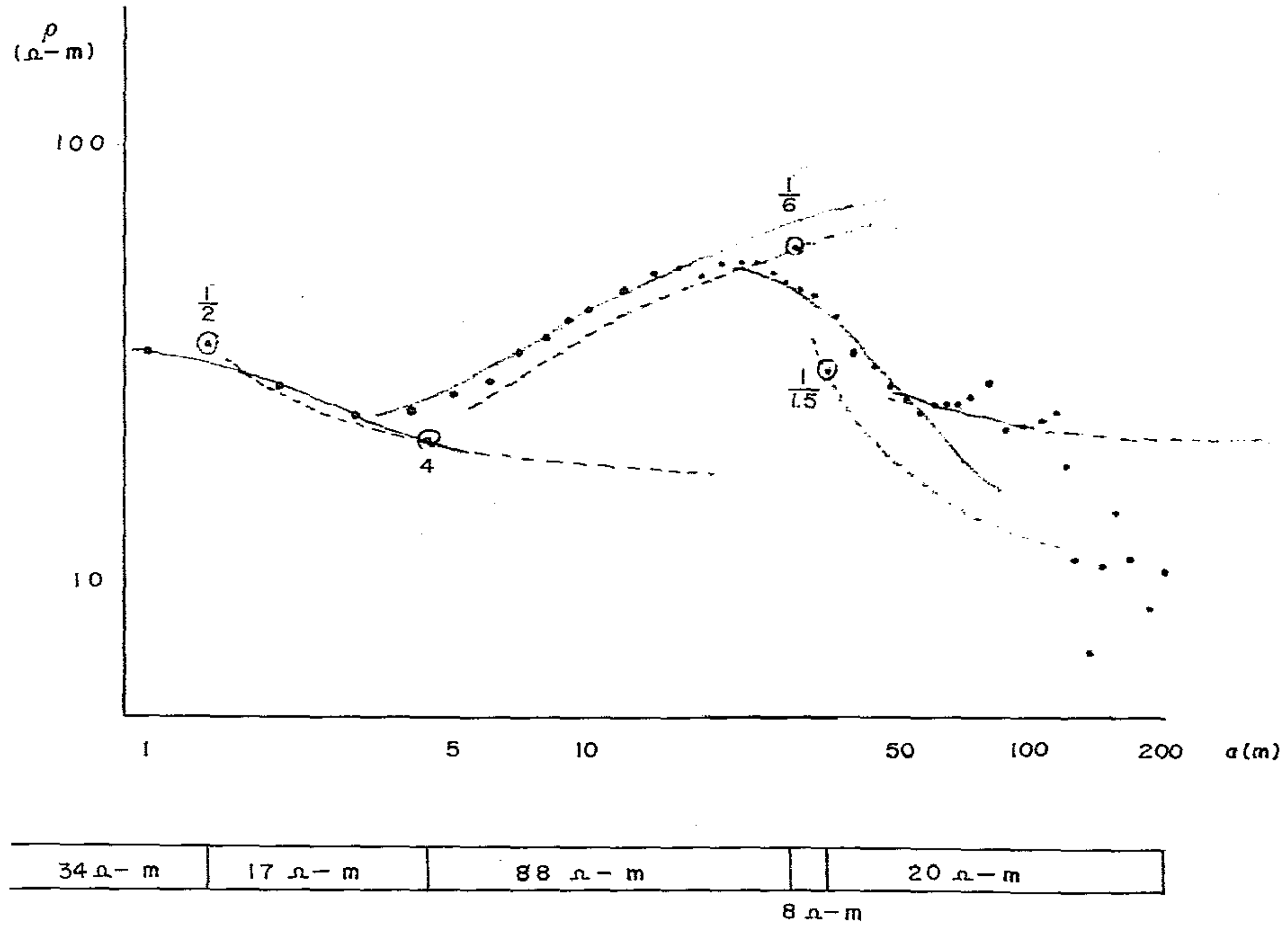
A－2・1 ELECTRICAL PROSPECTING IN MAGWE

NO.1



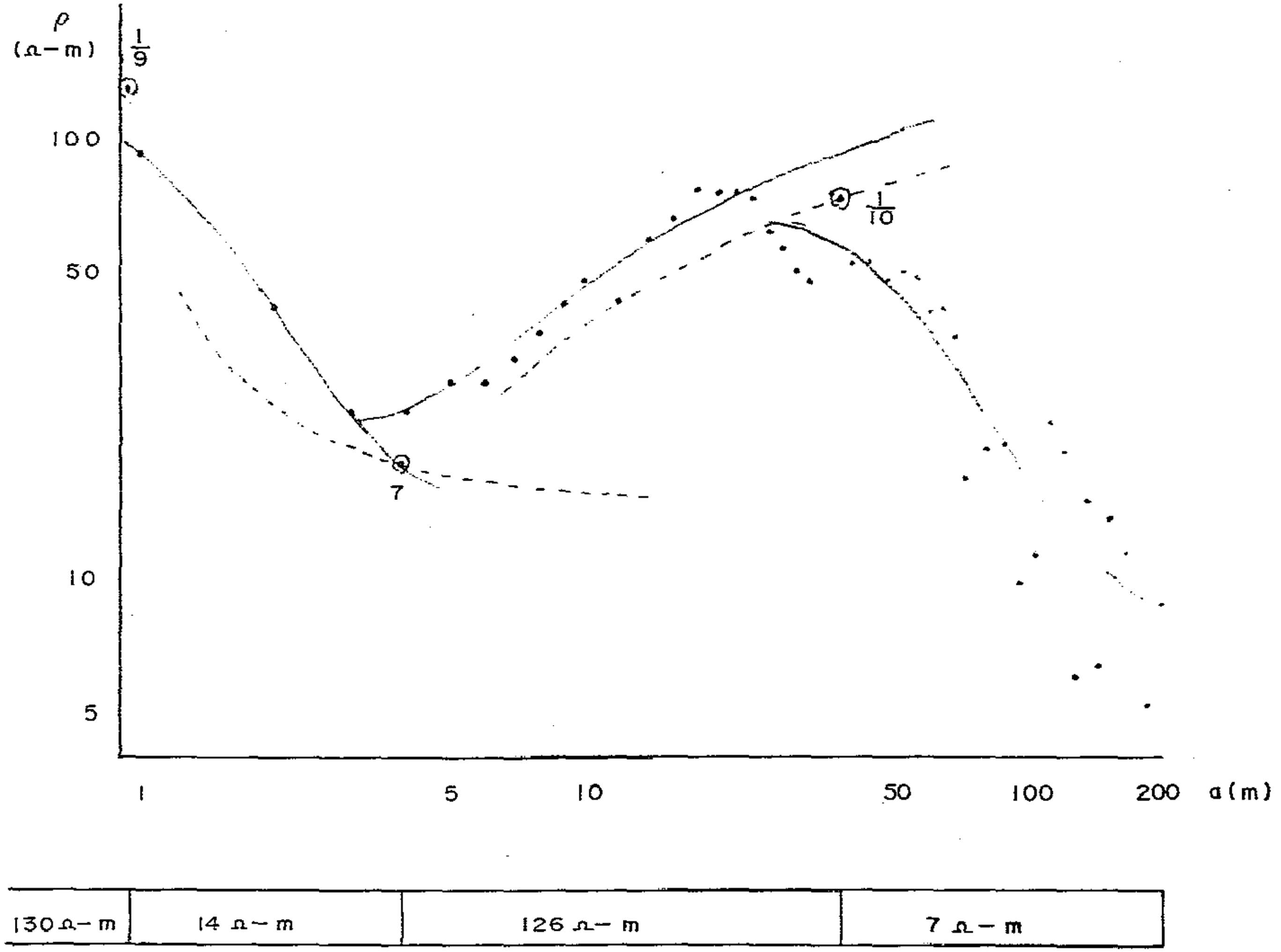
ELECTRICAL PROSPECTING IN MAGWE

NO.2



ELECTRICAL PROSPECTING IN MAGWE

NO. 3



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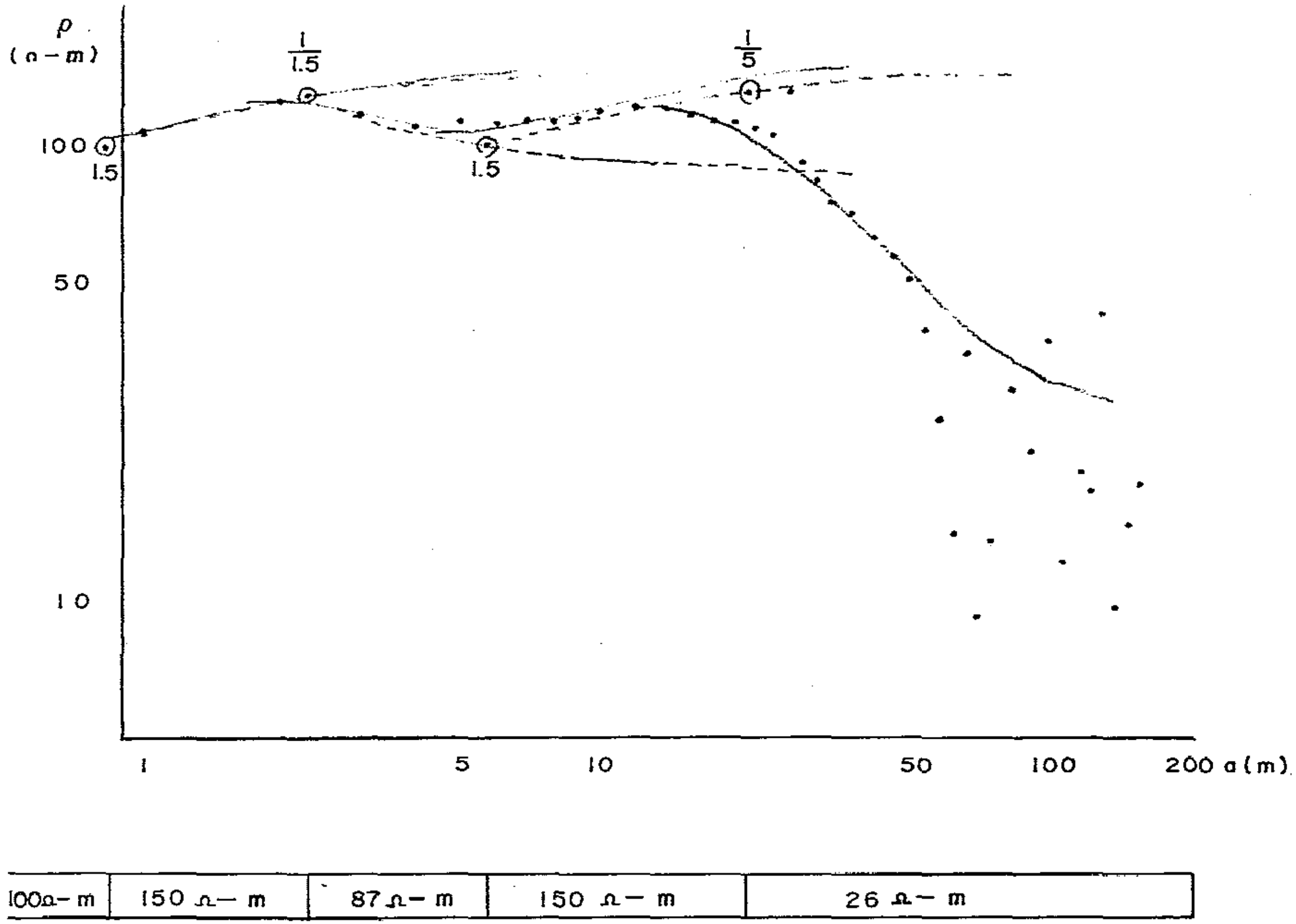

ELECTRICAL PROSPECTING IN MAGWE

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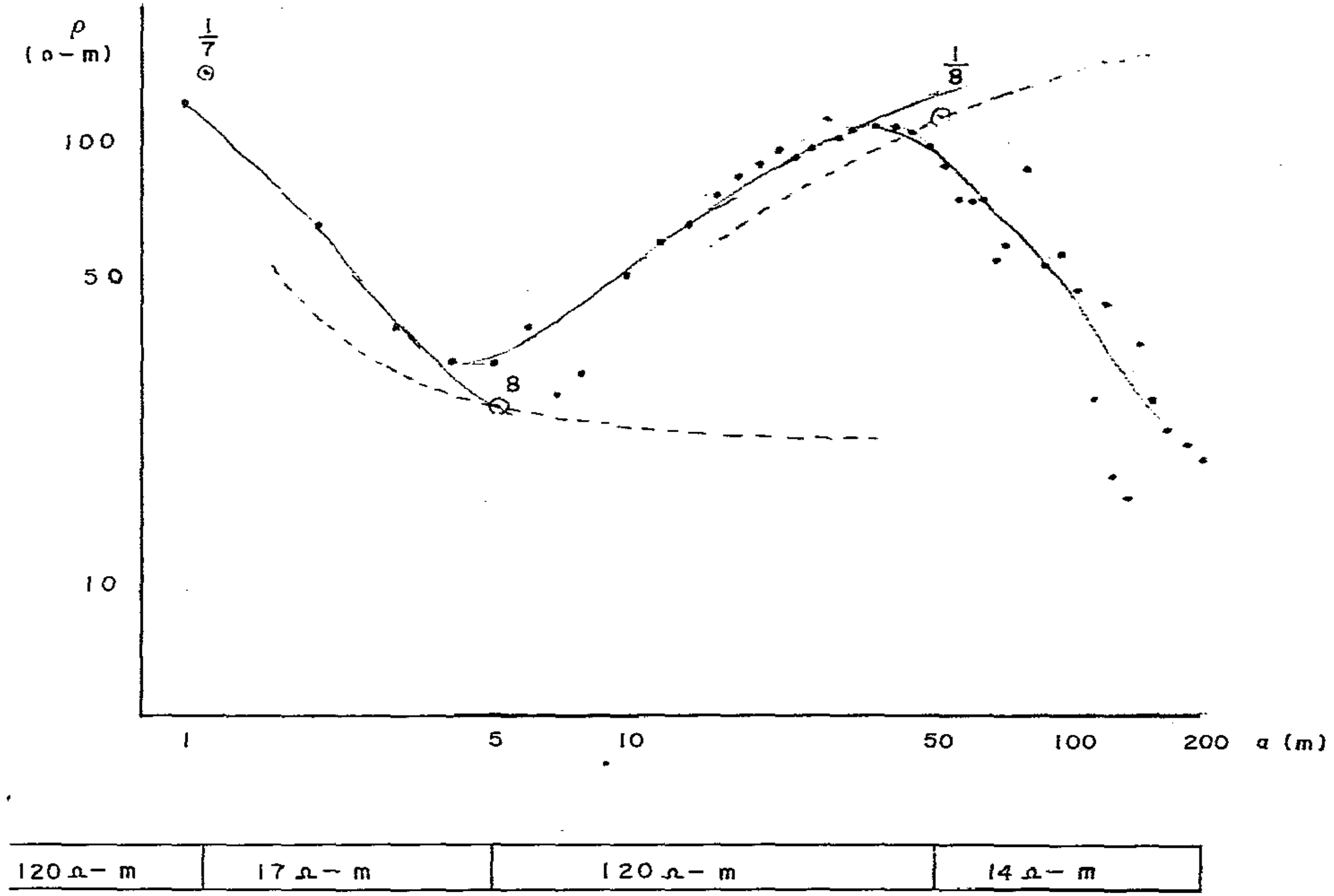

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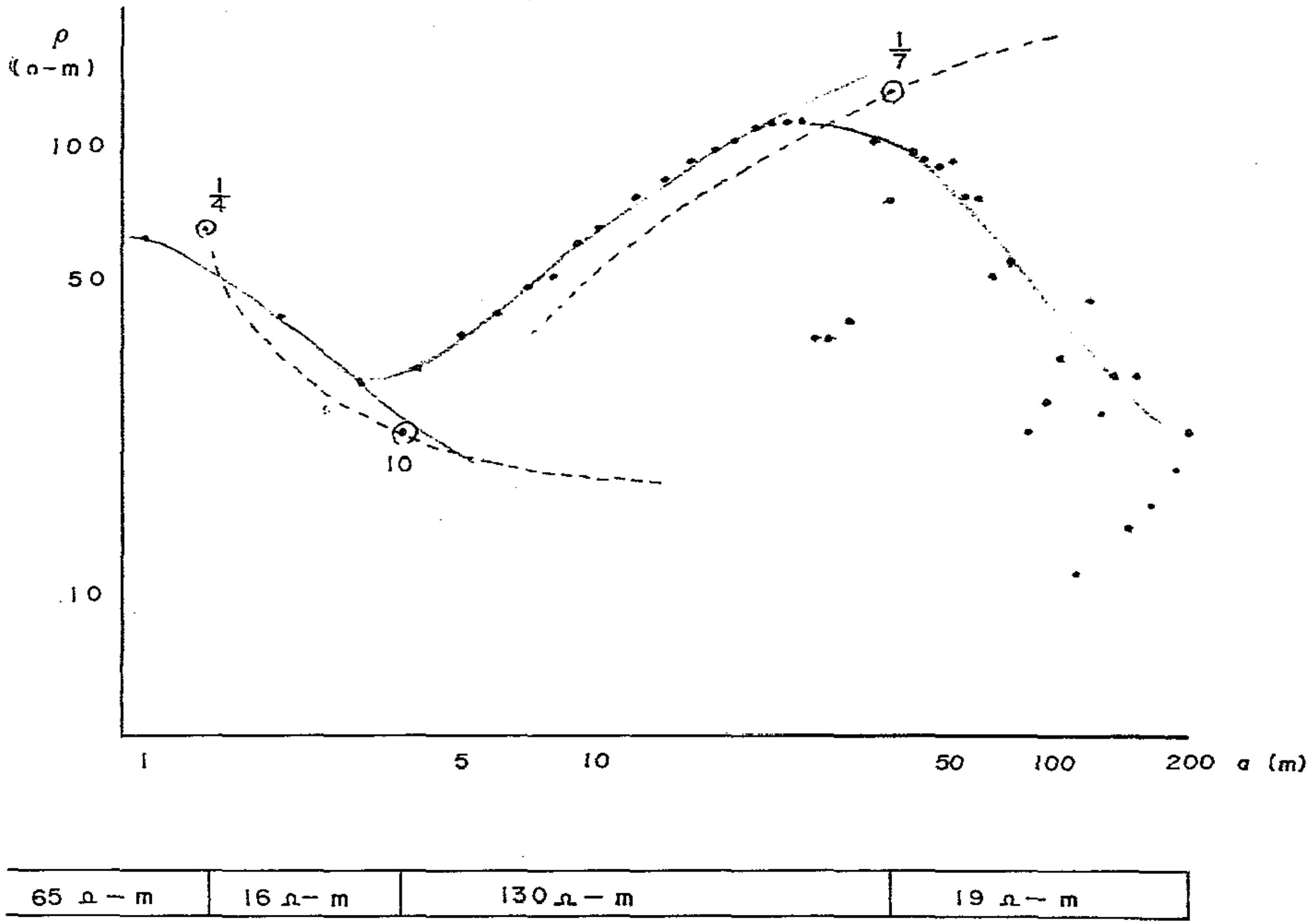
NO.6



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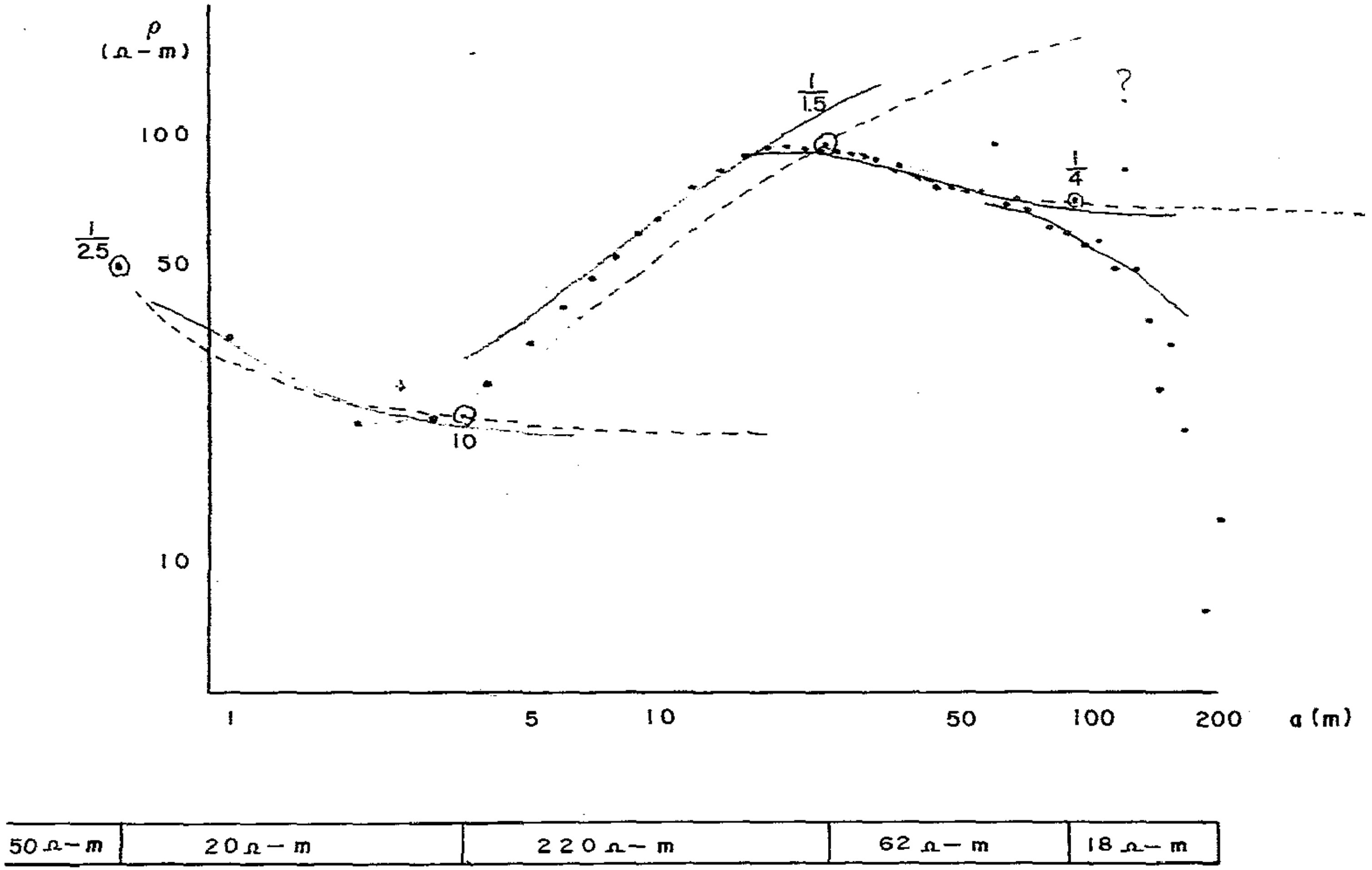

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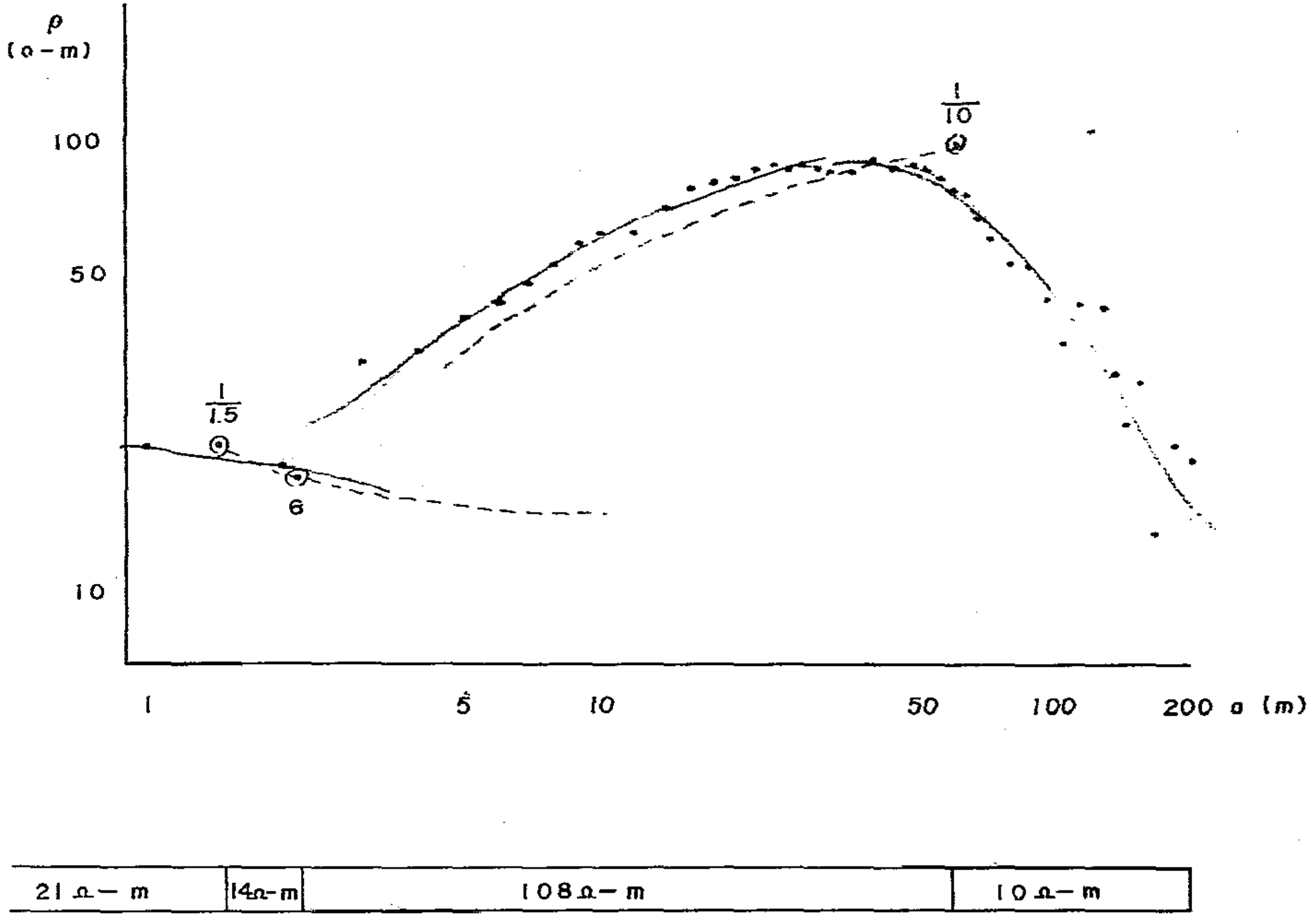

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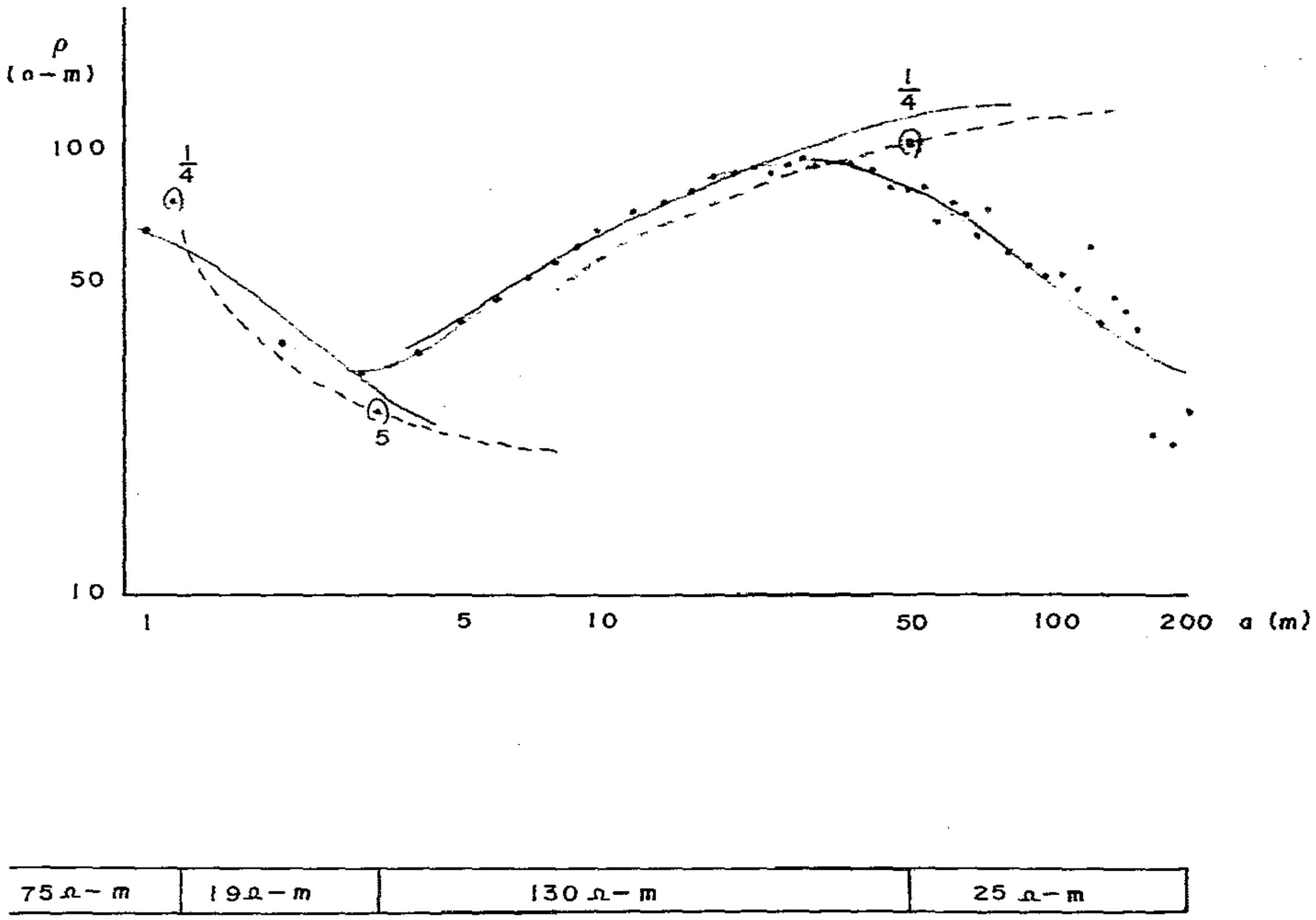

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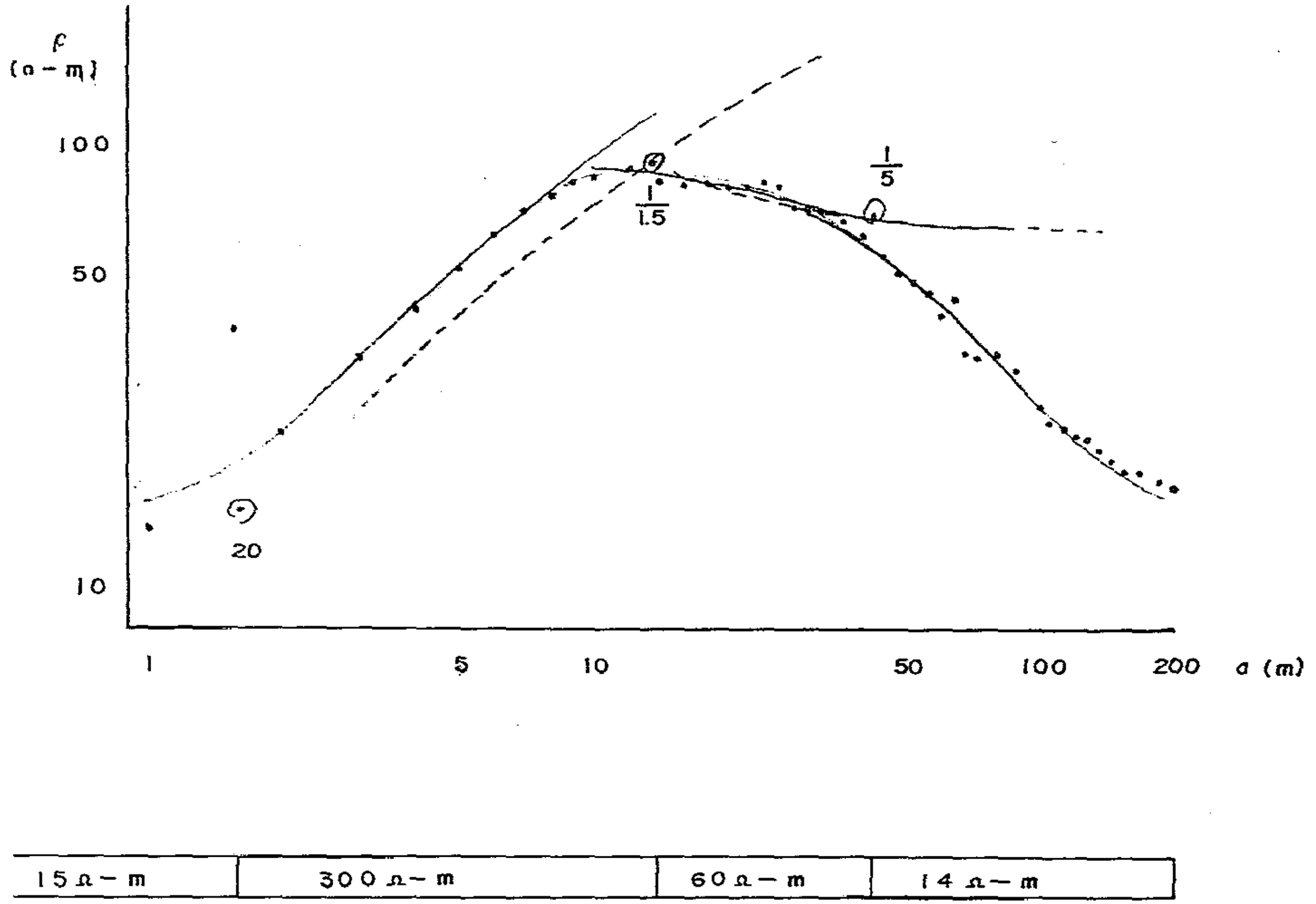

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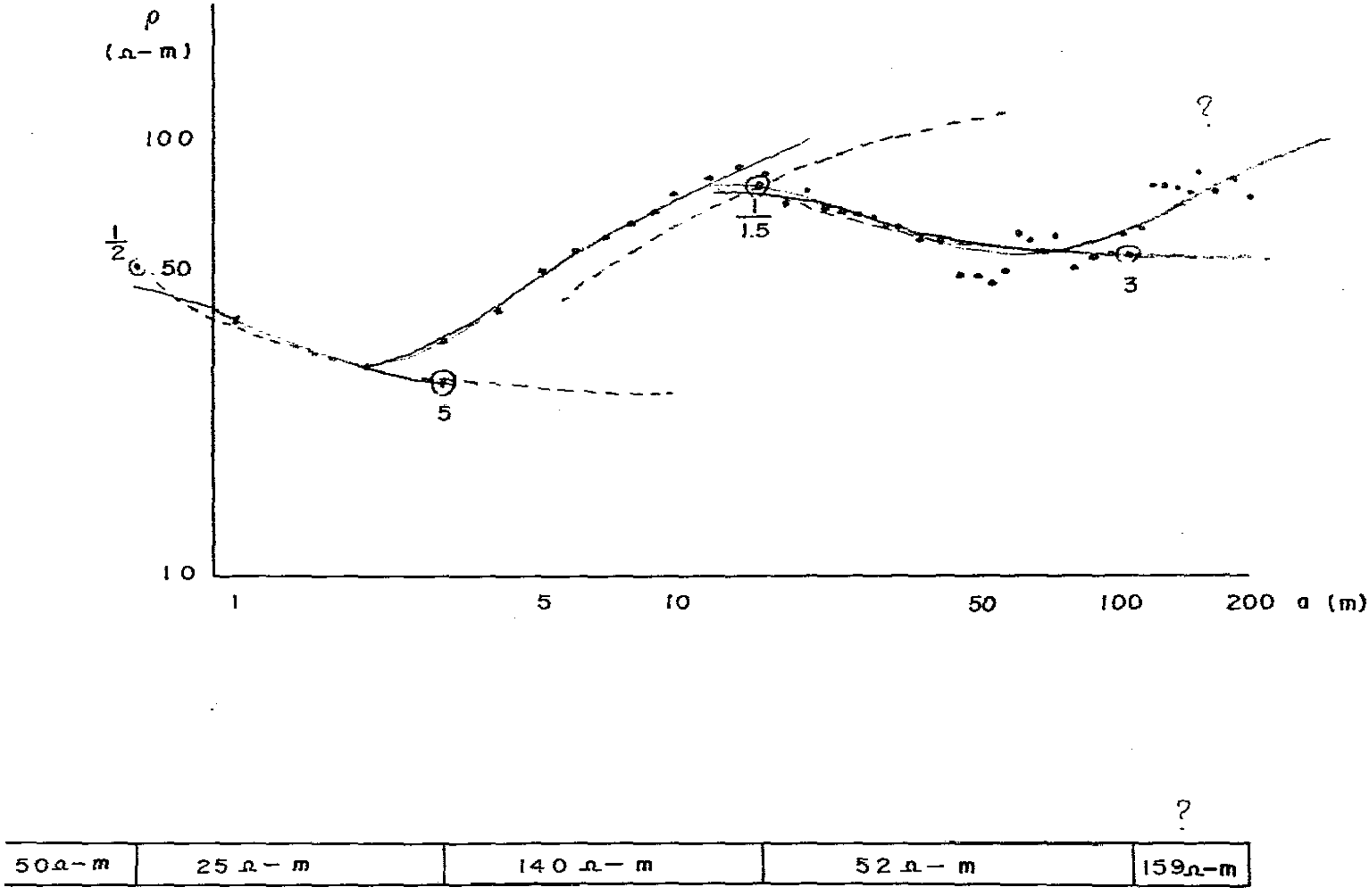

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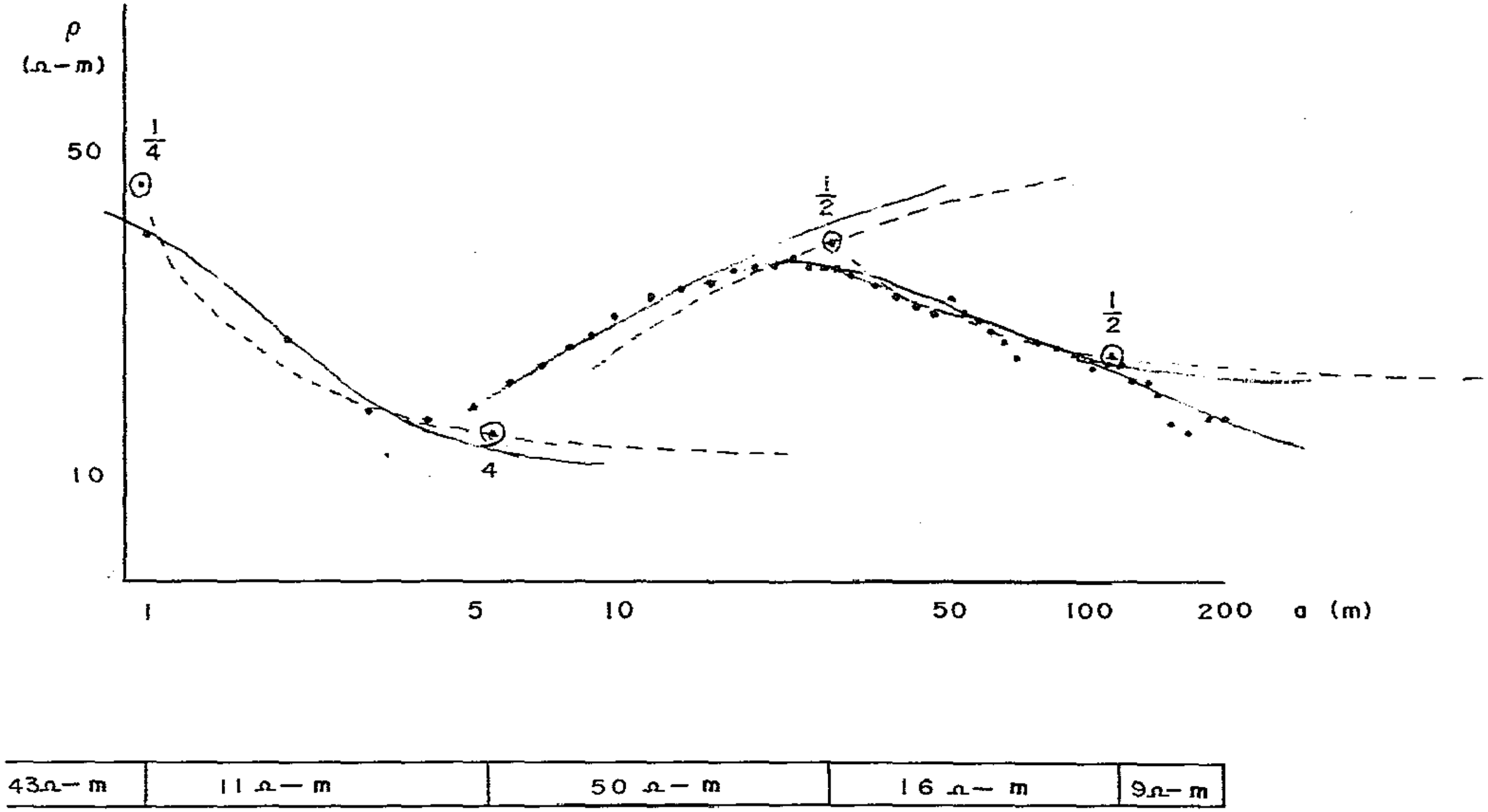

