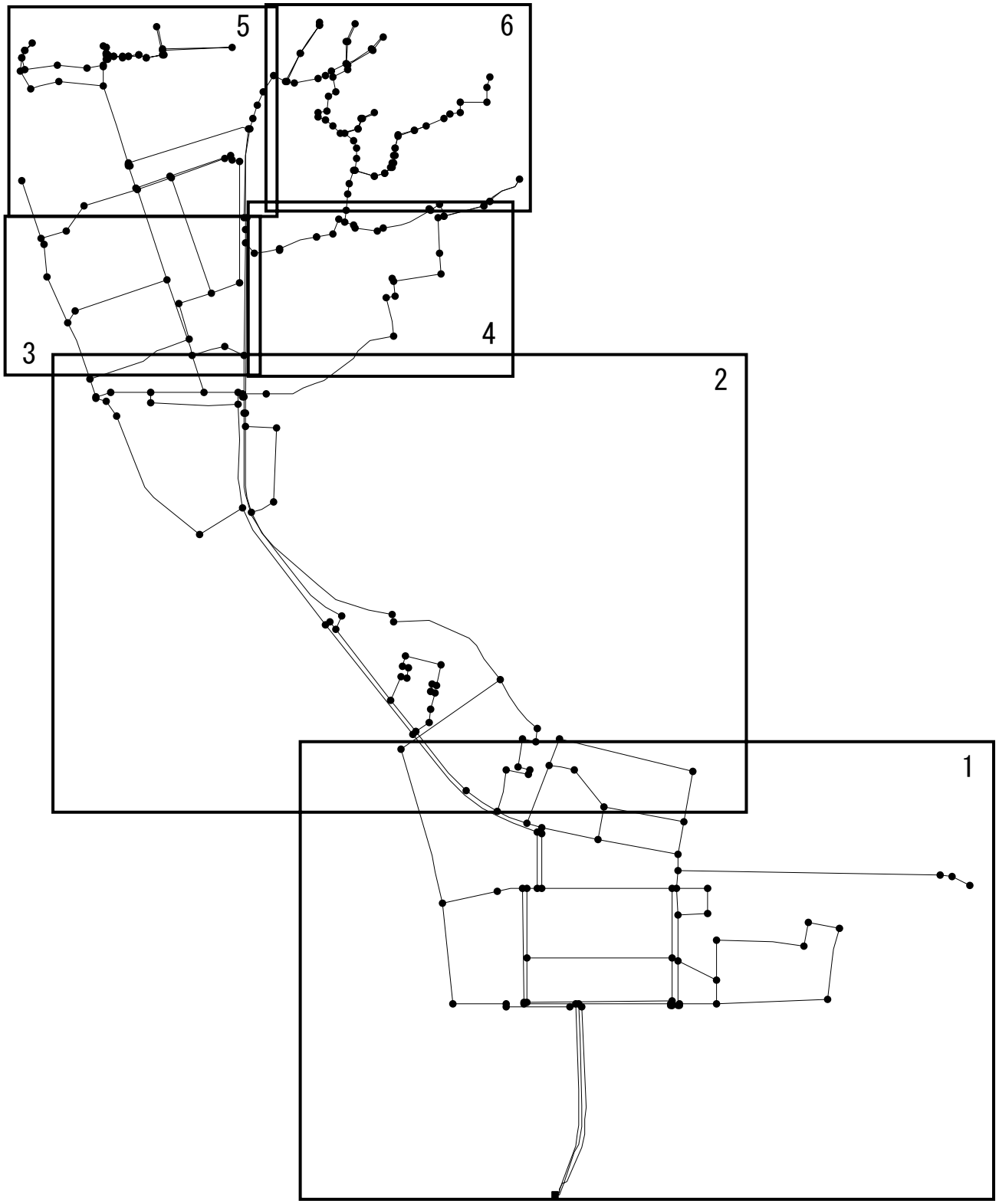
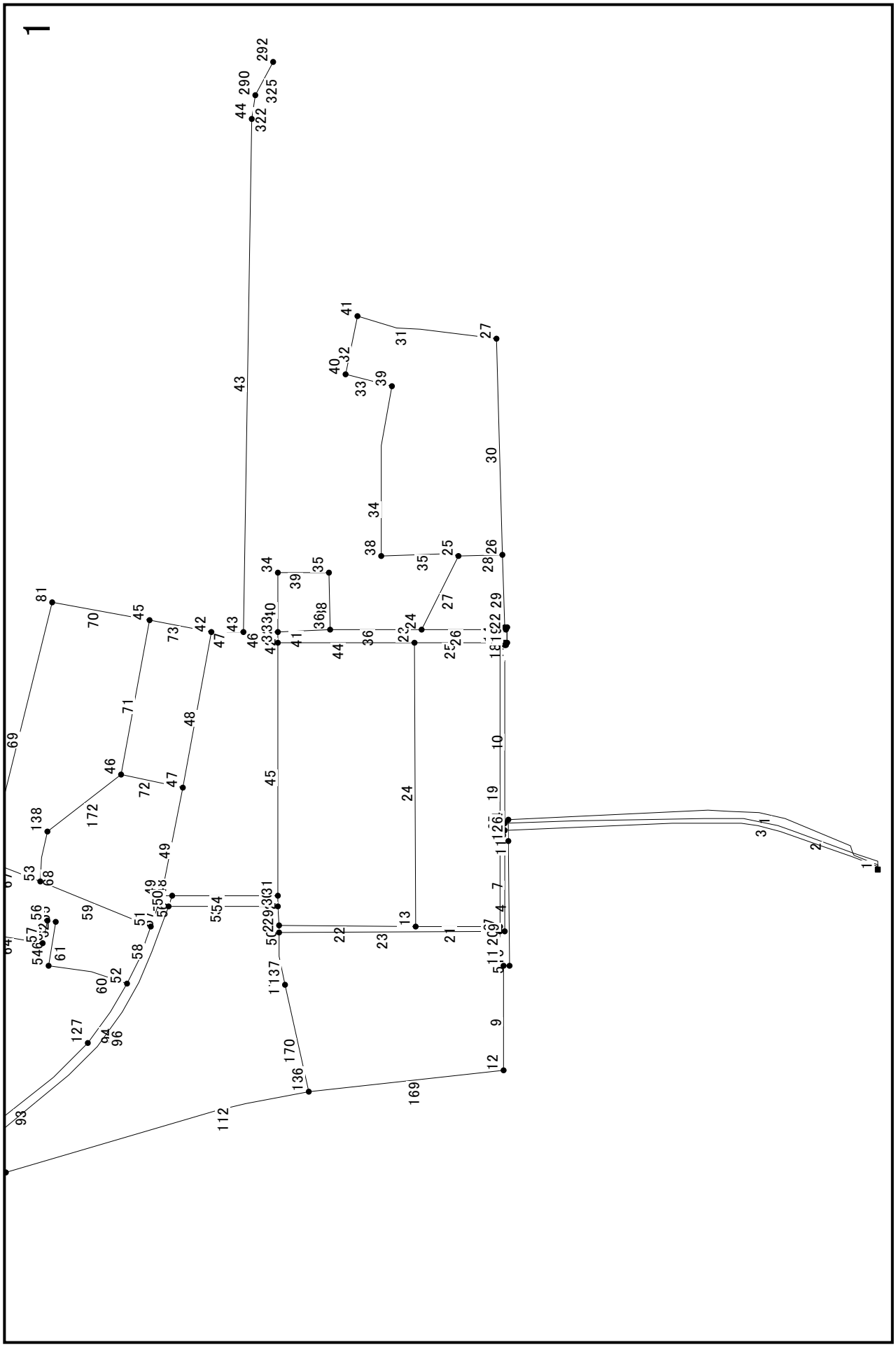
Appendix-6 References

1 Conservation of Natural Environment Low
2 Income Tax Low
3 Individual Income Tax Low
4 Added Value Tax Low
5 Enforcement Order of Taxation Low and Social Insurance Low
6 Demographic Statistics, Darkhan
7 Plan Study Report, Vol.1
8 Master Plan Study Report, Vol.2
9 Master Plan Study Report, Vol.3
10 Master Plan Study Report, Vol.4
11 Lifting Pump and Transmittal Pump Inspection Record, June 2006 – September 2006
12 Lifting Pump and Transmittal Pump Operation and Maintenance Record
13 Detailed Drawings of Water Supply Systems, No.7 Ger Area, Darkhan
14 Truck Crane Maintenance and Repair Record
15 Darkhan city Geology Map（1:100,000）
16 Darkhan city Hydro-Geology Map（1:100,000）
17 Requested Equipment List for Water Analysis Laboratory
18 Mobile Welder Maintenance and Repair Record
19 Population Census, Darkhan Som, as of February 23, 2008
20 Meteorological Data (Temperature, Precipitation, 2006 – 2007)
21 Water Quality Criteria, Mongolia
22 Electric Consumption Data, 2003 - 2008
23 Electric Diagram Information
24 Organization Chart, WSSSC-Darkhan
25 Employment Information (Number of Employee, Salary Scale), WSSSC-Darkhan
26 Employment Information (Duty of Employee, etc.), WSSSC-Darkhan
27 Organization Chart, Darkhan Prefectural Government
28 Organization Chart, Darkhan Som Municipal Government
29 Annual Report, Darkhan Heat supply Public Cooperation-Darkhan
30 Inflation Data（2003-2008.3）
31 Notice of Rate Revision, October 3, 2007
32 Statistic Data, May 2008

Appendix-7 Results of Network Analysis

1. Distribution Network

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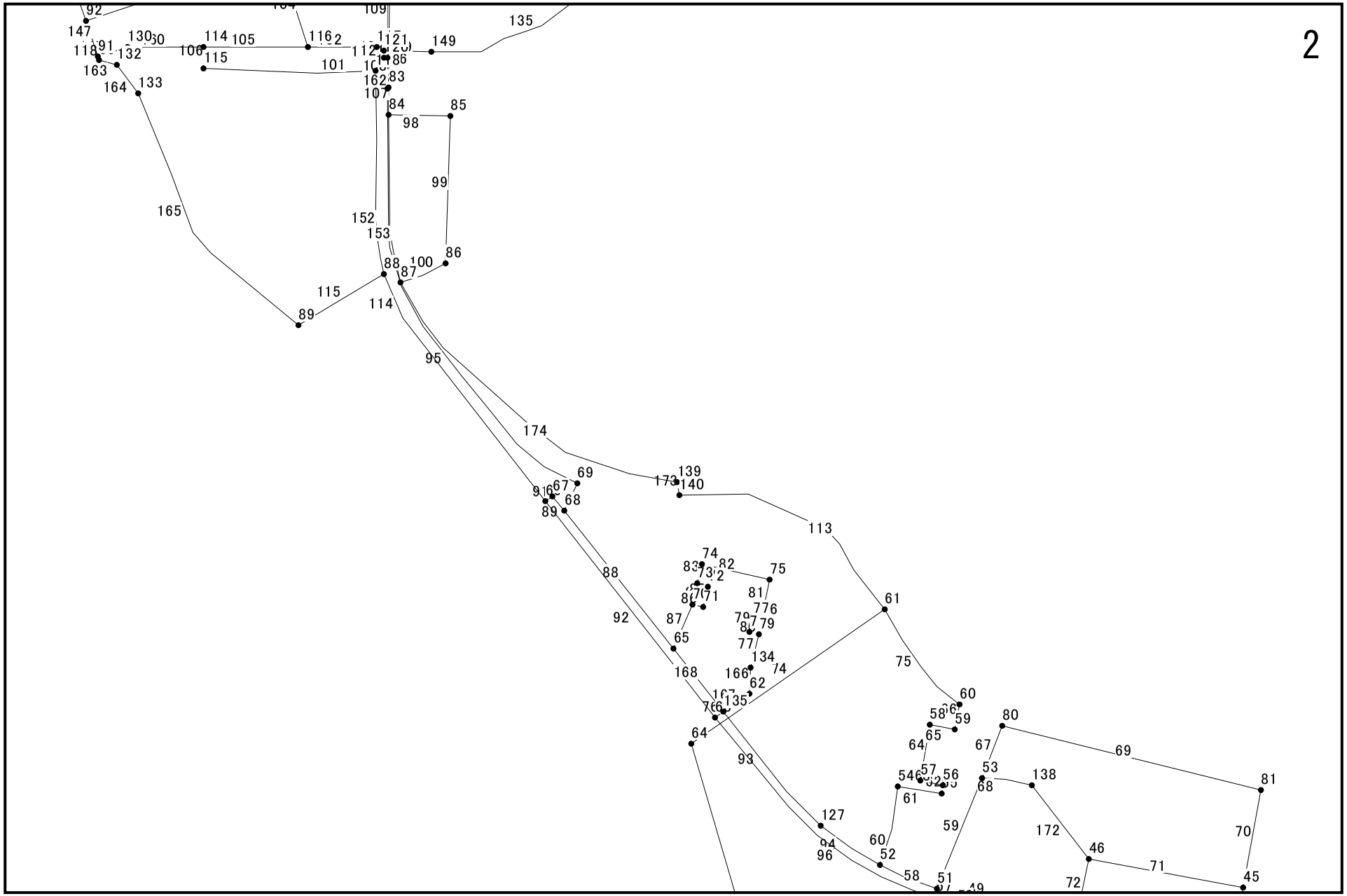
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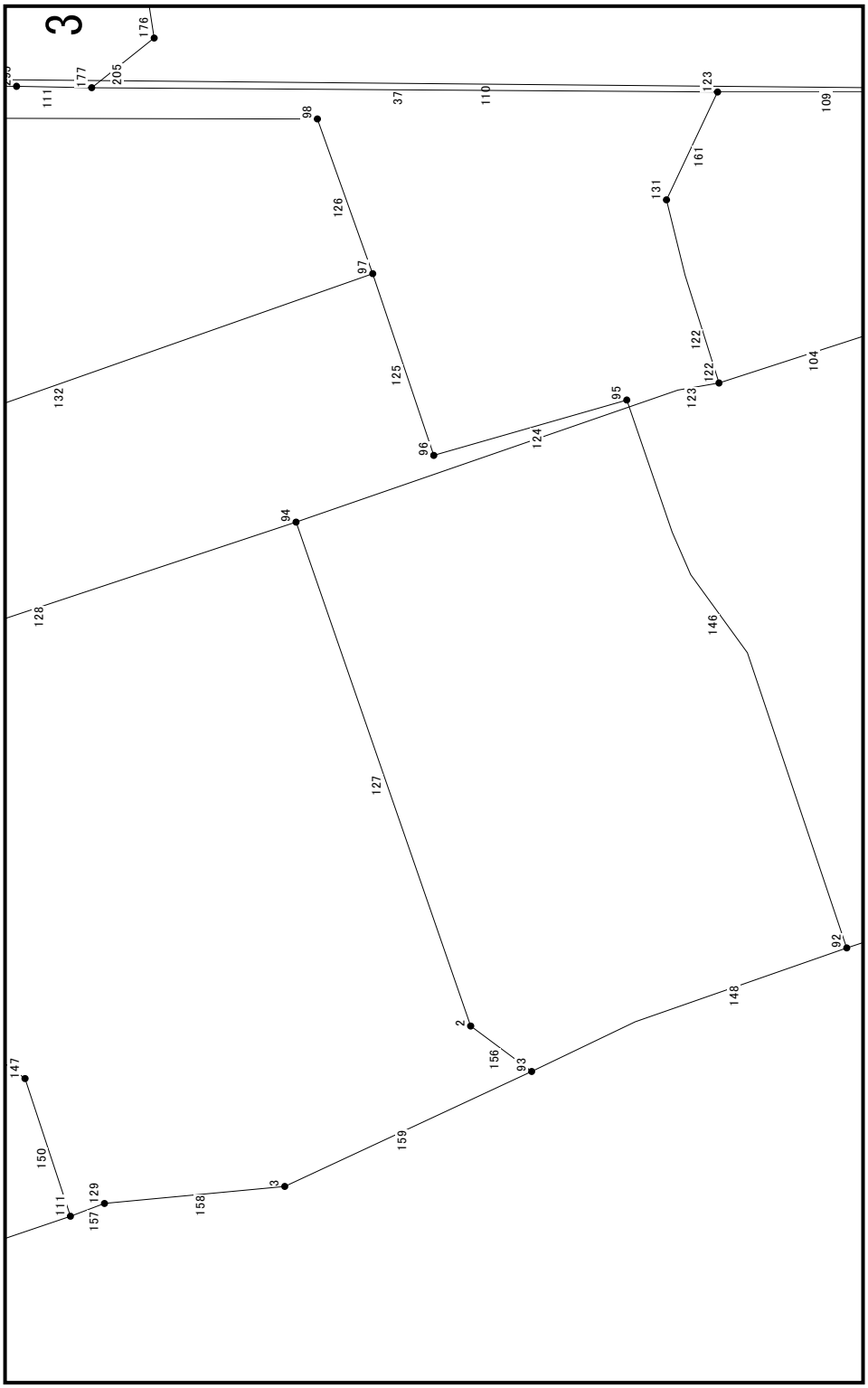
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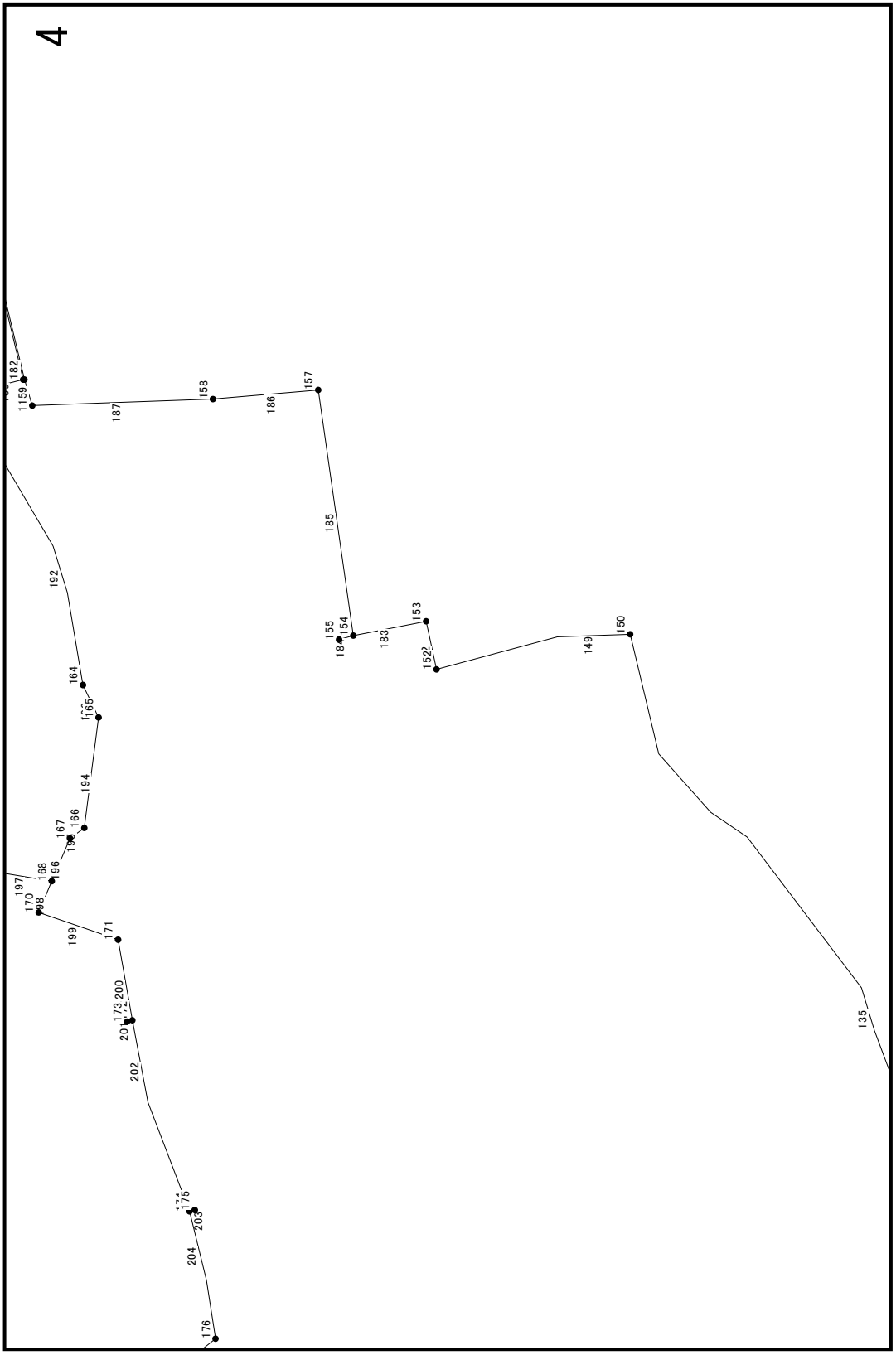
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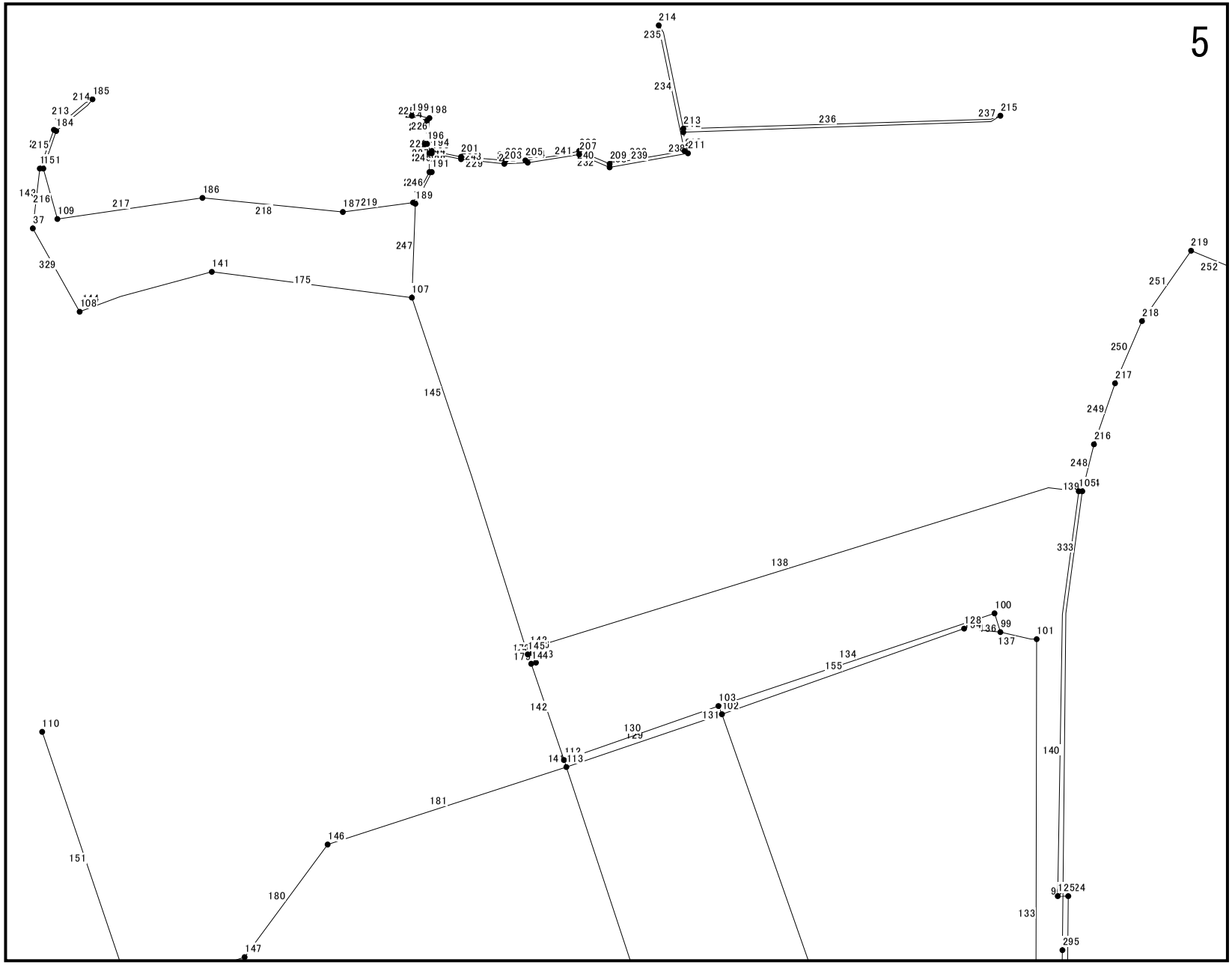
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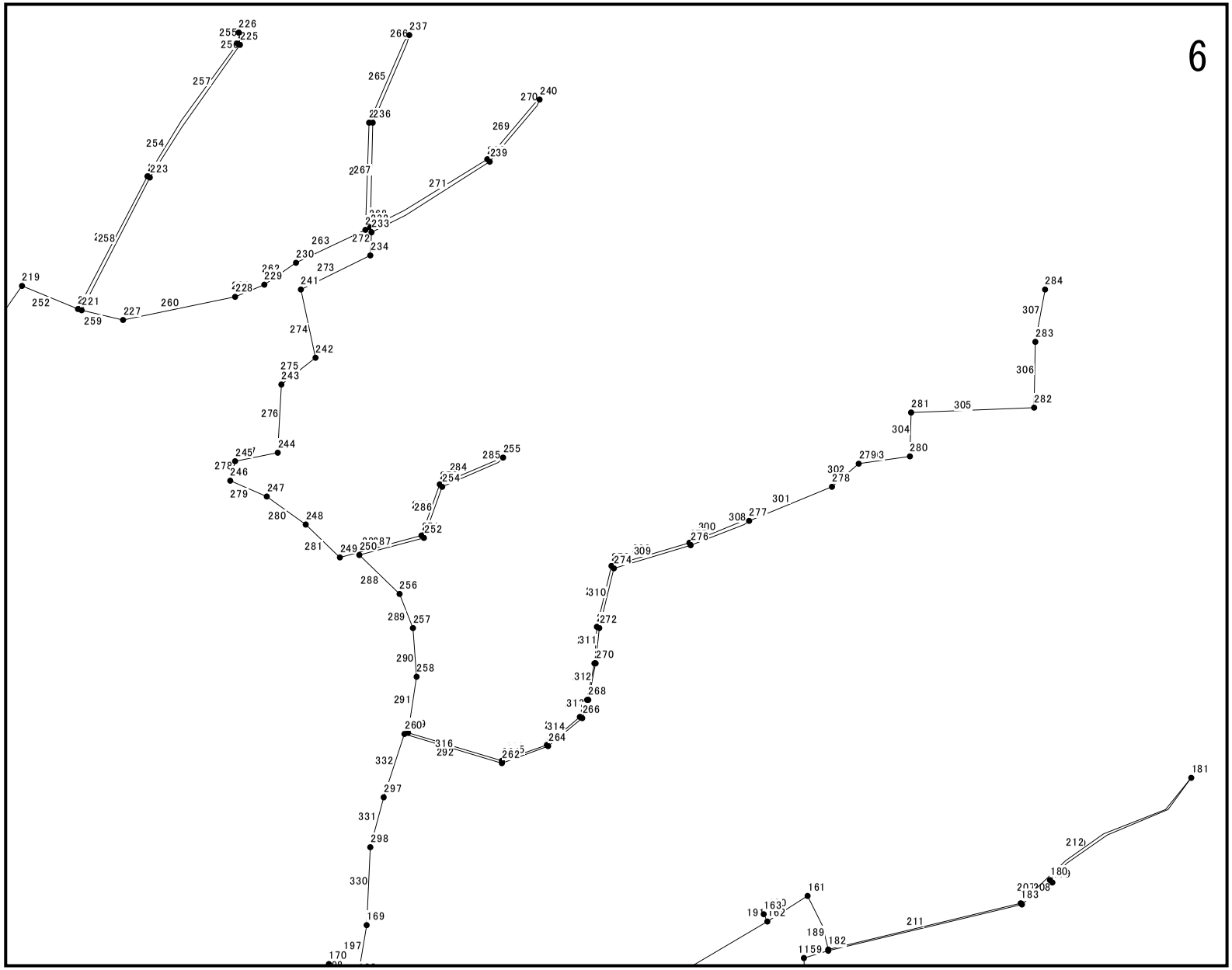
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2. Results of Network Analysis

