CHAPTER 10 ADAPTATION TO CLIMATE CHANGE

10.1 CONSIDERATION OF THE IMPACT OF CLIMATE CHANGE IN THE STUDY AREA

10.1.1 General

The Philippine climate is influenced by large-scale atmospheric phenomena that bring in substantial amounts of rains almost all year round. However, due to the uneven distribution of rain with respect to time and space and the occurrences of extreme events such as floods and droughts, the country's water resources have in the past experienced Imbalances. The Intergovernmental Panel on Climate Change (IPCC) has warned the climate changes associated with global warning. The climate changes include the rises of temperature, storm rainfall intensity and sea level, which could further aggravate the flood conditions of the Study Area.

The IPCC estimated the change of global temperature based on the Fourth Special Report on Emission Scenarios (SRES), which describes several scenarios on the future global emission volume of greenhouse gas (such as carbon dioxide and nitrogen monoxide and methane gas) and sulphate. The IPCC estimated based on the SRES that the present global average temperature would most likely rise by 1.8 to 4.0°C at the end of the 21st Century. Significant changes in the earth's climatic system, particularly an alteration of rainfall and temperature in both time and space, are expected.

The present endeavor is focus on the impacts of climate change in the development of flood control measures for Cagayan River. Expected output from the analysis would be a proposed component adoptive in future flood control plan of the current Sectoral Loan overall flood control project

10.1.2 Assessment Methodology

Assessment of climate variability and change impacts on the performance of a flood protection system is manifested through the following: (a) climate change scenarios; (b) hydrologic processes; and (c) impacts to the development of flood control measures (structural and non structural).

Climate Change Scenario

The Fourth Special Report on Emission Scenarios (SRES) for IPCC describes several scenarios on the future global emission volume of greenhouse gas and sulphate. Three (3) scenarios taken from the SRES are adapted to the present endeavor namely;

a) ***Status quo scenario***. No climate change

b) ***B1 scenario***. The temperature rise is predicted at the smallest which projects a convergent world with the same global growth of population but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource efficient technologies

c) ***A1FI scenario***. The temperature rise is predicted at the largest due to a very intensive use of fossil fuel for energy system which is consequent to a very rapid growth of the global economy.

Global Temperature Rise

The IPCC estimated that the present global average temperature would most likely rise by 1.8 to 4.0°C at the end of the 21st Century as shown in Table 10.1 and delineated in Figure 10.1.

Table R 10.1 Global Average Temperature Rise at the End of 21st Century

Scenario	Temperature Rise from the Average of 1980-1999 to the Average of 2090-2099 (ºC)	
	Best Estimate	Likely Range
B1	1.8	1.1-2.9
A1F1	4	2.4-6.4

Source:
IPCC 2007, Summary for Policymakers.

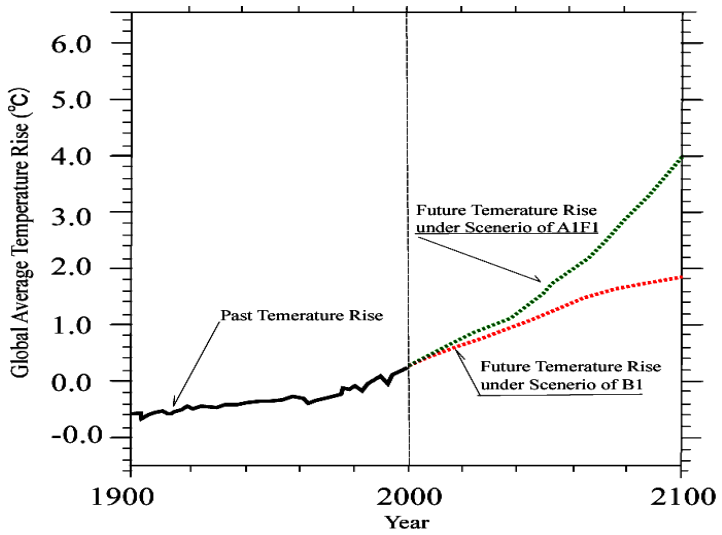


Figure R 10.1 Global Average Temperature Rise

(Consecutive Average Temperature Rise as the Base of Value in 1980-1999)
Source: IPCC 2007, Summary for Policymakers

The 2005 Study Report on Mapping Philippine Vulnerability on Environmental Disasters undertaken by the Department of Environment and Natural Resources (DENR) whose objective is to identify areas in the country that are at high vulnerability and risk to environmental disasters includes analysis on the temperature increases nationwide. Hazards and disasters are mapped and analyzed via geographic information systems (GIS), environmental modeling tools and resulting spatial databases.

One of the results of the analysis relevant to climate change is shown in Figure 10.2 and it tends to support the global trend on temperature increases. The figure suggests that the present temperature increases for the Project Area (Cagayan, Ilog-Hilabangan and Tagoloan River basins) are found to be more than 0.5 ºC.

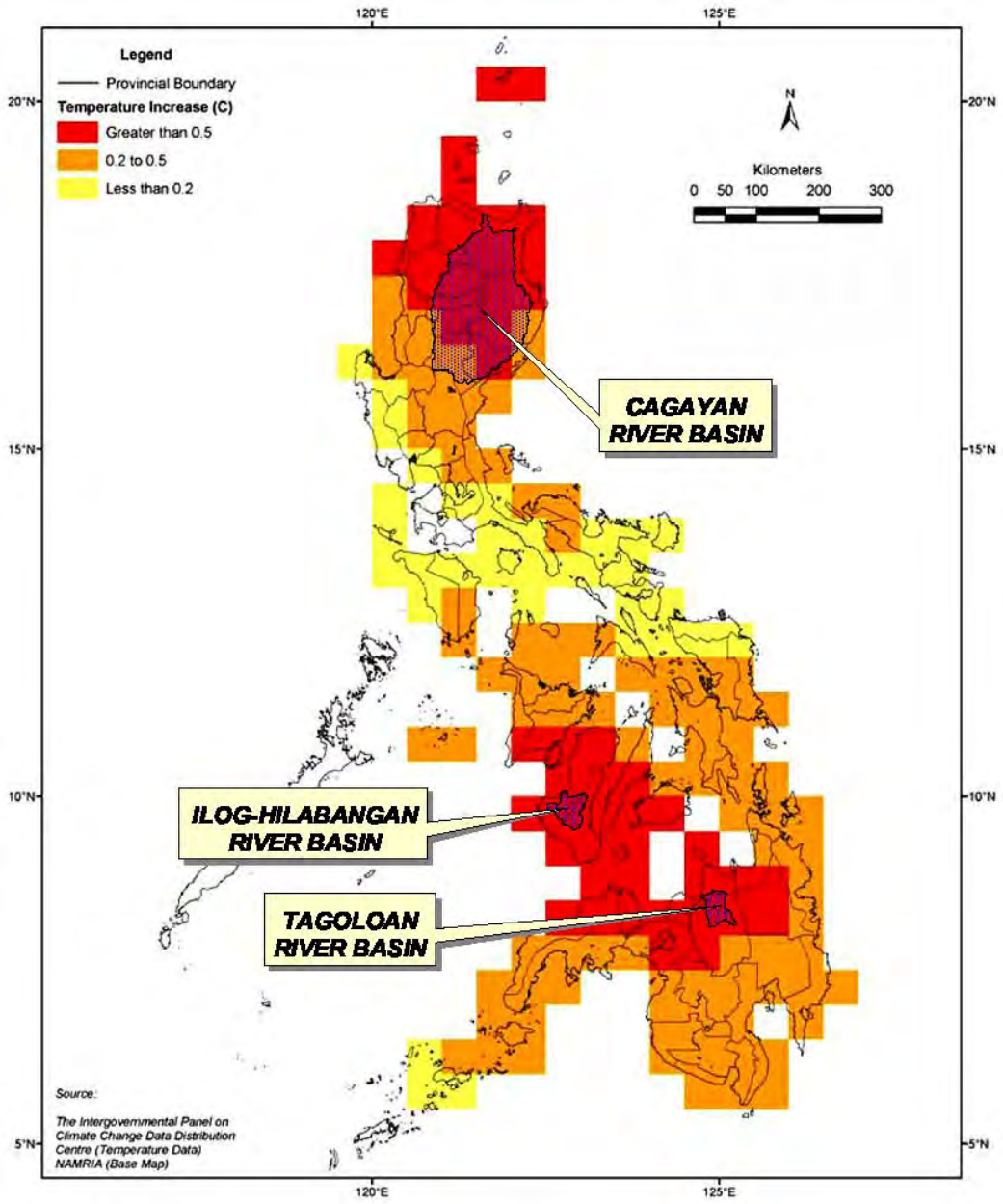


Figure R 10.2 Temperature Increase in the Philippines

Future Temperature Rise in the Project Area

In the recent Project Study titled "The Study on Comprehensive Flood Mitigation for Cavite Lowland Area in the Republic of the Philippines" undertaken in February 2009 undertaken by JICA, the relationship of the future global temperature rises and the local spatial temperature rises in the Philippines is analyzed by the TIGS/CCSR of the University of Tokyo.

The result of the mathematical modeling concerning the relationship between the aforesaid global average temperature rises and the local spatial average temperature rises in the Philippines is shown in Figure 10.3. The simulation which covers the area of long. 116.0 to 126.0°E and lat. 9.0 to 19.0°N (the area of about 1,000km x 1,000km) is made through a subset of models (twelve models) applied in the Forth Assessment Report of IPCC. The above temperature rises are expressed as the averages of those at each mesh of 100km x 100km, and at the same time as the

differences between the late 20th century (1981-2000) and the late 21st century (2081-2100) with assuming SRES A1FI and B1 scenarios.

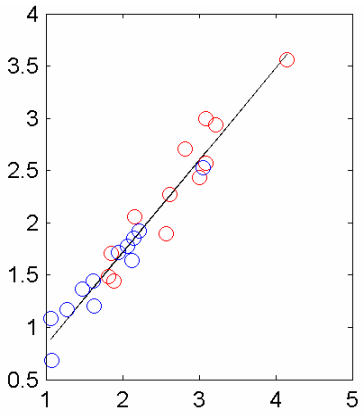


Figure R 10.3 Relation between Global Average Temperature Rise and Local Temperature Rise in the Philippines

According to the results of the above simulation, the local average temperature in the Philippines would rise by 1.1 to 2.3℃ in 2050 and further 1.5 to 3.5℃ in 2010 as shown in the following Table 10.2

Table R 10.2 Relation between Global Average Temperature Rise and Local Temperature Rise in the Philippines

Scenario	Year	Global Average Temperature Rise (ºC)	Local Average Temperature Rise in the Philippines (ºC)
B1	2050	1.2	1.1
	2100	1.8	1.5
A1FI	2050	2.6	2.3
	2100	4	3.5

Increase in Future Rainfall Intensity due to Temperature Rise

The IPCC projected that the global warning would possibly induce increment of the storm rainfall intensity causing more sever flood. In this connection, the aforesaid TIGS/CCSR simulated between the spatial-average changes of precipitable water and local temperature rises over the Philippines. This simulation is made in the same manner as that for the above relation between the global temperature rises and the local average temperature rises in the Philippines The results of the simulation are as shown in Figure 10.4.

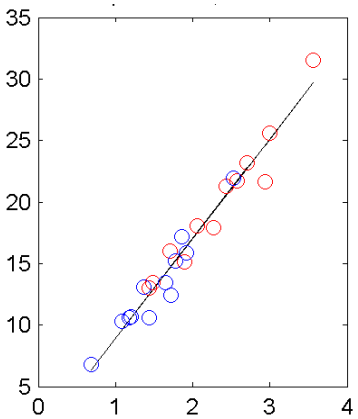


Figure R 10.4 Relationship between Local Average Temperature Rise and Incremental Rate of Precipitable Water in Philippines

The results of the simulations indicated that the storm rainfall intensity in the Philippines would increase by 11 to 20% in 2050 and 14 to 29% in 2100 as shown in Table 10.3

Table R 10.3 Relationship between Local Average Temperature Rise and Incremental Rate of Precipitable Water in Philippines

Scenario	Year	Temperature Rise (ºC)	Increase Rate of Rainfall Intensity (%)
B1	2050	1.1	11
	2100	1.5	14
A1FI	2050	2.3	20
	2100	3.5	29

Application of the above results as an increment of storm rainfall intensity for the Study Area will mean increasing the present design probable hyetograph or shortening the return period and consequently, the probable design flood runoff discharges would be increased as a design parameter in the future.

Upon the application of the above factor, the adjusted probable hyetographs for the subject project area of Cagayan River basin are listed in Table 10.4. The design for Cagayan River basin is based on 4-day storm.

Table R 10.4 Future Increment of Probable 4-day Storm Rainfall for Cagayan River Basin

Cagayan Design Rainfall (mm)			Return Period (y)					
			2	5	10	25	50	100
Status Quo			158	212	246	289	321	352
A1FI	2050		190	254	295	347	385	422
	2100		204	273	317	373	414	454
B1	2050		175	235	273	321	356	391
	2100		180	242	280	329	366	401

Based on the above figures, probable hyetographs for future design consideration are developed for the subject river basin considering the adopted climatic change scenarios and these are presented in Figures 10.5 to 10.8.

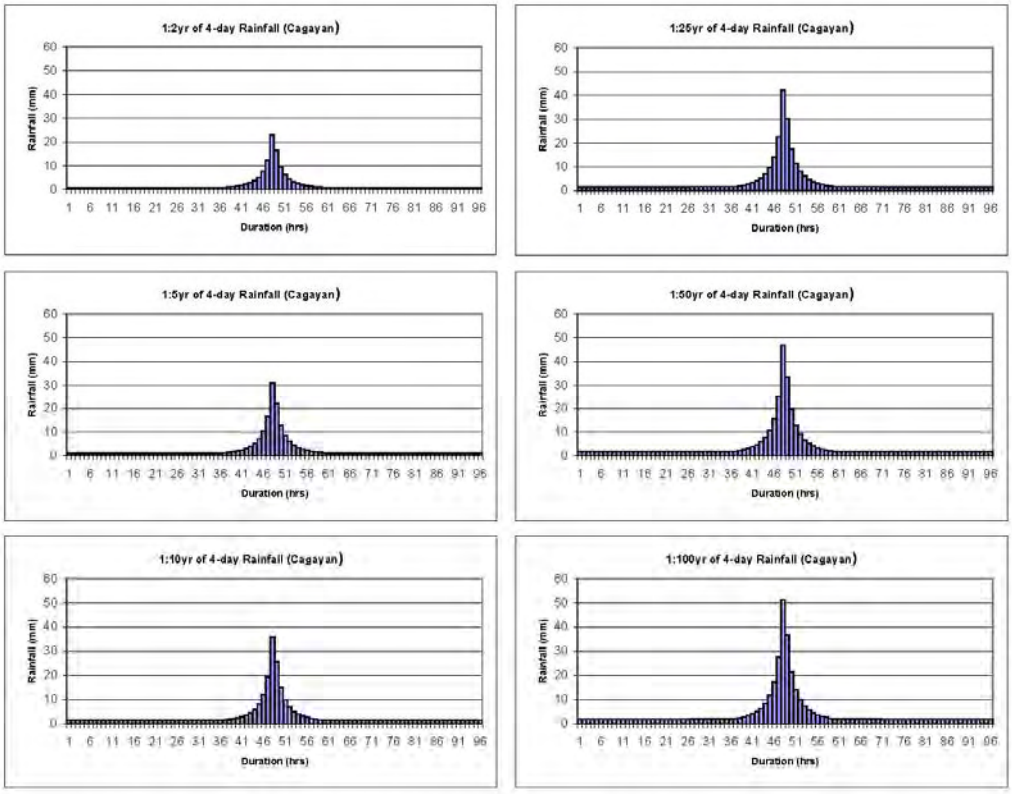


Figure R 10.5 Future Design Probable Hyetograph (B1-2050 Scenario) Cagayan River Basin

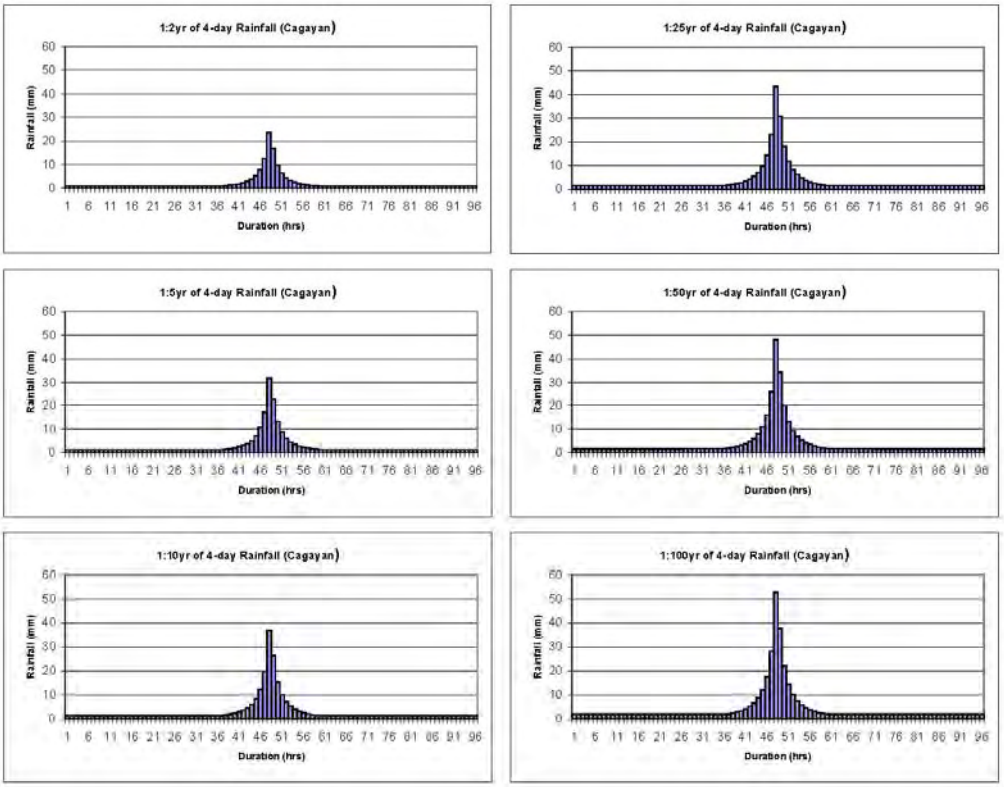


Figure R 10.6 Future Design Probable Hyetograph (B1-2100 Scenario) Cagayan River Basin

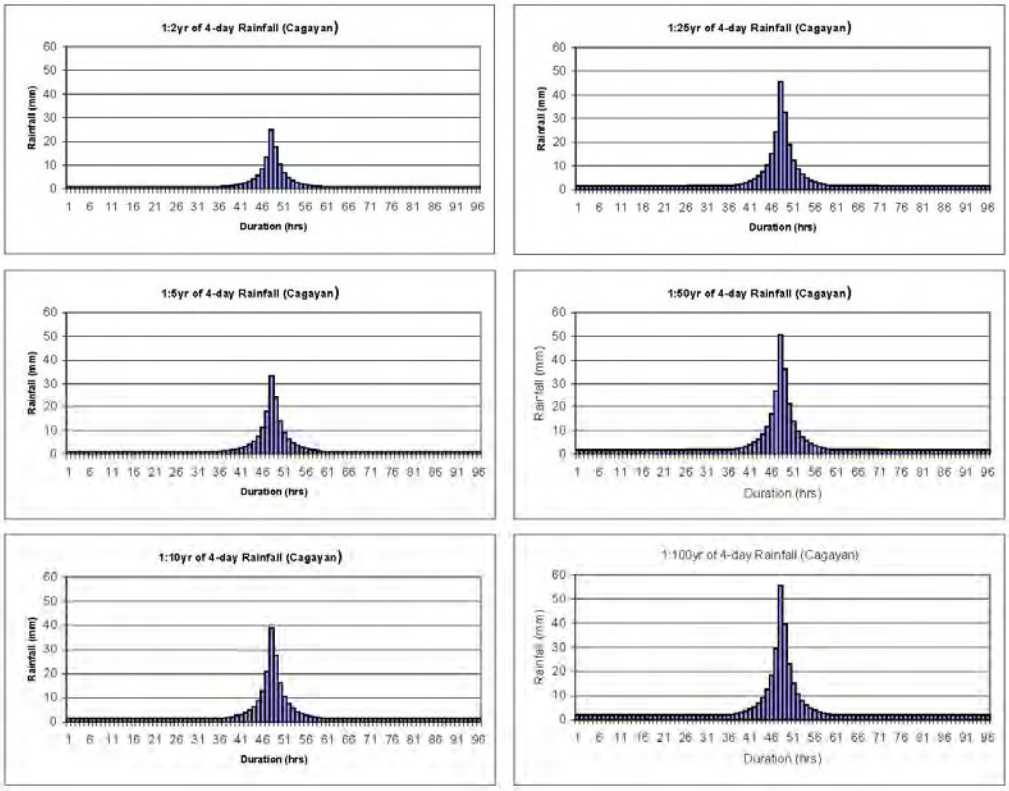


Figure R 10.7 Future Design Probable Hyetograph (A1FI-2050 Scenario) Cagayan River Basin

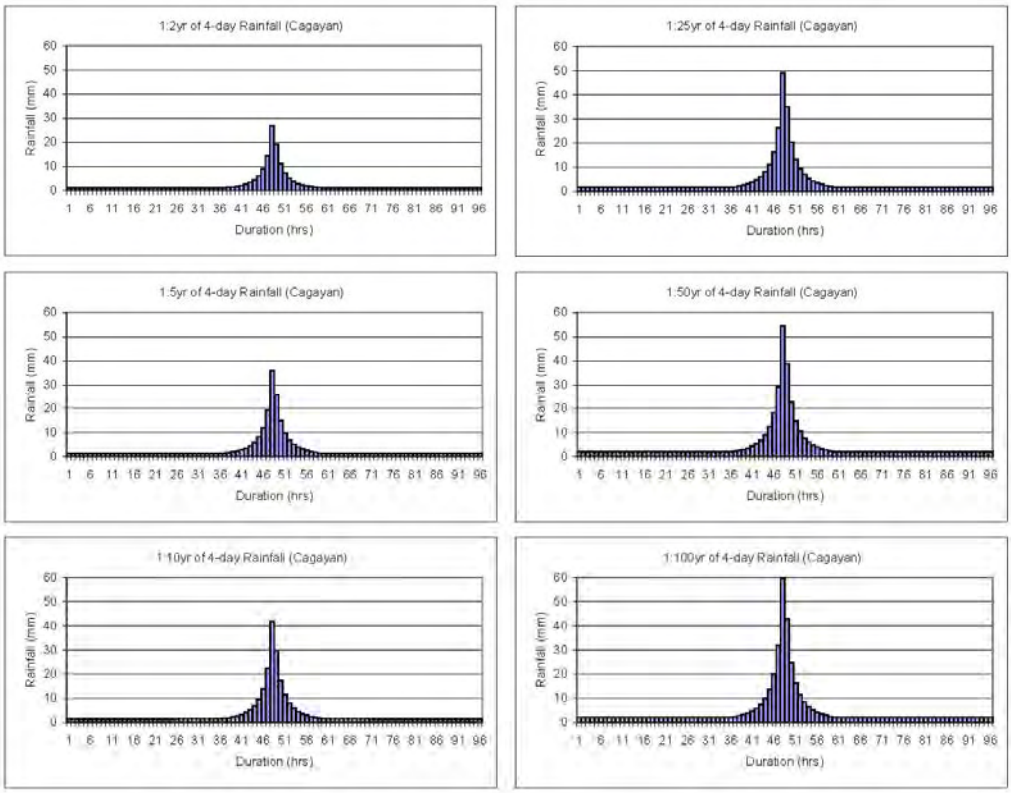


Figure R 10.8 Future Design Probable Hyetograph (A1FI-2100 Scenario) Cagayan River Basin

Increase in Future Sea Level due to Temperature Rise

The IPCC confirmed the global tendency in rise of sea level from the 19th to 20th century and estimated that the global average rate of sea level rises over 1961 to 2003 was about 1.8mm per year, while the rate was faster over 1993 to 2003: about 3.1 mm per year.

The IPCC further projected that the average sea level over 2090-2099 would rise by about 0.38cm at the maximum as compared with the average over 1980-2000 under the B1 Scenario and/or about 0.59cm under the A1FI Scenario as shown in Figure 10.9 and Table 10.5.

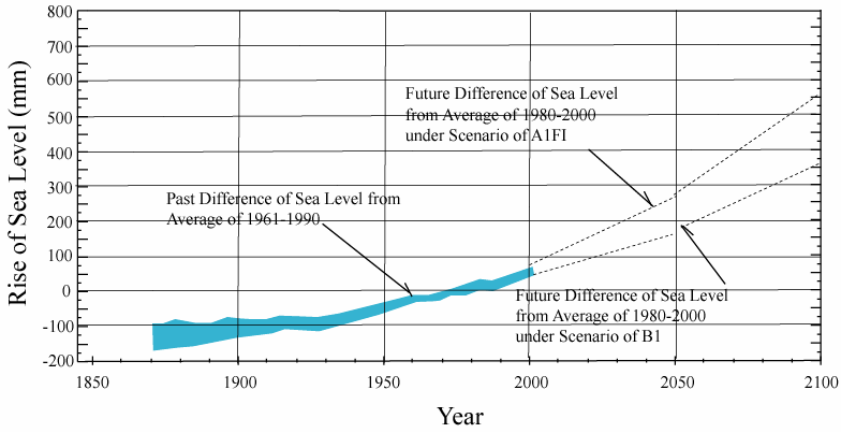


Figure R 10.9 Future Global Sea Level Rise

Table R 10.5 Future Global Sea Level Rise

Sea Rise (m)			Min	Max
A1FI	2050		0.13	0.29
	2100		0.26	0.59
B1	2050		0.09	0.19
	2100		0.18	0.38

The trends in monthly sea levels at Manila South Harbor where the long-term sea level records are available for the Philippines show that sea level has kept rising since 1996 up to the present. However, there is no constant increasing or decreasing trend in long term and the astronomical tide with a period of 19 years is deemed to be more predominant. In addition, datum planes had been adjusted at Manila South Harbor due to relocation of tidal gauge and land subsidence effect according to NAMRIA as of 2006.

Therefore, it is difficult to conclude that sea level at Manila Bay has been rising due to global warming based on the available historical records. Nevertheless, there is a high confidence that the sea level would rise in a long-term rage due primarily to thermal expansion of the oceans and melting of glaciers and ice caps as projected by IPCC.

Hydrologic Process

Determination of the future probable design flood runoff discharges for each of the Project Areas with the consideration of the adopted climatic change scenarios are made by superimposing and routing the respective future probable design hyetograph earlier presented through the respective Project Areas' catchment. The resulting hydrographs for each of the catchment for return period of 25-yr and 50-yr are shown in Figures 10.10 to 10.11.

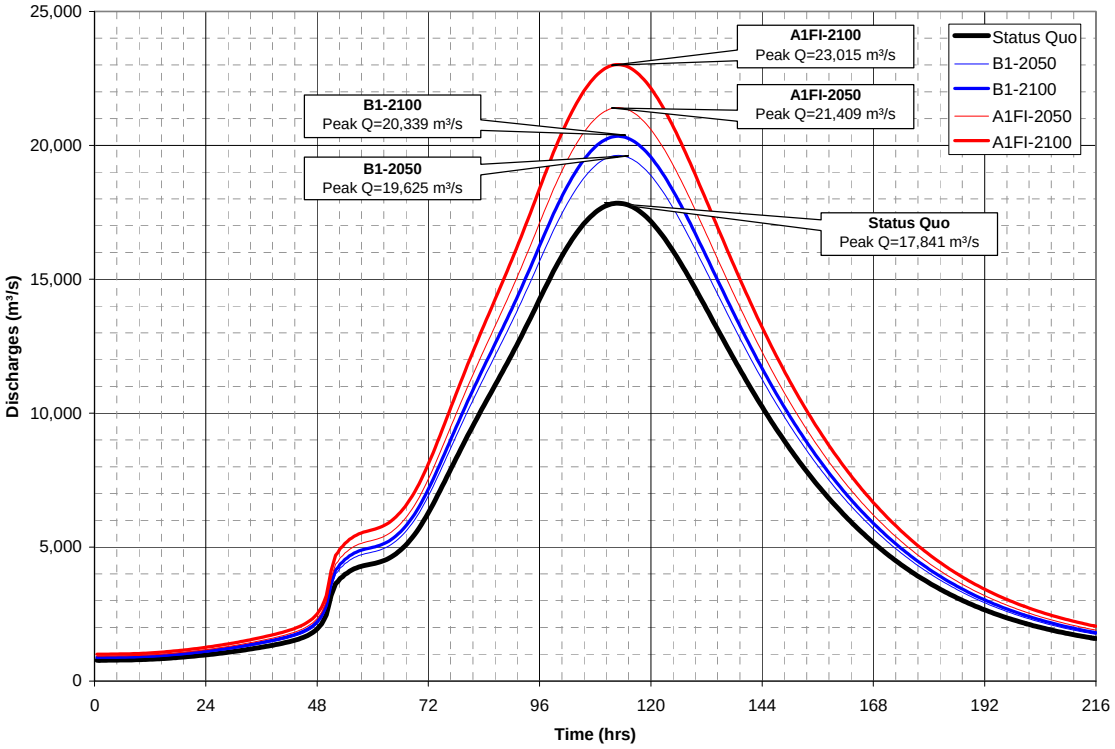


Figure R 10.10 Future 25-yr Probable Design Hydrographs Cagayan River Basin

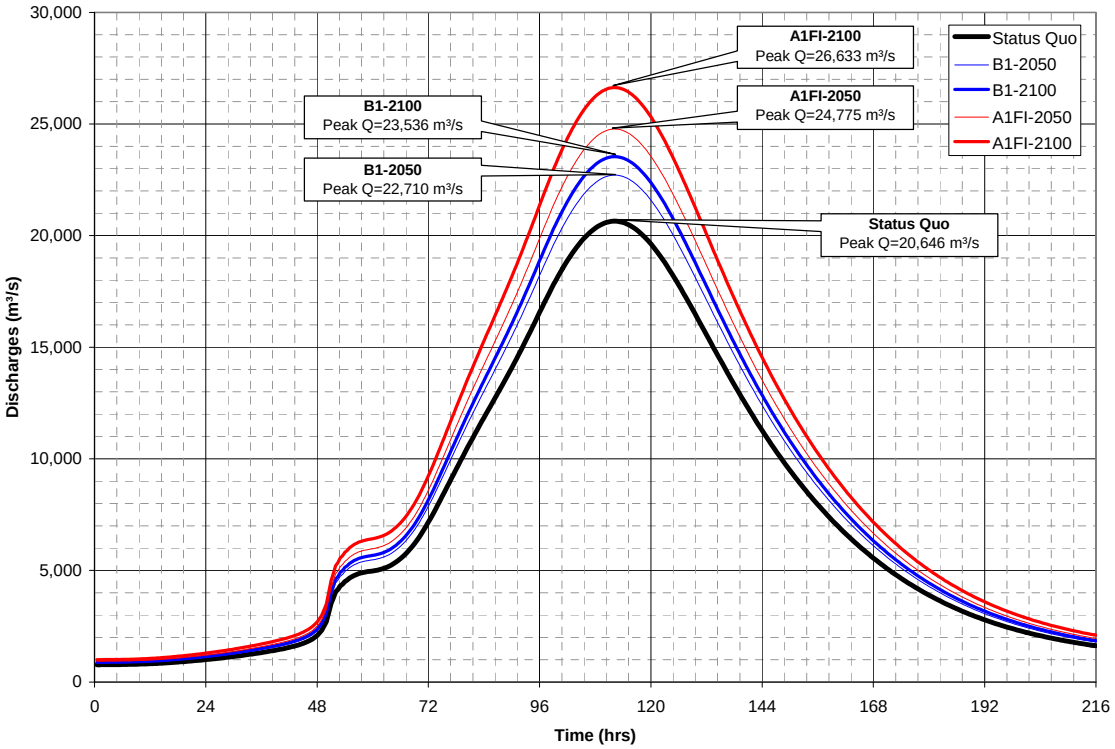


Figure R 10.11 Future 50-yr Probable Design Hydrographs Cagayan River Basin

10.2 IMPACT ON FLOOD MITIGATION PLAN

Based on the flood runoff computation as presented in the preceding section, the computed probable peak discharges and safety levels in return period would be changed in line with global warming. The following table summarizes the changes of probable discharge in 25-year and 50-year. Flood discharge would increase by 10 to 20 % in 2050 and by 14 to 29 % in 2100. Those increases of probable flood discharges are illustrated in Figure 10.12.

