Part VI: Data Book

CHAPTER 1 GENERAL FEATURES OF THE PHILIPPINES

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Table 1.1 Some Basic Development Indicators: ASEAN

	Population in 1990 (million)	Average Annual population growth rate: 1980-90 (percentage)	GNP per capita in 1990 (U.S. dollars)	Average Annual growth rate of GNP per capita: 1980-92 (percentage)
Singapore	3	2.2	11,160	6.5
Malaysia	18	2.6	2,230	4.0
Thialand	56	1.8	1,420	4.4
Philippines	61	2.4	730	1.3
Indonesia	178	1.8	570	4.5

Source: World Bank, World Development Report 1992.

Table 1.2 Selected Indicators of Human Development : 1990

Country	Life Expectancy (years)	Mean Years of Schooling	Adult Literacy Rate (percent)	Real GNP Per Capita (US $)	Human Dev't Index
Indonesia	61.5	3.9	77.0	570	0.496
Malaysia	70.1	5.3	78.4	2,320	0.789
Philippines	64.2	6.4	89.7	730	0.600
Singapore	74.0	3.9	88.0	11,160	0.848
Thialand	66.1	3.8	93.0	1,420	0.685

Source: UNDP, Human Development Report 1993.

Table 1.3 TYPHOON DAMAGE FOR THE PAST TEN YEARS (IN MILLION PESOS)

Years	No. of Typhoons Entering the PAR	No. of Typhoons Affecting the Country	Estimates Cost of Damage						Calamity Fund	
			Total		All Infrastructure		Roads/Bridges			
			Current Price	1994 Price	Current Price	1994 Price	Current Price	1994 Price	Current Price	1994 Price
1984	20	6	6,417.6	13,650.2	1,989.4	4,231.5	1,219.3	2,593.5	205 9	437 9
1985	17	4	1,703.2	3,595.5	204.4	431.5	85.2	179.9	226.6	477.7
1986	21	6	996.7	2,088.1	299.0	626.4	189.4	396.8	471.4	987.6
1987	16	5	3,634.0	7,333.4	872.0	1,759.7	366.2	739.0	325.6	657.1
1988	20	5	8,675.6	16,093.2	1,224.9	2,272.2	589.1	1,092.8	280.4	520 1
1989	19	7	4,529.2	7,609.1	1,221.0	2,051.3	598.5	1,005.5	649.6	1,090 8
1990	20	8	12,108.3	18,053.5	3,148.2	4,694.0	1,574.1	2,347.0	389.9	881.3
1991	19	6	4,760.2	5,969.3	1,237.7	1,552.1	618.8	776.0	580.0	727.3
1992	16	7	5,067.0	5,827.1	1,317.4	1,515.0	658.7	757.5	429.6	494.0
1993	32	10	16,276.4	17,415.7	4,231.9	4,528.1	1,953.2	2,089.9	798 5	854.4
Total	200	64	64,168 2	97,635.0	15,745.9	23,661.7	7,852.0	11,977.7	4,356.9	6,828.4
Average	20.0	6 4	6,416.8	9,763.5	1,574.6	2,366.2	785.3	1,197.8	435.7	682.8

NOTE: PAR - Philippine Area of Responsiblity
Source: Philippine Atmospherical Geophysical and Astronomical Services Administration (PAGASA)

Table 1.4 Summary of Major Indicators

Indicators	Annual Average 1987-1992	TARGETS Estimates 1993	1994	1995	1996	1997	1998	Annual Average 1994-1998
I. INCOME AND EMPLOYEMENT/a								
PER CAPITA GNP (In pesos, at constant 1985 Prices) / b	11,320	11,483/m	11,537	12,024	12,661	13,470	14,541	12,847
Unemployement Rate / b	9.8	9.29	9.13	8.84	8.37	7.53	6.60	8.09
Jobs to be Created (000) /b	781	686	858	972	1,086	1,321	1,509	1,149
II. HEALTH AND POPULATION /a								
Life Expectancy (in years)	64.58/c	67.9	68.3	68.7	69.1	69.4	69.7	69.04
Infant Mortality Rate (per 1000 livebirths)	58.35/c	55.2	54.0	52.7	51.5	50.5	49.7	51.62
Crude Death Rate (per 1000 population)	7.30/c	6 3	6.2	6.1	5.9	5.8	5.7	5.94
Crude Birth Rate (per 1000 population)	31.68/c	27.4	26 8	26.2	25.6	25.0	24.5	25.63
Maternal Mortality Rate /c (per 1000 livebirths)	0.81/c	0.7	0.7	0.7	0.6	0.6	0.6	0.64
Population Growth Rate	2.39/c	2.24	2.21	2.18	2.09	2.00	1.92	2.08
Totally fertility rate	4.04/c	3.36	3.26	3.17	3.07	2.99	2.91	3.08
Contraceptive prevalence rate	41.4/c	40.00/d	40.58	41.14	41.7	42.25	42.79	41.69
III. NUTRITION								
Perentage of pre-school children with weight less than 75% of standards weight-for-age	14.0/f	11.9	11.2	10.5	9.8	9.1	8.4	9.8
Percentage of school children aged 7-10 years old with weight less than 70% of standard weight-for-age	13.9	11.9	11.2	10.5	9.8	9.1	8.4	9.8
Per capita energy intake (in kcals)	1,735/g	1,872	1,892	1,913	1,934	1,956	1,977	1,934
Pecentage of households with energy intake less than 100% adequacy level	69.2	39.7	41.2	42.6	44.1	45.6	47.1	44.12
Prevalence of anemia among infants	70.4/h	67.2	66.6	66.1	65.5	65.0	64.5	65.54
Prevalence of Vitamin A deficiency/ Bitot's spot among preschool	0.20/h	0.11	0.1	0.08	0.06	0.05	0.04	0.066
Prevalence of iodine deficiency disorders/goiter	3.5/h	1.9	1.6	1.3	1.1	0.8	0.5	1.06
IV. EDUCATION /a								
Literacy Rate	89.8/i	92.78	93.53	94.27	95.02	95.76	96.51	95.02
Functional Literacy Rate	60.54/i	76.78	78.07	79.64	81.21	82.79	84.36	81.21
Elementary Achievement Rate	55.18	63.44	65.16	66.88	68.60	70.32	72.04	68.60
Participation Rate								
a. Elementary	91.38	85.90	88.8	4.70	92.50	93.50	94.2	92.12
b. Secondary	54.79	58.00	59.6	61.2	62.8	64.4	66.00	62.80
Cohort Survival Rate								
a. Grades I-IV	67.93	71.00	73.8	76.50	78.4	80.3	82.2	78.24
b. Years I-IV	76 01	78.86	78.9	8.50	80.60	82.71	84.13	81.17

Table 1.5 Government Infrastructure Program for 1993-1998 a/
(In Million Pesos, Current Prices)

SUBSECTOR	1993	1994	1995	1996	1997	1998	Total 1993-98	% to Total
ENERGY, POWER & ELECTRIFICATION	36,668	41,614	42,996	38,917	52,320	56,517	269,032	45.24%
Energy Resource Dev't. & Downstream Activities	5,895	6,198	7,115	5,175	1,152	995	26,530	
Power Generation & Transmission	29,958	34,319	34,469	32,140	50,181	54,604	235,671	
Electrification	672	997	1,234	1,381	757	710	5,751	
Othes b/	143	100	178	221	230	208	1,080	
TRANSPORTATION	18,660	20,574	25,847	34,105	37,896	49,599	186,681	31.39%
Land	13,808	15,225	16,825	22,828	27,605	39,664	135,955	
Water	2,426	2,674	2,948	2,923	3,352	3,217	17,540	
Air	933	1,029	1,791	2,351	3,566	6,372	16,042	
Rail	1,493	1,646	4,283	6,003	3,373	364	17,144	
COMMUNICATIONS	2,202	1,160	2,129	1,854	1,357	680	9,382	1.58%
Telecommunications	2,202	1,108	1,900	1,541	1,316	645	8,712	
Postal Communications		52	229	313	41	35	670	
WATER RESOURCES	8,354	11,114	13,980	16,497	17,838	21,432	89,215	15.00%
Irrigation	2,211	4,300	6,299	6,550	6,300	6,952	32,612	
Water Supply, Sewerage & Sanitation	4,318	4,864	5,471	6,506	5,879	5,115	32,153	
Flood Control & Drainage	1,799	1,826	2,116	3,360	5,595	9,297	23,993	
Other /c	26	124	94	81	64	68	457	
SUB-TOTAL /d	65,884	74,462	84,952	91,373	109,411	128,228	554,310	
SOCIAL INFRASTRUCTURE e/	4,192	7,546	9,659	5,579	6,776	6,641	40,393	6.79%
Schoolbuildings	2,301	5,784	7,055	3,167	3,853	4,938	27,098	
Health Infrastructure	50	93	890	746	1,412	1,091	4,282	
Housing	1,841	1,669	1,714	1,666	1,511	612	9,013	
TOTAL	70,076	82,008	94,611	96,952	116,187	134,869	594,703	100.00%

a/ Does not include projects of LGUs and the private sector. LUGs and the private sector are expected to play a more active role in infrastructure development and thus help fill the gap between total requirements demamd-based and the resources-based Infra Program. Capex program of the government infrastructure corporations do not include expected subsidies from the national governement

b/ Infrastructure program of DOE (OEA), ERB, and DOST-PCIERI)

c/ Infrastructure program of LLDA and NWRB

d/ Corresponds to the infrastructure component under the MTPIP except for the investment requirements of the transportation and water resources subsector that are not yet updated based on the April 1994 resource ceilings estimates.

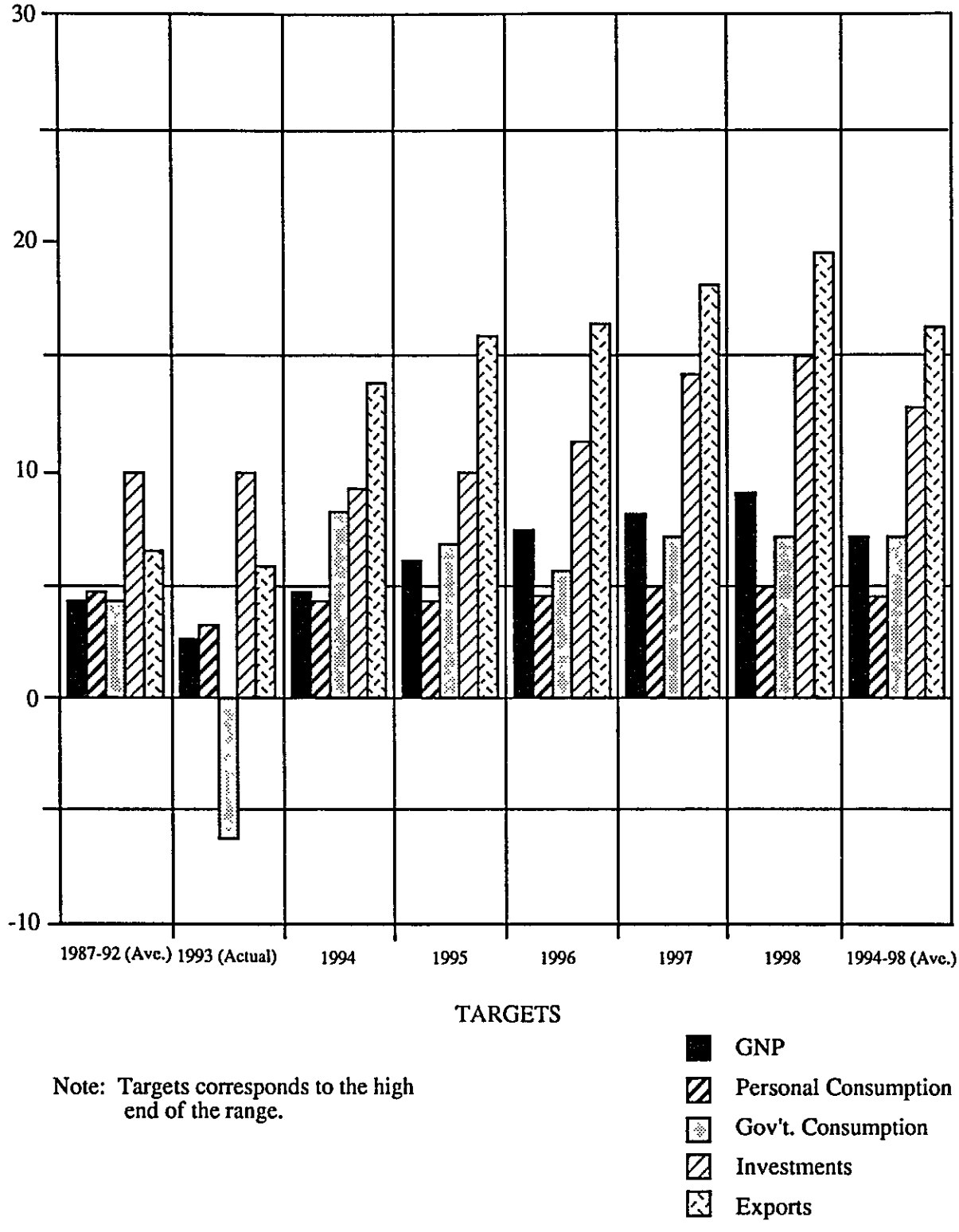
e/ Investment requirements for social infrastructure under the Chapter on Total Human Development.

Source: DPWH, DOTC, NPC, PNOC, NEDA

Table 1.6 List of Previous and Present Flood Control and Sabo Studies

No.	Name of Project	Location	Type of Study	Year Comple	Funding Source
1.	A Report on the Central Luzon Basins	Luzon Island	Basin Inventory/Water Development Plan	1966	USAID
2	A Report on the Cotabato Rier Basin	Mindanao Island	Basin Inventory	1966	USAID
3.	A Report on the Agusan River Basin	Mindanao Island	Basin Inventory	1996	USAID
4.	A Report on the Ilog-Hilabangan River Basin	Negros Island	Basin Inventory	1966	USAID
5.	A Report on the Bicol River Basin	Luzon Island	Basin Inventory	1967	USAID
6	Planning Report on the Pasig-Potrero River Flood Control and Sabo Project	Pampanga	Master Plan	1978	NK/JICA
7.	Cotabato-Agusan River Basins Development Project	Mindanao	Detailed Engineering ?	1980	OECF
8	Master Plan for Mayon Volcano Sabo and Flood Control Project	Bicol	Master Plan Feasibility Study	1981 1981	NK/JICA NK/JICA
9.	Pampanga Delta Development Project	Pampanga	Detailed Engineering	1992	NK/OECF
10.	Nationwide Flood Control Plan and River Dredging Program	Nationwide	Master Plan	1982	NK/OECF
11.	Re-Study of Mayon Volcano Sabo and Flood Control Projects	Bicol	Master Plan	1983	NK/JICA
12.	Lower Agusan Development Project	Mindanao Island	Detailed Engineering	1984	OECF
13.	Study on an Effective Flood Control Operation System Including Telemetering and Flood Warning System in the Pasig-Marikina-Laguna Lake Complex	Metro Manila and Rizal Province	Detailed Engineering	1985	JICA
14.	The Panay River Basin Wide Flood Control Study	Panay Island	Master Plan	1987	NK/JICA
15	The Master Plan Study on the Cagayan River Basin Water Resources Development	Cagayan Province	Master Plan	1990	NK/JICA
16	The Study on Flood Control and Drainage Project in Metro Manila	Metro Manila	Master Plan	1991	OECF
17.	Metro Manila Flood Cntrol Project II	Metro Manila	Detailed Engineering	1991	JICA
18.	Study on Ilog-Hilabangan River Basin Flood Control Project	Negros Island	Master Plan ?	1992	OECF
19.	Detailed Engineering Design of the North Laguna Urgent Flood Control Development Project	Metro Manila	Detailed Engineering	1994	JICA
20.	Study on Flood Control for Rivers in Selected Urban Centers	Nationwide	Master Plan/Feasibility	1995	JICA
21.	The Study of Agno River Flood Control	Pangasinan	Master Plan	1994	NK/OECF
22.	Plan for the Drainage of Metro Manila and Suburbs		Feasibility Study and Detailed Engineering	1954	Bureau of Public Works
23.	Paranaque Spillway Feasibility Study	Metro Manila	Feasibility Study	1975	DMJM(World Bank)
24.	Metro Manila Integrated Urban Drainage and Flood Control Master Plan	Metro Manila	Master Plan	1983	Engg Science Inc. & Basic Team, IBRD
25.	Flood Control and Drainage Project in Metro Manila	Metro Manila	Feasibility Study	1990	CTI/JICA
26.	Planning and Detailed Engineering Design for Flood Control and Drainage Project	Metro Manila	Detailed Engineering	1985	Asiatic Consultants (GOP)
27.	North Laguna Lakeshore Urgent Flood Control and Drainage Project	Metro Manila	Detailed Engineering	1993	OECF
28.	Development of Laguna Lake	Metro Manila	Feasibility Study	1975	DMJM, SOGREAH and INGELDOM (World Bank)

Source : DPWH



Note: Targets corresponds to the high end of the range.

Figure 1.1 Real Gross National Product (Growth rates, in percent)

Source: NEDA

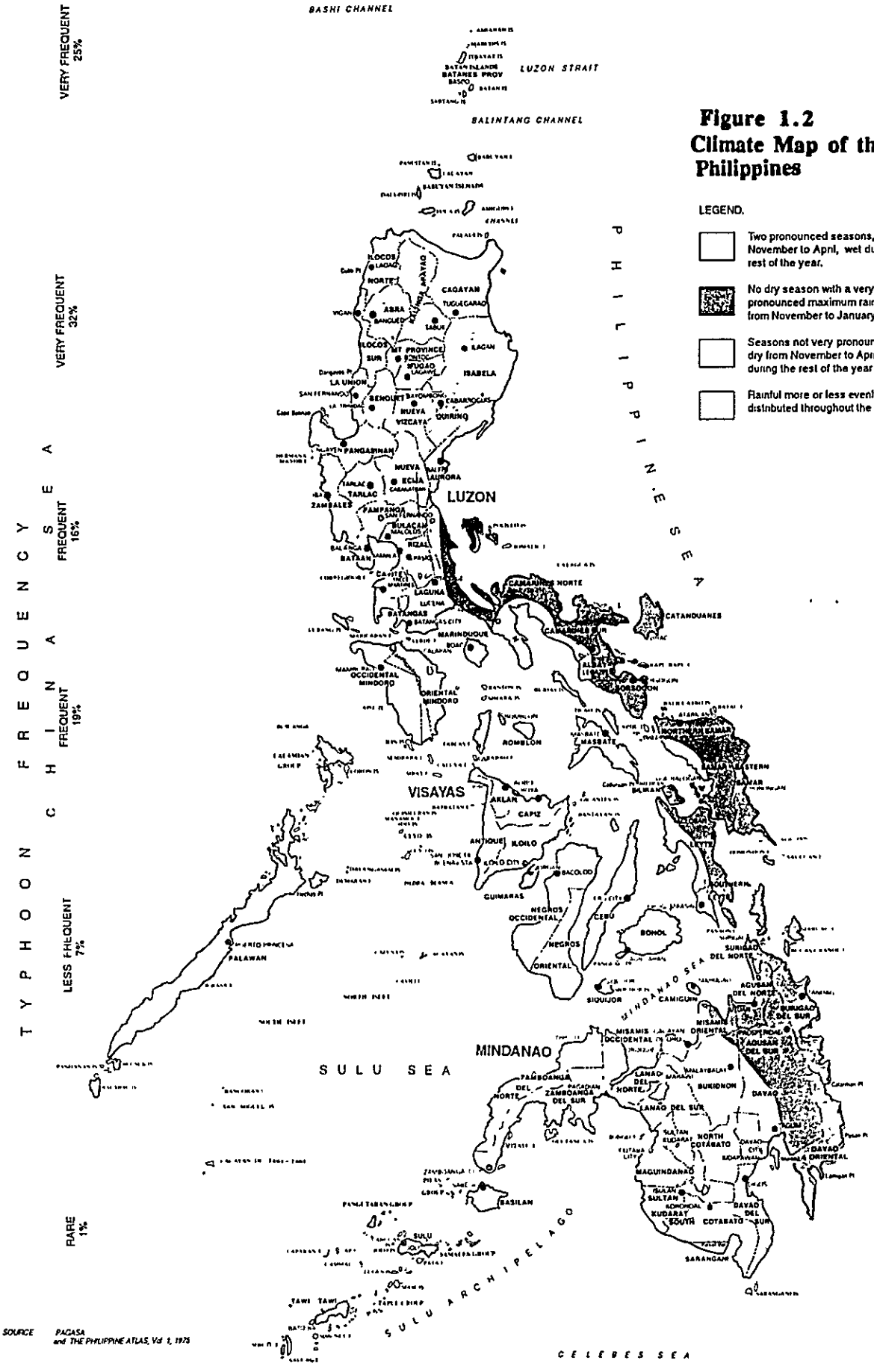
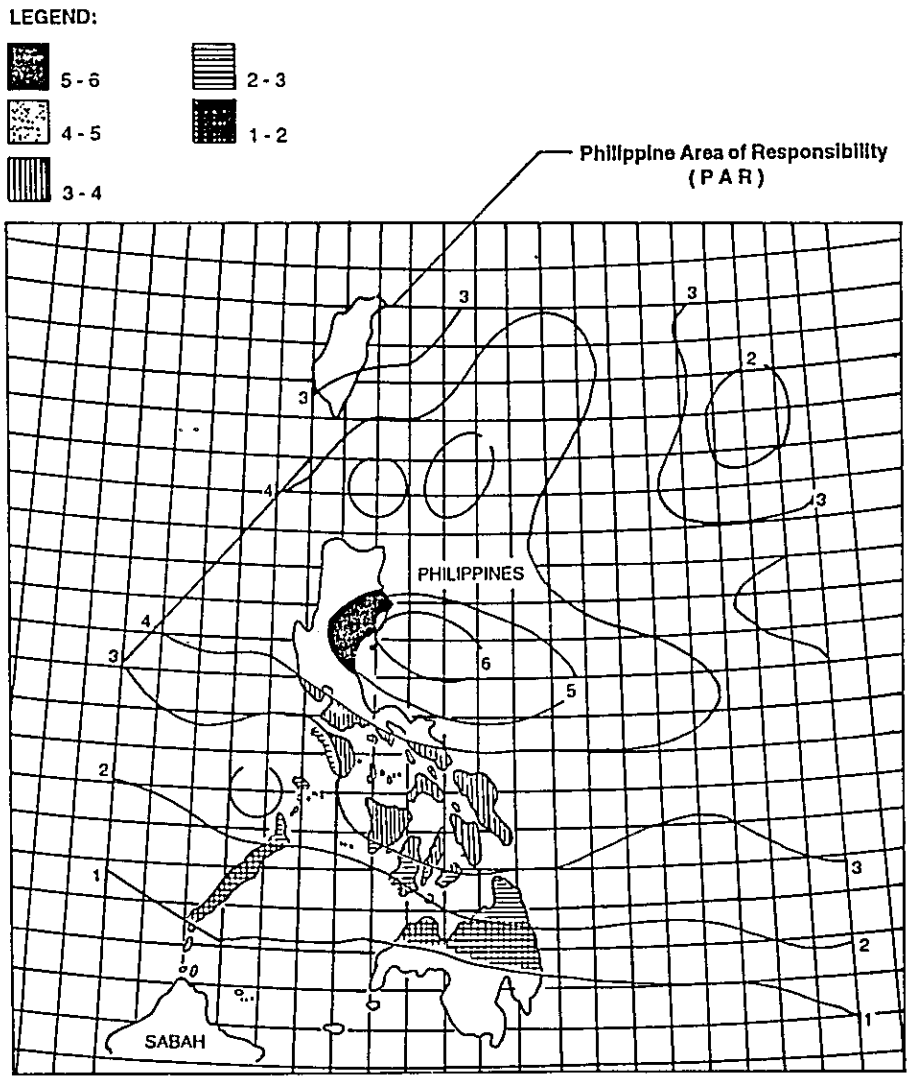


Figure 1.2
Climate Map of the Philippines

Figure 1.3 Frequency of Tropical Cyclones in the PAR

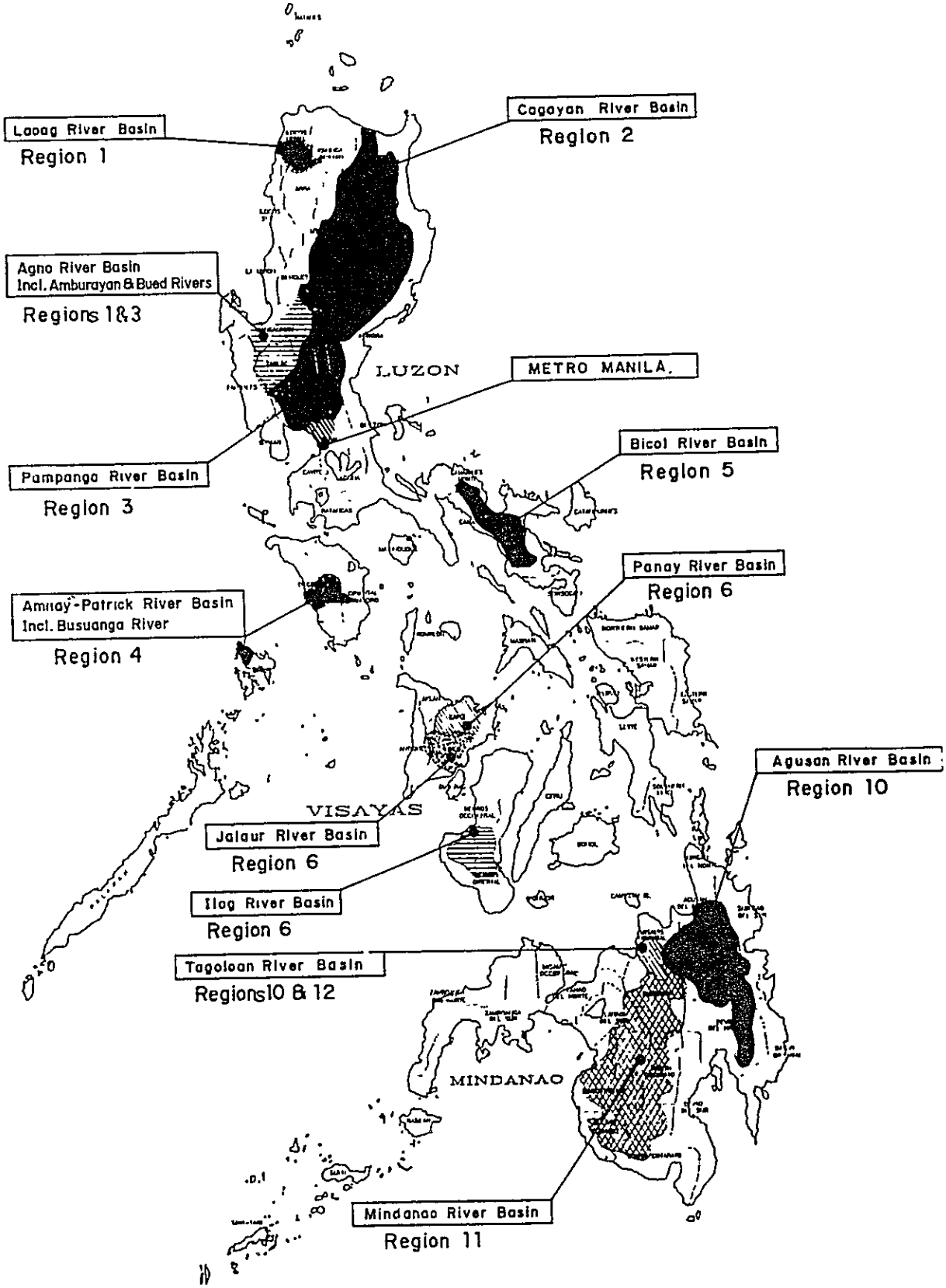
1984	0	0	0	0	0	1	2	8	1	4	3	1	20
1985	1	0	0	0	1	2	2	3	4	3	0	1	17
1986	0	1	0	1	1	2	3	2	1	4	3	3	21
1987	1	0	0	0	0	1	4	3	2	2	2	1	16
1988	1	0	0	0	1	3	3	0	3	6	2	1	20
1989	1	0	0	0	1	2	6	1	2	3	2	1	19
1990	0	0	0	0	3	3	2	3	4	1	3	1	20
1991	0	0	1	1	1	1	4	2	4	2	3	0	19
1992	0	0	0	0	0	2	3	5	1	3	2	0	16
1993	0	1	0	2	1	2	5	5	6	4	2	4	32
TOTAL	4	2	1	4	9	19	34	32	26	32	22	13	200
MEDIAN	0 4	0 2	0.1	0 4	0 9	1.9	3 4	3 2	2 8	3 2	2 2	1.3	20 0

