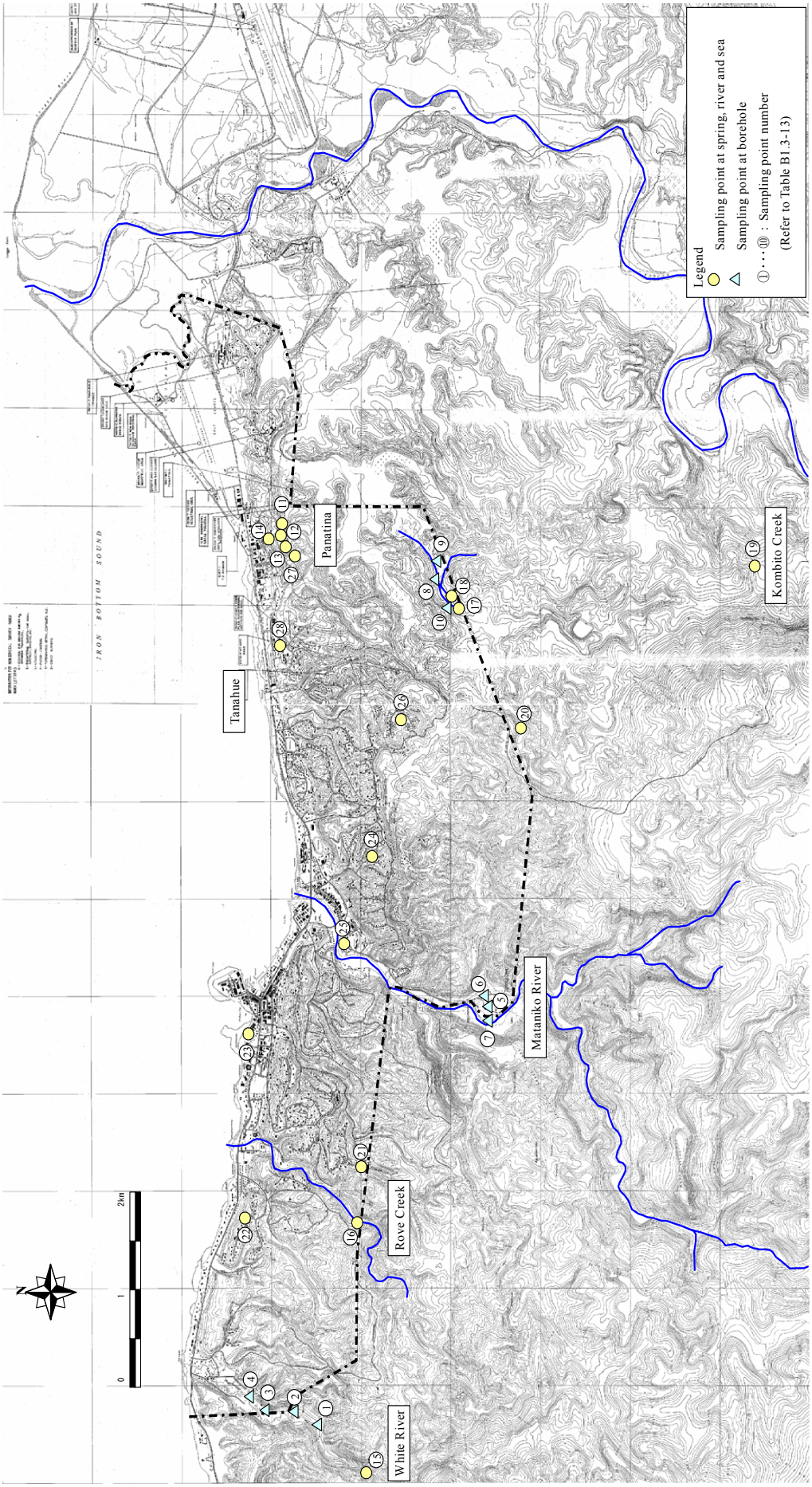


Figure B 1.3-13 Water Sampling Points for Water Quality Analysis

Source : JICA Study Team

(1) White River

(a) Results of the field water quality survey

Field water quality survey points were selected at upper/ middle/down area, outlet and estuary of the river including boreholes as water sources and supply system. The results of water quality are shown in Table B1.3-12. The range of each water quality item is shown in Table B1.3-14.

Table B1.3-14 Results of Field Water Quality Survey in White River

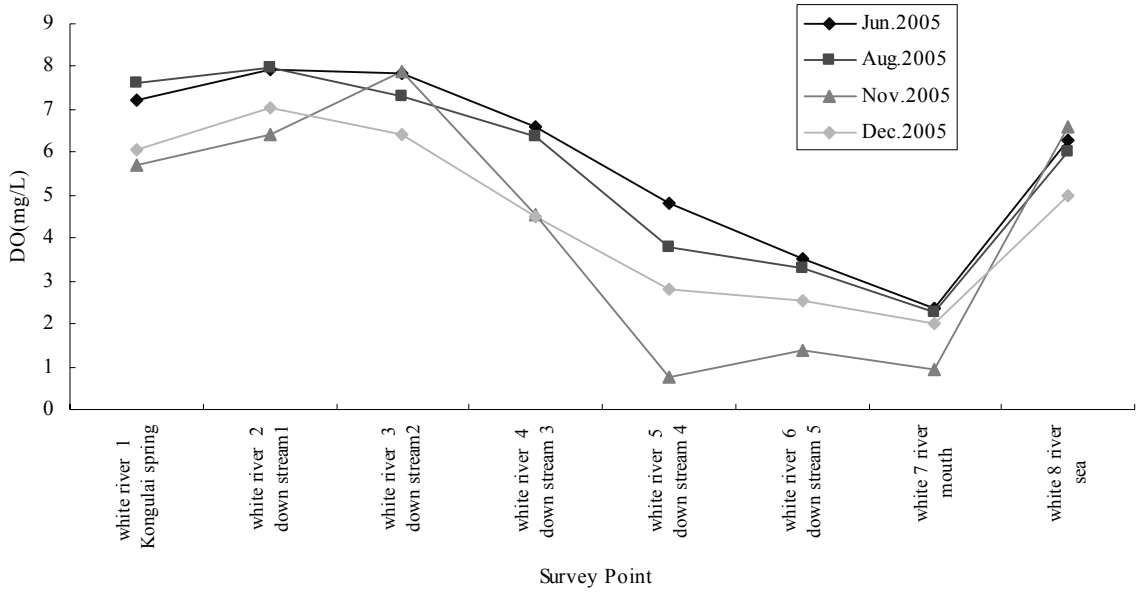
Survey date \ Items		Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (mg/L)	pH	DO (mg/L)	COD (mg/L)
June. 2005	River	23.9～27.6	26～38.3	1～5	7.5～8.2	2.35～7.9	1～9
	Sea	28	-	4	7.9	6.28	1
	Well	25.4～27.1	36.1～56.1	10～15	7.4～8.1	0.8～1.8	-
August 2005	River	23.9～26.6	33.6～39	15～28	7.5～8.2	2.2～7.96	1～9
	Sea	27.8	-	27	7.9	6.01	1
	Well	-	-	-	-	-	-
November 2005	River	23.6～30.2	25～39.1	0～7	7.3～8.6	0.7～7.43	5～9
	Sea	29.9	-	5	7.5	6.6	2
	Well	26.3～27.2	41.6～49.6	5 ～8	7.1～7.5	2.2～3.4	5～6
December 2005	River	24～28.6	21.4～39.1	0～92	7.3～8.0	2～7.1	6～9
	Sea	29.1	-	0	7.7	5	2
	Well	26.1～27	26.9～52.1	7	6.7～7.3	1.8～2.6	7

Source : JICA Study Team

The results of field water quality survey are summarized as below:

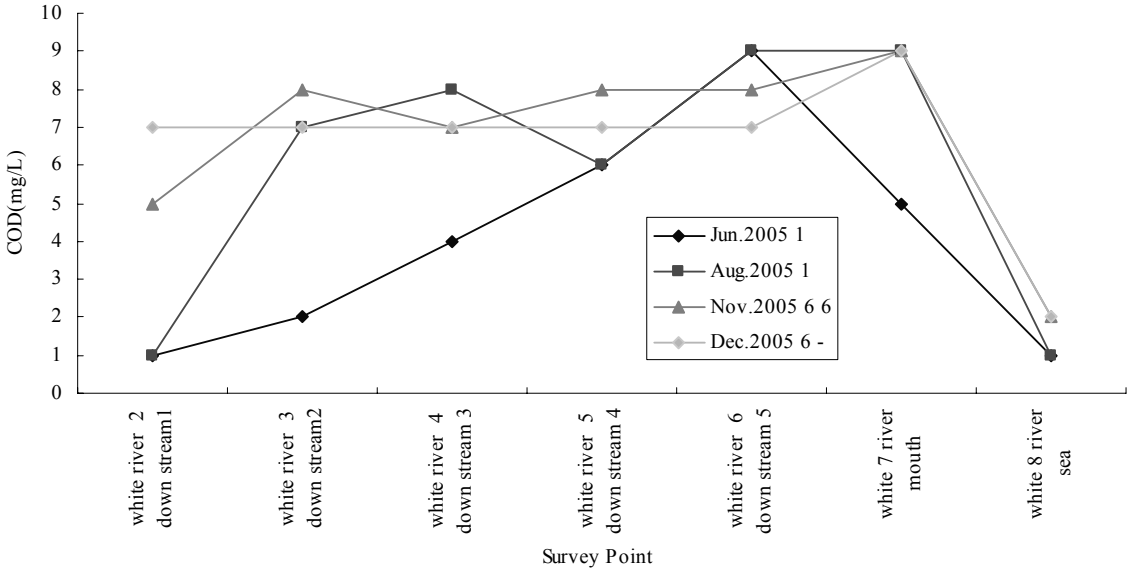
For water quality items of DO and COD, the results for the river and sea are shown in Figure B1.3-14 and Figure B1.3-15.

- Value of each item at each survey point did not show remarkable difference between the dry season (June and August) and the rainy season (November and December).
- The highest turbidity value was 92 mg/L on December at Konglai spring point. The cause for the high turbidity was a flood of up area.
- DO values were decreased toward to river mouth. It means that White River is contaminated in the lower reach of the river area.
- COD value indicated the contamination of sea and pond. In general, COD value less than 2mg/L indicates no contamination of the water. For survey point No.8 (at sea), COD value was less than 2mg/L for all the surveying period. It indicates that sea water did not show contamination.



Source : JICA Study Team

Figure B1.3-14 Result of DO Measurement in White River



Source : JICA Study Team

Figure B1.3-15 Results of COD Measurement in White River

(b) Results of water quality analysis in lab

Water sample were collected from boreholes and at tap of White River water supply system. The results of the water quality analysis are shown in Table B1.3-13.

