

For the village areas, Vunimoli was chosen as a model area. Since the scale of work is small, financial assistance is suggested for purchasing a series of distribution materials, small prefabricated tanks, corrugated galvanized sheets for shower house for ten water supply systems. Here again Fiji-made PVC pipes are recommended.

(5) Spare parts and supplies

In principle, spare parts and supplies were determined to ensure that the project can go smoothly in a period of two years. However, consideration was made to select less quantities of spares which can be easily available in Fiji, and greater quantities of those items that should be imported.

4-2-3. Materials, Equipment and Object Areas for Aid Scheme

The major components of materials and equipment considering from Japanese financial assistance for this project are well drilling rig and ancillary equipment. In addition, the well construction materials, well pumps, water distribution materials were selected among those items of high priority for financial assistance. Details of these items are presented in Tables 4.1 and 4.2.

For the settlement areas where the estimated construction costs are high, in considering high economic level of inhabitants, only the model area Vunicuicui is suggested for receiving financial assistance of the whole foreign cost component. For the other settlement areas, only well construction materials and well pumps are considered.

For the village areas where the construction cost of each water supply system is low, required costs for foreign component for all water supply systems (10) are considered for financial assistance in order to balance financial differences between villages and settlements.

Table 4-1. MATERIALS AND EQUIPMENT FOR FINANCIAL ASSISTANCE = BY PROJECT AREAS

Project Area	Materials and Equipments						
	Well Construction Materials		Pumping Equipments		Water Distribution Materials		
	Details	Quantity	Details	Quantity	Details	Quantity	
SETTLEMENTS	VUNICUCUI (Model Area)	Surface casing ø200 N.D. F.J. x 3 m	1 Nos.	Vertical turbine pump with heavy duty diesel engine ø75 x 6.5 Hp	1 set	PVC pipes ø75 x 6 m, Class D	140 Nos.
		Surface casing ø200 N.D. x 5.5 m	1 Nos.			Auto valve ø75	3 Nos.
		Well casing (PVC) ø150 x 6 m	5 Nos.			Buzzer box & pressure switch	1 No.
		Well screen (PVC) ø150 x 4 m	10 Nos.			PVC ø100 x 6 m, Class C	420 Nos.
						ø75 x 6 m, Class C	600 Nos.
					ø50 x 6 m, Class C	820 Nos.	
					Hum's tank DIA. 6 m x 2.1 m(H)	1	
VUNIKA	- do -	1 lot	Vertical turbine pump with heavy duty diesel engine ø75 x 8.5 Hp	1 set			
VUNIMOLI & WADAMUDAMU	- do -	2 lots	Mono pump with diesel engine ø50 x 3 Hp	2 sets			
NABEKAVU	- do -	2 lots	Vertical turbine pump with diesel engine ø75 x 6.5 Hp	2 sets			
VUNIVAU BUA	- do -	2 lots	Mono pump with diesel engine ø50 x 3 Hp	2 sets			
VILLAGES	VUNIMOLI (Model Area)	- do -	1 lot	Foot operated pump Q = 1.5 m ³ /hr, H = 30 m	1 set	Pump PVC ø25 x 6 m	3 Nos.
						SGP ø25 x 6 m	1 No.
						SGP ø15 x 6 m	2 Nos.
						Polyethylene pipe ø25	9 m
						Panel tank FRP-made Capacity = 2.5 m ³	1
						Drainage pipe PVC ø150 - ø75	5 Nos.
						Corrugated zink sheet 0.76 x 1.8m	20
	NAMOLI	- do -	1 lot	- do -	1 set	- do -	1 lot
	KOROWIRI	- do -	1 lot	- do -	1 set	- do -	1 lot
	VUO	- do -	2 lots	- do -	2 sets	- do -	2 lots
MATAI LABASA	- do -	5 lots	- do -	5 sets	- do -	5 lots	
SCHOOLS	LEKUTU Jr. Secondary School	- do -	1 lot	Mono pump ø40 x 2 Hp	1 set		
	Other Schools			Mono pump ø40 x 1.5Hp & 2Hp	3 sets		
COMMON-USE MATERIALS	Drilling Rig		1 lot				
	Spare parts		1 lot				
	Ocean Freight		1 lot				

