

CHAPTER 8 INSTITUTION

8.1 Objectives of Institutional Study

The objectives of the institutional study consist of the following two parts:

- 1) to formulate recommendations which may facilitate improvements for effective and efficient performance of the organizations relevant to watershed management and flood control
- 2) to plan and recommend organizational strengthening or restructuring and legal arrangement, if necessary, for smooth implementation, operation and maintenance of the projects and programs proposed by the Study

8.2 Scope of Institutional Study

In this Study, institution means laws/regulations, including the customary laws of native communities, organization of relevant authorities, and all that is associated. Relevant statutory legislation of the Republic, as well as the native customary laws of the Study Area is to be inquired. However, the customary laws, especially on land tenure and water rights, were studied only through reports and documents. Responsibilities or job allocation related to watershed management and flood control among the executive branch of the Government, and organization structure, staffing and financing to the relevant government bodies were also studied.

Watershed management includes management of lands and water resources of a drainage system as a unit of the management, with a linkage of upland productivity and the environmental conditions with motivations of downstream impacts on control of floods and sedimentation. The scope of the institutional study includes institutions for water resources management and land management, including forest and forestry management.

8.3 Relevant Institution

Relevant institution (laws/regulations and organizations) of the Government of Fiji to watershed management and flood control is described below.

8.3.1 Water Resources Management

(1) Meteorological and Hydrological Data Collection and Analysis

Department of Meteorological Services in the Ministry of Tourism and Transport is in charge of Meteorology, including data collection and forecasting services, while hydrological data collection and analysis are carried out by the Hydrological Section of the Water and Sewerage Division in Ministry of Communication, Works, and Energy.

(2) Water Rights Allocation and Management

The Department of Lands and Surveys in the Ministry of Lands and Mineral Resources is in charge of licensing for diversion of water from rivers according to the Rivers and Streams Act (Cap. 136). For public projects, such as domestic water supply or irrigation schemes, such authorization from the Department to derive water from rivers or streams is not

included in the due process of the implementation of such schemes. There are only several water rights granted by the Department all over the country.

(3) Water Use Management

1) Water Supply

The Water and Sewerage Division in the Ministry of Communication, Works, and Energy carries out water supply in accordance with Water Supply Act (Cap. 144). The Government intends to corporatize the Division. There is no public water supply scheme for industrial use only or other specific use than that for domestic or agricultural purpose in the country.

2) Irrigation

Irrigation schemes are managed by the Land and Water Resources Management Division (LWRMD) of the Ministry of Agriculture, Fisheries and Forests (MAFF) under Irrigation Act (Cap. 144A).

(4) Excess Water Management

1) Flood Control and Drainage

The LWRMD of the MAFF carries out dredging in river mouths of the Rewa and the Ba rivers. No major works for flood control have been constructed in the country. The Division has River Engineering Section which is in charge of technical matters for river works construction for flood control.

2) Disaster Management

National Disaster Management Plan has been formulated and published in 1995, which has replaced the Manual prepared by the Emergencies Services Committee in 1979. This plan shall be enforced by the National Controller, the Permanent Secretary of the Ministry of Regional Development and Multi-Ethnic Affairs, through Divisional Commissioners and District Officers, on behalf of the Cabinet.

The National Disaster Act is under drafting. "Standing Operating Procedure", which will provide organization of the National Emergency Operation Center (NEOC) set up upon emergency, contents of emergency operation, duties of the members of NEOC and the process of emergency communication, is on the way of drafting by the National Disaster Management Office. "Disaster Management Plan for Other Agencies" is yet to be prepared by relevant authorities.

(5) Water Resources Conservation

1) Water Quality Monitoring and Assessment

The Department of Environment in the Ministry of Local Government, Housing and Environment is in charge of the environment conservation, including that of water resources. There is no comprehensive environmental legislation in Fiji. A bill named "Fiji's Sustainable Development" has been drafted.

There is no regular water quality monitoring except that of supplied water. The water quality test laboratory belongs to the Water and Sewerage Division in the Ministry of

Communication, Works and Energy for quality monitoring and analysis of water to be supplied.

2) Sewerage

The Water and Sewerage Division, as its name shows, discharges the responsibility under the Sewerage Act (Cap. 128).

3) Control of Industrial Wastewater

Although the Sustainable Development Bill covers control of industrial wastewater, no major control measure seems to be enforced at present.

8.3.2 Land Management

(1) Land Registration and Dealing Management

Lands in Fiji, in terms of the ownership, are classified into Native Lands, including Native Reserve, State Lands and freehold lands. Native Lands are owned by Fijian communities with customary tenure. State Lands and freehold lands are owned by the State and individuals, respectively, with similar ownership and administration system to other countries, while the Native Lands are managed with a unique manner. The distribution and land use of the three types of lands are described in Section 5.2 of this report.

Native Lands are administered by the Native Land Commission and Native Land Trust Board in the Ministry of Fijian Affairs and ALTA in accordance with the Native Lands Act (Cap. 133) and Native Land Trust Act (Cap. 134, NLTA). The Commission is in charge of titles and boundaries of the lands, while the Board controls the land use, including leasing.

State Lands are managed by the Department of Lands and Surveys in the Ministry of Lands and Mineral Resources as a custodian according to the State Lands Act (Cap. 132). Titles and dealings of freehold lands are also registered in the Department. The Department is the center of information on land holdings and dealings of all land within the territory of the Republic including Native Lands.

Leasing of agricultural lands is controlled under Agricultural Landlord and Tenant Act (ALTA, Cap. 270). Since many of agricultural leases based on the ALTA will expire in near future, the ALTA Research Unit in the Ministry of Fijian Affairs and ALTA (recently shifted from the MAFF) is reviewing the ALTA in close consultation with the Native Land Trust Board and the Department of Lands and Surveys. Inclusion of the act into the Native Land Trust Act (Cap. 134) is discussed.

(2) Land Use Planning and Regulation

1) Town Planning and Regulation

The town planning is discharged by the Department of Town and Country Planning in the Ministry of Local Government, Housing and Environment under the Town Planning Act (Cap. 139) and Subdivision of Land Act (Cap. 140).

2) Promotion and Enforcement of Good Land Husbandry

The MAFF is in charge of land conservation and control of land husbandry in agricultural lands under Land Conservation and Improvement Act (Cap. 141), Land Development Act (Cap. 142). The Land Conservation Board in the Ministry has been established under Land Conservation and Improvement Act (Cap. 141). The Land Use Section in the Research Division of the MAFF is engaged in researches for the most suitable land husbandry practices.

(3) Forest and Forestry Management

Forest management is conducted under the Forests Act (Cap. 150). The Department of Forests, or the Conservator of Forests, in the MAFF is responsible for forest administration in the forest reserve and for forestry administration. Forests in Native Lands are controlled by the Native Land Trust Board, while Department of Forest controls the protected forests.

8.4 Current Institutional Framework on Major Issues

8.4.1 Major Issues

Fiji is blessed with abundant volume of water resources potential of good quality in almost all areas in the country except some small islands out of the Study Area. Although the sector of water resources development has things to be done, the water rights allocation or management is not a controversial issue. The water supply and sewerage sector has a plan to be corporatized for the efficient services by the sector. The direction of the sector improvement has already determined.

The water resources in Fiji have not been deteriorated much, except certain places in the middle reach in Ba watershed. Although wastewater treatment from some industries has to be guided properly, water resource conservation seems not to have serious problems. The enactment and enforcement of the Sustainable Development Bill and the strengthening of the Department of Environment would contribute to the enhancement of monitoring activities and effective control of water quality discussed in Section 5.4 of this report.

Despite frequent occurrences of huge damages by floods, the damage mitigation activities seem not to reach the sufficient solutions. Currently, flood control measures are conducted or discussed, giving an emphasis on non-structural measures except dredging some river mouths. These measures have limited effects on flood damage mitigation. To obtain sufficient solutions, some structural measures should be employed. Institutional study should also give emphases on the arrangement which may effectively and efficiently facilitate structural measures.

Serious degradation in land productivity and large volume of sedimentation into watercourses prevails in wide areas of the watersheds. Measures for land conservation seem not to attain the sufficient level.

Major issues for watershed management in Fiji can be summarized as the following points. The analysis of current institutional framework, and subsequent problem/constraint/necessity identification and analysis, as well as formulation of the institutional recommendations should focus on these points listed below.

- hydrological measurement and analysis
- flood control and damage mitigation
- land conservation
- forest and forestry management

In the discussion below, flood control and damage mitigation is divided to; i) flood control by structural measures, ii) land use regulation in flood prone areas, iii) disaster management. The following six issues are discussed below.

- 1) hydrological measurement and analysis
- 2) flood control by structural measures
- 3) land use regulation in flood prone areas (non-structural measures)
- 4) disaster management (non-structural measures)
- 5) land conservation
- 6) forest and forestry management

8.4.2 Institutional Framework

(1) Hydrological Measurement and Analysis

The Hydrological Section in the Water and Sewerage Division is responsible for the duties. The Section has 15 established staff as shown in the table below, while Water and Sewerage Division has 237 members of established staff. Staff of the Hydrological Section is allocated at three Division (regional) offices, namely, Central/Eastern, Western and Northern Divisions. The head of the Section in Central/Eastern Division manages the whole territory of the country.

As a part of the corporatization plan of the water supply and sewerage sector, the Hydrological Section is planned to be placed out of the sector.

Table-8.1 Staff of Hydrological Section

Rank	Number
Senior Hydrologist	1
Hydrologist	3
Technical Officer	1
Senior Hydrological Technician	5
Hydrological Technician	5
Sub Total	15
Unestablished Staff	50
Total	65

Source: Management Service Division, 1996

(2) Flood Control by Structural Measures (Drainage)

1) Relevant Legislation and Organization

The word "drainage" in the legislation and administration in Fiji means not only draining of land but also preventing and mitigating floods or erosion. The Central and Western Drainage Boards were established according to the Drainage Act (Cap. 143) after "drainage areas" were declared, whose chairman and members were appointed by the Minister of Agriculture, Fisheries, Forests (MAFF), and are responsible for drainage of the areas. The member shall include a land conservation officer, a drainage engineer, and not less than 2 landowners in the drainage area. The land conservation officer shall be the secretary for the Board.

The Land Conservation Board, to be constituted under the Land Conservation and Improvement Act (Cap. 141), is referred as the "Controlling Authority" in the Drainage Act. Most of important activities by a Drainage Board, such as entering into a contract of large amount, shall be approved and supervised by the Land Conservation Board. The designation of a drainage area, which leads to the establishment of a Drainage Board, shall be initiated by the Land Conservation Board.

The contents of the Drainage Act related to this study are summarized in Part K "Institution" of Supporting Report.

The Land and Water Resources Management Division (LWRMD, recently renamed from Drainage and Irrigation Division) takes the primary role in technical matters in the field of "drainage". The division is engaged in three Activities of three Programs of the government expenditure account number:

- * 30-1-5; policy and administration for drainage and irrigation
- * 30-2-5; crop-irrigation services
- * 30-6-1; land, drainage and flood protection

The number of the staff has been slightly decreasing, and the division had 84 established staff and 134 unestablished staff in 1996.

The Division was renamed recently, having an objective to manage the agricultural lands and water resources in order to attain optimum use of the resources in an environmentally sustainable manner, giving an emphasis on strengthening land conservation activities. The new name might show the intention for consolidated management of land and water, and to cover the all domain of the Land Conservation and Improvement Act and the Drainage Act.

2) Land Acquisition

Three types of land tenure prevail in Fiji, namely Native Lands, State Lands and freehold lands. Dominant portion of the land in Fiji is Native Land, accounting 84% of the land area. In Native Lands, customary land rights are vested in the land owning units, of which the 'mataqali' is the most common. Other units include the 'yavusa' (an ancestral group of one or more 'mataqali'), and 'tokatoka' (family unit) and even individuals and their agnate descendants through marriage by virtue of their traditional status. Holders

of the rights are not issued with a document of title, and the units are not legal entities. They do not hold the legal right of disposal or to deal in Native Land.

One third of the Native Lands have been designated as Native Reserve for the exclusive use of the indigenous Fijians to sustain their lives, and can not be leased to other than Fijians. State acquisition of some parts of the Native Reserve, however, can happen according to the legal procedure.

Lands for permanent use of public interests are to be converted to State Lands. The procedure for state land acquisition is stipulated in the State (Crown) Acquisition of Lands Act (Cap. 135). Normal procedures for the acquisition are as follows:

From Freehold Lands

- The executing entity proposing a project shall submit the plan of the project including maps of the project site to the Department of Lands and Surveys.
- The Department may start to negotiate with the titleholder for conditions of the dealing or compensation.
- In case that the conditions are not agreed, the Supreme Court determines the conditions.

From Native Lands, including Native Reserve

- The executing entity proposing a project shall submit the plan of the project including maps of the project site to the Department of Lands and Surveys.
- The Department will submit the intention, often with the executing entity, to the Native Land Trust Board (NLTB).
- The Board consults with the Native Land Commission for the inquiry of the titleholder (Mataqali).
- The Board, often with the Department and the executing entity, may start to negotiate with the mataqali for conditions of the compensation.
- In case that the conditions are not agreed, the Supreme Court determines the conditions.

During the colonial period, some Native Lands were acquired for the essential national development purposes, such as parts of Nausori Airport and Nadi Airport, using State powers provided in the State (Crown) Land Acquisition Act, Cap 135. The powers have not been used since the independence in 1970, when all acquisitions of Native Land for national roads and Monasavu Hydro-electricity Project were effected through negotiations by the NLTB on behalf of the native owners regarding the area, price and other terms and conditions of the transfer.

(3) Land Use Regulation in Flood Plains

Town Planning Act (Cap. 139) and Subdivision of Land Act (Cap. 140) are the primary legislation for restriction of land development in and around cities and towns. These laws control land use when a parcel of land is to be developed or re-developed, or when land use is to be changed.

A town planning area is constituted by an order of the Minister of Local Government, Housing and Environment upon an application by the Director of Town and Country Planning or a local authority, where any development of land shall be permitted by the local authority (Town Planning Act, Sec. 6, 7). The local authority shall not grant or refuse the permission without prior consent of the Director.

A town planning scheme will be made according to the provisions of the Act with the general object as follows (Sect. 16);

- a) of controlling the development of the area,
- b) of securing suitable traffic, transportation, disposition of commercial, residential and industrial area, proper sanitary conditions, amenities and convenience, parks, gardens and reserves,
- c) of making suitable provisions for the use of the land, or
- d) as more particularly set out in the Schedule.

The Act regulate land and building developments and the existing use of a land or a building can not be controlled by the Act since occupiers can enjoy the present use as assured by the Act.

Subdivision of Land Act is applied in the areas except i) State (Crown) Land, ii) those included within the boundaries of any city or town where Local Government Act (Cap. 125) is applied, and iii) Native Reserve. Prior approval by the Director shall be granted before the subdivision of the area other than the area i) where no land is situated in any town or within three miles of the boundaries of a town and ii) where the land is subdivided into lots not less than five acres (around 2 ha.).