As a result of the above increscent effects of flood discharge, the safety level of flood control structures would decrease in line with the progress of global warming. Those effects are presented in Figure 10.13. The safety level of 25-year is likely to decrease to 15- to 19-year in 2050 and to 11- to 17-year in 2100.

Table R 10.6 Computed Probable Flood Discharges in Line with Global Warming

Table 10.6

Return Period (Status Quo)	Year	Global Warming Scenario	
		B1	A1FI
25-year (17,840)	2050	19,800	21,410
	2100	20,340	23,010
50-year (20,650)	2050	22,920	24,770
	2100	23,540	26,630

unit: m^3/s

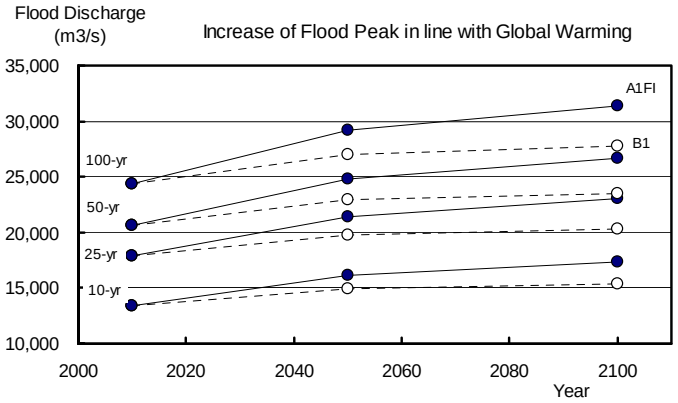


Figure R 10.12 Increase of Probable Flood Peak Discharge in Line with Global Warming

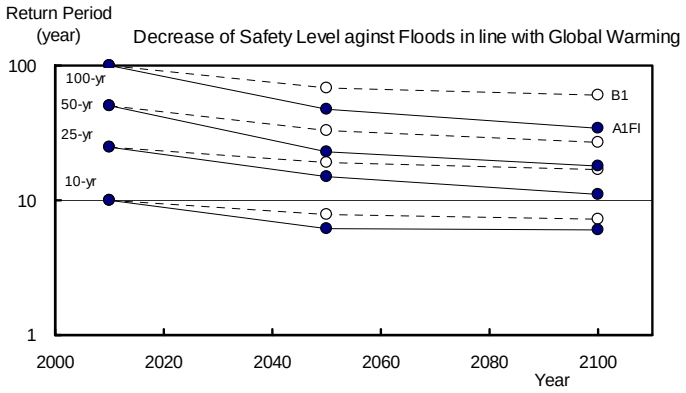


Figure R 10.13 Decrease of Safety Levels in Return Period in Line with Global Warming

10.3 CONCEIVED MITIGATION MEASURES AGAINST CLIMATE CHANGE

The global warming in climate change would have intensive impacts on flood control measures to be taken in the future. The process of global warming, however, still contains considerable uncertainty in scientific fields. Thus the mitigation measures shall be formulated with careful deliberation on decrease of secured safety level in temporal process and scientific progress in climate change. The basic concept of mitigation measures against hydrological effects in climate change could be summarized below. The concept of future program is depicted in Figure 10.14.

(1) After implementation of urgent flood control measures

After implementation of the urgent flood control measures, the secured safety level would decrease gradually in line with global warming. In this period, the following measures shall be taken until the effects of climate change will be clarified in a scientific manner, and the flood mitigation and management master plan shall be revised through incorporating the effects of climate change.

- Establishment and strengthening of meteo-hydrological monitoring system,
- Strengthening of early warning dissemination system through PABC flood forecasting system,
- Establishment and improvement of flood preparedness and emergency response plan in each local level, city, municipality and barangay, and
- Strengthening of land use plan or control in due consideration of flooding situation and future flood mitigation measures.

(2) Formulation of future master plan for flood risk management

The future flood mitigation and management plan shall be formulated on the basis of predicted effects of future climate change. To cope with increase of flood discharge due to climate change, the increment of reservoir capacity might be considered when the proposed dam for flood mitigation proposed in 2002 F/S as long-term or frame work plan. The consideration of heightening of flood protection dike shall be adopted at the last second in the plan of detailed engineering study for the climate change adaptation.

CHAPTER 11 CONCLUSION AND RECOMMENDATIONS

11.1 Selection of Optimum Flood Mitigation Plan

The alternative structural flood mitigation plans and the potential non-structural flood mitigation measures have been examined in Chapters 7 and 8. Socio-economic considerations on the structural flood mitigation plans were further made in Chapter 9. In addition, Chapter 10 delineates the measures for climate change adaptation in progress. Based on the results of those examinations, the optimum flood mitigation plan in the Sector Loan Project is as summarized below.

11.1.1 Proposed Structural Flood Mitigation Plan

(1) Summary of Structural Scheme to be Implemented under the Sector Loan

In the 2002 F/S, four (4) major flood control works have been proposed for the Lower Cagayan River Flood Control Project, namely 1) bank protection works; 2) dikes including maintenance roads and tree zones; 3) cut-off channels; and 4) related river structures such as culverts and sluices. The structural flood control measures were planned to be implemented in four (4) phases starting from the year 2002 up to the target year 2020, from the river mouth toward upstream.

In this connection, Tuguegarao and its suburban area, which is Phase IV in the said 2002 F/S, have been proposed as the core areas to be protected with flood control works under the Sector Loan Project, because Tuguegarao City as the provincial capital and the suburban municipality of Enrile are essential to the development of regional economy in Cagayan Province.

However, the implementation of structural measures against a 25-year return period flood is not applicable for funding under the Sector Loan because the construction cost of the project is estimated to exceed 6 billion pesos. Although the project will be effective and the urgency has been recognized, it is concluded that such a huge project could not be covered by the Sector Loan.

Therefore, erosion prevention measures for the most critical erosion areas, namely Alibago, Enrile and Cataggaman, have been selected as the viable structural measures for the Cagayan River Basin in the Sector Loan Project.

The main features and estimated costs of the erosion prevention works are as summarized below:

Table R 11.1 Summary of Sector Loan Project Components Proposed for Cagayan River Basin

Contents of Project	Quantity	Purpose of Project
Revetment at Alibago Area	L=900m	Erosion and Scouring Control
Revetment at Enrile Area	L=800m	Erosion and Scouring Control
Revetment at Cataggaman Area	L=1,400m	Erosion and Scouring Control

Table R 11.2 Summary of Sector Loan Project Cost Proposed for Cagayan River Basin

Major Items	Cost Items	Estimated Costs (Million Pesos)	Remarks
Cost Applicable for Loan	Construction Base	1,871	
	D/D & S/V	299	Construction Term:
	Contingencies	528	2012-2015
Sub-Total (1)		2,698	
Cost Not Applicable for Loan	Compensation	20	Houses and Lots
	Administration	95	DPWH and LGUs
	Contingencies	26	
	VAT & Tax	324	
Sub-Total (2)		465	
Total		3,163	
O&M		5.31	
EIRR		17.50%	

(2) Concerns in Project Implementation

The concerns in project implementation are as follows:

(a) Natural and Social Environmental Impact Evaluation

The erosion mitigation structural measure (revetment) proposed in this Study would require the relocation of several families and DENR had recommended the preparation of a relocation action plan (RAP) even though the number of resettlement is quite small. In view thereof, the RAP has to be formulated and implemented in accordance with "The Land Acquisition, Resettlement and Indigenous Peoples Policy of the Department of Public Works and Highways (DPWH)."

To execute the RAP, "Census Survey-cum-Structure Tagging (C/T)" shall be performed to identify the PAPs and to prevent illegal settlers from encroaching to the project site. Preparation of the RAP for Cagayan together with the other two candidate river basins (Ilog-Hilabangan and Tagoloan) will require six (6) months, at least, prior to project implementation.

(b) Erosion and Scouring Issues in Progress

Erosion and scouring by floodwater has been going on at the proposed three (3) critical erosion sites even during the study period. However, it may take two (2) years before the project is commenced assuming that the L/A is concluded, and during these two years the erosion and scouring is expected to further aggravate. In this connection, the related agencies, DPWH and LGUs, are required to monitor the progress of erosion and scouring activities.

11.1.2 Proposed Non-Structural Measures

Based on the measures proposed in the 2002 F/S and the current status and activities in the Cagayan River Basin described in Chapter 8, the following community-based non-structural measures are proposed in parallel with the structural measures:

- Identification of Necessary Preparedness Plan and FEWS

- Establishment of Hazard Map and Preparedness Plan, and
- Revision/Modification of Land Use/Development Plan

In connection with the execution of the proposed measures mentioned above, proposed is a Technical Assistant Activity to support and enhance the capacity of related agencies, such as DPWH, OCD and PAGASA, in parallel with and as one sphere of implementation of the Sector Loan.

The main contents in proposed T/A are as follows:

- Establishment of Early Flood Warning System utilizing the Basin Flood Forecasting System.
- Preparation of Flood Hazard Map with the participation of Residents, including dry run and map exercises in flood vulnerable areas.

11.1.3 Climate Change Adaptation

Tuguegarao City and the suburban area are located at the midstream (Sta. 120K from the river mouth) of the Cagayan River. The flood mitigation plan formulated in the 1987 M/P was proposed as a part of the Integrated Water Resources Development Plan in which the proposed sectors involved the construction of dam, watershed management, establishment of flood forecasting and warning system, irrigation development and the erosion control proposed in the Sector Loan, as well as flood control.

The integrated scheme did not consider the adverse effects of climate change. Therefore, a more elaborate study on how the increment of design flood discharge will be absorbed is required based on detailed researches on every sector.

As explained in Chapter 10 in detail, the most realistic plan might be the increment of capacity of the flood control dams proposed in long-term plan in the M/P. However, raising the elevation of the flood protection dike as proposed in the 1987 M/P and the 2002 F/S is recommended presupposing that there is no room to accept the additional flood control capacity in the other measures. According to the results, flood discharge would increase by 10 to 20 % in 2050 and by 14 to 29 % in 2100. Therefore, it is recommended that the elevation of the proposed dike shall be raised to sufficiently confine the additional flood discharge. This countermeasure will be more acceptable than the other measures to the stakeholders because the raising of dike is quite limited to attract the adverse interest of the stakeholders.

In addition to the structural measures explained above, the following non-structural measures shall be applied to climate change adaptation. Actually, non-structural measures shall principally be considered for the adaptation to climate change regarding flood mitigation:

- Enlightenment Activities to Stakeholders regarding the Impact of Climate Change
- Strengthening of Flood Forecasting and Warning System

11.1.4 Support and Capacity Enhancement of Related Agency Activities

As proposed in the Main Report (Part I), the Sector Loan Project aims at not only flood damage mitigation in the target core areas but also at strengthening and enhancing the capacity of the related agencies such as DPWH, LGU, OCD and PAGASA. In this regard, it is proposed that the following T/As regarding support for non-structural activities and contribution to the betterment of O&M activities shall be executed in parallel with the implementation of the project.

(1) Assistance on Setup of Non-Structural Measures

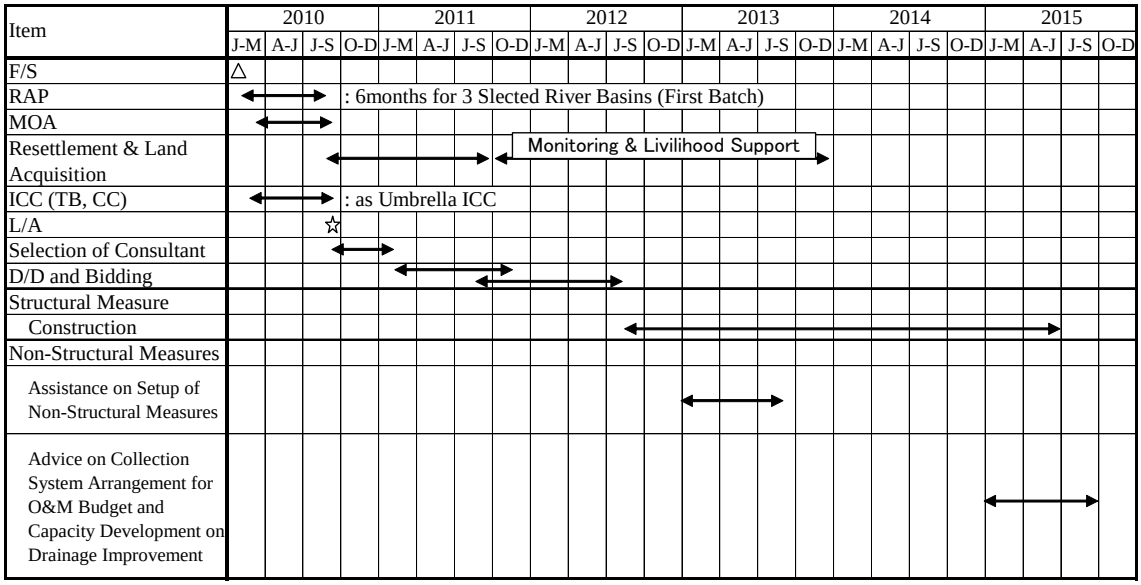
(2) Advice on Collection System Arrangement for the O&M Budget and Capacity Development for Drainage Improvement

The T/As mentioned above would contribute to the strengthening of the capacity for DRM of the Planning Service and FCSEC of DPWH, as well as OCD and PAGASA, and the enhancement of LGUs' activities regarding the DRM (Tuguegarao and Enrile)

11.2 Implementation Plan of the Project under Sector Loan

It is proposed that the revetment construction works at the three (3) critical erosion sites in/around Tuguegarao City proposed in this Study will be implemented as the First Batch in the Sector Loan Project. The estimated construction term is three (3) years during 2012-2015, as shown below:

Table R 11.3 Implementation Program of Cagayan River Basin Revetment Construction Works in the Sector Loan Project



TABLES

Table 2.1 Record of Standard Penetration Test

Depth (m)	Tuguegarao		
	TBH1 N	TBH2 N	TBH1 N
0.70 - 1.00			
1.70 - 2.00	10	14	11
2.70 - 3.00		22	9
3.70 - 4.00		16	11
4.70 - 5.00		14	13
5.70 - 6.00		11	14
6.70 - 7.00		13	15
7.70 - 8.00		17	17
8.70 - 9.00	20	13	20
9.70 -10.00	22		22
10.70 - 11.00	20	14	19
11.70 - 12.00	17	12	21
12.70 - 13.00	19	15	23
13.70 - 14.00	18	17	23
14.70 - 15.00	15	16	24
15.70 - 16.00	16	6	24
16.70 - 17.00	16	3	25
17.70 - 18.00	17	7	27
18.70 - 19.00	19	8	28
19.70 - 20.00	19	17	29

Table 2.2 Field Permeability Test Result (unit: cm/sec)

Depth (m)	NRB 2	Tuguegarao		
		TBH1	TBH2	TBH3
1	0.00E+00			0.00E+00
2	0.00E+00	2.19E-03		1.05E-04
3	0.00E+00			2.00E-04
4	0.00E+00			3.80E-04
5	0.00E+00			5.45E-04
6	3.80E-04		6.10E-05	3.63E-04
7	9.52E-04	1.52E-04	3.84E-04	3.80E-04
8	1.14E-03	7.90E-05	1.45E-03	4.00E-04
9	2.38E-03	7.90E-05	1.25E-03	1.05E-04
10	9.52E-04	5.50E-05	1.34E-03	1.24E-03
11	2.60E-03	7.10E-05	1.10E-03	1.77E-03
12	4.09E-03	5.40E-04	7.42E-04	1.39E-03
13	5.71E-03	3.40E-05	1.18E-03	1.80E-03
14	9.04E-03	6.90E-05	8.88E-04	1.78E-03
15	8.76E-03	1.36E-04	4.44E-04	2.50E-03
16	7.84E-03	4.50E-05	4.00E-04	2.40E-03
17	7.59E-03	6.80E-05	1.15E-03	2.90E-03
18	7.29E-03	7.40E-05	4.12E-04	2.40E-03
19	7.13E-03	5.40E-05	3.52E-04	3.20E-03
20	7.15E-03	7.40E-05	3.19E-04	3.22E-03

Table 2.3 Summary of Laboratory Test on Undisturbed Samples taken fron Bore Hole

LOCATION	Boring No.	Depth (m)	Gs	Gradation			Consistency			NMC	Consolidation			Unconfined Compression		Triaxial Compression			
																UU		CU	
				Gravel %	Sand %	Silt/Clay %	LL %	PL %	PI %	(%)	e_0	Pc (kPa)	Cc	e_f (%)	q_u (kPa)	C_{uu} (kPa)	$Ø_{UU}$ (deg.)	c' (kPa)	Ø' (deg.)
Tuguegarao	TBH-1A	0.55 - 1.00	2.6	0	60	40	42	29	13	35	1.164	17.0	0.345	9.66	32.36	62	4		
	TBH-1B	1.50 - 2.00	2.57	0	88	12	NP			9	0.944	19.0	0.323						
	TBH-2A	5.50 - 6.00	2.68	3	3	94	65	29	36	49	1.322	12.5	0.363	16.78	17.02	70	2		
	TBH-2B	9.50 - 10.00	2.65	0	1	99	70	30	40	54	1.321	13.0	0.389	9.86	33.73	74	3		
	TBH-3A	0.55 - 1.00	2.69	0	3	97	59	35	24	37	1.158	12.5	0.363	10.50	31.41	80	2	44	27
	TBH-3B	1.50 - 2.00	2.72	0	2	98	67	28	37	34	0.722	16.5	0.231	9.06	45.82	72	4		

Table 2.4 Summary of Laboratory Test on Embankment Material

Boring No.	Depth (m)	Gs	Gradation			Consistency			NMC	Proctor		Triaxial Compression			
												UU		CU	
			Gravel (%)	Sand (%)	silt/clay (%)	LL (%)	PL (%)	PI (%)	%	OMC %	MDD (t/m³)	c (kPa)	Ø (deg.)	c' (kPa)	Ø' (deg.)
TPT-1	0.00 - 3.00	2.763	0	3	97	45	29	16	37	25.0	1.53	100	13	130	21
TPT-2	0.00 - 3.00	2.791	0	8	92	NP	NP	NP	25	20.0	1.57	92	13	52	35
TPT-3	0.00 - 3.00	2.773	0	3	97	67	21	46	32	25.5	1.45	81	11	60	30
TPT-4	0.00 - 3.00	2.875	18	19	63	39	23	16	14	19.0	1.67	76	14	45	37
TPT-5	0.00 - 3.00	2.665	0	1	99	76	27	49	35	26.0	1.33	90	5	71	26
TPT-6	0.00 - 3.00	2.797	8	35	56	67	29	38	29	23.0	1.42	95	10	60	31
TPC-1	1.85 - 3.00	2.667	2	27	71	38	16	22	19	17.0	1.74	70	20	70	27
TPC-2	0.00 - 1.70	2.665	0	47	53	NP	NP	NP	15	15.0	1.78	68	16	37	38
TPC-2	1.70 - 3.00	2.654								15.0	1.66				
TPC-3	0.00 - 3.00	7.779	0	1	99	51	25	26	38	26.0	1.47	78	12	57	32
TPC-4	0.00 - 3.00	2.703	11	28	61	40	20	20	15	18.5	1.68	87	13	40	36
TPC-5	0.00 - 3.00	2.706	0	28	72	38	17	21	22	16.0	1.65	87	11	38	33
TPC-6	0.00 - 3.00	2.743	0	3	97	51	22	29	31	25.0	1.43	100	10	35	33

Table 2.5 Summary of Meteorological Record

Rainfall (mm)

Station	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Amout
Aparri	1951-85	134.4	75.2	45.4	35.3	99.4	175.2	183.5	226.5	286.8	345.2	397.6	210.8	2,215.3
APC, Iguig	1981-99	27.6	16.1	18.7	42.5	153.0	161.0	225.2	267.1	232.5	346.8	180.0	133.1	1,803.6
Lal-lo	1972-84	125.0	56.1	29.5	55.5	162.3	145.9	171.2	275.0	197.7	310.3	349.1	197.2	2,074.8
Bitag Grande	1975-80	85.5	21.0	28.9	27.4	212.6	118.3	313.0	199.9	548.7	214.2	286.3	141.2	2,197.0
Tuao	1956-85	29.4	24.3	31.2	63.3	171.0	195.4	214.8	232.2	175.1	246.7	230.8	96.9	1,711.1
Tuguegarao	1949-85	18.7	14.5	30.2	49.1	113.1	155.2	195.5	234.5	202.2	248.5	276.4	94.7	1,632.6
Pinukpuk	1970-81	83.7	26.0	58.4	75.8	203.8	233.6	263.2	322.3	212.7	365.5	364.2	189.2	2,398.4
Naneng	1956-85	38.3	28.1	51.4	72.9	208.0	271.8	285.4	337.8	288.7	298.2	299.2	94.9	2,274.7
Guilguila	1963-80	122.7	56.1	61.7	77.0	215.4	321.8	329.1	284.7	312.9	318.5	375.9	237.2	2,713.0
Lubuagan	1969-78	62.6	32.8	65.2	51.2	147.7	224.6	213.1	236.5	210.8	237.2	275.0	155.4	1,912.1
Basao	1963-75	95.6	27.2	70.6	114.8	288.8	422.0	382.0	341.4	314.9	312.6	439.8	271.5	3,081.2
Ilagan	1965-84	59.1	20.9	32.3	62.6	155.4	172.8	144.7	186.0	172.2	291.1	315.9	191.1	1,804.1
Banga-an	1963-78	27.2	7.6	22	78.8	218.7	274.8	302.4	375.6	274.5	148.8	115.3	26.4	1,872.1
Bontoc	1963-85	17.9	11.9	46.6	127.6	263.8	294.5	390.5	267.9	302.8	204.8	152.5	54.4	2,135.2
Barlig	1963-85	134.4	41.0	92.9	95.2	309.7	402.6	394.7	411.6	372.1	407.8	499.5	326.3	3,487.8
Bauko	1963-80	6.5	7.5	43.8	169.1	284.5	304.8	371.0	421.4	313.4	188.7	67.9	54.4	2,233.0
Mt. Polis	1963-80	160.4	134.0	110.1	157.7	337.3	457.1	516.8	553.5	453.0	378.1	370.9	246.6	3,875.5
Mt. Data	1950-78	27.2	25.0	74.6	187.9	357.0	413.5	619.4	563.3	465.2	296.3	220.4	78.2	3,328.0
Lagawe	1968-82	176.0	88.5	65.2	190.1	171.3	265.0	362.0	319.9	341.4	331.6	394.3	146.3	2,851.6
Nayon	1968-80	63.4	25.5	69.9	89.5	217.2	200.4	207.8	243.6	220.4	240.2	185.7	99.3	1,862.9
Echague	1976-86	17.5	9.1	18.2	91.7	114.5	97.1	148.8	259.9	189.6	272.8	128.0	142.3	1,489.5
Diadi	1968-71	54.2	16.3	49.9	54.4	173.0	239.2	275.8	192.4	211.4	399.6	280.0	153.3	2,099.5
Barat	1968-80	23.8	10.1	35.8	90.0	226.7	224.8	271.4	323.1	302.7	337.8	156.4	104.9	2,107.5
Consuelo	1956-85	33.5	18.0	44	70.9	221.5	252.6	380.4	331.0	325.5	263.9	211.8	60.5	2,213.6
Gabong	1972-52	38.6	13.0	25.5	33.4	128.5	179.9	251.5	216.7	229.0	230.0	284.9	90.3	1,721.3
Dakgan	1972-82	18.4	11.3	29.8	23.1	134.5	158.8	234.2	176.5	216.5	273.1	274.6	68.9	1,619.7
Casiguran	1961-84	234.2	113.8	176.5	136.3	242.3	229.4	284.7	251.9	592.5	421.7	628.8	402.9	3,715.0
Wacal	1980-85	36.8	19.6	112.2	160.7	174.1	107.5	255.5	201.4	183.2	259.9	141.4	50.4	1,702.7
Banti	1980-85	33.7	12.4	17.9	71.4	102.7	86.6	133.0	169.9	224.6	177.9	78.9	34.7	1,143.7
Dippadiw	1980-83	185.8	19.7	53.2	27.2	190.1	59.7	245.8	239.2	181.1	249.7	458.1	299.5	2,209.1
San Francisco	1975-80	122.8	138.2	47	41.8	146.3	82.3	143.1	143.4	153.9	328.3	209.8	171.7	1,728.6
NIA Cabarroguis	1982-85	54.2	7.7	52	95.5	170.3	185.8	96.0	187.8	124.2	159.2	121.0	117.5	1,371.2
Hapid	1976-85	15.4	21.7	42.8	115.2	222.5	167.9	209.4	173.7	241.4	213.4	109.4	29.9	1,562.7
Baretbet	1977-95	21.1	12.5	58.9	128.1	262.7	184.7	231.4	194.9	254.4	250.8	125.1	49.4	1,774.0
Baligatan	1976-85	29.4	10.7	37.6	98.7	206.8	177.0	234.2	213.1	231.0	202.9	125.1	50.9	1,617.4
Pobacion Lagawe	1976-85	44.9	37.5	62.7	117.9	240.1	183.3	284.8	267.4	230.1	250.7	136.3	64.3	1,920.0
Sto. Domingo	1976-85	28.6	14.6	29.7	115.3	113.9	161.7	193.5	157.3	232.7	245.3	116.3	44.8	1,453.7
Kasibu	1978-85	52.5	44.4	86	189.8	260.1	221.3	223.1	234.9	259.6	555.6	398.4	132.1	2,657.8
Kamamasi	1978-85	183.1	55.5	111.5	158.7	279.0	187.7	325.4	216.4	401.2	521.3	505.7	306.7	3,252.2
Alayan	1978-85	112.1	42.4	60.1	191.4	229.6	170.4	253.8	200.3	375.2	535.9	475.1	268.3	2,914.6
Packet	1979-84	45.4	30.5	75.2	126.2	261.3	171.9	259.5	187.3	335.8	231.5	277.7	201.8	2,204.1

Mean air temperature

Station	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Aparri	1951-85	23.1	23.8	25.3	27.1	28.3	28.5	28.3	27.9	27.6	26.8	25.4	23.8	26.3
Tuguegarao	1951-83	23.1	24.1	26.1	28.2	29.0	28.6	28.0	27.7	27.3	26.3	24.8	23.5	26.4
Echague	1981-84	21.5	22.7	24.5	26.1	26.9	27.6	26.8	26.6	26.3	25.3	24.2	22.2	25.1

Mean Maximum air temperature

Station	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Echague	1980-97	27.1	29.4	32.3	34.5	34.9	34.4	33.2	33.3	32.2	31.5	29.5	27.2	31.6
APC, Iguig	1981-99	28.1	29.8	32.9	35.3	36.5	35.7	34.5	33.9	33.2	31.5	29.6	27.6	32.4
Aparri	1951-85	26.3	27.6	29.6	31.6	33.3	33.5	32.9	32.4	31.6	30.2	28.3	26.8	30.3
Tuguegarao	1951-83	29.2	31.2	33.8	35.9	36.8	35.7	34.9	34.2	33.6	32.2	30.1	28.8	33.0
Malasin	1976-80	27.2	27.4	30.2	32.8	32.9	31.9	31.5	31.3	30.9	29.0	27.0	26.0	29.8
San Isidro	1976-80	27.3	28.2	30.6	33.1	33.0	31.9	31.7	31.6	31.3	29.2	27.3	26.2	30.1
Lagawe	1981-84	29.1	29.0	28.9	28.8	29.7	30.2	29.7	29.9	29.7	29.7	29.6	28.4	29.4
Hapid	1981-84	23.7	24.6	25.7	27.3	28.5	28.2	27.7	26.8	28.2	26.7	25.5	23.0	26.3
Baretbet	1981-84	26.1	28.2	31.2	31.0	30.1	29.9	29.1	28.8	29.8	28.4	27.8	25.9	28.9
Consuelo	1981-84	25.5	28.7	30.3	30.9	31.7	31.1	29.2	27.6	28.6	27.4	27.1	24.8	28.6
Sto. Domingo	1981-84	27.7	29.1	28.9	31.0	32.2	32.7	31.9	30.1	30.0	29.4	30.1	27.2	30.0

