JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF AGRICULTURE, FISHERIES AND FORESTS,

THE REPUBLIC OF FIJI ISLANDS

THE STUDY ON WATERSHED MANAGEMENT AND FLOOD CONTROL FOR THE FOUR MAJOR VITI LEVU RIVERS IN THE REPUBLIC OF FIJI ISLANDS

FINAL REPORT

SUPPORTING REPORT

YOLUME-1

October, 1998

Yachiyo Engineering Co., Ltd.

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COMPOSITION OF FINAL REPORT

1. SUMMARY

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   - Part I Master Plan for Four Major Viti Levu Rivers
   - Part II Feasibility Study for Nadi Diversion Channel

3. SUPPORTING REPORT

   Volume-1
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SUPPORTING REPORT

PART A

SOCIO-ECONOMY

THE STUDY ON WATERSHED MANAGEMENT AND FLOOD CONTROL
FOR THE FOUR MAJOR VITI LEVU RIVERS
IN THE REPUBLIC OF FIJI ISLANDS

SUPPORTING REPORT
PART A, SOCIO-ECONOMY

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LIST OF ABBREVIATION

B/C	: Benefit Cost Ratio
BOD	: Biological Oxygen Demand
COD	: Chemical Oxygen Demand
D&I	: Drainage and Irrigation Division, MAFF
DO	: Dissolved Oxygen
DOE	: Department of Environment, MUDHE
DOF	: Department of Forest, MAFF
EIA	: Environmental Impact Assessment
EIRR	: Economic Internal Rate of Return
FAO	: Food and Agriculture Organization of the United Nations
FEA	: Fiji Electricity Authority
FMS	: Fiji Meteorological Service, MTCA
FSC	: Fiji Sugar Corporation
GDP	: Gross Domestic Product
GIS	: Geographical Information System
IEE	: Initial Environmental Examination
INR	: Institute of Natural Resources
JICA	: Japan International Cooperation Agency
MAFFA	: Ministry of Agriculture, Fisheries, Forests and ALTA
MAFF	: Ministry of Agriculture, Fisheries, and Forests
MPWIT	: Ministry of Public Works, Infrastructure and Transport
MRD	: Mineral Resources Department
MTCA	: Ministry of Tourism and Civil Aviation
MUDHE	: Ministry of Urban Development, Housing and Environment
NLTB	: Native Land Trust Board
NPV	: Net Present Value
PWD	: Public Works Department, MPWIT
SOPAC	: South Pacific Applied Geoscience Commission
SPC	: South Pacific Commission
SS	: Suspended Solids
TH	: Total Hardness
TN	: Total Nitrogen
TOR	: Terms of Reference
TP	: Total Phosphorus
UNDP	: United Nation Development Programme
USP	: University of the South Pacific
WHO	: World Health Organization

CHAPTER 1 SOCIO-ECONOMY

1.1 Present Situation

1.1.1 National Socio-Economic Background

(1) Administration

Fiji is divided into four administrative divisions, namely, Central, Western, Northern and Eastern. Each of the four Divisions has a Commissioner who is the administrative head of the government operation in the Division. The division is divided into several Provinces which consist of 15 units in the country as a whole. Further, the respective provinces are also divided into Tikina (District) ranging from 2 to 14 units. The administrative least unit is a Village (Community or Locality) and there are between 1 and 75 units per Tikina.

Local governments fall under the jurisdiction of the Central Government, which is composed of the following 3 Offices and 18 Ministries (as of August 8, 1997);

Office of the President

Office of the Prime Minister

Office of the Attorney-General

Ministry with Special Responsibility for the Constitution

Ministry of Justice and Home Affairs

Ministry of National Planning

Ministry of Finance

Ministry of Agriculture, Fisheries and Forests

Ministry of Regional Development and Multi-Ethnic Affairs

Ministry of Foreign Affairs and External Trade

Ministry of Tourism and Transport

Ministry of Education and Technology

Ministry of Lands and Mining Resources

Ministry of Local Government, Housing and Environment

Ministry of Fijian Affairs and ALTA

Ministry of Youth, Employment Opportunities and Sports

Ministry of Communication, Works, and Energy

Ministry of Health

Ministry of Information, Women and Culture

Ministry of Labor and Industrial Relations

Ministry of Commerce, Industry, Co-operatives and Public Enterprises

(2) Population

1) Population Census

The Fiji's population constitutes of two major groups, the indigenous Melanesian population, subsequently referred to as Fijians, and the population who are of Indian descent, referred to as Indians. Apart from Fijians and Indians, there are Europeans, Part-Europeans, Chinese and Other Pacific Islanders, who form small proportions. Christianity (Wesleyan) is the dominant religion among Fijian people and those from Indian subcontinent are mostly followers of Hinduism and Islam.

The population censuses of Fiji have been conducted twelve times since 1881 and the historic changes of population since the 1956 census are provided in Table-A1.1. The population of Fiji reached 772,655 in 1996 rising by 426,918 (about 223 %) from the 1956 census population of 345,737. For the period from 1986 to 1996, the annual growth rate was 0.8 % which was the lowest of the historic intercensal growth rate since 1956. In the 1996 Census, Fijians and Indians recorded the populations of 394,999 and 336,579 or 51.1 % and 43.6 % of the total population, respectively.

Table-A1.1 Population by Ethnic Origin and Sex Group in Successive Censuses, 1956 ~ 1996

Ethnic Origin	Sex	Population (Person)					Average Annual Growth Rate (%)			
		1956	1966	1976	1986	1996	1956-66	1966-76	1976-86	1986-96
Chinese	Male	2,624	2,910	2,503	2,546		1.0	-1.5	0.2	
	Female	1,531	2,239	2,149	2,238		3.9	-0.4	0.4	
	Total	4,155	5,149	4,652	4,784		2.2	0.0	0.3	
European	Male	3,374	3,427	2,605	2,240		0.2	-2.7	-1.7	
	Female	3,028	3,163	2,324	1,956		0.4	-3.0	-1.7	
	Total	6,402	6,590	4,929	4,196		0.3	-2.9	-1.6	
Fijian	Male	74,989	102,479	131,413	167,256		3.2	2.5	2.4	
	Female	73,145	99,697	128,519	162,049		3.2	2.6	2.4	
	Total	148,134	202,176	259,932	329,305	394,999	3.2	2.5	2.4	1.8
Indian	Male	88,359	122,632	147,194	175,829		3.3	1.8	1.8	
	Female	88,359	122,632	147,194	175,829		3.3	1.8	1.8	
	Total	169,403	240,960	292,896	348,704	336,579	3.6	2.0	1.8	-0.4
Part-European	Male	4,008	4,951	5,358	5,396		2.1	0.8	0.1	
	Female	3,802	4,736	4,918	4,901		2.2	0.6	0.0	
	Total	7,810	9,687	10,276	10,297		2.2	0.6	0.0	
Rotuman	Male	2,232	2,932	3,666	4,387		2.8	2.2	1.8	
	Female	2,190	2,858	3,625	4,265		2.7	2.4	1.6	
	Total	4,422	5,797	7,291	8,652		2.7	2.3	1.7	
Other Islanders	Male	2,839	3,207	3,474	4,499		1.2	0.8	2.6	
	Female	2,481	2,888	3,348	4,128		1.5	1.5	2.1	
	Total	5,320	6,095	6,822	8,627		1.4	1.1	2.4	
All Others	Male	50	202	737	415		15.0	13.8	-5.6	
	Female	41	71	533	395		5.6	22.3	-3.0	
	Total	91	273	1,270	810		11.6	16.6	-4.4	
Other than Fijians and Indians						41,077			1.0	
Total	Male	178,479	242,747	296,950	362,568		3.1	2.0	2.0	
	Female	167,262	233,980	291,118	352,407		3.4	2.2	1.9	
	Total	345,737	476,727	588,068	715,375	772,655	3.3	2.1	2.0	0.8

Source: Bureau of Statistics, 1989[1] and Bureau of Statistics, 1997[1]

Table-A1.2 presents a divisional distribution of the population as of 1996. Among the four Divisions, the Central Division had the largest population of 297,255 or 38.5 % of the total population. Following the Central, the Western Division had a population of 295,891 or 38.3 %. The Central Division has many of Fijians and other ethics except Indians, while in the Western Division Indians account for larger number of population.

In 1996, the urban population in Fiji amounted to 358,131 with the annual growth rate of 2.6 % during the period 1986 ~ 1996, of which the Fijian population recorded a high growth rate of 4.1 % per annum. The urban population accounted for 45.2 % of Fiji's population in 1996, as against 38.9 % in 1986. The ethnic distribution of the urban population in 1996 was 45.2 % for Fijians, 46.6 % for Indians and 8.2 % for Others (Table-A1.3).

The main features of the 1996 Census result are;

1) Declining growth rates overall and lowest growth rate among censuses since 1901 Census
2) Dramatic change in ethnic composition of total population,
3) Decrease in the overall number of the Indian people due to a large fall in the rural population,
4) Intensified urbanization, especially by Fijians,
5) Decrease in rural proportion due to heavy Indian leave and a small increase of Fijian.

Table-A1.2 Population of Division by Ethnic Origin (1996 Census)

Division	Fijians		Indians		Others		Total	
	Number	%	Number	%	Number	%	Number	%
Central	176,842	44.8	97,970	29.1	22,443	54.6	297,255	38.5
Western	116,704	29.5	171,803	51.0	7,384	18.0	295,891	38.3
Northern	65,023	16.5	66,205	19.7	7,526	18.3	138,754	18.0
Eastern	36,430	9.2	601	0.2	3,724	9.1	40,755	5.3
Total	394,999	100.0	336,579	100.0	41,077	100.0	772,655	100.0

Source: Bureau of Statistics, 1997[1)]

Table-A1.3 Population Distribution by Urban and Rural Areas

Urban/Rural		Fijians		Indians		Others		Total	
		Number	(%)	Number	(%)	Number	(%)	Number	(%)
1. Urban	1986	107,780	38.9	144,533	52.2	24,712	8.9	277,025	100
	1996	161,824	45.2	166,851	46.6	29,456	8.2	358,131	100
	Annual Growth Rate (%)		4.1		1.4		1.8		2.6
2. Rural	1986	221,525	50.5	204,171	46.6	12,654	2.9	438,350	100
	1996	233,175	56.3	169,728	40.9	11,621	2.8	414,524	100
	Annual Growth Rate (%)		0.5		-1.8		-0.8		-0.6
3. Total	1986	329,305	46.0	348,704	48.7	37,366	5.2	715,375	100.0
	1996	394,999	51.1	336,579	43.6	41,077	5.3	772,655	100.0
	Annual Growth Rate (%)		1.8		-0.4		1.0		0.8
4. Share to Ethnic Total (%)	Urban (1986)		32.7		41.4		66.1		38.7
	Rural (1986)		67.3		58.6		33.9		61.3
	Urban (1996)		41.0		49.6		71.7		46.4
	Rural (1996)		59.0		50.4		28.3		53.6
5. Share to Total Population (%)	Urban (1986)		15.1		20.2		3.5		38.7
	Rural (1986)		31.0		28.5		1.8		61.3
	Urban (1996)		20.9		21.6		3.8		46.4
	Rural (1996)		30.2		22.0		1.5		53.6

Source: Bureau of Statistics, 1997[1]

2) Labor Force

Of the total labor force estimated to be 274,700 in 1994, a total of 258,200 were in some form of employment. As for the labor forces of Fiji from 1984 to 1994, the whole picture had showed comparatively moderate and stable movement. The ration of labor force to the total population was 32.6 % in 1984 and moved up to 34.9 % in 1994. The unemployment rate had remained within a range from 5.4 % to 6.4 % during 1989 to 1994. Meanwhile, the labor force composition of male and female were 81.0 % and 19.0 % respectively in 1984, and 78.8 % and 21.2 % in 1994. The average annual growth rate of male and female labor force during 1984 and 1994 were 1.7 % and 3.1 % respectively. A significant increase of female participation seems to have taken place in the middle of 1980's (refer to Table-A1.4).

Table-A1.4 Labor Force

Unit: 1,000 persons

	Labor Force						Unemployed (Both Sexes)		Total Population	Labor Force to Total Population (%)
	Number			Percentage			Number	%		
	Male	Female	Both Sexes	Male	Female	Both Sexes				
1984	182.2	42.8	225.0	81.0	19.0	100.0	16.8	7.5	691	32.6
1985	186.3	43.7	230.0	81.0	19.0	100.0	18.6	8.1	702	32.8
1986	189.9	51.2	241.1	78.8	21.2	100.0	20.1	8.3	715	33.8
1987	194.7	52.5	247.2	78.8	21.2	100.0	25.2	10.2	721	34.3
1988	199.1	53.6	252.7	78.8	21.2	100.0	28.0	11.1	724	34.9
1989	194.6	52.4	247.0	78.8	21.2	100.0	15.0	6.1	726	34.0
1990	199.0	53.6	252.6	78.8	21.2	100.0	16.0	6.4	736	34.3
1991	203.3	54.8	258.1	78.8	21.2	100.0	15.2	5.9	746	34.6
1992	207.6	56.0	263.6	78.8	21.2	100.0	15.8	5.4	758	34.8
1993	211.8	57.1	268.9	78.8	21.2	100.0	15.8	5.9	771	34.9
1994	216.4	58.3	274.7	78.8	21.2	100.0	16.5	6.0	784	35.0

Source: Bureau of Statistics (1985 ~ 1995)

Table-A1.5 presents a distribution of the total employment and paid employment by sector during period from 1988 to 1992. The overwhelming majority of 63 % to total employment were own account or unpaid family workers, most of whom were in agricultural sector. Fiji's economy is largely based on agro-economy and the agricultural sector actually comprised the dominant share, service sector shared 10.9 % and manufacturing sector was 8.5 % in 1992. Meanwhile, construction, manufacturing and electricity sectors had showed considerable increase of 12.5 %, 10.8 % and 10.1 % at the average annual growth rate respectively between 1988 and 1992.

Table-A1.5 Total Employment and Paid Employees by Sector

Unit: person

	1988	1989	1990	1991	1992	Share in 1992 (%)	Annual Average Growth Rate (%)
Agriculture	2,004	2,130	2,312	2,583	2,248	0.9	2.9
Mining	1,526	1,621	1,402	1,120	1,418	0.6	-1.8
Manufacturing	14,040	19,666	21,051	23,400	21,181	8.5	10.8
Electricity	1,858	2,017	2,543	2,712	2,727	1.1	10.1
Construction	5,304	5,227	5,727	7,031	8,480	3.4	12.5
Distribution, Hotels	11,864	14,330	14,848	14,536	13,622	5.5	3.5
Transport	8,048	9,852	9,520	8,950	9,731	3.9	4.9
Finance	5,071	5,823	5,633	5,855	5,816	2.3	3.5
Services	27,814	29,210	25,915	25,349	27,257	10.9	-0.5
Total Paid Employment	77,529	89,876	88,952	91,536	92,480	37.1	4.5
Own Account, unpaid family workers, other employees	148,400	142,800	147,400	151,400	156,900	62.9	1.4
Total Employment	225,900	232,700	236,400	242,900	249,400	100.0	2.5

Source: Government of Republic of Fiji, 1993

(3) Gross Domestic Product (GDP)

The GDP of Fiji at current prices reached F$ 2,338 million in 1994, increasing at an average annual gross rate of 7.1 % from 1990 to 1994. The GDP per capita at current prices also increased from F$ 2,474 to F$ 3,002 at an average annual growth rate of 5.5 % during the same period. Meanwhile, the GDP at 1977 constant price amounted to from F$ 849 million in 1990 to F$ 937 million in 1994, increasing at the average annual growth rate of 2.7 % during the same period. And the per capita GDP at the 1977 constant prices increased from F$ 1,160 in 1990 to F$ 1,203 in 1994, at the average annual growth rate of 1.2 % (refer to Table-A1.6).

Table-A1.6 Gross Domestic Product (GDP)

Items		1990	1991	1992	1993	1994	Average Annual Growth Rate (%)
A. at the Current Prices	GDP(F$ Million)	1,811	1,938	2,098	2,224	2,338	
	Annual Growth Rate (%)	(9.0)	(7.0)	(8.3)	(6.0)	(5.1)	(7.1)
	Per Capita GDP (F$)	2,474	2,605	2,787	2,907	3,002	
	Annual Growth Rate (%)	(7.8)	(5.3)	(7.0)	(4.3)	(3.3)	(5.5)
B. at the 1977 Constant Prices	GDP (F$ Million)	849	854	881	897	937	
	Annual Growth Rate (%)	(3.5)	(0.5)	(3.2)	(1.8)	(4.5)	(2.7)
	Per Capita GDP (F$)	1,160	1,148	1,170	1,172	1,203	
	Annual Growth Rate (%)	(2.4)	(-1.1)	(1.9)	(0.2)	(2.6)	(1.2)

Source: Bureau of Statistics, 1996

Table-A1.7 of the gross domestic products at 1977 constant prices by industries showed that the respective share of the primary and secondary industry was kept stable, and that of the tertiary industry was in progress. The annual growth showed ups and downs but the average growth rate during the period of 1987 ~ 1994 was 4.1 %.

Agriculture, including forestry and fisheries, which is major contributing sector to GDP in Fiji, accounted for around 20 % of the total GDP during the period from 1987 to 1994. The average annual growth rate was 2.7 % in real base during same period. Of the agriculture sector, sugarcane production has made the greatest contribution to the stable economic growth. In terms of GDP, the sugarcane production accounted for about 40 % of agricultural production during the period from 1987 to 1994. In Fiji, tourism is also an important sector with high economic growth. Hotel, restaurant and café industries related to tourism accounted for high share of GDP, 3.6 % of the total GDP in 1994. The average growth rate of value added by these tourism related industries was as high as 7.8 % in real base per annum during the period of 1987 ~ 1994.

Table-A1.7 Gross Domestic Product (GDP) at 1977 Constant Prices by Industries

Industries	GDP by Industries (F$ 1,000)								
	1987	1988	1989	1990	1991	1992	1993	1994	Average
1. Primary Industry	175,040	171,865	191,453	183,699	180,624	186,576	192,861	208,996	
(share, %)	(25)	(24)	(23)	(22)	(21)	(21)	(22)	(22)	(22.4)
2. Secondary Industry	121,884	121,949	138,386	139,458	148,832	157,164	149,965	162,300	
(share, %)	(17)	(17)	(17)	(16)	(17)	(18)	(17)	(17)	(17.1)
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	436,543	455,588	514,995	554,815	533,096	567,034	585,006	598,311	
(share, %)	(61)	(63)	(63)	(65)	(62)	(64)	(65)	(64)	(63.5)
4. Imputed Service Charges	-21,953	-22,634	-24,352	-28,596	-27,744	-29,843	-31,096	-32,679	
(share, %)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3)	(-3.3)
All Activities	711,514	726,768	820,482	849,376	853,808	880,931	896,736	936,928	
(share, %)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	
Annual Growth Rate of GDP (%)									
1. Primary Industry	–	-1.8	11.4	-4.1	-1.7	3.3	3.4	8.4	2.7
2. Secondary Industry	–	0.1	13.5	0.8	6.7	5.6	-4.6	8.2	4.3
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	–	4.4	13.0	7.7	-3.9	6.4	3.2	2.3	4.7
4. Imputed Service Charges	–	3.1	7.6	17.4	-3.0	7.6	4.2	5.1	6.0
All Activities	–	2.1	12.9	3.5	0.5	3.2	1.8	4.5	4.1

Source: Bureau of Statistics, 1996

(4) Industries

1) Agriculture and Agro-industry

Major agricultural products of Fiji are sugarcane, copra, paddy rice, chicken and eggs. The processed agricultural products are represented by sugar, coconut oil, flour, butter, cigarettes and stock feed.

Sugarcane and sugar are the most important agricultural products. The sugarcane production in Fiji rose at an average annual rate of 5.0 % during the period from 1991 to

1995, and in 1995 the production reached 4.1 million tones with its harvested area of 74,000 hectares and the yield of 55 ton/ha. In 1995, the input of sugarcane per ton of sugar showed 9.1 tones which was somehow higher compared to 8.7 tones in 1991. Meanwhile, sugar production rose at an average annual growth rate of 3.9 %. As a result, the 1995 production of sugar amounted to 454,000 tones, an increase of 65,000 tones compared to the 1991 production (refer to Table-A1.8).

Table-A1.8 Production and Price of Sugar Industry

Items		Unit	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
1. Sugarcane	Number of Contract		22,479	23,334	23,454	22,808	22,414	-0.1
	Area Harvested	1,000 ha	72	73	74	74	74	-0.1
	Production	1,000 ton	3,380	3,533	3,704	4,064	4,110	5.0
	Average Production per ha	ton	47	49	50	53	55	4.3
	Prices paid to Growers	F$/ton	51	55	49	51	54	1.3
	Input of Cane per ton of Sugar	ton	9	8	8	8	9	0.9
2. Sugar	Sugar Production	1,000 ton	389	426	442	517	454	3.9
	Molasses Production	1,000 ton	138	129	136	155	181	7.0
	Export of Sugar							
	Quantity	1,000 ton	357	365	439	471	445	5.7
	Value(FOB)	F$ 1,000	220,400	221,281	230,688	252,183	276,112	5.8
	Unit Value	F$/ton	617	607	525	535	620	0.1

Source: Bureau of Statistics, 1996

2) Manufacturing Industry

Major products of manufacturing industries in Fiji are gold, silver, cement, beer, paint, soap, soft drinks. Production of silver, cement and soft drinks showed considerably high increase rate of 34.7 %, 3.6 % and 5.0 % per annum respectively during the period of 1991 ~ 1995. Gold is one of the significant traditional products of Fiji, and its production increased at an average annual rate of 6.1 % during the same period (refer to Table-A1.9).