Schedule G of General Provisions approved by the Director (1980) under Town Planning Act (Cap. 139) stipulates that in flood prone areas no building shall have the floor level of any habitable room lower than the height, relative to the Mean Sea Level, as specified as follows (towns only in Study Area are listed below);

- | | |
|------------|------------|
| - Ba | 5.0 meters |
| - Sigatoka | 2.5 meters |
| - Nadi | 6.0 meters |
| - Nausori | 7.6 meters |
- or any other relative height applicable to any town, township or settlement areas, as determined from time to time by the Director.

For land use control in rural or agricultural areas, Land Conservation and Improvement Act (Cap. 141) and Forest Act (Cap. 150) or lease control through Agricultural Landlord and Tenant Act (Cap. 279), Native Land Trust Act (Cap. 134) are applicable.

(4) Disaster Management

The National Disaster Management Plan states the national policy for the management, being collaborated with participation of various ministries through coordinating efforts by the National Disaster Management Council (NDMC) under the leadership of the Prime

Minister. It covers prevention, mitigation, preparedness, emergency operations, relief and rehabilitation, while the previous manual of National Emergency Service Committee gave emphasis on responding operations. The Plan also mentions much about warning, and the Public Works Department is assigned as the agency to originate flood warning.

National Disaster Act has been drafted and will be submitted to the Parliament in the near future. Under the Plan, operational plan, guidelines, instructions and manuals are to be prepared by each agency as assigned in the Plan.

(5) Land Conservation

1) Current Leasing of Agricultural Lands

The Native Land Trust Board (NLTB) was created based on the ordinance (now Act) to administer all native land "for the benefit of Fijian owners". The NLTB has the sole power to grant leases or licenses over Native Lands, on the condition that the Board is satisfied that the land is neither beneficially occupied nor during the currency of the lease or license by the Fijian owner for their use, maintenance or support (Sec. 9 of Native Land Trust Act, Cap. 134).

Although Agricultural Landlord and Tenant Act (Cap. 270) contemplate that all agricultural tenancy shall be written in the prescribed form (Sec. 8), and shall be registered under Land Transfer Act (Cap. 131) or Registration Act (Cap. 224), the NLTB grants leaseholds in agricultural land under several types of documents in the following proportion (Clerk, 1986):

- | | |
|-----------------------------------------------------------------|------|
| - duly executed leases registered under Land Transfer Act; | 24 % |
| - instruments of tenancy registered under the Registration Act; | 1 % |
| - unregistered tenancy at will; | 5 % |
| - unregistered provisional approval notice; | 70 % |

A provisional approval notice is in the form of a letter, advising that an application for a lease has been approved. It sets out details of the land, the annual rental and the estimated survey fee. The legal status of these arrangement may have quite complicated implications with regard to watershed management, especially to land conservation practices.

2) Land Conservation Practices

The Land Conservation and Improvement Act (Cap. 141) is the primary legislation on conservation of land and water resources. Under the Act, the Land Conservation Board is established, whose members are as follows (Sec. 3):

- a) Director of Agriculture - Chairman
- b) Permanent Secretary for Public Works
- c) Director of Lands and Surveyor-General
- d) Conservator of Forests
- e) other members, holding any of the Government Office, appointed by the Minister of the MAFF

The functions of the Board are (Sec. 5);

- a) to exercise general supervision over land and water resources,
- b) to stimulate, by propaganda and other means, public interest in conservation and improvement of land and water resources,
- c) to recommend necessary legislation to the Minister,
- d) to make general or particular conservation orders necessary for conservation of land and water resources.

The Minister, currently delegated to the Permanent Secretary of the MAFF, may appoint, by notice in the Gazette, Conservation Committees for the area designated in the notice, to give advice to the Board on matters related to the conservation of land and water resources of the area (Sec. 6). The Minister may also appoint Conservation Officers to assist the Board (Sec. 13) in supervising land and water resources and encouraging their conservation and improvement.

A conservation order by the Board may;

- a) prohibit, regulate and control the breaking up or clearing of land for cultivation or any purposes,
- b) prohibit, regulate and control the grazing and watering livestock,
- c) prohibit or restrict the cultivation of specific crops,
- d) regulate the method of cultivation of land,
- e) require the uprooting or destruction, without payment of any compensation, of any crop in case of contravention of a conservation order,
- f) prohibit, regulate and control the use of sledges,
- g) prohibit, regulate and control the lighting of fires and burning of vegetation.

A conservation order may be;

- a) general, published in the Gazette and specific to some area, or particular, in writing addressed to the owner or occupier.

The Board may issue a "closing order", when any land is being or has become despoiled, by publishing in the Gazette, specifying the area, which prohibits;

- a) occupation of the land,
- b) cultivation of land,
- c) depasturing of cattle,
- d) cutting down of vegetation,
- e) destruction of vegetation.

(6) Forest and Forestry Management

Forest Act (Cap. 150) is the primary legislation on the administration of forests. A Conservator of Forests and the Deputy Conservator is directly responsible to the Minister of the MAFF. The Forestry Board is established by the Act, which is chaired by the Conservator, and whose six members are appointed by the Minister as follows, in order to give advice to the Minister (Sec. 4):

- a) one, appointed on the recommendation of the NLTB to represent the NLTB,
- b) not less than 4, holding any of the Government Office,
- c) at least one shall be a Fijian.

The Minister may also appoint Forestry Committees, as regional entities, to advise the Forestry Board on matters related to forestry in the region (Sec. 5).

In unalienated State (Crown) Lands or lands leased to the State (Crown), the Minister may declare (Sec. 6,7);

- "reserved forest" and therein,
- "nature reserve" or
 - "silvicultural area" may be declared.

In native land, not being "reserved forest" or alienated land, the Minister may declare with prior consent of the NLTB (Sec. 8);

- "protected forest" and therein,
"silvicultural areas".

The provisions of the Act are summarized in the Part K "Institution" of Supporting Report.

The Department of Forests of the MAFF is in charge of the administration of forests and forestry. The Department is engaged in the four programs of the expenditure account number with a staff of some 420 persons and the budget of around F\$ 10 million (Table-8.2).

Table-8.2 Activities and Budget of Department of Forests

Program/Activity	Established Staff	Unestablished Staff	Estimated Budget in 1996 (F\$1,000)
P.1. Administration and Support Services	113	71	4,007.0
A.1. General Administration	49	40	2,170.6
A.2. Forest Management Services	13	1	239.4
A.3. Training and Education	13	6	876.2
Aid-in Kind (for Logging Training School from EU)			(18,000.0)
A.4. Silviculture Research Administration	19	12	364.3
A.5. Silviculture Research (Pine)	0	0	0
A.6. Timber Utilization Research and Promotion	19	12	356.5
P.2. Forestry Department Plantations			
A.1. Plantation and Maintenance	45	104	3,135.1
P.3. Extension			
A.1. Planting (Assistance and Advice)	8	15	230.8
P.4. Natural Forest and Conservation	47	15	873.3
A.1. Harvesting	44	12	578.4
A.2. Forest Parks, Recreation and Nature Reserve	3	3	294.9
Total (Aid-in-Kind)	213	205	8,246.2 (1,800.0)

Source: Ministry of Finance and Economic Development, 1996

Currently the Department follows "Strategy for Forestry Sector Development" worked out with FAO in 1988 as a sectoral master plan which contains following strategies as recommendations. Programs for each of the strategies are listed in Part K "Institution" of Supporting Report.

- a) to adopt high quality export driven strategy
- b) to make an immediate start on the institutional restructuring and reform
- c) to implement the actions, corrections and improvement
- d) to start investigations, training and development program
- e) to bring or keep the current (of 1988) program

8.5 Problems/Constraints/Necessities and Targets on Major Issues

8.5.1 Concept for Analysis of Problems/Constraints/Necessities and Targets

Two ways of analyses of the current institutional conditions are adopted in the following discussion, because the proposals by the Study may include measures which the Government has some experiences, and those which should be introduced and the Government has few experiences. For the implementation of the former, improvement program of the current institution should be a target, and for the latter, a new type of administration should be introduced as a target to the relevant legislation and organization, referring successful models in other countries.

For the improvement approach, current institutional problems are analyzed and some institutional policies to solve the problems are formulated, while for the introduction approach, constraints and necessities of the relevant legislation and organization are assessed and subsequently some directions for the introduction are recommended. In addition, when a new type of administration, as well as major shift of the staff are recommended, training or re-training of the staff should accompany.

8.5.2 Problems/Constraints/Necessities and Targets in Each Sector

(1) Hydrological Measurement and Analysis

Current hydrological measurement and analysis are insufficient regarding stable data collection, data storage and analysis. The installation and maintenance of hydrological stations are inadequate allocation and manners, concentrating in the Rewa watershed and being scarce in other watersheds. Lack of data often occurs caused by discontinuous operation, resulting in unreliable analyses. The reasons seem to be insufficient staff with high level of knowledge and skills and financial resources.

Flood analysis is the fundamental element for formulation of a flood control plan, whether structural or non-structural. Analyses on sedimentation are the base for planning land conservation and sediment control programs. Without reliable hydrological analysis, watershed management cannot be planned or properly implemented, and the results of the management cannot be monitored. Thus, "insufficient hydrological analysis" seems to be the core problem to be resolved.

The Section is the central agency to issue flood forecasts the efforts for that purpose account a large portion of the tasks of the Section. Although timely flood warning can be done with comparatively cheap costs and very important, the damage mitigation by it is limited. The Section should also cover the flood analyses for effective flood control measures and for the enhancement of preparedness to floods, whether structural measures or non-structural measures for sediment control through land conservation activities, forest preservation and land use control.

The role of the Section in flood control and damage mitigation is very important not only for flood forecasts but also for promotion of preparedness against flood. Preparation of flood hazard maps is inevitable for effective land use regulation in flood plain and formulation of evacuation and relief program, as discussed above.

"To achieve effective and efficient flood analysis for flood control, to issue timely flood warning, and to provide information for enhancement preparedness against floods by the Section" is the target.

(2) Flood Control by Structural Measures

Currently major activities for flood control by structural measures are limited to dredging river mouths of large rivers, while floods occur and cause huge damages. Since the Master Plan proposed in the Study contains other types of projects, such as construction of a diversion channel, it would be necessary to formulate institutional plan for smooth construction, operation, maintenance and monitoring the performance of the project implementation.

Current capacity of the LWRMD or the River Engineering Section is quite limited in data collection, analysis, project planning and project evaluation for effective and efficient watershed management and flood control. Although measures for watershed management and flood control are discussed, the discussions seem to remain at master plan level, showing only an ideal status to be attained. Numerical forecast of the frameworks, estimated benefits and costs and project evaluation at feasibility study level should be promoted to achieve improvements of actual conditions.

“To strengthen the capability of implementing entity responsible for proposed projects in the Mater Plan” is the target.

As for land acquisition, some type of disputes has allegedly occurred in other governmental projects. The occurrence of such disputes may be the core problem for land acquisition. Investigations on social and cultural conditions to avoid social risks resulted by the implementation of projects should be carried out in each feasibility study as made in the Feasibility Study for Nadi Diversion Channel. The target in land acquisition for the watershed management is “to find a way to avoid unreasonable disputes by detailed investigation in feasibility studies”.

(3) Land Use Regulation in Flood Plains

Although the lowest floor levels of habitable rooms are provided in the General Provisions under Town Planning Act (Cap. 139), adequacy of the levels is unknown. The provision appears to be applied for all of each town area, while flood level may differs area by area. Although the coverage of the provision is limited to habitable rooms, some important facilities or equipment installation may also have to be regulated.

Proper provisions can be stipulated after preparation of adequate flood hazard maps and necessary information and close consultations with the Hydrological Section after its strengthening. The institution for land use regulation (the Department of Town and Country Planning and relevant laws/regulations) appears to be well organized basically and has enough capability. Recommended institutional arrangement will be discussed in the part of the Hydrological Section.

(4) Disaster Management

As discussed above, the National Disaster Management Plan well covers wide range of disaster management including that in the occurrence of floods. As emphasized in the Plan, preparedness and early warning, rather than responding disaster relief after the occurrence, is the key to the effective and efficient disaster management. The Hydrological Section should meet with the requirement of the Plan.

Enhancing preparedness will be promoted by the provision of flood hazard maps and related information, while early warning will be realized after the establishment and operation of flood forecasting and alarming system as discussed in Section 6.10 of this report. These two parts will also be discussed in the same part as the Hydrological Section.

Some over reactions, such as excessive emergency food supplies to the areas of minor damage, allegedly occurred in the past flood. Damages occurred in the past floods seem not to be well investigated, evaluated and filed. Immediate damage evaluation will be the base for proper disaster relief activities, while post damage evaluation will be the start for

flood control planning, including that through structural and non-structural measures, as well as for enhancement of the preparedness.

The framework of immediate damage evaluation is well covered in the Plan, while no major description for the post damage investigation and information accumulation has yet to be given in the Plan. Some post damage evaluation should be carried out after all major relief/rehabilitation activities.

The target of this sector should be;

- institutionalizing post damage evaluation.
- immediate preparation of "Disaster Management Plan for Other Agencies"

(5) Land Conservation

Current stage of land conservation activities seems to remain at the phases of research and development, and pilot farming, besides serious land degradation has progressed. Promotion of the activities identified most effective and efficient by the research and pilot farming will be issues from now on.

Implication of the land tenure in land conservation is discussed in the following three aspects.

- a) Because of insecure status of leasehold of the land, the leaseholder may hesitate to have long term view in soil management, or the investment for soil conservation. Therefore, land use may tend to be exhaustive, resulting losses in productivity in long term.
- b) Insecure tenure fails to provide collateral in a commercial credit for farm development, including that for soil conservation.
- c) Because of unwillingness of tenant farmers as well as of stagnated training activities for skill development of soil conservation techniques, dissemination of soil conservation practices may be hampered.

Various types of tenancy or interests prevail, whose legal base may be different, and may be complicated for the practitioners of land conservation activities, such as landowners, tenants or extension officers.

The recommendations given in the report of "Review of Watershed Management Legislation, Watershed Management Study (Clerk, 1986) are well formulated and needs to be followed.

"To establish institutional arrangement to spread land conservation practices found suitable by the research and the studies" is the target.

(6) Forest and Forestry Management

Forests and forestry management in watershed management is discussed, highlighting the following functions of forests:

- to retain rain so as to reduce peak discharge and to increase normal discharge of rivers
- to reduce soil loss in lands and sediment in rivers so as to maintain water cross section of rivers

Wide areas of land have been deforested without any contribution to production. Although tree plantation is carried out by the Department of Forests and Fiji Pine Limited, there still remain wide areas of waste lands. Exhaustive logging practices allegedly prevail without replanting logged out areas and account for large portion of deforestation. Wide areas of forests, especially in Western Division, have been observed to be burnt by the extension of fire.

The current problems are; i) insufficient afforestation, ii) unsustainable logging practices, and iii) habit of burning vegetation and accidental fire. To solve these problems is the target.

Research and pilot farming on agro-forestry have been carried out by Agro-forestry Unit in Extension Division of the Department of Agriculture. Some of measures were found feasible. Although researches should also be continued, spreading the measures found suitable in each agro-ecological area should also be a target.

