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JAPAN INTERNATIONAL COOPERATION AGENCY

THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE GOVERNMENT OF THE PHILIPPINES

THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA - BAMBAN / ABACAN RIVER DRAINING FROM MT. PINATUBO

O&M MANUAL

May 1996

NIPPON KOEI Co., Ltd., Tokyo Japan
in association with
CTI ENGINEERING Co., Ltd., Tokyo Japan

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Remarks : The cost estimate in this Study was based on the November 1995 price level, and expressed in Philippine Pesos equivalent according to the exchange rate Philippine Peso 25.0 = Japanese Yen 100.0 (= US dollars 1.0) prevailing at that time.

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
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THE STUDY ON FLOOD AND MUDFLOW CONTROL
FOR SACOBIA-BAMBAN/ABACAN RIVER
DRAINING FROM MT. PINATUBO

OPERATION AND MAINTENANCE

HYDROLOGICAL GAUGING EQUIPMENT

(O&M.1)

NIPPON KOEI Co., Ltd., Tokyo, Japan
in association with
CTI ENGINEERING Co., Ltd., Tokyo, Japan

PREFACE

This manual describes the configuration of equipment, required maintenance and inspection as well as the data processing for the Hydrological Stations constructed under the Mt. Pinatubo JICA Study.

The JICA Hydrological Stations are composed of three (3) rainfall gauging stations, five (5) stream flow/mud flow gauging stations and twelve (12) ground water level gauging stations as indicated in Figure 1. The list of equipment installed in respective stations is indicated in Table 1. The list of equipment for analyses and also supplementary materials including recording charts is shown in Table 2. The list of instruction manuals provided from the manufacturer is presented in Table 3.

To obtain accurate data, the hydrological equipment should be maintained in good condition and therefore, periodical maintenance and inspection works are required to be conducted. In this connection, this manual explains maintenance and inspection works including change of recording charts and recording pens, focusing on "When and What kinds of works are necessary to be conducted" based on the actual site conditions.

In addition, to indicate necessary items to be made in the inspection and to record the results of the inspection, Inspection Sheets were prepared by the Study Team for all the equipment installed in the rainfall gauge station, the stream flow/mud flow gauging station and the ground water level station.

Based on these Inspection Sheets, inspection was conducted during July and the beginning of August 1995 and results (the Inspection Sheets) are attached in Attachment I. And blank Inspection Sheets are also attached in Attachment II for periodical inspections in the future which are recommended to be conducted once a three (3) months including the end of dry season.

Moreover, this manual explains the data processing to extract rainfall, water level, flow velocity and ground water level data from the related recording charts of IC cards of the hydrological equipment. For this purpose, Data Sheets are also prepared by the Study team and to included in Attachment III in this manual.

OPERATION & MAINTENANCE (O&M.I)

HYDROLOGICAL GAUGING EQUIPMENT

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CHAPTER 1 RAINFALL GAUGING STATION

1.1 Location

(1) Sacobia Rainfall Gauging Station

Sacobia Rainfall Gauging Station is located at a top of a hill near Mactan Gate of Clark Field (Coordinate: 15°10'56.9"N, 120°29'13.7"E).

(2) Bamban Rainfall Gauging Station

This station is located at Bamban Central Elementary School (Coordinate: 15°16'52.2"N, 120°34'02.8'E).

(3) Angeles Rainfall Gauging Station

This station is located at Teodoro P. Tinio Elementary School near the Abacan Bridge of the Abacan River (Coordinate: 15°09'23.8"N, 120°35'19.9"E).

1.2 Configuration of Equipment

(1) Sacobia Rainfall Gauging Station

Automatic rainfall gauge of one unit type (Model Number: B-432-00) which can be operated by one dry battery size C is utilized at this station (Figure 2). However, serious ash fall at this point is judged to cause clogging of pipe to tipping bucket and therefore, overflow type rainfall collector was made which has similar structure used by the PHIVOLCS as indicated in Figure 3.

When it rains with ash, ash settles into the settling pipe and rain water overflows into the tipping bucket of the automatic rainfall gauge through a connecting pipe. A drain is made at the bottom of the settling pipe in order to drain the settled ash and make easy to clean the settling pipe.

To protect those equipment, fence with a height of 2.0 m was installed around the equipment as shown in Figure 4.

(2) Bamban and Angeles Rainfall Gauging Stations

In these stations, a separate type automatic rainfall gauge (BR-12-10-00) is installed. This rainfall gauge is composed of a rainfall collector with tipping bucket (B-011) and an automatic recorder (B-311) as shown in Figure 2. The rainfall collector is installed on a tower newly constructed with height of 6 m (Figure 5).

The automatic recorder is installed in the Principal's Office at the Angeles Station and in a small room near the Principal's Office at the Bamban Station. Rainfall data is sent from the collector to the recorder through a connection cable. The electricity is supplied from a dry battery (size C) to move recording chart and from a car battery which is also installed in the same room to move a recording pen.

1.3 Required Maintenance and Inspection

(1) Sacobia Rainfall Gauging Station

Recording chart (S-001), dry buttery and recording pen (N-015-12) need to be changed every three (3) months. Whenever recording chart is changed, zero point of the recorder should be adjusted and time line of the chart is adjusted to the actual time.

Also date and time when the new chart is inserted should be recorded on the new chart for the convenience to read recorded rainfall data.

In order to avoid clogging due to ash fall, rainfall collector and parts mentioned in the Instruction Manual may be cleaned every ten (10) days. In addition to water for cleaning the rainfall collector and other parts, water of about 3 litter will be required to fill the settling pipe up to the outlet to the tipping bucket. Interval for cleaning should be adjusted in consideration of ash fall condition.

The inspection should be made every three (3) months. The items of the inspection include accuracy check, cleaning of parts and tightening of terminals as shown in Inspection sheet attached.

(2) Bamban and Angeles Rainfall Gauging Stations

Car battery should be changed to the other recharged battery every one month (Two sets of batteries for both of the Bamban Station and Angeles Station and one battery charger are provided).

Recording chart (S-064) and recording pen (N-016-02) need to be changed every three (3) months. Whenever recording chart is changed, zero point should be adjusted and time line of the chart is adjusted to the actual time. Also date and time when the new chart is inserted should be written on the new chart for the convenience to read recorded rainfall data.

Periodical cleaning. especially to avoid clogging due to ash fall will be also required at these stations for the parts explained in the Instruction Manual, possibly one a ten days.

The same inspection is required for these stations.

1.4 Data Processing

The rainfall data will be used to analyze the relation between the rainfall intensity and the occurrence or the volume of lahar/flood. To analyze these relations, rainfall of short periods is necessary. For this purpose, data sheet to extract rainfall 30 minutes periods is prepared and this is attached and included in Data Sheet.

CHAPTER 2 STREAM FLOW/MUD FLOW GAUGING STATION

2.1 Location

(1) Sacobia Stream Flow/Mud Flow Gauging Station

Sensors to be explained in 2.2 are installed Sacobia Gorge as indicated in Figure 6 just upstream of the confluence with the left tributary around 1 km far from the Mactan Gate (Coordinate: 15°11'37.8"N, 120°29'24.9"E), while an electric house which accommodate several equipment is located on a hill just beside the acoustic sensor owned by the PHIVOLCS.

(2) San Francisco Stream Flow/Mud Flow Gauging Station

Sensors are installed on the San Francisco Bridge of the Bamban River (Coordinate: 15°17'42.1"N, 120°38'11.7"E), while the electric house is constructed beside the bridge on the right bank. The cross section at the San Francisco Bridge is indicated in Figure 7.

(3) Friendship Stream Flow/Mud Flow Gauging Station

Sensors are installed on the Friendship Bridge of the Abacan River (Coordinate: 15°09'30.9"N, 120°33'31.5"E), while the electric house is constructed beside the bridge on the left bank. The cross section at the Friendship Bridge is indicated in Figure 8.

(4) Capaya Stream Flow/Mud Flow Gauging Station

Sensors are installed on the Capaya Bridge of the Abacan River (Coordinate: 15°09'04.8"N, 120°37'18.6"E), while the electric house is constructed beside the bridge on the left bank. The cross section at Capaya Bridge is shown in Figure 9.

(5) San Juan Stream Flow/Mud Flow Gauging Station

Sensors are installed on the Ninoy Aquino Bridge of the Abacan River (Coordinate: 15°07'12.6"N, 120°42'05.8"E), while electric house is constructed beside the bridge on the right bank. The cross section of San Juan Bridge is presented in Figure 10.

2.2 Configuration of Equipment

(1) Sacobia Stream Flow/Mud Flow Gauging Station

Stream flow/mud flow gauging station has three (3) sensors, namely radio wave current sensor (Figure 11), ultrasonic wave water level sensor (Figure 12), and temperature sensor which measures air temperature to adjust the change of propagation speed of ultrasonic wave by air temperature (Figure 12).

At Sacobia Station, water level and temperature sensors are attached to an arm with a length of 8 m, while velocity sensor is installed on a steel stand with a height of 2 m with 25 degree of depression angle (Figure 13).

These sensors are connected with three (3) cables with a length of 200 m to the equipment installed in the electric house (Figure 14). The equipment related to water level measurement are; converter (Figure 12), IC memory card logger (Figure 15) and analog recorder with two pens (green and red), while those for velocity measurement are a converter with IC memory card logger (Figure 12) and an analog recorder. The analog recorders (M-143) which use roll type recording chart are installed only in the

Sacobia Station, since the 3057 portable recorder which uses fold type recording chart cannot be used due to moisture in this station.

The power to all the equipment mentioned above is supplied from the Clark Field by extending power line with 3 km inside and 1 km outside the Clark Field. At the electric house, the voltage is dropped from 240V to 100 V through a transformer and the power is stored in the batteries. The power to the equipment is supplied from the batteries through the power supply unit (Figure 15). The capacity of the batteries for both the water level and flow velocity is determined so as to supply the power at least half day in case of brownout. Figure 16 indicates wiring diagram of all equipment mentioned above.

(2) Other Four Stream Flow/Mud Flow Gauging Stations

Same equipment mentioned in the Sacobia Station are installed in the electric houses of the other stations, namely the San Francisco, the Friendship ,the Capaya and the San Juan stations except the recorders.

Three (3) sensors, namely ultrasonic wave water level sensor, radio wave velocity sensor and temperature sensor, are attached to an arm with a length of 2 m (Figures 17 and 20) fixed on the bridge.

Depression angle of velocity sensor is 45 degree for the Capaya Station and 30 degree for other three (3) station.

In the San Francisco and the San Juan stations, the portable recorder with two (2) pens for recording of water level and the portable recorder with one (1) pen for recording of flow velocity are installed.

For the Friendship and the Capaya stations, pen recorders are not equipped and therefore, water level and flow velocity data are recorded only on the IC memory card.

The power is supplied from the Angeles Electric Company to the Friendship and Capaya Stations, from the Tarlac Electric Company to the San Francisco Company and from the Anao Cooperative Electric Company to the San Juan Station. The power supplied from these companies is 220/240V and then same power supply system explained in the Sacobia Station is also used to drop it to 100V and to supply DC to all the equipment.

2.3 Required Maintenance and Inspection

IC memory card (M-863-20) for all the stations and recording chart (S-115) of the analog recorders installed in the Sacobia Station should be changed every three (3) months, while recording chart (B 9529AA) of the portable recorders installed in the San Francisco and the San Juan Station be changed every one (1) month.

When an IC memory card is inserted to the IC card logger , the formatting and creation of a data file are required to be made. To create a data file for water level data, file name, data length (number/times of data to be stored), base time to store data and time interval/cycle to store in/write to IC card.

To create a data file for flow velocity data, necessary items to be input are file name, data length (number/times of data to be stored) and time interval/cycle to store in/write to IC card.

As a file name six (6) digits can be used and the number (file name) listed below is recommended to be entered through the key operation of IC card loggers for identification of data.

Sacobia Station:	Water Level	11yymm
	Flow Velocity	21yymm
San Francisco Station:	Water Level	12yymm
	Flow Velocity	22yymm
Friendship Station:	Water Level	13yymm
	Flow Velocity	23yymm
Capaya Station:	Water Level	14yymm
	Flow Velocity	24yymm
San Juan Station:	Water Level	15yymm
	Flow Velocity	25yymm

When the data of IC memory card is retrieved by a computer with a IC card reader by running software named "M9711.EXE" explained in 2.4, this number will be used as a file name with extension ".DAT". The first digit means type of data (1: Water level, 2: Velocity) and the second digit indicates code name of station. Then, "yymm" shows year and month when the IC memory card is inserted.

As data length and time interval, 16,000 times and 10 minutes interval are recommended in consideration of small size of catchment area and interval to change IC card, since this combination of data length and time interval make it possible to record data for 3 months.

As base time to store the data, "Clock" is more convenient than "Start" for analysis and therefore, recommended to use (Refer to Instruction Manual).

Regarding the analog recorders (M143) to record both the waterlevel and flow velocity at the Sacobia Station, the chart speed is set at 6 mm/hr, and the recording chart (S-115) can record three (3) months data. The two (2) pens, N-05-13 (green) and N-05-12 (red) need to be changed every six (6) months for each of the recorder.

Regarding the 3057 portable recorders to record the water level and flow velocity in the San Francisco and the San Juan station, the chart speed is set at 2 cm/hr., the lowest speed of the pen recorder and therefore, the chart with a length of 15 m can record one (1) month data.

Regarding the recording pens for the 3057 portable recorder, following three (3) pens need to be changed, namely a green pen (B9518 CU) for the water level recorder as well as red pens (B9518 CT) for both the water level and flow velocity recorders.

Whenever recording chart is changed, zero point should be adjusted and time line of the chart be adjusted to the actual time. Also date and time when the new chart is inserted should be recorded on the new chart for the convenience to read recorded rainfall data.

The Inspection Sheets for the stream flow/mud flow gauging station are separately prepared for the ultrasonic wave water level gauge and radio wave current meter as indicated in Attachment.

For all the stations, the zero point of the water level is set at 10 m below the water level sensor. However, adjustment/checking of zero point of water level needs to be conducted, during inspection by the portable water level gauge which is provided by the manufacturer of the equipment.

At the Sacobia Station, there are many grasses in front of velocity sensor and these should be cut from time to time to avoid disturbance of radio wave propagation from and/or to the velocity sensor.

In July 1995, it was found that the voltage of the power line at the Sacobia Electric House was only 120 V due to fuse break (short circuit) at the power line inside the

Clark Field which was caused by trees hanging over the power line. This power line supplies the power only to the Sacobia Stream Flow/Mud Flow Gauging Station and maintenance of this power line including trimming of trees inside and outside the Clark Field needs to be undertaken by the DPWH.

2.4 Data Processing

Velocity and water level data which are recorded in the IC memory card are retrieved using the software "M9711.EXE" which is installed in the hard disk of the computer. This program reads the data recorded in the IC memory card and makes text file which can be read by any software such as "Lotus 1 2 3" or "Excel".

The procedure to run "M9711.EXE" in the EPSON Computer is as follow.

- Turn on the computer.
- Strike "Enter/Return Key" two (2) times when the explanation in Japanese appears.
- When the cursor is blinking after indication "A:¥>", type "CD¥M9711" and enter so as to change directory to "M9711" in which "M9711.EXE" and a device driver file "PC98.BGI" are installed.
- When the cursor is blinking after "A:¥M9711>", Type "M9711" and enter to run "M9711.EXE".

When the software "M9711.EXE" starts to run, follow the indication appearing on the screen to obtain a water level or flow velocity text file. When "path name" is requested to enter, type " A:¥M9711" and enter so that the data file which has the name mentioned in 2.4 with extension ".DAT" will be created in the directory "¥M9711".

The velocity data is directly recorded in the text file, but the water level data is recorded as the change of voltage in the IC memory card and therefore conversion of the voltage into the water level (height from the zero point) will be required using conversion factor 2.0.

Tables 4 and 5 tabulate the water level and velocity data of the San Juan Station which were recorded in the IC cards and retrieved by the M9711.EXE.

From these water level, the daily mean water level may recorded the using the Data Sheet included in Attachment.

CHAPTER 3 GROUND WATER LEVEL GAUGING STATION

3.1 Location

Twelve (12) stations were constructed inside the school ground of elementary schools.

(1) Angeles Ground Water Gauging Station

Gucco Balibago Elem. School, Angeles (Coordinate: 15°10'10.1"N, 120°35'42.1"E)

(2) Dau Ground Water Level Gauging Station

Dau Central Elem. School (Coordinate: 15°10'58.3"N, 120°35'03.3"E)

(3) Mabalacat Ground Water Level Gauging Station

Mabalacat Elem. School (Coordinate: 15°13'38.1"N, 120°34'13.6'E)

(4) Bamban Ground Water Level Gauging Station

Bamban Central Elem. School (Coordinate: 15°16'52.2"N, 120°34'02.8"E)

(5) Culubasa Ground Water Level Gauging Station

Culubasa Elem. School (Coordinate: 15°08'41.6"N, 120°39'06.9"E)

(6) San Jose Ground Water Level Gauging Station

San Jose Elem. School (Coordinate: 15°11'27.6"N, 120°38'04.7"E)

(7) Santo Rosario Ground Water Level Gauging Station

Santo Rosario Elem. School (Coordinate: 15°14'48.3"N, 120°38'13.9"E)

(8) San Francisco Ground Water Level Gauging Station

San Francisco Elem. School (Coordinate: 15°18'46.0"N, 120°38'11.1"E)

(9) San Juan Ground Water Level Gauging Station

San Juan Elem. School (Coordinate: 15°07'06.9"N, 120°42'06.1"E)

(10) Magalang Ground Water Level Gauging Station

Magalang Elem. School (Coordinate: 15°13'05.2"N, 120°39'31.6"E)

(11) Telapayung Ground Water Level Gauging Station

Telapayung Elem. School (Coordinate: 15°11'13.1"N, 120°40'26.5"E)

(12) San Bartolome Ground Water Level Gauging Station

San Bartolome Elem. School (Coordinate: 15°17'02.5"N, 120°40'35.8"E)

3.2 Equipment Configuration and Initial Setting

The station consist of observation well with a diameter of 150 mm and depth of 10 m as well as a pen recorder with two pens (green and red) to record water level as shown in Figure 19 which is installed in a station house shown in Figure 20. The pen recorder (W-761-03-00) is operated by four (4) dry batteries of size A. The zero point of the gauge is set at the ground level and ground water level is measured from this point.

3.3 Required Maintenance and Inspection

The recording chart (S-115), the recording pens of green and red (N-015-11) as well as four (4) dry batteries should be changed every three (3) months. Whenever chart is changed newly, the zero point adjustment of recorder will be required.

Accuracy of water level indication should be checked in the inspection and necessary adjustment should be made. The Inspection Sheet for the ground water level gauging station is attached in Attachment.

3.4 Data Processing

Daily mean ground water level is recommended to be recorded for these twelve (12) stations. Data sheet to extract daily mean data is prepared and attached in this Manual.

