ANNEX – 9

MONITORING AND INFORMATION SYSTEM

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1 Monitoring System

1.1 Present Condition of Monitoring System

The meteorological, hydrological and water quality data of the Brantas river basin are monitored by automatic or manual operation for the purposes of weather forecast, flood control, low flow management and pollution control. Present condition of the monitoring system in the Brantas river basin is described as follows.

1.1.1 Flood Forecasting and Warning System (FFWS)

The flood forecasting and warning system (FFWS) works for flood control and flood prevention in the Brantas river basin, by monitoring meteorological and hydrological data in the Brantas river basin such as rainfalls, water levels and discharges of rivers and reservoirs in real time, and if necessary, by forecasting the flood and informing it to related agencies for their quick action against the coming flood, under the management of Jasa Tirta Public Corporation (PJT).

FFWS of the Brantas river basin was installed at the end of 1990 and started operation from the beginning of 1991. Two rainfall gauging stations (Tugu, Kampak) and a water level and outflow gauging station (Gunungsari dam) were installed in 1994 additionally.

(1) System Features

FFWS consists of the following sub-systems:

- Telemetering system
- Flood analysis system
- Communication system

The features of these sub-systems are presented below.

(a) Telemetering System

The telemetering system is a centralized data management system consisting of observation facilities, relay stations for data transfer and supervisory/control /monitoring stations. In this system, the meteorological and hydrological data from the entire Brantas River basin are gathered by automatic and manual operation to the central observation station in real time. The gathered data are used for flood forecasting and other analysis for runoff and river flow characteristics of the basin.

Observation Facilities

The observation facilities and observed data are as follows:

	(Number of stations)
Stations for rainfall gauging	20
Stations for water level gauging	9
Stations for rainfall and water level gauging	2
Stations for water level and outflow (dam) gauging	6
Stations for rainfall, water level and outflow (dam) gauging	4
total	41 stations

	(Number of data)
Rainfall data	26
Water level data	21
Outflow data (dam)	10
total	57 data

Location of these gauging stations is shown in Figure III.6.1 and the list of stations in Table A9-1.

Thirteen rainfall gauging stations are located in the upstream area of Lodoyo dam, 3 stations in the Ngrowo river basin, and 10 stations in the middle and lower basin of the Brantas river basin.

The water level gauging stations are located at the major flow control facilities, reference points of the Brantas River and major tributaries.

As for the water level and outflow gauging station, outflow of the dam or weir is calculated based on the observed water level. The calculated outflow is input by manual operation and transmitted to supervisory/control /monitoring stations. The transmitted discharge is a total of outflow for power generation, irrigation and release from spillway. At Mrican barrage and Gunungsari dam, outflow for irrigation is not included in the total outflow to be transmitted.

Supervisory/Control/Monitoring Station

The stations are as follows:

- Master Station at Malang
- Sub-master stations at Kediri and Tulungagung
- Monitoring stations at Sengguruh Dam and Wlingi Dam

At these stations, the telemetering system is used for data collection, processing or management. The functions of these stations are shown in Table A9-2.

The telemetering radio network is shown in Figure A9-1, and the data flow diagram of the telemetering system is shown in Figure A9-2. The telemetering data are

printed out at each supervisory/control /monitoring station. The all data are stored and managed finally in Malang Master Station as follows:

1) Processing Telemetering Data

The hydrological values (cumulative rainfall, inflow discharge into reservoir, storage volume of reservoir, etc.) are calculated using the telemetering data by the Telemetering Supervisory/Control Equipment.

2) Temporary Data Storage

The processed data of the recent 3 days are stored in the Data Storage Equipment temporarily. The data temporarily stored are used for monitoring hydrological condition of the Brantas river basin on CRT display and paper printed out. The data are also used for various analysis and studies on the hydrology and hydraulics of the river basin, and if necessary, for forecasting flood by the Analysis System (PC).

3) Permanent Data Safekeeping

The processed data is permanently saved in the floppy disk through the Auxiliary Memory Equipment.

(b) Flood Analysis System

The flood analysis system is located in Malang Master Station. The system consists of computer system for analyzing hydraulic characteristics of the Brantas River basin and personal computer for flood forecasting.

The flood forecasting is performed through two procedures, i.e., runoff calculation by storage function method using the rainfall data transmitted by telemetering system during past 48 hours, and adjustment of calculated runoff based on the present observation records such as water level, inflow, outflow and channel discharge.

The points and items of forecasting correspond almost to those of flood warning as listed below.

River water level
Gadang
Tawangrejeni
Jeli
Kediri
Kertosono
Lengkong Widas
Ploso
Porong
Bendo

Reservoir	Inflow	Outflow	Water level
Sengguruh Dam	O	O	O
Sutami Dam	O	O	O
Lahor Dam	O	O	O
Wlingi Dam	O	O	O
Lodoyo Dam	O	O	O
Mrican Barrage	O	O	O
Selorejo Dam	O	O	O
Bening Dam	O	O	O
New Lengkong Dam	O	O	O
Tulungagung Inlet Gate	O	-	-

Flood forecasting is made three hours ahead considering the time necessary for forecasting analysis, evaluation of the results, judgement of actions to be taken, transmission of warning, and dispatch of flood-fighting party.

The flood analysis system has not been applied yet to the actual flood events since its establishment.

(c) Communication System

An independent communication system for FFWS has been established to transmit instructions for operation of flood control facilities, to obtain further information for confirmation of telemetering data, and to control data transmission system by telemetering.

The communication network consists of Malang Master Station, Pujon relay station and following sub-stations (Figure A9-3):

- Sengguruh Dam
- Sutami Dam
- Wlingi Dam
- Lodoyo Weir
- Tulungagung (PKB office)
- Selorejo Dam
- Kediri (PKB office)
- Bening Dam
- New Lengkong Weir
- Gunungsari Weir
- Porong (Irrigation office)
- Mrican Weir

(2) Operation Rule

Flow chart of flood control is shown in Figure A9-4. FFWS has been operated according to the flow chart since November 1996, though the flood protection activities have been made in the similar manner even before.

Figure A9-5 shows standard procedures for collecting telemetering data and examination of telemetering system. The examination of the system is carried out every morning at Malang Master Station. If any trouble is found in the automatic system, it is replaced by manual operation or data collection direct from the site.

Flow chart of operation standards of FFWS is shown in Figure A9-6. The FFWS has warning points (Table A9-3 and Figure A9-7) of which warning levels are indicated automatically by a combination of a lump and a buzzer in the Malang Master Station and sub-master stations. The FFWS is kept a watcher on during 24 hours. Upon receiving automatic warning information of FFWS, conditions of discharge and gate operation are checked at dam and weir sites. If the gate is allowed to be opened and the water level can be

lowered below the specified level for warning, the warning at the site would be canceled. After checking the automatic warning information, Warning is announced by PJT.

In some case, warning is also announced based on the direct information from the site not from FFWS.

The flood warning is transmitted by the communication system of FFWS and telephone line. Detailed information from the site and indication from the agencies concerned are also transmitted by the same media.

(3) Operation Records

Operation records of FFWS were not kept from the beginning of its operation until November 1996. Operation of FFWS during emergency such as announcement of warning, flood control measures taken, troubles of data transmission, etc. has been recorded since November 1996.

(4) Operation and Management

(a) Organization and Institution

Computer and FFWS Unit of Bureau of Program and Control, PJT is in charge of operation of FFWS and management and maintenance of equipment in Malang Master Station. Organizational setup of the Computer and FFWS Unit is shown in Figure A9-8. The unit consists of 14 persons. Major function of the unit is as follows:

Chief of Unit

- Responsible for the development of new system and software
- Responsible for the operation and maintenance of FFWS and telecommunication equipment
- Responsible for computer operation for data processing in PJT Malang office

Staff of Operation and Maintenance of FFWS and Telecommunication Equipment

- Maintenance of FFWS and telecommunication equipment
- Operation of FFWS and telecommunication equipment
- Preparation of report for maintenance operation
- Arrangement of spare parts for FFWS and telecommunication equipment

Expert of Hydrology

- Development of software for data processing including hydrological data and GIS data
- Check of flood forecasting and calibration of the parameters in simulation model

- Calibration and adjustment of gauging equipment for FFWS with the staff of maintenance of FFWS

Expert of Water Quality

- Analysis of the data of water quality
- Development of software about water quality and others
- Forecasting of water quality
- Preparation of monthly report about water quality

Expert of Computer

- Development and improvement of software
- Arrangement for operation of computers
- Coordinating and processing data to use for any job with other staff in each job
- Preparation of monthly report

Sub-divisions of two Water Services Divisions of PJT operate and manage FFWS equipment and appurtenant facilities at supervisory/control/monitoring stations, dam and weir office(Table A9-4). Besides, each unmanned observation station is kept by the nearby resident with payment.

Observation equipment for FFWS is inspected by the staff of Operation and Maintenance of FFWS and Telecommunication Equipment. Equipment is inspected periodically once in three months. During the inspection, they replace the recording paper and other consumables, examine observation equipment, appurtenant facilities and surrounding conditions of the observation station, and report the results to PJT. Telemetering transmission by FFWS is tested every day at Malang Master Station.

Director of PJT gives priority of repair and improvement, considering the importance of equipment and easiness of repair. Simple repair and adjustment such as replacement of spare parts and calibration of equipment are carried out by themselves. Difficult repair of the equipment is ordered to the dealers concerned. Sub-divisions of two Water Services Divisions of PJT takes charge of damages of the appurtenant facilities surrounding the observation facilities of the station.

In 1997, the inspection of entire system is being executed by JRC under the yearly maintenance contract and the contract will be extended to the next year.

Organization in charge of the OM activities of FFWS is summarized below.

Station		Master Station	Sub-Master Stations and Dam/Weir office (including Monitoring Stations)	Rainfall, Water Level and Relay Stations
Operation		Unit	ASA I/II	Automatic
Maintenance	Inspection	Unit		
	Simple Repair and Adjustment	Unit		
	Difficult Repair	Commission to the makers		
	For Appurtenant Facilities	ASA I/II		

Where, Unit: Unit of computer and FFWS
ASA I/II: Sub-divisions of two Water Services Divisions

(b) Operation and Maintenance Cost

The operation and maintenance (OM) cost of FFWS includes personnel expenses, equipment cost, traveling expenses for maintenance, electric charge, and expenses for repair and changing spare parts. Annual OM costs after the establishment of FFWS are summarized as follows:

Year	Cost (million rupiah)				
	Personal expenses	Repair cost	Equipment cost	Others	Total
1991	44.8	0.0	0.3	54.4	100
1992	59.1	0.0	0.3	54.1	114
1993	82.3	6.3	0.3	61.6	151
1994	90.3	0.0	0.4	65.8	157
1995	96.3	21.3	0.4	66.2	184
1996	109.7	51.6	7.9	68.6	238

The OM cost increases year by year mainly due to the increase of personnel expenses and repair cost. Equipment and spare parts stocked at the time of installation were supplied until 1995, after that they are bought every year.

(5) Expansion Plan of FFWS

The Wonorejo Multipurpose Dam Project (the Wonorejo project), that is being executed by PKB and major purpose of which is to supply raw water to Surabaya city and its vicinity for municipal and industrial uses through the Brantas River, includes design and construction for the expansion plan of FFWS.

The expansion plan aims to establish the telecommunication system for low flow management in the Brantas river basin using FFWS, as well as to expand the function of FFWS incorporating the new facilities to be constructed for the project.

According to the Wonorejo project, principal objectives of the establishment of low flow management system are (1) effective utilization of available water resources, (2) accurate control of river water, and (3) conservation of river environment.

In order to attain these objectives, the following basic concepts are introduced:

- Existing facilities of FFWS should be utilized effectively.
- The downstream reaches from the Sutami dam and Surabaya River should be incorporated in the objective river reaches. A large water demand exists in the river reaches of the Brantas and Surabaya rivers for domestic and industrial uses. All of this demand in the dry season is obliged to be supplied by Sutami and the new Wonorejo reservoirs, since there is no excess water to supply from other rivers and reservoirs to the main Brantas river additionally.
- All the information on the water distribution system in the Ngrowo River shown in Figure A9-9 should be transmitted to the Malang Master Station of FFWS to support the effective operation.
- The discharge at major irrigation intakes along the mainstream of Brantas river should be measured precisely and monitored, because the irrigation water of the Brantas river shares about 75% of whole water available in dry season.
- Water quality sensors should be installed in the Surabaya River at telemetering water quality monitoring station by means of on-line real-time observation, for the purpose of detecting unexpected chemical pollution.

Under these concepts, flow control facilities and the conditions necessary to observe were proposed as shown in Table A9-5. Additional data will be collected and monitored at the following stations:

- Data in Wonorejo area: Tulungagung sub-master station, Wonorejo Dam monitoring station (only monitoring)
- Data in Brantas middle/lower reaches: Kediri sub-master station
- Data in Lodagung irrigation intakes: Malang Master Station
- Water quality data: Malang Master Station

Additional observation stations are shown in Figure A9-1. Network of communication radio links are extended to the new gauging stations as shown in Figure A9-3.

(6) Problem of Existing FFWS

(a) Problem of Observation in Gauging Station

According to the result of interview with the staff of FFWS and field reconnaissance to gauging stations, problems of observation stations are presented in Table A9-6. Major problems and remarks are as follows:

Water level:

Some water level gauges are not functioning by sediment deposit especially in dry season.

In dry season of 1997, water levels in some gauging stations were lower than the bottom of water level gauge.

Outflow:

Outflow discharges are calculated and input on the setting panel of Data Transmitting Equipment by manual operation. The data input on the panel are automatically transmitted to supervisory/control/monitoring stations hourly. If the new data are late to be input on the panel, the old data input before one hour are transmitted (as shown in Table A9-7). Sometimes it takes time due to recalculation. Furthermore, the outflow of the reservoir for power generation is calculated based on the hourly power output data from PLN. This would take more time for calculation before input. Due to these reasons, the data input can not be made in proper time and accordingly old data are transmitted to supervisory/control/monitoring stations.

The water level by manual measurement is used for discharge calculation at Selorejo dam, because the pressure type automatic water level gauge dose not work well due to the mechanical trouble or influence by the sedimentation. The water level measurement is not always conducted hourly, but discharge calculation is conducted hourly by using water level not measured hourly.

(b) Problem of Processing of Telemetering Data

The inflow to reservoir is calculated based on the telemetering data by the Data Processing Equipment in Malang Master Station using H-V curves. The curves require to be revised based on the latest conditions of reservoirs. However, it is practically difficult to change the curve, because the curves are memorized in the ROM of the Data Processing Equipment, and it is difficult to replace the ROM.

The inflow to reservoir is also calculated at each dam office using H-V curve by manual operation. It took long time to prepare the H-V curves from the result of survey every other year.

(c) Problem of Telemetering Data Management

The processed data are permanently saved in floppy disk. But the saved data in floppy disk can not be used directly by other computers, and the data can not be converted to use in other computers by the existing equipment. At present, a part of the data kept in the Data Storage Equipment are converted to use in other computers through the WANG (PC) for flood forecasting, and the converted data are used for analysis and studies.

Two kinds of outflow data are kept in Malang Master Station at present. One is the data calculated at each outflow station for telemetering, and the other is telemetering data transmitted. These data are not compared each other. Even if there is a

transmission mistake, the telemetering data are not corrected. This will lead to confusion in using the data.

(d) Problems of Flood Analysis System

Storage function model to be used for runoff analysis includes the constants, which represent land use and other physical features of the basin. The calculated runoff varies corresponding to the change of these constants. The H-V curve (relationship between reservoir water level and volume) of the reservoir, which changes due to sedimentation, is also a factor of the model.

These constants and curve incorporated in the model must be the latest. The existing runoff model of the Brantas river basin is not updated as presented below.

- Verification of the basin constants is not made yet based on the actual past flood events. Flood forecasting is made using recent 3 day telemetering data of Data Storage Equipment of FFWS. This procedure does not allow runoff analysis of the past floods.
- Changes in H-V curve due to reservoir sedimentation are not incorporated in the model, since the staff for FFWS can not modify the computer programs.
- The flood forecasting model was prepared in 1990, and it does not incorporate additional rain gauging stations established in 1994.

(e) Problem of Communication System

Communication system for FFWS is interfered getting crossed with other wireless stations of similar frequency band.

(f) Problems of Operation

Flood forecasting has never been done since FFWS started operation in 1991 under existing operation rule. Inexperience of actual operation may cause inappropriate handling during the flood in future.

(g) Problems of Organization and Institution

At the outflow observation station, outflow is calculated by the staff working at the dam and weir sites. There are not many staffs who know the method of calculation in detail at each site. This situation may cause calculation mistake of outflow.

1.1.2 Low Water Management System

(1) Present Condition

Low water management is executed based on "POLA OPERASI WADUK-WADUK" (POLA, operation pattern of reservoir) decided by Provincial Water Management Committee (PWMC) consisting of water supplier and water user. PWMC has been established to have an integrated action of related agencies, in order to provide water management which could

serve an optimum benefit for the society in all life sectors, in relation to water resources management in river basins of East Java.

In case that shortage of water is observed at a monitoring point, adjustment of water allocation will be performed effectively in accordance with POLA (shown in Figure A9-10). In case of extreme shortage of water, the PWMC will reconsider the water allocation.

At present, information of low flow discharges at the monitoring points is collected by the PJT by use of telephone line or FFWS(shown in Table A9-8 and Figure A9-12).

In addition, the Wonorejo Multipurpose Dam Project proposes expansion plan of FFWS for Low Water Management System. By means of these systems, the amount of the major intake water will be monitored (refer to section **1.1.1 (5)**).

(2) Problems of Low Water Management System

The Brantas river basin had experienced the drought in 1982, 1987, 1994 and 1997.

During the drought seasons, the committee discussed and adjusted the water allocation against the drought in 1982, 1994 and 1997 (refer to Annex 5.Water Balance Study, The activities against the drought by the committee was not clear in 1987).

The committee took respective measures against each drought under discussions based on each drought conditions. Because there are not the standards for adjustment of water allocation against drought.

In view of the situation above-mentioned, it is recommendable that clear standards on water allocation against drought be established and the committee get the information on discharge of river and water volume in reservoir habitually so that the committee could take a proper and prompt action against the drought.

1.1.3 Water Quality Monitoring System

(1) Present Condition

At present, water quality monitoring is carried out by manual sampling and testing at several agencies including PJT.

PJT informs the results of the test to the several authorities concerned every month.

Automatic water quality monitoring stations are proposed to be installed by the Wonorejo project as parts of establishment of Low Water Management System.

The locations are as follows:

- Karangpilang (Surabaya River)
- Pelayaran (Surabaya River)

(2) Problems of Water Quality Monitoring System

There is duplication among the monitoring activities by several agencies including PJT.

1.2 Improvement Plan of the Monitoring System

1.2.1 Improvement of FFWS

The existing FFWS has various problems about hydrological observation, telemetering data processing and data management. Improvement plan against each problem is studied and proposed hereunder.

(1) Improvement of System Facilities

(a) Water Level Gauge

Some water level gauges in the river do not function well in dry season under influence of sedimentation and river bed erosion.

Improvement of these water level gauging stations are proposed as shown in Table A9-9, based on the following basic criteria for their location.

- Stream is steady.
- River course and river bed variation are not so much.
- It is not dangerous at maintenance of gauging facilities
- There is a stream to gauge water level in dry season.
- It is easy to observe river discharge.

(b) Manual Operation for Outflow data

In the existing FFWS system, hourly outflow data of dam and weir are sent from each dam and weir office to Master Station (M/S of FFWS) in PJT, Malang by telemetering system, through operator's manual operation in each office.

Problem is that some telemetering outflow data are not accurate. Cause of the problem is delay of manual typing into terminal of FFWS (called Setting Panel) against automatic data polling by telemetering system.

To reduce the above manual operation's problem, improvement plan is proposed from two points of view; deepening operator's awareness and supporting the discharge calculation.

The improvement plan for deepening operator's awareness is explained in the next section (2) (a).

<u>Preparation of equipment for supporting calculation</u>

Purpose of this preparation is rapid discharge calculation.

A personal computer (PC) will be set up at the dam and barrage office and software for discharge calculation will be installed.

The software, which has formula and coefficient required for discharge calculation, can make the manual operation short. Operator inputs only data such as reservoir water level, gate opening and power output, and types the result into the Setting Panel. The software shall be updated as required.

The data, input for discharge calculation in PC, will be stored in the PC and be able to use effectively for other water management activities.

(c) H-V Curves in FFWS

Reservoir water level – storage curve (H-V curve) changes due to sedimentation year by year. However, H-V curves installed in FFWS have not been revised from the start of operation in 1991. Therefore, the accurate values of inflow and storage of reservoir can not be known by FFWS.

To solve this problem, PJT is taking an action to replace the ROM to new one which the latest H-V curves are built in.

Replacing of the ROM takes much time and requires the cost. Therefore, it is difficult for FFWS to change the H-V curves in the reservoirs timely.

In this situation, it is required that H-V curves can be changed easily without changing of the ROM. For this requirement, FFWS should be modified to be able to change H-V curve by input on keyboard.

