

**JAPAN INTERNATIONAL COOPERATION AGENCY  
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
THE REPUBLIC OF THE PHILIPPINES**

**THE STUDY  
ON  
COMPREHENSIVE DISASTER PREVENTION  
AROUND MAYON VOLCANO  
IN  
THE REPUBLIC OF THE PHILIPPINES**

**FINAL REPORT  
VOLUME V : DATA BOOK**

**October 2000**

**NIPPON KOEI CO., LTD.**

**KRI INTERNATIONAL CORPORATION**

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# LIST OF REPORTS

## **Volume I EXECUTIVE SUMMARY**

## **Volume II MAIN REPORT**

- Part I : Master Plan
- Part II : Feasibility Study

## **Volume III SUPPORTING REPORT (1): Master Plan**

### Chapter

- I : Hydrology, Hydraulics/ River Planning
- II : Sabo Planning
- III : Facility Design
- IV : Land Use Planning
- V : Surveying/ Aerial Photo/ Topographic Mapping and Satellite Image Analysis
- VI : Disaster Mapping/ Hazard Mapping
- VII : Forecasting & Warning System
- VIII : Evacuation
- IX : Institutions
- X : Relocation and Resettlement
- XI : Cost Estimate
- XII : Socio-economy
- XIII : Environmental Assessment

## **Volume IV SUPPORTING REPORT (2): Feasibility Study**

### Chapter

- XIV : Hydrology, Hydraulics/ River Planning
- XV : Sabo Planning
- XVI : Facility Design
- XVII : Land Use Planning
- XVIII : Forecasting & Warning System
- XIX : Evacuation
- XX : Implementation Plan
- XXI : O&M Planning
- XXII : Relocation and Resettlement
- XXIII : Supporting Projects and Programs
- XXIV : Cost Estimate
- XXV : Socio-economy
- XXVI : Environmental Assessment
- XXVII : Pilot Project

<b>Volume V DATA BOOK</b>
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THE STUDY  
ON  
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THE REPUBLIC OF THE PHILIPPINES

DATA BOOK

**Table of Contents**

		<u>Page</u>
I	HYDROLOGY, HYDRAULICS/ RIVER PLANNING	
	DT I 1 Probable Flood Peak Runoff (2 Year).....	D - 1
	DT I 2 Probable Flood Peak Runoff (5 Year).....	D - 2
	DT I 3 Probable Flood Peak Runoff (10 Year).....	D - 3
	DT I 4 Probable Flood Peak Runoff (20 Year).....	D - 4
	DT I 5 Probable Flood Peak Runoff (50 Year).....	D - 5
	DT I 6 Probable Flood Peak Runoff (100 Year).....	D - 6
	DT I 7 Dimension of Basic Plan of Improvement for Macabalo and Tibu River.....	D - 7
	DT I 8 Existing Flow Capacity of River Channel (Macabalo River).....	D - 8
	DT I 9 Design Capacity of Planned River Channel (Macabalo River).....	D - 9
	DT I 10 Work Volume Calculation (Macabalo River).....	D - 10
	DT I 11 Existing Flow Capacity of River Channel (Tibu River).....	D - 11
	DT I 12 Design Capacity of Planned River Channel (Tibu River).....	D - 11
	DT I 13 Work Volume Calculation (Tibu River).....	D - 12
II	SABO PLANNING	
	1. Description of Historical Eruption in Mayon Volcano.....	D - 13
	2. Longitudinal Profile of River Bed Compared with the 1983 survey and the 1999 survey	
	2.1 Longitudinal Profile of River Bed (Based on March, 1999 Survey)	
	DT II 2.1 Longitudinal Profile of River Bed (Based on March, 1999 Survey).....	D - 26
	2.2 Relation Graph between Horizontal Distance and River Bed Gradient	
	DT II 2.2 Relation Graph between Horizontal Distance and River Bed Gradient.....	D - 47
	2.3 Profiles of River Bed Compared with the 1983 Survey and the 1999 Survey	
	DF II 2.3.1 Profile of Yawa River.....	D - 68
	DF II 2.3.2 Profile of Pawa-Burabod River.....	D - 69

DF II 2.3.3	Profile of Budiao River.....	D - 70
DF II 2.3.4	Profile of Anoling River.....	D - 71
DF II 2.3.5	Profile of Quirangay River.....	D - 72
DF II 2.3.6	Profile of Masarawag River.....	D - 73
DF II 2.3.7	Profile of Ogsong River.....	D - 74
DF II 2.3.8	Profile of Nasisi River.....	D - 75
DF II 2.3.9	Profile of Quinali (B) River.....	D - 77
3.	Survey on River Bed Composed with the 1983 Survey and the 1999 Survey....	D - 78
3.1	Location Map of Sampling Points for Sieve Analysis.....	D - 81
3.2	Results of Sieve Analysis for Each River and Sampling Point	
DT II 3.2.1	Results of Sieve Analysis for Each RIVER.....	D - 83
DT II 3.2.2	Results of Sieve Analysis for Sampling Points.....	D - 84
3.3	Sieve Curve Graphs for Each River	
DF II 3.3	Sieve Analysis.....	D - 87
4.	Results of Interview Survey - Calamity and Causality by Natural Disaster -	
DT II 4.1	Results of Interview Survey - Calamity and Causality by Natural Disaster -.....	D - 105
DF II 4.2	Results of Interview Survey - Calamity and Causality by Natural Disaster -.....	D - 113
5.	O&M Related Aggregate Plant	
5.1	Summary Report of Environment & Natural Resource Office, Albay (ENRO) Proposed Permits [from 1996 to 1998]	
DT II 5.1.1	Summary Report of Quarrying Permits Province of Albay (As of December 31, 1996).....	D - 114
DT II 5.1.2	Summary Report of PENRO-LGU Processed Permits Province of Albay (As of December 31, 1997).....	D - 121
DT II 5.1.3	Summary Report of ENRO Processed Permits Province of Albay (As of December 31, 1998).....	D - 129
5.2	Quality Check of Aggregate Materials	
DT II 5.2.	Result Sheet of Aggregate Quality Test.....	D - 137
5.3	Aggregate Demand for Construction Use in Sorsogon, Naga City and Iriga City	
DT II 5.3	Aggregate Construction Use in Sorsogon, Naga City and Iriga City by Hearing Survey.....	D - 138
5.4	LGU and Provincial Level Project	
DT II 5.4	Master Plan for the Legazpi-Iriga-Naga-Daet Growth Corridor Project/Program Profile.....	D - 139
5.5	Q&A about Dredging Work to the Regional Equipment Service (RES-V).....	D - 150

