(5) Increase in the employment opportunity during the construction period (750 workers annually on the average, 1,250 workers at the maximum) which will raise income in the project area and contribute to regional economic expansion.

(6) Transfer of knowledge to the Philippine staff through the project execution, particularly in the field of Sabo engineering.

(7) Pioneer effect that the Sabo works of the project would be a forerunner of coming Sabo projects in the Philippines and all the planning procedure, construction techniques and the control effect of the Sabo works would be fully utilized for them.

8.3 Project Evaluation

8.3.1 Economic Cost

The economic project cost is obtained by deducting taxes and duties levied on the project inputs from the financial project cost given in Chapter VII COST ESTIMATE. Taxes and duties on major construction machinery and materials required for the project execution were assumed at 50% for steel bar and steel pipe and 40% for construction machinery.

Economic cost for Sabo dams were, thus estimated at P127.6 million and that for river improvement works at P90.9 million, totalling P218.5 million. The breakdowns of the economic costs for Sabo dams and river improvement works are given in TABLE III-5 and TABLE III-6 respectively. The annual disbursement schedule of the project cost is shown in TABLE III-7.

8.3.2 Evaluation

Internal rate of return of the project was calculated on the basis of the estimated direct benefit, the economic cost and operation and maintenance cost of the project assuming that the full benefit will be attained after the completion of the river improvement works except the incremental benefit and that the economic life of the project is fifty (50) years after all the sabo works are completed. The estimated IRR is relatively low of 4.5% as shown in FIGURE VIII-2.

However, as mentioned earlier, the effect of the flood control and Sabo project will have substantial beneficial influence to the regions such as indirect and intangible ones and the estimated direct benefit for IRR calculation is only a part of them. Under this situation, if the feasibility of this kind of project is judged by IRR alone, it would lead to misallocation of the resources, allocating the fund only for such projects as serve for particular objectives with relatively large direct returns.

Especially, in due consideration of the fact that the relatively undeveloped present condition of the project area has come mainly from lack of the agricultural infrastructure caused by the flood and sand sedimentation, the execution of this project will promise to bring the substantial benefit to the region. Namely, the project execution would relieve the project area from flood and sedimentation damage and thus raise the agricultural production potential in the region. On the other hand, the flood control will facilitate the agricultural development in the next stage by introducing more intensive irrigation. The agricultural development thus attained might induce the growth of the agro-based industries and stimulate the regional economy.

Although the calculated IRR is relatively low, it is considered that the project implementation can be justifiable from economic point of view taking into the beneficial effects mentioned above.

From the financial viewpoint, the annual fund requirement for the project construction would range from P2.5 million to P38.8 million or P15.7 million on the average, which is equivalent to 3% of the national budget of P520 million annually allocated for flood control and the drainage projects during the Five-Year Development Period. But the fund required for the project during 1978-1982 is around P124.9 million, which corresponds to about 84% of the allocated amount for the whole Pampanga River Control System including the Pasig-potrero flood control works during the same period. It is, therefore, strongly recommended that the additional financial arrangement be made for the successful implementation of the project.

IX CONCLUSION AND RECOMMENDATION

9.1 Conclusion

1. This project was planned to mitigate the damages in the project area due to flood and sediment flow and to establish a future development base of this area. In planning the project, Sabo plan and river improvement plan was schemed as a combined project considering that although it may be theoritically possible to treat sediment flow discharged from the Pasig-potrero river, which has a large sand producing resourses at upper reaches, only by the river improvement works, it is not a fundamental means of settling a trouble from an engineering viewpoint as risk of levee break and overflow will ever remain.

2. The Sabo plan was schemed to arrest and control the discharged sediment of about 1,849,000 m^3 at the confluence of the Pasig-potrero river and the Timbu creek (Sub-control point) taking the past maximum flood discharge sediment volume as an objective volume to be treated. It was planned to arrest and control the discharged volume of about 1,014,000 m^3 out of 1,849,000 m^3 with 10 numbers of concrete dam located in the Bucbuc creek, Papatac creek and Timbu creek under the principle that the discharged sediment be treated in the mountain region as much as possible. Then, the remaining sediment volume of about 835,000 m^3 was planned to be controlled by a sand arresting basin located in the alluvial fan and the downstream river course.

3. For the river improvement plan, after reviewing the BPW plan, design flood discharge of 900 m^3/s at Mancatian (return period of 80 years) was justified as a reasonable one and applied to this project. Then all the downstream river channel was planned to have a composite cross section enough to discharge the design flood. The levees were located at all along the river course and the riverbed consolidation works, groynes and drainage facilities were planned to be provided at the places required.

4. Taking into consideration the conditions of project area and speciality of each work, the construction period of 15 years for the Sabo works and 5 years for the river improvement works were recommended. The required construction cost of the Sabo works and the river improvement works were estimated at P 138 million and P 97 million respectively, which totaled P 235 million. The operation and maintenance cost after completion of the project was estimated at P 0.6 million per annum.

5. The direct economic benefit expected from the implementation of this project was estimated at P 4.6 million per annum for flood control effect and P 7.3 million per annum for agricultural production increase, totalling P 11.9 million. Internal economic rate of return was calculated at 4.5% from the direct benefit and the economic construction cost of the project.

6. Though the internal economic rate of return is not so high, the feasibility of the project inplementation cannot be judged only by the rate if special characteristics of this project is taken into consideration. The project will bring about the indirect and intangible benefits which is larger than the tangible direct benefits, such as i) promotion of regional economy, ii) increase in the employment opportunity, iii) prevention of the loss of human life, iv) elimination of local social unrest, v) contribution to improved income distribution in the region and, vi) transfer of technical knowledge. Especially, stabilization of an agricultural land will make possible rapid progress of agriculture at the coming stage including the irrigation plan, giving a big impact for regional economic development through this. Taking into account these factors, implementation of this project will be satisfactorily justified.

9.2 Recommendation

General

It is strongly recommended that the flood control and Sabo project shall be implemented in early time in accordance with the implementation schedule taking into consideration the effect on regional society and economy. This project shall be executed under long-term and overall plan and view.

The project shall be designed to fit each project component in due consideration of the local conditions such as hydrology, topography and geology because there is no general standard applicable to every component. Moreover, for execution of this project the effect of the facility and structure already constructed and their influence shall be carefully observed, through which the most effective facility will be installed step by step.

Therefore, continuous and appropriate maintenance and management for the completed facilities and structures are necessary. At the same time, the observation works on the natural phenomenon in the project area shall also be carried out as mentioned below.

Observation and Measurement

1. Observation and measurement of topography and sand discharge conditions

To take aerial photographs (1/10,000 - 1/15,000) covering the whole Pasig-potrero basin with the interval of once every 3 years and also after every big flood and prepare a plan in scale of 1/5,000.

To carry out a river cross section survey (200 m interval) every year on the mountain region and the alluvial fan including the river course.

Using the above data, the river condition and movement of the sand from the mountain region to the river course can be grasped accurately, and then balance of the flowing sand can be calculated, which is most important for Sabo facility and river improvement works.

2. Observation and measurement of hydrology

In addition to the observation of hourly and daily rainfall at the existing rainfall observatories, periodical observation of the water level all through the dry and rainy seasons at the following existing water level observatories are recommended.

Water level Observatory	River
Der Carmen	Porac river
Verdez	- do -
HDA Dolores	Pasig-potrero river
Cabetican Bacolor	- do -
Mancatian bridge No.1	- do -
Sapan Labuan, Guagua	Guagua river
San Fernando, Minalin	- do -

Besides, it is desirable to establish new water level observatories at Mancatian bridge No.2, Sta. Barbara bridge (Olongapo - Gapan Road) and San Miguel bridge (San Fernando - Bataan Boundary Road) to grasp the runoff mechanism of the Pasig-potrero river by accurate observation at the consistent observatory network on the river. It is also necessary to research and measure the relation between the observation results of water level at Sapan Labuan, Guagua and San Fernando, Minalin and tide height in Manila bay.

Construction of the Facilities

1. Implementation plan

Regarding the Sabo facilities, No.5 dam on the Timbu creek is recommended to be constructed first of all taking into account the topographic and sediment condition, where flowing sand is relatively plenty for its catchment area. In succession, No. 4-A dam on the Buobuc creek where the largest amount of flowing sand exits will be implemented. The construction of No.3 dam on the Papatac creek and the river bed consolidation works in the lower reaches will follow.

River improvement works shall be implemented in conformity with the basic river improvement plan. The portions heavily damaged by floods such as the right side levee, especially just downstream of Mancatian bridge, and the parallel levee at Balas and up and down stream of the existing bridges shall be executed first.

Moreover, it shall be noted that every structure shall be constructed continuously until its completion to avoid destruction during execution by floods. It is also desirable to execute a main structure and the related structures simultaneously to avoid such damages.

2. Construction materials

A rocky hill consisting of Hornblends Andesite is situated north west of Dolores village which is the only available site for gravel and rock quarry site found so far in the Pasig-potrero river basin. If test drilling and other sufficient investigation reveals that the site is suitable, the following items shall be studied extensively.

- Removal and waste pile of overburden
- Height and layout of cutting bench
- Excavation and blasting method
- Loading and transportation method
- Machinery and equipment to be used

If the available volume of gravel is insufficient, a concrete block manufactured from the selected river bed material may be taken into consideration for the protecting materials of levee slope surface.

For collection of the river bed material, it is important that, the present collecting method which has been carried out at random shall be forbidden, and the collecting place shall be designated within the river in accordance with the river course plan and sand arresting basin plan.

3. Machinery and equipment for construction and labor force

Number and capacity of the heavy machinery employed for the present Pasig-potrero river improvement works are not considered sufficient. Therefore, it will be required to arrange necessary number of the larger capacity machinery to proceed the project in accordance with the schedule recommended in this report. It is also essential to arrange the necessary spare parts for the heavy machinery to increase actual working hours of the heavy machinery to the utmost.

As for labor force, local labor force shall be employed as much as possible from a regional economic viewpoint, and the opportunity is widely found in the construction of Sabo dams, revetment works, groyne works, etc.

