



SOLOMON ISLANDS WATER AUTHORITY

**THE STUDY FOR
REHABILITATION AND IMPROVEMENT
OF
SOLOMON ISLANDS WATER AUTHORITY'S
WATER SUPPLY AND SEWERAGE SYSTEMS**

**FINAL REPORT
SUPPORTING REPORT**

JUNE 2006



JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

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Exchange Rate applied in this report (Aug. 2005)

US\$1.0 = J¥111.67

A\$1.0 = J¥84.81

US\$1.0 = SI\$7.00

SI\$1.0 = J¥15.95

PREFACE

In response to a request from the Government of the Solomon Islands, the Government of Japan decided to conduct a study for Rehabilitation and Improvement of Solomon Islands Water Authority's Water Supply and Sewerage Systems, and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Masahiro Takeuchi of Yachiyo Engineering Co., Ltd. between May 2005 and June 2006.

The team held discussions with the officials concerned of the Government of the Solomon Islands and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Solomon Islands for their close cooperation extended to the study.

June 2006

Ariyuki Matsumoto,
Vice President
Japan International Cooperation Agency

June 2006

Mr. Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Matsumoto

LETTER OF TRANSMITTAL

We are pleased to submit to you the final report of the Study for Rehabilitation and Improvement of Solomon Islands Water Authority's Water Supply and Sewerage Systems in the Solomon Islands. The report has been prepared, the advices and suggestions of your Agency taken into account. Also included are the comments made by Solomon Islands Water Authority (SIWA).

The report consists of mid-term facility improvement plan for the target year 2010 for the capital city and provincial centers, and action plans for capacity development of SIWA for improving their management.

In the report, for the capital city of Honiara, water supply facility improvement project has been proposed for eliminating low pressure areas, improving water quality, expanding service areas, etc. and sewerage facility improvement project has been proposed for reducing water pollution. Meanwhile, for Auki as the provincial center, groundwater development project has been proposed for securing the required water source amount. Through these projects, in Honiara, stable water intake volume can be secured by shifting the unstable main spring source, whose water intake volume has been reduced 40% less than that in the normal condition due to the blockage occurred in October 2005, to the new groundwater source inside the town boundary. In Auki where the residents are now suffering from inconvenience of only two-hour water supply in a day due to the serious shortage of water source amount, the shortage will be eliminated by the development of new groundwater source and thereby 24 hour-water supply can be realized.

The action plan consists of an action plan for capacity development related to the management improvement and institutional strengthening, an action plan for water supply and sewerage facility improvement and an action plan for leakage reduction. It is expected that the management improvement and institutional strengthening be enhanced by implementing the above-mentioned action plans by SIWA.

We wish to take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to SIWA and the relating organizations for close cooperation and assistance extended to us during our study

Very truly yours,



Masahiro Takeuchi

Team Leader

The Study for Rehabilitation and Improvement of
Solomon Islands Water Authority's Water Supply
and Sewerage Systems

List of Report

This Final Report (F/R) has been prepared to compile the results of all the study which had been executed from the middle of May 2005 to the end of June 2006.

F/R consists of the following volumes, parts and annexes.

MAIN REPORT

PART A	FRAMEWORK OF THE STUDY
PART B	HONIARA WATER SUPPLY AND SEWERAGE
PART C	PROVINCIAL CENTERS WATER SUPPLY AND SEWERAGE
PART D	CONDITIONS OF WATER SUPPLY AND SEWERAGE MANAGEMENT
PART E	BUILDING PLAN FOR INSTITUTIONAL STRENGTHENING
PART F	PILOT PROJECTS OF THE STUDY
PART G	ACTION PLAN
PART H	ENVIRONMENTAL AND SOCIAL CONSIDERATIONS
PART I	URGENT REHABILITATION PALN
PART J	RECOMMENDATIONS

SUPPORTING REPORT

S-1	METEOROLOGICAL DATA OF THE STUDY AREA
S-2	ELECTRIC RESISTIVITY PROSPECTING
S-3	LEAKAGE SURVEY
S-4	WATER SOURCES SURVEY
S-5	SOCIO-ECONOMIC SURVEY
S-6	HYDRAULIC ANALYSIS
S-7	COST ESTIMATIO
S-8	DATA FOR FOLLOW-UP COOPERATION
S-9	BUILDING PLAN FOR INSTITUTIONAL STRENGTHENING
S-10	DATA FOR INTERMEDIATE WATER TREATMENT FACILITY

SUMMARY (ENGLISH)

SUMMARY (JAPANESE)

SUPPORTING REPORT

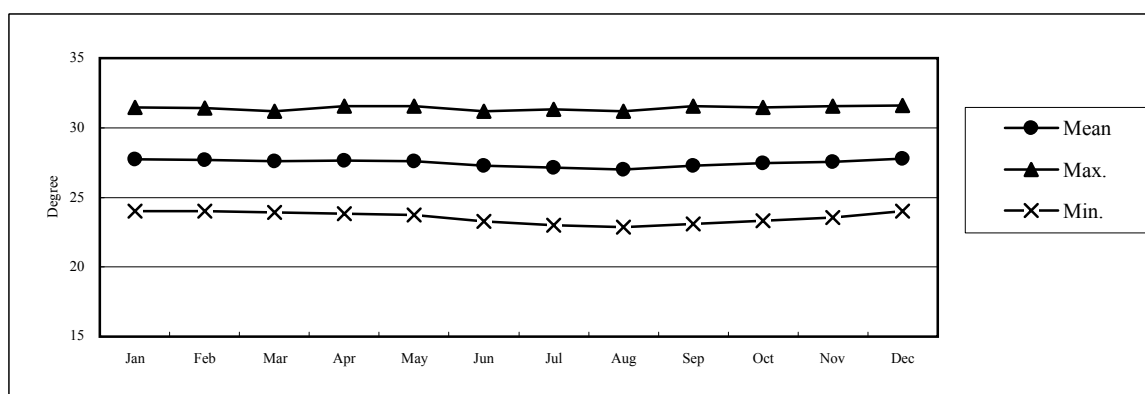
- S-1 METEOROLOGICAL DATA OF THE STUDY AREA
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**SUPPORTING METEOROLOGICAL DATA OF
REPORT S-1 THE STUDY AREA**

Honiara Daily Temperature (deg.)

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1986	Mean	26.5	26.3	26.5	26.7	26.7	26.7	26.7	26.6	26.6				26.6
	Max.	30.1	29.8	30.1	30.6	30.7	30.6	30.9	30.9	30.8				30.5
	Min.	22.8	22.7	22.9	22.7	22.6	22.8	22.5	22.3	22.4				22.6
1987	Mean			27.5	27.1	27.1	26.9	26.6	26.3	26.7	27.5	27.9	27.5	27.1
	Max.			31.2	31.0	30.8	31.4	30.7	30.9	30.4	31.3	31.6	31.0	31.0
	Min.			23.8	23.3	23.5	22.5	22.5	21.8	23.1	23.7	24.1	24.0	23.2
1988	Mean	27.5	27.5	28.1	27.4	27.9	27.2	26.8	26.9	27.0	27.0	27.0	26.6	27.2
	Max.	30.7	30.8	32.0	31.2	31.9	31.0	30.6	30.8	30.8	30.8	30.6	29.8	30.9
	Min.	24.1	24.1	24.2	23.6	23.9	23.4	23.0	23.0	23.2	23.2	23.5	23.4	23.6
1989	Mean	26.7	26.5	26.3	26.9	26.7	26.9	27.1	27.3	27.3	27.3	28.5	27.7	27.1
	Max.	30.4	29.7	29.5	30.5	30.4	31.0	31.3	31.8	31.6	32.1	32.9	31.3	31.0
	Min.	23.6	23.2	23.2	23.4	23.1	22.9	22.9	22.8	23.1	22.4	24.1	24.2	23.2
1990	Mean	28.0	27.7	27.7	27.7	27.7	27.3	26.9	27.3	27.3	28.0	27.9	27.7	27.6
	Max.	31.5	31.8	31.3	31.5	31.6	31.3	30.8	31.6	31.2	32.2	31.9	31.4	31.5
	Min.	24.2	23.6	24.2	23.8	23.9	23.4	23.1	23.1	23.3	23.8	23.8	24.0	23.7
1991	Mean	27.1	27.0	27.7	27.9	27.5	27.5	26.8	27.0	26.7	27.1	27.6	27.0	27.2
	Max.	31.4	30.0	31.5	31.9	31.3	31.1	30.4	30.6	30.3	31.0	31.1	31.3	31.0
	Min.	24.3	24.1	23.8	23.9	23.8	23.9	23.2	23.4	23.1	23.3	24.1	22.8	23.6
1992	Mean	27.1	27.1	27.3	27.3	27.3	27.2	26.7	27.0	26.9	27.0	26.9	27.6	27.1
	Max.	31.7	30.5	31.0	31.1	31.0	30.8	30.2	30.9	31.0	30.9	30.6	31.4	30.9
	Min.	31.7	30.5	31.0	31.1	31.0	30.8	30.2	30.9	31.0	30.9	30.6	31.4	30.9
1993	Mean	27.3	27.4	27.3	27.7	27.1	27.0	26.3	25.7	26.3	26.3	26.7	27.6	26.9
	Max.	31.6	31.1	31.4	31.3	30.5	30.5	29.9	29.6	30.2	30.7	31.9	31.6	30.9
	Min.	23.4	23.7	23.3	24.1	23.8	23.6	22.7	21.9	22.5	22.6	23.3	24.0	23.2
1994	Mean	27.7	27.5	27.7	27.6	27.6	26.6	26.4	26.8	26.6	27.1	27.4	27.5	27.2
	Max.	31.4	31.0	31.4	31.3	30.9	30.3	30.0	30.4	30.7	31.3	31.9	31.5	31.0
	Min.	24.0	24.0	23.9	23.8	23.7	22.9	22.8	23.2	22.5	22.9	22.9	23.4	23.3
1995	Mean	28.2	27.9	27.2	27.8	27.7	27.5	27.7	27.8	27.6	27.6	28.2	27.6	27.7
	Max.	32.0	31.5	30.4	31.6	31.4	31.7	32.2	32.0	31.9	31.6	32.6	31.4	31.7
	Min.	24.3	24.3	24.0	24.0	23.9	23.3	23.1	23.5	23.2	23.6	23.8	23.7	23.7
1996	Mean	27.6	27.8	28.0	27.3	27.4	27.3	27.4	27.3	27.6	27.9		27.6	27.6
	Max.	31.1	31.7	31.2	31.9	31.2	31.1	31.4	31.5	31.7	31.6	31.7	31.2	31.4
	Min.	23.9	24.0	23.8	23.8	23.5	23.4	23.4	23.1	23.4	23.3	23.3	23.9	23.6
1997	Mean	27.6	27.4	27.3	27.3	27.2	26.5	27.6	26.4	26.1	25.8	27.1	28.1	27.0
	Max.	31.4	30.8	30.7	31.0	31.3	30.7	32.1	30.5	30.2	29.9	31.4	32.1	31.0
	Min.	23.8	24.0	23.9	23.5	23.1	22.2	23.1	22.3	22.1	21.7	22.8	24.1	23.0
1998	Mean	27.7	27.9	27.4	27.9	27.8	27.6	27.4	27.2	27.5	28.1	28.0	27.8	27.7
	Max.	31.0	31.4	30.6	31.6	31.5	31.5	32.1	31.6	31.6	32.6	32.1	31.6	31.6
	Min.	24.3	24.4	24.1	24.2	24.0	23.7	22.6	22.9	23.4	23.7	23.9	23.9	23.8
1999	Mean	27.4	26.8	27.7	27.8	27.6	27.1	27.4	27.2	27.4	27.5	27.3	27.6	27.4
	Max.	30.9	29.8	31.8	31.8	31.7	31.2	31.8	31.8	32.0	31.8	31.3	31.5	31.5
	Min.	23.9	23.7	23.6	23.7	23.6	23.1	23.0	22.6	22.8	23.3	23.3	23.6	23.4
2000	Mean	27.7	27.6	27.4	27.3	27.3	27.5	26.9	27.3	27.8	28.2			27.5
	Max.	31.6	32.0	31.4		31.3	31.7	30.8	31.6	32.6	32.6			31.7
	Min.	23.7	23.2	23.4		23.3	23.2	23.0	23.0	23.0	23.9		24.6	23.4
2001	Mean		28.0	27.6	27.4	27.3	27.2		26.9	27.7	27.7	28.1	28.1	27.6
	Max.		32.0	31.4	31.1	30.8	31.0		31.2	32.2	31.6	32.1	32.0	31.5
	Min.		24.1	23.9	23.8	23.9	23.4		22.7	23.3	23.9	24.2	24.2	23.7
2002	Mean	27.6	27.6	27.6	28.1	27.9	27.7	27.0	26.7	26.8	27.0	27.5	27.7	27.4
	Max.	31.4	31.1	31.0	32.1	31.8	31.6	30.8	30.5	30.4	30.7	31.4	31.7	31.2
	Min.	23.9	24.2	24.2	24.2	24.1	23.8	23.2	22.9	23.2	23.3	23.6	23.8	23.7
2003	Mean	27.9	28.0	27.7	27.6	28.3	27.3	26.9						27.7
	Max.	31.8	31.9	31.2	31.6	32.6	31.2	31.0						31.6
	Min.	24.0	24.1	24.2	23.7	24.1	23.4	22.9						23.8
2004	Mean	28.4	28.3	27.7	27.6	27.7	27.1	26.6	26.9	27.4	27.3	27.4	27.6	27.5
	Max.	32.4	32.2	31.1	31.2	31.7	30.8	30.5	30.7	31.5	31.0	31.0	31.0	31.3
	Min.	24.3	24.4	24.3	24.0	23.8	23.4	22.8	23.2	23.3	23.7	23.8	24.2	23.8

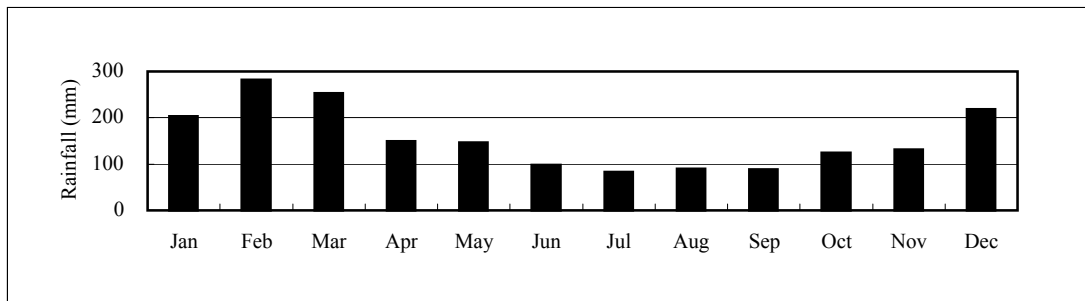
Mean	27.7	27.7	27.6	27.6	27.6	27.3	27.2	27.0	27.3	27.4	27.6	27.8	27.4
Max.	31.4	31.4	31.2	31.5	31.5	31.2	31.3	31.2	31.5	31.5	31.6	31.6	31.6
Min.	24.0	24.0	23.9	23.8	23.7	23.3	23.0	22.8	23.1	23.3	23.6	24.0	24.0