8.6 Recommended Institutional Arrangement

8.6.1 Principle Applied for Recommendation

Principles applied for the formulation of the Institutional Master Plan are as follows:

(1) Efficient Use of Current Institutional Resources

The Government of Fiji has a policy to reduce the size of the government administration, including decentralization of a part of its services. In this study, institutional recommendations should be made to promote efficiency in line with the Government policy.

Form this principal, the following sub-principal will be deduced:

- 1) to avoid duplication of the functions by different sections of the government, and to concentrate them into one unit
- 2) to encourage coordinated and synchronized implementation of related functions, programs or projects

Many divisions and sections seem to have enough or too many number of staff including those unestablished, while suffering lack of skilled staff with sufficient knowledge. Training and re-training through on-the-job-training (OJT) and off-the-job-training (OFF-JT), will solve the problems. In some case, streamlining will be necessary, giving incentives, such as higher salaries, to the proficient staff.

(2) Functioning of Regulatory, Operational and Deliberative Entities

The operational functions include;

- data collection, processing and dissemination,
- design,
- construction and supervision,
- operation and maintenance, including collection of charges, fees or tariff,
- extension services including education and training of residents,
- recording and registration.

These functions are conducted by governmental line agencies at various levels as well as by decentralized, semi- or non-governmental entities, such as public corporations, especially in operation and maintenance phases with authorization invoked by the legislative branch. The operational function should be placed under proper control by regulatory function.

The regulatory area constitutes;

- policy and strategy formulation,
- overall planning, and project planning, monitoring and evaluation,
- coordination with other sectors,
- guiding program actions,
- measuring the results of performance of the operational bodies in conformity with specified objectives (standards),
- monitoring activities and conditions and enforcement of established laws and regulations,
- financial aspect of operational entities,
- review of cost recovery schemes, policies for charging and financing operations.

Deliberative functions are set in shapes of a board or a committee to advise to the final decision making by ministers or other authorities. A deliberative entity can normally be named as a board when it also has operational functions for the sector, or as a committee when it has only deliberative functions. Deliberative entities hold meetings before the final approval of policies, strategies and plans proposed by regulatory entities, representing from and coordinating among various stakeholders and sectors of the residents and government offices.

Appropriate separation and functioning of the above three areas is inevitable for a proper management.

(3) Beneficiary-to-Pay

Even for the government projects, beneficiary-to-pay principle should be pursued as far as possible. If a project is funded with the general budget, the people without any benefit by the project pay some part of the cost through payment of taxes. The application of this principle should be limited only when; i) beneficiaries cannot be easily identified or

almost all the nation, such as construction of government office, ii) fee collection cannot be done properly or efficiently, such as construction and maintenance of rural roads.

(4) Financial Adjustment between Beneficiaries and Implementers

Beneficiaries and implementers are not always same. Even though some project is economically feasible, the implementers are not always willing to carry out the project, because the implementers sometimes can not take the benefits born by the implementation. In land conservation project, for example, if a lease to a farmer will expire in near future, the farmer would not be willing to implement the project because he would not receive the benefits of long term productivity of the land and intend to use the land exhaustively, while the owner of the land would receive that benefits in long term.

Some financial adjustment is required to promote that type of projects. The Government should be a mediator between the beneficiaries and the implementers. The Government should give incentives to the implementers whose costs can be collected from the beneficiaries. The principle should be considered especially for non-structural measures.

8.6.2. Recommended Institutional Arrangement

(1) Defining Watershed Management Entities and Administrative Units

1) Organization Set-up

The following responsibility allocation is recommendable.

Deliberative Functions: The Land Conservation Board can take the responsibility, according to the current legal framework.

Watershed management committees should be established, as stipulated by the Land Conservation and Improvement Act, by a watershed or by administrative unit as described below.

Drainage Boards can be placed under the committees.

Regulatory Functions: Re-organized Land and Water Resources Management Division and the Sections of Hydrology, River Engineering, and Land Use should take the functions after their strengthening, and should work as a secretarial organizations to the Land Conservation Board.

Regional branches of the above Division and Sections should carry out secretarial works to the committees proposed above.

Operational Functions: A Project office should be established for a large-scale project. Operational parts of Drainage Boards can take a part of functions.

Regional branches of the Division, Extension Division and the above Sections for the matters where decentralized organizations for operation can not be efficiently set up.

Re-vitalizing of the Land Conservation Board should be inevitable for proper watershed management. Legally the Board has strong power, including control of "drainage"

activities. The re-vitalization could be achieved through strengthening the regulatory entities as described above.

2) Administrative Unit

An administrative unit for watershed management and flood control should be set by each watershed in principle. The two divisions in the Study Area, however, are recommendable similar to the Central and Western Divisions of the general administrative unit, grouping watersheds, because of the size of the area, limited human and financial resources and large differences in geographical and climatological characteristics. Two Watershed Management Committees (or Land Conservation Committee) could cover the whole area of Viti Levu island. Central Committee should cover Rewa watershed (and Navua watershed), while Western Committee should cover Ba, Nadi and Sigatoka watersheds. Small watersheds in Viti Levu island may be covered by the two Committees of similar characteristics of the watersheds or the one near each watershed.

(2) Shift of the Hydrological Section and its Strengthening for Expanded Role

The strategies would be;

- to concentrate hydrological engineers and technicians into one section, and to promote human resource development,
- to institutionalize re-organization of hydrological measurement network and configuration of the facilities and equipment for data collection, communication, storage and analysis,
- to establish financial arrangement to fund the activities paid by the resource users.

1) Shift of the Hydrological Section

Institutional resources for technical matters of watershed management should be concentrated to the Land and Water Resources Management Division (LWRMD). The staff and budget of Hydrological Section would better to be transferred to the LWRMD. The Division intends to carry out an integrated watershed management not only related to agriculture, as the new name shows. The transfer would also contribute to close tie-up of the Hydrological Section with River Engineering Section and to grade up of the River Engineering Section, especially on structural measures for flood control. Close cooperation with Fiji Meteorological Services (FMS), World Meteorological Organization (WMO) and meteorological institutes of foreign governments for flood forecasting can continue even after the shift as well done at present.

After the shift, the Section should re-organize hydrological networks, including those for flood forecasting and alarming with installation of modernized facilities or equipment as discussed in Section 6.10 of this report. Adequate budget should be allotted. Data collection can be carried out by using Division branches after establishment of a data communication system, while data storage, analysis can be made in the headquarters. Data storage system for the analysis would be of keen necessity to be improved.

The transfer to the Division accompanied with the improvement of the network including data transfer with telecommunication system may help efficient use of unestablished staff in the Section. Substantial number of unestablished staff of the Section could be

reduced when tasks of staff in the Division branches or other field staff of the MAFF are efficiently organized. Operation manual for staff in charge of hydrological measurement and data collection/transfer should be prepared or revised. Training programs should be promoted for the person to remain in the Section, including those for persons who have possibility to promote to established staff, as well as for the persons to move to other sections.

2) Strengthening for Expansion of the Role

Training for level-up of established staff for the review of the effective and efficient installation and management of the hydrological network is necessary. In order to expand its role in watershed management and flood control, several to ten core persons should have high level of knowledge and techniques of hydrological analysis. Technical transfer by dispatched experts or advisors with sufficient experiences for hydrological analysis, preferably for a long term, from abroad might be recommendable.

An application for Project Type Technical Cooperation of JICA, a combination of dispatch of long- and short-term experts, equipment provision and counterpart training in Japan, could be one of the good options for the establishment or restructuring of the flood forecast system and hydrological measurement network.

Before the application for the project, the MAFF should clarify the objectives of the project, arrange the organization of the counterpart and other preparation, as well as policies for sustainable operation, in order for the Government of Japan to understand the intention of the Government Fiji and for smooth preparation and implementation of the technical cooperation.

A task force for preparation of flood hazard maps of major flood prone areas should be established with the initiative by the Section and with necessary budgeting in cooperation with the National Disaster Management Office, the Department of Town and Country Planning and the Department of Lands and Surveys.

In addition, a unit for sedimentation analysis would preferably added with participation of the River Engineering Section. Transfer of the Hydrogeological Section from the Division of Mineral Development and Mines of the Ministry Lands and Mineral Resources of should also be examined. Water right management, currently conducted by the Department of Lands and Surveys, is preferably to be shifted to the Section of the LWRMD, if possible.

3) Financial Arrangement

As the role and responsibility of the Section expand, budget allocation should accompany. Reliable hydrological analysis may enable effective and efficient flood control. Hydrological analysis of good quality might increase the benefits as well as decrease the costs. Increase in benefits and/or decrease in costs might be fairly enough to cover the increased costs of for the hydrological analysis. Allocation of budget to the Section should be increased.

The fee for water right application, assessment and authorization, in case water right management is transferred, may be chargeable to the resource user directly or through to water supply corporation, Fiji Electricity Authority (FEA) or irrigation facility operators.

(3) Facilitating Flood Control by Structural Measures

Major strategies for institutional arrangement set at present are;

- to establish and strengthen the implementing organization,
- to strengthen the River Engineering Section by encouraging training and technical transfer and information exchange, from foreign governments and international institutes, and within the Government, especially with the PWD,
- to search some financial arrangements to cover construction, operation and maintenance of the structures paid by the beneficiaries,
- to carry out smooth land acquisition for the projects.

1) Organization Set-up

A project advisory committee (special committee) as a task force for preparation and supervision of the design and construction of structures for flood control should be recommended. The relevant departments and divisions of the Government, such as the PWD, the Department of Lands and Surveys, the NLTB, the Ministry of Planning, and Local Government should participate in the preparation and supervision.

Project offices under the supervision of the Land and Water Resources Management Division (LWRMD) should be established up to the completion of a diversion channel or dikes in case of a large scale. Before the detail design, core persons should be trained, preferably in foreign country with experiences of similar projects. Human resources development should be promoted by the LWRMD before the establishment of the project offices.

Operation and maintenance, including monitoring conditions of the structures could be carried out by relevant Drainage Board when some additional staff are assigned. Staff for operation and maintenance should also be trained with operation manuals prepared by core persons of the Division before the completion of the structure.

2) Grade-up of Technical Capability of the River Engineering Section

For the planning of effective measures for flood control, which is the most important issue in watershed management in the Study Area, the capacity of the River Engineering Section should be strengthened. The Section should have the capability to assess the result of the hydrological analysis, to identify effective measures, to examine technical feasibility and to carry out cost benefit analyses. For strengthening, training of staff would be indispensable. The training by foreign long-term experts with abundant experiences of engineering practices would be inevitable.

3) Examining Cost Recovery Program

Cost recovery, at least costs for maintenance, through payment by the beneficiaries of the structures should be sought. The Central Drainage Board collects F\$ 11.52/ha/year as drainage rates for the maintenance of drainage schemes, although the collection faces difficulty, especially from subsistence and semi-subsistence farmers. The Western Drainage Board currently manages 39 drainage scheme, consisting of seawall, floodgates and drains. The drainage rates varies depending on the scheme, raging from F\$ 9.84/ha/year to F\$ 49.42/ha/year. The Western Drainage Board is not suffered with

difficulty in rate collection because almost all the farmers in the drainage areas produce sugarcane and the Fiji Sugar Corporation collects the rate on behalf of the Board upon purchase of sugarcane from the farmers. For the schemes completed after 1992, all investment costs were covered by the Government contribution.

However, establishing cost recovery program for the projects planned in the Master Plan would have some difficulties, theoretically and technically. In general, beneficiaries are willing to pay when he wants to take the benefits. One have to ask the prospective beneficiaries whether he wants the benefits or not before the investment, as currently done by the Drainage Boards to farmers before the implementation of draining projects or seawall construction projects, unless beneficiaries can choose to take or not occasionally after the investment, as water supply projects, where demand projection determines the scale of investment. Direct charging to beneficiaries might be very difficult.

Application of earmarked tax should be examined. There is an example of a similar case of earmarked tax in Fiji. Suva City Council collects property taxes, 2.0427 %/year of UCV (unimproved capital value) in total, 0.8745 %/year as General Rates (to cover the general services, such as maintenance of parks, etc.), 0.1375 %/year as Stipulated Rate (to maintain street lights) and 1.0307 %/year as Loan Rate (to cover the reimbursement of large scaled loan projects).

Some types of rate collection should be introduced. The example by Suva City Council would be examined in case of town areas. Some additional rate to tenant in flood prone area by the NLTB and the State should also be considered.

Earmarked tax is charged on prospective beneficiaries and a kind of system to apply "beneficiary-to-pay" principle. Introduction of rate collection can be made after the identification of the beneficiaries and estimation of the amount and distribution of the damages saved by the structural measure. In the present conditions, however, the identification and estimation might be technically difficult. Drawing flood hazard maps, and collection and evaluation of past flood damages and costs for relief/rehabilitation activities will help the identification and estimation of rates.

With flood hazard maps and result of the evaluation, the rates should be examine by area, preferably by ward in case of the town area, according to the level of the damage saved by the structure. Estimated value of saved damage by each area might not be directly applied to the rate to be collected, but the rate could be determined in proportion to the value of the benefits, including indirect benefits in the area. Collected rate in total should cover operation and maintenance cost. Some portion of investment costs, such as interest payment, should also be examined.

The LWRMD should examine the possibility of introduction of the cost recovery program through discussion in the Project Advisory Committee or with the relevant authorities such as Town Councils, the NLTB and the Ministry of Planning. In case cost recovery programs are not established, the Government has to pay additional operating costs to the relevant Drainage Board or other operating entity.

There may be another possibility. The structural measures may raise the price of land, increase in crop production, sales by business activities or prices of land (UCV) in specific areas. If these figures can be estimated, the gap in tax revenue or other levies is

payable to the managing or implementing bodies. Even in case that the figures can be counted roughly, some financial arrangement could be carried out.

4) Smooth Land Acquisition

Regarding site selection, although some residences can not be avoidable, native villages should be reserved because of their traditional and strong ties to their lands. Archeological site, as well as places of worship should also be avoided. Land acquisition plan should be formulated not to remain the small pieces of fragmented land, where current use would not able to continue.

For the land acquisition in the State Land, payment will be necessary only for the compensation to the current tenants. In case some governmental establishments (building or facility) are located, the cost for the relocation will be necessary to be paid. In case of the freehold land, the cost for purchase is to be paid to the land owner as well as compensation for the investment or improvement made by the tenant or the owner. In case of a State Land or a freehold land, the acquisition will be carried out in due process stipulated in the law.

In case that a project site for flood control proposed in the Mater Plan falls in a native land, there may be the following two alternatives:

- a) Lease to the State for 99 years, at longest
- b) Outright purchase by the State

Since the structures for flood control, such as diversion channels, are in almost permanent nature, land acquisition through the alternative ii) is recommendable. According to the discussions with the NLTB, however, the NLTB prefers lease for 99 years, taking a sense of ownership of the native owners, with conditions for the extension as follows:

- In case the works for flood control are still valid upon the expiry of the lease or the Government intends to use the works for the purpose, the extensions of the lease shall be made, considering the importance of the purpose of the works, and/or
- In case the extension will not be agreed, the landlords shall pay upon expiry the residual value of the investment and improvement by the Government.

The acquisition by leases would be permissible, considering smooth implementation of the Projects and virtually minor differences between the above two conditions.