TABLE III-1 RETURN PERIOD OF RAINFALL

Station	Rainfall	Return Period (T:Year) T=2	5	10	20	50	100	Remark
Porac	Daily	150	230	280	340	410	470	
	3-Days	270	430	560	700	900	1050	
	Monthly	470	880	1200	1600	2200	2700	
Clark Field	Daily	140	220	275	330	410	470	
	3-Days	240	410	510	690	900	1050	
	Monthly	400	770	1100	1500	2100	2700	

TABLE III-2 RAINFALL IN MAIN FLOODS

Floods	Rainfall	Sta. Cruz Porac Date	(mm)	Clark Air Base Date	(mm)	Remarks
May, 1966	Daily			5/19	279.9	
	3-Days			5/18 - 5/20	472.4	
	5-Days			5/18 - 5/22	533.4	
	7-Days			5/18 - 5/24	557.8	
Sept.,1970	Daily	9/1	157.7	9/1	222.0	
	3-Days	8/31 - 9/2	269.1	8/31 - 9/2	356.4	
	5-Days	8/30 - 9/3	284.6	8/21 - 9/4	511.3	
	7-Days	8/28 - 9/3	376.1	8/30 - 9/5	528.1	
July, 1972	Daily	7/18	269.4	7/19	291.6	
	3-Days	7/18 - 7/20	697.2	7/18 - 2/20	734.1	
	5-Days	7/17 - 7/21	927.2	7/11 - 7/21	912.9	
	7-Days	7/17 - 7/23	1007.7	7/17 - 7/23	938.8	
Aug., 1974	Daily	8/16	154.6			
	3-Days	8/15 - 8/17	389.1			
	5-Days	8/14 - 8/18	477.8			
	7-Days	8/14 - 8/20	502.8			
May, 1976	Daily	5/23	246.9			
	3-Days	5/22 - 5/24	488.6			
	5-Days	5/22 - 5/26	591.1			
	7-Days	5/21 - 5/27	725.6			

TABLE III-3 RAINFALL INTENSITY IN FLOOD 1972

Flood	June, 1972		July, 1972		Aug., 1972	
Hour	r(mm)	rt(mm/hr)	r(mm)	rt(mm/hr)	r(mm)	rt(mm/hr)
t=1 hr	42.5	42.5	37.4	37.4	24.0	24.0
2	56.5	28.3	54.0	27.0	32.0	16.0
3	60.0	20.0	62.2	22.4	43.0	14.3
4	60.0	10.0	93.0	31.0	51.0	8.5

TABLE III-4 RETURN PERIOD OF MAIN FLOODS

Floods	Rainfall	Sta. Cruz Porac			Clark Air Base		
		Date	Rainfall (mm)	Probability (1/T)	Date	Rainfall (mm)	Probability (1/T)
May, 1966	Daily				5/19	279.9	1/10.2
	3-days				5/18-5/20	477.4	1/6.2
	Monthly				5/1-5/31	813.8	1/5.6
	1-Floods				5/18-5/23	549.1	
Sept.1970	Daily	9/1	157.7	1/2.2	9/1	222.0	1/5.1
	3-days	8/31-9/2	269.1	1/8.2	8/31-9/2	356.4	1/36
	Monthly	9/1-9/30	257.1	1/1.3	9/1-9/30	451.5	1/2.3
	1-Floods	8/30-9/3	366.4	1/2.5	8/31-9/5	524.7	
July,1972	Daily	7/18	269.4	1/8.3	7/19	291.6	1/11.1
	3-days	7/18-7/20	697.2	1/20.0	7/18-7/20	734.1	1/25.0
	Monthly	7/1-7/31	2274.5	1/55.6	7/1-7/31	2267.0	1/62.5
	1-Floods	7/16-7/21	970.2	1/65.0	7/17-7/21	913.0	
Aug.1974	Daily	8/16	154.6	1/2.1			
	3-days	8/15-8/17	389.1	1/3.8			
	Monthly	8/1-8/21	665.6	1/3.3			
	1-Floods	8/14-8/18	477.8	1/4.8			
May, 1976	Daily	5/23	246.6	1/5.9			
	3-days	5/22-5/24	488.6	1/6.2			
	Monthly	5/1-5/31	869.2	1/5.0			
	1-Floods	5/19-5/27	804.6	1/25.0			

Note: Only the precipitation more than 10mm is considered as one flood rainfall.

TABLE III-5 RESULT OF RUN-OFF ANALYSIS

Points	Case A	Case B	Case C	Case D	Case E	Case F
No.5 DAM	160 m3/s	190 m3/s	280 m3/s	190 m3/s	261 m3/s	98.6 m3/s
No.4	300	320	510	380	382	196
No.3	430	420	580	480	476	292
No.2	480	500	620	540	516	317
No.1	600	620	640	630	610	423
Mancatian	900	900	850	900	835	704

Case A : from B.P.W. Form ($Q = 155A/\sqrt{A + 13}$)

Case B : from Discharge Record

Case C : from Dr. Mononobe Method

Case D : from Porac Rainfall Record

Case E : from Run-off Eq. proposed by M.M Obradorich
($Q = 126\ A^{\frac{1}{2}}$, for Pampanga Basin, A > 100 km2)

Case F : from Run-off Eq. proposed by M.M. Obradorich
($Q = 225A\ 1.1A^{-0.05}-1$, for All Philippines, A < 100 km2)

TABLE TII-6 AVERAGE YEARLY DEBRIS PRODUCTION

1) Bucbuc creek basin

Waste type	Area (m2)	Denudation rate (m/yr)	Produced debris Volume (m3/yr)
I-a	395,000	0.500	197,800
I-b	187,400	0.200	37,500
II	402,200	0.020	8,000
III	1,769,000	0.010	17,700
IV	380,000	0.001	400
V	5,323,200	0	0
River bed	1,042,000		
Total	9,500,000		261,400

2) Yangca creek basin

Waste type	Area (m2)	Denudation rate (m/yr)	Produced debris volume (m3/yr)
I-a	0	0.500	0
I-b	13,500	0.200	2,700
II	800	0.020	0
III	354,700	0.010	3,500
IV	0	0.001	0
V	4,211,000	0	
River bed	19,900		
Total	4,600,000		6,500

2) Papatac creek basin

Waste type	Area (m2)	Denudation rate (m/yr)	Produced debris Volume (m3/yr)
I-a	9,300	0.500	4,700
I-b	1,300	0.200	300
II	41,000	0.020	800
III	313,000	0.010	3,100
IV	338,000	0.001	300
V	2,163,700	0	0
River bed	333,700		
Total			9,200

4) Timbu creek basin

Waste type	Area (m2)	Denudation rate (m/yr)	Produced debris volume (m3/yr)
I-a	33,700	0.500	16,900
I-b	32,300	0.200	6,500
II	59,100	0.020	1,200
III	2,596,300	0.010	26,000
IV	252,000	0.001	300
V	1,400,300	0	0
River bed	326,300		
Total	4,700,000		50,900

b) Total area $\frac{327,700\ m^3/year}{(14,900\ m3/km2/year)}$

TABLE III-7 LAND USE

Land Category	Area (Ha)
Agricultural Land	11,950
Paddy field	
- Rain-fed	(1,330)
- Irrigated	(2,220)
Upland field	(5,780)
Others (Fruits, Bamboo)	(870)
Fallow/waste	(1,750)
Fishpond	1,190
Village Yard	2,030
Public Land	570
Forestry	7,800
Total	23,540

TABLE III-8 FARMGATE PRICE OF RICE
(Central Luzon)

(Peso per kg)

Year	Fancy	Ordinary
1971	0.653	0.612
1972	0.698	0.651
1973	0.774	0.745
1974	1.065	0.982
1975	1.120	0.999
1976	1.116	1.053

Source: Bureau of Agricultural Economics, Department of Agriculture

TABLE III-9 RETAIL PRICE OF RICE
(Pampanga Province)

(Peso per kg)

Year	Fancy	Ordinary
1973	0.631	0.625
1974	0.990	0.998
1975	1.170	0.916
1976	1.214	1.082
1977	1.299	1.107

Source: Bureau of Agricultural Economics, Department of Agriculture

TABLE III-10 PRICE OF SUGAR (BROWN) PURCHASED BY PNB

Year	Peso per picul /1	US dollar per ton
1974 - 75	134.43	287.2
1975 - 76	105	224.3
1976 - 77	81	173.1
1977 - 78	90	192.3

Source: Integrated Sugar Central Company Incorporation (ISCCO)

/1: One picul = 63.25 kg

TABLE III-11 MAJOR CROP PRODUCTION

Crops	Planting area(ha)	Unit Yield (ton/ha)	Production (ton)
Paddy (Irrigated)			
1st Paddy	2,820	3.78	10,660
2nd Paddy	1,640	3.78	6,200
3rd Paddy	370	3.78	1,400
(Sub-total)	(4,830)		(18,260)
Paddy (Rain-fed)	730	2.46	1,800
Total	5,560		20,060
Sugar Cane	5,610	34.0	189,800

TABLE III-12 GROSS AND NET VALUE OF AGRICULTURAL PRODUCTS PER YEAR

(P x 10³)

Crops	Value	Value
Sugar cane	51,250	31,610
Rice	23,060	12,850
Secondary crops (Mango-bean)	430	280
Upland crops (Maize)	130	70
Total	74,870	44,810

TABLE III-13 FARM BUDGET

(P/Household)

Description	Agricultural Block III	Agricultural Block V
(1) Gross income /1	17,240	3,470
(2) Production cost	6,890	1,540
(3) Net income (1)-(2)=(3)	10,850	1,930
(4) Financial outgo /2	4,610	2,400
(5) Net reserve (3)-(4)=(5)	6,240	- 470

/1: Includes agricultural credits for farm operation.

/2: Land rent, debt re-payment, living allowance, etc.

TABLE III-14 24 HOUR TRAFFIC ESTIMATES PER AVERAGE WEEKDAY PER STATION BY TYPE OF VEHICLES

Location	OPV	BV	Truck	Total
Cutcut, Angeles City	2,265	2,286	1,622	6,173
San Antonio, Bacolor	202	165	51	418
Pulung Santor, Porac	176	150	106	432
Dolores, San Fernando	6,360	5,258	3,875	15,493
San Juan, San Fernando	28	79	10	117
San Matias, Guagua	313	404	85	802
Cabetican-Bacolor	2,714	2,664	1,628	7,006
Bancal, Guagua	681	1,101	155	1,937

OPV : Other Passenger Vehicle
BV : Bus

TABLE III-15 BRIDGES ON THE MAIN PROVINCIAL ROADS

Road	KM	Type of structure	Length (m)	Width (m)	Remarks
Bacolor-Angeles Road	77.78	Bailey	6.70	3.80	Needs Repair
	84.85	R.C.D.G	19.50	6.80	
Bacolor-Sta.Rita Road	72.73	-"-	6.00	6.00	
	76.77	-"-	6.40	6.80	
	77.78	-"-		6.80	
Bacolor-Porac Road	72.73	-"-	4.90	8.30	
	73.74	-"-	4.10	6.20	
	74.75	-"-	4.20	7.30	
	76.77	-"-	6.80	4.20	
	76.77	-"-	9.10	4.30	
Suagua-Sta. Rita -Porac Road	77.78	-"-	23.80	6.90	Needs Repair

TABLE III-16 DRAINAGE FACILITIES

Name of Road & Distance, m	Drainage Facilities			Remarks
	Bridge	Concrete Pipe	Concrete Box	
Manila North Road (66,232-79,635)	2	24 ϕ1.50m-0.60m	2 W.1.00m-0.60m	
San Fernando-Bataan Baundary Road (66,322-79,307)	12	5 ϕ1.00m-0.60m	50 W.2.95m-0.60m	
Angeles-Porac Road (85,422-92,215)	6	13 ϕ1.00m-0.60m	3 W.1.80m-1.00m	
Olongapo-Gapan Road (67,751-79,985)	6	34 ϕ1.50m-0.75m	33 W.1.50m-0.75m	

TABLE III-17 INUNDATION AREA

(ha)

Description	1966	1972	1974	1976	1977
Gross flooded area	5,090	5,500	4,940	3,020	3,980
Area by inundation period					
- short duration	1,490	70	1,970	-	1,410
- medium duration	2,350	470	1,720	1,760	1,400
- long duration	1,250	4,960	1,250	1,260	1,170
Area by inundation depth					
- shallow	-	450	1,500	220	-
- moderate	3,840	90	2,190	2,550	2,810
- deep	1,250	4,960	1,250	250	1,170
Area affected by sand sediments					
- thin sand	1,540	450	930	530	220
- rather thick sand	1,030	150	-	160	190
- thick sand	-	2,310	-	-	-

TABLE III-18 FLOODED AREA BY LAND USE

(ha)

Land Use	1966	1972	1974	1976	1977
Paddy field	4,160	3,690	2,830	2,100	2,830
Upland field	70	70	70	70	70
Fishpond	390	540	1,190	540	540
Village yard /1	470	1,200	850	310	540

/1 Includes roads and other public facility yards.

