APPENDIX III

DRAINAGE

APPENDIX III DRAINAGE

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CHAPTER 1 DRAINAGE SYSTEMS AND CONSTRAINTS

1.1 Topographic Features

The UPRIIS service area is bounded by the Sierra Madre mountain areas in east and by the San Antonio and the North Candaba Swamps in the west. The area has the topographic slope, in general, from north to south and from east to west. The slope is about 1/400 in District I and about 1/400 in District II. Topographic undulation is significant in the PRIS area. In District III, the slope is about 1/500 for PBRIS proper area located at left of the Pampanga river and about 1/2,000 for PBRIS extension area. In District IV, the slope of the service area is about 1/1,000.

1.2 Hydrological Features

The areal distribution of annual rainfall has the characteristics of relatively high annual mean value of about 2,300 mm in the Sierra Madre mountain ranges whereas the annual rainfall within the service area varies from 1,300 mm to 2,400 mm, represented by Cabanatuan rainfall station.

Among four districts of the area, annual rainfall for the District IV shows the highest value of 1,500 mm to 2,300 mm. District I is the second, District II is the third and the lowest rainfall of about 1,000 mm - 1,500 mm occurs at District III.

The daily rainfall intensity and probability of occurrence are analyzed and presented in Table 3.1 for one day to seven days of successive rainfall. The hourly rainfall intensity record was collected at 23 stations in and around the project area. The maximum hourly intensity is 130.6 mm/hr at San Isidro and 113.0 mm/hr at Cabanatuan. The average value of the maximum hourly rainfall for 23 stations is 83.5 mm/hr.

1.3 Drainage Systems

The major drainage systems in the project area consist of rivers and natural drainage creeks and no artificial drainage systems exist except some of irrigation canals working as intercepting the surface runoff from the adjacent area. Since substantial investments for the improvement of drainage creeks and rivers were not mobilized yet in the area, the most of creeks keep their natural conditions. The courses of the creeks are winding and cross sections, embankment and gradient are not properly aligned, which created flatter gradient and small capacity for flood discharge and for sediment transportation.

Drainage creeks in the area are tabulated in Table 3.2. The drainage systems are shown in Fig. 3.1 and the drainage diagrams for each creek are shown in Fig. 3.2(1) to (7).

1.4 Characteristics of Drainage Problems

1.4.1 Inundation Area

The habitual inundation area map prepared by the UPRIIS staff is presented in Fig. 3.3.

Large scale inundation is often experienced in low-lying area adjacent to the San Antonio and the Candaba swamps such as downstream of PBRIS extension and downstream area of PEÑRIS and PEÑRIS extension. In these areas, the irrigation canals are extending deep into the swamp flooding plain. Inundation is caused by backwater from the swamp flood water level and small carrying capacity of creeks receiving all the drain water from upstream.

In addition to the above, the downstream area of Santo Domingo irrigation system is habitually damaged by inundation. This area is bounded by the Rio Chico and the Talavera rivers. During flood time, the flood water level in the rivers is higher than the ground elevation of the area. Drainage by gravity is only possible after withdrawal of flood in the river.

Overbanked flood from the right bank of the Talavera river augments the damage in this area.

1.4.2 Drainage Facilities

The farm drainage networks such as main and secondary drainage canals do not exist in the area. At farm level, farm drainage ditches were constructed at the time of integration but many of them were demolished by farmers to expand their planting area. Drainage water flows from paddy to paddy and finally reaches the natural drainage creeks.

Small and medium scale check structures are located on the creeks to re-use the irrigation return flow. Small earth dams are temporarily built by farmers in the creeks especially in the area far from the turnouts and short of irrigation water in the dry season. All these structures block the stream flow and cause flooding or drainage deficiencies at upstream.

Heavy growth of aquatic vegetation reduces the creek flow capacity and chokes up the check structures. Siltation is also noticeable in the downstream portion of creeks where the channel gradient becomes small.

CHAPTER 2 DRAINAGE IMPROVEMENT PLAN

2.1 General

In order to analyze the characteristics of inundation around the swamp area and to formulate the improvement plan, the drainage simulation study was conducted. The sample areas were selected from the San Antonio and the Candaba swamp areas. Firstly, the present drainage conditions were simulated to define the coefficients for simulation model.

The optimum improvement plan for the drainage creeks was then formulated through simulation studies. Probable rainfall scale of 5-year return period was adopted in the drainage improvement plan considering NIA standard for drainage requirement of 8.68 ℓ/sec'ha. In addition to this, probable rainfall scales of 2-year and 10-year return period were also analyzed to evaluate the proposed improvement plan.

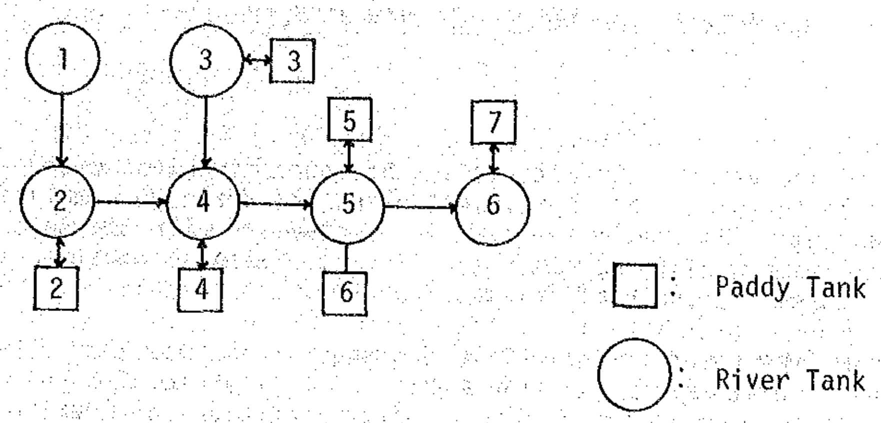
Based on the results of the above studies, the irrigable area during wet season was then determined by excluding the inundation area after the implementation of improvement plan.

Drainage problems at the Santo Domingo area along the Talavera river will be discussed together with the river improvement plan in Appendix IV.

2.2 Drainage Simulation Study

2.2.1 Methodology

In order to analyze the existing conditions of flow in the drainage creeks, the status of the submerged area and the effects of backwater from the swamp, the drainage simulation study was conducted by adopting the method developed by Japan Institute of Irrigation and Drainage. In this method, the area is converted into the simulation model consist of paddy tanks and river tanks. The status of water level and discharges is solved between each paddy tank and river tank by hydraulic overflow formula of submerged flow or complete overflow, and the flow condition between the successive river tanks is solved by the formula of either uniform or nonuniform flow. The computer, FACOM M140-F, in the TTC (Transport Training Center) was utilized for the simulation.

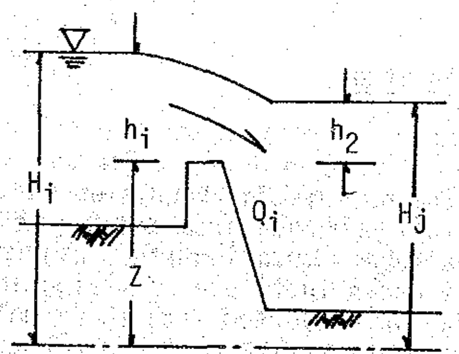


Simulation Model

The basic formula are expressed as follows:

1) Flow between Paddy Tank and River Tank

$$Q_i^{n+1} = -\frac{2W}{dt} H_i^{n+1} + \left(\frac{2W}{dt} H_i^n - Q_i^n + 2 \times W \times R\right) \quad \ldots\ldots\ldots \quad (1)$$



where, i: paddy tank number

Q_i^{n+1}: discharge from paddy tank i at time n+1

H: paddy water level

W: paddy area

dt: unit interval of time

R: rainfall

a) Complete Overflow

$$Q_i = \pm C_1 \times B \times h_1^{3/2} \quad \ldots\ldots\ldots \quad (2)$$

b) Submerged Overflow

$$Q_i = \pm C_2 \times B \times h_2 \times \sqrt{|H_i - H_j|} \quad \cdots\cdots\cdots\cdots \quad (3)$$

2) Flow between River Tanks

$$Q_j^{n+1} = -\frac{W_j^{n+1} + W_j^n}{dt} H_j^{n+1} + \frac{W_j^{n+1} + W_j^n}{dt} H_j^n$$

$$+ (Q_i^n - Q_j^n) + Q_i^{n+1} \quad \cdots\cdots\cdots\cdots \quad (4)$$

where, W_j^{n+1}: water surface area of river tank j at time n+1

H_j^{n+1}: water surface level of river tank j at time n+1

Q_j^n: discharge of river tank i at time n

a) Non-uniform Flow

$$Q_j = \pm \frac{A_j \times R_j^{2/3}}{N_j} \times \sqrt{\frac{|H_j - H_k|}{X_j}} \quad \cdots\cdots\cdots\cdots \quad (5)$$

b) Uniform Flow

$$Q_i = \frac{A_j \times R_j^{2/3}}{N_j} \times \sqrt{S_j} \quad \cdots\cdots\cdots\cdots \quad (6)$$

where, A_j: flow area of tank j

R_j: hydraulic radius of tank j

N_j: roughness coefficient of tank j

H_i: water level of tank i

X_j: distance between tank j and k

S_j: riverbed slope between j and k

The flow chart for computer program is shown in Fig. 3.4. The program for computer is listed in Reference 3.1.

2.2.2 Sample Area and Simulation Model

Two sample areas are selected, one is the San Antonio area in District III and the other is the Candaba area in District IV. The San Antonio area is located near the town of Zaragosa including Aliaga area, part of Murcon area and PBRIS extension area. The major creeks to be analyzed in this sample area are the Along-Along creek, the Manaol creek, the Sanggalang creek and their tributaries. Individual simulation models are prepared for the Along-Along creek system and for the Manaol-Sanggalang creeks system as shown in Fig. 3.5. Total drainage area covered by these models is 200.6 km^2.

The Candaba simulation area includes most part of the Peñaranda proper area. The creeks are the Tabon, the Cambabalo, the Candulian, the Panumbunan, the Malimba creeks and their tributaries. Total drainage area is 246 km^2. The simulation model for the Candaba area is shown in Fig. 3.6.

2.2.3 Conditions of Analysis

The results of flood control analysis conducted in the Feasibility Study on the Pampanga Delta Development Project were fully utilized to define the input conditions of the drainage simulation. These conditions are the hourly water level of swamps with the existing river condition, the runoff discharge from the respective upstream area and the hourly rainfall intensity for each corresponding probability of occurrence. These are summarized in Table 3.3.

The simulation period is set at 250 hrs or about 10 days duration and the output is obtained every 1 hr for present conditions and 2 hrs for improved condition. The results of cross section survey on the creeks were adopted to represent the corresponding river tank cross section.

According to the NIA design criteria for irrigation and drainage channels, the drainage requirement for drainage ditches is defined to be 5 ℓ/sec/ha for flat areas and 9 ℓ/sec/ha for moderately sloping areas. The drainage simulations show that the peak discharge from paddy field with probable rainfall scale of 5-year, is about 4.1 ℓ/sec/ha under present conditions. After the improvement of creek alignment, the peak discharge becomes 5.5 ℓ/sec/ha for flatter area and about 10 ℓ/sec/ha for sloping area.

The proposed improvement works is, then, formulated by applying the 5-year probable rainfall scale which shows almost same drainage requirement with the NIA design criteria.

In order to evaluate the proposed improvement works, the probable rainfall scales of 2-year, 5-year and 10-year scale were applied to the simulation study.

2.3 Results of Simulation for Present Condition

2.3.1 San Antonio Swamp Area

For the probable rainfall scale for a 2-year return period, overflow from creek or inundation does not occur for present physical conditions of creeks. For the scales of 5-year and 10-year return periods, overflow and inundation were clearly reproduced by the simulation model.

The inundation area within the sample area is almost same for both cases of 5-year and 10-year floods, only the duration for overflow and inundation is different. The inundation area is estimated at about 53 km^2 within the sample drainage area of 200.6 km^2. The inundation reaches almost up to the ground elevation of EL. 13.0 m. Applying this result, the inundation area at present condition with 5-year probability is estimated about 4,300 ha around San Antonio swamp within the boundary of about 15,000 ha of potential irrigation service area for PBRIS Extension system.

Inundation is caused by the overflow from the creek to the adjacent paddy field. Overflow from the creek is caused by small conveyance capacity of the creek section, the irregular alignment of creek bed gradient and by the swamp backwater. Overflow duration is short at upstream and long at downstream receiving return flow of flooded water from upstream. The characteristics of overflow are summarized in Table 3.4.

2.3.2 North Candaba Swamp Area

Overflow from the creek to the adjacent paddy fields occurs at mostly downstream reaches. The backwater effect of swamp flood water level is more significant and duration of overflow or submergence is longer than those at the San Antonio swamp. The inundation water level reaches up to the ground elevations of about EL. 7.0 to 7.2 m, EL. 8.0 to 9.0 m and EL. 10.0 m for probable rainfall scales of 2-year, 5-year and 10-year, respectively.

Based on these results, the present total inundation area by 5-year probability scale is estimated at about 100 km^2 or 10,000 ha (PEÑRIS Proper area 66.5 km^2, PEÑRIS Extension area 33.6 km^2) within the boundary of potential irrigation service area of about 29,800 ha.

Duration of overflow and submergence is summarized in Table 3.5. It is noted that the maximum unit drainage discharge in the creeks is about 4.1 ℓ/sec/hr under the present condition.

2.4 Improvement Plan

The purpose of improvement is to stop overflow from the creek to adjacent paddy field and to minimize the inundation area and duration by means of widening, deepening and shortening the creeks. Improvement plan was prepared to solve the problems for probable rainfall scale of 5-year. Following points are considered in the formulation of the improvement plan:

1) First attention was paid to create a smooth longitudinal profile of creek. Sedimentation is noticeable at downstream reach of present creek. Cross sectional flow area becomes smaller than upstream and longitudinal profile is sometimes reversed. In such case, smooth profile is first designed regardless of improvement scale of rainfall probability.

2) To keep the improved cross section within the existing sectional profile as much as possible to minimize the additional land compensation.

3) Winding creek is to be straightened except the portion near by community.

2.4.1 San Antonio Swamp

After the several simulations, longitudinal profile and cross sections at each improvement points were set and flow condition against 5-year probable rainfall scale was obtained by simulation model. The improved flow profile is shown in Fig. 3.7 together with the present condition of flow profile. No overflow occurs in the improved condition at upstream. Backwater or reversed flow from the swamp reaches to the extent of ground elevation 11.0 m and 11.5 m for Manaol creek system and Along-Along creek system respectively.

Below these elevation, the area is submerged by the flood water not from upstream drain water but from the swamp reversed flow. The area of inundation after improvement for 5-year probability scale is estimated to be reduced at about 17.5 km^2 from the present inundation of 43 km^2. This area of 17.5 km^2 (1,750 ha) will be eliminated from the potential irrigation service area of about 14,900 ha for PBRIS Extension area during wet season. The inundation area is compared with the present condition and shown in Fig. 3.8.

The flow condition was also simulated for 10-year probability scale to evaluate the improvement effects. The flow profile is shown in Fig. 3.9.

2.4.2 North Candaba Swamp

Similar to the case for San Antonio swamp, the optimum scale of improvement of creek was analyzed through many simulation studies for 5-year scale.

The flow profile for 5-year probability scale with improved creek conditions are presented in Fig. 3.10 for major tributaries of the Malimba creek system. With its improvement, the overflow at upstream does not occur and inundation area is reduced to the area lower than the ground elevation of about 7.0 m to 7.5 m. This inundation area is about the same as the area of no farming activity during wet season at present. Fig. 3.11 shows the estimated inundation area with present and improved condition of creeks.

