5.4.2 Technical Analysis

1) System Functioning

One of the consequences of a malfunction of a water supply scheme involves water suspension which aggravates the users. The most frequent incident for GFS witnessed during the monitoring survey was the clogging of the pipeline. After a heavy rain, extraneous materials such as silt, sand, leaves and other debris flowed into the pipe causing a blockage of the water flow. As a result, water did not come out of the taps. The villagers responded by going to the intake and cleaning out the unit. This relieved the situation only temporarily and after a while, the flow stopped again. Upon inspection of the intake area of these villages, it was found that the dam section behind the intake was also filled with silt and sand, raising the water level near the height of the intake. This resulted in the water to flow above the intake entering the intake unit directly without passing the filter section. Therefore, a solution would be to periodically clean out the dam section as well as the intake, and if this still does not solve the problem, then the pipes have to be disconnected to inspect the insides. Some of the problems with system functioning of GFS which were encountered during the monitoring stage are listed below.

Problem	Cause	Outcome	Solution
Pipe clogged	Silt, sand and leaves enter the pipe	Stop the flow of water	Dredge out dam behind intake and clean out intake.
Pipe uncovered	Shallow trenching or ground washed away by rain	Accidents such as pipe breakage or disconnection.	Periodic inspection of pipeline route and immediate correction upon discovery
Tap broken	Mishandling of tap, especially the handle. (Many reported children playing by hanging onto tap handle)	Leakage or running water	Education to villagers, especially children, on proper usage of facilities.
Poor drainage	Improper permeation into earth or poorly constructed drainage channel and/or soakaway.	Flooding of tapstand floor and can become a source for water-borne diseases.	Advice on proper drainage functioning and education on sanitation

For villages using groundwater with dug well or borehole, the problems with system functioning were limited to hand pump operation and drainage. Since the drainage situation is similar to that for GFS, the same can be mentioned as was listed above for GFS. As for the operation of hand pumps, even though different types of hand pumps involved different operation techniques, the

villagers are not having big problems with their use. Only specific women, as mentioned in the previous gender balance section, were having difficulties due to the height of the handle of Tara type pumps. For the village which received the Rope Pump Lao-99, the rope broke about a week after its installation, but upon advice on how to repair it, the villagers were able to solve the problem and learned how easy it is to repair this type of pump using materials locally available. The three types of pumps installed for the pilot study are compared in the following table. According to the response from the villagers, the rope pump Lao-99 was favored the most for reasons of comfortable turning of the handle and damages are easily repaired using locally available materials.

Hand Pump Type	Initial Cost	Handle Operation	VLOM Possibility	Spare Parts
Rope Pump Lao-99	Low	Vertical Plane Rotation	Very High	Easily procured locally
Tara	Medium	Vertical Push-Pull	High	Not always available in remotest areas
Afridev	Medium (higher than Tara)	Up-down Lever Action	High	Not always available in remotest areas

Since the latrines installed for the pilot study are of the pour flush type, their functioning is very simple. The mechanism of the pour flush latrine is very simple involving no mechanical parts, and up until the time of the monitoring, the villagers were not yet faced with any problems with their latrines. Therefore the only conceivable problems to be encountered are cracks or breakage of the bowl and fully filled underground pits. Maybe after about 5 years, when the underground pit becomes completely filled, this pit has to be desludged or cleaned out so that it can be used continuously.

2) Water Quality

The major problem associated with water quality occurred at the borehole villages. Although analysis of the groundwater in the borehole indicated levels acceptable for drinking, the water contains an undesirable odor to cause the villagers to avoid using the water for drinking. Treatment with a filter unit would probably solve the problem, but this requires periodic maintenance on a continuous basis. However, rather than maintaining the effectiveness of the filter, the villagers might resort back to the more easily handled dug well which they have been using for a long time. Another possible solution would be to store the water for a long period before using it.

The problem related to water quality of GFS is turbidity, especially during the rainy season. The villagers complained that after a heavy rain, the water from the tap is colored causing resentment for use. The main cause of this situation is at the intake where the increase in the stream flow allows the water to flow over the intake unit permitting the water to enter the intake while bypassing the filter effect. This situation can be relieved by dredging out the dam behind the intake, which is the same step taken to solve the pipe clogging problem. Also, the height of the intake may need to be raised to prevent intrusion of water from above.

Another water quality problem worth mentioning is the number of coliform bacteria. This problem was not raised by the villagers but is apparent in the results of water quality analyses. Since the source of GFS is a stream, it is exposed to open air and is easily liable for contamination. The water quality analyses results indicated concentrations of all indicators within the standards except for the coliform count of most of the GFS samples. This does not imply absolute fear, but probable indications of fecal contamination. The most positive solution is to boil the water before drinking. This solution is assured because most of the villages are already boiling their water.

3) Water Flow

The water flow can vary between the dry season and the rainy season. Since the source for GFS is a stream on top of the mountain, the flow can diminish during the dry season. Also, for villages using groundwater sources from dug wells or boreholes, the groundwater potential of the aquifer will influence the pumping rate. However, although the water supply systems were designed with consideration of low flow periods, some villages complained that they are not getting enough water.

Some probable causes and their countermeasures are listed below.

