THE PREPARATORY SURVEY
FOR
UPPER CITARUM BASIN TRIBUTARIES
FLOOD MANAGEMENT PROJECT
IN
INDONESIA

FINAL REPORT

MAIN REPORT

OCTOBER 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

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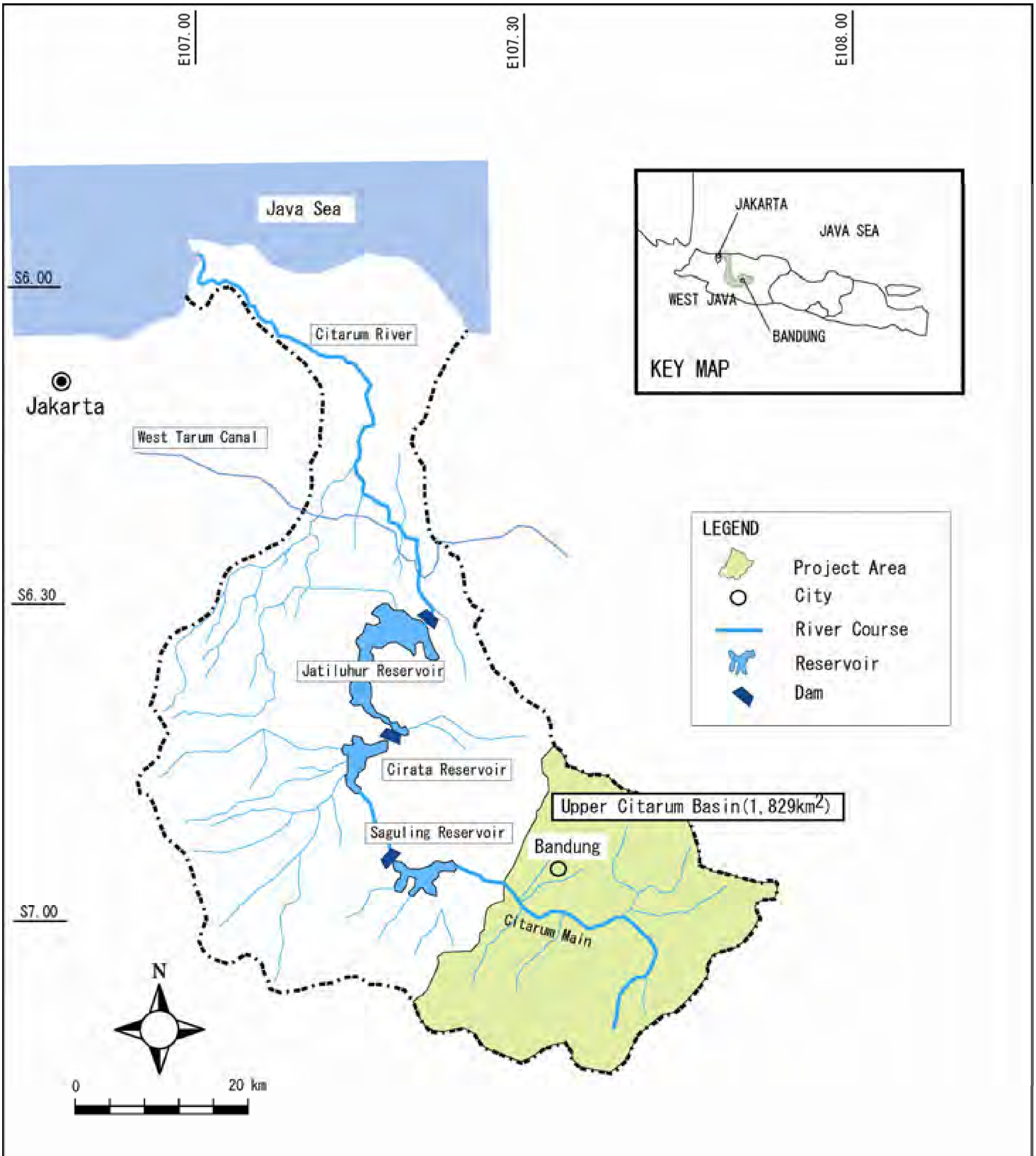
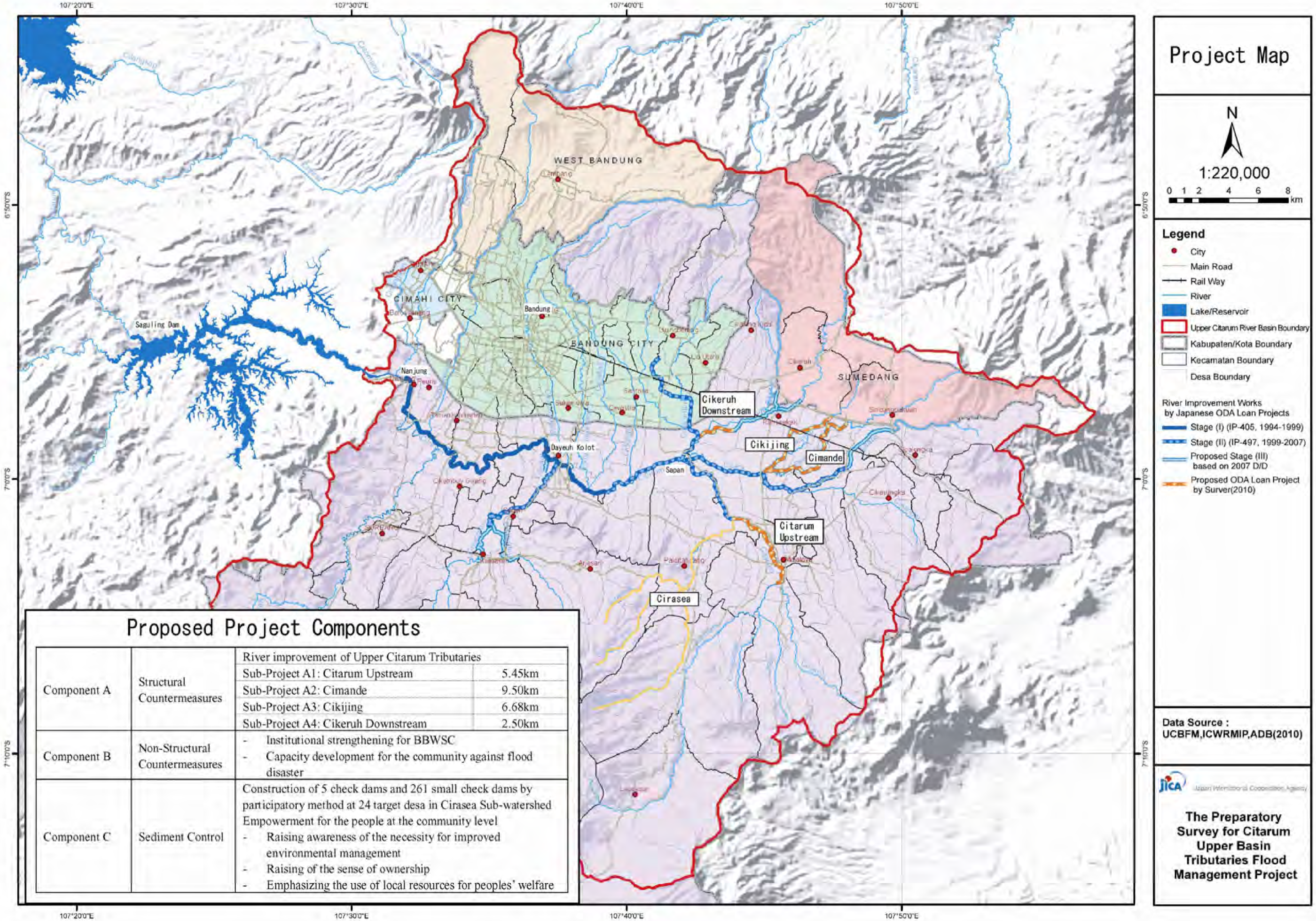
Foreign Currency Exchange Rates Applied in the Study

Currency	Exchange Rate/USD
Rupiah (IDR)	9017.00
Japanese Yen (JPY)	90.9

(Monthly Averaged Rate as of April, 2010)



LOCATION OF PROJECT AREA



Proposed Project Components

Component A	Structural Countermeasures	River improvement of Upper Citarum Tributaries	
		Sub-Project A1: Citarum Upstream	5.45km
		Sub-Project A2: Cimande	9.50km
		Sub-Project A3: Cikijing	6.68km
		Sub-Project A4: Cikeruh Downstream	2.50km
Component B	Non-Structural Countermeasures	- Institutional strengthening for BBWSC - Capacity development for the community against flood disaster	
Component C	Sediment Control	Construction of 5 check dams and 261 small check dams by participatory method at 24 target desa in Cirasea Sub-watershed Empowerment for the people at the community level - Raising awareness of the necessity for improved environmental management - Raising of the sense of ownership - Emphasizing the use of local resources for peoples' welfare	

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ABBREVIATIONS AND GLOSSARIES

Terms	English
1D	One dimensional
2D	Two dimensional
2007 D/D	Review of Flood Control Plan And Detailed Design Preparation Under Upper Citarum Basin Urgent Flood Control Project (II) (JBIC Loan No. IP-497), 2007
6 Cis RBT	River Basin territory covering Cidanau, Ciujung, Cidurian + Ciliwung, Cisadane + Citarum
ADB	Asian Development Bank
AMDAL	Environmental Impact Assessment
ANDAL	Environmental Report
APBN	State Annual Budget
BAKOSURTANAL	National Coordination Agency for Survey & Mapping (Badan Koordinasi Survei dan Pemetaan)
BAPPEDA	Regional body for planning and development (Badan Perencanaan Pembangunan Daerah)
BAPPENAS	National Development Planning Agency (Badan Perencanaan Pembangunan Nasional)
BBWSC	Balai Besar Wilayah Sungai Citarum
BMKG	Agency of Meteorology, Climatology and Geophysics (Badan Meteorologi Klimatologi dan Geofisika)
BNPB	National Disaster Management Agency (Badan Nasional Penanggulangan Bencana)
BPBD	Regional Disaster Management Agency (Badan Penanggulangan Bencana Daerah)
BPLHD	Regional Environmental Agency
BPN	National Land Board
COD	Chemical Oxygen Demand
D/D	Detailed Design
DEM	Digital Elevation Model
DEPHUT	Department of Forestry (Departemen Kehutanan)
DGWR	Directorate General for Water Resources at MPW
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EPA	Environmental Protection Agency
EWS	Early Warning System
F/S	Feasibility Study
GDP	Gross Domestic Products
GIS	Geographic Information System
GOI	Government of Indonesia
GOJ	Government of Japan
GPS	Global Positioning System
GRDP	Gross Regional Domestic Products
ICB	International Competitive Bidding
ICWRMIP	Integrated Citarum WRM Investment Program
IDR	Indonesian Rupiah
ITB	Bandung Institute Of Technology (Institut Teknologi Bandung)
IWRM	Integrated Water Resources Management
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
LARAP	Land Acquisition and Resettlement Action Plan
LMD	Village Consultative Committee (Lembaga Mushawarah Desa)
LPC	Land Procurement Committee
LRP	Livelihood Restoration Program
LRSC	Land Rehabilitation and Soil Conservation
M/D	Minutes of Discussion
MOHA	Ministry of Home Affairs
MPW	Ministry of Public Works (PU=Departemen Pekerjaan Umum)
NGO	Nongovernmental Organization
NJOP	Selling Value of Taxed Object
ODA	Official Development Assistance
PAP	Project Affected Person
PCMU	Project Coordination and Management Unit
PIU	Project Implementation Unit
PJTII	National Corporation for Basin Management (for Citarum)
PLN	Electricity Public Cooperation (Perusahaan Listrik Negara)
PM	Project Manager
PMU	Project Management Unit

Terms	English
PP	Government Regulation (Peraturan Pemerintah)
PSDA	Water Resources Management (Pengelolaan Sumber Daya Air)
PU	Department of Public Works (Departemen Pekerjaan Umum)
PUSAIR	Research Center for Water Resources (Puslitbang Sumber Daya Air)
RBO	River Basin Organization
RBT	River Basin Territory (Willayah Sungai, WS)
RCMU	Road Map Coordination Management Unit
RENSTRA	Strategic Plan (Rencana Strategis)
RKL	Environmental Management Plan
ROW	Right Of Way
RPJMN	Medium-Term Development Plan (Rencana Pembangunan Jangka Menengah Nasional)
RPJPN	Long Term Development Plan
RPL	Environmental Monitoring Plan
SAPROF	Special Assistance for Project Formation
SATKORLAK PB	Provincial Coordination Unit for Disaster Management (Satuan Koordinasi Pelaksana Penanggulangan Bencana)
SATLAK PB	District Coordination Units for Disaster Management (Satuan Pelaksana Penanggulangan Bencana)
SCF	Standard Conversion Factor
SMS	Short Message Service
SOBEK	1D2D Hydraulic Modeling Framework of Deltares – Delft Hydraulics
SRTM	Shuttle Rader Topography Mission
SS	Suspended Solid
TA	Technical Assistance
TCLP	Toxicity Characteristic Learning Procedure
TDA - US Embassy	Trade and Development Agency
TOR	Terms of Reference
UCBFM	Upper Citarum Basin Flood Management project
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPLDP	Upland Plantation and Land Development Project
USLE	Universal Soil Loss Equation
WB	World Bank
WISMP	Water Resources and Irrigation Sector Management program
WRM	Water Resources Management
WTC	West Tarum Canal

CHAPTER 1 INTRODUCTION

1.1. Background of the Survey

Flooding in Indonesia is considered to be a major disaster risk and the number of floods has been increasing yearly. Flooding causes not only direct physical damage but also indirect economic and social damage, such as the stagnation of economic activities. This causes an increase in the number of poor, thus adversely affecting sustainable economic development in Indonesia. Sustainable river basin management including flood control is crucial to the social and economic development of the country.

The Government of Indonesia (GOI) considers the Citarum River Basin to be the most strategic river basin in the country and has determined to adopt a concerted approach to improving land and water management in the area. It has requested ADB's help in developing and funding a long-term Integrated Water Resources Management (IWRM) Investment Program guided by a strategic Roadmap.

The Upper Citarum River Basin located in the Bandung region of West Java province, has incurred frequent floods for many years. These floods have caused enormous damage, especially to economic sectors such as the agricultural and textile industries.

JICA has been supporting the mitigation of flood damage in the Upper Citarum River Basin since the 1980s. Between 1987 and 1988, an overall flood control plan, the Master Plan (M/P), was formulated for the Upper Citarum River Basin. This Master Plan included a Feasibility Study (F/S) for the Urgent Flood Control Plan with technical cooperation from JICA. Subsequently, from 1992 to 1993, GOI carried out the Detailed Design (D/D). On the basis of the D/D, construction works were implemented from 1994 to 2007. Due to the Stage (I) & (II) projects, flooding has been decreasing along the Citarum main river to a considerable extent, however, countermeasures for flood management along the upper tributaries is still not sufficient.

Further, the river flow capacity of the Citarum main river, which was improved by the implementation of Stage (I) and Stage (II), has been considerably decreasing due to an excessive amount of sediment runoff from upstream mountainous regions since effective countermeasures could not be carried out. In fact, GOI carried out the "Upland Plantation and Land Development Project at Citarik Sub-Watershed" with financial assistance from JICA (1995-2006) for the reduction of the sediment runoff from the mountainous regions. However, no similar projects have been implemented after the project of IP-455. In addition, the river excavation works along the main Citarum River could not be implemented as the original O&M activity of GOI. As a result, the river flow capacity along the Citarum main river has been decreasing considerably due to sedimentation, which increases flood risk or causes recurrent flood disasters in the area.

Under the above circumstances, JICA had discussions on the Scope of Work of JICA Preparatory Survey for the Upper Citarum River Basin Tributaries Flood Management Project with officials of the Ministry of Public Works of Indonesia in December, 2009, aiming at formulation of a future ODA loan project. Refer to Annex at the end of this report for the Minutes of Discussion. In view of the recent flood disasters along the upper tributaries, GOI pre-requested ODA Loan Assistance to GOJ

(Government of Japan) for river improvement works of the tributaries in the Upper Citarum River Basin as an urgent prioritized project on 30th of June, 2010.

1.2. Objectives of the Survey

The Survey is aimed at formulating a future Official Development Assistance (ODA) loan project to minimize flood damage occurrence along the upper tributaries of the Citarum River. In addition, associated technical assistance for improving water-related environmental management in the area is to be proposed based on the results of the Survey.

1.3. Survey Area

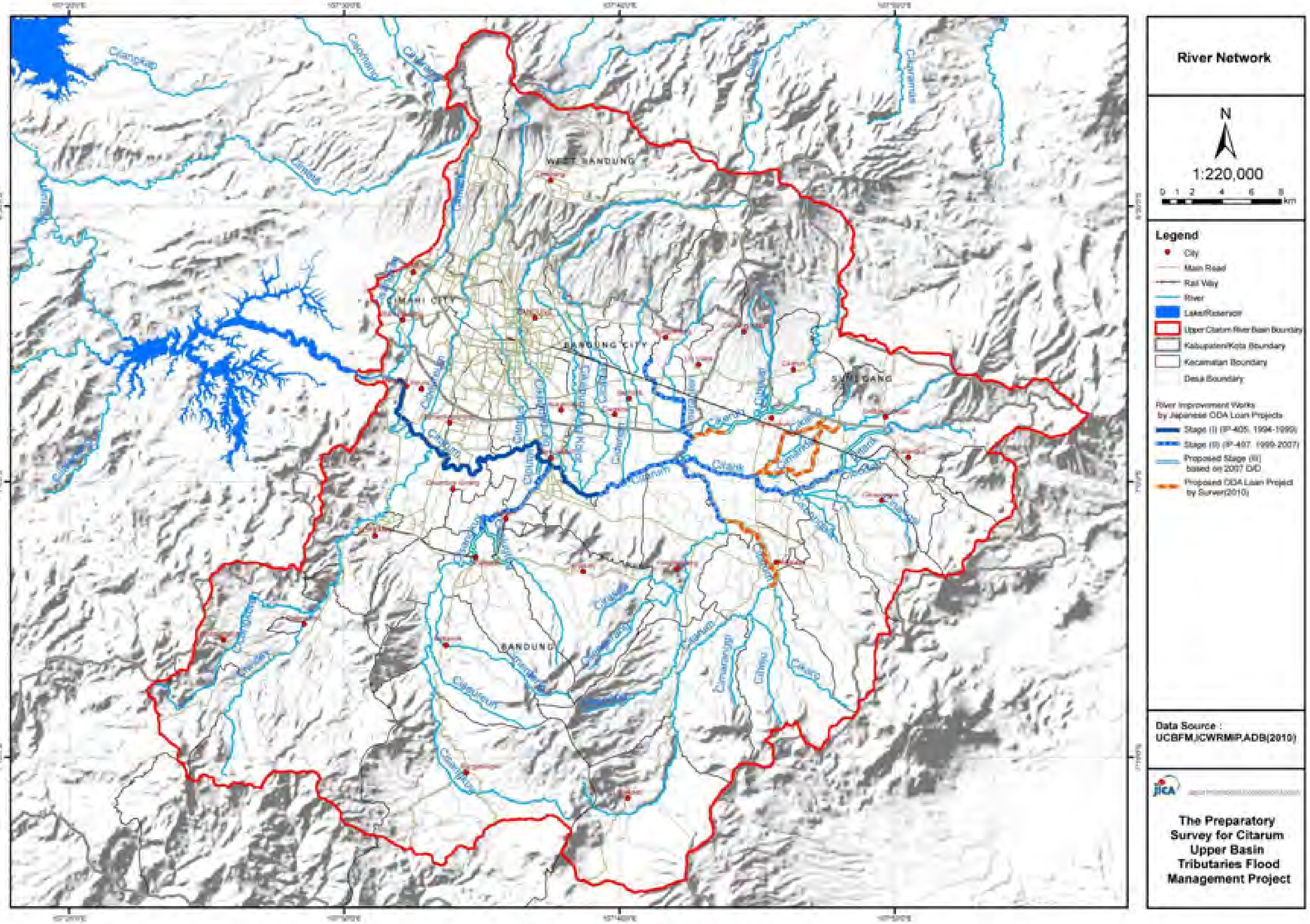
The survey area (1,829km^2)[1] covers the Upper Citarum River Basin in West Java Province as shown in the location maps below (Figure 1.3.1.1).

Source: Based on a pamphlet "UPPER CITARUM BASIN URGENT FLOOD CONTROL PROJECT" published by BBWSC

Figure 1.3.1.1 Location Map of Upper Citarum River Basin

Figure 1.3.1.2 on the next page shows the river network map in the Upper Citarum River Basin (Refer to Appendix).

[1] Although the area of 1,771km^2 has been adopted in the previous studies, the area of 1,829km^2 is adopted based on the DEM (Digital Elevation Model) analysis in Deltares (UCBFM,ICWRMIP,ADB) Report (2010).



Source: JICA Survey Team (Data Source: 2007 D/D and UCBFM, ICWRMIP, ADB)

Figure 1.3.1.2 River Network Map in Upper Citarum River Basin (Refer to Appendix for Original Map)

1.4. Scope and Schedule of the Survey

1.4.1. Survey Components

The Survey is to be carried out based on the “Minutes of Discussion” agreed between the GOI and JICA in December 2009. The scope of the Survey includes the following:

(1) Review of the background and necessity of the Project

1) Review RPJM2010-2014, Regional Development Plan and relevant policy

2) Review recent flood damage (Number of affected people, economic loss, damaged area)

3) Analyze bottlenecks for the implementation of the Project (Water quality and land subsidence, *etc.*)

(2) Review of the Feasibility of the Project

1) Propose selection criteria for the sub-projects

2) Implementation of runoff and flood analysis including collection of meteorological and hydrological data utilizing flood models (Impact assessment in the case with/without the Project)

3) Review existing detailed designs and propose essential structural measures for controlling water discharge volume to the downstream basin

4) Conduct basic designs of structural measures for possible new target tributaries, prepare the schedule, and calculate cost estimates based on the results of the runoff analysis

5) Identify the locations of needed land space to be acquired and the number of inhabitants to be relocated due to the proposed development

6) Conduct sampling surveys to determine the presence of heavy metals and propose countermeasures as necessary

7) Formulate key non-structural measures (including capacity strengthening of the community in response to the occurrence of frequent floods)

8) Make a preliminary determination of the scope of the Project based on information of flood damage within a reasonable loan amount

(3) Identify other issues of concerns and propose necessary countermeasures for identified concerns (for possible JICA assistance in coordination with concerned stakeholders considering the Project referred to above and taking the Roadmap into account)

(4) Evaluation of the Project Implementation and O&M Framework

(5) Evaluation of the Benefits of the Project (EIRR, Operation and Benefit Indicators)

(6) Assessment of the Environmental and Social Considerations

1) Review the preparation process of AMDAL and LARAP in accordance with JBIC Guidelines for confirmation of environmental and social issues (April 2002) (hereinafter called as "JBIC Guidelines")

2) Review the results of actual implementation of AMDAL and LARAP for Stage (I) and Stage (II) projects, and analyze issues of major concern (including necessary countermeasures)

3) Support the Indonesian side in preparing the LARAP framework for each sub-project should a large-scale involuntary resettlement and/or land acquisition be required

4) Review the EIA report, and if necessary, support the Indonesian side in conducting additional surveys, if needed

5) Support the Indonesian side in preparing the environmental checklist and monitoring forms in accordance with the JBIC Guidelines

1.4.2. Schedule of the Survey

The survey period is 8 months from March 2010 to October 2010 as shown in the table hereunder:

Table 1.4.2.1 Survey Schedule

Year	2010							
Month	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
	1	2	3	4	5	6	7	8
Work in Indonesia		1st work in Indonesia	1st work in Indonesia		2nd work in Indonesia	2nd work in Indonesia		3rd work in Indonesia
Work in Japan	1st work in Japan			2nd work in Japan			3rd work in Japan	4th work in Japan
Report	△ ICR			△ IR			△ DFR	△ FR

ICR: Inception Report   IR: Interim Report   DFR: Draft Final Report   FR: Final Report

Source: JICA Survey Team

1.5. Meetings and Workshops

During the Survey, the Survey Team had a number of meetings including two workshops in May and October of this year. Table 1.5.0.1 shows the list of major meetings and workshops with the relevant organizations of GOI. Refer to Appendix for presentation slides during the meetings and workshops.

Table 1.5.0.1 List of Major Meetings and Workshops

YY/MM/DD	Venue	Agenda
10/04/12	MPW	Explanation of Inception Report, *etc.*
	BAPPENAS	
10/04/13	ADB Indonesia	
10/04/19	BBWSC	
10/05/17	PUSAIR	1st Workshop (Preparation Selection Urgent Flood Mitigation Works in the Upper Citarum Basin)
10/07/26	BAPPENAS	Meetings during 1st JICA Fact Finding Mission
	MPW	
10/08/25	BAPPENAS	Meetings 2nd JICA Fact Finding Mission
10/10/05	Hotel (Banana Inn)	2nd Workshop (Selection of Urgent Flood Mitigation Works in the Upper Citarum River Basin)

Source: JICA Survey Team

CHAPTER 2 POSITION AND NECESSITY OF THE PROJECT

This chapter begins with a discussion on Indonesian development plans such as the National Long-Term Development Plan (RPJPN 2005-2025), the National Medium-Term Development Plan (RPJMN 2010-2014), and the Regional Medium-Term Development Plan, *etc.* in terms of water resources including flood management issues. It continues with a discussion on the current statuses of major donors (*e.g.* JICA, ADB, World Bank, UNESCO, *etc.*) in the field of water resources. Finally, the necessity of the Project is described at the end of this chapter.

2.1. Current Status of Development Plans in Indonesia

In Indonesia, development plans at the national level consist of the National Long-Term Development Plan (RPJPN: 20 years) and the National Medium-Term Development Plan (RPJMN: 5 years). The implementation period for the RPJPN covers the years from 2005 to 2025. The period for the first RPJMN (RPJMN I) covered the years 2005 to 2009, while the second RPJMN (RPJMN II) covers 2010 to 2014. The RPJMN I stated that countermeasures, for mitigation of flood damage that were included as water resource management, were considered as an important strategic program. The RPJMN II also places mitigation of flood risk as one of the most important goals of the national program due to climate change. In addition to the national plans above, both the national government (*e.g.* departments, agencies, *etc.*) and local government (*e.g.* provinces, districts, cities, *etc.*) are to establish their development plans in line with the national plans.

(1) National Long-Term Development Plan (RPJPN 2005-2025)

The objective of the RPJPN 2005-2025 is set for "providing direction and also as reference for all elements of the nation (*e.g.* government, society, the business community, *etc.*), in realizing the national ideals and goals in accordance with the vision, mission, and direction of development that have been commonly agreed so that the entire endeavors carried out by the stakeholders in development are synergic, coordinated, and mutually supporting in one pattern of perception and one pattern of behavior". In this RPJPN, the issues are pointed out in terms of water resources management, water quality, water demand, sewage systems, water pollution, sedimentation, insufficient infrastructure, and insufficient water supply for irrigation and disaster management. The necessity of the measures for those issues is also mentioned in the RPJPN. The contents of the RPJPN are shown in the table below.

Table 2.1.1.1 Contents of National RPJPN (2005-2025)

I.	INTRODUCTION
II.	OVERALL CONDITION
III.	THE VISION AND MISSION OF NATIONAL DEVELOPMENT FOR 2005-2025
IV.	DIRECTION, STAGES, AND PRIORITY OF THE LONG-TERM DEVELOPMENT 2005-2025
V.	CLOSING PROVISIONS

Source: Based on "RPJPN 2005-2025", which is an appendix of Law of the Republic of Indonesia Number 17 of 2007 on the Long-Term National Development Plan of 2005-2025. The above sentences were summarized from the pages related to water resources issues and flood issues. (Pages: 10, 25 to 26 and 54)

(2) National Medium-Term Development Plan (RPJMN 2010-2014)

The second RPJMN (2010-2014) aims at greater consolidation of the reform of Indonesia in all fields by emphasizing endeavors for increasing the quality of human resources, including the promotion of advancement in science and technology and the strengthening of economic competitiveness. In the RPJMN, the policy direction in water resources development is mentioned as below:

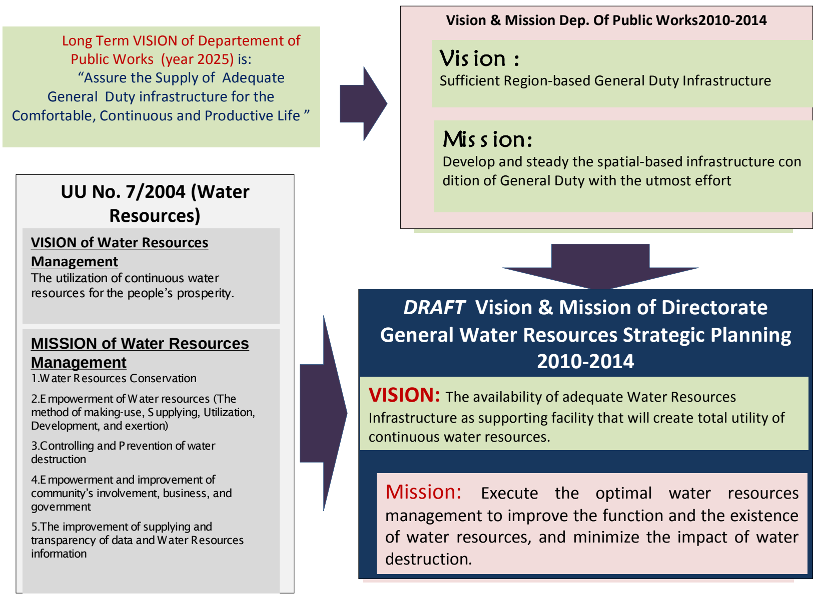
Table 2.1.1.2 Policy Direction in Water Resources Development in RPJMN (2010-2014)

FOCUS 1: Increasing the service level in accordance with minimum service standard - Increasing the service level of water resources facilities & infrastructures in accordance with the minimum service standard - Increasing the coverage area and quality of raw water services in an optimum, sustainable, fair and equitable way - Improve the institutional capacity, management and integrity in the water resources management - Increasing the availability and ease of access to data & information in water resources management FOCUS 2: Increasing the competitiveness of real sectors - Improvement and preservation of water availability in a sustainable manner - Improvement of irrigation networks services/swamps, controlling and reducing the impact of floods and landslides - Coastal protection FOCUS 3: Increase the Public Private Partnership initiative - Supporting the PPP initiative in the provision of water resources facilities and infrastructures, especially raw water conveyance

Source: Based on "Book II Chapter V, RPJMN 2010-2014". The above sentences were summarized from the pages related to water resources issues and flood issues. (Pages 55-56, 64-65 and 73)

(3) Ministerial Strategic Plan in terms of Water Resources (RENSTRA)

RPJMN is a National Medium-Term Development Plan covering a period of 5 years, while RENSTRA is a 5-year ministerial strategic plan for relevant agencies. DGWR, MPW prepared RENSTRA related to the water resources sector based on RPJMN and Water Resources Law (No.7/2004). The relation among RENSTRA, the vision of MPW and the law is indicated in Figure 2.1.1.1 below. The proposed program for 2010 to 2014 in Water Resources is shown in Table 2.1.1.3 and the water resources management strategy for the regions of Java and Bali is indicated in Table 2.1.1.4.



Source: Concept of National Strategic Development Plan of Water Resources 2010-2014 (Konsep RENCANA STRATEGIS, BIDANG SUMBER DAYA AIR 2010-2014)

Figure 2.1.1.1 The Relationship Between RENSTRA, Vision of DPU and Water Resources Law

Table 2.1.1.3 Proposed Program for 2010 to 2014 in Water Resources

Program	Purpose
Water Resources Conservation	To maintain and improve the continuous function and the existence of water sources and water resources infrastructure
Water Resources Empowerment	To utilize water resources continuously and improve the replenishment of raw water
Water Destructive Power Management	To reduce risk, area coverage and flood period as well as reduce coastal abrasion disasters
Role Improvement and Empowerment of Water Resources Stakeholders	To increase the involvement of stakeholders and the capacity of Water Resources Institutions in Water Resources Management
Water Resources Information System Management	To increase the accessibility of the Water Resources Information System to enable the relaying of water resources information in a timely and accurate manner

Source: Concept of National Strategic Development Plan of Water Resources 2010-2014 (Konsep RENCANA STRATEGIS, BIDANG SUMBER DAYA AIR 2010-2014)

Table 2.1.1.4 Water Resources Management Strategy for the Regions of Java and Bali

1. Controlling floods especially in residential areas
2. Maintaining a broad irrigation area for perpetual rice fields rehabilitating the damage of irrigation network
3. Controlling the utilization of water source with water surface priority
4. Pollution control and water quality management
5. Strengthening integrated water resources management in water area hall
6. Providing the needs of irrigation water and raw water for DMI (Domestic, Municipal and Industry) with water allocation and conflict solution
7. Implementing river basin area conservation efforts and water resources protection

Source: Based on "Konsep RENCANA STRATEGIS Bidang Sumber Daya Air 2010-2014". The above sentences were summarized from the page related to water resources issues and flood issues. (Page 32)

(4) Regional Medium-Term Development Plans (West Java Province, Kabupaten Bandung and Kota Bandung)

At the regional level, all local governments must prepare long, medium and annual term plans (RPJPD, RPJMD and RKPD) in accordance with the national level plans. The policy direction in water resources development in RPJMD 2008-2013 of West Java Province is shown as follows:

Table 2.1.1.5 Policy Direction in Water Resources Development of West Java Province

1. To increase the condition of water resources & irrigation infrastructure to support the conservation & utilization of water resources and the control of water destructive power
2. To increase the performance of drinking & waste water management
3. To increase the recovery & conservation effort of water resources, air, forest and land

Source: Based on "RPJMD 2008-2013 of West Java Province". The above sentences were summarized from pages and sections related to water resources issues and flood issues. (Page IV-4 and IV-6)

The provincial agency for water resources (Dinas PSDA) formulated their five-year plan (RENSTRA 2008-2013), which covers both structural and non-structural measures. The relevant program is indicated as follows:

Table 2.1.1.6 Program of Provincial Agency for Water Resources of West Java Province

1. Development & management of irrigation network, swamps and other water infrastructures
2. Development, management and conservation of rivers, lakes and other type of water resources
3. Flood control and coastal protection
4. Improvement, management and conservation of rivers, lakes and other water resources

Source: Based on "RENSTRA 2008-2013" prepared by Dinas PSDA of West Java Province. The above sentences were extracted from pages and sections related to water resources issues and flood issues. (Chapter V, Page 56)

The program activities in terms of water resources in RPJMD 2009-2013 of Kota Bandung are shown as follows:

Table 2.1.1.7 Program of Kota Bandung

1.	Control the cultivation & destruction of the environment
2.	Raw water provision
3.	Protection and conservation of natural resources
4.	Increasing the capacity and coverage of clean water services
5.	Construction of city drainage infrastructure
6.	Development, management and conservation of rivers, lakes and other types of water resources
7.	Performance development of drinking & waste water management

Source: Based on "RPJMD 2009-2013 of Kota Bandung". The above sentences were extracted from pages related to water resources issues and flood issues. (Page III-13)

In the RPJMD 2005-2010 of Kabupaten Bandung, a program for the development and management of water resources is explained. The purposes are shown as follows:

Table 2.1.1.8 Purposes of the Program in Kabupaten Bandung

1.	Utilization of master plan for raw and ground water
2.	Implementation of water resources management
3.	Utilization of clean water facility

Source: Based on "RPJMD 2005-2010 of Kabupaten Bandung". The above sentences were summarized from pages and sections related to water resources issues and flood issues. (Pages VI-10 to 11 and VII-28)

2.2. Current Status of Related JICA Projects

2.2.1. JICA Projects in the Field of Water Resources

The GOJ has stated its policy on the Assistance Plan for Indonesia since November 2004 to provide support for improvement of the living environment, including disaster measures, for the realization of "a fair and democratic social framework". JICA has implemented a number of projects related to the field of integrated water resources management in terms of "Development Study", "ODA Loan Project", "Technical Assistance", "Grant Aid", *etc*. for many years. In recent years, the following projects, shown in Table 2.2.1.1, have been implemented or are under planning.

The JICA Guidelines for Water Resources (prepared in 2004 and revised in 2009) mentions four pillars as development strategy goals: 1) Implementation of integrated water resources management, 2) Safe water supply considering stability and efficiency, 3) Improvement of flood control measures for protection of people's life and assets, and 4) Protection of the water environment. Further, the guidelines also state that a comprehensive program approach in the future should be done differently from the individual project implementation style used in the past. However, the four goals cannot be easily achieved at sufficient levels with only one project implementation; thus it is expected that the goals will be pursued by synergistic project coordination in a well-arranged manner.

Table 2.2.1.1 Recent JICA Projects Related to Water Resources

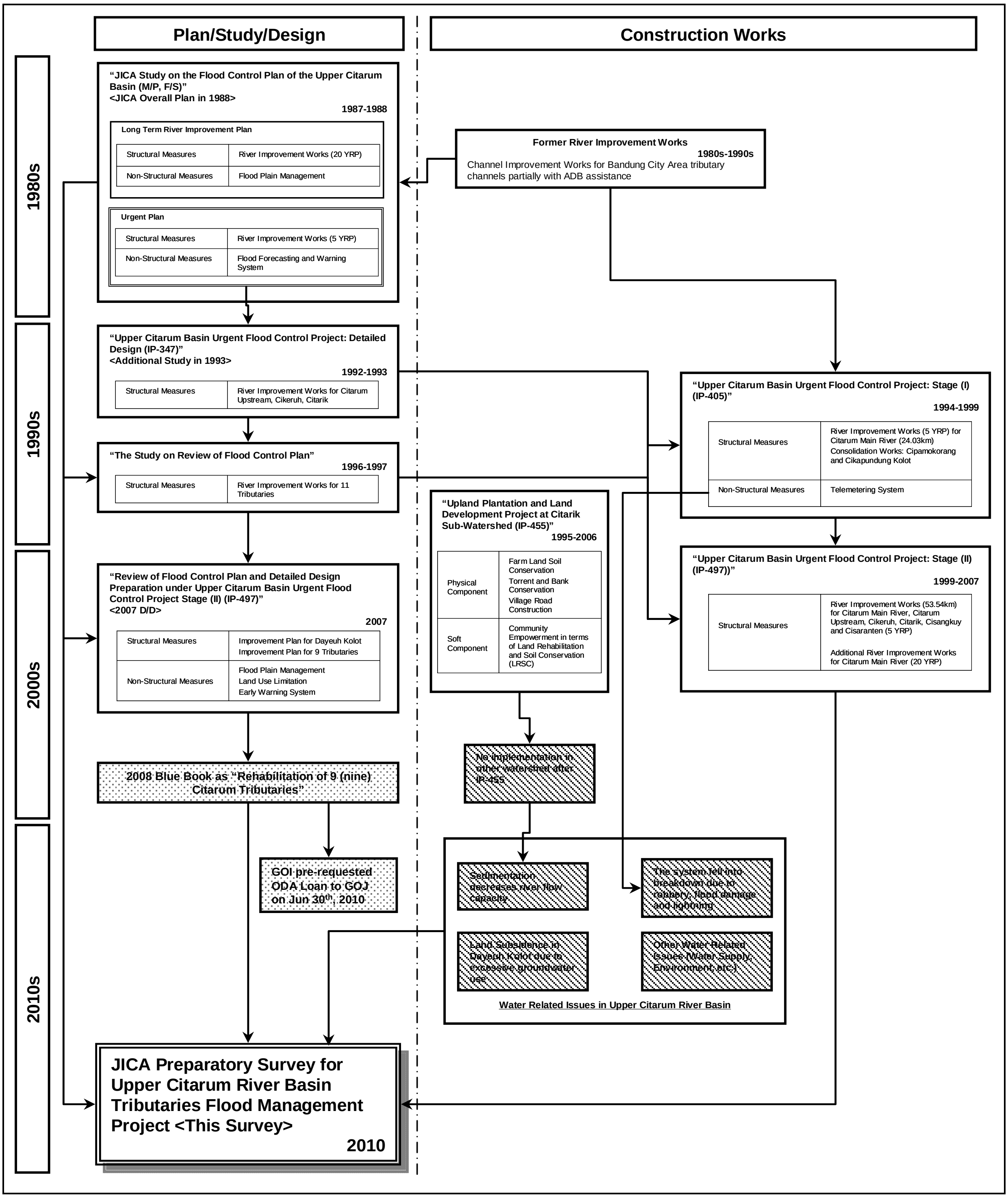
Name of Project	Scheme	Status	Present Situation and future plan	Schedule 2009	2010	2011	2012	2013	Cate-gory: Comprehensive Disaster Management	Integrated Water Resources Management
9 tributaries for Citarum river Improvement Project	LA	Pre-requested		→	→	→	→	→ ～2017		x
Urban Flood Control System Improvement in Selected Cities	LA	On going		→	→	→	→	→ ～2014.5		x
Project on Capacity Development for RBOs Practical Water Resources Management and Technology	TA	On going		→	→					x
The Institutional Revitalization Project for Flood Management in JABODETABEK	TA	Finished		→	→				x	x
Capacity Development Project for Comprehensive Flood Control in JABODETABEK	TA	Requested				→	→		x	x
Renovation of Pluit Drainage Pumping Station	GA	On going		→	→					x
Water Resources Policy Adviser	EXP	On going		→	→					x
Water Resources Existing Facilities Rehabilitation and Capacity Improvement Project	LA	On going		→						x
Integrated Water Resources and Flood Management Project for Semarang	LA	On going		→	→	→	→	→ ～2015.7	x	x
Contermeasure for Sediment in Wonogiri Multipurpose Dam Reservoir (1)	LA	On going		→	→	→	→			x
Lower Solo River Improvement Project (2)	LA	On going		→	→	→	→	→ ～2015.7		x
Urgent Disaster Reduction Project for Mt. Merapi / Progo River Basin and Mt. Bawakaraeng	LA	On going		→	→	→	→	→ ～2014.7	x	x
The Study on Disaster Management in Indonesia	DS	Finished		→					x	x
Capacity Development Project for Disaster Risk Management	TA	Proposed				→	→		x	x
Disaster Recovery and Management Sector Program Loan	LA	Under monitoring	Additional actions will be incooperated into CCPL.	→					x	x
Tsunami Early Warning Advisor	EXP	Adopted	under selecting						x	x

Source: JICA Preparatory Study on Disaster Management Program for Indonesia (2010) (Revised by JICA Survey Team)

2.2.2. JICA Assistances in the Upper Citarum River Basin

As mentioned in the previous chapter, JICA has been supporting the mitigation of flood damage of the Upper Citarum River Basin since the 1980s. Refer to Figure 2.2.2.1 and Table 2.2.2.1 indicating the related studies and projects in the Upper Citarum River Basin. Between 1987 and 1988, an overall flood control plan, the Master Plan (M/P), was formulated for the Upper Citarum River Basin. It included a Feasibility Study (F/S) for the Urgent Flood Control Plan and was implemented with technical cooperation from JICA. Subsequently, from 1992 to 1993, GOI carried out the Detailed Design (D/D) for the Urgent Flood Control Plan with financial assistance from JICA (IP-347, 1992-1993). On the basis of the D/D, the construction works were implemented from 1994 to 2007. The implementation was divided into two stages: Stage (I) (IP-405, 1994-1999) and Stage (II) (IP-497, 1999-2007). Refer to Figure 2.2.2.2 and Figure 2.2.2.3 for the Project components for Stage (I) and Stage (II), respectively.

During Stage (II), GOI prepared the “Final Engineering Report for Review of Flood Control Plan and Detailed Design Preparation” in 2007 (Hereinafter, to be referred to as “2007 D/D”) for the preparation of Stage (III), which consists of river improvement works of the upper tributaries for the completion of the Urgent Flood Control Plan.



Source: JICA Survey Team based on JICA Study on the Flood Control Plan of the Upper Citarum Basin (1988) and 2007 D/D Report

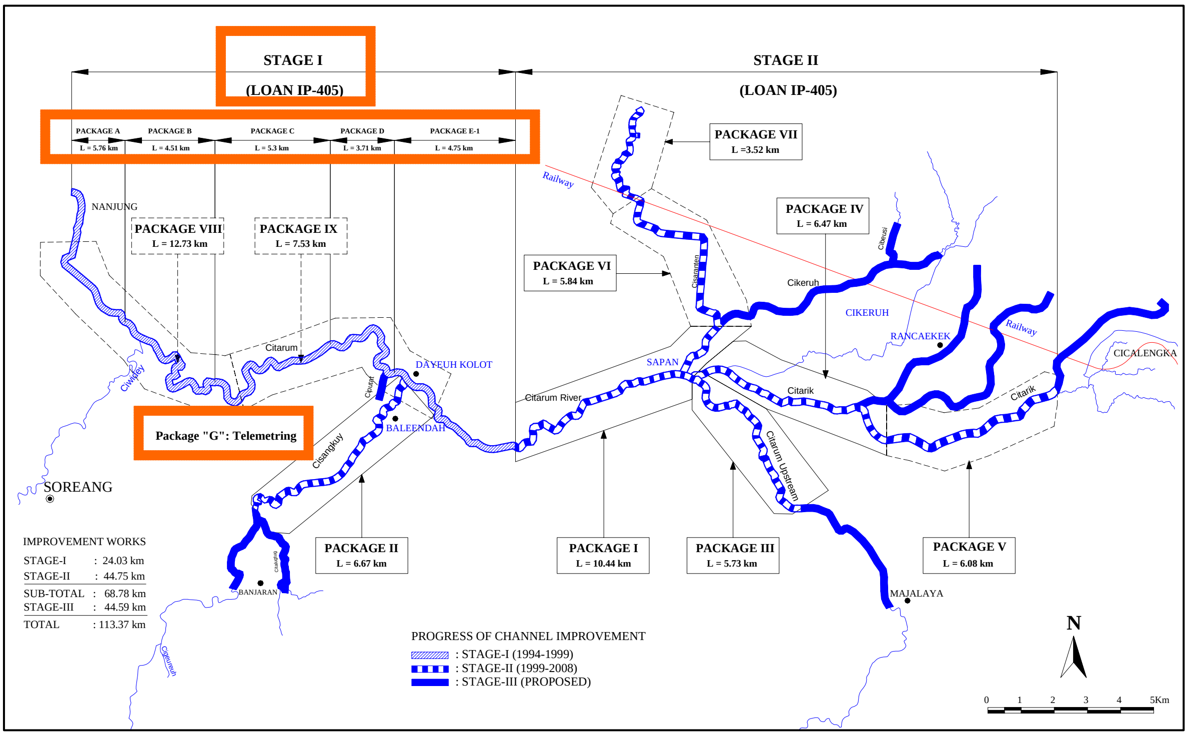
Figure 2.2.2.1 Related Studies and Projects in the Upper Citarum River Basin

Table 2.2.2.1 Related Studies and Projects in the Upper Citarum River Basin

Study / Project		Year	Contents		
Former River Improvement Works (GOI with ADB assistance)	C/W	1980s -1990s	Improvement Works for Bandung City Area Tributaries Partially with ADB Assistance	Cipamokolan, Cidurian, Ciwastra, Cicadas, Cikapundung Kolot, Citepus, Cikapundung-Cipalasari, Downstream Cikapungdung & Cipalasari (total 57.1 km)	
Study on the Flood Control Plan of the Upper Citarum Basin (JICA)	M/P, F/S	1987 -1988	Long-term River Improvement Plan	Structural Measures	River Improvement Works (20 YRP) 1) Citarum main 2) Tributaries: Citarum Upstream, Citarik, Cikeruh and Cisangkuy
				Non-structural Measures	Flood Plain Management 1) Land Use Regulation 2) Flood Forecasting and Early Warning System
			Urgent Plan	Structural Measures	River Improvement Works (5 YRP) 1) Citarum Main 2) Cisangkuy
				Non-structural Measures	Flood Forecasting and Early Warning System
Detailed Design of Urgent Plan (GOI with JICA ODA Loan Assistance: IP-347)	D/D	1993	Additional Study following the JICA Study in 1988	Citarum upstream, Cikeruh and Citarik rivers were included as an improvement works of major tributaries	
Upper Citarum Basin Urgent Flood Control Project: Stage (I) (GOI with JICA ODA Loan Assistance: IP-405)	C/W	1994 -1999	Implementation of Stage (I)	Structural Measures	1) River improvement Works for Citarum Main River(24.0km) 2) Consolidation works for Cipamokorang and Cikapundung Kolot
				Non-Structural Measures	Telemetering System
Upland Plantation and Land Development Project at Citarik Sub-Watershed	C/W	1995 -2006	Implementation of Upland Plantation and Land Development for Citarik Sub-Watershed	Physical Component	1) Farm Land Soil Conservation 2) Torrent and Bank Conservation 3) Village Road Construction
				Soft Component	Community Empowerment in terms of Land Rehabilitation and Soil Conservation (LRSC)
Upper Citarum Basin Urgent Flood Control Project: Stage (II) (GOI with JICA ODA Loan: IP-497)	C/W	1999 -2007	Implementation of Stage (II)	Structural Measures	River Improvement Works (5 YRP) Citarum Main River(6.7km), Citarum upstream(5.7km), Cikeruh(2.3km), Citarik(13.0km), Cisangkuy(6.7km) and Cisaranten(10.4km)
	C/W	2007 -2008	Additional River Improvement Works	Structural Measures	Additional River Improvement Works Citarum Main River (20 YRP)
Review of Flood Control Plan and Detailed Design Preparation under Upper Citarum Basin Urgent Flood Control Project Stage (II) (GOI with JICA ODA Loan: IP-497)	D/D	2007	Detailed Design for Stage (III)	Structural Measures	Improvement Plan for Upper Tributaries Citarum Upstream(8.0km), Cisangkuy(7.0km), Citalugtug(5.0km), Citarik Upstream(6.0km), Cikijing(8.0km), Cimande(8.0km), Cikeruh(10.0km), Cibeusi(2.5 km), Ciputat(1.2km)
			Review and Study for Flood Control Plan	Structural Measures	1) Improvement Plan for Upper Tributaries 2) River Improvement of Citarum Mainstream at Dayeuh Kolot 3) Improvement for Tributaries at Dayeuh Kolot - Diversion channel method - Dike method with drainage system including pumping facilities
				Non-Structural Measures	1) Flood Plain Management 2) Telemetering System 3) Flood Forecasting

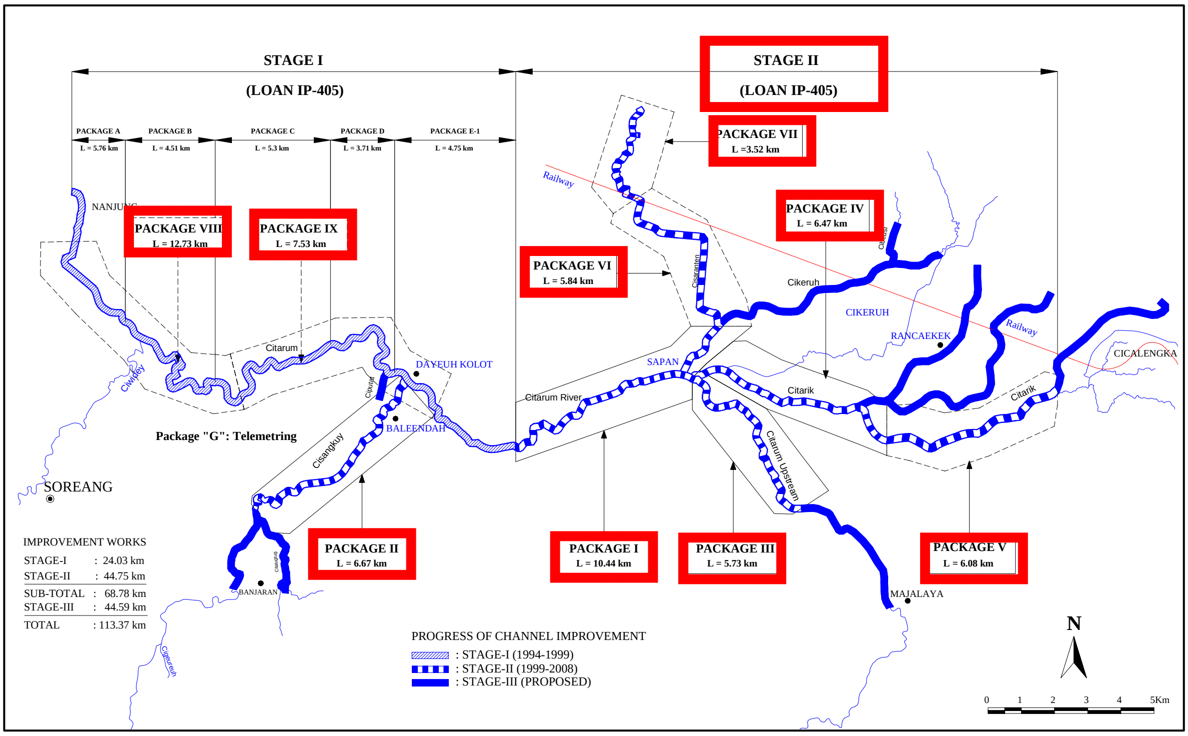
Note: C/W: Construction Works, M/P: Master Plan, F/S: Feasibility Study, D/D: Detailed Design

Source: JICA Survey Team based on JICA Study on the Flood Control Plan of the Upper Citarum Basin (1988) and 2007 D/D Report



Source: Upper Citarum Basin Urgent Flood Control Project (II) (1999-2007)

Figure 2.2.2.2 Location Map of Components of Stage (I) Project



Source: Upper Citarum Basin Urgent Flood Control Project (II) (1999-2007)

Figure 2.2.2.3 Location Map of Components of Stage (II) Project

2.3. Current Status of Major Donors

The Asian Development Bank (ADB), World Bank, Islamic Development Bank, Fonds D'etude Et D'aide Au Secteur Prive (FASEP), United Nations Educational Scientific and Cultural Organization (UNESCO) and the Trade and Development Agency (TDA - US Embassy) are donors presently working in the Citarum River Basin. DGIS- Netherlands Directorate-General of Development Cooperation also participates in grant technical assistance.

Table 2.3.1.1 Foreign Funding Projects in the Citarum River Basin

Donors	Project	Loan
Asian Development Bank (ADB)	Integrated Citarum Water Resources Management Investment Program (ICWRMIP) (Project-1) Technical Assistance	Loans: USD 20 M (2500-INO) USD 30 M (2501-INO SF) Grant: USD 3.75 M (GEF Grant) USD 8.0 M (ADB Grant) USD 2.55 M (ADB Grant for CCAM)
	Infrastructure Resources Sector Development Project –IRSDP	USD 2 M Loan No. 2264-INO Dutch Government Grant No. 0064 -INO.
World Bank	Water Resources and Irrigation Sector Management Program (WISMP - APL2) - Rehabilitation of Jatihulur Irrigation Canals	USD 25 M (IBRD Loan no 4711-IND) USD 45 M (IDA Credit no: 3807-IND) Grant: USD 14 M (Grant TF No: 052124)
	Dam operational improvement and safety (DOISP)	US $ 50 M (loan nr: 7669-ID)
Islamic Development Bank	The Construction of Transfer Water Inter Basin (Cibatarua-Cilaki Project)	USD 75 M IDB Loan: USD 63.75 M GOI: USD 11.25 M
FondsD'etude Et D'aide Au SecteurPrive (FASEP)	Design of Jakarta Raw Water Transmission Improvement Project for the Rehabilitation of the Raw Water Transmission of the West Tarum Canal between Bekasi&Cawang	
Trade and Development Agency (TDA - US Embassy)	Feasibility Study for Wastewater Treatment Technology and Service Options for the Upper Citarum River Basin	Cost of the study: USD 796,000
UNESCO	SWITCH in Asia Programme (Dara Ulim and Mahmud oxbows)	

Source: ROADMAP FOR A BETTER FUTURE National Steering Committee for Water Resources - Citarum Roadmap Coordination Meeting Jakarta, April 12th 2010 Deputy Minister for Infrastructure Affairs, State Ministry of National Development Planning CITARUM

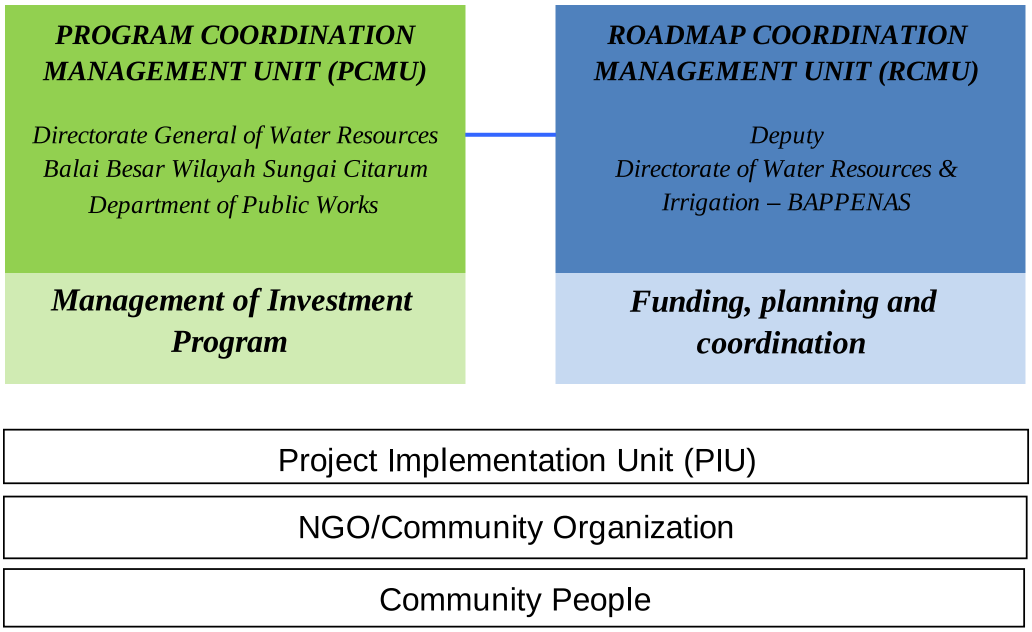
Water resources in the Citarum River Basin have been used in many fields such as industry, agriculture, power generation, and domestic water for a population of 28 million people living in the basin and its surroundings. However, in the field of water resources, various comprehensive issues have been pointed out in the RPJMN.

To combat interweaving issues and to establish an efficient water resources usage system, the GOI shifted from a traditional single project planning approach to an integrated and coordinated development approach with ownership by basin stakeholders, called Integrated Water Resources Management (IWRM).

DGWR conducted a survey and study of IWRM in the Citarum River Basin with technical assistance by ADB. As a consequence, a Roadmap for IWRM in the Citarum River Basin was established. The Roadmap sets out future interventions up to 2023 that will be required to achieve the specific objectives set for each key area.

The Roadmap comprises of about 80 various intervention programs related to water resources management under 5 main key areas, 2 supporting key areas and a program management area as shown in Figure 2.3.1.2. The initial estimate of the cost of the full suite of Roadmap interventions is approximately US$3.5 billion.

A Roadmap coordination and management unit (RCMU) has been established in the National Development Planning Agency (BAPPENAS) to ensure overall planning and financial management in the national and local governments. DGWR has established a project coordination and management unit (PCMU) in its Citarum River Basin organization, Balai Besar Wilayah Sungai Citarum, which is responsible for the overall management and coordination of all investment program activities. The RCMU and the PCMU will work closely with the National Steering Committee for Water Resources. Project Implementation Units (PIUs) will be established in each implementing agency. Routine communications from ADB on the Investment Program will be addressed to the PCMU.



Source: Road Map Pengelolaan Sumber Air Terpadu

Figure 2.3.1.1 Coordination Chart

Sources: Asian Development Bank and Government of Indonesia.

Figure 2.3.1.2 Strategic Framework for IWRM in the Citarum River Basin

These key areas and supporting key areas are defined below.

Table 2.3.1.2 Roadmap Key Areas and Definitions

Institutions and Planning for IWRM	The term "institutions" is used in its broadest sense that is, dealing with organizations, as well as legislation, policies and other protocols that define the relations among those organizations. Planning for IWRM (and in particular in this context, river basin planning) is seen as a mechanism for promulgating and implementing policies of government, and as such is included in this key area. Accordingly, the following activities are included: ・ Organization restructuring ・ Organizational capacity building ・ Policy development ・ Implementing the legislative framework ・ Planning for IWRM ・ Regulation (such as licensing of water utilization and wastewater discharge ・ Setting of water tariffs ・ Institutions for participatory irrigation management (PIM).
Water Resource Development and Management	This key area includes those activities that are related to exploiting water resources – that is, increasing water availability to authorized users, and operating and maintaining the infrastructure developed in the process. The main activities included are: ・ Project planning, including "master planning" (that is, planning that focuses on development of infrastructure, and distinct from broader basin planning) ・ Construction of infrastructure for storing and delivering water (including reservoirs, canals and pipeline systems) ・ Operation and maintenance of infrastructure ・ Promoting efficient and effective utilization of water ・ Drilling of wells for use of groundwater.
Water Sharing	This key area is often overlooked, particularly where water resources are plentiful relative to demand. It covers the process of establishing and protecting water rights and allocating water among competing uses and users, as well as setting priorities for water entitlement during times of shortage. Such allocations may be among sectors (irrigation, urban water supply and hydropower, for example), or geographically (upstream/downstream and inter-basin transfers). It does not include water use registration and licensing, which is a regulatory mechanism to assist in managing water rights and allocations, and thus comes under the key area for Institutions and Planning for IWRM.
Environmental	This key area includes activities for the protection of the environment (that has an impact on

Protection	water management), such as rivers, lakes, wetlands, forests and other natural ecosystems, and rehabilitation (enhancement) of already degraded environments (aquatic and terrestrial). Out of all the key areas, this one probably is the most difficult to define clearly, as environmental protection and enhancement normally must be achieved by a combination of structural and non-structural measures that may include infrastructure (for instance, wastewater treatment plants), improved institutional (regulatory) arrangements, community participation, and so on. Enhancement of environment management capacity in the organizations charged with this responsibility is included under the institutional key area. Water quality and environmental monitoring and research activities are included in "Data, Information and Decision Support". Provisions for mitigating the potential adverse effects of water development projects (for example, the impacts of dredging) are built into the projects themselves. Legislation and other regulatory processes aimed at minimizing adverse impacts are included in an environmental assessment and review procedure, and therefore come under "institutions".
Disaster Management	In this context, "disaster" includes only those disasters related to water, such as floods and mud flows. Activities related to disaster management under this definition include: ・ Planning and construction of structural measures to control flood and mud flows, such as levees (dikes), flood control reservoirs and so on ・ Development and implementation of disaster preparedness plans ・ Development and implementation of drought management plans.
Community Empowerment	Involvement of the community in planning and implementation, monitoring and evaluation of IWRM activities is essential. It may be considered as a "foundation" key area, as it supports the five "pillar" key areas described above. There is a strong feeling among stakeholders that empowerment of the community to participate should be an important theme of ICWRMP. In this context, community empowerment includes: ・ Education and awareness raising (capacity building) of communities and individuals on water management issues ・ Activities aimed at providing information to all that need it on water resource management and related activities ・ Implementing measures to facilitate participation of the community in water planning and management ・ Developing community-based "self-help" programs and specific projects to provide local improvement in water supply, the environment, water quality and so on.
Data and Information	This key area is another "foundation" key area, as data is fundamental to all aspects of decision-making in water resource planning and management as such it includes: ・ Data collection, including: surface and groundwater quantity and quality, other natural resources data, such as soils, geology, land cover, ecosystems and so on, and socio-economic data, such as population, poverty, land use, and so on ・ Data archiving and management, including collation of data from various sources, validation, computerization, and so on ・ Data sharing and dissemination among government agencies, research establishments and so on, and providing public access to data ・ Research to increase knowledge in such fields as catchment processes, demography, and so on, as well as the development of new technologies for water conservation and environmental protection ・ Development and implementation of decision support tools, including GIS systems, hydrologic and hydraulic models, and other analytical tools.
Program Management	Program Management forms another program specific "key area". A mechanism for ensuring that approved recommendations of the Steering Committee are implemented within the subcomponents is required, along with effective monitoring and reporting mechanisms to allow GOI and ADB to ensure that the funds are being disbursed in accordance with the plans and in a timely way. In addition, information exchange among the component projects will improve performance overall, and minimize wasted effort caused by overlaps.

Source: ROADMAP FOR INTEGRATED WATER RESOURCE MANAGEMENT IN THE CITARUM RIVER BASIN

The Upper Citarum Basin Urgent Flood Control Project (Stage (I) and (II)) is based on the M/P for Urgent Flood Control established in 1988 with assistance of JICA and is not part of ICWRM recently set up. GOI understands that the Urgent Flood Control Plan is now in the final stage of the Upper Citarum Basin Tributaries Flood Management Project. However, GOI considered that the Project is in line with several key areas of ICWRM. This encourages the government to implement the Project as soon as possible.

2.4. Necessity of the Project

The whole Citarum River Basin, which is located east of DKI Jakarta (Figure 1.3.1.1), has an area of 6,614km^2. It is the biggest basin and has the longest river in West Java Province. There are three dams in the basin: Saguling dam (982 million m^3), Cirata dam (2,165 million m^3) and Jatiluhur dam (3,000 million m^3) used for electric power generation and water supply (Domestic, Industrial and Agricultural) especially for DKI Jakarta. The Upper Citarum River Basin is located in the Bandung region of West Java Province. It is one of the most important regions in Indonesia since it is one of the centers of the textile and agriculture industries. According to the BPS (Badan Pusat Statistik), the total GRDP of the Bandung region (Kabupaten Bandung and Kota Bandung) is listed third after DKI Jakarta and Surabaya. Thus, the Upper Citarum River Basin is one of the most important regions in terms of socio-economic development in Indonesia.

Table 2.4.1.1 GRDP of Bandung Region Compared to Other Major Cities

(Unit: Billion Rupiahs)

No	Year / Region/City	2004	2005	2006	2007	2008	Remarks
1	Bandung Region	57,347	69,689	72,922	83,872	98,723	1=2+3
2	Kota Bandung	27,977	34,792	43,491	50,552	60,441	
3	Kab. Bandung	29,370	34,897	29,431	33,320	38,282	
4	DKI Jakarta	374,993	430,999	494,524	567,796	678,303	4=5+6+7+8+9
5	Kota Jakarta Selatan	84,436	96,852	110,649	128,741	152,151	
6	Kota Jakarta Timur	64,170	74,421	85,593	99,901	117,239	
7	Kota Jakarta Pusat	99,390	112,752	129,145	145,813	178,559	
8	Kota Jakarta Barat	56,146	64,701	74,004	85,198	100,960	
9	Kota Jakarta Utara	70,851	82,273	95,133	108,143	129,394	
10	Kota Surabaya	79,708	96,387	112,359	128,198	149,793	
11	Kota Medan	33,115	42,792	48,850	55,456	65,222	
12	Kota Makassar	13,143	15,744	18,166	20,844	26,068	

Source: Badan Pusat Statistik (BPS), 2009

The Project is aimed at contributing to the completion of the Urgent Flood Control Plan, the development of the Indonesian economy and industries through the mitigation of flood damage by river improvement and enhancement of flooding prevention capacity for target residents along tributaries of the Upper Citarum River Basin where serious flood damage has been occurring. Included in the Project is a series of Non-Structural Countermeasures comprised of Institutional Strengthening for BBWSC, Capacity Development for Community against Flood Disaster, and Sediment Control. The Project is therefore considered significant in terms of the economic development of the Indonesian economy.

CHAPTER 3 CURRENT CONDITIONS OF THE UPPER CITARUM RIVER BASIN

3.1. Geology

3.1.1. Topographical Condition

Bandung is the capital of West Java province, Indonesia. Topographically, it is surrounded by Late Tertiary and Quaternary volcanic terrain up to 2,400 m high and forms an intramontane basin known as the Bandung Basin (see Figure 3.1.1.1 Bandung Basin and its Surroundings). The basin, which is a highland plateau at approximately 650 to 700 m above sea level, lies in the catchment area of the Upper Citarum River (Dam et al. 1996).

The Upper Citarum River, which is the survey area, rises from the surrounding mountains of the Bandung Basin and flows from south to east. It then feeds into the Java Sea through the Saguling Reservoir. The tributary rivers of the Upper Citarum River are fed by the high slopes of the surrounding mountains.

The Bandung Basin was a lake 50,000 to 16,000 years ago and became a flatland due to an abundance of sediment from the surrounding mountains (Dam et al., 1996).

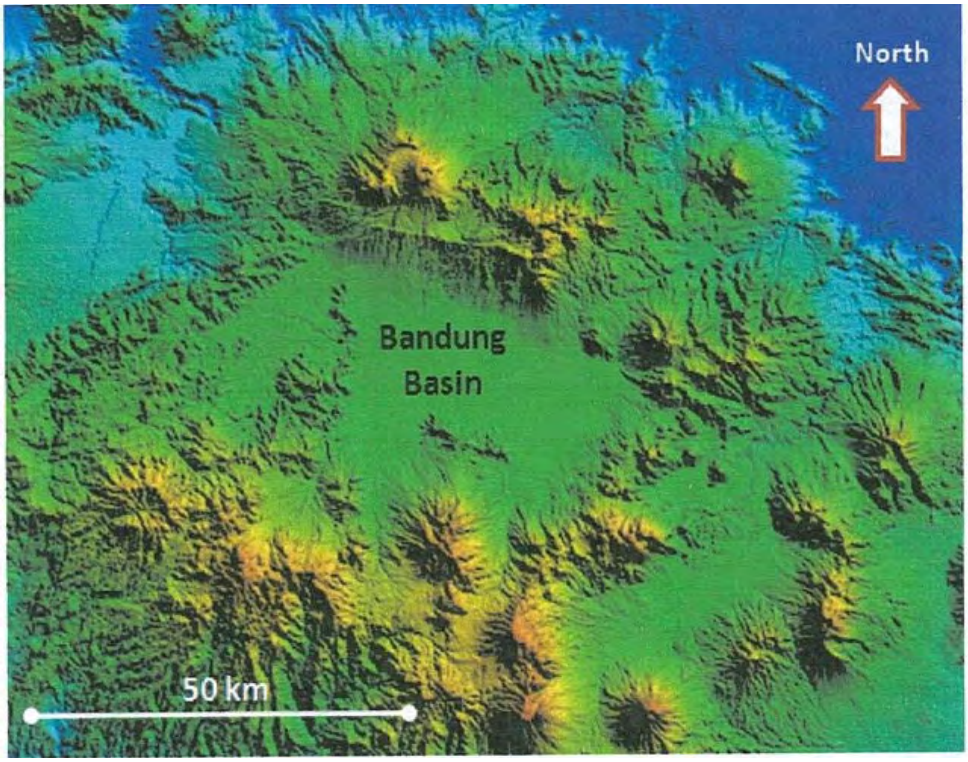
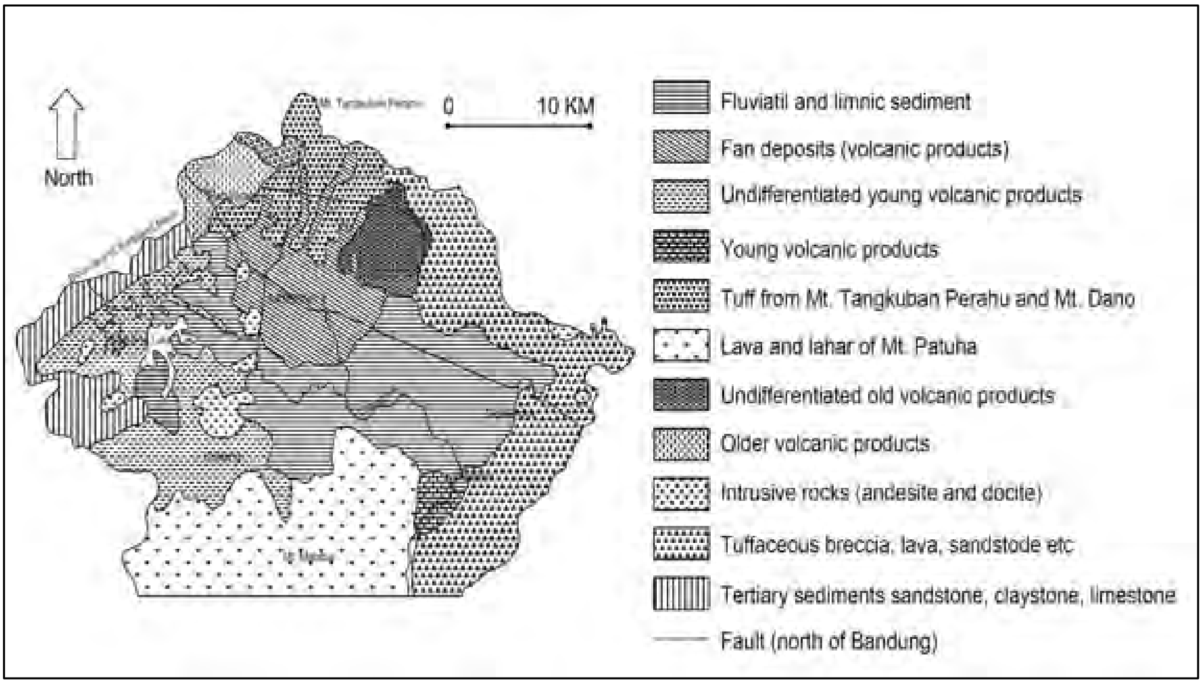


Figure 3.1.1.1 Bandung Basin and Its Surroundings

3.1.2. Geological Condition

The Basin is dominated by various Quaternary volcanic rocks consisting of andesitic to dacitic lava, breccia, agglomerate, tuff, lahar, and intrusive rocks. The western flanks of the basin consist of old Tertiary sediment comprising of sandstone, clay stone, and limestone, while the younger alluvium and fluvial sediment of reworked volcanic deposits are widespread in the center of the basin (Suhari and Siebenhuner, 1993). A Geological Map of the Bandung Basin and the surrounding area is shown in Figure 3.1.2.1 and a Geological Cross Section of the Bandung Basin is shown in Figure 3.1.2.2.

According to the drilling results (Citarum Basin Office 2007) of the Upper Citarum River and its 9 tributaries, the soil consists of sand, clay (silt) and a sand-clay mixture. The soil material is lake deposit. Andesitic rock is found at the Upper Cikeruh River at a depth of 10m to 20m b.g.l.



Source: Suhari and Siebenhuner, 1993

Figure 3.1.2.1 Geological Map of Bandung Basin and Surrounding Area

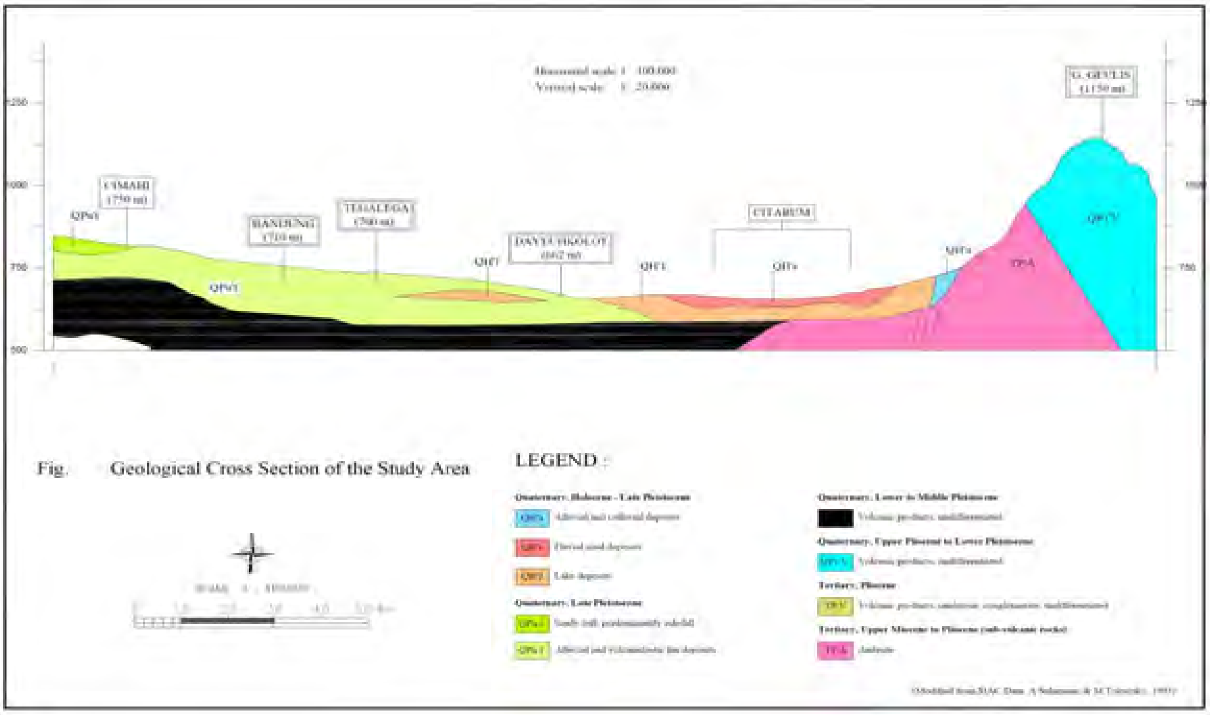


Figure 3.1.2.2 Geological Cross Section of Bandung Basin

3.1.3. Ground Water Extraction and Land Subsidence Phenomena

(1) Ground Water Extraction

The use of groundwater resources in the Bandung Basin has been rapidly increasing due to industrial activities since the 1980s.

In 2000, groundwater usage as a water resource in Greater Bandung was 60% of the whole water supply usage in Bandung. Industrial use is 80%, while 20% is for domestic use and is not used for irrigation.

The water supply for industries, commercial centers, offices and large scale residential areas in the Bandung Basin have mostly relied on groundwater resources from their own deep wells, due to an insufficient domestic water supply. In addition, the water supply of Bandung City requires an additional 42% (Bandung City 2010). Also, about 60% of the total clean water required in the Greater Bandung area is supplied by groundwater, and industry relies on nearly 100% of the groundwater resource (Wirakusmah, 2006).

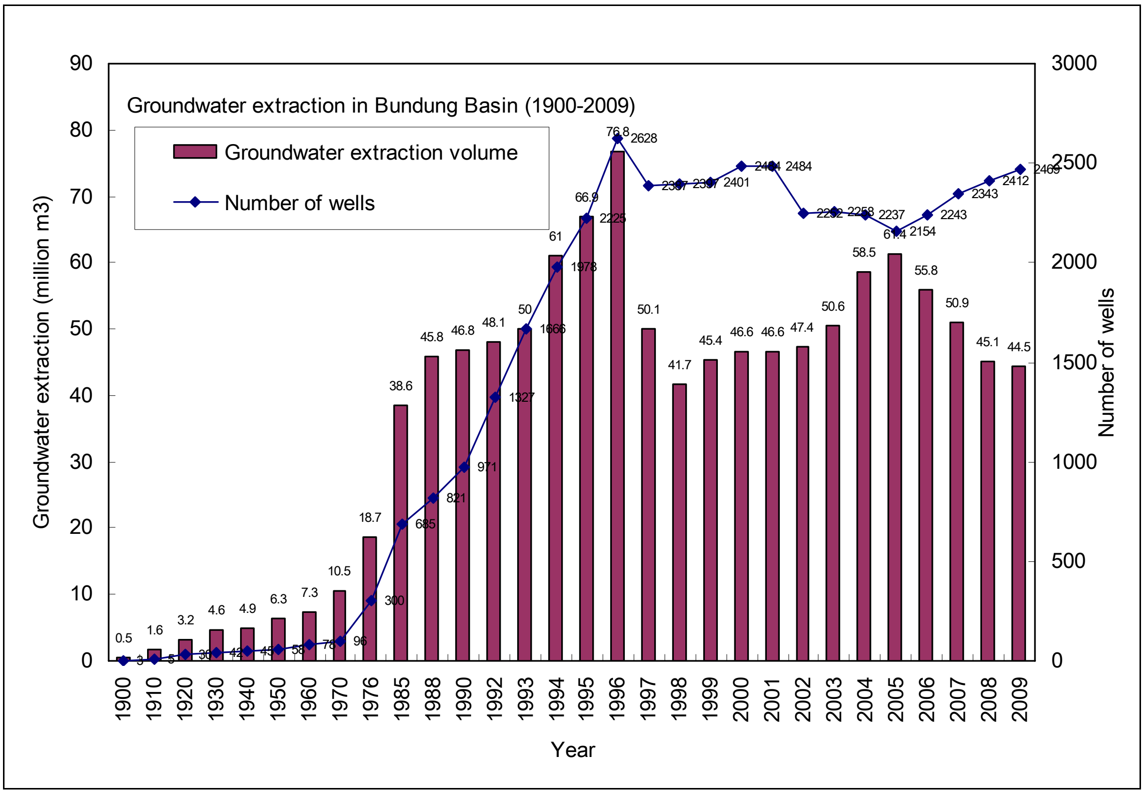
The registered number of deep wells and water extraction volume in the Bandung Basin as of December 2009 is shown in Figure 3.1.3.1. According to this latest data, extraction is 44.5 million cubic meters and the number of wells is 2,400. Although extraction is decreasing, the number of wells has recently been increasing.

The Dayeuh Kolot area is one of the industrial development areas and has 119 factory units. The main user of groundwater is the textile industry, which consists of 100 factories. The volume of extraction and number of deep wells (WJOM, 1997) are shown in Table 3.1.3.1.

A location map of deep wells at Dayeuh Kolot area is shown in Figure 3.1.3.2.

Table 3.1.3.1 Volume of Extraction and Number of Wells in Dayeuh Kolot

Description	1992	1993	1994	1995	1996
Volume of extraction (million m^3/year)	4.16	5.14	5.23	6.92	7.45
( ) % of total extraction in Bandung basin	(8.65)	(10.28)	(8.57)	(10.34)	(9.70)
Number of Production Wells	138	168	196	232	256
( ) % of total deep wells in Bandung Basin	(10.40)	(10-.08)	(9.91)	(10.43)	(9.74)



Source: West Java Province Office of Energy and Mineral Resources, 2010

Figure 3.1.3.1 Registered Groundwater Extraction in Greater Bandung (1900-2009) from the Deep Aquifer (40-250m) below the Surface

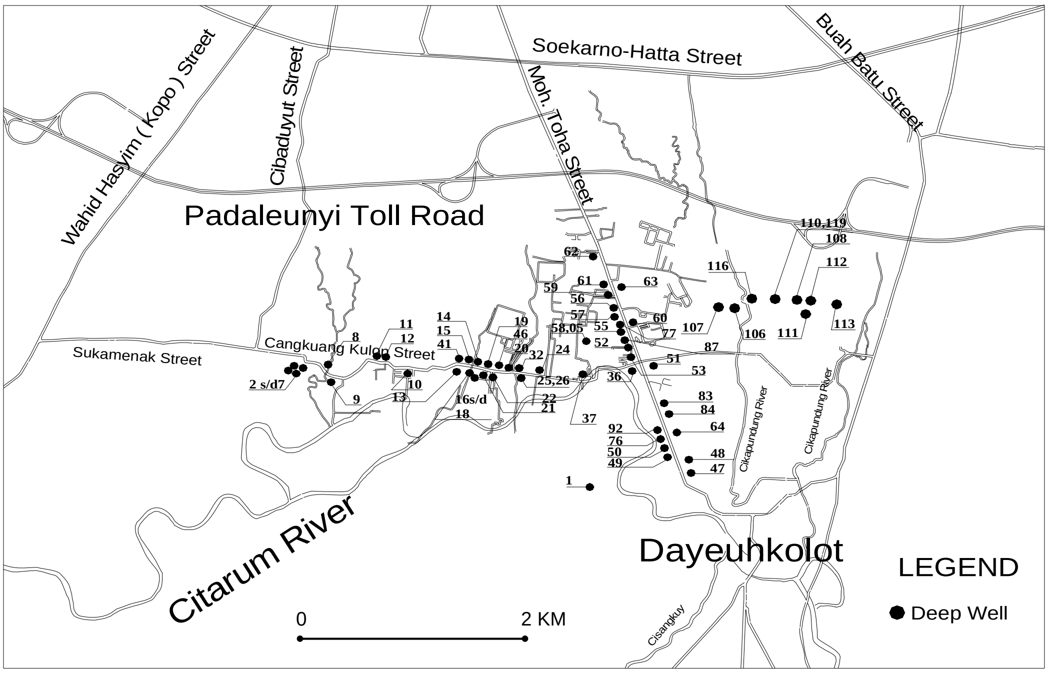


Figure 3.1.3.2 Location of Deep Wells in Dayeuh Kolot Area

(2) Ground Water Level

Increased groundwater extraction has led to a rapid sinking of water tables on the plain (Table 3.1.3.2), which in turn causes land subsidence. During the 1980s, the average annual drop in water tables in the basin was one (1) meter, while in the most heavy extracted areas, annual drops up to 2.5 meters were recorded (Soetrisno, 1991). As shown in Table 3.1.3.2, from 1980 to 2004, the groundwater level in the Bandung Basin has dropped by about 20 to 100m.

Table 3.1.3.2 Groundwater Level Decreases in Bandung Basin

No.	Location	1920	1980	1985	1995	2004
1	Cimahi	+19m	+15m	-10m	-40m	-86m
2	Kebon Kawung	-	+22	-	-	-36m
3	Rancaekek	-	+1m	-	-	-39m
4	Lanud Sulaeman	-	+7m	-	-	-14m
5	Dayeuh Kolot	+4m	+2m	-	-	-55m
6	Banjaran		+2m	-	-	-20m
7	Majalaya		+3m	-	-	-41m

Source: Wirakusumah 2006, Wagsaatmaja et al. 2007

Figure 3.1.3.3 shows declining of the water level at a factory in the Dayeuh Kolot area. The groundwater level declined to a depth of about 51 meters b.g.l. in 1994 (WJOM, 1997).

In addition, the groundwater level in Dayeuh Kolot declined significantly and a depression cone occurred with the lowest level of 62 meters b.g.l. in 2004, which caused a decrease in artesian pressure in the aquifer system by more than 6 atmospheres.

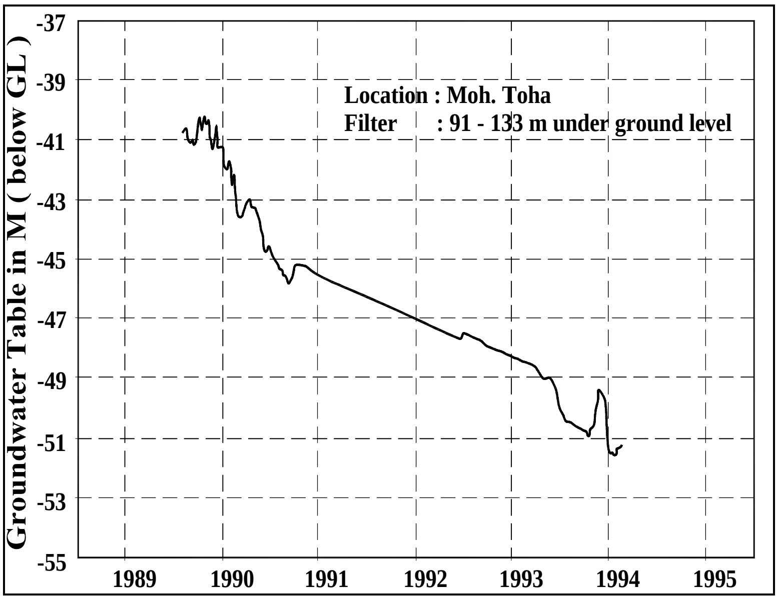


Figure 3.1.3.3 Lowering of Groundwater Level in Dayeuh Kolot Area

The WJOM implemented a simulation analysis on the change of groundwater level due to over extraction in 1997. Assuming that groundwater over extraction would be continuously under the same conditions, the simulated groundwater level is shown in Figure 3.1.3.4.

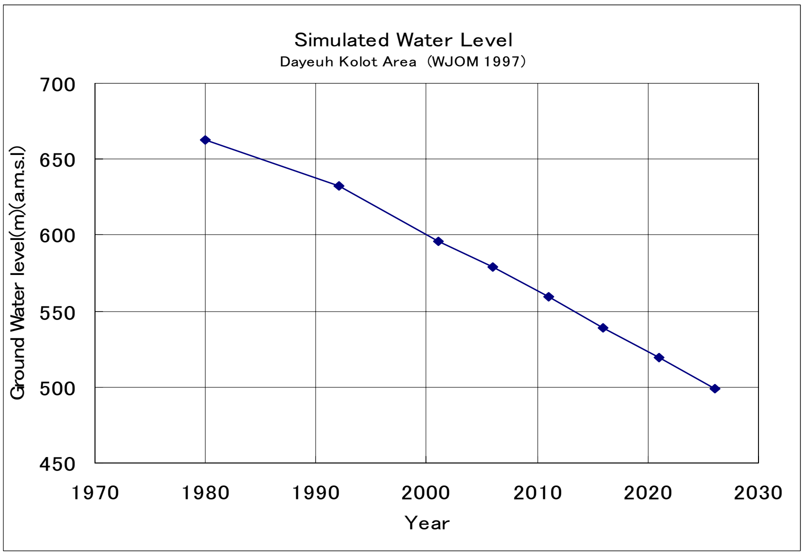


Figure 3.1.3.4 Simulated Groundwater Level (middle aquifer) at Dayeuh Kolot Area

Monitoring by WJOM (2004) in the period from 1992 until 2001 (9 years), showed the change of the water level in Dayeuh Kolot area was 35.98 m with a maximum drawdown rate of about 4m per year. The simulated groundwater levels in 1992 and 2011 are shown in Figure.3.1.3.5.

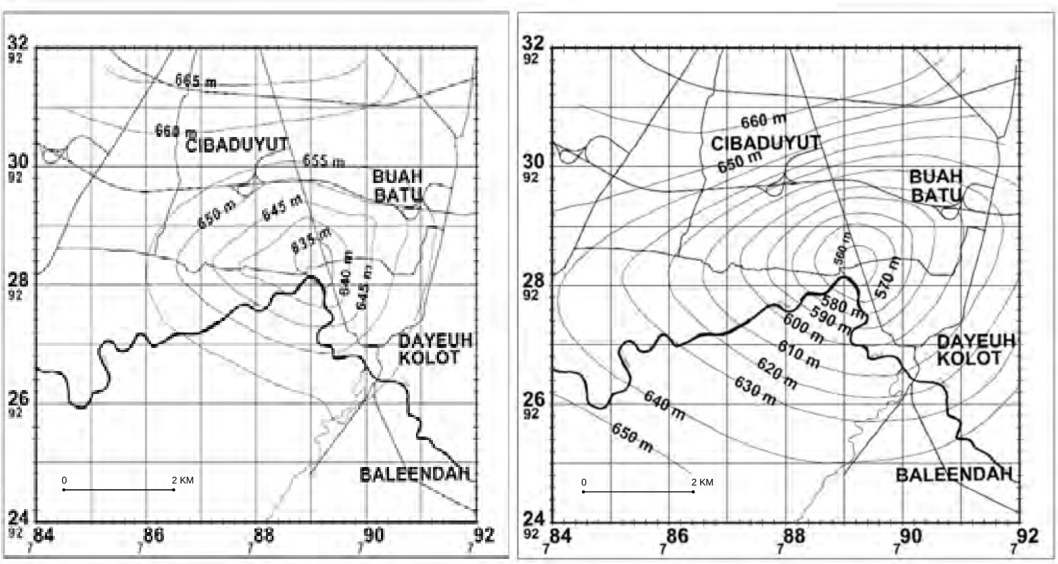


Figure 3.1.3.5 Simulated Groundwater Levels (1992 and 2011) in Dayeuh Kolot

(3) Land Subsidence Phenomena

Theoretically, excessive groundwater extraction will lead to a decrease in the groundwater level, which in turn will cause land subsidence. Field surveys were conducted at a) along the Citarum River and b) Dayeuh Kolot area using leveling instruments. Location of the surveys is shown in Figure 3.1.3.6.

According to Figure 3.1.3.7, during the period 2003 to 2010, 90 cm of land subsidence was observed at a rate of about 12 cm/year in the Dayeuh Kolot area.

In addition, since 2006, the Citarum Flood Control Project has established a monitoring system for land subsidence in the Dayeuh Kolot area comprised of 55 points with gridiron. The progression of land subsidence from 1996 until 2006 and the land subsidence rate in May 2010 (for the past 3.5 years) are shown in Figure 3.1.3.9 and Figure 3.1.3.10.

As shown in Figure 3.1.3.9, land subsidence is continuing, resulting in a total of more than 40 cm/3.5 years. A rate of 12 cm/year has been measured in the Dayeuh Kolot area.

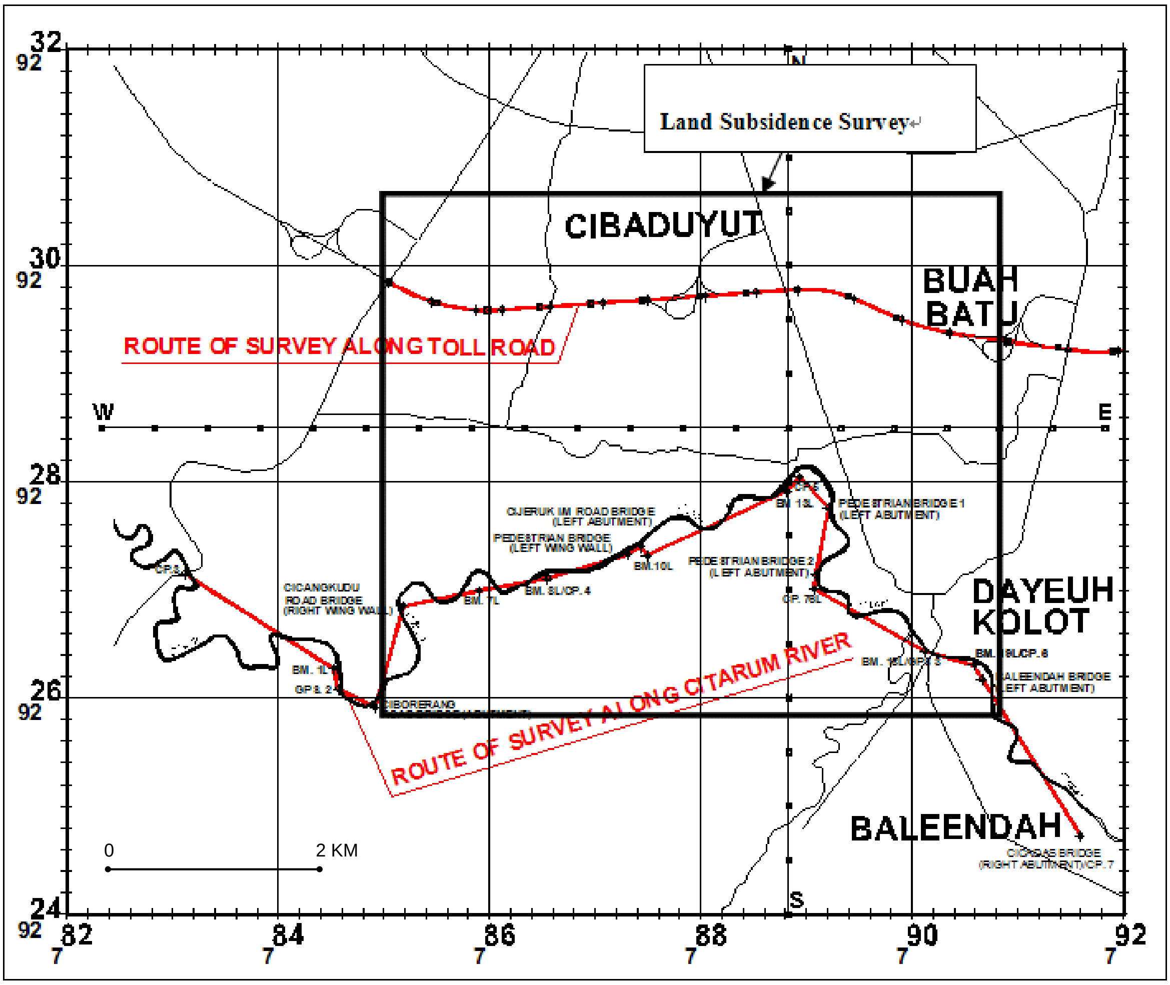


Figure 3.1.3.6 Location of Route Survey of Along the Citarum River and Dayeuh Kolot Area

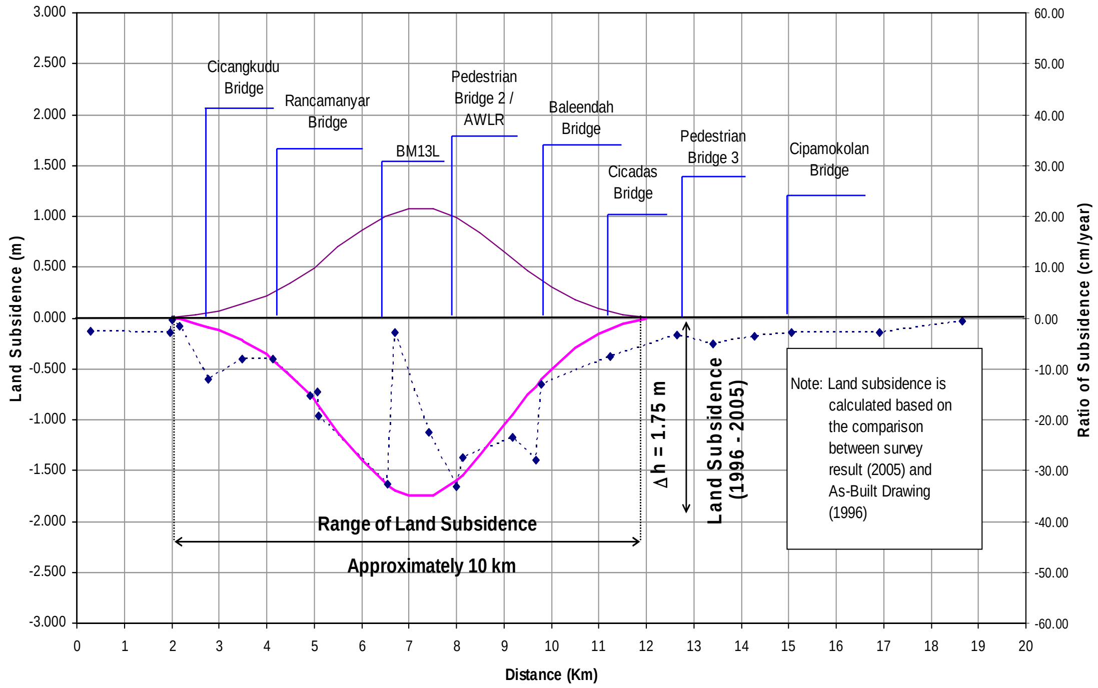


Figure 3.1.3.7 Section of Land Subsidence along the Citarum River (1996-2005)

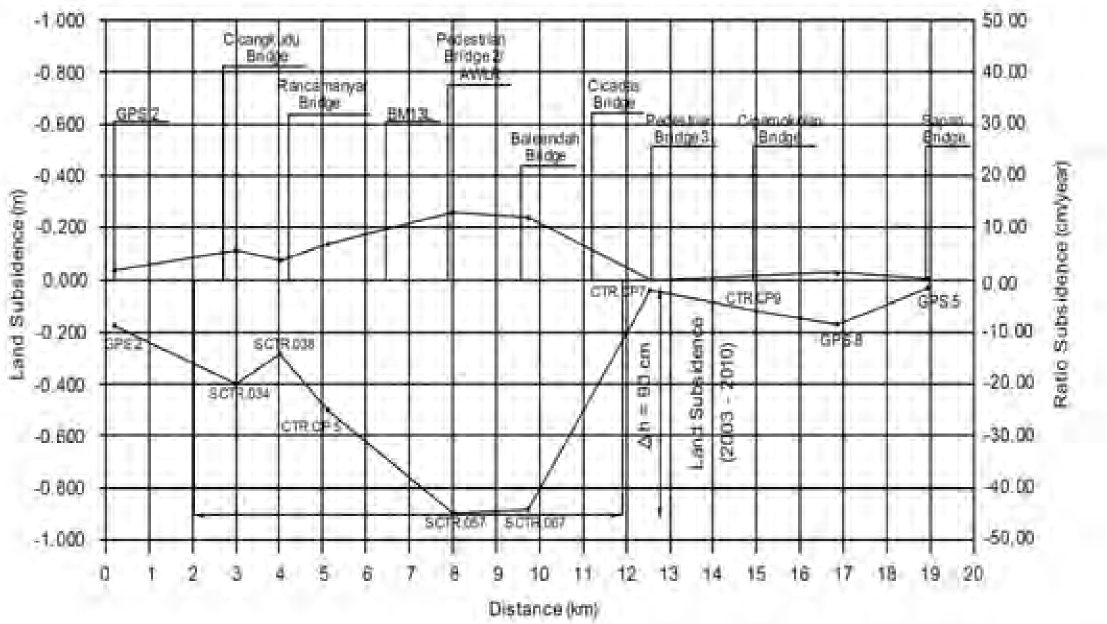
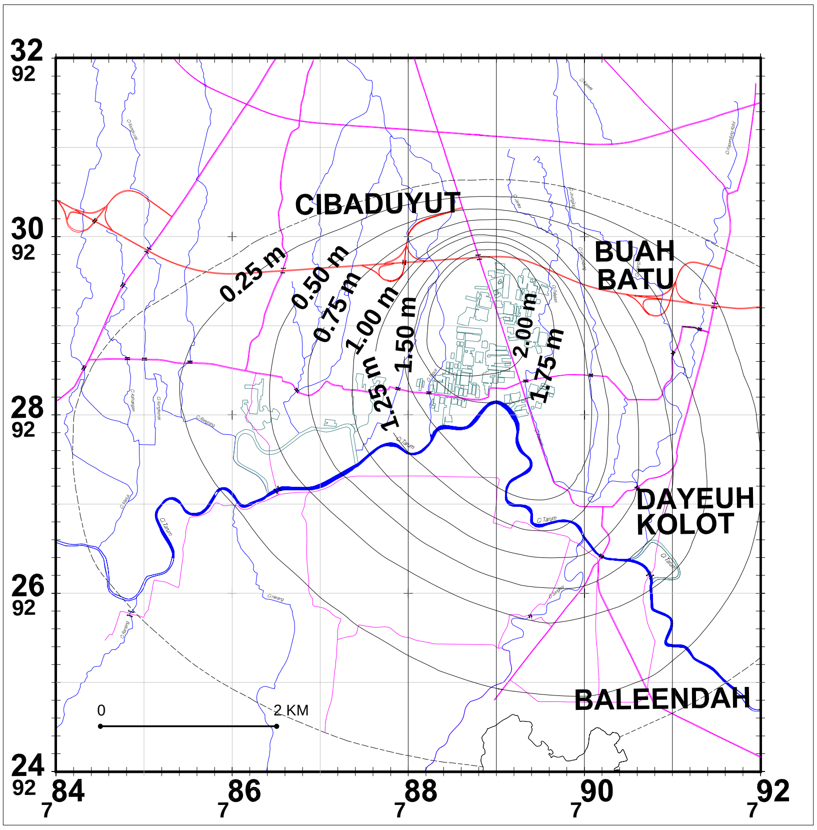
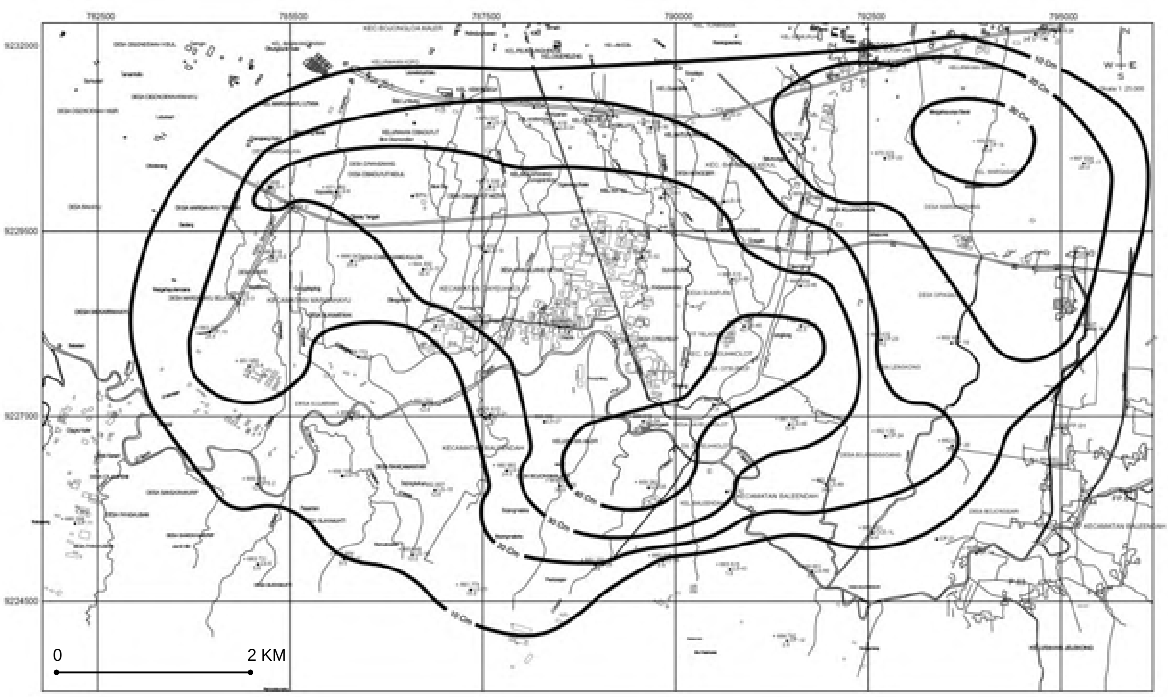


Figure 3.1.3.8 Section of Land Subsidence along the Citarum River (2003-2010)



Source: 2007 D/D

Figure 3.1.3.9 Progression of Land Subsidence from 1996 until 2006



Source: JICA Survey Team

Figure 3.1.3.10 Land Subsidence Rate from Nov. 2006 until May 2010

3.2. Socio-Economic Features

3.2.1. Administration

The survey area of 1,829km² is located within the 4,800km² area of the five administrative districts of Kota Bandung, Kota Cimahi, Kabupaten Bandung, Kabupaten West Bandung, and Kabupaten Sumedang in West Java Province. Most of the survey area is concentrated in Kota Bandung, Kabupaten Bandung, and Kota Cimahi. Refer to Annex at the end of the report for location map of the districts. Kota Bandung is the capital of West Java Province and is the third largest city in Indonesia. Kota Cimahi and Kabupaten West Bandung were established in June 21, 2001 and December 6, 2006 respectively, after separating from the original Kabupaten Bandung.