Honiara Monthly Rainfall (mm)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	273	182	263	251	366	40	84	116	141	9	208	37	1970
1987	94	231	114	84	60		66	30	63	98	166	299	1305
1988	318	409	123	78	33	104	95	139	130	198	453	549	2629
1989	244	483	152	247	207	146	34	36	72	65	71	171	1928
1990	231	71	333	160	168	53	112	48	123	42	74	274	1689
1991	274	275	235	151	189	140	144	154	139	74	35	16	1826
1992	91	423	109	117	61	46	68	35	24	131	100	155	1360
1993	62	233	131	188	60	112	98	96	33	41	43	168	1265
1994	258	364	344	140	174	201	73	97	19	55	18	98	1841
1995	76	98	344	152	151	40	41	71	129	260	15	175	1552
1996	149	162	369	154	91	93	109	134	71	218	124	517	2190
1997	188	306	583	74	35	61	5	112	151	98	36	45	1692
1998	264	240	396	56	130	46	22	273	115	25	182	351	2098
1999	350	601	179	119	221	78	43	114	99	189	226	364	2584
2000	212	181	304	245	429	94	44	68	25	51			
2001		417	244	203	148	123		35	48	192	118	198	
2002	196	306	236	105	120	45	232	33	181	237	226	163	2078
2003	201	95	248	102	73	178	167						
2004	49	303	275	217	72	169	56	31	35	269	140	123	1738
2005	334	250	72										

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average	203	281	253	150	147	98	83	90	89	125	131	218	1868
Lowest	49	71	72	56	33	40	5	30	19	9	15	16	
Highest	350	601	583	251	429	201	232	273	181	269	453	549	



Daily Pan Evaporation (millimetre)

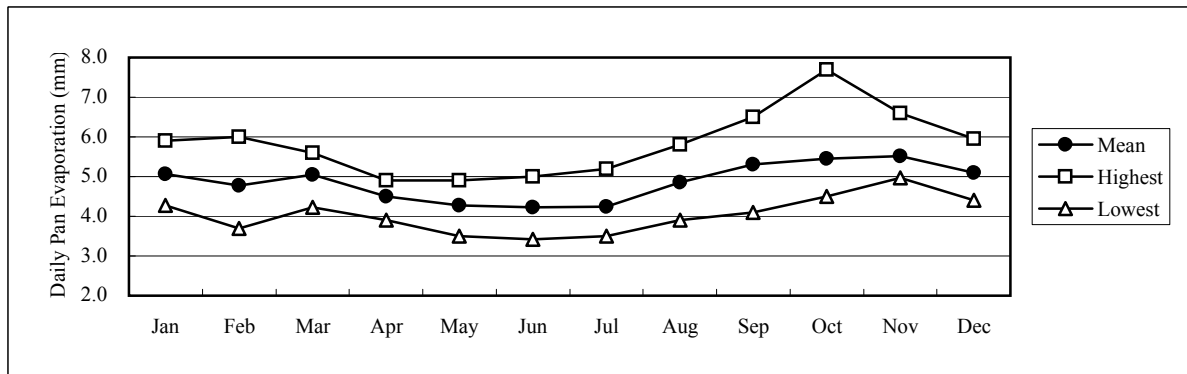
Henderson Airport
Latitude: 09 25'S

Island: Guadalcanal
Longitude: 160 03'E

Year: 1984 - 1996

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
1982										5.0	5.5	5.9	
1984	5.5	4.8	4.8	4.2	4.4	4.1	4.0	4.9	6.1	4.7	5.0	4.7	4.8
1985	4.5	4.7	4.2	4.8	4.0	4.2	4.1	4.4	5.1	4.8	5.0	4.8	4.5
1986	5.0	5.4	5.6	3.9	4.9	4.5	5.2	4.9	4.7	6.5	5.0	5.5	5.1
1987	5.9	4.5	5.5	4.2	4.1	5.0	4.4	5.8	5.8	4.9	5.6	4.6	5.0
1988	5.5	3.7	5.4	4.3	4.7	4.2	4.0	4.7	5.1	4.5	5.1	4.4	4.6
1989	4.4	4.3	5.2	4.9	4.1	4.0	4.4	5.6	6.5	5.5	6.0	4.8	5.0
1990	5.1	6.0	4.4	4.6	4.1	4.3	4.4	4.9	5.2	5.6	5.2	4.9	4.9
1991	5.0	4.4	5.2	4.6	4.1	4.2	3.6	3.9	4.1	4.7	5.2	5.8	4.6
1992	4.8	4.9	5.1	4.5	4.6	4.0	4.4	5.1	5.4	5.8	5.1	5.4	4.9
1993	5.5	5.4	5.3	4.7	4.1	3.9	4.1	4.6	5.0	5.6	6.6	4.8	5.0
1994	4.8	4.4	5.1	4.6	3.5	4.4	3.5	4.2	5.1	5.7	6.3	5.3	4.7
1995	5.7	4.9	5.4	4.7	4.4	4.7	4.5	5.3	5.9	7.7	6.4	5.1	5.4
1996	4.3	4.8	4.4		4.5	3.4	4.6	4.8	5.0	5.4	5.3	5.2	

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Average	5.1	4.8	5.1	4.5	4.3	4.2	4.2	4.9	5.3	5.5	5.5	5.1	4.9
Max.	5.9	6.0	5.6	4.9	4.9	5.0	5.2	5.8	6.5	7.7	6.6	5.9	5.8
Min.	4.3	3.7	4.2	3.9	3.5	3.4	3.5	3.9	4.1	4.5	5.0	4.4	4.0



Monthly Average Relative Humidity (%)

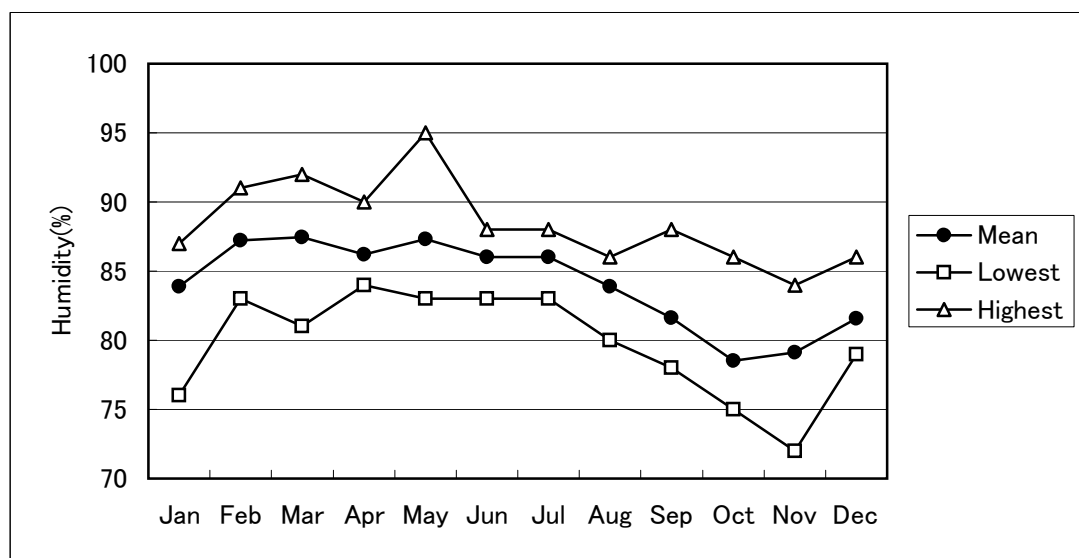
Station: Honiara
Latitude: 9 25' S

Island: Guadalcanal
Longitude: 159 58' E

Period: 1996-2004
Elevation: 55.0 M

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
1974	73	76	74	69	69	68	76	65	69			71	
1987			74	71	75	65	66	64	68	66	73	75	70
1988	78	78	64	74	71	69	67	71	71	78	75	81	73
1989	76	82	74	75	75	68	68	64	68	69	64	73	71
1990	71	56	74	73	75	72	71	68	70	67	70	74	70
1991	73	78	71	66	73	70	75	71	83	71	68	68	72
1992	66	76	84	70	71	72	72	69	71	68	73	69	72
1993	68	74	68	72	75	74	74	70	71	68	68	71	71
1994	74	75	74	74	75	72	75	74	68	69	64	68	72
1995	66	79	79	71	74	71	64	64	68	70	67	71	70
1996	84	85	87	85	95	86	86	85	80	78	79	86	85
1997	86	87	88	85	83	84	83	84	88	76	72	79	83
1998	87	89	92	85	87	87	83	82	79	75	79	81	84
1999	84	91	81	86	88	88	87	80	80	75	78	80	83
2000	87	89	90	90	90	87	87	86	79	77			
2001		89	86	88	87	86		83	78	80	78	80	
2002	87	88	91	86	87	87	88	86	86	86	84	82	87
2003	80	84	85	84	83	86	87						
2004	76	83	87	87	86	83	87	85	83	81	84	83	84

Mean	84	87	87	86	87	86	86	84	82	79	79	82	84
Lowest	76	83	81	84	83	83	83	80	78	75	72	79	80
Highest	87	91	92	90	95	88	88	86	88	86	84	86	89



Monthly Mean Sunshine Hours

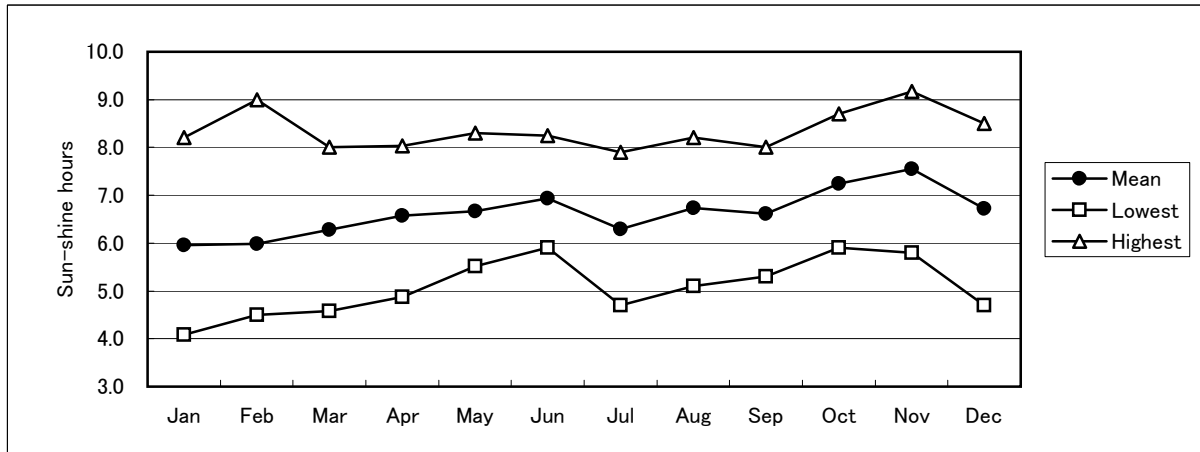
Station: Henderson Airport
Latitude: 9 25' S

Island: Guadalcanal
Longitude: 160 03' E

Year: 1986 - 1996
Elevation: 7.9M

Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1986	5.8	5.1	7.2	5.2	5.6	6.0	6.6	7.0	5.3	8.7	7.1	7.1	6.4
1987	8.2	4.9	5.6	6.4	6.6	7.4	5.9	8.2	6.6	6.4	7.3	5.1	6.6
1988	5.4	5.3	8.0	6.5	7.7	7.4	6.0	7.0	5.8	5.9	7.4	4.7	6.4
1989	4.2	6.4	6.5	6.9	8.3	7.6	7.9	7.4	8.0	8.0	5.8		7.0
1990	5.1	9.0	4.7	6.5	6.5	7.3	5.2	6.6	7.1	7.6	6.8	6.2	6.6
1991	6.0	5.2	7.0	7.2	7.0	6.4	5.5	5.1	5.4	6.4	7.3	8.4	6.4
1992	6.3	4.5	7.7	7.1	6.0	7.0	5.5	7.4	6.7	7.4	7.5	7.2	6.7
1993	7.9	5.8	7.3	6.1	6.2	6.2	5.4	6.9	5.5	7.2	7.8	6.2	6.5
1994	6.3	5.5	7.5	6.6	5.6	5.9	4.7	5.4	6.3	6.3	9.1	7.9	6.4
1995	7.1	7.0	5.2	7.8	6.4	7.8	7.8	7.0	7.7	7.6	8.4	6.3	7.2
1996	5.5	7.1	5.5	6.3	7.0	6.4	7.4	7.1	7.5	6.4	7.5	5.9	6.6
1997	5.5	5.5	4.9	4.9	8.3	8.3	6.2	5.5	6.1	8.2	9.2	7.1	6.6
1998	4.1	6.5	4.6	8.0	5.5	6.6	7.6	7.1	7.9	8.0	7.1	8.5	6.8

Mean	6.0	6.0	6.3	6.6	6.7	6.9	6.3	6.7	6.6	7.2	7.6	6.7	6.6
Lowest	4.1	4.5	4.6	4.9	5.5	5.9	4.7	5.1	5.3	5.9	5.8	4.7	6.4
Highest	8.2	9.0	8.0	8.0	8.3	8.3	7.9	8.2	8.0	8.7	9.2	8.5	7.2



Solomon Islands Meteorological Service

Monthly Rainfall (millimetre)