Table 5.1(1/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
0.0	749.28	26.28	749.28	26.28	749.28	26.28	749.28	26.28	749.28	26.28	749.28	26.28
0.5	749.72	26.28	749.81	26.28	749.87	26.28	749.93	26.28	749.98	26.28	750.02	26.28
1.0	750.67	26.28	750.99	26.28	751.15	26.28	751.35	26.28	751.51	26.28	751.64	26.28
1.5	751.37	26.28	751.85	26.28	752.10	26.28	752.40	26.28	752.65	26.28	752.84	26.28
2.0	751.96	26.28	752.58	26.28	752.91	26.28	753.30	26.28	753.62	26.28	753.86	26.28
2.5	752.47	26.28	753.22	26.28	753.62	26.28	754.09	26.28	754.47	26.28	754.77	26.28
3.0	752.93	26.28	753.79	26.28	754.25	26.28	754.80	26.28	755.24	26.28	755.58	26.28
3.5	753.35	26.29	754.31	26.30	754.82	26.31	755.44	26.32	755.93	26.33	756.32	26.33
4.0	753.72	26.34	754.78	26.38	755.35	26.41	756.02	26.45	756.57	26.48	756.99	26.51
4.5	754.06	26.42	755.21	26.52	755.82	26.58	756.57	26.67	757.16	26.75	757.62	26.82
5.0	754.40	26.54	755.63	26.71	756.29	26.83	757.09	26.99	757.73	27.14	758.23	27.27
5.5	754.73	26.69	756.07	26.97	756.79	27.16	757.65	27.42	758.35	27.66	758.89	27.86
6.0	755.09	26.88	756.55	27.30	757.34	27.57	758.29	27.95	759.07	28.29	759.67	28.59
6.5	755.49	27.11	757.10	27.68	757.98	28.06	759.03	28.58	759.90	29.05	760.58	29.46
7.0	755.94	27.38	757.73	28.13	758.71	28.62	759.89	29.31	760.88	29.93	761.65	30.47
7.5	756.45	27.69	758.45	28.64	759.54	29.27	760.90	30.14	762.02	30.93	762.90	31.61
8.0	757.02	28.03	759.26	29.21	760.51	29.99	762.05	31.07	763.33	32.05	764.35	32.89
8.5	757.67	28.41	760.18	29.85	761.60	30.79	763.36	32.09	764.82	33.28	765.99	34.29
9.0	758.39	28.83	761.22	30.54	762.82	31.66	764.82	33.21	766.51	34.62	767.84	35.82
9.5	759.17	29.29	762.36	31.29	764.18	32.60	766.46	34.41	768.38	36.06	769.92	37.46
10.0	760.03	29.78	763.61	32.10	765.67	33.61	768.25	35.70	770.44	37.60	772.19	39.21
10.5	760.98	30.30	764.99	32.96	767.30	34.69	770.21	37.07	772.69	39.24	774.67	41.07
11.0	761.99	30.86	766.47	33.87	769.06	35.83	772.33	38.51	775.12	40.96	777.36	43.02
11.5	763.10	31.45	768.08	34.83	770.97	37.03	774.63	40.03	777.76	42.76	780.28	45.06
12.0	764.30	32.07	769.83	35.84	773.04	38.28	777.13	41.61	780.61	44.63	783.41	47.17
12.5	765.61	32.72	771.73	36.89	775.29	39.58	779.82	43.26	783.69	46.58	786.81	49.37
13.0	767.05	33.40	773.78	37.98	777.72	40.94	782.73	44.95	787.01	48.58	790.47	51.62
13.5	768.60	34.10	776.00	39.11	780.34	42.33	785.86	46.70	790.58	50.64	794.40	53.93
14.0	770.27	34.84	778.40	40.28	783.15	43.77	789.22	48.49	794.40	52.74	798.59	56.29
14.5	772.07	35.59	780.96	41.48	786.17	45.24	792.80	50.32	798.47	54.88	803.05	58.68
15.0	774.01	36.37	783.70	42.71	789.37	46.75	796.61	52.19	802.79	57.06	807.78	61.11
15.5	776.06	37.18	786.60	43.96	792.77	48.28	800.65	54.08	807.36	59.26	812.79	63.56
16.0	778.26	38.00	789.68	45.24	796.38	49.83	804.91	55.99	812.17	61.48	818.05	66.03
16.5	780.58	38.84	792.93	46.54	800.16	51.41	809.39	57.92	817.22	63.71	823.58	68.50
17.0	783.03	39.69	796.35	47.86	804.15	53.00	814.08	59.87	822.51	65.95	829.35	70.98
17.5	785.60	40.56	799.92	49.19	808.31	54.61	818.98	61.82	828.04	68.19	835.38	73.45
18.0	788.30	41.44	803.66	50.53	812.65	56.22	824.10	63.77	833.78	70.43	841.65	75.91
18.5	791.11	42.34	807.55	51.88	817.18	57.84	829.42	65.72	839.76	72.66	848.17	78.36
19.0	794.05	43.25	811.61	53.24	821.88	59.46	834.94	67.67	845.96	74.87	854.92	80.78
19.5	797.10	44.16	815.82	54.60	826.76	61.08	840.67	69.60	852.37	77.06	861.91	83.17
20.0	800.28	45.08	820.17	55.97	831.81	62.69	846.60	71.52	859.00	79.23	869.14	85.54
20.5	803.56	46.01	824.68	57.33	837.03	64.30	852.72	73.42	865.85	81.38	876.60	87.86
21.0	806.97	46.94	829.34	58.69	842.42	65.90	859.04	75.31	872.92	83.49	884.31	90.15
21.5	810.48	47.87	834.14	60.04	847.99	67.48	865.57	77.17	880.21	85.57	892.25	92.40
22.0	814.11	48.81	839.10	61.39	853.73	69.05	872.30	79.00	887.72	87.61	900.44	94.60
22.5	817.85	49.75	844.21	62.72	859.64	70.60	879.23	80.80	895.47	89.62	908.88	96.75
23.0	821.71	50.68	849.48	64.05	865.73	72.13	886.38	82.58	903.43	91.58	917.57	98.85
23.5	825.68	51.61	854.89	65.36	872.01	73.64	893.74	84.32	911.64	93.50	926.54	100.90
24.0	829.76	52.54	860.47	66.65	878.47	75.13	901.32	86.03	920.10	95.37	935.76	102.90
24.5	833.97	53.46	866.20	67.93	885.11	76.59	909.13	87.70	928.81	97.20	945.28	104.84
25.0	838.29	54.38	872.10	69.19	891.96	78.03	917.17	89.33	937.77	98.98	955.08	106.73
25.5	842.74	55.29	878.15	70.43	898.99	79.44	925.44	90.93	947.00	100.71	965.18	108.56
26.0	847.31	56.20	884.39	71.66	906.23	80.82	933.96	92.48	956.51	102.40	975.59	110.33
26.5	852.01	57.09	890.81	72.86	913.68	82.17	942.75	94.00	966.32	104.03	986.32	112.05
27.0	856.83	57.98	897.39	74.04	921.34	83.49	951.79	95.47	976.40	105.62	997.37	113.71
27.5	861.79	58.86	904.16	75.20	929.22	84.78	961.08	96.91	986.77	107.15	1008.76	115.31
28.0	866.87	59.72	911.11	76.33	937.31	86.04	970.64	98.30	997.44	108.64	1020.48	116.86
28.5	872.07	60.58	918.23	77.44	945.62	87.27	980.47	99.65	1008.42	110.08	1032.55	118.36
29.0	877.41	61.46	925.54	78.58	954.15	88.54	990.57	101.05	1019.71	111.57	1044.95	119.91

Table 5.1(2/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
29.5	882.89	62.33	933.03	79.70	962.90	89.78	1000.96	102.41	1031.30	113.01	1057.71	121.41
30.0	888.49	63.18	940.71	80.80	971.89	90.98	1011.61	103.73	1043.21	114.40	1070.83	122.86
30.5	894.22	64.02	948.60	81.86	981.11	92.15	1022.56	105.00	1055.45	115.75	1084.32	124.24
31.0	900.11	64.85	956.67	82.90	990.56	93.28	1033.80	106.23	1068.03	117.04	1098.19	125.58
31.5	906.12	65.66	964.95	83.92	1000.26	94.39	1045.34	107.42	1080.93	118.29	1112.43	126.86
32.0	912.28	66.46	973.42	84.91	1010.19	95.45	1057.16	108.57	1094.18	119.48	1127.04	128.09
32.5	918.57	67.24	982.09	85.87	1020.37	96.49	1069.29	109.68	1107.75	120.64	1142.04	129.27
33.0	924.99	68.01	990.94	86.80	1030.77	97.50	1081.70	110.74	1121.66	121.74	1157.40	130.40
33.5	931.56	68.76	1000.00	87.71	1041.42	98.47	1094.40	111.77	1135.88	122.81	1173.13	131.48
34.0	938.25	69.49	1009.24	88.60	1052.29	99.41	1107.39	112.77	1150.43	123.83	1189.23	132.52
34.5	945.08	70.21	1018.68	89.45	1063.39	100.32	1120.66	113.72	1165.30	124.81	1205.68	133.51
35.0	952.05	70.92	1028.30	90.29	1074.73	101.20	1134.21	114.64	1180.48	125.75	1222.49	134.46
35.5	959.14	71.61	1038.11	91.09	1086.28	102.05	1148.03	115.53	1195.98	126.65	1239.65	135.37
36.0	966.37	72.28	1048.11	91.87	1098.06	102.87	1162.14	116.37	1211.79	127.51	1257.17	136.24
36.5	973.74	72.93	1058.32	92.63	1110.10	103.66	1176.54	117.19	1227.94	128.34	1275.06	137.07
37.0	981.29	73.57	1068.75	93.36	1122.39	104.42	1191.26	117.98	1244.45	129.13	1293.35	137.86
37.5	989.02	74.20	1079.44	94.07	1134.98	105.16	1206.33	118.73	1261.33	129.89	1312.06	138.62
38.0	996.89	74.81	1090.33	94.76	1147.82	105.87	1221.69	119.45	1278.56	130.61	1331.14	139.34
38.5	1004.95	75.40	1101.46	95.42	1160.94	106.55	1237.39	120.14	1296.16	131.31	1350.64	140.03
39.0	1013.17	76.11	1112.82	96.27	1174.32	107.45	1253.40	121.11	1314.10	132.31	1370.52	141.07
39.5	1021.58	76.81	1124.42	97.08	1187.99	108.32	1269.76	122.03	1332.43	133.28	1390.83	142.06
40.0	1030.16	77.89	1136.26	98.49	1201.95	109.90	1286.45	123.83	1351.13	135.26	1411.54	144.18
40.5	1038.97	78.94	1148.41	99.85	1216.25	111.43	1303.54	125.56	1370.27	137.16	1432.74	146.22
41.0	1047.99	80.43	1160.83	101.88	1230.87	113.76	1321.02	128.26	1389.85	140.18	1454.42	149.49
41.5	1057.30	81.90	1173.63	103.85	1245.94	116.01	1339.02	130.87	1409.99	143.09	1476.73	152.65
42.0	1066.88	84.00	1186.82	106.78	1261.45	119.42	1357.54	134.89	1430.74	147.62	1499.68	157.60
42.5	1076.85	86.06	1200.52	109.64	1277.55	122.73	1376.75	138.78	1452.24	152.01	1523.46	162.38
43.0	1087.21	89.03	1214.74	113.86	1294.26	127.69	1396.67	144.66	1474.53	158.69	1548.11	169.71
43.5	1098.09	91.97	1229.66	118.00	1311.75	132.53	1417.50	150.40	1497.85	165.19	1573.88	176.82
44.0	1109.51	96.17	1245.30	124.05	1330.08	139.66	1439.31	158.92	1522.25	174.90	1600.81	187.49
44.5	1121.67	100.34	1261.91	130.01	1349.53	146.67	1462.41	167.26	1548.07	184.37	1629.30	197.89
45.0	1134.63	106.44	1279.57	138.85	1370.18	157.15	1486.91	179.82	1575.46	198.74	1659.49	213.70
45.5	1148.69	112.51	1298.70	147.62	1392.47	167.49	1513.30	192.18	1604.94	212.82	1691.92	229.18
46.0	1164.03	121.80	1319.50	161.22	1416.70	183.66	1541.89	211.64	1636.87	235.11	1727.01	253.77
46.5	1181.20	131.14	1342.66	174.79	1443.57	199.72	1573.54	230.89	1672.15	257.10	1765.71	277.97
47.0	1200.82	146.09	1368.97	196.85	1474.01	226.01	1609.22	262.63	1711.87	293.56	1809.18	318.24
47.5	1223.94	161.26	1399.78	219.02	1509.48	252.34	1650.63	294.27	1757.88	329.74	1859.38	358.10
48.0	1246.33	187.52	1429.94	258.04	1544.40	298.99	1691.60	350.78	1803.58	394.77	1917.90	430.06
48.5	1267.98	214.49	1459.52	297.69	1578.84	346.15	1732.31	407.55	1857.25	459.79	1986.88	501.72
49.0	1290.03	267.40	1489.99	376.84	1614.51	441.08	1779.45	522.91	1920.26	592.84	2051.36	649.17
49.5	1312.71	322.67	1521.77	458.42	1651.92	538.25	1834.77	639.99	1978.62	726.99	2114.00	797.06
50.0	1338.16	455.94	1557.65	659.28	1694.23	779.91	1892.39	934.60	2041.89	1067.55	2182.58	1175.04
50.5	1367.86	598.88	1599.85	870.44	1747.19	1031.31	1956.60	1237.24	2113.51	1413.86	2260.78	1556.40
51.0	1404.56	681.19	1652.23	982.08	1815.26	1158.15	2034.34	1381.42	2200.87	1571.17	2356.49	1750.97
51.5	1451.43	758.51	1719.30	1083.52	1898.19	1271.42	2131.78	1507.60	2310.96	1730.87	2477.69	1981.62
52.0	1510.65	760.60	1803.96	1068.64	2000.99	1243.46	2253.25	1466.74	2448.68	1703.08	2630.43	1974.01
52.5	1577.96	762.42	1899.71	1056.07	2115.75	1220.27	2389.04	1449.31	2603.34	1705.10	2806.50	1996.51
53.0	1649.20	731.59	2000.26	996.86	2235.28	1142.73	2530.49	1368.59	2767.99	1622.10	3000.48	1907.68
53.5	1720.15	705.14	2099.45	947.70	2352.20	1081.42	2670.13	1313.52	2935.42	1568.41	3200.94	1849.29
54.0	1787.59	665.11	2192.64	881.09	2461.30	1003.00	2803.91	1231.05	3098.47	1475.86	3396.75	1739.71
54.5	1850.07	630.87	2279.02	825.68	2560.51	941.77	2929.70	1169.84	3252.94	1407.23	3582.01	1656.36
55.0	1906.73	591.62	2357.59	764.88	2649.35	874.95	3045.73	1096.83	3395.69	1320.96	3752.49	1550.29
55.5	1957.47	557.90	2426.44	713.87	2728.59	821.78	3151.52	1039.90	3525.67	1252.99	3906.80	1465.30
56.0	2002.46	522.58	2486.49	661.80	2799.14	766.80	3247.08	977.14	3642.58	1176.18	4044.51	1369.65
56.5	2042.18	492.03	2538.62	617.65	2862.01	722.17	3333.06	926.38	3747.08	1113.36	4166.50	1290.71
57.0	2077.23	461.43	2583.92	574.16	2918.21	677.26	3410.32	872.81	3840.13	1046.37	4274.05	1207.32
57.5	2108.28	434.75	2623.44	537.05	2968.83	640.12	3479.93	828.26	3923.11	990.19	4368.92	1137.12
58.0	2136.11	408.72	2658.39	501.52	3015.03	603.45	3543.21	782.74	3997.57	932.64	4453.14	1065.93
58.5	2161.49	385.86	2689.92	471.06	3057.94	572.60	3601.49	744.08	4065.25	883.48	4529.05	1005.11

Table 5.1(3/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
59.0	2185.11	363.79	2719.19	442.03	3098.62	542.23	3656.16	705.04	4127.93	833.93	4599.10	944.45
59.5	2207.60	344.26	2747.21	416.93	3138.00	516.28	3708.49	671.33	4187.48	791.03	4665.74	892.00
60.0	2229.48	325.56	2774.87	393.11	3176.94	490.89	3759.88	637.76	4245.69	748.48	4731.15	840.49
60.5	2251.21	308.90	2802.87	372.35	3216.17	468.90	3811.57	608.38	4304.09	711.22	4797.12	795.50
61.0	2273.13	292.95	2831.73	352.55	3256.29	447.25	3864.52	579.14	4363.84	674.35	4865.02	751.37
61.5	2295.52	278.65	2861.87	335.17	3297.86	428.27	3919.54	553.27	4425.88	641.76	4936.04	712.49
62.0	2318.61	265.09	2893.56	318.74	3341.32	409.87	3977.18	528.01	4490.91	610.12	5011.03	675.02
62.5	2342.54	252.86	2927.02	304.20	3386.98	393.55	4037.83	505.48	4559.48	581.93	5090.67	641.77
63.0	2367.42	241.79	2962.36	291.32	3435.06	379.03	4101.79	485.28	4632.00	556.72	5175.47	612.11
63.5	2393.32	231.74	2999.67	279.86	3485.72	366.06	4169.34	467.11	4708.87	534.08	5265.89	585.57
64.0	2420.29	222.60	3039.03	269.65	3539.13	354.42	4240.72	450.69	4790.42	513.66	5362.34	561.71
64.5	2448.40	214.24	3080.57	260.55	3595.47	343.96	4316.27	435.82	4877.10	495.20	5465.31	540.20
65.0	2477.71	206.60	3124.42	252.41	3654.94	334.51	4396.32	422.31	4969.31	478.46	5575.25	520.74
65.5	2508.28	199.58	3170.75	245.14	3717.76	325.97	4481.17	409.99	5067.45	463.22	5692.66	503.09
66.0	2540.14	193.13	3219.73	238.62	3784.11	318.21	4571.16	398.74	5171.90	449.33	5817.99	487.03
66.5	2573.38	187.18	3271.54	232.79	3854.21	311.15	4666.60	388.42	5283.04	436.62	5951.72	472.39
67.0	2608.05	181.69	3326.38	227.56	3928.28	304.71	4767.84	378.96	5401.25	424.98	6094.33	459.00
67.5	2644.23	176.61	3384.38	222.88	4006.51	298.83	4875.14	370.24	5526.85	414.28	6246.17	446.74
68.0	2682.01	171.90	3445.72	218.69	4089.08	293.44	4988.80	362.21	5660.10	404.44	6407.58	435.49
68.5	2721.42	167.52	3510.51	214.93	4176.13	288.50	5108.96	354.80	5801.17	395.37	6578.71	425.14
69.0	2762.53	163.45	3578.82	211.57	4267.74	283.95	5235.69	347.93	5950.11	387.00	6759.59	415.60
69.5	2805.34	159.67	3650.66	208.56	4363.90	279.76	5368.95	341.57	6106.79	379.25	6950.03	406.80
70.0	2849.83	156.13	3725.96	205.88	4464.51	275.90	5508.53	335.67	6270.96	372.08	7149.66	398.67
70.5	2895.94	152.83	3804.59	203.49	4569.37	272.33	5654.13	330.19	6442.22	365.42	7357.92	391.14
71.0	2943.60	149.74	3886.38	201.36	4678.28	269.03	5805.38	325.08	6620.08	359.24	7574.14	384.17
71.5	2992.67	146.85	3971.12	199.47	4790.89	265.97	5961.77	320.33	6803.92	353.49	7797.54	377.69
72.0	3043.01	144.14	4058.54	197.80	4906.85	263.13	6122.78	315.89	6993.08	348.14	8027.21	371.68
72.5	3094.48	141.60	4148.33	196.32	5025.79	260.49	6287.79	311.75	7186.85	343.16	8262.23	366.08
73.0	3146.93	139.14	4240.21	194.87	5147.27	257.84	6456.22	307.64	7384.46	338.22	8501.65	360.56
73.5	3200.15	136.83	4333.84	193.60	5270.91	255.37	6627.45	303.79	7585.21	333.62	8744.53	355.42
74.0	3254.00	134.65	4428.92	192.47	5396.27	253.06	6800.88	300.18	7788.38	329.32	8989.98	350.63
74.5	3308.28	132.60	4525.12	191.48	5522.96	250.91	6975.92	296.81	7993.27	325.29	9237.14	346.15
75.0	3362.84	130.67	4622.13	190.62	5650.59	248.90	7152.04	293.64	8199.27	321.53	9485.21	341.97
75.5	3417.52	128.85	4719.70	189.87	5778.83	247.01	7328.77	290.67	8405.81	318.00	9733.54	338.06
76.0	3472.18	127.13	4817.57	189.22	5907.37	245.25	7505.66	287.87	8612.40	314.69	9981.52	334.40
76.5	3526.70	125.50	4915.53	188.66	6035.92	243.59	7682.34	285.25	8818.63	311.59	10228.64	330.98
77.0	3580.95	123.96	5013.37	188.18	6164.27	242.04	7858.49	282.78	9024.13	308.68	10474.50	327.77
77.5	3634.85	122.50	5110.94	187.78	6292.19	240.58	8033.84	280.45	9228.59	305.94	10718.76	324.76
78.0	3688.30	121.12	5208.06	187.45	6419.50	239.21	8208.14	278.26	9431.78	303.37	10961.15	321.94
78.5	3741.24	119.81	5304.65	187.18	6546.08	237.92	8381.22	276.20	9633.50	300.96	11201.53	319.29
79.0	3793.61	118.57	5400.59	186.96	6671.80	236.71	8552.95	274.26	9833.63	298.68	11439.77	316.80
79.5	3845.37	117.39	5495.79	186.80	6796.56	235.56	8723.22	272.42	10032.08	296.54	11675.83	314.46
80.0	3896.49	116.27	5590.21	186.67	6920.31	234.49	8891.99	270.69	10228.80	294.53	11909.75	312.27
80.5	3946.92	115.21	5683.80	186.59	7042.98	233.47	9059.23	269.06	10423.80	292.63	12141.61	310.20
81.0	3996.70	114.20	5776.50	186.54	7164.56	232.51	9224.96	267.51	10617.12	290.84	12371.55	308.25
81.5	4045.77	113.24	5868.35	186.52	7285.05	231.61	9389.25	266.06	10808.85	289.15	12599.73	306.42
82.0	4094.16	112.33	5959.29	186.54	7404.46	230.75	9552.13	264.68	10999.06	287.55	12826.38	304.70
82.5	4141.87	111.46	6049.35	186.57	7522.82	229.95	9713.74	263.37	11187.91	286.05	13051.71	303.07
83.0	4188.91	110.63	6138.54	186.63	7640.16	229.18	9874.19	262.14	11375.55	284.63	13276.02	301.54
83.5	4235.31	109.84	6226.89	186.71	7756.55	228.46	10033.62	260.97	11562.16	283.29	13499.58	300.10
84.0	4281.06	109.09	6314.43	186.80	7872.08	227.78	10192.19	259.87	11747.96	282.03	13722.71	298.73
84.5	4326.20	108.37	6401.18	186.91	7986.80	227.13	10350.08	258.82	11933.15	280.83	13945.73	297.45
85.0	4370.75	107.69	6487.23	187.03	8100.83	226.52	10507.46	257.83	12117.97	279.70	14169.00	296.24
85.5	4414.74	107.03	6572.61	187.16	8214.26	225.94	10664.55	256.89	12302.70	278.63	14392.90	295.09
86.0	4458.20	106.41	6657.40	187.30	8327.22	225.39	10821.56	256.00	12487.58	277.62	14617.78	294.01
86.5	4501.15	105.81	6741.64	187.44	8439.82	224.87	10978.72	255.16	12672.92	276.67	14844.05	292.99
87.0	4543.64	105.25	6825.44	187.59	8552.20	224.37	11136.23	254.36	12859.00	275.76	15072.09	292.03
87.5	4585.69	104.70	6908.86	187.75	8664.48	223.90	11294.36	253.60	13046.09	274.91	15302.27	291.12
88.0	4627.33	104.18	6991.98	187.91	8776.81	223.45	11453.27	252.89	13234.46	274.10	15534.94	290.26

Table 5.1(4/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
88.5	4668.61	103.69	7074.90	188.08	8889.29	223.03	11613.22	252.20	13424.39	273.33	15770.38	289.45
89.0	4709.56	103.21	7157.69	188.24	9002.07	222.63	11774.37	251.56	13616.09	272.61	16008.87	288.68
89.5	4750.21	102.76	7240.42	188.41	9115.26	222.25	11936.90	250.94	13809.76	271.92	16250.62	287.96
90.0	4790.59	102.32	7323.18	188.58	9228.96	221.89	12100.95	250.36	14005.56	271.27	16495.75	287.27
90.5	4830.74	101.91	7406.04	188.74	9343.27	221.54	12266.62	249.81	14203.60	270.65	16744.32	286.63
91.0	4870.67	101.51	7489.04	188.91	9458.26	221.21	12433.99	249.28	14403.94	270.07	16996.31	286.01
91.5	4910.41	101.13	7572.25	189.08	9573.97	220.90	12603.10	248.79	14606.57	269.52	17251.61	285.43
92.0	4949.99	100.76	7655.71	189.24	9690.45	220.61	12773.90	248.31	14811.46	268.99	17510.03	284.88
92.5	4989.43	100.41	7739.42	189.40	9807.70	220.33	12946.34	247.86	15018.45	268.50	17771.27	284.37
93.0	5028.70	100.08	7823.43	189.56	9925.71	220.06	13120.33	247.44	15227.39	268.03	18034.99	283.87
93.5	5067.85	99.76	7907.72	189.72	10044.45	219.80	13295.71	247.03	15438.03	267.58	18300.72	283.41
94.0	5106.86	99.45	7992.28	189.88	10163.84	219.56	13472.27	246.65	15650.07	267.16	18567.95	282.97
94.5	5145.73	99.15	8077.08	190.03	10283.79	219.33	13649.79	246.28	15863.17	266.76	18836.11	282.55
95.0	5184.44	98.87	8162.09	190.18	10404.21	219.11	13827.96	245.93	16076.94	266.38	19104.57	282.16
95.5	5222.98	98.60	8247.23	190.32	10524.96	218.90	14006.51	245.60	16290.96	266.02	19372.67	281.79
96.0	5261.12	98.34	8331.91	190.47	10645.27	218.70	14184.42	245.29	16504.04	265.67	19638.98	281.43
96.5	5298.70	98.09	8415.77	190.60	10764.73	218.52	14361.05	244.99	16715.39	265.35	19902.45	281.10
97.0	5336.07	97.85	8499.60	190.74	10884.07	218.34	14537.02	244.71	16925.64	265.04	20163.55	280.78
97.5	5373.18	97.62	8583.30	190.87	11003.10	218.16	14711.99	244.44	17134.26	264.75	20421.57	280.48
98.0	5410.00	97.41	8666.75	191.00	11121.62	218.00	14885.54	244.18	17340.78	264.48	20675.84	280.20
98.5	5446.48	97.19	8749.85	191.13	11239.42	217.84	15057.29	243.94	17544.67	264.21	20925.70	279.93
99.0	5482.59	94.47	8832.46	184.28	11356.27	209.27	15226.84	233.54	17745.49	252.33	21170.50	266.85
99.5	5518.25	91.90	8914.41	177.85	11471.88	201.26	15393.74	223.89	17942.67	241.32	21409.54	254.76
100.0	5553.38	89.48	8995.46	171.82	11585.92	193.78	15557.44	214.90	18135.52	231.12	21642.02	243.58
100.5	5587.75	87.19	9074.96	166.14	11697.55	186.78	15716.87	206.52	18322.82	221.63	21866.52	233.21
101.0	5621.19	85.02	9152.49	160.80	11806.18	180.21	15871.23	198.70	18503.62	212.80	22081.93	223.58
101.5	5653.70	82.97	9228.03	155.76	11911.77	174.04	16020.40	191.38	18677.80	204.56	22288.06	214.61
102.0	5685.29	81.03	9301.61	151.00	12014.30	168.24	16164.26	184.53	18845.20	196.87	22484.72	206.25
102.5	5715.92	79.19	9373.21	146.51	12113.70	162.78	16302.71	178.10	19005.68	189.67	22671.73	198.45
103.0	5745.61	77.44	9442.82	142.26	12209.91	157.64	16435.61	172.06	19159.07	182.92	22848.88	191.15
103.5	5774.33	75.77	9510.40	138.23	12302.88	152.79	16562.84	166.38	19305.22	176.59	23015.99	184.31
104.0	5802.07	74.19	9575.94	134.41	12392.52	148.20	16684.25	161.03	19443.97	170.64	23172.88	177.89
104.5	5828.81	72.68	9639.40	130.79	12478.75	143.86	16799.74	155.99	19575.17	165.04	23319.37	171.87
105.0	5854.53	71.25	9700.72	127.35	12561.50	139.76	16909.15	151.23	19698.64	159.77	23455.28	166.20
105.5	5879.22	69.88	9759.87	124.08	12640.68	135.87	17012.37	146.73	19814.23	154.80	23580.45	160.86
106.0	5902.85	68.57	9816.80	120.97	12716.20	132.18	17109.26	142.47	19921.78	150.10	23694.73	155.82
106.5	5925.39	67.33	9871.43	118.01	12787.98	128.67	17199.72	138.44	20021.18	145.66	23797.97	151.07
107.0	5946.84	66.13	9923.71	115.18	12855.91	125.34	17283.57	134.61	20112.21	141.46	23890.02	146.58
107.5	5967.14	64.99	9973.53	112.49	12919.87	122.17	17360.68	130.99	20194.72	137.48	23970.71	142.33
108.0	5986.28	63.90	10020.81	109.92	12979.72	119.15	17430.90	127.54	20268.55	133.71	24039.91	138.31
108.5	6004.22	62.86	10065.47	107.47	13035.38	116.28	17494.10	124.27	20333.56	130.13	24097.52	134.49
109.0	6020.93	61.86	10107.43	105.12	13086.73	113.54	17550.18	121.15	20389.63	126.73	24143.47	130.87
109.5	6036.39	60.90	10146.63	102.87	13133.70	110.92	17599.04	118.18	20436.67	123.49	24177.70	127.43
110.0	6050.58	59.98	10183.00	100.73	13176.21	108.43	17640.63	115.35	20474.61	120.41	24200.22	124.16
110.5	6063.49	59.09	10216.49	98.67	13214.19	106.04	17674.87	112.66	20503.42	117.48	24211.04	121.05
111.0	6075.09	58.24	10247.03	96.69	13247.58	103.76	17701.72	110.08	20523.08	114.68	24210.22	118.09
111.5	6085.38	57.43	10274.61	94.80	13276.35	101.57	17721.20	107.62	20533.61	112.02	24197.86	115.26
112.0	6094.34	56.64	10299.17	92.99	13300.46	99.48	17733.29	105.27	20535.02	109.47	24174.07	112.57
112.5	6101.98	55.89	10320.69	91.24	13319.87	97.48	17738.02	103.02	20527.39	107.04	24139.01	110.00
113.0	6108.28	55.16	10339.13	89.57	13334.60	95.55	17735.44	100.87	20510.79	104.71	24092.86	107.54
113.5	6113.23	54.46	10354.49	87.96	13344.63	93.71	17725.57	98.80	20485.31	102.49	24035.79	105.19
114.0	6116.82	53.78	10366.75	86.41	13349.96	91.94	17708.51	96.83	20451.09	100.36	23968.06	102.95
114.5	6119.07	53.13	10375.89	84.92	13350.60	90.24	17684.32	94.93	20408.26	98.31	23889.89	100.80
115.0	6119.95	52.51	10381.91	83.49	13346.58	88.61	17653.12	93.11	20356.95	96.36	23801.54	98.74
115.5	6119.48	51.90	10384.81	82.11	13337.91	87.03	17615.00	91.37	20297.34	94.48	23703.29	96.76
116.0	6117.65	51.32	10384.58	80.78	13324.64	85.52	17570.07	89.69	20229.61	92.68	23595.43	94.87
116.5	6114.46	50.75	10381.23	79.50	13306.81	84.07	17518.47	88.08	20153.96	90.95	23478.27	93.05
117.0	6109.89	50.21	10374.77	78.26	13284.44	82.67	17460.32	86.53	20070.58	89.29	23352.11	91.31
117.5	6103.97	49.68	10365.21	77.06	13257.61	81.32	17395.81	85.03	19979.70	87.69	23217.29	89.64