3.2.2. Population

The total population of the five administrative districts in 2008 was 8.7 million inhabitants. In particular, Kabupaten Bandung and Kota Bandung are two of the most populated districts in West Java Province. In the four years since 2005, the population growth of each district has slightly increased by 2%, according to statistics of West Java (2008).

Table 3.2.2.1 Population in Five Administrative Districts of the Survey Area

Administrative District	Administrative Area (km^2)	Population				Population Density in 2008
		2005	2006	2007	2008	
Kota Bandung	167.29	2,315,895	2,340,624	2,364,312	2,390,120	14,287
Kab. Bandung	1762.39	4,263,934	4,399,128	3,038,038	3,116,056	1,768
Kab. West Bandung	1305.77	-	-	1,493,225	1,531,072	1,173
Kab. Sumedang	1522.2	1,067,361	1,089,889	1,112,336	1,134,288	745
Kota. Cimahi	40.2	493,698	506,250	518,985	532,114	13,237
Total	4797.85	8,140,888	8,335,891	8,526,896	8,703,650	-

Note: Bandung Barat Regency was established in December 2006, and used to be a part of Kabupaten Bandung.
Source: Statistics of West Java (BPS Jawa Barat) 2008

3.2.3. Land Use

According to the land use map of the survey area (1,829km²) from the National Coordination Agency for Surveys and Mapping (BAKOSURTANAL) 2008, built-up areas are mainly concentrated in Kota Bandung, and paddy fields mainly occupy the central north of Kabupaten Bandung. Dry field and plantation areas are spread across Kota Cimahi and Kabupaten Bandung. There are large areas of forest in the south of Kabupaten Bandung.

Table 3.2.3.1 Land Use of the Survey Area

Category	Area (km²)	Ratio
Built-up Area	367	20.0%
Paddy Field	496	27.1%
Forest	497	27.2%
Water Surface	9	0.5%
Dry Field & Plantation, etc.	461	25.2%
Total	1,829	100%

Source: BAKOSURTANAL, 2008

3.2.4. Gross Regional Domestic Product (GRDP)

The Gross Domestic Product (GRDP) of West Java was 602,420 billion Indonesian rupiah in 2008, corresponding to 12% of the total GDP of Indonesia. The total GRDP of the five administrative districts was responsible for 22% of the total GRDP of West Java, totaling 133,961 billion Indonesian rupiah(Table 3.2.4.1).

The manufacturing industries sector in the five administrative districts is responsible for 40.5% of the GRDP, followed by trade, and the hotel and restaurant sector with 28%. Most of the textile factories are concentrated in Kota Bandung and Kabupaten Bandung. These areas share 71% of the total manufacturing industry. Kota Bandung is the capital of West Java Province, and is a center of politics, economy and culture. As a result, Kota Bandung shares approximately 60% of the related services of the four sectors of trade, hotels and restaurants, transportation and communication, and finance, real estate and business services. On the other hand, the GRDP of the five administrative districts for the agricultural, livestock, and forestry and fisheries sectors is relatively low at 5%.

Table 3.2.4.1 GRDP of Five Administrative Districts (Current Market Price)

Industry	Kota Bandung	Kab. Bandung	Kab. West Bandung	Kab. Sumedang	Kota Cimahi	Five Administrative Districts	%
Agricultural, Livestock, Forestry & Fisheries	153,030	2,728,755	1,579,761	2,984,417	16,346	7,462,309	5.57
Mining & Quarrying	0	468,303	58,121	14,600	0	541,024	0.4
Manufacturing Industries	15,548,704	23,275,745	6,624,524	2,399,351	6,406,371	54,254,695	40.5
Electricity, Gas & Water Supply	1,363,364	642,658	919,660	273,611	357,246	3,556,539	2.65
Construction	2,604,004	648,394	361,715	222,446	764,118	4,600,677	3.43
Trade, Hotel & Restaurant	24,211,804	6,005,197	2,634,504	2,676,178	2,048,127	37,575,810	28.05
Transportation & Communication	7,071,588	1,783,920	951,601	448,048	189,601	10,444,758	7.8
Finance, Real Estate & Business Services	3,956,663	792,877	369,958	434,493	236,809	5,790,800	4.32
Services	5,532,326	1,936,315	720,563	847,794	697,669	9,734,667	7.27
Total	60,441,483	38,282,164	14,220,407	10,300,938	10,716,287	133,961,279	100

Source: Jawa Barat in Figures 2009, BPS Jawa Barat, PDRB Kabupaten/Kota di Jawa Barat 2006-2008, BPS Jawa Barat

3.3. Present Condition of River Improvement

3.3.1. Citarum Main River (Stage (I) & (II))

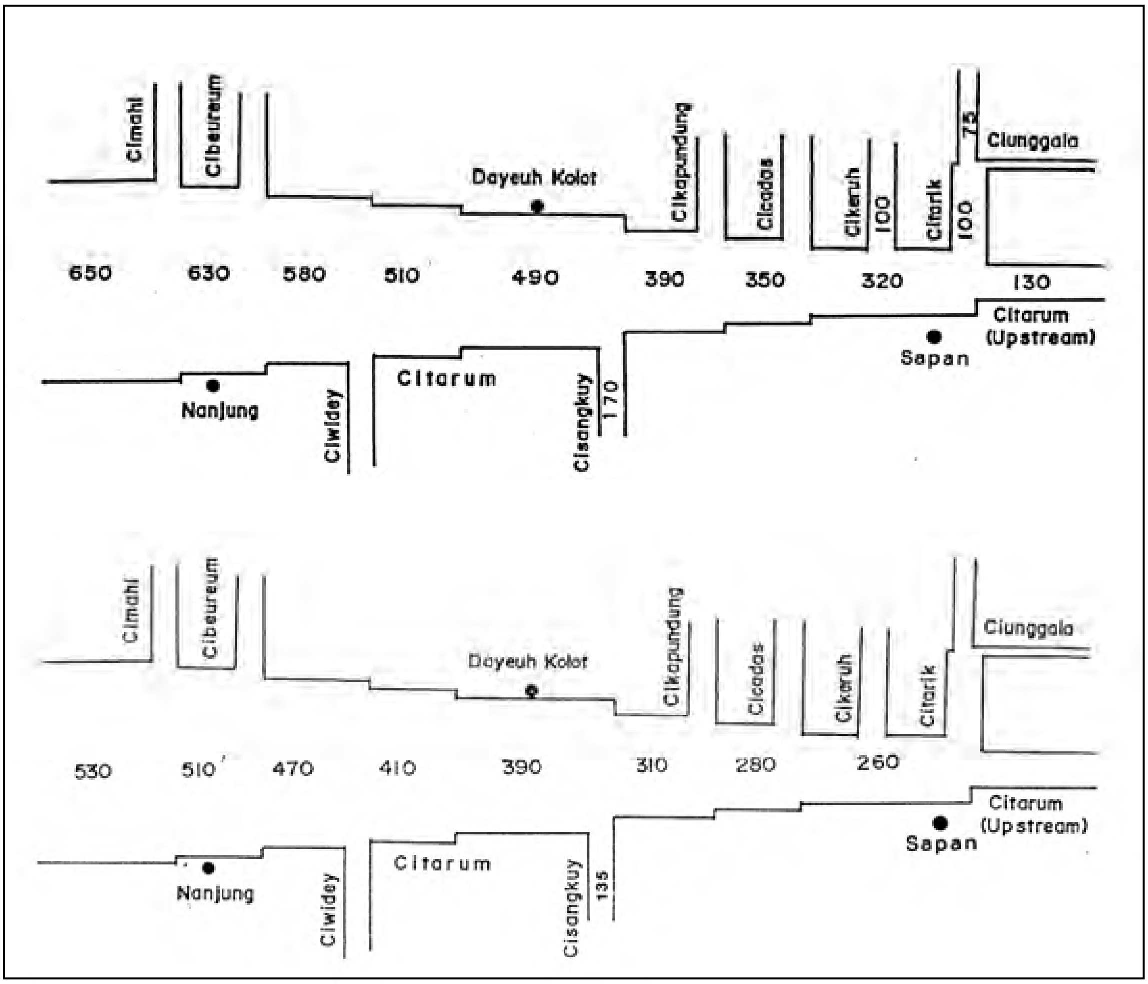
(1) JICA Master Plan (1988)

The JICA Master Plan (1988) was established and consisted of two plans as shown in Table 3.3.1.1. Design discharge distribution is shown in Figure 3.3.1.2. The Long Term Plan and Urgent Plan focus on 20-year and 5-year flood frequencies, and structural and non-structural measures have been determined corresponding to these return periods through hydrological and hydraulic model analysis.

Table 3.3.1.1 Long Term Plan and Urgent Plan in JICA Master Plan (1988)

Item	Long Term Plan	Urgent Plan
1. Target Year	2005	-
2. Design Flood/H.W.L		
1) Main Stream	20-year	5-year
D.H.W.L	*E.L. 654.68 (Nanjung)* *E.L. 658.14 (Dayeuh Kolot)*	*E.L. 654.68 (Nanjung)* *E.L. 658.14 (Dayeuh Kolot)*
2) Tributaries	20-year	5-year
3. River to be improved		
3.1 Citarum Main	31.2km	31.2km
3.2 Tributaries		
(1) Citarum Upstream	6.0km	- km
(2) Citarik	14.8km	- km
(3) Cikeruh	2.0km	- km
(4) Cisangkuy	7.4km	7.4km
Total	<u>61.4km</u>	<u>38.6km</u>
4. Nonstructural Measure	Required flood plain management area: Approx. 1,300 ha (50-year) Measures: - Land-use regulation - Establishment of Flood Forecasting and warning system	Required flood plain management area: Approx. 5,600 ha (50-year) Measures: - Telemeter Station: 6 - Monitoring Station: 1 - Master Station: 1

Source: JICA Study on Flood Control Plan of the Upper Citarum Basin (Hereinafter, to be referred as "JICA Master Plan Report in 1988") and Detailed Design Report in 1995



Source: JICA Master Plan Report in 1988

Figure 3.3.1.1 Design Discharge Distribution of Long Term Plan (upper) and Urgent Flood Control Plan (lower)

(2) Present River Conditions of Stage (I) & (II) segments (Citarum mainstream, Citarum upstream, Citarik, Cikeruh, Cisangkuy)

1) Citarum mainstream

In Stage (I) (1994-1999), Citarum mainstream from Nanjung to Leuwi Nutag (L = 24.0km) was improved with the following design conditions:

- Design Discharge: 280 – 530m³/s (5-year flood frequency)
- Riverbed slope: 1/5,500

Later, in Package VIII and IX of Stage (II) (2007), Citarum mainstream's riverbed from Nanjung to Citepus Village (L=20.2 km) was lowered to allow for 20-year flow capacity with the following design conditions:

- Design Discharge: 510 – 650m³/s (20-year flood frequency)
- Riverbed slope: 1/5,500

In Package I of Stage (II) (2003), Citarum mainstream from Leuwi Nutug to Sapan (L = 6.7km) was improved with the following design conditions:

- Design Discharge: 260 – 280m³/s (5-year flood frequency)
- Riverbed slope: 1/5,500

2) Citarum Upstream

In Package III of Stage (II) (2006), Citarum upstream from Sapan to Kantren (L = 5.7km) was improved with the following design conditions:

- Design Discharge: 110m³/s (5-year flood frequency)
- Riverbed slope: 1/2,050

3) Citarik Upstream

In Packages IV (2006) and V (2007), Citarik upstream from Sapan to Cisunggala (L = 6.48km) and Cisunggala to Bojong Gempol (L = 6.08km) were improved with the following design conditions:

- Design Discharge: 80 to 65, 65 to 40m³/s (5-year flood frequency)
- Riverbed slope: 1/4,300 to 1/3,300, 1/3,300 to 1/1,300

4) Cikeruh

In Package I (2006), Cikeruh River from Sapan to Ranca Kemuning (L = 4.75km) was improved with the following design conditions:

- Design Discharge: 80m³/s (5-year flood frequency)
- Riverbed slope: 1/7,500

5) Cisangkuy

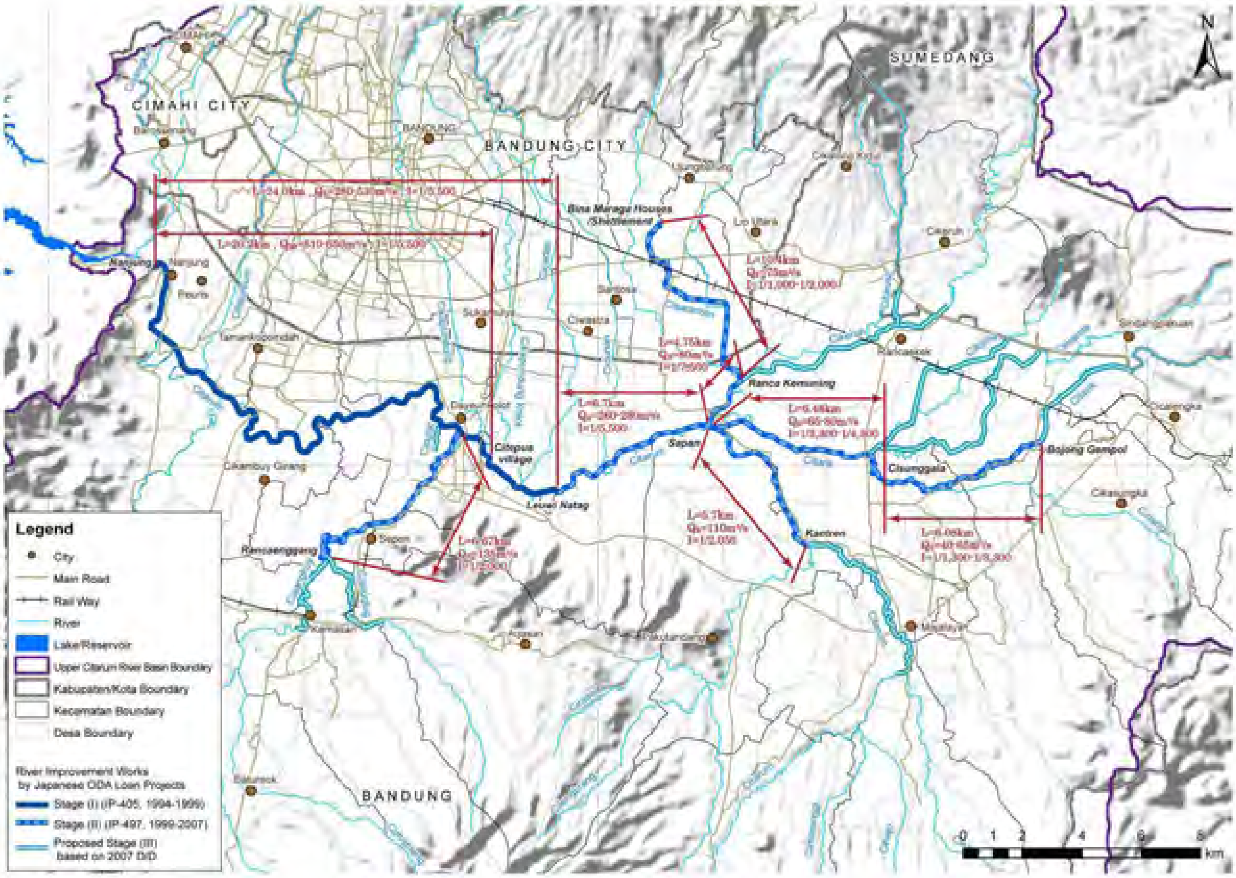
In Package II (2003), Cisangkuy from confluence with Citarum to Rancaenggang (L = 6.67km) was improved with the following design conditions:

- Design Discharge: 135m³/s (5-year flood frequency)
- Riverbed slope: 1/2,000

6) Cisaranten

In Package IV and V (2007), Cisaranten from confluence with Cikeruh to Bina Marga Houses / Settlement (L = 10.4km) was improved with the following design conditions:

- Design Discharge: 75m³/s (5-year flood frequency)
- Riverbed slope: 1/2000 to 1/1000



Source: JICA Survey Team based on the previous projects and studies

Figure 3.3.1.2 Present River Conditions of Stage (I) & (II) Segments

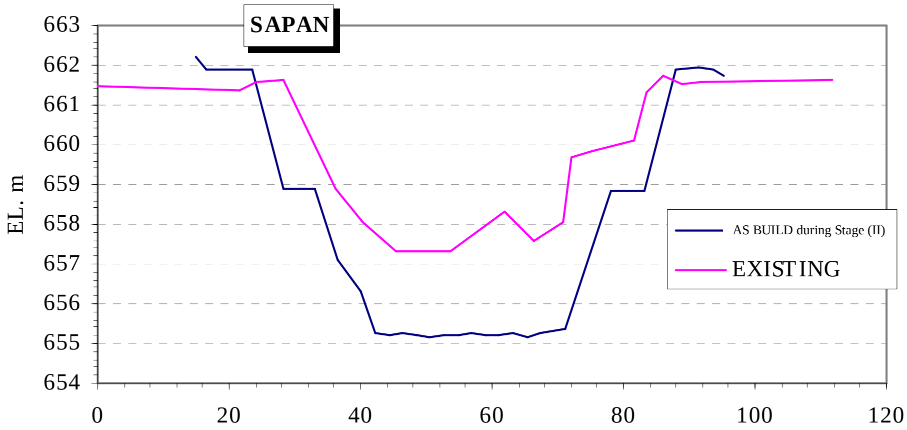
7) Sediment Deposition in the River

Because of both cultivation in steep terrain without terraces and forest collapse, the sediment yield in the Upper Citarum Basin is very high. In addition to soil erosion of steep sloped mountainous areas in the Upper Citarum Basin, human activities along the river channel have accelerated sedimentation in the river downstream, even at the segments that were improved in Stage (I) and (II).

Additionally, although banned, the river berm, which was formed in accordance with the design, is being used for planting vegetables, cassava or corn. After the corn is harvested, the remaining stalks trap rubbish, especially plastic waste, causing the subsequent capture of sediment. Similarly, when planting vegetables, grooves are built on the banks and the vegetables are grown on the high part. In the rainy season, these grooves are filled with sediment. So every year the height of the berm increases and eventually it will reach the same height as the inspection road.

Furthermore, in the dry season, the Citarum river discharge is very low, influencing the condition of the tributaries. Farmers who need water will stem the river traditionally using bamboo to raise the water level so it is easily pumped into the paddy fields. Farmers do not demolish the weirs in the rainy season because of their need the next dry season. According to the farmers, a little boost in the stem surface water will not cause flooding. But the resulting dam causes sedimentation and every year the river is normalized, it will become shallower. In some places, the farmers have dug up inspection roads to pass a pipe to drain water from the river to the paddy fields.

Figure 3.3.1.3 shows the cross-sectional difference between “As Build during Stage (II)” in 2007 and “Existing” conditions in 2010 at Sapan. Over 2m of sedimentation and riverbed rising is shown. Based on these cross-sectional data, hydraulic parameters, cross section area, wetted perimeter and the hydraulic radius can be calculated with Existing and As Build cases (Refer to Table 3.3.1.2). The ratio of cross section area and discharge between the cases are 54% and 40%, respectively[1]. This shows that sedimentation has caused a serious decrease in the flow capacity.



Source: BBWSC for As Build condition, PUSAIR for the Existing condition

Figure 3.3.1.3 Cross sections compared between As -Build and Existing at Sapan

Table 3.3.1.2 Hydraulic Parameters at Sapan based on the Cross Section Profiles (related to Figure 3.3.1.3)

Item	unit	Existing	As Build	Ratio
Cross Section Area	m^2	172	317	54%
Wetted Perimeter	m	60	68	88%
Hydraulic Radius	m	2.9	4.7	62%

Source: JICA Survey Team

[1] The ratio of discharge between the two cases can be calculated by Manning's formula using the same roughness coefficient and bed slope.

3.3.2. Tributaries of the Citarum River

The tributaries reported serious flood damage as shown in the 2007 D/D report (Table 3.3.2.1). In the 2007 D/D, the existing capacities of targeted tributaries were confirmed as below in order to establish the improvement plan.

Table 3.3.2.1 Tributaries That Reported Flood Damage

Stream	Targeted River	Location	Distance
1. Citarum Upstream	Citarum Upstream	Kantren to Majalaya	L = 8.0km
2. Cisangkuy	Cisangkuy	Rancaenggang to Kamasan	L = 7.0km
	Citalugtug	Waas to Cileutik	L = 5.0km
3. Citarik	Citarik Upstream	Bojong Gempol to Panenjoan	L = 6.0km
4. Cimande	Cikijing	Tanggeung to Cikijing village	L = 8.0km
	Cimande	Langensari to Rancapanjang	L = 8.0km
5. Cikeruh	Cikeruh	Ranca Kamuning to Sirna Galih	L = 10.0km
	Cibeusi	Buah Dua to Sindang Sari	L = 2.5km
6. Ciputat	Ciputat	Bojongasih to Kulalet Hilir	L = 1.2km

Source: 2007 D/D

(1) Existing River Capacity of Tributaries

1) Method

The river capacity of the tributaries is estimated by using Manning's formula. The cross sections around existing river structures are selected as representative cross sections for estimation of the capacity, because these sections have been constructed considering the required river capacity. Manning's roughness coefficient of 0.03 is adopted for existing and design conditions.

2) Existing Capacity of the Tributaries

The analysis of river capacity is shown in Table 3.3.2.3. The existing capacity of targeted tributaries is summarized in Table 3.3.2.2.

Table 3.3.2.2 Existing Capacity of Tributaries

Stream	Targeted River	Location	Existing Capacity
1. Citarum Up.	Citarum Upstream	Kantren to Majalaya	$65m^3/s$
2. Cisangkuy	Cisangkuy	Rancaenggang to Kamasan	$81m^3/s$
	Citalugtug	Waas to Cileutik	$31m^3/s$
3. Citarik	Citarik Upstream	Bojong Gempol to Panenjoan	$19m^3/s$
4. Cimande	Cimande	Langensari to Rancapanjang	$5m^3/s$
	Cikijing	Tanggeung to Cikijing village	$10m^3/s$
5. Cikeruh	Cikeruh	Ranca Kamuning to Sirna Galih	$37m^3/s$
	Cibeusi	Buah Dua to Sindang Sari	$40m^3/s$
6. Ciputat	Ciputat	Bojongasih to Kulalet Hilir	$3m^3/s$

Source: 2007 D/D

Table 3.3.2.3 Features of Existing Tributaries

Item	Citarum Up.	Cisangkuy		Citarik Up.	Cimande		Cikeruh		Ciputat
		Cisangkuy	Citalugtug		Cikijing	Cimande	Cikeruh	Cibeusi	
1. Section	Kantren to Majalaya (L = 8.0km)	Rancaenggang to Kamasan (L = 7.0km)	Waas to Cileutik (L = 5.0km)	Bojong Gempol to Panenjoan (L = 6.0km)	Tanggeung to Cikijing (L = 8.0km)	Langensari to Rancapanjang (L = 8.0km)	Ranca Kamuning to Sirna Galih (L = 10.0km)	Buah Dua to Sindang Sari (L = 2.50km)	Bojongasih to Kulalet Hilir (L = 1.2km)
2. Dimensions									
(1) Cross Section	Single/Double	Single	Single	Single	Single	Single	Single	Single	Single
Width (m')	14.0 ~ 39.0	14.0 ~ 50.0	6.0 ~ 22.0	5.0 ~ 22.0	3.0 ~ 28.0	3.0 ~ 65.0	7.0 ~ 27.0	3.0 ~ 32.0	0.8 ~ 16.0
Depth (m')	3.3 ~ 6.5	1.2 ~ 6.6	0.9 ~ 4.5	1.6 ~ 4.5	1.0 ~ 3.2	0.7 ~ 3.4	1.7 ~ 4.4	1.4 ~ 5.2	0.3 ~ 2.5
Bank Slope	1 : 0.2 ~ 5.0	1 : 0.1 ~ 8.0	1: 0.1 ~ 4.0	1 : 0.1 ~ 3.0	1 : 0.1 ~ 10.4	1: 0.1 ~ 12.0	1: 0.1 ~ 14.0	1 : 0.2 ~ 0.5	1: 0.3 ~ 16.0
(2) Embankment	No	No	No	No	No	No	No	No	No
(3) Bank Slope	1/1,030	1/1,450	1/720 ~ 1/60	1/920	1/750	1/1,400	1/710	1/220	1/1,400
3. Flow Capacity (m^3/ s)	K.11: 59.9	J.59 81.4	P.9 36.3(1/720)	P.32 *5.5	P.0 13.0	CMD.6 *20.2.	P.6 45.5	P.36 30.7	P.0 2.8
	K.56: 57.6	J.91 93.9	P.18 21.5(1/720)	P.42 18.6	P.18 10.0	CMD.56 5.7	P.137 42.5	P.64 37.0	P.12 3.2
	K.107: 78.2	J.131 81.0	P.41 35.0(1/250)	P.106 18.7	P.35 6.3	CMD.100 2.8	P.216 29.3	P.70 51.8	P.18 0.3
	-	J.147 66.8	P.57 *275.3(1/60)	P.142 18.5	-	CDM.216 5.6	P.228 31.7	-	-
Average (m^3/ s)	65.2	80.8	30.9	18.6	9.8	4.7	37.3	39.8	3.0
Design Discharge (m^3/s)	(110)	(115)	(90)	(80)	(50)	(35)	(90)	(50)	(10)
Capacity	59.2%	70.3%	34.3%	23.3%	19.6%	13.4%	41.4%	79.6%	30.0%

Note: Calculated discharge marked * is not considered relevant to river capacity

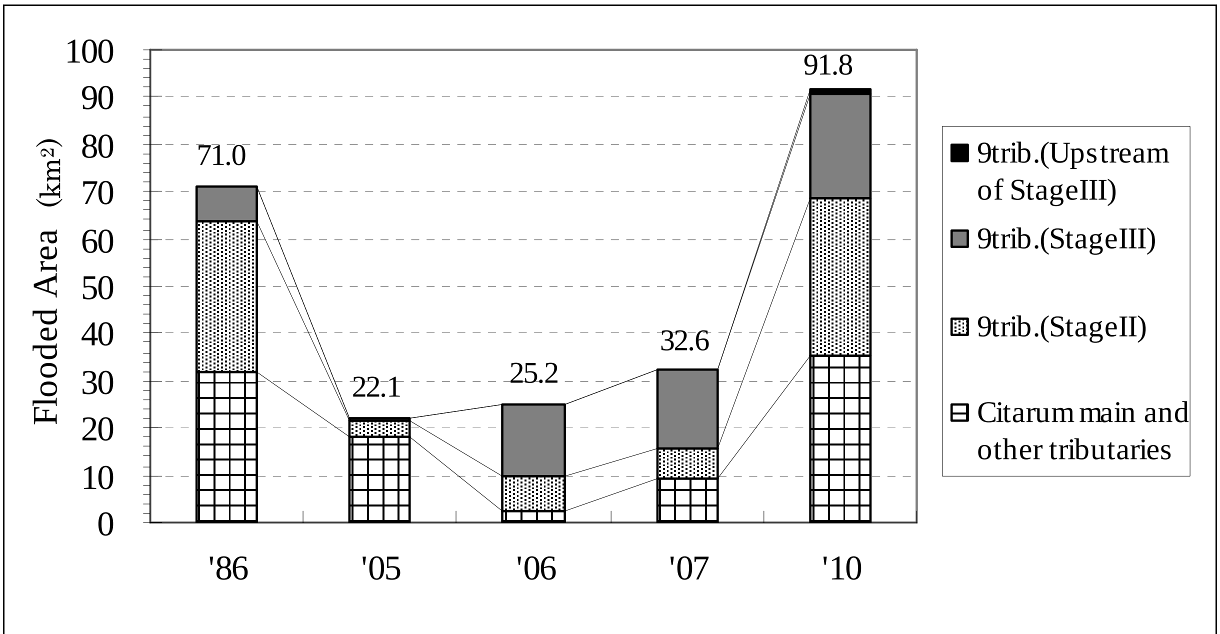
Source: 2007 D/D

3.3.3. Flood and Inundation Areas / Flood Disaster Records

Serious floods have occurred frequently in the Upper Citarum Basin. Damage conditions of the recent floods are shown in Figure 3.3.3.1, Table 3.3.3.1 and Table 3.3.3.2. Inundation areas of recent major floods (1986, 2005, 2007, and 2010) are illustrated in Figure 3.3.3.2 to 3.3.3.6.

The effects of river improvement have been exposed by the floods after 2005. As shown in Figure 3.3.3.1 and Figures 3.3.3.2 to 3.3.3.6, the inundated area spread along the Citarum mainstream in the March 1986 flood. However, the inundated area was limited to Dayeuh Kolot at Citarum main while the unimproved section of the tributaries upstream of the improved section suffered from inundation in the 2006 and 2007 floods. In the 1986 flood, the inundated area appeared widely along the Citarum mainstream, resulting from overtopping of the Citarum main. Subsequently, due to river improvement of the Citarum main and its major tributaries such as Citarik and Cisangkuy in the JBIC-Loan Stage (I) & (II) projects, flooding has been decreasing considerably along the Citarum main river. Figure 3.3.3.7 indicates the annual maximum inundation area from 1994 to 2007, while Figure 3.3.3.8 shows the annual maximum inundation period from 1994 to 2007. However, flood damage still occurs along the upper tributaries that have not been improved, and around the Dayeuh Kolot area where land subsidence has been recorded.

The 2010 flood caused serious damage in a wide area upstream of Dayeuh Kolot in February and March. The peak discharge at Nanjung was evaluated to be over a 10-year return period, which is far beyond the channel capacity for Q5 (5-year return period discharge).



Source: JICA Survey Team

Figure 3.3.3.1 Flooded Area of Recent Major Floods

Table 3.3.3.1 Flooded Area of Recent Major Floods (Breakdown of Figure 3.3.3.1)

River		Segment [*1]	Catchment area	Flooded area									
				'86		'05		'06		'07		'10	
			km2	km2	% [*2]	km2	% [*2]	km2	% [*2]	km2	% [*2]	km2	% [*2]
9tiributaries	Citarum Upstream	Stage II	16.8	5.0	7%	0.0	0%	0.4	2%	0.1	0%	2.6	3%
		Stage III	10.4	0.5	1%	0.0	0%	3.5	14%	4.9	15%	2.3	2%
		Upstream of Stage III	219.3	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.1	0%
		Subtotal	***246.5***	***5.5***	***8%***	***0.0***	***0%***	***3.9***	***16%***	***5.0***	***15%***	***5.0***	***5%***
	Citarik	Stage II	95.0	21.1	30%	3.0	14%	6.0	24%	5.4	17%	26.5	29%
		Stage III	74.9	0.0	0%	0.0	0%	1.8	7%	1.3	4%	4.5	5%
		Upstream of Stage III	22.5	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.4	0%
		Subtotal	***192.4***	***21.2***	***30%***	***3.0***	***14%***	***7.8***	***31%***	***6.7***	***20%***	***31.4***	***34%***
	Cimande	Stage III	10.0	2.9	4%	0.0	0%	1.1	5%	1.6	5%	4.0	4%
		Upstream of Stage III	31.2	0.0	0%	0.0	0%	0.1	0%	0.0	0%	0.3	0%
		Subtotal	***41.2***	***2.9***	***4%***	***0.0***	***0%***	***1.2***	***5%***	***1.6***	***5%***	***4.3***	***5%***
	Cikijing	Stage III	10.9	3.4	5%	0.0	0%	3.3	13%	4.4	14%	4.2	5%
		Upstream of Stage III	9.8	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
		Subtotal	***20.8***	***3.4***	***5%***	***0.0***	***0%***	***3.3***	***13%***	***4.4***	***14%***	***4.2***	***5%***
	Cikeruh	Stage II	4.4	4.0	6%	0.0	0%	0.2	1%	0.0	0%	1.9	2%
		Stage III	2.5	0.1	0%	0.5	2%	2.5	10%	3.6	11%	4.8	5%
		Upstream of Stage III	75.2	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
		Subtotal	***82.1***	***4.1***	***6%***	***0.5***	***2%***	***2.7***	***11%***	***3.6***	***11%***	***6.7***	***7%***
	Cibeusi	Stage III	1.8	0.0	0%	0.0	0%	0.3	1%	0.0	0%	0.0	0%
		Upstream of Stage III	9.0	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
		Subtotal	***10.7***	***0.0***	***0%***	***0.0***	***0%***	***0.3***	***1%***	***0.0***	***0%***	***0.0***	***0%***
	Cisangkuy	Stage II	29.2	1.9	3%	0.3	1%	0.7	3%	0.5	2%	2.1	2%
		Stage III	18.4	0.0	0%	0.0	0%	1.2	5%	0.4	1%	1.6	2%
		Upstream of Stage III	222.7	0.0	0%	0.0	0%	0.1	0%	0.0	0%	0.1	0%
		Subtotal	***270.3***	***1.9***	***3%***	***0.3***	***1%***	***2.0***	***8%***	***1.0***	***3%***	***3.8***	***4%***
	Citalugtug	Stage III	15.9	0.0	0%	0.0	0%	1.4	5%	0.4	1%	0.4	0%
		Upstream of Stage III	23.6	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
		Subtotal	***39.5***	***0.0***	***0%***	***0.0***	***0%***	***1.4***	***5%***	***0.4***	***1%***	***0.4***	***0%***
	Ciputat	Stage III	0.8	0.4	1%	0.2	1%	0.0	0%	0.4	1%	0.6	1%
	Subtotal of Stage III segment		***145.5***	***7.4***	***10%***	***0.7***	***3%***	***15.2***	***60%***	***17.0***	***52%***	***22.4***	***24%***
	Subtotal of 9 tributaries		***904.3***	***39.3***	***55%***	***4.0***	***18%***	***22.6***	***90%***	***23.1***	***71%***	***56.5***	***62%***
Citarum main and other tiributaries	Citarum main		134.4	19.9	28%	4.6	21%	0.2	1%	4.0	12%	21.7	24%
	Ci Bubuay		8.8	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Ci Cangkorah		33.8	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Ci Sondari		52.2	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Ci Tambakruyung		15.0	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Cibeureum		47.0	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Cicadas		17.5	4.6	6%	0.3	1%	0.0	0%	0.0	0%	0.5	1%
	Cidurian		29.3	1.0	1%	0.0	0%	0.0	0%	0.0	0%	0.8	1%
	Cikapundung		117.2	0.9	1%	1.6	7%	0.0	0%	0.9	3%	0.3	0%
	Cikoneng		47.5	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Cimahi		78.8	0.0	0%	0.0	0%	0.0	0%	0.0	0%	0.0	0%
	Cinambo		42.0	0.0	0%	3.2	15%	0.2	1%	0.9	3%	3.7	4%
	Cipamokolan		36.3	2.3	3%	1.1	5%	0.0	0%	0.5	1%	3.1	3%
	Cirasea		45.4	0.1	0%	0.0	0%	2.1	9%	2.6	8%	0.5	1%
	Cisaranten		53.3	0.9	1%	6.9	31%	0.0	0%	0.0	0%	2.8	3%
	Citeupus		22.3	0.0	0%	0.2	1%	0.0	0%	0.4	1%	0.1	0%
	Ciwidey		108.1	0.0	0%	0.0	0%	0.0	0%	0.0	0%	1.4	1%
	Ckapundung Kolot		27.0	1.9	3%	0.2	1%	0.0	0%	0.3	1%	0.6	1%
Total			***1820.3***	***71.0***	***100%***	***22.1***	***100%***	***25.2***	***100%***	***32.6***	***100%***	***91.8***	***100%***

Note:
*1: Stage III segments are besed on 2007 D/D
*2: Ratio between flooded area within tributaries and one of whole basin

Source: JICA Survey Team

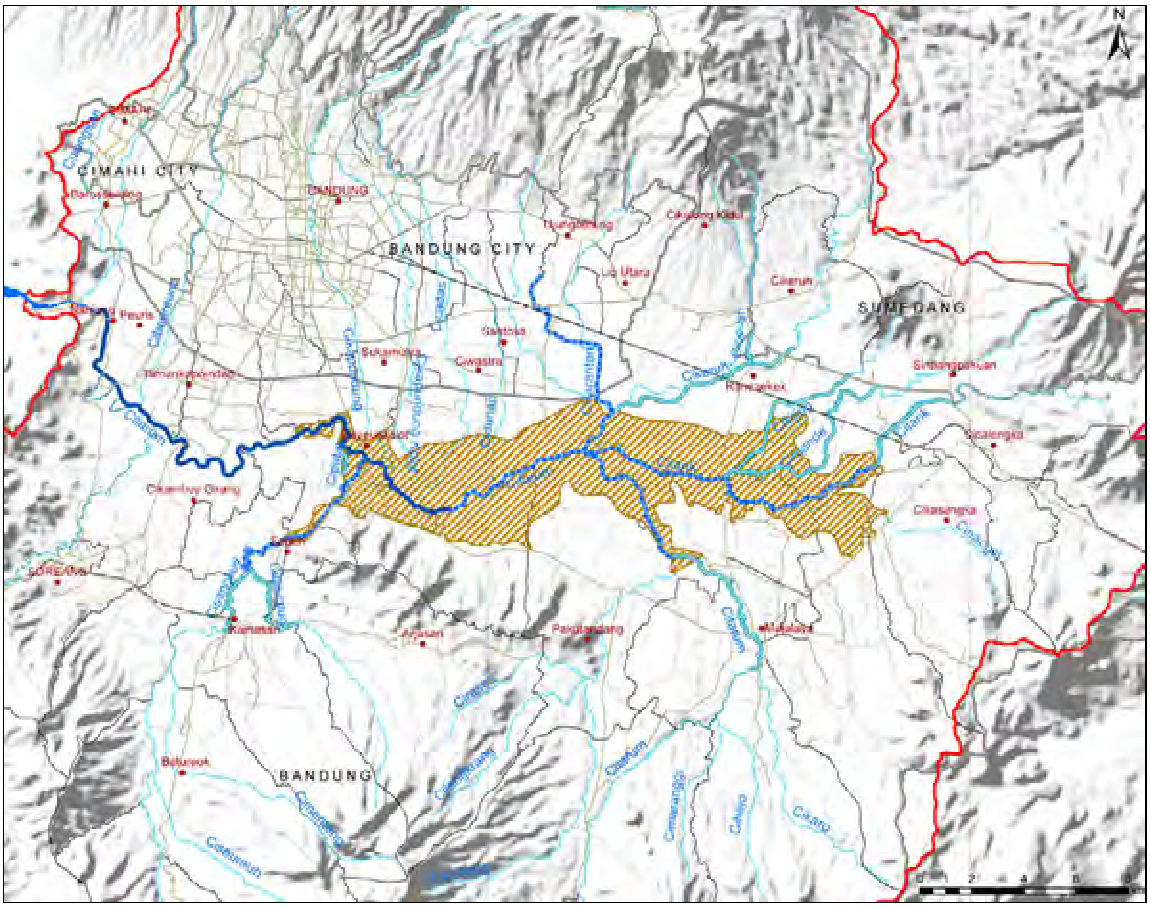
Table 3.3.3.2 Population in Flood Area and Damage Amount at Stage (III) Segments

Tributaries	Catchment area	Improvement length	Population in flooded area					Damage amount				
			'86	'05	'06	'07	'10	'86	'05	'06	'07	'10
Unit	km2	m	1000 person					Rp. Billion				
Citarum Upstream	229.7	5,450	10.4	0.0	111.3	140.8	69.0	164	0	1,782	2,274	1,096
Citarik Upstream	97.4	4,820	0.0	0.0	24.4	29.7	40.3	0	0	417	476	706
Cimande	41.2	9,510	6.0	0.0	8.8	6.6	37.1	101	0	144	111	627
Cikijing	20.8	6,680	14.3	0.0	50.2	58.1	31.5	229	0	839	954	545
Cikeruh	77.7	7,650	0.0	1.6	70.2	55.8	47.4	0	28	1,114	881	760
Cibeusi	10.7	1,360	0.0	0.0	12.3	0.1	0.8	0	0	199	1	12
Cisangkuy Upstream	241.0	3,730	0.0	0.0	33.9	7.3	15.8	0	0	556	113	271
Citalugtug	39.5	4,010	0.0	0.0	41.1	9.5	12.8	0	0	834	210	244
Ciputat	0.8	660	5.7	5.2	0.0	5.8	6.2	88	80	0	89	95
Total	**758.9**	**43,870**	**36.5**	**6.8**	**352.1**	**313.6**	**260.9**	**582**	**107**	**5,885**	**5,110**	**4,357**

Note: calculation method of population in flooded and damage amount is as follows:

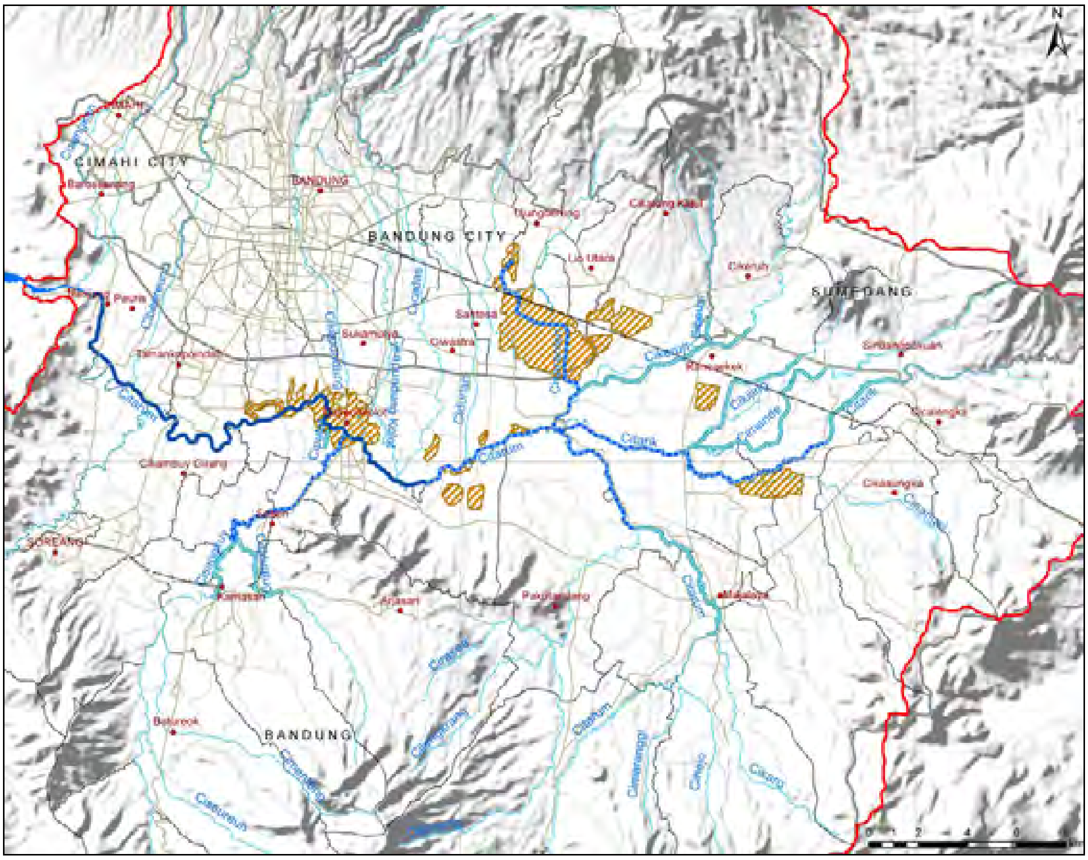
- Population in flooded area is calculated by multiplying the number of households by 5.0, the average population per household. The number of households is calculated by dividing the settlement area in the flooded area by 59.45m^2, the average area per household.
- Damage amount is damage total of house, housing assets, paddy fields, industries, industry stock, social facilities and roads. Each damage amount is calculated by multiplying the unit price and flooded area (or number, length) of related land use.

Source: JICA Survey Team



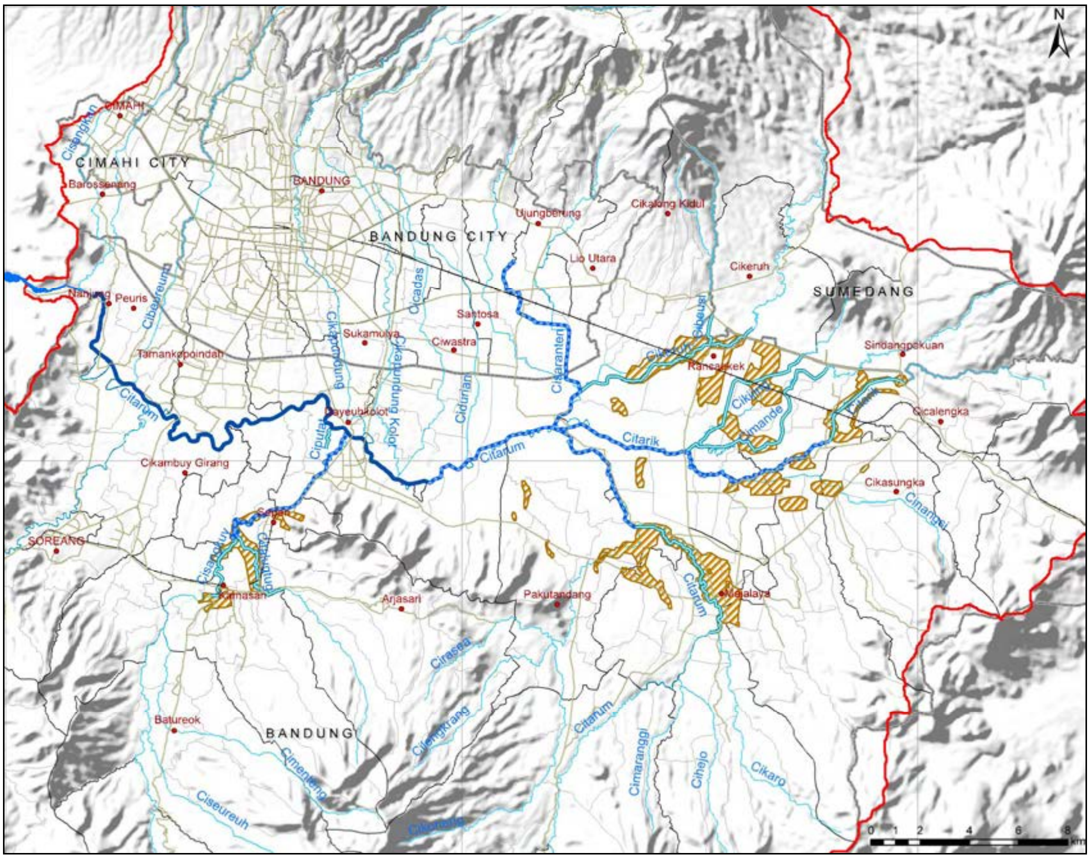
Source: JICA Survey Team

Figure 3.3.3.2 Inundation Area of 1986 Flood



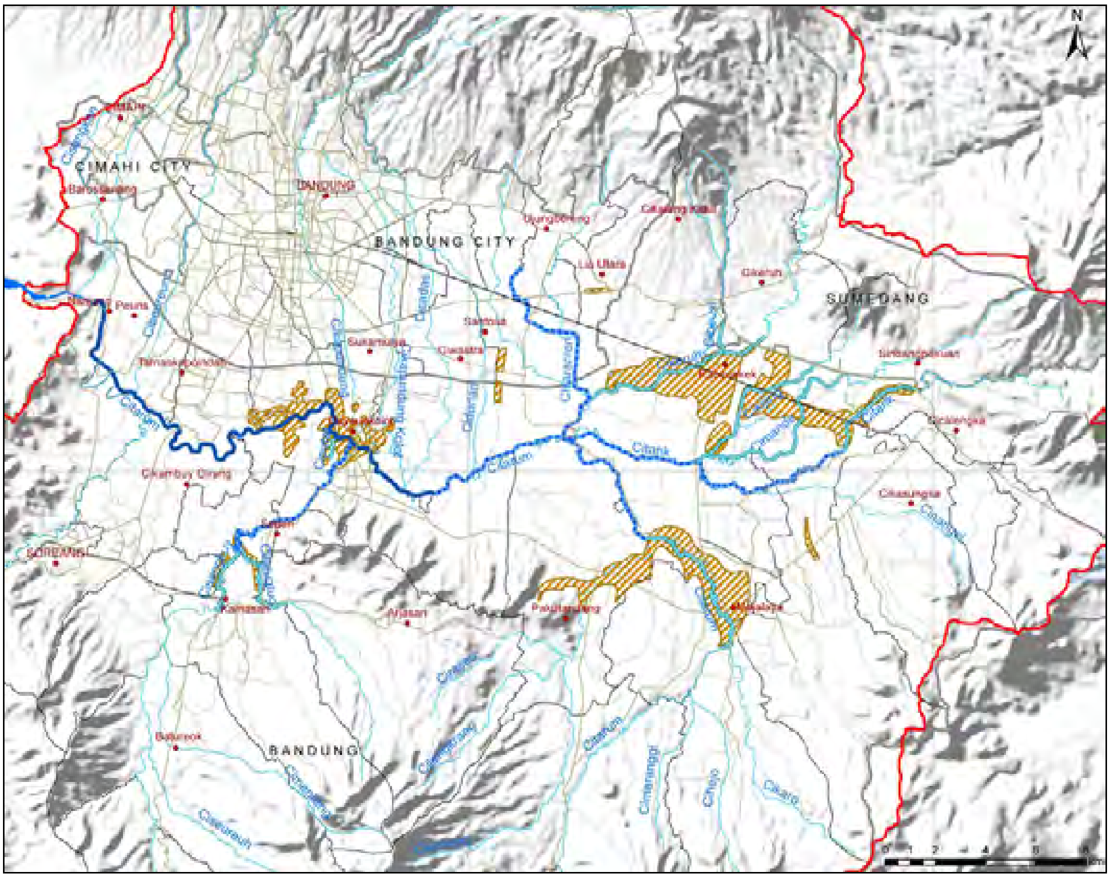
Source: JICA Survey Team

Figure 3.3.3.3 Inundation Area of 2005 Flood



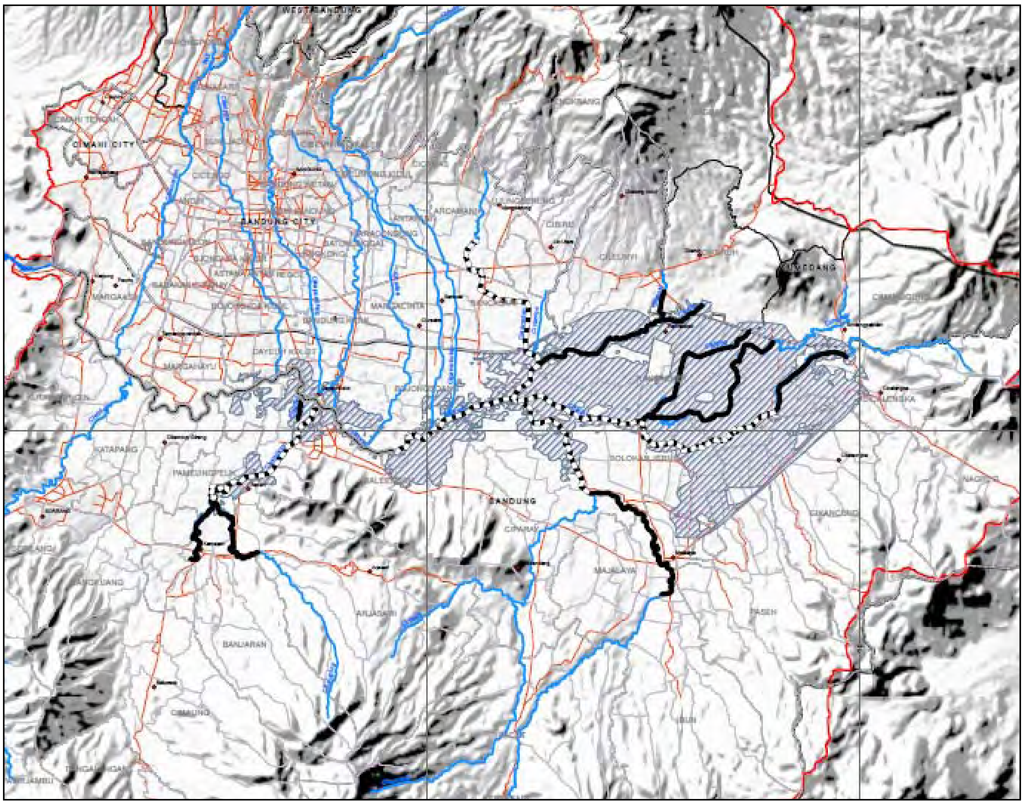
Source: JICA Survey Team

Figure 3.3.3.4 Inundation Area of 2006 Flood



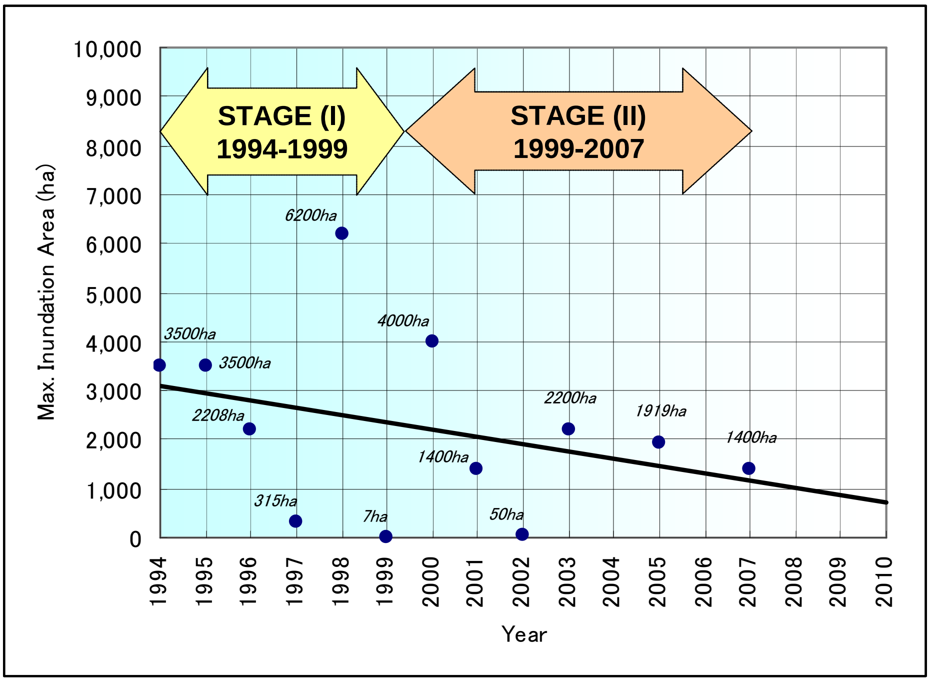
Source: JICA Survey Team

Figure 3.3.3.5 Inundation Area of 2007 Flood



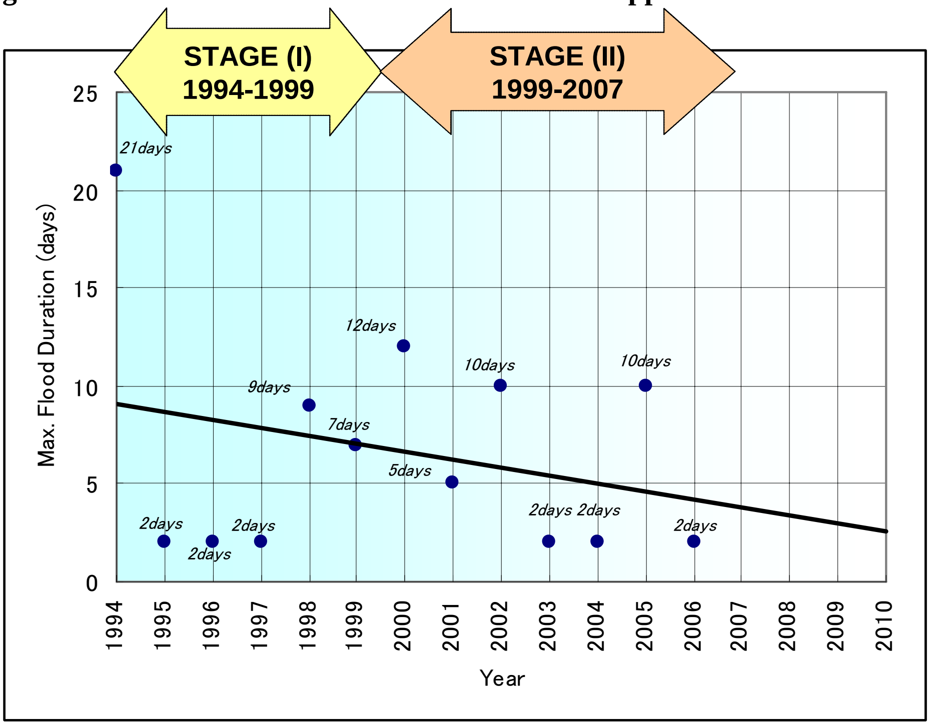
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 3.3.3.6 Inundation Area of 2010 Flood



Source: Final Report on Project Impact Survey for UFCP, PT. RAYA KONSULT (2007)

Figure 3.3.3.7 Maximum Inundation Area in the Upper Citarum River Basin



Source: Final Report on Project Impact Survey for UFCP, PT. RAYA KONSULT (2007)

Figure 3.3.3.8 Maximum Inundation Duration in the Upper Citarum River Basin

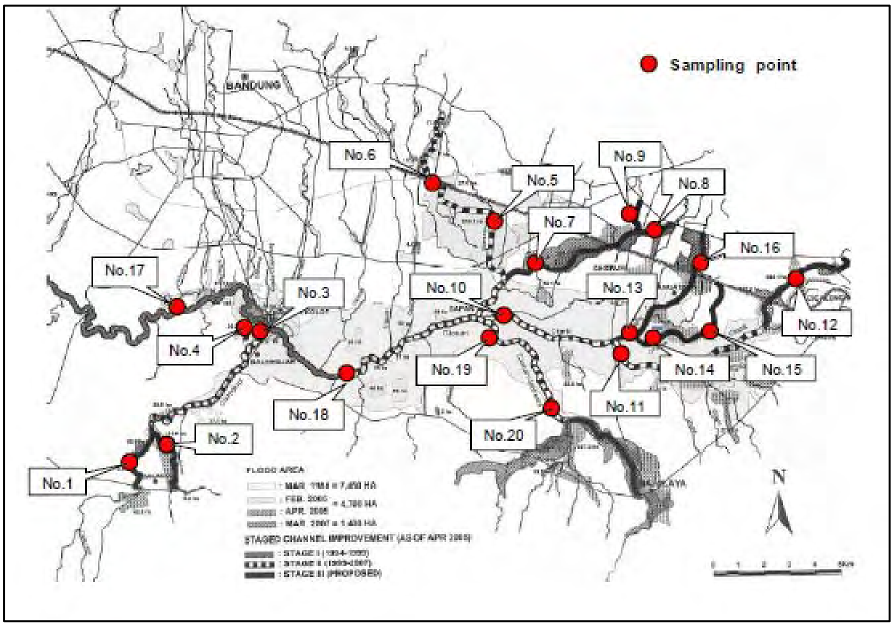
3.3.4. Sediment Contamination and Water Quality Survey

Since 2006, heavy metal contaminated sediment in the Upper Citarum River Basin has been a problem. In this Project, a huge volume of dredging sediment will be generated through river dredging. Therefore, it is important to adopt an appropriate sediment disposal method.

A heavy metal survey of river water and sediment of the Upper Citarum River Basin was conducted to understand the existing heavy metal contamination conditions and to determine an appropriate disposal method.

(1) Sampling dates and Sampling points

Sampling of river water and sediment was done on May 2 and 3, 2010. In this survey, 20 sampling points were chosen in the Citarum River mainstream and 9 tributaries. The sampling points are shown on the map in Figure 3.3.4.1 and listed in Table 3.3.4.1.



Source: JICA Survey Team

Figure 3.3.4.1 Sampling Points in the Upper Citarum River Basin

Table 3.3.4.1 List of Sampling Points

No.	Sampling point	No.	Sampling point
1	Cisangkuy Upstream	11	Citarik 2
2	Citalugtug	12	Citarik 3
3	Cisangkuy - Citarum	13	Cimande 1
4	Ciputat	14	Cimande 2
5	Cisaranten 1	15	Cimande 3
6	Cisaranten 2	16	Cikijing
7	Cikeruh 1	17	Citarum Rancamanyar
8	Cikeruh	18	Citarum A
9	Cikeruh branch	19	Citarum Upstream A
10	Citarik A	20	Citarum Upstream 2

(2) Test item

1) Heavy metal survey

Sediment content test

Heavy metals and related items: As, Ba, Cd, Cr, Cu, Co, Pb, Hg, Mo, Ni, Sn, Se, Ag, Zn, CN and F

Sediment leaching test

Heavy metals: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag and Zn

2) Water quality survey

River water quality

Physical and chemical items: Temperature, TDS, TSS, pH, BOD_5, CODcr, T-N, NH_4-N and T-P

Heavy metals and related items: As, Ba, Cd, Cr, Cu, Co, Pb, Hg, Mo, Ni, Sn, Se, Ag, Zn, CN and F

(3) Survey results

Data is shown in Appendixes IV-2). The following describes the summary of each survey.

1) Heavy metal survey

Sediment content test

The survey results are illustrated in Figure 3.3.4.2 The major heavy metals in the sediment are Ba, Cr, Cu, Pb, Sn and Zn.

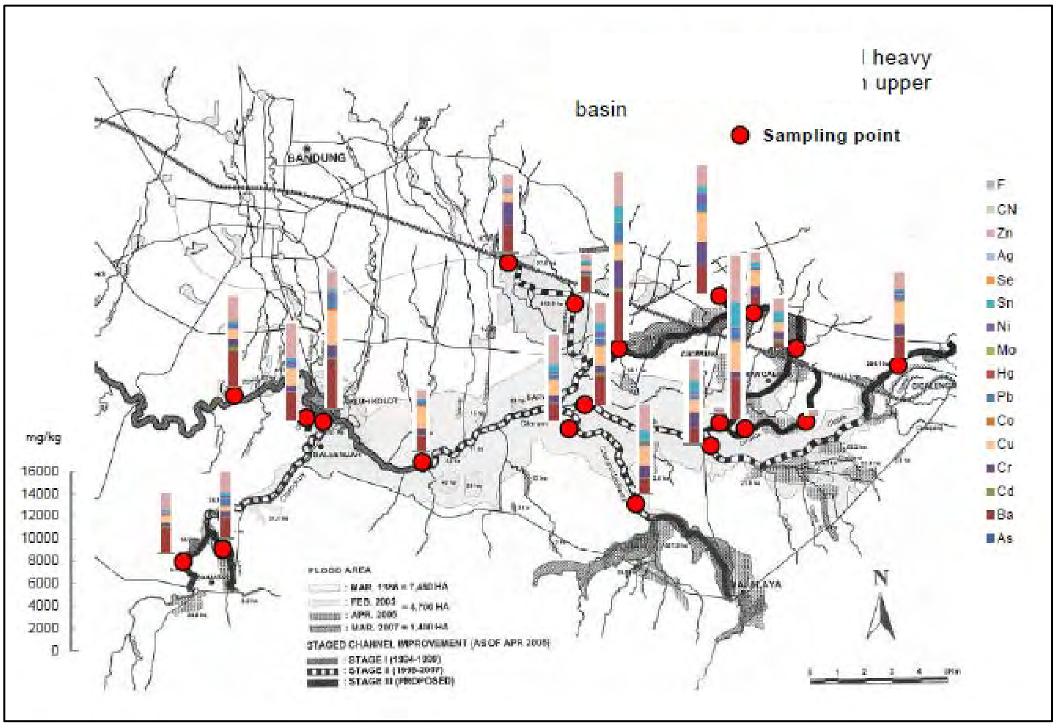


Figure 3.3.4.2 Heavy Metal Content in Sediment

Table 3.3.4.2 shows a summary of heavy metal content in the sediment. In this table, the maximum value and minimum value of each measurement item is shown. As a reference, Indonesian regulations for decisions on dumping methods (Kep-04/BAPEDAL/09/1995) and US limit value for the land application of sewage sludge are also shown. There is no regulation on environmental quality of river sediment in Indonesia. Therefore, in this survey, Kep-04/BAPEDAL/09/1995 and US limit value are used as a reference to assess sediment quality.

Table 3.3.4.2 Summary of Heavy Metal Content in Sediment

Item (mg/kg)	Max	Min*	Indonesian regulation**	US Pollutant limits***
Arsenic (As)	25.4	1.8	300	75
Barium (Ba)	4184.8	81.6	---	---
Cadmium (Cd)	335.9	7.6	50	85
Chromium (Cr)	2344.6	21.0	2500	3000
Copper (Cu)	3003.1	38.8	1000	4300
Cobalt (Co)	242.6	13.4	500	---
Lead (Pb)	1668.5	61.2	3000	840
Mercury (Hg)	0.0008	0.00008	20	57
Molybdenum (Mo)	205.0	0.03	400	57
Nickel (Ni)	724.1	11.8	1000	420
Tin (Sn)	2245.9	0.03	500	---
Selenium (Se)	166.9	0.03	100	100
Silver (Ag)	5.7	1.3	---	---
Zinc (Zn)	3915.3	210.7	5000	7500
Cyanide (CN)	4.1	1.4	---	---
Fluoride (F)	206.1	67.1	---	---

* N.D. is excepted

** Kep-04/BAPEDAL/09/1995, Procedures and requirements for the dumping the processing result, requirements of the former processing location, and former location of hazardous and harmful waste dumping site, Head of Bapedal Decree No.4/1995.

*** Pollutant limits for the land application of sewage sludge (Ceiling concentrations, Table 1 of 40 CFR 503,13)

Source: JICA Survey Team

The regulations define the final disposal method for toxic and hazardous waste (abbreviation in Indonesia: B3 waste). In the results of the survey, the concentrations of Cd, Cu, Sn and Se exceeded the value. Moreover, Cd, Pb and Se exceeded US Pollutant limits for land application.

Sediment leaching test

Table 3.3.4.3 shows a summary of the leaching test. The results show that the leaching concentration of heavy metal is lower than the Indonesian standard and U.S. EPA regulatory level. From these results, the sediment of the Upper Citarum River Basin is interpreted as non-hazardous waste.

Table 3.3.4.3 Summary of Heavy Metal Leaching Test

Item (mg/L)	Max	Min	Indonesian standard* (B3 waste dumping)	US EPA Regulatory level (Waste leachate)
Arsenic (As)	0.054	0.006	5	5
Barium (Ba)	4.294	0.294	100	100
Cadmium (Cd)	0.076	0.001	1	1
Chromium (Cr)	0.552	0.017	5	5
Copper (Cu)	6.152	0.001	10	-
Lead (Pb)	0.942	0.053	5	5
Mercury (Hg)	0.00062	0.00042	0.2	0.2
Selenium (Se)	0.144	0.005	1	1
Silver (Ag)	0.008	0.001	5	5
Zinc (Zn)	5.435	0.033	50	-

Kep-04/BAPEDAL/09/1995, Procedures and requirements for the dumping the processing result, requirements of the former processing location, and former location of hazardous and harmful waste dumping site, Head of Bapedal Decree No.4/1995.

Source: JICA Survey Team

Heavy metal survey by PUSAIR

In August 2010, PUSAIR implemented a heavy metal survey in the Upper Citarum River Basin. In the Citarum mainstream and 9 tributaries, sampling was implemented at same locations as the previous survey by the JICA survey team. In the PUSAIR survey, an additional 5 sampling points in the Citarum mainstream (from Rancamanyar to Batujajar) were decided. A TCLP test and a heavy metal content test were implemented. The same test items as the former survey were evaluated (See Table 3.3.4.2 and 3.3.4.3).

Summary of this test is as follows:

- In the content test, all the test items didn't exceed the marine sediment quality standard in Washington state, USA (WAC 173-204-320)
- In the TCLP test, all the tested heavy metals didn't exceed the Indonesian standards for TCLP test (Kep-04/BAPEDAL/09/1995).

These test results support the test results of JICA Survey Team. From these test results, it is considered that dredged sediment containing heavy metal by this Project don't have serious environmental effect. In the implementation of this Project, dredged sediment is assessed by leaching test, and assessed by Indonesian TCLP standard (Kep-04/BAPEDAL/09/1995). Sediment that satisfies Kep-04/BAPEDAL/09/1995 is treated as non-hazardous waste; therefore, such sediment is dumped into geotextile bedded oxbow without solidification. Details of this process are described in Section 9.3.2.

2) Water quality survey

Physical-chemical items

Table 3.3.4.4 Summary of Physical-chemical Items

Item	Unit	Max	Min	Indonesian standard criteria			
				I	II	III	IV
pH	-	7.8	6.6	6-9	6 - 9	6 - 9	5 - 9
Water Temp. *	^{o}C	32.8	31.4	∓3	∓3	∓3	∓5
SS	mg/L	340	2	50	50	400	400
DS	mg/L	3800	54	1000	1000	1000	2000
T-P	mg/L	0.7	0.01***	0.2	0.2	1	5
BOD_5	mg/L	132.2	18.4	2	3	6	12
CODcr	mg/L	368.6	36.9	10	25	50	100
NH_4-N	mg/L	1.4	0.1	0.5	(-)**	(-)**	(-)**
T-N	mg/L	2.0	0.1	0.06	0.06	0.06	(-)**

Reference: Water quality management and controlling the water pollution, No.82/2001. This regulation defines the following 4 water quality criteria:

I For drinking water, and / or for other purposes that require similar quality
II For water tourism facilities, cultivation of freshwater fish, livestock, irrigation, and / or other purposes that require similar quality
III For cultivation of freshwater fish, livestock, irrigation, and / or other purposes that require similar quality
IV For watering plants and / or other purposes that require similar quality
* Water temperature deviation from the natural condition
** (-) means that for that class, this parameter is not required
*** T-P of Cikeruh, Citaric3, Citaric2 and Cimande 2 was N.D.

Source: JICA Survey Team

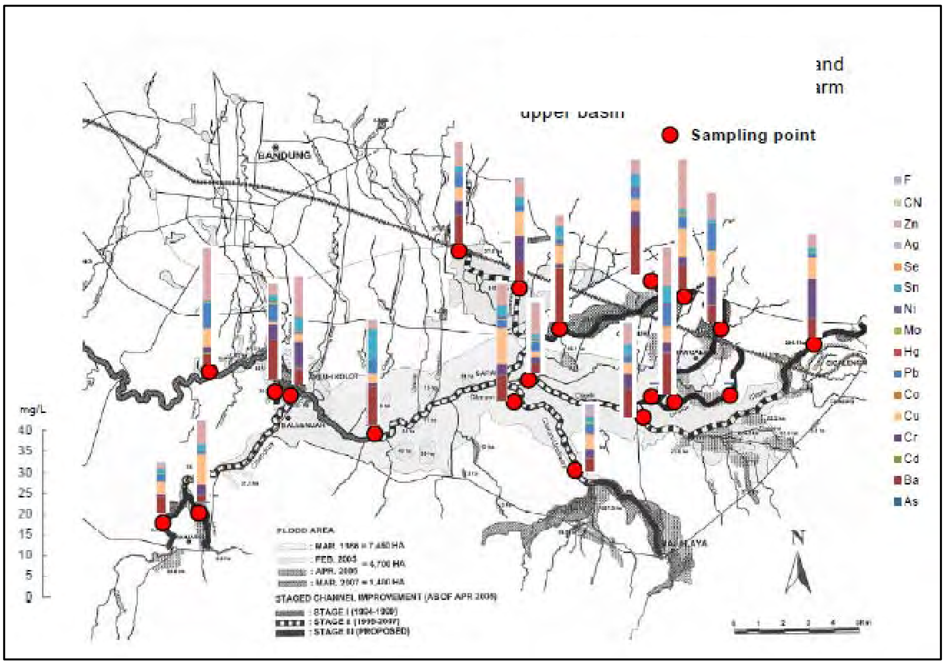
The BOD_5 ranged from 18.4mg/L to 132.2mg/L, and the CODcr ranged from 36.9mg/L to 368.6mg/L. This result shows that water quality of the Upper Citarum River Basin is categorized as Criteria III or IV.

When this water quality is compared with Japanese standards (See Appendix IV-1)), the water quality of the Upper Citarum River Basin is assessed as being E class (Industry water class 3 and conservation of environment). The NH_4-N concentration ranged from 0.08mg/L to 1.42mg/L. In comparison with water quality criteria for aquatic biodiversity of Japan, water quality for aquatic biodiversity in the Upper Citarum River Basin is assessed as being from “Poor” to “Very good”. T-N and T-P were compared with the eutrophication indices of Japan. T-N of most sampling points exceeded 0.15mg/L. Therefore, eutrophication of the Upper Citarum River Basin is expected.

Heavy metal

A summary of the heavy metal survey is shown in Figure 3.3.4.3 and Table 3.3.4.5. Major heavy metals in the Upper Citarum River Basin are Ba, Cr, Cu, Pb, Sn and Zn. Notably, Cr, Cu, Pb and Zn were detected at all the sampling points.

Cd levels at most sampling points exceeded the standard value of Indonesia, and Sn was detected at all the sampling points. All Cr data exceeded Indonesian standards (0.1mg/L). Also, Ba, Cu and Pb levels at all the sampling points exceeded Indonesian standards. However, Hg was detected in only 3 sampling points and the concentrations were very low (0.00004 to 0.0004mg/L).



Source: JICA Survey Team

Figure 3.3.4.3 Heavy Metal Concentration in River Water

Table 3.3.4.5 Summary of Heavy Metal Concentration in River Water

Item (mg/L)	Max	Min*	Indonesian standard			
			I	II	III	IV
Arsenic (As)	0.1	0.005	0.5	1.0	1.0	1.0
Barium (Ba)	12.3	0.247	1.0	(-)***	(-)	(-)
Cadmium (Cd)	0.56	0.03	0.01	0.01	0.01	0.01
Chromium VI (Cr^{6+})	9.12**	0.06**	0.05	0.05	0.05	0.1
Copper (Cu)	8.33	0.02	0.02	0.02	0.02	0.02
Cobalt (Co)	0.4	0.03	0.2	0.2	0.2	0.2
Lead (Pb)	6.32	0.40	0.03	0.03	0.03	1.0
Mercury (Hg)	0.0004	0.00004	0.001	0.002	0.002	0.005
Molybdenum (Mo)	0.77	0.05	---	---	---	---
Nickel (Ni)	0.95	0.01	---	---	---	---
Tin (Sn)	7.22	0.0001	---	---	---	---
Selenium (Se)	0.42	0.0001	0.01	0.05	0.05	0.05
Silver (Ag)	0.04	0.01	---	---	---	---
Zinc (Zn)	12.44	0.07	0.05	0.05	0.05	2
Cyanide (CN)	N.D.	N.D.	0.02	0.02	0.02	(-)*
Fluoride (F)	1.5	0.3	0.5	1.5	1.5	(-)*

Reference: Water quality management and controlling the water pollution, No.82/2001. Definitions of criteria I to IV are the same as Table 3.3.4.4.

* N.D. is excepted

** Measurement data is Total Chromium

*** (-) means that for that class, this parameter is not required

Source: JICA Survey Team

In Japan, the standard value for Zn is determined according to the level required for protection of the habitat of aquatic life (See Appendix IV, Table Zinc (Zn) Standard Value to Protect Aquatic Life (Japanese standard)). For fish and their habitat, 0.03mg/L of Zinc is accepted as the limitation value. However, the Zn concentration of the Upper Citarum River Basin was 0.07 to 12.4mg/L. Therefore, the water environment of the Upper Citarum River Basin is expected to be hostile for the habitation of aquatic life.

(4) Recommendations to improve sediment and river water quality

As described above, river water and sediment in the Upper Citarum River Basin is contaminated with organic pollutants and heavy metals.

The major source of organic contaminants is assumed to be untreated domestic wastewater and untreated industrial wastewater. Photos 1 and 2 show (colored) wastewater discharge near industrial sites. This colored water shows that industrial wastewater is being discharged without treatment.

Source: JICA Survey Team

Photo 3.3.4.1 Black colored wastewater at Upper Citarum, Majaraya

Source: JICA Survey Team

Photo 3.3.4.2 Black colored wastewater at Cikijing (No.16 in Figure 3.3.4.1)

In addition, waste dumped into river is a contaminant source that cannot be ignored. Photos 3 and 4 shows accumulated domestic waste in small rivers.

Source: JICA Survey Team

Photo 3.3.4.3 Drainage canal in Bandung city nearby BBWSC office

Source: JICA Survey Team

Photo 3.3.4.4 Cikeruh branch (No.9 in Figure 3.3.4.1)

In contrast, the source of heavy metals is determined by examining the application of each heavy metal (Table 3.3.4.6).

Table 3.3.4.6 Expected Source of Heavy Metals

Heavy metal	Application (major use)	Estimated heavy metal source
Ba	Braun tube, Ceramic capacitor, Filler (for ink, pigment, paint)	Waste electrical equipment, Dye house effluent (Textile)
Cd	Nickel-cadmium battery, Pigment, Alloyed metal	Waste electrical equipment, Dye house effluent (Textile)
Cr^{6+}	Plating, Stain	Plating wastes, Dye house effluent (Textile)
Cu	Electrical cable, Machine component	Waste electrical equipment
Pb	Lead battery, Electrical cable, Gasoline additive, Pigment	Waste electrical equipment, Dye house effluent (Textile)
Sn	Plating, Electrical cable, Solder	Waste electrical equipment, Metal waste
Zn	Plating, Cast metal, Sheet steel, Dyeing and finishing	Plating wastes, Foundry effluent, Dye house effluent (Textile), Metal waste

From Table 3.3.4.6, the major source of heavy metal contamination is shown to be industrial wastewater. Thus, improvement of industrial wastewater is essential to solve heavy metal discharge in the Upper Citarum River Basin. As a measure of industrial wastewater improvement, installation of on-site wastewater treatment facilities is recommended.

To treat heavy metal in wastewater, the following methods are usually employed (Table 3.3.4.7).

Table 3.3.4.7 Heavy Metal Treatment Method for Waste Water

Treatment method	Characteristics
Coagulating sedimentation (alkaline property)	Low running cost Chemicals are readily available Easy to control (only pH meter) and widely applicable
Coagulating sedimentation (alkaline property with displacement reaction of Ca, Mg or Fe)	Suitable for organic acids or complex chemicals (EDTA, STPP, CN, etc.) including wastewater e.g. plating industry, machine factories
Ferritization and magnetic isolation	Suitable for concentrated heavy metal wastewater treatment Sludge can be reused as ferrite material
Ion exchange	Operation cost (resin regeneration cost) is high Suitable for recovery of valuable metals

Notably, the coagulating sedimentation method doesn’t require particular reagents or facilities.

For small factories that cannot construct a full-scale water treatment facility (*e.g.* coagulating sedimentation or ion exchange), it is desirable to promote a simple treatment facility (*e.g.* sedimentation tank, grease trap, *etc.*).

(5) Summary

- Through this survey, the following results on heavy metal concentration were found:Sediment was contaminated by Ba, Cr, Cu, Pb, Sn and Zn.
- However, the leaching test showed that the sediment of Upper Citarum River Basin can be interpreted as non-hazardous waste. Therefore, environment impact due to the dumping of sediment is expected to be small.
- Assessment of dredged sediment is done accordance with Kep-04/BAPEDAL/09/1995. Sediment that satisfies Kep-04/BAPEDAL/09/1995 is dumped into geotextile bedded oxbow without solidification.In comparison with the Japanese standards, the water quality of the Upper Citarum River Basin is expected to be hostile for the habitation of aquatic life.

CHAPTER 4 REVIEW OF EXISTING DETAILED DESIGN FOR THE 9 TRIBUTARIES

4.1. Detailed Design in 2007 (2007 D/D)

The tributaries that reported suffering from serious flood damage in recent years as described in Chapter 3, are shown in Table 4.1.0.1. These 9 tributaries were selected to be improved in Stage (III) of the Project in 2007 D/D. In this section, the existing detailed design for the 9 tributaries (2007 D/D) will be reviewed in terms of methodology, design condition, design discharge and channel improvement plan to prepare for the modification of 2007 D/D which is deliberated in section 4.3.

Table 4.1.0.1 Subjective Tributaries for Detailed Design in 2007

Stream	Targeted River	Location	Distance
1. Citarum Upstream	Citarum Upstream	Kantren to Majalaya	L = 8.0km
2. Cisangkuy	Cisangkuy	Rancaenggang to Kamasan	L = 7.0km
	Citalugtug	Waas to Cileutik	L = 5.0km
3. Citarik	Citarik Upstream	Bojong Gempol to Panenjoan	L = 6.0km
4. Cimande	Cikijing	Tanggeung to Cikijing village	L = 8.0km
	Cimande	Langensari to Rancapanjang	L = 8.0km
5. Cikeruh	Cikeruh	Ranca Kamuning to Sirna Galih	L = 10.0km
	Cibeusi	Buah Dua to Sindang Sari	L = 2.5km
6. Ciputat	Ciputat	Bojongasih to Kulalet Hilir	L = 1.2km

Source: 2007 D/D

4.1.1. Methodology

The required river capacity is determined by focusing on a 5-year flood frequency based on the concept of the present Urgent Flood Control Plan. River capacity is obtained by enlarging the river cross section. The river capacity of these tributaries is described in Chapter 3.

4.1.2. Design Conditions

(1) Design Discharge for Tributaries

Due to a lack of data for calibration, the Design discharge for targeted tributaries is estimated using the following rational formula.

$$Q = 1/3.6 \cdot f \cdot r \cdot A$$

Where:

Q: Peak runoff discharge (m^3/sec)

f: Runoff coefficient for the year 2025

r: Rainfall intensity (mm/hr)

A: Catchment are at interest point (km^2)

(2) Parameters of Rational Method

1) Run-off Coefficient

The run-off coefficient at the point of interest is estimated using a weighted mean. Future land use conditions for the year 2025 are adopted for the run-off simulation for the mainstream.

Table 4.1.2.1 Run-off Coefficient

Land use factor	Water	Forest	Paddy Field	Dry Field	Built-up Area
f	1.0	0.3	0.4	0.4	0.7

Source: 2007 D/D

2) Time Concentration

For estimation of point rainfall intensity at the point of interest, the following Kiprich Equation is adopted.

$$T = To + Tc$$

$$Tc = 0.00032 \times L^{0.77} \times S^{-0.385}$$

Where,

T: Time of Concentration (hr)

To: Inlet time into channel for $2.0 km^2$ at the uppermost basin (=0.5hr)

Tc: Traveling time in channel (hr)

L: Total channel length from inlet point to the interest point (m)

S: Average channel slope between inlet point and interest point

3) Point Rainfall Intensity

Point rainfall intensities for the respective durations and return periods are estimated using the rainfall intensity-duration curve at Bandung Meteorological Station prepared by the Bandung Urban Development Project.

Table 4.1.2.2 Point Rainfall Intensity

Rainfall Duration	Point Rainfall Intensity (mm/hr)				
	2-year	5-year	10-year	20-year	50-year
1 hr. (60 min.)	50.5	56.0	61.0	65.5	72.5
2 hrs. (120 min)	31.5	33.5	37.5	40.5	44.5
3 hrs. (180 min)	22.9	24.8	27.5	29.6	33.0
4 hrs. (240 min)	17.6	19.0	21.5	23.5	25.5
5 hrs. (300 min)	15.0	16.3	18.1	20.1	21.9

Source: 2007 D/D

4) Area Reduction Factor for Area Rainfall Intensity

Based on the experimental relationship in the 1st review report in 1997, point rainfall intensity is reduced by multiplying the following area reduction factors.

Table 4.1.2.3 Area Reduction Factor

Catchment Area (km^2)	Area Reduction Factor
10.0 km^2 or less	1.00
20.0 km^2	0.78
41.2 km^2	0.59
62.3 km^2	0.35
103.1 km^2	0.25
128.1 km^2 or more	0.20

Source: 2007 D/D

5) Required River Capacity for Tributaries

Based on the above conditions, the required river capacity of each tributary is computed in Table 4.1.2.4 and Table 4.1.2.5.