Water Scheme	Problem	Possible Cause	Solution
GFS	Flow stopped	Pipe clogged	Dredge out intake area.
		Pipe disconnected	Inspect pipeline and repair
	Insufficient flow	Pipe clogged	Dredge out intake area.
		Low flow rate	Schedule supply hours
		Design fault	Confirm design and modify
Dug Well Borehole	Not enough water when pumping	Water level lowering	Dig well to deeper level

Another important consideration for preserving the water sources is conservation of the environment around the water source. Slash-and-burning of forests around streams can have adverse effects on their flow rate. Some villagers have come to realize this situation and are beginning to change their attitude towards disruption of the environment.

4) Maintenance

The key to sustained usage of facilities is preventive maintenance. If periodic inspections are made and foreseeable problems are solved before a major damage occurs, then the system can last a long time without a big burden on expenses.

One of the easiest and most important task for GFS villages is regular cleaning of the system. The village caretakers in many of the pilot villages are cleaning the intake on a monthly basis, and the storage tank every three months or so. Cleaning of each of the tapstands and their surroundings are the responsibilities of the residents who are using those tapstands. Another important maintenance job is the cleaning out of the drainage facilities. Periodic cleaning operations can prevent clogging of pipes and drainages which can stop the flow of water with eventual high cost requirements for their repairs. Moreover, cleaning of drainages can prevent health hazards such as malaria and cholera. However, these operations are not always being conducted at all villages.

Any activity requires expenses of some kind to continue its success. Collecting maintenance fees on a periodic basis, such as each month, is very effect to achieve this goal. Many of the pilot villages have set a rate of about 100 kip/person/month on the average as the maintenance fee, but only about half of the villages are actually collecting these fees. Payment of periodic fees can contribute to foster a stronger sense of ownership for the facilities. Some villagers complained that they do not want to pay the fee because their house is farther away from the tapstand than others, which creates unfairness in the quantity of water use. This situation can be alleviated by collecting fees on a volumetric basis instead of a fixed price. For proper volumetric levying of fees, the flow meters installed in each of the tapstands should be used for this purpose.

Some of the problems communicated by the villagers related to maintenance as well as solutions to them are listed below.

Problem	Situation	Solution
Lack of basic tools	The villagers cannot make appropriate repairs because they do not have any basic hand tools.	Province and District should hand out some of the tools used during the construction to the villages.
Delays in response upon informing of damages	Upon informing the District and Province, repairs are not conducted immediately.	Province and District should make periodic interventions to handle these emergencies. And District and Province need means of transportation for this purpose.
Low knowledge of caretakers	Village caretakers cannot properly handle maintenance tasks and repairs because they were not trained.	A training program should be prepared and District and Province should make frequent interventions to advice on water use and sanitation, and support on operation and maintenance.
Maintenance fees not collected	Village misunderstands that the contribution in cash that they made for the construction is to be used for maintenance. Also, some villagers are unwilling to pay because of irregular supply or they are situated far away from tapstand.	The villagers should be trained on operation and maintenance, and given an education to foster a sense of ownership.
Unfairness of maintenance fee	Some villagers complaint that they cannot pay the same amount as others because they are using less than others due to distance from the tapstand or irregular supply.	Fees should be collected on a volumetric basis instead of a fixed amount. For this, the water meter is useful to determine the exact amount consumed by each user.

5.4.3 Monitoring Survey Analysis

For the present Study, two monitoring surveys were conducted at an interval of about three or four months. The overall response and cooperation given by the villagers concerning the monitoring survey was excellent. However, some problems, as listed below, need to be pointed out and lessons should be learned from them to be reflected in future monitoring surveys.

Item	Lesson Learned
Interval	Second survey should be conducted at least 6 months apart
Frequency	Should be continued periodically, e.g. once a year
Format	Should be simplified
No Response Topics and Misleading or Difficult to understand Topics	Should be deleted, reworded, explained more in detail, or reconsidered for its appropriateness. Using illustrations may also solve this problem.
Different styles in expressing the responses	One style should be standardized and explained clearly to the monitoring teams

One major constraint was the limited time requirement. If more time could be allowed for monitoring, other methods such as PCM and PRA could be used to gain a more realistic response.

6. CASE STUDY OF VIENTIANE PROVINCE GROUNDWATER DEVELOPMENT PROJECT

6.1 Background

In 1993, the "Project for Groundwater Development in Vientiane Province" was implemented at 52 villages in three Districts of Vientiane Province through a grant aid from the Japanese government. The project included the construction of (1) Level I water supply facilities using handpumps, (2) Level II water supply networks with communal taps, and (3) a maintenance center.