Applying the simulation results to the PEÑRIS Proper and Extension areas, the total inundation area expected for 5-year rainfall probability is reduced from 100 km^2 at present condition to 70 km^2 (7,000 ha) after the improvement works. This area of 7,000 ha (4,900 ha in PEÑRIS Proper, 2,100 ha in PEÑRIS Extension) will be deleted from the potential irrigation area of about 29,800 ha. The effects of improvement were also evaluated by simulation against 2-year and 10-year scales. The representative flow profile are presented in Fig. 3.12 and Fig. 3.13 for the evaluation.

Inundation and benefit areas within the potential irrigation area by proposed improvement works for 5-year probable rainfall are summarized as follows:

1) San Antonio Area (PBRIS Extension Area)

Inundation area at present	4,300 ha
Inundation area after improvement	1,750 ha
Benefit area by improvement	2,550 ha

2) North Candaba Area (PEÑRIS Proper and Extension Areas)

Inundation area at present	10,000 ha
Inundation area after improvement	7,000 ha
Benefit area by improvement	3,000 ha

CHAPTER 3 PROPOSED WORKS

The proposed works are the improvement of creeks systems around the San Antonio and the North Candaba swamps through re-alignment of creek cross section and longitudinal profile. The design of the creeks are prepared to meet with the drainage requirement of 5-year probable rainfall intensity based on the results of simulation. Estimated work quantities are summarized as follows:

Proposed Work	San Antonio Area	North Candaba Area
Total improvement length (km)	53	46
Surface stripping (m^2)	710,000	710,000
Excavation (m^3)	1,270,000	710,000
Embankment (m^3)	470,000	850,000
Land acquisition (ha)	18	77
Structure		
Drainage inlet (no.)	20	24
Bridge (no.)	8	2
(Width 4.0 m Length 10 m)		

CHAPTER 4 COST ESTIMATE

The construction cost for the drainage improvement is estimated based on the work quantities and respective unit prices described in Appendix X.

Direct construction cost is estimated at about ₱78.82 million. The breakdown of the cost is shown in Table 3.6 and summarized below.

(Unit: ₱10^3)

Item	Foreign Currency	Local Currency	Total
1. San Antonio Swamp			
1.1 Preparation Work	1,407	600	2,007
1.2 Earth Work	27,883	11,171	39,054
1.3 Structure Construction	310	857	1,167
1.4 Land Acquisition	-	202	202
Total	29,600	12,830	42,430
2. North Candaba Swamp			
2.1 Preparation Work	1,201	487	1,688
2.2 Earth Work	23,957	9,535	33,492
2.3 Structure Construction	82	266	348
2.4 Land Acquisition	-	862	862
Total	25,240	11,150	36,390
Grand Total	54,840	23,980	78,820

The operation and maintenance costs for drainage facilities are explained in Appendix X.

Table 3.1 PROBABLE AVERAGE RAINFALL IN THE UPPER PAMPANGA RIVER BASIN

Return Period (year)	Probable Rainfall (mm)						
	1-day	2-day	3-day	4-day	5-day	6-day	7-day
2	77.1	119.6	141.3	159.4	173.1	193.1	211.7
5	116.5	198.8	264.2	280.3	316.9	340.3	365.1
10	142.6	251.2	315.8	360.3	412.3	437.8	466.6
20	167.7	301.4	382.4	437.2	503.6	531.2	564.1
50	200.2	366.5	468.7	536.6	621.9	652.2	690.2
80	216.6	399.6	512.6	587.1	682.1	713.8	754.3
100	224.4	415.3	533.4	611.1	710.5	742.9	784.7
150	238.7	443.7	571.1	654.5	762.2	795.8	839.7
200	248.7	463.9	597.9	685.3	798.8	833.2	878.8
500	280.6	528.0	682.9	783.2	915.4	952.4	1,002.9
1,000	304.8	576.5	747.1	857.3	1,003.4	1,042.5	1,096.9

Notes

1. Probable average rainfalls in the Upper Pampanga river basin were estimated from the probable rainfalls at Cabanatuan City through the correlation curves.
2. Probable average rainfalls were estimated in the stage of Feasibility Study on Pampanga Delta Development Project from 1980 to 1981 by JICA.

Table 3.2 DRAINAGE CREEKS IN THE UPRIIS AREA

Location	Name of Creek	Catchment Area (km2)	Confluence
District I	Bubon	32	Talavera River
	De Babuyan	108	Talavera River
	Baclao	25	Talavera River
	Sta. Maria	92	Talavera River
	Cabaldon	12	Ilog Baliwag River
District II	Vaca-Murcon	130	Pampanga River
	Carinaya	19	Pampanga River
	Carol	28	Pampanga River
	Kamandag	30	Pampanga River
	Bibulo	35	Pampanga River
District III	Cabu	123	Pampanga River
	Pangatian	36	Pampanga River
	Bato-Bato	103	Pampanga River
	Tabuating	102	Pampanga River
	Tambo	25	Pampanga River
	Tarian	31	Pampanga River
	Along-Along	71	San Antonio Swamp
	Manaol	43	San Antonio Swamp
	Sanggalang	86	San Antonio Swamp
	Papaya	58	San Antonio Swamp
District IV	Malimba	246	Candaba Swamp
	Mayantoc	24	Bulo River
	San Miguel	200	Bulo River
	Mapaniqui	174	Candaba Swamp

Table 3.3(1) INPUT CONDITIONS OF DRAINAGE SIMULATION

San Antonio Swamp (1/2 Flood)

Date	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(1976 5.22)	0	1.38	7.52	2.25
	1	1.69	8.56	2.30
	2	1.46	9.41	2.36
	3	1.65	10.24	2.43
	4	1.98	11.06	2.50
	5	1.60	12.05	2.57
	6	0.71	12.96	2.65
	7	0.35	13.39	2.74
	8	0.19	13.42	2.84
	9	0.01	13.29	2.94
	10	0.08	13.04	3.03
	11	0.26	12.78	3.10
	12	0.57	12.62	3.17
	13	0.37	12.63	3.25
	14	0.34	12.65	3.33
	15	0.15	12.60	3.41
	16	0.08	12.46	3.49
	17	1.37	12.26	3.57
	18	1.36	12.55	3.66
	19	2.31	13.18	3.74
	20	2.92	14.18	3.83
	21	2.70	15.66	3.92
	22	1.85	17.19	4.01
	23	1.35	18.29	4.12
(5.23)	0	2.22	18.92	4.22
	1	2.03	19.74	4.32
	2	2.27	20.72	4.43
	3	1.09	21.71	4.54
	4	1.14	22.28	4.66
	5	1.41	22.51	4.78
	6	2.76	22.86	4.91
	7	1.22	23.83	5.04
	8	1.26	24.53	5.17
	9	0.14	24.80	5.30
	10	0.06	24.61	5.44
	11	0.0	24.08	5.57
	12	0.01	23.51	5.70
	13	0.01	22.95	5.84
	14	0.01	22.40	5.97
	15	0.92	21.87	6.10
	16	0.70	21.73	6.23
	17	0.70	21.75	6.36
	18	0.70	21.71	6.48
	19	0.26	21.67	6.60
	20	4.79	21.45	6.71
	21	1.88	22.95	6.81
	22	1.91	24.52	6.91
	23	1.88	25.24	7.00
(5.24)	0	1.68	25.94	7.09
	1	1.19	26.52	7.18
	2	1.21	26.84	7.26
	3	1.18	27.02	7.33
	4	1.17	27.18	7.41
	5	0.96	27.34	7.48
	6	1.19	27.39	7.55
	7	2.32	27.48	7.61
	8	1.45	28.10	7.68
	9	1.23	28.66	7.75
	10	1.22	28.88	7.81
	11	1.19	29.02	7.88
	12	2.77	29.14	7.96
	13	1.19	29.90	8.01
	14	0.50	30.45	8.05
	15	0.70	30.24	8.08
	16	0.25	29.93	8.12
	17	0.26	29.50	8.15
	18	0.47	28.95	8.19
	19	0.94	28.50	8.23
	20	0.94	28.32	8.27
	21	0.94	28.28	8.30
	22	0.72	28.24	8.34
	23	0.72	28.12	8.38
(5.25)	0	0.71	27.93	8.42
	1	0.70	27.75	8.45
	2	1.39	27.56	8.49
	3	1.63	27.65	8.53
	4	0.75	28.04	8.57
	5	0.28	28.13	8.60
	6	0.26	27.76	8.64
	7	0.25	27.27	8.68
	8	0.25	26.86	8.71
	9	0.93	26.52	8.75
	10	0.48	26.72	8.79
	11	0.72	26.93	8.82
	12	1.18	27.10	8.86
	13	0.26	27.74	8.89
	14	0.94	27.91	8.93
	15	1.39	28.11	8.96
	16	0.71	29.04	9.00
	17	0.71	29.66	9.03
	18	0.94	29.89	9.06
	19	0.95	30.30	9.08
	20	1.40	30.85	9.11
	21	2.58	31.74	9.13
	22	1.42	33.80	9.16
	23	1.40	35.54	9.18

(to be continued)

Table 3.3(2) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.26)	0	0.72	36.59	9.20
	1	0.71	37.06	9.22
	2	0.49	37.13	9.24
	3	1.17	37.01	9.26
	4	0.24	37.32	9.28
	5	0.24	37.25	9.30
	6	0.24	36.67	9.32
	7	0.0	36.11	9.33
	8	0.0	35.36	9.34
	9	0.23	34.51	9.35
	10	0.23	33.85	9.36
	11	1.14	33.34	9.37
	12	0.92	33.57	9.38
	13	0.01	34.13	9.39
	14	0.23	33.82	9.39
	15	0.23	33.19	9.39
	16	0.46	32.70	9.40
	17	0.46	32.40	9.40
	18	0.0	32.23	9.40
	19	0.23	31.71	9.39
	20	0.0	31.13	9.39
	21	0.23	30.50	9.38
	22	0.0	29.95	9.38
	23	0.0	29.36	9.37
(5.27)	0	0.0	28.66	9.36
	1	0.0	27.97	9.35
	2	0.46	27.30	9.34
	3	0.23	27.02	9.33
	4	0.46	26.81	9.31
	5	0.46	26.66	9.30
	6	0.24	26.65	9.29
	7	0.46	26.46	9.27
	8	0.0	26.33	9.26
	9	0.01	25.96	9.24
	10	0.0	25.35	9.23
	11	0.0	24.75	9.21
	12	0.0	24.17	9.19
	13	0.0	23.60	9.17
	14	0.0	23.04	9.14
	15	0.0	22.50	9.12
	16	0.0	21.97	9.09
	17	0.0	21.46	9.06
	18	0.0	20.96	9.03
	19	0.0	20.47	9.00
	20	0.0	19.99	8.97
	21	0.0	19.53	8.93
	22	0.0	19.08	8.89
	23	0.0	18.64	8.86
(5.28)	0	0.0	18.21	8.82
	1	0.0	17.79	8.77
	2	0.0	17.38	8.73
	3	0.0	16.98	8.69
	4	0.0	16.59	8.65
	5	0.0	16.22	8.60
	6	0.0	15.85	8.56
	7	0.0	15.49	8.51
	8	0.0	15.14	8.47
	9	0.0	14.80	8.43
	10	0.0	14.46	8.38
	11	0.0	14.14	8.34
	12	0.0	13.82	8.30
	13	0.0	13.51	8.25
	14	0.0	13.21	8.21
	15	0.0	12.92	8.17
	16	0.0	12.63	8.13
	17	0.0	12.35	8.09
	18	0.0	12.08	8.04
	19	0.0	11.82	8.00
	20	0.0	11.56	7.91
	21	0.0	11.30	7.82
	22	0.0	11.06	7.73
	23	0.0	10.82	7.65
(5.29)	0	0.0	10.58	7.57
	1	0.0	10.36	7.50
	2	0.0	10.13	7.43
	3	0.0	9.92	7.36
	4	0.0	9.70	7.30
	5	0.0	9.50	7.24
	6	0.0	9.30	7.18
	7	0.0	9.10	7.12
	8	0.0	8.91	7.07
	9	0.0	8.72	7.02
	10	0.0	8.54	6.97
	11	0.0	8.36	6.93
	12	0.0	8.19	6.88
	13	0.0	8.02	6.84
	14	0.0	7.85	6.80
	15	0.0	7.69	6.76
	16	0.0	7.53	6.72
	17	0.0	7.38	6.68
	18	0.0	7.23	6.65
	19	0.0	7.08	6.61
	20	0.0	6.94	6.58
	21	0.0	6.80	6.55

(to be continued)

Table 3.3(3) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m3/s)	Water Level (m)
	22	0.0	6.67	6.51
	23	0.0	6.53	6.48
(5.30)	0	0.0	6.40	6.45
	1	0.0	6.28	6.43
	2	0.0	6.16	6.40
	3	0.0	6.04	6.37
	4	0.0	5.92	6.35
	5	0.0	5.80	6.32
	6	0.0	5.69	6.30
	7	0.0	5.58	6.27
	8	0.0	5.48	6.25
	9	0.0	5.37	6.23
	10	0.0	5.27	6.21
	11	0.0	5.17	6.19
	12	0.0	5.08	6.17
	13	0.0	4.98	6.15
	14	0.0	4.89	6.13
	15	0.0	4.80	6.11
	16	0.0	4.71	6.09
	17	0.0	4.63	6.08
	18	0.0	4.54	6.06
	19	0.0	4.46	6.04
	20	0.0	4.38	6.03
	21	0.0	4.31	6.01
	22	0.0	4.23	6.00
	23	0.0	4.16	5.98
(5.31)	0	0.0	4.08	5.97
	1	0.0	4.01	5.96
	2	0.0	3.95	5.94
	3	0.0	3.88	5.93
	4	0.0	3.81	5.92
	5	0.0	3.75	5.90
	6	0.0	3.69	5.89
	7	0.0	3.62	5.88
	8	0.0	3.57	5.86
	9	0.0	3.51	5.85
	10	0.0	3.45	5.84

	Time	Rainfall (mm)	Inflow (m3/s)	Water Level (m)
	11	0.0	3.39	5.83
	12	0.0	3.34	5.82
	13	0.0	3.29	5.80
	14	0.0	3.24	5.79
	15	0.0	3.19	5.78
	16	0.0	3.14	5.77
	17	0.0	3.09	5.76
	18	0.0	3.04	5.75
	19	0.0	2.99	5.74
	20	0.0	2.95	5.73
	21	0.0	2.91	5.72
	22	0.0	2.86	5.71
	23	0.0	2.82	5.70
(6.1)	0	0.0	2.78	5.69
	1	0.0	2.74	5.68
	2	0.0	2.70	5.67
	3	0.0	2.66	5.66
	4	0.0	2.63	5.65
	5	0.0	2.59	5.64
	6	0.0	2.55	5.63
	7	0.0	2.52	5.62
	8	0.0	2.49	5.61
	9	0.0	2.45	5.60
	10	0.0	2.42	5.59
	11	0.0	2.39	5.59
	12	0.0	2.36	5.58
	13	0.0	2.33	5.57
	14	0.0	2.30	5.56
	15	0.0	2.27	5.55
	16	0.0	2.24	5.54
	17	0.0	2.21	5.54
	18	0.0	2.19	5.53
	19	0.0	2.16	5.52
	20	0.0	2.14	5.51
	21	0.0	2.11	5.51
	22	0.0	2.09	5.50
	23	0.0	2.06	5.49

Table 3.3(4) INPUT CONDITIONS OF DRAINAGE SIMULATION

San Antonio Swamp (1/5 Flood)