Network Table - Nodes

Node ID	Elevation m	Demand m3/d	Head m	Pressure m	Node ID	Elevation m	Demand m3/d	Head m	Pressure m
Junc 4	703.70	0.0	765.31	61.61	Junc 54	699.22	0.0	758.08	58.86
Junc 5	704.50	0.0	763.76	59.26	Junc 55	700.56	0.0	758.07	57.51
Junc 6	704.40	0.0	763.76	59.36	Junc 56	700.64	0.0	758.07	57.43
Junc 7	703.19	0.0	762.65	59.46	Junc 57	699.96	900.0	758.06	58.10
Junc 8	703.29	0.0	762.72	59.43	Junc 58	700.58	0.0	758.15	57.57
Junc 9	703.46	0.0	762.77	59.31	Junc 59	701.38	0.0	758.20	56.82
Junc 10	701.15	0.0	764.37	63.22	Junc 60	702.37	900.0	758.26	55.89
Junc 11	700.69	0.0	764.24	63.55	Junc 61	701.19	1,797.0	758.27	57.08
Junc 12	689.59	0.0	763.14	73.55	Junc 62	697.47	0.0	757.23	59.76
Junc 13	702.57	714.0	761.75	59.18	Junc 63	696.50	0.0	757.39	60.89
Junc 14	706.49	528.0	762.69	56.20	Junc 64	696.83	0.0	759.54	62.71
Junc 15	706.42	528.0	762.79	56.37	Junc 65	696.69	0.0	756.87	60.18
Junc 16	706.32	0.0	762.79	56.47	Junc 66	710.37	0.0	756.44	46.07
Junc 17	705.06	0.0	762.74	57.68	Junc 67	710.60	0.0	756.44	45.84
Junc 18	705.13	0.0	762.70	57.57	Junc 68	708.92	0.0	756.44	47.52
Junc 19	704.42	0.0	762.63	58.21	Junc 69	711.07	1,072.5	756.37	45.30
Junc 20	704.23	0.0	762.43	58.20	Junc 70	697.62	0.0	756.71	59.09
Junc 21	706.64	0.0	762.38	55.74	Junc 71	697.71	0.0	756.67	58.96
Junc 22	705.45	0.0	762.56	57.11	Junc 72	698.71	0.0	756.58	57.87
Junc 23	705.63	1,056.0	761.76	56.13	Junc 73	699.49	0.0	756.55	57.06
Junc 24	706.04	0.0	761.69	55.65	Junc 74	702.91	1,072.5	756.49	53.58
Junc 25	708.17	364.5	761.15	52.98	Junc 75	699.23	1,072.5	756.49	57.26
Junc 26	707.53	364.5	761.28	53.75	Junc 76	697.72	0.0	756.72	59.00
Junc 27	712.25	364.5	760.68	48.43	Junc 77	697.53	0.0	756.80	59.27
Junc 28	700.98	714.0	761.21	60.23	Junc 78	697.32	0.0	756.90	59.58
Junc 29	701.01	714.0	761.15	60.14	Junc 79	697.49	0.0	756.97	59.48
Junc 30	701.49	1,302.0	760.92	59.43	Junc 80	703.12	1,287.0	758.74	55.62
Junc 31	701.64	1,302.0	760.66	59.02	Junc 81	706.42	1,020.0	759.17	52.75
Junc 32	704.51	1,395.0	760.77	56.26	Junc 82	706.26	0.0	755.84	49.58
Junc 33	704.63	100.5	760.74	56.11	Junc 83	706.30	0.0	755.84	49.54
Junc 34	706.27	100.5	760.80	54.53	Junc 84	706.70	0.0	755.90	49.20
Junc 35	706.90	100.5	760.85	53.95	Junc 85	706.80	529.5	755.75	48.95
Junc 36	705.47	100.5	760.93	55.46	Junc 86	712.51	529.5	755.85	43.34
Junc 38	707.05	364.5	760.82	53.77	Junc 87	702.08	0.0	756.30	54.22
Junc 39	711.21	364.5	760.55	49.34	Junc 88	700.95	0.0	754.08	53.13
Junc 40	710.42	364.5	760.51	50.09	Junc 89	694.50	211.5	750.90	56.40
Junc 41	711.80	417.0	760.51	48.71	Junc 90	691.36	0.0	748.05	56.69
Junc 42	704.76	0.0	759.73	54.97	Junc 91	691.08	211.5	748.05	56.97
Junc 43	704.99	199.5	760.25	55.26	Junc 92	690.52	0.0	747.11	56.59
Junc 44	742.39	0.0	759.66	17.27	Junc 93	691.67	1,605.0	744.35	52.68
Junc 45	704.48	766.5	759.31	54.83	Junc 94	702.18	1,605.0	750.70	48.52
Junc 46	702.56	766.5	759.12	56.56	Junc 95	702.41	0.0	747.10	44.69
Junc 47	702.10	0.0	759.18	57.08	Junc 96	701.73	0.0	746.95	45.22
Junc 48	700.25	0.0	759.20	58.95	Junc 97	705.48	0.0	746.79	41.31
Junc 49	700.19	0.0	759.18	58.99	Junc 98	710.70	459.0	746.14	35.44
Junc 50	700.09	0.0	759.20	59.11	Junc 99	712.76	0.0	747.52	34.76
Junc 51	699.65	0.0	758.84	59.19	Junc 100	712.06	0.0	747.53	35.47
Junc 52	698.85	0.0	758.10	59.25	Junc 101	712.67	0.0	747.41	34.74
Junc 53	701.67	645.0	758.86	57.19	Junc 102	700.44	345.0	747.70	47.26
Junc 103	700.48	345.0	747.71	47.23	Junc 158	734.17	72.0	752.40	18.23
Junc 104	719.12	1,176.0	752.25	33.13	Junc 159	745.63	0.0	752.39	6.76
Junc 105	719.04	1,177.5	752.25	33.21	Junc 160	745.87	0.0	752.39	6.52
Junc 106	701.25	0.0	750.38	49.13	Junc 161	749.93	0.0	752.39	2.46
Junc 107	708.13	0.0	750.34	42.21	Junc 162	749.93	0.0	752.39	2.46
Junc 108	700.16	0.0	750.33	50.17	Junc 163	750.33	72.0	752.39	2.06
Junc 110	690.17	1,624.5	735.66	45.49	Junc 164	748.24	0.0	752.42	4.18
Junc 111	689.50	1,311.0	736.91	47.41	Junc 165	745.17	0.0	752.42	7.25
Junc 112	698.51	1,605.0	750.22	51.71	Junc 166	732.13	0.0	752.43	20.30
Junc 113	698.57	1,605.0	750.22	51.65	Junc 167	731.12	0.0	752.43	21.31
Junc 114	697.19	0.0	750.79	53.60	Junc 168	726.86	0.0	752.44	25.58
Junc 115	696.56	423.0	750.89	54.33	Junc 169	728.25	72.0	752.42	24.17
Junc 116	706.28	0.0	752.03	45.75	Junc 170	727.12	0.0	752.46	25.34
Junc 117	705.78	0.0	752.39	46.61	Junc 171	726.19	0.0	752.53	26.34

Network Table - Nodes									
Node ID	Elevation m	Demand m3/d	Head m	Pressure m	Node ID	Elevation m	Demand m3/d	Head m	Pressure m
Junc 118	706.21	0.0	752.50	46.29	Junc 172	735.68	0.0	752.60	16.92
Junc 119	706.15	0.0	755.50	49.35	Junc 173	736.12	72.0	752.60	16.48
Junc 120	705.91	0.0	755.48	49.57	Junc 174	729.70	0.0	752.81	23.11
Junc 121	705.94	0.0	755.41	49.47	Junc 175	730.19	72.0	752.81	22.62
Junc 122	702.50	0.0	751.79	49.29	Junc 176	715.74	0.0	753.00	37.26
Junc 123	707.35	0.0	754.56	47.21	Junc 177	710.90	400.5	753.10	42.20
Junc 124	710.20	0.0	753.45	43.25	Junc 178	753.77	0.0	756.38	2.61
Junc 125	710.27	0.0	753.42	43.15	Junc 179	754.28	72.0	756.38	2.10
Junc 127	697.96	900.0	757.40	59.44	Junc 180	754.75	0.0	756.38	1.63
Junc 128	711.12	0.0	747.53	36.41	Junc 181	754.27	72.0	756.38	2.11
Junc 2	692.59	0.0	745.05	52.46	Junc 182	746.12	0.0	752.39	6.27
Junc 3	691.25	0.0	739.61	48.36	Junc 183	754.01	0.0	756.38	2.37
Junc 129	689.99	1,527.0	737.20	47.21	Junc 126	703.71	0.0	765.24	61.53
Junc 130	693.57	0.0	748.91	55.34	Junc 37	708.11	0.0	750.33	42.22
Junc 131	703.70	0.0	753.44	49.74	Junc 109	707.28	0.0	750.31	43.03
Junc 132	691.47	0.0	748.06	56.59	Junc 148	711.67	0.0	750.32	38.65
Junc 133	692.95	211.5	748.09	55.14	Junc 151	711.41	0.0	750.31	38.90
Junc 134	697.35	0.0	757.12	59.77	Junc 156	715.97	0.0	750.32	34.35
Junc 135	696.43	0.0	757.30	60.87	Junc 184	715.52	0.0	750.31	34.79
Junc 136	698.54	238.5	761.42	62.88	Junc 185	716.20	51.0	750.32	34.12
Junc 137	700.23	0.0	761.35	61.12	Junc 186	706.30	0.0	750.31	44.01
Junc 138	702.90	645.0	758.91	56.01	Junc 187	713.34	0.0	750.30	36.96
Junc 139	716.36	0.0	757.33	40.97	Junc 188	715.67	0.0	750.30	34.63
Junc 140	715.59	1,072.5	757.38	41.79	Junc 189	715.75	0.0	750.34	34.59
Junc 141	703.98	0.0	750.34	46.36	Junc 190	718.40	0.0	750.30	31.90
Junc 142	699.55	574.5	750.39	50.84	Junc 191	718.72	0.0	750.34	31.62
Junc 143	699.87	573.0	750.36	50.49	Junc 192	719.61	0.0	750.30	30.69
Junc 144	697.57	0.0	750.35	52.78	Junc 193	719.91	0.0	750.34	30.43
Junc 145	699.55	0.0	750.38	50.83	Junc 194	720.05	0.0	750.30	30.25
Junc 146	693.78	0.0	743.03	49.25	Junc 195	719.69	0.0	750.30	30.61
Junc 147	692.05	0.0	740.09	48.04	Junc 196	720.09	0.0	750.30	30.21
Junc 149	706.40	0.0	755.00	48.60	Junc 197	721.62	0.0	750.30	28.68
Junc 150	719.33	471.0	752.55	33.22	Junc 198	722.12	0.0	750.30	28.18
Junc 152	725.67	0.0	752.49	26.82	Junc 199	721.72	51.0	750.30	28.58
Junc 153	725.80	0.0	752.48	26.68	Junc 200	723.36	0.0	750.33	26.97
Junc 154	730.11	0.0	752.45	22.34	Junc 201	723.53	0.0	750.30	26.77
Junc 155	731.44	72.0	752.45	21.01	Junc 202	726.56	0.0	750.30	23.74
Junc 157	727.47	0.0	752.42	24.95	Junc 203	726.28	0.0	750.33	24.05
Junc 204	726.16	0.0	750.33	24.17	Junc 248	722.84	0.0	752.17	29.33
Junc 205	726.45	0.0	750.30	23.85	Junc 249	723.96	0.0	752.17	28.21
Junc 206	724.35	0.0	750.30	25.95	Junc 250	724.01	0.0	752.19	28.18
Junc 207	724.08	0.0	750.33	26.25	Junc 251	724.84	0.0	752.17	27.33
Junc 208	721.23	0.0	750.33	29.10	Junc 252	725.56	0.0	752.19	26.63
Junc 209	721.51	0.0	750.30	28.79	Junc 253	725.25	0.0	752.17	26.92
Junc 210	719.30	0.0	750.30	31.00	Junc 254	724.95	0.0	752.18	27.23
Junc 211	719.51	0.0	750.32	30.81	Junc 255	732.11	40.5	752.18	20.07
Junc 212	719.74	0.0	750.32	30.58	Junc 256	725.09	0.0	752.20	27.11
Junc 213	719.87	0.0	750.30	30.43	Junc 257	725.26	0.0	752.20	26.94
Junc 214	728.42	51.0	750.30	21.88	Junc 258	724.85	0.0	752.21	27.36
Junc 215	736.44	51.0	750.30	13.86	Junc 259	724.33	0.0	752.21	27.88
Junc 216	721.50	0.0	752.25	30.75	Junc 260	724.36	0.0	752.37	28.01
Junc 217	725.45	0.0	752.24	26.79	Junc 261	730.99	0.0	752.22	21.23
Junc 218	729.64	0.0	752.23	22.59	Junc 262	730.82	0.0	752.35	21.53
Junc 219	733.71	0.0	752.22	18.51	Junc 263	734.88	0.0	752.22	17.34
Junc 220	732.62	0.0	752.22	19.60	Junc 264	734.29	0.0	752.33	18.04
Junc 221	732.61	0.0	752.17	19.56	Junc 265	737.68	0.0	752.23	14.55
Junc 222	739.14	0.0	752.20	13.06	Junc 266	737.68	0.0	752.32	14.64
Junc 223	739.22	0.0	752.17	12.95	Junc 267	737.59	0.0	752.23	14.64
Junc 224	748.37	0.0	752.18	3.81	Junc 268	737.60	0.0	752.32	14.72
Junc 225	748.39	0.0	752.18	3.79	Junc 269	738.01	0.0	752.23	14.22
Junc 226	749.40	40.5	752.18	2.78	Junc 270	738.11	0.0	752.31	14.20
Junc 227	733.34	0.0	752.17	18.83	Junc 271	738.95	0.0	752.23	13.28
Junc 228	733.91	0.0	752.16	18.25	Junc 272	738.82	0.0	752.30	13.48
Junc 229	734.37	0.0	752.16	17.79	Junc 273	742.41	0.0	752.24	9.83

Network Table - Nodes									
Node ID	Elevation m	Demand m3/d	Head m	Pressure m	Node ID	Elevation m	Demand m3/d	Head m	Pressure m
Junc 230	733.50	40.5	752.16	18.66	Junc 274	742.25	0.0	752.29	10.04
Junc 231	734.31	0.0	752.15	17.84	Junc 275	744.67	0.0	752.25	7.58
Junc 232	734.38	0.0	752.15	17.77	Junc 276	744.61	0.0	752.27	7.66
Junc 233	734.34	0.0	752.15	17.81	Junc 277	747.23	40.5	752.25	5.02
Junc 234	732.20	0.0	752.15	19.95	Junc 278	751.27	0.0	752.25	0.98
Junc 235	739.18	0.0	752.15	12.97	Junc 279	752.39	0.0	752.25	-0.14
Junc 236	738.12	0.0	752.15	14.03	Junc 280	754.70	0.0	752.25	-2.45
Junc 237	743.76	40.5	752.15	8.39	Junc 281	754.90	0.0	752.25	-2.65
Junc 238	740.38	0.0	752.15	11.77	Junc 282	766.00	0.0	752.25	-13.75
Junc 239	740.00	0.0	752.15	12.15	Junc 283	763.62	0.0	752.25	-11.37
Junc 240	746.58	40.5	752.15	5.57	Junc 284	763.19	40.5	752.25	-10.94
Junc 241	730.85	0.0	752.15	21.30	Junc 295	711.22	0.0	753.00	41.78
Junc 242	727.45	40.5	752.16	24.71	Junc 297	725.21	0.0	752.38	27.17
Junc 243	725.97	0.0	752.16	26.19	Junc 298	725.85	0.0	752.40	26.55
Junc 244	725.11	0.0	752.16	27.05	Junc 290	743.18	0.0	759.62	16.44
Junc 245	724.50	0.0	752.16	27.66	Junc 292	717.90	513.0	759.52	41.62
Junc 246	723.90	0.0	752.16	28.26	Resvr 1	766.60	-45,751.5	766.60	0.00
Junc 247	723.51	0.0	752.16	28.65					

Note:
1) Demand =Basic Demand x 1.5(Houry factor)
2) Installation of Boosting Pump at Junc277(Water Kiosk No.6-7)
3) Hazen - Williams

Network Table - Links											
Link ID	Leng-th m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km	Link ID	Length m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km
Pipe 1	940	600	-16,089.52	0.66	1.37	Pipe 64	112	200	-676.32	0.25	0.82
Pipe 2	990	500	14,830.32	0.87	2.87	Pipe 65	54	200	-676.32	0.25	0.82
Pipe 3	990	500	14,831.66	0.87	2.87	Pipe 66	74	200	-676.32	0.25	0.82
Pipe 4	260	500	16,089.52	0.95	3.34	Pipe 67	138	200	678.14	0.25	0.82
Pipe 5	40	500	16,089.52	0.95	3.34	Pipe 68	120	300	-1,484.00	0.24	0.49
Pipe 6	10	500	1,620.00	0.10	0.05	Pipe 69	634	200	608.86	0.22	0.67
Pipe 7	284	500	16,451.66	0.97	3.48	Pipe 70	246	300	1,628.86	0.27	0.58
Pipe 8	16	500	16,451.66	0.97	3.47	Pipe 71	396	300	1,482.41	0.24	0.49
Pipe 9	330	500	16,089.52	0.95	3.34	Pipe 72	146	300	1,413.08	0.23	0.44
Pipe 10	420	500	13,210.32	0.78	2.32	Pipe 73	144	300	3,877.78	0.63	2.88
Pipe 11	4	500	6,312.04	0.37	0.58	Pipe 43	1210	200	-513.00	0.19	0.49
Pipe 12	6	300	6,898.28	1.13	8.36	Pipe 74	526	500	-13,506.90	0.80	2.41
Pipe 13	5	300	6,898.28	1.13	8.38	Pipe 75	288	500	1,576.32	0.09	0.05
Pipe 14	10	200	2,010.63	0.74	6.15	Pipe 76	22	250	2,794.48	0.66	3.82
Pipe 15	34	200	2,010.63	0.74	6.15	Pipe 77	62	200	1,206.50	0.44	2.39
Pipe 16	31	300	4,887.65	0.80	4.42	Pipe 78	30	200	1,206.50	0.44	2.39
Pipe 17	8	200	2,010.63	0.74	6.15	Pipe 79	42	200	1,206.50	0.44	2.39
Pipe 18	16	300	5,784.04	0.95	6.04	Pipe 80	30	200	1,206.50	0.44	2.39
Pipe 19	696	200	-163.56	0.06	0.06	Pipe 81	96	200	1,206.50	0.44	2.39
Pipe 20	18	200	1,559.60	0.57	3.84	Pipe 82	174	200	134.00	0.05	0.04
Pipe 21	194	200	1,723.16	0.63	4.62	Pipe 83	44	200	-938.50	0.35	1.50
Pipe 22	326	200	1,048.80	0.39	1.84	Pipe 84	20	200	-938.50	0.35	1.50
Pipe 23	520	500	14,892.06	0.88	2.89	Pipe 85	56	200	-938.50	0.35	1.50
Pipe 24	696	150	39.64	0.03	0.02	Pipe 86	26	200	-938.50	0.35	1.50
Pipe 25	194	300	5,092.48	0.83	4.77	Pipe 87	106	200	-938.50	0.35	1.50
Pipe 26	196	300	4,887.65	0.80	4.42	Pipe 88	442	250	1,329.93	0.31	0.96
Pipe 27	208	150	593.37	0.39	2.61	Pipe 89	38	500	1,143.40	0.07	0.02
Pipe 28	108	200	-837.33	0.31	1.21	Pipe 90	12	300	3,710.19	0.61	2.65
Pipe 29	178	200	2,010.63	0.74	6.15	Pipe 91	22	500	1,143.40	0.07	0.03
Pipe 30	526	200	808.79	0.30	1.14	Pipe 92	646	500	-10,305.99	0.61	1.46
Pipe 31	456	200	444.29	0.16	0.38	Pipe 93	367	250	-680.44	0.16	0.28
Pipe 32	214	200	27.29	0.01	0.00	Pipe 94	178	200	-1,580.44	0.58	3.94
Pipe 33	176	200	337.21	0.12	0.23	Pipe 95	1210	300	-1,400.82	0.23	0.44
Pipe 34	312	200	701.71	0.26	0.88	Pipe 96	796	500	-13,100.48	0.77	2.28
Pipe 35	172	200	-1,066.21	0.39	1.90	Pipe 97	58	300	-2,473.32	0.40	1.25
Pipe 36	220	300	-4,294.28	0.70	3.48	Pipe 98	148	150	357.16	0.23	1.02