Table 4.1.2.4 Required River Capacity for Tributaries by Rational Method (1)

River/Point		Catchment	Runoff		Elevation (m)			Average	Time of Concentration				Point Rainfall Intensity (mm/hr)					Area	Area Rainfall Intensity (mm/hr)					**Calculated Peak Discharge (m^3/s)**					**Specific Discharge ($m^3/s/km^2$)**				
		Area (km2)	Coefficient (2025)	Length (km)	Highest	at Point	Difference	Slope	Inlet (min)	Travelling (hr)	Travelling (min)	Total (min)	2-year	5-year	10-year	20-year	50-year	Reduction Rate	2-year	5-year	10-year	20-year	50-year	2-year	5-year	10-year	20-year	50-year	2-year	5-year	10-year	20-year	50-year
1. Citarum Upstream																																	
Majalaya	at road bridge	192.00	0.3739	27.0	1,400	675	725	0.0269	30.0	3.328	199.7	229.7	18.4	20.0	22.4	24.4	26.4	0.200	3.7	4.0	4.5	4.9	5.3	73.4	79.8	89.3	97.3	105.3	0.38	0.42	0.47	0.51	0.55
Kantren	before confl. of Cirasea	197.00	0.3736	33.0	1,400	668	732	0.0222	30.0	4.180	250.8	280.8	15.6	17.0	18.9	20.9	22.8	0.200	3.1	3.4	3.8	4.2	4.6	63.8	69.5	77.3	85.5	93.2	0.32	0.35	0.39	0.43	0.47
Kantren	Cirasea river	93.10	0.4250	23.0	1,100	668	432	0.0188	30.0	3.375	202.5	232.5	18.1	19.7	22.1	24.1	26.1	0.275	5.0	5.4	6.1	6.6	7.2	54.6	59.4	66.7	72.7	78.7	0.59	0.64	0.72	0.78	0.85
Kantren	after confl. of Cirasea	290.10	0.3901	33.0	1,400	668	732	0.0222	30.0	4.180	250.8	280.8	15.6	17.0	18.9	20.9	22.8	0.200	3.1	3.4	3.8	4.2	4.6	98.1	106.9	118.8	131.4	143.3	0.34	0.37	0.41	0.45	0.49
Sapan	before confl. of Citarik	290.10	0.3901	39.0	1,400	663	737	0.0189	30.0	5.057	303.4	333.4	13.7	15.0	16.9	17.9	19.9	0.200	2.7	3.0	3.4	3.6	4.0	86.1	94.3	106.3	112.5	125.1	0.30	0.33	0.37	0.39	0.43
2. Citarik Upstream																																	
Panenjohan	at road bridge	61.92	0.3826	13.0	1,100	683	417	0.0321	30.0	1.770	106.2	136.2	27.8	30.4	33.8	35.3	39.5	0.354	9.9	10.8	12.0	12.5	14.0	64.8	70.9	78.8	82.3	92.1	1.05	1.14	1.27	1.33	1.49
Cobok Kaler	railway bridge	62.92	0.3826	14.0	1,100	673	427	0.0305	30.0	1.911	114.6	144.6	26.5	28.9	32.2	34.9	38.1	0.348	9.2	10.1	11.2	12.2	13.3	61.8	67.3	75.0	81.3	88.8	0.98	1.07	1.19	1.29	1.41
Bojonggempol	before confl. of Cibodas	63.42	0.3826	19.0	1,100	671	429	0.0226	30.0	2.714	162.8	192.8	21.4	23.3	25.8	27.8	30.9	0.347	7.4	8.1	9.0	9.7	10.7	50.1	54.5	60.4	65.1	72.3	0.79	0.86	0.95	1.03	1.14
Bojonggempol	after confl. of Cibodas	123.95	0.3842	19.0	1,100	671	429	0.0226	30.0	2.714	162.8	192.8	21.4	23.3	25.8	27.8	30.9	0.208	4.5	4.9	5.4	5.8	6.4	59.0	64.2	71.1	76.6	85.1	0.48	0.52	0.57	0.62	0.69
Babakanmuara	before confl. of Cisungalah	124.95	0.3842	23.5	1,100	666	434	0.0185	30.0	3.454	207.2	237.2	17.7	19.3	21.7	23.7	25.7	0.206	3.7	4.0	4.5	4.9	5.3	48.7	53.1	59.7	65.2	70.7	0.39	0.42	0.48	0.52	0.57
Babakanmuara	after confl. of Cisungalah	183.40	0.3837	23.5	1,100	666	434	0.0185	30.0	3.454	207.2	237.2	17.7	19.3	21.7	23.7	25.7	0.200	3.5	3.9	4.3	4.7	5.1	69.2	75.5	84.8	92.7	100.5	0.38	0.41	0.46	0.51	0.55
Langensari	before confl. of Cimande	187.40	0.3837	26.0	1,100	664	436	0.0168	30.0	3.875	232.5	262.5	16.2	17.7	19.8	21.8	23.8	0.200	3.2	3.5	4.0	4.4	4.8	64.7	70.7	79.1	87.1	95.1	0.35	0.38	0.42	0.46	0.51
Langensari	Cimande river	48.00	0.3826	20.0	800	664	136	0.0068	30.0	4.482	268.9	298.9	15.3	16.7	18.6	20.5	22.4	0.513	7.8	8.6	9.5	10.5	11.5	40.0	43.7	48.6	53.6	58.6	0.83	0.91	1.01	1.12	1.22
Langensari	after confl. of Cimande	235.40	0.3835	26.0	1,100	664	436	0.0168	30.0	3.875	232.5	262.5	16.2	17.7	19.8	21.8	23.8	0.200	3.2	3.5	4.0	4.4	4.8	81.2	88.8	99.3	109.3	119.4	0.35	0.38	0.42	0.46	0.51
Sapan	before confl. of Citarum	281.40	0.3833	32.0	1,100	663	437	0.0137	30.0	4.921	295.2	325.2	14.2	15.4	17.3	18.7	20.6	0.200	2.8	3.1	3.5	3.7	4.1	85.1	92.3	103.7	112.1	123.4	0.30	0.33	0.37	0.40	0.44
3. Cimande																																	
Pangsor		13.80	0.3826	9.0	800	679	121	0.0134	30.0	1.864	111.8	141.8	26.9	29.4	32.8	35.4	38.7	0.916	24.7	26.9	30.1	32.4	35.5	36.2	39.5	44.1	47.6	52.0	2.62	2.86	3.19	3.45	3.77
Jambuleutik		15.20	0.3826	13.0	800	672	128	0.0098	30.0	2.789	167.4	197.4	21.1	23.0	25.4	27.6	30.6	0.886	18.7	20.4	22.5	24.4	27.1	30.2	32.9	36.3	39.5	43.8	1.99	2.16	2.39	2.60	2.88
Rancawaru	at road bridge	15.50	0.3826	13.5	800	669	131	0.0097	30.0	2.888	173.3	203.3	20.5	22.5	25.0	27.0	29.5	0.879	18.0	19.8	22.0	23.7	25.9	29.7	32.6	36.2	39.1	42.7	1.92	2.10	2.34	2.52	2.76
Rancapanjang	railway bridge	16.00	0.3826	14.5	800	666	134	0.0092	30.0	3.109	186.5	216.5	19.3	21.1	23.7	25.8	28.1	0.868	16.8	18.3	20.6	22.4	24.4	28.5	31.1	35.0	38.1	41.5	1.78	1.95	2.19	2.38	2.59
Tanggeung	before confl. of Cikijing	23.00	0.3826	19.0	800	665	135	0.0071	30.0	4.236	254.1	284.1	15.5	16.9	18.8	20.7	22.6	0.753	11.7	12.7	14.2	15.6	17.0	28.5	31.1	34.6	38.1	41.6	1.24	1.35	1.50	1.66	1.81
Tanggeung	Cikijing river	24.70	0.3826	10.5	700	665	35	0.0033	30.0	3.591	215.4	245.4	17.1	18.5	21.0	23.0	24.9	0.738	12.6	13.7	15.5	17.0	18.4	33.1	35.8	40.7	44.6	48.2	1.34	1.45	1.65	1.80	1.95
Tanggeung	after confl. of Cikijing	47.70	0.3826	19.0	800	665	135	0.0071	30.0	4.236	254.1	284.1	15.5	16.9	18.8	20.7	22.6	0.516	8.0	8.7	9.7	10.7	11.7	40.6	44.2	49.2	54.2	59.1	0.85	0.93	1.03	1.14	1.24
Langensari	before confl. of Citarik	48.00	0.3826	20.0	800	664	136	0.0068	30.0	4.482	268.9	298.9	15.1	16.4	18.3	20.2	22.0	0.513	7.7	8.4	9.4	10.4	11.3	39.5	42.9	47.9	52.8	57.5	0.82	0.89	1.00	1.10	1.20
4. Cikijing																																	
Cikijing	at road bridge	11.80	0.3826	3.0	700	673	27	0.0090	30.0	0.934	56.0	86.0	40.0	43.5	47.0	50.5	57.0	0.960	38.4	41.8	45.1	48.5	54.7	48.2	52.4	56.6	60.8	68.7	4.08	4.44	4.80	5.15	5.82
Rancakendar dua	railway bridge	17.00	0.3826	6.0	700	666	34	0.0057	30.0	1.902	114.1	144.1	26.6	29.0	32.3	35.0	38.2	0.846	22.5	24.5	27.3	29.6	32.3	40.7	44.3	49.4	53.5	58.4	2.39	2.61	2.90	3.15	3.43
Tanggeung	before confl. of Cimande	24.70	0.3826	10.5	700	665	35	0.0033	30.0	3.591	215.4	245.4	17.1	18.5	21.0	23.0	24.9	0.738	12.6	13.7	15.5	17.0	18.4	33.1	35.8	40.7	44.6	48.2	1.34	1.45	1.65	1.80	1.95

Source: 2007 D/D

Table 4.1.2.5 Required River Capacity for Tributaries by Rational Method (2)

River/Point		Catchment Area (km2)	Runoff Coefficient (2025)	Length (km)	Elevation (m) Highest	Elevation (m) at Point	Elevation (m) Difference	Average Slope	Time of Concentration Inlet (min)	Time of Concentration Travelling (hr)	Time of Concentration Travelling (min)	Time of Concentration Total (min)	Point Rainfall Intensity (mm/hr) 2-year	5-year	10-year	20-year	50-year	Area Reduction Rate	Area Rainfall Intensity (mm/hr) 2-year	5-year	10-year	20-year	50-year	Calculated Peak Discharge (m^3/s) 2-year	5-year	10-year	20-year	50-year	Specific Discharge ($m^3/s/km^2$) 2-year	5-year	10-year	20-year	50-year
5. Cikeruh																																	
Sirnagalih	at road bridge	57.00	0.3861	19.5	1,000	677	323	0.0166	30.0	3.120	187.2	217.2	19.3	21.1	23.7	25.8	28.1	0.410	7.9	8.7	9.7	10.6	11.5	48.4	52.9	59.4	64.7	70.5	0.85	0.93	1.04	1.14	1.24
Buahdua	before confl. of Cibeusi	58.00	0.3884	21.0	1,000	673	327	0.0156	30.0	3.382	202.9	232.9	18.1	19.7	22.1	24.1	26.1	0.399	7.2	7.9	8.8	9.6	10.4	45.2	49.2	55.2	60.2	65.1	0.78	0.85	0.95	1.04	1.12
Buahdua	Cibeusi river	10.80	0.5182	8.5	800	673	127	0.0149	30.0	1.713	102.8	132.8	28.3	31.1	34.3	37.0	40.9	0.982	27.8	30.6	33.7	36.3	40.2	43.2	47.5	52.4	56.5	62.5	4.00	4.40	4.85	5.23	5.78
Buahdua	after confl. of Cibeusi	68.80	0.4088	21.0	1,000	673	327	0.0156	30.0	3.382	202.9	232.9	18.1	19.7	22.1	24.1	26.1	0.334	6.0	6.6	7.4	8.1	8.7	47.2	51.4	57.7	62.9	68.1	0.69	0.75	0.84	0.91	0.99
Rancaekek Kulon	before confl. of right drain	69.80	0.4103	21.5	1,000	673	327	0.0152	30.0	3.475	208.5	238.5	17.7	19.3	21.6	23.6	25.6	0.332	5.9	6.4	7.2	7.8	8.5	46.7	50.9	57.0	62.3	67.5	0.67	0.73	0.82	0.89	0.97
irrigation weir	after confl. of right drain	105.60	0.4469	21.5	1,000	673	327	0.0152	30.0	3.475	208.5	238.5	17.7	19.3	21.6	23.6	25.6	0.245	4.3	4.7	5.3	5.8	6.3	56.8	62.0	69.4	75.8	82.2	0.54	0.59	0.66	0.72	0.78
Babakansinyal	Railway Bridge	106.10	0.4472	22.5	1,000	670	330	0.0147	30.0	3.650	219.0	249.0	16.8	18.1	20.6	22.3	24.5	0.244	4.1	4.4	5.0	5.4	6.0	54.0	58.2	66.3	71.7	78.8	0.51	0.55	0.62	0.68	0.74
Bugel	Irrigation Weir	110.10	0.4498	26.5	1,000	665	335	0.0126	30.0	4.384	263.0	293.0	15.3	16.6	18.5	20.4	22.3	0.236	3.6	3.9	4.4	4.8	5.3	49.7	53.9	60.1	66.2	72.4	0.45	0.49	0.55	0.60	0.66
Rancakamuning	before confl. of Cisaranten	111.11	0.4504	28.0	1,000	664	336	0.0120	30.0	4.666	280.0	310.0	14.9	16.1	17.9	19.8	21.6	0.234	3.5	3.8	4.2	4.6	5.1	48.5	52.4	58.2	64.4	70.3	0.44	0.47	0.52	0.58	0.63
Rancakamuning	Cisaranten river	67.49	0.4899	19.5	1,100	664	436	0.0224	30.0	2.779	166.8	196.8	21.2	23.1	25.5	27.5	30.7	0.337	7.2	7.8	8.6	9.3	10.4	65.7	71.6	79.0	85.2	95.1	0.97	1.06	1.17	1.26	1.41
Rancakamuning	after confl. of Cisaranten	178.60	0.4654	28.0	1,000	664	336	0.0120	30.0	4.666	280.0	310.0	14.9	16.1	17.9	19.8	21.6	0.200	3.0	3.2	3.6	4.0	4.3	68.8	74.3	82.7	91.4	99.7	0.39	0.42	0.46	0.51	0.56
Sapan	before confl. of Citarum	204.60	0.4657	30.0	1,000	663	337	0.0112	30.0	5.048	302.9	332.9	13.8	15.1	17.0	18.0	20.0	0.200	2.8	3.0	3.4	3.6	4.0	73.1	79.9	90.0	95.3	105.9	0.36	0.39	0.44	0.47	0.52
6. Cibeusi																																	
Sindangsari	at road bridge	9.10	0.5182	6.0	800	707	93	0.0155	30.0	1.291	77.5	107.5	34.0	36.5	40.0	42.0	48.0	1.000	34.0	36.5	40.0	42.0	48.0	44.5	47.8	52.4	55.0	62.9	4.89	5.25	5.76	6.05	6.91
Cipacing	at road bridge	10.30	0.5182	7.0	800	688	112	0.0160	30.0	1.436	86.2	116.2	32.0	33.9	38.0	40.7	45.5	0.993	31.8	33.7	37.7	40.4	45.2	47.1	49.9	56.0	59.9	67.0	4.58	4.85	5.43	5.82	6.51
Buahdua	before confl. of Cikeruh	10.80	0.5182	8.5	800	673	127	0.0149	30.0	1.713	102.8	132.8	28.3	31.1	34.3	37.0	40.9	0.982	27.8	30.6	33.7	36.3	40.2	43.2	47.5	52.4	56.5	62.5	4.00	4.40	4.85	5.23	5.78
7. Cisangkuy Upstream																																	
Kamasan	at road bridge	204.90	0.3836	19.0	1,600	669	931	0.0490	30.0	2.014	120.8	150.8	25.7	27.9	31.0	33.8	36.7	0.200	5.1	5.6	6.2	6.8	7.3	112.2	121.8	135.4	147.6	160.3	0.55	0.59	0.66	0.72	0.78
Waas	before confl. of Citalugtug	206.90	0.3836	22.0	1,600	666	934	0.0425	30.0	2.383	143.0	173.0	23.0	25.0	27.9	30.3	33.3	0.200	4.6	5.0	5.6	6.1	6.7	101.4	110.2	123.0	133.6	146.8	0.49	0.53	0.59	0.65	0.71
Waas	Citalugtug river	44.55	0.4164	11.0	1,000	674	326	0.0296	30.0	1.605	96.3	126.3	25.2	27.5	30.4	33.1	36.2	0.570	14.4	15.7	17.3	18.9	20.6	74.0	80.7	89.2	97.1	106.2	1.66	1.81	2.00	2.18	2.38
Waas	after confl. of Citalugtug	251.45	0.3894	22.0	1,600	666	934	0.0425	30.0	2.383	143.0	173.0	23.0	25.0	27.9	30.3	33.3	0.200	4.6	5.0	5.6	6.1	6.7	125.1	136.0	151.8	164.8	181.1	0.50	0.54	0.60	0.66	0.72
Rancaenggang	end of Stage-I work	252.45	0.3895	23.0	1,600	665	935	0.0407	30.0	2.507	150.4	180.4	22.8	24.7	27.4	29.5	32.8	0.200	4.6	4.9	5.5	5.9	6.6	124.6	134.9	149.7	161.2	179.2	0.49	0.53	0.59	0.64	0.71
Dayeuh Kolot	before confl. of Citarum	276.50	0.3919	29.5	1,600	658	942	0.0319	30.0	3.333	200.0	230.0	18.4	20.0	22.4	24.4	26.4	0.200	3.7	4.0	4.5	4.9	5.3	110.8	120.4	134.8	146.9	158.9	0.40	0.44	0.49	0.53	0.57
8. Citalugtug																																	
Cihamerang	before confl. of Cipeusing R.	21.90	0.4164	10.0	1,000	677	323	0.0323	30.0	1.442	86.5	116.5	32.0	33.9	38.0	40.7	45.5	0.763	24.4	25.9	29.0	31.1	34.7	61.8	65.5	73.4	78.7	87.9	2.82	2.99	3.35	3.59	4.02
Cihamerang	after confl. of Cipeusing R.	31.00	0.4164	10.0	1,000	677	323	0.0323	30.0	1.442	86.5	116.5	32.0	33.9	38.0	40.7	45.5	0.681	21.8	23.1	25.9	27.7	31.0	78.2	82.8	92.8	99.4	111.2	2.52	2.67	3.00	3.21	3.59
Banjaran	before confl. of Cibanjaran R.	31.80	0.4164	11.0	1,000	674	326	0.0296	30.0	1.605	96.3	126.3	29.7	32.7	35.7	38.7	42.7	0.674	20.0	22.0	24.1	26.1	28.8	73.7	81.1	88.5	96.0	105.9	2.32	2.55	2.78	3.02	3.33
Banjaran	Cibanjaran River	11.20	0.4164	11.5	1,000	674	326	0.0283	30.0	1.689	101.3	131.3	28.5	31.3	34.5	37.2	41.1	0.974	27.7	30.5	33.6	36.2	40.0	35.9	39.5	43.5	46.9	51.8	3.21	3.52	3.89	4.19	4.63
Banjaran	after confl. of Cibanjaran R.	43.00	0.4164	11.0	1,000	674	326	0.0296	30.0	1.605	96.3	126.3	29.7	32.7	35.7	38.7	42.7	0.570	16.9	18.6	20.3	22.0	24.3	84.1	92.6	101.1	109.6	121.0	1.96	2.15	2.35	2.55	2.81
Waas	before confl. of Cisangkuy	44.55	0.4164	14.0	1,000	666	334	0.0239	30.0	2.100	126.0	156.0	25.2	27.5	30.4	33.1	36.2	0.552	13.9	15.2	16.8	18.3	20.0	71.7	78.2	86.5	94.1	102.9	1.61	1.76	1.94	2.11	2.31
9. Ciputat																																	
Ciputat	before confl. of Citarum Main	1.38	0.5063	1.0	660	658	2	0.0020	30.0	0.000	0.0	30.0	79.0	85.0	93.0	99.0	110.0	1.000	79.0	85.0	93.0	99.0	110.0	15.3	16.5	18.0	19.2	21.3	11.11	11.95	13.08	13.92	15.47

Source: 2007 D/D

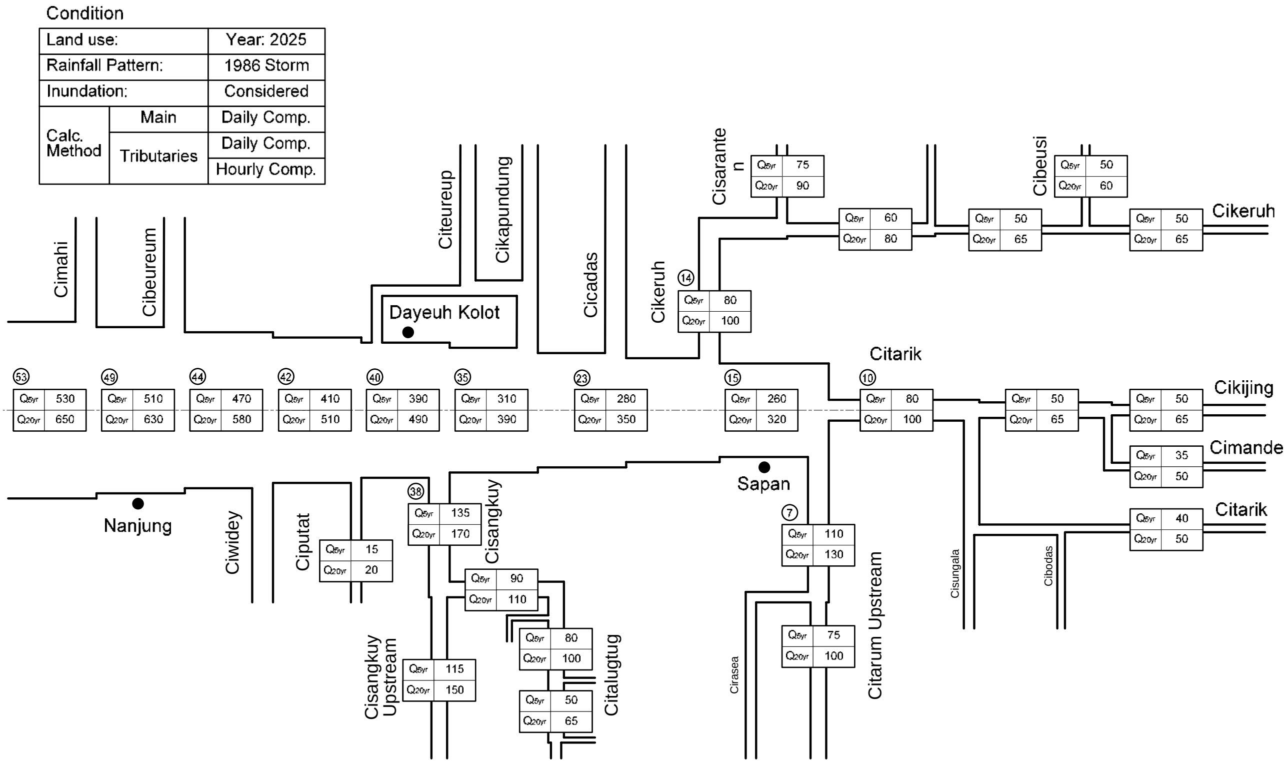
4.1.3. Design Discharge in 2007 D/D

The run-off discharges for 5-year return period floods are summarized in Table 4.1.3.1.

Table 4.1.3.1 Run-off Discharge in a 5-year Flood Frequency

Stream	Targeted River	Location	Design Discharge
1. Citarum Up.	Citarum Upstream	Kantren to Majalaya	75m^3/s
2. Cisangkuy	Cisangkuy	Rancaenggang to Kamasan	115m^3/s
	Citalugtug	Waas to Cileutik	90m^3/s
3. Citarik	Citarik Upstream	Bojong Gempol to Panenjoan	40m^3/s
4. Cimande	Cikijing	Tanggeung to Cikijing village	50m^3/s
	Cimande	Langensari to Rancapanjang	35m^3/s
5. Cikeruh	Cikeruh	Ranca Kamuning to Sirna Galih	50m^3/s
	Cibeusi	Buah Dua to Sindang Sari	50m^3/s
6. Ciputat	Ciputat	Bojongasih to Kulalet Hilir	15m^3/s

Source: 2007 D/D



Source: 2007 D/D

Figure 4.1.3.1 Discharge Distribution for Proposed River Improvement Works in 2007 D/D

4.1.4. Channel Improvement Plan

(1) Design River Alignment, Profile and Cross Section

Required items for river improvement works such as channel alignment, longitudinal profile and cross sectional profile are defined by the following concepts:

1) Channel Alignment

The proposed channel alignment basically follows the existing channel course except at the stretches with extreme meanders. The following factors are also considered important for design channel alignment if possible.

- Provision of smooth curves
- Reduction in house relocation numbers
- Utilization of existing facilities
- Space for inspection and maintenance (I/M) road

2) Longitudinal Profile

The basic factors for the design longitudinal profile are presented below:

- Design high water levels are set around the existing ground level.
- At the lower end point, the design high water level for the downstream section is applied as the initial water level.
- Longitudinal channel slope gradually becomes steep toward upstream sections.
- Elevations of existing major irrigation intake facilities are considered to sustain their function.
- Adequate clearance is considered on the existing road and railway bridges, which will still be available after channel improvement works.
- Design water depth is set as deep as possible to reduce the land acquisition area.

3) Cross-sectional Profile

The basic factors for the design cross-sectional profile are presented below.

- Cross sections are designed to convey the design discharge.
- Design cross sections are prepared within the area of future cross section of the long-term plan.
- A single cross section is applied.
- Bank slope of 1: 2 is applied principally, except in the stretches of densely built-up area where bank slopes of 1: 1 or 1: 0.5 are applied with revetment (bank protection works).
- Minimum bottom width is set at 3.5m considering the workability for construction.
- I/M road with a side drain is provided on both banks.

(2) Related Structures for River Improvement Plan

The proposed major river structures related to the river improvement works consist of bank protection, bridges, culverts for drainage, chutes/groundsill and irrigation weirs. The concept of each improvement work is described as follows, and lists of the works in each river are shown in Table 4.1.4.1.

1) Bank Protection

When executing river improvement works, bank protection will be provided. Installation locations are listed as follows:

- Where the river is extremely concave

- Where a bank slope of 1: 2 is not secured due to land acquisition
- Where the longitudinal profile of the river is too steep
- Where the river structures such as bridges, weirs, etc. will be newly provided.

2) Groundsill & Drop Works

Based on the adequate longitudinal profile of the rivers, groundsill and drop structures are to be provided in order to adjust and maintain the river bed slope. A concrete body will be applied to these structures because hydraulic forces, such as the hydraulic jump, are often used at this point. In order to protect the body while adjusting the roughness coefficient, a gabion will be placed around the main body of the structure.

3) Drainage by Box Culvert/Sluiceway

At present, many drainage channels for domestic water are installed in the rivers. Furthermore, in the river improvement plan, since the short cut method is applied to meandering rivers in order to secure smooth flow of the river, it is necessary provide some new drainage channels if the river is to be abandoned. Consequently, a box culvert used for drainage measures will be installed according to the required drainage capacity. The size of culvert/sluiceway will be from 1.00 x 0.80m to 2.50 x 2.50m dependent on the existing drainage capacity and bed elevation of the drainage channel/abandoned channel.

4) Bridges

Reinstallation of existing bridges will be required due to the enlargement of river cross section to secure the suitable river capacity. The bridges to be installed in the plan are: 1) road, 2) pedestrian and 3) inspection and maintenance road bridges. For pedestrian bridges, at present, two (2) types of bridges, temporary and permanent, have been prepared. In the plan, the temporary bridges should be reinstalled as permanent structures.

5) Irrigation Weirs

In the river to be improved, natural intake works have been installed for irrigation purposes. The usable water level will be lower due to the enlargement of the river cross section, so fixed weirs should be installed after considering the required water level for irrigation. To reduce construction costs, the location of the weirs will be toward the upstream in order to reduce the required weir height. H.W.L of the river will be higher due to these fixed weirs so the water level will be controlled by means of additional riverbanks.

(3) Proposed Construction Works for Stage (III) by 2007 D/D

The river improvement works including the Cikapundung diversion channel at Dayeuh Kolot consists of 1) the main excavation/dredging works, 2) river bank protection, 3) installation of groundsill and drop works, 4) installation of drain outlets, 5) bridge works and 6) reconstruction of irrigation facilities. The required major construction works are as follows:

Table 4.1.4.1 Proposed Construction Works for Stage (III) by 2007 D/D

River Name	Improved Distance	1. Bank Protection	2. Groundsill & Drop	3. Culvert & Sluice	4. Bridge			5. Irrigation Weir
					Road	Pedestrian	I/M Road	
1. Citarum Mainstream	20,260	0	0	0	0	0	0	0
2. Citarum Up.	5,450	4,760	2	29	0	4	0	0
3. Citarik	4,820	2,460	2	30	0	6	1	1
4. Cimande	9,580	1,775	6	35	3	3	1	1
5. Cikijing	6,680	1,745	5	22	3	4	0	1
6. Cikeruh	7,650	10,170	3	32	5	9	2	2
7. Cibeusi	1,360	2,665	7	8	1	0	0	0
8. Cisangkuy Up.	3,730	2,070	1	27	0	4	0	0
9. Citalugtug	4,050	6,240	4	29	1	9	1	0
10. Ciputat	660	240	1	5	1	2	0	0
11. Cikapundung DC	715	1,430	2	0	1	0	1	0
Total	64,955	33,555	33	217	15	41	6	5

Source: 2007 D/D

4.2. Hydrology and Hydraulic Analysis by SOBEK

4.2.1. Outline of SOBEK Model

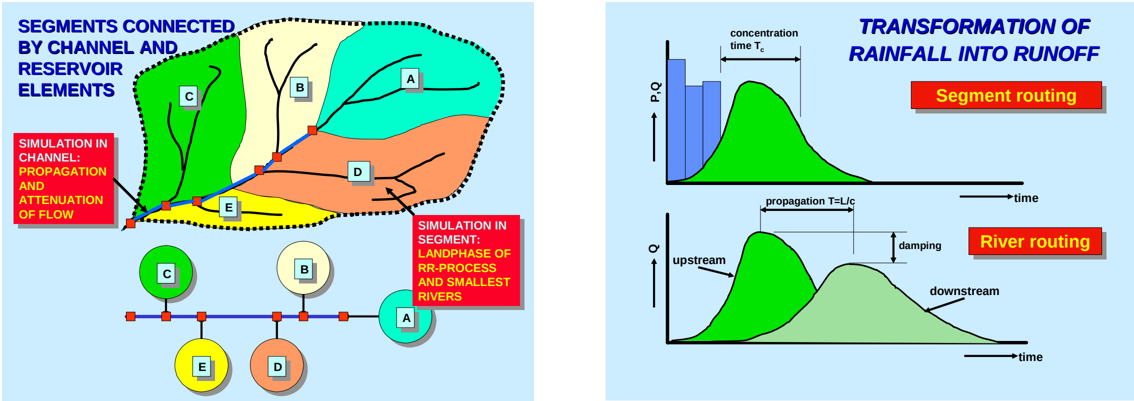
The SOBEK mathematical model developed by Deltares, Delft Hydraulics was used to simulate the river network of the Citarum River and its tributaries. SOBEK is an integrated software package for river, urban or rural management used for a comprehensive overview of waterway systems. SOBEK-Rural, used for modeling irrigation systems, drainage systems, natural streams in lowlands and hilly areas, was applied to set-up the river model network. It incorporates three modules: RR rainfall-runoff model, 1D and 1D2D hydraulic models.

(1) SOBEK RR

The Sacramento (sub-basin) model is used in the Upper Citarum Basin for transformation of rainfall into runoff in the basin. The use of a rainfall-runoff model is essential as rainfall is the starting point to arrive at homogeneous flow series for design. Historical flow series for the main stream cannot be used for design purposes directly in view of the many (natural and anthropogenic) changes in the runoff characteristics in the basin and in the layout and capacity of the hydraulic infrastructure.

1) Model structure

The application of the Sacramento model as integrated in the DELFT-1D modeling package is based on a semi-distributed approach. It implies that a catchment is divided into a number of segments, which are interconnected by channel reaches as shown in Figure 4.2.1.1.



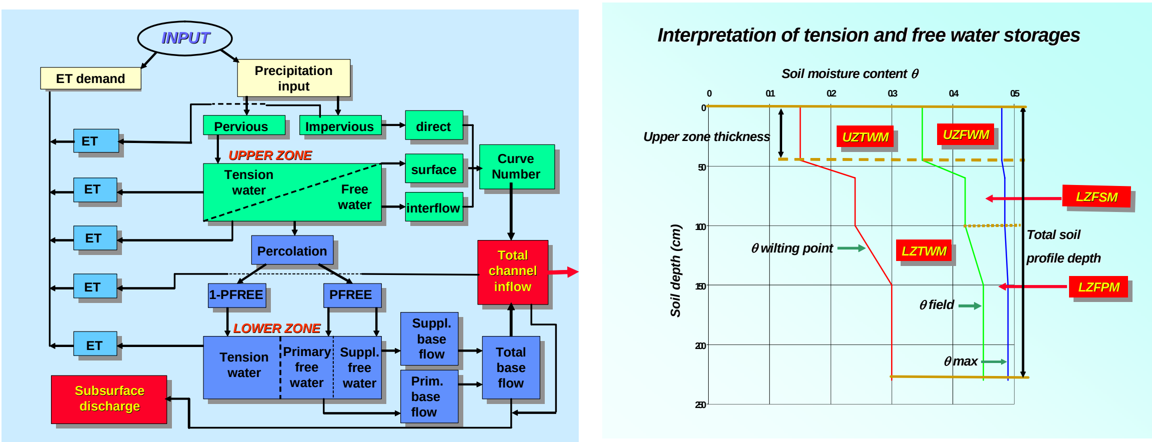
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.1 Semi-distributed Approach towards Rainfall Run-off Simulation and Segment and River Routing

In a segment, rainfall is transformed into runoff to the main river system. An explicit moisture accounting lumped parameter model is used to carry out the transformation. Important elements in the segment phase are the computation of the rainfall abstractions and the response time of the catchment to rainfall input, for which the time of concentration is an indicator. Within a segment, areal homogeneity of rainfall input and basin characteristics are assumed. The contributions of the segments to the main river are routed through the river network where the main features are travel time and flood wave damping. In the model for the Upper Citarum the Muskingum approach is used for the hydrological routing.

Basic data input requirements are basin characteristics (including area, slope, flow path length and land use) as well as time series of rainfall, evaporation and the observed runoff for comparison with calculated flows. Short interval time series of rainfall and runoff is required for calibration in view of the rapid response of the basin. All parameters and storage capacities must also be initially estimated on the basis of physical properties of the segment and the river system. Some then remain fixed whilst others are recommended for optimization.

The segment module simulates the rainfall-runoff process in part of the catchment, where the attention is on the land-phase of the rainfall-runoff process. It is assumed that the open water system in the segments contributes little to the shaping of the hydrograph. The processes represented in the segment module are schematically shown in Figure 4.2.1.2.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.2 Schematic of Segment Processes with Interpretation of Tension and Free Water Storage

From the connected impervious areas, precipitation immediately discharges to the channel. The pervious areas contain an upper and a lower zone. Both zones have a tension and a free water storage element. Tension water is considered as the water closely bound to soil particles. Generally, the tension water requirements are fulfilled before water enters the free water storage. The outflow from the free water lower zones comprises the base flow, simulated by linear reservoir outflows, with a slow and a fast component.

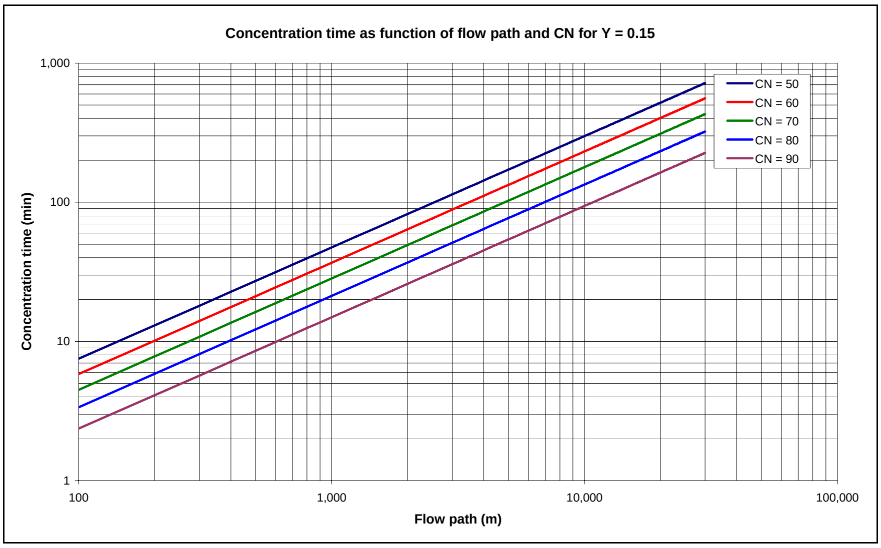
2) Shaping surface runoff

The Curve Number method is used in this case to model the surface runoff component in the model. The main model parameter that has to be determined through the Curve Number is the time of concentration tc (the time it takes for excess rainfall of the most remote point in the basin to contribute to the basin outflow). The concentration time is derived as a function of the basin length and slope and the Curve Number. The following formula applies:

$$t_c(\text{min}) = 100\frac{L^{0.8}\left(2{,}540 - 22.86CN\right)^{0.7}}{14{,}104CN^{0.7}\,Y^{0.5}} \qquad (4.1)$$

where, t_c: time of concentration (minutes), *L*: flow path (m), *CN*: SCS Curve Number (Refer to Table 4.2.1.1), *Y*: average sub-basin slope (m/m)

Note that this formula only gives a first estimate of the concentration time. It has to be obtained through concurrent field observations on rainfall and runoff.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.3 Concentration Time as Function of Flow Path Length for Selected Curve Numbers, Y=0.15

Curve Numbers (0 - 100) basically determine rainfall abstractions to surface runoff and are based on land use types, average soil groups and land treatment. The lower the losses to rainfall the higher the Curve Number is (e.g. National Engineering Handbook, Part 630 Hydrology, USDA, 1997). The values for the specific land use types are presented in Table 4.2.1.1. To translate the table values to the sub-basin, Curve Numbers area weighted averages have been applied.

Table 4.2.1.1 Assumed Relation between Land Use Type and Curve Number

Land use	CN	Land use	CN
Settlement	90	Irrigated rice	50
Bush	60	Rain fed rice	56
Estate	65	Grass	75
Dry crops	65	River/Lake	100
Forest	60	Swamp	60
Barren land	75		

Source: UCBFM, ICWRMIP, ADB (2010)

The time of concentration determines the unit hydrograph derived from the time-area diagram. Let the total fraction of the rainfall on a sub-basin that reaches the basin outlet in one, two,.., N time steps be denoted by I1, I2,…,IN for which (HEC-HMS, 2000):

$$I_{n\Delta t} = \sqrt{2}\left(\frac{n\Delta t}{t_c}\right)^{1.5} \qquad \text{for } n\Delta t \le 0.5t_c$$

$$I_{n\Delta t} = 1 - \sqrt{2}\left(1 - \frac{n\Delta t}{t_c}\right)^{1.5} \qquad \text{for } 0.5t_c \le n\Delta t \le t_c \qquad (4.2)$$

Note that for nΔt ≥ tc it follows InΔt = 1, i.e. the excess rainfall of the most remote point in the sub-basin has reached the sub-basin outlet. Hence, equation (4.2) describes the runoff of a sub-basin due to a continuous constant rain depth, the so-called S-curve. By taking the difference St - St-dt, that is the increment of the successive cumulative fractions of (4.2), the unit hydrograph ordinals are obtained, which add up to 1. The values and total number of ordinals depend on sub-catchment characteristics like land use (Curve Number), slope and flow path length as specified by equation (4.1). In large, flat catchments, the number of ordinals, N, will be relatively large as it will take some time before all runoff water reaches the outlet. For small, steep catchments, N will be small.

3) Hydrological flood routing

To route in the hydrological model of the segment output through the river system, the Muskingum routing technique is used. It translates and attenuates the segment output by means of two parameters K and x, where K stands for the channel lag time and x determines the degree of attenuation. The latter can assume values between 0.0 and 0.5, where x = 0.0 refers to maximum damping and x = 0.5 to pure translation. Generally, values of about 0.3 apply. The channel lag time is the quotient of channel length and flood wave celerity. The celerity is 5/3 the flow velocity for in-bank flow. When the flow goes over-bank, the celerity has to be multiplied by the ratio of river width / total width (= river + flood plain width) (assuming that flood plain velocities << main stream velocities). Hence, for over-bank the celerity will be reduced and a different set of K, x parameters apply. Such a layered approach is included in the flood routing module of DELFT-1D modeling package.

(2) SOBEK 1D

In this sub-section, the SOBEK 1D model, which forms the backbone of the Upper Citarum 1D2D model, is described. SOBEK 1D describes cross-sectional averaged flow in a network of open and closed channels. The SOBEK Rural version used in the modeling, is based upon the solution of the full de Saint Venant equations:

$$\begin{aligned} &\frac{\partial A_f}{\partial t} + \frac{\partial Q}{\partial x} = q_{lat} \\ &\frac{\partial Q}{\partial t} + \frac{\partial}{\partial x}\left(\frac{Q^2}{A_f}\right) + gA_f \frac{\partial \varsigma}{\partial x} + gA_f \frac{Q|Q|}{K^2} - W_f \frac{\tau_{wi}}{\rho_w} = 0 \end{aligned} \qquad (4.3)$$

where: A_f = wetted cross-sectional area, Q = discharge, q_{lat} = lateral discharge per unit length of channel, ς = water level above a horizontal reference plain, K = conveyance, g = gravitational acceleration, W_f = flow width, τ_{wi} = wind shear stress, ρ_w = density of water, x = position along channel axis, t = time

1) Numerical solution

In SOBEK, the numerical solution of the de Saint Venant equations is based upon an implicit formulation on a staggered numerical grid. This offers great advantages in the numerical stability and robustness, in particular through the time step controller implemented in the numerical algorithm. On the staggered grid the dependent variables Q and ζ are defined alternating at successive grid points along the x-axis. The staggered grid approach offers distinct advantages over non-staggered grids by guaranteeing the convergence of numerical solutions and the better ability to handle flooding and drying of grid sections.

2) Initial and boundary conditions

Boundary conditions in most practical applications comprise inflowing discharges specified at the upstream ends of channels entering the flood model domain and water levels or rating curves at outflow channels leaving the flood model domain. At internal boundaries, such as channel junctions, usually a modified continuity equation is applied, jointly with water level compatibility at all channel boundaries at that junction. SOBEK allows for the inclusion of meteorological effects, such as wind, precipitation and evapotranspiration. Rainfall can also be entered directly in the 1D model domains.

Initial data can be given as dry bed, water depth or water level. The model will adjust automatically to the correct initial state as a function of boundary data supplied. Water levels can also be specified along line elements in order to follow gradients along rivers and channels. A hot-start functionality is available allowing the continuation of a simulation from a previously computed state.

3) Cross-sections

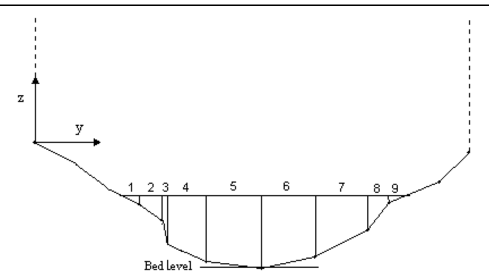
Of the various cross-section options available in SOBEK 1D, the y-z cross section has been used in the Upper Citarum model. This is a series of y-z co-ordinates that form a general profile. The total conveyance of the cross section is calculated by summing up the conveyances of all subsections as given in Figure 4.2.1.4. Conveyance is a quantity that represents the discharge capacity of a river for every water level. It combines the values for friction and hydraulic radius into one as follows:

$$K_i = A_i C_i \sqrt{R_i}$$
$$K = \sum_{i=1}^{n} K_i$$

(4.4)

where: Ki = conveyance of the subsection under the applying water depth and friction

i = subsection I, i=1,n, K = total conveyance of the cross-section, Ai = wetted area within the sub section under the applying water depth, Ci = Chèzy friction value under the applying water depth, Ri = Hydraulic radius under the applying water depth. i = the number of a subsection (counted from y=0), n = the number of subsections



y	z
0	0
0.6	-04
1.0	-09
1.4	-13
1.8	-16
1.9	-22
2.5	-26
3.3	-28
4.0	-25
4.8	-20
5.1	-13
5.9	-08
6.3	-02

Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.4 Y-Z Cross Section in SOBEK 1D with Sub-Sections

4) Weirs and gated structures

Weirs and gated structures have been modeled as an orifice as presented in the definition sketch in Figure 4.2.1.5.

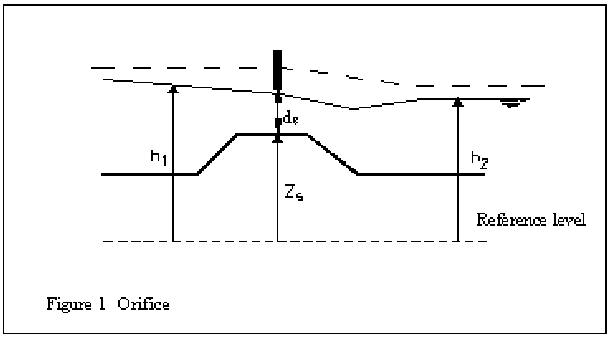


Figure 1 Orifice

Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.5 Definition Sketch of Weir or Gated Structure

Flow across the orifice can be of the following types: submerged weir flow, free weir flow, submerged orifice flow, free orifice flow or no flow (water levels below crest level or orifice closed) depending on the dimensions of the structure and the flow conditions. The Delft-scheme switches from one flow type to another without major transitional effects.

The following discharge equations and wetted areas are applied during the computations:

<u>Orifice</u>:

$$Q = c_w W_s \mu d_g \sqrt{2g(h_1 - h)} \quad \text{and:} \quad A_f = W_s \mu d_g$$

$$\text{free flow:} \quad h = z_s + \mu d_g \quad \text{condition:} \quad h_1 - z_s \geq \frac{3}{2} d_g \quad \text{and} \quad h_2 \leq z_s + d_g \tag{4.5}$$

$$\text{submerged flow:} \quad h = h_2 \quad \text{condition:} \quad h_1 - z_s \geq \frac{3}{2} d_g \quad \text{and} \quad h_2 > z_s + d_g$$

<u>Weir:</u>

$$\text{free flow:} \quad Q = c_w W_s \frac{2}{3}\sqrt{\frac{2}{3}g}(h_1 - z_s)^{3/2} \quad \text{and:} \quad A_f = W_s \frac{2}{3}(h_1 - z_s)$$

$$\text{subm. flow:} \; Q = c_e c_w A_f \sqrt{2g(h_1 - h_2)} \quad \text{and:} \quad A_f = W_s \left(h_1 - z_s - \frac{u_s^2}{2g} \right) \tag{4.6}$$

$$\text{conditions free flow:} \quad h_1 - z_s < \frac{3}{2} d_g \quad \text{and} \quad h_1 - z_s > \frac{3}{2}(h_2 - z_s)$$

$$\text{conditions subm. flow:} \quad h_1 - z_s < \frac{3}{2} d_g \quad \text{and} \quad h_2 - z_s \leq \frac{3}{2}(h_2 - z_s)$$

where: Q = discharge across orifice [m3/s], Af = wetted area [m2], μ = Contraction coefficient [-] default 0.63, cw = lateral contraction coefficient [-], Ws = crest width [m], dg = opening height [m] (opening level minus crest level), h1 = upstream water level [m], h2 = downstream water level [m], zs = crest level [m], us = velocity over crest [m/s]

5) Bridges

The energy losses due to abutment bridges have been modeled as:

$$Q = \mu A_f \sqrt{2g(h_1 - h_2)} \quad \text{with:} \quad \mu = (\xi_e + \xi_f + \xi_o)^{-0.5}$$
$$\xi_f = \frac{2gL}{C^2R}; \quad \xi_o = k\left(1 - \frac{A_f}{A_{f2}}\right)^2 \qquad (4.7)$$

where: Q = discharge through bridge [m3/s], μ = coefficient derived from loss-coefficients [-], Af = wetted area [m2] of flow through bridge at upstream side, Af2 = wetted area [m2] of flow in reach at downstream side of bridge, h1 = upstream water level [m], h2 = downstream water level [m], ξe ,ξf , ξo = entrance (constant), friction and exit loss coefficients

6) Hydraulic roughness

The Manning coefficient is used to compute the actual value of the Chèzy coefficient, by:

$$C = \frac{R^{1/6}}{n_m} \qquad (4.8)$$

Where: n_m = Manning coefficient [s/m$^{1/3}$]

7) Storage nodes

In SOBEK Rural version applied in this model, storage is not included in the cross-section Af in the continuity equation. Hence, storage nodes were added to simulate the 1D model storage sections. Storages are schematized by a level area relation.

(3) SOBEK 1D2D

1) 2D modeling

The two-dimensional (2D) shallow water equations applied in SOBEK are given below:

$$\frac{\partial h}{\partial t} + \frac{\partial\,(uh)}{\partial x} + \frac{\partial\,(vh)}{\partial y} = 0$$

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + g\frac{\partial(h+z_b)}{\partial x} + c_f\frac{u\sqrt{u^2+v^2}}{h} = 0 \qquad (4.9)$$

$$\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + g\frac{\partial(h+z_b)}{\partial y} + c_f\frac{v\sqrt{u^2+v^2}}{h} = 0$$

where u and v are the flow velocities in x and y direction. It should be noted that in 2D, the only model parameter is the friction term cf. A good choice of this parameter and accurate digital elevation model (DEM) are needed to obtain the correct results of 2D models.

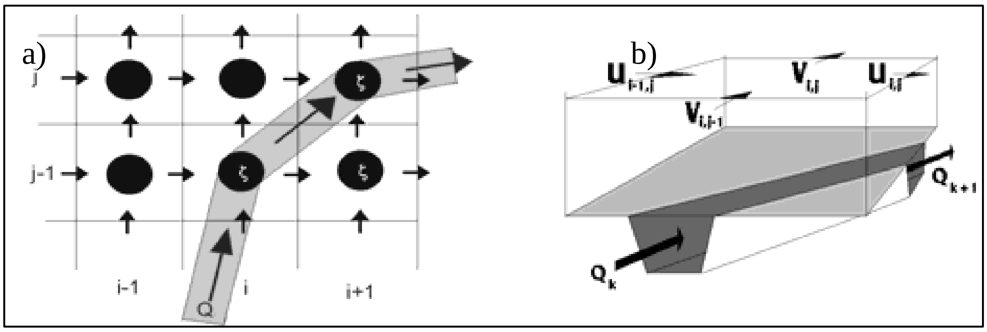
For combinations of narrow channels and wide flood plains, a full 2D approach is not generally applied, as the narrow channels would require a very narrow grid in 2D for accurate simulations. In such cases, a combination of 1D for the channels and 2D for the flood plain is required as described in 1D2D modeling.

2) 1D2D modeling

In flood modelling, there are numerous practical examples where flows are best described by combinations of 1D and 2D schematizations. An obvious example is the flooding of flood plains, often characterized by a flat topography with complex networks of natural levees, polder dikes, drainage channels, elevated roads and railways and a large variety of hydraulic structures. The SOBEK-1D2D system is designed for the simulation of overland flooding or inundation. In normal conditions (in case of no flooding) the hydraulic infrastructure can be modelled as a one-dimensional (1D) network. If large areas are inundated then assumptions for 1D flow are normally no longer valid. In that case the system becomes truly two-dimensional (2D).

The computational domain is divided into a 1D network, with general sections of arbitrary shapes, and a 2D system with rectangular computational cells. The 1D network and 2D system are implicitly coupled and solved simultaneously based upon the momentum balance and the conservation of mass between separate computational layers.

For the momentum balance the 1D and the 2D system remain strictly separated. For the conservation of mass, being a scalar quantity, the appropriate 1D and 2D volumes are combined so that they share the same water level.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.1.6 Schematization of the Hydraulic Model: a) Combined 1D/2D Staggered Grid; b) Combined Finite Mass Volume for 1D/2D Computations

Both the 1D and the 2D computational layers have finite difference formulations for volume and momentum equations, based upon the staggered grid approach. In other words, the finite volume approach is applied, the momentum volumes are different from the mass volumes, and there exists no interaction between the 1D and the 2D momentum volumes. This means that vertical velocities and shear stress interaction between 1D flow and 2D flow are neglected. For each momentum volume the following law is applied:

Rate of change of momentum + transport of momentum +
integrated hydrostatic pressure + friction-losses=0. (4.10)

The numerical implementation is such that in the vicinity of steep gradients proper shock conditions are being fulfilled, both for 1D and 2D volumes. The interaction between the 1D and the 2D part takes place via mutual volumes, see Figure 4.2.1.6. For mutual 1D/2D mass volumes the following equation is solved:

$$\frac{dV_{i,j}(\zeta)}{dt} + \Delta y\left((uh)_{i,j} - (uh)_{i-1,j}\right) + \Delta x\left((vh)_{i,j} - (vh)_{i,j-1}\right) + \sum_{l=K_{i,j}^{1}}^{l=K_{i,j}^{L_{i,j}}} (Q_n)_l = 0. \qquad (4.11)$$

where: V = combined 1D/2D volume; u = velocity in x direction; v = velocity in y direction; h = total water height above 2D bottom; ζ = water level above plane of reference (the same for 1D and 2D); Δx = 2D grid size in x (or i) direction; Δy = 2D grid size in y (or j) direction; Qn = discharge in the direction normal to the mass volume faces; i, j, l, K, L = integer numbers for nodal point numbering.

For Figure 4.2.1.6, equation (4.11) becomes:

$$\frac{dV_{i,j}(\zeta)}{dt} + \Delta y\left((uh)_{i,j} - (uh)_{i-1,j}\right) + \Delta x\left((vh)_{i,j} - (vh)_{i,j-1}\right) + Q_{k+1} - Q_k = 0. \qquad (4.12)$$

After discretisation in time by the "method" the velocities are eliminated by substitution of the momentum equations into the continuity equation. The resulting system is linear for purely 2D volumes, but if a 1D part is involved the equation might be non-linear with respect to the volume V(ζ). This is solved by Newton iteration. The resulting linearised equations, per Newton iteration step, are positive definite and symmetric. The method used for the solution is a combination of the so-called "minimum degree algorithm" and of the pre-conditioned CG (conjugate gradient).

The continuity equation is discretised in a way that excludes the possibility of negative volumes. This allows for very efficient and also realistic flooding of dry beds when the 1D rivers are flooding their 2D surroundings. In normal conditions, i.e. if there is no flooding, the 2D part is not activated. This means that in equation (4.11) the uh and vh values are supposed to be zero.

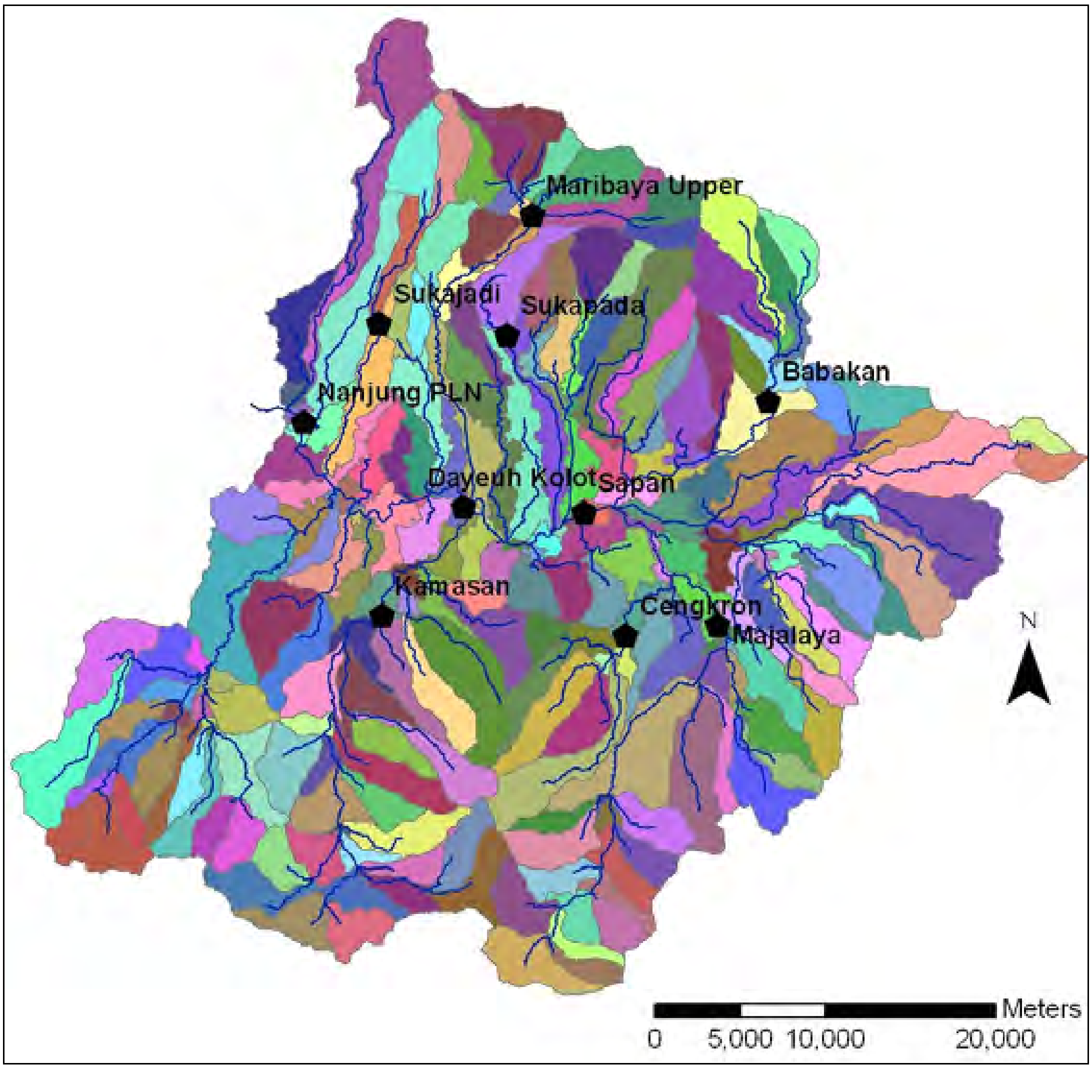
4.2.2. Design Conditions

The Citarum River Basin and channel network is set-up in a schematization of the SOBEK model as given below.

(1) Sub-catchment delineation

The analysis of the hydrological network has been carried out with ArcHydro 1.3 in ArcGIS 9.3 and was based on the SRTM 30 x 30m DEM of 2000. The ArcHydro function DEM Reconditioning has been used to ensure that the flow directions in the DEM follow the stream network. The stream network consists of selected streams from the topographical map combined with the riverbed of the Citarum after its normalization. The sub-catchment delineation was done by ArcHydro using the function of flow accumulation that consists the items of stream definition, stream segmentation, catchment grid delineation, catchment polygon processing, drainage line processing and drainage point processing.

The basin has been divided into 258 segments or sub-basins as shown in Figure 4.2.2.1.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.2.1 Layout of Upper Citarum Basin with Sub-division in Segments

The catchment basin was divided into several sub-basins (clusters) following the stream network as given below. Rainfall analysis was done separately on a cluster basis.

- Cluster 1: Citarum upstream of Majalaya
- Cluster 2: Cirasea at mouth
- Cluster 3: Citarik at mouth
- Cluster 4: Cikeruh at mouth
- Cluster 5: Basin of Citarum upstream at Sapan, including Clusters 1 to 4
- Cluster 6: Basin draining north of Citarum between Cikeruh mouth and Dayeuh Kolot, indicated as Cidurian-Cikapundung
- Cluster 7: Cisangkuy at mouth
- Cluster 8: Basin draining north of Citarum between Dayeuh Kolot and Nanjung, indicated as Citepus-Cibeureum
- Cluster 9: Ciwidey at mouth
- Cluster 10: Whole basin of Citarum upstream of Saguling reservoir, indicated as Citarum at Nanjung.

The cluster areas are presented in Table 4.2.2.1.

Table 4.2.2.1 Cluster Areas

Cluster	Area (km^2)	Cluster	Area (km^2)
1: u/s Majalaya	213.8	6: Cidurian-Cikapundung	236.0
2: Cirasea	92.9	7: Cisangkuy	282.9
3: Citarik	269.7	8: Citepus-Cibeureum	152.3
4: Cikeruh	112.4	9: Ciwidey	217.9
5: Basin of Citarum at Sapan including Cluster 1 to 4	699.5	10: Whole basin of Citarum at Nanjung	1,827.1

Source: UCBFM, ICWRMIP, ADB (2010)

(2) Sub-catchment hydrological parameters

1) Sacramento model parameters

For this hydrological model, one set of sub-surface parameters has been assumed for the Bandung basin. The surface runoff and routing parameters very spatially based on land use and channel flow characteristics. An overview of the Sacramento parameters of the Bandung basin optimized for reproduction of peak discharges in Citarum at Nanjung is presented in Table 4.2.2.2.

Table 4.2.2.2 Sacramento Parameter Optimized for Bandung Basin

Parameter	Value	Parameter	Value
Upper Zone		**Infiltration**	
uztm	84 mm	zperc	5.0
uzfwm	116 mm	rexp	2
uzk	0.20	pfree	0.3
Lower Zone		**Surface runoff**	
lztwm	150 mm	pctim	0.0
lzfsm	100 mm	adimp	0.2
lzsk	0.05	**Additional**	
lzfpm	150 mm	sarva	0.0125
lzpk	0.003	side	0.0
		ssout	0.0

Source: UCBFM, ICWRMIP, ADB (2010)

2) Muskingum routing parameters

The routing links use the Muskingum method to account for travel time and storage in the links. For the Citarum River, two layers are used with the second layer describing the reduced celenity when the riverbanks are flooded. Imput parameters for each layer are the calculation time step, a dimensionless parameter x and parameter K representing the travel time through the link.

(3) 1D Hydraulic model parameters

1) Hydraulic roughness

For the hydraulic roughness in the 1D model for all branches, a Manning value of nm=0.03 has been applied. This value was obtained from experience with model runs for extrapolation of rating curves at Majalaya and Kamasan and calibration of the model for Nanjung in 2002, 2005 and 2010.

With respect to the model runs made for discharge rating curve extrapolation, the Manning value was varied between 0.025 and 0.035. It was found that when running the model with a Manning value of 0.03, the shape of the observed part of the discharge rating could best be reproduced.

2) List of reach of river cross-sections

The river cross section and structure data were collected from various government agencies. The existing condition of the main channel from Nanjung to Sapan was recently surveyed by the Provincial Water Resources Agency in Bandung. It is the latest data available and was incorporated in the model set up for the existing condition.

For other simulation conditions, JICA design cross sections, measured during the previous designs at Stage (I), (II) and proposed Stage (III) design, were used as necessary to update the model framework. The sources of river cross section data available are summarized below.

Table 4.2.2.3 Cross Sections Availability and Its Case

River	Authority	To Constructior		Design (2)		After Constructed (3)		Current Situation (4)		CASES					
		Year	XS	Year	XS	Year	XS	Year	XS	1986	2002	2005	2010	DESIGN	ASBUILD
Citarum	BBWS Citarum	1996	20	1996	20					1					
Citarum	BBWS Citarum	1994	6	1994						1					
Citarum	BBWS Citarum	1996	16	1996						1					
Citarum	BBWS Citarum	1996	12	1996						1					
Citarum	BBWS Citarum	1998	8	1998						1					
Cisangkuy	BBWS Citarum	1998	13	1998						1					
Citarum	BBWS Citarum	1999	20	1999						1					
Citarum - Cikeruh - Citarik	BBWS Citarum	1999	36	1999											
Citarum	BBWS Citarum	1999	13	1999											
Citarum	BBWS Citarum	2003	15	2003											
Citarik	BBWS Citarum			2003		2003	148						3		
Citarik	BBWS Citarum			2004		2004	138						3		
Cisaranten	BBWS Citarum			2004		2004	114						3		
Cisaranten	BBWS Citarum	2006	19	2006		2006	19						3		
Citarum	BBWS Citarum			2007		2007	254								3
Citarum	BBWS Citarum			2007		2007	158								3
Citarum - Majalaya	BBWS Citarum			2007											
Cisangkuy - Kamasan	BBWS Citarum	2007	53	2007									1	2	
Citalugtug	BBWS Citarum	2007	118	2007									1	2	
Ciputat	BBWS Citarum	2007	24	2007									1	2	
Citarik	BBWS Citarum	2007	248	2007									1	2	
Cikeruh	BBWS Citarum	2007	183	2007									1	2	
Cibeusi	BBWS Citarum	2007	53	2007									1	2	
Cimande	BBWS Citarum	2007	215	2007									1	2	
Cikijing	BBWS Citarum	2007	140	2007									1	2	
Cipamokolan	BBWS Citarum							1999	6						
Cikapundung Kolot	BBWS Citarum							1999	12						
Citarum	Dinas PSDA Jabar							2005	55			4			
Cibeureum	Dinas PSDA Jabar							2005	11			4			
Cibeusi	Dinas PSDA Jabar							2005	10			4			
Cicadas	Dinas PSDA Jabar							2005	14			4			
Cikeruh	Dinas PSDA Jabar							2005	23			4			
Cikeruh Lama	Dinas PSDA Jabar							2005	9			4			
Cimande	Dinas PSDA Jabar							2005	47			4			
Cipamokolan	Dinas PSDA Jabar							2005	17			4			
Cirasea	Dinas PSDA Jabar							2005	25			4			
Cisangkuy	Dinas PSDA Jabar							2005	15			4			
Citepus	Dinas PSDA Jabar							2005	12			4			
Ciwidey	Dinas PSDA Jabar							2005	14			4			
Citarik	Dinas PSDA Jabar							2005	74			4			
Cidurian	Dinas PSDA Jabar							2005	8			4			
Cikapundung	Dinas PSDA Jabar							2005	23			4			
Citarum	Dinas PSDA Jabar							2009				4			
Cirasea	Dinas PSDA Jabar							2006	30			4			
Cikoneng	Dinas PSDA Jabar							2006	17			4			
Cibeureum	Dinas PSDA Jabar							2007	17			4			
Citarum	PUSAIR							2009	752				4		
Citarum - Majalaya	PUSAIR							2010	114				4		
			1212		20		831		1305						

Source: UCBFM, ICWRMIP, ADB (2010)

3) List of storage nodes

Since the cross-sections in the river network in the SOBEK 1D version used in the project contain only conveying sections without storage, storage nodes has been added to simulate the flood plain storage. For each node a storage curve has been developed. The SOBEK channel flow network was cut in 1000 m line sections and subsequently converted to points to obtain the location of the storage nodes used in SOBEK 1D. Storage was calculated for each storage node using sub-catchments derived from the DEM.

(4) 1D2D Hydraulic model parameters

1) Spatial distribution of hydraulic roughness in the flood plains

The land use map used for setting up the hydrological schematization is also used to spatially distribute the roughness coefficients for the DEM. Whenever a land use type has an area greater than 1% of the total area, a DEM land use type is specified.

Table 4.2.2.4 Classification of Land Use Type

Land use type	Area (ha)	Percentage of total area	DEM land use type
Barren land	**197.7**	**0.5%**	**Other**
Bush	1,656.2	4.6%	Bush
Dry crops	284.6	0.8%	Other
Estate	50.4	0.1%	Settlement
Forest	0.0	0.0%	Other
Grass	136.0	0.4%	Other
Rice Irrigation	21,728.2	59.8%	Rice Irrigation
River/Lake	379.6	1.0%	-
Settlement	11,879.8	32.7%	Settlement
Swamp	10.9	0.0%	Other
Total	**36,323.2**	**100.0%**	

Source: UCBFM, ICWRMIP, ADB (2010)

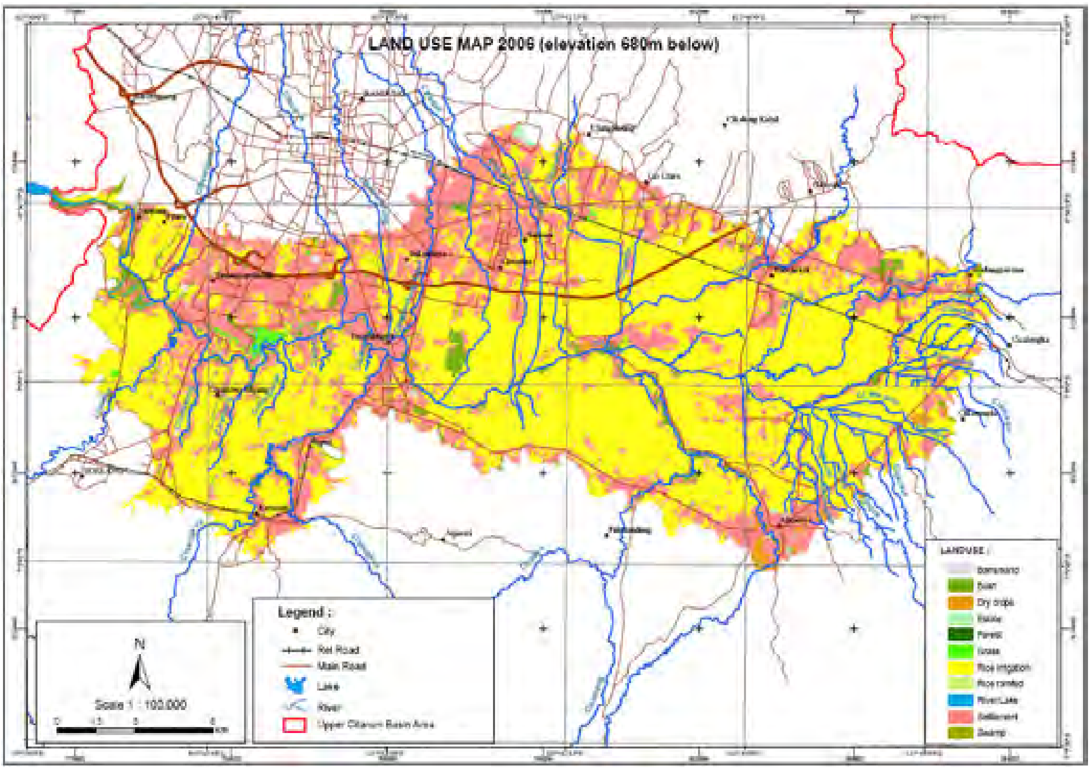
The Nikuradse roughness coefficients (kn) are derived from land use - roughness coefficients research in the Netherlands (Van Velzen et. al., 2003) and, where necessary, adjusted to the local situation in the Upper Citarum basin. The grid representing roughness coefficients has the same cell size as the DEM, i.e. 100m x 100m. In the model the kn–values are used in the White-Colebrook formula relating kn and the Chézy coefficient as a function of the water depth.

Table 4.2.2.5 Roughness Coefficients for Land Use Types Occurring in the Flood Prone Area

DEM land use type	Percentage of total area	Roughness coefficient (k_n)
Bush	4.6%	0.5
Settlement	**32.8%**	**1.0**
Rice Irrigation	59.8%	0.4
Other	2.8%	0.2
Total	100.0%	

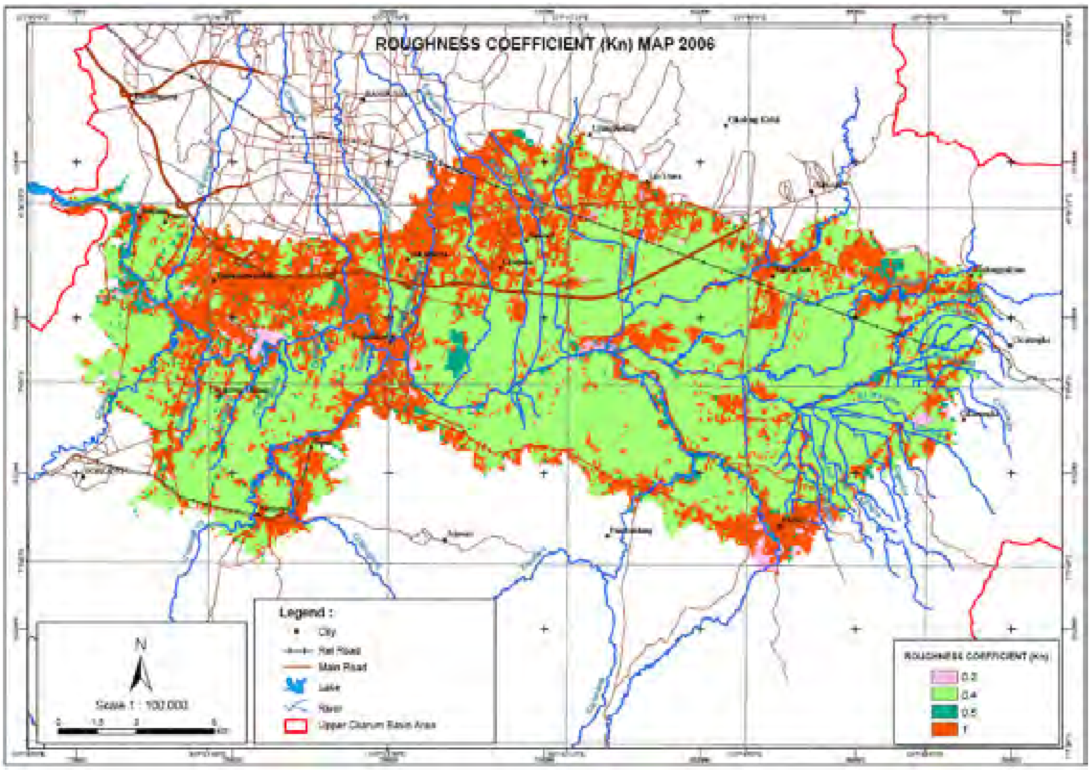
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.9 shows the land use types in the DEM area, and Figure 4.10 shows the spatial distributed roughness coefficient as used in the 1D2D hydrodynamic simulations.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.2.2 Land Use in the DEM Area of 1D2D Model



Source: UCBFM, ICWRMIP, ADB (2010)

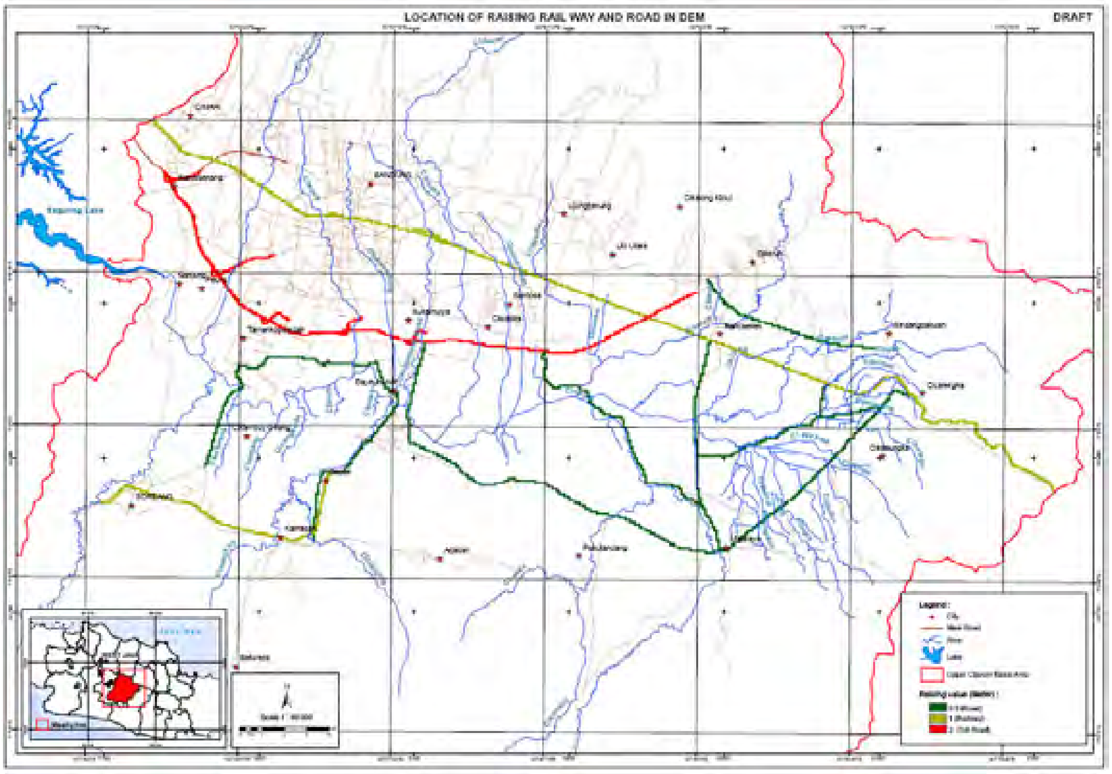
Figure 4.2.2.3 Roughness Coefficients kn based on Reclassified Land Use Map

2) Introduction of line elements in DEM

In the field, elevated line elements like roads and railways will influence the distribution of the flood waters. It is represented by a line element with a relative height. This relative lift is added to the DEM grid cell value, thus creating a heightened line element in the DEM. In the project three types of line elements were distinguished:

1. Roads
2. Railways
3. Highways

Based on the information collected from field visits, a rise between 0.5m and 2m was assumed, as shown in Figure 4.2.2.4.

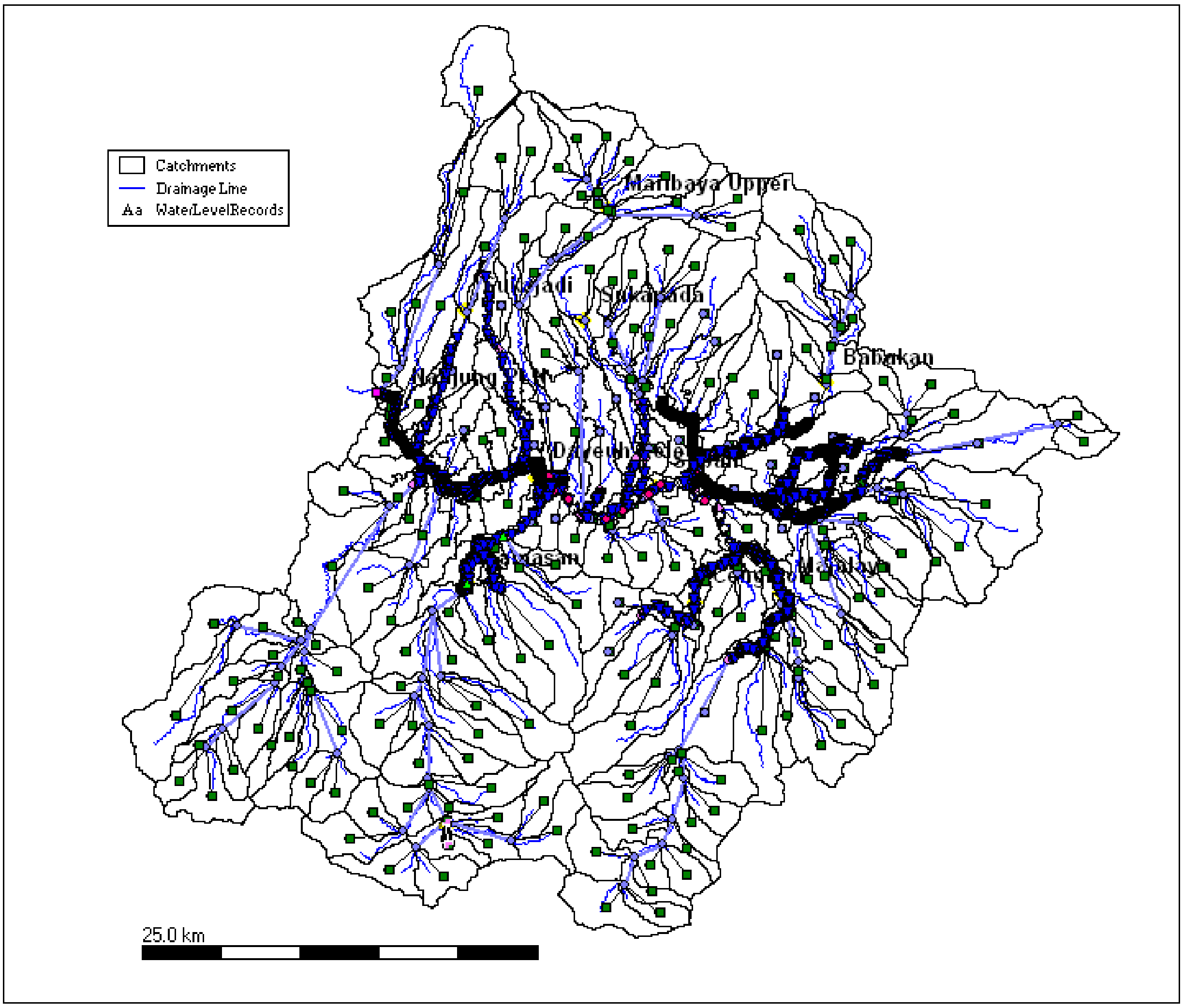


Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.2.4 Rise of Line Elements in the DEM

(5) Model Schematization

The basin has been divided into 258 sub-catchments and river network is represented by a large number of cross sections and hydraulic infrastructures such as bridges, weirs etc. as explained above. In 1D model, storage nodes are connected to the channel at approximately 1,000m intervals. In 1D2D model, storage nodes were replaced by DEM with topographic data. The upstream boundary conditions to the hydrodynamic model are the linked run-off discharges of sub-catchments through rainfall-runoff process. The downstream boundary condition is the fixed water level at the stable rocky downstream station, Nanjung. The schematic view of model is given in Figure 4.2.2.5.



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.2.5 Schematization of SOBEK Model

4.2.3. Output of SOBEK Model

This chapter describes the calibration and verification of the combined hydrological-hydraulic model for the Upper Citarum Basin upstream of Nanjung. The first model framework was set up based on existing river cross sections. In the Citarum Basin, the only reliable and stable gauging station is Nanjung with availability of rating curves. Therefore, model calibration and verification was possible only at Nanjung for both discharge and water level and at Dayeuh Kolot and Sapan only for water levels.

The months January to March of 2002 and 2005 have been selected for calibration and verification as in these months, the Citarum discharge in Nanjung was large and the data availability was sufficient with respect to hydrological boundary conditions and river cross-sectional data. A final verification of the model was done on a simulation of the floods of February-March 2010. The performance of the 1D2D hydraulic model has been verified on the observed 2010 mainstream water levels.

The stations with hourly and daily rainfall data available during the calibration and verification periods are given in the Table 4.2.3.1 and Table 4.2.3.2. During the flooding periods of 2002, 2005 and

2010, 5-day basin average rainfalls at upstream Nanjung were 88mm (08/03/2002 - 12/03/2002), 118mm (19/02/2005 - 23/02/2005) and 132mm (18/03/2010 - 22/03/2010). The spatial coverage of hourly rainfall stations was not high due to limited number of hourly rainfall stations. After careful data validation, daily rainfall series were disaggregated by hour assuming the mean Bandung hourly distribution. Then, for each of the 258 sub-catchments in the model, hourly precipitation series were generated using the Thiessen interpolation method.

Table 4.2.3.1 Overview of Stations with Hourly Data for Calibration and Verification

2002	2005	2010
Bandung Dago_PLN	Bandung Dago_PLN	Bandung Cemara_BMKG
Chinchona_PLN	Chinchona_PLN	Lembang_BMKG
Cicalengka_PLN	Cicalengka_PLN	Cicalengka_PLN
Ciparay_PLN	Ciparay_PLN	Ciparay_PLN
Cisondari_PLN	Cisondari_PLN	Dampit_PusAir
Montaya_PLN	Montaya_PLN	Ciparay_ PusAir
Paseh_PLN	Paseh_PLN	Bandung_ PusAir
Saguling dam_PLN	Saguling dam_PLN	Cipadung_ PusAir
Sukawana_PLN	Sukawana_PLN	
Ujujng Berung_PLN	Ujujng Berung_PLN	

Source: UCBFM, ICWRMIP, ADB (2010)

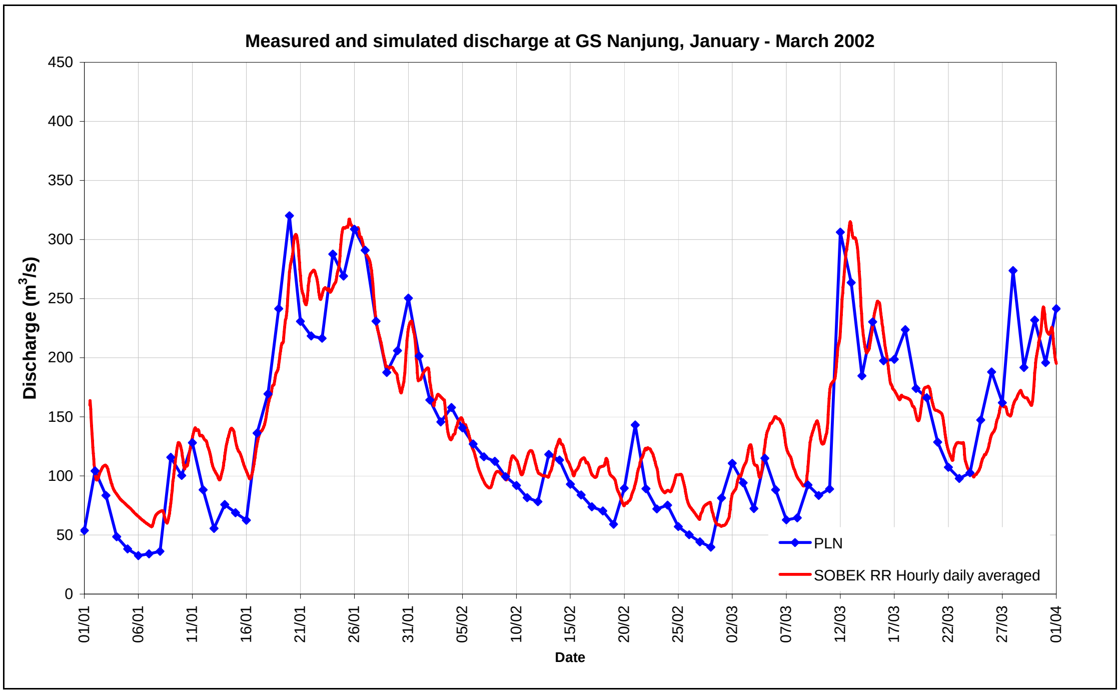
Table 4.2.3.2 Overview of Stations with Daily Rainfall Data for Calibration and Verification

2002	2005	2010	
Baleendah_BMKG	Baleendah_BMKG	Baleendah_BMKG	Cililin_PLN
Bandung_PLN	Bandung_PLN	Bandung_PLN	Montaya_BMKG
Cibeureum_BMKG	Cibeureum_BMKG	-	Cileunyi_BMKG
Cipanas(Pangalengan)_IHE	Cipanas(Pangalengan)_IHE	-	Soreang Indah_BMKG
Bandung (Cipaganti)_BMKG	Bandung (Cipaganti)_BMKG	Bandung (Cemara)_BMKG	Bandung_PusAir
Ciparay_BMKG	Ciparay_BMKG	-	Cipadung_PusAir
Ciwidey_BMKG	Ciwidey_BMKG	-	Ciparay_PusAir
Gambung_BMKG	Gambung_BMKG	-	Dampit_PusAir
Jatinangor (Perk)_BMKG	Jatinangor (Perk)_BMKG	-	Cicalengk _DINAS
Lembang (Meteo)_BMKG	Lembang (Meteo)_BMKG	Lembang (Pencut)_BMKG	Cidadan (Montaya)_DINAS
-	Majalaya_BMKG	-	Cileunca_DINAS
Malabar (Perk)_BMKG	Malabar (Perk)_BMKG	Malabar_BMKG	Ciluluk_DINAS
-	Pakar Dago_BMKG	Pakar Dago_BMKG	Cipanas_DINAS
Margahayu 2_BMKG	-	-	Cipeusing_DINAS
Padalarang_BMKG	-	-	Cisondai_DINAS
Pangalengan_BMKG	Pangalengan_BMKG	Padalarang_BMKG	Cisurupan_DINAS
Paseh_PLN	Paseh_PLN	Paseh_PLN	Jatiroke_DINAS
Chinchona_PLN	Chinchona_PLN	Chinchona_PLN	Kayu Ambon_DINAS
Cicalengka_PLN	Cicalengka_PLN	Cicalengka_PLN	Kertamanah_DINAS
Ciparay_PLN	Ciparay_PLN	Ciparay_PLN	Margahayu_DINAS
Cisondari_PLN	Cisondari_PLN	Cisondari_PLN	Paseh_DINAS
Saguling Dam_PLN	Saguling Dam_PLN	Saguling Dam_PLN	PCH_Ciherang_DINAS
Sukawana_PLN	Sukawana_PLN	Sukawana_PLN	
Ujung Berung_PLN	Ujung Berung_PLN	Ujung Berung_PLN	
Situraja_BMKG	Situraja_BMKG	-	
Tanjungsari_BMKG	Tanjungsari_BMKG	Tanjungsari_BMKG	

Source: UCBFM, ICWRMIP, ADB (2010)

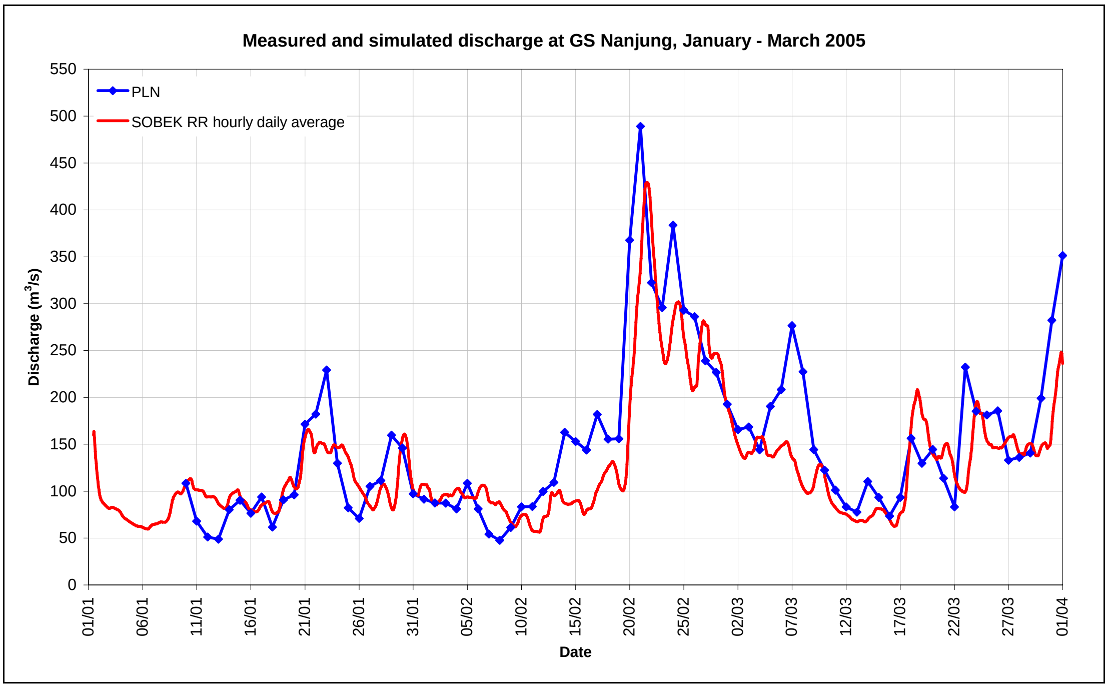
The calibration result of the hydrological-hydraulic model for the period of January to March 2002 at Nanjung is given in Figure 4.2.3.1 and the model has been verified at Nanjung for the period January-March 2005 as shown in Figure 4.2.3.2.

The 1D model performance for 2010 has also been verified on the observed water levels at Sapan, Dayeuh Kolot and Nanjung and the discharge at Nanjung. In this analysis, an additional comparison is made with the results of the 1D2D model, subjected to the same boundary conditions. The main difference between the two models is that in the 1D2D model, the 1D storage nodes have been removed and replaced by the 2D model for the flood plain based on the available DEM. Results are shown in Figures 4.2.3.3 to Figure 4.2.3.10.



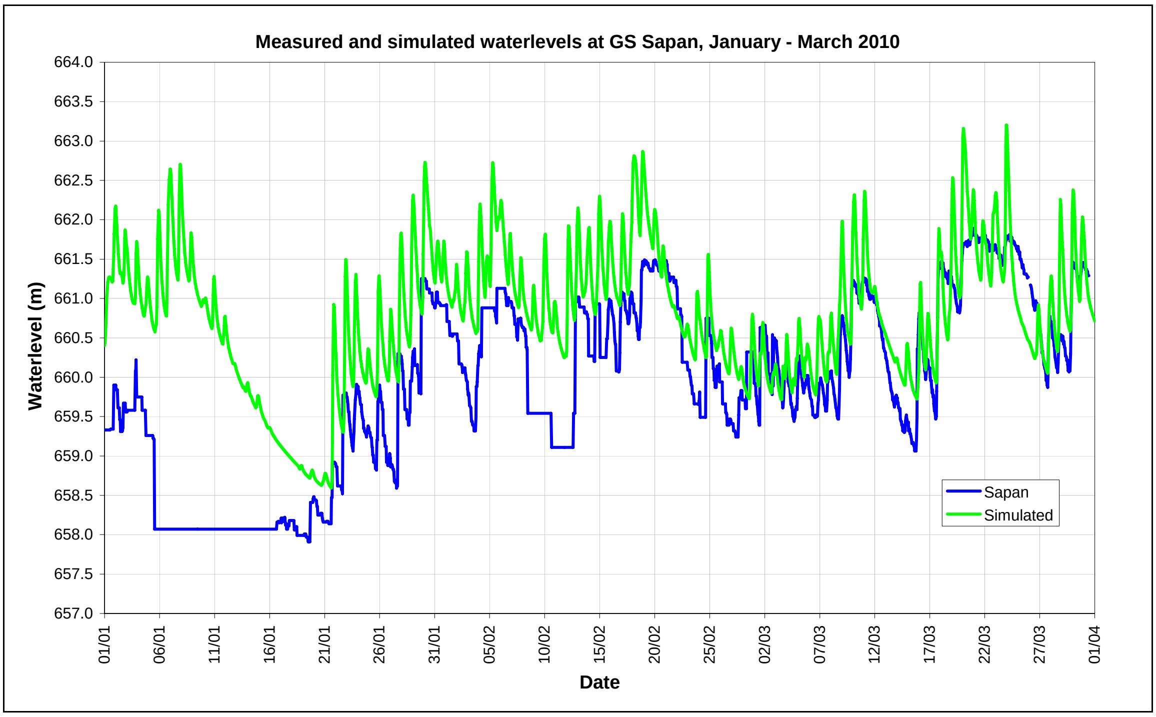
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.1 Comparison of Observed and Simulated Daily Discharge at Nanjung, Jan-Mar. 2002



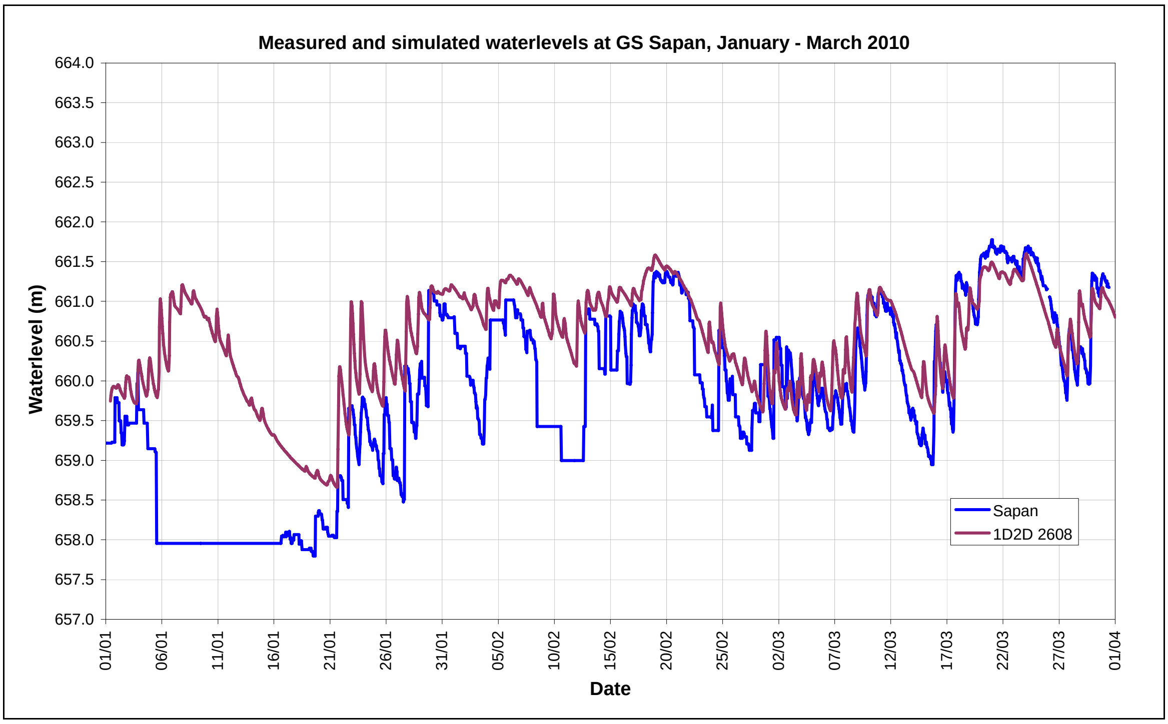
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.2 Model Verification on Daily Discharge at Nanjung, Jan-Mar. 2005



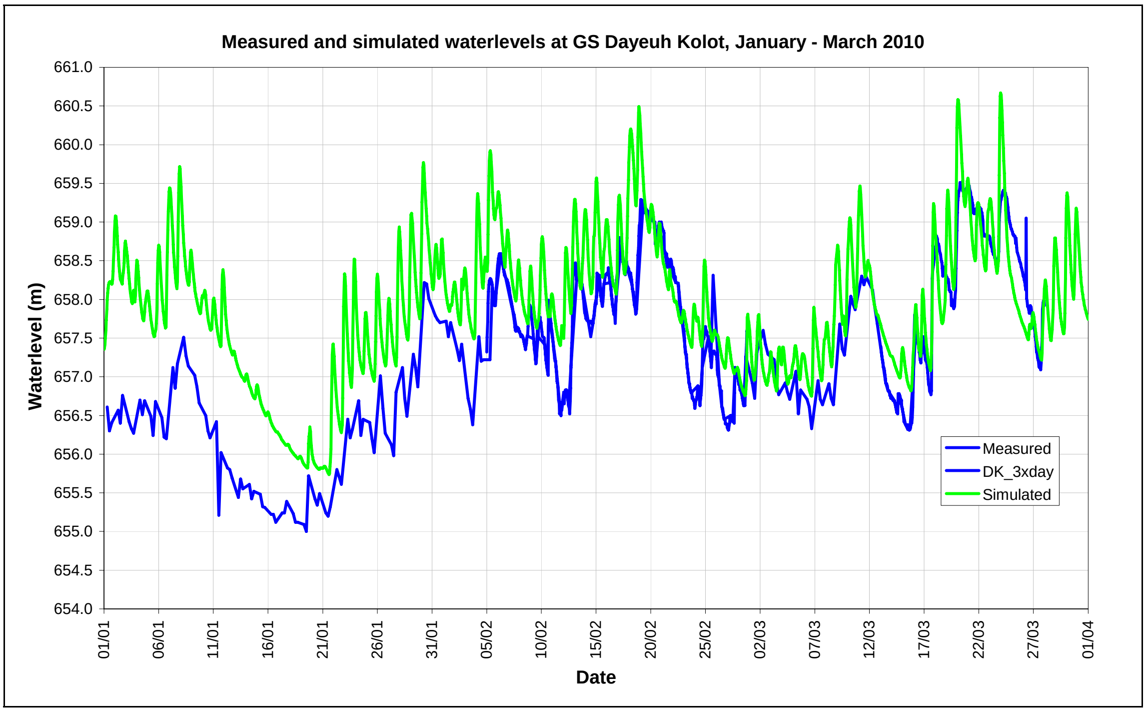
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.3 Measured and 1D Computed Water Levels at Sapan, Jan-Mar. 2010



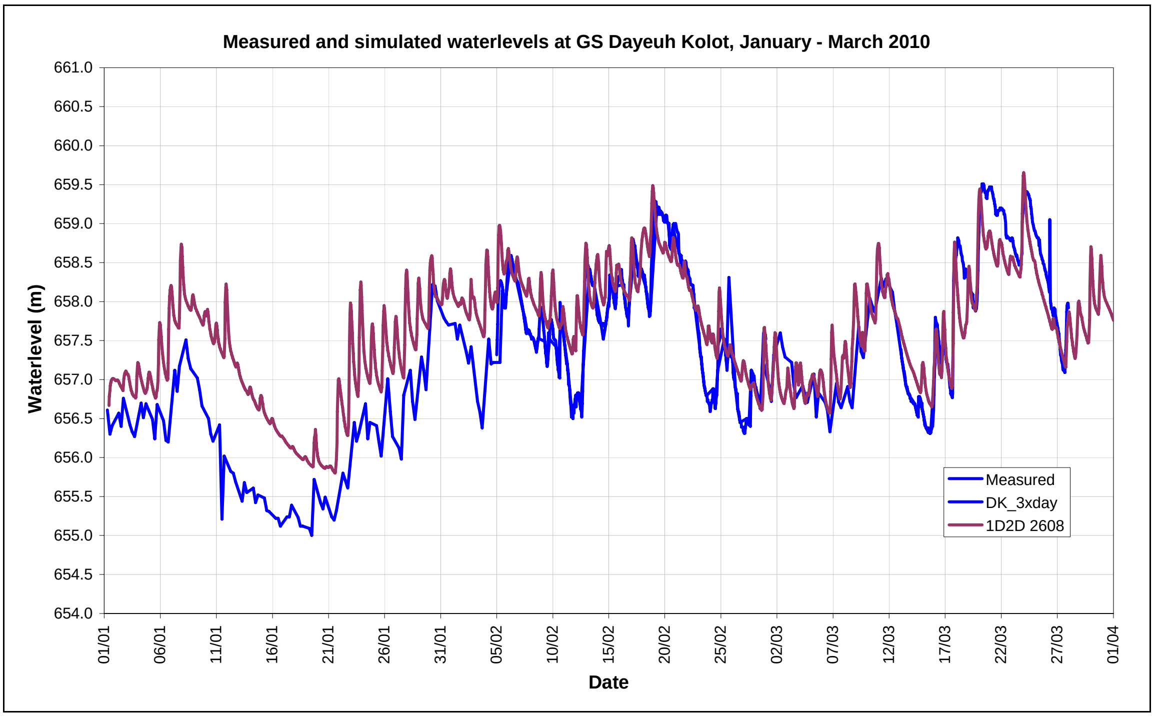
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.4 Measured and 1D2D Computed Water Levels at Sapan, Jan-Mar. 2010



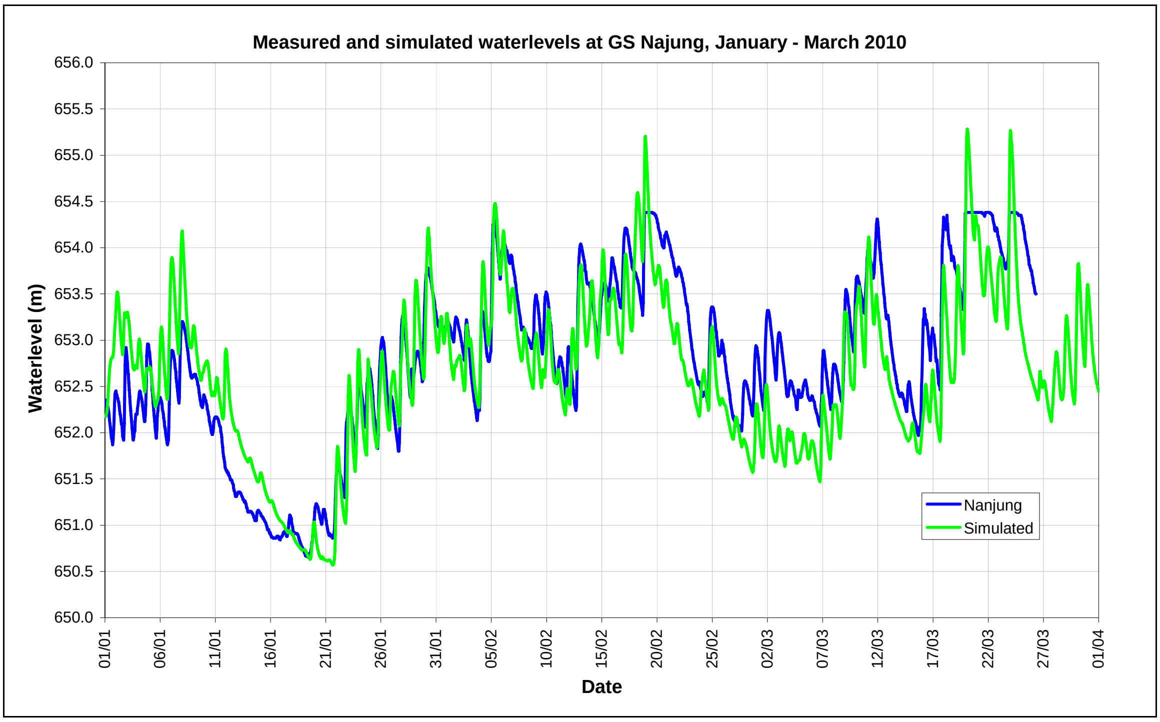
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.5 Measured and 1D Computed Water Levels at Dayeuh Kolot, Jan-Mar. 2010



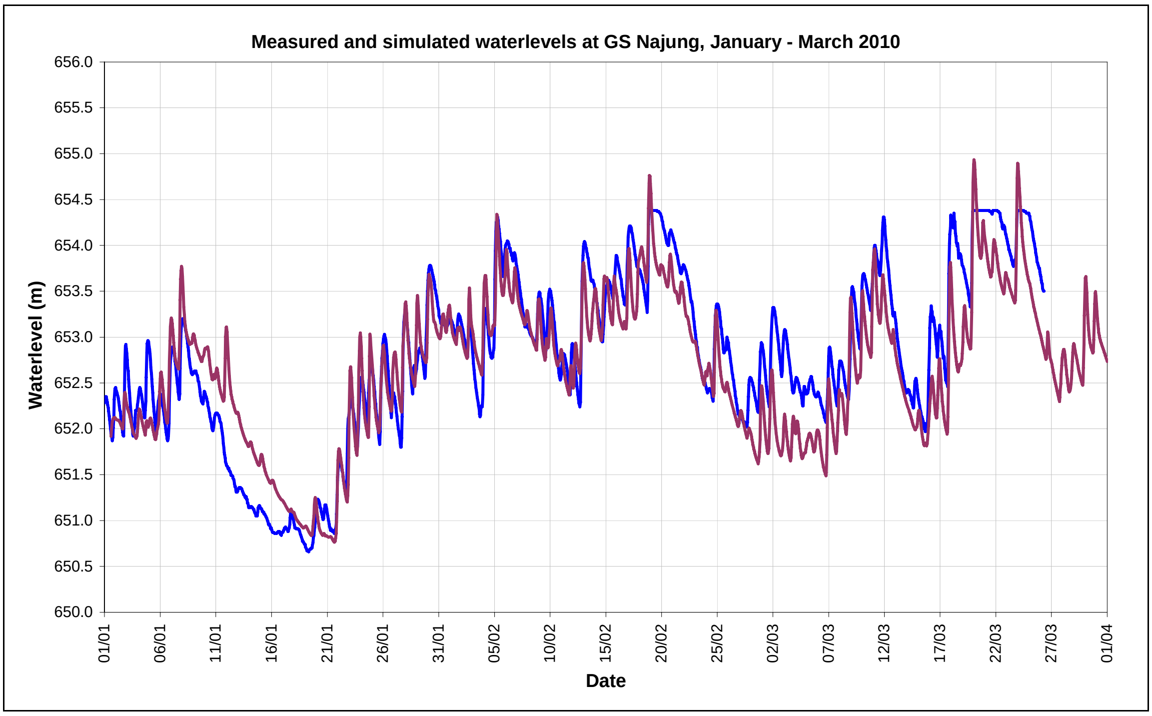
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.6 Measured and 1D2D Computed Water Levels at Dayeuh Kolot, Jan-Mar. 2010



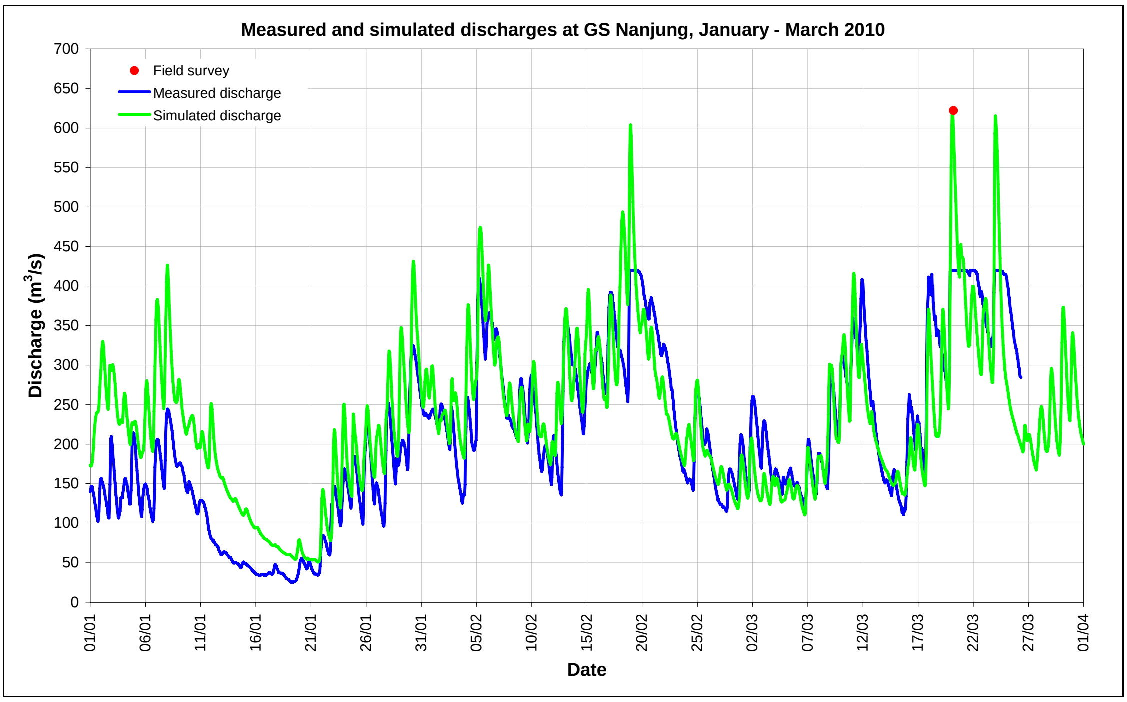
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.7 Measured and 1D Computed Water Levels at Nanjung, Jan-Mar. 2010



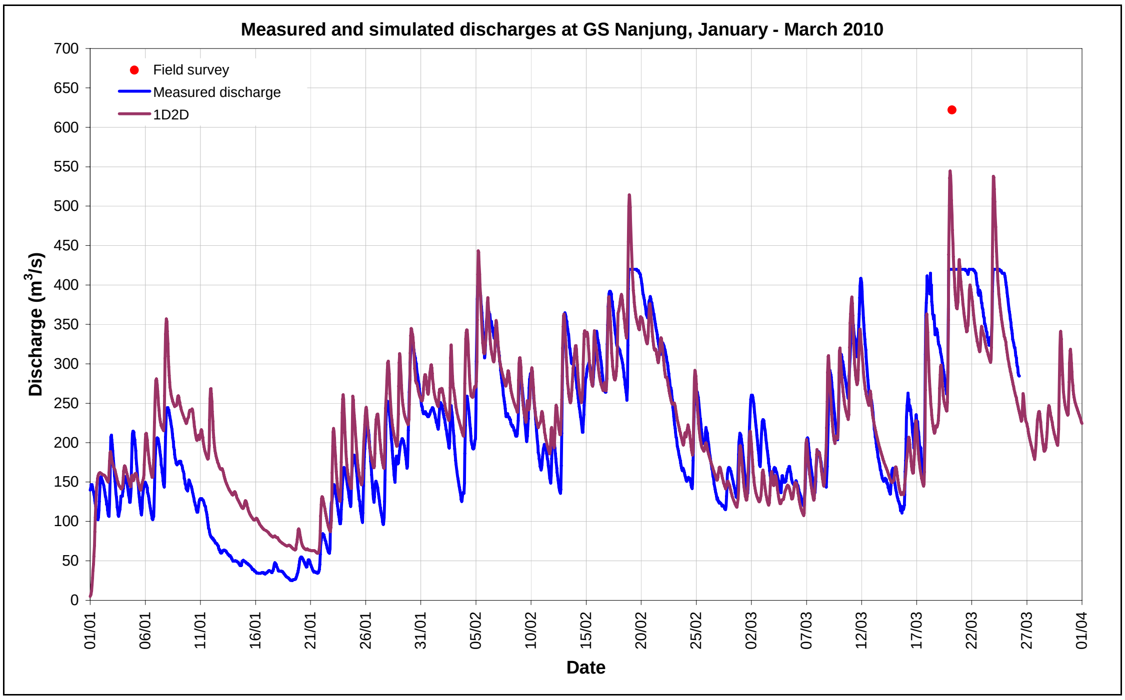
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.8 Measured and 1D2D Computed Water Levels at Nanjung, Jan-Mar.2010



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.9 Measured and 1D Computed Discharges at Nanjung, Jan-Mar. 2010



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.3.10 Measured and 1D2D Computed Discharges at Nanjung, Jan-Mar. 2010

4.2.4. Design Rainfall Event

The design rainfall events are constructed to represent the design tributaries and also the main Citarum River for various return periods. The design hyetographs for the tributaries are based on areal daily rainfall statistics disaggregated into hourly rainfall using the median hourly distribution for extreme rainfall events as observed at station Bandung, with a randomized rainfall start for the sub-basins in the hydrological model. The tributaries for which design events are included cover:

(a) Citarum upstream of Majalaya
(b) Citarik, including Cimande and Cikijing
(c) Cikeruh
(d) Cisangkuy, including upper Cisangkuy and Citalugtug.