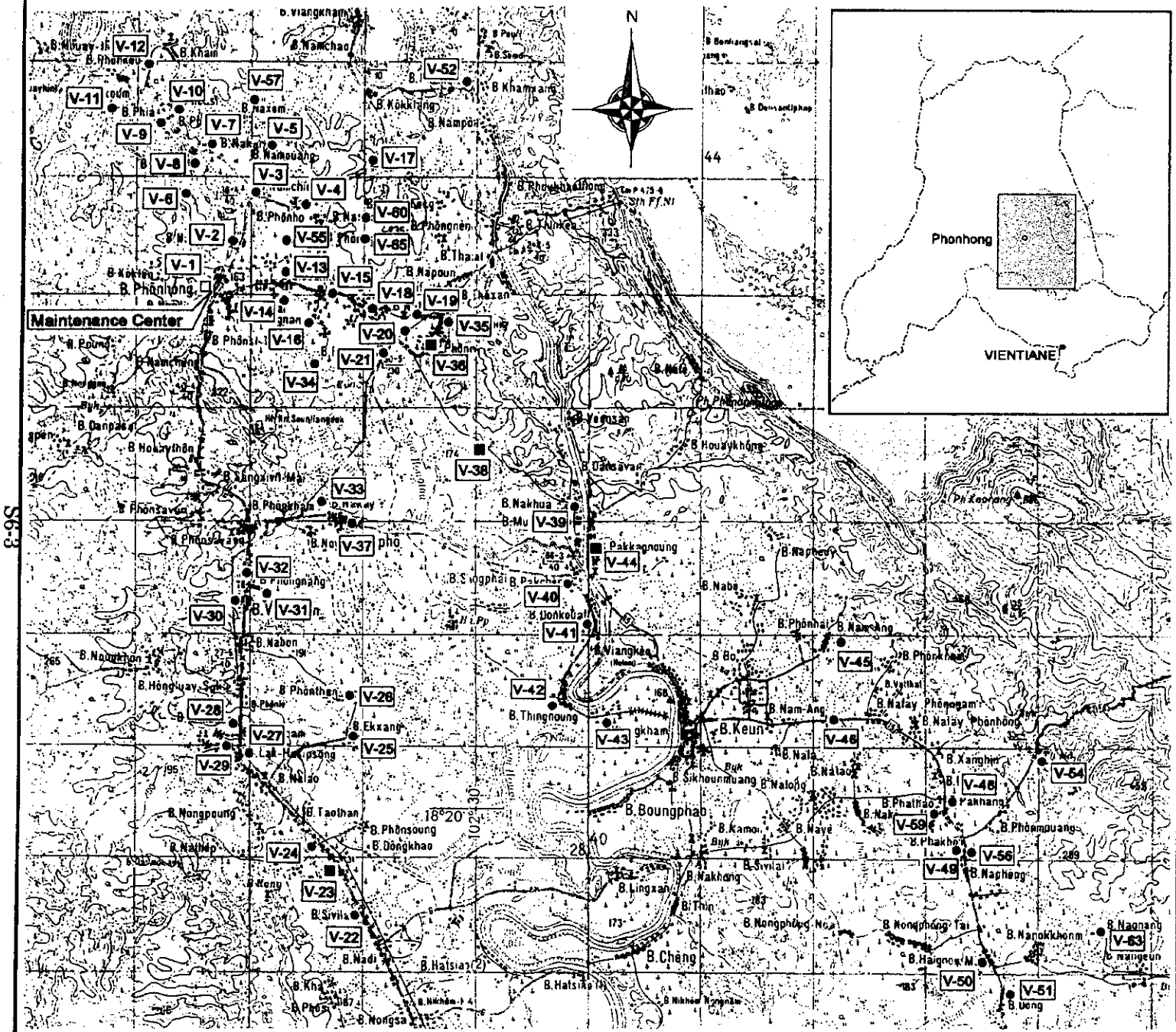
Then after completion of this project, an evaluation and follow-up survey was carried out. The results revealed that groundwater quality problems caused villagers to avoid using the facilities and that supply facilities were not maintained properly. As a countermeasure to the water quality problem concerning iron content, simple filter units were installed by the Japanese side, but this modification still did not solve the problem of not wanting to use the handpump facilities. The problems of management of the facilities were reported to be due to the low level of awareness on clean water and sanitation.

Therefore during the present Study, these problems as well as other actual situations in the villages were surveyed, reviewed and analyzed to be reflected in the present Study. Surveys particularly for Vientiane Province were carried out in March, April, November and December 1999 to confirm the present situation. The locations of the project sites are depicted in the adjoining map. The numbers of implemented project sites are listed below and the names of the villages are presented in the following page.

Description		No. of Sites Implemented
Maintenance Center		1 center
Level I	Handpump	47
Level II	Piped System with Communal Taps	5

List of Villages in Vientiane Province
Implemented by Groundwater Development Project

Facilities	District	Village No.	Village Name	No. of Boreholes
Level I	Phong Hong	V-2	Na Pho Neua	1
		V-3	Nam Chiim	2
		V-4	Phong Ho	1
		V-5	Na Moung	2
		V-6	Nong Tao	1
		V-7	Na Kaam	1
		V-8	Sen Saat	2
		V-9	Phia	1
		V-10	Phon Si Neua	1
		V-11	Sen Xoum	2
		V-12	Phon Keo Phon Nguen	3
		V-13	Si Boun Heuang	2
		V-14	Na Xou	2
		V-15	Na Lou Khoun	2
		V-16	Na Gnang	2
		V-17	Na Souak	1
		V-18	Phon Sawath	2
		V-19	Na Lao	3
		V-20	Phon Tha	1
		V-21	Na Thong	2
		V-22	Sovalail	1
		V-24	Phon Xail	6
		V-25	Ek Xang	3
		V-26	Phon Than	2
		V-27	Lak Hasiv Song	5
		V-28	Phon Kham	1
		V-29	Nong Nak	4
		V-30	Vang Monh	3
		V-31	Saka	2
		V-32	Phon Ngang	3
		V-33	Na Xay	2
		V-34	Phon Sida	1
		V-35	Phon Xong	4
		V-37	Na Pho Taii	5
	Tholakhom	V-39	Pakcheng Neua	9
		V-40	Pak Cheng	3
		V-41	Dong Koat	2
		V-42	Thin Gnung	4
		V-43	Vieng Kham	2
		V-45	Nam Ang	1
		V-46	Na Xang Leuk	1
		V-47	Na Fay	0
		V48	Pak Hang	2
		V-49	Na Pheng	4
		V-50	Hai Gnon	2
		V-51	Dong	2
	Keo Oudom	V-52	Phonekham	2
Level II	Phong Hong	V-1	Phong Hong Hospital	2
		V-23	Mai	2
		V-36	Phon Mii	5
	Tholakhom	V-38	Hong Hien Sueb Thod	1
		V-44	Pak Ka Gnung	3