Station: Munda

Island: New Georgia

Year: 1996 - 2004

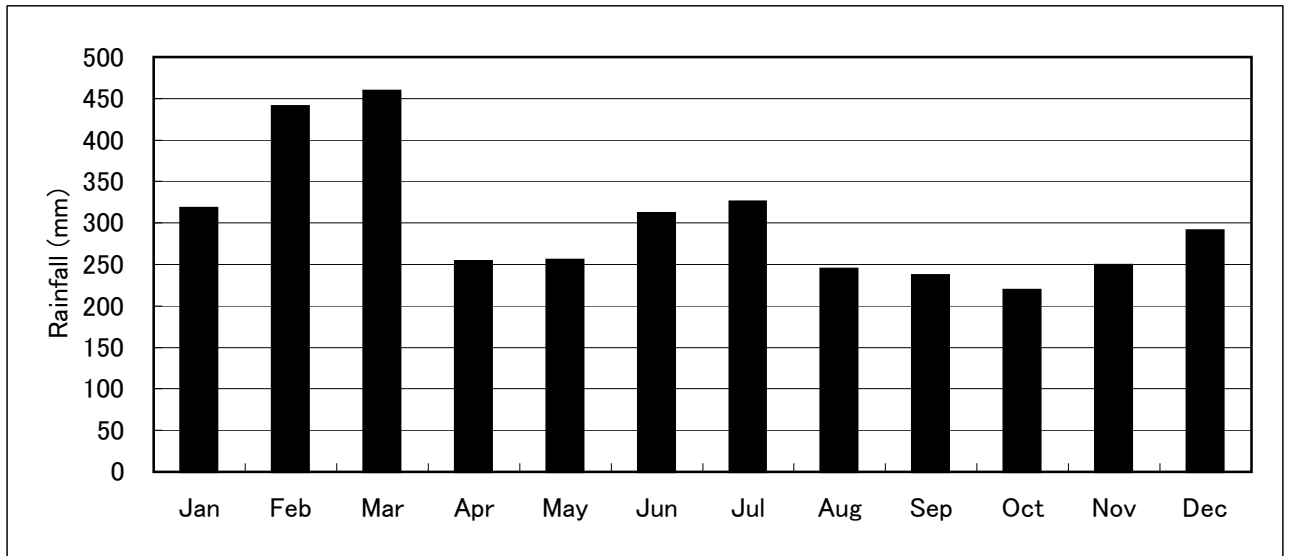
Latitude: 08 20'S

Longitude: 157 16'E

Elevation: 2.7 M

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1996	317	347	775	184	441	245	186	329	220	169	336	509	4057.5
1997	241	363	454	289	66	186	66	119	105	13	98	113	2112.1
1998	652	594	654	171	170	354	144	337	263	197	313	254	4101.8
1999	166	380	223	270	188	188	224	198	367	340	298	199	3039.9
2000	269	123	368	165	333	438	498	369	265	110	215	569	3720.5
2001	241	707			419	299	564	195	238	240	184	196	3283
2002	256	834	422	198	313	235	547	196	133	320	213	126	3794
2003	323	191	432	273	190	489	230	288	159	386	421	321	3704
2004	345	428	346	483	181	376	474	170	382	195	164	329	3873
2005	372												

Average	318	441	459	254	256	312	326	245	237	219	249	291	3606
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Solomon Islands Meteorological Service

Daily Maximum Temperature (Deg Cel)

Station: Munda

Island: New Georgia

Year: 1996-2004

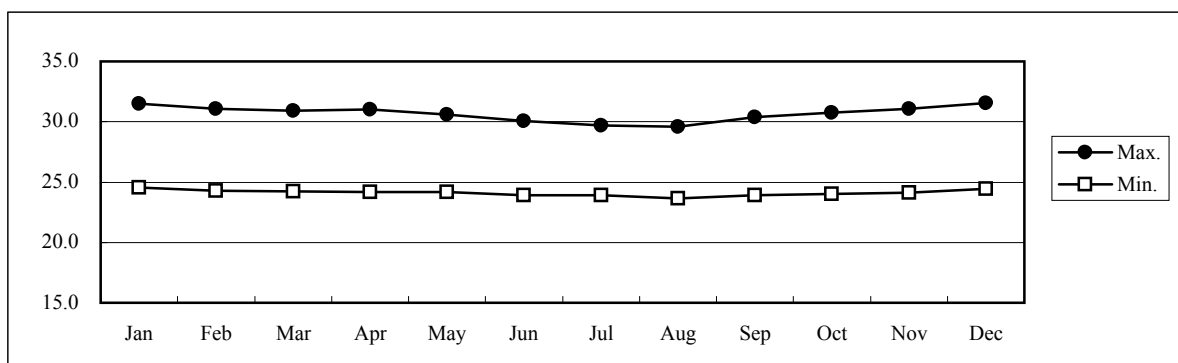
Latitude: 8 20' S

Longitude: 157 16' E

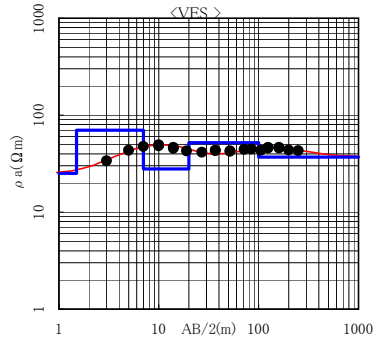
Elevation: 2.7 M

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
1996	Max.	24.3	24.1	23.8	24.2	24.0	23.9	23.9	24.0	23.8	24.2	23.8	24.2	
	Min.	31.4	31.2	30.8	31.3	30.2	30.1	30.0	30.3	30.7	30.8	31.2	31.6	30.8
1997	Max.	24.3	24.3	24.7	24.1	24.5	22.9	24.5	23.0	23.4	22.7	23.4	24.5	23.9
	Min.	31.0	31.0	31.4	30.3	30.4	29.6	29.5	28.9	29.5	30.2	31.3	31.8	30.4
1998	Max.	24.9	24.8	24.5	24.4	24.8	24.4	24.2	24.1	24.4	24.2	24.3	24.7	24.5
	Min.	31.4	31.2	30.5	31.2	30.8	30.2	29.9	30.1	30.6	31.0	30.6	31.5	30.7
1999	Max.	24.5	24.1	24.0	23.9	24.0	23.6	23.4	23.2	23.2	23.8	23.9	24.1	23.8
	Min.	31.6	30.3	31.1	31.0	30.6	30.3	30.0	29.9	30.7	30.8	30.1	31.3	30.6
2000	Max.	24.5	23.7	23.8	23.8	23.7	23.8	23.5	23.7	23.8	24.1	24.3	24.6	23.9
	Min.	31.8	31.7	30.7	31.4	30.4	30.2	29.7	29.5	30.7	31.3	31.5	31.4	30.9
2001	Max.	24.3	24.3			24.0	23.9	23.8	23.6	24.4	24.4	24.5	25.0	24.2
	Min.	32.0	30.7			30.3	29.9	29.6	30.2	30.9	31.2	32.0	31.6	30.8
2002	Max.	24.8	24.6	24.3	24.2	24.1	24.3	24.0	23.6	23.5	24.3	24.4	23.8	24.2
	Min.	31.5	30.4	30.9	31.2	30.8	30.5	29.1	29.2	29.8	30.1	31.0	31.6	30.5
2003	Max.	24.8	24.1	24.3	24.4	24.3	23.9	24.0	23.9	24.6	24.5	24.2	24.6	24.3
	Min.	30.9	31.8	31.1	31.0	31.0	30.0	30.0	29.1	30.5	30.7	31.1	31.5	30.7
2004	Max.	24.6	24.6	24.7	24.5	24.4	24.3	23.9	23.6	24.2				24.3
	Min.	31.9	31.2	31.0	30.6	31.1	29.7	29.5	29.3	30.2				30.5

Mean	31.5	31.1	30.9	31.0	30.6	30.1	29.7	29.6	30.4	30.8	31.1	31.5	30.7
Mean	24.5	24.3	24.3	24.2	24.2	23.9	23.9	23.6	23.9	24.0	24.1	24.4	24.1

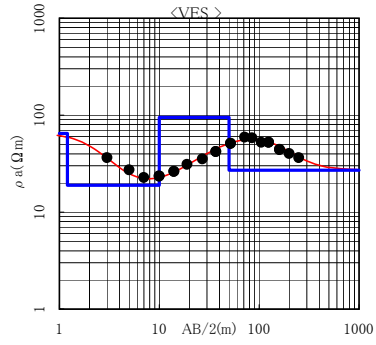


**SUPPORTING ELECTRIC RESISTIVITY
REPORT S-2 PROSPECTING**



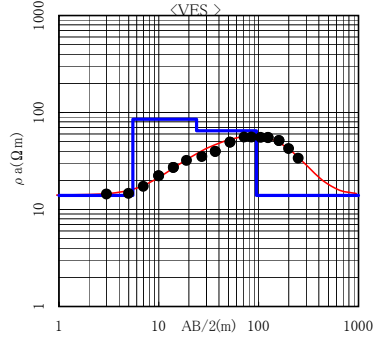
Location **No.1**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
25	2
70	7
28	20
52	100
37	



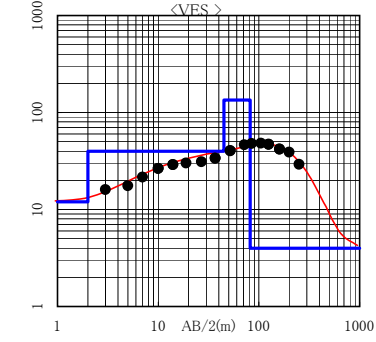
Location **No.2**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
65	1
19	10
95	50
27	



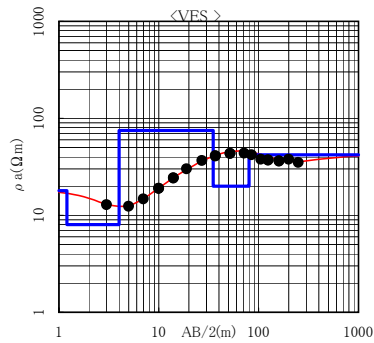
Location **No.3**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
14	6
85	24
65	95
14	



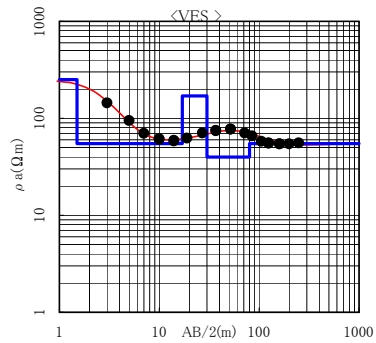
Location **No.4**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
12	2
40	45
135	82
4	



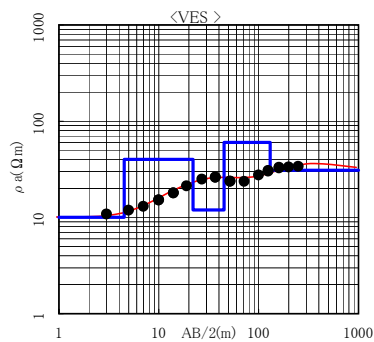
Location **No.5**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
18	1
8	4
75	35
20	80
42	



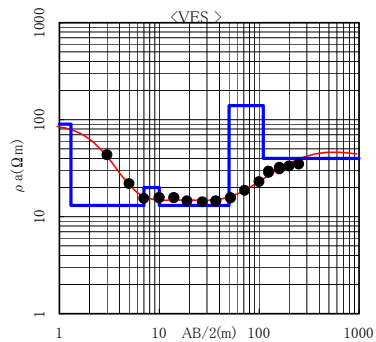
Location **No.6**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
250	2
55	17
170	30
40	80
55	



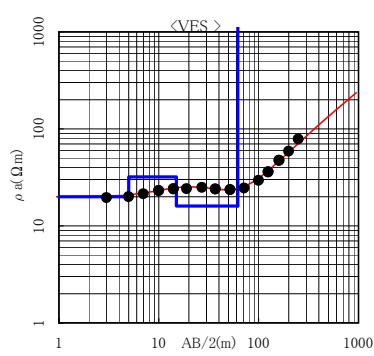
Location **No.7**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
10	5
40	22
12	45
60	130
31	



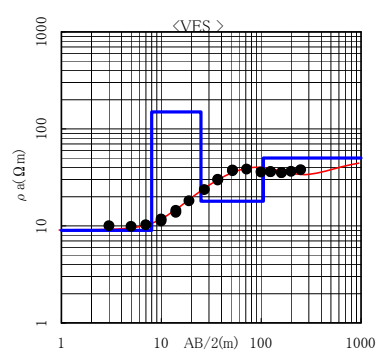
Location **No.8**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
90	1
13	7
20	10
13	50
140	110
40	



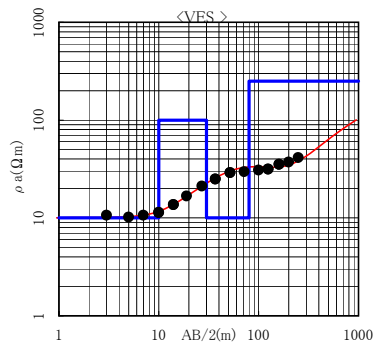
Location **No.9**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
20	5
32	15
16	62
1500	



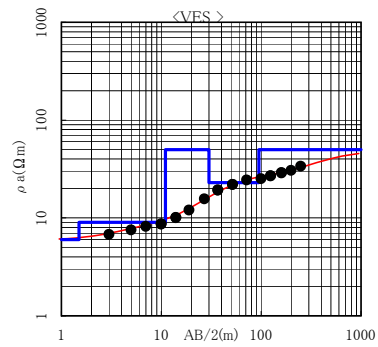
Location **No.10**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
9	8
150	25
18	105
50	



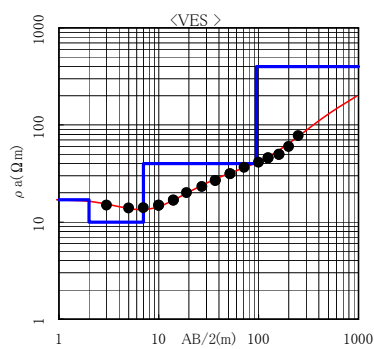
Location **No.11**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
10	10
100	30
10	80
250	



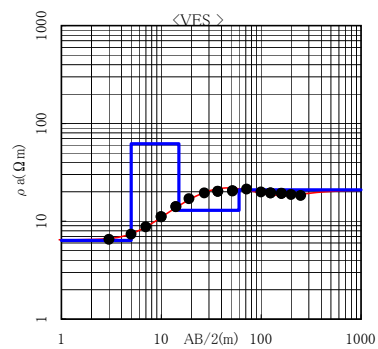
Location **No.12**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
6	2
9	11
50	30
23	95
50	



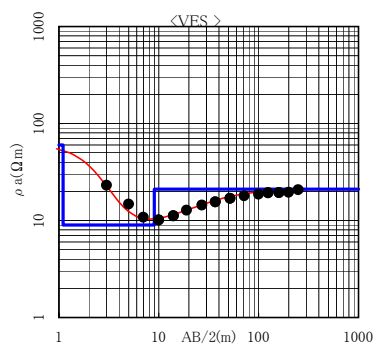
Location **No.13**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
17	2
10	7
40	95
400	