TABLE III-19 CROP DAMAGE

Crop Production	1966	1972	1974	1976	1977
Paddy in normal condition (tons)	8,310	8,490	10,770	4,620	6,420
Paddy damaged by flood (tons)	3,170	7,550	3,120	2,420	2,140
(damage rate: %)	(38.1)	(88.9)	(29.0)	(52.4)	(33.3)
Damage value of paddy ($P10^3$)	3,650	8,680	3,590	2,780	2,460

TABLE III-20 DAMAGE ON AGRICULTURAL FACILITIES

Description	1966	1972	1974	1976	1977
Farm land damaged					
- Seriously eroded (ha)	230	370	250	230	190
- Partially eroded (ha)	390	500	550	440	340
Irrigation canal damaged					
- Seriously eroded (km)	6.4	19.1	3.4	4.0	4.1
- Partially eroded (km)	14.1	33.0	10.9	7.9	10.5
Farm rods damaged					
- Seriously eroded (km)	1.3	7.1	0.5	0.8	0.5
- Partially eroded (km)	3.1	11.9	2.3	1.8	1.5
Major structure damaged					
- Bridges (Nos.)	5	13	2	0	0
- Curverts (Nos.)	14	31	5	5	3
Damage value ($P10^3$)	460	920	490	430	360

TABLE III-21 ADDITIONAL EXPENDITURE FOR CROP PRODUCTION

(P10^3)

Description	1966	1972	1974	1976	1977
Re-transplanting	1,240	-	-	340	20
Other additional works	200	-	-	100	80
Total	1,440	-	-	440	100

Note: No additional works were done in 1972 and in 1974 since the crops were at the stages of young panicle formation and maximum tillering at the time of flooding.

TABLE III-22 DAMAGE ON LAND ARABILITY AND PRODUCTIVITY

Description	1966	1972	1974	1976	1977
Damaged land (Paddy field)	2,570	2,910	930	520	360
- Transformed into waster land (ha)	0	1,080	0	0	0
- Transformed into upland crop field (ha)	280	220	0	40	10
- Transformed into rain-fed field (ha)	1,060	1,140	0	0	0
- Lower productivity (ha)	960	470	830	520	155
Damage value (P10^3)	2,120	5,080	1,290	680	240

TABLE III-23 DAMAGE ON FISHPOND AND FISH PRODUCTION

($P10^3$)

Description	1966	1972	1974	1976	1977
Value of damages					
- Fishpond	16	474	39	-	13
- Fish production	63	517	28	80	17
Total	79	991	67	80	30

TABLE III-24 DAMAGE ON HOUSES IN 1972

Name of Affected Villages	No. of Houses	House Value	Depth Above Floor Level	Damage Rate	Damage (P)
Municipality Bacolor					
B. Balas	170	8,500	0-0.5	0.05	72,250
B. Cabambangan	170	8,500	0.5-1.0	0.07	101,150
B. Cabetican	530	16,550	0.5-1.0	0.07	614,005
B. Parulog	252	8,500	1.0-1.5	0.10	214,200
B. San Antonio	834	8,500	0.5-1.0	0.07	496,230
B. San Vicenta	899	16,550	0-0.5	0.05	743,923
Municipality of Guagua					
B. San Juan	240	8,500	0-0.5	0.05	102,000
B. San Juan Bantista	252	16,550	0-0.5	0.05	208,530
B. San Roque	350	16,550	0-0.5	0.05	289,625
Municipality of Sta. Rita					
B. San Isidro	500	8,500	0-0.5	0.05	212,500
B. San Juan	335	8,500	0.5-1.0	0.07	199,325
B. Sta Monica	300	8,500	1.0-1.5	0.10	255,000
Total Damage					P3,508,738

TABLE III-25 REHABILITATION COST FOR ROAD AND BRIDGE (1973-1975)

Rehabilitation Project	Expenditure (Pesos)
Bacolor-Angeles	403,100
Guagua-Sta. Rita-Porac	390,744
Bacolor-Porac	384,800
Bacolor-Sta. Rita	241,300
Bacolor-Porac Ph. I	161,390
Guagua-Sta. Rita	325,900
Bacolor-Porac	350,457
Total	P2,257,691

TABLE III-26 TOTAL DAMAGE BY MAIN FLOODS

(Px10^3)

Damage Category \ Main Floods	1966	1972	1974	1976	1977
1) Agricultural Production					
- Crops	3,650	8,680	3,590	2,780	2,460
- Agricultural Facilities	460	920	490	430	360
- Unexpected Farming Expenditures	1,440	-	-	440	100
- Land Arability and Productivity	2,120	5,080	1,290	680	240
- Fishpond Culture	79	991	67	80	30
Sub-total	7,749	15,671	5,437	4,410	3,190
2) Houses, Tranportation Facilities and River Structures					
- Houses	-	3,509	-	-	-
- Transportation facilities	1,200	2,300	570	n.a.	n.a.
- River Structures	n.a.	n.a.	n.a.	n.a.	n.a.
Sub-total	1,200	5,809	570	-	-
Total	8,949	21,480	6,007	4,410	3,190

TABLE IV-1 SUMMARY OF SEDIMENT RUN-OFF VOLUME

( ): Without facility

($10^3 m^3$)

Location	Volume of Production	Volume of Unstable Sand	River Control Volume	Sabo Dam Controlled Volume	Sabo Dam Retained Volume	Run-off Volume
Dam No. 4-A	(2,065) 2,065	(1,015) 921	(1,483) 1,342	440	140	(1,597) 1,064
Downstream end of Bucbuc River	(26) 26	(53)	(80)			(1,596) 1,090
Yangca River	(50) 50	(40) 35	(30) 22			(1,656) 1,153
Dam No. 3	(30) 30	(18)	(27)	120	30	(1,677) 1,033
Dam No. 2-B	(3) 3	(85) 5	(120)	100		(1,645) 941
Dam No. 2-A	(3) 3	(97) 5	(138)	120		(1,607) 829
Downstream end of Papatac River	(38) 38	(148) 148	(215) 215		19	(1,578) 781
Dam No. 5	(330) 330	(294) 194	(407) 257	267		(217) 0
Downstream end of Timbu River	(77) 77	(60) 60	(83) 83			(271) 54
Auxiliary Control Point	(2,622) 2,622	(1,810) 1,368	(2,583) 1,919	1,047	189	(1,849) 835
Planned Control Point	(1,176) 1,176	(333)	(1,063) 10	685	1,176	(2,295) 140

TABLE IV-2 SUMMARY OF SABO FACILITIES

Facility		Location	Catchment Area	Planned flood q'ty	Elements							* Distance between main and auxiliary facility					
					Height	Length of dam	Crown	Width	Depth of overflow	External slope	Internal slope	*	Apron thickness	Volume of Sedimentation	Controlled Volume	Retained Volume	Elevation of Crown
			Km^2	m^3/sec	m	m	m	m	m			m	m				EL. m
No. 1 A Ground sill	Main ground sill	26 K 498	23.5	630	7.0	194	2.0	120.0	1.65	1:0.2	1:0.6		1.5				218.0
	Auxiliary ground sill				4.0	194	2.0	120.0	1.65	1:0.2	1:0.6	14.0	1.5				214.0
	Vertical wall				4.0	194	2.0	120.0	1.65	1:0.2	1:0	14.0	1.5				213.0
No. 1 B Ground sill	Main ground sill	27 K 000	22.6	630	6.0	190	2.0	120.0	1.65	1:0.2	1:0.6		1.5				225.0
	Auxiliary ground sill				4.0	190	2.0	120.0	1.65	1:0.2	1:0.6	12.0	1.5				222.0
	Vertical wall				4.0	190	2.0	120.0	1.65	1:0.2	1:0	10.0	1.5				221.0
No. 1 C Ground sill	Main ground sill	27 K 500	22.4	630	6.0	176	2.0	120.0	1.65	1:0.2	1:0.6		1.5				232.0
	Auxiliary ground sill				4.0	176	2.0	120.0	1.65	1:0.2	1:0.6	12.0	1.5				229.0
	Vertical wall				4.0	176	2.0	120.0	1.65	1:0.2	1:0	10.0	1.5				228.0
No. 1 D Ground sill	Main ground sill	28 K 000	22.0	630	7.0	290	2.0	120.0	1.65	1:0.2	1:0.6		1.5				240.0
	Auxiliary ground sill				4.0	290	2.0	120.0	1.65	1:0.2	1:0.6	14.0	1.5				236.0
	Vertical wall				4.0	290	2.0	120.0	1.65	1:0.2	1:0	14.0	1.5				235.0
No. 2 A Dam	Main dam	28 K 895	16.8	540	15.0	63.0	2.0	46.0	3.50	1:0.2	1:0.7		2.0	380	120	0	257.0
	Auxiliary dam				7.0	58.0	2.0	46.0	3.50	1:0.2	1:0.7	23.0	2.0				247.0
No. 2 B Dam	Main dam	30 K 200	15.7	510	14.0	60.0	2.0	46.0	3.50	1:0.2	1:0.7		2.0	220	100	0	276.0
	Auxiliary dam				6.0	59.0	2.0	46.0	3.50	1:0.2	1:0.7	23.0	2.0				267.0
No. 3 Dam	Main dam	31 K 655	14.3	480	14.0	40.0	2.0	33.0	4.00	1:0.2	1:0.7		2.0	490	120	30	298.0
	Auxiliary dam				6.0	45.0	2.0	33.0	4.00	1:0.2	1:0.7	23.0	2.0				289.0
No. 4 A Dam	Main dam	32 K 902	9.2	380	15.0	38.0	2.0	25.0	4.00	1:0.2	1:0.8		2.0	370	110	30	326.0
	Auxiliary dam				7.0	36.0	2.0	25.0	4.00	1:0.2	1:0.7	23.0	2.0				316.0
No. 4 B Dam	Main dam	34 K 400	6.1	250	15.0	43.0	2.0	20.0	3.50	1:0.2	1:0.7		2.0	270	80	30	364.0
	Auxiliary dam				7.0	39.0	2.0	20.0	3.50	1:0.2	1:0.7	23.0	2.0				354.0
No. 4 C Dam	Main dam	35 K 000	5.2	220	15.0	48.0	2.0	18.0	3.50	1:0.2	1:0.7		2.0	200	80	20	399.0
	Auxiliary dam				7.0	30.0	2.0	18.0	3.50	1:0.2	1:0.7	23.0	2.0				389.0
No. 4 D Dam	Main dam	35 K 500	4.8	210	15.0	68.0	2.0	17.0	3.50	1:0.2	1:0.7		2.0	200	70	20	425.0
	Auxiliary dam				7.0	49.0	2.0	17.0	3.50	1:0.2	1:0.7	23.0	2.0				415.0
No. 4 E Dam	Main dam	36 K 200	3.8	170	15.0	65.0	2.0	14.0	3.50	1:0.2	1:0.7		2.0	150	50	20	461.0
	Auxiliary dam				5.0	42.0	2.0	14.0	3.50	1:0.2	1:0.6	23.0	2.0				447.0
No. 4 F' Dam	Main dam	36 K 550	3.0	14.0	15.0	43.0	2.0	12.0	3.50	1:0.2	1:0.7		2.0	150	50	20	503.0
	Auxiliary dam				5.0	31.0	2.0	12.0	3.50	1:0.2	1:0.6	23.0	2.0				489.0
No. 5 Dam	Main dam	1,528 m	4.7	190	15.0	31.0	2.0	20.0	3.20	1:0.2	1:0.7		2.0	900	267	0	276.0
	Auxiliary dam				6.0	34.0	2.0	20.0	3.20	1:0.2	1:0.6	23.0	2.0				266.0