LEVEL I (Handpump)		
Village No.	District Name	Village Name
V-2	PHONG HONG	Na Pho Neua
V-3		Nam Chiim
V-4		Phong Ho
V-5		Na Moung
V-6		Nong Tao
V-7		Na Kaam
V-8		Sen Saat
V-9		Phia
V-10		Phon Si Neua
V-11		Sen Xoum
V-12		Phon Keo Phon Ngeun
V-13		Si Boun Heuang
V-14		Na Xou
V-15		Na Lou Khoun
V-16		Na Gnang
V-17		Na Souak
V-18		Phon Sawath
V-19		Na Lao
V-20		Phon Tha
V-21		Na Thong
V-22		Sovalail
V-24		Phon Xail
V-25		Ek Xang
V-26		Phon Than
V-27		Lak Hasiv Song
V-28		Phon Kham
V-29		Nong Nak
V-30		Vang Monh
V-31		Saka
V-32		Phon Ngang
V-33		Na Xay
V-34		Phon Sida
V-35		Phon Xong
V-37		Na Pho Tai
V-39	THOLAKHOM	Pakcheng Neua
V-40		Pak Cheng
V-41		Dong Koat
V-42		Thin Gnung
V-43		Vieng Kham
V-45		Nam Ang
V-46		Na Xang Leuk
V-47		Na Fay
V-48		Pak Hang
V-49		Na Pheng
V-50		Hai Gnon
V-51		Dong
V-52	KEO-OUDOM	Phonekham

LEVEL II (Elevated Tank and Communal Taps)		
Village No.	District Name	Village Name
V-1	PHONG HONG	Phong Hong Hospital
V-23		Mai
V-36		Phon Mii
V-38	THOLAKHOM	Hong Hien Sueb Thod
V-44		Pak Ka Gnung

STUDY SITES FOR CASE STUDY IN VIENTIANE PROVINCE

6.2 Maintenance Center

The main functions of the maintenance center are management and repair of the water supply facilities; analyses for quality of the supplied water; water fee management of Level II facilities; and storage and control of spare parts. At the present time, these activities are being conducted relatively smoothly by the ten member staff assigned to the center, without any major problems.

6.3 Level I Facilities

6.3.1 Present Problems

The main problem confronting these villages arises from the high rate of development due to their location. Vientiane Province is located next to the Lao capital of Vientiane Municipality. Therefore, the residents of Vientiane Province are fortunate to share in the development of the capital area, which in turn helps the economy of the Province so that the residents are relatively wealthy. The boreholes of Level I villages are equipped with Mark III handpumps. Since they are able to receive electric power, handpumps are obsolete to them, and they rather prefer to have piped water supply systems with public taps or even house connections which require higher operation and maintenance costs. However, due to their relatively affluent economy, they are capable of paying for higher costing facilities.

The other problem results from water quality, especially in iron, pH and chloride. The water quality analyses results for samples taken at the study villages are listed in the attached table. The present situations concerning water quality are described hereafter.

Iron

For the handpump facilities using groundwater with high contents of iron, a simple filter unit was installed for deferrization, and this proved to be an effective solution (one example of the treatment effect can bee seen at Phon Keo, where the iron content in raw water of 32 mg/l was reduced to <0.03 mg/l after passing through the filter unit). Although the treated water is much clearer than the reddish raw water, the scum built up on the filter media is unsightly and is not desirable to the villagers. Some villages put covers on the filter units to solve the problem of unfavorable sight, but basically, the problem stems from the fact that the villagers want a higher level water supply system such as a piped system with communal taps.

pH

Water containing low pH is causing corrosion in the steel riser pipes of Mark III handpumps due to the acidity. Upon realizing this situation, the villagers now want to install Tara pumps which use PVC pipes. However, at one of the villages surveyed, the Mark III pump was replaced by a Tara pump, but due to faulty installation, sand is being pumped up. However, the villagers prefer piped systems rather than handpump facilities.

Chloride

Water from some boreholes contain chloride which causes the water to give a saline taste, especially in the dry season. The unfavorable taste is causing the residents to avoid using the facilities. This gives further cause to reject handpumps in favor of communal taps.

The overall problem of Level I facilities is the lack of village awareness on water use and sanitation, and also to the fact that community dialogue and participatory village surveys were not conducted before the construction. As a result, water supply facilities, which were not actually chosen by the villagers through informing them of the alternatives and explanation of the proper use and maintenance of facilities, were constructed with resultant consequences.