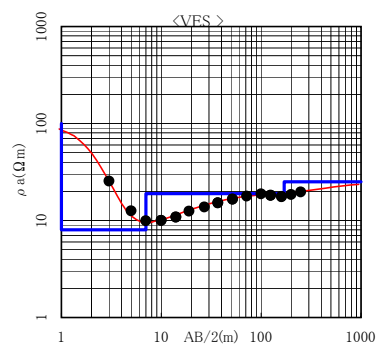
Location **No.14**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
6	5
62	15
13	60
21	



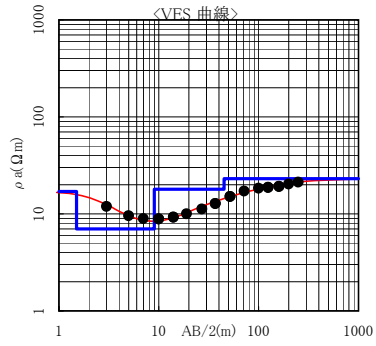
Location **No.15**

Model	
Layer	5
Resis. (Ωm)	Dep.(m)
60	1
9	9
21	



Location **No.16**

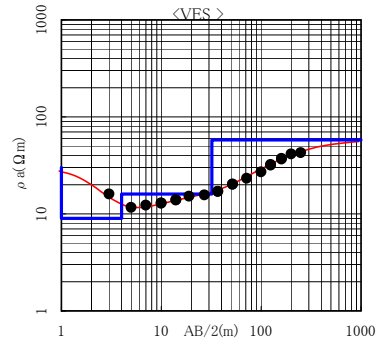
Model	
Layer	5
Resis. (Ωm)	Dep.(m)
100	1
8	7
19	170
25	



Location **No.17**

Model

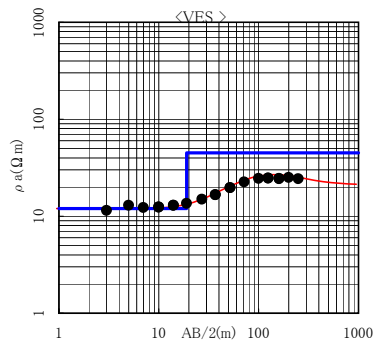
Layer	5
Resis. (Ωm)	Dep.(m)
17	2
7	9
18	45
23	



Location **No.18**

Model

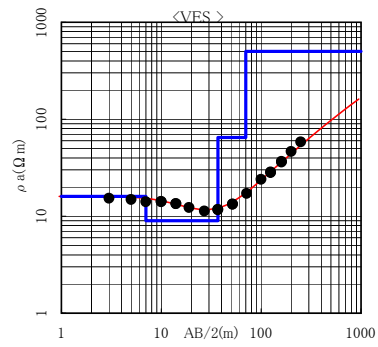
Layer	5
Resis. (Ωm)	Dep.(m)
30	1
9	4
16	32
58	



Location **No.19**

Model

Layer	5
Resis. (Ωm)	Dep.(m)
12	19
45	



Location **No.20**

Model

Layer	5
Resis. (Ωm)	Dep.(m)
16	7
9	37
65	70
500	

SUPPORTING LEAKAGE SURVEY
REPORT S-3

S-3-1 LEAKAGE SURVEY IN PHASE-1

S-3-2 PILOT PROJECT IN PHASE-2

S-3-1 LEAKAGE SURVEY IN PHASE-1

S-3-1-1 Model Block for Leakage Survey

S-3-1-2 Summary of Leakage Survey Results

S-3-1-3 Water Flow (Total Flow and Loss) in Each Model Block

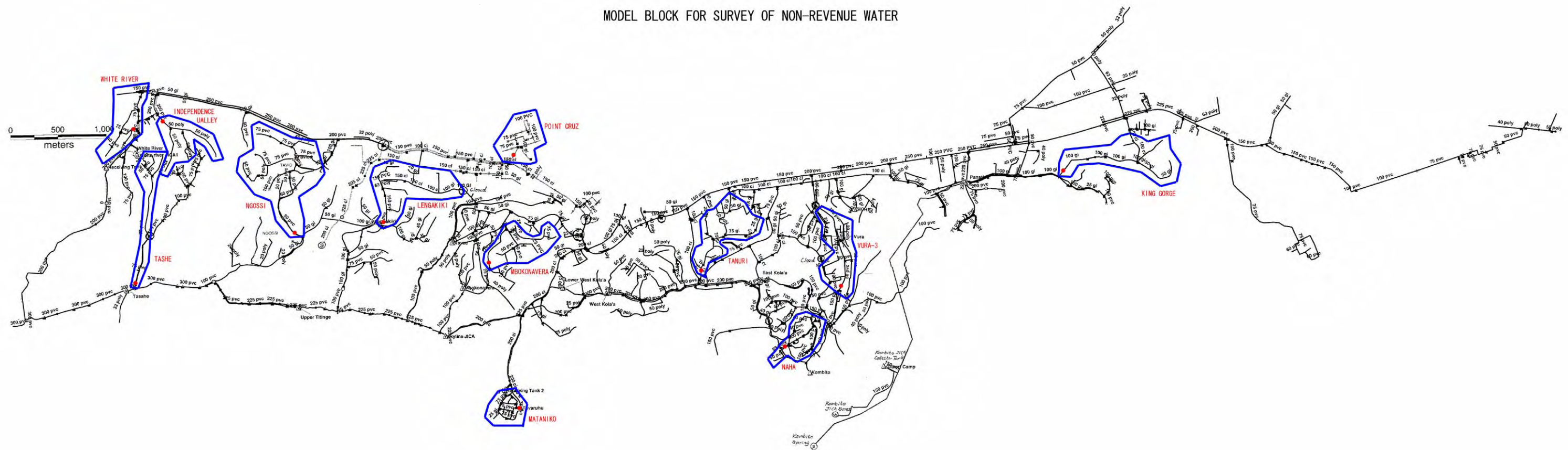
S-3-1-4 Quantity Survey of Leakage in Typical Model Block

S-3-1-5 Map of Leakage Point

S-3-1-6 Observation of Leakage Conditions

S-3-1-1 Model Block for Leakage Survey

MODEL BLOCK FOR SURVEY OF NON-REVENUE WATER



S-3-1-2 Summary of Leakage Survey Results

Rate of water loss

System	Area	Length (m)	Total flow (m ³ /d)	Ave (m ³ /h)	Max (m ³ /h)	Min (m ³ /h)	Flow in Loss (m ³ /d)	Rate of loss(%)	Loss (m ³ /d/km)	House Hold	Illegal Connection
ROVE	POINT CRUZ	1,761	160.94	6.71	20.89	2.56	56.80	35.29	32.25	35	
JICA Mataniko	TANULI RIDGE	2,866	472.21	19.68	27.04	13.99	315.07	66.72	109.93	135	
White River Pumping	TASHE	1,920	226.40	13.17	18.21	4.32	102.62	45.33	53.45	63	
	NGOSSI	5,587	597.71	24.90	33.21	15.03	315.61	52.80	56.49	213	3
	LENGEKIKI	2,767	624.21	26.01	38.31	12.01	248.89	45.64	89.95	152	
White River Gravity(SIWA)	MBOKONAVERA	2,213	122.45	5.10	9.15	3.33	75.83	61.93	34.27	121	
	WHITE RIVER	*	*	*	*	*	*	*	*	111	
Panatina Boreholes	INDEPENDENCE VALLEY	*	*	*	*	*	*	*	*	133	
	TUVAI	1,530	155.44	6.48	12.17	2.16	41.09	26.43	26.86	89	
Kombito	VURA	4,485	457.02	19.04	27.40	8.90	211.33	46.24	47.12	201	1
	NAHA	2,767	582.12	24.26	33.41	12.12	290.13	49.84	104.85	151	
Total & Average	SCHOOL	2,422	194.94	8.12	14.34	2.01	45.95	23.57	18.97	69	
		28,318	3,593.44				1,703.32	47.40	60.15		

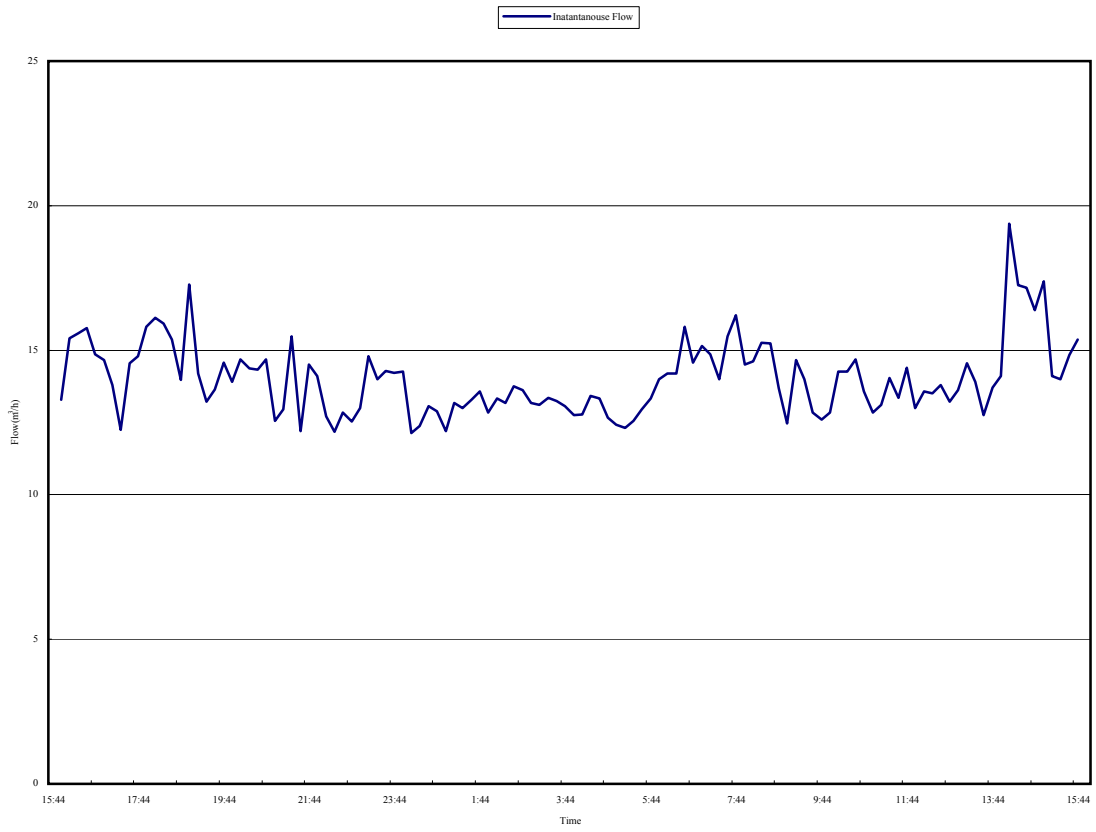
Rate of water loss

System	Area	Length (m)	Total flow (m ³ /d)	Ave (m ³ /h)	Max (m ³ /h)	Min (m ³ /h)	Flow in Loss (m ³ /d)	Rate of loss(%)	Loss (m ³ /d/km)
ROVE	POINT CRUZ	1,761	160.94	6.71	20.89	2.56	56.80	35.29	32.25
JICA Mataniko	TANULI RIDGE	2,866	472.21	19.68	27.04	13.99	315.07	66.72	109.93
White River Pumping	TASHE	1,920	226.40	13.17	18.21	4.32	102.62	45.33	53.45
	NGOSSI	5,587	597.71	24.90	33.21	15.03	315.61	52.80	56.49
	LENGEKIKI	2,767	624.21	26.01	38.31	12.01	248.89	45.64	89.95
	MBOKONAVERA	2,213	122.45	5.10	9.15	3.33	75.83	61.93	34.27
White River Gravity(SIWA)	WHITE RIVER	1,271	785.26	35.69	43.24	32.36	711.70	90.63	559.95
	INDEPENDENCE VALLEY	1,745	336.36	14.01	19.37	12.13	290.40	86.34	166.42
Mataniko Pumping(SIWA)	TUVAI	1,530	155.44	6.48	12.17	2.16	41.09	26.43	26.86
Kombito	VURA	4,485	457.02	19.04	27.40	8.90	211.33	46.24	47.12
	NAHA	2,767	582.12	24.26	33.41	12.12	290.13	49.84	104.85
Panatina Boreholes	SCHOOL	2,422	194.94	8.12	14.34	2.01	45.95	23.57	18.97
Total & Average		31,334	4,715.06				2,705.42	57.38	86.34

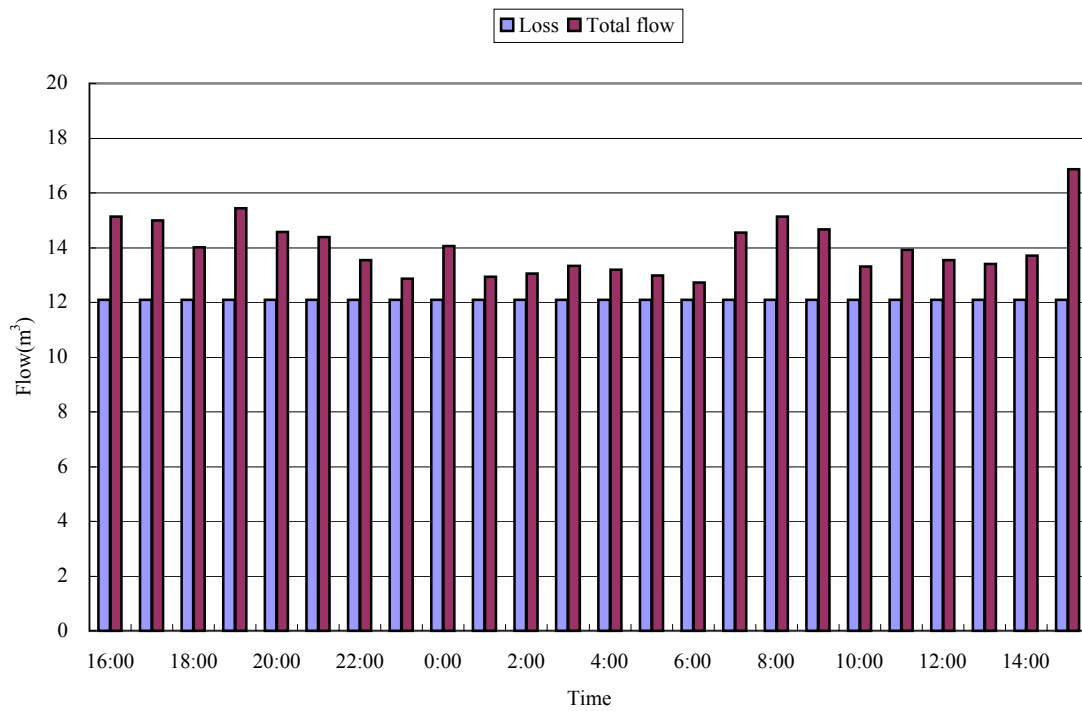
S-3-1-3 Water Flow (Total Flow and Loss) in Each Model