Network Table - Links											
Link ID	Leng-th m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km	Link ID	Length m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km
Pipe 38	148	300	-1,500.58	0.25	0.50	Pipe 99	350	150	-172.34	0.11	0.26
Pipe 39	126	300	1,400.08	0.23	0.44	Pipe 100	128	150	-701.84	0.46	3.55
Pipe 40	148	300	1,299.58	0.21	0.38	Pipe 101	444	200	1,511.18	0.56	3.62
Pipe 41	126	300	2,693.20	0.44	1.47	Pipe 102	160	400	-7,170.54	0.66	2.21
Pipe 42	26	300	-2,295.85	0.38	1.09	Pipe 103	50	400	7,170.54	0.66	2.21
Pipe 44	326	300	3,996.85	0.65	3.05	Pipe 104	180	400	5,497.48	0.51	1.35
Pipe 45	610	200	306.00	0.11	0.19	Pipe 105	284	200	1,673.06	0.62	4.37
Pipe 46	72	300	6,188.13	1.01	6.84	Pipe 106	50	200	1,088.18	0.40	1.97
Pipe 47	96	300	5,475.63	0.90	5.46	Pipe 107	68	500	8,002.08	0.47	0.91
Pipe 48	400	250	1,597.85	0.38	1.35	Pipe 108	58	300	5,692.71	0.93	5.86
Pipe 49	254	250	184.77	0.04	0.02	Pipe 109	204	300	4,989.60	0.82	4.59
Pipe 50	18	500	16,522.18	0.97	3.51	Pipe 110	902	300	-3,710.19	0.61	2.65
Pipe 51	64	500	16,856.98	0.99	3.64	Pipe 112	780	500	13,506.90	0.80	2.41
Pipe 52	22	200	2,874.64	1.06	11.92	Pipe 113	630	500	10,133.58	0.60	1.42
Pipe 53	270	400	12,680.34	1.17	6.36	Pipe 114	678	400	-9,162.60	0.84	3.49
Pipe 54	268	200	1,878.64	0.69	5.42	Pipe 115	250	100	480.88	0.71	12.72
Pipe 55	22	250	1,458.50	0.34	1.14	Pipe 117	78	200	-2,761.24	1.02	11.06
Pipe 56	24	250	420.14	0.10	0.11	Pipe 118	12	200	57.88	0.02	0.01
Pipe 57	80	200	1,643.27	0.61	4.23	Pipe 120	20	150	-703.11	0.46	3.57
Pipe 58	146	200	1,804.13	0.66	5.03	Pipe 121	6	150	-703.11	0.46	3.57
Pipe 59	294	200	-160.86	0.06	0.06	Pipe 122	160	150	-1,248.87	0.82	10.34
Pipe 60	202	200	223.68	0.08	0.11	Pipe 123	552	400	6,746.35	0.62	1.98
Pipe 61	108	200	223.68	0.08	0.11	Pipe 124	158	100	-117.92	0.17	0.94
Pipe 62	38	200	223.68	0.08	0.11	Pipe 125	172	100	117.92	0.17	0.94
Pipe 63	54	200	223.68	0.08	0.10	Pipe 126	144	100	273.01	0.40	4.46
Pipe 127	468	200	-2,893.12	1.07	12.06	Pipe 190	49	150	-55.89	0.04	0.02
Pipe 128	456	300	2,248.23	0.37	1.05	Pipe 191	7	150	72.00	0.05	0.04
Pipe 129	174	100	515.68	0.76	14.48	Pipe 192	243	150	-127.89	0.08	0.10
Pipe 130	174	100	515.40	0.76	14.46	Pipe 193	34	150	-127.89	0.08	0.10
Pipe 131	8	100	78.08	0.12	0.44	Pipe 194	105	150	-127.89	0.08	0.10
Pipe 132	586	100	155.09	0.23	1.56	Pipe 195	17	150	-127.89	0.08	0.11
Pipe 133	578	100	185.99	0.27	2.19	Pipe 196	43	150	-127.89	0.08	0.11
Pipe 134	294	100	92.32	0.14	0.60	Pipe 197	52	150	269.55	0.18	0.42
Pipe 136	18	100	92.32	0.14	0.60	Pipe 198	32	150	-397.44	0.26	0.85
Pipe 137	50	100	185.99	0.27	2.19	Pipe 199	79	150	-397.44	0.26	0.86
Pipe 138	600	300	-4,029.03	0.66	3.09	Pipe 200	76	150	-397.44	0.26	0.86
Pipe 139	4	300	-1,496.34	0.25	0.50	Pipe 201	2	150	72.00	0.05	0.04
Pipe 140	440	300	3,710.19	0.61	2.65	Pipe 202	187	150	-469.44	0.31	1.16
Pipe 141	12	300	-557.14	0.09	0.08	Pipe 203	3	150	72.00	0.05	0.05
Pipe 142	86	300	-2,677.53	0.44	1.45	Pipe 204	122	150	-541.44	0.35	1.52
Pipe 144	130	200	-115.43	0.04	0.03	Pipe 205	67	150	-541.44	0.35	1.52
Pipe 145	410	200	-204.00	0.08	0.09	Pipe 206	198	150	88.11	0.06	0.05
Pipe 146	514	200	117.92	0.04	0.03	Pipe 207	37	150	88.11	0.06	0.05
Pipe 147	94	200	2,607.62	0.96	9.95	Pipe 208	1	150	72.00	0.05	0.00
Pipe 148	302	200	2,489.70	0.92	9.13	Pipe 209	174	150	16.11	0.01	0.00
Pipe 150	130	100	-684.68	1.01	24.47	Pipe 211	198	150	55.89	0.04	0.02
Pipe 151	302	200	1,624.50	0.60	4.14	Pipe 212	212	150	55.89	0.04	0.02
Pipe 152	500	400	8,681.72	0.80	3.16	Pipe 116	115	150	703.11	0.46	3.57
Pipe 153	400	500	8,359.24	0.49	0.99	Pipe 119	50	600	-16,089.52	0.66	1.37
Pipe 154	26	100	-93.67	0.14	0.61	Pipe 37	542	300	-3,740.73	0.61	2.69
Pipe 155	272	100	-93.67	0.14	0.62	Pipe 143	63	150	115.43	0.08	0.09
Pipe 156	58	200	-2,893.12	1.07	12.06	Pipe 210	43	150	115.43	0.08	0.09
Pipe 157	38	200	-2,250.82	0.83	7.58	Pipe 213	51	150	115.43	0.08	0.09
Pipe 158	122	200	-3,777.82	1.39	19.77	Pipe 214	50	150	64.43	0.04	0.03
Pipe 159	240	200	3,777.82	1.39	19.77	Pipe 215	41	150	64.43	0.04	0.03
Pipe 160	170	200	-2,761.24	1.02	11.06	Pipe 216	54	150	64.43	0.04	0.03
Pipe 161	108	150	-1,248.87	0.82	10.34	Pipe 217	152	150	64.43	0.04	0.03
Pipe 162	12	500	4,291.88	0.25	0.29	Pipe 218	146	150	64.43	0.04	0.03
Pipe 163	48	100	-57.88	0.09	0.25	Pipe 219	74	150	64.43	0.04	0.03
Pipe 164	110	100	-57.88	0.09	0.25	Pipe 220	36	150	64.43	0.04	0.03
Pipe 165	646	100	-269.38	0.40	4.35	Pipe 221	20	150	64.43	0.04	0.03
Pipe 166	46	200	1,206.50	0.44	2.39	Pipe 222	10	150	64.43	0.04	0.03
Pipe 167	94	250	1,206.50	0.28	0.81	Pipe 223	26	150	64.43	0.04	0.03

Network Table - Links											
Link ID	Leng-th m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km	Link ID	Length m	Dia. mm	Flow m3/d	Veloc-ity m/s	Unit Head-loss m/km
Pipe 168	168	250	2,268.42	0.53	2.59	Pipe 224	16	150	64.43	0.04	0.03
Pipe 169	515	500	-16,089.52	0.95	3.34	Pipe 225	19	150	13.43	0.01	0.00
Pipe 170	274	400	2,344.12	0.22	0.28	Pipe 226	27	150	13.43	0.01	0.00
Pipe 171	116	300	2,344.12	0.38	1.13	Pipe 227	8	150	13.43	0.01	0.00
Pipe 172	216	300	-2,129.00	0.35	0.95	Pipe 228	32	150	13.43	0.01	0.00
Pipe 173	40	500	9,061.08	0.53	1.15	Pipe 229	46	150	13.43	0.01	0.00
Pipe 174	896	500	9,061.08	0.53	1.15	Pipe 230	22	150	13.43	0.01	0.00
Pipe 175	232	200	115.43	0.04	0.03	Pipe 231	57	150	13.43	0.01	0.00
Pipe 176	6	200	-204.00	0.08	0.09	Pipe 232	34	150	13.43	0.01	0.00
Pipe 177	6	300	-2,677.53	0.44	1.45	Pipe 233	79	150	13.43	0.01	0.00
Pipe 178	12	300	-3,250.53	0.53	2.08	Pipe 234	133	150	13.43	0.01	0.00
Pipe 179	6	300	3,454.53	0.57	2.32	Pipe 235	109	150	-37.57	0.02	0.01
Pipe 180	120	100	-684.68	1.01	24.47	Pipe 236	329	150	-37.57	0.02	0.01
Pipe 181	294	100	-684.68	1.01	24.47	Pipe 237	329	150	-88.57	0.06	0.05
Pipe 135	686	150	703.11	0.46	3.57	Pipe 238	23	150	-88.57	0.06	0.05
Pipe 149	184	150	232.11	0.15	0.32	Pipe 239	83	150	-88.57	0.06	0.05
Pipe 182	45	150	232.11	0.15	0.32	Pipe 240	34	150	-88.57	0.06	0.05
Pipe 183	70	150	232.11	0.15	0.32	Pipe 241	55	150	-88.57	0.06	0.05
Pipe 184	12	150	72.00	0.05	0.04	Pipe 242	24	150	-88.57	0.06	0.06
Pipe 185	230	150	-160.11	0.10	0.16	Pipe 243	45	150	-88.57	0.06	0.05
Pipe 186	98	150	-160.11	0.10	0.16	Pipe 244	32	150	-88.57	0.06	0.05
Pipe 187	169	150	88.11	0.06	0.05	Pipe 245	20	150	-88.57	0.06	0.06
Pipe 188	26	150	88.11	0.06	0.05	Pipe 246	37	150	-88.57	0.06	0.05
Pipe 189	60	150	-55.89	0.04	0.02	Pipe 247	97	150	-88.57	0.06	0.05
Pipe 248	51	150	126.45	0.08	0.10	Pipe 287	67	150	-116.55	0.08	0.09
Pipe 249	67	150	126.45	0.08	0.10	Pipe 288	56	150	-116.55	0.08	0.09
Pipe 250	70	150	126.45	0.08	0.10	Pipe 289	36	150	-116.55	0.08	0.09
Pipe 251	89	150	126.45	0.08	0.10	Pipe 290	49	150	-116.55	0.08	0.09
Pipe 252	60	150	126.45	0.08	0.10	Pipe 291	56	150	-116.55	0.08	0.09
Pipe 253	150	150	126.45	0.08	0.10	Pipe 292	97	150	-116.55	0.08	0.09
Pipe 254	160	150	126.45	0.08	0.10	Pipe 293	48	150	-116.55	0.08	0.09
Pipe 255	11	150	126.45	0.08	0.10	Pipe 294	43	150	-116.55	0.08	0.09
Pipe 256	12	150	85.95	0.06	0.05	Pipe 295	19	150	-116.55	0.08	0.09
Pipe 257	159	150	85.95	0.06	0.05	Pipe 296	36	150	-116.55	0.08	0.09
Pipe 258	149	150	85.95	0.06	0.05	Pipe 297	38	150	-116.55	0.08	0.09
Pipe 259	42	150	85.95	0.06	0.05	Pipe 298	62	150	-116.55	0.08	0.09
Pipe 260	114	150	85.95	0.06	0.05	Pipe 299	82	150	-116.55	0.08	0.09
Pipe 261	32	150	85.95	0.06	0.05	Pipe 300	64	150	-116.55	0.08	0.09
Pipe 262	38	150	85.95	0.06	0.05	Pipe 301	89	150	40.50	0.03	0.01
Pipe 263	77	150	45.45	0.03	0.02	Pipe 302	35	150	40.50	0.03	0.01
Pipe 264	107	150	45.45	0.03	0.02	Pipe 303	52	150	40.50	0.03	0.01
Pipe 265	95	150	45.45	0.03	0.02	Pipe 304	44	150	40.50	0.03	0.01
Pipe 266	94	150	4.95	0.00	0.00	Pipe 305	123	150	40.50	0.03	0.01
Pipe 267	105	150	4.95	0.00	0.00	Pipe 306	66	150	40.50	0.03	0.01
Pipe 268	137	150	4.95	0.00	0.00	Pipe 307	53	150	40.50	0.03	0.01
Pipe 269	79	150	4.95	0.00	0.00	Pipe 308	64	150	-197.55	0.13	0.23
Pipe 270	80	150	-35.55	0.02	0.01	Pipe 309	81	150	-197.55	0.13	0.23
Pipe 271	139	150	-35.55	0.02	0.01	Pipe 310	61	150	-197.55	0.13	0.23
Pipe 272	23	150	-35.55	0.02	0.01	Pipe 311	36	150	-197.55	0.13	0.24
Pipe 273	76	150	-35.55	0.02	0.01	Pipe 312	38	150	-197.55	0.13	0.23
Pipe 274	69	150	-35.55	0.02	0.01	Pipe 313	20	150	-197.55	0.13	0.23
Pipe 275	43	150	-76.05	0.05	0.04	Pipe 314	44	150	-197.55	0.13	0.24
Pipe 276	68	150	-76.05	0.05	0.04	Pipe 315	49	150	-197.55	0.13	0.23
Pipe 277	43	150	-76.05	0.05	0.04	Pipe 316	101	150	-197.55	0.13	0.23
Pipe 278	21	150	-76.05	0.05	0.04	Pipe 329	100	200	115.43	0.04	0.02
Pipe 279	40	150	-76.05	0.05	0.04	Pipe 330	79	150	197.55	0.13	0.23
Pipe 280	48	150	-76.05	0.05	0.04	Pipe 331	52	150	197.55	0.13	0.23
Pipe 281	47	150	-76.05	0.05	0.04	Pipe 332	66	150	197.55	0.13	0.23
Pipe 282	84	150	-76.05	0.05	0.04	Pipe 322	80	200	513.00	0.19	0.49
Pipe 283	55	150	-76.05	0.05	0.04	Pipe 325	190	200	513.00	0.19	0.49
Pipe 284	69	150	-76.05	0.05	0.04	Pipe 111	65	300	2,798.79	0.46	1.57
Pipe 285	67	150	-116.55	0.08	0.09	Pipe 333	475	300	-2,798.79	0.46	1.57
Pipe 286	55	150	-116.55	0.08	0.09						

Appendix-8 Results of Borehole TV Camera Survey

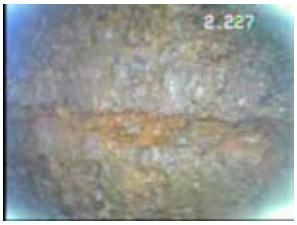
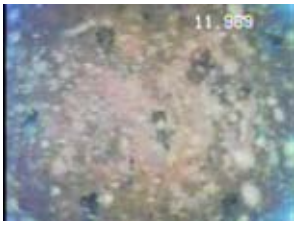
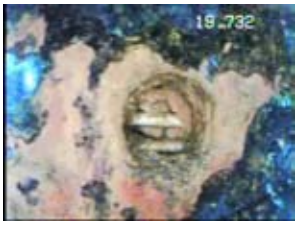
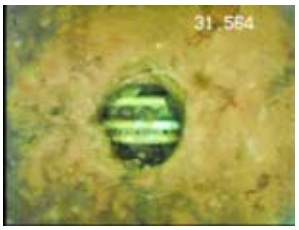
Borehole TV Camera Survey Log

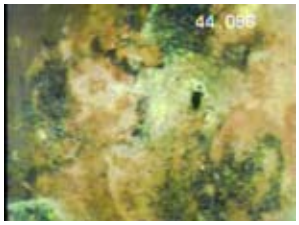
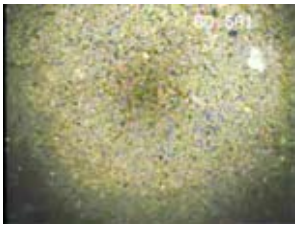
Date of Survey: 19/06/2008

No. of Well	1	Latitude	N49° 23' 41.1"	Longitude	E105° 54' 30.4"	Evaluation of Rehabilitation Priority	A

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	19/06/2008	S.W.L. (GL-m)	4.71 m		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	67.5 m	Pumping Rate (m3/h)		110	140	170	200	230
Position of Screen	8 m ~ 60.5 m	Drawdown (m)		0.92	1.12	1.39	1.66	1.97
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		119.6	125.0	122.3	120.5	116.8
Slot Size	16 mm	Sand Contents (mg/l)		0.2	0.1	0.1	0.1	0.1
Open Ratio	(%)	It is seemed that the screen with a depth of about 18-25m is main part for obtaining water. The iron rust and scale are remarkable upto a depth of 46m and slots are 50 to 90% plugged by iron rust and scale. But it is judged that these slots are well-functioned through water channel as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
2.23	Cracks on the casing pipe	 Cracks on the casing pipe (depth: 2.23m)
4.66	S.W.L.	
5		
8.90	(Screw Joint) - screen from this part onward	
10		 Slots are 60 to 70 % plugged by scales but are functioned as the screen (depth: 11.96m).
14.49	(Screw Joint)	
15		
20		 There are few iron incrustation and scale and the wrapped wire prevent intrusion of sand and gravel into the well (depth: 19.73m)
20.23	(Screw Joint)	
25		
26.21	(Screw Joint)	 There are few iron incrustation and scale and the wrapped wire prevent intrusion of sand and gravel into the well (depth: 31.56m)
30		
31.92	(Screw Joint)	
35		

Depth* (m)	Layer	Observation
35		
36.87	(Screw Joint)	 Iron rust and scales become thick but slots are not plugged by scales and are functioned as the screen (depth: 37.29m).
40		
42.67	(Screw Joint)	
45		 Slots are 80 to 90 % plugged by scales but are functioned through water passage as the screen (depth: 44.01m).
47.40	(Screw Joint)	
50		
53.18	(Screw Joint)	 Slots are not functioned as the screen due to large humped iron incrustation and scale (depth: 53.62m)
55		
58.01	(Screw Joint)	
60		
60.66	Well Bottom	 Well bottom burried by incrustations and scales (depth: 60.66m)
65		
70		

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 03/06/2008

No. of Well	2	Latitude	N49° 23' 48.9"	Longitude	E105° 54' 35.6"	Evaluation of Rehabilitation Priority	B

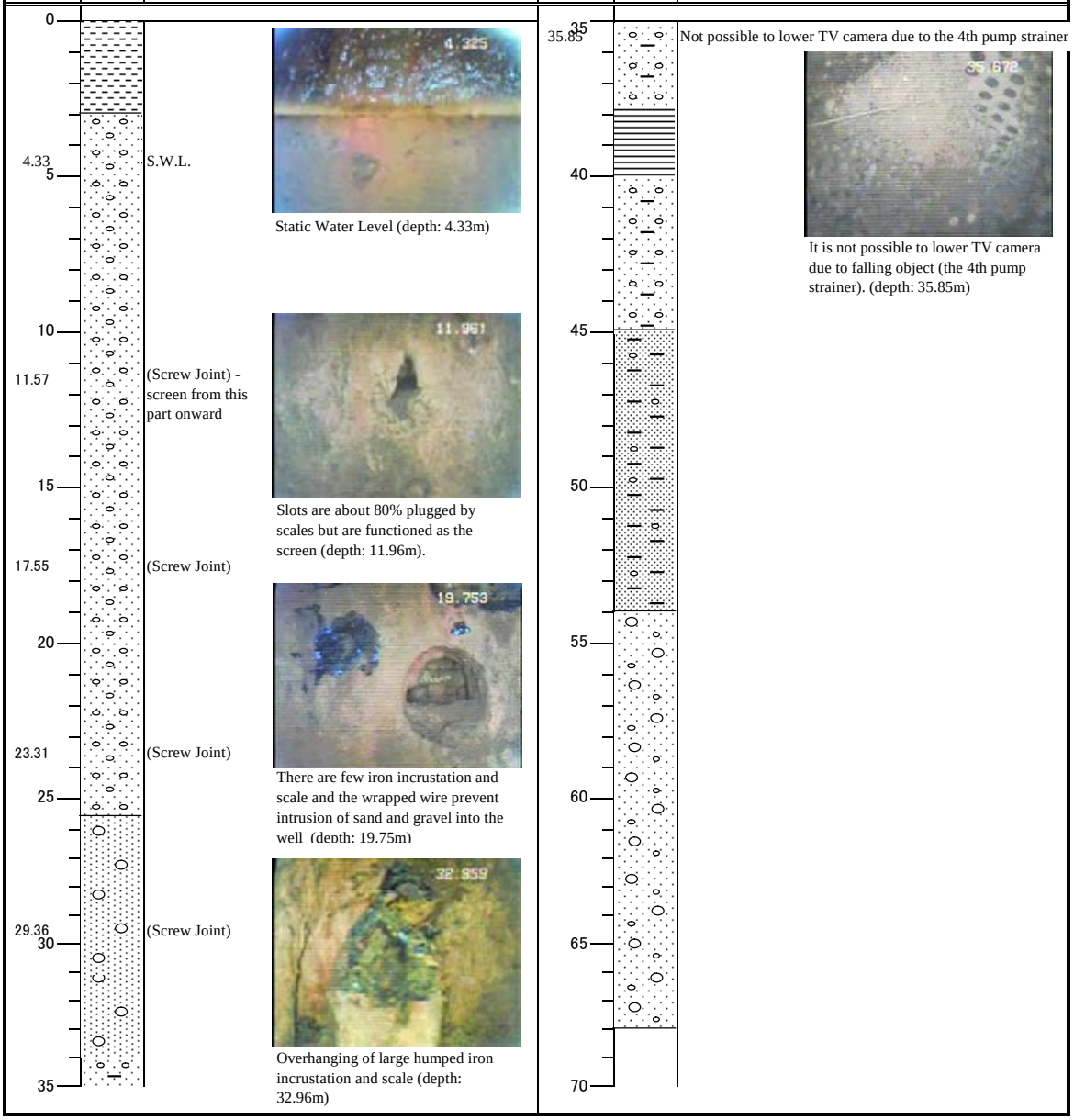
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1965
Casing Diameter	426 mm
Well Depth	68.0 m
Position of Screen	9 m ~ 45 m
Type of Screen	Slotted wire-wrapped pipe base screen
Slot Size	16 mm
Open Ratio	(%)
Material of Screen	Carbon steel
Material of Casing	Carbon steel

Result of Pumping Test and Sand Contents Test

Date	02/06/2008	S.W.L. (GL-m)	4.22 m			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		200	250	300	350	–
Drawdown (m)		1.65	2.24	2.70	3.13	-
Specific Capacity (m3/h/m)		121.2	111.6	111.1	111.8	-
Sand Contents (mg/l)		0.9	1.4	1.2	-	-

The iron rust and scale are remarkable from a depth of about 20m and slots are 60 to 80% plugged by iron rust and scale. But it is judged that slots upto a depth of 20m are slightly plugged butu are well-functioned totally as the screen.

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Suface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 05/06/2008

No. of Well	3	Latitude	N49° 23' 55.8"	Longitude	E105° 54' 39.8"	Evaluation of Rehabilitation Priority	A

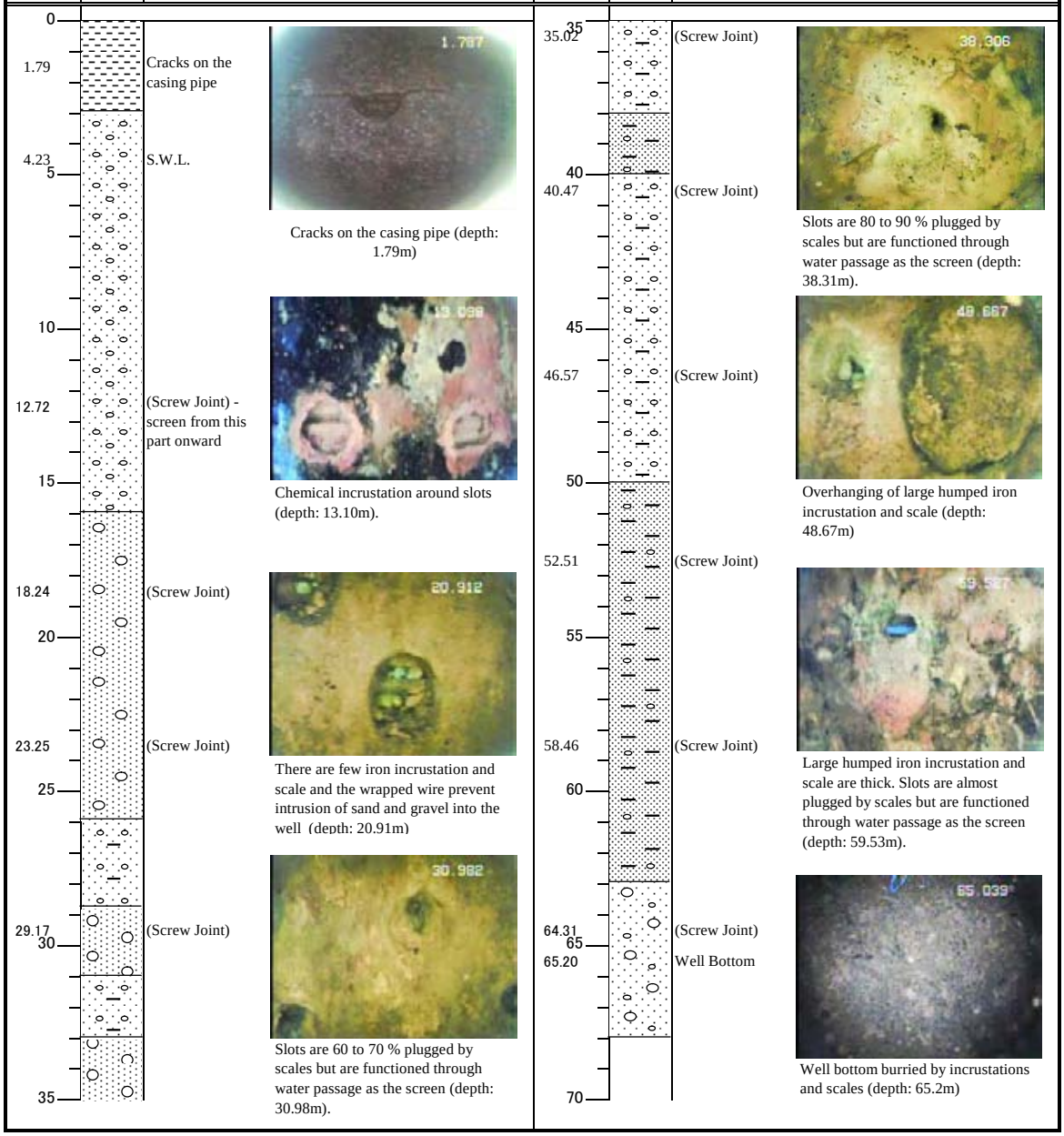
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1965
Casing Diameter	426 mm
Well Depth	68.0 m
Position of Screen	9.6 m ~ 61 m
Type of Screen	Slotted wire-wrapped pipe base screen
Slot Size	16 mm
Open Ratio	(%)
Material of Screen	Carbon steel
Material of Casing	Carbon steel

Result of Pumping Test and Sand Contents Test

Date	04/06/2008	S.W.L. (GL-m)	4.24 m			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		130	160	190	220	250
Drawdown (m)		1.08	1.23	1.49	1.83	2.08
Specific Capacity (m3/h/m)		120.4	130.1	127.5	120.2	120.2
Sand Contents (mg/l)		0.1	0.1	0.9	0.8	2.1

It is seemed that the screen with a depth of about 13-21m is main part for obtaining water. The iron rust and scale become remarkable from a depth of 36m to the bottom and slots are 50 to 90% plugged by iron rust and scale. But it is judged that these slots are well-functioned through water channel as the screen.

* : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

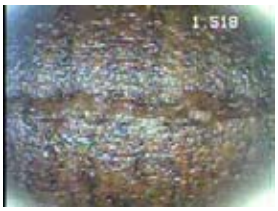
Date of Survey: 08/06/2008

No. of Well	4	Latitude	N49° 24' 03.3"	Longitude	E105° 54' 42.4"	Evaluation of Rehabilitation Priority	C

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	07/06/2008	S.W.L. (GL-m)	4.08		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	67.0 m	Pumping Rate (m3/h)		80	100	120	140	
Position of Screen	8 m ~ 59 m	Drawdown (m)		9.35	15.69	18.98	24.44	
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		8.6	6.4	6.3	5.7	
Slot Size	16 mm	Sand Contents (mg/l)		Nil	Nil	Nil	Nil	
Open Ratio	(%)	It is seemed that the screen with a depth of about 10-24m is slightly plugged by scales but is main part for obtaining water. It is judged that the slots from a depth of 32m to the bottom are almost 100% plugged by iron rust and scales and are not functioned as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
1.52		Cracks on the casing pipe
4.09		S.W.L.
5		
9.91		(Screw Joint) - screen from this part onward
10		
15		
15.75		(Screw Joint)
20		
21.55		(Screw Joint)
25		
27.22		(Screw Joint)
30		
32.92		(Screw Joint)
35		



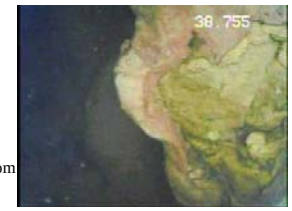
Cracks on the casing pipe (depth: 1.79m)

Functioned slots and wrapped wires (depth: 12.17m)

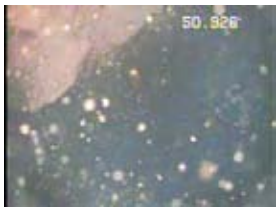
There are few iron incrustation and scale and the wrapped wire prevent intrusion of sand and gravel into the well (depth: 23.44m)

Slots are almost 100 % plugged by scales and are not functioned as the screen (depth: 33.70m).