5 - YEAR AVERAGE FREQUENCY OF TROPICAL CYCLONE PASSAGE



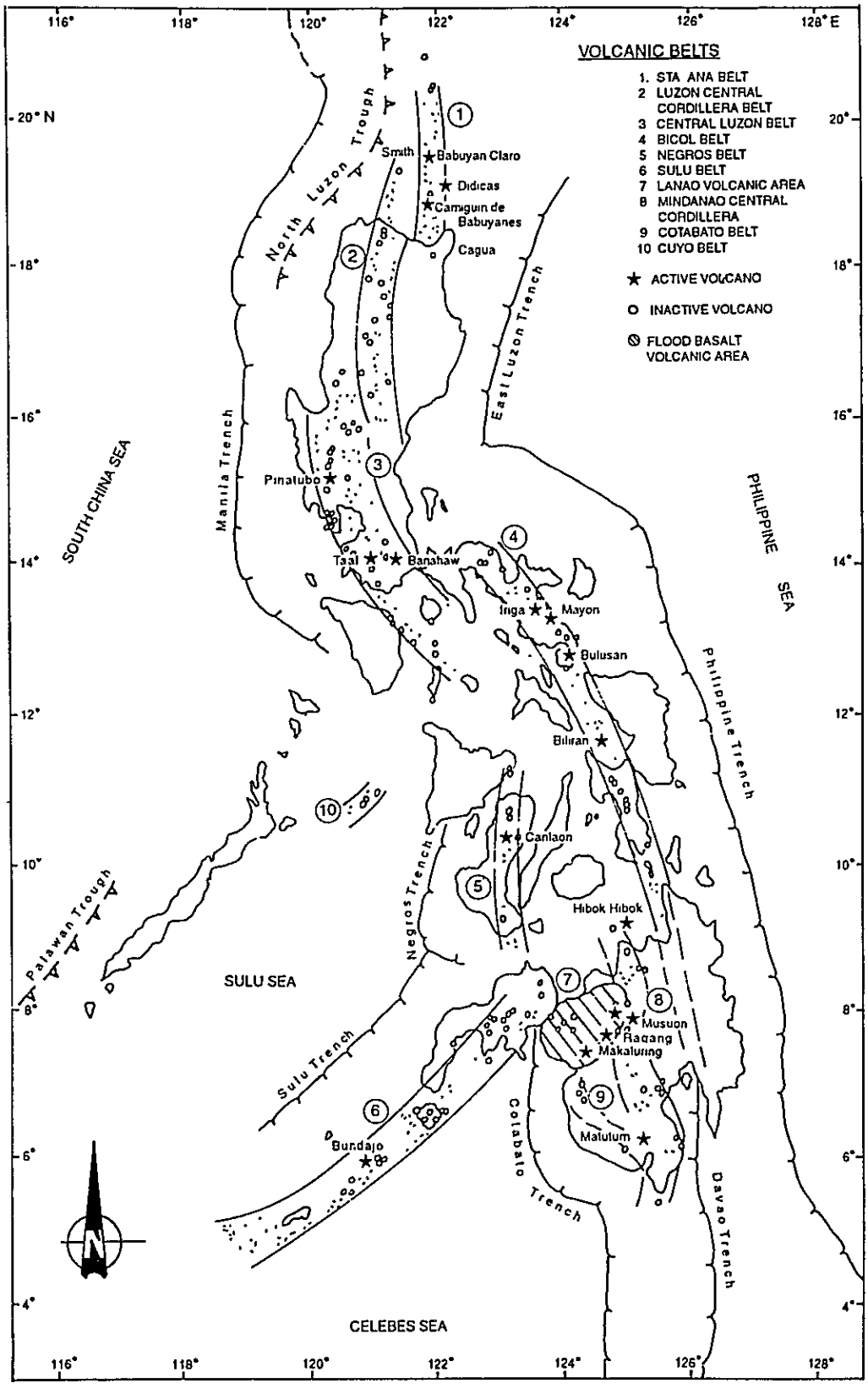
Sources: **Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)**

Figure 1.4 Flood Control and Drainage Projects in 12 Major River Basins and in Metro Manila



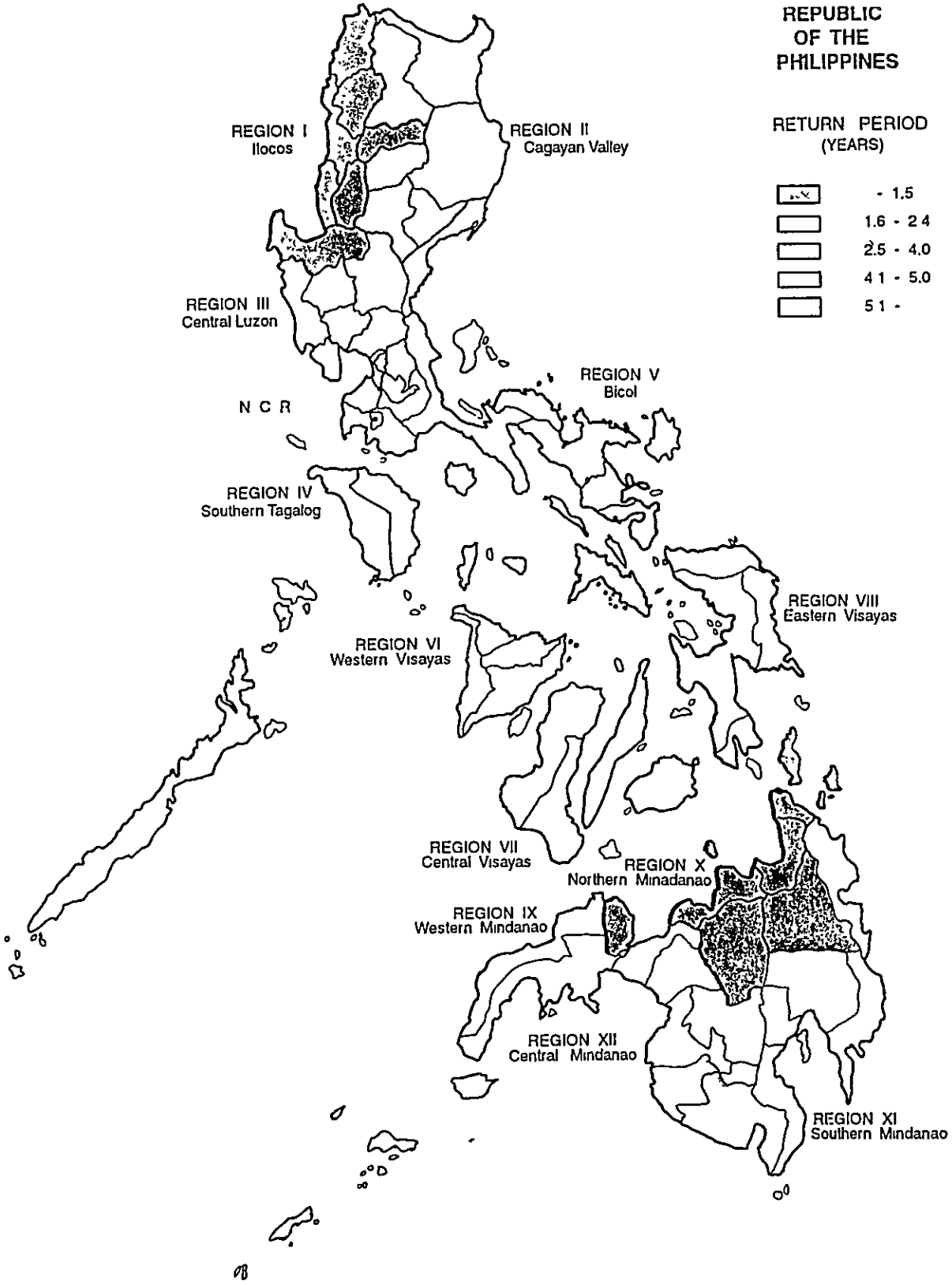
Sources: Department of Public Works and Highways (DPWH)

Figure 1.5 Location of Volcanos



Source: PAGASA Geologic Hazards and Disaster Preparedness, 1987
Note : Volcanic Belts Supplemented From "Geology and Mineral Resources", 1981

Figure 1.6 Frequency of Earthquake



Source: Southeast Asia and Association of Seismology and Earthquake Engineering; Series of Seismology Vol.I, Earthquake Hazard Mitigation Programme in Southeast Asia, April 1986

Attachment 1.1

DPWH MEDIUM TERM INFRASTRUCTURE PROGRAM, 1993-1998

PROGRAM THRUSTS

As a major component of the overall Medium-Term Philippine Development Plan (MTPDP) for 1993-1998, the medium-term infrastructure program of the Department of Public Works and Highways (DPWH) has been framed to achieve the following thrusts:

a. Rehabilitation/improvement/construction of the national road network, with emphasis on the arterial road system, to provide for more efficient flow of people and goods among regions and between principal production and consumption areas.

b. Provision of flood control works in the major river basins, to mitigate losses from flooding thereby inducing greater production.

c. To a lesser extend, the provision of potable rural water supply (Level I or wells) for improved health and production, but limited to on-going foreign-assisted projects, considering that rural water supply has been devolved to Local Government Units (LGUs).

d. To a similar limited extend, the provision of small urban community infrastructure under on-going foreign-assisted projects to help improve the economic base of the country's urban centers.

INVESTMENT LEVELS

The DPWH medium-term infrastructure program calls for a total investment of P 166.1 billion from 1993-1998. The bulk of the investments at P 127.7 B, or 76.9% of the total, is allocated for roads or highways, while P 24.1 B or 14.5% is earmarked for flood control. The rest, about P 14.3 B or 8.6 % of the total, is intended for foreign-assisted rural water supply and urban community infrastructure, and for other public works.

TRANSPORT POLICIES AND STRATEGIES

The DPWH medium-term road infrastructure program is based on the following policies and strategies for the overall transport sector under the MTPDP:

a. Provide the transport infrastructure requirements of the productive sector (principally agriculture and industry), with priority given to those supportive of the designated growth centers/networks.

b. Strengthen the arterial road network for efficient nationwide mobility.

c. Intensity maintenance and upgrade service standards to prolong the economic life of the transport infrastructure and reduce user cost.

d. Enhance the participation of the private sector (e. g., thru the Build-Operate-and-Transfer scheme), and of the LGUs.

e. Provide deregulation of transport utilities (in entry/pricing), decentralization, and improve institutional and inter-agency coordination.

f. Incorporate safety, environment, and socio-economic concerns in transport projects.

ARTERIAL ROADS

The main focus of the road infrastructure program lies on the arterial road network, totalling 15,848 km. This includes the following:

a. Roads connecting regional and provincial capitals and other urban areas.

b. Roads leading to planned growth centers, in areas of significant economic development potentials.

c. Roads leading to regional industrial and tourist centers.

d. Roads traversing the principal agriculture production areas.

e. Roads leading to major national ports and airports.

f. Other roads of strategic importance for regional development and emergencies.

Supporting the arterial road network are complementary secondary roads totalling 10,706 km which seek to facilitate the distribution/collection of traffic to/from the hinterlands.

ROAD IMPROVEMENT REQUIREMENTS

Of the national road network totalling 26,554 km, 7,166 km (27%), are already improved, leaving 19,388 km (73%) still to be improvement/rehabilitated. The cost of such improvement is P 146.9 B. Out of this, P 108.9 B was proposed for projects under the 1993-1998 program, covering the rehabilitation of 4,962 km of damaged paved roads and the paving of 9,616 km of unpaved roads. Of this P 108.9 B program, P 32.0 B has "committed" funding thru approved foreign Official Development Assistance (ODA) and the required Philippine Government counterpart, leaving an uncommitted balance of P 76.9 B.

For the national arterial roads alone totalling 15,848 km, about 4,778 km (30%) are already improved, leaving 11,070 km (70%) which required improvement at a cost of P 88.2 B. Of this, P 77.8 B was proposed for projects under the 1993-1998 program covering the rehabilitation of 3,212 km of damaged paved arterial roads and the paving of 5,740 km of unpaved arterial roads. Of this P 77.8 B program, P22.0 B has been committed under approved ODA and the Philippine Government counterpart, thereby leaving a P 55.8 B in uncommitted balance.

ROAD PROGRAM TARGETS

Under its medium-term road infrastructure program, the DPWH has set the following targets:

a. For the national arterial roads totalling 15,848 km, the improved/paved sections shall be increased from the present 30% of the total length to 87% by the end of 1998, while all-weather roads will increase from 80% at present to 100% by end of 1998.

b. For national secondary roads totalling 10,706 km, the improved/paved sections will be extended from the current 22 % to 75% by end of 1998, while all-weather roads will rise from 73% to 89%.

c. For bridges along national roads, the length of permanent structures will increase from the present 88% to 100% by end of 1998.

1993-1998 MEDIUM TERM PUBLIC INVESTMENT PROGRAM
(In Million Pesos, Current Prices)

SUMMARY

			1993	1994	1995	1996	1997	1998	Years-	1993-1998	1999	2000
1.	Highways	P	12,940	11,809	16,019	21,835	26,601	38,526	44,961	127,729	24,933	9,765
	Arterial Roads	P	6,775	7,112	10,681	13,704	16,247	23,338	10,315	77,857	10,315	
	Secondary Roads	P	4,653	2,852	3,020	5,041	6,336	9,161	28,138	31,062	10,618	7,257
	Urban Roads/ Expressways	P	1,512	1,845	2,318	3,090	4,018	6,027	6,508	18,810	4,000	2,508
2	Flood Control and Drainage	P	1,799	1,907	2,116	3,360	5,595	9,297	22,906	24,074	8,192	7,345
3	Water Supply	P	795	660	847	1,055	782	713	0	4,851		
4	Urban Infrastructure	P	603	519	360	437	450	520	0	2,889		
5	Various Projects	P	913	5,605	0	0	0	0	0	6,517		
	TOTAL	P	17,049	20,500	19,341	26,686	33,427	49,056	67,866	166,060	33,125	17,110

Includes program for Ports, Detailed Eng'g, and National Buildings

1993-1998 DPWH INFRASTRUCTURE PROGRAM BY PROJECT CATEGORY TOTAL = P 166.1 BILLION

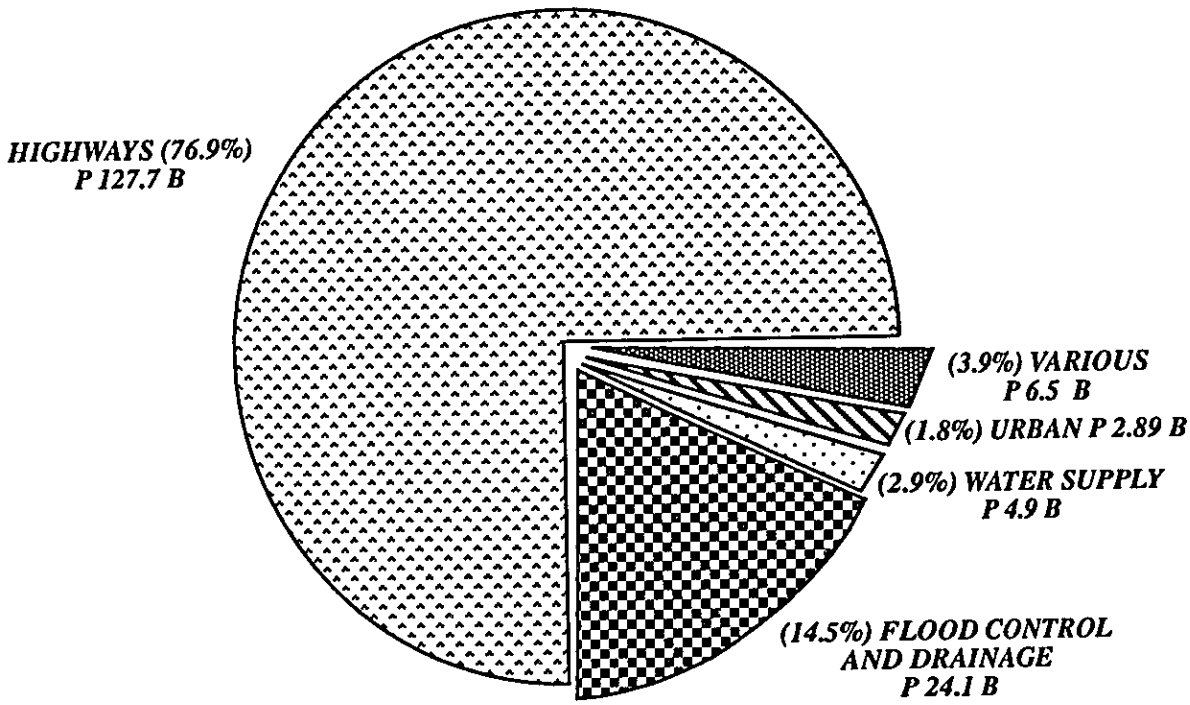


Table 2.1 Mayon Volcano Alert Signals
(As revised, Feb. 1993)

The "Alert and Warning Signals for Mayon" was revised at the start of the Volcano's unrest in February 1993

ALERT LEVEL	CRITERIA	INTERPRETATION
No Alert (NORMAL)	Background, quite	No eruption in foreseeable future
1 (ABNORMAL)	Low level seismicity fumarole, other unrest	Magnetic, Tectonic or hydrothermal disturbance; no eruption imminent
2 (ALARMING)	Low to moderate level of seismicity, other unrest (ash, puffs, rocks falls) with positive evidence of involvement of magna (crater glow and/or lava trickles)	(A) Probable magnetic intrusion; could eventually lead to an eruption (B) If trends shows further decline, volcano may soon go to level 1
3 (CRITICAL)	Relatively high unrest including increasing occurrence of low frequency earthquakes, frequent observance of lava trickles and/or occasional small ash explosions	(A) If trends is one of increasing unrest. eruption is possible within days to weeks (B) If trends is one of decreasing unrest, volcano may soon go to level 2.
4 (ERUPTION IMMINENT)	Intense unrest, including harmonic tremor and/or "long period" (=low frequency) earthquakes or quiet lava emissions and/or frequent small ash explosions	Hazardous explosive eruption is possible within hours to days
5 (ERUPTION)	Eruption in progress with pyroclastic flows and/or eruption columns reaching 6 km or 20,000 feet above sea level	Hazardous eruption progress. Hazards in valleysand downwind

Source: Operation Mayon (PHILVOLCS)

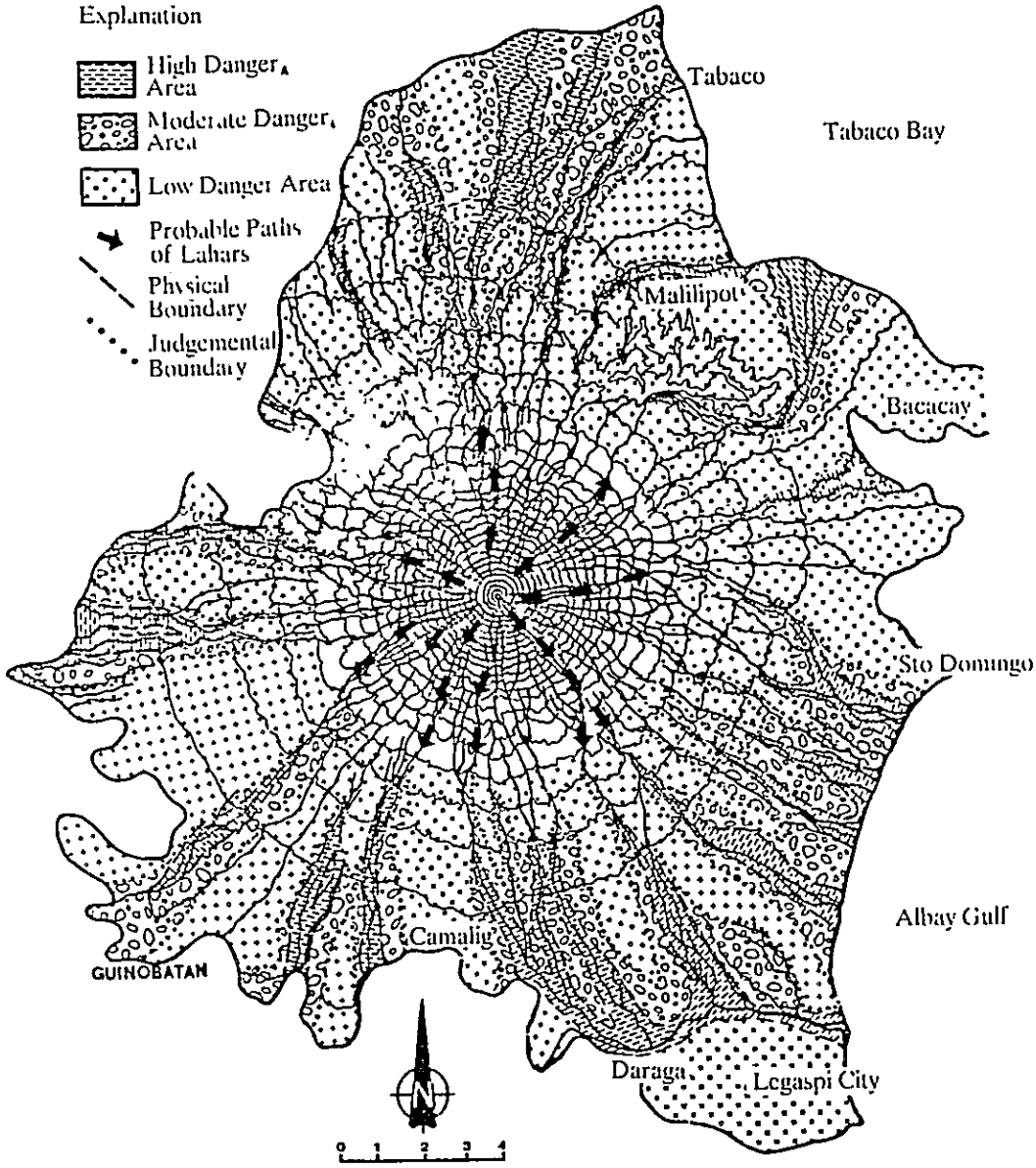


Figure 2.1 Lahar Hazard Map

Source: Operation Mayon (PHILVOLCS)

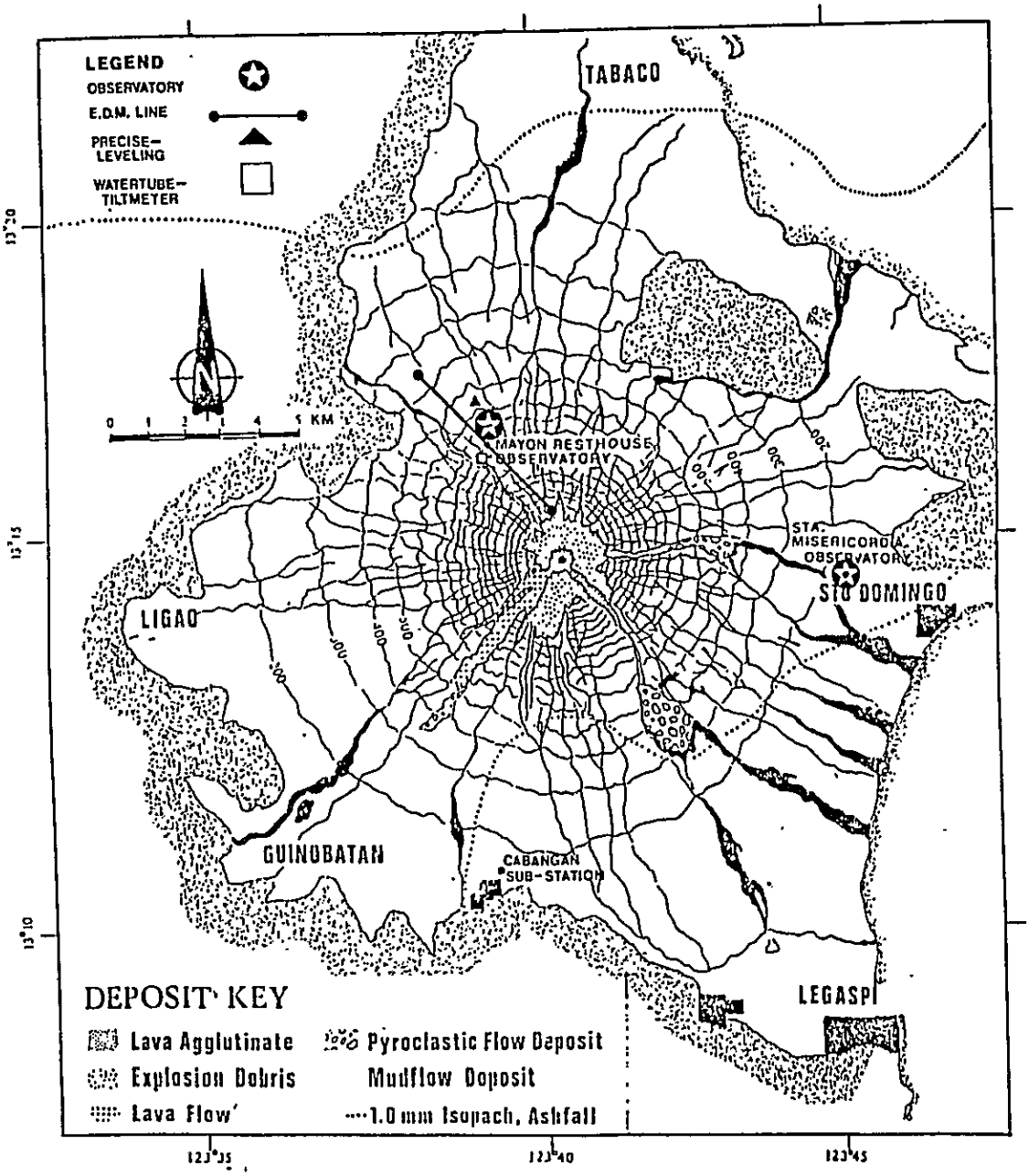


Figure 2.2 **PHIVOLCS Monitoring Network at Mayon Volcano**
PHIVOLCS monitoring network at Mayon Volcano showing the location of volcanological stations, EDM lines and precise leveling benchmarks

Source: Operation Mayon (PHILVOLCS)

Table 3.1.1 Chronological Table of Volcanic Activities

Year	Date	Volcanic Activities	Seconadary Explosion/Lahar	Warning Evacuation
1991	April 02	The renewal of volcanic activity at Mount Pinatubo began.		
	April 05	High-frequency volcanic earthquakes were observed by PHIVOLCS		PHIVOLCS recommended precautionary evacuation of areas within a 10km radius of the summit
	Apr-May	A radio-telemetered network of 7 seismic stations was installed by PHIVOLCS USGS		
				A volcanic hazard map was prepared indicated that previous pyroclastic flow had reached Clark Air Base. The volcano was Alert Level 2.
	May 30	Almost all earthquakes occurred in a cluster roughly 5km NNW of the summit and from 2 tab km deep.		
	June 05 June 07 June 09 June 10			Alert Level was raised to 3 (June 05) Alert Level was raised to 4 (June 07) Alert Level was raised to 5 The radius of evacuation was increased to 15km then 20km and 20 000 people moved in evacuation camps(June 09) At the Clark Air Base more than 14 000 military personnel were evacuated to Subic Naval Station (June 10)
	June 12	Major explosive eruptions produced substantial pyroclastic fall and flow deposits on the slope of Mount Pinatubo	Lahars occurred as soon as the major eruptionbegan one was recorded on the Sacobia River another on the northeast side of the Mountain	
	June 15	The climactic phase of explosive eruption began at approximately 1400h and continued through late evening. This eruption produced a caldera at summit with a diameter of 2km	A number of multiple-pulsed lahars of varying size and rheology were triggered by heavy rainfall on all side of Mount Pinatubo	
	June 17	Tephra emission decreased and no more primary flows were produced A succession of major explosive eruptions produced pyroclastic fall deposit (0 1 to 0 2 km3) and pyroclastic flow deposit (1 0 to 1 6 km3) on the eastern slope of Mount Pinatubo	The riverbed aggradation in the Sacobia River was observed at 2 to 3m at Mactan Gate of Clark Air Base.	
	June to July		The Abacan-River captured sometimes the upstream reach of the Sacobia River The Sacobia River produced lahar 183 times for the period of July 17 to September 4 at the lahar observation point of Mactan Gate.	
	Aug to Sept		The aggradation of Sacobia River was terminated by rapid downcutting of 6 to 7m and widening of 30 to 50m in late August to September Lahars in 1991 may be mainly organized into the secondary movement of pyroclastic fall deposit	
	Nov 05		DPWH commenced the construction of sabo dams During the construction of sabo dams, no lahar was observed in the Sacobia Bamban and Abacan rivers	
1992	April 04		Secondary pyroclastic flow had caussed the aggradation of about 5m in the reach of 2.5 to 3 0km downstream from the piracy point of Abacan and Sacobia rivers Sabo dam (No.2) in the Sacobia River stopped completely the secondary pyroclastic flow	
	July 13	Volcanic earthquakes were observed 8 times for 0600h of July 13 to 0600h of July 14 Ashfall observed in the Clark Air Base	During the heavy rainfall the secondary pyroclastic flow occurred in the upstream reach of Pasig River Lahar was observed in the Pasig River at 1854 to 1927h At 1830 to 1937h the lahar was observed in the downstream reach of the Sacobia River	
	Sept 20 to 21		After a heavy rainfall for a few days the lahars were observed on all side of Mount Pinatubo At 0957h on Sept 21 the ash column of 18km high was observed at Clark Air Base Ash fall was also observed in wide areas including Metro Manila.	
	Nov 23 to 24		Seconadary pyroclastic flow occurred in the upstream reach of Bucao and O'donnell rivers and in the middle reach of the Sacobia River	
1993	July to Aug		In the Sacobia River the tertiary pyroclastic flow occurred from the deposition area of secondary pyroclastic flow	
	Oct.05 to 06		During the passage of typhoon Kadiang the large-scale secondary pyroclastic flow occurred in the uppermost reach of the Sacobia River As a result, the Pasig-Potrero River captured the upstream reach of the Sacobia River In the morning, lahar resulted in 4 to 5m of deposition at Mancatian Bridge in Pasig-Potrero River Lahar nearly overtopped the dike in the afternoon In the Sacobia/Bamban River lahar resulted in 5m deposition along the river course at Macapagal Village the active channel shifted about 100m northward from the south bank.	