5.6	Mayon Sabo and River Improvement Projects	
DT II 5.6.1	Mayon Sabo and River Improvement Projects Financial Requirements and Actual Releases.....	D - 152
DT II 5.6.2	Mayon Sabo and River Improvement Projects Financial Requirements and Releases of Yawa River System .....	D - 153
DT II 5.6.3	Mayon Sabo and River Improvement Projects Financial Requirements and Actual Releases of Quinali (A) River System .	D - 154
DT II 5.6.4	Mayon Sabo and River Improvement Projects Financial Requirements and Actual Releases of Quinali (B) River System .	D - 155
DT II 5.6.5	Mayon Sabo and River Improvement Projects Financial Requirements and Actual Releases of Other Rivers.....	D - 156
6.	Structure and Volume of Planning Facilities for Master Plan	
DF II 6.1	Consolidation Dam H=6.0m-1 .....	D - 157
DF II 6.2	Consolidation Dam H=6.0m-2 .....	D - 158
DF II 6.3	Consolidation Dam H=6.0m-3 .....	D - 159
DF II 6.4	Consolidation Dam H=6.0m-1 .....	D - 160
DF II 6.5	Consolidation Dam H=6.0m-2 .....	D - 161
DF II 6.6	Consolidation Dam H=6.0m-3 .....	D - 162
DF II 6.7	Consolidation Dam H=4.0m.....	D - 163
DF II 6.8	Ground Sill .....	D - 164
DF II 6.9	Spur Dike A .....	D - 165
DF II 6.10	Spur Dike B .....	D - 166
DF II 6.11	Spur Dike C .....	D - 167
DF II 6.12	Spur Dike D .....	D - 168
DF II 6.13	Training Dike H=6.6m.....	D - 169
DF II 6.14	Training Dike H=6.0m.....	D - 170
DF II 6.15	Training Dike H=4.6m.....	D - 171
7.	Alternatives for Sabo Planning	
DF II 7.1	Alternatives for Sabo Planning - Yawa River System.....	D - 172
DF II 7.2	Alternatives for Sabo Planning - Quinali (B) River System .....	D - 178
DF II 7.3	Alternatives for Sabo Planning - Buang River System .....	D - 183
DF II 7.4	Alternatives for Sabo Planning - San Vicente River System.....	D - 185
DF II 7.5	Alternatives for Sabo Planning - Padang River System.....	D - 188
DF II 7.6	Alternatives for Sabo Planning - Basud River System.....	D - 190
DF II 7.7	Alternatives for Sabo Planning - Bulawan River System.....	D - 194
8.	Inventory of Existing Facilities Condition in the Study Area	
DT II 8	Inventory of Existing Facilities Condition in the Study Area .....	D - 198

9.	Alignment of Existing Facilities in the Study Area	
DF II 9.1	Existing Condition of Sabo Facilities (Yawa River) .....	D - 205
DF II 9.2	Existing Condition of Sabo Facilities (Quirangay River, Masarawag River).....	D - 206
DF II 9.3	Existing Condition of Sabo Facilities (Nasisi River) .....	D - 207
DF II 9.4	Existing Condition of Sabo Facilities (San Vicente River) .....	D - 208
DF II 9.5	Existing Condition of Sabo Facilities (Arimbay River, Padang River, Basud River) .....	D - 209
DF II 9.6	Existing Condition of Sabo Facilities (Bulawan River) .....	D - 210
10.	Existing Facilities Designed by DPWH	
DF II 10.1	Master Plan of Pawa-Burabod Sabo Projects - Legazpi City .....	D - 211
DF II 10.2	Construction of (315 L.M.) Revetment Downstream - Pawa Side .....	D - 212
DF II 10.3	Master Plan of Yawa Sabo - Legazpi City.....	D - 213
DF II 10.4	Accomplishment for Budiao Sabo Projects.....	D - 214
DF II 10.5	Master Plan of Anoling Sabo Projects - Anoling, Camalig, Albay.....	D - 215
DF II 10.6	Master Plan of Binitayan Sabo Projects - Daraga, Albay.....	D - 216
DF II 10.7	Master Plan of Busay River Control - Busay, Daraga, Albay .....	D - 217
DF II 10.8	Master Plan of Camalig Sabo River Control - Ligban, Camalig, Albay .....	D - 218
DF II 10.9	Master Plan of San Vicente Sabo Projects - Tabaco, Albay .....	D - 219
DF II 10.10	Master Plan of Masarawag Sabo Projects - Guinobatan, Albay....	D - 220
DF II 10.11	Master Plan of San Francisco Sabo Projects - Guinobatan, Albay .....	D - 221
DF II 10.12	Master Plan of Nasisi Sabo Projects - Ligao, Albay .....	D - 222
DF II 10.13	Master Plan of San Vicente Sabo Projects - Tabaco, Albay .....	D - 223
DF II 10.14	Master Plan of San Ramon River Control - San Ramon, Tabaco, Albay .....	D - 224
DF II 10.15	Master Plan of Tabaco Sabo River Control - Tagas, Tabaco, Albay .....	D - 225
DF II 10.16	Master Plan of Arimbay Sabo Projects.....	D - 226
DF II 10.17	Master Plan of Paclas-Talisay River Control - Libon, Albay.....	D - 227
DF II 10.18	Master Plan of Quinali River Control (San Agustin Section) - Libon, Albay.....	D - 228
DF II 10.19	Master Plan of Quinali River Control (Carisac Section) - Libon, Albay.....	D - 229
DF II 10.20	Master Plan of Bonga-Pandan River Control - Ligao, Albay.....	D - 230
DF II 10.21	Master Plan of Quinali River Control (Quinali Section) - Polangu, Albay.....	D - 231
DF II 10.22	Master Plan of Bacolod-Talahib River Control - Libon, Albay ....	D - 232