Depth* (m)	Layer	Observation
35		
38.58		(Screw Joint) Position of screw joint is unclear from this part onward.
40		
45		
50		
55		
58.04		Falling object (Pump strainer)
60		
65		
70		



Slots are not functioned as the screen due to large humped iron incrustation and scale (depth: 38.76m)



Overhanging of large humped iron incrustation and scale (depth: 50.93m)

Falling object (Pump strainer) (depth: 58.04m)

It is not possible to lower TV camera due to falling object (the another pump strainer). (depth: 58.2m)

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

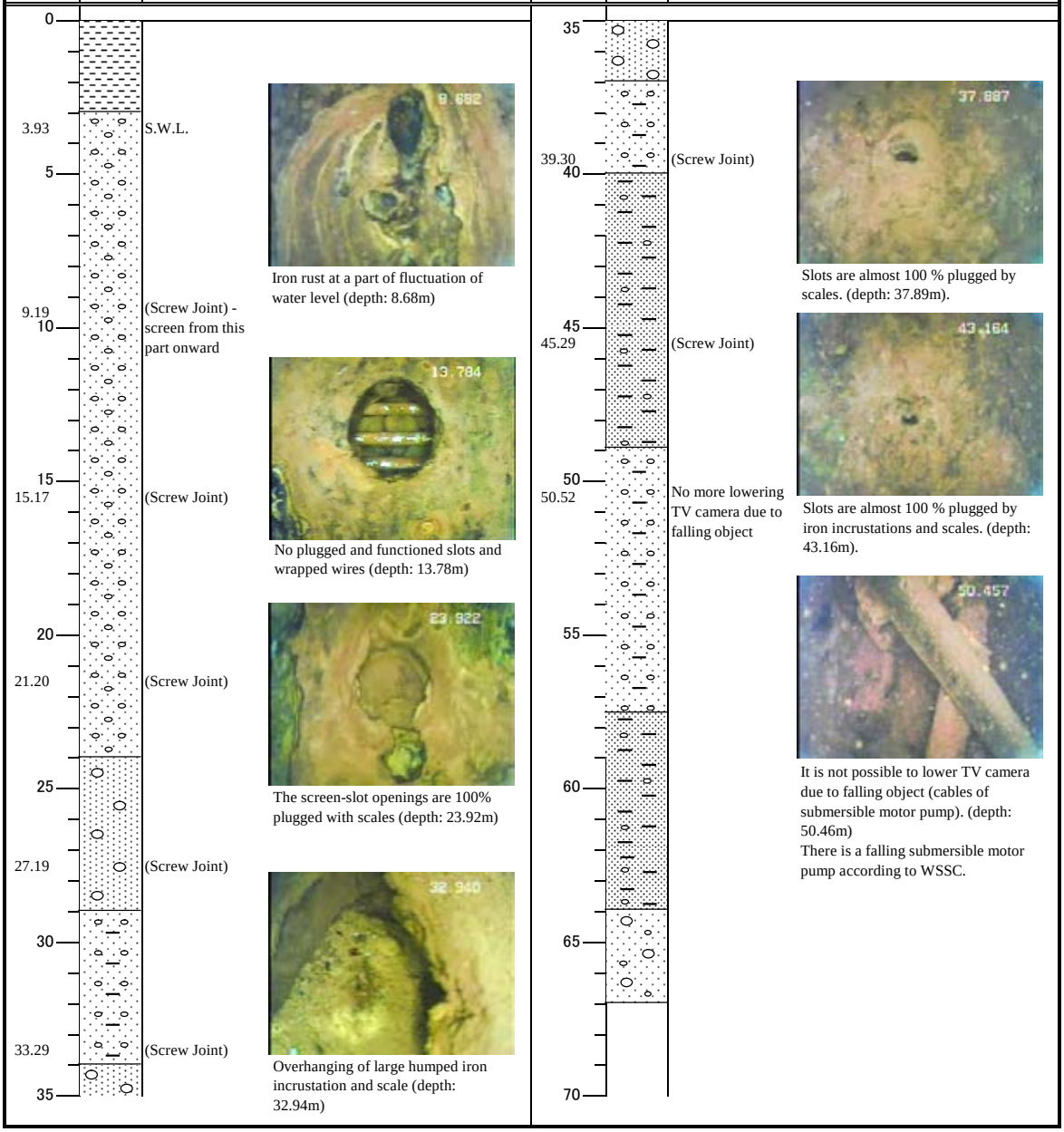
Borehole TV Camera Survey Log

Date of Survey: 09/06/2008

No. of Well	5	Latitude	N49° 24' 10.9"	Longitude	E105° 54' 44.6"	Evaluation of Rehabilitation Priority	C

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	09/06/2008	S.W.L. (GL-m)	3.98 m		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	68.0 m	Pumping Rate (m3/h)		120	140	160	180	190
Position of Screen	8 m ~ 59.6 m	Drawdown (m)		4.52	5.56	6.44	7.65	7.76
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		26.5	25.2	24.8	23.5	24.5
Slot Size	16 mm	Sand Contents (mg/l)		0.7	0.6	0.5	2.4	3.2
Open Ratio	(%)	The iron rust and scale become remarkable from a depth of 30m to the bottom and slots are 90 to 100% plugged by iron rust and scale. Therefore it is judged that these slots are not functioned as the screen.						
Material of Screen	Carbon steel							
Material of Casing	Carbon steel							

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 10/06/2008

No. of Well	6	Latitude	N49° 24' 18.1"	Longitude	E105° 54' 47.4"	Evaluation of Rehabilitation Priority	C

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	09/06/2008	S.W.L. (GL-m)	3.87		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	67.0 m	Pumping Rate (m3/h)		90	110	130	150	
Position of Screen	8.5 m ~ 60 m	Drawdown (m)		8.84	9.93	10.31	10.51	
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		10.2	11.1	12.6	14.3	
Slot Size	16 mm	Sand Contents (mg/l)		Nil	0.2	0.3	0.3	
Open Ratio	(%)	It is seemed that the screen with a depth of about 10-24m is slightly plugged by scales but is main part for obtaining water. It is judged that the slots from a depth of 32m to the bottom are almost 100% plugged by iron rust and scales such as No. 4 and No. 5 Well and are not functioned as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

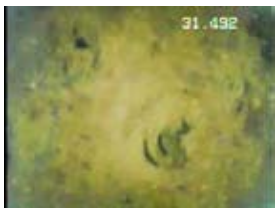
∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
0.26		Hole caused by corrosion
2.00		Cracks on the casing pipe
2.54		
3.92		S.W.L.
5		
7.88		(Screw Joint) - screen from this part onward
10		
13.95		(Screw Joint)
15		
19.65		(Screw Joint)
20		
25		
25.41		(Screw Joint)
30		
31.02		(Screw Joint)
35		

Cracks on the casing pipe (depth: 1.99m)

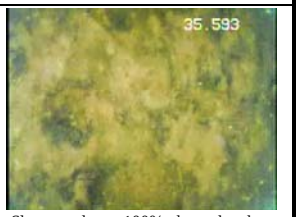
There are few scales around slots but these slots are functioned normally as the screen. (depth: 12.13m)

There are few scales and the wrapped wires prevent intrusion of sand and gravel into the well (depth: 20.32m)

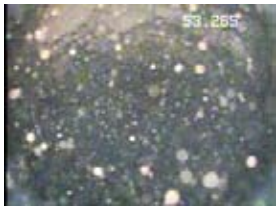


Slots are 90 to 100 % plugged by scales and are not functioned as the screen (depth: 31.50m).

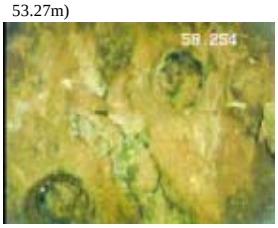
Depth* (m)	Layer	Observation
35		
37.05		(Screw Joint)
40		
42.93		(Screw Joint)
45		
48.18		(Screw Joint)
50		
53.81		(Screw Joint)
55		
59.68		(Screw Joint)
60		
61.71		Well bottom
65		
70		



Slots are almost 100% plugged and are not functioned as the screen due to large humped iron incrustation and scale (depth: 35.60m)



Overhanging of large humped iron incrustation and scale (depth: 53.27m)



Slots are almost 100% plugged and are not functioned as the screen due to large humped iron incrustation and scale (depth: 58.26m)

Well bottom burried by thick iron incrustations and scales (depth: 65.2m)

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

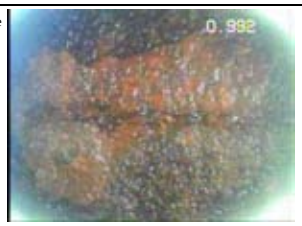
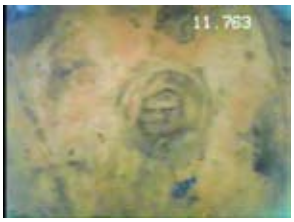
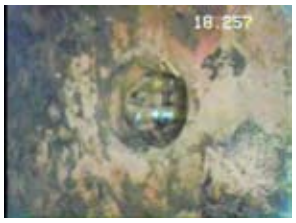
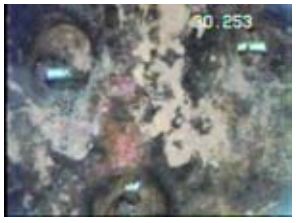
Borehole TV Camera Survey Log

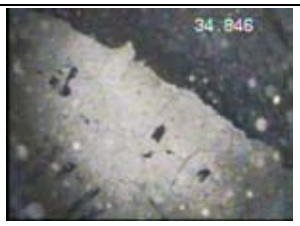
Date of Survey: 17/06/2008

No. of Well	7	Latitude	N49° 24' 25.7"	Longitude	E105° 54'50.0"	Evaluation of Rehabilitation Priority	A

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	17/06/2008	S.W.L. (GL-m)		3.89	
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)	164.7	158.9	163.9	162.0	168.8
Slot Size	16 mm	Sand Contents (mg/l)	Nil	Nil	Nil	1.1	0.2
Open Ratio	(%)	It is seemed that the screen with a depth of about 10-25m is main part for obtaining water. The iron rust and scale become remarkable from a depth of 25m to 35m and slots are 50 to 70% plugged by iron rust and scale. But it is judged that these slots are well-functioned through water channel as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
0.99	Cracks on the casing pipe	 Cracks on the casing pipe and some leakage observed (depth: 0.99m)
1.09	(Screw Joint)	
3.88	S.W.L.	
5		
10		 There are few scales around slots but these slots are functioned normally as the screen. (depth: 11.76m)
10.45	(Screw Joint) - screen from this part onward	
15		
15.62	(Screw Joint)	
20		 There are few scales around slots and the wrapped wires prevent intrusion of sand and gravel into the well (depth: 18.26m)
21.37	(Screw Joint)	
25		
27.08	(Screw Joint)	 Slots are almost 70% plugged by scales but are functioned through water passage as the screen (depth: 30.25m).
30		
33.04	(Screw Joint)	
35		

Depth* (m)	Layer	Observation
35付近	Falling object (Pump strainer)	 It is not possible to lower TV camera due to falling objects (two pump strainers). (depth: about 35m)
40		
45		
50		
55		
60		
65		
70		

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

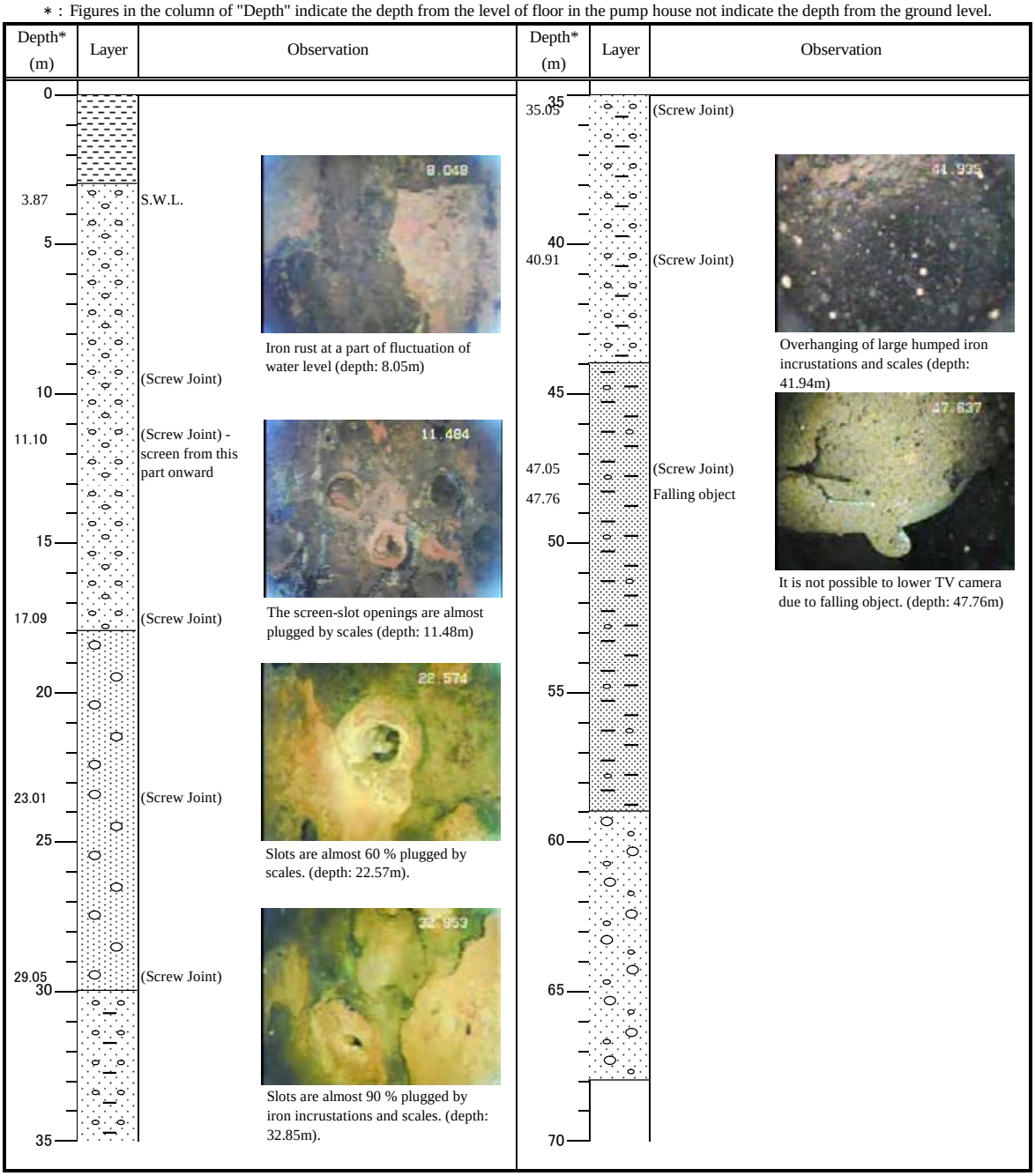
Borehole TV Camera Survey Log

Date of Survey: 16/06/2008

No. of Well	8	Latitude	N49° 24' 33.6"	Longitude	E105° 54' 49.4"	Evaluation of Rehabilitation Priority	C

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	15/06/2008	S.W.L. (GL-m)	3.90 m		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	67.5 m	Pumping Rate (m3/h)		130	160	190	220	250
Position of Screen	9 m ~ 57 m	Drawdown (m)		3.02	4.16	5.14	6.36	7.37
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		43.0	38.5	37.0	34.6	33.9
Slot Size	16 mm	Sand Contents (mg/l)		Nil	0.5	0.9	0.8	2.1
Open Ratio	(%)	The iron rust and scale become remarkable from a depth of 31m to the bottom and there is a possibility that coroosion is in progress in the casing pipe. And slots are 90 to 100% plugged by iron rust and scale. Therefore it is judged that these slots are not functioned as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 17/06/2008

No. of Well	9	Latitude	N49° 24' 42.0"	Longitude	E105° 54'48.9"	Evaluation of Rehabilitation Priority	C

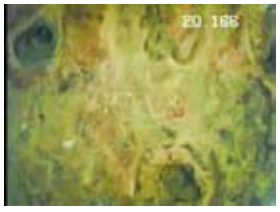
Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	15/06/2008	S.W.L. (GL-m)	3.64		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	68.0 m	Pumping Rate (m3/h)		110	140	170	200	225
Position of Screen	9.3 m ~ 61.6 m	Drawdown (m)		4.54	6.30	7.57	7.77	8.05
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		24.2	22.2	22.5	25.7	28.0
Slot Size	16 mm	Sand Contents (mg/l)		Nil	Nil	Nil	Nil	Nil
Open Ratio	(%)	The slots with a depth of 10 to 22m are functioned as the screen. But the iron rust and scale become remarkable from a depth of 22m to the bottom and slots are almost 100% plugged by iron rust and scale. Therefore it is judged that these slots are not functioned as the screen.						
Material of Screen	Carbon steel							
Material of Casing	Carbon steel							

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
1.75		Cracks on the casing pipe
3.64		S.W.L.
5		
10		
10.64		(Screw Joint) - screen from this part onward
15		
16.46		(Screw Joint)
20		
22.26		(Screw Joint)
24.01		Falling object (Pump strainer)
25		
28.09		(Screw Joint)
30		
30.69		Falling object (Pump strainer)
35		

Cracks on the casing pipe (depth: 1.75m)

There are few scales around slots but these slots are well-functioned as the screen. (depth: 11.42m)



Slots are almost 70% plugged by scales but are functioned through water passage as the screen (depth: 20.17m).

It is not possible to lower TV camera due to falling objects (pump strainer). (depth: about 31m)

Depth* (m)	Layer	Observation
35		
40		
45		
50		
55		
60		
65		
70		

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

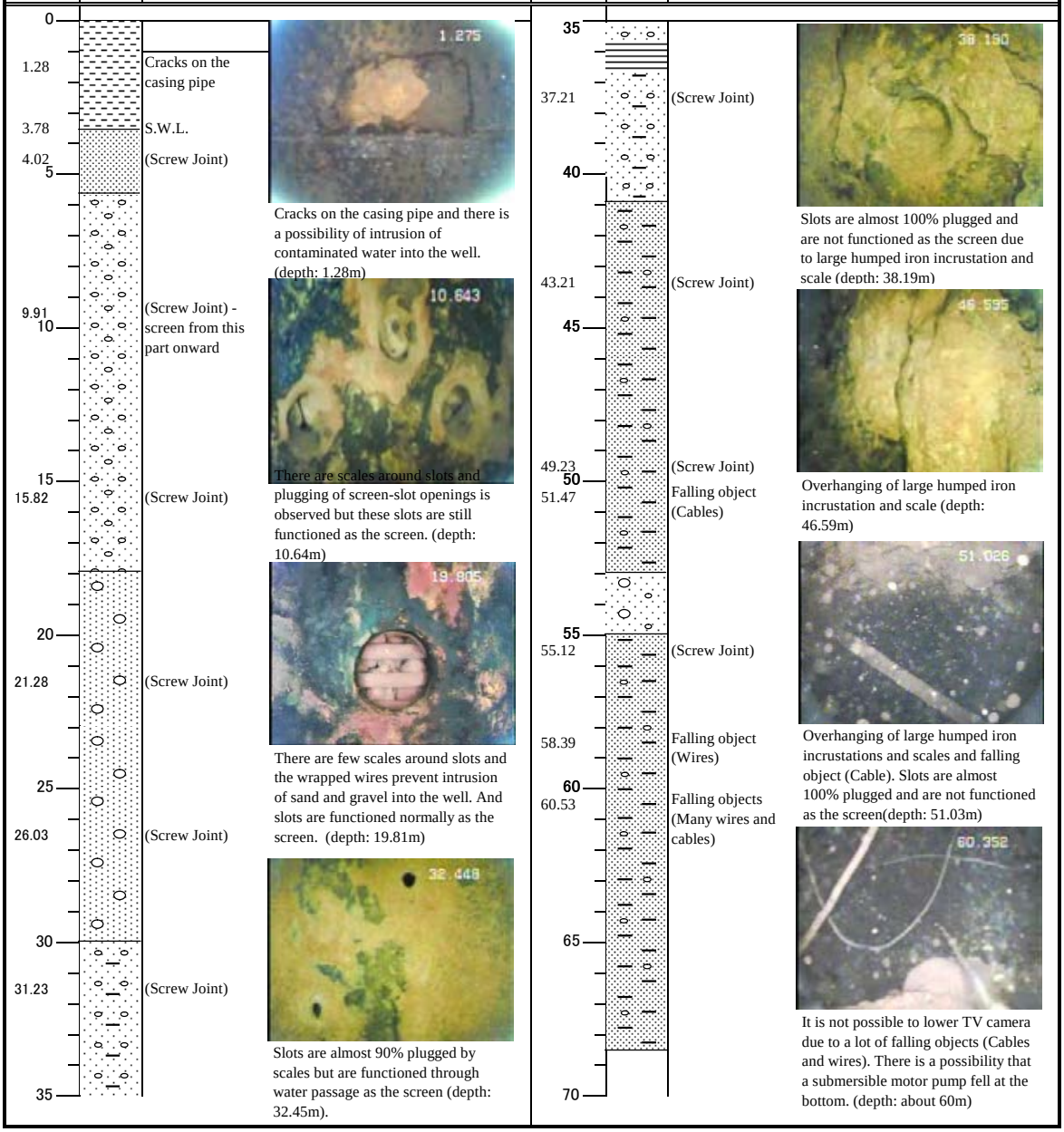
Borehole TV Camera Survey Log

Date of Survey: 15/06/2008

No. of Well	10	Latitude	N49° 24' 49.7"	Longitude	E105° 54'47.8"	Evaluation of Rehabilitation Priority	C

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1965	Date	16/06/2008	S.W.L. (GL-m)	3.81		
Casing Diameter	426 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	68.5 m	Pumping Rate (m3/h)		100	120	140	160	180
Position of Screen	8.5 m ~ 61.3 m	Drawdown (m)		5.98	7.69	10.06	11.98	13.16
Type of Screen	Slotted wire-wrapped pipe base screen	Specific Capacity (m3/h/m)		16.7	15.6	13.9	13.4	13.7
Slot Size	16 mm	Sand Contents (mg/l)		Nil	Nil	Nil	0.1	0.7
Open Ratio	(%)	The slots with a depth of 10 to 22m are functioned as the screen. But the iron rust and scale become remarkable from a depth of 31m to the bottom and slots are 80 to 100% plugged by iron rust and scale. Therefore it is judged that these slots are not functioned as the screen.					
Material of Screen	Carbon steel						
Material of Casing	Carbon steel						

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 11/06/2008

No. of Well	11	Latitude	N49° 24' 57.2"	Longitude	E105° 54' 47.9"	Evaluation of Rehabilitation Priority	A

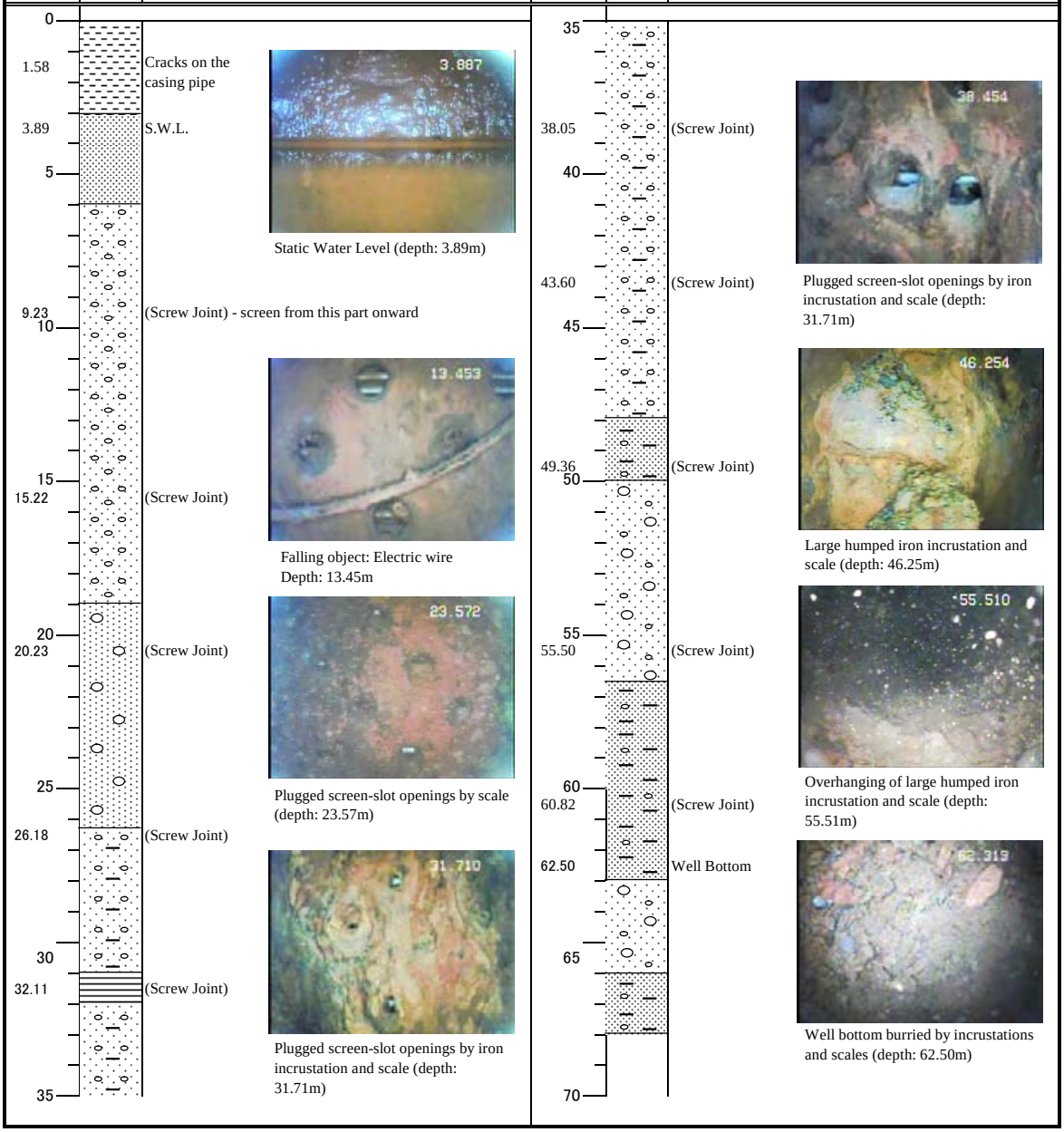
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1965
Casing Diameter	426 mm
Well Depth	68.0 m
Position of Screen	8.4 m ~ 59.8 m
Type of Screen	Slotted wire-wrapped pipe base screen
Slot Size	16 mm
Open Ratio	(%)
Material of Screen	Carbon steel
Material of Casing	Carbon steel

Result of Pumping Test and Sand Contents Test

Date	10/06/2008	S.W.L. (GL-m)	3.87			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		140	170	200	230	260
Drawdown (m)		1.06	1.36	1.61	1.87	2.12
Specific Capacity (m3/h/m)		132.1	125.0	124.2	123.0	122.6
Sand Contents (mg/l)		Nil	Nil	Nil	Nil	Nil

The iron rust and scale become remarkable from a depth of 32m to the bottom same as No. 4 and No. 6 Well and slots are 40 to 70% plugged by iron rust and scale. But it is judged that these slots are well-functioned totally through water channel as the screen.