In case of the lease by the NLTB, payment of the rent would be made in upfront (payment at once initially), following the policy of the NLTB. Even in case of the upfront payment to the NLTB, the owning units (mataqali) will receive the rents every year from the return of investment made by the NLTB. The continuous payment might help to avoid problems which often occurs in land acquisition. Besides the rent payment, compensation to the current tenant will be necessary for the residual value of the investments or improvements made by the tenants.

In case that a project site falls in Native Reserve, some swap operation of the land with a State Land could be an option, if a certain land for equivalent use is available.

Originally, the Native Reserve was designated destined to exclusive use for subsistence of the local community.

Before the land acquisition, socio-economic survey and subsequent assessment should be carried out to avoid negative social impacts and to reduce social risk caused by the land acquisition and resettlement as much as possible, as done in the Feasibility Study for Nadi diversion channel and short cut. General terms of reference for the survey are shown in Part K "Institution" of Supporting Report. Consultations with School of Social and Economic Development in the University of the South Pacific would be helpful.

(4) Enhancing Preparedness in Disaster Management

1) Facilitating Post Damage Evaluation

The framework for post damage evaluation would have a similar structure to that of immediate damage evaluation with a wider scope, including hampered commercial activities. The National Disaster Management Office should formulate a framework for post damage evaluation in consultation with relevant organizations included in immediate damage survey and assessment. For the preparation of the framework, existing records on types, amount and mechanism of damages caused by the past large disasters, as well as the type, timing and amount of relief activities and their effects should be collected as much as possible in cooperation with relevant organizations. Establishment of a task force for past records collection/analysis as well as for preparation of post damage evaluation would be recommendable.

Results of post damage evaluation, as well as the costs for disaster relief and rehabilitation, should be disseminated and filed. Accumulation of the evaluation would further improve the level of the evaluation. The records can be used not only in flood control planning and promotion of preparedness but also in establishing rational cost recovery program with payment by beneficiaries.

2) Promotion of the Preparation of "Disaster Management Plan for Other Agencies"

"Disaster Management Plan for Other Agencies" should immediately be prepared, including manuals for immediate damage evaluation and be made effective soon after the enactment of the "National Disaster Management Bill". The results of the analysis on collected information on past damages and review of past relief and rehabilitation activities should be reported to the other agencies. Kick-off meeting with explanation of the result of analysis on past records and major agenda to be included in the respective "Disaster Management Plan" for each of the agency, made through the evaluation of the past records by the above task force, may help quick preparation.

(5) Strengthening for Extension of Land Conservation

The strategies institutional enhancement which enable;

- to prepare applicable standards and guidelines to be provided in the tenant agreement,
- to promote duly executed leases,
- to strengthen the organization in order to enhance inspection, extension and training services,
- to formulate plain manuals understandable for extension officers and farmers.
- to initiate 'train-the-trainer' courses, and to train field officers and farmers
- to give incentives and penalties to farmers

1) Preparation of Standards and Guidelines for Provisions in the Tenant Agreement and Promotion of Duly Executed Leases

Review of ALTA should be promptly finalized to give security to tenants whose leasehold may expire in near future. The lessee would not be willing to carry out good land husbandry practices at present, worrying their future means of living.

Provisions currently given in the ALTA or NLTA and in lease agreement documents are much generalized and tenant farmers might not understand what to do. After the ALTA review is finalized, a regulation should be drafted, preferably by the present ALTA review unit with additional staff, to give framework for provisions to be attached to tenant agreements. Subsequently, standards and guidelines for drafting attached conditions to each tenant document should be prepared in consultation with the Land Use Section of the MAFF. As recommended in Clerk, 1986, the provisions should be understandable to field officers and farmers.

Duly executed leases are delayed due to the costs for the survey required before the registration and long time taken for the approval. Since the costs of survey may be expensive for tenants and they may need to investment for cultivation when they start leaseholding, some financial assistance might be preferable, despite some improvement in Native Land Trust (Leases and Licences) Regulation 1984. To lend the survey cost by NLTB to the lessee, when other conditions for tenancy are agreeable to the NLTB, would be recommendable. The repayment, including interest, by a lessee could be added to the rent.

When legal status of the tenant become rigid, the tenant farmer may be willing to cultivate with good land husbandry practices so that the productivity of the land will be maintained in the long term. The benefits for the landlord may also increase. This arrangement would be worth for consideration by NLTB, on behalf of the land owners. Normally in Torrens system, survey costs for registration are born by the person who claim the title, and a lease will be granted by the titleholder. Allocation of the survey fee to the landlord might preferably be considered.

A task force in the Department of Lands and Surveys would be necessary for the checking surveys and documents in the near future, when new applications concentrate after expiry.

2) Organization Strengthening for Extension Services

The Land Use Section of the Research Division in the MAFF should be strengthened with more skilled staff and increased budget, as a regulatory organization, to identify the most promising land conservation practices, to plan projects and programs by region and by types of crop cultivation, to manage demonstration farming, and to start training of the key persons and field officers. The Section should increase its capacity to discharge secretarial function, as core section, to the Land Conservation Board. Shift of the Section to the Land and Water Resources Management Division, or Extension Division of the Department of Agriculture should also be considered.

The land conservation activities should reach the extension stage. Promotion and diffusion of the identified land conservation practices should involve the Extension Division of the Department of Agriculture. The Division has the strongest capacity or potential in the Ministry with its extension network over the country. Involvement of the extension system of Fiji Sugar Corporation (FSC) is indispensable in the Western Division. The strategy for the extension phase would better be formulated with the participation of the Division and managers of the extension system of the FSC, preferably with the advise of the foreign experts with similar experiences in similar conditions.

Some institutional arrangement will be necessary to add duties for the diffusion and promotion of land conservation practices to the job description of the staff of the Extension Division. Evaluation of their achievement will also be necessary to be changed their concern from short-term land productivity to long-term or sustainable productivity.

3) Implementing Training Programs

The extension stage should start with the training of the core personnel of the Extension Division and Field Officers of FSC. The Section should prepare and conduct the training courses for extension officers ('train-the-trainer course'). Senior Agricultural Officers of the Division and District Field Staff of FSC might be the target trainee of this level of the training. Planning, guiding, supervising, monitoring and evaluating extension scheme, as well as training and education methods to field officers should be included in the curricula.

The training for Agricultural Technical Officers of the Division (around 30 persons) and leaders of Extension Support Group of FSC should follow. The main curricula would be the methodology of the guidance and education to the field staff and farmers. The training of Senior Agricultural Assistants (around 100 persons) of the Division and extension officers of each sector (38 sectors in total) of the FSC should subsequently be conducted for the method of education to the farmers and for other extension services for good land husbandry practices. Subsequently, the Section should prepare the training courses of farmers with cooperation with the Division.

Training manuals and materials, including brochure to farmers, should also be prepared, preferably with the technical transfer from the foreign experts dispatched. The training of the core personnel can start smoothly after participation in the training courses provided by foreign development assistance agencies, such as JICA. JICA has a suitable training course on "Farming Technology in Sloping Areas for Environmental Conservation", of which duration extends around two months.

Project Type Technical Cooperation of JICA, including dispatch of experts for training of the trainers, development of training and education materials, provision of equipment for education and management of demonstration farms, and counterpart training in Japan, would also be recommendable. For the preparation of the Project Type Technical Cooperation and for the programming of the training scheme, application to dispatch of long-term expert would be recommendable.

Demonstration farms, three of which are managed by the Section at present, should be increased in order to cover all major type of crops, conservation practices, regions, topographic and climate conditions. The demonstration farms can be the best instruments for the training of officers of the Division and training of farmers by those officers.

4) Incentives and Penalties

Another recommendable measure for the promotion and dissemination of land conservation is to establish some awarding by the Minister, such as "Best Land Husband of the Year", for farmers as well as for field officers. The awarding may not only give incentives to farmers or officers but also help disseminating the policy of the Government or showing how the good land husbandry can be practiced.

After clear and plain provisions are attached to the tenant agreement, farmers can know what their responsibilities are. Periodic, such as once in three or five years, or at least near the end of the term, inspection and evaluation should be carried out by the extension officers and officers from the NLTB. In case the farmer fully follow the agreement or engage good land husbandry, some certificate or recommendation could be issued for extension of leases or other incentives, while if the farmer does not, the farmer could be charged penalties, such as fine, increased rent or termination of the lease.

(6) Afforestation

Major strategies would be;

- to initiate afforestation program along rivers by the River Engineering Section, Department of Forests and the NLTB,
- to control logging practices,
- to regulate and inspect burning,
- to promote agro-forestry, or community forestry.

1) Afforestation in Critical Areas

Although afforestation as recommended in Section 5.5 of this report is not so feasible as to be discussed as a priority project in the Feasibility Study, some critical parts of the slopes along rivers, such as those close to the rivers with steep slopes, can be selected with high priority.

First, critical areas, especially bands of areas along the river banks, should be selected according to collected data and analysis, preferably by the sedimentation unit in the Hydrological Section as proposed above. The areas could be designated as forest reserve, and afforestation should follow by the Department of Forest. Some concept of

“river areas”, not only simply a breadth of 20 feet as currently enacted but also determined for normal functioning of water courses, whose destination should be determined or granted by the entity who manages rivers and streams under the Act, should be considered after a study by a task force consisted of the River Engineering Section, the Hydrological Section, the Department of Forest, the Department of Lands and Surveys and the NLTB.

Financial arrangements from payments of the downstream beneficiaries, such as a part of property taxes in towns in the lower reach to the implementing entities of afforestation is preferable, especially in case of the plantation by Fiji Pine Limited, which is decentralized entity and whose activities are determined mainly from commercial viewpoints.

2) Stricter Control of Logging Practices

Replanting of logged out areas should be included all of the logging licenses with provisions on type of trees and manners of replanting at least. Inspection should be made before the termination of the licensing, and before the leave of the loggers in case of foreign companies. In case the loggers do not follow the provisions, strict penalties, at least no more licensing in Fiji and more fines than the costs for replanting by the Department of Forest or Fiji Pine Limited.

3) Regulating Burning

Some measures for controlling vegetation burning, such as that described as follows, should be examine for establishing, especially in Western Division:

- Burning of vegetation, all or that with a larger scale than prescribed, for farming or grazing purposes should be notified to the nearest office under Extension Division of the Department of Agriculture, Department of Forest or the Land Conservation Board or Committee, prior to lighting.
- The notice should include time, place, area and means against unnecessary expansion.
- In case land conservation or forest management entities are not satisfied with the conditions, they could order to modify or to stop the burning.
- In case the scale is larger than a certain area or the site is located in a critical area, some officer could accompany for inspection.
- If unnotified burning is found, the person who causes the fire should be strictly punished.

A task force should be established to examine the system for control.

4) Spreading Agro-forestry

Agro-forestry in Fiji should also reach to extension phase. The agro-forestry unit should enhance its capacity to continue identification of suitable programs as well as to extend the lessons acquired in previous researches. Promotion with participation of local communities is recommendable. Participation of communities enables expansion with sustainable manner, utilizing local knowledge held by the communities.

Participation of communities should be required not only in operation and maintenance of the identified scheme but also in every stage, from the planning to monitoring and evaluation stage. The involvement of the NLTB should be encouraged, if necessary.

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CHAPTER 9 MASTER PLAN FOR WATERSHED MANAGEMENT AND FLOOD CONTROL

9.1 Outline of Master Plan

9.1.1 Structural Measures

(1) Rewa River

The proposed flood control plan in Rewa river, combination of diversion channel and dike on the left and right banks, is not feasible in economic evaluation (refer to the section 6.6.8) for the design flood of 20 year return period. However, as an alternative solution, step wise implementation of the project could be proposed.

Since most of properties in the Rewa delta are currently located on the left bank of Rewa river (Nausori town and international airport), dike on the left bank is proposed as the first step. Others structural measures (diversion channel and dike on the right bank) should be implemented as development in the Rewa delta expands. Technical specifications and economic evaluation of the dike on the left bank are shown in Table-9.1.

Table-9.1 Outline of the Dike Construction on the Left Bank of Rewa River

Dike Specification	
Design Flood Discharge	5,900 m ³ /sec with Return Period of 11 years
Present Capacity	3,800 m ³ /sec with Return Period of 7 years
Length of Dike	4.5 km
Height of Dike	3 m
Volume of Dike	200,000 m ³
Project Cost	7,350,000 F\$
Economic Evaluation	
Economic Benefit	798,000 F\$/year
Economic Project Cost	6,039,000 F\$
Economic Maintenance Cost	2,000 F\$/year
EIRR	13.15 %
B/C	1.31
NPV	1,685,000 F\$

Discount Rate: 10 %

(2) Sigatoka River

Either dredging or afforestation is not feasible in economic evaluation. Although the economic effect of afforestation is less than that of dredging, the afforestation in the upstream of the Sigatoka watershed is recommended for the Master Plan. During the economic evaluation, the benefit was considered in terms of flood control only; however, afforestation has various effects, such as prevention of soil erosion, mitigation of sedimentation, conservation of water resources, preservation of water quality, conservation of diversified animals, plants and coral reef, contribution to tourism and so on which are difficult to evaluate the effect quantitatively. If those effects are included in the benefit, the afforestation is expected to be feasible.

(3) Nadi River

The combination of diversion channel and short cut channel is quite feasible and proposed in the Master Plan.

(4) Ba River

The dike construction is feasible and proposed in the Master Plan.

9.1.2 Non-Structural Measures

The following non-structural measures are proposed in the Master Plan for the watershed management and flood control.

(1) Improvement of Land Use Regulation

- Zoning and restriction of residence in flood prone area
- Preservation of land for water retention and water retarding such as agricultural land, bushes, forests, park, swamp, pond etc.
- Flood proofing such as elevating ground and structures

(2) Flood Forecasting, Alarming and Evacuation System

(3) Soil Erosion Control

- Fire prevention in forest, grassland and agricultural land
- Improvement of commercial crop area by means of planting vetiver grass, hedgerow planting and installing sedimentation pits or ditches
- Agroforestry for small farming
- Forest belts along river for river bank protection

(4) Preservation of Forest and Afforestation

- Preservation of protection forest and newly designated forest
- Maintenance of sustainable forestry production
- Afforestation of non-commercial forest, devastated forest, grassland and grazing land

(5) Institutional Improvement

- Defining watershed management entities and functionalizing the Land Conservation Board
- Defining administrative units and establishment of watershed management committees
- Reorganization of the hydrological section and its strengthening
- Establishment and strengthening organizations for planning and implementing structural flood control measures

- Enhancement of preparedness in disaster management, including implementation of post damage evaluation
- Institutional strengthening for extension of land conservation practices
- Strengthening the forest and forestry management

9.2 Implementation Schedule

The implementation schedule of the Master Plan is shown in Table-9.2.