DF II 10.23	Master Plan of Arimbay Sabo Projects (As of May 2000).....	D - 233
DF II 10.24	Master Plan of Nasisi Sabo Projects (As of May 2000).....	D - 234
DF II 10.25	Master Plan of Masarawag Sabo Projects (As of May 2000).....	D - 235
DF II 10.26	Master Plan of Quirangay Sabo Projects (As of May 2000).....	D - 236
DF II 10.27	Master Plan of Basud Sabo Projects (As of May 2000).....	D - 237
DF II 10.28	Master Plan of Pawa-Burabod Sbao Projects (As of May 2000) ..	D - 238
DF II 10.29	Master Plan of Accomplishment for Budiao Sabo Projects (As of May 2000) .....	D - 239
DF II 10.30	Master Plan of Anoling Sabo Projects (As of May 2000).....	D - 240
DF II 10.31	Master Plan of Yawa Sabo Projects (As f May 2000).....	D - 241
DF II 10.32	Master Plan of San Vicente Sabo Projects (As of May 2000).....	D - 242
11.	Stability Analysis of Sabo Dam Structure	
DF II 11	Stability Analysis of Sabo Dam Structure.....	D - 243
III	FORECASTING & WARING SYSTEM	
DF III	Terrain Profile .....	D - 249
IV	COST ESTIMATE	
DT IV	List of Unit Price .....	D - 267
V	SOCIO – ECONOMY	
DT V 1	Damage Rate of Agricultural Products by Mud Flow in Case of Sabo Dam Construction (Land Use Plan : Option-2&3).....	D - 272
DT V 2	Damage Rate of Structural Assets by Mud Flow in Case of Sabo Dam Construction (Land Use Plan : Option-2&3).....	D - 273
DT V 3	Calculation of Average Annual Flood Damages for River Improvement Project of Yawa River .....	D - 274
DT V 4	Calculation of Average Annual Flood Damages for River Improvement Project of Nasisi River .....	D - 274
DT V 5	Calculation of Average Annual Flood Damages for River Improvement Project of Ogsong River.....	D - 274
DT V 6	Calculation of Average Annual Flood Damages for River Improvement Project of Quinali (B) River.....	D - 275
DT V 7	Calculation of Average Annual Flood Damage for River Improvement Project of Sanb Vicente River.....	D - 275
DT V 8	Calculation of Average Annual Flood Damage for Urban Drainage Project of Legazpi City .....	D - 275
DT V 9	Cash Flow of Economic Cost and Benefit for Yawa River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-1) .....	D - 276
DT V 10	Cash Flow of Economic Cost and Benefit for Yawa River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-2) .....	D - 277



DT V 11	Cash Flow of Economic Cost and Benefit for Yawa River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .....	D - 278
DT V 12	Cash Flow of Economic Cost and Benefit for Alternative-1 of Quinali (A) River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3).....	D - 279
DT V 13	Cash Flow of Economic Cost and Benefit for Alternative-2 of Quinali (A) River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3).....	D - 280
DT V 14	Cash Flow of Economic Cost and Benefit for Buang River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .	D - 281
DT V 15	Cash Flow of Economic Cost and Benefit for San Vicente River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .....	D - 282
DT V 16	Cash Flow of Economic Cost and Benefit for Padang River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .	D - 283
DT V 17	Cash Flow of Economic Cost and Benefit for Basud River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .	D - 284
DT V 18	Cash Flow of Economic Cost and Benefit for Bulawan River in Sabo Plan (Return Period : 20 Year ; Land Use Plan : Option-3) .	D - 285
DT V 19	Cash Flow of Economic Cost and Benefit for River Improvement Project of Yawa River (Return Period : 20Year) .....	D - 286
DT V 20	Cash Flow of Economic Cost and Benefit for Urban Drainage Project of Legazpi City Return Period 10 .....	D - 288
VI	PREPARATORY AND SUPPORTING SERVICE OF THE PILOT PROJECT .....	D - 289

*The Study on Comprehensive Disaster Prevention  
around Mayon Volcano*

**DATA BOOK**

**I : HYDROLOGY, HYDRAULICS/RIVER**

**PLANNING**

Table DT I 1 Probable Flood Peak Runoff (2 Year)