Table 5.1(5/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
118.0	6096.69	49.17	10352.57	75.91	13226.37	80.02	17325.05	83.60	19881.53	86.16	23074.14	88.02
118.5	6088.06	48.68	10336.87	74.80	13190.80	78.76	17248.24	82.21	19776.34	84.68	22923.03	86.48
119.0	6078.09	48.21	10318.14	73.72	13150.96	77.55	17165.56	80.88	19664.36	83.25	22764.30	84.98
119.5	6066.77	47.74	10296.41	72.68	13106.96	76.38	17077.20	79.59	19545.87	81.88	22598.34	83.55
120.0	6054.13	47.30	10271.74	71.68	13058.87	75.25	16983.35	78.35	19421.13	80.56	22425.50	82.17
120.5	6040.19	46.87	10244.16	70.71	13006.81	74.16	16884.24	77.16	19290.44	79.29	22246.19	80.84
121.0	6024.96	46.45	10213.72	69.77	12950.88	73.11	16780.07	76.00	19154.09	78.06	22060.79	79.55
121.5	6008.46	46.04	10180.50	68.85	12891.22	72.09	16671.07	74.89	19012.34	76.87	21869.69	78.31
122.0	5990.71	45.65	10144.55	67.97	12827.92	71.10	16557.48	73.81	18865.54	75.73	21673.26	77.12
122.5	5971.75	45.27	10105.94	67.12	12761.15	70.15	16439.52	72.77	18713.95	74.62	21471.93	75.96
123.0	5951.59	44.89	10064.75	66.29	12691.00	69.23	16317.42	71.76	18557.90	73.55	21266.06	74.85
123.5	5930.28	44.53	10021.06	65.49	12617.64	68.33	16191.45	70.78	18397.67	72.52	21056.02	73.77
124.0	5907.84	44.19	9974.93	64.71	12541.19	67.47	16061.82	69.84	18233.58	71.52	20842.22	72.73
124.5	5884.31	43.85	9926.47	63.95	12461.81	66.63	15928.78	68.93	18065.92	70.55	20625.01	71.73
125.0	5859.71	43.52	9875.77	63.22	12379.64	65.82	15792.57	68.04	17894.98	69.62	20404.75	70.75
125.5	5834.09	43.20	9822.90	62.51	12294.82	65.03	15653.41	67.19	17721.06	68.71	20181.79	69.81
126.0	5807.49	42.89	9767.96	61.82	12207.50	64.27	15511.55	66.36	17544.44	67.83	19956.48	68.90
126.5	5779.94	42.58	9711.04	61.15	12117.83	63.52	15367.21	65.55	17365.41	66.98	19729.16	68.02
127.0	5751.48	42.29	9652.24	60.50	12025.96	62.80	15220.62	64.77	17184.22	66.16	19500.12	67.16
127.5	5722.16	42.00	9591.65	59.86	11932.02	62.11	15071.99	64.02	17001.15	65.36	19269.71	66.33
128.0	5692.01	41.73	9529.35	59.25	11836.18	61.43	14921.55	63.28	16816.43	64.59	19038.20	65.53
128.5	5661.08	41.45	9465.46	58.65	11738.55	60.77	14769.49	62.57	16630.33	63.84	18805.87	64.75
129.0	5629.39	41.19	9400.06	58.07	11639.28	60.13	14616.02	61.88	16443.09	63.11	18573.00	63.99
129.5	5597.01	40.93	9333.23	57.50	11538.52	59.50	14461.34	61.21	16254.90	62.40	18339.85	63.26
130.0	5563.96	40.68	9265.08	56.95	11436.39	58.90	14305.61	60.55	16066.02	61.71	18106.65	62.55
130.5	5530.28	40.44	9195.69	56.41	11333.02	58.31	14149.04	59.92	15876.63	61.05	17873.64	61.86
131.0	5496.02	40.20	9125.15	55.89	11228.53	57.74	13991.79	59.30	15686.92	60.40	17641.03	61.18
131.5	5461.21	39.97	9053.53	55.38	11123.05	57.18	13834.02	58.70	15497.09	59.77	17409.00	60.53
132.0	5425.89	39.75	8980.94	54.89	11016.69	56.64	13675.89	58.12	15307.31	59.15	17177.78	59.90
132.5	5390.11	39.53	8907.43	54.41	10909.56	56.11	13517.55	57.55	15117.76	58.56	16947.53	59.28
133.0	5353.88	39.31	8833.11	53.94	10801.78	55.60	13359.13	57.00	14928.57	57.98	16718.41	58.68
133.5	5317.25	39.10	8758.04	53.48	10693.45	55.10	13200.77	56.46	14739.90	57.42	16490.58	58.10
134.0	5280.26	38.89	8682.29	53.03	10584.66	54.61	13042.61	55.94	14551.88	56.87	16264.16	57.53
134.5	5242.93	38.69	8605.93	52.59	10475.51	54.13	12884.74	55.43	14364.64	56.33	16039.30	56.98
135.0	5205.31	38.50	8529.04	52.17	10366.09	53.67	12727.29	54.93	14178.30	55.81	15816.10	56.45
135.5	5167.41	38.31	8451.69	51.75	10256.49	53.22	12570.35	54.45	13992.97	55.31	15594.68	55.92
136.0	5129.27	38.12	8373.92	51.35	10146.78	52.78	12414.03	53.98	13808.73	54.81	15375.12	55.41
136.5	5090.92	37.94	8295.81	50.95	10037.05	52.35	12258.41	53.52	13625.70	54.33	15157.53	54.92
137.0	5052.39	37.76	8217.41	50.56	9927.37	51.93	12103.58	53.07	13443.94	53.87	14941.97	54.43
137.5	5013.70	37.59	8138.78	50.19	9817.81	51.52	11949.60	52.64	13263.54	53.41	14728.51	53.96
138.0	4974.87	37.42	8059.97	49.82	9708.42	51.12	11796.56	52.21	13084.56	52.96	14517.21	53.51
138.5	4935.94	37.25	7981.03	49.46	9599.28	50.73	11644.51	51.79	12907.08	52.53	14308.13	53.06
139.0	4896.91	37.09	7902.01	49.11	9490.44	50.35	11493.52	51.38	12731.13	52.11	14101.30	52.62
139.5	4857.83	36.93	7822.96	48.76	9381.96	49.97	11343.63	50.99	12556.77	51.69	13896.77	52.19
140.0	4818.70	36.78	7743.91	48.43	9273.87	49.61	11194.90	50.60	12384.04	51.29	13694.56	51.78
140.5	4779.55	36.63	7664.91	48.10	9166.24	49.25	11047.37	50.22	12212.99	50.89	13494.70	51.37
141.0	4740.39	36.48	7586.00	47.78	9059.09	48.91	10901.08	49.85	12043.64	50.51	13297.22	50.97
141.5	4701.24	36.34	7507.21	47.46	8952.48	48.57	10756.06	49.49	11876.02	50.13	13102.11	50.59
142.0	4662.11	36.19	7428.59	47.16	8846.44	48.24	10612.35	49.14	11710.15	49.76	12909.40	50.21
142.5	4623.04	36.06	7350.15	46.86	8741.00	47.91	10469.97	48.79	11546.06	49.40	12719.09	49.84
143.0	4584.01	35.92	7271.93	46.56	8636.20	47.60	10328.94	48.46	11383.76	49.05	12531.17	49.48
143.5	4545.07	35.79	7193.97	46.28	8532.06	47.29	10189.29	48.13	11223.26	48.71	12345.66	49.13
144.0	4506.20	35.66	7116.29	45.99	8428.62	46.98	10051.04	47.81	11064.58	48.38	12162.53	48.78
144.5	4467.43	35.53	7038.91	45.72	8325.89	46.69	9914.19	47.49	10907.71	48.05	11981.78	48.45
145.0	4428.77	35.40	6961.86	45.45	8223.90	46.40	9778.77	47.19	10752.66	47.73	11803.41	48.12
145.5	4390.23	35.28	6885.16	45.19	8122.67	46.11	9644.78	46.88	10599.43	47.42	11627.40	47.80
146.0	4351.82	35.16	6808.83	44.93	8022.22	45.84	9512.23	46.59	10448.03	47.11	11453.73	47.48
146.5	4313.54	35.05	6732.90	44.68	7922.57	45.56	9381.12	46.30	10298.45	46.81	11282.39	47.18
147.0	4275.41	34.93	6657.38	44.43	7823.72	45.30	9251.47	46.02	10150.68	46.52	11113.36	46.87

Table 5.1(6/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
147.5	4237.44	34.82	6582.30	44.19	7725.71	45.04	9123.27	45.75	10004.72	46.23	10946.62	46.58
148.0	4199.63	34.71	6507.66	43.95	7628.54	44.78	8996.52	45.48	9860.57	45.95	10782.15	46.29
148.5	4161.99	34.60	6433.48	43.72	7532.21	44.53	8871.24	45.21	9718.21	45.68	10619.93	46.01
149.0	4124.53	34.49	6359.78	43.49	7436.75	44.29	8747.40	44.95	9577.64	45.41	10459.95	45.74
149.5	4087.25	34.39	6286.58	43.26	7342.17	44.05	8625.02	44.70	9438.84	45.15	10302.17	45.47
150.0	4050.16	34.29	6213.87	43.04	7248.46	43.81	8504.09	44.45	9301.81	44.89	10146.57	45.20
150.5	4013.26	34.19	6141.69	42.83	7155.64	43.58	8384.61	44.21	9166.53	44.64	9993.14	44.95
151.0	3976.57	34.09	6070.04	42.62	7063.72	43.36	8266.57	43.97	9033.00	44.39	9841.85	44.69
151.5	3940.08	33.99	5998.93	42.41	6972.70	43.14	8149.97	43.74	8901.20	44.15	9692.68	44.44
152.0	3903.80	33.90	5928.36	42.21	6882.59	42.92	8034.79	43.51	8771.12	43.91	9545.60	44.20
152.5	3867.73	33.80	5858.36	42.01	6793.39	42.71	7921.05	43.29	8642.75	43.68	9400.59	43.96
153.0	3831.89	33.71	5788.93	41.82	6705.10	42.50	7808.72	43.07	8516.07	43.45	9257.64	43.73
153.5	3796.26	33.62	5720.07	41.62	6617.73	42.30	7697.80	42.85	8391.06	43.23	9116.70	43.50
154.0	3760.87	33.54	5651.80	41.44	6531.28	42.10	7588.29	42.64	8267.73	43.01	8977.77	43.28
154.5	3725.70	33.45	5584.12	41.25	6445.76	41.90	7480.18	42.43	8146.04	42.80	8840.83	43.06
155.0	3690.76	33.36	5517.04	41.07	6361.16	41.71	7373.45	42.23	8026.00	42.59	8705.83	42.84
155.5	3656.06	33.28	5450.57	40.89	6277.49	41.52	7268.10	42.03	7907.58	42.38	8572.78	42.63
156.0	3621.60	33.20	5384.70	40.72	6194.75	41.33	7164.12	41.84	7790.76	42.18	8441.64	42.43
156.5	3587.38	33.12	5319.45	40.55	6112.93	41.15	7061.51	41.64	7675.54	41.98	8312.39	42.22
157.0	3553.40	33.04	5254.82	40.38	6032.04	40.97	6960.24	41.46	7561.91	41.79	8185.01	42.02
157.5	3519.68	32.96	5190.82	40.21	5952.08	40.79	6860.32	41.27	7449.84	41.60	8059.48	41.83
158.0	3486.20	32.89	5127.44	40.05	5873.04	40.62	6761.73	41.09	7339.32	41.41	7935.78	41.64
158.5	3452.97	32.81	5064.70	39.89	5794.92	40.45	6664.46	40.91	7230.34	41.23	7813.89	41.45
159.0	3419.99	32.74	5002.58	39.74	5717.73	40.29	6568.50	40.74	7122.89	41.05	7693.78	41.26
159.5	3387.27	32.67	4941.11	39.58	5641.46	40.12	6473.85	40.57	7016.94	40.87	7575.44	41.08
160.0	3354.80	32.60	4880.28	39.43	5566.10	39.96	6380.49	40.40	6912.49	40.69	7458.84	40.91
160.5	3322.59	32.53	4820.09	39.28	5491.66	39.80	6288.41	40.23	6809.52	40.52	7343.97	40.73
161.0	3290.65	32.46	4760.54	39.14	5418.14	39.65	6197.60	40.07	6708.02	40.36	7230.81	40.56
161.5	3258.96	32.39	4701.63	38.99	5345.52	39.50	6108.05	39.91	6607.97	40.19	7119.33	40.39
162.0	3227.53	32.32	4643.37	38.85	5273.80	39.35	6019.75	39.75	6509.36	40.03	7009.52	40.23
162.5	3196.37	32.26	4585.76	38.71	5202.99	39.20	5932.69	39.60	6412.17	39.87	6901.36	40.06
163.0	3165.47	32.19	4528.79	38.58	5133.07	39.06	5846.86	39.45	6316.40	39.71	6794.83	39.90
163.5	3134.84	32.13	4472.46	38.44	5064.05	38.91	5762.24	39.30	6222.02	39.56	6689.90	39.75
164.0	3104.48	32.07	4416.79	38.31	4995.91	38.77	5678.83	39.15	6129.02	39.41	6586.57	39.59
164.5	3074.38	32.01	4361.76	38.18	4928.66	38.64	5596.62	39.01	6037.38	39.26	6484.82	39.44
165.0	3044.55	31.95	4307.37	38.05	4862.29	38.50	5515.59	38.87	5947.11	39.12	6384.62	39.29
165.5	3014.99	31.89	4253.62	37.93	4796.79	38.37	5435.73	38.73	5858.17	38.97	6285.96	39.15
166.0	2985.70	31.83	4200.52	37.81	4732.16	38.24	5357.03	38.59	5770.56	38.83	6188.81	39.00
166.5	2956.67	31.77	4148.06	37.68	4668.40	38.11	5279.48	38.46	5684.26	38.69	6093.18	38.86
167.0	2927.92	31.72	4096.23	37.56	4605.49	37.98	5203.08	38.33	5599.26	38.56	5999.02	38.72
167.5	2899.44	31.66	4045.04	37.45	4543.43	37.86	5127.80	38.20	5515.54	38.43	5906.34	38.59
168.0	2871.23	31.61	3994.49	37.33	4482.22	37.74	5053.63	38.07	5433.10	38.29	5815.11	38.45
168.5	2843.29	31.55	3944.57	37.22	4421.85	37.62	4980.58	37.94	5351.91	38.16	5725.31	38.32
169.0	2815.62	31.50	3895.28	37.10	4362.31	37.50	4908.62	37.82	5271.97	38.04	5636.93	38.19
169.5	2788.22	31.45	3846.61	36.99	4303.60	37.38	4837.74	37.70	5193.26	37.91	5549.95	38.06
170.0	2761.09	31.39	3798.57	36.89	4245.72	37.27	4767.93	37.58	5115.76	37.79	5464.36	37.94
170.5	2734.23	31.34	3751.15	36.78	4188.64	37.15	4699.18	37.46	5039.48	37.67	5380.13	37.81
171.0	2707.65	31.29	3704.34	36.67	4132.38	37.04	4631.48	37.34	4964.38	37.55	5297.26	37.69
171.5	2681.33	31.25	3658.15	36.57	4076.92	36.93	4564.82	37.23	4890.46	37.43	5215.72	37.57
172.0	2655.29	31.20	3612.58	36.47	4022.25	36.83	4499.19	37.12	4817.70	37.32	5135.50	37.46
172.5	2629.51	31.15	3567.60	36.37	3968.37	36.72	4434.58	37.01	4746.10	37.20	5056.59	37.34
173.0	2604.00	31.10	3523.24	36.27	3915.27	36.61	4370.97	36.90	4675.63	37.09	4978.97	37.23
173.5	2578.77	31.06	3479.47	36.17	3862.95	36.51	4308.35	36.79	4606.29	36.98	4902.62	37.11
174.0	2553.80	31.01	3436.29	36.07	3811.39	36.41	4246.71	36.68	4538.06	36.87	4827.53	37.00
174.5	2529.10	30.97	3393.71	35.98	3760.60	36.31	4186.05	36.58	4470.93	36.76	4753.68	36.89
175.0	2504.66	30.92	3351.72	35.89	3710.55	36.21	4126.35	36.48	4404.89	36.66	4681.06	36.79
175.5	2480.50	30.88	3310.30	35.79	3661.26	36.12	4067.60	36.38	4339.92	36.56	4609.64	36.68
176.0	2456.59	30.83	3269.47	35.70	3612.70	36.02	4009.78	36.28	4276.01	36.45	4539.43	36.58
176.5	2432.96	30.79	3229.21	35.61	3564.87	35.93	3952.89	36.18	4213.15	36.35	4470.40	36.47

Table 5.1(7/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
177.0	2409.58	30.75	3189.52	35.52	3517.77	35.83	3896.92	36.08	4151.32	36.25	4402.53	36.37
177.5	2386.48	30.71	3150.39	35.44	3471.38	35.74	3841.86	35.99	4090.52	36.16	4335.81	36.27
178.0	2363.63	30.67	3111.83	35.35	3425.71	35.65	3787.69	35.90	4030.73	36.06	4270.23	36.18
178.5	2341.04	30.63	3073.82	35.27	3380.73	35.56	3734.40	35.80	3971.93	35.97	4205.77	36.08
179.0	2318.72	30.59	3036.36	35.18	3336.45	35.48	3681.98	35.71	3914.12	35.87	4142.42	35.99
179.5	2296.65	30.55	2999.44	35.10	3292.86	35.39	3630.43	35.62	3857.27	35.78	4080.16	35.89
180.0	2274.85	30.51	2963.06	35.02	3249.94	35.30	3579.73	35.53	3801.39	35.69	4018.98	35.80
180.5	2253.29	30.47	2927.22	34.94	3207.70	35.22	3529.87	35.45	3746.46	35.60	3958.86	35.71
181.0	2232.00	30.44	2891.92	34.86	3166.12	35.14	3480.84	35.36	3692.46	35.51	3899.79	35.62
181.5	2210.96	30.40	2857.13	34.79	3125.20	35.06	3432.63	35.28	3639.38	35.43	3841.75	35.53
182.0	2190.17	30.36	2822.87	34.71	3084.93	34.98	3385.23	35.19	3587.22	35.34	3784.73	35.44
182.5	2169.64	30.33	2789.12	34.63	3045.30	34.90	3338.62	35.11	3535.95	35.26	3728.72	35.36
183.0	2149.35	30.29	2755.88	34.56	3006.30	34.82	3292.80	35.03	3485.56	35.17	3673.70	35.27
183.5	2129.32	30.26	2723.14	34.49	2967.93	34.74	3247.76	34.95	3436.06	35.09	3619.66	35.19
184.0	2109.53	30.22	2690.90	34.41	2930.18	34.67	3203.49	34.87	3387.41	35.01	3566.58	35.11
184.5	2089.99	30.19	2659.16	34.34	2893.04	34.59	3159.97	34.79	3339.61	34.93	3514.45	35.03
185.0	2070.69	30.15	2627.90	34.27	2856.50	34.52	3117.20	34.72	3292.65	34.85	3463.26	34.95
185.5	2051.64	30.12	2597.13	34.20	2820.57	34.45	3075.16	34.64	3246.52	34.78	3412.99	34.87
186.0	2032.83	30.09	2566.83	34.13	2785.21	34.37	3033.85	34.57	3201.20	34.70	3363.63	34.79
186.5	2014.26	30.06	2537.01	34.07	2750.45	34.30	2993.26	34.49	3156.68	34.62	3315.17	34.72
187.0	1995.92	30.02	2507.65	34.00	2716.25	34.23	2953.36	34.42	3112.95	34.55	3267.58	34.64
187.5	1977.83	29.99	2478.76	33.93	2682.62	34.16	2914.17	34.35	3070.01	34.48	3220.87	34.57
188.0	1959.97	29.96	2450.32	33.87	2649.55	34.10	2875.66	34.28	3027.83	34.40	3175.01	34.49
188.5	1942.34	29.93	2422.33	33.80	2617.04	34.03	2837.82	34.21	2986.40	34.33	3129.99	34.42
189.0	1924.94	29.90	2394.78	33.74	2585.06	33.96	2800.65	34.14	2945.72	34.26	3085.80	34.35
189.5	1907.78	29.87	2367.68	33.68	2553.63	33.90	2764.13	34.07	2905.78	34.19	3042.43	34.28
190.0	1890.84	29.84	2341.01	33.62	2522.72	33.83	2728.26	34.01	2866.56	34.12	2999.86	34.21
190.5	1874.13	29.81	2314.76	33.55	2492.33	33.77	2693.03	33.94	2828.05	34.06	2958.08	34.14
191.0	1857.64	29.78	2288.95	33.49	2462.46	33.70	2658.42	33.87	2790.24	33.99	2917.08	34.07
191.5	1841.37	29.75	2263.54	33.43	2433.10	33.64	2624.43	33.81	2753.12	33.92	2876.84	34.00
192.0	1825.33	29.73	2238.55	33.38	2404.24	33.58	2591.05	33.75	2716.68	33.86	2837.36	33.94
192.5	1809.50	29.70	2213.97	33.32	2375.87	33.52	2558.27	33.68	2680.90	33.79	2798.62	33.87
193.0	1793.89	29.67	2189.79	33.26	2347.99	33.46	2526.07	33.62	2645.79	33.73	2760.60	33.81
193.5	1778.50	29.64	2166.01	33.20	2320.59	33.40	2494.45	33.56	2611.32	33.67	2723.31	33.74
194.0	1763.31	29.62	2142.62	33.15	2293.66	33.34	2463.41	33.50	2577.49	33.61	2686.71	33.68
194.5	1748.34	29.59	2119.61	33.09	2267.20	33.29	2432.92	33.44	2544.28	33.55	2650.81	33.62
195.0	1733.58	29.56	2096.98	33.04	2241.19	33.23	2402.99	33.38	2511.69	33.49	2615.60	33.56
195.5	1719.03	29.54	2074.73	32.98	2215.64	33.17	2373.61	33.32	2479.71	33.43	2581.05	33.50
196.0	1704.68	29.51	2052.85	32.93	2190.53	33.12	2344.75	33.27	2448.32	33.37	2547.16	33.44
196.5	1690.53	29.49	2031.33	32.88	2165.86	33.06	2316.43	33.21	2417.51	33.31	2513.91	33.38
197.0	1676.58	29.46	2010.18	32.83	2141.62	33.01	2288.62	33.15	2387.29	33.25	2481.31	33.32
197.5	1662.84	29.44	1989.37	32.78	2117.81	32.95	2261.32	33.10	2357.63	33.20	2449.32	33.26
198.0	1649.29	29.41	1968.92	32.72	2094.41	32.90	2234.52	33.04	2328.52	33.14	2417.95	33.21
198.5	1635.93	29.39	1948.81	32.67	2071.43	32.85	2208.22	32.99	2299.97	33.09	2387.19	33.15
199.0	1622.77	29.37	1929.05	32.62	2048.85	32.80	2182.40	32.94	2271.95	33.03	2357.01	33.10
199.5	1609.79	29.34	1909.61	32.58	2026.67	32.75	2157.05	32.88	2244.46	32.98	2327.42	33.04
200.0	1597.01	29.32	1890.51	32.53	2004.89	32.70	2132.18	32.83	2217.49	32.92	2298.40	32.99
200.5	1584.41	29.30	1871.73	32.48	1983.49	32.65	2107.76	32.78	2191.03	32.87	2269.94	32.94
201.0	1572.00	29.27	1853.27	32.43	1962.47	32.60	2083.80	32.73	2165.07	32.82	2242.03	32.88
201.5	1559.77	29.25	1835.12	32.39	1941.82	32.55	2060.28	32.68	2139.60	32.77	2214.67	32.83
202.0	1547.72	29.23	1817.29	32.34	1921.54	32.50	2037.20	32.63	2114.62	32.72	2187.83	32.78
202.5	1535.85	29.21	1799.76	32.29	1901.63	32.45	2014.55	32.58	2090.11	32.67	2161.52	32.73
203.0	1524.15	29.19	1782.53	32.25	1882.07	32.41	1992.32	32.53	2066.07	32.62	2135.71	32.68
203.5	1512.63	29.16	1765.60	32.20	1862.86	32.36	1970.50	32.48	2042.49	32.57	2110.41	32.63
204.0	1501.28	29.14	1748.96	32.16	1844.00	32.31	1949.09	32.44	2019.36	32.52	2085.61	32.58
204.5	1490.10	29.12	1732.60	32.12	1825.47	32.27	1928.09	32.39	1996.67	32.47	2061.29	32.53
205.0	1479.09	29.10	1716.53	32.07	1807.28	32.22	1907.47	32.34	1974.41	32.43	2037.44	32.48
205.5	1468.24	29.08	1700.74	32.03	1789.42	32.18	1887.24	32.30	1952.58	32.38	2014.06	32.44
206.0	1457.56	29.06	1685.22	31.99	1771.87	32.14	1867.39	32.25	1931.17	32.33	1991.13	32.39

Table 5.1(8/8) Probable Discharge in Cagayan River and Tuguegarao River

Time	2-yr		5-yr		10-yr		25-yr		50-yr		100-yr	
(Hour)	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in	Cagayan-in	Tuguegarao in
206.5	1447.04	29.04	1669.97	31.95	1754.65	32.09	1847.92	32.21	1910.17	32.29	1968.66	32.34
207.0	1436.68	29.02	1654.98	31.91	1737.73	32.05	1828.81	32.16	1889.57	32.24	1946.62	32.30
207.5	1426.48	29.00	1640.25	31.86	1721.12	32.01	1810.06	32.12	1869.37	32.20	1925.02	32.25
208.0	1416.43	28.98	1625.79	31.82	1704.82	31.97	1791.66	32.08	1849.55	32.15	1903.84	32.21
208.5	1406.54	28.96	1611.57	31.78	1688.80	31.92	1773.60	32.04	1830.12	32.11	1883.08	32.16
209.0	1396.80	28.94	1597.60	31.75	1673.08	31.88	1755.89	31.99	1811.06	32.07	1862.72	32.12
209.5	1387.21	28.93	1583.88	31.71	1657.64	31.84	1738.51	31.95	1792.37	32.03	1842.77	32.08
210.0	1377.76	28.91	1570.39	31.67	1642.49	31.80	1721.46	31.91	1774.03	31.98	1823.20	32.03
210.5	1368.47	28.89	1557.14	31.63	1627.60	31.76	1704.73	31.87	1756.06	31.94	1804.02	31.99
211.0	1359.31	28.87	1544.13	31.59	1612.99	31.72	1688.32	31.83	1738.42	31.90	1785.22	31.95
211.5	1350.30	28.85	1531.34	31.55	1598.65	31.68	1672.21	31.79	1721.13	31.86	1766.79	31.91
212.0	1341.43	28.83	1518.77	31.52	1584.56	31.65	1656.41	31.75	1704.17	31.82	1748.72	31.87
212.5	1332.69	28.82	1506.43	31.48	1570.74	31.61	1640.91	31.71	1687.54	31.78	1731.00	31.83
213.0	1324.10	28.80	1494.30	31.44	1557.16	31.57	1625.70	31.67	1671.22	31.74	1713.63	31.79
213.5	1315.63	28.78	1482.39	31.41	1543.83	31.53	1610.78	31.63	1655.23	31.70	1696.61	31.75
214.0	1307.30	28.76	1470.69	31.37	1530.75	31.50	1596.14	31.60	1639.54	31.66	1679.92	31.71
214.5	1299.10	28.75	1459.19	31.34	1517.90	31.46	1581.78	31.56	1624.15	31.62	1663.56	31.67
215.0	1291.03	28.73	1447.89	31.30	1505.29	31.42	1567.69	31.52	1609.06	31.59	1647.51	31.63
215.5	1283.08	28.71	1436.80	31.27	1492.91	31.39	1553.86	31.48	1594.26	31.55	1631.79	31.59