TABLES

Table 1 LIST OF EQUIPMENT INSTALLED
IN JICA HYDROLOGICAL STATIONS

ITEM	DESCRIPTION	QTY	MODEL #	SERIAL #
1.Rainfall Gauging Station				
1.1 Sacobia Station				
1	Rainfall Gauge	1 unit	B-432-00	
1.2 Bamban Station				
1	Battery 12 Volts	1 pc		
2	Cable Wire	100m		
3	Rainfall Gauge Sensor	1 unit	B-011	93349
4	Rainfall Recorder	1 unit	B-311	
1.3 Angeles Station				
1	Battery 12 Volts	1 pc		
2	Cable Wire	100m		
3	Rainfall Gauge Sensor	1 unit	B-011	93349
4	Rainfall Recorder	1 unit	B-311	
2. Stream Flow/Mud Flow Gauging Station				
2.1 Sacobia Station				
1	Accessory for Battery	1 box		
2	Battery 2 Volts for Current Meter	6 pcs		
3	Battery 6 Volts for W.L. Gauge	2 pcs		
4	Cable Wire for Current Sensor	200m		
5	Cable Wire for Temperature Sensor	200m		
6	Cable Wire for W.L. Sensor	200m		
7	Current Meter	1 unit	J-7642	
8	Current Sensor	1 unit	J-7641	
9	Memory Card Logger for W.L.	1 unit	M-812-10-20	
10	Portable Recorder for Current Meter	1 unit	305713	
11	Portable Recorder for W.L. Gauge	1 unit	305723	
12	Power Supply for Current Meter	1 unit	304-02-00	
13	Power Supply for W.L. Gauge	1 unit	304-02-00	
14	Temperature Sensor	1 unit	E-735	
15	Terminal Board for Current Sensor	1 unit	J-7645	
16	Transformer	2 pcs		
17	Water Level Gauge	1 unit	W-826-00-20	
18	Water Level Sensor	1 unit	W-826	
2.2 San Francisco Station				
1	Accessory for battery	1 box		
2	Battery 2 Volts for Current Meter	6 pcs		
3	Battery 6 Volts for W.L. Gauge	2 pcs		
4	Cable Wire for Current Sensor	200m		
5	Cable Wire for Temperature Sensor	200m		
6	Cable Wire for W.L. Sensor	200m		

Table 1 LIST OF EQUIPMENT INSTALLED
IN JICA HYDROLOGICAL STATIONS

ITEM	DESCRIPTION	QTY	MODEL #	SERIAL #
7	Current Meter	1 unit	J-7642	119
8	Current Sensor	1 unit	J-7641	128
9	Memory Card Logger for W.L. Gauge	1 unit	M-812-10-20	343
10	Portable Recorder for Current Meter	1 unit	305713	43PJ0951
11	Portable Recorder for W.L. Gauge	1 unit	305723	43PJ0947
12	Power Supply for Current Meter	1 unit	304-02-00	20606
13	Power Supply for W.L.Gauge	1 unit	304-02-00	20609
14	Temperature Sensor	1 unit	E-735	576
15	Terminal Board	1 unit	J-7645	0132
16	Transformer	2 pcs		
17	Water Level Gauge	1 unit	W-826-00-20	649
18	Water Level Sensor	1 unit	W-826	738
2.3 Friendship Station				
1	Accessory for battery	1 box		
2	Battery 2 Volts for Current Meter	6 pcs		
3	Battery 6 Volts for W.L. Gauge	2 pcs		
4	Cable Wire for Current Sensor	200m		
5	Cable Wire for Temperature Sensor	200m		
6	Cable Wire for W.L. Sensor	200m		
7	Memory Card Logger for W.L. Gauge	1 unit	M-812-10-20	0349
8	Power Supply for Current Meter	1 unit	304-02-00	20610
9	Power Supply for W.L. Gauge	1 unit	304-02-00	20594
10	Current Meter	1 unit	J-7642-10-2	0122
11	Current Sensor	1 unit	J-7641	0131
12	Temperature Sensor	1 unit	E-736	0568
13	Terminal Box for Current Sensor	1 unit	J-7645	0133
14	Transformer	2 pcs		
15	Water Level Gauge	1 unit	W-826-00-20	0640
16	Water Level Sensor	1 unit	W-826	93349
2.4 Capaya Station				
1	Accessory for Battery	1 box		
2	Battery 2 Volts for Current Meter	6 pcs		
3	Battery 6 Volts for W.L. Gauge	2 pcs		
4	Cable Wire for Current Sensor	200m		
5	Cable Wire for Temperature Sensor	200m		
6	Cable Wire for W.L. Sensor	200m		
7	Current Meter	1 unit	J-7642	0118
8	Current Sensor	1 unit		
9	Memory Card Logger for W.L.Gauge	1 unit	M-812-10-20	0352
10	Power Supply for Current Meter	1 unit	M-304-02-00	20595
11	Power Supply for W.L.Gauge	1 unit	M-304-02-00	20593
12	Temperature Sensor	1 unit		

Table 1 LIST OF EQUIPMENT INSTALLED
IN JICA HYDROLOGICAL STATIONS

ITEM	DESCRIPTION	QTY	MODEL #	SERIAL #
13	Terminal Board for Current Sensor	1 unit	J-7645	0135
14	Transformer	2 pcs		
15	Water Level Gauge	1 unit	W-826-00-20	0641
16	Water Level Sensor	1 unit		
2.5 San Juan Station				
1	Accessory for battery	1 box		
2	Battery 2 Volts for Current Meter	6 pcs		
3	Battery 6 Volts for W.L. Gauge	2 pcs		
4	Cable Wire for Current Sensor	200m		
5	Cable Wire for Temperature Sensor	200m		
6	Cable Wire for W.L. Sensor	200m		
7	Current Sensor	1 unit	W-826	0737
8	Current Sensor	1 unit	J-7641	0126
9	Memory Card Logger for W.L.Gauge	1 unit	M-812-10-20	0353
10	Portable Recorder for Current Meter	1 unit	305713	43PJ0949
11	Portable Recorder for W.L. Gauge	1 unit	305723	43PJ0949
12	Power Supply for Current Meter	1 unit	M-304-02-00	20607
13	Power Supply for W.L. Gauge	1 unit	M-304-02-00	20613
14	Temperature Sensor	1 unit	N-735	0575
15	Terminal Board for Current Sensor	1 unit	W-826	0134
16	Transformer	2 units		
17	Water Level Gauge	1 unit	W-826-00-20	0648
18	Water Level Sensor	1 unit	W-826	
3. Ground Water Level Gauging Station				
3.1 Angeles Station				
1	Water Level Recorder	1 set	W-761-03-00	1430
3.2 Dau Station				
1	Water Level Recorder	1 set	W-761-03-00	1434
3.3 Mabalacat Station				
1	Water Level Recorder	1 set	W-761-03-00	1420
3.4 Bamban Station				
1	Water Level Recorder	1 set	W-761-03-00	1418
3.5 Culubasa Station				
1	Water Level Recorder	1 set	W-761-03-00	1421
3.6 San Jose Station				
1	Water Level Recorder	1 set	W-761-03-00	1433

Table 1 LIST OF EQUIPMENT INSTALLED
IN JICA HYDROLOGICAL STATIONS

ITEM	DESCRIPTION	QTY	MODEL #	SERIAL #
3.7 Santo Rosario Station				
1	Water Level Recorder	1 set	W-761-03-00	1435
3.8 San Francisco Station				
1	Water Level Recorder	1 set	W-761-03-00	1432
3.9 San Juan Station				
1	Water Level Recorder	1 set	W-761-03-00	1425
3.10 Magalang Station				
1	Water Level Recorder	1 set	W-761-03-00	1419
3.11 Telapayung Station				
1	Water Level Recorder	1 set	W-761-03-00	1436
3.12 San Baltolome Station				
1	Water Level Recorder	1 set	W-761-03-00	1431

Table 2 LIST OF EQUIPMENT FOR ANALYSIS AND MAINTENANCE

ITEM	DESCRIPTION	QTY	BOX #	MODEL #	SERIAL #
1	AVR for Computer	1 unit		SVC-1010/A	B30410
2	Computer Printer	1 unit		MJ1000V2	
3	Computer w/adopter	1 unit		PC486NAS2	ILT0014328
4	IC Memory Card Reader	2 units	1	CM3F-1	
5	Ink Cartridge for Printer	6 pcs		MJIC1	
6	Lotus 1,2,3 V.2.3J	1 box			
7	Lotus 1,2,3 V.2.4J	1 box			
8	Aluminum Staff	20 pcs		A1055	
9	Camera	8 pcs		Espio 115	
10	Portable Water Level Gauge	1 pc			
11	Stereoscope	4 units			
12	Battery Charger	1 pc			
13	Battery w/Batt.Solu. for Rainfall Sta	2 pcs			
14	Cartridge Pen for Rainfall Recorder	1 box	82	N-016 -02	
15	Recording Chart for Rainfall Gauge	6 pcs	83	S-001	
16	Recording Chart for Rainfall Record	33 pcs	82	S-064	
17	Cartridge Pen for Portable Recorder	1 box	83	B9518	
18	Folding Chart for Portable Recorder	240 pcs	82	B-9529AA	
19	IC Memory Card	10 pcs		M-863-20	
20	Cartridge Pen for G.W.L.Recorder	3 box	82	N-015-11	
21	Recording Chart for G.W.L. Gauge	144 pcs	83	S-115(201)	
22	Tool Box	14 pcs.	54		
23	Instruction Manual	6 pcs	55		
24	Manual (Memory Card Reader)	8 pcs	55		
25	Manual (Portable Recorder)	50 pcs	55		
26	Cable Wire (Rain Gauge)	2x100m			
27	Rainfall Gauge	1 unit	52	B011-11	93914
28	Rainfall Recorder	2 units	2 & N.N	B-311	
29	Tipping Bucket	1 unit		B-011-00	93349
30	Transformer for Rain Gauge	3 units	63	SD21-300A	
31	Battery 6 Volts for W.L. Gauge	2 pcs			
32	Cable Wire for Temperature Sensor	2x200m	5 & 91		
33	Cable Wire for W.L. Sensor	2x200m	6 & 88		
34	Memory Card Logger	2 units	1 & 43	M-812-10-20	
35	Power Supply for W.L. Gauge	2 units	1 & 3	M-304-02-00	
36	Temperature Sensor	2 units	24 & 25	E-735	
37	Transfornet for W.L. Gauge	1 unit	64	SD21-01KB	
38	Water Level Gauge	2 units	24 & 25	W-826-00-20	
39	Water Level Sensor	2 units	24 & 25	W-826	
40	Battery 2 Volts for Current Meter	6 pcs			
41	Cable Wire for Current Sensor	200m			
42	Current Meter	1 unit	17	J-7642	121
43	Current Sensor	1 unit	17	J-7641	130
44	Power Supply for Current Meter	1 unit	9	M-304-02-00	20608
45	Terminal Board for Current Sensor	1 unit	19	J-7645	131
46	Transformer for Current Meter	1 unit	64	SD21-01KB	
47	Cable for Stream Flow Sta.	9 pcs	54		
48	Cable Wire 7	6x10m	84		

Table 3 LIST OF INSTRUCTION MANUALS

1. Water Level Recorder (W-761)
2. Ultrasonic Water Level Gauge (W-826)
3. Memory Card Logger (M-812)
4. Power Supply Unit (M-304)
5. Recording Rain Gauge (BR-12)
6. Radio Current Sensor (J7641)
7. Radio Current Meter (M7642-10-z1)
8. Portable Recorder (3057)
9. Recording Rain Gauge (B-432)

Table 4 WATER LEVEL DATA IN IC CARD

DATE	TIME	ch.01 V	ch.02 V		WL (m)	WL (cm)
950717	1020	1.948	4.467		3.90	89.34
950717	1030	1.953	4.518		3.91	90.36
950717	1040	1.956	4.566		3.91	91.32
950717	1050	1.961	4.613		3.92	92.26
950717	1100	1.957	4.559		3.91	91.18
950717	1110	1.958	4.579		3.92	91.58
950717	1120	1.953	4.525		3.91	90.50
950717	1130	1.95	4.489		3.90	89.78
950717	1140	1.95	4.496		3.90	89.92
950717	1150	1.95	4.49		3.90	89.80
950717	1200	1.951	4.5		3.90	90.00
950717	1210	1.95	4.49		3.90	89.80
950717	1220	1.952	4.511		3.90	90.22
950717	1230	1.951	4.498		3.90	89.96
950717	1240	1.952	4.521		3.90	90.42
950717	1250	1.952	4.517		3.90	90.34
950717	1300	1.949	4.49		3.90	89.80
950717	1310	1.946	4.458		3.89	89.16
950717	1320	1.948	4.481		3.90	89.62
950717	1330	1.95	4.483		3.90	89.66
950717	1340	1.952	4.505		3.90	90.10
950717	1350	1.948	4.469		3.90	89.38
950717	1400	1.947	4.467		3.89	89.34
950717	1410	1.945	4.439		3.89	88.78
950717	1420	1.943	4.419		3.89	88.38
950717	1430	1.946	4.441		3.89	88.82
950717	1440	1.944	4.434		3.89	88.68
950717	1450	1.943	4.429		3.89	88.58
950717	1500	1.947	4.466		3.89	89.32
950717	1510	1.942	4.412		3.88	88.24
950717	1520	1.943	4.431		3.89	88.62
950717	1530	1.946	4.454		3.89	89.08
950717	1540	1.945	4.447		3.89	88.94
950717	1550	1.946	4.467		3.89	89.34
950717	1600	1.949	4.481		3.90	89.62
950717	1610	1.95	4.494		3.90	89.88
950717	1620	1.95	4.49		3.90	89.80
950717	1630	1.95	4.497		3.90	89.94

Note: Figures in the box are data recorded in IC Card.
To obtain water level, the figures are necessary to be doubled.

Table 5 FLOW VELOCITY DATA IN IC CARD

DATE	TIME	ch.01 m/s	MAINT	2nd INT.
950728	1050	0.76	0	0
950728	1100	0.75	0	0
950728	1110	0.75	0	0
950728	1120	0.74	0	0
950728	1130	0.74	0	0
950728	1140	0.71	0	0
950728	1150	0.69	0	0
950728	1200	0.73	0	0
950728	1210	0.72	0	0
950728	1220	0.7	0	0
950728	1230	0.71	0	0
950728	1240	0.68	0	0
950728	1250	0.71	0	0
950728	1300	0.69	0	0
950728	1310	0.68	0	0
950728	1320	0.66	0	0
950728	1330	0.69	0	0
950728	1340	0.66	0	0
950728	1350	0.73	0	0
950728	1400	0.72	0	0
950728	1410	0.71	0	0
950728	1420	0.69	0	0
950728	1430	0.69	0	0
950728	1440	0.75	0	0
950728	1450	0.77	0	0
950728	1500	0.77	0	0
950728	1510	0.75	0	0
950728	1520	0.74	0	0
950728	1530	0.75	0	0
950728	1540	0.74	0	0
950728	1550	0.8	0	0
950728	1600	0.81	0	0
950728	1610	0.79	0	0
950728	1620	0.8	0	0
950728	1630	0.86	0	0
950728	1640	0.86	0	0
950728	1650	0.91	0	0
950728	1700	0.89	0	0
950728	1710	0.89	0	0
950728	1720	0.97	0	0
950728	1730	1.04	0	0
950728	1740	1.15	0	0
950728	1750	1.24	0	0
950728	1800	1.16	0	0

FIGURES

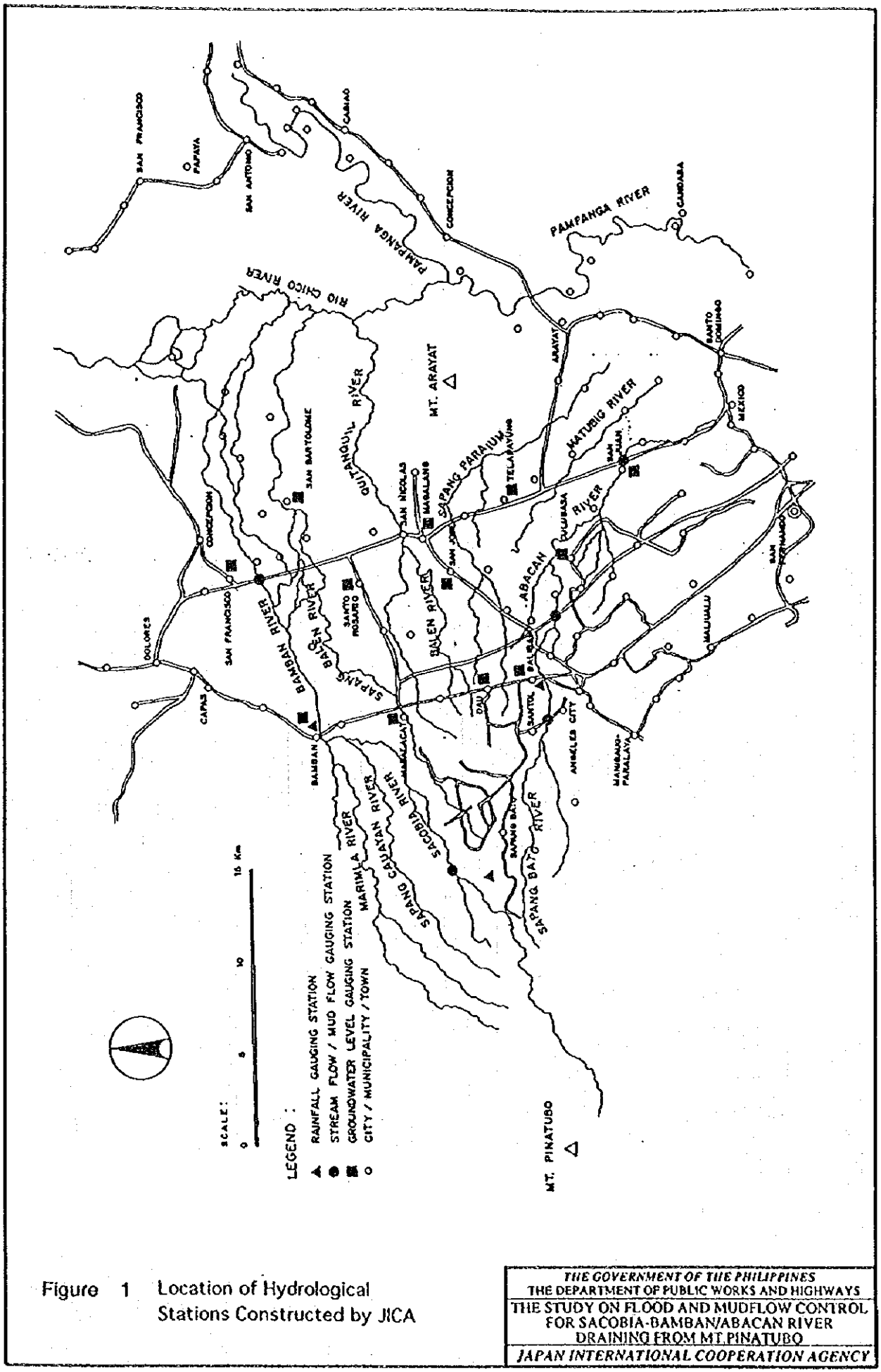
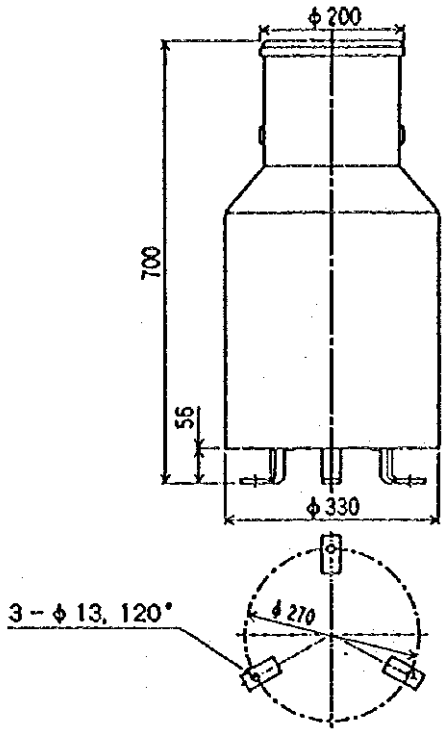
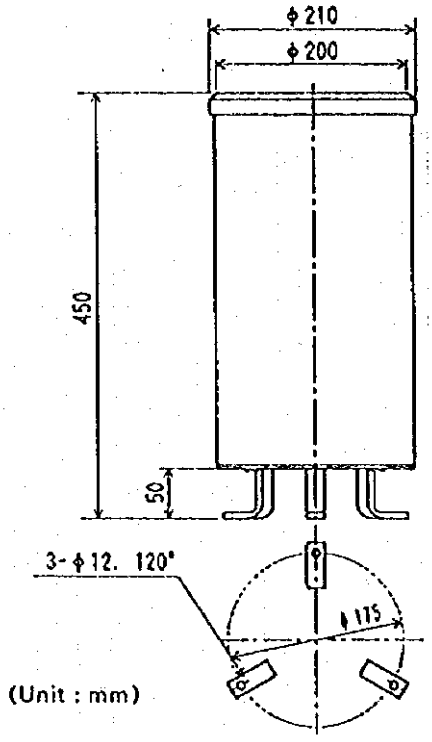


Figure 1 Location of Hydrological Stations Constructed by JICA

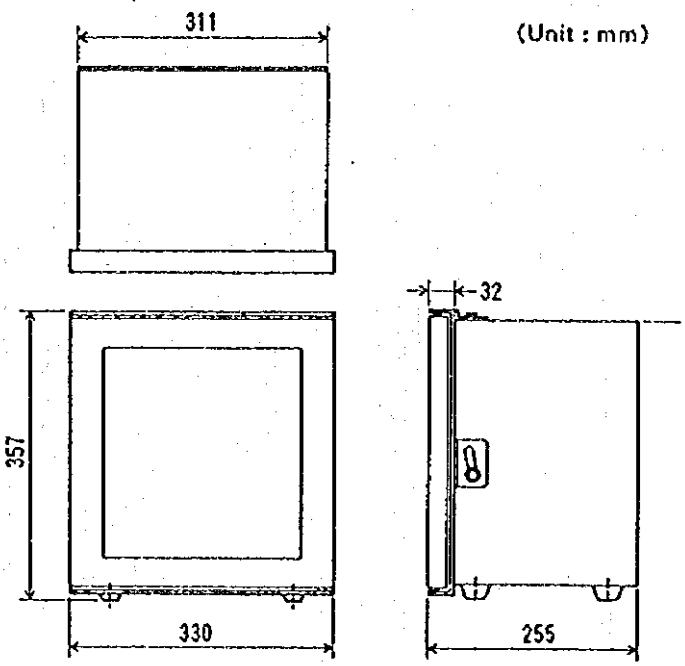
THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY



ONE UNIT TYPE



RAINFALL GAUGE



(Unit : mm)