∗ : Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 02/06/2008

No. of Well	12	Latitude	N49° 23' 35.3"	Longitude	E105° 54' 25.9"	Evaluation of Rehabilitation Priority	B

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**					
Year of Construction	1978～1984	Date	01/06/2008	S.W.L. (GL-m)	3.88		
Casing Diameter	352 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	65.0 m (Design Policy)	Pumping Rate (m3/h)		300	330	360	390	
Position of Screen	38 m ～ 63 m (Design Policy)	Drawdown (m)		1.48	1.70	1.83	1.96	
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)	Specific Capacity (m3/h/m)		202.7	194.1	196.7	199.0	
Slot Size	16 mm (Design Policy)	Sand Contents (mg/l)		0.3	0.5	0.7	2.0	
Open Ratio	(%)	The iron rust and scale are totally remarkable and slots are 30 to 50% plugged by iron rust and scale. But it is judged that these slots are well-functioned totally through water channel as the screen. Therefore if pump cables are fished away out of the well it is judged that the well can be rehabilitated by proper manner.					
Material of Screen	Carbon steel (Design Policy)						
Material of Casing	Carbon steel (Design Policy)						

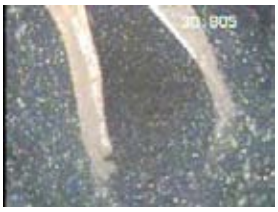
＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
0		
0.13	(Welded Joint)	
2.06	S.W.L.	
5		
8.64	(Welded Joint)-screen from this part onward	
10		
15		
20		
25		
30		
30.78	Falling object (Pump cable)	
35		
40		
45		
50		
55		
60		
65		
70		

Static Water Level: 2.06m)

There are few scales around slots but these slots are well-functioned as the screen. (depth: 12.08m)

There are few scales around slots but these slots are well-functioned through water passage as the screen. (depth: 24.88m)



It is not possible to lower TV camera due to falling objects (pump cable). (depth: 30.81m)

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 20/06/2008

No. of Well	13	Latitude	N49° 23' 29.3"	Longitude	E105° 54' 22.3"	Evaluation of Rehabilitation Priority	B

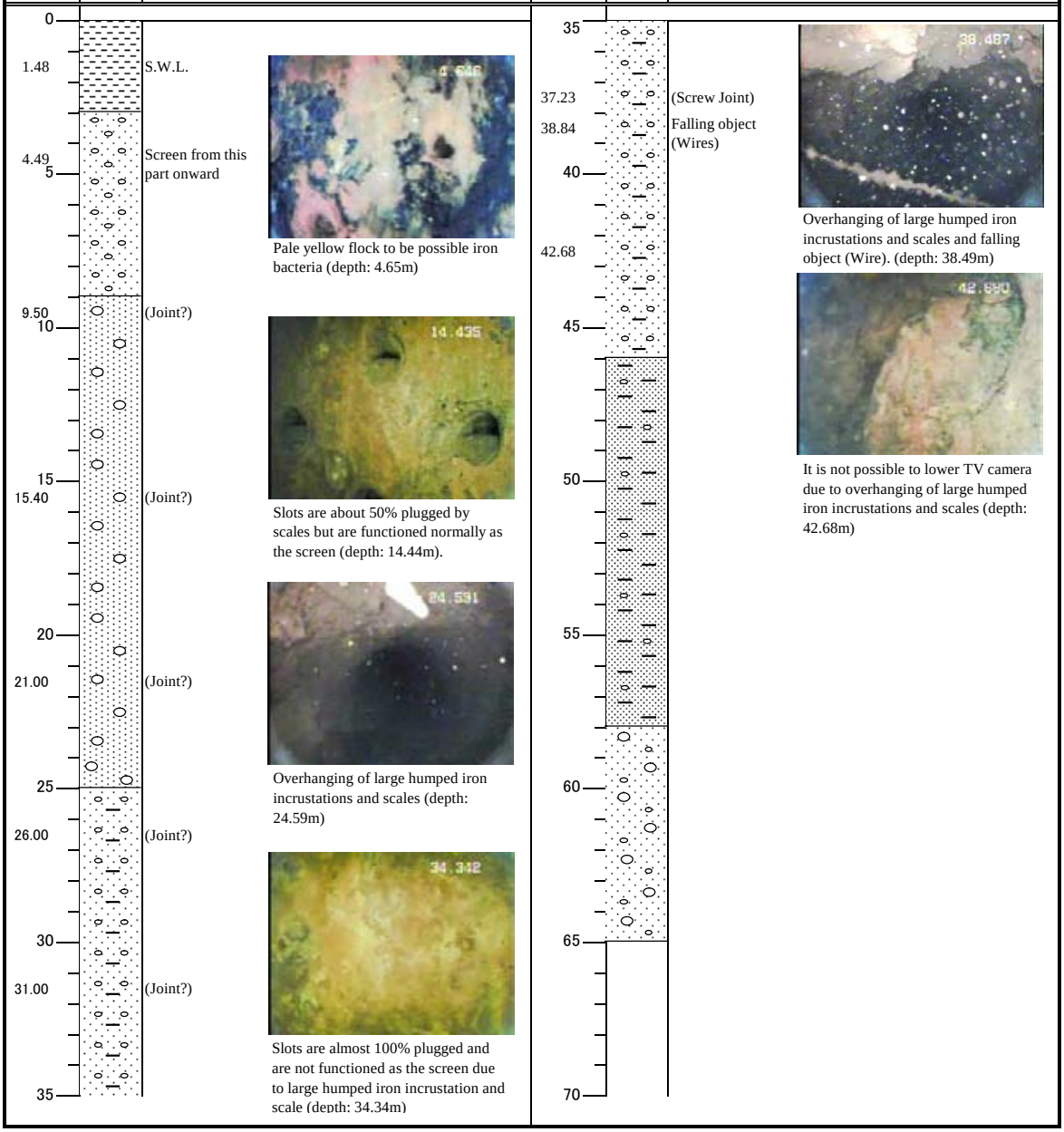
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1978～1984
Casing Diameter	352 mm
Well Depth	65.0 m (Design Policy)
Position of Screen	38 m ～ 63 m (Design Policy)
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)
Slot Size	16 mm (Design Policy)
Open Ratio	(%)
Material of Screen	Carbon steel (Design Policy)
Material of Casing	Carbon steel (Design Policy)

Result of Pumping Test and Sand Contents Test

Date	27/05/2008	S.W.L. (GL-m)	3.55			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		200	250	300	350	400
Drawdown (m)		1.39	1.81	2.19	2.63	2.88
Specific Capacity (m3/h/m)		143.9	138.1	137.0	133.1	138.9
Sand Contents (mg/l)		3.5	1.4	1.2	1.0	2.6

The slots with a depth of 9 to 17.5m are functioned as the screen. And the iron rust and scale become remarkable from a depth of 22m. It is judged that these slots from a depth of 27m are not functioned as the screen.

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 27/05/2008

No. of Well	14	Latitude	N49° 23' 22.9"	Longitude	E105° 54' 17.5"	Evaluation of Rehabilitation Priority	B

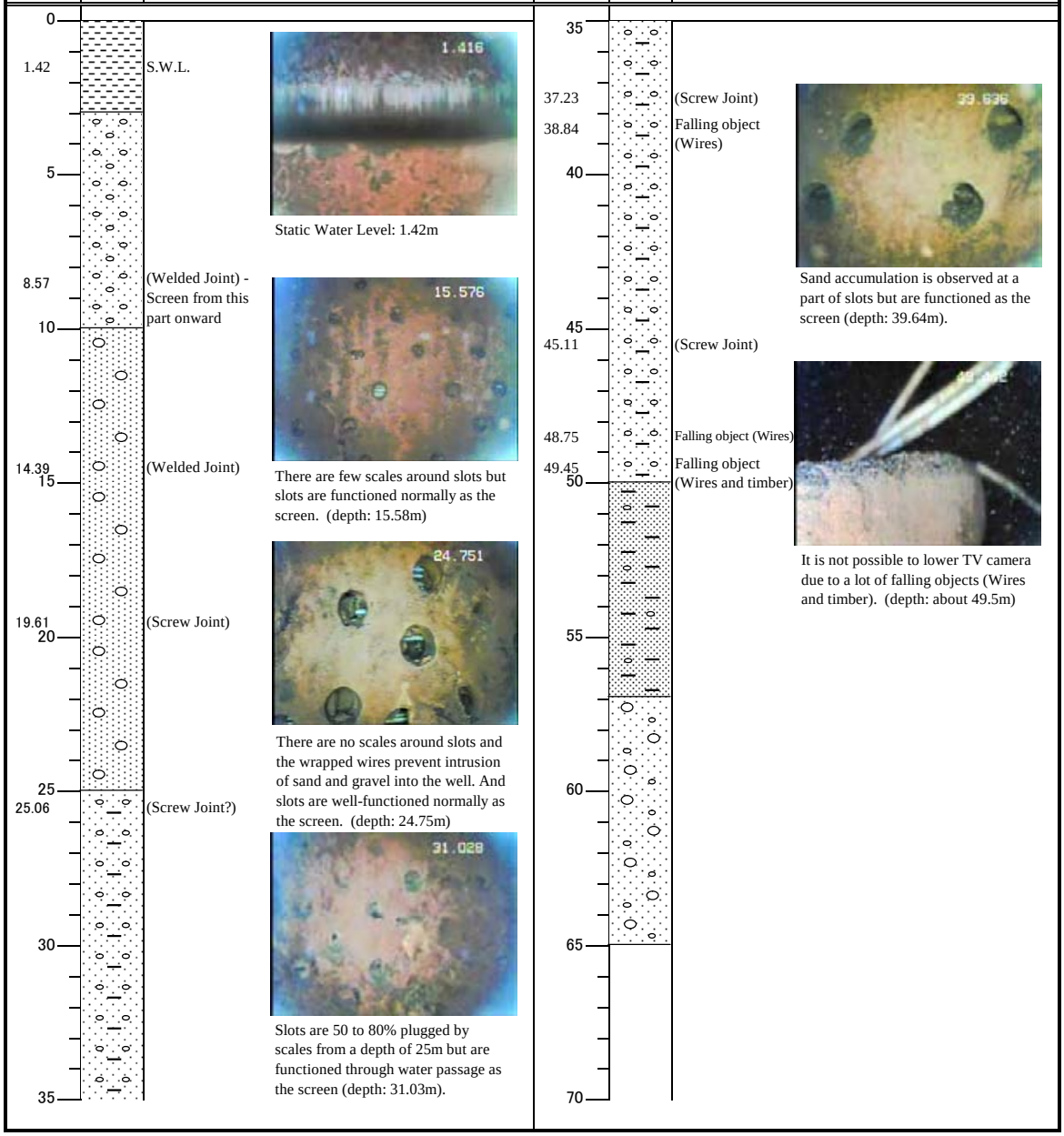
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1978～1984
Casing Diameter	352 mm
Well Depth	65.0 m (Design Policy)
Position of Screen	38 m ～ 63 m (Design Policy)
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)
Slot Size	16 mm (Design Policy)
Open Ratio	(%)
Material of Screen	Carbon steel (Design Policy)
Material of Casing	Carbon steel (Design Policy)

Result of Pumping Test and Sand Contents Test

Date	26/05/2008	S.W.L. (GL-m)	3.65			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		200	250	300	350	400
Drawdown (m)		1.00	1.27	1.57	1.85	2.11
Specific Capacity (m3/h/m)		200.0	196.9	191.1	189.2	189.6
Sand Contents (mg/l)		0.9	0.2	0.2	2.7	3.5

The slots with a depth of 9 to 25m are well-functioned as the screen. And the iron rust and scale become remarkable from a depth of 25m and slots are 60 to 80% plugged by scales. But it is judged that these slots are well-functioned through water channel as the screen.

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 22/06/2008

No. of Well	15	Latitude	N49° 23' 17.7"	Longitude	E105° 54' 14.0"	Evaluation of Rehabilitation Priority	A

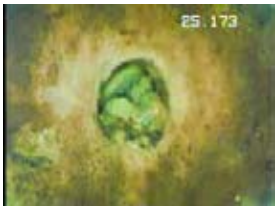
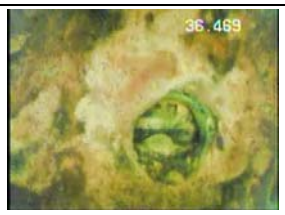
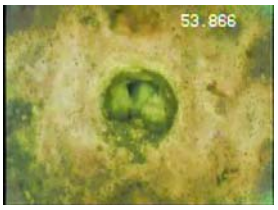
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1978～1984
Casing Diameter	352 mm
Well Depth	65.0 m (Design Policy)
Position of Screen	38 m ～ 63 m (Design Policy)
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)
Slot Size	16 mm (Design Policy)
Open Ratio	(%)
Material of Screen	Carbon steel (Design Policy)
Material of Casing	Carbon steel (Design Policy)

Result of Pumping Test and Sand Contents Test

Date	21/06/2008	S.W.L. (GL-m)	3.31 m			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		130	160	190	220	250
Drawdown (m)		0.73	0.96	1.12	1.28	1.43
Specific Capacity (m3/h/m)		178.1	166.7	169.6	171.9	174.8
Sand Contents (mg/l)		1.3	1.1	0.9	1.2	1.0

This well has only few iron rust and scales among all of 18 wells. The screen-slot openings with a depth 10 to 56m are slightly plugged by scales but there are water channels in those openings. Therefore it is judged that these slots are well-functioned through water channel as the screen. Meanwhile it is recommended that the length of riser pipe shall be maximum 3m since it was not possible to lower dowm a riser pipe with a length of 5m in the well.

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.

Depth* (m)	Layer	Observation
1.13	S.W.L.	 Static Water Level: 1.13m
1.23	(Screw Joint)	
10.16	(Screw Joint) - Screen from this part onward	 Slot is plugged by gravel.Sand accumulation is observed at a part of slot. (depth: 14.35m).
19.73	(Screw Joint)	 Falling object: Pump strainer (depth: 17.02m)
29.51	(Screw Joint)	 Slot is plugged by gravel. (depth: 25.17m).
40.92	(Screw Joint)	 Iron rusts are thick on the casing pipe but slot itself has no plugging. (depth: 36.47m).
48.19	(Screw Joint)	 There are few plugging on slots but are functioned through water passage as the screen (depth: 42.96m).
55.95	(Screw Joint) Casing pipes continues from this part to the bottom.	 There are few plugging on slots but are functioned through water passage as the screen (depth: 53.87m).
61.13	Well bottom	 Well bottom being burried by thick iron incrustations and scales (depth: 61.13m)

Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 20/06/2008

No. of Well	16	Latitude	N49° 23' 11.8"	Longitude	E105° 54' 10.2"	Evaluation of Rehabilitation Priority	A

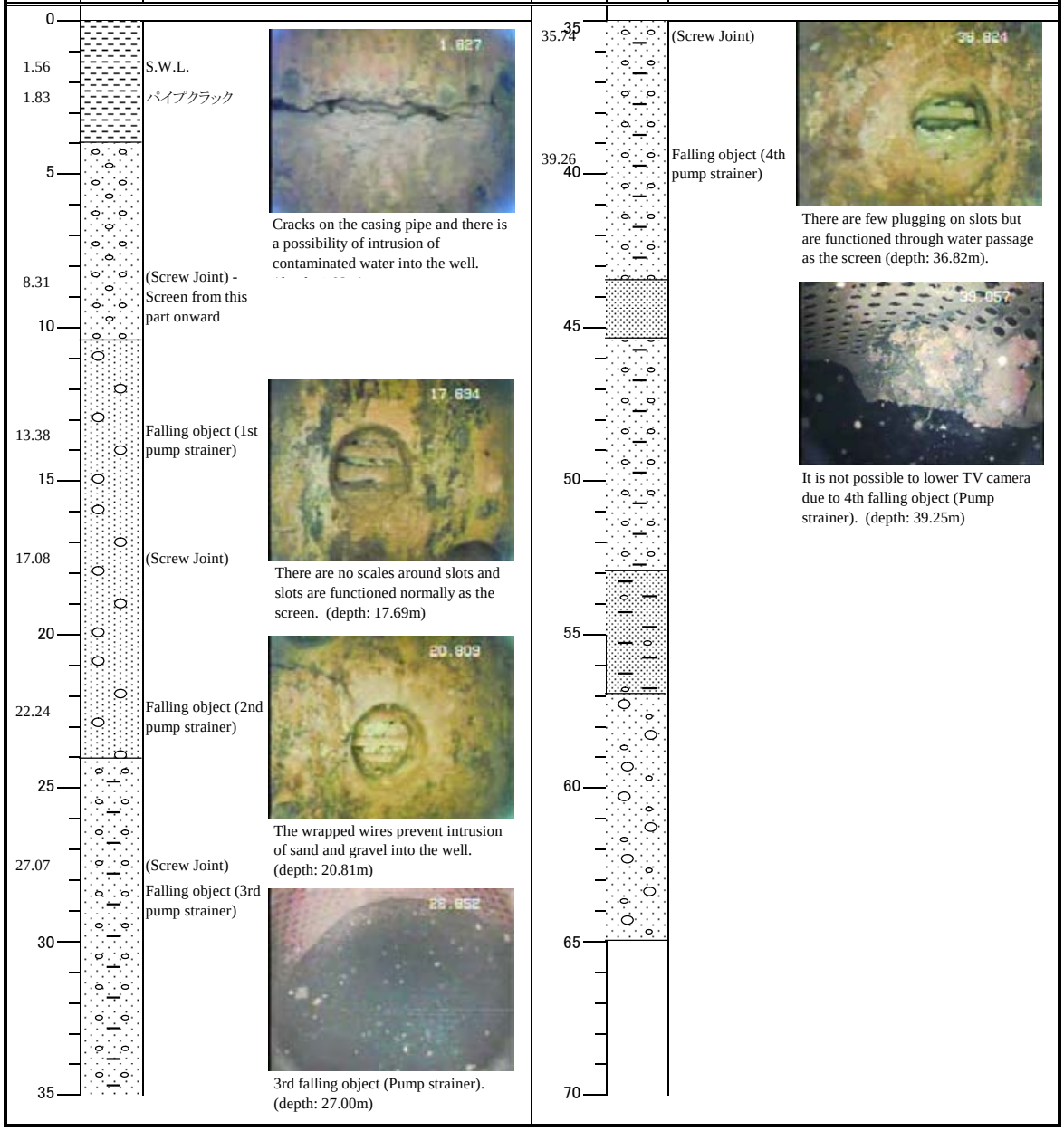
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1978～1984
Casing Diameter	352 mm
Well Depth	65.0 m (Design Policy)
Position of Screen	38 m ～ 63 m (Design Policy)
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)
Slot Size	16 mm (Design Policy)
Open Ratio	(%)
Material of Screen	Carbon steel (Design Policy)
Material of Casing	Carbon steel (Design Policy)

Result of Pumping Test and Sand Contents Test

Date	28/05/2008	S.W.L. (GL-m)	3.40 m			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		200	250	300	350	400
Drawdown (m)		0.95	1.27	1.49	1.78	1.88
Specific Capacity (m3/h/m)		210.5	196.9	201.3	196.6	212.8
Sand Contents (mg/l)		0.9	1.4	1.7	1.5	3.9

The screen-slot openings are partially plugged by scales but it is judged that these slots are well-functioned totally as the screen. Therefore if four pump strainers are fished away out of the well it is judged that the well can be rehabilitated by proper manner.

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

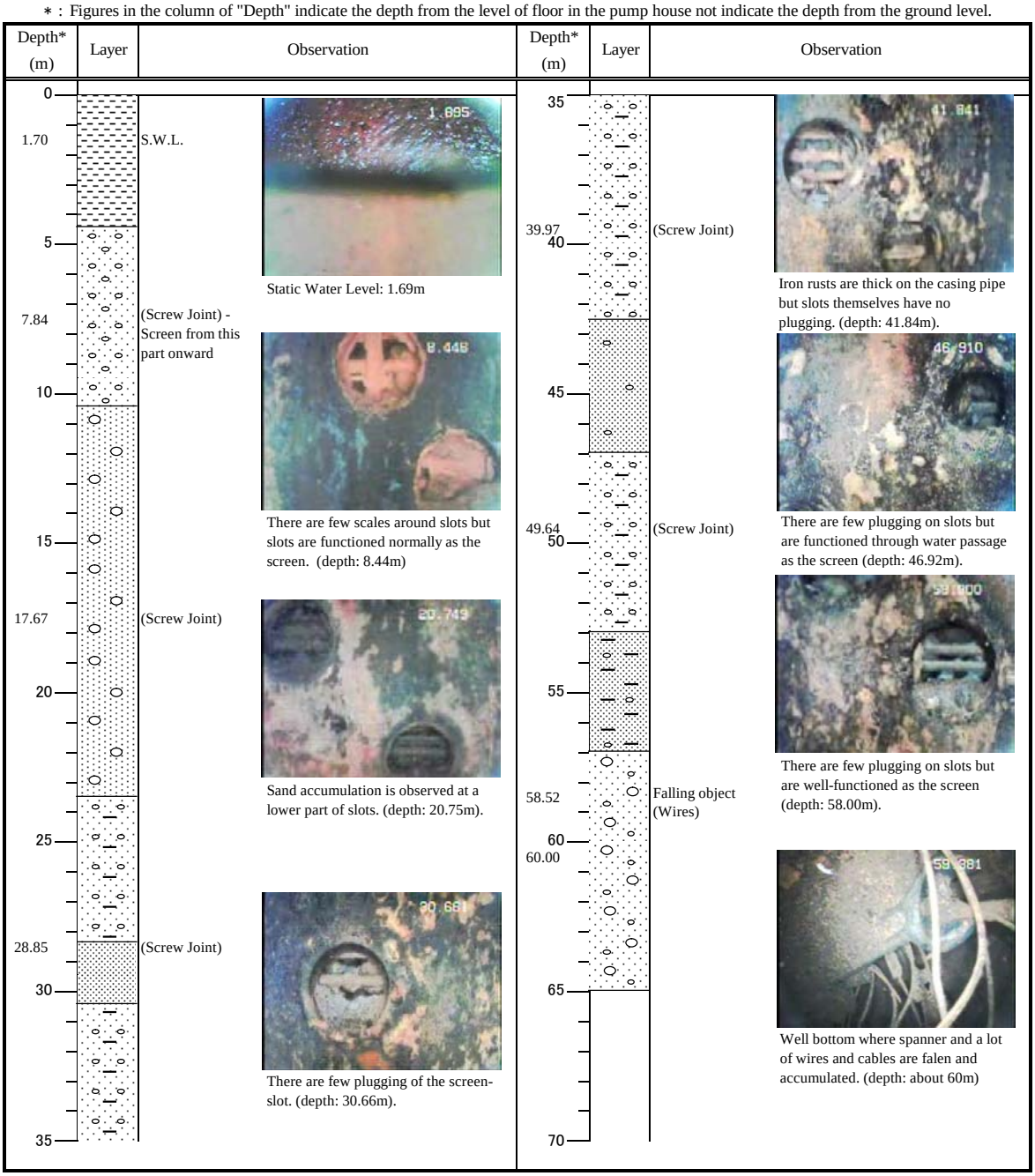
Borehole TV Camera Survey Log

Date of Survey: 30/05/2008

No. of Well	17	Latitude	N49° 23' 05.2"	Longitude	E105° 54' 05.5"	Evaluation of Rehabilitation Priority	A

Basic Information (based on PNIIS report, 1978)		**Result of Pumping Test and Sand Contents Test**						
Year of Construction	1978～1984	Date	29/05/2008	S.W.L. (GL-m)	3.62 m			
Casing Diameter	352 mm	Step		1st step	2nd step	3rd step	4th step	5th step
Well Depth	65.0 m (Design Policy)	Pumping Rate (m3/h)		200	250	300	350	400
Position of Screen	38 m ～ 63 m (Design Policy)	Drawdown (m)		1.05	1.33	1.63	1.92	2.21
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)	Specific Capacity (m3/h/m)		190.5	188.0	184.0	182.3	181.0
Slot Size	16 mm (Design Policy)	Sand Contents (mg/l)		0.4	1.4	1.7	1.5	3.9
Open Ratio	(%)	This well has few iron rust and scales and has few plugging of the screen-slot openings. The iron rust and scales become slightly large and the screen-slot openings are partially plugged by scales from a depth of 45m to the bottom but there are water channels in those openings. Therefore it is judged that these slots are well-functioned even below 45m through water channel as the screen.						
Material of Screen	Carbon steel (Design Policy)							
Material of Casing	Carbon steel (Design Policy)							