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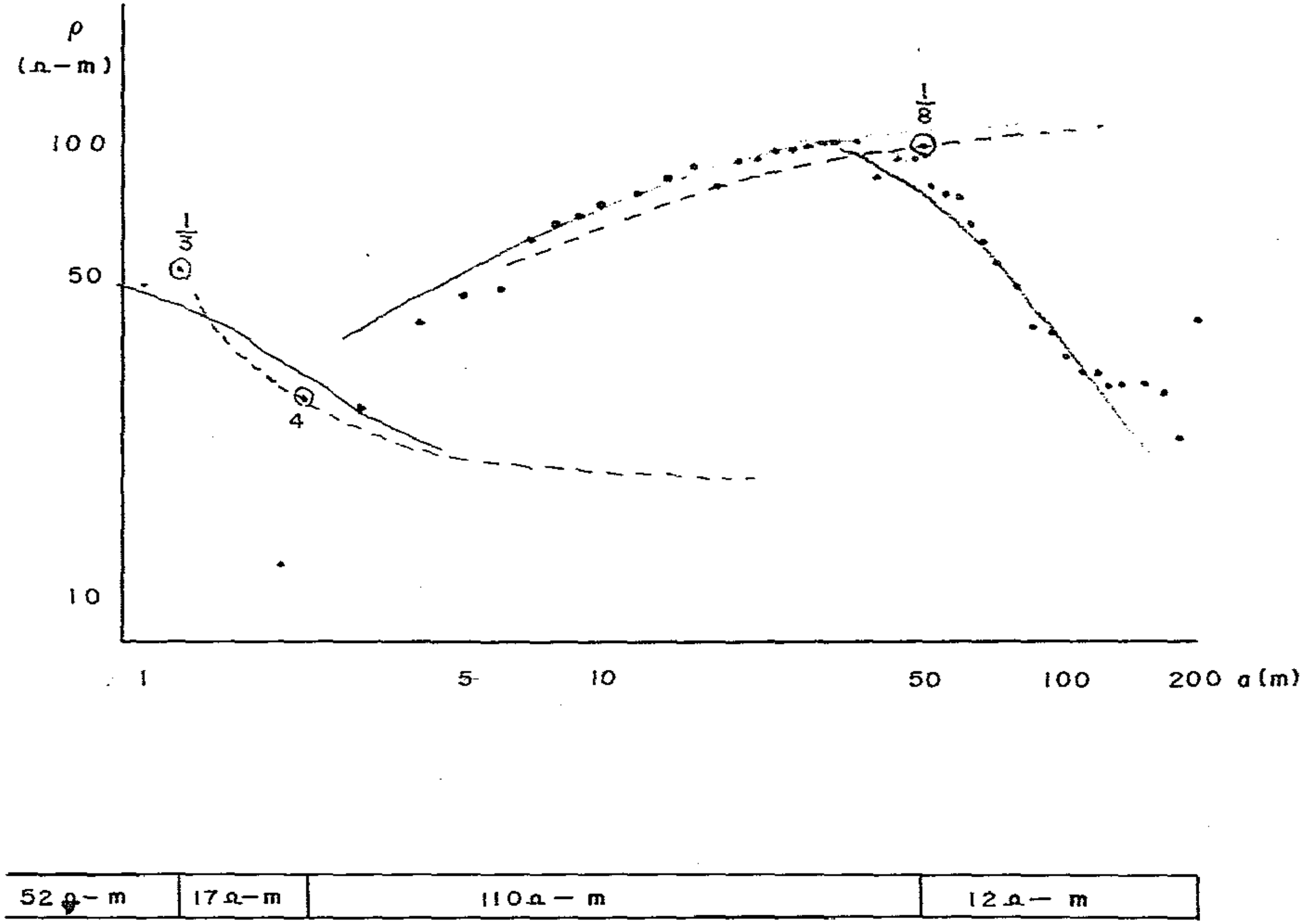

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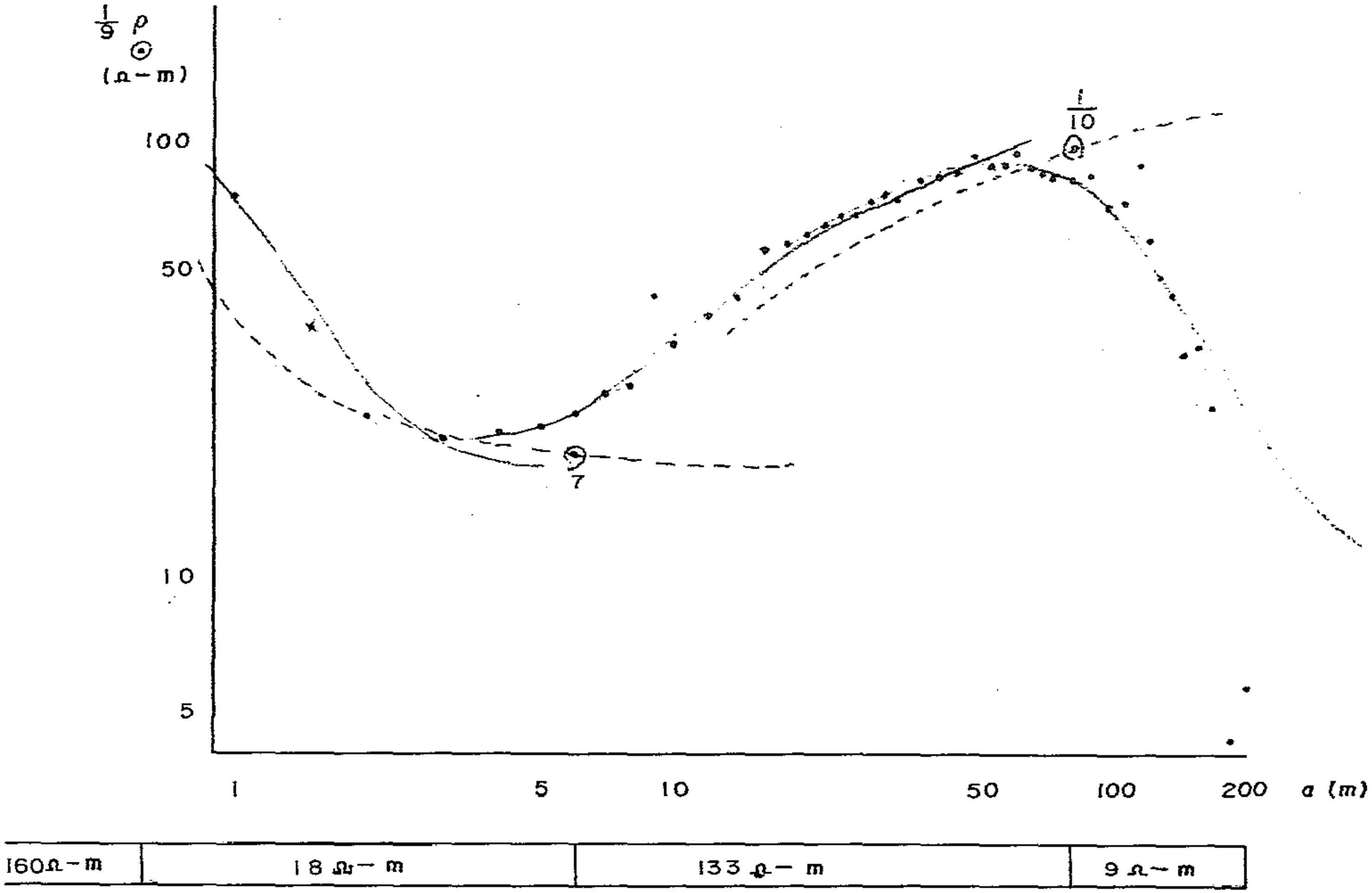

ELECTRICAL PROSPECTING IN MAGWE

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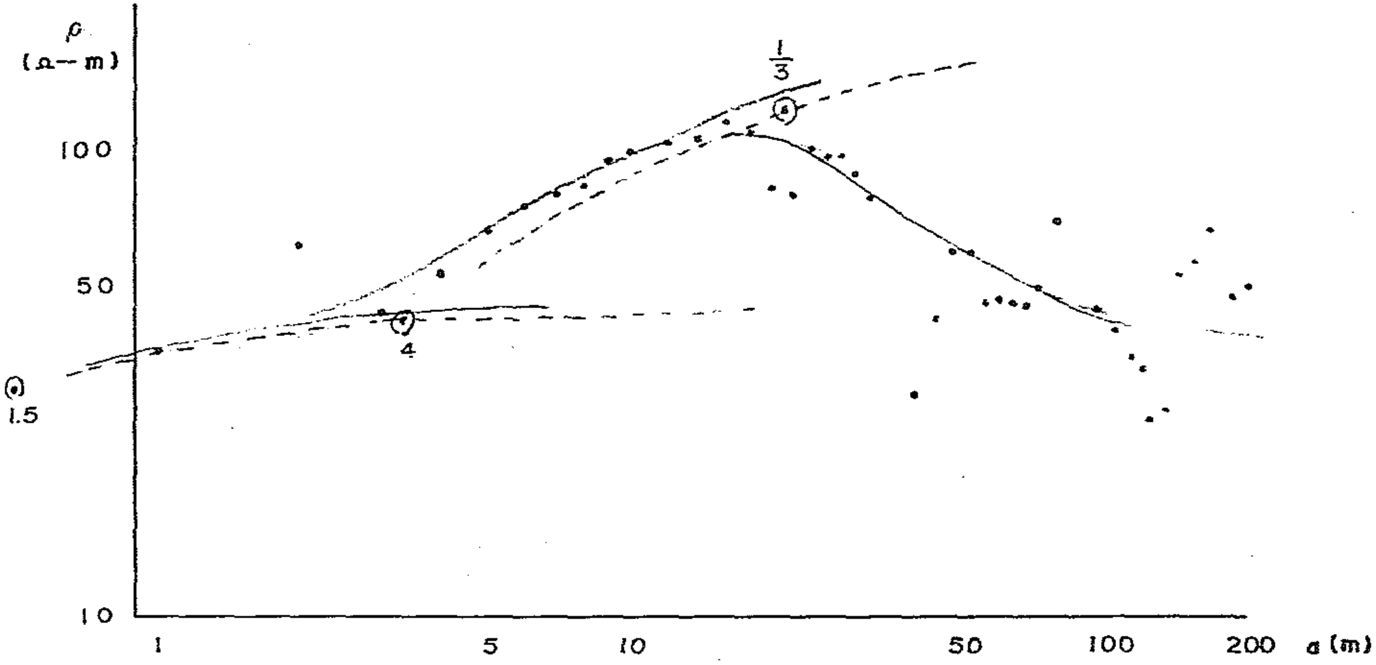
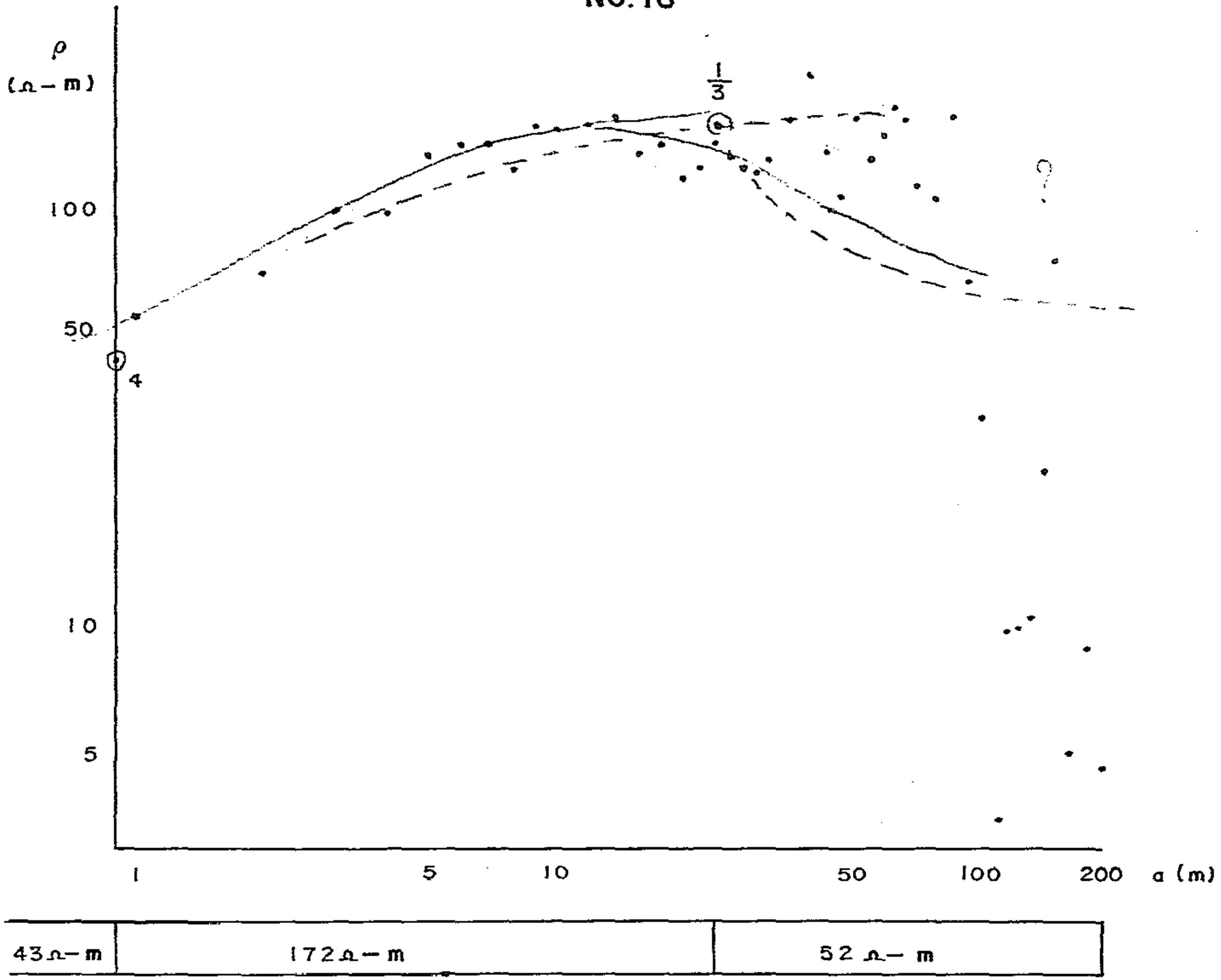


30Ω−m	45Ω−m	172Ω−m	40Ω−m

ELECTRICAL PROSPECTING IN MAGWE

NO. 16



ELECTRICAL PROSPECTING IN MAGWE

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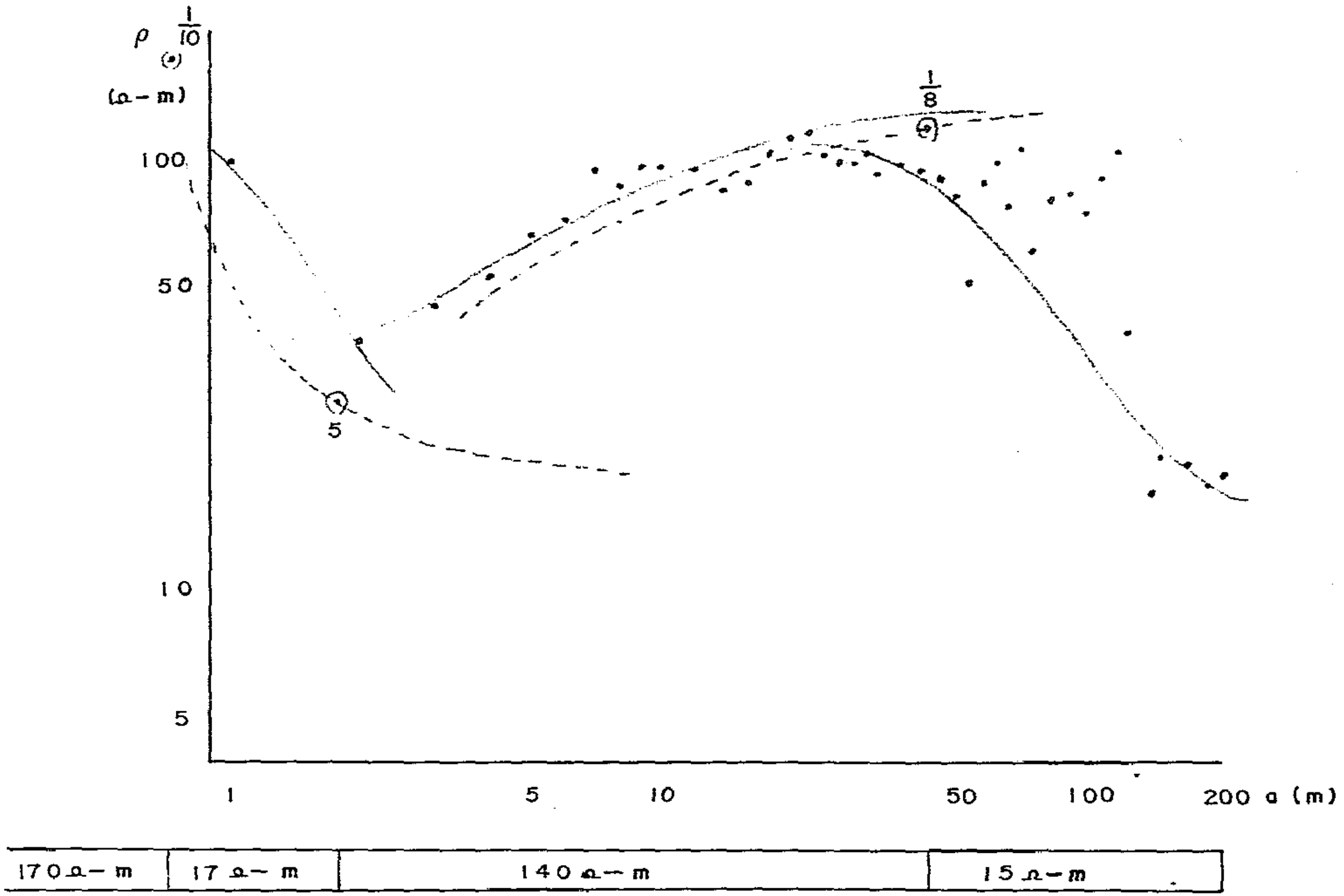

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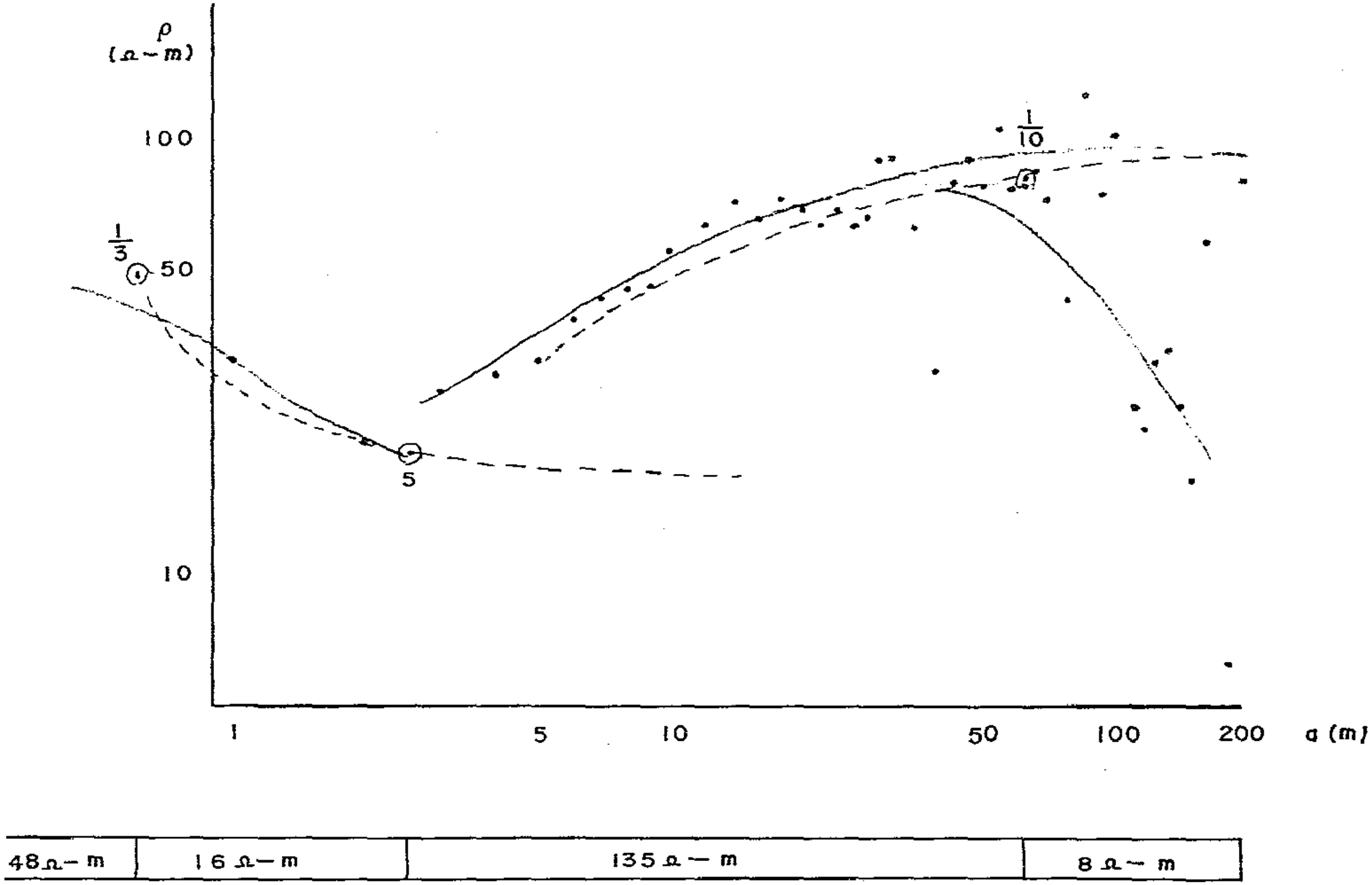

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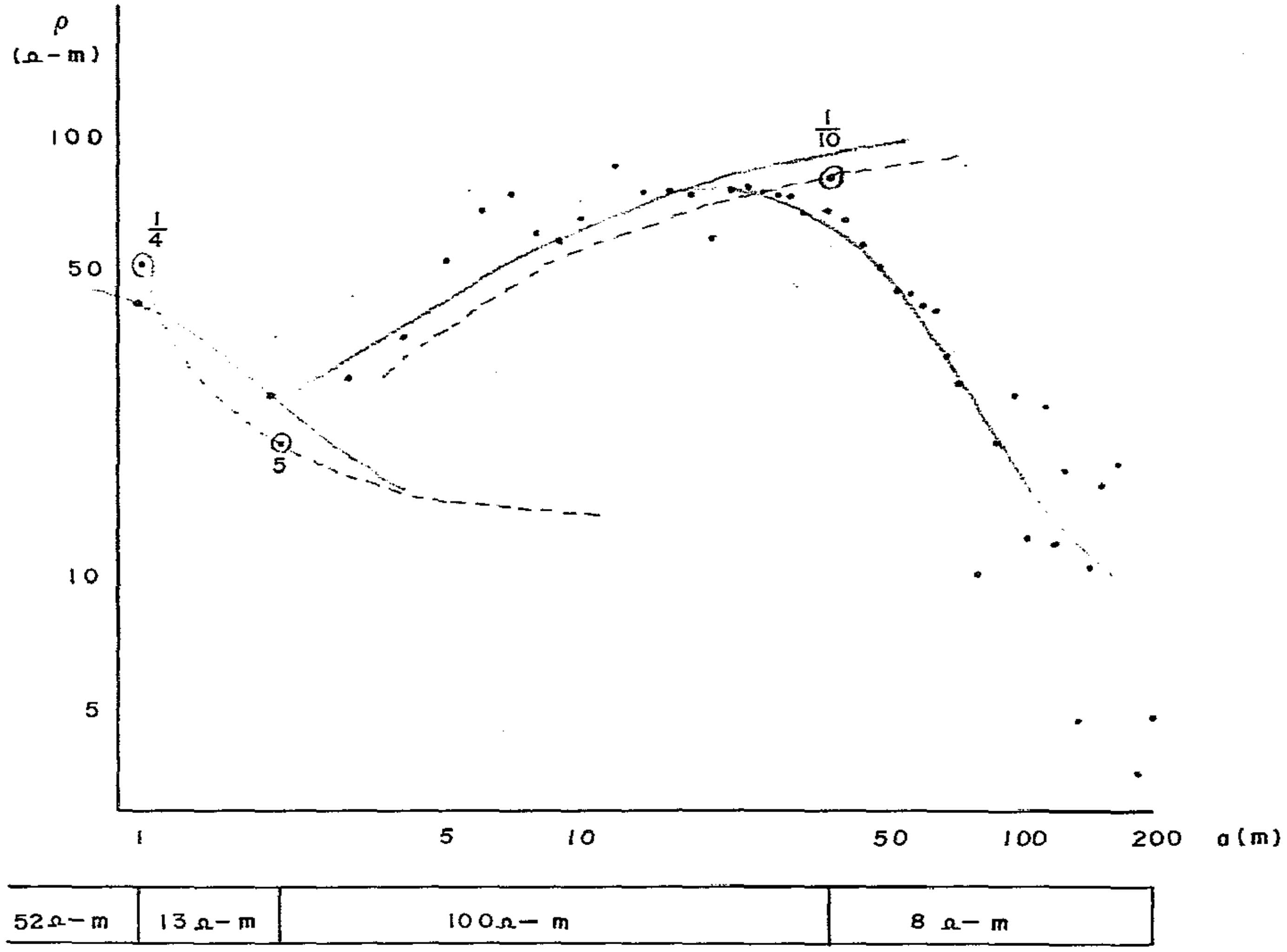

ELECTRICAL PROSPECTING IN MAGWE

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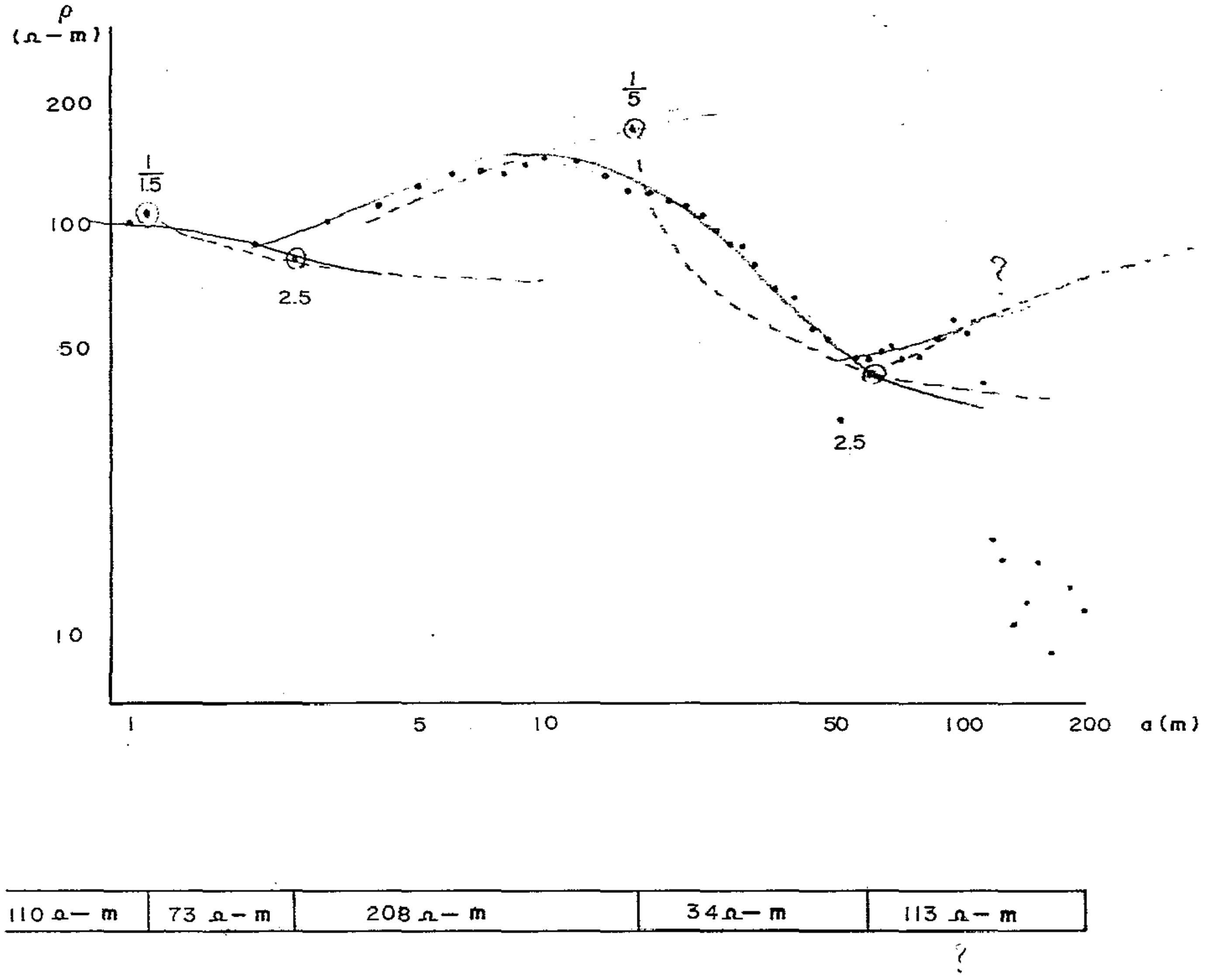

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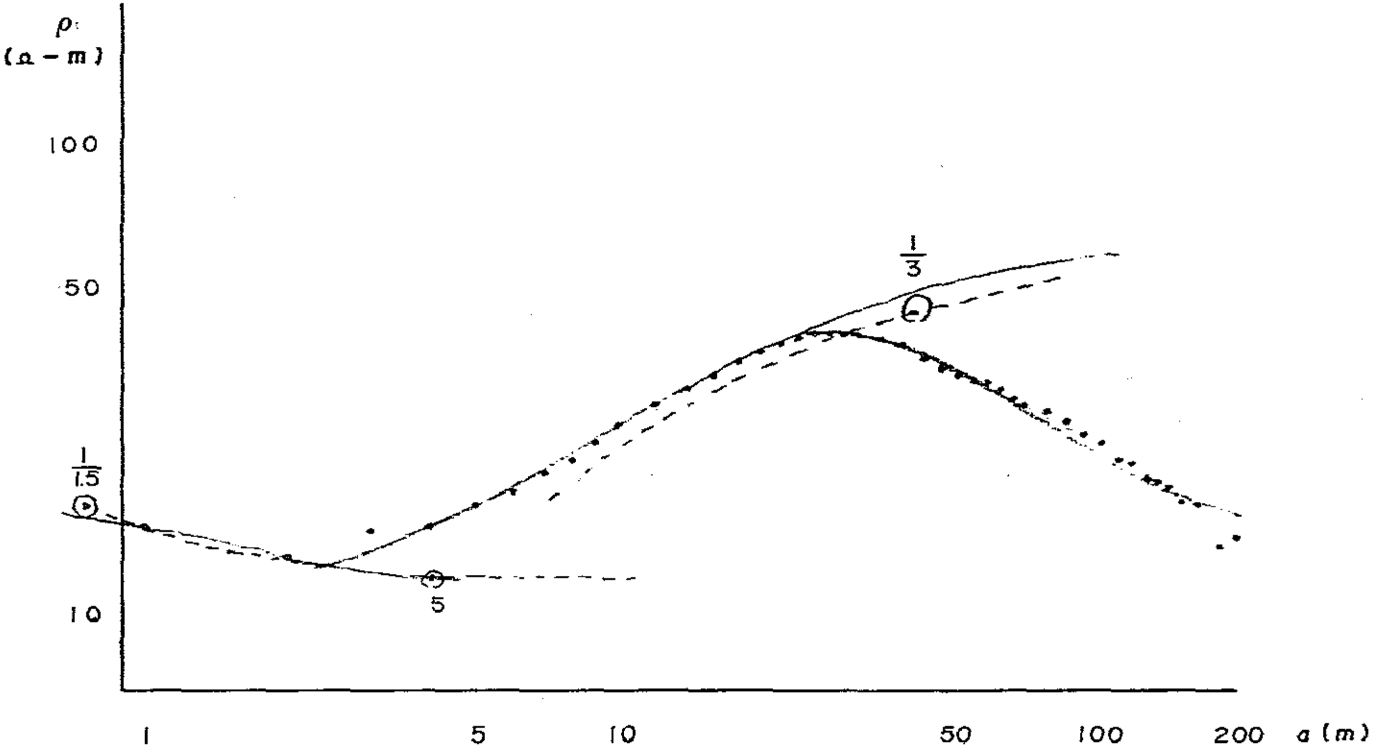

17 Ω − m	11 Ω − m	60 Ω − m	15 Ω − m

ELECTRICAL PROSPECTING IN MAGWE

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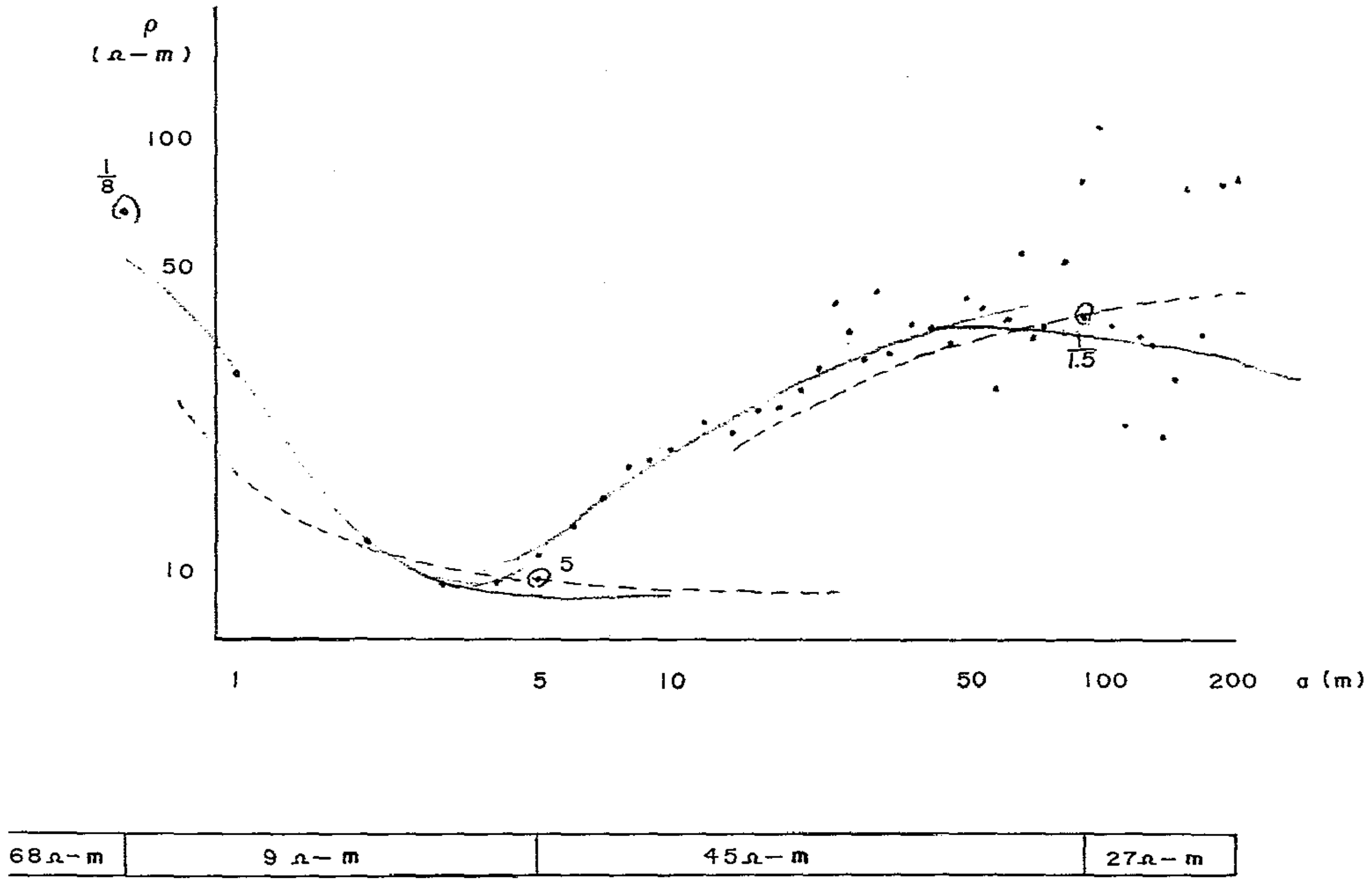

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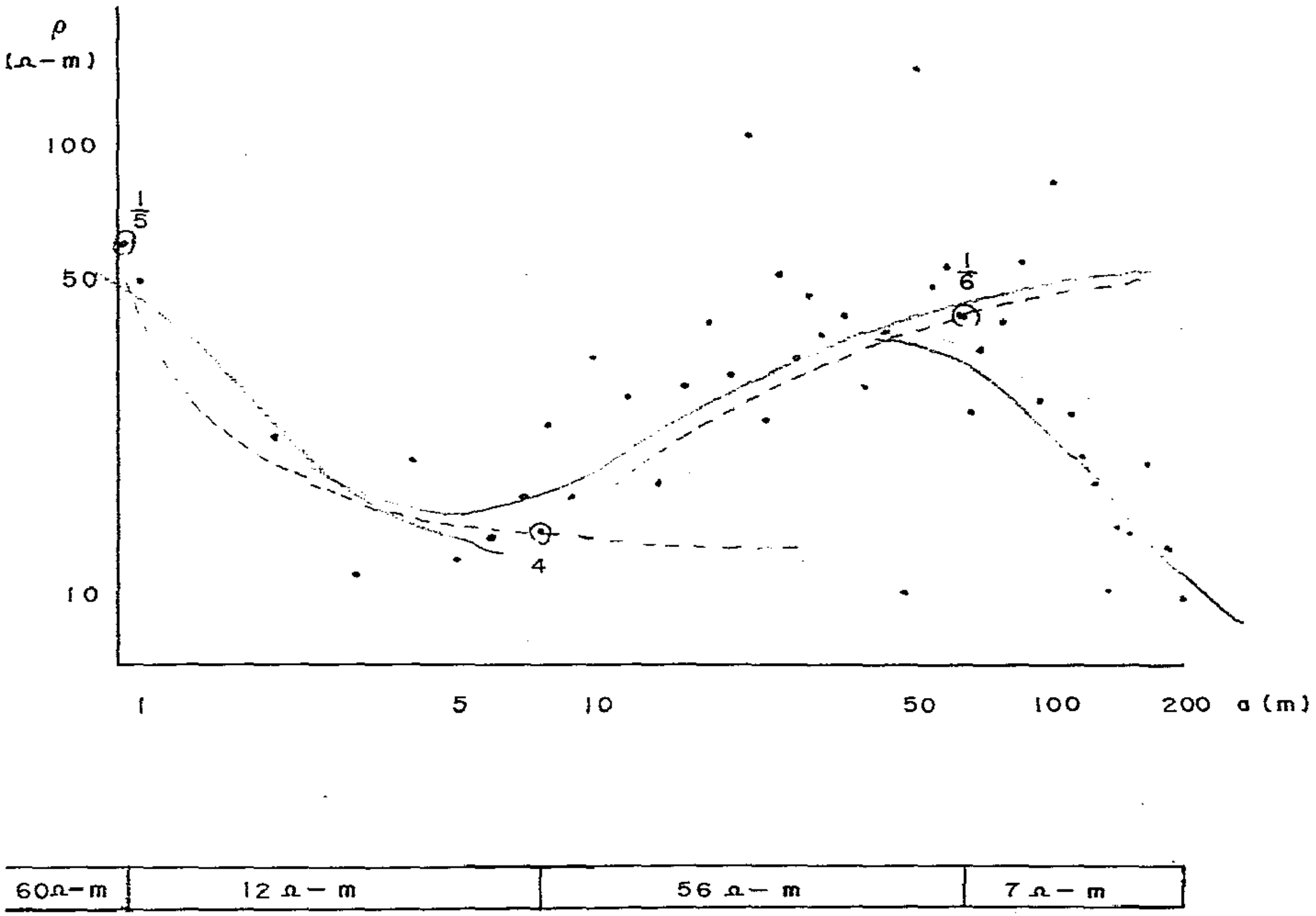