Also, account is given to the rainfall statistics of Sapan downstream of the Citarik, Cikeruh confluence with Citarum, needed to provide realistic downstream hydraulic boundary conditions in the main stream for determination of backwater effects in the tributaries. The main stream is represented by the areal rainfall in the basin upstream of the Saguling reservoir entrance near Nanjung.

As explained in Chapter 4.2.2 Model Setup, the catchment basin was divided into several sub-basins (clusters) basically following the stream network. Clusters 1, 2, 3 and 4 represent the Citarum upstream of Majalaya, Cirasea at mouth, Citarik at mouth and Cikeruh at mouth respectively. The catchment basin of the Citarum River at Sapan is termed as cluster 5, which is nearly the summation of cluster 1, 2, 3 and 4. Cluster 6 is the basin draining north of the Citarum between Cikeruh mouth and Dayeuh Kolot, indicated as Cidurian-Cikapundung and cluster 7 is Cisangkuy at mouth. Cluster 8 is the basin draining north of the Citarum between Dayeuh Kolot and Nanjung, indicated as Citepus-Cibeureum and cluster 9 is Ciwidey at mouth. The entire basin of the Citarum upstream of Saguling reservoir, indicated as Citarum at Nanjung is termed as cluster 10.

Accordingly, the catchment basin of Citarum River upstream Nanjung, is mainly divided into eight clusters as C1, C2, C3, C4 and C6, C7, C8, C9. The clusters C5 and C10 are demarcated at Sapan and Nanjung of Citarum mainstream for the analysis of basin average results at these locations.

The development of the design hyetograph is presented in Table 4.2.4.1.

On day 1, the rainfall in C1 and C7 is at design level (1 day rainfall) whereas rainfall in C2, C3 and C9 is added to meet the day 1 conditions at Sapan and Nanjung.

On day 2, the rainfall in C3 and C4 is at design level (1 day rainfall), which sums up to 1 day design rainfall at Sapan, and rainfall in C6 and C8 below design level is added to meet the day 2 rainfall conditions at Nanjung.

On day 3, rainfall in C6 to C9 downstream of Sapan is applied to meet day 3 rainfall conditions at Nanjung.

On days 4 and 5, rainfall is applied in C1 to C4 upstream of Sapan, to meet day 4 and day 5 rainfall conditions at Nanjung.

Note that the clusters that contribute on a specific day to the basin rainfall have been varied to realistically approach the random spatial rainfall pattern in the basin.

Table 4.2.4.1 Summary of Rainfall Distribution on Clusters C1 to C10 for Design Hyetograph

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
	rainfall events									
Day 1	D	R	R	0	D	0	D	0	R	D
Day 2	0	0	D	D	D	R	0	R	0	D
Day 3	0	0	0	0	0	R	R	R	R	D
Day 4	R	R	R	R	R	0	0	0	0	D
Day 5	R	R	R	R	R	0	0	0	0	D

Source: UCBFM, ICWRMIP, ADB (2010)

Legend: D = design rainfall
R = rainfall to meet C5 and/or C10 design conditions
C1 = Citarum u/s Majalaya
C2 = Cirasea
C3 = Citarik
C4 = Cikeruh
C5 = Basin of Citarum at Sapan
C6 = Cidurian-Cikapundung
C7 = Cisangkuy
C8 = Citepus-Cibeureum
C9 =Ciwidey
C10= Whole basin of Citarum u/s Saguling reservoir, near Nanjung

The daily rainfall for 5-year rainfall event is given in Table 4.2.4.2.

Table 4.2.4.2 Summary of Daily Rainfall for 5 year Event on Clusters C1 to C10

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Day 1	75.0	80.0	47.1	0	N/A	0	78.0	0	48.9	N/A
Day 2	0	0	78.0.	91.0	N/A	13.3	0	13.3	0	N/A
Day 3	0	0	0	0	N/A	34.9	34.9	34.9	34.9	N/A
Day 4	34.1	34.1	34.1	34.1	N/A	0	0	0	0	N/A
Day 5	36.0	36.0	36.0	36.0	N/A	0	0	0	0	N/A

Note: N/A: Not Applicable
C5 represents by C1, C2, C3 and C4 clusters
C10 represents by C1, C2, C3, C4, C6, C7, C8 and C9 clusters.

Source: UCBFM, ICWRMIP, ADB (2010)

For the distribution of the rainfall intensities within a day, the median time distribution of storms > 50 mm in a day has been selected. This data will lead to a representative rainfall pattern within the day and it covers a storm lasting 8 hours, with 84% of the total storm depth falling in the first 3 hours.

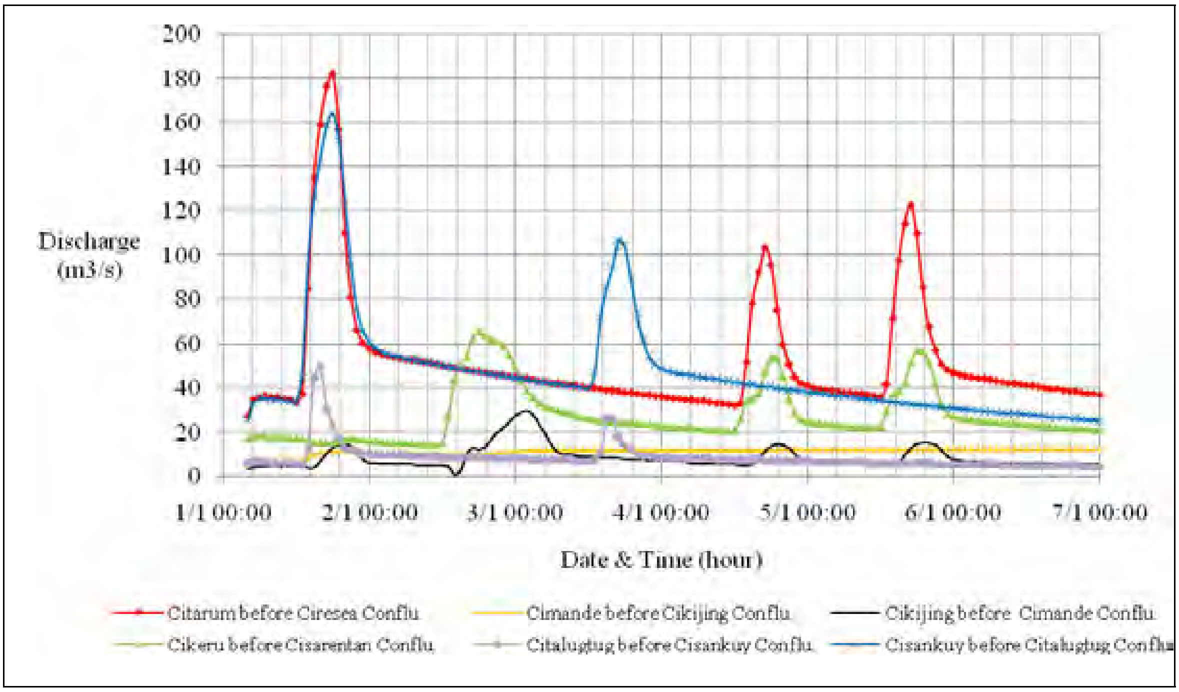
Beside the temporal distribution, realistic hyetographs for design should also take into account the spatial rainfall characteristics. In view of the convective nature of the storms with its limited spatial extent, separate hyetographs for each sub-basin in the Sacramento model have been made, starting at different times. The start of the storm for a sub-basin is taken randomly at -2, -1, 0, +1, +2 hours away from an average beginning at 12.00 hrs. This implies that the results of the model that include more than 1 sub-basin will be dependent on the randomly chosen start of the storms within a sub-basin. Therefore, in the case of the return period evaluation, the results were judged for several randomly chosen storm start selections. The average effect and the range of the effects are taken into consideration.

4.2.5. Simulation Results of SOBEK Model

The river sections that were improved during the Stage (I) and Stage (II) of Upper Citarum Basin Urgent Flood Control Project are known as "As Build" sections and the tributaries in their present condition as "Existing" sections. The nine tributaries designed in 2007 design were reviewed and some of them were modified in the present design. The proposed new design is termed as "Modified Design". The "As Build + Existing" condition was simulated by 1D model and 1D2D model for several return periods using the derived design rainfall hyetograph as explained above. Also the "As Build + Modified Design" condition was simulated with same parameters.

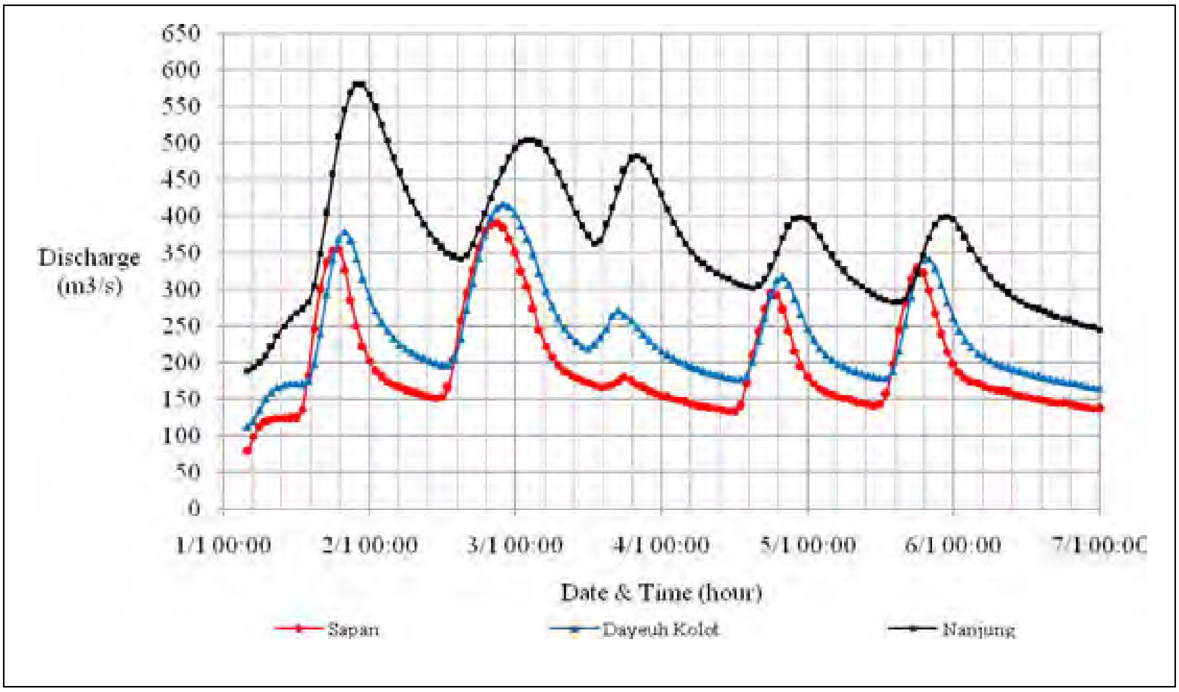
The results of 1D simulations for the "As Build + Existing" condition are illustrated below at the tributaries and the key locations of Citarum mainstream at Sapan, Dayeuh Kolot and Nanjung, for a 5-year return period flood. Results of 1D simulations for "As Build + Modified Design" are also given at the same locations for 2, 3, 5 and 10 year return periods.

(1) As Build + Existing condition



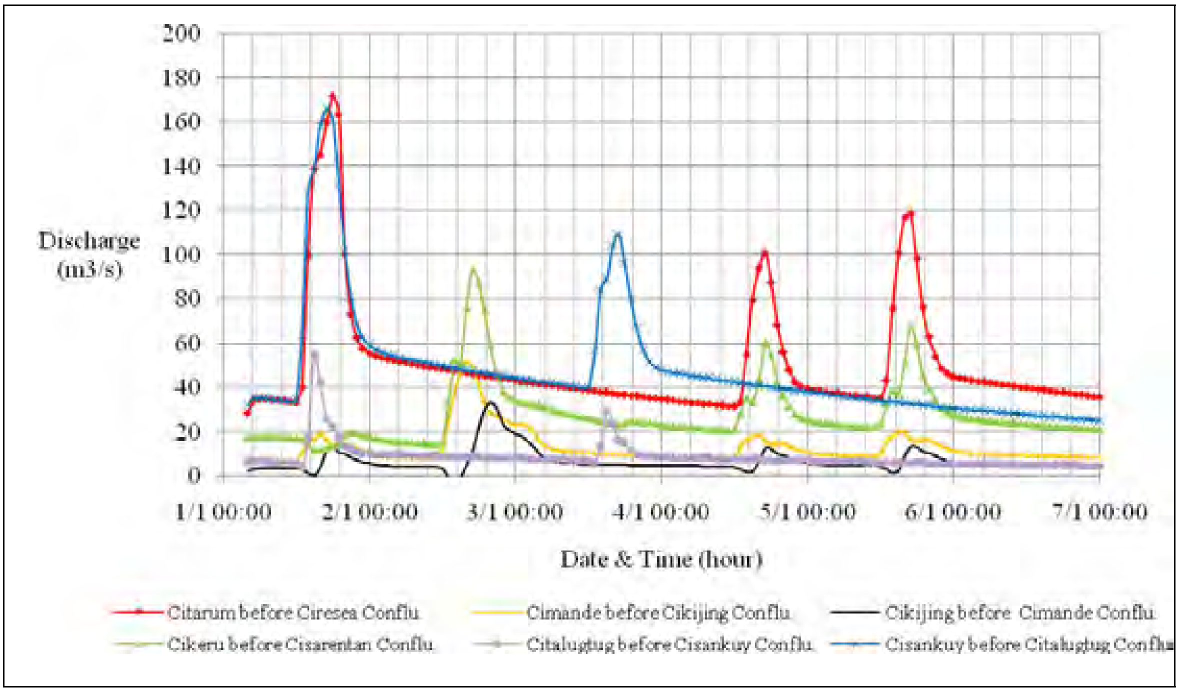
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.1 1D Simulation Results at Tributaries for 5-year Rainfall Event (As Build + Existing)



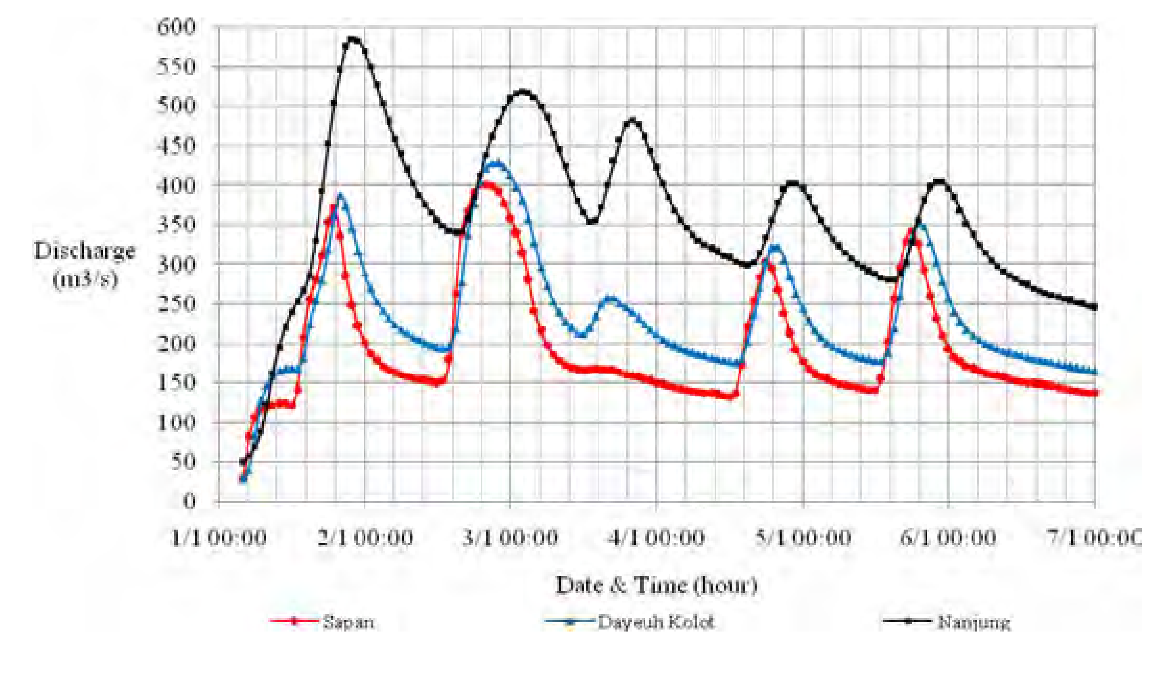
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.2 1D Simulation Results at Citarum River for 5-year Rainfall Event (As Build + Existing) As Build + Modified Design Condition



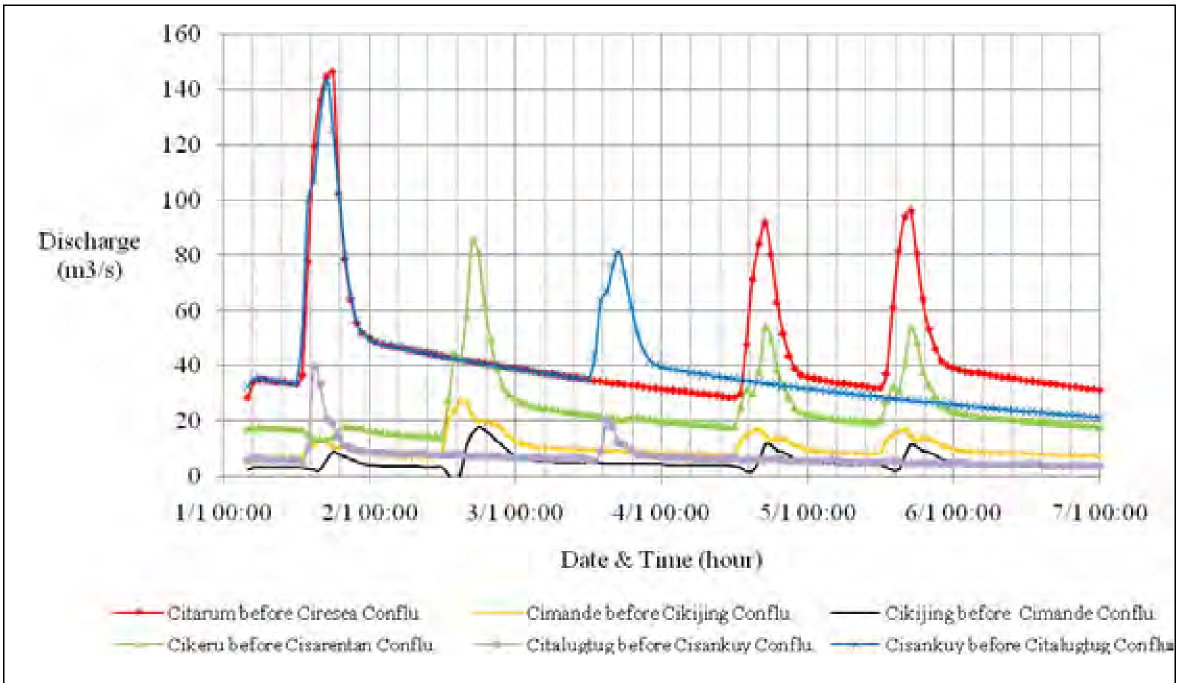
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.3 1D Simulation Results at Tributaries for 5-year Rainfall Event (As Build + Modified Design)



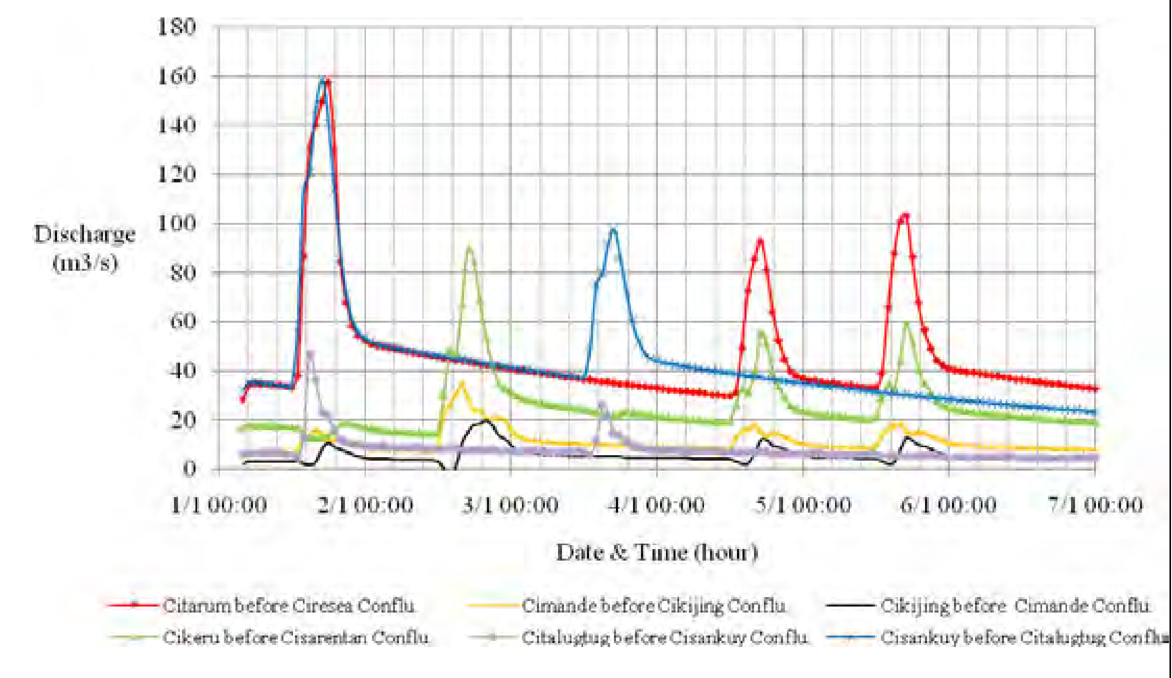
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.4 1D Simulation Results at Citarum River for 5-year Rainfall Event (As Build + Modified design)



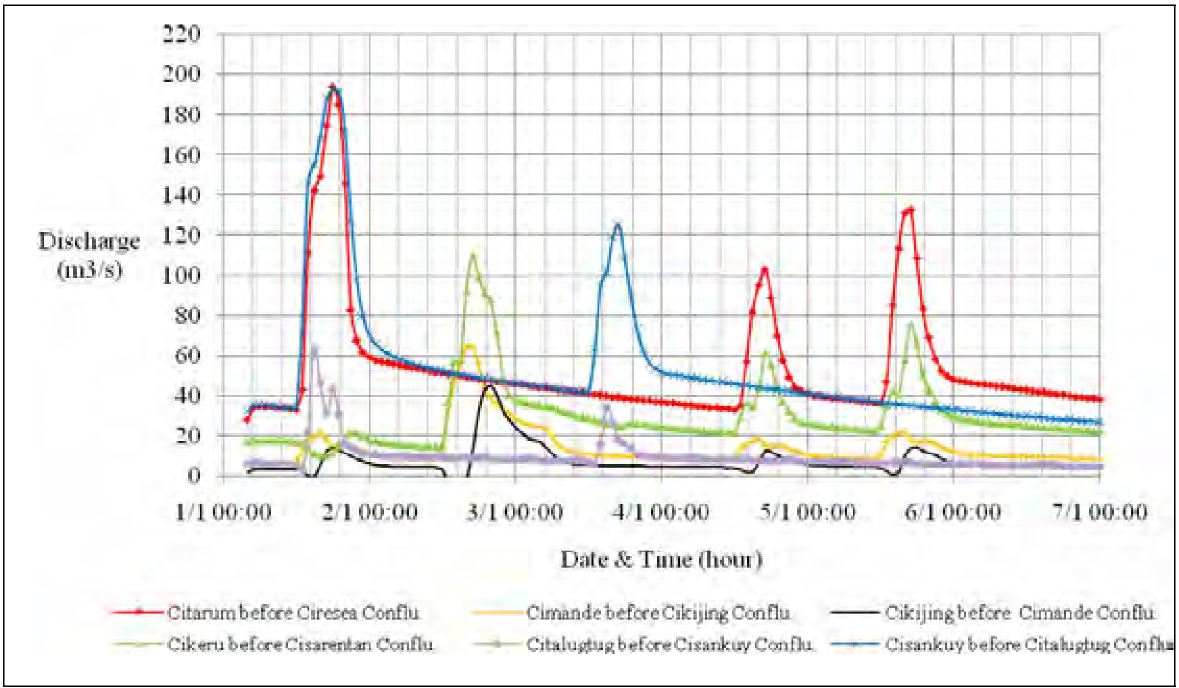
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.5 1D Simulation Results at Tributaries for 2-year Rainfall Event (As Build + Modified Design)



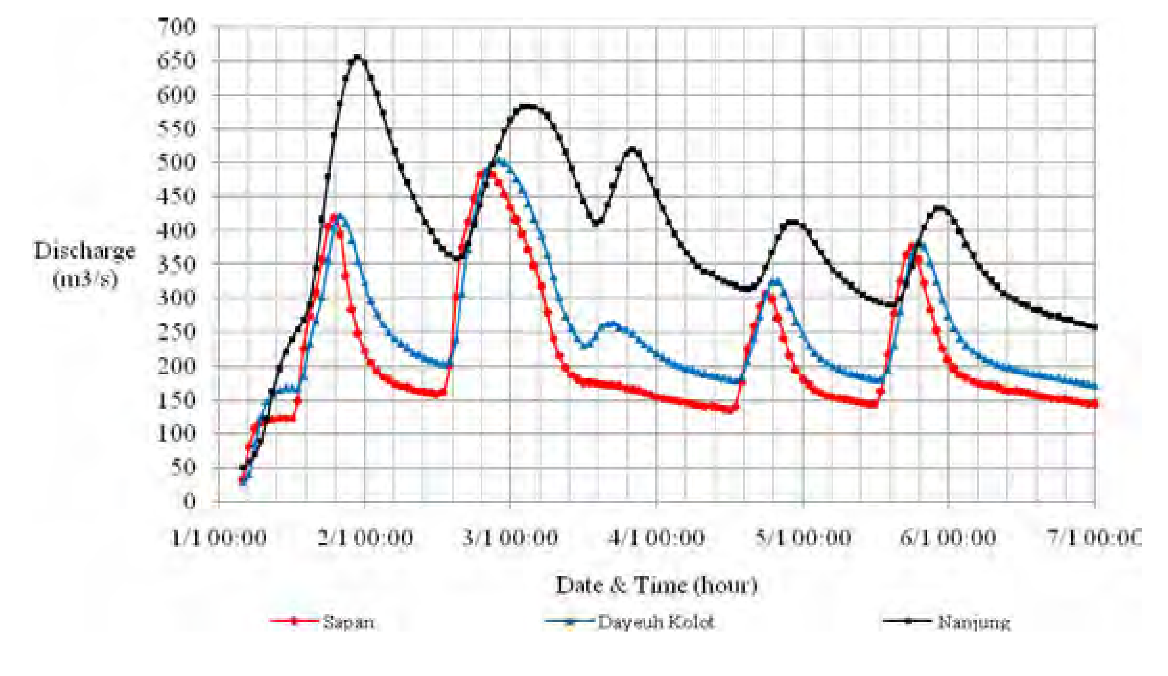
Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.6 1D Simulation Results at Tributaries for 3-year Rainfall Event (As Build + Modified Design)



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.7 1D Simulation Results at Tributaries for 10-year Rainfall Event (As Build + Modified Design)



Source: UCBFM, ICWRMIP, ADB (2010)

Figure 4.2.5.8 1D Simulation Results at Citarum River for 10-year Rainfall Event (As Build + Modified Design)

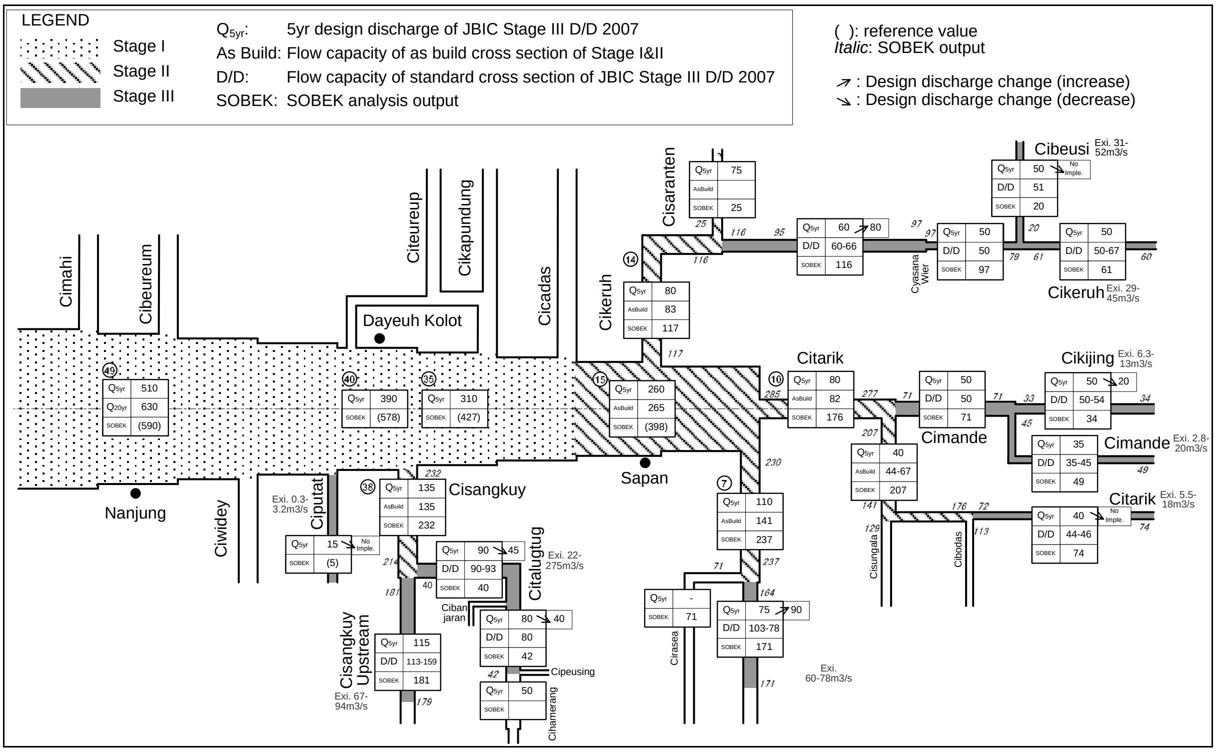
4.3. Modification of 2007 D/D

(1) SOBEK analysis output

The SOBEK outputs are arranged in Figure 4.3.1.1. In this figure, besides the peak discharges of SOBEK outputs at typical points (gray and small figures), 5-year return period design discharges and flow capacities of standard cross sections of “As Build”, which are calculated by Slice Method of Manning’s Formula, at the improved segments of Stage (I) and (II) are presented. 5-year return period design discharges and flow capacities of standard cross sections of 2007 detailed design at the Stage (III) segments of 9 tributaries are also presented.

9 tributaries’ design discharges were reviewed and decided based on these SOBEK outputs.

The details of SOBEK analysis are described in Section 4.2.



Source: JICA Survey Team

Figure 4.3.1.1 Discharge Distribution Comparison Between 2007D/D and SOBEK Output

(2) Deliberation of discharge of tributaries

The 9 tributaries to be improved have been deliberated as follows and have been decided basically following the 2007 D/D as shown in Table 4.3.1.1 and Figure 4.3.1.2. The improved river segments will accommodate approximately 5-year return period flood or less (the flow capacity of each tributary is determined by SOBEK analysis output and downstream flow capacity). The Citarik Upstream, Cibeusi and Ciputat were determined to be not so urgent for improvement from the following technical point of view.

Citarik Upstream: After Stage (II), the improved segment of Citarik (downstream of Stage (III) segment) has a flow capacity of 40-80m^3/s and flow increase caused by Stage (III) segment improvement will procure the flood at Stage (II) segment. The improvement design should be done together with the design of other left tributaries such as the Cibotas along the Citarik upstream.

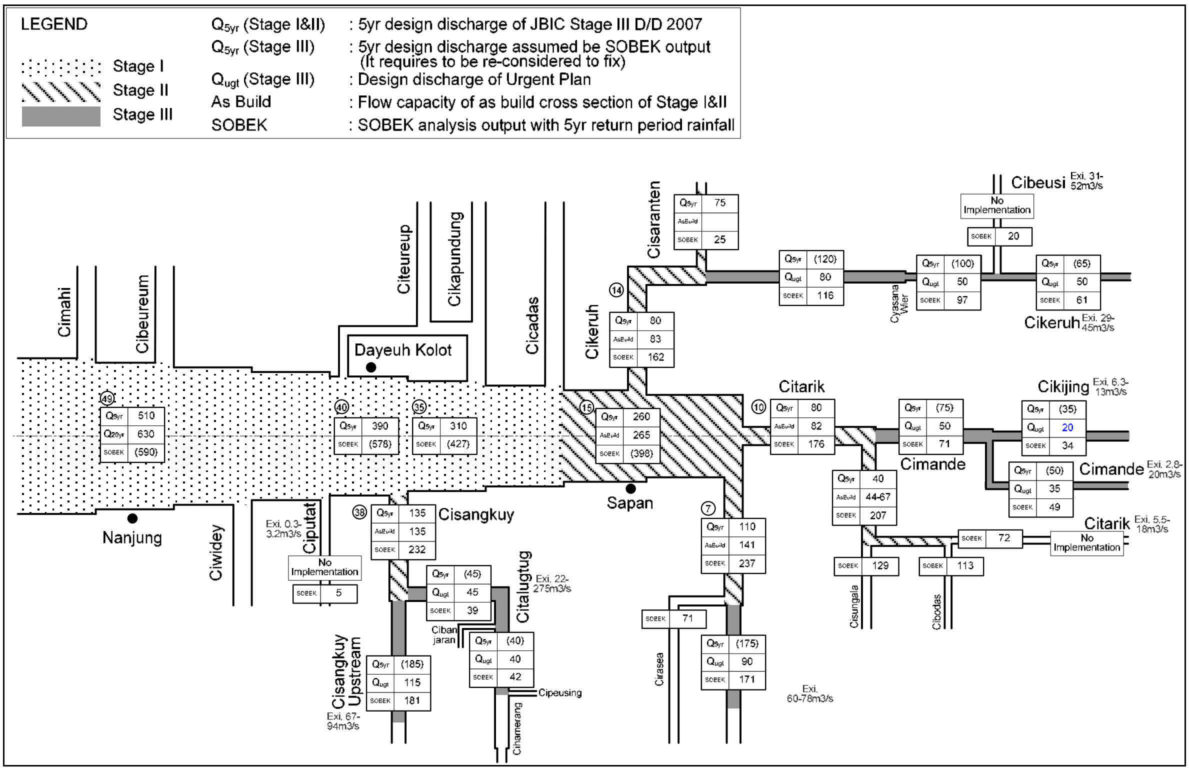
Cibeusi: In its current condition, it can accommodate a 5-yr return period flood. River improvement can be done as an excess flood countermeasure in the future.

Ciputat: This reach can be affected by the backwater of the Citarum main. River improvement can be huge scale with a floodgate and a pump station at the confluence of the Citarum mainstream while the affected area is small.

Table 4.3.1.1 Modified Design Discharge

Tributaries	Design Discharge of 2007D/D	Modified design discharge
Citarum Upstream	75m^3/s	90m^3/s
Citarik upstream	40m^3/s	-
Cimande	50－35m^3/s	50－35m^3/s
Cikijing	50m^3/s	20m^3/s
Cibeusi	50m^3/s	-
Cikeruh	60－50m^3/s	90－50m^3/s
Citalugtug	90－80m^3/s	45－40m^3/s
Cisangkuy	115m^3/s	115m^3/s
Ciputat	15m^3/s	-

Red: design discharge change (increase compared to 2007 D/D), Blue: design discharge change (decrease compared 2007 D/D)
Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.3.1.2 Design Discharge Distribution

1) Citarum Upstream

- The As-Build flow capacity of the improved section of Stage (II) at Citarum Upstream is 141m^3/s. Design discharge for the targeted segment should be determined within a range that does not exceed this downstream flow capacity.
- The SOBEK output discharge is 164m^3/s at Citarum Upstream (Stage (III)) and 71m^3/s at the Cirasea tributary. Though peak discharges before the confluence of these 2 tributaries occur at nearly same time, the peaks of these tributaries can occur with some time lag due to catchment

areas (Citarum Upstream (Stage (III)); 230km^2, Cirasea; 45km^2) and travel times.

- In the case where the peaks of Citarum Upstream and Cirasea occur at the same time, design discharge of Citarum Upstream must be 70m^3/s, which is calculated from difference between the flow capacity of Stage (II) in Citarum Upstream of 141m^3/s, and the Cirasea peak discharge of 71m^3/s. However, the discharge is determined to be 90m^3/s considering the peak lag.
- The flow capacity of the design flow area at Citarum Upstream in 2007 D/D is 78-103m^3/s. Hence, the flow capacity at the most upstream segment (near Majalaya) should be enlarged and the flow capacities at the other segment reaches will follow the former design.

2) Citarik Upstream

- The As-Build flow capacity of the most upstream area of the improved section of Stage (II) at Citarik is 44m^3/s. Design discharge for the targeted segment should be determined within a range that does not exceed this downstream flow capacity.
- The SOBEK output discharge is 72m^3/s at Citarik Upstream (Stage (III), 113m^3/s at the Cibodas tributary, and 176m^3/s at Citarik after the confluence of Cibodas. The peak discharges of Citarik Upstream and Cibodas occur at nearly same time.
- The sum of the existing flow capacity of Citarik Upstream, 5.5-18m^3/s and the SOBEK output discharge at Cibodas exceeds the downstream As-Build channel capacity, 44m^3/s. In terms of discharge distribution, the improvement of Citarik Upstream can't be implemented from a technical point of view. Downstream flow capacity must be increased prior to this section.
- As a result of the hydrological and hydraulic analysis by the Survey Team, the difference in river discharge was found out between the As-Build flow capacity and the estimated discharge by using SOBEK. The As-Build flow capacity was calculated to be lower than the estimated discharge by SOBEK simulation model. The difference is considered to be attributed to the difference of the calculation conditions and methods as well as reliable data amount.
- Therefore, the Citarik Upstream is recommended to be excluded from the Short List as well as the Long List.

3) Cimande

a) From after the confluence of Cikijing to before the confluence of Citarik

- The As-Build flow capacity of the improved section of Stage (II) at Citarik after the confluence of Cimande is 82m^3/s. Design discharge for the targeted segment should be determined within a range that does not exceed this downstream flow capacity.
- The SOBEK output discharge is 71m^3/s at Cimande and 207m^3/s at Citarik before the confluence of Cimande. Though peak discharges before the confluence of these 2 tributaries occur at nearly same time, the peaks of these tributaries can occur with some time lag due to catchment areas (Cimande: 71km^2, Citarik: 197km^2) and travel times.
- Considering the downstream (Citarik) flow capacity of 82m^3/s and flow capacity of the most upstream section of Stage (II) at Citarik of 44m^3/s, the allowed discharge of Cimande should be approximately 40m^3/s. Although SOBEK output discharge is 71m^3/s, the discharge is determined to be 50m^3/s considering the above conditions, which is in accordance with the

former plan.

b) Upstream of the confluence of Cikijing

- Considering the design discharge of the downstream segment (from after the confluence of Cikijing to before the confluence of Citarik) of $50m^3/s$, and the ratio of the SOBEK output between Cimande of $45\text{-}49m^3/s$ and Cikijing (as described below) of $33\text{-}34m^3/s$, the design discharge is determined to be $35m^3/s$, which is in accordance with the former plan.

4) Cikijing

- The SOBEK output discharge is $33\text{-}34m^3/s$ and is smaller than the former design discharge of $50m^3/s$.
- Cikijing's catchment area is $21km^2$. Compared with the adjacent tributary Cimande's catchment area of $41km^2$, and the former design discharge of 35 m^3/s, Cikijing's design discharge of $50m^3/s$ seems to be excessive.
- Considering the design discharge of Cimande's downstream segment, $50m^3/s$, and the ratio of the SOBEK output between Cimande, $45\text{-}49m^3/s$ and Cikijing, $33\text{-}34m^3/s$, the design discharge is changed to $20m^3/s$.

5) Cibeusi

- Flood damage has not occurred in recent years at Cibeusi.
- Cibeusi has a catchment area of only $11km^2$.
- The existing flow capacity of Cibeusi is $31\text{-}52m^3/s$. It can accommodate the SOBEK output peak discharge of 5-year return period of $20m^3/s$.
- Hence, the improvement of Cibeusi is not required from a technical point of view.

6) Cikeruh

a) From the confluence of Cisaranten to Cyasana Weir

- The As-Build flow capacity of the improved section of Stage (II) at Cikeruh after the confluence of Cisaranten is $80m^3/s$. Design discharge for the targeted segment should be determined within a range that does not exceed this downstream flow capacity.
- The SOBEK output discharge at the confluence of Cisaranten is $116m^3/s$ both before and after the confluence. This means the peak discharges of Cikeruh and Cisaranten occur with a large time lag.
- Hence, the allowed discharge of this segment is $80m^3/s$.
- Although SOBEK output discharge of this segment is $97\text{-}116m^3/s$, the discharge is determined to be $80m^3/s$ considering the above factors.

b) Upstream of Cyasana Weir

- The ratio between the SOBEK output downstream discharge of $116m^3/s$ (the largest value), and the design discharge of $80m^3/s$ is approximately 69%.
- Multiplying the SOBEK output discharge of $60\text{-}97m^3/s$ by the above percentage results in a discharge of $41\text{-}67m^3/s$. As this value is almost same as the former design discharge of $50m^3/s$,

the design discharge is determined to be 50m^3/s in accordance with the former plan.

7) Citarum Upstream

- The SOBEK output discharge of Citalugtug is 30-42m^3/s and is smaller than the former design discharge of 90m^3/s.
- Citalugtug's catchment area is 40km^2. Compared with adjacent tributary Cisangkuy's catchment area of 241km^2, and its former design discharge of 115m^3/s, Citalugtug's design discharge of 90m^3/s seems to be excessive.
- Considering the above, the design discharge is changed to 40-45m^3/s based on the SOBEK output.

8) Cisangkuy

- The As-Build flow capacity of the improved section of Stage (II) at Cisangkuy after the confluence of Citalugtug is 135m^3/s. Design discharge for the targeted segment should be determined within a range that does not exceed this downstream flow capacity.
- The SOBEK output discharge is 40m^3/s at Citalugtug and 181m^3/s at Cisangkuy before the confluence of Citalugtug. Though peak discharges before the confluence of these 2 tributaries occur at nearly the same time, the peaks of these tributaries can occur with some time lag due to catchment areas (Cisangkuy: 241km^2 Citalugtug: 40km^2) and travel times.
- Although SOBEK output discharge of this segment is approximately 180m^3/s, the discharge is determined to be 115m^3/s, which follows the former plan, considering the downstream allowed discharge of 135m^3/s and the design discharge of Citalugtug of 40m^3/s.

9) Ciputat

- As the design high water level of Ciputat is lower than that of the Citarum mainstream, river improvement can cause the negative effect of reverse flow during a Citarum mainstream flood. To avoid this problem, a water gate and a pump station are required at the confluence. This will result in an increase in construction costs and O&M efforts.
- Cibeusi has only 0.8km^2 as its catchment area.
- Although flood damage has occurred in the Ciputat watershed, the causes of floods seem to be caused by reverse flow of the Citarum mainstream, floods from Citarum mainstream and Cisangkuy, and landside water near Dayeuh Kolot. The runoff impact from the Ciputat itself seems small.
- Hence, improvement of Cibeusi is not required from a technical point of view.

(3) Deliberation of Standard Cross Section and Longitudinal Section

1) Basic Concept

a) Basic Concept

- Basically following 2007 D/D.
- Not changing design HWL, longitudinal slope, bank slope and cross section shape (single cross section).

b) Tributaries with the design discharge increase

- Increasing bed and river width to accommodate the increase of the design discharge.

c) Tributaries with the design discharge decrease

- Decreasing bed and river width and decreasing water depth (raising riverbed elevation) to suit the decrease of the design discharge.

2) Modification of Standard Cross Sections and Longitudinal Profile

Based on the change of the design discharges and the above basic concepts, standard cross sections were modified as shown in Table 4.3.1.2. As for Cikijing and Citalugtug, as water depth and riverbed elevation are changed, longitudinal profiles were also modified. The standard cross sections and longitudinal profile of the 6 tributaries to be improved are presented in Appendix.

Table 4.3.1.2 Modification of Standard Cross Sections

River	Standard XS Type	Segment		Former Design Discharge	New Design Discharge	River Width			Bottom Width			Water Depth		
						Former	Modified	Ratio	Former	Modified	Ratio	Former	Modified	Ratio
		From	To	m3/s	m3/s	m	m	-	m	m	-	m	m	-
Citarum Upstream	Type I	0.000	0.367	75	**90**	24.5	24.5		6.5	6.5		4.00	4.00	
	Type II	0.367	2.389			24.5	24.5		8.5	8.5		3.50	3.50	
	Type III	2.389	3.839			22.5	22.5		6.5	6.5		3.50	3.50	
	Type IV	3.839	5.547			13.0	**14.5**	1.12	9.0	**10.5**	1.17	3.50	3.50	
Cimande	Type I	0.035	1.190	50	50	24.0	24.0		6.0	6.0		4.00	4.00	
	Type II	1.270	6.522	35	35	19.2	19.2		4.0	4.0		3.30	3.30	
	Type III-V 1/1500	6.668	7.988			18.0	18.0		4.0	4.0		3.00	3.00	
	Type III-V 1/1000	7.988	9.537			18.0	18.0		4.0	4.0		3.00	3.00	
Cikijing	Type I	0.000	1.516	50	*20*	24.0	*18.5*	*0.77*	6.0	*4.5*	*0.75*	4.00	*3.00*	*0.75*
	Type II	1.516	3.131			22.0	*17.0*	*0.77*	4.0	*3.0*	*0.75*	4.00	*3.00*	*0.75*
	Type III&IV	3.131	6.679			20.0	*15.0*	*0.75*	4.0	*3.0*	*0.75*	3.50	*2.50*	*0.71*
Cikeruh	Type I	0.375	1.315	60	**80**	23.8	**27.8**	1.17	6.0	**10.0**	1.67	3.95	3.95	
	Type II	1.315	3.016			21.5	**25.0**	1.16	5.5	**9.0**	1.64	3.50	3.50	
	Type III Lower	3.016	4.046			19.5	**21.5**	1.10	3.5	**5.5**	1.57	3.50	3.50	
	Type IV Lower	4.046	5.223			11.2	**14.0**	1.25	7.2	**10.0**	1.39	3.50	3.50	
	Type III Upper	5.223	5.549			19.5	**21.5**	1.10	3.5	**5.5**	1.57	3.50	3.50	
	Type IV Upper	5.549	5.997			11.2	**14.0**	1.25	7.2	**10.0**	1.39	3.50	3.50	
	Type V 1/800	5.997	7.634	50	50	10.7	10.7		7.0	7.0		3.20	3.20	
	Type V 1/450	5.997	7.634			10.7	10.7		7.0	7.0		3.20	3.20	
	Type VI	7.634	8.398			9.1	9.1		5.5	5.5		3.10	3.10	
Cisangkuy Upstream	Type I	6.650	7.187	115	115	29.0	29.0		7.0	7.0		5.00	5.00	
	Type II	7.187	11.064			24.5	24.5		4.5	4.5		4.50	4.50	
Citalugtug	Type I	0.000	1.398	90	*45*	24.7	*20.0*	*0.81*	6.7	*6.0*	*0.90*	4.00	*3.00*	*0.75*
	Type II	1.398	2.226			15.7	*13.0*	*0.83*	6.7	*6.0*	*0.90*	4.00	*3.00*	*0.75*
	Type III 1/750	2.226	2.637			15.5	*12.5*	*0.81*	6.5	*5.5*	*0.85*	4.00	*3.00*	*0.75*
	Type III 1/700	2.637	3.219			15.5	*12.5*	*0.81*	6.5	*5.5*	*0.85*	4.00	*3.00*	*0.75*
	Type IV	3.219	4.049	80	*40*	11.0	*8.5*	*0.77*	6.5	*5.0*	*0.77*	4.00	*3.00*	*0.75*

Bold: Design discharge increased, *Italic* : Design discharge decreased
Dot cell: Cross Section Changed
Dark cell: Cross Section Changed

Source: JICA Survey Team

(4) Required Land Acquisition Area and House Relocation

For the 6 tributaries to be improved, the required land acquisition area and the number of houses to be relocated were calculated. The required land acquisition area is defined as areas within the Right of Way (ROW) excluding the river channel. After the extents of ROW based on the standard design cross-section drawing were superimposed over the land use data, the land use within ROW is allocated with GIS. Google Earth satellite images were primarily used to estimate the number of houses within the ROW. The breakdown of the required land acquisition area (112 ha) and the number of houses to be relocated (369) is presented in Table 4.3.1.3 for the targeted river channels.

Table 4.3.1.3 Required Land Acquisition Area and Number of Houses to be Relocated

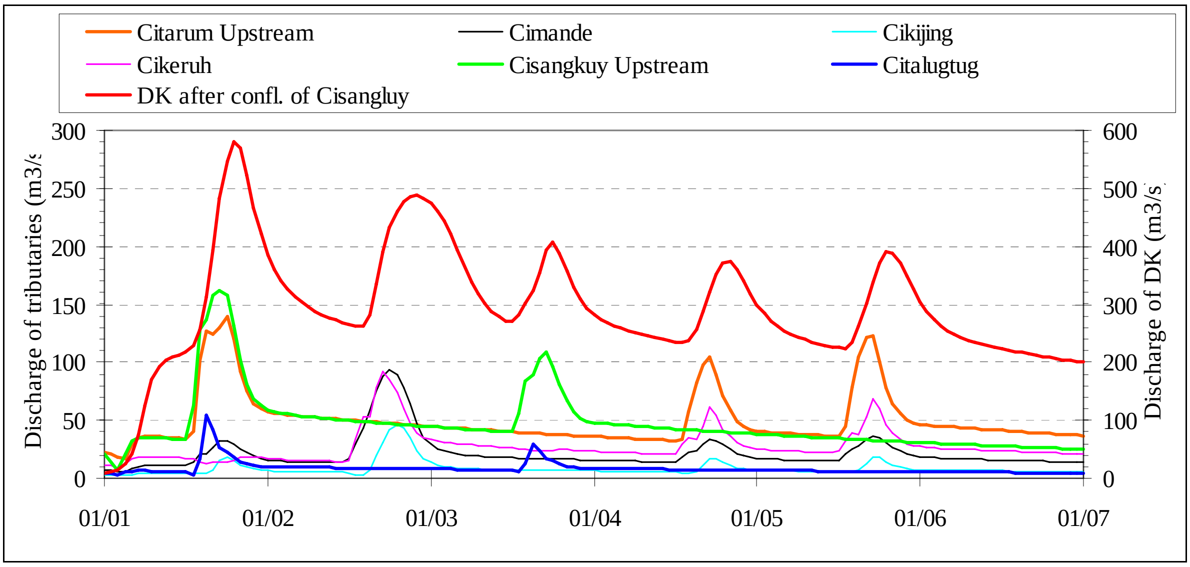
Tributaries	Land Acquisition Area				House Relocation
	Agricultural Land	Residential Area	Idle Space	Total	
Unit	ha				house
Citarum Upstream	9.5	1.9	1.2	12.5	34
Cimande	26.7	4.1	0.7	31.5	16
Cikijing	18.6	2.6	0.0	21.2	40
Cikeruh	12.2	11.3	0.0	23.5	190
Cisangkuy Upstream	12.6	1.9	0.0	14.5	25
Citalugtug	6.0	4.7	0.0	10.6	64
Total(6tiributaries)	85.6	26.4	1.9	113.9	369

Source: JICA Survey Team

4.4. Impact Assessment for Downstream Reach

The increase of discharge at the Citarum downstream due to the improvement of the 6 tributaries would cause the negative impacts in the Citarum mainstream. Since serious land subsidence, which can be seen in Dayeuh Kolot, has occurred along the Citarum Main River, the negative impacts can cause result into the substantial increase of the inundation damage. In this section, the effects caused by the increase of discharge at Dayeuh Kolot due to the improvement of 6 tributaries are assessed.

Figure 4.4.1.1 shows the hydrograph at the end points of the tributary segments to be improved and at Dayeuh Kolot (after the confluence of Cisangkuy) by SOBEK 2D model (with inundation). According to this figure, the peak discharge at Dayeuh Kolot is 581m^3/s and occurs on the first day. This peak is affected only by the peak discharge of Citarum Upstream, Cisangkuy and Citalugtug. Though tributaries other than these 3 tributaries (Cimande, Cikijing and Cikeruh) contribute to the formation of peak discharge at Dayeuh Kolot after the second day, these tributaries don’t contribute to the formation of the largest peak on the first day and the impacts are relatively small.



Source: JICA Survey Team

Figure 4.4.1.1 Hydrograph at the End Point of DD Segment of Tributaries and Dayeuh Kolot by SOBEK 2D Model

Next, the Citarum Upstream, Cisangkuy and Citalugtug impacts on Dayeuh Kolot are evaluated using the following procedure:

a) Flow runoff volume increases caused by improvement of the 3 tributaries are calculated comparing the without implementation case (existing condition) and the with implementation case.
b) Volumes of channel storage from downstream of the improved section to Dayeuh Kolot are calculated by multiplying the flow area of a typical cross section and the river length.
c) The ratio between a) and b) is regarded as the impact indicator on Dayeuh Kolot. It is understood that the larger this indicator's value is, the higher the probability the flood runoff volume will have a direct impact on Dayeuh Kolot.

The result of this evaluation is shown in Table 4.4.1.1. As shown in this table, the impacts of Citarum Upstream and Citalugtug are small. In contrast, Cisangkuy's indicator value is big at 1.67 and the impact is regarded as being significant.

Table 4.4.1.1 Potential Impact on Dayeuh Kolot by Tributaries River Improvement

Tributaries	Characteristics		Impact on DK	Amount of channel storage				Flow amount increase		
				Amount of channel storage from downstream of Stage III to DK (w/ allowance) (see below table)				Flow amount at downstream Stage III of SOBEK output		
	Catchment area	Improvement length	Ratio between flow amount increase and amount of channel capacity	Total	Citarum Main	Citarum Upstream	Cisangkuy	Difference	w/o implementation	w/ implementation
Unit	km2	m	-	1000 m3				1000 m3		
Citarum Up	245.2	5,450	0.21	3,348	2,721	627		714	25,263	25,976
Cisangkuy Up	274.3	3,730	1.67	663			663	1,109	23,875	24,984
Citalugtug	44.5	4,010	0.24	663			663	158	4,438	4,596

Source: JICA Survey Team

Table 4.4.1.2 Potential Channel Storage of Downstream of Tributaries

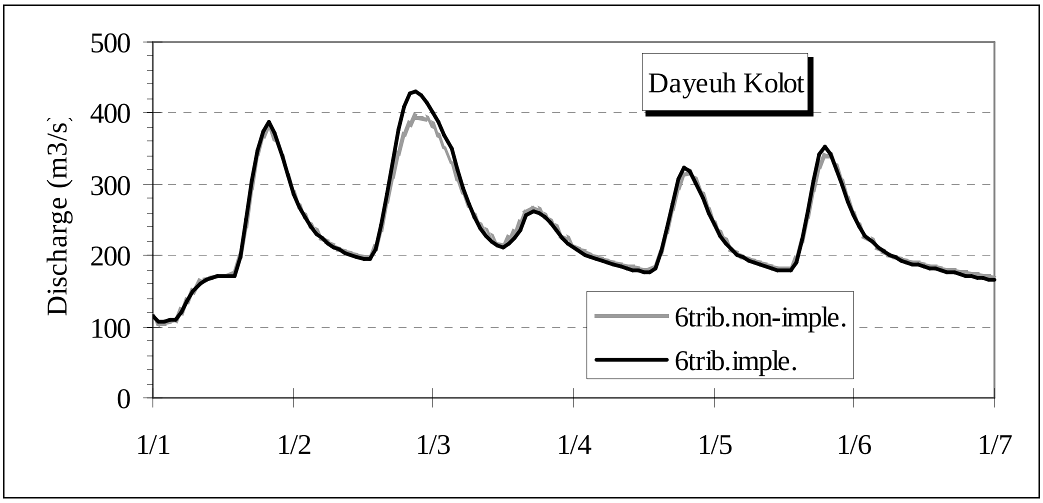
Channel Storage								
River	Standard XS Type	Segment		Length	Flow area		Channel storage volume	
					w/o allowance	w/ allowance	w/o allowance	w/ allowance
		From	To	km	m2	m2	m3	m3
Citarum Main	Type I	A.000	A.066	7.000	243.9	272.5	1,707,125	1,907,500
	TypeII	A.067	A130	3.300	219.9	246.5	725,588	813,450
Citarum Up	Type I	F.000	F.124+39.00	5.700	92.4	110.0	526,680	627,000
Cisangkuy	TypeII	Y.001	Y.168	6.700	85.0	99.0	569,500	663,300

Note: This table is calculated only with Stage (II) section.
Source: JICA Survey Team

4.5. Retarding Reservoirs

(1) Objectives of the Reservoirs

As explained above, a considerable increase in peak discharge in the Citarum main river is anticipated in areas such as Dayeuh Kolot due to the improvement of 6 tributaries (Figure 4.5.1.1). Therefore, to mitigate the increase of peak discharge, placing reservoirs at Citarik and Citarum at Sapan is considered.

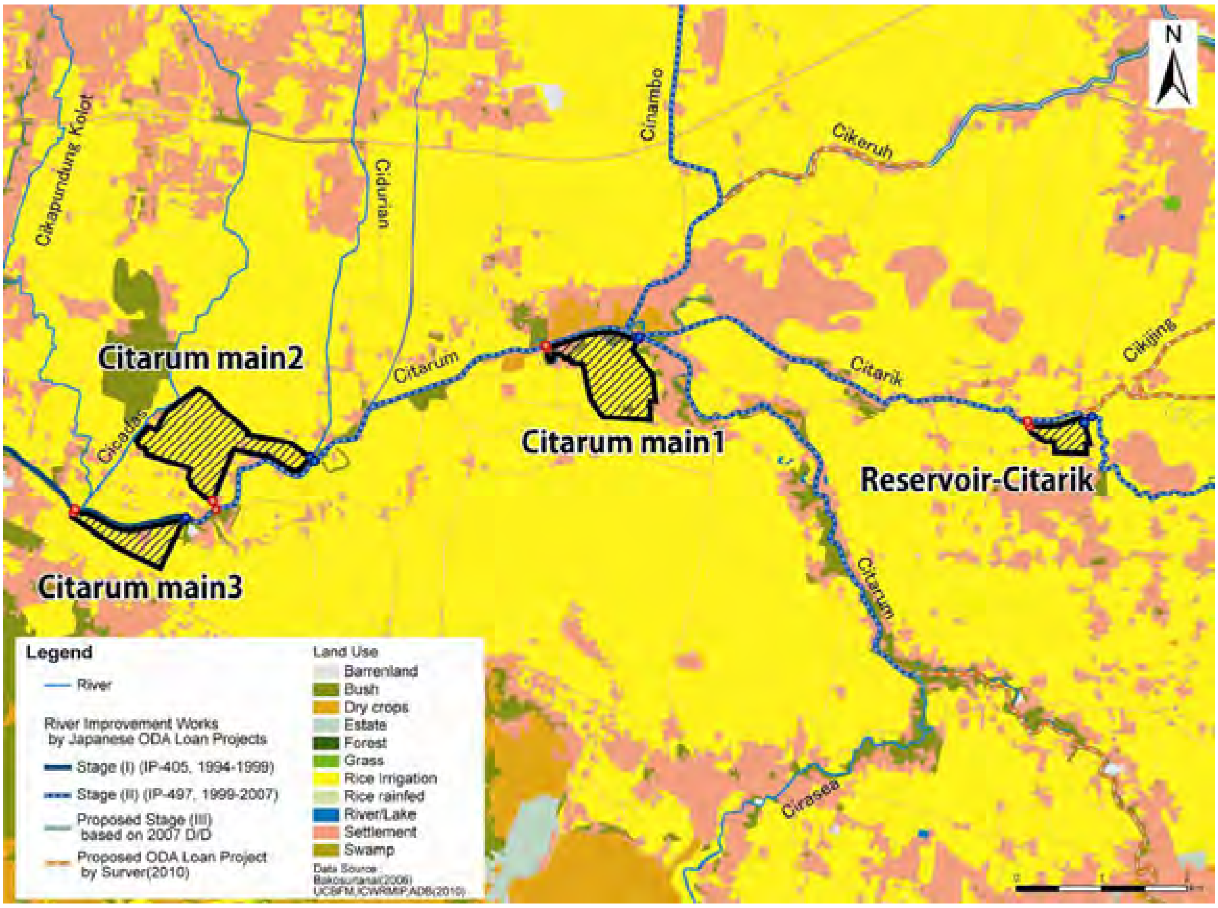


Source: JICA Survey Team

Figure 4.5.1.1 Hydrograph at Dayeuh Kolot before the Confluence of Cisangkuy

(2) Location of the Reservoirs

Firstly, 4 candidate reservoirs along the Citarik, Citarum mainstream, Reservoir-Citarik and Reservoir-Citarum Main 1-3 are nominated (Figure 4.5.1.2). The candidate locations of these reservoirs are to be located in paddy fields to avoid the massive relocation of houses.



Source: JICA Survey Team

Figure 4.5.1.2 Candidate Reservoirs along Citarik and Citarum Main

With SOBEK analysis in section 4.2, placing reservoirs at Citarik at the confluence of Cimande and Citarum at Sapan have been proven to be effective. The reservoirs will be placed in the following 2 locations:

A) Reservoir-1: Citarik Reservoir

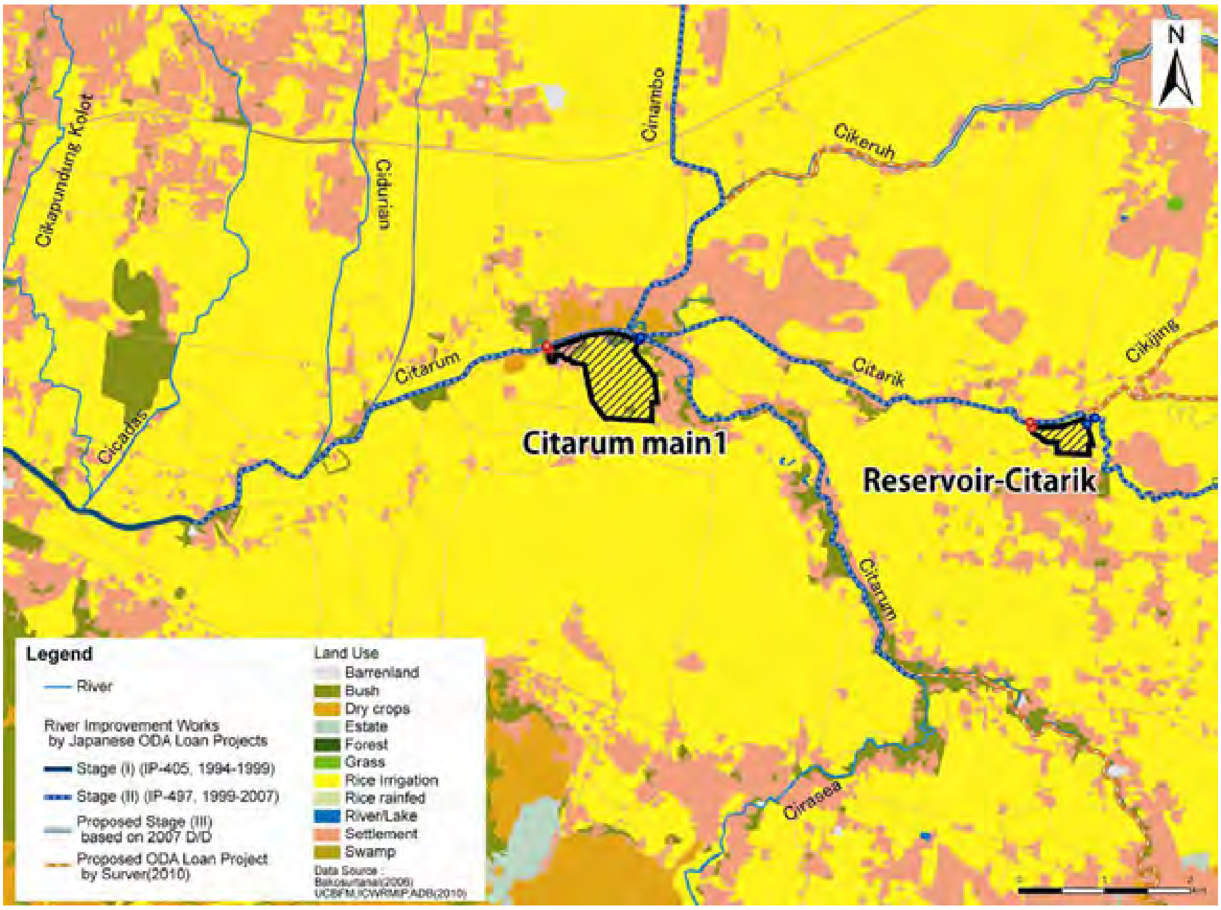
Location: Citarik before the confluence of Cimande (left bank)

Objective: To compensate for the negative effects due to the improvement of Cimande and Cikijing and to improve the flow capacity of Citarik's Stage (II) segment.

B) Reservoir-2: Citarum Main Reservoir (left bank)

Location: Citarum main at Sapan

Objective: To compensate for the negative effects due to the improvement of Citarum Upstream, Cimande, Cikijing and Cikeruh.



Source: JICA Survey Team

Figure 4.5.1.3 Location of the Reservoirs

(3) The Dimensions and Factors of the Reservoirs and Their Equipments

The dimensions and elevations of the reservoirs and the auxiliary structure are determined using SOBEK 1D model in order that the reservoirs downstream peak discharge w/ 6 tributaries' improvement becomes same or less than the peak discharge w/o reservoirs and w/ 6 tributaries' improvement[1]. The decided dimensions and elevations are as shown in Table 4.5.1.1.

[1] As described in section 4.2, for tributaries the discharge and water level simulations tend result in large values because storage nodes do not function well in SOBEK 1D model. To handle this problem, the diverting side weir is set to a higher level than the actual height in SOBEK analysis. In addition, with SOBEK analysis, diverting weir width of the Reservoir Citarik tuned out to be the most effective way to store floods of 10m. However, as there are analytical problems as mentioned above, a width of 10m is too short and is to be replaced by 30m as described in Table 4.5.1.1 from practical experience. These dimensions and elevations require re-deliberation in the detailed design study.

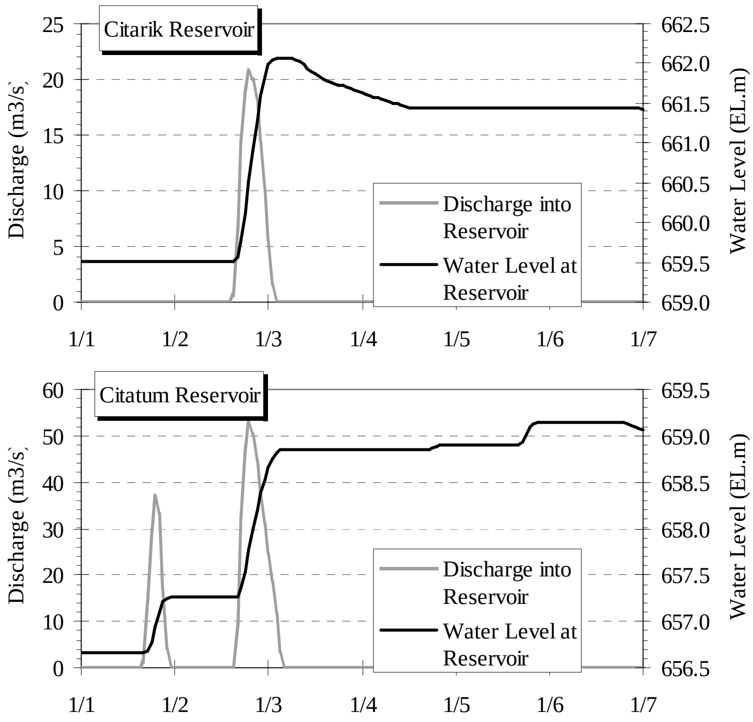
Table 4.5.1.1 The Scales and Factors of the Reservoirs and Their Equipment

Items		Unit	Citarik	Citarum
Location	Right/Left	-	Left Bank	Left Bank
Diverting point	Cross section ID	-	AsB_G.116	Asb_A.132
	HWL		662.07	661.09
	River bed elevation	ELm	658.07	655.09
Drainage point	Cross section ID	-	AsB_G.101	AsB_A.111
	HWL		662.51	661.18
	River bed elevation	ELm	658.51	655.18
Diverting weir	Wier width	m	30	50
	Weir height	m	4.13	5.61
	Weir top elevation	ELm	662.20	660.70
Reservoir	Clown elevation	ELm	663.15	661.59
	Top elevation	ELm	662.65	661.09
	Bottom elevation	ELm	659.51	656.18
	Allowance	m	0.5	0.5
	Depth	m	3.14	4.92
	Clown area	m2	189,978	804,933
	Top area	m2	187,967	800,842
	Bottom Area	m2	175,333	760,627
	Volume	m3	570,380	3,837,310

Source: JICA Survey Team

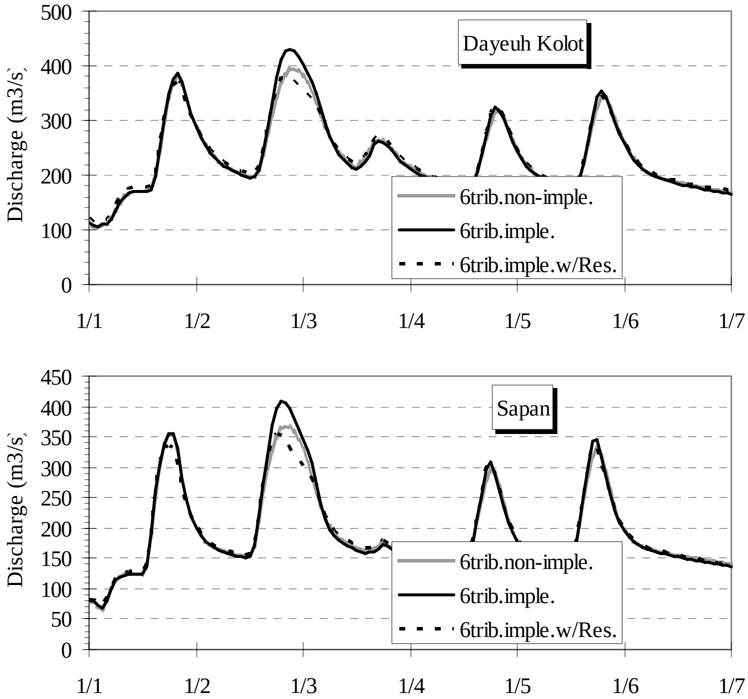
(4) Flow Cut Effect by Reservoirs

The flow cut effect of the reservoirs is shown in Figure 4.5.1.4. The cut volumes of the Citarik Reservoir and the Citarum Reservoir are 473,000m^3 (83% of total volume) and 2,040,000m^3 (53% of total volume). These flow cut effects reduce the discharge of Citarum mainstream. As shown in Figure 4.5.1.5, the peak discharge of 6 tributaries' improvement at Sapan and Dayeuh Kolot is reduced to the level of discharge without improvement due to the cut effects of the reservoirs.



Source: JICA Survey Team

Figure 4.5.1.4 Flow Cut Effect by Reservoirs



Source: JICA Survey Team

Figure 4.5.1.5 Hydrograph at Sapan and Dayeuh Kolot with Flow Cut Effect of Reservoirs

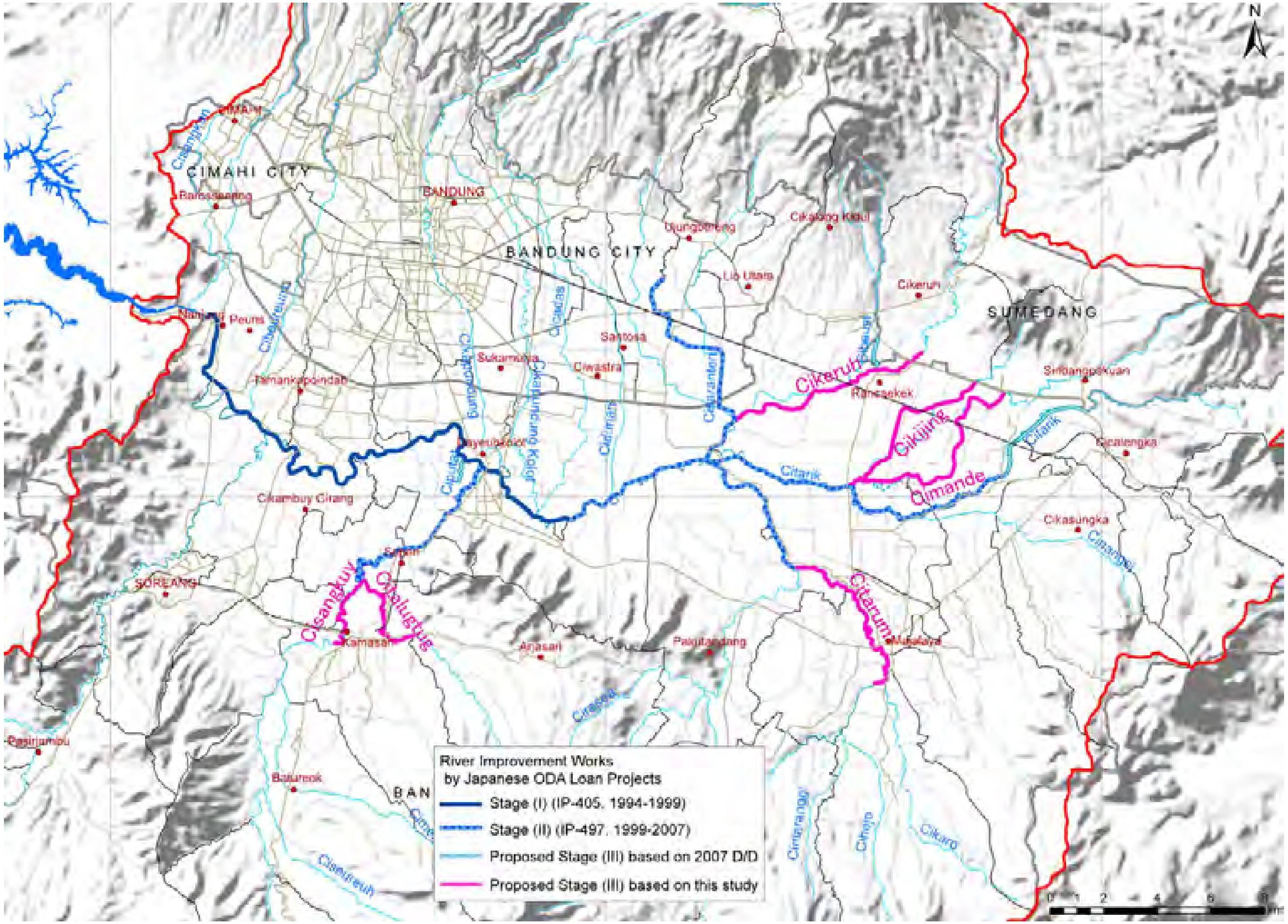
4.6. Definitive Design for the 9 Tributaries

The 6 tributaries to be improved have been decided as shown in Table 4.6.1.1 and Figure 4.6.1.1. These decisions basically follow the 2007 D/D. The improved river segments will accommodate approximately a 5-year return period flood or less. Figure 4.6.1.2 shows the design discharge distribution of each tributary. The Citarik Upstream, Cibeusi and Ciputat were determined to be inappropriate for improvement from a technical point of view.

Table 4.6.1.1 Improved Length and Design Discharge of 6 tributaries

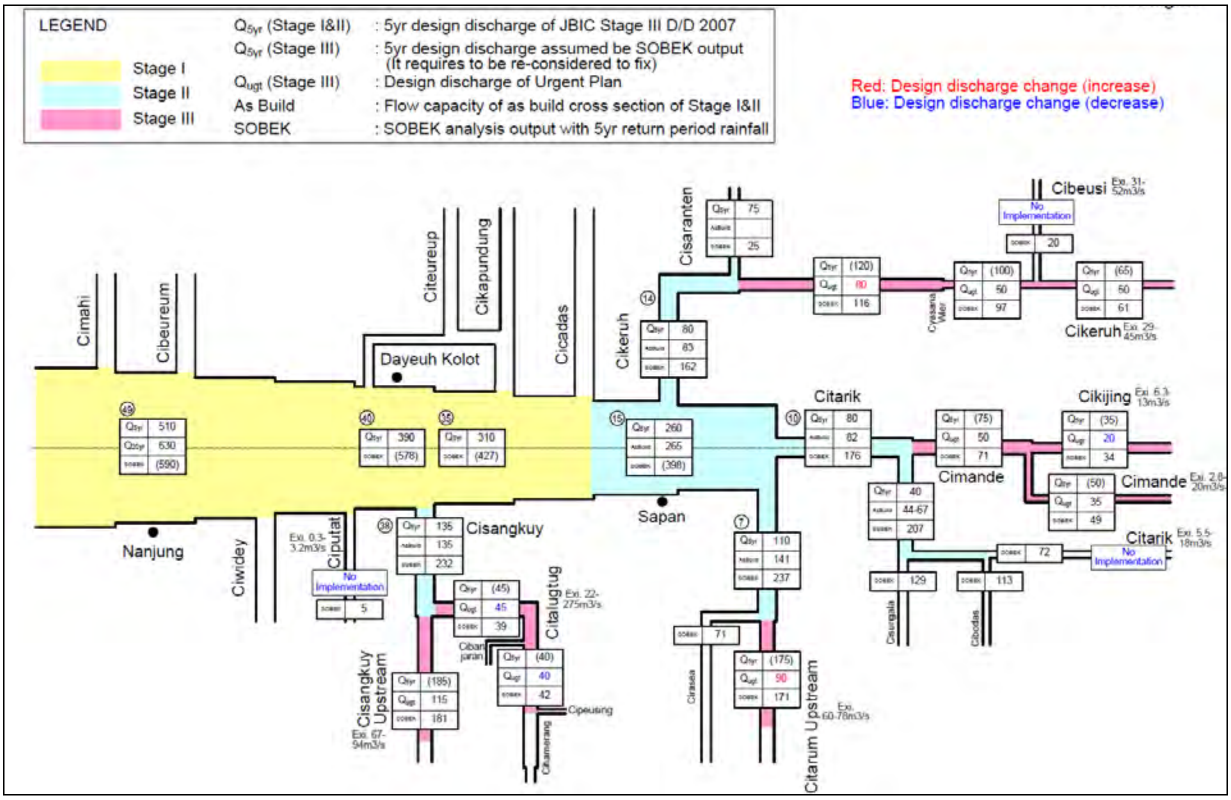
Tributaries	Improved Length	Design Discharge
Citarum Upstream	L=5,450m	90m^3/s
Cimande	L=9,510m	50－35m^3/s
Cikijing	L=6,680m	20m^3/s
Cikeruh	L=7,650m	90－50m^3/s
Citalugtug	L=3,730m	40－45m^3/s
Cisangkuy	L=4,010m	115m^3/s

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.6.1.1 6 Tributaries to be Improved



Source: JICA Survey Team

Figure 4.6.1.2   Design Discharge Distribution

CHAPTER 5 DELIBERATION OF THE PROJECT COMPONENTS

5.1. Objectives of the Project

JICA has been supporting the mitigation of flood damage in the Upper Citarum River Basin since the 1980s, especially through the implementations of "Upper Citarum Basin Urgent Flood Control Project (I) & (II)". The Project is aimed at contributing to the completion of the Urgent Flood Control Plan, continued from the Stages (I) & (II). Included in the Project is a series of Non-Structural Countermeasures comprised of Institutional Strengthening for BBWSC, Capacity Development for Community against Flood Disaster, and Sediment Control. The Project is therefore considered significant in terms of the economic development of the Indonesian economy.

5.2. Process of Deliberation of the Project Components

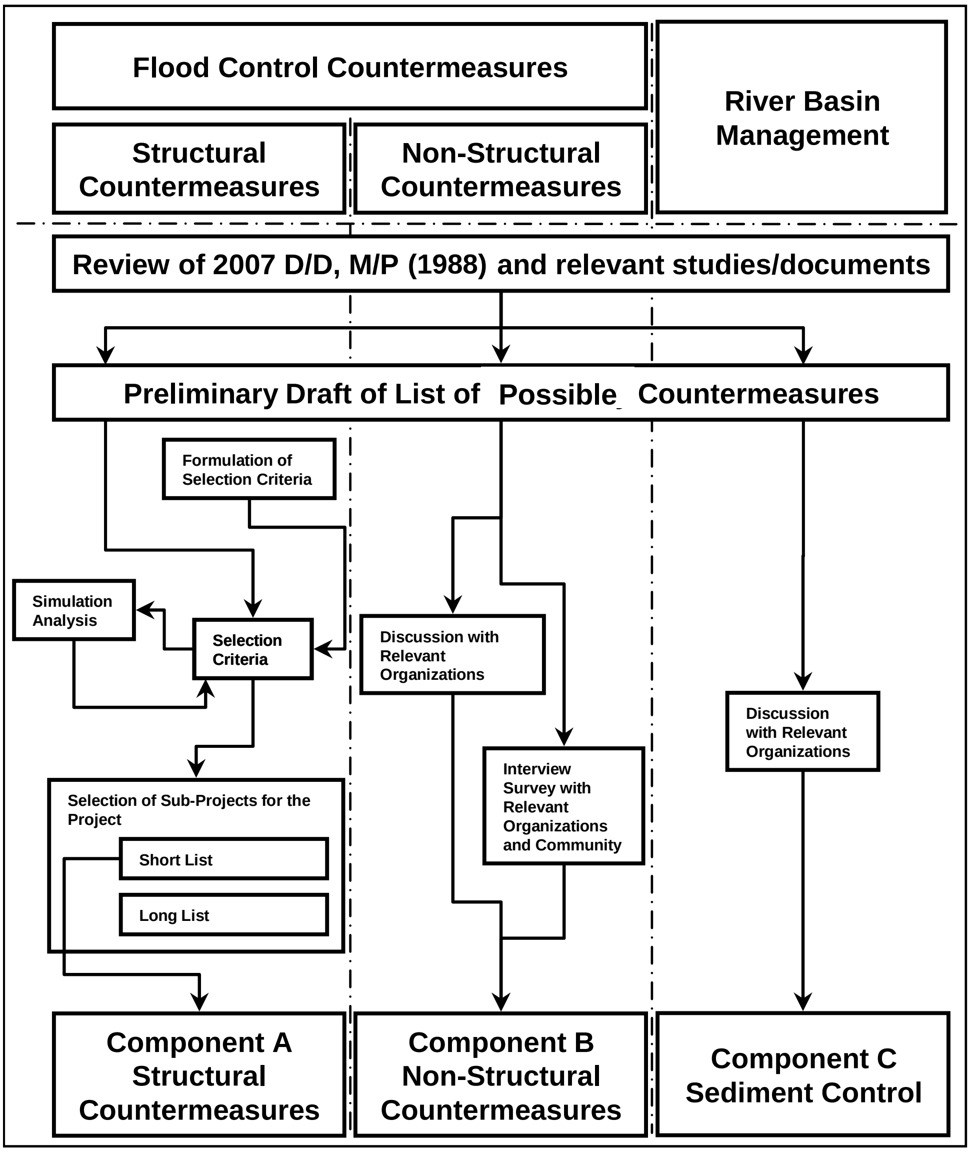
In this section, the procedure of deliberation of the Project components is briefly explained. The Project comprises of three components: 1) Structural Countermeasures, 2) Non-Structural Countermeasures and 3) River Basin Management (Sediment Control).

In regards to structural countermeasures, the possible countermeasures were determined in a preliminary draft based on the review of the relevant study reports/documents (*e.g.* 2007 D/D, M/P in 1988, *etc.*). Then, the prioritized sub-projects were selected from the list based on the selection criteria (*e.g.* flood damage impact, social impact, regional demand, cost, data existence, *etc.*), which were proposed and formulated by the Survey Team using hydraulic simulation model results. The selected sub-projects in this component (Component A: Structural Countermeasures) are regarded as those in the Short List, which are expected to be implemented during the Project. Any sub-project in the Short List can be interchanged with sub-projects on the Long List and vice versa under certain conditions.

A similar approach was taken to list the possible countermeasures for the non-structural countermeasures component (Component B: Non-Structural Countermeasures). The activities for Component B were selected through discussions with the relevant organizations of GOI (*i.e.* BBWSC, DGWR, BAPPENAS, *etc.*) and the Survey Team. Interview surveys were also carried out with the governmental agencies and individuals (*e.g.* BBWSC, Kabupaten Bandung, residents, *etc.*) in order to formulate the activities.

A list of the possible countermeasures for River Basin Management was also created. The activities for this component (Component C: River Basin Management) regarding Sediment Control were selected through discussions with the relevant organizations of GOI (*i.e.* BBWSC, DGWR, BAPPENAS, *etc.*).

Refer to Figure 5.2.1.1 which shows a brief representation of the procedure for deliberation of the project components.



Source: JICA Survey Team

Figure 5.2.1.1 Process of Deliberation of the Project Components

5.3. Structural Countermeasures

5.3.1. Draft of Possible Countermeasures

Based on the review of the relevant study reports/documents (*e.g.* 2007 D/D, M/P in 1988, *etc.*), a draft of the candidate sub-projects and possible countermeasures for the Project was created (refer to Table 5.3.1.1).

As shown in Table 5.3.1.1, the draft list can be classified into two parts: 1) River Improvement Works for Upper Tributaries and 2) Citarum Main River. The "River Improvement Works for Upper Tributaries" category is comprised of "9 Tributaries" and "Other Tributaries". Considering the problems along the Citarum main river such as sediment runoff and deposition in the river course and serious land subsidence in Dayeuh Kolot, the candidate sub-projects were drafted (*i.e.* Dredging works, Retarding reservoir, Flood walls, Dyke and Diversion channel) as shown in Table 5.3.1.1.

Table 5.3.1.1 Draft of Candidate Sub-Projects for Structural Countermeasures

Candidate Sub-Project or Countermeasures for Flood Control Countermeasures (Structural Countermeasures)				
Structural Countermeasures	Upper Tributaries	River Improvement Works	9 Tributaries	Citarum Upstream
				Citarik Upstream
				Cimande
				Cikijing
				Cikeruh
				Cibeusi
				Cisangkuy Upstream
				Citalugtug
				Ciputat
			Other Tributaries	Cirasea
				Cisunngala
				Cibodas
				Cicadas
				Cidurian
				Cikapundung
				Citepus
				Cikapundung Kolot
	Citarum Main	Dredging Works for the Completed Sections during Stage (I) and (II)		
		Retarding Reservoir	Citarum Main -1	
			Citarum Main -2	
			Citarum Main -3	
			Citarik -1 (after the confl. of Cimande)	
			Oxbow	
		Installation of Flood Walls nearby Dayeuh Kolot		
		Construction of Dyke nearby Dayeuh Kolot		
		Diversion Channel		

Source: JICA Survey Team

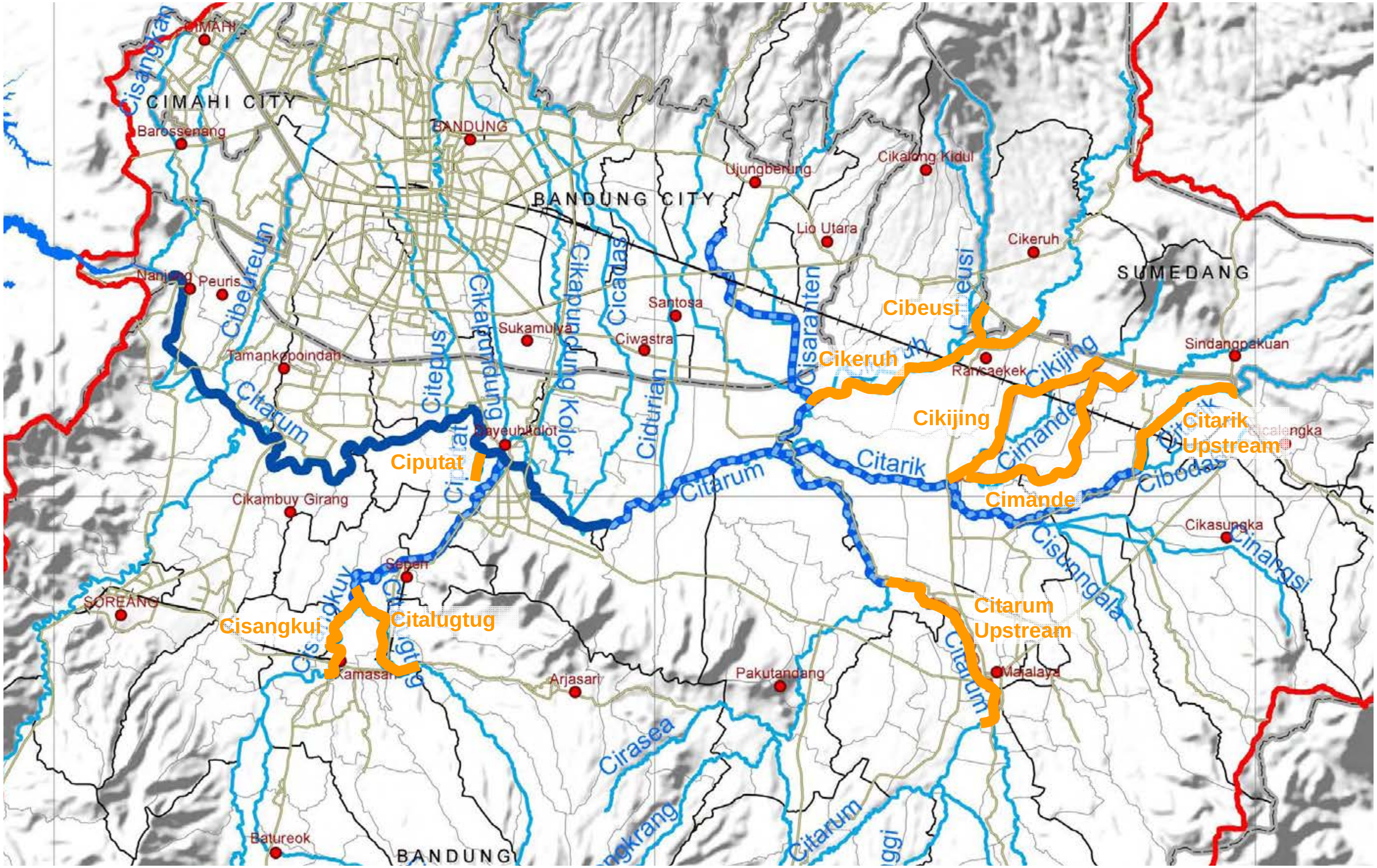
5.3.2. River Improvement Works for Upper Tributaries

(1) 9 Tributaries

The 9 tributaries river improvement works were reviewed and deliberated in Chapter 4 from a technical viewpoint. As a result, 6 tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream and Citalugtug) have been selected. The improved river segments will accommodate approximately a 5-yr return period flood or less (the flow capacity of each tributary is determined by SOBEK analysis output and by considering the existing downstream flow capacity). The Citarik Upstream, Cibeusi and Ciputat were determined to be inappropriate for improvement from a technical point of view.

(2) Other Tributaries

Floods occurred mainly in the 9 selected tributaries but were also seen in other tributaries, such as Cirasea, Cisungala and Cibodas (see Chapter 3). Due to the lack of survey results and drawings for these tributaries, surveying is necessary prior to the design analysis. These tributaries are listed in the Long List, though improvement priority is lower than for the 9 selected tributaries.



Source: JICA Survey Team (Data Source: 2007 D/D)

Figure 5.3.2.1 Location of 9 tributaries

5.3.3. Retarding Reservoir

As discussed in Chapter 4, if all of the 6 tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream and Citalugtug) improvements are implemented, the increase in discharge is expected to magnify the negative impacts in the Citarum mainstream. To avoid this problem, 4 candidate reservoirs (Citarum main 1, Citarum main 2, Citarum main 3 and Citarik 1) have been nominated. Based on the SOBEK hydraulic simulation model analysis, the 2 reservoirs at Citarik and Citarum mainstream have been proven to be effective in countering the negative effects. Refer to Chapter 4 for details.

The location and factors of the two reservoirs (Citarik and Citarum) are as follows:

(1) Reservoir-1: Citarik Reservoir

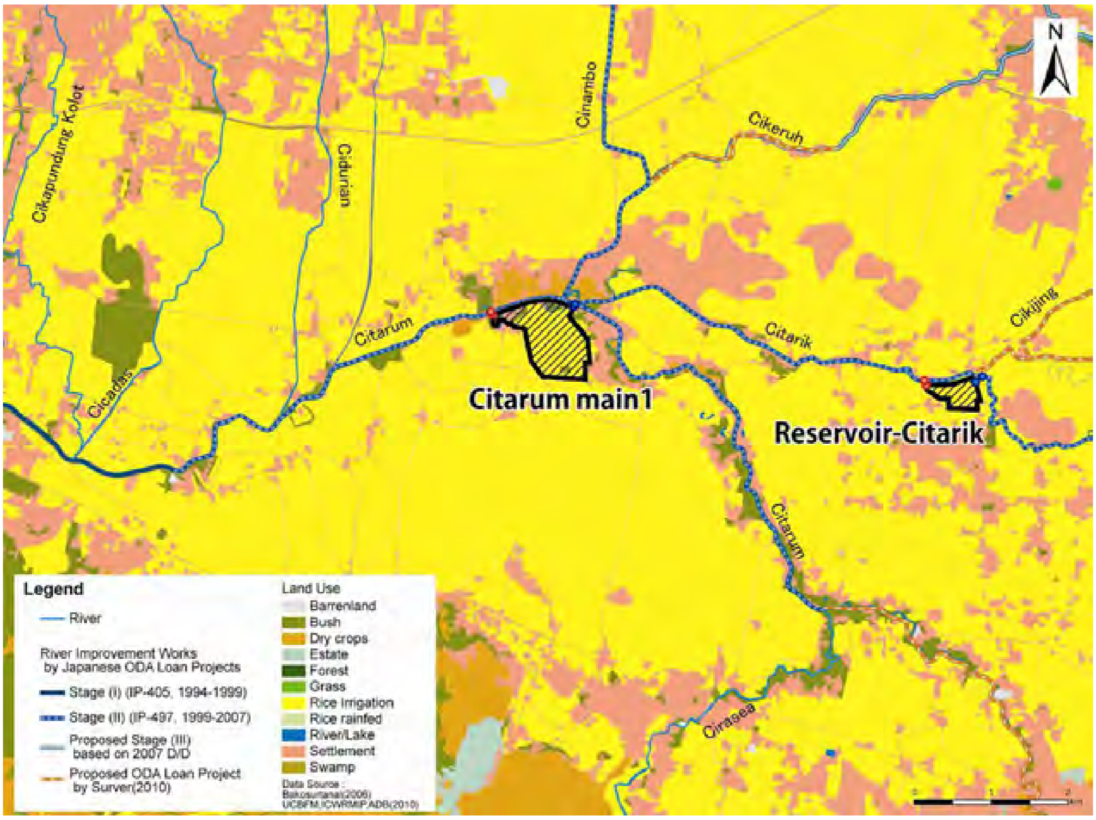
Location: Citarik before the confluence of Cimande (left bank)

Objective: To compensate for negative effects due to the improvement of Cimande and Cikijing and for the lack of flow capacity of Citarik's Stage (II) segment.

(2) Reservoir-2: Citarum Main Reservoir (left bank)

Location: Citarum mainstream at Sapan

Objective: To compensate for negative effects due to the improvement of Citarum upstream, Cimande, Cikijing and Cikeruh.



