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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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LOCAL WATER UTILITIES ADMINISTRATION REPUBLIC OF THE PHILIPPINES

# CAVITE WATER SUPPLY DEVELOPMENT STUDY IN

## THE REPUBLIC OF THE PHILIPPINES

**VOLUME 3** 

## SUPPORTING REPORT

MAY 1995

KOKUSAI KOGYO CO., LTD. NIPPON JOGESUIDO SEKKEI CO., LTD.



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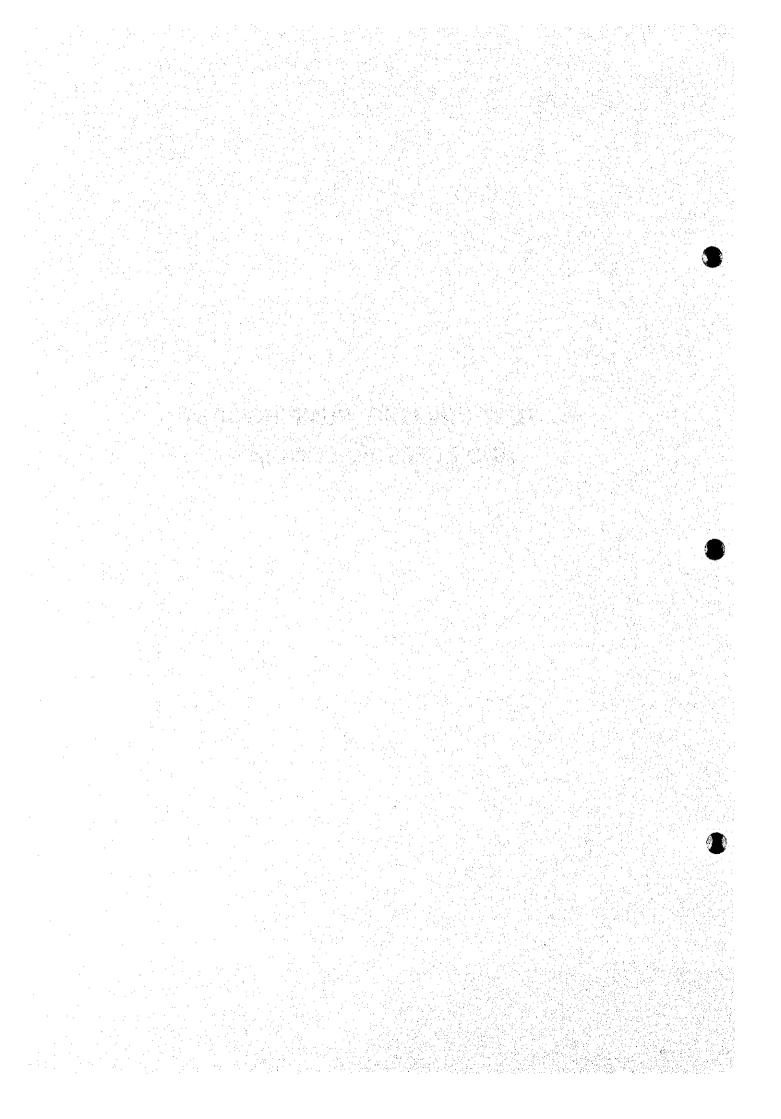
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1. TEST DRILLING, PUMPING TEST AND ELECTRIC LOGGING



### 1. TEST DRILLING, PUMPING TEST AND ELECTRIC LOGGING

### 1.1 STUDY METHOD AND WORK AMOUNTS

The sites where test wells were drilled in the Study are shown in Fig.s 1-1 to 1-4 and the work amount for these wells is shown in Table 1-1. Daily activity records of drilling work are presented in Tables 1-2 to 1-5.

Main equipments and materials used in test drilling, pumping test and electric logging are as follows:

(1) Lotary Drilling Machine

LONGYEA-38	:	Spindle-type (for G.M.A and Naic)
LONGYEA-44	:	Spindle-type (for Mendez)
TOHO-HD6	:	Spindle-type (for Tanza)

(2) Instrument for Well Logging

GEOLOGGER		
(Model 3434)	:	Electric logging for G.M.A
MAC-OHM	:	Electric logging for Tanza, Naic,
(Model 2115)		and Mendez

Gamma-ray logging was carried out by GEOLOGGER for G.M.A., Tanza, Naic, and Mendez.

(3) Compressor for Well Development

KOMATSU Engine drive rotary type compressor (7-8 kg/cm<sup>2</sup>, 7 m<sup>3</sup>/min)

Riser Pipe	:	ø100 mm х 6 m (49 pcs)
Air Pipe	:	ø 25 mm x 6 m (25 pcs)
Air Hose	:	ø 25 mm x 20 m (1 pc)

(4) Submersible Pump for Pumping Test

· · .

Grund Jose	: 2" diameter x 22 stage 10 Hp x 220 V (for G.M.A.)
Pleuger	: 4" diameter x 6 stage x 70 Hp x 440 V (for Tanza)
Pleuger	: 4" diameter x 6 stage x 70 Hp x 440 V (for Naic)
Grund Jose	: 3" diameter x 20 stages x 30 Hp x 440 V (for Mendez)

(6) Screen Pipe

MK Continuous V-shaped slot wedge stainless wire wound screen AISI Type 304

ø 150 mm Slot # 60	;	78 m
ø 200 mm Slot # 60	:	96 m
Total	:	174 m

(7) Gravel for Packing

# 10	:	30,800 kg
# 5	:	2,100 kg
Total	:	32,900 kg

## 1.2 HYDROGEOLOGICAL CHARACTERISTICS OF MAIN AQUIFERS

Well structure and geologic columnar section of tanza, Naic and Mendez test wells are presented in Tables 1-6 to 1-8.

Electric logging data are presented in Fig.s 1-5 to 1-8.

Fig.s 1-9 to 1-12 show the pumping test results of each test well.

Table 1-9 shows the hydrological constants obtained from electric logging and pumping test for the four test wells.

According to the results of the four test wells, three aquifers, shown in Table 1-10, were distinguished.

Middle Aquifer is the best aquifer among the three judging from its large specific capacity (Sc) and transmissivity (T), it was deposited at the end of Cavite Slope as alluvial fan conglomerate.

From the fact that conductivity is low in Upper Aquifer and Middle Aquifer but high in Lower Aquifer, groundwater stored in the former two is free and the latter is confined since the pressure holds the dissolved mineral in solution which gave high conductivity values.

Fig.s 1-13 to 1-16 show the relationship between pumping discharge and drawdown obtained from the step-drawdown pumping test for each test well.

Table 1-1 WORK AMOUNT FOR TEST WELL

				T	······	<b></b>
REMARKS		Well site is in a lot for No. 4 well of G.M.A Water District	<ol> <li>Well site is in a private had about 4.6 km south of a lot for the well of Tanza Water District.</li> </ol>	<ol> <li>Well site is in a lot of the elementary school of Naio.</li> </ol>	<ol> <li>Well aits is a private land</li> <li>about 600 m south of a lot for</li> <li>the well of Mandez Water District.</li> </ol>	
EST	SE		<b>944</b>	٦,		4
PUMPING TEST	CONT	• •		1		4
R.	STEP	4	**	4		16
Logging		220	130	150	360	730
Leagth of Electric Logging	Normal Gamma	220	5 <u>1</u> 02	150	290	810
Length of	₿	730	130	150	290	\$10
	19 19	160	130	150	330	750 (174)
Length of Caning (m)	<b>♦</b> 150	( <del>8</del> 8) (88)	ł .	8	<b>6</b> (00)	150 (78)
Longth o	900	8	8 <del>(</del> 8)	90 (48)	500	430 (96)
	957. <b>♦</b>	1	8	80	8	120
	Total	160	130	150	38	750
(m) alodo	+ 320	8	I		8.	150
Leagth of Borchole (m)	<b>\$</b> 350	100	I	· 1	<b>50</b>	300
Leag	♦ 370	1	8	8	I	180
	8 •	I	ୢୖୖୖ	60	I	120
	TEST WELL	*1 A. G.M.A	B. TANZA	C. NAIC	*2 D. Mendez	TOTAL

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\* Figure with parentheses means the total depth of screens.

\*1 The length of the borehole of G.M.A. was designed as 220 m at first but it was changed to 160 m because permeability between 160 m and 220 below GL was estimated low.

\*2 The length of the borehole of Mendez was designed as 230 m at first, but it was changed

to 290 m because the groundwater level was estimated deeper than 100 m below GL.

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WELL NO. LOCATION (G. EL.) WELL CONSTRUCTION DATA	CONTRACTOR (MACHINE)	S	30[31]1]2]3[4]5]6	)	()		0	6 -14 -26 		EE SE			) 68 61		23.47 133.23	
G.M.A., CAVITE WELL NO. A DEPTH: 220 (M.), HOLE DIAMETER 350 mm.		AUGUST S E P T E M B E R O CTOBER								۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲	· · · · · · · · · · · · · · · · · · ·	2.12 2.12 2.12 2.12 2.12 2.12 2.12 2.12			9.36 	
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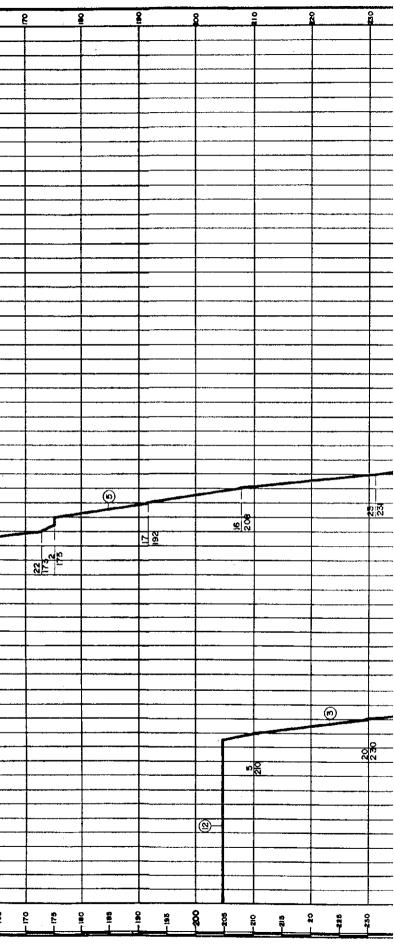
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## Table 1-6(1/2)

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6						54	-	197	1.611	8.10	0.735	14.78
7	- 13.8					55	-	194	2.832	14.24	0.840	16.8
8	- 163					56	-	194	4.742	23.84	0.756	15.20
9	- 413					57	-	198	4.262	21.42	0,964	19.30
10	- 202	2,519	12.66	0.971	19.52	58	-	215	4.338	21.81	1.155	23.2
11	- 182	2.548	12.80	0.971	19.52	59	-	209	3.763	18.91	0.996	20.03
12	- 188	4.091	20.56	1.075	21.61	60	-	20	3,608	18.14	1.057	21.2
13	- 198	7.878	35.60	1.170	23.52	61	-	193	4.465	22.44	0.938	18.80
14	- 195	6.910	34.73	1.415	28.45	62		197	1.465	7.36	0.440	8.8
15	- 218	7.004	35.21	1.692	34.02	63	-	200	1.049	5.27	0.487	9.79
16	- 193	6.060	30.46	1.459	29.33	64	-	212	1.054	5.30	0,462	9.29
17	- 192	2.874	14.45	0.978	19.66	65	-	192	1.060	5,33	0.429	8.6
18	- 187	2.149	10.80	1.009	20.29	66		198	2.438	12.25	0.465	9.3
19	- 188	2.667	13.41	1.038	20.87	67	-	194	2.434	12.23	0.465	9.3
20	- 188	3.862	19.41	0.775	15.58	68	-	195	3.981	20.01	0.50	10.01
21	- 190	2.101	10.56	0.886	17.81	69	-	200	2.390	12.01	0.692	14.0
22	- 214	2.716	13.65	1.015	20.41	70		203	2.350	11.81	0,666	13.3
23	+ 193	3.742	18.81	0.906	18.22	71	-	200	1.639	8.24	0,549	11.0
24	- 197	2,503	12.58	0.931	18.72	72	-	203	1.723	8.66	0.521	10.4
25	- 186	2.655	13.35	1.146	23.04	73	-	221	1.297	6.52	0.498	10.0
26	- 187	4.904	24.65	1.044	20.99	74	-	205	1.786	8.97	0.547	11.00
27	- 193	5.064	25.45	1.241	24.95	75	-	201	3.542	17.80	0.301	6.0.
28	- 184	7.658	38.49	1.551	31.18	76	-	206	0.947	4.76	0.292	5.8
29	- 192	10.330	51.92	1.870	37.60	77	-	207	0.699	3.51	0.347	6.9
30	- 191	11.29	56.75	2.513	50.53	78	-	193	0.666	3.35	0.297	5,9
31	- 191	11.00	55.29	2.811	56.52	79	<u> -</u>	197	0.475	2.39	0.293	5.8
· 32	- 188	10.86	54.59	2.820	56.70	80		198	0.801	4.03	0.270	5.4
33	- 195	9.770	49.11	2.627	52,82	81		197	0,857	4.31	0.291	5.8
34	- 192	6.042	30.37	2.239	45.02	82	-	199	0.858	4.31	0.301	6.0
. 35.	- 186	8.022	40.32	2.573	51.73	83	<u> -</u>	107	0.854	4.29	0.258	5.1
36	- 190	10.86	54.59	2.379	47.83	84	-	99	0.810	4.07	0.270	- 5.4
37	- 190	13.19	66.30	2,858	57.46	85	-	203	0.578	2.91	0.289	5.8
38	- 195	13.15	66.10	2.845	57.20	86	-	21.5	0.967	4.86	0.316	6.3
39	- 202	12.20	61.32	2.539	51.05	87		201	1.287	6.47	0.313	6.2
40	- 193	3.361	16.89	1.327	26.68	88	<u> -</u> _	204	0.627	3,15	0.311	6.2
41	- 207	6.055	30.44	1.563	31.42	89		114	1.065	5.35	0.345	6.9
42	- 203	10.210	51.32	1.303	26.20	90	<u> -</u>	208	1.220	6,13	0.325	6.5
43	- 193	10.820	54.39	1.639	32.95	91	-	100	1.087	5.46	0.341	6.8
44	- 199	2.413	12.13	0.846	17.01	92	<u> -</u>	207	1.272	6.39	0.367	7.3
45	193	1.896	9.53	0.890	17.89	93	~	219	0.757	3.81	0.359	7.2
46	- 190	2.510	12.62	0.844	16.97	94		122	1.325	6,60	0.421	8.4
47	- 192	2.209	11.10	0.630	12.67	95	-	212	1.579	7.94	0.430	8.6
48	- 196	2.016	10.13	0.781	15.70	96	<u> -</u>	209	2.395	12.04	0.433	8.7
49	- 192	2,597	13.05	0.767	15.42	97		209	1.578	7.93	0.613	12.3
50	- 200	3.947	19.84	0.906	18.22	98	<u> -</u>	138	1.723	8.66	0.691	13.8
	- 207	6.137	30.85	0.983	19.76	99	-	206	3.234	16.26	0.617	12.4
52	- 204		33.65	1.213	24.39	100	-  -	207	1.089	5,47	0.298	5.9