Table 4-2. VALUE OF FINANCIAL ASSISTANCE BY PROJECT AREA

Project Area		Materials and Equipments to be cooperated						Construction Cost			Remarks	
		Water Mounting Pump		Well Construction Materials		Distribution Materials		Total (¥1,000)	Foreign (¥1,000)	Local (¥1,000)		Total (¥1,000)
		Quantity	Value (¥1,000)	Quantity	Value (¥1,000)	Quantity	Value (¥1,000)					
Settlement Areas	VUNICUICUI (Model)	T.P. x 1	2,000	1 lot	625	1 lot	14,985	17,610	17,610	15,490	33,100	Total foreign component considered
	VUNIKA	T.P. x 1	2,000	1 lot	625	0	0	2,625	41,275	27,725	69,000	Well construction materials and pumps considered
	VUNIMOLI & W AidAMUDAMU	Mo.P x 2	2,800	2 lots	1,250	0	0	4,050	28,648	30,452	59,100	"
	NABEKAVU	T.P. x 2	4,000	2 lots	1,250	0	0	5,250	38,878	33,122	72,000	"
	VUNIVAU BUA	Mo.P x 2	2,800	2 lots	1,250	0	0	4,050	22,179	23,221	45,400	"
	SUB-TOTAL		8	13,600	-	5,000	-	14,985	33,585	148,590	130,010	278,600
Village Areas	VUNIMOLI (Model)	M.P. x 1	500	1 lot	625	1 lot	697	1,822	1,822	1,078	2,900	Total foreign component considered
	NAMOLI	M.P. x 1	500	1 lot	625	1 lot	697	1,822	1,822	1,078	2,900	"
	KOROWIRI	M.P. x 1	500	1 lot	625	1 lot	697	1,822	1,822	1,078	2,900	"
	VUO	M.P. x 2	1,000	2 lots	1,250	2 lots	1,394	3,644	3,644	2,156	5,800	"
	MATAI LABASA	M.P. x 5	2,500	5 lots	3,125	5 lots	3,485	9,110	9,110	5,390	14,500	"
	SUB-TOTAL		10	5,000	-	6,250	-	6,970	18,220	18,220	10,780	29,000
Schools	Three School with existing wells	Mo.P x 3	4,200	0	0	0	0	4,200	4,200	210	4,410	Pumps considered
	LEKUTU Junior Secondary School	Mo.P x 1	1,400	1 lot	625	0	0	2,025	2,025	1,165	3,190	Well construction materials and pumps considered
	SUB-TOTAL		4	5,600	-	625	-	0	6,225	6,225	1,375	7,600
TOTAL (I)			24,200		11,875		21,955	58,030	173,035	142,165	315,200	
ARRANGEMENT			0		625		345	970	-	-	-	
TOTAL (II)			24,200		12,500		22,300	59,000	-	-	-	

Note: T.P. = Turbine pumps; Mo.P = Mono pumps; M.P. = Manual pumps

4-2-4 Estimated Costs of Equipments and Materials Suggested for
Financial Assistance

I.	<u>WATER WELL DRILLING RIG FOR GROUNDWATER DEVELOPMENT COMPLETE WITH ANCILLARY EQUIPMENT</u>	<u>1 UNIT</u>	Yen 99,000,000
1.	<u>Water Well Drilling Rig:</u>	<u>1 Unit</u>	
2.	<u>Standard Drilling Tools: (150 m)</u>	<u>1 Unit</u>	
3.	<u>Drill Bits and Subs: (146 - 311 mm)</u>	<u>1 Unit</u>	
4.	<u>Fishing Tools:</u>	<u>1 Unit</u>	
5.	<u>Casing Tools: (150 mm N.D.F.J.)</u>	<u>1 Unit</u>	
6.	<u>Testing and Development Equipment:</u> (Test pump, logger and pump for jetting)	<u>1 Unit</u>	
7.	<u>Tender Vehicles and Tents:</u>	<u>1 Unit</u>	
II.	<u>WELL CONSTRUCTION MATERIALS:</u>	<u>1 LOT</u>	Yen 12,500,000
1.	Surface casing 200 mm N.D. F.J. x 3 m	20 nos.	
2.	- do - but plain end 200A, 5.5 m long	20 nos.	
3.	Well casing, PVC, 150A socket end, 6 m long	100 nos.	
4.	Well screen, PVC slotted or perforated, 4 m long	200 nos.	