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Table 3.1.2 **Chemical Properties of Lahar Deposits.**

LOCATION	pH	OM (%)	EXCHANGEABLE BASES (meq/100g soil)				CEC (meq/ 100g soil)	BSP (%)	P (ppm)	SO4 (ppm)	MICRONUTRIENTS (ppm)			
			Ca	Mg	Na	K					Zn	Cu	Fe	Mn
ABACAN RIVER														
1. Sapalibutad, Angeles City	6 4	0.52	1.00	0.18	0.03	0.08	2.39	53.97	13.20	0	0.60	5 60	41 80	4.00
2. Sapalibutad, Angeles City	6.2	0.19	0 85	0.17	0.03	0.05	3.80	28.95	6.00	101	0.20	5.40	17.60	3.20
3. Capaya Is , Angeles City	5.9	0 09	0.70	0.26	0 07	0.06	2 69	40.52	0.50	297	0.20	2.80	6.80	2 00
4. Sapalibutad, Angeles City	6.5	0.14	0.65	0 10	0 03	0.03	1.91	42.40	0.30	0	0.40	2.88	5.60	1.40
5. San Juan, Magalang	6.4	0 02	1.64	0.15	0.07	0.04	1.90	100.00	5.23	0	0.25	2 88	5.28	7.93
6. Purok 4, S. Bato	6.6	T	1.08	0.03	0.05	0.02	1.18	100.00	1.55	0	0.82	2.45	35.91	8 98
SACOBIA-BAMBAN														
1. Bamban River	6.5	0.14	1.05	0 03	0.06	0.05	4.43	26.86	0.10	0	0.20	2.20	4.40	1.00
2. Culatingan	6.4	0.19	0.70	0 26	0.04	0.09	3 25	33.54	4.90	0	0.60	4.80	28.60	0.80
3. Culatingan	6.2	1.46	2.60	1 10	0.11	0.34	6.35	65 35	8.80	0	1.20	15.40	92.40	22 00
4. Dolores, Magalang	5 7	0.02	1.75	0 08	0.14	0.06	3.65	55.62	0.10	830	0.20	2.20	6.00	13.20
5. San Vicente, Concepcion	6 7	0 38	3.56	0.39	0.21	0.26	9.37	47.17	9.71	58	0.27	12.98	142.78	53.53

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Table 3.1.3 **Physical Properties of Lahar Deposit.**

LOCATION	PERCENT			TEXTUAL GRADE	BULK DENSITY (gm/cc)	AVAILABLE MOISTURE (%)	HYDRAULIC CONDUCTIVITY (cm/sec)	
	Sand	SiH	Clay					
ABACAN RIVER								
1. Sapalibutad, Angeles City	86.4	5.6	8.0	LS	0.98	11.58	2.6×10^{-2}	Very Fast
2. Sapalibutad, Angeles City	86.4	6.6	7.0	LS		11.88		
3. Capaya	87.4	4.6	8.0	LS	1.83	6.36	9.7×10^{-4}	Medium
4. Sapalibutad, Angeles City	95.4	0.6	4.0	S	1.40	6.12	6.5×10^{-2}	Very Fast
SACOBIA-BAMBAN RIVER								
1. Bamban River	86.4	4.6	9.0	LS	1.69	8.04	2.0×10^{-2}	Fast
2. Culatingan River	80.4	10.6	9.0	SL	1.78	1.89	1.2×10^{-4}	Medium
3. Culatingan River	20.4	53.6	26.0	SiL				
4. Dolores, Magalang	82.4	9.6	8.0	SiL		23.70		

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

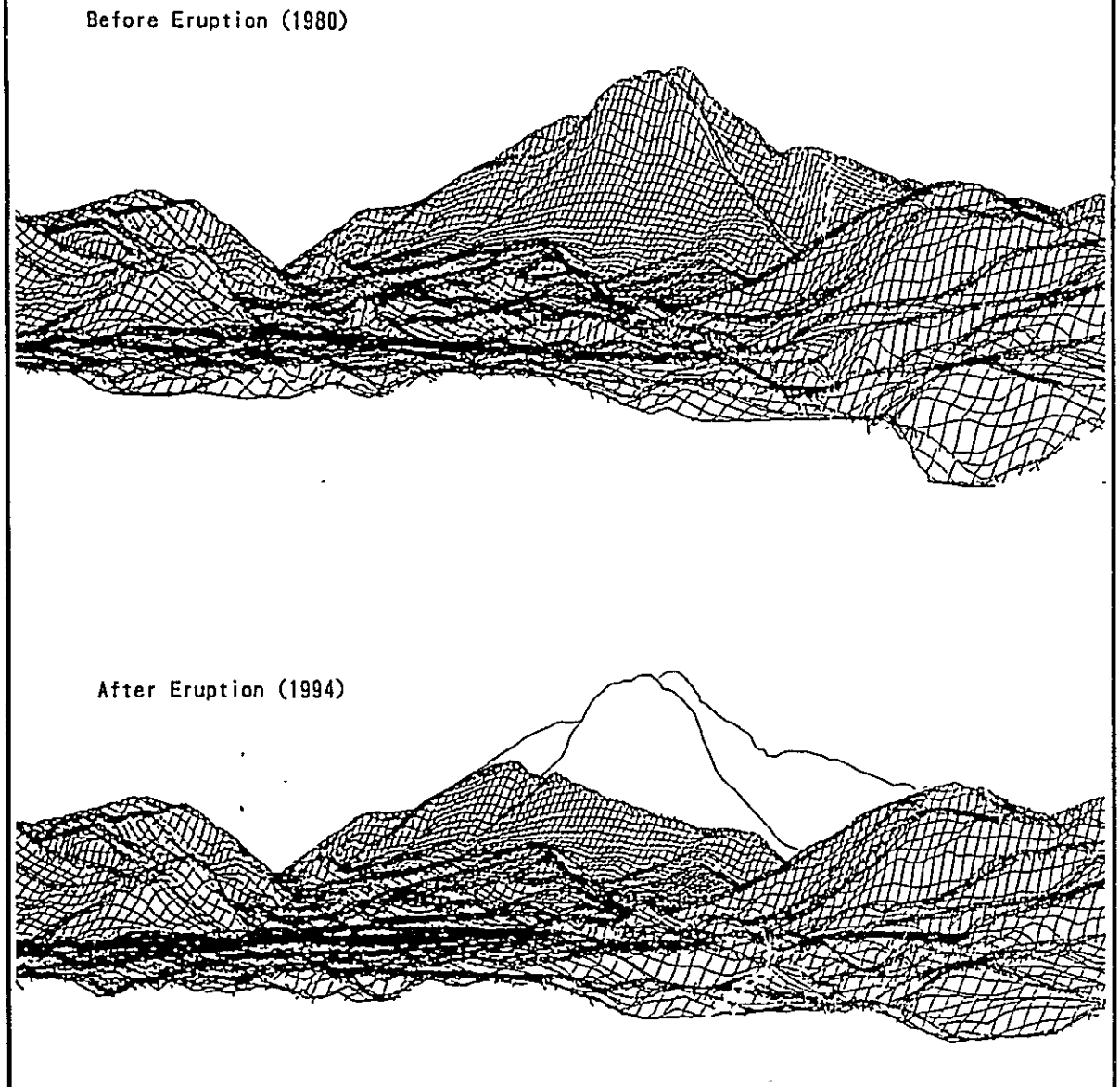


Figure 3.1.1
Bird's - Eye View of Mt. Pinatubo

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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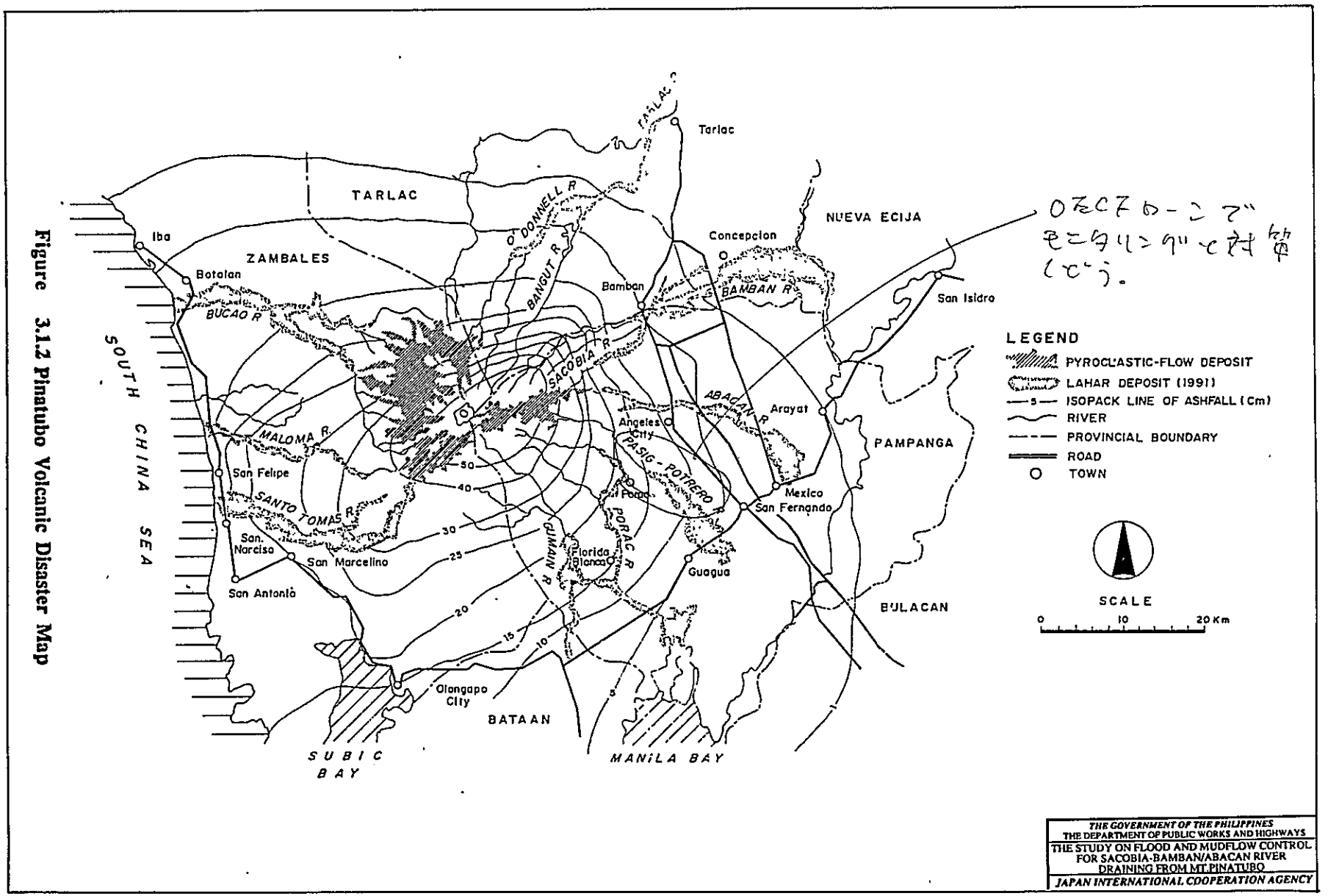


Figure 3.1.2 Pinatubo Volcanic Disaster Map

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

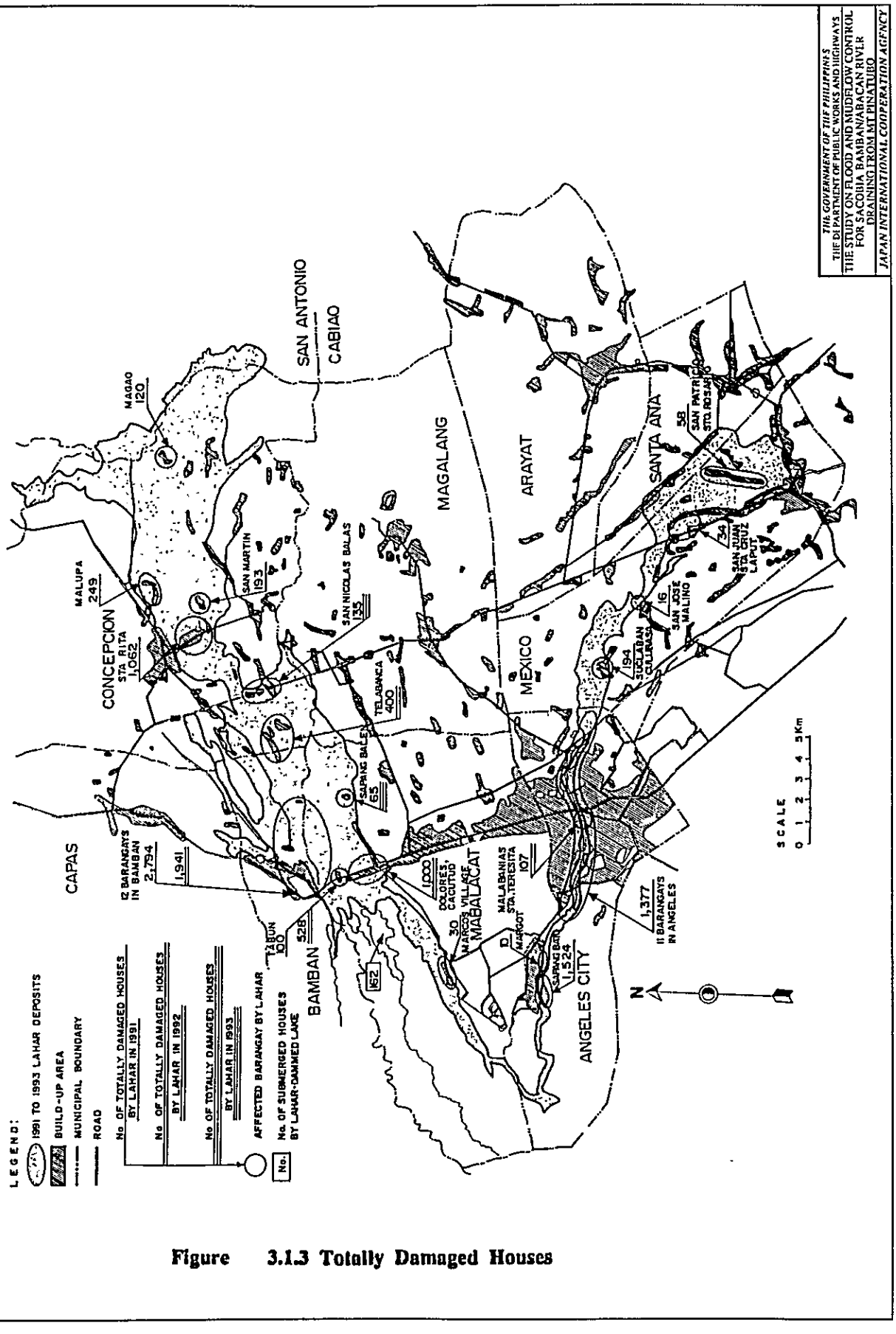
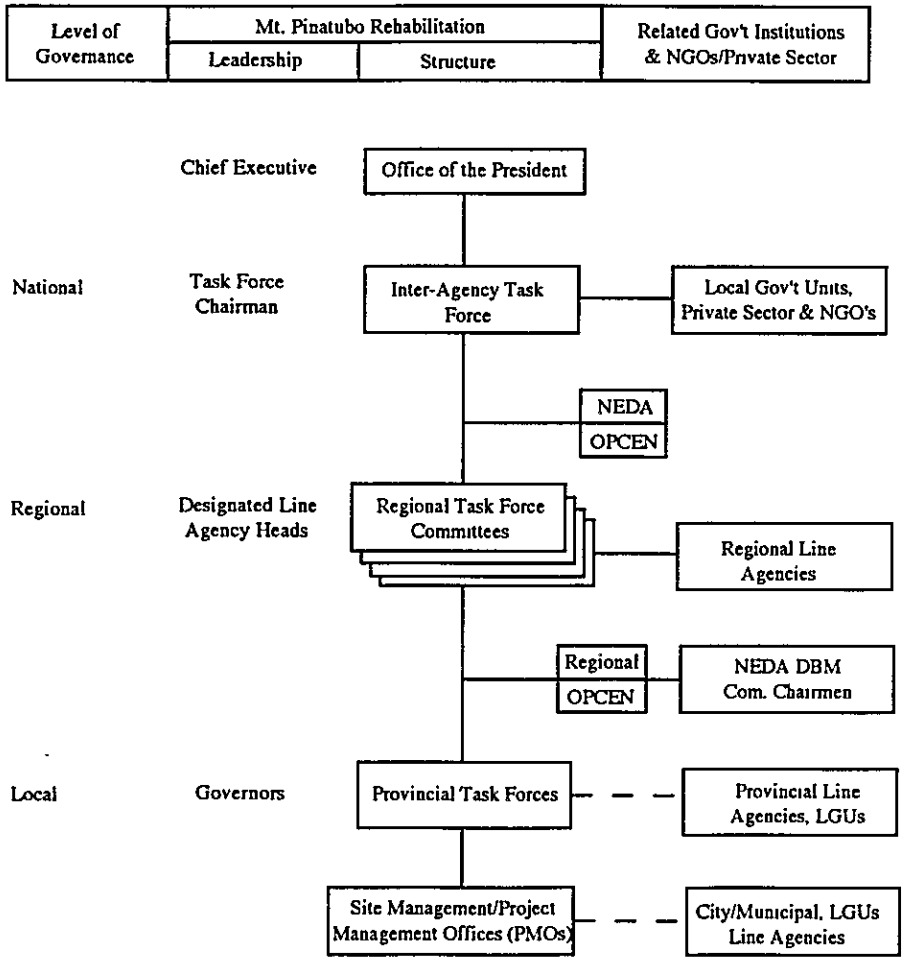


Figure 3.1.3 Totally Damaged Houses

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)



Legend:

— — — = Extends support/assistance

——— = Supervises/Coordinates

OPCEN = Operations Center

Inter-Agency Task Force = Composed of 4 main committees (Social, Infra, Resettlement, Livelihood)

Regional TF =Replicates committees at national

Figure 3.2.1 Organizational Structure of Task Force Mt. Pinatubo (1991 - 1992)

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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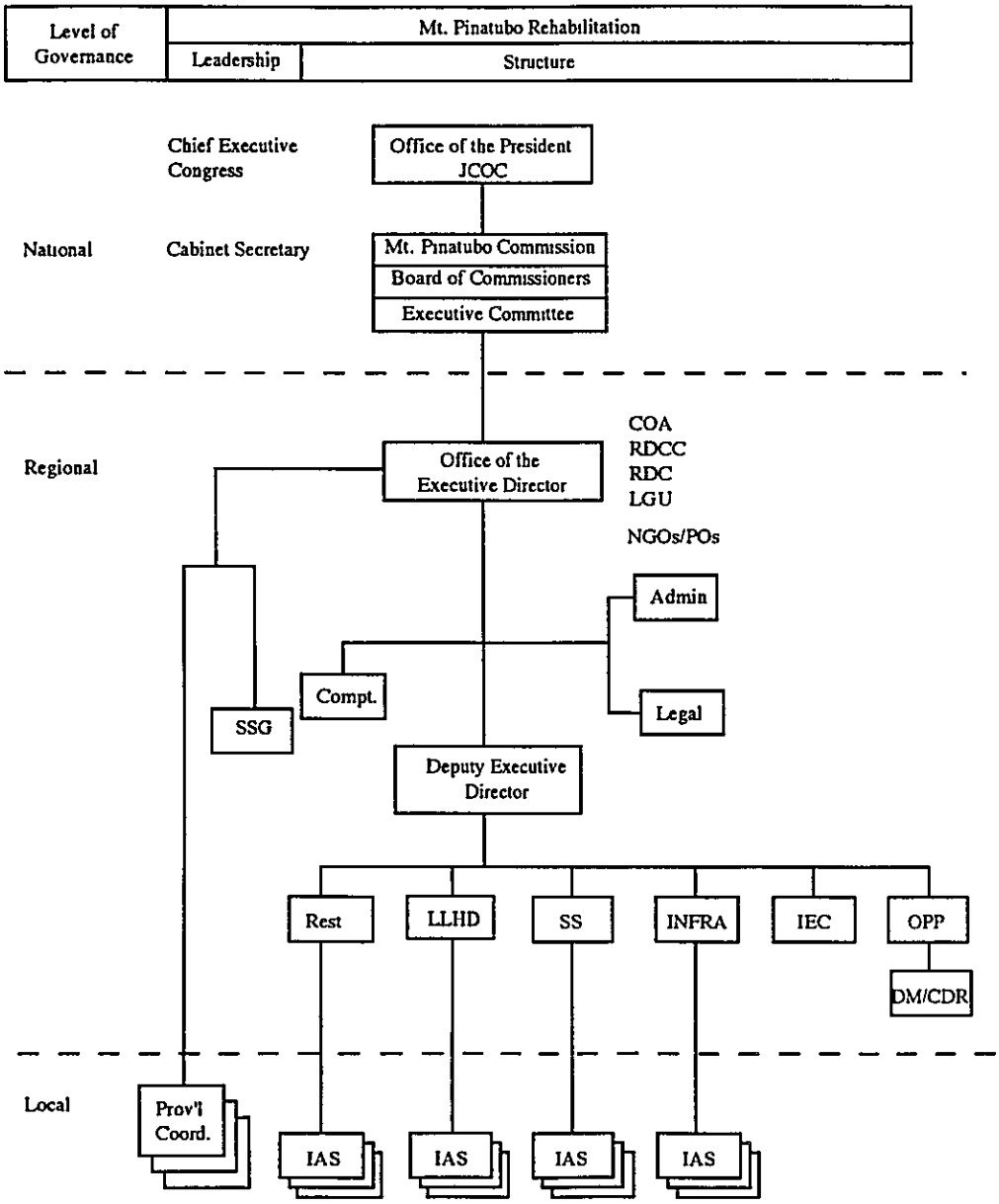

Legend:
SSG/TC = Special Services Group/Technical Consultants
Prov'l Coord. = Provincial Coordinators
Rest = Resettlement Administration
LLHD = Livelihood Administration
SS = Social Services Administration
INFRA = Infrastructure Administration
IEC = Information, Education & Communication
OPP = Office of Plans and Programs
DM/CDR = Data Management/Central Data Repository
Compt. = Comptroller
Admin = Administrative Services
Legal = Legal Services

Figure 3.2.2 Organizational Structure of the Mt. Pinatubo Commission

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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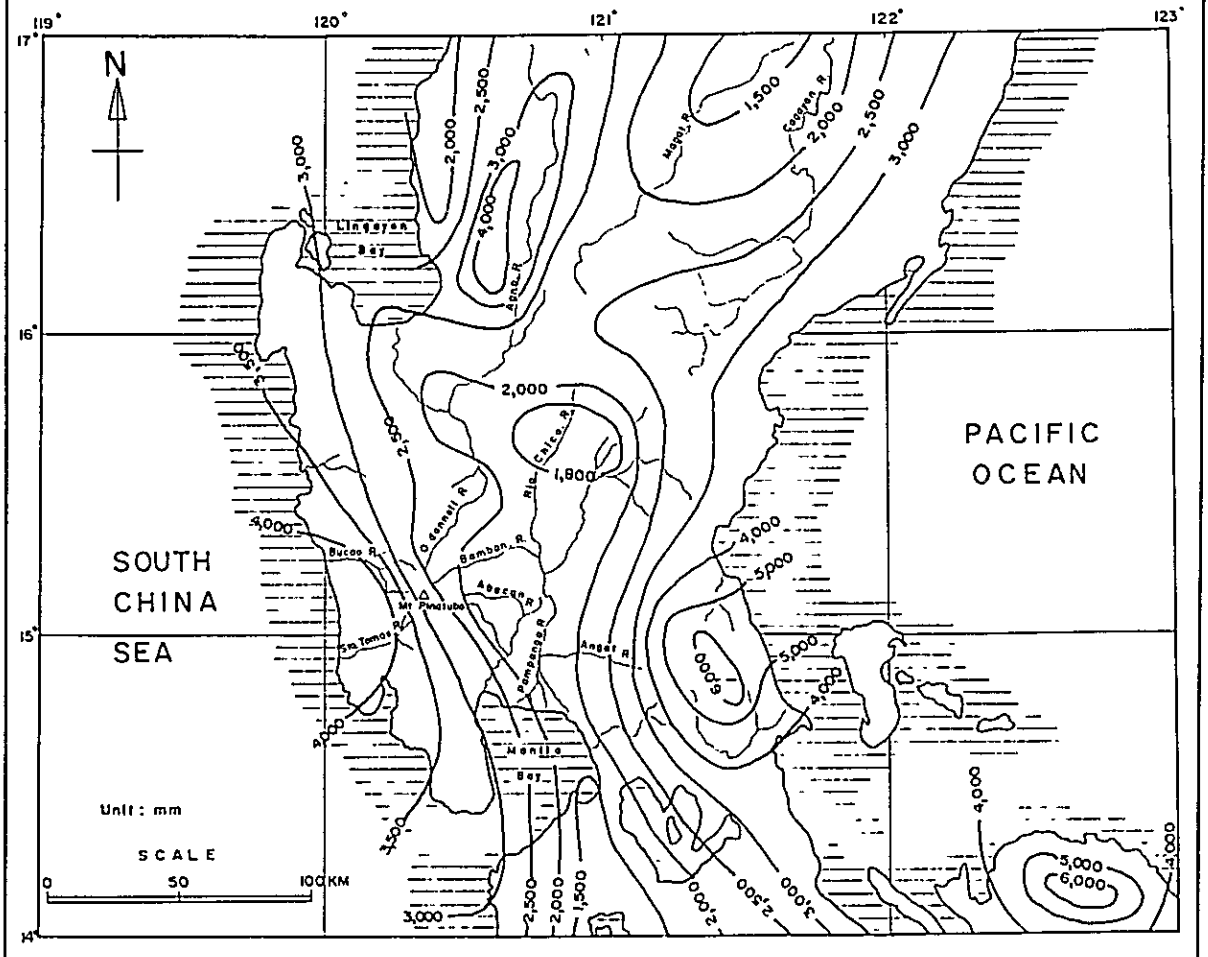

Figure 3.3.1 Isohyetal Map of Annual Rainfall

Sources:

The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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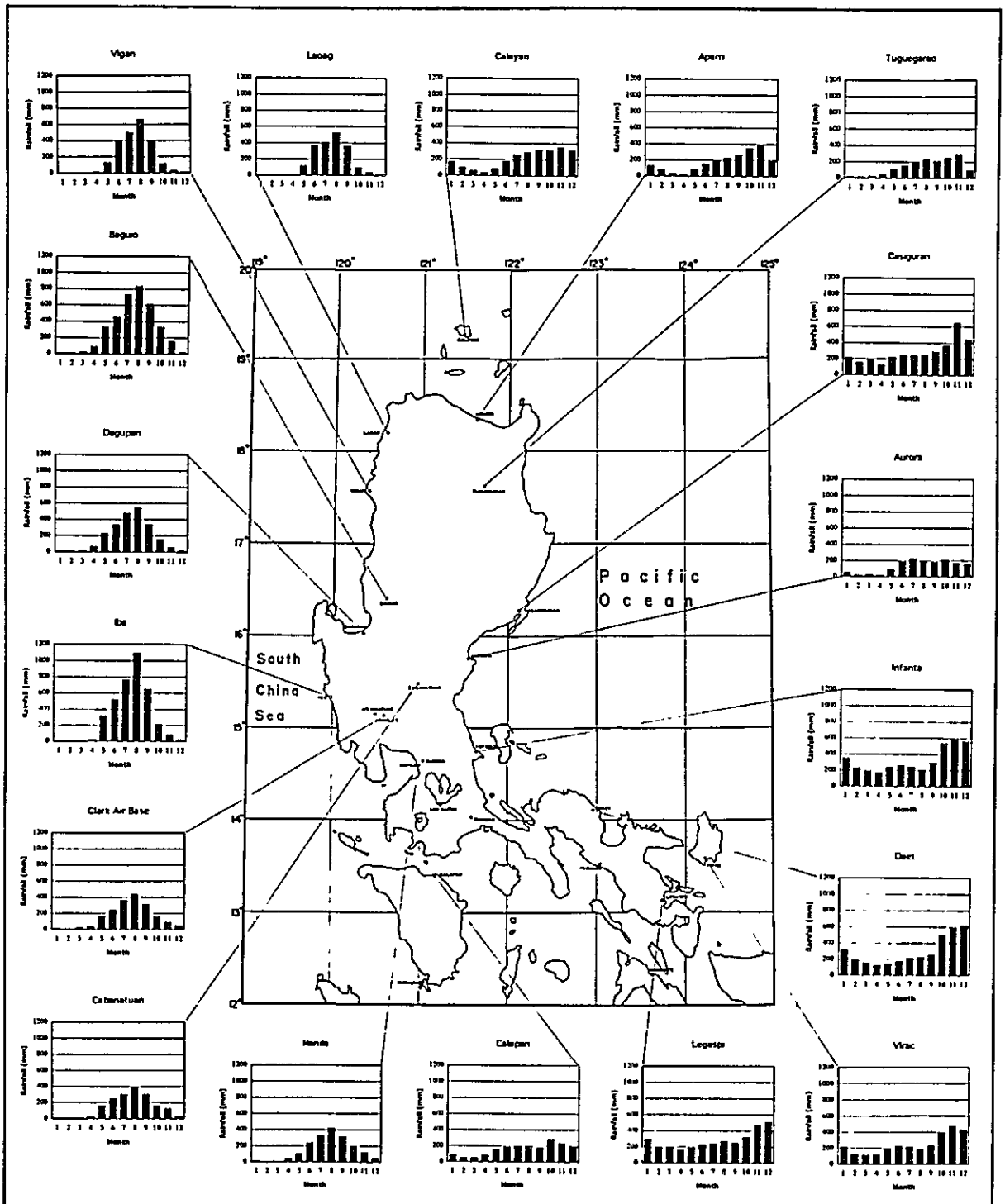

Figure 3.3.2 MONTHLY MEAN RAINFALL

Sources:
The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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Table 3.4.1 National Accounts by Sector of Origin (Percentage Distribution of GNP and GDP)

(Unit : billion pesos)

Sector	Constant 1985 Prices						Current
	1987	1988	1989	1990	1991	1992	1992
Agriculture, Fishery & Forestry	150.4	155.3	160.0	160.7	160.5	159.9	290.3
	(24.7)	*(23.8)*	*(23.2)*	*(22.3)*	*(22.2)*	*(21.9)*	*(21.2)*
Industry	215.1	232.5	251.6	258.1	248.7	247.5	446.7
	(35.5)	*(35.7)*	*(36.5)*	*(35.8)*	*(34.4)*	*(33.9)*	*(32.6)*
Mining and Quarrying	11.2	11.7	11.4	11.1	10 8	11.3	16.2
Manufacturing	154.6	167.7	178.4	184.0	183.1	181.3	329.9
Construction	31.7	33.2	41.4	42.6	35.7	36.0	66.9
Electricity, Gas and Water	18.6	19.9	20.4	20.4	20.6	20.4	33.7
Services	253.1	270.6	286.8	298.5	303.1	305.3	606.0
	(41.6)	*(41.5)*	*(41.6)*	*(41.4)*	*(42.0)*	*(41.8)*	*(44.2)*
Transportation	35.1	37.9	40.2	41.2	41 4	42.1	77.9
Trade	90.0	94.6	99.3	101.4	102.9	104.5	185.4
Finance and Housing	56.2	60.5	66.3	70.1	69.4	69.8	139.9
Other services	71.8	77.6	81.0	85.8	86 6	86.1	202.8
Gross Domestic Product (GDP)	619.6	658.4	698.4	717.3	712.3	712.7	1,342.5
	(101.8)	*(101.0)*	*(101.3)*	*(99.5)*	*(98.6)*	*(97.7)*	*(98.0)*
Growth of GDP (% p.a.)	-	*(06 3)*	*(06.1)*	*(02.7)*	*-(00.7)*	*(00.1)*	
Net Factor Income from Abroad	-11.0	-6.2	-8 7	3.7	10.0	17.1	27 5
Gross National Product(GNP)	608.6	652 2	689.7	721.0	722 3	729.8	1,370 0
	(100.0)	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100.0)*	*(100 0)*
Growth of GNP (% p a.)	-	*(07.2)*	*(05.7)*	*(04.5)*	*(00.2)*	*(01.0)*	

Source : National Statistical Coordination Board
Inception Report of Master Plan Study for West Central Luzon Development Program

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

Table 3.4.2 Major Indices of Two Provinces Related to the Study

		Provinces			
		Pampanga	Tarlac	Region III	Philippines
1. Area	sq.km	2,181	3,053	18,230	300,000
2. Population (1990)	thousand	1,532 6	859.2	6,198.5	60,685.0
Density (1990)	/sq.km	703	281	340	202
Growth rate (1970-80)	% p a.	2.54	2.09	2 88	
(1980-90)	% p.a.	2.63	2.24	2.57	2 32
Urban population (1990)	%	70.5	29.8	60.3	48.5
Employment in agriculture	%	22.9	54.9	35 4	44.5
3. Economic structure (1990)					
Agriculture	%	16.0	31.6	22 8	22.7
Industry	%	42.2	32.0	39.2	35.4
Services	%	41.2	36.5	38.0	41.9
4. Gross regional domestic products (1990)	mill.Peso	22,650	10,614	94,158	1,066,224
Per capita GRDP (1990)	P	14,779	12,353	15,190	17,570
5. Land classification - A & D land	ha (%)	164,912 (75.6)	184,975 (60.6)	1,051,908(57.7)	
Land use (1991) - Agriculture land	ha (%)	104,421 (47.9)	137,400 (45.0)	635,345 (34.9)	
Grass/shrub lands	ha (%)	(9 0)	(27.8)	(33.2)	
Wood lands	ha (%)	(7.3)	(17.8)	(19.8)	
Paddy harvested area	ha	42,800	97,990	499,870	
Paddy yield	t/ha	3.91	2 54	3.50	
Irrigation service area	%	70.7	55.2		
6. Physical infrastructure					
Road density (1990)	km/sq.km	1.07	0.80 (0.89)	0 72	0.54
Household electrification	%	82.9	68.1		
Access to improved water supply (1990)	%	80.4	61.8	63.0	
No of telephones (1990)	/100 popul'n	0.63	0 34	0 49	
7. Social infrastructure					
Population per hospital bed		903	1,197	896	
Enrollment ratio - Primary	%	111	111	111	
Secondary	%	75	78	76	
8 Major towns		San Fernando (157)	Tarlac (79)		
(urban population in 1990)	thousand	Angeles (236)			
		Mabalacat (111)			
		Guagua (88)			
		Apalit (62)			
		Macabebe (55)			
		Bacolor (50)			

Source: Prepared based on "Inception Report of the Master Plan Study for West Central Luzon Development Program" JICA, Nov. 1993

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

Table 3.4.3 Estimated Change in Population in the Study Area between 1990 and 1994

City/Municipalities	Population 1990	Population 1994	Change in 90-94	Ratio of Change (%)
I. Pampanga Province				
Angeles (20/33)	236,700	210,000	-26,700	88.7
Arayat (9/30)	73,200	77,500	4,300	105.9
Mabalacat (20/27)	121,100	105,400	-15,700	87.0
Magalang (12/27)	43,900	44,600	700	101.6
Mexico (15/43)	69,400	69,300	-100	99.9
Sta. Ana (7/14)	32,500	33,700	1,200	103.7
Pampanga Total (83/174)	576,900	540,400	-36,500	93.7
II. Tarlac Province				
Bamban (13/15)	35,600	18,000	-17,600	50.6
Capas (7/8)	25,800	20,000	-5,800	77.5
Concepcion (24/43)	97,800	100,500	2,700	102.8
Tarlac Total (44/66)	159,200	138,500	-20,700	87.0
Pampanga and Tarlac Total (127/240)	736,100	678,900	-57,200	92.2

Sources : Same as Table 5.1

Notes : Figures in parentheses show the number of barangay whose population decreased in the period of 1990-1994 toward the total number of barangay in the city/municipalities.

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

Table 3.4.4 Agricutural Land Use Before and After the Eruption in the Study Area

Town/City	Year	Irrigated Rice		Rainfed Rice		Sugarcane		Cassava		Rootcrops		Corn		Legumes		Fishponds		Commercial Crops		Fruit Trees		Other Crops		Total
		(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)
Concepcion	1980	14,820	77			3,490	18															866	5	19,176
	1993	7,135	62	2,196	19	925	8	750	7	51	0			168	1	16	0	263	2					11,504
Bamban	1990	2,326	42			1,441	26			65	1	30	1	81	1					1,640	29			5,583
	1993	882	24			995	27			65	2	21	1	44	1					1,640	45			3,647
Angeles City	1988	265	13	14	1	1,024	51	27	1	578	29			38	2			50	3					1,996
	1992	190	13	5	0	801	55	13	1	344	24			77	5			15	1					1,445
Mabalacat	1985	993	21			1,400	30			2,259	49								0					4,652
	1992	1,391	32	226	5	2,297	53	28	1	334	8							34	1					4,310
Mexico	1991	4,742	40	2,791	23	2,234	19	1,074	9	10	0			911	8			130	1					11,892
Magalang	1993	2,889	41	1,892	27	1,885	26									448	6							7,114
Santa Ana	1993	2,300	98			6	0	15	1					10	0	17	1							2,348

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

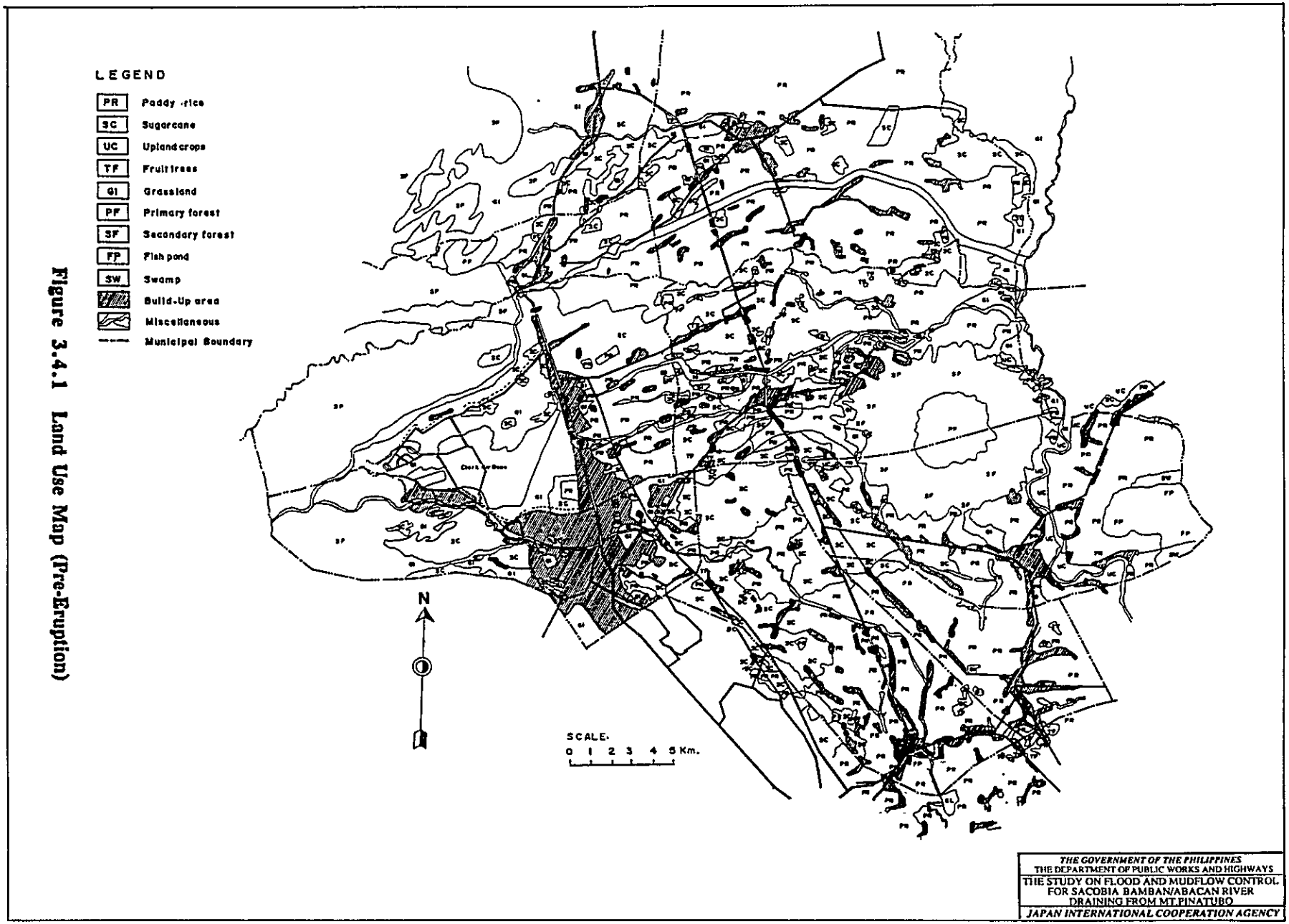

Figure 3.4.1 Land Use Map (Pre-Eruption)

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Figure 3.4.2 Land Use Map (Post-Eruption)

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JAPAN INTERNATIONAL COOPERATION AGENCY

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

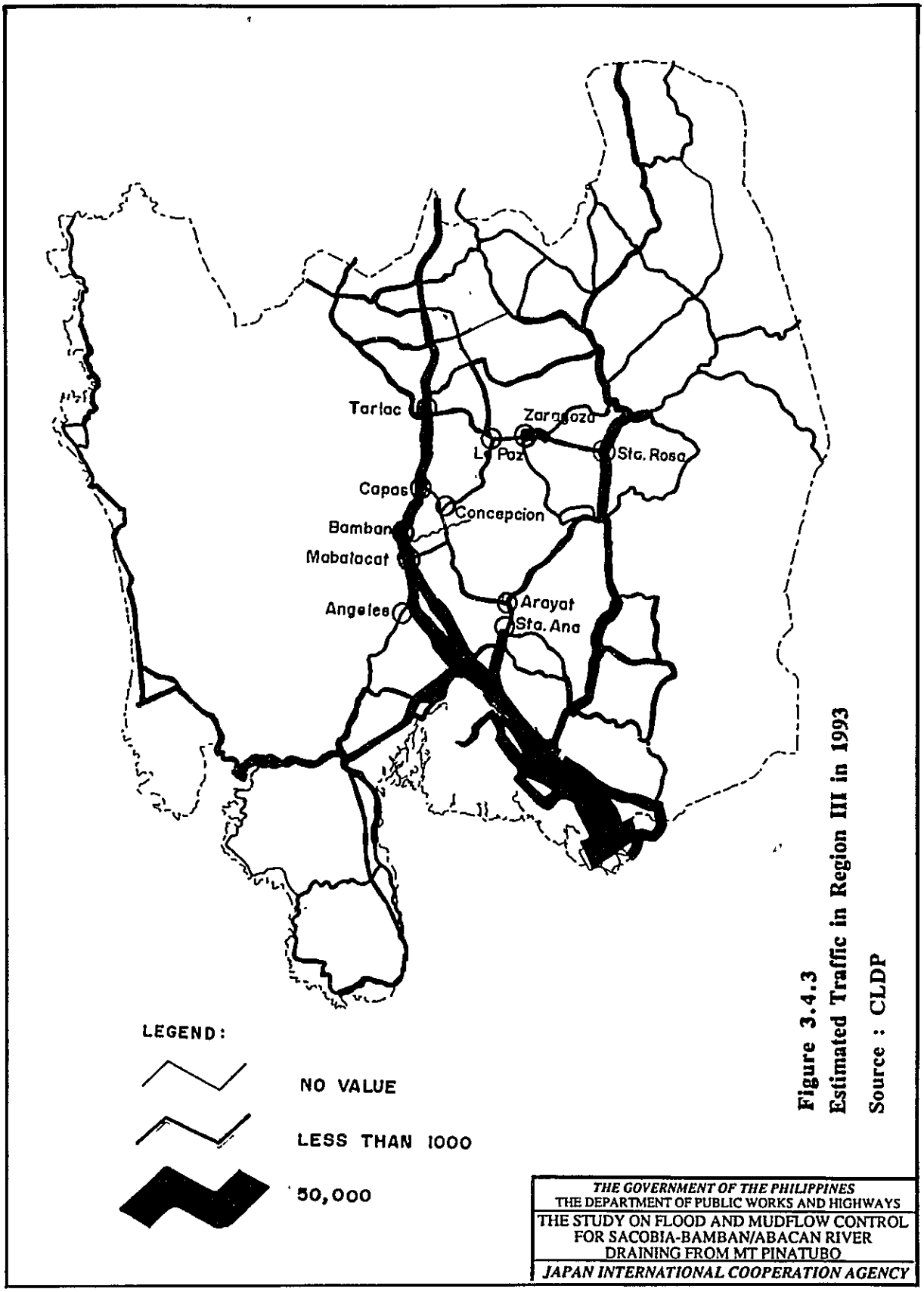


Figure 3.4.3
Estimated Traffic in Region III in 1993

Source : CLDP

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Table 3.5.1 List of Rainfall Station in and Around Sacobia-Bamban and Abacan River Basins

Agency	Station	Location Latitude	Longitude	Type of * Equipment	Remarks
OCD					
	Dolores			T	
	Sapang Bato			T	
	Pasig Potrero			T	
	Porac			T	
	Gumain			T	
PAGASA					
- Hydromet	Balucoc	14deg 58min	120deg 52min	M	
	Becuran	15deg 00min	120deg 34min	M and A	
	Cansinala	14deg 58min	120deg 46min	M and A	
	Lubao	14deg 56min	120deg 33min	M	
	San Agustin	15deg 09min	120deg 46min	A	
	Sta. Cruz	15deg 05min	120deg 33min	A	
- Pampanga	Arayat	15deg 10.10min	120deg 46.93min	A and T	
FFWS	Candaba	15deg 06.98min	120deg 51.02min	A and T	
	San Isidro	15deg 18.82min	120deg 54.15min	A and T	
	San Rafael	14deg 58.80min	120deg 55.60min	A and T	
	Sulipan	14deg 56.37min	120deg 45.52min	A and T	
	Zaragoza	15deg 26.60min	120deg 45.05min	A and T	
- Climate	BAI Magalang	15deg 13min	120deg 42min	M	
	Hacienda Luicita	15deg 26min	120deg 36min	M	
	Masantol	14deg 52min	120deg 42min	M	
	San Julian Subd.	15deg 02min	120deg 42min	M	
PHIVOLCS					
	Cuadrado	15deg 02.59min	120deg 21.22min	T	A/201
	O'Donnell-Upper Bacan	15deg 13.78min	120deg 20.61min	T	G/207
	Piz	15deg 13.26min	120deg 25.03min	T	C/203
	Sacobia	15deg 09.10min	120deg 27.08min	T	F/206
	Summit Rim	15deg 09.13min	120deg 21.55min	T	F/205 **

Note: *A: Automatic Recorder, T: Telemeter, M: Manual
**:In 1991 and 1992, this code was used for Gumain Station

Table 3.5.2 List of Water Level Gauging Station in and Around Sacobia-Bamban and Abacan River Basins

Agency	River	Station	Catchment Area (km2)	Location Latitude	Longitude	Type of * Equipment
DPWH	Bamban	San Nicolas	148	15deg 15.63min	120deg 33.43min	M (2)
		San Francisco				M (3)
	Abacan	San Juan				M (3)
	Pasig-Potrero	Cabetican	242	15deg 59.40min	120deg 38.83min	M (2)
		HDA-Dolores	28	15deg 06.65min	120deg 31.97min	M (2)
	O'Donnell	Palublub	240	15deg 23.78min	120deg 30.08min	M (2)
		Patling	112	15deg 21.37min	120deg 26.45min	M (2)
	Bangut	Sta. Lucia	90	15deg 22.17min	120deg 29.18min	M (2) and A
	Tarlac	Tibag	872	15deg 29.92min	120deg 34.00min	A
	Porac	Del Carmen	111	14deg 59.57min	120deg 32.08min	M (3)
		Valdez	118	14deg 58.92min	120deg 32.10min	M (3)
		Nasudeco	119.1	14deg 59.57min	120deg 32.08min	M (3)
PAGASA	Tarlac	Tibag	872	15deg 29.92min	120deg 34.00min	A

Note: * A: Automatic recorder, M: Manual
Figures in parenthesis after M indicates times of staff reading a day.

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Table 3.5.3 Point and Basin Mean Daily Rainfall during Major Floods (1/2)

(Unit:mm)

Yr	Date		Point Rainfall				Basin Rainfall		Remarks
			Piz	Sacobia	Zaragoza	Arayat	Sacobia-Bamban	Abacan	
74	Aug	15	(285)	(197)	122	171	220	189	
		16	(282)	(328)	203	169	276	280	
		17	(235)	(86)	54	141	148	103	
	Nov.	2	(289)	(20)	13	173	144	66	
75	Aug.	9	(152)	(233)	(78)	92	172	191	
	Oct.	20	(174)	(109)	68	105	130	108	
76	May	22	(178)	(125)	78	107	138	120	
	May	23	(398)	(143)	89	238	249	172	
	Sept.	29	(331)	(154)	96	198	223	167	
77	Nov	14	(184)	(192)	119	111	171	167	
78	Oct.	26	(220)	(346)	(104)	132	251	282	
79	May	12	(28)	(307)	190	18	148	220	
	Aug	15	(240)	(9)	6	144	116	49	
	Aug.	21	0	(250)	155	0	110	175	
80	Nov.	5	(142)	(250)	155	(210)	200	238	
81	Jul.	4	(119)	(122)	76	72	109	107	
	Jul.	8	(75)	(143)	89	(108)	110	133	
82	Jul.	15	(302)	(210)	130	181	233	201	
83	Jul.	24	(124)	(1)	1	75	58	23	
	Aug.	14	(77)	(106)	66	47	83	88	
	Aug 1	16	(63)	(62)	39	39	57	55	
84	Oct	28	(28)	(242)	150	18	119	175	
	Oct.	29	(152)	(65)	41	92	100	73	
85	Jul.	5	(233)	(368)	(110)	140	267	300	
86	May.	18	(306)	(489)	(138)	183	353	397	
87	Aug.	18	(193)	(235)	146	116	194	200	
88	Oct.	24	(111)	(201)	125	(164)	159	190	
90	Jun.	14	(149)	(261)	162	(220)	210	249	
	Aug.	7	(169)	(294)	182	(251)	237	281	

Rainfall in parenthesis indicates estimated rainfall.

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

Table 3.5.3 Point and Basin Mean Daily Rainfall during Major Floods (2/2)

(Unit:mm)

Yr.	Date		Point Rainfall				Basin Rainfall		Remarks
			Piz	Sacobia	Zaragoza	Arayat	Sacobia-Bamban	Abacan	
91	Jun.	14	(1)	(156)	97	2	69	110	T.Dıdıng
	Jun.	15	(26)	(205)	127	17	102	148	T.Dıding
	Jul.	22	133	(46)	29	8	68	35	T.S.Helmıng
	Aug.	13	79	(23)	15	15	41	21	T Luding
	Aug.	20	91	(30)	19	7	46	23	
	Aug.	25	86	(35)	22	54	56	40	
	Sept.	7	85	0	0	0	30	0	
	Sept.	16	25	93	(19)	0	48	65	
	Sept.	19	70	78	(19)	0	58	55	
	Oct.	28	75	67	(22)	5	56	48	T.Trining
	Nov.	17	(88)	129	(80)	(55)	98	107	T.S.Yayang
92	May	19	0	0	113	0	3	0	
	Jun.	28	77	15	0	(15)	36	15	T.Asiang
	Jul.	11	83	84	0	(39)	72	71	T.S.Konsing
	Jul.	13	30	85	0	(39)	54	71	
	Jul.	26	79	48	0	(26)	53	42	
	Aug.	18	96	54	(34)	(28)	63	46	
	Aug.	20	140	57	(36)	(30)	80	49	
	Aug.	28	76	210	(130)	(84)	135	172	
	Aug.	29	69	170	(106)	(70)	112	140	
	Aug.	30	48	76	(48)	(36)	57	64	
93	Jun.	26	193	252	180	108	200	209	T Gorng
	Jul.	2	1	105	0	7	46	76	
	Jul.	22	(14)	8	82	10	13	9	T.D.Luming
	Jul.	27	84	47	15	33	56	43	
	Jul.	30	80	72	10	10	61	53	
	Aug.	18	(191)	(145)	90	115	153	136	T.S.Rubıng
	Aug.	28	30	130	1	26	70	99	
	Aug.	30	94	24	1	0	43	17	
	Oct.	4	57	182	93	65	112	147	T.S.Kadıang
	Oct.	5	102	247	131	97	162	202	T.S.Kadiang
	Oct.	7	76	44	10	7	47	33	T.D.Epang
	Nov.	1	97	76	94	81	85	78	T.S.Husing

Rainfall in parenthesis indicates estimated rainfall.