Block

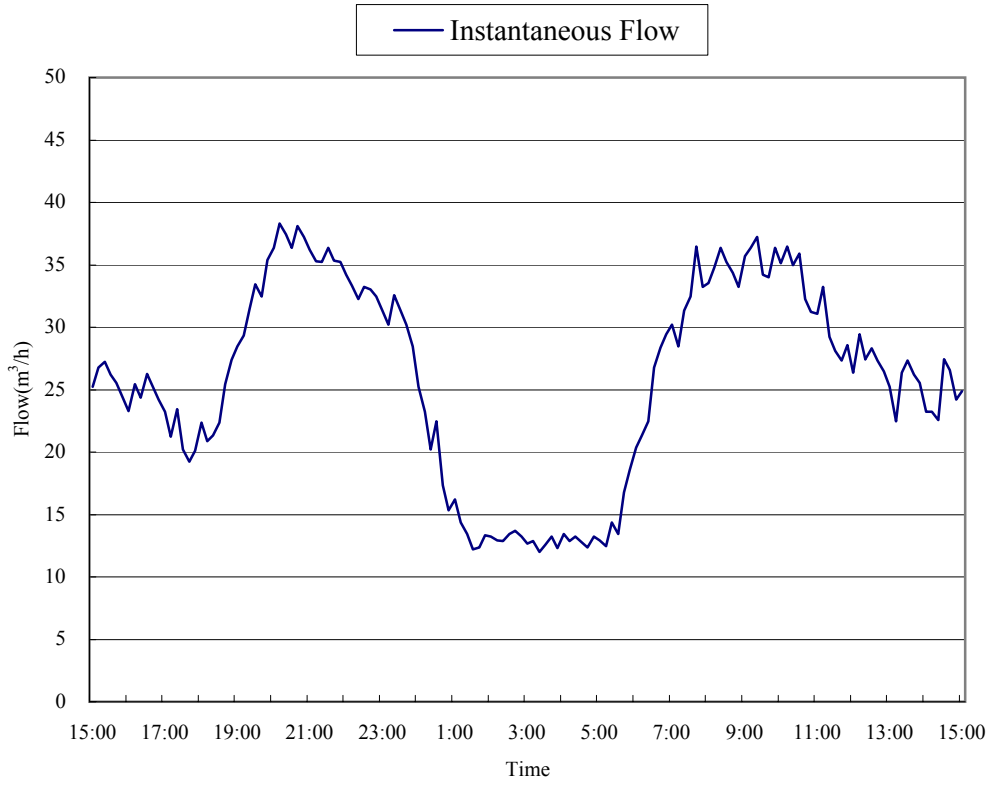
Instantaneous Flow in INDEPENDENCE VALLEY



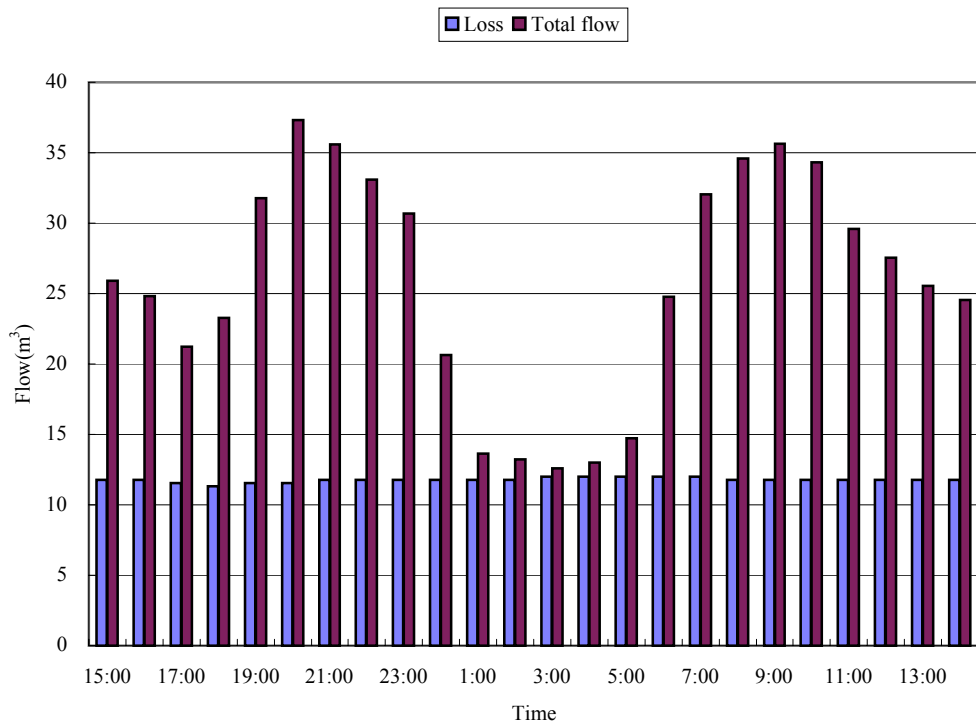
Integrated flow in INDEPENDENCE VALLEY



Instantaneous Flow in LENGAKIKI



Integrated flow in LENGAKIKI



No. 09
 LOG NAME :LENGAKIKI
 START :06:07:15:00
 END :06:08:15:00
 INTERVAL :00:10:00

Converted flow
 (P2*PI)/(1/2)*Q1
 P1:0.55
 Q1:2.00

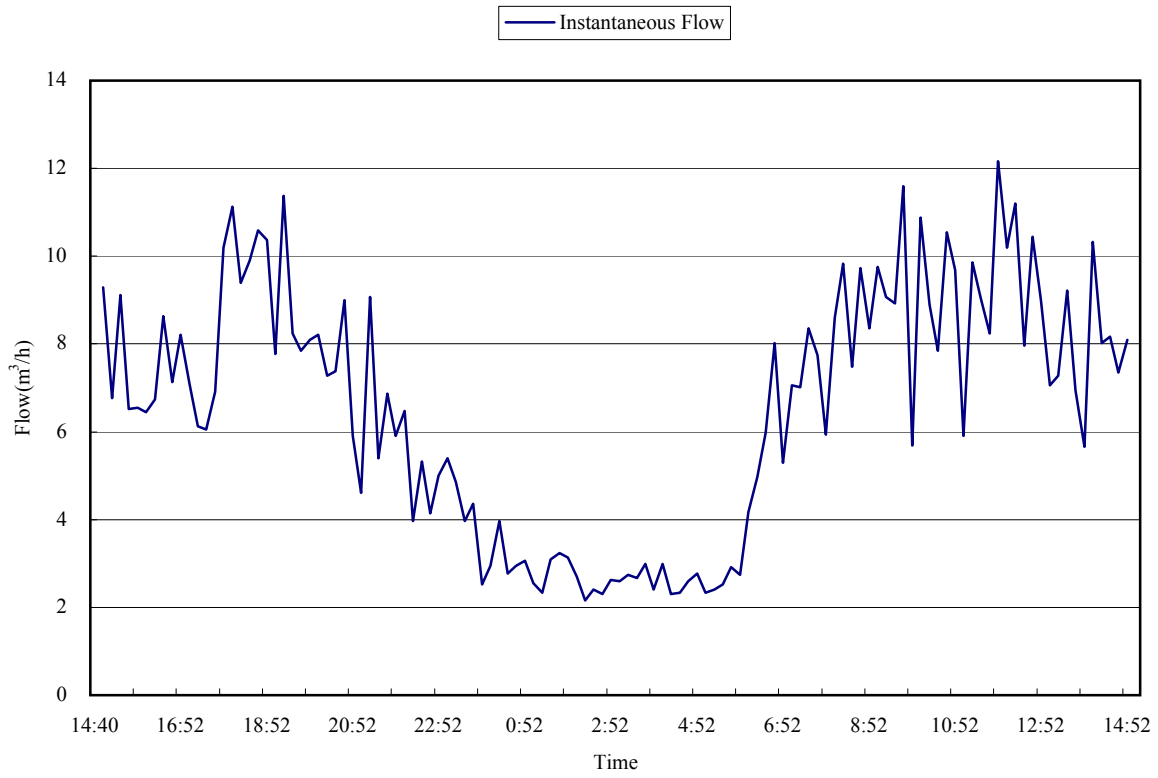
Date	Time	Instantaneous flow m ³ /h	Velocity m/s	Integrated flow m ³	Water pressure MPa	Converted flow m ³	Flow in loss m ³	Total flow m ³	2:10	2:15	2:20	2:25	2:30	2:35	2:40	2:45	2:50	2:55	3:00	3:05	3:10	3:15	3:20	3:25	3:30	3:35	3:40	3:45	3:50	3:55	4:00	4:05	4:10	4:15	4:20	4:25	4:30	4:35	4:40	4:45	4:50	4:55	5:00	5:05	5:10	5:15	5:20	5:25	5:30	5:35	5:40	5:45	5:50	5:55	6:00	6:05	6:10	6:15	6:20	6:25	6:30	6:35	6:40	6:45	6:50	6:55	7:00	7:05	7:10	7:15	7:20	7:25	7:30	7:35	7:40	7:45	7:50	7:55	8:00	8:05	8:10	8:15	8:20	8:25	8:30	8:35	8:40	8:45	8:50	8:55	9:00	9:05	9:10	9:15	9:20	9:25	9:30	9:35	9:40	9:45	9:50	9:55	10:00	10:05	10:10	10:15	10:20	10:25	10:30	10:35	10:40	10:45	10:50	10:55	11:00	11:05	11:10	11:15	11:20	11:25	11:30	11:35	11:40	11:45	11:50	11:55	12:00	12:05	12:10	12:15	12:20	12:25	12:30	12:35	12:40	12:45	12:50	12:55	13:00	13:05	13:10	13:15	13:20	13:25	13:30	13:35	13:40	13:45	13:50	13:55	14:00	14:05	14:10	14:15	14:20	14:25	14:30	14:35	14:40	14:45	14:50	14:55	15:00	15:05	15:10	15:15	15:20	15:25	15:30	15:35	15:40	15:45	15:50	15:55	16:00	16:05	16:10	16:15	16:20	16:25	16:30	16:35	16:40	16:45	16:50	16:55	17:00	17:05	17:10	17:15	17:20	17:25	17:30	17:35	17:40	17:45	17:50	17:55	18:00	18:05	18:10	18:15	18:20	18:25	18:30	18:35	18:40	18:45	18:50	18:55	19:00	19:05	19:10	19:15	19:20	19:25	19:30	19:35	19:40	19:45	19:50	19:55	20:00	20:05	20:10	20:15	20:20	20:25	20:30	20:35	20:40	20:45	20:50	20:55	21:00	21:05	21:10	21:15	21:20	21:25	21:30	21:35	21:40	21:45	21:50	21:55	22:00	22:05	22:10	22:15	22:20	22:25	22:30	22:35	22:40	22:45	22:50	22:55	23:00	23:05	23:10	23:15	23:20	23:25	23:30	23:35	23:40	23:45	23:50	23:55	24:00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
8-Jun	15:00	25.21	0.40	4.20	0.53	1.96	11.79	25.89	2:10	0.16	2:15	0.53	1.96	2:20	12.87	0.15	2:25	0.53	1.96	2:30	13.43	0.14	2:35	0.53	1.96	2:40	13.67	0.11	2:45	0.53	1.96	2:50	13.23	0.13	2:55	0.53	1.96	3:00	12.67	0.08	3:05	0.55	2.00	3:10	12.89	0.09	3:15	0.55	2.00	3:20	12.01	0.10	3:25	0.55	2.00	3:30	12.56	0.12	3:35	0.55	2.00	3:40	13.23	0.09	3:45	0.55	2.00	3:50	12.32	0.10	3:55	0.55	2.00	4:00	13.45	0.11	4:05	0.55	2.00	4:10	12.89	0.10	4:15	0.55	2.00	4:20	13.23	0.10	4:25	0.55	2.00	4:30	12.78	0.11	4:35	0.55	2.00	4:40	12.34	0.11	4:45	0.55	2.00	4:50	13.23	0.16	4:55	0.55	2.00	5:00	12.90	0.15	5:05	0.55	2.00	5:10	12.45	0.20	5:15	0.55	2.00	5:20	14.34	0.23	5:25	0.55	2.00	5:30	13.45	0.21	5:35	0.55	2.00	5:40	16.78	0.26	5:45	0.55	2.00	5:50	18.56	0.29	5:55	0.55	2.00	6:00	20.34	0.32	6:05	0.55	2.00	6:10	21.34	0.34	6:15	0.55	2.00	6:20	22.45	0.35	6:25	0.55	2.00	6:30	26.78	0.42	6:35	0.55	2.00	6:40	28.35	0.45	6:45	0.55	2.00	6:50	29.45	0.46	6:55	0.55	2.00	7:00	30.23	0.48	7:05	0.55	2.00	7:10	28.45	0.45	7:15	0.55	2.00	7:20	31.34	0.49	7:25	0.55	2.00	7:30	32.45	0.51	7:35	0.55	2.00	7:40	36.45	0.57	7:45	0.55	2.00	7:50	33.23	0.52	7:55	0.55	2.00	8:00	33.56	0.53	8:05	0.53	1.96	8:10	34.78	0.55	8:15	0.53	1.96	8:20	36.34	0.57	8:25	0.53	1.96	8:30	35.21	0.55	8:35	0.53	1.96	8:40	34.37	0.54	8:45	0.53	1.96	8:50	33.24	0.52	8:55	0.53	1.96	9:00	35.67	0.56	9:05	0.53	1.96	9:10	36.38	0.57	9:15	0.53	1.96	9:20	37.21	0.58	9:25	0.53	1.96	9:30	34.23	0.54	9:35	0.53	1.96	9:40	33.98	0.53	9:45	0.53	1.96	9:50	36.35	0.57	9:55	0.53	1.96	10:00	35.12	0.55	10:05	0.53	1.96	10:10	36.45	0.57	10:15	0.53	1.96	10:20	34.98	0.55	10:25	0.53	1.96	10:30	35.90	0.56	10:35	0.53	1.96	10:40	32.26	0.51	10:45	0.53	1.96	10:50	31.21	0.49	10:55	0.53	1.96	11:00	31.10	0.49	11:05	0.53	1.96	11:10	33.21	0.52	11:15	0.53	1.96	11:20	29.24	0.46	11:25	0.53	1.96	11:30	28.12	0.44	11:35	0.53	1.96	11:40	27.34	0.43	11:45	0.53	1.96	11:50	28.56	0.45	11:55	0.53	1.96	12:00	26.34	0.41	12:05	0.53	1.96	12:10	29.45	0.46	12:15	0.53	1.96	12:20	27.45	0.43	12:25	0.53	1.96	12:30	28.32	0.45	12:35	0.53	1.96	12:40	27.31	0.43	12:45	0.53	1.96	12:50	26.45	0.42	12:55	0.53	1.96	13:00	25.24	0.40	13:05	0.53	1.96	13:10	22.45	0.35	13:15	0.53	1.96	13:20	22.45	0.35	13:25	0.53	1.96	13:30	22.45	0.35	13:35	0.53	1.96	13:40	22.45	0.35	13:45	0.53	1.96	13:50	22.45	0.35	13:55	0.53	1.96	14:00	22.45	0.35	14:05	0.53	1.96	14:10	22.45	0.35	14:15	0.53	1.96	14:20	22.45	0.35	14:25	0.53	1.96	14:30	22.45	0.35	14:35	0.53	1.96	14:40	22.45	0.35	14:45	0.53	1.96	14:50	22.45	0.35	14:55	0.53	1.96	15:00	22.45	0.35	15:05	0.53	1.96	15:10	22.45	0.35	15:15	0.53	1.96	15:20	22.45	0.35	15:25	0.53	1.96	15:30	22.45	0.35	15:35	0.53	1.96	15:40	22.45	0.35	15:45	0.53	1.96	15:50	22.45	0.35	15:55	0.53	1.96	16:00	22.45	0.35	16:05	0.53	1.96	16:10	22.45	0.35	16:15	0.53	1.96	16:20	22.45	0.35	16:25	0.53	1.96	16:30	22.45	0.35	16:35	0.53	1.96	16:40	22.45	0.35	16:45	0.53	1.96	16:50	22.45	0.35	16:55	0.53	1.96	17:00	22.45	0.35	17:05	0.53	1.96	17:10	22.45	0.35	17:15	0.53	1.96	17:20	22.45	0.35	17:25	0.53	1.96	17:30	22.45	0.35	17:35	0.53	1.96	17:40	22.45	0.35	17:45	0.53	1.96	17:50	22.45	0.35	17:55	0.53	1.96	18:00	22.45	0.35	18:05	0.53	1.96	18:10	22.45	0.35	18:15	0.53	1.96	18:20	22.45	0.35	18:25	0.53	1.96	18:30	22.45	0.35	18:35	0.53	1.96	18:40	22.45	0.35	18:45	0.53	1.96	18:50	22.45	0.35	18:55	0.53	1.96	19:00	22.45	0.35	19:05	0.53	1.96	19:10	22.45	0.35	19:15	0.53	1.96	19:20	22.45	0.35	19:25	0.53	1.96	19:30	22.45	0.35	19:35	0.53	1.96	19:40	22.45	0.35	19:45	0.53	1.96	19:50	22.45	0.35	19:55	0.53	1.96	20:00	22.45	0.35	20:05	0.53	1.96	20:10	22.45	0.35	20:15	0.53	1.96	20:20	22.45	0.35	20:25	0.53	1.96	20:30	22.45	0.35	20:35	0.53	1.96	20:40	22.45	0.35	20:45	0.53	1.96	20:50	22.45	0.35	20:55	0.53	1.96	21:00	22.45	0.35	21:05	0.53	1.96	21:10	22.45	0.35	21:15	0.53	1.96	21:20	22.45	0.35	21:25	0.53	1.96	21:30	22.45	0.35	21:35	0.53	1.96	21:40	22.45	0.35	21:45	0.53	1.96	21:50	22.45	0.35	21:55	0.53	1.96	22:00	22.45	0.35	22:05	0.53	1.96	22:10	22.45	0.35	22:15	0.53	1.96	22:20	22.45	0.35	22:25	0.53	1.96	22:30	22.45	0.35	22:35	0.53	1.96	22:40	22.45	0.35	22:45	0.53	1.96	22:50	22.45	0.35	22:55	0.53	1.96	23:00	22.45	0.35	23:05	0.53	1.96	23:10	22.45	0.35	23:15	0.53	1.96	23:20	22.45	0.35	23:25	0.53	1.96	23:30	22.45	0.35	23:35	0.53	1.96	23:40	22.45	0.35	23:45	0.53	1.96	23:50	22.45	0.35	23:55	0.53	1.96	24:00	22.45	0.35