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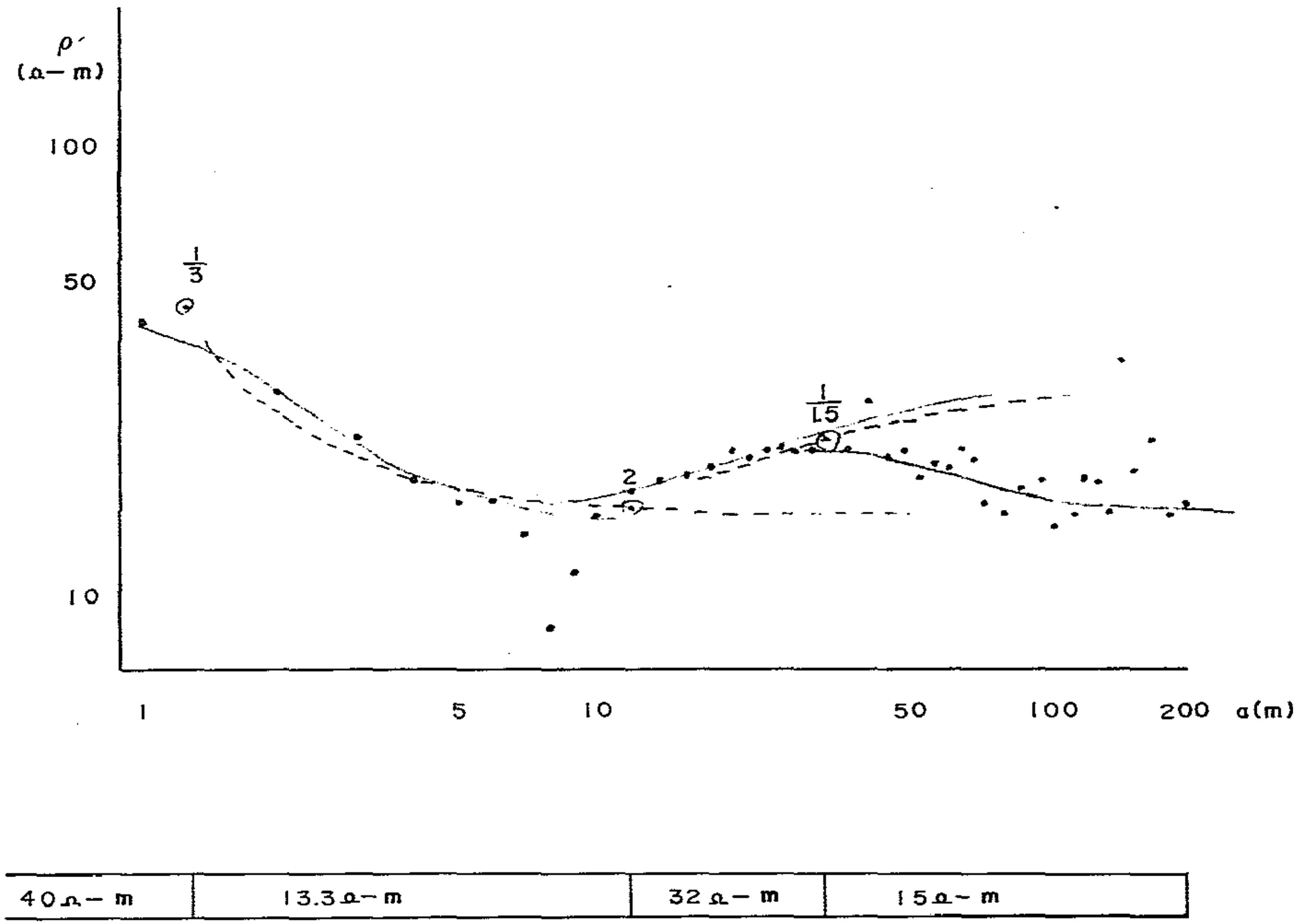

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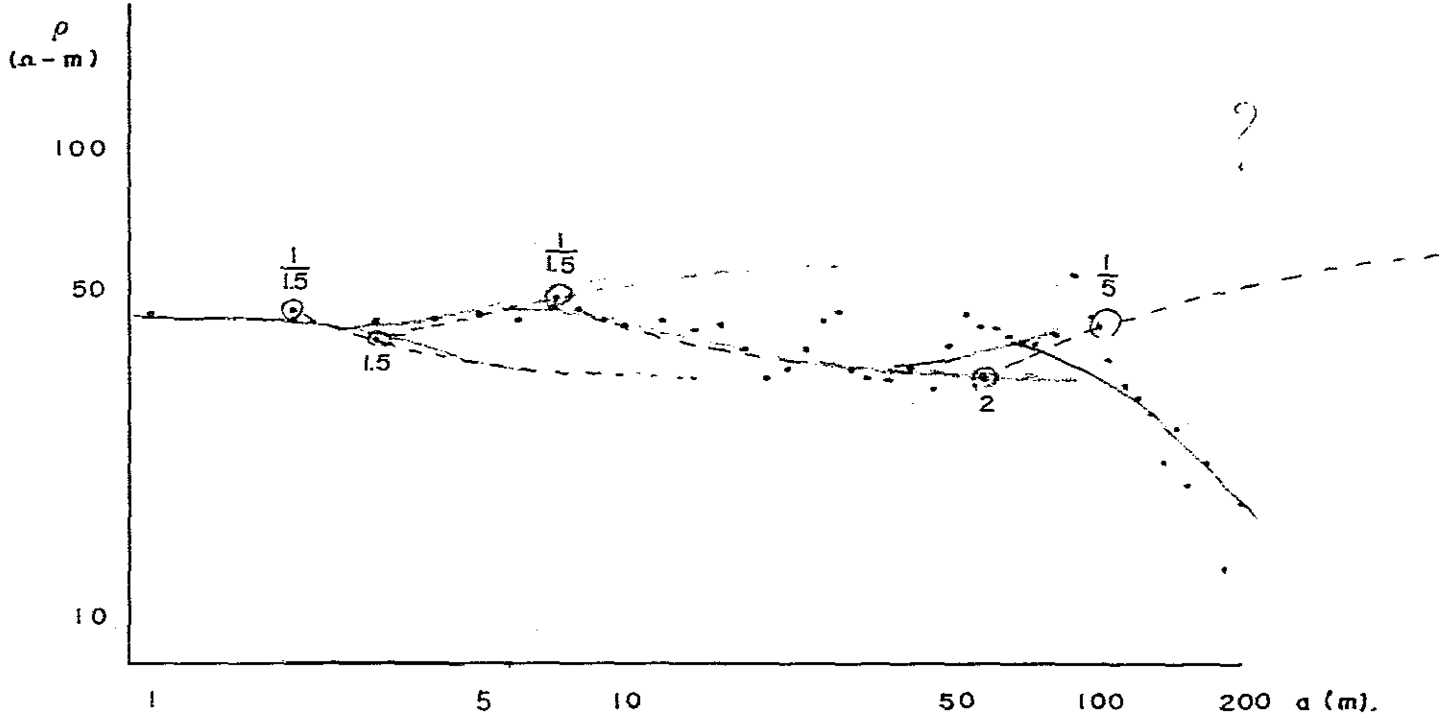
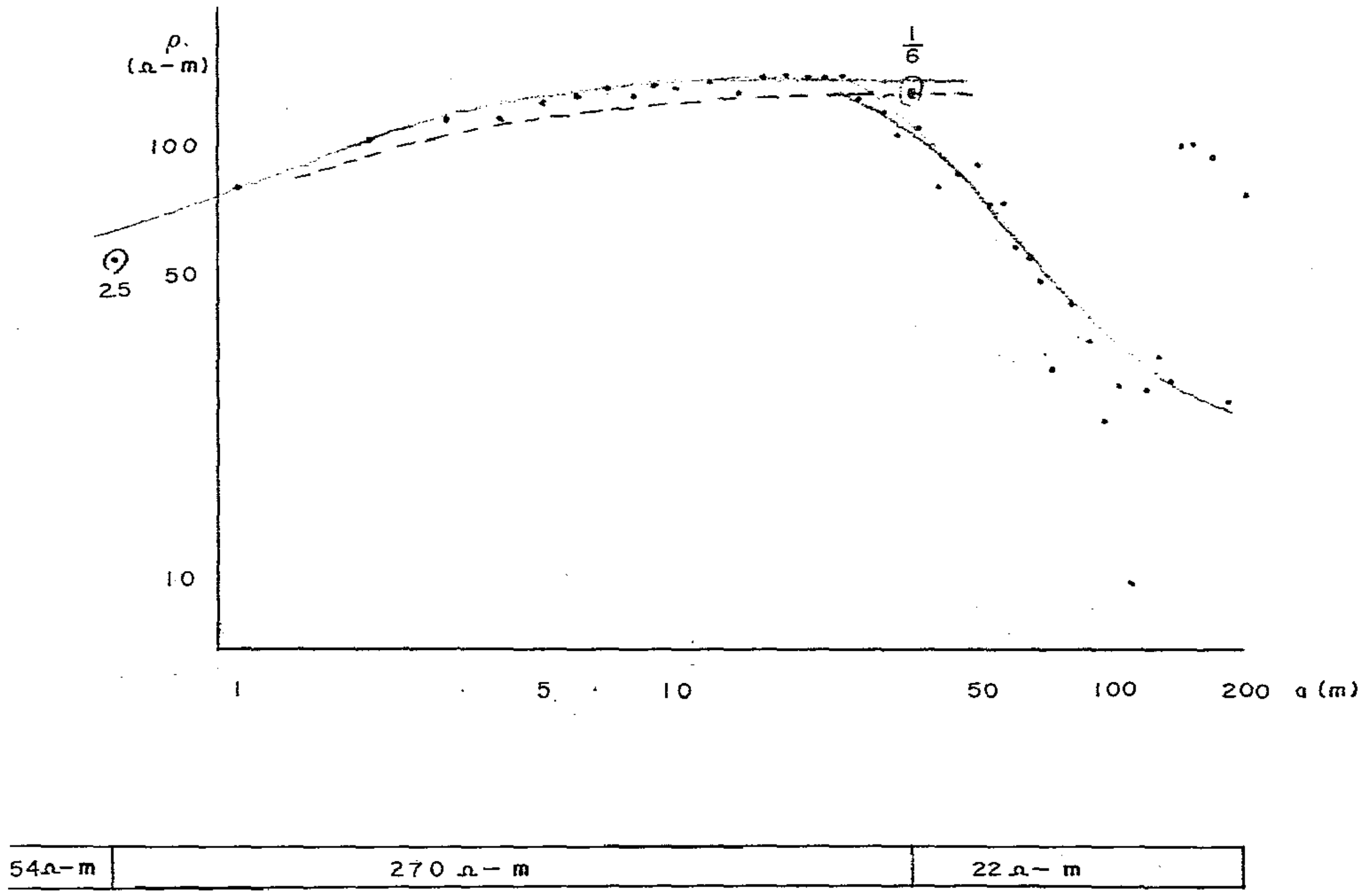


45 Ω – m	30Ω-m	57Ω – m	32 Ω – m	70Ω-m	8 Ω – m

ELECTRICAL PROSPECTING IN MAGWE

NO. 26



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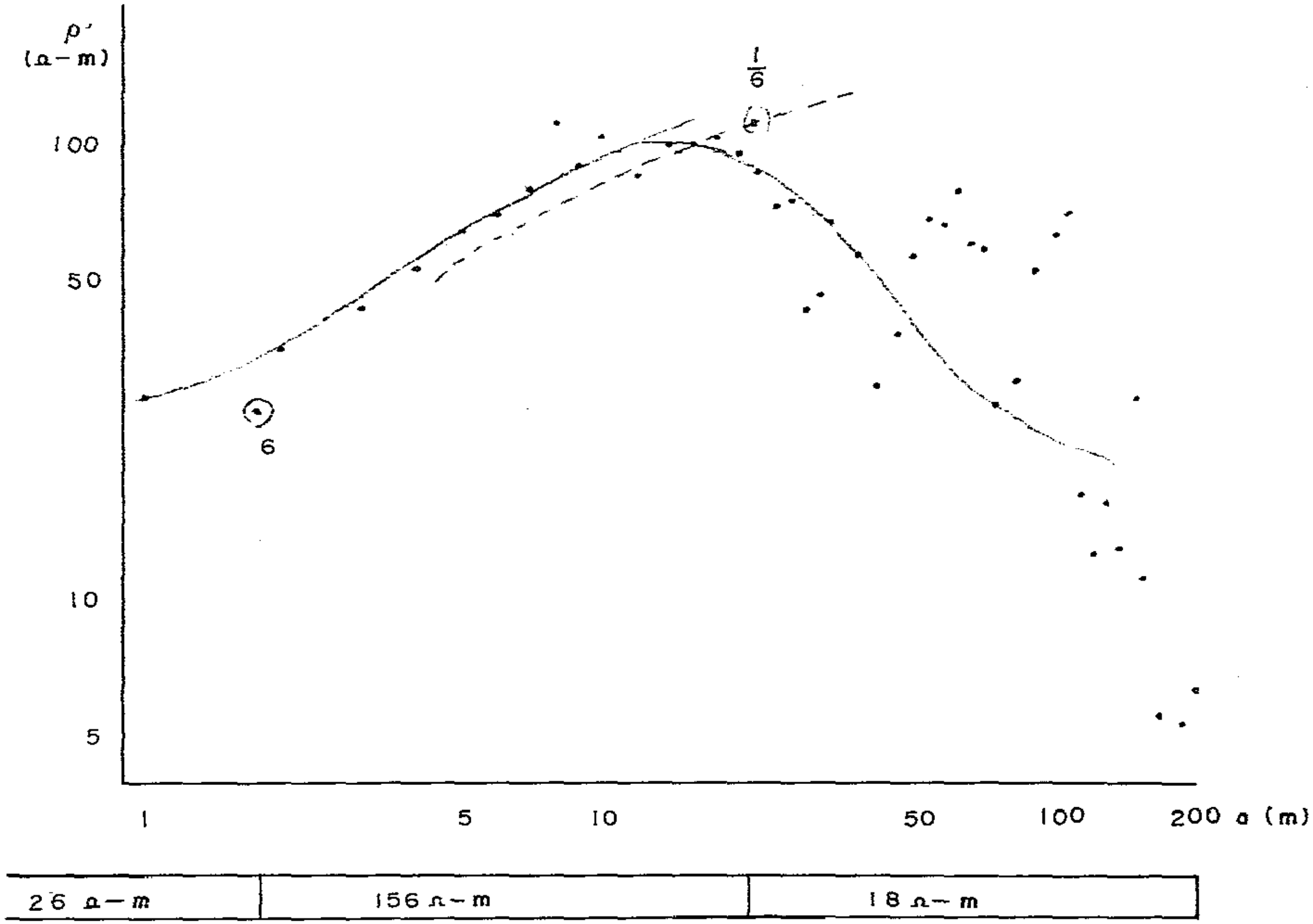
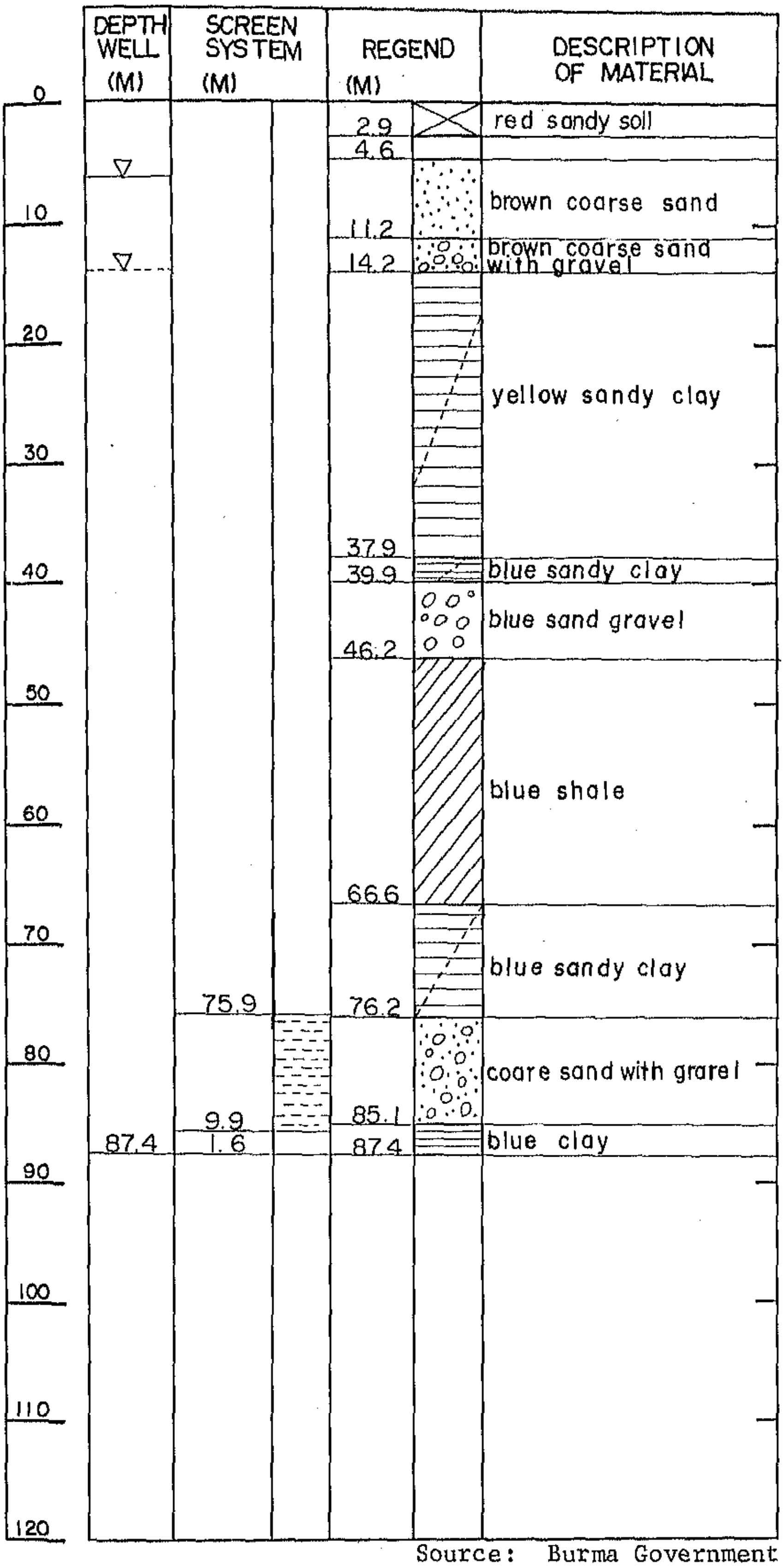


A－2・2 EXISTING WELL LOGS

DIVISIONAL REGIONAL PARTY COMMITTEE-MAGWE-NO.1

WELL LOG



MEMORANDUM

DRILLING MACHINE

JOY I

DATE

16·7·64—27·7·64

TOTAL WELL DEPTH

87·4m

CASING PIPE

ø100 m/m GI

CASING LENGTH

ø100 m/m x 75.9m

SCREEN LENGTH

ø100m/m x 9.9m

S.W.L ▽

6.3m

D.W.L ▽

14.1 m

YIELD

926 L·P·M

※ REMARKS

MUD CECING

62.7m

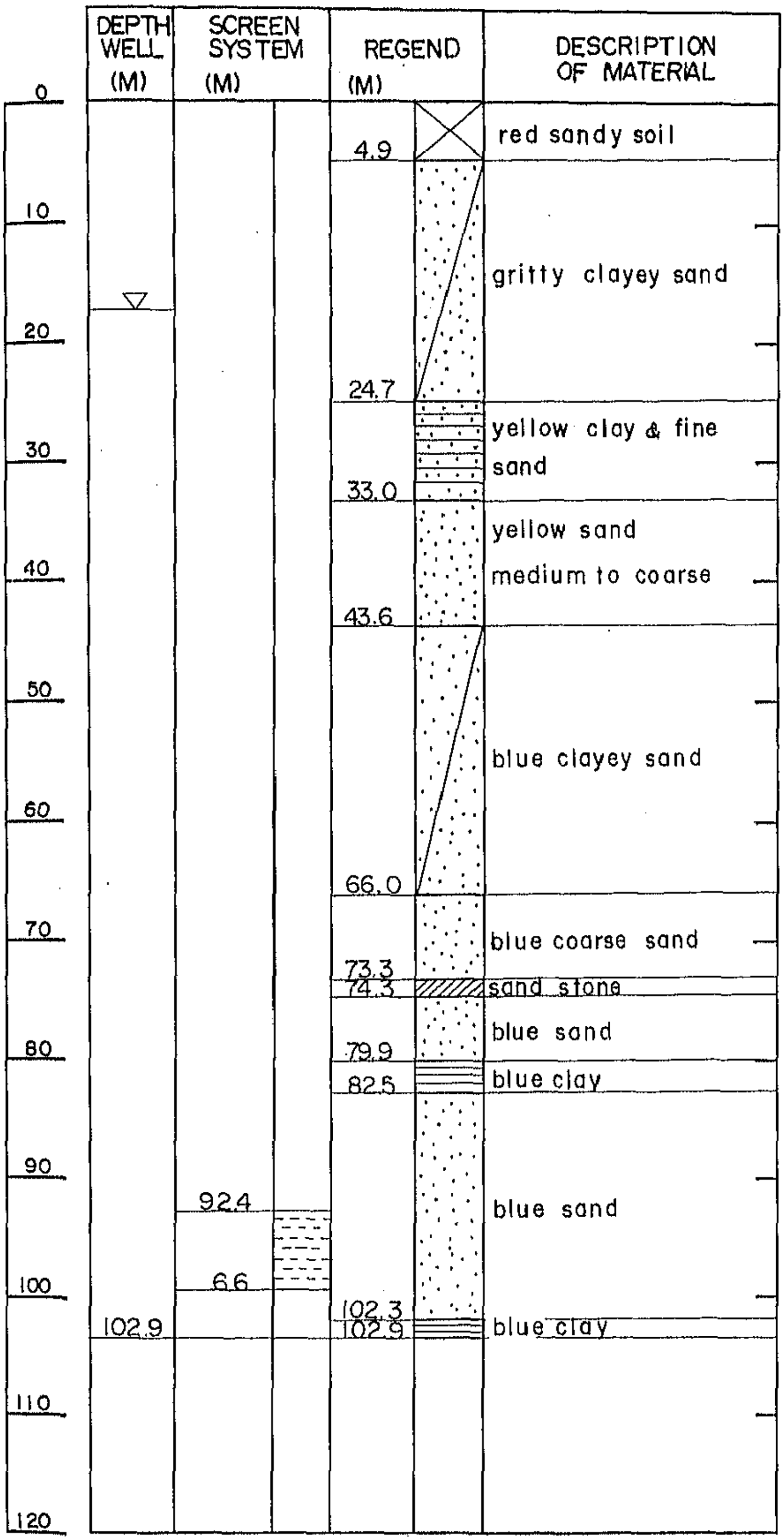
GRAVEL DACKING

24.8m

Source: Burma Government

DIVISIONAL PEOPLE'S COUNCIL. MAGWE - NO.2

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

PORTA

DATE

14·6·79 – 16·6·79

TOTAL WELL DEPTH

102.9 m

CASING PIPE

ø150 m/m G·I

CASING LENGTH

ø150m/m x 92.4 m

SCREEN LENGTH

ø125 x 6.6 m

S.W.L ▽

17.2 m

D.W.L --▽--

—

YIELD

300 L·P·M

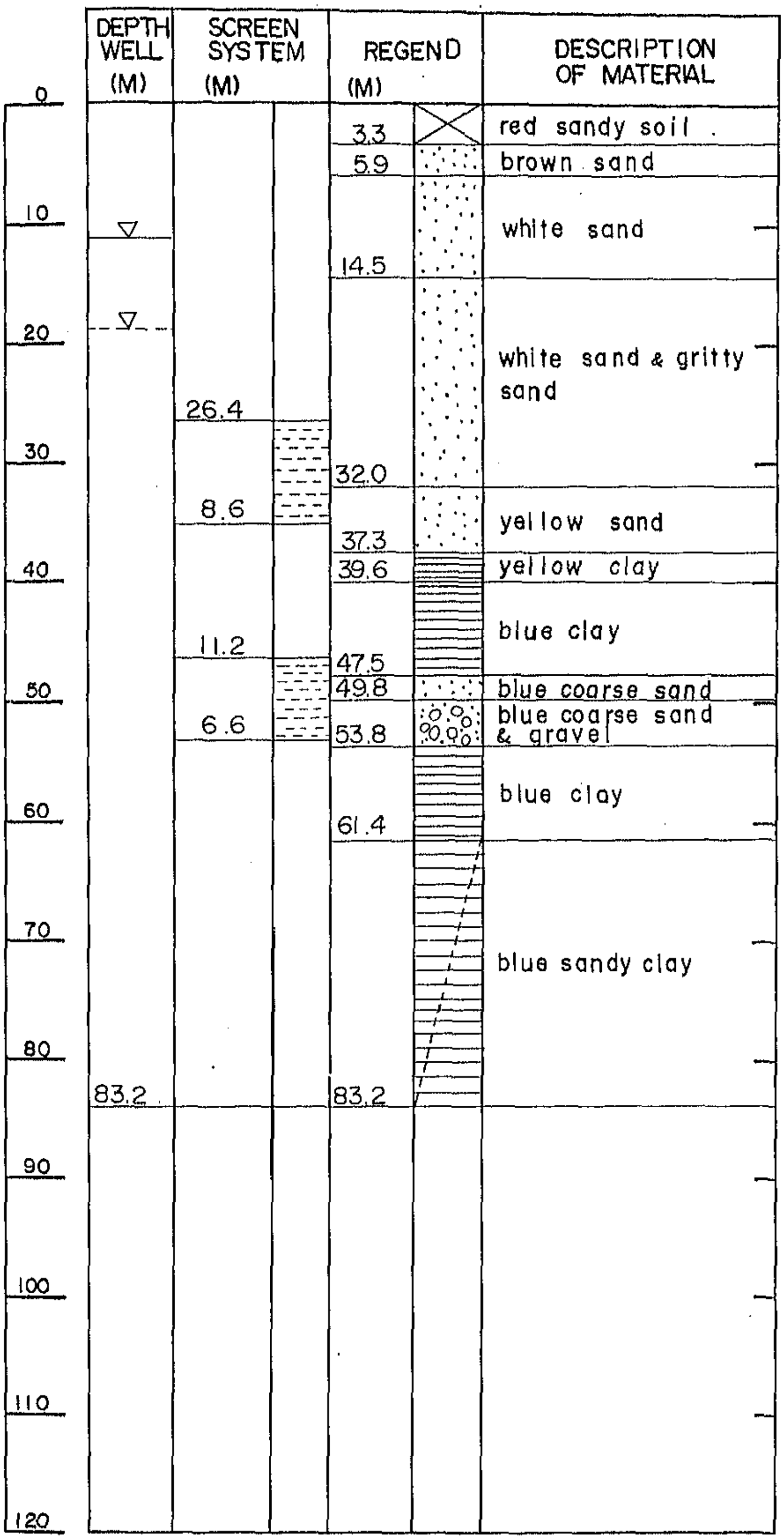
※ REMARKS

AIR PIPE

ø69 m/m x 89.1 m

DIVISIONAL SPORTS & PHPARTMENT.MAGWE NO.3

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

JOY I

DATE

31.8.62 — 9.9.62

TOTAL WELL DEPTH

83.2 m

CASING PIPE

ø 150 m/m GI

CASING LENGTH

ø 150 m/m x 37.6 m

SCREEN LENGTH

ø 150 m/m x 15.18 m

S.W.L ▽

10.9 m

D.W.L --▽--

18.5 m

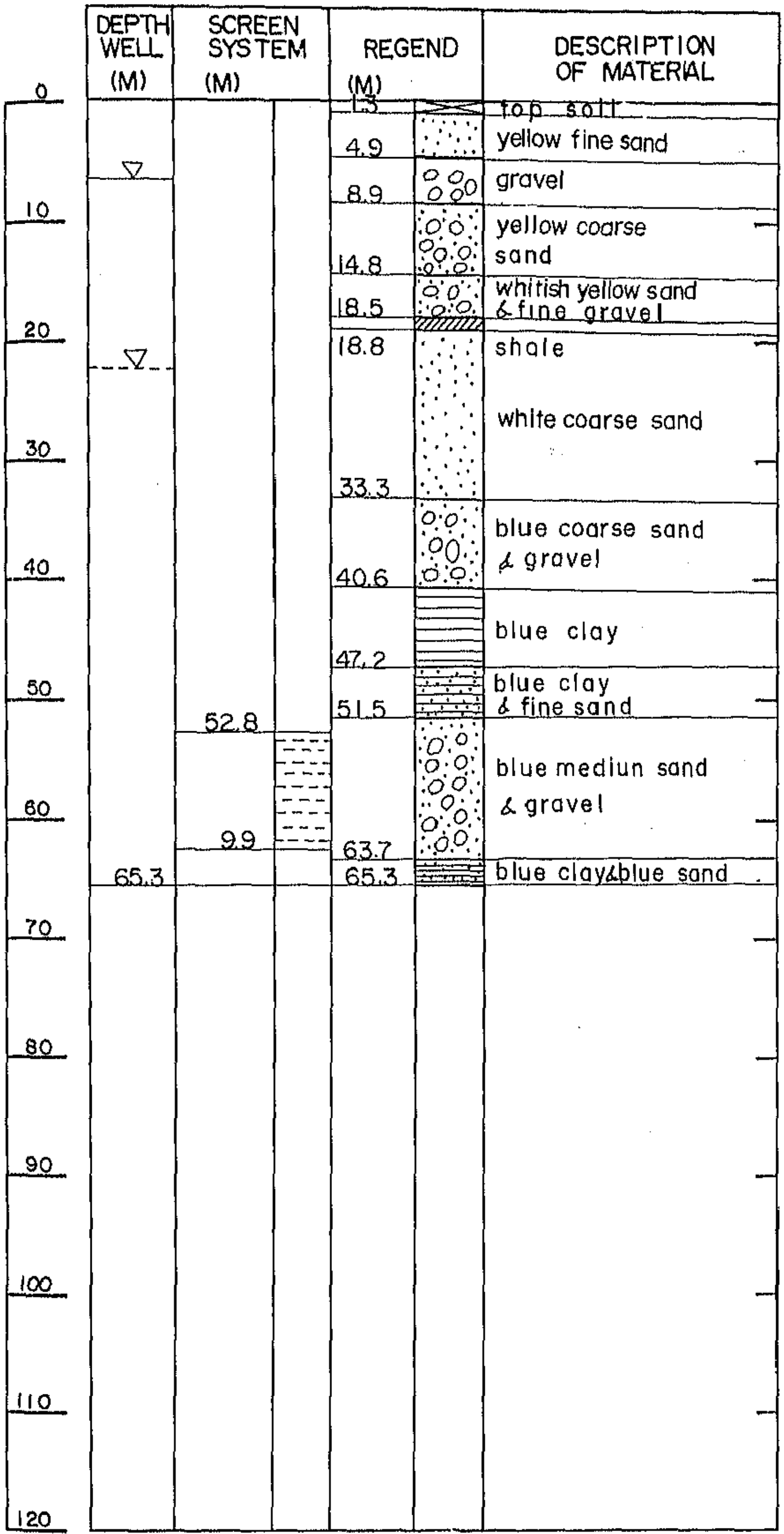
YIELD

922 L·P·M

※ REMARKS

MAGWE COLLEGE (NO.1)- NO.4

WELL LOG



DEPTH WELL (M)	SCREEN SYSTEM (M)	REGEND (M)	DESCRIPTION OF MATERIAL
		1.3	top soil
		4.9	yellow fine sand
		8.9	gravel
		14.8	yellow coarse sand
		18.5	whitish yellow sand & fine gravel
		18.8	shale
		33.3	white coarse sand
		40.6	blue coarse sand & gravel
		47.2	blue clay
		51.5	blue clay & fine sand
	52.8		
	9.9	63.7	blue mediun sand & gravel
65.3		65.3	blue clay&blue sand

Source: Burma Government

MEMORANDUM

DRILLING MACHINE

JOY I

DATE

—

TOTAL WELL DEPTH

63.5m

CASING PIPE

Ø150m/m G·I

CASING LENGTH

Ø150m/m x 52.8m

SCREEN LENGTH

Ø150m/m x 9.9m

S.W.L ▽

6.6m

D.W.L ▽

22.4m

YIELD

472.5 L·P·M

※ REMARKS

BORE HOLE

37.5m/m

CLAY SEAL

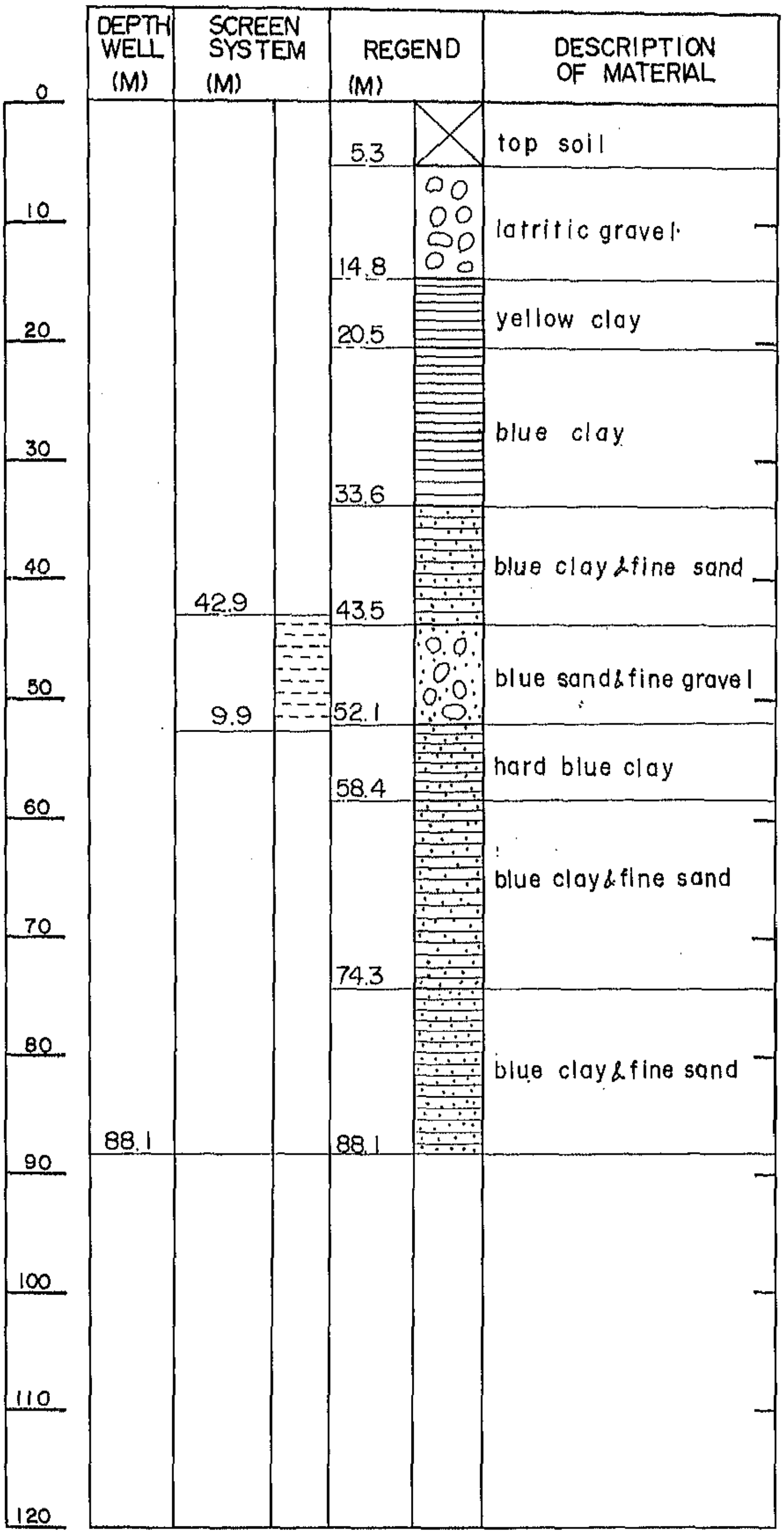
46.2m

GRAVEL·PACKING

19.1m

MAGWE COLLEGE (NO.2) – NO.4"

WELL LOG



MEMORANDUM

DRILLING MACHINE

—

DATE

—

TOTAL WELL DEPTH

88.1 m

CASING PIPE

—

CASING LENGTH

ø200 m/m × 42.9 m

SCREEN LENGTH

ø200 m/m x 9.9 m

S.W.L ∇

—

D.W.L ∇

—

YIELD

—

※ REMARKS

CLAY SEAL

29.7 m

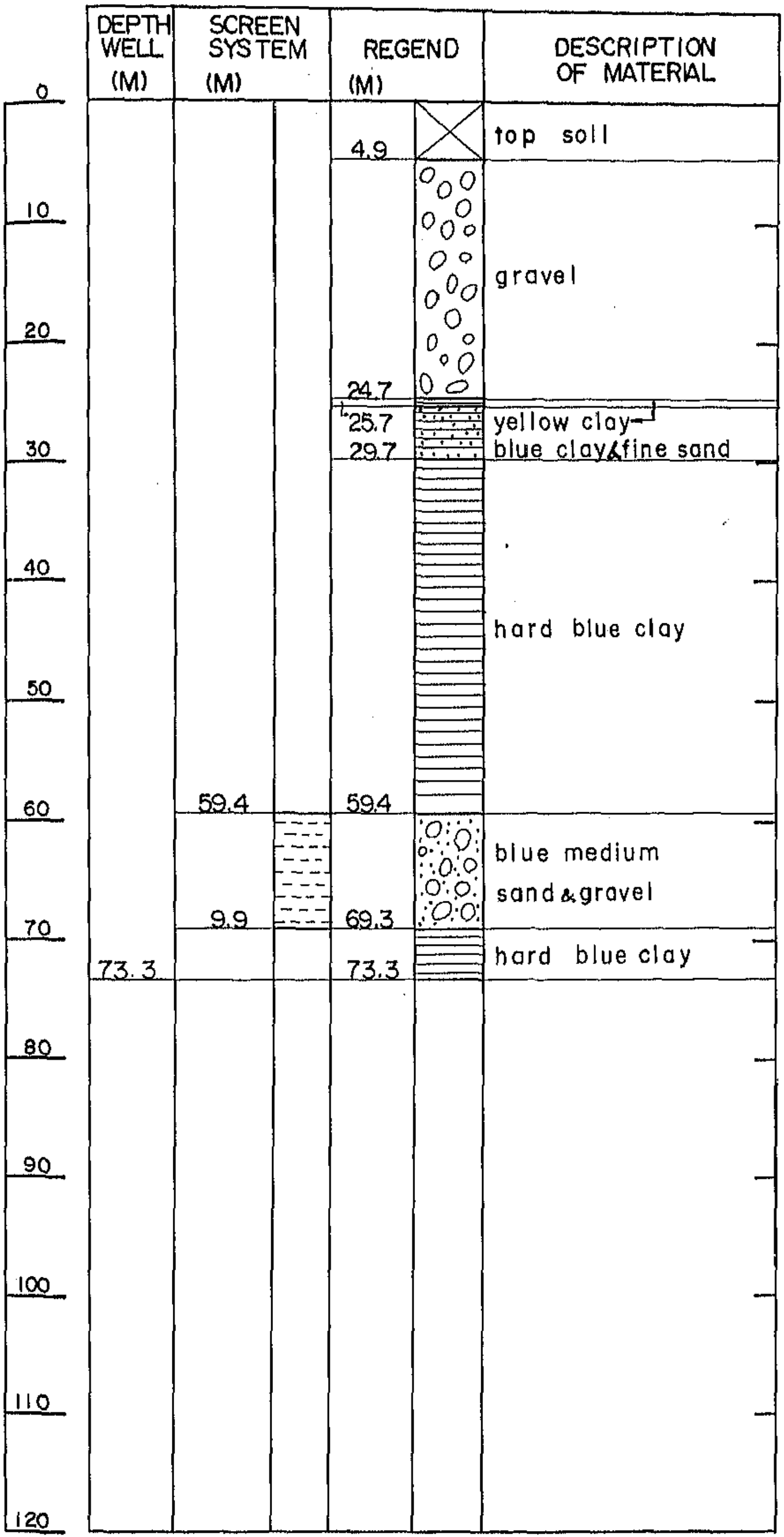
GRAVEL PACKING

26.4 m

Source: Burma Government

MAGWE COLLEGE (NO.3) - NO.4"'