Water Source:

White River has five (5) water sources, bores W1 to W4 and Konglai Spring.

Water samples were collected from Konglai Spring and Bores W1 to W4. It is found that the analysis results of these boreholes satisfied WHO guideline value except for Total Coliform Bacteria. Total Coliform Bacteria was more than 200(MPN/mL) at Bore W1 and 4(MPN/mL) at Bore W3.

Tap Water:

Water samples were collected from the tap in the White River high level system and the White River Spring gravity system. Manganese (Mn) content of each tap water was higher than WHO guideline value. Total Coliform Bacteria was not detected in each tap water.

(c) Evaluation of Water Quality

Regarding water survey and analysis in White River, the evaluation results can be summarized as below:

- According to the results of water quality analysis, tap water of White River system does not have serious problem.
- Although Manganese was not detected at water sources, the content of Manganese exceeded WHO guideline value for the tap water. This cause could not be identified during the survey.
- DO indicate that White River is contaminated in the lower reach of the river, and COD surveyed at sea indicate that seawater around river mouth is not contaminated.

(2) Rove Creek

(a) Results of field water quality survey

Field water quality survey points were selected at Rove spring and upper/middle/down area, outlet and estuary of Rove Creek. The results of water quality analysis are shown in Table B1.3-12. The range of each water quality item is shown in Table B1.3-15.

The result of DO measurement is shown in Figure B1.3-16 and the result of COD measurement is shown in Figure B1.3-17.

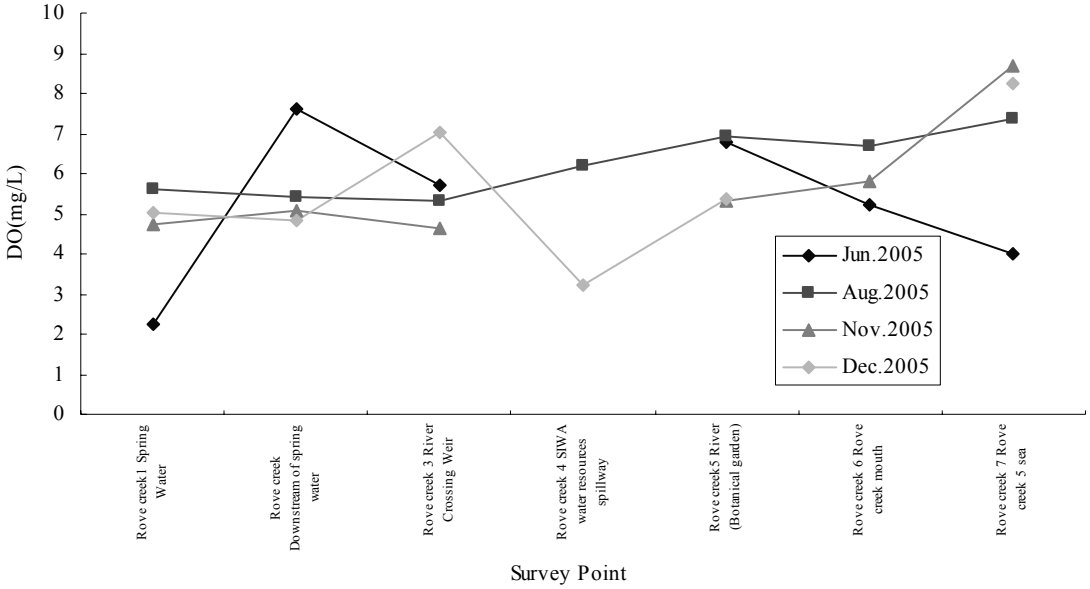
Table B1.3-15 Results of Field Water Quality Survey in Rove Creek

Survey date \ Items		Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (mg/L)	pH	DO (mg/L)	COD (mg/L)
June 2005	River	26.2～26.9	35～56	2～15	7.0～7.9	2.2～7.6	1～2
	Sea	27.1	-	14	8.1	4	0
August 2005	River	26.1～26.7	48.3～54.6	14～17	6.8～8.0	5.4～6.9	1～6
	Sea	28.1	-	16	7.91	7.35	0
November 2005	River	26.2～29.2	42～53	3～8	7.3～7.9	4.6～5.8	5～9
	Sea	31	-	6	7.8	8.7	1
December 2005	River	26.2～28.8	32～51	4～35	6.8～7.6	3.1～7.0	6～7
	Sea	31.2	-	2	8.0	8.3	2

Source : JICA Study Team

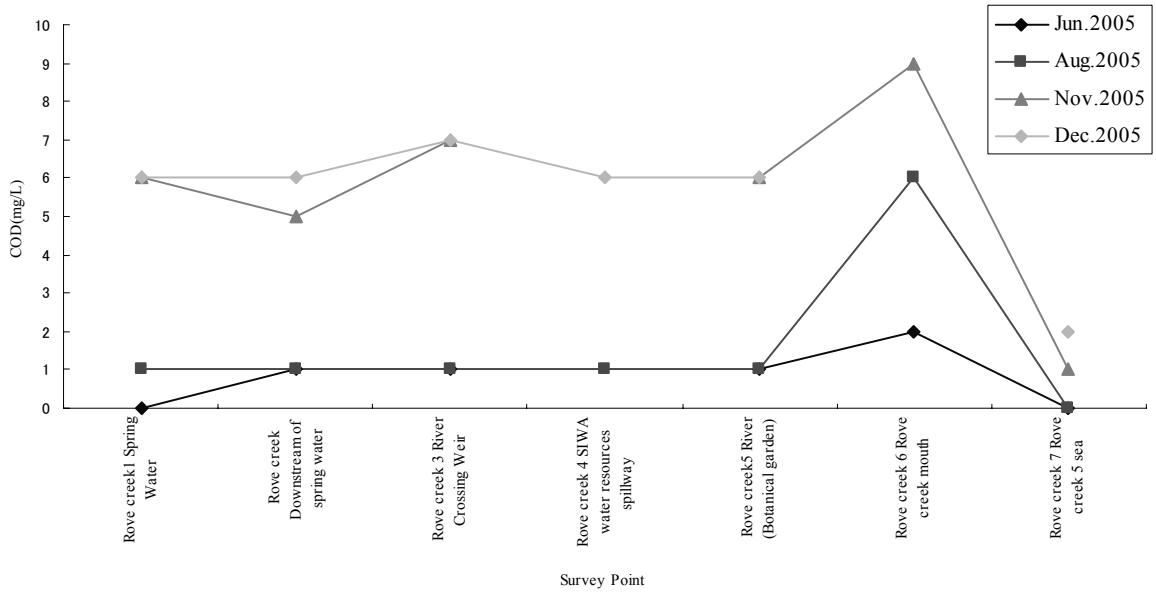
The results of field water quality survey are summarized as below:

- Value of each item at each survey point did not show remarkable difference between the dry season and the rainy season..
- DO values did not show remarkable change from the up to down area point. of Rove creek does not show remarkable contamination.
- At the survey point No.7 (at sea), COD value was less than 2mg/L during the surveying period. It shows that seawater is not contaminated.



Source : JICA Study Team

Figure B1.3-16 Result of DO Measurement in Rove Creek



Source : JICA Study Team

Figure B1.3-17 Result of COD Measurement in Rove Creek

(b) Results of water quality analysis in lab

Water samples were collected from Rove Spring and the tap of Rove Spring water supply system. The results of the water quality analysis are shown in Table B1.3-13.

Water Source:

Analysis results did not exceed WHO guideline value except for Total Coliform Bacteria. Total Coliform Bacteria was more than 200(MPN/mL) at the water intake point of Rove Spring.

Tap Water:

Water samples were collected from the tap of Rove Spring gravity system. Analysis results did not exceed WHO guideline value. Total Coliform Bacteria was not detected in the tap water.

(c) Evaluation of Water Quality

Regarding water quality survey and water quality analysis in Rove creek, the evaluation results can be summarized as below:

- According to the results of water quality analysis, tap water of White River systems does not have serious problem.
- DO did not show characteristic difference in the monthly results as well as in the survey points along the river. COD surveyed at seashore indicates that seawater around river mouth is not contaminated.

(3) Mataniko River

(a) Results of field water quality survey

Field water quality survey points were selected at upper, middle tributary, outlet and estuary of the Mataniko River. Mataniko River has two drain points at middle reach. Up and down area of the drain point were also selected as field water quality survey points. The results of water quality analysis are shown inTable B1.3-12. The range of each water quality item is shown in Table B1.3-16.

The results of DO and COD along the river and at seashore are shown in Figure B1.3-18 and Figure B1.3-19.

Table B1.3-16 Results of Field Water Survey in Mataniko River

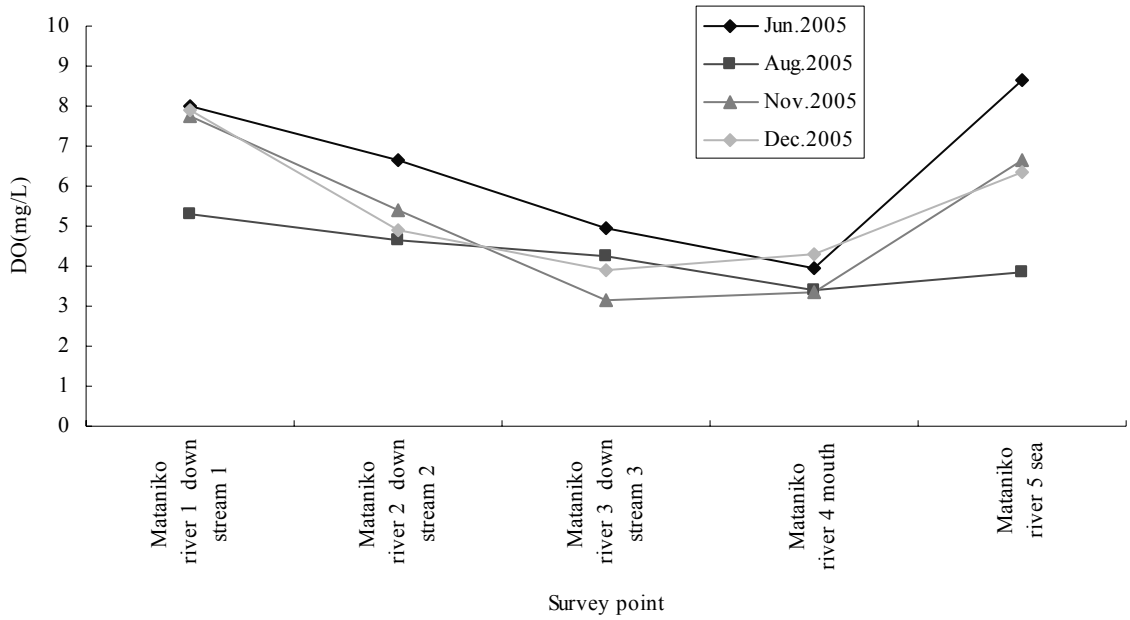
Survey date \ Items		Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (mg/L)	pH	DO (mg/L)	COD (mg/L)
June 2005	River	25.8～26.6	30～48	3～75	7.8～8.2	3.9～8.0	1～5
	Sea	28	-	102	7.1	8.7	2
August 2005	River	25.1～26.7	37～44(238)	8～20	7.6～8.2	3.4～5.3	5～9
	Sea	29.4	-	21	8.0	3.8	0
November 2005	River	26.1～32.3	21～35(990)	3～5	7.8～8.1	3.2～7.8	7～8
	Sea	31.1	-	0	7.8	6.7	7
December 2005	River	25.1～26.6	23～41	3～10	7.4～8.2	3.9～7.9	5～7
	Sea	30.3	-	28	8.0	6.4	5