TABLE IV-3 VARIED FLOW CALCULATION RESULT (1)
(PROPOSED CHANNEL)

STA	Proposed River Bed	The Top of Proposed Levee	Water Level EL. (m) Q = 120	Q = 400	Q = 520	Q = 900	Q = 1,100
0	-2.500	R = 3.50 L = (3.50)	-1.000	0.700	1.300	3.500	3.500
0.7	-2.111	3.78 (3.78)	-0.254	1.355	1.930	3.779	3.913
1	-1.914	5.40 (3.90)	-0.095	1.567	2.130	3.898	4.076
1.8	-1.500	5.64 (5.64)	0.274	1.932	2.465	4.136	4.386
2	-1.389	5.67 (5.66)	0.346	1.983	2.507	4.161	4.419
2.3	0.227	6.628	1.178	2.407	2.874	4.370	4.666
3	0.689	6.65 (6.97)	3.297	4.172	4.399	5.142	5.527
4	1.379	7.32 (7.62)	3.481	4.599	4.918	5.816	6.235
4.2	1.517	10.30 (10.30)	3.538	4.697	5.029	5.942	6.364
5	2.517	8.36 (8.36)	4.351	5.615	5.984	6.855	7.253
6	4.517	10.25 (10.25)	6.365	7.640	8.001	8.746	9.087
7	7.850	13.70 (13.53)	9.327	10.466	10.796	11.503	11.814
8	12.850	18.62 (18.43)	14.201	15.232	15.444	16.116	16.314
9	17.850	23.05 (22.58)	19.309	20.287	20.477	21.024	21.187
10	23.379	28.52 (27.92)	24.692	25.344	25.530	26.090	26.266
11	29.261	33.20 (35.10)	30.540	31.187	30.329	31.695	31.851
12	35.143	39.36 (39.44)	36.469	37.229	37.381	37.855	38.070
13	41.811	45.84 (46.57)	43.041	43.646	43.886	44.331	44.516
14	48.954	53.15 (53.15)	50.217	51.099	51.240	51.647	51.843
14.8	54.668	59.00 (60.80)	55.911	56.691	56.919	57.494	57.764
15	56.668	60.70 (61.50)	57.999	58.494	58.708	59.205	59.380
16	66.668	70.80 (70.60)	67.351	67.961	68.149	68.649	68.882
16.2	68.668	72.50 (72.50)	69.220	69.783	69.983	70.481	70.715
16.4	70.668	73.90 (73.60)	70.979	71.382	71.528	71.950	72.156
17	76.668	81.30 (81.70)	77.013	77.415	77.556	77.945	78.119
17.4	81.112	84.50 (85.30)	81.395	81.685	81.773	82.015	82.122
18	87.779	92.50 (92.30)	88.286	88.845	89.019	89.315	89.458
18.4	93.493	98.70 (98.70)	94.194	94.781	94.989	95.509	95.752
19	102.065	107.72 (105.50)	102.622	103.232	103.401	103.868	104.077

(to be continued)

TABLE IV-4. VARIED FLOW CALCULATION RESULT (2)

STA	Proposed River Bed	The Top of Proposed Levee	Water Level EL. (m)				
			Q = 120	Q = 400	Q = 520	Q = 900	Q = 1.100
19.4	107.779	114.66 (112.20)	108.219	108.750	108.929	109.313	109.488
20	115.429	125.19 (121.20)	115.623	115.862	115.945	116.172	116.277
20.4	121.143	132.45 (127.70)	121.330	121.561	121.641	121.860	121.963
21	133.567	142.64 (138.00)	134.321	135.197	135.467	136.062	136.190
21.4	140.234	149.64 (146.50)	140.969	141.855	142.124	142.572	142.809
22	150.234	160.55 (157.90)	150.995	151.905	152.213	153.023	159.849
23	166.425	178.30 (176.60)	167,631	168.709	169.072	169.651	169.926
23.4	172.774	183.77 (183.39)	174.241	174.729	174.893	175.325	175.525
24	182.294	192.11 (194.81)	183,639	184.170	184.300	184.657	184.823
24.4	188.080	198.22 (202.25)	189.203	189,971	190.151	190.618	190.837
25	196.610	216.45 (212.99)	197.275	197.801	197.985	198.320	198.474
25.4	201.360	220.83 (218.35)	202.088	202,479	202.615	202.992	203.142
26	208.800	234.72 (221.62)	209.308	209,748	209.900	210.319	210.515
26.4	213.440		214.192	214.680	214.849	215.290	215.491
27	222.370		223.038	223.573	223.759	224.270	224.508

TABLE IV-5 PROSPECTIVE LAND USE IN COMPARISON WITH THE PRESENT LAND USE

Land Category	Present Land Use (ha)	Prospective Land Use (ha)	Incremental (ha)	Extent (%)
Paddy field	3,550	4,380	830	(18.9)
a. irrigated	2,220	3,260	1,040	(46.8)
b. rain-fed	1,330	1,120	- 210	(- 15.8)
Upland field	5,780	6,030	250	(4.1)
a. sugar cane	5,610	5,610	0	(0)
b. other crop	170	420	250	(4.1)
Forest growth	0	570	570	-
Fallow or Waste	1,750	100	- 1,650	(- 94.3)
Others	870	870	0	(0)
Total	11,950	11,950	-	-

TABLE IV-6 PROSPECTIVE CROPPING PATTERN

Land Category	Cropping Pattern Wet season	Dry season	area (ha)	share (%)
Paddy field				
a. Irrigated	1. Paddy - paddy	- Paddy	730	(7.0)
	2. Paddy - 2nd crop (1/2)	- Paddy	730	(7.0)
	3. Paddy	- Paddy	1,800	(17.3)
b. Rain-fed	1. Paddy	- 2nd crop (1/2)	390	(3.7)
	2. Paddy	- follow	730	(7.0)
Upland field				
a. Sugar cane	1. Sugar cane with twice ratooning		5,610	(53.9)
b. Other crop	1. Cassava, maize, etc.		420	(4.1)
Total			10,410	(100)

TABLE IV-7 PROSPECTIVE ANNUAL GROSS PRODUCTION

Major Crops	Planting Area (ha)	Unit Field (Ton/ha)	Gross Production (tons)
Paddy			
a. first cropping irrigated	3,260	3.8	12,390
b. second cropping irrigated	730	3.8	2,770
c. third cropping irrigated	3,260	3.8	12,390
Sub-total	7,250		27,550
d. rain-fed cropping	1,120	2.5	2,800
Total	8,370		30,350
Sugar cane			
a. new planting	1,870	42.0	78,540
b. first ratooning	1,870	34.0	63,580
c. second ratooning	1,870	25.5	47,680
Total	5,610		189,800
Secondary crops	560	0.6	340
Other crops	420	1.0	420
Grand total	14,960		220,900

TABLE IV-8 INCREMENTAL GROSS VALUES AND NET VALUES OF AGRICULTURAL PRODUCT

Major Crops	Present Condition		Prospective Condition		Increment	
	Gross Values ($P \times 10^3$)	Net Values ($P \times 10^3$)	Gross Values ($P \times 10^3$)	Net Values ($P \times 10^3$)	Gross Values ($P \times 10^3$)	Net Values ($P \times 10^3$)
Paddy	23,060	12,850	34,900	19,550	11,840	6,700
Sugar cane	51,250	31,610	51,250	31,610	0	0
Secondary crops	430	280	430	280	0	0
Upland crops	130	70	310	200	180	130
Total	74,870	44,810	86,890	51,640	12,020	6,830

Note: Secondary crops and upland crops are represented by mango-bean and white-maize, respectively.

TABLE IV-9 FARM ECONOMY (Incremental Benefit)

(Pesos/household)

Description	Present Condition		Future Condition with Project		Incremental Condition	
	Agricultural Block III	Agricultural Block V	Agricultural Block III	Agricultural Block V	Agricultural Block III	Agricultural Block V
Gross income	17,240	3,470	30,310	24,980	13,070	21,510
- Crops	14,310	3,470	23,830	20,550	9,520	17,080
- Agri-credits	2,930	-	6,480	4,430	3,550	4,430
Production cost	6,390	1,540	10,390	9,150	4,000	7,610
Net income	10,850	1,930	19,920	15,830	9,070	13,900
Financial outgo	4,610	2,400	7,720	4,960	3,110	2,560
Net reserve	6,240	- 470	12,200	10,870	5,960	12,670

TABLE VII-1 PROJECT COST FOR SABO DAM

(P$\times 10^3$)

WORK ITEMS	LOCAL CURRENCY PORTION	FOREIGN CURRENCY PORTION	TOTAL
Preparatory Works	7,292	380	7,672
Earth Works	6,115	1,530	7,645
Structural Works	65,434	19,540	84,974
Administrative Expenses	8,200	0	8,200
Contingency	13,020	3,250	16,270
Engineering Cost	7,320	5,700	13,020
Total	107,381	30,400	137,781

TABLE VII-2 PROJECT COST FOR RIVER IMPROVEMENT WORKS AND RELATED FACILITIES

(P$\times 10^3$)

WORK ITEMS	LOCAL CURRENCY PORTION	FOREIGN CURRENCY PORTION	TOTAL
Preparatory Works	1,000	0	1,000
Earth Works			
Embankment	4,300	3,400	7,700
Excavation	18,700	10,730	29,430
Structural Works	32,300	810	33,110
Administrative Expenses	5,710	0	5,710
Contingency	9,320	2,200	11,520
Engineering Cost	4,640	4,590	9,230
Total	75,970	21,730	97,700

TABLE VII-3 ANNUAL DISBURSEMENT SCHEDULE OF THE PROJECT COST

($Px10^3$)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
SABO DAM															
Foreign	683	1,283	1,406	2,038	3,465	4,664	3,683	3,175	1,069	1,650	1,501	1,573	1,706	1,491	1,013
Local	1,816	4,152	4,486	7,767	13,309	17,788	14,028	11,495	3,142	5,654	4,884	5,334	5,760	4,878	2,888
Total	2,499	5,435	5,892	9,805	16,774	22,452	17,711	14,670	4,211	7,304	6,385	6,907	7,466	6,369	3,901
RIVER IMPROVEMENT WORK AND RELATED FACILITIES															
Foreign	-	3,660	5,060	5,220	4,745	3,045	-	-	-	-	-	-	-	-	-
Local	-	9,040	19,130	20,320	17,290	10,190	-	-	-	-	-	-	-	-	-
Total	-	12,700	24,190	25,540	22,035	13,235	-	-	-	-	-	-	-	-	-
TOTAL COST															
Foreign	683	4,943	6,466	7,258	8,210	7,709	3,683	3,175	1,069	1,650	1,501	1,573	1,706	1,491	1,013
Local	1,816	13,192	23,616	28,087	30,599	27,978	14,028	11,495	3,142	5,654	4,884	5,334	5,760	4,878	2,888
Total	2,499	18,135	30,082	35,345	38,809	35,687	17,711	14,670	4,211	7,304	6,385	6,907	7,466	6,369	3,901