AUTOMATIC RECORDER

SEPARATE TYPE

Figure 2 Automatic Rainfall Gauge

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

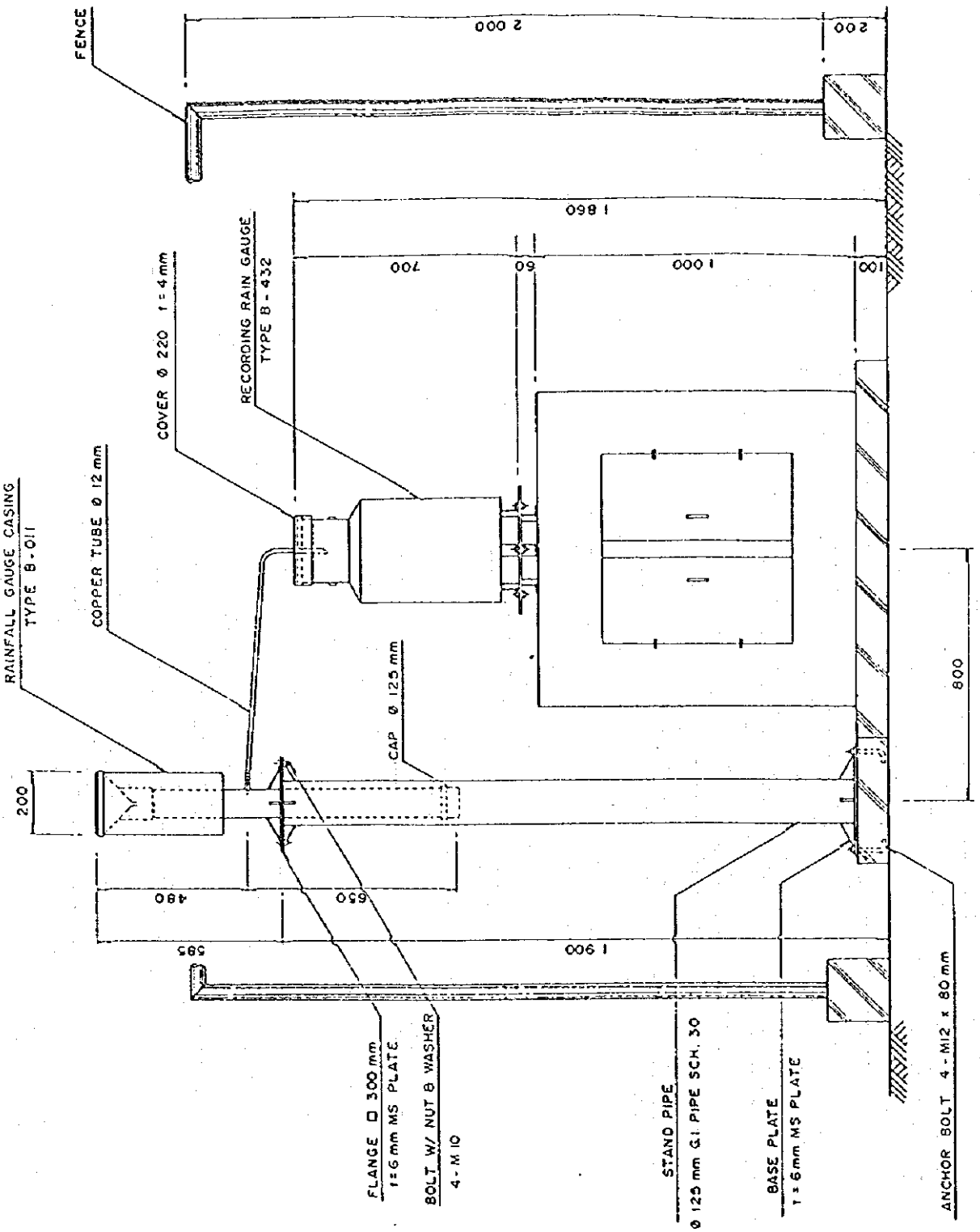
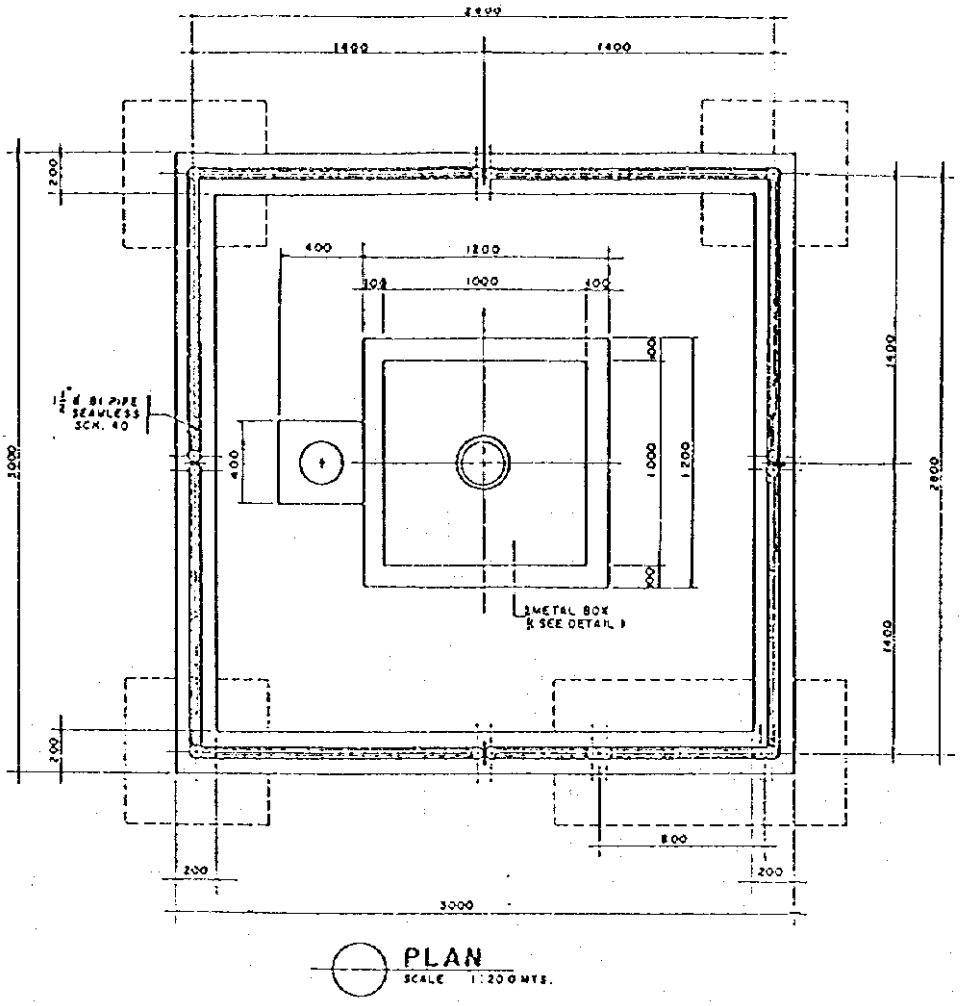


Figure 3 Rainfall Collector at Sacobia Rainfall Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY



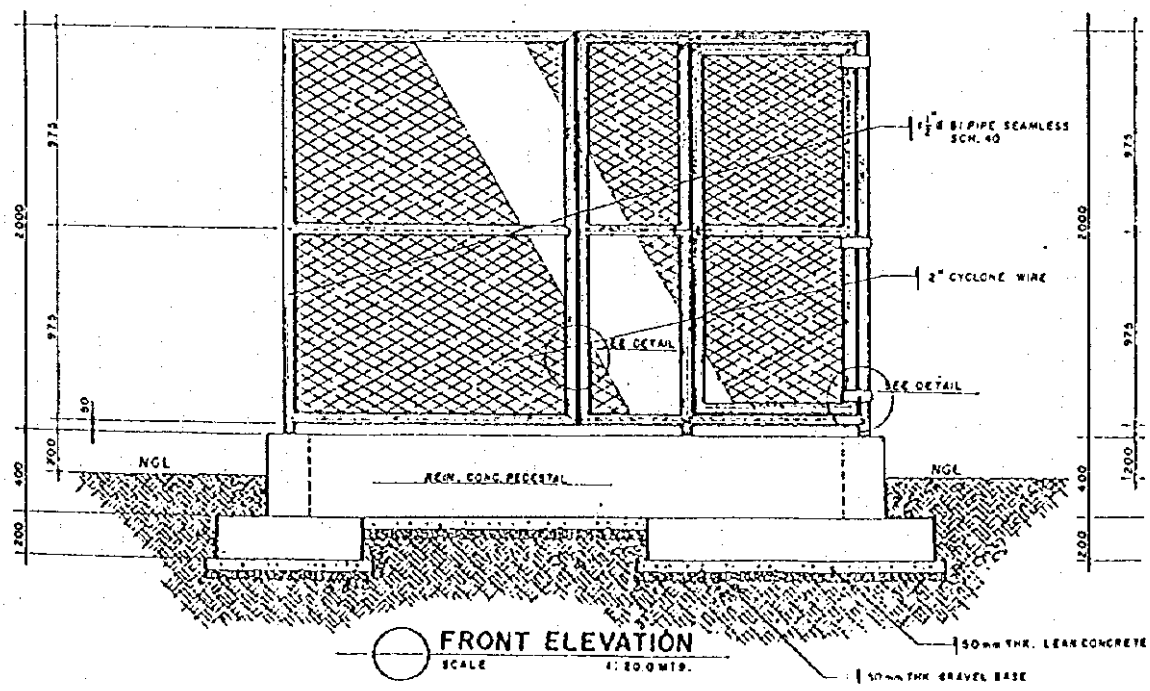


Figure 4 Sacobia Rainfall Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT. PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

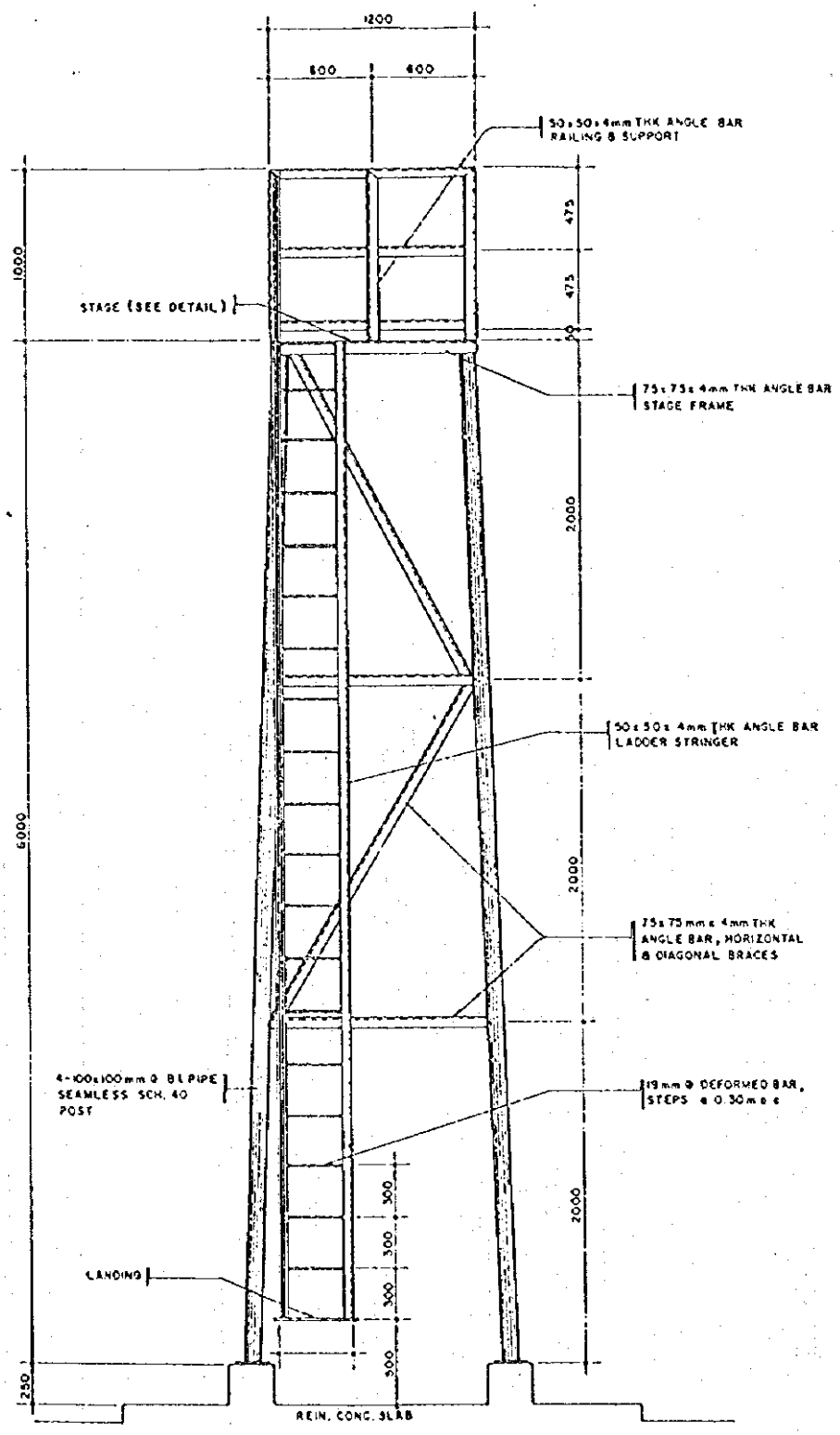


Figure 5 Tower at Bamban and Angeles Rainfall Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL
FOR SACOBIA-BAMBAN/ABACAN RIVER
DRAINING FROM MT PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

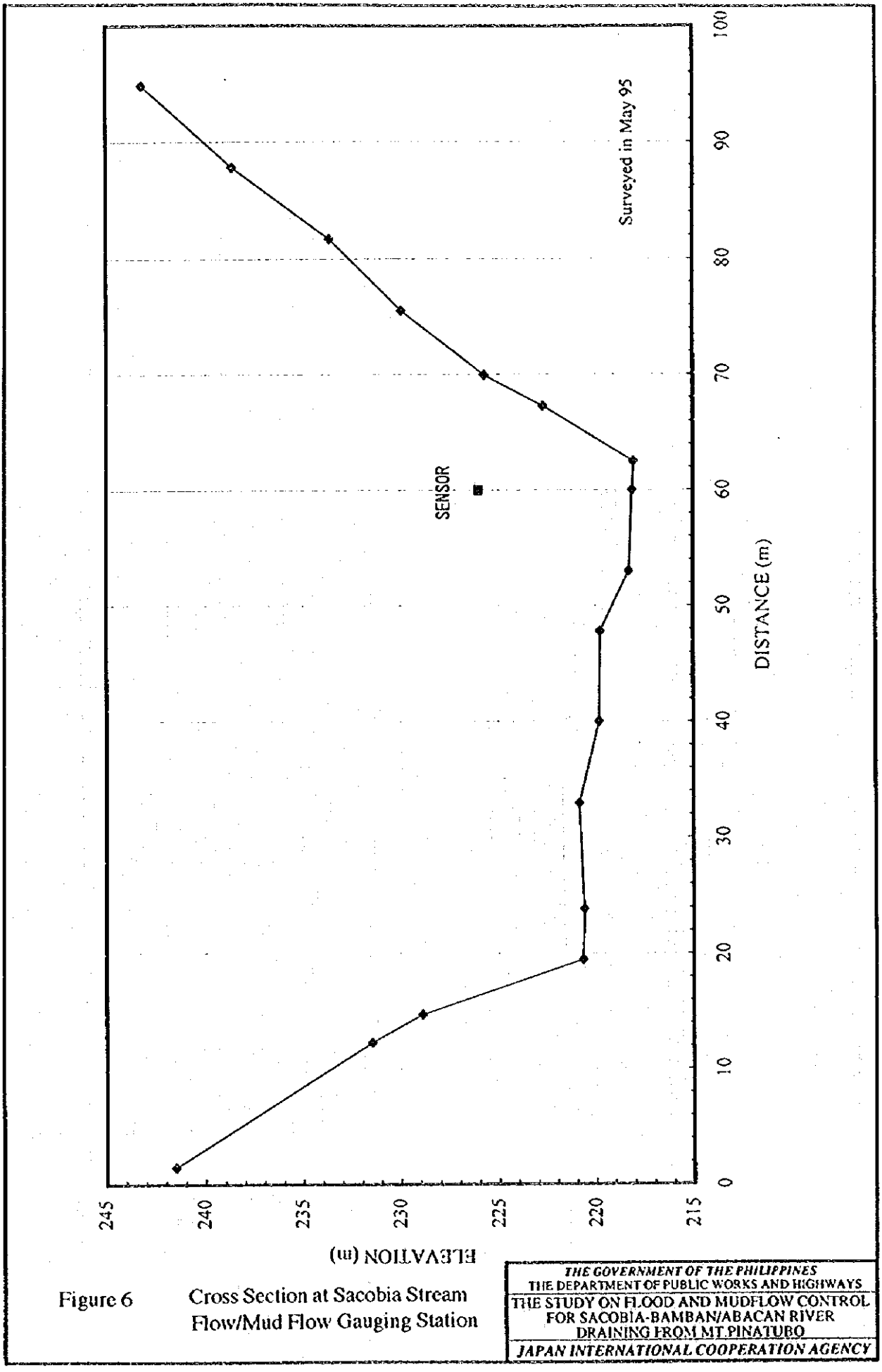


Figure 6 Cross Section at Sacobia Stream Flow/Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

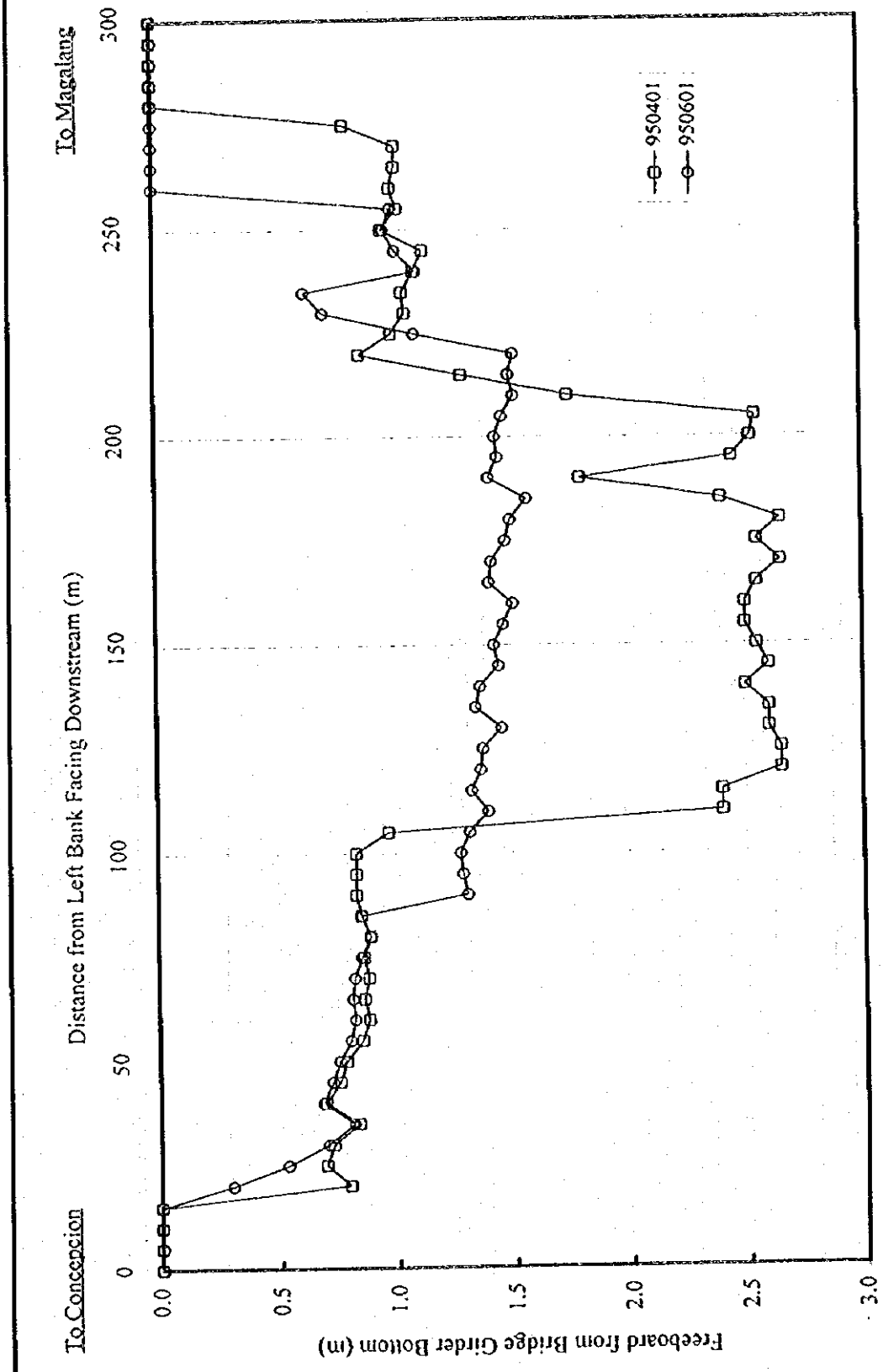


Figure 7 Cross Section at San Francisco Stream Flow/Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