LOCATI	TRUCT										i = 150 i	
			=0.4m					SP	Short a	=0.4m	Long a	=1.6
DEPTH	MV	R	4次 aFl			DEPTH		MV	R	4 <i>i</i> TaR	R	45
									ļ. 	· · ·		<b> </b>
101 -	212	0.763	3.84	0.357	7.18	149	-	248	1.548	7.78	0,506	10.
102 -	223	0.807	4.06	0.303	6.09	150		286	0.811	4.08	0.507	10.
103 -	210	0.489	2.46	0.281	5.65				<u> </u>			<u>}                                    </u>
104 -	204	0.555	2.79	0.292	5.87							<b> </b>
105 -	209	0.717	3.60	0.284	5.71				·			<b> </b>
106 -	112	0.760	3.82	0.300	6.03				ļ		<b>_</b>	<b> </b>
107 -	204	0.567	2.85	0.321	6.45			. <u></u>				
108 -	207	1.713	8.61	0.391	7.86	• · ·					<b> </b>	
109 -	206	4.349	21.86	0.447	8.99				ļ			
110 -	102	7.889	39.65	0.746	15.00							<u> </u>
i11 -	217	6.208	31.20	0.878	17.65							<u> </u>
112 -	216	1.891	9.50	1.018	20.47					L	L	ļ
113 -	208	4.027	20.24	1.061	21.33							L
.114 -	219	5.847	29.39	0.890	17.89							<u> </u>
115 -	222	4.217	21.20	1.046	21.03							<u> </u>
116 -	226	5.541	27.85	1.265	25.43							l
117 -	213	5.640	28.35	0.788	15.84							
118 -	214	1,962	9.86	0,503	10.11							]
119 -	117	1.338	6.73	0.382	7.68				·			
120 -	214	0.926	4.65	0.383	7.70						•	T
121 -	217	0.620	3.12	0.370	7.44		_		1			Τ
121	224	1.103	5.54	0.351	7.06				1			
123 -	220	1.470	7.39	0.376	7,52							ŀ
123	229	1.600	8.04	0.370	7.44				1			1
124	223	1.469	7.38	0.415	8.34				1	<u> </u>	<u> </u>	1
125	230	0.939	4.72	0.469	9,43	· · · · · · · · ·			1			1
120 -		1.041	5.23	0.539	10.84							1
<u>├</u>	- 223	3.436	17.27	0.522	10.50				1	1		1-
128 -		h	15.79	0.772	15.52				1			
129 -	- 213	3.142	23.87	0.835	16.79							
130 -	203	4.749 4.449	22.36	0.860	17.29		_					1
131 -	126		7.44	0.617	12.40							<u> </u>
132 -	- 213	1.480 2.341	11.77	0.656	13.19						1	
133	<u>121</u> 131	1.731	8.70	0.529	10.64						t	1
134 - 135 -	- 218	1.741	8.75	0.534	10.74	······		· • · · · ·	<u> </u>	1	1	1
}t	- 212	1.737	8.73	0.517	10.79		-	<u>`</u>		<u>                                      </u>		1
136		1.736	8.73	0.513	10.31	{			·	ļ	1	1
137	- 210 - 212	1.734	8.72	0.506	10.17	<b> </b>						1
138	- 212	1.432	7.20	0.503	10.11	<u> </u>			1	1	1	+
139		t	7.28	0.500	10.05				<u> </u>	· · · · · ·		
140	- 212	1.448		· · · · · · · · · · · · · · · · · · ·					- <u> </u>			
141	- 219	1.465	7.36	0.506	10.17 10.13	+			-			+
142	- 122	1.471	7,39	0.504		<u>+</u>			- <u> </u>	<u> </u>	<b> </b>	+
143	- 222	1.033	5.19	0.505	10.15	<b> </b>			<u> </u>	· [ · · · · · · · · · · · · · · · · · ·	+	
144	- 25	1.679	8.44	1.494	30.04	<u> </u>		·····	<b></b>	<u> </u>		
145	- 216	0.520	2.61	1.548	31.12	ļ		····				<b></b>
146	214	1.512		0.509	10.23	<b>_</b>						+
147	- 22.5	1.520	7.64	0.506	10.17	I	L		1	I	1	<u></u>

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WELL	STRUC	TURE A	AND GE		C COL	• •	-	SECTIO	N OF	NAIC '	TEST V	VELL
	ION: NAI					EL 10.4					= 150 r	
	SP		=0.26 n	<u></u>	······			SP	Short a	=0.26m	Long a	=1.02m
DEPTH			4πaR			DEPTH		MV	R	4 / aR	R	4 <i>[</i> [ aR
4	- 240	1.30	4.25	0.75	9.61	52	-	195	1.38	4.51	1.06	13.59
5	- 45	9.64	31.50	3.28	42.04	53	-	205	1.29	4.21	0.99	12.69
• 6	- 140	1.96	6.40	1.00	12.82	54	-	203	1.28	4.18	0.99	12.69
7	- 180	1.23	4.02	0.76	9.74	55	-	194	1.29	4.21	1.00	12.82
8	- 220	1.35	4,41	0.83	10.64	56	-	187	1.24	4.05	1.03	13.20
. 9	- 183	1.38	4.51	0.87	11.15	57		191	1.13	3.69	1.00	12.82
10	- 205	1.36	4.44	0.89	11.41	58	-	204	1.26	4.11	0.97	12.43
11	- '211	1.36	4.44	0.80	10.25	59	-	204	1.18	3.86	0.96	12.30
12	- 198	0.93	3.04	0.63	8.08	60	-	198	0.93	3.04	0.93	11.92
13	- 197	0.63	2.06	0.51	6.54	61		182	1.03	3.37	0.96	12.30
14	~ 154	0.93	3.04	0.69	8.84	62	-	181	1.03	3.37	1.00	12.82
15	- 201	1.31	4.28	1.02	13.07	63	-	181	1.10	3.59	1.06	13.59
16	- 203	0.99	3.28	0.63	8.08	. 64		[83	1.06	3.46	1.02	13.07
17	- 217	0.82	2.69	0.55	7.50	65		183	0.98	3.20	0.90	11.54
18	- 200	0.76	2.48	0.54	6.92	66		186	0.91	2.97	0.84	10.77
19	- 202	1.29	4.21	0.82	10.51	67		193	0.86	2.81	0.76	9.74
20	- 165	2.69	8.79	1.52	19.48	68		198	0.84	2.74	0.78	10.00
21	+ 203	7.39	24.15	2.42	31.02	69	-	205	0.61	1.99	0.69	8.84
22	- 202	8.36	27.31	2.84	36.40	70	-	218	0.35	1.14	0.51	6.54
23	- 220	1.28	4.17	0.73	<u>9</u> .36	71	-	200	0.31	1.01	0.46	5.90
24	- 198	1.23	4.18	0.75	9.61	72		200	0.30	0.98	0.35	4.49
25	- 203	1.33	4.35	0.80	10.25	73		196	0.30	0.98	0.34	4.36
26	- 202	1.47	4.80	0.97	12.43	74		184	0.27	0.88	0.31	3.97
27	202	1.47	4.80	1.00	12.82	75		213	0.27	0,88	0.31	3.97
28	- 204	1.32	4.31	0.83	10.64	76		218	0.38	1.24	0.34	4.36
29	- 200	0.93	3.04	0.50	6.41	77		221	0.27	0.88	0.31	3.97
30	- 201	1.09	3.56	0.56	7.18	78	-	219	0.26	0.85	0.31	3.97
31	- 197	1.09	3.56	0.56	7.18	79		232	0.17	0.56	0.37	4.74
32	- 186	1.12	3.66	0.71	9.10	80		223	1.10	3.59	0.56	7.18
33	- 163	1.25	4.02	0.80	10.25	81		200	1.15	3.76	0,77	9.87
34	- 157	1.12	3,60	0.71	9.10	82		157	1.70	5.55	1.02	13.70
35	- 104	1.29	4.21	0.85	10.90	83	-	220	0.87	2.84	0.60	7.69
36	- 156	1.34	4.38	0.89	11.41	. 84		238	0.73	2.39	0.54	6.92
37	- 155	1.55	5.06	1.28	16.41	85	-	237	0.69	2.25	0.46	5.90
38	- 158	1.57	5.13	1.28	16.41	86		232	0.87	2.84	0,49	6.28
39	- 163	1.52	4.90	1.24	15.89	87		236	0.73	2.39	0.56	7.18
40	- 172	1.15	3.76	0.88	11.28	88		23.5	0.74	2.42	0.68	8.72
41	- 154	1.29	4.21	0.99	12.69	89		203	0.94	3.07	0.74	9.49
42	- 123	1.23	4.20	0.95	12.18	90		220	0.95	3,10	0.78	10.00
43	~ 159	1.50	4.90	1.15	14.74	91		222	0.96	3.14	0.82	10.51
44	178	1.00	3.27	0.77	9.87	92		224	0.98	3.20	0.85	10.90
45	- 186	0.91	2.97	0.74	9.49	93		216	1.25	4.08	1.00	12,82
46	~ 186	1.46	4.77	1.06	13.59	94		201	1.25	4.08	0.99	12.69
47	- 164	1.86	6.08	1.42	18.20	95		162	1.44	4.70	-1.04	13.33
48	- 95	1.81	5.91	1.38	17.69	96		179	1.36	4.44	0.99	12.69
49	- 157	1.69	5.52	1.29	16.53	97		203	0.64	2.09	0.65	8.33
50	- 172	1.57	5.13	1.20	15.38	98		216	0.87	2.84	0,49	6.28
51	188	1.56	5.10	1.21	15.51	99		218	0.30	0,98	0.45	5.77

Table 1-7(1/2)

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	STRUCT				NO. C	Ft 10 4	3 m		DEPTH	= 150	m
LOCAT	ON: NAI	Chorte	=0.26m				SP	Short a	=.26m		
			≠0.20m 4 /( aR		4 /7 aR		MV	R	4 /CaR	R	4 /( aR
DEPTH	MV_	<u> </u>	4 /( an		4 Je ari						
	207	0.53	1.73	0.41	5.26	148	- 303	0.42	1.37	0.32	4,10
100	- 207	0.53	1.73	0.41	5.26	149	- 316	0.42	1.37	0.32	4.10
101	- 206	0.55	1.73	0.45	5.77	150	- 320	0.40	0.31	0.31	3.97
102	- 205		2.88	0.45	8.20			1			
103	- 207	0.88	3.00	0.71	9.10	······································		1			
104	- 206 - 198	1.23	4.02	0.91	11.66						
105	- 184	1.19	3.89	0.88	11.28						
106	- 184	1.19	4.02	0.91	11.66			1			
107	- 119	1.41	4.61	1.06	12.59			1			
108		2.39	7.81	1.62	20.76						
109	- 161 - 202	4.73	15.45	2.04	16.15						
110	- <u>202</u> - 198	5.53	18.07	2,37	30.38			1			
111		1.34	4.38	1.10	14.10						
112	- 216 - 213	1.34	4.12	0.97	12.43						
113		1.15	3.76	0.93	11.92						
114			4,57	0.99	12.69						
115	- 216	1.40	4.41	0.94	12.05		. <u></u>		<u></u>		
116	- 215	1.35	4.41	0.93	11.92		,		·		
117	- 230	1.33	2.88	0.66	8.46					1	
118	- 234	0.80	1.93	0.52	6.67				· · · · · · · · · · · · · · · · · · ·	· ·	
119	- 233 - 238	0.59	2.45	0.56	7.18					1	
120	- 237	0.86	2.81	0.64	8.20			1			2
121		1.29	4.21	0.96	12.30						
. 122		2.01	6.57	1.49	19.10			-			
123	- <u>235</u> - 195	3.20	98.70	2.33	29.87			-			
124	- 143	6.50	21.34	3.39	43.45						
125	- <u>143</u> - 62	8.27	27.02	4.01	51.40						
	- 02	8.36	27.31	4.07	52.17			+			
127	- <u>134</u> - 210	7.20	ł	3.64	46.66						
128		4.83	15,78	2.76							
129		1.39	4.54	0.86							
130	- 235	1.22		0.75	9.61		1				
131	- 214	1.12		0.69							
132	- 240			1.11	14.23	1					
133		1.29		0.94	-						
135				0.86							
135				0.79							
130				0.82	·   ·····						
137	+			1			1				
139											
140											
140				-							ļ
[42											
143	·										
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144							-		-	1	
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146	- 302				-{			-+			1