6.3.2 Evaluation and Considerations

The present situation on conditions of the facilities, proper usage, maintenance and other factors concerning the 118 boreholes with handpump water supply facilities were surveyed to make a comprehensive evaluation and considerations on requirements for follow-up support. The results are summarized in the attached table. The evaluation procedures have been carried out based on the eight parameters indicated below and in the table as numbers 2 through 9. The evaluation process and consideration factors as outlined in the table are explained in the pages after the table following the numbered sequence listed below.

- 1. Evaluation
- 2. Water use: Drinking/Miscellaneous
- 3. Water quality
- 4. Sand filter unit
- 5. Follow-up (F/U) survey, 1998
- 6. Maintenance
- 7. Opinion of Provincial Nam Saat
- 8. Facilities allocation
- 9. Present situation

Evaluation Table of Level I Facilities of Vientiane Province

No.	Site No.	1. Evaluation	2. Water Use		3. Water Quality	4. Sand Filter Unit	5. F/U Survey	6. Maintenance	7. Province Opinion	8. Allocation	9. Present Situation
			Drinking	Misc.							
1	V-2-1/1	△	×	×	×	×	○	△		A	
2	V-3-1/2	○	△	○	△			△		B	
3	V-3-2/2	×	×	×	×		○	×	×	C	B
4	V-4-1/1	○	△	○	△			○	△	A	
5	V-5-1/2	○	○	○	△		○	○		A	
6	V-5-2/2	○	×	○	△			○		B	
7	V-6-1/1	○	×	○	△		○	○		A	
8	V-7-1/1	○	○	○	△	×	○	×		A	
9	V-8-1/2	○	○	○	△	×		○		A	
10	V-8-2/2	○	○	○	△			○	△	B	
11	V-9-1/1	○	○	○	△	×		○		A	
12	V-10-1/1	○	○	○	△			○	○	A	
13	V-11-1/2	×	×	×	△	×		×	×	C	C
14	V-11-2/2	△	×	○	×		○	△	△	A	
15	V-12-1/3	○	○	×	×	×	○	△		A	C
16	V-12-2/3	△	×	○	△			○	○	B	E
17	V-12-3/3	○	○	×	△	○		○		I	K
18	V-13-1/2	△	×	○	△	×	○	△		B	J
19	V-13-2/2	×	×	×	△	×		×		A	J
20	V-14-1/2	△	×	△	△			△		B	J
21	V-14-2/2	△	○	○	△			○	×	C	J
22	V-15-1/2	×	×	×	△			×	×	C	C
23	V-15-2/2	×	×	×	△	×	○	×		A	
24	V-16-1/2	○	×	○	△		○	○		A	
25	V-16-2/2	○	×	○	△			△	△	A	
26	V-17-1/1	○	×	○	△			○	△	A	
27	V-18-1/2	○	×	○	△			○		A	C
28	V-18-2/2	○	×	○	△			○	△	B	
29	V-19-1/3	○	×	×	△	×	○	○	△	A	
30	V-19-2/3	○	○	○	△			○	△	C	
31	V-19-3/3	○	×	○	△		○	○	○	B	C
32	V-20-1/1	×	×	×	×		○	×		A	
33	V-21-1/2	○	△	○	△			○	△	B	
34	V-21-2/2	×	×	×	△			×	×	C	
35	V-22-1/1	○	△	△	△	×		△		B	C
36	V-24-1/6	×	×	×	×	×		×		G	
37	V-24-2/6	×	×	△	△	×		×		D	H
38	V-24-3/6	○	△	△	△	×	○	△	○	F	C
39	V-24-4/6	○	○	○	△			○	○	I	A
40	V-24-5/6	○	○	○	△			○	○	B	
41	V-24-6/6	○	×	○	△			○	×	C	
42	V-25-1/3	○	○	△	△	○	○	○		I	
43	V-25-2/3	○	○	○	△	×		△	△	A	
44	V-25-3/3	×	×	×	×	×		×		B	
45	V-26-1/2	○	×	○	△			×	△	B	C
46	V-26-2/2	△	×	○	△			×		C	
47	V-27-1/5	×	×	×	×	×	○	×		I	
48	V-27-2/5	○	×	△	△			×		B	
49	V-27-3/5	○	△	○	△	×		×		B	
50	V-27-4/5	×	×	×	△			×	×	C	G
51	V-27-5/5	○	○	○	△			○		A	
52	V-28-1/1	○	○	○	△		○	○	○	C	
53	V-29-1/4	○	○	○	△		○	○	○	I	A
54	V-29-2/4	○	○	○	△			○	○	I	A
55	V-29-3/4	○	○	○	△			○	○	I	A
56	V-29-4/4	○	○	○	△			○	○	I	A
57	V-30-1/3	○	○	○	△		○	○	△	A	
58	V-30-2/3	×	×	×	×	×		×		I	
59	V-30-3/3	○	○	○	△	○		○		B	
60	V-31-1/2	○	○	○	△	○	○	○		A	A
61	V-31-2/2	○	○	○	△			○		I	A
62	V-32-1/3	○	○	○	△	○		○	△	I	D
63	V-32-2/3	△	×	○	△			○	×	C	
64	V-32-3/3	○	×	△	△	×		△	○	B	D