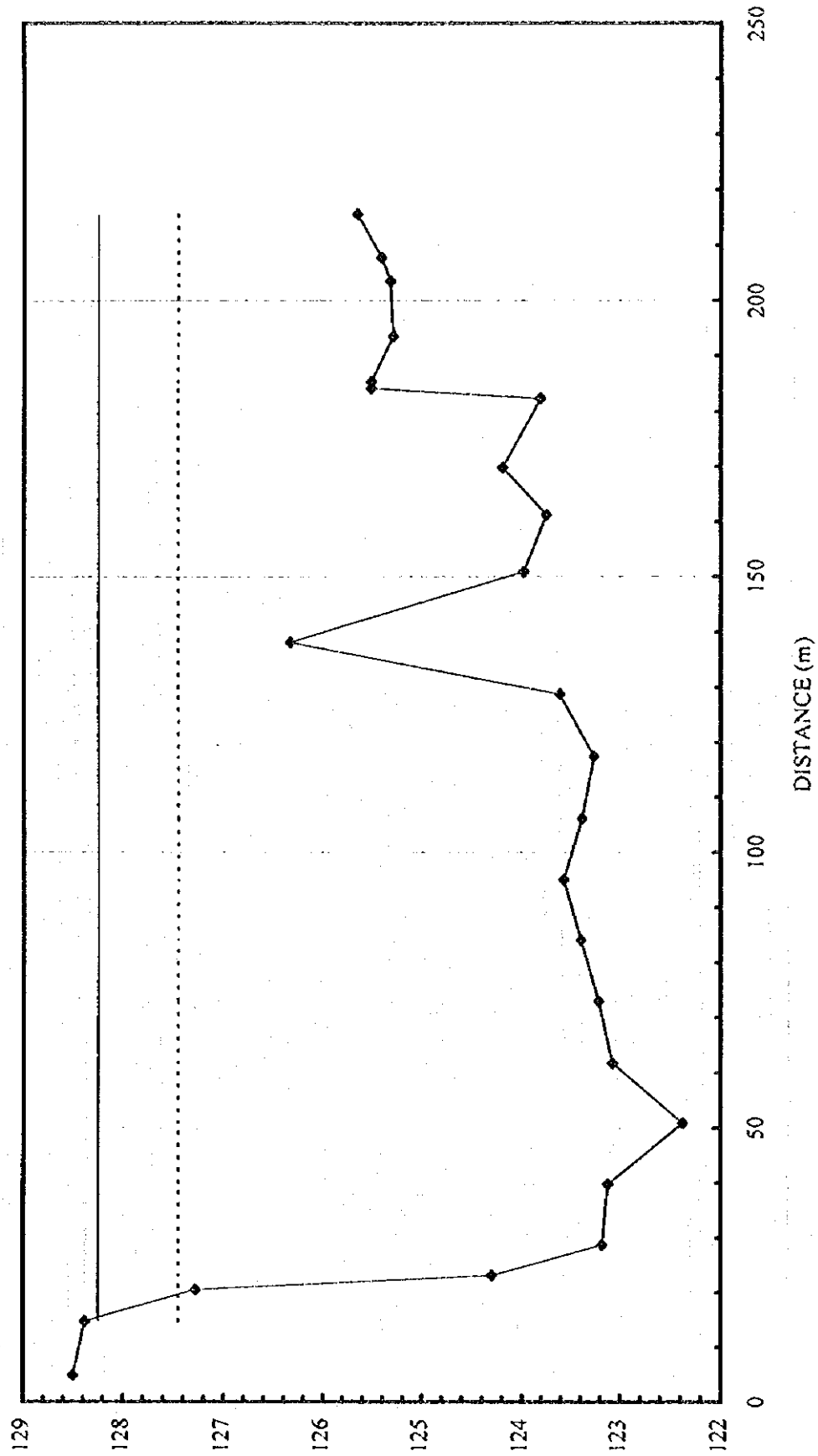


Figure 8 Cross Section at Friendship Stream Flow/Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

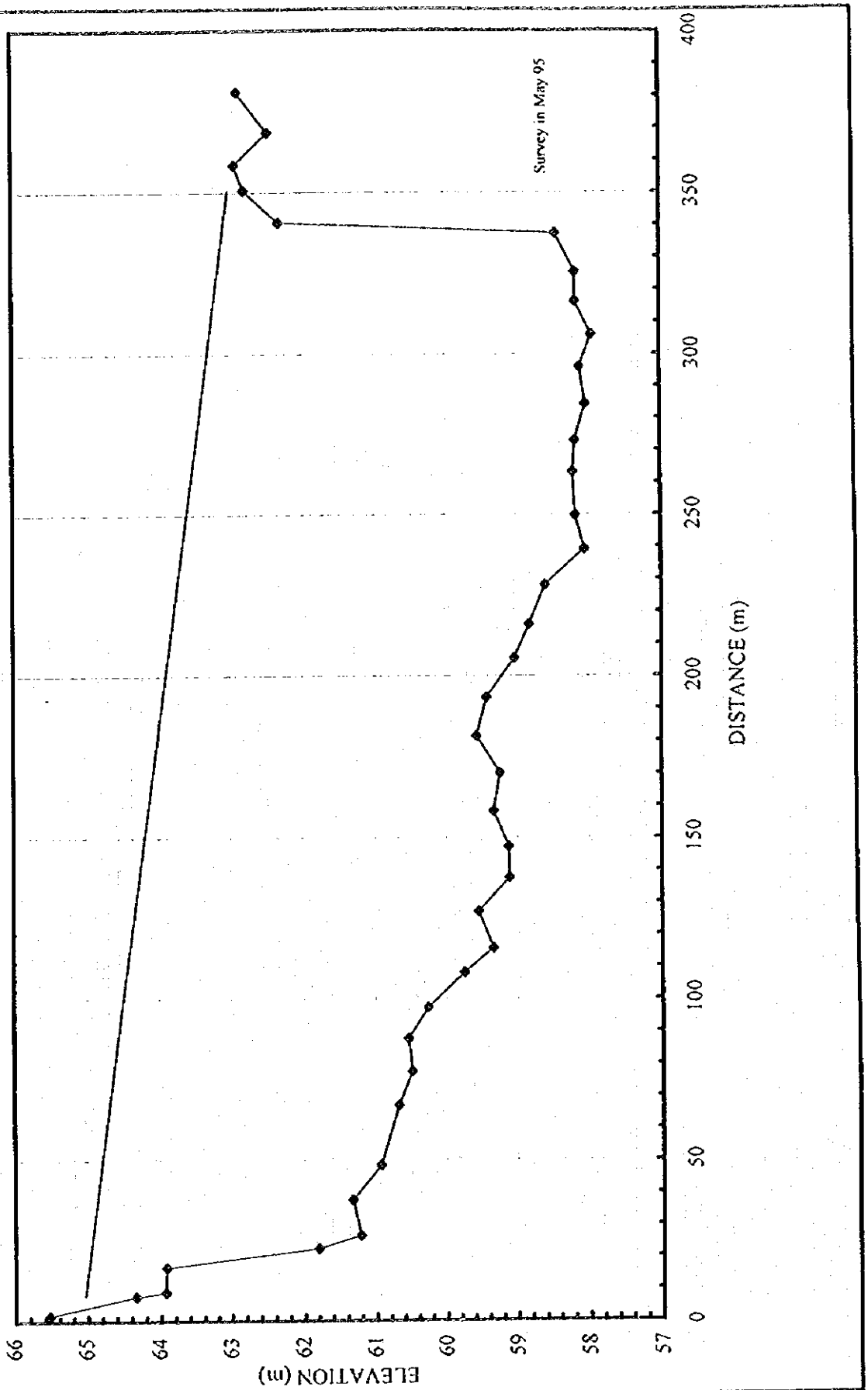


Figure 9 Cross Section at Capaya Stream Flow/Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

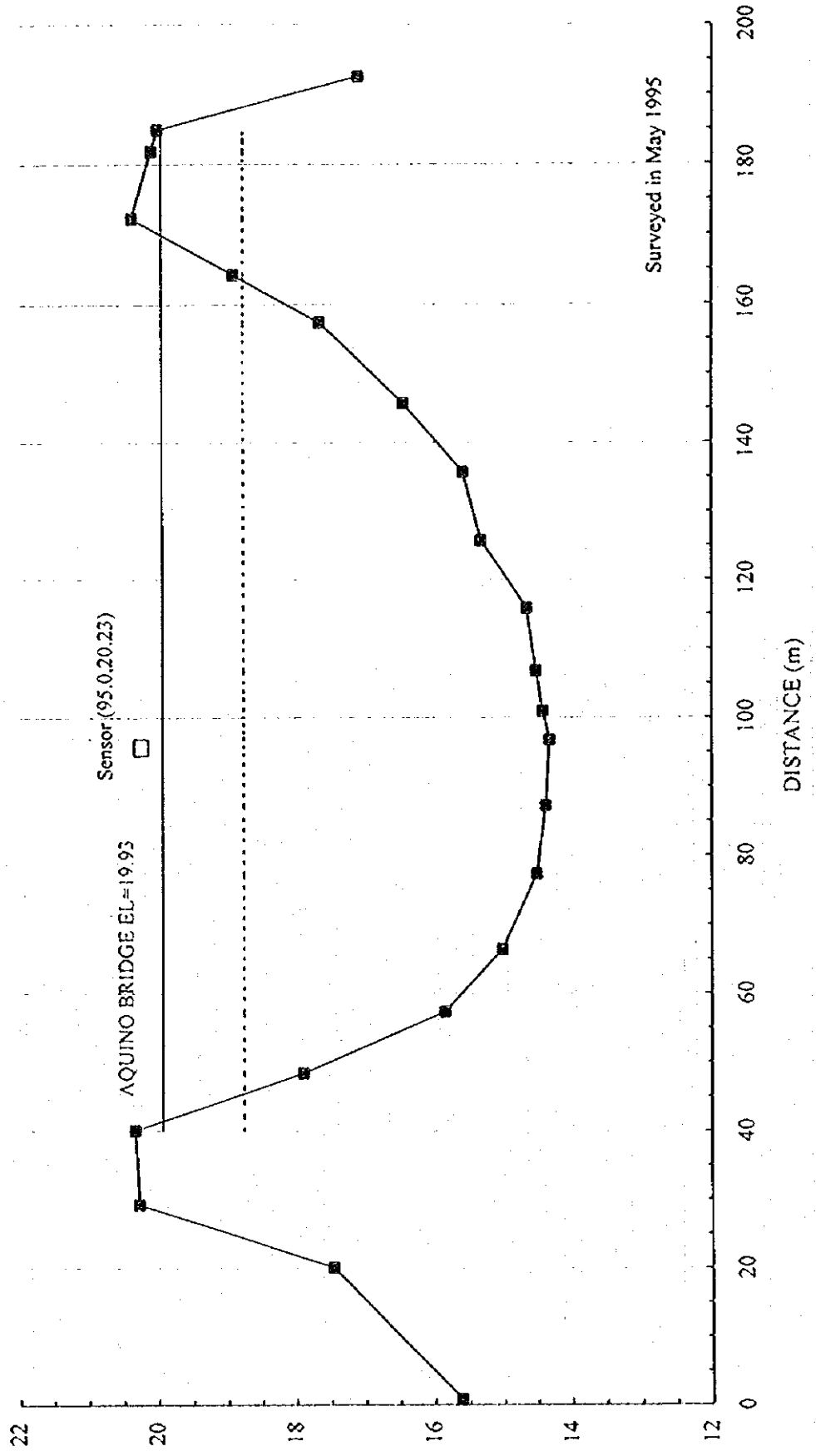
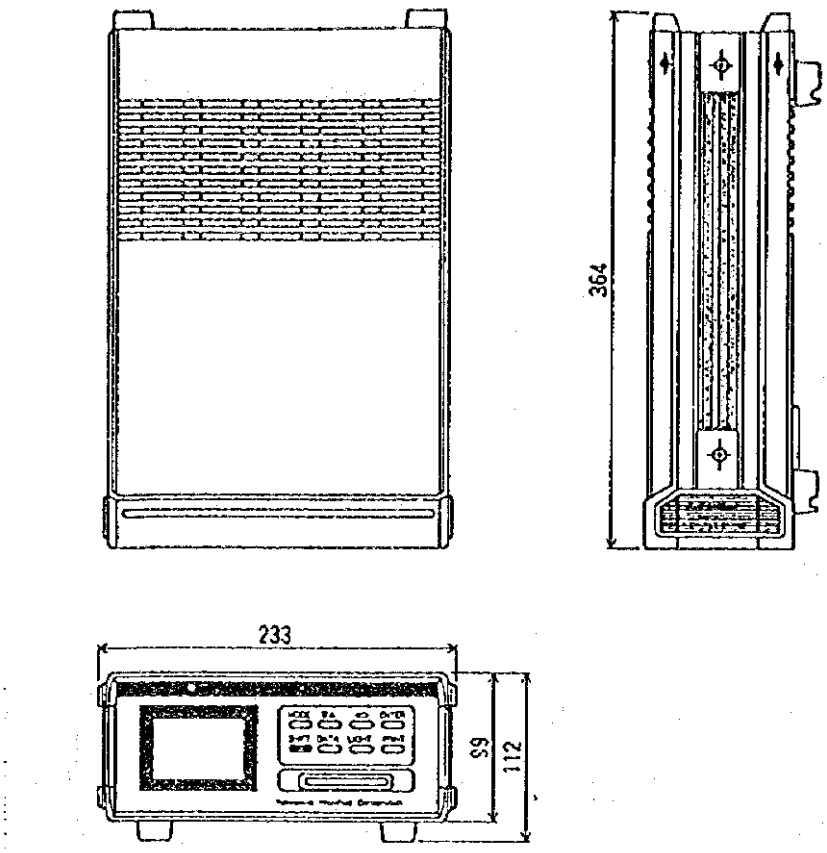


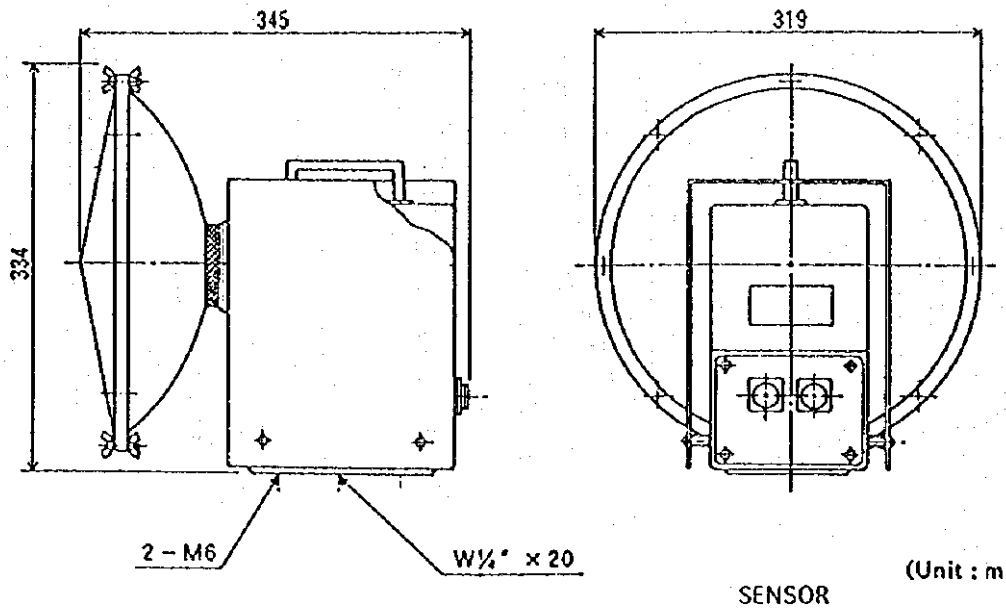
Figure 10 Cross Section at San Juan Stream Flow/Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY



(Unit : mm)

CURRENT METER WITH MEMORY CARD LOGGER

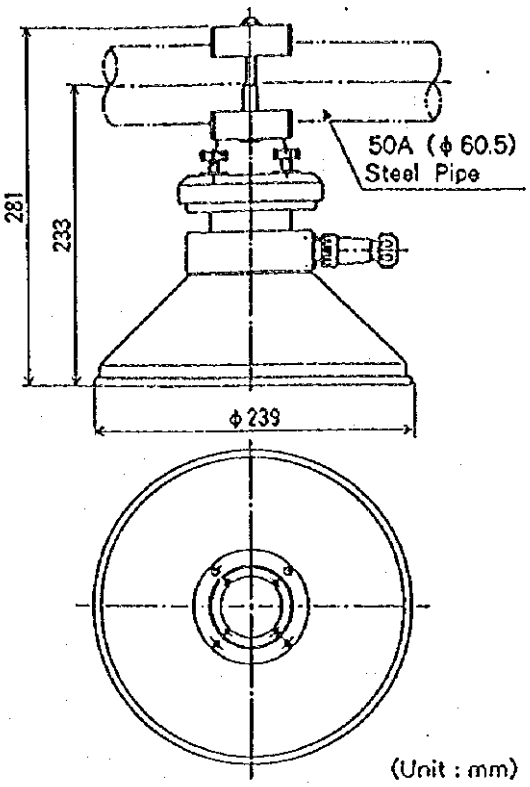


(Unit : mm)

SENSOR

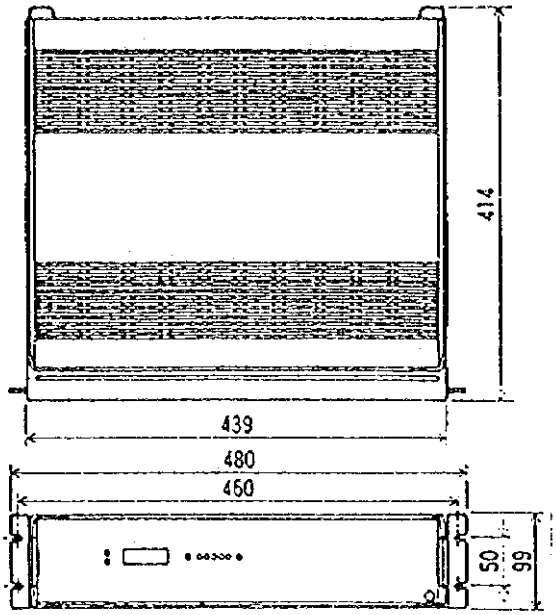
Figure 11 Radio Wave Current Meter

THE GOVERNMENT OF THE PHILIPPINES THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY



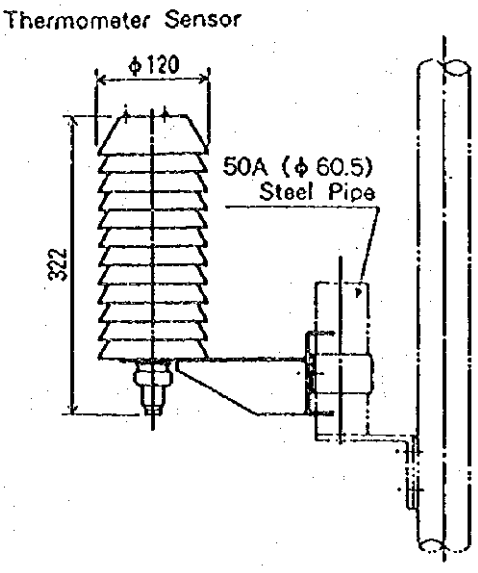
(Unit : mm)

WATER LEVEL SENSOR



(Unit : mm)

WATER LEVEL CONVERTER



(Unit : mm)