	RUCT	ENDEZ		WELL		EL. 5				DEPTH		
OCAH		Short a	-0.26m							=0.26m		
	SP		4/( ₂R		4 /( #R			MV		4/ .R	R	4/( =R
DEPTH	MV Guide	Casing Pi			• 1	80.5	-	8.1	4.12	13.46	2.33	29.87
	ary Guioe			[]		81.5	-	4.8	3.74	12.22	2.22	28.46
33.5						82.5	-	2.5	3.04	9.93	1.76	22.56
34.5 35.5		+				83.5		1.9	2.67	8.72	1.80	23.07
36.5	- 3.8	4.25	13.89	1.90	24.35	84.5		2.1	3,80	11.11	1.88	24.10
37.5	- 3.3	4.93	16.10	2.52	32.30	85.5	_	2.2	4.46	14.57	2.35	30.12
38.5	- 3.0		14.57	2.58	33.07	86.5		2.8	5.70	18.62	2.98	38.19
39.5	- 5.5	4.16	13.59	2.37	30.38	87.5	_	2.9	6.75	22.05	3.42	43.34
40.5	- 4.0		12.48	2.27	29.10	88.5		4.6	6.88	22.48	4.08	52.30
41.5	- 3.8	3.79	12.38	2.23	28.58	89.5	-	7.5	8.79	28.72	4.67	59.86
42.5	- 3.5	4.20	13.72	2.22	28.46	90.5	-	15.6	9.75	31.86	5.63	72.16
43.5	- 3.2	+	12.09	1.83	23.46	91.5	-	6.1	10.16	33.20	6.04	77.42
44.5			6.14	1.35	17.30	92.5	-	4.0	10.38	33.91	4.10	52.55
45.5	- 8.4		5.85	1.22	15.64	93.5	-	9.9	9.98	32.61	5.71	73.19
46.5	- 5.1	2.80	9.15	1.45	18.59	94.5	-	4.2	8.81	28.78	5.08	65.11
47.5	- 3.3		16.17	2.55	32.69	95.5	-	1.7	8.63	28.19	4.14	53.07
48.5	- 4.9	+	19.24	3.20	41.01	96.5	-	3.2	4.14	13.53	2.65	33.97
49.5	- 7.2	+	20.91	3.69	47.30	97.5	-	3.6	3.16	10.32	2.10	26.92
50.5	- 8.0	+	21.07	4.00	51.27	98.5	-	3.7	2.79	9.12	1.90	24.35
51.5	- 10.6	+	21.89	4.10	52.55	99.5	-	3.9	3.63	11.86	2.10	26.92
52.5	- 13.2		22.94	4.22	54.09	100.5	-	5.1	5.79	18.92	2.84	36.80
53.5	- 14.1	7.41	24,21	4.24	54.35	101.5	-	5.3	10.88	35.55	4.65	59.60
54.5	- 6.4	6.63	21.66	3.62	46.40	102.5	-	9.8	8.96	29.27	4.82	61.78
55.5		3.21	10.49	2.16	27.69	103.5		4.0	8.33	20.68	3.94	50.50
56.5		2.88	9.41	1.84	23.58	104.5		5.2	5.84	19.08	3.58	49.35
57.5	- 7.3	2.95	9.68	1.79	23.94	105.5		2.3	6.33	20.68	3.35	42.94
58.5	- 4.7	2.49	8.14	1.47	18.84	106.5	-	2.0	4.10	13.40	2.72	34.86
59.5	- 4.8	1.95	6.37	1.37	17.56	107.5	-	3.2	4.19	13.69	2.98	38.20
60.5	- 4.6	2,84	9.28	1.57	20.13	108.5	-	12.3	7.40	24.18	3.29	42.17
61.5	- 5.8	5.25	7.15	2.53	32.43	109.5	<u> </u>	14.3	8.68	28.36	4.63	59.34
62.5	- 11.7	,6.88	22.48	4.00	51.27	110.5	-	12.1	9.60	31,37	5,10	65.37
63.5	- 12.0	6.33	20.68	4.04	51.78	111.5		4.3	10.39	33.95	5.71	73.19-
64.5	- 8.0	5.56	18.17	3.71	47.55	112.5	-	4.3	9.53	31.14	5,23	67.04
65.5	- 8.3	5.86	19.15	3.80	48.71	113.5	-	7.4	8.17	26.69	4.83	61.91
66,5	- 7.6	6.18	20.19	4.00	51.27	114.5	-	4.5	7.47	24.41	5.35	68.57
67.5	- 2.5	5.11	16.70	3.35	42.94	115.5		1.8	3.44	11.24	2.13	27.30
68.5	- 3.4	4.31	14.08	3.06	39.22	116.5		2.0	3.41	11.14	1.36	17.43
69.5	- 2.1	4.41	9.51	2.67	34.22	117.5		4.2	3.58	11.70	1.83	23.46
70.5	- 2.	3.82	12.48	2.16	27.68	118.5		2.6	2.38	7.78	1.83	23.46
71.5	- 1.8	2.05	6.70	1.43	18.33	119.5		2.8	2.90	9.48	1.85	23.71
72.5	- 2.2	1.95	6.37	1.31	16.79	120.5		5.7	4,79	15.63	2.25	28.84
73.5	- 2.2	2 1.85	6.04	1.22	15.64	121.5	-	2.5	5.45	17.81	2.98	38,20
74.5	- 2.1	5 1.96	6.40	1.24	15.89	122.5	┠-	8.1	7.53 6.83	24.60	3.15	40.38
75.5	- 2.	1.74	5.69	1.22	15.64	123.5		16.3		22.32	3.79	48.58
76.5	- 2.	1.70	5.55	1.16	14.87			10.0	7.78	25.42	3.98	51.01
77.5	- 2.0	2.26	7,38	1.39	17.82	·		5.9	6.61	21.60	3.68	47.14
78.5	- 2.0	) 4.12	13.46	1.67	21.41	126.5	1_	7.8	6.12	· 20.00	4.68	59.99

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LL STR	UCTUR	E AND	GEOI	OGIC	COLU	MNAR	S	ECTIC	ON OF	MEND	EZ TE	ST WE
LOCATI	ION: MI	ENDEZ							· ·			
	SP		-0.26m	Long a-	-(.02m		 	SP		=0.26m		
DEPTH	MV	R	4Л aR	R	4 (aR	DEPTH		MV	R	417 aR	R	4 A aR
							L					
128.5	- 8.3	7.28	23.79	4.26	54.60	176.5		11.0	12.19	39.83	6,51	83.44
129.5		9.53	31.14	5.00	64.09	177.5	-	9.8	10.31	33.69	7.00	89.72
130.5		9.47	30.94	5.42	69.47	178.5	-	8.7	9.81	32.05	5.23	67.04
		9.79	31.99	5.55	71.14	179.5	-	10.5	9.41	30.74	6.50	83.32
131.5		10.03	32.77	5.85	74.98	180.5	<u> </u>	1.8	2.39	7.81	1.49	19.10
132.5	- 11.3	ł	<u>}</u> '	6.15	78.83	181.5	<b> </b> _	2.5	1.60	5.23	1.35	17.30
133.5	- 12.1	10.81	35.32	6.4.5	82.67	182.5	┢──	2.6	1.87	6.11	1.28	16.41
134.5	1	11.34	37.05		87.29	183.5		2.5	5.15	16.83	1.67	21.41
135.5	- 16.2	11.79	38.52	6.81			┟──	2.4	9.68	31.63	5.27	67.55
136.5	- 14.3	12.57	41.07	7.26	93.06	184.5	┢──		12.85	41.93	6.62	84.85
137.5	- 12.4	13.57	44.34	7.77	99.59	185.5		2.0			9.61	123.18
138.5	- 10.0	13.97	45.64	8.09	103.70	186.5		2.4	21.89	71.52		162.14
139.5	- 10.0	14.56	47.57	8.53	109.33	187.5		2.4	22.02	71.94	12.65	174.45
140.5	- 10.2	15.09	49.30	8,91	114.21	188.5		3.8	23.17	75.70	13.61	
141.5	- 10.7	15.69	51.26	9.32	119.46	189.5	ļ	4.3	25.68	83.90	14.31	183.42
142.5	- 12.0	16.00	52.28	9.47	121.38	190.5		7.9	23.26	76.00	13.55	173.63
143.5	- 11.1	15.71	51.33	9.33	119.59	191.5		2.2	18.22	59.53	10.44	133.82
144.5	- 9.8	14.97	48.91	9.02	115.62	192.5		2.1	12.44	40.64	5.02	64.34
145.5	- 10.4	14.72	48.09	8.78	112.54	193.5		2.5	5.90	19.28	2.96	37.94
146.5	- 11.7	14.78	48.29	8.74	112.03	194.5		2.7	2.59	8.46	1.86	23.84
147.5	·		49.79	9.02	115.62	195.5	1	2.1	2.75	8.98	1.63	20.89
148.5		15.14	49.47	9.08	116.38	196.5	1	2.0	2.72	8.89	1.74	22.30
		14.53	47.47	8.59	110.10	197.5	1	1.9	2.53	8.27	1.75	22.43
149.5	· · · · · · · · · · · · · · · · · · ·		43.98	7.89	101.13	198.5		2.0	2.72	8.89	1.84	23.58
150.5		13.46	· • · · · · · · · · · · · · · · · · · ·	5.31	68.06	199.5	-[	2.4	3.03	9.90	1.93	24.74
151.5	+		33.62		52.94	200.5	╞─	3.0	3.15	10.29	2.02	25.89
152.5		5.93	19.37	4.13			┢	2.4	2.68	8.76	1.51	19.35
153.5			32.21	4.52	57.94	201.5		3.1	1.75	5.72	1.53	19.61
154.5	- 9.2		37.05	6.04	77.42	202.5				5,52	1.40	17.94
155.5		**************************************	39.21	6.65	85.24	203.5		3.3	1.69			20.89
156.5	- 10.0	12.14	39.66	6.83	87.54	204.5		2.7	3.25	7.35	1.63	<b> </b>
157.5	- 10.1	12.15	39.70	6.96	89.21	205.5		2.1	4.38	14.31	2.25	28.94
158.5	- 7.6	12.41	40.55	7.11	91.13	206.5		1.9	5.95	19.44	3.18	40.76
159.5	7.4	12.26	40.06	7.11	91.13	207.5		2.0	8.83	28.85	4.00	51.27
160.5	- 7.0	11.41	37.28	6.60	84.60	208.5	1	2.1	8.83	27.38	4.66	59.73
161.5	- 7.2	11.12	36.33	6.42	82.29	209.5		2.5	10.75	35.12	5.86	75.11
162.5	- 9.0	11.42	37.31	6.45	82.67	210.5		4.2	8.02	26.20	6.64	85.11
163.5	- 8.1	11.58	37.83	6.72	86.13	211.5		16.3	15.37	50.22	8.89	113.95
164.5		11.98	39.14	6.81	87.29	212.5		4,4	14.97	48.91	8.35	107.03
165.5		12.12	39.60	6.96	89.21	213.5		2.8	6.95	22.71	4.54	58.19
166.5				7.17	91.90	214.5	Τ	1.9	4.90	16.01	3.88	49.73
167.5	·· +					215.5	1	2.0	6.27	20.49	4.15	53.19
	╺-┞╍────					216.5	-	2.6	10.19	33.29	5.85	74.98
168.5							-1-	2,9	<u></u>		8.27	106.00
169.5		·•••						3.4				
170.5	***	***										
171.5							-+	8.5				
172.5			- <del> </del> /			220.5		19.7			·	
173.5	- 13.8	13.50	44.11	7.65			-+	4,3				38.20
174.5	- 13.9	13.12	42.87	7,70	98.70	-	~/~	3.8			·	38.20
175.5	- 12.7	13.72	44.83	7.54	96.65	223.5		3.7	4.01	13.10	3.02	38.70

Table 1-8(2/3)