(d) Effective Use of Telemetering Data

In the existing FFWS, there are two kinds of storage types for hydrological data, one is in the Data Storage Equipment of the FFWS, and other is in the floppy disks.

The data in the Data Storage Equipment are used for grasping present hydrological condition of the Brantas river basin on CRT displays, and the data are used for flood forecasting. For that purpose, the equipment can store 3 days' data required.

For verification of flood forecasting program, the past flood data stored in other equipment are needed. However, the personal computer, which is set up for flood forecasting, can not use the data from the floppy disk through the floppy disk drive of FFWS.

Furthermore, the data in floppy disks are recorded by special format for FFWS. For that reason, it is difficult to use the data for verification of flood forecasting program in another PC. This means that the data in floppy disks can not be used for other analysis for water resources management.

The above problems are caused by capacity of memory of FFWS and a limited use of the stored data. To solve this problem, conceivable countermeasures are as follows:

- To establish the database system with large storage capacity for hydrological data from FFWS. For this purpose, modification of FFWS is required to adapt the new database system.
- Analysis system for flood forecasting of FFWS should be modified to use the past hydrological data from the new database system.

The hydrological database system should include other hydrological data (not FFWS) for effective use.

(2) **Improvement of Ability of FFWS's Staff**

(a) On the Job Training for Deepening Operator's Awareness about FFWS

Operators, who work for FFWS operation at each site, are to be educated about necessity and importance of FFWS through on-the-job training at Master Station (M/S) of FFWS in PJT Malang office.

At the same time, the staff of M/S of FFWS is to be sent to the site to know well the actual condition of the operation.

Training will require about 2 to 4 weeks in dry season.

(b) Basic Training of Flood Forecasting

Flood forecasting model is required to be updated as occasion demands. However, staff of M/S of FFWS can not modify and update the flood forecasting model due to lack of the knowledge of hydrology and programming.

To deepen their understanding of flood forecasting and the model, training of staff is required regarding the following matters.

- Learning of a knowledge of flood forecasting
- Learning of a fundamental knowledge of programming

(c) Trial Operation of FFWS

Flood control should be done effectively by suitable and accurate operation. For such effective operation, experience is also important. However, the staff for flood control operation do not have enough experience of the action based on flood forecasting by FFWS, because of no big flood since commencement of FFWS operation.

In this situation, a trial operation for flood control based on FFWS operation should be done in the following matters;

Subject persons:

All staff of PJT concerned in flood control operation including

- Unit of Computer and FFWS
- FFWS operators at each dam and weir site (Sub division of ASA I/II)
- Flood control facilities' operators at each dam and weir site (Sub division of ASA I/II)

Frequency:

Once a year (Before rainy season).

Purpose of trial operation is a preliminary drill of the all staffs' action for flood control on the assumption that a flood will come. The matters to be trained are as follows.

- Action to know the present condition
  - Report the condition to M/S of FFWS from the staffs of sites.
  - Hydrological data collection by FFWS at M/S of FFWS.
- Evaluation of present condition and flood forecasting
  - Evaluation of collected data and information
  - Flood forecasting.
  - Determination of flood scale based on above evaluation and forecast.
- Action against coming flood
  - Instructions from M/S of FFWS to the operators at the sites for flood control.
  - Continuous observation at the sites and M/S of FFWS.

1.2.2 Information System for Low Water Management

Regarding the low water management, it is recommendable that the information monitored and managed by PJT shall be given to all the members concerned, for deep understanding about the present condition of reservoirs and rivers.

Contents of this system are as follows.

Information user:

- The all agencies concerned with water use and supply.

Information:

- Present reservoir water level and storage volume.
- Present amount of water supply from dam and major intake.
- Other hydrological data observed by PJT (discharge, rainfall, etc.)

The information flow:

- The hydrological data managed by PJT are collected by end users.
- The data are processed to visual information using a software in the terminal computer at each agency's office.

This system is included in the Inter-agency Information System studied in the next section.

1.2.3 Establishment of Water Quality Database System

At present, water quality monitoring is carried out by several agencies including PJT. There is duplication among these monitoring activities.

To avoid this duplication and to manage the water quality monitoring efficiently, the intensive monitoring under supervision by one agency is required. Based on this consideration, it is recommended that the water quality monitoring should be supervised by PJT and the monitored data should be managed by PJT.

Furthermore, the Study team has recommended to establish a laboratory in Malang.

The above situations mean that water quality data and data user will increase. Accordingly, management of water quality data by PJT will become more important.

To manage the monitoring data of the water quality efficiently and to keep water quality data as a common property with related agencies, establishment of water quality database system connected to the Internet are required.

This system is included in the Inter-agency Information System studied in the next section.

2 Establishment of Inter-agency Information System

2.1 Background

The Study team proposes to reorganize the water resources management system. Proposed management system will be required to be operated through cooperation of all the agencies concerned.

At present, many agencies carry out various management activities related to the water resources management, and the agencies keep the information about their management. Agencies concerned and their information are summarized in Table A9-10.

The following issues are found in relation to utilization of information on water resource management.

- It is not clear what kind of and where the information related to water resources exists among the agencies concerned.
- Information is not put in order for easy use, and accordingly special attention is needed for using the information to avoid the mis-use of the information.
- The activities of a agency are not clear for the other agencies. Accordingly the information of the other agencies is not clear among the agencies.
- There are some differences of data arrangement among the related agencies, and accordingly it causes the ineffective use of data and information among the agencies.

- Similar study or investigation under different agencies have been conducted.

In consideration of the above situation, the unified management of data and information will be essential for the water resources management in cooperation with the agencies concerned. Therefore, it is required to establish the information management (exchange) system linking all the agencies concerned with water resources management (= Inter-agency Information System).

2.2 Basic Principle of Inter-agency Information System

In the above situation, the Inter-agency Information system is required for water resources management in the Brantas river basin by New PJT (or PERSERO Jasa Tirta) in cooperation with agencies concerned.

Basic principles of Inter-agency Information System are as follows:

- New PJT (or PERSERO Jasa Tirta) should be able to grasp the situation of management and information related to the management by all agencies concerned with the water resources management in Brantas river basin.
- The agencies concerned should be able to get necessary information quickly through New PJT for their activities for water resources management.

2.3 Outline of Inter-agency Information System

(1) Agencies and Information Flow of Inter-agency Information System

(a) Members

Conceivable members of this system are the agencies,

which are related to water resources management in the Brantas river basin,
which are implementation agencies for water resources management and,
which are the source and user of information for water resources management,

and information user as water user like agricultural cooperative associations.

The members of BWMC and other agencies and organization to meet the above conditions are selected as the members of Inter-agency Information System. Member of this system are listed below.

Sector	Watershed Management	Flood Control Management	Water Quantity Management/ Water Resources Development	Water Quality Management	River Environment Management	Others
Member	BRLKT, DPKT, Kanwil Kehutanan	PJT	Dinas Pengairan, DPRIKAN, PDAM, PT.PLN, DISTAMB, Kanwil Pertanian, DPRIND	BAPEDALDA, DPU Cipta Karya, DPERTA, DKES,		Kanwil PU, BAPEDA, Agricultural cooperative associations

(b) Information Management

Information, which are collected, managed and used by New PJT (or PERSERO Jasa Tirta) and agencies concerned, are shown in Table A9-11. The information are categorized into two kinds. One is information to be accumulated and used like the results of river survey. Another is information to be monitored in real-time like river discharge.

i) Management of information accumulated

PJT should collect and arrange the information from agencies concerned for supervising the overall water resources management in the Brantas river basin.

And, PJT should manage the information and make them utilizable as common information open to all agencies related to water resources management.

Related agencies should arrange their information to provide for the system.

Regarding the huge amount of detailed information about each agency, New PJT (or PERSERO Jasa Tirta) should manage the essence of the information and the direct manager of the information. This kind of indirect information management by New PJT (or PERSERO Jasa Tirta) should be conducted by the following reasons:

- To avoid excessive centralization of huge amount of data and information.
- Each competent agency can manage each sector's data and information from their expertise viewpoint and consequently updating data and information will be easier.

Accordingly, each agency should continue to manage the detailed information they have. In addition, each agency should make summaries of the information and bring them to PJT. The forms of summaries should be unified under discussion among related agencies beforehand.

ii) Management of information monitored in real-time

The monitoring data which are collected in real-time by PJT, should be provided to agencies concerned understanding the water situation in the Brantas river basin. At that time, visualization of the data is desirable.

Information management at each agency are shown in Table A9-12.

(c) Information Flow

Information flow of the Inter-agency Information System is shown in Figure A9-14.

(2) System facilities

In accordance with the information flow above mentioned, network for information management system should be built up.

(a) Network Structure

New PJT (or PERSERO Jasa Tirta) offices, dam/weir offices and offices of agencies as constituent of the network are scattered all over the place in Brantas river basin. The following two network measures are conceivable for the network system.

- Wide area network(WAN) using public lines such as ISDN(Integrated Service Digital Network) or analogue telephone lines.
- WAN using dedicated service lines

In Indonesia, above services are provided by PT.TELKOM. The Study Team proposes WAN using dedicated service lines with the flowing reasons:

- Heavy traffic of information is expected for large number of user and frequent use like hourly monitoring of river condition.
- The lines are always secured. In an emergency, required information can be exchanged without waiting a connection.
- It is more economical to use the dedicated service lines than ISDN on the assumption that the lines are almost used constantly.(shown in Table A9-13)

At the agencies,

- Local area network(LAN) in New PJT (or PERSERO Jasa Tirta) head office and branch office.
- Two terminal computers of WAN in each agency's office concerned and dam/weir office of New PJT (or PERSERO Jasa Tirta).
- Four terminal computers of WAN for DPKT and agricultural cooperative associations in each regency's office.

In addition, New PJT (or PERSERO Jasa Tirta) should send information to agencies of ministry concerned in DKI Jakarta using Internet.

(b) Hardware and Software

Major facilities of LAN in New PJT are proposed as follows:

- PC Server (as name server, mail server, database server, file server, firewall server)
- Terminal and peripherals (personal computer, printer, scanner, UPS(Uninterruptive Power Supply), HUB, router)
- Application software for network

Major facilities in each agency concerned, dam/weir office of New PJT (or PERSERO Jasa Tirta) and regency's office are proposed as follows:

- Personal computer as a terminal of WAN
- Peripherals (printer, UPS, HUB, router)

Quantity of facilities to be installed are proposed as shown in Table A9-14.

(3) Operation and Maintenance

Required staffs for operation and maintenance of Inter-agency Information System in New PJT (or PERSERO Jasa Torta) are proposed as follows:

- System manager (number of staff : 2)
  for overall system management and educating general staff as end user how to use the system.
- Coordinator (2)
  for coordinating with other agencies concerned.
- Computer system engineer (3)
  for technical support of the system.
- Operator (4)

System manager, computer system engineer will work at the head and branch offices of New PJT, but work for technical support of other offices.

Electrical and electronic devices like personal computer of the system will be updated to keep the function of the system once per 5 years on the assumption that life span of the devices are 5 years under the normal use.

(4) Tasks to be Conducted upon Introduction

(a) Coordination with Agencies Concerned

Coordination between New PJT and agencies concerned is required about management of Inter-agency Information System. The coordination should be done through a committee consisting of responsible unit of New PJT and representative of each agency concerned. Under this committee, policy and rule of this system management should be agreed.

(b) Training of Staff

For effective use of Inter-agency Information System, end users should be skilful in using Inter-agency Information System. Accordingly all staff should be trained for the system.

(c) Risk Management of Inter-agency Information System

Conceivable crises of Inter-agency Information System will be as follows:

- Damage by a hacker from outside of the network
- Damage by an inside intentional operation
- Damage by computer virus
- Damage by disasters and accidents

Against those crises, following measures should be prepared.

- Establishment of firewall in New PJT's LAN
- Establishment of trouble shooting system for Inter-agency Information System by system manager and the staff
- Establishment of operation rule of Inter-agency Information System
- Technical and ethics education to all staff
- Establishment of backup system
- Introduction of antiviral software

3 Cost Estimate and Implementation Program

Cost estimate and implementation programs for improvement of monitoring system and establishment of Inter-agency Information System are proposed as follows.

3.1 Cost Estimate

Project cost are estimated as follows.

(1) Improvement of FFWS

(a) Improvement of water level gauging station

Cost for shifting of water level gauging station is estimated based on construction cost for water level gauging station of other project in Indonesia.

Cost of modification of water level gauge is estimated referring the past cost estimation from the report "Water Management Report on Wonorejo Multipurpose Dam Project February 1993".

Existing telemetering equipment except water level gauge for the water level gauging station are used after the improvement. Here, coaxial cable for extension from the station house to the new water level gauge are taken into account.

(b) Installation of personal computer and software for outflow calculation

As personal computer which will be installed in dam/weir offices of PJT, a general functional one is selected. The cost of Software for outflow discharge calculation are estimated referring to a development cost in Japan.

(c) Modification of FFWS

Cost of modification of FFWS is estimated referring to the past cost estimate for maintenance and modification of Existing FFWS.

(d) Engineering services

Engineering services cost is estimated as 10% of total cost of (a)+(b)+(c).

(e) Administration cost

Administration cost is estimated as 5% of total cost of (a)+(b)+(c).

(f) Physical Contingency

Physical contingency (15% of the total cost of each item) is considered to the respective cost items.

(2) Establishment of Inter-agency Information System

(a) Equipment

Cost of the equipment of Inter-agency Information System (shown in Table A9-14) are estimated. A general functional one is selected as the wquipment.

Equipment and set up cost to get service of dedicated lines (shown in Table A9-13) are taken into account.

(b) Engineering services:

Engineering services cost is estimated as 10% of total cost (a).

(c) Administration cost :

Administration cost is estimated as 5% of total cost (a).

(d) Physical Contingency

Physical contingency (15% of the total cost of each item) is considered to the respective cost items.

Based on the above conditions, the costs are summarized as follows:

Project	Preliminary project cost (million Rp.)
Improvement of existing FFWS	938
Improvement of WL gauging stations	323
Installation of PC for outflow calculation	135
Modification of FFWS	357
Engineering services	82
Administration cost	41
Establishment of Inter-agency Information System	5,729
(including Information system for low water management, water quality database system)	
Equipment	4,982
Engineering services	498
Administration cost	249

Physical contingency is considered to the respective cost items.

Breakdown of the estimated cost are shown in Table A9-15.

3.2 Project Benefit

(1) FFWS and LWMS

One of functions of FFWS is to provide accurate information on a flood before the flood comes. By this information, following benefits are brought about.

- Effective operation of flood control facilities
- Effective flood fighting activities
- Decrease of damage to human life and household goods by taking refuge

New PJT can monitor accurate and actual water supply at intakes from the Brantas river by LWMS. Obtained information will be useful for proper water reallocation.

(2) Inter-agency Information System

The expected effects of this system are as follows:

- Time and trouble for collection, processing and utilization of information will be saved because of common information managed and digitization of basic information. Accordingly, quick implementation is expected.
- Communication expense for information exchange will be saved.
- Agencies will implement each sector's work effectively to utilize information from the result of other agencies studies.

It is difficult to show the value of the above effects as the value of money. But benefit is estimated from manpower saving through information retrieval system of the Inter-agency Information System on the following assumptions.

- Number of staff as end user : 584 (persons)

- Average personnel expenses per year :
  10.8 - 43.2(million Rp./year) in 1999 - 2020, estimated by this study)
- Decreasing time for searching information : 1 (hour/day)
- Time saved by using information retrieval system : 1 hour per capita on average
- Man power saving : 1/8 of all staffs

Estimated benefit of Inter-agency Information System about manpower saving is 36,300 million rupiah during 1999 – 2020(shown in Table A9-16). This amount of money is almost equal to project cost during 1999 – 2020.

3.3 Implementation Program

(1) Implementation Program of FFWS

(a) Implementation Schedule

Improvement of FFWS which is managed by PJT at present, should be completed before the consolidation of PKB, PGKS and PJT.

In order to improve FFWS, the following sequence of implementation is needed.

- Improvement of water level gauging stations	
Survey and detailed design	1st year
Construction	2nd – 3rd year
- Installation of personal computers for outflow calculation	
Preparation of conditions for outflow calculation	1st year
Development of the software and installation	2nd – 3rd year
- Modification of FFWS	
Investigation of existing conditions of FFWS	1st year
Modification and training	2nd – 3rd year

(b) Disbursement Schedule

Disbursement schedule of the above implementation program is shown in Figure A9-15.

In the figure, operation and maintenance cost is estimated as the replacement cost of the whole electric and electronic facilities of FFWS and personal computers. One percent of the total of the construction and equipment cost of FFWS including expanded facilities at Wonorejo dam project as the annual cost of consumables of the facilities (Table A9-17).

Here, electric facilities of FFWS will be updated once per 10 years on the assumption that life span of the equipment is 10 years. The updating will be conducted in 3 years on the assumption that the requirement of the updating will not spring up at the same time. Similarly, personal computer and automatic water quality monitoring facilities will be updated once per 5 years for their life spans.

The cost of the electric facilities of FFWS is estimated based on the cost of the existing facilities of FFWS. Cost of facilities to be supplemented for the Wonorejo Project is estimated from the functions to be added in consideration of the cost of existing facilities of FFWS.

(2) Establishment of Inter-agency Information System

(a) Implementation Schedule

Inter-agency Information System is one of the required functions of New PJT(or PERSERO Jasa Tirta) for water resources management. The operation of the system should be started after the consolidation of PKB, PGKS and PJT. The system should be established with the coordination of related agencies. And it will take a lot of time to determine the basic principles of the system. Accordingly it is recommendable that the Inter-agency Information System be established and the operation of the system be started before New PJT changes to PERSERO Jasa Tirta.

In order to establish Inter-agency Information System, the following sequence of implementation is needed.

- Coordination with agencies concerned	1st year
- Investigation of present information management and preparation of general design of the System	2nd year
- Detailed design of the system	3rd year
- Installation, test and training	4th – 6th year

(b) Disbursement Schedule

Disbursement schedule of the above implementation program is shown in Figure A9-15.

In the figure, operation and maintenance cost is estimated as the replacement cost of the hardware of this system. One percent of the cost of hardware and software cost for the system as the annual cost of consumables of the facilities (Table A9-17).

Here, hardware of this system will be updated once per 5 years on the assumption that life span of the equipment is 5 years. The updating will be conducted in 2 years on the assumption that the requirement of the updating will not spring up at the same time.

4 Action Plan

In order to prepare New PJT by consolidation of PKB, PGKS and PJT in 2002 and change of status from Perm to Persero in 2005, the following will be required to the best use of FFWS and the suitable Inter-agency Information System introduction and effective use of the system.

1999-2001

(a) Improvement of facilities and preparation of competent operation staff to make the best use of FFWS and LWMS.

(b) Preparation for establishment of Inter-agency Information System in cooperation with agencies concerned under the guidance of the specialist.

- Decision of basic policy of Inter-agency Information System.
- Analysis and evaluation of present information management.
- Design of the optimum system plan.

2002-2004

Introduction of Inter-agency Information System.

- Installation of equipment for the system and test of operation.
- Training of the system manager of New PJT and end users.

The contents of the above actions are explained below (refer to Annex 13 for training).

(1) Improvement of FFWS

(a) Improvement of Water Level Gauging Stations

1) Survey/Detailed Design for Shifting and Modifying of Water Level Gauging Stations in the 1st year

2) Construction in the 2nd – 3rd Year

The following should be considered for the improvement of water level gauging stations:

(for shifting the stations)

- Space for the gauging station
- Caretaker of the gauging station

(for lowering the lowest limit of gauging range)

- More frequent maintenance against sedimentation

(b) Introduction of equipment and software for Outflow Calculation

1) Preparation in the 1st Year

PJT should prepare the followings under the guidance of a specialist.

- Outflow calculation method and equations/tables/constants of each dam and weir
- Items that should be changed at updating
- Input items
- Required output form

2) Installation in the 2nd – 3rd Year

PJT should commission the specialist to develop the software for outflow calculation based on the above items.

And then, PJT should set up personal computers at each dam and weir office for outflow calculation.

The software should be installed in personal computers at each dam and weir office. Backup of this software should be managed by Unit of Computer and FFWS, PJT.

The specialist should give the instructions to the concerned staff of dam/weir offices and staff of Unit of Computer and FFWS about the way of operation and updating the software.

PJT should make a rule about software updating based on the change of outflow calculation method.

(c) Modification of FFWS

1) Request in the 1st Year

PJT should request a maker to modify FFWS. The maker should make a plan and implement after understanding FFWS' structure and function well.

2) Modification of FFWS and Getting Education about the Modification in the 2nd – 3rd Year

The maker should modify the FFWS. And then, The chief and staff of Unit of Computer and FFWS of PJT should get a full knowledge of the new functions and the way of operation through the maker.

The chief of Unit of Computer and FFWS should manage more strictly the H-V curves memorized in FFWS because the value can be changed easily from terminal of FFWS by this modification.