TABLE VIII-1 FLOOD DAMAGE ESTIMATED IN ECONOMIC PRICE

(P x 10^3)

Category	1966	1972	1974
Agricultural Production /1	7,906	16,044	5,591
Transportation Facilities	1,200	2,300	570
Houses	-	3,509	-
Total	9,106	21,853	6,161

TABLE VIII-2 EXPECTED FLOOD DAMAGE REDUCTION

Return Period (year)	Exceeding Probability	Occurrence Probability	3-Day Rainfall (mm)	Flood Damage (P x 10^6)	Average Flood Damage (P x 10^6)	Average Annual Flood Damage (P x 10^6)	Accumulated Average Annual Flood Damage (P x 10^6)
1.12	0.89		90	0			
		0.39			1.20	0.468	0.468
2	0.5		240	2.40			
		0.30			4.50	1.350	1.818
5	0.2		410	6.60			
		0.10			9.05	0.905	2.723
10	0.1		540	11.50			
		0.05			15.65	0.7825	3.506
20	0.05		690	19.80			
		0.03			26.15	0.7845	4.250
50	0.02		900	32.50			
		0.0075			37.75	0.2681	4.558
80	0.0125		1000	39.00			

/1 : For crop damage estimation, economic price of rice (paddy) is used, which is estimated at P 1,200/t on the basis of the Bangkok f.o.b. price of rice forecast by IBRD in 1978, in due consideration of inland transportation cost and milling charge.

TABLE VIII-3 AGRICULTURAL INCREMENTAL BENEFIT

	With-Project					Without-Project					
	Crop Production (ton)	Unit Price (Px/ton)	Gross Value (Px10^3)	Total Production Cost (Px10^3)	Net Value (Px10^3)	Crop Production (ton)	Unit Price (Px/ton)	Gross Value (Px10^3)	Total Production Cost (Px10^3)	Net Value (Px10^3)	Incremental Benefit (Px10^3)
Paddy											
- Irrigated paddy	27,550	1,200	33,060	13,850	19,210	18,260	1,200	21,910	9,230	12,680	6,580
- Rain-fed paddy	2,800	1,200	3,360	1,500	1,860	1,800	1,200	2,160	980	1,180	680
Sub-total	30,350		36,420	15,350	21,070	20,060		24,070	10,210	13,860	7,210
Sugar cane	189,800	140	26,570	19,640	6,930	189,800	140	26,570	19,640	6,930	0
Secondary crops	340	1,300	440	150	290	340	1,300	440	150	290	0
Others	420	700	310	110	200	170	740	130	60	70	130
Total			63,740	35,250	28,490			51,210	30,060	21,150	7,340

TABLE VIII-4 FLOOD CONTROL AND SABO BENEFIT

(Px10^6)

Year	Damage Reduction	Production Increment	Total
1984	4.56	1.47	6.03
1985	4.56	2.94	7.50
1986	4.56	4.40	8.96
1987	4.56	5.87	10.43
1988	4.56	7.34	11.90
1989	4.56	7.34	11.90
1990	4.56	7.34	11.90
1991	4.56	7.34	11.90
1992	4.56	7.34	11.90
1993 - 2042	4.56	7.34	11.90

TABLE VIII-5 ECONOMIC COST FOR SABO DAMS

(P x 10^3)

WORK ITEMS	LOCAL CURRENCY PORTION	FORRIGN CURRENCY PORTION	TOTAL
Preparatory Works	17,292	190	7,482
Earth Works	6,115	920	7,035
Structural Works	65,434	11,470	76,904
Administrative Expenses	8,200	0	8,200
Contingency	13,020	1,950	14,970
Engineering Cost	7,320	5,700	13,020
Total	107,381	20,230	127,611

TABLE VIII-6 ECONOMIC COST FOR RIVER IMPROVEMENT WORKS AND RELATED FACILITIES

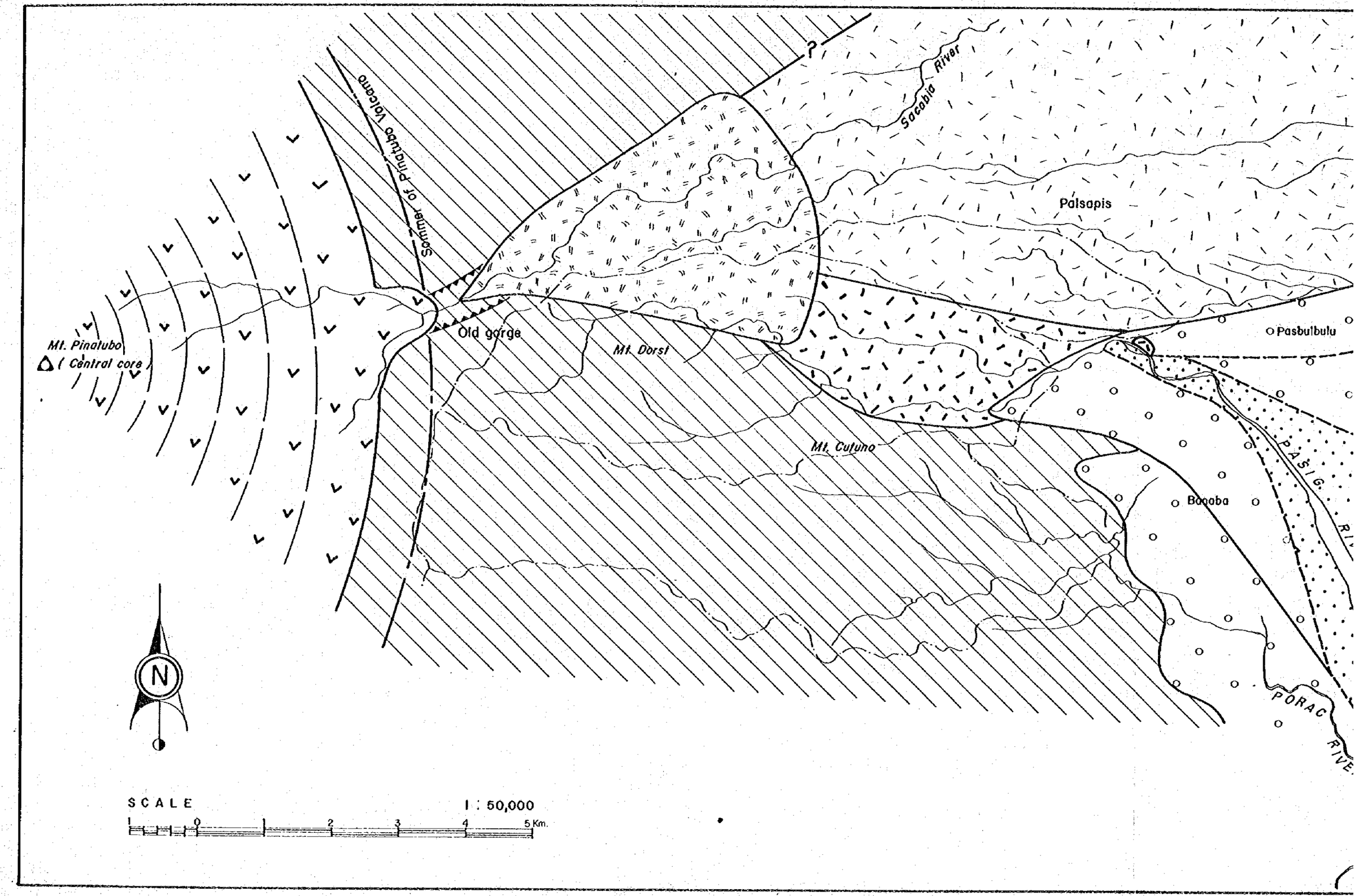
(P x 10^3)

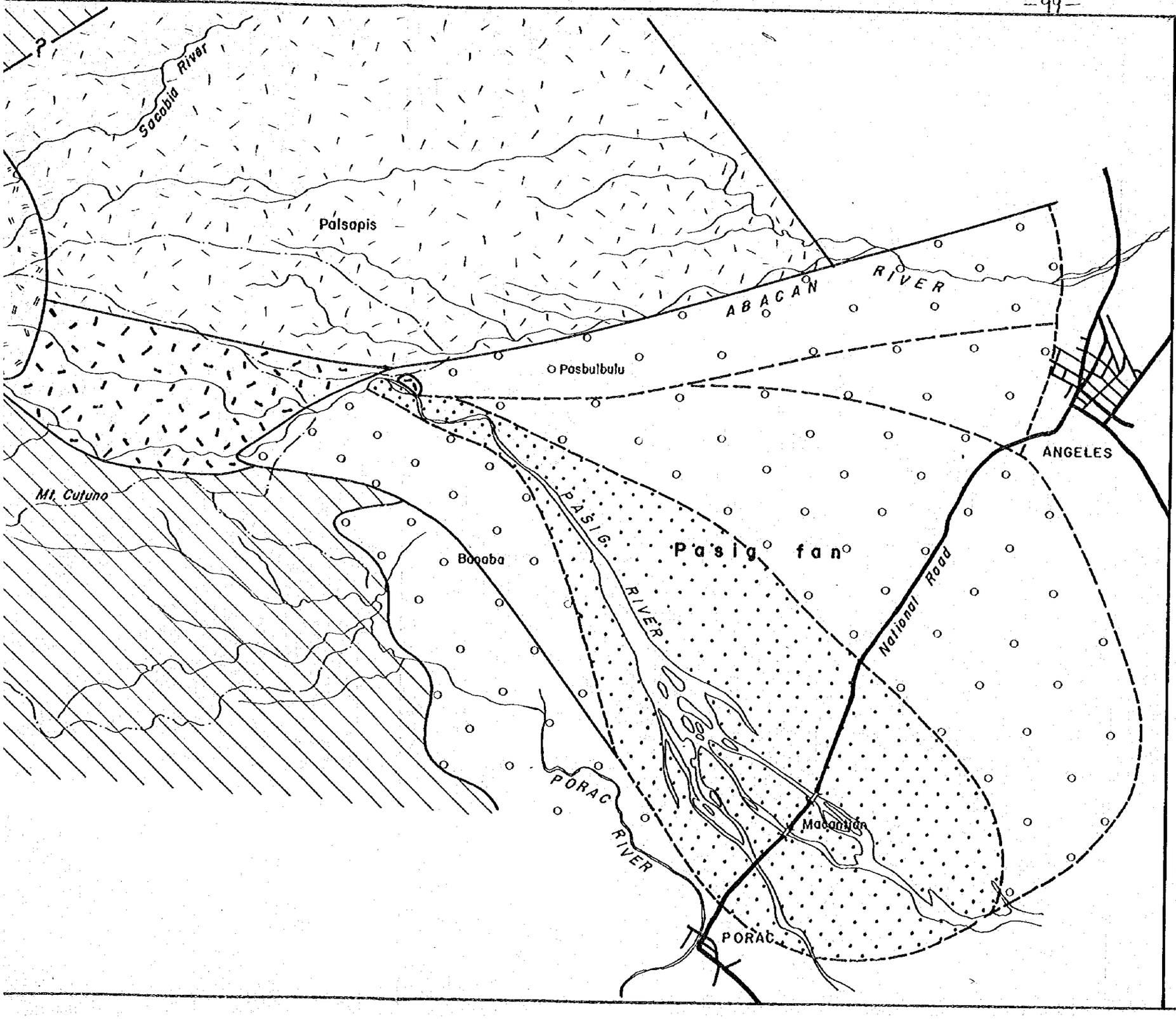
WORK ITEMS	LOCAL CURRENCY PORTION	FOREIGN CURRENCY PORTION	TOTAL
Preparatory Works	1,000	0	1,000
Earth Works			
Embankment	4,300	2,050	6,350
Excavation	18,700	6,440	25,140
Structural Works	32,300	500	32,800
Administrative Expenses	5,710	0	5,710
Contingency	9,340	1,340	10,680
Engineering Cost	4,640	4,590	9,230
Total	75,990	14,920	90,910