WELL STRUCTURE AND GEOLOGIC COLUMNAR SECTION OF MENDEZ TEST WELL

	ON: MI		0.04	Lancis	_1 02	[ ]	SP	Short e	-0.26m	Long a	=1.02m
			=0.26m	Long a	=1.02m	DEDETIT			4 / aR	R	4 /( aR
DEPTH	MV	<u>R</u>	4 <i>1</i> [ aR	R	47 ak	DEPTH	MV	R	4 <u>(</u> al	<u> </u>	<u>- 11 - 11</u>
		3.98	13.00	3,13	40.12	4.0	9.9	7.59	24.80	5.60	76.91
224.5	3.5	4.29	14.02	3.39	43.45	6.2	6.3	7.16	23.39	4.54	58.19
225.5 226.5	3.2	7.28	23.79	4.27	54.73	5.5	5.0	7.36	24.05	4.96	63.58
220.5	3.9	12.68	41.43	6.67	85.49	4.8	5.3	9.75	31.85	5.86	75.11
228.5	3.9	14.23	46.49	8.56	109.72	5.7	8.3	11.69	38.19	7.88	101.00
229.5	7.8	15.83	51.72	9.65	122.54	5.1	22.5	11.70	38.23	8.80	112.80
230.5	9.9	15.88	51.88	10.13	129.84	5.4	24.1	12.25	40.02	8.88	113.82
230.5	6.5	16.66	54.43	10.51	134.71	10.2	14.2	12.41	40.55	8.81	112.92
232.5	7.0	18.12	59.20	11.29	144.71	6.6	10.1	12.18	39.80	8.63	110.62
233.5	6.5	21.05	68.75	11.93	152.91	1.5	6.1	9.49	31.01	5.36	68,70
234.5	19.8	14.03	45.84	9.27	118.82	1.0	6.3	4.96	16.21	4.22	54.09
235.5	5.7	12.86	48.02	7.69	98.57	1.1	3.7	4.38	14.31	3.53	45.25
236.5	2.1	3.95	12.91	3.17	40.63	0.8	4.1	4.87	15.91	3.66	46.91
237.5	- 1.2	1.84	6.01	2.14	27.43	1.5	4.3	4.43	14.47	3.86	49.48
238.5	- 2.2	1.90	6.20	1.92	24.61	2.3	4.2	3.64	11.89	3.78	48.43
239.5	- 2.3	1.90	6.20	2.18	27.94	2.7	······································				
240.5	- 2.6	2.05	6.70	2.15	27.56	4.2					<u> </u>
241.5	- 2.3	2.19	7.16	1.84	23.58	5.2					
242.5	- 2.0	3.76	12.28	1.47	18.84	6.2					
243.5	- 1.8	1.63	5.33	. 1.40	17.94						
244.5	- 1.9	2.25	7.35	1.65	21.15						
245.5	- 1.9	6.59	21.53	2.70	34.61						L
246.5	0.0	5.37	17.55	3.30	42.30						L
247.5		2.62	8.56	2.26	28.97		_				
248.5		5.52	18.04	2.29	29.35					I	
249.5	3.6	7.48	24.44	4.45	57.04						ļ
250.5	4.0	8.73	28.52	5.84	74.98					ļ	<u> </u>
251.5	4.8	10.62	34.70	7.15	91.64				 	ļ	L
252.5	4.6	11.08	36.20	7.96	102.03				ļ		ļ
253.5	4.9	11.63	38.00	8.50	108.95						
254.5	12.4	11.60	37.90	8.59	110.10	·	L	· · ·	ļ		ļ
255.5	10.0	11.48	37.51	8.67	111.13			••••	ļ	ļ	<b></b>
256.5	4,3	10.19	33.29	7.79	99.85						ļ
257.5	4.0	9.22	30.12	6.66	85.36			ļ	ļ	ļ	
258,5	1.8	3.37	110.10	3.84	49.22	<u> </u>		ļ	<u> </u>		<b> </b>
259.5	0.7	2.88	9.41	2.77	35.51	ļ	<del></del>	ļ	· · · · · · · · · · · · · · · · · · ·	<b> </b>	╀
260.5	- 4.0	2.85	9.31	2.10	26.92	ļ		ļ			┨
261.5	- 4.0	3.94	12.87	2.05	26.28			<u> </u>	ļ	┨────	
262.5	- 4.2	4.34	14.18	2.33	29.87	l		ļ			.
263.5	- 2.1	5.31	17.35	2.82	36.15			<b> </b>	<u> .                                    </u>		·
264.5	- 1.2	6,44	21.04	3.19				<b> </b>		–−−	·}
265.5	+ 1.8	5.03	16.43	3.81	48.84	<u> </u>	ļ				<u> </u>
266.5	3.0	5.02	16.40	3.33	42.68				<b> </b>	<u> </u>	<u> </u>
267.5	4.3	3.97	12.97	2.82	36.15	<b>_</b>		<b> </b>		┨────	<u> </u>
268.5	4.3	3.95	12.91	2.60	33.33	<b></b>			ļ	<b> </b>	<b> </b>
269.5	4.7	6.32	20.68	3.05	39.09						<b> </b>
270.5	4,4	9.35	30.55	4.00	51.27	<u> </u>		┟───		<b> </b> -	
271.5	4.0	9.53	31.44	5.37	68.83	L	l		<u> </u>	L	L

Table 1-8(3/3)

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WELL STRUCTURE AND GEOLOGIC COLUMNAR SECTION OF MENDEZ TEST WELL

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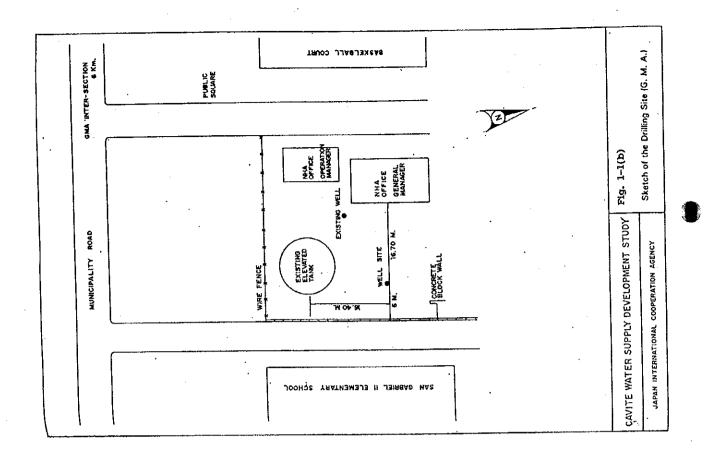
Table 1-9 DETAILS OF TEST WELLS.

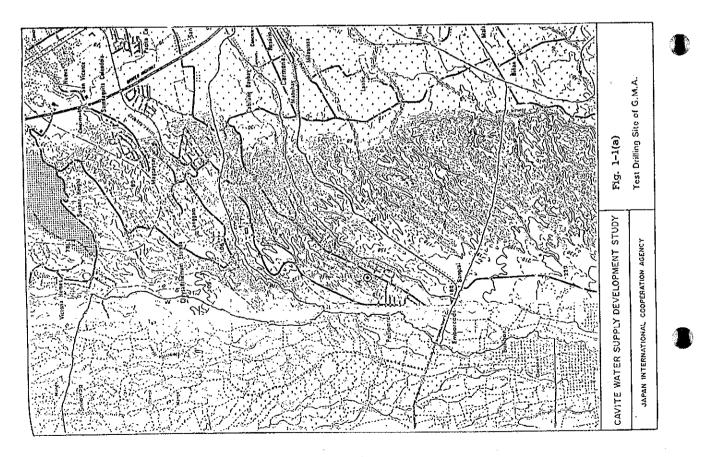
	Remitivity Stratigraphic	Horzon				30~50 Kaybubutong	Formation	(lower)		Kaybubutong	Formation	(IBMOT)		Formation								Talisay Formation				· · · · ·		1	E-restion				
₹	le intivity	(=-mqo)				30~50		20~30 (lower)		Ş	20~60				202.40					_ <del></del>		30~50											
WELL LOGGING DATA		Aquifer	-			Scoria tuff	~C.S.S	(Scoria rich)		(Upper)	Conglomerate ?	~ CITVELY		(Lower) Gamelly		~Pumice tuff				MSS	~ FSS	510 (scoria rich)						Scona tuff	~ Volcanic	congromerate			
VELLI	Cond.	(S/CE)					370					57	Ş									510											
		<u> </u>					26.5					- v										30.2								_			
		e	<u> </u>				34.00						CK.CC								•	22.20											
	CONSTANT DESCHARGE TEST	9	(1/2/10)				1.07						3									1.05											
DATA	TANT DIS	Drawd					1.62					200	00.6	. <u>.</u>								36.38											_
TEST	CONS	c	_	<del></del> -			1.74				_ ,, ,		1.76 14.54									1.08 33.08											
PUMPING TEST DATA	TEST	3	(m/m)	<u> </u>			1.18						1.76									1.03							0.65				
	NWOOTW						1.59						19.43									33.20							12.60		• ,		
	STEP DRAWDOWN TEST	1					1.88				<u>.</u>		34.10							_		36.00							8.24				
			GL-m				99.45						10.45									6.26					_		284 112.19				
		16		154	(Total 48 m)				<u></u> , <b>u</b> -	84	102	_		144		(Total 45 m)	•					128		(Total 48 m)		221					(Total 30 m)		
RE	Screen			106	Total							<b>_</b>	126	138		Ê		L	;	L		120	L	Ê	+-	218			ـــ		Ů	<del>-</del>	
WELL STRUCTURE	с,		+ 10r (mm) GL-m	130							ន្ត	Ř	8	+		-		╇	ŝ	38	1	3 8 -			8	Ĩ			4-	L		<b>.</b>	0
LL STI			¢ (88)				Ş		150	+-			87	╇			200	+			_	22		š.	<u>'</u>	<b></b> .		0 200	+-				270 150
WE	į	5	100 100 100				ş	3	5	3			8				9					8		9				200	Ļ				
		9	¢ [				Ş	252	100	2			400				ş	Ş				<b>Ş</b>		170	+			ş					320
		Dorebole	Ωeh Γ	1				3	200	777			Ş				9	3				ଞ		Ş	3			ş					280
z	Ground	Tere Level	<u>.</u>			<del>.</del>	1	163.65			_		20 63									5.40					<del></del> .	69 W				<b></b> .	
LOCATION		Site 1						GMA					TAN73	5	•		_					NAIC						Versine7					
F	ـــــل ئــــــ	ż.						<					P	_								U			1				<u>}</u>				

Table 1-10 CLASSIFICATION OF AQUIFERS DISTINGUISHED IN THE STUDY AREA •

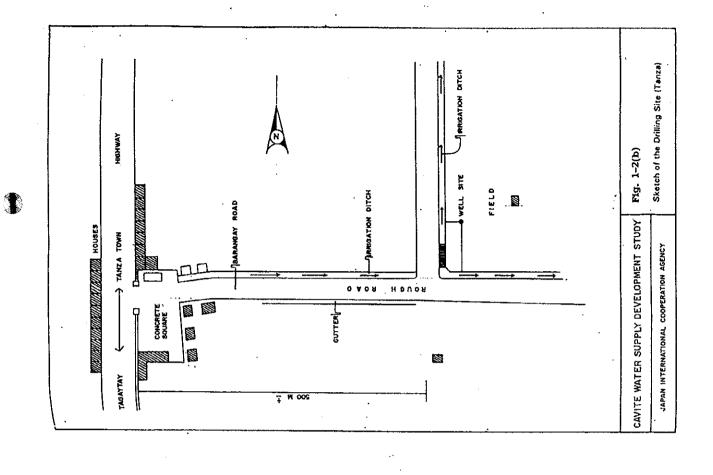
Scoria, Tuff, Volcanic
Conglomerate ~ Coarse sand
Coarse sandstone with gravel ~ Medium Sandstone

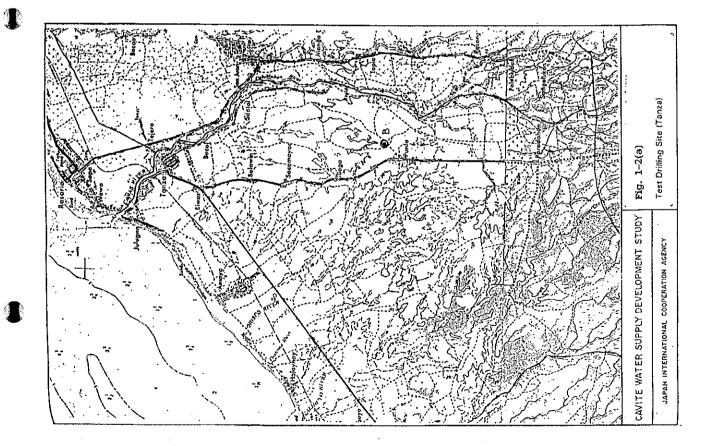
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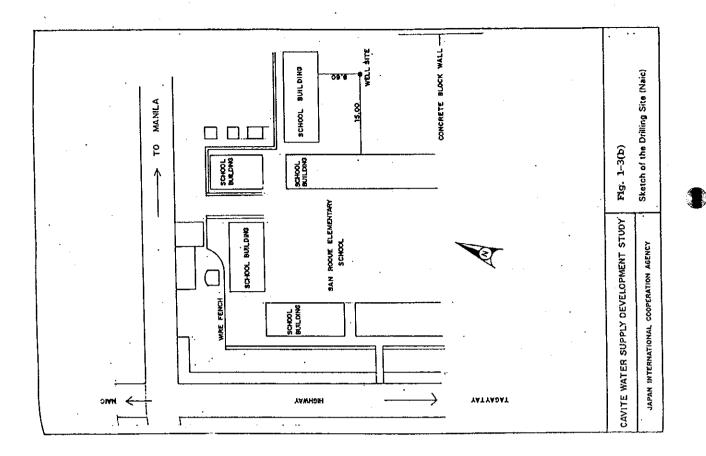