WELL LOG



MEMORANDUM

DRILLING MACHINE

—

DATE

—

TOTAL WELL DEPTH

73.3m

CASING PIPE

Ø200m/m

CASING LENGTH

Ø200m/m X 59.4m

SCREEN LENGTH

Ø200m/m X 9.9m

S.W.L ▽

—

D.W.L ▽

—

YIELD

862.5L·P·M

※ REMARKS

CLAY SEAL

39.6 m

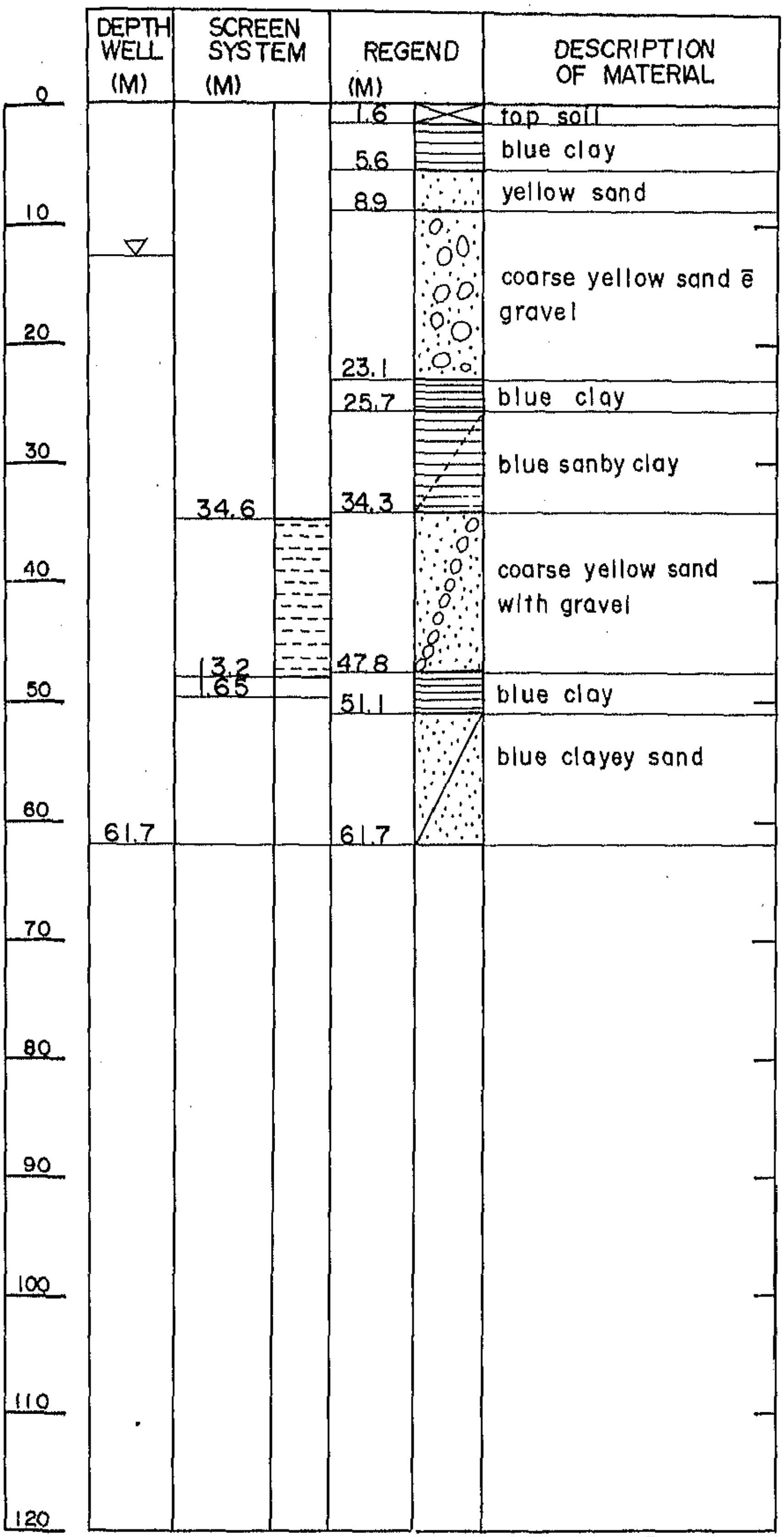
GRAVEL PACKING

33.6 m

Source: Burma Government

MAGWE HOSPITAL -NO.5

WELL LOG



MEMORANDUM

DRILLING MACHINE

PORTA

DATE

29.7.65—5.8.65

TOTAL WELL DEPTH

61.7m

CASING PIPE

Ø150m/m GI

CASING LENGTH

Ø150m/m X36.3m

SCREEN LENGTH

150m/mX 13.2m

S.W.L ▽

12.8m

D.W.L ▽

—

YIELD

750 L·P·M

※ REMARKS

CLAY SEAL

26.4m

GRAVEL PACKING

24.1m

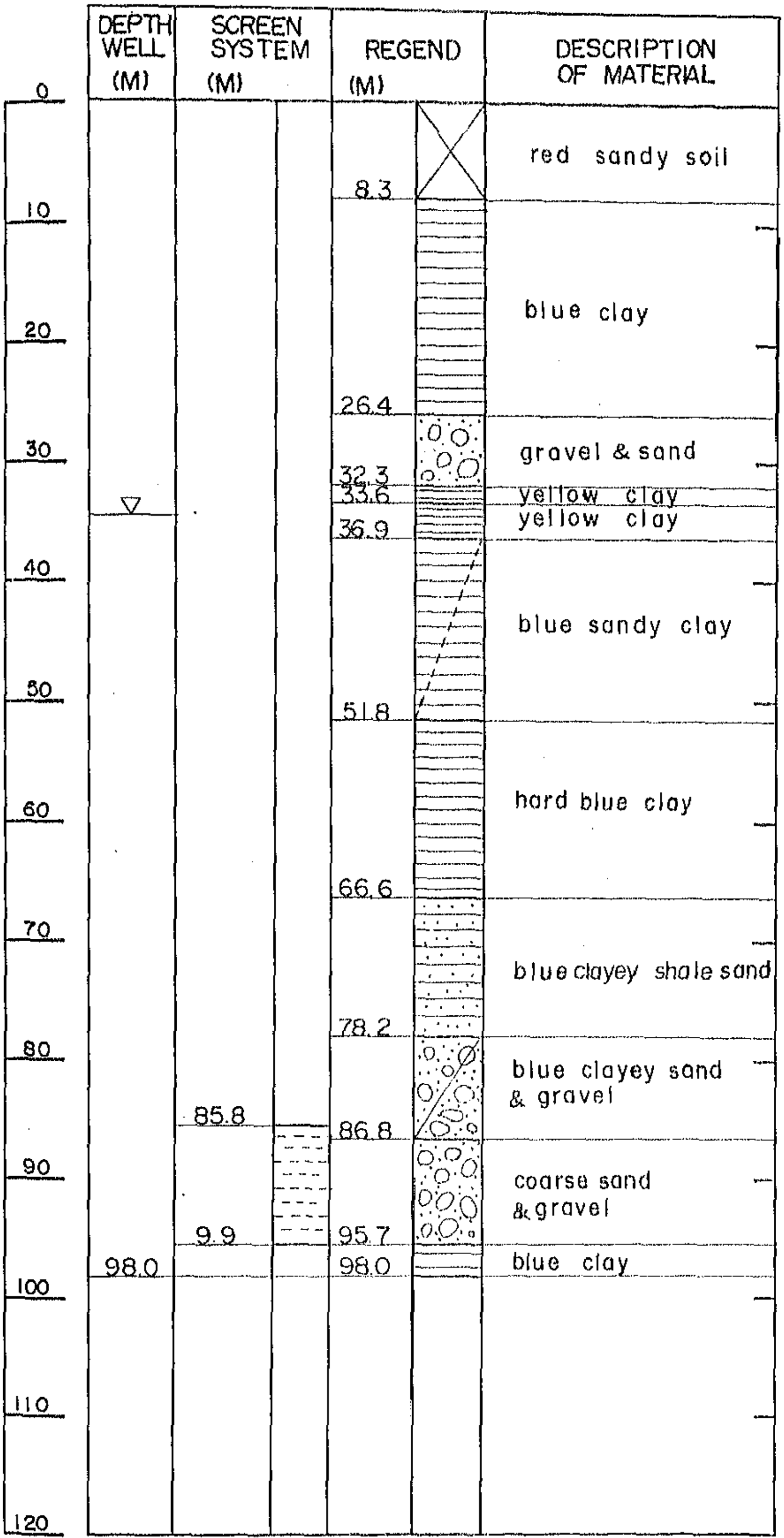
TEMPRATURE

31°C(4.8.81)

Source: Burma Government

DIVISIONAL TOWNSHIP CO-OPERATIVE SOCIATY MAGWE-NO.6

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

FAILING 1

DATE

16.5.74—23.5.79

TOTAL WELL DEPTH

98.0 m

CASING PIPE

Ø150m/m GI

CASING LENGTH

Ø150m/m X 85.8 m

SCREEN LENGTH

Ø150m/m X 9.9 m

S.W.L ▽

34.6m

D.W.L ▽

—

YIELD

270 L·P·M

※ REMARKS

AIR PIPE

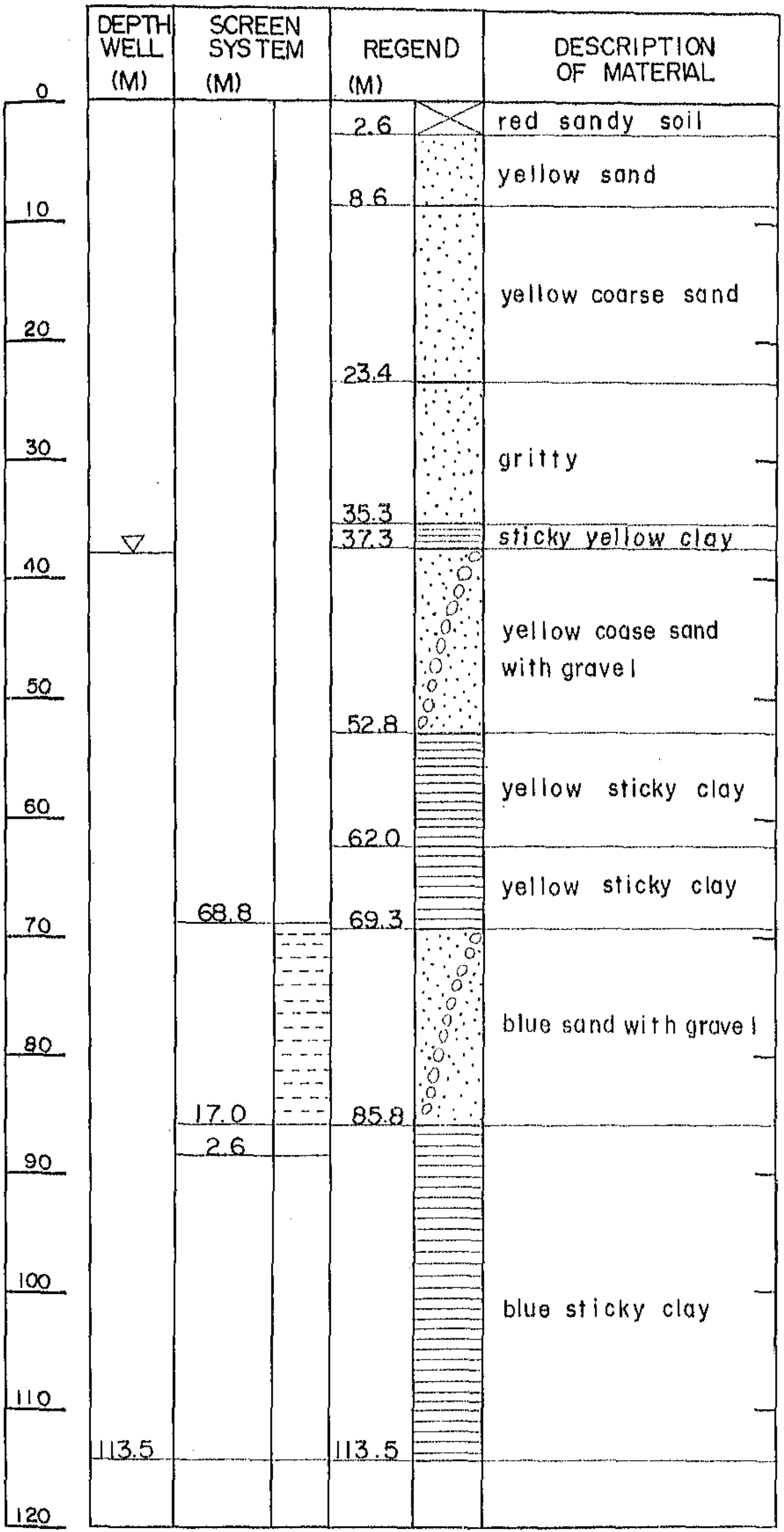
19m/m X 66m

RISER PIPE

50m/m X66m

AGRICULTURAL CORPORATION (FARM) MAGWE - NO. 8

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

PORTA

DATE

11·8·65 — 20·8·65

TOTAL WELL DEPTH

113.5 m

CASING PIPE

ø150 m/m G·I

CASING LENGTH

ø150 m/m x 71.4 m

SCREEN LENGTH

ø150 m/m x 17.4 m

S.W.L ▽

37.6 m

D.W.L ▽

—

YIELD

420 L·P·M

※ REMARKS

CLAY SEAL

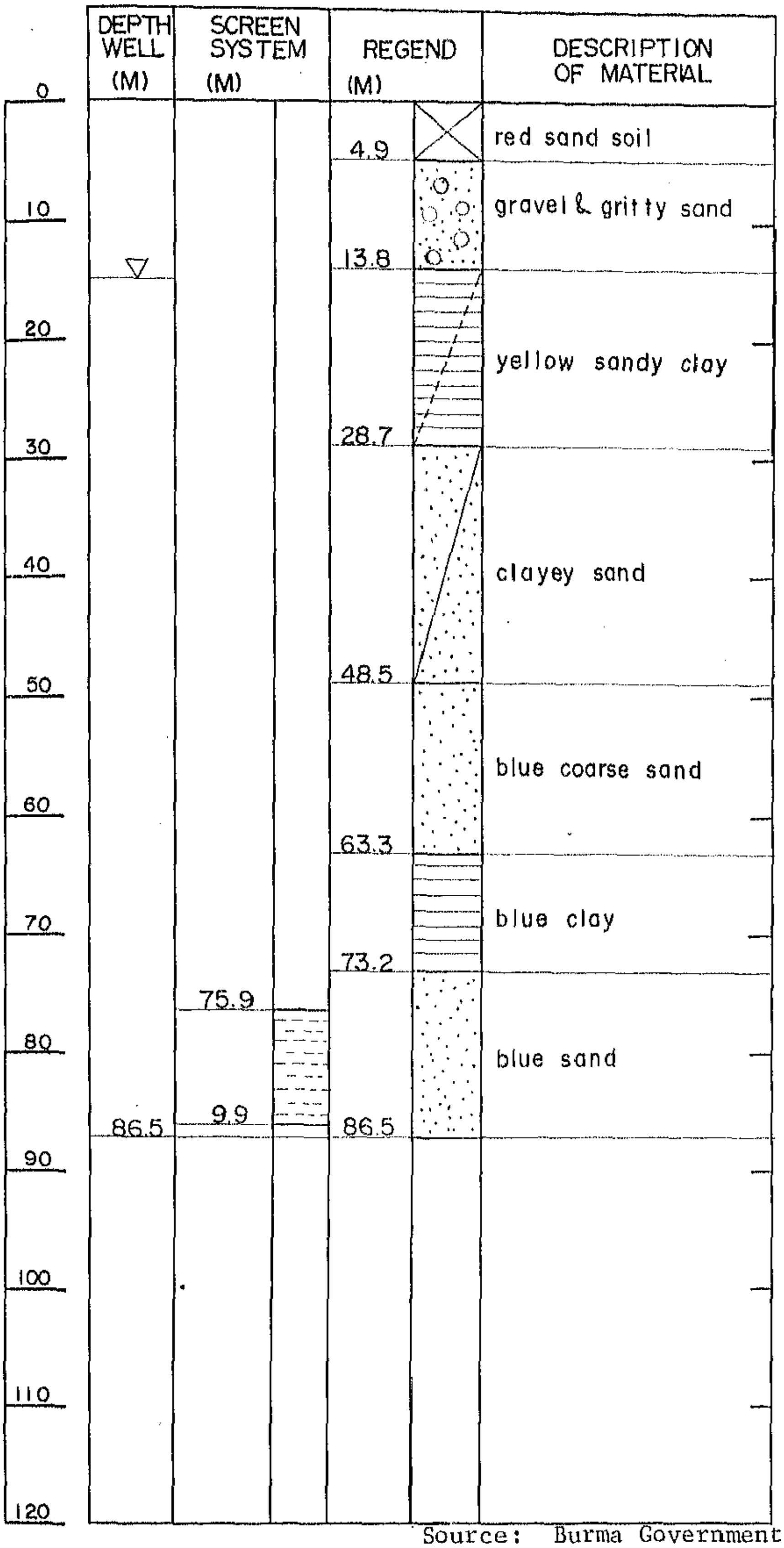
59.4 m

GRAVEL PACKING

33.6 m

TEREGRAPH OFFICE COMPOUND, MAGWE - NO.12

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

FAILING I

DATE

25.5.79 - 30.5.79

TOTAL WELL DEPTH

86.5 m

CASING PIPE

Ø100m/m · G·I

CASING LENGTH

Ø100m/m X75.9m

SCREEN LENGTH

Ø100m/m X 9.9 m

S.W.L ▽

14.8 m

D.W.L ▽

—

YIELD

300 L·P·M

※ REMARKS

AIR PIPE

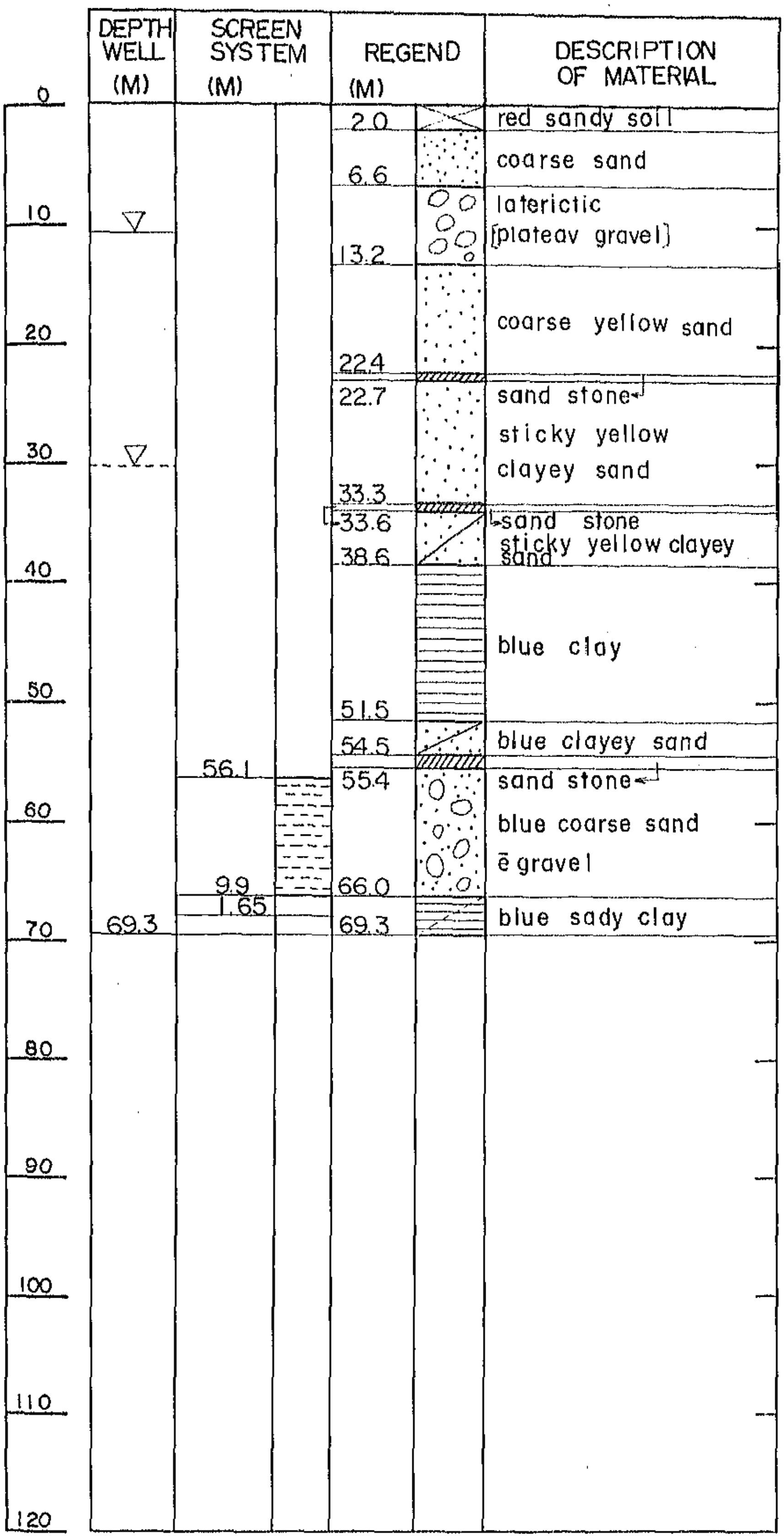
Ø19m/m X 82.5m

RISER PIPE

Ø50m/m X 82.5m

AGRICULTURAL MECHANIZATION DEPARTMENT(WATERSUPPLY)-NO.13

WELL LOG



MEMORANDUM	
DRILLING MACHINE	PORTA
DATE	25.7.66–3.8.66
TOTAL WELL DEPTH	69.3m
CASING PIPE	Ø150m/m G I
CASING LENGTH	Ø150m/m X57.7m
SCREEN LENGTH	Ø150m/m X9.9m
S.W.L ▽	10.9m
D.W.L ▽	15.2m
YIELD	850.5L·P·M
※ REMARKS	
CLAY SEAL	42.9m
GLAVEL PACKING	26.4m

Source: Burma Government

No. 433/81, 434/81 & 435/81

A — 2 · 3 (1) REPORT OF WATER ANALYSIS

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appearance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness	Saline ammonia	Albuminoid ammonia	Iron
						Lab.No.433/81 Sample No.Magwe(4) Tube well, Magwe College			Lab.No.434/81 Sample No. Magwe(5) Tube well, Magwe Hospital			Lab.No.435/81 Sample No.Magwe(6) Tube well, Divisional Co-op.			
	1. Total solids.						660.0	mg/1		700.0	mg/1		760.0	mg/1	
	2. Total hardness, as $CaCO_3$						99.0	"		144.0	"		152.0	"	
	3. Permanent hardness, as $CaCO_3$						10.0	"		8.0	"		10.0	"	
	4. Calcium, as Ca						8.0	"		15.6	"		22.8	"	
	5. Magnesium, as Mg						19.2	"		25.5	"		23.1	"	
	6. Iron, as Fe						0.05	"		0.05	"		1.3	"	
	7. Manganese, as Mn						Nil			Nil			Nil		
	8. Zinc, as Zn						Nil			Nil			0.25	"	
	9. Chloride, as Cl						61.0	"		94.0	"		85.0	"	
	10. Sulphate, as SO_4						13.7	"		169.5	"		161.7	"	
	11. Nitrate, as N						0.2	"		0.2	"		1.0	"	
	12. Carbonate, as CO_3						Nil			Nil			Nil		
	13. Bicarbonate, as HCO_3						469.7	"		427.0	"		430.1	"	
	14. Free & saline ammonia as NH_3						0.01	"		0.01	"		0.01	"	
	15. Albuminoid ammonia as NH_3						0.02	"		0.01	"		0.20	"	
	16. pH.						7.8			8.0			7.9		

Remarks— Samples not sufficient for further tests.

DAW KHIN KHIN SOE,
M.B.B.S., D.P.H.
Asst. Director, N.H.L

No. 436/81, 437/81 & 438/81.

A — 2 · 3 (2) REPORT OF WATER ANALYSIS

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appear-ance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness'	Saline ammonia	Albuminoid ammonia	Iron

	Lab.No.436/81 Sample No.Magwe(7) Tube well, Pyidawtha Estate		Lab.No.437/81 Sample No.Magwe (8) Tube well, Agricultural Corporation farm.		Lab.No.438/81 Sample No.Magwe(11) Tube well, Garrison Engineer.	
1. Total solids.	825.0	mg/1	826.0	mg/1	740.0	mg/1
2. Total hardness, as $CaCO_3$	150.0	"	148.0	"	120.0	"
3. Permanent hardness, as $CaCO_3$	7.0	"	8.8	"	8.0	"
4. Calcium, as Ca	29.6	"	21.6	"	18.8	"
5. Magnesium, as Mg	18.5	"	22.8	"	17.8	"
6. Iron, as Fe	0.35	"	0.05	"	0.05	"
7. Manganese, as Mn	Nil		Nil		Nil	
8. Zinc, as Zn	Nil		Nil		Nil	
9. Chloride, as Cl	82.0	"	32.0	"	74.0	"
10. Sulphate, as SO_4	140.1	"	147.0	"	132.3	"
11. Nitrate, as N	0.10	"	1.10	"	1.20	"
12. Carbonate, as CO_3	Nil		Nil		Nil	
13. Bicarbonate, as HCO_3	540.0	"	500.8	"	448.4	"
14. Free & saline ammonia, as NH_3	0.01	"	0.01	"	0.02	"
15. Albuminoid ammonia, as NH_3	0.01	"	0.01	"	0.04	"
16. pH.	7.8		7.8		7.6	

Remarks—

Samples not sufficientfor furher tests.

DAW KHIN KHIN SOE.
M.B., B.S., D.P.H.
Asst. Director. H.M.B

A — 2 · 3 (3) REPORT OF WATER ANALYSIS

No. 439/81, 440/81 & 441/81.

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appearance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness'	Saline ammonia	Albuminoid ammonia	Iron
						Lab.No.439/81. Sample No.Magwe(13) Tube Well, AMD, Magwe.			Lab.No.440/81 River water Salween River, Pa-an			Lab.No.441/81 Tube well, Pa-an.			
	1. Total solids.						850.0	mg/l	-	1460.0	mg/l		340.0	mg/l	
	2. Total hardness, as $CaCO_3$						152.0	"		106.0	"		195.0	"	
	3. Permanent hardness, as $CaCO_3$						10.0	"		30.0	"		50.0	"	
	4. Calcium, as Ca						16.8	"		27.2	"		38.2	"	
	5. Magnesium, as Mg						26.7	"		9.26	"		23.3	"	
	6. Iron, as Fe						0.1	"		12.50	"		0.25	"	
	7. Manganese, as Mn						Nil			Nil			Nil		
	8. Zinc, as Zn						Nil			Nil			Nil		
	9. Chloride, as Cl						88.0	"		4.0	"		4.6	"	
	10. Sulphate, as SO_4						132.3	"		—			—		
	11. Carbonate, as CO_3						36.0	"		Nil			Nil		
	12. Bicarbonate, as HCO_3						503.3	"		136.0	"		249.5	"	
	13. Nitrate, as N						1.2	"		1.0	"		0.7	"	
	14. Free & saline ammonia, as NH_3						0.01	"		—			—		
	15. Albuminoid ammonia, as NH_3						0.10	"		—			—		
	16. pH.						8.4	—		7.5			7.1		

Remarks— Samples not sufficient for further tests.

DAW KHIN KHIN SOE,
M.B.B.S., D.P.H.
Asst. Director, H.H.B

A - 2 - 4 CALCULATION SHEETS FOR DISTRIBUTION NET WORK (PROPOSED PIPELINES)

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)   PIPELINE NETWORK  TYPE-2                    PAGE

 LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                          (MM)    ( M )     ( L/S )     ( M/S )     ( 0/00 )    ( M )

                *** LOOP   1 ***     SIGMA-H=  .000000

 109     1- 84    150.   250.     10.00     -13.90        .283        .315      -.003
   1     1-  4    150.   250.    160.00      96.60       1.968      11.389      1.822
   2     4-  5    150.   250.    180.00      91.78       1.870      10.360      1.865

                *** LOOP   2 ***     SIGMA-H= -.000607

  55    13-  5    150.   250.    490.00     -53.98       1.100       3.882     -1.902
  54    12- 13    150.   250.    265.00     -53.98       1.100       3.882     -1.029
  53    11- 12    150.   250.     75.00     -51.53       1.050       3.561      -.267
   8    10- 11    140.   150.     70.00      -5.41        .306        .753      -.053
   7     7- 10    140.   150.    600.00      -5.41        .306        .753      -.452
   4     6-  7    140.   100.    315.00       6.53        .831       7.675      2.418
   3     5-  6    140.   150.    500.00      10.51        .595       2.570      1.285

                *** LOOP   3 ***     SIGMA-H=  .000000

   6     7-  8    140.   150.    350.00       3.98        .225        .426       .149

                *** LOOP   4 ***     SIGMA-H=  .000000

   5     7-  9    140.   100.    230.00       3.96        .507       3.072       .707

                *** LOOP   5 ***     SIGMA-H= -.006587

  37    18- 11    140.   150.    470.00      -8.10        .458       1.588      -.747
  53    11- 12    150.   250.     75.00     -51.53       1.050       3.561      -.267
  52    46- 12    140.   100.    300.00      -2.46        .313       1.258      -.377
  51    45- 46    140.   100.    365.00       1.52        .194        .520       .190
  50    44- 45    140.   100.    242.00      -3.37        .429       2.258      -.546
  49    43- 44    140.   100.     40.00      -3.37        .429       2.258      -.090
  41    81- 43    140.   150.    315.00      -4.54        .257        .545      -.172
  40    18- 81    140.   150.     20.00      -4.54        .257        .545      -.011

                *** LOOP   6 ***     SIGMA-H= -.001665

 106    15- 14    150.   200.     90.00     -23.05        .734       2.383      -.214
   9    11- 14    150.   250.    340.00      34.03        .693       1.653       .562
  37    18- 11    140.   150.    470.00      -8.10        .458       1.588      -.747
  39    17- 16    140.   150.     40.00      -4.79        .271        .600      -.024
  38    16- 17    140.   150.    340.00      -4.79        .271        .600      -.204
  18    15- 16    150.   200.    168.00      15.82        .504       1.188       .200
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```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)   PIPELINE NETWORK TYPE-8  LH =  0.0 M          PAGE

  LINE  JOINT NO.     C     DIA.     LENGTH     QUANTITY     VELOCITY     GRADIENT    HEAD LOSS
                            (MM)     ( M )      ( L/S )      ( M/S )      ( 0/00 )     ( M )

                *** LOOP   7 ***      SIGMA-H=  .002800

   70      6- 48    140.   150.     390.00        2.10         .119         .130        .051
   68     48- 49    140.   100.     500.00        3.15         .401        1.994        .997
   67     49- 50    140.   100.     160.00         .75         .096         .140        .022
   66     50- 51    140.   100.     270.00         .05         .007         .001        .000
   60      8- 51    140.   150.     200.00        3.33         .188         .305        .061
   41      7-  8    140.   150.     450.00        8.56         .485        1.759        .792
   40      6-  7    150.   200.     320.00       11.62         .370         .671        .215

                *** LOOP   8 ***      SIGMA-H=  .001152

   56     41- 42    140.   150.      60.00        -.96         .054         .031       -.002
   57      7- 42    140.   150.     150.00        1.66         .094         .085        .013
   41      7-  8    140.   150.     450.00        8.56         .485        1.759        .792
   59      8- 43    140.   100.     100.00        -.25         .031         .018       -.002
   58     41- 43    140.   100.     440.00        2.95         .375        1.759        .774

                *** LOOP   9 ***      SIGMA-H=  .000760

   53     40- 42    140.   100.     360.00        1.30         .166         .388        .140
   56     41- 42    140.   150.      60.00        -.96         .054         .031       -.002
   52     39- 41    140.   150.     410.00        3.39         .192         .316        .130
   54     39- 40    140.   150.      90.00       -2.07         .117         .127       -.011

                *** LOOP  10 ***      SIGMA-H=  .001591

   40      6-  7    150.   200.     320.00       11.62         .370         .671        .215
   57      7- 42    140.   150.     150.00        1.66         .094         .085        .013
   53     40- 42    140.   100.     360.00        1.30         .166         .388        .140
   55      6- 40    140.   150.     170.00        4.37         .247         .506        .086

                *** LOOP  11 ***      SIGMA-H=  .000587

   50     37- 38    140.   150.     120.00       -5.93         .335         .891       -.107
   49      5- 38    140.   150.     170.00        8.46         .479        1.721        .293
   39      5-  6    150.   200.     170.00       21.09         .671        2.021        .344
   55      6- 40    140.   150.     170.00        4.37         .247         .506        .086
   54     39- 40    140.   150.      90.00       -2.07         .117         .127       -.011
   51     37- 39    140.   150.     160.00        3.02         .171         .256        .041
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)   PIPELINE NETWORK TYPE-B. LH =  0.0 M        PAGE

      LINE  JOINT NO.     C     DIA.    LENGTH     QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                                (MM)     ( M )      ( L/S )     ( M/S )    ( 0/00 )     ( M )

                    *** LOOP  12 ***       SIGMA-H=  .001606

        3     3-  4    150.    250.    270.00      42.51        .866       2.494        .673
       71     3- 48    140.    150.    480.00      11.97        .677       3.269       1.569
       70     6- 48    140.    150.    390.00       2.10        .119        .130        .051
       39     5-  6    150.    200.    170.00      21.09        .671       2.021        .344
       38     4-  5    150.    200.    130.00      29.85        .950       3.844        .500

                    *** LOOP  13 ***       SIGMA-H=  .000640

       46    35- 36    140.    150.    150.00        .89        .051        .027        .004
       48    35- 38    140.    100.    350.00      -1.14        .145        .302       -.106
       50    37- 38    140.    150.    120.00      -5.93        .335        .891       -.107
       47    36- 37    140.    150.    350.00       -.51        .029        .009       -.003

                    *** LOOP  14 ***       SIGMA-H=  .000931

       45    12- 35    140.    150.     90.00       1.76        .100        .094        .008
        4     4- 12    140.    150.    320.00      10.96        .620       2.777        .889
       38     4-  5    150.    200.    130.00      29.85        .950       3.844        .500
       49     5- 38    140.    150.    170.00       8.46        .479       1.721        .293
       48    35- 38    140.    100.    350.00      -1.14        .145        .302       -.106

                    *** LOOP  15 ***       SIGMA-H=  .000000

        5    12- 13    140.     75.    290.00       7.50       1.698      40.270      11.678
        6    13- 14    140.     75.    750.00       5.10       1.154      19.730      14.797

                    *** LOOP  16 ***       SIGMA-H=  .000000

        7     3- 15    140.    150.    340.00      31.50       1.783      19.587       6.660

                    *** LOOP  17 ***       SIGMA-H= -.000208

       14    21- 22    140.     75.    180.00       1.77        .400       2.779        .500
       15    16- 22    140.     75.    310.00       2.14        .484       3.948       1.224
        8    15- 16    140.    150.    170.00      25.03       1.417      12.803       2.177
       13    15- 21    140.     75.    300.00       3.47        .785       9.666       2.900

                    *** LOOP  18 ***       SIGMA-H= -.000051

       16    22- 23    140.     75.    180.00       1.21        .273       1.368        .246
       17    17- 23    140.    100.    210.00       2.33        .297       1.145        .240
        9    16- 17    140.    150.    180.00      17.83       1.009       6.832       1.230
       15    16- 22    140.     75.    310.00       2.14        .484       3.948       1.224
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK TYPE-8  LH =  0.0 M          PAGE

LINE  JOINT NO.    C     DIA.     LENGTH     QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)     ( M )      ( L/S )     ( M/S )     ( 0/00 )    ( M )

                 *** LOOP  19 ***      SIGMA-H= -.000203

  18    23- 24   140.     75.    130.00        1.54        .348       2.151       .280
  19    18- 24   140.     75.    210.00        1.06        .240       1.080       .227
  10    17- 18   140.    150.    120.00       10.23        .579       2.445       .293
  17    17- 23   140.    100.    210.00        2.33        .297       1.145       .240

                 *** LOOP  20 ***      SIGMA-H= -.000149

  20    24- 25   140.     75.    120.00         .90        .204        .796       .096
  21    19- 25   140.     75.    210.00         .96        .217        .899       .189
  11    18- 19   140.    150.    110.00        7.01        .397       1.215       .134
  19    18- 24   140.     75.    210.00        1.06        .240       1.080       .227

                 *** LOOP  21 ***      SIGMA-H= -.000128

  22    25- 26   140.     75.    110.00         .16        .036        .033       .004
  23    20- 26   140.     75.    200.00         .84        .190        .701       .140
  12    19- 20   140.    150.    110.00        4.22        .239        .476       .052
  21    19- 25   140.     75.    210.00         .96        .217        .899       .189

                 *** LOOP  22 ***      SIGMA-H= -.000239

  12    19- 20   140.    150.    110.00        4.22        .239        .476       .052
  24    20- 31   140.     75.    150.00        1.28        .290       1.532       .230
  25    30- 31   140.     75.    110.00         .12        .027        .019       .002
  26    19- 30   140.     75.    150.00        1.43        .323       1.869       .280

                 *** LOOP  23 ***      SIGMA-H= -.000574

  11    18- 19   140.    150.    110.00        7.01        .397       1.215       .134
  26    19- 30   140.     75.    150.00        1.43        .323       1.869       .280
  28    29- 30   140.     75.    110.00         .09        .021        .012       .001
  27    18- 29   140.     75.    150.00        1.76        .398       2.755       .413

                 *** LOOP  24 ***      SIGMA-H= -.000375

  10    17- 18   140.    150.    120.00       10.23        .579       2.445       .293
  27    18- 29   140.     75.    150.00        1.76        .398       2.755       .413
  30    28- 29   140.     75.    120.00         .99        .223        .946       .114
  33    17- 28   140.    100.    150.00        4.56        .581       3.956       .593
```

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---CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK TYPE-8  LH =  0.0 M        PAGE

     LINE  JOINT NO.     C     DIA.     LENGTH     QUANTITY     VELOCITY     GRADIENT    HEAD LOSS
                               (MM)     ( M )      ( L/S )      ( M/S )      ( 0/00 )     ( M )

                 *** LOOP  25 ***      SIGMA-H= -.000265

       9    16- 17    140.    150.    180.00      17.83        1.009        6.832       1.230
      33    17- 28    140.    100.    150.00       4.56         .581        3.956        .593
      34    27- 28    140.     75.    170.00       1.15         .261        1.258        .214
      37    16- 27    140.     75.    150.00       3.67         .831       10.730       1.610

                 *** LOOP  26 ***      SIGMA-H= -.000092

      34    27- 28    140.     75.    170.00       1.15         .261        1.258        .214
      32    28- 33    140.    100.    140.00       3.33         .424        2.206        .309
      35    32- 33    140.     75.    170.00        .82         .185         .667        .113
      36    27- 32    140.     75.    140.00       1.82         .411        2.925        .409

                 *** LOOP  27 ***      SIGMA-H= -.000192

      30    28- 29    140.     75.    120.00        .99         .223         .946        .114
      29    29- 34    140.     75.    150.00       1.26         .284        1.474        .221
      31    33- 34    140.     75.    120.00        .44         .101         .217        .026
      32    28- 33    140.    100.    140.00       3.33         .424        2.206        .309
```

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---- CALUCULATION OF HYDRAULIC NETWORK --- (FOR JOINT)        PIPELINE NETWORK TYPE-8  LH =  0.0 M        PAGE

 JOINT  SUM-Q   SUM-H    G.L.    W.L.    L.H.  PRESSURE    JOINT  SUM-Q   SUM-H    G.L.    W.L.    L.H.  PRESSURE
        (L/S)    (M)     (M)     (M)     (M)   (KG/CM2)           (L/S)    (M)     (M)     (M)     (M)   (KG/CM2)