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.22)	0	2.42	12.70	2.30
	1	2.97	14.55	2.37
	2	2.56	16.08	2.47
	3	2.90	17.56	2.57
	4	3.49	19.03	2.70
	5	2.81	20.81	2.84
	6	1.24	22.43	3.00
	7	0.62	23.19	3.12
	8	0.33	23.23	3.26
	9	0.02	22.98	3.40
	10	0.15	22.53	3.56
	11	0.45	22.06	3.72
	12	0.99	21.76	3.89
	13	0.66	21.77	4.07
	14	0.59	21.79	4.27
	15	0.27	21.69	4.46
	16	0.15	21.45	4.66
	17	2.40	21.07	4.85
	18	2.39	21.58	5.03
	19	4.06	22.71	5.20
	20	5.14	24.49	5.37
	21	4.74	27.15	5.53
	22	3.26	29.89	5.70
	23	2.37	31.84	5.86
(5.23)	0	3.90	32.97	6.03
	1	3.57	34.44	6.21
	2	3.99	36.17	6.39
	3	1.92	37.95	6.57
	4	2.00	38.95	6.76
	5	2.49	39.35	6.95
	6	4.85	39.98	7.14
	7	2.14	41.70	7.34
	8	2.22	42.94	7.53
	9	0.24	43.40	7.72
	10	0.11	43.05	7.92
	11	0.0	42.09	8.04
	12	0.01	41.06	8.12
	13	0.01	40.04	8.20
	14	0.02	39.04	8.28
	15	1.62	38.08	8.37
	16	1.22	37.81	8.45
	17	1.24	37.84	8.54
	18	1.22	37.76	8.63
	19	0.45	37.70	8.73
	20	8.43	37.74	8.82
	21	3.31	43.66	8.92
	22	3.36	49.91	9.02
	23	3.31	53.23	9.11
(5.24)	0	2.95	56.48	9.20
	1	2.10	59.33	9.28
	2	2.12	61.22	9.36
	3	2.07	62.61	9.44
	4	2.06	63.94	9.51
	5	1.69	65.20	9.57
	6	2.09	66.11	9.64
	7	4.07	67.12	9.70
	8	2.55	69.97	9.75
	9	2.16	72.63	9.81
	10	2.15	74.03	9.86
	11	2.09	75.16	9.91
	12	4.87	76.22	9.95
	13	2.10	79.51	10.00
	14	0.87	82.04	10.01
	15	1.24	81.88	10.02
	16	0.44	81.33	10.04
	17	0.45	80.34	10.05
	18	0.82	78.92	10.06
	19	1.65	77.85	10.07
	20	1.65	77.72	10.08
	21	1.66	78.06	10.09
	22	1.27	78.40	10.10
	23	1.27	78.43	10.11
(5.25)	0	1.25	78.22	10.12
	1	1.24	78.01	10.13
	2	2.44	77.77	10.14
	3	2.87	78.53	10.15
	4	1.31	80.32	10.16
	5	0.49	81.03	10.17
	6	0.46	80.13	10.18
	7	0.44	78.75	10.19
	8	0.44	77.38	10.20
	9	1.64	76.03	10.20
	10	0.85	75.71	10.21
	11	1.26	75.44	10.22
	12	2.07	75.06	10.23
	13	0.45	75.60	10.24
	14	1.65	75.25	10.25
	15	2.45	74.97	10.26
	16	1.25	76.05	10.26
	17	1.25	76.57	10.27
	18	1.60	76.38	10.28
	19	1.67	76.54	10.29

(to be continued)

Table 3.3(5) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	20	2.46	76.94	10.30
	21	4.54	78.00	10.31
	22	2.50	81.20	10.32
	23	2.46	83.83	10.32
(5.26)	0	1.27	85.18	10.33
	1	1.25	85.50	10.34
	2	0.86	85.09	10.35
	3	2.05	84.36	10.36
	4	0.42	84.42	10.37
	5	0.42	83.81	10.38
	6	0.42	82.27	10.38
	7	0.0	80.78	10.39
	8	0.0	78.97	10.40
	9	0.40	76.97	10.41
	10	0.40	75.35	10.41
	11	2.00	74.01	10.42
	12	1.62	74.02	10.42
	13	0.01	74.64	10.43
	14	0.40	73.70	10.43
	15	0.40	72.18	10.44
	16	0.80	70.91	10.44
	17	0.80	70.02	10.44
	18	0.0	69.37	10.45
	19	0.40	68.08	10.45
	20	0.0	66.70	10.45
	21	0.40	65.25	10.46
	22	0.0	63.94	10.46
	23	0.0	62.57	10.46
(5.27)	0	0.0	61.00	10.46
	1	0.0	59.47	10.46
	2	0.81	57.99	10.46
	3	0.40	57.21	10.46
	4	0.80	56.57	10.46
	5	0.81	56.04	10.46
	6	0.42	55.77	10.47
	7	0.81	55.19	10.47
	8	0.0	54.72	10.47
	9	0.01	53.82	10.47
	10	0.0	52.49	10.47
	11	0.0	51.20	10.47
	12	0.0	49.93	10.47
	13	0.0	48.69	10.46
	14	0.0	47.49	10.46
	15	0.0	46.32	10.46
	16	0.0	45.18	10.46
	17	0.0	44.07	10.46
	18	0.0	42.99	10.45
	19	0.0	41.93	10.45
	20	0.0	40.91	10.44
	21	0.0	39.91	10.44
	22	0.0	38.93	10.43
	23	0.0	37.98	10.42
(5.28)	0	0.0	37.06	10.42
	1	0.0	36.16	10.41
	2	0.0	35.28	10.40
	3	0.0	34.43	10.39
	4	0.0	33.59	10.38
	5	0.0	32.78	10.37
	6	0.0	31.99	10.36
	7	0.0	31.22	10.35
	8	0.0	30.47	10.34
	9	0.0	29.74	10.32
	10	0.0	29.03	10.31
	11	0.0	28.34	10.30
	12	0.0	27.66	10.28
	13	0.0	27.00	10.27
	14	0.0	26.36	10.26
	15	0.0	25.74	10.24
	16	0.0	25.13	10.23
	17	0.0	24.54	10.21
	18	0.0	23.96	10.19
	19	0.0	23.39	10.17
	20	0.0	22.84	10.14
	21	0.0	22.31	10.11
	22	0.0	21.79	10.08
	23	0.0	21.28	10.05
(5.29)	0	0.0	20.78	10.01
	1	0.0	20.30	9.93
	2	0.0	19.83	9.82
	3	0.0	19.37	9.71
	4	0.0	18.92	9.60
	5	0.0	18.49	9.51
	6	0.0	18.06	9.42
	7	0.0	17.65	9.33
	8	0.0	17.24	9.25
	9	0.0	16.85	9.17
	10	0.0	16.46	9.10
	11	0.0	16.09	9.03
	12	0.0	15.72	8.97
	13	0.0	15.37	8.90
	14	0.0	15.02	8.84
	15	0.0	14.68	8.77

(to be continued)

Table 3.3(6) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	16	0.0	14.35	8.71
	17	0.0	14.03	8.65
	18	0.0	13.72	8.59
	19	0.0	13.41	8.53
	20	0.0	13.12	8.47
	21	0.0	12.82	8.41
	22	0.0	12.54	8.36
	23	0.0	12.26	8.30
(5.30)	0	0.0	12.00	8.25
	1	0.0	11.73	8.20
	2	0.0	11.48	8.15
	3	0.0	11.23	8.10
	4	0.0	10.98	8.05
	5	0.0	10.74	8.00
	6	0.0	10.51	7.90
	7	0.0	10.29	7.80
	8	0.0	10.07	7.70
	9	0.0	9.85	7.61
	10	0.0	9.64	7.52
	11	0.0	9.44	7.44
	12	0.0	9.24	7.37
	13	0.0	9.04	7.30
	14	0.0	8.85	7.23
	15	0.0	8.67	7.17
	16	0.0	8.48	7.12
	17	0.0	8.31	7.06
	18	0.0	8.14	7.01
	19	0.0	7.97	6.96
	20	0.0	7.80	6.92
	21	0.0	7.64	6.88
	22	0.0	7.49	6.84
	23	0.0	7.34	6.80
(5.31)	0	0.0	7.19	6.76
	1	0.0	7.04	6.73
	2	0.0	6.90	6.69
	3	0.0	6.76	6.66
	4	0.0	6.63	6.63
	5	0.0	6.50	6.60
	6	0.0	6.37	6.58
	7	0.0	6.24	6.55

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	8	0.0	6.12	6.52
	9	0.0	6.00	6.50
	10	0.0	5.89	6.48
	11	0.0	5.77	6.45
	12	0.0	5.66	6.43
	13	0.0	5.56	6.41
	14	0.0	5.45	6.39
	15	0.0	5.35	6.37
	16	0.0	5.25	6.36
	17	0.0	5.15	6.34
	18	0.0	5.05	6.32
	19	0.0	4.96	6.31
	20	0.0	4.87	6.29
	21	0.0	4.78	6.27
	22	0.0	4.69	6.26
	23	0.0	4.61	6.25
(6.1)	0	0.0	4.52	6.23
	1	0.0	4.44	6.22
	2	0.0	4.36	6.21
	3	0.0	4.29	6.19
	4	0.0	4.21	6.18
	5	0.0	4.14	6.17
	6	0.0	4.07	6.16
	7	0.0	4.00	6.15
	8	0.0	3.93	6.14
	9	0.0	3.86	6.13
	10	0.0	3.80	6.12
	11	0.0	3.73	6.11
	12	0.0	3.67	6.10
	13	0.0	3.61	6.09
	14	0.0	3.55	6.08
	15	0.0	3.49	6.07
	16	0.0	3.44	6.06
	17	0.0	3.38	6.06
	18	0.0	3.33	6.05
	19	0.0	3.28	6.04
	20	0.0	3.22	6.03
	21	0.0	3.17	6.03
	22	0.0	3.13	6.02
	23	0.0	3.08	6.01

Table 3.3(7) INPUT CONDITIONS OF DRAINAGE SIMULATION

San Antonio Swamp (1/10 Flood)

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.22)	0	3.11	16.19	2.33
	1	3.82	18.60	2.43
	2	3.29	20.57	2.55
	3	3.74	22.49	2.70
	4	4.49	24.40	2.88
	5	3.61	26.70	3.06
	6	1.60	28.80	3.22
	7	0.80	29.78	3.40
	8	0.43	29.83	3.60
	9	0.03	29.50	3.83
	10	0.19	28.92	4.07
	11	0.58	28.29	4.33
	12	1.28	27.89	4.61
	13	0.85	27.90	4.88
	14	0.76	27.93	5.14
	15	0.34	27.80	5.38
	16	0.19	27.48	5.62
	17	3.09	26.98	5.84
	18	3.08	27.64	6.07
	19	5.23	29.10	6.29
	20	6.61	31.41	6.51
	21	6.10	34.86	6.72
	22	4.19	38.41	6.92
	23	3.05	40.95	7.12
(5.23)	0	5.02	42.40	7.31
	1	4.60	44.30	7.51
	2	5.14	46.55	7.71
	3	2.47	48.85	7.91
	4	2.57	52.20	8.05
	5	3.20	54.28	8.14
	6	6.24	56.90	8.23
	7	2.75	62.30	8.33
	8	2.86	66.49	8.44
	9	0.31	68.70	8.54
	10	0.14	68.83	8.65
	11	0.0	67.38	8.75
	12	0.02	65.75	8.86
	13	0.02	64.10	8.97
	14	0.03	62.51	9.07
	15	2.09	60.96	9.16
	16	1.58	61.15	9.25
	17	1.59	62.08	9.34
	18	1.58	62.71	9.43
	19	0.58	63.32	9.52
	20	10.84	63.09	9.60
	21	4.26	70.73	9.69
	22	4.32	78.66	9.77
	23	4.26	82.69	9.86
(5.24)	0	3.79	86.61	9.94
	1	2.70	90.01	10.01
	2	2.73	92.14	10.03
	3	2.67	93.62	10.05
	4	2.65	95.03	10.07
	5	2.17	96.35	10.10
	6	2.68	97.23	10.12
	7	5.24	98.24	10.14
	8	3.28	101.65	10.16
	9	2.78	104.83	10.19
	10	2.76	106.37	10.21
	11	2.68	107.56	10.23
	12	6.27	108.65	10.25
	13	2.70	112.68	10.28
	14	1.12	115.70	10.30
	15	1.59	115.23	10.32
	16	0.56	114.25	10.35
	17	0.58	112.70	10.37
	18	1.06	110.60	10.39
	19	2.12	108.98	10.41
	20	2.12	108.57	10.43
	21	2.14	108.79	10.45
	22	1.64	109.02	10.46
	23	1.64	108.83	10.48
(5.25)	0	1.61	108.36	10.50
	1	1.59	107.87	10.51
	2	3.14	107.36	10.52
	3	3.70	108.16	10.54
	4	1.69	110.30	10.55
	5	0.62	111.03	10.57
	6	0.59	109.68	10.58
	7	0.56	107.72	10.59
	8	0.56	105.76	10.61
	9	2.11	103.84	10.62
	10	1.09	103.26	10.63
	11	1.62	102.75	10.64
	12	2.67	102.10	10.66
	13	0.58	102.66	10.67
	14	2.12	102.06	10.68
	15	3.15	101.55	10.69
	16	1.61	102.31	10.70
	17	1.61	103.35	10.71
	18	2.14	102.98	10.72
	19	2.15	103.06	10.73

(to be continued)

Table 3.3(8) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	20	3.17	103.46	10.73
	21	5.84	104.70	10.74
	22	3.21	108.75	10.75
	23	3.17	112.05	10.76
(5.26)	0	1.64	113.70	10.77
	1	1.61	113.99	10.78
	2	1.11	113.36	10.79
	3	2.64	112.30	10.79
	4	0.55	112.27	10.80
	5	0.55	111.37	10.81
	6	0.55	109.28	10.82
	7	0.0	107.24	10.82
	8	0.0	104.80	10.83
	9	0.51	102.11	10.83
	10	0.51	99.92	10.84
	11	2.57	98.08	10.84
	12	2.09	98.02	10.84
	13	0.02	98.75	10.84
	14	0.51	97.45	10.85
	15	0.51	95.39	10.85
	16	1.03	93.68	10.85
	17	1.03	92.44	10.85
	18	0.0	91.53	10.85
	19	0.51	89.79	10.85
	20	0.0	87.93	10.85
	21	0.51	85.99	10.85
	22	0.0	84.22	10.85
	23	0.0	82.38	10.85
(5.27)	0	0.0	80.29	10.85
	1	0.0	78.25	10.84
	2	1.05	76.27	10.84
	3	0.51	75.20	10.84
	4	1.03	74.33	10.84
	5	1.05	73.59	10.84
	6	0.55	73.19	10.84
	7	1.05	72.39	10.84
	8	0.0	71.74	10.83
	9	0.02	70.53	10.83
	10	0.0	68.77	10.83
	11	0.0	67.05	10.83
	12	0.0	65.36	10.83
	13	0.0	63.72	10.83
	14	0.0	62.12	10.83
	15	0.0	60.57	10.83
	16	0.0	59.05	10.82
	17	0.0	57.58	10.82

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	18	0.0	56.14	10.82
	19	0.0	54.74	10.81
	20	0.0	53.38	10.81
	21	0.0	52.06	10.80
	22	0.0	50.77	10.80
	23	0.0	49.51	10.79
(5.28)	0	0.0	48.28	10.79
	1	0.0	47.09	10.78
	2	0.0	45.93	10.78
	3	0.0	44.80	10.77
	4	0.0	43.70	10.77
	5	0.0	42.63	10.76
	6	0.0	41.58	10.75
	7	0.0	40.56	10.75
	8	0.0	39.57	10.74
	9	0.0	38.61	10.74
	10	0.0	37.67	10.73
	11	0.0	36.75	10.72
	12	0.0	35.86	10.72
	13	0.0	34.99	10.71
	14	0.0	34.14	10.70
	15	0.0	33.32	10.70
	16	0.0	32.51	10.69
	17	0.0	31.73	10.69
	18	0.0	30.97	10.68
	19	0.0	30.23	10.67
	20	0.0	29.50	10.67
	21	0.0	28.80	10.66
	22	0.0	28.11	10.65
	23	0.0	27.44	10.64
(5.29)	0	0.0	26.79	10.63
	1	0.0	26.15	10.62
	2	0.0	25.53	10.61
	3	0.0	24.93	10.59
	4	0.0	24.34	10.58
	5	0.0	23.77	10.57
	6	0.0	23.21	10.55
	7	0.0	22.66	10.53
	8	0.0	22.13	10.52
	9	0.0	21.61	10.50
	10	0.0	21.11	10.48
	11	0.0	20.62	10.46
	12	0.0	20.14	10.44
	13	0.0	19.67	10.42
	14	0.0	19.22	10.39
	15	0.0	18.77	10.36