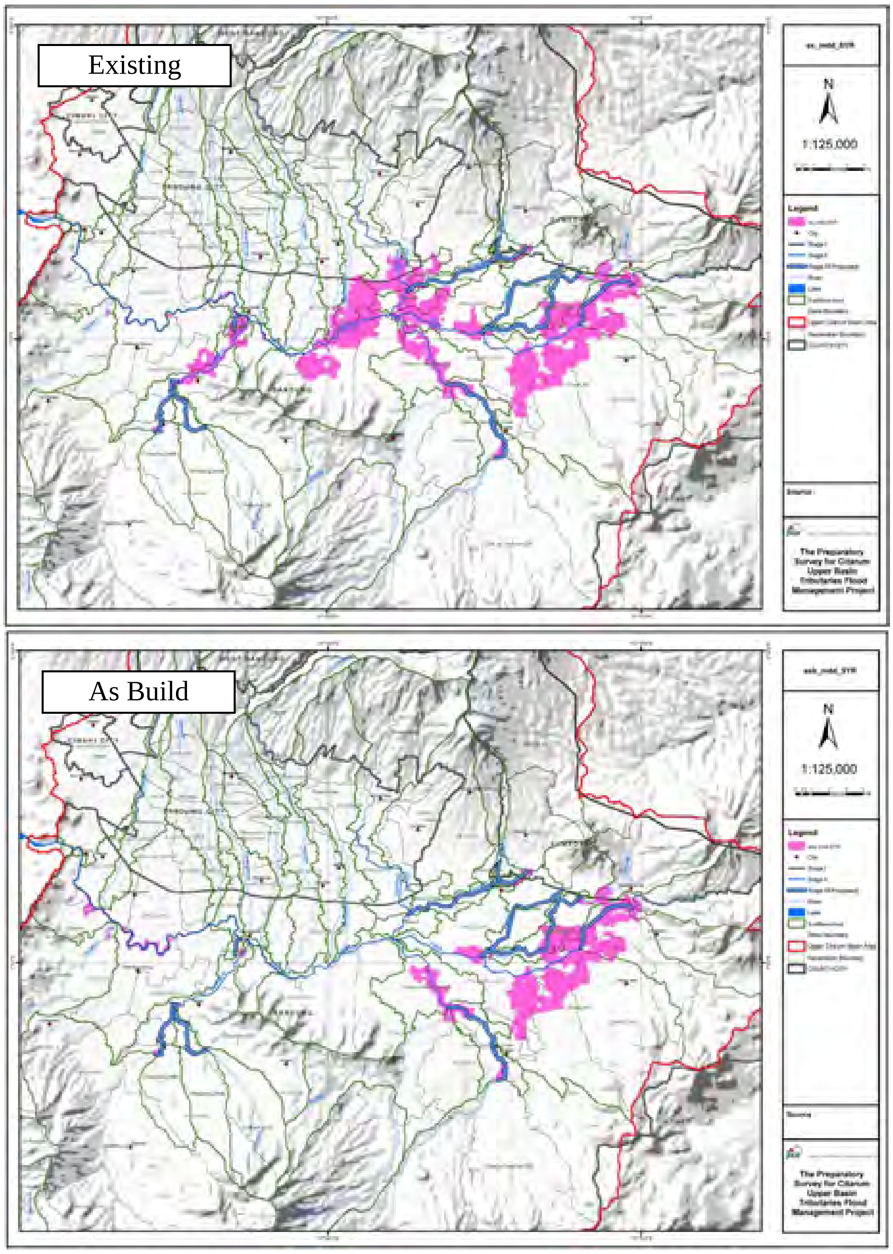
Source: JICA Survey Team

Figure 5.3.3.1 Location of the Reservoirs

5.3.4. Dredging Works for the Completed Sections during Stage (I) and (II)

As described in Chapter 2, sedimentation and riverbed rising was observed at the segments (e.g. Citarum main river) that were improved during the Stage (I) or (II) implementation periods.

Figure 5.3.4.1 shows the difference in inundation area with 5-year return period rainfall between “Existing” and “As Build” cross-sectional conditions along the Citarum main river. “Existing” means the cross-sectional condition in 2010, while “As Build” indicates the condition immediately after the completion of Stage (I) and Stage (II). As indicated in Figure 5.3.4.1, the flood extent will spread (from 2,722 ha to 5,168 ha in this case) if excavation works are not properly implemented. Thus, the excavation works are recommended prior to the river improvement works for the upper tributaries. This excavation work should be implemented as the main O&M activity of GOI.

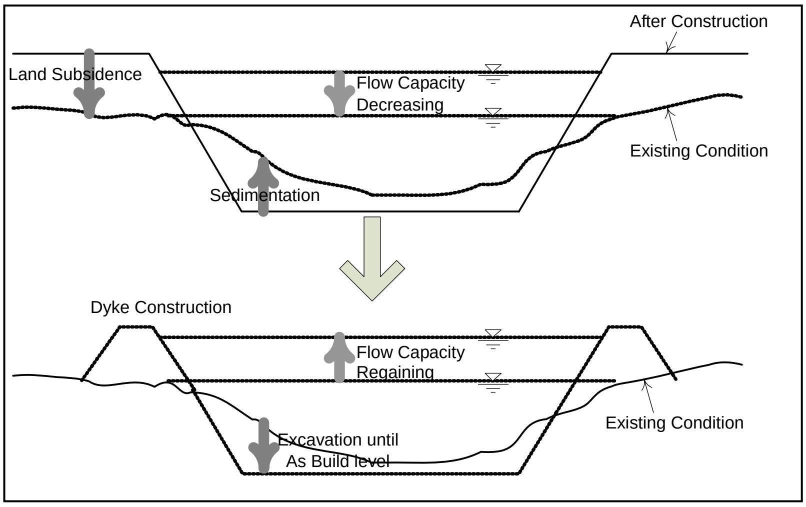


Source: JICA Study Team

Figure 5.3.4.1 Comparison of Inundation Areas with 5-year Return Period Rainfall between “Existing” and “As Build” Conditions for the Segments of Stage (I) and (II)

5.3.5. Dyke Construction near Dayeuh Kolot

Due to land subsidence, the bank level has become lower than the high water level and the flow capacity has narrowed along the Citarum and its tributaries at a subsidence area near Dayeuh Kolot. One solution to settle this problem is to construct dykes (polders) in the area to a level above the high water level. However, dyke construction requires a large amount of land acquisition in the settlement area of Dayeuh Kolot. Additionally, pump stations should be installed to drain subterranean inundated water.

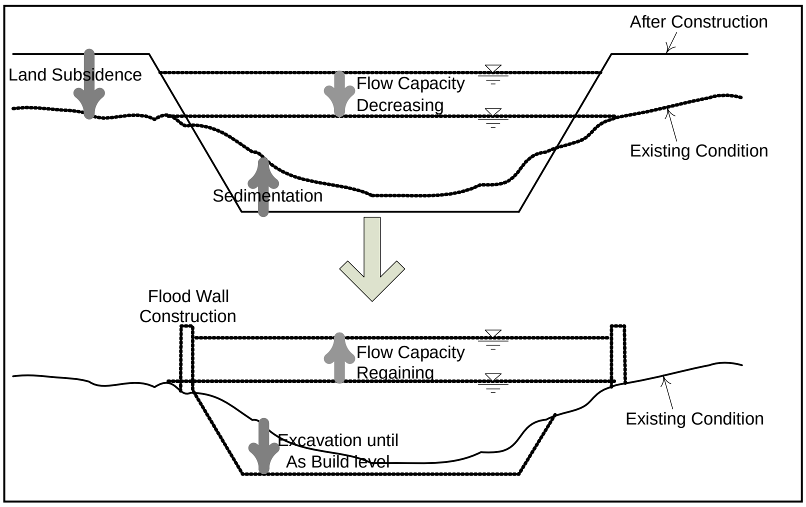


Source: JICA Survey Team

Figure 5.3.5.1 Dyke Construction near Dayeuh Kolot

5.3.6. Flood Wall Construction near Dayeuh Kolot

Flood wall construction can mitigate this problem because it requires less land than a dyke. Likewise, in the dyke construction case, pumping stations should be equipped and increasing of the flood wall will be required repeatedly depending on the extent of land subsidence.



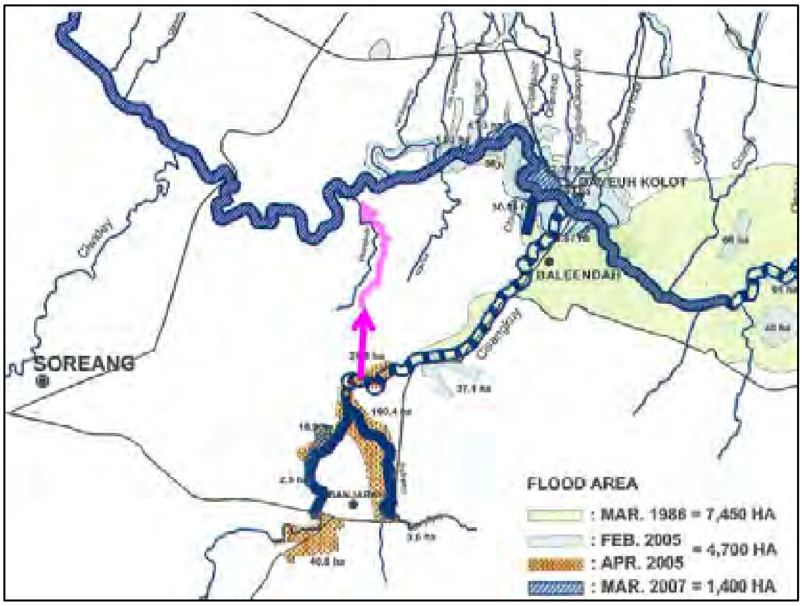
Source: JICA Survey Team

Figure 5.3.6.1 Flood Wall Construction near Dayeuh Kolot

5.3.7. Diversion Channel Construction

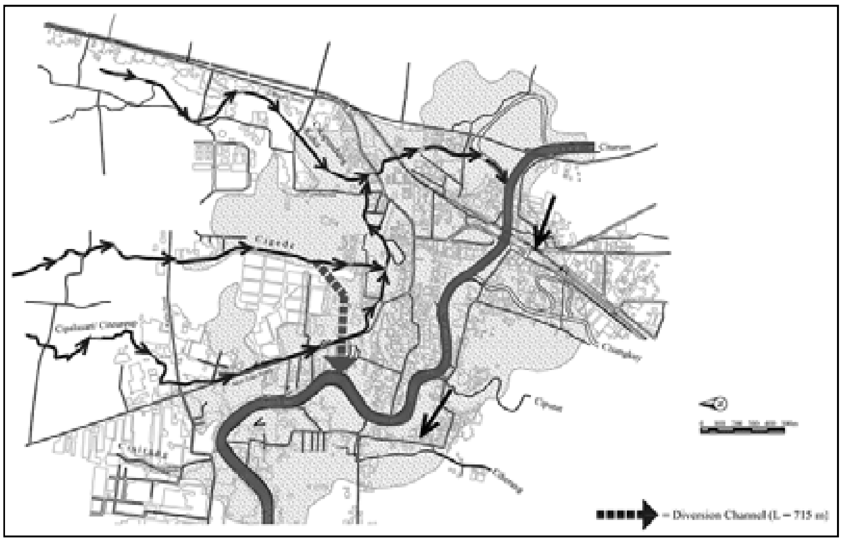
To reduce the negative impact on Dayeuh Kolot, the tributaries flowing into Dayeuh Kolot can be diverted to a different direction.

1) Cisangkuy to downstream Dayeuh Kolot (to Cicangkudu) (Refer to Figure 5.2.7.1)
2) Cidage and Citeureup for channel improvement at DK (Refer to Figure 5.2.7.2)



Source: JICA Survey Team

Figure 5.3.7.1 Diversion Plan-1 (Cisangkuy to Cicangkudu)



Source: JICA Survey Team

Figure 5.3.7.2 Diversion plan-2 (Cidage and Citeureup for channel improvement at DK)

5.3.8. Formulation of Selection Criteria

The following selection criteria were formulated in order to select prioritized sub-projects in terms of structural countermeasures. Refer to Table 5.3.9.1.

1) Flood Damage Potential
2) Flood Control Effect
3) Impact on Dayeuh Kolot
4) Houses to be relocated (Social Impact)
5) Acquisition of Agricultural Land (Social Impact)
6) Direct Cost
7) Existence of Detailed Survey Data

(1) Flood Damage Potential (unit: billion rupiah)

This indicates the flood damage potential based on the total amount of property in the flood areas of the 1986, 2005, 2006, 2007 and 2010 floods.

(2) Flood Control Effect (unit: billion rupiah)

This indicator shows the potential flood damage reduction amount due to the river improvement works for a 5-year return period flood.

(3) Impact on Dayeuh Kolot

This indicator shows the ratio between the increased discharge due to tributary improvement works and downstream river storage capacity, which shows the potential discharge impact on Dayeuh Kolot due to improvement works of each tributary. If the value is less than 1.0, the increased discharge due to tributary improvement works isn’t expected to cause serious impact on Dayeuh Kolot. If the value is greater than 1.0, the increased discharge due to tributary improvement works is expected to cause serious impact on Dayeuh Kolot.

- More than 1.0: Increased discharge due to tributary improvement works is expected to cause serious impact on Dayeuh Kolot.
- Less than 1.0: Increased discharge due to tributary improvement works will not cause serious impact on Dayeuh Kolot.
- Slight: Very small impact on Dayeuh Kolot due to improvement works
- None: No impact on Dayeuh Kolot due to improvement works
- "-": Not estimated

(4) Houses to be relocated (Social Impact)

An assessment on the possibility of large resettlement was carried out for each sub-project. The expected numbers of relocated houses were counted for the sub-projects for the tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug). The other sub-projects were also assessed following to the indicator as below:

- Large: Large-sized resettlement is expected.
- Not Large: Large-sized resettlement is not expected.

- "-": Not estimated

(5) Acquisition of Agricultural Land (Social Impact)

If a large agricultural land acquisition is required or not for each sub-project is considered. The expected areas of acquisition of agricultural land were estimated for the sub-projects for the 6 tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug). For other tributaries, the result is shown as below.

- Large: Expected to be large agricultural acquisition
- Not Large: Not Expected to be large agricultural acquisition
- "-": Not estimated

(6) Direct Cost

The direct costs were estimated for the tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug) including improvement works and excavation works. The direct costs for the retarding reservoirs (Citarum Main -1, Citarum Main -2, Citarum Main -3 and Citarik -1) along the Citarum main river were roughly estimated. Except for the estimated direct cost for tributaries, the cost was assessed with the three conceptual classifications (Large (>1,000 billion Rp.), Middle (between 10 billion Rp. and 1,000 billion Rp.) and Small (<10 billion Rp.)) based on past practices and experiences.

- Large: >1,000 billion Rp.
- Middle: between 10 billion Rp. and 1,000 billion Rp.
- Small: <10 billion Rp.
- "-": Not estimated

(7) Existence of Detailed Survey Data

This indicates the existence of detailed survey data.

- ○: Detailed survey results and drawings exist. Thus, it is possible to proceed to design analysis based on the results and drawings.
- △: Detailed survey results and drawings exist but are insufficient for design analysis. Surveying is necessary prior to design analysis.
- ×: Survey results and drawings do not exist. Surveying is necessary prior to design analysis.

5.3.9. Selection of Prioritized Sub-Projects (Short List) and Long List

Table 5.3.9.1 at the end of this chapter shows the results of the selection of prioritized sub-projects (Short List), Long List and the others.

(1) Long List

In this sub-section, the reasons for selection or exclusion of sub-projects from the possible countermeasures for the Long List are explained. The Long List consists of a series of candidate sub-projects included in the Project.

Some of the candidate sub-projects were excluded from the Long List. “Dredging Works for the Completed Sections during Stage (I) and (II)” cannot be included in the Long List (or excluded from the Project), since the dredging works for the completed sections during Stage (I) and (II) along the Citarum main river should be implemented as the ordinal O & M activity of GOI. “Installation of Flood Walls nearby Dayeuh Kolot” was also excluded from the Project, because it requires excessive costs in the aspect of the construction and operation & maintenance. Increasing the height of the flood wall will be required repeatedly depending on the extent of continuous land subsidence, which also increases the risk of potential flood damage in case of collapse of the wall. “Construction of Dyke nearby Dayeuh Kolot” was also excluded from the Project due to similar reasons. This also requires a large amount of resettlement. “Diversion Channel” was also excluded considering the excessive cost and resettlement. The utilization of oxbows along the Citarum main river as retarding reservoirs is not feasible from a technical point of view, since the oxbows have a limited effect in terms of flood control when there is excessive flood discharge.

Among the possible countermeasures, the countermeasures which satisfy the following features were excluded to result into the Long List.

- the ordinal O & M activity of GOI
- excessive costs in the aspect of the construction and operation & maintenance
- limited effect in terms of flood control

(2) Short List (Prioritized Sub-Projects)

In this sub-section, the reasons for selection of the Short List sub-projects taken from the Long List (or exclusion from the Short List) are explained. The Short List consists of a series of sub-projects with higher priority considering the selection criteria from the Long List. The short listed sub-projects are expected to be implemented during the Project. Any sub-project in the Short List can be interchanged with any sub-project on the Long List and vice versa under certain conditions. Refer to Chapter 10 for details.

The sub-projects of river improvement works for the other upper tributaries cannot be included in the Short List, since necessary survey results and drawings do not exist. Surveying is necessary prior to design analysis.

The sub-projects for retarding reservoirs along the Citarum main river also cannot be included in the Short List considering the significant social impact (Large-sized Resettlement).

As mentioned in 5.3.2 and Chapter 4, the 9 tributaries river improvement works were reviewed and deliberated from a technical viewpoint. As a result, the 6 tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream and Citalugtug) have been selected. Additionally, the Citarik Upstream, Cibeusi and Ciputat were excluded from the Short List.

From the remaining sub-projects for the 6 tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream and Citalugtug), the prioritized sub-projects were carefully examined and selected. Table 5.3.9.2 shows the indicators for “Flood Damage Potential”, “Flood Control Effect”, “Impact on Dayeuh Kolot”, “Social Impact (Houses to be relocated)”, and “Direct Cost” as a part of the selection criteria.

From the viewpoint of “Flood Damage Potential”, the Citarum Upstream, Cikijing and Cikeruh show a higher potential value, which means higher priority compared to the other three tributaries. The indicator “Flood Control Effect” indicates that a greater positive impact is expected from improvement works for Cimande, Cikijing and Cikeruh. Citalugtug was excluded from the Short List, since the flood control effect is much lower than the others. From the viewpoint of “Impact on Dayeuh Kolot” due to river improvement of the upper tributaries, Cisangkuy results in the most negative impact on Dayeuh Kolot and thus Cisangkuy was dropped from the Short List.

On the basis of the indicators of “Flood Damage Potential”,” Flood Control Effect” and “Impact on Dayeuh Kolot”, Citarum Upstream, Cimande, Cikijing, Cikeruh can be recommended.

However, it is necessary to consider the social impact due to river improvement. Taking the social impact into account, Cikeruh improvement is implemented to the downstream segment: 2.5km.

Table 5.3.9.2 Selection of Prioritized Sub-Projects (Short List) <Extraction from Table 5.3.9.1>

Tributary	Short List	Length	Flood damage Potential	Flood control effect	Impact on DK	Direct cost	Social impact Houses to be relocated
		m	Rp. Billion	Rp. Billion	-	Rp. Billion	house
Citarum Upstream	○	5,450	1,063	112	0.21	44.8	34
Cimande	○	9,510	196	1,147	Slight	44.5	16
Cikijing	○	6,680	513	563	Slight	44.0	40
Cikeruh(up to 2.5km)	○	2,500	557	626	Slight	21.9	34
Cikeruh(upstream)	-	5,150				77.7	156
Cisangkuy Upstream	-	3,730	188	82	1.67	40.3	25
Citalugtug	-	4,010	258	65	0.24	51.5	64

Source: JICA Survey Team

The profiles of Component A (Structural Countermeasures) of the proposed Project are explained in the next chapter (Chapter 6).

5.3.10. Replacement of Sub-Projects

As stated above, the Component A (Structural Countermeasures) is composed of 4 sub-projects as the results of selection of prioritized known as the Short Listed projects to be supposed to be implemented during the Project period. Any sub-project in the Short List can be interchanged with sub-projects on the Long List and vice versa under certain condition. The sub-project can be re-analyzed and proposed by GOI, if it satisfies the selection criteria as well as the conditions stated hereunder.

Readjustments will be made in a systematic manner within the overall objectives of the Project and carried out with appropriate due diligence. The sub-project selection criteria that will be adhered to for sector loan approval by JICA, include the requirement for sub-projects to be selected from the long list, assurances of sound technical and economic viability, and compliance with the Government and JICA environmental and social safeguards.

In order to change sub-projects, the procedures will be as follows:

(1) The BBWSC will prepare:

1) Project appraisal reports, including scope, technical viability assessments, cost, and financing and implementation arrangements.
2) An initial environmental examination and, if required, an environmental impact assessment.
3) A resettlement plan if required.
4) Economic, financial, and institutional analysis.

(2) Appraisal and concurrence of the proposed sub-projects by JICA.

5.4. Non-Structural Countermeasures

5.4.1. Draft of Possible Countermeasures

Compared to the progress of structural countermeasures in the Upper Citarum River Basin, there has been less progress in terms of non-structural countermeasures. It is indispensable to carry out the non-structural countermeasure along with structural measures. Based on the review of the relevant study reports/documents (*e.g*. 2007 D/D, M/P in 1988, *etc*.), a draft of candidate sub-projects or countermeasures from the possible countermeasures was created (Refer to Table 5.4.1.1).

Table 5.4.1.1 Draft of Candidate Sub-Projects for Non-Structural Countermeasures

Candidate Sub-Project or Countermeasures as Flood Control Countermeasures (Non-Structural Countermeasures)			
Non-Structural Measures	Floodplain Management	Preparation and delivery of Flood Hazard Map	
		Community Disaster Prevention Activity	Flood fighting activity
			Emergency Supply Goods Storage
			Education in School
			Evacuation Drill, etc.
		Institutional Strengthening	Rehabilitation of the System installed in Stage (II)
			Technical support and advise for the existing system and the future system of Indonesian side
			Land use regulation for flood-prone area
			Flood-proofing structure
	Runoff Storage and Infiltration Measures	Urban Area	On-site storage
			Infiltration Pavement
			Retention Area
		Upstream Recharge Area	Preservation of Forest
			Land use regulation

Source: JICA Survey Team

5.4.2. Profile of Activity for Non-Structural Countermeasures

The activities for Component B were selected through discussions with the relevant organizations of GOI (*i.e*. BBWSC, DGWR, BAPPENAS, *etc*.) and the Survey Team. Interview surveys were also carried out for the governmental agencies or individuals (*e.g*. BBWSC, Kabupaten Bandung, residents, *etc*.) in order to formulate the activities. Table 5.4.2.1 and 5.4.2.2 show the profiles of activities for non-structural countermeasures.

Table 5.4.2.1 Profile of Activity for Non-Structural Countermeasures (Institutional Strengthening for BBWSC)

Implementation Agency	Balai Besar Wilayah Sungai Citarum: BBWSC
Activity	1) Institutional Strengthening for Early Warning System (EWS) ・Strengthening of the existing Automated Water Level System (AWLS) for Early Warning ・Strengthening of Information Network System connecting Upper, Middle and Lower areas in the Citarum River Basin ・Strengthening Early Warning Communication System (PUSAIR, Kab., Kota, BPBD, Community) ・Data Storage and Data Accumulation for Reliable Early Warning System, *etc.* 2) Strengthening for Operation & Maintenance (O&M) ・Regular Monitoring for River Structure ・Regular Dredging as ordinal O&M activity, *etc.*

Source: JICA Survey Team

Table 5.4.2.2 Profile of Activity for Non-Structural Countermeasures (Capacity Development for Community against Flood Disasters)

Implementation Agency	BBWSC in associated with Community (Desa), Kab. Bandung and PUSAIR
Purpose	Coping Capacity against Flood Disaster will be strengthened or developed at community level.
Activity	1) Application of Flood Hazard Mapping prepared by ADB project 2) Reinforcement of Desa activity (LMD) through BBWSC supports (Temporary Flood Walls, Sand bags, Commodities, etc.) 3) Community discussion forum 4) Prevention education in school, Evacuation Drills, etc.
Outputs	The following capacity will be raised through the activities. 1) Establishment of Information flow network involving communities 2) Enhancement of Flood fighting capacity, evacuation, etc.

Source: JICA Survey Team

The detailed profiles of Component B (Non-Structural Countermeasures) of the proposed project are explained in the next chapter (Chapter 6).

5.5. River Basin Management

5.5.1. Draft of Possible Countermeasures

As mentioned previously in Chapter 3, many issues related to flood disaster have occurred such as: i) Land subsidence, ii) Heavy metal contamination, iii) Excessive sediment runoff and deposition, iv) a decrease in water quality of the river and reservoir, v) Waste disposal to river, etc. due to population increase, urbanization, and the increasing tempo of economic and social activities in the basin. Such issues cannot be dealt with by only flood control. The draft of candidate sub-projects or countermeasures from the possible countermeasures was created (refer to Table 5.5.1.1).

Table 5.5.1.1 Draft of Candidate Sub-Projects for River Basin Management

Candidate Sub-Project or Countermeasures as Flood Control Countermeasures (River Basin Management)				
River Basin Management	Sediment Discharge Control	Cirasea Sub-Watershed (11,500ha)	Sediment Discharge Control (Communities' participation)	Check Dam
				Small Check Dam
				Gully Plug
				Bank Conservation Works
				Farmland and Forest Land Conservation
				Establishment of Terrace
			Rain Water Runoff Control	Absorbing Well
			Supporting Activities	Road Construction & Improvement
				Irrigation System
				Water Supply
			Soft Measures	Environmental Enlighten
				Natural Resources Management
				Group Management
				Land Use Management
				Self-reliance
		Citarik Sub-watershed		
		Cikapundung Sub-watershed		
		Ciwidey Sub-watershed		
		Cisangkuy Sub-watershed		
	Measure for Old-channel	Measure for Garbage	Environment Improvement and People's education	
		Filling up		
	Measure for Land Subsidence	Control of Abstraction		
		Alternative Water Sources		
		Improvement of recycle of industry water usage		
		Relocation of Factory		
	Water Quality	Domestic Measure	Sewerage System	
			Septic Tank	
		Industrial Measure	Control of Effluent	
			Monitoring of Effluent	
			Effluent Treatment Facility	
		Non-point source	Agricultural measure to protect environment	
			Rainwater Storage	
	Measure for	People's education		
		Improvement of Garbage collection system		

Source: JICA Survey Team

5.5.2. Profile of Activity for Sediment Control

The activities for Component C for Sediment Control (River Basin Management) were selected through discussions with the relevant organizations of GOI (*i.e*. BBWSC, DGWR, BAPPENAS, *etc*.). The name of the component was titled "Component C for Sediment Control" through the discussion.

Table 5.5.2.1 Profile of Activity for Sediment Control as Component C

Construction of 5 check dams and 261 small check dams by participatory method at 24 target desa in Cirasea Sub-Watershed Empowerment for the people at the community level - Raising awareness of the necessity for improved environmental management - Raising the sense of ownership - Emphasizing the use of local resources for peoples' welfare

Source: JICA Survey Team

The profiles of Component C (Sediment Control) of the proposed project are explained in the next chapter (Chapter 6).

Table 5.3.9.1 Long List and Selection Results of the Sub-Projects (Structural Countermeasures)

Candidate Sub-Project or Countermeasures as Flood Control Countermeasures (Structural Countermeasures)					Dimension	Possible Counter-measures *1	Classification of Sub-Project (Countermeasure): Next ODA Loan: Long List *2	Next ODA Loan: Short List *3	Next ODA Loan: Excluded from Short List *4	Others: Counter-measures by GOI *5	Others: Others *6	Selection Criteria: Flood Damage Potential (B. Rp.) *7	Flood Control Effect (B. Rp.) *8	Impact on DK (-) *9	Social Impact: Houses to be relocated (house) *10	Social Impact: Acquisi-tion of Agri-cultural Land (ha) *11	Direct Cost (B. Rp.) *12	Existence of Detailed Survey Data *13	Remarks
Structural Countermeasures	Upper Tributaries	River Improvement Works	9 Tributaries	Citarum Upstream	L=5,450m	○	○	○				1,063.3	112	0.21	34	9.5	44.8	○	-
				Citarik Upstream	L=4,820m	○	○		○			320.0	−	Slight	-	-	Middle	○	As mentioned in Chapter 4, the sub-project for Citarik river was exluded from the Short List. Then, the indicators for "Flood Control Effect" and "Social Impact (Houses to be relocated, Acquisition of Agricultural Land)" were not estimated.
				Cimande	L=9,510m	○	○	○				196.4	1,147	Slight	16	26.7	44.5	○	-
				Cikijing	L=6,680m	○	○	○				513.4	563	Slight	40	18.6	44.0	○	-
				Cikeruh (downstream)	L=2,500m	○	○	○				556.6	626	Slight	34	6.9	21.9	○	-
				Cikeruh (upstream)	L=5,150m	○	○		○						156	5.3	77.7		-
				Cibeusi	L=1,360m	○	○		○			42.4	-	Slight	-	-	Middle	○	As mentioned in Chapter 4, the sub-project for Citarik river was exluded from the Short List. Then, the indicators for "Flood Control Effect" and "Social Impact (Houses to be relocated, Acquisition of Agricultural Land)" were not estimated.
				Cisangkuy Upstream	L=3,730m	○	○		○			188.1	82	1.67	25	12.6	40.3	○	-
				Citalugtug	L=4,010m	○	○		○			257.6	65	0.24	64	6.0	51.5	○	-
				Ciputat	L=660m	○	○		○			70.3	-	None	-	-	Middle	○	As mentioned in Chapter 4, the sub-project for Citarik river was exluded from the Short List. Then, the indicators for "Flood Control Effect" and "Social Impact (Houses to be relocated, Acquisition of Agricultural Land)" were not estimated.
			Other Tributaries	Cirasea	-	○	○		○			-	-	-	-	-	-	△	GOI has implemented the excavation works for 1km section in 2009. However, the survey needs to be implemented before the design since the existing survey map shows a limited part. Surveying is necessary prior to design analysis. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK,
				Cisunngala	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Cibodas	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Cicadas	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Cidurian	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Cikapundung	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Citepus	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
				Cikapundung Kolot	-	○	○		○			-	-	-	-	-	-	×	There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis. The indicators (Flood Damage Potentilal, Flood Control Effect, Impact on DK, Social Impact and Direct Cost) were not estimated.
	Citarum Main	Dredging Works for the Completed Sections during Stage (I) and (II)			-	○				○		-	○	-	Not Large	Not Large	Middle	○	The river excavation works for the main Citarum river should be implemented as the original O&M activity of GOI.
		Retarding Reservoir	Citarum Main -1		A=2,054,000m^2	○	○		○			-	○	None	Not Large	Large	115	×	This plan cannot be implemented urgently (or short term) considering the social impact, etc.
			Citarum Main -2		A=5,906,000m^2	○	○		○			-	○	None	Not Large	Large	328	×	This plan cannot be implemented urgently (or short term) considering the social impact, etc.
			Citarum Main -3		A=4,238,000m^2	○	○		○			-	○	None	Not Large	Large	237	×	This plan cannot be implemented urgently (or short term) considering the social impact, etc.
			Citarik -1 (after the confl. of Cimande)		A=175,000m^2	○	○		○			-	○	None	Not Large	Large	56	×	This plan cannot be implemented urgently (or short term) considering the social impact, etc.
			Oxbow		A=43,193m^2	○					○	-	×	None	Not Large	Large	Small	×	Oxbows have few positive effect in terms of flood control considering limited volume.
		Installation of Flood Walls nearby Dayeuh Kolot			-	○					○	-	○	-	Not Large	Not Large	Large	×	In the aspect of the construction cost and the operation & maintenance, this plan cannot be implemented urgently (or short term) due to its high cost, etc.
		Construction of Dyke nearby Dayeuh Kolot			-	○					○	-	○	-	Large	Large	Large	×	In the aspect of the construction cost and the operation & maintenance, this plan cannot be implemented as urgently (or short term) due to its high cost. The plan cannot be implemented considering the social impact.
		Diversion Channel			-	○					○	-	○	-	Large	Large	Large	×	This plan cannot be implemented urgently (or short term) considering the social impact, etc.

Source: JICA Survey Team

Note:
*1: Possible Countermeasures
- Possible Countermeasures in the Upper Citarum River Basin for reducing flood damages without regard to Term Classification (Short, Middle and Long)

*2: Long List
- A series of Candidate Sub-Projects for the Next ODA Loan Project
- The following countermeasures are excluded from "Possible Countermeasures":
  - Countermeasures to be improved by GOI as ordinal O&M activity
  - Countermeasures not included as sub-project for JICA Yen Loan considering a) Required budget is too large, b) Advanced Tech., Cost, Institution are necessary for O&M, etc.
  - Countermeasures not to be expected from the technical view point of flood control effect

*3: Short List
- Sub-projects selected as higher priority considering the Selection Criteria from Long List.

*4: Excluded from Short List
- A series of Sub-Projects which are lower priority. This type of Sub-Project can be implemented (short-listed) under certain conditions.

*5: Countermeasures implemented by GOI
- The countermeasure which is supposed to be implemented by GOI, thus excluded from the next ODA loan project.

*6: Others
- The countermeasure which is not expected to be implemented as urgent or prioritized measures.

*7: Flood Damage Potential (unit: billion rupiah)
- This indicates the flood damage potential based on the total amount of property in the flood areas of the 1986, 2005, 2006, 2007 and 2010 floods.
  "-": Not estimated

*8: Flood Control Effect (unit: billion rupiah)
- This indicator shows the potential flood damage reduction amount due to the river improvement works for a 5-year return period flood.
  ○: Potential flood damage reduction can be expected due to the construction works.
  ×: Salient flood damage reduction cannot be expected.
  "-": Not estimated

*9: Impact on DK
- This indicator shows the potential discharge impact on Dayeuh Kolot due to improvement works of each tributary or construction of river facility.
- The ratio between increased discharge due to tributary improvement works and downstream river storage capacity
  None: No impact on Dayeuh Kolot due to improvement works
  Slight: Very small impact on Dayeuh Kolot due to improvement works
  Less than 1.0: Increased discharge due to tributary improvement works will not cause serious impact on Dayeuh Kolot.
  More than 1.0: Increased discharge due to tributary improvement works is expected to cause serious impact on Dayeuh Kolot.
  "-": Not estimated

10*: Social Consideration in terms of Resettlement
- An assessment on the possibility of large resettlement was carried out for each sub-project.
- The expected number of relocated houses were counted for the sub-projects for the tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug).
- The other sub-projects were also assessed following to the indicator as below:
  Large: Large-sized resettlement is expected.
  Not Large: Large-sized resettlement is not expected.
  "-": Not estimated

11*: Social Consideration in terms of Acquisition of Paddy fields, etc.
- An assessment on the possibility of large acquisition was carried out for each sub-project.
- The expected area of acquisition of Agricultural land were estimated for the sub-projects for the tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug).
  Large: Large-sized acquisition is expected.
  Not Large: Large-sized acquisition is not expected.
  "-": Not estimated

12*: Direct Cost (unit: billion rupiah)
- The direct costs were estimated for the tributaries (Citarum Upstream, Cimande, Cikijing, Cikeruh, Cisangkuy Upstream, Citalugtug) including improvement works and excavation works.
- The direct costs for the retarding reservoirs (Citarum Main -1, Citarum Main -2, Citarum Main -3 and Citarik -1) along the Citarum main river were roughly estimated.
- Except for the estimated direct cost for tributaries and retarding reservoirs, the cost was assessed with the three conceptual classifications (Large, Middle and Small) based on the past practices and experiences.
  Large: >1,000 billion Rp.
  Middle: between 10 billion Rp. and 1,000 billion Rp.
  Small: <10 billion Rp.
  "-": Not estimated
- The cost should be estimated more accurately during the detailed design stage.

13*: Existence of Detailed Survey Data
  ○: There exist detailed survey results and drawings. Thus, it is possible to proceed to design analysis based on the results and drawings.
  △: There exist detailed survey results and drawings, but insufficient for design analysis. Surveying is necessary prior to design analysis.
  ×: There doesn't exist survey results and drawings. Surveying is necessary prior to design analysis.

CHAPTER 6 THE PROPOSED PROJECT

6.1. Project Components

The Project is composed of three components: 1) Component A: Structural Countermeasures, 2) Component B: Non-Structural Countermeasures and 3) Component C: Sediment Control. Each component is explained hereunder.

Table 6.1.0.1 Components of Proposed Project by the Survey

Component A	Structural Countermeasures	River improvement of Upper Citarum Tributaries	
		Sub-Project A1: Citarum Upstream	5.45 km
		Sub-Project A2: Cimande	9.50 km
		Sub-Project A3: Cikijing	6.68 km
		Sub-Project A4: Cikeruh Downstream	2.50 km
Component B	Non-Structural Countermeasures	- Institutional strengthening for BBWSC - Capacity development for the community against flood disaster	

Component C	Sediment Control	- Construction of 5 check dams and 261 small check dams by participatory method at 24 target desa in Cirasea Sub-watershed
		- Empowerment for the people at the community level
		  - Raising awareness of the necessity for improved environmental management
		  - Raising of the sense of ownership
		  - Emphasizing the use of local resources for peoples' welfare
		  - Strengthening institutions at the village level for community-based watershed management	

Source: JICA Survey Team

6.1.1. Component A: Structural Countermeasures

(1) Objectives

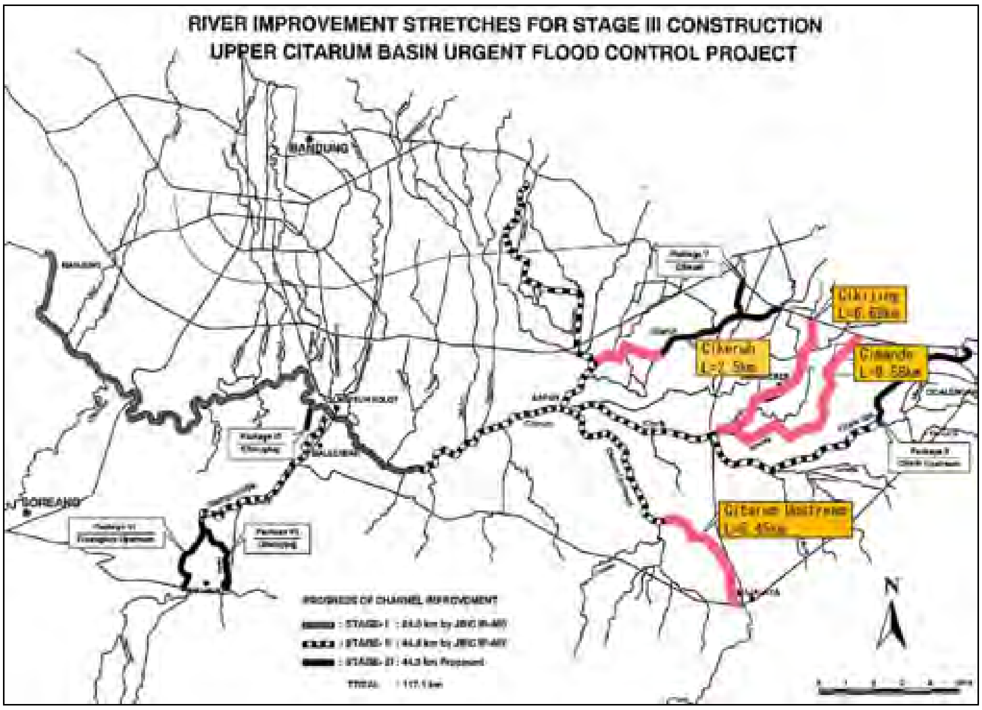
Component A (Structural countermeasures) is aimed at contributing to the completion of the Urgent Flood Control Plan through river improvement works for the upper tributaries: Citarum upstream, Cimande, Cikijing and Cikeruh downstream.

(2) Implementation Area

The locations of Citarum upstream (Kantren - Majalaya: 5.45km), Cimande (Langensari - Rancapanjang: 9.58km), Cikijing (Tanggeung - Cikijing village: 6.68km) and Cikeruh downstream (Ranca Kamuning - Ranca Bango village: 2.50km) are shown in Figure 6.3.1.1. Refer to the Appendix or the Annex attached at the end of this report for the plan view, longitudinal profiles and standard cross-sections.

(3) Construction Works

The river improvement works primarily involve channel normalization through channel excavation and bank slope protection, resulting in compensation works such as the replacement of bridges, irrigation weirs, culverts/sluice ways and groundsill. The profile of the construction works is briefly indicated in Table 6.1.1.1.



Source: JICA Survey Team based on a map in a pamphlet published by BBWSC.

Figure 6.1.1.1 Location of Selected 4 Tributaries

The required major construction works are as follows:

Table 6.1.1.1 Proposed Construction Works

River Name	Improved Distance	1. Bank Protection	2. Groundsill & Drop	3. Culvert & Sluice	4. Bridge			5. Irrigation Weir
					Road	Pedestrian	I/M Road	
Citarum Upstream	5,450	4,887	2	30	0	4	0	0
Cimande	9,510	2,162	6	36	3	3	1	1
Cikijin	6,680	1,720	4	26	3	4	0	1
Cikeruh Downstream	2,490	824	1	13	0	4	1	1
Total	24,130	9,593	13	105	6	15	2	3

Source: JICA Survey Team

The plan, longitudinal profile and standard cross section are shown in Appendix II.

Land acquisition and house resettlement compensation for each tributary are required prior to the implementation of the construction work. Refer to Chapter 8 for details. The quantities of land acquisition and compensation are summarized below:

Table 6.1.1.2 Land Acquisition/House Compensation around the Tributaries

River	Land Acquisition Area (ha)				No. House Relocation
	Agricultural Land	Residential Area	Idle Space	Total	
1. Citarum Upstream	9.5	1.9	1.2	12.5	34
2. Cimande	26.7	4.1	0.7	31.5	16
3. Cikijing	18.6	2.6	0.0	21.2	40
4. Cikeruh Downstream (up to 2.5km)	6.9	2.7	0.0	9.6	34
Total	61.7	11.3	1.9	74.8	124.0

Source: JICA Survey Team

6.1.2. Component B: Non-Structural Countermeasures

(1) Background and Objectives

The river improvement works for the upper tributaries for 1) Citarum Upstream, 2) Cimande, 3) Cikijing and 4) Cikeruh Downstream were selected as prioritized sub-projects for the Project. The return period for the design channel capacity is 5 years or less. Through channel improvement of the 4 tributaries, the flood peak runoff discharge will increase compared to present conditions.

To combat this runoff increase, the construction of a few retarding reservoirs along the Citarum Mainstream was examined in order to maintain the flood level at Dayeuh Kolot for 5-year return period floods after the improvement of the selected 4 tributaries. However, the sub-projects for retarding reservoirs along the Citarum main river cannot be included in the Short List of the Project upon considering the social impact (Large-sized Resettlement). The construction of the retarding reservoirs may be implemented after the Project completion, which is tentatively set as the year 2017 by the Survey. Thus, during the implementation of the Project, the flood safety level along the Citarum mainstream would be regarded as low.

Also, it has been clarified that the Stage (I) and Stage (II) sections were significantly aggraded. The GOI has been advised to conduct periodical dredging of the river channel of the Stage (I) and (II) sections in order to maintain the As Build cross section depth.

Considering the above circumstances, in addition to structural countermeasures such as channel improvement and retarding reservoirs, non-structural countermeasures should be implemented to ease the flood damage along the Citarum mainstream and other tributaries.

(2) Sub-components of non-structural countermeasures

The following sub-components are proposed for the Project.

- Institutional Strengthening for BBWSC
- Capacity Development for Community against Flood Disaster

As mentioned in Chapter 5, the activities of the sub-components are indicated in the tables below.

Table 6.1.2.1 Profile of Institutional Strengthening for BBWSC

Implementation Agency	Balai Besar Wilayah Sungai Citarum: BBWSC
Activity	1) Institutional Strengthening for Early Warning System (EWS) ・Strengthening of the existing Automated Water Level System (AWLS) for Early Warning ・Strengthening of Information Network System connecting Upper, Middle and Lower areas in the Citarum River Basin ・Strengthening Early Warning Communication System (PUSAIR, Kab., Kota, BPBD, Community) ・Data Storage and Data Accumulation for Reliable Early Warning System, *etc.* 2) Strengthening for Operation & Maintenance (O&M) ・Regular Monitoring for River Structure ・Regular Dredging as ordinal O&M activity, *etc.*

Source: JICA Survey Team

Table 6.1.2.2 Profile of Capacity Development for Community against Flood Disaster

Implementation Agency	BBWSC in associated with Community (Desa), Kab. Bandung and PUSAIR
Purpose	Coping Capacity against Flood Disaster will be strengthened or developed at community level.
Activity	1) Application of Flood Hazard Mapping prepared by ADB project 2) Reinforcement of Desa activity (LMD) through BBWSC supports (Temporary Flood Walls, Sand bags, Commodities, etc.) 3) Community discussion forum 4) Prevention education in school, Evacuation Drills, etc.
Outputs	The following capacity will be raised through the activities. 1) Establishment of Information flow network involving communities 2) Enhancement of Flood fighting capacity, evacuation, etc.

Source: JICA Survey Team

(3) Institutional Strengthening for BBWSC

The establishment of “River Basin Organization (RBO)” was a part of the main movement in the field of integrated water resources management after the enforcement of Water Resources Law (No.7/2004) in Indonesia. It is based on the concept that the operation of integrated water resources management has to be changed from a project-oriented basis into an organization-oriented basis. The Ministerial Regulation No.11A/PRT/M/2006 concerning “Criteria and Decision of River Basin Area” stipulates the river basin areas in which RBOs are supposed to manage integrated water resources. According to the regulation, the total of 69 river basin groups are to be directly controlled and managed by 31 UPTs (Technical Implementation Unit), established by MPW. UPTs consist of 11 offices of Balai Besar Wilayah Sungai (BBWS) and 19 offices of Balai Wilayah Sungai (BWS) throughout the country. BBWSC (Balai Besar Wilayah Sungai Citarum), established in 2007, belongs to one of the 11 BBWS offices. BBWSC has been preparing its organizational structure through budget acquisition and a gradual increase of staff, aiming to launch its activities as the core organization for IWRM of the whole Citarum River Basin including the Upper Citarum River Basin. Under the above mentioned situation, it is indispensable for BBWSC to implement institutional strengthening urgently, especially in the field of EWS (Early Warning System) and O&M (Operation and Maintenance).

(3)-1) Institutional Strengthening for Early Warning System (EWS)

Through interview surveys with BBWSC and a review of the relevant documents (*e.g.* 2007 D/D, *etc.*), the Early Warning System, which was installed during Stage (I) project, has malfunctioned because of accidents (*e.g.* struck by lighting, *etc.*), burglary, obsolete software systems, poor operation & maintenance, *etc.* It is necessary to review the current situation in detail and provide further analysis and discussions with BBWSC in order to establish a reliable and practical EWS for disseminating smooth and accurate early warning to the public. During the Project implementation period, BBWSC will be assisted by the EWS sub-component of Component B activity. Currently, the four items stated below are expected to be the main activities:

- Strengthening of the existing Automated Water Level System (AWLS) for Early Warning
- Strengthening of Information Network System connecting Upper, Middle and Lower sections in the Citarum River Basin
- Strengthening Early Warning Communication System (PUSAIR, Kab., Kota, BPBD,

Community)

- Storing and Accumulating Data for Reliable Early Warning System, etc.

1) Strengthening of the existing Automated Water Level System (AWLS) for Early Warning

BBWSC regularly operates an Automated Water Level System (AWLS) for water level measurement at several observatory stations distributed in the whole Citarum River Basin. The system was purchased from a German company by BBWSC. An operator can confirm the hourly water level at each observatory from BBWSC through a mobile telecommunication system from an operating PC. A few observatory stations have been installed in the Upper Citarum River Basin. Since the current system is a pull-based information distribution system, it is not convenient for the purpose of early warning. A push-based information distribution system will make it easier for accurate and smooth early warning activities (*e.g.* evacuation, flood fighting, *etc.*).

2) Strengthening of Information Network System connecting Upper, Middle and Lower sections of the Citarum River Basin

A conceptual plan has been discussed in terms of an integrated telemeter networking system connecting the upper, the middle and lower river basin areas in the whole Citarum River Basin. The system is not only aimed at early flood warning but also for the purpose of integrated water resources management. Technical assistance or advice is necessary for the realization of this integrated information system.

3) Strengthening Early Warning Communication System (PUSAIR, Kab., Kota, BPBD, Community)

The relevant governmental organizations are BBWSC, PUSAIR, BPBDs (Province, Kabupaten and Kota), LKD (Desa) at the community level, *etc.* Technical assistance or advice is necessary for those organizations in order to deliberate the most efficient and practical early warning communication system.

4) Storing and Accumulating Data for Reliable Early Warning System, etc.

It is recommended that a system for data collection, accumulation and storage should be established or improved so that reliable data can be accumulated for a more practical early warning system. In addition to rainfall and water level data, flood disaster data should be linked in a well-arranged manner.

For instance, the accumulation of disaster location maps for many years (*e.g.* 10 years, 20 years or more) helps in understanding the tendency of natural disasters. The combinational use of GIS (Geographical Information System) and GPS (Global Positioning System) may be useful for identifying accurate locations of disaster events. Another combination of GIS and application software enables the user to conduct simulation calculations for a more reliable and appropriate analysis. For the use of the application software for hydrology and hydraulic analyses, capacity development, especially for flood control engineering and sabo engineering, is necessary. Furthermore, with the combination of rainfall data and disaster damage data, an analysis on the relationship between rainfall and disaster events can be conducted. Based on the analysis, it may be possible to obtain a more accurate threshold rainfall amount or intensity, which in turn will provide more reliable data for early warning prior to a flood disaster. As a result, more appropriate and prompt emergency activities, such as early warning, rescuing, evacuation, *etc.*, can be realized.

(3)-2) Strengthening for Operation & Maintenance (O&M)

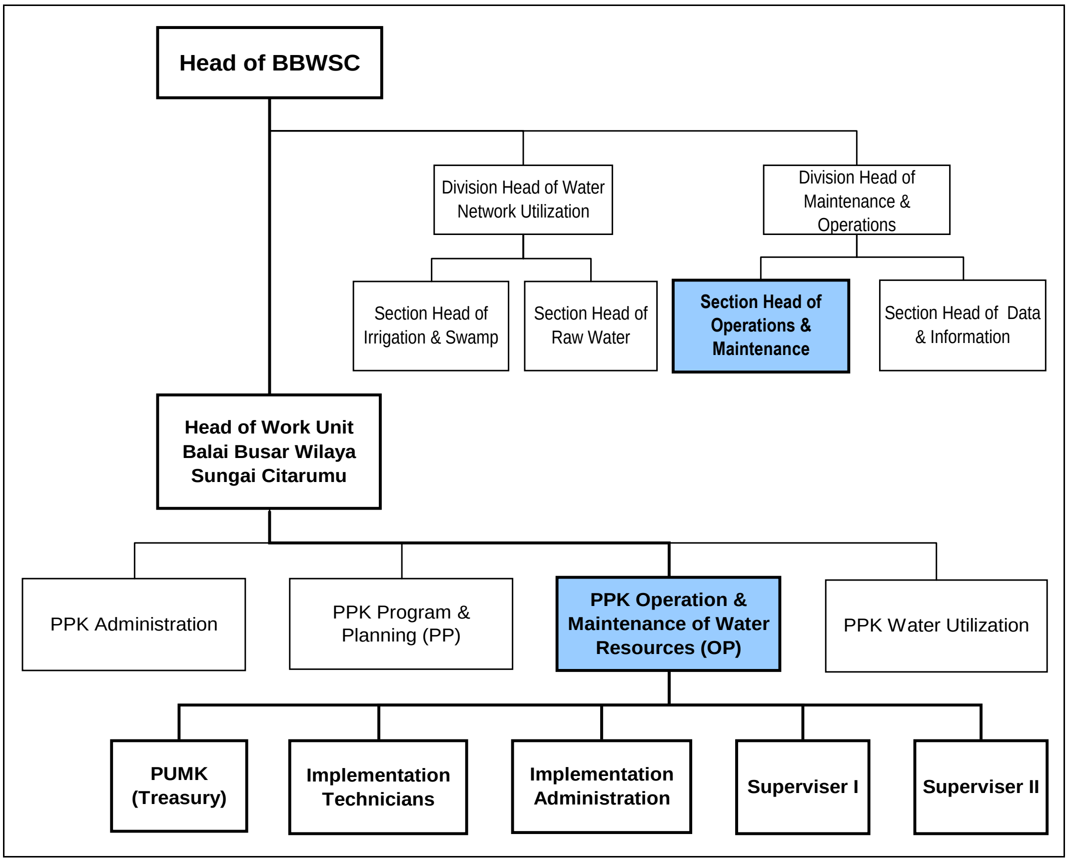
1) Operation and Maintenance (O&M) Organization

Section of Operation & Maintenance and PPK of Operation and Maintenance will be in charge of O&M of the Citarum River and its tributaries. (See Figure 6.1.2.1) The total number of O&M staff is 47 people, including 22 water watchmen as shown in Table 6.1.2.3.

Table 6.1.2.3 List of Staff for O & M

Staff	Number of Staff
Operator of Heavy Equipment	2
Technician	11
Administration	5
Finance	3
Hydrology Staff	4
Watchmen for Gates	22

Source: JICA Survey Team based on relevant documents and interview survey with BBWSC



Source: JICA Survey Team based on relevant documents and interview survey with BBWSC

Figure 6.1.2.1 O&M Organization in BBWSC

The O&M section has to consider the institutional issue that the guidance for River Operation and Maintenance is still being discussed in the Central Government since this matter involves a large amount of the budget to maintain the river on a regular basis. If sufficient funds and equipment are available, the maintenance of the river can be done regularly.

2) General Routine Maintenance Works by BBWSC

General routine maintenance on the river and damage to related facilities / structures is the main job of BBWSC. Expected future maintenance problems and proposed maintenance measures that will be managed by BBWSC are tabulated below.

Table 6.1.2.4 Maintenance Problems and Maintenance Measures

Expected Future Maintenance Problems	Proposed Maintenance Measures
River Channel	
Sedimentation in the river channel	Periodic dredging at a minimum of once a year
Bank erosion due to flow or other factors	Renovate excessive erosion, especially near structures
Deposit in the river channel due to excessive dumping of garbage	Periodic removal at a minimum of once a year
Obstructive growing of trees on river bank	Periodic cleaning at a minimum of once a year
Clogging of garbage / floating trees at the bridge piers	Periodic cleaning at a minimum of once a year, especially after floods
River Structure	
Damage on revetment due to local erosion especially in the foundation	Inspect every other month and immediately reconstruct if damaged
Damage of inspection road pavement	Monthly inspection and immediate rehabilitation if damaged
Environmental Problems	
Illegal garbage dumping into river / flood plain	Enlighten people through capacity development
Environmental degradation of oxbows	Periodic cleaning at a minimum of once a year

Source: JICA Survey Team based on relevant documents and interview survey with BBWSC

Due to the lack of budget, the present O & M activities are limited to only sediment excavation and repair and protection of collapsing slopes. In this year, PKK O&M dredged the Citarum River between Ciputat and Baleendah Bridge and increased the height of parapet / retaining wall by 0.5m at Cieunteung Village. These works are simple and require a small budget. Large scale O&M works will usually be tendered. The O & M budget of BBWSC since 2007 is shown below.

Table 6.1.2.5 O & M Budget in BBWSC

(unit: Rp. Billion)

Budget	2007	2008	2009	2010
O&M Budget (Requested)	6	6	6	6
O&M Budget (Accepted)	2.22	4.176	1.821	4.15
% of Requests accepted	37%	70 %	30 %	69 %

Source: BBWSC

In order to minimize the occurrence of floods, excavation of sediment deposit in the river is one of the most important maintenance activities.

According to a BBWSC officer, for routine maintenance of the Upper Citarum River, especially for the excavation / dredging of sediment deposits, the heavy equipment required includes at least 3 standard excavators, 3 long arm excavators, 2 loaders, 2 dozers and 2 baby rollers.

However, the amount of existing O & M equipment is very limited. The number and kinds of equipment and their condition are shown below. No new equipment has been bought since 2007.

Table 6.1.2.6 Existing O & M Equipment List

Equipment	Specification	Quantity	Remarks
Dump Truck	4t	2	1 out of order
Truck		2	1 out of order
Excavator	PC.100, PE.200	2	Minor damage
Loader		2	Minor damage

Source: JICA Survey Team based on relevant documents and interview survey with BBWSC

The existing heavy equipment is still under the management of the Division of Administration, and has not yet been handed over to O&M management.

3) Existing Problems Related to O & M

The Operation and Maintenance manual for river facilities was prepared in December 2007 during the Upper Citarum Basin Urgent Flood Control Project (II). The manual indicated that there are many problems regarding operation and maintenance in the Upper Citarum River and its tributaries. These problems are caused not only by nature but also by inappropriate human behavior. The degraded river environment worsens flood damage along the river. The following are problems recognized in the Project area (Table 6.1.2.7).

Table 6.1.2.7 Problems/Issues in terms of O & M

- Clogging of garbage / floating trees at bridge piers with narrow span
- Obstructive growing of vegetation in high water channel beds and bank slopes
- Sediments in the river channel due to excessive garbage dumping
- Illegal vegetative cultivation on the levee slopes and high water channel beds
- Illegal extraction of riverbed and bank materials
- Damage to paved roads
- No maintenance roads
- Backwater effect due to improper operation and maintenance of irrigation weir and its narrow span of piers
- Illegal garbage dumping into river
- Dumping of garbage in the flood plain
- Disposal of human waste into the river
- Disposal of insufficiently treated industrial waste into the river
- Ineffective use of the old river by short cut.

Source: JICA Survey Team based on relevant documents and interview survey with BBWSC

The underlying causes of these above-mentioned problems are based on complicated and intimately intertwined social problems. Nevertheless, from the viewpoint of river environmental management, BBWSC should enforce monitoring and adherence of regulations on illegal human activities such as garbage dumping, disposal of industrial / human waste into the river, *etc.*

During the Project implementation period, BBWSC will be assisted by the O & M sub-component of Component B activity. Currently, the two items stated below are expected to be the main activities:

- Regular Monitoring for River Structure
- Regular Dredging as ordinal O&M activity, etc.

4) Regular Monitoring for River Structure

It is a principal activity of BBWSC to carry out regular monitoring for river structures in order to maintain the functionality of the river network in the Upper Citarum River Basin. Based on an interview survey with BBWSC, insufficient budget allocated to BBWSC impedes their regular monitoring properly. The risk of malfunctioning of the river network (*e.g.* flood protection, water use and environmental management, *etc.*) will increase if proper continuous O & M activities are not carried out. BBWSC will be effectively assisted through technical assistance and advice for activities such as a river reconnaissance survey for the Citarum River and its major tributaries.

5) Regular Dredging as ordinal O&M activity, etc.

Sedimentation caused serious a reduction in the flow capacity at the segment improved in Stages (I) and (II). Such river dredging works for the main Citarum River should be implemented as the ordinal O & M activity of GOI or BBWSC. The necessary technical assistance and advice will be provided during the Project.

(4) Capacity Development for Community against Flood Disaster

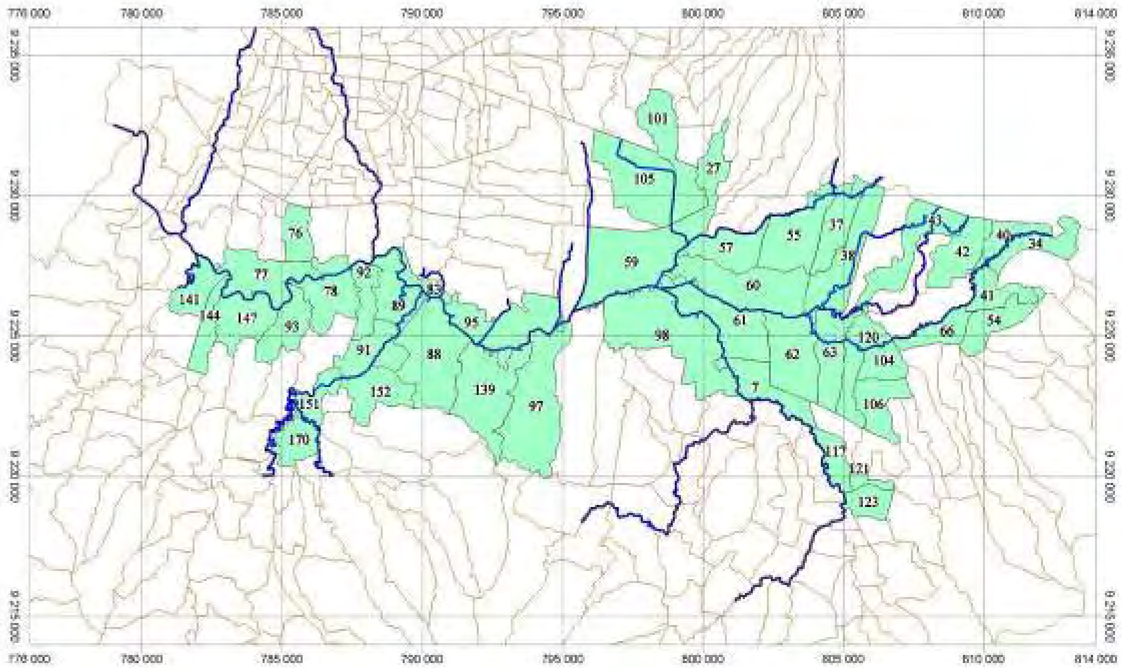
In order to strengthen social resilience against flood disasters in the Upper Citarum River Basin, in addition to depending on the structural countermeasures by the government, non-structural countermeasures and capacity development at the community level are indispensable activities.

During the Project period, the communities (*e.g.* desa, *etc.*), which will be selected, are to be assisted by a sub-component of Component B. Currently, the four items stated below are expected to be the main activities:

- Reinforcement of desa activity (LMD) through BBWSC supports (Temporary Flood Walls, Sand bags, Commodities, etc.)
- Community discussion forums
- Prevention education in school, Evacuation Drills, etc.
- Application of Flood Hazard Mapping prepared by ADB project

(4)-1) Target community (desa)

The basic unit in terms of the actual activity location should be regarded as village (desa). The figure and table below show the locations and names of the villages in the Upper Citarum Basin in which the flood affected settlement area in the 2010 flood was larger than 10 ha. In these villages, communities are expected to exist. This list is of candidate villages and is to be used as a reference at this time. The actual target villages will be decided by the Consultant based on the discussion with BBWSC and other concerned agencies in the course of the consulting services during the Project.



Source: JICA Survey Team

Figure 6.1.2.2 Location of Candidate Villages (Desa) for Floodplain Management

Table 6.1.2.8 List of Candidate Villages (Desa) for Floodplain Management

ID	Name of Village	Affected Settlement Area in 2010 Flood (m2)	ID	Name of Village	Affected Settlement Area in 2010 Flood (m2)
7	DESA RANCAKASUMBA	128,223	89	KEL. ANDIR	782,830
27	DESA CIBIRU HILIR	160,738	91	DESA MALAKASARI	119,845
34	DESA PANENJOAN	265,971	92	DESA BOJONGMALAKA	181,547
37	DESA RANCAEKEK WETAN	1,033,477	93	DESA SUKAMUKTI	272,532
38	DESA BOJONG	567,822	95	DESA BOJONGSARI	148,812
40	DESA NANJUNGMEKAR	145,295	97	KELURAHAN JELEKONG	147,601
41	DESA BOJONGSALAM	141,631	98	DESA SUMBERSARI	247,988
42	DESA CANGKUANG	289,072	104	DESA PADAMUKTI	118,065
43	DESA LINGGAR	199,066	106	DESA PANYADAP	335,437
54	DESA TANJUNGLAYA	127,879	117	DESA MAJALAYA	318,751
55	DESA RANCAEKEK KULON	332,091	120	DESA CIBODAS	143,510
57	DESA TEGALSUMEDANG	332,667	121	DESA MAJAKERTA	289,807
59	DESA TEGALLUAR	364,790	123	DESA SUKAMANAH	267,257
60	DESA SUKAMANAH	1,421,294	139	KELURAHAN MANGGAHANG	180,125
61	DESA BOJONGEMAS	198,911	141	DESA CILAMPENI	386,613
62	DESA SOLOKANJERUK	182,090	144	DESA PANGAUBAN	143,642
63	DESA LANGENSARI	204,543	147	DESA SANGKANHURIP	270,916
66	DESA SANGHIANG	174,483	151	DESA SUKASARI	225,040
76	DESA SUKAMENAK	152,456	152	DESA LANGONSARI	132,044
77	DESA SULAEMAN	320,363	170	DESA TARAJUSARI	100,039
78	DESA RANCAMANYAR	322,294	101	KEL. MEKARMULYA	144,449
83	DESA DAYEUHKOLOT	122,252	105	KEL. CISARANTEN KIDUL	110,328
88	KEL. BALEENDAH	654,180			

Source: JICA Survey Team

(4)-2) Reinforcement of Desa activity (LMD) through BBWSC supports (Temporary Flood Walls, Sand bags, Commodities, etc.)

At community level (*e.g.* desa, kecamatan, *etc.*), a committee, which is called "LMD", is the responsible body for the relevant activities in terms of flood disaster. Some villages (desa) construct a temporary flood wall along the river or channel, consisting of bamboo wall and sandbags, as flood fighting activity prior to flood events in order to reduce the damage to a minimum. Such materials (*e.g.* bamboo, sandbags, *etc.*) are to be provided by BBWSC for assisting community level flood countermeasure activities. During the Project, this activity will be reviewed and strengthened if necessary. The review will be performed by the Consultant and further development of the current system will be discussed among BBWSC, LMD (desa), NGO and the Consultant. Further, technical assistance or advice will be provided by the Consultants for publishing the flood fighting activities in order to disseminate such activity to the other desa in the Upper Citarum River Basin. The dissemination activity will be mainly carried out by NGO under the supervision of the Consultant and BBWSC.

(4)-3) Community discussion forums

A series of community discussion forums will be held regularly by the initiative of BBWSC in order to strengthen close coordination between the governmental agencies and the communities (desa/kecamatan) on a regular basis so that early responses in emergency situations can be possible such as early warning dissemination, flood fighting, rescue, evacuation, *etc.* Further, the needs of the people living in the flood hazard area can be identified through the forum. Capacity development at community level will be achieved through the forums. The expected needs from the community level may include the following:

- Establishment of an information flow network involving communities
- Disaster prevention education in school
- Enhancement of flood fighting
- Evacuation drills
- Introduction of flood proofing houses
- Land use regulations
- Rehabilitation of Early Warning System (equipment)

The matters mentioned above are summarized in the table below (Table 6.1.2.9). The detailed activities and output of each stakeholder are indicated in Table 6.1.2.10.

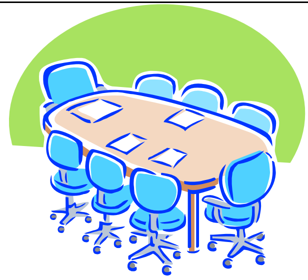
Table 6.1.2.9 Profile of Community Discussion Forum Activity

1 Sub-component	Community Disaster Prevention Activity
2 Purpose	Identification of the needs of the people living in the flood hazard area. The needs are to be confirmed as pre-disaster phase and post-disaster phase regarding flood damage mitigation.
3 Activity (Input)	Holding a series of discussion forums (community “desa/kelurahan” based). Holding a series of discussion forums (local government “kecamatan” based).
4 Output	The needs of the people living in the flood hazard area. For example, the following can be expected as conclusions of the discussion. (1) Establishment of an information flow network involving communities (2) Disaster prevention education in school (3) Enhancement of flood fighting (organization) (4) Introduction of flood proof houses (5) Evacuation Drills (6) Land use regulations (7) Rehabilitation of Early Warning System (equipment)

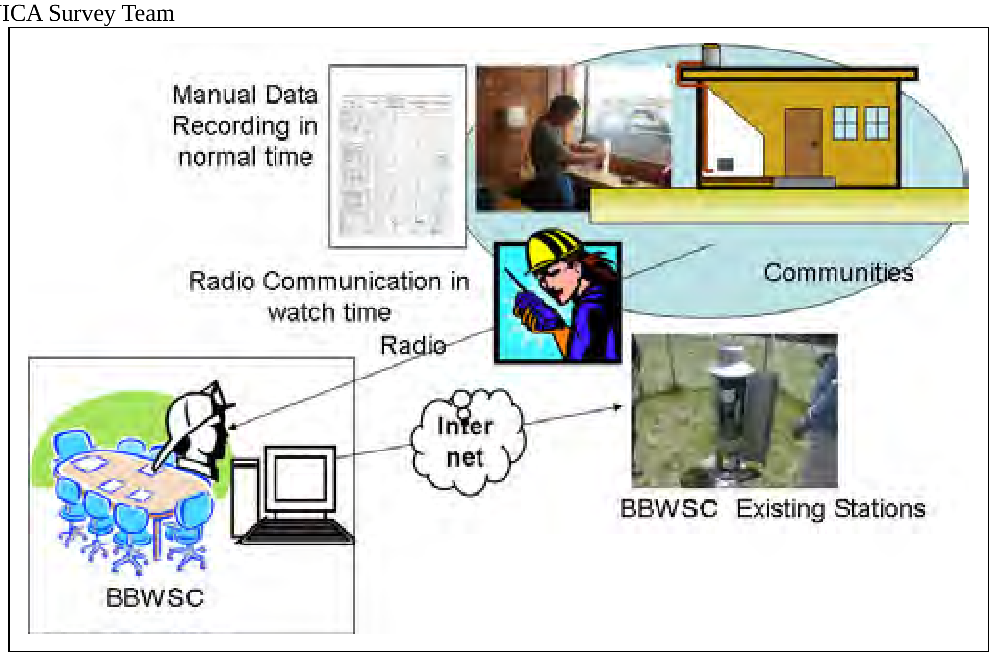
Source: JICA Survey Team

Table 6.1.2.10 Activities and Output of Each Stakeholder for Community Disaster Prevention Activity

Stakeholder	Activity	Output
BBWSC Bandung City	Holding a series of discussion forums (community “desa/kelurahan” based). One forum will be composed of 3-4 villages. The number of forums to be held is 3	List of the needs regarding community disaster prevention resulting from the discussion forums.

	times per session. The agenda of the forums shall be as follows: 1st Forum: Introduction of Flood Hazard Map to people 2nd Forum: Questionnaire and Interview survey to people regarding their needs on disaster prevention 3rd Forum: Summarization of the people's needs	
BBWSC Bandung City	Holding a series of discussion forums (local government "City" basis). The members of the forum shall be BBWSC, Bandung City and representatives of the villages which are not limited to the selected 10 villages.	Formulation of urgent measures as the government for the community disaster prevention.
BBWSC	Establishment of a local-based early warning system. The present BBWSC early warning system is one that can be accessed only by the BBWSC at the hydrological stations via the Internet when they need hydrological information. The aim is to involve the local people (*1) in the monitoring of water levels and rainfall data. The local people are to watch the existing BBWSC stations and when they recognize the critical level (standby or watch level) to inform the BBWSC of the situation. This collaboration among the local people and BBWSC will be held for 1 year in Stage (III).	Establishment of a local-based early warning system in which the people can understand the meaning of the hydrological data and the early warning criteria.

Note: (*1): One group of watchmen for each selected village. The group shall be provided with a hand-held radio for communication with BBWSC.
Source: JICA Survey Team



Source: JICA Survey Team

Figure 6.1.2.3 Image of Establishment of a Local-based Early Warning System

(4)-3) Prevention education in school, Evacuation Drills, *etc.*

Disaster education at the school level is very important for raising public awareness for flood disaster management at community level. Propagation of knowledge from children to their parents can be expected after lectures at the school level. In general, lectures are taught by teachers in school; however, lectures on flood disaster reduction including governmental activities can be delivered by BBWSC. In addition, evacuation training or flood fighting training can be carried out to raise awareness at the community level.

(4)-4) Application of Flood Hazard Mapping prepared by ADB project

The flood hazard mapping components will provide unofficial, technical information on the flood hazard areas in each community to the related government and the target communities. Currently, an ADB project is providing technical assistance to PUSAIR for strengthening flood simulation model analysis, and further similar assistance will be provided by the Grant Aid Project from the Netherlands Government for the next 5 years. During the course of the Project implementation, BBWSC or the Consultant will be able to coordinate with this activity which means that PUSAIR can be expected to delineate the flood hazard area maps (*e.g.* several patterns of return period: 100-year, 50-year, 20-year, *etc.*) using flood simulation model analysis. The flood map can be utilized for multiple purposes.

The above mentioned matters can be summarized in the table below (Table 6.1.2.11). The detailed activities and output of each stakeholder are indicated in Table 6.1.2.12.

Table 6.1.2.11 Profile of Flood Hazard Map

1 Sub-project Name	Preparation of Flood Hazard Map
2 Purpose	Identification of Flood Hazard Areas and the resultant flood risk for specific return period Providing reference information on the flood hazard and risks to the affected people and the local related organizations such as the government and other public groups.
3 Activity (Input)	Topographical Survey of floodplain GIS Data Collection Hydrology and Hydraulic modeling and analysis
4 Output	Hazard Map (scale 1:5,000) identifying the flood hazard area and the extent of the flood risk that can be used for community activities and land use regulation

Source: JICA Survey Team

Table 6.1.2.12 Activities and Output of Each Stakeholders for Preparation of Hazard Map

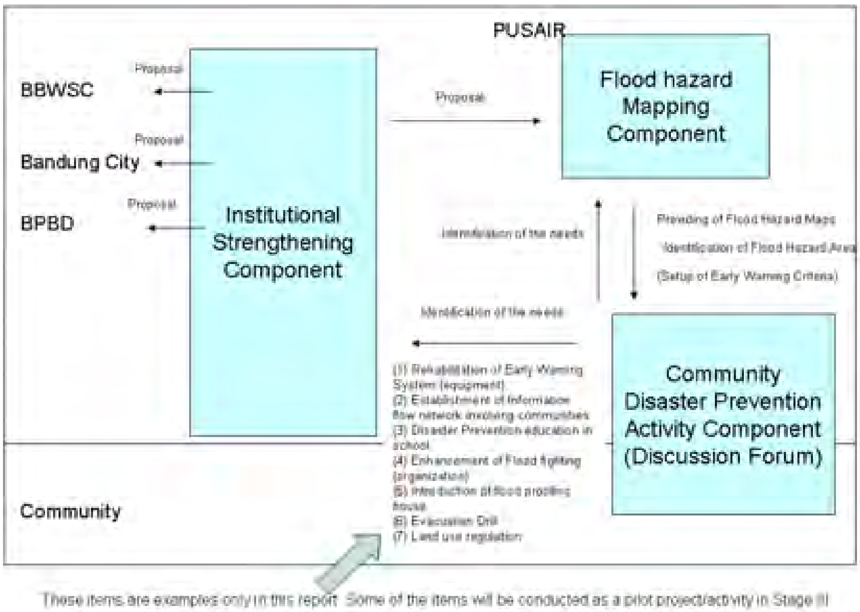
Stakeholder	Activity	Output
BBWSC	Topographical Survey of floodplain	Topographical Survey of floodplain ($60km^2$)
PUSAIR	GIS Data Collection Hydrology and Hydraulic modeling and analysis Setting up tentative early warning system	Flood Hazard Map (scale 1:5,000) for the selected 10 villages (*1) Early warning system
BBWSC	Delivery of the Flood Hazard Maps to Bandung City	Local villages under Bandung City receive the flood hazard maps (*2)

Note:
*1: The selection of the villages will be done by Bandung City and BBWSC among the villages listed in Figure 6.3.2.3 and Table 6.3.2.8.
*2: The return period of the flood is 5 and 20 years. The map should contain the information of outline of houses/buildings, streets and flood depth. Other information will be added in the course of the community disaster prevention activities.
Source: JICA Survey Team

(5) Relationship among Sub-components of Component B (Non-structural countermeasures)

The conceptual relationship among these sub-components is illustrated as follows. The flood hazard mapping components will provide unofficial, technical information on the flood hazard areas in each community to the related government and the target communities. The community disaster prevention committees will hold a series of discussions based on the provided hazard map and identify their own needs for flood damage mitigation. Some conceivable examples are shown in Figure 6.1.2.4 below. The institutional strengthening proponents will review and analyze the identified needs in the community disaster prevention meetings and propose effective solutions to the related organizations.

Some of the identified needs in the community disaster prevention component should be implemented as a pilot project. The cost for the pilot project is included in the Stage (III) loan amount in the budget. Confirmation on use of the budget for the pilot project will be discussed by the Indonesian side and approved by BBWSC.



Source: JICA Survey Team

Figure 6.1.2.4 Relationships among Sub-components of Component B

One part of the non-structural countermeasures is technical assistance. The section of component B related to this is Institutional Strengthening for Flood Damage Mitigation for both governmental and community levels. This component intends to aid the government in accomplishing the identified needs related to Community Disaster Prevention Activities.

6.1.3. Component C: Sediment Control

(1) Background

Upper Citarum Basin Tributaries Flood Management Project is now under preparation and the management of sediment discharge is one of the most important issues for improving the basin to a desirable condition. In 1997 the GOI implemented the Upland Plantation and Land Development Project (UPLDP) at Citarik Sub-watershed, one of the most degraded sub-watersheds of the Upper Citarum Basin, under a Japanese ODA loan and completed the project in December 2006. In December 2008, JBIC (currently called JICA) carried out the Ex-post evaluation of the project. The report described that the sediment discharge had improved. The Ex-post evaluation also interviewed a selected 120 households regarding the environmental aspects. The results showed that 39 households answered that the sediment discharge was reduced. This shows the effectiveness of sediment control through LRSC (Land Rehabilitation and Soil Conservation) activities with terrace construction and vegetative treatment.

During the implementation of UPLDP, the surveys of the other four Upper Citarum sub-watersheds namely Cikapundung, Ciwidey, Cisangkuy, and Cirasea were carried out and the Development Plan was established. The Cirasea Sub-watershed is the most critical area in terms of soil loss among the four sub-watersheds surrounding Bandung City. In accordance with the study mentioned above, Cirasea is also the area with the highest soil loss amount to be controlled and highest in terms of LRSC cost performance among the four sub-watersheds. Consequently, the Cirasea Sub-watershed has been selected as the priority project area.

Component C is part of the activities of the Development Plan and in this project, though the efectiveness is limited, it is expected to be a herald of future watershed management of the Upper Citarum Basin.

(2) Objectives

The objective of this component is to minimize the negative effects on the river caused by sediment discharge. By construction of sediment control facilities in streams, sediment discharge to the river will be controlled.

(3) Scope of the Component

In order to minimize the negative effects of sediment discharge, check dams and small check dams will be constructed through communities' participation. In addition to this construction, the following empowerment of communities will be carried out with the help of NGO.

1) Raising awareness of the necessity for improved environmental management
2) Raising of the sense of ownership (to develop communities' sense of belonging for local natural resources)
3) Emphasizing the use of local resources for peoples' welfare
4) Strengthening institutions at the village level for community-based watershed management

(4) Implementation Area

The Cirasea Sub-watershed, is located in the upper reaches of the Citarum River, and consists of 55 desa in 7 kecamatan. The proposed Project area is extended to 24 desa in 5 kecamatan in the Cirasea Sub-watershed, which has been designated as critical land with high soil loss. Table 6.1.3.1 shows the soil loss conditions of all the desa in the Cirasea Sub-watershed. The target 24 villages (desa) are shown in yellow in Table 6.1.3.1.

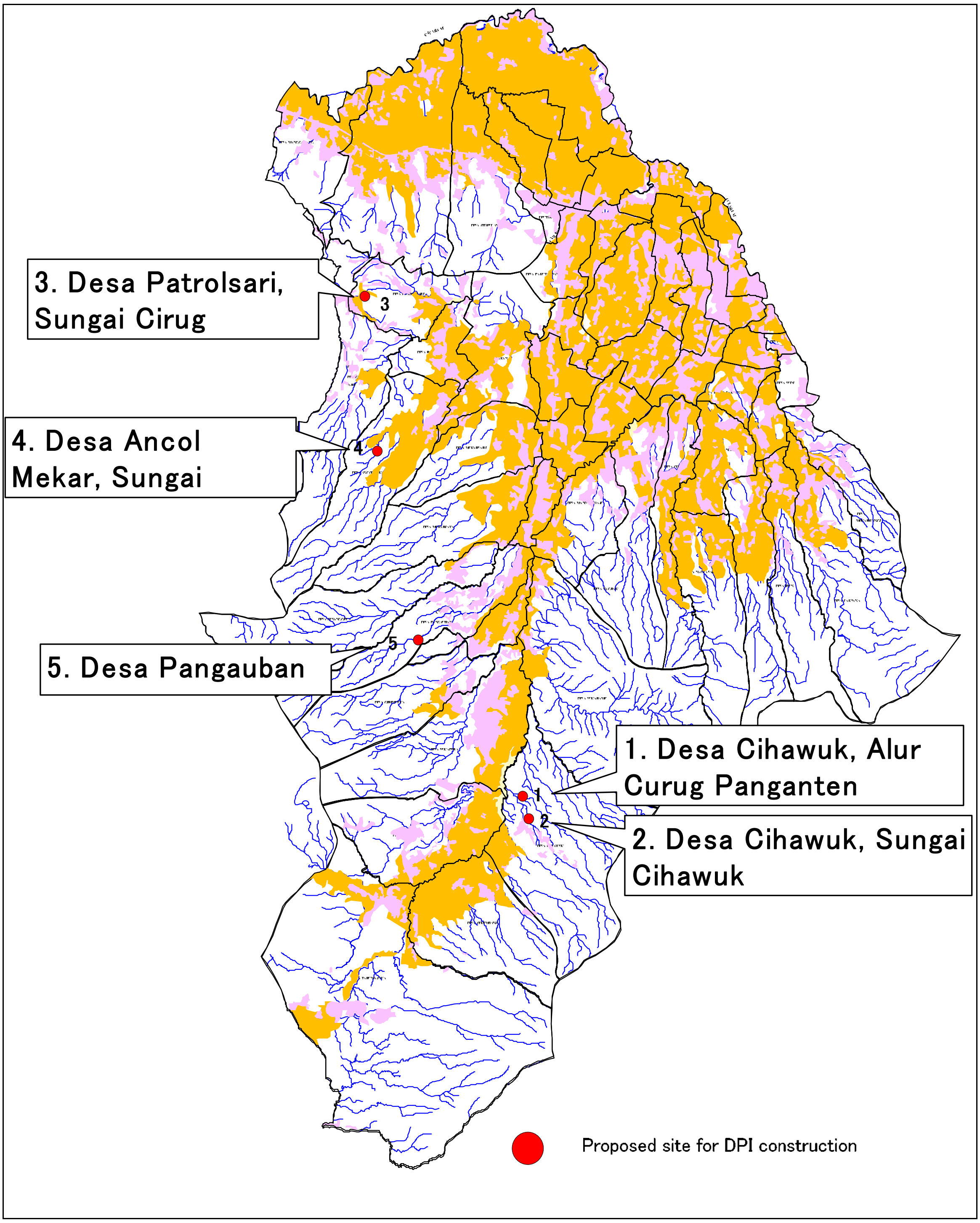
Table 6.1.3.1 Soil Loss by Desa in Cirasea Sub-watershed

Desa	Soil Erosion Hazard Class					Acreage	Unit Soil Loss	Soil Loss
	I	II	III	IV	V			
	(ha)					(ha)	(ton/ha/year)	(ton/year)
Manggahang	89.4	109.9	12.0	414.4	1.9	627.6	**230.6**	144,695.2
Jelekong	620.9	260.3	376.2	178.4	199.6	1,635.4	**207.2**	338,830.6
Sumbersari	807.9	141.1	0.0	0.0	0.0	949.0	3.7	3,491.7
Ciheulang	309.4	232.2	184.3	173.3	0.0	899.2	80.2	72,096.0
Serangmekar	226.9	33.8	0.0	0.0	0.0	260.7	2.8	737.8
Sarimahi	289.8	32.2	0.0	0.0	0.0	322.0	2.3	744.9
Ciparay	173.9	40.1	0.0	0.0	0.0	214.0	5.4	1,162.2
Mekarsari	155.6	60.3	0.0	0.0	0.0	215.9	8.2	1,763.8
Manggung Harja	115.6	55.8	1.5	0.0	0.0	172.9	9.4	1,630.0
Paku Tandang	148.5	133.4	2.5	30.4	0.0	314.8	36.9	11,621.6
Gunung Leutik	40.6	44.6	0.0	0.0	0.0	85.2	16.0	1,362.8
Babakan	551.8	134.2	35.0	28.4	0.0	749.4	22.2	16,627.7
Sagara Cipta	103.0	31.0	20.7	0.0	0.0	154.7	15.7	2,435.2
Cikoneng	222.5	57.1	0.0	0.0	0.0	279.6	5.4	1,506.9
Biru	428.3	41.2	0.0	0.0	0.0	469.5	4.2	1,954.8
Pada Ulun	305.0	14.7	0.0	0.0	0.0	319.7	3.8	1,227.7
Sukamukti	234.0	6.8	0.0	0.0	0.0	240.8	4.8	1,161.7
Padamulya	177.7	19.1	0.0	0.0	0.0	196.8	7.1	1,388.2
Sukamaju	179.0	26.0	0.0	0.0	0.0	205.0	6.4	1,315.6
Wangi Sagara	146.9	64.2	15.5	0.0	0.0	226.6	13.1	2,964.2
Neglasari	222.7	71.7	0.0	0.0	0.0	294.4	6.3	1,865.0
Tanggulun	27.9	14.1	3.8	0.0	0.0	45.8	14.4	660.9
Talun	19.1	6.2	12.8	0.0	0.0	38.1	43.1	1,643.8
Lampengan	88.2	3.1	34.8	0.0	0.0	126.1	21.5	2,716.7
Sudi	34.9	46.1	33.1	9.4	0.0	123.5	55.7	6,880.0
Karya Laksana	120.9	26.2	48.9	0.0	0.0	196.0	25.0	4,907.6
Cibeet	111.9	10.0	15.1	34.8	0.0	171.8	48.1	8,266.3
Pangguh	291.8	13.6	31.7	76.9	0.0	414.0	61.0	25,266.9
Mekarwangi	31.3	56.0	114.9	135.2	212.8	550.2	**592.1**	325,771.6
Naglasari	559.9	0.0	0.0	80.2	224.5	864.6	**370.0**	319,877.2
Dukuh	324.2	0.0	14.9	188.9	248.8	776.8	**596.9**	463,648.3
Ibun	96.3	42.6	11.1	286.7	285.2	721.9	**641.5**	463,119.6
Laksana	167.0	240.9	225.0	230.4	564.4	1,427.7	**530.4**	757,215.8
Cikawao	199.6	17.2	49.7	126.3	176.5	569.3	**625.1**	355,871.5
Nagrak	92.9	3.6	150.4	367.6	330.8	945.3	**767.3**	725,316.7
Maruyung	90.6	47.9	28.2	0.0	0.0	166.7	23.8	3,969.7
Mandala Haji	126.6	26.7	152.6	196.1	43.3	545.3	**200.4**	109,294.4
Cipeujeuh	176.9	45.8	0.0	0.0	0.0	222.7	5.8	1,292.5
Tanjungwangi	177.6	58.1	0.0	0.0	0.0	235.7	6.6	1,564.4
Mekarsari	277.7	124.2	132.8	9.6	80.2	624.5	**249.1**	155,548.4
Mekarjaya	236.8	12.8	31.9	301.5	323.6	906.6	**644.1**	583,915.7
Cinanggela	627.9	0.0	73.5	190.2	216.9	1,108.5	**400.9**	444,440.7
Pangauban	195.5	0.0	205.5	211.3	183.0	795.3	**332.2**	264,214.9
Cikitu	113.5	19.4	20.9	93.7	8.6	256.1	144.9	37,118.4
Girimulya	258.0	35.1	58.9	181.4	281.4	814.8	**377.2**	307,358.0
Sukarame	1,167.6	20.4	83.2	238.0	494.0	2,003.2	**480.9**	963,272.3
Pinggir Sari	440.2	68.4	79.5	160.4	255.3	1,003.8	**521.9**	523,886.9
Patrolsari	185.1	141.1	155.5	0.0	0.0	481.7	41.8	20,124.1
Rancakole	241.4	70.6	0.0	0.0	0.0	312.0	9.6	2,983.8
Ancol Mekar	482.1	58.4	34.1	41.0	461.4	1,077.0	**691.0**	744,220.2
Sukapura	352.3	142.8	302.6	237.3	191.8	1,226.8	**245.6**	301,273.2
Cihawuk	602.8	1.9	14.6	180.4	824.3	1,624.0	**769.9**	1,250,276.5
Cibeureum	258.5	169.1	127.0	169.2	174.6	898.4	**304.7**	273,783.7
Cikembang	513.4	44.0	98.4	184.8	189.9	1,030.5	**292.1**	300,980.3
Tarumajaya	992.3	502.5	1,079.6	342.0	831.2	3,747.6	**344.5**	1,291,182.6

Source: Basic Survey and Planning Upland Plantation and Land Development Project at Upper Citarum Watershed, 2003

(5) Sediment Control Facilities

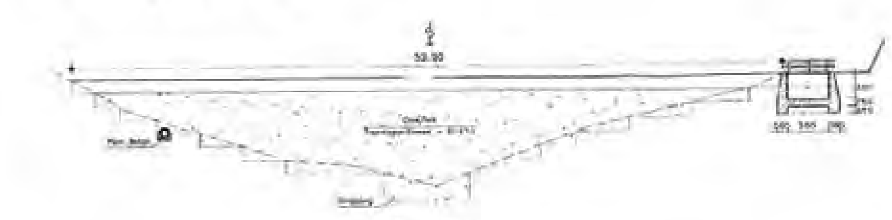
Considering the difficulties of land acquisition due to land ownership, the number of check dam constructions was limited. Therefore, instead of large check dams, multistage small check dam systems were introduced. 5 check dams and 261 small check dams are planned in 24 desas. Figure 6.1.3.1 shows the location of check dams and Figure 6.1.3.2 shows Standard Design of Check Dam and S. Check Dam.



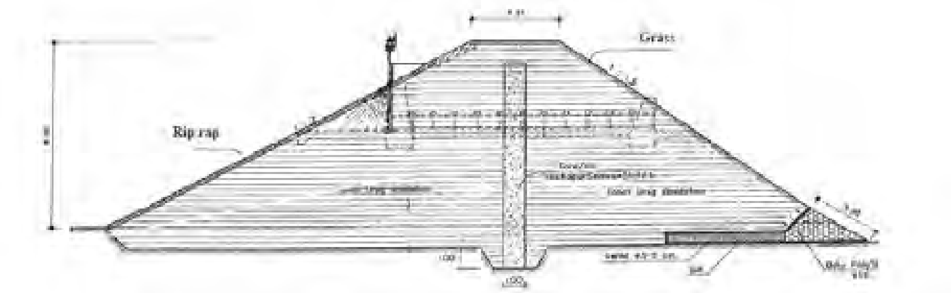
DPI: Dam Pengendali
Source: JICA Survey Team

Figure 6.1.3.1 Location of Proposed Check Dams

Standard Design of Check Dam

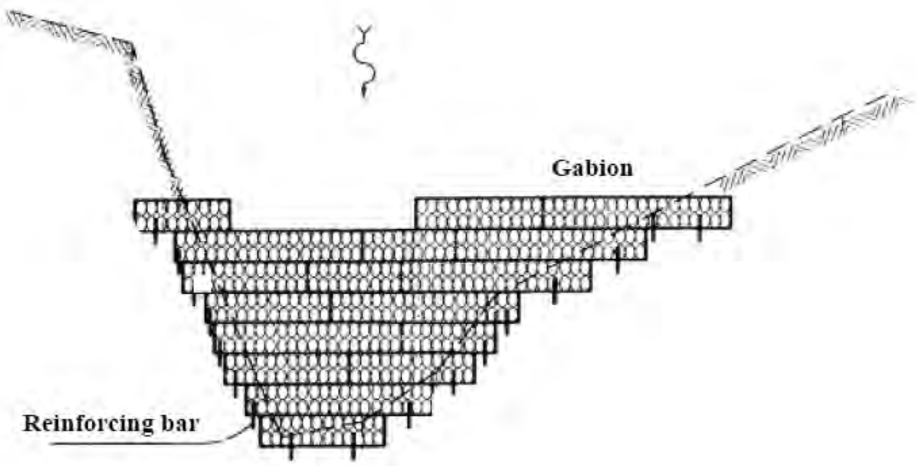


Front View



Side View

Standard Design of small Check Dam



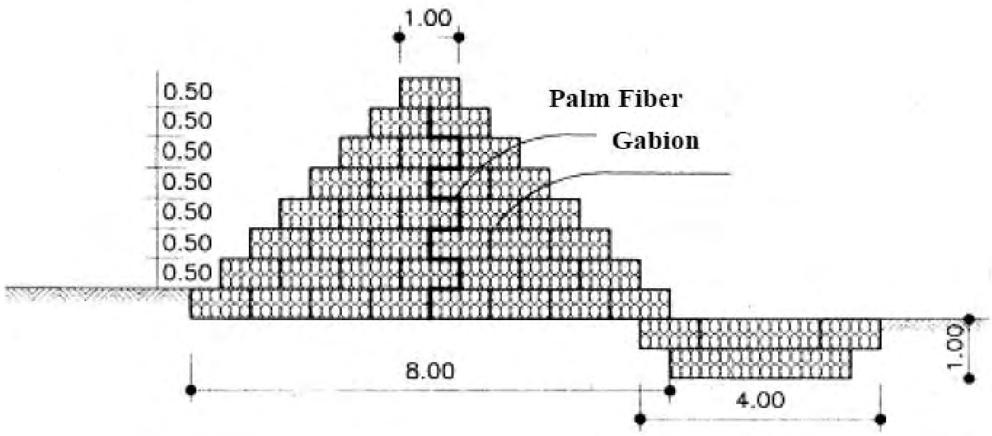


Figure 6.1.3.2 Standard Design of Check Dam and S. Check Dam

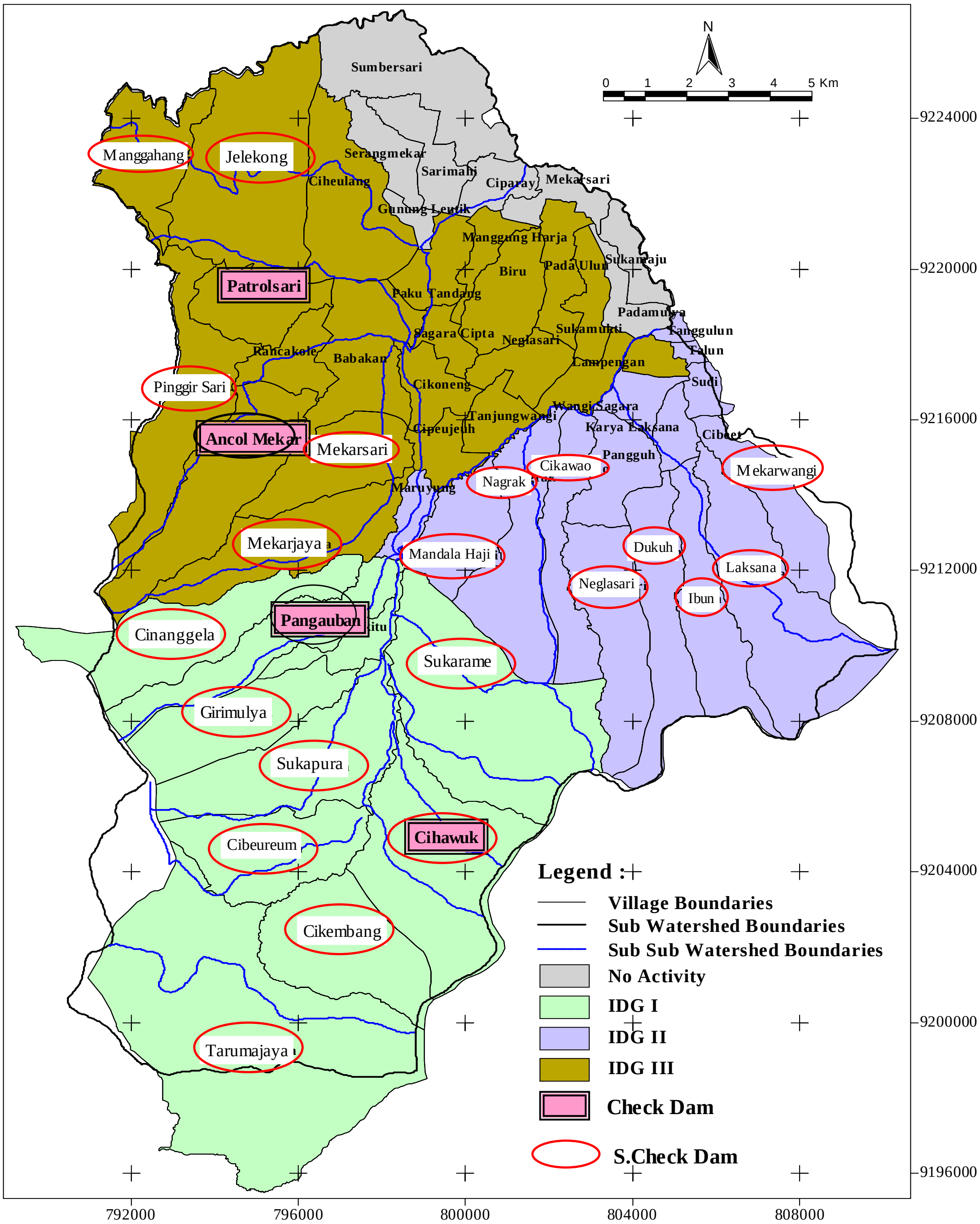
The component will be implemented in a participatory manner, with the voice and opinion of people being accommodated in the design. This bottom-up approach is the basic concept of this component. Therefore, each location and the size of the facility will be designed prior to construction. The local people's opinions will be collected through a PRA (Participatory Rural Appraisal) by NGO representatives hired by the consultant.

(6) Planning and Design

After the consulting team is set up, Design and planning / Design for Project implementation shall be carried out immediately as follows:

1) Topographic Survey for check dams and small check dams for each target desa
2) Detailed Design for check dams and small check dams for each target desa
3) Cost Estimate for check dams and small check dams for each target desa
4) Mobilization of NGO Coordinator
5) LRSC Activity Implementation Planning, Manuals making
6) Community Development Implementation Planning, Manuals making
7) Recruitment & training of Kecamatan Conservation Facilitator (KCF)
8) Preparation of Annual Budget Allocation

The target desas (24 desas) are divided into three groups (called IDG: Implementation Desa Groups) as shown below. Each IDG is composed of several desas. Each desa is scheduled to complete all activities in accordance with their own local two-year plan established during the local planning period mentioned above.



Source: JICA Survey Team

Figure 6.1.3.3 Target Desas for Construction of Check Dams and Small Check Dams

(7) Dissemination / Local Planning and Financing

1) Project Dissemination

The following dissemination will be carried out:

- Dissemination at Kabupaten level (Rakorbang)

  Information will be disseminated on the logical framework of Component, overall plan of activities for the Component, organizational structure for the Component, standards of work and procedures, regulations, financial arrangements and administration requirements.

- Dissemination at desas (MUSBANGDES I)

  Information disseminated to target desas includes: identifying local desas by critical lands and recommend annual LRSC activities, organizational structure for the Component, standards of works, procedures and work mechanisms, regulations, financial arrangements and administration requirements.

- Dissemination at sub-desas (MUSBANGDUS)

  Information disseminated to target sub-desas includes: identifying local sub-desa by critical lands and recommended annual LRSC activities, organizational structure for the Component, standards of works, procedures and work mechanisms, regulations, financial arrangements and administration requirements.

(8) Local Planning and Financing

1) Local Planning

Local planning began as a follow-up of project dissemination at target desa and sub-desa levels.

The initial stage of local planning was completed when Kabupaten Pimpro approved the project grant proposed for the recommended desa proposals and contract document of SPPB (Surat Perjanjian Pemberian Bantuan). Local planning will be at targeted at desas and sub-desas found to have eroded catchment areas.

2) Local Financing

A budget is given to LKMD to be used for the approved LRSC activities. Recipient of the budget is LKMD of the approved LRSC activities.

(9) Implementation

All construction work on check dams and small check dams shall be carried out and completed during this phase. The period is extended over three (3) years. Target communities shall be empowered through participating as a primary body in project implementation.

(10) Annual Work Volume

The workload of the project is consistent over the entire period of the implementation phase so that target communities will be able to manage planned works without difficulty. The planned work volume for each implementation year is shown in Table 6.1.3.3 below.