   1.   99.70     .00   79.20   79.20     .00     .000        2   -6.20   12.07   61.00   67.13    6.13     .613
   3     -.20   13.00   61.00   66.20    5.20     .520        4   -1.70   13.67   61.00   65.53    4.53     .453
   5     -.30   14.17   61.00   65.03    4.03     .403        6   -3.00   14.51   61.00   64.69    3.69     .369
   7    -1.40   14.73   61.00   64.47    3.47     .347        8   -2.00   15.52   61.00   63.68    2.68     .268
   9    -2.40   16.29   51.80   62.91   11.11    1.111       10   -1.40   16.78   61.00   62.42    1.42     .142
  11    -1.00   16.92   51.80   62.28   10.48    1.048       12   -1.70   14.56   61.00   64.64    3.64     .364
  13    -2.40   26.24   61.00   52.96   -8.04    -.804       14   -5.10   41.03   61.00   38.17  -22.83   -2.283
  15    -3.00   19.66   61.00   59.54   -1.46    -.146       16   -1.40   21.83   61.00   57.37   -3.63    -.363
  17     -.70   23.06   70.10   56.14  -13.96   -1.396       18    -.40   23.36   70.10   55.84  -14.26   -1.426
  19     -.40   23.49   70.10   55.71  -14.39   -1.439       20   -2.10   23.54   70.10   55.66  -14.44   -1.444
  21    -1.70   22.56   61.00   56.64   -4.36    -.436       22   -2.70   23.06   61.00   56.14   -4.86    -.486
  23    -2.00   23.30   61.00   55.90   -5.10    -.510       24   -1.70   23.58   70.10   55.62  -14.48   -1.448
  25    -1.70   23.68   61.00   55.52   -5.48    -.548       26   -1.00   23.68   61.00   55.52   -5.48    -.548
  27     -.70   23.44   70.10   55.76  -14.34   -1.434       28   -1.40   23.66   70.10   55.54  -14.56   -1.456
  29    -1.40   23.77   79.20   55.43  -23.77   -2.377       30   -1.40   23.77   79.20   55.43  -23.77   -2.377
  31    -1.40   23.77   79.20   55.43  -23.77   -2.377       32   -1.00   23.85   70.10   55.35  -14.75   -1.475
  33    -3.70   23.96   79.20   55.24  -23.96   -2.396       34   -1.70   23.99   79.20   55.21  -23.99   -2.399
  35    -2.00   14.57   61.00   64.63    3.63     .363       36   -1.40   14.57   61.00   64.63    3.63     .363
  37    -2.40   14.57   61.00   64.63    3.63     .363       38   -1.40   14.46   61.00   64.74    3.74     .374
  39    -1.70   14.61   61.00   64.59    3.59     .359       40   -1.00   14.60   61.00   64.60    3.60     .360
  41    -1.40   14.74   51.80   64.46   12.66    1.266       42   -2.00   14.74   51.80   64.46   12.66    1.266
  43    -2.70   15.51   51.80   63.69   11.89    1.189       44    -.70   13.02   61.00   66.18    5.18     .518
  45    -1.40   13.84   61.00   65.36    4.36     .436       46   -4.10   15.10   61.00   64.10    3.10     .310
  47    -3.40   14.87   61.00   64.33    3.33     .333       48   -2.40   14.57   61.00   64.63    3.63     .363
  49    -2.40   15.57   61.00   63.63    2.63     .263       50    -.70   15.59   61.00   63.61    2.61     .261
  51     -.70   15.59   61.00   63.61    2.61     .261       52   -1.00   15.61   61.00   63.59    2.59     .259
  53    -1.40   15.90   61.00   63.30    2.30     .230       54   -1.40   16.24   61.00   62.96    1.96     .196
  55    -3.10   15.56   61.00   63.64    2.64     .264       56    -.70   15.09   61.00   64.11    3.11     .311
```

TOTAL LENGTH OF PIPELINE

```
(            )

        DIA =  100      L = 4567.00
        DIA =  150      L =20903.00
        DIA =  200      L = 2662.00
        DIA =  250      L = 2555.00
*STOP*
```

NET WORK (EXISTING PIPELINES)

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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)   PIPELINE NETWORK TYPE-B  LH =  0.0 M          PAGE

      LINE  JOINT NO.     C     DIA.    LENGTH    QUANTITY   VELOCITY   GRADIENT   HEAD LOSS
                                (MM)    ( M )     ( L/S )    ( M/S )    ( 0/00 )   ( M )

                    *** LOOP   1 ***     SIGMA-H=  .000000

        1     1-  2   150.   250.    1000.00     99.70      2.031     12.074      12.074

                    *** LOOP   2 ***     SIGMA-H=  .005440

        2     2-  3   150.   250.     100.00     86.17      1.755      9.219       .922
       78     2- 44   140.   100.     100.00      7.33       .933      9.508       .951
       74    44- 47   140.    75.     530.00      2.00       .452      3.475      1.842
       72    47- 48   140.   150.     170.00     -8.51       .482      1.741      -.296
       71     3- 48   140.   150.     480.00     11.97       .677      3.269      1.569

                    *** LOOP   3 ***     SIGMA-H=  .007938

       77    44- 45   140.   100.     200.00      4.63       .590      4.072       .814
       76    45- 46   140.   100.     600.00      3.23       .412      2.094      1.256
       75    46- 56   140.   100.      50.00      -.87       .111       .182      -.009
       73    47- 56   140.   150.     170.00      7.11       .402      1.247       .212
       74    44- 47   140.    75.     530.00      2.00       .452      3.475      1.842

                    *** LOOP   4 ***     SIGMA-H=  .004547

       72    47- 48   140.   150.     170.00     -8.51       .482      1.741      -.296
       73    47- 56   140.   150.     170.00      7.11       .402      1.247       .212
       69    55- 56   140.   150.     600.00     -5.54       .313       .787      -.472
       65    52- 55   140.   150.     370.00     -2.44       .138       .173      -.064
       61    51- 52   140.   150.     100.00      2.68       .151       .204       .020
       66    50- 51   140.   100.     270.00       .05       .007       .001       .000
       67    49- 50   140.   100.     160.00       .75       .096       .140       .022
       68    48- 49   140.   100.     500.00      3.15       .401      1.994       .997

                    *** LOOP   5 ***     SIGMA-H=  .000264

       60     8- 51   140.   150.     200.00      3.33       .188       .305       .061
       61    51- 52   140.   150.     100.00      2.68       .151       .204       .020
       62    52- 53   140.   100.      90.00      4.12       .524      3.270       .294
       63    53- 54   140.   100.     220.00      2.72       .346      1.515       .333
       64     9- 54   140.   100.     150.00     -1.32       .168       .397      -.060
       42     8-  9   140.   100.     320.00      3.48       .444      2.401       .768

                    *** LOOP   6 ***     SIGMA-H=  .000000

       43     9- 10   140.    75.     100.00      2.40       .543      4.892       .489
       44    10- 11   140.    75.     150.00      1.00       .226       .969       .145
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK  TYPE-2                      PAGE

LINE  JOINT NO.    C     DIA.    LENGTH     QUANTITY     VELOCITY    GRADIENT   HEAD LOSS
                         (MM)    ( M )      ( L/S )      ( M/S )     ( 0/00 )     ( M )

                *** LOOP   7 ***     SIGMA-H= -.000602

  17    22- 21   140.   100.    370.00        .84         .107         .174       .064
  12    20- 21   140.   150.     70.00       7.01         .396        1.215       .085
  11    19- 20   140.   150.    215.00       7.01         .396        1.215       .261
  10    14- 19   140.   150.    125.00       7.01         .396        1.215       .152
 106    15- 14   150.   200.     90.00     -23.05         .734        2.383      -.214
  16    15- 22   140.   150.    170.00       7.22         .409        1.285       .218

                *** LOOP   8 ***     SIGMA-H= -.000393

  14    23- 24   140.   150.    358.00        .11         .006         .001       .000
  13    21- 24   140.   150.    170.00       3.87         .219         .405       .069
  17    22- 21   140.   100.    370.00        .84         .107         .174       .064
  15    22- 23   140.   150.    130.00       6.38         .361        1.021       .133

                *** LOOP   9 ***     SIGMA-H= -.000629

  18    15- 16   150.   200.    168.00      15.82         .504        1.188       .200
  19    16- 26   140.   150.    170.00       5.39         .305         .747       .127
  20    26- 25   140.   150.     98.00       4.32         .244         .496       .049
  21    25- 23   140.   150.    160.00      -2.29         .130         .154      -.025
  15    22- 23   140.   150.    130.00       6.38         .361        1.021       .133
  16    15- 22   140.   150.    170.00       7.22         .409        1.285       .218

                *** LOOP  10 ***     SIGMA-H= -.000969

  22    25- 28   140.   150.    410.00       2.63         .149         .199       .081
  20    26- 25   140.   150.     98.00       4.32         .244         .496       .049
  27    27- 26   140.   100.    380.00      -1.07         .136         .269      -.102
  23    28- 27   140.   150.     90.00      -3.27         .185         .296      -.027

                *** LOOP  11 ***     SIGMA-H= -.000931

  27    27- 26   140.   100.    380.00      -1.07         .136         .269      -.102
  19    16- 26   140.   150.    170.00       5.39         .305         .747       .127
  26    29- 16   150.   200.    130.00     -11.24         .358         .632      -.082
  25    30- 29   150.   200.    200.00     -11.24         .358         .632      -.126
  24    27- 30   140.   150.    140.00      -2.20         .125         .142      -.020
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK  TYPE-2                    PAGE

     LINE  JOINT NO.     C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                               (MM)    ( M )     ( L/S )     ( M/S )     ( 0/00 )   ( M )

                 *** LOOP  12 ***     SIGMA-H= -.000724

      28    31- 28    140.   100.    440.00      -1.92        .244         .799       -.351
      23    28- 27    140.   150.     90.00      -3.27        .185         .296       -.027
      24    27- 30    140.   150.    140.00      -2.20        .125         .142       -.020
      31    33- 30    140.   150.    273.00      -5.06        .286         .666       -.182
      30    32- 33    140.   150.    160.00      -5.06        .286         .666       -.107
      29    32- 31    140.   100.    120.00       2.06        .262         .907        .109

                 *** LOOP  13 ***     SIGMA-H= -.008986

      25    30- 29    150.   200.    200.00     -11.24        .356         .632       -.126
      26    29- 16    150.   200.    130.00     -11.24        .358         .632       -.082
      38    16- 17    140.   150.    340.00      -4.79        .271         .600       -.204
      39    17- 18    140.   150.     40.00      -4.79        .271         .600       -.024
      36    41- 18    140.   100.    500.00      -3.88        .494        2.925     -1.463
      35    40- 41    140.   100.    170.00       -.06        .007         .001       -.000
      34    39- 40    140.   100.    270.00       3.76        .479        2.771        .748
      33    34- 39    140.   150.    210.00       -.74        .042         .019       -.004
      32    34- 32    140.   150.     10.00      -3.00        .170         .254       -.003
      30    32- 33    140.   150.    160.00      -5.06        .286         .666       -.107
      31    33- 30    140.   150.    273.00      -5.06        .286         .666       -.182

                 *** LOOP  14 ***     SIGMA-H= -.007402

      34    39- 40    140.   100.    270.00       3.76        .479        2.771        .748
      35    40- 41    140.   100.    170.00       -.06        .007         .001       -.000
      36    41- 18    140.   100.    500.00      -3.88        .494        2.925     -1.463
      40    18- 81    140.   150.     20.00      -4.54        .257         .545       -.011
      41    81- 43    140.   150.    315.00      -4.54        .257         .545       -.172
      42    43- 42    140.   150.    615.00      -5.15        .292         .688       -.423
      43    42- 38    140.   150.    370.00      12.22        .692        3.396       1.257
      44    38- 39    140.   150.    105.00       4.50        .255         .534        .056

                 *** LOOP  15 ***     SIGMA-H= -.000228

      48    35- 34    140.   100.    330.00      -3.74        .476        2.736       -.903
      33    34- 39    140.   150.    210.00       -.74        .042         .019       -.004
      44    38- 39    140.   150.    105.00       4.50        .255         .534        .056
      45    37- 38    140.   100.    100.00      -3.90        .497        2.961       -.296
      46    36- 37    140.   100.    225.00      -3.90        .497        2.961       -.666
      47    36- 35    140.   100.    170.00        .08        .010         .002        .000
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)   PIPELINE NETWORK  TYPE-2                PAGE

 LINE  JOINT NO.    C     DIA.    LENGTH     QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                          (MM)    ( M )      ( L/S )     ( M/S )     ( 0/00 )    ( M )

              *** LOOP  16 ***     SIGMA-H= -.004868

   51   45- 46   140.    100.    365.00        1.52        .194        .520        .190
   52   46- 12   140.    100.    300.00       -2.46        .313       1.258       -.377
   54   12- 13   150.    250.    265.00      -53.98       1.100       3.882      -1.029
   55   13-  5   150.    250.    490.00      -53.98       1.100       3.882      -1.902
   56    5- 47   150.    200.    192.00       27.29        .869       3.256        .625
   57   47- 48   140.    150.     70.00       22.47       1.271      10.480        .734
   61   49- 48   140.    150.    455.00       -8.79        .497       1.845       -.839
   62   49- 45   140.    150.    487.00        8.87        .502       1.880        .915

              *** LOOP  17 ***     SIGMA-H= -.004526

   49   43- 44   140.    100.     40.00       -3.37        .429       2.258       -.090
   50   44- 45   140.    100.    242.00       -3.37        .429       2.258       -.546
   62   49- 45   140.    150.    487.00        8.87        .502       1.880        .915
   77   56- 49   150.    200.    535.00        1.36        .043        .013        .007
   79   58- 56   150.    200.    440.00      -14.29        .455        .983       -.433
  104   58-  2   150.    250.    340.00      -11.49        .234        .222       -.075
  103    2- 65   150.    250.    215.00       38.43        .783       2.070        .445
  102   65- 42   140.    150.     35.00       21.20       1.199       9.407        .329
   42   43- 42   140.    150.    615.00       -5.15        .292        .688       -.423

              *** LOOP  18 ***     SIGMA-H= -.000290

  100   67- 66   140.    150.    335.00       -6.83        .387       1.160       -.388
  101   66- 65   140.    150.     90.00      -17.24        .976       6.422       -.578
  103    2- 65   150.    250.    215.00       38.43        .783       2.070        .445
  104   58-  2   150.    250.    340.00      -11.49        .234        .222       -.075
   81   59- 58   150.    200.    340.00      -21.15        .673       2.033       -.691
   83   76- 59   150.    200.    172.00      -20.86        .664       1.981       -.341
  105   76- 73   140.    150.    380.00        5.83        .330        .865        .329
   94   73- 67   140.    150.     50.00       -4.32        .244        .496       -.025

              *** LOOP  19 ***     SIGMA-H= -.000100

   93   67- 68   140.    150.    445.00        2.51        .142        .182        .081
   95   68- 69   140.    150.    100.00       -2.78        .158        .220       -.022
   96   69- 70   140.    150.    135.00       -2.78        .158        .220       -.030
   97   70- 71   140.    150.    170.00       -6.59        .373       1.086       -.185
   98   71- 72   140.    150.     65.00       -6.59        .373       1.086       -.071
   99   66- 72   140.    150.    150.00        6.59        .373       1.086        .163
  100   67- 66   140.    150.    335.00       -6.83        .387       1.160       -.386
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK  TYPE-2                              PAGE

LINE  JOINT NO.    C     DIA.     LENGTH     QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)     ( M )      ( L/S )     ( M/S )     ( 0/00 )    ( M )

               *** LOOP  20 ***     SIGMA-H= -.000066

  90   74- 73   140.    150.     680.00       -6.34        .359       1.010       -.687
  91   74- 75   140.    150.     420.00       -1.49        .084        .069       -.029
  92   75- 68   140.    150.     830.00       -5.30        .300        .724       -.601
  93   67- 68   140.    150.     445.00        2.51        .142        .182        .081
  94   73- 67   140.    150.      50.00       -4.32        .244        .496       -.025

               *** LOOP  21 ***     SIGMA-H= -.000131

  90   74- 73   140.    150.     680.00       -6.34        .359       1.010       -.687
 105   76- 73   140.    150.     380.00        5.83        .330        .865        .329
  84   77- 76   140.    150.     400.00      -11.22        .635       2.901      -1.160
  88   80- 77   140.    150.     470.00       -2.96        .167        .246       -.116
  89   80- 74   140.    150.     600.00       -4.02        .228        .435       -.261

               *** LOOP  22 ***     SIGMA-H= -.000013

  88   80- 77   140.    150.     470.00       -2.96        .167        .246       -.116
  85   78- 77   140.    150.     445.00       -4.45        .252        .525       -.234
  86   79- 78   140.    150.     350.00        -.64        .036        .015       -.005
  87   79- 80   140.    150.     440.00       -3.17        .179        .280       -.123

               *** LOOP  23 ***     SIGMA-H= -.000142

  81   59- 58   150.    200.     340.00      -21.15        .673       2.033       -.691
  80   57- 58   140.    150.     400.00         .20        .011        .002        .001
  72   60- 57   140.    150.     350.00       -7.44        .421       1.357       -.475
  82   60- 59   140.    150.     400.00        4.53        .256        .542        .217

               *** LOOP  24 ***     SIGMA-H= -.000586

  79   58- 56   150.    200.     440.00      -14.29        .455        .983       -.433
  78   55- 56   150.    200.     395.00       20.46        .651       1.912        .755
  73   57- 55   140.    150.     337.00      -12.46        .705       3.522      -1.187
  80   57- 58   140.    150.     400.00         .20        .011        .002        .001
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NETWORK  TYPE-2                    PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)    ( M )     ( L/S )     ( M/S )     ( 0/00 )   ( M )

                *** LOOP  25 ***    SIGMA-H= -.000502

 67    64-  3   140.    150.    770.00     -11.55        .654       3.060     -2.357
 68    64- 63   140.    150.    170.00       6.73        .381       1.127       .192
 69    63- 62   140.    150.    130.00       6.73        .381       1.127       .146
 70    62- 61   140.    150.    140.00       6.73        .381       1.127       .158
 71    61- 60   140.    150.    100.00       1.91        .108        .109       .011
 72    60- 57   140.    150.    350.00      -7.44        .421       1.357     -.475
 73    57- 55   140.    150.    337.00     -12.46        .705       3.522     -1.167
 76     3- 55   150.    250.    440.00      44.65        .910       2.732      1.202

                *** LOOP  26 ***    SIGMA-H= -.000429

 74    55- 50   140.    150.    530.00       6.91        .391       1.182       .627
 75    54- 50   140.    150.    440.00       3.11        .176        .271       .119
 66     3- 54   140.    150.    530.00      11.88        .672       3.226      1.710
 76     3- 55   150.    250.    440.00      44.65        .910       2.732      1.202

                *** LOOP  27 ***    SIGMA-H= -.000539

 77    56- 49   150.    200.    535.00       1.36        .043        .013       .007
 60    50- 49   140.    150.    395.00       3.55        .201        .345       .136
 74    55- 50   140.    150.    530.00       6.91        .391       1.182       .627
 78    55- 56   150.    200.    395.00      20.46        .651       1.912       .755

                *** LOOP  28 ***    SIGMA-H= -.001143

 61    49- 48   140.    150.    455.00      -8.79        .497       1.845     -.839
 58    48- 51   140.    150.    395.00       8.86        .501       1.874       .740
 59    50- 51   140.    150.    455.00       1.65        .093        .084       .038
 60    50- 49   140.    150.    395.00       3.55        .201        .345       .136

                *** LOOP  29 ***    SIGMA-H= -.000175

 59    50- 51   140.    150.    455.00       1.65        .093        .084       .038
 63    51- 52   140.    150.     55.00       5.69        .322        .827       .045
 64    52- 53   140.    150.    440.00        .87        .049        .026       .011
 65    54- 53   140.    150.    510.00       3.95        .223        .420       .214
 75    54- 50   140.    150.    440.00       3.11        .176        .271       .119

                *** LOOP  30 ***    SIGMA-H=  .000000

107    82-  2   150.    250.     20.00      53.73       1.095       3.847       .077
```

```
--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)    PIPELINE NET-URK  TYPE-2                    PAGE

LINE  JOINT NO.     C     DIA.    LENGTH     QUANTITY    VELOCITY    GRADIENT    HEAD LOSS
                          (MM)    ( M )      ( L/S )     ( M/S )     ( 0/00 )    ( M )

                *** LOOP  31 ***      SIGMA-H=  .000000

108      83-  3   150.   250.     20.00      72.90       1.485       6.766        .135
```

--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR JOINT) PIPELINE NETWORK TYPE-2

JOINT	SUM-Q (L/S)	SUM-H (M)	G.L. (M)	W.L. (M)	L.H. (M)	PRESSURE (KG/CM2)	JOINT	SUM-Q (L/S)	SUM-H (M)	G.L. (M)	W.L. (M)	L.H. (M)	PRESSURE (KG/CM2)
1	82.70	.00	88.30	100.30	12.00	1.200	2	-3.81	6.26	61.00	94.04	33.04	3.304
3	-4.82	3.94	70.10	96.36	26.26	2.626	4	-4.82	1.83	79.20	98.47	19.27	1.927
5	.00	3.69	79.20	96.61	17.41	1.741	6	-3.98	4.98	79.20	95.32	16.12	1.612
7	-3.98	7.39	70.10	92.91	22.81	2.281	8	-3.98	7.54	61.00	92.76	31.76	3.176
9	-3.98	8.10	61.00	92.20	31.20	3.120	10	.00	6.94	61.00	93.36	32.36	3.236
11	-3.98	6.89	61.00	93.41	32.41	3.241	12	.00	6.62	61.00	93.68	32.68	3.268
13	.00	5.59	70.10	94.71	24.61	2.461	14	-3.98	7.45	61.00	92.85	31.85	3.185
15	.00	7.67	61.00	92.63	31.63	3.163	16	-3.98	7.67	61.00	92.43	31.43	3.143
17	.00	7.66	61.00	92.64	31.64	3.164	18	-3.98	7.63	61.00	92.67	31.67	3.167
19	.00	7.60	61.00	92.70	31.70	3.170	20	.00	7.66	61.00	92.44	31.44	3.144
21	-3.98	7.95	61.00	92.35	31.35	3.135	22	.00	7.88	61.00	92.42	31.42	3.142
23	-3.98	8.02	61.00	92.28	31.28	3.128	24	-3.96	8.02	61.00	92.28	31.26	3.128
25	-3.98	8.04	61.00	92.26	31.26	3.126	26	.00	7.99	61.00	92.31	31.31	3.131
27	.00	8.10	51.80	92.20	40.40	4.040	28	-3.98	8.12	51.80	92.18	40.38	4.038
29	.00	7.95	61.00	92.35	31.35	3.135	30	-3.98	8.08	61.00	92.22	31.22	3.122
31	-3.98	8.45	51.80	91.85	40.05	4.005	32	.00	8.34	51.80	91.96	40.16	4.016
33	.00	8.24	51.80	92.06	40.26	4.026	34	.00	8.35	51.80	91.95	40.15	4.015
35	-3.82	9.25	51.80	91.05	39.25	3.925	36	-3.82	9.25	61.00	91.05	30.05	3.005
37	.00	8.58	61.00	91.72	30.72	3.072	38	-3.82	8.29	61.00	92.01	31.01	3.101
39	.00	8.34	61.00	91.96	30.96	3.096	40	-3.82	9.09	61.00	91.21	30.21	3.021
41	-3.82	9.09	61.00	91.21	30.21	3.021	42	-3.82	7.03	61.00	93.27	32.27	3.227
43	-3.98	7.45	61.00	92.85	31.85	3.185	44	.00	7.36	61.00	92.94	31.94	3.194
45	-3.98	6.81	61.00	93.49	32.49	3.249	46	-3.98	7.00	61.00	93.30	32.30	3.230
47	-4.82	4.33	79.20	95.97	16.77	1.677	48	-4.82	5.07	79.20	95.23	16.03	1.603
49	-4.82	5.91	70.10	94.39	24.29	2.429	50	-4.82	5.77	70.10	94.53	24.43	2.443
51	-4.82	5.81	88.30	94.49	6.19	.619	52	-4.82	5.65	88.30	94.45	6.15	.615
53	-4.82	5.87	88.30	94.43	6.13	.613	54	-4.82	5.65	79.20	94.65	15.45	1.545
55	-4.82	5.14	70.10	95.16	25.06	2.506	56	-4.82	5.90	61.00	94.40	33.40	3.340
57	-4.82	6.33	61.00	93.97	32.97	3.297	58	-4.82	6.33	61.00	93.97	32.97	3.297
59	-4.82	7.02	61.00	93.28	32.28	3.228	60	-4.82	6.80	61.00	93.50	32.50	3.250
61	-4.82	6.79	61.00	93.51	32.51	3.251	62	.00	6.64	61.00	93.66	32.66	3.266
63	.00	6.49	61.00	93.81	32.81	3.281	64	-4.82	6.30	70.10	94.00	23.90	2.390
65	.00	6.70	61.00	93.60	32.60	3.260	66	-3.81	7.28	61.00	93.02	32.02	3.202
67	.00	7.67	61.00	92.63	31.63	3.163	68	.00	7.75	61.00	92.55	31.55	3.155
69	.00	7.73	61.00	92.57	31.57	3.157	70	-3.81	7.70	61.00	92.60	31.60	3.160
71	.00	7.51	61.00	92.79	31.79	3.179	72	.00	7.44	61.00	92.86	31.86	3.186
73	-3.81	7.69	61.00	92.61	31.61	3.161	74	-3.81	8.38	61.00	91.92	30.92	3.092
75	-3.81	8.35	61.00	91.95	30.95	3.095	76	-3.81	7.36	61.00	92.94	31.94	3.194
77	-3.81	8.52	61.00	91.78	30.78	3.078	78	-3.81	8.76	70.10	91.54	21.44	2.144
79	-3.81	8.76	70.10	91.54	21.44	2.144	80	-3.81	8.64	61.00	91.66	30.66	3.066
81	.00	7.62	61.00	92.68	31.68	3.168	82	53.73	6.18	61.00	74.12	33.12	3.312
83	72.90	3.81	79.20	96.49	17.29	1.729	84	13.90	.00	88.30	100.30	12.00	1.200

TOTAL LENGTH OF PIPELINE

(   )

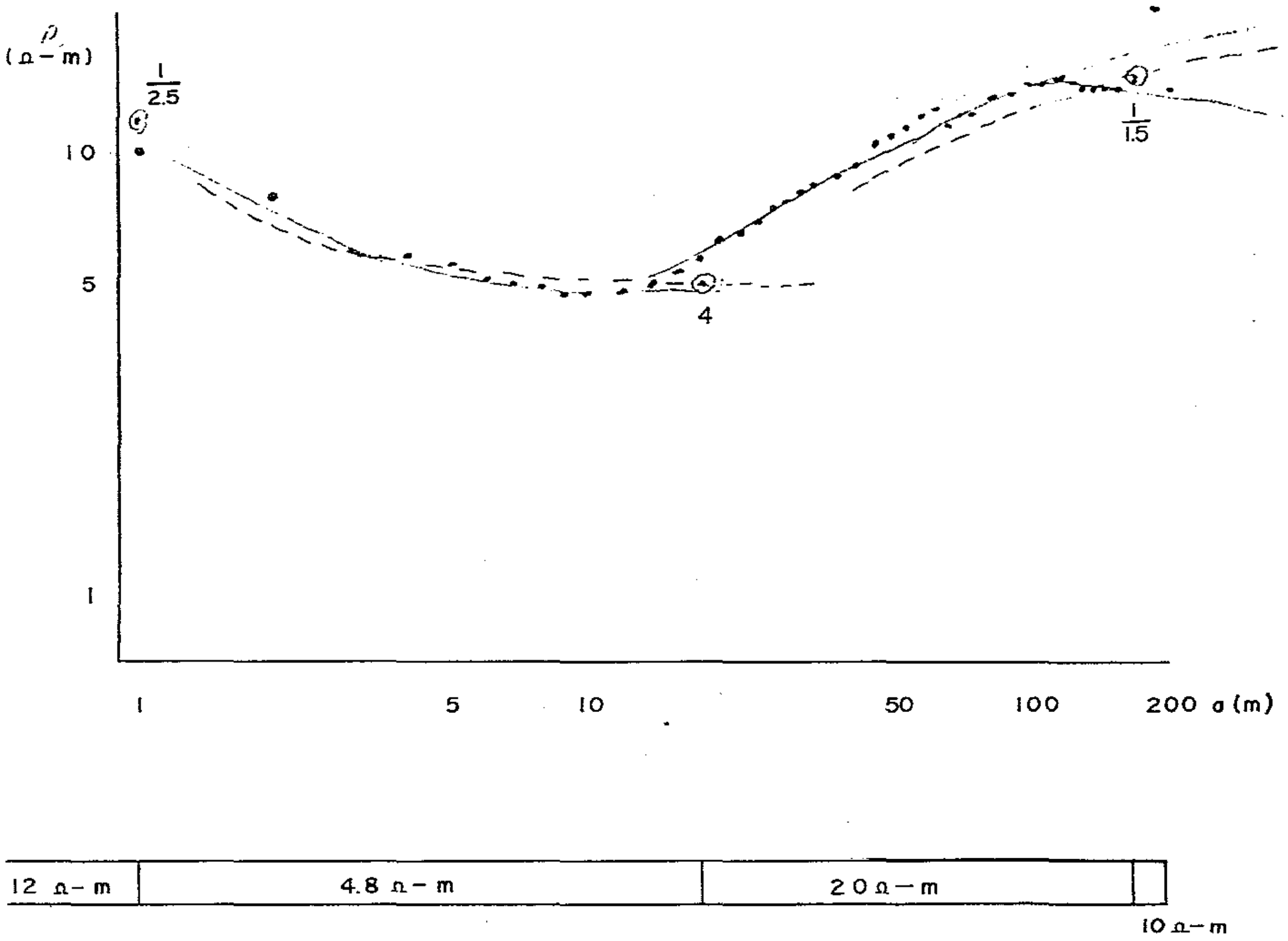
```
DIA =   75     L = 5460.00
DIA =  100     L = 4410.00
DIA =  150     L = 6200.00
DIA =  200     L =  620.00
DIA =  250     L = 1370.00
*STOP*
```

APPENDIX 3

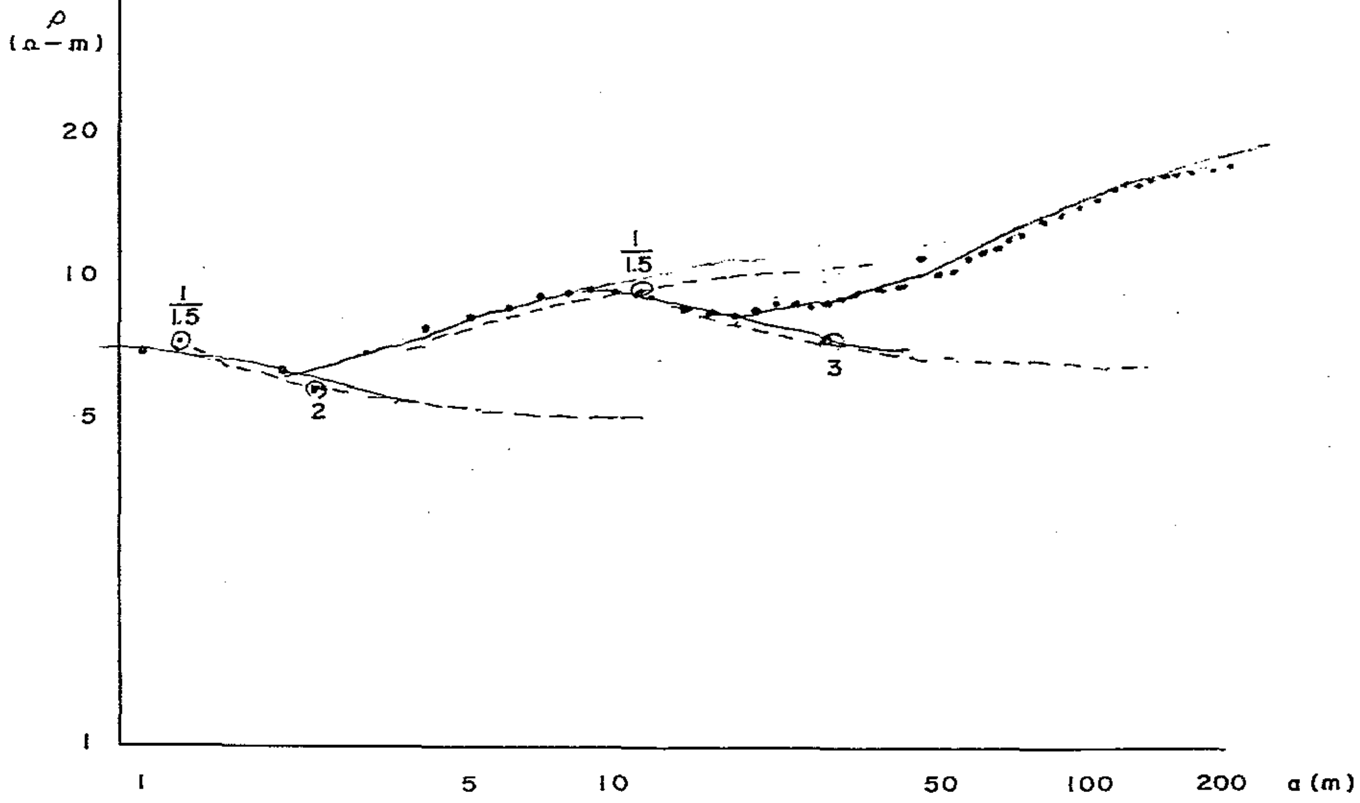
PROME PROJECT

ELECTRICAL PROSPECTING RESULT

A — 3 · 1 ELECTRICAL PROSPECTING IN PROME
NO. I

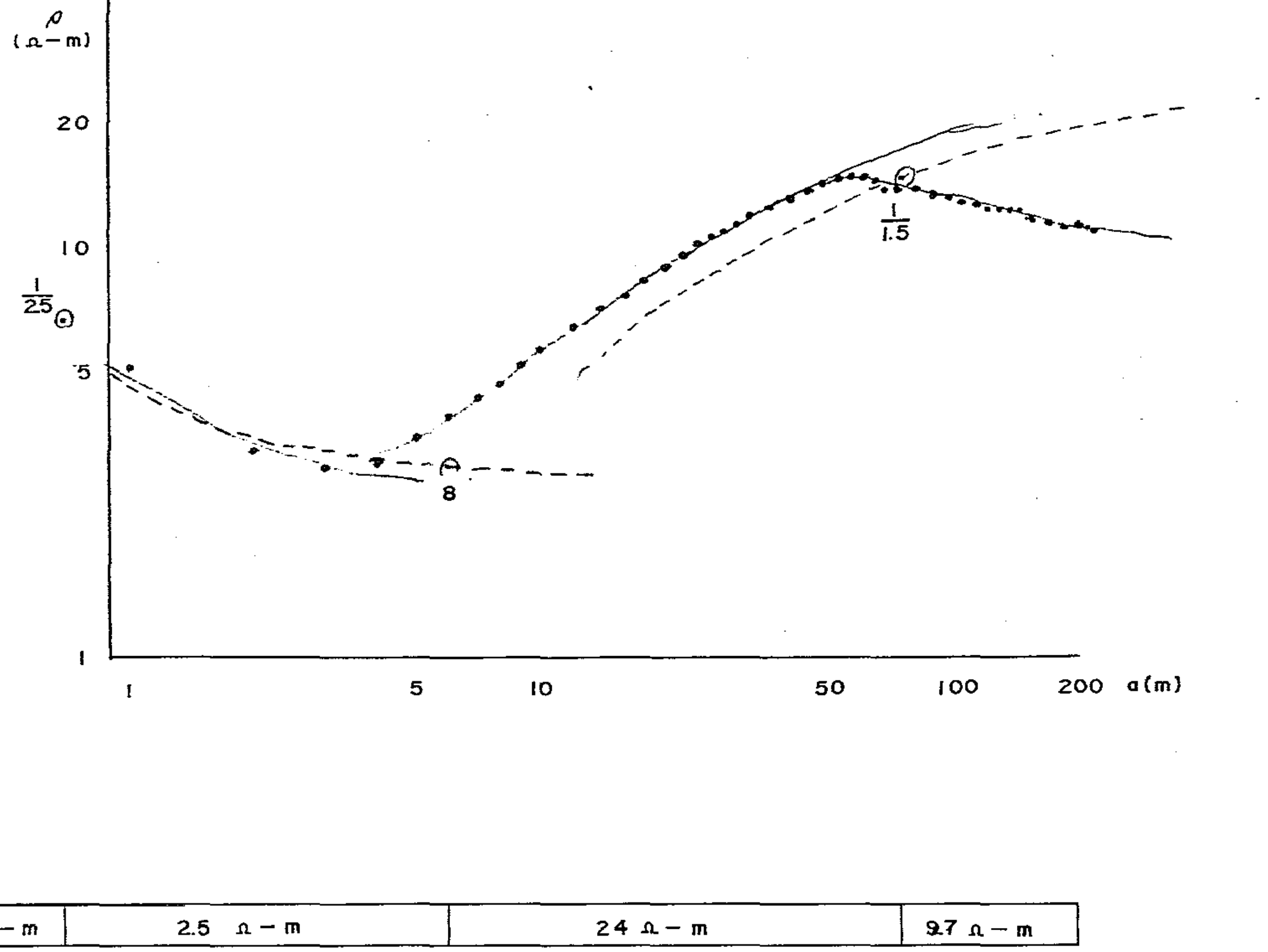


ELECTRICAL PROSPECTING IN PROME
NO. 2



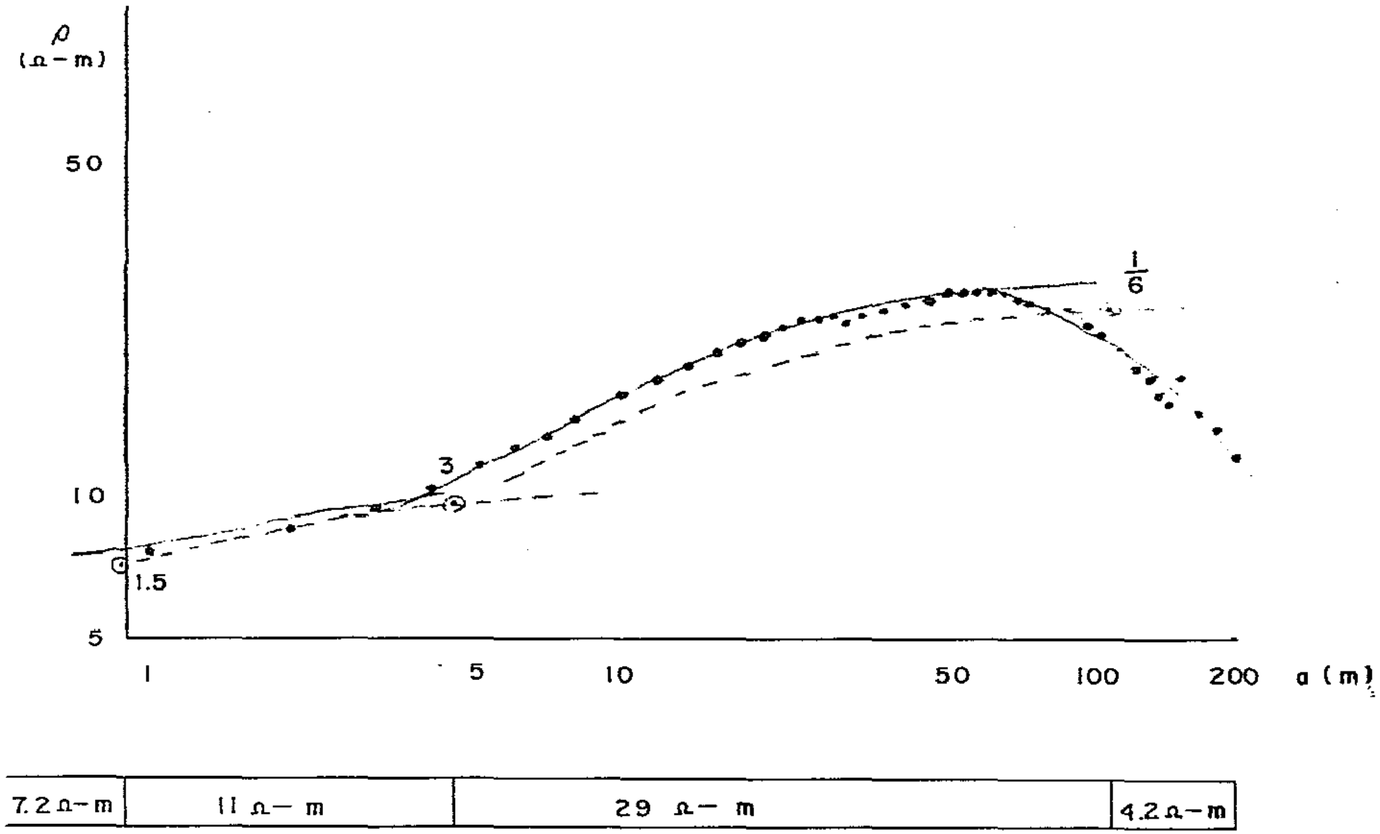
7.2 Ω−m	4.8 Ω−m	12 Ω−m	6.3 Ω−m	22 Ω−m

ELECTRICAL PROSPECTING IN PROME
NO. 3



ELECTRICAL PROSPECTING IN PROME

NO.4



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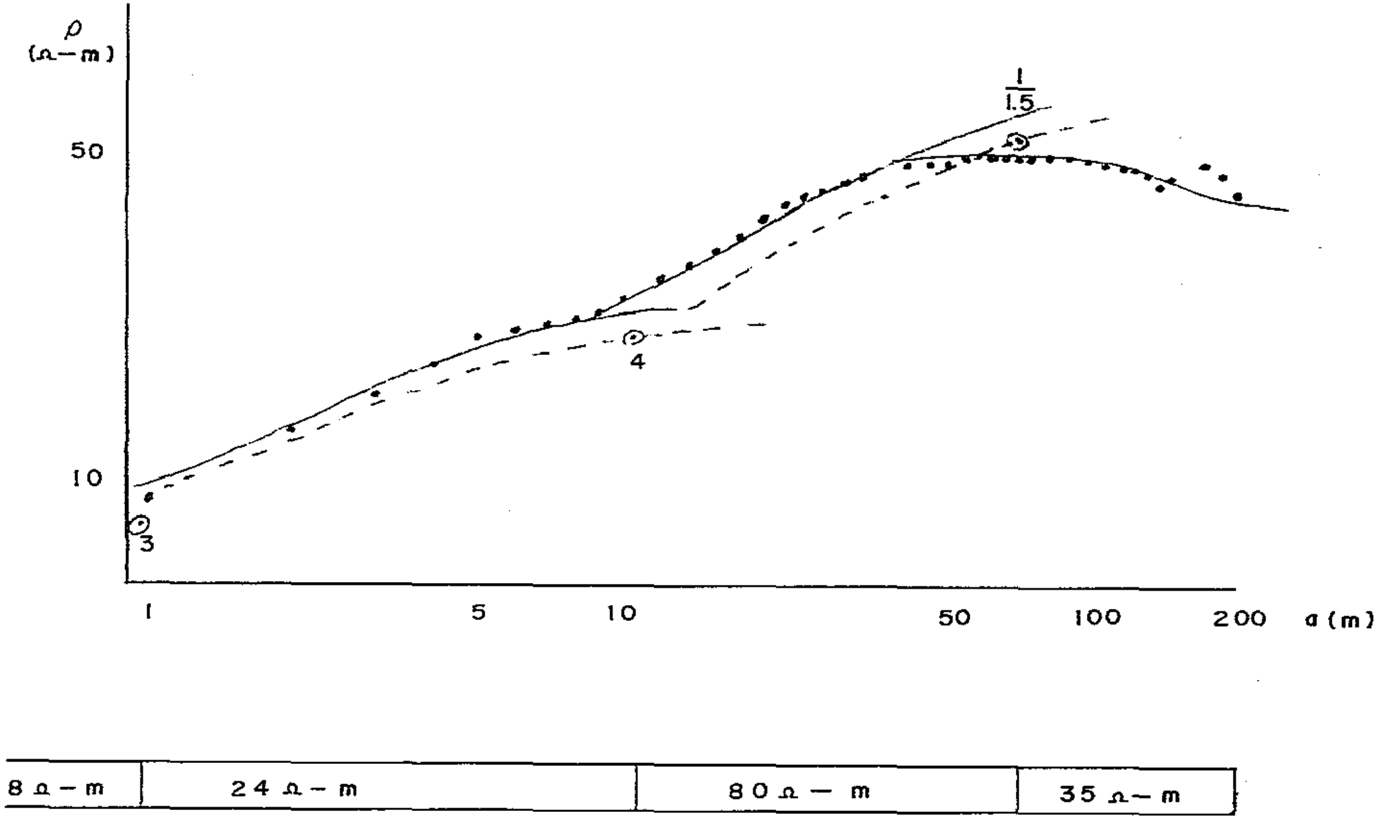