III.	<u>PUMPING EQUIPMENT: (For 22 sets)</u>	<u>1 LOT</u>	Yen 24,200,000
1.	Foot operated submersible pump with 30 m hoses and accessories	10 sets	
2.	Vertical shaft pump with diesel engine	4 sets	
3.	Vertical shaft Mono type pump with diesel engine	8 sets	
IV.	<u>WATER DISTRIBUTION MATERIALS - MODEL CASES BASIC DESIGN FOR VUNICUI (SETTLEMENT) AND VUNIMOLI (VILLAGE)</u>	<u>1 UNIT</u>	Yen 22,300,000
V.	<u>SPARE PARTS & SUPPLIES FOR TWO YEARS NORMAL OPERATION</u>	<u>1 UNIT</u>	Yen 24,000,000
	Ocean freight		Yen 18,000,000
	TOTAL:		<u>YEN 200,000,000</u>

The materials and equipments suggested for financial assistance can be classified into common-use component and individual-area-use component as follows.

Table 4.3 Common-Use Component and Individual Area-Use Component of Materials and Equipments Suggested for Financial Assistance

Items		Value (¥1,000)
Common-Use	Well drilling rig and Ancillary Equipment	99,000
	Spare Parts	24,000
	Ocean Freight	18,000
	Sub-Total	141,000
Individual-Use	Well Construction Materials	12,500
	Pumps	24,200
	Water Distribution Materials	22,300
	Sub-Total	59,000
TOTAL		200,000

4-3. Construction Schedule

The proposed construction schedule of the present project is presented in Table 4.4.

The Terms of Reference and the Specifications prepared by the Fiji government is scheduled to be issued within 3 months after exchanging E/N. Then order, production and transportation of materials and equipment will be undertaken within a period of 6 months.

Three months were set for preparing construction works after the arrival of materials and equipment. Since the budget for 1981 was already fixed, actual financial response to the present project cannot be expected to take place before 1982 fiscal year. However, it early implementation would be desirable because it needs about one year before materials and equipment delivered to the sites.

In considering information concerning budgetary conditions of the authorized departments of Fiji, a period of three years is expected for construction works. It is suggested that the construction unit, except those persons allocated for well drilling, is divided into 4 teams to undertake these preparation and construction works.

Regarding well drilling works, since on the average the drilling of one well requires about one month, the number of months required for the completion of 20 wells is scheduled at 30 months, with mobilization time included and using one drilling rig.

The construction schedule is prepared in basis of the feasibilities given by the technical point of view and have possibilities to be postponed and/or modified the schedule in connection with the amount of budget allocated by the Fiji Government in each fiscal year.

Table 4-4 Construction Schedule

Year Item	1981												1982												1983												1984												Remarks
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
Preparation of TOR & Specification																																																	
Assembly by maker and shipping																																																	
Preparation Works																																																	
Construction Works Settlement (1)																																															10km x 3 systems/30m/day x 2 teams = 500 day = 24 months		
" Settlement (2)																																															"		
" Village																																															20days/1 system x 10 systems = 200 days = 10 months		
" School																																															Pump Installation only 10days/1 system x 4 systems = 40days = 2 months		
Well drilling																																															For one well (mobilization and rest included) 1.5 months ; 20 wells x 1.5 months = 30 months		

CHAPTER 5 EFFECTS ON PROJECT

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Regional development including ground water and water supply projects has been of high priority in the 7th five-year development of Fiji (1976 - 1980). However, caused by financial shortage and lack of manpower, this plan was ended in 1980 and succeeded by the 8th five-year development plan started from January, 1981.