Table-A1.9 Production of Selected Manufactured Products

Products	Units	Production					Average Annual Growth Rate (%)
		1991	1992	1993	1994	1995	
1. Gold	kg	2,743	3,701	3,784	3,440	3,477	6.1
2. Silver	kg	477	1,258	1,112	1,386	1,572	34.7
3. Cement	1,000 ton	79	84	80	94	91	3.6
4. Beer	mega liter	18	17	17	16	15	-4.5
5. Paints	1,000 liter	2,339	2,535	2,795	2,626	2,363	0.3
6. Soap	ton	7,068	6,891	7,002	7,248	7,070	0
7. Matches	1,000 Gross Box	147	142	145	162	167	3.2
8. Electricity	million kwh	474	470	480	520	544	3.5
9. Ice Cream	1,000 liter	2,450	2,479	2,772	2,930	2,755	3.0
10. Soft Drinks	1,000 liter	8,186	9,173	10,292	8,962	9,941	5.0
11. Toilet Paper	1,000 roll	9,676	9,780	9,719	11,543	11,190	3.7

Source: Bureau of Statistics, 1996

3) Tourism

Together with the sugar industry, tourism is one of the most important industries of Fiji for earning foreign currencies. In 1995, visitor arrivals in Fiji were 318,494, of which 80 % were on vacation. During the period from 1991 to 1995, the arrivals increased at the annual rate of 5.3 % on average (Table-A1.10). Of these tourist, 24.6 % were Australians, 18.5 % New Zealanders, 14.2 % Japanese, 12.5 % Americans and 7.7 % British in 1995.

Table-A1.10 Visitor Arrival by Purpose of Visit

Unit: person

Purpose of Visit	1991	1992	1993	1994	1995	Share in 1995 (%)	Average Annual Growth Rate (%)
Business	12,524	13,442	15,685	17,729	16,570	5.2	7.2
Conference	5,589	5,280	5,038	6,412	7,279	2.3	6.8
Holiday	209,146	228,715	233,081	256,425	255,973	80.4	5.1
Visiting Friends/Relatives	14,146	16,997	16,912	19,619	21,487	6.7	11.0
Education/Training	2,621	2,727	2,725	3,350	3,660	1.1	8.7
Others	15,324	11,571	14,021	15,339	13,664	4.3	-2.8
Total	259,350	278,534	287,462	318,874	318,494	100.0	5.3
Expenditure(F$ Mil)	286	328	347	393	442		11.5

Source: Bureau of Statistics, 1996

Table-A1.11 provides situations of capacity and occupancy of hotels in Fiji for the period of 1991 ~ 1995. During this period, the room and bed capacities of hotels increased at the annual rate of 3.8 % and 2.9 % respectively, with total of 1,880,812 rooms and 4,901,068 beds in 1995. Of these capacities, the occupancies were 1,013,011 of rooms and 1,965,328 of beds, corresponding to 53.9 % and 40.1 % of the respective total capacities in the same year.

Table-A1.11 Capacity and Occupancy of Hotel in Fiji

Capacity/Occupancy	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
1.Capacity						
Number of Rooms	4,466	5,050	5,059	5,065	4,913	2.4
Room Capacity (persons)	1,617,168	1,717,679	1,845,929	1,848,725	1,880,812	3.8
Number of Beds	12,071	13,330	13,384	14,554	12,712	1.3
Bed Capacity	4,366,564	4,592,502	4,905,306	4,844,703	4,901,068	2.9
2.Occupancy						
Room Sold	839,110	878,323	893,113	1,007,849	1,013,011	4.8
Bed Sold	1,641,816	1,717,595	1,770,815	1,976,638	1,965,328	4.6
Room Occupancy (%)	51.6	51.1	48.4	54.5	53.9	1.1
Bed Occupancy(%)	37.6	37.4	36.1	40.8	40.1	1.6

Source: Bureau of Statistics, 1996

(5) Prices

Table-A1.12 shows the consumer price index of Fiji for the period from 1993 to 1995. Annual escalation rate for all items recorded 1.4 % on average for the said period, of which the alcoholic drink & tobacco and service sectors showed comparatively high escalation rates of 5.4 % and 3.7 % per annum, respectively. Meanwhile, the inflation rate of Fiji during 1993 ~ 1995 showed 2.7 % on average.

Table-A1.12 Consumer Price Index and Inflation Rate

Base Year 1993 = 100

Items	Price Index				Average Annual Rise Rate(%)
	Weight	1993	1994	1995	
Foods	353.6	100.0	100.5	101.2	0.6
Alcoholic Drinks and Tobacco	61.3	100.0	105.9	111.0	5.4
Housing	164.9	100.0	100.6	103.2	1.6
Heating & Lighting	49.0	100.0	99.3	99.5	-0.3
Durable Housing Goods	65.2	100.0	99.8	100.0	0.0
Clothing and Foot Wear	53.9	100.0	99.4	101.4	0.7
Transport	128.5	100.0	100.7	105.4	2.0
Services	75.8	100.0	103.0	107.7	3.6
Miscellaneous	47.8	100.0	99.5	101.0	0.5
All Items	1,000	100.0	100.8	103.0	1.4
Average Annual Inflation Rate (%)		5.2	0.6	2.2	

Source: Bureau of Statistics, 1996

(6) External Trade and Payments

1) Export

In 1995, Fiji's exports amounted to F$ 869.9 million, of which domestic exports and re-exports were F$ 764.5 million and F$ 105.5 million, respectively. During the period of 1991 ~ 1995, the annual growth rate showed 7.1 % on average (refer to Table-A1.13).

Table-A1.13 External Trade

Unit: F$ 1,000

Items	1991	1992	1993	1994	1995	Average Annual Growth Rate (%)
Export	664,599	666,971	692,402	800,495	869,941	7.0
Domestic	554,785	554,778	588,389	657,041	764,481	8.3
Re-Export	109,814	112,198	104,013	143,454	105,460	-0.1
Import	961,767	947,110	1,109,807	1,209,852	1,218,934	6.1
Trade Balance	-297,168	-280,134	-417,405	-409,357	-348,993	

Source: Bureau of Statistics, 1996

Principal commodities of domestic export are sugar, fish, molasses, cork & wood, garment and gold. Export of sugar, which ranked first and had a share of 37.8 % in value to the total domestic export commodities, amounted to F$ 276.1 million in 1995 with an increase by F$ 23.9 million compared with the 1994 export, but its quantity in 1995 decreased 26,000 tones compared to that in 1994. Following sugar, garments and gold ranked second and third, respectively, with value of F$ 185.0 million and F$ 58.6 million in 1995 (refer to Table-A1.14)

Table-A1.14 Principal Domestic Export Commodities

Unit: Quantity = 1,000kg, Value = F$ 1,000

Commodities	1991		1992		1993		1994		1995		Share in 1995
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	
Fish											
Canned	5,692	35,789	5,667	28,726	4,736	31,425	9,798	39,134	6,981	34,153	4.7
Others	–	16,895	–	10,581	–	11,819	–	16,697	–	29,706	4.1
Bakery Products	949	1,593	1,112	1,860	1,355	2,089	1,094	1,838	1,395	2,096	0.3
Pasta	–	4,100	–	4,545	–	4,858	–	4,693	–	3,418	0.5
Taro	863	964	1,550	2,001	512	549	3,491	5,542	5,591	7,952	1.1
Sugar (1,000 tones)	357	220,400	365	221,281	439	230,680	471	252,183	445	276,112	37.8
Molasses (1,000 tones)	155	13,300	137	13,111	118	9,991	140	13,602	189	21,301	2.9
Ginger											
Green	1,578	2,599	1,233	1,636	974	1,432	1,015	1,488	1,030	1,475	0.2
Others	–	1,986	–	1,132	–	21	–	66	–	488	0.1
											0.0
Cigarette	3	67	0	7	0	1	1	1	1	9	0.0
Cork & Wood											
Woodchips	–	14,381	–	51,818	–	18,179	–	15,827	–	32,234	4.4
Others	–	5,141	–	5,366	–	12,780	–	15,389	–	12,893	1.8
Trochus Shell	68	626	71	674	52	617	66	657	52	482	0.1
Coconut Oil (1,000 Tones)	3	1,354	7	4,760	7	3,667	4	3,787	4	3,899	0.5
Paint & Enamels	195	862	143	679	198	1,029	251	873	194	829	0.1
Veener Sheet ($1,000m^3$)	3	3,067	4	4,036	4	3,673	5	4,319	4	3,971	0.5
Plywood ($1,000\ m^3$)	3	1,352	1	1,283	3	1,495	2	1,777	33	2,440	0.3
Cartons, Boxes & Cases	–	3,643	–	3,813	–	4,616	–	4,445	–	49,132	6.7
Portland Cement (1,000 tones)	17	1,865	4	528	3	360	1	197	12	1,283	0.2
Iron & Steel											0.0
Roofing Sheets	–	1,791	–	2,730	–	1,527	–	1,903	–	1,333	0.2
Others	–	766	–	1,434	–	1,036	–	1,975	–	1,036	0.1
Garments	–	131,123	–	116,794	–	128,769	–	140,988	–	185,005	25.3
Gold (Quantity: grams)	2,704	46,612	3,694	60,723	3,784	33,746	3,501	62,607	3,410	58,598	8.0
Total		510,276		539,518		504,359		589,988		729,845	100

Source: Bureau of Statistics, 1996

2) Import

Fiji's imports amounted to F$ 1,218.9 million in 1995 on the increase at an average annual rate of 6.1 % since 1991. Major import commodities of Fiji are manufactured goods, machinery, foods, mineral fuel, chemicals, etc. Among them, manufactured goods and machinery showed F$ 337.0 million and F$ 278.0 million, respectively, or the proportion to the total imports was about 27.6 % and 22.8 %. The average annual growth rate of imports were 6.1 % for total commodities, 8.2 % for manufactured goods and 6.5 % for machinery, during the period of 1991 ~ 1995 (refer to Table-A1.15).

Table-A1.15 Imported Commodities

Unit: F$ 1,000

Commodities	1991	1992	1993	1994	1995	Share in 1995	Average Annual Growth Rate (%)
Foods	141,444	136,192	166,939	165,889	182,314	15.0	6.5
Beverage and Tobacco	7,888	8,133	9,863	10,489	13,182	1.1	13.7
Crude Material	7,864	7,198	6,423	7,023	9,106	0.7	3.7
Mineral Fuel	146,326	133,487	132,710	137,525	137,470	11.3	-1.5
Animal and Vegetable Oil and Fats	10,087	11,329	13,138	12,679	16,487	1.4	13.1
Chemicals	72,525	78,634	82,142	89,521	92,835	7.6	6.4
Manufactured Goods	245,175	239,342	251,559	278,999	336,961	27.6	8.2
Machinery	216,265	233,473	306,255	377,204	277,783	22.8	6.5
Miscellaneous							
Manufactured Articles	104,005	90,150	126,590	118,476	139,333	11.4	7.6
Transaction	10,188	9,172	14,188	12,320	13,463	1.1	7.2
Total	961,767	947,110	1,109,807	1,209,852	1,218,934	100.0	6.1

Source: Bureau of Statistics, 1996

3) Balance of External Trade and Payments

External trade balance of Fiji showed a deficit every year during the period of 1991 ~ 1995. The trade deficit amount per annum was F$ 351 million on average. However, the trade deficit has been mostly compensated by services account of tourism and others. Nevertheless, the overall balance showed a deficit in 1993 through 1994, due to the unfavorable balance of accounts of investments and private transfers (refer to Table-A1.16).

Table-A1.16 Balance of External Payment

Unit: F$ million

Items	1991	1992	1993	1994	1995
Good and Service (net)	-45.5	-27.0	-152.9	-55.5	-63.1
Factor Services (net)	-58.5	-75.2	-83.6	-126.1	-104.9
Private Transfers (net)	-36.3	-24.5	-17.1	-34.8	-37.2
Government Transfers (net)	142.1	141.9	123.6	105.4	149.7
Current Account Balance	1.8	15.2	-130.0	-111.0	-55.5
Capital (excluding Reserves)	-26.4	88.2	20.7	41.1	106.2
Errors and Omissions	37.3	-14.3	38.9	53.3	58.2
Overall Balance	12.7	89.1	-70.4	-16.6	108.9

Note: Factor Services includes investment income.
Source: Ministry of Finance and Economic Development (1996. 11)

(7) Government Finance - Revenue and Expenditure

1) Central Government

The 1992 Budget announced changes to compensate income tax payers for the introduction of VAT, which became effective on 1st July, 1992. The changes raised the tax threshold significantly, abolished basic tax, aligned company tax with the top personal tax rate and reduced the number of tax bands.

In 1995, the revenue and expenditure of the Central Government amounted to F$ 718.9 million and F$ 804.1 million on the increase at an average annual growth rates of 5.7 % and 5.3 % respectively, during the period of 1991 ~ 1995.

Table-A1.17 Current Revenue and Expenditure of Central Government

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995
Revenue	574,970.5	602,306.1	654,086.8	697,810.7	718,904.2
General Revenue	562,517.8	588,809.1	645,773.1	689,022.8	705,987.9
Capital Revenue	12,452.7	13,497.0	8,313.7	8,787.9	12,916.3
Expenditure	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5
Operating Expenditure	550,678.7	602,059.5	688,703.2	663,975.4	688,674.0
Capital Expenditure	107,771.1	95,108.7	94,450.3	106,687.5	86,020.3
VAT		16,670.3	35,638.4	33,398.5	34,418.2
Balance	-83,479.3	-111,532.4	-164,705.1	-106,250.7	-90,208.3

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

The revenue is represented by two major components; 1) customs, and port and harbor dues, and 2) income tax, estate and gift duties and Value Added Tax (VAT). In 1995, the revenue from the former amounted to F$ 207.8 million (28.9 % of the total revenue). The latter revenue amounted to F$ 395.1 million (55.0 % of the total revenue). The annual increase rates of both revenues were -1.5 % and 14.6 % respectively, during the period of 1991 ~ 1995. The grant aid from overseas donors is an important revenue source for financing various capital investment by the Government.

Table-A1.18 Breakdown of Central Government Revenue

(Unit: F$ 1,000)

Heads of Revenue	1991	1992	1993	1994	1995
REVENUE	574,970.5	602,306.1	654,086.8	697,810.7	718,904.2
General Revenue	562,517.8	588,809.1	645,773.1	689,022.8	705,987.9
- Customs, Port and Harbour Dues, etc.	220,483.1	198,733.5	179,435.9	190,785.5	207,838.9
- Income Tax, Estate and Gift Duty, VAT	229,205.1	284,369.4	348,567.5	375,522.3	395,081.6
- Licences, Fees, Royalties, Sales and Reinbursement	60,238.2	57,548.4	64,077.4	58,608.1	56,942.0
- Others	52,591.4	48,157.8	53,692.3	64,106.9	46,125.4
Capital Revenue	12,452.7	13,497.0	8,313.7	8,787.9	12,916.3
- Grant Aid	7,303.7	7,189.5	4,114.8	4,458.8	6,274.2
- Others	5,149.0	6,307.5	4,198.9	4,329.1	6,642.1

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

The expenditure of Central Government consists mainly of departmental expenditure and public debt charge. In 1995, these expenditures were F$ 566.0 million and F$ 161.5 million which accounted for 70.0 % and 20.0 % of the total expenditure, respectively.

During the period of 1991 ~ 1995, the annual increase of them were 4.2 % and 4.3 %, respectively.

Table-A1.19 Breakdown of Central Government Expenditure

(Unit: F$ 1,000)

Heads of Revenue	1991	1992	1993	1994	1995
EXPENDITURE	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5
Departmental Expenditure	479,539.7	529,237.1	584,125.3	580,191.2	566,018.8
Miscellaneous Services	19,237.6	18,552.9	19,467.6	17,467.7	17,585.8
Pension Gratuities and Compassionate Allowances	23,330.0	25,833.8	26,591.0	28,903.0	29,559.6
Public Debt Charge	136,342.5	123,544.4	152,969.6	144,101.0	161,530.1
VAT		16,670.3	35,638.4	33,398.5	34,418.2

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

2) Expenditure by Functional Categories

Table-A1.20 shows the expenditure by functional categories. The capital expenditure of Government averaged F$ 98.0 million in the period of 1991 ~ 1995. The averages of capital expenditure for infrastructure development were 40.9 million.

Table-A1.20 Expenditure by Functional Categories

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995	Average
Government Total						
Operating Expenditure	550,678.7	602,059.5	688,703.2	663,975.4	688,674.0	-
Capital Expenditure	107,771.1	95,108.7	94,450.3	106,687.5	86,020.3	98,007.6
VAT		16,670.3	35,638.4	33,398.5	34,418.2	-
total	658,449.8	713,838.5	818,791.9	804,061.4	809,112.5	-
of which						
Infrastructure						
Operating Expenditure	56,765.9	67,527.3	73,235.2	63,878.5	61,278.1	-
Capital Expenditure	30,093.1	28,925.3	48,288.9	50,093.7	47,085.3	40,897.3
VAT		4,613.3	9,332.0	9,557.7	9,733.2	-
total	86,859.0	101,065.9	130,856.1	123,529.9	118,096.6	-
of which						
MIPW inclusive Marine Dept. and Road Transport Dept.						
Operating Expenditure	43,676.0	48,446.4	56,779.9	48,627.1	46,025.6	-
Capital Expenditure	27,986.0	27,035.2	45,818.6	47,244.8	45,579.9	38,732.9
VAT		4,070.3	8,331.7	8,539.2	8,569.4	-
total	71,662.0	79,551.9	110,930.2	104,411.1	100,174.9	-
MAFFA inclusive Dept. of Forests						
Operating Expenditure	19,298.1	20,713.6	27,523.4	22,659.4	22,859.9	-
Capital Expenditure	16,482.7	15,826.4	5,120.8	9,627.2	6,659.9	10,743.4
VAT		1,908.2	2,697.7	2,577.9	2,449.8	-
total	35,780.8	38,448.2	35,341.9	34,864.5	31,969.6	-

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

3) Overseas Assistance and Loans

Table-A1.21 shows the flow of the foreign grant aid and loan disbursement to the Government. In 1995, the amount of grant aid and overseas loan was F$ 27.4 million in total.

Table-A1.21 Foreign Aid

(Unit: F$ 1,000)

	1991	1992	1993	1994	1995	Average
A. Grant Aid (Capital Receipt)	7,303.7	7,189.5	4,114.8	4,458.8	6,274.2	5,868.2
B. Overseas Loans	21,597.9	11,302.1	11,825.0	31,054.1	21,137.7	19,383.4
C. Domestic Loans	50,624.1	61,950.6	61,950.6	83,626.4	101,003.2	71,831.0
- Overseas Assistance (A+B)	28,901.6	18,491.6	15,939.8	35,512.9	27,411.9	25,251.6
- Total Loan (B+C)	72,222.0	73,252.7	73,775.6	114,680.5	122,140.9	91,214.3

Source: Ministry of Finance and Economic Development, 1993 ~ 1997

(8) Transport and Communication

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), current conditions on transport and communication are described as follows.

1) Roads

In 1986, the total road length of Fiji amounted to 4,839 km consisting of 1,302 km of main roads, 643 km of secondary roads, 2,678 km of residential roads and 106 km of other roads. In the Viti Levu island, the main roads are represented by Kings Road and Queens Road, which are 486 km in length and run the circumstance of the island. The road distribution in the country uniforms comparatively; 1,525 km in the Central and Eastern Division, 1,676 km in the Western Division and 1,638 km in the Northern Division.

The public investment for the road network shows its expansion from around 2,600 km in 1970 to around 4,800 km in the mid 1980's. Since then the emphasis has shifted from extension of network to maintenance of existing roads. The road network now totals around 5,100 km of which 1,030 km are sealed. Viti Levu and Valua Levu account for 90 percent of the total network and Viti Levu accounts for 90 percent of the sealed roads.

Meanwhile, since 1983 there have been a number of major road projects undertaken;

- Fiji Road Upgrading Project (FRUP) Stage 1: The project started in 1987 and 121.2 km road upgraded and 24 new bridges constructed. The F$ 59 million project was co-funded by the World Bank and Fiji government.
- Road Maintenance Sector Project: Under this project, the rehabilitation and maintenance works were carried out on main roads, rural roads and major bridges.

A National Road Safety Council (NRSC) as a statutory authority was formed in 1995 with responsibility for overall coordination of road safety activities in Fiji.

2) Shipping

Since Fiji comprises more than 300 islands, shipping is a vital means of transport for people living in the outlying areas. The inter-island shipping fleet is a mix of private and government vessels. Larger roll-on roll-off ferries have been introduced on the busier routes, and there has been a reduction in the number of private operators involved in the industry.

The Port Authority of Fiji administers three international ports; Suva, Lautoka and Levuka. Major redevelopment of the Port of Suva and Lautoka has been completed. Suva and Lautoka have wharf facilities with the capacities to cargo vessels and the largest cruise liners. Lautoka port has bulk handling facilities for sugar and wood chips, and a major upgrading is in progress.

3) Air Services

The international airports are located at Suva and Nadi. The expansion of Nadi airport was implemented with a cost of F$ 10 million in 1987 ~ 88. Nadi, the principal international airport, is owned and operated by the Civil Aviation Authority of Fiji (CAAF). The CAAF is also contracted by Government to operate other domestic airports. Air Pacific (78 % government owned) is the center of the international air services. In the domestic arena, there are several airlines serving in Fiji.

4) Telecommunications

Fiji is equipped with both internal and international telecommunications. All major towns have digital telephone exchanges and the islands are linked by cable and satellite to worldwide network. Telex facilities are available over the country and facsimile machines are in wide use.

At the beginning of 1990, the old Telecommunications Department was replaced by Fiji Post and Telecommunications Ltd., a private company wholly owned by the Government. FPTL currently consists of the Telecom Fiji Ltd., and Posts Fiji Ltd.

(9) Energy and Electricity

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), the current situation of energy and electricity in Fiji is summarized as follows.

1) Energy

Fiji's current energy demands are met from numerous of sources including hydro and diesel generated electricity, fuel wood, bagasse, coal and petroleum products. In 1992, Fiji imported F$ 133 million worth of petroleum which amounted to about 6 % of the GDP. In 1992, transport sector accounted for 68 % of the fuel consumption. The industrial sector used up 18 %, domestic 9 % and the Government 5 %.

Fiji continues to seek alternative sources of energy to supplement its large import bill. The Department of Energy is continuing investigations to assess the economic viability of renewable energy sources, such as wind, geothermal and hydro power. Solar lighting systems are being promoted for rural electrification.

2) Electricity

At present, electricity in Fiji is supplied for more than 50 % of the total number of household; 75 % of urban households and 30 % of rural households. The Fiji Electricity Authority (FEA), which was established in 1966 under the Electricity Act of Fiji, provides nearly 95 % of the whole power supply in Fiji. FEA is responsible for generation, transmission and distribution of electricity in Fiji. FEA's responsibilities extend to the administration of technical and safety regulations. FEA operates six separate supply systems of which the hydro based Viti Levu Interconnected System (VLIS) is the largest, accounting for more than 90 % of the total FEA sales.