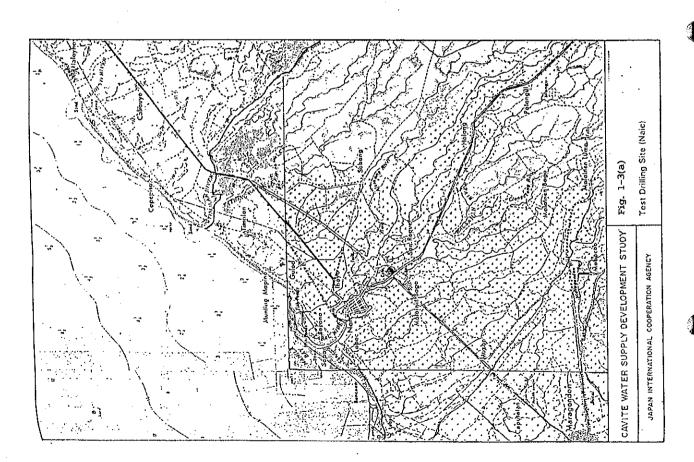


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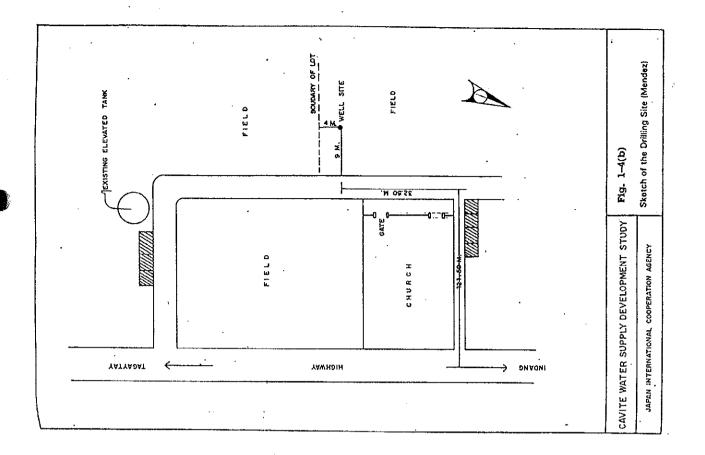


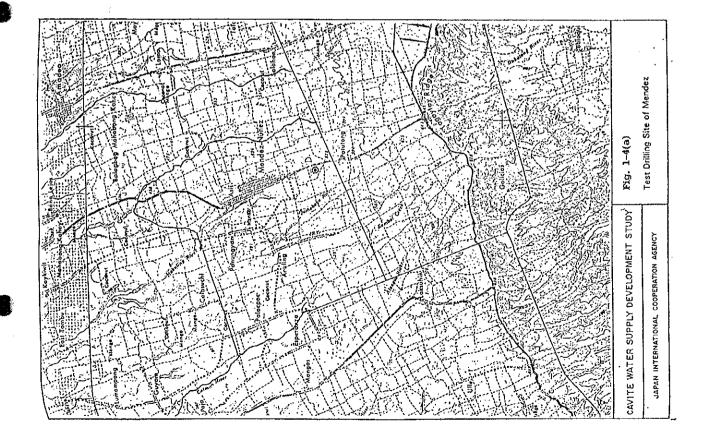






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CASING PIPE : STEEL Ø 200mm. 100m.; SCREEN : STAINLESS STEEL & BOM 48m E N 8 20 ្ន 2 8 8 2 ទ 2 Q 8 30 Ŷ ŝ 5 80 8 ŝ 2 99.45m. NUMBER OF DAYS: 38 DAYS BEND BEOMM STEEL CASING PIPE, L=6M. X IPC. =6M. SAND TRAP WITH BOTTOM PLUG ØBOMM WELL SCREEN WRE ROUND STAINLESS STEEL SLOT NO.60 L 3M. X BPCS. • 48 m. ØI50mm STEEL CASING PPE, L=6m.x1PC=6m. @200mm STEEL CASING PIPE L=6m x 17 PCS.=102m (PUMP HOUSING) GRAVEL NO.10+70% B NO. 5-30% T= 704m CASING CENTRALIZER AT EVERY I2 m. WITH CLAY WITH CLAY CASING CENTRALIZI AT EVERY 18 m. **0320 mm BOREHOLE** GROUT - 6200mm x 6150n COARSE SAND Ē EMENT 4 WELL DESIGN IO mm., 2.5 m.~ NORMAL WATER LEVEL = G.L. -n A Straight of the second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon YEAR 5 mm.~ U C U U U U ALCONT. **XXX** S XXXXX DAY 03 5 BLEND ( YEAR TO: MONTH '94 DATE: OCTOBER GAMMA CPS mine my many and many many many where we want where we want the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of th + SLOT NO. 60 (1,524 mm.); GRAVEL: # 10 8-DAY 27 <del>6</del>-E 10 20 30 4 163.65 m. DURATION : FROM : MONTH ۲ 160 m. ; λĹ Ś ~. / . . . . . / -Aurona -Ė DEPTH: s S Ц G.M.A.,CAVITE BLACK BROWN 5.00 YELLOW 1.50 BROWN 1.50 9.00 3.00 8 88 COLOR TO 3.00 3.00 20 6.00 1.50 8 8 8 8 8 8 8 8 8 88 4 N CONSTRUCTION DATA 8 8 8 Č C 8 ğ 8 8 8 REDISH BROWN DARK MNCH GRA -DO-BROWN GRAY NACE N ACK GRAY BROWNESH GRAY BLACK BROWN BROWN BLACK BROWN DARK DARK YELLOW BROWNSS GRAY BROWNSS FRAY PELLOW BLACK BLACK BLACK BLACK BROWN CARK BROWNISH GRAX DARK BROWNE GRAY BL.ACK BROWN BROWNES 64 BLACK DARK BROWNISH GRAY - DO -DARK BROWN BROWN PALE ģ BLACK GRAY DARX BROWNI GRAY BLACK DARK BROWNE GRAY BLACK NAC POMATE SAND FORMELES AND FORMELES AND FORMELES AND MIX 5-X. MEDICASTIC FLOW MEDICASTIC FLOW MEDICASTIC FLOW MEDICASTIC SAND MEDICASTIC SAND PUMATE MIX 5-X. RECOMMELEMIX 5-X. 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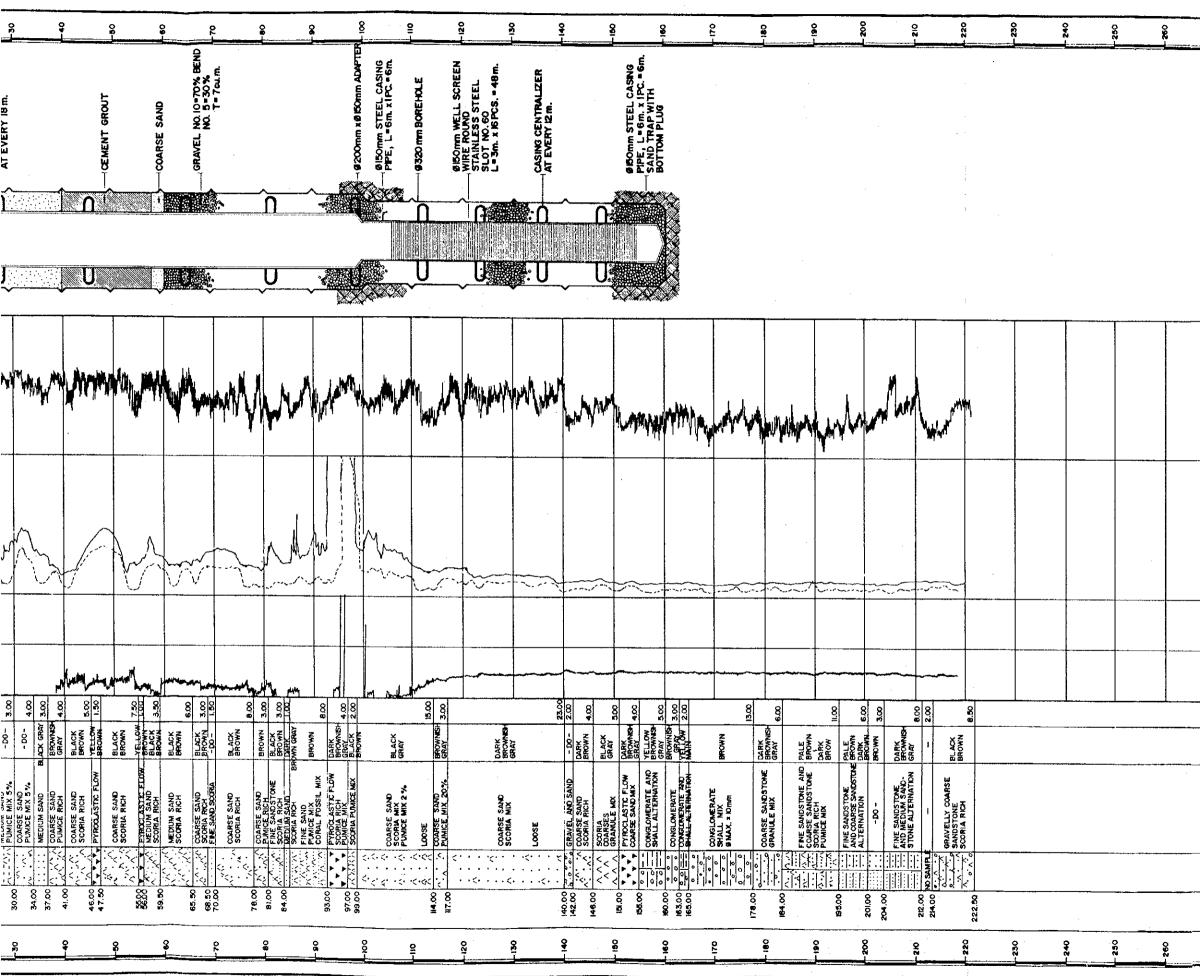
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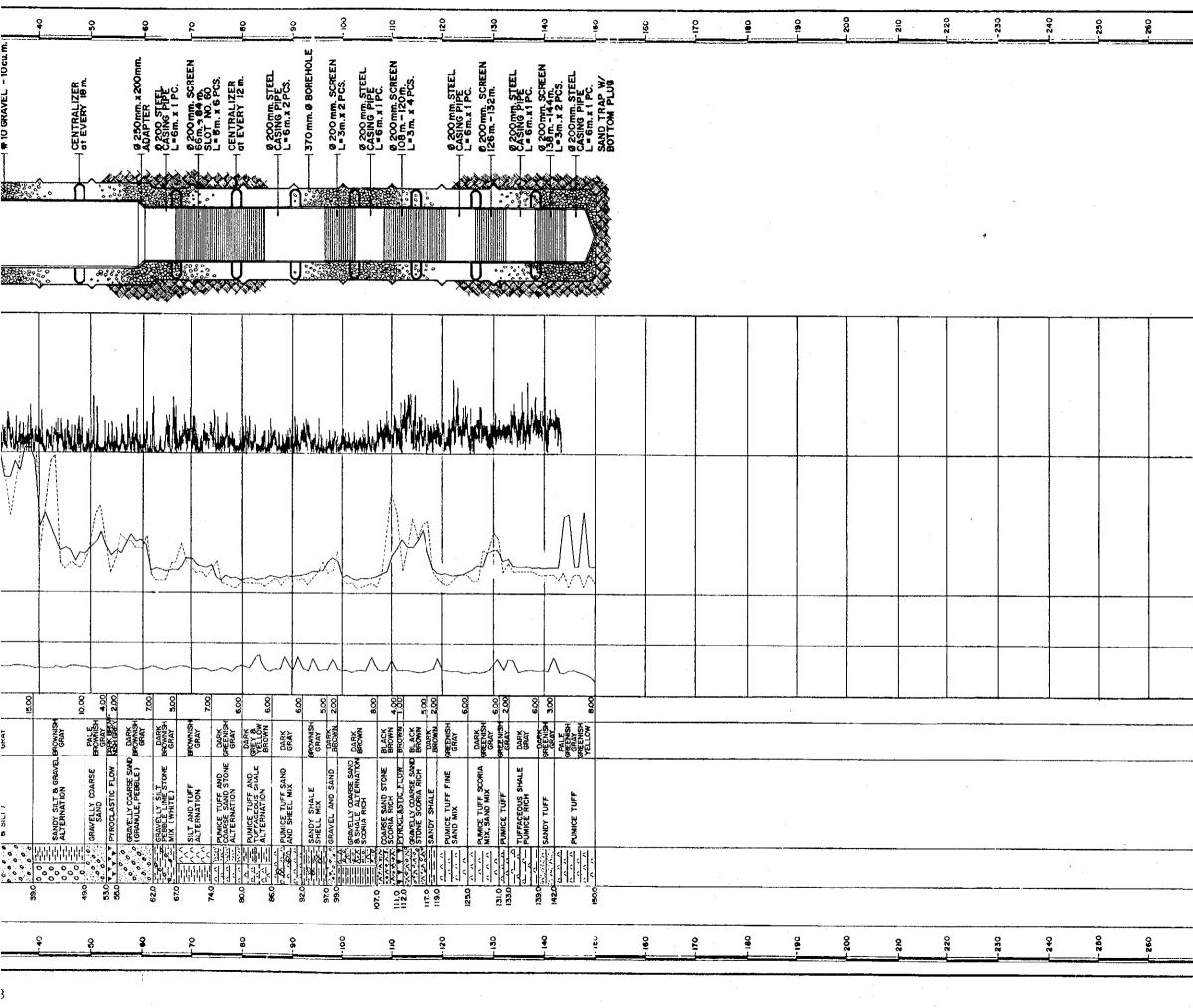
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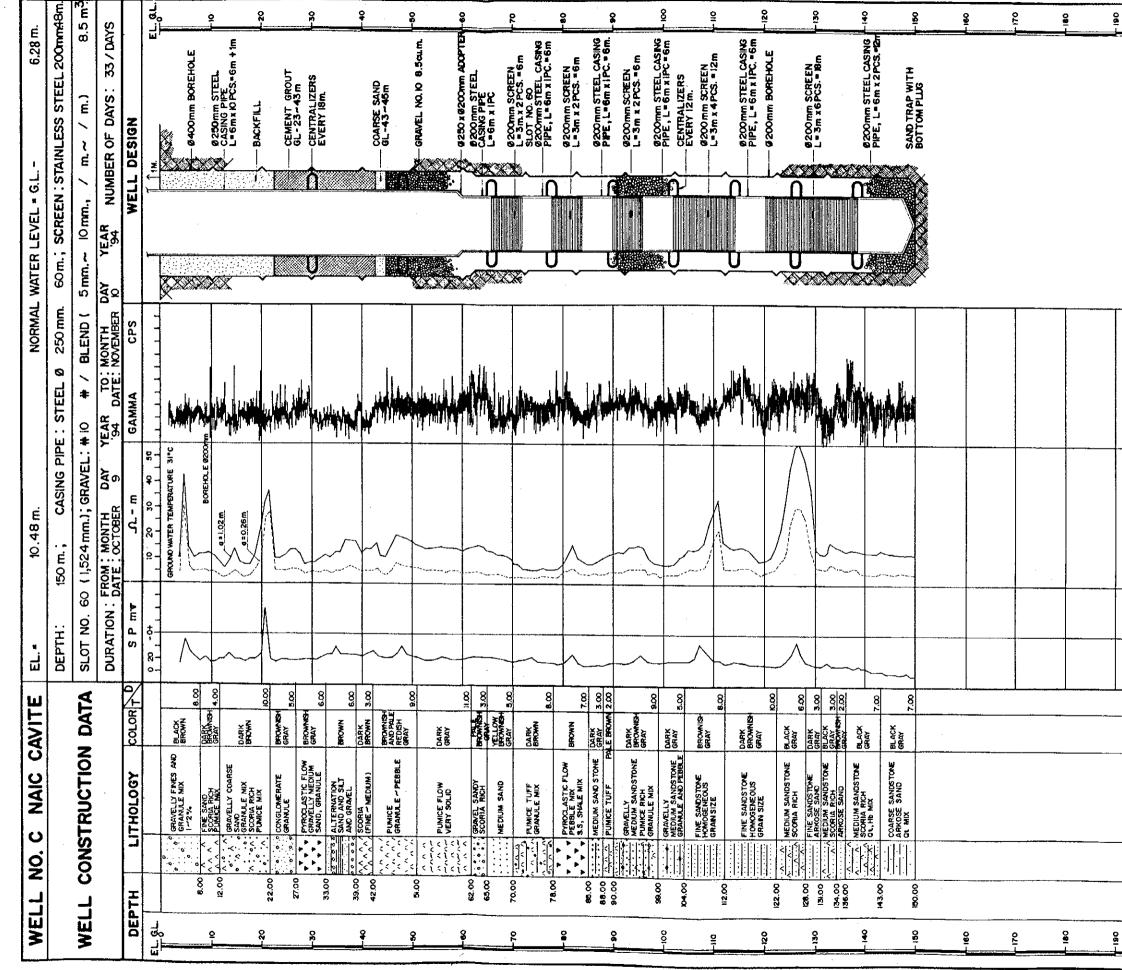