Table 6.1.3.3 Annual Work Volume by Desa

IDG	Kec.	Desa	Facilities	2012	2013	2014	2015	2016	2017	2018	Total
IDG I	Kertasari	Cibeureum	Checkdam								0
			S. Checkdam		4	5					9
		Cihawuk	Checkdam		1	1					2
			S. Checkdam		6	7					13
		Cikembang	Checkdam								0
			S. Checkdam		4	5					9
		Sukapura	Checkdam								0
			S. Checkdam		5	5					10
		Tarumajaya	Checkdam								0
			S. Checkdam		14	14					28
	Pacet	Cinanggela	Checkdam								0
			S. Checkdam		4	5					9
		Girimulya	Checkdam								0
			S. Checkdam		5	5					10
		Pangauban	Checkdam		1						1
			S. Checkdam			3					3
		Sukarame	Checkdam								0
			S. Checkdam		7	8					15
	TOTAL		**Checkdam**		**2**	**1**					**3**
			S. Checkdam		**49**	**57**					**106**
IDG II	Ibun	Dukuh	Checkdam								0
			S. Checkdam			7	7				14
		Ibun	Checkdam								0
			S. Checkdam			13	14				27
		Laksana	Checkdam								0
			S. Checkdam			7	7				14
		Mekarwangi	Checkdam								0
			S. Checkdam			3	4				7
		Neglasari-Ibn	Checkdam								0
			S. Checkdam			3	4				7
	Pacet	Cikawao	Checkdam								0
			S. Checkdam			6	6				12
		Mandala Haji	Checkdam								0
			S. Checkdam			3					3
		Nagrak	Checkdam								0
			S. Checkdam			11	12				23
	TOTAL		**Checkdam**			**0**	**0**				**0**
			S. Checkdam			**53**	**54**				**107**
IDG III	Arjasari	Ancol Mekar	Checkdam				1				1
			S. Checkdam				14				14
		Patrolsari	Checkdam				1				1
			S. Checkdam								0
		Pinggir Sari	Checkdam								0
			S. Checkdam				4				4
	Bale Endah	Jelekong	Checkdam								0
			S. Checkdam				6				6
		Manggahang	Checkdam								0
			S. Checkdam				5				5
	Pacet	Mekarjaya	Checkdam								0
			S. Checkdam				14				14
		Mekarsari-Pacet	Checkdam								0
			S. Checkdam				5				5
	TOTAL		**Checkdam**				**2**				**2**
			S. Checkdam				**48**				**48**
TOTAL			**Checkdam**	**-**	**2**	**1**	**2**	**-**	**-**	**-**	**5**
			S. Checkdam	**-**	**49**	**110**	**102**	**-**	**-**	**-**	**261**

Source: JICA Survey Team

6.2. Consulting Services

6.2.1. Objective of Consulting Services

Consulting services are required for implementation of the rehabilitation of the Upper Citarum River. The objectives of the consulting services are to facilitate the implementation of the Project by assisting the Balai Busar Wilayah Sungai Citarum (BBWSC), Directorate General of Water Resources, Ministry of Public Works in review of detailed design, bidding, supervision of tributaries improvement construction works, Flood Plain Management, and Sediment Control. The services comprise of engineering and construction technical supervision and advisory instructions. The services will be performed at the field site and will be done in close cooperation with related agencies.

6.2.2. Scope of Services

The Consultant is responsible for carrying out the entire project components as outlined below on behalf of and in collaboration with DGWR and BBWSC. The Consultants will consult with other concerned agencies and/or institutions in order to reach a common ground for the implementation of the activities at every stage of the Project.

The scope of the consulting services is itemized as follows:

(1) Component A: Structural Countermeasures

1) Review of the existing study and detailed design
2) Review of pre-qualification and bid documents
3) Assistance with bidding and contracting
4) Assistance with construction supervision
5) Monitoring for environmental protection
6) Monitoring for land acquisition and resettlement
7) Transfer of knowledge to counterpart personnel
8) Reporting.

(2) Component B: Non-Structural Countermeasures

1) Institutional Strengthening for BBWSC
   - Institutional Strengthening for Early Warning System (EWS)
   - Strengthening for Operation & Maintenance (O&M)
2) Capacity Development for Community against Flood Disaster
   - Application of Flood Hazard Mapping prepared by ADB project
   - Reinforcement of desa activity (LMD) through BBWSC supports (temporary flood walls, sand bags, commodities, etc.)
   - Community discussion forums
   - Prevention education in schools, Evacuation Drills, etc.

(3) Component C: Sediment Control

1) Detailed Design

2) Assistance with Project dissemination in desa
3) Assistance with local project planning and financing
4) Assistance with yearly review of participatory LRSC activities
5) Supervision of participatory LRSC activities
6) Supervision of NGO activities

(4) Feasibility Study of Dayeuh Kolot and its surroundings

Regarding the Feasibility Study for Flood Damage Mitigation Measure for the DK right bank area, the following activities will be carried out.

1) To review the existing study for DK flooding issues.
2) To conduct topographical survey (river cross section including floodplain for Cicapundung, Cicapundung Kolot and Citeureup Basins)
3) To study the flooding mechanism including interview survey to local people, hydrological data collection and evaluation of existing river capacity.
4) To set-up and calibration of hydrology and hydraulic model
5) To study alternatives for flood mitigation measures
6) To study the economic evaluation for main alternatives
7) To prepare definitive plan for Flood Damage Mitigation Measure for DK right bank area

6.2.3. Required Experts

The required experts for the consulting services are as shown, but not limited to the following:

1) Professional A
   - Team Leader
   - Constr/Struct. Engineer (A)
   - River Engineer (A)
   - Environmental Specialist (A)
   - Institutional Specialist (A)
   - Watershed Management Specialist (A)
   - Hydrologist (A)

2) Professional B
   - Co-Team Leader
   - River Engineer (B)
   - Design Engineer (B)
   - Construction Plan/Cost Estimate Eng. (B)
   - Construction Engineer (B1)
   - Construction Engineer (B2)
   - Construction Engineer (B3)
   - Construction Engineer (B4)
   - Structural Engineer (B1)
   - Structural Engineer (B2)
   - Structural Engineer (B3)

Structural Engineer (B4)
Quantity Surveyor Engineer (B1)
Quantity Surveyor Engineer (B2)
Quantity Surveyor Engineer (B3)
Quantity Surveyor Engineer (B4)
Geodetic Engineer (B)
PQ/Bid Documents Specialist (B)
Land Acquisition Monitoring Expert (B)
Environmental Specialist (B)
Institutional Specialist (B)
Rural/Community Development Specialist (B)
Soil and Water Conservation Specialist (B)
Hydrologist (B)
Socio-Economist (B)

6.2.4. Transfer of Knowledge

The consultant shall conduct the transfer of knowledge on the related field to the related government's personnel during the whole services period. Transfer of knowledge shall be conducted through on the job training.

6.2.5. Assignment of Consultants for the Services

The services period of the Consultants is estimated at 51 months. The total man-months for the services are estimated at 656 man-months comprising of 94 man-months for Professional A and 562 man-months for Professional B.

6.2.6. Reporting

The metric system shall be used exclusively in all the reports, drawings and calculations. Reports and calculations shall be written in English while drawings and the O & M manual shall be edited in English and the Indonesian language. The required reports are as follows:

(1) Inception Report giving comments and/or suggestions based on reviews of previous studies and detailed designs, summary of main findings and technical problems obtained through field surveys, detailed work plans and programs of the Consultant's Services, and recommendations of possible alternative plans, if any (10 copies).

(2) Finalized Bid Documents for international competitive bidding.

(3) Review of the Design Report giving all the results of the reviewed design including tender drawings and all the activities of the Consultants (10 copies).

(4) Monthly and Quarterly Progress Reports giving a summary of progress of the works during the reporting period including the Consultants' activities and the program and schedule of the works in the next period (10 copies).

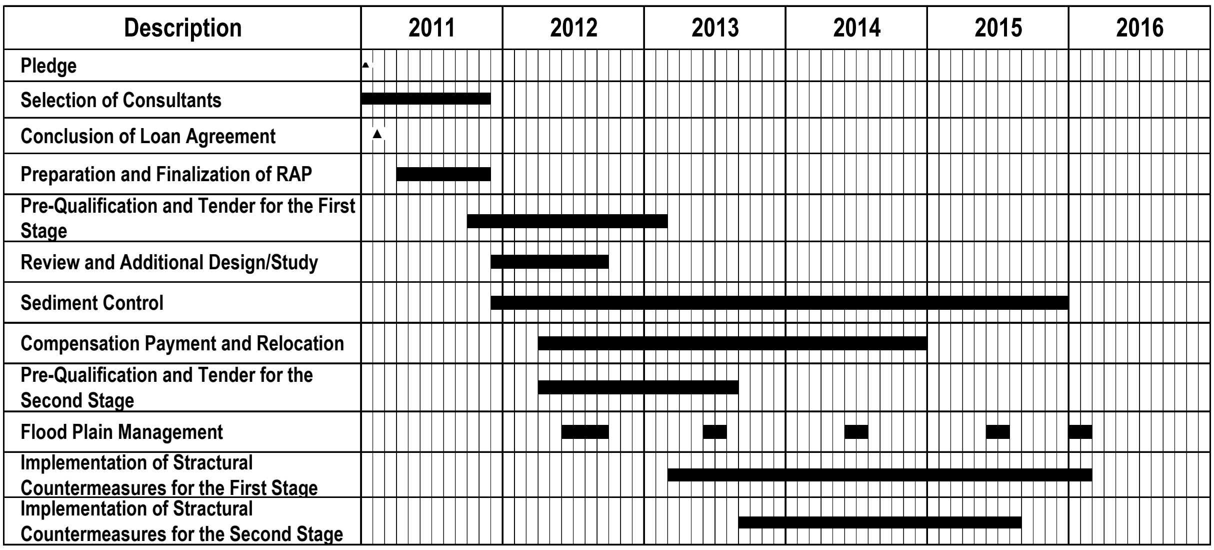
(5) Annual report which gives the details of the works executed in the past twelve months and the program and schedule of the next twelve months including the budgetary schedule (10 copies).

(6) Project Completion Report and drawings of all the aspects of construction of the Project at completion of services (10 copies).

6.3. Implementation Schedule

During the preparation stage of the project implementation, Selection of consultants, Preparation and Finalization of RAP and Pre-qualification of contractors for Phase 1 is carried out. Implementation period of this project are expected to be approximately 51 months from the beginning of Consulting services in December 2011until the end of the river improvement work of Phase 2 in February 2016.

The tentative schedule of the Project is shown in Figure 6.3.0.1 below.



Source: JICA Survey Team

Figure 6.3.0.1 The Tentative Schedule of the Project

CHAPTER 7 PROJECT COST

7.1 Basic Conditions for Cost Estimate

7.1.1 General

The followings are the basic conditions for the Project cost estimate.

(1) The Project consists of three components as described below:

Table 7.1.1.1 Three Components of the Project

Component A	Structural Countermeasures	River improvement of Upper Citarum Tributaries	
		Sub-Project A1: Citarum Upstream	5.45 km
		Sub-Project A2: Cimande	9.50 km
		Sub-Project A3: Cikijing	6.68 km
		Sub-Project A4: Cikeruh Downstream	2.50 km
Component B	Non-Structural Countermeasures	- Institutional strengthening for BBWSC - Capacity development for the community against flood disaster	

Component C	Sediment Control	- Construction of 5 check dams and 261 small check dams by participatory method at 24 target desa in Cirasea Sub-watershed
		- Empowerment for the people at the community level
		  - Raising awareness of the necessity for improved environmental management
		  - Raising of the sense of ownership
		  - Emphasizing the use of local resources for peoples' welfare
		  - Strengthening institutions at the village level for community-based watershed management	

Source: JICA Survey Team

(2) The funds required for the construction works will be financed by a foreign loan.

(3) The funds required for the construction and procurement of goods for each component will be financed 100% by a JICA ODA loan.

(4) The funds required for land acquisition and compensation will be financed by the local budget.

(5) The implementation of river improvement construction works (Component A) will be done by using a full contracting system through International Competitive Bidding (ICB) with pre-qualified contractors from eligible source countries including Indonesia.

(6) The contract of Component A will be calculated on a unit price basis excluding the mobilization/demobilization and preparatory works.

(7) The construction works of Sediment Control (Component C) will be done through community participation method.

(8) The project will take 51 months from the start-up of the Consulting Services to the completion of the construction of river improvement works excluding a defect liability period of 12 months.

The project will be supervised and administrated by Balai Busar Wilaya Sungai Citarum with assistance of the Consultant.

7.1.2 Unit Price, Exchange Rate, Price Escalation and Physical Contingency

(1) Labor wages and material costs are based on "Keputusan Gubernur Jawa Barat September 2009 (Standar Biyaya Belanja Daerah Pemerintah Provinsi Jawa Barat Tahun Anggaran 2010)" and "Analisa Haruga Satuan Pekerjaan Kabupaten Bandung October 2009".

(2) The exchange rate of currencies is US $1.00 = Yen 90.90. Accordingly, the rates Rp. 1 = Yen 0.0101 and US $1.00 = Rp. 9017 are applied.

(3) The cost is classified into foreign and local currency components.

(4) An annual price escalation of 1.8% and 7.9% are applied to the foreign currency portion (F/C) and the local currency portion (L/C) respectively.

(5) A physical contingency of 5% of the total cost of base cost and price escalation is counted.

7.1.3 Composition of Project Cost

The Project cost consists of the direct construction cost (base cost), price contingency, physical contingency, consulting service cost, land acquisition and compensation cost, government administration cost and value added tax (VAT).

(1) Direct Construction Cost (Base Cost)

The direct construction cost for the contract of Component A consists of the cost for preparatory works, main civil works and miscellaneous expenses. The direct construction costs are estimated by adopting the unit cost basis multiplied by the corresponding work quantity.

1) Material cost

All the unit prices include transition fees to the project site. These prices are counted into the local currency component.

2) Labor cost

The labor cost was calculated with the local currency component. The rates of labor wages include all the laborers' fringe benefits such as vacation and sick leave, insurance charges, medical care, living allowance, etc.

Regarding Component C, the rates of wages exclude all fringe benefits due to the participatory method.

3) Equipment cost

The equipment cost consists of the depreciation cost, repair cost and administration cost, which are calculated using the Indonesian standard economical life and repair rate. With regard to the operation cost of equipment, the cost of the operator, petroleum, oil, lubricant and consumables, they are counted into each unit cost.

4) Contractor's indirect cost

The contractor's expenses are counted in every unit cost proportionally. An estimated 10% of the direct cost will be used to cover the following expenses:

a) Field administration and supervision
b) Corporate overhead and profit
c) Assistance and back support from head office
d) Material handling
e) Insurance
f) Bond and taxes
g) Other incidentals

Regarding Component C, the contractor’s expenses are excluded due to the community participatory method.

(2) Cost for Land Acquisition and Compensation

The cost is estimated in local currency based on the required area and unit cost estimated for each parcel of land and housing.

(3) Administration Cost

The cost is estimated at 5% of the total direct construction cost of Components A, B and C.

(4) Consulting Services

The cost for Consulting Services is estimated on a man-month basis with the direct cost according to the proposed assignment schedule.

(5) Contingencies

1) Physical Contingency: estimated at 5% of the direct cost.
2) Price Contingency: estimated at 7.9% per annum for local currency and 1.8% per annum for foreign currency, as price escalation.

(6) Government Tax

Value added tax (VAT) is estimated at 10% of the sum of the total cost, in terms of the equivalent in Indonesian Rupiah (IDR).

The detailed cost for structural countermeasures is shown in Table 7.1.3.1.

(7) Land Acquisition and Compensation

Estimating the amount of Land Acquisition and Compensation for the project, unit costs in 2007DD was employed.

Table 7.1.3.1 Structural Countermeasures Cost

(Unit : Rp. Million)

Name of River and Channel	Citarum Upstream	Cimande	Cikijing	Cikeruh	Total
Improvement Length (m)	**5,450**	**9,510**	**6,680**	**2,500**	**24,140**
L/S	705	752	574	235	2,266
Channel	7,816	14,904	9,328	4,493	36,541
Revetment	17,601	9,089	8,398	4,476	39,563
Groundsill	901	3,104	1,444	645	6,094
Drop	0	0	0	0	0
Culvert	5,170	5,359	4,477	0	15,006
Weir	0	1,244	1,268	2,104	4,616
I/M Road	5,873	10,077	6,842	2,668	25,461
Bridge	2,733	8,194	3,889	4,017	18,832
Dumping with Geot	4,033	5,184	7,822	3,309	20,348
Total	**44,832**	**57,906**	**44,043**	**21,947**	**168,727**

Source: JICA Survey Team

The cost for non-structural measures is assumed to be 5,000 million Rp. for purchasing some necessary equipment, machines and goods *(i.e.* materials for Flood Fighting, *etc.*) in this report. The details will be discussed in the course of the discussion forum among the related stakeholders on the non-structural countermeasures.

The cost for sediment control is estimated to be 17,608 million Rp. This cost includes the construction cost for 261 small check dams and 5 check dams, 14,935 and 2,673 million Rp., respectively.

The detailed costs of small check dams and check dams for sediment control are shown in Table 7.1.3.2 and 7.1.3.3.

Table 7.1.3.2 Small Check Dam Cost for Sediment Control

Kind of Works	Quantity	Unit	Unit Cost (Rp)	Total Cost (Rp)
1. Preparation				752,185
2. Land Cutting and drainage	18	m2	21,285	383,130
3. Gabion Construction	72.3	m3	574,405	41,529,463
4. Dam Apron Construction	12	m3	610,587	7,327,044
5. Reinforcing	120	Kg	8,243	989,160
6. Foreman	20	man-day	52,000	1,040,000
Sub -Total				52,020,982
4. Miscellaneous Expenses (10%)		LS		5,202,098
Total				57,223,080
Rounded	1	Unit		57,223,000
Total Cost for Small Check Dam	261	Unit	57,223,000	14,935,203,000

Note: Standard size of DPN (based on Citarik data) ; Lemgth of Crest-9.5m, hight of Dam-3.5m

Table 7.1.3.3 Check Dam Cost for Sediment Control

Kind of Works	Quantity	Unit	Unit Cost (Rp)	Total Cost (Rp)
1. Road Construction (Temporary Road 500 m)				43,524,422
2. Preparation				38,589,952
3. Dam body Construction				
3.1 Land Cutting and drainage	160	m3	21,285	3,405,600
3.2 Cutting, Filling and penetration	3,755	m3	22,940	86,139,700
3.3 Construction of Water-proof layer	344	m3	278,827	95,846,863
3.4 Form	90	m2	31,820	2,863,803
3.5 Grass Planting	500	m2	7,110	3,554,969
Sub Total				191,810,935
4. Construction of drainage and Water Gate				
4.1 Land Cutting and drainage	116	m3	21,285	2,469,060
4.2 Water gate construction	1	set		6,000,000
4.3 Wet Stone masonry 1:3	53	m3	484,315	25,562,146
4.4 Floor Cement 1:4	19	m2	34,528	665,697
4.5 Mortar Pluging	45	m2	30,067	1,347,906
4.6 Concrete pipe	15	m	1,464,438	21,966,563
4.7 Land Filling	50	m3	7,353	367,650
Sub Total				58,379,021
5. Construction of Spill Way				
5.1 Land Cutting and drainage	500	m3	21,285	10,642,500
5.2 Wet Stone masonry 1:3	151	m3	484,315	73,228,428
5.3 Floor Cement 1:4	181	m2	34,528	6,249,545
5.4 Mortar Pluging	341	m2	30,067	10,246,851
5.5 Spill way Bridge construction(jembatan spill wa	7	m	501,438	3,309,488
Sub Total				103,676,812
6.Dray Masonry				
6.1 Rip rap	179	m3	177,153	31,705,072
6.2 Drinage	102	m3	179,048	18,209,131
Sub Total				49,914,203
Total	1	Unit		485,895,345
7. Miscellaneous Expenses		LS		48,590,000
Rounded	1	Unit		534,485,000
Total cost for Check Dam	5	Unit	534,485,000	2,672,425,000

Note: Standard size of Check dam (based on Citarik data) ; Lemgth of Crest-54m, hight of Dam-8m,
Legth of Spill way=80m

7.2 Fund Requirement

7.2.1 Required Funds

The required funds for execution of the Project was estimated at 451,982 million IDR (Indonesian Rupiah) consisting of an eligible portion (loan portion) of 349,685 million IDR + 251 million JPY equivalent to 3,783 million JPY, and a non-eligible portion (local currency Indonesian portion) of 102,297 million IDR (including VAT). A summary of the required funds is shown in Table 7.2.1.1.

Table 7.2.1.1 Required Funds

Unit: million

Eligible Portion (JICA Loan Portion)				
Component		Foreign Currency (Japanese Yen)	Local Currency (Indonesian Rupiah)	Total in Japanese Yen
Component A Structural Counter-measures	Sub-Project A1 : Citarum Upstream River	0	44,832	453
	Sub-Project A2 : Cimande River	0	57,906	585
	Sub-Project A3 : Cikijing River	0	44,043	445
	Sub-Project A4 : Cikeruh River (Downstream)	0	21,947	222
	Sub-Total		168,728	1,704
Component B	Non-Structural Countermeasures	0	5,000	51
Component C	Sediment Control (IDG - I)		7,669	77
	Sediment Control (IDG - II)		6,123	62
	Sediment Control (IDG - III)		3,816	39
	Sub-Total		17,608	178
Direct Construction Cost (Base Cost)		**0**	**191,336**	**1,933**
Price escalation		0	89,823	907
Physical contingency		0	14,058	142
Total of Direct Construction Cost			**295,217**	**2,982**
Consulting services		251	54,468	801
Price escalation		0	0	0
Physical contingency		0	0	0
Total of Consulting services		**251**	**54,468**	**801**
Total of JICA Loan Portion		**251**	**349,685**	**3,783**
Non Eligible Portion (Local Portion)				
Land Acquisition		0	32,123	
Price escalation		0	11,799	
Physical contingency		0	2,196	
Administration cost		0	18,727	
VAT		0	37,452	
Total of Local Portion			**102,297**	
Total Fund Required		**251**	**451,982**	**4,816**

Source: JICA Survey Team

7.2.2 Annual Fund Requirement

The annual fund requirement with price escalation is shown in Table 7.2.2.1 on page 7-8.

7.2.3 Loan Application

Financial assistance is required to implement the Project. The JICA ODA Loan is applicable to eligible structural and non-structural countermeasures, sediment control and consultant services. The amount of the loan is proposed at 3,783 million JPY (374,532 million IDR).

7.2.4 Consulting Services

Consulting services by foreign and local consultants will be required to assist with the implementation of the Project in review of design and construction supervision. The cost estimated for these consulting services is 801 million JPY consisting of 54,468 million IDR for the local currency portion and 251 million JPY for the foreign currency portion excluding price escalation and physical contingencies, as shown in Table 7.2.4.1.

Table 7.2.4.1 Consulting Services Cost

unit: Million

ITEM	AMOUNT JPY	AMOUNT IDR	Amount in JPY
I. Remuneration			
1. Professional A	235		235
2. Professional B	0	28,100	284
3. Sub-Professional	0	1,930	19
4. Office Supporting Staff	0	1,224	12
SUB TOTAL REMUNERATION	235	31,254	315
II. Reimbursable Cost			
1. Mobilization/Demobilization	16	253	19
2. Miscellaneous Travel Expenses	0	118	1
3. Subsistence Allowance	0	2,817	28
4. Local Transportation Costs	0	3,604	36
5. Office rent/ accomodation/ clerical assistance	0	464	5
6. NGO Services		12,830	130
SUB TOTAL REIMBURSABLE COST	16	20,086	219
III. Miscellaneous Expenses			
1. Communication Costs	0	550	6
2. Drafting, Reproduction of Reports	0	267	3
3. Equipment/Furniture: Computers, etc.	0	843	9
4. Software	0	1,468	15
SUB TOTAL MISCELLANEOUS EXP	0	3,128	33
TOTAL	251	54,468	801

Source: JICA Survey Team

Table 7.2.2.1 Annual Fund Requirement

Base Year For Cost Estimation:	Sep.	2009	FC & Total:	million JPY
Exchange Rates	Rupiah	= yen 0.0101	LC:	million Rupiah
PriceEscaration:	FC:	1.80%	LC:	7.90%
Physical Contingency	5%			
Physical Contingency for Consultant	0%			

Item	Total			2011			2012			2013			2014			2015			2016		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																					
I) Procurement / Construction	**0**	**295,216**	**2,982**	**0**	**0**	**0**	**0**	**2,198**	**22**	**0**	**71,775**	**725**	**0**	**126,603**	**1,279**	**0**	**87,397**	**883**	**0**	**7,242**	**73**
Component A - Sub Project A1 : Citarum Upstream River Improvement Works	0	44,832	453	0	0	0	0	0	0	0	18,680	189	0	22,416	226	0	3,736	38	0	0	0
Component A - Sub Project A2 : Cimande River Improvement Works	0	57,906	585	0	0	0	0	0	0	0	16,085	162	0	19,302	195	0	19,302	195	0	3,217	32
Component A - Sub Project A3 : Cikijing River Improvement Works	0	44,043	445	0	0	0	0	0	0	0	7,340	74	0	22,021	222	0	14,681	148	0	0	0
Component A - Sub Project A4 : Cikeruh (Downstream) River Improvement Works	0	21,947	222	0	0	0	0	0	0	0	3,658	37	0	10,973	111	0	7,316	74	0	0	0
Component B: Non-Structural Countermeasures	0	5,000	51	0	0	0	0	1,667	17	0	833	8	0	833	8	0	833	8	0	833	8
Component C: Sediment Control (IDG - I)	0	7,669	77	0	0	0	0	0	0	0	3,835	39	0	3,835	39	0	0	0	0	0	0
Component C: Sediment Control(IDG - II)	0	6,123	62	0	0	0	0	0	0	0	0	0	0	3,061	31	0	3,061	31	0	0	0
Component C: Sediment Control(IDG - III)	0	3,816	39	0	0	0	0	0	0	0	0	0	0	0	0	0	3,816	39	0	0	0
Base cost for JICA financing	0	191,335	1,932	0	0	0	0	1,667	17	0	50,431	509	0	82,442	833	0	52,745	533	0	4,050	41
Price escalation	0	89,823	907	0	0	0	0	427	4	0	17,926	181	0	38,133	385	0	30,491	308	0	2,846	29
Physical contingency	0	14,058	142	0	0	0	0	105	1	0	3,418	35	0	6,029	61	0	4,162	42	0	345	3
II) Consulting services	251	54,468	801	13	419	17	73	11,113	185	69	11,117	181	48	16,273	212	40	13,344	175	9	2,202	31
Base cost	251	54,468	801	13	419	17	73	11,113	185	69	11,117	181	48	16,273	212	40	13,344	175	9	2,202	31
Price escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (I +II)	251	349,684	3,783	13	419	17	73	13,311	207	69	82,893	906	48	142,876	1,491	40	100,741	1,058	9	9,444	104
B. NON ELIGIBLE PORTION																					
a Land Acquisition	0	46,119	466	0	0	0	0	11,559	117	0	16,623	168	0	17,937	181	0	0	0	0	0	0
Base cost	0	32,123	324	0		0	0	8,763	89	0	11,680	118	0	11,680	118	0		0	0		0
Price escalation	0	11,799	119	0	0	0	0	2,245	23	0	4,152	42	0	5,402	55	0	0	0	0	0	0
Physical contingency	0	2,196	22	0	0	0	0	550	6	0	792	8	0	854	9	0	0	0	0	0	0
b Administration cost	0	18,727	189	0	83	1	0	1,026	10	0	4,484	45	0	7,381	75	0	5,237	53	0	515	5
c VAT	0	37,453	378	0	166	2	0	2,052	21	0	8,968	91	0	14,762	149	0	10,474	106	0	1,030	10
Total (a+b+c)	0	102,298	1,033	0	248	3	0	14,637	148	0	30,076	304	0	40,080	405	0	15,712	159	0	1,545	16
TOTAL (A+B)	251	451,983	4,816	13	667	19	73	27,948	355	69	112,969	1,210	48	182,956	1,896	40	116,453	1,217	9	10,989	120

Source: JICA Survey Team

CHAPTER 8 INVOLUNTARY RESETTLEMENT

8.1. General

The Project aims at minimizing flood damage along the upper tributaries of the Citarum River. The Project, which contains river widening and diversion, will cause involuntary resettlement issues due to land acquisition necessary for the Project.

Involuntary resettlement under development projects often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. Therefore, the establishment of the appropriate safeguards for the Project to address and mitigate the above impoverishment risks will be indispensable.

JICA clearly indicates the basic principle on involuntary Resettlement in the JBIC guidelines for Confirmation of Environmental and Social Considerations (April 2002) that, "*People to be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by the project proponents in a timely manner*". Therefore, JICA requests borrowers to submit a Land Acquisition and Resettlement Action Plan (LARAP) for development projects that contain large-scale involuntary resettlement prior to the JICA appraisals of the projects.

In this chapter, the system of involuntary resettlement and land acquisition in Indonesia will be reviewed to identify the differences in international practices for land acquisition and to discuss necessary arrangements in order to implement the Project. This will include preparation of a proposal on the framework of LARAP (FLARAP).

8.2. Involuntary Resettlement of GOI

8.2.1. Legal Framework and Procedures

(1) Indonesian Regulations

The Indonesian regulations (refer to Appendix V-1, 2, 3 for details) on land procurement for infrastructure projects, which have been provided by the central government of the Republic of Indonesia, are as follows:

1) Presidential Regulation No. 36/2005 on Land Procurement for Implementation of Public Interest

2) Presidential Regulation No. 65/2006 on Amendment of Presidential Regulation No. 36/2005

3) Head of National Land Board (BPN) Regulation No. 3/2007 on Guidelines for Implementation of Presidential Regulation No. 36/2005 on Land Procurement for Implementation of Public Interest as amended by Presidential Regulation No. 65/2006

(2) Responsible Agency

The Land Procurement Committee (LPC) and Land Price Appraisal Team conduct land procurement for public facilities construction. The Land Procurement Committee will be established based on the request by the Project Implementer.

1) Land Procurement Committee

The Land Procurement Committee is the committee for land procurement for public facilities construction established by Governor/Mayor. The Committee consists of representatives from the related local government and the National Land Board.

The level of the establishment of the Land Procurement Committee, i.e. district or provincial, will be decided depending on where the land needed for the public facilities is located. The Land Procurement Committee is called Panitia (committee) 9 due to the membership consisting of 9 persons.

2) Land Price Appraisal Team

Land price appraisal is to be done by a Land Price Appraisal Team based on the request from the LPC.

The Land Price Appraisal Team consists of the members listed below.

- Agent from the institution responsible for building and/or plantations
- Agent from the central government responsible for National Land
- Agent from the institution of Land and Building Tax Service
- Experts or persons with experience in land value appraisal
- Academic person with the ability to conduct appraisals of land, buildings, plantations and/or other objects built on the land
- NGO representative, if necessary

(3) Compensation System

The kinds of assets to be affected by the Project are stipulated by Presidential Regulation No.65/2006 as follows:

1) Land rights
2) Buildings
3) Crops / Plants
4) Other objects built on the land.

The forms of compensation for the assets affected by the Project are as follows:

1) Cash, and/or
2) Replacement land, and/or
3) Resettlement, and/or
4) Combination of two or more forms of compensation as referred to in 1), 2), and 3)
5) Other forms which are agreed on / approved by the related parties.

Land price appraisal is conducted based on the Taxed-Object Selling Value (*NJOP*) or the real value by taking into consideration the *NJOP* price of the current year, as well as the following factors (Article 28 of BPN Regulation No.3/2007).

1) Location and area of land
2) Land status
3) Land entitlement
4) Synchronization between land and existing spatial planning or city planning
5) Facilities and infrastructure available

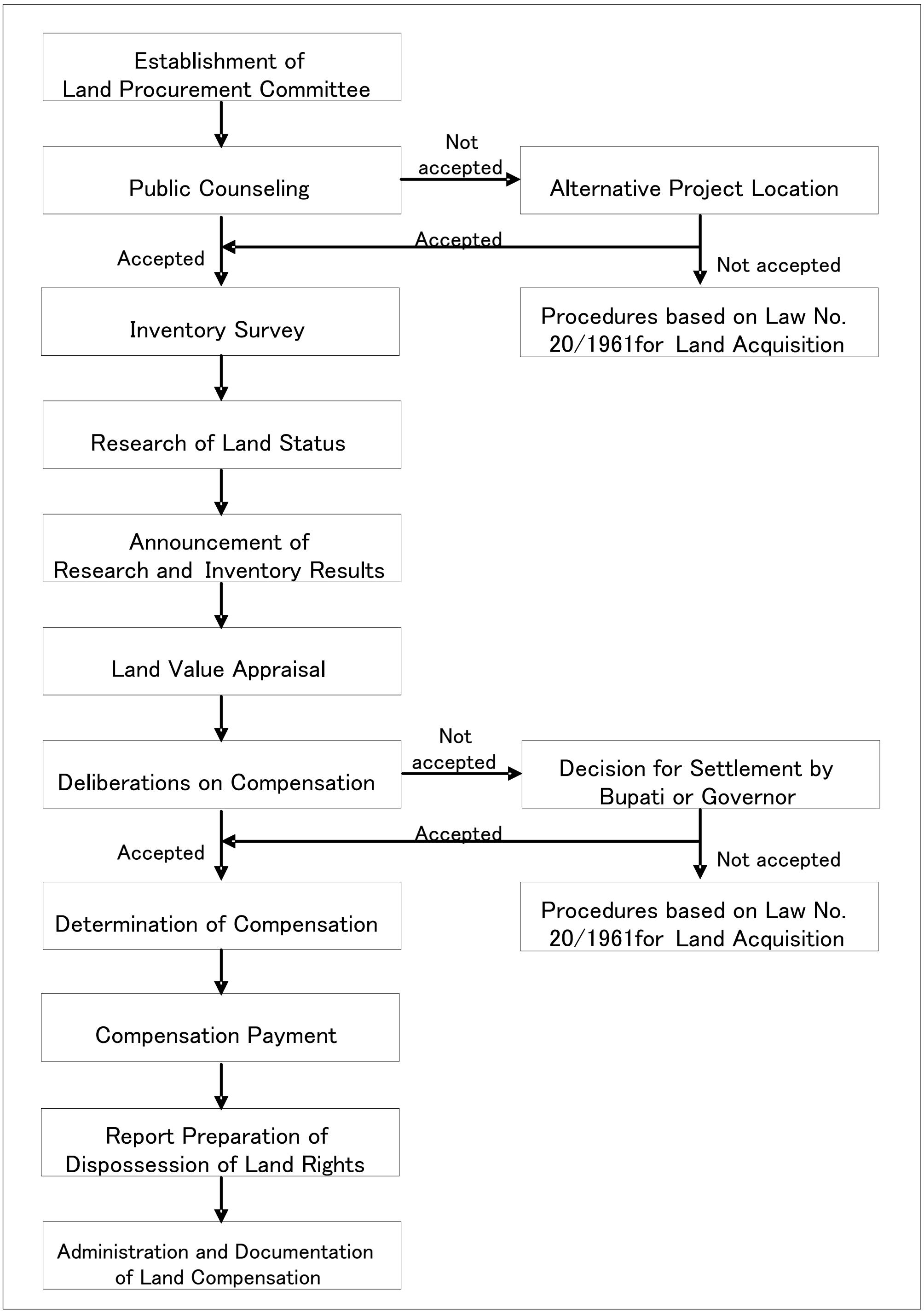
The appraisal of buildings and plantation prices is done by the related government staff of the district government that are responsible for buildings and farming/landscaping by referring to the price standard, set by laws and regulations (Article 29 of BPN Regulation No.3/2007).

(4) Compensation Procedure

The process of land acquisition compensation including resettlement for public facilities construction is as follows:

1) Provide explanations or dissemination to the people (Public Counseling).
2) Conduct research and an inventory survey on land, buildings, plantations, and any other objects built on the land, for which rights are to be dispossessed or delivered (Inventory Survey).
3) Conduct research on the legal status of land, of which rights are to be dispossessed, as well as supporting documents (Research of Land Status).
4) Announce the outcome of the research and inventory survey, as referred to in 2) and 3) above, in a document (Announcement of Research and Inventory Results).
5) Receive the appraisal results on land from the Land Value Appraisal Agency/Team and the government staff responsible for conducting appraisal on the buildings, plantations and/or any other objects built on the land (Land Value Appraisal).
6) Conduct a discussion with owners and the project implementer in order to determine the form and amount of compensation (Deliberations on Compensation).
7) Determine the amount of compensation on the land of which rights are to be dispossessed, in a document (Determination of Compensation).
8) Witness the process of compensation delivery to the landowners (Compensation Payment).
9) Make an official report on the dispossession or delivery of the rights (Report Preparation of Dispossession of Land Rights).
10) Administer and document all land procurement-related documents and submit them to the Project Implementer who requires the land, and also to the District Land Office (Administration and Documentation of Land Compensation).
11) In the case where no agreement is achieved from the discussion, the Land Procurement Committee should report/deliver the problems raised as well as several solution proposals to the Regent (Bupati) of the related district (Decision for Settlement).

Standard procedures for land compensation are shown in Figure 8.2.1.1.



Source: JICA Survey Team

Figure 8.2.1.1 Standard Procedures for Land Compensation

8.2.2. Experiences on Involuntary Resettlement

The Project Implementer for the Project, BBWSC, has experience in land acquisition through the project implementation of Stages (I) and (II) of the "Upper Citarum Basin Urgent Flood Control Project" under Japanese ODA loan. The results of land acquisition activities for those projects are as follows. Note that the submission of the LARAP for both Projects was not required by the Japanese Government.

(1) Project Description

1) Stage (I)

Stage (I) of the Upper Citarum Basin Urgent Flood Control Project was located in Bandung District, West Java. The Stage (I) project was divided into several packages: Packages A, B, C, D, E1 and a Consolidation Package. The Consolidation Package was a completion package.

The Stage (I) project started in 1994. Package A, B, C, D and E1 were located on the Citarum river, while the Consolidation Package included the Cikapundung Kolot and Cipamokolan rivers. The length of each Package covered by the project was as follows:

Package A: 5.7km
Package B: 4.5km
Package C: 5.3km
Package D: 3.7km
Package E1: 4.7km

2) Stage (II)

Stage (II) of the project was carried out on the Citarum River and its branches including: Cisangkuy, Citarik and Cisaranten across Kota Bandung, and was aimed to mitigate flooding of 5-year return period in the Bandung urban area. The result expected from this project was to reduce the damage caused by floods in Bandung urban areas and to support economic activity.

The project covered 7 rivers, including: Citarum (10.44km), Cisangkuy (6.67km), Citarum Upstream (5.37km), Cikeruh (6.47km), Citarik (6.08km) and Cisaranten (5.84km) and Cisaranten upstream (3.47km).

(2) Legal Base for Land Acquisitions Activities

The legal base for land acquisition for the project Stage (I) was Presidential Decree 55 of 1993 on Land Procurement for Development of Public Utilities. Additionally, the following three (3) legal bases were considered in the project Stage (II):

- Presidential Decree 34 of 1993 on Land National Policy which was used as the legal base for land procurement conducted up to 2004.
- Presidential Decree No 65 of 2006 which provided several options for compensation of individual assets required for implementing government development programs.
- BPN Regulation No 3 of 2007 on Guidelines for Land Acquisition which were operational guidelines for implementing the Presidential Decree 65 of 2006.

(3) Compensation Cost

The total compensation provided for the project of Stage (I) was Rp. 12,302,407,477-. Payment for the compensation was done in several phases and was completed over a 5-year period (1993-1997).

The total compensation cost provided for the project of Stage (II) was Rp 163,552,128,569-. Payment for the compensation was done in several phases and was completed over a 12-year period (1996-2007) (See APPENDIX V-4.5 for details).

(4) Redress Grievance System and its Associated Problems

Any complaints addressed by the PAPs were accommodated and solved within the 'refute period' for both phases. Within this period, PAPs had the right to propose claims on the size and classification of land and property as well as the number of plants within the project boundaries.

According to the requests from the PAPs, the LPC re-conducted the measurement of land and other properties to determine adequate size and classification that was acceptable for the PAPs.

Problems faced by the Committee were as follows:

- The owners of land and other properties were not available during the measurement period, which affected the schedule of the committee.
- Unavailability of neighbors to witness the land and property measurement/stocktaking.
- The land acquisition process was conducted at the same time as construction work. Therefore, a lot of land and other properties that had not been listed for compensation became objects for compensation.

8.3. Comparative Analysis with International Practices on Involuntary Resettlement

The "*Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations* (April 2002)" (hereinafter called JBIC Guidelines) has been applied to the Project since the Indonesian government submitted the official request for the Project to Japanese Government prior to 1st July 2010.

In order to assist BBWSC to prepare the framework of LARAP (FLARAP), a comparative analysis between Indonesian Regulations and international practices including JBIC on involuntary resettlement was conducted.

8.3.1. JBIC Guidelines on Involuntary Resettlement

Regarding involuntary resettlement, the JBIC guidelines indicate the following principles.

- Involuntary resettlement and loss of means of livelihood are to be avoided where feasible, exploring all viable alternatives. When, after such examination, it is proved impractical, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
- People to be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by the project proponents, etc. in a timely manner. The project proponents, etc. must make efforts to enable the people affected by the project, to improve their standard of living, income opportunities and production levels, or at least to restore them to pre-project levels. Measures to achieve this may include: providing land

and monetary compensation for losses (to cover land and property losses), supporting the means for an alternative sustainable livelihood, and providing the expenses necessary for relocation and the re-establishment of a community at relocation sites.

- Appropriate participation by the people affected and their communities must be promoted in planning, implementation and monitoring of involuntary resettlement plans and measures against the loss of their means of livelihood.

Note that the JICA requests the borrower to follow the OP 4.12 of World Bank for addressing individual issues on involuntary resettlement.

World Bank experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks. The policy includes safeguards to address and mitigate these impoverishment risks. Following are the key principles in the Bank's policy on involuntary resettlement.

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Displaced persons are provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.
- Resettlement activities should be conceived and executed as sustainable development programs.
- Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.
- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.
- The absence of a formal legal title to land is not a bar to WB policy entitlements.
- Particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.
- The full costs of resettlement activities necessary to achieve the objectives of the project are included in the total costs of the project.

8.3.2. Comparative Analysis with International Practices on Involuntary Resettlement

There are some gaps between the Indonesian regulations and international practice on Involuntary Resettlement. For example, the Indonesian regulations do not stipulate the preparation of a Land Acquisition and Resettlement Action Plan (LARAP). The results of the comparative analysis on Involuntary Resettlement between the Indonesian regulations and OP 4.12 based on the review them are shown in Table 8.3.2.1.

Table 8.3.2.1 Comparison Analysis on the Gaps between OP 4.12 and Indonesian Regulations in terms of "Involuntary Resettlement"

Issue	Operational Policy 4.12 of WB on Involuntary Resettlement	Indonesian Regulations on Involuntary Resettlement
Preparation of Resettlement Action Plan (RAP)	A resettlement plan or abbreviated resettlement plan is required for all operations that entail involuntary resettlement unless otherwise specified.（OP 4.12 para 17(a)）	No stipulation on the obligation of preparation of RAP is found.
Minimization of Involuntary Resettlement	Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs, and where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.（OP 4.12 para 2）	No stipulation for minimization of Involuntary resettlement is found
Impact Covered	(a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) lost of assets or access to assets; or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.（OP 4.12 para 3）	a. Land rights b. Buildings c. Crops/Plants d. Other objects attached to the land （Article 12 of President Regulation No.36/2005）
Compensation for Squatters	Those who do not have formal legal rights to land but have a claim to such land or assets--provided that such claims are recognized under the laws of the country, are provided compensation for the land they lose, and other assistance; and those who have no recognizable legal right or claim to the land and occupy the project area prior to a cut-off date, are provided resettlement assistance.（OP 4.12 para 16）	No stipulation on Compensation for Squatters is found.

Issue	Operational Policy 4.12 of WB on Involuntary Resettlement	Indonesian Regulations on Involuntary Resettlement
Estimation of compensation cost	To provide prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project. In applying this method of valuation, depreciation of structures and assets should not be taken into account. With regard to land and structures, "replacement cost" is defined as follows: <u>For agricultural land</u>, it is the pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes. <u>For land in urban areas,</u> it is the pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes. <u>For houses and other structures</u>, it is the market cost of the materials to build a replacement structure with an area and quality similar to or better than those of the affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes. (OP 4.12 para 6(a)(ii), O.P 4.12 footnote 11, O.P 4.12 Annex footnote 1)	Land value appraisal is done by a Land Value Appraisal Team. The Land Value Appraisal Team conducts land value appraisal based on the Selling Value of Taxed-Object (NJOP) or real/actual value by taking into consideration the NJOP of the current year, as well as the variables below: ● Location and area of land ● Land status ● Land entitlement ● Synchronization between land and existing area spatial planning or city planning ● Facilities and infrastructure available ● Any other factors that may have effects on land price/value. Appraisal of price of buildings and/or plantations and/or other objects attached to the land is conducted by Head of Agency/Office/Body responsible for building and/or plantations and/or other objects attached/related to the land in city/district level, by referring to the price standard, set by laws and regulations. (Article 28 and 29, Head of National Land Affairs Agency Decree No. 03/2007)

Issue	Operational Policy 4.12 of WB on Involuntary Resettlement	Indonesian Regulations on Involuntary Resettlement
Assistance for Restoration of Livelihood and Living Standard	Displaced persons should be (i) offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living; and (ii) provided with development assistance in addition to compensation measures; (iii) such as land preparation, credit facilities, training, or job opportunities.（OP 4.12 para 6(c)）	No description on assistance for restoration of livelihood and living standard
Paying attention to vulnerable groups	Particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation. （OP 4.12 para 8）	No description on consideration of vulnerable groups

Source: JICA Survey Team based on Operation Policy 4.12 of WB on Involuntary Resettlement and Indonesian Regulations on Involuntary Resettlement

8.4. Assistance on the Preparation of FLARAP

As previously mentioned, the Indonesian regulations do not stipulate the preparation of LARAP. However, the submission of the LARAP prior to the JICA appraisals for project is a necessary condition for borrowers. The Project has been designed as a “Sector Loan Project” with a collection of sub-projects selected as result of the Survey.

For this Project under Japanese ODA Loan, the Indonesian Government is requested to submit the FLARAP to confirm consistency with JICA’s basic policies on involuntary resettlement. The LARAP will be prepared based on the FLARAP after determination of the sub-projects for smooth implementation of the Project.

8.4.1. Requirements of JBIC Guidelines on Involuntary Resettlement

JICA requests borrowers to prepare an FLARAP that is consistent with the basic policy on involuntary resettlement mentioned in the JBIC Guidelines referring to the OP 4.12. There are considerable gaps between the Indonesian regulations and the JBIC guidelines in terms of involuntary resettlement policies as follows:

(1) Impacts Covered

While Indonesian regulations stipulate the provision of compensation on only physical aspects such as land, buildings, crop/plants and other objects attached to the land, the OP 4.12 stipulates for compensation on the loss of income sources or means of livelihood as well as on those physical aspects.

(2) Estimation of Compensation Cost

The OP 4.12 has a policy of providing compensation at full replacement cost without any depreciation. On the other hand, in Indonesia, compensation costs are decided by a LPC based on the NJOP or real/actual value by taking into consideration the NJOP of the current year.

(3) Squatters

No stipulation on the compensation for squatters is found in the Indonesian regulations. However, the OP 4.12 stipulates that those who do not have formal legal rights to land are eligible for compensation.

(4) Assistance for Restoration on Livelihood and Living Standards

The OP 4.12 contains a policy on assistance for restoration of livelihood and living standards for displaced persons. However, there is no description on this issue in the Indonesian regulations.

(5) Paying Attention to Vulnerable Groups

While no description on consideration of vulnerable groups such as those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, *etc.* is stated in the Indonesian regulations, the OP 4.12 requests that attention be paid to these groups.

8.4.2. Review on the RAP Framework Prepared for the ICWRMIP

It is essential that the FLARAP for the Project will be prepared in the form of closing the gaps between Indonesian regulations and JBIC Guidelines (WB OP 4.12) with “mutually acceptable mechanisms”.

The Integrated Citarum Water Resources Management Investment Program（ICWRMIP), which had the target area in the Citarum River Basin, commenced in February 2005 and was funded by ADB. The program successfully prepared an RAP framework based on “mutually acceptable mechanisms” closing the gaps between Indonesian regulations and ADB’s resettlement policies.

In order to examine if the framework is applicable to this Project, the RAP Framework prepared for the ICWRMIP was reviewed due to the following reasons.

- Both projects have the same target area, the Citarum River Basin, and they will be implemented by the same project proponent, *i.e.*, BBWSC.
- The projects have been supported by international donors (ADB and JICA).

(1) Background

The ICWRMIP has several key areas such as water resources development and management, environmental protection, disaster management, community empowerment etc. The rehabilitation of the West Tarum Canal is one of the sub-projects for the key area of water resources development and management. The RAP Framework for ICWRMIP was prepared to address involuntary resettlement issues arising from the program with technical assistance (TA) by ADB. The draft of the RAP Framework was approved in August 2008 by ADB.

(2) Livelihood Restoration Program (LRP)

In the RAP Framework, the Livelihood Restoration Program (LRP), which is the Project Resettlement Policy for the ICWRMIP, was specifically proposed to close the gap between the ADB’s policies and existing Indonesian regulations on involuntary resettlement.

The LRP is divided into two components: (i) special program and (ii) general program.

The special program under the LRP has allocated an estimated amount to cover any gaps in local government regulations on providing for affected structures, crops and trees, required during relocation. It should be noted that these are estimates of only the actual impacts, costs and levels of assistance will be determined during RAP updating (to be conducted from October 2010).

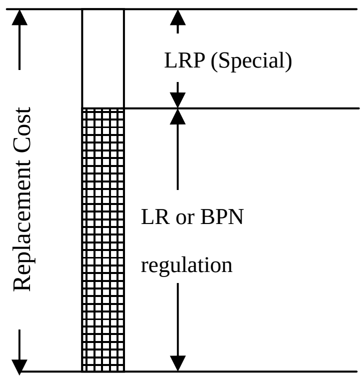
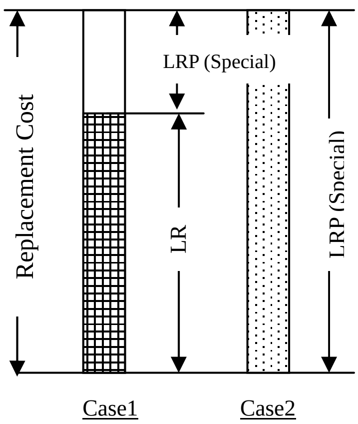
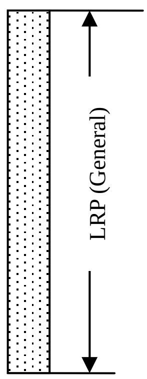
In the general program of the LRP, the Project will also provide suitable livelihood activities under the LRP for the severely affected and vulnerable AHs. The program will be based and designed according to the results of needs assessment to be carried out by the local organization with the AHs during the updating of the RP. In deciding on an appropriate livelihood activities, the following factors will be taken into account: (i) the nature of loss and/or situation of the AH, (ii) preference of the AH, (iii) level of preparedness of the AH to participate in the livelihood activity, and (iv) economic viability of the livelihood activity.

The BBWSC will engage the services of a local NGO or any organization that has expertise in social development and training. Participating AHs will also receive transition subsistence allowance in form of a program for a maximum of 6 months sufficient to provide the minimum basic needs for a household of 5 members. This is also based on the assumption that it will take a maximum of 6 months in order for these AHs to start earning income from the program. It should be noted that the local organization or NGO will review and adjust the program if necessary depending on the final design of the livelihood activities as per consultation with AHs.

The basic compensation policies applied in the RAP Framework are as follows (see Table 8.4.2.1):

- In the case that there are local regulations available regarding compensation, APs will be entitled to compensation as stipulated in the existing local government regulations available at the time of implementation.
- In the case that there are no local regulations available regarding compensation, APs will be entitled to replacement cost as described in the entitlement matrix.
- Any gaps in the local regulations on providing replacement cost compensation will be fulfilled in the form of a special program of the LRP.
- “Assistance for restoration of livelihood and living standards” and “Paying attention to vulnerable groups” will be considered in the form of a general program of the LRP.
- Allowances defined in the entitlement matrix may be provided as cash or goods or services or alternatively may be provided in the form of the LRP (community empowerment program).

Table 8.4.2.1 Basic Compensation Policies Applied in the RAP

<table>
<tr><th>Compensation Items</th><th>Official Dweller</th><th>Squatter</th></tr>
<tr><td>Land</td><td>The compensation cost for land will be determined based on the BPN regulation/bupati or mayoral decree with several considerations such as land transaction results in the last 6 months, NJOP, and market price (Sumedang District experience). Note that the cost will be examined in the process of RAP reparation.</td><td>None</td></tr>
<tr><td>Property (Crops, Buildings)</td><td>
</td><td>
</td></tr>
<tr><td>Assistance for Restoration on Livelihood and Living Standards</td><td colspan="2" rowspan="2">

The eligibility groups and the amount for LRP (General) will be identified in the RAP Updating.</td></tr>
<tr><td>Paying attention to vulnerable groups</td></tr>
</table>

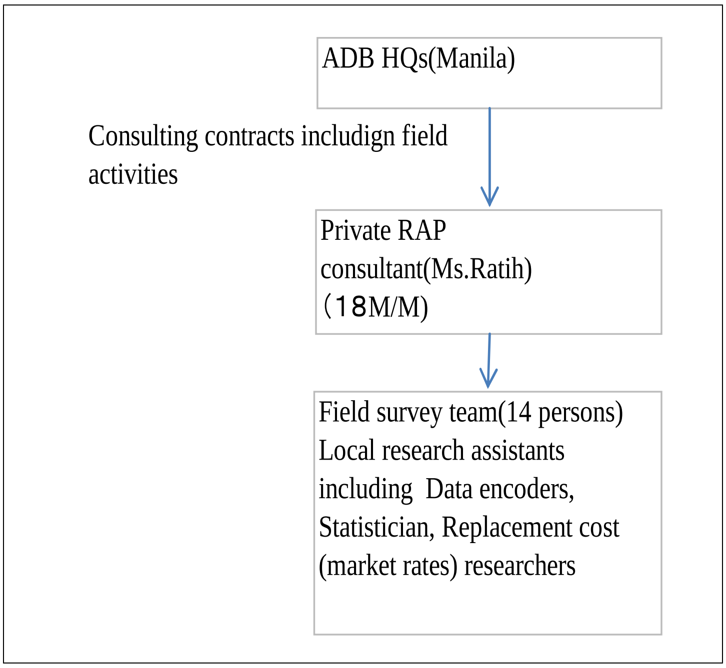
- LR: Local Regulations on compensation
- BPN regulation: Compensation cost based on Indonesian Regulations decided by BPN
- LRP (Special): Special Program for Livelihood Restoration Program
- LRP (General): General Program for Livelihood Restoration Program
- Case1: Local Regulations available
- Case2: Local Regulations not available

Source: JICA Survey Team through interview to RAP consultant for the ICWRMIP

(3) Summary of the RAP for the Rehabilitation of West Tarum Canal (WTC)

The RAP for the rehabilitation of the West Tarum Canal, which is one of the sub-projects of ICWRMIP, was developed and approved by ADB in August 2008. The summary of the RAP is as follows:

- The number of Project Affected Persons (PAPs) is 892 (all squatters).
- The WTC didn't require any land acquisition because the project ROW was inside government land. Therefore, the compensation for the project was only for buildings, crops, trees, etc.
- The LPC was established and the Replacement Cost Survey (RCS) was conducted through coordination with a "Resettlement Working Group (RWG)" under the LPC.
- The field surveys (census, Inventory of Loss, and replacement cost survey) necessary for preparation of the RAP commenced in September 2006. At the same time, public meetings were conducted at district levels. After the update of the RAP, it was finalized in August 2008 and officially approved by ADB. (Refer to Table 8.4.2.2)
- Updating on the approved draft of the RAP will be conducted from October 2010 to August 2011.
- The formation of the RAP preparation team for the WTC is shown in Figure 8.4.2.1.



Source: JICA Survey Team based on interview to the RAP preparation consultant

Figure 8.4.2.1 Formation of the RAP Preparation team for the West Tarum Canal Project

Table 8.4.2.2 The Process of the RAP Preparation for ADB ICWRMIP (West Tarum Canal)

	2006						2007						2008					
	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
1. Preliminary Design	■ ■ ■	■ ■ ■	■ ■ ■															
2. Consultation meetings (41 times)																		
District level (2times)					▬													
District level (3times)					▬	▬												
Socialization & Gender meeting (2times)					▬	▬												
Focus Grope Discussion (24times) -village level-								▬	▬									
Working group Coodination (8times) -sub-district level														▬	▬			
District level (2times)														▬	▬			
2. Field Survey																		
Socio-eco survey (Census)				▬	▬			▬	▬					▬	▬			
Inventory of Loss survey (IOL)				▬	▬			▬	▬					▬	▬			
Replacament cost survey (RCS)				▬	▬									▬	▬			
Declaration of "Cut-off Date"															▲			
3. RAP Preparation																		
Preparation of Draft of RAP				■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■		
Approval of ADB																▲		
4. Upadating of the RAP (from Oct. 2010 to August 2011)																		

Source: JICA Survey Team through interview to RAP consultant for the ICWRMIP

8.4.3. Comparative Analysis on the Requirements of WB (OP 4.12) and ADB Policies for Involuntary Resettlement

A comparative analysis on the requirements of OP 4.12 and ADB Policies for involuntary resettlement was conducted to examine the appropriateness in applying the Project Resettlement Policies with LRP of the ICWRMIP to the Project（see Table 8.4.3.1).

Table 8.4.3.1 Comparison Analysis on the Policies in terms of "Involuntary Resettlement" between WB (OP 4.12) and ADB (SPS)

Main Issues	Operational Policy 4.12 of WB on Involuntary Resettlement	Involuntary Resettlement Safeguard of ADB (Safeguard Policy Statement: SPS)
Preparation of Resettlement Action Plan (RAP)	A resettlement plan or abbreviated resettlement plan is required for all operations that entail involuntary resettlement unless otherwise specified.（OP 4.12 para 17(a)）	To Prepare a resettlement plan elaborating on displaced persons' entitlements, the income and livelihood restoration strategy, institutional arrangements, monitoring and reporting framework, budget, and time-bound implementation schedule. (SPS p 17)
Minimization of Involuntary Resettlement	Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs, and where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits.（OP 4.12 para 2）	To avoid involuntary resettlement wherever possible; <u>to minimize involuntary resettlement</u> by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups. (SPS p17)
Impact Covered	The policy covers direct economic and social impacts that both result from World Bank assisted investment projects, and are caused by: (a) the involuntary taking of land resulting in (i) relocation or loss of shelter (ii) loss of assets or access to assets (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.（OP 4.12 para 3）	The involuntary resettlement safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihood) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. It covers them whether such losses and involuntary restrictions are full or partial, permanent or temporary. (SPS p17)
Compensation for Squatters	Those who do not have formal legal rights to land but have a claim to such land or assets--provided that such claims are recognized under the laws of the country, are provided compensation for the land they lose, and other assistance. In addition, those who have no recognizable legal right or claim to the land they are occupying are provided compensation for loss of assets other than land.（OP 4.12 para 15,16）	Ensure that displaced persons without titles to land or any recognizable legal rights to land are eligible for resettlement assistance and compensation for loss of non-land assets. (SPS p17)
Estimation of compensation cost	To provide prompt and effective compensation <u>at full replacement cost</u> for losses of assets attributable directly to the project. "Replacement cost" is determined by a method of valuation of	Improve, or at least restore, the livelihoods of all displaced persons through (i) land-based resettlement strategies when affected livelihoods are land based where possible, or cash compensation <u>at replacement value</u> for land when the loss of

Main Issues	Operational Policy 4.12 of WB on Involuntary Resettlement	Involuntary Resettlement Safeguard of ADB (Safeguard Policy Statement: SPS)
	assets that helps calculate the amount sufficient to replace lost assets and cover transaction costs. In applying this method of valuation, depreciation of structures and assets should not be taken into account. （OP 4.12 para 6(a)(ii), O.P 4.12 footnote 11, O.P 4.12 Annex footnote 1）	land does not undermine livelihoods, (ii) prompt replacement of assets with access to assets of equal or higher value, (iii) prompt compensation at full replacement cost for assets that cannot be restored, and (iv) additional revenues and services through benefit sharing schemes where possible. (SPS p17)
Assistance for Restoration of Livelihood and Living Standard	Where necessary to achieve the objectives of the policy, the resettlement plan or resettlement policy framework also include measures to ensure that displaced persons are (i) offered support after displacement, for a transition period, based on a reasonable estimate of the time likely to be needed to restore their livelihood and standards of living; and (ii) provided with development assistance in addition to compensation measures such as land preparation, credit facilities, training, or job opportunities. （OP 4.12 para 6(c)）	Provide physically and economically displaced persons with needed assistance, including the following: (i) if there is relocation, secured tenure to relocation land, better housing at resettlement sites with comparable access to employment and production opportunities, integration of resettled persons economically and socially into their host communities, and extension of project benefits to host communities(SPS p17); (ii) transitional support and development assistance, such as land development, credit facilities, training, or employment opportunities; and (iii) civic infrastructure and community services, as required. (SPS p17)
Paying attention to vulnerable groups	To achieve the objectives of this policy, particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation. （OP 4.12 para 8）	Improve the standards of living of the displaced poor and other vulnerable groups, including women, to at least national minimum standards. In rural areas provide them with legal and affordable access to land and resources, and in urban areas provide them with appropriate income sources and legal and affordable access to adequate housing. (SPS p17)

Source: JICA Survey Team

8.4.4. Conclusion (The Policies for the FLARAP for The Project)

The Survey Team concluded that the preparation of the FLARAP for the Project following the basic policies of the RAP Framework for ICWRMIP is considered appropriate for the following reasons:

- Both ICWRMIP and the Project are located in the same river basin and have similar project components.
- There are no remarkable differences between the requirements of OP 4.12 and ADB policies on involuntary resettlement.
- The Project Resettlement Policy with the LRP is appropriate as “mutually acceptable mechanisms” to close the gap between JICA’s policies (WB OP 4.12) and existing Indonesian regulations on involuntary resettlement.

A draft of the FLARAP for the Project was prepared based on the principles of the RAP Framework of ICWRMIP by the Survey Team. This draft of the FLARAP was agreed on in the meeting with DGWR including BBWSC on 11th August. (Refer to Appendix V-6, 7) The summary of the draft the FLARAP is explained in the next section.

8.4.5. Summary of the FLARAP

(1) Project description

According to this Survey, the expected area of land required for acquisition and the number of affected houses is summarized as shown in Table 8.4.5.1.

Table 8.4.5.1 Land Acquisition Area and Number of House Relocations for the Project

Tributaries	Land Acquisition Area				House Relocation
	Agricultural Land	Residential Area	Idle Space	Total	
Unit	ha				house
Citarum Upstream	9.5	1.9	1.2	12.5	34
Citarik Upstream	12.7	0.5	0.0	13.2	16
Cimande	26.7	4.1	0.7	31.5	16
Cikijing	18.6	2.6	0.0	21.2	40
Cikeruh	12.2	11.3	0.0	23.5	190
Cikeruh (up to 2.5km)	6.9	2.7	0.0	9.6	34
Cibeusi	0.1	3.0	0.0	3.1	46
Cisangkuy Upstream	12.6	1.9	0.0	14.5	25
Citalugtug	6.0	4.7	0.0	10.6	64
Ciputat	2.7	0.1	0.0	2.8	4
Total	101.1	30.1	1.9	133.1	469

Source: JICA Survey Team

(2) Objectives and Policies

1) Objectives

The FLARAP has been prepared to support the implementing agency (BBWSC) in setting out strategies to mitigate adverse effects and to maintain living standards of those affected by land acquisition and any other resettlement effects. The LARAP for each sub-project will be prepared based on the FLARAP after determination of the sub-projects for the Project.

2) Principles

The basic principles of the FLARAP are as follows:

- Acquisition of land and other assets, and resettlement of people will be avoided or minimized as much as possible by identifying possible alternative project designs and appropriate social, economic, operation and engineering solutions that have the least impact on populations in the Project area.
- All AHs residing, working, doing business and/or cultivating land within areas affected by the Project as of the date of the latest census and inventory of lost assets (IOL), are entitled to compensation for their lost assets (land and/or non-land assets) at replacement cost, restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels. The rehabilitation measures include the following:
    - Training on skill acquisition for job placement
    - Providing micro financing if the AHs will engage in small scale business
    - Others
- All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the AHs from entitlements to such compensation and rehabilitation measures or resettlement objectives.
- If the local governments relocate PAPs for some other development projects in part of the area of this Project before Project commencement, the registered PAPs in the process of LARAP preparation for Project will be excluded from the list of the inventory of loss based on the basic agreement of PAPs.
- AHs will be fully consulted and given the opportunity to participate in matters that will have adverse impacts on their lives during the design, implementation and operation of the Project. Plans for the acquisition of assets will be carried out in consultation with the AHs who will

receive prior information of the compensation, relocation and other assistance available to them.

- Payment for land and/or non-land assets will be based on the principle of replacement cost (local regulations, where available and applicable, shall be fully followed in the implementation process).
- There shall be effective mechanisms for hearing and resolving grievances during implementation of the land acquisition and resettlement plans.
- Special measures will be incorporated in the RPs and in complementary mitigation and enhancement activities to protect socially and economically vulnerable groups at high risk of impoverishment, such as ethnic minorities, women-headed families, disabled-headed households, landless households, children and elderly people without support structures, and people living in poverty.
- Adequate resources will be identified and committed during land acquisition and resettlement planning. This includes adequate budgetary support fully committed and made available to cover the costs of land acquisition, compensation, resettlement and rehabilitation within the agreed implementation period for the Project and, adequate human resources for supervising, liaising and monitoring of land acquisition, resettlement and rehabilitation activities.
- The LARAPs summary in the form of a Project Information Booklet (PIB) will be translated into Bahasa and placed in the village offices for the reference of AHs as well as other interested groups. A copy of the RP in the local language will be placed in the Project Implementing Agency (BBWSC) and district offices.

(3) Entitlement Matrix

The project entitlements developed and presented in the entitlement matrix correspond to the potential impacts identified during the census and inventory of losses (refer to Table 8.4.5.2). It should be noted that these entitlements may be revised or enhanced, as necessary, following the conduct of the detailed measurement survey (DMS) and consultation with AHs.

Table 8.4.5.2 Entitlement Matrix

No.	Category of Impacts/Losses	Entitled Persons	Project Entitlements	Notes/ Implementation Arrangement
A. Impacts on Land				
1	Permanent loss of paddy/residential/ commercial land	who have formal legal rights and customary and traditional rights and those whose claim over the affected land is under application for full title	• Cash or in kind compensation at replacement cost which is based on market value that reflect recent land sales and in the absence of such recent sales, based on productive value (for productive/agricultural) or based on similar location attributes (for residential and commercial land	• Local regulations, where available and applicable, shall be fully followed in the implementation process.
2	Temporary loss of paddy/residential/commercial land	who have formal legal rights and customary and traditional rights and those whose claim over the affected land is under application for full title	• Payment of rent for residential land based on existing or ongoing rental agreement in the area or as per negotiation with AHs. For productive land, rental will be no less than the net income that would have been derived from the affected property during disruption. • Compensation for affected crops at replacement cost for the duration of the impact, and land will be restored to pre-project condition or better.	• Contractor will be responsible for returning land to pre-project/better condition. • Local regulations, where available and applicable, shall be fully followed in the implementation process.
3	Marginal Impacts due to Permanent Loss of Land Use	Users/Occupants who have no formal legal rights nor customary and traditional rights : Marginal impacts:	• No compensation for land • Compensation for crops and trees based on replacement cost principle	• Local regulations, where available and applicable, shall be fully followed in the implementation process. Not their main source of income
4	Temporary Loss of Land Use Due to spoil dumping on ex-river bed or due to construction activities	Users/Occupants who have NO formal legal rights nor customary and traditional rights:	• No compensation for land • Compensation for affected crops at replacement cost for the duration of the impact • The project will facilitate formal leasing if requested by user/occupant. • The potential identified land will be assessed for any contamination and certified as safe for use.	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • APs to re-use land after dredged material has been dumped and assessed for any contamination and certified safe for use. Should the land be deemed unusable, AHs will be entitled to livelihood restoration under a LRP • Contractor will be responsible for returning ex-river bed land to pre-project/ better conditions.

No.	Category of Impacts/Losses	Entitled Persons	Project Entitlements	Notes/ Implementation Arrangement
B .Relocation of AHs				
1	Relocation of AHs and Shop Owners due to Permanent Loss of Land Use	who have formal legal rights and customary and traditional rights and those whose claim over the affected land is under application for full title	• Compensation for crops and trees based on replacement cost principle • Provision of transport allowance based on actual cost of moving to new site (labor, transport cost) or provision of transport assistance will be provided in the form of program within the LRP. • Provision of transition subsistence allowance will be provided in the form of program within the LRP. • Entitled to participate in Livelihood restoration program	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • The LRP allowance shall be based on poverty threshold for an average 5 household members. A single person household will receive 1/5 of said amount.
2	Relocation of AHs and Shop Owners due to Permanent Loss of Land Use	Informal Dwellers but have other land on Which outside the Project Area	• No compensation for land, • Compensation for structures based on replacement cost principle • Compensation for crops and trees based on replacement cost principle • Provision of transport allowance based on actual cost of moving to new site (labor, transport cost) or provision of transport assistance will be provided in the form of program within the LRP. • Provision of Transition subsistence allowance will be provided in the form of program within the LRP. • Entitled to participate in Livelihood restoration program	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • The LRP allowance shall be based on poverty threshold for an average 5 household members. A single person household will receive 1/5 of said amount.
3	Relocation of AHs and Shop Owners due to Permanent Loss of Land Use	Informal Dwellers but have no other land outside the Project Area	• No compensation for land • Compensation for structures based on replacement cost principle • Compensation for crops and trees based on replacement cost principle • For house and house-cum-shop, the Project will facilitate to find access to a residential plot (and with commercial advantage for house-cum-shops) within the village or nearby, with an affordable renewable lease or lease-to-buy agreement. The area will be with similar or better conditions as before with a latrine	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • Individual or small group relocation sites as per AHs' final option. AHs have the option to have access to a place to rent outside the residential plot that will be facilitated by the PIU. • The Project will assist AHs in the determination of lease amount. • For vulnerable AHs who may not have the ability to generate much income, the LRP will be designed to increase income levels sufficiently to be able to pay

No.	Category of Impacts/Losses	Entitled Persons	Project Entitlements	Notes/ Implementation Arrangement
			• For shops, the Project will facilitate to find access to a place/plot to lease/rent with similar commercial advantage either in existing market sites or a plot of land suitable for putting up stalls/shops (new market). Lease arrangement will be with a provision to renew and shall be facilitated by the project. • Provision of transport allowance based on actual cost of moving to new site (labor, transport cost) or provision of transport assistance will be provided in the form of the LRP. • Provision of transition subsistence will be provided in the form of the LRP. • Entitled to participate in Livelihood restoration program.	the full local market leases. • The LRP allowance shall be based on poverty threshold for an average 5 household members. A single person household will receive 1/5 of said amount.
C. Non-Land Assets				
1a	Houses/Shops and Secondary Structures	Owners regardless of whether or not the owner has hak guna bangun (building permit)	• Compensation at replacement cost based on actual current market prices of materials and actual cost of labor for demolishing, transfer and rebuild	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • Any gaps in the local regulation on providing replacement cost compensation will be fulfill in the form of a special program of the Livelihood Restoration Program (LRP).
1 b		Renters of Structures (house/shops)	• Assistance to tenants/renters to find a new place to live or do business • Assistance to find new rental property • Entitled to participate in Livelihood Restoration Program (LRP).	Local regulations, where available and applicable, shall be fully followed in the implementation process.
2	Public Infrastructure and Facilities	Owner (Government)	• Rebuild the facilities based on agreement by both parties.	
3	Crops and Trees	Owners	• Annual Crops: If standing crops are destroyed or cannot be harvested, compensation based on replacement cost principle • Perennial Crops: Compensation based on replacement cost • Timber Trees: Compensation at current market rates based on type of tree and diameter of trunk at breast	• Local regulations, where available and applicable, shall be fully followed in the implementation process. • Any gaps in the local regulation on providing replacement cost compensation will be fulfill in the form of a special program of the Livelihood Restoration Program (LRP).

No.	Category of Impacts/Losses	Entitled Persons	Project Entitlements	Notes/ Implementation Arrangement
			height	
D. Income Loss				
1	Significant Impact due to relocation of shops or house-cum-shops	House-cum-shop and shop-owners whether or not with land outside the Project Area	• Entitled to participate in the Livelihood Restoration Program (LRP)	• The LRP allowance shall be based on poverty threshold for an average 5 household members. A single person household will receive 1/5 of said amount.
E. High Risk of Impoverishment/Hardship				
1	Due to loss of resource base	Poor and vulnerable Households even if marginally affected	• Entitled to participate in the Livelihood Restoration Program and LRP Allowance	• "LRP allowance" will be provided to participants using a poverty threshold for an average 5 household members. A single person household will receive 1/5 of said amount. • AHs are taking part in the program and in the process of restoring their income.
F. Loss of Access				
1	Restricted use of waterway for toilet and laundry purposes and source of HH water		• Provision of Communal Sanitary Toilet and Safe water facilities in selected points along the river as included in the Project design activities.	• As per consultation with AHs, residents and local government
2	Restricted Access to resources		• Community decision making on what resource use shall be restricted and identification of alternative livelihoods to replace the lost resources. • Community design of alternative livelihoods to replace the restricted use of resources.	
G .Impacts During Construction				
1 •	Non-Land Assets	Owners of affected non land assets	• Compensation at Replacement Cost as indicated above	
H .Unexpected Impacts				
1	**Unexpected Impacts**	-	• The mitigation measures for unexpected negative impacts caused by involuntary resettlement will be discussed in the detailed design stage.	

Source: JICA Survey Team based on the Resettlement framework for CWRMIP (August 2008)

(4) LARAP Preparation

1) Implementation Arrangements

The DGWR of the MPW will be the Project Executing Agency. The Citarum River Basin Organization Unit (BBWSC) will be responsible as the implementing agency for overall management and coordination of all project activities including the preparation of the LARAP. Note that the necessary actions and responsible agencies for each compensation activity will be described in the LARAP in detail.

The DGWR will approve the LARAP for a particular sub-project. Likewise, overall responsibility in ensuring the necessary budget for implementation of land acquisition and resettlement based on the approved LARAP rests on the DGWR.

In the Project, the Government bodies that will play a key role in the preparation and implementation of resettlement plans are the Implementing Agencies and the LPC. For each sub-project of the Project that entails involuntary resettlement, the BBWSC will work closely with the LPC to ensure mutually agreeable LARAPs are designed and implemented consistent with the FLARAP.

2) Decision on a Full or a Abbreviated LARAP

According to OP 4.12 of the World Bank, a resettlement plan is required for all operations that entail involuntary resettlement unless otherwise specified. Note that where impacts on the entire displaced population are minor, or fewer than 200 people are displaced, an abbreviated resettlement plan may be agreed with the borrower.

3) Contents of a Full or a Short LARAP

The scope and level of detail of the resettlement plan vary with the magnitude and complexity of resettlement. The resettlement plan covers the elements below, as relevant.

a) Description of the project (General description of the project and identification of the project area)
b) Potential impacts (Identification of the project component or activities, the zone of impact of such component or activities etc.)
c) Alternatives considered to avoid or minimize resettlement in the preliminary design stage
d) Objectives
e) Socioeconomic studies (The findings of socioeconomic studies)
f) Legal framework (The findings of an analysis of the legal framework)
g) Institutional Framework (The findings of an analysis of the institutional framework)
h) Eligibility (Definition of displaced persons and criteria for determining their eligibility for compensation and other resettlement assistance)
i) Valuation of and compensation for losses
j) Resettlement measures (A description of the packages of compensation and other resettlement measures)
k) Site selection, site preparation, and relocation (Alternative relocation sites considered and explanation of those selected)

l) Housing, infrastructure, and social services (Plans to provide housing, infrastructure and social services)
m) Environmental protection and management
n) Community participation (Involvement of resettlers and host communities)
o) Integration with host populations (Measures to mitigate the impact of resettlement on any host communities)
p) Grievance procedures
q) Organizational responsibilities (The organizational framework for implementing resettlement)
r) Implementation schedule
s) Costs and budget
t) Monitoring and evaluation

In case of an abbreviated plan, it shall cover the following minimum elements:

a) A census survey of displaced persons and valuation of assets
b) Description of compensation and other resettlement assistance to be provided
c) Consultations with displaced people about acceptable alternatives
d) Institutional responsibility for implementation and procedures for grievance redress
e) Arrangements for monitoring and implementation
f) A timetable and budget.

4) Surveys for LARAP Preparation

If resettlement impacts are unavoidable and preparation of a resettlement plan is therefore required, an RAP will be prepared following detailed design using the following procedures:

a) Undertake a census of all APs.
b) Undertake inventory of loss survey (IOL) of all losses of all APs. At the same time, inform potential APs of the sub-project, its likely impacts, and principles and entitlements as per the LARAP Framework.
c) Undertake a socioeconomic survey (SES) of at least 20%～25% of all APs, 20% of severely affected AHs and ethnic minorities' population.
d) Undertake a replacement cost survey for various types of affected assets as a basis for determining compensation rates at replacement cost. Determine the losses in accordance with the entitlement matrix.
e) Provide project and resettlement information to all persons affected in a form and language that is understandable to them, and closely consult them on compensation and resettlement options, including relocation sites and economic rehabilitation.
f) Prepare the draft LARAP with time-bound implementation schedule, procedures for grievance mechanism and monitoring and evaluation, and a budget.
g) Finalize the subproject LARAP and translate the summary (PIB) into the local language.
h) Disclose the draft and final LARAP in accordance with JICA's policy on public communications to the affected communities. The draft LARAP will be disclosed to APs prior to submission to JICA. The final LARAP will be disclosed after approval.

Table 8.4.5.3 Surveys for LARAP Preparation

Inventory of Loss (IOL) Survey	The census and Inventory of Loss (IOL) Survey of lost assets will collect data on the affected assets from 100% of APs following detailed engineering design. The data collected during the IOL will constitute the formal basis for determining AP entitlements and levels of compensation. For each AP, the scope of the data will include: - Total and affected areas of land, by type of land assets - Total and affected areas of structures, by type of structure (main or secondary) - Legal status of affected land and structure assets, and duration of tenure and ownership - Quantity and types of affected crops and trees - Quantity of other losses, e.g., business or other income, jobs or other productive assets estimated daily net income from informal shops - Quantity/area of affected common property, community or public assets, by type - Summary data on AHs, by ethnicity, gender of head of household, household size primary and secondary source of household income vis-à-vis poverty line, income level, whether the household is headed by women, elderly, disabled, poor or indigenous peoples - Identify whether affected land or source of income is the primary source of income - AP knowledge of the sub-project and preferences for compensation and, as required, relocation sites and rehabilitation measures.
Socioeconomic Survey	At a minimum, the socioeconomic survey (SES) will collect information from a sample of 10% of affected people and 20% of severely affected AHs, disaggregated by gender and ethnicity. The purpose of the socioeconomic survey is to provide baseline data on AHs to assess resettlement impacts, to be sure proposed entitlements are appropriate, and to be used for resettlement monitoring. The scope of data to be collected includes: 1) Household head: name, sex, age, livelihood or occupation, income, education and ethnicity 2) Household members: number, livelihood or occupation, school age children and school attendance, and literacy, disaggregated by gender 3) Living conditions: access to water, sanitation and energy for cooking and lighting; ownership of durable goods 4) Access to basic services and facilities.
Replacement Cost Survey	The replacement cost survey (RCS) will be done in parallel with DMS and SES activities by collecting information from both secondary sources and primary sources (direct interviews with people in the affected area, material suppliers, house contractors, local governments), and from both those affected and those not affected. The methodology employed in the RCS will include the following: a. Conducting bill of materials and bill of quantities survey of typical structures, coupled by a canvass of prices of construction materials and interview with contractors and builders to determine the current cost of labor in the construction business, and come up with the unit cost for each average type of main structures (houses and similar buildings) found in the project area b. Discussing with government officials involved in land acquisition (such as the LPC) in previous projects to gain insights on various methodologies in calculating compensation rates c. Meeting with vendors and agriculture specialists, including officials of the Department of Agriculture, to establish the current market rates of perennial and annual crops d. Interviewing District, Sub-District, and village officials, including residents, to find out the current market rates of fixed assets, especially land, in the Project area as per record of recent sale transactions. Compensation rates will be continuously updated to ensure that APs receive compensation at replacement cost at the time of compensation payment.

Source: JICA Survey Team based on the Resettlement framework for ICWRMIP (August 2008)

(5) Consultation and Information Disclosure

1) Consultation and Information Disclosure based on Indonesian Regulations

According to the Article 8 of the BPN Regulations (No. 3 Year 2007), after receiving the decision on determination of location, the EA that needs the land is obliged to disclose the construction planning for public facilities to the people within 14 days at most through socialization (directly and/or indirectly such as using printed media, electronic media, or others), Meanwhile, the LPC and the EA that needs the land will conduct public counseling for the people to explain the benefits, objectives, and goals of construction and also in order to get approval/readiness from the owners. (Article 19 of the BPN Regulations)

The results of the identification and inventory survey will be written/recorded in the form of Land Area Mapping. Land Area Mapping and the List will be announced/published by LPC in the district office, in the city/district Land Office, through the website for 7 days, and/or through the mass media at least in two editions/publications in order to provide every opportunity for related parties to propose their objections. (Article 23 of the BPN Regulations)

2) Information Disclosure for the LARAP

Note that there is no stipulation related to information disclosure for the LARAP in the Indonesian Regulations. The draft LARAP will be disclosed to AHs prior to submission to JICA for review. The EA will disclose (i) draft LARAP, (ii) final LARAP approved by the EA, and (iii) any revisions to the LARAP as a result of design layout. Key information in the LARAP to be disclosed to the affected households will include (a) compensation, relocation and rehabilitation options, (b) DMS results, (c) detailed asset valuations, (d) entitlements and special provisions, (e) grievance procedures, (f) timing of payments, and (g) displacement schedule. The information will be made publicly available in Project and commune offices and provided to the affected households in the form of a summary LARAP, an information leaflet or brochure.

(6) Grievance Redress

Grievances related to any aspect of resettlement will be handled through negotiation aimed at achieving consensus within 120 calendar days referring to existing Indonesian regulations. Complaints will pass through the following 3 stages before they can be elevated to a court of law as a last resort.

1) First Stage

An aggrieved AH may bring his/her complaint to any member of the RWG or the area coordinator of SES, either in writing or verbally. The complaint will be informed to the Camat (the head of sub-district) through the Village Chief. The Sub-district Chief together with the Village Chief will have 40 calendar days following the lodging of the complaint by the aggrieved AH to act on the case. He/she may call, as needed, any member of the LPC, to help him/her come up with an acceptable resolution of the complaint. The Sub-district government is responsible for documenting and keeping a file of all complaints that it handles.

2) Second Stage

If after 40 calendar days the aggrieved AH does not hear from the Camat or the Desa/Lurah about the complaint, or if the AH is not satisfied with the decision taken by the Camat, the AH may bring the complaint, either in writing or verbally, to the Bupati (Head of Regency or District) or the Walikota

(City Mayor). The Bupati or Walikota in turn will have 40 calendar days following the lodging of the complaint by the aggrieved AH to act on the case. He/she may call, as needed, any member of the LPC, to help him/her come up with an acceptable resolution of the complaint. The Kabupaten/Kota (Regency/City Government) is responsible for documenting and keeping a file of all complaints that it handles.

3) Third Stage

If after 40 calendar days the aggrieved AH does not hear from the Kabupaten/Kota, or if the AH is not satisfied with the decision taken by the Bupati or Walikota, the AH may bring the complaint, either in writing or verbally, to the Office of the Provincial Governor. The Governor has 40 calendar days within which to resolve the complaint to the satisfaction of all concerned. The Office of the Governor is responsible for documenting and keeping a file of all complaints that reach the office.

4) Final Stage, the Court of Law Arbitrates

If after 40 days following the lodging of the complaint, the aggrieved AH does not hear from the Office of the Provincial Governor of if he/she is not satisfied with the decision taken by the Provincial Governor, the complaint may be brought to a court of law for adjudication. The rules of court will be followed in the adjudication of the complaint.

(7) Monitoring

The BBWSC will serve as the Project's internal monitoring body. Quarterly reports will be submitted to the DGWR starting from the commencement of LARAP updating, which coincides with the conduct of the detailed measurement survey and other LARAP updating activities. The DGWR in turn will include updates on resettlement in its regular progress reports to JICA. Social monitoring reports will be made available to the affected households and will be submitted to JICA.

8.5. Recommendations

(1) Approval on the LARAP Framework

The Indonesian regulations do not stipulate an approval procedure for the FLARAP. The BBWSC will submit the draft FLARAP to the MPW through DGWR. Then, the approved draft FLARAP will be submitted to JICA. The BBWSC should obtain approval on the draft FLARAP from the related local governments before submission to DGWR.

(2) LARAP Preparation

The LARAP for the sub-projects should be prepared by BBWSC based on the policies described in the FLARAP. The expected LARAP preparation schedule is shown in the Table 8.5.1.1. The draft of terms of references for LARAP preparation is referred to in Appendix V-8.

(3) Monitoring on the LARAP Updating for ICWRMIP funded by ADB

The Involuntary Resettlement Policies applied in the draft FLARAP for the Project basically follow those of ICWRMIP. The LARAP for the "Rehabilitation of West Citarum Canal (ICWRMIP)" will be updated from October 2010 to August 2011. The updating of the RAP should be monitored carefully because the Livelihood Restoration Program for closing the gaps between Indonesian regulations and ADB's resettlement policies will be completed in the updating process.

Table 8.5.0.1 Preliminary Work Schedule for LARAP Preparation

	1st Month	2nd Month	3rd Month	4th Month	5th Month	6th Month	7th Month	8th Month	9th Month	10th Month	11th Month	12th Month
Procurement of Local Consultant for LARAP preparation	■											
Mobilization		■										
Stakeholder Meeting			■			■		■				■
Topographic Survey				■	■							
Socio-eco survey(Census)					■	■	■					
Inventory of Loss survey(IOL)							■	■	■			
Replacement cost survey(RCS)							■	■	■			
Preparation of Draft of LARAP										■	■	

Source: JICA Survey Team

CHAPTER 9 ENVIRONMENTAL CONSIDERATION AND ENVIRONMENTAL PROTECTION

This chapter begins with a review of the related laws and regulations for the EIA process (AMDAL) in Indonesia as well as the general procedure of AMDAL. It continues with a discussion on the EIA processes of the previous Upper Citarum Basin Urgent Flood Control Projects (*i.e.* Stage (I) and Stage (II)), which is the basis of further discussion on the process for preparation and authorization of EIA for the Project. The relevant documents in terms of environmental considerations are also listed at the end of this chapter.

9.1. Review of Relevant Laws, Regulations and AMDAL Procedure

9.1.1. Relevant Laws and Regulations

The relevant laws and regulations for EIA process (AMDAL) in Indonesia are shown in the table below (Table 9.1.1.1), while the environmental quality standards and related regulations/guidelines concerning AMDAL are indicated in Table 9.1.1.2.

Table 9.1.1.1 Laws and Regulations in Relation to EIA Process (AMDAL) in Indonesia

Title of Law/Regulation	Profile
Protection and Management of the Environment, Law of the Republic of Indonesia, No.32/2009.	This law describes the basic principles of environmental protection and management in Indonesia.
Regarding analysis of Environmental Impacts, Government Regulation, No.27/1999.	This regulation describes the details of AMDAL. Purpose, scope and procedure of AMDAL are defined in this regulation.
Head of Environmental Impact Control Agency, Decree regarding Public Participation and Information Sharing on Process of Environment Impact Analysis, No.8/2000.	This regulation describes public participation and information sharing in the AMDAL process.
Guideline for the Preparation of RKL (Environmental management plan) and RPL (Environmental monitoring plan), Decree of the State Minister of the Environment, No.45/2005.	This degree describes the details of RKL and RPL. Purpose, scope and contents of RKL and RPL are defined in this regulation.
Type of Business and/or Activities that Require AMDAL, State Minister of Environment Regulation Environmental, No.11/2006.	This regulation defines the type and scale of business for which AMDAL is required.
Guidelines for the Implementation of Environmental Management Efforts and Environmental Monitoring Efforts, Environmental Decree, No.86/2002.	This guideline describes environmental management and monitoring activities that do not require AMDAL in Regulation No.11/2006.

Source: JICA Survey Team

The following explains the abbreviations of the terms regarding EIA in Regulation No.27/1999.

- AMDAL: Process of environment impact assessment
- ANDAL: Assessment of the important impacts from planned business and/or activities
- KA-ANDAL: TOR of ANDAL
- RKL: An effort to manage important environmental impacts, which are caused by planned business and/or activities
- RPL: An effort to monitor the environmental components that are affected by important impacts from planned business and/or activities.

Table 9.1.1.2 Quality Standards, Regulations and Guidelines Concerning AMDAL

Category	Title of Law/Regulation
Ambient Air Quality and Noise	1) Air pollution control, Government regulation, No.41/1999. 2) Noise level standard, Decree of the State Ministry of Environment, No.48/1996.
Water Quality	1) Water quality management and controlling water pollution, Government regulation, No.82/2001. 2) Water resources, Law No.7/2004
Waste Control	1) Kep-04/BAPEDAL/09/1995, Procedures and requirements for dumping processing waste, requirements of the former processing location, and former location of hazardous waste (B3 waste) dumping site, Head of Bapedal Decree No.4/1995. 2) Management of hazardous waste and toxic materials, Government regulation No.18/1999. 3) Amendment to Government regulation No.18/1999 about the management of hazardous and toxic waste, Government regulation No.85/1999.
River Management	River bank demarcation line, River usage area, River coverage area and Former river, Minister of Public Work Regulation, No. 63/ 1993.
Work Place Safety	Implementation of Occupational Health and Safety (K3) for Construction site, Ministry of Public works, 2009.

Source: JICA Survey Team

9.1.2. Legal Framework of AMDAL

Decree No.11/2006 defines the sectors or projects which require AMDAL. Type of business and/or activities that require AMDAL are the following 13 categories:

1) Defense sector
2) Agricultural sector
3) Fisheries sector
4) Forestry sector
5) Transportation sector
6) Satellite technology sector
7) Industrial sector
8) Public works sector
9) Energy and mineral resource sector
10) Tourism sector
11) Nuclear development sector
12) Management of B3 waste (Hazardous and toxic material) sector
13) Genetic engineering sector

In this decree, the activity including river improvement works is classified as “8) public works sector”. Generally, the following criteria (Table 9.1.2.1) are applied to decide on AMDAL implementation.

Table 9.1.2.1 Criteria for AMDAL Implementation

Classification	Criterion
a. Big/Metropolitan city	
▪ Length, or	≥ 5km
▪ Dredging Volume	≥ 500,000m^3
b. Middle sized city	
▪ Length, or	≥ 10km
▪ Dredging Volume	≥ 500,000m^3
c. Village	
▪ Length, or	≥ 15km
▪ Dredging Volume	≥ 500,000m^3

Source: Type of Business and/or Activities that Require AMDAL, State Minister of Environment Regulation Environmental, No.11/2006.

9.1.3. AMDAL Procedure

1) AMDAL procedure

Basically, AMDAL procedure consists of the following 7 steps (Regulation No.27/1999).

Step1: Announcement of planned activities (30 days)

Step2: Preparation of TOR (KA-ANDAL) by Project owner

Step3: Evaluation / approval of TOR by AMDAL committee (Max. 75 days)

Step4: Preparation of ANDAL, RKL and RPL by Project owner

Step5: Evaluation of ANDAL, RKL and RPL by AMDAL committee (Max. 75 days)

Step6: Approval of ANDAL, RKL and RPL

Step7: Project approval

2) Public participation in AMDAL

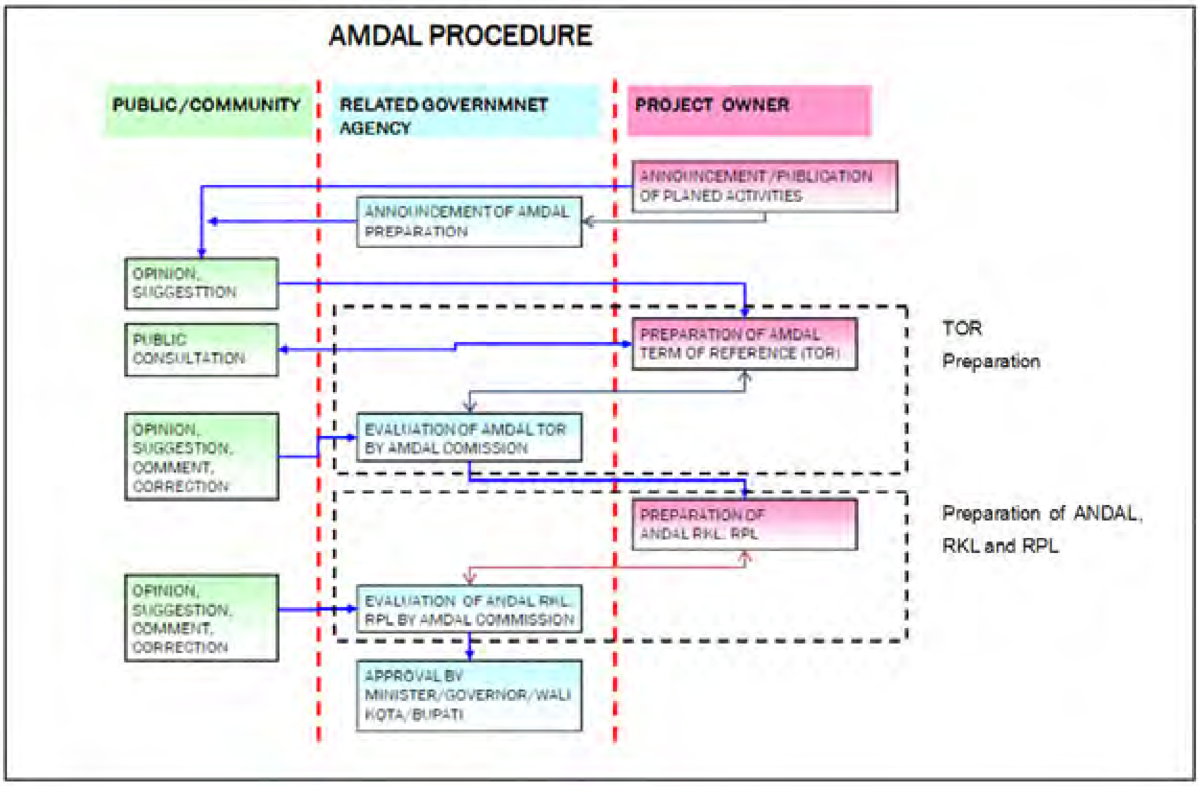
According to Degree No.8/2000, AMDAL procedure requires a public participation process. The purposes of public participation are as follows:

- Protecting public interest
- Empowering the community in making decisions regarding the business plans and/or development activities that potentially create a large and important impact on the environment
- Ensuring the transparency of the EIA process in the overall business plan and/or activities
- Creating an atmosphere with equal partnerships between all interested parties, with respect for the rights and requirements of all parties to obtain and convey all pertinent information to all related parties.

In AMDAL procedure, the following opportunities for public participation have been established (Degree No.8/2000).

- Announcement of planned activities
- Opinions and suggestions for TOR preparation
- Public consultation on TOR preparation
- Opinions, suggestions and comments regarding TOR evaluation
- Opinions, suggestions and comments regarding ANDAL, RKL and RPL evaluation

This AMDAL procedure is illustrated in Figure 9.1.3.1.



Source: JICA Survey Team based Degree No.27/1999

Figure 9.1.3.1 AMDAL Procedure

9.2. Review of AMDAL Process of Previous Upper Citarum Basin Urgent Flood Control Project

9.2.1. Review of AMDAL process for Upper Citarum Basin Urgent Flood Control Project

The components of Stage (I), Stage (II), 2007 D/D and the Project (proposed by the Survey) for AMDAL process are indicated in Table 9.2.1.1 below.

Table 9.2.1.1 Outline of Components of Stages (I), (II), 2007 D/D and the Project for AMDAL Process

Stage	Project area	Implementation Period
Stage (I)	Citarum River Main River (Nanjung - Upper Dayeuh Kolot)	1994-1999
Stage (II)	Citarum River Main River (Upper Dayeuh Kolot - Sapan), Upper Citarum River, Citarik River, Cisaranten River and Cisangkuy River	1999-2007
2007 D/D	Citarum Upstream River, Citarik River, Cimande River, Cikijing River, Cikeruh River, Cibeusi River, Cisangkuy Upstream River, Ciputat River and Citalugtug River	-
The Project (Proposed)	Structural Countermeasures (River Improvement Works) Cikeruh Downstream River, Cikijing River, Cimande River and Citarum Upstream River Sediment Control (Check Dam) Cirasea Watershed Note: Citarik, Cikeruh Upstream, Cibeusi, Cisangkuy, Ciputat, Citalugtug and Citarum Main River are also included in AMDAL	2011-2017

Source: JICA Survey Team

AMDAL procedures for Stage (I), Stage (II) and 2007 D/D were as follows:

(1) Stage (I)

In 1993, AMDAL for Stage (I) was implemented in accordance with standard procedure (See Figure 9.1.3.1). In this procedure, EIA documents (ANDAL, RKL and RPL) for Stage (I) were prepared, and public involvement (stake holder meeting) and assessment by AMDAL committee were implemented. Finally, AMDAL was authorized by BPLHD prior to the project implementation.

(2) Stage (II)

In Stage (II), the standard AMDAL procedure (Figure 9.1.3.1) was not implemented. In lieu of this, a "Supplemental AMDAL document" was prepared (1999). Stage (II) was treated as an expansion project of Stage (I). Therefore, the AMDAL document of Stage (I) was reviewed, and a supplemental document for Stage (II) was developed. This supplemental AMDAL document was added to the Stage (I) AMDAL document, and included the following contents:

- Environmental condition of Stage (II) implementation area
- Environmental condition of old river channel (oxbow) in Stage (II) implementation area

- Environmental management plan (RKL) for oxbow
- Environmental monitoring plan (RPL) for oxbow

Even though the AMDAL document was prepared, the AMDAL document was not submitted and thus not authorized by BPLHD.

The above descriptions for AMDAL preparation are based on the explanation from BBWSC, however there was no clear evidence found.

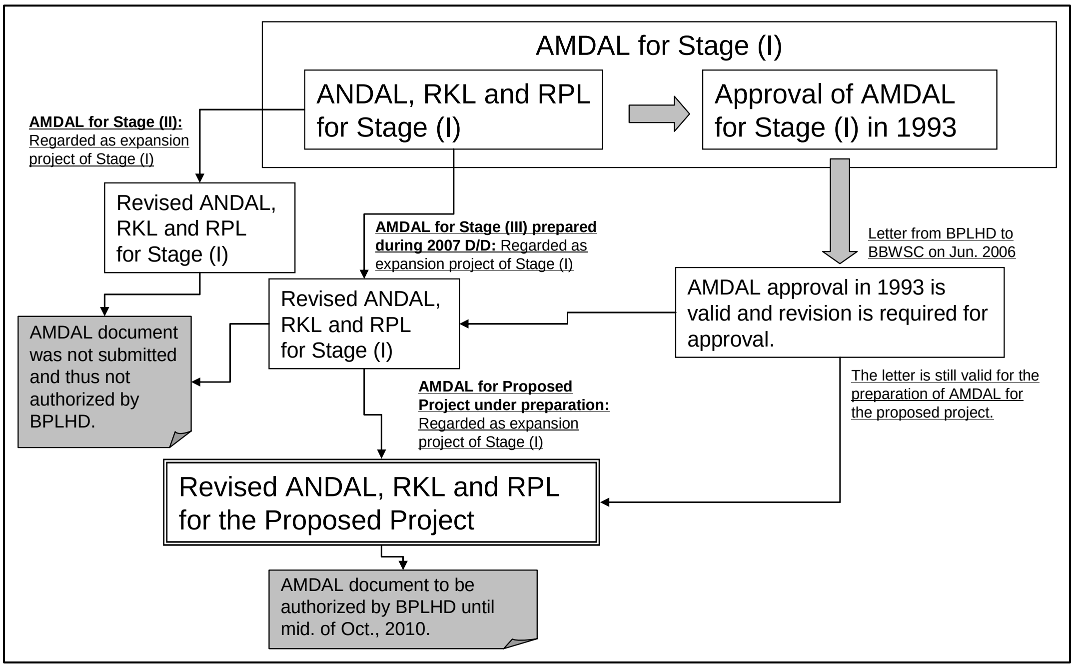
(3) 2007 D/D

During 2007 D/D preparation, AMDAL was also prepared, which includes the river improvement works for the 9 tributaries. Similar to the process for Stage (II), a “Supplemental AMDAL document” was prepared for 2007 D/D, since river improvement work in 2007 D/D could be treated as an expansion project of Stage (I). Even though the AMDAL document was prepared, the AMDAL document was not submitted and thus not authorized by BPLHD.