(2) Establishment of Inter-agency Information System

1) A basic policy of Inter-agency Information System should be established in the first year.

PJT should make a work unit temporarily for the establishment. The unit should discuss the policy of Inter-agency Information System and prepare the draft. The policy's contents should be as follows:

- Purpose of the system
- Expected effects of the system
- Coverage of the system
- Time of Introduction of the system

A committee consisting of the responsible staff of PJT and representatives of concerned agencies should decide the policy of Inter-agency Information System based on the draft.

2) Investigation of present information management for water resources management at each agency concerned and general design of Inter-agency Information System should be conducted in the second year.

Present information management for water resources management will be investigated and analyzed to prepare a optimum system for the policy. These investigation and analysis should be conducted by the specialists such as system analyst or system planner. Existing problems and expected needs for information management should be made clear in the investigation and analysis.

General design of Inter-agency Information System will be prepared by the specialists based on the information flow, required functions and some restrictions.

3) Detailed design should be prepared in the third year.

The following should be designed and arranged by the specialists.

- Form of information arrangement in the system
- System structure and method of information processing
- Hardware and software

PJT and concerned agencies should discuss and decide the following in cooperation with the specialists.

- Staff for system management
- Risk manage method of the system
- Rule of copyright of information

4) The system will be installed in from the fourth year to the sixth year.

System facilities will be set up and tested by the maker. After completion of the installation, the staff for management of the system of PJT and end user of all agencies concerned should be trained for the operation and/or utilization of the system.

Afterward, concerned agencies should start the input of the data and information in accordance with the forms determined.

5) After introduction of the system, New PJT and concerned agencies should evaluate the system continuously from the viewpoint the expected effect is obtained or not. Inter-agency Information System should be improved based on the evaluation continuously.

Table A9-1 Existing and Proposed Station of FFWS

Existing Stations

No.	STATION	RF	WL	OF	RC	WQ
1	Malang (Master Station)				1	
2	Gadang		1			
3	Poncokusumo	1				
4	Tangkil	1				
5	Dampit	1				
6	Tawangrejeni		1			
7	Sengguruh Dam (Monitoring Station)	1	1	1	1	
8	Wagir	1				
9	Lahor Dam		1			
10	Sutami Dam	1	1	1	1	
11	Pondokkobong (Relay Station)					
12	Birowo	1				
13	Tunggorono	1				
14	Doko	1				
15	Wates Wlingi	1				
16	Semen	1				
17	Sumberagung	1				
18	Wlingi Dam (Monitoring Station)	1	1	1	1	
19	Lodoyo Dam		1	1	1	
20	Tulungagung (Sub-Master Station)				1	
21	Inlet Gate		1	1		
22	Kampak	1				
23	Tugu	1				
24	Beodo		1			
25	Tanggung (Relay Station)					
26	Pagerwojo	1				
27	Jeli	1	1			
28	Wates	1				
29	Wilis (Relay Station)	1				
30	Kediri (Sub-Master Station)	1			1	
31	Kediri		1			
32	Mrican Barrage		1	1	1	
33	Kertosono	1	1			
34	Ploso		1			
35	Pujon (Relay Station)	1			1	
36	Selorejo Dam	1	1	1	1	
37	Bening Dam		1	1	1	
38	Wates Sawahan	1				
39	Berbek	1				
40	Lengkong Widas		1			
41	Tampung	1				
42	New Lengkong Dam		1	1	1	
43	Porong		1		1	
44	Perning		1			
45	Gunungsari Dam		1	1	1	
	Total	26	21	10	14	

Proposed Stations and Facilities in Wonorejo Project

No.	STATION	RF	WL	OF	RC	WQ
A	Wonorejo Dam (Monitoring station)	1	2		1	
B	Segawe Weir		1		1	
C	Tiudan Headworks		2	1	1	
D	Tulungagung Pump Station (Sub-Master Station : New)			1	1*	
E	Jatimlerek Rubber Gate		1	1	1	
F	Menturus Rubber Gate		1	1	1	
G	Ngujang		1			
H	MliripGate			1		
I	Porong Canal		1			
J	Mangetan Canal		1			
K	Karangpilang					1
L	Pelayaran					1
M	Mrican Kiri		1			
N	Mrican Kanan		1			
18	Wlingi Dam (Monitoring station : Existing)			1		
	Total	1	12	6	5	2

RF : Rainfall Gauging facility
WL : Water Level Gauging facility
OF : Outflow Setting Panel
Wonorejo Project : Wonorejo Multipurpose Dam Construction Project

RC : Radio Communication Equipment
WQ : Water Quality Sensor
* : use existing equipment

Table A9-2 Function of Observation Base Stations

Station Name	Location	Function
Malang Master Station	PJT Office in Malang	· Data collection of all telemetering Data in Brantas river basin and printing out of the · Observation of hydrological condition in whole Brantas river by graphic display panel and CRT monitor · Evaluation of warning information from FFWS · Analysis of the telemetering data including Flood forecasting · Communication with each flow control facilities for confirmation of the site condition and flow · Data management of the telemetering data and processed data · Back up for data collection from the area covered by Kediri Sub-master station without Widas river basin
Kediri Sub-master Station	BTS Office in Kediri	· Data collection of telemetering Data in Brantas middle/lower river basin and printing out of the collecting data · Observation of hydrological condition in Brantas middle/lower river stretches · Data transmission to Malang master station · Collection and observation the processed data of Lodoyo barrage from Malang master station
Tulungagung Sub-master Station	BTS Office in Tulungagung	· Data collection of telemetering Data in Tulungagung area and printing out of the collecting data · Data transmission to Malang master station
Sengguruh Dam Monitoring Station	Sungguruh Dam Office	· Monitoring the data of Sungguruh and Sutami dam basin
Wlingi Dam Monitoring Station	Wlingi Dam Office	· Monitoring the data of Wlingi and Sutami dam basin · Direct data collection from the area covered by this monitoring station if Malang master station is in emergency

Table A9-3 Flood Warning Criteria

(1997)

Control Point	river	Warning	Water Level (m)	Outflow Discharge (m^3/s)	Free Boad (m)
Tawangrejeni (FFWS)	Lesti	I	EL= 320.60		
		II	EL= 320.60		
		III	EL= 320.60		
Gadang (FFWS)	Brantas	I	EL= 391.22		
		II	EL= 391.22		
		III	EL= 391.22		
Sengguruh Dam (FFWS)	Brantas	I	292.60 <EL≦ 292.85	450 <Q≦ 600	
		II	292.85 <EL≦ 293.10	600 <Q≦ 850	
		III	293.10 <EL	850 <Q	
Sutami Dam (FFWS)	Brantas	I	272.80 <EL≦ 273.50	200 <Q≦ 300	
		II	273.50 <EL≦ 275.50	300 <Q≦ 450	
		III	275.50 <EL	450 <Q	
Lahor Dam (FFWS)	Lahor	I	272.80 <EL≦ 273.50	50 <Q≦ 100	
		II	273.50 <EL≦ 275.50	100 <Q≦ 150	
		III	275.50 <EL	150 <Q	
Wlingi Dam (FFWS)	Brantas	I	163.60 <EL≦ 164.00	400 <Q≦ 700	
		II	164.00 <EL≦ 164.50	700 <Q≦ 850	
		III	164.50 <EL	850 <Q	
Lodoyo Weir (FFWS)	Brantas	I	136.25 <EL≦ 136.50	400 <Q≦ 800	
		II	136.50 <EL≦ 137.00	800 <Q≦ 950	
		III	137.00 <EL	950 <Q	
Bendo (FFWS)	Parit Raya	I	90.00 <EL≦ 91.00	223.42 <Q≦ 358.88	4.00 ≧F> 3.00
		II	91.00 <EL≦ 92.00	358.88 <Q≦ 525.66	3.00 ≧F> 2.00
		III	92.00 <EL	525.66 <Q	2.00 ≧F
Tulungagung Inlet Gate (FFWS)	Kendal	I	79.00 <EL≦ 80.00		
		II	80.00 <EL≦ 81.00		
		III	81.00 <EL		
Jeli (FFWS)	Brantas	I	EL= 80.50		
		II	EL= 80.50		
		III	EL= 80.50		
Kediri (FFWS)	Brantas	I	62.65 <EL≦ 62.85	797.74 <Q≦ 882.55	1.40 ≧F> 1.20
		II	62.85 <EL≦ 63.05	882.55 <Q≦ 971.63	1.20 ≧F> 1.00
		III	63.05 <EL	971.63 <Q	1.00 ≧F
Mrican Weir (FFWS)	Brantas	I	EL= 59.59		
		II	EL= 59.59		
		III	EL= 59.59		
Kertosono (FFWS)	Brantas	I	43.46 <EL≦ 43.66	943.90 <Q≦ 1028.94	1.40 ≧F> 1.20
		II	43.66 <EL≦ 43.86	1028.94 <Q≦ 1117.46	1.20 ≧F> 1.00
		III	43.86 <EL	1117.46 <Q	1.00 ≧F
Bening Dam (FFWS)	Widas	I	109.00 <EL≦ 109.20	100 <Q≦ 200	
		II	109.20 <EL≦ 109.30	200 <Q≦ 400	
		III	109.30 <EL	400 <Q	
Lengkong Widas (FFWS)	Widas	I	40.59 <EL≦ 40.79	437 <Q≦ 469	
		II	40.79 <EL≦ 40.99	469 <Q≦ 502	
		III	40.99 <EL	502 <Q	
Ploso (FFWS)	Brantas	I	31.51 <EL≦ 31.76	1417 <Q≦ 1540	1.59 ≧F> 1.34
		II	31.76 <EL≦ 32.01	1540 <Q≦ 1672	1.34 ≧F> 1.09
		III	32.01 <EL	1672 <Q	1.09 ≧F
Selorejo Dam (FFWS)	Konto	I	622.20 <EL≦ 622.60	200 <Q≦ 260	
		II	622.60 <EL≦ 623.14	260 <Q≦ 360	
		III	623.14 <EL	360 <Q	
New Lengkong Dam (FFWS)	Brantas	I	18.00 <EL≦ 18.50		
		II	18.50 <EL≦ 19.00		
		III	19.00 <EL		
Porong (FFWS)	Porong	I	6.60 <EL≦ 6.80	1334 <Q≦ 1415	1.91 ≧F> 1.71
		II	6.80 <EL≦ 7.00	1415 <Q≦ 1498	1.71 ≧F> 1.51
		III	7.00 <EL	1498 <Q	1.51 ≧F
Perning (FFWS)	Surabaya	I	10.25 <EL≦ 10.41	113.28 <Q≦ 125.54	3.13 ≧F> 2.97
		II	10.41 <EL≦ 10.65	125.54 <Q≦ 145.11	2.97 ≧F> 2.73
		III	10.65 <EL	145.11 <Q	2.73 ≧F
Gunungsari (FFWS)	Surabaya	I	EL= 4.60	230 <Q≦ 250	
		II	EL= 4.60	250 <Q≦ 290	
		III	EL= 4.60	290 <Q	

(FFWS):Observated by FFWS

Table A9-4 Existing Staff for Operation of FFWS in Each Station

(1997)

Station	Observer**	Gate Operator**	Operator of Telecomunication Equipment	Others
Malang (Master Station)	-	-	-	14*
Sengguruh Dam (Monitoring Station	3	3	2	-
Sutami, Lahor Dam	3	2	3	-
Wlingi Dam (Monitoring Station)	3	3	3	-
Lodoyo Weir	3	3	-	-
Sclorejo Dam	2	2	2	-
Tulungagung (Sub-master Station)	-	-	2	-
Tulungagung Inlet Gate	3	3	-	-
Kediri (Sub-master Station)	-	-	2	-
Mrican Weir	-	4	=Gate operator (4)	-
Bening Dam	1	2	=Gate Operator (2) +1	-
New Lengkong Weir	-	3	=Gate operator (3) +1	-
Gunungsari Weir	1	2	=Ovserver (1) +Gate operator(2)	-
Porong			(Staff of Irrigation Office)	
Total			76	

*Computer and FFWS Unit

**The observers and gate operators hold the post for FFWS.

Table A9-5 Proposed Monitoring for Low Flow Management

LOCATION	MONITORING SUBJECT		REMARKS
(Flow control)			
Sutami dam	Reservoir WL, OF	existing	
Wlingi dam	Reservoir WL, OF	existing	
Lodoyo dam	Reservoir WL, OF	existing	
Mrican weir	Reservoir WL, OF	existing	
Jatimlerek rubber dam	Reservoir WL	**proposed**	
Menturus rubber dam	Reservoir WL	**proposed**	
New Lengkong weir	Reservoir WL, OF	existing	
Mlirip gate	Reservoir OF	**proposed**	setting panel
Gunungsari weir	Reservoir WL, OF	existing	
(Flow control/ the Ngrowo water conveyance system)			
Segawe weir and connection tunnel	Intake weir WL	**proposed**	
	Connection tunnel discharge	**proposed**	setting panel
Wonorejo dam	Reservoir and tailrace WL	**proposed**	
	RF	**proposed**	
Tiudan headworks and canal	Intake weir and canal WL	**proposed**	
	Canal discharge	**proposed**	setting panel
Tulungagung pump station	Pumping up discharge	**proposed**	setting panel
Tulungagung inlet gate	Reservoir WL, OF	existing	
(Observation of subjective river stretch)			
Ngujang	River WL	**proposed**	
Jeli	River WL	existing	
Kediri	River WL	existing	
Kertosono	River WL	existing	
Ploso	River WL	existing	
Perning	River WL	existing	
(Observation of Intake discharge for irrigation system)			
Lodagung	Intake OF	**proposed**	setting panel
Mrican Kanan	Canal WL	**proposed**	
Mrican Kiri	Canal WL	**proposed**	
Brantas Kiri Jombang	Intake OF	**proposed**	setting panel
Brantas Kiri Mojokerto	Intake OF	**proposed**	setting panel
Delta Brantas			
Prong canal	Canal WL	**proposed**	
Mangetan canal	Canal WL	**proposed**	
(Observation of water quality)			
Karangpilang	Water temperature, pH, DO, Conductivity, Turdidity	**proposed**	providing automatic cleaning device for sensors
Pelayaran	Water temperature, pH, DO, Conductivity, Turdidity	**proposed**	providing automatic cleaning device for sensors

WL: Water level
OF : Outflow
proposed : proposed in the Wonorejo Multipurpose Dam Constriction Project

Table A9-6 Condition of Gauging Stations of FFWS

No.	STATION	SUBJECT	FACILITY/METHOD	PROBLEMS
2	Gadang	WL	Float type	Sedimentation among the gauging equipment
3	Poncokusumo	RF	Tipping bucket type	-
4	Tangkil	RF	Tipping bucket type	-
5	Dampit	RF	Tipping bucket type	-
6	Tawangrejeni	WL	Float type	-
7	Sengguruh Dam	RF	Tipping bucket type	-
		WL	Float type	-
		OF	Manual calculation	-
8	Wagir	RF	Tipping bucket type	-
9	Lahor Dam	WL	Pressure type	Measurement error by the gauging equipment
10	Sutami Dam	RF	Tipping bucket type	-
		WL	Float type	-
		OF	Manual calculation	-
12	Birowo	RF	Tipping bucket type	-
13	Tunggorono	RF	Tipping bucket type	-
14	Doko	RF	Tipping bucket type	-
15	Wates Wlingi	RF	Tipping bucket type	-
16	Semen	RF	Tipping bucket type	-
17	Sumberagung	RF	Tipping bucket type	-
18	Wlingi Dam	RF	Tipping bucket type	-
		WL	Float type	-
		OF	Manual calculation	-
19	Lodoyo Dam	WL	Pressure type	Measurement error by the gauging equipment
		OF	Manual calculation	Fear for the late of setting data
21	Inlet Gate	WL	Float type	-
		OF	Manual calculation	-
22	Kampak	RF	Tipping bucket type	Fear for incomplete charge to solar panel for battery by the shadow of trees
23	Tugu	RF	Tipping bucket type	-
24	Bendo	WL	Float type	
26	Pagerwojo	RF	Tipping bucket type	-
27	Jeli	RF	Tipping bucket type	Fear for incomplete charge to solar panel for battery by the shadow of trees
	Jeli	WL	Float type	Impossibility of measurement for lower water level in such dry season in 1997
28	Wates	RF	Tipping bucket type	-
29	Wilis	RF	Tipping bucket type	-
30	Kediri	RF	Tipping bucket type	-
31	Kediri	WL	Float type	-
32	Mrican Barrage	WL	Float type	-
		OF	Manual calculation	-
33	Kertosono	RF	Tipping bucket type	-
		WL	Float type	Sedimentation among the gauging equipment
34	Ploso	WL	Float type	Impossibility of measurement for lower water level in such dry season in 1997
35	Pujon	RF	Tipping bucket type	-
36	Selorejo Dam	RF	Tipping bucket type	-
		WL	Pressure type	Measurement error by the gauging equipment
		OF	Manual calculation	Outflow calculation by the reading of staff gauge (the reading is not done in every hour)
37	Bening Dam	WL	Pressure type	-
		OF	Manual calculation	-
38	Wates Sawahan	RF	Tipping bucket type	-
39	Berbek	RF	Tipping bucket type	-
40	Lengkong Widas	WL	Pressure type	Impossibility of measurement for lower water level in such dry season in 1997
41	Tampung	RF	Tipping bucket type	-
42	New Lengkong Dam	WL	Float type	-
		OF	Manual calculation	Outflow calculation by only gate operation assuming water level constant
43	Porong (at Irrigation office)	WL	Float type	Impossibility of measurement for lower water level in such dry season in 1997
44	Perning	WL	Float type	-
45	Gunungsari Dam	WL	Float type	-
		OF	Manual calculation	-

RF : Rainfall Gauging facility
WL : Water Level Gauging facility
OF : Outflow Setting Panel

Float type : Float type water level gauging equipment
Pressure type : Pressure type water level gauging equipment
Tipping bucket type : Tipping bucket type rainfall gauging equipment

Table A9-7 Comparison of Telemetering and Manual Operated Data at Sutami Dam

(Comparison in hourly data) (1996, October)

<1996/10/01>

Date	Time	Manual Operated Data (①) W.L. (El.m)	Manual Operated Data (①) Outflow (m³/s)	Telemetering Data (②) W.L. (El.m)	Telemetering Data (②) Outflow (m³/s)	Difference (① - ②) W.L. (El.m)	Difference (① - ②) Outflow (m³/s)
1996/10/01	1	263.93	41.92	-	-	-	-
	2	263.93	34.57	-	-	-	-
	3	263.92	34.89	-	-	-	-
	4	263.91	32.75	-	-	-	-
	5	263.90	33.95	-	-	-	-
	6	263.89	35.21	-	-	-	-
	7	263.88	33.22	263.88	35.00	0.00	-1.78
	8	263.87	34.61	263.87	35.00	0.00	-0.39
	9	263.86	32.92	263.86	35.00	0.00	-2.08
	10	263.85	30.94	263.85	35.00	0.00	-4.06
	11	263.84	30.94	263.84	35.00	0.00	-4.06
	12	263.83	30.18	263.84	35.00	-0.01	-4.82
	13	263.83	32.17	263.83	31.00	0.00	1.17
	14	263.82	30.64	263.82	31.00	0.00	-0.36
	15	263.83	30.95	263.83	31.00	0.00	-0.05
	16	263.83	31.10	263.83	31.00	0.00	0.10
	17	263.83	34.01	263.83	31.00	0.00	3.01
	18	263.83	68.94	263.83	34.00	0.00	34.94
	19	263.82	113.53	263.82	34.00	0.00	79.53
	20	263.82	71.40	263.82	114.00	0.00	-42.60
	21	263.83	64.80	263.83	71.00	0.00	-6.20
	22	263.85	36.30	263.85	71.00	0.00	-34.70
	23	263.87	32.00	263.87	71.00	0.00	-39.00
1996/10/02	0	263.89	32.45	263.88	32.00	0.01	0.45
	1	-	-	263.90	32.00	-	-
	2	-	-	263.90	32.00	-	-
	3	-	-	263.90	32.00	-	-
	4	-	-	263.90	32.00	-	-
	5	-	-	263.90	32.00	-	-
	6	-	-	263.89	35.00	-	-