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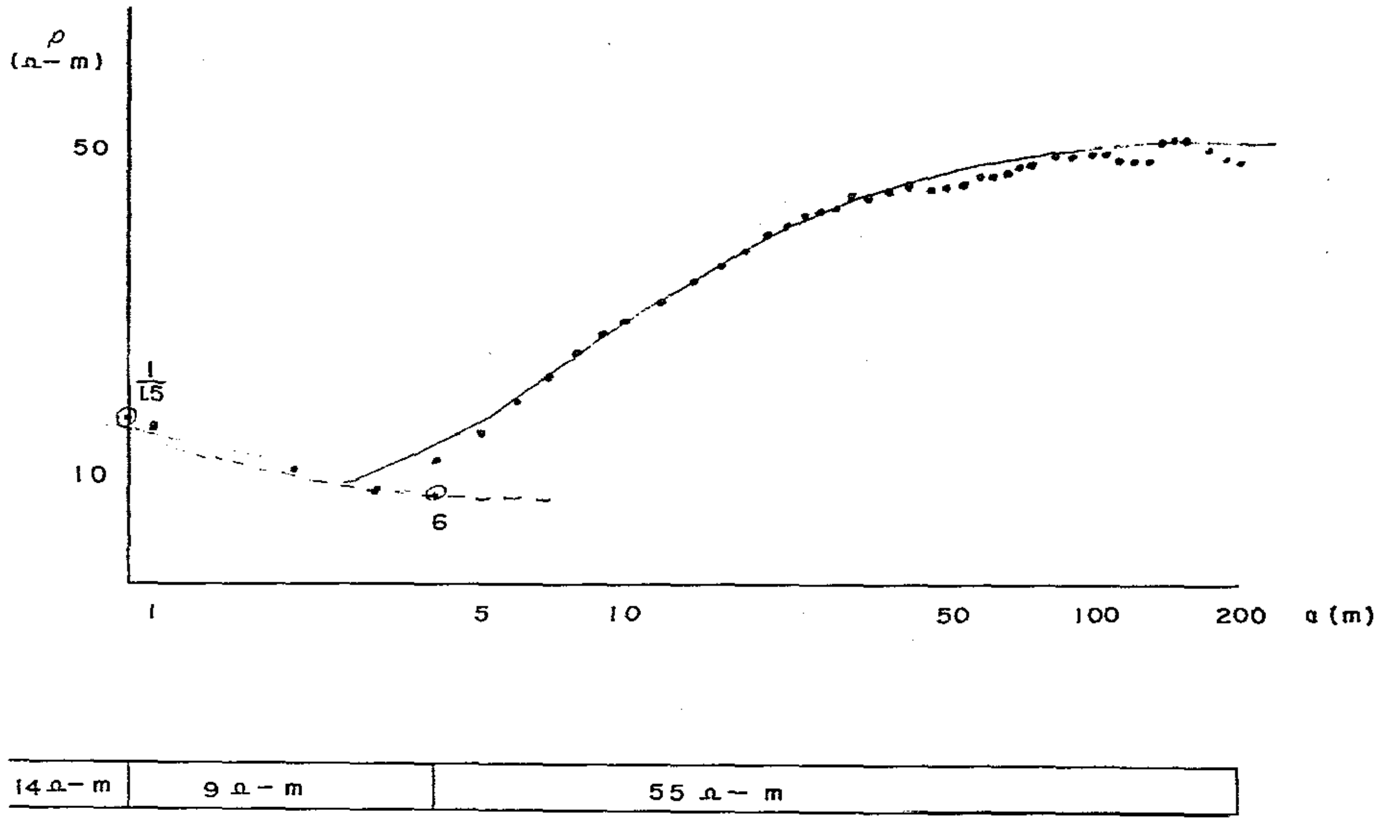
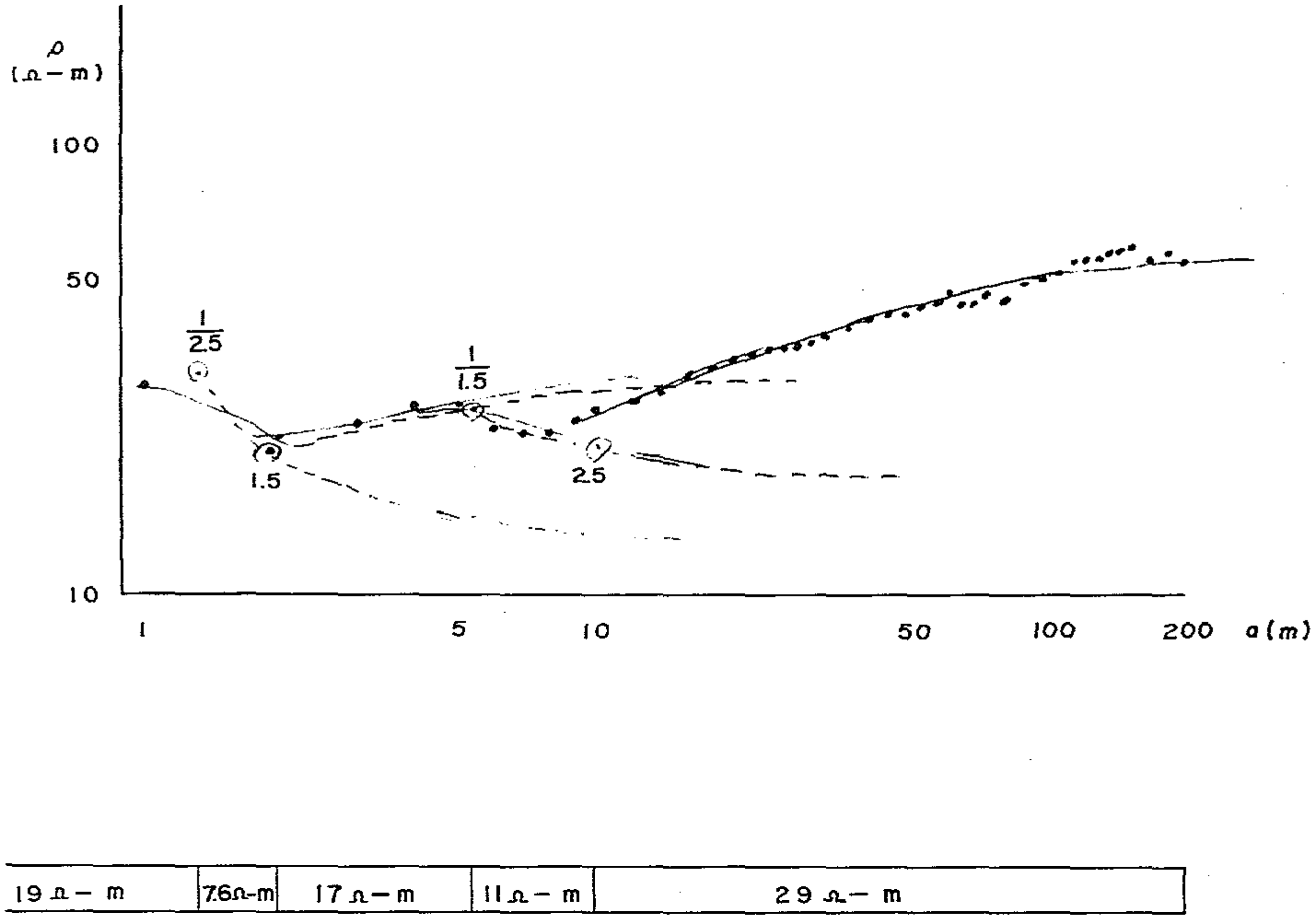
NO. 6



ELECTRICAL PROSPECTING IN PROME

NO. 7



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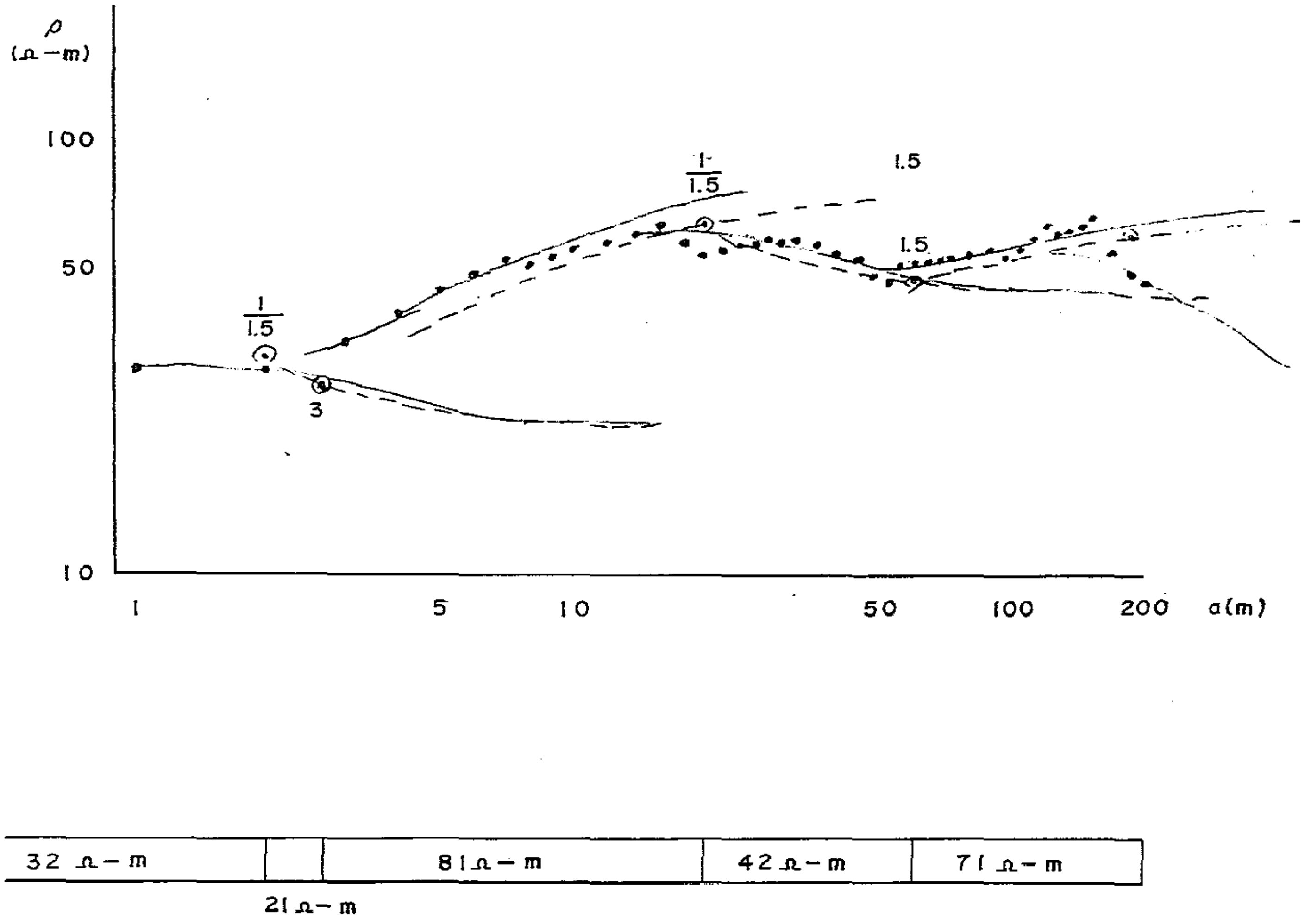
NO.8



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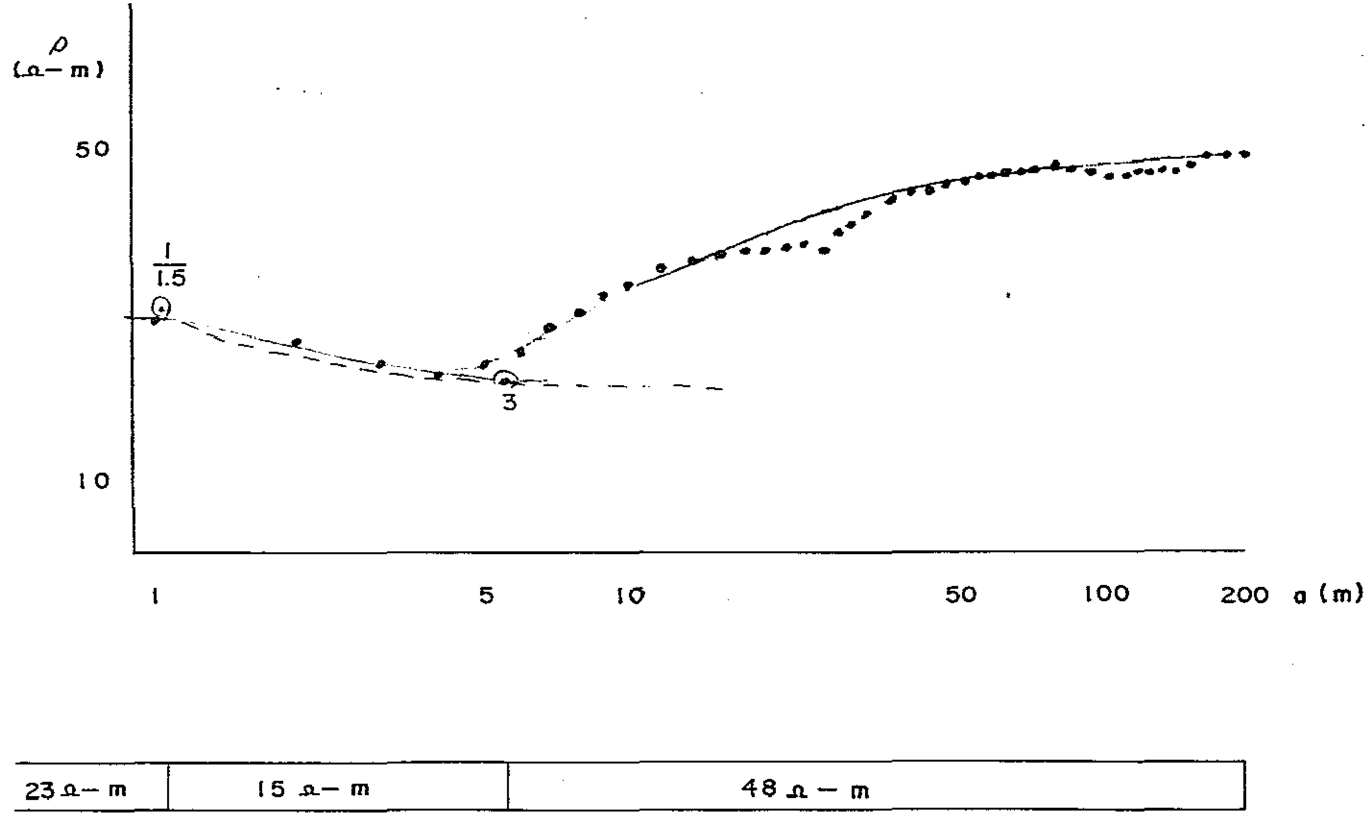
ELECTRICAL PROSPECTING IN PROME

NO.9



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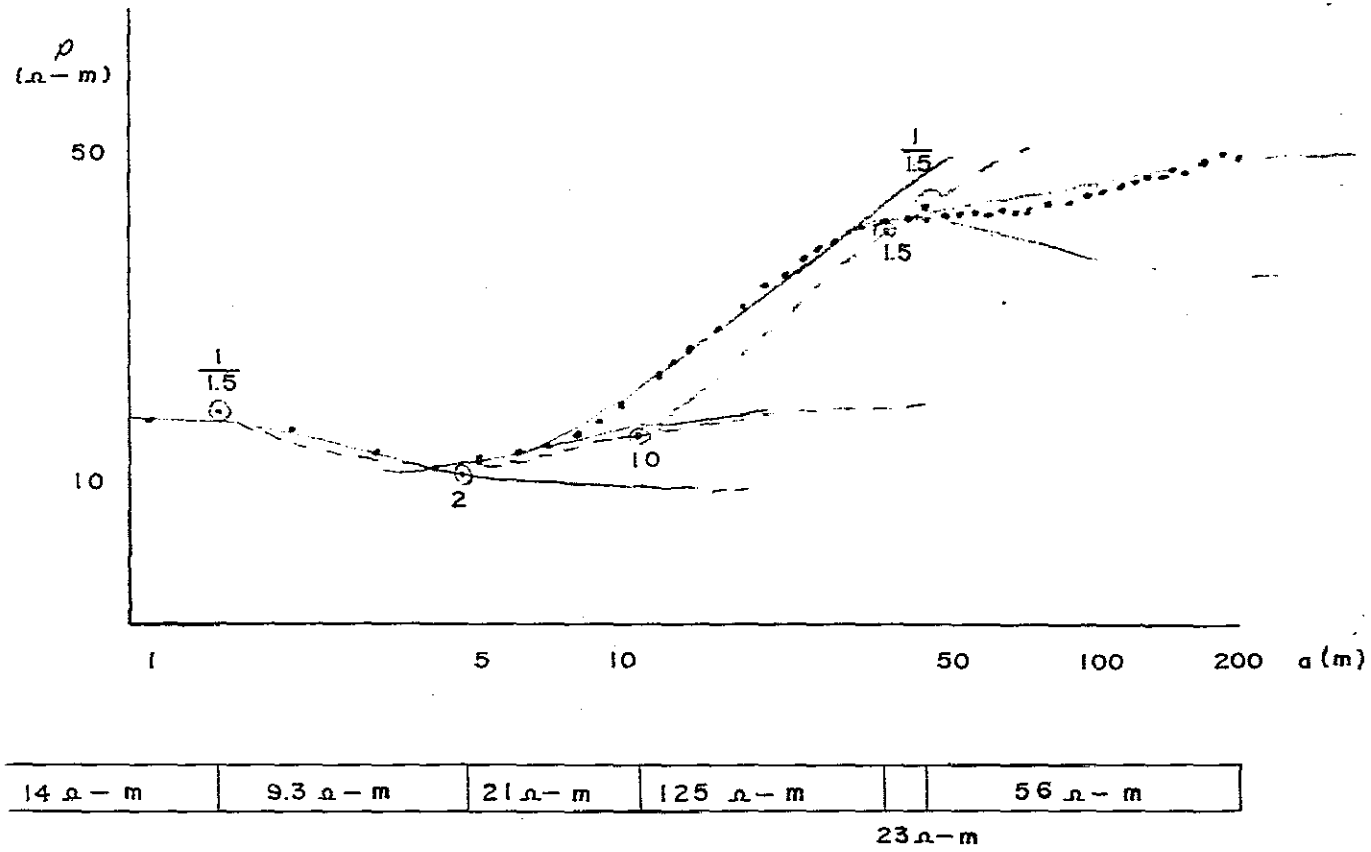

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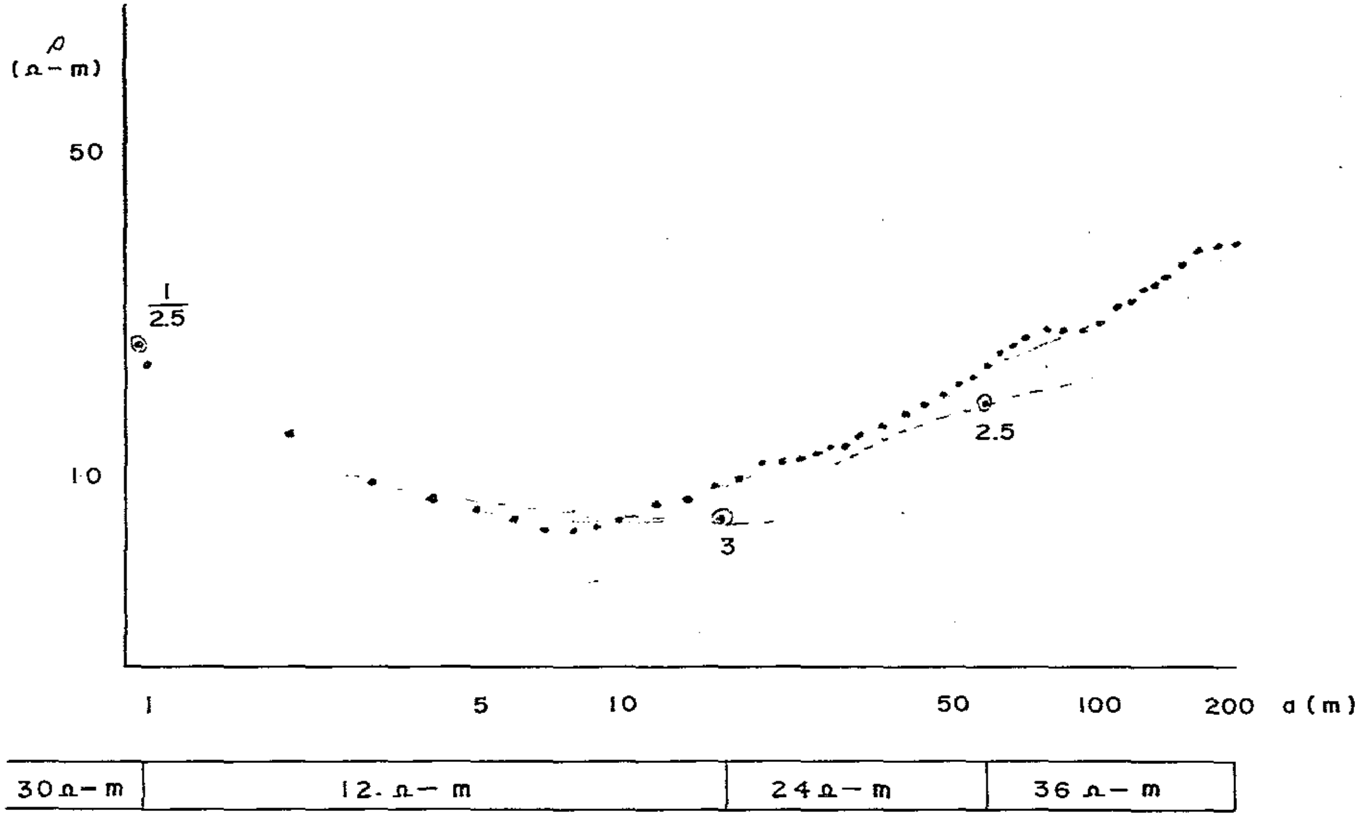

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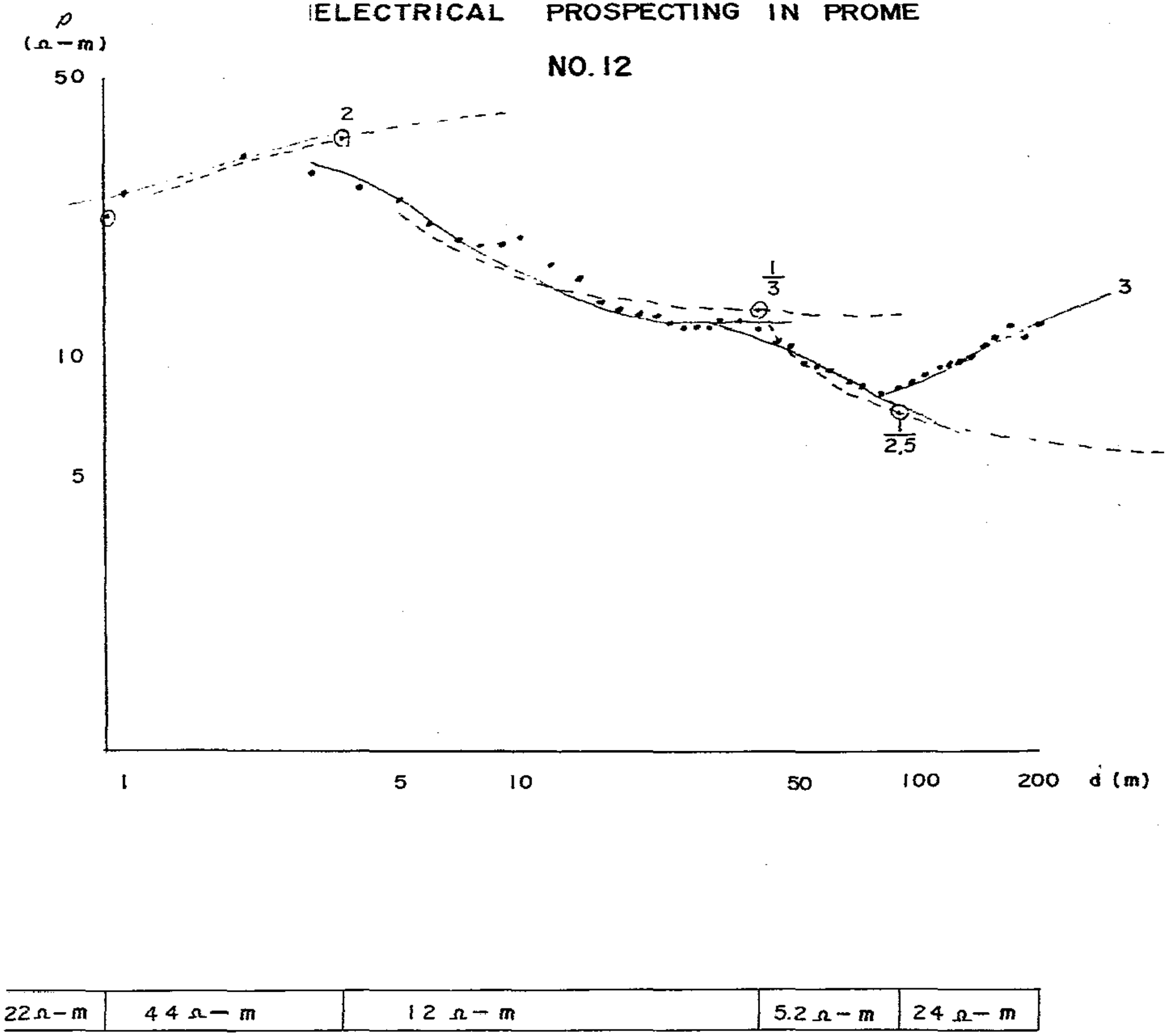

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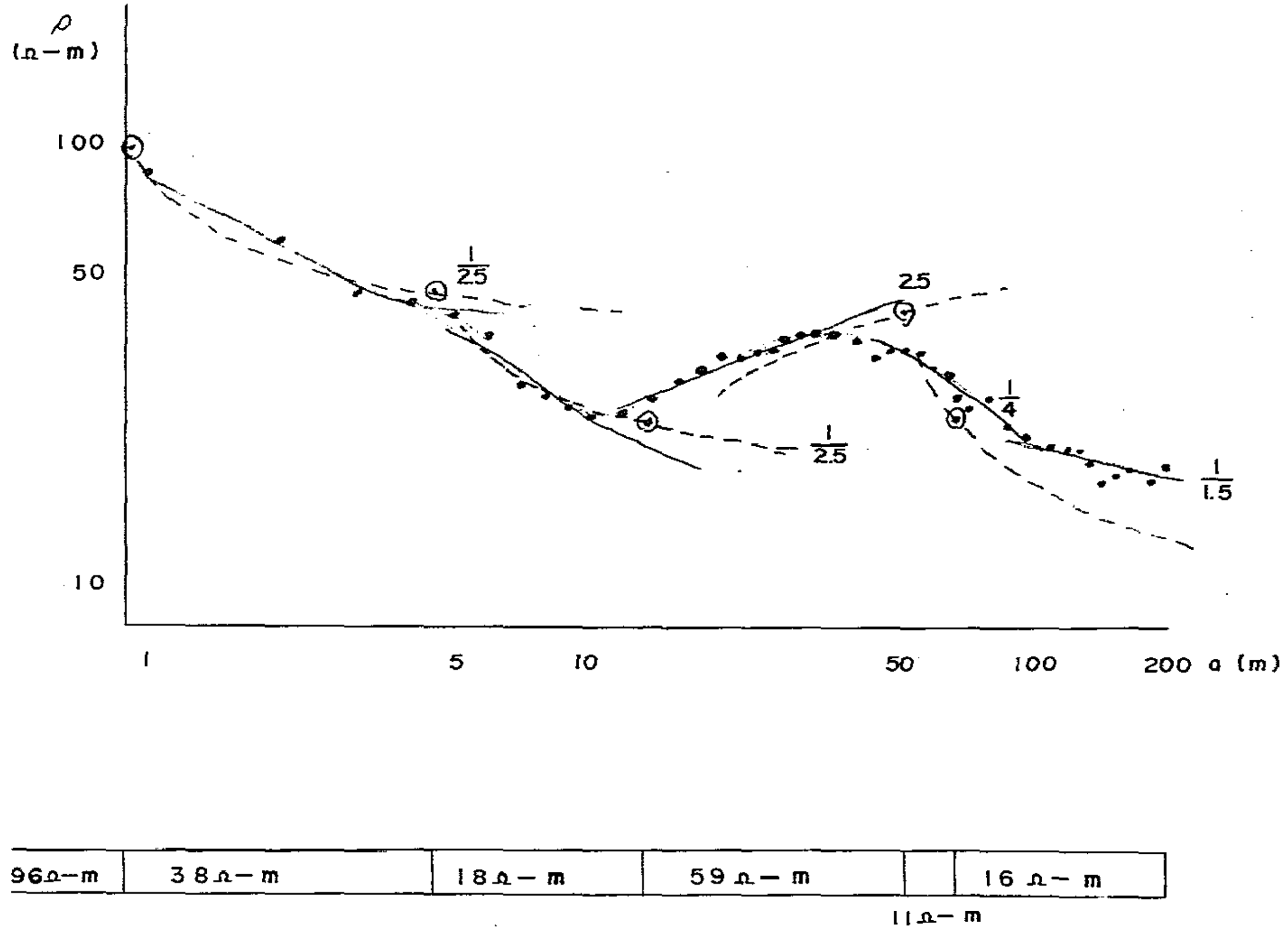

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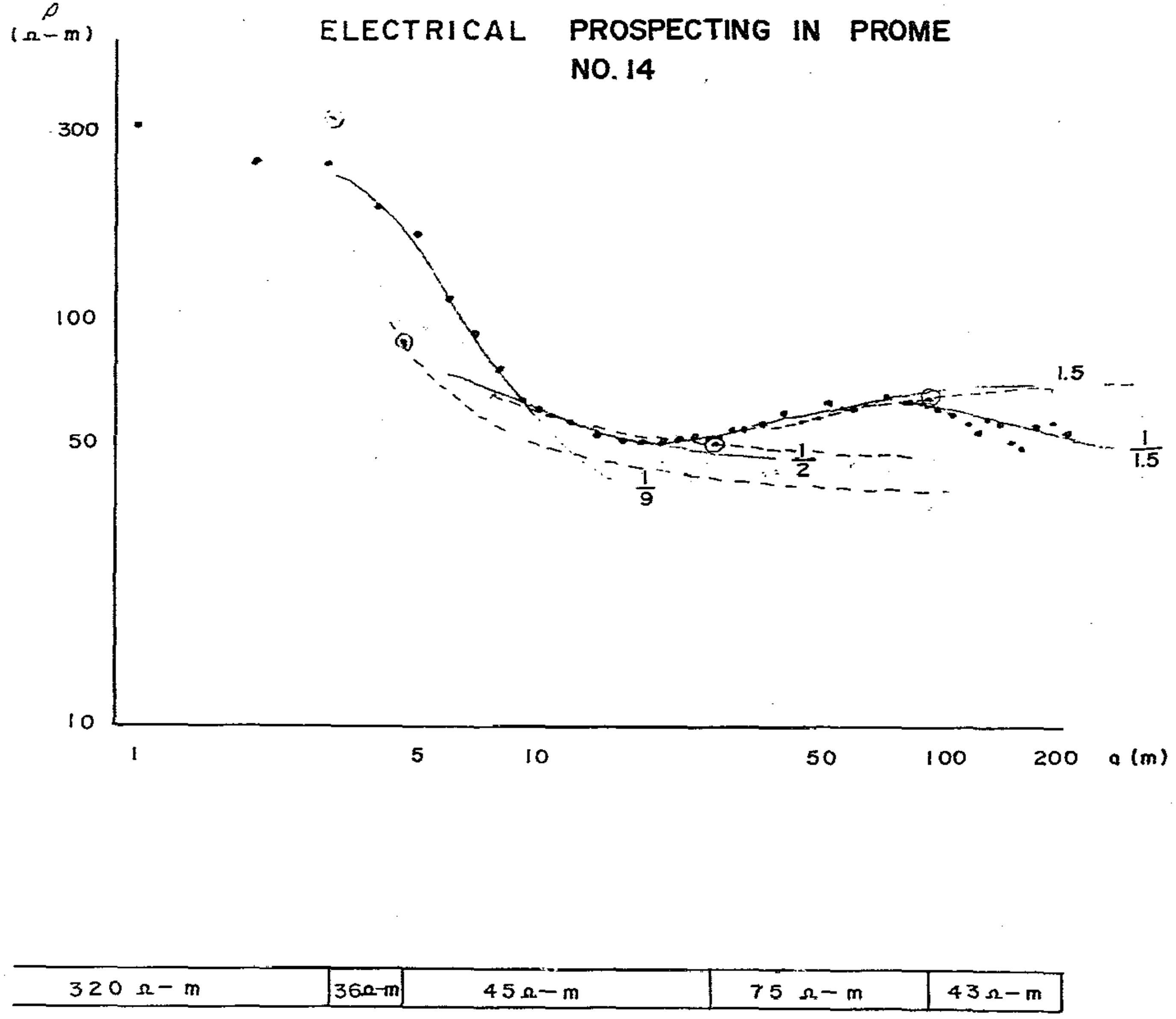

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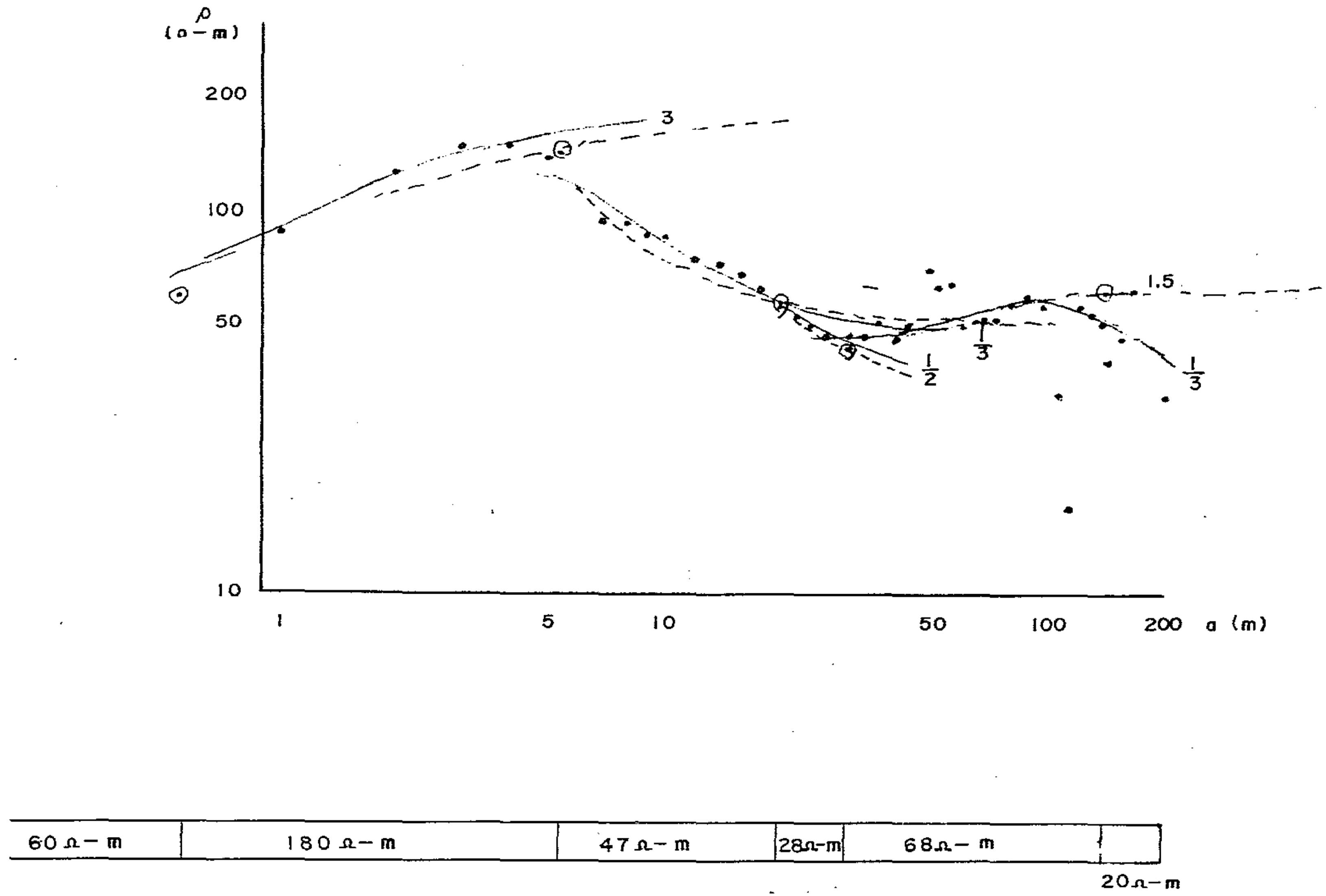
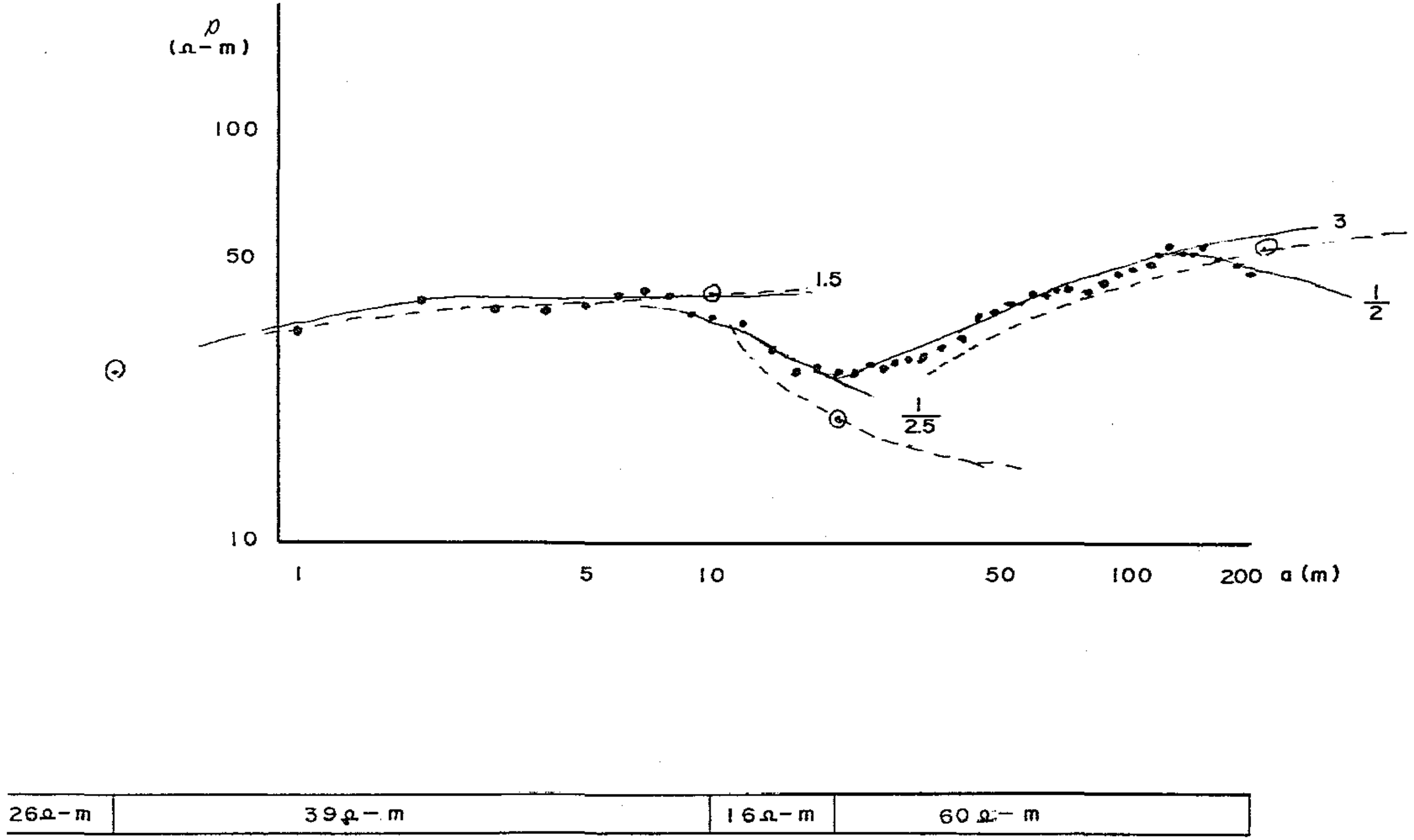