Source : JICA Study Team

The results of field water quality survey are summarized as below:

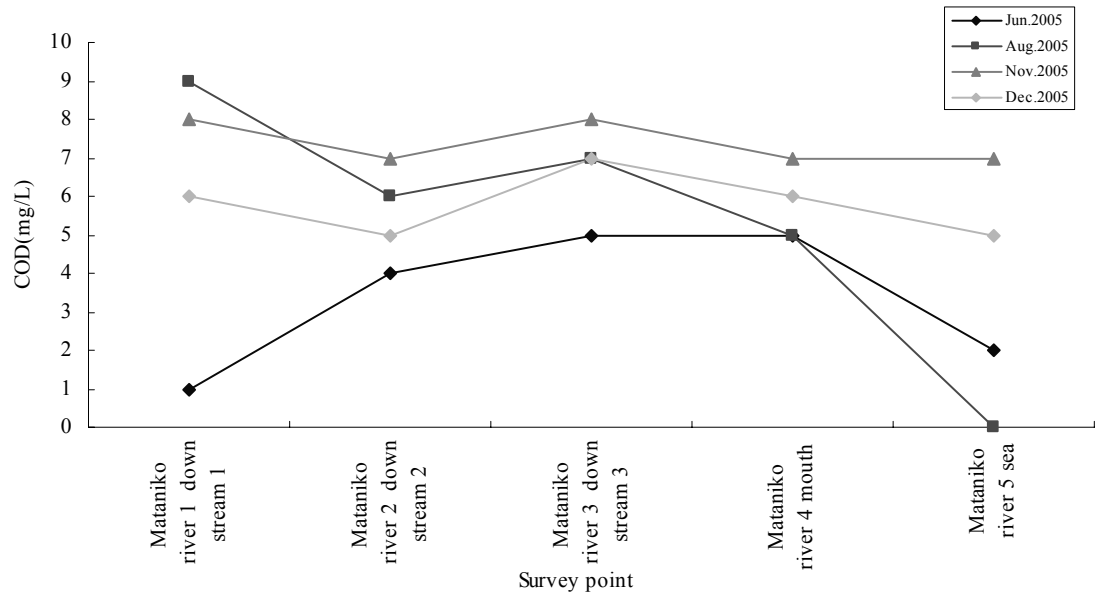
- Value of each water quality item at each point did not show remarkable difference between dry season (June and August) and rainy season (November and December).
- DO value is increased toward the river mouth. That means Mataniko River is contaminated from the up to down area.
- EElectric conductivity indicated 238 and 990 which are very high value in August and November. These values were measured at the river mouth and it is considered that it was caused by the high tide.
- At the survey point No.5 (at sea), COD value was less than 2mg/L in the dry season and ranges from 5 to 7 in the rainy season. It shows that seawater is not contaminated in the dry season and is contaminated in the rainy season. The cause of contamination in the rainy season is considered as follows;

  A lot of contaminants and wastewater produced in the residential district along the river easily run into the sea with much rain water discharge in the rainy season.



Source : JICA Study Team

Figure B1.3-18 Results of DO Measurement in Mataniko River



Source : JICA Study Team

Figure B1.3-19 Result of COD Measurement in Mataniko River

(b) Results of water quality analysis in lab

Water samples were collected from Bore M-2, M-4, SIWA Bore No.1 and the tap of Mataniko low level system and Mataniko SIWA system. The results of the water quality analysis are shown in Table B1.3-13.

Water Source:

Manganese (Mn) content of each bore exceeded WHO guideline value except for Total Coliform Bacteria. Total Coliform Bacteria was more than 200(MPN/mg) at Bore M-2 and 4(MPN/mL) at Bore M-4.

Tap Water:

The analysis results of these bores did not exceeds WHO guideline value. Total Coliform Bacteria

for the tap water of Mataniko skyline system was not detected.

(c) Evaluation of Water Quality

Regarding water quality survey and analysis in Mataniko River, the evaluation can be summarized as below:

- According to the results of water quality analysis, tap water of Mataniko system has no problem.
- Manganese content was decreased for the tap water. Manganese can be changed insoluble substance by oxidation through the water distribution pipe from bore to tap. It means that insoluble substance is increased in process of water distribution.
- Existence of Manganese may be caused by distribution of geology.
- DO changing along the river indicates that Mataniko River is contaminated in the lower reach of the river. COD surveyed at seashore indicates that seawater around river mouth is not contaminated.

(4) Kombito Creek

(a) Results of field water quality survey

Field water quality survey points were selected from Spring-1, 2, 3, the upper, middle reach of the river, Kombito SIWA wel-1, 2 and EU bore.

Mamulele Spring and Mt. Austin Spring were also selected as new spring sources. The results of water quality analysis are shown in Table B1.3-12. The range of each water quality item is shown in Table B1.3-17.

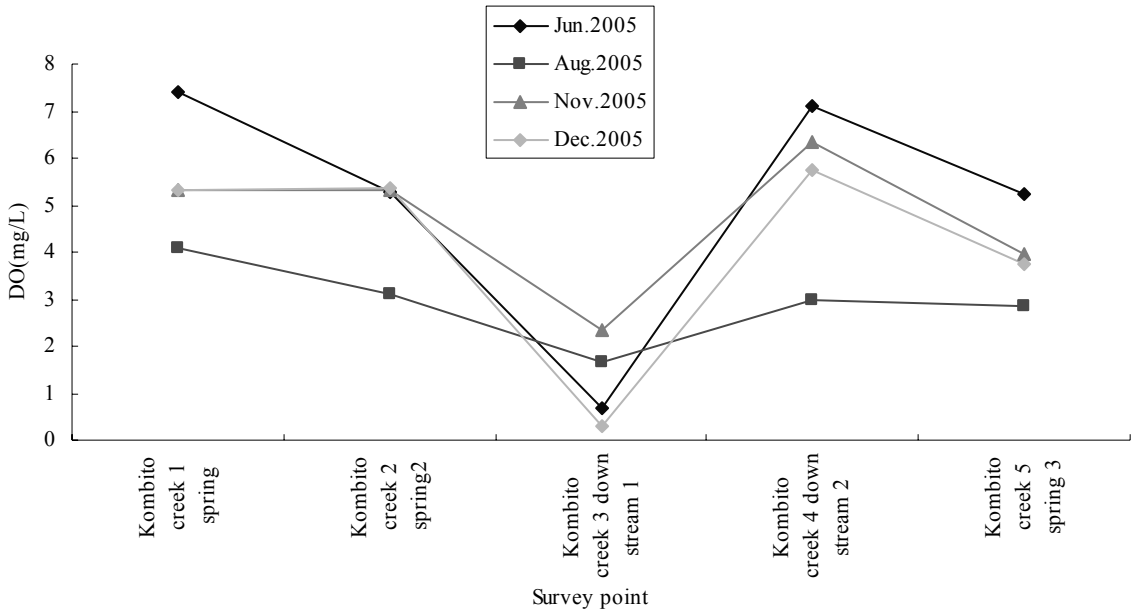
Table B1.3-17 Results of Field Water Survey in Kombito Creek

Survey date \ Items		Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (mg/L)	pH	DO (mg/L)	COD (mg/L)
June 2005	River	25.2～27.5	35～63	18～44	7.1～8.1	0.7～7.1	4～8
	Well *	25.9～26.8	40～68	0 ～15	7.2～7.6	1.1～2.0	-
August 2005	River	25.2～27.3	36～64	12～34	7.1～8.1	1.7～4.1	1～8
	Well *	25.9～26.1	44.6～45.1	11～14	7.1～7.2	7.1～7.3	-
November 2005	River	25.2～27.7	36.2～57.4	2～37	7.0～8.3	2.3～6.4	7～8
	Well *	25.9～26.4	39.2 ～45.4	7 ～8	6.4～7.7	3.8～5.4	6～7
December2005	River	25.3～28.6	41.6～56.3	0～16	6.9～7.9	0.3～5.7	6～9
	Well	26.0～26.1	44.5～44.9	7	6.9～7.0	3.3～4.2	4～6

Note: * Well and spring (Mt. Austin and Mamlele)
Source : JICA Study Team

The results of field water quality survey are summarized as below:

- Value of each water quality at each point did not show remarkable difference between dry season (June and August) and rainy season (November and December). The result of DO along the river and at seashore is shown in Figure B1.3-20.
- Kombito Creek does not have river mouth and river flow, which disappears at the down area point of survey point No.5.
- DO shows its minimum value at survey point No.3. There is a small hog farm up area of the survey point No.3.



Source : JICA Study Team

Figure B1.3-20 Result of DO Measurement in Kombito Creek

(b) Results of water quality analysis in lab

Water samples were collected at upper, middle of the river and the Spring-1, 2 and new spring source, tap of Kombito K-1/K-2 system and Kombito spring system. The results of the water quality analysis are shown in Table B1.3-13.

Water Source:

The analysis results did not exceed WHO guideline value except for Total Coliform Bacteria. Total Coliform Bacteria was 5(MPN/mL) at Bore K-1 and 17(MPN/mL) at Bore K-2.

Tap Water:

Total Coliform Bacteria was 78(MPN/mL) for the tap water of Kombito Bores K-1/K-2 system and more than 200(MPN/mL) for the tap water of Kombito Spring system.

(c) Evaluation of Water Quality

Regarding water quality survey and analysis for Kombito Creek, the evaluation can be summarized as below:

- According to the results of water quality analysis, tap water is considered as contaminated by Coliform Bacteria. And content of Total Coliform Bacteria is increased at a tap as compared with water source. It is assumed that Coliform Bacteria be mixed and increased in the process of water distribution.
- According to the DO value change, Kombito Creek is contaminated at survey point No.3. There is a small pasture in at the up-stream area of the creek. It is considered that this is the main cause of contamination.

(5) Panatina area

ield water quality survey point was not selected because there was no surface water. Water quality analysis samples were collected from bore-1, 2, 3, Panatina reservoir and tap water of Panatina system. The results of water quality analysis are shown in Table B1.3-12.