<1996/10/31>

1996/10/31	1	261.01	30.53	-	-	-	-
	2	261.03	31.64	-	-	-	-
	3	261.05	30.99	-	-	-	-
	4	261.08	31.30	-	-	-	-
	5	261.10	32.06	-	-	-	-
	6	261.12	34.15	-	-	-	-
	7	261.14	34.62	261.14	34.00	0.00	0.62
	8	261.14	35.25	261.15	34.00	-0.01	1.25
	9	261.15	80.66	261.15	34.00	0.00	46.66
	10	261.14	81.46	261.14	34.00	0.00	47.46
	11	261.12	82.42	261.12	34.00	0.00	48.42
	12	261.10	81.64	261.09	34.00	0.01	47.64
	13	261.07	98.52	261.07	34.00	0.00	64.52
	14	261.03	120.67	261.03	81.00	0.00	39.67
	15	261.00	118.01	260.99	121.00	0.01	-2.99
	16	260.94	121.29	260.94	121.00	0.00	0.29
	17	260.90	116.74	260.90	121.00	0.00	-4.26
	18	260.86	117.53	260.86	121.00	0.00	-3.47
	19	260.82	117.54	260.81	121.00	0.01	-3.46
	20	260.79	117.94	260.79	117.00	0.00	0.94
	21	260.79	119.07	260.79	118.00	0.00	1.07
	22	260.79	115.55	260.79	115.00	0.00	0.55
	23	260.79	72.78	260.79	115.00	0.00	-42.22
1996/11/01	0	260.80	38.14	260.80	73.00	0.00	-34.86
	1	-	-	260.81	38.00	-	-
	2	-	-	260.81	38.00	-	-
	3	-	-	260.81	38.00	-	-
	4	-	-	260.80	38.00	-	-
	5	-	-	260.79	38.00	-	-
	6	-	-	260.79	38.00	-	-

(Comparison in the monthly mean)

Date	Manual Operated Data (①) W.L. (El.m)	Manual Operated Data (①) Outflow (m³/s)	Telemetering Data (②) W.L. (El.m)	Telemetering Data (②) Outflow (m³/s)	Difference (① - ②) W.L. (El.m)	Difference (① - ②) Outflow (m³/s)
1996/10/01	263.86	41.92	263.86	41.13	0.00	0.11
10/02	263.85	46.60	263.91	47.00	-0.06	-0.40
10/03	264.23	59.80	264.24	70.00	-0.01	-10.20
10/04	264.01	72.37	263.94	70.00	0.07	2.37
10/05	263.81	48.20	263.79	53.00	0.02	-4.80
10/06	263.57	77.92	263.48	83.00	0.09	-5.08
10/07	263.37	45.99	263.36	51.00	0.01	-5.01
10/08	263.28	60.61	263.28	69.00	0.00	-8.39
10/09	263.28	66.64	263.25	73.00	0.03	-6.36
10/10	263.12	54.17	263.08	64.00	0.04	-9.83
10/11	262.97	60.36	262.93	70.00	0.04	-9.64
10/12	262.77	54.30	262.72	57.00	0.05	-2.70
10/13	262.57	50.26	262.53	54.00	0.04	-3.74
10/14	262.43	56.59	262.37	57.00	0.06	-0.41
10/15	262.14	65.11	262.09	63.00	0.05	2.11
10/16	261.96	49.93	261.96	69.00	0.02	-19.07
10/17	261.94	57.00	261.96	66.00	-0.02	-9.00
10/18	261.92	70.97	261.89	82.00	0.03	-11.03
10/19	261.79	71.66	261.74	98.00	0.05	-26.34
10/20	261.55	69.02	261.50	62.00	0.05	7.02
10/21	261.43	44.07	261.43	41.00	0.00	3.07
10/22	261.51	45.78	261.54	47.00	-0.03	-1.22
10/23	261.70	49.13	261.77	66.00	-0.07	-16.87
10/24	261.81	68.64	261.83	83.00	-0.02	-14.36
10/25	261.96	116.19	261.93	125.00	0.03	-8.81
10/26	261.51	143.43	261.36	143.00	0.15	0.43
10/27	260.96	136.41	260.85	138.00	0.11	-1.59
10/28	260.71	64.93	260.72	54.00	-0.01	10.93
10/29	260.83	47.39	260.86	48.00	-0.03	-0.61
10/30	260.94	49.36	260.96	49.00	-0.02	0.36
10/31	260.99	77.52	260.92	70.42	0.07	7.10
1st 10-day	263.64	57.33	263.62	62.11	0.02	-4.78
2nd 10-day	262.21	60.52	262.17	67.80	0.04	-7.28
3rd 10-day	261.30	76.62	261.29	78.58	0.02	-1.96
Monthly Mean	262.35	65.21	262.33	69.79	0.02	-4.59

Daily telemetering data are calculated from hourly data until 7 to 6 o'clock.
Daily manual operated data are calculated from hourly data until 1 to 0 o'clock.

Table A9-8 Existing Low Flow Monitoring

STATION	SUBJECT	POLA	MEASUREMENT OPERATION AT SITE	MONITORING METHOD AT PJT MALANG OFFICE	MONITORING INTERVAL	REMARKS
Gadang (Brantas river)	WL		ASA I/1	FFWS	Hourly	
Tawangrejeni (Brantas river)	WL		ASA I/1	FFWS	Hourly	
Sengguruh Dam	WL/OF	WL/OF(P, S)	ASA I/1	Telephone/FFWS	Daily/Hourly	
Lahor Dam	WL		ASA I/1	Telephone/FFWS	Daily/Hourly	
Sutami Dam	WL/OF	WL/OF(P, S)	ASA I/1	Telephone/FFWS	Daily/Hourly	
Wlingi Dam	WL/OF	WL/OF(P, I, S)	ASA I/2	Telephone/FFWS	Daily/Hourly	
Wlingi Dam (Lodagung Irrigation Intake)	OF	OF(I)	ASA I/2	Telephone	Daily	Wonorejo
Lodoyo Dam	WL/OF	WL/OF(P, S)	ASA I/2	Telephone/FFWS	Daily/Hourly	
Inlet Gate	WL/OF	WL/OF(P, S)	ASA I/3	Telephone/FFWS	Daily/Hourly	
Bendo (Parti Raya)	WL		ASA I/3	FFWS	Hourly	
Jeli (Brantas river)	WL		ASA II/1	FFWS	Hourly	
Kediri (Brantas river)	WL		ASA II/1	FFWS	Hourly	
Mrican Barrage	WL		ASA II/1	Telephone/FFWS	Daily/Hourly	
Mrican Kiri (Irrigation system)	WL	OF(I)	ASA II/1	Telephone	Daily	Wonorejo
Mrican Kanan (Irrigation system)	WL	OF(I)	ASA II/1	Telephone	Daily	Wonorejo
Kertosono (Brantas river)	WL		ASA II/1	FFWS	Hourly	
Brantas Kiri Kediri Irrigation system	Of	OF(I)	Irrig. Office	(no monitoring)	-	Discharge less than 1 m^3/s
Jatimlerek Rubber Dam	WL/OF		BTS	Telephone	Daily	Wonorejo
Jatimlerek Rubber Dam (Brantas Kiri Jombang)	OF	OF(I)	BTS	Telephone	Daily	Wonorejo
Ploso (Brantas river)	WL		ASA II/1	FFWS	Hourly	
Menturus Rubber Dam	WL/OF		ASA II/2	Telephone	Daily	Wonorejo
Menturus Rubber Dam (Brantas Kiri Mojokerto)	OF	OF(I)	ASA II/3	Telephone	Daily	Wonorejo
Jatikulon Irrigation system	OF	OF(I)	Irrig. Office	(no monitoring)	-	Discharge less than 1 m^3/s
Selorejo Dam	WL/OF	WL/OF(P, S)	ASA I/2	Telephone/FFWS	Daily/Hourly	
Bening Dam	WL/OF	WL/OF(P, S)	ASA II/1	Telephone/FFWS	Daily/Hourly	
Lengkong Widas (Widas river)	WL		ASA II/1	Telephone/FFWS	Daily/Hourly	
Mlirip Gate	OF	OF	ASA II/2	Telephone	Daily	Wonorejo
Magetan Canal	WL	OF*(I)	ASA II/2	Telephone	Daily	Wonorejo
Porong Canal	WL	OF*(I)	ASA II/2	Telephone	Daily	Wonorejo
New Lengkong Dam	WL/OF		ASA II/2	Telephone/FFWS	Daily/Hourly	
Porong (Porong river)	WL		ASA II/2	Telephone/FFWS	Daily/Hourly	
Perning (Surabaya river)	WL		ASA II/3	FFWS	Hourly	
Gunungsari Dam	WL/OF		ASA II/3	Telephone/FFWS	Daily/Hourly	

WL : Water Level
OF : Outflow Discharge
Monitoring OF by FFWS is total of discharge in().
(P): Discharge for Power Generation
(S) : Discharge through flow control structure
(I) : Discharge for Irrigation
ASA I : Division of U/S Water Service in PJT
ASA II : Division of D/S Water Service in PJT
Wonorejo : In Wonorejo multipurpose Dam Construction Project, automatic data collection is proposed by expanded FFWS.
* :OF of Magetan and Porong Canal is agreed as one OF(Brantas Delta) in POLA.

Table A9-9 Improvement of Water Level Gauge

Station	Problem/ Present condition	Improvement plan
Gadang	(Problem) There is sedimentation at a mouth of the observation well and in a small ditch from mainstream to the observation well. (Present condition) The water level gauge is positioned at right side of the river. Main stream of the river is at left side. A small ditch is constructed to lead water from mainstream to the water level gauge in dry season. The ditch dose not function well because of sedimentation in the ditch.	Shifting the gauge to a little to the center of the river to be close the mainstream.(Fugure A9.13) It need protection facility against the main stream.
Jeli	(Problem) The gauge, which is positioned at downstream of bridge pier, is under influence of turbulent flow. (Present condition) There is not so much variation of river course, based on the map edited in 1943-44 and present condition. The shoal is shaping in left side of river. The main stream of the river is in right side. The shoal is shaping in left side of river.	Shifting the gauge to right side of the river, downstream of the railway bridge, out of area under influence of turbulent flow (Fugure A9.13). It need protection facility against the main stream.
Kertosono	(Problem) The gauge is under the influence of sedimentation in dry season. (Present condition) There is not so much variation of river course, based on the map edited in 1943-44 and present condition. The main stream of the river is in right side. There is river bed erosion in these river reaches (Figure A9.12). The sedimentation, which influence to water level gauge, is shaped under effect of the groynes laid on upstream and downstream of the gauging station at right side of river.	Shifting the water level gauge to upstream of the road bridge that lays upstream of existing gauge, to avoid the influence of the groynes (Figure A9.13).
Ploso	(Problem) The water level is under the lowest limit of measurement in dry season. (Present condition) The position of gauge is good. There is river bed erosion in these river reaches (Figure A9.12).	Lowering the lowest limit of measurement, to take river bed erosion into consideration.
Porong	(Problem) the water level is under the lowest limit of measurement in dry season. (Present condition) There is river bed erosion in the downstream of this gauging station (Figure A9.12).	Lowering the lowest limit of measurement, to take river bed erosion into consideration.

Table A9-10 Information for Water Resources Management (1/6)

M:Agency as information manager, U:Agency as information user and/or observer

Works and duties / Information	Type of information	Agencies related to Water Resources Management in the Brantas River Basin																															Problem	Effect by use of the System
		1 OGWRD	2 OPU Cipta Karya	3 Kanwil PU	4 PKB (Kali Brantas)	5 PGKS (Gunung Kelud)	6 PJT (Jasa Tirta)	7 DGRLR (M. of Forestry)	8 Kanwil Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 BRLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp.)	12 Kanwil Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PUT (East Java Irrig.Project)	15 PIAT (East Java G.W. Irrig. Project)	16 DPERIKAN (Fishery Service)	17 MIT (M.of Industry and Trade)	18 DPRIND (Industry Service)	19 KIME (M. of Mining & Energy)	20 DINSTAMB (Mining Service)	21 MOE (M.of Environment)	22 BAPEDAL (Environ. Agency)	23 BBLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 MHA (M. of Home Affairs)	27 BAPPEDA/Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PHMC (Water Management Committ.)	32 SATKORLAK PB (Disast. Coord. Unit)	33 DKK	34 SPPT		
I. WATERSHED MANAGEMENT																																		
(Land use management)																																		
Forestry law	Document				U			M	U	U	U	U	U															U					The keeping place and existence are not known by some staff of agencies concerned.	It will be easy to know the keeping place.
Regulation for land use	Document				U	U	U		M	U	U	U	U															U						
Present land use	drawing (Photo)				U	U	U		M	U	M	M	M															U					Informations of land use are not coordinated.	Information of land use will be coordinated.
Commercial forest area and other forest area	drawing, data								U	U	M	M																U					Forest management areas are not clear between Perum Perhutani and BRLKT.	Management area will be clear.
Water quality data	Data			M			M		U														M											It will be easy to use the data for some development plans.
Water demand	Data		M						U					M	M		M		M										M	M				
Land development plan	Document, drawing				U	U	U		M		M	M	M															U						It will be easy to know about the development plans for other development planning.
Urban development plan	Document, drawing				U	U	U		M		M	M	M															U						
Afforestation plan	Document, drawing				U	U	U		U		M	M																U						
Watershed conservation plan	Document, drawing				U	U	U		M		M	M	M															U						
Outline of implementation plans and work progress	Document, drawing				U	U	U		M	M	M	M	M															U						It will be easy to know the work progress.
(Land slide and erosion prevention management)																																		
Condition of landslide and erosion specified area	Document, drawing				U	M	U			U	M	U																U						
landslide and erosion specified area	drawing				U	M	U			U	M	U																U						
Land slide prevention plan	Document, drawing				U	M	U			U	M	U																U						
Outline of implementation plans and work progress	Document, drawing				U	M	U			M	M	U																U						It will be easy to know the work progress.
(Sediment control)																																		
Government regulation on river	Document	M			U	U	U	U	U		U	U																						
Regulation for land use	Document				U	U	U	U	M	U	U	U																						
Regulation for sand mining	Document				U	U	U	U	U		U	U									M	M						M						
Forestry law	Document				U	U	U	M	U		U	U																					The keeping place and existence are not known by some staff of agencies concerned.	It will be easy to know the keeping place.
River and reservoir survey	drawing, data				U		M															U											Information about the reservoir survey result is not known well, because of lack of communication between a user and administrator in PJT	The newest data will be used certainly.
Bed material	drawing, data				U	U	M																											
Geological and soil analysis data	drawing, data				U	U	U			U	M	M																						

Table A9-10 Information for Water Resources Management (2/6)

Works and duties / information	Type of information	Agencies related to Water Resources Management in the Brantas River Basin: 1 DGWRD	2 DPU Cipta Karya	3 Kanwil PU	4 PKB (Kali Brantas)	5 PSKS (Gunung Kelud)	6 PJT (Jasa Tirta)	7 DGRLR (M. of Forestry)	8 Kanwil Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 BRLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp.)	12 Kanwil Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PLT (East Java Irrig. Project)	15 PIAT (East Java G.W. Irrig. Project)	16 DPERIKAN (Fishery Service)	17 MIT (M.of Industry and Trade)	18 DPRIND (Industry Service)	19 MME (M. of Mining & Energy)	20 DSTAMB (Mining Service)	21 MOE (M.of Environment)	22 BAPEDAL (Environ. Agency)	23 BBLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 MHA (M. of Home Affairs)	27 BAPPEDA/Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PJWMC (Water Management Commit.)	32 SATKORLAK PB (Disast. Coord. Unit)	33 DKK	34 SPPT	Problem	Effect by use of the System
Present land use	drawing				C	C	C		M			M	M																							
Hydrological data	Data				C	C	C																													Some telemetering data is not accurate, and the accurate data on paper is not useful in PJT.	The accurate data will be used easily.
Condition of sand mining	drawing, data				C	C	M		C		C		C																							
Condition of river bed variation	drawing, data				C	C	M																													
Sabo plan	Document					C	C		M	C	M	C									U														It will be easy to know about the sabo plans for the sabo planning.
Outline of implementation plans and work progress	Document, drawing				M	C	M		C	C	C	C																							It will be easy to know the work progress.
(G.Kelud debris control)																																				
Sedimentation in the existing sand pocket	drawing, data				C	M	C		C		C	C																								
Result of sand mining	drawing, data				C	M	C		C		C	C																								
Countermeasures of sedimentation	Document, drawing				C	M	C		C	C	C	C																								It will be easy to know the work progress.
Outline of implementation plans and work progress	Document, drawing				C	M	C		C	C	C	C																								
II. FLOOD MANAGEMENT																																				
(Flood control works)																																				It will be easy to refer.
Flood control manual	Document	M												C									C					C								
Government regulation on river	Document	M												C									C					C								
River, reservoir survey	drawing, data	U			M		M																													Information about the reservoir survey result is not known well, because of lack of communication between a user and administrator in PJT.	The newest data will be used certainly.
Present condition of flood control facilities	drawing, data	U			M		M																C													It will be easy to know the condition of flood control facilities.
Present condition of FFWS and observation facilities	drawing, data	U			M		M							M																						
Rehabilitation plan	Document, drawing	U			M		U							U									C					C								It will be easy to know about the plans for other planning.
Flood control plan	Document, drawing	U			M		U																C					C								
Outline of implementation plans and work progress	Document, drawing	U			M		M				U	M		U			C						C					C	C	C						It will be easy to know the work progress.
(Flood damage management)																																				
Flood control manual	Document	M																											C	C						
Reservoir operation rule	Document	U					M																													
FFWS operation rule	Document	U					M																													
Hydrological data	Data	U				M	M				M			M																						Some telemetering data is not accurate, and the accurate data on paper is not useful in PJT.	The accurate data will be used easily.
condition of river (water level and discharge)	Data	U					M							M																						

Table A9-10 Information for Water Resources Management (3/6)

Works and duties / information	Type of information	Agencies related to Water Resources Management in the Brantas River Basin																																	Problem	Effect by use of the System
		1 DGWRD	2 DPU Cipta Karya	3 Kanwil PU	4 PKB (Kali Brantas)	5 PGKS (Gunung Kelud)	6 PJT (Jasa Tirta)	7 DGRLR (M. of Forestry)	8 Kanwil Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 BRLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp.)	12 Kanwil Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PUT (East Java Irrig Project)	15 PIAT (East Java G.W. Irrig. Project)	16 DPEPIKAN (Fishery Service)	17 MIT (M of Industry and Trade)	18 DPRIND (Industry Service)	19 MME (M. of Mining & Energy)	20 DISTAMB (Mining Service)	21 MCE (M.of Environment)	22 BAPEDAL (Environ. Agency)	23 BSLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 MHA (M. of Home Affairs)	27 BAPPEDA Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PWMC (Water Management Commit.)	32 SATKORLAK PB (Bassk. Coord Unit)	33 DKK	34 BPPT		
condition of reservoir and gate operation	Data	U					M																													
Staffing of picket for flood	Table, drawing	U					M																													
Communication system in emergency and contact address	Table, drawing	U			U	U	U	M						U														U					U			
Flood forecasting	Data	U						M																												
Flood warning	Data	U			U	U	U	M						U														U					U			
Flood defense system	Document, drawing	U			U	U	U	U	M	U					U				U					U			U	U	U			M			
Disposition of flood lighting equipment	Table								M																								M			
Flood damage report	Document, table	U			M	U	U	M	M	U					U			U					U					U	U	U			M			
Outline of implementation plans and work progress	Document, drawing				M	U	U	U	M	U					U			U					U					U	U	U			M			
III. WATER SUPPLY MANAGEMENT																																				
(Regulations)																																				
Government reguration on river	Document	M			U	U	U	U		U					U	U		U		U				U				U	U	U		U				
Water Rights	Document	M	U		U	U		U							U	U		U		U				U					U	U		U				
Water Allocation (POLA)	Data	U	U				U								U	U		U		U									U	U		M				
Dam Operation Rule	Document, drawing	U					M								U			U											U	U		U				
(Water Supply)																																				
<Domestic water>																																				
Supply Record	Data	U	M	U	U		U		U	U	U				U			U		U				U				U	U	M		U				Water demand of other major water users will be able to check.
Water demand (monthly water demand)	Data	U	M	U	U		U		U	U	U				U			U	U	U				U				U	U	M		U				
Demand forecasting / basic data	Data	U	M				U								U			U						U					U	M						
Condition of intake facilities	Document, drawing		M		U		U																								M					
Outline of service	Document	U	M	U	U		U																								M					
<Irrigation water>																																				
Supply Record	Data	U	U	U	U		U		U	U	U		U	M	M	U	U		U					U				U	U	U		U				Water demand of other major water users will be able to check.
Water demand (monthly water demand)	Data	U	U	U	U		U		U	U	U		U	M	M	U	U		U					U				U	U	U		U				
Demand forecast forecasting / basic data	Data	U	U				U							M	M	U	U		U										U	U						
Condition of irrigation facilities	Document, drawing						U							M	M																					

Table A9-10 Information for Water Resources Management (4/6)