Table 7.1 Result of Flood Inundation Analysis

(1) Without Project

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	1.50	2.08	6.04	1.65	1.18	0.48
0.25	-	0.49	1.26	1.98	5.11	3.21	0.46	0.52
0.50	-	0.99	2.27	4.27	5.83	4.53	2.83	1.00
1.00	-	1.99	3.46	8.54	8.12	19.17	10.87	4.54
2.00	-	2.99	2.95	7.03	8.86	9.64	19.08	11.71
	>=	3.00	18.78	32.74	41.34	53.38	59.87	77.89
Total			30.22	56.64	75.30	91.57	94.28	96.15

(2) With COC & Dike (Alt-C1)

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	0.93	0.60	0.93	0.15	1.41	0.54
0.25	-	0.49	0.79	0.85	0.97	0.21	1.70	0.56
0.50	-	0.99	1.22	2.35	1.13	0.39	5.09	1.59
1.00	-	1.99	2.10	4.13	3.65	3.21	18.29	9.16
2.00	-	2.99	4.44	6.26	4.69	3.85	10.86	18.28
	>=	3.00	13.97	20.98	27.27	32.77	56.04	65.47
Total			23.45	35.17	38.64	40.58	93.39	95.60

(3) With Dike (Alt-C2)

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	1.32	0.94	1.18	0.16	1.18	0.48
0.25	-	0.49	1.16	1.15	1.02	0.22	0.46	0.52
0.50	-	0.99	2.03	2.12	1.44	0.38	2.83	1.00
1.00	-	1.99	3.14	5.81	3.32	2.73	10.87	4.54
2.00	-	2.99	2.72	5.05	5.44	3.05	19.08	11.71
	>=	3.00	17.97	26.11	32.57	39.95	59.87	77.89
Total			28.34	41.18	44.97	46.49	94.28	96.15

(4) With COC (Alt-C3)

Inundation Depth (m)			Extent of Inundation Area (km2)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
0.01	-	0.24	0.75	2.04	3.37	2.91	1.41	0.54
0.25	-	0.49	0.72	2.14	2.74	3.05	1.70	0.56
0.50	-	0.99	1.17	3.65	4.36	11.39	5.09	1.59
1.00	-	1.99	4.62	6.64	8.89	13.12	18.29	9.16
2.00	-	2.99	2.13	6.35	7.83	10.08	10.86	18.28
	>=	3.00	13.77	32.25	38.43	48.92	56.04	65.47
Total			23.16	53.06	65.62	89.47	93.39	95.60

Table 7.2 Construction Base Cost for Revetment Construction Works

Enrile Revetment Project *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Earth Work							
Clearing and Grubbing	10,014	m^2	8.1	15.9	80,946	159,303	240,249
Removal and Stripping of Topsoil	10,014	m^2	186.3	367.0	1,865,209	3,675,076	5,540,285
Excavation and Loading -1	97,528	m^3	22.6	47.6	2,200,191	4,645,950	6,846,141
Hauling - 2 km -1	97,528	m^3	30.1	60.5	2,931,501	5,904,580	8,836,082
Dike Embankment	97,528	m^3	49.2	103.7	4,797,412	10,111,277	14,908,689
	Subtotal				*11,875,260*	*24,496,186*	*36,371,446*
Revetment Works							
Stone Masonry/Wet Stone Masonry-1	19,608	m^2	843.3	579.9	16,535,328	11,370,074	27,905,401
Gravel Bedding and Backfill	2,941	m^3	989.4	239.0	2,909,918	703,022	3,612,940
Gabion Mattress, w/ Filter Cloth Bedding	5,022	m^3	2602.0	6402.9	13,065,779	32,152,185	45,217,963
Gabion Mattress (Local Made)	12,432	m^3	2166.4	1420.3	26,931,987	17,656,296	44,588,283
Steel Sheet Pile Type IIIA, Furnishing and Driving	12,255	m^2	1685.9	13182.6	20,660,872	161,552,287	182,213,159
Concrete Work for Small Structure-2	1,091	m^3	1517.6	2518.1	1,655,255	2,746,504	4,401,758
Formwork F2 (for Small Sized Structure)	3,505	m^2	384.5	70.9	1,347,526	248,586	1,596,113
Reinforcing Bar (Grade 60)	87	ton	25785.1	47542.7	2,243,304	4,136,212	6,379,516
	Subtotal				*85,349,968*	*230,565,165*	*315,915,133*
Grand Total					*97,225,228*	*255,061,350*	*352,286,579*

Cataggaman Revetment Project *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Earth Work							
Clearing and Grubbing	3,778	m^2	8.1	15.9	30,536	60,096	90,632
Removal and Stripping of Topsoil	3,778	m^2	186.3	367.0	703,634	1,386,390	2,090,024
Excavation and Loading -1	458,815	m^3	22.6	47.6	10,350,729	21,856,723	32,207,452
Hauling - 2 km -1	458,815	m^3	30.1	60.5	13,791,154	27,777,908	41,569,063
Dike Embankment	458,815	m^3	49.2	103.7	22,569,271	47,568,177	70,137,448
Grass Sodding	4,465	m^2	62.8	5.1	280,188	22,789	302,977
	Subtotal				*47,725,513*	*98,672,084*	*146,397,596*
Revetment Works							
Stone Masonry/Wet Stone Masonry-1	51,615	m^2	843.3	579.9	43,526,670	29,929,944	73,456,614
Gravel Bedding and Backfill	7,742	m^3	989.4	239.0	7,659,904	1,850,597	9,510,501
Gabion Mattress, w/ Filter Cloth Bedding	0	m^3	2602.0	6402.9	0	0	0
Gabion Mattress (Local Made)	72,413	m^3	2166.4	1420.3	156,876,685	102,846,519	259,723,204
Furnishing Steel Sheet Pile	3,704	ton	8685.0	78165.3	32,166,985	289,502,865	321,669,850
Vibro-Hummer Piling of SSP Type IV-w	10,372	m^2	151.4	283.7	1,570,274	2,942,620	4,512,894
Concrete Work for Small Structure-2	2,427	m^3	1517.6	2518.1	3,683,706	6,112,239	9,795,945
Formwork F2 (for Small Sized Structure)	6,905	m^2	384.5	70.9	2,654,834	489,753	3,144,587
Reinforcing Bar (Grade 60)	194	ton	25785.1	47542.7	5,002,309	9,223,277	14,225,586
	Subtotal				*253,141,366*	*442,897,814*	*696,039,179*
Grand Total					*300,866,879*	*541,569,897*	*842,436,776*

Alibago Revetment Project *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Earth Work							
Clearing and Grubbing	12,206	m^2	8.1	15.9	98,667	194,177	292,845
Removal and Stripping of Topsoil	12,206	m^2	186.3	367.0	2,273,541	4,479,624	6,753,166
Excavation and Loading -1	301,563	m^3	22.6	47.6	6,803,171	14,365,657	21,168,828
Hauling - 2 km -1	301,563	m^3	30.1	60.5	9,064,442	18,257,444	27,321,886
Dike Embankment	301,563	m^3	49.2	103.7	14,833,990	31,264,894	46,098,884
	Subtotal				*33,073,811*	*68,561,797*	*101,635,609*
Revetment Works							
Stone Masonry/Wet Stone Masonry-1	34,817	m^2	843.3	579.9	29,361,001	20,189,303	49,550,304
Gravel Bedding and Backfill	5,223	m^3	989.4	239.0	5,167,003	1,248,324	6,415,327
Gabion Mattress, w/ Filter Cloth Bedding	0	m^3	2602.0	6402.9	0	0	0
Gabion Mattress (Local Made)	5,776	m^3	2166.4	1420.3	12,513,305	8,203,577	20,716,882
Furnishing Steel Sheet Pile	2,498	ton	8685.0	78165.3	21,698,303	195,284,728	216,983,031
Vibro-Hummer Piling of SSP Type IV-w	10,349	m^2	151.4	283.7	1,566,920	2,936,335	4,503,256
Concrete Work for Small Structure-2	1,637	m^3	1517.6	2518.1	2,484,851	4,123,023	6,607,874
Formwork F2 (for Small Sized Structure)	4,658	m^2	384.5	70.9	1,790,823	330,364	2,121,187
Reinforcing Bar (Grade 60)	131	ton	25785.1	47542.7	3,377,848	6,228,089	9,605,937
	Subtotal				*77,960,055*	*238,543,743*	*316,503,798*
Grand Total					*111,033,867*	*307,105,540*	*418,139,406*

Table 7.3 Compensation Cost

Project / Item / Description	Quantity	Unit	Unit Cost (Php)	Total Cost (Php)	Remarks
Cagayan River Revetment Construction Project					
House Relocation					
Formal Dwellers	10	house	350,000	3,500,000	inclusive of Livelihood Support
Infromal Dwellers	10	family	100,000	1,000,000	Livilihood Support
Land Acquisition	240		500	120,000	Cagayan:0.8km x 3m x 10%
	270		500	135,000	Cagayan:0.9km x 3m x 10%
	420		500	210,000	Cagayan:1.4km x 3m x 10%
	280,000	m^2	30	8,400,000	for Alibago
	100,000	m^2	30	3,000,000	for Enrile
	150,000	m^2	30	4,500,000	for Cataggaman
	Total			20,865,000	
Summary					
House Relocation				4,500,000	
Land Acquisition				15,900,000	
Grand Total				20,400,000	

Table 7.4 Project Cost Excluding Contingencies

Objective / **Imus Retarding Basin**	Cost L/C	Cost F.C	Cost Total	Remarks	
Construction Cost (Construction Base Cost)	*590,584,000*	*1,280,332,000*	*1,870,916,000*		– (A)
Estimated Direct Cost + OPC	509,125,000	1,103,736,000	1,612,861,000		
Mobilization & Demobilization	5,091,000	11,037,000	16,128,000	1.0%	of Estimated Direct Cost
Site Expenses	25,456,000	55,186,000	80,642,000	5.0%	of Estimated Direct Cost
Temporary Work	50,912,000	110,373,000	161,285,000	10.0%	of Estimated Direct Cost
Compensation Cost (Base Cost)	*20,400,000*	*0*	*20,400,000*		– (B)
House Relocation & Livelihood Support	4,500,000		4,500,000		
Land Acquisition	15,900,000		15,900,000		
Administration Cost (Base Cost)	*94,565,000*		*94,565,000*	5.0%	of (A) + (B)
Engineering Service Cost (Base Cost)	*119,737,000*	*179,606,000*	*299,343,000*		– (C)
Detailed Design Engineering	44,901,000	67,352,000	112,253,000	6.0%	of (A)
Supervision	74,836,000	112,254,000	187,090,000	10.0%	of (A)
Tax and Duties	*260,432,000*		*260,432,000*	12.0%	of (A) + (C)
Total	***1,085,718,000***	***1,459,938,000***	***2,545,656,000***		

Table 7.5 Assumed O&M Cost for Revetment to be Constructed in Cagayan River Flood Control Project

Item of O & M					Annual		Unit Cost		Cost			Remarks
General	Item	Description	Frequency	Unit Item	Q'ty	Unit	L/C	F/C	L/C	F/C	Total	
Inspection												
	Inspection	Conducted by City and Municipal Government	Monthly	Inspector	6		Salary				0	2 person x 12months
				Gasoline	360	litre	10	40	*3,600*	*14,400*	*18,000*	10litre x 12months
Maintenance												
	Preventive	Conducted by City and Municipal Government	Semiannually	Labor (Residential P.)	10	persons	200		2,000	0	2,000	Based on Bayanihan
				Small Truck	16	hours	195	455	3,120	7,280	10,400	2cargo truck x 8hours x 2
				Leaders	4		Salary				0	
				Plastic Garbage Bag etc	1	L.S.	30000		30,000	0	30,000	for Garbage Collection
				Subtotal							*42,400*	
	Corrective (Repair of Structure)	Conducted by Provincial Government or DPWH	As Required	1% for New Masonry and Gabion	1	L.S.	2,988,108	2,223,479	*2,988,108*	*2,223,479*	*5,211,587*	
Operation												
	In Flood	Personnel committed	1year contract	Personnel committed	12	months	3000	0	*36,000*	*0*	*36,000*	2 persons x 3Locations
Grand Total									*3,027,708*	*2,237,879*	*5,307,987*	

Table 7.6 (1/2) Estimation of Damage by Erosion at Three (3) Sites

Collataral Cost for Revetment Works

Alibago New Road Project *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Earth Work							
Clearing and Grubbing	40,000	m^2	8.1	15.9	323,328	636,311	959,639
Removal and Stripping of Topsoil	40,000	m^2	186.3	367.0	7,450,295	14,679,532	22,129,827
Purchasing Soil	40,000	m^2	200	0	8,000,000	0	8,000,000
Road Embankment	60,000	m^3	82.0	172.8	4,919,035	10,367,616	15,286,651
Subtotal					*20,692,658*	*25,683,459*	*46,376,118*
Road Works							
Subgrade Preparation	20,000	m^2	41.5	27.7	830,369	554,564	1,384,933
Sub-base Course	3,000	m^3	830.9	328.5	2,492,794	985,361	3,478,155
Base Course	3,000	m^3	841.6	349.3	2,524,935	1,047,964	3,572,899
Portland Cement Concrete Pavement	20,000	m^2	531.4	777.3	10,628,159	15,546,046	26,174,205
Subtotal					*16,476,258*	*18,133,934*	*34,610,192*
Total-1					*37,168,916*	*43,817,393*	*80,986,309*
Compensation Cost							
Land Acquisition for Road	40,000	m^2	500.0	0.0	20,000,000	0	20,000,000
Subtotal					*20,000,000*	*0*	*20,000,000*
Total-2					*20,000,000*	*0*	*20,000,000*
Grand Total					*57,168,916*	*43,817,393*	*100,986,309*

Enrile New Road Project *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Earth Work							
Clearing and Grubbing	44,000	m^2	8.1	15.9	355,661	699,942	1,055,603
Removal and Stripping of Topsoil	44,000	m^2	186.3	367.0	8,195,325	16,147,486	24,342,810
Purchasing Soil	66,000	m^3	200.0	0.0	13,200,000	0	13,200,000
Road Embankment	66,000	m^3	82.0	172.8	5,410,939	11,404,378	16,815,316
Subtotal					*27,161,924*	*28,251,805*	*55,413,729*
Bridge Works							
L=60m PC Girder Bridge/piles	1	L.S.	15000000.0	20000000.0	15,000,000	20,000,000	35,000,000
Subtotal					*15,000,000*	*20,000,000*	*35,000,000*
Road Works							
Subgrade Preparation	22,000	m^2	41.5	27.7	913,406	610,020	1,523,426
Sub-base Course	3,300	m^3	830.9	328.5	2,742,074	1,083,897	3,825,970
Base Course	3,300	m^3	841.6	349.3	2,777,428	1,152,760	3,930,188
Portland Cement Concrete Pavement	22,000	m^2	531.4	777.3	11,690,975	17,100,651	28,791,626
Subtotal					*18,123,883*	*19,947,327*	*38,071,211*
Total-1					*60,285,807*	*68,199,133*	*128,484,940*
Compensation Cost							
Land Acquisition for Road	44,000	m^2	500.0	0.0	22,000,000	0	22,000,000
Subtotal					*22,000,000*	*0*	*22,000,000*
Total-2					*22,000,000*	*0*	*22,000,000*
Grand Total					*82,285,807*	*68,199,133*	*150,484,940*

Alibago Existing Infrastructure Property *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Road Work							
Sub-base Course	2,400	m^3	830.9	328.5	1,994,235	788,289	2,782,524
Base Course	2,400	m^3	841.6	349.3	2,019,948	838,371	2,858,319
Portland Cement Concrete Pavement	16,000	m^2	531.4	777.3	8,502,528	12,436,837	20,939,364
Subtotal					*12,516,711*	*14,063,496*	*26,580,207*
Other Infrastructure							
Water, Drainage, and Elecricity	40	has	1000000.0	0.0	40,000,000	0	40,000,000
Subtotal					*40,000,000*	*0*	*40,000,000*
Grand Total					*52,516,711*	*14,063,496*	*66,580,207*

Table 7.6 (1/2) Estimation of Damage by Erosion at Three (3) Sites

Enrile Existing Infrastructural Property *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Road Work							
Sub-base Course	1,500	m3	830.9	328.5	1,246,397	492,680	1,739,077
Base Course	1,500	m3	841.6	349.3	1,262,467	523,982	1,786,449
Portland Cement Concrete Pavement	10,000	m2	531.4	777.3	5,314,080	7,773,023	13,087,103
		Subtotal			*7,822,944*	*8,789,685*	*16,612,629*
Other Infrastructure							
Water, Drainage, and Elecricity	30	has	1000000.0	0.0	30,000,000	0	30,000,000
		Subtotal			*30,000,000*	*0*	*30,000,000*
Grand Total					*37,822,944*	*8,789,685*	*46,612,629*

Cataggaman Existing Infra. Property *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Road Work							
Sub-base Course	9,000	m3	830.9	328.5	7,478,383	2,956,082	10,434,465
Base Course	9,000	m3	841.6	349.3	7,574,804	3,143,891	10,718,696
Portland Cement Concrete Pavement	60,000	m2	531.4	777.3	31,884,478	46,638,138	78,522,616
		Subtotal			*46,937,665*	*52,738,112*	*99,675,777*
Other Infrastructure							
Water, Drainage, and Elecricity	80	has	1000000.0	0.0	80,000,000	0	80,000,000
		Subtotal			*80,000,000*	*0*	*80,000,000*
Grand Total					*126,937,665*	*52,738,112*	*179,675,777*

Others *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Present House Property with Assets							
Alibago	300	unit	150,000	0.0	45,000,000	0	45,000,000
Enrile	100	unit	150,000	0.0	15,000,000	0	15,000,000
Cataggaman	2,000	unit	150,000	0.0	300,000,000	0	300,000,000
		Subtotal			*360,000,000*	*0*	*360,000,000*
House Transferring Cost							
Alibago	300	unit	300,000	0.0	90,000,000	0	90,000,000
Enrile	100	unit	300,000	0.0	30,000,000	0	30,000,000
Cataggaman	2,000	unit	300,000	0.0	600,000,000	0	600,000,000
		Subtotal			*720,000,000*	*0*	*720,000,000*
Largescale Building Propety							
Cataggaman	20	unit	3,780,000	0.0	75,600,000	0	75,600,000
		Subtotal			*75,600,000*	*0*	*75,600,000*
Largescale Building transferring Cost							
Cataggaman	20	unit	4,000,000	0.0	80,000,000	0	80,000,000
		Subtotal			*80,000,000*	*0*	*80,000,000*
Lost of Land							
Alibago	400,000	m^2	500.0	0.0	200,000,000	0	200,000,000
Enrile	300,000	m^2	500.0	0.0	150,000,000	0	150,000,000
Cataggaman	800,000	m^2	500.0	0.0	400,000,000	0	400,000,000
		Subtotal			*750,000,000*	*0*	*750,000,000*
Purchasing of Land							
Alibago	400,000	m^2	500.0	0.0	200,000,000	0	200,000,000
Enrile	300,000	m^2	500.0	0.0	150,000,000	0	150,000,000
Cataggaman	800,000	m^2	500.0	0.0	400,000,000	0	400,000,000
		Subtotal			*750,000,000*	*0*	*750,000,000*
Grand Total					*2,735,600,000*	*0*	*2,735,600,000*

Table 7.7 Sumarry of Estimation of Damage by Erosion at Three (3) Sites

Summary of Collateral Cost *Major* Work Description	Quantity	Unit	Unit Cost L/C	Unit Cost F/C	Total Cost L/C	Total Cost F/C	Total Cost Total
Infrastructure Property and Collateral Construction							
Alibago	1	L.S.			89,685,626	57,880,890	147,566,516
Enrile	1	L.S.			98,108,752	76,988,818	175,097,570
Cataggaman	1	L.S.			126,937,665	52,738,112	179,675,777
	Subtotal				*314,732,043*	*187,607,820*	*502,339,863*
House and Other Buildings							
Alibago	1	L.S.			135,000,000	0	135,000,000
Enrile	1	L.S.			45,000,000	0	45,000,000
Cataggaman	1	L.S.			1,055,600,000	0	1,055,600,000
	Subtotal				*1,235,600,000*	*0*	*1,235,600,000*
Land and Lot							
Alibago	1	L.S.			420,000,000	0	420,000,000
Enrile	1	L.S.			322,000,000	0	322,000,000
Cataggaman	1	L.S.			800,000,000	0	800,000,000
	Subtotal				*1,542,000,000*	*0*	*1,542,000,000*
Grand Total					*3,092,332,043*	*187,607,820*	*3,279,939,863*
				／30years	*103,077,735*	*6,253,594*	*109,331,329*

Summary of Annual Lost of Product *Major* Work Description	Quantity	Unit	Unit Annual Loss L/C	Unit Annual Loss F/C	Total Annual L/C	Total Annual F/C	Total Annual Total
Land and Lot							
Alibago	40	ha	1901743.7	0.0	76,069,750	0	76,069,750
Enrile	30	ha	1901743.7	0.0	57,052,312	0	57,052,312
Cataggaman	80	ha	8946110.0	0.0	715,688,800	0	715,688,800
	Subtotal				*848,810,862*	*0*	*848,810,862*
							28,293,695

Table 7.8 Cash Stream of Cagayan River Control Project (Economic Cost)

Withtout Price Contingency (without Tax, etc (VAT)) million P.

No.	Year	Construction				Compe-	Admin.	Engineering Service Cost				O&M				Grand
		L/C		F/C	Total	nsation		L/C		F/C	Total	L/C		F/C	Total	Total
		Labor	M&E			L/C	L/C	Labor	M&E			Labor	M&E			
0	2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2010	0	0	0	0	10	0	0	0	0	0	0	0	0	0	11
2	2011	0	0	0	0	10	0	37	5	71	112	0	0	0	0	123
3	2012	14	99	248	360	0	18	18	2	35	56	0	0	0	0	434
4	2013	31	223	557	810	0	40	22	3	41	65	0	0	0	0	916
5	2014	24	173	433	630	0	31	18	2	35	56	0	1	1	2	719
6	2015	0	0	0	0	0	0	3	0	6	9	0	2	2	5	14
7	2016	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
8	2017	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
9	2018	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
10	2019	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
11	2020	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
12	2021	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
13	2022	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
14	2023	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
15	2024	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
16	2025	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
17	2026	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
18	2027	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
19	2028	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
20	2029	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
21	2030	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
22	2031	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
23	2032	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
24	2033	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
25	2034	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
26	2035	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
27	2036	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
28	2037	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
29	2038	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
30	2039	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
31	2040	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
32	2041	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
33	2042	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
34	2043	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
35	2044	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
36	2045	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
37	2046	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
38	2047	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
39	2048	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
40	2049	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
41	2050	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
42	2051	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
43	2052	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
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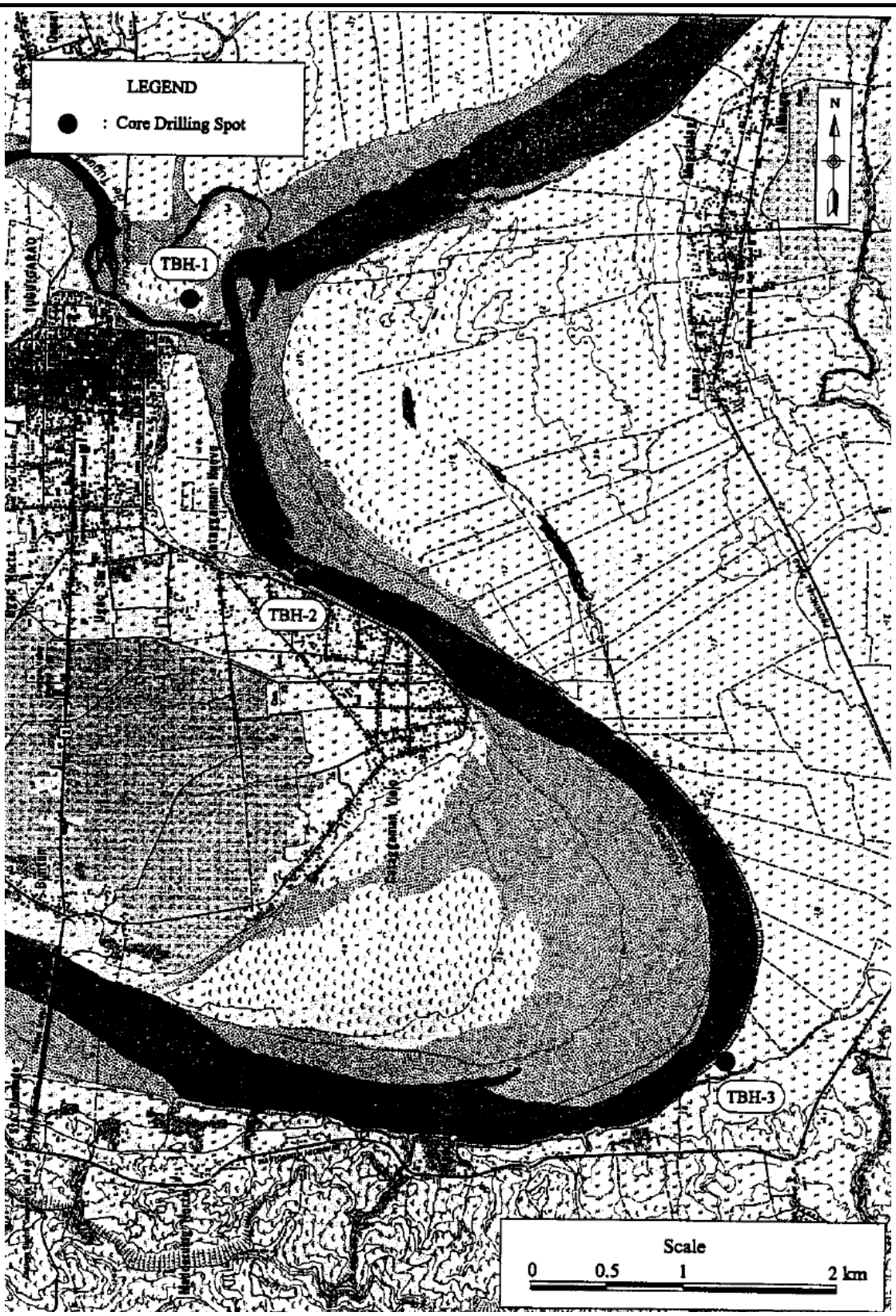
45	2054	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
46	2055	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
47	2056	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
48	2057	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
49	2058	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5
50	2059	0	0	0	0	0	0	0	0	0	0	0	2	2	5	5

Table 7.9 Economic Evaluation for Cagayan Rivers

(million Pesos)

Calendar Year	Year in Order	Economic Cost			Base of Benefit from Economic Product	Benefit to Be Derived			Cash Balance
		Project Cost	OM Cost	Total		Benefit Derived from Collateral Cost	Benefit Derived from Economic Product	Economic Benefit in Total	
2005	-4			0				0	0
2006	-3			0				0	0
2007	-2			0				0	0
2008	-1			0				0	0
2009	Base Year	0	0	0	28			0	0
2010	1	11	0	11	57	0	0	0	-11
2011	2	123	0	123	85	0	0	0	-123
2012	3	434	0	434	113	0	0	0	-434
2013	4	916	0	916	141	36	47	83	-833
2014	5	717	2	719	170	54	85	139	-580
2015	6	9	5	14	198	108	198	306	292
2016	7	0	5	5	226	108	226	334	329
2017	8	0	5	5	255	108	255	362	358
2018	9	0	5	5	283	108	283	391	386
2019	10	0	5	5	311	108	311	419	414
2020	11	0	5	5	340	108	340	447	442
2021	12	0	5	5	368	108	368	476	471
2022	13	0	5	5	396	108	396	504	499
2023	14	0	5	5	424	108	424	532	527
2024	15	0	5	5	453	108	453	561	556
2025	16	0	5	5	481	108	481	589	584
2026	17	0	5	5	509	108	509	617	612
2027	18	0	5	5	538	108	538	645	641
2028	19	0	5	5	566	108	566	674	669
2029	20	0	5	5	594	108	594	702	697
2030	21	0	5	5	622	108	622	730	725
2031	22	0	5	5	651	108	651	759	754
2032	23	0	5	5	679	108	679	787	782
2033	24	0	5	5	707	108	707	815	810
2034	25	0	5	5	736	108	736	843	839
2035	26	0	5	5	764	108	764	872	867
2036	27	0	5	5	792	108	792	900	895
2037	28	0	5	5	821	108	821	928	923
2038	29	0	5	5	849	108	849	957	952
2039	30	0	5	5	849	108	849	957	952
2040	31	0	5	5	849	108	849	957	952
2041	32	0	5	5	849	108	849	957	952
2042	33	0	5	5	849	108	849	957	952
2043	34	0	5	5	849	108	849	957	952
2044	35	0	5	5	849	108	849	957	952
2045	36	0	5	5	849	108	849	957	952
2046	37	0	5	5	849	108	849	957	952
2047	38	0	5	5	849	108	849	957	952
2048	39	0	5	5	849	108	849	957	952
2049	40	0	5	5	849	108	849	957	952
2050	41	0	5	5	849	108	849	957	952
2051	42	0	5	5	849	108	849	957	952
2052	43	0	5	5	849	108	849	957	952
2053	44	0	5	5	849	108	849	957	952
2054	45	0	5	5	849	108	849	957	952
2055	46	0	5	5	849	108	849	957	952
2056	47	0	5	5	849	108	849	957	952
2057	48	0	5	5	849	108	849	957	952
2058	49	0	5	5	849	108	849	957	952
2059	50	0	5	5	849	108	849	957	952
2060	51	0	5	5	849	108	849	957	952
2061	52	0	5	5	849	108	849	957	952
2062	53	0	5	5	849	108	849	957	952
2063	54	0	5	5	849	108	849	957	952
2064	55	0	5	5	849	108	849	957	952
2065	56	0	5	5	849	108	849	957	952
2066	57	0	5	5	849	108	849	957	952
2067	58	0	5	5	849	108	849	957	952
2068	59	0	5	5	849	108	849	957	952
2069	60	0	5	5	849	108	849	957	952
2070	61	0	5	5	849	108	849	957	952
2071	62	0	5	5	849	108	849	957	952
Total		2,210	278	2,487		6,235	40,705	46,940	44,453
Applied Discount Rate: 15 % according to a regulation of the nation.									
NPV				1,289				1,729	441
EIRR									18.64%
B/C									1.34