No.	Site No.	1.	2.		3.	4.	5.	6.	7.	8.	9.
		Evaluation	Water Use		Water Quality	Sand Filter Unit	F/U Survey	Maintenance	Province Opinion	Allocation	Present Situation
			Drinking	Misc.							
65	V-33-1/2	○	○	○	△			○	○	I	A
66	V-33-2/2	△	△	△	△			△	○	A	B
67	V-34-1/1	×	×	×	△			×		I	H
68	V-35-1/4	×	×	×	△			×		C	G
69	V-35-2/4	○	×	○	△			○	○	B	
70	V-35-3/4	△	×	×	△	×	○	×	×	C	I
71	V-35-4/4	○	×	○	△			○		B	
72	V-37-1/5	○	×	○	△	×		△	△	C	
73	V-37-2/5	○	×	△	△	△		○	○	B	
74	V-37-3/5	○	×	△	△	×	○	○	△	I	
75	V-37-4/5	△	×	×	△	×		○	△	A	
76	V-37-5/5	×	×	×	△			×		A	
77	V-39-1/9	○	○	○	△	×	○	○		C	
78	V-39-2/9	×	×	×	△	×		×		J	F
79	V-39-3/9	△	×	△	△	×		△		E	
80	V-39-4/9	△	×	×	△			△	△	I	
81	V-39-5/9	△	×	△	△	×		△	△	I	
82	V-39-6/9	×	×	×	△			×	×	C	
83	V-39-7/9	○	×	△	△			△	○	B	
84	V-39-8/9	×	×	×	△	×		×	×	C	
85	V-39-9/9	○	×	△	△	×		○	○	H	C
86	V-40-1/3	○	×	○	△			○	△	B	
87	V-40-2/3	○	×	○	△			○	△	B	
88	V-40-3/3	×	×	×	△		○	×	×	C	
89	V-41-1/2	○	×	△	△			△	△	A	
90	V-41-2/2	○	△	○	△		○	○	○	D	
91	V-42-1/4	○	△	○	△			△	△	B	
92	V-42-2/4	○	△	○	△			△	○	I	D
93	V-42-3/4	△	○	○	△	○		○		A	
94	V-42-4/4	○	×	○	△			○	○	C	
95	V-43-1/2	○	△	△	△		○	○	△	A	
96	V-43-2/2	○	△	○	△			○	△	C	
97	V-45-1/1	○	○	○	△			○	○	I	D
98	V-46-1/1	○	×	○	△			○		B	
99	V-48-1/2	○	×	△	△	×		×	△	I	D
100	V-48-2/2	○	△	○	△	×		○	△	A	
101	V-49-1/4	△	○	○	△	△	○	△		I	B
102	V-49-2/4	△	△	△	△	×		×		I	C
103	V-49-3/4	△	△	△	△	×		×		B	C
104	V-49-4/4	△	×	○	△	×		×	△	A	
105	V-50-1/2	○	×	○	△	×		×	△	B	
106	V-50-2/2	△	×	△	△	×	○	×	△	A	
107	V-51-1/2	△	×	×	△	×		×	△	I	C
108	V-51-2/2	△	×	△	△	×		×	△	B	C
109	V-52-1/2	○	×	○	△		○	△	○	B	C
110	V-52-2/2	○	×	△	△	×		△	△	A	C
111	V-54-1/1	○	○	△	△	○		○	△	I	A
112	V-55-1/1	○	×	△	△		○	○	△	A	
113	V-56-1/1	△	×	△	△			○		I	B
114	V-57-1/1	○	○	○	△			○	○	I	
115	V-59-1/1	○	×	○	△			○	△	A	
116	V-60-1/1	○	×	○	△			○	△	B	
117	V-63-1/1	○	×	○	△		○	○	△	I	
118	V-65-1/1	○	×	○	△		○	○	△	A	
Evaluation Total		○:75 △:23 ×:20	○:32 △:15 ×:71	○:66 △:25 ×:27	○:0 △109 ×:9	○:7 △:2 ×:40	○32	○61 △23 ×34	○24 △37 ×12	A: 35 B: 31 C: 21 D: 2 E: 1 F: 1 G: 1 H: 1 I: 24 J: 1	A: 10 B: 4 C: 15 D: 5 E: 1 F: 1 G: 2 H: 2 I: 1 J: 4 K: 1
Total		118	118	118	118	49	32	118	73	118	46

1. **Evaluation:** The evaluation parameters were examined and classified into the three evaluation levels listed below according to their requirements for further support concerning facilities rehabilitation.