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

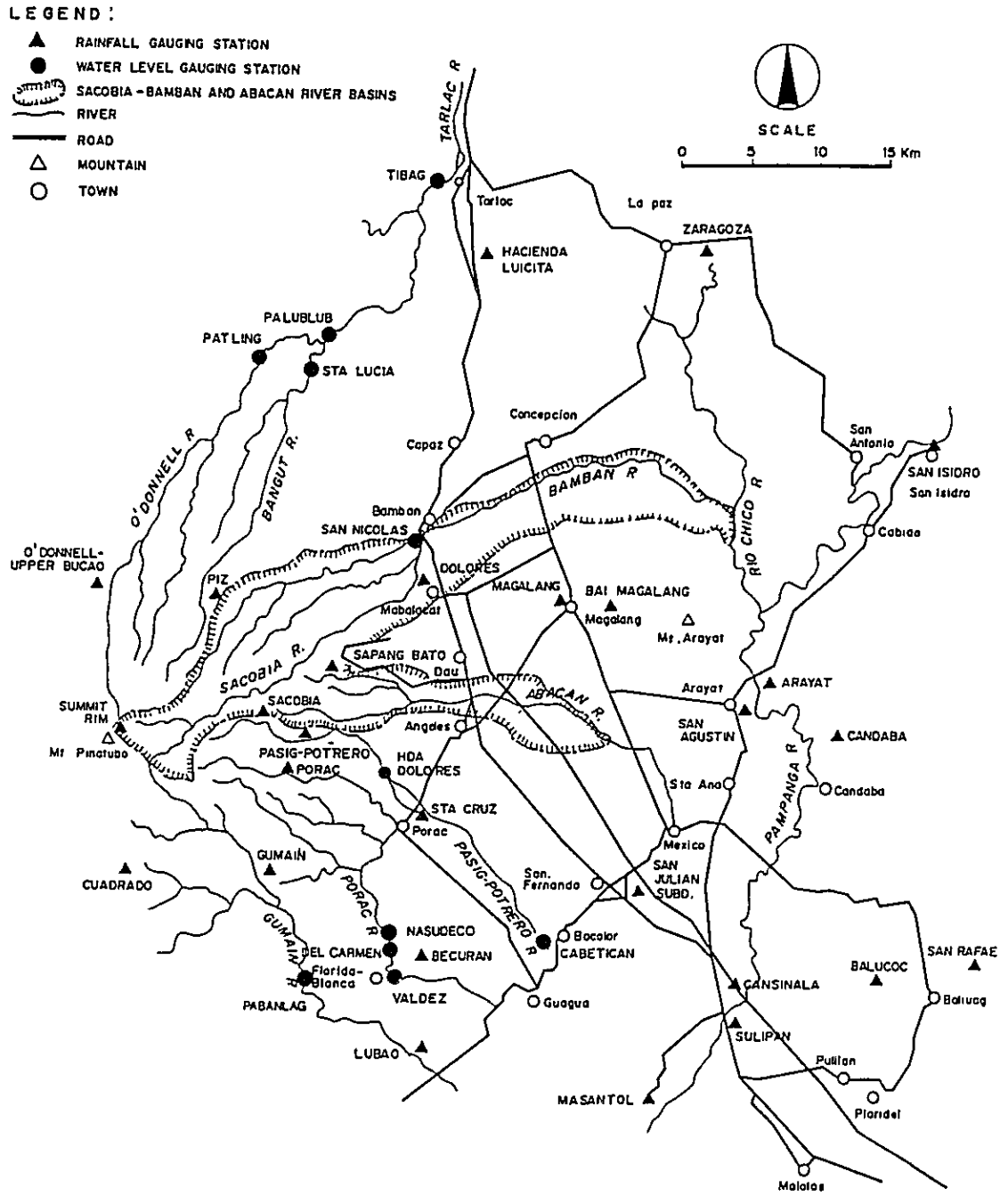


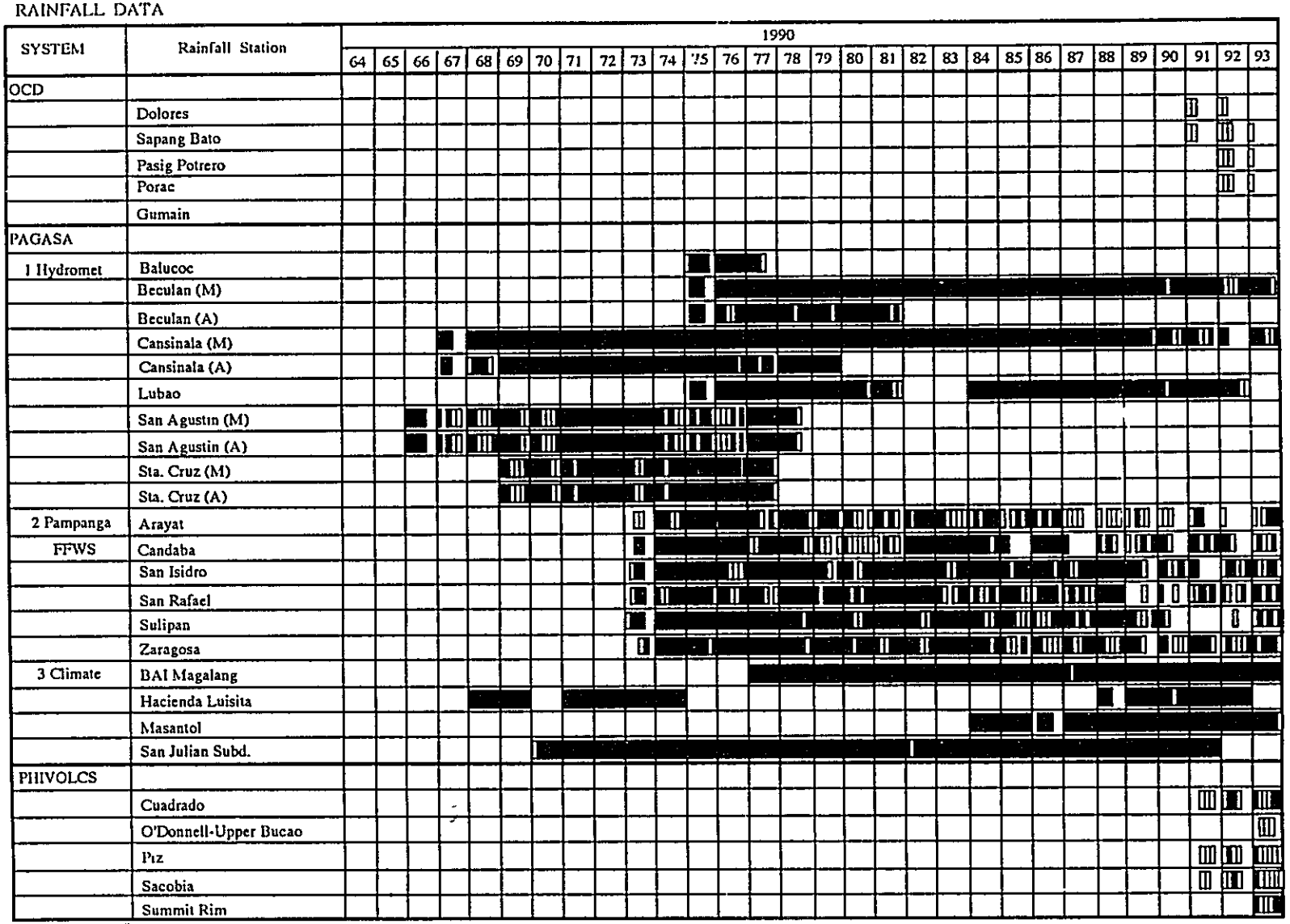
Figure 3.5.1 Location of Hydrological Data

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

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Figure 3.5.2 Available Rainfall Data

RAINFALL DATA



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

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

DISCHARGE DATA

SYSTEM	Water Level Station	1990
		64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93
DPWH		
1 Bamban	San Nicolas	
	San Francisco *	
2 Abacan	San Juan *	
3 Pasig Potrero	Cabetican **	
	HDA-Dolores	
4 O'Donnell	Palublub	
	Patling	
5 Bangut	Sta Lucia	
6 Tarlac	Tibag	
7 Porac	Del Carmen	
	Valdez	
	Nasudeco	
PAGASA		
1 Tarlac	Tibag	

Legend : ▮-Complete ▯-Incomplete

* As rating curve has not established, discharged data are not available
** In Cabetican Station, only water level data is available after 1970

Figure 3.5.3 Available Discharge Data

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

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

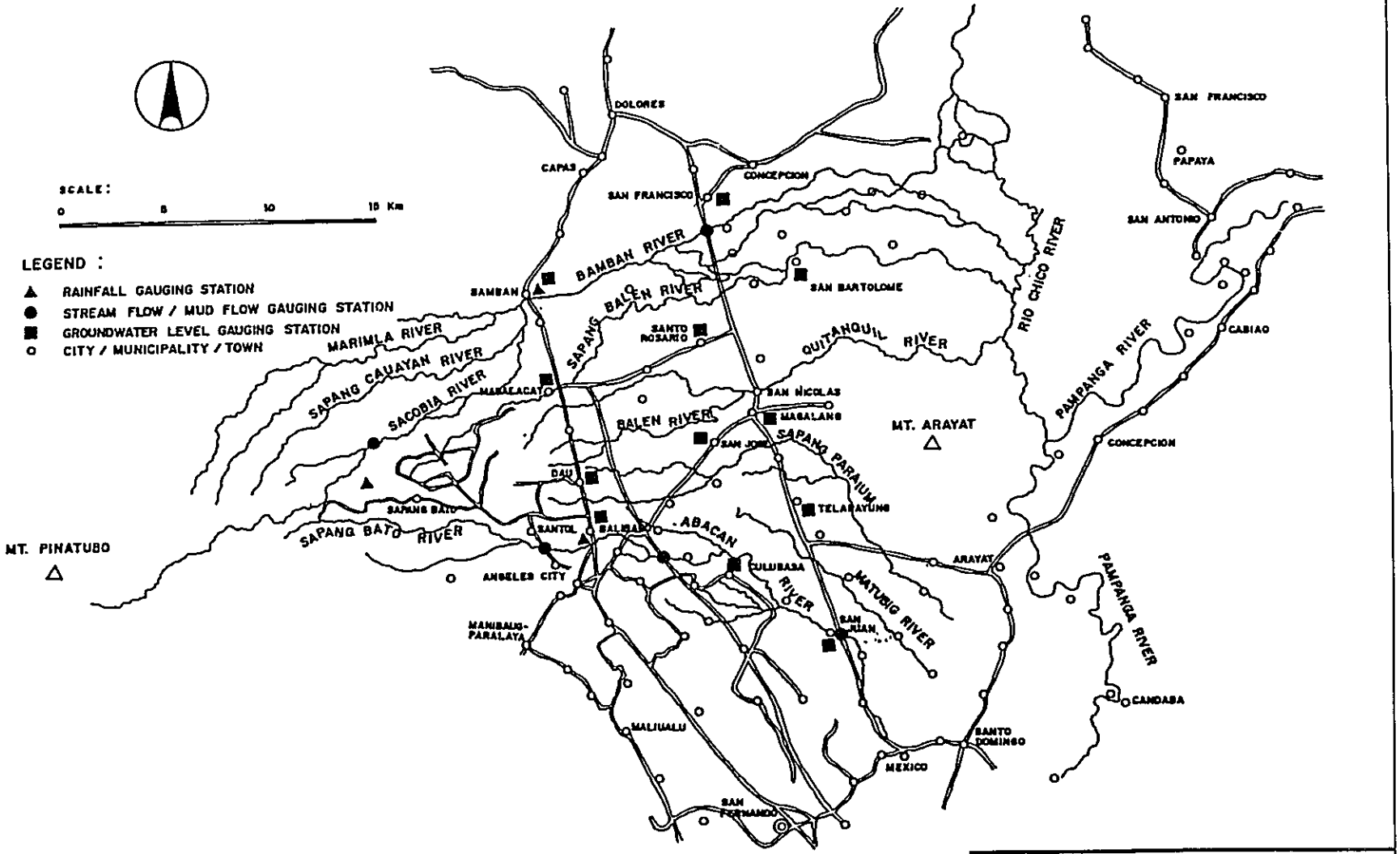


Figure 3.5.4
Location of Hydrological Stations Constructed by JICA

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
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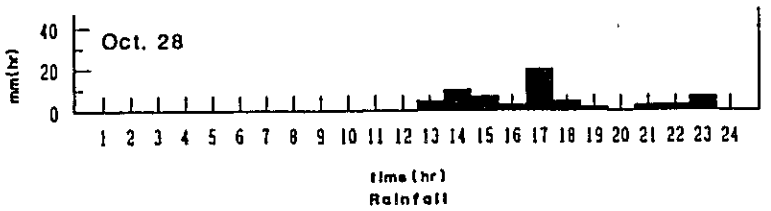
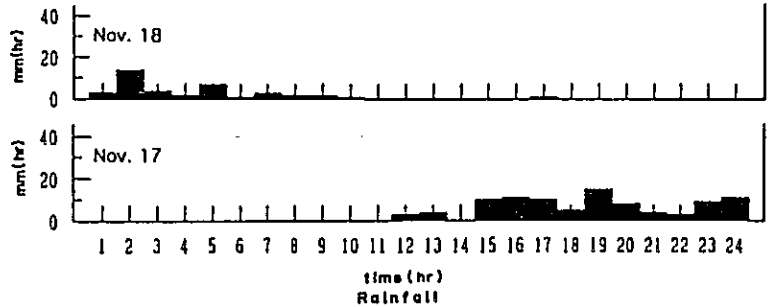
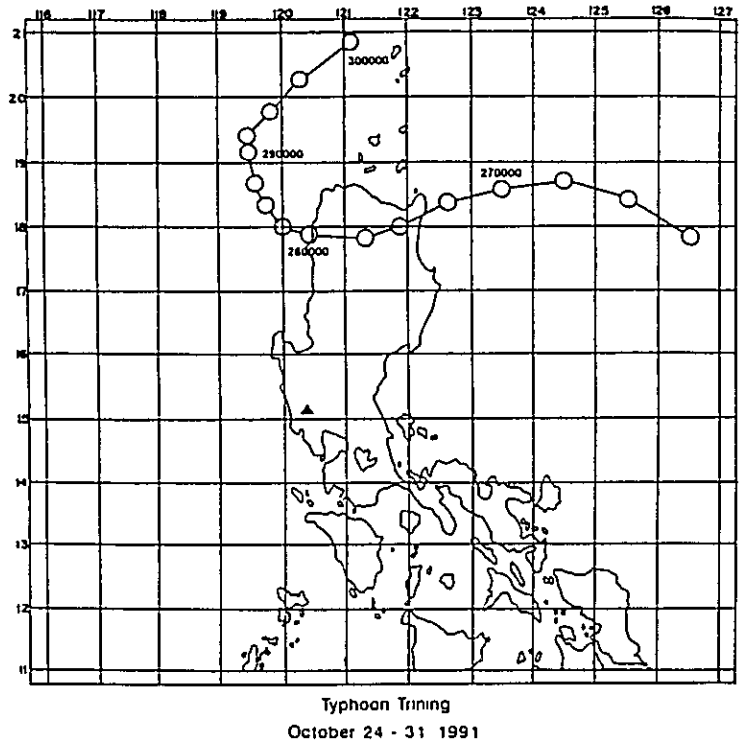
Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**







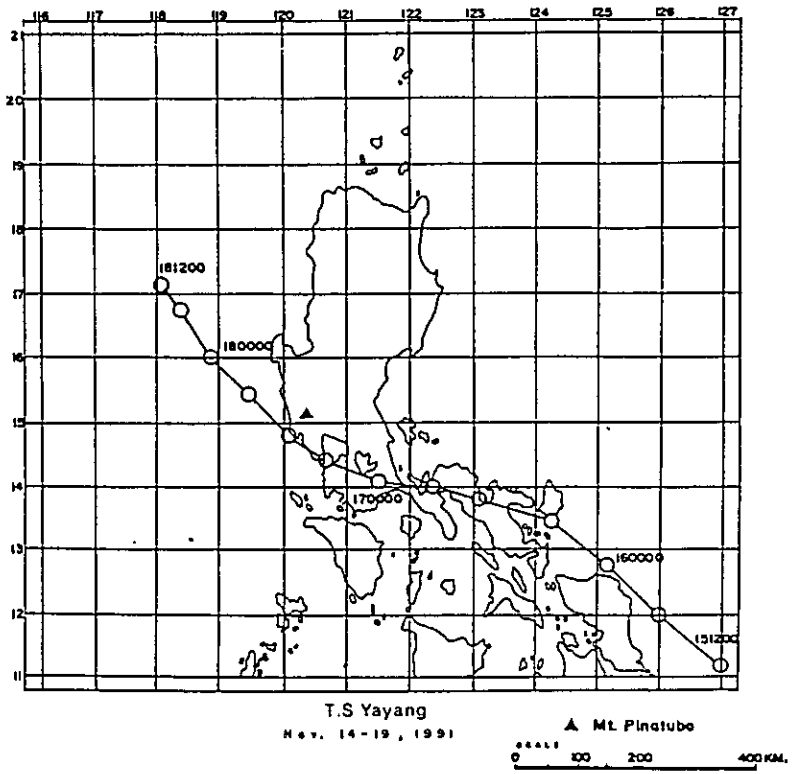
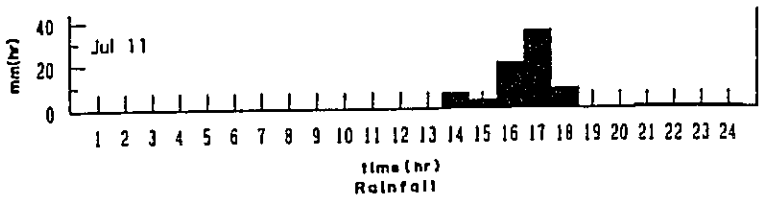
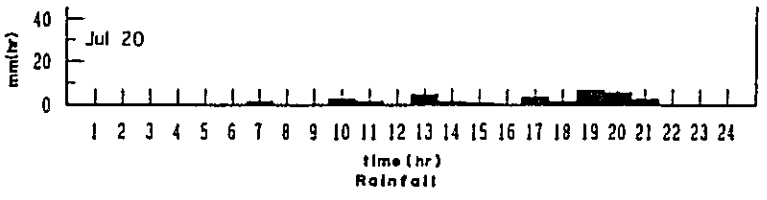


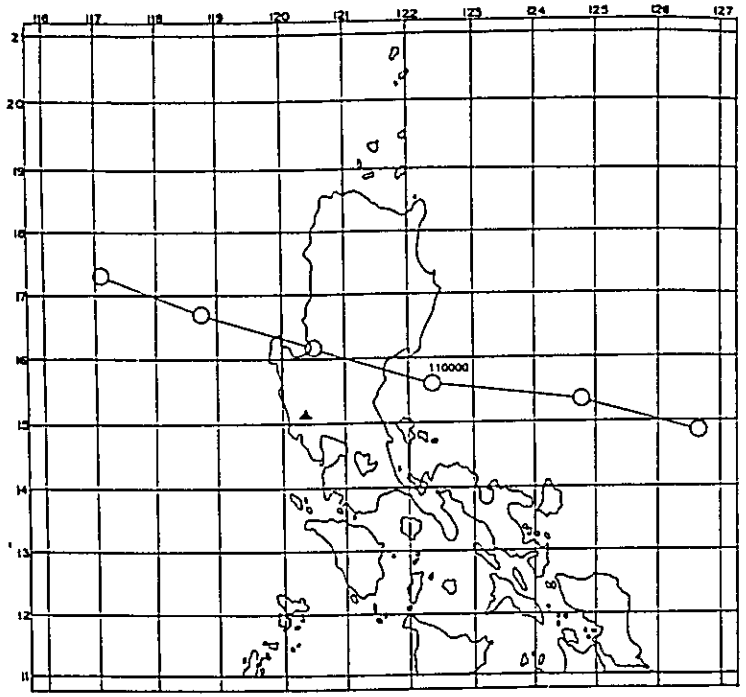
Figure 3.5.5
Rainfall Intensity and Track during Tropical Cyclones (1/5)

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

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

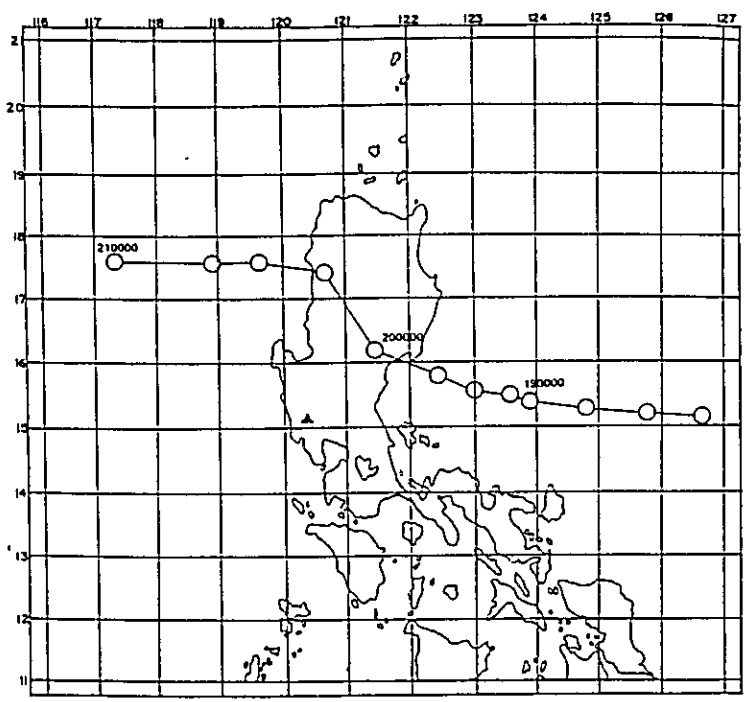






TS Konsing

July09 - 12, 1992



TD Ditang

July 17 - 21, 1992

▲ Mt. Pinatubo

SCALE 0 100 200 400 KM

Figure 3.5.5
Rainfall Intensity and Track during Tropical Cyclones (2/5)

THE GOVERNMENT OF THE PHILIPPINES
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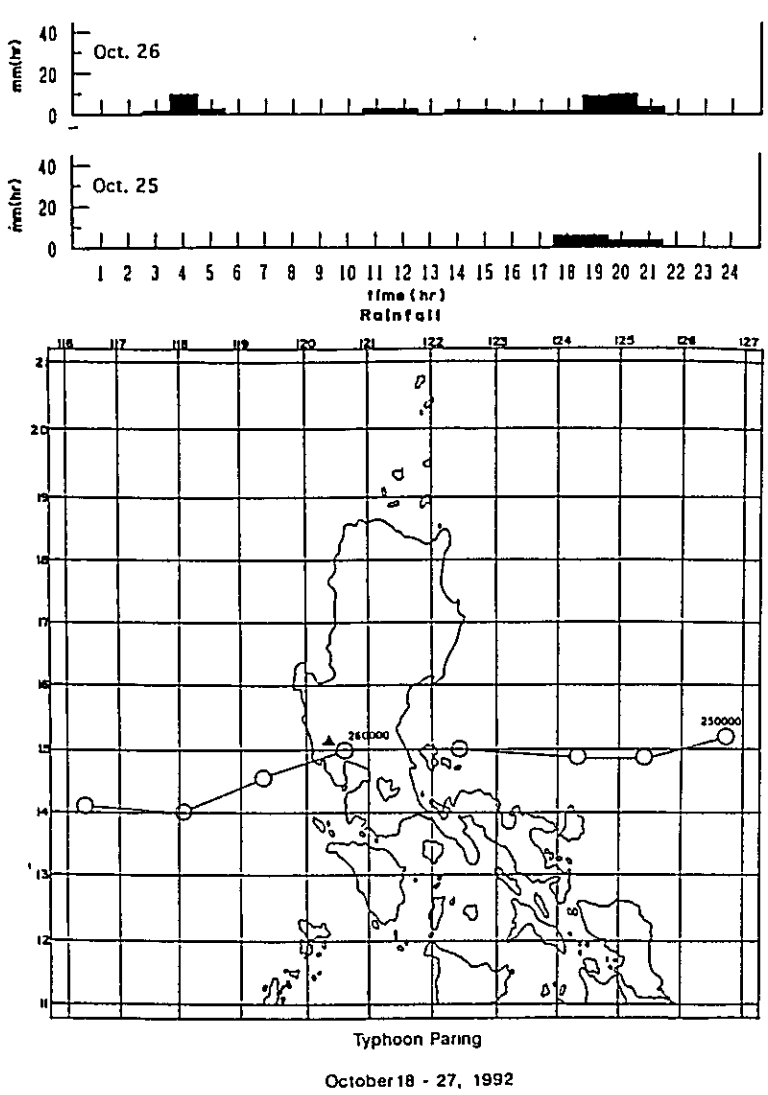
Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**



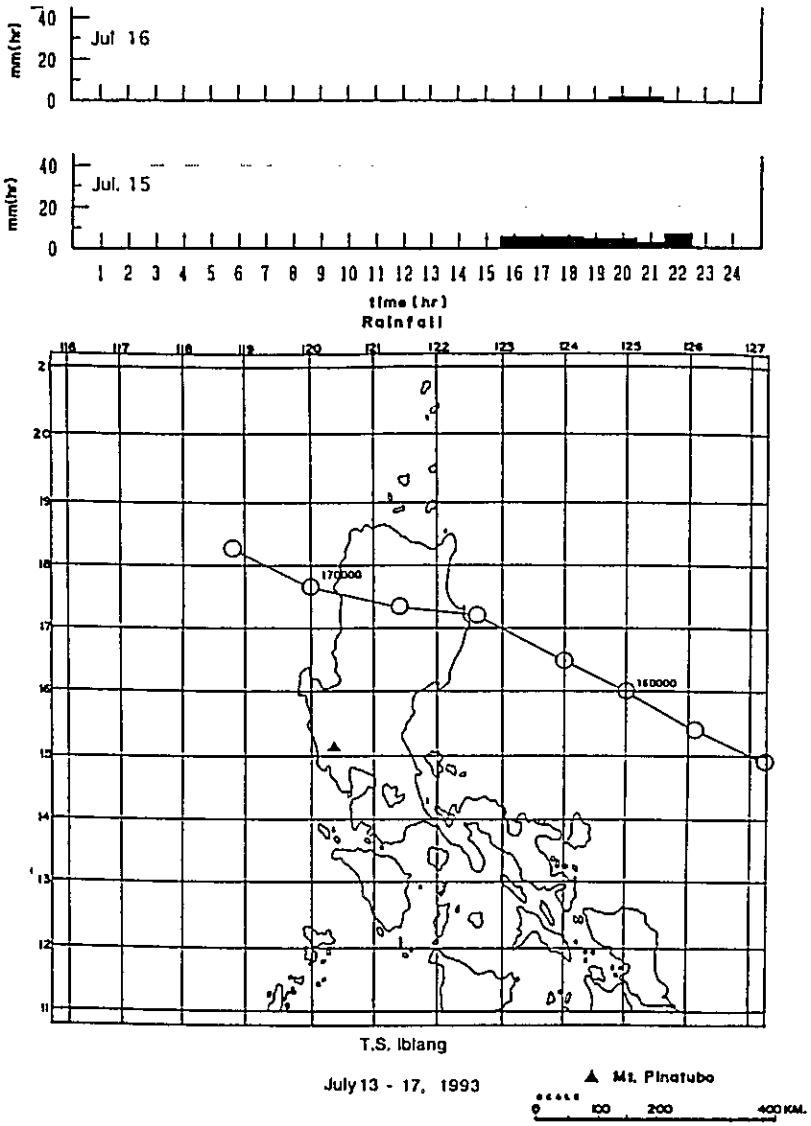
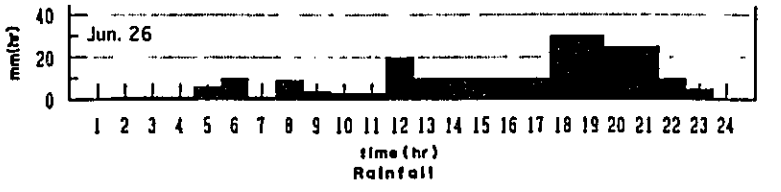
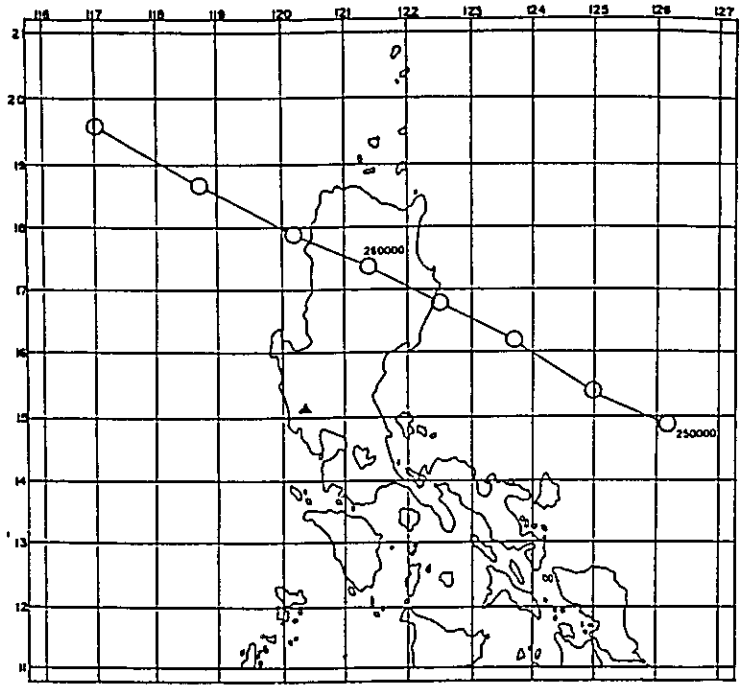


Figure 3.5.5
Rainfall Intensity and Track during Tropical Cyclones (3/5)

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

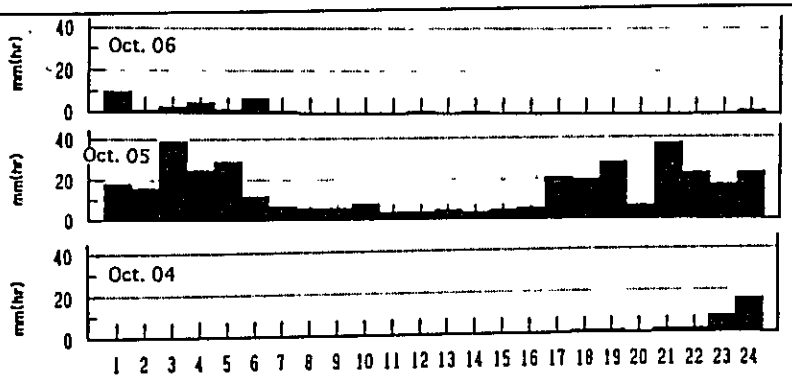
Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

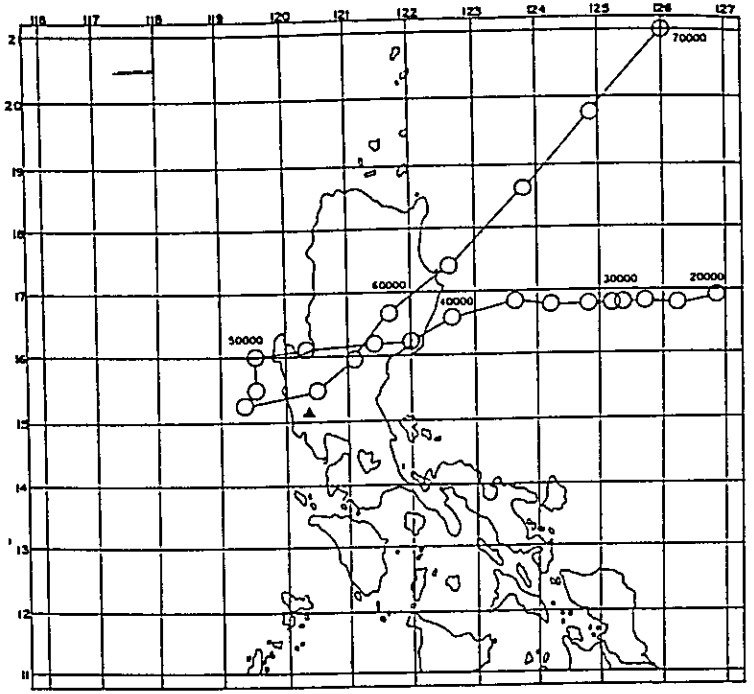




Typhoon Goring

July22 - 27, 1993





Typhoon Kadiang

September30 - October07, 1993

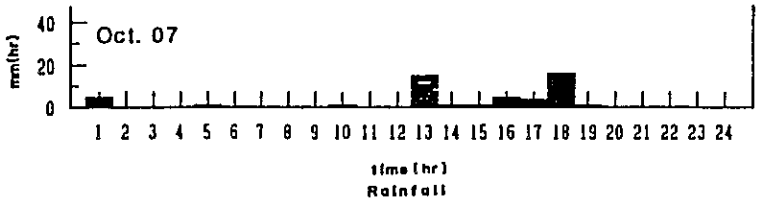
▲ Mt. Pinatubo

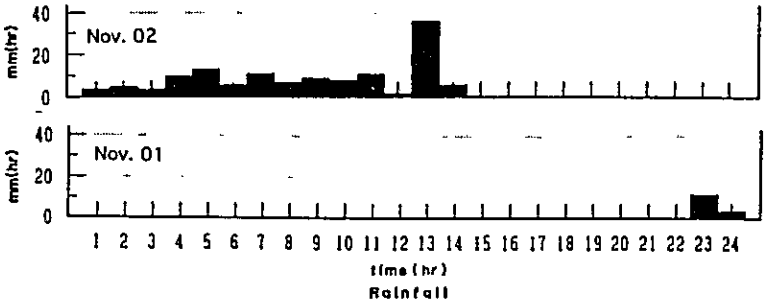
SCALE 0 100 200 400 KM.