ELECTRICAL PROSPECTING IN PROME

NO. 16



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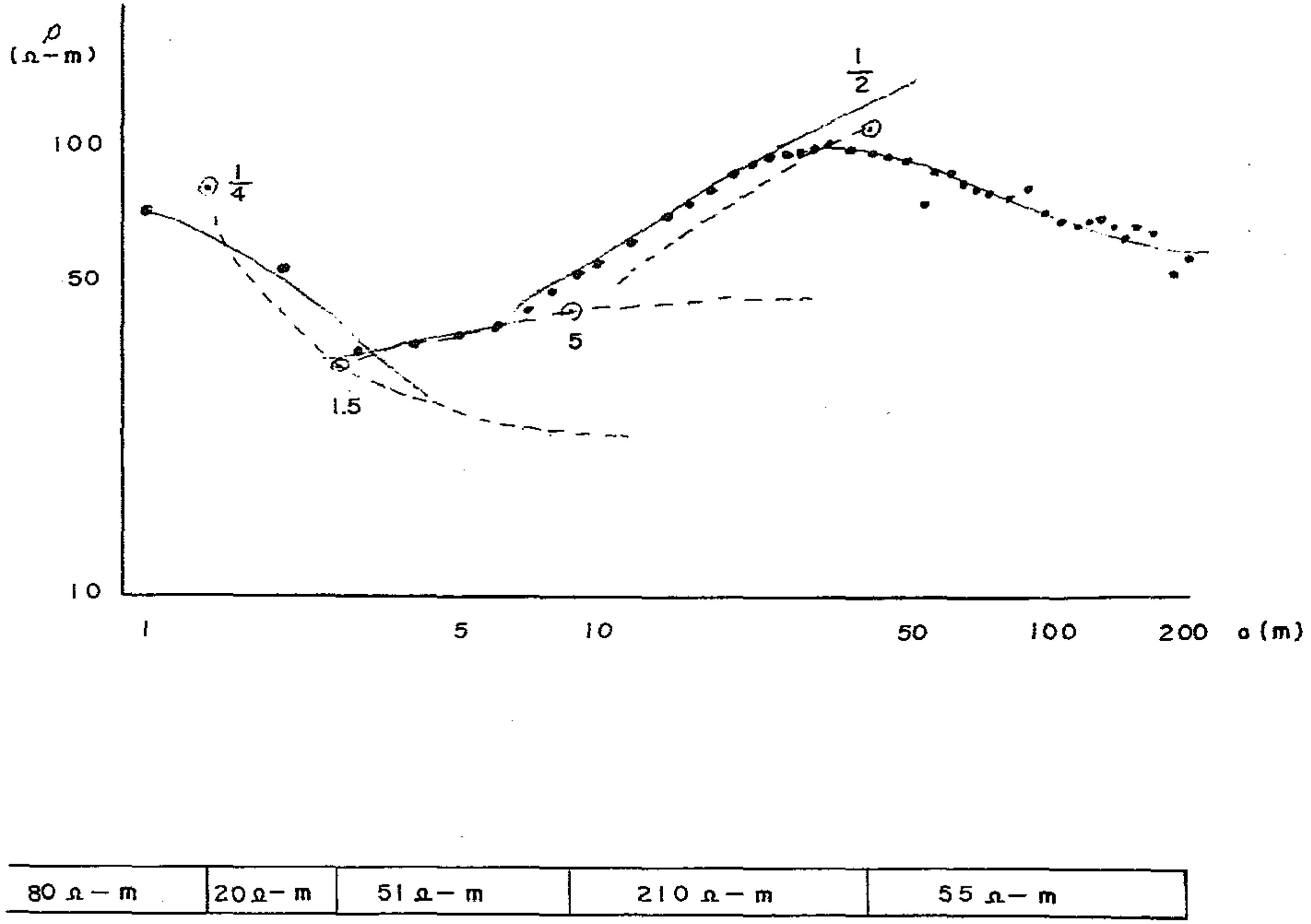

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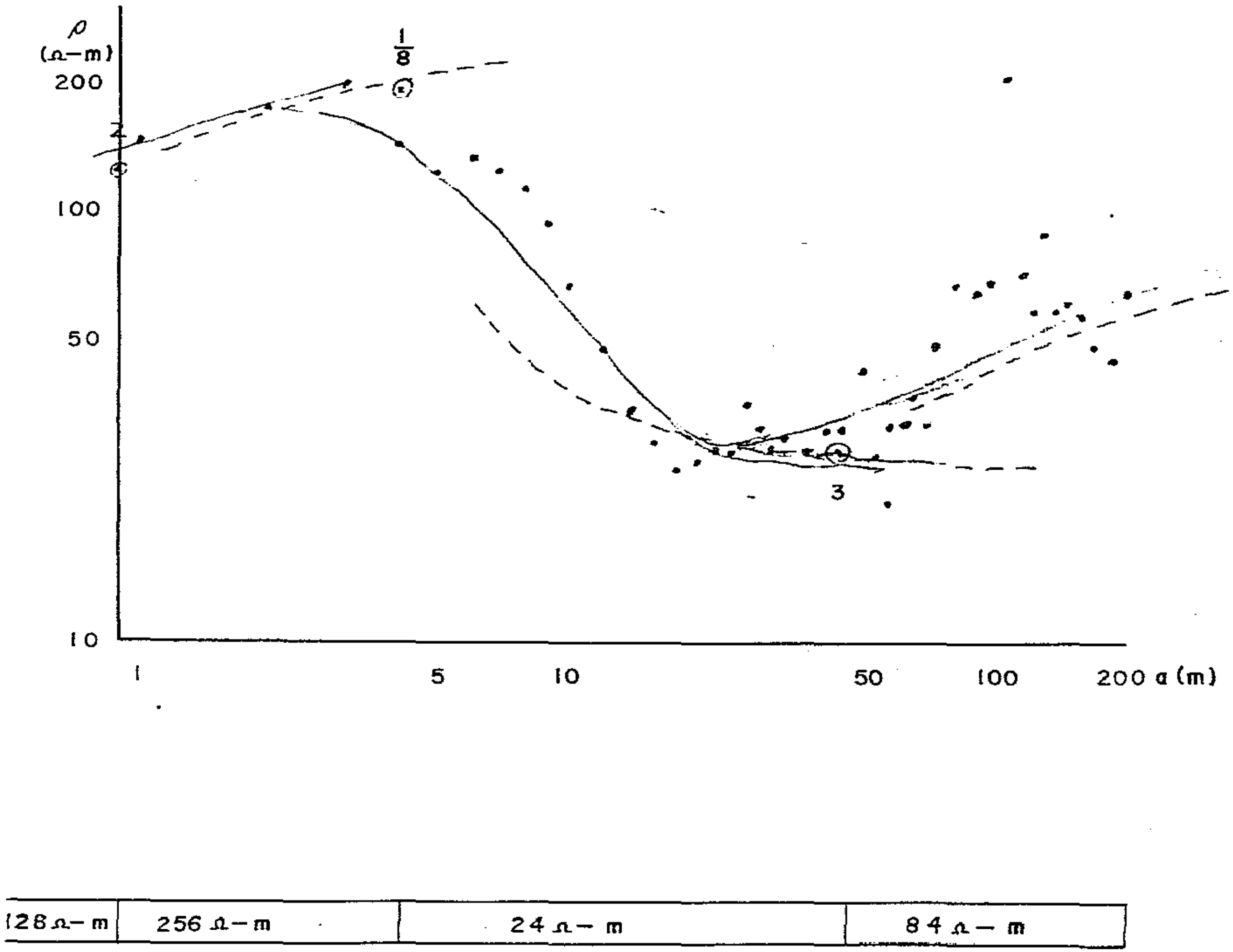
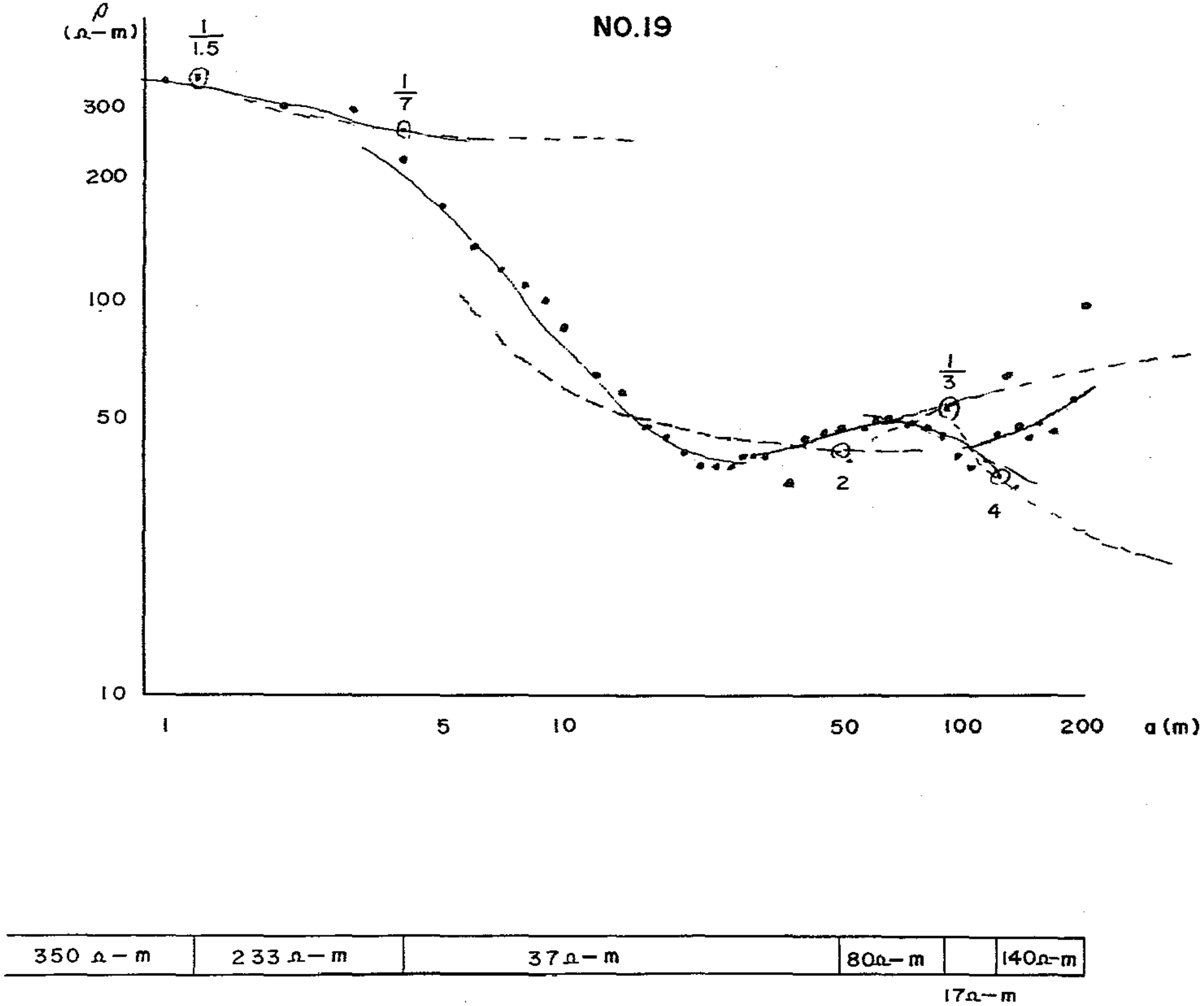


ELECTRICAL PROSPECTING IN PROME

NO.19



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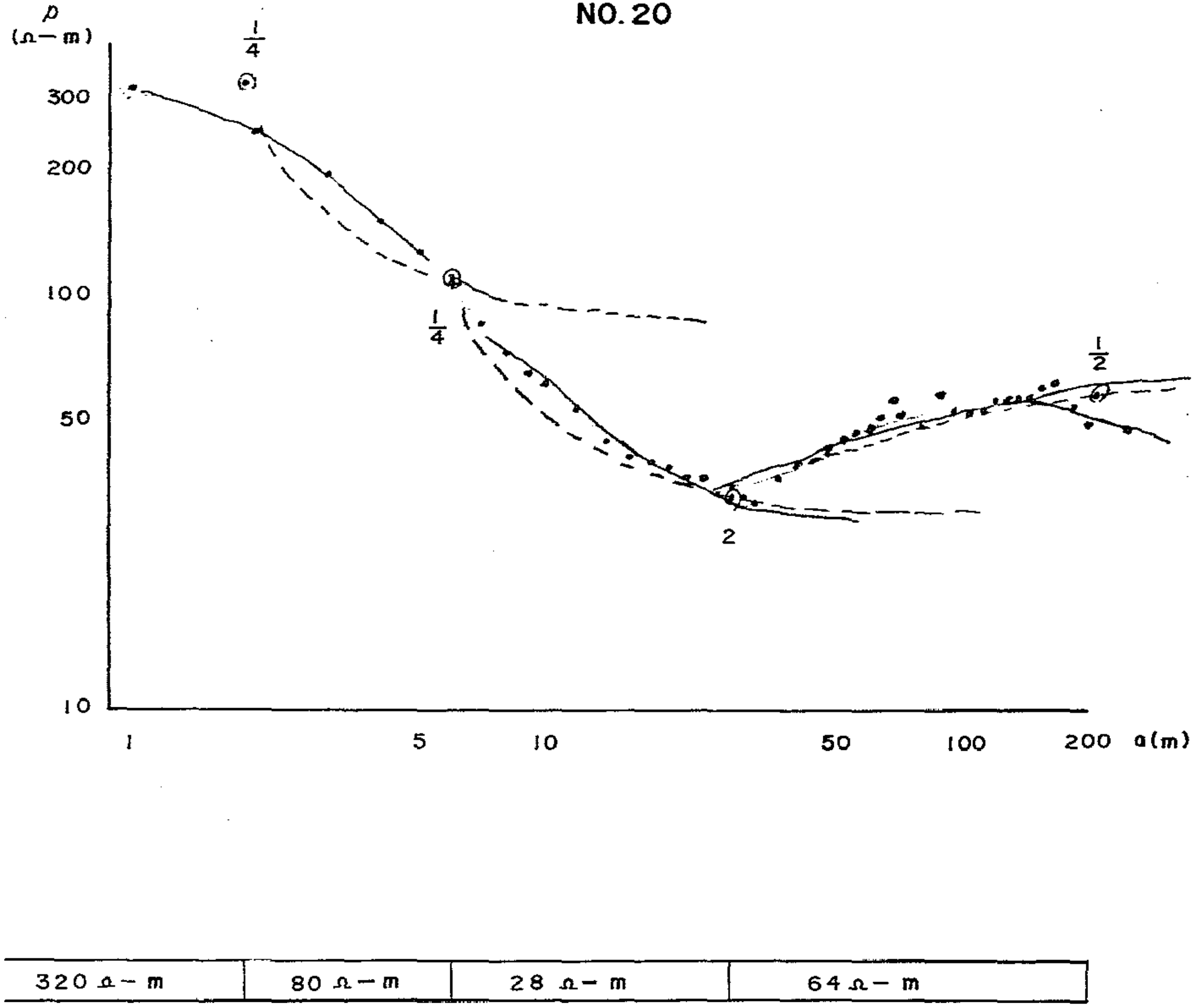
NO. 20



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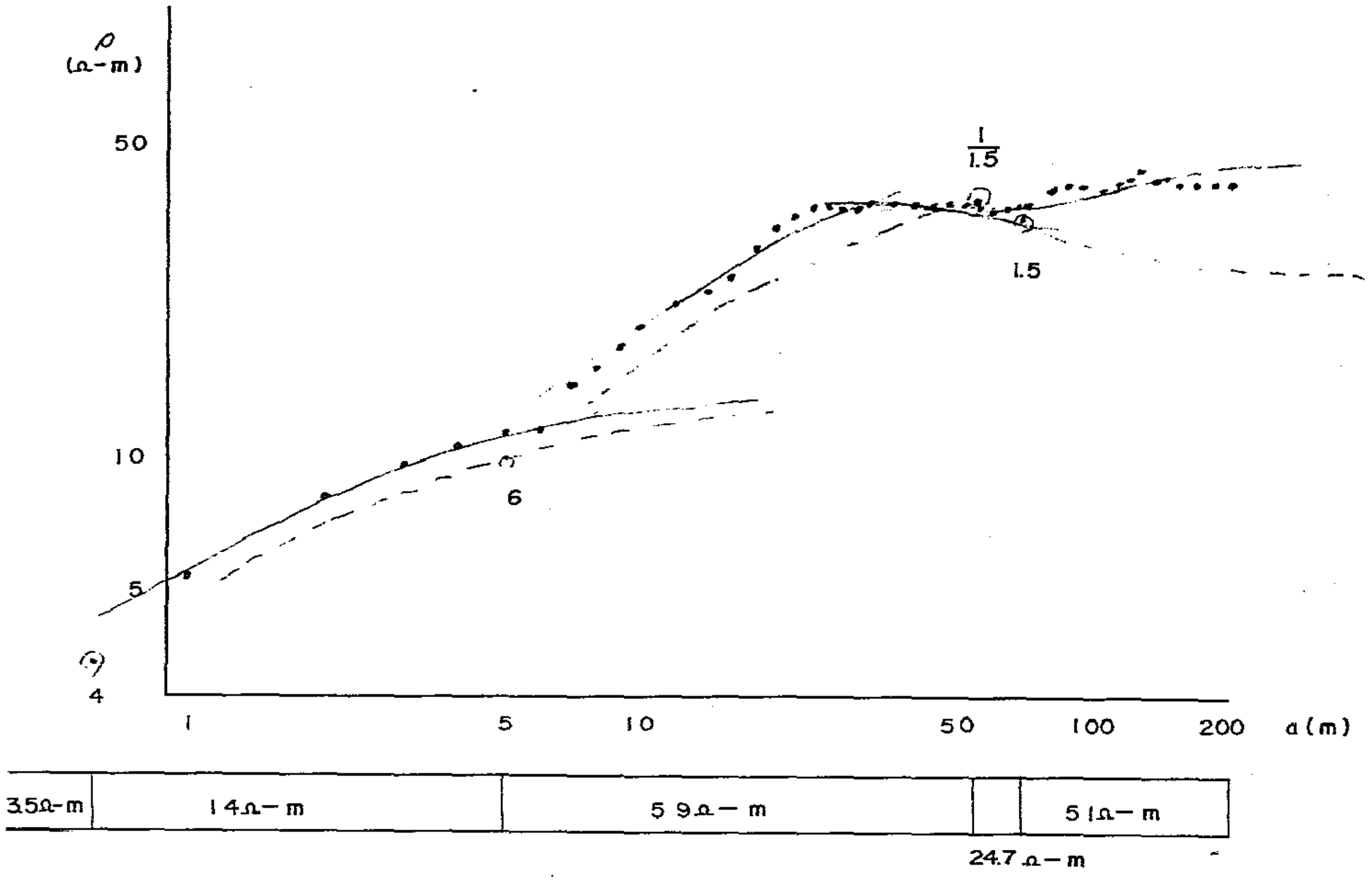
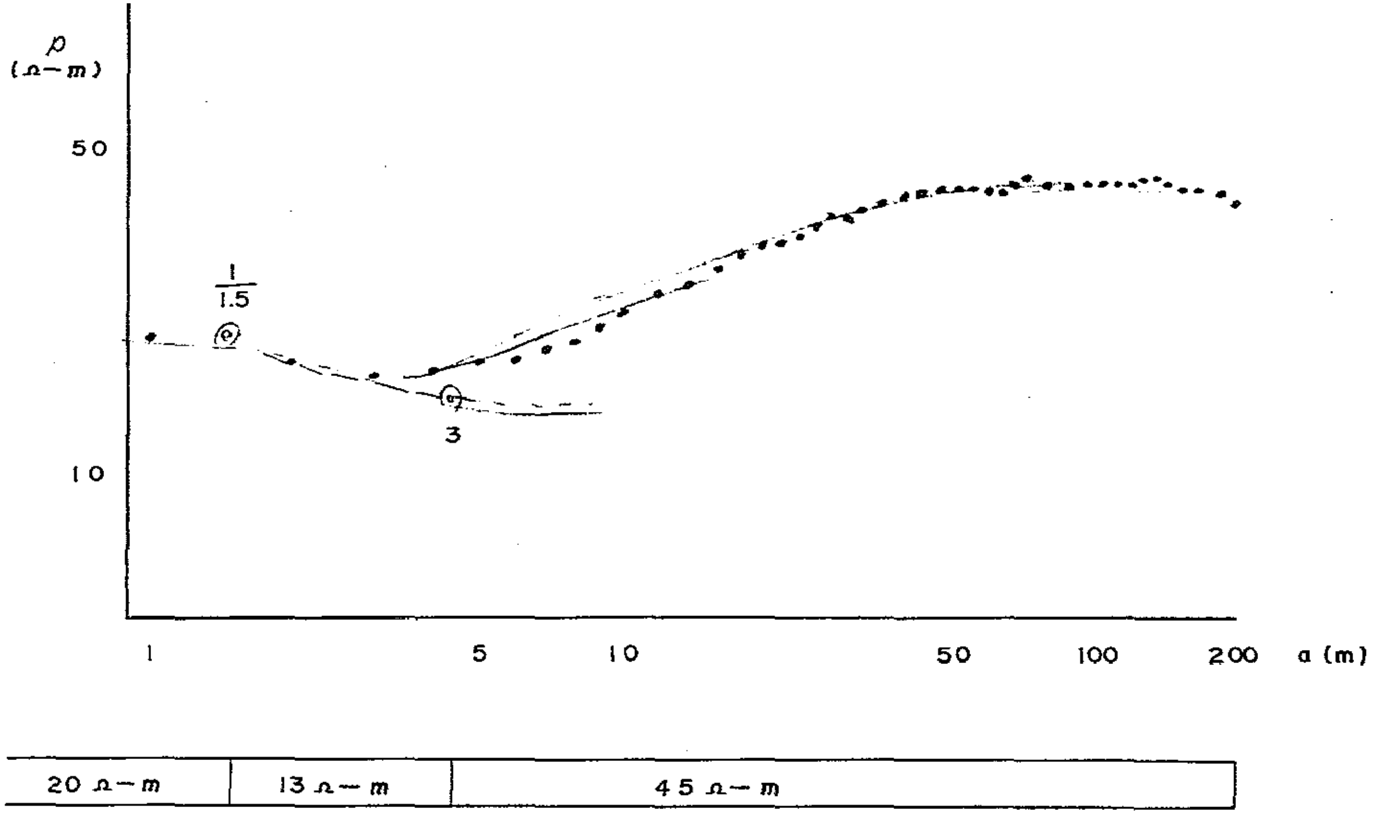


ELECTRICAL PROSPECTING IN PROME

NO. 22



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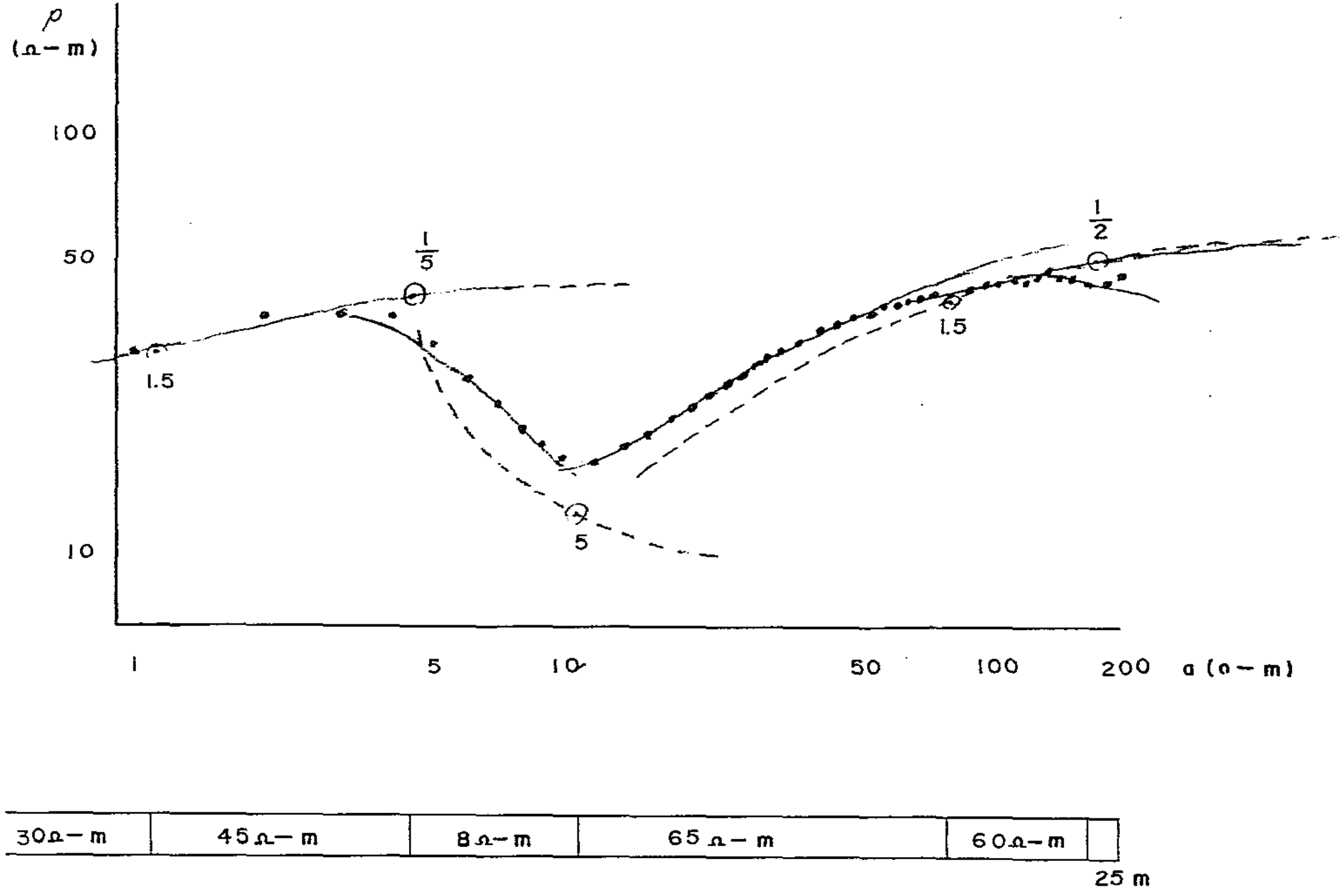
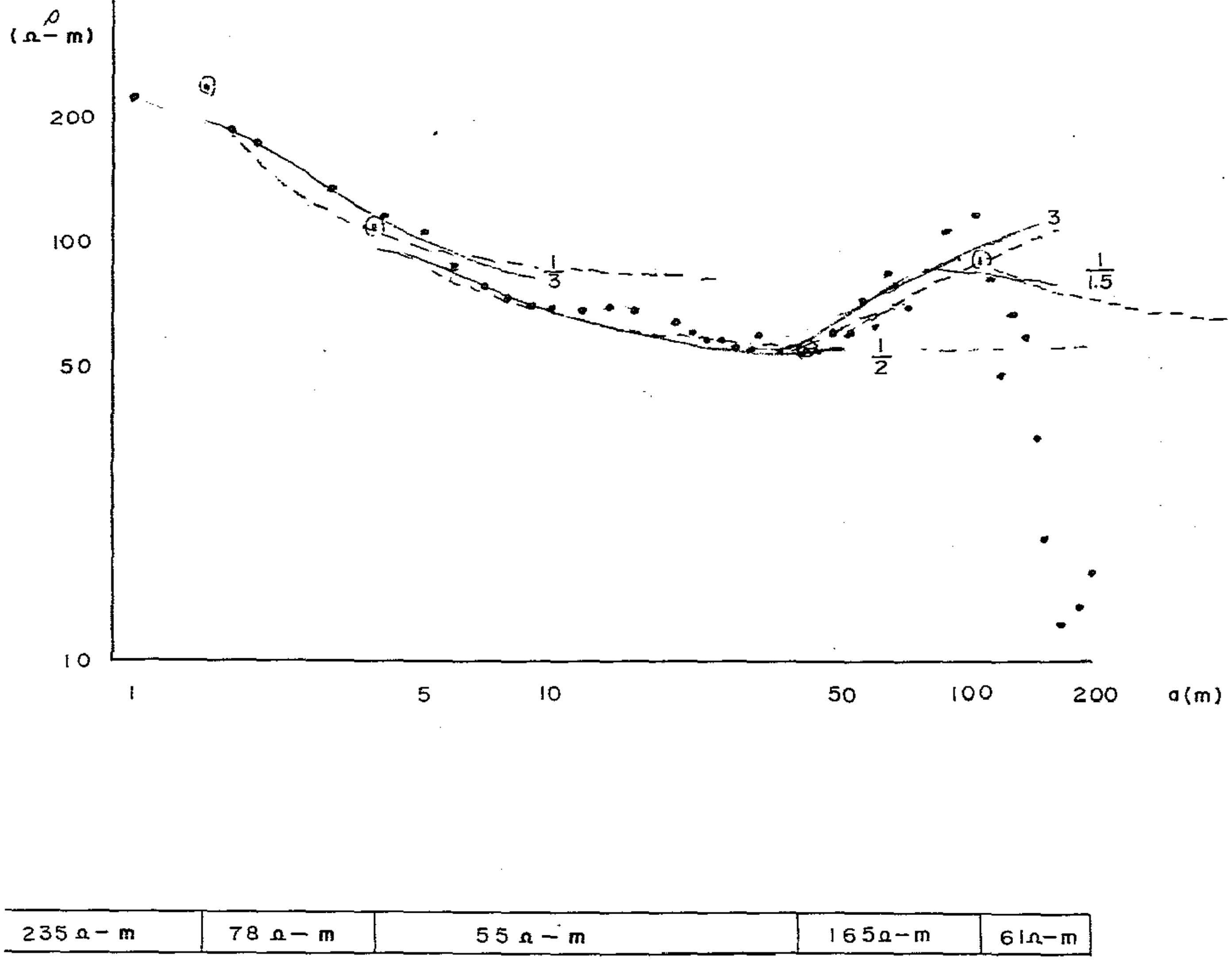


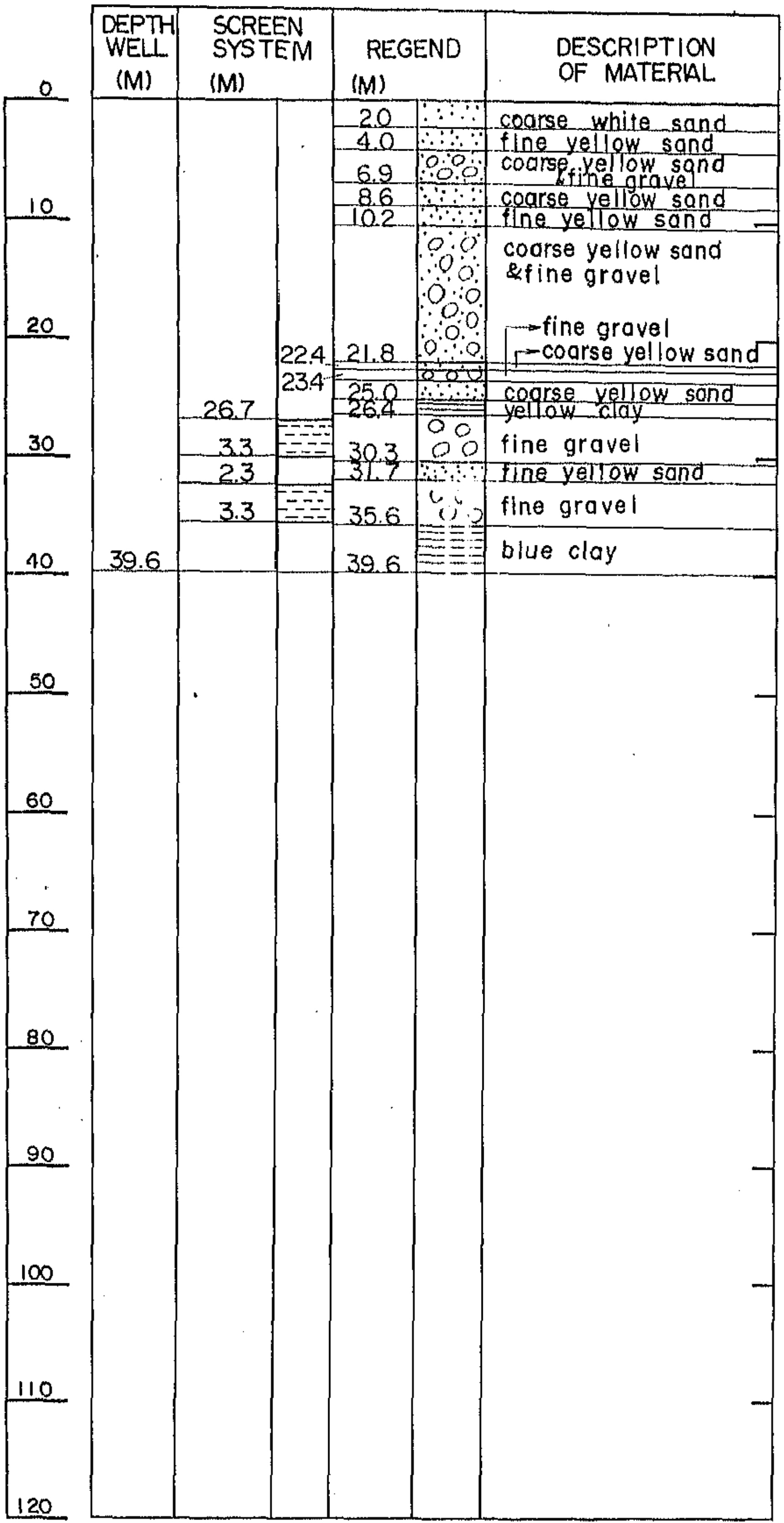
ELECTRICAL PROSPECTING IN PROME
NO. 24 (TAHAL 30)