TEMPERATURE SENSOR

Figure 12 Sensors and Converter for Water Level Gauge

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

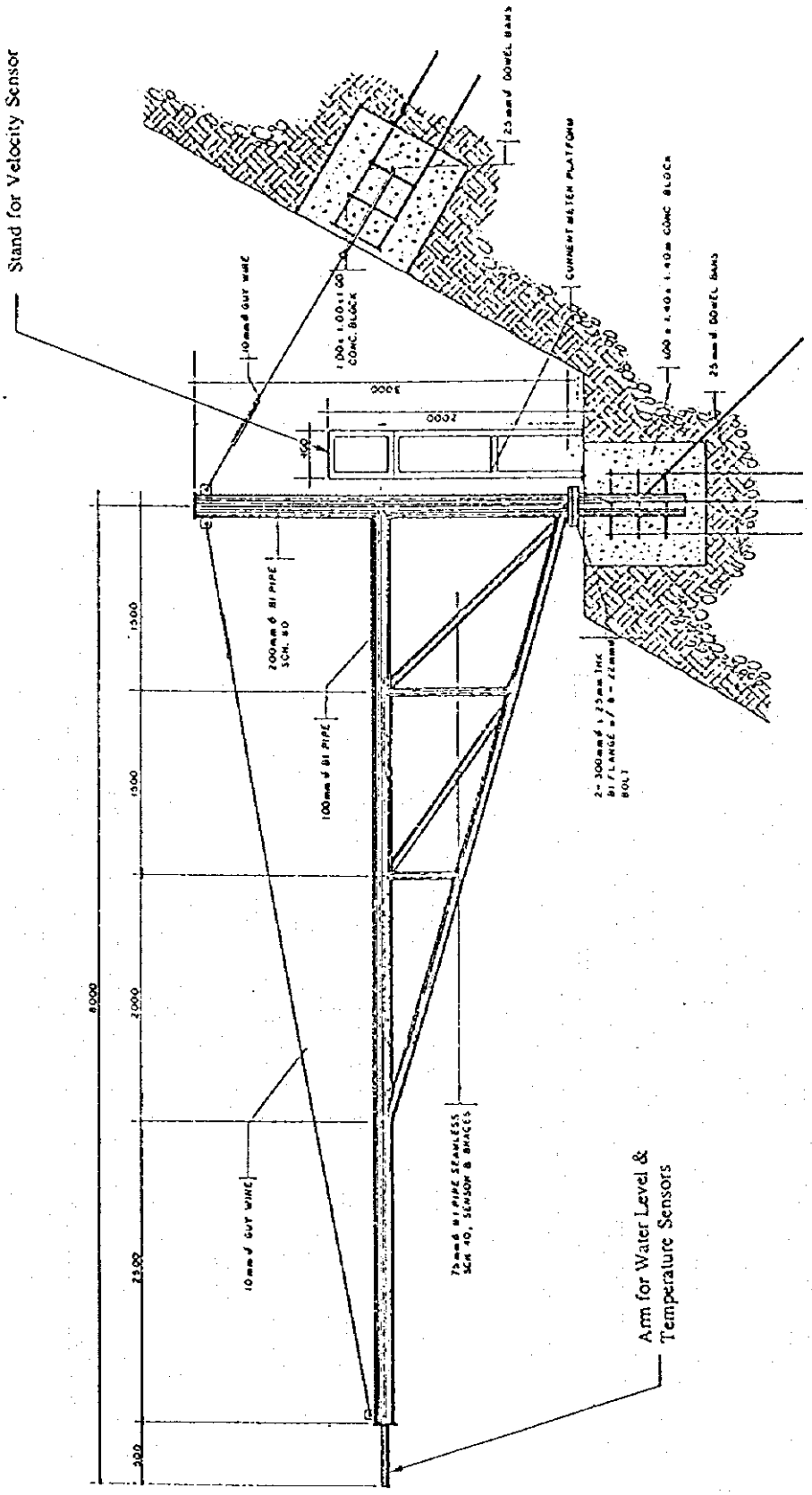


Figure 13 Gauging Arm at Sacobia Stream Flow / Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

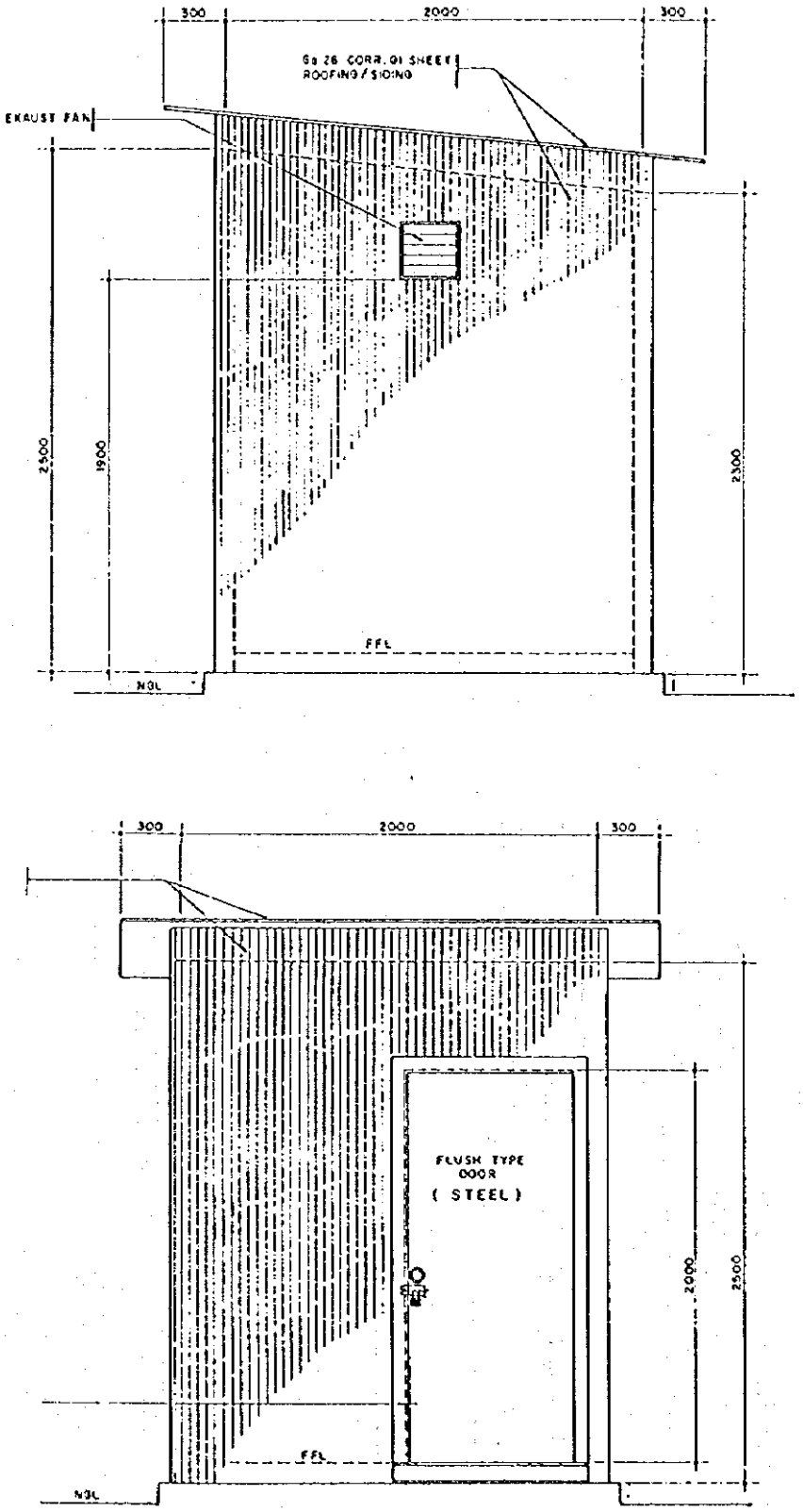


Figure 14 Electric House for Stream Flow / Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

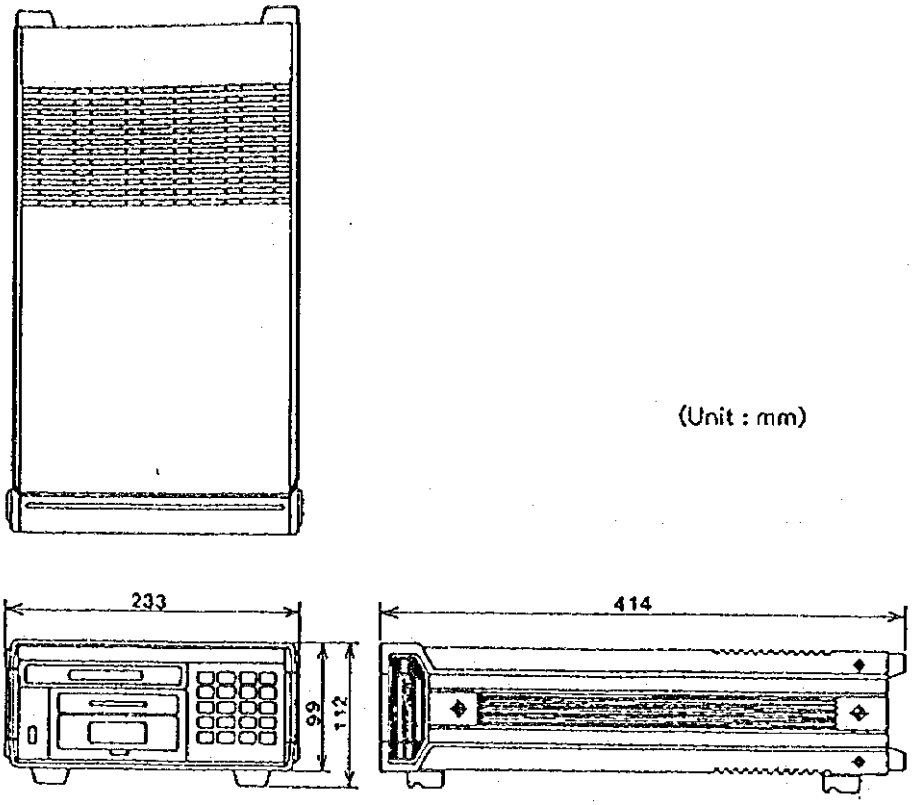


Figure 15 Memory Card Logger and Power Supply Unit

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

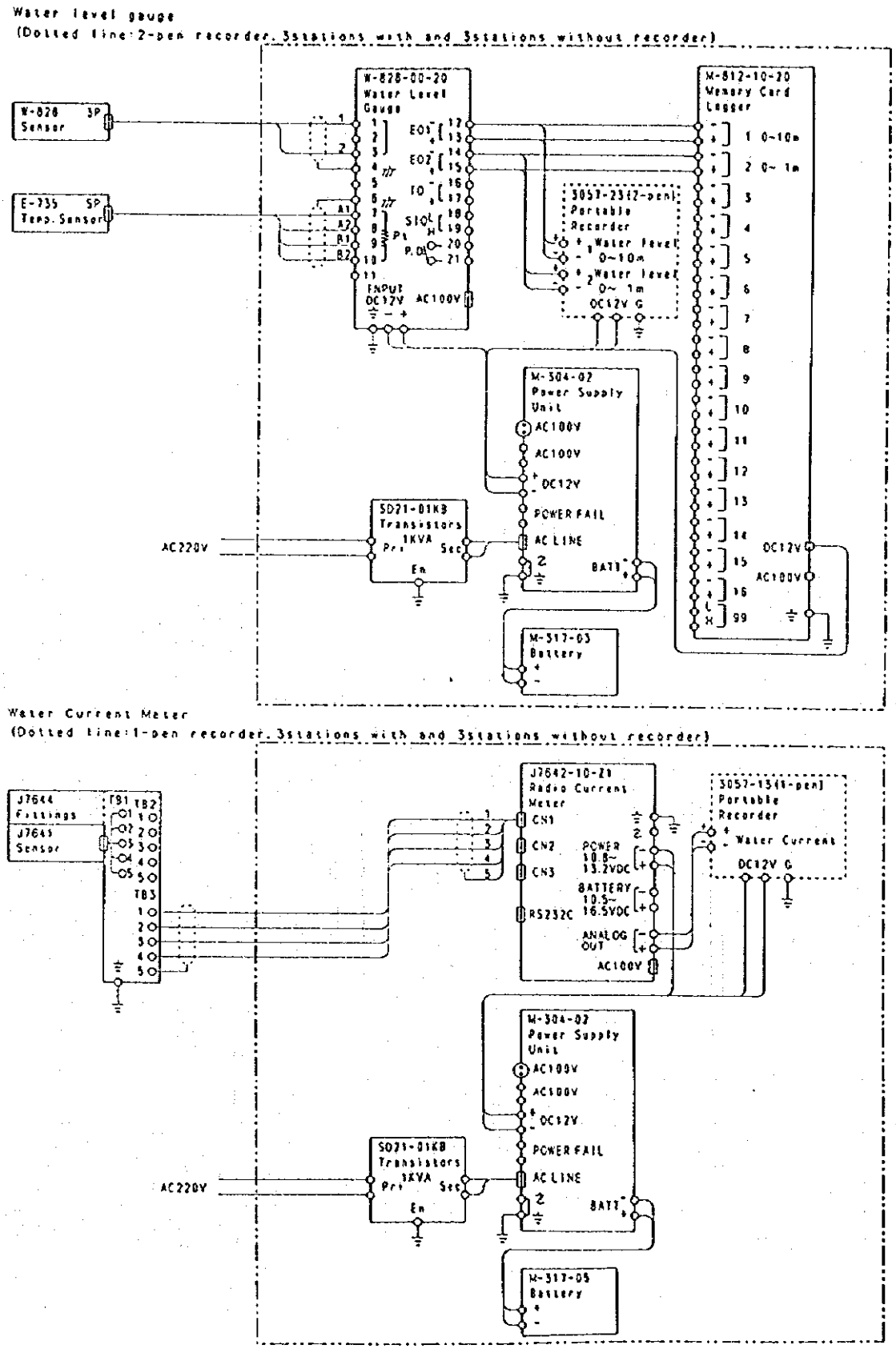


Figure 16 Wiring Diagram for Stream Flow / Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

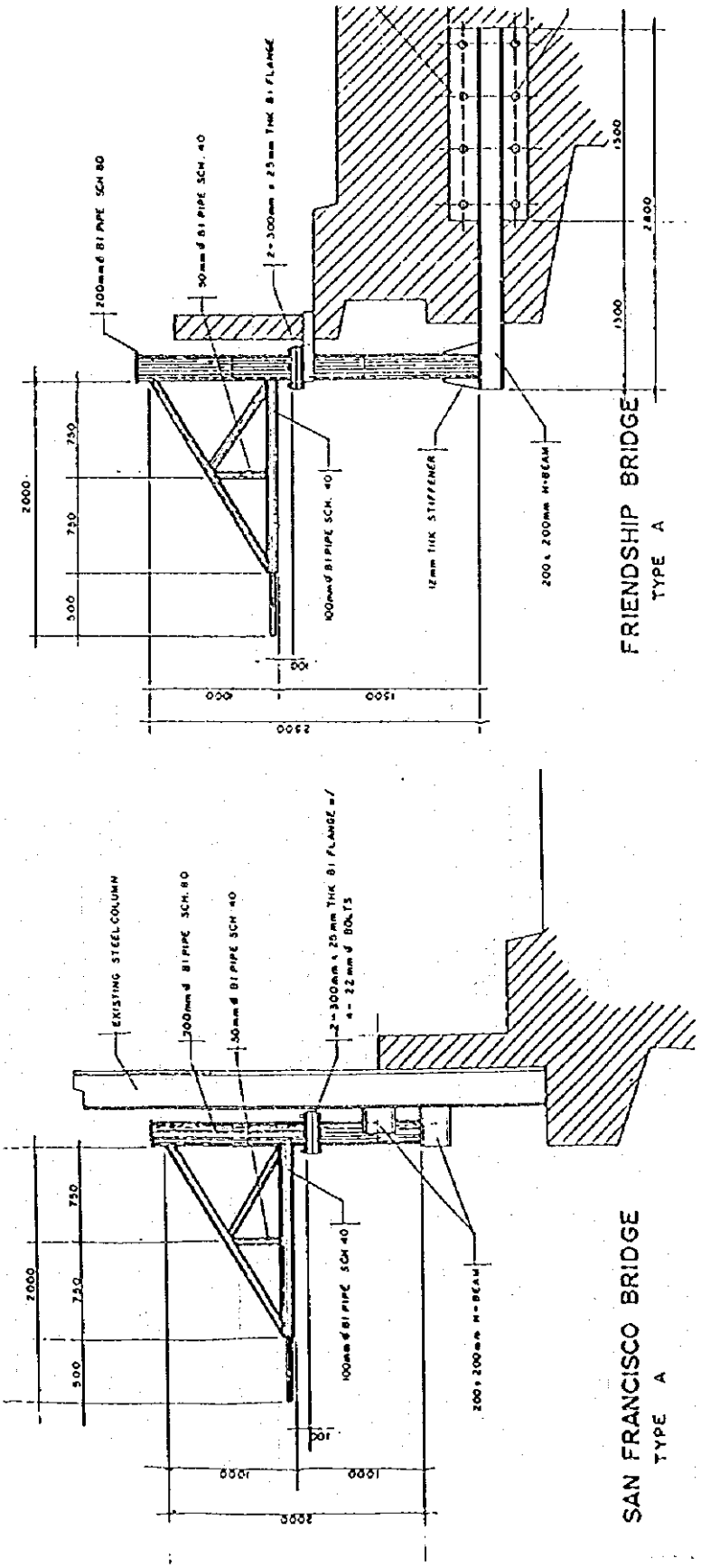
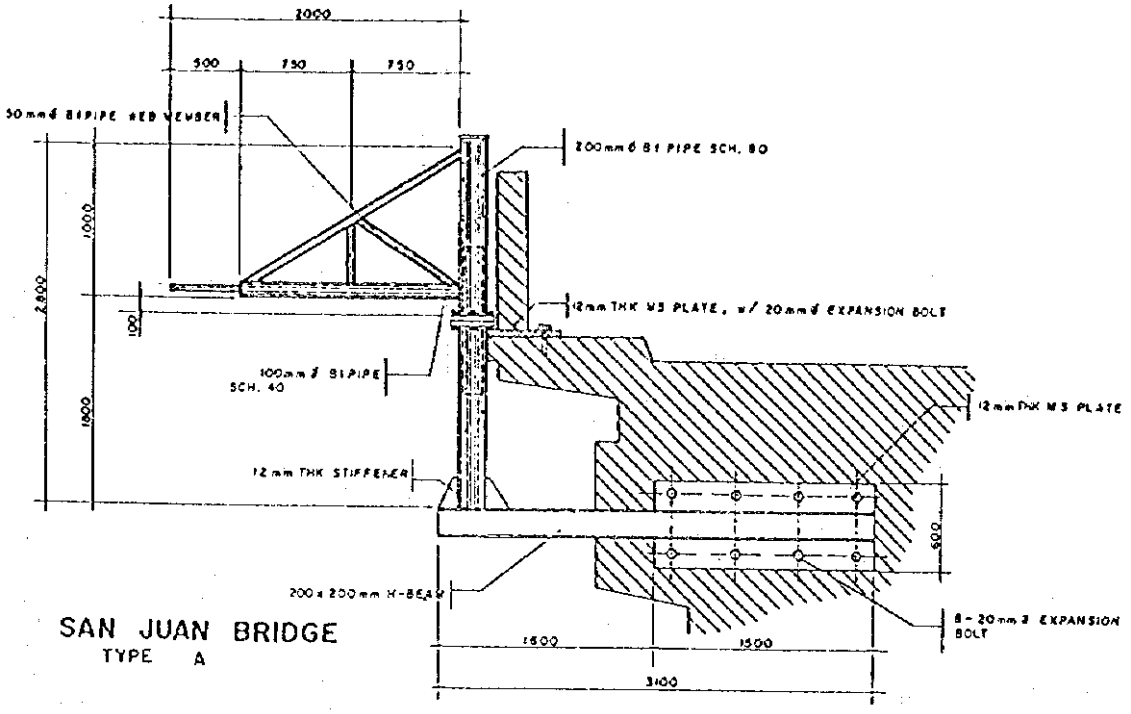


Figure 17 Gauging Arm at San Francisco and Friendship Stream Flow /Mud Flow Gauging Station

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY



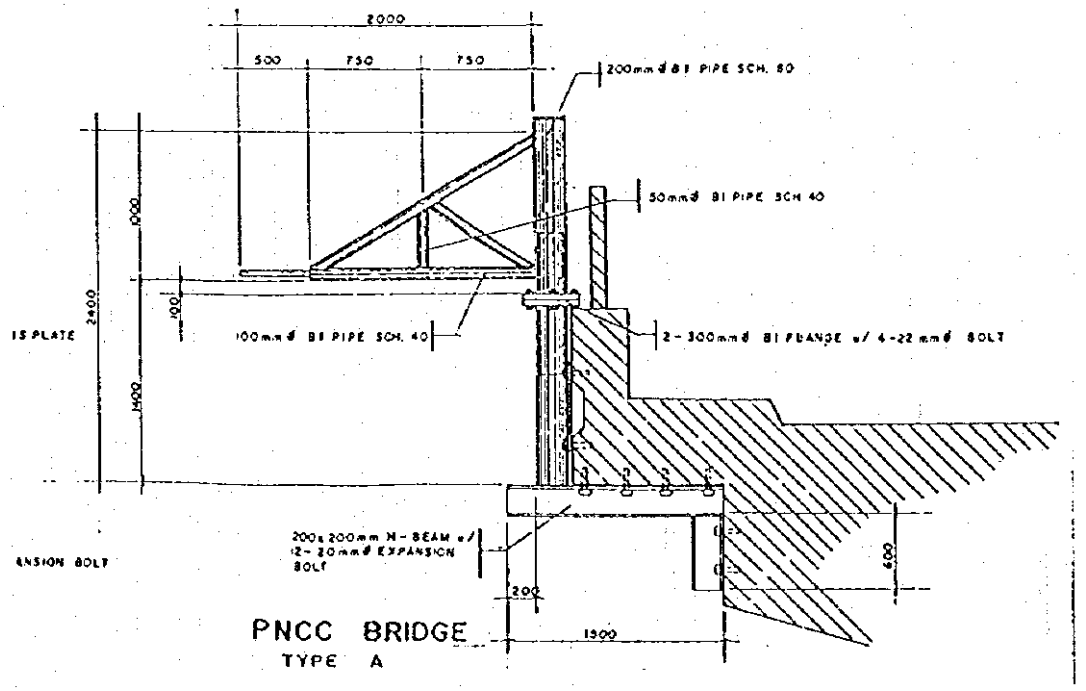


Figure 18 Gauging Arm at San Juan and Capaya Stream Flow / Mud Flow Gauging Stations