Works and duties / information	Type of information	Agencies related to Water Resources Management in the Brantas River Basin																																	Problem	Effect by use of the System
		1 DGWRD	2 DPU Opta Karya	3 Kamal PU	4 PKB (Kali Brantas)	5 PDKS (Gaming Kediri)	6 PJT (Jasa Tirta)	7 DGRLR (M. of Forestry)	8 Kamdi Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 BPLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp.)	12 Kamdi Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PUT (East Java Irrig Project)	15 PJAT (East Java G.W. Irrig. Project)	16 DPERIKAN (Fishery Service)	17 MIT (M. of Industry and Trade)	18 DPRIND (Industry Service)	19 MME (M. of Mining & Energy)	20 BSTAMB (Mining Service)	21 MOE (M. of Environment)	22 BAPEDAL (Environ. Agency)	23 BBLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 NHA (M. of Home Affairs)	27 BAPPEDA Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PMMC (Water Management Commit.)	32 SATKORLAK PB (Disast. Coord. Unit)	33 DKK	34 BPPT		
Information of another water resources	Document, drawing			C	C		C							M	M																C					
Production target	Document						C							M	M																					
<Brackish fisheries water>																																				
Supply Record	Data	C	C	C	C	C	C		C				C	C			M		C					C			C	C	C		C				Water demand of other major water users will be able to check.
Water demand (monthly water demand)	Data	C	C	C	C	C	C		C	C	C		C	C			M		C					C			C	C	C		C				
Demand forecast forecasting / basic data	Data	C	C				C							C			M		C									C	C						
Irrigation return flow (water from irrigation to fishpond)	Data						C							M	M		C																		
Condition of fishpond and irrigation canal	Document, drawing																M																		
Production target	Document						C										M																		
<Industrial water>																																				
Supply Record	Data	C	C	C	C	C	C		C	C				C			C		M					C			C	C	C		C				Water demand of other major water users will be able to check.
Water demand (monthly water demand)	Data	C	C	C	C	C	C		C	C				C			C		M					C			C	C	C		C				
Demand forecast forecasting / basic data	Data	C	C	C			C							C			C		M					C				C	C						
Water saving plan	Document	C		C			C												M					C							C				
Type of industry / production target	Document						C												M																
<River maintenance water>																																				
River maintenance water (discharge and water depth)	Data	M	C	C			M		C	C				C			C		C					C			C	C	C		C				
Present river discharge	Data	M					M																		C										
Present river water quality	Data	C		M			M																		M										
<Hydro-electric power>																																				
Supply Record	Data	C	C	C	C	C	C		C					C			C		C					C			C	M	C		C	C			Water demand of other major water users will be able to check.
Water demand (hourly pattern)	Data	C	C	C	C	C	C		C	C				C			C		C					C			C	M	C		C	C			
Demand forecast forecasting / basic data	Data	C	C	C			C							C			C		C									M	C						
Generation Record	Data						C																					M							
another source for power generation	Document						C												C									M							
(Water resources)																														C						
Hydrological data	Data				C		M							M	C	C																				It will be easy to know the condition of river and reservoirs for planning of water resources

Table A9-10 Information for Water Resources Management (5/6)

Works and duties / Information	Type of Information	Agencies related to Water Resources Management in the Brantas River Basin: 1 DGWRD	2 DPU Cipta Karya	3 Kanwil PU	4 PKB (Kali Brantas)	5 PGKS (Gunung Kelud)	6 PJT (Jasa Tirta)	7 DGRLR (M. of Forestry)	8 Kanwil Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 BRLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp)	12 Kanwil Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PUT (East Java Irrig Project)	15 PIAT (East Java G.W. Irrig. Project)	16 DFERPIKAN (Fishery Service)	17 MIT (M.of Industry and Trade)	18 DPPRIND (Industry Service)	19 MME (M. of Mining & Energy)	20 DSTAMB (Mining Service)	21 MOE (M.of Environment)	22 BAPEDAL (Environ. Agency)	23 BRLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 MHA (M. of Home Affairs)	27 BAPPEDA/Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PrMMC (Water Management Commit.)	32 SATKORLAK PB (Disast. Coord. Unit)	33 DKK	34 BPPT	Problem	Effect by use of the System
Operation Record of reservoirs	Data				C		M								C	C																				development.
Forecasted water demand	Data	C	M	C	C		M							M	M	C	M		M											M	M						
Condition of reservoirs	Document, drawing	C			C	C		M	C	C		C		C	C	C					C									C	C						
Actual use of groundwater at each well	Data	C	C											C		C			C		M			C							C						
Condition of each well	Document, drawing	C	C											C		C			C		M			C							C						
Topographical map of project area	drawing, Data				C	C								C	C	C					C										C						
Present land use of project area	drawing				C	C				M		M	M	M	C	C	C												C								
Social Condition of project area	Document, Data	C			C	C								C															C								
Water resources development plans	Document, drawing	C	C	C	C	M		C	C	C	C	C	C	M	M	M	C		C	C	M			C				C	C	C	M						
Outline of implementation plans and work progress	Document	C			C	M		C	C	C	C	C	C	C	M	M			C	C	M			C						C	C						
(Water balance)																																					
Water demand	Data	C	M	C	C		C							M	M	C	M		M											C	M		C				
Amount of each intake water	Data						M							M	M		M		M												M		C				
River discharge	Data						M							C	C	C								C						C	C		C				
Inflow and outflow of reservoirs	Data						M							C	C															C	C		C				
Forecasted water demand in future	Data	C	M	C	C		C							M	M		M		M											C	M		C				
Water resources development plans	Document, data	C	C	C	M		C							M	M	M					M			C						M	M		C				
(Low water management system(LWMS))																																					
POLA	Data	C	C	C			M							C	C		C		C											C	C		M				
Measure against drought	Document	C	C	C	C		C							C	C		C		C											C	C		M				
Amount of each intake water	Data						M							M	M		M		M												M		C				
River discharge	Data						M																										C				
Inflow and outflow of reservoirs	Data						M																										C				
Condition of facilities for LWMS	Document, drawing	C			M		M							C																C						
Rehabilitation / Expansion plans	Document, drawing	C			M		M							C																C						
IV. WATER QUALITY MANAGEMENT																																					
Manuel for Water quality surveying	Document				C			C																M	C												

Problem: It is Difficult to use the data managed by many agencies concerned. Some telemetering data is not accurate, and the accurate data on paper is not useful in PJT.

Effect by use of the System:
- development.
- It will be easy to know major useful information for planning of water resources development.
- It will be easy to know the work progress.
- It will be easy to know the major information for evaluation of water balance.
- It will be easy to know the condition of river and reservoirs against the drought.

Table A9-10 Information for Water Resources Management (6/6)

Works and duties / information	Type of information	Agencies related to Water Resources Management in the Brantas River Basin: 1 DGWRD	2 OPU Cipta Karya	3 Kanwil PU	4 PKB (Kali Brantas)	5 PGKS (Gunung Kelud)	6 PJT (Jasa Tirta)	7 DGPLR (M. of Forestry)	8 Kanwil Kehutanan (Forestry)	9 DPKT (Forestry & Soil Conserv.)	10 SRLKT (Land Rehab. Agency)	11 Perum Perhutani (Forestry Corp.)	12 Kanwil Pertanian (Agriculture)	13 Dinas Pengairan (PWRS)	14 PUT (East Java Irrig Project)	15 PJAT (East Java G.W. Irrig. Project)	16 DPPERIKAN (Fishery Service)	17 MIT (M. of Industry and Trade)	18 DPRIND (Industry Service)	19 MME (M. of Mining & Energy)	20 DIST.AMB (Mining Service)	21 MOE (M.of Environment)	22 BAPEDAL (Environ. Agency)	23 BBLH (Environ. Bureau)	24 MOH (M. of Health)	25 Dinas Kebersihan (Sanitation Service)	26 MHA (M. of Home Affairs)	27 BAPPEDA Local Govt.	28 PT PLN	29 PDAM (Water Supply Company)	30 Dam Safety Unit	31 PWMC (Water Management Comm.)	32 SATKORLAK PB (Disast. Coord. Unit)	33 KKK	34 BPPT	Problem	Effect by use of the System
Water quality data	Data (monthly report)				C		M																	C											There is Duplication of water quality monitoring by several agencies.	Data will be monitored economically (to avoid duplication by the intentional monitoring).
	Data (annual report)		C				C							C			C							M									C			
	Data (annual repor)	C		M										C																						
Result of Water quality simulation	Data		C				M							C			C		C		C			C						C					WQMPCS is used only in PJT.	WQMPCS will be used effectively by PJT and other agencies concerned with pollution control.
V. RIVER ENVIRONMENT																																				
(Land use in river area)																																				
Regulation for land use in river area	Document	M	C	C		C	C																	C			C								
Present land use in river area	Drawing	C		C	C	C	M		C															C			C								
Management plan of land use in river area	Document, Drawing	C	C	C	C	C	M		C															C			C								
(Biota in the river area)																																				
Regulation for river environment conservation	Document	C		C			C		C								C					C	M	M		C									
River environment (biota in river area)	Document	C		C			C		C								C					C	C	M		C	C								River environment will be understood easily by agencies concerned.
Problem of river environment (biota in river area)	Document	C		C			C		C								C					C	C	M		C	C								
Environmental management plan	Document	C		C			C		C								C					C	C	M		C	C								
(Recreation in river space)																																				
Use of facilities (rate of operation)	Data	C		C			M																													
Condition of facilities for recreation in river area	Document	C		C	C	C	M																													
Development / improvement plan	Document, Drawing	C		C	C	C	M																													

Table A9-11 Information to be Collected

Kind of Information		Watershed Management	Flood Control Management	Water Quantity Management/ Water Resources	Water Quality Management	River Environment Management
Accumulated Data	General Information	Text of laws, regulations, and standards				
		Contents of operation manual				
		Outline of existing reports				
	Basic Data of River Basins	Socio-economic situation (population, households, and production of the basin)				
		Land information Land use map Maps on land slide and erosion Geologic map Topographic map	Information on flood fighting system			
	Information on Projects and Plans	Information on plans River basin conservation plan Land slide control plan Sabo plan	Information on plans Flood control plan River improvement plan	Water resources development plan Facility rehabilitation, extension plan	Pollution control plan	Environmental management plan Development of recreation facilities, rehabilitation plan
		(Outline of the Plan and its Progress)				
				POLA Water supply plan domestic, irrigation brackish, industrial hydro-electric power		
	Observed Information		Observation results precipitation, river water level, river discharge volume, water level of reservoir, and total discharge volume	Water supply records domestic, irrigation brackish, industrial hydro-electric power	Results of water quality observation	
			Records of gate operations			
	Information on River Basins	Results of investigations Riverbed material investigation Sand sampling investigation Investigation of land slide and erosion	Survey results Survey results of rivers and reservoirs Flood damage assessment			Environmental assessment
		Survey on present condition of erosion control barriers	Survey on conditions of flood control facilities and observation facilities	Survey results on facilities Low water observation facilities Intake facilities Irrigation facilities Fishpond		
	Information of Calculation Results, etc.			Water demand forecasting domestic, irrigation brackish, industrial hydro-electric power	Simulation results of Water Quality Monitoring Pollution Control System	
Real-time Information	Observed Information		Observation precipitation, river water level, river discharge volume, water level of reservoir, and total discharge volume	Actual situation of water supply	Actual condition of water quality	
			Actual situation of gate operations			
			Results of flood forecasting Flood warning			

Table A9-12 Information to be Managed in Inter-agency Information System (1/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
PJT head office	O	O		Text of laws	Text	Collection and obtain permission of use Manual input	Electronic data files
				Statistical data (socio-economic situation)	Table	Collection and obtain permission of use Preparation of tables	Electronic data files
				Topographic map	Image	Electronic filing by scanning	Original drawings, Electronic data files
				Basic data (inventory of structures, flood fighting system)	Text, table, and image	Preparation of documents (or use existing documents) Electronic filing by scanning	Documents, original drawings, Electronic data files
				Survey results (including topographic survey)	Outline (image, table, picture, etc.) Table Topographic survey data	Preparation of outline Electronic filing by scanning Result data processing	Original reports, Electronic data files
				Hydrological data	Table	Data collection from FFWS Data input and processing (data other than FFWS) Preparation of table	Electronic data files
				Water quality data	Table	Data collection from FFWS (2 stations) Data processing and input at Malang Laboratory Preparation of tables	Electronic data files
				Survey results (for delivery) Flood damage assessment Monthly report on rivers Water quality	Reports (for delivery) Electronic mail for acknowledgement of the delivery	Preparation of reports Preparation of electronic mails	Original reports Electronic data files of the electronic mails
				Progress of projects	Outline (progress)	Preparation of outline (fixed format)	Original progress reports, Electronic data files of outlines
				Information on existing reports	List	Preparation of list	Original reports Electronic data files
				Present condition of rivers (water volume, water quality)	Information by image of real-time condition of rivers	Collection of real-time data from FFWS Process the data into image data	Electronic data files
PJT(SURABAYA)		O		Progress of projects	Outline (progress)	Preparation of outline (fixed format)	Original progress reports, Electronic data files of outlines
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
Sutami		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files

Table A9-12 Information to be Managed in Inter-agency Information System (2/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
Wlingi		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Lodoyo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Selorejo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tulungagung inlet gate		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tulungagung pump station		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Wonorejo		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Segawe		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Tiudan		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Mrican		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Bening		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Jatimlerek		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Menturus		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
New Lengkong		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
Mlirip		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files

Table A9-12 Information to be Managed in Inter-agency Information System (3/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
Gunungsari		O		Record of operation	Table	Manual input and automatic calculation of discharge volume and preparation of table	Original recording sheets, Electronic data files
WQ Laboratory (Mojokerto)				Observation, test, and water quality data	Table	Manual input	Original recording sheets, Electronic data files
BRLKT	O			Information of drawings	Image	Electronic filing by scanning	Original drawings, Electronic data files
				Survey results	Outline Table	Preparation of outline Processing of survey results	Original reports, Electronic data files
				Precipitation data	Table	Manual input	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
PDAM	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets, Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
Dinas Pengairan	O	O		Precipitation data	Table	Manual input	Original recording sheets, Electronic data files
				Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files

Table A9-12 Information to be Managed in Inter-agency Information System (4/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
(Dinas Pengairan)				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
DPRIKAN	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets. Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets. Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports. Electronic data files
DPRIND	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets. Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets. Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets. Electronic data files
				Results of treatment of industrial waste water Data on water quality	Outline Table (water quality data)	Preparation of outline of the results Manual data input	Original recording sheets. Electronic data files (documents and numeric data)
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports. Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports. Electronic data files

Table A9-12 Information to be Managed in Inter-agency Information System (5/5)

Organization	Member of BWMC	Observe river information	Observe water quality data	Information to be managed	Form of Information	Data processing to be required for common use of data and information	Method of data management
PT.PLN	O	O		Water use plan (water demand)	Outline Table	Preparation of outline of the plan	Original recording sheets, Electronic data files
				Water use forecasting	Table	Preparation of outline of the forecasting	Original recording sheets, Electronic data files
				Actual water use records	Outline of activities Table (Consumption volume)	Preparation of table of water consumption records (consumption items and volume)	Original recording sheets, Electronic data files
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
BAPEDALDA	O	O	O	Results of environmental assessment on rivers	Outline	Preparation of outline of the plan	Original recording sheets, Electronic data files
				River environmental management (including water quality) Periodical reports	Outline	Preparation of outline (electronic mail)	Electronic data file of electronic mails
				Progress of projects	Outline (progress)	Preparation of outline (electronic mail)	Original progress reports, Electronic data file of electronic mails
				Information on existing reports	List	Preparation of list	Original reports, Electronic data files
DPU Cipta Karya			O	Results of treatment of urban waste water Water quality data	Outline Table (water quality data)	Preparation of outline of the results Manual data input	Original recording sheets, Electronic data files (documents and numeric data)
DPERTA			O	Water quality data	Table (water quality data)	Manual data input	Original recording sheets, Electronic data files
DKES			O	Water quality data	Table (water quality data)	Manual data input	Original recording sheets, Electronic data files

Table A9-13 Comparison dedicated service lines with ISDN

(unit: Rp.)

	Unit	Dedicated service lines			ISDN			remarks
		Quantity	Unit price	Amount	Quantity	Unit price	Amount	
Equipment & set up cost	access point	47	800,000	37,600,000	47	1,500,000	70,500,000	
Monthly charge for servic	user	1	5,920,772	5,920,772	47	80,000	3,760,000	
(speed: 64kbps)		5	4,511,530	22,557,650				
		23	2,216,620	50,982,260				
sub-total				79,460,682				
1 Year charge				953,528,184			45,120,000	
Charge for call	pulse	0	-	0	9	150	1,286	one call of one minute
					514	150	77,143	one call of one hour
1 Year charge				0			1,812,857,143	
(Annual cost)								
1 st year				991,128,184			1,928,477,143	
2 nd year -				953,528,184			1,857,977,143	

(data source of change and cost: information from PT.TELKOM in 1998)

Note

1) access points are as follows:

- PJT: Head office, branch office(Surabaya)
  Dam/weir offices:
  Sunggoruh, Sutami, Wlingi, Lodoyo, Selorejo, Inlet gate, Tulungagung pumpstation, Wonorejo, Segawa, Tuidan, Mrican, Bening, Jatimlerek, Menturus, New lengkong, Mlirip, Gunungsari

- Concerned agencies (14)
  Kanwil PU, Kanwil Kehutanan, BRLKT, Kanwil Pertanian, Dinas Pengairan, DPRIKAN, DPRIND, DISTAMB, BBLH(BAPEDALDA), BAPEDA, PT. PLN, PDAM, DPERTA, DKES

- Regency's office (9) for DPKT & Agricultural cooperation associations
- Others (Project office(5) in temporarily)

2) Charge for dedicated service lines are related to the distance of lines leased.

(Speed: 64kbps) US$ 1 = Rp. 2446.6

Distance(km)	-25	25-100	100-200	200-300	300-600	600-1000	1000-
Charge (Rp.)	2,216,620	4,511,530	4,773,317	5,066,909	5,920,772	7,082,907	8,506,828

assumption:
Distance of lines of all PJT offices are 500km
Distance of lines of conserned agencies are 25km or less.
Distance of lines of project office in temporarily are 25-100km.

3) assumption of charge for call in 1 year

user	47 user
using hour	2 hour/day
working days	250 days/year

Table A9-14 Hardware and Software

Hardware and Software	Quantity	assumption
PJT head office (including Laboratory in Malang)		(LAN for 400 persons)
Network server	6	Primary name server, Secondly name server, Mail server, Database server, File server & WWW server, Firewall server
UPS	3	one piece for 2 PC servers
Personal computer (as terminal)	200	one for two persons
Printer	24	one for President director, Directors and each grope
Scanner	2	for Directorate Technical Affairs & Directorate Infrastructure
Switching HUB	2	for server to LAN
HUB	20	for each grope
Ruter	1	
Software for network computing	1	
Software for firewall	1	
Software for visualization of river condition using FFWS data through database system	1	
PJT Surabaya office		(LAN for 100 persons)
Network server	3	Name server + Mail server, Database server, File server + WWW
UPS	2	one piece for 2 PC servers
Personal computer (as terminal)	50	one for two persons
Printer	5	for each grope/5 gropes of 20 persons
Scanner	1	
Switching HUB	1	for server to LAN
HUB	5	
Ruter	1	
Dam and weir offices		(17: Sengguruh, Sutami, Wlingi, Lodoyo, Selorejo, Tulungagung inlet gate, Tulungagung pump station, Wonorejo, Segawe, Tiudan, Mrican, Bening, Jatimlerek, Menturus, New lengkong, Mlirip, Gunungsar)
Personal computer (as terminal)	34	one office, two terminal PC
UPS	17	
Printer	17	
Ruter	17	
Laboratory in Mojokerto		in New lengkong weir office
Personal computer (as terminal)	5	
UPS	1	
Printer	1	
Related agencies		(14: Kanwil PU, Kanwil Kehutanan, BRLKT, Kanwil Pertanian, Dinas Pengairan, DPRIKAN, DPRIND, DISTAMB, BBLH(BAPEDALDA), BAPEDA, PT. PLN, PDAM, DPERTA, DKES 9: Regency's offices for DPKT & Agricultural cooperation associations 5: project offices in temporarily)
Personal computer (as terminal)	74	two terminal PCs for each organization/DPKT & Agricultural cooperation associations are counted separately
UPS	37	DPKT & Agricultural cooperation associations are counted separately
Printer	37	DPKT & Agricultural cooperation associations are counted separately
Ruter	28	