(a) Results of water quality analysis in lab

The results of the water quality analysis are shown in Table B1.3-13.

Water Source:

The analysis results did not exceed WHO guideline criteria. Total Coliform Bacteria was not detected at each bore. The results of the water quality analysis are shown in Table B1.3-13.

Tap water:

Total Coliform Bacteria was not detected from the tap water.

(b) Evaluation of Water Quality

Regarding the water quality survey and analysis in Panatina area, the evaluation can be summarized as below;

- No water quality item of Panatina Borefield exceeded WHO guideline value. Water of the Panatina Borefield and tap water has no problem.

(6) Lungga River

Two (2) points were selected as field water quality survey points from the upper and middle reach of the river. Water quality analysis samples were not collected. The results of water quality analysis are shown in Table B1.3-12. The range of each water quality item is shown in Table B1.3-18.

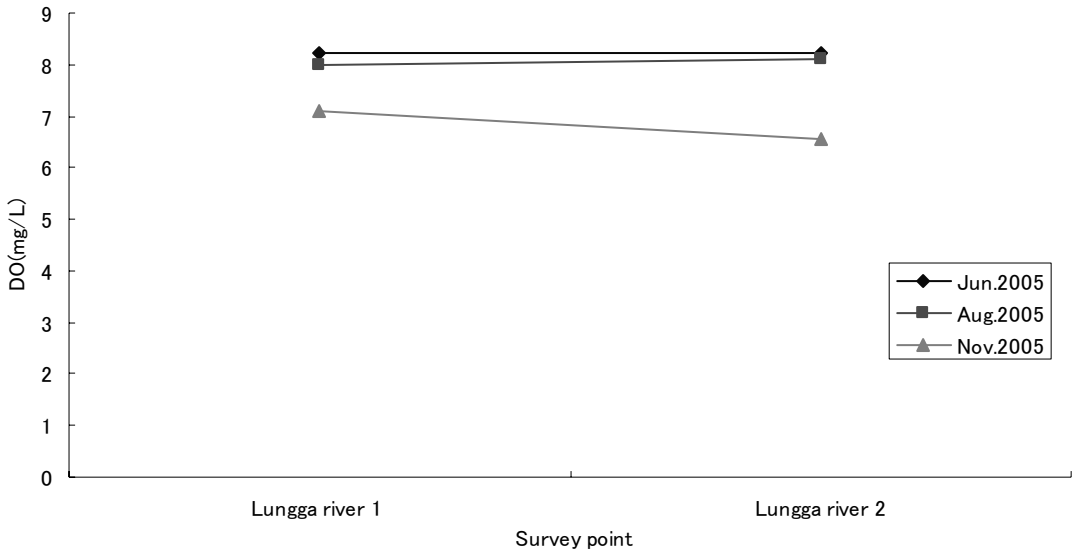
Table B1.3-18 Results of Field Water Quality Survey in Lungga River

Items / Survey date	Temperature (℃)	Electric Conductivity (mS/m)	Turbidity (mg/L)	pH	DO (mg/L)	COD (mg/L)
June.2005	26.6～28.7	26～30	0～12	8.1～8.2	8.2	6
August.2005	26.7～27.0	20～23	16～17	8.0～8.2	8.0～8.1	6
November.2005	27.5～27.6	15～16	15～16	7.8	6.6～7.1	7～8

Source : JICA Study Team

The results of field water quality survey are summarized as below:

- Value of each water quality item at each point did not show remarkable difference between dry season (June and August) and rainy season (November and December).
- The result of DO along the river and at seashore is shown in Figure B1.3-21.
- DO value did not show remarkable change between survey point No.1 and No.2. It shows that there is no remarkable contamination between survey point No.1 and No.2.



Source : JICA Study Team

Figure B1.3-21 Result of DO Measurement in Lungga River

(a) Evaluation of Water Quality

Regarding water survey and analysis in Lungga River, the evaluation results can be summarized as follows:

- Lungga River is the largest river of Honiara area. It is difficult to evaluate the water quality of the Lungga River from only water survey results in the Study.

(7) Wastewater Outfall at Seashore and Along the Mataniko River

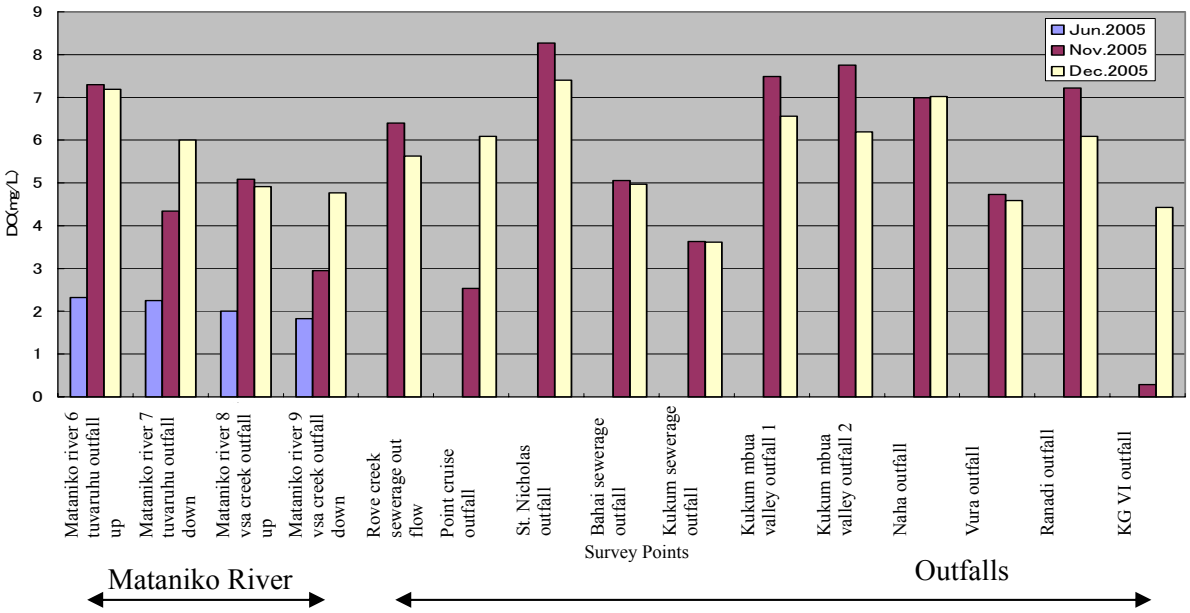
The field water quality survey was carried out at the Wastewater outfall points which are located at seashore. Honiara city has twelve (12) outfalls along its coast and two (2) out falls along the Mataniko River. The locations of the survey points are shown in Figure B1.3-12 (the measurement points of field water quality) and survey results are shown in Table B1.3-12 (the results of the field water quality survey). This field water quality survey was carried out in August 2005, and it was also carried out in November and December 2005.

The survey points, Tuvaruhu and Vara Creek outfall are located along the Mataniko River, and contamination of river water can be evaluated by DO value. The results of DO measurement are shown in Figure B1.3-22. The other outfalls are located along the coast line, and contamination of sea water can be evaluated by COD value. The results of COD value are shown in Figure B1.3-23. The results of water quality survey are summarized as below.

- The Tuvaruhu and Vara Creek outfall which are located along the Mataniko River, DO value was decreased toward the downstream point. It shows the contamination of lower reach of the river. At these outfalls, it emits very bad smell and water seemed much contaminated at the confluence of outfall and Mataniko River.
- COD value ranges from 5to 7mg/L at St Nicholas, Bahai and KG VI School survey points. When COD showed high value at St Nicholas, Bahai and KG VI School outfalls, surveys were curried out around 8:00 in the morning. It is considered that wastewater with high concentration from resident houses was the cause of high COD value.
- Although COD shows high value in the morning, the other survey results of each point were less

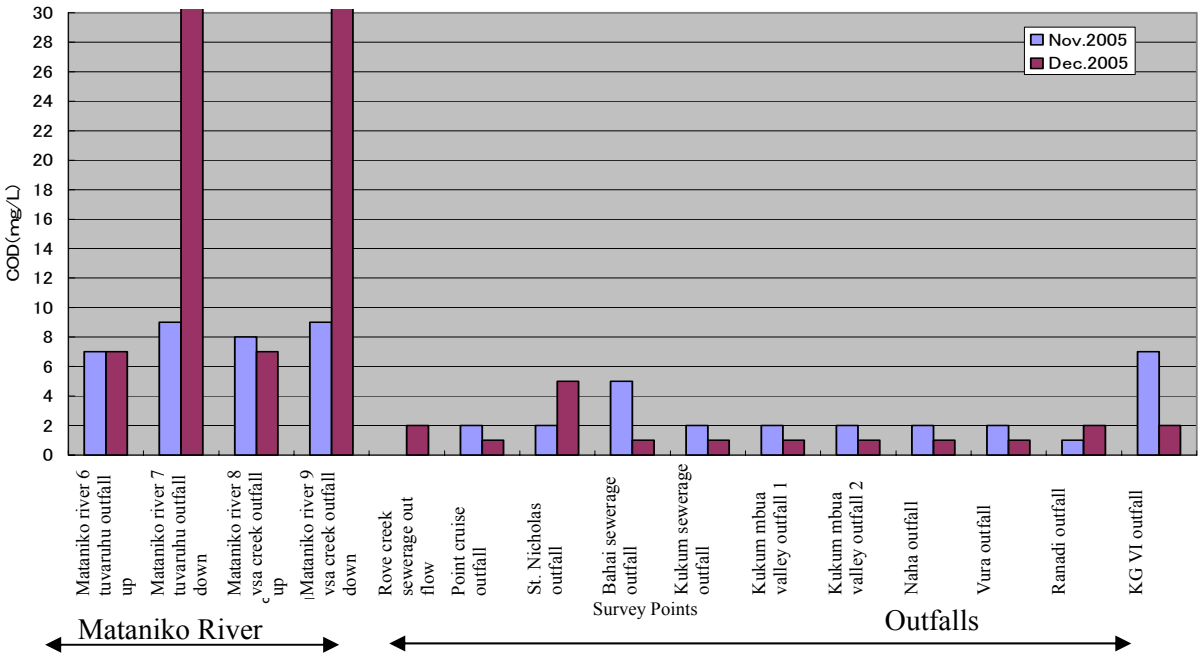
than 2mg/L. It indicates that seawater does not have remarkable contamination except during the morning.

- So far, it is considered that seawater does not have remarkable contamination in Honiara costal zone.
- Although drain pipes extend to offshore, there are many drain pipes broken near the beach and wastewater is leaked from the pipes. Remarkable contamination of seawater was not found at those points. However, it smell very bad and there are residents living near the points. Therefore, it is recommended that rehabilitation of drain pipes are needed.