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

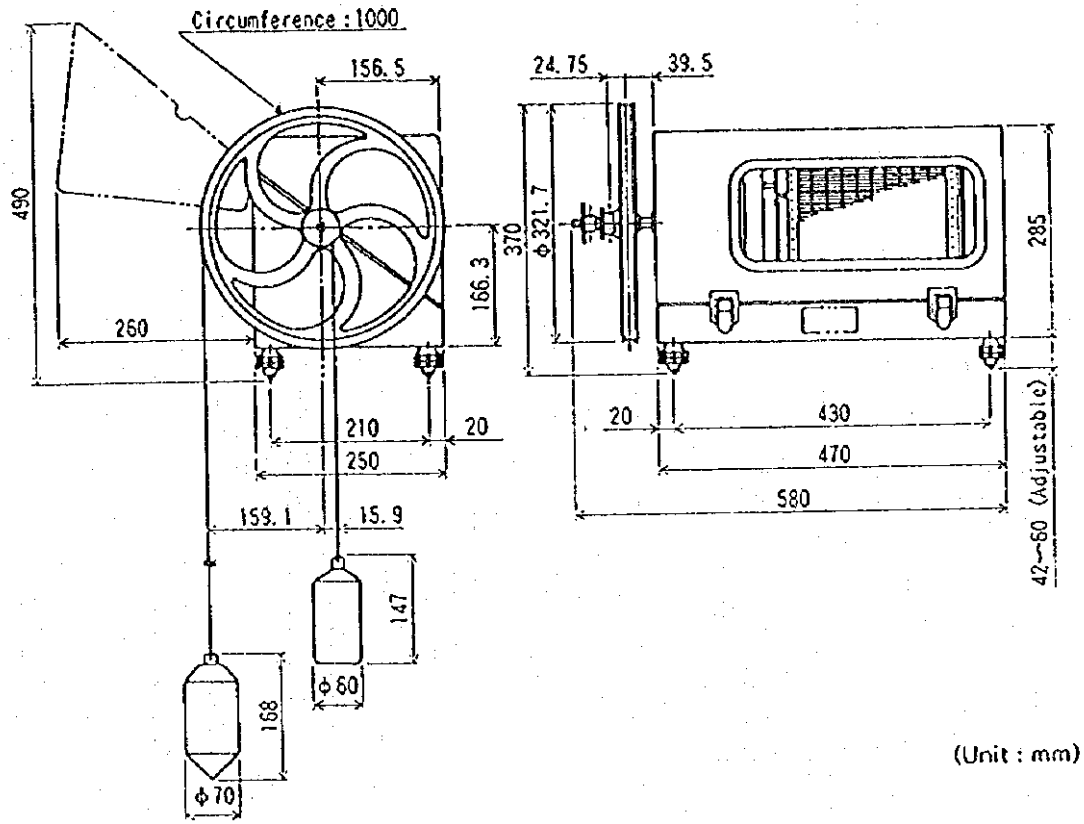


Figure 19 Ground Water Level Gauging Equipment

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

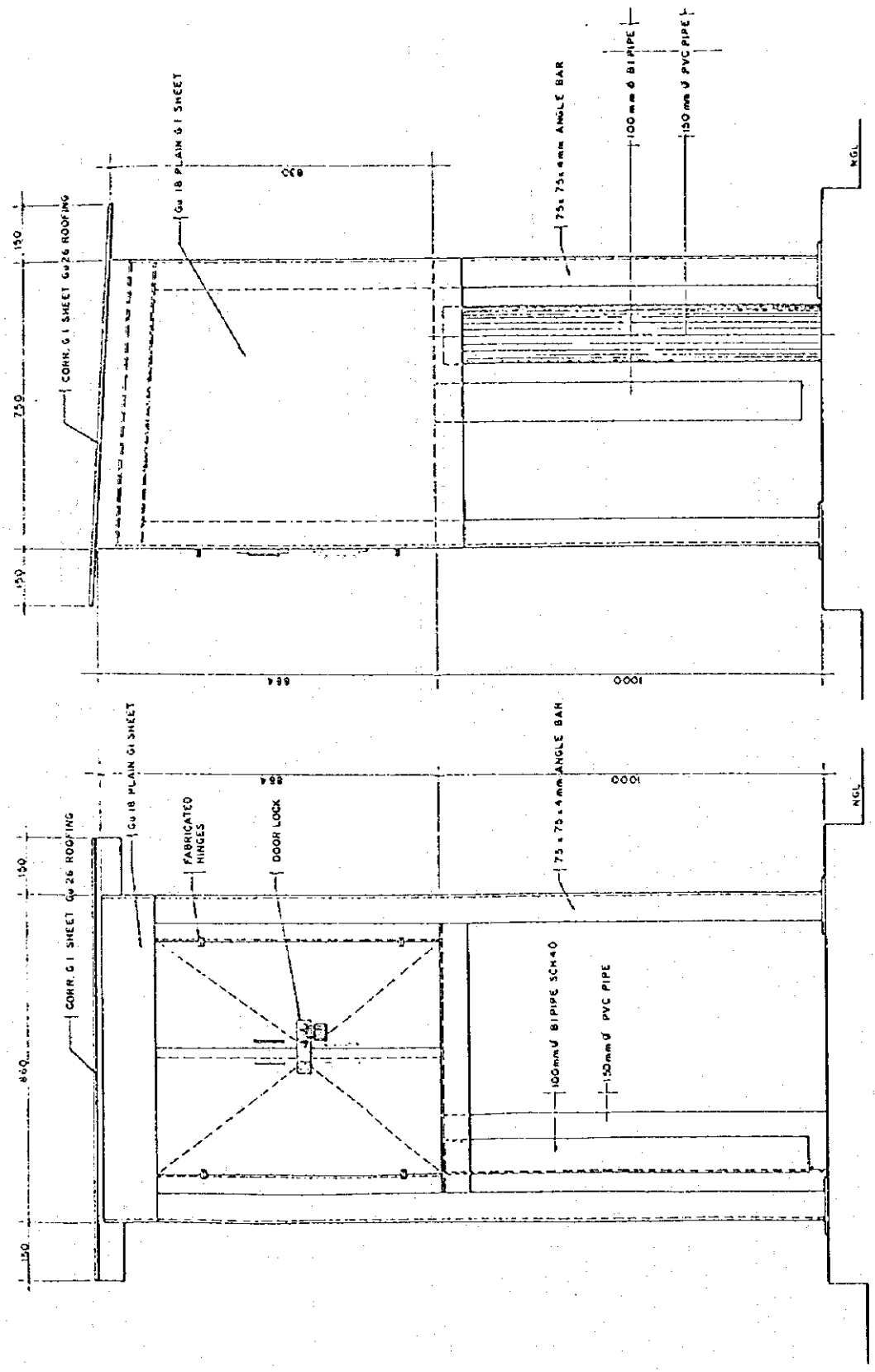


Figure 20 Station House of Ground Water Level Gauging Stations

THE GOVERNMENT OF THE PHILIPPINES
THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE STUDY ON FLOOD AND MUDFLOW CONTROL FOR SACOBIA-BAMBAN/ABACAN RIVER DRAINING FROM MT.PINATUBO
JAPAN INTERNATIONAL COOPERATION AGENCY

ATTACHMENT I

RESULTS OF INSPECTION ON
RAINFALL GAUGING STATION

1. Name of Station : Sacobia Station (Top of the Hill)
2. Date of Inspection : August 3, 1995 9:50 a.m.

RECORDER

Equipment	Portion	Maintenance	Problems & Measures	Results
Recorder	Exterior & Interior	Cleaning	None	OK
	Terminals	Tightening	None	OK

TIPPING BUCKET

Equipment	Portion	Maintenance	Problems & Measures	Results
Tipping Bucket	Exterior	Cleaning	None	OK
	Setting (Level)		None	OK
	Terminals	Tightening	None	OK

ACCURACY CHECK

Number of Pulse[1)]	Reading of Recorder[2)]	Result
0	mm	OK
10	10 mm	OK
20	20 mm	OK

Note: 1) Pulse is given by moving the tipping bucket by hand.
2) Allowable error is within 0.5mm.

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
RAINFALL GAUGING STATION

1. Name of Station : Bamban Elementary School
2. Date of Inspection : July 24, 1995 10:50 A.M.

RECORDER

Equipment	Portion	Maintenance	Problems & Measures	Results
Recorder	Exterior & Interior	Cleaning	None	OK
	Terminals	Tightening	None	OK

TIPPING BUCKET

Equipment	Portion	Maintenance	Problems & Measures	Results
Tipping Bucket	Exterior	Cleaning	None	OK
	Setting (Level)		None	OK
	Terminals	Tightening	None	OK

ACCURACY CHECK

Number of Pulse 1)	Reading of Recorder 2)	Result
0	mm	
10	10 mm	OK
20	20 mm	OK

Note: 1) Pulse is given by moving the tipping bucket by hand.
2) Allowable error is within 0.5mm.

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
RAINFALL GAUGING STATION

1. Name of Station : Abacan (Tinio Elementary School)
2. Date of Inspection : July 19, 1995

RECORDER

Equipment	Portion	Maintenance	Problems & Measures	Results
Recorder	Exterior & Interior	Cleaning		OK
	Terminals	Tightening		OK

TIPPING BUCKET

Equipment	Portion	Maintenance	Problems & Measures	Results
Tipping Bucket	Exterior	Cleaning		OK
	Setting (Level)			OK
	Terminals	Tightening		OK

ACCURACY CHECK

Number of Pulse 1)	Reading of Recorder 2)	Result
0	mm	
10	10 mm	OK
20	20 mm	OK

Note: 1) Pulse is given by moving the tipping bucket by hand.
2) Allowable error is within 0.5mm.

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
ULTRASONIC WAVE WATER LEVEL GAUGE

1. Name of Station : Sacobia Station
2. Date of Inspection : August 4, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Convertor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK
Transmitter-receiver	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK
Temperature Sensor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 13 V
AC Power Failure	Confirmation of power supply when power off	

CONVERTOR

Items	Criteria/Checking Method	Measured Value/Setting	Problems & Measures	Results
Receiving Level	More than one lump (w/AGC)	4 ~ 5 Nos.		OK
Indicator	-ditto- (w/o AGC)	4 ~ 5 Nos.		OK
Transmission of Ultrasonic Wave	by lighting up of transmission indicator lump			
Measuring System	by lighting off of abnormality indicator lump			
Range of W.L.		0 m~ 10 m		OK
W.L.Averaging Interval		10 sec.		OK
Standard Point Setting		10 m		OK

ACCURACY CHECK

Actual Water Level 1)	Indication of Convertor	Portable Recorder	Memory Card Logger	Results 2)
3.37 m	3.37 m	3.37 m	3.37 m	

Note : 1) Water Level which is observed by the portable water level gauge.

2) Allowable error is within ± 1.0 cm.

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
RADIO WAVE CURRENT METER

1. Name of Station : Sacobia Station
2. Date of Inspection : August 4, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems &Measures	Results
Convertor	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Terminals	Tightening		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning	Not working	OK
	Terminals	Tightening	Need to change	OK
	Recording			OK
	Chart Feeding			OK

RADIO WAVE CURRENT SENSOR

Equipment	Portion	Maintenance	Problems & Measures	Result
Sensor	Externals	Cleaning		OK
	Terminals	Tightening		OK
	Angles	Adjustment		OK

SETTING OF EQUIPMENT

Item	Setting	Problems & Measures	Result
Number of Channels	2		
Range of Velocity	0 ~ 10 m/s		
Sampling Time	10 sec		
Times for Average	3		
Angle of Depression & Deviation	25 Deg. 0 Deg.		
Output (Printing) Interval	0 min.		
Supplementary Output Interval	0 min.		
Writing Interval to IC Card	10 min.		
Specified Velocity	0 m/s		

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 13 V
AC Power Failure	Confirmation of power supply when power off	

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
ULTRASONIC WAVE WATER LEVEL GAUGE

1. Name of Station : San Francisco
2. Date of Inspection : July 24, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning	None	OK
Transformer	Exterior	Cleaning	None	OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Convertor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK
Transmitter-receiver	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK
Temperature Sensor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 12 V
AC Power Failure	Confirmation of power supply when power off	

CONVERTOR

Items	Criteria/Checking Method	Measured Value/Setting	Problems & Measures	Results
Receiving Level Indicator	More than one lump (w/AGC)	2 ~ 5 Nos.		OK
	-ditto- (w/o AGC)	2 ~ 5 Nos.		OK
Transmission of Ultrasonic Wave	by lighting up of transmission indicator lump			
Measuring System	by lighting off of abnormality indicator lump			
Range of W.L.		0 m~ 10 m		OK
W.L. Averaging Interval		20 sec.		OK
Standard Point Setting		10.20 m		OK

ACCURACY CHECK

Actual Water Level[1)]	Indication of Convertor	Portable Recorder	Memory Card Logger	Results[2)]
5.75 m	5.55 m	5.55 m	5.55 m	Adjusted

Note : 1) Water Level which is observed by the portable water level gauge.

2) Allowable error is within ± 1.0 cm.

OTHERS

Indication of convertor, portable recorder and memory card logger adjusted.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
RADIO WAVE CURRENT METER

1. Name of Station : San Francisco
2. Date of Inspection : July 24, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems &Measures	Results
Convertor	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Terminals	Tightening		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK

RADIO WAVE CURRENT SENSOR

Equipment	Portion	Maintenance	Problems & Measures	Result
Sensor	Externals	Cleaning		OK
	Terminals	Tightening		OK
	Angles	Adjustment	Little adjustment	OK

SETTING OF EQUIPMENT

Item	Setting	Problems & Measures	Result
Number of Channels	2		
Range of Velocity	0 ~ 10 m/s		
Sampling Time	10 sec		
Times for Average	3		
Angle of Depression & Deviation	30 Deg. 0 Deg.		
Output (Printing) Interval	0 min.		
Supplementary Output Interval	0 min.		
Writing Interval to IC Card	10 min.		
Specified Velocity	0 m/s		

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 13 V
AC Power Failure	Confirmation of power supply when power off	

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
ULTRASONIC WAVE WATER LEVEL GAUGE

1. Name of Station : Capaya (PNCC)
2. Date of Inspection : August 3, 1995 5:10 p.m.

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Convertor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK
Transmitter-receiver	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK
Temperature Sensor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 13 V
AC Power Failure	Confirmation of power supply when power off	

CONVERTOR

Items	Criteria/Checking Method	Measured Value/Setting	Problems & Measures	Results
Receiving Level	More than one lump (w/AGC)	4 ~ Nos.		OK
Indicator	-ditto- (w/o AGC)	~ Nos.		OK
Transmission of Ultrasonic Wave	by lighting up of transmission indicator lump			
Measuring System	by lighting off of abnormality indicator lump			
Range of W.L.		0 m~ 10 m		OK
W.L.Averaging Interval		10 sec.		OK
Standard Point Setting		10 m		OK

ACCURACY CHECK

Actual Water Level1)	Indication of Convertor	Portable Recorder	Memory Card Logger	Results2)
4.63 m	4.63 m	cm	cm	

Note : 1) Water Level which is observed by the portable water level gauge.

2) Allowable error is within ± 1.0 cm.

OTHERS

Indication of convertor, portable recorder and memory card logger adjusted.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
RADIO WAVE CURRENT METER

1. Name of Station : Capaya (PNCC)
2. Date of Inspection : August 3, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Convertor	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Terminals	Tightening		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK

RADIO WAVE CURRENT SENSOR

Equipment	Portion	Maintenance	Problems & Measures	Result
Sensor	Externals	Cleaning		OK
	Terminals	Tightening		OK
	Angles	Adjustment	Littleadjustment	OK

SETTING OF EQUIPMENT

Item	Setting	Problems & Measures	Result
Number of Channels	2		
Range of Velocity	0 ~ 10 m/s		
Sampling Time	10 sec		
Times for Average	3		
Angle of Depression & Deviation	45 Deg. 0 Deg.		
Output (Printing) Interval	0 min.		
Supplementary Output Interval	0 min.		
Writing Interval to IC Card	10 min.		
Specified Velocity	0 m/s		

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 13 V
AC Power Failure	Confirmation of power supply when power off	

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
ULTRASONIC WAVE WATER LEVEL GAUGE

1. Name of Station : San Juan Mexico
2. Date of Inspection : July 21, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Convertor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK
Transmitter-receiver	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK
Temperature Sensor	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Setting			OK

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 12 V
AC Power Failure	Confirmation of power supply when power off	

CONVERTOR

Items	Criteria/Checking Method	Measured Value/Setting	Problems & Measures	Results
Receiving Level Indicator	More than one lump (w/AGC)	2 ~ 5 Nos.		OK
	-ditto- (w/o AGC)	2 ~ 5 Nos.		OK
Transmission of Ultrasonic Wave	by lighting up of transmission indicator lump			
Measuring System	by lighting off of abnormality indicator lump			
Range of W.L.		0 m~ 10 m		OK
W.L.Averaging Interval		20 sec.		OK
Standard Point Setting		10.15 m		OK

ACCURACY CHECK

Actual Water Level[1)]	Indication of Convertor	Portable Recorder	Memory Card Logger	Results[2)]
4.07 m	3.92 m	3.92 m	3.92 m	OK

Note : 1) Water Level which is observed by the portable water level gauge.

2) Allowable error is within ± 1.0 cm.

OTHERS

Indication of convertor, portable recorder and memory card logger adjusted.

Prepared by: Checked by: Approved by:

RESULTS OF INSPECTION ON
RADIO WAVE CURRENT METER

1. Name of Station : San Juan Mexico
2. Date of Inspection : July 21, 1995

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems &Measures	Results
Convertor	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Terminals	Tightening		OK
Transformer	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Power Supply	Exterior	Cleaning		OK
	Interior	Cleaning		OK
	Indicator			OK
Battery	Exterior	Cleaning		OK
	Terminals	Tightening		OK
Portable Recorder	Exterior	Cleaning		OK
	Terminals	Tightening		OK
	Recording			OK
	Chart Feeding			OK

RADIO WAVE CURRENT SENSOR

Equipment	Portion	Maintenance	Problems & Measures	Result
Sensor	Externals	Cleaning		OK
	Terminals	Tightening		OK
	Angles	Adjustment	Little adjustment	OK

SETTING OF EQUIPMENT

Item	Setting	Problems & Measures	Result
Number of Channels	1 - 2		
Range of Velocity	0 ~ 10 m/s		
Sampling Time	10 sec		
Times for Average	3		
Angle of Depression & Deviation	30 Deg. 0 Deg.		
Output (Printing) Interval	0 min.		
Supplementary Output Interval	0 min.		
Writing Interval to IC Card	10 min.		
Specified Velocity	0 m/s		

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC 100 V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC 12 V
AC Power Failure	Confirmation of power supply when power off	

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Gueco Angeles City Elementary School
2. Date of Inspection : July 25, 1995 1:50 P.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
3.045 m	3.75	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Clearance must be covered.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Dau Elementary School
2. Date of Inspection : July 21, 1995 2:50 P.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight	New as of July 21, 1995	OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point		OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
4.32 m	4.32	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base

OTHERS

Wire was cut.
Float wire stolen.
The measuring well was improved.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Mabalacat Elementary School
2. Date of Inspection : July 21, 1995 3:33 P.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight	New (July 21, 1995)	OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point		OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
2.615 m	New	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Wire was cut.
Float wire stolen.
The measuring well was improved.

Prepared by: Checked by: Approved by:

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Bamban Elementary School
2. Date of Inspection : July 24, 1995 11:30 A.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little Adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
1.644 m	1.57	OK

Note; Actual groundwater level is measured by portable water level gauge from Concrete Base .

OTHERS

CM Pen Adjusted (7.4 cm)

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Culubasa Elementary School
2. Date of Inspection : July 25, 1995 10:15 A.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire	released from the pulley	OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
2.415 m	0.79	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Clearance must be covered.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : San Jose Magalang Elementary School
2. Date of Inspection : July 24, 1995

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
1.945 m	1.83	OK

Note; Actual groundwater level is measured by portable water level gauge from Concrete Base .

OTHERS

cm Pen adjusted (11.5 cm)

Prepared by: Checked by: Approved by:

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Sto. Rosario Elementary School
2. Date of Inspection : July 25, 1995 12:10 P.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point		OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
2.51 m	2.63	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Clearance must be covered.

Prepared by: Checked by: Approved by:

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : San Francisco Elementary School
2. Date of Inspection : July 24, 1995 2:40 P.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little Adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
0.72 m	0.69	OK

Note; Actual groundwater level is measured by portable water level gauge from Concrete Base .

OTHERS

cm Pen adjusted (3.0 cm)

Prepared by: Checked by: Approved by:

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : San Juan Elementary School
2. Date of Inspection : July 21, 1995

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight	New (July 21, 1995)	OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point		OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
2.40 m	New	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Wire was cut.
Float wire stolen.
The measuring well was improved.

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Magalang Elementary School
2. Date of Inspection : July 24, 1995

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little Adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
0.39 m	0.39	OK

Note; Actual groundwater level is measured by portable water level gauge from Concrete Base .

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : Telapayung Elementary School
2. Date of Inspection : July 25, 1995 11:25 A.M.

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little Adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
0.34 m	0.34	OK

Note; Actual groundwater level is measured by portable water level gauge from Top of Concrete Base .