Accordingly, in the period after 1981 the expansion of rural water supply systems are conducted continuously. Groundwater development which is the key component of the present project and planned for 60 - 80 proposed areas in the country seems to be urgently in need of well drilling rig. Our suggestion for financial assistance concerning this drilling rig is thus of critical importance.

As foreign assistance to Fiji has been biased towards Viti Levu Island, where Suva City, the Capital of Fiji is located, the present cooperation plan of Japan on Vanua Levu Island would have good effects on both the island's inhabitant and the relationship between Japan and Fiji. In this sense, the present domestic water supply project should be highly appreciated.

Fiji is an agriculture-based country, with tourism and sugar-cane plantations being the main economic activities. Japan's assistance to the present project which aims at supplying domestic water for the inhabitants of Vanua Levu Island where sugar-cane and olive cultivation dominates should be considered most adequate.

Considering construction cost is estimated 315 million yen (foreign component : 173 million yen; local component: 142 million yen) and the total budget for rural water supply development in the 8th five-year development plan at 1240 million yen, recommended amount of financial assistance covering the drilling rig and about 34 % of foreign component of the present project in Vanua Levu would contribute much to the rural water supply development plan of this country.

APPENDICES

Appendices

1. List of Machinery and Equipments Selected as Objects at Cooperation

Annex I. Items requested by the Government of Fiji whose cost will be born by the Government of Japan.

I.	<u>WATER WELL DRILLING RIG FOR GROUNDWATER DEVELOPMENT COMPLETE WITH ANCILLARY EQUIPMENT</u>	<u>1 UNIT</u>
1.	<u>Water Well Drilling Rig:</u>	<u>1 Unit</u>
2.	<u>Standard Drilling Tools: (150 m)</u>	<u>1 Unit</u>
	2-1. Drill string for Air Percussion Drilling	
	2-1a. F.J. drill pipe, 120.7 mm O.D. x 3 m, with 3-1/2 IF box to pin, thread pro- tectors and wrench recesses on both ends.	50 nos.
	2-1b. Drill collar, 5" O.D., 3 m long with 3-1/2 IF box to pin, thread protectors and wrench recesses on both ends.	2 nos.
	2-1c. Drive rod sub, 3-1/2 IF box to pin	1 no.
	2-2. Drill String for Mud Circulation	
	2-2a. F.J. drill pipe, 89 mm O.D. x 3 m long, with 2-3/8 IF box to pin, thread pro- tectors and wrench recesses on both ends.	50 nos.
	2-2b. - do - but 1.5 m long	2 nos.
	2-2c. Drill Collar, 7" O.D., 3 m long with 3-1/2 IF box to pin, thread protectors and wrench recesses on both ends.	2 nos.
	2-3. Hoisting wire rope with safety clevis, 12.5 mm x 60	1 roll
	2-4. Running block, 305 mm x 1 wheel	1 no.
	2-5. Heavy duty water/air swivel, 6 ton capacity, with 3-1/2 IF pin and 50 mm hose connection	1 no.

2-6a.	Swing hanger for 120.7 mm drill pipe	1 no.
2-6b.	- do - for 89 mm drill pipe	1 no.
2-7.	Hoisting swivel, telescoping type, with 3-1/2 IF pin	1 no.
2-8.	Sub for swivel, 3-1/2 to 2-3/8 IF box to pin	1 no.
2-9.	Tubing spider for drill pipe with 225 mm opening	1 no.
2-10.	Jaws for 120.7 mm and 89 mm D.P. ea.	1 set
2-11.	Drill collar lifting sub	1 no.
2-12.	Breakout tongs for 89 mm drill pipes	1 no.
2-13.	- do - for 120.7 mm D.P. and drill collars	1 no.
2-14.	Back-up wrench for 89 mm drill pipes	1 no.
2-15.	- do - for 120.7 mm D.P. and drill collars	1 no.
2-16.	Hoses with fittings:	
	a) Suction hose, 100 mm x 4.5 m	1 no.
	b) Foot valve, 100 mm	1 no.
	c) Delivery hose, high pressure type, 50 mm x 6 m	1 no.
2-17.	Down-the-hole hammer drill, 130 mm size for 146 - 150 mm holes	1 set
2-18.	Line oiler (to be mounted on the rig)	1 no.
2-19.	Disassembling tools for down-the-hole hammer drill	1 set
2-20.	Damper, 3-1/2 IF for DTH hammer drilling	1 no.
2-21.	Air hose with fittings, 50 mm x 10 m	1 roll