The Monasavu hydro-electricity project opened in 1983, is the largest energy diversification project undertaken in Fiji, resulting in annual saving of F$ 22 million in terms of petroleum import. However, The Monasavu project which generates 95 % of Viti Levu's electricity needs has now reached its maximum generation capacity, requiring diesel backup in times of peak demand. The industrial sector stays as the main consumer of electricity, accounting for more than two-third of total electricity consumption.

Rural electrification (RE) has been given a high priority by the Government. The formation of a RE Unit (REU) is part of the Government's commitment to ensure effective implementation of the policy. The new RE policy is based on a user pays principle with rural consumers paying 10 % of the capital costs and the Government, 90 %. The policy offers consumers the choice of electrification system from diesel, grid connections, solar and hydro.

(10) Water and Sewerage

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), water and sewerage in Fiji are described as follows.

1) Water

Water is one of the nation's most important resources and availability of adequate water supplies is the prerequisite for health of the nation and development activities. About 70 % of the total population have access to proper piped water supplies. The Government funds the development of regional and urban water supplies and also carries out the construction, operation and maintenance of these schemes through the Water and Sewage Division of the Public Works Department. The Government also assists rural communities in developing water supplies through the rural self help scheme, where communities provide one third of cost of materials and free labor. Assistance has been provided in the development of over 1,400 rural water supply scheme since 1965.

The Department of Mineral Resources undertakes hydro-geological investigation designed to identify potential groundwater sources, particularly in outer islands and rural areas of main islands.

2) Sewerage

It is estimated that 12 % of Fiji's population have access to treated sewage facilities, compared to 6 % in 1980. It is also estimated that 57 % of all urban areas have sewerage. Cost recovery is low, with 15 % of annual expenditure (including capital expenditure)

being recovered through charges for sewerage services. Town and city councils were traditionally responsible for sewerage services within their boundaries, but these responsibilities have transferred to the Central Government.

(11) Education and Health

Based on the information from Ministry of Information (1997) and the Government of Republic of Fiji (1993), current status of education and health in Fiji are described as follows.

1) Education

About a quarter of the entire population is of school-going age and although education is not compulsory at any stage, over 98 % of children between 6 and 14 years of age are attending primary schools. The Education for All by Year 2000 Programme will continue, aiming to phase in compulsory primary education for all by the year 2000.

There is a high degree of community participation in the delivery of education services. Most schools are managed by non-governmental organizations. The Government operates only 2 % of the primary schools, 8 % of the secondary schools, 8 % of vocational and technical education schools, and two out of the five teachers training institutions.

The pupil-teacher ratio at the primary school level is around 1:31 with a lower ratio (1:20) in the rural area and higher ratio (1:42) for the urban area. Many secondary schools are staffed with unqualified teachers. The Fiji College of Advanced Education (FCAE) has been established to rectify this deficiency. The FCAE trains teachers at diploma level for junior secondary teaching. Expansion and improvements of facilities at the FCAE will be incorporated in the education and training investment programme of the Government.

Vocational and technical education is necessary for securing skilled labor. The Fiji Institute of Technology (FIT) is country's main technical education center. What is more, new directions in agro, technical and vocational education will be developed through diversification of school based programme to cater for the lower to medium level of skilled workers, now much demand in Fiji's economy.

Meanwhile, the University of the South Pacific (USP), established in 1968 and located in Suva, is the only regional university in its kind in the world, belonging to 12 Pacific island countries. In the past 25 years, the university has grown, and now has a campus in Western Samoa and centers in ten member countries.

The main components of government policies and strategies in education and training are as follows;

- to ensure the education system to be sensitive to changing needs of the community and economy
- to increase access to education, especially for the rural and urban poor
- to provide a balanced programme of both academic and practical course for the full development of Fiji's youth in rapidly changing society

- to retain the strength inherent in a high level of community participation in education system, while improving efficiency through more effective planning of resource allocation
- to develop vocational and technical education in response to, and to cater for, market demands
- to improve the quality of education by resourcing schools with qualified teachers and materials

2) Health

Fiji generally has a good standard of health. People are living longer with life expectancy of 61.4 years for male and 65.2 years for female. Infant mortality rate has fallen by over 37 % over the last ten years and is now 16.6 deaths per 1,000 live births at present. Good obstetrical services contribute to the lower infant death rate. Effective control has been achieved over childhood infectious diseases. The active immunization program where the coverage rate for 1995 was reported to be 94 % or more. There are 409 village clinics, 100 nursing stations, 74 health centers, 16 sub-divisional hospitals, three divisional hospitals and two specialty hospitals in the country. The ratio of doctor-population as projected in 1992 is 1:2448. Using the 1996 population, the nurse-population ratio is about 1:312.

Main policies and strategies for the development of the health sector are as follows;

- to provide preventive and primary health care, clinical and rehabilitative facilities with adequate manpower resources
- to encourage involvement of local communities in health care
- to ensure attainment of a population growth which is conductive to better standard of living
- to upgrade and strengthen training institutions in an effort to provide a well trained and highly skilled force
- to review the organization of health service delivery to improve efficiency and provide effective incentives

1.1.2 Present Situation of Study and Inundated Area

(1) Area and Population in Study Area

The total area of the four watersheds, namely the Rewa, the Sigatoka, the Nadi and the Ba, is approximately 6,000 km^2. The population of 1996 was calculated by using the latest available tikina figures of 1986 census as the basis and adopting the average annual growth rate of 0.8 % during 1986 and 1996. The population in 1996 was estimated at around 228,000 in the four watersheds, which accounts for 29.5 % of the total population of 772,655. The future population of the watershed was projected and described in the Section 1.2.1.

(2) Area and Population in Inundated Area

1) General

The Flood Damage Survey of the Flood Prone Areas was conducted by JICA Study Team in cooperation with Fiji counterpart personnel, and the questionnaire survey was carried out by a local contractor in the six cites of major Viti Levu rivers in five watersheds, including the Navua watershed. According to the report from the contractor, most sufferers recall the flood incidents of the cyclone Kina of 1993 other than the incidents of, say 1990 and/or 1995 flood.

The questionnaire survey was conducted mainly for the purpose of obtaining the average sample data of income, general assets, agricultural field crops, etc. under the various conditions of inundation, which shall be helpful for the analysis and evaluation of the flood damage of concerned areas. The various figures collected are consolidated and used in Supporting Report Part E.

2) Population and Area

By the leveling survey of flood marks, interview to the district officers and the sufferers in the inundated area of the cyclone Kina in 1993 was estimated at about 21,700 ha in the objective four watersheds. The population in the inundated areas was also estimated by identifying towns and villages in inundated areas on the 1: 50,000 maps, summing up the population of each town and village in 1986 first, and then projecting the population in 1993 with annual growth rate of 0.8 %. As a result, the total population suffered by the cyclone Kina in the objective four watersheds was estimated at 44,500.

3) Information Collected by the Survey on Inundated Areas

a) Rewa-1

Lower reach area of the Rewa river basin, extending over Rewa, Nako, Nakelo, and Bau tikina. This wide delta area has a long history of frequent flooding. The people living there have such a thoughts that the area is located on one of the wettest parts of Viti Levu, and much of the damages in the north eastern delta area were caused by the sudden rise of the tidal Waidamu river. And also they believe that the floodgate which enhances desalination acted as a dam after flood by the cyclone Kina and had subsided causing heavy silt problems. The region was previously dominated by sugarcane land of large holding but now many of them have fragmented into small scale subsistence farming with a peri-urban setting.

b) Rewa-2

The interviews were carried out mainly in the area of Namuamula, Baulevu, Delaiwaikalou and Kasavu of Naitasiri tikina. This area had the worst hit encountered in the course of interviews, especially the southern side of Rewa river. In some places of this area, flood waters rose to roof level. This area is basically a market garden farming area, that provide most of the vegetables to Nausori market. Major damages to all types of vegetables grown here experienced heavy loss of crops. It is reported that the flood waters receded normally but the slit deposited on the whole area ranging in depth from 30 to 100 cm caused a major problem, and that it took six months for the farmers to realize pre-flood crop production.

c) Rewa-3

The interviews were exercised in the areas of Maitailobau, Waimaro, Vunindawa and Serewa of Naitasiri tikina in upper basin of the Rewa river. Vunindawa area is predominantly a dairy farming area with the concentration on the river flats which was created by the confluence of upper major river tributaries of the Rewa, the Wainimala and the Wainibuka river. In the event of the cyclone Kina, it is interviewed that the river rose 22 m above the normal flow level at the Nataveya channel acting as a bottleneck. Flooding in this area is a perennial experience, hence major settlement and villages are located on safe level ground. In this area, sufferers are mainly recent settlers who were not familiar with or reminded of the 1931 flood disaster which affected all the major rivers of Viti Levu. Most farmers took the usual precaution of moving livestock to higher grounds, but strong winds drove the animals to the flat to seek the shelter. Hence most farmers sustained heavy losses of livestock when water level rose quickly through night amidst high wind. The duration of inundation ranged from half an hour at Nairukurukuru village to five days at Kabara Farm located at downstream from Nabaitavo village. There is no record of damages from either of the cyclone Sina and 1995 flood in Vunindawa area.

d) Sigatoka

The interviews were done along the river, namely from Sigatoka and Raiwaka to Bilalevu and Vunarewa. Sufferers are generally accommodated near the foot of the hill and on high ground level, and could easily evacuate to higher grounds. The results of the interview, however show that the water level was raising so fast or all of a sudden at the time of the cyclone Kina. The sufferers, for example in Korokoro village, moved to higher grounds to survive themselves leaving every thing behind. It is reported that most of the flood damages were caused by the high level of debris which washed down the household effects, livestock and agricultural products as well.

e) Nadi

In this area, the interviews were carried out around the areas of Nawaka, Narewa and Saunaka, which were identified by the District Officers and the Town Engineer. At the time of the cyclone Kina, in the lower delta area, flood waters rose very quickly. In the town areas it was found that town was flooded from the Sigatoka side and not from the Lautoka side. This occurred allegedly due to the quick flooding at the confluence of the Malakua, the Nawaka and Nadi rivers causing the waters to back up toward the town areas. According to the report, this effect can be gleaned from the fact that even in times of moderate rainfall, the railway crossing at the main road just before the town always floods, and it does not take much rain for this to happen. Nadi town was "cut off from the rest of the island" because of this effect as the same thing happened north of the town. Crops, such as rice, root crops, vegetables and sugarcane were damaged in this area.

f) Ba

The interviews were exercised in the down stream area of the Ba river, namely around Nasolo, Maurura, Yalalevu and Vadraulailai. Ba is predominantly a sugarcane farming area. Inundation here mainly affected cane farms where in the main crops might not so much suffer from flood damages, but newly planted cane were damaged to certain extent. There were allegedly exceptional cases where high banks caused water

to be trapped in flat depressions with drainage problems. Here the standing cane crops, partly submerged under water for several days, might rot at the roots and could not survive to maturity. Cane farmers, generally well reminded of the 1931 cyclone disaster from their elders and mill advisers, mostly had built their houses just out of reach of major flood levels. However the new settlers to this area might have no recollection of previous disasters and tend to make their dwellings in the lower flat, and were the main sufferers. This phenomenon was observed in Koronubu and Veisaru area for example. Most house damages by flood were caused by debris, particularly floating logs, when riding downstream with great force and breaking the weak building structures in its way.

1.2 Future Projections

1.2.1 Population Projections

(1) Growth Rate of Population

The growth rate for population projections had been prepared by the Bureau of Statistics based on the different sets of assumptions on fertility, mortality and migration. The growth rates were made by component populations, such as Fijians, Indians and others, under three different variants; High, Medium and Low (refer to Table-A1.22).

Table-A1.22 Average Annual Growth Rate of Population

(unit: %)

Ethnic Origin and Variant		1996-2001	2001-2006	2006-2011	2011-2016
Fijian	High	1.9	2.0	1.9	1.8
	Medium	1.7	1.6	1.5	1.3
	Low	1.6	1.4	1.3	1.2
Indian	High	0.8	1.3	1.2	1.1
	Medium	0.4	0.2	0.5	0.3
	Low	-0.01	-0.1	-0.1	-0.4
Others	High	2.4	2.3	2.1	1.9
	Medium	0.9	0.9	0.8	0.6
	Low	-0.01	-0.1	-0.1	-0.4
Total	High	1.5	1.7	1.7	1.5
	Medium	1.1	1.2	1.1	0.9
	Low	0.9	0.9	0.7	0.5

Source: Bureau of Statistics, 1997[2)]

(2) Population Projections of Fiji

The population projections were made based on the average annual growth rates given by the Bureau of Statistics, as Scenario A (High Variant), Scenario B (Medium Variant) and Scenario C (Low Variant) from 1996 to 2015,which are shown in the Table-A1.23. Since the provisional result of census 1996 provided the Fiji Population by ethnic origin only, (not by male and female), the calculation has been done accordingly.

Table-A1.23 Population Projection of Fiji

(persons)

Ethnic Origin	Year	Scenario A High Variant	Scenario B Medium Variant	Scenario C Low Variant
1. Fijians	1996 (Base year)	394,999	394,999	394,999
	2001	433,977	429,735	427,626
	2006	479,146	465,232	458,410
	2011	526,428	501,187	488,992
	2015	565,366	527,761	512,889
2. Indians	1996 (Base year)	336,579	336,579	336,579
	2001	350,259	343,365	336,411
	2006	373,626	346,812	334,732
	2011	351,740	355,569	333,062
	2015	367,474	359,856	327,765
3. Others	1996 (Base year)	41,077	41,077	41,077
	2001	44,252	42,959	42,959
	2006	48,143	44,927	44,927
	2011	52,377	46,753	45,107
	2015	56,425	48,173	46,477
4. Total	1996 (Base year)	772,655	772,655	772,655
	2001	828,488	816,059	806,996
	2006	900,915	856,971	838,070
	2011	930,544	903,510	867,161
	2015	989,264	935,789	887,131

Source: Bureau of Statistics, 1997[1)]
Bureau of Statistics, 1997[2)]

According to these projections, it is estimated that the Fiji's population will be approximately 936,000 in 2015 with an increase of 163,000 since the 1996 population census. The population growth for the period of 1986 ~ 1996 showed relatively low annual growth rates of 0.8 % mainly due to the decline of Indian population by the high rate of emigration coming out from a result of the event in 1987. There may be some opinion that this tendency of low growth shall continue in the future; however, in this Study the medium variant is adopted for the projection from 1996 to 2015 in safety. The population by ethnic origin in 2015 with medium variant will be 1.34 times for Fijians, 1.07 times for Indians and 1.17 times for others, respectively, compared with the figures of 1996.

(3) Population Projections in the Study Area

The Study Area extends over 28 tikinas. The area of the watershed in each tikina was measured and the population density of watershed in each tikina was also estimated. Besides, the population of every tikina in 1986 was given by 1986 census but those of 1996 census were unavailable. Therefore, the 1996 population of tikina was calculated adopting the annual growth rate of 0.8 % during 1986 and 1996. Using those data the population of the Study Area in 2015 of the High, Medium and Low Variant was estimated by tikina. The result is shown in Table-A1.24.

Table-A1.24 Estimate of Population in 2015 in the Study Area

Scenario	A (High)	B (Medium)	C (Low)
Population	308,114	279,438	263,045

As shown in Table-A1.25, the total population of each watershed in 2015 by medium variant shall reach approximately 279,000 with the increase of 51,000 or 1.22 times from 228,000 in 1996. This total population are composed of 141,000 (50 %) of the Rewa watershed, 32,000 (11 %) of the Sigatoka watershed, 50,000 (18 %) of the Nadi watershed and 57,000 (21 %) of the Ba watershed , respectively.

Table-A1.25 Population Projections by Watershed Area and by Medium Variant

Watershed	Division	Province	Tikina	1986 Census	Area(km2) in Watershed	Watershed Area(%)in Tikina	Adjusted by Populatyion Density(%)	Population in Watershed Area(1986)	Projection 1996	2001	2006	2011	2015
Rewa	Central	Rewa	Naco	1,796	19	100	100	1,796	1,945	2,054	2,181	2,303	2,387
			Suva	19,630	52	31	0	0	0	0	0	0	0
			Rewa	5,089	31	64	96	4,885	5,291	5,588	5,932	6,265	6,491
			Sub-total	26,515				6,681	7,236	7,642	8,112	8,568	8,881
		Tailevu	Nakelo	7,661	59	100	100	7,661	8,296	8,763	9,301	9,824	10,183
			Bau	20,631	70	71	96	19,806	21,448	22,654	24,047	25,399	26,325
			Verata	7,766	86	25	10	777	841	888	943	996	1,032
			Wainibuka	3,018	192	97	100	3,018	3,268	3,452	3,664	3,870	4,011
			Sawakasa	5,173	9	3	0	0	0	0	0	0	0
			Sub-total	44,249				31,261	33,854	35,758	37,955	40,089	41,552
		Namosi	Namosi	772	120	79	100	772	836	883	937	990	1,026
			Veivatuloa	2,353	10	7	0	0	0	0	0	0	0
			Sub-total	3,125				772	836	883	937	990	1,026
		Naitasiri	Naitasiri	85,534	208	81	50	42,767	46,314	48,918	51,925	54,844	56,845
			Waimaro	3,404	493	100	100	3,404	3,686	3,894	4,133	4,365	4,525
			Lomaivuna	5,092	143	100	100	5,092	5,514	5,824	6,182	6,530	6,768
			Matailobau	3,333	331	100	100	3,333	3,609	3,812	4,047	4,274	4,430
			Wainimala	2,864	443	100	100	2,864	3,102	3,276	3,477	3,673	3,807
			Sub-total	100,227				57,460	62,226	65,724	69,764	73,686	76,375
	Western	Nadroga	Navosa	4,971	39	5	0	0	0	0	0	0	0
		Ba	Tavua	25,509	2	0	0	0	0	0	0	0	0
		Ra	Rakiraki	15,325	63	18	0	0	0	0	0	0	0
			Saivau	7,109	273	70	50	3,555	3,849	4,066	4,316	4,558	4,725
			Nalawa	4,270	244	100	95	4,057	4,393	4,640	4,925	5,202	5,392
			Nakorotubu	4,581	205	56	50	2,291	2,480	2,620	2,781	2,937	3,044
			Sub-total	61,765				9,902	10,723	11,326	12,022	12,698	13,161
Rewa Total				235,881	3,092			106,076	114,875	121,333	128,790	136,031	140,995
Sigatoka	Western	Nadoroga	Sigatoga	11,237	105	50	100	11,237	12,169	12,853	13,643	14,410	14,936
			Baravi	7,293	31	7	1	73	79	83	89	94	97
			Ruailevu	5,041	402	100	100	5,041	5,459	5,766	6,120	6,465	6,700
			Navosa	4,971	612	76	99	4,921	5,329	5,629	5,975	6,311	6,541
			Sub-total	28,542				21,272	23,037	24,332	25,827	27,279	28,275
		Ba	Nawaka	9,742	76	15	4	390	422	446	473	500	518
			Magodro	6,106	121	25	19	1,160	1,256	1,327	1,409	1,488	1,542
			Tavua	25,509	101	16	4	1,020	1,105	1,167	1,239	1,308	1,356
			Sub-total	41,357				2,570	2,783	2,940	3,121	3,296	3,416
	Central	Naitasiri	Wainimala	2,864	5	1	0	0	0	0	0	0	0
Sigatoka Total				72,763	1,453			23,842	25,820	27,272	28,948	30,575	31,691
Nadi	Western	Ba	Nadi	34,215	93	64	80	27,372	29,642	31,309	33,233	35,102	36,382
			Nawaka	9,742	387	78	99	9,645	10,445	11,032	11,710	12,368	12,819
			Magodro	6,106	17			0	0	0	0	0	0
			Sub-total	50,063				37,017	40,087	42,341	44,943	47,470	49,202
		Nadroga	Navosa	4,971	19	3	1	50	54	57	60	64	66
Nadi Total				55,034	516			37,066	40,141	42,397	45,003	47,533	49,268
Ba	Western	Ba	Ba	44,416	285	81	85	37,754	40,885	43,181	45,838	48,415	50,181
			Magodro	6,106	320	65	85	5,190	5,621	5,937	6,301	6,656	6,899
			Tavua	25,509	271	41	1	255	276	292	310	327	339
			Sub-total	76,031					46,782	49,412	52,449	55,398	57,419
		Nadroga	Navosa	4,971	61	8	1	50	54	57	60	64	66
Ba Total				81,002	937			43,249	46,836	49,469	52,509	55,461	57,485
Grand Total				444,680	5,998			210,233	227,671	240,471	255,250	269,601	279,438

1.2.2 Projection of Gross Domestic Product (GDP)

(1) Past Trend of Gross Domestic Product (GDP)

Table-A1.6 in Section 1.1.1 (3) shows the past trend of GDP at current prices of Fiji which reached F$ 2,338 million in 1994 from F$ 1,811 million in 1990, and the per capita GDP at current prices which increased from F$ 2,474 to F$ 3,002 during the same period. Meanwhile, the GDP at 1977 constant price amounted from F$ 849 million in 1990 to F$ 937 million in 1994 and the per capita GDP at 1977 constant price increased from F$ 1,160 to F$ 1,203 during the same period.

(2) Future Trend of GDP

The figures of Table-A1.7 in Section 1.1.1 (3) indicate annual growth rate of GDP and the shares of the activities of the Primary, Secondary, Tertiary Industry and Imputed Service Charges in Fiji.

Using those figures, while taking the fact of limited amount of available past data into consideration, Scenarios of A (High), B (Medium) and C (Low) are assumed to be 5.0 %, 3.5 % and 2.0 %, respectively as the annual growth rate of total GDP at 1994 constant prices during the period 1994 ~ 2015 (Projection I). As a result, the GDP of 2015, using those annual growth rates and the GDP in 1994 of F$ 2,338 million at 1994 prices, is estimated as follows;

Table-A1.26 Estimates of GDP at 1994 Constant Prices in 2015 (Projection I)

Scenario	A (High)	B (Medium)	C (Low)
GDP (Million F$)	6,514	4,815	3,544

Those figures present that the real GDP will increase 2.8 times for High, 2.1 times for Medium and 1.5 times for Low Scenario during 1994 ~ 2015, respectively.