Table-9.2 Implementation Schedule of Master Plan

Contents of Master Plan	Cost F\$ 1,000	Implementation Schedule			
		- 2000	2001 ~ 2005	2006 ~ 2010	2011 ~ 2015
I. Structural Measures					
(1) Rewa River Dike (L= 4.5 km), (Step I)	7,350				
(2) Nadi River Diversion (L=3.0 km) and Short Cut (L= 0.25 km)	50,950				
(3) Ba River Dike (L=13 km)	13,170				
Sub total	71,470				
II. Non-Structural Measures					
(1) Improvement of Land Use Regulation - Zoning and restriction of residence - Preservation of land for water retention and retarding - Flood proofing	N A				
(2) Flood Forecasting, Alarming and Evacuation - Rewa River - Sigatoka River - Nadi River - Ba River	1,800 800 300 500				
Sub total	3,400				
(3) Soil Erosion Control - Fire prevention - Improvement of commercial crop area - Agroforestry for small farming - Forest belt along river	N A				
(4) Afforestation - Sigatoka River (232 km ²) - Nadi, Ba, Rewa River (611 km ²)*	21,900 -				
			(to be implemented after 2015)		
(5) Institutional Improvement - Defining watershed management entities - Defining administrative units and establishment of water management committees - Reorganization/strengthening of the hydrological section - Establishment/strengthening organizations for structural flood control measures - Enhancement of preparedness in disaster management (facilitating post damage evaluation) - Institutional strengthening for extension of land conservation practices - Strengthening the forest and forestry management	N A				
Annual Average Cost (per year)	5,690		8,860	2,910	4,050
Total Cost	96,770		62,010 (64 %)	14,530 (15 %)	20,230 (21 %)

* It may be implemented much earlier than 2015 if alternative finance is available.

9.3 Evaluation of Master Plan

(1) Technical Evaluation

The Master Plan is formulated with sufficient technical examination and precision required. Each component of the Master Plan is the result of the studies, taking account of the followings, and consequently they are technically safe and feasible.

- 1) Analysis of all available basic data and information
- 2) Elaborated comparison and examination of alternatives for both technical and economic aspects
- 3) Technical assessment on safety of proposed plans
- 4) Technical assessment on reliability of proposed plans
- 5) Technical assessment on practicability of proposed plans

(2) Economic Evaluation

1) Magnitude of Investment

The average capital expenditure of related agencies of public work, grant aid and overseas loan are shown in Table-9.3.

Table-9.3 Average Capital Expenditure and Foreign Aid

Unit: F\$ 1,000/year

	Average Amount (1991-1995)
Government Total	98,000
Infrastructure	40,900
MAFFA	10,700
Grant Aid	5,900
Overseas Loan	19,400

Note: The above figures exclude VAT.

Infrastructure; Ministry of Infrastructure and Public Works (inclusive Marine Dept. and Road Transport Dept.), Dept. of Civil Aviation, and Dept. of Meteorological Service

MAFFA; Ministry of Agriculture, Fisheries, Forests and ALTA inclusive of Dept. of Forests

The total cost required for implementation of the Master Plan is estimated F\$ 96,890 thousand with the annual average cost of F\$ 5,700 thousand over the whole implementation period and the maximum annual average cost of F\$ 8,860 thousand to 2005. The annual average cost is 6 % of the total capital expenditure of the Government, 14 % of total capital expenditure for infrastructure construction and 29 % of overseas loan. Even to the maximum average cost, the ratios of these expenditure and loan are 9 %, 22 % and 46 %, respectively. Taking into consideration importance and urgent necessity of the Master Plan (for example the reduced damage by the structural measures would account for nearly 0.5 % of the GDP of Fiji in 1994), such magnitude of budget allocation to the implementation of the Master Plan is quite reasonable and possible.

2) Economic Evaluation

The results of economic evaluation for proposed structural flood control measures are shown in the Table-9.4.

Table-9.4 Economic Evaluation of Flood Control Measure

Watershed	Rewa	Nadi	Ba
Project	Dike (4.5 km) (Step 1)	Diversion (3.0 km) & Short Cut (0.25 km)	Dike (13.0 km)
Economic Benefit (F\$ 1,000/year)	798	8,278	1,446
Economic Project Cost (F\$ 1,000)	6,039	43,794	11,358
Economic Maintenance Cost (F\$ 1,000/year)	2	31	8
EIRR (%)	13.2	15.1	10.7
B/C (ratio)	1.31	1.61	1.08
NPV (F\$ 1,000)	1,685	21,143	737

Note: EIRR (Economic Internal Rate of Return), B/C (Benefit and Cost Ratio), NPV (Net Present Value)
Discount Rate: 10 %

Source: from Table-6.41 and Tabel-9.1

The opportunity cost of capital (OCC) in Fiji, a criterion with which EIRR can be compared, is estimated around 10 %. Therefore, the proposed three projects are economically feasible and recommendable. Among the three, the diversion and shortcut channel in the Nadi watershed has the highest economic effect, secondly the dike in the Rewa river (Step-I) and thirdly the dike in the Ba river.

(3) Social and Natural Environment Evaluation

The structural and non-structural measures proposed in the Master Plan have much greater positive impact rather than negative impact on environment. Since this Study is at the master plan level, detailed examination of the negative impacts would be difficult. According to the Initial Environmental Examination (IEE) (refer to the section 7.3), the following negative issues should be examined in detail in feasibility studies.

1) Significant Impacts

- Lands acquisition, compensation and resettlement
- Effect on traffic and living facilities
- Solid waste during earth work
- Sedimentation and ecology in coastal area
- Water pollution

2) Possible Impacts

- Economic activity
- Water right and right of common
- Topography and geography
- Groundwater
- Landscape
- Noise and vibration during construction stage

9.4 Recommendations

(1) Implementation of the Master Plan

Proposed measures in the Mater Plan for watershed management and flood control, whether structural or non structural, are quite important for socio-economic development of Fiji. Those measures should be implemented by the target year of 2015, following the proposed schedule. Comparing to the scale of the current expenditure by the Government of Fiji, and assuming overseas loans, the project cost could be allocated within the financial capability of the Government. Introduction of a kind of earmarked tax in the beneficial area could also be considered.

(2) Review of the Master Plan

Since the Master Plan is formulated according to the current socio-economic framework of Fiji, the Mater Plan should be reviewed in every five years. For example, the benefit of diversion and dike construction near Nausori in the Rewa watershed currently estimated is not so large to make the measure economically viable. The areas to be protected by the measure are located in the Greater Suva, and have significant importance. Corresponding to the development of the Greater Suva, the area will have, and should have in terms of land use development policy, further importance. The same measure could be feasible, if analyzed in five or ten years later.

(3) Hydro-power Development

At present, 90% of the electricity in Viti Levu island is generated only at Monasavu Power Plant. The power supply is quite vulnerable to risks, such as disordered facilities. Besides, the demand for electricity in 2015 is estimated to reach twice as much as the present one. To meet the growing demand and to reduce the vulnerability, a hydro-power development project in the upstream or middle stream of Rewa river where there is abundant hydro-power potential should be started immediately.

(4) Water Quality Management

Although water quality in the four major rivers in Viti Levu island is good, except in the middle reach of Ba river, strengthened water quality management is necessary to control water pollution and to improve water quality for the promotion of tourism development. Measures, such as designation of water area and water quality criteria, regular water quality monitoring, restriction on industrial wastewater and untreated domestic discharge, sanitary education programs should be implemented immediately.

(5) Enhancement of Hydrological Observation and Analysis

Hydrological data, such as those of rainfall or discharge, are the basis of watershed management and flood control planning. Sufficient human and financial resources should be allocated in order to enhance hydrological networks, regular observation, data collection and storage, and hydrological analysis.

(6) Accumulation of Data on Flood Damages

Data on damages occurred in the past floods, such as levels of flood marks, the amount of damages on human lives, crops, houses and buildings, household effects, commercial goods and activities, public facilities, are inevitable to assess economic effects of a flood control measure. A system to collect, store and evaluate the data on flood damage should be established.

(7) Accumulation of Data for Watershed Management

Formulation of watershed management plan with sufficient preciseness is very difficult because of the limited data on land use, soil erosion and loss, forest and forestry. Collection of these data in Fiji seems to have just started. Much more efforts should be continuously given in collection and accumulation of these data.

(8) Review of Land Tenure

Fiji has a unique land tenure system. The area of 84% of the total land is Native Land, owned by native communities. Transfer of the Native Land is prohibited by the law, and Indians can use the area only by leaseholding. Although the system has merits, there are demerits as well, such as hindrance to lands acquisition for public interests and ignorance of long-term productivity by land users, resulting in exhaustive use and waste of lands. Some review might be necessary.



CHAPTER 10 SELECTION OF PRIORITY PROJECT

A priority project for the Feasibility Study was selected among the projects which compose the Master Plan described in the Table-9.2. Among the projects proposed, the structural measures in four watershed were adopted for comparison because of their drastic effect on flood damage mitigation compared with other non-structural measures.

(1) Factors to be Considered

The following major factors should be considered for selection of priority project.

- 1) Present Capacity of River Channel
- 2) Population in Beneficial Area
- 3) Total Project Cost
- 4) Average Annual Damage Reduction
- 5) Economic Effect
- 6) Land Acquisition and Compensation
- 7) Impact on Social and Natural Environment

(2) Significance Criteria

After examination of each factor for a flood control measure, significance of a factor in each flood control measure was evaluated and classified into four classes of significance from A to D with as shown below.

Degree of Significance;

- A: High Significance
- B: Medium Significance
- C: Low Significance
- D: Negligible Significance

The degree of significance was judged in accordance with the criteria for index of each factor as defined in Table-10.1.

Table-10.1 Criteria of Degree of Significance

Factor	Index	Criteria of Degree of Significance			
		A	B	C	D
Present Capacity of River Channel	Flood Return Period (year)	DS ≤ 3	3 < DS ≤ 10	10 < DS ≤ 15	15 < DS
Population in Beneficial Area	person	DS ≥ 10,000	10,000 > DS ≥ 8,000	8,000 > DS ≥ 6,000	6,000 > DS
Total Project Cost	F\$ million	DS ≤ 10	10 < DS ≤ 50	50 < DS ≤ 100	100 < DS
Average Annual Damage Reduction	F\$ million	DS ≥ 5.0	5.0 > DS ≥ 2.5	2.5 > DS ≥ 1.0	1.0 > DS
Economic Effect	EIRR (%)	DS ≥ 15.0	15.0 > DS ≥ 12.5	12.5 > DS ≥ 10.0	10.0 > DS
Land Acquisition and Compensation	Cost (F\$ million)	DS ≤ 1.0	1.0 < DS ≤ 2.5	2.5 < DS ≤ 5.0	5.0 < DS
Impact on Social and Natural Environmental	Number of Significant Adverse Impact	DS = 0	1 ≤ DS ≤ 3	3 < DS ≤ 5	5 < DS

Note DS: Degree of Significance

(3) Selection of Priority Project

The degree of significance for each factor examined is shown in the Table-10.2. Based on the integrated assessment of the degree of significance for each factor, the priority for Feasibility Study seems to be given to the flood control measure in the Nadi watershed, namely the combination project of Nadi diversion channel and short cut channel at confluence with the Nawaka river, because the number of A is highest and that of D is lowest among the proposed projects.

Table-10.2 Selection of Priority Project

Watershed		Rewa		Sigatoka	Nadi	Ba
Flood Control Measure		Diversion & Dike	Dike (Step I)	Dredging	Diversion & Short Cut Channel	Dike
Present Capacity of River Channel	Flood Return Period (year)	7	7	16	1	5
	Evaluation	B	B	D	A	B
Population in Beneficial Area	person	10,800	10,800	5,300	9,100	7,700
	Evaluation	A	A	D	B	C
Total Project Cost	F\$ 1,000	153,860	7,770	12,340	50,950	13,170
	Evaluation	D	A	B	C	B
Average Annual Damage Reduction	F\$ 1,000	1,966	884	381	8,278	1,446
	Evaluation	C	D	D	A	C
Economic Effect	EIRR (%)	Negative	12.2	2.0	15.1	10.7
	Evaluation	D	C	D	A	C
Land Acquisition and Compensation	Cost (F\$ 1,000)	5,000	3,500	0	4,000	1,000
	Evaluation	D	C	A	C	A
Impact on Social and Natural Environment	No. of Significant Adverse Impact	5 (16)	1 (5)	1(3)	5 (14)	0 (6)
	Evaluation	C	B	B	C	A
Priority Order					I	

* Number in the parentheses shown number of possible adverse impact from HEE.

PART II FEASIBILITY STUDY FOR NADI DIVERSION CHANNEL

CHAPTER 11 FIELD INVESTIGATION

The following field investigations were conducted through subcontracts with local consultants for the Feasibility Study on the Nadi diversion channel and short cut channel. Main objectives of the field investigations are 1) to determine hydraulic and structural design of the channels, 2) to examine effects of the channels on natural and social environments, 3) to estimate costs for land acquisition and compensation.

Results of the field investigations, except geological survey described in this chapter, are discussed in chapters concerned. Outline of each investigation is discussed below.

11.1 Topographical Survey

Topographical survey was conducted in proposed sites as shown in Figure-11.1. Items, area and accuracy of the survey are described in Table-11.1.

Table-11.1 Contents of Topographical Survey

Topographical Survey	Diversion Channel	Area: $2.7 \text{ km}^2 = 0.6 \text{ km} \times 4.5 \text{ km}$ Accuracy: 1/2,500
	Diverting Point	Area: $0.4 \text{ km}^2 = 0.4 \text{ km} \times 1.0 \text{ km}$ Accuracy: 1/500
	Outlet (Echo-sounding)	Area: $1.0 \text{ km}^2 = 1.0 \text{ km} \times 1.0 \text{ km}$ Accuracy: 1/2,500
	Short Cut Channel	Area: $0.5 \text{ km}^2 = 0.5 \text{ km} \times 1.0 \text{ km}$ Accuracy: 1/2,500
Longitudinal Profile and Cross Section Survey	Longitudinal Profile	Diversion Channel: 4.5km Short Cut Channel: 1.0 km
	Cross Section	Diversion Channel: 46 sections with 100 m interval Short Cut Channel: 11 sections with 100 m interval

11.2 Geological Survey

Geological survey was conducted to examine use of surplus soil, slope gradient, necessity of slope protection and so on. 12 exploratory boreholes were drilled as shown in Figure-11.2 and samples were taken for laboratory test. Items and quantity of the geological survey are shown in Table-11.2. In addition, groundwater level and electric conductivity were measured at each borehole.