Name of River	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)
	Drainage Area (km <sup>2</sup> )	Flood Concentration Time(min)	Return Period (year)	Runoff Coefficient	Name of Station	Probable 1-Day Rainfall(mm)	24-Hour Rainfall (mm)	Rainfall Intensity (mm/hr)	Probable Basin 1-Day Rainfall(mm)	Average Rainfall Intensity(mm/hr)	Probable Flood Peak Runoff(m <sup>3</sup> /s)
Yawa	74.4	96	2	0.7	Legazpi	176	163	41	195	49	716
Pawa-Burabod	7.6	55	2	0.7	Legazpi	176	163	56	229	78	116
Budiao	7.5	56	2	0.7	Legazpi	176	163	55	229	77	113
Anoling	9.4	49	2	0.7	Legazpi	176	163	60	227	83	152
Quirangay	9.3	46	2	0.7	Guinobatan	162	163	62	209	79	143
Tumpa	5.7	37	2	0.7	Guinobatan	162	163	71	213	93	103
Maninila	4.9	51	2	0.7	Guinobatan	162	163	59	215	77	73
Masarawag	10.5	58	2	0.7	Guinobatan	162	163	54	207	68	140
Ogsong	38.1	128	2	0.7	Guinobatan	162	163	36	191	42	308
Nasisi	84.2	117	2	0.7	Guinobatan	162	163	37	177	41	663
Buang	4.5	39	2	0.7	Buang	194	163	69	172	73	64
Quinali (B)	157.8	178	2	0.7	San Ramon	110	163	29	112	20	619
San Vicente	9.9	63	2	0.7	San Ramon	110	163	51	141	44	86
Arimbay	2.6	25	2	0.7	Sto Domingo	174	163	87	236	126	63
Padang	7.6	44	2	0.7	Sto Domingo	174	163	64	226	88	131
Basud	14.0	52	2	0.7	Sto Domingo	174	163	58	219	78	212
Bulawan	15.4	55	2	0.7	Sto Domingo	174	163	56	218	75	223

**Table DT I 2 Probable Flood Peak Runoff (5 Year)**

Name of River	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)
	Drainage Area (km <sup>2</sup> )	Flood Concentration Time(min)	Return Period (year)	Runoff Coefficient	Name of Station	Probable 1-Day Rainfall(mm)	24-Hour Rainfall (mm)	Rainfall Intensity (mm/hr)	Probable Basin 1-Day Rainfall(mm)	Average Rainfall Intensity(mm/hr)	Probable Flood Peak Runoff(m <sup>3</sup> /s)
Yawa	74.4	96	5	0.7	Legazpi	251	255	62	278	68	978
Pawa-Burabod	7.6	55	5	0.7	Legazpi	251	255	81	326	104	154
Budiao	7.5	56	5	0.7	Legazpi	251	255	80	327	103	150
Anoling	9.4	49	5	0.7	Legazpi	251	255	87	323	110	201
Quirangay	9.3	46	5	0.7	Guinobatan	230	255	90	296	104	189
Tumpa	5.7	37	5	0.7	Guinobatan	230	255	103	303	122	135
Maninila	4.9	51	5	0.7	Guinobatan	230	255	85	305	102	97
Masarawag	10.5	58	5	0.7	Guinobatan	230	255	79	294	91	185
Ogsong	38.1	128	5	0.7	Guinobatan	230	255	54	271	57	421
Nasisi	84.2	117	5	0.7	Guinobatan	230	255	56	252	55	906
Buang	4.5	39	5	0.7	Buang	335	255	100	297	116	102
Quinali (B)	157.8	178	5	0.7	San Ramon	166	255	45	169	30	908
San Vicente	9.9	63	5	0.7	San Ramon	166	255	75	213	63	121
Arimbay	2.6	25	5	0.7	Sto Domingo	227	255	125	308	151	76
Padang	7.6	44	5	0.7	Sto Domingo	227	255	92	295	107	158
Basud	14.0	52	5	0.7	Sto Domingo	227	255	84	286	94	257
Bulawan	15.4	55	5	0.7	Sto Domingo	227	255	81	284	91	272

**Table DT I 3 Probable Flood Peak Runoff (10 Year)**

Name of River	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)
	Drainage Area (km <sup>2</sup> )	Flood Concentration Time(min)	Return Period (year)	Runoff Coefficient	Name of Station	Probable 1-Day Rainfall(mm)	24-Hour Rainfall (mm)	Rainfall Intensity (mm/hr)	Probable Basin 1-Day Rainfall(mm)	Average Rainfall Intensity(mm/hr)	Probable Flood Peak Runoff(m <sup>3</sup> /s)
Yawa	74.4	96	10	0.7	Legazpi	303	316	76	336	80	1163
Pawa-Burabod	7.6	55	10	0.7	Legazpi	303	316	98	394	123	181
Budiao	7.5	56	10	0.7	Legazpi	303	316	97	394	121	177
Anoling	9.4	49	10	0.7	Legazpi	303	316	105	390	130	237
Quirangay	9.3	46	10	0.7	Guinobatan	274	316	108	353	121	219
Tumpa	5.7	37	10	0.7	Guinobatan	274	316	124	361	141	157
Maninila	4.9	51	10	0.7	Guinobatan	274	316	103	363	118	113
Masarawag	10.5	58	10	0.7	Guinobatan	274	316	95	351	105	215
Ogsong	38.1	128	10	0.7	Guinobatan	274	316	66	322	67	495
Nasisi	84.2	117	10	0.7	Guinobatan	274	316	69	300	65	1066
Buang	4.5	39	10	0.7	Buang	451	316	120	400	152	133
Quinali (B)	157.8	178	10	0.7	San Ramon	208	316	55	212	37	1127
San Vicente	9.9	63	10	0.7	San Ramon	208	316	91	267	77	148
Arimbay	2.6	25	10	0.7	Sto Domingo	262	316	150	356	169	86
Padang	7.6	44	10	0.7	Sto Domingo	262	316	111	341	120	177
Basud	14.0	52	10	0.7	Sto Domingo	262	316	102	330	106	289
Bulawan	15.4	55	10	0.7	Sto Domingo	262	316	98	328	102	306