Table A9-15 Cost Estimate

	unit	Quantity	Unit price (10^3 JPY)	Amount (10^3 JPY)	Unit price (10^3 Rp.)	Amount (10^3 Rp.)	Equivalent cost (10^6 Rp.)	Remarks
1. Improvement of Existing FFWS								
1.1 Improvement of Water Level Gauging Stations								
Shifting	Ls	3	3,000	9,000				
Repairing	Ls	2	1,000	2,000				
Extenuation cable	m	300	7	2,100				(100 m for one station)
total of 1.1				13,100			280	
1.2 Installation of PC for outflow calculation								
Personal computer	piece	17	300	5,100				
Software for outflow calculation	set	1	400	400				
total of 1.2				5,500			118	
1.3 Modification of FFWS for change of H-V curve in FFWS								
Software	set	1	7,100	7,100				
Additional Hardware	Ls	1	900	900				
Personal computer	piece	1	300	300				
total of 1.3				8,300			178	
1.4 Establishment of Hydrological database system connected to FFWS and Analysis System								
Software(data transmission and processin	Ls	1	5,000	5,000				
Hardware	Ls	1	900	900				
Personal computer	piece	1	300	300				
total of 1.4				6,200			133	
Total of 1.1-1.4				33,100			709	
1.5 Egineering Services (10% of 1.1 - 1.4)				3,310			71	
1.6 Administration (5% of 1.1-1.4)				1,655			35	
1.7 Base Cost (1.1-1.6)				38,065			815	
1.8 Physical contingency (15% of 1.7)				5,710			122	
Grand total (1.7 + 1.8)				43,775			938	
2. Establishment of inter-agency Information System (including information system for low water management and water quality database system)								
2.1 Equipment and software for PJT Head office (including Laboratory in Malang)								
Network server	set	6	2,000	12,000				
UPS		3	300	900				
Personal computer (terminal)		200	300	60,000				
Printer		24	70	1,680				
Scanner		2	100	200				
Switching HUB		2	600	1,200				
HUB		20	90	1,800				
Ruter		1	500	500				
Software for network conputing		1	10,000	10,000				
Software for firewall		1	2,000	2,000				
Software for making visual image (river co	Ls	1	10,000	10,000				
Joining INTERNET		1	50	50				
Installation of private line		1			800	800		
total of 2.1				100,330		800	2148	
2.2 Equipment for PJT branch office								
Network server	set	3	2,000	6,000				
UPS		2	300	600				
Personal computer (terminal)		50	300	15,000				
Printer		5	70	350				
Scanner		1	100	100				
Switching HUB		1	600	600				
HUB		5	90	450				
Ruter		1	500	500				
Installation of private line		1			800	800		
total of 2.2				23,600		800	506	
2.3 Equipment fore dam/weir offices								
Personal computer (as server & terminal)		34	300	10,200				
UPS		17	300	5,100				
Printer		17	70	1,190				
Ruter		17	500	8,500				
Installation of private line		17			800	13,600		
total of 2.3				24,990		13,600	548	
2.4 Equipment for laboratory in Mojokerto								
Personal computer (as terminal & server)		5	300	1,500				
UPS		1	300	300				
Printer		1	70	70				
total of 2.4				1,870			40	
2.5 Equipment for related agencies								
Personal computer (as server & termina		74	300	22,200				
UPS		37	300	11,100				
Printer		37	70	2,590				
Ruter		28	500	14,000				
Installation of private line		28			800	22,400		
total of 2.5				49,890		22,400	1090	
Total of 2.1-2.5				200,680		37,600	4332	
2.6 Egineering Services (10% of 2.1 - 2.5)				20,068		3,760	433.2	
2.7 Administration (5% of 2.1-2.5)				10,034		1,880	216.6	
2.8 Base Cost (2.1-2.7)				230,782		43,240	4981.8	
2.9 Physical contingency (15% of 2.8)				34,617		6,486	747.27	
Grand total (2.8+2.9)				265,399		49,726	5729.07	

exchange rate: Yen 1 = Rp.21.4 (1997.6)

Table A9-16 Manpower Saving through Inter-agency Information System

Year	Averaged personnel expense (10^6 Rp./year)	Number of staff in PJT	Manpower saving (10^6 Rp./year)
1999	10.8	584	791
2000	11.4	584	831
2001	11.9	584	871
2002	12.6	584	916
2003	16.0	584	1,172
2004	17.0	584	1,242
2005	18.0	584	1,316
2006	19.1	584	1,395
2007	20.3	584	1,479
2008	21.5	584	1,568
2009	22.8	584	1,662
2010	24.1	584	1,761
2011	25.6	584	1,867
2012	27.1	584	1,979
2013	28.7	584	2,098
2014	30.5	584	2,224
2015	32.3	584	2,357
2016	34.2	584	2,499
2017	36.3	584	2,649
2018	38.5	584	2,808
2019	40.8	584	2,976
2020	43.2	584	3,155
Total			39,615

* Averaged personnel expense and number of staff are estimated by the Study team

Table A9-17 OM Cost Estimate

(FFWS)

Item	cost (million Rp.)	Remarks
Annual OM Cost	327 /year	1% of the construction & equipment cost of existing FFWS and expanded FFWS Refer to the following tables. JPY1=Rp.21.4 in 1997.6
Updating of PC	122	Price of PC for Improvement of existing FFWS Refer to Table A9.15
Updating of Existing FFWS Equipment	15,140	Current(1997.6) price of electric & electronic facilities of existing FFWS
Updating of Expanded FFWS Equipment (Wonorejo)	3,257	Estimated cost of of electric & electronic facilities of expanded FFWS based on price of facilities of existing FFWS
Automatically Water Quality Monitoring Equioment	856	Refer to the following table JPY1=Rp.21.4 in 1997.6

(Inter-agency Information System)

Item	cost (million Rp.)	Remarks
Annual OM Cost	50 /year	1% of the cost of hardware & software for Inter-agency Information System
Updating of PC and Accessories	3,994	Hardware cost for Inter-agency Information System Refer to Table A9.15
Subscription Fee to Internet Service Providers	51 /year	estimated based on general fee in Japan JPY200,000/month JPY1=Rp.21.4 in 1997.6
Lease of Private Line	954 /year	Refer to Table A9.13

Cost for Existing FFWS

Category	value in refering million Yen	Current Price million Yen
Civil Works (FFWS)	27	28
Equipment for FFWS	1,183	1,219

sourse: Brantas Middle Reachs River Improvement Project (II) Completion Report on River Improvement Works Dec. 1993
\106.4(in 1993)=\109.6(in 1997.6)

Cost Estimate of Equipment to be installed for expansion plan of FFWS at the Wonorejo Project

Items	Unit	Total cost (million Yen)
Wonorejo Dam (FFWS Monitoring Station)	Ls	51
Tulungagung Pump Station (FFWS Sub-master Station(New))	Ls	14
Modification of Master, Sub-master and Monitoring Stations of FFWS	Ls	31
(Water Level and Otflow Monitoring Station with Radio Communication Equipment)		
Segawe Weir	Ls	15
Tiudan Headworks	Ls	17
Jatimlerek Rubber Gate	Ls	15
Menturus Rubber Gate	Ls	15
(Outflow Monitoring Station)		
Mlirip Gate	Ls	5
(Water Level Gauging Station)		
Ngujang	Ls	6
Porong Canal	Ls	6
Mangetan Canal	Ls	6
Mrican Kiri	Ls	6
Mrican Kanan	Ls	6
(Water Quality Monitoring Station)		
Karangpilang	Ls	40
Pelayaran	Ls	40
Spare parts	Ls	7
Sub total		280

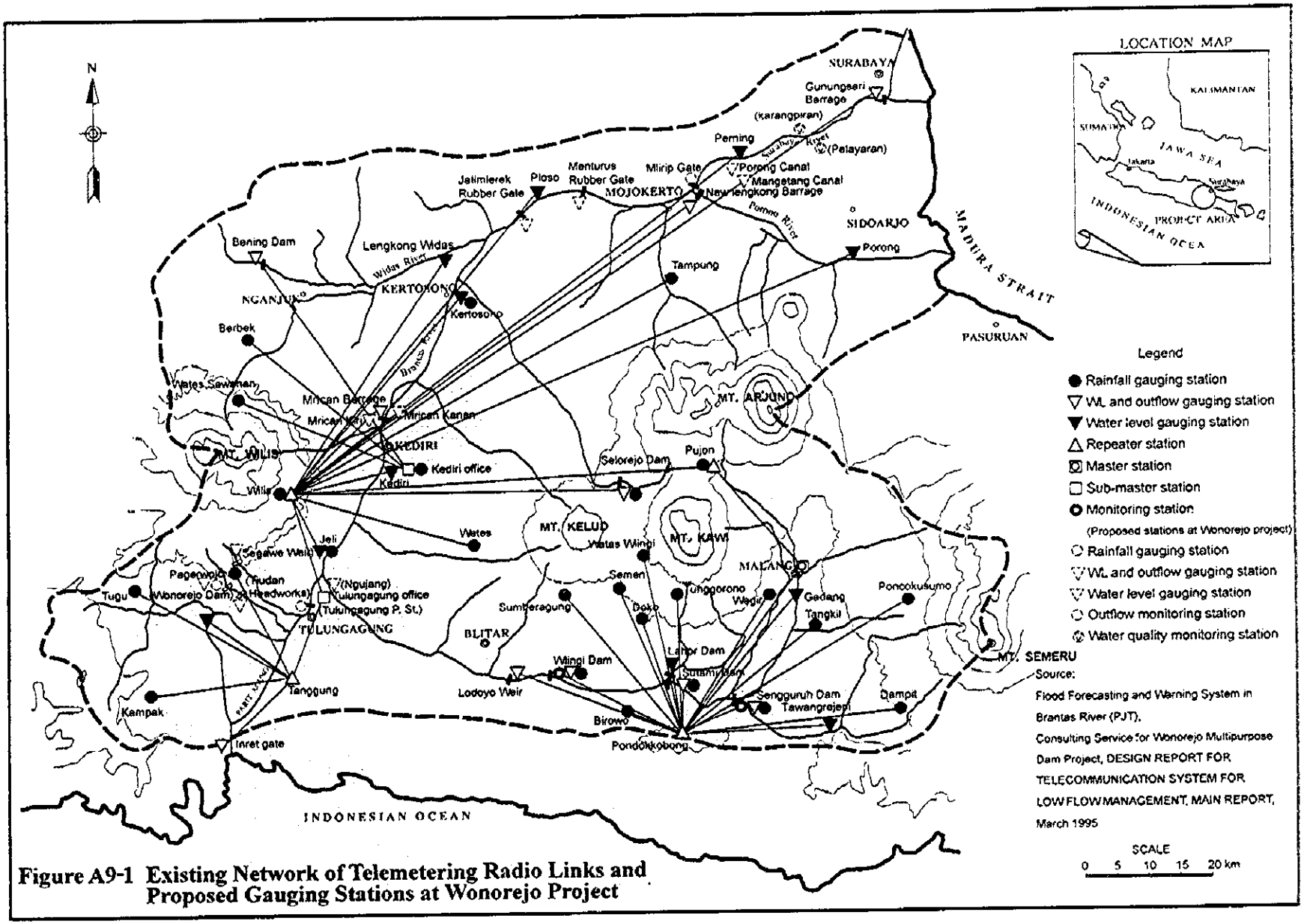

Figure A9-1 Existing Network of Telemetering Radio Links and Proposed Gauging Stations at Wonorejo Project

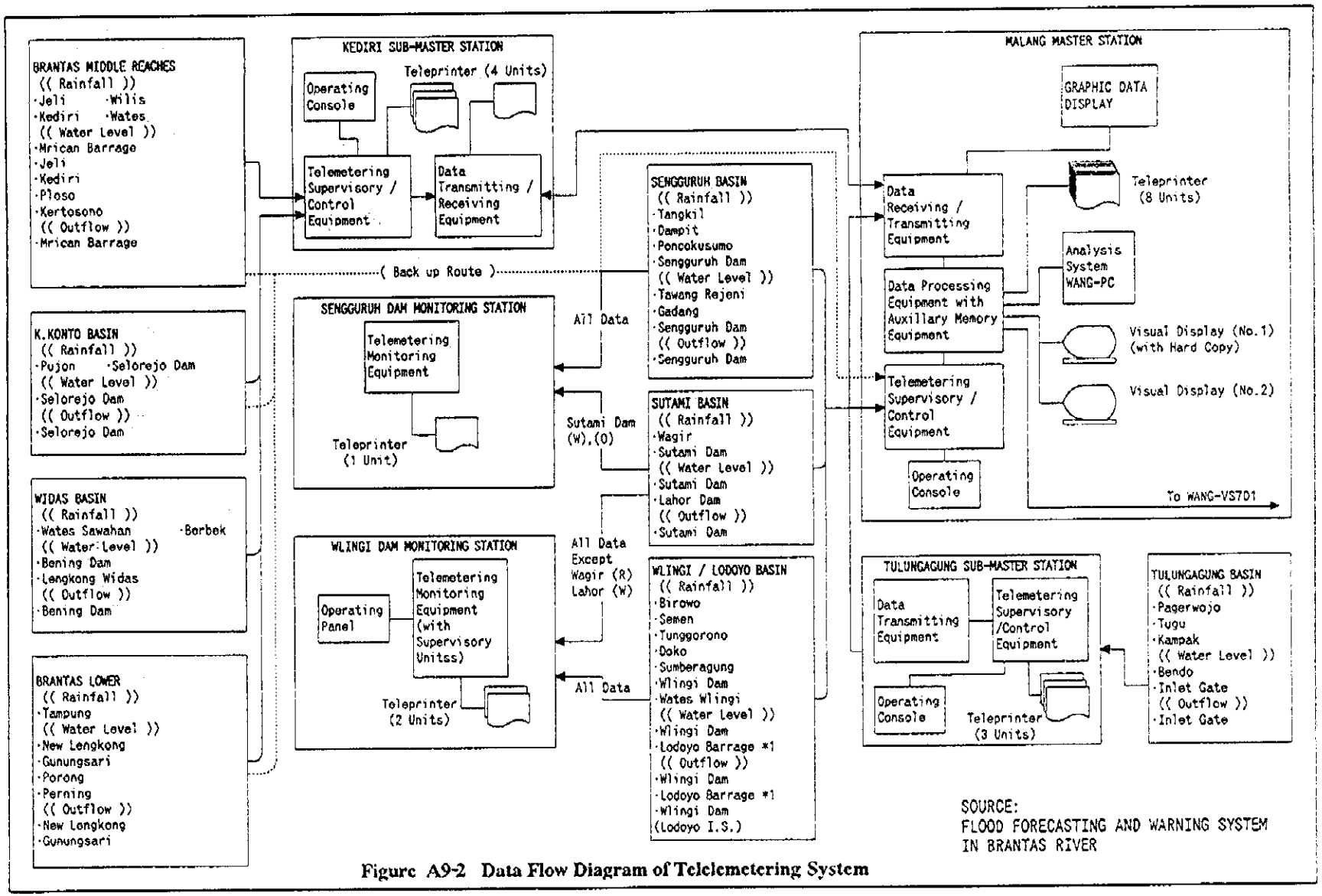

Figure A9-2 Data Flow Diagram of Telelemetering System

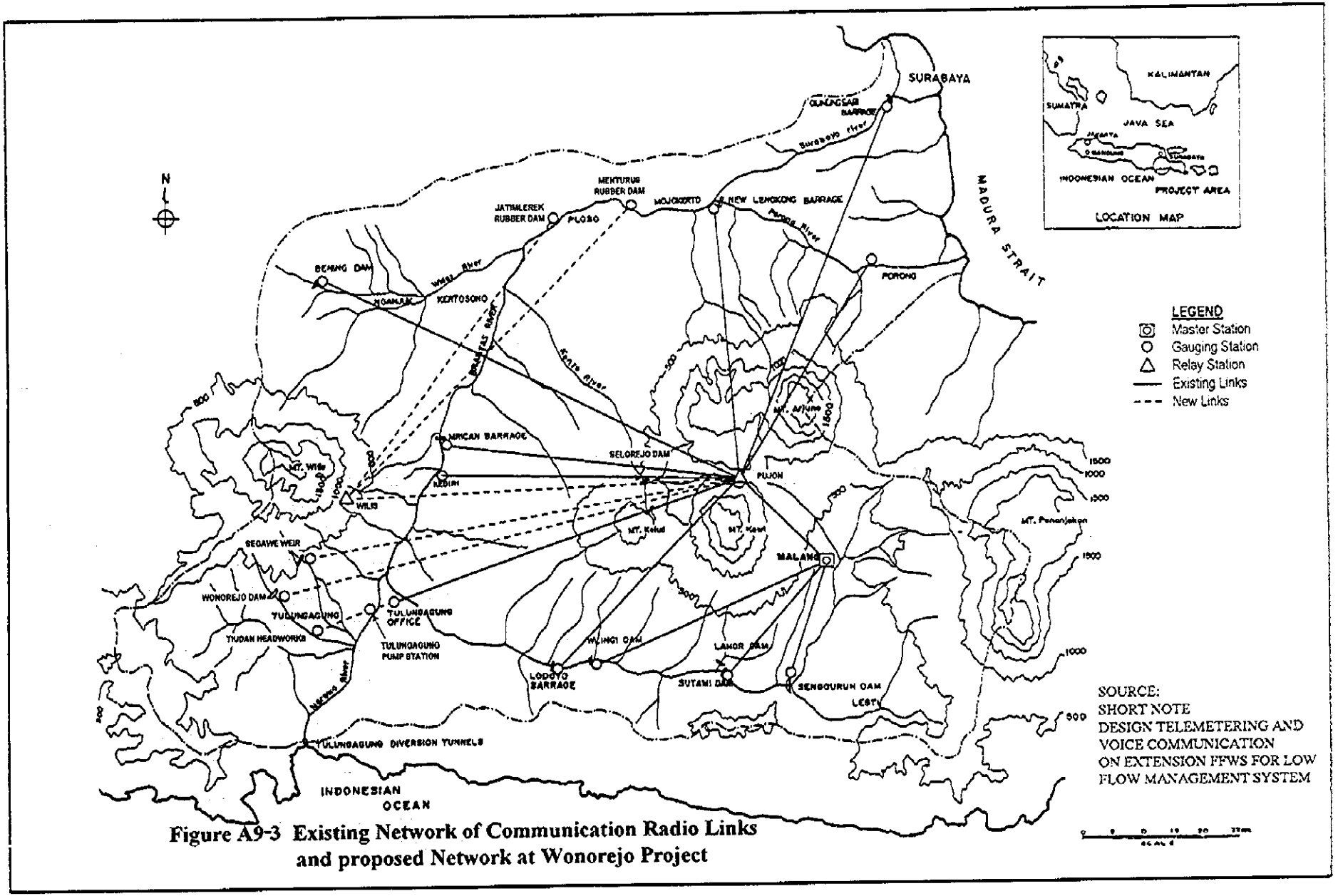

Figure A9-3 Existing Network of Communication Radio Links and proposed Network at Wonorejo Project