(to be continued)

Table 3.3(9) INPUT CONDITIONS OF DRAINAGE SIMULATION

Date	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	16	0.0	18.34	10.33
	17	0.0	17.92	10.29
	18	0.0	17.51	10.26
	19	0.0	17.11	10.22
	20	0.0	16.72	10.18
	21	0.0	16.34	10.14
	22	0.0	15.97	10.09
	23	0.0	15.60	10.05
(5.30)	0	0.0	15.25	10.01
	1	0.0	14.91	9.91
	2	0.0	14.57	9.78
	3	0.0	14.25	9.65
	4	0.0	13.93	9.54
	5	0.0	13.62	9.43
	6	0.0	13.31	9.33
	7	0.0	13.02	9.24
	8	0.0	12.73	9.16
	9	0.0	12.45	9.08
	10	0.0	12.17	9.01
	11	0.0	11.91	8.93
	12	0.0	11.65	8.86
	13	0.0	11.39	8.79
	14	0.0	11.14	8.72
	15	0.0	10.90	8.65
	16	0.0	10.67	8.59
	17	0.0	10.44	8.52
	18	0.0	10.21	8.46
	19	0.0	9.99	8.40
	20	0.0	9.78	8.34
	21	0.0	9.57	8.29
	22	0.0	9.37	8.23
	23	0.0	9.17	8.18
(5.31)	0	0.0	8.98	8.13
	1	0.0	8.79	8.08
	2	0.0	8.60	8.03
	3	0.0	8.43	7.95
	4	0.0	8.25	7.84
	5	0.0	8.08	7.74
	6	0.0	7.91	7.65
	7	0.0	7.75	7.56
	8	0.0	7.59	7.48
	9	0.0	7.44	7.40
	10	0.0	7.29	7.33
	11	0.0	7.14	7.27
	12	0.0	7.00	7.21
	13	0.0	6.86	7.15
	14	0.0	6.72	7.10
	15	0.0	6.59	7.05
	16	0.0	6.46	7.00
	17	0.0	6.33	6.96
	18	0.0	6.20	6.92
	19	0.0	6.08	6.88
	20	0.0	5.96	6.84
	21	0.0	5.85	6.81
	22	0.0	5.74	6.77
	23	0.0	5.63	6.74
(6.1)	0	0.0	5.52	6.71
	1	0.0	5.42	6.68
	2	0.0	5.31	6.66
	3	0.0	5.21	6.63
	4	0.0	5.12	6.61
	5	0.0	5.02	6.58
	6	0.0	4.93	6.56
	7	0.0	4.84	6.54
	8	0.0	4.75	6.52
	9	0.0	4.66	6.50
	10	0.0	4.58	6.49
	11	0.0	4.50	6.47
	12	0.0	4.42	6.45
	13	0.0	4.34	6.44
	14	0.0	4.26	6.42
	15	0.0	4.19	6.41
	16	0.0	4.12	6.39
	17	0.0	4.04	6.38
	18	0.0	3.97	6.37
	19	0.0	3.91	6.36
	20	0.0	3.84	6.34
	21	0.0	3.78	6.33
	22	0.0	3.71	6.32
	23	0.0	3.65	6.31

Table 3.3(10) INPUT CONDITIONS OF DRAINAGE SIMULATION

Candaba Swamp (1/2 Flood)

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)		Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.22)	0	0.01	14.86	2.19		22	1.95	48.57	3.95
	1	0.27	14.84	2.20		23	1.45	49.12	3.98
	2	0.17	14.91	2.25	(5.24)	0	1.30	49.33	4.02
	3	0.30	14.95	2.28		1	0.72	49.40	4.04
	4	0.32	15.03	2.31		2	0.60	49.06	4.05
	5	1.12	15.12	2.33		3	0.35	48.60	4.07
	6	1.25	15.53	2.36		4	1.39	47.98	4.09
	7	2.13	16.03	2.39		5	0.61	48.07	4.10
	8	1.86	16.91	2.42		6	0.29	47.69	4.12
	9	1.21	17.74	2.45		7	1.15	47.05	4.13
	10	0.72	18.28	2.48		8	1.17	47.00	4.15
	11	1.62	18.56	2.52		9	0.99	47.02	4.16
	12	2.54	19.24	2.55		10	0.71	46.91	4.18
	13	1.87	20.41	2.59		11	0.58	46.61	4.19
	14	1.67	21.30	2.63		12	1.19	46.21	4.21
	15	2.13	22.07	2.67		13	1.72	46.22	4.22
	16	1.13	23.07	2.71		14	1.15	46.63	4.24
	17	1.21	23.56	2.76		15	0.32	46.68	4.25
	18	0.52	24.04	2.80		16	0.71	46.13	4.27
	19	0.10	24.15	2.85		17	0.71	45.80	4.28
	20	4.76	24.00	2.91		18	1.79	45.51	4.30
	21	0.83	26.36	2.96		19	0.30	45.95	4.32
	22	0.82	26.80	2.99		20	0.63	45.45	4.33
	23	2.33	27.01	3.03		21	0.61	45.08	4.35
(5.23)	0	0.46	28.06	3.06		22	0.63	44.73	4.37
	1	2.68	28.13	3.09		23	0.91	44.40	4.38
	2	2.61	29.36	3.13	(5.25)	0	0.76	44.27	4.40
	3	2.14	30.67	3.16		1	3.25	44.06	4.42
	4	2.41	31.70	3.20		2	0.76	45.52	4.30
	5	2.24	32.85	3.23		3	1.90	45.43	4.45
	6	5.24	33.90	3.27		4	1.33	45.96	4.47
	7	3.27	36.80	3.31		5	2.39	46.15	4.49
	8	3.94	38.64	3.35		6	1.26	47.04	4.51
	9	3.39	40.78	3.39		7	1.92	47.19	4.53
	10	1.56	42.58	3.43		8	1.19	47.73	4.56
	11	1.58	43.11	3.48		9	1.19	47.80	4.58
	12	1.66	43.52	3.52		10	1.03	47.81	4.60
	13	1.41	43.97	3.56		11	1.33	47.72	4.63
	14	1.95	44.26	3.61		12	0.89	47.82	4.65
	15	1.65	44.89	3.65		13	1.59	47.64	4.67
	16	1.93	45.33	3.69		14	1.30	47.91	4.70
	17	1.19	45.93	3.74		15	0.56	48.03	4.72
	18	2.53	46.04	3.78		16	0.43	47.61	4.75
	19	1.21	47.01	3.82		17	0.57	47.07	4.77
	20	2.69	47.15	3.87		18	0.15	46.62	4.80
	21	1.56	48.21	3.91		19	0.0	45.92	4.83

(to be continued)

Table 3.3(11) INPUT CONDITIONS OF DRAINAGE SIMULATION

Date	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	20	0.13	45.11	4.85
	21	0.12	44.40	4.88
	22	1.44	43.71	4.91
	23	2.40	43.92	4.93
(5.26)	0	0.25	44.86	4.96
	1	0.75	44.39	4.98
	2	0.02	44.13	5.00
	3	0.53	43.42	5.02
	4	0.50	43.02	5.04
	5	0.0	42.65	5.05
	6	0.12	41.96	5.07
	7	0.13	41.33	5.09
	8	0.12	40.73	5.10
	9	0.25	40.15	5.12
	10	0.14	39.67	5.14
	11	0.37	39.13	5.15
	12	0.27	38.75	5.17
	13	0.39	38.33	5.19
	14	1.03	37.99	5.21
	15	1.68	38.08	5.23
	16	1.32	38.62	5.25
	17	1.14	38.96	5.26
	18	0.0	39.15	5.28
	19	0.37	38.60	5.30
	20	0.02	38.22	5.31
	21	0.01	37.66	5.33
	22	0.26	37.08	5.35
	23	0.0	36.68	5.37
(5.27)	0	0.0	36.14	5.39
	1	0.12	35.60	5.41
	2	0.68	35.15	5.42
	3	0.52	35.06	5.44
	4	2.47	34.91	5.46
	5	5.17	35.97	5.47
	6	1.86	38.85	5.49
	7	0.49	39.75	5.51
	8	0.0	39.54	5.52
	9	0.82	38.93	5.54
	10	0.0	38.84	5.56
	11	0.0	38.27	5.57
	12	0.0	37.67	5.59
	13	0.0	37.09	5.60
	14	0.0	36.52	5.62
	15	0.0	35.96	5.63
	16	0.0	35.43	5.64
	17	0.0	34.91	5.66
	18	0.0	34.40	5.67
	19	0.0	33.90	5.68
	20	0.0	33.42	5.69
	21	0.0	32.96	5.70
	22	0.0	32.50	5.71
	23	0.0	32.06	5.72
(5.28)	0	0.0	31.63	5.73
	1	0.0	31.21	5.74
	2	0.0	30.80	5.75
	3	0.0	30.40	5.76
	4	0.0	30.01	5.77
	5	0.0	29.64	5.77
	6	0.0	29.27	5.78
	7	0.0	28.91	5.79
	8	0.0	28.56	5.79
	9	0.0	28.22	5.80
	10	0.0	27.89	5.81
	11	0.0	27.57	5.81
	12	0.0	27.25	5.82
	13	0.0	26.94	5.82
	14	0.0	26.64	5.83
	15	0.0	26.35	5.83
	16	0.0	26.07	5.83
	17	0.0	25.79	5.84
	18	0.0	25.52	5.84
	19	0.0	25.25	5.84
	20	0.0	24.99	5.85
	21	0.0	24.74	5.85
	22	0.0	24.50	5.85
	23	0.0	24.26	5.86
(5.29)	0	0.0	24.02	5.86
	1	0.0	23.79	5.86
	2	0.0	23.57	5.87
	3	0.0	23.55	5.87
	4	0.0	23.14	5.87
	5	0.0	22.93	5.87
	6	0.0	22.73	5.87
	7	0.0	22.53	5.87
	8	0.0	22.33	5.88
	9	0.0	22.14	5.88
	10	0.0	21.96	5.88
	11	0.0	21.78	5.88
	12	0.0	21.60	5.88
	13	0.0	21.42	5.88
	14	0.0	21.25	5.89
	15	0.0	21.09	5.89

(to be continued)

Table 3.3(12) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	16	0.0	20.93	5.89
	17	0.0	20.77	5.89
	18	0.0	20.61	5.89
	19	0.0	20.46	5.89
	20	0.0	20.31	5.90
	21	0.0	20.17	5.90
	22	0.0	20.03	5.90
	23	0.0	19.89	5.90
(5.30)	0	0.0	19.75	5.90
	1	0.0	19.62	5.90
	2	0.0	19.49	5.91
	3	0.0	19.36	5.91
	4	0.0	19.23	5.91
	5	0.0	19.11	5.91
	6	0.0	18.99	5.91
	7	0.0	18.88	5.91
	8	0.0	18.76	5.91
	9	0.0	18.65	5.91
	10	0.0	18.54	5.91
	11	0.0	18.43	5.92
	12	0.0	18.32	5.92
	13	0.0	18.22	5.92
	14	0.0	18.12	5.92
	15	0.0	18.02	5.92
	16	0.0	17.92	5.92
	17	0.0	17.83	5.92
	18	0.0	17.73	5.92
	19	0.0	17.64	5.92
	20	0.0	17.55	5.92
	21	0.0	17.46	5.92
	22	0.0	17.38	5.92
	23	0.0	17.29	5.93
(5.31)	0	0.0	17.21	5.93
	1	0.0	17.13	5.93
	2	0.0	17.05	5.93
	3	0.0	16.97	5.93
	4	0.0	16.89	5.93
	5	0.0	16.82	5.93
	6	0.0	16.74	5.93
	7	0.0	16.67	5.93

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	8	0.0	16.60	5.93
	9	0.0	16.53	5.93
	10	0.0	16.46	5.93
	11	0.0	16.39	5.93
	12	0.0	16.33	5.93
	13	0.0	16.26	5.93
	14	0.0	16.20	5.93
	15	0.0	16.14	5.93
	16	0.0	16.08	5.93
	17	0.0	16.02	5.93
	18	0.0	15.96	5.93
	19	0.0	15.90	5.93
	20	0.0	15.84	5.93
	21	0.0	15.79	5.93
	22	0.0	15.73	5.93
	23	0.0	15.68	5.93
(6.1)	0	0.0	15.62	5.93
	1	0.0	15.57	5.93
	2	0.0	15.52	5.93
	3	0.0	15.47	5.94
	4	0.0	15.42	5.94
	5	0.0	15.37	5.94
	6	0.0	15.32	5.94
	7	0.0	15.28	5.94
	8	0.0	15.23	5.94
	9	0.0	15.19	5.94
	10	0.0	15.14	5.94
	11	0.0	15.10	5.94
	12	0.0	15.06	5.94
	14	0.0	15.01	5.94
	14	0.0	14.97	5.94
	15	0.0	14.93	5.94
	16	0.0	14.89	5.94
	17	0.0	14.85	5.94
	18	0.0	14.81	5.94
	19	0.0	14.78	5.94
	20	0.0	14.74	5.94
	21	0.0	14.70	5.94
	22	0.0	14.66	5.94
	23	0.0	14.63	5.94

Table 3.3(13) INPUT CONDITIONS OF DRAINAGE SIMULATION

Candaba Swamp (1/5 Flood)

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.22)	0	0.02	17.91	2.24
	1	0.48	17.85	2.27
	2	0.30	17.98	2.30
	3	0.53	18.04	2.34
	4	0.56	18.19	2.39
	5	1.98	18.37	2.42
	6	2.19	19.21	2.45
	7	3.74	20.22	2.49
	8	3.28	22.05	2.53
	9	2.12	23.75	2.57
	10	1.27	24.83	2.61
	11	2.86	25.38	2.65
	12	4.46	26.76	2.70
	13	3.29	29.15	2.76
	14	2.94	30.97	2.82
	15	3.74	32.51	2.87
	16	1.99	34.52	2.93
	17	2.13	35.47	2.99
	18	0.92	36.40	3.04
	19	0.18	36.56	3.08
	20	8.38	36.18	3.12
	21	1.46	40.99	3.17
	22	1.45	41.81	3.22
	23	4.10	42.15	3.27
(5.23)	0	0.80	44.25	3.31
	1	4.71	44.29	3.37
	2	4.59	46.74	3.43
	3	3.77	49.36	3.49
	4	4.23	51.37	3.56
	5	3.94	53.62	3.63
	6	9.22	55.67	3.69
	7	5.75	61.54	3.76
	8	6.93	65.19	3.83
	9	5.96	69.43	3.91
	10	2.75	72.97	3.96
	11	2.77	73.87	4.01
	12	2.92	74.51	4.05
	13	2.48	75.25	4.08
	14	3.43	75.64	4.11
	15	2.90	76.74	4.15
	16	3.39	77.46	4.18
	17	2.09	78.51	4.21
	18	4.44	78.53	4.25
	19	2.13	80.33	4.29
	20	4.73	80.42	4.33