7-Jun

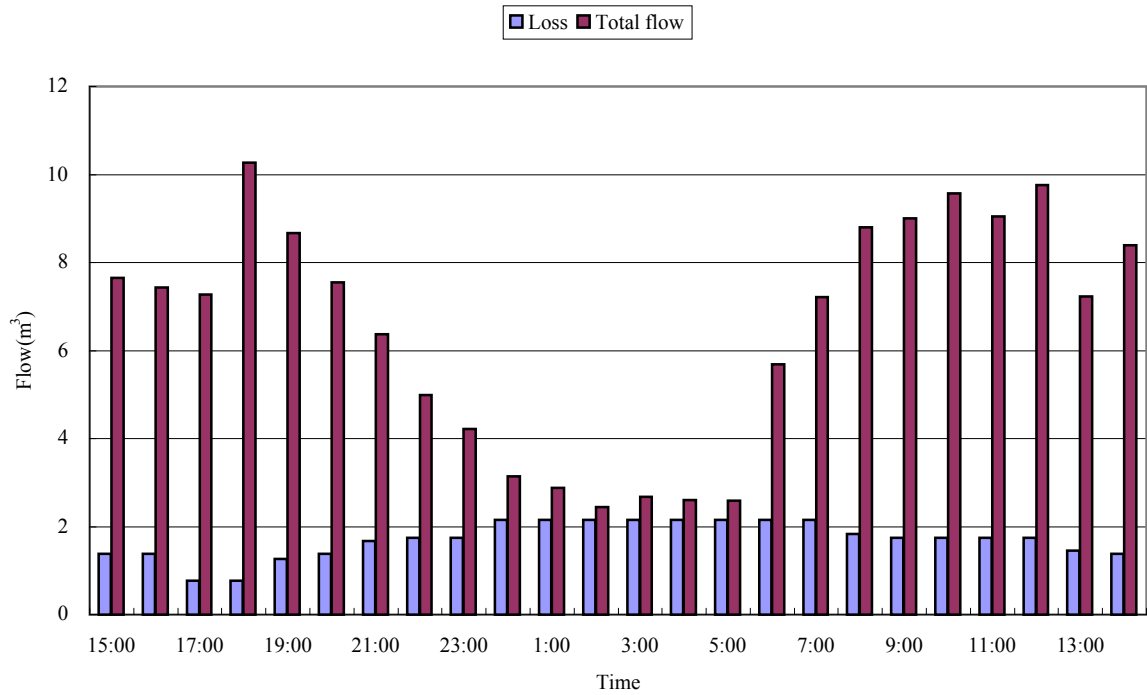
Total
 Ave 624.21 m³
 Max 38.31 m³/h
 Min 12.01 m³/h
 Loss 284.85 m³
 Rate of loss 45.64 %

11.79 24.54

Instantaneous Flow in MATANIKI(TUVA1)



Integrated Flow in MATANIKO(TUVAL1)



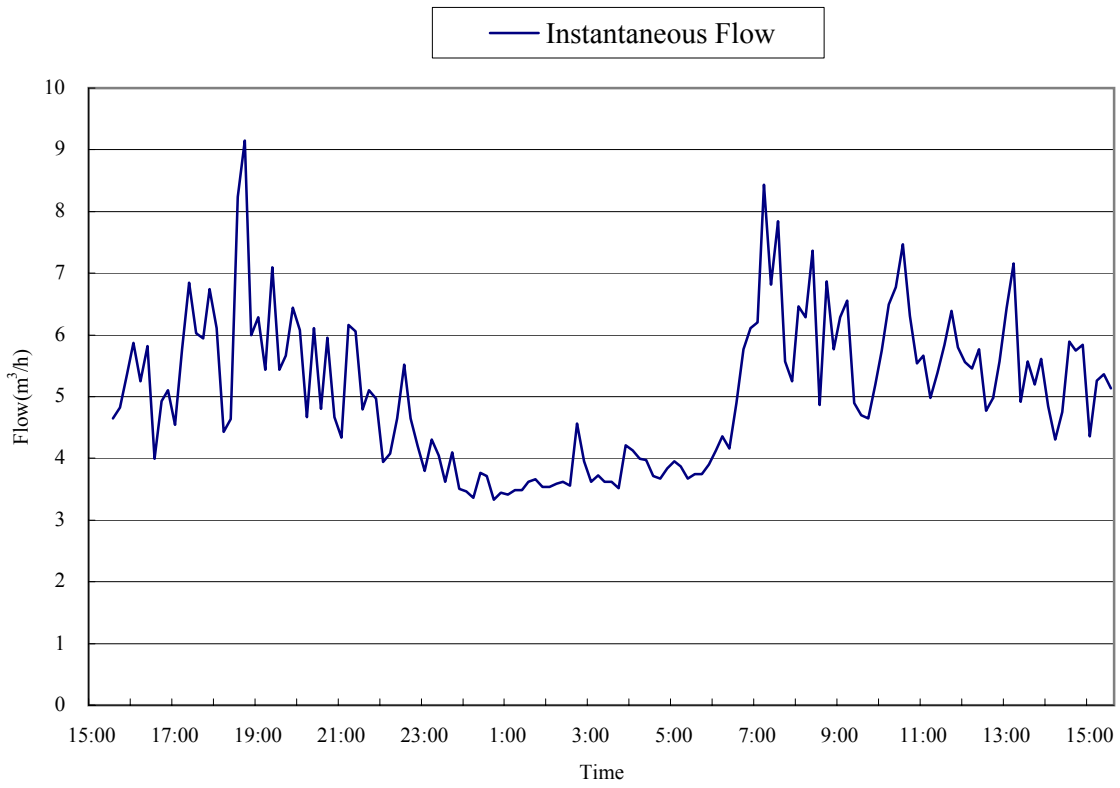
DETAILS
 Mitamiko(Twa1)
 23/6/2005 15:04:32
 PIPE SIZE: 80 MM
 PIPE TYPE: GALVANISED IRON