FIGURES



Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.1 Location Map of Boring in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

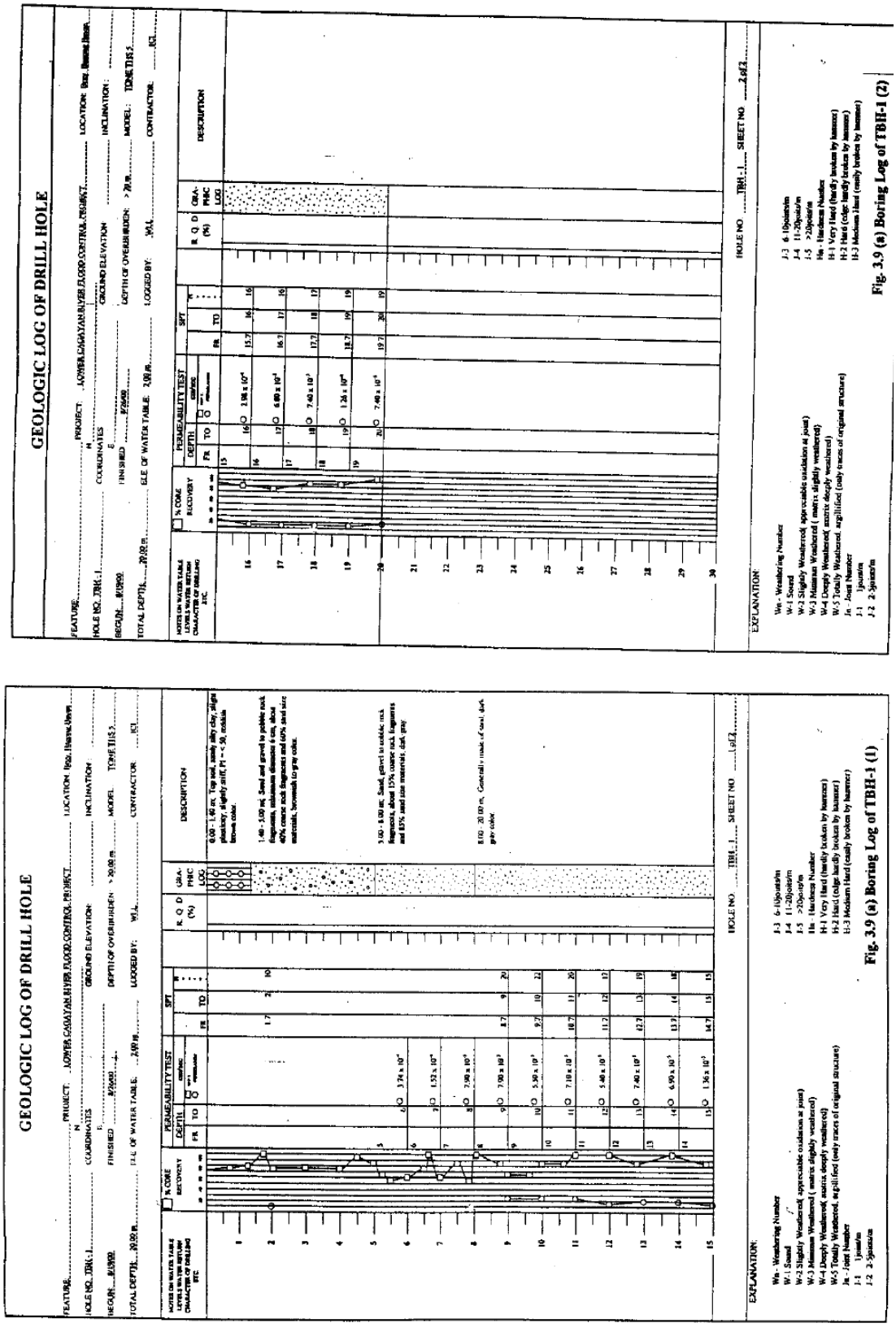
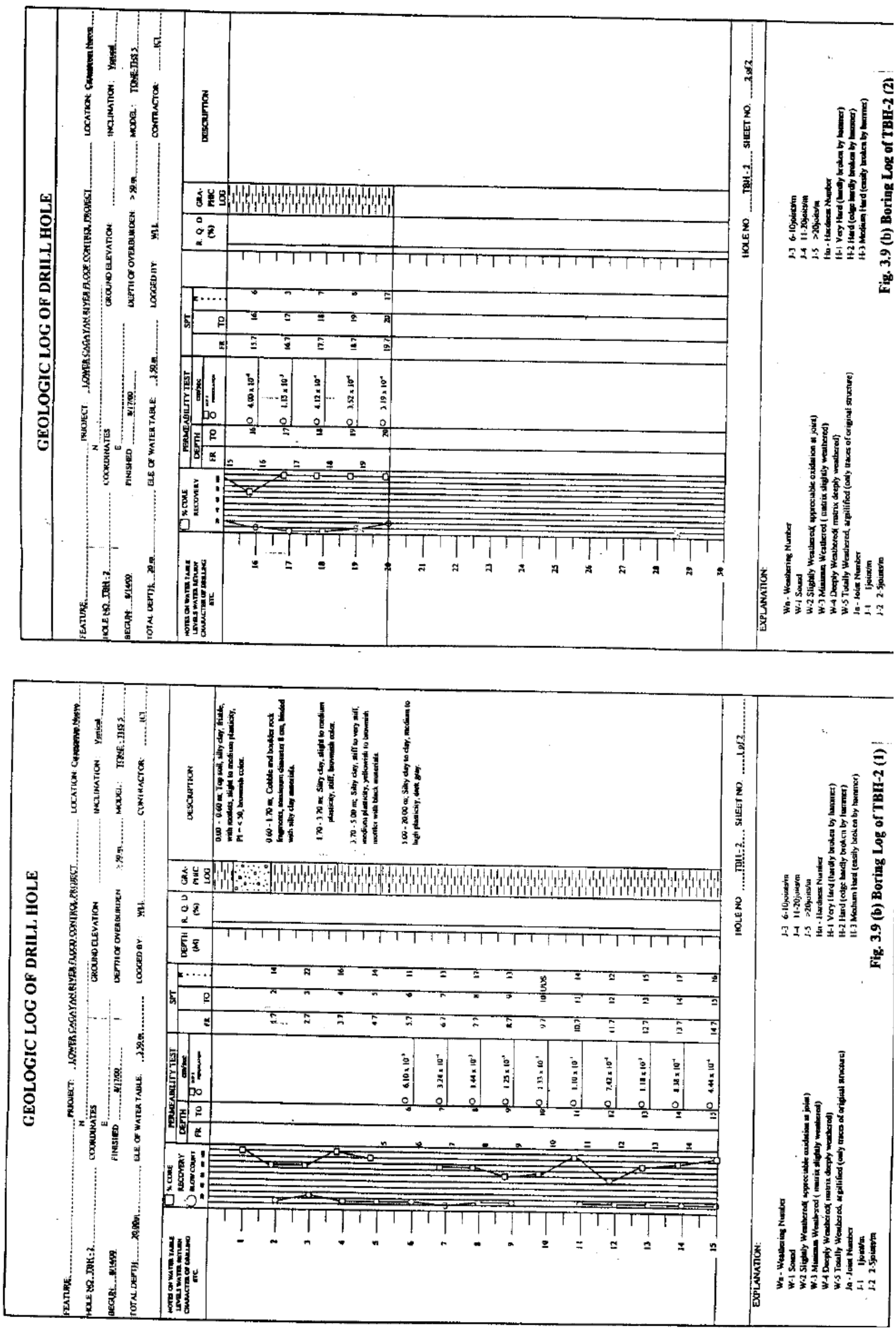


Fig. 3.9 (a) Boring Log of TBH-1 (1)

Fig. 3.9 (a) Boring Log of TBH-1 (2)

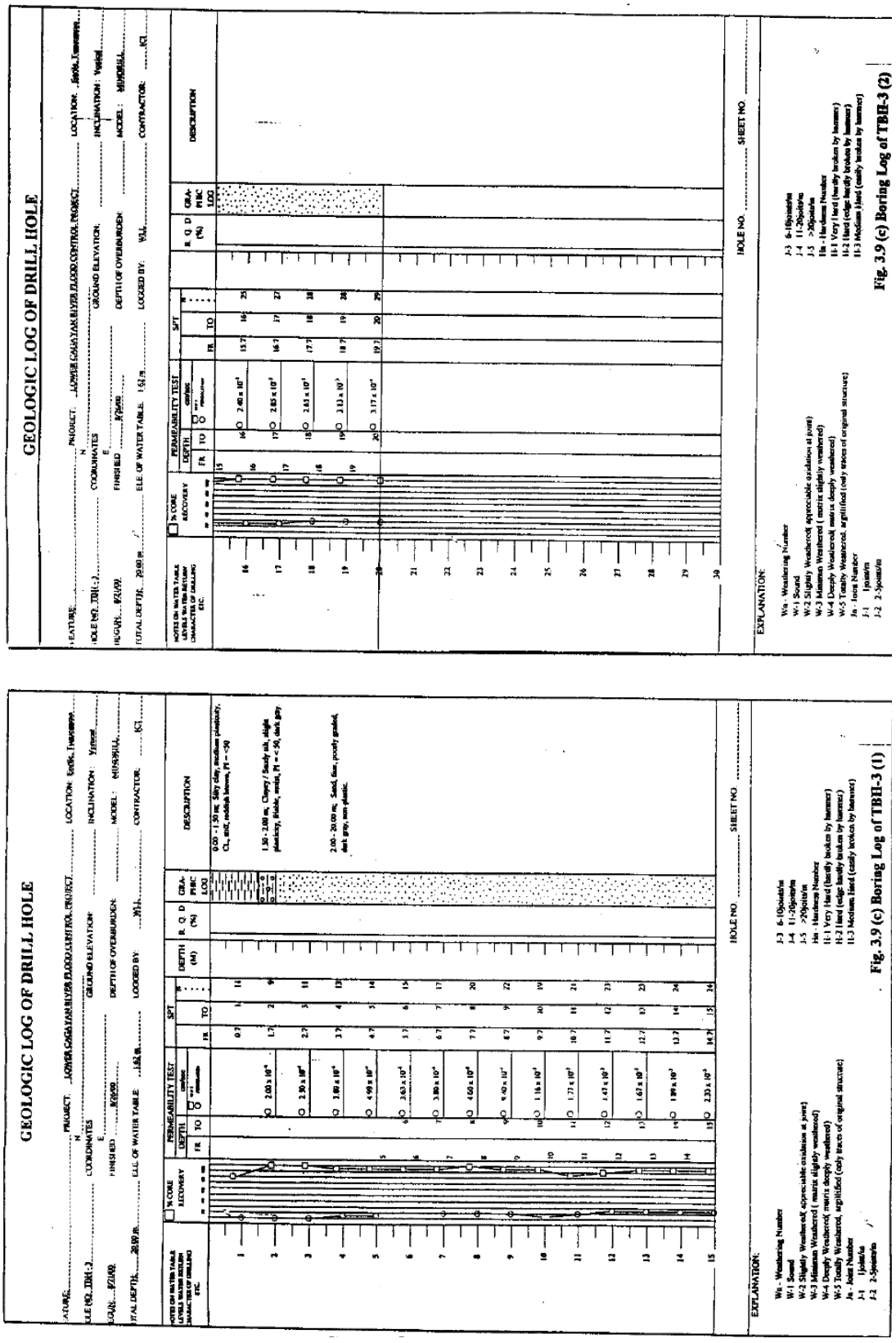
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.2 (1/3)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	The Bring Log Results (TBH-1)



Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.2 (2/3)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	The Bring Log Results (TBH-2)

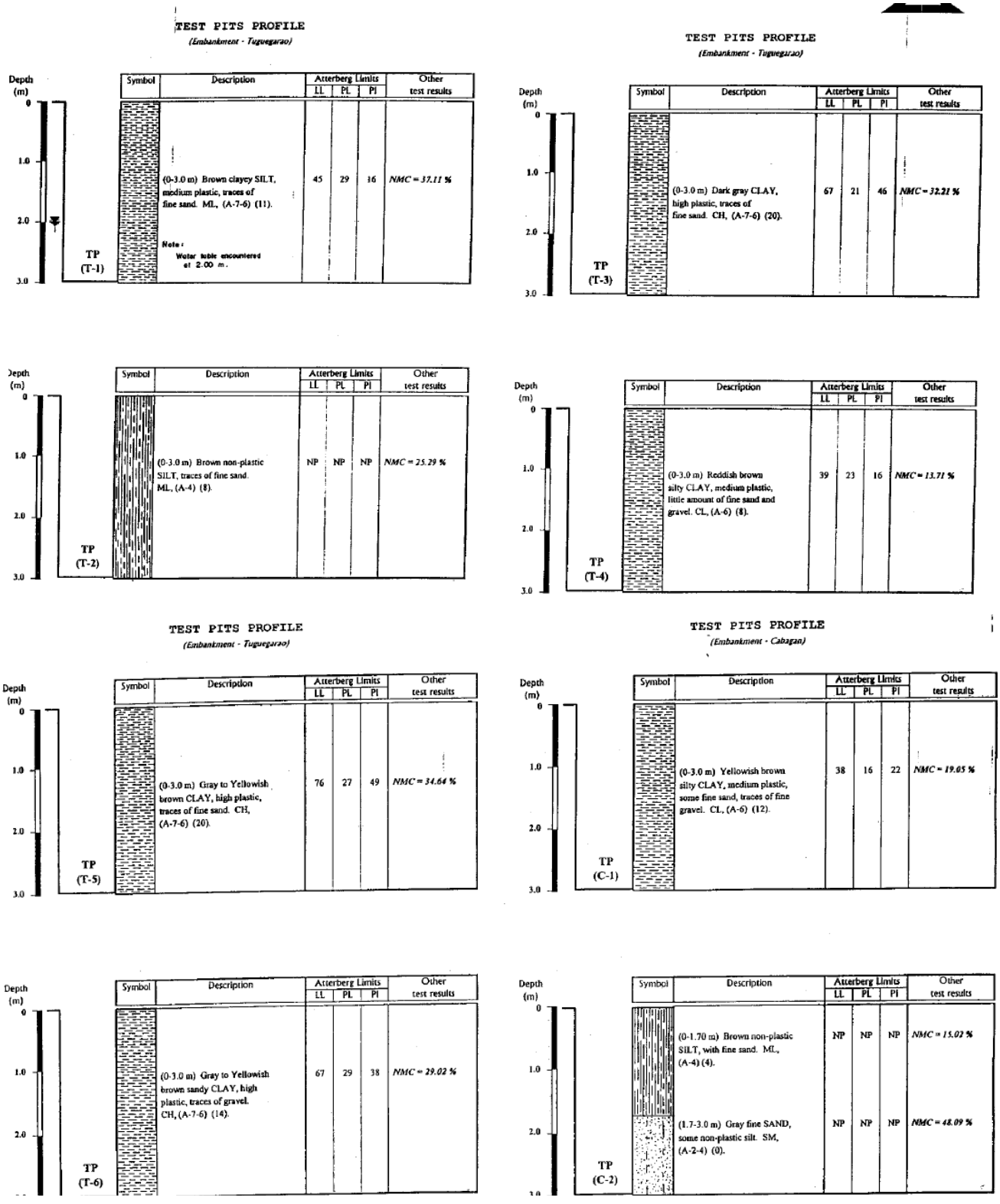


Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.2 (3/3)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	The Bring Log Results (TBH-3)

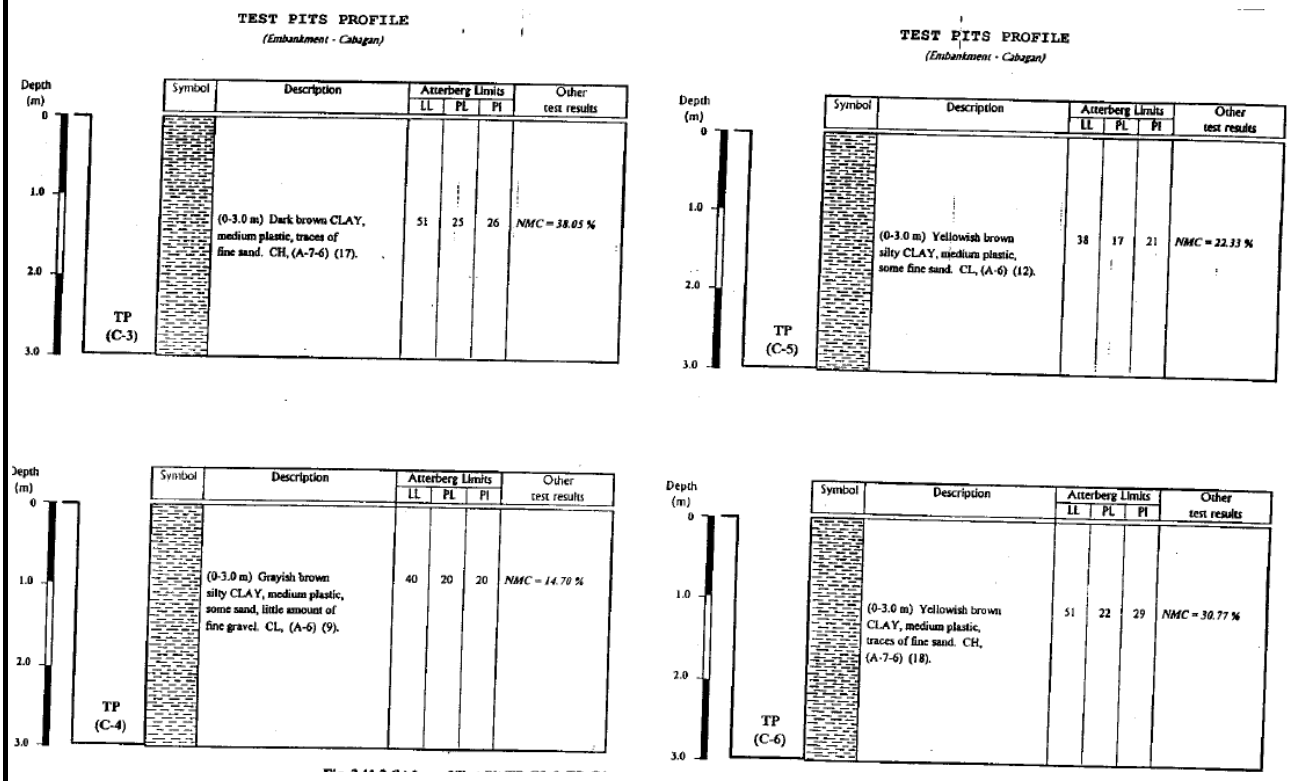
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.3 Location Map of Test Pits in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



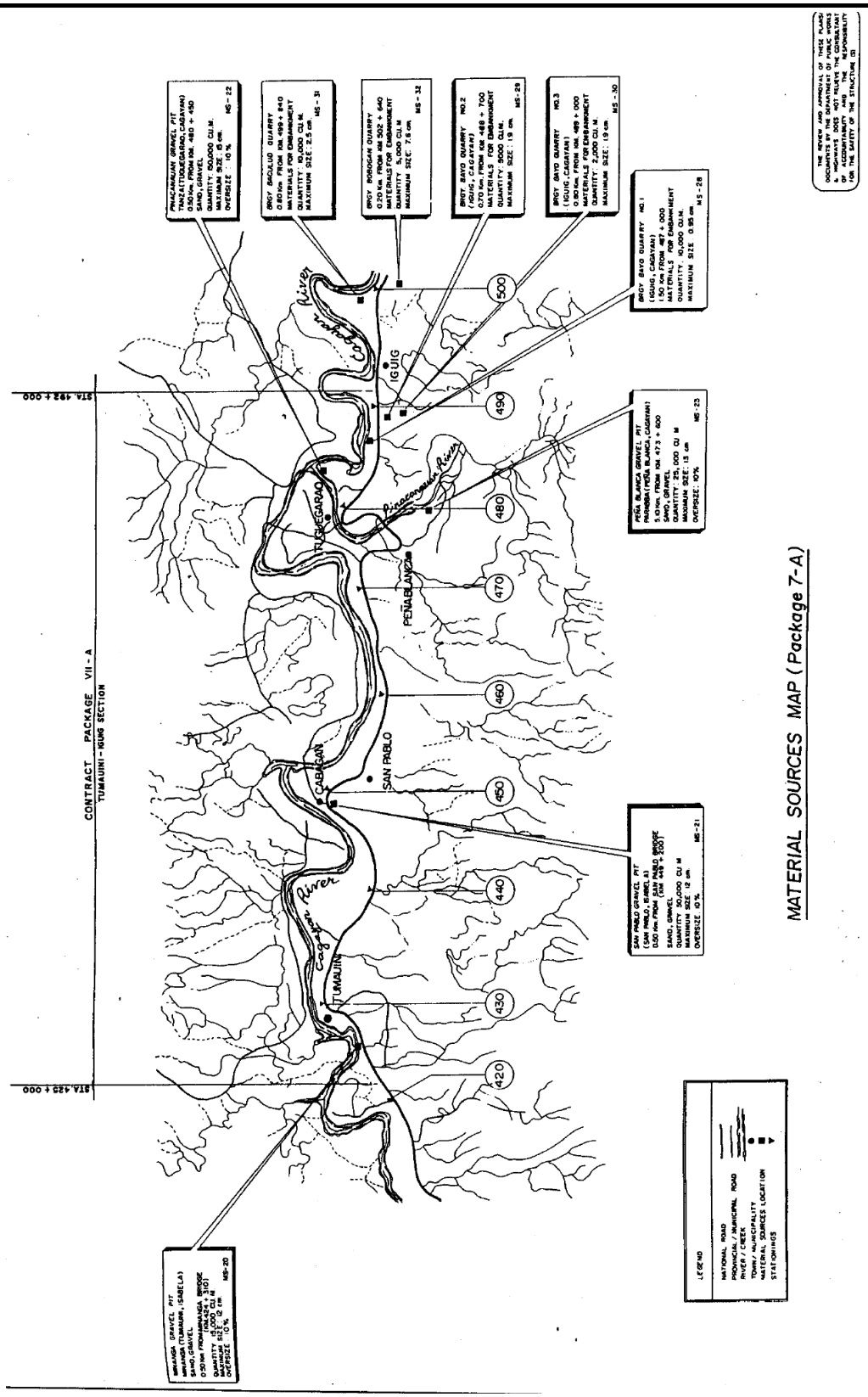
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.4 (1/2) Test Pits Profile Results in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



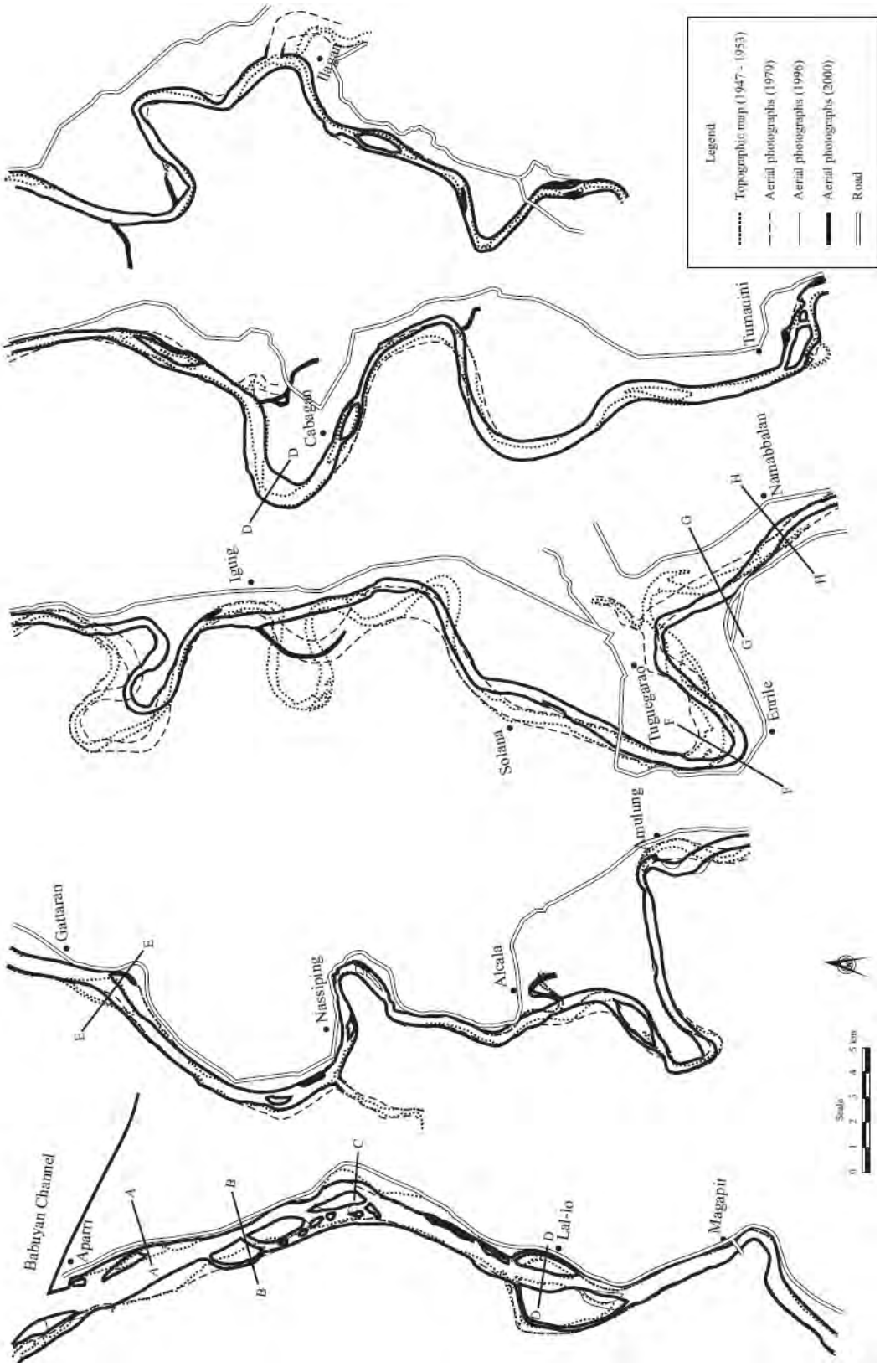
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.4 (2/2) Test Pits Profile Results in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



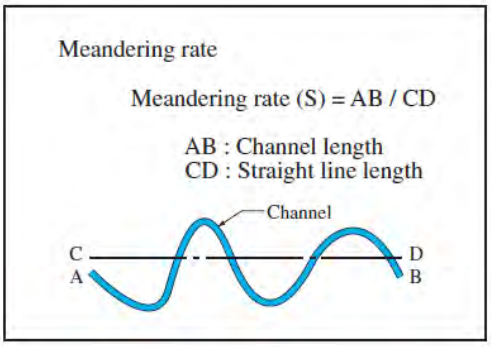
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.5 Location Map of Material Sources for Aggregates and Boulders
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



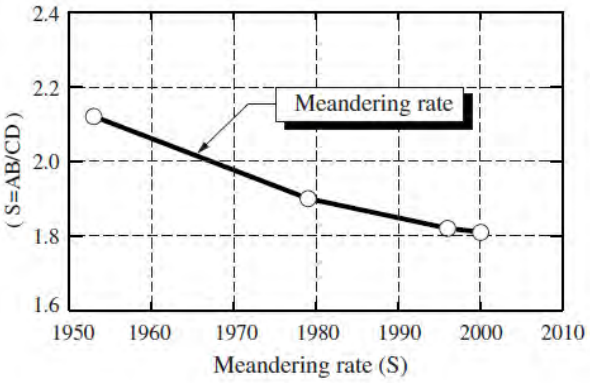
Source: 2002 F/S

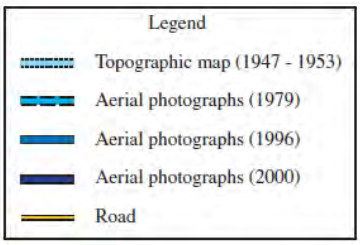
THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.6 River Course Shifting
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