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	21	2.74	82.42	4.37
	22	3.44	82.96	4.41
	23	2.54	83.89	4.45
(5.24)	0	2.29	84.13	4.50
	1	1.27	84.09	4.55
	2	1.06	83.21	4.60
	3	0.61	82.10	4.66
	4	2.44	80.65	4.72
	5	1.06	80.68	4.78
	6	0.52	79.75	4.83
	7	2.03	78.31	4.88
	8	2.06	78.07	4.93
	9	1.75	77.97	5.01
	10	1.25	77.64	5.04
	11	1.03	76.90	5.07
	12	2.08	75.97	5.11
	13	3.02	75.88	5.14
	14	2.03	76.61	5.18
	15	0.56	76.62	5.22
	16	1.25	75.38	5.26
	17	1.25	74.62	5.30
	18	3.14	73.94	5.33
	19	0.53	74.75	5.37
	20	1.10	73.65	5.41
	21	1.07	72.82	5.44
	22	1.10	72.04	5.47
	23	1.59	71.30	5.51
(5.25)	0	1.34	70.97	5.55
	1	5.71	70.72	5.59
	2	1.33	75.30	5.63
	3	3.34	75.71	5.67
	4	2.33	78.01	5.71
	5	4.21	79.40	5.75
	6	2.21	83.03	5.79
	7	3.38	84.41	5.83
	8	2.10	87.05	5.87
	9	2.10	88.18	5.91
	10	1.80	89.14	5.95
	11	2.35	89.72	5.99
	12	1.57	90.98	6.02
	13	2.79	91.27	6.04
	14	2.29	93.12	6.06
	15	0.99	94.44	6.09
	16	0.76	93.88	6.12
	17	1.00	92.86	6.15

(to be continued)

Table 3.3(14) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	18	0.27	92.18	6.17
	19	0.0	90.55	6.20
	20	0.23	88.53	6.22
	21	0.22	86.84	6.25
	22	2.53	85.21	6.28
	23	4.23	86.75	6.31
(5.26)	0	0.44	90.88	6.33
	1	1.32	90.00	6.36
	2	0.03	89.83	6.39
	3	0.93	88.04	6.41
	4	0.89	87.34	6.43
	5	0.0	86.73	6.46
	6	0.22	84.94	6.49
	7	0.23	83.37	6.52
	8	0.22	81.90	6.55
	9	0.45	80.46	6.57
	10	0.24	79.36	6.60
	11	0.65	78.06	6.63
	12	0.47	77.31	6.65
	13	0.69	76.40	6.67
	14	1.81	75.78	6.69
	15	2.95	76.69	6.72
	16	2.32	79.24	6.75
	17	2.01	81.06	6.78
	18	0.01	82.35	6.80
	19	0.65	80.87	6.82
	20	0.04	80.04	6.84
	21	0.01	78.49	6.87
	22	0.45	76.88	6.89
	23	0.01	75.89	6.91
(5.27)	0	0.0	74.40	6.49
	1	0.22	72.89	6.96
	2	1.19	71.71	6.98
	3	0.92	71.86	7.00
	4	4.35	71.77	7.01
	5	9.09	76.16	7.03
	6	3.27	87.47	7.05
	7	0.86	91.35	7.06
	8	0.0	90.99	7.08
	9	1.44	89.10	7.09
	10	0.0	89.15	7.10
	11	0.0	87.40	7.12
	12	0.0	85.50	7.14
	13	0.0	83.67	7.16
	14	0.0	81.90	7.17
	15	0.0	80.17	7.18
	16	0.0	78.50	7.19

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	17	0.0	76.88	7.20
	18	0.0	75.31	7.21
	19	0.0	73.79	7.22
	20	0.0	72.31	7.22
	21	0.0	70.88	7.23
	22	0.0	69.48	7.24
	23	0.0	68.13	7.25
(5.28)	0	0.0	66.82	7.26
	1	0.0	65.54	7.26
	2	0.0	64.31	7.27
	3	0.0	63.10	7.27
	4	0.0	61.93	7.27
	5	0.0	60.80	7.28
	6	0.0	59.69	7.28
	7	0.0	58.62	7.28
	8	0.0	57.58	7.29
	9	0.0	56.56	7.29
	10	0.0	55.58	7.29
	11	0.0	54.62	7.29
	12	0.0	53.68	7.29
	13	0.0	52.77	7.29
	14	0.0	51.89	7.29
	15	0.0	51.03	7.29
	16	0.0	50.19	7.29
	17	0.0	49.38	7.29
	18	0.0	48.53	7.29
	19	0.0	47.81	7.29
	20	0.0	47.06	7.29
	21	0.0	46.32	7.29
	22	0.0	45.61	7.29
	23	0.0	44.91	7.28
(5.29)	0	0.0	44.24	7.28
	1	0.0	43.58	7.28
	2	0.0	42.93	7.27
	3	0.0	42.30	7.27
	4	0.0	41.69	7.27
	5	0.0	41.09	7.26
	6	0.0	40.51	7.26
	7	0.0	39.94	7.25
	8	0.0	39.39	7.25
	9	0.0	38.85	7.24
	10	0.0	38.32	7.23
	11	0.0	37.81	7.23
	12	0.0	37.31	7.22
	13	0.0	36.82	7.21
	14	0.0	36.34	7.21
	15	0.0	35.87	7.20

(to be continued)

Table 3.3(15) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m³/s)	Water Level (m)
	16	0.0	35.41	7.19
	17	0.0	34.97	7.18
	18	0.0	34.54	7.16
	19	0.0	34.11	7.15
	20	0.0	33.70	7.14
	21	0.0	33.29	7.12
	22	0.0	32.90	7.10
	23	0.0	32.51	7.08
(5.30)	0	0.0	32.13	7.07
	1	0.0	31.76	7.05
	2	0.0	31.40	7.04
	3	0.0	31.05	7.02
	4	0.0	30.70	7.00
	5	0.0	30.37	6.98
	6	0.0	30.04	6.96
	7	0.0	29.71	6.94
	8	0.0	29.40	6.92
	9	0.0	29.09	6.90
	10	0.0	28.79	6.88
	11	0.0	28.49	6.86
	12	0.0	28.21	6.84
	13	0.0	27.92	6.83
	14	0.0	27.55	6.81
	15	0.0	27.38	6.79
	16	0.0	27.11	6.78
	17	0.0	26.85	6.77
	18	0.0	26.60	6.75
	19	0.0	26.35	6.74
	20	0.0	26.11	6.73
	21	0.0	25.87	6.72
	22	0.0	25.84	6.71
	23	0.0	25.41	6.70
(5.31)	0	0.0	25.19	6.69
	1	0.0	24.97	6.68
	2	0.0	24.75	6.67
	3	0.0	24.54	6.66
	4	0.0	24.34	6.65
	5	0.0	24.14	6.64
	6	0.0	23.94	6.63
	7	0.0	23.75	6.62

	Time	Rainfall (mm)	Inflow (m³/s)	Water Level (m)
	8	0.0	23.56	6.62
	9	0.0	23.37	6.61
	10	0.0	23.19	6.60
	11	0.0	23.01	6.60
	12	0.0	22.83	6.59
	13	0.0	22.66	6.58
	14	0.0	22.50	6.58
	15	0.0	22.33	6.57
	16	0.0	22.17	6.57
	17	0.0	22.01	6.56
	18	0.0	21.85	6.56
	19	0.0	21.70	6.55
	20	0.0	21.55	6.55
	21	0.0	21.41	6.54
	22	0.0	21.26	6.54
	23	0.0	21.12	6.53
(6.1)	0	0.0	20.98	6.53
	1	0.0	20.85	6.52
	2	0.0	20.71	6.52
	3	0.0	20.58	6.51
	4	0.0	20.45	6.50
	5	0.0	20.33	6.50
	6	0.0	20.20	6.49
	7	0.0	20.08	6.49
	8	0.0	19.96	6.48
	9	0.0	19.84	6.48
	10	0.0	19.73	6.48
	11	0.0	19.62	6.47
	12	0.0	19.50	6.47
	13	0.0	19.40	6.47
	14	0.0	19.29	6.46
	15	0.0	19.18	6.46
	16	0.0	19.08	6.45
	17	0.0	18.98	6.45
	18	0.0	18.88	6.44
	19	0.0	18.78	6.44
	20	0.0	16.69	6.43
	21	0.0	18.59	6.43
	22	0.0	18.50	6.42
	23	0.0	18.41	6.42

Table 3.3(16) INPUT CONDITIONS OF DRAINAGE SIMULATION

Candaba Swamp (1/10 Flood)

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
(5.22)	0	0.03	20.15	2.28
	1	0.62	20.07	2.32
	2	0.39	20.23	2.35
	3	0.69	20.30	2.39
	4	0.72	20.51	2.43
	5	2.54	20.75	2.47
	6	2.82	21.90	2.51
	7	4.81	23.30	2.56
	8	4.21	25.81	2.60
	9	2.73	28.15	2.65
	10	1.63	29.63	2.70
	11	3.67	30.37	2.76
	12	5.74	32.25	2.81
	13	4.23	35.54	2.88
	14	3.78	38.03	2.94
	15	4.82	40.13	3.01
	16	2.56	42.87	3.06
	17	2.74	44.15	3.10
	18	1.19	45.39	3.15
	19	0.23	45.56	3.20
	20	10.78	44.98	3.26
	21	1.88	51.60	3.31
	22	1.86	52.68	3.37
	23	5.28	53.09	3.44
(5.23)	0	1.03	55.94	3.50
	1	6.06	55.92	3.58
	2	5.91	59.26	3.65
	3	4.85	62.81	3.73
	4	5.44	65.52	3.82
	5	5.07	68.55	3.91
	6	11.86	71.30	4.00
	7	7.40	79.33	4.04
	8	8.91	84.27	4.09
	9	7.67	90.02	4.13
	10	3.54	94.80	4.18
	11	3.57	95.90	4.22
	12	3.76	96.66	4.27
	13	3.19	97.56	4.32
	14	4.42	97.97	4.38
	15	3.73	99.36	4.43
	16	4.37	100.22	4.49
	17	2.69	101.55	4.55
	18	5.72	101.47	4.61
	19	2.74	103.83	4.68
	20	6.09	103.83	4.76
	21	3.53	106.46	4.83
	22	4.42	107.77	4.90
	23	3.27	110.44	4.97
(5.24)	0	2.95	112.03	5.04
	1	1.63	113.16	5.08
	2	1.36	112.59	5.13
	3	0.79	111.55	5.17
	4	3.15	109.79	5.22
	5	1.37	111.14	5.26
	6	0.66	110.46	5.31
	7	2.61	108.63	5.36
	8	2.65	109.41	5.40
	9	2.25	110.52	5.45
	10	1.61	111.11	5.50
	11	1.32	110.78	5.54
	12	2.68	109.99	5.59
	13	3.89	111.09	5.64
	14	2.61	114.10	5.69
	15	0.72	115.43	5.75
	16	1.61	113.87	5.79
	17	1.61	113.37	5.84
	18	4.04	113.03	5.89
	19	0.69	116.21	5.94
	20	1.41	114.84	5.98
	21	1.38	114.08	6.03
	22	1.42	113.41	6.07
	23	2.05	112.82	6.10
(5.25)	0	1.72	113.18	6.14
	1	7.34	113.15	6.17
	2	1.71	121.33	6.21
	3	4.30	121.88	6.24
	4	3.00	125.46	6.28
	5	5.41	127.40	6.31
	6	2.84	132.80	6.35
	7	4.35	134.52	6.39
	8	2.70	138.16	6.43
	9	2.70	139.39	6.47
	10	2.32	140.34	6.51
	11	3.02	140.69	6.54
	12	2.02	142.05	6.58
	13	3.59	141.94	6.62
	14	2.95	144.15	6.66
	15	1.27	145.55	6.70
	16	0.97	144.15	6.74
	17	1.29	142.08	6.77
	18	0.35	140.52	6.81
	19	0.0	137.59	6.84
	20	0.30	134.09	6.88
	21	0.28	131.11	6.91

(to be continued)

Table 3.3(17) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	22	3.26	128.25	6.94
	23	5.44	130.04	6.98
(5.26)	0	0.57	135.61	7.01
	1	1.70	133.84	7.04
	2	0.04	133.13	7.06
	3	1.19	130.05	7.09
	4	1.14	128.59	7.11
	5	0.0	127.28	7.14
	6	0.28	124.26	7.16
	7	0.30	121.59	7.19
	8	0.28	119.08	7.21
	9	0.57	116.63	7.24
	10	0.31	114.69	7.26
	11	0.83	112.47	7.29
	12	0.61	111.05	7.31
	13	0.89	109.42	7.33
	14	2.33	108.22	7.36
	15	3.80	109.21	7.38
	16	2.98	112.56	7.40
	17	2.58	114.85	7.42
	18	0.01	116.36	7.44
	19	0.84	113.94	7.46
	20	0.05	112.45	7.48
	21	0.01	109.96	7.50
	22	0.58	107.38	7.52
	23	0.01	105.71	7.53
(5.27)	0	0.0	103.35	7.55
	1	0.28	100.96	7.57
	2	1.53	99.05	7.58
	3	1.18	99.03	7.60
	4	5.59	98.68	7.62
	5	11.69	104.67	7.63
	6	4.20	120.36	7.65
	7	1.11	125.54	7.67
	8	0.0	124.74	7.68
	9	1.85	121.82	7.70
	10	0.0	121.62	7.71
	11	0.0	118.91	7.73
	12	0.0	116.01	7.74
	13	0.0	113.21	7.75
	14	0.0	110.51	7.77
	15	0.0	107.89	7.78
	16	0.0	105.36	7.79
	17	0.0	102.91	7.79
	18	0.0	100.54	7.80
	19	0.0	98.25	7.81
	20	0.0	96.03	7.81

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	21	0.0	93.88	7.82
	22	0.0	91.80	7.83
	23	0.0	89.78	7.83
(5.28)	0	0.0	87.82	7.84
	1	0.0	85.93	7.84
	2	0.0	84.09	7.85
	3	0.0	82.31	7.85
	4	0.0	80.59	7.85
	5	0.0	78.92	7.85
	6	0.0	77.29	7.85
	7	0.0	75.72	7.85
	8	0.0	74.19	7.85
	9	0.0	72.71	7.85
	10	0.0	71.27	7.85
	11	0.0	69.87	7.85
	12	0.0	68.51	7.85
	13	0.0	67.20	7.85
	14	0.0	65.92	7.85
	15	0.0	64.67	7.85
	16	0.0	63.47	7.85
	17	0.0	62.29	7.84
	18	0.0	61.15	7.84
	19	0.0	60.04	7.84
	20	0.0	58.97	7.84
	21	0.0	57.92	7.84
	22	0.0	56.90	7.83
	23	0.0	55.91	7.83
(5.29)	0	0.0	54.94	7.83
	1	0.0	54.00	7.83
	2	0.0	53.09	7.82
	3	0.0	52.20	7.82
	4	0.0	51.34	7.82
	5	0.0	50.50	7.81
	6	0.0	49.68	7.81
	7	0.0	48.88	7.81
	8	0.0	48.10	7.80
	9	0.0	47.34	7.80
	10	0.0	46.60	7.80
	11	0.0	45.89	7.79
	12	0.0	45.19	7.78
	13	0.0	44.50	7.77
	14	0.0	43.84	7.76
	15	0.0	43.19	7.75
	16	0.0	42.56	7.74
	17	0.0	41.94	7.73
	18	0.0	41.34	7.72
	19	0.0	40.75	7.71

(to be continued)

Table 3.3(18) INPUT CONDITIONS OF DRAINAGE SIMULATION

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	20	0.0	40.18	7.70
	21	0.0	39.62	7.69
	22	0.0	39.03	7.68
	23	0.0	38.55	7.67
(5.30)	0	0.0	38.03	7.65
	1	0.0	37.53	7.64
	2	0.0	37.03	7.62
	3	0.0	36.55	7.60
	4	0.0	36.08	7.59
	5	0.0	35.62	7.57
	6	0.0	35.17	7.55
	7	0.0	34.73	7.54
	8	0.0	34.31	7.53
	9	0.0	33.89	7.51
	10	0.0	33.48	7.49
	11	0.0	33.08	7.47
	12	0.0	32.69	7.45
	13	0.0	32.31	7.43
	14	0.0	31.94	7.41
	15	0.0	31.58	7.40
	16	0.0	31.22	7.38
	17	0.0	30.87	7.35
	18	0.0	30.53	7.33
	19	0.0	30.20	7.31
	20	0.0	29.88	7.28
	21	0.0	29.56	7.26
	22	0.0	29.25	7.23
	23	0.0	28.94	7.19
(5.31)	0	0.0	28.65	7.16
	1	0.0	28.35	7.15
	2	0.0	28.07	7.14
	3	0.0	27.79	7.12
	4	0.0	27.52	7.10
	5	0.0	27.25	7.08
	6	0.0	26.99	7.06
	7	0.0	26.73	7.04
	8	0.0	26.48	7.02
	9	0.0	26.24	6.99