Converted flow
 (P2/P1)^(1/2)*Q1
 P1=0.20
 Q1=0.43

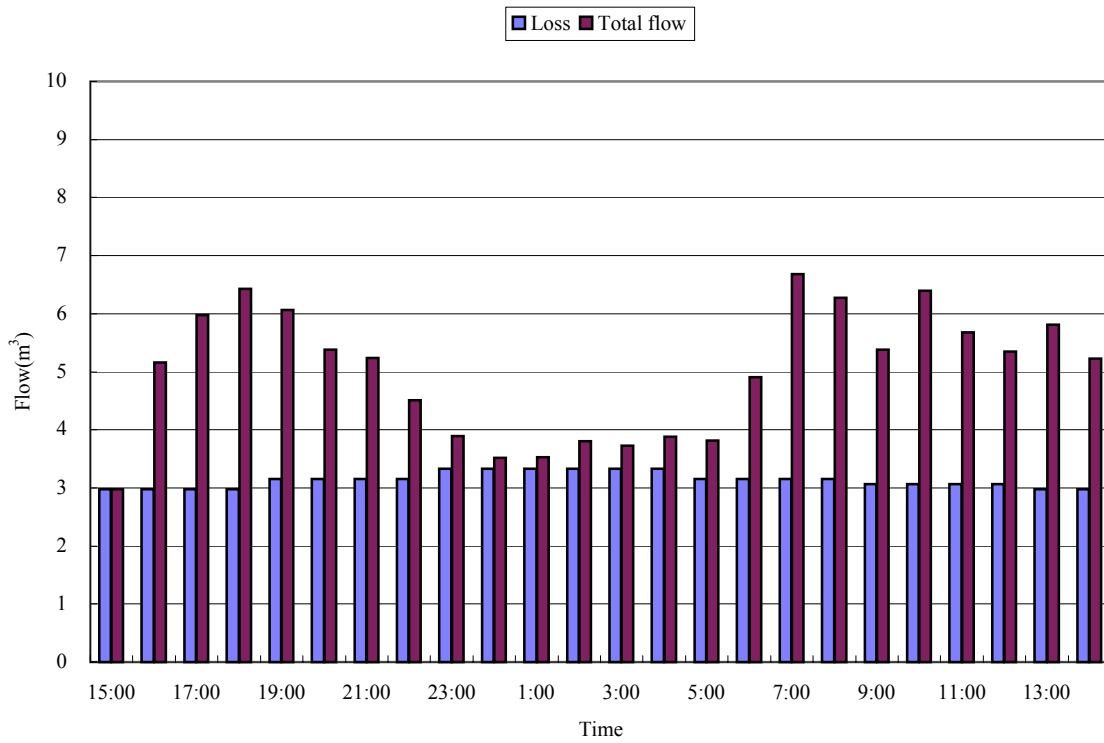
Date	Time	Instantaneo us flow	Velocity m/s	Integrated Flow m³	Water pressuer (P2)MPa	Converted Flow m³	Flow in loss m³	Total Flow m³	Date	Time	Instantaneo us flow	Velocity m/s	Integrated Flow m³	Water pressuer (P2)MPa	Converted Flow m³	Flow in loss m³	Total Flow m³
14:52	14:52	9.29	0.51	1.86	0.16	0.39	1.93	7.65		1:40	3.24	0.18	0.65	0.20	0.43		
15:04	15:16	6.77	0.37	1.35	0.16	0.39				1:52	3.13	0.17	0.63	0.20	0.43		
15:28	15:40	9.11	0.50	1.82	0.16	0.39	2.16	2.44		2:04	2.70	0.15	0.54	0.20	0.43	2.16	
15:40	15:52	6.52	0.36	1.30	0.16	0.39				2:16	2.16	0.12	0.43	0.20	0.43		
15:52	16:04	6.55	0.36	1.31	0.16	0.39				2:28	2.41	0.13	0.48	0.20	0.43		
16:04	16:16	6.44	0.36	1.29	0.16	0.39	1.93	7.43		2:40	2.30	0.13	0.46	0.20	0.43		
16:16	16:28	6.73	0.37	1.35	0.16	0.39				2:52	2.63	0.15	0.53	0.20	0.43		
16:28	16:40	8.64	0.48	1.73	0.16	0.39				3:04	2.59	0.14	0.52	0.20	0.43	2.16	2.68
16:40	16:52	7.13	0.39	1.43	0.16	0.39				3:16	2.74	0.15	0.55	0.20	0.43		
16:52	17:04	8.21	0.45	1.64	0.16	0.39				3:28	2.66	0.15	0.53	0.20	0.43		
17:04	17:16	7.09	0.39	1.42	0.12	0.33	1.67	7.27		3:40	2.99	0.17	0.60	0.20	0.43		
17:16	17:28	6.12	0.34	1.22	0.12	0.33				3:52	2.41	0.13	0.48	0.20	0.43	2.16	2.60
17:28	17:40	6.05	0.33	1.21	0.12	0.33				4:04	2.99	0.17	0.60	0.20	0.43		
17:40	17:52	6.91	0.38	1.38	0.12	0.33				4:16	2.30	0.13	0.46	0.20	0.43		
17:52	18:04	10.19	0.56	2.04	0.12	0.33	1.67	10.27		4:28	2.34	0.13	0.47	0.20	0.43		
18:04	18:16	11.12	0.61	2.22	0.12	0.33				4:40	2.59	0.14	0.52	0.20	0.43		
18:16	18:28	9.40	0.52	1.88	0.12	0.33				4:52	2.77	0.15	0.55	0.20	0.43	2.16	2.58
18:28	18:40	9.90	0.55	1.98	0.12	0.33				5:04	2.34	0.13	0.47	0.20	0.43		
18:40	18:52	10.58	0.58	2.12	0.12	0.33				5:16	2.41	0.13	0.48	0.20	0.43		
18:52	19:04	10.37	0.57	2.07	0.12	0.33	1.88	8.67		5:28	2.52	0.14	0.50	0.20	0.43		
19:04	19:16	7.78	0.43	1.56	0.12	0.33				5:40	2.92	0.16	0.58	0.20	0.43		
19:16	19:28	11.38	0.63	2.28	0.16	0.39	1.88	8.67		5:52	2.74	0.15	0.55	0.20	0.43	2.16	5.69
19:28	19:40	8.24	0.46	1.65	0.16	0.39				6:04	4.18	0.23	0.84	0.20	0.43		
19:40	19:52	7.85	0.43	1.57	0.16	0.39				6:16	4.97	0.27	0.99	0.20	0.43		
19:52	20:04	8.10	0.45	1.62	0.16	0.39				6:28	5.98	0.33	1.20	0.20	0.43		
20:04	20:16	8.21	0.45	1.64	0.16	0.39	1.93	7.55		6:40	8.03	0.44	1.61	0.20	0.43		
20:16	20:28	7.27	0.40	1.45	0.16	0.39				6:52	5.29	0.29	1.06	0.20	0.43	2.16	7.22
20:28	20:40	7.38	0.41	1.48	0.16	0.39				7:04	7.06	0.39	1.41	0.20	0.43		
20:40	20:52	9.00	0.50	1.80	0.16	0.39				7:16	7.02	0.39	1.40	0.20	0.43		
20:52	21:04	5.90	0.33	1.18	0.16	0.39	2.03	6.37		7:28	8.35	0.46	1.67	0.20	0.43		
21:04	21:16	4.61	0.25	0.92	0.16	0.39				7:40	7.74	0.43	1.55	0.20	0.43		
21:16	21:28	9.07	0.50	1.81	0.18	0.41				7:52	5.94	0.33	1.19	0.20	0.43		
21:28	21:40	5.40	0.30	1.08	0.18	0.41				8:04	8.60	0.48	1.72	0.20	0.43	2.07	8.80
21:40	21:52	6.88	0.38	1.38	0.18	0.41				8:16	9.83	0.54	1.97	0.18	0.41		
21:52	22:04	6.48	0.36	1.30	0.18	0.41	2.05	4.98		8:28	7.49	0.41	1.50	0.18	0.41		
22:04	22:16	3.96	0.22	0.79	0.18	0.41				8:40	9.72	0.54	1.94	0.18	0.41		
22:16	22:28	5.33	0.29	1.07	0.18	0.41				8:52	8.35	0.46	1.67	0.18	0.41		
22:28	22:40	4.14	0.23	0.83	0.18	0.41				9:04	9.76	0.54	1.95	0.18	0.41	2.05	9.01
22:40	22:52	5.00	0.28	1.00	0.18	0.41				9:16	9.07	0.50	1.81	0.18	0.41		
22:52	23:04	5.40	0.30	1.08	0.18	0.41	2.05	4.22		9:28	8.93	0.49	1.79	0.18	0.41		
23:04	23:16	4.86	0.27	0.97	0.18	0.41				9:40	11.59	0.64	2.32	0.18	0.41		
23:16	23:28	3.96	0.22	0.79	0.18	0.41				9:52	5.69	0.31	1.14	0.18	0.41		
23:28	23:40	4.36	0.24	0.87	0.18	0.41				10:04	10.87	0.60	2.17	0.18	0.41	2.05	9.57
23:40	23:52	5.14	0.30	1.04	0.18	0.41				10:16	8.89	0.49	1.78	0.18	0.41		
23:52	0:04	3.95	0.16	0.59	0.20	0.43	2.16	3.14		10:28	7.85	0.43	1.57	0.18	0.41		
0:04	0:16	3.96	0.22	0.79	0.20	0.43				10:40	10.55	0.58	2.11	0.18	0.41		
0:16	0:28	2.77	0.15	0.55	0.20	0.43				10:52	9.68	0.54	1.94	0.18	0.41		
0:28	0:40	2.95	0.16	0.59	0.20	0.43				11:04	5.90	0.33	1.18	0.18	0.41	2.05	9.04
0:40	0:52	3.06	0.17	0.61	0.20	0.43				11:16	9.86	0.55	1.97	0.18	0.41		
0:52	1:04	2.56	0.14	0.51	0.20	0.43	2.16	2.87		11:28	9.04	0.50	1.81	0.18	0.41		
1:04	1:16	2.34	0.13	0.47	0.20	0.43				11:40	8.24	0.46	1.65	0.18	0.41		
1:16	1:28	3.10	0.17	0.62	0.20	0.43				11:52	12.17	0.67	2.43	0.18	0.41	2.05	9.76
1:28										12:04	10.19	0.56	2.04	0.18	0.41		

Total
 Ave 155.44 m³
 Max 6.48 m³/h
 Min 2.16 m³/h
 Loss 48.58 m³
 Rate of loss 31.25 %

Instantaneous Flow in MBOKONAVERA



Integrated flow in MBOKONAVERA

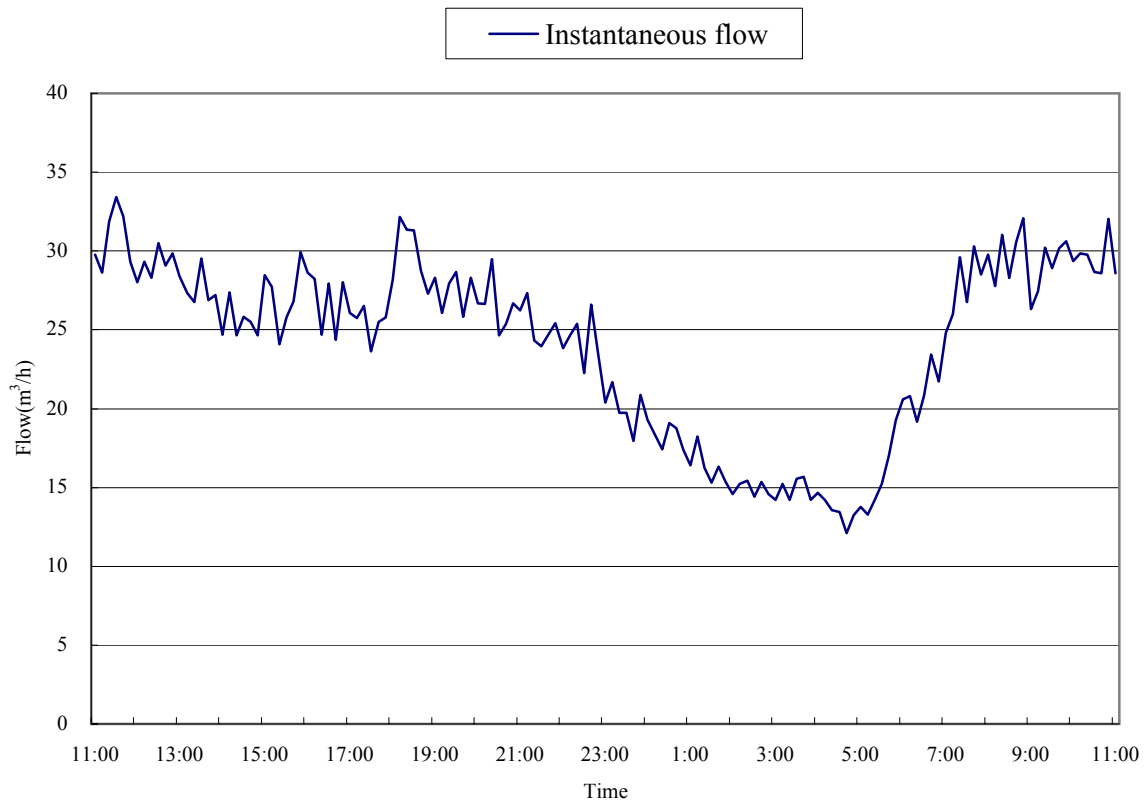


No. 03
 LOG NAME :MBOKNAVERA
 START :05-31 15:30
 END :06-01 15:30
 INTERVAL :00:10:00

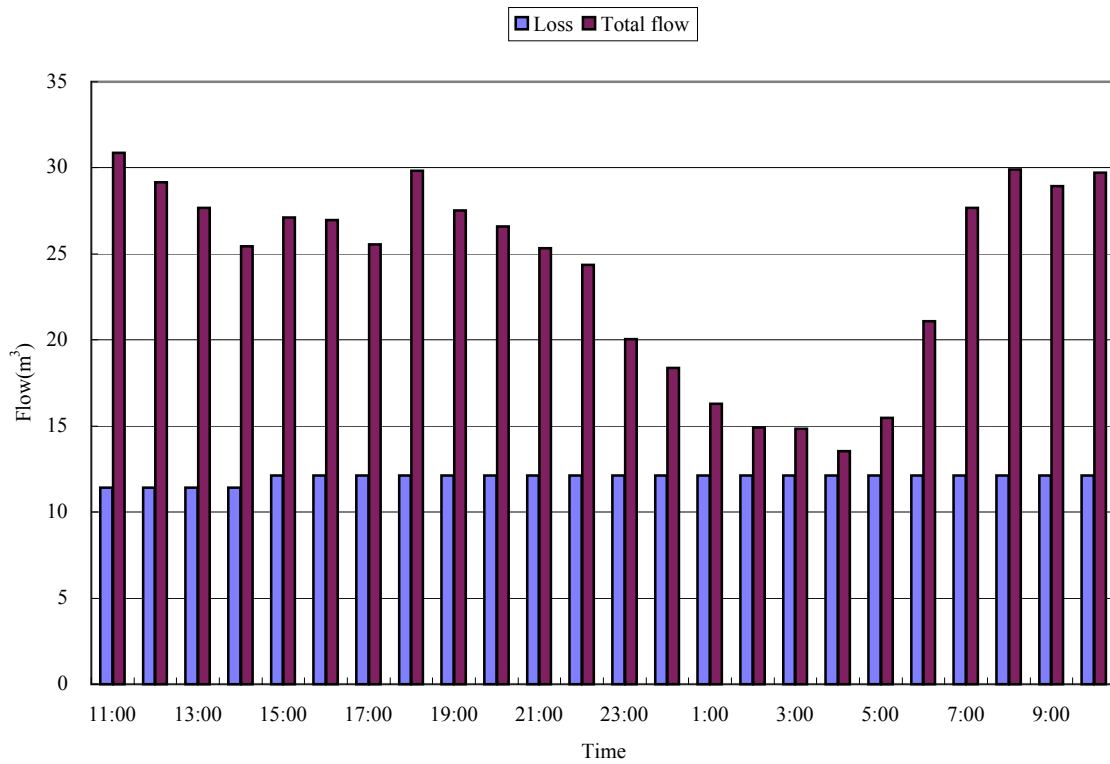
Converted flow
 (P2)/P1*(1/2)*Q1
 P1:0.20
 Q1:0.55