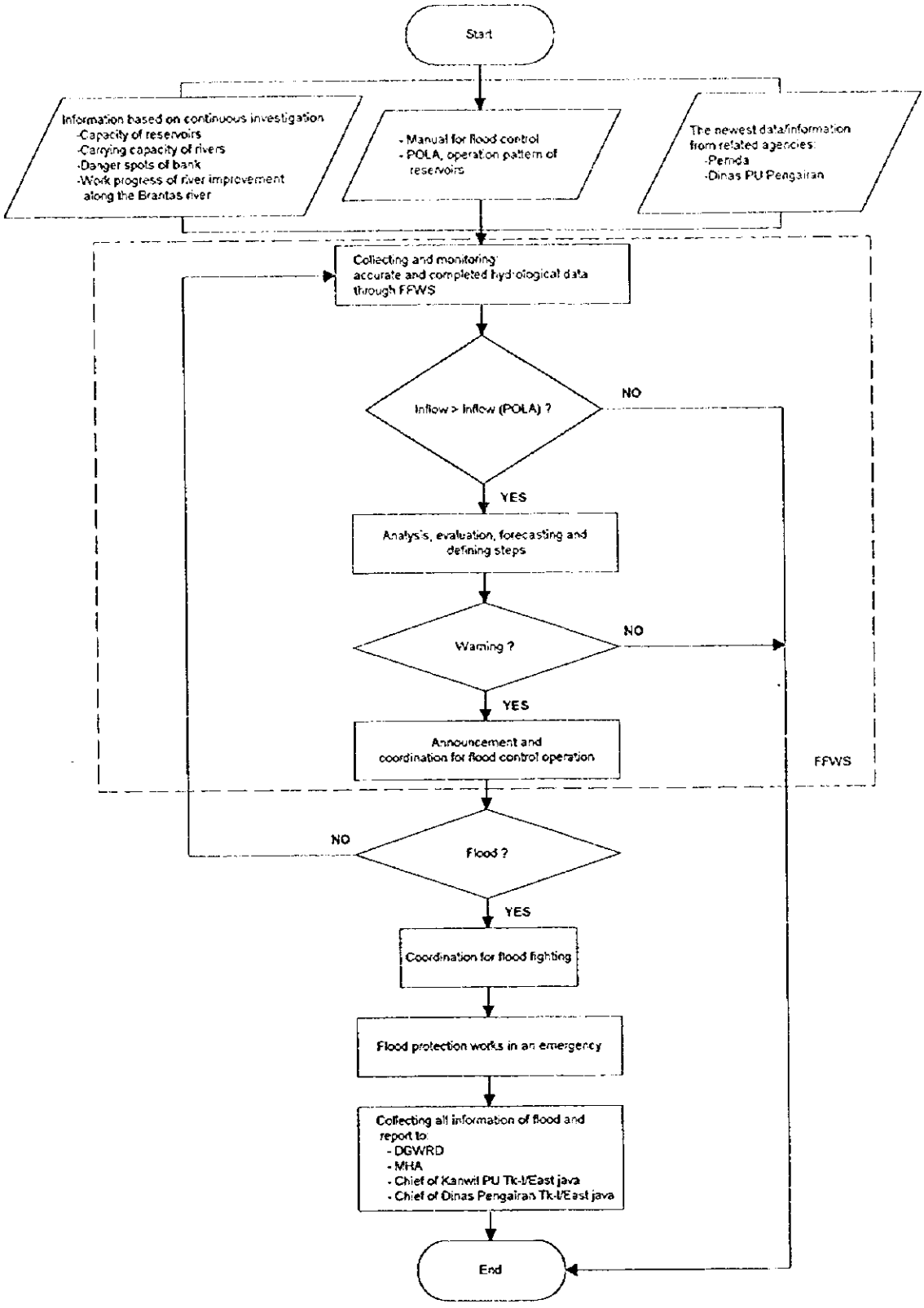

Figure A9-4 Main Flow of Flood Control

SOURCE:PJT

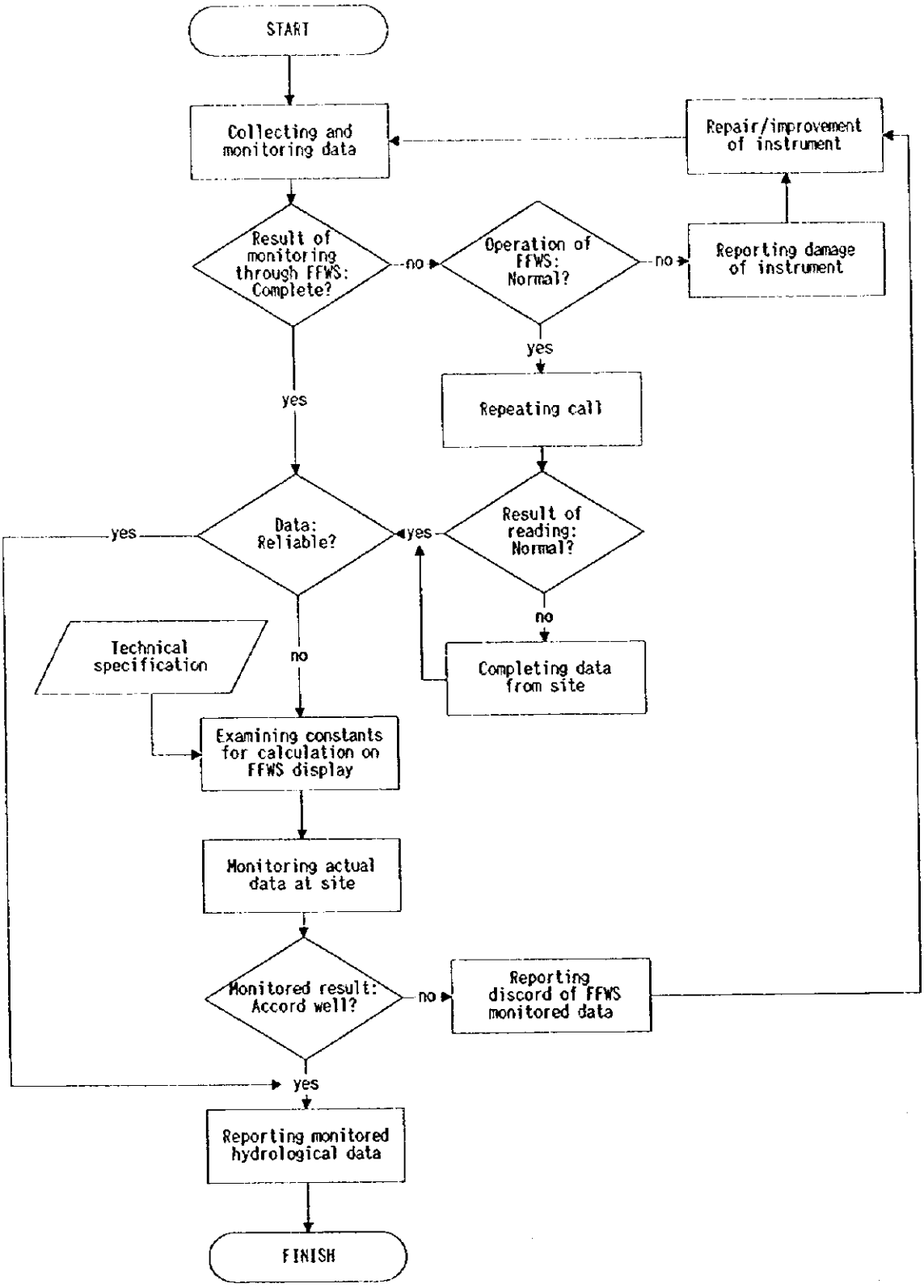

Figure A9-5 Flow of Hydrological Data Monitoring

SOURCE:PJT

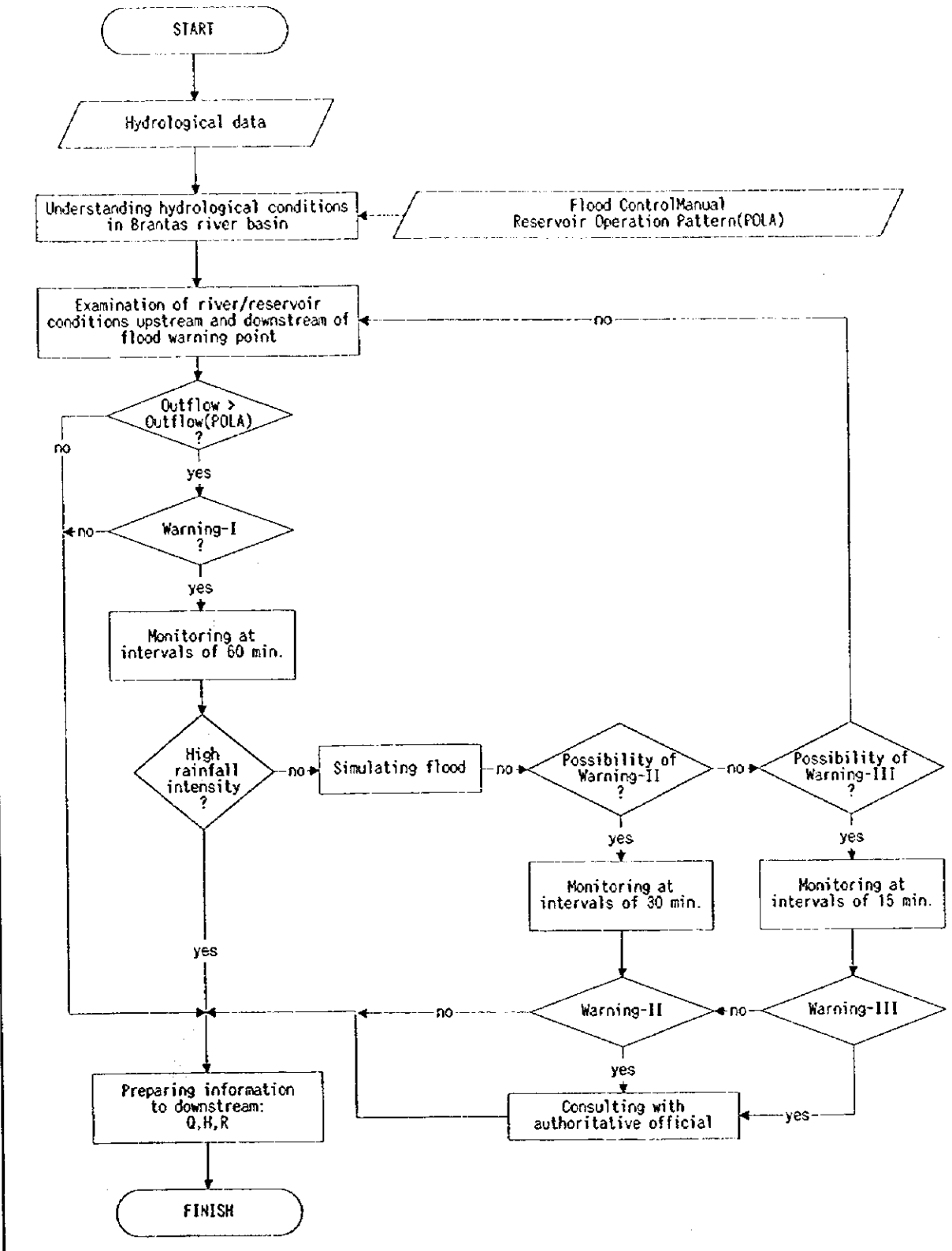

Figure A9-6 Flow of Procedures for Analysis, Evaluation, Prediction and Establishment of Flood Warning Levels

SOURSE:PJT

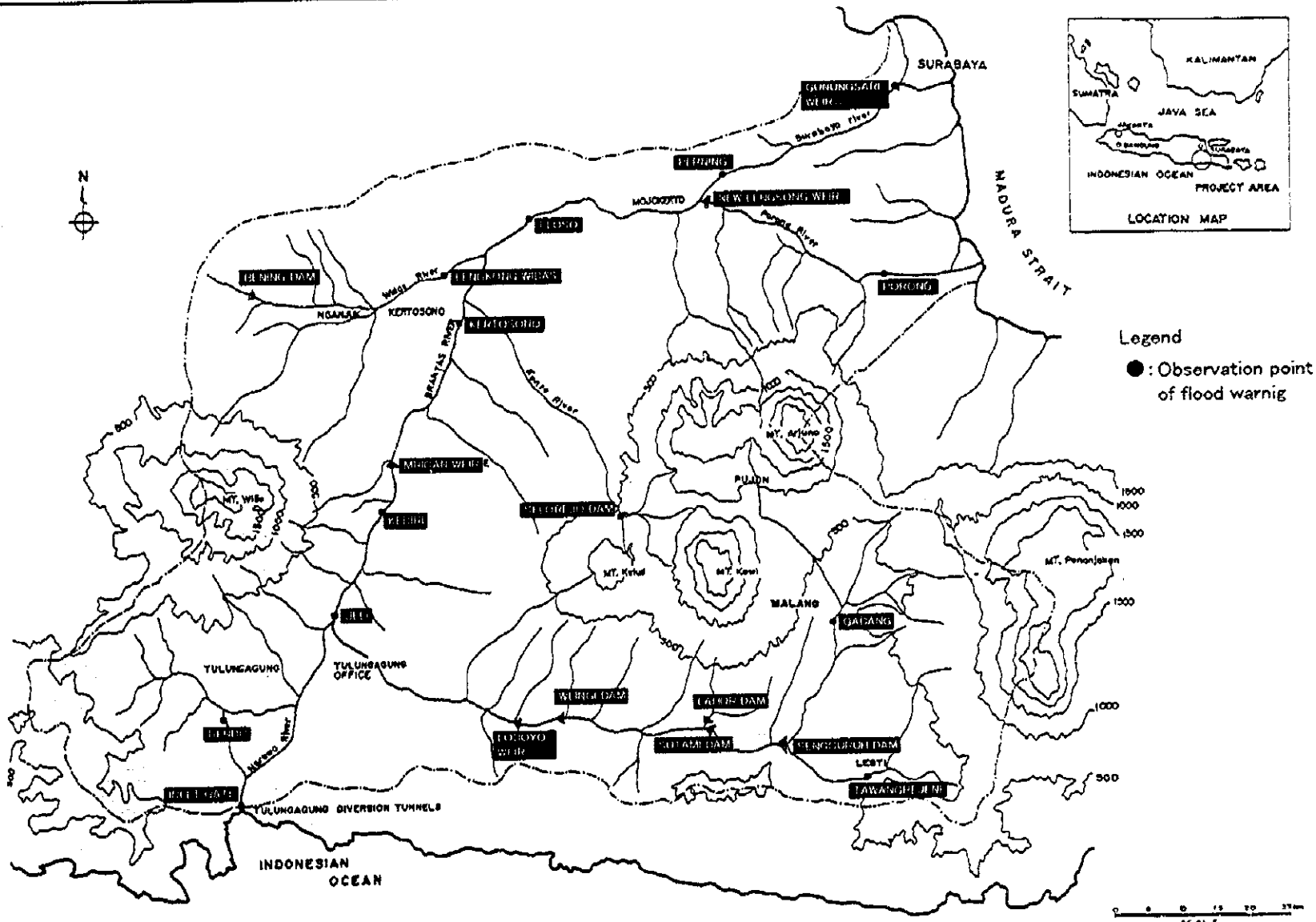

Figure A9-7 Observation Point of Flood Warning

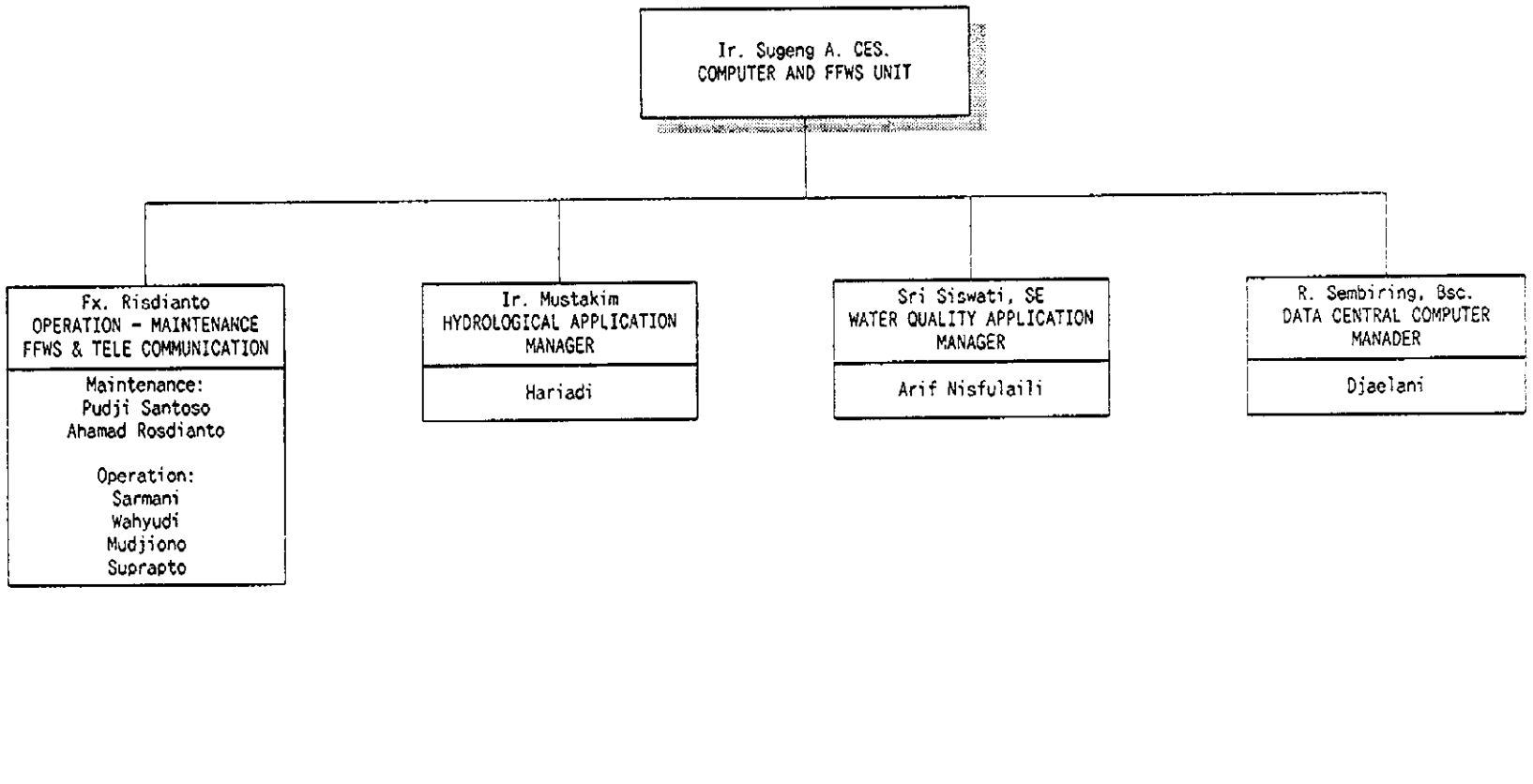

Figure A9-8 Organizational Structure of Computer and FFWS Unit
(As of August in 1997)