	Time	Rainfall (mm)	Inflow (m^3/s)	Water Level (m)
	10	0.0	26.00	6.97
	11	0.0	25.76	6.95
	12	0.0	25.53	6.93
	13	0.0	25.31	6.91
	14	0.0	25.09	6.88
	15	0.0	24.87	6.86
	16	0.0	24.66	6.84
	17	0.0	24.45	6.82
	18	0.0	24.25	6.81
	19	0.0	24.05	6.79
	20	0.0	23.85	6.77
	21	0.0	23.66	6.76
	22	0.0	23.48	6.75
	23	0.0	23.29	6.74
(6.1)	0	0.0	23.11	6.73
	1	0.0	22.94	6.72
	2	0.0	22.76	6.70
	3	0.0	22.59	6.69
	4	0.0	22.43	6.68
	5	0.0	22.26	6.67
	6	0.0	22.10	6.66
	7	0.0	21.95	6.65
	8	0.0	21.79	6.65
	9	0.0	21.64	6.64
	10	0.0	21.49	6.63
	11	0.0	21.35	6.63
	12	0.0	21.20	6.62
	13	0.0	21.06	6.61
	14	0.0	20.93	6.60
	15	0.0	20.79	6.59
	16	0.0	20.66	6.59
	17	0.0	20.53	6.58
	18	0.0	20.40	6.58
	19	0.0	20.28	6.57
	20	0.0	20.16	6.57
	21	0.0	20.04	6.56
	22	0.0	19.92	6.55
	23	0.0	19.80	6.54

Table 3.4 CHARACTERISTICS OF OVERFLOW FOR SAN ANTONIO SWAMP

	Duration of Overflow (hr)		Max. Inundation Depth(cm)	
	1/5	1/10	1/5	1/10
(Present Condition)				
Along-Along creek system				
Section 13	86	134	19.6	44.4
15	146	172	33.4	51.0
17	119	161	17.4	33.3
Sanggalang-Manaol creek system				
8	84	101	17.4	30.9
21	233*	238*	122.6	160.9
22	0**	16	0	7.0
24	88	139	15.0	54.1
(Improved Condition)				
Along-Along creek system				
Section 13	0	68	0	17.5
15	0	62	0	10.5
17	0	4	0	2.5
Sanggalang-Manaol creek system				
8	0	0	0	0
21	0	0	0	0
22	0	0	0	0
24	86	132	18.3	62.6

* : Overflow continues more

** : No overflow because of overflow at upstream section 21.

Table 3.5 CHARACTERISTICS OF OVERFLOW FOR NORTH CANDABA SWAMP

		Duration of Overflow(hr)			Max. Inundation Depth (cm)		
		1/2	1/5	1/10	1/2	1/5	1/10
(Present Condition)							
Section	8	85	207	228*	14.0	63.9	111.3
	9	120	226	231*	33.2	113.1	171.1
	13	-**	119	139	0	21.2	30.6
	16	100	221	228*	21.1	113.1	171.8
	21	101	224	228*	22.0	115.4	175.5
	26	90	195	234*	38.6	78.7	90.1
	31	-**	218	222*	0	68.7	127.8
(Improved Condition)							
Section	8	0	120	198	0	10.8	52.9
	9	0	132	200*	0	15.7	99.6
	13	0	22	136	0	11.4	33.0
	16	0	84	180	0	16.5	77.7
	21	0	76	174	0	16.1	78.9
	26	0	104	202	0	14.0	22.0
	31	0	56	158*	0	10.1	74.5

* : Overflow continues more.

** : Overflow occurs in upstream.

Table 3.6 BREAKDOWN OF DIRECT CONSTRUCTION COST FOR DRAINAGE IMPROVEMENT

Work Item	Unit	Quantity	Amount (₱10³) Foreign Currency	Local Currency
I. SAN ANTONIO SWAMP				
1. Preparation Work			1,407.0	600.7
2. Civil Work				
- Surface Stripping	m^3	355,000	1,810.5	887.5
Loading	m^3	355,000	2,875.5	1,029.5
Hauling	m^3	355,000	2,769.0	1,313.5
- Excavation by BHS	m^3	1,270,000	10,287.0	3,429.0
- Hauling to spoil area	m^3	800,000	6,240.0	2,960.0
- Spreading	m^3	470,000	1,692.0	611.0
- Compacting	m^3	470,000	2,209.0	940.0
Sub-total			27,883.0	11,170.5
3. Structure				
- Drainage inlet	no.	20	4.7	54.2
- Bridge	no.	8	305.3	803.0
Sub-total			310.0	857.2
4. Land Acquisition	ha	18	-	201.6
Total			29,600.0	12,830.0
II. NORTH CANDABA SWAMP				
1. Preparation Work			1,201.1	487.3
2. Civil Work				
- Surface Stripping	m^3	355,000	1,810.5	887.5
Loading	m^3	355,000	2,875.5	1,029.5
Hauling	m^3	355,000	2,769.0	1,313.5
- Excavation by BHS	m^3	710,000	5,751.0	1,917.0
- Spreading	m^3	850,000	3,060.0	1,105.0
- Compacting	m^3	850,000	3,995.0	1,700.0
- Excavation in borrow area	m^3	140,000	1,134.0	378.0
- Hauling to site	m^3	140,000	2,562.0	1,204.0
Sub-total			23,957.0	9,534.5
3. Structures				
- Drainage inlet	no.	24	5.6	65.1
- Bridge	no.	2	76.3	200.7
Sub-total			81.9	265.8
4. Land Acquisition	ha	77	-	862.4
Total			25,240.0	11,150.0
Grand Total			54,840.0	23,980.0