2-22.	Operating hand tools:	
	a) Heavy duty pipe wrench, No. 48	2 nos.
	b) - do - No. 36	2 nos.
	c) - do - No. 24	2 nos.
	d) - do - No. 18	2 nos.
	e) Super tong, ST-2	2 nos.
	f) - do - ST-2-1/2	2 nos.
	g) Engineering tools such as files chisels, steel level, etc.	1 set
	h) Rope, 22 mm x 30 m	1 roll
	i) Socket wrench set	1 set
	j) Sledge hammer, 4.5 kg	1 no.
	k) Snatch block, 200 mm x 1 wheel	1 no.
	l) Wire sling, 12.5 mm x 6 m	2 nos.
	m) - do - 12.5 mm x 3 m	2 nos.
	n) - do - 12.5 mm x 1.5 m	2 nos.
	o) - do - 9 mm x 6 m	2 nos.
	p) - do - 9 mm x 3 m	2 nos.
	q) Steel tool box with lock and key	2 nos.
2-23.	Bailer, size 4" x 5.5 m	1 no.
2-24.	Collapsible tank, 5 m ³	5 nos.
3.	<u>Drill Bits and Subs: (146 - 311 mm)</u>	<u>1 Unit</u>
3-1.	Three cutter rock bits, size 146 mm (5-3/4") for medium hard formation	2 nos.
3-2.	- do - but size 194 mm (7-5/8") for soft to medium hard formation	3 nos.
3-3.	- do - but size 245 mm (9-5/8") for soft to medium hard formation	2 nos.
3-4.	- do - but size 311 mm (12-1/4") for soft formation	1 no.
3-5.	Cross bit for 130 air hammer, size 146 mm	6 nos.
3-6.	- do - but size 150 mm	3 nos.
3-7.	- do - but TC insert type 146 mm	3 nos.

3-8.	Subs, 2-3/8 IF box to 3-1/2 IF pin	1 no.
3-9.	- do - 3-1/2 IF box to 3-1/2 Reg box	1 no.
3-10.	- do - 3-1/2 IF box to 4-1/2 Reg box	2 nos.
3-11.	- do - 3-1/2 IF box to 6-5/8 Reg box	2 nos.
3-12.	- do - 3-1/2 IF box to 2-3/8 IF pin	1 no.
4.	<u>Fishing Tools:</u>	<u>1 Unit</u>
4-1.	Taper tap for 89 mm drill pipe, 2-3/8 If	1 no.
4-2.	- do - for 120.7 mm (3-1/2" IF) drill pipe	1 no.
4-3.	Overshot for 89 mm drill pipe, 2-3/8 IF	1 no.
4-4.	Pipe spider for 8-5/8" O.D. and 6-5/8" O.D. Pipe with slips	1 set
4-5.	Hydraulic jacks, 50 tons	2 sets
5.	<u>Casing Tools: (150 mm N.D. F.J.)</u>	<u>1 Unit</u>
5-1.	Slush joint casing 150 mm N.D. x 3 m long with square threads 3 per inch, steel thread protectors (Similar to DCDMA SW casing)	20 nos.
5-2.	Casing Clamp, 150 mm N.D.	2 sets
5-3.	Casing head, 150 mm N.D.	2 nos.
5-4.	Casing shoe, 150 mm N.D.	2 nos.
5-5.	Casing swivel, 150 mm N.D. with 3-1/2" IF box	1 no.
6.	<u>Testing and Development Equipment:</u>	<u>1 Unit</u>
	(Test pump, logger and pump for jetting)	
6-1.	Well logger, single channel, with resistivity, temperature, and spontaneous potential modules, cable and probe for 200 meters	1 unit

6-2. Test pump with power unit electric submersible type suitable to use in 150 mm I.D. well with appropriate diesel generator and all necessary pipes and accessories for setting to 60 meters.