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		STEE				4 @ 400mm. BOREHOLE	J CEMENT GROUT GL-4∼24m.=20m. 4 Ø 250mm. <u>ST</u> EEL	1 CASING FIRE L=6m.x IOPCS=60m. -1 COARSE SAND +1m. -*1m.	H to GRAVEL = 10 cu.π		⊣ CENTRALIZER gi EVERY 18m.		4 0 250mm.x 200mm. Adapter 0 200 steel	1 ČÁŠIŇG PIPE L=6m. x 1 PC. Ø 200 mm. SCREEN	L SLOT NO. 60 L SLOT NO. 60 L Sm. 16 PCS.	at EVERY 12 m. Ø 200mm.STEEL	Le6m.x 2 PCS.	† sromm.ø BORENULE → Ø 200 mm. SCREEN → L*3m.x 2 PCS.	¢ 200 mm. STEEL ↓ CASING PIPE L=6 m.x I PC.	@ 200mm. SCREEN   108 m 120 m. L = 3 m. x 4 PCS.	Ø 200 mm. STEEL d CASING PIPE	L= өл.х т.с. Ø 200 mm. SCREEN - 126 m 132 m.	Ø 200mm, STEEL † CASING PIPE L = 6m.x1 PC. Ø 200mm. SCREEN H 138 m - 144 m.	L=3m.x 2 PCS. 0 200mm. STEEL CASING PIPE L = 6m.x1 PC.	SAND TRAP W/ BOTTOM PLUG										
MELL LOUSTRUCTION DATA     LL     30.60     m       MELL CONSTRUCTION DATA     LEPHIN LINE     LL     SUBJIC FIEL       DEFHIN LINE     LL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     LL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN LINE     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL     SUBJIC FIEL       DEFHIN     SUBJIC FIEL     SUBJIC FIEL     SU	R LEVEL = G.L	SCREEN :	10 mm EAR					\$1356x	Â								1			<b>\$</b> :0															
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WELL NO. B-TANZA, CAVITE     E.L.     Sol.65     m.       WELL NO. B-TANZA, CAVITE     E.L.     Sol.65     m.     Cooler     m.       VELL NO. B-TANZA, CAVITE     E.T.     DETTN.     DETTN.     DETTN.     DETNN.     DETNN.       VELL NO. B-TANZA, CAVITE     E.T.     Sol.65     m.     Cooler     m.     Cooler     m.       VELL NO. B-TANZA, CAVITE     E.T.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.     DETNN.       DETNN.     DETNN.     DETNN. </td <td></td> <td>: STEEL Ø 2</td> <td># 10 # - BLEND ( #</td> <td>994 DATE:NOVEMBER GAMMA CPS</td> <td></td> <td></td> <td></td> <td></td> <td>MANN</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Murris</td> <td></td> <td></td> <td></td> <td>Velocity Mark</td> <td></td>		: STEEL Ø 2	# 10 # - BLEND ( #	994 DATE:NOVEMBER GAMMA CPS					MANN									Murris				Velocity Mark													
		D m.; CASING PIF	24 mm.); GRAVEL: : MONTH DAY	.OCTOBER 28. .0 m b 20 10 10 10 10		o ≏.0.4m. <	iΛ	×.					×t		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~			M				$\mathcal{M}$											
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	SAI.			COLOR	SAVAGE				B2	1 1	BROWNISH GRAY	BROWNISH GRAY USU BRY	DARK GRAY	BROWNISH GRAY BROWNISH GRAY	GREENISH	DARK GREY B YELLOW BROWN	DARK GRAY		DARK BROWN	BROWN	DARK BROWN GREENISH GRAY	DARK GREENISH GRAY	DARK GRAY GREENIS	PALE OPEEDNISH GRAY GREENISH YELLOW											
	-TANZA,		TRUCTION	THOLOGY		PERBLE PUMICE MIX	GRAVELLY FINE SANC	GRAVEL & CUMPE	GRAVEL & SAND (PEBBLE & SAND ( SILT )		SANDY SILT & GRAVE ALTERNATION	GRAVELLY COARSE SAND PYROCLASTIC FLOW	GRAVELLY COARSE SAND (GRAMMLE, PEBBLE) GRAVELLY SILT	PEBBLE LIME STONE MIX (WHITE) SILT AND TUFF ALTERNATION	PUMICE TUFF AND COARSE SAND STONE ALTERNATION	PUMICE TUFF AND TUFFACEOUS SHALE ALTERNATION	PUMICE TUFF SAND AND SHEEL MIX	SANDY SHALE Shell Mix Gravel And Sand	GRAVELLY COARSE SAND B SHALE ALTERNATON SCORIA RICH	CUARSE SAMU STONE SCORIA RICH EDROCLASTIC FLOW GRAVELLY COARSE SANC STONE SCORIA RICH	SANDY SHALE PUMICE TUFF FINE SAND MIX	PUMICE TUFF SCORIA MIX, SAND MIX PUMICE TUFF	TUFFACEOUS SHALE	WINCE TUFF	~										
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CAVITE WATER SUPPLY DEVELOPMENT STUDY		
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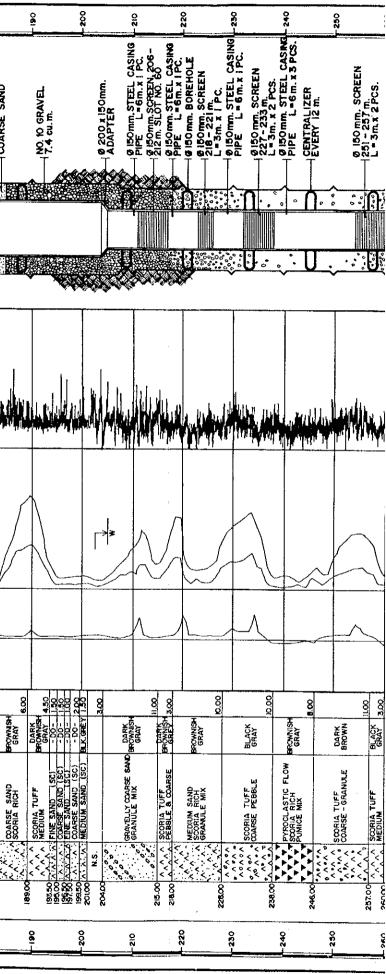
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COARSE SAND GL-43~45m	- GRAVEI			0.200mm SCREEN L=3m x 2 PCS. = 6m 0.200mm STEEL CASING PVPF 1 = 6m x 1 PC = 6m		PIPE, L= 6m x IPC = 6m CENTRALIZERS EVERY 12m. G200mm SCREEN	L=3m x 4PCS. = 12m		— 0200mm SCREEN — L= 3m x6PcS. = 18m	#200mm STEEL CASING	SAND TRAP WITH BOTTOM PLUG																	ION (C) NAIC
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DARK BROWN 3.00 BROMISH ANDFALE REDISH	GRAY DARK GRAY	TELLOW TELLOW	DARK DARK BROWN 8.00	EROWIN DARK 7.00 GRAY 3.00	DARK DARK BROWISH GRAY	DARK GRAY BROWNIS	GRAY DARK DARK BROWNISH		6.00 DARK 3.00 GRAY 3.00 BLACK 3.00 GRAY 3.00		BLACK GRAY 7.00																	
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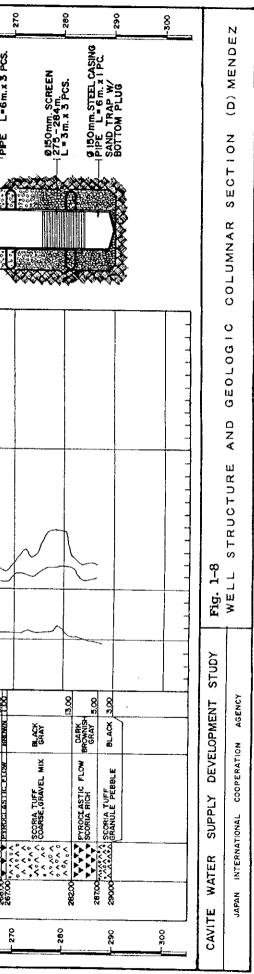
WELL	LL NO. D-MENDEZ, CAVITE	ت. ت	542 a.	NORMAL	WATER	· G.L 1	112.19 m.
		DEPTH: 290	m.; CASING PI	CASING PIPE : STEEL @ 200 mm.	200 m.;	SCREEN : STAINLESS STEEL ISO mm30m	150 mm30
WELL	LL CONSTRUCTION DATA	SLOT NO.60	<b>24</b> mm.); GF	+ 10 + BLEND (	n.~ [0 mm	Е. ~ . Е.	Ë
		DURATION : FR	ROM: MONTH DAY	YEAR TO: MONTH 1994 DATE: DECEMBER	DAY YEAR N 16 1994 N	NUMBER OF DAYS :	109
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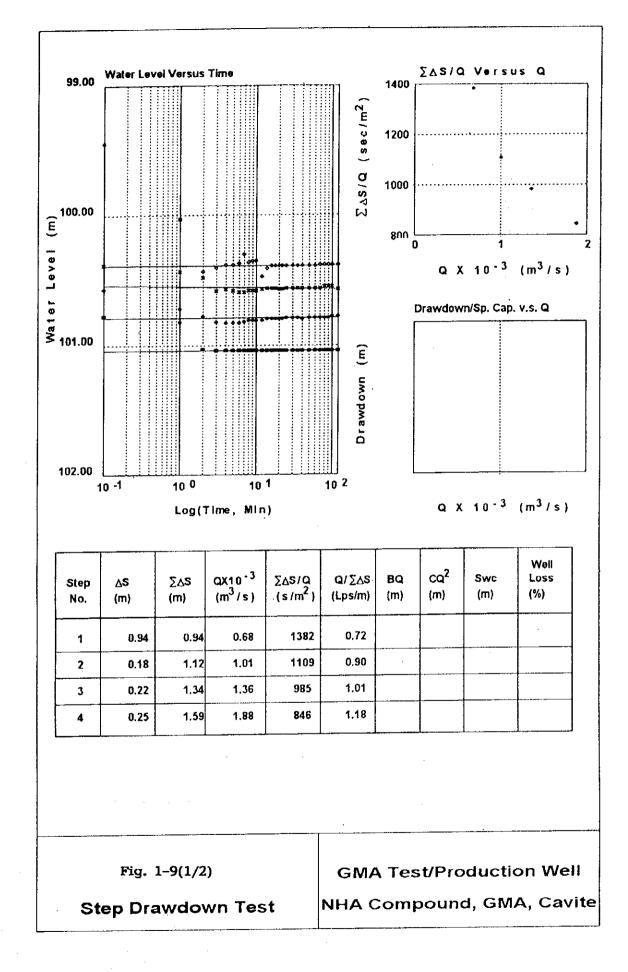