This Result (Projection I) was compared with another projection of GDP (Projection II) which is estimated from GDP per capita and population.

According to the past statistics, the real growth rate of GDP per capita for the period of 1990 ~ 1994 indicated 1.2 % on average ranging from -1.1 % to 2.6 %, as shown in the Table-4.6. Judging from those growth rates, the future trend of the annual growth rates for the period 1994 ~ 2015, are assumed to be 4.0 % for the Scenario A (High), 2.5 % for Scenario B (Medium) and 1.0 % for Scenario C (Low).

Using those annual growth rates and per capita GDP of F$ 3,002 in 1994, the per capita GDP at 1994 constant prices in 2015 is estimated as follows.

Table-A1.27 Estimates of GDP per Capita at 1994 Constant Prices in 2015 (Projection II)

Scenario	A (High)	B (Medium)	C (Low)
Per Capita GDP (F$)	6,841	5,042	3,700

According to the population projection made above, the 2015 population of Fiji is estimated at 935,789(by medium variant). The estimates of the population and the GDP per capita at 1994 constant prices would give another projection of the GDP in 2015, as shown below:

Table-A1.28 Estimates of GDP at 1994 Constant Prices in 2015 (Projection II)

Scenario	A (High)	B (Medium)	C (Low)
GDP (F$ Million)	6,402	4,718	3,462

The GDP (Projection II), which is estimated indirectly, is close to the foregoing direct estimate of GDP (Projection I), though slight somehow low value in general. The comparison of the results of GDP estimated by Projection I and II may show that Projection I by direct estimation might be a reasonable projection.

As for the activities of Primary, Secondary and Tertiary Industry, taking into consideration the past trend (Table-4.7) and the future prospects, that is, the share of the Primary Industry will decrease, and those of the Secondary and Tertiary Industry will increase, the shares of respective industry in 2015 are assumed to be 20 % for Primary, 19 % for Secondary, 64 % for Tertiary Industry and -3 % for Imputed Service Charges. As a result, in Medium Scenario, GDP of Primary Industry shall amount to F$ 963 million, Secondary Industry to F$ 915 million, Tertiary Industry to F$ 3,081 million and Imputed Service Charges to -144 million, respectively in 2015 (refer to Table-A1.29).

Table-A1.29 Estimate of Gross Domestic Product (GDP) of 2015 at 1994 Constant Prices

(F$ million)

Activities	GDP by Activity		2015 GDP by Activity			
	1994	Share (%)	High	Medium	Low	Share (%)
1. Primary Industry	521	22.3	1,303	963	709	20
2. Secondary Industry	404	17.3	1,238	915	673	19
3. Tertiary Industry (Commerce, Transport, Communication, Finance, etc.)	1,494	63.9	4,169	3,081	2,268	64
4. Imuputed Service Charges	-82	-3.5	-196	-144	-106	-3
All activities	2,338	100	6,514	4,815	3,544	100
GDP per Capita (F$)	3,002		6,961	5,145	3,787	
Population (persons)	772,655		935,789	935,789	935,789	

Remarks 1) Real Annual Growth Rates assumed to be 5.0 % for High Rate, 3.5 % for Medium and 2.0 % for Low.
2) Share in Industries in 2015 assumed to be 20 % for Primary,19 % for Secondary and 64 % for Tertiary Industry and 3 % for Imputed Service Charges .
3) Population projection based on Medium Variant.

Source: Bureau of Statistics, 1996 for GDP in 1994

1.3 Social Environmental Survey

1.3.1 General

The Social Environmental Survey of in and around project site of Nadi was conducted in the Study in cooperation with Fiji counterpart personnel, and the questionnaire survey was conducted by a local contractor. The objectives of the social environmental survey are to

acknowledge the present conditions of social environment of the project area and to provide data and information for equitable land acquisition planning as well as for the environmental impact assessment (EIA).

This interview survey was carried out both in the area of 2.7 km^2 for the Diversion Channel with the Land Development, and of 0.5 km^2 for the Short Cut Channel, and as for the survey on groundwater and land use, in the site of 6.0 km2 for diversion channel and its vicinity. The traffic survey was also carried out at the crossing of Queens Road and Enamanu Road.

1.3.2 Social Condition of Project Site

(1) General

The areas of construction site are decided as 109 ha for Diversion Channel with Land Development and as 2.4 ha for Short Cut Channel respectively. And by using the 1/10,000 map, the relation between the land of the construction site, and land owners and residential families are examined. Consequently, it has revealed that the number of families in relation to the whole areas are counted to be 50; 47 of them for Diversion Channel with Land Development and 3 for Short Cut Channel. Meanwhile, the number of the residential families within each construction site are 36 of them for Diversion Channel with Land Development, and 0 (zero) for Short Cut Channel. And out of those 36 families, 33 interview survey sheets are available and the analysis of the social condition of the construction site is carried out by them as under .

(2) Social Condition of Diversion Channel Site

1)	Resident Classification:	Various Occupation: 17 (teacher, driver, hotel employee, night watchman, laundry, salesman, carpenter, retired, fisherman), Agriculture: 15 (farmer and with other occupation), Commerce: 1 (butcher)
2)	Race:	Indian: 25, Fijian: 7, Part European: 1
3)	Religion:	Hindu: 21 and Muslim: 4, Methodist: 7, Catholic: 1
4)	Family:	6 members on an average
5)	Work Place:	on site, Nadi town, Immigration Office, Nadi Airport, Club Fiji, Skylodge, Sheraton .
6)	Present Place:	residing in present place oldest from 1957 and newest 1997; on an average 1978.
7)	From Where:	borne here, Rakiraki, Lomolomo, Nakavu, Sigatoka, Nausori, Lautoka, Tovotova, Tavua, Nukuloa.

8)	Reason for Choice:	for better job, for better farming, property was divided.
9)	School:	primary and secondary school: Nadi town, / tertiary: Lautoka.
10)	Medical Classification:	hospital in Nadi town, private doctor in Nadi town.
11)	Income of Household:	F$ 14,707/year on an average.
12)	Residence:	building structure with materials of concrete, wood and corrugated iron: 210m^2 on an average, / built year:1974 on an average.
13)	Land Status:	Crown Lease: 18, Freehold: 15, Native Land: 0 (zero).
14)	Agriculture:	mostly sugar cane, / vegetable, / rice .

The interview survey results of above 1)-14) tell that majority of the people there are Indian in the religion of Hindu and Muslim, next Fijian in Methodist and Part European in Catholic. The Indian and Fijian live on various occupation and agriculture about in half-and-half. Their work places are on site, near the residence and Nadi town. Education and medical classification also rely mostly on Nadi town. Land status are crown lease and freehold. And farmers are mostly engaged in sugarcane growing.

(3) General Opinion of Residents

In the interview survey, special attentions have been paid on collecting the real voices from the people living there.

As the result, almost all the people living in-and-around the project site recognize basically the importance and necessity of the proposed project itself, by making different kind of expression of their minds. Such expression of the opinions as ; The proposed project is a very good choice to save villages and Nadi town from the flood damage, to enhance safety of environment and also to benefit the wealth and health of future generation. The project will provide safety to shops in town and boost production and maintain safety to tourism industry in Nadi town. It is very important to the whole community, being ready to cooperate with authorities concerned. In view of progress and development of the Nation, one has to give way and assistance in any possible manner.

Meanwhile, the people there hold considerable amount of uneasiness about the possible resettlement or relocation, by disclosing their minds in various ways. Such expression of the opinions as ; The household income would be affected. Convenience of being near to town, school, medical services, main road, airport and cheap living standard are to be affected. Difficulty in acclimatizing to new environment is to be worried. Sentimental and cultural value is to be lost. Relocation is great concern in terms of financial expenditure and time to resettle, being positive but subject to financial assistance and safe residential land, and asking for reasonable and fair compensation to cater for present and future generation.

Taking the above described resident's voices into consideration, it may be acknowledged that the people living in-and-around construction site basically have an affirmative

understanding for the proposed project, and at the same time they feel uneasy about their possible resettlements, which may affect the household income, convenience of daily life, education, medical treatment and sentimental value. Meanwhile, they hold great concern about financial compensation.

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CHAPTER 2 ECONOMIC EVALUATION AND FINANCIAL EXAMINATION

2.1 Economic Evaluation of Master Plan

Economic evaluation of structural measures as well as afforestation project are discussed in Supporting Report E "Flood Control Plan", regarding applied methodology and the results. In economic evaluation, financial costs, were converted to economic costs. The conversion rates are given in Table-A2.1.

Table-A2.1 Conversion Factors of Fiji Project

	Item	Rate	Remarks
	A. Conversion Rate		
1	Standard conversion rate (SCR)	0.94	Calculated on average figures of 1991-95 foreign trade*
2	Transfer payment (Tra-p)	0.90	Vat 10%
3	Economic Cost of Land (EC Land)	0.90	10% of vacancy to be assumed
4	Opportunity Cost of Labor (OC Labor)	0.94	Unemployment of 1989-94 average=6%
5	Opportunity Cost of Capital (OC Capital)	0.10	To be assumed 10% CPO Information
	B. Formula of the Conversion from "Financial" to "Economic" for Local Currency Portion,excluding Transfer Payment		
1	Construction Material and Equipment: Material and Equipment Cost x SCR	0.940	
2	Unskilled Labor: Labor cost x SCR x OC Labor	0.884	
3	Land Acquisition : Land acquisition cost x SCR x EC Land	0.846	
4,5	Adomministration/Engineerig : Adomministration/Engineerig x SCR	0.940	
6	Physical Contingency : Physical Contingency x SCR	0.940	

Note :
SCR= 1 +E / { (1 + di) + (E - de) } ; where, I:Import, E:Export,
di :Import duty, de :Export duty.
SCR* =(1,218,934+869,941) / { (1,218,934+138,560) + (869,941 - 11,382) }
SCR = 2,088,875 / 2,216,053 = 0.94261
Source: Bureau of Statistics (1996)

2.2 Economic Evaluation of Priority Project by Flood Probability

Methodology taken in the evaluation of the Master Plan was also applied in the economic evaluation of the Priority Project.

2.2.1 Economic Cost

Economic cost is converted value from the financial project cost. Applying the same conditions and assumptions in the Master Plan Study, economic costs for the 4 cases were estimated based on the project costs (financial costs).

Annual OM cost (operation and maintenance), which is required every year during the period of project life (50 years), was assumed to be 0.1 % of the construction cost. Financial OM cost was converted to economic OM cost.

Table-A2.2 Financial and Economic Cost of Projects

Cost		Scale of Project (Flood Probability)			
		1/20	1/15	1/10	1/5
Financial Cost	Project Cost (F$ 1,000)	62,940	56,210	50,030	42,420
	Annual OM Cost (F$ 1,000/year)	37	33	29	24
Economic Cost	Project Cost (F$ 1,000)	53,139	47,449	42,203	35,724
	Annual OM Cost (F$ 1,000/year)	36	32	28	24

Financial and economic project costs and annual OM costs by each flood probability are compared in Table-A2.3.

Table-A2.3 (1/2) Estimate of Economic Cost

Nadi-1/20 (Financial)

Unit: F$ 1,000

Classification of cost	L.C.	F.C	Total
1 Constructioin cost	14,060	22,940	37,000
1) Material and Equipment	5,180	20,720	25,900
2)Labor	8,880	2,220	11,100
2 Land acquisition	8,900	0	8,900
3 Administration	1,900	0	1,900
4 Engineering service	1,120	4,480	5,600
5 Phisical contingency	1,080	1,620	2,700
Sub-total	27,060	29,040	56,100
6 Price Contingency	680	440	1,120
7 Tax	5,720	0	5,720
Grand total	33,460	29,480	62,940
OM Cost			37

Nadi-1/20 (Economic)

Unit: F$ 1,000

Classification of cost	L.C.	F.C	Total
1 Constructioin cost	12,716	22,940	35,656
1) Material and Equipment	4,869	20,720	25,589
2)Labor	7,846	2,220	10,066
2 Land acquisition	7,529	0	7,529
3 Administration	1,786	0	1,786
4 Engineering service	1,053	4,480	5,533
5 Phisical contingency	1,015	1,620	2,635
Sub-total	24,099	29,040	53,139
6 Price Contingency	0	0	0
7 Tax	0	0	0
Grand total	24,099	29,040	53,139
OM Cost			36

Nadi-1/15 (Financial)

Unit: F$ 1,000

Classification of cost	L.C.	F.C	Total
1 Constructioin cost	12,540	20,460	33,000
1) Material and Equipment	4,620	18,480	23,100
2)Labor	7,920	1,980	9,900
2 Land acquisition	8,000	0	8,000
3 Administration	1,700	0	1,700
4 Engineering service	1,000	4,000	5,000
5 Phisical contingency	960	1,440	2,400
Sub-total	24,200	25,900	50,100
6 Price Contingency	610	390	1,000
7 Tax	5,110	0	5,110
Grand total	29,920	26,290	56,210
OM Cost			33

Nadi-1/15 (Economic)

Unit: F$ 1,000

Classification of cost	L.C.	F.C	Total
1 Constructioin cost	11,341	20,460	31,801
1) Material and Equipment	4,343	18,480	22,823
2)Labor	6,998	1,980	8,978
2 Land acquisition	6,768	0	6,768
3 Administration	1,598	0	1,598
4 Engineering service	940	4,000	4,940
5 Phisical contingency	902	1,440	2,342
Sub-total	21,549	25,900	47,449
6 Price Contingency	0	0	0
7 Tax	0	0	0
Grand total	21,549	25,900	47,449
OM Cost			32

Table-A2.3 (2/2) Estimate of Economic Cost

Nadi-1/10 (Financial)

Unit: F$ 1,000

	Classification of cost	L.C.	F.C	Total
1	Constructioin cost	11,120	18,080	29,200
	1) Material and Equipment	4,080	16,320	20,400
	2)Labor	7,040	1,760	8,800
2	Land acquisition	7,400	0	7,400
3	Administration	1,500	0	1,500
4	Engineering service	880	3,520	4,400
5	Phisical contingency	840	1,260	2,100
	Sub-total	21,740	22,860	44,600
6	Price Contingency	540	340	880
7	Tax	4,550	0	4,550
	Grand total	26,830	23,200	50,030
	OM Cost			29

Nadi-1/10 (Economic)

Unit: F$ 1,000

	Classification of cost	L.C.	F.C	Total
1	Constructioin cost	10,056	18,080	28,136
	1) Material and Equipment	3,835	16,320	20,155
	2)Labor	6,221	1,760	7,981
2	Land acquisition	6,260	0	6,260
3	Administration	1,410	0	1,410
4	Engineering service	827	3,520	4,347
5	Phisical contingency	790	1,260	2,050
	Sub-total	19,343	22,860	42,203
6	Price Contingency	0	0	0
7	Tax	0	0	0
	Grand total	19,343	22,860	42,203
	OM Cost			28

Nadi-1/5 (Financial)

Unit: F$ 1,000

	Classification of cost	L.C.	F.C	Total
1	Constructioin cost	9,260	15,140	24,400
	1) Material and Equipment	3,420	13,680	17,100
	2)Labor	5,840	1,460	7,300
2	Land acquisition	6,700	0	6,700
3	Administration	1,200	0	1,200
4	Engineering service	740	2,960	3,700
5	Phisical contingency	720	1,080	1,800
	Sub-total	18,620	19,180	37,800
6	Price Contingency	470	290	760
7	Tax	3,860	0	3,860
	Grand total	22,950	19,470	42,420
	OM Cost			24

Nadi-1/5 (Economic)

Unit: F$ 1,000

	Classification of cost	L.C.	F.C	Total
1	Constructioin cost	8,375	15,140	23,515
	1) Material and Equipment	3,215	13,680	16,895
	2)Labor	5,160	1,460	6,620
2	Land acquisition	5,668	0	5,668
3	Administration	1,128	0	1,128
4	Engineering service	696	2,960	3,656
5	Phisical contingency	677	1,080	1,757
	Sub-total	16,544	19,180	35,724
6	Price Contingency	0	0	0
7	Tax	0	0	0
	Grand total	16,544	19,180	35,724
	OM Cost			24

A2-4

2.2.2 Economic Evaluation

The 4 cases with different return period floods were evaluated from economic point of view, with the following assumptions. The results are shown in Table-A2.4.

1) The project life is 50 years.
2) Construction period is 2 years.
3) Discount rate is 10 % same as the Master Plan Study.

Table-A2.4 Economic Evaluation of Nadi Diversion Channel and Short Cut Channel

Scale of Project (Flood Probability)	1/20	1/15	1/10	1/5
Annual Economic Benefit (F$ 1,000/year)	8,278	6,974	5,250	2,070
Economic Project Cost (F$ 1,000)	53,139	47,449	42,203	35,724
Economic Annual Maintenance Cost (F$ 1,000/year)	36	32	28	24
EIRR (%)	14.45	13.67	11.65	5.13
B/C (Ratio)	1.46	1.38	1.17	0.54
NPV (F$ 1,000)	21,423	15,708	6,167	-14,235

EIRR of the project for 1/20, 1/15, 1/10 and 1/5 probability floods is 14.45 %, 13.67 %, 11.65 % and 5.13 %, respectively. Those figures indicate that the projects are feasible for 1/20, 1/15 and 1/10 probability floods, as long as the opportunity cost of capital is assumed to be 10 %. In addition, respective B/C of 1.46, 1.38 and 1.17 supports the feasibility of these projects. Meanwhile, EIRR of 5.13 % for 1/5 probability flood indicates that the project is not feasible, and B/C of 0.54 implies the difficulty of the project implementation.

The project for 1/20 probability flood is the most feasible because of its highest economic indices, compared to other two feasible projects. In the case that there are some financial constraints, the project at least for 1/10 probability flood should be implemented.

Cost and benefit stream during the project life as well as major indicators of economic evaluation by flood probability are given in Table-A2.5.

Table-A2.5 (1/4) Economic Analysis :Nadi (1/20)

Unit:F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	26,570	0	26,570	0	-26,570
2	26,570	0	26,570	0	-26,570
3	0	36	36	8,278	8,242
4	0	36	36	8,278	8,242
5	0	36	36	8,278	8,242
6	0	36	36	8,278	8,242
7	0	36	36	8,278	8,242
8	0	36	36	8,278	8,242
9	0	36	36	8,278	8,242
10	0	36	36	8,278	8,242
11	0	36	36	8,278	8,242
12	0	36	36	8,278	8,242
13	0	36	36	8,278	8,242
14	0	36	36	8,278	8,242
15	0	36	36	8,278	8,242
16	0	36	36	8,278	8,242
17	0	36	36	8,278	8,242
18	0	36	36	8,278	8,242
19	0	36	36	8,278	8,242
20	0	36	36	8,278	8,242
21	0	36	36	8,278	8,242
22	0	36	36	8,278	8,242
23	0	36	36	8,278	8,242
24	0	36	36	8,278	8,242
25	0	36	36	8,278	8,242
26	0	36	36	8,278	8,242
27	0	36	36	8,278	8,242
28	0	36	36	8,278	8,242
29	0	36	36	8,278	8,242
30	0	36	36	8,278	8,242
31	0	36	36	8,278	8,242
32	0	36	36	8,278	8,242
33	0	36	36	8,278	8,242
34	0	36	36	8,278	8,242
35	0	36	36	8,278	8,242
36	0	36	36	8,278	8,242
37	0	36	36	8,278	8,242
38	0	36	36	8,278	8,242
39	0	36	36	8,278	8,242
40	0	36	36	8,278	8,242
41	0	36	36	8,278	8,242
42	0	36	36	8,278	8,242
43	0	36	36	8,278	8,242
44	0	36	36	8,278	8,242
45	0	36	36	8,278	8,242
46	0	36	36	8,278	8,242
47	0	36	36	8,278	8,242
48	0	36	36	8,278	8,242
49	0	36	36	8,278	8,242
50	0	36	36	8,278	8,242
51	0	36	36	8,278	8,242
52	0	36	36	8,278	8,242
	53,139	1,800	54,939	413,900	358,961

EIRR 14.45%

Discount Rate(%)	B/C	PV Cost	PV Benefit	NPV
10	1.46	46,407	67,830	21,423

Table-A2.5 (2/4) Economic Analysis :Nadi (1/15)

Unit:F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	23,725	0	23,725	0	-23,725
2	23,725	0	23,725	0	-23,725
3	0	32	32	6,974	6,942
4	0	32	32	6,974	6,942
5	0	32	32	6,974	6,942
6	0	32	32	6,974	6,942
7	0	32	32	6,974	6,942
8	0	32	32	6,974	6,942
9	0	32	32	6,974	6,942
10	0	32	32	6,974	6,942
11	0	32	32	6,974	6,942
12	0	32	32	6,974	6,942
13	0	32	32	6,974	6,942
14	0	32	32	6,974	6,942
15	0	32	32	6,974	6,942
16	0	32	32	6,974	6,942
17	0	32	32	6,974	6,942
18	0	32	32	6,974	6,942
19	0	32	32	6,974	6,942
20	0	32	32	6,974	6,942
21	0	32	32	6,974	6,942
22	0	32	32	6,974	6,942
23	0	32	32	6,974	6,942
24	0	32	32	6,974	6,942
25	0	32	32	6,974	6,942
26	0	32	32	6,974	6,942
27	0	32	32	6,974	6,942
28	0	32	32	6,974	6,942
29	0	32	32	6,974	6,942
30	0	32	32	6,974	6,942
31	0	32	32	6,974	6,942
32	0	32	32	6,974	6,942
33	0	32	32	6,974	6,942
34	0	32	32	6,974	6,942
35	0	32	32	6,974	6,942
36	0	32	32	6,974	6,942
37	0	32	32	6,974	6,942
38	0	32	32	6,974	6,942
39	0	32	32	6,974	6,942
40	0	32	32	6,974	6,942
41	0	32	32	6,974	6,942
42	0	32	32	6,974	6,942
43	0	32	32	6,974	6,942
44	0	32	32	6,974	6,942
45	0	32	32	6,974	6,942
46	0	32	32	6,974	6,942
47	0	32	32	6,974	6,942
48	0	32	32	6,974	6,942
49	0	32	32	6,974	6,942
50	0	32	32	6,974	6,942
51	0	32	32	6,974	6,942
52	0	32	32	6,974	6,942
	47,449	1,600	49,049	348,700	299,651

EIRR 13.67%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.38	41,437	57,145	15,708