Delivery volume 450 lit/min.
T.D.H. 70 m max. 1 unit

6-3. High pressure pump duplex type for jetting development of the well screen, max. discharge 185 lit/min. at 35 kg/cm² pressure with diesel engine and 4 or 5 speed transmission, skid mounted, the pump shall be complete with suction hose and 50 mm high pressure delivery hose. 1 unit

7. Tender Vehicles and Tents: 1 Unit

7-1. Cargo truck with HIAB type crane 1 unit

7-2. Pickup, 4 x 4 equivalent to Toyota Landcruiser with diesel engine and vinyl hood for the rear deck, one unit for drilling crew and another for the construction crew. 2 units

7-3. Sheet to protect important equipment and supplies in the Project field, 3 x 4k 8 nos.

7-4. - do - but 2 x 3k 8 nos.

7-5. Tent for temporary mobilization, 2.3 x 2.5 m, 3 m long 8 units

II. WELL CONSTRUCTION MATERIALS: 1 LOT

1. Surface casing 200 mm N.D. F.J. x 3 m (Temporary casing) 20 nos.

2. - do - but Plain, 200A, 5.5 m long (Temporary casing) 20 nos.

3. Well casing, PVC, 150A socket end, 6 m long (Made in Fiji) (5 nos/well x 20) 100 nos.

4. Well screen, PVC slotted, 4 m long (10 nos/well x 20) 200 nos.

<u>III. PUMPING EQUIPMENT</u>	<u>1 LOT</u>
1. Foot operated submersible pump with 30 m hoses and accessories	10 sets
2. Vertical shaft pump with heavy duty diesel engine	4 sets
3. Vertical shaft MONO type pump with diesel engine	8 sets
* Item 1. For villages and scattered settlements. Item 2 & 3. For settlements and schools.	
 <u>IV. WATER DISTRIBUTION MATERIALS - MODEL CASES BASIC DESIGN FOR VUNICUICUI (SETTLEMENT) AND VUNIMOLI(VILLAGE)</u>	<u>1 UNIT</u>
 A. <u>For Vunicuicui Settlement Model</u>	<u>1 Unit</u>
1. PVC pipe, 100A, 6m long, rubber ring, class C	420 nos. (2,520m)
2. - do -, 80A, 6m long, rubber ring, class C	600 nos. (3,600m)
3. - do -, 50A, 6m long, rubber ring class C	820 nos. (4,920m)
4. - do -, 80A, 6m long, rubber ring class D	140 nos. (840m)
5. Hume's tank, dia. 6m x 2.1m (H)	1 set
6. Auto valves	3 sets
7. Buzzer box, Pressure switch	1 set each
 B. <u>For Vunimoli Village Model (10 Villages)</u>	<u>10 Units</u>
1. PVC pipe, 25A, 6m long, socketted, class E	30 nos. (180m)

2.	Galvanized steel pipe, 25A, 6 m long, screwed	10 nos. (60m)
3.	- do -, 15A, 6m long, screwed	20 nos. (120m)
4.	Polyethylene pipe, 25A	90 m
5.	Water tank, effective capacity 2.5m ³ , FRP panel type	10 units
6.	PVC pipe, 150A, for drain	20 nos. (120m)
7.	- do -, 100A, for drain	20 nos. (120m)
8.	- do -, 80A, for drain	10 nos. (60m)
9.	Corrugated zink sheet, 0.76 x 1.8m, for shower room	200 nos.

Notes: All PVC pipes to be made in Fiji.