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

Borehole TV Camera Survey Log

Date of Survey: 31/05/2008

No. of Well	18	Latitude	N49° 22' 59.6"	Longitude	E105° 54' 01.5"	Evaluation of Rehabilitation Priority	A

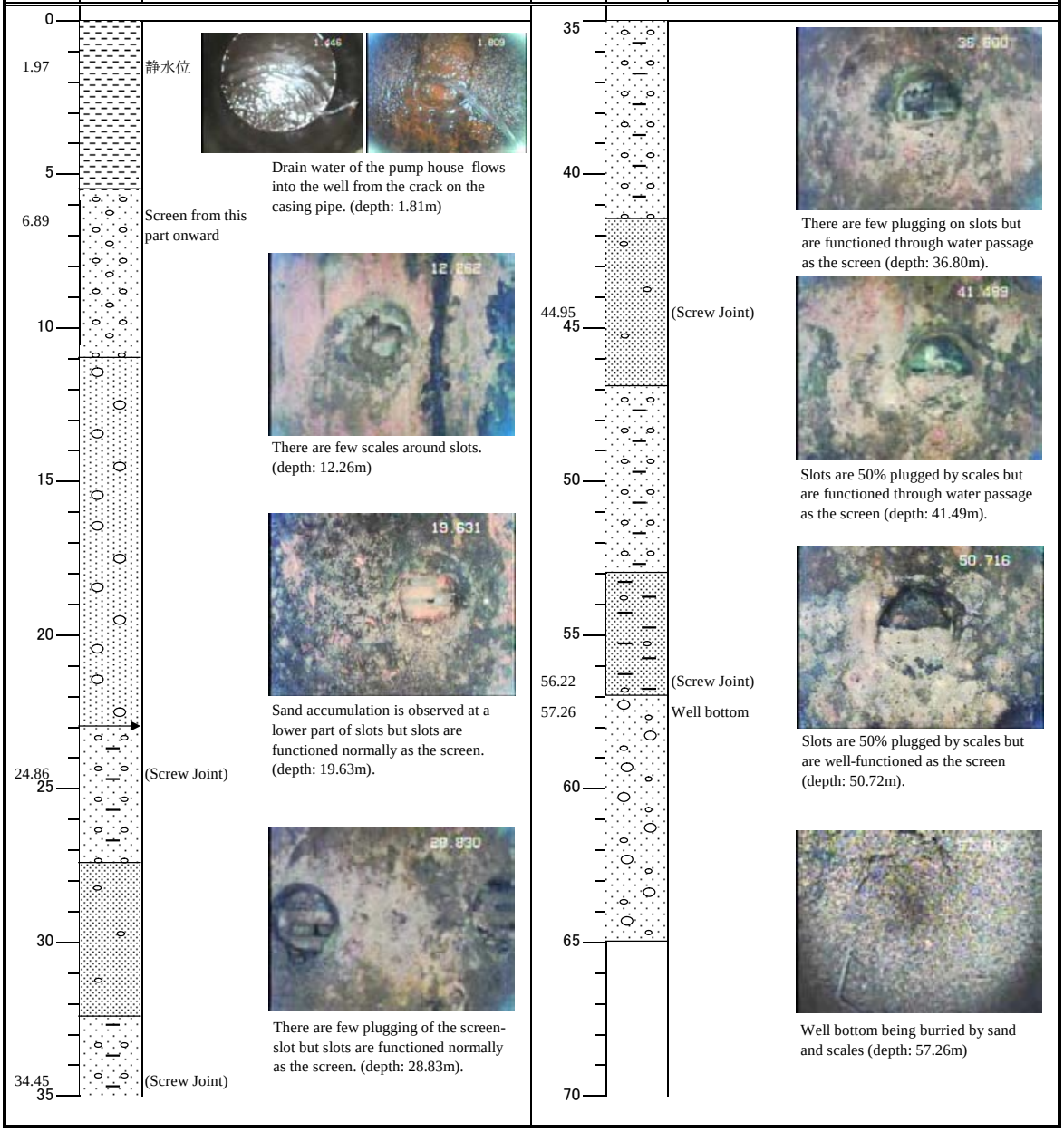
Basic Information (based on PNIIS report, 1978)	
Year of Construction	1978～1984
Casing Diameter	352 mm
Well Depth	65.0 m (Design Policy)
Position of Screen	38 m ～ 63 m (Design Policy)
Type of Screen	Slotted wire-wrapped pipe base screen (Design Policy)
Slot Size	16 mm (Design Policy)
Open Ratio	(%)
Material of Screen	Carbon steel (Design Policy)
Material of Casing	Carbon steel (Design Policy)

Result of Pumping Test and Sand Contents Test

Date	30/05/2008	S.W.L. (GL-m)	3.67 m			
Step		1st step	2nd step	3rd step	4th step	5th step
Pumping Rate (m3/h)		200	250	300	350	400
Drawdown (m)		1.38	1.76	2.16	2.44	2.74
Specific Capacity (m3/h/m)		144.9	142.0	138.9	143.4	146.0
Sand Contents (mg/l)		0.9	1.0	1.2	1.0	3.3

This well has few iron rust and scales and has few plugging of the screen-slot openings. The iron rust and scales become slightly large and the screen-slot openings are partially plugged by scales from a depth of 30m to the bottom but there are water channels in those openings. Therefore it is judged that these slots are well-functioned even below 30m through water channel as the screen.

＊: Figures in the column of "Depth" indicate the depth from the level of floor in the pump house not indicate the depth from the ground level.



Legend:

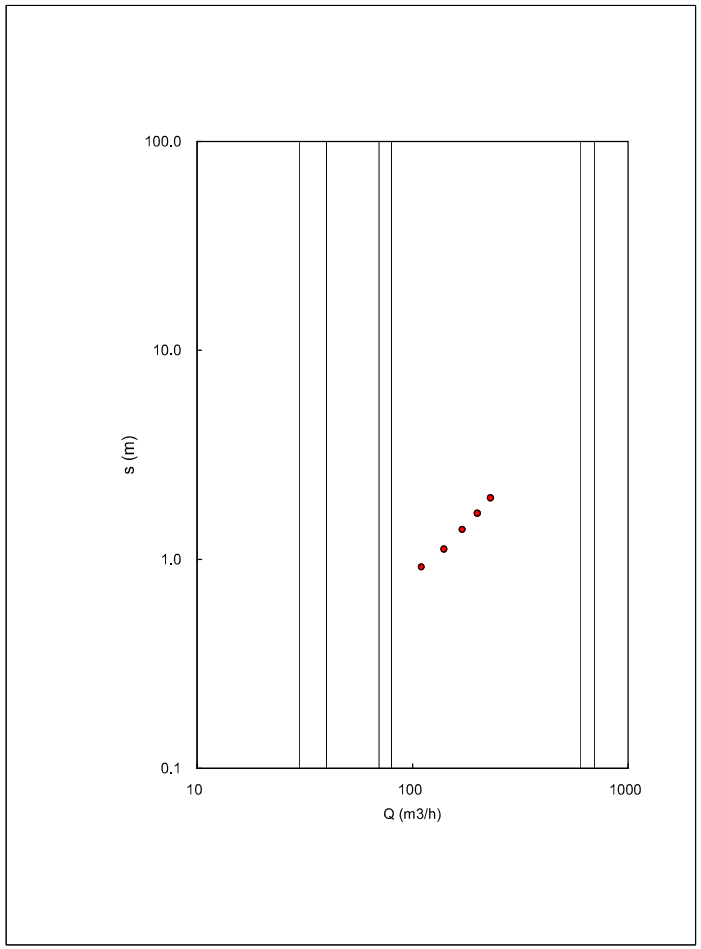
- Sufface soil (mixed clay, silt, sand and gravel including humus)
- Coarse sand (Aquifer, intercarated gravel)
- Sand (including gravel, interbedded lenticular clayey layer)
- Gravel
- Gravel (Aquifer, interbedded lenticular clayey layer)
- Gravel including cobbles
- Interbedded clayey layer

(Geological classification is based on PNIIS report (1978).)

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 1 Well
STATION: 1st Station
SWL: 4.71 (m)

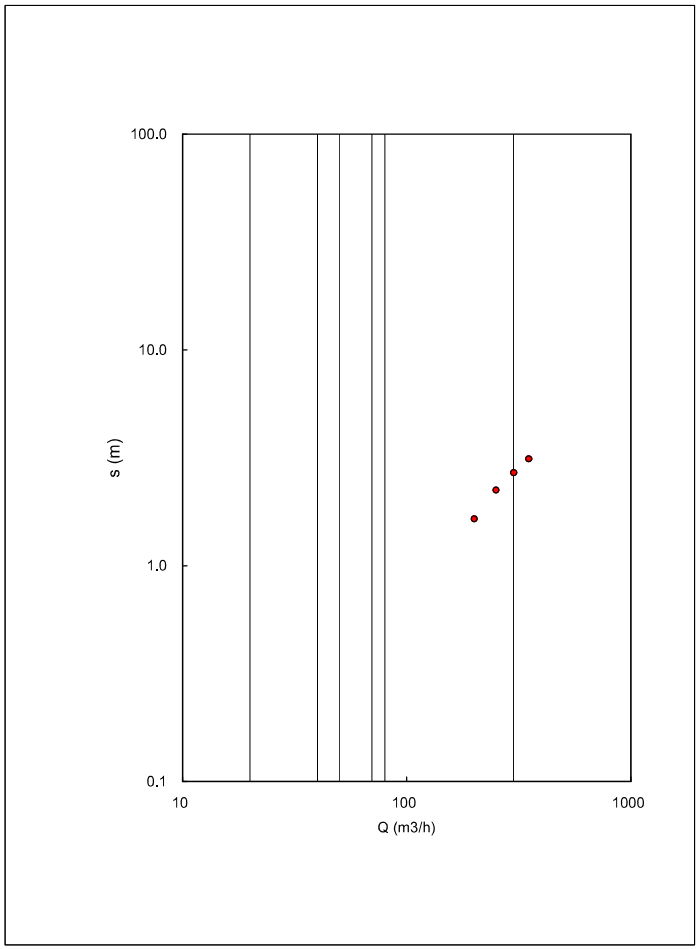


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	110.00	5.63	0.92	119.57
2	140.00	5.83	1.12	125.00
3	170.00	6.10	1.39	122.30
4	200.00	6.37	1.66	120.48
5	230.00	6.68	1.97	116.75

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 2 Well
STATION: 1st Station
SWL: 4.22 (m)

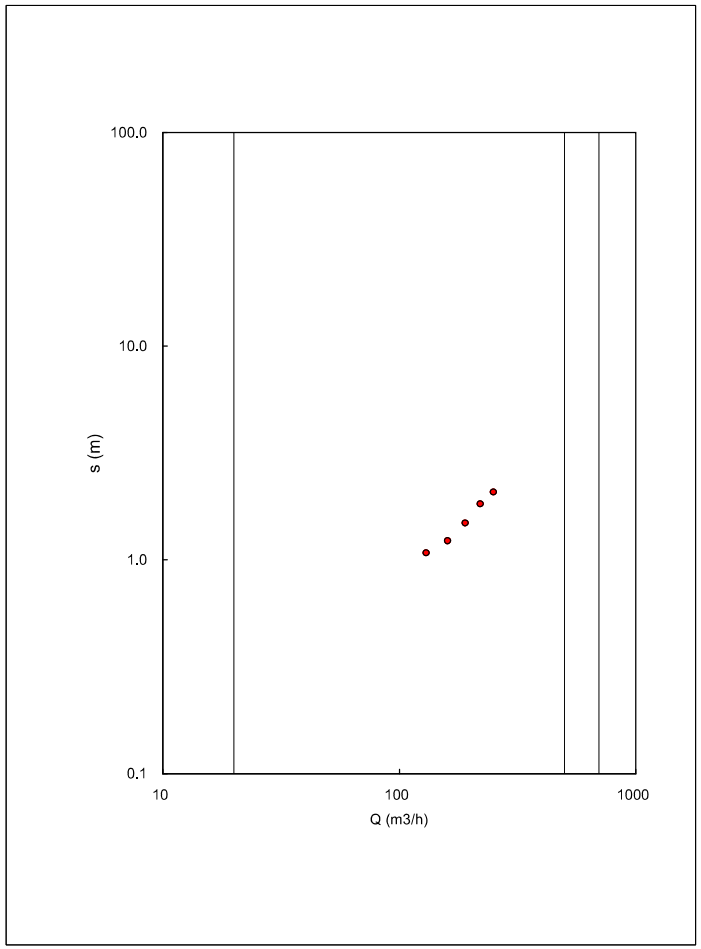


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	5.87	1.65	121.2
2	250.00	6.46	2.24	111.6
3	300.00	6.92	2.70	111.1
4	350.00	7.35	3.13	111.8

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 3 Well
STATION: 1st Station
SWL: 4.24 (m)

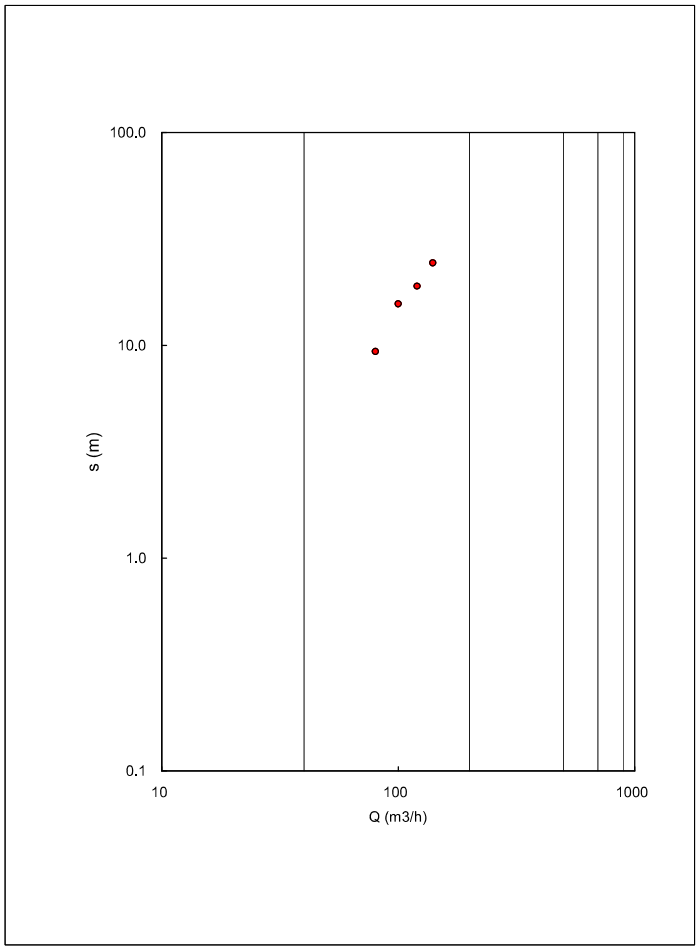


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	130.00	5.32	1.08	120.37
2	160.00	5.47	1.23	130.08
3	190.00	5.73	1.49	127.52
4	220.00	6.07	1.83	120.22
5	250.00	6.32	2.08	120.19

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 4 Well
STATION: 1st Station
SWL: 4.08 (m)

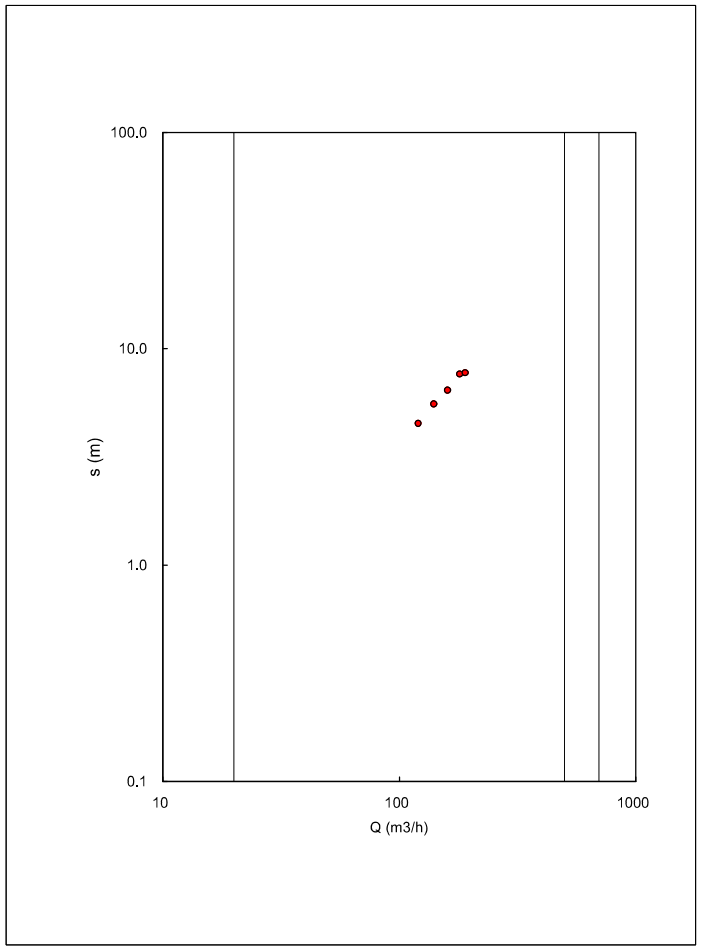


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	80.00	13.43	9.35	8.56
2	100.00	19.77	15.69	6.37
3	120.00	23.06	18.98	6.32
4	140.00	28.52	24.44	5.73

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 5 Well
STATION: 1st Station
SWL: 3.98 (m)

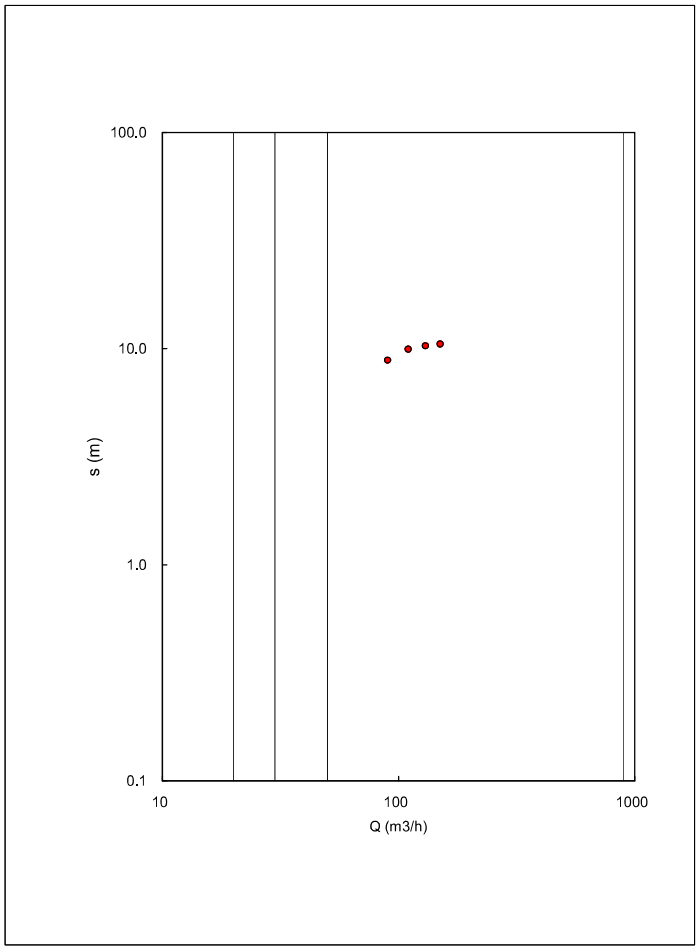


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	120.00	8.50	4.52	26.55
2	140.00	9.54	5.56	25.18
3	160.00	10.42	6.44	24.84
4	180.00	11.63	7.65	23.53
5	190.00	11.74	7.76	24.48

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 6 Well
STATION: 1st Station
SWL: 3.87 (m)

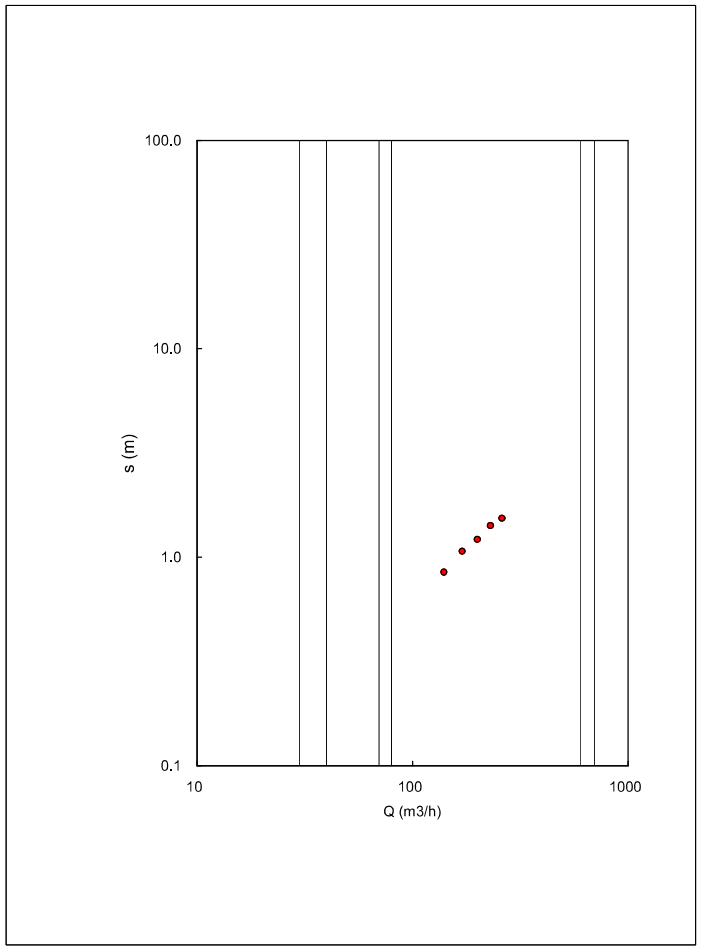


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	90.00	12.71	8.84	10.18
2	110.00	13.80	9.93	11.08
3	130.00	14.18	10.31	12.61
4	150.00	14.38	10.51	14.27

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 7 Well
STATION: 1st Station
SWL: 3.89 (m)

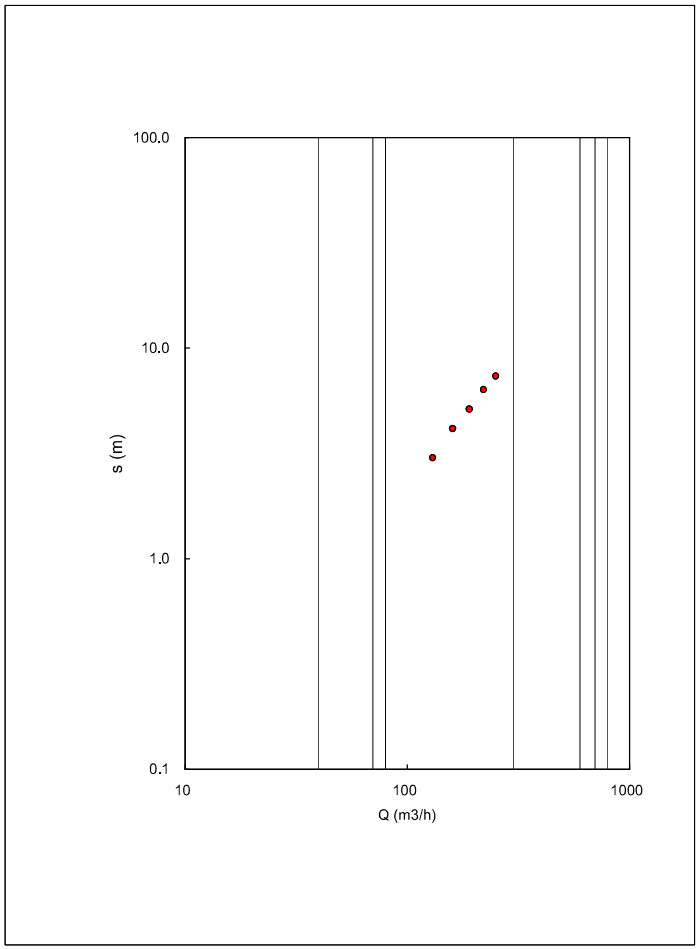


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	140.00	4.74	0.85	164.71
2	170.00	4.96	1.07	158.88
3	200.00	5.11	1.22	163.93
4	230.00	5.31	1.42	161.97
5	260.00	5.43	1.54	168.83

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 8 Well
STATION: 1st Station
SWL: 3.9 (m)

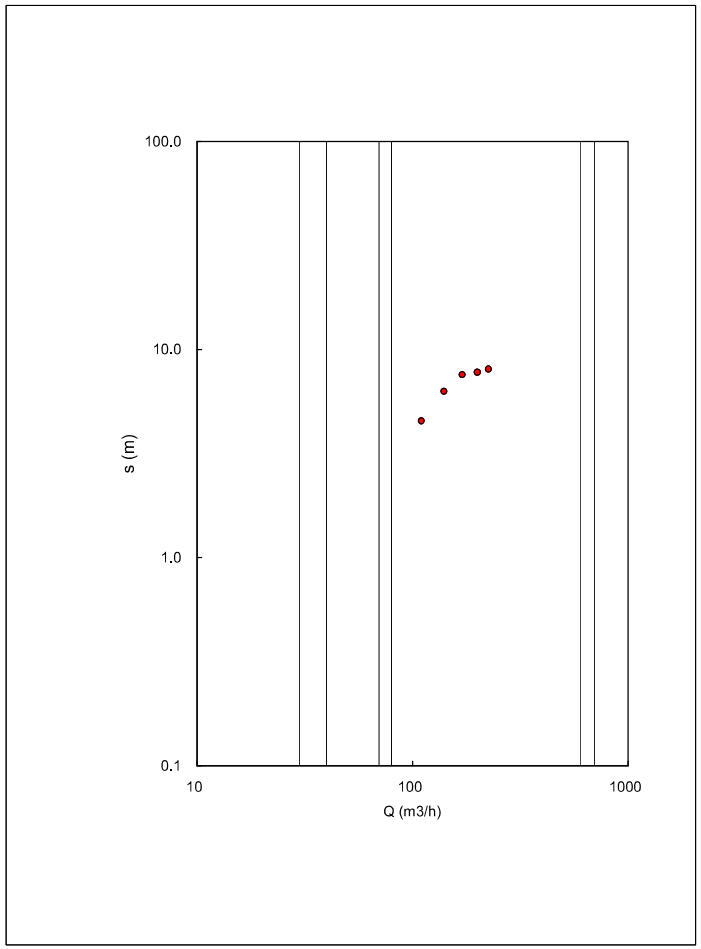


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	130.00	6.92	3.02	43.05
2	160.00	8.06	4.16	38.46
3	190.00	9.04	5.14	36.96
4	220.00	10.26	6.36	34.59
5	250.00	11.27	7.37	33.92