Source : JICA Study Team

Figure B1.3-22 Results of DO Measurement at Outfall



Source : JICA Study Team

Figure B1.3-23 Results of COD Measurement at Outfall

B1.3.5 Ownership and Water Right of Water Sources

(1) Current Situation of Ownership and Water Right of Water Sources

According to the Ministry of Water Resources, river and its water belong to the Government, and use of water resources must be approved by the Ministry. To the contrary, it is also widely recognized that river and its water belong to landowners. There is contradiction in ownership of river water as mentioned above. Catchments area of rivers usually belongs to customary lands, and landowners usually request payment for water right of river water taken by SIWA. Water from Konglai Spring, which is the main water source for Honiara water supply, originates from wide catchments area. Landowners of the catchments area of Konglai Spring request payment for water taken by SIWA. Then, the Government pays it to the landowners. On the other hand, ownership of the groundwater is not as clearly defined as river water because its catchments area is not clear.

The Ministry of Water Resources intends to conduct new study on management of water resources in 2006 including discussion on ownership of water resources.

(2) Current Situation of Payment for Water Right

Current situation of payment by the Government/SIWA for water right in Honiara, Noro, Auki, and Tulaghi is summarized in Table B1.3-19.

Table B1.3-19 Current Situation of Payment for Water Right

Water source/facilities		Water right	Land lease	Note
1.	White River spring	25% of total sales of water from Konglai Spring. It is around S$3,600,000/year.	SI$32,000/year	• White river spring is located within customary land. • Contract period is from 1981-2055 for 75 years. The contract is reviewed every 5 years.
2.	White River: Borehole W-1and W-2, pipe-line	—	SI$8,000/year	W-1 and W-2 are located within customary land.
3.	White River: Borehole W-4	—	SIWA is now under negotiation with the current lease-holder who has leased the area from the Government.	W4 is located within Honiara
4.	Skyline distributing reservoir	—	SI$2000/year	The reservoir is located within Honiara.

Source : JICA Study Team

The contract on Konglai Spring is valid until year 2055. According to the contract, payment for land lease will be continued until 2055. On the other hand, payment for water right is proportional to the water intake volume by SIWA. Therefore, payment for water right will be reduced when water intake volume is reduced.

(3) Ownership and Water Right of Konglai Spring

Konglai Spring is the main water source for water supply for Honiara. The outline of the contract for water right for the use of Konglai Spring is shown in Table B1.3-19. This spring is very important and content of the contract is described more in detail below.

(a) Content of the Contract

Contract for the use of Konglai Spring was concluded in 1981 between landowners and the Ministry of Land, which stipulates payment of water right. Period of the contract is 75 years, and it will

continue to the year 2055. The contract was revised in 1991. Payment comprises two parts as shown below;

Item	Payment	Note
① Land-lease	SI$32,000/year	Amount of payment is fixed.
② Water-right	Around SI$3,600,000/year	25% of total sales of water from Konglai Spring. Payment is done every month.
Total	Around SI$3,7000,000/year	

Source : JICA Study Team

Payment above is done by the Government monthly. SIWA reports monthly water sales from Konglai Spring to the Ministry of Land every month. Based on this report, the Ministry does payment to landowners.

(b) Payment

Payment for water-right changes every month in proportion to water intake volume from Konglai Spring. In fact, payment has become as half as in the normal condition since October 2005 due to the reduction of less than 50% in the water intake by SIWA, which was caused by reduction in water volume by the blockage of Konglai Spring. If SIWA stops taking water from Konglai Spring, payment for water-right becomes zero, though land-lease charge must be paid to the landowners within contract period. Land-lease charge is much smaller than payment for water right.

(c) Revise of Contract

The contract is to be revised every 5 years. In the past, the contract was revised once in 1991 since it was concluded in 1981. Next opportunity for revision is in 2006. If SIWA announces reduction in intake of water from Kongulai Spring, which will be achieved by construction of new boreholes, the land-owners may revise the contract again to compensate reduction in payment for water-right. They will increase payment for water-right, it is currently 25% of total sales of water from Konglai Spring

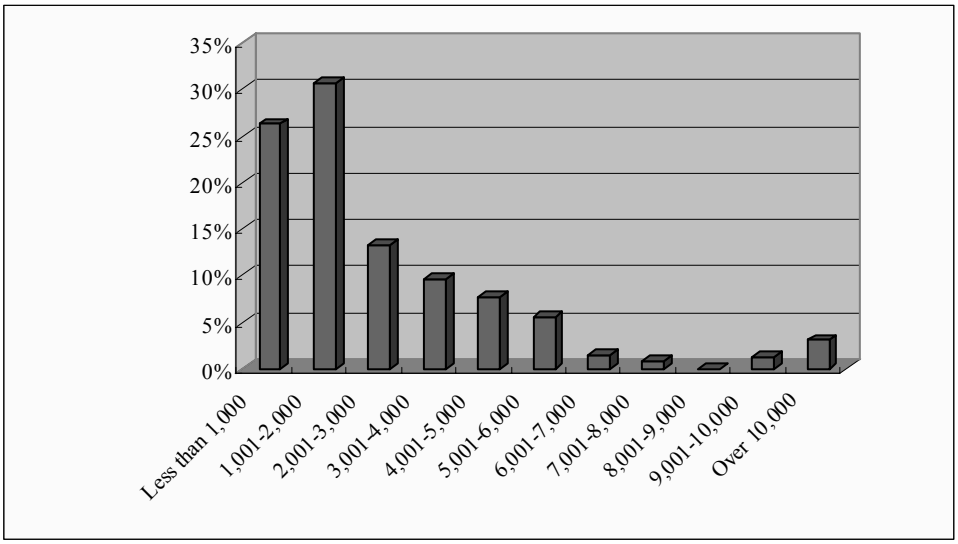
B1.3.6 Socio-economic Survey

Socio-economic survey was conducted from July to August 2005 not only in Honiara but also in Noro, Auki and Tulagi. Sample households were selected based on the cluster sampling treating an area as a sampling unit, which considers an area as representative of all areas within the target area because certain variables such as for housing tend to cluster around a certain neighborhood. The following are the summary from the survey for Honiara. The details of the survey are compiled as S-5 of Supporting Report.

(1) General Information

Major type of dwelling is "owned" (67%). The distribution is different between in the low income area and in the high income. 78% of the low income households live in owned dwellings. In contrast to the low income area, the percentage of high in come households which reside in owner occupied dwellings is only 55%. The 1999 census noted that 43% of dwellings in the urban areas are owner-occupied followed by rented (34%) and rent-free (20%). One-third of respondents live in the area for less than 5 years. The distribution also differs in income level. In the high income areas, the percentage of less than 5 years accounts for 49%, while only 10% of the households live in the area for over 20 years. It means that half of the high income households settled in recent years, community in the high income area is not well-organized. Therefore, there is no help from outside including NGOs. However, community members think that there is a need to form as a group so that a collective voice can represent people's concern as a group. On the other hand, 50% of the low income households are living in the area for over 20 years. The communities in the low income area are well-organized under the leadership of community chiefs.

The survey result shows the average household size is 8.6 persons. By income level, it is 8.3 and 8.9 in the high income area and the low income area respectively. It seems that influx from provincial areas to Honiara is increasing after ethnic tension. The number of paid workers per household is 2.1 persons. The average monthly income per household is 3,553 Solomon Islands Dollars (SI$) in Honiara. By income level, it is SI$4,456 for the high income area and SI$2,007 for the low income area. As shown in Figure B1.3-24, SI$1,001 to SI$2,000 group accounts 31%, followed by less than SI$1,000 group (27%) and SI$2,001-3,000 group (13%). According to the statistics of Bureau of East Asian and Pacific Affairs, the United States Department of State, it is reported that per capita income of Solomon Islands in 2003 is US$425. Which is equivalent to SI$2,975. Therefore, the average monthly income obtained from the survey is considered valid.



Source : JICA Study Team

Figure B1.3-24 Income Level of Honiara

There are two types of social activities in Solomon Islands. Those are community based activities and religious ones (initiated by church). As for community based activities, Awareness talk for crime and health, sports such as soccer and rugby, custom dance are very active. Community work such as logging, piggery and shell money making is organized by community members. Activities initiated by church are also active in Honiara

(2) Water Supply

The households use four major types of water supply in Solomon Islands: piped water, rain tank, bore hole/well/spring, and river/. Regarding the piped water, there are three types: inside dwelling, outside or private use, and outside for shared use. Piped water and rain tanks are the main sources of water supply. The low income households are more dependent on the piped water than the high income households. One-forth of households in the high income area have rain tanks for water supply. 1999 census noted that piped water is the major source (89%) for the households in Honiara. However, the percentage obtained from this survey is lower (75%) because the high income households use rain tanks for the source of dinking water. On the other hand, only 22% of households rely on rain tanks for drinking water. Rainwater is usually preferred for drinking use because the piped water is sometimes contaminated during rainy days and too much chlorinated.

The average water consumption volume in Honiara is 303 liter per day per household (L/d/HH). By income level, it is 279 and 326 L/d/HH (or 36 and 46LCD) in the high income area and low income area respectively. These consumptions are much less than the actual consumption of 197LCD, even taking into account the water losses inside the house. It is supposed that the interviewees

misunderstood the questions from the surveyor of the Team or they believe to consume only such amount.

78% of the households are satisfied with the water volume in Honiara. Regarding the monthly amount paid for water supply by the households in Honiara, 27 % of the households paid less than SI$50 per month followed by SI$100–200 group (25%), SI$50–100 group (22%) and SI$200-300 group (14%). By income level, one-forth of the low income households pay for water less than SI$50 per month.

63% of households show the willingness to use the additional standing pipes in Honiara. By income level, the percentage is 47% and 80% in the high income area and the low income area respectively. This result indicates that additional sources of water supply are needed in the low income area.

It is stated that method of purchasing is not satisfactory, this is simply because unit of water used is not only paid for but other expenses such as fuel adjustment cost, tariff and maintenance cost. Billing seems to be not satisfactory as everybody does not have post office box hence it was strongly recommended that SIWA deliver water bills to residences or households. However, the households are prepared to pay more for quality water services particularly if water is continuously supply to residences. It is also stated that there is a need for water conservation as it is part of safeguarding water from water wastage. Moreover, there is also need for water conservation education by both SIWA and Honiara residences to Honiara Town dwellers and household members.

In the interview survey, the households were asked to prioritize the following items in order to improve living condition: food, water, house, education, electricity and clothes. Half of the households in Honiara think that water is most important among them.

(3) Sanitation

Major type of toilet is flush in Honiara same as provincial centers. Major sewer system is septic tank. 71% of the households use septic tank in Honiara. The households with sewer connection are only 5%. For sewerage services by SIWA (installation of septic tank and maintenance), 84% of the households are willing to use the facility and are prepared to pay for the services in Honiara.