V.	<u>SPARE PARTS & SUPPLIES FOR TWO YEARS NORMAL OPERATION</u>	<u>1 UNIT</u>
1.	Spare parts for drilling and drilling tools	1 lot
2.	Spare parts for truck engines	1 lot
3.	Spare parts for test pump and diesel generator	1 lot
4.	Spare parts for air compressor	1 lot
5.	Spare parts for water pump and engine	1 lot
6.	Supplies for drilling bits and air hammer bits	1 lot
7.	Miscellaneous supplies	1 lot

2. COLLECTED DATA LIST

A. Printed data or reports

1. Topographical maps
Vanua Levu Sheet 1 - 13 (Scale 1:50,000)
Vanua Levu Sheet 2 (Scale 1:200,000)
2. M J Rickard, Ph. D.,
F.G.S. Geologist
1966
Reconnaissance Geology of Vanua Levu
3. W H Hindle, M.Sc
1976
The Geology of West-central Vanua Levu, Bulletin No. 1
4. P Ibbotson, B Sc,
Ph D, A.R.C.S.,
F.G.S. 1969
The Geology of East-central Vanua Levu Bulletin No. 16
5. F I E Coulson,
B Sc, 1971
The Geology of Western Vanua Levu Bulletin No. 17
6. United Nations,
New York 1974
United Nations Development Program Fiji, Survey of Groundwater Resources of Fiji
7. A Green and A
Rahiman 1980
A preliminary investigation of the groundwater resources around Labasa, Seaqqa and univau in Bua
8. New Zealand Meteorological Office
Laucala, Suva, Fiji
1970
Summaries of Climatological Observations (Table of Averages)
9. R Krishna 1980
Fiji Meteorological Service
Technical Note No. 8, Rainfall Maps of Viti Levu, Vanua Levu and Taveuni
10. J D Coulter 1980
Information Sheet No. 53
(Provisional)

B. Unpublished data or reports

1. Bore Hole Data
CDH/W/80/22 (1980)
CDH/W/80/23 (1980)
CDH/W/80/24 (1980)
2. Monthly Rainfall Data
Labasa Airfield Station (1960 - 1970)
Seaqaqa Forest Station (1960 - 1971)
Dreketi River Station (1960 - 1971)
Mbua
Naruwai
3. Monthly Streamflow Data
Labasa River at Korotori
Wailevu River at Nakama
Dreketi River at Batiri
Mbua River at Togo
Noruwai River at Naruwai
4. Design Guideline for Water Supply and Sewage
5. Population of Vanua Levu
6. Cost for Construction Materials and Wages
(Replies to the 1st Questionnaire)
7. Nos. of schools, population in the Additional Area, present served population, etc. in Vanua Levu
(Replies to the 2nd Questionnaire)
8. Rent for Construction Machinery

C. Test

1. Water Examination

5 samples x 10 items

Well Water in Vunicuicui (Well No. 6/7)

in Vunicau Bua (Well No. CDH/W/80/23)

in Vunivau Bua (Well No. CDH/W/80/40)

Surface Water in Vunimoli (Water from the pipeline)

Hot Spring Water in Nabekavu (Hot Spring in Nakama)

Note: Analysis items are :

Cations Ca^{++} , Mg^{++} , Na^{++} , K^+ , T-Mn, T-Fe

Anions HCO_3^- , CO_3^{--} , SO_4^{--} , Cl^- , NO_3^- ,

Total Hardness

Total Solids

Conductivity

pH

3. Guidelines for Design

Water Supply and Sewerage

(Fiji, PWD)

1. Outline Considerations

Design guidelines are detailed later for water supply and sewerage and careful consideration has been given to the necessity to: -

- 1.1 a) Strike a balance between reasonable engineering and economic considerations.
 - b) Ensure that our engineering standards are based on developing nation rather than European standards.
 - c) Apply different standards to villages and settlements, and urban areas.
 - d) Ensure that engineering should be as simple as possible, is
 - (a) Gravity schemes are preferred to pumped schemes.
 - (b) Unpolluted water supply sources requiring not treatment or chlorination are preferred to suspect sources.
 - (c) Chlorination of water supply sources is not carried out except for the schemes which are maintained by P.W.D., other than in emergency or periods of disaster.
 - (d) Attainment of European W.H.O. standards of water and effluent quality are not always possible.
 - (e) Maintenance requirements are minimal.
 - e) Review the design guidelines from time to time when additional knowledge or information becomes available.
- 1.2 It must be borne in mind that Fiji is much better off financially than the majority of the developing nations and its per capita income is substantially higher. The design parameters have taken this into account to ensure that schemes are not put in

which need replacing at a very early date.