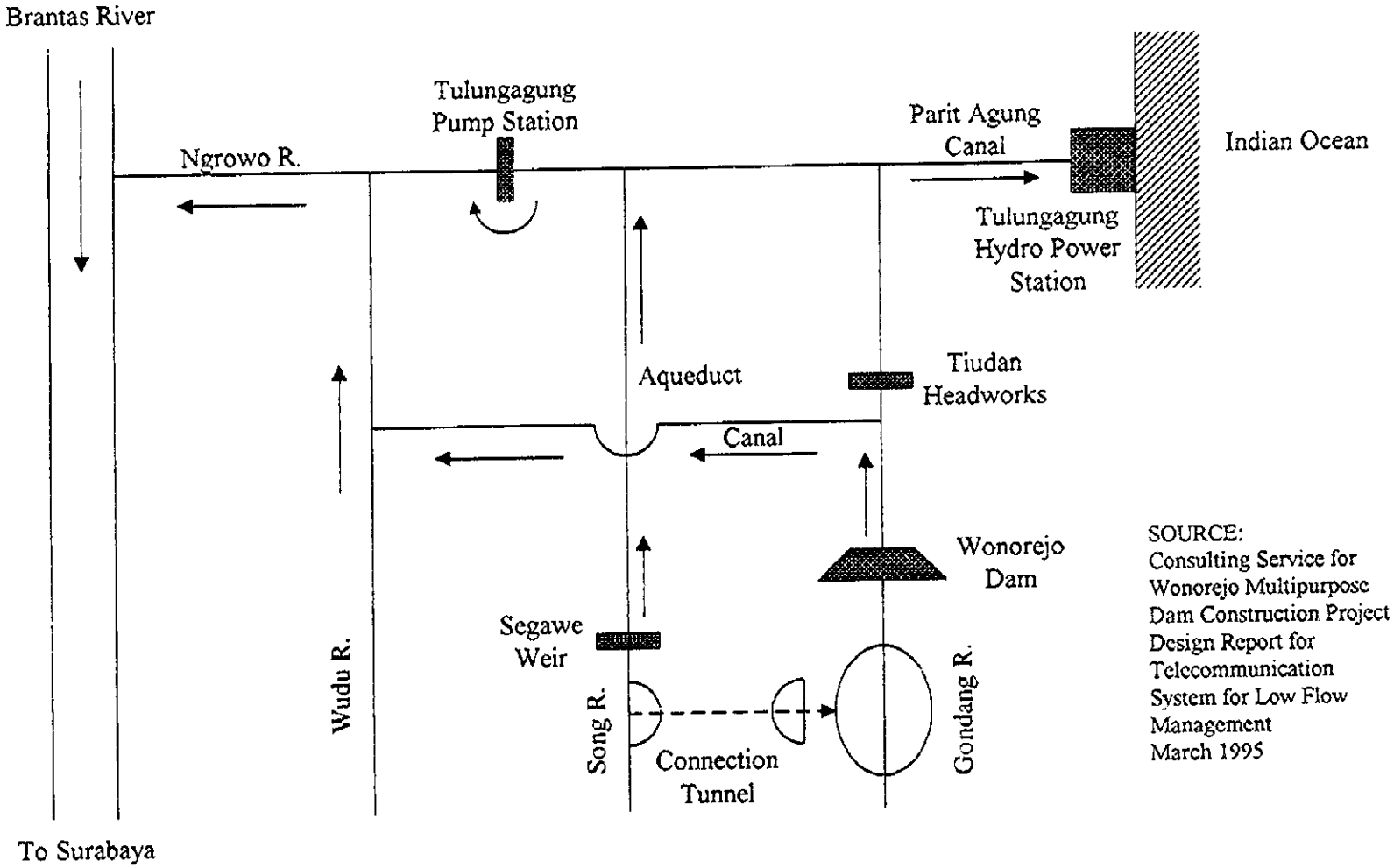

Figure A9-9 Ngrowo River Water Conveyance System

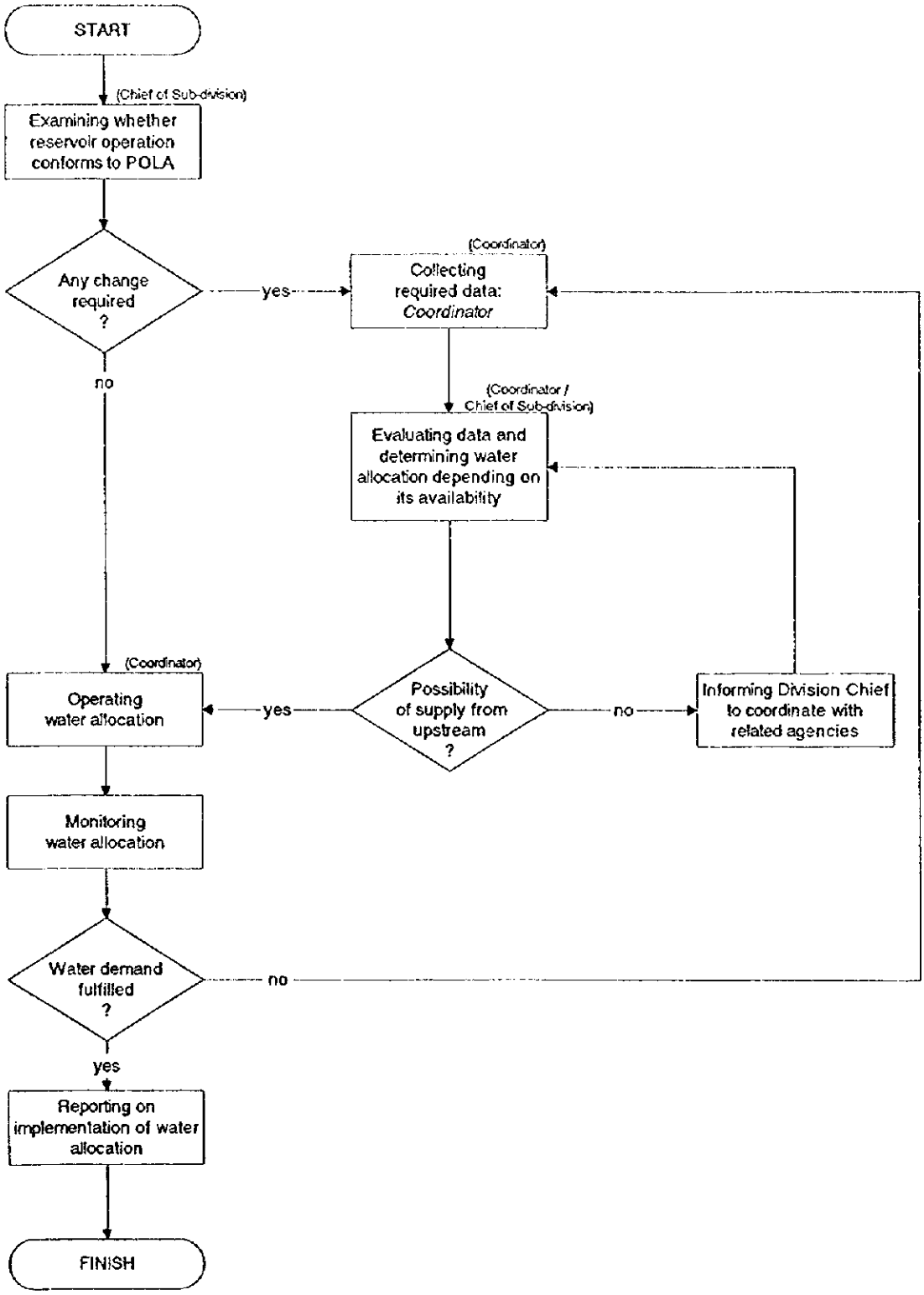

Figure A9-10 Flow of Principal Procedures on Daily Water Allocation

SOURCE: PJT

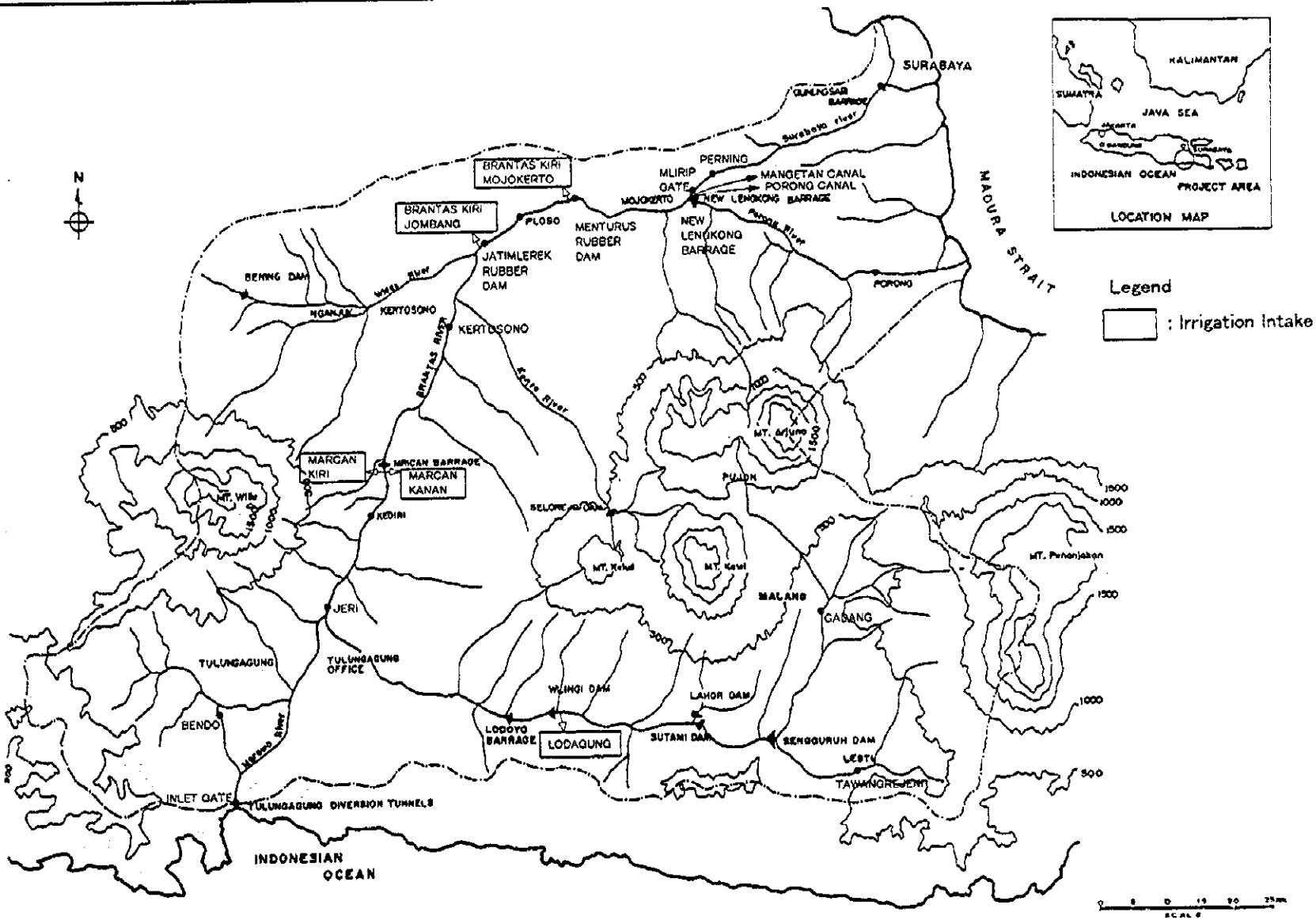

Figure A9-11 Low Flow Monitoring Point

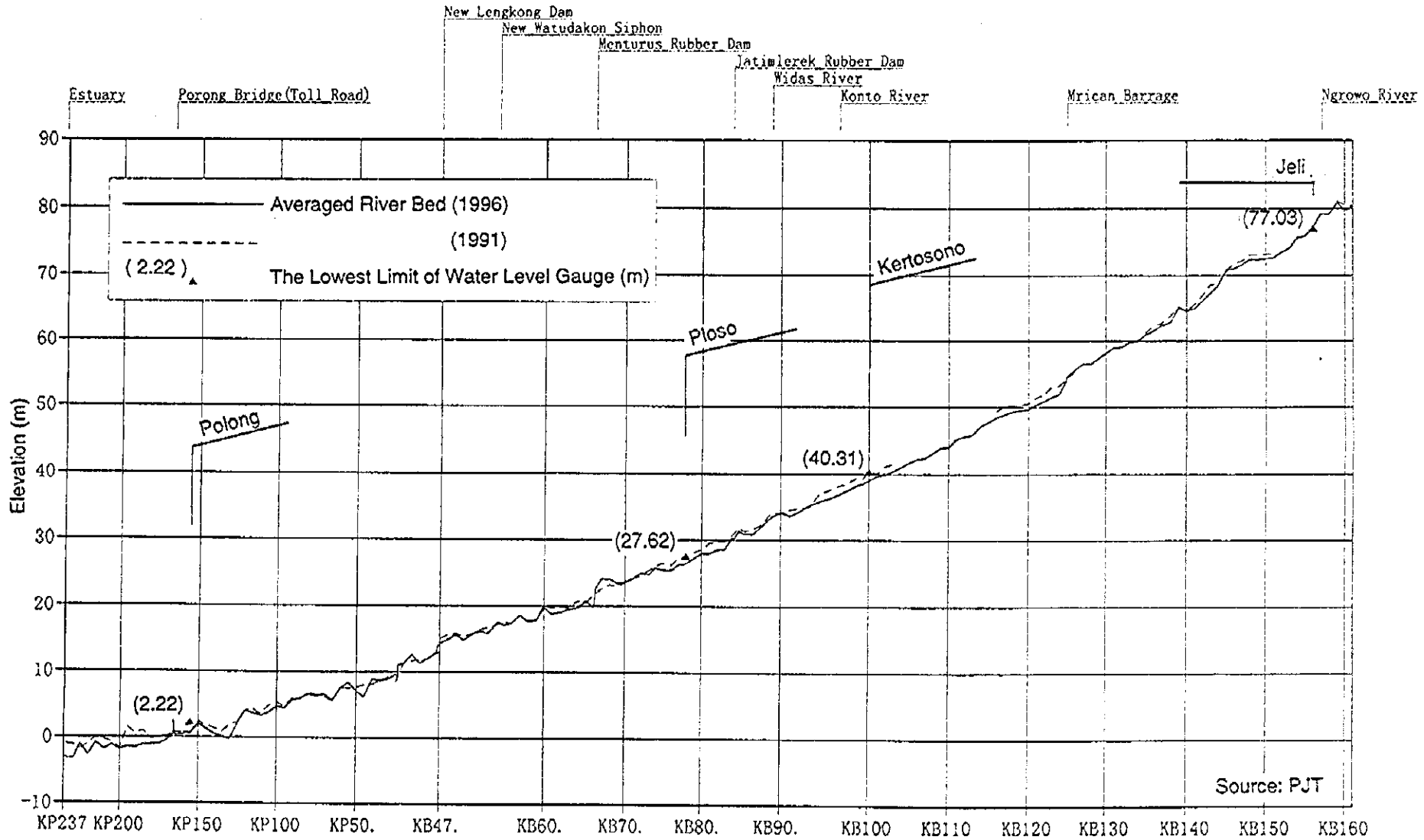

Figure A9-12 Lowest Limit of Water Level Gauge and Averaged River Bed of Brantas River

(Gadang Water Level Gauging Station)

Figure A9-13 Proposed Water Level Gauging Station Point (1/2)

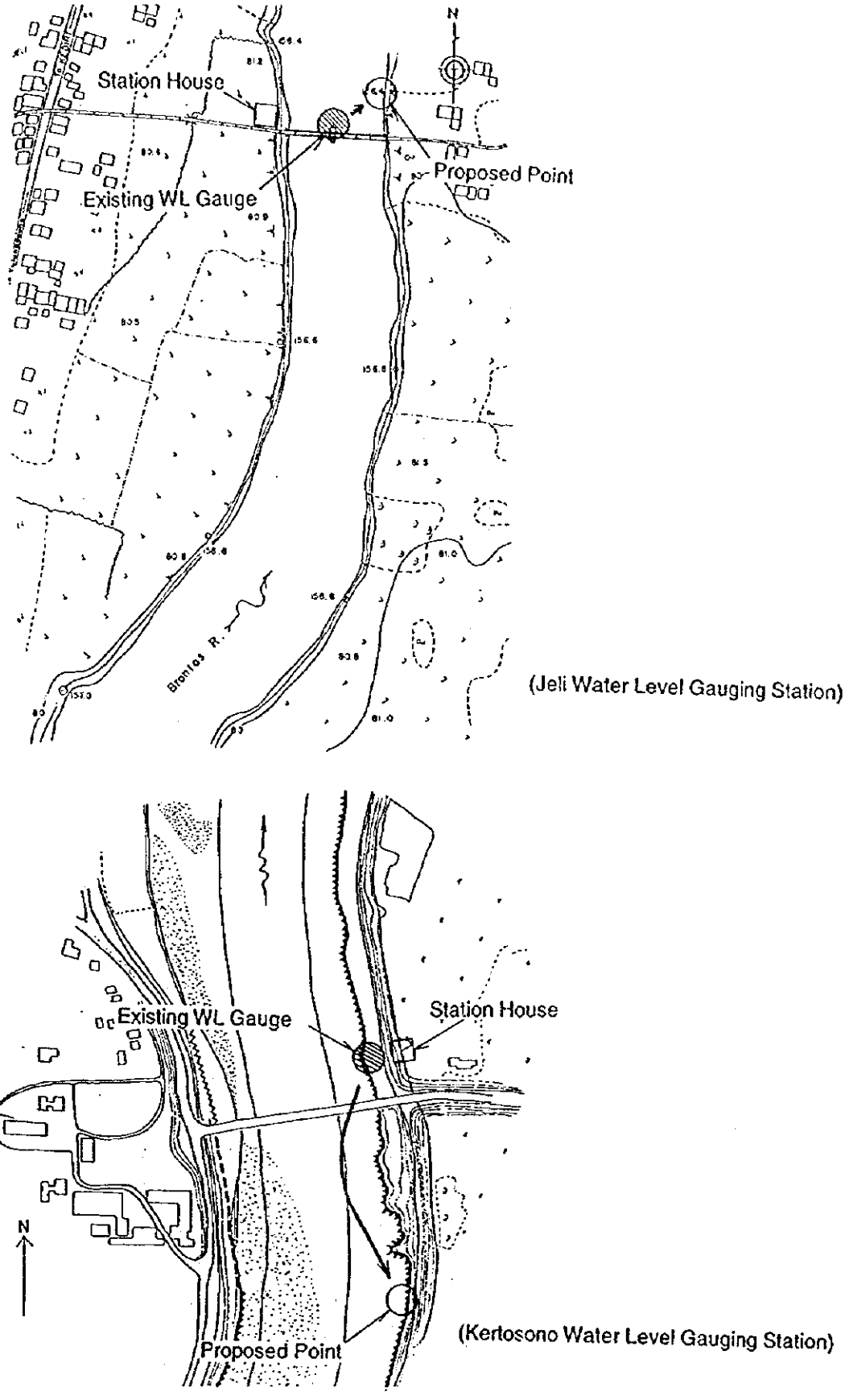

Figure A9-13 Proposed Water Level Gauging Station Point (2/2)

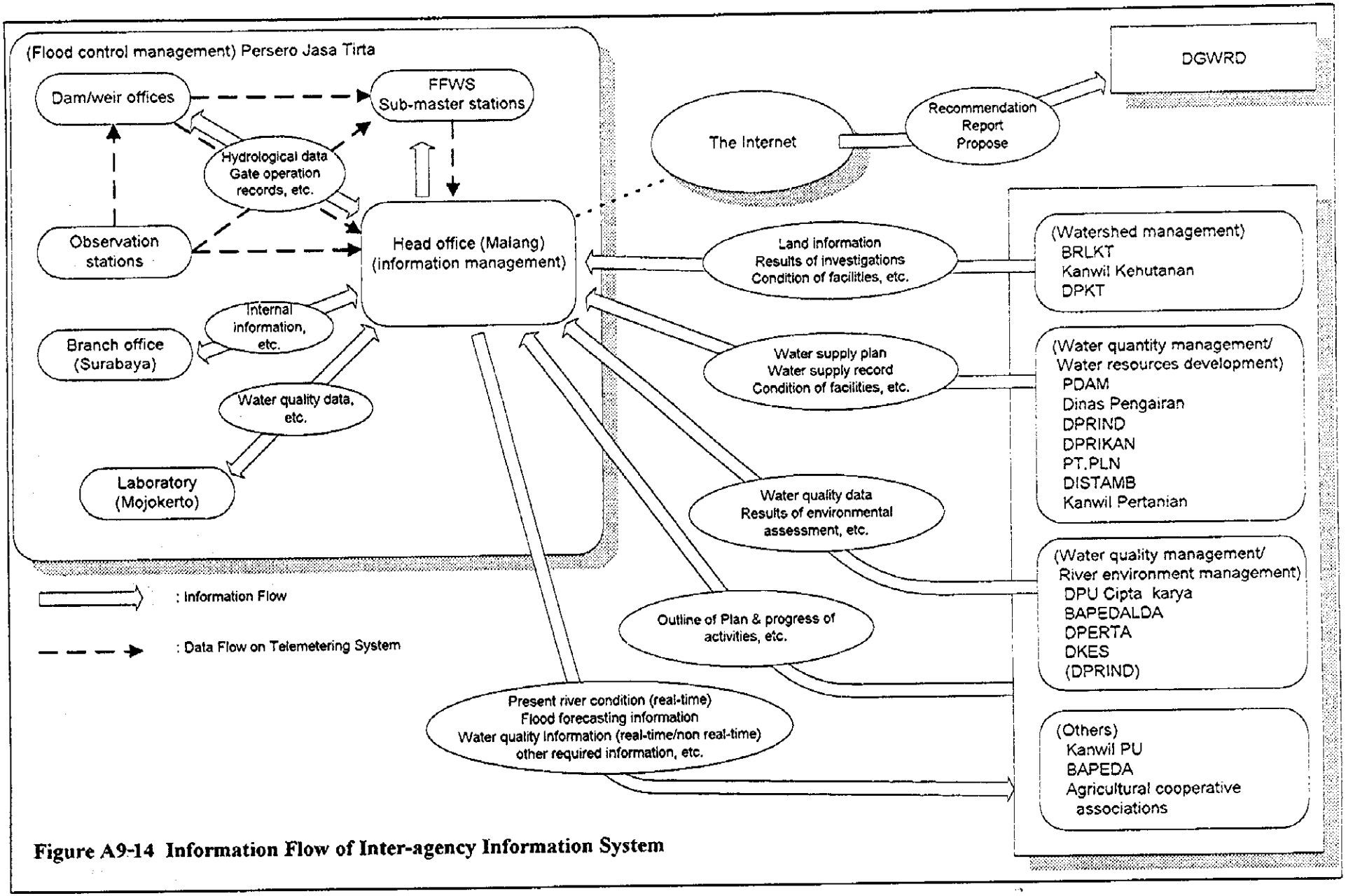

Figure A9-14 Information Flow of Inter-agency Information System

Figure A9-15 Implementation Program and Disbursement Schedule for Monitoring System and Information System

(Unit: Million Rp.)

Project		Total cost	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Improvement of existing FFW	(F/S, D/D)																							
	(Construction, Installation)																							
	- Improvement of WL Gauging Stations - Installation of PC for Outflow Calculation - Modification of FFWS	815		408	408																			
	Engineering Services	82	33	24	24																			
	Administration Cost	41	14	14	14																			
	Total OM Cost	62,975	7,897	7,897	327	327	327	1,183	388	388	1,413	6,459	7,315	5,434	388	327	327	1,183	388	388	1,413	6,459	7,315	5,434
	(Annual OM Cost)	(7,191)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)	(327)
	(Updating of PC)	(427)							(61)	(61)				(61)	(61)				(61)	(61)				(61)
	(Updating of Existing FFWS Equipment)	(45,420)	(7,570)	(7,570)								(5,047)	(5,047)	(5,047)								(5,047)	(5,047)	(5,047)
	(Updating of Expanded FFWS Equipment)	(6,514)									(1,086)	(1,086)	(1,086)								(1,086)	(1,086)	(1,086)	
	(Automatically Water Quality Monitoring Equip.)	(3,424)						(856)					(856)					(856)					(856)	
	Total	63,913	7,943	8,343	773	327	327	1,183	388	388	1,413	6,459	7,315	5,434	388	327	327	1,183	388	388	1,413	6,459	7,315	5,434
Establishment of Inter-agency Information System (Including - Information System for Low Water Management - Water quality database system)	(Coordinate with Agencies Concerned)																							
	(F/S)																							
	(D/D)																							
	(Installation)																							
	(Test, Training)																							
	Hardware and Software Cost	4,982				2,491	2,491																	
	Engineering Services	498		149	199	50	75	25																
	Administration Cost	249	42	42	42	42	42	42																
	Total OM Cost	30,968					1,055	1,055	1,055	1,055	3,052	3,052	1,055	1,055	1,055	3,052	3,052	1,055	1,055	1,055	3,052	3,052	1,055	1,055
	(Annual OM Cost)	(897)					(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)	(50)
	(Updating of PC and Accessories)	(11,982)									(1,997)	(1,997)				(1,997)	(1,997)				(1,997)	(1,997)		
	(Subscription Fee to Internet Service Providers)	(925)					(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)
	(Lease of Private Line)	(17,165)					(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)	(954)
	Total	36,697	42	191	241	2,582	3,662	1,121	1,055	1,055	3,052	3,052	1,055	1,055	1,055	3,052	3,052	1,055	1,055	1,055	3,052	3,052	1,055	1,055
	Grand Total	100,611	7,985	8,534	1,013	2,909	3,989	2,304	1,443	1,443	4,464	9,511	8,370	6,489	1,443	3,379	3,379	2,238	1,443	1,443	4,464	9,511	8,370	6,489

Note: Physical contingency (15% of the total cost) is disbursed to the respective cost items.
without VAT