OTHERS

Prepared by: _____ Checked by: _____ Approved by: _____

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : San Bartolome Elementary School
2. Date of Inspection : July 24, 1995

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		OK
	Float wire		OK
	Pulley & pulley axis		OK
Recorder	Appearance		OK
	Terminals		OK
	Settings		OK
	Recording		OK
	Chart feeding		OK
	Cartridge pen		OK
	Zero point	Little adjustment	OK

ACCURACY CHECK

Actual Groundwater Level 1)	Reading of Recorder	Result
2.843 m	2.79	OK

Note; Actual groundwater level is measured by portable water level gauge from Concrete Base .

OTHERS

cm Pen adjusted (5.3 cm)

Prepared by: Checked by: Approved by:

ATTACHMENT II

RESULTS OF INSPECTION ON
RAINFALL GAUGING STATION

1. Name of Station : .....
2. Date of Inspection : .....

RECORDER

Equipment	Portion	Maintenance	Problems & Measures	Results
Recorder	Exterior & Interior	Cleaning		
	Terminals	Tightening		

TIPPING BUCKET

Equipment	Portion	Maintenance	Problems & Measures	Results
Tipping Bucket	Exterior	Cleaning		
	Setting (Level)			
	Terminals	Tightening		

ACCURACY CHECK

Number of Pulse[1)]	Reading of Recorder[2)]	Result
0	mm	
10	mm	
20	mm	

Note: 1) Pulse is given by moving the tipping bucket by hand.
2) Allowable error is within ± 0.5mm.

OTHERS

Prepared by Checked by Approved by

RESULTS OF INSPECTION ON
RADIO WAVE CURRENT METER

1. Name of Station : .....
2. Date of Inspection : .....

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems &Measures	Results
Convertor	Exterior	Cleaning		
	Interior	Cleaning		
	Terminals	Tightening		
Transformer	Exterior	Cleaning		
	Terminals	Tightening		
Power Supply	Exterior	Cleaning		
	Interior	Cleaning		
	Indicator			
Battery	Exterior	Cleaning		
	Terminals	Tightening		
Portable Recorder	Exterior	Cleaning		
	Terminals	Tightening		
	Recording			
	Chart Feeding			

RADIO WAVE CURRENT SENSOR

Equipment	Portion	Maintenance	Problems & Measures	Result
Sensor	Externals	Cleaning		
	Terminals	Tightening		
	Angles	Adjustment		

SETTING OF EQUIPMENT

Item	Setting	Problems & Measures	Result
Number of Channels			
Range of Velocity	~ m/s		
Sampling Time	sec		
Times for Average			
Angle of Depression & Deviation	Deg. Deg.		
Output (Printing) Interval	min.		
Supplementary Output Interval	min.		
Writing Interval to IC Card	min.		
Specified Velocity	m/s		

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC V
AC Power Failure	Confirmation of power supply when power off	

OTHERS

Prepared by Checked by Approved by

RESULTS OF INSPECTION ON
GROUNDWATER LEVEL GAUGING STATION

1. Name of Station : .....
2. Date of Inspection : .....

EQUIPMENT

Equipment	Portion	Problems & Measures	Results
Sensor	Float weight		
	Float wire		
	Pulley & pulley axis		
Recorder	Appearance		
	Terminals		
	Settings		
	Recording		
	Chart feeding		
	Cartridge pen		
	Zero point		

ACCURACY CHECK

Actual Groundwater Level [1]	Reading of Recorder	Result
m		

Note; Actual groundwater level is measured by portable water level gauge from .....

OTHERS

Prepared by Checked by Approved by

POWER SUPPLY UNIT

Item	Criteria	Measured Voltage
AC Output Voltage	AC 90 ~ 110 V in AC Output Indicator	AC V
DC Output Voltage	DC10.0 ~16.5 V in DC Output Indicator	DC V
AC Power Failure	Confirmation of power supply when power off	

CONVERTOR

Items	Criteria/Checking Method	Measured Value/Setting	Problems & Measures	Results
Receiving Level Indicator	More than one lump (w/AGC)	~ Nos.		
	-ditto- (w/o AGC)	~ Nos.		
Transmission of Ultrasonic Wave	by lighting up of transmission indicator lump			
Measuring System	by lighting off of abnormality indicator lump			
Range of W.L.		m~ m		
W.L.Averaging Interval		sec.		
Standard Point Setting		m		

ACCURACY CHECK

Actual Water Level[1)]	Indication of Convertor	Portable Recorder	Memory Card Logger	Results[2)]
m	m	m	m	

Note : 1) Water Level which is observed by the portable water level gauge.
2) Allowable error is within ± 1.0 cm.

OTHERS

Prepared by Checked by Approved by

RESULTS OF INSPECTION ON
ULTRASONIC WAVE WATER LEVEL GAUGE

1. Name of Station : .....
2. Date of Inspection : .....

EQUIPMENT IN ELECTRIC HOUSE

Equipment	Portion	Maintenance	Problems & Measures	Results
Rack		Cleaning		
Transformer	Exterior	Cleaning		
	Terminals	Tightening		
Power Supply	Exterior	Cleaning		
	Terminals	Tightening		
	Indicator			
Battery	Exterior	Cleaning		
	Terminals	Tightening		
Convertor	Exterior	Cleaning		
	Terminals	Tightening		
Portable Recorder	Exterior	Cleaning		
	Terminals	Tightening		
	Recording			
	Chart Feeding			
Transmitter-receiver	Exterior	Cleaning		
	Terminals	Tightening		
	Setting			
Temperature Sensor	Exterior	Cleaning		
	Terminals	Tightening		
	Setting			

ATTACHMENT III

DAILY RAINFALL

STATION

YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
2												
3												
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29												
30												
31												
TOTAL												

ANNUAL TOTAL

D.MAX.												
R.DAY												

STATION
MONTH 19

RAINFALL FOR 30 MINUTES PERIODS

DATE		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	30																								
	60																								
2	30																								
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STATION

MONTH 19

RAINFALL FOR 30 MINUTES PERIODS

DATE		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
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DAILY MEAN WATERLEVEL

STATION

YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
2												
3												
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31												
MAX.												

GROUNDWATER LEVEL

STATION

YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1												
2												
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31												
AVERAGE												

JAPAN INTERNATIONAL COOPERATION AGENCY

THE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
THE GOVERNMENT OF THE PHILIPPINES

THE STUDY ON FLOOD AND MUDFLOW CONTROL
FOR SACOBIA-BAMBAN/ABACAN RIVER
DRAINING FROM MT. PINATUBO

OPERATION AND MAINTENANCE

GIS TRAINING FOR DPWH STAFF

(O&M.2)

NIPPON KOEI Co., Ltd., Tokyo, Japan
in association with
CTI ENGINEERING Co., Ltd., Tokyo, Japan

I

OPERATION & MAINTENANCE (O&M.2)

GIS TRAINING

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1 INTRODUCTION

This document is the final report of the contract agreement between Nippon Koei Co. Ltd., representing the JICA Study Team, and Louis Berger International Inc. (LBII). The works carried out under this contract agreement are a component of the JICA-funded study on flood and lahar/mudflow control for Sacobia-Bamban and Abacan Rivers draining from Mount Pinatubo. In June, 1994 a Progress Report documenting the Phase I activities of the contract was submitted. The present report resumes the Phase I activities and describes the additional Phase II work, thus providing a full description of activities carried out under the contract.

In general terms, the contract agreement covers the provision by LBII of technical assistance to the Mount Pinatubo Rehabilitation Project Management Office (MPR-PMO) of the Philippines Department of Public Works and Highways (DPWH). The contract Terms of Reference (TOR) stipulate LBII's specific responsibilities under the agreement. These responsibilities fall into several somewhat inter-related areas:

(1) Technology transfer: LBII is to provide for the continuing transfer of GIS and other computer technology to the MPR-PMO, pursuing earlier activities in this area. According to the TOR, technology transfer is to be accomplished by providing expatriate and local staff to work directly with the staff of the MPR-PMO to assist in the PMO's activities. In addition, however, it has been agreed between the JICA Study Team and LBII that an important mechanism for technology transfer is a formal program of technical training of the PMO's staff in a number of areas particularly relevant to the PMO's operations.

(2) GIS-related activities: LBII is to assist the MPR-PMO in the production, maintenance and transfer of the cartographic products (in hard copy and digital form) which are required by the JICA Study Team for the analysis of the control works on the Sacobia-Bamban and Abacan Rivers, as well as the production and maintenance of other cartographic products necessary to the PMO itself. This activity includes, among others, data conversion, data management, and map production and distribution.

(3) General technical assistance to the MPR-PMO: LBII is to provide technical assistance to the PMO in the fulfillment of its routine operations. This includes specific assistance and training in the utilization of available computer hardware and software (more general training is treated under technology transfer, above); assistance in the preparation of presentations, reports and briefings; and other types of technical assistance.

(4) Operational assistance: LBII is to furnish the MPR-PMO with limited amounts of consumable and non-consumable supplies, and to cover some cost of equipment repair, utilities and other direct expenses, when this is requested by the PMO, and to the extent that the overall costs of this activity are consistent with the amounts allocated for this purpose in the contract.

To carry out this work, LBII assigned a team consisting of an expatriate systems specialist as project manager, and GIS operators, programmers and engineers from its permanent local staff. This team was based in the PMO itself and worked closely with PMO personnel throughout the project.

The following sections describe the activities which LBII has carried out in each of these areas during both phases of the contract agreement, with particular emphasis on those performed in Phase II.

CHAPTER 2 TECHNOLOGY TRANSFER

As provided for in the contract, LBII expatriate and local personnel worked directly with the staff of the MPR-PMO and assisted the staff as needed with technical matters, particularly relating to GIS, CADD ad similar computer-based activities.

Furthermore, LBII developed a formal training program covering two technical subject areas - GIS and computer hardware/software systems - which are particularly important to the PMO's operations. PMO personnel were selected to take part in the training program.

The PMO staff targeted for GIS training included:

(1) Messrs. Lobs Fabic, Rolly de Jesus and Tony Buñag, relatively experienced AutoCAD operators who have been involved for some time in the PMO's AutoCAD map production activities;

(2) Messrs. Jay Fazonela and Alain Maniaul, who were assigned to the CADD section in early March to train on both AutoCAD and GIS.

Mr. Maniaul fell sick and requested an indefinite leave of absence from DPWH, and was not replaced. Thus, four PMO staff members participated in the complete GIS training program.

PMO staff targeted for hardware/software systems training included Ms. Leonor Ronquillo and Messrs. Toto Pagayonan and Pedrito Abergas. (This team is often referred to as the systems crew.) Mr. Abergas resigned from DPWH in July and was not replaced. Thus, two PMO staff members participated in the complete systems training program.

The initial task of the training program was an assessment of the PMO's GIS and computer system training needs, based on a review of activities in the CADD section and elsewhere in the PMO, and based on an individual evaluation of the skills and knowledge of each of the designated trainees. These findings were discussed with the PMO Director, and a program for filling the staff training needs was outlined and agreed on.

There were occasional difficulties, especially at the beginning of the training program, due to interruptions by other PMO activities: trainees were sometimes unable to participate because they were given urgent work by their supervisors just before the beginning of a training session. This problem was discussed with the PMO Director. As a result, he formally recognized training as a priority activity and instructed trainees and their supervisors to organize their daily and weekly work schedules to avoid conflicts with the training program. Subsequently, there have been few interruptions to the schedule.

Additional training activities were targeted at the PMO's "encoders" (data entry personnel), most of whom currently lack even basic computer skills.

Each of these components of the training program is discussed below.

2.1 GIS Training

GIS Training involved three distinct but related modules:

- basic notions of cartography;
- basic notions of GIS; and
- use of ArcCAD

The modules on basic cartography and GIS were completed early in the project, while the module on ArcCAD was completed in mid-July, 1994. A final project was then assigned.

Upon the completion of the formal ArcCAD training, the trainees were asked whether they would prefer to practice their ArcCAD skills, or to begin a new module on pc-ARC/INFO. The unanimous preference was for ArcCAD practice. Upon reflection, this seemed a wise choice: the trainees had assimilated a relatively large amount of classroom material in a relatively short time and there was a risk that, without more extensive practice than was possible during the formal training, the ArcCAD knowledge might be forgotten. Thus, practical ArcCAD work was substituted for the formal training on pc-ARC/INFO which had originally been considered for conclusion in the program.

2.1.1 Format of the GIS Training

The general organization of formal training sessions on cartography, GIS and ArcCAD consisted of a classroom-type lecture which introduced and elaborated upon the ideas to be communicated. There was generally a handout to accompany the lecture. Questions from the trainees were encouraged, and the lecture usually included short questions to the trained to test their understanding of the material which was being presented.

When the session involved software use or features, the lecture included a demonstration (by the instructor) of the commands and capabilities that were discussed. Sample data files were usually prepared beforehand for this purpose. Before the classroom session ended, each of the trainees was given the opportunity to practice using the software under the supervision of the instructor and the observation of other trainees. This allowed immediate feedback if some aspect of the lecture was poorly assimilated, and discussions among the trainees during this phase were often useful for cementing their understanding of the material.

Classroom sessions (lecture, questions/answer, demonstration, practice) generally took approximately 2 1/2 hours each (with flexibility to continue as needed) and were usually held twice a week. Table 1 indicates the complete schedule of GIS training sessions. In all, there was a total of approximately 75 hours of formal lectures, and each trainee practiced for at least an equivalent amount of time between lectures and on the final project.

Following the lecture, the sample data files were copies to a computer which was principally used for GIS practice and was readily accessible to the trainees. The trainees were encouraged to take time between classroom sessions to work on their own with the data files, practicing the commands and becoming more familiar with the software and its utilization. If questions arose during this phase of learning, the instructor was available to clarify things and to expand on the material learned in the classroom session. In fact, the trainees usually did take time to work with the software between sessions. Thus, there was a constant reinforcement of the training material through discussion and application.

Formal training ended with each trainee being assigned a medium-sized GIS project: preparation of a digital map of the 1993 lahar coverage. PHIVOLCS kindly provided map manuscripts containing this information for each river basin. Each trainee was responsible for one basin. The trainees work covered all major aspects of a typical GIS application including digitizing; construction and editing of coverage; transforming the input data (to UTM coordinates); input, manipulation and management of attribute data; map design, annotation and editing; and plotting. Following review and correction as needed, the final maps were displayed prominently in the CADD office and they have been used frequently since then. As an indication of the level of ability attained by the trainees during the training project, one of these maps is included in the pocket on the inside back cover of the report.

Following the suggestion of Dr. Seetharam of the JICA Study Team, official certificates of training were obtained. The certificates were presented to the trainees in an awards ceremony held during October, 1994.

2.1.2 Content of Training on Basic Notions of Cartography

The assessment of training needs for the designated GIS trainees revealed that none of them was familiar with basic cartography concepts or terminology. Thus, a first module of the GIS training consisted of an introduction to maps, their components and their characteristics.

Following a presentation of general map concepts and terminology, there was a more in-depth treatment of the Mercator and Transverse Mercator projections, including in particular the Universal Transverse Mercator (UTM) and Philippine Transverse Mercator (PTM) projections. Because the trainees come from a technical and engineering background, the discussion included an informal presentation of the mathematics underlying the Mercator projection for the sphere and the ellipsoid.

The module concluded with a discussion of some of the practical questions which sometimes arise in the PMO's cartographic work, in the light of the cartographic concepts which had been presented. Examples include conversions between UTM and PTM projections; implications of using UTM Zone 51 for mapping areas of the Philippines outside of longitudes 120°E to 126°E; and edge-matching map sheets or coverages which are based on different Transverse Mercator (UTM or PTM) zones.

2.1.3 Content of Training on Basic Notions of GIS

GIS training per se began with a module on general GIS concept including both raster- and vector-based approaches. The intent of the module was to provide an overview of GIS without focusing on the characteristics and capabilities of one particular software system. The discussion illustrated the scope of GIS by briefly discussing a range of applications including presentation cartography, infrastructure management, environmental and natural resource management, and land use/transportation planning. It also covered the history of GIS from its origins as systems for computerized mapping. Raster and vector-based approaches were compared and contrasted in terms of their conceptual approach, intrinsic feature types, data structures, typical operations, and appropriate applications and uses.

There was a brief review of some of the major raster- and vector-based GIS packages currently available on the market. The module then focused specifically on vector-based systems. There was a more in-depth presentation of intrinsic feature types, a discussion of typical data storage methods for topological data, and a discussion of generic operations that can be performed with a vector-based GIS system (symbolizing GIS objects, creating GIS objects and combining GIS objects). The module ended with a clarification of some of the differences between CAD and GIS.

2.1.4 Content of Training on ArcCAD

Following this general introduction to GIS, training then focused specifically on ArcCAD. Initial sessions provided an explanation of the relationship between ArcCAD and AutoCAD, and related ArcCAD's concepts of coverage and themes to the more general discussion of GIS concepts in the preceding module. Training in ArcCAD commands and capabilities began with its feature symbolizing options; sample coverage used to illustrate these capabilities included both very simple point, line, polygon and annotation data developed for tutorial purposes, as well as actual coverages which are used for the PMO's mapping operations. Entity-feature links were introduced and their importance was emphasized. Training stressed determining and applying the optimal

combination of AutoCAD and ArcCAD commands and capabilities to achieve a particular mapping objectives.

ArcCAD's data management capabilities were the next general area covered. Because most of the trainees were not familiar with basic database management system concepts, it was necessary to include a session covering this topic. In addition to the basic notions of records, fields, data types, etc., discussion emphasized the operations necessary to relate or join two Foxbase (a dBase-III+ clone) were used to illustrate the concepts. The training covered creation, modification and utilization of database files in ArcCAD and included work with selection sets, (for both spatial and non-spatial data), look-up tables, key legends, and basic data analysis commands (class, statistic and frequency).

Next, coverage creation and editing was presented in detail. Training emphasized the relationship between drawing entities digitized using AutoCAD and the GIS features which can be created from them. Each step that is required to establish a final-form coverage was covered in depth: digitizing and georeferencing; entity selection; topology creation; coverage building and cleaning; coverage modification and maintenance. The precaution which must be observed when modifying coverage via their associated entities were dealt with in detail. Individual training sessions dealt with the particularities of creating and editing point, line and polygon coverages.

The transform and project commands were discussed at length. The various options of the transform command were explained and recommendations were given for the most appropriate usage of the command. Only the most frequently-used options of the project command were discussed in detail, although there was a presentation of the range of possibilities which the command provides. The trainees were able to work with a number of sample data files (containing PTM, UTM and lat/lon coordinates) that were prepared specifically for the session to illustrate the most common manipulations.

ArcCAD's various map management commands were next presented. Differences and similarities between the map join, append, clip and split commands were discussed and sample coverage were used to illustrate the operation of each.

The final component of the ArcCAD training program covered the spatial analysis operations available in ArcCAD and explained their utility and operation. The presentation began with a discussion of buffer generation of points, lines and polygons, including an explanation of typical uses for this operation. It concluded with an explanation and comparison of the various forms of spatial overlay commands and operations which ArcCAD provides.

2.2 Computer System Training

The objective of the computer systems training was to ensure that the PMO has in-house staff capable of carrying out routine operations of computer hardware and software maintenance, and capable of undertaking the development of software applications of intermediate complexity when required. The three members of the systems crew were selected because they have some prior experience with computers, because of their enthusiasm about training, and because of the willingness of their supervisor to make time available for their training.

The system training comprised a number of modules:

- routine hardware and software maintenance;
- database programming (applications development with Foxbase and Clipper);
- software system design principles and approaches; and,
- local area network (LAN) concepts and administration.

Formal training was completed at the end of August, 1994. In recognition of the achievements of the two systems crew trainees, they were transferred to the CADD group office during August and relieved from their former obligations for data entry. The systems crew has now assumed responsibility within the PMO for much of the routine hardware and software system maintenance and development work that formerly required outside consultants. It is expected that they will be promoted within DPWH before the end of 1994.

Although both of the trainees received instruction in programming and computer maintenance, their current responsibilities are divided. Mr. Pagayonan is in charge of the PMO's computer hardware maintenance and trouble-shooting activities, while Ms. Ronquillo is more specifically responsible for software maintenance and system development.

2.2.1 Computer Hardware/Software Environment

As an indication of the computer environment which the systems trainees are responsible for, Tables 2 and 3 indicate the hardware installation in the GIS group and within the entire PMO. The software running on these machines includes Lantastic, AutoCAD, ArcCAD, pc-Arc/Info, MapInfo for Windows, Foxbase, Foxpro, WordPerfect, Wordstar, Lotus 1-2-3 and other commercial software, as well as applications development in-house.

2.2.2 Format of the Computer Systems Training

The format of the computer systems training was similar to that of the GIS training. There was a lecture-type presentation of the concepts to be covered, with questions and interactions from the trainees encouraged at all times. In the case of the hardware maintenance training, emphasis was on hands-on involvement. In case of the software systems training, the software was installed on a training computer that was used for demonstrations during the training session, and was available for practice afterwards.

In general, training took place twice a week in two-hour sessions. Table 4 indicates the schedule and course content followed during the program. Over 100 hours of formal lectures were given.

2.2.3 Content of Computer Systems Training

Training in computer hardware and software maintenance involved hands-on experience in basic trouble-shooting activities. Trainees were asked to remove viruses, configure a computer, install and/or upgrade software, clean computer interiors remove and install circuit boards and drives, and other related activities.