TABLE VIII-7 ANNUAL DISBURSEMENT SCHEDULE OF THE ECONOMIC COST

(P x 10^3)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
SABO DAM															
Foreign	556	910	987	1,351	2,190	2,901	2,321	2,030	784	1,129	1,041	1,084	1,159	1,035	752
Local	1,817	4,153	4,486	7,767	13,310	17,786	14,027	11,495	3,142	5,654	4,884	5,334	5,761	4,878	2,887
Total	2,373	5,063	5,473	9,118	15,500	20,687	16,348	13,525	3,926	6,783	5,925	6,418	6,920	5,913	3,639
RIVER IMPROVEMENT WORK AND RELATED FACILITIES															
Foreign	-	2,595	3,405	3,505	3,215	2,220	-	-	-	-	-	-	-	-	-
Local	-	9,060	19,130	20,320	17,290	10,190	-	-	-	-	-	-	-	-	-
Total	-	11,655	22,535	23,825	20,505	12,390	-	-	-	-	-	-	-	-	-
TOTAL COST															
Foreign	556	3,505	4,392	4,856	5,405	5,101	2,321	2,030	784	1,129	1,041	1,084	1,159	1,035	752
Local	1,817	13,213	23,616	28,087	30,600	27,976	14,027	11,495	3,142	5,654	4,884	5,334	5,761	4,878	2,887
Total	2,373	16,718	28,008	32,943	36,005	33,077	16,348	13,525	3,926	6,783	5,925	6,418	6,920	5,913	3,639


Mt. Pinatubo
(Central core)
Somma of Pinatubo Volcano
Old gorge
Mt. Dorsl
Mt. Culuno
Sacobia River
Palsapis
Pasbulbulu
Bacaba
PASIG - RIV
PORAC RIVE
N
SCALE
1 : 50,000
1 0 2 3 4 5 Km.

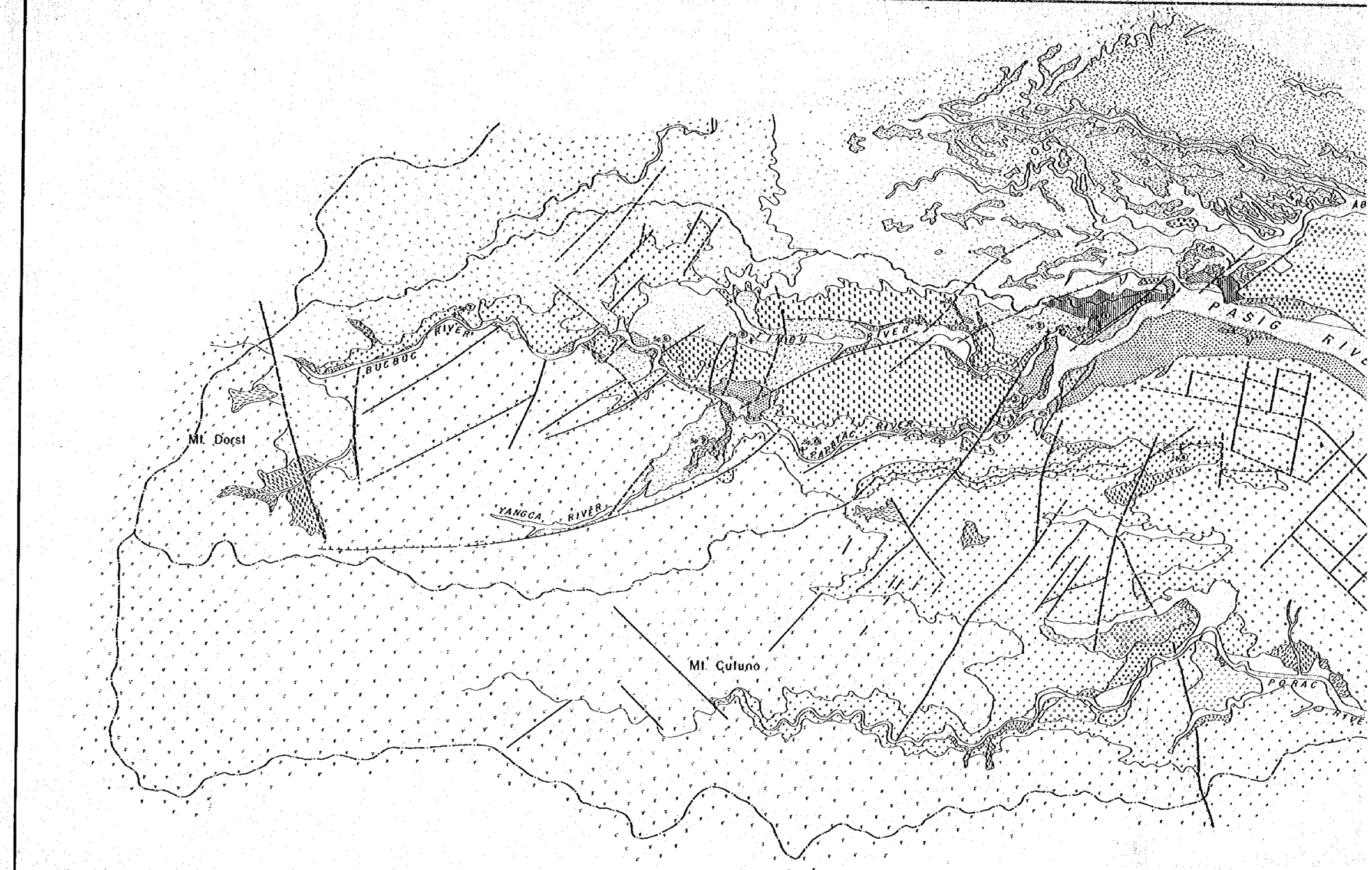


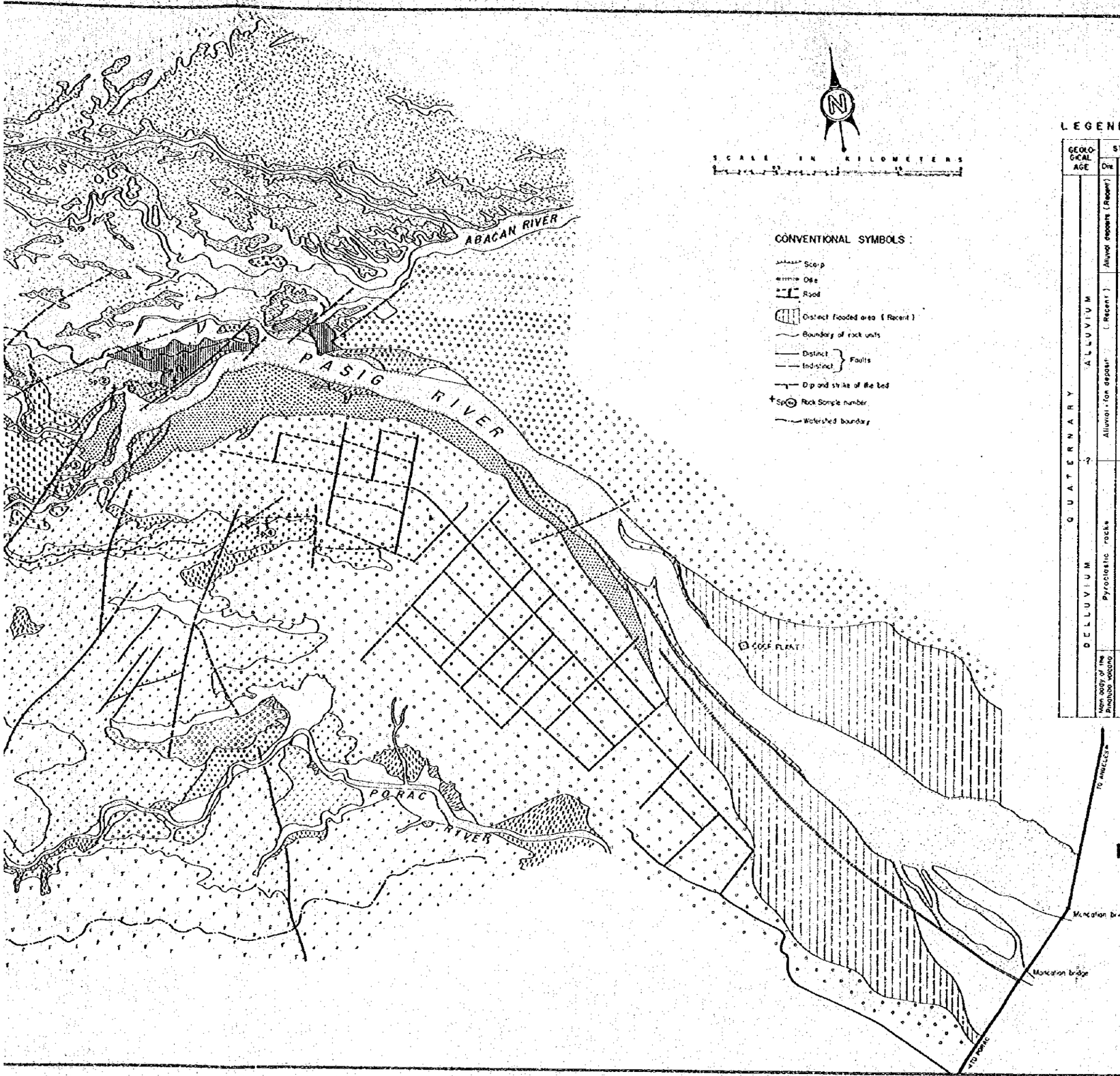
LEGEND :

- Alluvium
- Fan deposits
  - Recent flood plane
  - Old flood plane
- Pyroclastic flow deposits (II)
- Pyroclastic flow deposits (I)
- Welded tufl (I),(II)
- Lava flow and pyroclastics (?) (central cone)
- Agglomerates and lava flow