**Table DT I 4 Probable Flood Peak Runoff (20 Year)**

Name of River	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)
	Drainage Area (km <sup>2</sup> )	Flood Concentration Time(min)	Return Period (year)	Runoff Coefficient	Name of Station	Probable 1-Day Rainfall(mm)	24-Hour Rainfall (mm)	Rainfall Intensity (mm/hr)	Probable Basin 1-Day Rainfall(mm)	Average Rainfall Intensity(mm/hr)	Probable Flood Peak Runoff(m <sup>3</sup> /s)
Yawa	74.4	96	20	0.7	Legazpi	356	374	89	394	94	1353
Pawa-Burabod	7.6	55	20	0.7	Legazpi	356	374	115	463	142	210
Budiao	7.5	56	20	0.7	Legazpi	356	374	113	463	140	205
Anoling	9.4	49	20	0.7	Legazpi	356	374	122	458	150	274
Quirangay	9.3	46	20	0.7	Guinobatan	316	374	126	407	137	248
Tumpa	5.7	37	20	0.7	Guinobatan	316	374	144	416	160	177
Maninila	4.9	51	20	0.7	Guinobatan	316	374	120	419	134	128
Masarawag	10.5	58	20	0.7	Guinobatan	316	374	111	404	120	244
Ogsong	38.1	128	20	0.7	Guinobatan	316	374	77	372	76	565
Nasisi	84.2	117	20	0.7	Guinobatan	316	374	80	346	74	1217
Buang	4.5	39	20	0.7	Buang	581	374	140	515	193	168
Quinali (B)	157.8	178	20	0.7	San Ramon	252	374	65	256	44	1359
San Vicente	9.9	63	20	0.7	San Ramon	252	374	106	324	92	177
Arimbay	2.6	25	20	0.7	Sto Domingo	297	374	175	403	188	95
Padang	7.6	44	20	0.7	Sto Domingo	297	374	130	386	134	198
Basud	14.0	52	20	0.7	Sto Domingo	297	374	118	374	118	322
Bulawan	15.4	55	20	0.7	Sto Domingo	297	374	115	372	114	341

Table DT I 5 Probable Flood Peak Runoff (50 Year)

Name of River	(1) Drainage Area (km <sup>2</sup> )	(2) Flood Concentration Time(min)	(3) Return Period (year)	(4) Runoff Coefficient	(5) Representative Station		(6) 24-Hour Rainfall (mm)	(7) Rainfall Intensity (mm/hr)	(8) Probable Basin 1-Day Rainfall(mm)	(9) Average Rainfall Intensity(mm/hr)	(10) Probable Flood Peak Runoff(m <sup>3</sup> /s)
					Name of Station	Probable 1-Day Rainfall(mm)					
Yawa	74.4	96	50	0.7	Legazpi	426	450	106	472	111	1604
Pawa-Burabod	7.6	55	50	0.7	Legazpi	426	450	136	554	167	247
Budiao	7.5	56	50	0.7	Legazpi	426	450	134	554	165	241
Anoling	9.4	49	50	0.7	Legazpi	426	450	145	548	176	322
Quirangay	9.3	46	50	0.7	Guinobatan	368	450	149	474	157	284
Tumpa	5.7	37	50	0.7	Guinobatan	368	450	170	485	183	203
Maninila	4.9	51	50	0.7	Guinobatan	368	450	142	488	154	146
Masarawag	10.5	58	50	0.7	Guinobatan	368	450	131	471	137	280
Ogsong	38.1	128	50	0.7	Guinobatan	368	450	92	433	88	654
Nasisi	84.2	117	50	0.7	Guinobatan	368	450	96	403	86	1406
Buang	4.5	39	50	0.7	Buang	785	450	165	696	256	224
Quinali (B)	157.8	178	50	0.7	San Ramon	316	450	77	322	55	1694
San Vicente	9.9	63	50	0.7	San Ramon	316	450	126	406	114	219
Arimbay	2.6	25	50	0.7	Sto Domingo	344	450	206	467	214	108
Padang	7.6	44	50	0.7	Sto Domingo	344	450	153	447	152	225
Basud	14.0	52	50	0.7	Sto Domingo	344	450	140	433	135	368
Bulawan	15.4	55	50	0.7	Sto Domingo	344	450	136	431	130	389

**Table DT I 6 Probable Flood Peak Runoff (100 Year)**

Name of River	(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)	(10)
	Drainage Area (km <sup>2</sup> )	Flood Concentration Time(min)	Return Period (year)	Runoff Coefficient	Name of Station	Probable 1-Day Rainfall(mm)	24-Hour Rainfall (mm)	Rainfall Intensity (mm/hr)	Probable Basin 1-Day Rainfall(mm)	Average Rainfall Intensity(mm/hr)	Probable Flood Peak Runoff(m <sup>3</sup> /s)
Yawa	74.4	96	100	0.7	Legazpi	481	506	118	533	125	1802
Pawa-Burabod	7.6	55	100	0.7	Legazpi	481	506	151	626	187	276
Budiao	7.5	56	100	0.7	Legazpi	481	506	150	626	185	270
Anoling	9.4	49	100	0.7	Legazpi	481	506	161	619	197	361
Quirangay	9.3	46	100	0.7	Guinobatan	407	506	166	524	172	311
Tumpa	5.7	37	100	0.7	Guinobatan	407	506	189	536	201	222
Maninila	4.9	51	100	0.7	Guinobatan	407	506	158	540	168	161
Masarawag	10.5	58	100	0.7	Guinobatan	407	506	146	521	151	307
Ogsong	38.1	128	100	0.7	Guinobatan	407	506	103	479	97	720
Nasisi	84.2	117	100	0.7	Guinobatan	407	506	108	445	95	1549
Buang	4.5	39	100	0.7	Buang	975	506	184	865	315	275
Quinali (B)	157.8	178	100	0.7	San Ramon	369	506	87	375	64	1971
San Vicente	9.9	63	100	0.7	San Ramon	369	506	141	474	132	254
Arimbay	2.6	25	100	0.7	Sto Domingo	379	506	230	514	233	118
Padang	7.6	44	100	0.7	Sto Domingo	379	506	171	493	166	246
Basud	14.0	52	100	0.7	Sto Domingo	379	506	156	477	147	401
Bulawan	15.4	55	100	0.7	Sto Domingo	379	506	151	475	142	425