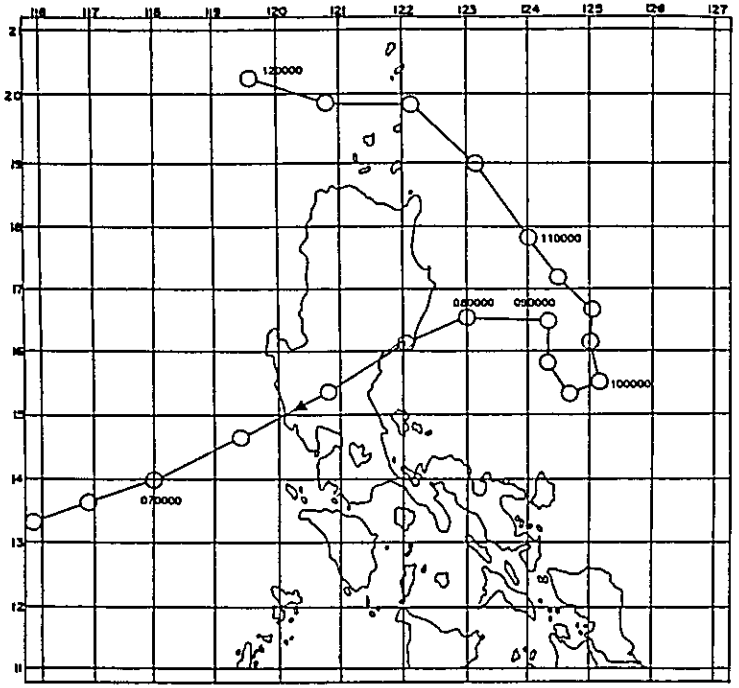
Figure 3.5.5
Rainfall Intensity and Track during Tropical Cyclones (4/5)

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

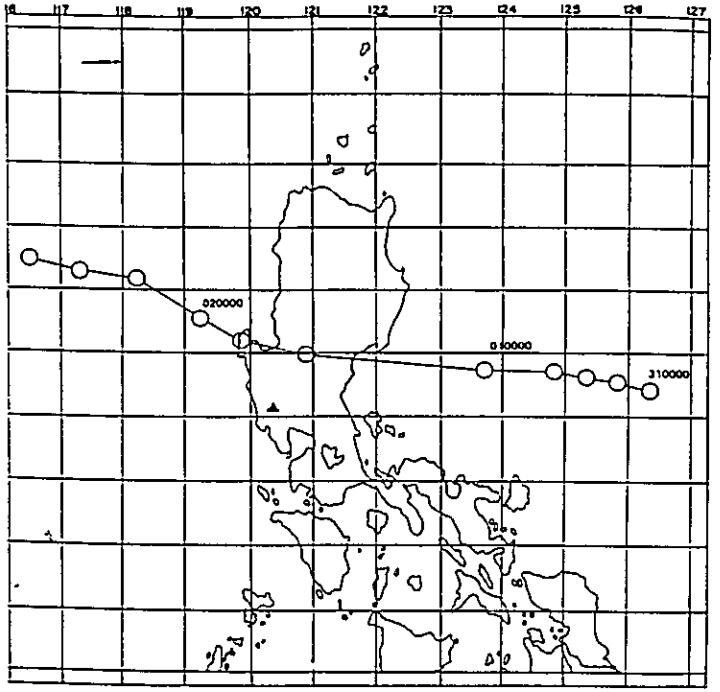
Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**







TD Epang
October 06 - 13, 1993



Typhoon Husing
October29 - November02, 1993

▲ Mt. Pinatubo

0 100 200 400KM.

Figure 3.5.5
Rainfall Intensity and Track during Tropical Cyclones (5/5)

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

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**

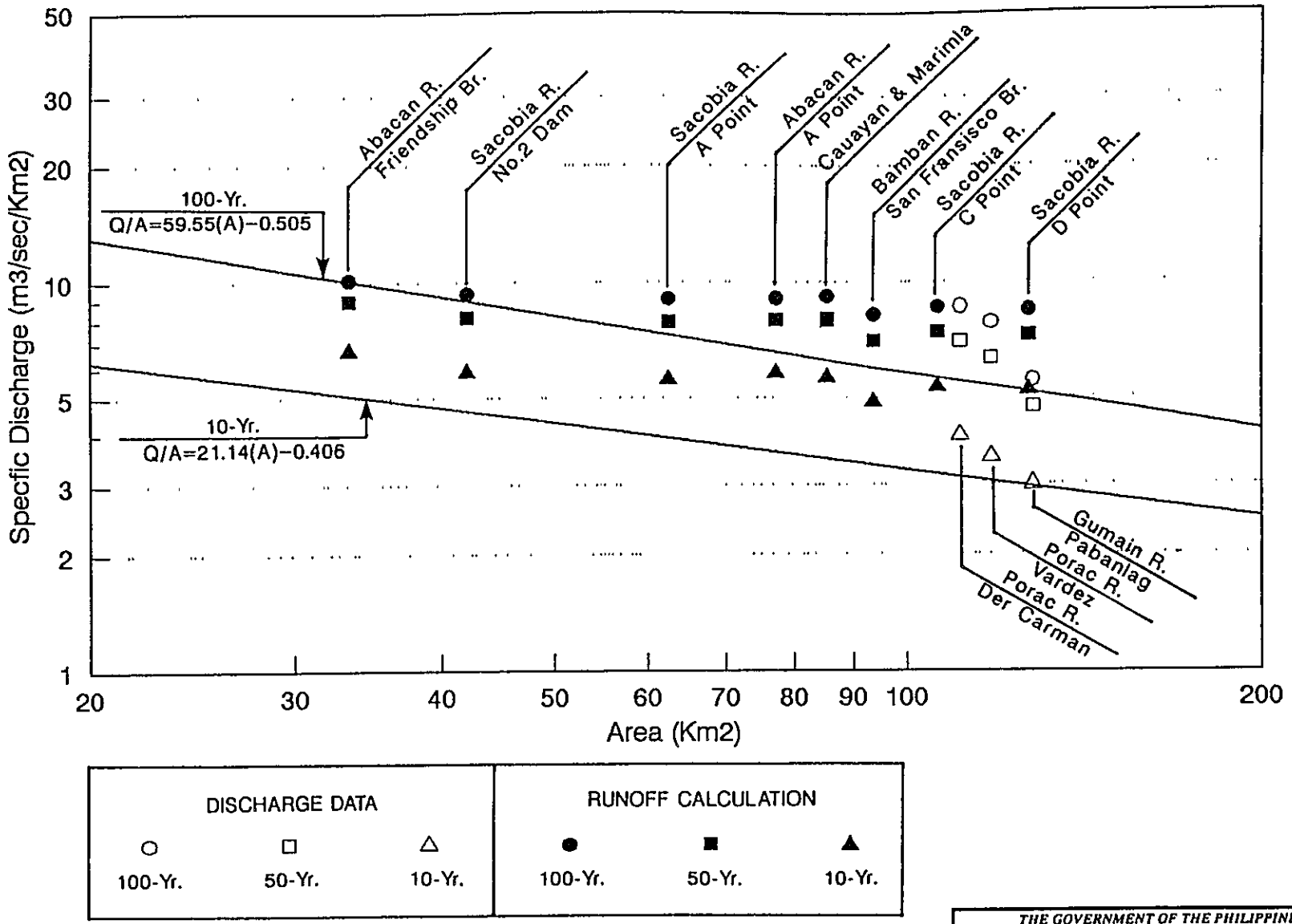


Figure 3.5.6
Comparison of Specific Discharge

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

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

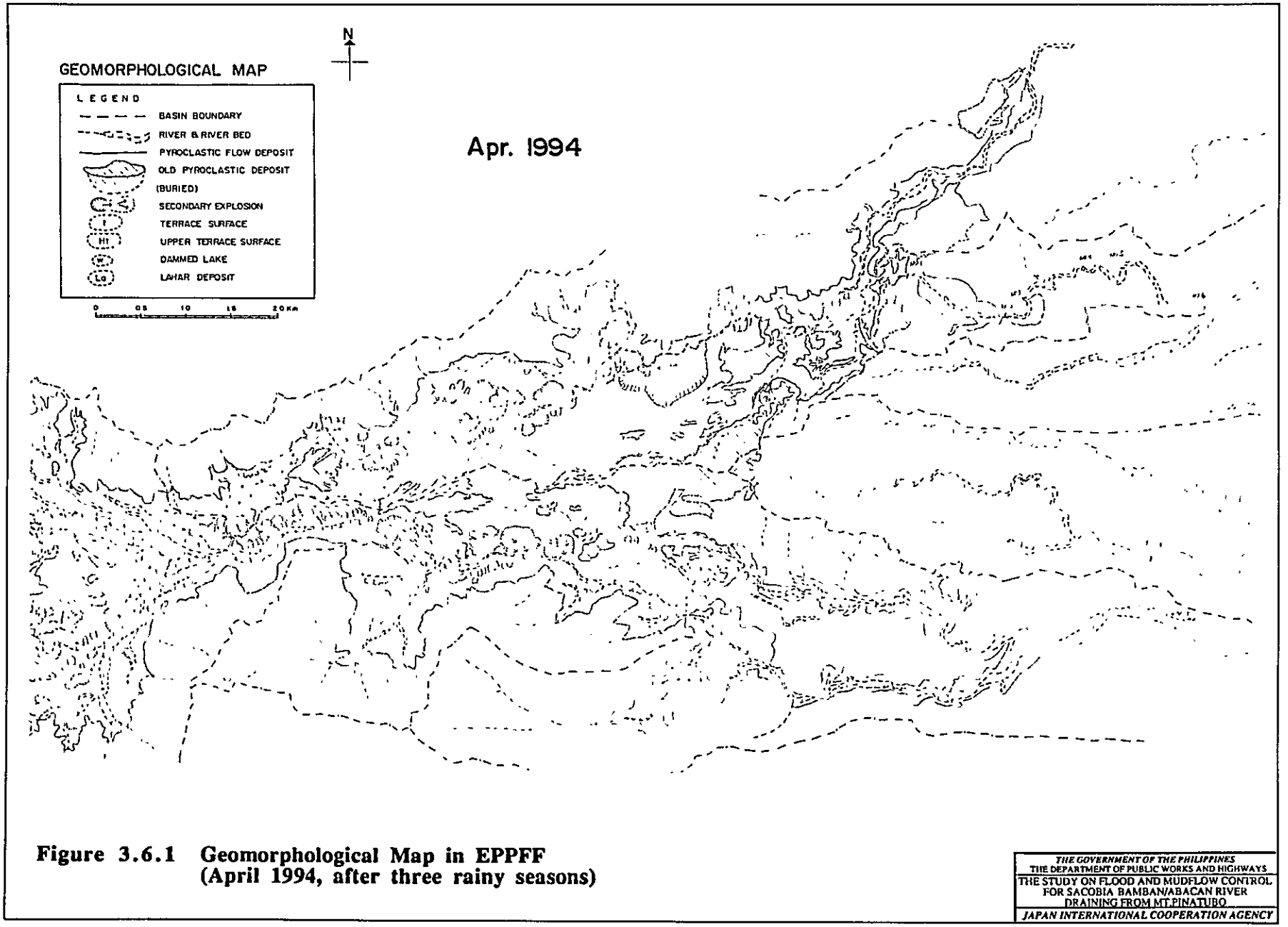
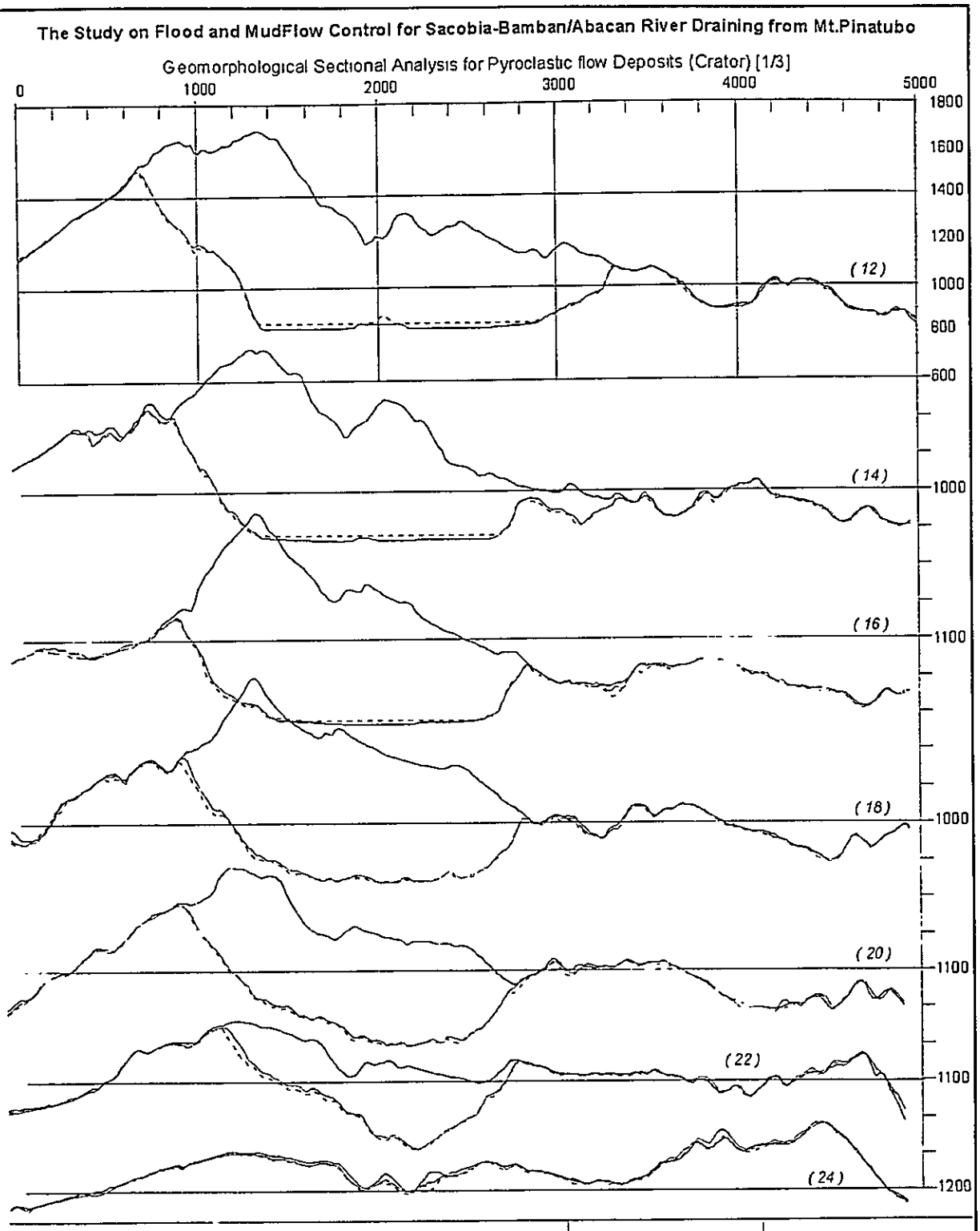


Figure 3.6.1 Geomorphological Map in EPPFF (April 1994, after three rainy seasons)

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

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**



Comments . The analysis was performed using the GIS database created by JICA Study Team from the DTM for 1980, 1992 and 1994 with a contour interval of 5m mapped to scale of 1 10000 from Aerial Photographs of varying scales The data has been modelled with a spatial resolution of 10m The volume analysis was performed by estimating the area along sections at every 200m near the Crator and every 500m at other locations. The Pyroclastic flow area was identified by the Team Experts by Aerial Photo Interpretation The results have been plotted to a scale of 1 20000 in three parts, namely, Crator, Upstream and Down stream

Legend :

( ) Section Number

Before Eruption (1980)

After 2 Rainy Seasons (1992 Oct.)

After 3 Rainy seasons (1994 Apr.)

S.No	(After Eruption) S.Area (x1,000sq m)
12	-1340.99
14	-1194.96
16	-1161.52
18	-1103.58
20	-837.94
22	-390.17
24	-22.46

Figure 3.6.2 Geomorphological Sectional Analysis for Pyroclastic Flow Deposits (Crator) [1/3]

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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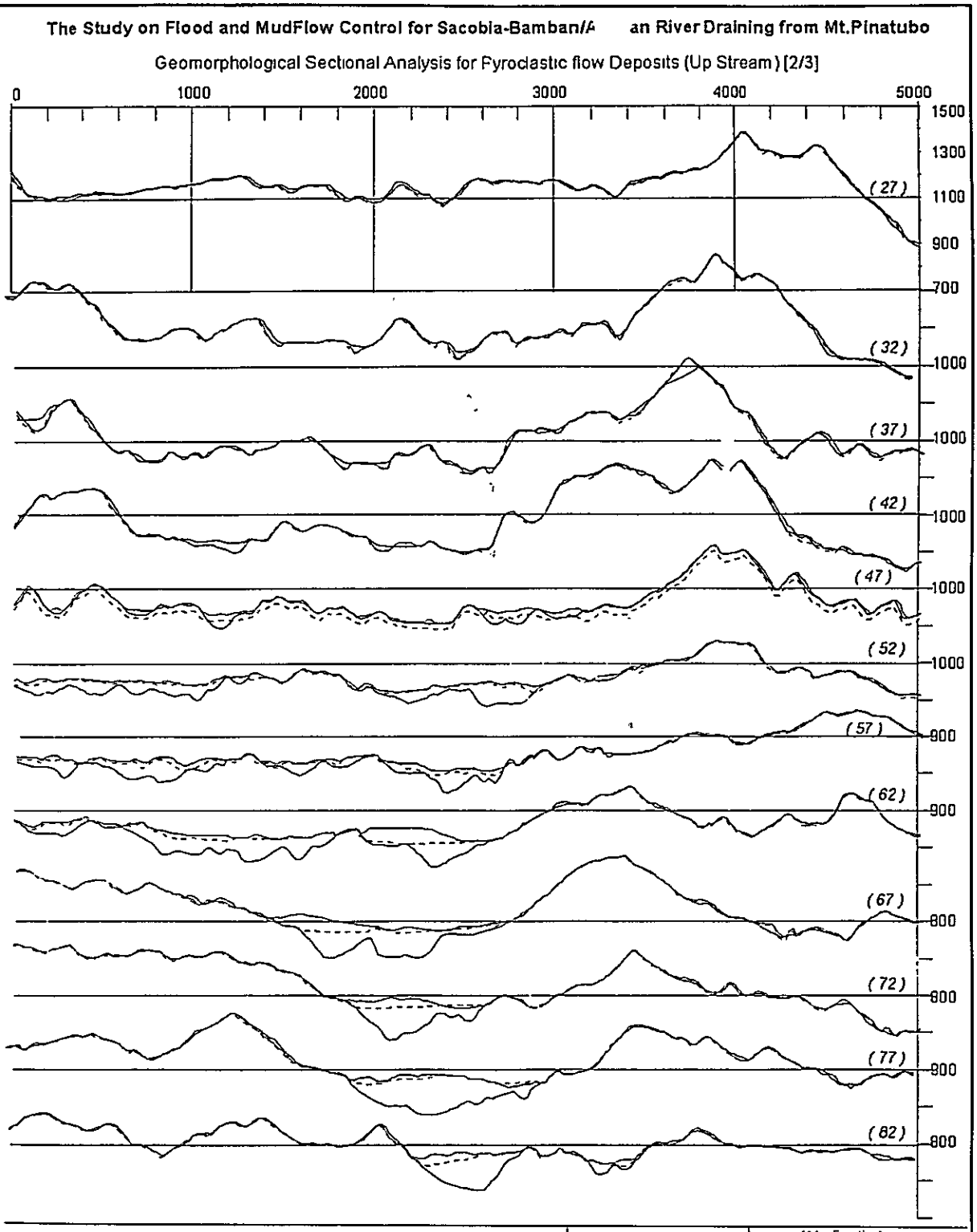

Comments : The analysis was performed using the GIS database created by JICA Study Team from the DTM for 1980, 1992 and 1994 with a contour interval of 5m mapped to scale of 1:10000 from Aerial Photographs of varying scales. The data has been modelled with a spatial resolution of 10m. The volume analysis was performed by estimating the area along sections at every 200m near the Crator and every 500m at other locations.. The Pyroclastic flow area was identified by the Team Experts by Aerial Photo Interpretation. The results have been plotted to a scale of 1.20000 in three parts, namely, Crator, Upstream and Down stream.

Legend :

( ) Section Number
Before Eruption (1980)
After 2 Rainy Seasons (1992 Oct.)
After 3 Rainy seasons (1994 Apr)

S.No	(After Eruption) S Area (x1,000sq.m)
27	5.38
32	-6.38
37	1.06
42	16.28
47	41.64
52	121.95
57	128.54
62	184.57
67	121.28
72	77.69
77	124.19
82	81.84

Figure 3.6.2 Geomorphological Sectional Analysis for Pyroclastic Flow Deposits (Crator) [2/3]

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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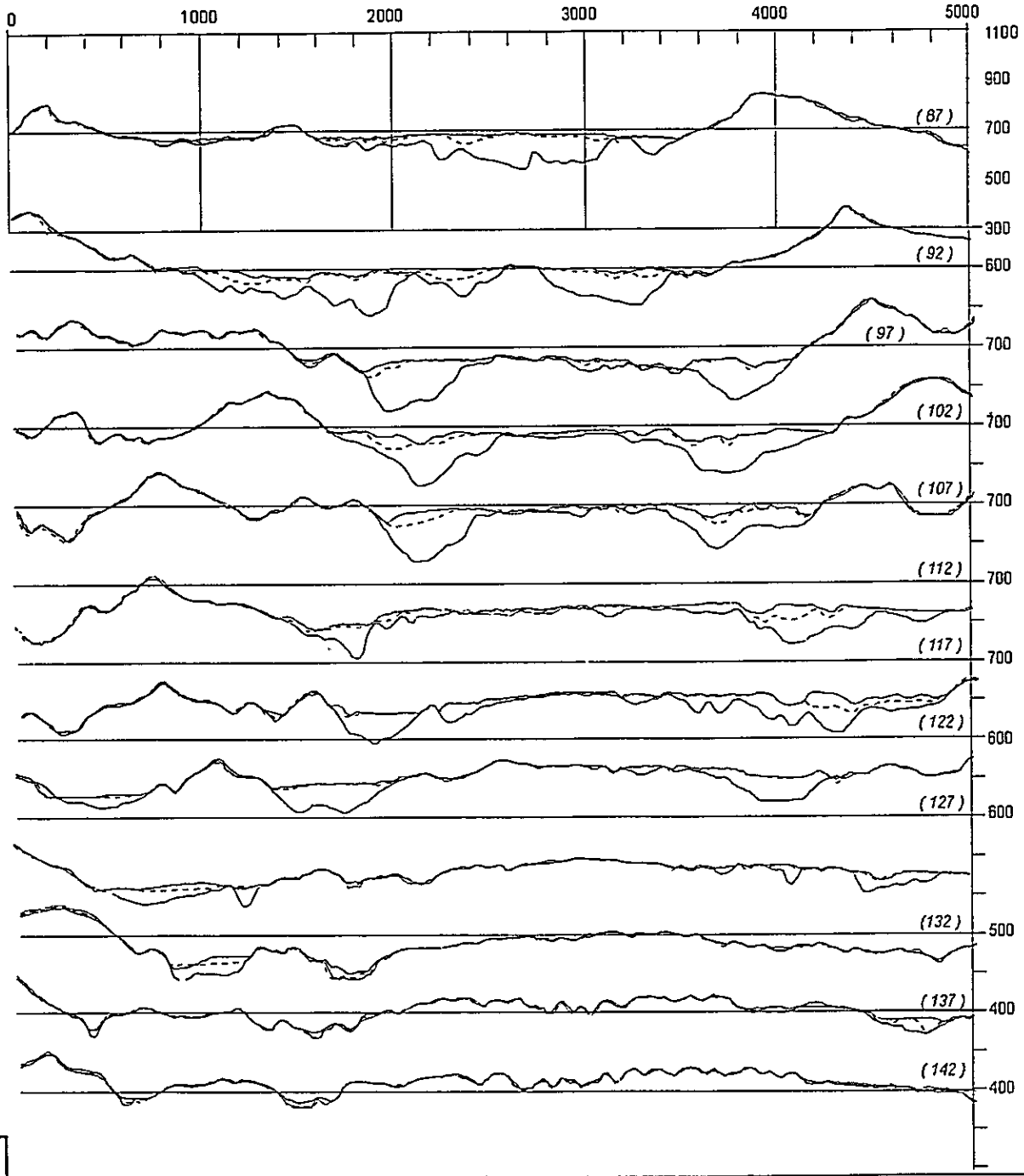
The Study on Flood and MudFlow Control for Sacobia-Bamban/Abacan River Draining from Mt.Pinatubo

Geomorphological Sectional Analysis for Pyroclastic flow Deposits (Down Stream) [3/3]



Comments : The analysis was performed using the GIS database created by JICA Study Team from the DTM for 1980, 1992 and 1994 with a contour interval of 5m mapped to scale of 1 10000 from Aerial Photographs of varying scales The data has been modelled with a spatial resolution of 10m. The volume analysis was performed by estimating the area along sections at every 200m near the Crator and every 500m at other locations. The Pyroclastic flow area was identified by the Team Experts by Aerial Photo Interpretation The results have been plotted to a scale of 1 20000 in three parts, namely, Crator, Upstream and Down stream

Legend :

( ) Section Number

Before Eruption (1980)

After 2 Rainy Seasons (1992 Oct.)