Table-A2.5 (3/4) Economic Analysis :Nadi (1/10)

Unit:F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	21,102	0	21,102	0	-21,102
2	21,102	0	21,102	0	-21,102
3	0	28	28	5,250	5,222
4	0	28	28	5,250	5,222
5	0	28	28	5,250	5,222
6	0	28	28	5,250	5,222
7	0	28	28	5,250	5,222
8	0	28	28	5,250	5,222
9	0	28	28	5,250	5,222
10	0	28	28	5,250	5,222
11	0	28	28	5,250	5,222
12	0	28	28	5,250	5,222
13	0	28	28	5,250	5,222
14	0	28	28	5,250	5,222
15	0	28	28	5,250	5,222
16	0	28	28	5,250	5,222
17	0	28	28	5,250	5,222
18	0	28	28	5,250	5,222
19	0	28	28	5,250	5,222
20	0	28	28	5,250	5,222
21	0	28	28	5,250	5,222
22	0	28	28	5,250	5,222
23	0	28	28	5,250	5,222
24	0	28	28	5,250	5,222
25	0	28	28	5,250	5,222
26	0	28	28	5,250	5,222
27	0	28	28	5,250	5,222
28	0	28	28	5,250	5,222
29	0	28	28	5,250	5,222
30	0	28	28	5,250	5,222
31	0	28	28	5,250	5,222
32	0	28	28	5,250	5,222
33	0	28	28	5,250	5,222
34	0	28	28	5,250	5,222
35	0	28	28	5,250	5,222
36	0	28	28	5,250	5,222
37	0	28	28	5,250	5,222
38	0	28	28	5,250	5,222
39	0	28	28	5,250	5,222
40	0	28	28	5,250	5,222
41	0	28	28	5,250	5,222
42	0	28	28	5,250	5,222
43	0	28	28	5,250	5,222
44	0	28	28	5,250	5,222
45	0	28	28	5,250	5,222
46	0	28	28	5,250	5,222
47	0	28	28	5,250	5,222
48	0	28	28	5,250	5,222
49	0	28	28	5,250	5,222
50	0	28	28	5,250	5,222
51	0	28	28	5,250	5,222
52	0	28	28	5,250	5,222
	42,203	1,400	43,603	262,500	218,897

EIRR 11.65%

Discount Rate(%)	B/C	PV Cost	PV Benefit	NPV
10	1.17	36,852	43,019	6,167

Table-A2.5 (4/4) Economic Analysis :Nadi (1/5)

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	17,862	0	17,862	0	-17,862
2	17,862	0	17,862	0	-17,862
3	0	24	24	2,070	2,046
4	0	24	24	2,070	2,046
5	0	24	24	2,070	2,046
6	0	24	24	2,070	2,046
7	0	24	24	2,070	2,046
8	0	24	24	2,070	2,046
9	0	24	24	2,070	2,046
10	0	24	24	2,070	2,046
11	0	24	24	2,070	2,046
12	0	24	24	2,070	2,046
13	0	24	24	2,070	2,046
14	0	24	24	2,070	2,046
15	0	24	24	2,070	2,046
16	0	24	24	2,070	2,046
17	0	24	24	2,070	2,046
18	0	24	24	2,070	2,046
19	0	24	24	2,070	2,046
20	0	24	24	2,070	2,046
21	0	24	24	2,070	2,046
22	0	24	24	2,070	2,046
23	0	24	24	2,070	2,046
24	0	24	24	2,070	2,046
25	0	24	24	2,070	2,046
26	0	24	24	2,070	2,046
27	0	24	24	2,070	2,046
28	0	24	24	2,070	2,046
29	0	24	24	2,070	2,046
30	0	24	24	2,070	2,046
31	0	24	24	2,070	2,046
32	0	24	24	2,070	2,046
33	0	24	24	2,070	2,046
34	0	24	24	2,070	2,046
35	0	24	24	2,070	2,046
36	0	24	24	2,070	2,046
37	0	24	24	2,070	2,046
38	0	24	24	2,070	2,046
39	0	24	24	2,070	2,046
40	0	24	24	2,070	2,046
41	0	24	24	2,070	2,046
42	0	24	24	2,070	2,046
43	0	24	24	2,070	2,046
44	0	24	24	2,070	2,046
45	0	24	24	2,070	2,046
46	0	24	24	2,070	2,046
47	0	24	24	2,070	2,046
48	0	24	24	2,070	2,046
49	0	24	24	2,070	2,046
50	0	24	24	2,070	2,046
51	0	24	24	2,070	2,046
52	0	24	24	2,070	2,046
	35,724	1,200	36,924	103,500	66,576

EIRR 5.13%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	0.54	31,197	16,962	-14,235

2.3 Economic Evaluation and Financial Examination of the Project with Design flood of 1/20 Probability

2.3.1 Objectives

As a result of preliminary economic evaluation on scale of diversion channel in Section 12.2 of Chapter 12, it has been recognized that the Nadi diversion channel and short cut channel for the design flood of 1/20 probability has the highest economic viability.

The objective of economic evaluation is to examine the project in detail for the design flood of 1/20 in terms of economy. Sensitivity analysis were employed to examine the economic viability in unexpected risky conditions.

Financial considerations were made assuming overseas loan. Scale of repayment for the project were examined by comparing with the mid-term schedule of repayment by the Government. The portion of funds not to be covered by overseas loan were examined by comparison with the current capital expenditure of the Government.

2.3.2 Sensitivity Analysis

Sensitivity analysis is to be conducted to assess whether the projects can maintain their viability, when supposed to be placed under unfavorable circumstances during and after implementation. A test is therefore carried out about the sensitivity of EIRR affected by variations in the economic costs and benefits.

EIRR sensitivity analysis was examined under the conditions of the increase in 5 % and 10 % of economic cost and the decrease in 5 % and 10 % in the economic benefits for the 1/20 probability flood. Conditions, such as project life, construction period and so on, are assumed to be same as in the economic evaluation of the priority project. The results are summarized in Table-A2.6.

Table-A2.6 EIRR Sensitivity Analysis of the Project

		Increase in Cost		
		0 %	5 %	10 %
Decrease in Benefit	0 %	14.45	13.79	13.19
	5 %	13.76	13.13	12.56
	10 %	13.07	12.47	11.92

Note: Unit of EIRR : %

As shown above, EIRR for the project of 1/20 probability flood maintains the figures of 11.92 % which indicate the economic feasibility of the project in comparison with the opportunity cost of capital of 10 % , even for the unfavorable case where both the increase in cost and the decrease in benefit are 10 %.

The results of the economic analysis by each of eight cases are given in Table-A2.7.

Table-A2.7 (1/8) Economic Analysis :Nadi (1/20)

Sensitivity (1): Cost unchanged, Benefit 5 % down

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	26,570	0	26,570	0	-26,570
2	26,570	0	26,570	0	-26,570
3	0	36	36	7,864	7,828
4	0	36	36	7,864	7,828
5	0	36	36	7,864	7,828
6	0	36	36	7,864	7,828
7	0	36	36	7,864	7,828
8	0	36	36	7,864	7,828
9	0	36	36	7,864	7,828
10	0	36	36	7,864	7,828
11	0	36	36	7,864	7,828
12	0	36	36	7,864	7,828
13	0	36	36	7,864	7,828
14	0	36	36	7,864	7,828
15	0	36	36	7,864	7,828
16	0	36	36	7,864	7,828
17	0	36	36	7,864	7,828
18	0	36	36	7,864	7,828
19	0	36	36	7,864	7,828
20	0	36	36	7,864	7,828
21	0	36	36	7,864	7,828
22	0	36	36	7,864	7,828
23	0	36	36	7,864	7,828
24	0	36	36	7,864	7,828
25	0	36	36	7,864	7,828
26	0	36	36	7,864	7,828
27	0	36	36	7,864	7,828
28	0	36	36	7,864	7,828
29	0	36	36	7,864	7,828
30	0	36	36	7,864	7,828
31	0	36	36	7,864	7,828
32	0	36	36	7,864	7,828
33	0	36	36	7,864	7,828
34	0	36	36	7,864	7,828
35	0	36	36	7,864	7,828
36	0	36	36	7,864	7,828
37	0	36	36	7,864	7,828
38	0	36	36	7,864	7,828
39	0	36	36	7,864	7,828
40	0	36	36	7,864	7,828
41	0	36	36	7,864	7,828
42	0	36	36	7,864	7,828
43	0	36	36	7,864	7,828
44	0	36	36	7,864	7,828
45	0	36	36	7,864	7,828
46	0	36	36	7,864	7,828
47	0	36	36	7,864	7,828
48	0	36	36	7,864	7,828
49	0	36	36	7,864	7,828
50	0	36	36	7,864	7,828
51	0	36	36	7,864	7,828
52	0	36	36	7,864	7,828
	53,139	1,800	54,939	377,477	338,266

EIRR 13.76%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.39	46,407	64,439	18,032

Table-A2.7 (2/8) Economic Analysis :Nadi (1/20)

Sensitivity (2): Cost unchanged, Benefit 10 % down

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	26,570	0	26,570	0	-26,570
2	26,570	0	26,570	0	-26,570
3	0	36	36	7,450	7,414
4	0	36	36	7,450	7,414
5	0	36	36	7,450	7,414
6	0	36	36	7,450	7,414
7	0	36	36	7,450	7,414
8	0	36	36	7,450	7,414
9	0	36	36	7,450	7,414
10	0	36	36	7,450	7,414
11	0	36	36	7,450	7,414
12	0	36	36	7,450	7,414
13	0	36	36	7,450	7,414
14	0	36	36	7,450	7,414
15	0	36	36	7,450	7,414
16	0	36	36	7,450	7,414
17	0	36	36	7,450	7,414
18	0	36	36	7,450	7,414
19	0	36	36	7,450	7,414
20	0	36	36	7,450	7,414
21	0	36	36	7,450	7,414
22	0	36	36	7,450	7,414
23	0	36	36	7,450	7,414
24	0	36	36	7,450	7,414
25	0	36	36	7,450	7,414
26	0	36	36	7,450	7,414
27	0	36	36	7,450	7,414
28	0	36	36	7,450	7,414
29	0	36	36	7,450	7,414
30	0	36	36	7,450	7,414
31	0	36	36	7,450	7,414
32	0	36	36	7,450	7,414
33	0	36	36	7,450	7,414
34	0	36	36	7,450	7,414
35	0	36	36	7,450	7,414
36	0	36	36	7,450	7,414
37	0	36	36	7,450	7,414
38	0	36	36	7,450	7,414
39	0	36	36	7,450	7,414
40	0	36	36	7,450	7,414
41	0	36	36	7,450	7,414
42	0	36	36	7,450	7,414
43	0	36	36	7,450	7,414
44	0	36	36	7,450	7,414
45	0	36	36	7,450	7,414
46	0	36	36	7,450	7,414
47	0	36	36	7,450	7,414
48	0	36	36	7,450	7,414
49	0	36	36	7,450	7,414
50	0	36	36	7,450	7,414
51	0	36	36	7,450	7,414
52	0	36	36	7,450	7,414
	53,139	1,800	54,939	357,610	317,571

EIRR 13.07%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.32	46,407	61,047	14,640

Table-A2.7 (3/8) Economic Analysis :Nadi (1/20)

Sensitivity (3): Cost 5 % up, Benefit unchanged

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	27,898	0	27,898	0	-27,898
2	27,898	0	27,898	0	-27,898
3	0	38	38	8,278	8,240
4	0	38	38	8,278	8,240
5	0	38	38	8,278	8,240
6	0	38	38	8,278	8,240
7	0	38	38	8,278	8,240
8	0	38	38	8,278	8,240
9	0	38	38	8,278	8,240
10	0	38	38	8,278	8,240
11	0	38	38	8,278	8,240
12	0	38	38	8,278	8,240
13	0	38	38	8,278	8,240
14	0	38	38	8,278	8,240
15	0	38	38	8,278	8,240
16	0	38	38	8,278	8,240
17	0	38	38	8,278	8,240
18	0	38	38	8,278	8,240
19	0	38	38	8,278	8,240
20	0	38	38	8,278	8,240
21	0	38	38	8,278	8,240
22	0	38	38	8,278	8,240
23	0	38	38	8,278	8,240
24	0	38	38	8,278	8,240
25	0	38	38	8,278	8,240
26	0	38	38	8,278	8,240
27	0	38	38	8,278	8,240
28	0	38	38	8,278	8,240
29	0	38	38	8,278	8,240
30	0	38	38	8,278	8,240
31	0	38	38	8,278	8,240
32	0	38	38	8,278	8,240
33	0	38	38	8,278	8,240
34	0	38	38	8,278	8,240
35	0	38	38	8,278	8,240
36	0	38	38	8,278	8,240
37	0	38	38	8,278	8,240
38	0	38	38	8,278	8,240
39	0	38	38	8,278	8,240
40	0	38	38	8,278	8,240
41	0	38	38	8,278	8,240
42	0	38	38	8,278	8,240
43	0	38	38	8,278	8,240
44	0	38	38	8,278	8,240
45	0	38	38	8,278	8,240
46	0	38	38	8,278	8,240
47	0	38	38	8,278	8,240
48	0	38	38	8,278	8,240
49	0	38	38	8,278	8,240
50	0	38	38	8,278	8,240
51	0	38	38	8,278	8,240
52	0	38	38	8,278	8,240
	55,796	1,890	57,686	397,344	356,214

EIRR 13.79%

Discount Rate(%)	B/C	PV Cost	PV Benefit	NPV
10	1.39	48,728	67,830	19,103

Table-A2.7 (4/8) Economic Analysis :Nadi (1/20)

Sensitivity (4): Cost 5 % up, Benefit 5 % down

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	27,898	0	27,898	0	-27,898
2	27,898	0	27,898	0	-27,898
3	0	38	38	7,864	7,826
4	0	38	38	7,864	7,826
5	0	38	38	7,864	7,826
6	0	38	38	7,864	7,826
7	0	38	38	7,864	7,826
8	0	38	38	7,864	7,826
9	0	38	38	7,864	7,826
10	0	38	38	7,864	7,826
11	0	38	38	7,864	7,826
12	0	38	38	7,864	7,826
13	0	38	38	7,864	7,826
14	0	38	38	7,864	7,826
15	0	38	38	7,864	7,826
16	0	38	38	7,864	7,826
17	0	38	38	7,864	7,826
18	0	38	38	7,864	7,826
19	0	38	38	7,864	7,826
20	0	38	38	7,864	7,826
21	0	38	38	7,864	7,826
22	0	38	38	7,864	7,826
23	0	38	38	7,864	7,826
24	0	38	38	7,864	7,826
25	0	38	38	7,864	7,826
26	0	38	38	7,864	7,826
27	0	38	38	7,864	7,826
28	0	38	38	7,864	7,826
29	0	38	38	7,864	7,826
30	0	38	38	7,864	7,826
31	0	38	38	7,864	7,826
32	0	38	38	7,864	7,826
33	0	38	38	7,864	7,826
34	0	38	38	7,864	7,826
35	0	38	38	7,864	7,826
36	0	38	38	7,864	7,826
37	0	38	38	7,864	7,826
38	0	38	38	7,864	7,826
39	0	38	38	7,864	7,826
40	0	38	38	7,864	7,826
41	0	38	38	7,864	7,826
42	0	38	38	7,864	7,826
43	0	38	38	7,864	7,826
44	0	38	38	7,864	7,826
45	0	38	38	7,864	7,826
46	0	38	38	7,864	7,826
47	0	38	38	7,864	7,826
48	0	38	38	7,864	7,826
49	0	38	38	7,864	7,826
50	0	38	38	7,864	7,826
51	0	38	38	7,864	7,826
52	0	38	38	7,864	7,826
	55,796	1,890	57,686	377,477	335,519

EIRR 13.13%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.32	48,728	64,439	15,711

Table-A2.7 (5/8) Economic Analysis :Nadi (1/20)

Sensitivity (5): Cost 5 % up, Benefit 10 % down

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	27,898	0	27,898	0	-27,898
2	27,898	0	27,898	0	-27,898
3	0	38	38	7,450	7,412
4	0	38	38	7,450	7,412
5	0	38	38	7,450	7,412
6	0	38	38	7,450	7,412
7	0	38	38	7,450	7,412
8	0	38	38	7,450	7,412
9	0	38	38	7,450	7,412
10	0	38	38	7,450	7,412
11	0	38	38	7,450	7,412
12	0	38	38	7,450	7,412
13	0	38	38	7,450	7,412
14	0	38	38	7,450	7,412
15	0	38	38	7,450	7,412
16	0	38	38	7,450	7,412
17	0	38	38	7,450	7,412
18	0	38	38	7,450	7,412
19	0	38	38	7,450	7,412
20	0	38	38	7,450	7,412
21	0	38	38	7,450	7,412
22	0	38	38	7,450	7,412
23	0	38	38	7,450	7,412
24	0	38	38	7,450	7,412
25	0	38	38	7,450	7,412
26	0	38	38	7,450	7,412
27	0	38	38	7,450	7,412
28	0	38	38	7,450	7,412
29	0	38	38	7,450	7,412
30	0	38	38	7,450	7,412
31	0	38	38	7,450	7,412
32	0	38	38	7,450	7,412
33	0	38	38	7,450	7,412
34	0	38	38	7,450	7,412
35	0	38	38	7,450	7,412
36	0	38	38	7,450	7,412
37	0	38	38	7,450	7,412
38	0	38	38	7,450	7,412
39	0	38	38	7,450	7,412
40	0	38	38	7,450	7,412
41	0	38	38	7,450	7,412
42	0	38	38	7,450	7,412
43	0	38	38	7,450	7,412
44	0	38	38	7,450	7,412
45	0	38	38	7,450	7,412
46	0	38	38	7,450	7,412
47	0	38	38	7,450	7,412
48	0	38	38	7,450	7,412
49	0	38	38	7,450	7,412
50	0	38	38	7,450	7,412
51	0	38	38	7,450	7,412
52	0	38	38	7,450	7,412
	55,796	1,890	57,686	357,610	314,824

EIRR 12.47%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.25	48,728	61,047	12,320

Table-A2.7 (6/8) Economic Analysis :Nadi (1/20)

Sensitivity (6): Cost 10 % up, Benefit unchanged

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	29,226	0	29,226	0	-29,226
2	29,226	0	29,226	0	-29,226
3	0	40	40	8,278	8,238
4	0	40	40	8,278	8,238
5	0	40	40	8,278	8,238
6	0	40	40	8,278	8,238
7	0	40	40	8,278	8,238
8	0	40	40	8,278	8,238
9	0	40	40	8,278	8,238
10	0	40	40	8,278	8,238
11	0	40	40	8,278	8,238
12	0	40	40	8,278	8,238
13	0	40	40	8,278	8,238
14	0	40	40	8,278	8,238
15	0	40	40	8,278	8,238
16	0	40	40	8,278	8,238
17	0	40	40	8,278	8,238
18	0	40	40	8,278	8,238
19	0	40	40	8,278	8,238
20	0	40	40	8,278	8,238
21	0	40	40	8,278	8,238
22	0	40	40	8,278	8,238
23	0	40	40	8,278	8,238
24	0	40	40	8,278	8,238
25	0	40	40	8,278	8,238
26	0	40	40	8,278	8,238
27	0	40	40	8,278	8,238
28	0	40	40	8,278	8,238
29	0	40	40	8,278	8,238
30	0	40	40	8,278	8,238
31	0	40	40	8,278	8,238
32	0	40	40	8,278	8,238
33	0	40	40	8,278	8,238
34	0	40	40	8,278	8,238
35	0	40	40	8,278	8,238
36	0	40	40	8,278	8,238
37	0	40	40	8,278	8,238
38	0	40	40	8,278	8,238
39	0	40	40	8,278	8,238
40	0	40	40	8,278	8,238
41	0	40	40	8,278	8,238
42	0	40	40	8,278	8,238
43	0	40	40	8,278	8,238
44	0	40	40	8,278	8,238
45	0	40	40	8,278	8,238
46	0	40	40	8,278	8,238
47	0	40	40	8,278	8,238
48	0	40	40	8,278	8,238
49	0	40	40	8,278	8,238
50	0	40	40	8,278	8,238
51	0	40	40	8,278	8,238
52	0	40	40	8,278	8,238
	58,453	1,980	60,433	397,344	353,467

EIRR 13.19%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.33	51,048	67,830	16,782

Table-A2.7 (7/8) Economic Analysis :Nadi (1/20)

Sensitivity (7): Cost 10 % up, Benefit 5 % down

Unit:F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	29,226	0	29,226	0	-29,226
2	29,226	0	29,226	0	-29,226
3	0	40	40	7,864	7,825
4	0	40	40	7,864	7,825
5	0	40	40	7,864	7,825
6	0	40	40	7,864	7,825
7	0	40	40	7,864	7,825
8	0	40	40	7,864	7,825
9	0	40	40	7,864	7,825
10	0	40	40	7,864	7,825
11	0	40	40	7,864	7,825
12	0	40	40	7,864	7,825
13	0	40	40	7,864	7,825
14	0	40	40	7,864	7,825
15	0	40	40	7,864	7,825
16	0	40	40	7,864	7,825
17	0	40	40	7,864	7,825
18	0	40	40	7,864	7,825
19	0	40	40	7,864	7,825
20	0	40	40	7,864	7,825
21	0	40	40	7,864	7,825
22	0	40	40	7,864	7,825
23	0	40	40	7,864	7,825
24	0	40	40	7,864	7,825
25	0	40	40	7,864	7,825
26	0	40	40	7,864	7,825
27	0	40	40	7,864	7,825
28	0	40	40	7,864	7,825
29	0	40	40	7,864	7,825
30	0	40	40	7,864	7,825
31	0	40	40	7,864	7,825
32	0	40	40	7,864	7,825
33	0	40	40	7,864	7,825
34	0	40	40	7,864	7,825
35	0	40	40	7,864	7,825
36	0	40	40	7,864	7,825
37	0	40	40	7,864	7,825
38	0	40	40	7,864	7,825
39	0	40	40	7,864	7,825
40	0	40	40	7,864	7,825
41	0	40	40	7,864	7,825
42	0	40	40	7,864	7,825
43	0	40	40	7,864	7,825
44	0	40	40	7,864	7,825
45	0	40	40	7,864	7,825
46	0	40	40	7,864	7,825
47	0	40	40	7,864	7,825
48	0	40	40	7,864	7,825
49	0	40	40	7,864	7,825
50	0	40	40	7,864	7,825
51	0	40	40	7,864	7,825
52	0	40	40	7,864	7,825
	58,453	1,980	60,433	377,477	332,772

EIRR 12.56%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.26	51,048	64,439	13,391

Table-A2.7 (8/8) Economic Analysis :Nadi (1/20)

Sensitivity (8): Cost 10 % up, Benefit 10 % down

Unit F$ 1,000

Year	Economic Cost			Economic Benefit(B)	(B)-(C)
	Construction	MO	Total(C)		
1	29,226	0	29,226	0	-29,226
2	29,226	0	29,226	0	-29,226
3	0	40	40	7,450	7,411
4	0	40	40	7,450	7,411
5	0	40	40	7,450	7,411
6	0	40	40	7,450	7,411
7	0	40	40	7,450	7,411
8	0	40	40	7,450	7,411
9	0	40	40	7,450	7,411
10	0	40	40	7,450	7,411
11	0	40	40	7,450	7,411
12	0	40	40	7,450	7,411
13	0	40	40	7,450	7,411
14	0	40	40	7,450	7,411
15	0	40	40	7,450	7,411
16	0	40	40	7,450	7,411
17	0	40	40	7,450	7,411
18	0	40	40	7,450	7,411
19	0	40	40	7,450	7,411
20	0	40	40	7,450	7,411
21	0	40	40	7,450	7,411
22	0	40	40	7,450	7,411
23	0	40	40	7,450	7,411
24	0	40	40	7,450	7,411
25	0	40	40	7,450	7,411
26	0	40	40	7,450	7,411
27	0	40	40	7,450	7,411
28	0	40	40	7,450	7,411
29	0	40	40	7,450	7,411
30	0	40	40	7,450	7,411
31	0	40	40	7,450	7,411
32	0	40	40	7,450	7,411
33	0	40	40	7,450	7,411
34	0	40	40	7,450	7,411
35	0	40	40	7,450	7,411
36	0	40	40	7,450	7,411
37	0	40	40	7,450	7,411
38	0	40	40	7,450	7,411
39	0	40	40	7,450	7,411
40	0	40	40	7,450	7,411
41	0	40	40	7,450	7,411
42	0	40	40	7,450	7,411
43	0	40	40	7,450	7,411
44	0	40	40	7,450	7,411
45	0	40	40	7,450	7,411
46	0	40	40	7,450	7,411
47	0	40	40	7,450	7,411
48	0	40	40	7,450	7,411
49	0	40	40	7,450	7,411
50	0	40	40	7,450	7,411
51	0	40	40	7,450	7,411
52	0	40	40	7,450	7,411
53	0	40	40	7,450	7,411
54	0	40	40	7,450	7,411
	58,453	2,059	60,512	372,510	326,898

EIRR 11.93%

Discount Rate(%)	B/C	PV		NPV
		Cost	Benefit	
10	1.20	51,049	61,138	10,090

2.3.3 Financial Examination

Assumptions were given on raising of the construction fund in order to examine a financial viability of the project.