9.2.2. AMDAL Preparation Process for the Proposed Project

(1) Position of AMDAL Preparation Process for the Proposed Project

For the preparation of AMDAL process including authorization, discussions have been held among BBWSC, BPLHD and the Indonesian Ministry of Environment. As a result of these discussions, the Proposed Project can be regarded as an expansion project of Stage (I) and it was confirmed that the supplementary report of Stage (I) prepared during 2007 D/D is still valid. Additionally, the revision of 2007 D/D can be accepted as AMDAL preparation process for the proposed Project. The position of the AMDAL process for the Proposed Project is indicated in Figure 9.2.2.1.



Source: JICA Survey Team

Figure 9.2.2.1 Position of AMDAL for the Proposed Project

(2) Time Schedule for AMDAL Preparation Process for the Proposed Project

Upon discussion with BBWSC, the time schedule for the AMDAL preparation process was made for EIA (AMDAL) authorization. The time schedule of AMDAL process is shown below (Table 9.2.2.1). The supplemental report was to be submitted in the middle of September, 2010, and it was expected to be authorized by BPLHD by the middle of October, 2010.

Table 9.2.2.1 Time Schedule of AMDAL Approval

No.	Activity	July	August				September					October			
		5	1	2	3	4	1	2	3	4	5	1	2	3	4
1	**Data Collection**														
1.1	Demography	━	━	━											
1.2	Environmental / Physical Condition	━	━	━											
2	**Preparation / Revision of RKL and RKL**														
2.1	Updating Scope of Work	━	━	━	━										
2.2	Evaluation of Impact				━	━	━								
2.3	Design of Sediment Handling Method				━	━									
2.4	Environmental Management Plan (RKL)							━	━						
2.5	Environmental Monitoring Plan (RPL)							━	━						
3	**Approval**														
3.1	Submission to BPLHD									▲					
3.2	AMDAL commission meeting										━				
3.3	Revision and Improvement											━			
3.4	Approval												▲		

Source: JICA Survey Team

9.3. Technical Review of AMDAL Document

9.3.1. Review of AMDAL Documents for Stage (I) and Stage (II)

(1) AMDAL document for Stage (I)

The scope of the AMDAL document for Stage (I) describes the activities along the 50.6 km of the Citarum River mainstream from Sapan to Curug Jompong and the 6.9 km of the Cisangkuy River (i.e. including a part of the Stage (II) implementation area). In this document, the following activities were identified as those that affect the environment.

The countermeasures to the environmental effects noted above were shown in RKL and RPL. A summary of RKL and RPL is indicated in Table 9.3.1.1.

Table 9.3.1.1 Environmental Effect and Proposed Measure in AMDAL Document for Stage (I)

Project Stage	Activity and expected environmental effect	Environmental management plan described in RKL	Environmental monitoring plan described in RPL
Pre-construction	<u>Land acquisition</u> Land acquisition of 169 ha, in relation to the broadening of the river	The social restlessness regarding land acquisition was due to the dissatisfaction with the system of payment and the amount of compensation for land and houses. To avoid such matters, making an agreement with the local people and discussing the price for the land compensated, adjusted to the land classification and types of building subject to compensation was proposed.	Prior to this report, there was no standard monitoring procedure regarding public concern. Therefore, in this project, the frequency of occurrence and nature of social complaints were monitored. Parameters measured include the issues growing in the community, social restlessness, dissatisfaction regarding compensation given, etc.
Construction	<u>*Mobilization of manpower, equipment and materials, and ancillary works*</u> Mobilization of manpower, equipment and materials cause traffic jams, noise and air pollution. Construction of access roads, workshops and offices cause noise and air pollution. <u>*Excavation and Dredging*</u> Excavation and dredging of rivers and channels <u>*Transportation of excavated sediment*</u> Transportation of materials and dredged soils from the dredging sites to the piling sites or specific areas <u>*Operation of heavy equipment*</u> Project operational activities using heavy equipment through existing roads	<u>*Mobilization of manpower, equipment and materials, and ancillary works*</u> The environmental impacts of this activity include air pollution due to the emissions of the vehicles and heavy equipment and traffic jams due to the mobilization of vehicles and heavy equipment. To remediate these impacts, issuing regulations regarding vehicles used and regulations on traffic and transport frequency was proposed. <u>*Excavation and Dredging*</u> *Excavation and dredging of rivers and channels*: The environmental impact of this activity is an increase of suspended solids (SS) due to the excavation and dredging activities. To remediate this impact, application of a "dredging pump" technique was proposed. <u>*Transportation of excavated sediment*</u> The environmental impact of this activity is air pollution due to the emissions of the vehicles and heavy equipment and traffic jams due to the mobilization of the vehicles and heavy equipment. The same management strategies as for "Mobilization of manpower, equipment and materials, and ancillary works" were proposed. <u>*Operation of heavy equipment*</u> The environmental impacts of this activity are air pollution due to the emission of the vehicles and heavy equipment and traffic	<u>*Mobilization of manpower, equipment and materials, and ancillary works*</u> Monthly monitoring of SO_2, CO, NOx, NO_3 and noise was planned. Monitoring methods were in accordance with Kep-02/MenKLH/I/1968. Monitoring points were chosen along the roads used for transportation in the project area, around the working barracks, warehouses, workshops and dredging/ canalling/ digging area. In Stage (I), water quality monitoring was not proposed. <u>*Transportation of excavated sediment*</u> The environmental impact of this activity is air pollution due to the emissions of the vehicles and heavy equipment and traffic jams due to the mobilization of the vehicles and heavy equipment. The same monitoring strategies as for "Mobilization of manpower, equipment and materials, and ancillary works" were proposed. <u>*Operation of heavy equipment*</u> The environmental impacts of this activity are air pollution due to the emission of the vehicles and heavy equipment

		jams due to the mobilization of the vehicles and heavy equipment. The same management strategies as for "Mobilization of manpower, equipment and materials, and ancillary works" were proposed.	and traffic jams due to the mobilization of the vehicles and heavy equipment. The same monitoring strategies as for "Mobilization of manpower, equipment and materials, and ancillary works" were proposed. *Other monitoring efforts* *1) Socio-economics and culture* The socio-economics and cultural monitoring includes the number of opportunities obtained by the working generation, the number of local people employed in the project activities and alternative ways of getting in and out of the residents' settlements. Monitoring was designed based on the frequency of occurrence and social complaints. *2) Hydrology and water quality* For hydrology and water quality monitoring, heavy metals and biological monitoring were planned. Monitoring points were chosen in the Citarum River and tributaries.
Post-construction stage	*The use of riverbanks and areas within the flood zone* Maintenance of inspection roads *The use of the rest of the river straightening area* Dredging of river in relation to maintenance Control of the stipulated boundary lines and the flood inundation area	*The use of riverbanks and areas within the flood zone* Generally, the riverbanks and areas within the flood zone are thought of as places to live or cultivate land for new settlements. Therefore, RKL mentioned that clear and strict management and regulations are necessary to appease the people without harming the project. *The use of the rest of the river straightening area* The oxbow is considered to be farm-land or an aquaculture pond for the people living adjacent. Therefore, RKL mentioned that clear and strict management and regulations are necessary to appease the people without harming the project.	*The use of riverbanks and areas within the flood zone* *The use of the rest of the river straightening area* For these issues, following socio-economical monitoring was proposed. 1) Monitoring of the level of prosperity, employment opportunities and the improvement of land carrying capacity in the project area was designed. This monitoring was planned to investigate the development of settlements along the inspection road. 2) Monitoring was designed to determine the feelings of unsatisfied people regarding the control policy. This monitoring was planned to monitor the frequency of complaints expressed by people through interviews or protest against officer's orders.

Source: JICA Survey Team

(2) AMDAL document for Stage (II)

Major issues of AMDAL of Stage (II) were the revision of RKL and RPL in the oxbows along the Citarum main river (implementation area of Stage (I)) and the renewal of water quality data for the Citarum main river including the oxbows.

In RKL, environmental management plans for 10 locations of the oxbows (along Citarum main river) were added. Environmental impacts that should be managed are the following:

1) Government land has been used by local people for plantation without permission
2) Garbage disposal in the oxbows and garbage accumulation along the river bank
3) Contamination of the oxbows due to the disposal of domestic waste and domestic wastewater
4) Offensive odor and infectious insects (malaria mosquitoes, *etc.*) caused by polluted water in the oxbows
5) Contamination of the fish habitat in the oxbows.

To counter these impacts, the following management and monitoring efforts were proposed (Table 9.3.1.2). However, an AMDAL document for Stage (II) was not submitted or authorized by BPLHD. The expected reason of this is as follows:

1) Stage (II) was considered an expansion work of Stage (I). Therefore, the AMDAL document for Stage (II) was a revised version of the AMDAL document for Stage (I).
2) AMDAL document for Stage (I) was already approved.
3) Therefore, re-submission for the AMDAL document for Stage (II) was not emphasized.

Table 9.3.1.2 Additional Measures in AMDAL Document for Stage (II)

Project stage	Additional Environmental management effort	Additional Environmental monitoring effort
Construction	*Short and Medium Term Efforts*: Construction of a drainage channel from the downstream of the inundation area to the Citarum River to reduce the inundation area. *Long Term Effort*: Relocate the mouth of the small river/small channel from the inundation area directly to the Citarum River to reduce the amount of polluted water flowing from the housing and farm land into the inundation area. If technically possible and economically beneficial, the old river should be filled up and then changed into an agricultural area.	Monitor to ensure good function and construction of the drainage channel so that it can be operated properly.
Post-construction	Announce information regarding land use in the oxbow and river border, etc. to the local people through village leaders or the local government. The following efforts were proposed: - Installation of Governmental land and Citarum Project signs - Issue land certificates for the old river area - Clean up the water body of the oxbow	Land of the old river site is to be used for agriculture and fishery by the local people. Proposed monitoring items and implementation activities are follows: - Installation of Government land border signs and project warning sign - Analyze the agreement between the project and the local people. - Issue land certificates for the old river - Permanent inundation of the old river - Cleaning garbage in and along the river - Fish habitat - Fishery with poisonous substances - Health of peripheral people (malaria and other diseases) - Ask local government and people about the use of the existing fish pond

Source: JICA Survey Team

9.3.2. Preparation of AMDAL for the Proposed Project Based on 2007 D/D AMDAL Report

In this section, the items to be considered in the AMDAL preparation for the Proposed Project are clarified based on the 2007 D/D AMDAL report. AMDAL document 2007 was reviewed through comparison with “JICA’s Environmental checklist”. The results of the review are summarized in Table 9.3.2.2.

The following issues with consideration of the JICA environmental guidelines are described hereunder.

- Renewal of Environmental Data
- Review of Water Quality Monitoring Plan
- Work Place Safety Management
- Waste Management
- Sediment Survey before Construction
- Disposal Procedure for Dredged Sediment

(1) Renewal of Environmental Data

Environmental data in ANDAL is important information and will provide baseline data through environmental monitoring during and after construction. The existing environmental data in the project area was collected before 2007. These environmental data may be different from the current environmental conditions because of changes in human activity. Therefore, additional environmental data collection and analysis is necessary to understand the current environmental status.

(2) Review of Water Quality Monitoring Plan

Water quality monitoring and aquatic life (plankton and benthos) monitoring was proposed in the 2007 D/D AMDAL report. However, it is necessary to revise monitoring points in accordance with the revision of the project area. For 4 tributaries (Citarum upstream, Cimande, Cikijing and Cikeruh), the following monitoring points are recommended for both water quality and aquatic life monitoring.

- Nanjung, Dayeuh Kolot and Sapan (Citarum main river)
- Sapan Bridge (Citarum upstream river)
- Citarik Bridge (Citarik River)
- Cikeruh Bridge (Confluence of Cikeruh River and Cisaranten River)
- Cikeruh River (Improved Section during Stage (II))
- Cimande River (Cimande Bridge)
- Cikijing River (Confluence of Cikijing River and Citarik River)

For both water quality and aquatic life monitoring, monitoring of the pre-construction period and during construction (until all construction activity is finished) is desirable because monitoring in the pre-construction period is necessary to obtain baseline data.

In Indonesia, a monitoring frequency of 2 times/year (every 6 months) is usually used. However, for water quality monitoring, 4 times/year (every 3 months) is desirable in order to respond to any increase in water contamination from the construction area.

On the contrary, the monitoring frequency for aquatic life monitoring can be 2 times/year (every 6 months) because the fluctuation of the aquatic community is slower than the change of water quality.

(3) Work Place Safety Management

Work place safety is not described in the 2007 D/D AMDAL report. According to the JICA environmental guidelines (2010), consideration of the work environment (occupational safety) is necessary. Indonesia has guidelines for workplace safety (Keselamatan dan Keselahatan Kerja). According to these guidelines, adequate work place safety measures should be established in construction areas. These measures are to be implemented by the contractor. To give the responsibility to the contractor, a written contract should be delivered to the contractor. Regarding workplace safety, the following measures are possible:

- Establishment of safety management structure
- Installation of sign boards to warn workers
- Periodical safety patrol

(4) Waste Management[1]

Construction activity generates many kinds of waste (construction waste, domestic waste, *etc.*). In Bandung, both construction waste and domestic waste are collected by public or private collection companies. Reusable waste (*e.g.* electrical waste, wood waste, *etc.*) is recycled by a recycling company, and the remaining waste is dumped in a waste dumping site.

In order to facilitate the recovery and reuse of construction waste and to prevent the spread of waste, the following items should be included as the responsibilities of the contractor:

- Separate collection of waste. In order to facilitate reuse, reusable waste (electric, metal glass, plastic) and non-reusable waste (wood, paper, garbage) will be separated.

- Storage of waste to prevent unauthorized dumping around the construction area.

(5) Sediment Survey before Construction

The existing conditions of heavy metal contamination in sediment were surveyed by the Survey Team (Section 3.4.1). From the result of the leaching test, the tested heavy metals didn't exceed the Indonesian standards for TCLP test (Kep-04/BAPEDAL/09/1995). However, to confirm the condition of heavy metal contamination and to obtain the exact amount of sediment volume to be dumped, an additional sediment survey (*i.e.* TCLP test) should be carried out before the construction of river improvement works or dredging works of the Project. This additional sediment survey should be carried out with the following methodology:

[1] Reference: Bandung City's Eco-town Project Team, Environmental issues and need assessment for eco-town development in Bandung city (2009)

- This survey should be implemented before the start of construction works (*e.g.* river improvement works, dredging works, *etc.*).
- This survey will be carried out by a contractor. (The contractor may sublet the task to a consultant or contract labs for sampling and TCLP test.)
- This survey is to be supervised by the project owner (BBWSC).

(6) Disposal Procedure for Dredged Sediment

1) Disposal Process during Stage (II)

Heavy metal contamination in the Upper Citarum River Basin appeared around 2006. This has become the most important issue in this project.

In Stage (II) (1999 – 2007), excavated soil and sediment was disposed of at the following sites:

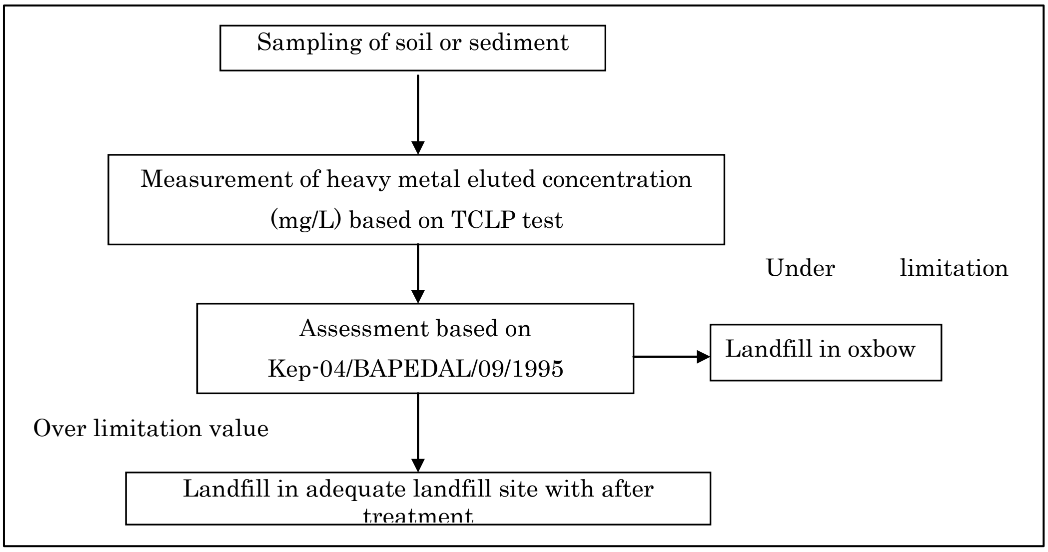
- Rancamanyar oxbow (partially), Daraurin oxbow, Ciharum oxbow
- Sulaiman Air force base (Refer to Appendix for the procedure indicated in a Minutes of Meeting)

In the oxbow disposal sites, black bamboo was planted as a safety measure (*i.e.* Black Bamboo Afforestation) to prevent corrosion or erosion of soil particles and to keep people away. Sediment dumping during Stage (II) was done without a geotextile layer or a drainage system.

2) Assessment process of soil and sediment

For the assessment process of soil and sediment, the following process was proposed by JICA Survey Team based on the discussion with BPLHD (Figure 9.3.2.1).

This assessment process should be done before construction starts, while a detailed assessment plan should be considered in D/D stage.



Source: JICA Survey Team

Figure 9.3.2.1 Assessment Process for Dredged Sediment

There are no standards or criteria for dredged sediment treatment in Indonesia. Therefore, a criterion for B3 waste dumping (Kep 04/BAPEDAL/09/1995) is applied to this assessment process.

sediment The assessment process includes the following steps:

1st step

Excavated sediment is assessed using an elution test (Toxicity Characteristic Leaching Procedure: TCLP) based on Kep 04/Bapedal/09/1995.

2nd step

Elution of sediment is assessed accordance with Kep 04/Bapedal/09/1995 (See also Table 9.3.2.1).

3rd step

Sediment under the limitation value of the regulation Kep 04/Bapedal/09/1995 is treated and dumped in an oxbow. If eluent exceeds the limitation value, the sediment is dumped in the adequate landfill site after solidification treatment.

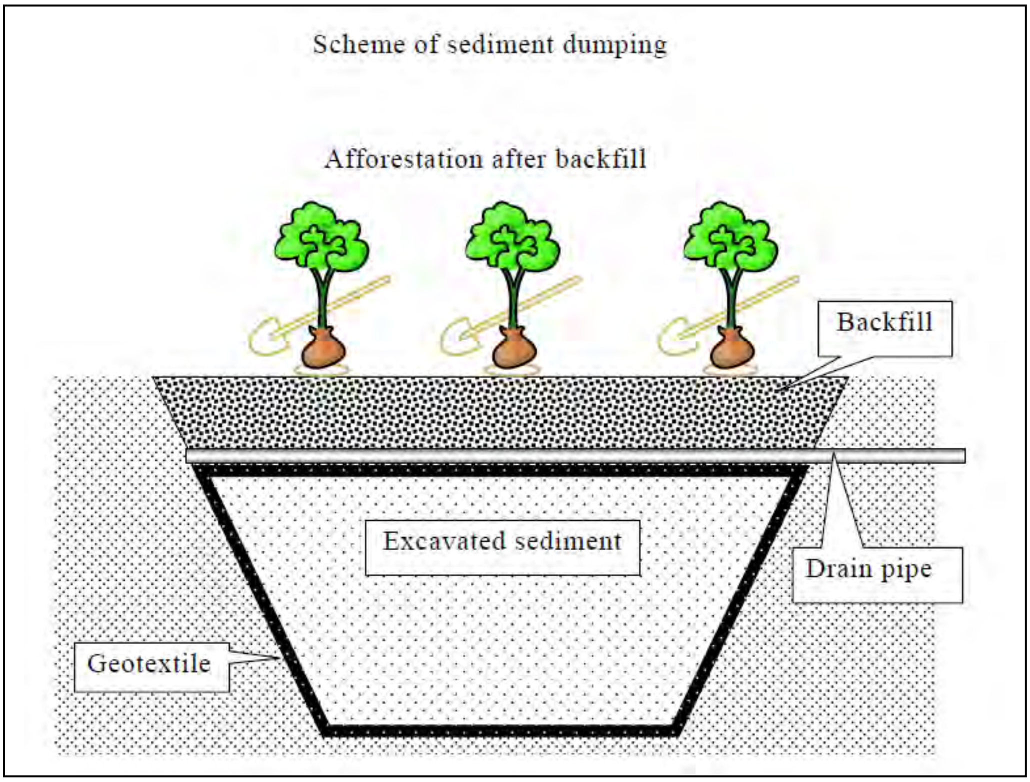
Table 9.3.2.1 Elution Limitation Values of Heavy Metals

Item	Limitation value (mg/L)
Arsenic (As)	5
Barium (Ba)	100
Cadmium (Cd)	1
Chromium (Cr)	5
Copper (Cu)	10
Lead (Pb)	5
Mercury (Hg)	0.2
Selenium (Se)	1
Silver (Ag)	5
Zinc (Zn)	50

Source: Kep 04/Bapedal /09/1995

3) Schema of dumping in oxbow

Near the Bandung area, there is no efficient dumping site with enough volume to accommodate the dredged sediment from the upper tributaries to be improved during the Project except for a number of oxbows along the Citarum main river. As described above, a few oxbows were used as dumping sites for dredging sediment. There are a number of oxbows, which may be able to be available for dredged sediment during the implementation of the Project. The utilization of oxbows for dumping the dredged sediment is also suggested based on the discussion with BPLHD. The schema of oxbow dumping is indicated in Figure 9.3.2.2. The installation of a geotextile layer (to prevent runoff of sediment particles) and a drainage system (to prevent rainfall infiltration) is recommended in order to reduce re-contamination from disposed sediment. It should be pointed out that the sediment should be dehydrated (solar drying) so that the volume will be reduced before dumping. After dumping, the top of the disposal site should be backfilled, and black bamboo is to be planted to prevent corrosion or erosion of the top soil and to keep people away.



Source: JICA Survey Team

Figure 9.3.2.2 Scheme of Sediment Dumping in Oxbow

Table 9.3.2.2 Review of Environmental Measures in 2007 D/D AMDAL Report

Environmental item		Expected environmental impact	Environmental measures have been proposed in 2007 D/D AMDAL report	Additional environmental measures for the Project
Permits and Explanation	EIA and environmental permits		AMDAL was approved in 1993	AMDAL was approved in 1993
	Explanation to the Local stake holders	*Land acquisition* *(pre-construction)* - Social unrest - Rejection of land acquisition	*Management* - Conduct public consultation - Apply adequate land price *Monitoring* - Social survey (questionnaire) - Discussion with leaders - Data collection from other institutions (land office, etc.)	Public consultation was done in 1993.
	Examination of alternatives	*Large scale relocation*	Alternatives concerning large-scale relocation were not considered.	In the Project, project site is revised to minimize impact of relocation
Pollution control	Water Quality	*In case that the excavation and dredging work is not conducted properly, it may cause the degradation of water quality in the downstream area.*	*Monitoring* - Periodical monitoring of river water - Once every 6 months during construction stage *Management* - Dump the soil and dredging material in a proper place (i.e. disposal area) directly after dredging or excavation. - Storage of soil from cut off project to temporary disposal area. - Soil from cut off is immediately transported and stored at flat land site. Land disposal area cultivated with type of vegetation (acacia and weeds)	*Monitoring* - Monitoring location have to be modified accordance with the project site - Monitoring implementation of pre-construction stage and during construction stage is desirable - Frequency of monitoring should be once every 3 months
	Waste management	Generation of domestic and construction waste	Waste management was not mentioned in 2007 D/D AMDAL report	*Waste management* - Separate collection of waste - Storage of waste to prevent wild dumping around construction area.
	Subsidence	There is no apparent possibility that excavation work will cause land subsidence.	Measures were not mentioned	Measures are not implemented

Natural environment	Protected areas	Project area is not located in protected area.	Measures were not mentioned	Measures are not implemented
	Ecosystem	*Influence to aquatic life* - Degradation by civil works	*Monitoring* - Monitoring of plankton and benthos - Once every 6 months during construction stage	*Monitoring* - Monitoring location have to be modified accordance with the project site - Monitoring implementation of pre-construction stage and construction stage is desirable
	Hydrology	Adverse effect to surface water flow and ground water flow is not expected.	Measures were not mentioned	Measures are not mentioned
	Topography and geology	Excavation and earth work in this project doesn't change topographical and geological features.	Measures were not mentioned	Measures are not mentioned
Social environment	Resettlement	*The project implementation will cause involuntary resettlement.*	LARAP document will be prepared in the near future.	LARAP document will be prepared in the near future.
	Living and Livelihood	*Degradation of environment.* - Health effects from air and water quality disturbance and impact of dredging materials around dumping site. - The growth of unsanitary insects in the oxbows.	*Monitoring* - Observation, interviews and secondary data collection - Once every 6 months during construction stage	The same monitoring plan as 2007 D/D AMDAL report is mentioned.
	Heritage	Heritage site is not located in the project area	Measures were not mentioned	Measures are not mentioned
	Landscape	Adverse effect on local landscapes is not expected.	Measures were not mentioned	Measures are not mentioned
	Ethnic minorities and indigenous peoples	No ethnic minorities and indigenous people will be affected by this project.	Measures were not mentioned	Measures are not mentioned
	Working conditions	*Manpower recruitment / mobilization.* - Increasing work opportunities. - Increasing community income.	*Management* - Urge contractors to give priority to local job seekers. - Conflict between local manpower and project workers. *Monitoring* - Social survey (questionnaire) - Discussions with leaders.	*Work place safety* - According to the guidelines of workplace safety (Keselamatan dan Keselahatan Kerja), an adequate safety management plan has been established.

Others	Impacts during Construction	*Mobilization of vehicles and heavy equipment* - Increase of traffic for transportation - Increase of air pollution - Increase of noise level.	Management - Erection of traffic signs - Discipline of drivers - Applying equipment, trucks, and cars which comply with emission standards. - For locations near residential areas, the activities are to be carried out only during the day time. - Water spray along working areas and the transportation route and dumping site. - Dump the soil and dredging material in a proper place. *Monitoring* - Traffic count survey during peak hours - Air monitoring along transportation route - Once every 6 months during construction stage. - Monitoring of dust, SO_2, NOx and CO.	The same management and monitoring plan as 2007 D/D AMDAL report is mentioned.
		Land clearing and dredging, river cut off. - Erosion and sedimentation	*Management* - Dump the soil and dredging material in a proper place (i.e. disposal area) directly after dredging or excavation. - Storage of soil from cut off project in a temporary disposal area. - Soil from cut off is immediately transported and stored at flat land site. - Land disposal area cultivated with type of vegetation (acacia and weeds)	The same management and monitoring plan as 2007 D/D AMDAL report is mentioned.
		- Decrease of stream water quality	*Management* - Storage of soil from dredging and of project far off temporary disposal area. - Soil from cut off is immediately transported and stored at flat land site. *Monitoring* - Sampling and monitoring of water quality. - Once every 6 months during construction stage.	*Monitoring* - Monitoring locations have to be modified accordance with the project site - Monitoring implementation of pre-construction stage and construction stage is desirable - Frequency of monitoring should be once every 3 months
			Management - Cutting of soil from dredging of project at a slope	The same management and monitoring plan as 2007 D/D AMDAL report is mentioned.

		- Possibility of land slide	of not more than 45 deg. - To mitigate of possibility land slide at edge of the river build a construction for control of land slide. - Soil from cut off is immediately transported and stored at flat land site. *Management* - Applying standard construction procedures. - Conduct maintenance activities during dry season.	The same management and monitoring plan as 2007 D/D AMDAL report is mentioned.
		Maintenance of river and utilities - Decrease of water quality - Flow disturbance	*Management* - Socialization. - Provide notice board - Provide a gate at every entrance road	
		Operation of inspection road - Changes of land use - Anticipate disturbance to restricted area such as river bank. - Traffic along the roads - Inspection of road damage	*Monitoring* - Observation - Once every 6 months provide a gate at every entrance road	
		Dredging sediment management	*Management* - Conduct mapping of heavy metal content. - Conduct testing concerning the solidification process of the sediment. - Dump the soil and dredging material with appropriate methods at an approved location.	*Monitoring* - Sediment survey (TCLP test) is implemented before construction *Management* - Sediment is dumped in an oxbow near the construction site

Source: JICA Survey Team

9.4. Collecting and Organizing Documents Related to Environmental Considerations for Related Projects

During the Survey, the past report and related letter (Refer to Appendix) and documents were collected. Table 9.4.1.1 shows the list of the collected documents.

Table 9.4.0.1 List of Collected Documents

Classification	Summary and Title of Document
Past Report	The following documents describe the EIA implementation process and the viewpoints on environmental concerns in the field of flood control in Upper Citarum River Basin. - Upper Citarum Basin Urgent Flood Control Project, Environmental Impact Assessment, Summary, ANDAL, RKL and RPL, 1993. - Environmental Study for Perfection of Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) of Environmental Impact Assessment (EIA) Study on River Improvement and Management of Upper Citarum River in 1993, Particularly of Construction and Post Construction Stages on Old Rivers under Citarum Water Resources Management and Flood Control Project, Final Report, 1999. - Executive Summary for Revision Study of Environmental Management Plan and Environmental Monitoring Plan Upper Citarum Flood Control Project, 2007. - Data of Questionnaire on Environmental Aspects of Upper Citarum River Improvement Project (II), 1997. The following document describes the detail of soil and sediment dumping in the oxbow in the previous Upper Citarum Basin Urgent Flood Control Project (Stage (II)). - Drawing of the location of soil / sediment dumping site in Upper Citarum Basin Urgent Flood Control Project (II), 2007.
Letter and Minutes of meeting (See Appendix IV-3)	The following letters describe a background about AMDAL implementation procedure of Stage (II) and the proposed project. (Refer to APPENDIX). - Letter from BPLHD to Citarum River Improvement Activity DG of Water Resources, PU: Regarding the status of AMDAL from Upper Citarum Urgent Flood Control Project in Kab./Kota Bandung, 24th July, 2006. - Letter from Ministry of Environment to Head of BBWS Citarum: Regarding direction on the environmental assessment, 13th August, 2010. The following minutes of meeting describes sediment dumping measures of Stage (II). This document shows that sediment was dumped in oxbow and air force base (Refer to Appendix). - Minutes of meeting, Soil Embankment Management Result of Citarum River Excavation, 6th August, 2007.
Report about sediment treatment and sediment survey	The following document describes the test procedure of sediment leaching test using the TCLP test and the result of the cement solidification test. This article provides important information about soil and sediment treatment procedures. - Sediment Leaching Test and Treatment Test for Disposed Sediment of Semarang River, Asin River and Baru River in Semarang, Chemical engineering Department, Faculty of Engineering, Diponegoro University, Semarang, 1998. The following document describes the heavy metal survey results of the Citarum Main River and upper tributaries. This article provides additional information about heavy metal distribution in the Upper Citarum River Basin. - Study Deposit Sediment Sungai Citarum Hulu, Balai Lingkungan Keairan, August, 2010
Report about Waste treatment	The following document describes the existing condition of waste collection and treatment in Bandung. Additionally, this article includes information about waste collection and recycling companies (both public and private). - Environmental issues and need assessment for eco-town development in Bandung City, Bandung City's eco-town project team, August, 2009.

Source: JICA Survey Team

CHAPTER 10 IMPLEMENTATION PROGRAM

10.1. Implementation Schedule

10.1.1. Implementation Period

During the preparation stage of the project implementation, Selection of consultants, Preparation and Finalization of RAP and Pre-qualification of contractors for Phase 1 is carried out. Implementation period of this project are expected to be approximately 51 months from the beginning of Consulting services in December 2011until the end of the river improvement work of Phase 2 in February 2016.

The tentative schedule of the Project is shown in Table 10.1.1.1.

Table 10.1.1.1 The Tentative Schedule of the Project

	Activities	Period			
1.	Pledge	Jan-2011			
2.	Selection of Consultants	Jan-2011	-	Nov-2011	11 months
3.	Conclusion of Loan Agreement	Feb-2011			
4.	Preparation and Finalization of RAP	Apr-2011	-	Nov-2011	8 months
5.	Pre-Qualification and Tender for the First Stage	Oct-2011	-	Feb-2013	17 months
6.	Review and Additional Design/Study	Dec-2011	-	Sep-2012	10 months
7.	Sediment Control	Dec-2011	-	Dec-2015	49 months
8.	Compensation Payment and Relocation	Mar-2012	-	Dec-2014	34 months
9.	Pre-Qualification and Tender for the Second Stage	Apr-2012	-	Sep-2013	17 months
10.	Flood Plain Management	Jun-2012	-	Feb-2016	45 months
11.	Structural Countermeasures for the First Stage	Mar-2013	-	Feb-2016	36 months
12.	Structural Countermeasures for the Second Stage	Sep-2013	-	Aug-2015	24 months

Source: JICA Survey Team

10.2. Construction Schedule

10.2.1. Basic Considerations

The following are the basic considerations required for making the schedule of construction.

(1) The execution of construction works will be made by using a full contracting system through International Competitive Bidding (ICB) with pre-qualified contractors from eligible source countries including Indonesia.

(2) Tender will start after review of the detailed design and will take at least 17 months.

(3) Preparation and finalization of RAP will take at least 12 months.

10.2.2. Construction Schedule

(1) Structural Countermeasures and Non-Structural Countermeasures

The construction works for structural countermeasures consist of the following 4 sub-projects and will be implemented in 2 phases:

- First phase works: Cimande Sub-project (9.51km)
- Second phase works: Citarum Upstream Sub-project (5.45km)

Cikijing River Sub-project (6.68km)

Cikeruh Downstream Sub-project (2.5km)

Table 10.2.2.1 Construction Schedule for Structural Countermeasures

Phase	Sub-project	Tender Period incl. P/Q	Construction Works	Defect Liability Period
Phase 1	Cimande	Oct-2011 - Feb-2013	Mar-2013 - Feb-2016	Mar-2016 - Feb-2017
Phase 2	Citarum Upstream	Apr-2012 - Aug-2013	Sep-2013 - Aug-2015	Sep-2015 - Aug-2016
	Cikijing	Apr-2012 - Aug-2013	Sep-2013 - Aug-2015	Sep-2015 - Aug-2016
	Cikeruh Downstream	Apr-2012 - Aug-2013	Sep-2013 - Aug-2015	Sep-2015 - Aug-2016

Source: JICA Survey Team

Non-Structural Countermeasures will start just after the review of the design. During the first year, an activity plan or activity schedule will be formulated. Technical assistance and advice will be given through Consulting Services regularly once a year.

(2) Sediment Control

The implementation is divided into four stages as stated below:

1) Planning and Design Stage
2) Dissemination Stage
3) Local Planning and Financing Stage
4) Implementation Stage

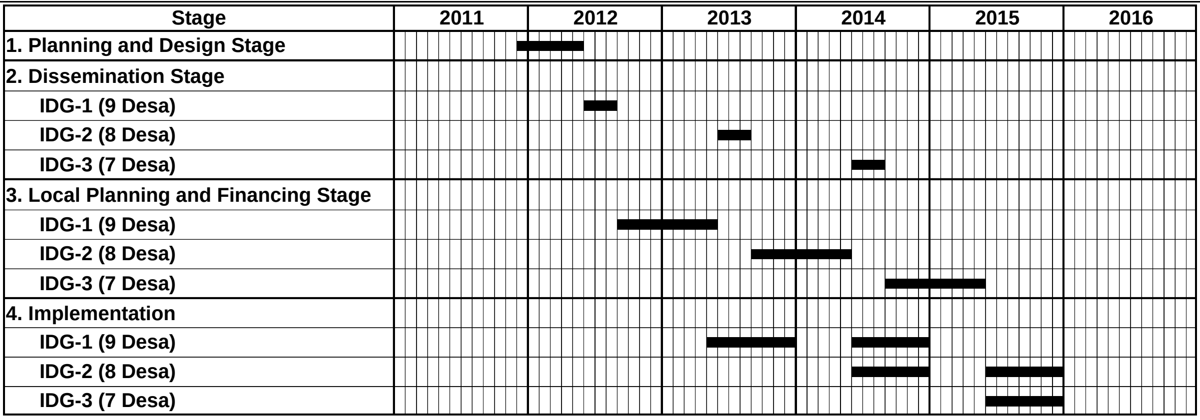
All construction works of check dams and small check dams shall be carried out and completed during this phase. The construction period is extended over three (3) years. Target communities shall be empowered through participating as a primary body in project implementation.

The implementation schedule for this component is shown in Table 10.2.2.2 and Figure 10.2.2.1 below.

Table 10.2.2.2 Implementation Period by Stage

IDG	Planning and Design	Dissemination	Local Planning and Financing	Implementation
I	Nov-2011 - May-2012	Jun-2012 - Sep-2012	Oct-2012 - May-2013	Jun-2013 - Dec-2013
		Jun-2013 - Sep-2013	Oct-2013 - May-2014	Jun-2014 - Dec-2014
II	Nov-2011 - May-2012	Jun-2013 - Sep-2013	Oct-2013 - May-2014	Jun-2014 - Dec-2014
		Jun-2014 - Sep-2014	Oct-2014 - May-2015	Jun-2015 - Dec-2015
III	Nov-2011 - May-2012	Jun-2014 - Sep-2014	Oct-2014 - May-2015	Jun-2015 - Dec-2015

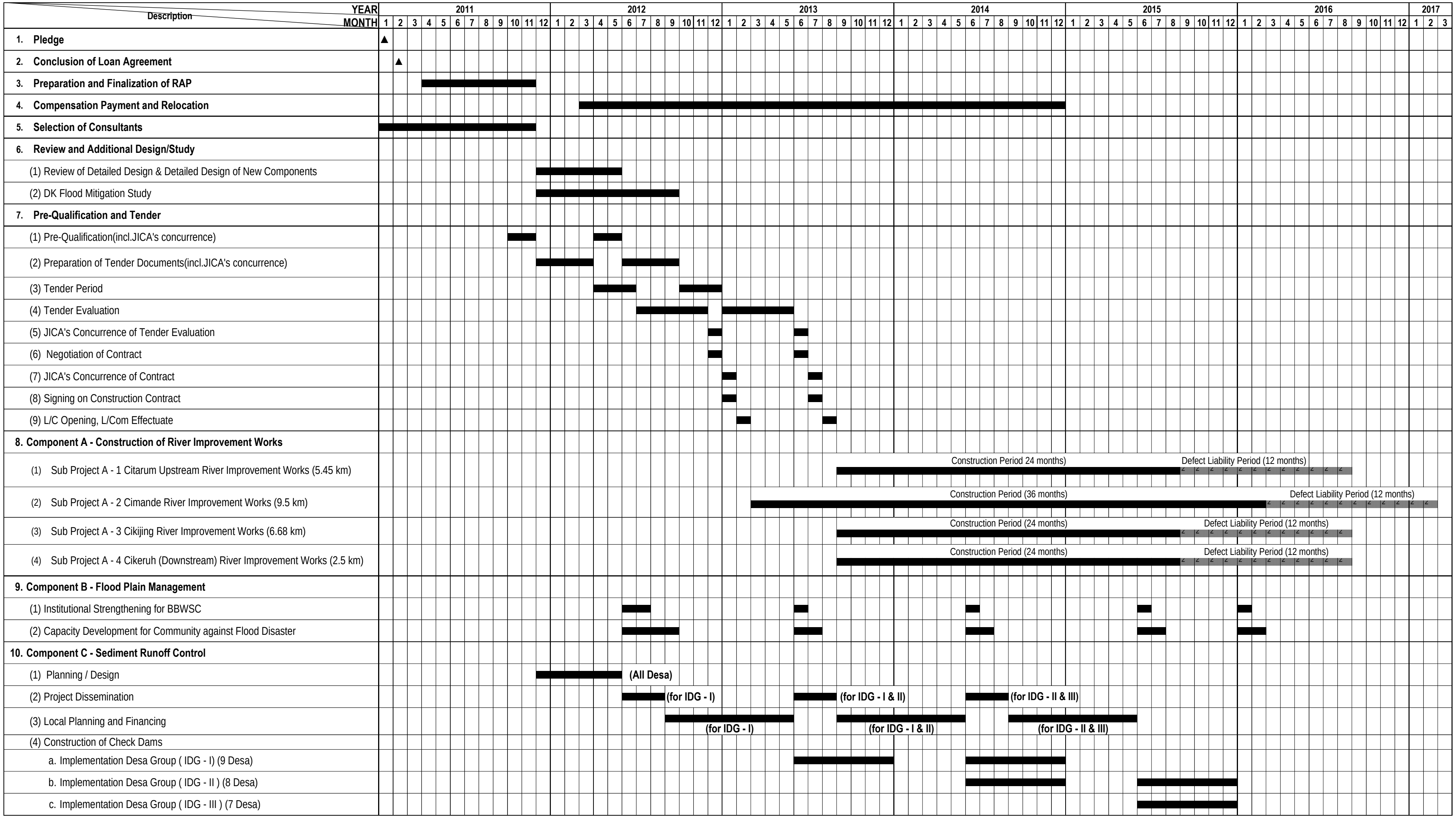
Source: JICA Survey Team



Source: JICA Survey Team

Figure 10.2.2.1 Implementation Schedule

The entire project implementation schedule is shown in Figure 10.2.2.2.



Source: JICA Survey Team

Figure 10.2.2.2 Tentative Implementation Schedule

10.3. Procurement Method

10.3.1. Contractor/Supplier

Goods and Services shall be procured in accordance with the "Guidelines for Procurement under Japanese ODA Loans", dated March 2009, and valid and relevant laws and regulations of the Government of Indonesia as long as these laws and regulations are not in contradiction with JICA Guidelines.

10.3.2. Consulting Services

The consultant shall be selected by a Short List Method in accordance with the "Guidelines for Employment of Consultants under Japanese ODA Loans", dated March 2009, and valid and relevant laws and regulations of the Government of Indonesia as long as these laws and regulations are not in contradiction with JICA Guidelines.

The consultant will be selected in 1 (one) package through short listing, in accordance with the said guidelines.

10.4. Implementation Organizations

The Minister of Public Works has established the Organization and Administration of Balai Busar Wilayah Sungai (BBWS) in order to manage water resources.

BBWS is a technical unit in the field of conservation of water resources, water resources development, utilization of water resources and control of water pollution in the river basin, which is under and responsible to the Directorate General of Water Resources.

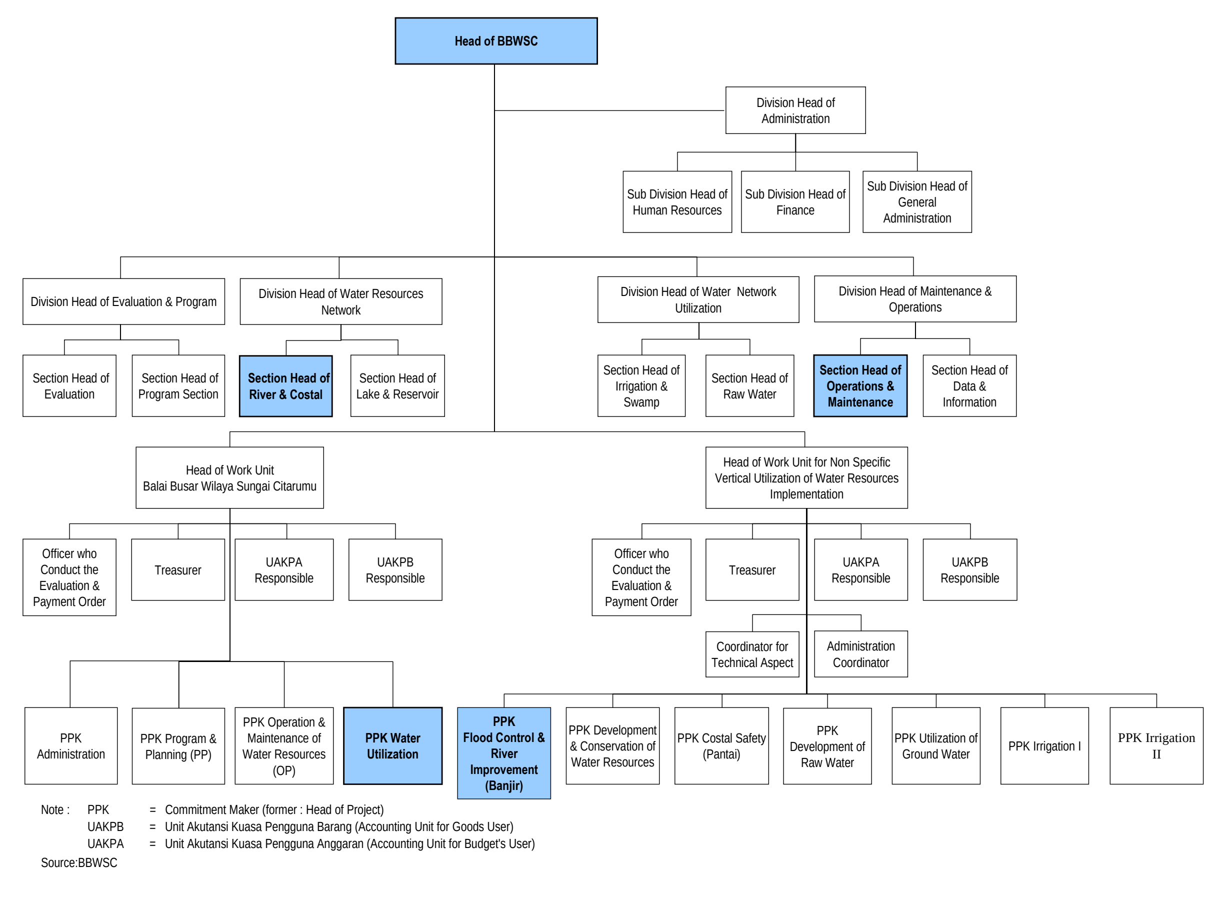
BBWS has the task to implement water resource management which includes planning, construction, operation and maintenance in order to conserve water resources, utilization of water resources and control of water pollution in the river basin.

The BBWSC Office, once called the Citarum River Basin Office (CRBO), is one of the 11 BBWS and has an original function of operation and maintenance of the Citarum River Basin and a new function of water resources management in the Citarum River Basin called the Integrated Water Resources Management in the Citarum River Basin (IWRMC).

Regarding the current project implementation, the executing agency of the Project is the DGWR, MPW. DGWR entrusts BBWSC to manage and operate the Project with assistance of the Directorate of Bina Program and the Directorate of Rivers, Lakes and Dams at the central level.

No Project Management Unit (PMU) and Project Implementation Unit (PIU) will be established for this Project due to the Project location being within a single basin and jurisdiction. The head of BBWSC will have the initiative to organize existing sections and human resources in the BBWSC.

The existing organization of BBWSC in accordance with Regulation of the Minister PU: 23/PTR/M/2008 is shown in Figure 10.4.1.1 below.



Source: JICA Survey Team based on the organization chart provided by BBWSC

Figure 10.4.1.1 Organization of BBWSC(2010)

(1) Component A (Structural Countermeasures)

Regarding the implementation of structural countermeasures, the River & Coastal section and PPK of Flood Control & River Improvement will be in charge of construction supervision. At present, PPK of Flood Control has only 2 field managers and 4 supervisors. The addition of personnel has been proposed to BBWSC.

(2) Component B (Non-Structural Countermeasures)

1) Institutional Strengthening for Early BBWSC

For this sub-component, the Operation and Maintenance section will be in charge. At present the EWS is under the management of Operation and Maintenance section. Substantial costs are required to repair and renew the damaged EWS. This system will be operated by trained personnel. The EWS will provide the data required by each division.

2) Capacity Development for Community against Flood Disasters

This sub-component is comprised of four activities: 1) Reinforcement of Desa activity (LMD) through

BBWSC supports, 2) Community discussion forum, 3) Prevention education in school, Evacuation Drills, 4) Application of flood hazard mapping prepared by ADB project, *etc.*

Each activity will be organized as indicated in the table below (Table 10.4.1.2).

Table 10.4.1.2 Implementation Organization for Capacity Development for Community

Activity	Implementation Organization
Reinforcement of Desa activity (LMD) through BBWSC supports	PPK of Water Utilization with support the LMD in supplying materials required during floods
Community discussion forum	PPK of Water Utilization will participate in discussions with regard to the Citarum River and its tributaries
Prevention education in school, Evacuation Drills, etc.	In this case, the PPK of Water Utilization will participate in community empowerment when handling issues such as flood mitigation and evacuation of residents.
Application of flood hazard mapping prepared by ADB projects	BBWSC will work with concerned agencies (PUSAIR, Province, Kabupaten, Kota) on the socialization of flood maps

Source: JICA Survey Team

(3) Component C (Sediment Control)

1) Implementation Organizations

A community based bottom-up system will be adopted in this Component C. Local people will be expected to participate from the planning stage through to the monitoring stage. Due to the participatory implementation and bottom-up concept, utilization of human resource of Kabupaten Dinas will be effective for smooth implementation of this component. In this case, an institutional arrangement between Central, BBWSC, and Kabupaten will be mandatory.

Assuming that BBWSC is responsible for the implementation of the component by endorsing all the field implementation to Kabupaten DINAS concerned, the following Implementation Organization in Figure 10.4.1.2 may be proposed and discussed among agencies concerned. The role of each related agency in the organization is also proposed and stated below.

a) Kabupaten Level

Bupati (Head of Bandung Kabupaten) will be responsible for the entire long-term and annual regional development within the Bandung Kabupaten. Bupati will appoint concerned Dinas for field implementation.

The Kabupaten Dinas is to be appointed by a Bupati Decree and will be responsible for daily management of project implementation with the help of Kabupaten Pimpro, Secretary, Treasurer and supporting staff.

The Kabupaten Pimpro is responsible for all stages of project dissemination, support to Village project planning, funding, organizing, implementation, M&E and reporting on behalf of Bupati to the BBWSC.

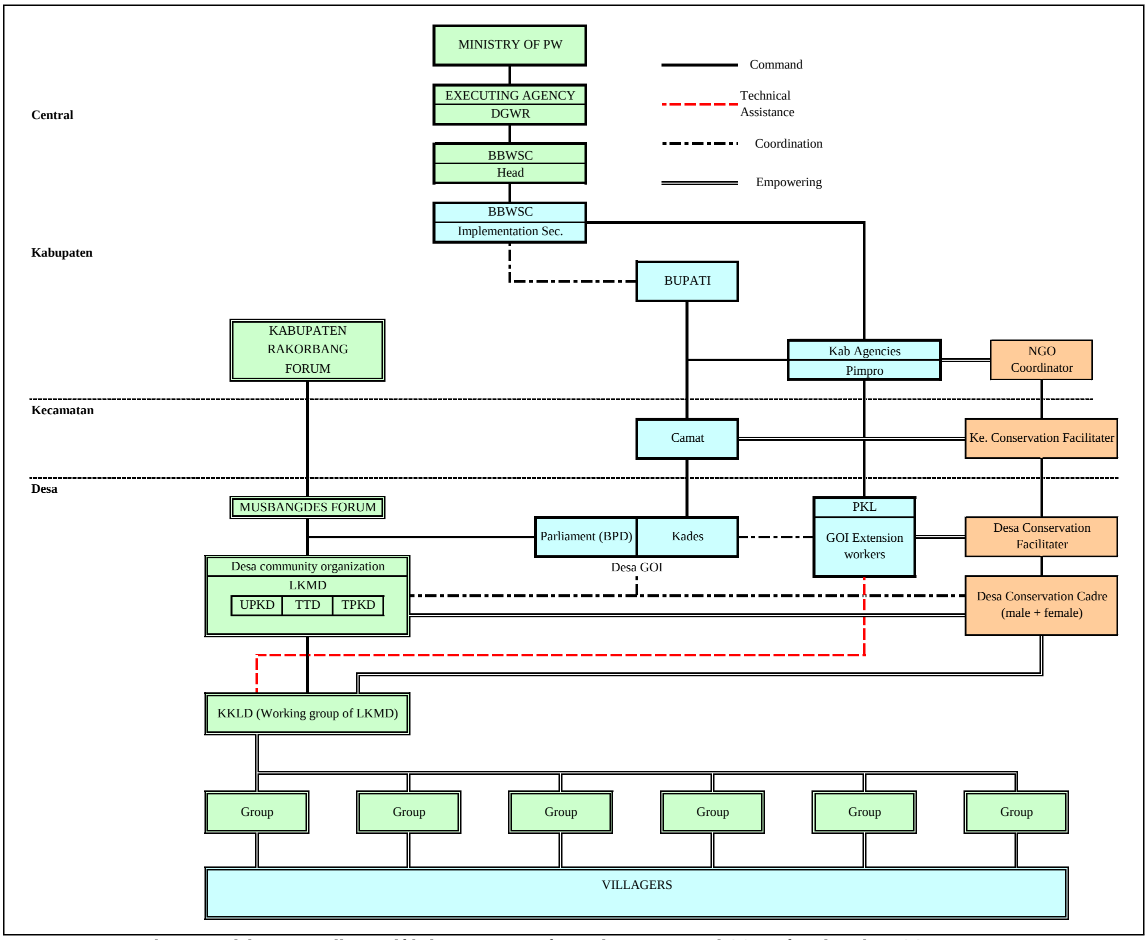
b) Kecamatan level

By the proposed scheme, a Camat is needed to recommend the approved Village proposals before they are submitted to the Kabupaten Pimpro for budget approval.

c) Village level

LKMD is a Village community institution initiated by GOI regulations. Specifically the functions of LKMD (or similar names) include: a) Formulation of participative village development planning, b) Promotion of village communities' solidarity and self-reliance, and c) Implementation and control of village development.

For the proposed scheme, the LKMD has the function of being the local organizer of Project dissemination at Musbangdes Forum, coordinating local Project planning, funding, organizing, implementation and control of local target groups of Sediment Control activities (KKLD), with the help of UPKD (Village Financial Management Unit, for grant allocation), TTD (Village Conservation Technical Team) and TPKD (Village Proposal Preparation Team). Implementation Organizations chart is shown in Figure 10.4.1.2.



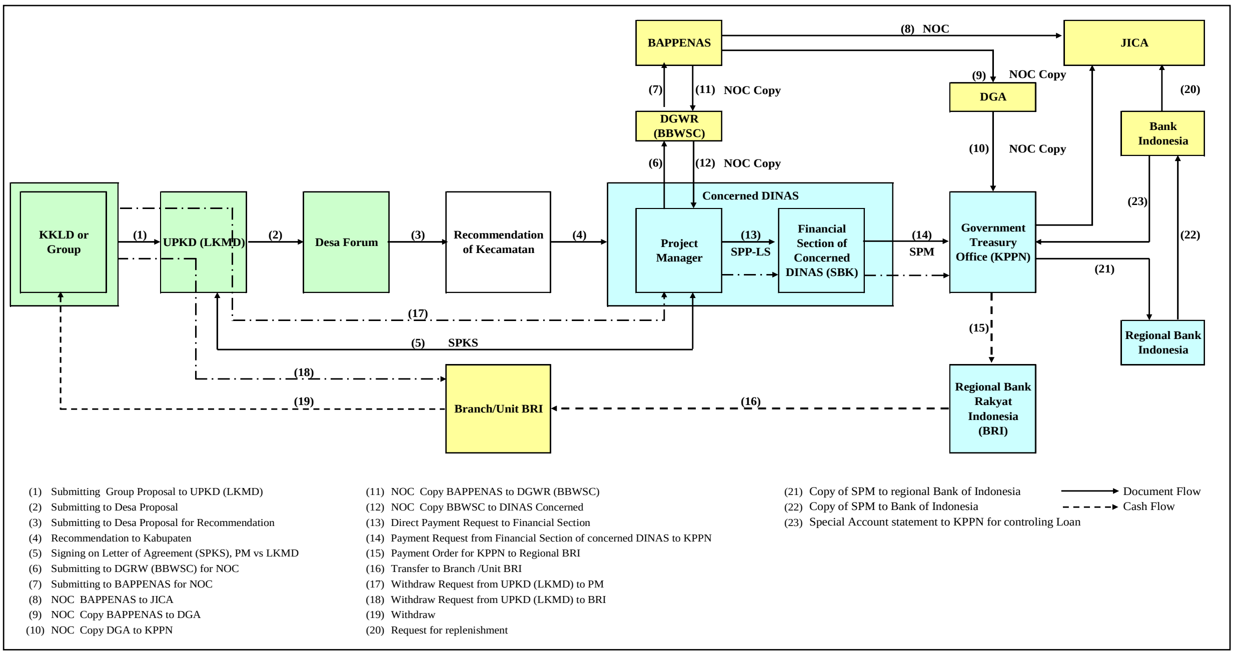
KKLD: group to be initiated democratically as self-help group active for implementation and O&M of civil work LRSC activities.
PKL: LRSC field extension worker of Kabupaten Dinas LH posted at Village level.
DCF: Village conservation facilitator posted at Village level for working under KCF and to be responsible to train DCC.
DCC:male and female Village conservation cadres selected from and by the local Village community (Musbangdes Forum), working under DCF.
Source: JICA Survey Team

Figure 10.4.1.2 Implementation Organizations Chart

2) Cash Flow Mechanism

Active community participation by people in the project processes such as investigation, analysis, implementation planning, decision-making, financial management of the group in a transparent manner, and monitoring and evaluation, are the most important factors in achieving success of a community-oriented project.

In particular, financial management by a group in a transparent manner is indispensable to unite the group for the target work and enhance the sense of belonging. For this purpose, the following cash flow mechanisms (Figure 10.4.1.3), which enable a group to manage themselves independently, may be proposed and needs to be discussed among all concerned agencies.



Source: JICA Survey Team

Figure 10.4.1.3 Cash Flow Mechanism

This Cash Flow Mechanism was proposed in order to materialize the financial management by group in a transparent manner.

The annual budget for the construction of sediment control facilities (check dams and small check dams) will be prepared in APBD in Kabupaten based on the proposal approved by the group. This means that the GOI will reimburse the construction cost first and will be replenished by JICA loan in due course. The system is based on procedures of the Special Account Loan of JICA. Should the loan type change, the methodology of paying to a group has to be studied thoroughly. As shown above, the important thing is that payment will be made to an individual group account in order to motivate management of the group. Withdrawal from the bank requires a witness from NGO and a government extension worker. After withdrawal, NGO representative will assist the group in making payments to the members of the group.

CHAPTER 11 ECONOMIC EVALUATIONS

In this chapter, the results of the economic evaluation for the Project are briefly described. In addition to the evaluation, operation and effect indicators are proposed.

11.1. Methodology

The economic evaluation for the Project is done by calculating the estimated Project cost and the flood control benefit. The economic evaluation calculations are used to determine the Economic Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit-Cost ratio (B/C).

11.2. Economic Costs

For the economic evaluation, financial costs are converted to economic costs by deducting the tax and subsidies portions, and applying a standard conversion factor (SCF) to the portion of non-trade goods. For this Project, a value of 0.9 has been applied to the local portion of costs in order to adjust the price.

11.3. Hydraulic Analysis for Estimation of Economic Benefits

Hydraulic analysis was carried out using SOBEK 1D and 1D2D model simulations for the Upper Citarum River Basin. The 1D2D Model represents the river network and the topography of the surrounding flood plain incorporated by Digital Elevation Method (DEM). Model simulations were done under the existing condition “without Project’ and proposed design “with Project”. The proposed design “with Project” consists of improvement of these four tributaries:

- Citarum River Upstream
- Cimande River
- Cikijing River
- Cikeruh River Downstream

1D2D model simulations were conducted for 2, 5, 10, 20 and 50-year return period flood conditions and respective flood extents and inundation depths were marked. In order to evaluate the economic benefit, a comparison study was done based on “with Project” and “without Project” simulation results.

11.4. Economic Benefits

Benefits of the flood control Project are defined as the reduction of flood damage costs derived from the economic difference between the “with Project” and “without Project” scenarios. The “with Project” scenario covers the situation where flood control is implemented, and the “without Project” scenario covers the situation where no flood control takes place. Benefits are analyzed both quantitatively and qualitatively.

The Economic Benefits are shown below in Table 11.4.1.1.

Table 11.4.1.1 Economic Benefits of Project

(Unit : Rp. Million)

Without Project	2-year	5-year	10-year	20-year	50-year	Annual Average
Houses	256,820	400,807	544,338	802,511	1,186,175	209,403
Building	137,089	211,314	283,604	419,609	606,841	109,983
Household Assets	119,732	189,493	260,734	382,902	579,334	99,419
Paddy	5,270	9,193	12,442	16,198	20,944	4,524
Industry	74,389	113,497	136,140	160,449	266,021	54,477
Building	5,441	8,099	9,492	11,170	18,635	3,874
Depreciable Assets	56,681	86,810	104,497	123,177	204,007	41,689
Inventory Stock	5,010	7,795	9,510	11,387	19,361	3,770
Business Operations	7,258	10,793	12,641	14,715	24,018	5,144
Social-Infrastructure	5,418	9,557	13,352	19,000	29,101	4,922
Building	2,902	4,968	6,997	9,911	14,978	2,575
Assets	2,516	4,588	6,355	9,089	14,123	2,347
Road	71,910	112,226	152,415	224,703	332,129	58,633
Total	413,808	645,279	858,686	1,222,860	1,834,370	331,958
Total Annual Average Damage						**331,958**

(Unit : Rp. Million)

With Project	2-year	5-year	10-year	20-year	50-year	Annual Average
Houses	214,782	355,533	509,252	775,306	1,149,041	189,766
Building	116,644	189,475	266,427	405,960	590,043	100,463
Household Assets	98,138	166,057	242,825	369,346	558,998	89,303
Paddy	4,213	8,121	11,481	15,241	19,884	4,025
Industry	40,843	69,659	109,785	145,072	287,834	38,412
Building	3,011	5,054	7,868	10,425	20,600	2,779
Depreciable Assets	31,237	53,303	84,090	111,101	221,088	29,413
Inventory Stock	2,889	4,817	7,520	10,092	20,387	2,670
Business Operations	3,705	6,485	10,308	13,453	25,758	3,550
Social-Infrastructure	4,906	9,248	12,962	18,291	26,646	4,689
Building	2,640	4,874	6,767	9,542	13,807	2,467
Assets	2,266	4,373	6,195	8,749	12,839	2,222
Road	60,139	99,549	142,591	217,086	321,731	53,134
Sub-total (Direct Damage)	324,882	542,110	786,071	1,170,996	1,805,135	290,027
Total Annual Average Damage						**290,027**

Expected Annual Benefit of Project = **41,932**

Note: Expected Annual Benefit = Total Annual Average Damage (without) – Total Annual Average Damage (with)

Source: JICA Survey Team

11.5. Economic Evaluations for the Proposed Flood Control Project

(1) Basic Assumption

The EIRR, NPV and B/C are calculated based on the economic benefits, the construction costs, and operation and maintenance costs (O&M costs). The following basic assumptions were made:

1) Project life is 30 years after completion of the construction works.

2) Discount rate is 10%.

3) Price for exchange rate is IDR 1.0 = JPY 0.0101

(2) Construction Costs

The financial costs of the Project are converted to economic costs. The price contingency portion is excluded from the economic construction costs.

The financial and economic costs for construction of the Project are shown below.

Table 11.5.1.1 Project Costs

(Unit: Million)

Cost Item	Financial Cost F/C Yen	Financial Cost L/C Rp.	Financial Cost Total Equiv. Rp.	Economic Cost F/C Yen	Economic Cost L/C Rp.	Economic Cost Total Equiv. Rp.
1. Construction Cost	0	191,335	191,335	0	172,202	172,202
1.1 Component A	0	168,727	168,727	0	151,855	151,855
1.2 Component B	0	5,000	5,000	0	4,500	4,500
1.3 Component C	0	17,608	17,608	0	15,847	15,847
2 Consulting Service Cost	251	54,468	79,314	251	49,022	73,868
3 Land Acquisition and House Compensation Cost	0	50,850	50,850	0	45,765	45,765
3.1 Land Acquisition	0	32,123	32,123	0	28,911	28,911
3.2 Administration	0	18,727	18,727	0	16,854	16,854
4 Contingencies	0	117,876	117,876	0	14,629	14,629
4.1 Physical Contingency	0	16,254	16,254	0	14,629	14,629
4.2 Price Contingency	0	101,622	101,622	0	0	0
Total	**251**	**414,529**	**439,375**	**251**	**281,616**	**306,463**

Source: JICA Survey Team

(3) Operation and Maintenance Costs

According to BBWSC, the annual operation and maintenance cost is Rp. 100 million/km. Dredging is assumed to be implemented every three years. Therefore, the annual operation and maintenance cost is expected to be Rp. 800 million.

(4) Cost Benefit Analysis

All the three indicators of the economic evaluations for the Project ensure economic feasibility of the proposed Project: 10.3% EIRR (higher than the discount rate 10%), 1.04 B/C Ratio (one or above), and a sufficiently positive NPV.

Table 11.5.1.2 Evaluation Results of the Project

Indicator	Result
EIRR	10.3%
B/C (at discount rate of 10%)	1.04
NPV (Rp.billion, at discount rate of 10%)	10.17

Source: JICA Survey Team

A case that the project is 50 years after completion of the construction work is also evaluated as follow.

Table 11.5.1.3 Evaluation Results of the Project (Project Life 50 Years)

Indicator	Result
EIRR	10.7%
B/C (at discount rate of 10%)	1.10
NPV (Rp.billion, at discount rate of 10%)	22.66

(5) Sensitive Analysis

A sensitive analysis was undertaken to assess Project feasibility under the following worse case scenarios:

- Increase in construction costs by 10% and 20%

- Decrease in economic benefits by 10% and 20%

According to the results of sensitive analysis for the Project, the EIRR does not show economic feasibility in any of the cases.

Table 11.5.1.4 The Results of Sensitive Analysis of the Project

		Benefit		
		0%	-10%	-20%
Cost	0%	10.3%	9.2%	7.9%
	+10%	9.3%	8.1%	7.0%
	+20%	8.3%	7.3%	6.1%

Source: JICA Survey Team

11.6. Operation and Effect Indicators

(1) General

JBIC introduced operation and effect indicators in 2000 as performance indicators to enable project monitoring and evaluation through comparison with data that has been consistently measured in previous pre- and post-stages of a project. Operation and effect indicators are comparable to outcome indicators used by the World Bank. In the log frame for the ODA loan project, they are recorded as indicators for “Project purpose”.

Operation and effect indicators are used to evaluate the performance of facilities, the effectiveness of the functions of the Project, and the efficiency of operation and maintenance activities after the Project implementation.

(2) Operation and Effect Indicators

The definitions of operation and effect indicators are as follows:

1) Operation indicator: An indicator to quantitatively measure the operational status of a project.

2) Effect indicator: An indicator to quantitatively measure the effects generated by a project.

In order to evaluate the achievements of the Project quantitatively, the benchmarks of operation and effect indicators are set up based on the current available data. Balai Besar Wilayah Sungai Citarum (BBWSC) is in charge of selecting and reviewing the available data for operation and effect indicators as given in the following table proposed by the Survey Team.

Table 11.6.1.1 Operation and Effect Indicators (Proposal)

Operation and Effect Indicators (Proposal)
Max. Discharge at Nanjung (unit: m^3/s)
Max. Flood Area (unit: ha)
The number of damaged buildings (houses, stores, factories, offices, etc.)
Return Period of Rainfall Amount (1-day, 2-day, 3-day, 4-day, 5-day) in the Upper Citarum Basin (1,771km^2) (unit: Return Period Year)

Source: JICA Survey Team

In a discussion with BBWSC and the Survey Team, BBWSC confirmed that data is available for the following indicators: maximum discharge at Nanjung (unit: m^3/s), maximum flood area (unit: ha), and the number of damaged buildings with necessary budget and mobilization. However, regarding the return period of rainfall amount (unit: return period year), it is difficult to collect rainfall data due to the shortage of available data and the current status of BBWSC. Therefore, only the three former indicators will be applied to the Project.

Table 11.6.1.2 shows the operation and effect indicators for the past floods (1986 Flood, 2002 Flood, 2005 Flood, 2006 Flood, 2007 Flood and 2010 Flood).

Table 11.6.1.2 Operation and Effect Indicators for the Past Floods

		Unit	1986 Flood	2002 Flood	2005 Flood	2006 Flood	2007 Flood	2010 Flood
Max. Discharge at Nanjung		m^3/s	482	508	486	311	481	622
Max. Flood Area		km^2	71.0	-	22.1	25.2	32.6	91.8
The Number of Damaged Buildings	Building including	number of buildings	1174	-	419	261	460	1220
	Bridge	number of buildings	65	-	32	48	55	124
	Education	number of buildings	42	-	26	29	49	64
	Hospital	number of buildings	7	-	4	2	7	8
	Religious	number of buildings	58	-	27	37	47	99
Basin Average Rainfall	1-day Rainfall	mm	32.5	29.1	38.5	-	-	49.1
	2-day Rainfall	mm	53.5	52.5	55.3	-	-	72.7
	3-day Rainfall	mm	80.3	65.2	85.7	-	-	100.6
	4-day Rainfall	mm	99.5	73.2	93.9	-	-	116.3
	5-day Rainfall	mm	119.1	88.1	117.7	-	-	131.3
Return Period of Basin Average Rainfall	1-day Rainfall	Year (Return Period)	1.2	1.1	1.7	-	-	6.0
	2-day Rainfall	Year (Return Period)	1.2	1.2	1.3	-	-	3.8
	3-day Rainfall	Year (Return Period)	1.6	1.1	2.1	-	-	4.8
	4-day Rainfall	Year (Return Period)	1.7	1.1	1.5	-	-	4.1
	5-day Rainfall	Year (Return Period)	1.9	1.1	1.8	-	-	3.5

Source: JICA Survey Team (Data Source: BBWSC, UCBFM)

CHAPTER 12 CONCLUSION

The Preparatory Survey for Upper Citarum Basin Tributaries Flood Management Project was conducted for the proposition and formulation of a future ODA loan project funded by JICA in order to reduce or minimize flood damage occurrence in the Upper Citarum River Basin. Based on the results of the Survey, the following conclusions have been drawn:

The Upper Citarum River Basin, which is located in the Bandung region of West Java Province, has the important role of supplying water for DKI Jakarta. The Upper Citarum River Basin also plays an important role for socio-economic activity, since the total GRDP of the Bandung region (Kabupaten Bandung and Kota Bandung) is the third largest after DKI Jakarta and Surabaya. It is necessary to implement flood countermeasures continuously in order to reduce or minimize flood damage occurrence in the Upper Citarum River Basin.

The following components of the Project (Sector Loan) were proposed by the Survey as indicated in Table 12.0.0.1.

Table 12.0.0.1 Components of Proposed Project by the Survey

Component A	Structural Countermeasures	River improvement of Upper Citarum Tributaries	
		Sub-Project A1: Citarum Upstream	5.45 km
		Sub-Project A2: Cimande	9.50 km
		Sub-Project A3: Cikijing	6.68 km
		Sub-Project A4: Cikeruh Downstream	2.50 km
Component B	Non-Structural Countermeasures	- Institutional strengthening for BBWSC - Capacity development for the community against flood disaster	

Component C	Sediment Control	- Construction of 5 check dams and 261 small check dams by participatory method at 24 target desa in Cirasea Sub-watershed
		- Empowerment for the people at the community level
		  - Raising awareness of the necessity for improved environmental management
		  - Raising of the sense of ownership
		  - Emphasizing the use of local resources for peoples' welfare
		  - Strengthening institutions at the village level for community-based watershed management	

Source: JICA Survey Team

Component A (Structural Countermeasures) is composed of 4 sub-projects (Citarum Upstream, Cimande, Cikijing and Cikeruh Downstream) chosen for river improvement works for the upper tributaries of the Citarum River as so-called Short Listed sub-projects to consider the flood effect to the Dayeuh Kolot, project scale and environmental-social issues. Flood damage in the area of those upper tributaries will be reduced by implementation of river improvement works. Component B (Non-Structural Countermeasures) will be implemented, aiming for institutional strengthening of BBWSC in terms of EWS, O&M and capacity development at the community level. The total number of 266 Sabo dams distributed in 24 villages (desa) in the Cirasea Sub-watershed of the Upper Citarum River Basin will be constructed with community participation through the activities of Component C (Sediment Runoff Control).

The Project components were assessed as reasonable and proper in view of technical aspects as well as economic evaluations and socio-environmental considerations. Early implementation of the proposed Project is recommended.

Annex I: Minutes of Discussion on Scope of Work of the Survey (December 8th, 2009)

MINUTES OF DISCUSSION
ON
SCOPE OF WORK
OF
JICA PREPARATORY SURVEY
FOR
UPPER CITARUM RIVER BASIN TRIBUTARIES FLOOD MANAGEMENT PROJECT
BETWEEN
MINISTRY OF PUBLIC WORKS
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

DATE: December 8 , 2009
PLACE: Jakarta, Indonesia

1. Japan International Cooperation Agency (hereinafter referred to as "JICA") had discussions on the Scope of Work of JICA Preparatory Survey for the Upper Citarum River Basin Tributaries Flood Management Project (hereinafter referred to as "the Project") with officials of the Ministry of Public Works (hereinafter referred to as "MPW").

2. JICA Mission and MPW hereby agreed upon the Scope of Work of the Preparatory Survey for the Project as per Annex-1, subject to the approval by the competent higher authorities of both sides. It should be noted that implementation of the Survey does not imply any decision or commitment by JICA to extend its loan for the Project at this stage.

For JICA

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Widagdo
Director of River, Lake and Reservoir, Directorate General of Water Resources

For BAPPENAS

Donny Azdan
Director of Water Resources and Irrigation

Annex-1

DRAFT IMPLEMENTATION PROGRAM
ON
JICA PREPARATORY SURVEY
FOR
UPPER CITARUM RIVER BASIN TRIBUTARIES FLOOD MANAGEMENT PROJECT

1. Background

(1) In Indonesia, flooding is considered as a major disaster risk and the number of flooding has been increasing year after year. Flooding causes not only direct physical damage but also indirect economic and social damage, such as the stagnation of economic activities and an increase in the number of poor, which has an adverse affect on sustainable economic development in Indonesia.

(2) The Government of Indonesia stipulates in the Midterm National Development Plan (RPJM 2004-2009) that the mitigation of flood damage under Integrated Water Resources Management is an important strategy program for the acceleration of construction and improvement of flood mitigation infrastructures centering on densely populated areas and major industrial areas, and disaster mitigation activities with public participation, and balance between non-structural and structural measures.

(3) Upper Citarum river basin located in the south of Bandung city, capital of West Java Province, had hit frequent floods for many years and caused enormous damage to especially economic activities such as agriculture sector and textile industry in this area. Although due to GOI' s continuous effort for flood management and JICA' s supports towards it from 1980s, flooding along Citarum main river has been reduced, countermeasures for flood management along upper tributaries has not been sufficient.

(4) Currently, it is reported that Citarum River is caused by pollution from untreated waste water, solid waste from factories and houses in and around Bandung City and also by the poor management of the upper watershed including the forest area control. This tendency in the upper basin of Citarum river has numerous negative impacts on the functions of water resources facilities on water for domestic purpose not only for Bandung area but also the Jakarta Metropolitan area such as declining electric generation, degrading fish farming in the reservoirs, and possibly even reducing human health.

2. Purpose of the Survey

The Survey aims to formulate a future ODA loan project which intends to minimize flood damage along upper tributaries of Citarum River. In addition, necessary technical assistance for improving water-related environmental management in this area may be proposed through the Survey.

3. Outline of the Proposed Project to be surveyed

(1) Subject of the Survey

Upper Citarum River Basin Tributaries Flood Management Project

(2) Scope of the Project

The project is designed as a "sector loan project" which has collection of sub-projects aiming to minimize flood damage along upper tributaries of Citarum River. The candidate sub-project will be selected based on the selection criteria which will be set through the Survey. Although selected sub-projects should be more urgent and effective than other sub-projects, depending on the changes of the situation, candidate sub-project can be changed in the course of the project implementation.

In this project, following components will be implemented.

1) Civil works (Channel improvement, embankment, retarding reservoir, etc.)

2) Consulting services (detailed design, bidding support, construction monitoring, environmental management, land acquisition monitoring, supporting of Flood Disaster Preparedness Enhancement, etc.)

(3) Executing Agency

Ministry of Public Works

4. Terms of Reference of the Preparatory Survey

(1) Review of the background and necessity of the Project

(1-1) Review RPJM2010-2014, Long-term Development Plan (2005-2025) and Mid-term Development Plan (2008-2013) of West Jawa Province, and relevant policy

(1-2) Review recent Flood Damage (Number of affected people, economic loss, damaged area)

(1-3) Analyze bottlenecks on implementation of the Project (Water quality, sedimentation and land subsidence, etc.)

(2) Review of the Feasibility of the Project

(2-1) Propose selection criteria for sub-project

(2-2) Collect and review of metrological, hydrological, hydraulic, morphological and land subsidence data

(2-3) Implement runoff and flood analysis utilizing Upper Citarum Basin Flood Management Model (Impact assessment in the case with / without the Project)

(2-4) Review existing detail design and propose necessary additional structural measures for controlling discharge volume to downstream basin

(2-5) Conduct basic design of structural measures for possible new target tributaries, and propose schedule, cost estimation based on the result of runoff analysis

(2-6) Identify the necessary land acquisition space and the number of resettlement

(2-7) Conduct sampling survey on the contamination of toxic substance including heavy metals, and propose its necessary countermeasures

(2-8) Propose basic design of non-structural measures (Capacity strengthening of the community so as to respond to frequent flood)

(2-9) Propose Pre-Selection of scope of the Project based on the information of flood damage within a predictable Loan amount registered in Blue Book

(3) Point out other concerns and propose necessary countermeasures for identified concerns (Any possibility of JICA's additional assistance coordinating with related stakeholders is proposed aside from the Project taking the Road Map into account)

(4) Assessment of the Project Implementation and O&M Framework

(5) Assessment of the Effect and Benefit of the Project (EIRR, Operation and Effect Indicator)

(6) Assessment of the Environmental and Social Considerations

(6-1) Review the preparation process of AMDAL and LARAP in accordance with JBIC Guidelines for confirmation of environmental and social considerations (April 2002) (hereinafter mentioned as "JBIC Guidelines")

(6-2) Review the result of actual implementation of AMDAL and LARAP in the phase1 and phase2 project, and analyze the issues (including necessary countermeasures).

(6-3) Support Indonesian side to prepare LARAP framework on each sub-project if the sub-project have a large scale involuntary resettlement and/or land acquisition

(6-4) Review EIA report, and if necessary, support Indonesian side to conduct additional survey.

(6-5) Support Indonesian side to prepare the environmental checklist and monitoring form in accordance with the JBIC Guidelines.

5. Implementation Framework of the Preparatory Survey

(1) Preparatory Survey Team

JICA will select and dispatch a Preparatory Survey team to carry out the services. The team will include the following experts.

- Hydrologist
- Geologist
- Geotechnical engineer
- River Basin Plan Specialist
- Flood Control Engineer
- Design and cost estimate engineer
- Hydraulic Engineer
- Economics and Finance Specialist
- Environmental Specialist
- Social Environmental Specialist
- Stakeholder Coordinator

The Preparatory Survey team may engage local consultants, NGOs, and/or other supporting staffs.

(2) Implementation Schedule

The Survey will be conducted in accordance with the tentative schedule shown below. The schedule is tentative and may be modified if and when such modification becomes necessary during the course of the Survey and is mutually agreed upon by both sides.

Dec. 2009- Jan 2010	- Discussion and confirmation of the Preparatory Survey Implementation Program
	- Selection of consultants by JICA
Feb. 2010	- Mobilization of the Preparatory Survey team, commencement of the Survey, submission of Inception Report
May. 2010	- Submission of Progress Report
Aug. 2010	- Submission of Draft Final Report
Oct. 2010	- Submission of Final Report

(3) Reports

The Preparatory Survey team will prepare and present the following reports.

Inception Report	:	10 copies in English (8 to GOI and 2 to JICA), 2CD-R
Progress Report	:	10 copies in English (8 to GOI and 2 to JICA), 2CD-R
Draft Final Report	:	10 copies in English (8 to GOI and 2 to JICA), 2CD-R
Final Report	:	10 copies in English (8 to GOI and 2 to JICA), 2CD-R 3 copies in Japanese: (all copies to JICA)
Final Report (Summary)	:	10 copies in English (8 to GOI and 2 to JICA), 2CD-R 3 copies in Japanese: (all copies to JICA)

(4) Monitoring

The Preparatory Survey team's work will be subject to periodic review by JICA. JICA staff will attend meetings between the Preparatory Survey team and Executing Agency and/or other organizations involved during the implementation of the Preparatory Survey if necessary.

6. Undertakings by Executing Agency and other organizations involved

The executing agencies and other relevant organizations will undertake to provide the following in order to assist the implementation of the Preparatory Survey services on schedule, through close coordination with the authorities of GOI:

(1) To provide security-related information as well as measures to ensure the safety of the survey team upon request

(2) To provide information as well as support in obtaining medical service

(3) To furnish the Preparatory Survey team with all available and relevant data, information and documents requested by the team

(4) To assign counterpart personnel

(5) To provide the team with appropriate office space, office equipment and secretarial services

(6) To provide the Survey Team with credentials or identification card

(7) To provide assistance for issuance of entry permits necessary for the Preparatory Survey team members to conduct field survey

(8) To ensure close coordination and information sharing with relevant authorities and organizations regarding the contents and progress of the Survey

(9) To assist the team in customs clearance, exempt from any duties with respect to equipment, instruments, tools and other articles to be brought into and out of Indonesia in connection with the implementation of the services

(10) To assist the team to obtain other privileges and benefits if necessary

7. Others

The nature of the services to be rendered by the Preparatory Survey team shall be exclusively advisory, with all decisions as to whether to accept or implement any recommendation(s) made or instruction(s) given in the course of the implementation of the services shall be the responsibility of GOI and other agencies involved.

The GOI through relevant agencies shall take, with their own responsibility, all the necessary measures for the utilization of the recommendations and outcomes of the Preparatory Survey in the JICA financed projects.

(end)

Annex-2

MAIN POINTS DISCUSSED

The JICA Mission and MPW discussed and agreed on the following points.

I. Project Type

The JICA Mission and MPW agreed that the project is designed as a sector loan, and new target tributaries other than 9 tributaries can be candidate sub-projects under the Project based on the selection criteria set in the Survey in terms of urgency, priority and efficiency as mentioned in Annex-1. In addition, the JICA Mission and MPW confirmed that possible bottlenecks including contamination of heavy metal and toxic substance in river bed and necessary land acquisition and resettlements should be considered carefully in sub-project selection process.

II. Review the Detailed Design of 9 tributaries

The JICA Mission and MPW agreed that the detail design of 9 tributaries river improvement, which was completed in 2007 by MPW, should be reviewed considering the impact to the downstream area, especially, Dayeuh Kolot.

III. Flood Model

The JICA Mission and MPW agreed that MPW provides the basic data of Upper Citarum Basin Flood Management Model Framework which is under developing by PusAir to the Survey Team. In close coordination with PusAir, the Survey Team will study the flood management plan of Upper Citarum River Basin.

IV. Relevant Problem

The JICA Mission and MPW confirmed that Citarum River has more challenges to be tackled than flooding. In order to promote integrated water resources management in Citarum River, the Survey may propose possible additional assistance not only for flood management but also water quality improvement, heavy metal in river bed and land subsidence and so on.

V. Executing agency of the Survey

The JICA Mission and MPW confirmed that the executing agency of the Survey is MPW represented by BBWSC who work together with the Survey Team.

In addition, the JICA Mission and MPW confirmed that the Survey should be conducted coordinating relevant stakeholders including BAPPENAS and regional governments in Indonesian in order to make necessary consensus for the progress of the Survey.

VI. Environmental and social consideration studies and procedures

MPW will undertake necessary studies for environmental and social consideration, such as environmental impact assessment, in accordance with the laws and regulations in force in Indonesia as well as JBIC guidelines for confirmation of environmental and social considerations (April 2002) if the projects whose finance will be requested to GOJ.

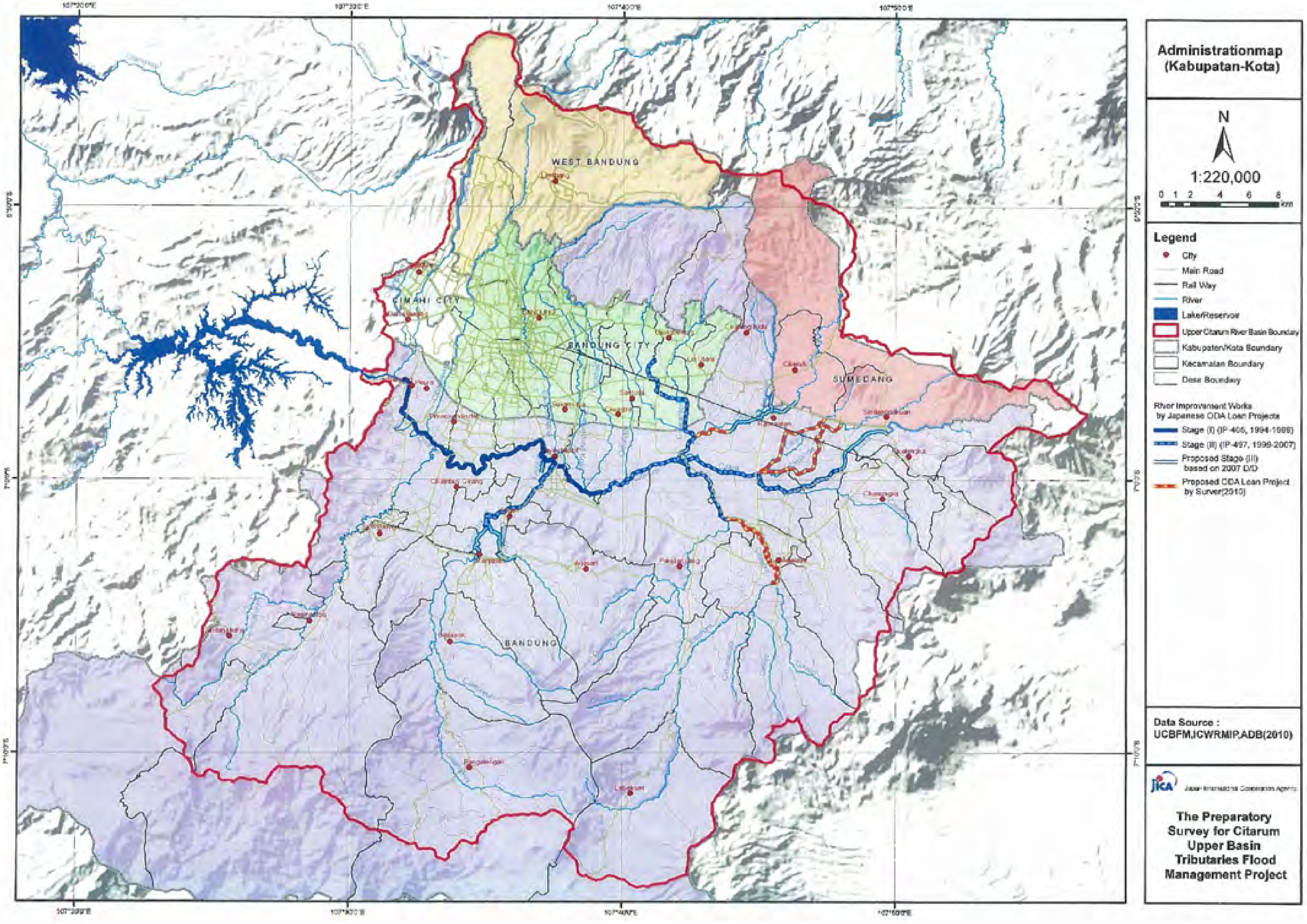
Regarding the social consideration, in the case of having large amount of resettlement and/or land acquisition, LARAP framework is requested to be prepared and submitted to JICA prior to its actual project examination. Therefore MPW will conduct necessary examination throughout the Survey. Also, MPW will review the EIA report and conduct additional examination if necessary. The Survey Team will provide necessary technical support to MPW throughout the studies. EIA report is required to be approved in accordance with AMDAL procedure prior to the submission to JICA.

VII. Disclosure of the final report of the Survey

MPW and the JICA Mission agreed that the final report of the Survey will be disclosed to the public except information related to tender, which may be included in the results of the feasibility study, such as cost estimates.