Date	Time	Instantaneous flow m ³ /h	Velocity m/s	Integrated flow m ³	Water pressure MPa	Converted flow m ³	Flow in loss m ³	Total flow m ³	Date	Time	Instantaneous flow m ³ /h	Velocity m/s	Integrated flow m ³	Water pressure MPa	Converted flow m ³	Flow in loss m ³	Total flow m ³																																																																																																												
31-May	15:30	4.65	0.29	0.78	0.16	0.50	0.50	0.50	1-Jun	0:50	3.45	0.22	0.57	0.20	0.55	0.55	0.55	10:10																																																																																																											
	15:40	4.83	0.30	0.80	0.16	0.50	0.50	0.50		1:00	3.41	0.21	0.57	0.20	0.55	0.55	0.55	10:20																																																																																																											
	15:50	5.37	0.34	0.89	0.16	0.50	0.50	0.50		1:10	3.48	0.22	0.58	0.20	0.55	0.55	0.55	10:30																																																																																																											
	16:00	5.87	0.37	0.98	0.16	0.50	0.50	0.50		1:20	3.48	0.22	0.58	0.20	0.55	0.55	0.55	10:40																																																																																																											
	16:10	5.24	0.33	0.87	0.16	0.50	0.50	0.50		1:30	3.62	0.23	0.60	0.20	0.55	0.55	0.55	10:50																																																																																																											
	16:20	5.82	0.37	0.97	0.16	0.50	0.50	0.50		1:40	3.66	0.23	0.61	0.20	0.55	0.55	0.55	11:00																																																																																																											
	16:30	3.99	0.25	0.66	0.16	0.50	0.50	0.50		1:50	3.54	0.22	0.59	0.20	0.55	0.55	0.55	11:10																																																																																																											
	16:40	4.93	0.31	0.82	0.16	0.50	0.50	0.50		2:00	3.54	0.22	0.59	0.20	0.55	0.55	0.55	11:20																																																																																																											
	16:50	5.11	0.32	0.85	0.16	0.50	0.50	0.50		2:10	3.59	0.23	0.60	0.20	0.55	0.55	0.55	11:30																																																																																																											
	17:00	4.55	0.29	0.76	0.16	0.50	0.50	0.50		2:20	3.62	0.23	0.60	0.20	0.55	0.55	0.55	11:40																																																																																																											
	17:10	5.77	0.36	0.96	0.16	0.50	0.50	0.50		2:30	3.55	0.22	0.59	0.20	0.55	0.55	0.55	11:50																																																																																																											
	17:20	6.85	0.43	1.14	0.16	0.50	0.50	0.50		2:40	4.56	0.29	0.76	0.20	0.55	0.55	0.55	12:00																																																																																																											
	17:30	6.03	0.38	1.00	0.16	0.50	0.50	0.50		2:50	3.96	0.25	0.66	0.20	0.55	0.55	0.55	12:10																																																																																																											
	17:40	5.94	0.37	0.99	0.16	0.50	0.50	0.50		3:00	3.62	0.23	0.60	0.20	0.55	0.55	0.55	12:20																																																																																																											
	17:50	6.74	0.42	1.12	0.16	0.50	0.50	0.50		3:10	3.73	0.23	0.62	0.20	0.55	0.55	0.55	12:30																																																																																																											
	18:00	6.12	0.38	1.02	0.16	0.50	0.50	0.50		3:20	3.62	0.23	0.60	0.20	0.55	0.55	0.55	12:40																																																																																																											
	18:10	4.43	0.28	0.74	0.16	0.50	0.50	0.50		3:30	3.62	0.23	0.60	0.20	0.55	0.55	0.55	12:50																																																																																																											
	18:20	4.63	0.29	0.77	0.16	0.50	0.50	0.50		3:40	3.52	0.22	0.59	0.20	0.55	0.55	0.55	13:00																																																																																																											
	18:30	8.24	0.52	1.37	0.16	0.50	0.50	0.50		3:50	4.22	0.27	0.70	0.20	0.55	0.55	0.55	13:10																																																																																																											
	18:40	9.15	0.58	1.52	0.16	0.50	0.50	0.50		4:00	4.13	0.26	0.66	0.20	0.55	0.55	0.55	13:20																																																																																																											
18:50	5.99	0.38	1.00	0.16	0.50	0.50	0.50	4:10	3.99	0.25	0.66	0.20	0.55	0.55	0.55	13:30																																																																																																													
19:00	6.29	0.40	1.05	0.18	0.53	0.53	0.53	4:20	3.97	0.25	0.66	0.20	0.55	0.55	0.55	13:40																																																																																																													
19:10	5.44	0.34	0.91	0.18	0.53	0.53	0.53	4:30	3.71	0.23	0.62	0.20	0.55	0.55	0.55	13:50																																																																																																													
19:20	7.09	0.45	1.18	0.18	0.53	0.53	0.53	4:40	3.68	0.23	0.61	0.20	0.55	0.55	0.55	14:00																																																																																																													
19:30	5.44	0.34	0.91	0.18	0.53	0.53	0.53	4:50	3.83	0.24	0.64	0.20	0.55	0.55	0.55	14:10																																																																																																													
19:40	5.66	0.36	0.94	0.18	0.53	0.53	0.53	5:00	3.96	0.25	0.66	0.18	0.53	0.53	0.53	14:20																																																																																																													
19:50	6.45	0.41	1.07	0.18	0.53	0.53	0.53	5:10	3.87	0.24	0.64	0.18	0.53	0.53	0.53	14:30																																																																																																													
20:00	6.08	0.38	1.01	0.18	0.53	0.53	0.53	5:20	3.68	0.23	0.61	0.18	0.53	0.53	0.53	14:40																																																																																																													
20:10	4.67	0.29	0.78	0.18	0.53	0.53	0.53	5:30	3.75	0.24	0.62	0.18	0.53	0.53	0.53	14:50																																																																																																													
20:20	6.12	0.38	1.02	0.18	0.53	0.53	0.53	5:40	3.75	0.24	0.62	0.18	0.53	0.53	0.53	15:00																																																																																																													
20:30	4.81	0.30	0.80	0.18	0.53	0.53	0.53	5:50	3.90	0.25	0.65	0.18	0.53	0.53	0.53	15:20																																																																																																													
20:40	5.96	0.37	0.99	0.18	0.53	0.53	0.53	6:00	4.13	0.26	0.69	0.18	0.53	0.53	0.53	15:30																																																																																																													
20:50	4.67	0.29	0.78	0.18	0.53	0.53	0.53	6:10	4.36	0.27	0.73	0.18	0.53	0.53	0.53	15:40																																																																																																													
21:00	4.34	0.27	0.72	0.18	0.53	0.53	0.53	6:20	4.16	0.26	0.69	0.18	0.53	0.53	0.53	15:50																																																																																																													
21:10	6.17	0.39	1.03	0.18	0.53	0.53	0.53	6:30	4.90	0.31	0.82	0.18	0.53	0.53	0.53	16:00																																																																																																													
21:20	6.06	0.38	1.01	0.18	0.53	0.53	0.53	6:40	5.77	0.36	0.96	0.18	0.53	0.53	0.53	16:10																																																																																																													
21:30	4.79	0.30	0.80	0.18	0.53	0.53	0.53	6:50	6.12	0.38	1.02	0.18	0.53	0.53	0.53	16:20																																																																																																													
21:40	5.11	0.32	0.85	0.18	0.53	0.53	0.53	7:00	6.20	0.39	1.03	0.18	0.53	0.53	0.53	16:30																																																																																																													
21:50	4.97	0.31	0.83	0.18	0.53	0.53	0.53	7:10	8.43	0.53	1.41	0.18	0.53	0.53	0.53	16:40																																																																																																													
22:00	3.94	0.25	0.66	0.18	0.53	0.53	0.53	7:20	6.81	0.43	1.14	0.18	0.53	0.53	0.53	16:50																																																																																																													
22:10	4.08	0.26	0.68	0.18	0.53	0.53	0.53	7:30	7.84	0.49	1.31	0.18	0.53	0.53	0.53	17:00																																																																																																													
22:20	4.65	0.29	0.78	0.18	0.53	0.53	0.53	7:40	5.58	0.35	0.93	0.18	0.53	0.53	0.53	17:10																																																																																																													
22:30	5.52	0.35	0.92	0.18	0.53	0.53	0.53	7:50	5.24	0.33	0.87	0.18	0.53	0.53	0.53	17:20																																																																																																													
22:40	4.65	0.29	0.78	0.18	0.53	0.53	0.53	8:00	6.46	0.41	1.08	0.18	0.53	0.53	0.53	17:30																																																																																																													
22:50	4.20	0.26	0.70	0.18	0.53	0.53	0.53	8:10	6.29	0.40	1.05	0.18	0.53	0.53	0.53	17:40																																																																																																													
23:00	3.80	0.24	0.63	0.20	0.55	0.55	0.55	8:20	7.37	0.46	1.23	0.18	0.53	0.53	0.53	17:50																																																																																																													
23:10	4.30	0.27	0.72	0.20	0.55	0.55	0.55	8:30	4.86	0.31	0.81	0.18	0.53	0.53	0.53	18:00																																																																																																													
23:20	4.04	0.25	0.67	0.20	0.55	0.55	0.55	8:40	6.86	0.43	1.14	0.18	0.53	0.53	0.53	18:10																																																																																																													
23:30	3.62	0.23	0.60	0.20	0.55	0.55	0.55	8:50	5.77	0.36	0.96	0.18	0.53	0.53	0.53	18:20																																																																																																													
23:40	4.09	0.26	0.68	0.20	0.55	0.55	0.55	9:00	6.29	0.40	1.05	0.17	0.51	0.51	0.51	18:30																																																																																																													
23:50	3.50	0.22	0.58	0.20	0.55	0.55	0.55	9:10	6.55	0.41	1.09	0.17	0.51	0.51	0.51	18:40																																																																																																													
0:00	3.47	0.22	0.58	0.20	0.55	0.55	0.55	9:20	4.90	0.31	0.82	0.17	0.51	0.51	0.51	18:50																																																																																																													
0:10	3.36	0.21	0.56	0.20	0.55	0.55	0.55	9:30	4.70	0.30	0.78	0.17	0.51	0.51	0.51	19:00																																																																																																													
0:20	3.76	0.24	0.63	0.20	0.55	0.55	0.55	9:40	4.65	0.29	0.78	0.17	0.51	0.51	0.51	19:10																																																																																																													
0:30	3.71	0.23	0.62	0.20	0.55	0.55	0.55	9:50	5.19	0.33	0.87	0.17	0.51	0.51	0.51	19:20																																																																																																													
0:40	3.33	0.21	0.55	0.20	0.55	0.55	0.55	10:00	5.75	0.36	0.96	0.17	0.51	0.51	0.51	19:30																																																																																																													
<table border="0" style="width:100%; text-align:center;"> <tr> <td>TOTAL</td> <td>122.45</td> <td>m³</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>AVE</td> <td>5.10</td> <td>m³/h</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MAX</td> <td>9.15</td> <td>m³/h</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>MIN</td> <td>3.33</td> <td>m³/h</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Loss</td> <td>75.83</td> <td>m³</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Rate of loss</td> <td>61.93</td> <td>%</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>																		TOTAL	122.45	m ³																AVE	5.10	m ³ /h																MAX	9.15	m ³ /h																MIN	3.33	m ³ /h																Loss	75.83	m ³																Rate of loss	61.93	%															
TOTAL	122.45	m ³																																																																																																																											
AVE	5.10	m ³ /h																																																																																																																											
MAX	9.15	m ³ /h																																																																																																																											
MIN	3.33	m ³ /h																																																																																																																											
Loss	75.83	m ³																																																																																																																											
Rate of loss	61.93	%																																																																																																																											
1-Jun	0:00	3.47	0.22	0.58	0.20	0.55	0.55	0.55	3:51	3.33	0.21	0.55	0.20	0.55	0.55	0.55	3.33	5.38																																																																																																											
	0:10	3.36	0.21	0.56	0.20	0.55	0.55	0.55	3:51	3.33	0.21	0.55	0.20	0.55	0.55	0.55	0.55	3.33	5.38																																																																																																										
0:20	3.76	0.24	0.63	0.20	0.55	0.55	0.55	3:51	3.33	0.21	0.55	0.20	0.55	0.55	0.55	0.55	3.33	5.38																																																																																																											
0:30	3.71	0.23	0.62	0.20	0.55	0.55	0.55	3:51	3.33	0.21	0.55	0.20	0.55	0.55	0.55	0.55	3.33	5.38																																																																																																											
0:40	3.33	0.21	0.55	0.20	0.55	0.55	0.55	3:51	3.33	0.21	0.55	0.20	0.55	0.55	0.55	0.55	3.33	5.38																																																																																																											

Instantaneous flow in NAHA



Integrated flow in NAHA



No. 07
 LOG NAME :NAHA
 Converted flow
 (P2/P1)*(1/2)*Q1
 START :06:23 11:00
 P1:0.18
 END :06:24 11:00
 Q1:2.69
 INTERVAL :00:10:00

Date	Time	Instantaneous flow m ³ /h	Velocity m/s	Integrated flow m ³	Water pressure MPa	Covered flow m ³	Flow in loss m ³	Total flow m ³	Date	Time	Instantaneous flow m ³ /h	Velocity m/s	Integrated flow m ³	Water pressure MPa	Covered flow m ³	Flow in loss m ³	Total flow m ³
23-Jun	11:00	29.77	0.52	4.96	0.16	1.90	11.43	30.87									
	11:10	28.63	0.50	4.77	0.16	1.90											
	11:20	31.88	0.56	5.31	0.16	1.90											
	11:30	33.41	0.59	5.57	0.16	1.90											
	11:40	32.22	0.57	5.37	0.16	1.90											
	11:50	29.32	0.52	4.89	0.16	1.90											
	12:00	28.01	0.49	4.67	0.16	1.90	11.43	29.18									
	12:10	28.29	0.52	4.89	0.16	1.90											
	12:20	29.32	0.50	4.72	0.16	1.90											
	12:30	30.51	0.54	5.09	0.16	1.90											
	12:40	29.09	0.51	4.85	0.16	1.90											
	12:50	29.83	0.52	4.97	0.16	1.90											
	13:00	28.40	0.50	4.73	0.16	1.90	11.43	27.68									
	13:10	27.32	0.48	4.55	0.16	1.90											
	13:20	26.75	0.47	4.46	0.16	1.90											
	13:30	29.54	0.52	4.92	0.16	1.90											
	13:40	26.87	0.47	4.48	0.16	1.90											
	13:50	27.21	0.48	4.54	0.16	1.90											
	14:00	24.70	0.43	4.12	0.16	1.90	11.43	25.45									
	14:10	27.38	0.48	4.56	0.16	1.90											
	14:20	24.65	0.43	4.11	0.16	1.90											
	14:30	25.84	0.45	4.31	0.16	1.90											
	14:40	25.50	0.45	4.25	0.16	1.90											
	14:50	24.65	0.43	4.11	0.16	1.90											
	15:00	28.46	0.50	4.74	0.18	2.02	12.12	27.13									
	15:10	27.72	0.49	4.62	0.18	2.02											
	15:20	24.08	0.42	4.01	0.18	2.02				24-Jun							
	15:30	25.79	0.45	4.30	0.18	2.02											
	15:40	26.81	0.47	4.47	0.18	2.02											
	15:50	29.94	0.53	4.99	0.18	2.02											
	16:00	28.63	0.50	4.77	0.18	2.02											
	16:10	28.23	0.50	4.71	0.18	2.02											
	16:20	24.70	0.43	4.12	0.18	2.02	12.12	26.98									
	16:30	27.95	0.49	4.66	0.18	2.02											
	16:40	24.36	0.43	4.06	0.18	2.02											
	16:50	28.01	0.49	4.67	0.18	2.02											
	17:00	26.07	0.46	4.35	0.18	2.02											
	17:10	25.73	0.45	4.29	0.18	2.02	12.12	25.54									
	17:20	26.53	0.47	4.42	0.18	2.02											
	17:30	23.62	0.42	3.94	0.18	2.02											
	17:40	25.50	0.45	4.25	0.18	2.02											
	17:50	25.79	0.45	4.30	0.18	2.02											
	18:00	28.18	0.50	4.70	0.18	2.02	12.12	29.84									
	18:10	32.16	0.57	5.36	0.18	2.02											
	18:20	31.36	0.55	5.23	0.18	2.02											
	18:30	31.31	0.55	5.22	0.18	2.02											
	18:40	28.75	0.51	4.79	0.18	2.02											
	18:50	27.27	0.48	4.55	0.18	2.02											
	19:00	28.29	0.50	4.72	0.18	2.02	12.12	27.52									
	19:10	26.07	0.46	4.35	0.18	2.02											
	19:20	27.95	0.49	4.66	0.18	2.02											
	19:30	28.69	0.50	4.78	0.18	2.02											
	19:40	25.84	0.45	4.31	0.18	2.02											

Total
 Ave 582.12 m³
 Max 24.26 m³/h
 Min 12.12 m³/h
 Loss 290.13 m³
 Rate of loss 49.84 %

S-3-1-4 Quantity Survey of Leakage in Typical Model Block

Flow chart of leakage survey in NGOSSI