FIGURE III - 1

GENERAL GEOLOGIC MAP OF PASIG RIVER AND VICINITY


BUCBUC RIVER
TINDU RIVER
PABATAC RIVER
YANGCA RIVER
PASIG RIV
Mt. Dorst
Mt. Culuno
PORAC



SCALE IN KILOMETERS

CONVENTIONAL SYMBOLS :

- Scarp
- Dike
- Road
- Distinct flooded area (Recent)
- Boundary of rock units
- Faults: Distinct / Indistinct
- Dip and strike of the bed
- Sp⑩ Rock Sample number
- Watershed boundary

LEGEND:

GEOLOGICAL AGE		STRATIGRAPHIC DIVISION: Div.	Sub-division	Sign	LITHOLOGICAL EXPLANATIONS		CHARACTERISTIC PROBLEMS OF ROCK ON SABO WORKS	RESISTANCE TO EROSION ※ (Weaker → Stronger)
QUATERNARY	ALLUVIUM	Alluvial deposits (Recent)	River bed deposits (recent)		Sand and gravel (occasionally including of quartz, feldspar and hornblende)	Unconsolidated	Main origin of the debris, readily movable and transportable by water	
			Alluvial deposits (recent)		Sand and gravel			
			Talus deposits (including the collapsed materials)		Breccia, sand		Remarkably evolved along the stream courses	
		Alluvial - fan deposits (Recent)	Fan deposits (III - b)		Gravel and sand, well-bedded		Next to recent river bed deposits, one of the most important origin of the debris due to its remarkable excessiveness of the materials	
			Fan deposits (III - a)		Gravel and sand, well-bedded			
			Fan deposits (II - c)		Gravel and sand, well-bedded			
			Fan deposits (II - b)		Gravel and sand, well-bedded			
			Fan deposits (II - a)		Gravel and sand, well-bedded			
			Fan deposits (I)		Gravel and sand, well bedded			
	DILUVIUM ?	Pyroclastic rocks	Pyroclastic flow deposits (II - s)		Secondary (?) / Primary (?) — Dacitic pyroclastic flow deposits (excessive)	Low consolidated	Next to recent river bed deposits, one of the most important origin of the debris due to its remarkable collapsibleness and excessiveness, especially work on vertical erosion	
			Pyroclastic flow deposits (II - p)					
			Old fan deposits		Gravel and sand, roughly bedded			
			Pyroclastic flow deposits (I)		Dacitic pyroclastic flow deposits (roughly bedded, partly massive)			
			Welded tuff (II)		Welded tuff of bottle by hornblende dacite (distinguished platy joint)	Well consolidated	There is no serious problem on the Sabo works and suitable for domaites	
			Welded tuff (I)		Easily welded tuff of bottle by hornblende dacite			
		Mon. ancestor of the Pinatubo volcano	Agglomerates (II)		Agglomeratic lava flows or pure lava flows of hornblende andesite (partly consists of welded tuff)			
			Agglomerates (I)		Volcanic conglomerate, volcanic breccia, tuff breccia, tuff, etc. of hornblende andesite (roughly bedded)			

NOTES : ※ On the basis of the quantitative decision

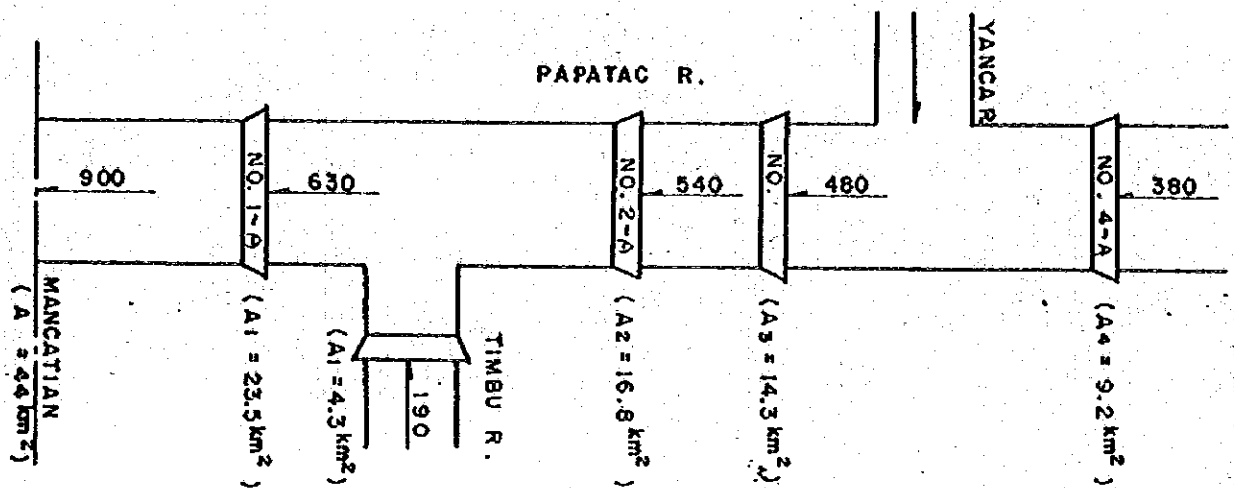
※※ Rarely contains a bedded portion indicating the secondary deposits