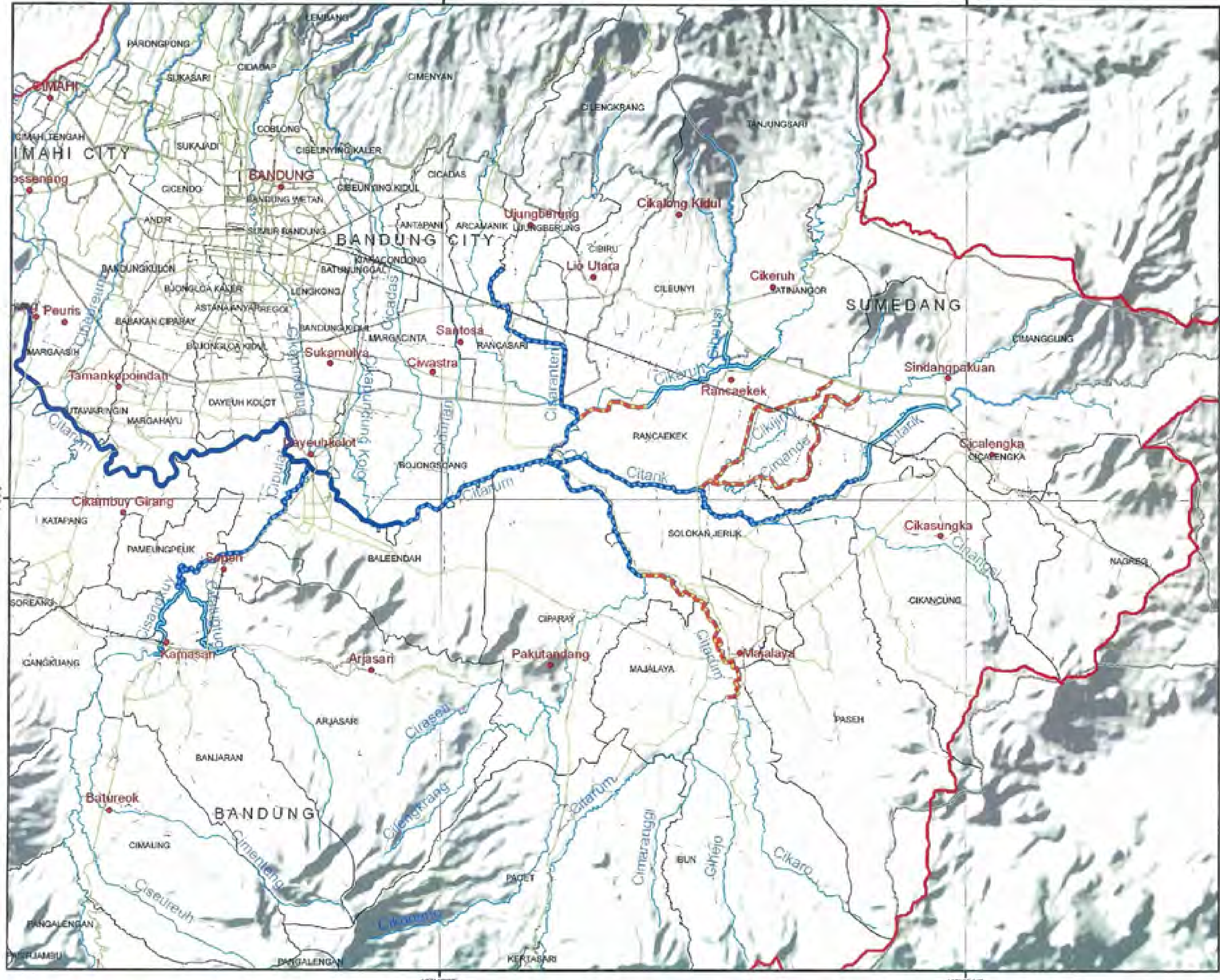
Annex II: Referential Figures

List of Referential Figures



Administrationmap
(Kabupatan-Kota)
N
1:220,000
0 1 2 4 6 8
km
Legend
City
Main Road
Rail Way
River
Lake/Reservoir
Upper Citarum River Basin Boundary
Kabupaten/Kota Boundary
Kecamatan Boundary
Desa Boundary
River Improvement Works by Japanese ODA Loan Projects
Stage (I) (IP-405, 1994-1999)
Stage (II) (IP-497, 1999-2007)
Proposed Stage (III) based on 2007 D/D
Proposed ODA Loan Project by Survey(2010)
Data Source :
UCBFM,ICWRMIP,ADB(2010)
Japan International Cooperation Agency
The Preparatory Survey for Citarum Upper Basin Tributaries Flood Management Project
WEST BANDUNG
CIMAHI CITY
BANDUNG CITY
SUMEDANG
BANDUNG

Administration Map (Flood Prone Area)



Legend

- City
- Main Road
- Rail Way
- River
- Lake/Reservoir
- Upper Citarum River Basin Boundary
- Kabupaten/Kota Boundary
- Kecamatan Boundary
- Desa Boundary

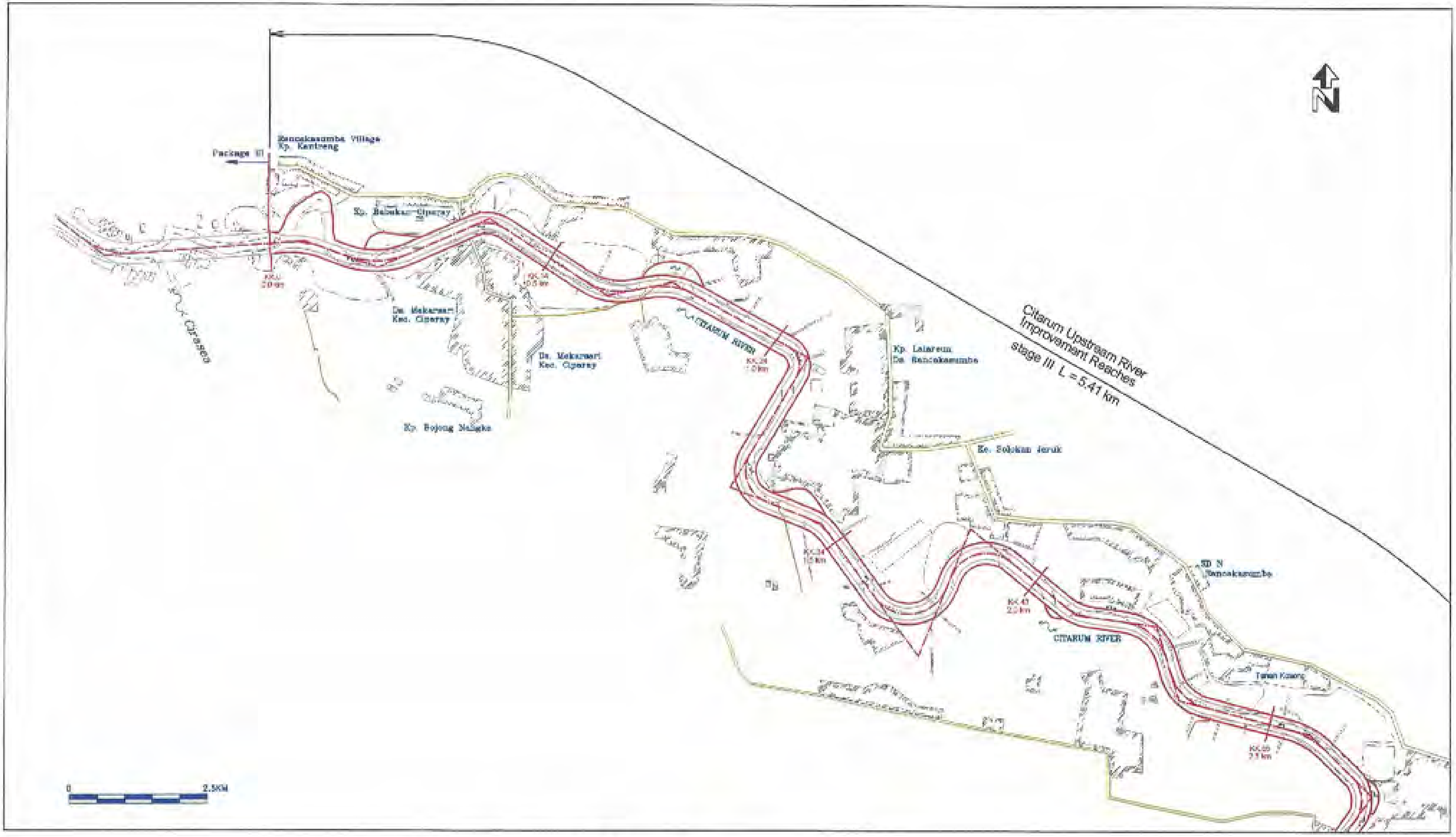
River Improvement Works by Japanese ODA Loan Projects

- Stage (I) (IP-405, 1994-1999)
- Stage (II) (IP-497, 1999-2007)
- Proposed Stage (III) based on 2007 D/D
- Proposed ODA Loan Project by Survey(2010)

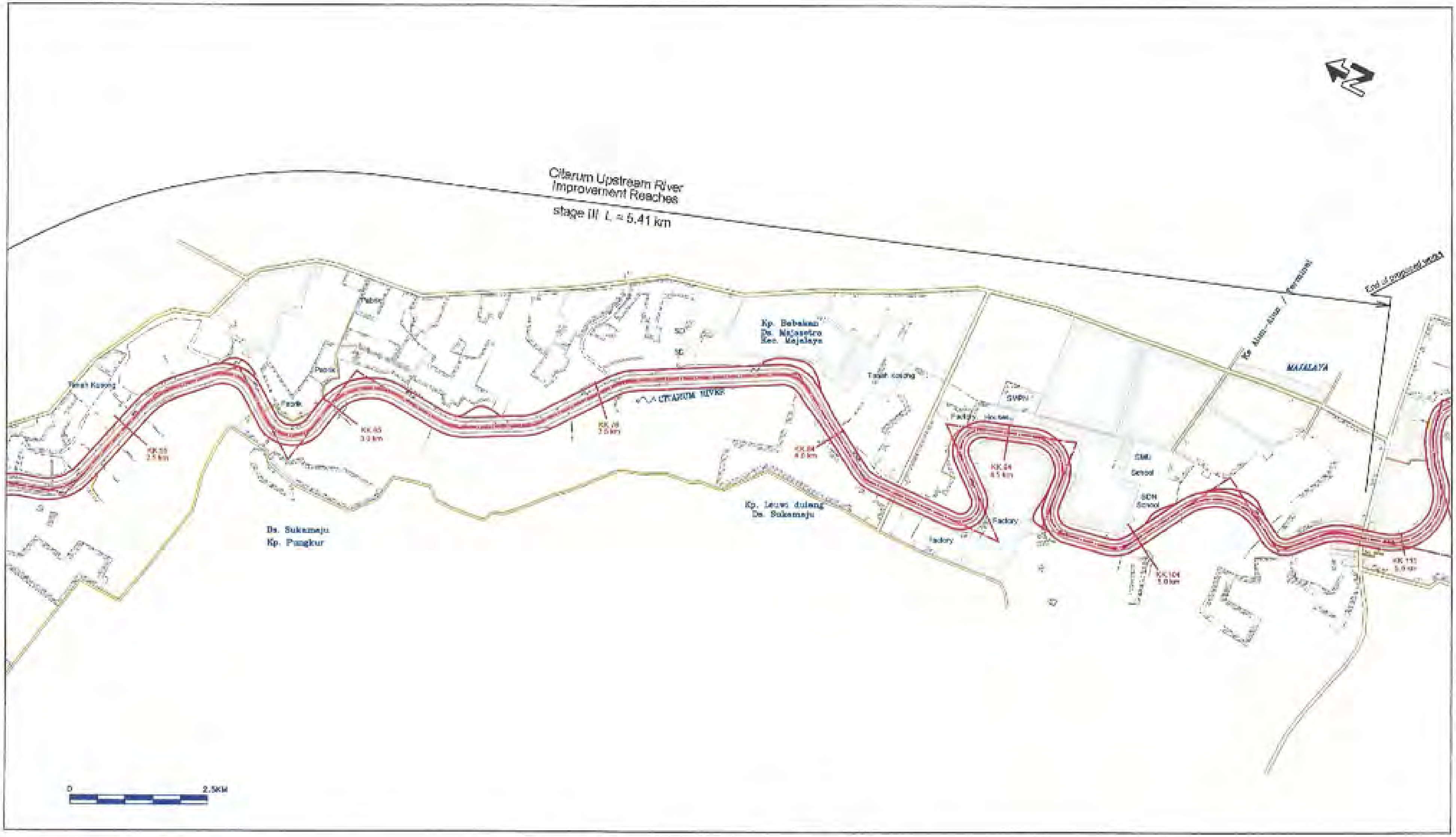
Data Source : UCBFM,ICWRMIP,ADB(2010)

JICA Japan International Cooperation Agency

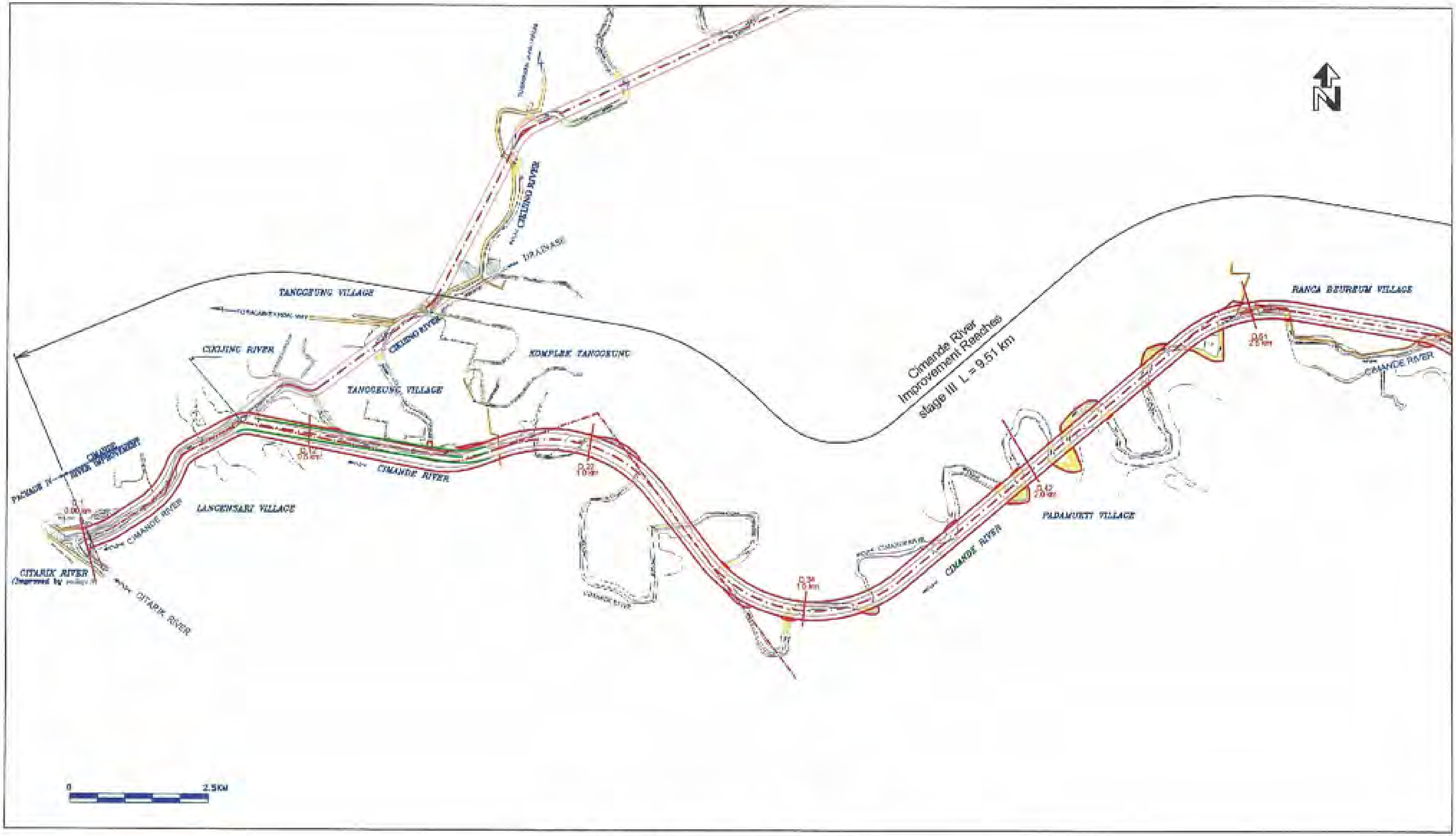
The Preparatory Survey for Citarum Upper Basin Tributaries Flood Management Project



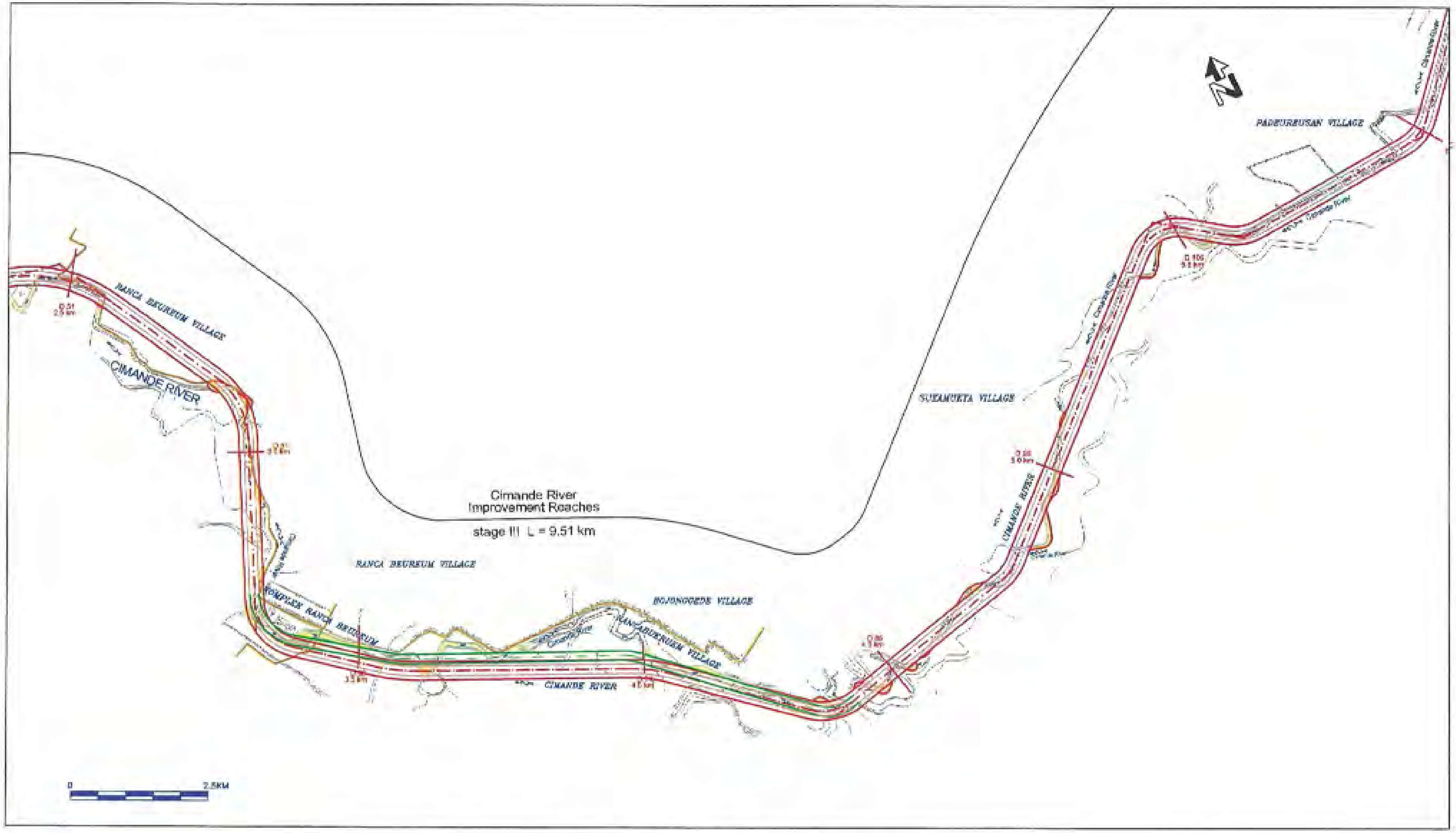
Plan of Citarum Upstream River (1/2)



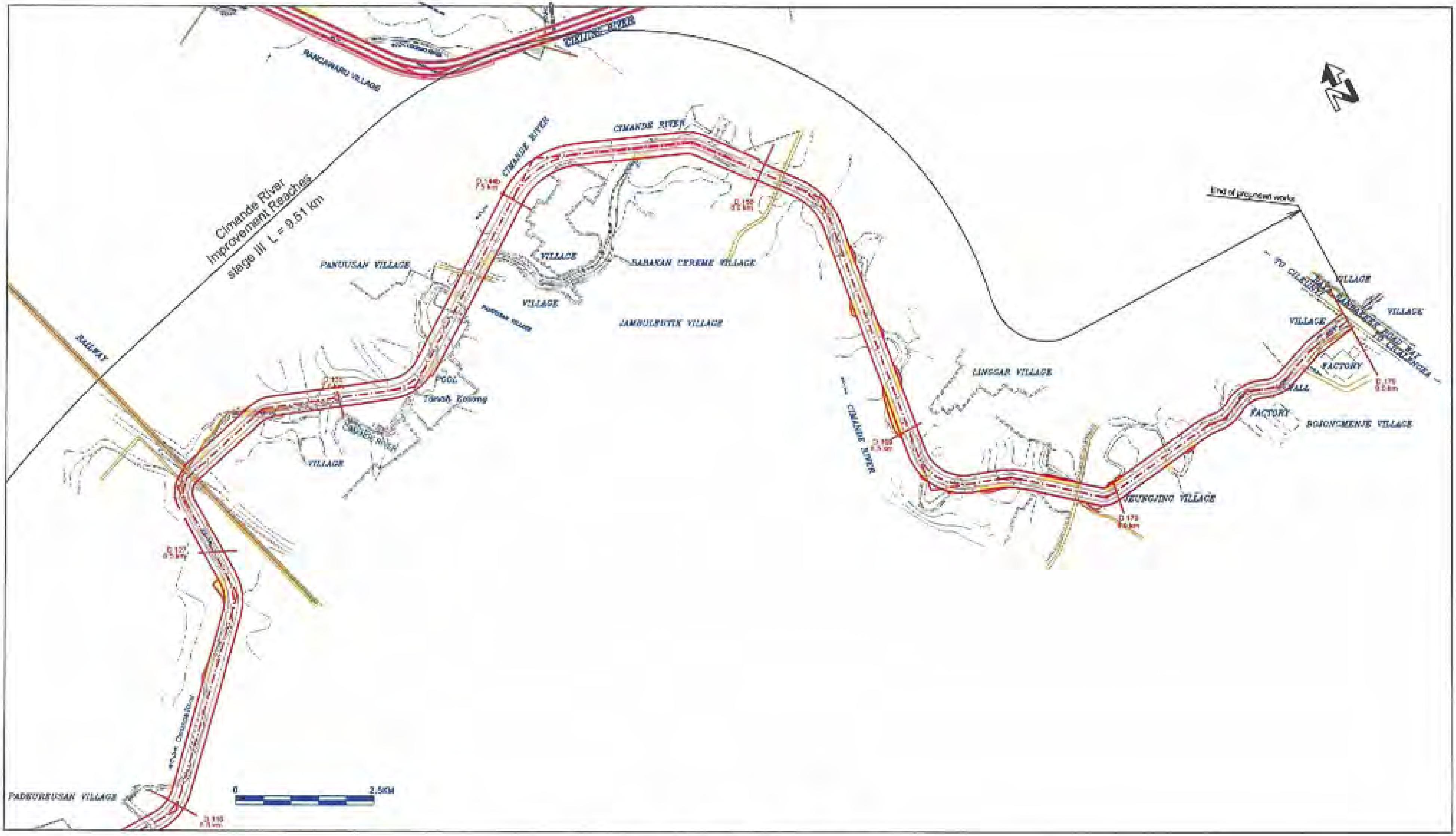
Plan of Citarum Upstream River (2/2)



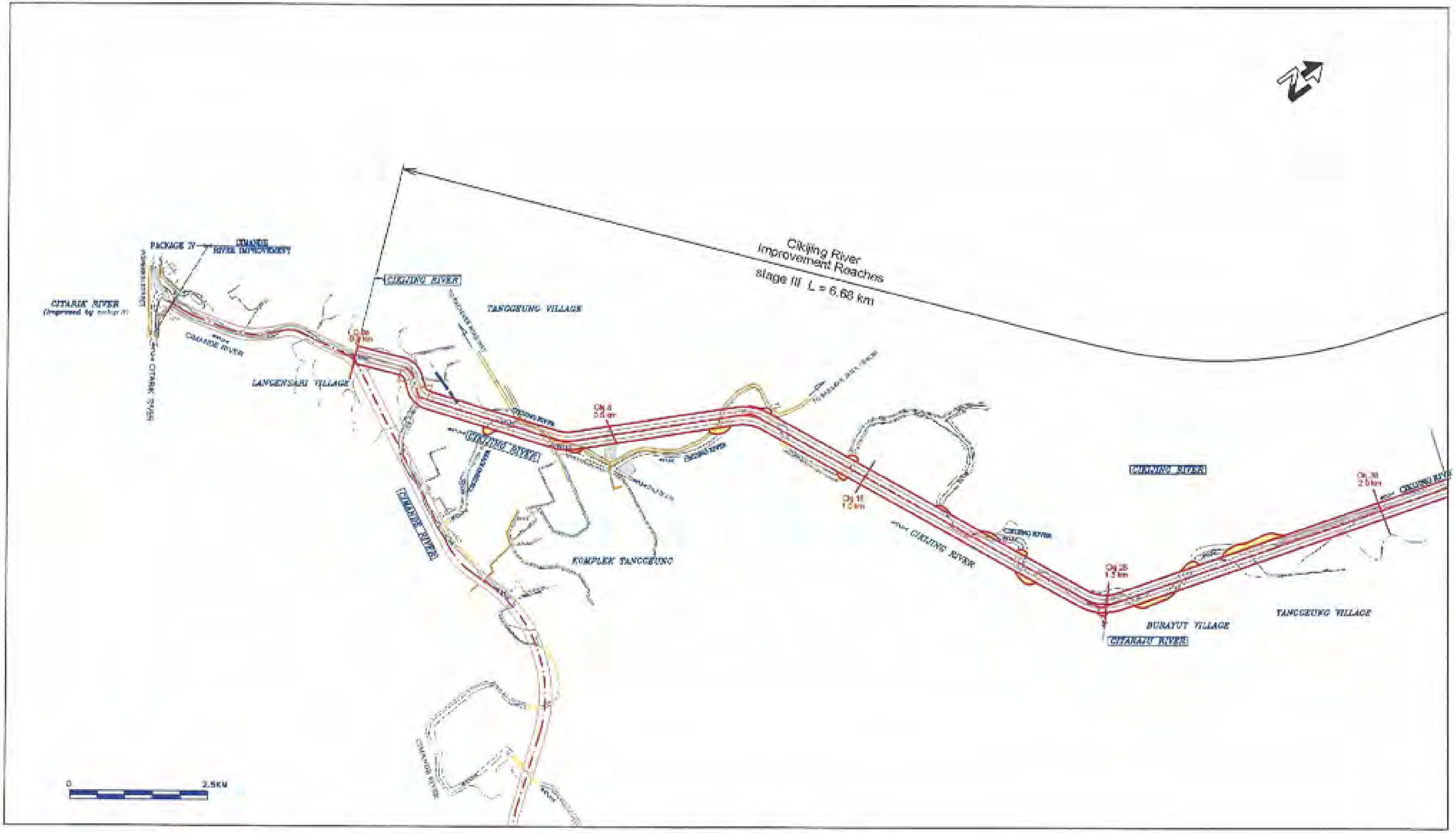
Plan of Cimande River (1/3)



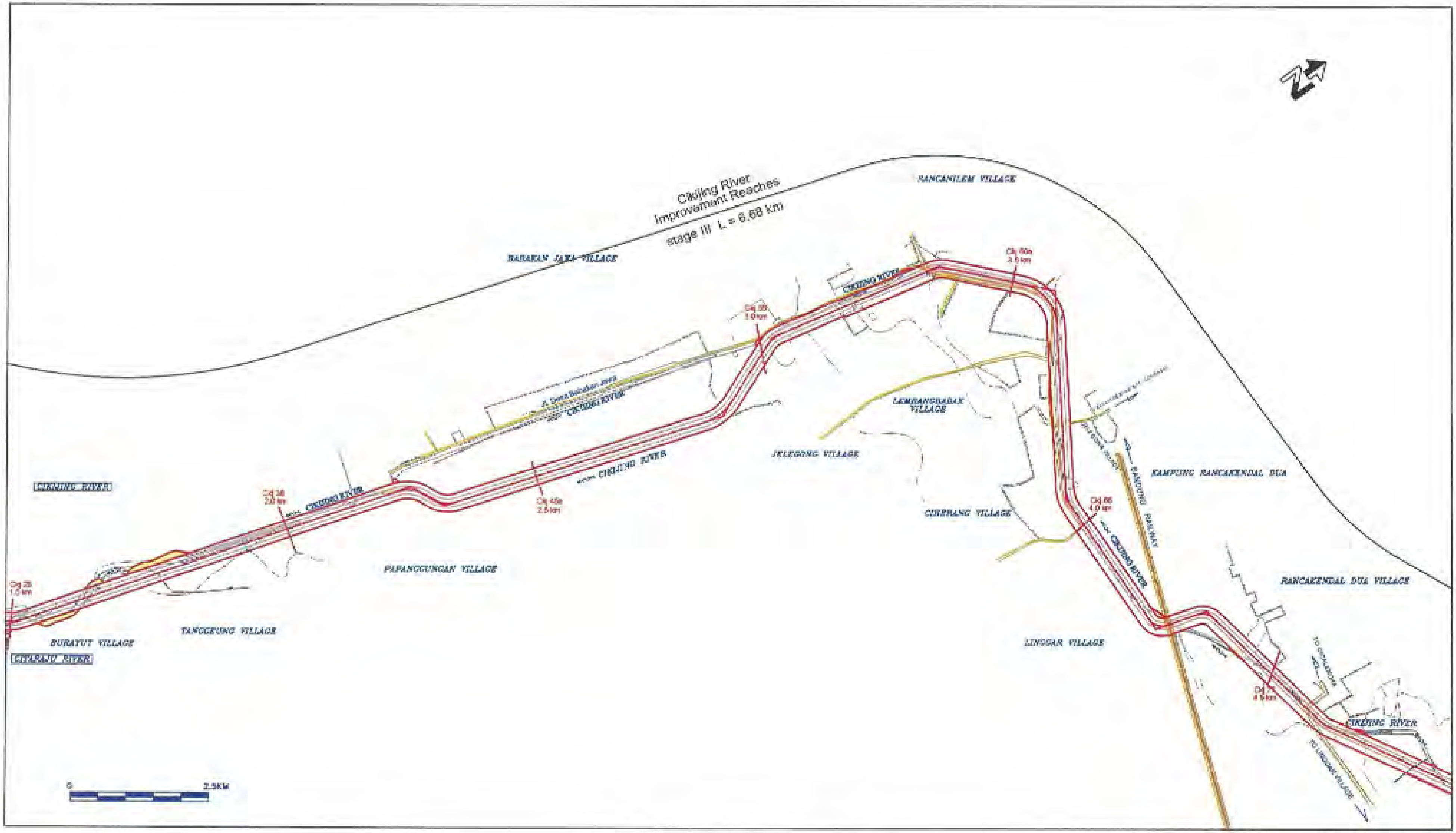
Plan of Cimande River (2/3)



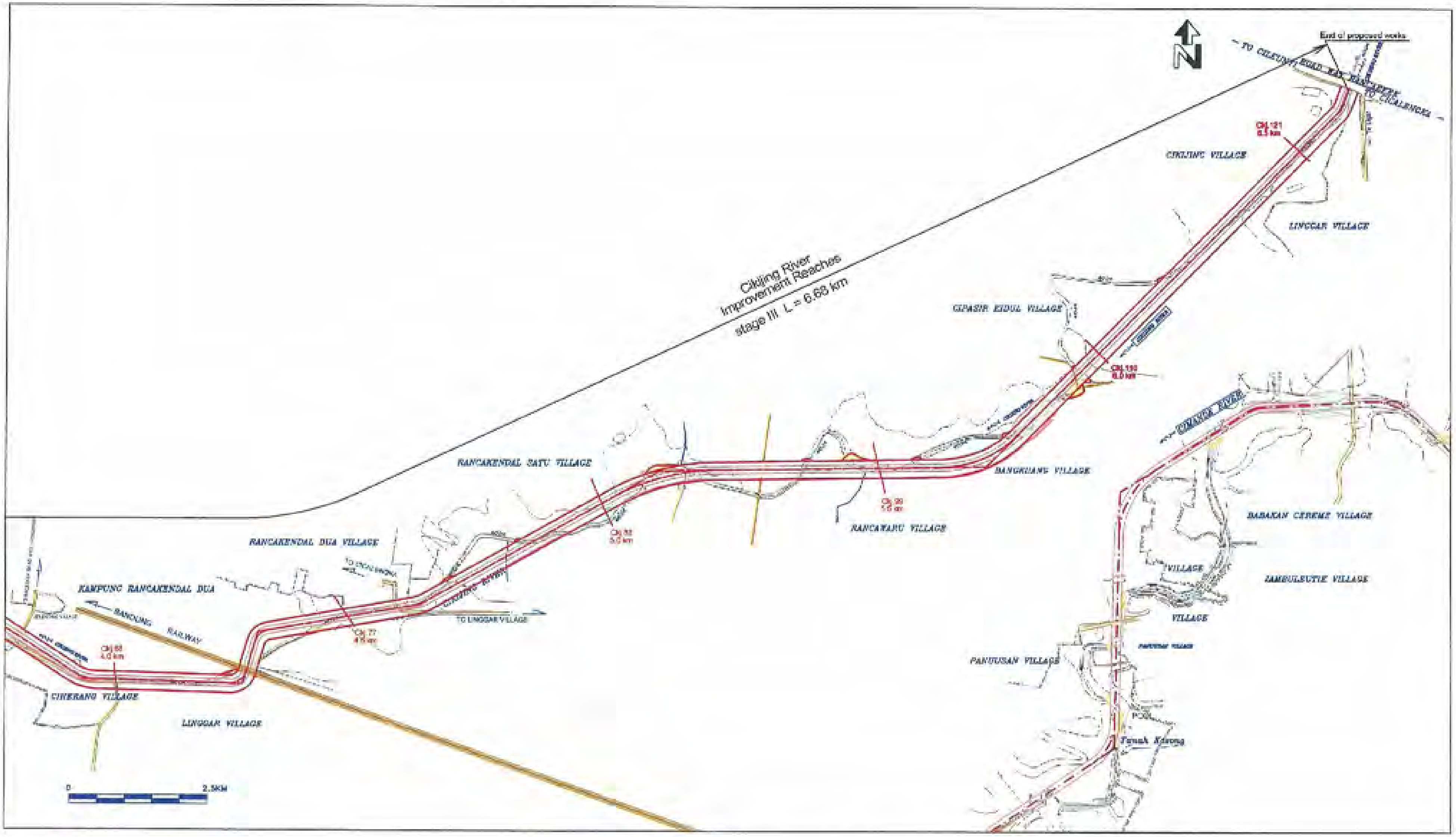
Plan of Cimande River (3/3)



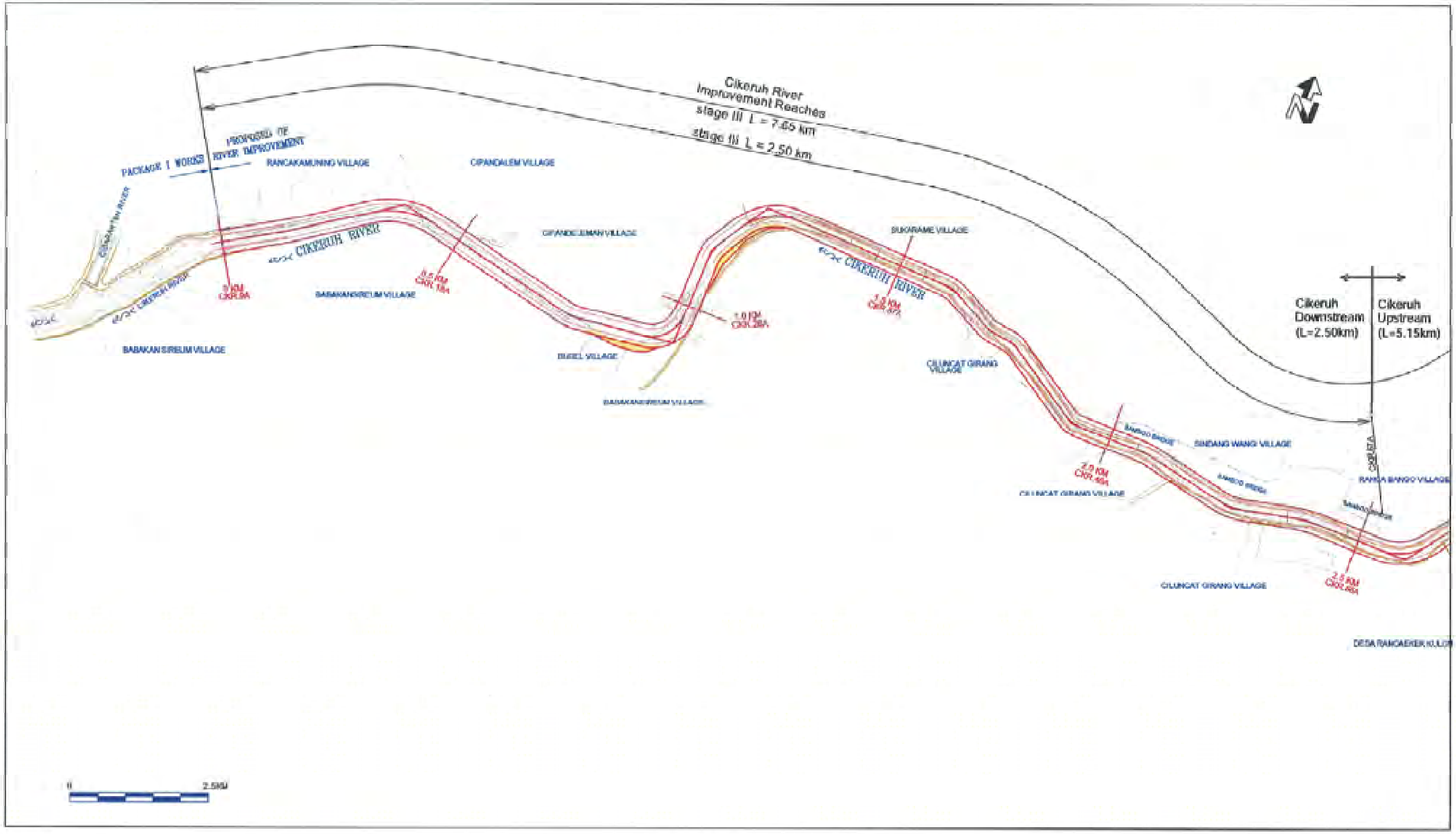
Plan of Cikijing River (1/3)



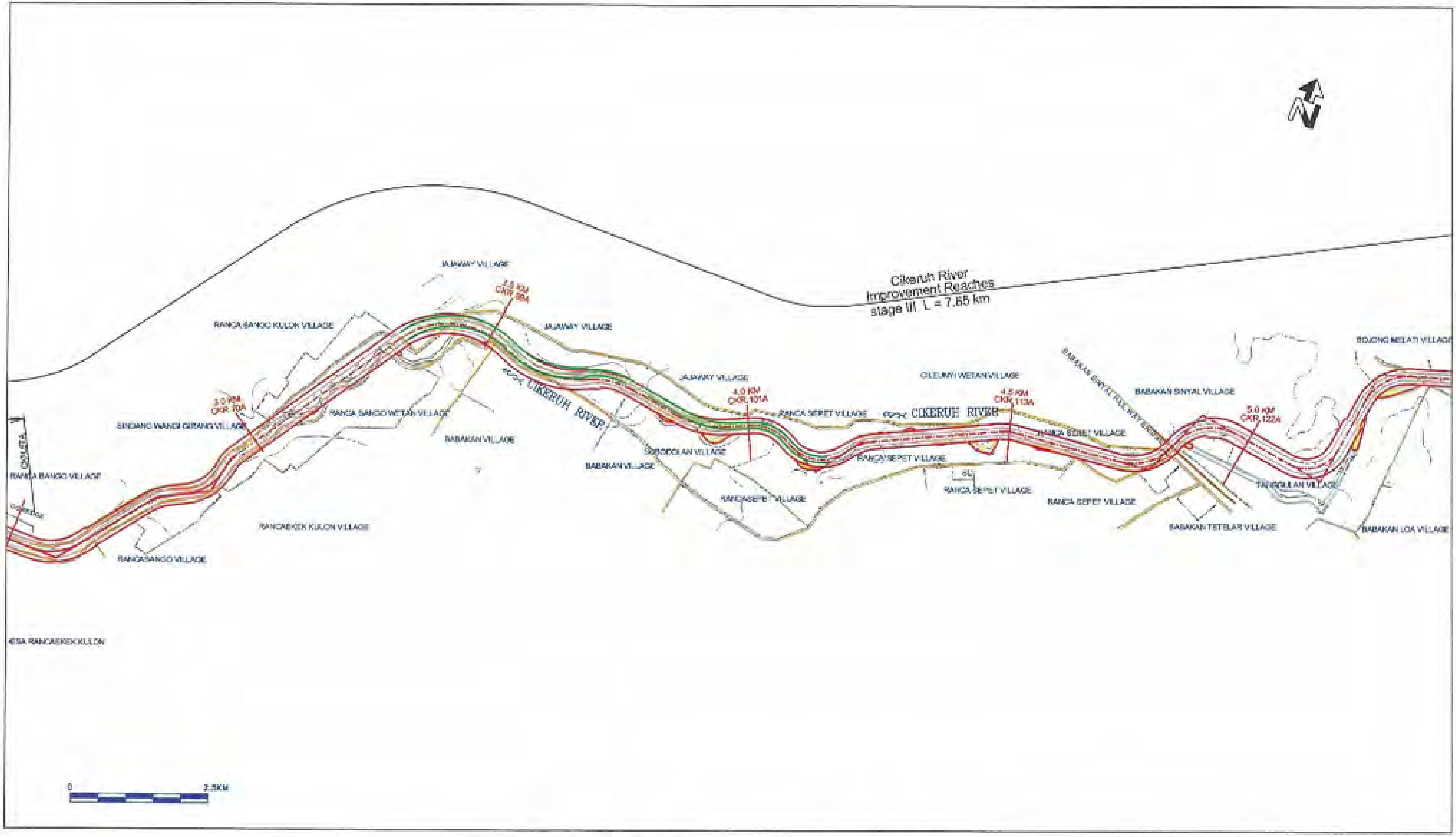
Plan of Cikijing River (2/3)



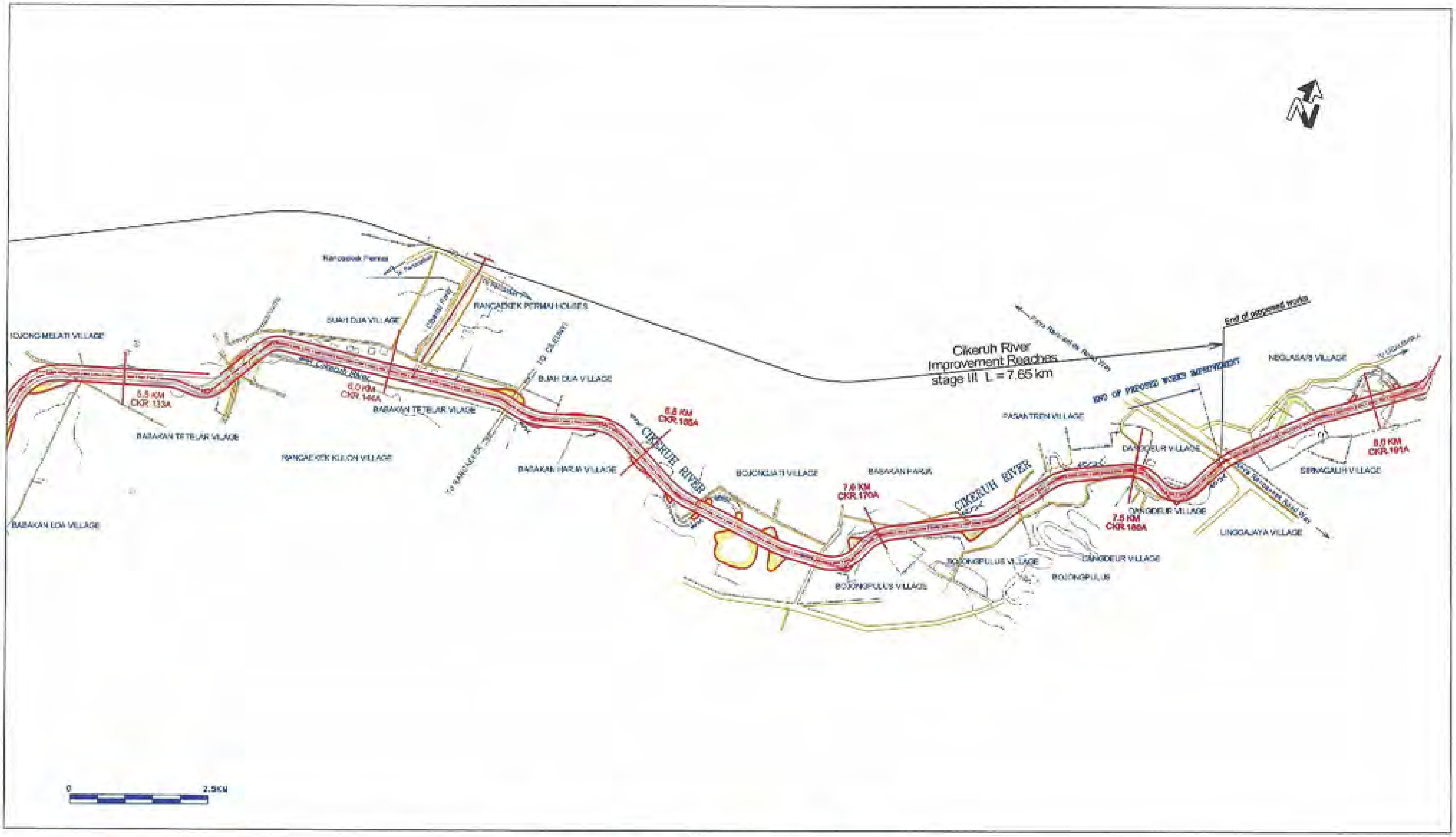
Plan of Cikijing River (3/3)



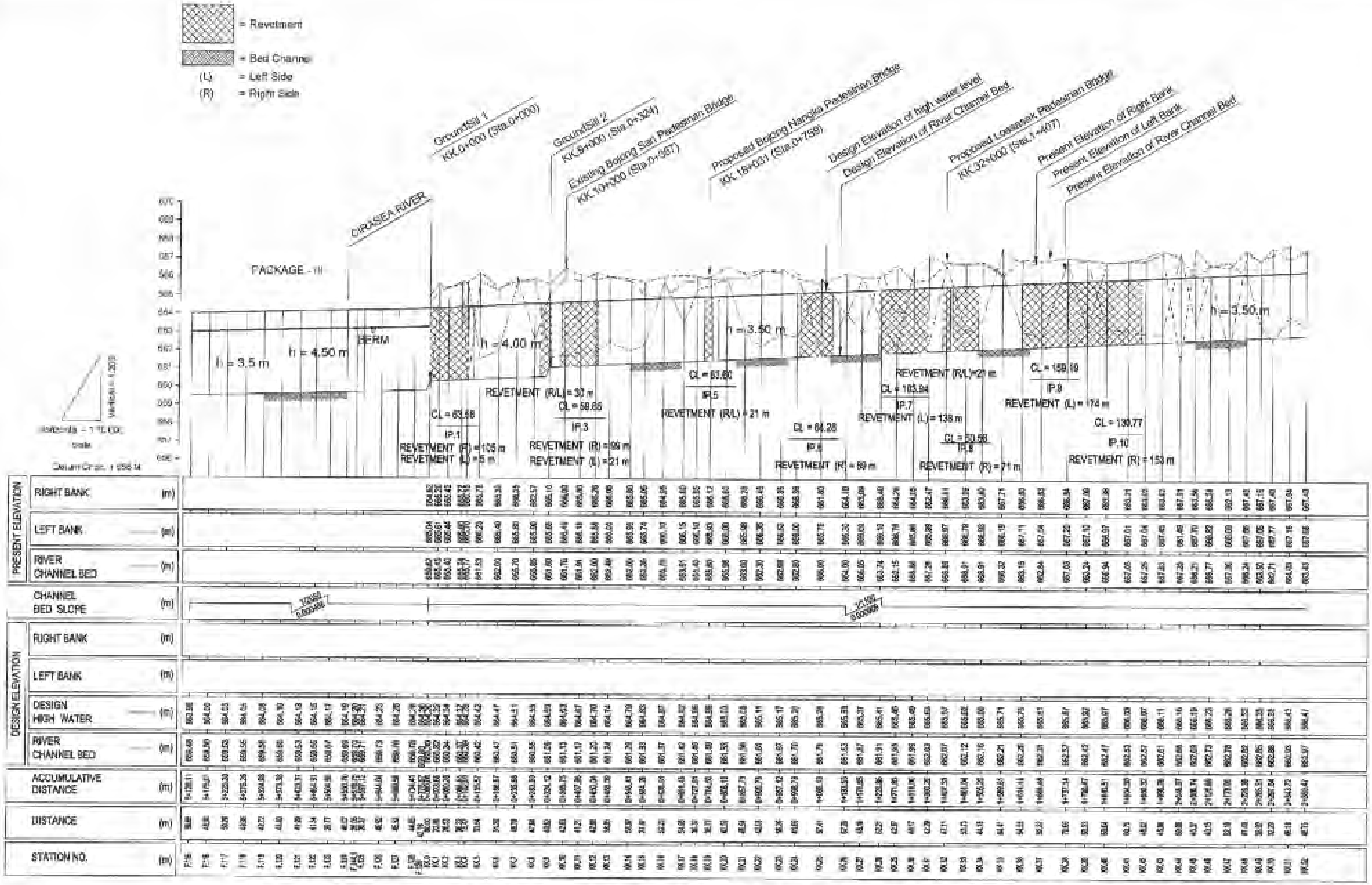
Plan of Cikeruh Upstream River (1/3)



Plan of Cikeruh Upstream River (2/3)



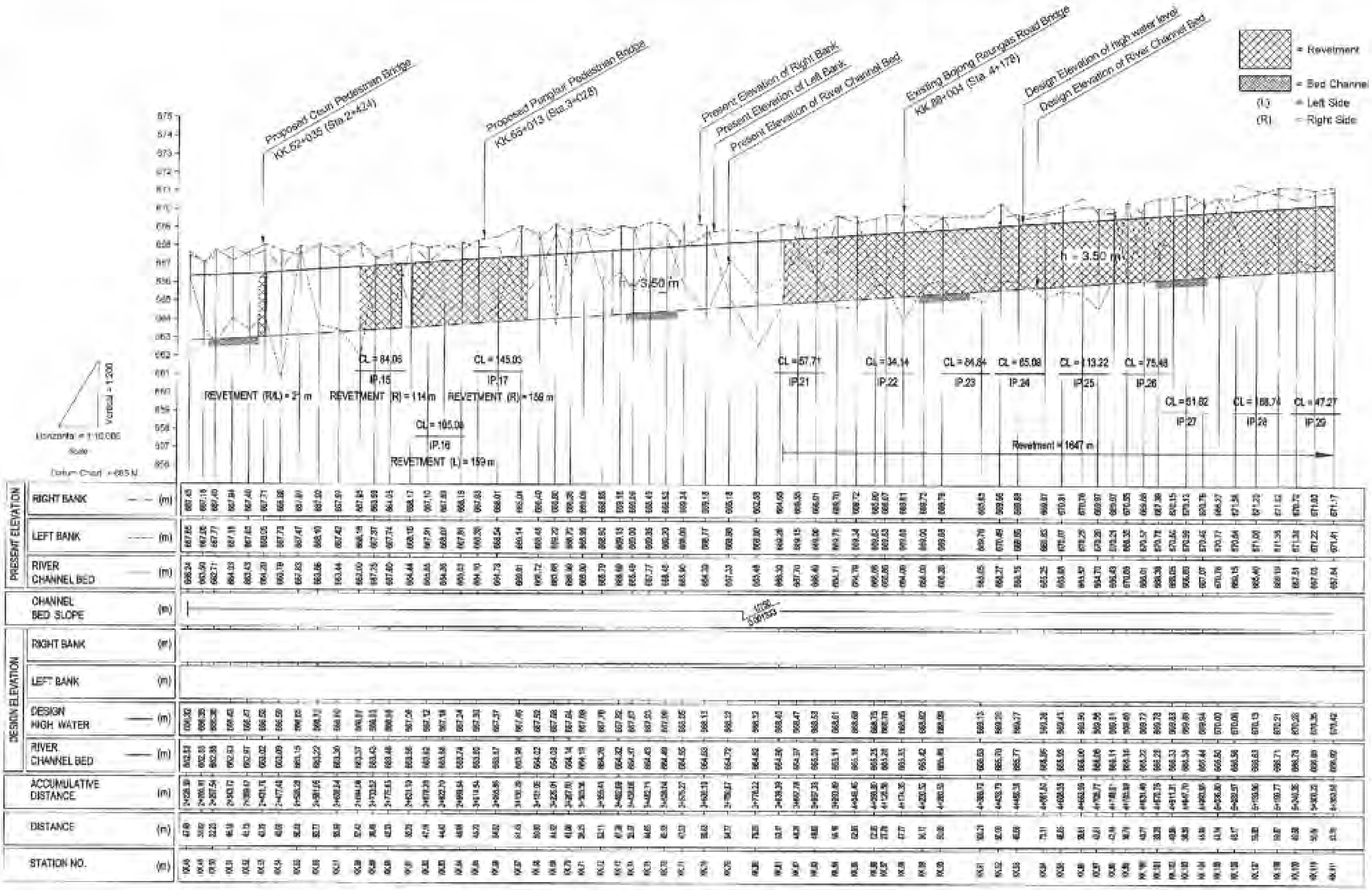
Plan of Cikeruh Upstream River (3/3)



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CITARUM UPSTREAM RIVER (1/3)

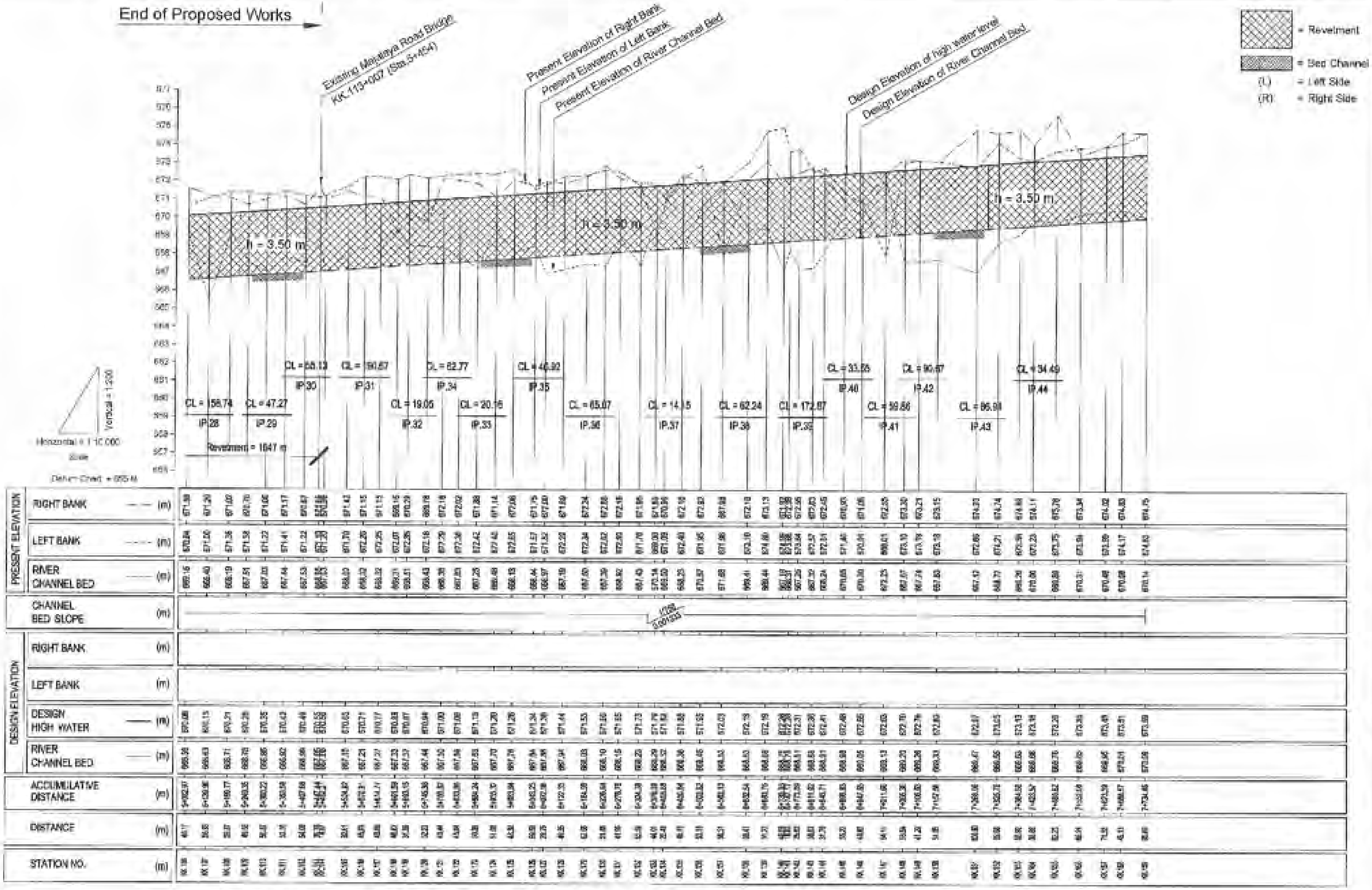
DRAWING NO.
P00-010PF001



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CITARUM UPSTREAM RIVER (2/3)

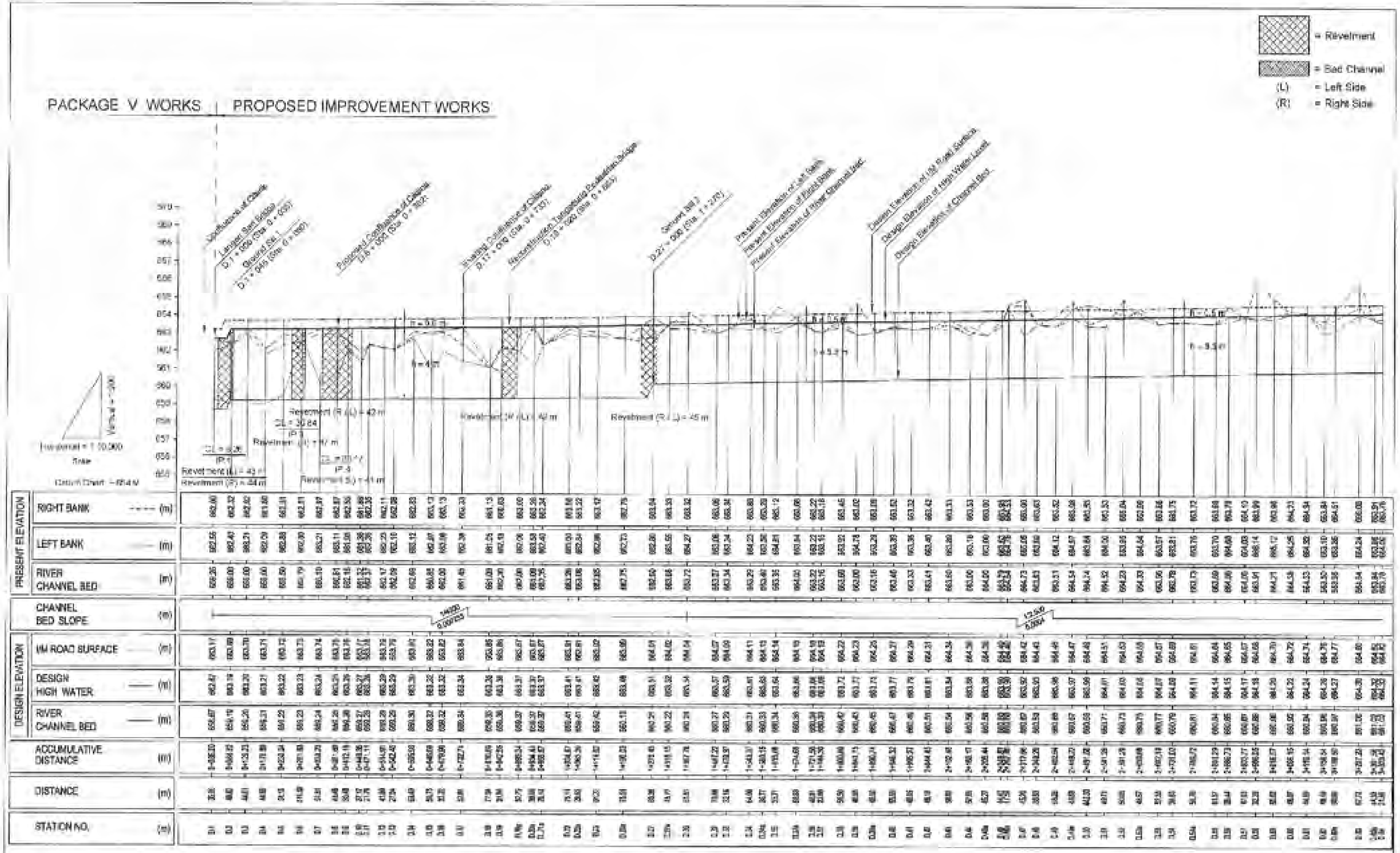
Drawing No.
PD3-01OPF002



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CITARUM UPSTREAM RIVER (3/3)

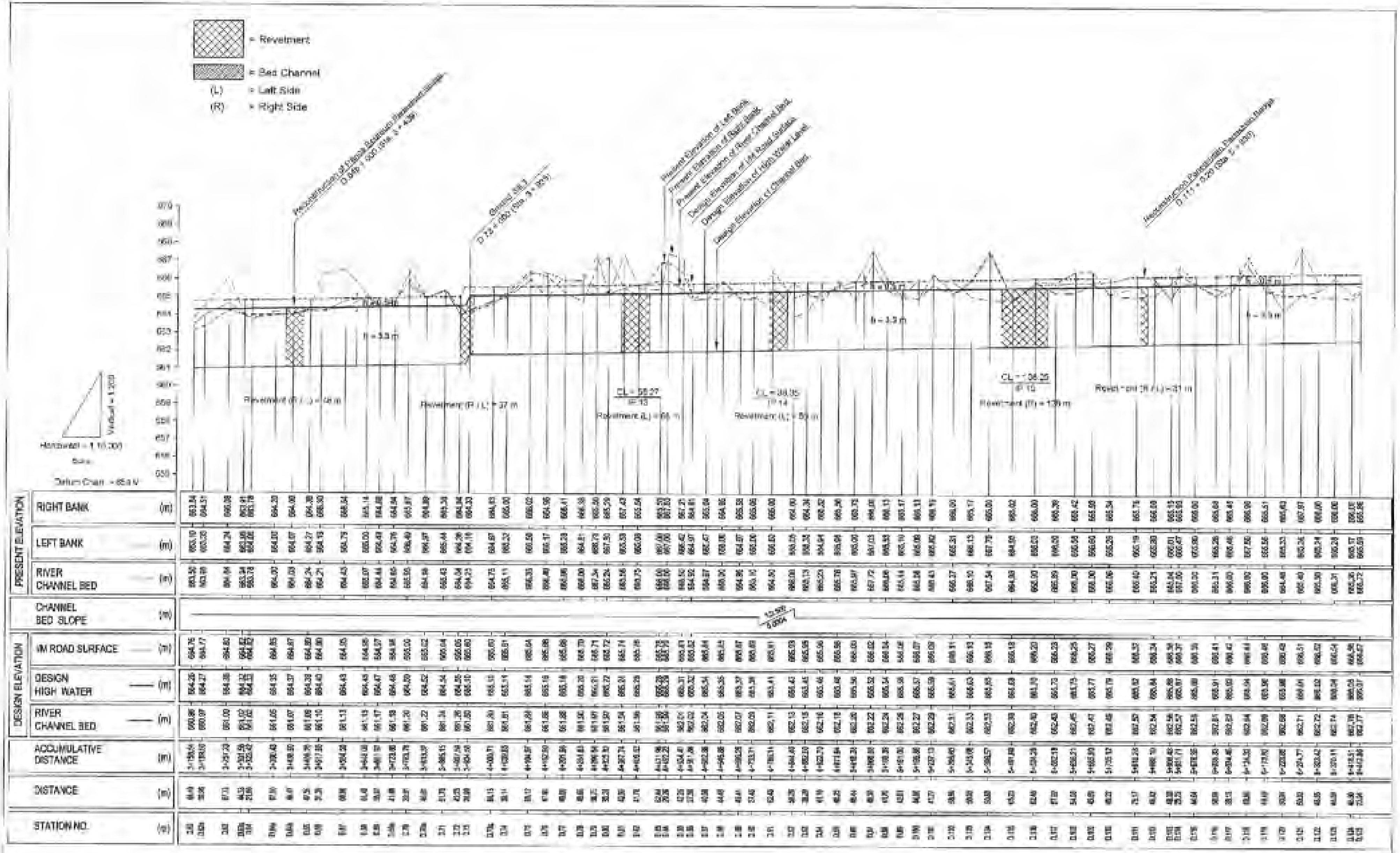
DRAWING NO.
P00-010FF003



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIMANDE RIVER (1/3)

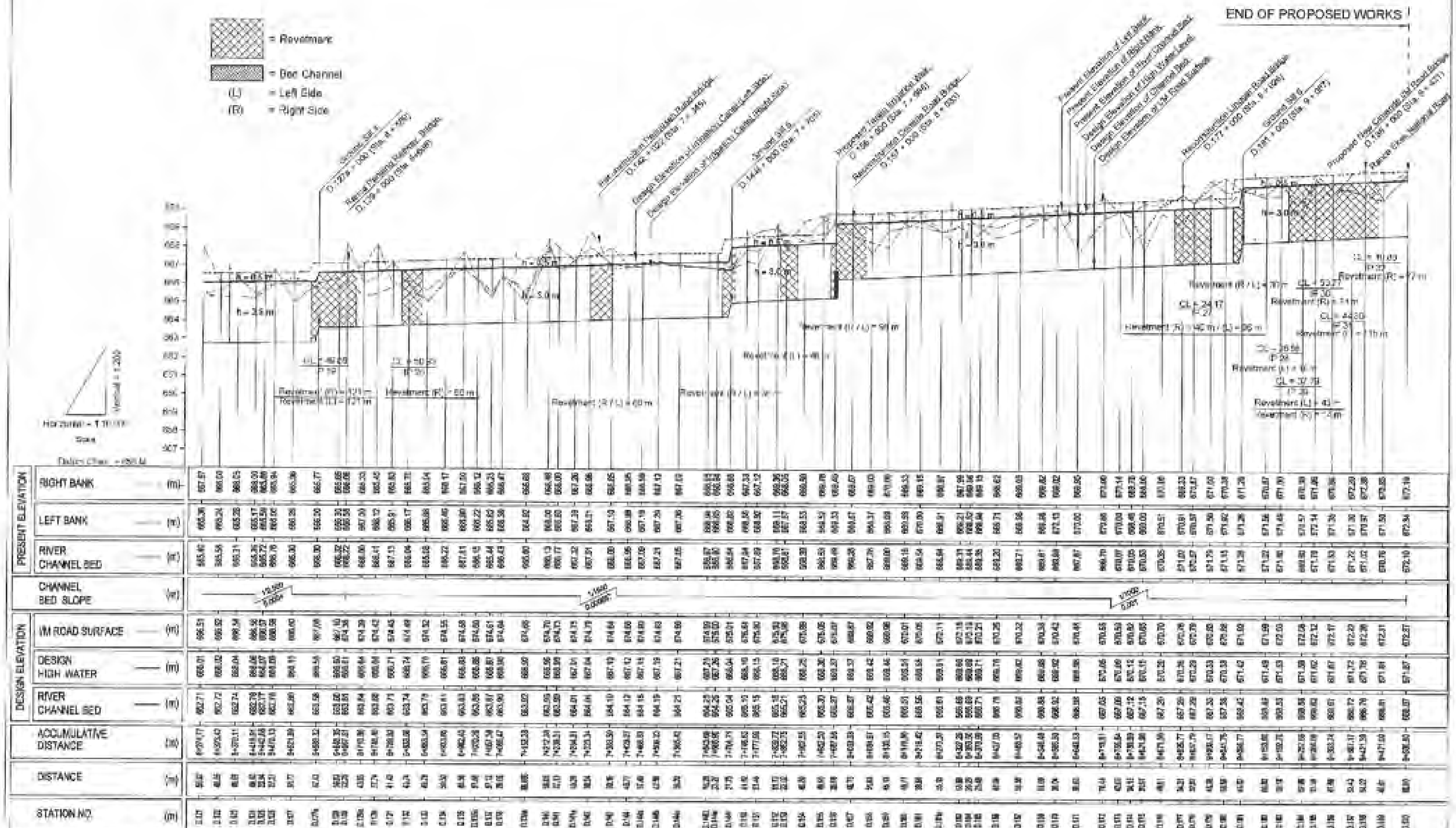
DRAWING NO.
PDG-050PF001



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIMANDE RIVER (2/3)

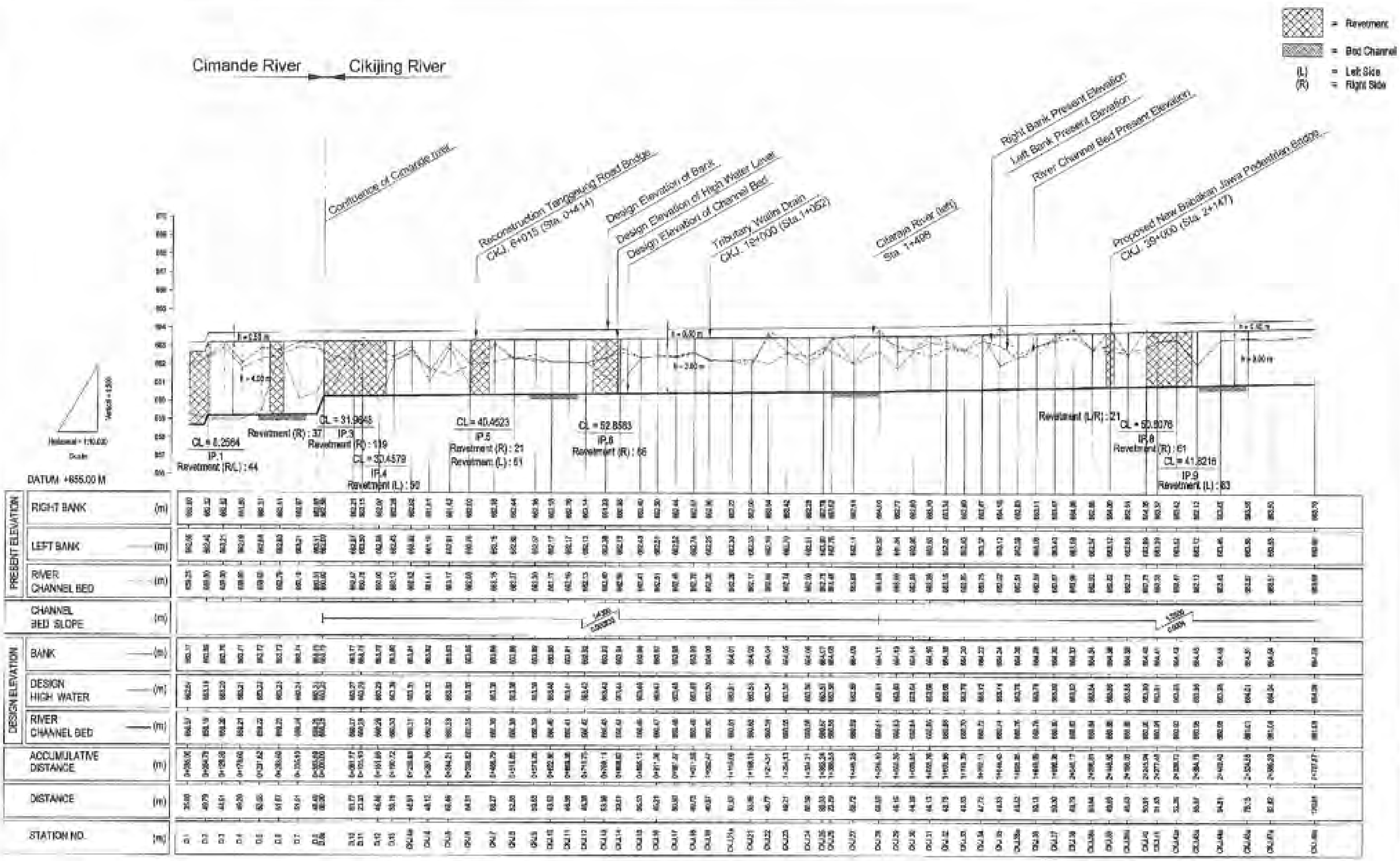
DRAWING NO.
P00-03CPF002



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIMANDE RIVER (3/3)

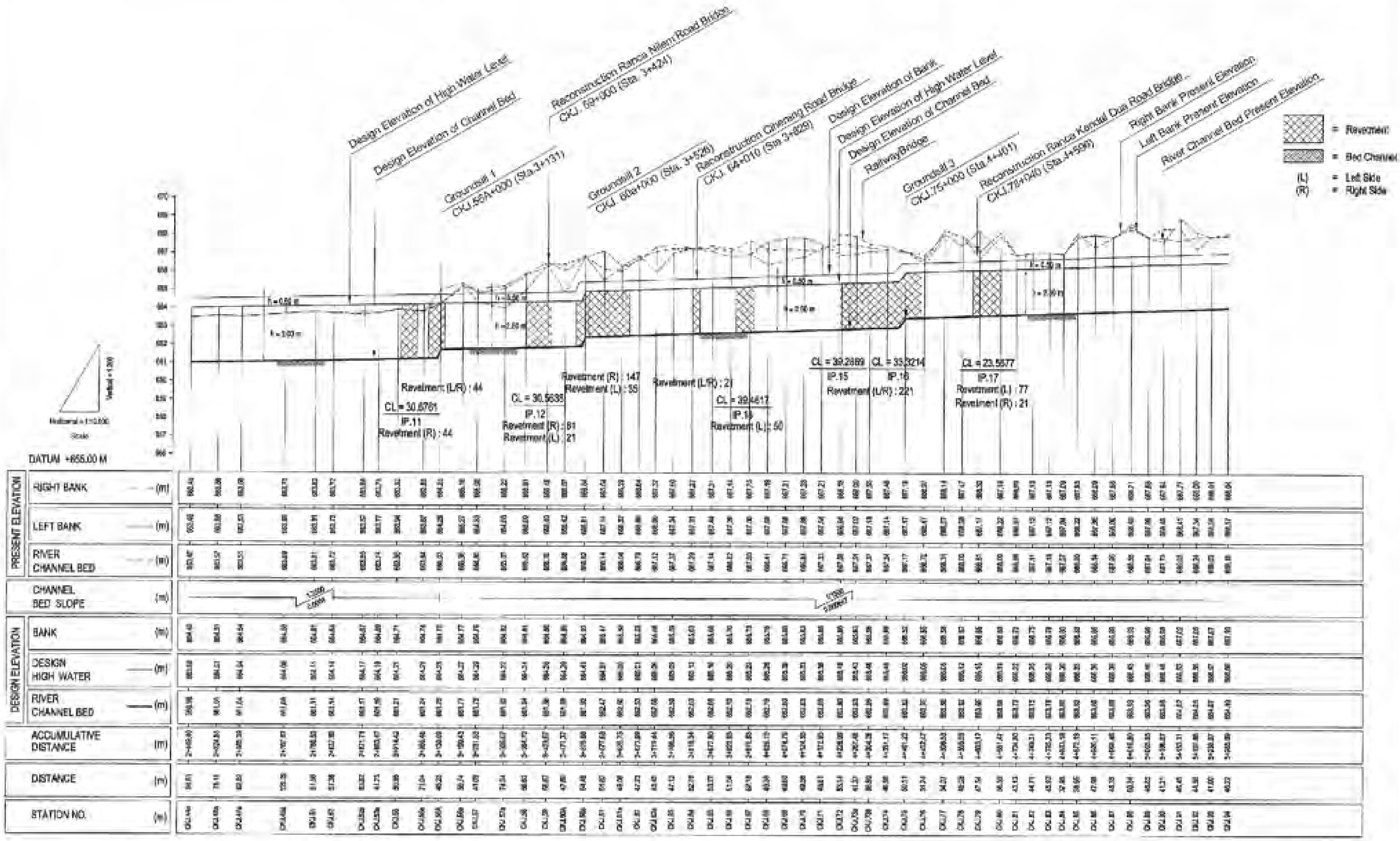
Drawing no.
P00-03OPF003



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIKIJING RIVER (1/3)

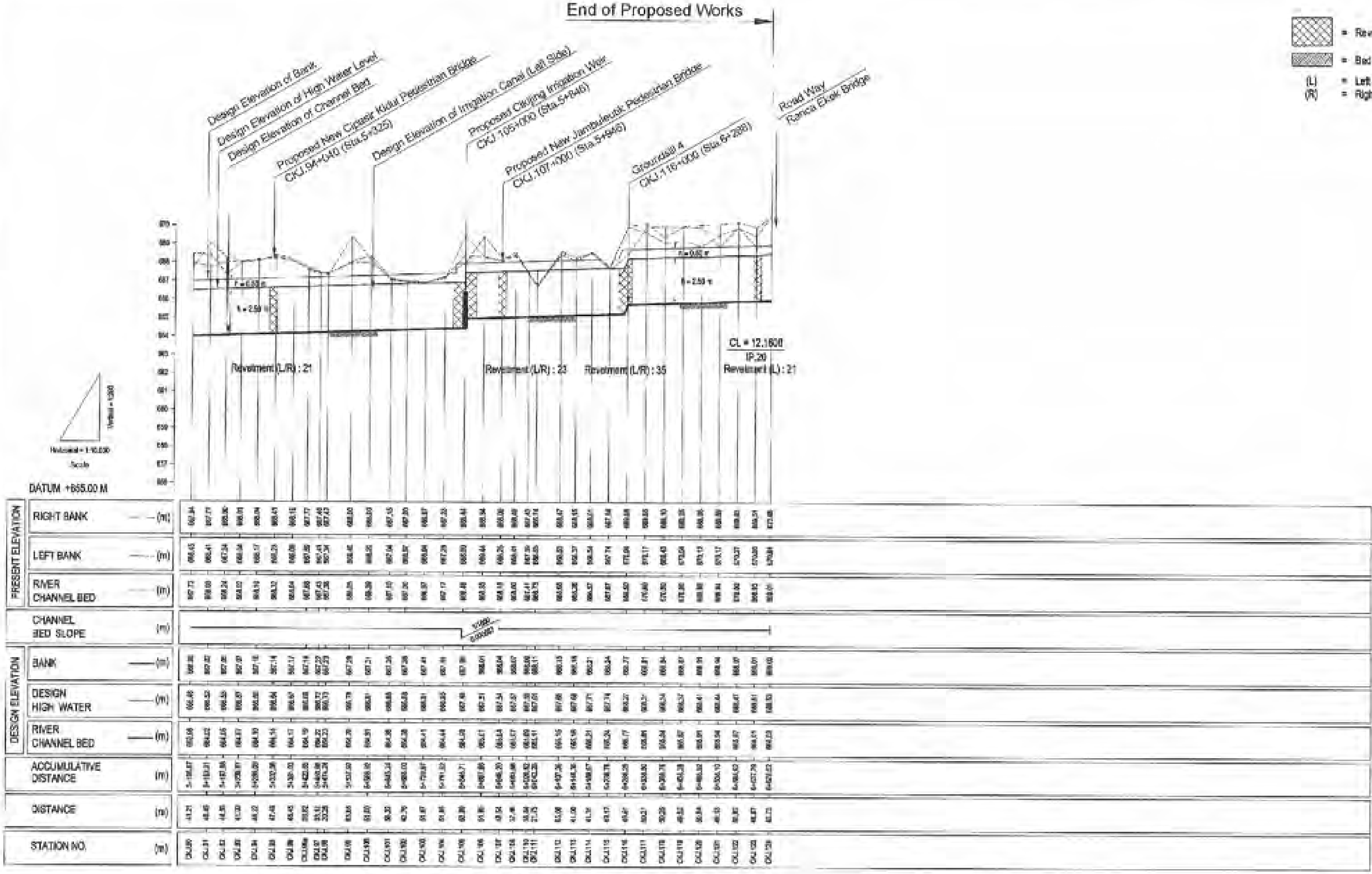
DRAWING NO.
P00-040PF001



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIKIJING RIVER (2/3)

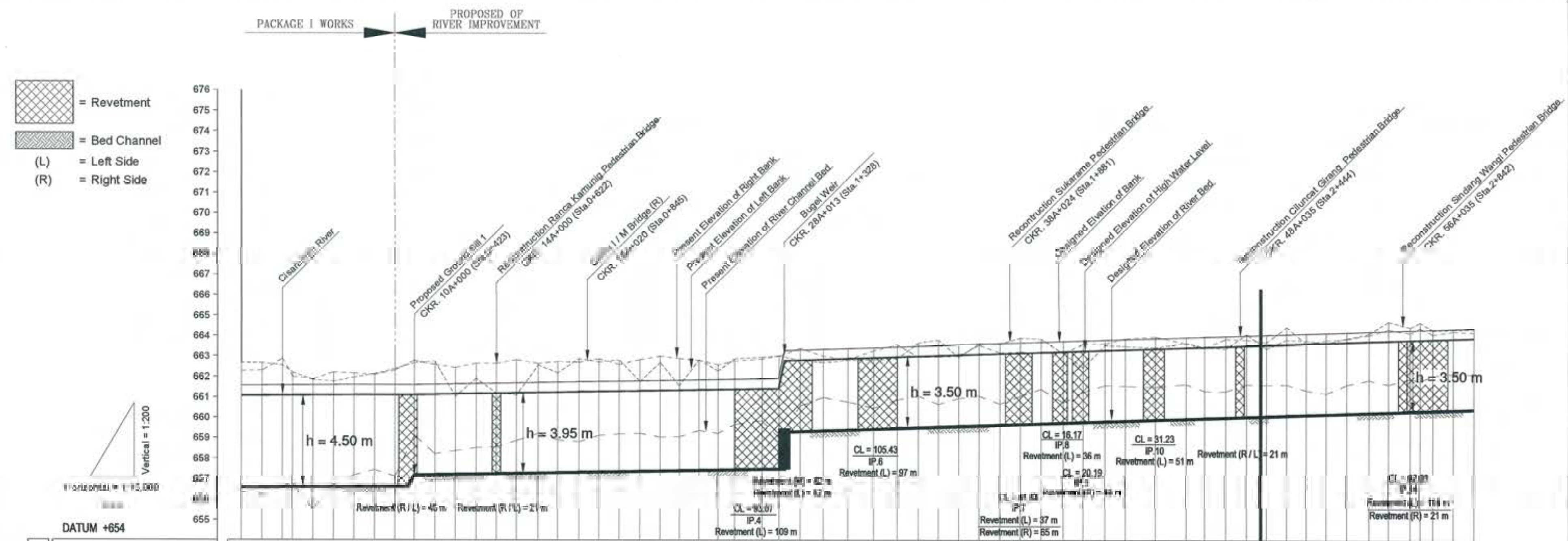
DRAWING NO.
P00-04CPF002



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIKIJING RIVER (3/3)

DRAWING NO.
POD-04OPF033



Station No.	Distance (m)	Cumulative Distance (m)	Present Elevation: Right Bank (m)	Present Elevation: Left Bank (m)	Present Elevation: River Channel Bed (m)	Design Elevation: Right Bank (m)	Design Elevation: Left Bank (m)	Design Elevation: High Water Level (m)	Design Elevation: Channel Bed (m)
CKR.1	0.00	0+000.00	662.27	662.67	656.37	661.57	661.57	661.07	656.57
CKR.2	50.08	0+050.08	662.30	662.66	656.14	661.57	661.57	661.07	656.57
CKR.3	50.02	0+100.10	662.86	662.55	656.63	661.58	661.58	661.08	656.58
CKR.4	25.01	0+125.11	662.00	662.20	656.74	661.58	661.58	661.08	656.58
CKR.5	49.98	0+175.09	661.87	661.85	655.53	661.59	661.59	661.09	656.59
CKR.6	49.95	0+225.04	662.21	661.77	656.67	661.60	661.60	661.10	656.60
CKR.7	50.08	0+275.12	662.16	661.96	657.16	661.61	661.61	661.10	656.60
CKR.8	50.14	0+325.26	662.10	662.13	657.43	661.61	661.61	661.11	656.61
CKR.8A	49.98	0+375.25	662.31	662.38	657.10	661.61	661.61	661.11	656.61
CKR.10A	47.54	0+422.79	662.78	662.67	659.12	661.61	661.61	661.11	657.16
CKR.11A	50.21	0+473.00	662.58	662.74	658.22	661.62	661.62	661.12	657.17
CKR.12A	50.21	0+522.07	662.44	661.03	658.36	661.64	661.64	661.14	657.19
CKR.13A	50.76	0+572.83	662.65	661.91	658.52	661.66	661.66	661.16	657.21
CKR.14A	49.44	0+622.27	662.64	661.19	658.55	661.68	661.68	661.18	657.23
CKR.15A	49.08	0+671.27	662.82	661.10	658.86	661.69	661.69	661.19	657.24
CKR.16A	53.43	0+724.70	662.64	662.56	659.21	661.71	661.71	661.21	657.26
CKR.17A	47.82	0+772.52	662.73	662.19	658.89	661.73	661.73	661.23	657.28
CKR.18A	52.38	0+824.73	662.70	662.88	658.81	661.75	661.75	661.25	657.30
CKR.19A	48.68	0+873.42	662.87	662.71	659.13	661.77	661.77	661.27	657.32
CKR.20A	49.68	0+923.07	662.60	662.82	659.19	661.78	661.78	661.28	657.33
CKR.21A	50.62	0+973.69	662.83	661.78	659.23	661.80	661.80	661.30	657.35
CKR.22A	49.87	1+023.56	663.00	662.69	659.04	661.82	661.82	661.32	657.37
CKR.23A	46.89	1+070.45	662.89	661.57	659.06	661.84	661.84	661.34	657.39
CKR.24A	48.35	1+118.80	662.79	662.83	659.37	661.85	661.85	661.35	657.40
CKR.25A	46.57	1+165.37	662.59	662.29	659.23	661.87	661.87	661.37	657.42
CKR.26A	40.60	1+205.97	662.77	662.88	659.66	661.89	661.89	661.39	657.44
CKR.27A	66.88	1+272.85	662.87	662.96	659.85	661.91	661.91	661.41	657.46
CKR.28A	41.84	1+314.69	663.01	663.02	659.01	661.92	661.92	661.42	657.47
CKR.29A	52.31	1+367.00	663.40	662.81	660.59	663.31	663.31	662.81	659.31
CKR.30A	56.59	1+423.59	663.01	662.71	661.01	663.35	663.35	662.85	659.35
CKR.31A	60.02	1+483.61	662.84	662.80	660.78	663.39	663.39	662.89	659.39
CKR.32A	63.37	1+546.98	663.29	662.84	660.48	663.43	663.43	662.93	659.43
CKR.33A	57.66	1+604.64	663.58	662.90	660.89	663.47	663.47	662.97	659.47
CKR.34A	51.65	1+656.29	662.97	663.67	661.08	663.50	663.50	663.00	659.50
CKR.35A	49.07	1+705.36	662.97	663.81	660.67	663.53	663.53	663.03	659.53
CKR.36A	49.97	1+755.33	663.02	662.97	660.96	663.57	663.57	663.07	659.57
CKR.37A	49.53	1+804.86	663.57	663.64	661.08	663.60	663.60	663.10	659.60
CKR.38A	51.65	1+856.51	663.19	663.61	660.68	663.64	663.64	663.14	659.64
CKR.39A	49.55	1+906.06	663.23	663.92	661.07	663.67	663.67	663.17	659.67
CKR.40A	51.06	1+957.12	663.17	663.87	661.41	663.70	663.70	663.20	659.70
CKR.41A	54.40	2+011.52	663.18	663.17	660.76	663.74	663.74	663.24	659.74
CKR.42A	48.36	2+059.88	663.61	662.47	661.27	663.77	663.77	663.27	659.77
CKR.43A	53.98	2+113.86	663.63	663.56	661.61	663.81	663.81	663.31	659.81
CKR.44A	49.64	2+163.50	663.89	663.52	661.57	663.84	663.84	663.34	659.84
CKR.45A	73.37	2+236.87	663.99	663.46	661.53	663.89	663.89	663.39	659.89
CKR.46A	75.89	2+312.77	663.63	663.66	661.66	663.94	663.94	663.44	659.94
CKR.47A	44.39	2+357.16	663.43	663.48	661.32	663.97	663.97	663.47	659.97
CKR.48A	52.15	2+409.31	663.86	663.39	661.30	664.00	664.00	663.50	660.00
CKR.49A	51.13	2+460.44	663.83	664.11	661.65	664.04	664.04	663.54	660.04
CKR.50A	48.28	2+508.72	663.71	663.40	661.62	664.07	664.07	663.57	660.07
CKR.51A	49.62	2+558.34	664.46	663.83	661.64	664.10	664.10	663.60	660.10
CKR.52A	47.52	2+605.86	663.64	663.79	661.35	664.14	664.14	663.64	660.14
CKR.53A	48.22	2+654.08	663.81	663.66	661.19	664.17	664.17	663.67	660.17
CKR.54A	51.06	2+705.14	663.88	663.90	661.63	664.20	664.20	663.70	660.20
CKR.55A	53.68	2+758.82	664.07	664.14	661.86	664.24	664.24	663.74	660.24
CKR.56A	48.26	2+807.08	664.35	664.74	661.65	664.27	664.27	663.77	660.27
CKR.57A	52.78	2+859.85	664.17	664.44	661.93	664.30	664.30	663.80	660.30
CKR.58A	24.48	2+884.33	664.41	664.70	661.82	664.32	664.32	663.82	660.32
CKR.59A	31.38	2+915.71	664.11	664.31	662.09	664.34	664.34	663.84	660.34
CKR.60A	49.70	2+965.41	664.26	664.34	662.18	664.37	664.37	663.87	660.37
CKR.61A	50.39	3+015.80	664.21	664.36	662.15	664.41	664.41	663.91	660.41

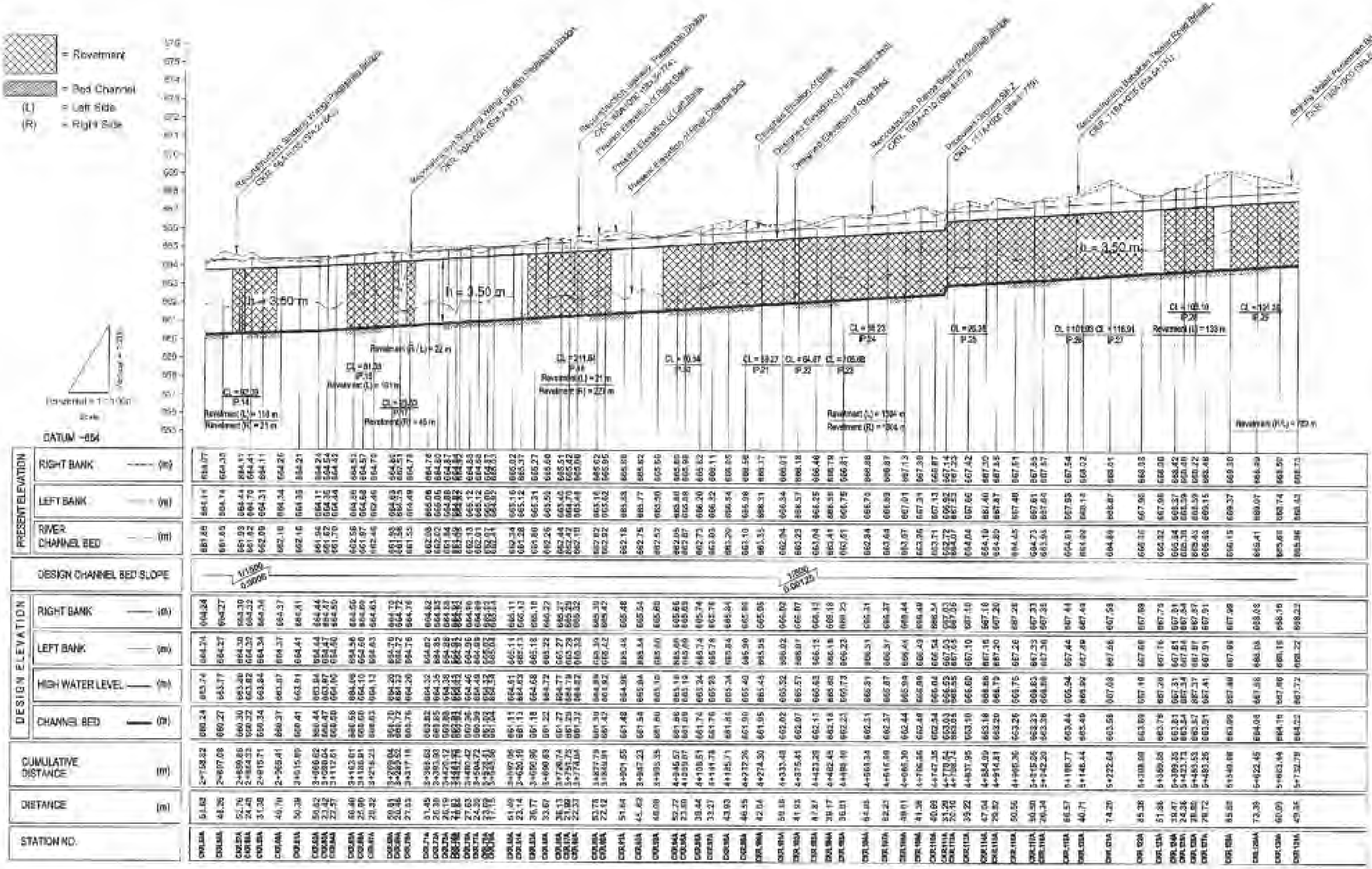
DESIGN CHANNEL BED SLOPE: 1/7500 (0.00013) from CKR.1 to CKR.8A; 1/2800 (0.00036) from CKR.8A to CKR.29A; 1/1500 (0.0006) from CKR.29A to CKR.61A

Cikeruh Downstream (L=2.50km) ← → Cikeruh Upstream (L=5.15km)

SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIKERUH RIVER (1/3)

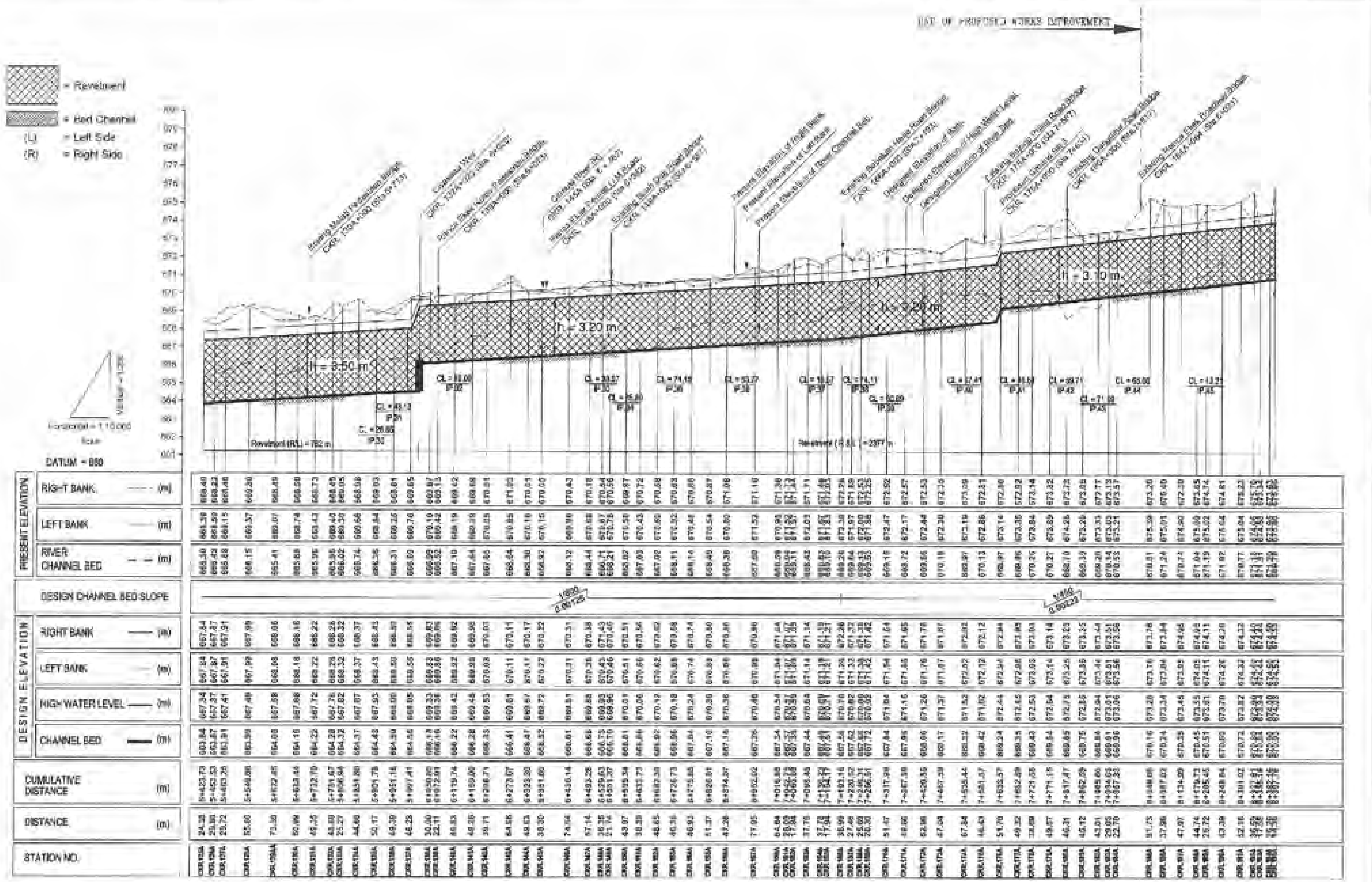
DRAWING NO.
P00-050PF001



SCALE V 1 : 200
SCALE H 1 : 10000

LONGITUDINAL PROFILE OF CIKERUH RIVER (2/3)

DRAWING NO.
P09-05OPF002

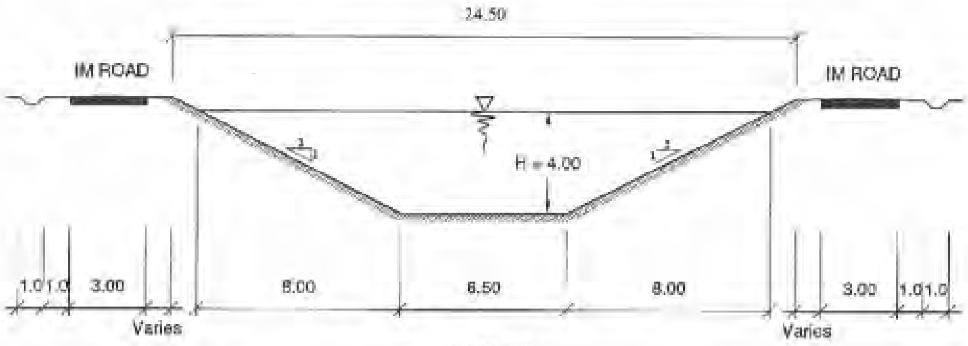


SCALE V 1 : 200

SCALE H 1 : 10000

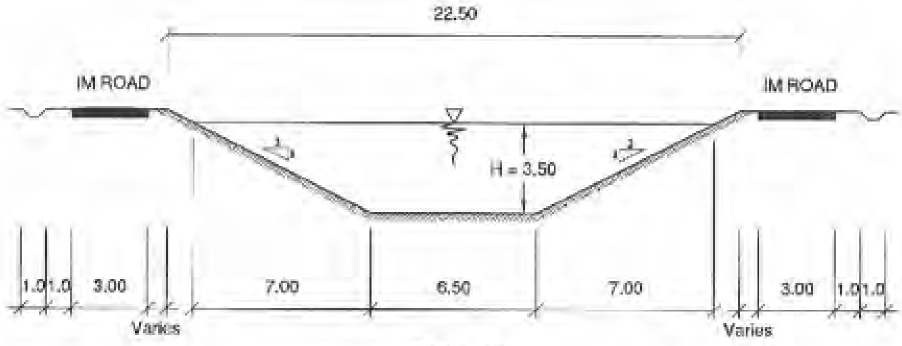
LONGITUDINAL PROFILE OF CIKERUH RIVER (3/3)

POD-CSDPF003



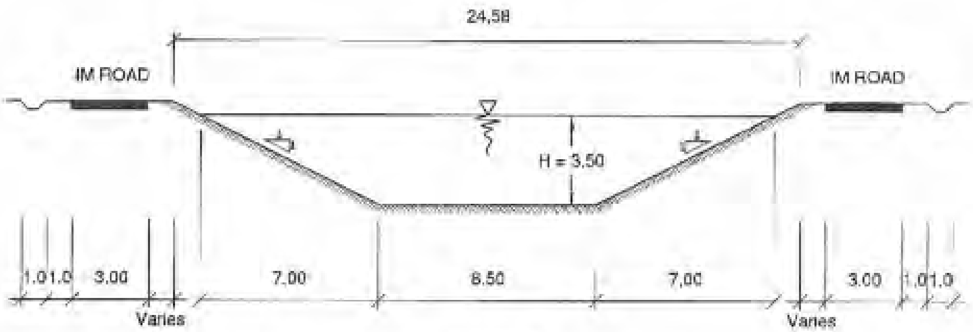
TYPE I

FROM : KK.0 - KK.10
STA. 0 + 000 - STA. 0 + 367



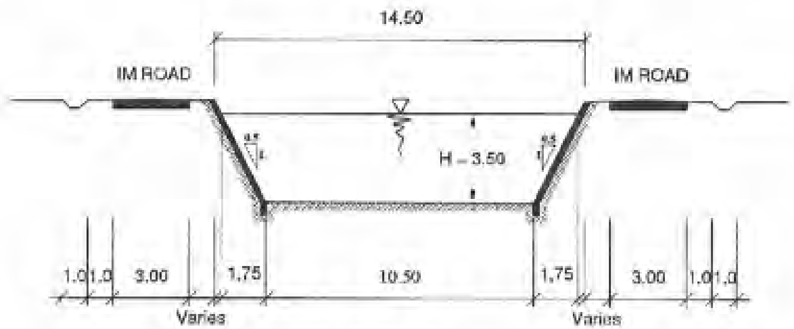
TYPE III

FROM : KK.52 - KK.83
STA.2 + 389 - STA.3 + 839



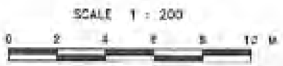
TYPE II

FROM : KK.10 - KK.52
STA. 0 + 367 - STA.2 + 389



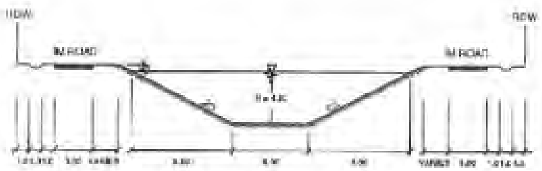
TYPE IV

FROM : KK.84 - KK.159
STA.3 + 839 - STA.7 + 734

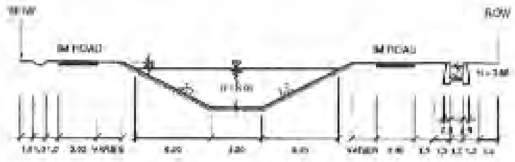


STANDARD CROSS SECTION OF CITARUM UPSTREAM RIVER

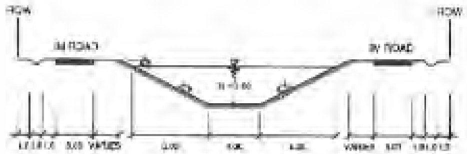
DRAWING NO.
P00-01055001



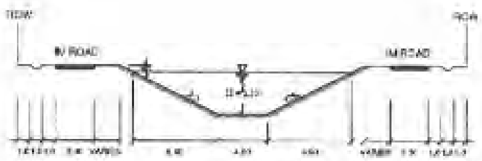
TYPE I
FROM : D.1 - D.23a
STA. 0 + 035 - STA.1+190



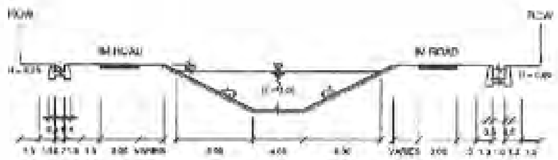
TYPE III
FROM : D.129 - D.138a
STA. 6 + 668 - STA. 7 + 153



TYPE V
FROM : D.127a - D.190
STA. 6 + 589 - STA. 9 + 537



TYPE II
FROM : D.27 - D.127
STA. 1 + 270 - STA. 6 + 522

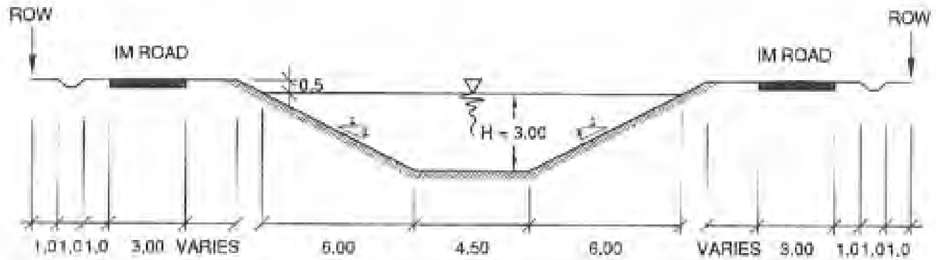


TYPE IV
FROM : D.1.38a - D.156
STA. 7+153 - STA. 7 + 988

SCALE 1 : 400

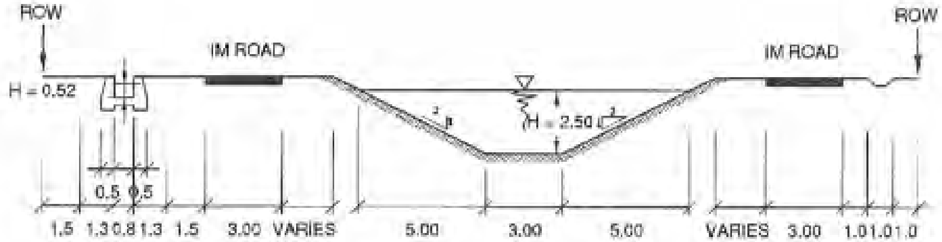
STANDARD CROSS SECTION OF CIMANDE RIVER

DRAWING NO.
P00-03OSS001



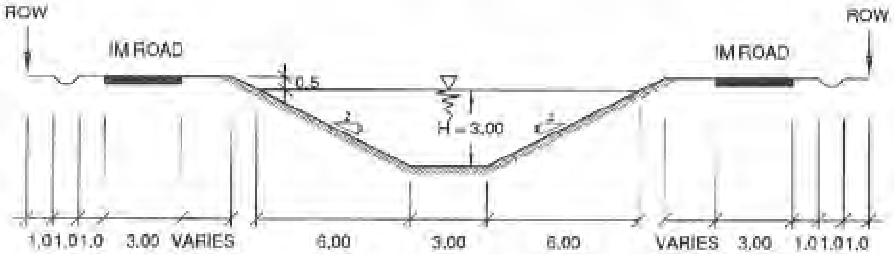
TYPE I

CKJ.1 - CKJ.28
STA.0+0.00 - STA.1+516



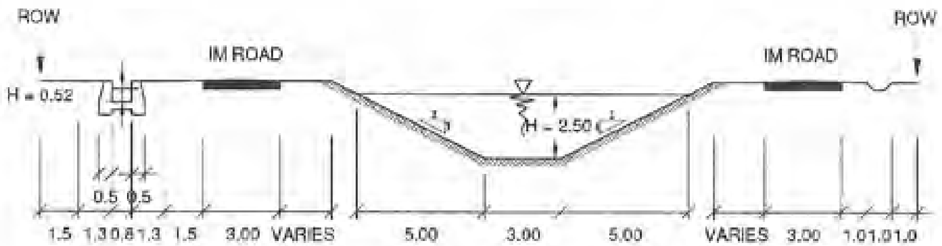
TYPE III

CKJ.85 - CKJ.106
STA.4+872 - STA.5+898



TYPE II

CKJ.28 - CKJ.56a
STA.1+516 - STA.3+131



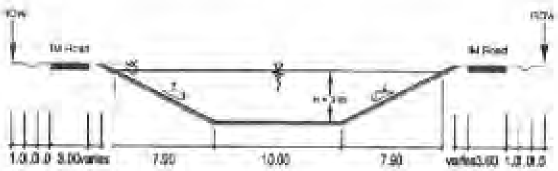
TYPE IV

CKJ.56a - CKJ.124
STA.3+131 - STA.6+879

STANDARD CROSS SECTION OF CIKIJING RIVER

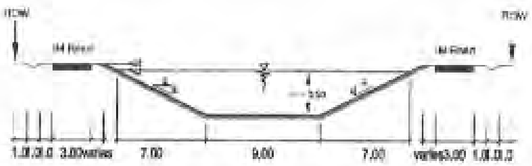
DRAWING NO.
PDO-CACSS001

STANDARD CROSS SECTION OF CIKERUH RIVER



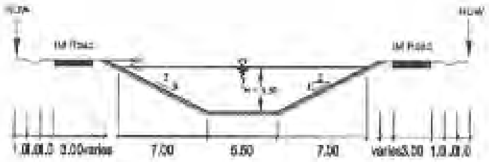
TYPE I

FROM : CKR.9A - CKR.28A
STA.0+375 - STA.1+315



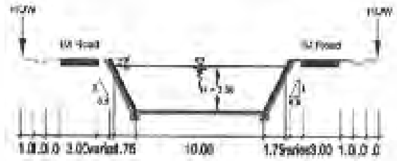
TYPE II

FROM : CKR.28A - CKR.60A
STA.1+315 - STA. 3 + 016



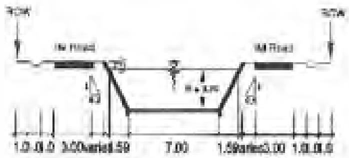
TYPE III

FROM : CKR. 60A - CKR. 94A
STA. 3 + 016 - STA. 4 + 046
FROM : CKR. 121A - CKR. 128A
STA. 5 + 223 - STA. 5 + 549



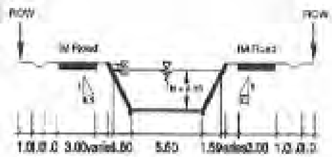
TYPE IV

FROM : CKR. 94A - CKR. 121A
STA. 4 + 046 - STA. 5 + 223
FROM : CKR. 128A - CKR. 137A
STA. 5 + 549 - STA. 5 + 997



TYPE V

FROM : CKR. 137A - CKR. 176A
STA. 5 + 997 - STA. 7 + 634



TYPE VI

FROM : CKR. 176A - CKR. 195A
STA. 7 + 634 - STA. 8 + 396

SCALE 1 : 400

DRAWING NO.
F00-03055001