The financial project cost for 1/20 design flood project is estimated at F$ 62.94 million. Most of these amount is scheduled to be disbursed over the construction period of 2 years. Considering that the project will require such a substantial amount of fund for the short period, as an example, the project cost is assumed to be financed with a loan through the overseas financial agency. Henceforth, two scenario of conditions shall be discussed ;

Scenario 1: under the terms of 1) interest rate of 1.7 % per annum, 2) a repayment of 25 years including a grace period of 7 years, and 3) paying only the interest of debt every year for the grace period, and the principal with interest in years after the grace period. And the loan amount is to be 85 % of Financial Cost.

Scenario 2: under the terms of 1) interest rate of 7.0 % per annum, 2) a repayment of 17 years including a grace period of 5 years, and 3) paying only the interest of debt every year for the grace period, and the capital amount with interest in years after the grace period. And the loan amount is to be 85 % of financial cost.

In case of Scenario 1, the total refund with interest will amount to F$ 67,141 thousand . The maximum of annual payment will amount to F$ 3,831 thousand at the eighth year from the commencement of the project. Payment schedule by each scenario is shown in Table-A2.8.

While in case of Scenario 2, the total refund with interest will amount to F$ 90,948 thousand . The maximum of annual payment will amount to F$ 7,831 thousand at the sixth year from the commencement of the project.

Table-A2.9 shows the repayment schedule for overseas borrowing of the Government of Fiji. Such a repayment schedule might be manageable in the more favorable conditions for the Scenario 1, judging from the following figures;

(a) The peak annual repayment will be 11.7 % of the total amount of the average total annual repayment to overseas loan by the Government for Scenario 1 and 24.0 % for Scenario 2.

(b) Debt coverage ratio at the peak repayment year by the figure of the average government expenditure will be 3.51 % for Scenario 1, and 3.90 % for Scenario 2.

Table-A2.8 Financial Cash Flow and Loan Repayment: Nadi (1/20)

Scenario 1

1. Project Cost (85 % loan of Financial Cost) Unit : F$ 1,000

Year in Order	Loan Disbursement			Repayment		
	Capital Cost	Interest	Cummurative Debt	Principal	Interest	Total
1	26,750	455			455	455
2	26,750	909			909	909
3		909			909	909
4		909			909	909
5		909			909	909
6		909			909	909
7		909			909	909
8			53,499	2,972	859	3,831
9			50,527	2,972	808	3,781
10			47,555	2,972	758	3,730
11			44,583	2,972	707	3,680
12			41,610	2,972	657	3,629
13			38,638	2,972	606	3,578
14			35,666	2,972	556	3,528
15			32,694	2,972	505	3,477
16			29,722	2,972	455	3,427
17			26,750	2,972	404	3,376
18			23,777	2,972	354	3,326
19			20,805	2,972	303	3,275
20			17,833	2,972	253	3,225
21			14,861	2,972	202	3,174
22			11,889	2,972	152	3,124
23			8,917	2,972	101	3,073
24			5,944	2,972	51	3,023
25			2,972	2,972	0	2,972
Total	53,499			53,499	13,642	67,141

Note : A Condition of International Financial Agency on Environmental Project to be ;
Interest:1.7 % , Disbursement period:25 years (including grace period of 7 years).

Scenario 2

1.Project Cost (85 % loan of Financial Cost) Unit : F$ 1,000

Year in Order	Loan Disbursement			Repayment		
	Capital Cost	Interest	Cummurative Debt	Principal	Interest	Total
1	26,750	1,872			1,872	1,872
2	26,750	3,745			3,745	3,745
3		3,745			3,745	3,745
4		3,745			3,745	3,745
5		3,745			3,745	3,745
6			53,499	4,458	3,433	7,891
7			49,041	4,458	3,121	7,579
8			44,583	4,458	2,809	7,267
9			40,124	4,458	2,497	6,955
10			35,666	4,458	2,185	6,643
11			31,208	4,458	1,872	6,331
12			26,750	4,458	1,560	6,019
13			22,291	4,458	1,248	5,707
14			17,833	4,458	936	5,394
15			13,375	4,458	624	5,082
16			8,917	4,458	312	4,770
17			4,458	4,458	0	4,458
Total	53,499			53,499	37,449	90,948

Note : A Condition of International Financial Agency on Project to be ;
Interest:7.00 % , Disbursement period:17 years (including grace period of 5 years).

Table-A2.9 Government Repayment to Overseas Loans

Unit: F$ 1,000

		Actual	Estimate		Projection		
		1996	1997	1998	1999	2000	Average (1996/2000)
Overseas Loan Interest Payments		11,171	12,917	13,653	12,475	11,223	12,288
Overseas Loan Principal Payments		19,670	16,954	21,241	21,868	22,924	20,531
(1) Total Repayment (without the Project)		30,840	29,871	34,894	34,343	34,147	32,819
(2) Total Expenditure of the Government		958,436	1,093,237	1,101,507	1,046,645	1,032,356	1,046,436
(3) (1) / (2) x 100: (%)*		3.22	2.73	3.17	3.28	3.31	3.14
Comparison of Peak Repayment for the Project with the whole Government Repayment of each year							
(4) Peak Repayment (8th year) of Scenario 1 (F$3,831 thousand)	(5) (4) / (1) x 100 (%)	12.4	12.8	11.0	11.2	11.2	11.7
	(6) (4) / (2) x 100: (%)	0.4	0.4	0.3	0.4	0.4	0.4
	(7) 3) + (6) : (%)*	3.62	3.08	3.52	3.65	3.68	3.51
(8) Peak Repayment (6th year) of Scenario 2 (F$7,891 thousand)	(9) (8) / (1) x 100 (%)	25.6	26.4	22.6	23.0	23.1	24.0
	(10) (8) / (2) x 100: (%)	0.8	0.7	0.7	0.8	0.8	0.8
	(11) (3) + (10) : (%)*	4.04	3.45	3.88	4.04	4.07	3.90

Source: Ministry of Finance 1998
Note: * Debt Coverage Ratio; the ratio of overseas loan repayment to government expenditure.

On the other hand, the balance 15 % of whole cost amounts to be F$ 9,441 thousand, and the average cost of F$ 4,721 thousand over construction period of 2 years accounts for 4.8 % of average capital expenditure (1991 ~ 1995) by the whole Government, and 11.5 % of average expenditure for infrastructure development by the Government (refer to Table-A1.20). Meanwhile, the Government may raise, if necessary, this balance of whole cost by means of domestic loan on longer term than two years of construction period in order to reduce the annual amount of the expenditure.

Taking into consideration importance and urgent necessity of the priority project, such magnitude of budget allocation to the implementation of the priority project is reasonable and possible.

In conclusion, repayment for the overseas borrowing as well as payment for the balance of whole cost shall fall in manageable range of the Government finance.

Literature Cited

Ministry of Finance (1998), "Fiji Budget Estimate, 1998", Suva.

SUPPORTING REPORT

PART B

TOPOGRAPHY AND GEOLOGY

THE STUDY ON WATERSHED MANAGEMENT AND FLOOD CONTROL
FOR THE FOUR MAJOR VITI LEVU RIVERS
IN THE REPUBLIC OF FIJI ISLANDS

SUPPORTING REPORT
PART B, TOPOGRAPHY AND GEOLOGY

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LIST OF ABBREVIATION

B/C	: Benefit Cost Ratio
BOD	: Biological Oxygen Demand
COD	: Chemical Oxygen Demand
D&I	: Drainage and Irrigation Division, MAFF
DO	: Dissolved Oxygen
DOE	: Department of Environment, MUDHE
DOF	: Department of Forest, MAFF
EIA	: Environmental Impact Assessment
EIRR	: Economic Internal Rate of Return
FAO	: Food and Agriculture Organization of the United Nations
FEA	: Fiji Electricity Authority
FMS	: Fiji Meteorological Service, MTCA
FSC	: Fiji Sugar Corporation
GDP	: Gross Domestic Product
GIS	: Geographical Information System
IEE	: Initial Environmental Examination
INR	: Institute of Natural Resources
JICA	: Japan International Cooperation Agency
MAFFA	: Ministry of Agriculture, Fisheries, Forests and ALTA
MAFF	: Ministry of Agriculture, Fisheries, and Forests
MPWIT	: Ministry of Public Works, Infrastructure and Transport
MRD	: Mineral Resources Department
MTCA	: Ministry of Tourism and Civil Aviation
MUDHE	: Ministry of Urban Development, Housing and Environment
NLTB	: Native Land Trust Board
NPV	: Net Present Value
PWD	: Public Works Department, MPWIT
SOPAC	: South Pacific Applied Geoscience Commission
SPC	: South Pacific Commission
SS	: Suspended Solids
TH	: Total Hardness
TN	: Total Nitrogen
TOR	: Terms of Reference
TP	: Total Phosphorus
UNDP	: United Nation Development Programme
USP	: University of the South Pacific
WHO	: World Health Organization

CHAPTER 1 TOPOGRAPHY AND GEOLOGY OF VITI LEVU

1.1 Topographic Features of Viti Levu

Viti Levu is the largest island in the archipelago of the Fiji islands with an area of 10,389 km^2 having the oval shape of 146 km in length and 106 km in breadth. On Viti Levu, the central mountain range named Nandrau plateau forms backbone dividing Viti Levu into western area and eastern area with its generally north-south orientation as shown in Figure-B1.1.

The Nandrau plateau contains 29 peaks of over 900 m above sea level, with the highest, Mt. Victoria reaching 1,323 m above sea level. The Nandrau plateau shows highly rugged mountain shape with perpendicular cliffs and pointed peaks.

Highlands which show well rounded hills at elevation of 300 m to 600 m widely spread in both side of the Nandrau plateau. The east highland is covered with dense tropical rain forest. The west highland, on the contrary, is in a dry zone known as talasiga (sun-burnt or barren lands) mainly covered with grass and reed.

Alluvial plains including the coastal plains on Viti Levu are fairly narrow and they quickly merged into low hills. In the delta areas of the main rivers, populations are dense and cultivation such as sugarcane and vegetables is intensive because of the fertility of soils. These areas, however, are flood prone and have suffered from many flood damages.

1.2 River System of Viti Levu

The drainage system of Viti Levu consists of five major rivers, namely Rewa, Sigatoka, Nadi, Ba and Navua, and the former four rivers constitute the Study Area as shown in Figure-B1.1.

There are two remarkable characteristics found on the river systems in Viti Levu. One of them is that the southern drainage areas occupy the greater part of the island and only small parts are remained for the northern drainage areas.

Another remarkable characteristic is that the gradient of the riverbeds is very gentle from the mouth to the middle reach and abruptly gets very steep in the upper reach as shown in Figure-B1.2. The average riverbed gradient of main four rivers is shown in Table-B1.1.

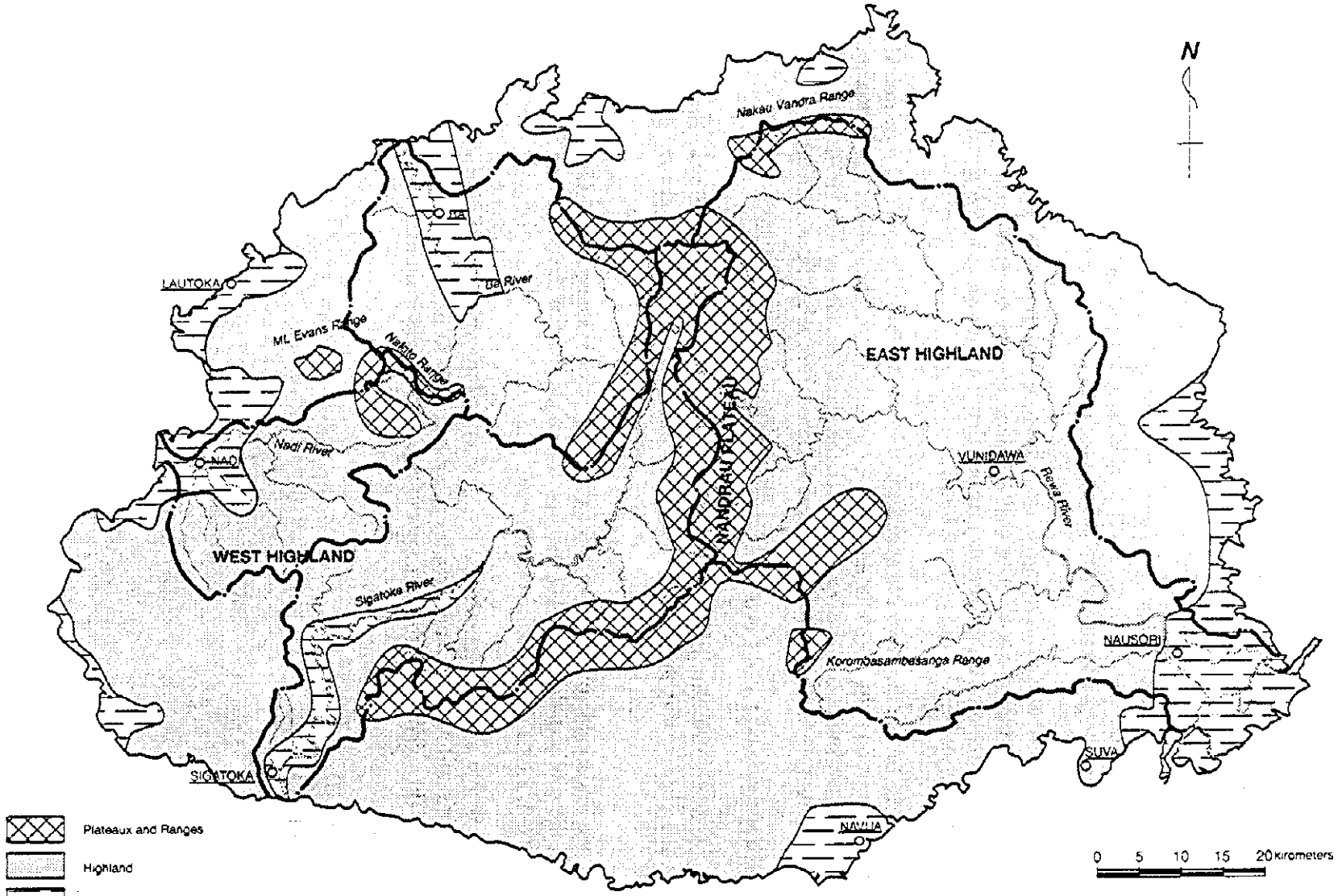


Figure-B1.1 General Topographic Features of Viti Levu

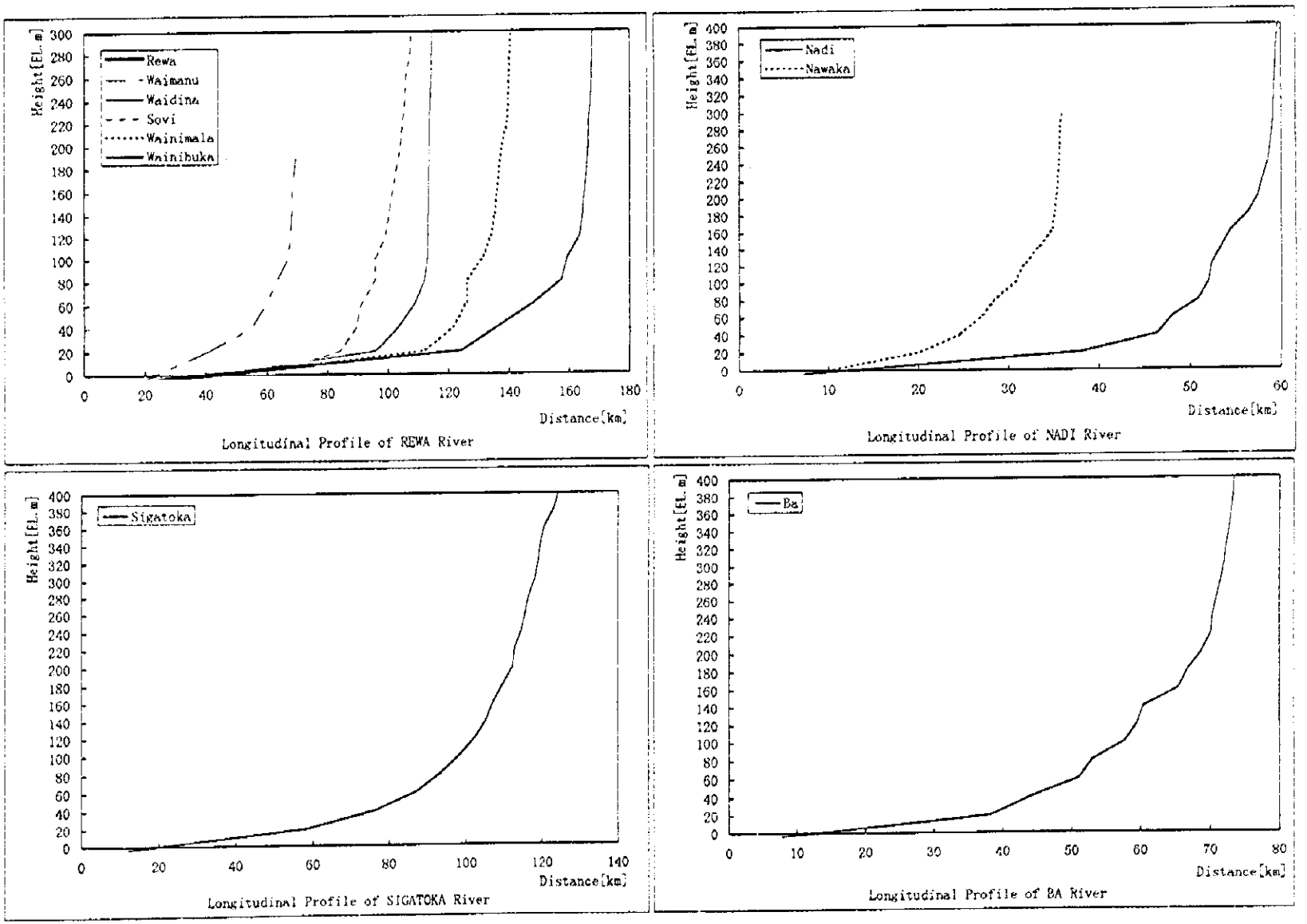


Figure-B1.2 Longitudinal Profiles of Objective Rivers

Table-B1.1 Average Riverbed Gradient of Four Main Rivers

River	Average Riverbed Gradient		
	Lower Reach[a]	Middle Reach[a]	Upper Reach[a]
Rewa[c]	1/4,400 (0 - 120 km)[b]	1/550 (120 - 160 km)	1/30 (160 - 174 km)
Sigatoka	1/2,000 (0 - 60 km)	1/300 (60 - 110 km)	1/60 (110 - 149 km)
Nadi	1/1,200 (0 - 40 km)	1/120 (40 - 55 km)	1/20 (55 - 69 km)
Ba	1/1,300 (0 - 40 km)	1/200 (40 - 70 km)	1/20 (70 - 83 km)

a : classified based on the longitudinal profile of river
b : Bracketed figures show the distance from the river mouth.
c : Rewa includes the Rewa mainstream and Wainibuka river.

Such forms of the riverbeds are normally caused by rapid uplifting of the hills located in the upstream area or sudden regression of sea level. In fact, it is reported that doming and lifting of the island took place in recent geological age (Early Pliocene, 5.0 to 4.5 million years ago) according to Rodda (1984).