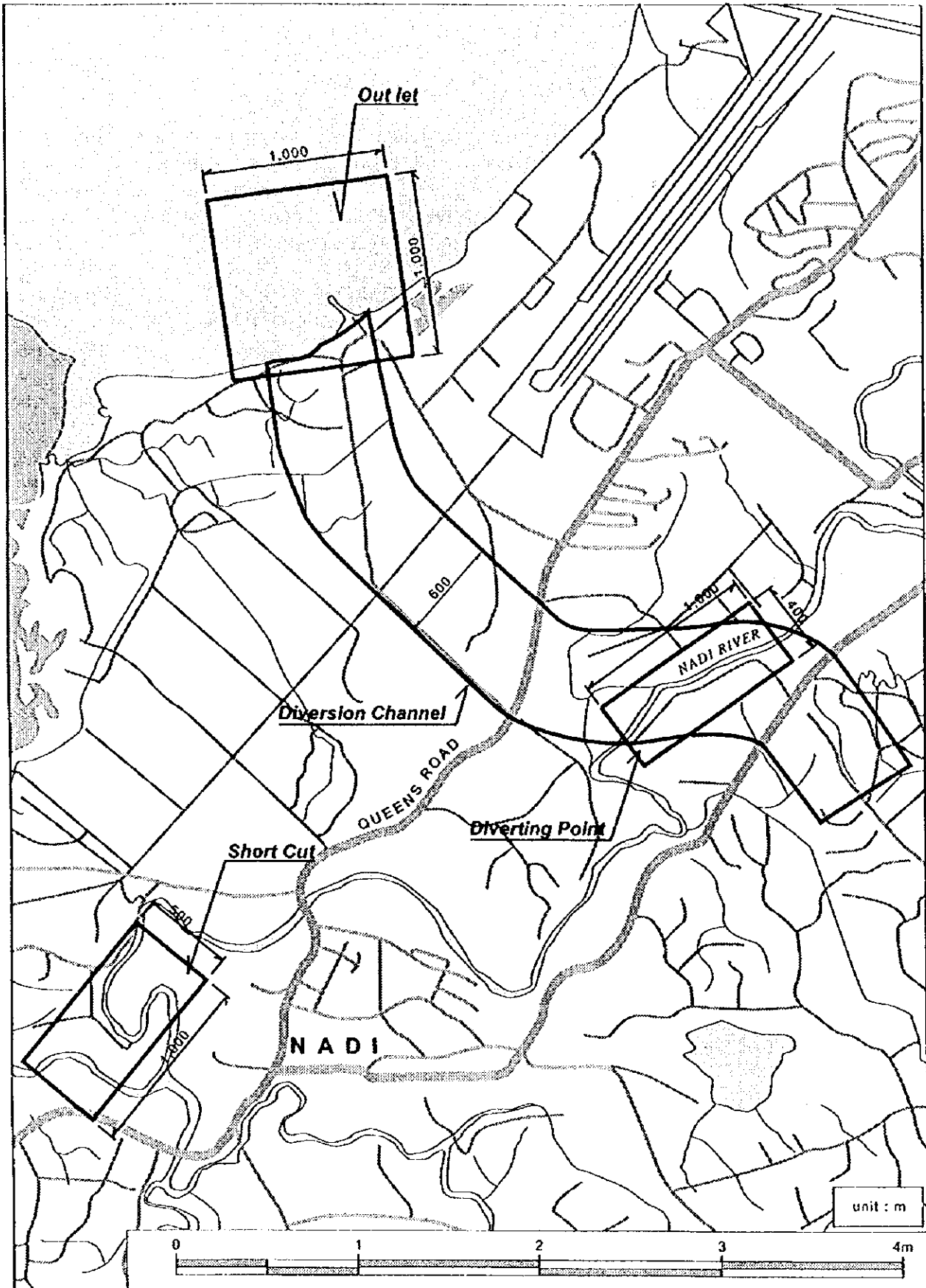


Figure-11.1 Sites for Topographical Survey

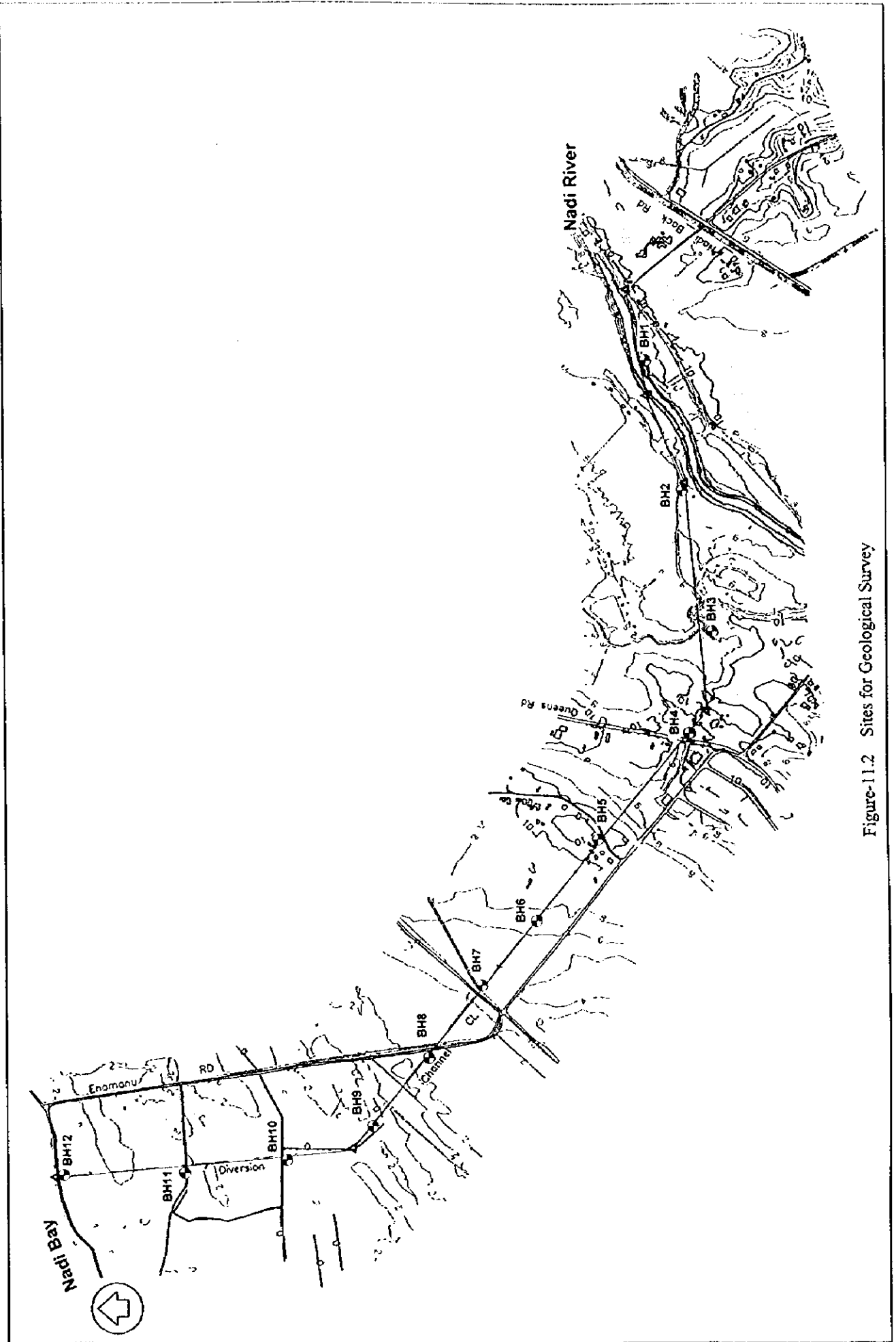


Figure-11.2 Sites for Geological Survey

Table-11.2 Item and Quantity of Geological Investigation

Borehole No.	Depth (m)	SPT No.	U/D Sample No.	Soil Test					
				M. Cont.	P. Dens.	P/S Dis.	C. Limit	U/C Test	Con. Test
BH1	20.0	16	3	18	17	18	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	127	100	18	18

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

Results of the geological survey are discussed below.

(1) General Topographical Features of Sites

Proposed 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 with 50 m to 250 m width. The upper half area of the channel shows gently hilly features and the lower half area is a low-lying flat plain.

(2) Results of the Geotechnical Investigation

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 (Figure-11.3). The results of the geotechnical investigation are summarized in Table-11.3.

1) Basement

Sound layer underlies along the whole diversion channel. This sound layer is called as basement. Depth to the basement varies from 6 m to 16 m. 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 (1984).

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. Since the soil type of the basement is classified

as Bs (clayey sand, sand-clay mixtures) based on the results of the laboratory soil tests, it is judged that these soils can be used for the embankment materials.

2) Hill Clayey Deposits

Sandy clayey deposits are widely distributed in the upper half of the channel. These deposits are referred as Hcs. 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.

The N-value of the Hcs widely ranges from 5 to 30. Its unconfined compressive strength (UCS) also widely ranges from 50 kPa to 220 kPa; however, majority shows 50 kPa to 100 kPa. The compressibility of the Hcs is not so high judging from the consolidation test results. As the soil type of the Hcs is mainly classified as CH (inorganic clays of high plasticity), it is judged that most part of the Hcs can be used for the embankment materials.

3) Coastal Sand and Clay Deposits

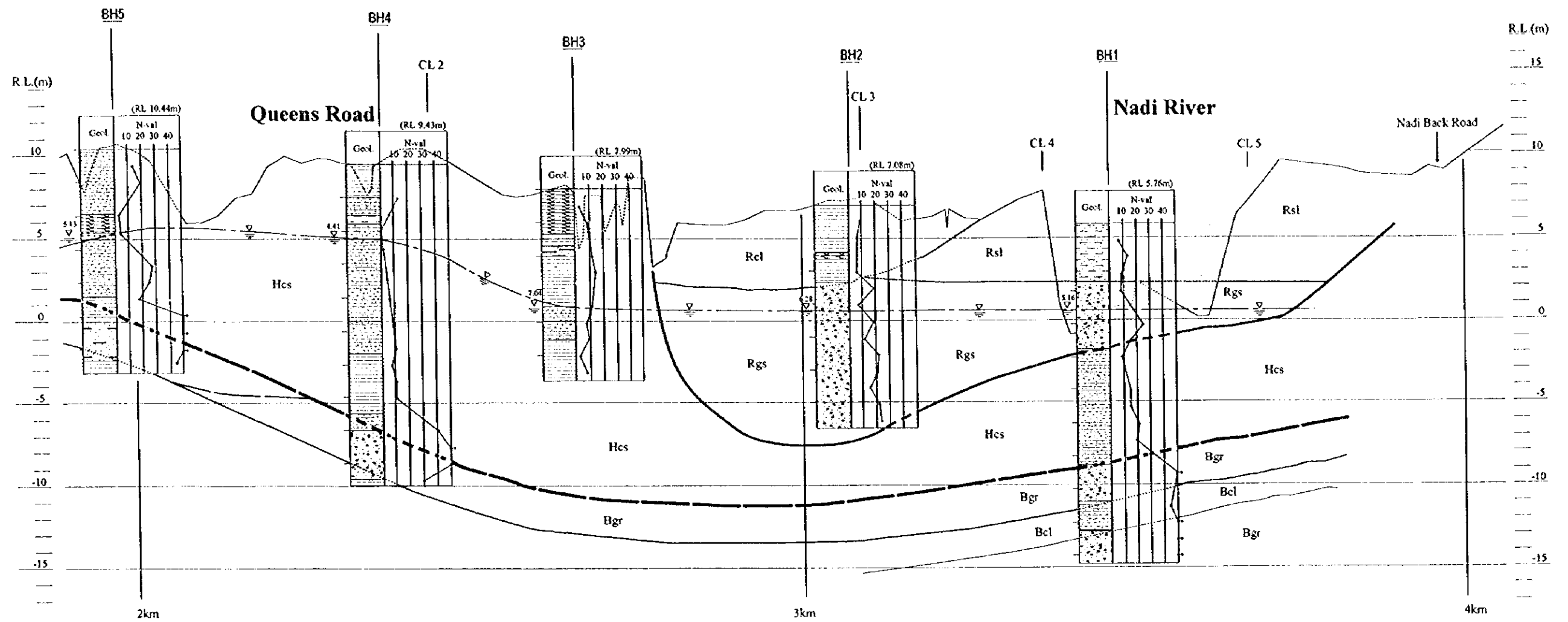
Loose and weak sand and clay deposits including many shell fragments are distributed in the low-lying flat plain located in the lower reach of the channel. These deposits referred as Csc consist of loose sand layer, weak silt layer and weak clay layer from surface to bottom. It is important to note that the weak silt and clay layers would widely expose on the bottom of the excavated channel in the down reach area according to the design of the diversion channel.

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 N-value of the weak silt layer is also less than 1. It is inferred that the UCS of the weak silt layer might be as low as the underlying weak clay layer. The N-value of the loose sand layer is 2 to 10. Since the loose sand layer is classified as SP, this layer cannot be used for the embankment materials. For the weak silt and clay layers, it is also judged unsuitable for embankment materials because of their low trafficability.

4) Terrace Deposits

Terrace deposits are distributed in the terraces along the Nadi river. Terrace deposits referred as Rts is composed of surface clay layer, sandy silt layer and gravelly sand layer from surface to bottom. The total thickness of the Rts is around 15 m.

The N-value of the gravelly sandy layer, the sandy silt layer and the clay layer are around 10 to 25, around 10, and 6 to 8 respectively. The UCS value of the clay layer is 235 kPa. The surface clay layer can be used for the embankment materials because it is classified as CH. It is judged that the sandy silt layer can be used for the embankment materials because this layer is classified as ML and SM which contain some fine materials. The gravelly sand layer cannot be used for the embankment materials as it is composed of non-plastic materials.



LEGEND :

Boring Logs		Geological Profile	
	Clay	Age	Rts : Terrace Deposits
	Clay with Organic Substances		Rcl Clay Layer
	Sandy Clay		Rsl Sandy Silt Layer
	Silt		Rgs Gravelly Sand Layer
	Sandy Silt		Csc : Coastal Sand and Clay Layer
	Clayey Sand		Cls Loose sand Layer
	Sand		Cws Weak Silt Layer
	Gravelly Sand		Cwc Weak Clay Layer
			Hcs : Hi Clay and Sand Layer
			Hcs Sandy Clay Layer
		Basement : Sand, Gravel, Hard Clay Layers	
		Bgr Sandy Gravel Layer	
		Bs Sand Layer	
		Bcl Hard Clay Layer	
		Geological Boundary	
		Groundwater Surface	