Training in software systems development included both theoretical as well as practical aspects. Considerable emphasis was given to hands-on practice with the concepts that were presented in classroom sessions. In addition to the formal lecture approach for database programming, the trainees were given opportunities to maintain existing systems operating in the PMO, and to develop new applications under the supervision of the project programmers. Simple applications developed by the trainees include:

- contractor database: used by the PMO to monitor contractors performance and keep basic data about them;
- computer database: developed to manage information about the computer hardware resources of the PMO, including type, condition, and configuration.

Other more complex applications which the trainees developed are discussed in detail below.

2.3 Training of Encoders

The project has provided some training to the "encoders" (data entry personnel) working in the PMO. Many of the encoders lack knowledge of elementary computer manipulations and turn to the systems crew when they need to do such operation; this results in a loss of time for all involved and an inappropriate utilization of the systems crew.

Under the supervision of LBII personnel, the systems crew itself undertook training of limited numbers of PMO encoders. They trained most of the new encoders hired by the PMO during the project, and also trained PMO encoders with particular requirements.

CHAPTER 3 GIS-RELATED ACTIVITIES

3.1 Map Production

Table 5 presents a list of most of the hard copy and digital maps which have been provided by the project to the JICA Study Team. The project also digitized the delineation of the Abacan and Sacobia-Bamban River Basins and the location of Sabo dams in the study area. A sampling of the maps produced during the project is included, although many A0 maps were created during the project.

The standard base map prepared by the project contained layers with administrative boundaries, population centers, river systems, the road network, pyroclastic deposits, existing lahar zones and lahar and flood hazard areas. A plot of this base, at 1:50,000 scale, is included separately as a project deliverable.

A digital coverage containing 20m contour lines for the study area was provided by the JICA Study Team to the project. The contours are too dense to be plotted over the entire study area at 1:50,000 scale, although smaller areas were plotted. A sparser version of the contours was prepared and overlain on the base maps.

Very late in the GIS Training project, LBII was requested by members of the JICA Study Team to prepare maps presenting certain results of socio-economic surveys carried out as part of the Sacobia-Bamban and Abacan River basins study. LBII agreed to work with the Study to develop the requested maps.

During the project, a considerable amount of time was also spent developing and maintaining maps (AutoCAD drawings) needed by the MPR-PMO for its operations. As shown in Table 6 below, two types of maps were prepared: those depicting an entire river basin and those depicting individual municipalities in the delta. The maps identify and locate projects being managed by the PMO, and provide basic information about each. The maps are constantly being revised as information about projects is updated or corrected. The maps have been distributed to all the DPWH "point men" responsible for supervising works in each basin, and have become a basic working tool which the PMO relies on in its day-to-day activities. Feedback provided by the point men is also an important source of information for revising or correcting the maps when needed.

Other maps produced in support of PMO requirements include maps of the proposed Sual-Pagbilao BOT road project and maps of BOT flagship projects.

3.2 Map Data Collection/Investigation

NAMRIA and NSO maps are known to contain inaccuracies with respect to barangay (and sometimes municipal and provincial) boundaries. These maps were the sources used in the original preparation coverages with more accurate and authoritative boundary data.

To this end, the project contacted the Region III Bureau of Lands, which is responsible for cadastral surveys and boundary records-keeping in that area. The project obtained information on the provincial, municipal, barangay (or barrio) and Bureau of Lands location monuments, which are the references used for the original establishment of provincial, municipal and barangay (formerly barrio) boundaries.

The original surveys of these monuments used the so-called Local Plane Coordinate System (LPCS). The system was based on a rectangular grid at full scale and oriented towards true north. Each municipality had its own individual grid that was centered at an arbitrary location within the municipality. Clearly such a system was not convenient for maps extending beyond the boundaries of a municipality. When the Philippine

Transverse Mercator (PTM) projection and the associated Philippines Plane Coordinate System (PPCS) were officially introduced in the early 1970s, the monument surveys were supposed to be converted to PTM. This was done in some cases, but not in all. Most of the available boundary monument survey data is still based on the LPCS grids. Generally, one Bureau of Land location monument in each municipality has been e-surveyed and its latitude and longitude established. Thus, in most cases there is one location monument in each municipality for which both latitude/longitude and LPCS coordinates are available; other monument coordinates in the municipality remain reference to the LPCS grid.

Boundary coordinate data is maintained in both hard copy and machine-readable (Lotus spreadsheet) form by the Region III Bureau of Lands. The project obtained ten diskettes containing the boundary data for all provinces of the region. Each spreadsheet file contains boundary data corresponding to one municipality and one type of monument (province, municipality, barangay, Bureau of Lands location monument, or other).

Unfortunately, the files were very poorly organized. It was found that the diskettes (with literally hundreds of files) contained many duplicate or near-duplicate files. In some cases, a set of near-duplicate files might include files containing clearly erroneous data; in other cases, some files in a set might contain only a subset of the data in other files in the set. Some files were mis-named (e.g., a file named APALIT.WK1 might contain data for Bacolor). Spreadsheet formats were not examine the files, and to organize them so that a unique set of boundary data, in a consistent format, was available for each municipality and each type of monument. This effort was completed for the province of Pampanga.

Next, a computer program was developed to convert LPCS coordinates to UTM coordinates based on the one reference monument in each municipality for which both LPCS coordinates and latitude/longitude were available. The program first determines the true meridian distance (TMD) from the equator to the reference monument, based on the reference monument's known latitude. Given the LPCS coordinates of a target monument whose UTM coordinates are to be determined, the program next computes the difference in LPCS northings between the reference monument and the target monument. This difference, applied to the TMD of the reference monument, gives the TMD of the target monument. From the TMD of the target monument, the program can determine its latitude. The program next calculates the length of an arc of longitude at the target monument's latitude, and this is used to convert the difference of LPCS eastings between the reference and target monument into an equivalent difference of longitude. The program then applies this difference of longitude to the known longitude of the reference monument to obtain the longitude of the target monument. It finally converts the target monument's latitude and longitude into UTM coordinates. The formulas for TMD, longitude arc length, and lat/lon to UTM conversions are based on the Clark 1899 ellipsoid, and are accurate at the centimeter level at least.

The program was applied to the boundary monument data prepared for Pampanga. Output UTM coordinates were used to create point coverages, which were overlaid on a base map containing the boundaries digitized from NAMRIA maps. The following conclusion were drawn:

- in most cases, the monument points were located on or near the digitized NAMRIA boundaries. They were generally very near those boundaries defined by natural features such as rivers;

- monuments are too sparse to completely establish provincial, municipal or barangay boundaries. At most they may fix a number of points along those boundaries, but the boundary alignment between the points remains imprecise;

- in a few cases an entire set of monument points for a municipality are far from their true location. This indicates that the LPCS grid coordinates or the latitude/longitude of the reference monument was incorrect;

- where the monument points are correct, it is entirely feasible to use them to edit and correct the boundary coverages from the digitized NAMRIA maps.

The project also identified Commission on Election (COMELEC) municipal and barangay maps as a potential source for correcting boundary information. These maps are used to prepare and monitor local elections (the most recent barangay elections took place in early May). However, the maps are not georeferenced and sometimes refer to features which are only apparent in the field; this makes them useful for visual verification of the general shape of boundaries whose geographic location is established by other means. It cam be presumed that these maps are completely up-to-date in terms of recent boundary changes, creation of new barangays, etc.

3.3 Preparation of a GIS Data Dictionary

The project prepared a GIS data dictionary to document and illustrate available GIS data maintained by the PMO.

The data dictionary provides, in a standard format, information about the various spatial data items or coverages which the PMO maintains. Included in the dictionary are information about the nature of each data item, its source and accuracy, and other comments about it. A sample plot illustrates the data.

In addition to information about individual spatial data items or coverages, the dictionary also includes a description and sample plots of representative composites (particular overlays of selected data) of general utility.

In general, the data dictionary is organized as an updatable notebook in A3 landscape format.

CHAPTER 4 GENERAL TECHNICAL ASSISTANCE TO THE PMO

4.1 Software System Development/Maintenance

In the past, LBII has developed a number of computer applications which are in daily use by the PMO for its operations. From time to time, the PMO Director requests enhancements to these applications; occasionally the request is for the development of an entirely new application.

One of the major applications developed by LBII and in current use by the PMO is the correspondence and activity monitoring (CAM) system, which is used to track the PMO's incoming and outgoing correspondence and to assist PMO management in overseeing the different activities handled by its personnel.

During the project, the PMO Director requested certain enhancements to the existing CAM system. The enhancements required not only programming changes to the software system, but also procedural changes in the way which activities are identified and tracked within the PMO. The software changes were made during Phase I of the GIS Training project, and the procedural changes were implemented during Phase II.

The PMO Director also requested development of a new software application to automate and facilitate the various administrative steps involved in purchases and rental of supplies, materials and equipment. Currently, these steps are performed manually. The purpose of the requested application was to alleviate much of the manual work and institute a system of checks to ensure that variances from specifications are identified and corrected at an early stage.

Overall system design and implementation of the data input module were completed during Phase I. Following a review of the concept and system design by PMO management, a number of specific report modules were requested. One of the PMO systems crew (Ms. Ronquillo) developed these modules under the supervision of the project programmers. The system has been in operation throughout Phase II relatively small system modifications have occasionally been requested by the system's users, and these have been implemented by Ms. Ronquillo without difficulty.

4.2 Assistance in a Structure Data Collection Effort

One of the recommendations made by the U.S. Army Corps of Engineers (USACE) in its study of Mt. Pinatubo response options was the establishment of an on-going data collection effort for information relevant to the planning and design of protection and rehabilitation works around the volcano.

The PMO established a group that is responsible for all activities relating to this effort. Its initial focus is on data pertaining to the condition of existing lahar protection structures. The data collection activity has been underway since shortly after the beginning of the rainy season. It is an on-going substantial effort involving DPWH personnel in all river basins and in the PMO.

The CADD group was asked to assist this effort by establishing and operating a data management/GIS system to handle, process report on and display most of the data generated by the structure data collection activity.

A data entry, verification and reporting system was developed by Ms. Ronquillo under supervision of the project programmers. A data encoder was hired by the PMO and assigned to the group to work exclusively on entering the data received from the field.

The GIS trainees developed ArcCAD coverages of the structures using map manuscripts prepared by DPWH personnel in each basin. Plots of these coverage were field-verified and modified as required, and are now undergoing at most minor correction. The trainees use ArcCAD to generate plots showing structure conditions and highlighting critical sections.

4.3 Technical Review/Inputs

Members of the project team have assisted the PMO by reviewing a number of technical documents related to general Region III development activities (previous master plans and specific road improvement proposals).

4.4 Preparation of Reports/Briefings

The project has assisted the PMO in the preparation of materials to be used in reports and briefings. This has included preparation of maps used for internal working meetings with the river basin "point men" to monitor and program civil works; maps used for meetings with other DPWH officials to inform them of the status of PMO operations; maps used in meetings with other government officials including President Ramos, a number of Senators, and members of the Mount Pinatubo Commission; and maps used for presentation of the MPR-PMO works program on Philippine national television.

4.5 Other Technical Assistance

Project members have served as technical resources persons for the PMO and the DPWH in general on a number of occasions during the project. This has ranged from helping with cases of computer virus infestation to providing review and comments on technical documents such as feasibility studies and master plans.

CHAPTER 5 OPERATIONAL ASSISTANCE TO THE PMO

The project has provided operational assistance to the PMO in a number of areas as indicated below:

- purchasing of consumable computer supplies: HP LaserJet toner cartridges; HP PaintJet color ink cartridges; paper and other plotting media;
- purchasing of other consumables such as color toner cartridges for the PMO's color photocopier;
- paying for repairs to PMO computer hardware: two of the PMO's computer monitors, one of its printers and one of its plotters have been repaired and paid for by the project;
- paying for repairs to PMO computer hardware (continued): several of the PMO's computers have also been repaired and the project has agreed to cover the cost;
- paying for repairs to PMO vehicles: two of the PMO's all-terrain vehicles required a number of repairs and replacement parts. These were paid for out of the project's funds.

TABLES

Table 1 GIS Training Schedule

25 April	Basic Notions of Cartography - Map Concepts
27 April	Basic Notions of Cartography - Mercator and Transverse Mercator Projections
4 May	Basic Notions of GIS
6 May	ArcCAD - Introduction
13 May	ArcCAD - Basic System and Feature Display Commands
16 May	ArcCAD - Basic System and Feature Display Commands (continued)
18 May	ArcCAD - Database Concepts in General
23 May	ArcCAD - Specific Database Capabilities and Commands in ArcCAD
25 May	ArcCAD - Review of Material Covered to Date
30 May	ArcCAD - Lookup Tables and Selection Sites
2 June	ArcCAD - Key, Class, Statistics and Frequency Commands
7 June	ArcCAD - Review of Material Covered to Date
9 June	ArcCAD - Introduction to Coverage Creation and Editing; Point Coverages
15 June	ArcCAD - Line Coverages: Building and Cleaning
17 June	ArcCAD - Polygon Coverages: Building and Cleaning
21 June	ArcCAD - Polygon Coverages continued; Annotation; Property Tables
23 June	ArcCAD - Property Tables continued (session interrupted by typhoon)
28 June	ArcCAD - Property Tables continued and General review
30 June	ArcCAD - Ties and the Transform Command
5 July	ArcCAD - Transform Command continued; Project Command
7 July	ArcCAD - Managing Digital Maps: Mapjoin, Append, Clip, Split Commands
12 July	ArcCAD - Spatial Analysis Command
14 July	ArcCAD - Conclusion of Formal ArcCAD Training; Assignment of Projects

Table 2 Hardware Environment of GIS Group

Computers

Quantity	Type	Hard Disk Size	RAM
2	486DX	450MB	16MB
2	486DX	350MB	16MB
4	486DX	210MB	4MB
2	386DX	150MB	4MB
1	386SX	150MB	2MB

Digitizers

Quantity	Brand	Description
3	Kurta XLC	48 x 36 inches, 16 button cursor
3	SummaGraphics	18 x 12 inches, 4 button cursor

Plotters and Printers

Quantity	Brand
1	NOVA InkJet Plotter
1	ROLAND 8 pen Plotter
1	HP Paintjet XL300 Color Printer
2	HP LaserJet Series III

Table 3 Hardware Environment of Entire PMO

LOCATION	COMPUTER TYPE	Number	PRINTER	Number
MPE	XT	1	Citizen (132 col.)	1
	286	1		
Sub-Total		2		1
TECHNICAL	286	6	Epson (132 col.)	1
	386	2	Fujitsu (132 col.)	3
			LaserJet III	1
			Epson (80 col.)	1
Sub-Total		8		6
DIRECTOR'S	286	2	LaserJet III	1
OFFICE				
Sub-Total		2		1
ELSIE	386SX	2	LaserJet IV	1
	286	1	Epson (132 col.)	2
Sub-Total		3		3
BOY IGNACIO	286	2	Epson (132 col.)	1
ANGIE	386SX	1	LaserJet III	1
GIS	486DX	8	Epson (132 col.)	1
GROUP	386DX	3	HP PaintJet XL300	1
	386SX	1	NOVAJET	1
	286	1	LaserJet III	2
			Epson (80 col.)	1
Sub-Total		13		6
Total		**31**		**19**

Table 4 Computer Systems Training Schedule

18 January	Flowcharting
20 January	Flowcharting (continued)
25 January - 3 February	
	Introduction to Foxbase
	Dot Prompt Commands
	Filters and Indexes
	Basic Functions and Commands
	Introduction to Foxbase Programming
8 February - 18 February	
	Memory Management under DOS: Extended/Expanded Memory;
	CONFIG.SYS and AUTOEXEC.BAT options
	DOS Commands and Norton Utilities
	Computer Viruses; Detection and Removal; SCAN and CLEAN
22 February - 8 March	
	Computer Configuration
	Use of Laplink
	Installing Windows, WordPerfect, Lotus 123, Foxbase, DOS
	Hard Disk management
10 March - 7 April	
	Hardware Maintenance (hands-on)
	Basic Troubleshooting and Diagnosis
	Routine Maintenance (Cleaning Drives, Printer, etc.)
	Hardware Installation and Configuration
21 April	Foxbase - Logical and Memo Fields; Format Files; SET Command
26 April	Foxbase - Foxbase Functions
28 April	Foxbase - Applications (Hands-On)
3 May	Foxbase - Arrays
5 May	Foxbase - Arrays (continued)
10 May	Foxbase - Arrays (continue)
12 May	Foxbase - Procedures and User-defined Functions
17 May	Foxbase - Data Import (APPEND FROM Command)
24 May	Foxbase - ON Commands (ERROR, ESCAPE, KEY)
26 May	Foxbase - SET RELATION Command; Printing
2 June	Foxbase - Wordwrap

Table 4 Computer Systems Training Schedule (continued)

9 June - 19 June	System Design
	Introduction to System Design
	Tools used in Analysis and Design
	Feasibility Study
	File Design Specification
	Detailed System Study
	Development of the System
	Documentation
22 June - 5 July	Database File Conversion
	Steps in Database File Conversion
	Application (Hands-On)
7 July - 2 August	BASIC Programming
	Introduction to BASIC
	BASIC Commands and Functions
	File Handling in BASIC (Sequential Files)
	Applications (Hand-On)
4 August - 11 August	Clipper Programming
	Introduction to Clipper
	Commands and Functions (Differences with Foxbase)
	Compiling and Creating Clipper EXE Files
	Applications (Hands-On)
23 August - 30 August	Local Area Networks
	Introduction to LANs
	Introduction to Lantastic
	Hardware and Software Maintenance in Lantastic
	Applications

Table 5 Maps Produced for JICA Study Team

Map Description	Size
Base Map of Abacan & Sacobia-Bamban River Vicinity (includes administrative boundaries, population centers, river systems, road network, pyroclastic deposits, existing lahar zones and lahar and flood hazard areas)	A0
Mudflow Hazard Map for the JICA Study Area	A0
Base Map/Mudflow Hazard Map	A0
Mudflow Hazard Map	A0
Mudflow Hazard Map, Abacan River and Vicinity	A3
Mudflow Hazard Map, Sacobia-Bamban River Vicinity	A3
Mudflow Hazard Map	A0, A3
Land use Map for Study Area	A0
Mudflow Hazard Map	A3
River Basin Map	A0
Mudflow Hazard Map	A0
Mudflow Hazard Map	A3
River Basin Map	A0
Base Map	A0
Mudflow Hazard Map for Entire Area (4 sheets)	A0
Basin Boundary map	A0
Sabo Dam Location Map	A0
Base Map with Basin Delineation and Sabo Dams	A2
Ashfall Distribution Map	A0, A2
Mudflow Hazard Map with Sabo Dams	A2
Resettlement Map	A0, A2
Base Map with basin Delineation and Sabo Dams	A2
Ashfall Distribution Map	A0, A2
Mudflow Hazard Map with Sabo Dams	A2
Resettlement map	A0, A2
Sample Contour Map at Full Density	A2
Base Map with Basin Delineation, Sabo Dams and Contours	A2
Ashfall Distribution Map with Contours	A0, A2
Mudflow Hazard Map with Sabo Dams and Contours	A2
Resettlement Map with Contours	A0, A2
Socio-Economic data maps	A3
Bureau of Lands Administrative Boundary Maps	

Table 6 Map Series Produced in Support of MPR-PMO

Individual River Basin Map Series

- Bucao River Basin
- Cabangan River Basin (Tanguay River)
- Maloma River Basin
- Santo Tomas River Basin
- Olongapo River Basin (Kalaklan River)
- O'Donnell-Tarlac-Agno River Basin
- Sacobia-Bamban River Basin

Individual Municipality Map Series

- Angeles (Abacan River Basin)
- Mexico (Abacan River Basin)
- Santa Ana (Abacan River Basin)
- San Fernando (Abacan and Pasac-Guagua-San Fernando River Basins)
- San Simon (Abacan and Pasac-Guagua-San Fernando River Basins)
- Santo Tomas (Abacan and Pasac-Guagua-San Fernando River Basins)
- Porac (Pasig-Potrero and Pasac-Guagua-San Fernando River Basins)
- Bacolor (Pasig-Potrero and Pasac-Guagua-San Fernando River Basins)
- Santa Rita (Pasig-Potrero River Basin)
- Guagua (Pasig-Potrero and Pasac-Gugua-San Fernando River Basins)
- Floridablanca (Porac-Gumain/Bataan River Basin)
- Lubao (Porac-Gumain/Bataan River Basin)
- Sasmuan (Porac-Gumain/Bataan and Pasac-Guagua-San Fernando River Basins
- Orani (Porac-Gumain/Bataan River Basin)
- Hermosa (Porac-Gumain/Bataan River Basin)
- Dinalupihan (Porac-Gumain/Bataan River Basin)
- Masantol (Pasac-Guagua-San Fernando River Basin)
- Macabebe (Pasac-Guagua-San Fernando River Basin)
- Minalin (Pasac-Guagua-San Fernando River Basin)
- San Luis (Pasac-Guagua-San Fernando River Basin)
- Apalit (Pasac-Guagua-San Fernando River Basin)