Security of water sources is important to protect water sources from people contaminating the water sources in Honiara as well as in the water supply to their residences. Direct contamination of water sources includes people wrongly use s, rivers, bush and beaches for personal comfort or as toilets. Reduction of water pollution in Honiara will include education. Honiara Town dwellers and provincial drifters should be aware of proper use of water and water conservation. Preventing of water contamination is partly the responsibility of Honiara residences, therefore there is a need for people to know what involves the causes of water contamination and those found of polluting water in Honiara must be severely penalized.

Almost half of the households have the experiences of disease caused by drinking water. The percentage in the low income area (61%) of Honiara is twice as much as that in the high income area (29%). Almost of the disease type is diarrhea (94%). Over 90% of households think that water source should be conserved in order to avoid contamination of water.

(4) Findings from Socio-Economic Survey

87% of the respondents pointed out the problems of water supply and sewerage systems. As shown in Table B1.3-20, the most common opinion about water supply is poor water quality and necessity of filtration. Half of the respondents noted that water was contaminated and not safe for drinking after rain or filtration system should be installed to purify water. Unreliable billing system/meter reading and low water pressure are also their major concerns about water supply.

Table B1.3-20 Opinions of Water Supply and Sewerage Systems (the first survey)

Opinions	No. of respondents
Water quality should be improved - Poor water quality (dirty/muddy/not safe) during rainy days, and too much chlorine.	126
Billing/metre reading should be reliable.	82
Frequency/pressure of water supply should be improved.	61
Filtration system should be installed to purify water.	40
Sewerage service including sewage treatment plant and septic tanks should be provided.	20
Standing pipe should be installed.	15

Source : JICA Study Team

70% of the respondents feel that water price is expensive. While 20% of the respondents are satisfied with SIWA's water supply service, 50% feel the service is poor. The reasons why they think so are as follows:

- Not reliable meter reading
- Poor service compared to the price

Of the respondents indicating water price is high, 34% noted that meter reading is not reliable. Some respondents pointed out that water bills continue to increase even though there is no water during couple of days or they use less water. The others said water bills were not sent them periodically.

SIWA conducted a customer satisfaction survey in Honiara on April 1998. Table B1.3-21 shows the result of the customer survey. Areas of customer services with which least customers were satisfied were the meter readers, followed by field staffs. Although meter readers are the most visible staffs of SIWA, the public perception of meter readers is the worst of all and has not been improved since this customer survey.

Table B1.3-21 Area of Customer services and the Levels of Satisfaction

Service Area	Satisfied
Front counter	83%
Administration	75%
Service centre	73%
New connections	69%
Accounts section	69%
Field staffs	60%
Meter readers	52%

Source : SIWA

SIWA has 6 meter readers and they read all the meters every month. It takes two weeks for Honiara and one week for provincial areas (Noro, Auki, and Tulagi). Bills are issued as the records come in from meter readers, and posted to the customers. Those who do not have postal address have to come to SIWA to pick their bills up. Over 2,000 bills stay in SIWA because of wrong postal address or no postal address.

Over 2,000 meters do not work properly at this moment because most of them are used over 35 years. SIWA applies fixed rate of SI$41.04 to the customers with the broken meters. It accounts one-third of the domestic users. Some customers said that the water bill suddenly increased after replacement of meter and they doubted meter readers might guess the amount. Less information leads to unreliability of meter reading and billing system.

There are households sharing a meter but having each account. In that case, those households pay same amount of water bill because monthly water use is divided by the number of households sharing the meter. However, the number of family and actual water use differ from one to another. Those households feel that this billing system is not unfair. This system also caused less reliability of meter

reading and billing system.

57% of the respondents noted that water quality is dirty after rain. 62% of households feel that water interruption occurs frequently. The customers have to pay for meter, pipelines and maintenance. However, water quality is not good and water supply is irregular. This makes the respondents feel that water price is high compared with the services. Table B1.3-22 shows dissatisfaction with the services including poor water quality (color and taste), low pressure, frequent interruption, improvement of customer service, and insufficient monitoring of leakage by area.

Table B1.3-22 Dissatisfaction with Water Supply Services

Area	Dissatisfaction
White River (L)	59%
Nggosi (H)	82%
Vavae Ridge (L)	88%
Skyline (H)	64%
Tanuli Ridge (H)	84%
Matariu (L)	88%
Vaivila (L)	45%
Panatina (H)	42%

Note: L – low income group / H – high income group
Source : JICA Study Team

The other reason that for their feeling of high water price is that they cannot afford to pay for water supply due to low income. SIWA introduced a tariff adjustment on October 2003 based on the recommendation of EU mission in 2003. Current water tariffs for domestic users are SI$1.00 for the first 30$m^3$ and SI$2.42 for over 30$m^3$. For new connection, the applicants have to pay connection fee SI$400 and deposit SI$500. Affordability of the low income households is taken into consideration in this tariff structure. However, initial fee for new connection is so high that the low income households cannot afford to have private taps.

In interview survey and REA workshop, many problems and suggestions are pointed out from the institutional and technical aspects.

In order to improve consumer services and perception of the public, and to establish better relationship with the public, the following actions are to be implemented by SIWA.

<Institutional Aspect>
- Improvement of reliability/the public perception of meter reading
- Dissemination of information (Public relations)
- Community education/public awareness
- Improvement of billing system
- Consideration on the low income households

<Technical Aspect>
- Construction of water treatment facility for water from spring sources
- Conversion of water sources from spring water to the other sources
- Establishment of indicators for leakage reduction, water quality and pressure control
- Mapping of the existing meters on GIS system

(5) Willingness to Pay (WTP)

As shown in Table B1.3-23, monthly water bill averages SI$138.22 for Honiara, SI$147.16 for the high income group and SI$128.80 for the low income group. Based on data gained from the socio-economic survey, average willingness to pay additionally for better water supply (MWTP)is SI$56.53 per month for Honiara, SI$71.94 for high income group and SI$38.34 for the low income group. WTP is the sum of monthly water bill and MWTP. It is total monthly amount which they are

prepared to pay for better water supply.

98% of the respondents express willingness to pay for better water supply (MWTP), whereas 70% of the respondents feel water price is expensive. If the quality and reliability of water supply could be improved, then convenience could be improved, together with reduced water-related negative health impacts due to dirty water. This would result that 98% of the respondents were willing to pay in Honiara.

Table B1.3-23 Monthly Water Bill and Willingness to Pay

Area		Monthly water bill (A)	MWTP [1] (B)	WTP [2] (A+B)
Honiara	High income group	147.16	71.94	219.10
	Low income group	128.80	38.34	167.14
	Average	138.22	56.53	194.75

Notes: 1 Willingness to pay for the better water supply services
2 Sum of monthly bill (A) and MWTP (B)
Source : JICA Study Team

The tariffs should be set at less than ability to pay (ATP). ATP is calculated by the statistics of income and distribution of household expenditure. However, those data is not available in Solomon Islands, so that 4% of monthly income is applied in the Study. It is a benchmark of maximum ability to pay for water supply in the developing countries used by the World Bank. As shown in Table B1.3-24, monthly income averages SI$3,553 for Honiara, SI$4,456 for the high income group, and SI$2,007 for the low income group. ATP averages SI$142.12 for Honiara, SI$178.24for the high and SI$80.28 for low income group in Honiara.

Table B1.3-24 Average Monthly Income and Ability to Pay

Area		Average monthly income (SI$)	ATP (4%)
Honiara	High income group	4,456	178.24
	Low income group	2,007	80.28
	Average	3,553	142.12

Source : JICA Study Team

Average monthly bill accounts for 3.9% of average monthly income for Honiara, 3.3% for the high income group, 6.4% for the low income group (see Table B1.3-25). As abovementioned, 4% of monthly income is the maximum ability to pay for water supply in the developing countries. However, the average water bill for the low income group in Honiara is over 4%. After summing up monthly water bill and WTP, it is not affordable for the respondents to pay for water supply.

Table B1.3-25 Monthly Water Bill, WTP and ATP

Area		Monthly water bill	WTP	ATP
Honiara	High income group	147.16 (3.3%)	219.10 (4.9%)	178.24
	Low income group	128.80 (6.4%)	167.14 (8.3%)	80.28
	Average	138.22 (3.9%)	194.75 (5.9%)	142.12

Note 1: Percentage in blackest is an expenditure ratio of water supply to the average income.
2: Highlighted cells mean over 4% of expenditure ratio of water supply.
3: Monthly water bill for high and low income groups of Honiara is an average after eliminating the extremely high values
Source : JICA Study Team

Based on these results, it is difficult for SIWA to increase the water tariffs due to less affordability of the customers unless the following countermeasures are carried out.

- Improvement of water supply capacity
- Improvement of customer services
- Improvement of financial management
- Demand Control (water conservation)

B1.4 Water Supply System

B1.4.1 Issues for Water Supply Service

(1) Issues to be solved

Water supply service by SIWA has following issues to be solved.

Table B1.4-1 Issues for Water Supply Service by SIWA in Honiara

Category	Issues to be solved
Management and Institution	1. Since leakage ratio is high (estimated as more than 40%), water sales to water produced ratio is low (57.4%).
	2. Water tariff collection method should be improved. Arrear by the large users (commercial and governmental customers) is rather large.
	3. Electricity charge occupies the most of the operation costs and much affect the water supply service management by SIWA.
	4. Present office of SIWA is too small to hire the necessary staff and do the effective arrangement of staff.
Water Supply System	1. Water source More than 50% of water sources in Honiara rely on Konglai Spring. This source is vulnerable to sudden suspension of water supply due to blockage by natural calamity or intentional blockage by the residents. In the past 10 years, four (4) major blockages occurred and the residents suffered from limited water supply for long period. More over, it is located in the customary land, so that the Government has to pay the land owners 25% of the water revenue from this source. Therefore, SIWA is desirous of shifting the water source from this spring source to the groundwater sources inside the town boundary.
	2. Water distribution district Water transmission pipeline and distribution pipeline are not separated so that the water distribution reservoir can not work with its original functions such as absorbing peak demand, supplementing water supply in emergency case, etc.
	3. Water pressure About 25% of Honiara water distribution districts are suffering from low water pressure during the peak demand period.
	4. Pipe diameter Pipe diameters are too small to transfer the required water to customers. Inadequate pipe diameter is also the cause of low water pressure.
	5. Storage capacity of reservoir Currently, nine (9) reservoirs are being operated and their capacity is about 6,000m^3 corresponding to 5 hour-volume of daily maximum water demand.
	6. Water quality Tap water often shows high turbidity after heavy rain in the catchment area of each spring source.
	7. Unserved area Unserved water supply area accounts for 30% of water distribution districts of SIWA. There are unserved areas even inside the town boundary.

Source : JICA Study Team

(2) Basic Data for Water Utility Management

Basic data for water utility management of SIWA in 2004 are shown in Table B1.4-2 below.