1.3 General Geology of Viti Levu

1.3.1 Lithostratigraphy

Fiji archipelago is composed of a complex arc of volcanic rocks, volcanic originated sediments and reef deposits. Viti Levu is the largest island among the Fiji archipelago and also mainly composed of various type of igneous rocks and sedimentary rocks delivered from volcanic rocks dating from the Early Cenozoic (40 to 50 million years ago) to present as shown in Figure-B1.3.

Northern part of Viti Levu is wholly covered with relatively young volcanic rocks named Ba Basaltic Group, and many types of older rocks including plutonic rocks are exposed in the southern part of the island.

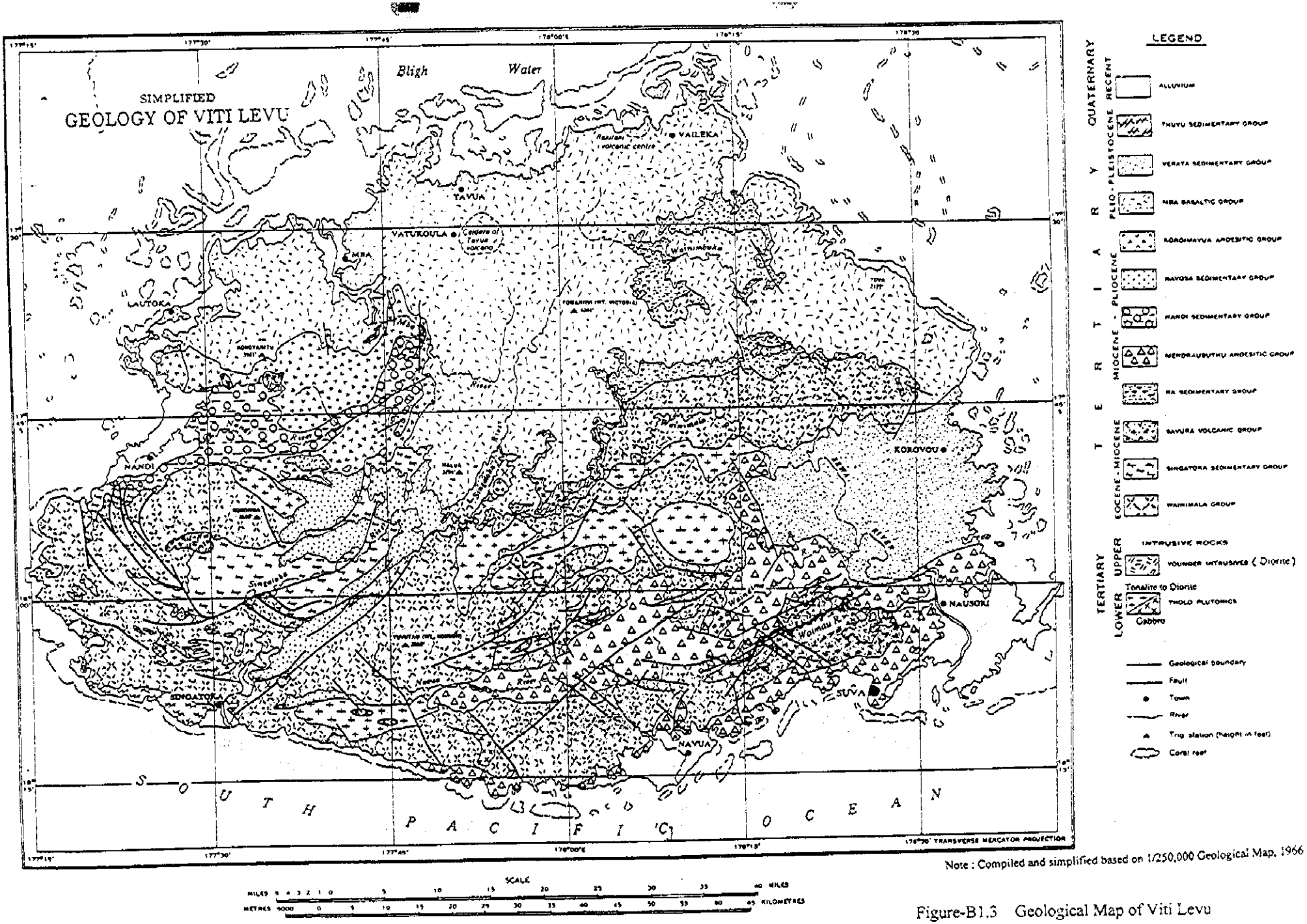
Lithostratigraphic units of Viti Levu are briefly summarized below based on the exiting geological maps and bulletins (see Literature Cited).

(1) Wainimala Group

Wainimala Group comprises largely basaltic, andesitic flows and coarse volcaniclastic rocks. Minor thin limestone layers are also occurring in this Group. The Wainimala Group widely outcrops in the southwestern part of Viti Levu.

(2) Sigatoka Sedimentary Group

Sigatoka Sedimentary Group is composed of sandstone, mudstone, various volcanic rocks and massive limestone. Its distribution area is restricted to middle to upper reach of the Sigatoka watershed and south to Nadi town.



Note : Compiled and simplified based on 1/250,000 Geological Map, 1966

Figure-B1.3 Geological Map of Viti Levu

(3) Savura Volcanic Group

Savura Volcanic Group is composed of andesite lava, rhyolite lava, basalt lava and their pyroclastic rocks. It mainly distributes in the right bank of Waimanu river which is one of the big tributaries of Rewa river.

(4) Ra Sedimentary Group

Ra Sedimentary Group is composed of conglomerate, sandstone, mudstone and minor limestone. It distributes in the upstream of the Rewa watershed.

(5) Mendrausuthu Andesitic Group

Mendrausuthu Andesitic Group is composed of andesite lava, mudstone, sandstone andesitic volcanic conglomerate, marl and limestone. It distributes in southwest of the island and its outcrop area shows narrow bands in east-west direction along Navua river to Waindina river and coastline between Suva city and Navua town.

(6) Nadi Sedimentary Group

Nadi Sedimentary Group is composed of conglomerate, marl and andesitic pyroclastic rocks. It distributes along Nadi river.

(7) Navosa Sedimentary Group

Navosa Sedimentary Group is composed of conglomerate grading up into sandstone and marl and limestone. It distributes surrounding the upper reach of the Sigatoka watershed.

(8) Koroimavua Andesitic Group

Koroimavua Andesitic Group is composed of andesite lava and andesitic pyroclastis rocks grading southeastward into sandstone. It distributes surrounding the Nadi watershed.

(9) Ba Basaltic Group

Ba Basaltic Group is composed of basalt lava, basaltic breccia, basaltic conglomerate, sandstone mainly derived from basalt, andesite lava and minor limestone. Its distribution area occupies almost northern half of the island.

(10) Verta Sedimentary Group

Verta Sedimentary Group is composed of weakly consolidated conglomerate and soft sandstone. It distributes in the middle course of the Rewa watershed.

(11) Thuvu Sedimentary Group

Thuvu Sedimentary Group is composed of soft marl, limestone and conglomerate. Its outcrop area is narrow and restricted to the southeast corner of the island where is west to Sigatoka town.

(12) Alluvium

Alluvium is composed of recent unconsolidated sand, gravel, silt and clay. It forms deltas in the mouth of the main rivers and narrow strips of the coastal plains along the shorelines. The thickness of the Alluvium occasionally exceeds more than 50 m in the deltas of the main rivers.

(13) Intrusive Rocks

Intrusive rocks vary basic to intermediate plutonic rock ranging from gabbro to diorite and tonalite. They intruded rocks which are older than Ba Basaltic Group and sporadically distribute in the southern half of the island.

1.3.2 Geological Structure

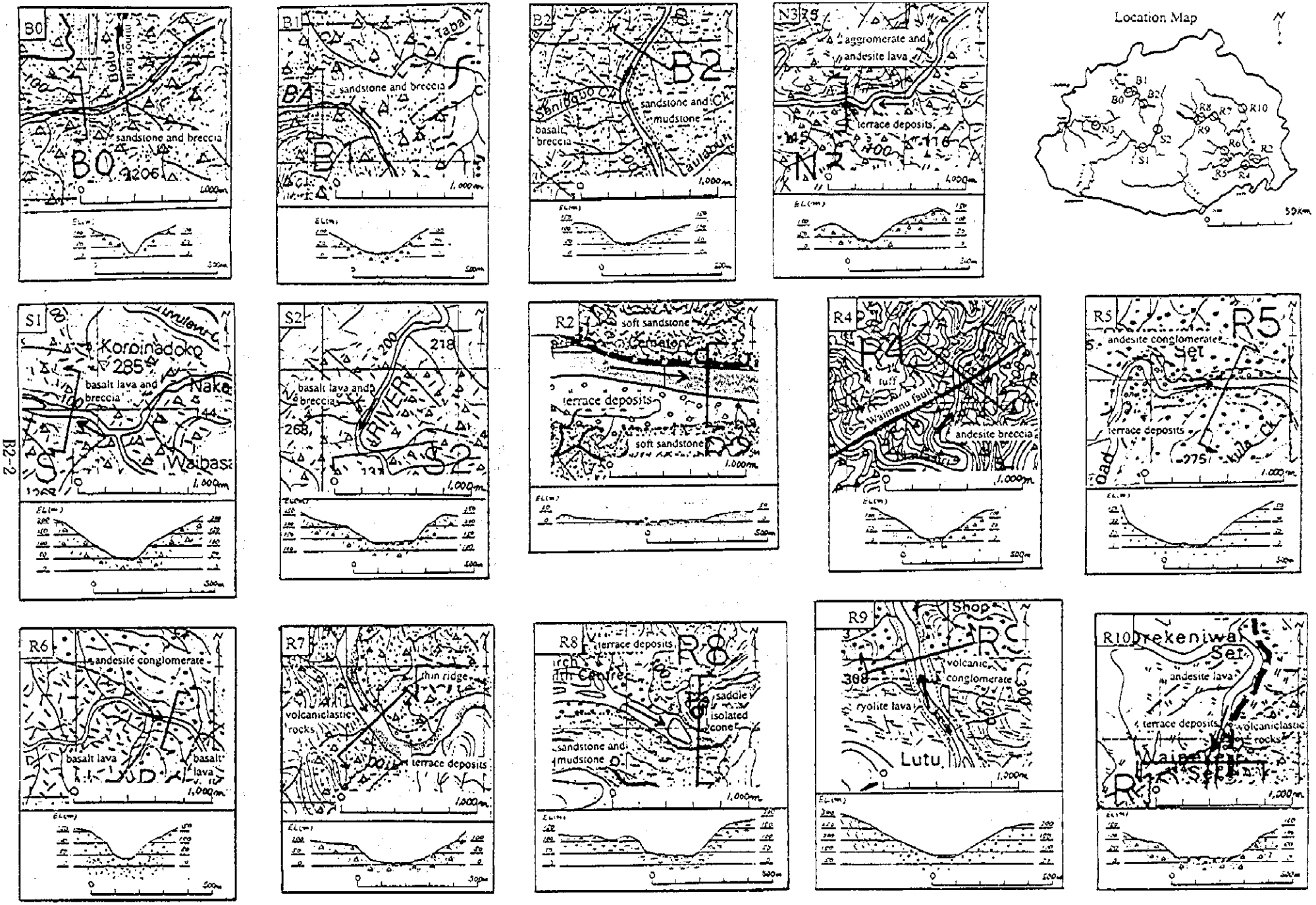
As shown in the geological map, southern part of the island is highly faulted. Any major faults, on the contrary, cannot be detected in the northern part of the island. It is explained by the reason that the older rocks which have experienced several tectonic movements mainly expose in the southern part and younger volcanic rocks of the Ba Basaltic Group which flowed and deposited after the main tectonic movements widely cover the northern half of the island.

The faults in NE-SW and NW-SE direction are prominent. It is thought that this fault system were formed by an orogenic phase called "Colo Orogeny" which took place in Middle to Late Miocene (inferred around 12 to 7 million years ago). During this orogenic phase, most of folding and faulting of the Wainimala Group occurred, accompanied by intrusion of plutonic rocks such as gabbro and diorite (Rodda, 1984).

After the Colo Orogeny, doming of the island occurred in the Early Pliocene (inferred about 5.0 to 4.5 million years ago). Among the effects of the doming the present Nandrau plateau was formed and there may have been overall tilting and uplifting of the island reactivating the existing fault system (Rodda, 1984)

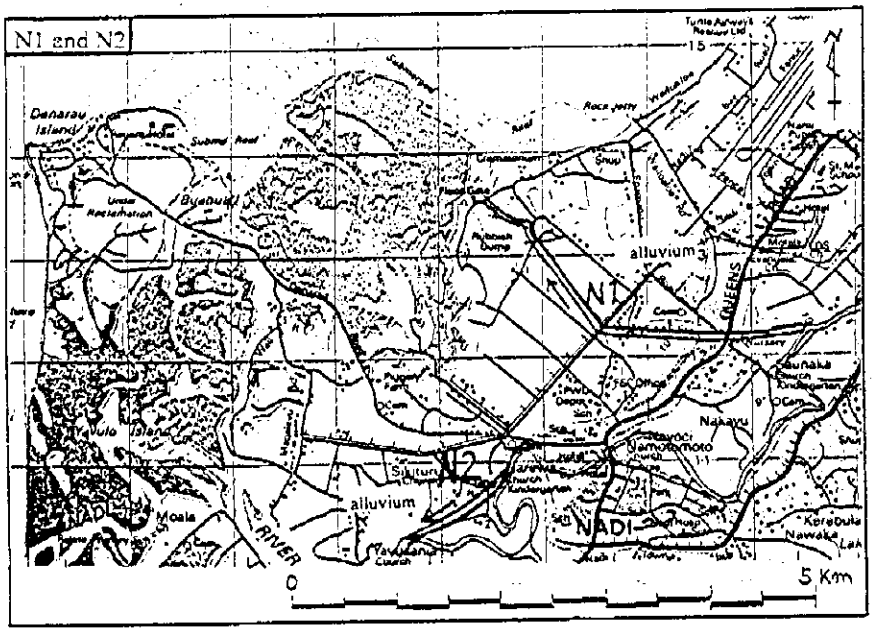
CHAPTER 2 CONDITION OF PROPOSED DAM SITES AND DIVERSION CHANNELS

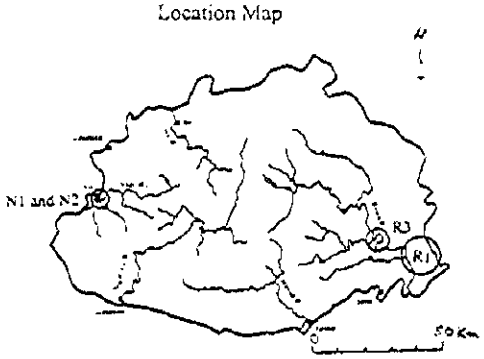
Topographic and geologic conditions of the dam sites and diversion channels proposed for flood control measures were preliminarily investigated based on the existing geological maps, aerialphoto interpretation (approximate scale: 1/24,000, taken in 1967) and supplementary field reconnaissance. The investigation results are summarized in Figure-B2.1, Figure-B2.2, Table-B2.1 and Table-B2.2.

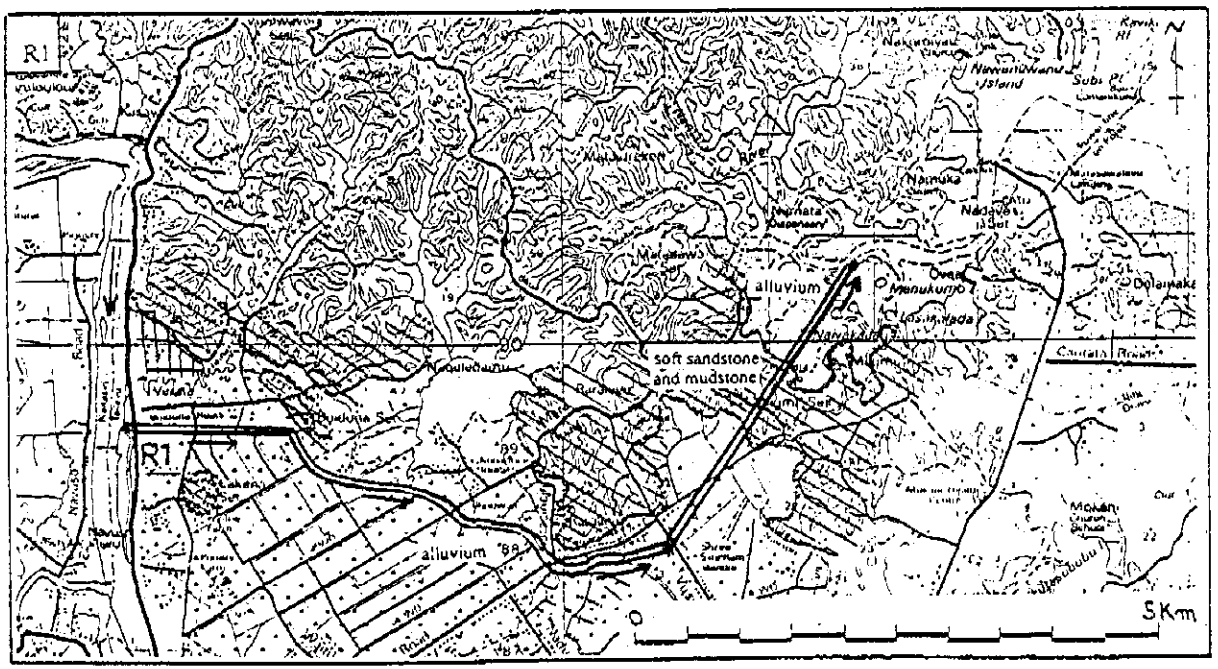


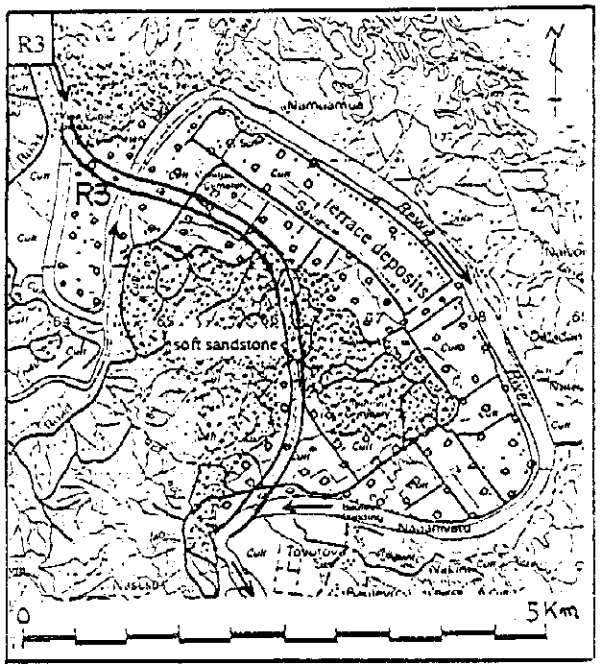
Note : compiled based on the existing 1/50,000 geological maps

Figure-B2.1 General Geological Condition Map of Proposed Dam Sites









Note : compiled based on the existing 1/50,000 geological maps

Figure-B2.2 General Geological Condition Map of Proposed Diversion Channels

Table-B2.1 Topographic and Geological Conditions of Proposed Dam Sites

River	Proposed Damsite	Riverbed Width (m)	Slope Condition		Geology	Fault	Estimated Weathering Condition
			Right bank	Left bank			
REWA	R2	500	low hill	low hill	soft mudstone, sandstone	no major fault	highly weathered with laterite
	R4	100	protruded steep slope	concaved steep slope	right bank: andesite breccia left bank: tuff	Waimanu fault[a] running in river bed	moderate
	R5	150	steep slope and terrace	steep slope	andesitic conglomerate	no major fault	moderate
	R6	60	protruded ridge	concave steep slope	andesitic conglomerate	no major fault	moderate
	R7	200	concave steep slope	protruded thin ridge	volcaniclasite rocks	no major fault	moderate
	R8	150	concave steep slope	isolated small cone with suddle behind	sandstone, mudstone	no major fault	moderate
	R9	150	steep slope	steep slope	volcanic conglomerate	no major fault	moderate
	R10	200	steep slope	steep slope with wide terrace	right bank: andesite lava left bank: volcaniclastic rocks	no major fault	moderate
SIGATOKA	S1	80	steep slope	steep slope	breccia and basalt lava	no major fault	moderate
	S2	60	concave steep slope	concave steep slope	breccia and basalt lava	no major fault	moderate
NADI	N3	70	convex steep slope	steep slope and terrace	agglomerate with andesite lava	no major fault	moderate
BA	B0	30 m (gorge)	very steep slope, almost perpendicular	very steep slope, almost perpendicular	andesitic breccia with sandstone	no major fault but jointed	fresh to moderate
	B1	50 m	Steep slope	steep slope	andesitic breccia with sandstone	no major fault	moderate
	B2	40 m	Steep slope	steep to moderate slope	mudstone and sandstone	no major fault	moderate

a: from 1/50,000 Geological Map Sheet 19 "Geology of Mau Area", 1965

Table-B2.2 Topographic and Geological Conditions of Proposed Diversion Channels

River	Proposed Diversion Channel	Topography	Geology
Rewa	R1	Flat alluvial plain, low hills are situated in the mouth of the proposed channel course	Alluvial deposits such as unconsolidated sand, clay, silt with some gravels, low hills located in the mouth of the proposed channel course consist of soft sandstone and pebbly siltstone
	R2	Flat river terrace, low hills are situated in the middle course at the proposed channel.	Terrace deposits such as unconsolidated sand, gravel, silt, clay, low hills consist of soft sandstone and siltstone
Nadi	N1	Flat Alluvial plain, some ancient river course remains and natural levees can be found in the Alluvial plain	Alluvial deposits such as sand, clay silt with some gravels
	N2	Flat Alluvial plain with some ancient river course remnants	Alluvial deposits such as unconsolidated sand, clay, silt with some gravels

CHAPTER 3 TOPOGRAPHIC AND GEOLOGICAL CONDITION ALONG THE DIVERSION CHANNEL

3.1 Topographic Condition

Site of the diversion channel is located in the downstream of Nadi river and typical coastal plain spreads in this area. The coastal plain shows almost flat topography with some low hills and shallow valleys.