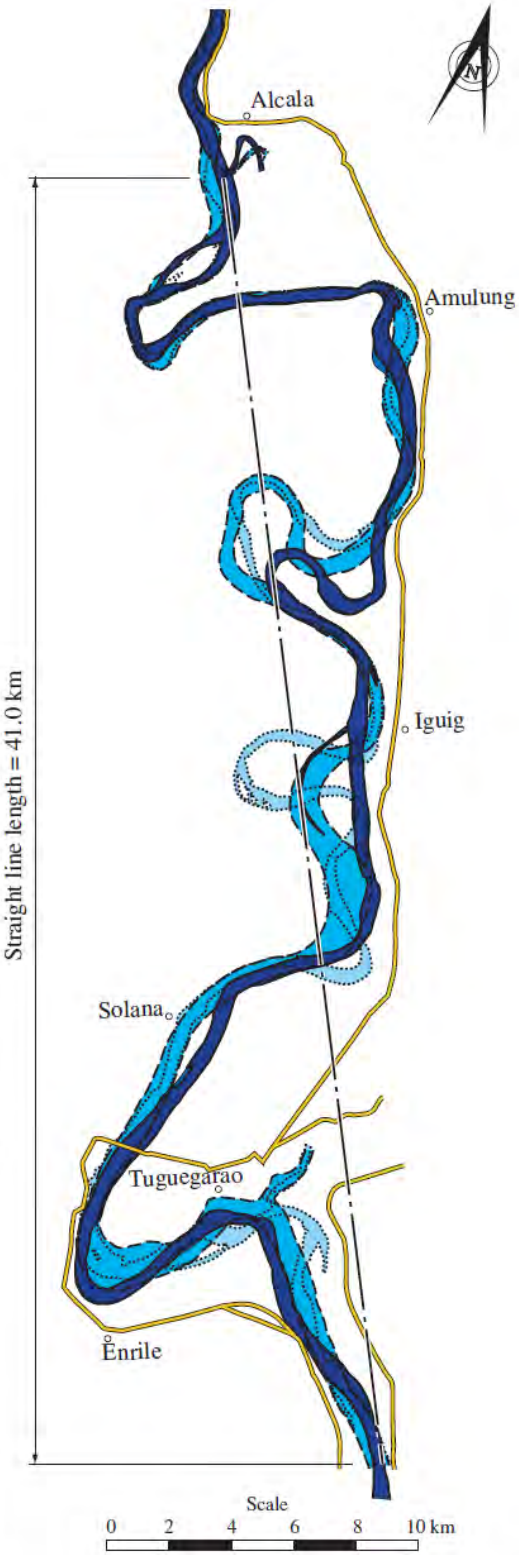


Meandering rate (S)

Year	AB (km)	CD (km)	S (AB/CD)
1953	87.0	41.0	2.12
1979	78.0	41.0	1.90
1996	74.8	41.0	1.82
2000	74.4	41.0	1.81

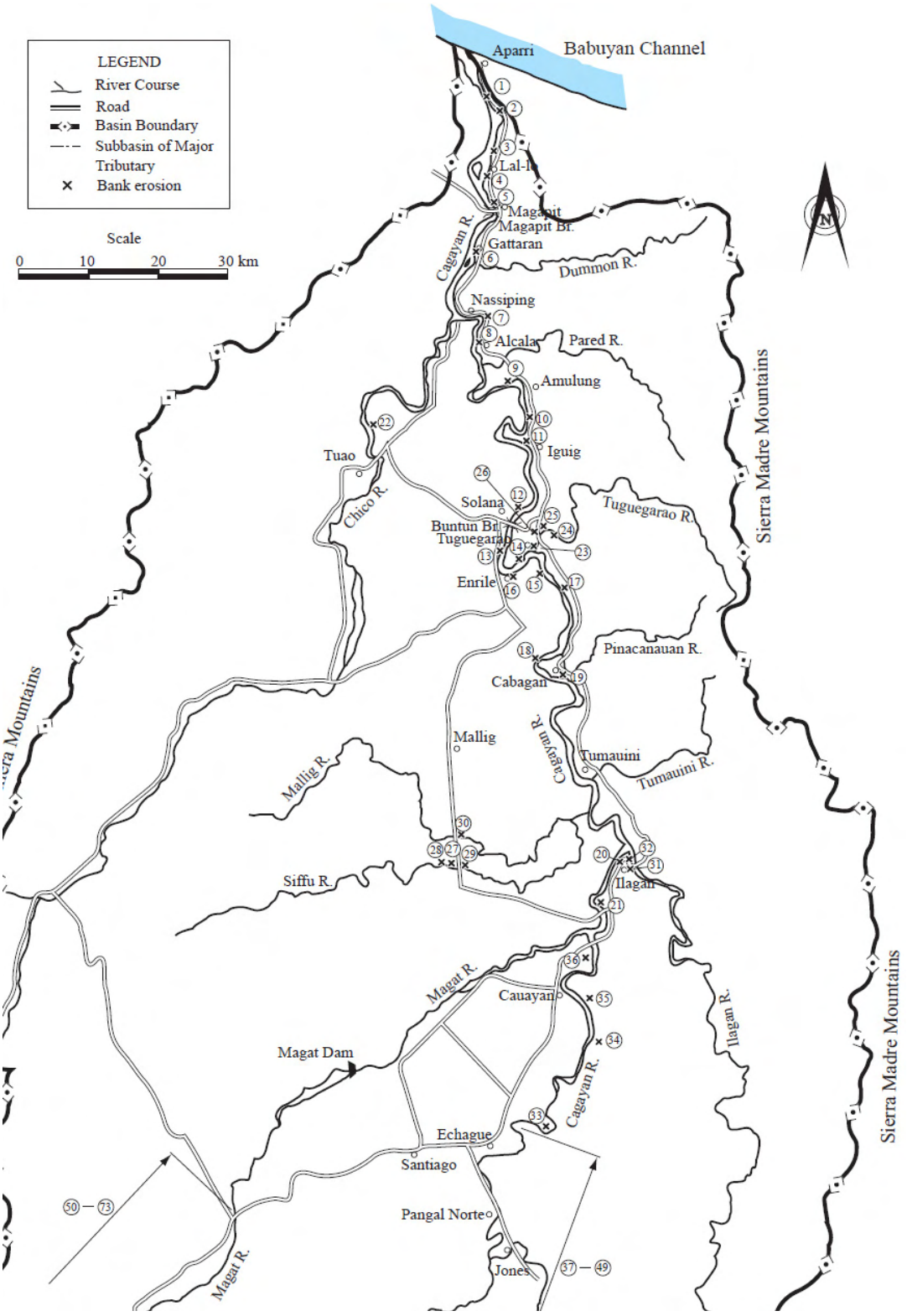






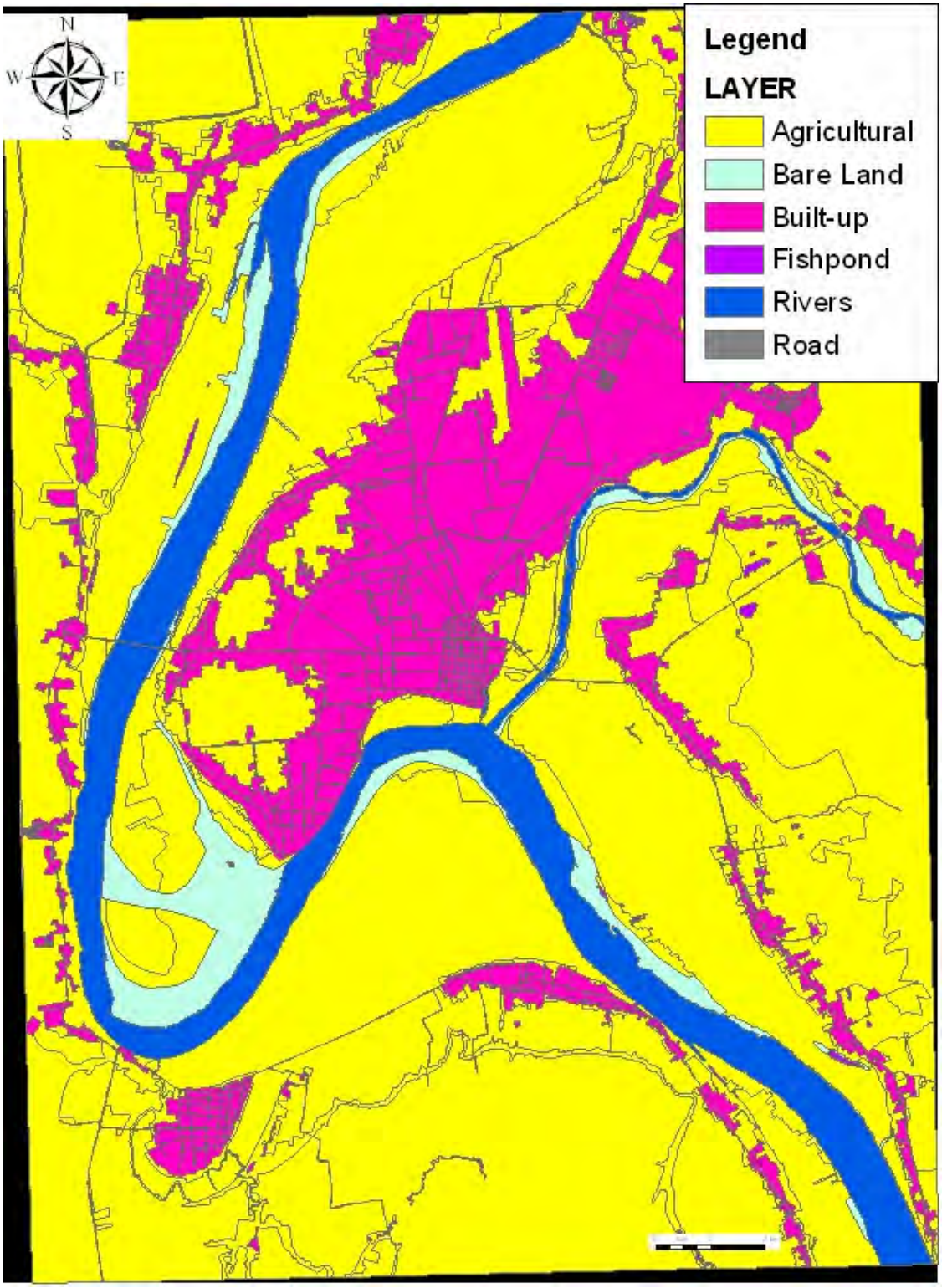
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.7
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	River Course Meandering



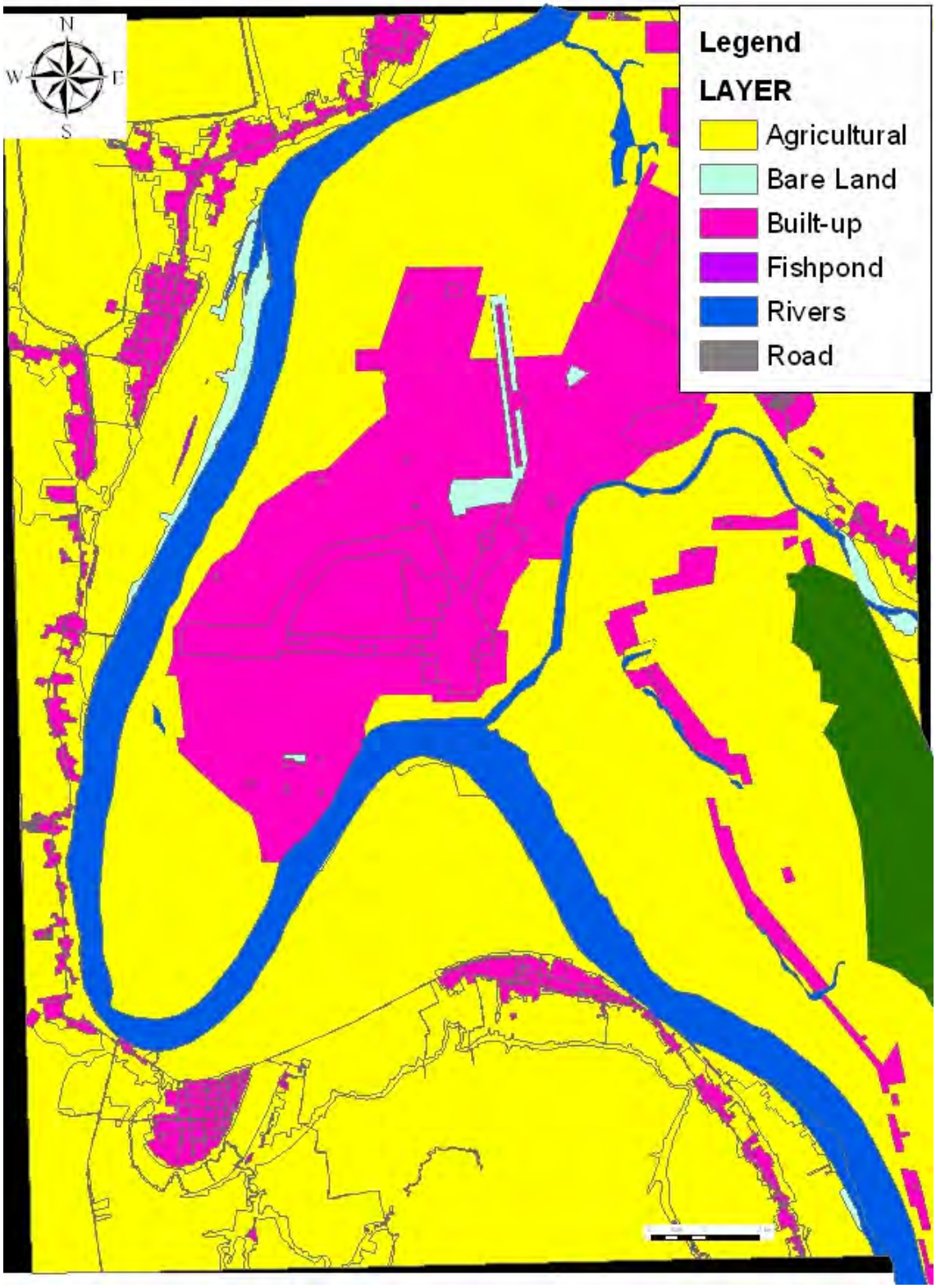
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure2.8
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	Critical Bank Erosion Sites



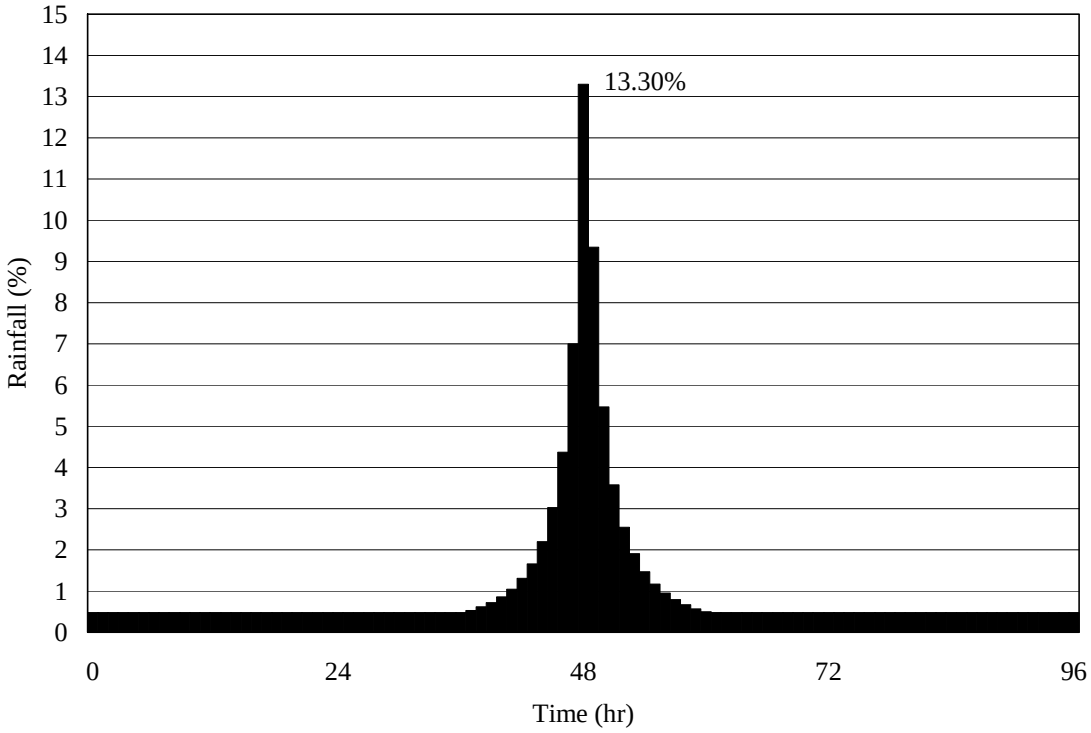
Source: Satellite Image by World View 2009

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure 3.1 Present Land Use Map in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

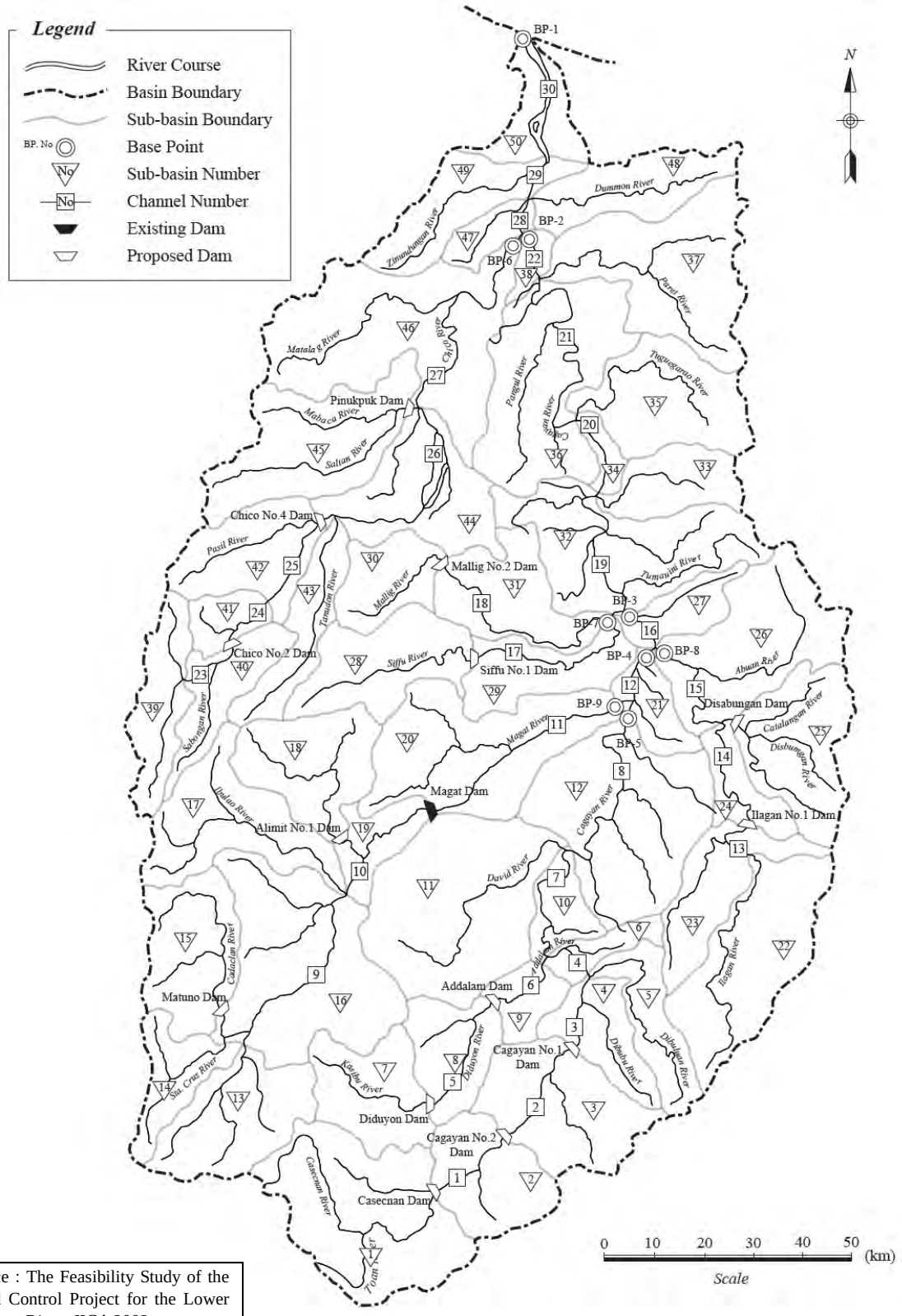


Source: CLUP and Satellite Image by Worldview 2008

THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure 4.1 Future Land Use Condition in/around Tuguegarao
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

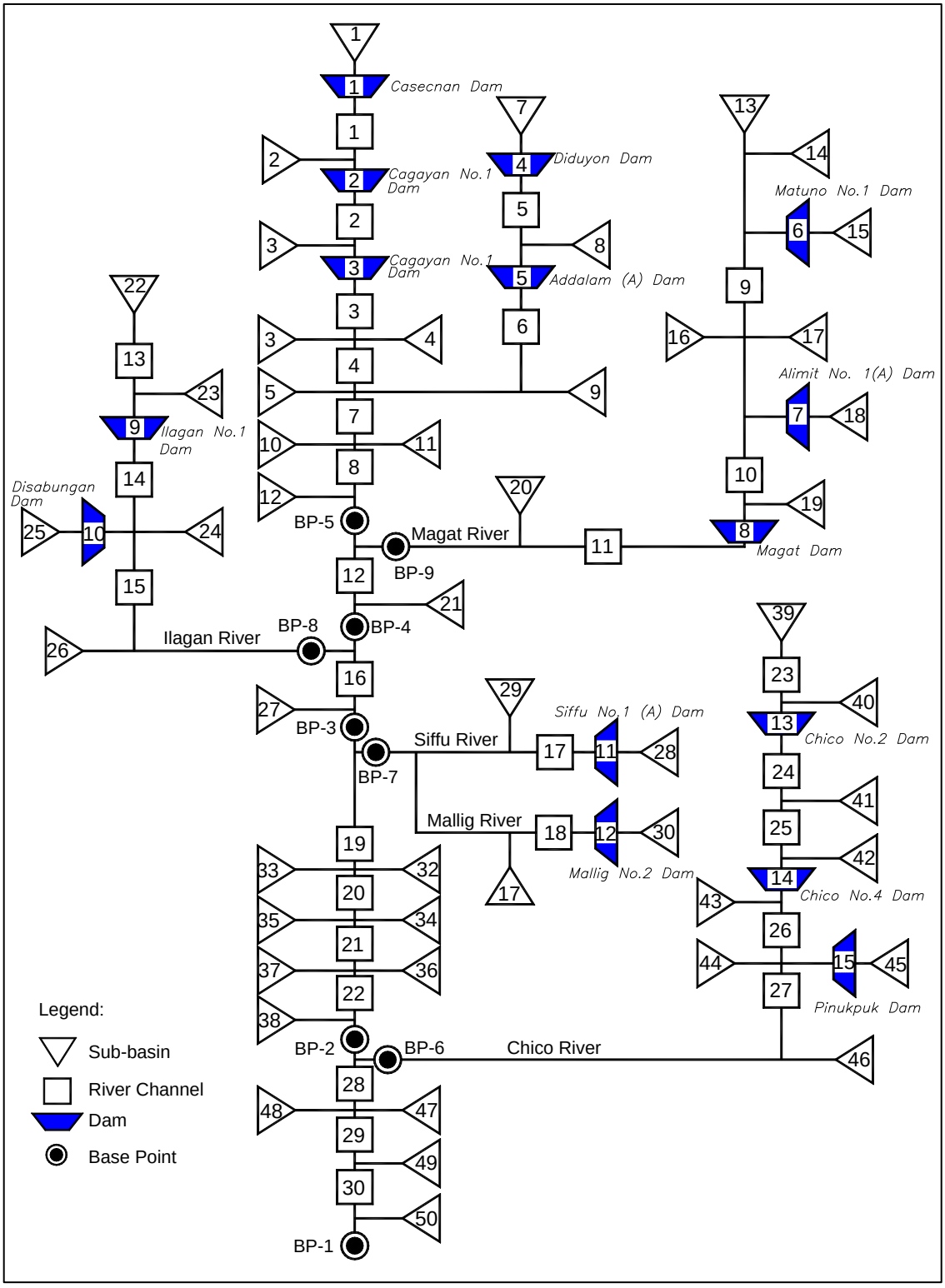


time (hr)	Rainfall (%)	time (hr)	Rainfall (%)	time (hr)	Rainfall (%)	time (hr)	Rainfall (%)
1	0.48	25	0.48	49	9.35	73	0.48
2	0.48	26	0.48	50	5.47	74	0.48
3	0.48	27	0.48	51	3.58	75	0.48
4	0.48	28	0.48	52	2.55	76	0.48
5	0.48	29	0.48	53	1.91	77	0.48
6	0.48	30	0.48	54	1.47	78	0.48
7	0.48	31	0.48	55	1.17	79	0.48
8	0.48	32	0.48	56	0.95	80	0.48
9	0.48	33	0.48	57	0.79	81	0.48
10	0.48	34	0.48	58	0.67	82	0.48
11	0.48	35	0.48	59	0.57	83	0.48
12	0.48	36	0.48	60	0.5	84	0.48
13	0.48	37	0.53	61	0.48	85	0.48
14	0.48	38	0.62	62	0.48	86	0.48
15	0.48	39	0.72	63	0.48	87	0.48
16	0.48	40	0.86	64	0.48	88	0.48
17	0.48	41	1.05	65	0.48	89	0.48
18	0.48	42	1.31	66	0.48	90	0.48
19	0.48	43	1.66	67	0.48	91	0.48
20	0.48	44	2.2	68	0.48	92	0.48
21	0.48	45	3.03	69	0.48	93	0.48
22	0.48	46	4.37	70	0.48	94	0.48
23	0.48	47	7	71	0.48	95	0.48
24	0.48	48	13.3	72	0.48	96	0.48

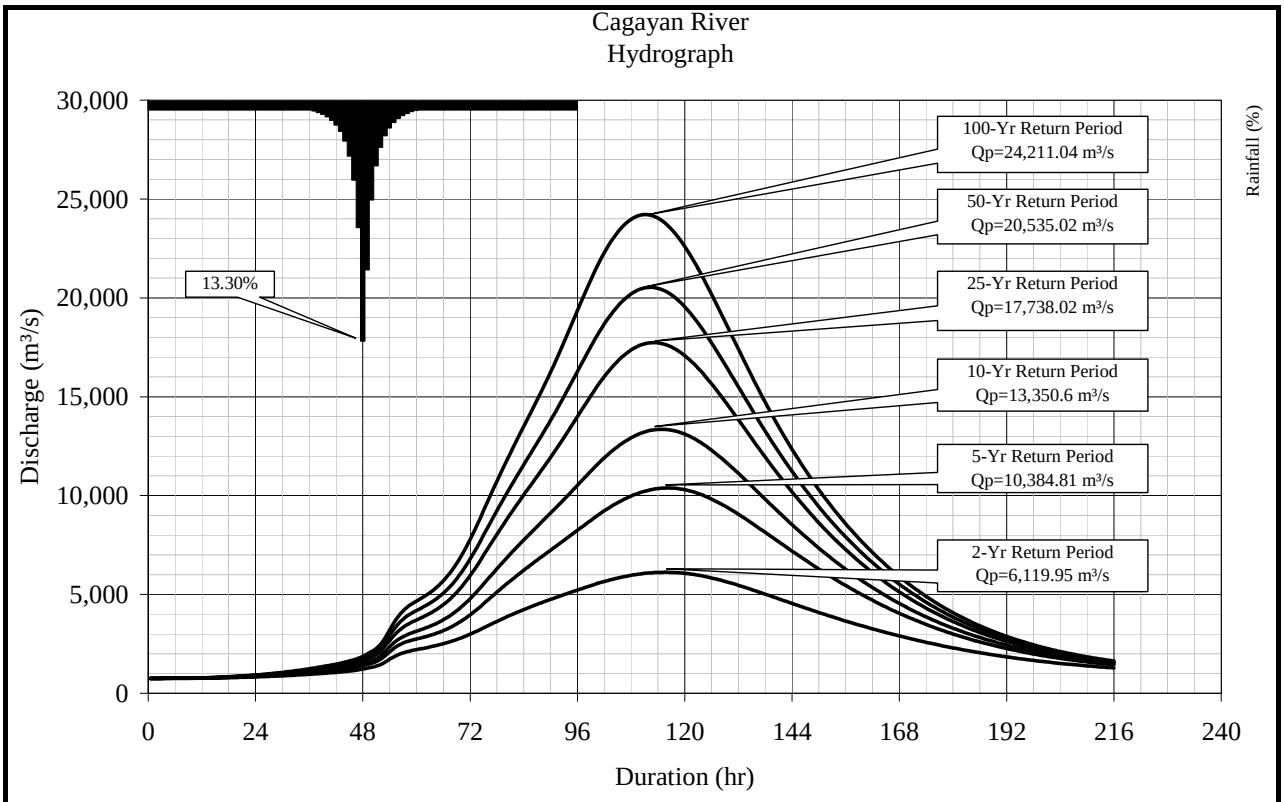


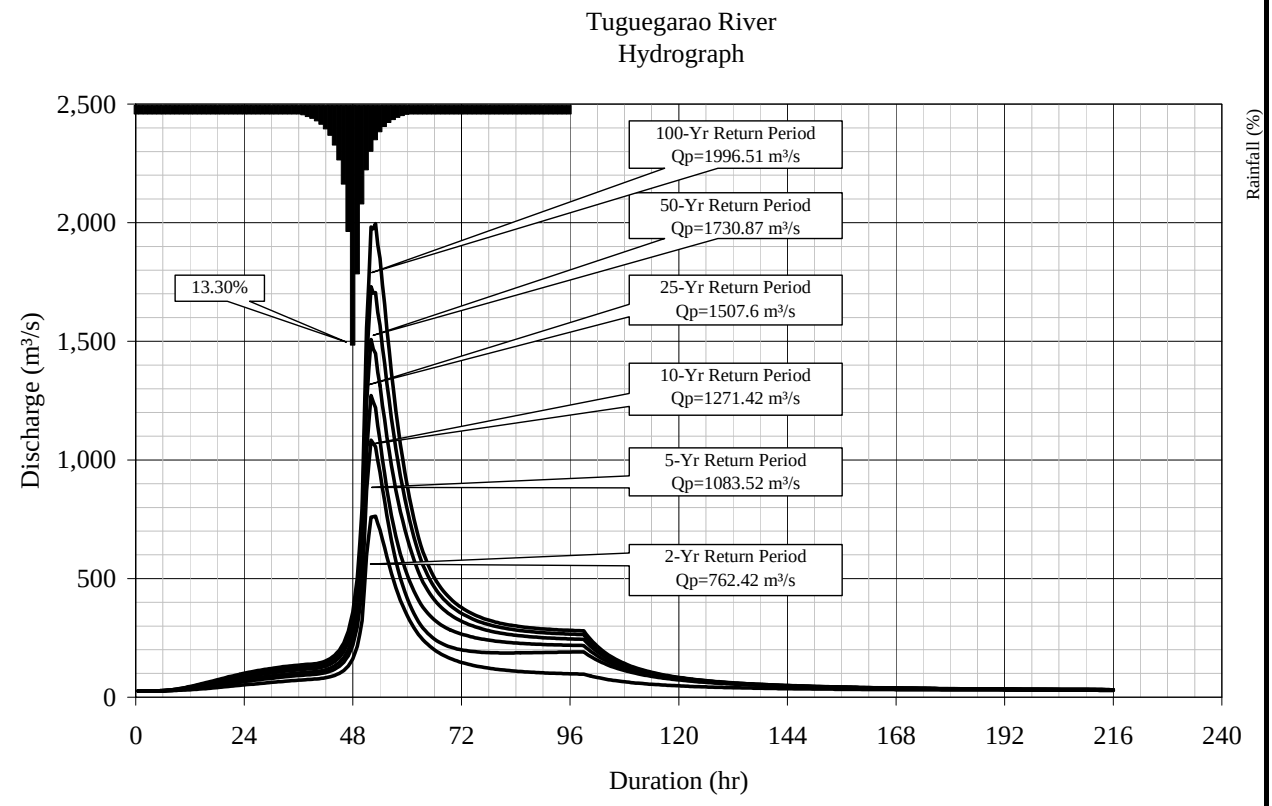
Source : The Feasibility Study of the Flood Control Project for the Lower Cagayan River, JICA 2002