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 9 Well
STATION: 1st Station
SWL: 3.64 (m)

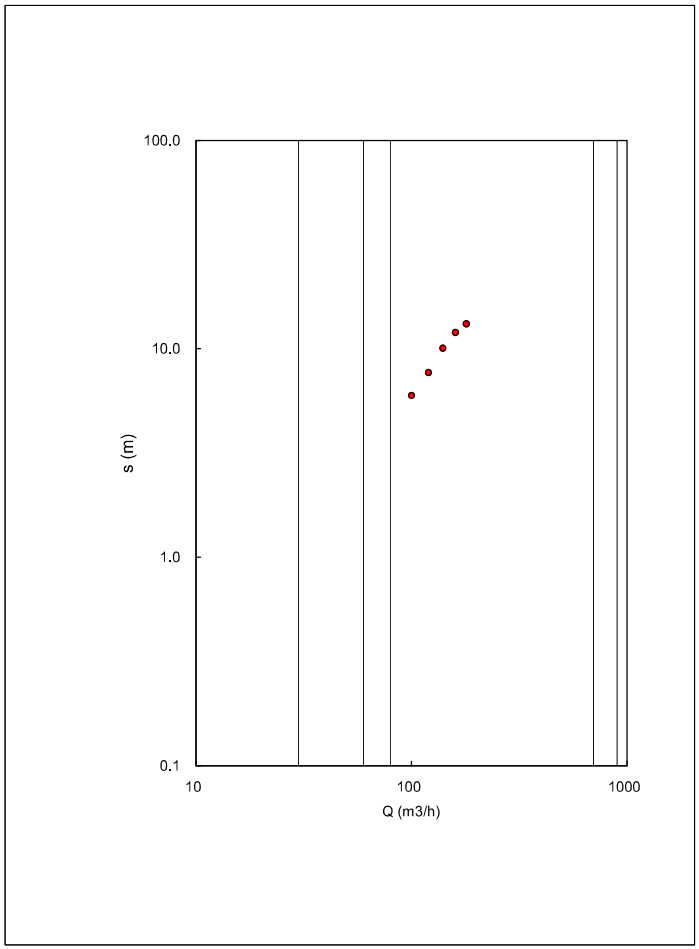


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	110.00	8.18	4.54	24.23
2	140.00	9.94	6.30	22.22
3	170.00	11.21	7.57	22.46
4	200.00	11.41	7.77	25.74
5	225.00	11.69	8.05	27.95

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 10 Well
STATION: 1st Station
SWL: 3.81 (m)

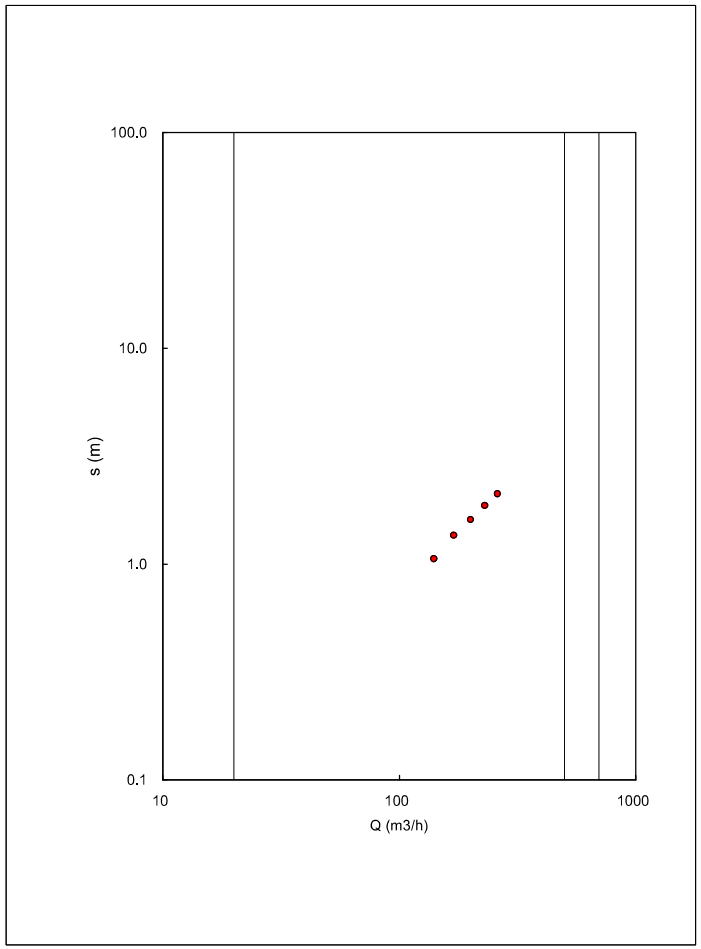


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	100.00	10.37	5.98	16.72
2	120.00	12.08	7.69	15.60
3	140.00	14.45	10.06	13.92
4	160.00	16.37	11.98	13.36
5	180.00	17.55	13.16	13.68

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 11 Well
STATION: 1st Station
SWL: 3.87 (m)

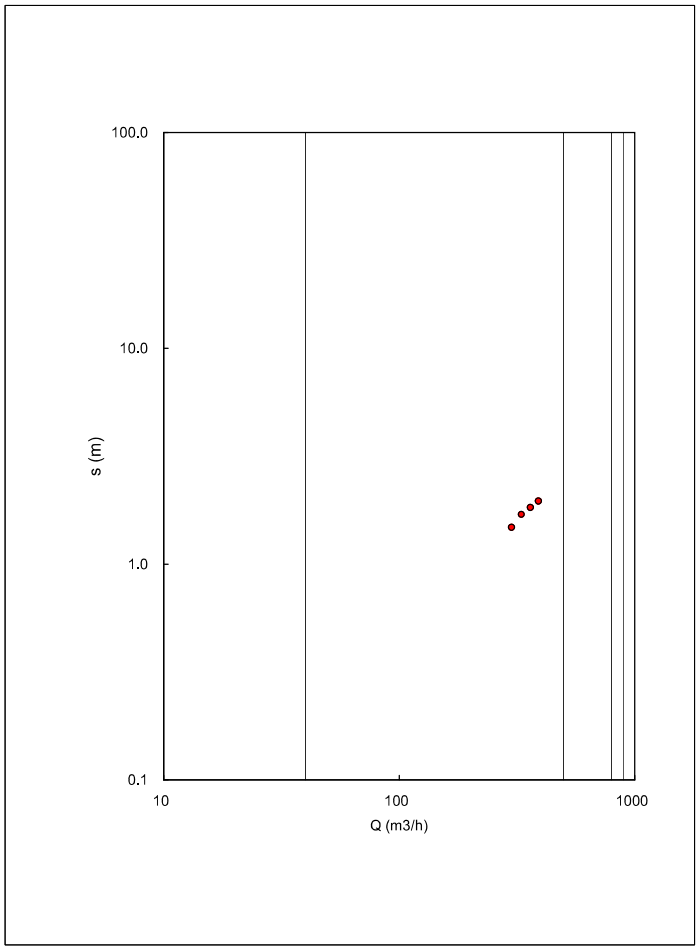


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	140.00	4.93	1.06	132.08
2	170.00	5.23	1.36	125.00
3	200.00	5.48	1.61	124.22
4	230.00	5.74	1.87	122.99
5	260.00	5.99	2.12	122.64

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 12 Well
STATION: 1st Station
SWL: 3.88 (m)

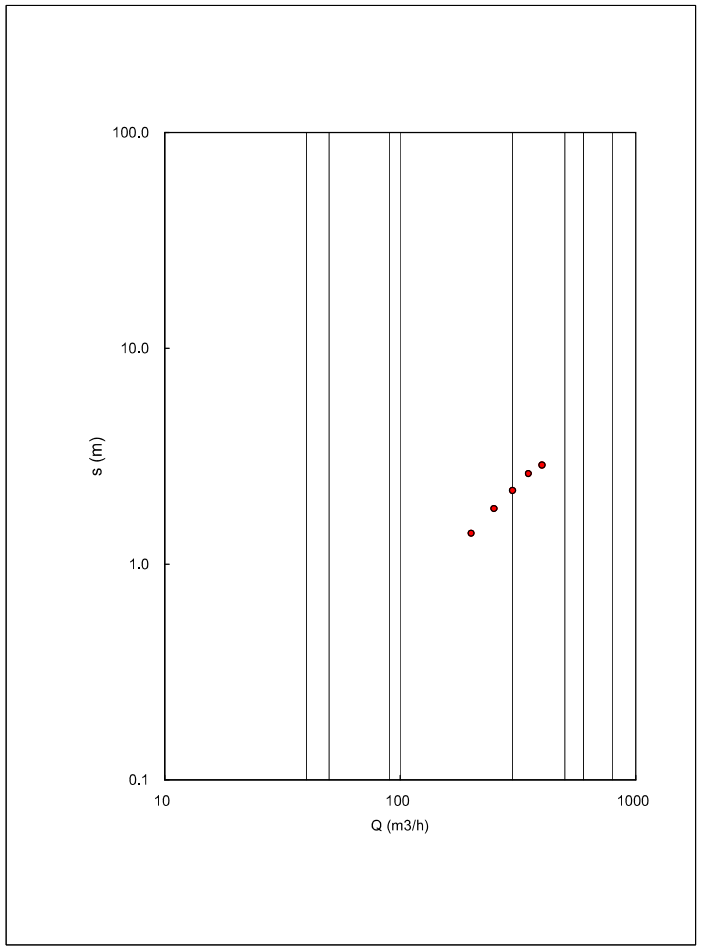


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	300.00	4.05	1.48	202.70
2	330.00	4.27	1.70	194.12
3	360.00	4.40	1.83	196.72
4	390.00	4.53	1.96	198.98

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 13 Well
STATION: 1st Station
SWL: 3.55 (m)

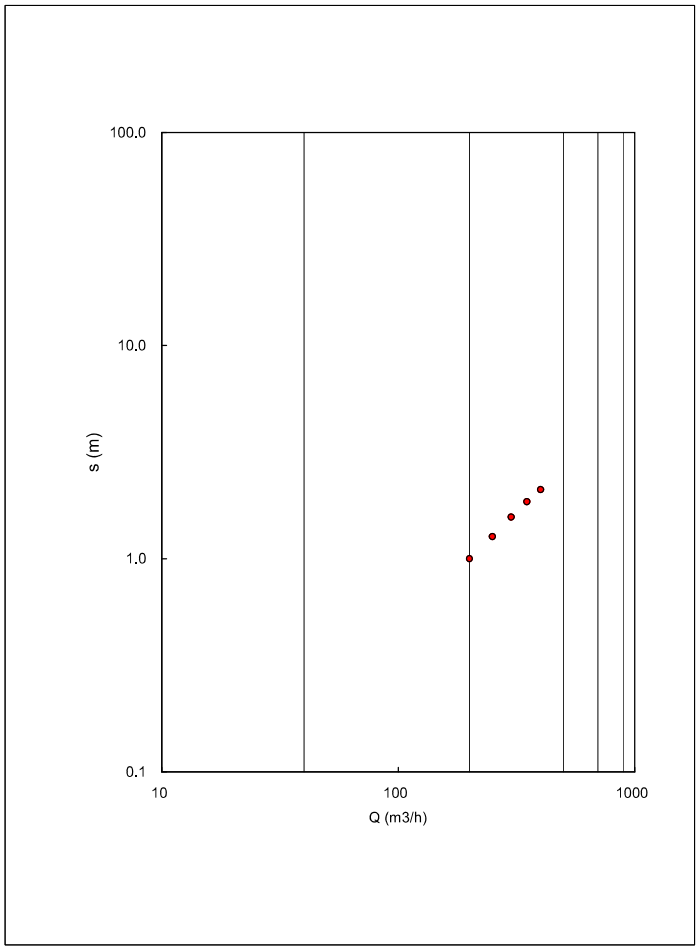


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	3.60	1.39	143.88
2	250.00	4.02	1.81	138.12
3	300.00	4.40	2.19	136.99
4	350.00	4.84	2.63	133.08
5	400.00	5.09	2.88	138.89

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 14 Well
STATION: 1st Station
SWL: 3.65 (m)

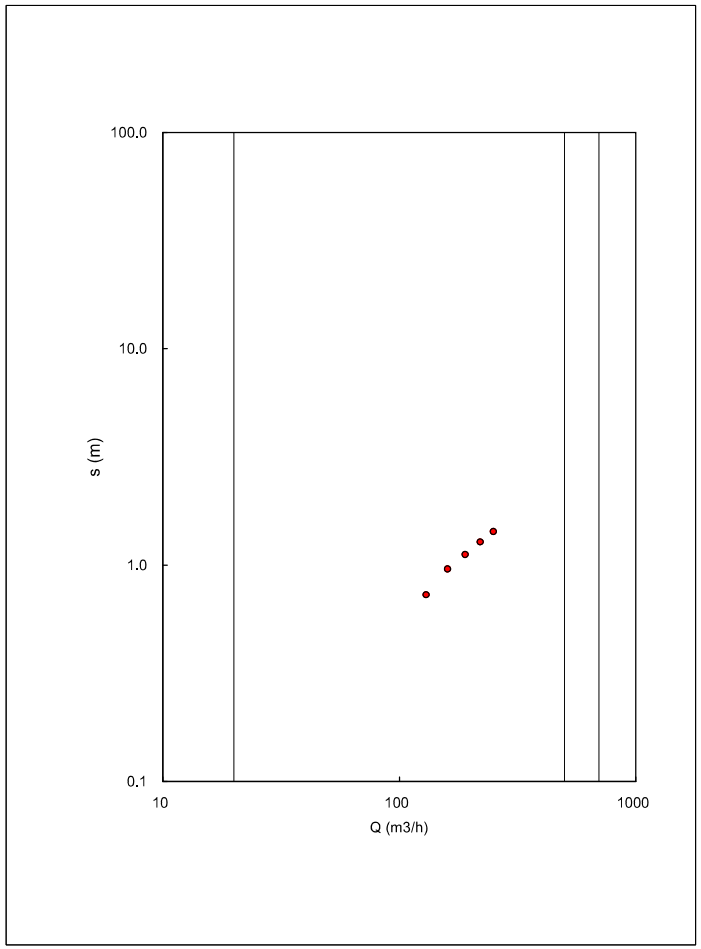


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	4.65	1.00	200.00
2	250.00	4.92	1.27	196.85
3	300.00	5.22	1.57	191.08
4	350.00	5.50	1.85	189.19
5	400.00	5.76	2.11	189.57

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 15 Well
STATION: 1st Station
SWL: 3.31 (m)

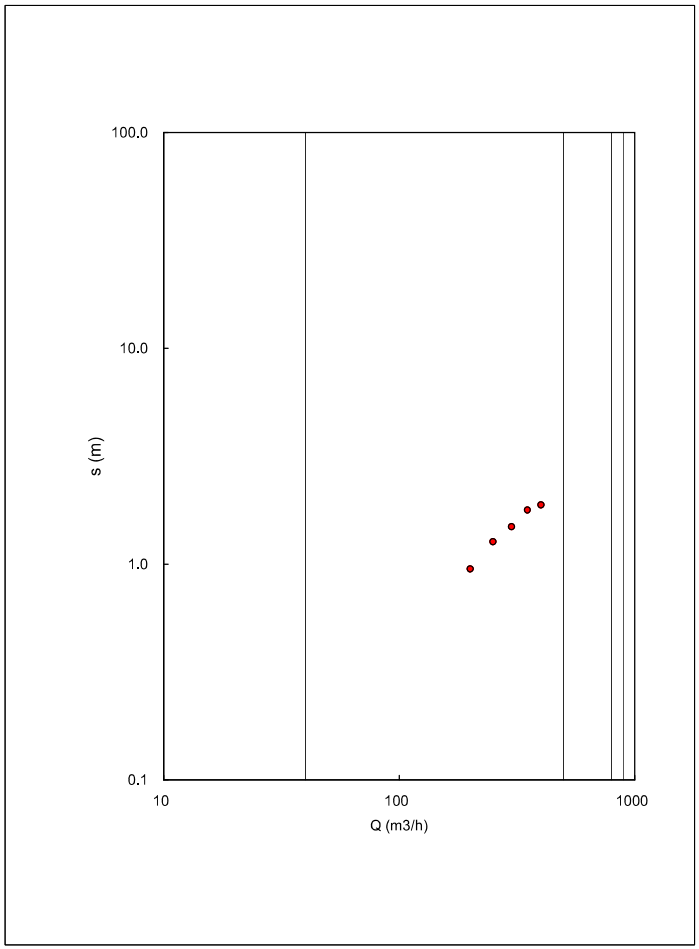


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	130.00	2.70	0.73	178.08
2	160.00	2.93	0.96	166.67
3	190.00	3.09	1.12	169.64
4	220.00	3.25	1.28	171.88
5	250.00	3.40	1.43	174.83

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 16 Well
STATION: 1st Station
SWL: 3.4 (m)

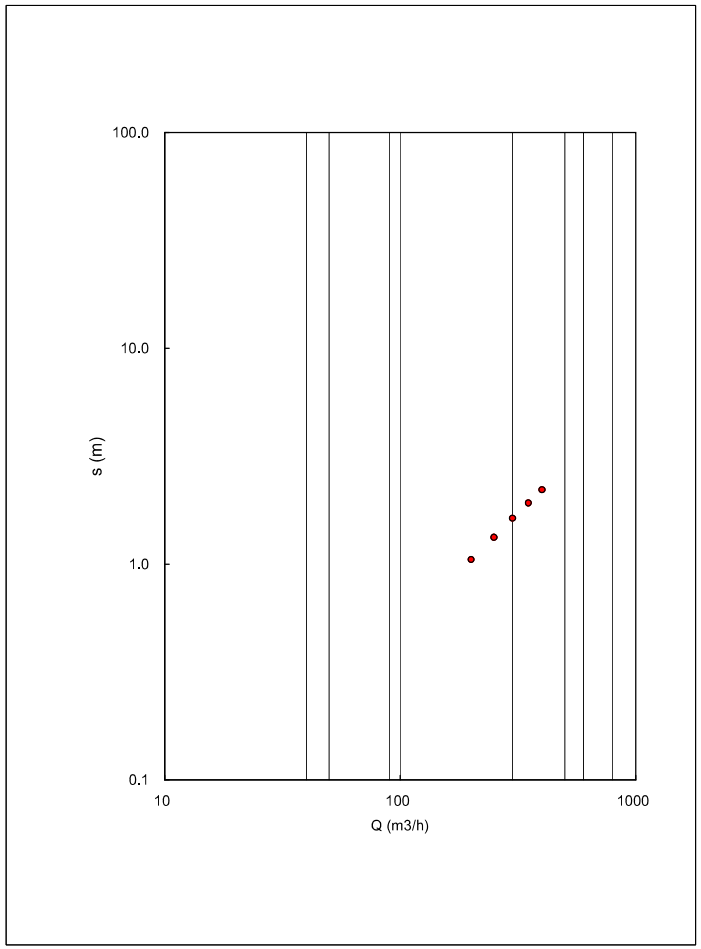


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	3.11	0.95	210.53
2	250.00	3.43	1.27	196.85
3	300.00	3.65	1.49	201.34
4	350.00	3.94	1.78	196.63
5	400.00	4.04	1.88	212.77

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 17 Well
STATION: 1st Station
SWL: 3.62 (m)

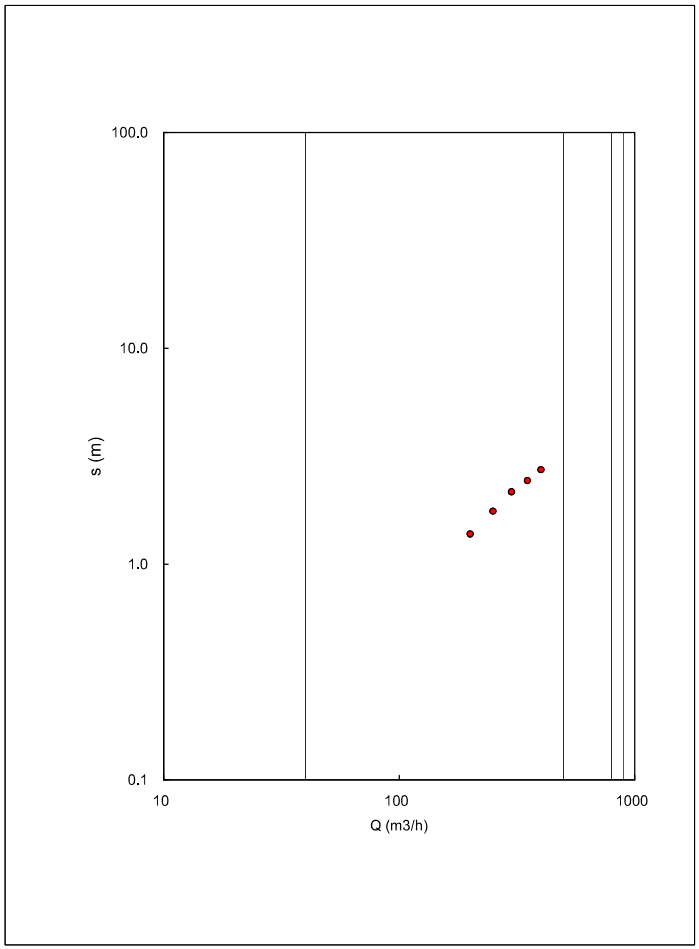


Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	3.50	1.05	190.48
2	250.00	3.78	1.33	187.97
3	300.00	4.08	1.63	184.05
4	350.00	4.37	1.92	182.29
5	400.00	4.66	2.21	181.00

STEP DRAW DOWN TEST

PROJECT TITLE: The Project for Improvement of Water Supply Facilities at Darkhan City in Mongolia

SITE No.: No. 18 Well
STATION: 1st Station
SWL: 3.67 (m)



Step	Q (m3/h)	N.D. (m)	s (m)	Q/s (m3/h/m)
1	200.00	3.89	1.38	144.93
2	250.00	4.27	1.76	142.05
3	300.00	4.67	2.16	138.89
4	350.00	4.95	2.44	143.44
5	400.00	5.25	2.74	145.99

Appendix-10 Results of Socio-economic Survey

1. Survey Methodology

(1) Survey Object Household

To investigate inhabitants' consciousness about the satisfaction rating and the reliability to the water supply in Darkhan city as well as actual conditions of the city water supply, utilization, consumption and so on, investigators visited each home and implemented interview survey by the pre-established questionnaire.

As for the population of Darkhan city in 2007, the population which lives in the gel area is 24,659 accounting for about 1/3 of the entire population; 74,526. These inhabitants use the drinking water retail service through the watering kiosk which differs from that of the apartment area with the remaining 2/3 of the population and, thus differences are attended about the living conditions in addition to the water utilization. Therefore, the survey is implemented between roughly classified 2 areas, the apartment area and the bug(Ger) area, according to the housing pattern.

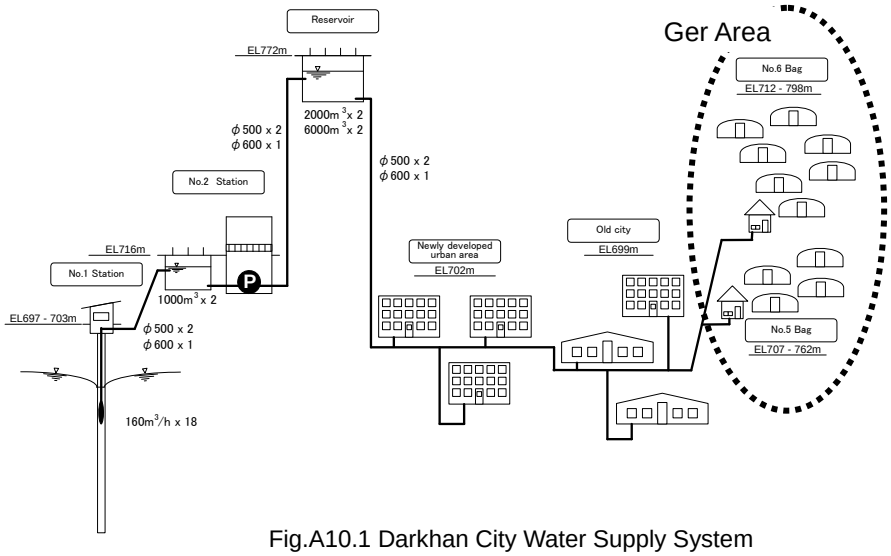


Fig.A10.1 Darkhan City Water Supply System

(i) Apartment Area

In case of the survey in the apartment area connected to the city water systems, canvass survey at each 20 households was conducted on both having the water meter and not-having it.

(ii) Ger Area

Focus group discussions targeted to the habitants in the Ger area where the newly planned water KIOSKs will be established, in addition to the interview survey with questionnaire targeted to 20 households as baseline survey. Summary is as shown in the table A10.1.

Table A10.1 Contents of Socio-Economic Survey

Survey	Methodology	Target(Area, Resident)	Survey Items
1. Household survey, Apartment Area	Questionnaire survey by interview	With a water meter, w/o a water meter, each 20 and Total 40 households	Living conditions, Current status of the city water service
2. Household survey, Ger Area	Questionnaire survey by interview	20 households covered by the KIOSK watering service	Living conditions, Current status of the city water service
3. Supplement survey, Ger Area	Focus group discussion	Inhabitants in No.5 and 6 Zones where new watering KIOSKS are planned to be established.	Current status of the water service, Requests for newly established KIOSKs

(2) Survey Methodology

In order to conduct the survey to the apartment households, the survey questionnaire was originally drafted by the study team. After discussion and reviewing this with WSSSC-Darkhan, interview survey was conducted by the three investigators who were employed locally with questionnaire sheets translated in Mongolia by them under the study team member's instructions. Featuring quantitative survey items such as current status of water use and household income, suppositious comments on the water supply service from their everyday life were included as well. Though the resident registry and other reference data were not available, selective method for canvassing households is considered to avoid any bias towards a specific class by identifying income brackets from the housing appearance and social segment beforehand.