Fig. 3.1 DRAINAGE SYSTEM IN UPRIIS

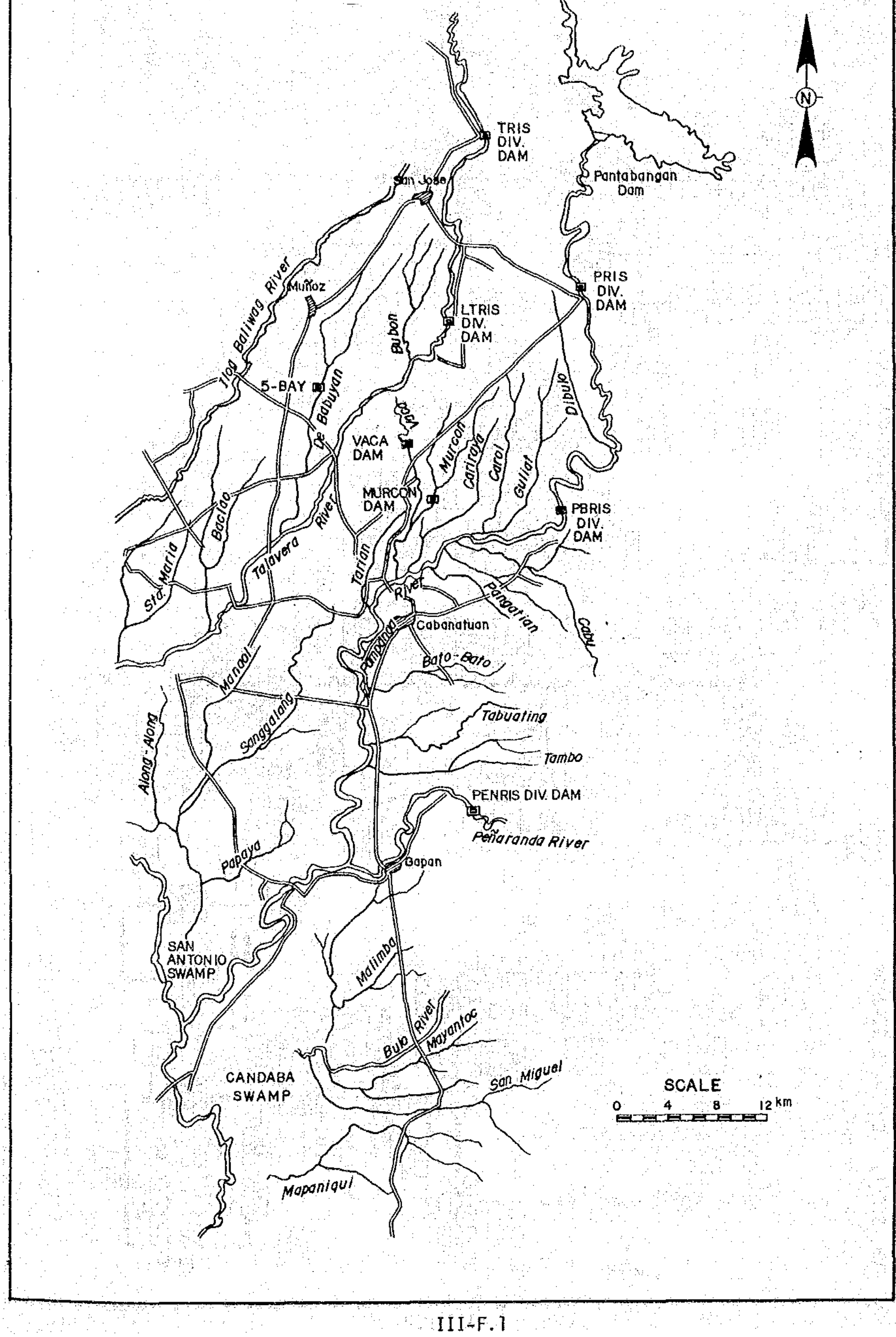


Fig. 3.2(1) DRAINAGE DIAGRAM

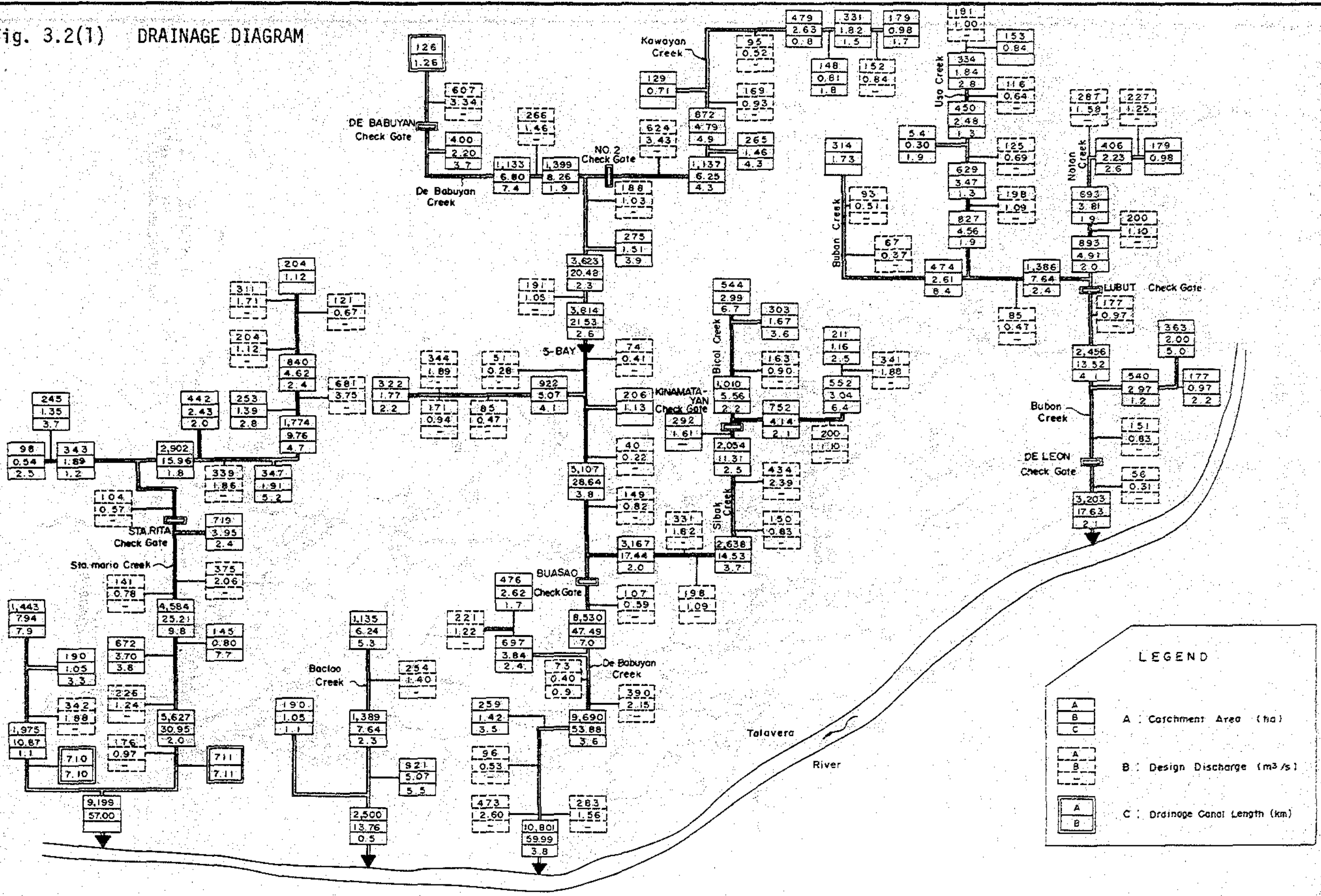


Fig. 3.2(2) DRAINAGE DIAGRAM

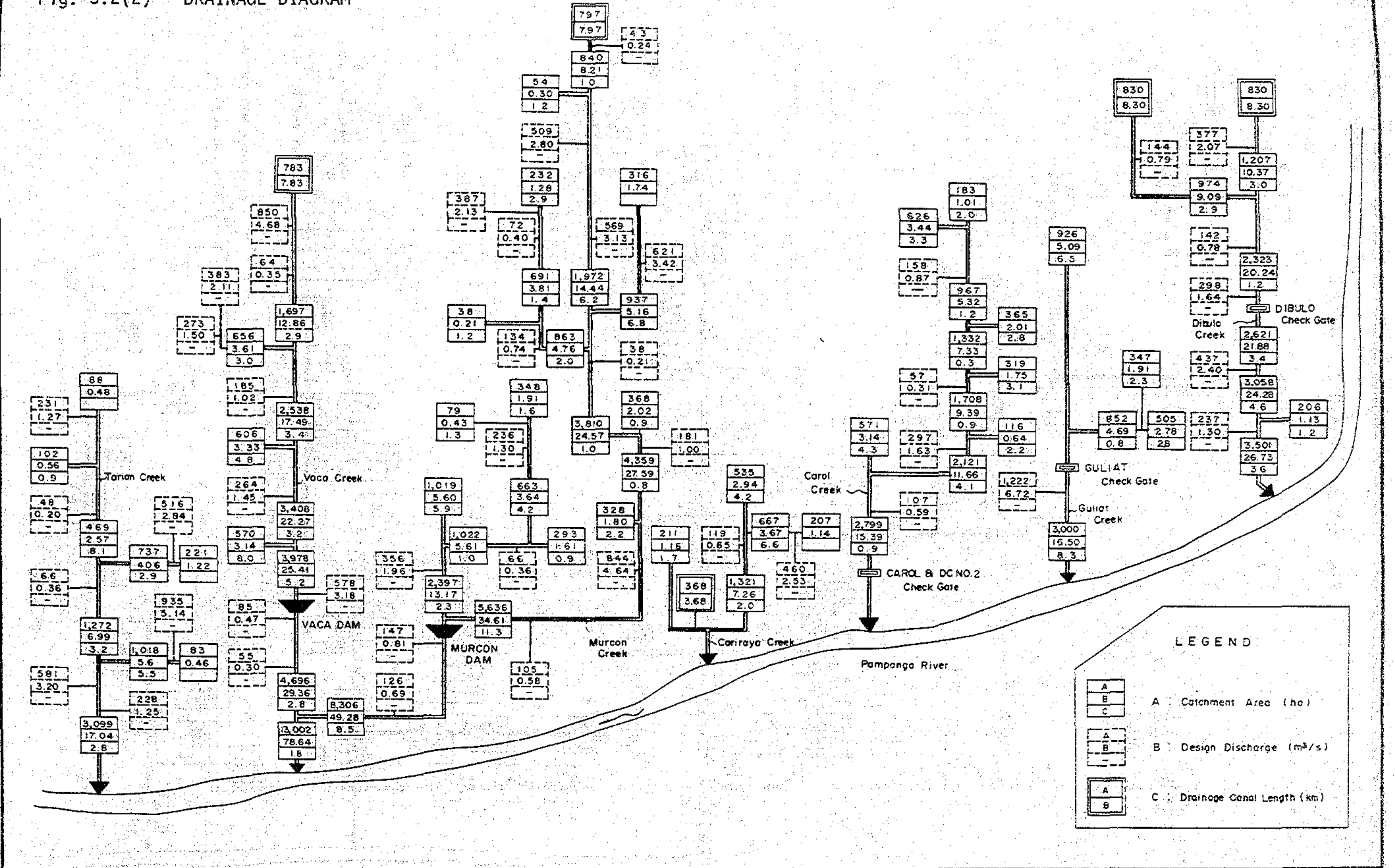


Fig. 3.2(3) DRAINAGE DIAGRAM

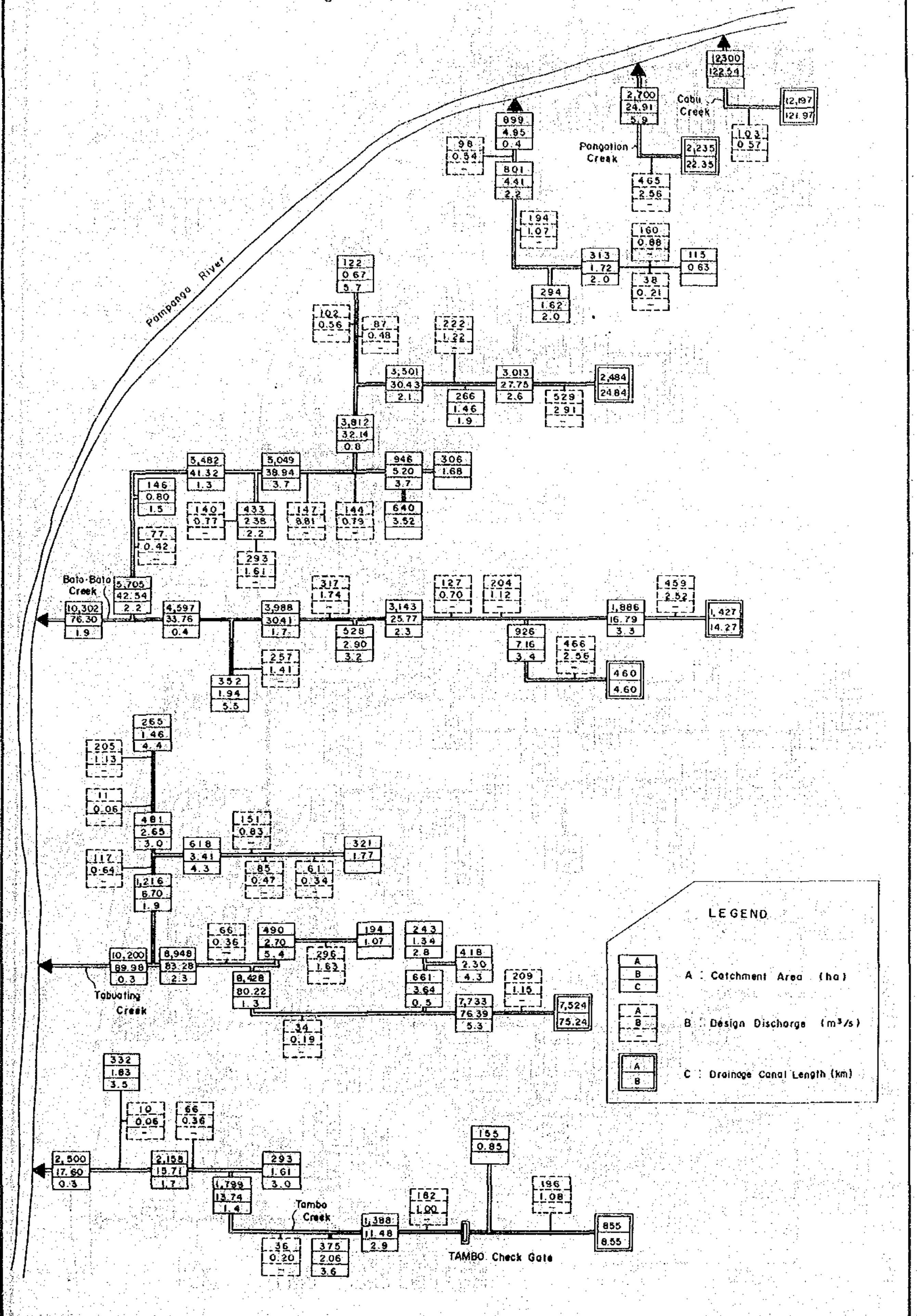


Fig. 3.2(4) DRAINAGE DIAGRAM

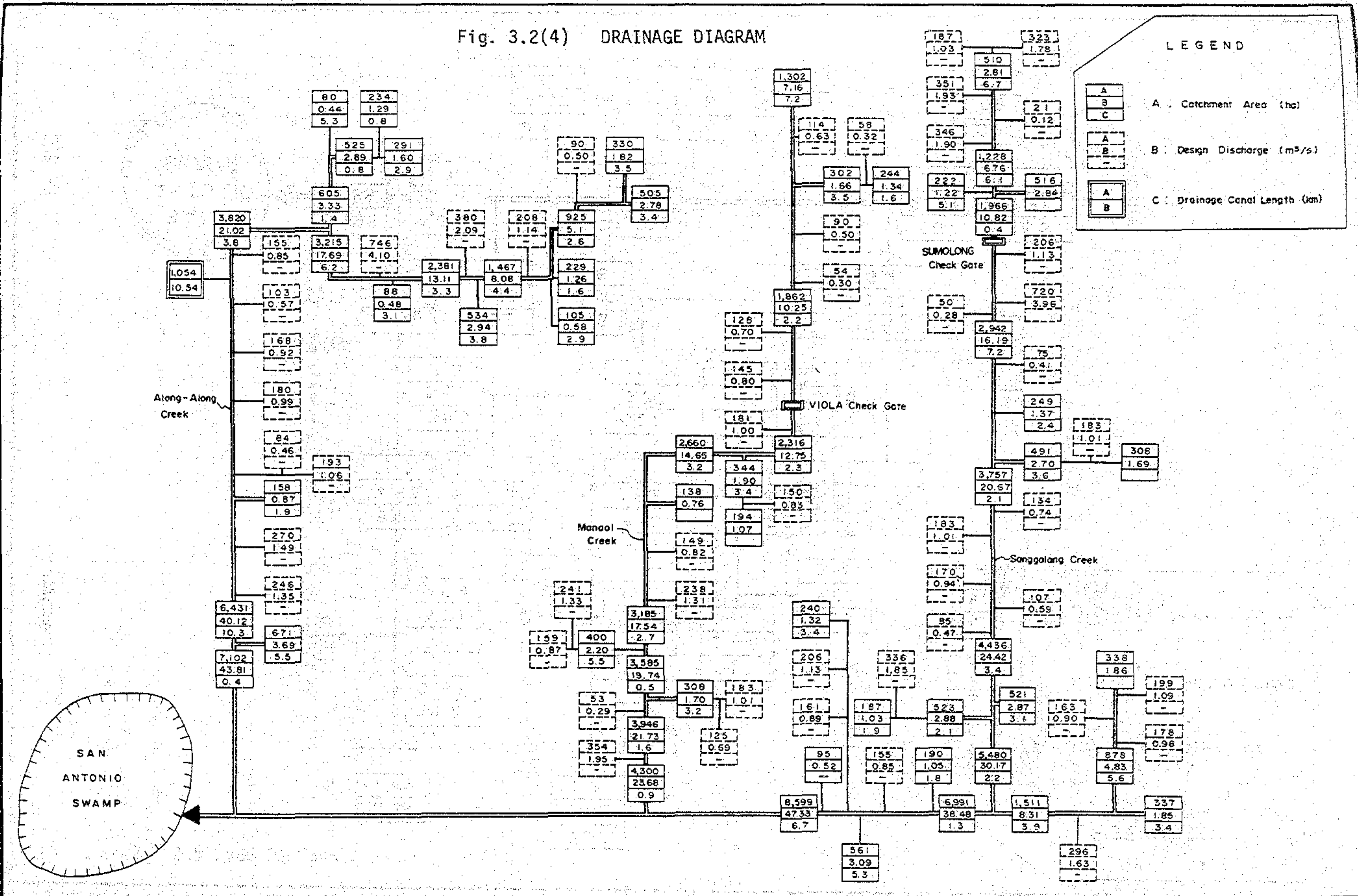


Fig. 3.2(5) DRAINAGE DIAGRAM

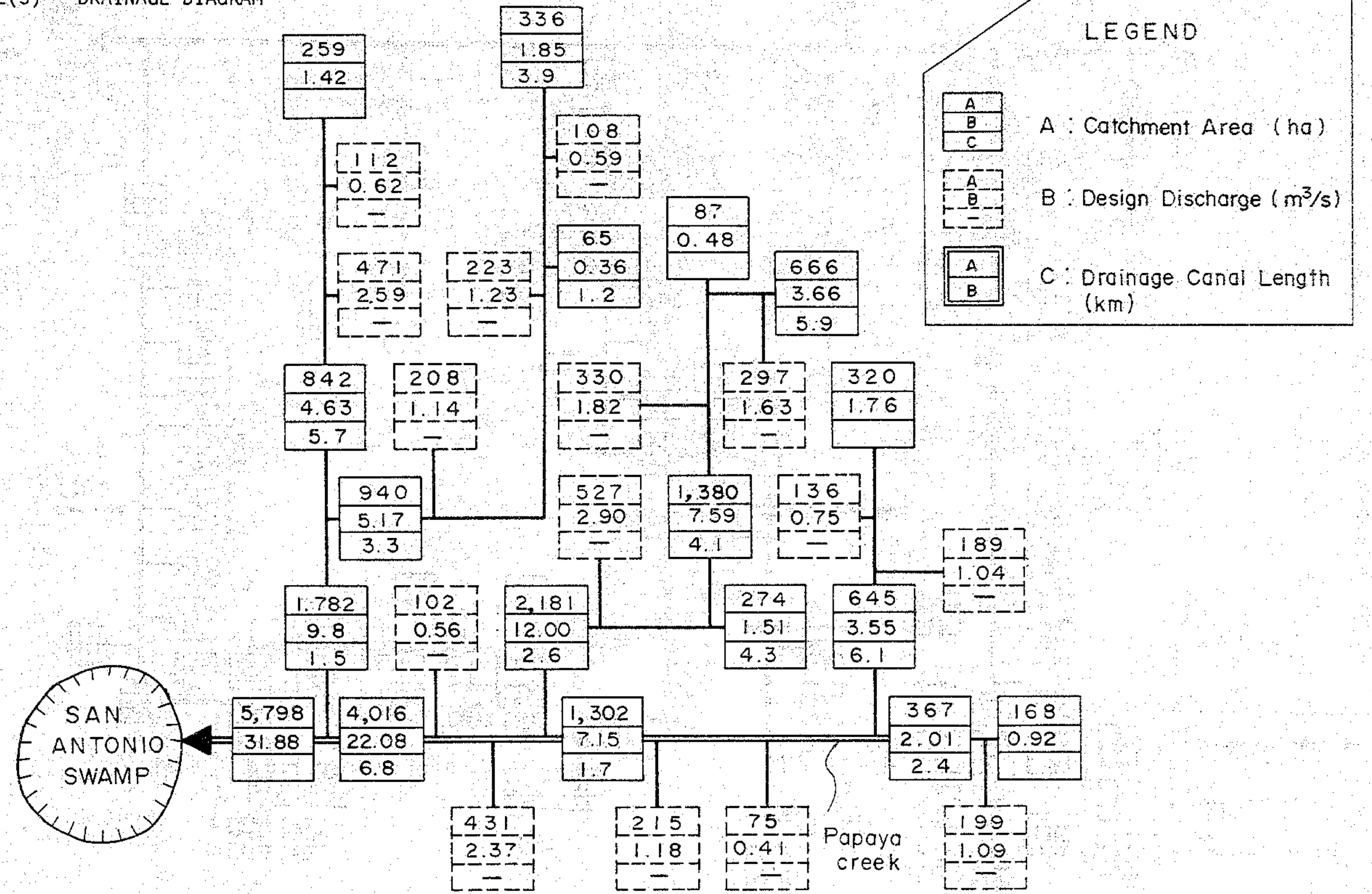


Fig. 3.2(6) DRAINAGE DIAGRAM

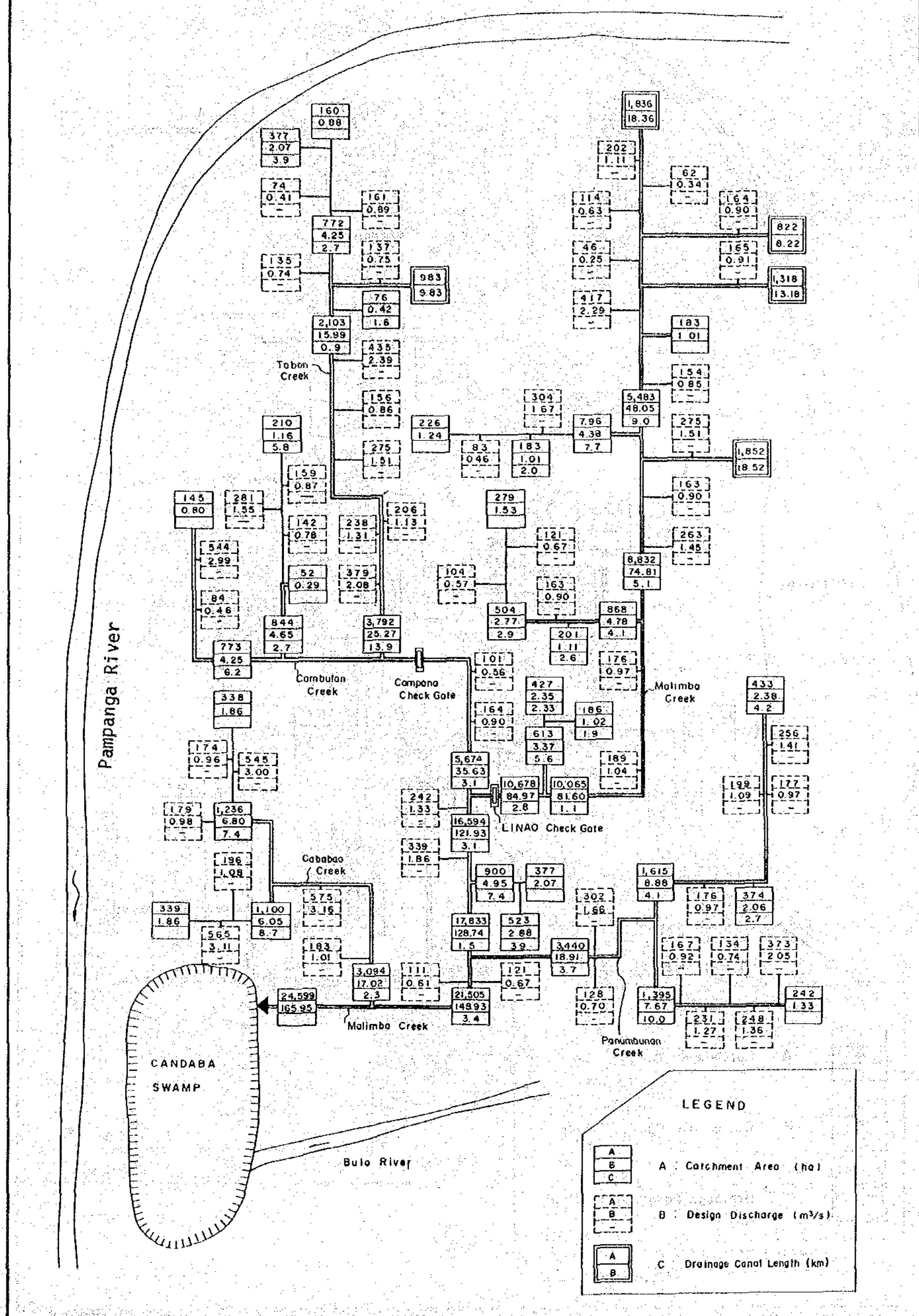