DRAFT FINAL REPORT FOR SECTORAL LOAN FOR DISASTER RISK MANAGEMENT	Figure5.2 Catchment Delineation of Cagayan River Basin
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	

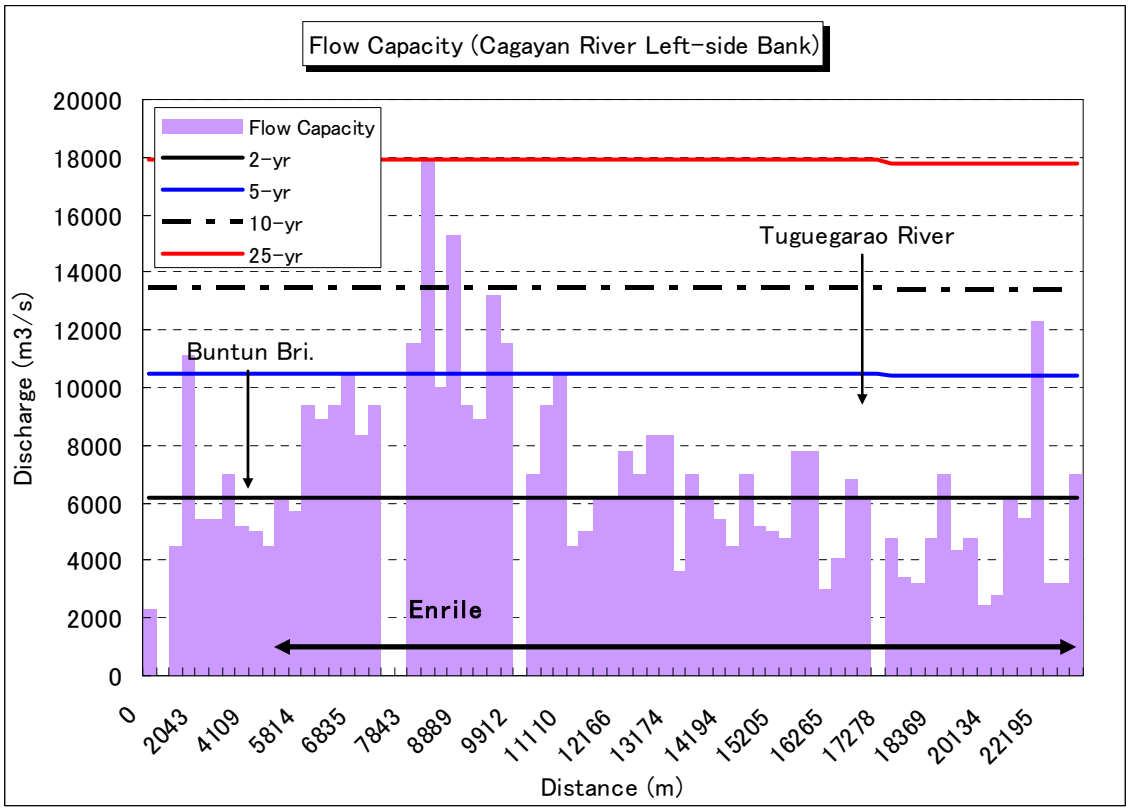


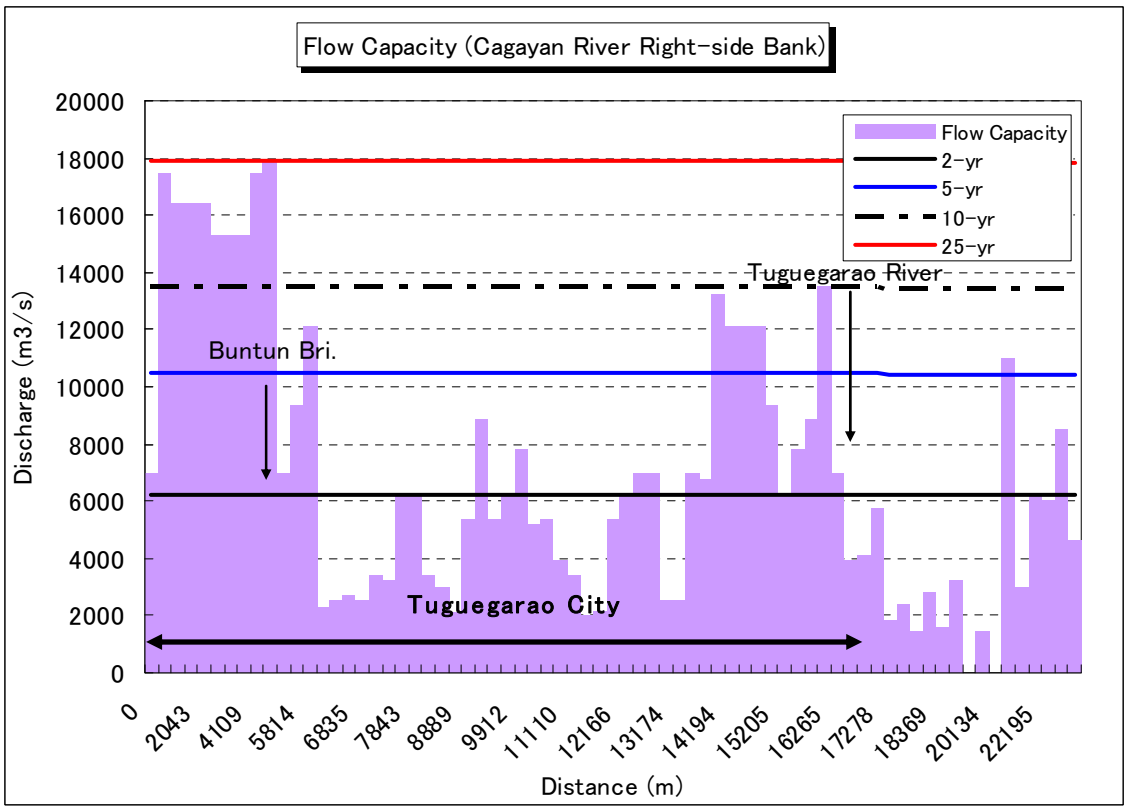
DRAFT FINAL REPORT FOR SECTORAL LOAN FOR DISASTER RISK MANAGEMENT	Figure5.3 River System Model for Flood Runoff Analysis Cagayan River Basin
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



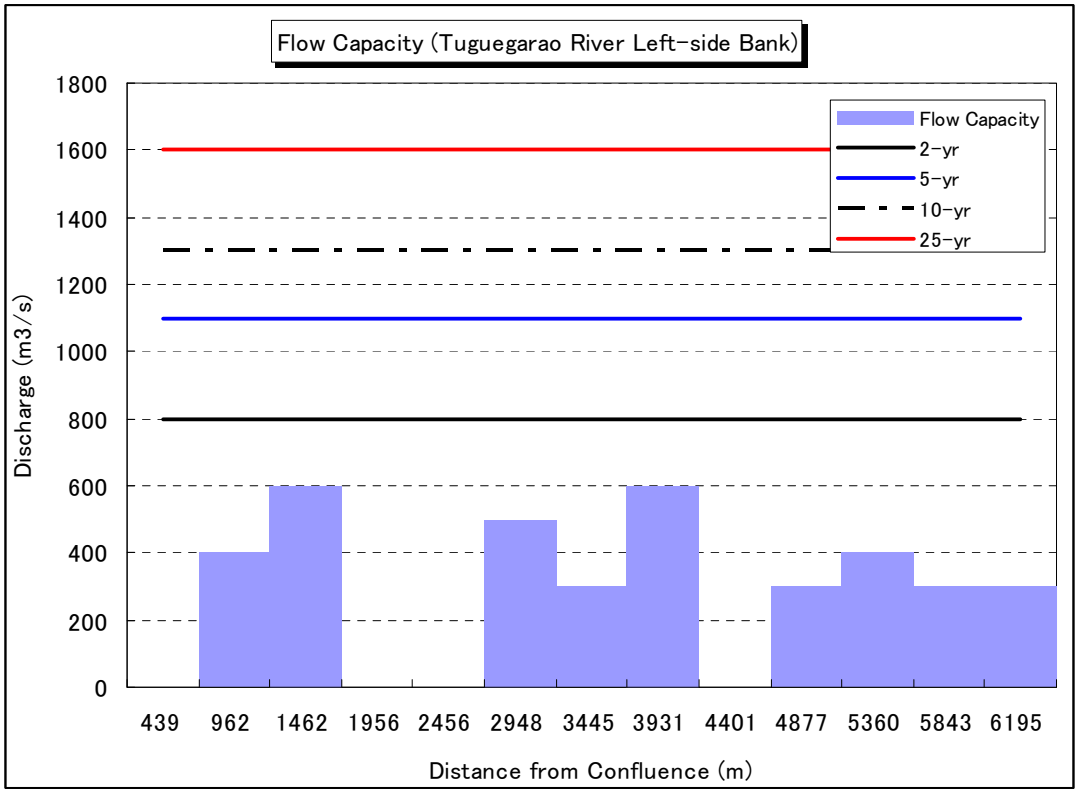


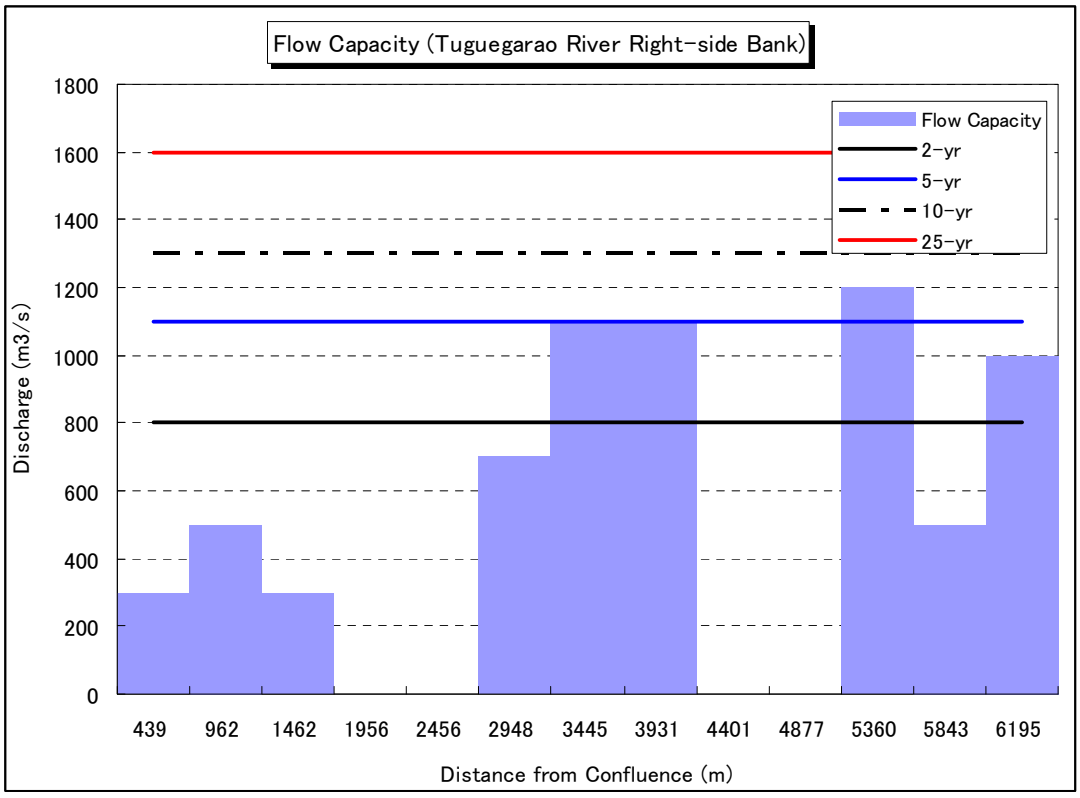
DRAFT FINAL REPORT FOR SECTORAL LOAN FOR DISASTER RISK MANAGEMENT	Figure5.4 Flood Hydrographs at Cagayan and Tuguegarao Confluence
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



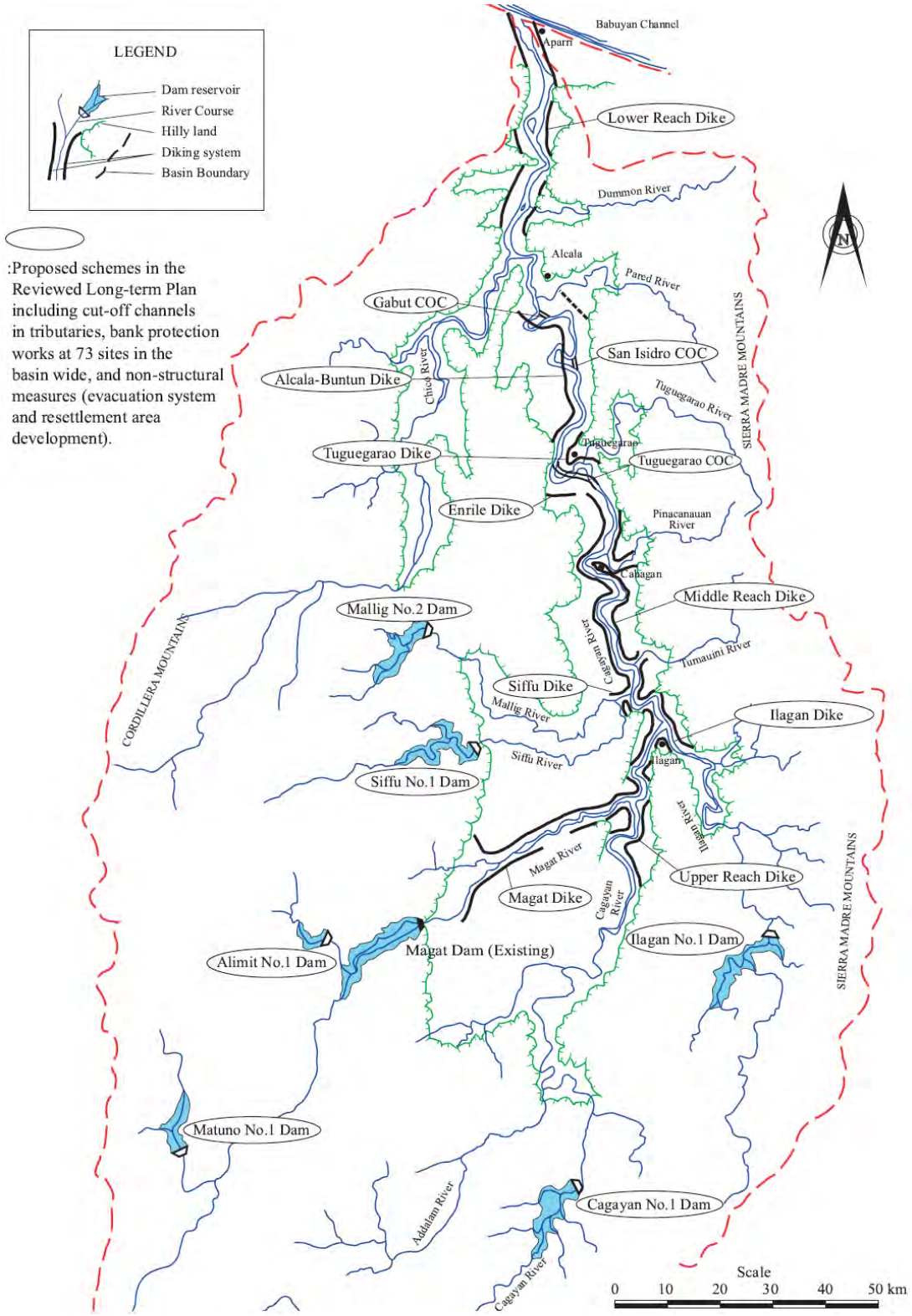


THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure 5.5(1/2) Flow Capacity (Cagayan River)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



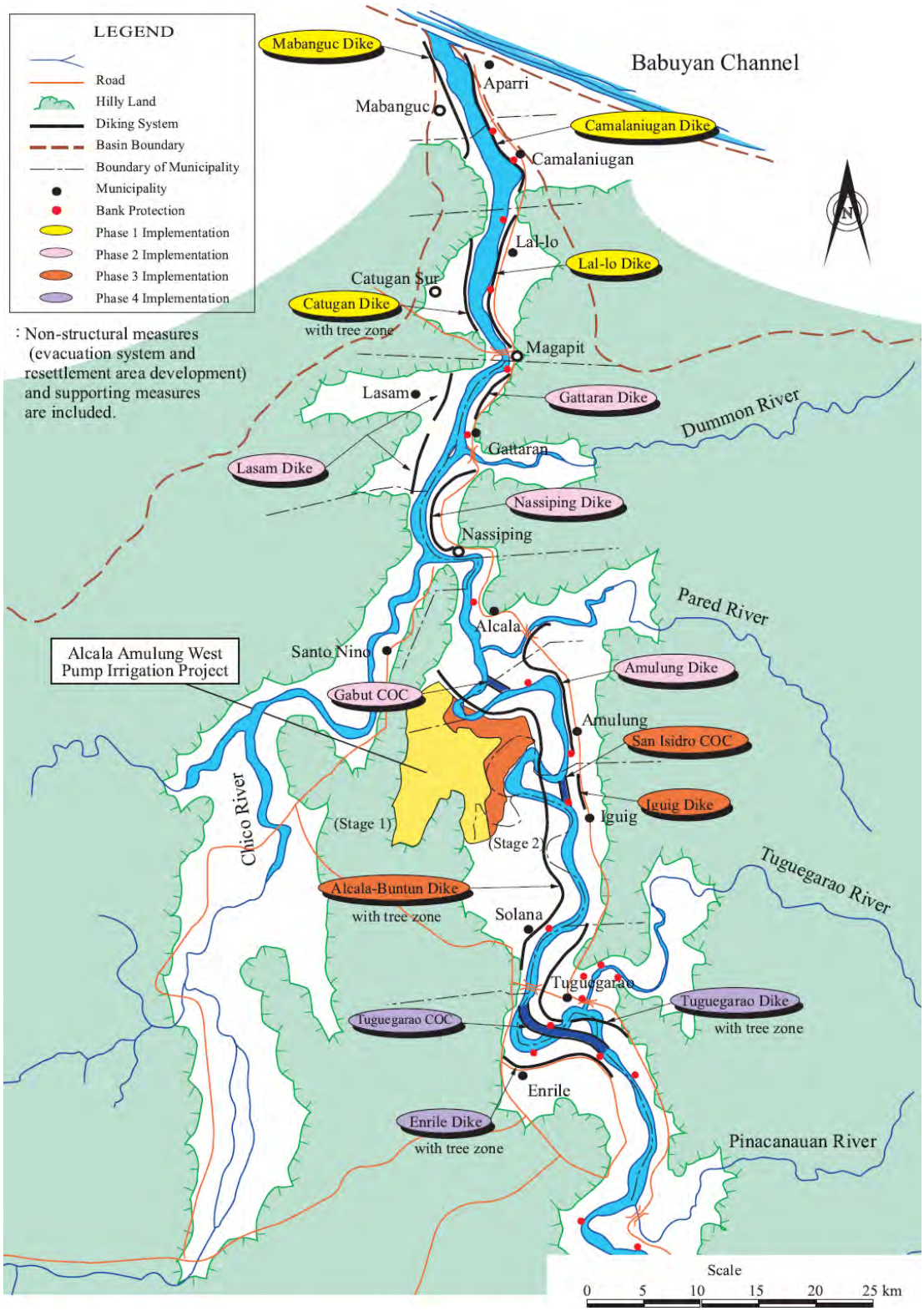


THE PREPARATORY STUDY FOR SECTOR LOAN ON DISASTER RISK MANAGEMENT	Figure 5.5(2/2) Flow Capacity (Tuguegarao River)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



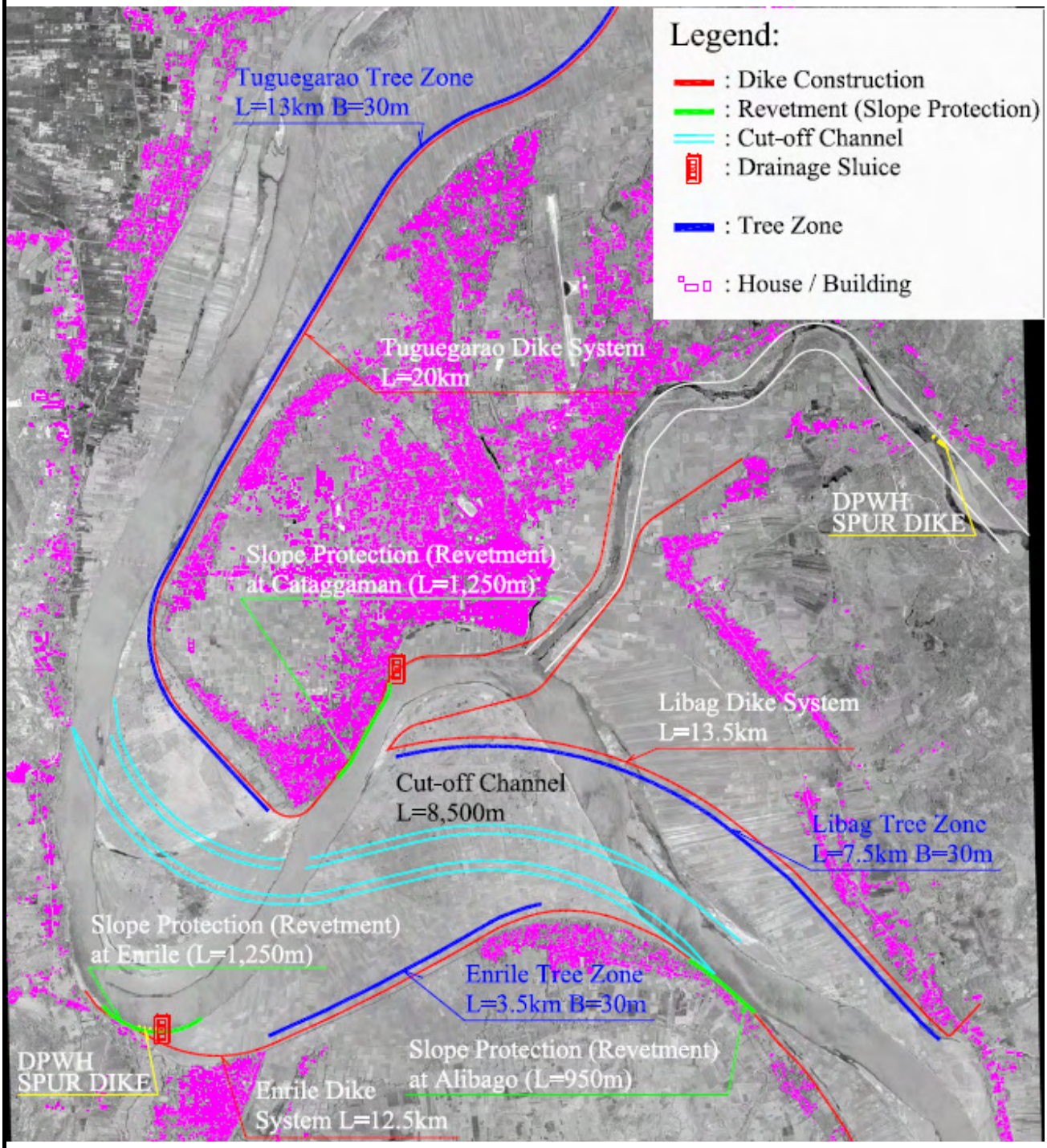
Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN FOR DISASTER RISK MANAGEMENT	Figure 6.1
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	Long Term Plan of Flood Control in the Cagayan River Basin

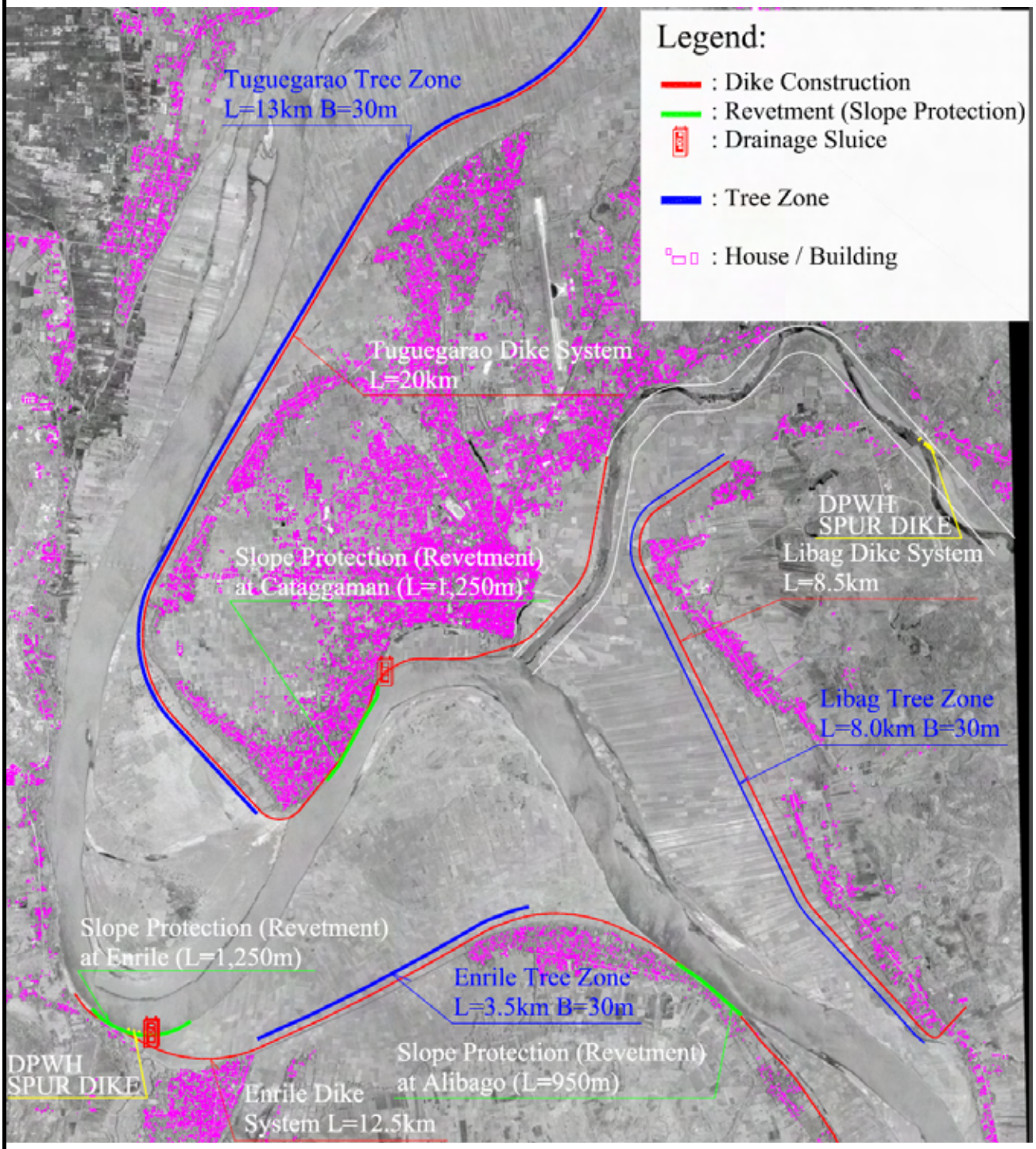


Source: 2002 F/S

THE PREPARATORY STUDY FOR SECTOR LOAN FOR DISASTER RISK MANAGEMENT	Figure 6.2
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	Location of the Proposed Projects in 2002 F/S



THE PREPARATORY STUDY FOR SECTOR LOAN FOR DISASTER RISK MANAGEMENT	Figure7.1 Cagayan River Improvement Plan (Alternative C-1: Full Improvement)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	



THE PREPARATORY STUDY FOR SECTOR LOAN FOR DISASTER RISK MANAGEMENT	Figure 7.2 Cagayan River Improvement Plan (Alternative C-2: Dike & Slope Protection)
CTI Engineering International Co., Ltd. Nippon Koei Co., Ltd	