Table B1.4-2 Basic Data for Water Utility Management of SIWA (2004)

Item	Formula	Data
Yearly water production (m^3/year)		9,387,360
Yearly water sales (m^3/year)		5,393,006
Water sales to water production ratio (%)	$\frac{\text{Yearly water sales}}{\text{Yearly water production}}$	57.4
Unit revenue (SI$/$m^3$)	$\frac{\text{Revenue from water supply}}{\text{Yearly water sales}}$	2.55
Unit cost of water (SI$/$m^3$)	$\frac{\text{Ordinary expenses}}{\text{Yearly water sales}}$	2.29

Source : Calculated by the Study Team based on the data from SIWA

According to the above table, the unit revenue is more than the unit cost of water. This is because the investment cost (or "Project Works" in Table D2.2-3) was very small in 2004. In 2005, SIWA will put investment for building branch offices in Auki, Noro and Tulagi. Therefore, it is expected that the unit cost will become much higher than the unit revenue. This means that the more SIWA sells water, the more it will become deficit.

In order to improve this situation, SIWA has to take following actions.

- To decrease non revenue water (or leakage)
- To decrease yearly production
- To increase yearly water sales
- To decrease ordinary expenses

B1.4.2 Water Supply Volume and Water Quality

(1) Water Supply Volume

(a) Number of Customer

Current numbers of domestic, commercial, governmental and major customers in 2005 are shown in Table B1.4-3 below.

Table B1.4-3 Current Number of Customers for Each Category in 2005

Description	Conditions	Active Customer	Not considered as Customer
Domestic	Current active customers	**5,434**	
	Disconnected customers		869
	Vacated premises		728
	Non-functioning meters	(344)	(included in active customer)
Commercial	Current active customers	**617**	
	Disconnected customers		240
	Vacated premises		87
	Non-functioning meters	(22)	(included in active customer)
Government	Current active customers	**198**	
	Non-functioning meters	(10)	(included in active customer)
Major Customers	Major Customers - Total	**261**	
- Police	Current active customers	107	
	Non-functioning meters	(3)	(included in active customer)
- SICHE	Current active customers	35	
- Solbrew	Current active customers	2	
- Honiara Soltaiyo	Current active customers	10	
- Solgreen	Current active customers	4	
- Honiara NBSI	Current active customers	10	
- Honiara SIEA	Current active customers	2	
- Honiara City Council	Current active customers	28	
- HCC - Institutions	Current active customers	11	
- Hotels	Current active customers	20	
	Non-functioning meters	(1)	(included in active customer)
- Motels	Current active customers	26	
- NPF	Current active customers	6	
Total Number of Customer in Honiara (Current active customers including non-functioning meter)		**6,510**	

Source : SIWA

(b) Served Ratio

The served ratios in 2005 are estimated through the number of active customer. Using the obtained data as shown in Table B1.2.1-1 and Table B1.4-4, the served ratio of 2005 is calculated as follows.

Table B1.4-4 Served Ratio in 2005

Year	Population	Customer	Served Population	Served Ratio (%)
2005	66,402	6,510	46,221	69.6

Source : Calculated by the Study Team using data from SIWA

(c) Water Consumption

Current water consumption in 2005 is shown in Table B1.4-5.

Table B1.4-5 Current Water Consumptions in 2005

Category	Population	Customer	Effective Water Consumption	Effective Water Consumption	Served Pop.	Per Capita Consumption
	(No.)	(No.)	(m^3/year)	(m^3/day)	(No.)	(LCD)
Domestic		5,434	2,772,677	7,596	46,221	164
Large Users		1,076	2,859,739	7,835		
- Commercial		*617*	*1,602,312*	*4,390*		
- Governments		*198*	*716,450*	*1,963*		
- Major Customers		*261*	*540,977*	*1,482*		
Whole Honiara	66,402	6,510	5,632,416	15,431	46,221	334

Source : Calculated by the Study Team using data from SIWA

(d) Large Water Users' Consumption

Consumption of the large water users in 2005 is as shown in Table B1.4-6.

Table B1.4-6 Large Users' Consumptions in 2005

User's Name	Ave. Dauly Consumption (m^3/day)
Prison	475
Mendana Hotel	270
King Solomon Hotel	190
Iron Bottom Sound Hotel	190
Honiara Hotel	190
Quality Motel	190
Casino Hotel	190
SICHE Kukum campus	330
SICHE Panatina campus	330
Betikama High School	160
King George VI School	160
Solbrew	300
Central Hostpital	700
Port Authority	1,200
Solomon Soap	40
Ranadi Industrial Area-1	180
Ranadi Industrial Area-2	170
Ranadi Industrial Area-3	170
CBD 1: Works	390
CBD 2: PM's Area	390
CBD 3: NPF Area	450
CBD 4:Shops	450
Henderson Airport	200
Chinatown 1	260
Chinatown 2	260
total	7,835

Notes:
SCHIE = Solomon Islands College of Higher Education
CBD = Central Business District
PM = Prine Ministrer
NPF = National Provident Fund

(e) Distributed Amount of Water

Distributed amount of water is the water volume distributed from the water supply sources such as bore pumping station, water reservoir, etc., to the water distribution districts and to the customers. It is calculated as follows.

$$\text{Distributed amount of water} = \frac{\text{Effective water consumption}}{\text{Effective water ratio}}$$

Where;
Effective water consumption : Water consumed effectively (Authorized consumption + Apparent losses: refer to Table B1.3.1-1)
Effective water ratio = 1 – Leakage ratio = 0.6
Leakage ratio = 0.40

Using above equation and data, per capita water demand and maximum daily distributed amount of

water have been calculated as shown in Table B1.4-7.

As shown in the table, maximum daily distributed amount of water in 2005 is 25,719m^3/day.

Table B1.4-7 Current Daily Distributed Amount of Water in 2005

Category	Customer	Effective Water Consumption per year	Effective Water Consumption per day	Served Pop.	Per Capita Consumption	Per Capita Water Demand	Maximum Daily Water Demand
	(No.)	(m^3/year)	(m^3/day)	(No.)	(LCD)	(LCD)	(m^3/day)
Domestic	5,434	2,772,677	7,596	46,221	164	273	
Large Users	1,076	2,859,739	7,835				
-Commercial	*617*	*1,602,312*	*4,390*				
-Governments	*198*	*716,450*	*1,963*				
-Major Customers	*261*	*540,977*	*1,482*				
Whole Honiara	6,510	5,632,416	15,431	46,221	334	556	25,719
						Effective water ratio = 0.6	

Source : Calculated by the Study Team using data from SIWA

(2) Water Quality

As mentioned in section B1.3.4, water quality survey has been done during the study for the water from water sources and water taps of each water supply system. The results of water quality analysis related to the water supply system are summarized in Table B1.4-8.

Table B1.4-8 Results of Water Quality Survey for Water Supply System

Name of Surveyed Water Source	Sampling Point	Comment on Water Quality
White River	◆ JICA Bore-1 to Bore-4 ◆ Konglai spring ◆ Water tap of White River water supply system	➢ According to the results of water quality analysis, tap water of White River system does not have serious problem. ➢ Manganese is not detected at water sources. However, the content of Manganese exceeds WHO guideline value at water tap. This cause could not be identified during the survey.
Rove Creek	◆ Rove spring ◆ Water tap of Rove spring water supply system	Tap water of Rove spring water supply systems does not have serious problem.
Mataniko River	◆ JICA Bore M-2, M-4 ◆ SIWA Bore -1 ◆ Water tap of Mataniko low level system and Mataniko SIWA system	➢ Tap water of Mataniko systems has no problem. ➢ Manganese content is decreased at tap water. Manganese can be changed insoluble substance by oxidation thorough the water pipe from bore to tap. It means that insoluble substance is increased in the process of water distribution. ➢ Existence of Manganese may be caused by distribution of geology.
Kombito creek	◆ Upper, middle of the creek ◆ Spring-1, 2 and new spring source ◆ Water tap of Kombito K-1/K-2 system and Kombito spring system	Tap water from Kombito system is considered contaminated by Coliform Bacteria. Content of Total Coliform Bacteria is increased at a tap as compared with water source. It is assumed that Coliform Bacteria has been mixed and increased in the process of water distribution. Therefore, chlorination disinfection has to be done more sufficiently in Kombito system.
Panatina area	◆ Bore-1, 2 and 3 ◆ Panatina tank ◆ Water tap of Panatina system	➢ No water quality item of Panatina Borefield exceeds WHO guideline value. ➢ Water from the Panatina Borefield and the tap has no problem.
Lungga River	No sampling in this river. Water quality test was done at the site.	Lungga River is the largest river of Honiara area. It is difficult to evaluate the water quality of the Lungga River from only water survey results.

Source : JICA Study Team

As mentioned in the above, water quality for water supply (source and the tap) does not have serious problem. For Kombito water supply system, chlorination injection system has to be improved to secure disinfection.

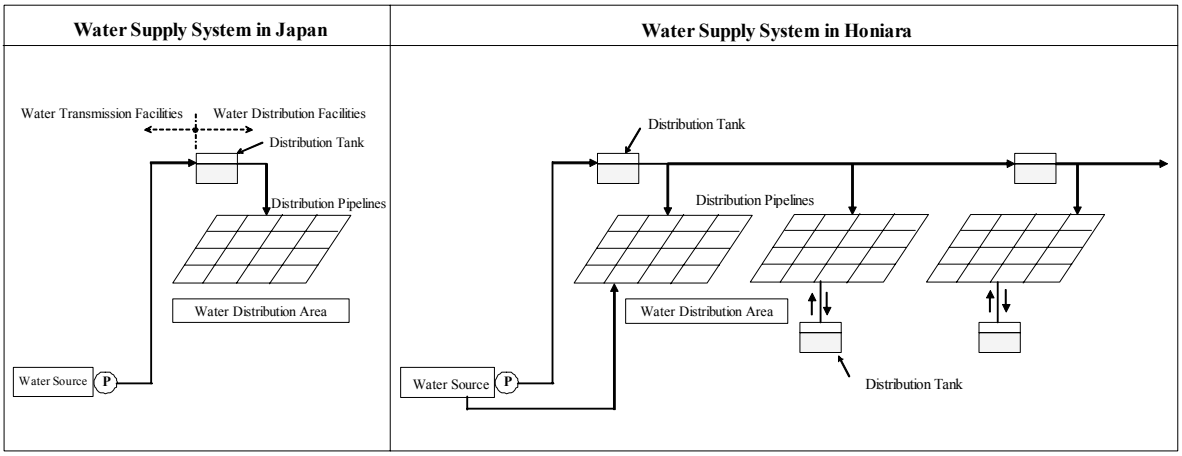
B1.4.3 Outline of Existing Water Supply System

Water supply system in Honiara consists of the following.