After 3 Rainy seasons (1994 Apr)

Pasig (After Eruption)		Sacobian	
S.No	S.Area (x1,000sq.m)	S.No	S.Area
87	31.91	87	125.94
92	151.19	92	81.57
97	92.99	97	79.03
102	96.59	102	107.42
107	84.30	107	91.26
112	58.99	112	111.53
117	52.54	117	113.56
122	78.40	122	63.07
127	42.09	127	33.14
132	25.47	132	5.72
		137	22.22
		142	14.85

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Figure 3.6.2 Geomorphological Sectional Analysis for Pyroclastic Flow Deposits (Crator) [3/3]

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

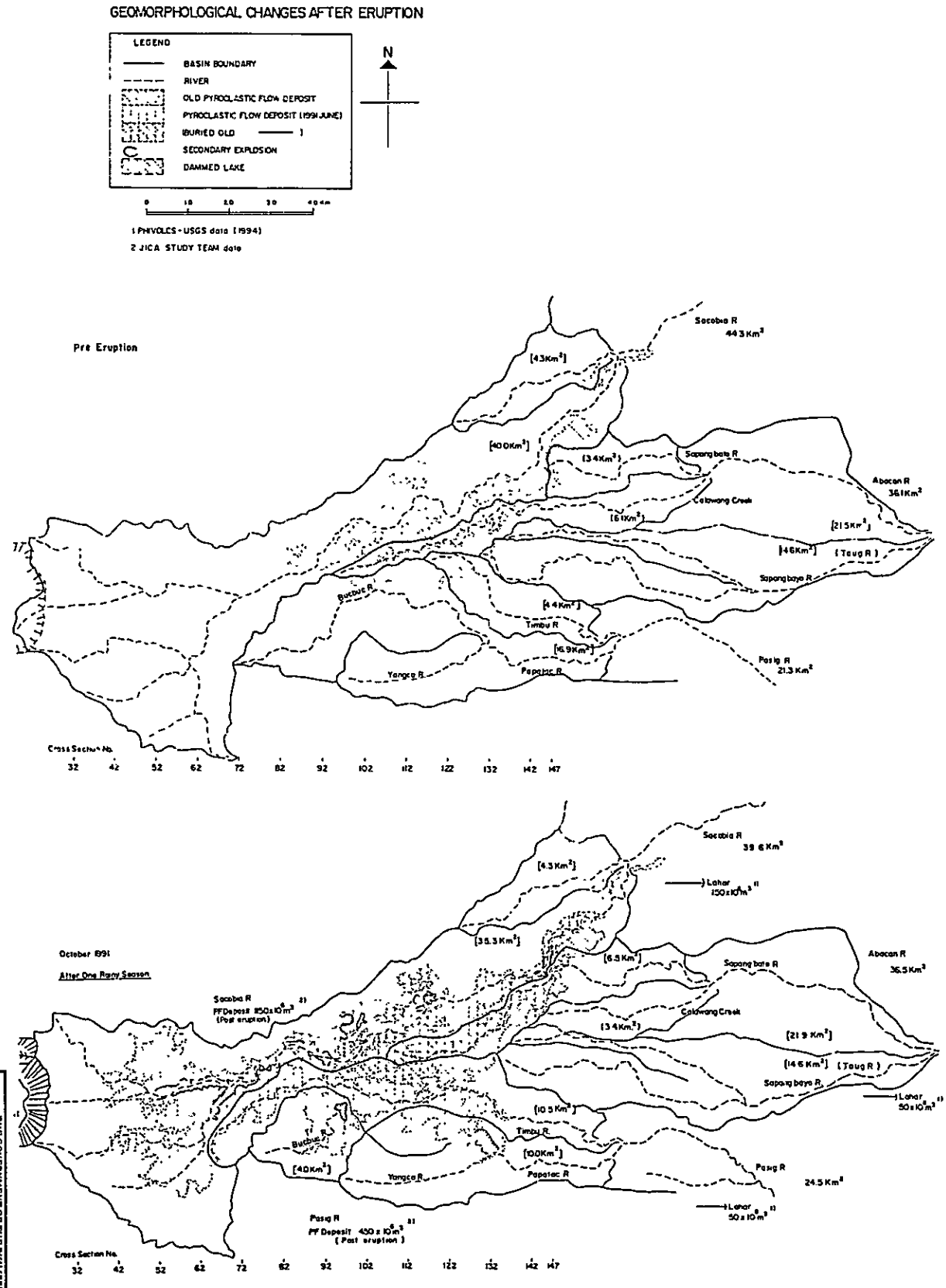

Figure 3.6.3 Geomorphological Changes after Eruption in Downstream Area (1/2)

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

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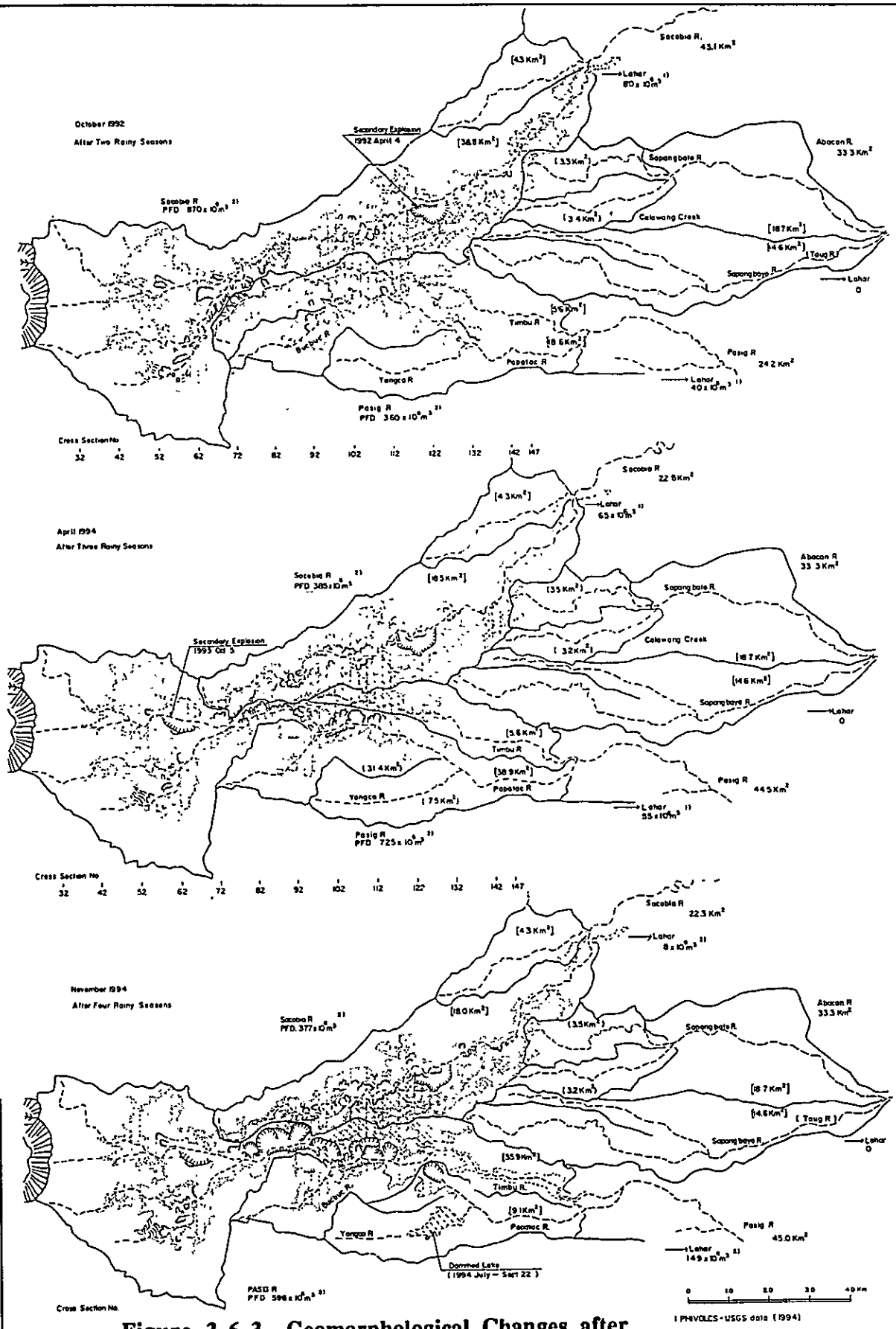

Figure 3.6.3 Geomorphological Changes after Eruption in Downstream Area (2/2)

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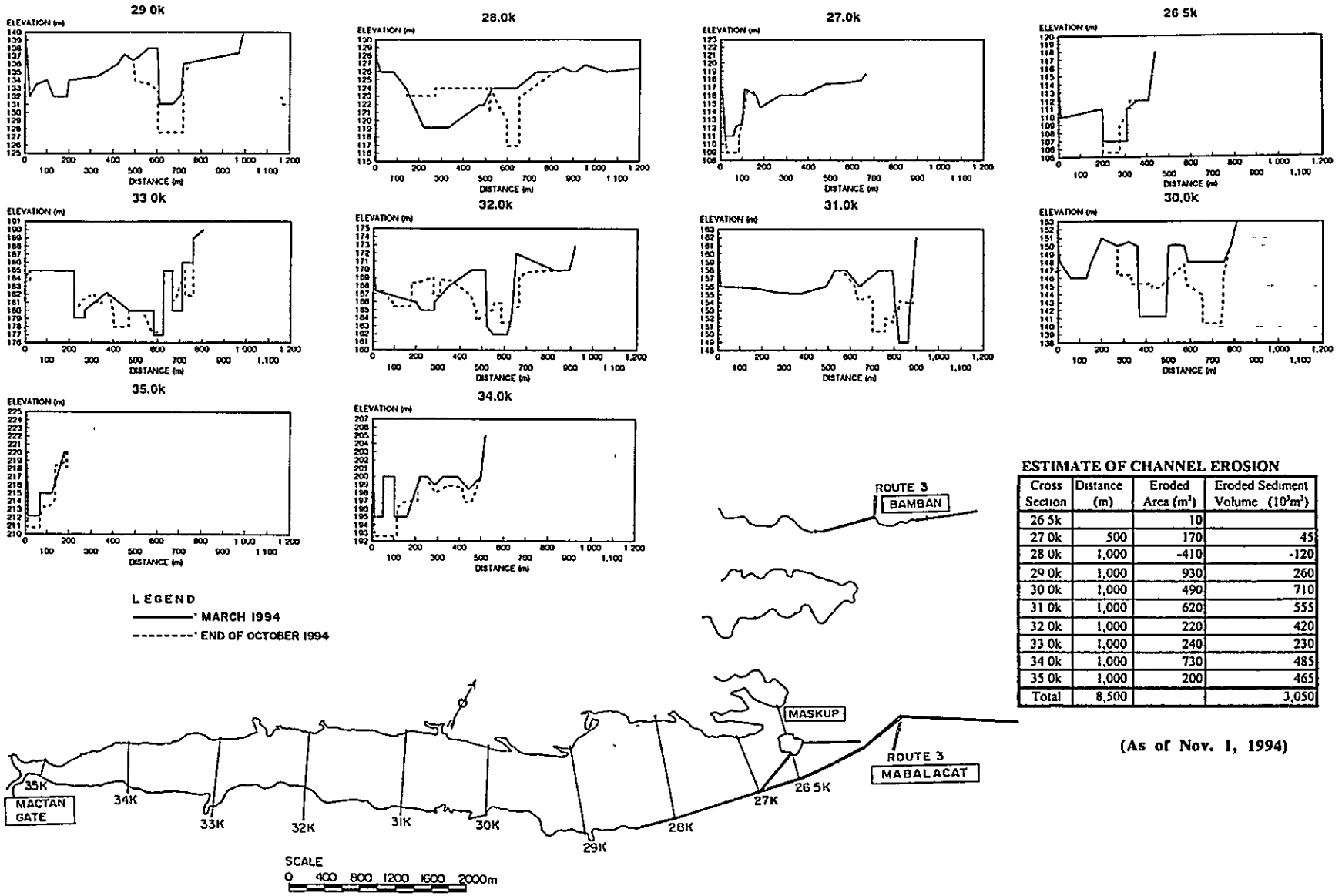
Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Table 3.7.1 Volume of Sediment Deposition in Inundated Areas of Pasig-Potrero River, 1994

Square No	Sub-No	Area (km^2)	Average Depth(m)	Volume (10^6m^3)	Square No	Sub-No	Area (km^2)	Average Depth(m)	Volume (10^6m^3)
1 -A		0 05	1 1	0 06	6 -H	1	0 53	4 0	2 12
1 -B		0 48	2.2	1 06		2	0 48	3 6	1.73
1 -C		0 50	2 1	1.05	6 -I		0 98	2 5	2 45
2 -B	1	0 10	2 3	0.23	6 -I*		0.20	0 6	0 12
	2	0 10	2 2	0.22	6 -J		0 23	1 1	0 25
2 -C	1	0 30	2.3	0 69	6 -J*	1	0 13	0 6	0 08
	2	0 60	2.1	1 26		2	0 08	1 0	0 08
2 -D		0 88	1 1	0 97	7 -D		0 08	0.6	0 05
2 -D*		0 08	0 6	0 05	7 -E		0.35	0 6	0 21
2 -E		0 53	0 8	0 42	7 -F*		0.80	0 5	0 40
2 -E*		0 10	0 6	0 06	7 -H		0 70	0 6	0 42
2 -F		0 06	0 8	0 05	7 -I	1	0 55	4 5	2 48
2 -F*		0 05	0 6	0 03		2	0 45	1 5	0 68
3 -A		0 15	2.1	0 32	7 -J		0 90	2 9	2 61
3 -B		0 30	2.0	0 60	7 -J*		0 13	1 0	0 13
3 -C		0 15	2 3	0 35	7 -K		0 05	1 5	0 08
3 -D	1	0 28	2 3	0 64	7 -K*		0 30	1 0	0.30
	2	0 45	2 1	0 95	8 -F		0.20	0 9	0 18
3 -D*		0 10	0 6	0 06	8 -I		0.50	1 8	0 90
3 -E		1 00	2 0	2 00	8 -J	1	0 80	2 0	1 60
3 -E*		0 35	0 6	0 21		2	0.20	1 8	0 36
3 -F		0 98	1 8	1 76	8 -K		0 78	1 5	1.17
3 -F*		0 73	0 6	0 44	8 -K*		0.20	1 0	0 20
3 -G		0 53	0 7	0 37	8 -L		0 15	1 5	0 23
3 -G*	1	0 53	0 6	0 32	8 -L*		0 05	0 6	0 03
	2	0 25	1 0	0 25	9 -F		0 30	0 9	0 27
3 -H		0 01	0 7	0 01	9 -J		0 83	1 2	1 00
3 -H*		0 15	1 0	0 15	9 -K	1	0 58	3 0	1 74
4 -B		0 53	2 0	1 06		2	0 42	2 1	0 88
4 -C		0 28	1 2	0 34	9 -L		0 73	3 0	2 19
4 -E	1	0 10	2 3	0 23	9 -L*		0 03	0 6	0 02
	2	0 35	1 6	0 56	9 -M*		0 08	0 6	0 05
4 -F		0 90	1 6	1 44	10-G		0 65	0 6	0 39
4 -G		1 00	2 0	2 00	10-H*		0 60	0 5	0 30
4 -G*		0 50	1 0	0 50	10-I*		0 80	0 5	0 40
4 -H		0 80	0 6	0 48	10-K		0.70	2 1	1 47
4 -H*	1	0 80	1 0	0 80	10-L	1	0 43	3 0	1 29
	2	0 05	0 6	0 03		2	0 57	1 5	0 86
4 -I		0 05	0 6	0 03	10-M		0 23	1 5	0 35
4 -I*		0 05	0 6	0 03	10-M*		0 23	0 6	0 14
5 -B		0 08	0 6	0 05	11-L		0 80	1 2	0 96
5 -C		0 85	0 9	0 77	11-M	1	0 23	1 5	0 35
5 -D		0 30	0 6	0 18		2	0 40	1 8	0 72
5 -F		0 30	3 0	0 90	11-M*		0 03	1 0	0 03
5 -G		1 00	3 3	3 30	12-L		0 40	2 1	0 84
5 -H		1 00	1 0	1 00	12-M	1	0 80	2 1	1 68
5 -H*		0 53	0 9	0 48		2	0 17	0 6	0 10
5 -I		0 58	0 5	0 29	12-N		0 13	0 6	0 08
5 -I*		0 68	0 6	0 41	13-L		0 50	1 2	0 60
6 -C		0 25	0 6	0 15	13-M		1 00	1 0	1 00
6 -D		0 38	0 6	0 23	13-N		0 60	0 7	0 42
6 -E		0 38	0 6	0 23	14-L		0 13	1 0	0 13
6 -E*		0 80	1 0	0 80	14-M		0.75	1.0	0 75
6 -F*		0 30	0 5	0 15	14-N		0 83	0 6	0 50
6 -G		0 63	3 6	2 27	14-O		0 53	0 6	0 32
					Total		47.56		71.88

Note * Additional Survey Results to October 22 Lahar

Sources:
The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)



ESTIMATE OF CHANNEL EROSION

Cross Section	Distance (m)	Eroded Area (m^2)	Eroded Sediment Volume ($10^3 m^3$)
26 5k		10	
27 0k	500	170	45
28 0k	1,000	-410	-120
29 0k	1,000	930	260
30 0k	1,000	490	710
31 0k	1,000	620	555
32 0k	1,000	220	420
33 0k	1,000	240	230
34 0k	1,000	730	485
35 0k	1,000	200	465
Total	8,500		3,050

(As of Nov. 1, 1994)

Figure 3.7.1 Cross-Sectional Changes and Estimate of Channel Erosion from Mactan to Maskup in 1994

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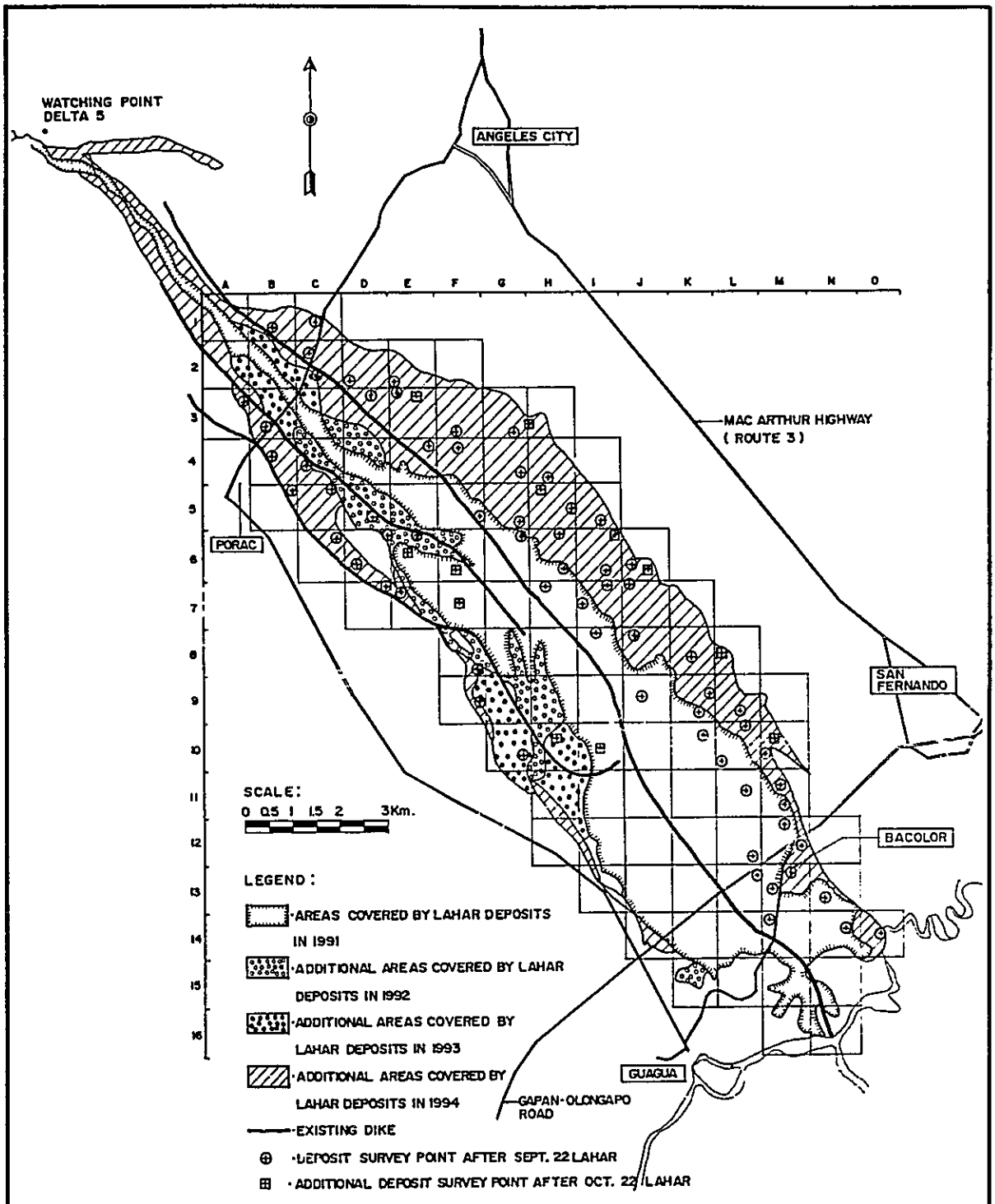

Figure 3.7.2 Sediment Deposition Survey Area in Pasig-Potrero

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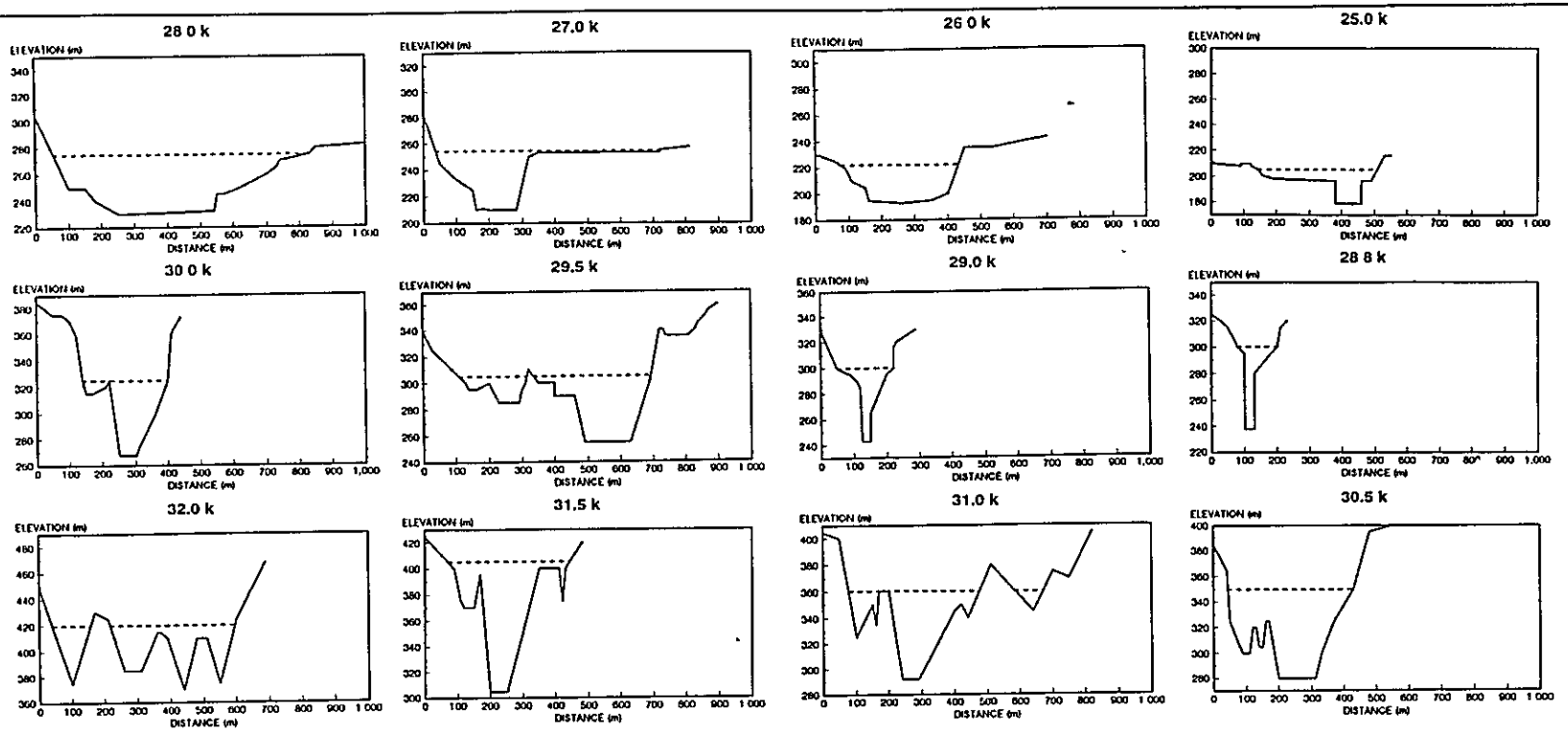

ESTIMATE OF LAHAR DEPOSITS

Cross Section	Distance (m)	Deposited Area (10^3m^2)	Accumulated Sediment Volume (10^3m^3)
25.0k		4.2	
26.0k	1,000	7.8	6,030
27.0k	1,000	9.4	8,635
28.0k	1,000	22.9	16,160
28.8k	800	2.6	10,192
29.0k	200	3.0	562
29.5k	500	13.3	4,073
30.0k	500	7.2	5,113
30.5k	500	17.3	6,123
31.0k	500	12.7	7,500
31.5k	500	14.8	6,875
32.0k	500	11.5	6,568
	Sub-Total	25.0k-28.8k	41,017
		28.8k-32.0k	36,812
	Total		77,829

(As of Nov. 1, 1994)

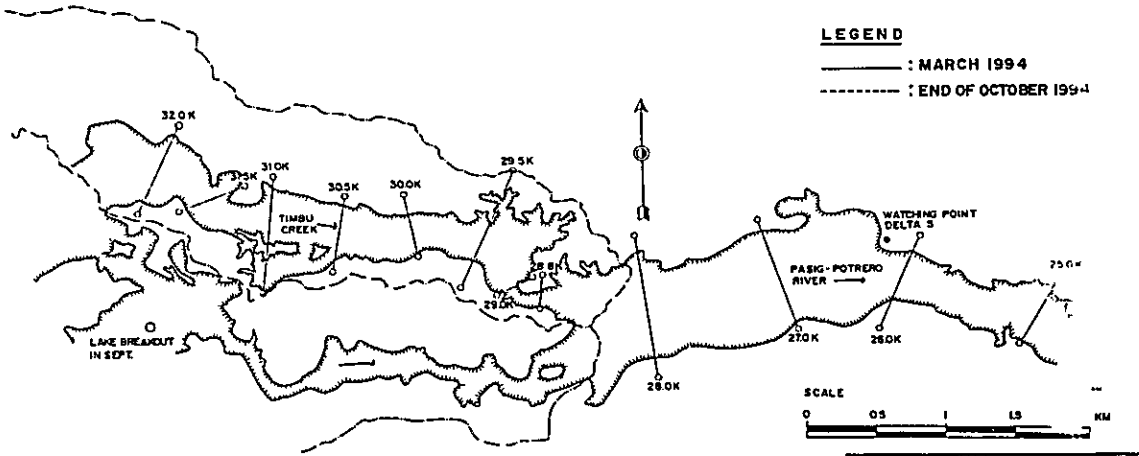

Figure 3.7.3 Sediment Deposition in Upper Reach from Watching Point Delta 5 in Pasig-Potrero