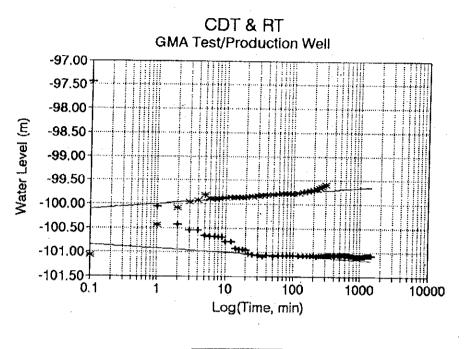
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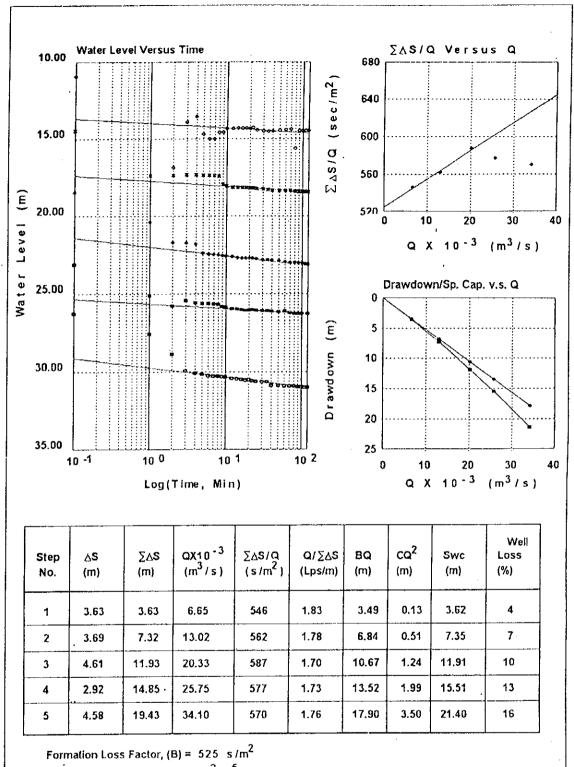


+	COT	ж	<b>R</b> T	

		CDT	R	T
Delta S	0.08	m	0.11	m
Average Discharge	1.74	L/s		
Transmissivity	0.004	m^2/s	0.00289	m^2/s

Ave. Trans =  $0.0034 \text{ m}^2/\text{s}$ 

Fig. 1-9(2/2) PUMPING TEST RESULTS OF GMA TEST WELL



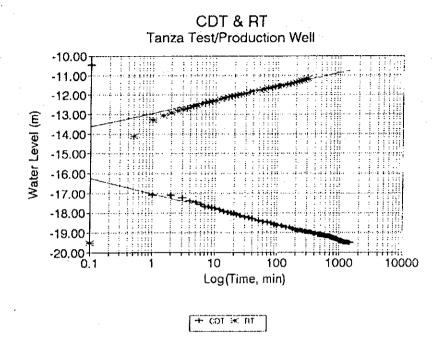
Well Loss Factor, (C) =  $3007 \text{ s}^2/\text{m}^5$ 

Transmissivity =  $3.98 \times 10^{-3} \text{ s}^2/\text{m}^5$ 

Fig. 1-10(1/2)

Step Drawdown Test

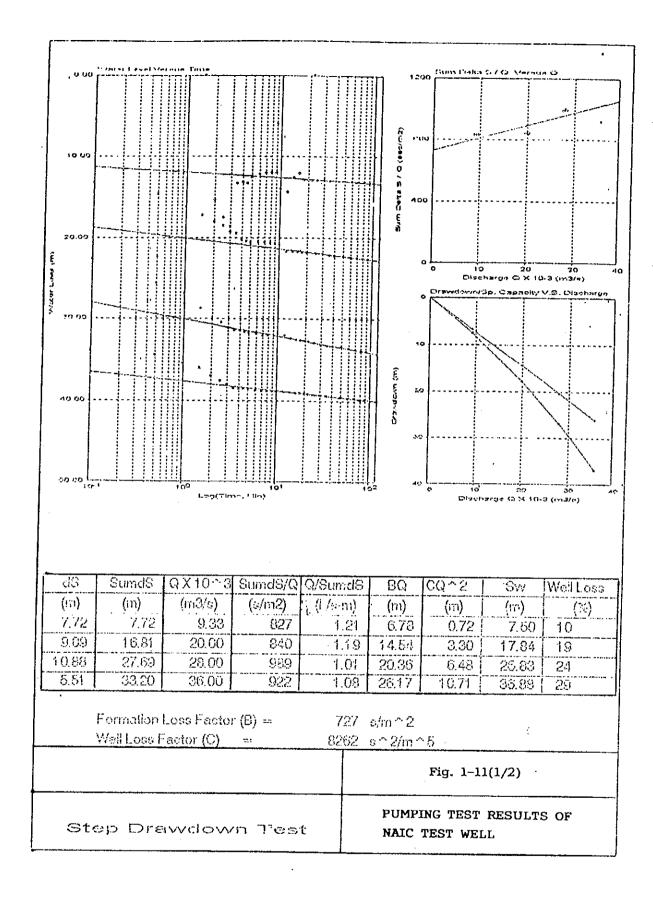
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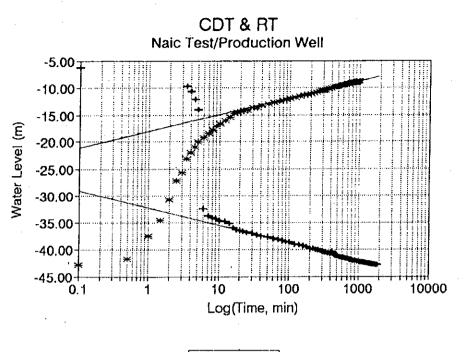


	CDT	RT
Delta S	0.80 m	0.69 m
Ave. Discharge	14.54 L/s	
Transmissivity	0.00333 m^2	/s 0.00386 m^2/s

Ave. Transmissivity 0.003595 m<sup>2</sup>/s

Fig. 1-10(2/2) PUMPING TEST RESULTS OF TANZA TEST WELL





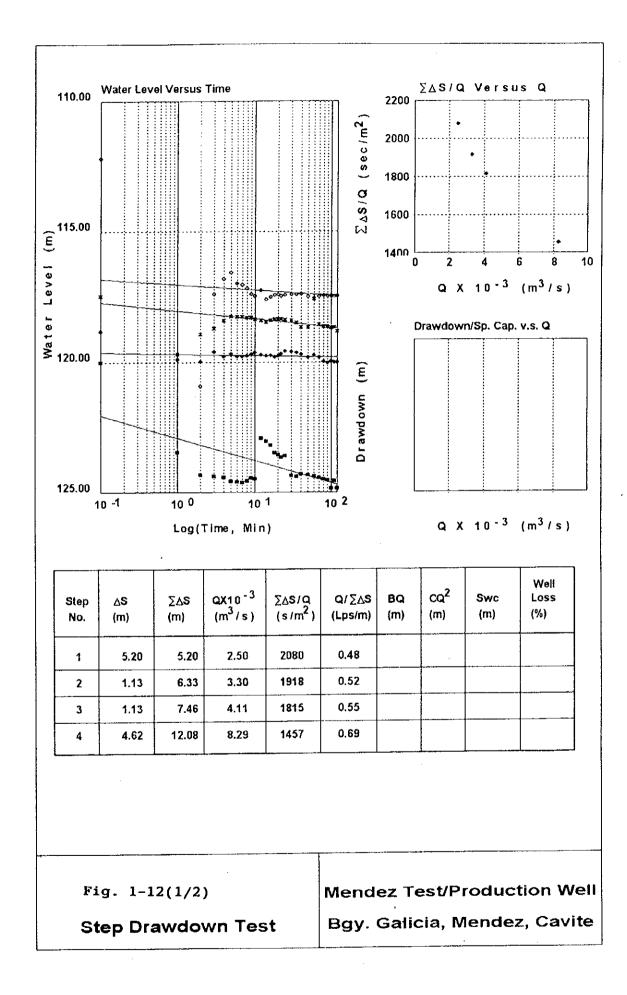


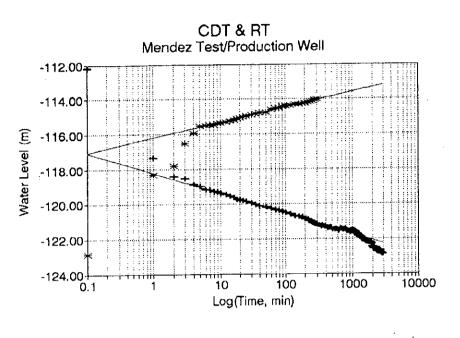
	CDT	RT
Delta S	3.23 m	· 3.07 m
Average Discharge	38.08 L/s	
Transmissivity	0.00216 m2/s	0.00227 m2/s

Ave. Trans

0.00222 m2/s

Fig. 1-11(2/2) PUMPING TEST RESULTS OF NAIC TEST WELL





+	CDT	ж	RT	1
				T

	CDT	RT	
Delta S	1.16 m	0.86 m	
Ave. Discharge	8.27 L/s		
Transmissivity	0.00130 m^2/s	0.00176 m^2/s	

Ave. Trans =  $0.00153 \text{ m}^2/\text{s}$ 

Fig. 1-12(2/2) PUMPING TEST RESULTS OF MENDEZ TEST WELL

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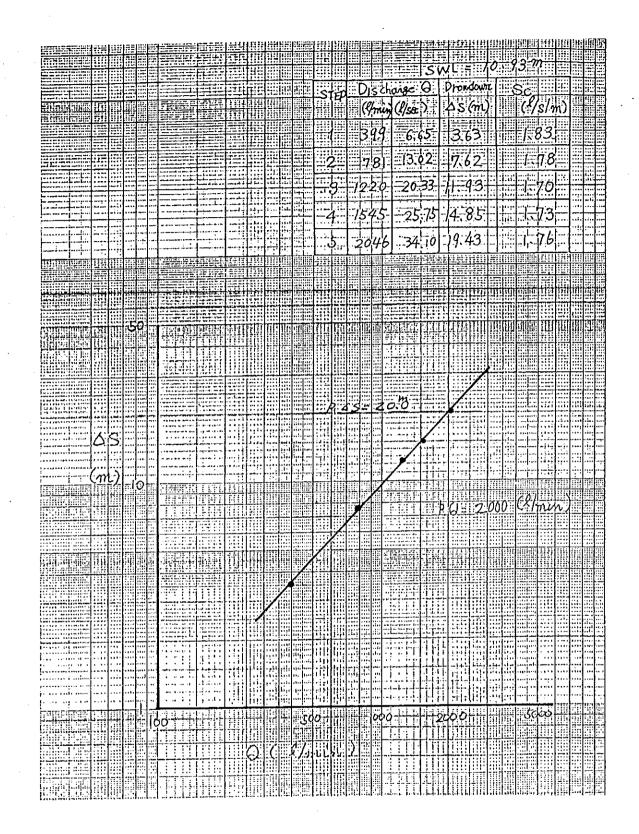