DT I 7 Dimention of Basic Plan of River Improvement for Macabalo and Tibu River

Macabalo River

Section	Distance (m)	Top Width (m)	Botom Width (m)	Depth R (m)	Depth L (m)	New Dike	Raising Dike Height	Widening River Channel	rip-rap R	rip-rap L
7	196.7	30.00	26.00	2.81	2.81	○	--	--	○	○
6	155.4	30.00	26.00	3.00	3.00	○	--	--	○	○
5	504.0	30.00	26.00	3.00	3.00	○	--	--	○	○
4	300.0	36.00	32.00	3.50	3.50	○	--	--	○	○
3	100.0	12.20	11.20	1.90	1.90	○	○ 1.1m	○ +20.3m	○	○
2	323.0	12.20	11.20	1.90	1.90	○	○ 1.1m	○ +20.3m	○	○
1	122.5	12.20	11.20	1.90	1.90	○	○ 1.1m	○ +20.3m	○	○
27	70.0	6.00	4.00	2.00	2.00	○	○ 1.0m	○ +27.5m	○	○
26	70.0	7.00	5.00	3.50	3.50	○	--	○ +9.5m	○	○
25	30.0	5.50	4.00	2.00	2.00	○	○ 1.0m	○ +6.0m	○	○
24	65.0	4.50	3.50	1.00	1.00	○	○ 2.0m	○ +6.5m	○	○
28	50.0	7.50	6.00	2.00	2.00	○	○ 1.0m	○ +4.5m	○	○
66	100.0	13.00	10.00	2.50	2.50	○	○ 0.5m	○ +1.5m	○	○

Tibu River

Section	Distance (m)	Top Width (m)	Botom Width (m)	Depth R (m)	Depth L (m)	New Dike	Raising Dike Height	Widening River Channel	rip-rap R	rip-rap L
24	124.7	40.00	39.00	5.00	5.00	○	--	--	○	○
23	78.4	40.00	39.00	2.10	2.10	○	--	--	○	○
22	236.6	14.00	4.80	3.50	3.50	○	--	--	○	○
21	70.0	14.00	4.80	4.50	3.50	○	--	--	○	○
20	186.2	11.40	10.40	2.20	2.20	○	○ 0.6m	--	○	○
19	90.3	11.40	10.40	2.20	2.20	○	○ 0.6m	--	○	○
18	48.1	10.30	9.30	3.80	3.80	○	--	--	○	○

**DT I 8 Existing Flow Capacity of River Channel (Macabalo River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth (m)	River Width (m)	Bed Slope 1/n	Sidewall Slope 1:m	Rough- ness <i>n</i>	Water Depth <i>h<sub>1</sub></i> (m)	Sectional Area <i>A</i> (m <sup>2</sup> )	Wetted Perimeter <i>P</i> (m)	Hydraulic Radius <i>R</i> (m)	Velocity <i>V<sub>1</sub></i> (m/s)	Calculated Discharge	Design Discharge
									1.00						
7	196.7	30.00	26.00	2.81	26.0	1/1,000	1:0.71	0.030	1.81	49.392	30.443	1.622	1.455	71.9	105.0
6	155.4	30.00	26.00	3.00	26.0	1/1,000	1:0.67	0.030	2.00	54.667	30.807	1.774	1.545	84.5	105.0
5	504.0	30.00	26.00	3.00	26.0	1/1,000	1:0.67	0.030	2.00	54.667	30.807	1.774	1.545	84.5	105.0
4	300.0	36.00	32.00	3.50	32.0	1/1,000	1:0.57	0.030	2.50	83.571	37.759	2.213	1.790	149.6	105.0
3	100.0	12.20	11.20	1.90	11.2	1/1,000	1:0.26	0.030	0.90	10.293	13.061	0.788	0.899	9.3	105.0
2	323.0	12.20	11.20	1.90	11.2	1/1,000	1:0.26	0.030	0.90	10.293	13.061	0.788	0.899	9.3	105.0
1	122.5	12.20	11.20	1.90	11.2	1/1,000	1:0.26	0.030	0.90	10.293	13.061	0.788	0.899	9.3	105.0
27	70.0	6.00	4.00	2.00	4.0	1/1,000	1:0.50	0.030	1.00	4.500	6.236	0.722	0.848	3.8	105.0
26	70.0	7.00	5.00	3.50	5.0	1/1,000	1:0.29	0.030	2.50	14.286	10.200	1.401	1.320	18.9	70.0
25	30.0	5.50	4.00	2.00	4.0	1/1,000	1:0.38	0.030	1.00	4.375	6.136	0.713	0.841	3.7	34.0
24	65.0	4.50	3.50	1.00	3.5	1/1,000	1:0.50	0.030	0.00	-	3.500	-	-	-	34.0
28	50.0	7.50	6.00	2.00	6.0	1/1,000	1:0.38	0.030	1.00	6.375	8.136	0.784	0.896	5.7	35.0
66	100.0	13.00	10.00	2.50	10.0	1/1,000	1:0.60	0.030	1.50	16.350	13.499	1.211	1.198	19.6	39.0