SCALE

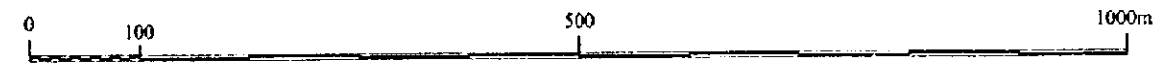
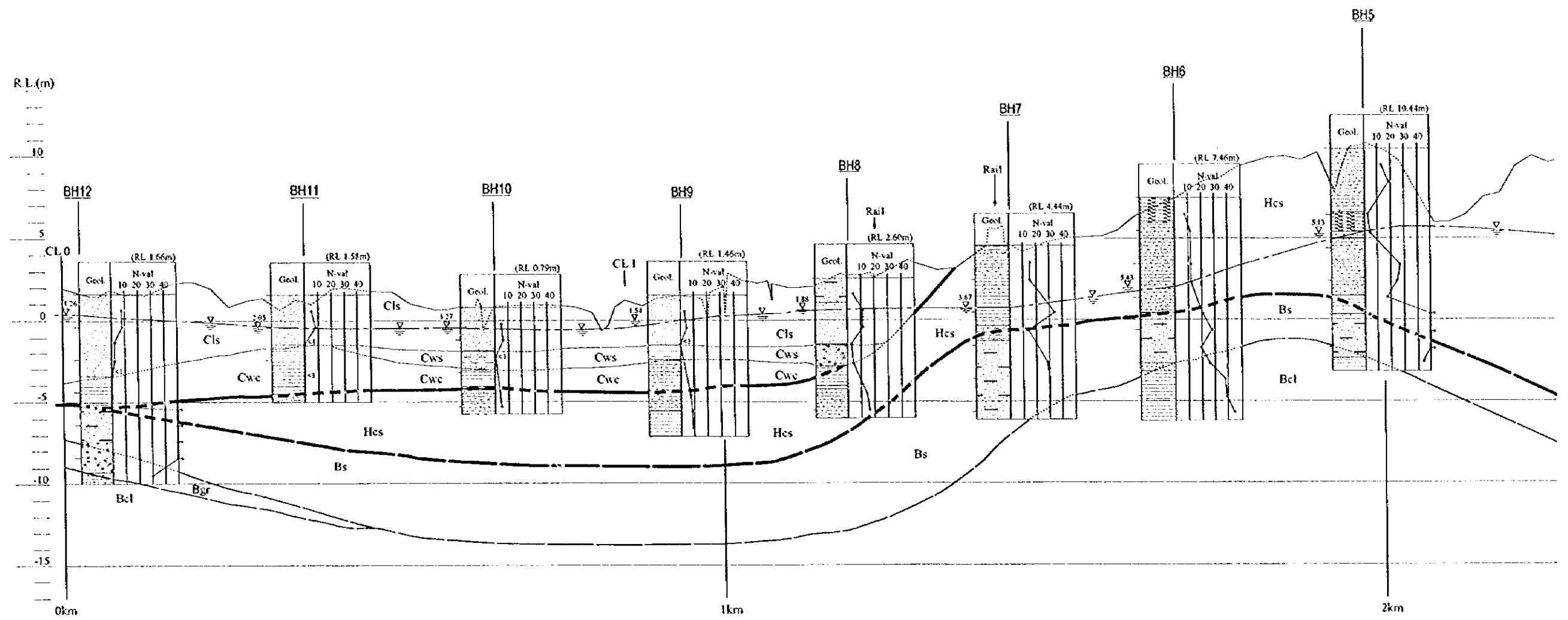


Figure-11.3 (1/2) Geological Profile along Proposed Diversion Channel



LEGEND

Boring Logs		Geological Profile	
	Clay	Age	Rts : Terrace Deposits
	Clay with Organic Substances		Rcl : Clay Layer
	Sandy Clay		Rsl : Sandy Silt Layer
	Silt		Rgs : Gravelly Sand Layer
	Sandy Silt	Holocene	Csc : Coastal Sand and Clay Layer
	Clayey Sand		Cls : Loose sand Layer
	Sand		Cws : Weak Silt Layer
	Gravelly Sand		Cwc : Weak Clay Layer
		Pleistocene	Hcs : Hill Clay and Sand Layer
			Hcs : Sandy Clay Layer
		Basement	Basement : Sand, Gravel, Hard Clay Layers
			Bgr : Sandy Gravel Layer
			Bs : Sand Layer
			Bcl : Hard Clay Layer
			Geological Boundary
			Groundwater Surface

SCALE

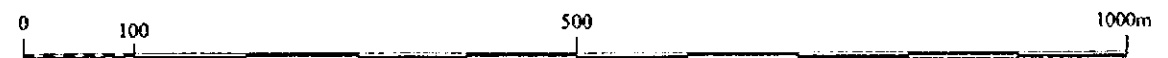


Figure-11.3 (2/2) Geological Profile along Proposed Diversion Channel

Table-11.3 Summary of Laboratory Soil Test

Layer	Soil Type	L.L. (%)	P.L. (%)	P.L. (%)	P.I. (%)	L.S. (%)	M.C. (%)	P. 0.075mm (%)	N.D.	UCS (MPa)	Consolidation - Pressure Curve	
Terrace Deposits (Rts)	Clay layer	50-64	18-27	23-46	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	36	23	13	13	7	8-39	16-69	-	-		
	Gravelly Sand Layer	-	-	-	-	-	8-29	6-15	-	-		
	Loose Sand Layer	-	-	-	-	-	17-43	10-52	-	-		
Coastal Sand and Clay Deposits (Csc)	Weak Silt Layer	27-37	22-26	5-10	3-7		19-51	10-66	-	-		
	Weak Clay Layer	43-69	21-45	22-35	8-14		46-70	61-88	1.75	27-57		
Hill Clayey Deposits (Hcs)	Sandy Clay Layer	46-104	11-45	20-80	10-24		30-71	48-99	1.57-1.8	47-222		
	Basement	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

(3) Groundwater

The boreholes were left for more than one month after drilling and then the groundwater level and the electric conductivity were measured at each borehole. The results were used to examine effects of the diversion channel on soil and water properties in site of the diversion channel (see Chapter 18).

Groundwater ridge is formed in the upper reach of the channel and groundwater table gently inclines toward both to the Nadi river and to the sea.

The electric conductivity of the groundwater in the hilly area is as low as rainwater. On the contrary, electric conductivity shows extremely high in the coastal sediments distributed in the low-lying flat plain. Reasons are probably that the seawater intrudes into low-lying area through the drainage channels and the coastal sediment itself contains much salt.

11.3 Tidal Current Survey

Tidal current survey was conducted to examine sedimentation at outlet of the diversion channel and effects of sediment load through the channel on the Nadi bay. 4 buoys were located in the Nadi bay and their coordinates were measured by GPS (Global Positioning System). Tidal current was observed every one hour for 25 hours when the tide was the high water springs. The details are discussed in Chapter 17.

11.4 Social Environmental Survey

Social environment survey consists of interview survey to residents, traffic volume survey, groundwater survey and landuse survey in the proposed sites. Main objectives of the social environmental survey are to examine effects of the channels on natural and social environments and to estimate costs for land acquisition and compensation.

11.4.1 Interview Survey

The interview survey area covers the area where land acquisition and resettlement may probably happen with project implementation. It includes the planned sites for the Nadi diversion channel and shortcut channel (Figure-11.4).

The interview survey was conducted by visiting the households living in the survey area by a subcontractor. Public and private facilities other than residential houses were also visited and the interviews were conducted.

The interview items are as follows:

- Composition of the household (name, age, sex, education, etc.)
- Living in the present house since (when) and came from (where)
- Reasons for choosing the location for the present house
- Race and religion
- Occupation and work place location
- School learning and its location

- Location of medical care
- Monthly or annual income of the household
- Area and condition (building, garden, parking etc.) of land
- House condition (building area, floor area, structure, quality, year built, maintenance condition)
- Land ownership and status
- Size of farmland owned/occupied, land status, average income of farming
- Values of house, land and property owned/occupied
- Effect of resettlement
- Utilities (road, water supply, sewerage, electricity, telephone, etc.)
- Other social aspects

134 households were visited during the interview survey from December 1997 to February 1998.

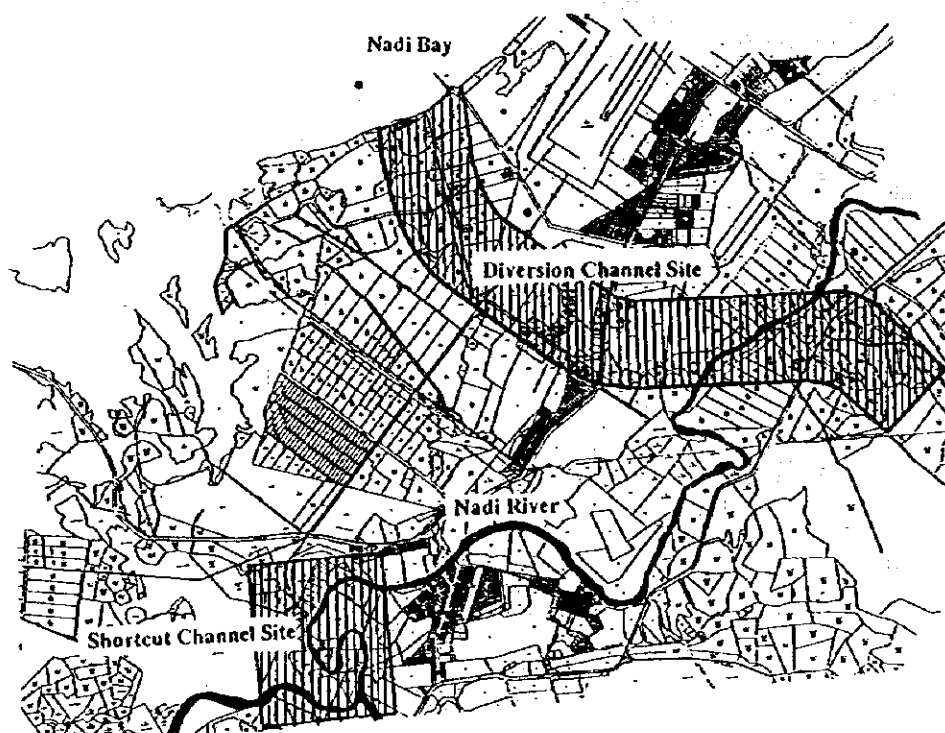


Figure-11.4 Interview Survey Area

11.4.2 Traffic Volume Survey

Traffic volume survey was conducted for understanding the traffic condition on Queens Road. Three representative sections were selected at the crossing of Queens Road and Enamanu Road near McDonald's – two at Queens Road (upper and down the crossing) and one at Enamanu Road. The survey points are at the two sides of each section for counting the traffic volume of each lane. The survey was conducted on a weekday (Jan. 28, 1998) from 6:00 a.m. to 8:00 p.m. by a subcontractor. Vehicle number was counted by vehicle type as heavy truck, small truck, large bus, microbus/mini van, passenger car passing the survey point. Numbers were noted at 30-minute interval.

The results were used for the environmental impact assessment (see Chapter 18).

11.5 Groundwater Survey

The groundwater survey area covers the diversion channel site and its vicinity with a total area of 6 km² (Figure-11.5).

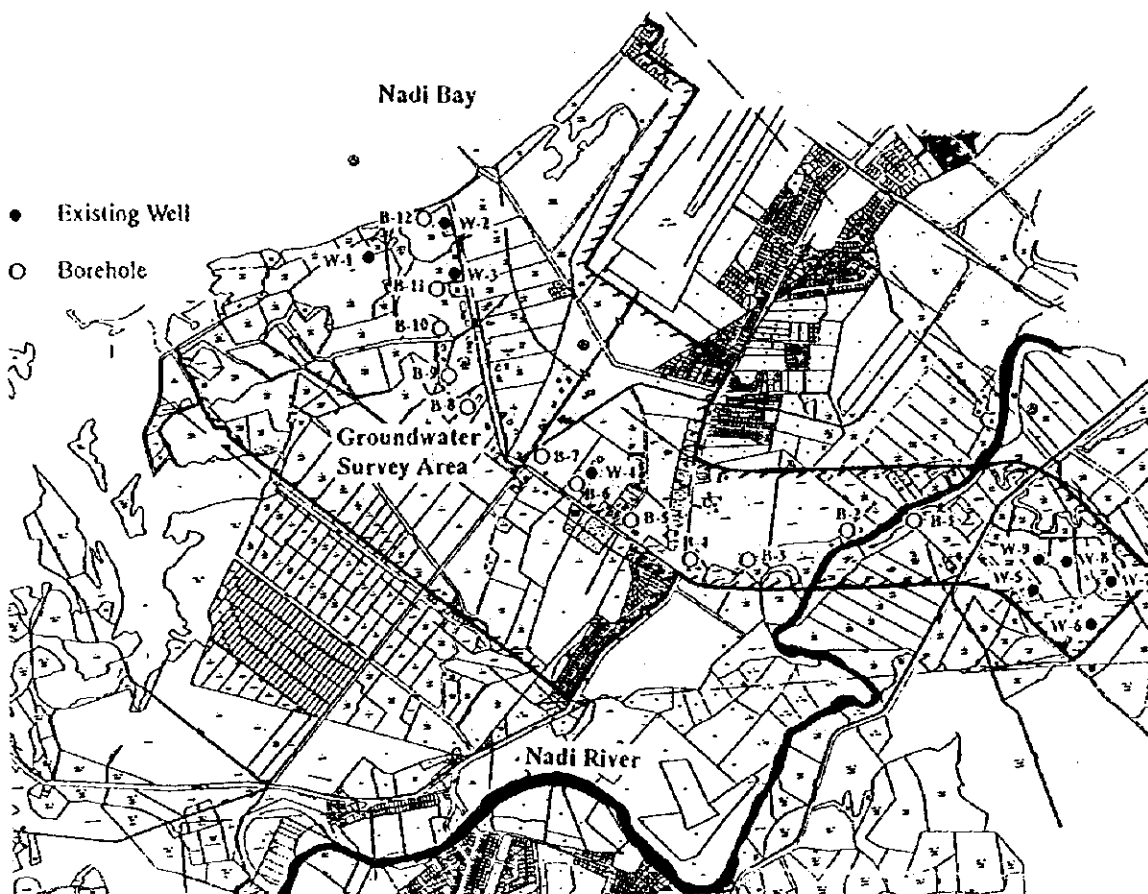


Figure-11.5 Location of Existing Wells and Boreholes Drilled During This Study

In the whole survey area, 9 existing wells were identified, 4 at the right bank (coastal side) and 5 at the left bank (inland side) of Nadi River. Groundwater table, electric conductivity (EC) and utilization condition of these wells were investigated. The EC measurement was carried out by using a portable EC meter. For better understanding of groundwater quality in the project area, EC measurement was also conducted for the 12 boreholes drilled during the geological survey as mentioned in the section 11.2. The survey results were used for the environmental impact assessment (see Chapter 18).

11.6 Landuse Survey

To identify landuse in the site for the diversion channel and its vicinity (totally 6.0 km²), the land use survey was conducted. The survey method is field reconnaissance and items surveyed are public facilities, residential areas, commercial areas, industrial areas, airport, tourist areas, parks, crop lands, mangrove, river and native villages. The result is plotted on the cadastral map.

Literature Cited

P. Rodda (1984). "Geology of Fiji (with special reference to palaeogeography)". Ministry of Lands, Energy & Mineral Resources, MRD Note BP1/59.



CHAPTER 12 EXAMINATION OF SCALE OF DIVERSION CHANNEL

12.1 Design Flood

During the Master Plan Study of flood control on 4 major Viti Levu rivers, the design flood of each watershed has been determined considering the area of watershed, social and economic importance of objective area, flood damage expected and so on. The result of design flood determination is discussed briefly below.

As a result of examination of watershed indices, such as area of watershed, area of inundation, population and properties in inundated area etc., the flood of 50 year return period is considered appropriate as the design flood of 4 watersheds, Rewa, Sigatoka, Nadi and Ba. However, to achieve the safety degree against 1/50 probability flood, the flow capacity of Rewa, Sigatoka and Ba rivers has to be improved approximately twice as much as the current capacity, while that of Nadi has to be improved 10 times more.

When the difference between the current flow capacity and design flood discharge is very large, the flood control plans often encounter the difficulty of implementation due to the large investment and works to be required. Under this kind of circumstances, the stepwise plans are practical and effective to flood control. Therefore, two step plan has been proposed. The first step is to improve the flow capacity by 50 % of insufficient capacity (= 1/50 probability flood - current flow capacity) and at the second step, the river is improved to drain 1/50 probability flood. Since the flood probability of first step target is almost 1/20 throughout the four watersheds, the flood of 20 year return period was set as a goal of the first step and the Master Plan on flood control was formulated for the first step, 1/20 probability flood.