Terraces are formed along Nadi river 50 m to 250 m in width. Terrace is a relic of ancient river course. Two terrace plains can be recognized at least in the vicinity of the channel. The relative height of the higher terrace from the present riverbed is 5 m to 7 m and lower one is 2 m to 4 m. The steep cliffs are formed behind these terraces bounding the terraces and gently hilly area. The heights of cliffs are 3 m to 5 m in general.

The upper half area of the channel (between boring BH1 to BH7) shows gently hilly features and the lower half area (between boring BH8 to BH12) is a low-lying flat plain.

The coastal plain gently inclines toward the shoreline. The elevation in the vicinity of the inlet of the channel is around 10 m above sea level. The average inclination of the coastal plain is around 1/300.

3.2 Geological Condition

(1) Exploratory Boring and Laboratory Soil Test

Twelve exploratory borings were drilled along the planned route of the diversion channel as shown in Figure-B3.1. Laboratory soil tests were also conducted on the samples taken from the borings. Item and quantity of the geological investigation are shown in Table-B3.1.

Table-B3.1 Item and Quantity of the Geological Investigation

Borehole No.	Depth (m)	SPT No.	U/D Sample	Soil Test					
				M. Cont.	P. Dens.	P/S Dis.	A. Limits	U/C Test	Con. Test
BH1	20.0	16	3	18	17	17	13	2	2
BH2	13.0	12	1	11	10	11	5	1	1
BH3	11.0	9	2	11	11	11	10	1	1
BH4	19.0	14	4	18	18	16	13	2	3
BH5	13.0	11	2	13	13	13	11	2	2
BH6	13.0	11	2	13	13	13	13	2	2
BH7	10.0	8	2	10	10	10	5	1	1
BH8	8.0	7	1	8	8	8	7	1	1
BH9	8.0	6	2	6	6	6	6	1	1
BH10	6.0	4	2	6	6	6	6	2	1
BH11	6.0	4	2	5	5	5	5	2	2
BH12	11.1	10	1	10	10	10	6	1	1
Total	138.1	112	24	129	127	126	100	18	18

M. Cont.: Moisture Content Test, SPT : Standard Penetration Test, U/D Sample : Undisturbed Sample,
P. Dens.: Particle Density Test, P/S Dis. : Particle Size Distribution Test, A. Limit : Atterberg Limits Test,
U/C Test: Unconfined Compression Test, Con. Test : Consolidation Test

Figure-B3.1 Site of Exploratory Boring

(2) Geological and Geotechnical Condition

Based on the data obtained from the borings and soil tests, geological and geotechnical condition along the channel is discussed in this section.

The strata in this area can be basically classified into four units, which are basement, hill clayey deposits, coastal sand and clay deposits, terrace deposits as shown in the geological profile along the channel.

1) Basement

– Soil type

Sound layer underlies along the whole diversion channel. This sound layer is called as basement in this report. Depth to the basement is 6 m to 16 m (encountered at boring BH1, 4, 5, 6, 7 and 12). The basement consists of semi-consolidated clayey sand, gravelly sand and sandy clay layers. It is inferred that the basement can be correlated to "Meigunyah beds" of late Pliocene to early Pleistocene in age according to Rodda (1986).

– Geotechnical properties

The N-value of the basement is 30 to over 50. It is judged that this layer can be used as the supporting layer for the structures and no subsidence will take place by the filling works.

– Suitability for the embankment materials

According to the present plan of the channel excavation works, the surface layer of the basement will be excavated in the area between boring BH5 and BH7. As the soil type of the basement in this area is classified as SC (clayey sand, sand-clay mixtures) based on the results of the laboratory soil tests which are grain size distribution test and Atterberg limits test, it is judged that these soils can be used for the embankment materials.

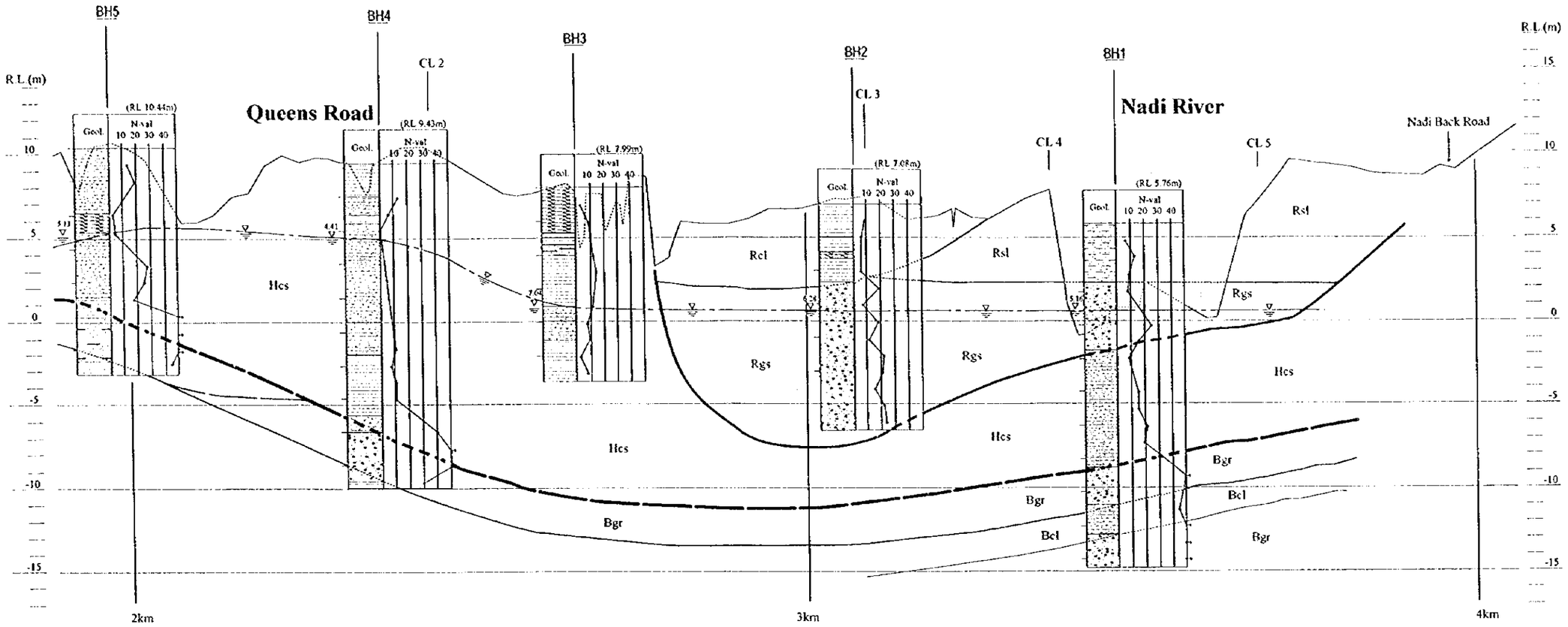
2) Hill Clayey Deposits

– Soil type

Sandy clayey deposits widely distribute in the gently hilly area located in the upper half of the channel. These deposits are referred as Hcs in this report. The Hcs is mainly composed of sandy clay layers intercalated with thin clayey sand layers. The maximum thickness of the Hcs is around 18 m and it is inferred that this layer thins out toward the sea as shown in the geological profile.

– Geotechnical properties

The N-value of the Hcs widely ranges from 5 to 30 and major parts of this layer show around 10 in general. Its unconfined compressive strength (UCS) also widely ranges from 50 kPa to 220 kPa and major parts show 50 kPa to 100 kPa in general according to the laboratory soil test results. The compressibility of the Hcs is not so high judging from its N value and consolidation test results.



LEGEND

Boring Logs

- Clay
- Clay with Organic Substances
- Sandy Clay
- Silt
- Sandy Silt
- Clayey Sand
- Sand
- Gravelly Sand

Geological Profile

Age

Holocene

Pleistocene

Pliocene

- Rts : Terrace Deposits
  - Rcl Clay Layer
  - Rsl Sandy Silt Layer
  - Rgs Gravelly Sand Layer
- Csc : Coastal Sand and Clay Layer
  - Cls Loose sand Layer
  - Cws Weak Silt Layer
  - Cwc Weak Clay Layer
- Hcs : Hill Clay and Sand Layer
  - Hcs Sandy Clay Layer
- Basement : Sand,Gravel,Hard Clay Layers
  - Bgr Sandy Gravel Layer
  - Bs Sand Layer
  - Bcl Hard Clay Latyer

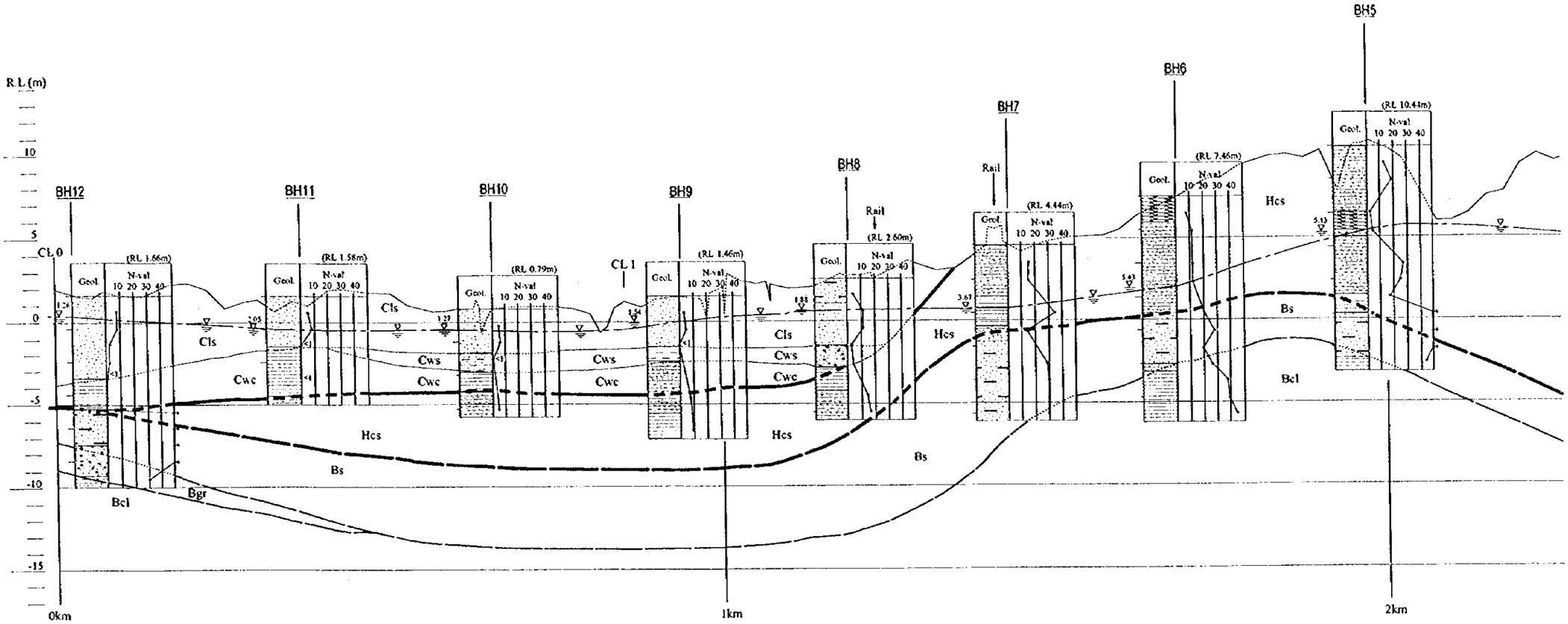
Geological Boundary

Groundwater Surface

SCALE

0 100 500 1000m

Figure-B3.2 (1/2) Geological Profile along the Proposed Diversion Channel



LEGEND

Boring Logs

- Clay
- Clay with Organic Substances
- Sandy Clay
- Silt
- Sandy Silt
- Clayey Sand
- Sand
- Gravelly Sand

Geological Profile

Age

Holocene

Pleistocene

Pliocene

- Rts : Terrace Deposits
  - Rcl Clay Layer
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- Csc : Coastal Sand and Clay Layer
  - Cls Loose sand Layer
  - Cws Weak Silt Layer
  - Cwc Weak Clay Layer
- Hcs : Hill Clay and Sand Layer
  - Hcs Sandy Clay Layer
- Basement : Sand,Gravel,Hard Clay Layers
  - Bgr Sandy Gravel Layer
  - Bs Sand Layer
  - Bcl Hard Clay Latyer

Geological Boundary

Groundwater Surface

SCALE

0 100 500 1000m

Figure-B3.2 (2/2) Geological Profile along the Proposed Diversion Channel

- Suitability for the embankment materials

According to the present plan of the channel excavation works, the Hcs will occupy the main part to be excavated.

The soil type of the Hcs is mainly classified as CH (inorganic clays of high plasticity) based on the laboratory soil test results. Therefore, it is judged that the main part of the Hcs can be used for the embankment materials.

However, it should be noted that the organic substances such as roots are included in the surface layer and occasionally subsurface layer as shown in the geological profile. Attention should be paid to the layers including the organic substances because such soil will shrink after filling by the disintegration of the organic substances.

3) Coastal Sand and Clay Deposits

- Soil type

Loose and weak sand and clay deposits including many shell fragments are distributed in the low-lying flat plain located in the lower reach of the channel (between boring BH8 to BH12). These deposits are referred as Csc in this report. The Csc consists of loose sand layer, weak silt layer and weak clay layer from surface to bottom. It is inferred that the Csc deposited in the lagoons formerly spread behind the present coast in the latest geological age (Holocene).

The weak clay layer in the bottom is composed of dark gray sandy silty clay 1m to 2 m in thickness. The weak silt layer changes its component from sandy silt to gravelly sand. The thickness of the weak silt layer is 1 m to 2 m. The loose sand layer is composed of fine to coarse sand including some gravel and widely covers the coastal plain. The thickness of the loose sand layer is 3 m to 5 m.

- Geotechnical properties

The N-value of the weak clay layer is less than 1 and its unconfined compressive strength (UCS) ranges from 27 kPa to 57 kPa. The compressibility of this layer is high judging from its N value and consolidation test results.

The N-value of the weak silt layer is also less than 1. As the undisturbed sample could not be taken because of its looseness, the UCS is not known. It is inferred that the UCS of this layer might be as low as the underlying weak clay layer. The compressibility is also assumed to be high, but the subsidence may cease in short time because this layer is composed of relatively coarse-grained materials.

The N-value of the loose sand layer is 2 to 10. The UCS is also unknown. The land subsidence to be caused by the embankment construction works will be negligible because of sandy layer.

It is very important to note that the weak silt and clay layers will widely expose on the bottom of the excavated channel in the down reach area according to the present plan of excavation works.

- Suitability for the embankment materials

According to the present plan of the channel excavation works, the loose sand layer and surface part of the weak silt and clay layers are subject to excavation.

As the loose sand layer is classified as SP, this layer cannot be used for the embankment materials. As for the weak silt and clay layers, it is also judged unsuitable for embankment materials because their trafficability is too low during the filling works.

4) Terrace Deposits

- Soil type

Terrace deposits are ancient river sediments delivered by Nadi river. Terrace deposits distribute in the terraces along Nadi river. Terrace deposits are referred as Rtd in this report. The Rtd is composed of surface clay layer, sandy silt layer and gravelly sand layer from surface to bottom.

The total thickness of the Rtd is around 15 m. The maximum thickness of the clay layer, the sandy silt layer and the gravelly sand layer is around 5 m, 7 m and 10 m respectively.

- Geotechnical properties

The N-value of the gravelly sandy layer is around 10 to 25. The UCS value is not known on this layer because of the difficulty of the undisturbed sampling. The land subsidence to be accompanied by the filling works will not take place on this layer.

The N-value of the sandy silt layer is around 10. The UCS value is also unknown. It is supposed that the land subsidence will not take place on this layer too.

The N-value of the clay layer on surface is 6 to 8. The UCS value is 235 kPa. Based on the N-value and the UCS, it is judged that this clay layer is stiff to very stiff. The compressibility of this clay layer is not so high judging from its N value and consolidation test results.

- Suitability for the embankment materials

According to the present plan of the channel excavation works, the clay layer and sandy silt layer will be fully excavated and the surface part of the gravelly sand layer will be excavated.

As the surface clay layer is classified as CH according to the soil test results, it is judged that this layer can be used for the embankment materials.

The sandy silt layer is classified as ML (inorganic silts, rock flour, sandy or clayey silts of low plasticity) and SM (silty sand, sand-silt mixtures). In spite that the soil types of ML and SM are not best materials for impervious structures because of lack of fines, it is supposed that such soils can be used for the embankment materials.

The gravelly sand layer is classified as SP (poorly graded sands less than 12 % fines, non-plastic). Therefore, this layer cannot be used for the embankment materials. This layer can be used for aggregate materials.

(3) Groundwater

After the completion of the boring work, temporary perforated PVC pipes were installed in every borehole and they were left for a while in order to counteract the disturbance of the groundwater caused by the drilling work such as drilling fluid.

More than one month after the boring completion, the groundwater level and the electric conductivity were measured in each borehole. The results of the groundwater observation are shown in Table-B3.2.

Table-B3.2 Results of the Groundwater Observation

Borehole No.	Boring Completion Date	Groundwater Observation Results			
		Observation Date	groundwater Table (m)	EC (μ s/cm)	Temperature (°C)
BH1	20/12/'97	19/2/'98	-5.16	1,400	28.6
BH2	6/1/'98	19/2/'98	-6.28	400	27.4
BH3	5/1'98	19/2/'98	-7.04	300	26.7
BH4	18/12/'97	19/2/'98	-4.41	100	27.7
BH5	7/1/'98	19/2/'98	-5.13	200	29.1
BH6	3/1/'98	19/2/'98	-5.43	200	27.4
BH7	16/12/'97	19/2/'98	-3.67	500	27.4
BH8	9/1/'98	19/2/'98	-1.88	1,300	27.6
BH9	2/1/'98	19/2/'98	-1.54	3,100	28.6
BH10	9/1/'98	19/2/'98	-1.27	56,800	28.3
BH11	23/12/'97	19/2/'98	-2.05	12,200	27.3
BH12	22/12/'97	19/2/'98	-1.26	4,600	28.5

EC: Electric Conductivity

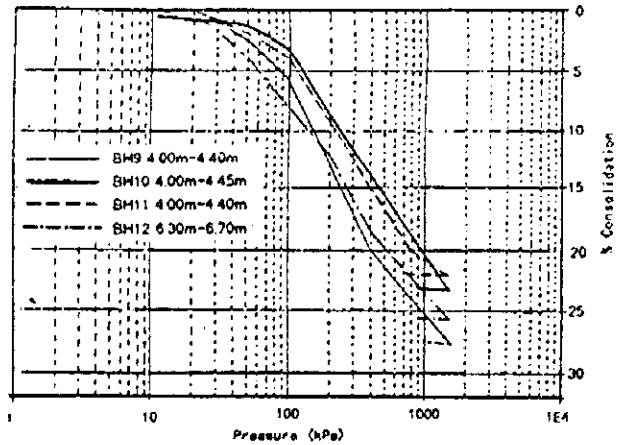
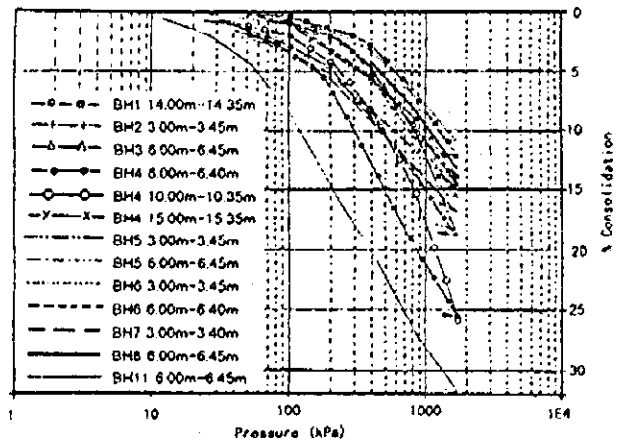
As shown in Table-B3.2 and the geological profile, groundwater ridge can be found in the hilly area and groundwater table gently inclines toward both to Nadi river and to the sea.

Distinctive difference can be found in the groundwater electric conductivity between hilly area (BH1 to BH7) and low-lying flat coastal plain area (BH8 to BH12). The electric conductivity of the groundwater in the hilly area is as low as rainwater except of BH1, which is located just beside Nadi river. It is inferred that the electric conductivity in BH1 gets slightly higher because of the brackish river water intrusion to the original fresh groundwater. On the contrary, electric conductivity of the groundwater shows extremely high in the coastal sediments distributed in the low-lying flat plain. It is assumed that the seawater invades into this area through discharging channels for the irrigation and, furthermore, the coastal sediment itself includes much salt.

(4) Summary of the soil test results

The results of the laboratory soil tests are summarized in Table-B3.3.

Table-B3.3 Summary of the Laboratory Soil Test Results

Layer		Soil Type	L.L. (%)	P.L. (%)	P.I. (%)	L.S. (%)	M.C. (%)	P. 0.075mm(%)	N.D.	UCS(kPa)	Consolidation – Pressure Curve
Terrace Deposits (Rts)	Clay layer	CH	50–64	18–27	23–46	12–16	37–43	91–97	1.85	235	see C – P Curve of Hcs Sandy Clay Layer BH-2
	Sandy silt Layer	SM~ML	36	23	13	7	8–39	16–69	–	–	–
	Gravelly Sand Layer	SP	–	–	–	–	8–29	6–15	–	–	–
Coastal Sand and Clay Deposits (Csc)	Loose Sand Layer	SP~SC	–	–	–	–	17–43	10–52	–	–	–
	Weak Silt Layer	ML~SP	27–37	22–26	5–10	3–7	19–51	10–66	–	–	–
	Weak Clay Layer	CH	43–69	21–45	22–35	8–14	46–70	61–88	1.75	27–57	
Hill Clayey Deposits (Hcs)	Sandy Clay Layer	CH	46–104	11–45	20–80	10–24	30–71	48–99	1.57–1.8	47–222	
Basement		SM,SC,SP, CH,GM	30–106	15–27	11–83	3–23	8–51	15–95	–	–	–

L.L.:Liquid Limit, P.L.:Plastic Limit, P.I.:Plasticity Index, L.S.:Linear Shrinkage, P.0.075:Passing 0.075mm, ND:Natural Density, UCS:Unconfined Compressive Strength

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