**DT I 9 Design Capacity of Planned River Channel (Macabalo River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth (m)	River Width (m)	Bed Slope 1/n	Sidewall Slope 1:m	Rough- ness <i>n</i>	Water Depth <i>h<sub>1</sub></i> (m)	Sectional Area <i>A</i> (m <sup>2</sup> )	Wetted Perimeter <i>P</i> (m)	Hydraulic Radius <i>R</i> (m)	Velocity <i>V<sub>1</sub></i> (m/s)	Calculated Discharge	Design Discharge
7	196.7	30.70	26.00	3.30	26.0	1/1,000	1:0.71	0.030	2.30	63.565	31.646	2.009	1.678	106.7	105.0
6	155.4	30.41	26.00	3.30	26.0	1/1,000	1:0.67	0.030	2.30	63.327	31.529	2.009	1.678	106.3	105.0
5	504.0	30.41	26.00	3.30	26.0	1/1,000	1:0.67	0.030	2.30	63.327	31.529	2.009	1.678	106.3	105.0
4	300.0	36.00	32.00	3.50	32.0	1/1,000	1:0.57	0.030	2.50	83.571	37.759	2.213	1.790	149.6	105.0
3	100.0	<b>38.70</b>	<b>31.50</b>	3.00	31.5	1/1,000	<b>1:1.20</b>	0.030	2.00	67.800	37.748	1.796	1.558	105.6	105.0
2	323.0	<b>38.70</b>	<b>31.50</b>	3.00	31.5	1/1,000	<b>1:1.20</b>	0.030	2.00	67.800	37.748	1.796	1.558	105.6	105.0
1	122.5	<b>38.70</b>	<b>31.50</b>	3.00	31.5	1/1,000	<b>1:1.20</b>	0.030	2.00	67.800	37.748	1.796	1.558	105.6	105.0
27	70.0	<b>38.70</b>	<b>31.50</b>	3.00	31.5	1/1,000	<b>1:1.20</b>	0.030	2.00	67.800	37.748	1.796	1.558	105.6	105.0
26	70.0	<b>22.90</b>	<b>14.50</b>	3.50	14.5	1/1,000	<b>1:1.20</b>	0.030	2.50	43.750	22.310	1.961	1.651	72.3	70.0
25	30.0	<b>17.20</b>	<b>10.00</b>	3.00	10.0	1/1,000	<b>1:1.20</b>	0.030	2.00	24.800	16.248	1.526	1.397	34.7	34.0
24	65.0	<b>17.20</b>	<b>10.00</b>	3.00	10.0	1/1,000	<b>1:1.20</b>	0.030	2.00	24.800	16.248	1.526	1.397	34.7	34.0
28	50.0	<b>17.70</b>	<b>10.50</b>	3.00	10.5	1/1,000	<b>1:1.20</b>	0.030	2.00	25.800	16.748	1.540	1.406	36.3	35.0
66	100.0	<b>18.70</b>	<b>11.50</b>	3.00	11.5	1/1,000	<b>1:1.20</b>	0.030	2.00	27.800	17.748	1.566	1.422	39.5	39.0

**DT I 10 Work Volume Calculation (Macabalo River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth Existing (m)	Depth Plan (m)	rip-rap h	Sidewall Slope	Upper +Width (m)	Bottom +Width (m)	Depth +h (m)	rip-rap s (m2/m)	rip-rap S (m2)	Excavation v1 (m3/m)	Excavation v2 (m3/m)	Excavation va (m3)	Embank- ment v3 (m3/m)	Embank- ment vh (m3)
7	196.7	30.70	26.00	2.81	3.30	4.30	1:0.71	0.00	0.00	0.49	10.56	2,077	1.86	-	366	1.35	266
6	155.4	30.41	26.00	3.00	3.30	4.30	1:0.67	0.00	0.00	0.30	10.34	1,607	1.83	-	284	0.74	115
5	504.0	30.41	26.00	3.00	3.30	4.30	1:0.67	0.00	0.00	0.30	10.34	5,211	1.83	-	922	0.74	373
4	300.0	36.00	32.00	3.50	3.50	4.50	1:0.57	0.00	0.00	0.00	10.37	3,111	1.79	-	537	-	-
3	100.0	38.70	31.50	1.90	3.00	4.00	1:1.20	23.86	20.30	1.10	12.50	1,250	2.10	41.95	4,405	4.66	466
2	323.0	38.70	31.50	1.90	3.00	4.00	1:1.20	23.86	20.30	1.10	12.50	4,038	2.10	41.95	14,228	4.66	1,505
1	122.5	38.70	31.50	1.90	3.00	4.00	1:1.20	23.86	20.30	1.10	12.50	1,531	2.10	41.95	5,396	4.66	571
27	70.0	38.70	31.50	2.00	3.00	4.00	1:1.20	30.30	27.50	1.00	12.50	875	2.10	57.80	4,193	4.03	282
26	70.0	22.90	14.50	3.50	3.50	4.50	1:1.20	15.90	9.50	0.00	14.06	984	2.10	44.45	3,259	-	-
25	30.0	17.20	10.00	2.00	3.00	4.00	1:1.20	9.30	6.00	1.00	12.50	375	2.10	15.30	522	4.03	121
24	65.0	17.20	10.00	1.00	3.00	4.00	1:1.20	7.90	6.50	2.00	12.50	813	2.10	7.20	605	12.13	788
28	50.0	17.70	10.50	2.00	3.00	4.00	1:1.20	7.80	4.50	1.00	12.50	625	2.10	12.30	720	4.03	202
66	100.0	18.70	11.50	2.50	3.00	4.00	1:1.20	4.50	1.50	0.50	12.50	1,250	2.10	7.50	960	1.51	151
												23,747			36,397		4,840
												23,750			36,400		4,840