For the Feasibility Study, the same design flood as the Master Plan is applied to examine the project specifications of Nadi diversion channel and short cut channel. The distribution of design flood discharge, 1/20 probability flood, in Nadi river is shown in Figure-12.1.

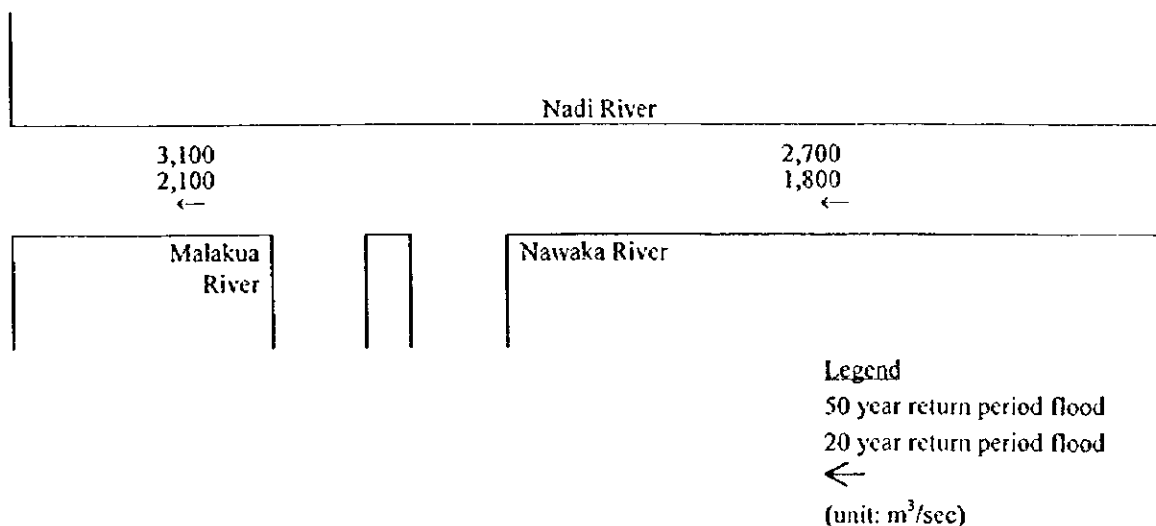


Figure-12.1 Distribution of Flood Discharge

12.2 Scale of Diversion Channel

The distribution of design flood discharge, 20 year return period flood, with implementation of the diversion channel is shown in Figure-12.2.

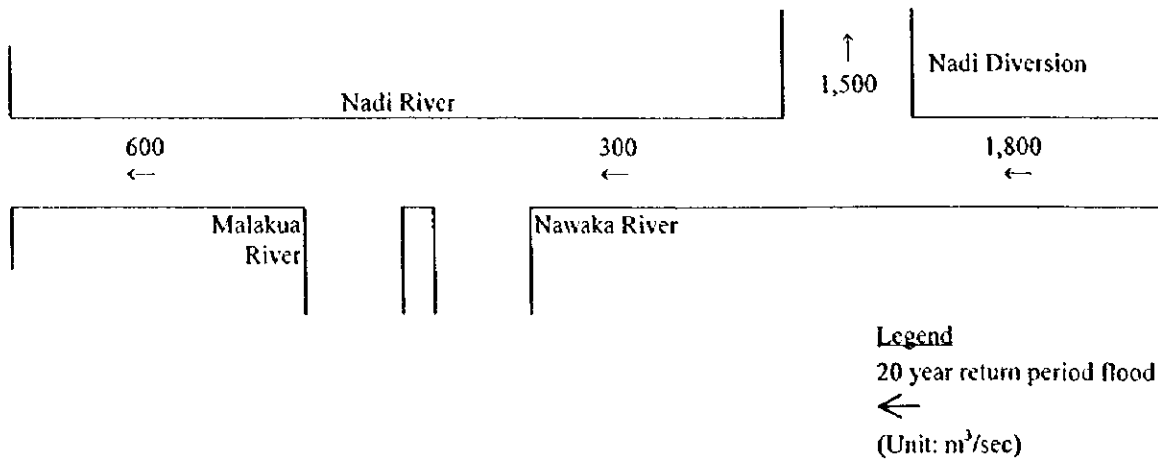


Figure-12.2 Distribution of Design Flood Discharge (1/20 Probability Flood) with Diversion Channel

As shown in Figure-12.2, the flow capacity of the diversion channel is 5 times as much as the current flow capacity of Nadi river as long as the design flood is 1/20 probability flood. Even 1/20 probability flood may be too large to realize flood control measures for Nadi river in terms of finance. Therefore, the stepwise implementation of the Nadi diversion channel was examined. To assess the possibility of stepwise implementation of the diversion channel, the scale of diversion channel with smaller probability floods, 1/15, 1/10 and 1/5, was examined. The distribution of different flood discharges with implementation of the diversion channel is shown in Figure-12.3.

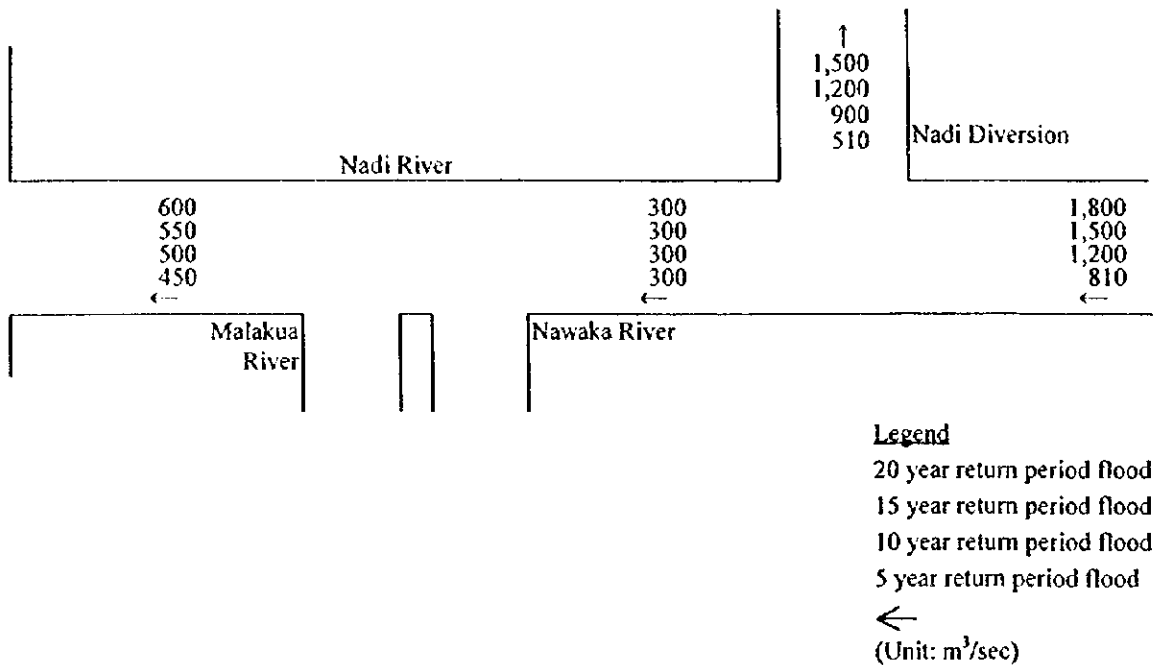


Figure-12.3 Distribution of Different Flood Discharges with Diversion Channel

A diversion channel for a smaller flood than 1/20 probability flood was designed to have the same longitudinal profile as the diversion channel for 1/20 probability flood but smaller channel width depending on flood discharge, in order to implement the stepwise construction smoothly. The standard cross section of diversion channel for each flood probability is shown in Figure-12.4, based on the hydraulic design discussed in Chapter 13.

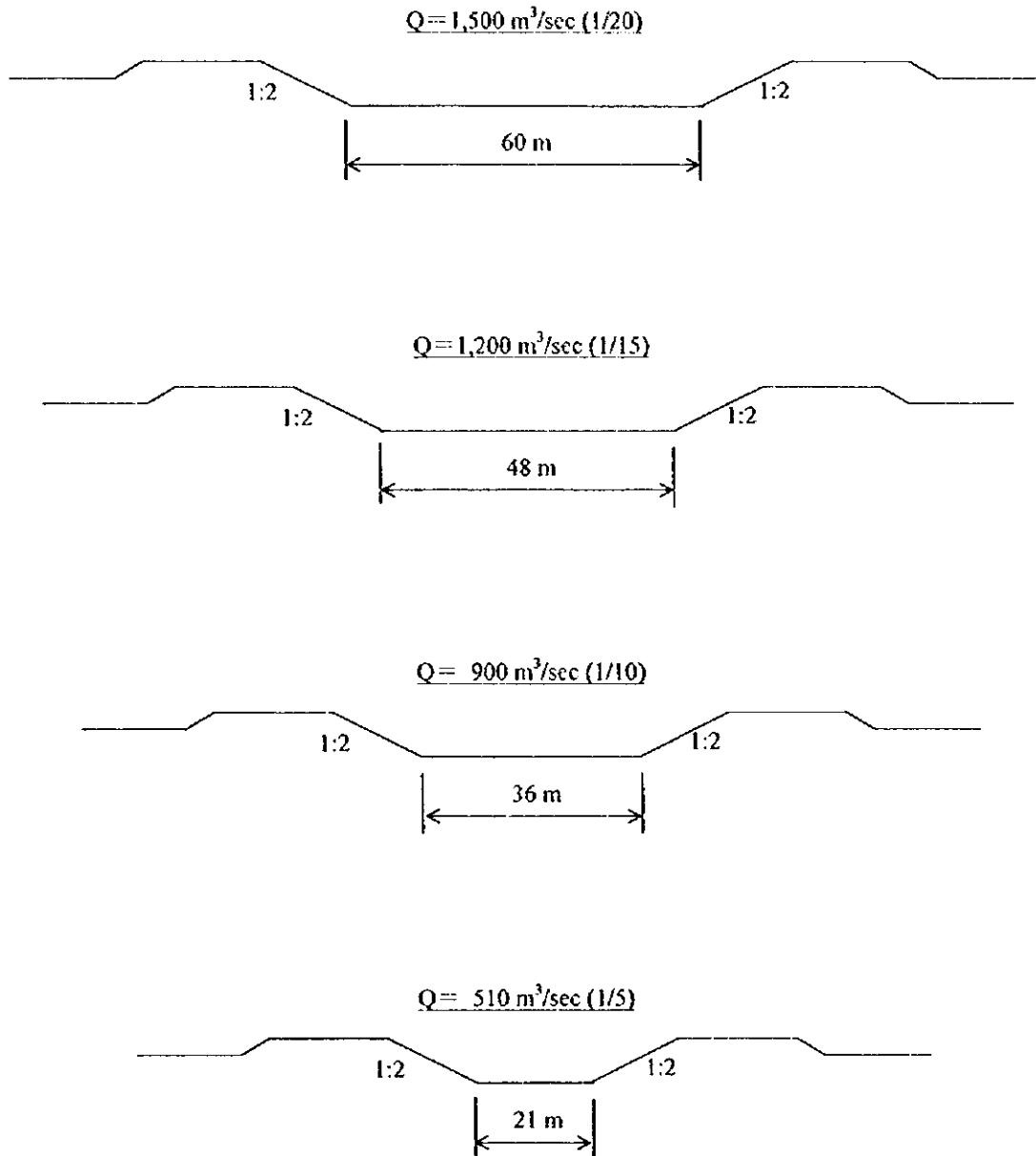


Figure-12.4 Standard Cross Section of Nadi Diversion Channel for Different Flood Probability

12.3 Economic Evaluation

12.3.1 General

The flood control project (Nadi diversion channel and short cut channel) was examined and designed for 4 different scale of floods (1/20, 1/15, 1/10 and 1/5 probability floods). The hydraulic design and structural design of the flood control project are discussed in Chapter 13, and results of cost estimate are described in Chapter 15.

Based on the project cost estimated in Chapter 15, economic evaluation was conducted to evaluate the 4 cases of the project from economic point of view.

12.3.2 Annual Average Economic Benefit

The same method and same relation between discharge and flood damage of Nadi river (Chapter 6) was adopted to estimate the annual average flood damage reduction for each case. The results of estimate are shown in Table-12.1.

Table-12.1 Annual Average Damage Reduction by Nadi Diversion and Short Cut Channels

Design Flood	Return Period		Annual Average Return Periods	Discharge			Flood Damage		Flood Damage Reduction	Average Flood Damage Reduction	Annual Average Flood Damage Reduction
				Current	After Implementation	Effect	Current	After Implementation			
				①	②	③	④=②-③	⑤			
			m ³ /sec	m ³ /sec	m ³ /sec	10 ³ F\$	10 ³ F\$	10 ³ F\$	10 ³ F\$	10 ³ F\$	
1/20 Probability Flood	1/20	0.050	-	2,100	550	1,550	78,241	0	78,241	-	-
	1/10	0.100	0.050	1,400	370	1,030	42,906	0	42,906	60,574	3,028
	1/5	0.200	0.100	960	250	710	20,696	0	20,696	31,801	3,180
	1/2.5	0.400	0.200	550	140	410	0	0	0	10,348	2,070
	Total										8,278
1/15 Probability Flood	1/20	0.050	-	2,100	550	1,550	78,241	0	78,241	-	-
	1/15	0.067	-	1,750	460	1,290	60,574	0	60,574	-	-
	1/10	0.100	0.033	1,400	370	1,030	42,906	0	42,906	51,740	1,724
	1/5	0.200	0.100	960	250	710	20,696	0	20,696	31,801	3,180
	1/2.5	0.400	0.200	550	140	410	0	0	0	10,348	2,070
Total										6,974	
1/10 Probability Flood	1/20	0.050	-	2,100	550	1,550	78,241	0	78,241	-	-
	1/10	0.100	-	1,400	370	1,030	42,906	0	42,906	-	-
	1/5	0.200	0.100	960	250	710	20,696	0	20,696	31,801	3,180
	1/2.5	0.400	0.200	550	140	410	0	0	0	10,348	2,070
	Total										5,250
1/5 Probability Flood	1/20	0.050	-	2,100	550	1,550	78,241	0	78,241	-	-
	1/10	0.100	-	1,400	370	1,030	42,906	0	42,906	-	-
	1/5	0.200	-	960	250	710	20,696	0	20,696	-	-
	1/2.5	0.400	0.200	550	140	410	0	0	0	10,348	2,070
	Total										2,070

Annual average damage reduction varies from F\$ 2,070,000 to F\$ 8,278,000 depending on the scale of the diversion channel. Economic benefit is assumed to be equivalent to annual average damage reduction. Therefore, figures in Table-12.1 were used as annual average economic benefit. Annual average economic benefit is expected to accrue every year during the project life of 50 years after completion of the construction works.

12.3.3 Economic Cost

Economic cost is converted value from the project cost. Applying the same conditions and assumptions in Chapter 6, economic costs for the 4 cases were estimated based on the project costs (financial costs) in Chapter 15.

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-12.2 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

12.3.4 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-12.3.

- 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-12.3 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

Discount Rate: 10 %

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.