- Groundwater source (Borefield)
- Spring source
- Disinfection facility
- Pump facilities (bore pumps and transmission pumps)
- Water reservoirs
- Water distribution pipelines

Water supply system in Honiara is compared with that in Japan (Figure B1.4-1). As shown in the figure, the water supply system in Honiara is considered inadequate for the following reasons.

- One water source covers many water distribution districts so that the districts at the end of the water distribution system suffer from low water pressure and water shortage.
- One water source covers many water distribution districts so that accidents in the water source will affect a water supply of a large number of water users in the city.
- Water reservoirs can not work with the function of additional supply at the peak demand and in emergency case.



Source : JICA Study Team

Figure B1.4-1 Comparison between Water Supply System in Japan and in Honiara

Existing main water supply facilities and water distribution zones are shown in Figure B1.4-2.

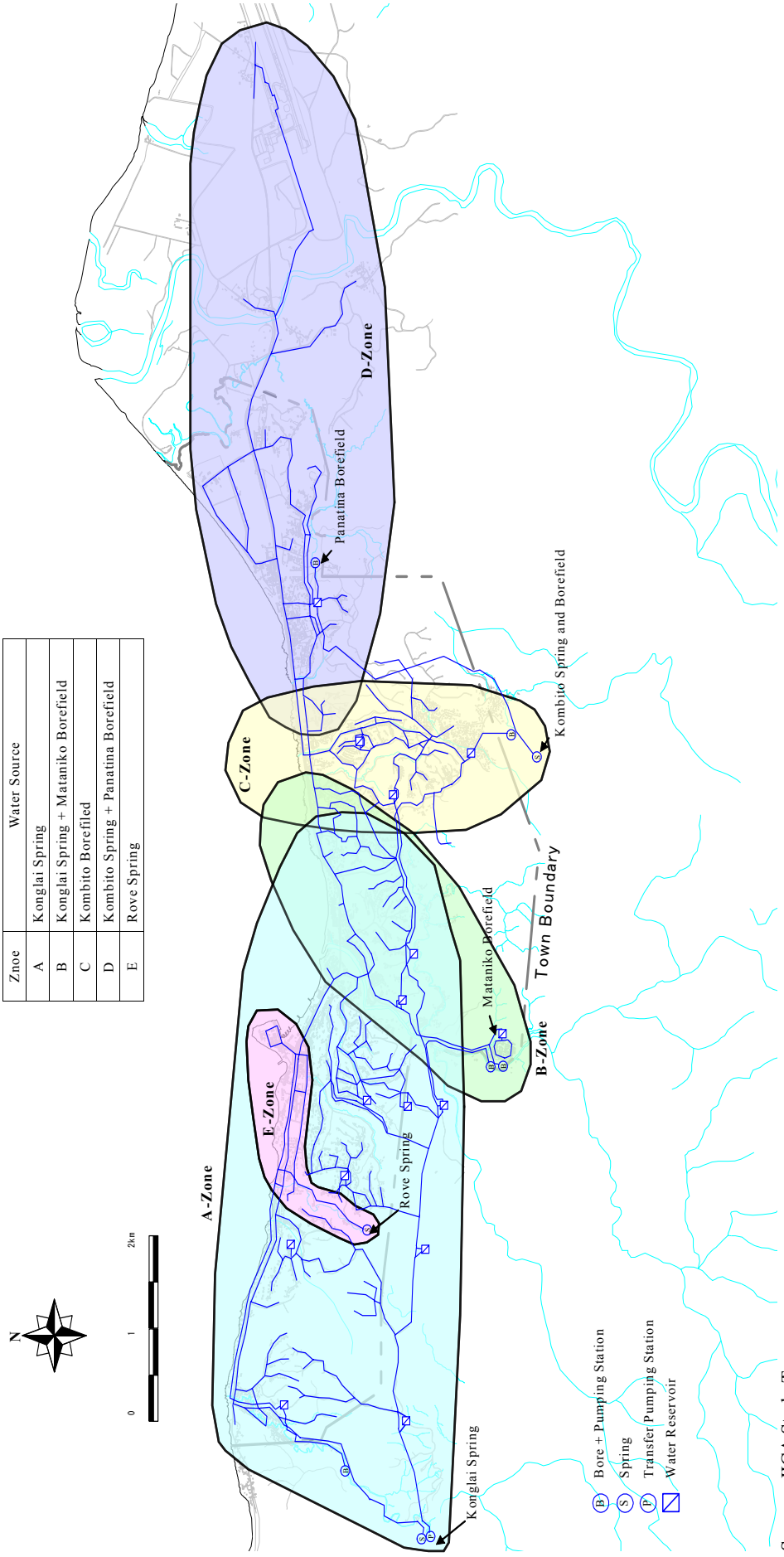


Figure B1.4-2 Existing Main Water Supply Facilities and Water Distribution Zones (2005)

(1) Water Sources

There are four (4) groundwater bore fields and three (3) spring sources for Honiara water supply system. Among the bore fields, White River Borefield which was developed under the Japan's grant aid project completed in 1998 are used only for emergency case.

Water production volume for each source is shown in Table B1.4-9. As shown in the table, groundwater source accounts for about 40% and spring source for about 60% of the whole production volume. For the spring source, Konglai spring source accounts for about 50% of the whole water sources.

Table B1.4-9 Current Water Production Volume for Each Water Source (2005)

Water Source	2005					Average Monthly Production (m^3/month)	Expected Yearly Production (m^3/year)
	Jan.	Feb.	Mar.	Apr.	May		
[Groundwater]							
Panatina Bores	122,700	102,600	113,200	97,500	121,300	111,460	1,337,520
Mataniko JICA Bores	91,100	69,000	78,800	76,800	75,000	78,140	937,680
Mataniko SIWA Bores	63,100	59,100	64,600	60,000	64,200	62,200	746,400
Kombito JICA Bores	49,900	53,800	59,500	61,500	69,000	58,740	704,880
White River JICA Bores (For emergency)	---	---	---	---	---	(110,000)	(1,320,000)
Groundwater - Total	326,800	284,500	316,100	295,800	329,500	310,540	3,726,480 39.7%
Groundwater - Total (Potential)						(420,540)	(5,046,480)
[Spring]							
Kombito Spring Source	53,600	48,400	48,400	48,000	48,000	49,280	591,360
Rove Spring Source	64,300	40,000	55,800	55,000	57,900	54,600	655,200
Konglai Spring Source - Pumped System	251,800	219,500	238,600	223,600	260,100	238,720	2,864,640
Konglai Spring Source - Gravity System	120,500	124,000	141,500	133,900	125,800	129,140	1,549,680
Spring -Total	490,200	431,900	484,300	460,500	491,800	471,740	5,660,880 60.3%
Total (m^3/month)	817,000	716,400	800,400	756,300	821,300	**782,280**	**9,387,360**
Total Production (Potential)						**(892,280)**	**(10,707,360)**
Total (m^3/day)	26,355	24,703	25,819	25,210	26,494	**25,716**	

Source : SIWA

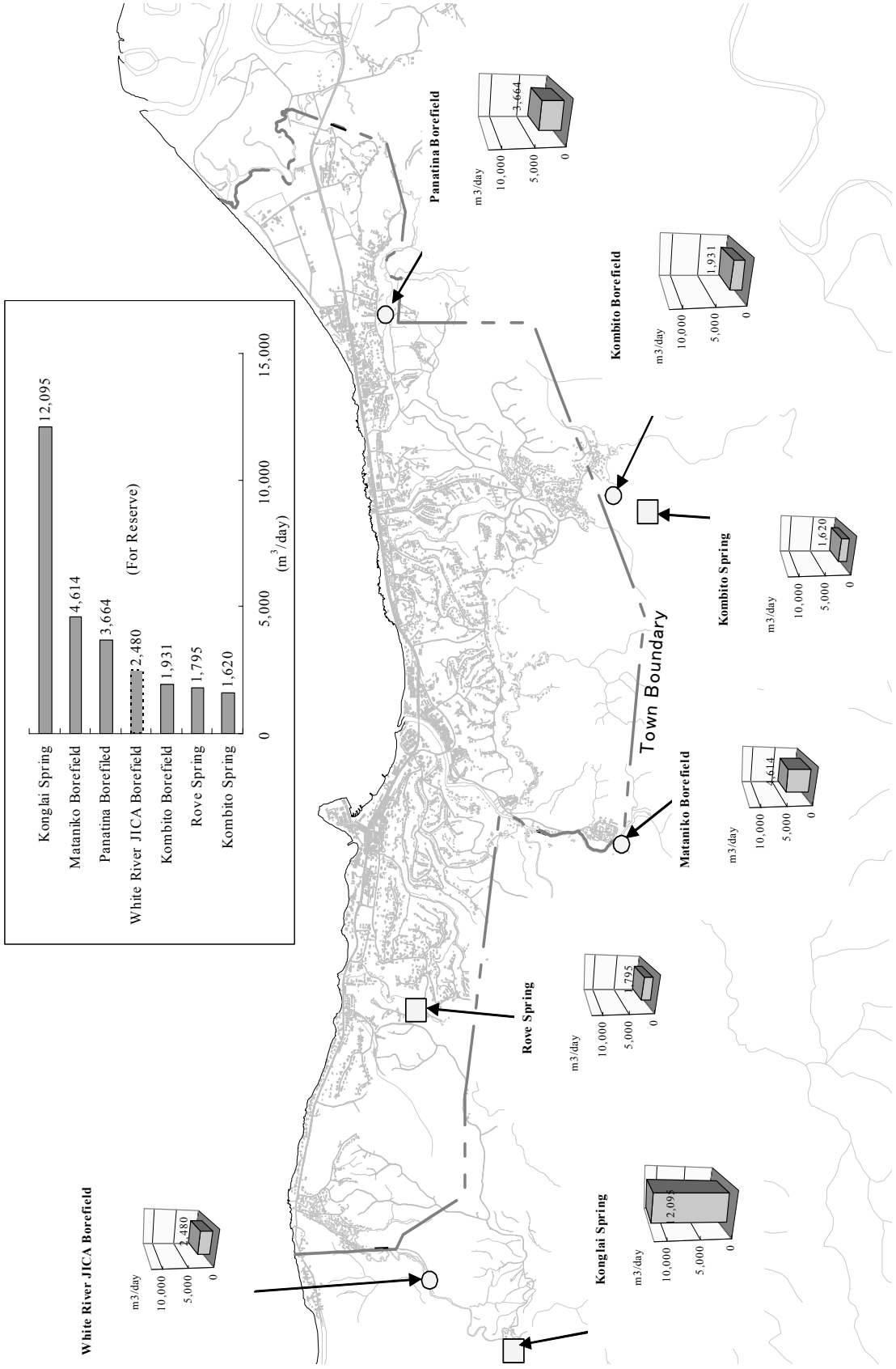


Figure B1.4-3 Water Sources in 2005

Source : JICA Study Team