   ○: Facilities requiring replacement of pump, but maintenance in good condition :75 sites
   △ : Facilities not being used, so willingness of village to continue use needs to be confirmed, and maintenance in poor condition :23 sites
   × : Facilities having no possibility for use in the future, including those with very poor quality and not acceptable for drinking :20 sites

2. **Water Use:** The water use conditions have been evaluated according to the purpose of consumption into a) for drinking and b) for miscellaneous use other than drinking.

   a) <u>For Drinking</u>
   ○ : Used for drinking with no problems : 32 sites
   △ : Used for drinking, but at a low rate due to problems with water quality in iron, chlorine, others : 15 sites
   × : Not used for drinking : 71 sites

   b). <u>For Miscellaneous Purpose</u>
   ○ : Used for miscellaneous purpose : 66 sites
   △ : Used for miscellaneous purpose , but at a low rate due to problems with water quality in iron, chlorine, others : 25 sites
   × : Not used even for miscellaneous purpose : 27 place

3. **Water Quality:** Water quality has been reviewed based on the results of the water quality analysis by the Follow-Up survey in 1998 and other survey data. A significant water quality problem is associated with low pH values resulting in acidity acting on iron portions of hundpumps. One example of a measure taken to counter this problem can be given for the project on groundwater development in Champasack and Sarawan Provinces, where steel and iron components of handpumps were exchanged to stainless steel and/or PVC parts. Since Vientiane Province is facing a similar problem with water quality, using handpumps having nonferrous metal parts may be one solution. The problems related to water quality are categorized into the following three situations.

   ○ : Good water quality : 0 site
   △ : Poor water quality at present (such as high iron content), but possibility of improvement in situation by changing handpump : 109 sites
   × : Inferior water quality : 9 sites

4. **Sand Filter Unit:** The sand filtering unit was installed at 49 sites after completion of the project for the purpose of water quality improvement especially in removing iron. The present utilization situation of these units of was surveyed, and revealed that these were not being used at over 80% of the sites having filter units. Even those using the units are presently dissatisfied because of the low flow rate. Evaluation on the sand filter units was classified as follows.

○	: In operation (being used)	: 7 sites
△	: Occasionally used	: 2 sites
×	: Not functioning	: 40 sites

5. **F/U (Follow-Up) Survey, 1998:** The 1st F/U survey was carried out in August 1998 at 32 sites. The survey report clearly stated that the abnormally low value of pH acting on steel pump components is the cause for water quality problems of high iron content and iron smell. The sites surveyed during the F/U mission are marked with a circle ○ in the table.

6. **Maintenance Condition:** The actual conditions in maintenance done by the villagers were reviewed at the sites with the following rating.

○	: Well maintained, and probably will continue to be maintained even in the future	: 61 sites
△	: Somewhat maintained, but requires dialogue with the villagers in order to anticipate continued maintenance	: 23 sites
×	: Not maintained	: 34 sites

7. **Opinion of Provincial Nam Saat:** The intentions of the Vientiane Provincial Nam Saat office were confirmed through discussions concerning the requirements and site priorities for rehabilitation. The priorities are ranked as follows.

○	: Top priority	: 24 sites
△	: Secondary priority	: 37 sites
×	: Problem sites where the facilities have now become located on private land, therefore loosing their public character	:12 sites

8. **Facilities Allocation:** The allocation of the water supply facilities was identified and classified into the following locations.

A:	Temple	: 35 sites
B:	School	: 31 sites
C:	Residence/Private land	: 21 sites
D:	Hospital	: 2 sites
E:	Public office	: 1 site
F:	Market	: 1 site
G:	Police post	: 1 site
H:	Military camp	: 1 site
I:	Public land	: 24 sites
J:	Along road	: 1 site

9. **Present Conditions:** The present conditions of the water supply facilities were surveyed and found that many changes had occurred since the implementation of the project. The situations are categorized as follows.

A:	Especially good operation and maintenance	: 10 sites
B:	Unsuitable for drinking due to inferior water quality	: 4 sites
C:	Handpump destroyed	: 13 sites
D:	Handpump broken	: 5 sites
E:	Replaced with Tara pump	: 1 site
F:	Facility removed due to road widening	: 1 site
G:	Facility buried underground due to land development	: 2 sites
H:	Motorized pump installed nearby	: 2 sites
I:	Fenced inside private land	: 1 site
J:	Connected to public water supply	: 4 sites
K:	Installed with gravity fed system (GFS)	: 1 site

6.4 Level II Facilities

6.4.1 Outline of Facilities

Five villages are equipped with level II facilities. Three villages, V-23, V-36 and V-44 are receiving coverage to the whole area, while two other villages have the facilities only in the hospital at V-1 and school at V-38. The details of the facilities are shown in the table in the next page.