Fig. 1–13

RELATION BETWEEN PUMPING DISCHARGE AND DRAWDOWN OF TANZA TEST WELL

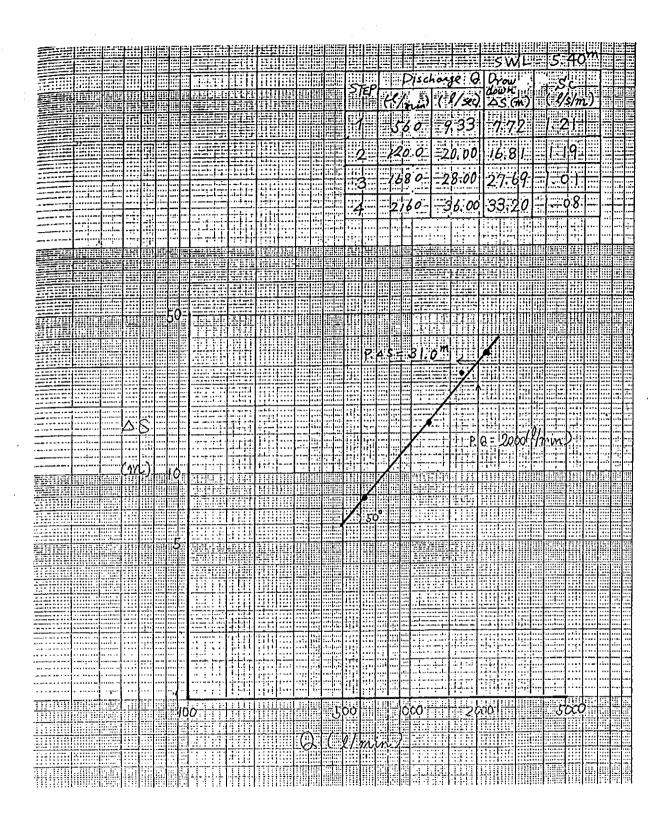
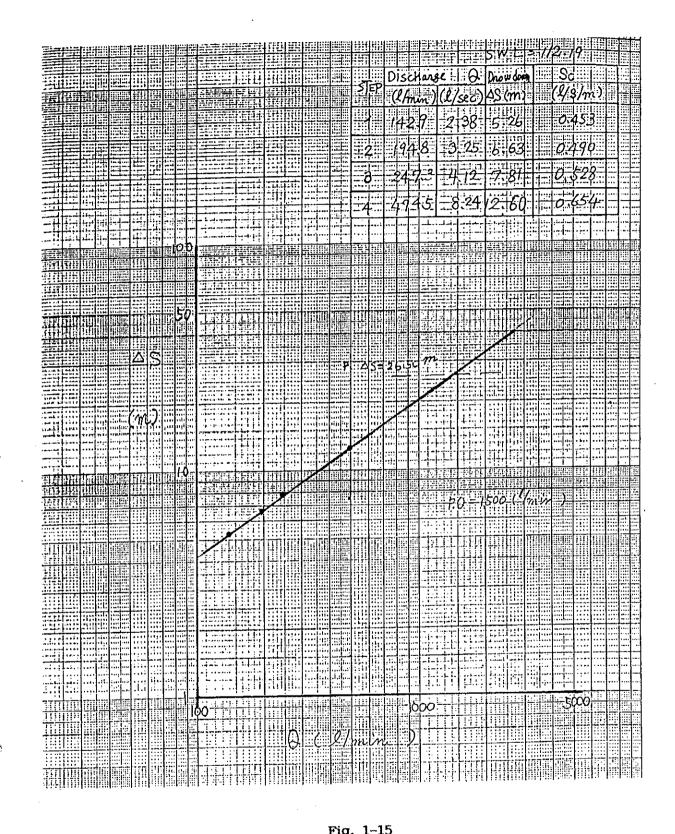


Fig. 1–14

RELATION BETWEEN PUMPING DISCHARGE AND DRAWDOWN OF NAIC TEST WELL

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Fig. 1-15

RELATION BETWEEN PUMPING DISCHARGE AND DRAWDOWN OF MENDEZ TEST WELL

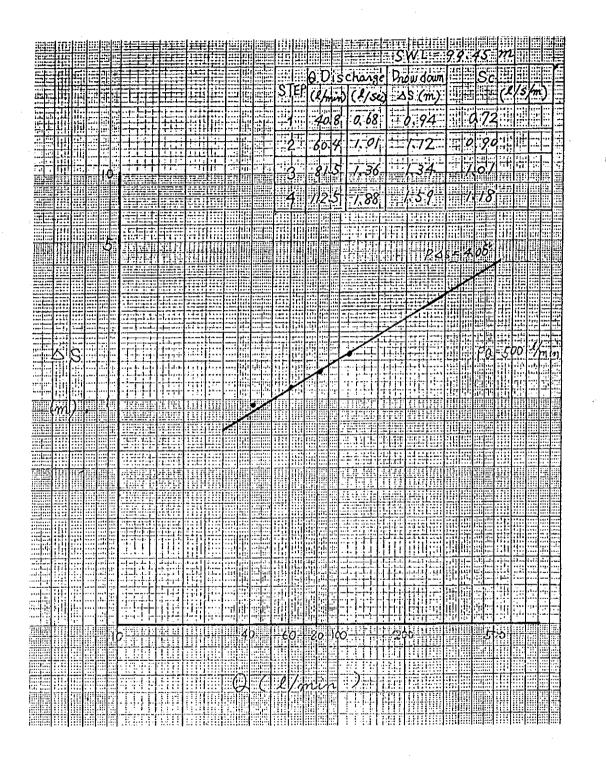
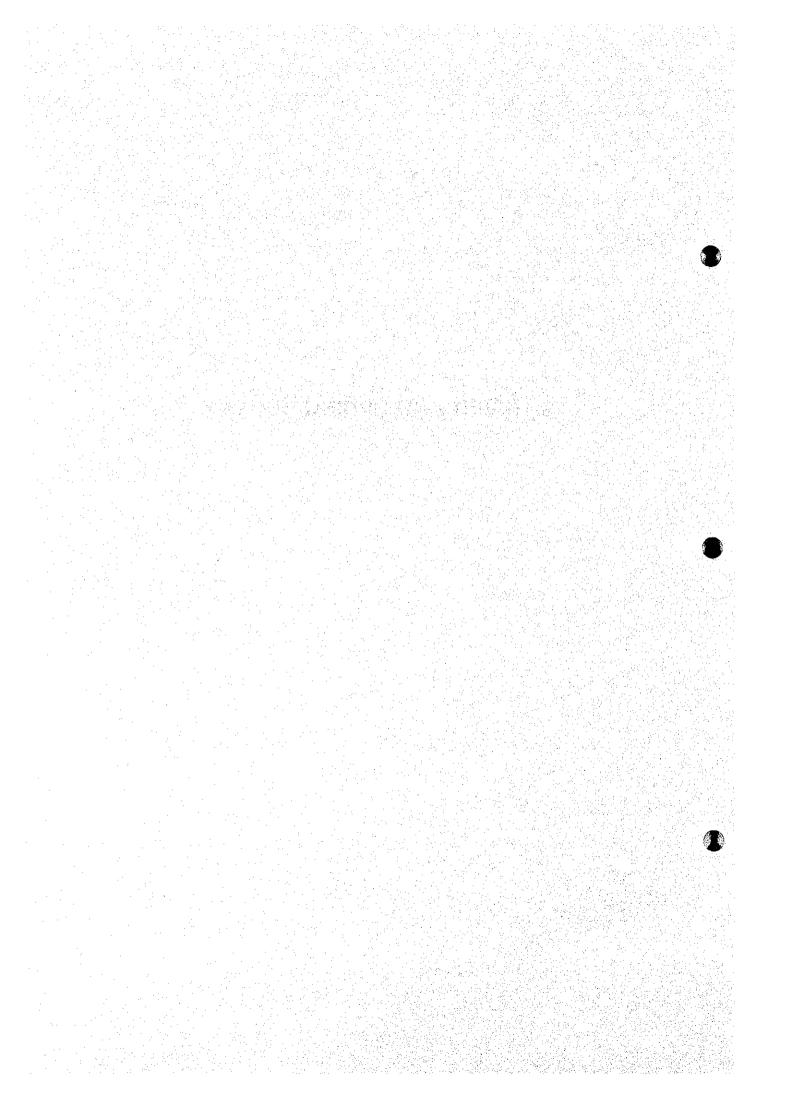


Fig. 1-16

RELATION BETWEEN PUMPING DISCHARGE AND DRAWDOWN OF GMA TEST WELL

# 2. RIVER AND SPRING SURVEY



## 2. RIVER AND SPRING SURVEY

## 2.1 MEASUREMENT POINTS

The survey aims to grasp both surface and groundwater conditions of the Study Area by measuring river and spring discharges in both dry and wet seasons, to establish the relationship between rainfall and runoff for water balance analysis and to obtain basic data for groundwater simulation.

A total of 30 measurement points were selected for river discharge survey in the dry season. Besides these 30 points, there were three (3) additional measurements made in the wet season, Hasaan Creek (R-31), Ilang-Ilang River (R-32) and Imus River (R-33). These additional measurements were made in order to checked the actual discharge resulting from the diversion. The coordinates of the measurement points were determined in the field using the Global Positioning System (GPS). Since the coordinates of discharge measurement and sampling points in Phase I were based from the topographic map, they were adjusted using the actual readings taken from the field. Discharge measurements were conducted using the Price-type current meter. Of all thirty (33) measurement points selected for rivers, in the wet season eight (8) points while in the dry season, 6 points were located inside the groundwater simulation area.

Twenty four (24) measurement points were made for springs. Each measurement points were photographed by the survey team. Water samples were also taken for water quality, analysis, ten (10) for rivers and ten (10) for springs.

The selection of measurement points for discharge considered the cross-section, topography and catchment area and channel characteristics. Existence of hydraulic structures such as diversion dams was also considered as basis for the selection of discharge measurement points. As much as possible, measurements were made in straight reach were the velocity threads are parallel to each other, stable stream bed free of bed rocks, weeds and protruding obstructions which would create turbulence and flat streamed profile to minimize vertical velocity components. For springs, previous studies made by LWUA were used to determine the locations.

#### 2.2 METHODOLOGY

For discharge measurement using the current meter, the basic principle is based on the proportionality between the velocity of the stream and revolution of the rotor.

The velocity can be expressed as follows:

$$v = a + b x N$$

where:

v = velocity of current at a point
 a,b = constant to be determined by calibration

## N = number of revolutions

The discharge measurement procedure that was used is as follows. After selecting the section for discharge measurement, set the taglines and determine the width of the stream. Determine the spacing of vertical such that no partial section should discharge 5% of the total discharge. Unless discharge is uniformly distributed, equal widths of partial sections are not recommended. Indicate the distance of the initial point from the edge of the water and also the depth of water. Decide on the method of velocity measurement. For shallow depths less than 0.50 meter, use the 0.6 D method (current meter placed at 0.6 of depth below the water surface). During times of high water, when velocities are great and it is impossible to place the meter of 0.6 or 0.8 depth, the current meter may be placed at 0.2 of depth below the surface and then apply a coefficient to the observed velocity to get the mean in the interval. After the meter position has been computed and meter placed at the proper depth, allow the meter to adjust to the current before starting the velocity observation. Then, get the number of revolutions made by the rotor for about 40 to 60 seconds. It will be convenient if counting is ended on a convenient number given in the meter rating column heading. Stop the stop watch on that exact count and record the number of revolutions and time interval. Move to the next vertical and repeat the same procedure, always recording the distance from the initial point, depth, meter position depth, revolution, and time interval until the entire stream section is covered.

Then, the discharge can be computed using the equation:

q = a x v

where:

q	=	discharge at a point
V	=	velocity of current at a point
a	=	area of the section

The total discharge is the summation of all the discharge at a point.

Fig. 2-1 to 2-7 illustrates the flow scheme for the river basins of Maragondon, Labac, Canas, San Juan, Imus and Binan rivers, and river systems below tagaytay ridge.

For springs, the Volumetric Procedure in computing the spring yield were used in the survey. The discharge can be expressed as:

8) (Q

where:	Q =	$\frac{\mathbf{v}}{T}$	
	Q	=	discharge
	V	=	volume of container
	T	=	required time to fill the container

#### 2.3 RUNOFF THROUGH RIVERS

Streamflow data were collected from BRS for four stream gaging stations located within the Study Area. Unfortunately, these stations which were established by the former Bureau of Public Works (BPW) as early as 1952 were already abandoned by BRS. The respective coordinates, drainage areas and periods of record of the four (4) gaging stations are shown in **Table 2-1**. All four stations have about twenty years of available data. However, only data up to 1979 are discharge data. The data from 1980 to the present are recorded in terms of gage height and not converted to discharge value.

Streamflow measurements made by BPW in Maragondon River, Ilang-Ilang River, Balsahan River and Panaysayan River seem to be underestimated due to heavy diversion for irrigation use upstream of the gaging stations. This is illustrated in Figs. 2-1 to 2-4 as a result of the river and spring surveys. At least 2,041 lps is being diverted from Ilang-Ilang River above the gaging station, 830 lps from Panaysayan River, 1,241 lps from Balsahan River, and 1,100 lps from Maragondon River. Table 2-2 details the volume of water being diverted by NIA for irrigation of some 14,650 has. of paddy fields in the Study Area. As shown in Table 2-3, these data were needed to adjust the discharge records to obtain a better estimates of surface runoff for water balance analysis.

## 2.4 WATER SAMPLING PROCEDURE

Twenty (20) water samples were taken, ten (10) for rivers and ten (10) for springs. The sampling requirements are as follows:

For Bacteriological Analysis:

- . minimum sample amount is one (1) liter;
- . bottle is full of sample and airtight;
- . bottle is a clean amber glass;
- . sample is kept in ice box as a low temperature storage and;
- . sample is taken to the laboratory analysis within six (6) hours.

For Physical and Chemical Analyses:

- . minimum sample amount is two (2) liters;
- . bottle is full of sample and airtight;
- . bottle is a clean ordinary glass and;
- sample is taken to the laboratory analysis within twenty four (24) hours.