In case of the household survey in Ger area, Interview survey by the questionnaire sheets was conducted as the baseline survey with 20 households on the current status of water use and the existing water supply facilities prior to the survey in No.5 and No.6 Ger area where new watering KIOSKS are planned. Meanwhile, in order to obtain supplementary data unlikely to collect by the questionnaire, focus group discussions were carried out for the resident about the current status of water use, the degree of satisfaction to the watering service, envisioned location of the newly construction site of the watering KIOSK, etc. As previous arrangement, opinion and requests are collected from the inhabitants of No. 5 and No.6 bugs as well as prior explanation of the project outlines. A series of discussion was conducted with cooperation of WSSSC-Darkhan based on practical experience of No.7 Bug implemented with the support of ADB. The inhabitants actively addressed current problems on the water supply service and planned new watering KIOSKs through their opinion and requests. And then, construction sites of the KIOSK have been decided consensually.

2. Survey Results

(1) Overview of Respondents to the Questionnaire

In interview survey with the questionnaire, answer was asked to family members who grasp their household economy. Aggregate calculation results are as shown in the Table A10.2.

Table A10.2 Questionnaire Respondent

Area	Age	Male	Female	Total	Ave. family members	Ave. Annual Income
1. Apartment Area	43.8	23	17	40	3.52	3,120,750
2. Ger Area	50.9	9	11	20	5.18	2,136,947

- In family structures, there is a difference between the Apartment household area and the Ger household area. Average number of the Apartment household area is smaller than that of the Ger household area. Besides spread of the nuclear family, under registration of family members as descried in the following clause seem to be another reason. At the same time, two or three generation families are common and there is a tendency having rather many children in Ger area.
- In case of the Apartment household without the water meter, water charge will be calculated based on number of the family member. Consequently, Family members are apt to be under registered than actual numbers. Average number of the family members of the Apartment households and the Ger households are 3.55 and 3.50 respectively. There seems not be a significant difference between these figures. However, the average number of household member in Darkhan city is 4.00 and introduction of the water meter started in 2005 result in rather lower adoption rate. Considering these circumstances, there is a possibility that even the households with the water meter answered originally registered figures at the point in time of the fixed charge.
- Annual income of the Ger household area is approximately 1 million MNT less than that of the Apartment area. Without respect to the number of the household family members, there seems to be a poverty disparity from the Apartment households. One of this background factors is that considerable number of elderly adults and/or unemployed persons live there.

(2) Current Status of Water Use in Darkhan City

（i） Apartment Area Household Survey

a) Inhabitants Attribution and Household Income

Attribution and occupation of householders in the Apartment area are as shown in Fig.A10.2 and Fig.A10.3.

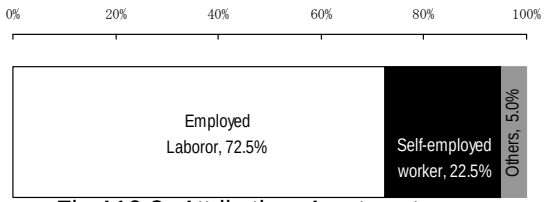


Fig.A10.2 Attribution, Apartment household

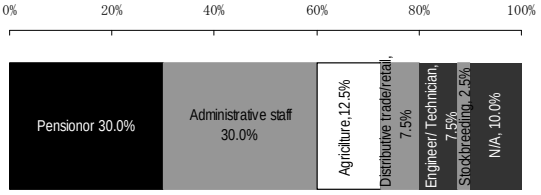


Fig.A10.3 Occupation, Apartment household

As stated above, most of them are employed or retired laborer categorized as administrative staff and/or pensioner household. Meanwhile, self-employed workers are agriculture, stockbreeding and distributive trade/retail.

Regarding annual income, there is some of the degree of 15 times disparity from less than one million MNT to more than 10 million MNTs. Additionally, around 50% of the households have multiple income sources, and mostly their marital partners are involved in business for the

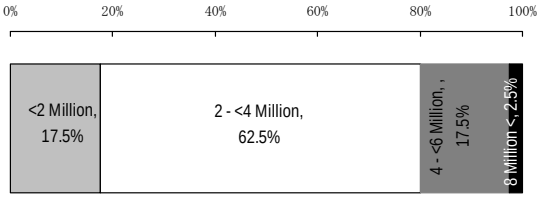


Fig.A10.4 Household income

income. As shown in Fig.A10.4, approximately 62% of the household annual incomes distribute in range from 2 million MNT or more but less 4 million MNT, and average income is 3.12 million MNT. According to National Statistics Bureau, average household income of 2007 is 284,000MNT/Month(3.4 million MNT/Year). The above average apartment household annual income comes near to the statistical data even though some 10% below this.

This survey results indicate that main expenditure item is food expanse paying an average of more than 100,000MNT. Average house rent is 40,000MNT, outlay on clothing and education expenses are slightly larger than 40,000MNT respectively. Other necessary items, electricity charge and miscellaneous expenditure are more than 20,000MNT each. Water charge is 5 to 10 MNT and equivalent sum of money is required as heating expense for hot water circulation system. These come to a grand total of approximately 300,000MNT as monthly living expanse. Nowadays ownership ratio is around 40%, if a private car is owned, additional fuel cost some 100,000MNT shall be added to. Consequently, even though monthly living expenses can be covered somehow with the above average households income, it's quite far from an affluent life considering further expenses such as culture/recreational expense and cost for ceremonial occasions.

b) Current Status of Resident's Utilization for the Water Supply Service

- Water Charge and Payment Status

WSSSC adopts stepwise rate revision of the water tariff to establish a financial base and secure operational expenses under the self-support accounting system. And the last rate raise was executed in October 2007. For example, the tariff for a general household became 3.8 times as much as that of 2003. Meanwhile, fixed charge system that depends on number of the family members is the main channel because that introduction of the water meter started in 2005with rather lower adoption rate. In this case, it's not in adequate conditions since around half of the family members are under registered than actual numbers.

Data on current water tariff, water usage and paid water charge in the apartment area are shown in table A10.3 and table A10.4.

Table A10.3 Water Charge Structure

(Unit : MNT/m^3)

Classification	2007
Business enterprise（Corporate status）	600
Individual with Water meter, Metered rate(Tg/m^3)	230
Individual w/o Water meter, Fixed charge(Tg /Month/Person)	1,725(Tg/ Month/Person)
Watering facilities(KIOSK) （Individual）	1.5Tg/L（equivalent to 1,500Tg/m^3）

Table A10.4 Water consumption and payment in Apartment area

Classification		Surveyed household	Average family number	Payment/Month（MNT）	Consumption/ Month
(a)	Household with Water meter	20	3.55	5,389	23,430L
(b)	Household w/o Water meter	20	3.50	7,108	N/A
Number of object household Total		40			

The above table shows that apartment households without the water meter pay additional 32% of water charge compared to that of the households with the meter. Responding to the previous rate revision adopted last October, larger numbers answered that the water charge is expensive

among the households adopted the fixed charge system on family members without the water meter. In our interview survey results among household having or will have the water meter, their prime motivation for installing the water meter is expectation for reduction of water usage and/or derived water charge. This means that consciousness of conserving water is expanding as the effect of the installation of the meter.

In order for efficient use of water and optimization of water treatment cost, prompt transition to the metered rate charge system with dissemination of the meter is necessary. In this case, it cost approximately 28,000MNT/unit for commissioning procedures including installation fee. Therefore, in order for smooth adoption to the low-income households, some measures such as installment payment should be considered.

Regarding payment for the water charge, approximately 33% of the entire households have received the remainder notice from WSSSC-Darkhan due to overdue for the payment. Average number of times for the notice is 3.3, and 78.6% of these households have made settlement after that. Improvement of collection rate of the water charge among the apartment households affects the sound management of WSSSC-Darkhan. That means further improvement of the rate collection through enhancement of public and collections activities are required.

Table A10.5 Delinquency of Water Charge

Status	Remainder notice received		Average number remainder notice received	Clear off rate after follow-up
	Yes	No		
Delinquency experienced	13	27	3.3 times	78.6%

- Priority of Water Use

Priority for the water supply service is as follows,

No.1: Drinking Water > No.2: Cooking >>> No.3: Laundry, Shower, Bathing

Above all, it is important to secure drinking and cooking water firstly. After that, the priority falls considerably for Laundry, Shower and Bathing. It seems to be quite reasonable as usage for the treated safe water.

- Processing of the Drinking Water

In all apartment families that conducted the survey, they drink the tap water after some kind of processing such as boiling and applying the water purifier as shown in Fig.A10.5. This result conforms to another answer that there is no case that the tap water had lead to deconditioning among their family members. Further feedback from parents fostering small children demand for improvement of safety quality as well as the top prioritized request for supplying safe water to the questionnaire on water supply service. Considering these circumstances, consciousness of the apartment inhabitants to the safe water is quite high and the tap water is processed properly. In the survey results to the question for water borne disease such as diarrhea, typhoid and hepatitis, there is not any affected case among family members including children in past one year.

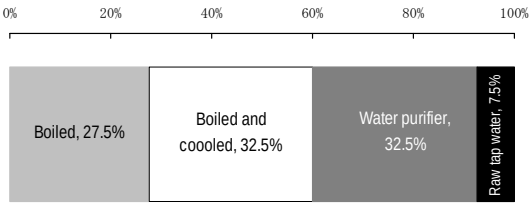


Fig.A10.5 Processing Water to drink

c) Consciousness and Satisfaction to the Water Supply Service of the Inhabitants

Regarding satisfaction to the water supply service, 70% of inhabitants answered that the water pressure is enough as well as the water quality. Furthermore, more than half pointed out some points as additional personal comments as shown in the Table A10.6

Table A10.6 Problems on Water Supply System

Problem		Ticked "Yes"	Remarks
(a)	Insufficient supply	30%	Shortage or unstable in fifty-fifty
(b)	Water outage	40%	Occasionally, Everyday、
(c)	Quality(Color, odor, taste)	33%	Color 4, Taste 1, Odor 0, Rusty、Quality worsen
(d)	Deteriorated piping system	33%	Necessity for replacement or cleaning
(e)	Water charge too expensive	60%	Reduced charge with water meter observed
(f)	Installation of water meter	35%	too expensive cost, Queuening time, Mass adoption

Satisfaction level to the current water supply systems seem to be high as the results of the questionnaire survey, while results of the interview survey indicate that some inhabitants don't have problem consciousness in spite of frequent water outage cases occurring several times per month. Additionally, they have a difficulty for using shower due to shortage of water, and there are some cases that no-water period is too long, etc in the terminus zone of the piping network. These phenomenons raise possibility of some troubles such as insufficient prevailing water supply service according to area and/or time zone. Besides indications on water quality such as color, odd, rusty contamination, etc., similar numbers of comment and/or requests about the deteriorated piping system are indicated. It seems that sensory anxious thought is becoming common even if any abnormality of water quality has not been detected.

d) Water Supply Service that Prior Improvement is Desired

Answer to the question on "Water supply service that prior improvement is desired." is as shown in Fig.A10.6. Demand for the safe water is shown up similarly to the other survey items.

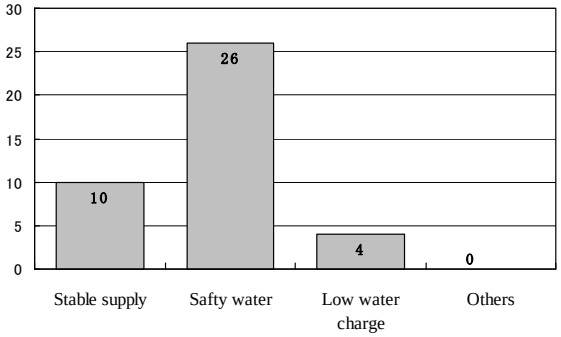


Fig.A10.6 Prioritized matter, Water supply service

In case of the question on the current water tariff, 60% of respondent answered that it's expensive exceeding other answers such as "inexpensive" and "medium'. However, scrutinizing with the results of other questions, this tendency seems to be deviated by the survey methodology and regarded as rather less important. In fact, higher amount of the water charge for the improved service is mentioned as payment intention as described below.

e) Payment Intention on Water Supply Service

Average amount based on payment intention to the improved and satisfactory water supply service is 7,564MNT/Month that is equivalent to 1.21 times as much as the current average water charge on both the meter rate and the fixed charge without the meter. In conclusion, this shows expectation of inhabitants to the improvement of the water supply service. (Refer to

Table A10.7)

Table A10.7 Payment intention on improved Water Supply Service

Object household	Average family member (person)	Average Payment/ Month (MNT)	Payment intention/ household (MNT)	Remarks
40	3.53	2,146	7,564	Currently 6,250

(ii) Ger Area Household Survey

a) Inhabitants Attribution and Household Income

Attribution and occupation of householders in the Ger area are as shown in Fig.A10.7 and Fig.A10.8.

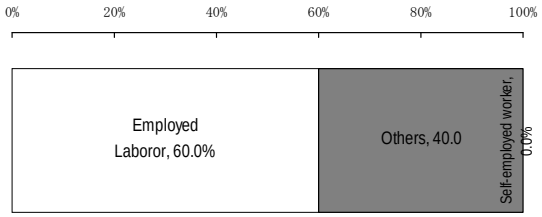


Fig.A10.7 Attribution, Ger Household

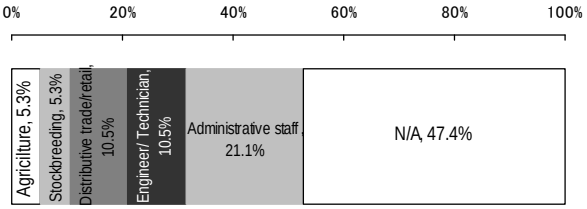


Fig.A10.8 Occupation, Ger Household

As shown in the above, majority is employed labor and the rest are regarded as pensioner household consist of elderly adults. Self-employed workers are agriculture, stockbreeding and distributive trade/retail. Occupations are administrative staff, engineer/technician, distributive trader/retailer, agriculture, stockbreeding, etc.

Regarding annual income, nearly half of households distributes in range from one million MNT to 2 million MNT. And 80% are within 3 million MNT zone, hence majority belong to low-income class. Additionally, around one-third of the households have multiple income sources with mostly their marital partners. Average income is 2.14 million MNT that correspond approximately to 60% of the average household income of 3.4 million MNT/Year (284,000MNT/Month) in accordance with National Statistics Bureau.

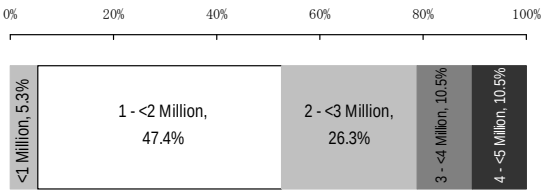


Fig.A10.9 Household Income

b) Current Status of Resident's Utilization for the Water Supply Service

Most of inhabitants buy water at the watering KIOSK operated by WSSSC-Darkhan since this area has not been covered by the distribution-piping network except for a part of apartment buildings. In results of this survey, targeted inhabitants entirely use purchased water at the watering gers without utilizing other water resources such as their own shallow well and/or nearby rivers.

As shown in table A10.8, average water is 24.8 litters per caput per day.

Table A10.8 Water Usage in Ger Area

	No. household	No. Family member	Consumption (L/day/person)	Daily Consumption (L/day/family)	Annual Payment(MNT)
Water consumption in Ger area	20	5.18	24.8	128	70,080

The above value, 24.8 litters per caput per day, is just at a fraction of that of the apartment area and, thus conditions of the water supply is distinctively worse and adverse effects are concerned. Furthermore, retail price of the water at the KIOSK is at least 6 times as much as that of the water rate of the apartment area. Consequently, annually expended amount can be equal to that of the annual water usage of the apartment household. Considering rather lower annual household income, it can trigger aggravation of their living conditions.

c) Satisfaction and Awareness on Water supply Service

Survey results interviewing to the inhabitants in the germ area on the current water supply service is as shown in Fig. A10.10 and Table. A10.9 on number of cases and its ratio. This indicates that problems mostly concerned about the purchased water are the distance to the watering KIOSK that is far from their home and matters of the water quality (the color, odor and taste.

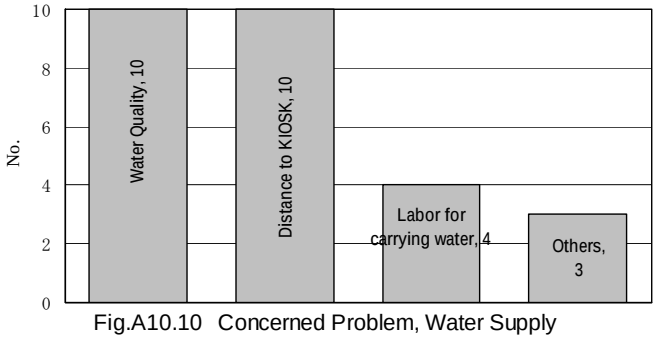


Fig.A10.10 Concerned Problem, Water Supply Service at KIOSK

There are a lot of request for improvement on the newly planned watering KIOSK as shown in order in prevalence 1) Safety water vendition, 2) Establishment of a new KIOSK in nearby location, 3) Reduction of queueing time due to sold out stocks in Fig. A10.11.

Table A10.9 Prioritized Matters on Water Supply Service at Kiosk

Matter	Ticked "Yes"
Long distance to KIOSK	37%
Quality(Color, Odor, Taste)	37%
Labor for carrying water	15%
Others	11%

As the benefit from implementing the project, reduction of queueing time with unlimited operating hour by connecting a new watering kiosk to the water distribution network directly and safety improvement of the water quality by introduction of the chlorination are anticipated. The project plans to increase number of the KIOSK from the existing 3 to 4 in No.5 Ger, and the existing 5 to 8 in No.6 Ger respectively. Therefore, these contents of the project implementation plan correspond to the inhabitant needs.

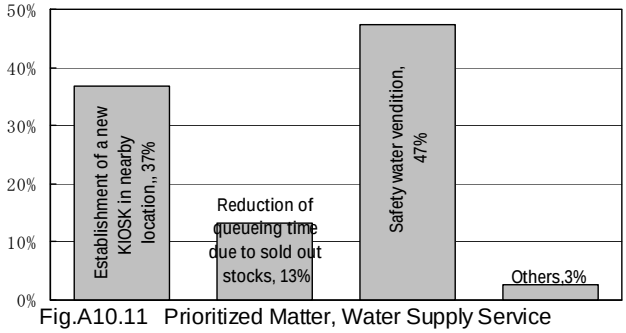


Fig.A10.11 Prioritized Matter, Water Supply Service at KIOSK

(3) Payable Amount of Water Charge and Intention

According to the result of the socio-economic survey on the present water bill standard, the annual water bill outlay rate account for 2.34 % of the family income of the Apartment area inhabitants, 3.28 % of that of the Ger area inhabitants using the watering KIOSK. These figures are within 5% of the annual income, which is standard index as payable water rate and, thus there seems to be room of the rate-revision in accordance with necessity due to particular-business-situation of WSSSC-Darkhan.

Table A10.10 Ratio of water charge in household income

(Unit:MNT)

Area	Annual Payment	Average household income	Ratio（%）
(a) Apartment area household	72,908	3,120,750	2.34
(b) Ger are household(KIOSK)	70,680	2,136,947	3.28

Questionnaire for Household Survey

Respondent's Name : _____ Date ___/___/2008

Age ___ years ①Female ②Male _____

Respondent's address : _____

Name of Enumerator : _____

(Checked by Enumerator ①With Meter ②Without Meter _____)

A. Current water supply awareness/problem/satisfaction

〔1〕 Current water supply problem

*The ones that apply to each

- Volume (①Enough ②Not enough ③Not constant) _____
- Quality (①Good ②Taste ③Smell ④Color ⑤Others_____) _____
- Supply hour (hour/day)
- Service

(①Method of water charge payment・②Repair ・③Frequency of supply suspension)

④Others_____

_____

- Evaluation on the current water charge

(①Expensive ・ ②Normal ・③Cheap) _____

〔2〕 Any other problem _____

B. Valuing the water supply service to be improved

〔1〕 If the above-mentioned problem is improved, how much are you willing to pay for water services?

_____Tg/month/head or _____Tg/m3

Special note (_____)

〔2〕 What do you regard as importance on water supply?

*The ones that apply to each

(①Stability ・②Safety water ・③Cheapness ・④Others (_____))

_____

C. Sanitary condition

〔1〕 Location of toilet

(①Inside of the room ・②Share of apartment residents ・③Others_____

_____

〔2〕 2-1) Any member of living in same room got sick in last year due to: ?

①Diarrhea ② Typhoid ③ Hepatic

2-2)Who were sick and how many times?

	Sickness ○	More than 5 years old	under 5 years old
① Diarrhea		times	times
② Typhoid		times	times
③ Hepatic		times	times

2-3)Medical expense for this treatment _____Tg/year

D. Water use reality

〔1〕 Number of faucets Total_____

〔2〕 Total tap water consumption _____m3/Month (Tg/month)

〔3〕 Main purpose of tap water use 1st _____ 2nd_____ 3rd_____

①Drinking ②Cooking ③Washing ④Bath ⑤Shower ⑥Others_____

〔4〕 1)If you are drinking the tap water, how to drink ?

①Boiled water ②Cool down after boiled ③Water filter ④Direct drink of tap water

_____

2)What do you take a body wash ①Bath ②Shower ③Others_____

_____

3)How many times do you take a Bath/Shower in summer season ? ____times/week

How many times do you take a Bath/Shower in winter season ? ____times/week

4)How to wash your clothing ? ①Washing machine ②Hand washing ③Landry

_____

5)How many times a week do you wash your clothing ? ____times/week

〔5〕 Installation of water meter ①Yes installed ・ ②Not installed _____

1) If yes, reason of installation (_____)

2) If no,

① Do you know that the water charge may be reduced

①Yes・②No _____

② Do you mind installing a water meter by spending your money?

①Yes・②No _____

1. If yes

Do you mind paying current rate? (28,000.Tg/meter include the installation)

①Yes・②No _____

2. If no

・ What do you think about current amount of 28,000 Tg/meter?

(①Expensive ・ ②Normal ・③Cheap) _____

〔6〕 Method of water charge payment

(①Collector ②Deduction from bank account ③others_____) _____

1) The reason of that _____

2) Have you ever received the reminder for the water payment ?

①Yes・②No _____ If Yes, how many times? _____ times

3) Did you paid the reminder payments? ①Yes・②No _____

E. Household/information

〔1〕 Number of family and component

Total family _____ persons

①father___ person ② Mother___ person ③Grandparents_____ persons

④Children(over 15years) ___ persons ⑤Children(below 15year) ___ persons

⑥Husband/Wife_____ persons

〔2〕 Primary wage earner's job

2-1) ①Salaried employee ②Self-employment _____

2-2) ①Agricultural farmer ②Cattle farmer ③Shopper ④ Engineer/Technician

⑤Clerk/Administration ⑥Others_____

_____

Annual income _____Tg/year

Number of other earners ____ persons

①Oneself ②Father ③ Mother ④Husband/Wife ⑤Son/Daughter ⑥Others_____

Breakdown _____ _____Tg/year

_____ _____Tg/year

_____ _____Tg/year

Others income _____Tg/year

〔3〕 Expenditure per month

House rent	_____Tg
Food	_____Tg
Water	_____Tg
Other Utilities (Gas,Electricity)	_____Tg
Fuel for Vehicle	_____Tg
Education	_____Tg
Clothes	_____Tg
Others	_____Tg

〔4〕 Property

1)House	①Yes	②No	_____	
2)Lands	①Yes	②No	_____	_____m2
3)Vehicles	①Yes	②No	_____	_____nos
4)Cows/Sheep	①Yes	②No	_____	_____nos
5)Others_____	①Yes	②No	_____	_____nos

Questionnaire for Bag Area

Respondent's Name : _____ Date ___/___/2008

Age ___ years ①Female ②male _____

Respondent's address : _____

Name of Enumerator : _____

1. Household

1)Number of family and component Total family _____ persons

①father ___ person ② Mother ___ person ③Grandparents _____ persons

④Children(over 15years) ___ persons ⑤Children(below 15year) ___ persons

2)Main water conveyer of the family 1st _____ 2nd _____

*The two that choose from ①—⑤

①father ②Mother ③Grandparents ④Children(over 15year)

⑤Children(below 15year)

3)Occupation of head of family

3-1) ①Employer ②Self-employment _____

3-2) ①Agricultural farmer ②Cattle farmer ③Shopper ④Factory Engineer

⑤Clerk ⑥Others _____

_____

4) Annual income of the family Total _____ Tg/year

Breakdown _____ _____ Tg/year

_____ _____ Tg/year

_____ _____ Tg/year

1. Current water source

1-1)

*The ones that apply to use of water

①Drinking ②Cooking ③Washing ④Cattle ⑤Plant ⑥Others

	Place to Obtain	Use of water(①to⑥)	Volume(ℓ/Day)
1	Water Kiosk	1st 2nd	
2	Well	1st 2nd	
3	River	1st 2nd	
4	Others	1st 2nd	

1-2) Average of house water stocks of Kiosk water (ℓ/day)

_____ (ℓ/day)

2-1. Problems to be solved on current water use _____

*The ones that apply to

①Price ②Distance ③Selling hours ④Waiting time ⑤Water Quality

⑥Kiosk Services ⑦Conveyance ⑧Security ⑨Way of Payment

⑩Others(If Any) _____

2-2. Reason of Request for New Kiosk installation _____

*The ones that apply to

①Price reduction ②Short distance from house ③Selling hours

④Long waiting time ⑤Safety water

⑨Others(If Any) _____

3. Kiosk water

1)Current waiting time for purchasing _____ Minute/time

2)How much are you thinking about proper price of current Kiosk water?(1ℓ) _____

①0.5Tg ②1.0Tg ③1.5Tg ④2.0Tg ⑤2.5Tg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