Outline of Level II Facilities

Village Number	V-1	V-23	V-36	V-38	V-44
Site Name	Phong Hong Hospital	Ban Mai	Phon Mii	Hong Mien Sueb Thod	Pak Ka Gnung
Population Served	Hospital / School	68 HH / 350 Pers.	250 HH / 1,700 Pers.	School / 600 Pers.	225 HH / 1,900 Pers.
No. of Wells	2	2	5	1	3
Discharge Rate (l/min)	163	372	549	204	588
Water Tank Capacity (m^3)	7 m^3	40 m^3	22 m^3 / 40 m^3	15 m^3	15 m^3 / 40 m^3
No. of Taps No. of Valves	PF-13 Valve-2	PF-37 Valve-9	PF-58 Valve-21	PF-29 Valve-4	PF-61 Valve-34
Well Condition	1—Pump Under Cleaning 1—Out of Use(Red Water)	1—Working 1—Out of Use (Panel Trouble)	3—Working 1—Out of Use(Red Water) 1—Out of Use (Panel Trouble)	1—Working	3—Working
Communal Tap Condition	Tap removed and connected into building	Reformed and connected into houses	Reformed and connected into houses	Tap removed and connected into building	Distributed to houses using hose
Quantity	Nam Papa water used together	Not Enough	Sufficient	Not Enough (Used at once)	Sufficient
Quality	Red Water (Have Filter Unit)	Potable	Red Water	Red Water Iron-Smell	Potable
Management Responsible	Account by Hospital	Account by Village	Account by Village	School Staff	Account by Village
Water Fee	300 k/m^3/mon	300 k/m^3/mon	300 k/m^3/mon	Not Collected	300 k/m^3/mon 400 k/meter
Comments	· Filter unit + 30 m^3 tank (Built by Thai)→ 7m^3 tank (JICA) · Nam Papa fee (350 k/m^3/mon) · School covers deficiency	· Water insufficient · Water meter often soaked by leakage · Panel trouble from gecko intrusion	· Two tanks, two separate supply systems · Panel trouble from short-circuit by rain water · Booster Pump out of operation	· Maintenance under school (cleaning, electricity, etc.) · Clothes turn red when washed · Bottled water bought for drinking	· Two tanks, one supply system (Operated by Nam Saat) · Houses using hose share fees · Good quality (no need to boil)

6.4.2 Maintenance Organization

Operation and maintenance are under the control of the maintenance center of Vientiane Province Nam Saat office. The village does not organize a water committee, but a person in charge of keeping account is selected by the village people. This person in charge has responsibilities of (1) keeping record of the number of households and served population, (2) recording water consumptions of each user and (3) collecting water fees. The staffs of the maintenance center visit each village twice a month to inspect the facilities, and once a month, the staffs supervises the cleaning of the water tank and washing out the pipelines.

In case of accidents such as the control panel alarm going on or water leakages occurring, the person in charge of the village should report to the maintenance center, but the reporting takes time because of the lack of a means for communication and transportation. The level control system of the water tank is automatic and so the person in charge does not have to continuously stay to keep a watch. Therefore, when the automatic control system was broken down in V-36, the manual control can be used, but since the person in charge lives far away from the well, the pump was not functioning and the system had to be kept inoperable.

6.4.3 Water Fee Management

Water fees are collected on a monthly basis by the person in charge (village volunteer) who was selected by the village. Before April 1999, the fee was 100 kips/m^3 and since then, this was raised to 300 kips/m^3 per user. Water fees for commercial use are set at 500 kips/month up to 20 m^3 and 800 kips/month for over 20 m^3. Additionally, 400 kips/month per water-meter are collected and saved for maintenance at village V-44. No water fees are collected at V-38 but the school takes responsibility for all the costs for the operation and maintenance. The communal taps are under the responsibility of groups consisting of the users of each tap (about five households per tap). If a group or a user, in the case of a house connection, does not pay the fees, they are allowed arrears of one month, after which if they still do not pay, the supply will be cut. The maintenance center opens bank accounts for each village separately, and the maintenance center bills the villages each month. The breakdown of collected fees is shown below.

Breakdown	Percentage (%)
State Tax	30
Maintenance Fee	70
Electricity	(17)
Repairs	(40)
Village Committee Service	(7)
Maintenance Center	(2)
Materials Office	(2)
Storage Tank Cleaning	(2)

6.4.4 Considerations

The level II facilities are not being faced with major problems at the present time. The maintenance system is functioning well under the maintenance center. A person in charge of the village keeps account of each water user or group, and the staff of the maintenance center works on management and repair of the facilities. In respect to community participation, villagers should organize a village water committee and keep a record of inspections and cleanings in each village.

Some problems stem from the water supply facilities themselves. Wells which yield water with a high iron content are out of operation or their use is limited to miscellaneous purposes and not for drinking. Control panels for motorized pumps are exposed to the climate, where short-circuits are inevitable. And one strange situation is that a booster station was not in operation, but water was coming out of the tap at the end of the network, meaning that the booster was not necessary.

One minor problem is the situation of communal taps unevenly distributed. That is, the villagers whose houses are far away from the taps must pay the same fees as those who live nearby even though the rate of water use is uneven due to difference in convenience resulting from the difference in distance. Another problem arises from the fact that many households have made house connections with their own budget. House connections can be metered correctly thus fees can be collected properly, but for communal taps, the metered rate is divided equally by the number of users which creates unfairness due to unequal usage among the users.

The villagers should be educated to raise their awareness towards proper use of water and importance of maintenance of the supply facilities so that the maintenance center can transfer the responsibility of maintenance to the village level. However, the water supply facilities need to be inspected thoroughly and rehabilitated properly so that the villagers can get a sufficient supply of good quality water.

6.5 Overall Consideration

The biggest problem of the Vientiane Province water supply facilities implemented through the Japanese grant lies in the planning stage. The project was supply-oriented rather than demand-oriented which is generally the case for grant projects. That is, the beneficiaries, or the villagers, did not have the chance to participate in the planning, nor were they informed in advance of what they were going to receive. The villagers were given facilities without actual consent and no contributions were made by the users which led to a situation where there is no sense of ownership. In order to avoid such circumstances, the present Study incorporated participatory planning with community dialogue and informed choice at every possible stage of the Study. In this respect, Nam Saat was given full responsibility to initiate the implementation of the pilot studies.

INDEX