**DT I 11 Flow Capacity of Existing River Channel (Tibu River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth (m)	River Width (m)	Bed Slope 1/n	Sidewall Slope 1:m	Rough- ness <i>n</i>	Water Depth <i>h<sub>1</sub></i> (m)	Sectional Area <i>A</i> (m <sup>2</sup> )	Wetted Perimeter <i>P</i> (m)	Hydraulic Radius <i>R</i> (m)	Velocity <i>V<sub>1</sub></i> (m/s)	Calculated Discharge	Design Discharge
							1:m	<i>n</i>	<i>h<sub>1</sub></i> (m)	<i>A</i> (m <sup>2</sup> )	<i>P</i> (m)	<i>R</i> (m)	<i>V<sub>1</sub></i> (m/s)		
24	124.7	40.00	39.00	5.00	39.0	1/2,000	1:0.10	0.030	4.00	157.600	47.040	3.350	1.669	263.0	17.0
23	78.4	40.00	39.00	2.10	39.0	1/2,000	1:0.24	0.030	1.10	43.188	41.261	1.047	0.768	33.2	17.0
22	236.6	14.00	4.80	3.50	4.8	1/2,000	1:1.31	0.030	2.50	20.214	13.057	1.548	0.997	20.2	17.0
21	70.0	14.00	4.80	3.50	4.8	1/2,000	1:1.31	0.030	2.50	20.214	13.057	1.548	0.997	20.2	17.0
20	186.2	11.40	10.40	2.20	10.4	1/2,000	1:0.23	0.030	1.20	12.807	12.861	0.996	0.743	9.5	17.0
19	90.3	11.40	10.40	2.20	10.4	1/2,000	1:0.23	0.030	1.20	12.807	12.861	0.996	0.743	9.5	17.0
18	48.1	10.30	9.30	3.80	9.3	1/2,000	1:0.13	0.030	2.80	27.072	14.948	1.811	1.107	30.0	17.0

**DT I 12 Design Capacity of Planned River Channel (Tibu River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth (m)	River Width (m)	Bed Slope 1/n	Sidewall Slope 1:m	Rough- ness <i>n</i>	Water Depth <i>h<sub>1</sub></i> (m)	Sectional Area <i>A</i> (m <sup>2</sup> )	Wetted Perimeter <i>P</i> (m)	Hydraulic Radius <i>R</i> (m)	Velocity <i>V<sub>1</sub></i> (m/s)	Calculated Discharge	Design Discharge
							1:m	<i>n</i>	<i>h<sub>1</sub></i> (m)	<i>A</i> (m <sup>2</sup> )	<i>P</i> (m)	<i>R</i> (m)	<i>V<sub>1</sub></i> (m/s)		
24	124.7	40.00	39.00	5.00	39.0	1/2,000	1:0.10	0.030	4.00	157.600	47.040	3.350	1.669	263.0	17.0
23	78.4	40.00	39.00	2.10	39.0	1/2,000	1:0.24	0.030	1.10	43.188	41.261	1.047	0.768	33.2	17.0
22	236.6	14.00	4.80	3.50	4.8	1/2,000	1:1.31	0.030	2.50	20.214	13.057	1.548	0.997	20.2	17.0
21	70.0	14.00	4.80	3.50	4.8	1/2,000	1:1.31	0.030	2.50	20.214	13.057	1.548	0.997	20.2	17.0
20	186.2	11.68	10.40	<b>2.80</b>	10.4	1/2,000	1:0.23	0.030	1.80	19.456	14.092	1.381	0.924	18.0	17.0
19	90.3	11.68	10.40	<b>2.80</b>	10.4	1/2,000	1:0.23	0.030	1.80	19.456	14.092	1.381	0.924	18.0	17.0
18	48.1	10.30	9.30	3.80	9.3	1/2,000	1:0.13	0.030	2.80	27.072	14.948	1.811	1.107	30.0	17.0

**DTI 13 Work Volume Calculation (Tibu River)**

Section	Distance (m)	Top Width (m)	Bottom Width (m)	Depth Existing (m)	Depth Plan (m)	rip-rap h (m)	Sidewall Slope 1:m	Upper +Width (m)	Bottom +Width (m)	Depth +h (m)	rip-rap s (m <sup>2</sup> /m)	rip-rap S (m <sup>2</sup> )	Excavation v1 (m <sup>3</sup> /m)	Excavation v2 (m <sup>3</sup> /m)	Excavation Va (m <sup>3</sup> )	Embank- ment V3 (m <sup>3</sup> /m)	Embank- ment Vh (m <sup>3</sup> )
24	124.7	40.00	39.00	5.00	5.00	6.00	1:0.10	0.00	0.00	0.00	12.06	1,504	1.55	-	193	-	-
23	78.4	40.00	39.00	2.10	2.10	3.10	1:0.24	0.00	0.00	0.00	6.37	499	1.62	-	127	-	-
22	236.6	14.00	4.80	3.50	3.50	4.50	1:1.31	0.00	0.00	0.00	14.86	3,516	2.16	-	511	-	-
21	70.0	14.00	4.80	3.50	3.50	4.50	1:1.31	0.00	0.00	0.00	14.86	1,040	2.16	-	151	-	-
20	186.2	11.68	10.40	2.20	2.80	3.80	1:0.23	0.00	0.00	0.60	7.79	1,450	1.61	-	300	1.58	294
19	90.3	11.68	10.40	2.20	2.80	3.80	1:0.23	0.00	0.00	0.60	7.79	703	1.61	-	145	1.58	143
18	48.1	10.30	9.30	3.80	3.80	4.80	1:0.13	0.00	0.00	0.00	9.68	466	1.57	-	76	-	-
												9,178			1,503		437
												9,180			1,500		437