- 1.3 The priority of one water supply scheme over another is a difficult matter. It is suggested that the distance to reliable source should be the main criterion and the determination of people to have their own supply by self-help, another.

2. General

- 2.1 Surveys - must be comprehensive, to produce complete pipeline route plans, sections, hydraulic gradients, site plans etc.
- 2.2 Designs - are to be based on the guidelines detailed later.
- 2.3 Drawings - Complete construction drawings of everything (intakes, pumphouses, treatment plants, ripelings, chambers etc.) must be provided to the divisions, including all the necessary detail drawings.

All drawings must be agreed with and initialled by the P.
- 2.4 Materials - Must be ordered/indented from the N.O. Where pumps are being ordered, normally the standard specification should be used, but care must also be taken to ensure that pumps, motors, starters and relevant equipment such as pressure switches, time switches, no-flows controls, ammeters, hour - run meters etc. are ordered as a complete unit from one source.
- 2.5 Construction - During construction the design engineer should maintain contact with the division to ensure the scheme is built as intended. The design engineer should be aware of changes occurring for any reason, during construction.

2.6 Water Supply Sources

- Must be assessed as fully as possible depending on the scheme, (village, settlement, urban) to determine the safe yield.

3. Design Guidelines for Water Supply

3.1 Water Supply

Design Period for Gravity Systems	(Village and)	15 years
	(Settlement)	
	(Urban area)	20 years
Design Period for Pumped Systems	(Village and)	10 years
	(Settlement)	
	(Urban area)	15 years

3.2 Approximate assumed water demands:-

Human population:-

Villages (No individual connections)	A minimum of	50 litres/head/day
Settlements(With some individual connections)		150 litres/head/day
Urban areas(including 180 litres/h/d plus 200 litres/h/d for commerce and industry).		400 litres/head/day
Animal population - Cattle and horses		50 litres/head/day
	Pigs, sheep and goats	10 litres/head/day

Human population increase - See latest estimates

- if no information is available use 2% per annum (compound).

3.3 Water Storage

For villages and settlements, whenever possible, storage should be provided at the source by the construction of a sufficiently large dam. Tank storage should be considered in the context of the realibility of the source and in the case of roof catchments which should be maximised in rural areas, be not less than 60 days at 50 litres/head/day. Roof catchment schemes are however a function of roof area available, rainfall, population and storage/should be designed in accordance with the graphs on file prepared by Mr. Ijzormans and Mr. Harris.

Tank Water Storage (Village and settlements) 30% of Average Daily
(Excluding roof catchment schemes) Demand

Note:-

Where the source is suspect increase tank
storage to 50% of Average Daily Demand.

Service reservoir storage in Urban Areas 100% of Average Daily
Demand

3.4 Trunk and Distribution Mains

Pumping mains to storage - To deliver daily demand in 20 hours

Gravity mains to storage - to deliver daily demand at 1.1 x
average rate of flow

Distribution mains - deliver daily demand at 2.5 x average
rate of flow for villages and settlements

- to deliver daily demand at 2.0 x average
rate of flow for urban areas

Water mains should not be less than 75 mm diameter in urban areas
or settlements unless there is no possibility of extension.

In villages from water source to storage should never be less
than 50 mm.

3.5 Pipe Materials

Preferred pipe materials are:-

Up to 200 mm diameter - Asbestos Cement, P.V.C. or Polyethylene
in smaller diameters

200 mm upwards - Asbestos Cement or Ductile Iron with
Steel for very high pressure situations.

The use of galvanised steel pipes is not recommended and they
should be avoided whenever possible.

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