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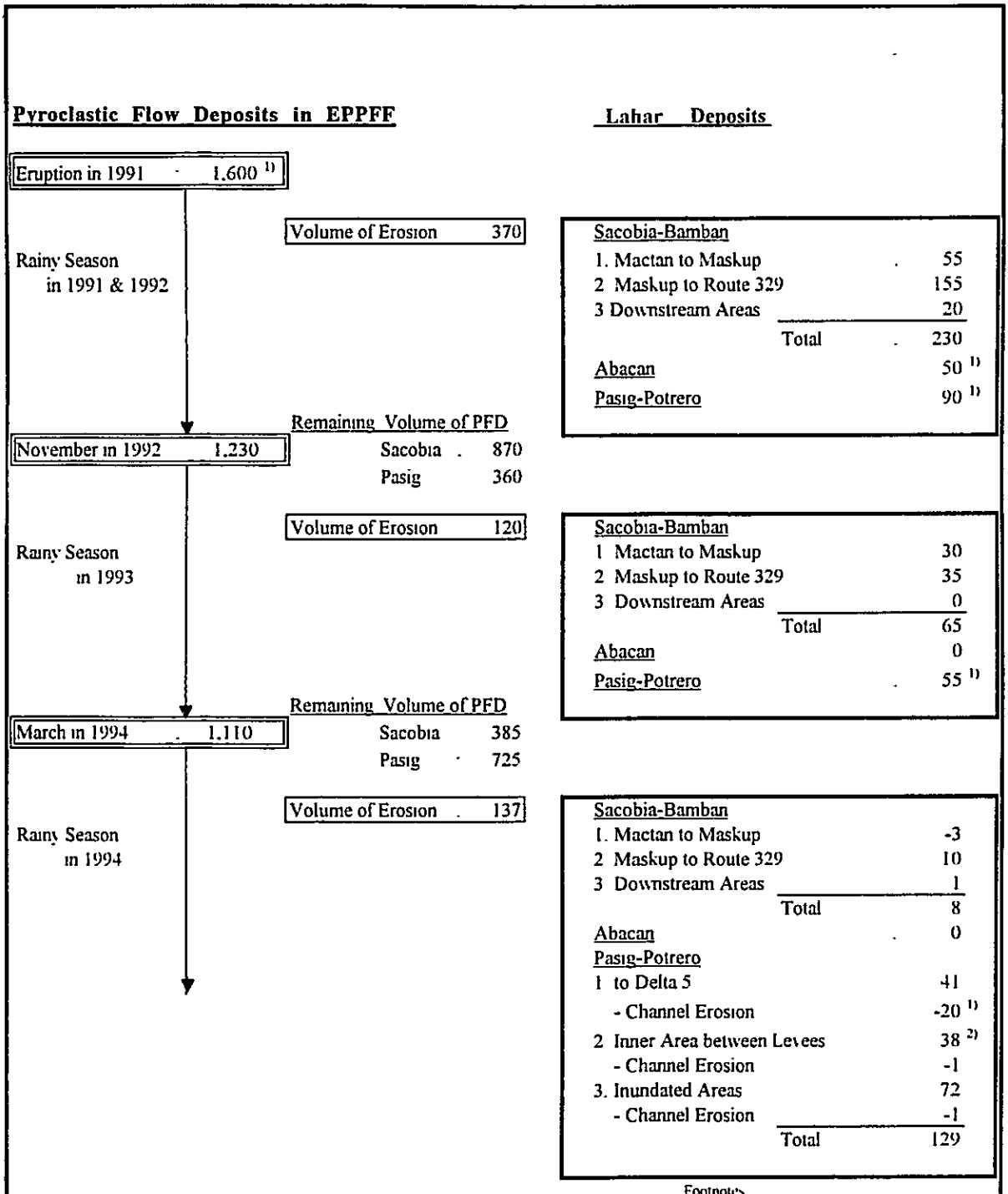

Figure 3.7.4 Volumes of Source Material, Erosion and Lahar Deposition, 1991-1994

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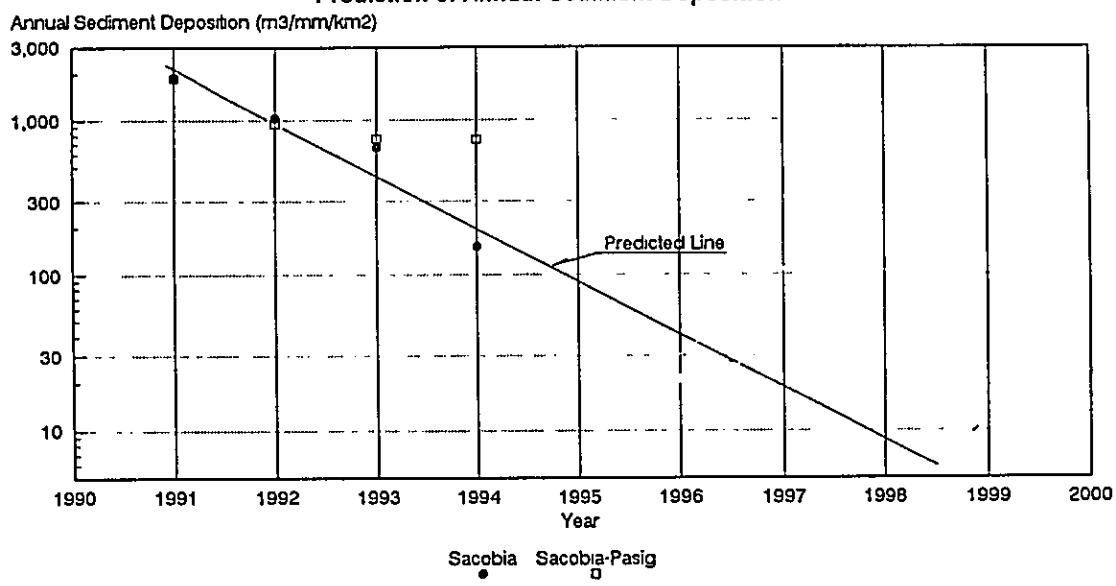

Volume of Source Material, Lahar Deposition, Rainfall and Catchment Area

Year	Volume of Pyroclastic Flow Deposits (10^6 m^3)			Volume of Lahar Deposits (10^6 m^3)				Annual Rainfall (mm)	Catchment Area of Headwaters (km^2)			Normalized Sediment Yields (m^3/mm/km^2)		
	Sacobia-Abacan	Pasig	Total	Sacobia	Abacan	Pasig	Total		Sacobia	Pasig	Total	Sacobia	Pasig	Total
1991	1,100	500	1,600	150	50	50	250	2,250	35.3	24.5	59 8	1,889	907	1,858
1992	-	-	-	80	0	40	120	2,000	38 8	24.2	63 0	1,031	826	952
1993	870	360	1,230	65	0	55	120	2,500	38 8	24 2	63.0	670	909	762
1994	385	725	1,110	8	0	129	137	2,900	18 0	45 0	63.0	153	989	750

Note 1) Volume of pyroclastic flow deposits and lahar deposits is obtained by combination of PHIVOLCS-USGS & DPWH data and the results of the Study

2) Annual rainfall from 1991 to 1993 is refered to PHIVOLCS-USGS data, the value of 1994 is refered to PHIVOLCS observation data at Upper-Sacobia gauge

Prediction of Lahar Deposits from P.F.D in Sacobia River

Year	Volume of Lahar Deposits (10^6m^3)	Accumulation Volume(10^6m^3)
1995	4.1 (8.9)	4.1 (8.9)
1996	1.8 (4.0)	5.9 (12.9)
1997	0.9 (1.8)	6.8 (14.7)
1998	0.4 (0.9)	7.2 (15.6)
1999	0.4 (0.9)	7.6 (16.5)
2000	0.4 (0.9)	8.0 (17.4)

Note Values in the parentheses show the case of recapturing the headwaters by the Sacobia River.

Figure 3.7.5 Prediction of Annual Sediment Deposits from Pyroclastic Flow Deposits

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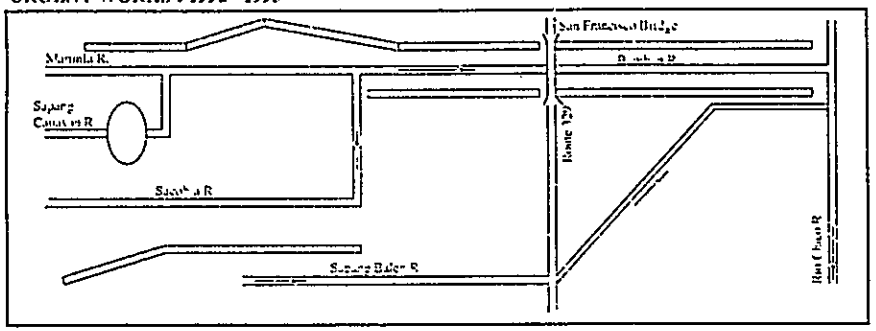
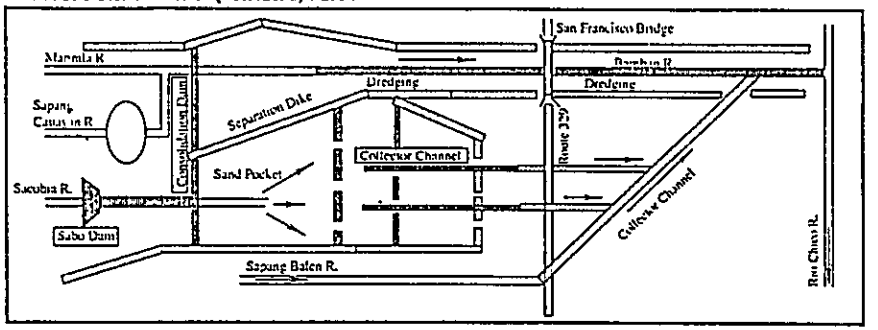
Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

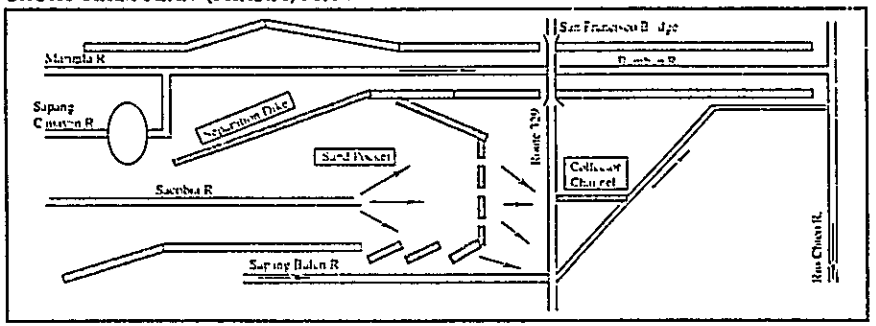
URGENT WORKS : 1992 - 1993



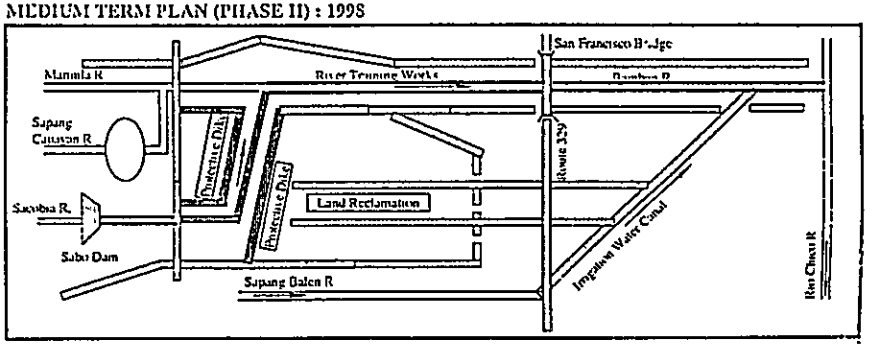
MEDIUM TERM PLAN (PHASE I) : 1997



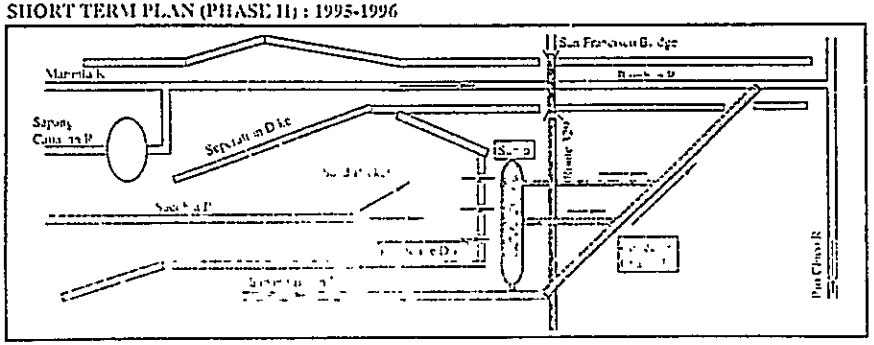
SHORT TERM PLAN (PHASE I) : 1994



MEDIUM TERM PLAN (PHASE II) : 1998



SHORT TERM PLAN (PHASE II) : 1995-1996



LONG TERM PLAN : 1999 -

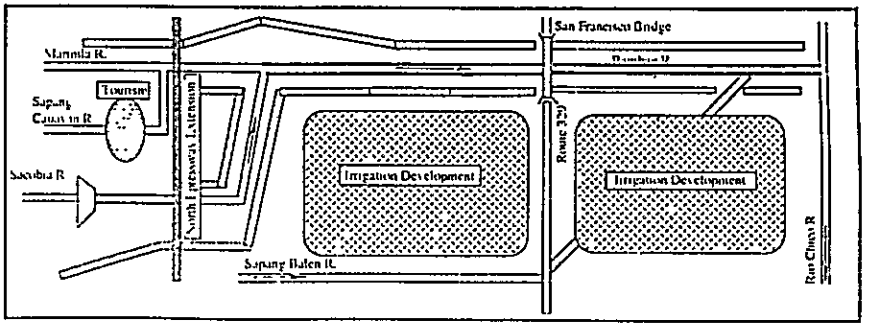


Figure 3.8.1 Phase Development Plan in the Sacobia-Bamban River

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JAPAN INTERNATIONAL COOPERATION AGENCY

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

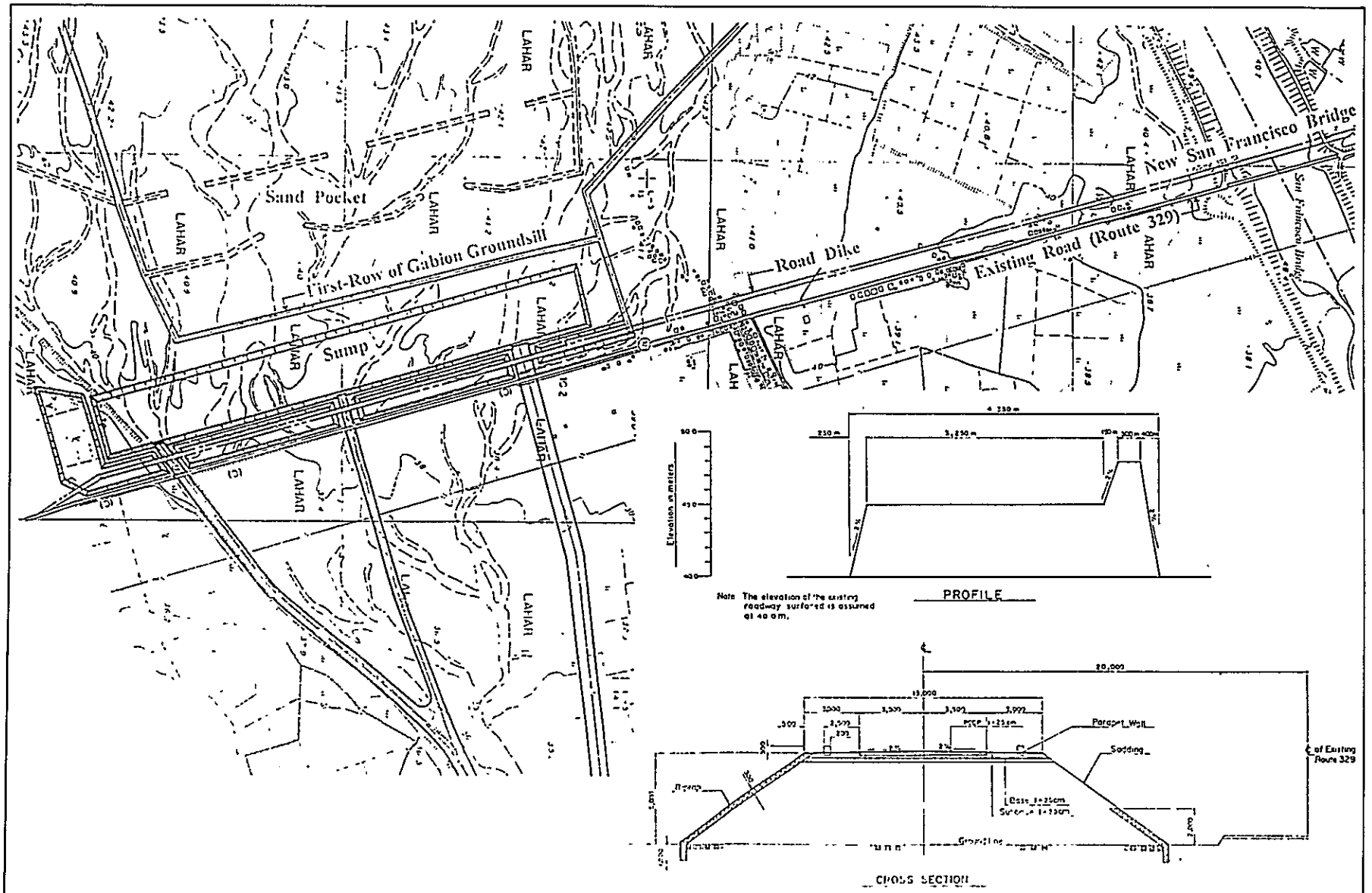
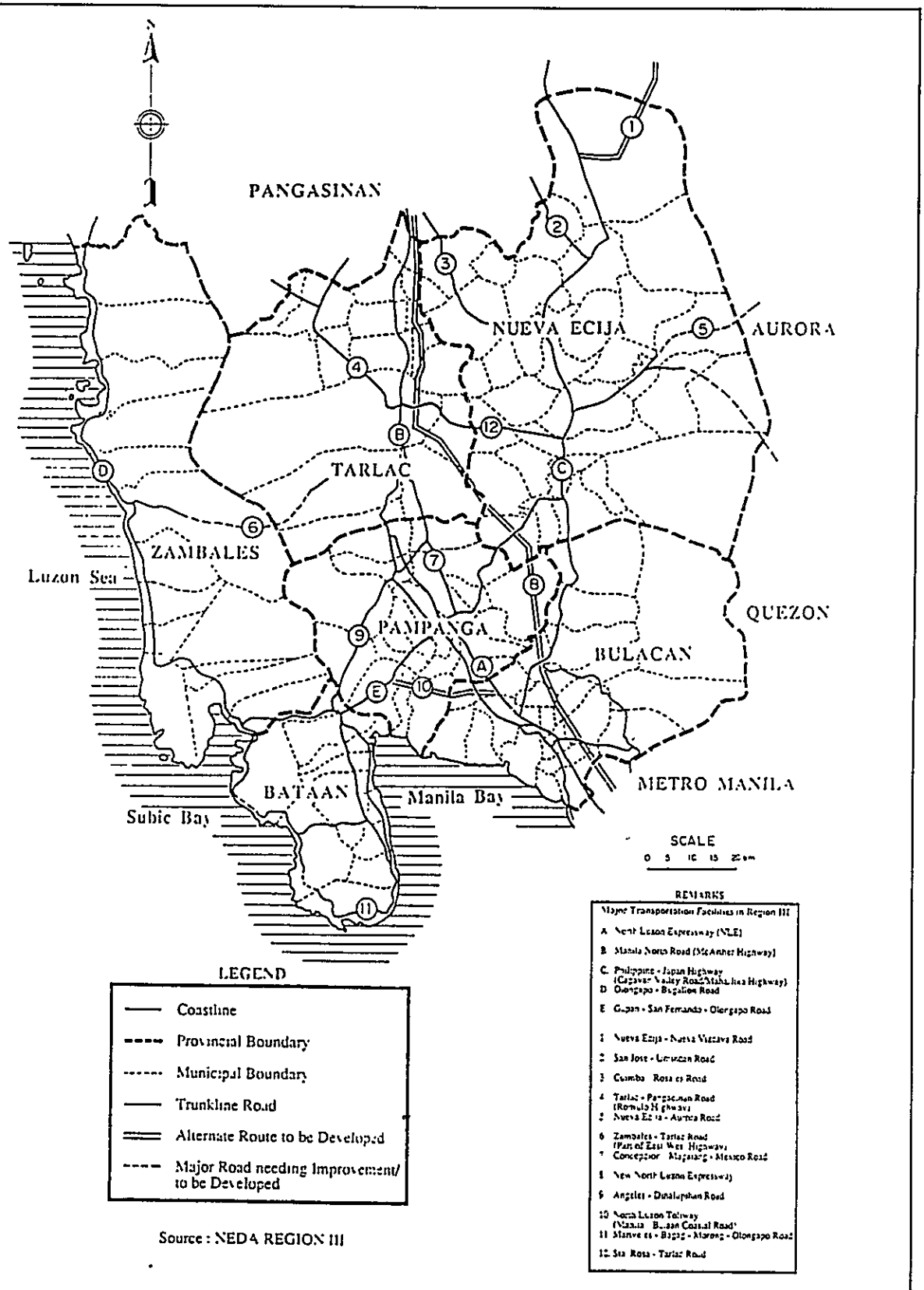


Figure 3.8.2 Preliminary Plan of Road Dike of Route 329 Highway

Sources: **The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)**



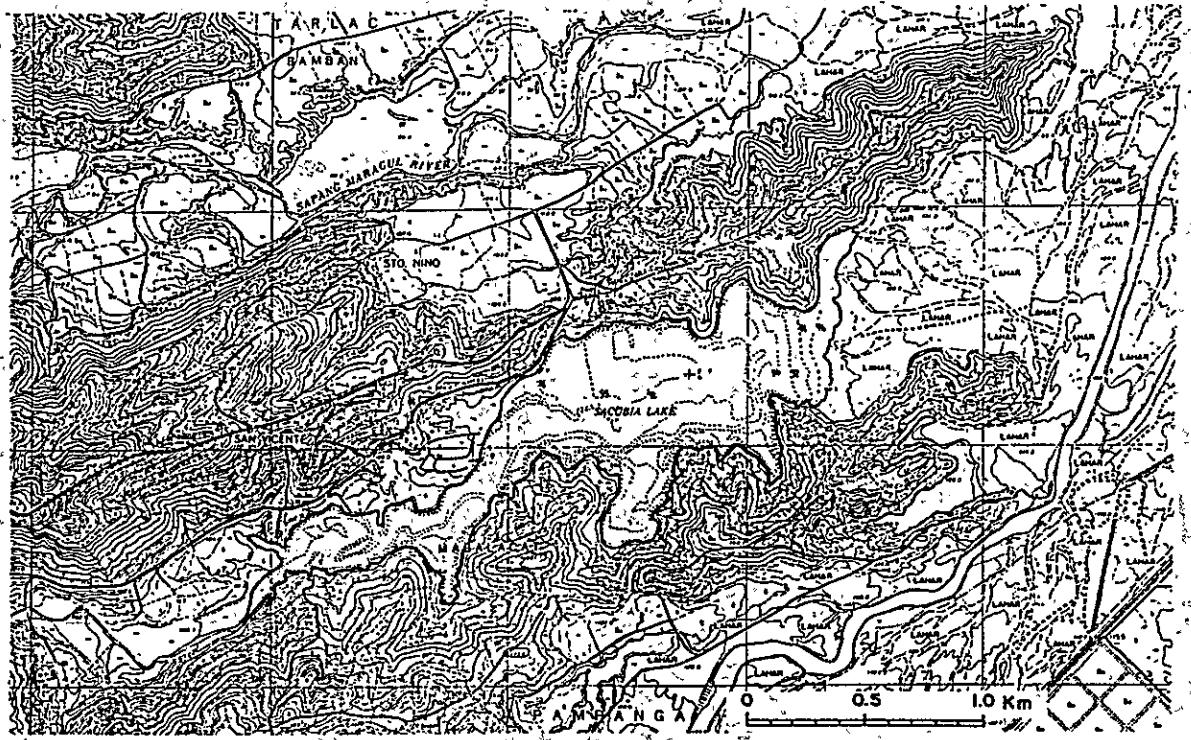
Source : NEDA REGION III

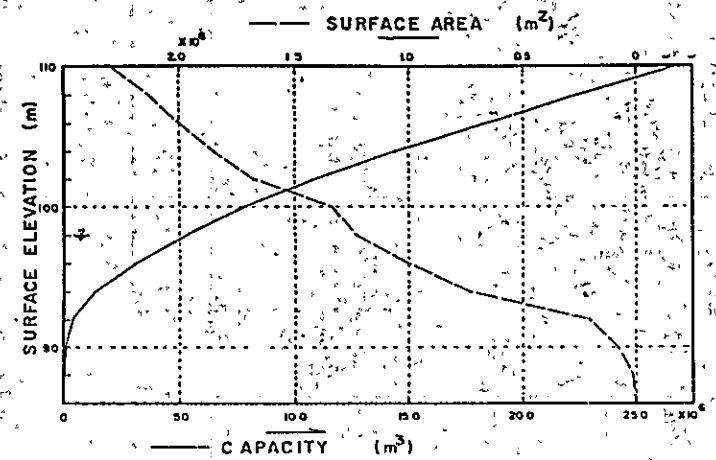
Figure 3.9.1 Road Network Plan

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

Sources: The Study of Flood and Mudflow Control for Sacobia-Bamban/Abacan River Draining from Mt. Pinatubo, Progress Report (2)

Figure 3.9.2 Location Map of Dammed Lake at Sapang Cauayan River





SURFACE ELEVATION (m)	SURFACE AREA (m^2)	C APACITY (m^3)
110	2 299 x 10^6	26.819 x 10^6
108	2.132 x 10^6	22.366 x 10^6
106	2.002 x 10^6	18.234 x 10^6
104	1.847 x 10^6	14 405 x 10^6
102	1.679 x 10^6	10.879 x 10^6
100	1.336 x 10^6	7.864 x 10^6
98	1.225 x 10^6	5.303 x 10^6
96	1.001 x 10^6	3.077 x 10^6
94	0.737 x 10^6	1.339 x 10^6
92	0 210 x 10^6	0.392 x 10^6
90	0.077 x 10^6	0 105 x 10^6
88	0 014 x 10^6	0.014 x 10^6
86	0	0

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Acknowlegment

While no man-made structure in the world could possibly prevent any natural disaster from occurring, at least timely and well-conceived man-made measures and structures could help mitigate the effects of such disasters.

This publication therefore is an attempt to document to the extent possible past and current efforts, as well as future plans, both in the Philippines and in Japan, in minimizing the catastrophic effects of volcanic and other geologically induced disasters.

For sure, the preparation and completion of this publication was not an easy task. And it would not have been possible without the unstinting support, cooperation and assistance of the people and agencies who have all helped in putting this together.

I am particulary indebted to both the Philippine Department of Public Works and Highways (DPWH) and the Japan International Cooperation Agency (JICA) for the opportunity to serve in the Philippines as JICA Sabo Expert. I am especially grateful and proud to have worked with their very highly professional officials and personnel, as well as those of the other government departments and agencies which I have dealt with during my two-year-and-three-month assignment in the Philippines. I would like to especially mention Undersecretary Teodoro Encarnacion and Assistant Secretary Manuel M. Bonoan of the DPWH for their assistance and support.

Last, but not least, I would like to express my sincerest thanks and gratefulness to the Filipino and Japanese peoples whose hardy and deep faith in themselves amid life's difficulties and natural disasters have inspired me no end. To them I dedicate this work.

Hiroyuki Ohno

HIROYUKI OHNO
JICA Sabo Expert

Manila, Philippines
March 1995