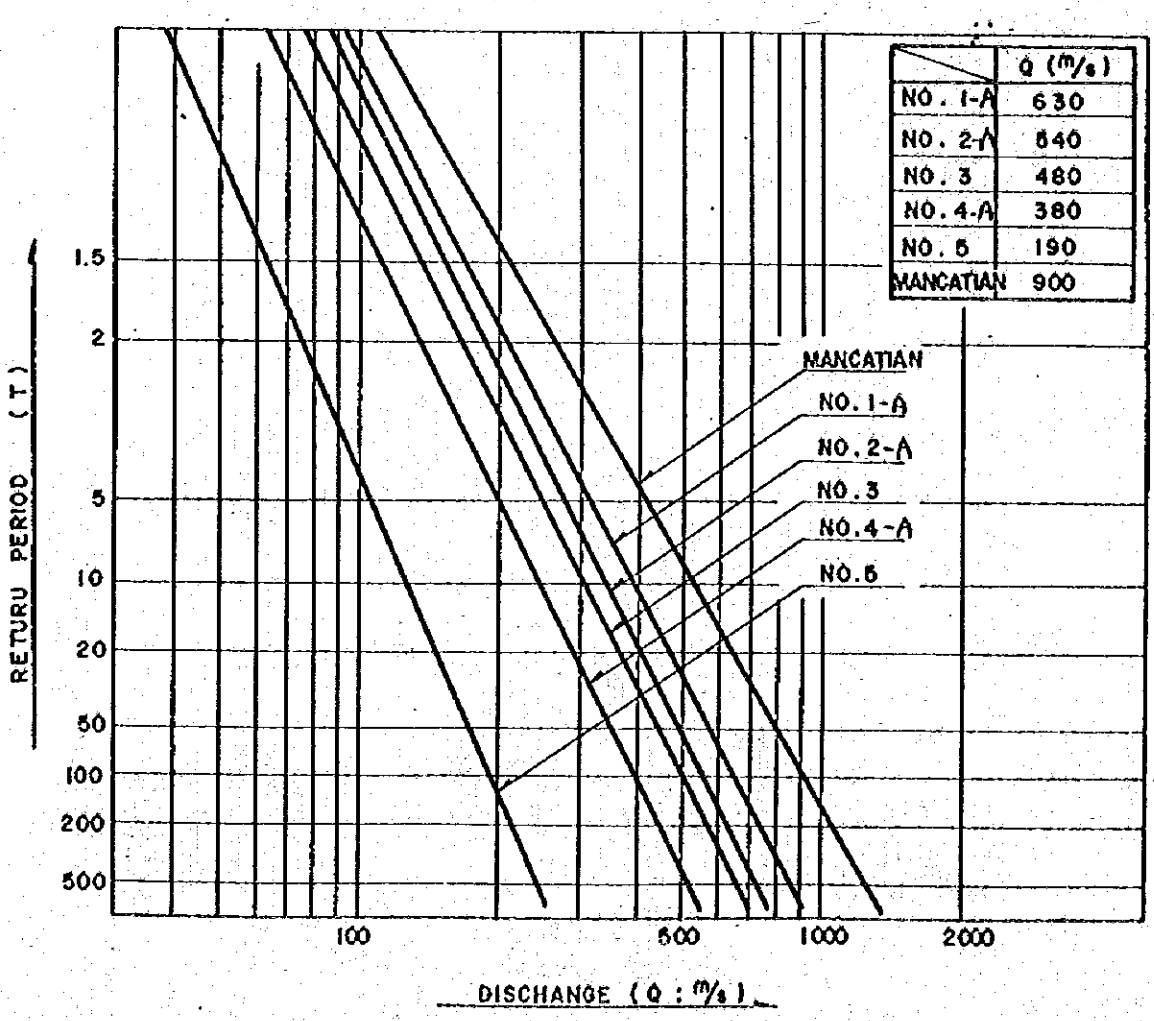
FIGURE III - 2

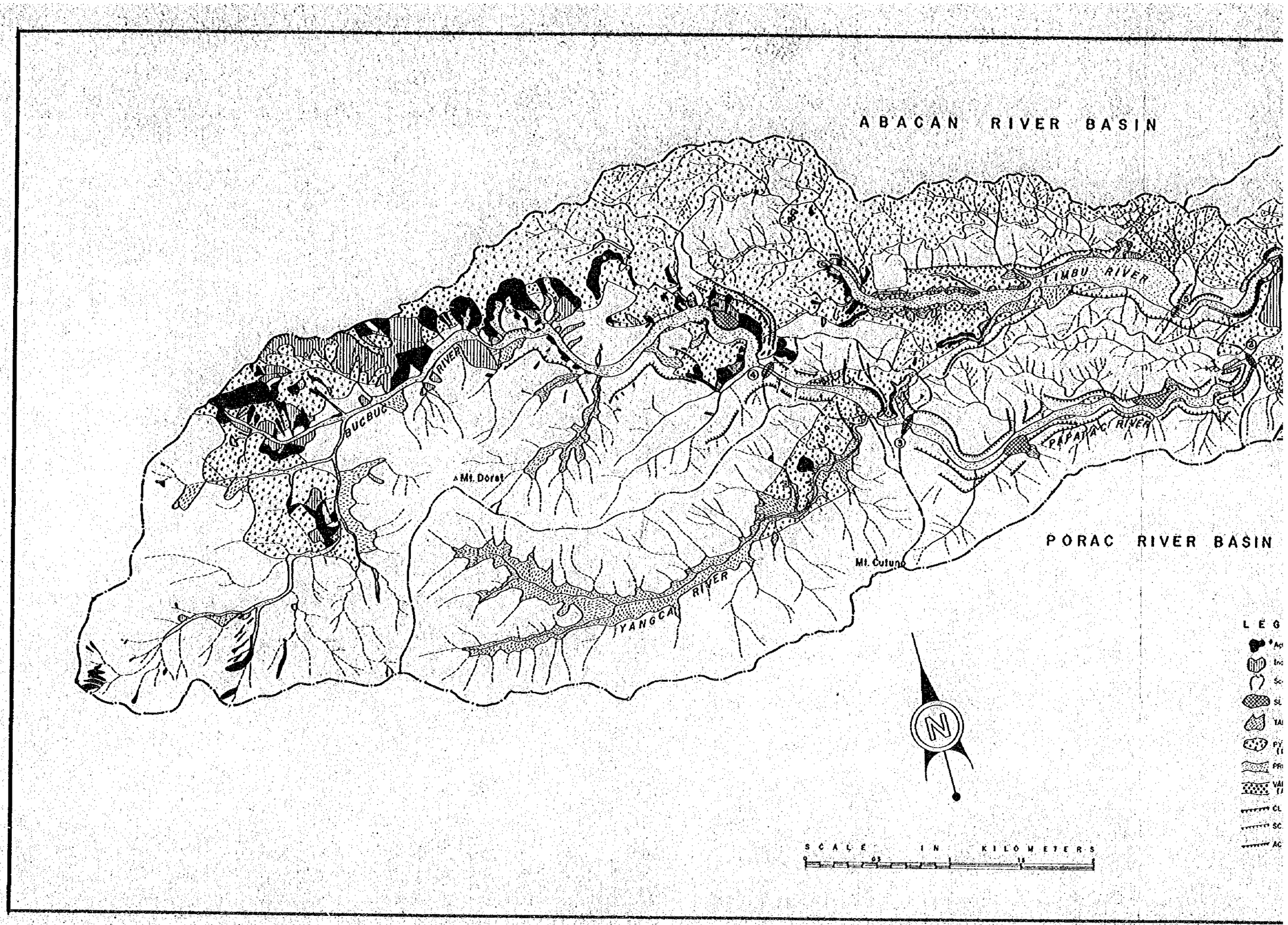
GEOLOGIC MAP

PASIG RIVER BASIN AND VICINITY

FIGURE III-3 DESIGN FLOOD WATER DESTRIBUTION






ABACAN RIVER BASIN
BUCBUC RIVER
Mt. Dorat
TIMBU RIVER
PAPATAC RIVER
Mt. Cutuno
YANGCA RIVER
PORAC RIVER BASIN
N
SCALE IN KILOMETERS

FIGU

ABACAN RIVER BASIN

SUB-CONTROL POINT

Bo. Selbang

TIMBU RIVER

PASIG RIVER

PAPATAC RIVER

PASIG FAN

PORAC RIVER BASIN

Mt. Cutud

IYANGCA RIVER

N

SCALE IN KILOMETERS

0 0.5 1.5 2

LEGEND :

- * Active
- Inactive
- Scars

} COLLAPSES (rock-fall, rock slide, etc.) * Shows remarkably active colapses

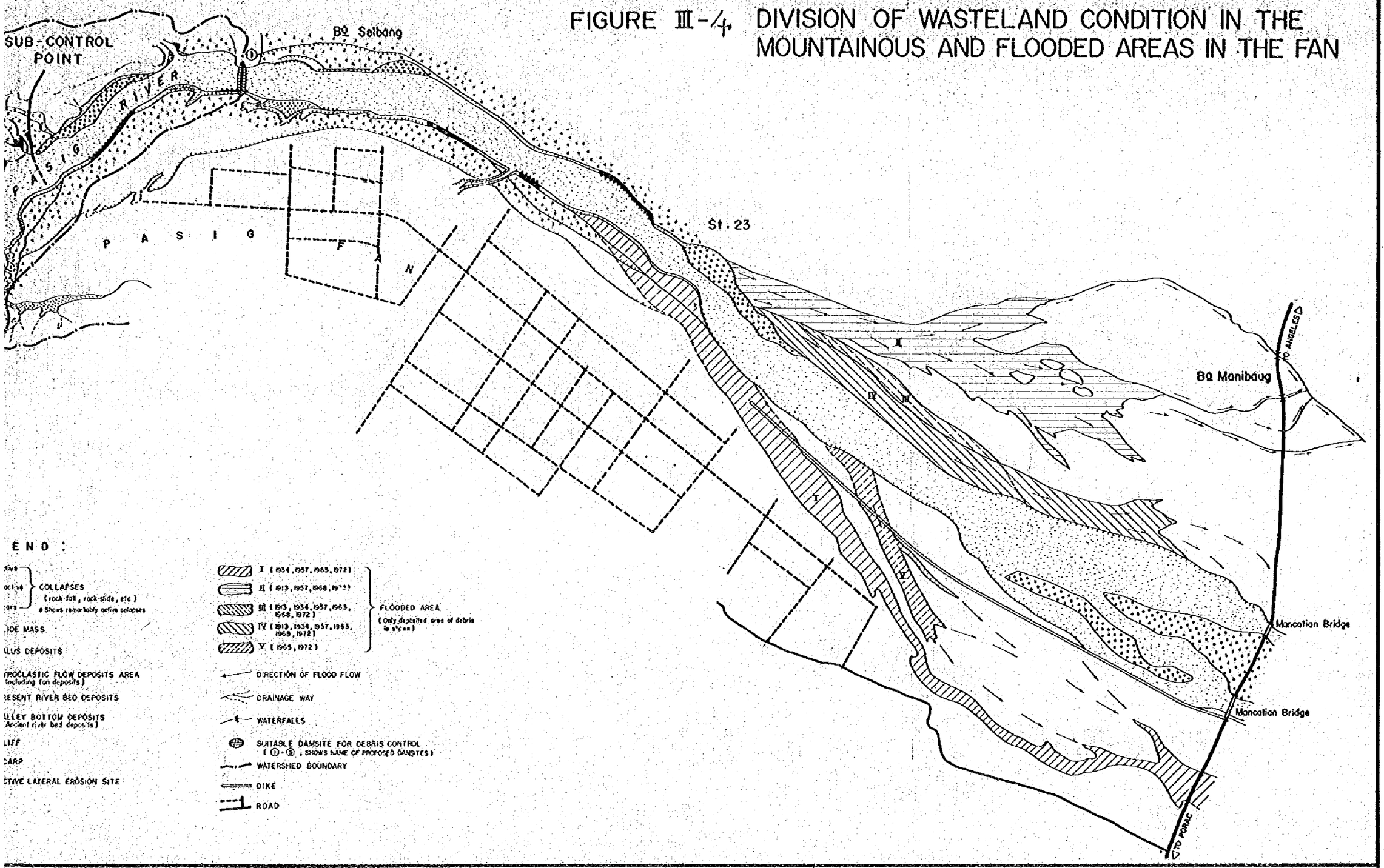
- SLIDE MASS
- TALUS DEPOSITS
- PYROCLASTIC FLOW DEPOSITS AREA (Including fan deposits)
- PRESENT RIVER BED DEPOSITS
- VALLEY BOTTOM DEPOSITS (Ancient river bed deposits)
- CLIFF
- SCARP
- ACTIVE LATERAL EROSION SITE

- I (1934, 1957, 1963, 1972)
- II (1913, 1957, 1968, 1972)
- III (1913, 1934, 1957, 1963, 1968, 1972)
- IV (1913, 1934, 1957, 1963, 1968, 1972)
- V (1965, 1972)

} FLOODED AREA (Only deposited area of debris is shown)

- DIRECTION OF FLOOD FLOW
- DRAINAGE WAY
- WATERFALLS
- SUITABLE DAMSITE FOR DEBRIS CONTROL (①-⑤, SHOWS NAME OF PROPOSED DAMSITES)
- WATERSHED BOUNDARY
- DIKE
- 1 ROAD

FIGURE III-4 DIVISION OF WASTELAND CONDITION IN THE MOUNTAINOUS AND FLOODED AREAS IN THE FAN



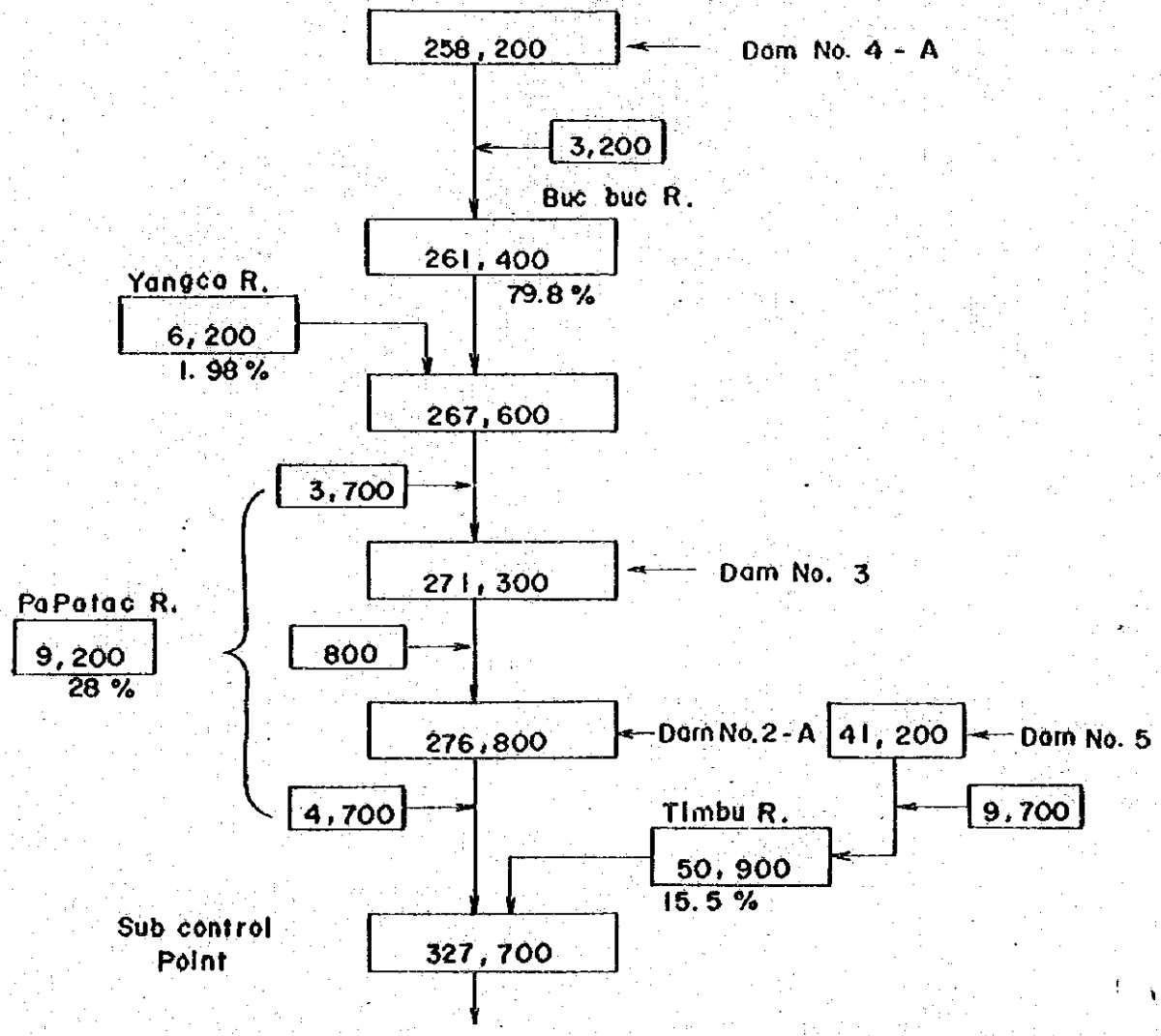


FIGURE III-5 DISTRIBUTION OF AVERAGE DEBRIS DISCHARGE VOLUME AT THE SUB-CONTROL POINT (m^3/yr)