A－3・2 EXISTING WELL LOGS

CONSTRUCTION CORPORATION DIVISIONAL STORES-NO. PROME4

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE
—

DATE
—

TOTAL WELL DEPTH
39.6m

CASING PIPE
ø100m/m

CASING LENGTH
ø100m/m X29.0m

SCREEN LENGTH
ø100m/m X6.6m

S.W.L ▽
—

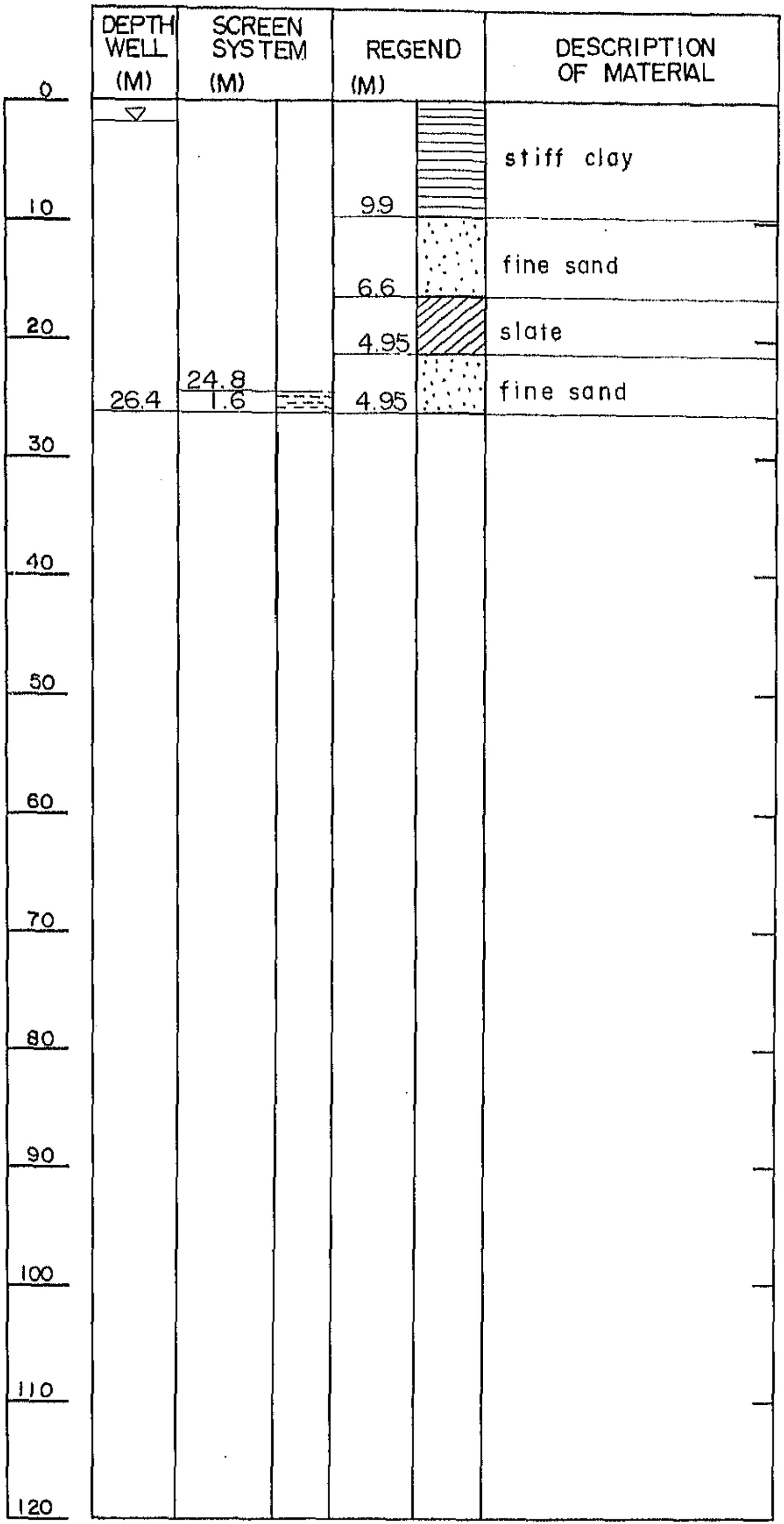
D.W.L ▽
—

YIELD
300 L·P·M

※ REMARKS

PROME HOUSING SITE-NO.14

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

—

DATE

—

TOTAL WELL DEPTH

29.0m

CASING PIPE

—

CASING LENGTH

27.4m

SCREEN LENGTH

1.6m

S.W.L ▽

3.9m

D.W.L ▽

9.9m

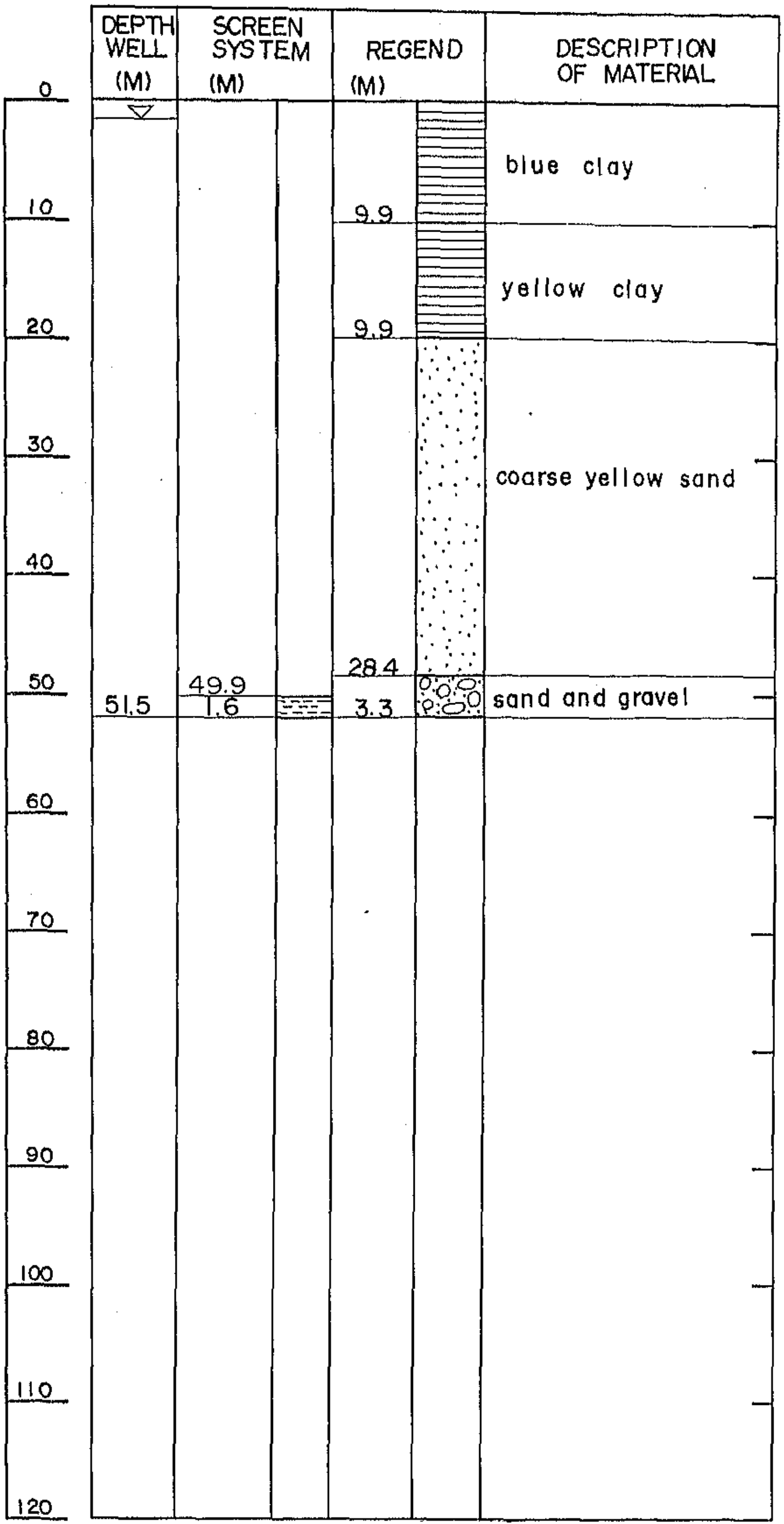
YIELD

300 L·P·M

※ REMARKS

PROME JAIL - NO.15

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

—

DATE

COMPLETED ON 21.9.61

TOTAL WELL DEPTH

53.1 m

CASING PIPE

—

CASING LENGTH

49.9m

SCREEN LENGTH

1.6 m

S.W.L ▽

1.0 m

D.W.L ▽

—

YIELD

375L·P·M

※ REMARKS

STARTING PRESSURE

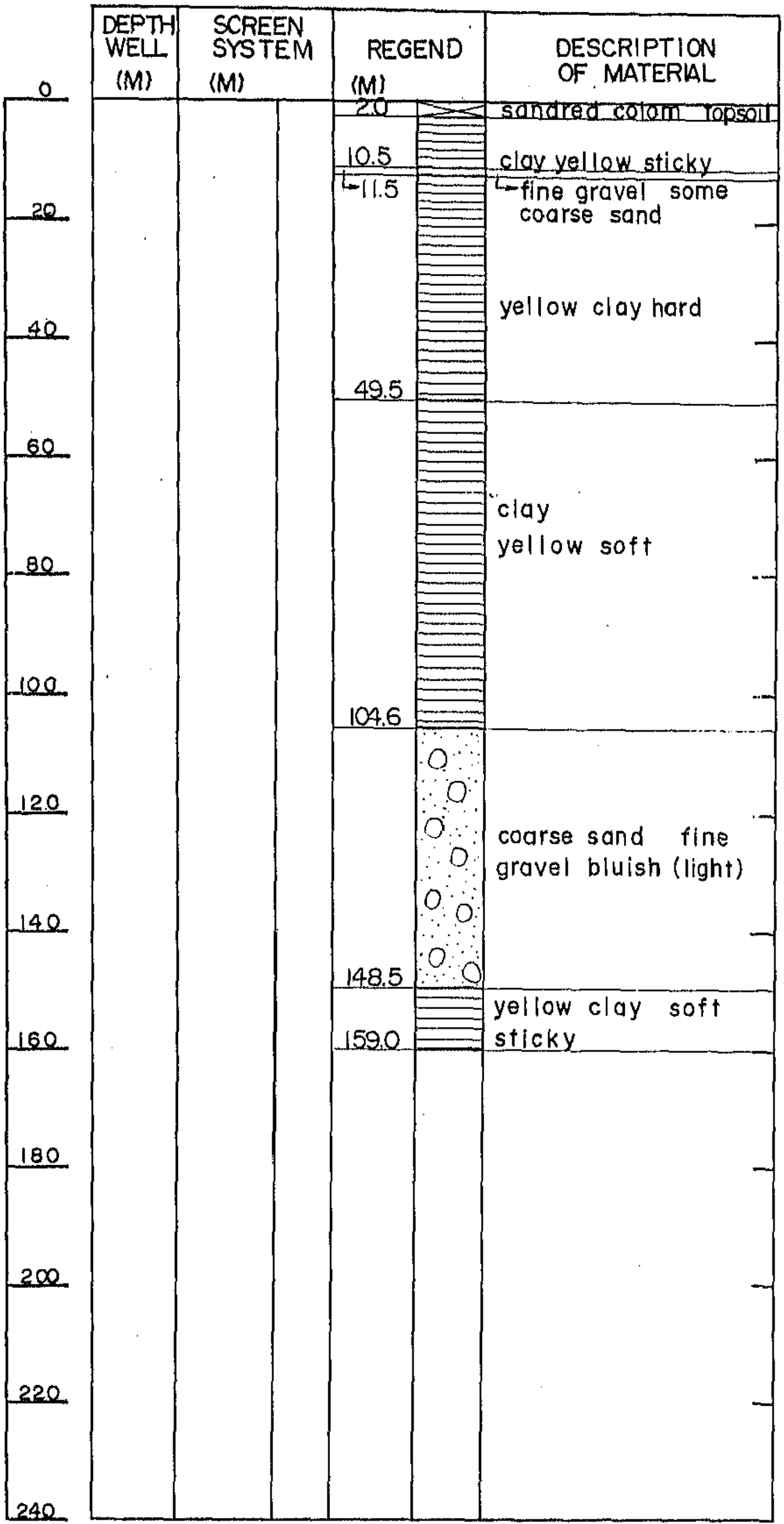
45 LBS

WORKING PRESSURE

35 LBS

NATIONAL CATTLE BREEDING & RESEARCH CENTER

WELL LOG



Source: Burma Government

MEMORANDUM

DRILLING MACHINE

PORTA

DATE

TOTAL WELL DEPTH

CASING PIPE

CASING LENGTH

SCREEN LENGTH

S.W.L ▽

D.W.L ▽

YIELD

※ REMARKS

No. 448/81, 449/81 and 450/81.

A — 3 · 3 (1) REPORT OF WATER ANALYSIS

Source | Physical Character: Appearance, Colour, Smell, Sediment | Chemical Tests. Qualitative: Sulphate, Nitrates, Nitrites, Ignition | Quantitative [Parts Per Million]: Total Solid, Chlorine, Total hardness, Permanent hardness, Saline ammonia, Albuminoid ammonia, Iron

	Lab.No.448/81 Sample No.Prome(10) Tube well, Jail, Prome		Lab.No.449/81 Sample No.Prome(11) Hot Spring, Prome.		~~Lab.No.450/81 Sample No.A Tube well, 17A, Burg Theikki, Mayangon.~~	
1. Total solids.	480.0	mg/1	340.0	mg/1	~~335.0~~	~~mg/1~~
2. Total Hardness, as $CaCO_3$	23.0	"	103.0	"	~~113.0~~	~~"~~
3. Permanent hardness, as $CaCO_3$	7.0	"	7.0	"	~~6.0~~	~~"~~
4. Calcium, as Ca	7.2	"	22.8	"	~~24.8~~	~~"~~
5. Magnesium, as Mg	1.3	"	11.2	"	~~18.5~~	~~"~~
6. Iron, as Fe	0.03	"	0.03	"	~~2.2~~	~~"~~
7. Manganese, as Mn	Nil		Nil		~~Nil~~	
8. Zinc, as Zn	Nil		Nil		~~Nil~~	
9. Copper, as Cu	Nil		Nil		~~Nil~~	
10. Lead, as Pb.	Nil		Nil		~~Nil~~	
11. Sulphate, as SO_4	14.7	"	Trace		~~Trace~~	
12. Chloride, as Cl	8.0	"	5.0	"	~~17.0~~	~~"~~
13. Nitrate, as N	1.0	"	0.2	"	~~8.5~~	~~"~~
14. Carbonate, as CO_3	Nil		Nil		~~Nil~~	
15. Bicarbonate, as HCO_3	337.4	"	280.6	"	~~247.1~~	~~"~~
16. Free & saline ammonia, as NH_3	0.01	"	0.01	"	~~3.12~~	~~"~~
17. Albuminoid ammonia, as NH_3	0.02	"	0.01	"	~~0.028~~	~~"~~
18. pH.	8.0		7.4		~~7.6~~	

Remarks—

DAW KHIN KHIN SOE,
M.B., B.S., D.P.H.
Asst. Director, N.H.L.

No. 430/81, 431/81 & 432/81.

A — 3 · 3 (2) REPORT OF WATER ANALYSIS

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appearance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness'	Saline ammonia	Albuminoid ammonia	Iron
						Lab.No.430/81 Sample No.Prome (7) Tube Well, Prome.			Lab.No.431/81 Sample No.Prome(8) Tube well, Prome.			Lab.No.432/81 Sample No.Prome(9) Tube well, Irrigation Compound, Prome.			
	1. Total solids						155.8	mg/1		165.0	mg/1		215.0	mg/1	
	2. Total hardness, as $CaCO_3$						57.0	"		52.0	"		68.0	"	
	3. Permanent hardness, as $CaCO_3$						14.0	""		32.0	"		17.0	"	
	4. Calcium, as Ca						14.8	"		12.8	"		16.0	"	
	5. Magnesium, as Mg						4.8	"		4.8	"		6.7	"	
	6. Iron, as Fe						0.05	"		0.05	"		0.06	"	
	7. Manganese, as Mn						Nil			Nil			Nil		
	8. Zinc, as Zn						Trace			Nil			Nil		
	9. Carbonate, as CO_3						Nil			Nil			Nil		
	10. Bicarbonate, as HCO_3						94.6	"		91.5	"		115.9	"	
	11. Chloride, as Cl						8.0	"		6.0	"		9.0	"	
	12. Sulphate, as SO_4						Trace			Trace			Trace		
	13. Nitrate, as N						0.60	"		0.60	"		0.70	"	
	14. Free & saline ammonia, as NH_3						0.01	"		0.01	"		0.01	"	
	15. Albuminoid ammonia, as NH_3						0.20	"		0.20	"		0.08	"	
	16. pH.						7.8			6.8			7.0		

Remarks—
Samples not sufficient for further tests.

DAW KHIN KHIN SOE,
M. B., B. S., D.P.H.
Asst. Director, N.H.L.

No. 445/81,446/81 and 447/81.

A — 3 · 3 (3) REPORT OF WATER ANALYSIS

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appear-ance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness'	Saline ammonia	Albuminoid ammonia	Iron

	Lab.No.445/81 Sample No.Prome(4) Tube well C.C.Divisional Stores, Prome		Lab.No.446/81 Sample No.Prome(5) Tube well Khittayar Garden, Prome		Lab.No.447/81 Sample No.Prome(6) Tube well Shwebintha Qr: Prome	
1.Total solids	250.0	mg/1	270.0	mg/1	180.0	mg/1
2.Total Hardness,as $CaCO_3$	80.0	"	52.0	"	72.0	"
3Permanent Hardness,as $CaCO_3$	7.0	"	28.0	"	35.0	"
4.Calcium,as Ca	12.0	"	12.4	"	16.0	"
5.Magnesium,as Mg	8.6	"	5.2	"	7.8	"
6.Iron,as Fe	0.63	"	0.16	"	0.03	"
7.Manganese,as Mn	1.37	"	0.11	"	0.25	"
8.Zinc,as Zn	Nil		Nil		Nil	
9.Copper,as Cu	Nil		Nil		Nil	
10.Lead,as Pb.	Nil		Nil		Nil	
11.Sulphate,as SO_4	Trace		Trace		Trace	
12.Chloride,as Cl	8,0	"	16.0	"	21.0	"
13.Nitrate,as N	0.3	%	0.5	"	0.7	"
14.Carbonate,as CO_3	Nil		Nil		Nil	
15.Bicarbonate,as HCO_3	219.6	"	85.4	"	106.8	"
16.Free & saline ammonia,as NH_3	0.01	"	0.01	"	0.01	"
17.Albuminoid ammonia,as NH_3	0.01	"	0.04	"	0.026	"
18.pH.	7.0		6.6		6.9	

Remarks—

DAW KHIN KHIN SOE,
M.B.,B.S., D.P.H.
Asst. Director, N.H.L.

No. 442/81,443/81 and 444/81

A — 3 · 3 (4) REPORT OF WATER ANALYSIS

Source	Physical Character				Chemical Tests.										
					Qualitative				Quantitative [Parts Per Million]						
	Appearance	Colour	Smell	Sediment	Sulphate	Nitrates	Nitrites	Ignition	Total Solid	Chlorine	Total hardness	Permanent hardness'	Saline ammonia	Albuminoid ammonia	Iron
						Lab.No.442/81 Sample No.Prome(1) Tube well,Timber Corporation.				Lab.No.443/81 Sample No.Prome(2) Tube well (1) G.T.I.,Prome.			Lab.No.444/81 Sample No.Prome(3) Tube well(2), G.T.I. Prome.		
	1. Total solids.						230.0	mg/1			230.0	mg/1		230.0	mg/1
	2. Total hardness,as $CaCO_3$						95.6	"			74.8	"		92.6	"
	3. Permanent hardness, as $CaCO_3$						11.0	"			8.0	"		6.0	"
	4. Calcium,as Ca						21.6	"			15.0	"		19.6	"
	5. Magnesium,as Mg						9.9	"			9.8	"		10.5	"
	6. Iron,as Fe						0.35	"			0.06	"		0.62	"
	7. Manganese,as Mn						1.60	"			0.44	"		0.11	"
	8. Zinc,as Zn						Nil				Nil			Nil	
	9. Copper,as Cu						Nil				Nil			Nil	
	10. Lead,as Pb.						Nil				Nil			Nil	
	11. Sulphate,as SO_4						2.9	"			Trace			Trace	
	12. Chloride,as Cl						11.0	"			7.0	"		5.0	"
	13. Nitrate,as N						0.1	"			0.2	"		0.2	"
	14Carbonate,as CO_3						Nil				Nil			Nil	
	15. Bicarbonate,as HCO_3						149.5	"			152.5	"		183.6	"
Remarks—	16. Free & saline ammonia, NH_3						0.01	"			0.01	"		0.021	"
	17. Albuminoid ammonia,as NH_3						0.01	"			0.03	"		0.028	"
	18. pH.						6.8				6.6			7.5	

DAW KHIN KHIN SOE,
M.B., B.S., D.P.H.
Asst. Director, N.H.L.

A－3・4　CALCULATION SHEETS FOR DISTRIBUTION NET WORK (PROPOSED PIPELINES)

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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                                  PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)    ( M )     ( L/S )     ( M/S )     ( 0/00 )   ( M )

                *** LOOP   1 ***     SIGMA-H= -.000010

  1    43- 45    150.    150.    400.00      -2.78       .157        .193       -.077      JIS G 5526
  3    45- 44    150.    150.    375.00       -.24       .013        .002       -.001      JIS G 5526
  2    43- 44    150.    150.    700.00      -2.06       .117        .111       -.078      JIS G 5526

                *** LOOP   2 ***     SIGMA-H= -.000021

  3    45- 44    150.    150.    375.00       -.24       .013        .002       -.001      JIS G 5526
  4    45- 48    150.    150.    375.00      -7.38       .418       1.176       -.441      JIS G 5526
  6    48- 47    150.    150.    350.00       -.63       .035        .012       -.004      JIS G 5526
  7    47- 46    150.    150.    375.00       3.03       .171        .226        .085      JIS G 5526
  5    44- 46    150.    150.    325.00      -7.14       .404       1.107       -.360      JIS G 5526

                *** LOOP   3 ***     SIGMA-H= -.000056

  7    47- 46    150.    150.    375.00       3.03       .171        .226        .085      JIS G 5526
  8    47- 50    150.    150.    275.00      -8.53       .482       1.536       -.423      JIS G 5526
 12    50- 51    150.    150.    450.00       1.95       .110        .100        .045      JIS G 5526
  9    46- 51    150.    150.    275.00      -8.95       .507       1.682       -.462      JIS G 5526

                *** LOOP   4 ***     SIGMA-H= -.000099

  6    48- 47    150.    150.    350.00       -.63       .035        .012       -.004      JIS G 5526
 10    48- 49    150.    150.    350.00     -11.62       .658       2.726       -.954      JIS G 5526
 11    49- 50    150.    150.    550.00       6.61       .374        .958        .527      JIS G 5526
  8    47- 50    150.    150.    275.00      -8.53       .482       1.536       -.423      JIS G 5526

                *** LOOP   5 ***     SIGMA-H= -.000200

 11    49- 50    150.    150.    550.00       6.61       .374        .958        .527      JIS G 5526
 15    49- 54    150.    150.    300.00     -18.55      1.050       6.475      -1.943      JIS G 5526
 16    54- 53    150.    150.    550.00      13.23       .749       3.465       1.906      JIS G 5526
 13    50- 53    150.    150.    300.00      -9.51       .538       1.879       -.564      JIS G 5526

                *** LOOP   6 ***     SIGMA-H= -.000093

 12    50- 51    150.    150.    450.00       1.95       .110        .100        .045      JIS G 5526
 13    50- 53    150.    150.    300.00      -9.51       .538       1.879       -.564      JIS G 5526
 17    53- 52    150.    150.    500.00       4.45       .252        .462        .231      JIS G 5526
 14    51- 52    150.    150.    325.00      -7.33       .415       1.162       -.378      JIS G 5526
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                                    PAGE

LINE  JOINT NO.    C      DIA.    LENGTH    QUANTITY     VELOCITY    GRADIENT    HEAD LOSS
                          (MM)    ( M )     ( L/S )      ( M/S )     ( 0/00 )    ( M )

              *** LOOP   7 ***     SIGMA-H= -.000158

  16   54- 53   150.    150.    550.00      13.23         .749       3.465       1.906      JIS G 5526
  18   54- 55   150.    150.    300.00      16.66         .943       5.307       1.592      JIS G 5526
  21   55- 56   150.    150.    550.00       4.90         .278        .552        .304      JIS G 5526
  19   53- 56   150.    150.    300.00      -1.05         .060        .032       -.010      JIS G 5526

              *** LOOP   8 ***     SIGMA-H= -.000044

  17   53- 52   150.    150.    500.00       4.45         .252        .462        .231      JIS G 5526
  19   53- 56   150.    150.    300.00      -1.05         .060        .032       -.010      JIS G 5526
  22   56- 57   150.    150.    550.00       3.53         .200        .300        .165      JIS G 5526
  20   57- 52   150.    150.    300.00       3.20         .181        .251        .075      JIS G 5526

              *** LOOP   9 ***     SIGMA-H= -.000069

 100   76- 54   150.    150.    140.00      48.77        2.760      38.706       5.419      JIS G 5526
 101   76- 59   150.    150.    115.00      57.03        3.227      51.693       5.945      JIS G 5526
  24   58- 59   150.    150.    175.00     -20.77        1.176       7.981      -1.397      JIS G 5526
  23   55- 58   150.    150.    125.00      11.43         .647       2.644        .330      JIS G 5526
  18   54- 55   150.    150.    300.00      16.66         .943       5.307       1.592      JIS G 5526

              *** LOOP  10 ***     SIGMA-H= -.000050

  26   60- 59   150.    150.    350.00     -32.69        1.850      18.470      -6.464      JIS G 5526
  27   61- 60   150.    150.    175.00       1.11         .063        .036        .006      JIS G 5526
  25   61- 58   150.    150.    350.00     -28.65        1.621      14.461      -5.062      JIS G 5526
  24   58- 59   150.    150.    175.00     -20.77        1.176       7.981      -1.397      JIS G 5526

              *** LOOP  11 ***     SIGMA-H=  .000000

  29   62- 63   150.    150.    300.00       8.57         .485       1.553        .466      JIS G 5526
  31   61- 62   150.    150.    300.00      23.97        1.356      10.401       3.120      JIS G 5526
  27   61- 60   150.    150.    175.00       1.11         .063        .036        .006      JIS G 5526
  28   60- 66   150.    150.    150.00      30.25        1.712      15.995       2.399      JIS G 5526
  32   63- 66   150.    150.    300.00     -14.18         .802       3.936      -1.181      JIS G 5526

              *** LOOP  12 ***     SIGMA-H= -.000046

  33   68- 67   150.    150.    300.00      -8.95         .507       1.682       -.505      JIS G 5526
  38   68- 63   150.    150.    300.00      -6.27         .355        .871       -.261      JIS G 5526
  32   63- 66   150.    150.    300.00     -14.18         .802       3.936      -1.181      JIS G 5526
  37   67- 66   150.    150.    300.00     -12.51         .708       3.125       -.937      JIS G 5526
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                    PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)    ( M )     ( L/S )     ( M/S )     ( O/OO )    ( M )

               *** LOOP  13 ***      SIGMA-H= -.000010

 30    65- 64    150.    150.    300.00      -8.28        .468       1.454      -.436      JIS G 5526
 34    64- 62    150.    150.    350.00     -11.84        .670       2.819      -.987      JIS G 5526
 29    62- 63    150.    150.    300.00       8.57        .485       1.553       .466      JIS G 5526
 35    65- 63    150.    150.    325.00     -12.12        .686       2.945      -.957      JIS G 5526

               *** LOOP  14 ***      SIGMA-H= -.000019

 36    69- 68    150.    150.    325.00     -11.67        .660       2.744      -.892      JIS G 5526
 39    69- 73    150.    150.    200.00       8.11        .459       1.399       .280      JIS G 5526
 40    73- 65    150.    150.     88.00     -16.83        .953       5.409      -.476      JIS G 5526
 35    65- 63    150.    150.    325.00     -12.12        .686       2.945      -.957      JIS G 5526
 38    68- 63    150.    150.    300.00      -6.27        .355        .871      -.261      JIS G 5526

               *** LOOP  15 ***      SIGMA-H=  .000000

 41    70- 73    150.    150.    150.00     -21.38       1.210       8.417     -1.263      JIS G 5526

               *** LOOP  16 ***      SIGMA-H= -.000016

 44    72- 33    150.    150.    200.00       3.70        .210        .328       .066      JIS G 5526
 46    33- 74    150.    150.    200.00      15.62        .884       4.711       .942      JIS G 5526
 45    74- 71    150.    150.    250.00      -7.00        .396       1.066      -.267      JIS G 5526
 43    70- 71    150.    150.    400.00      10.56        .597       2.282       .913      JIS G 5526
 42    70- 72    150.    150.    150.00       7.26        .411       1.142       .171      JIS G 5526

               *** LOOP  17 ***      SIGMA-H= -.000030

 47     4- 33    150.    150.    300.00      15.48        .876       4.631      1.389      JIS G 5526
 51     4-  8    150.    150.    325.00      27.79       1.573      13.677      4.445      JIS G 5526
 50     8-  9    150.    150.    250.00     -13.69        .775       3.690      -.922      JIS G 5526
 49    10-  9    150.    150.     75.00      19.06       1.079       6.806       .510      JIS G 5526
 48    74- 10    150.    150.    100.00      19.06       1.079       6.806       .681      JIS G 5526
 46    33- 74    150.    150.    200.00      15.62        .884       4.711       .942      JIS G 5526

               *** LOOP  18 ***      SIGMA-H= -.000019

 51     4-  8    150.    150.    325.00      27.79       1.573      13.677      4.445      JIS G 5526
 52     5-  4    150.    150.    250.00     -48.72       2.757      38.624     -9.656      JIS G 5526
 55     5-  6    150.    150.    200.00      11.87        .671       2.832       .566      JIS G 5526
 54     6-  7    150.    150.    225.00     -11.07        .626       2.490      -.560      JIS G 5526
 53     7-  8    150.    150.    225.00     -36.97       2.092      23.189     -5.217      JIS G 5526
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                          PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY     VELOCITY    GRADIENT    HEAD LOSS
                         (MM)     ( M )     ( L/S )      ( M/S )    ( 0/00 )     ( M )

              *** LOOP  19 ***      SIGMA-H= -.000005

 71    17-  6   150.    150.    200.00    -18.42        1.043       6.391      -1.278       JIS G 5526
 75    16- 17   150.    150.    275.00     -3.12         .177        .239       -.066       JIS G 5526
 74    16-  7   150.    150.    350.00    -16.89         .956       5.440      -1.904       JIS G 5526
 54     6-  7   150.    150.    225.00    -11.07         .626       2.490       -.560       JIS G 5526

              *** LOOP  20 ***      SIGMA-H= -.000004

 70    18- 17   150.    150.    400.00    -10.79         .611       2.377       -.951       JIS G 5526
 72    15- 18   150.    150.    250.00      1.97         .111        .102        .025       JIS G 5526
 73    15- 16   150.    150.    350.00    -10.99         .622       2.456       -.860       JIS G 5526
 75    16- 17   150.    150.    275.00     -3.12         .177        .239       -.066       JIS G 5526

              *** LOOP  21 ***      SIGMA-H=  .000000

 77    13- 16   150.    150.    150.00     -4.51         .255        .473       -.071       JIS G 5526

              *** LOOP  22 ***      SIGMA-H=  .000000

 76    14- 15   150.    150.    170.00     -4.51         .255        .473       -.080       JIS G 5526

              *** LOOP  23 ***      SIGMA-H= -.000034

 69    77- 18   150.    150.    360.00     -8.25         .467       1.446       -.520       JIS G 5526
 70    18- 17   150.    150.    400.00    -10.79         .611       2.377       -.951       JIS G 5526
 71    17-  6   150.    150.    200.00    -18.42        1.043       6.391      -1.278       JIS G 5526
 55     5-  6   150.    150.    200.00     11.87         .671       2.832        .566       JIS G 5526
 56    19-  5   150.    150.    150.00    -32.34        1.830      18.101      -2.715       JIS G 5526
 58    20- 19   150.    150.    200.00    -14.19         .803       3.944       -.789       JIS G 5526
 68    21- 20   150.    150.    200.00     -4.31         .244        .435       -.087       JIS G 5526
 61    22- 21   150.    150.    250.00       .20         .011        .001        .000       JIS G 5526
103    77- 22   150.    150.    190.00      8.25         .467       1.446        .275       JIS G 5526

              *** LOOP  24 ***      SIGMA-H= -.000011

 59    23- 24   150.    150.    225.00     -1.82         .103        .089       -.020       JIS G 5526
 60    23- 20   150.    150.    225.00     -5.37         .304        .654       -.147       JIS G 5526
 58    20- 19   150.    150.    200.00    -14.19         .803       3.944       -.789       JIS G 5526
 57    19- 24   150.    150.    250.00     13.64         .772       3.664        .916       JIS G 5526
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                       PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY    GRADIENT   HEAD LOSS
                         (MM)    ( M )     ( L/S )     ( M/S )     ( 0/00 )    ( M )

                *** LOOP  25 ***      SIGMA-H= -.000010

 67    22- 23   150.    150.    200.00        3.54        .200        .302        .060     JIS G 5526
 61    22- 21   150.    150.    250.00         .20        .011        .001        .000     JIS G 5526
 68    21- 20   150.    150.    200.00       -4.31        .244        .435       -.087     JIS G 5526
 60    23- 20   150.    150.    225.00       -5.37        .304        .654       -.147     JIS G 5526

                *** LOOP  26 ***      SIGMA-H= -.000012

 66    26- 25   150.    150.    275.00       -2.79        .158        .195       -.054     JIS G 5526
 63    26- 23   150.    150.    375.00       -6.23        .352        .859       -.322     JIS G 5526
 59    23- 24   150.    150.    225.00       -1.82        .103        .089       -.020     JIS G 5526
 62    25- 24   150.    150.    250.00       -7.30        .413       1.154       -.288     JIS G 5526

                *** LOOP  27 ***      SIGMA-H=  .000000

 65    27- 26   150.    150.    200.00       -4.51        .255        .473       -.095     JIS G 5526
 64    27- 22   150.    150.    500.00         .00        .000        .000        .000     JIS G 5526
 67    22- 23   150.    150.    200.00        3.54        .200        .302        .060     JIS G 5526
 59    23- 24   150.    150.    225.00       -1.82        .103        .089       -.020     JIS G 5526

                *** LOOP  28 ***      SIGMA-H=  .000000

 78     7- 12   150.    150.    175.00        4.51        .255        .473        .083     JIS G 5526

                *** LOOP  29 ***      SIGMA-H=  .000000

 79    29- 30   150.    150.    350.00       -2.03        .115        .108       -.038     JIS G 5526

                *** LOOP  30 ***      SIGMA-H=  .000000

 99     3- 76   150.    200.    125.00      105.80       3.368      39.950       4.994     JIS G 5526

                *** LOOP  31 ***      SIGMA-H=  .000012

 90    41- 40   150.    150.    325.00        -.76        .043        .018       -.006     JIS G 5526
105    40- 79   150.    150.    115.00        3.44        .195        .286        .033     JIS G 5526
 88    79- 42   150.    150.    610.00        3.44        .195        .286        .175     JIS G 5526
 87    41- 42   150.    150.    650.00        3.59        .203        .311        .202     JIS G 5526
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--- CALUCULATION OF HYDRAULIC NETWORK --- (FOR PIPE-LINE)                                  PAGE

LINE  JOINT NO.    C     DIA.    LENGTH    QUANTITY    VELOCITY   GRADIENT   HEAD LOSS
                         (MM)    ( M )     ( L/S )     ( M/S )    ( O/OO )   ( M )

               *** LOOP  32 ***    SIGMA-H=  .000022

  91   39- 38    150.    150.    400.00     -1.97       .111       .102      -.041     JIS G 5526
  89   38- 40    150.    150.    450.00      8.23       .466      1.439       .648     JIS G 5526
  90   41- 40    150.    150.    325.00      -.76       .043       .018      -.006     JIS G 5526
  86   39- 41    150.    150.    550.00      7.16       .405      1.114       .612     JIS G 5526

               *** LOOP  33 ***    SIGMA-H=  .000034

  92   37- 36    150.    150.    350.00    -13.45       .761      3.572     -1.250     JIS G 5526
  93   36- 78    150.    150.    310.00     14.23       .805      3.961      1.228     JIS G 5526
 104   78- 38    150.    150.    175.00     14.23       .805      3.961       .693     JIS G 5526
  91   39- 38    150.    150.    400.00     -1.97       .111       .102      -.041     JIS G 5526
  85   37- 39    150.    150.    400.00      9.23       .522      1.779       .712     JIS G 5526

               *** LOOP  34 ***    SIGMA-H=  .000000

  83    9- 11    150.    150.    250.00      -.19       .011       .001      -.000     JIS G 5526
  84   11- 37    150.    150.    250.00      -.19       .011       .001      -.000     JIS G 5526

               *** LOOP  35 ***    SIGMA-H=  .000000

  95   75- 34    150.    150.    150.00     15.76       .892      4.786       .718     JIS G 5526
  97   34- 35    150.    150.    225.00      2.03       .115       .108       .024     JIS G 5526

               *** LOOP  36 ***    SIGMA-H=  .000000

  82   32- 34    150.    150.    500.00    -10.15       .575      2.123     -1.062     JIS G 5526
  96   32- 31    150.    150.    175.00      2.03       .115       .108       .019     JIS G 5526

               *** LOOP  37 ***    SIGMA-H=  .000000

  81   30- 32    150.    150.    450.00     -6.09       .345       .825      -.371     JIS G 5526
  80   28- 30    150.    150.    300.00     -2.03       .115       .108      -.032     JIS G 5526

               *** LOOP  38 ***    SIGMA-H=  .000000

  98    1-  4    150.    200.    265.00     96.50      3.072     33.697      8.930     JIS G 5526

               *** LOOP  39 ***    SIGMA-H=  .000000

 102    2- 75    150.    150.     35.00     49.49      2.801     39.773      1.392     JIS G 5526
  94   75- 36    150.    150.    200.00     31.71      1.794     17.450      3.490     JIS G 5526
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             --- CALUCULATION OF HYDRAULIC NETWORK --- (FOR JOINT)                                              PAGE

 JOINT   SUM-Q   SUM-H    G.L.    W.L.    L.H.  PRESSURE      JOINT   SUM-Q   SUM-H    G.L.    W.L.    L.H.  PRESSURE
         (L/S)    (M)     (M)     (M)     (M)   (KG/CM2)              (L/S)    (M)     (M)     (M)     (M)   (KG/CM2)

     1   96.50   13.60   61.00   59.40   -1.60    -.160           2   49.49   19.92   45.00   53.08    8.08     .808
     3  105.80     .00   73.00   73.00     .00     .000           4   -4.51   22.53   45.00   50.47    5.47     .547
     5   -4.51   32.18   30.00   40.82   10.82    1.082           6   -4.51   32.75   28.00   40.25   12.25    1.225
     7   -4.51   32.19   28.00   40.81   12.81    1.281           8   -4.51   26.97   29.00   46.03   17.03    1.703
     9   -5.56   26.05   30.00   46.95   16.95    1.695          10     .00   25.54   32.00   47.46   15.46    1.546
    11     .00   26.05   32.00   46.95   14.95    1.495          12   -4.51   32.27   25.00   40.73   15.73    1.573
    13   -4.51   34.16   26.00   38.84   12.84    1.284          14   -4.51   35.03   28.00   37.97    9.97     .997
    15   -4.51   34.95   29.00   38.05    9.05     .905          16   -4.51   34.09   27.00   38.91   11.91    1.191
    17   -4.51   34.03   28.00   38.97   10.97    1.097          18   -4.51   34.98   33.00   38.02    5.02     .502
    19   -4.51   34.90   33.00   38.10    5.10     .510          20   -4.51   35.69   31.00   37.31    6.31     .631
    21   -4.51   35.77   28.00   37.23    9.23     .923          22   -4.51   35.77   32.00   37.23    5.23     .523
    23   -4.51   35.83   32.00   37.17    5.17     .517          24   -4.51   35.81   32.00   37.19    5.19     .519
    25   -4.51   36.10   32.00   36.90    4.90     .490          26   -4.51   36.16   32.00   36.84    4.84     .484
    27   -4.51   36.25   32.00   36.75    4.75     .475          28   -2.03   23.49   24.00   49.51   25.51    2.551
    29   -2.03   23.50   28.00   49.50   21.50    2.150          30   -2.03   23.46   26.00   49.54   23.54    2.354
    31   -2.03   23.11   22.00   49.89   27.89    2.789          32   -2.03   23.09   24.00   49.91   25.91    2.591
    33   -3.56   23.92   35.00   49.08   14.08    1.408          34   -3.57   22.03   29.00   50.97   21.97    2.197
    35   -2.03   22.05   30.00   50.95   20.95    2.095          36   -4.03   24.80   29.00   48.20   19.20    1.920
    37   -4.03   26.05   32.00   46.95   14.95    1.495          38   -4.03   26.72   27.00   46.28   19.28    1.928
    39   -4.03   26.76   31.00   46.24   15.24    1.524          40   -4.03   27.37   27.00   45.63   18.63    1.863
    41   -4.33   27.37   30.00   45.63   15.63    1.563          42   -7.03   27.57   28.00   45.43   17.43    1.743
    43   -4.84   13.83   53.00   59.17    6.17     .617          44   -4.84   13.75   49.00   59.25   10.25    1.025
    45   -4.84   13.75   53.00   59.25    6.25     .625          46   -4.84   13.39   43.00   59.61   16.61    1.661
    47   -4.87   13.30   49.00   59.70   10.70    1.070          48   -4.87   13.31   51.00   59.69    8.69     .869
    49    -.32   12.36   51.00   60.64    9.64     .964          50   -5.64   12.88   46.00   60.12   14.12    1.412
    51    -.32   12.93   40.00   60.07   20.07    2.007          52    -.32   12.55   35.00   60.45   25.45    2.545
    53    -.32   12.32   40.00   60.68   20.68    2.068          54    -.32   10.41   55.00   62.59    7.59     .759
    55    -.32   12.01   49.00   60.99   11.99    1.199          56    -.32   12.31   35.00   60.69   25.69    2.569
    57    -.32   12.47   30.00   60.53   30.53    3.053          58   -3.56   12.34   47.00   60.66   13.66    1.366
    59   -3.56   10.94   55.00   62.06    7.06     .706          60   -3.56   17.40   48.00   55.60    7.60     .760
    61   -3.56   17.40   40.00   55.60   15.60    1.560          62   -3.56   20.52   38.00   52.48   14.48    1.448
    63   -4.36   20.98   40.00   52.02   12.02    1.202          64   -3.56   21.50   38.00   51.50   13.50    1.350
    65   -3.56   21.94   40.00   51.06   11.06    1.106          66   -3.56   19.80   48.00   53.20    5.20     .520
    67   -3.56   20.74   47.00   52.26    5.26     .526          68   -3.56   21.24   43.00   51.76    8.76     .876
    69   -3.56   22.14   43.00   50.86    7.86     .786          70   -3.56   23.68   40.00   49.32    9.32     .932
    71   -3.56   24.59   38.00   48.41   10.41    1.041          72   -3.56   23.85   42.00   49.15    7.15     .715
    73   -3.56   22.42   43.00   50.58    7.58     .758          74   -3.56   24.86   33.00   48.14   15.14    1.514
    75   -2.03   21.31   30.00   51.69   21.69    2.169          76     .00    4.99   61.00   68.01    7.01     .701
    77     .00   35.50   32.00   37.50    5.50     .550          78     .00   26.03   28.00   46.97   18.97    1.897
    79     .00   27.40   27.00   45.60   18.60    1.860
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TOTAL LENGTH OF PIPELINE

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( JIS G 5526 )

         DIA =  150     L =30433.00
         DIA =  200     L =  390.00
*STOP*
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JICA