Fig. 3.2(7) DRAINAGE DIAGRAM

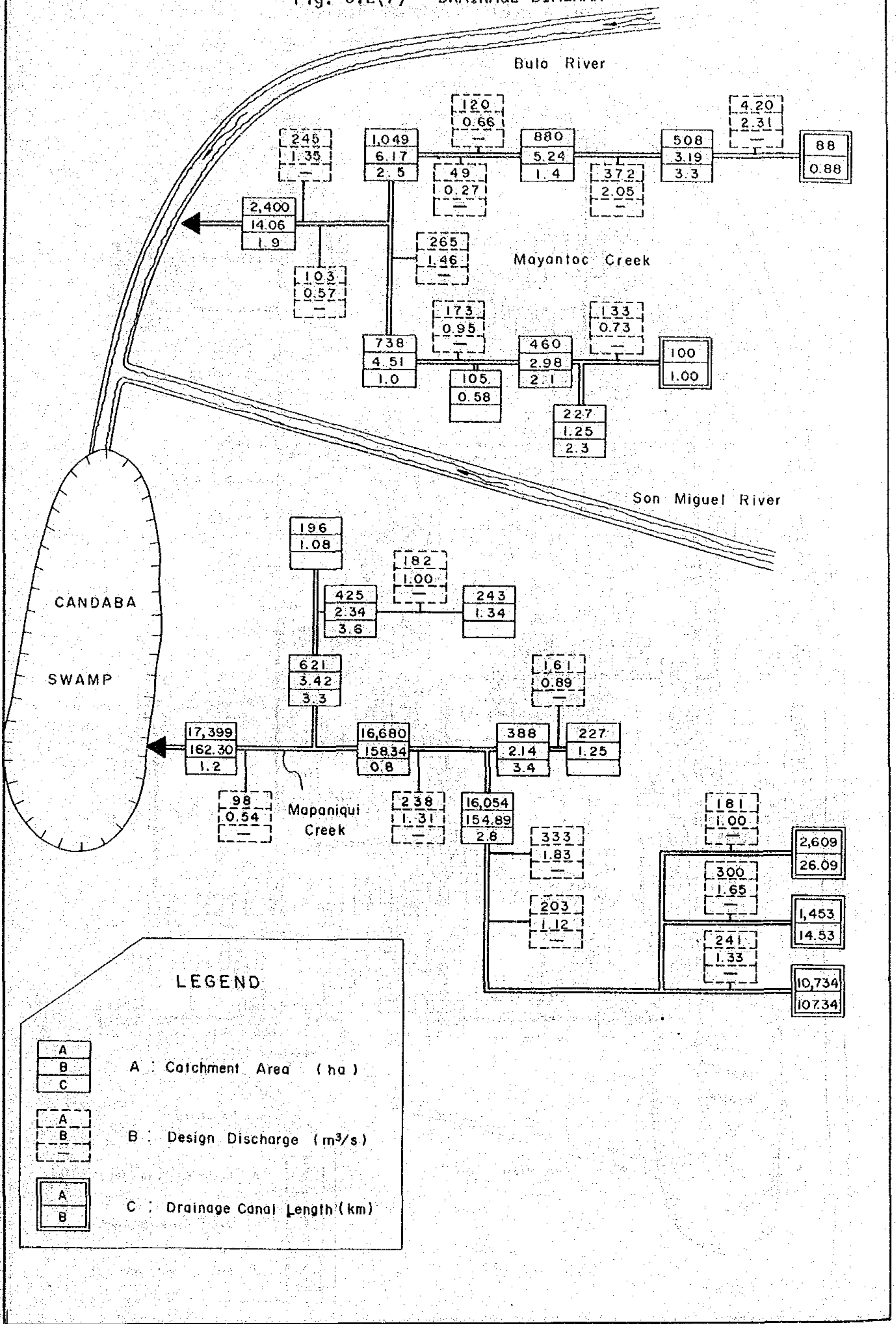


Fig. 3.3 INUNDATION AREA IN UPRIIS

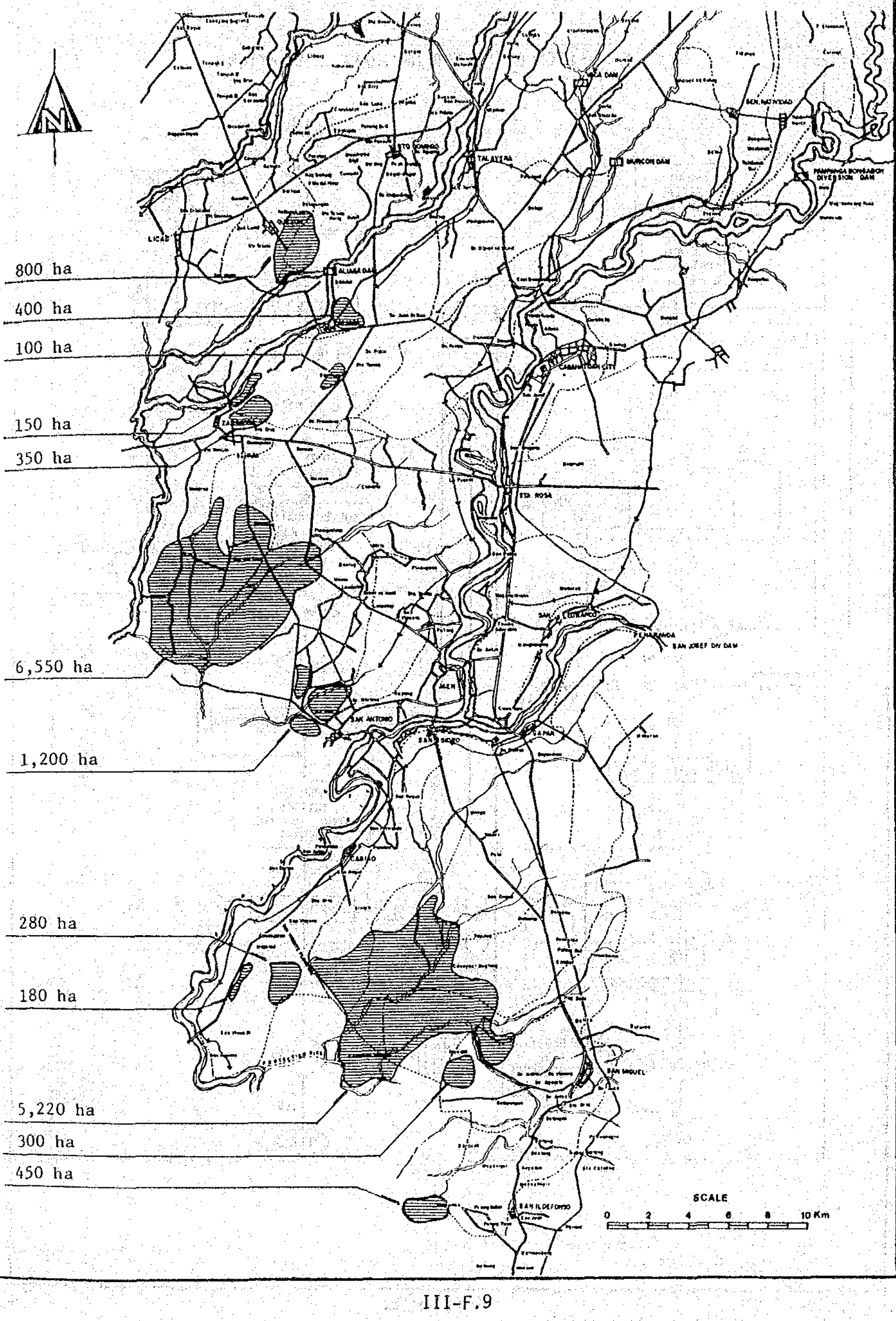


Fig. 3.4 FLOW CHART FOR DRAINAGE SIMULATION

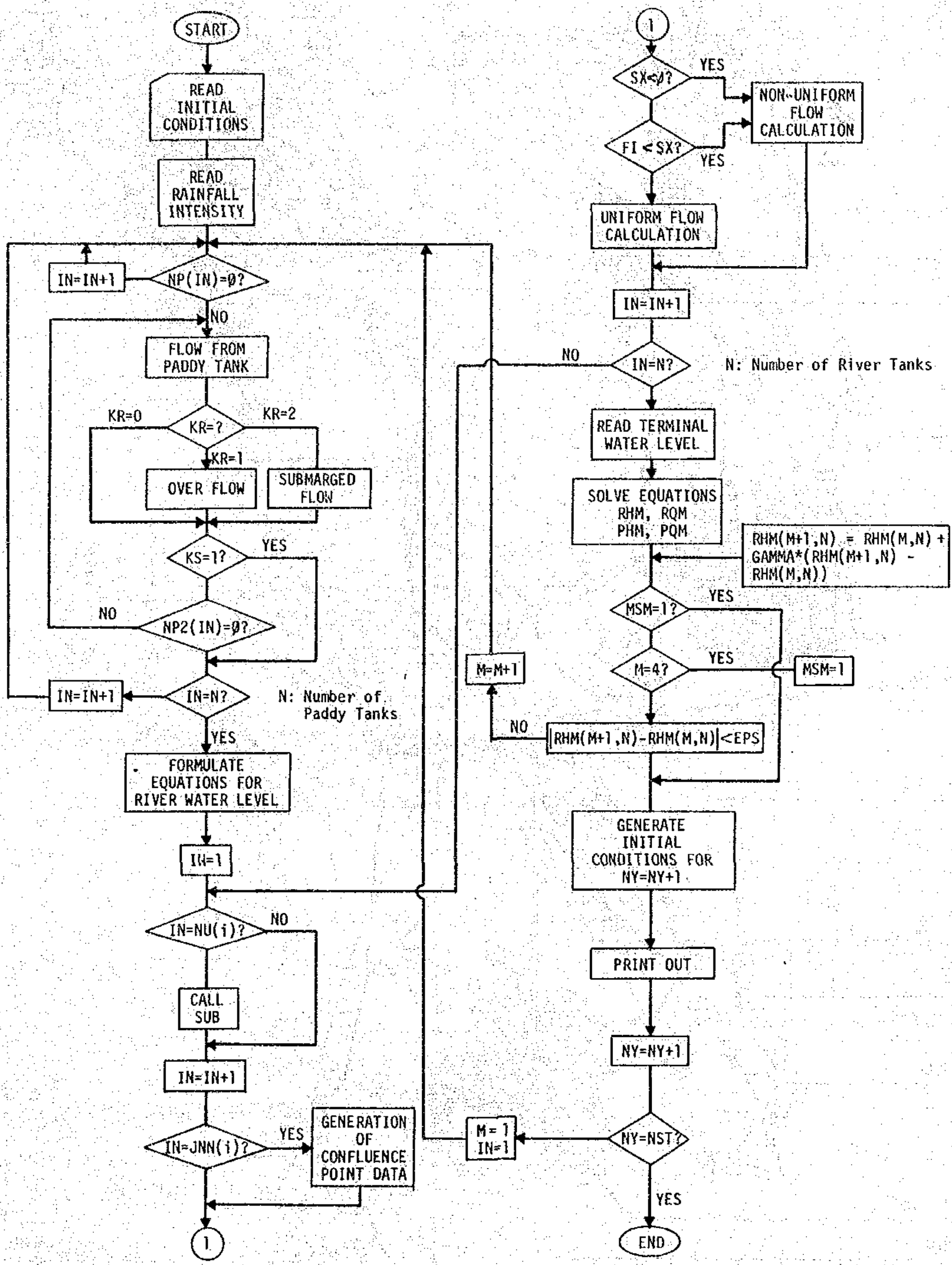
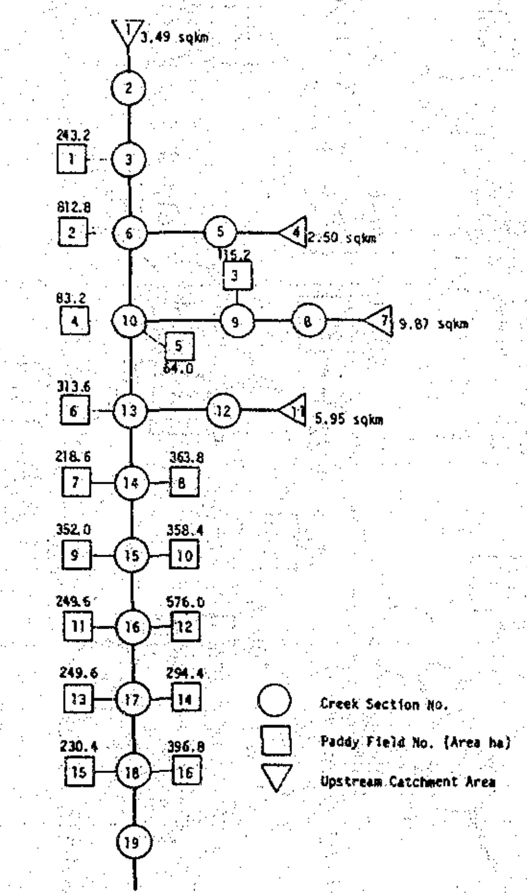


Fig. 3.5 DRAINAGE SIMULATION MODEL OF SAN ANTONIO AREA

Alog-Alog Creek



Manaol-Sanggalang Creek

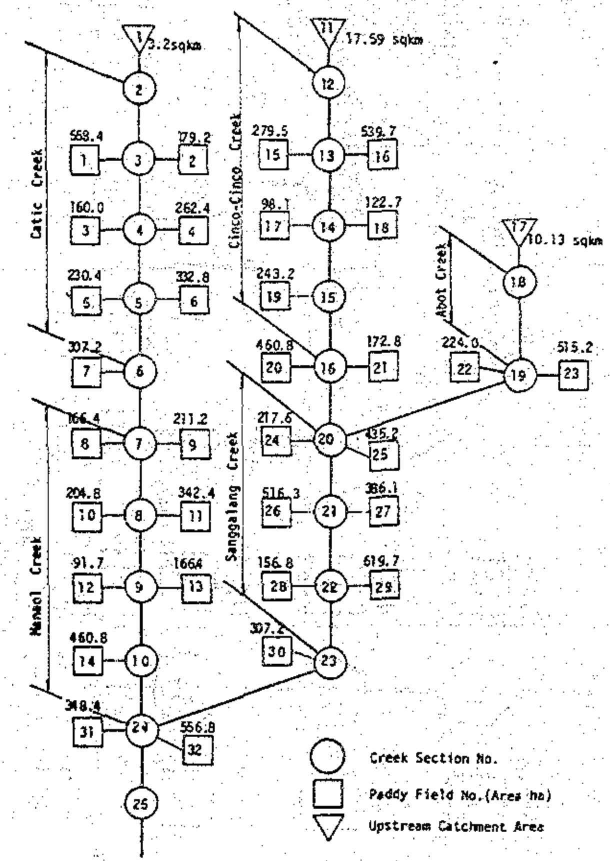


Fig. 3.6 DRAINAGE SIMULATION MODEL OF NORTH CANDABA AREA

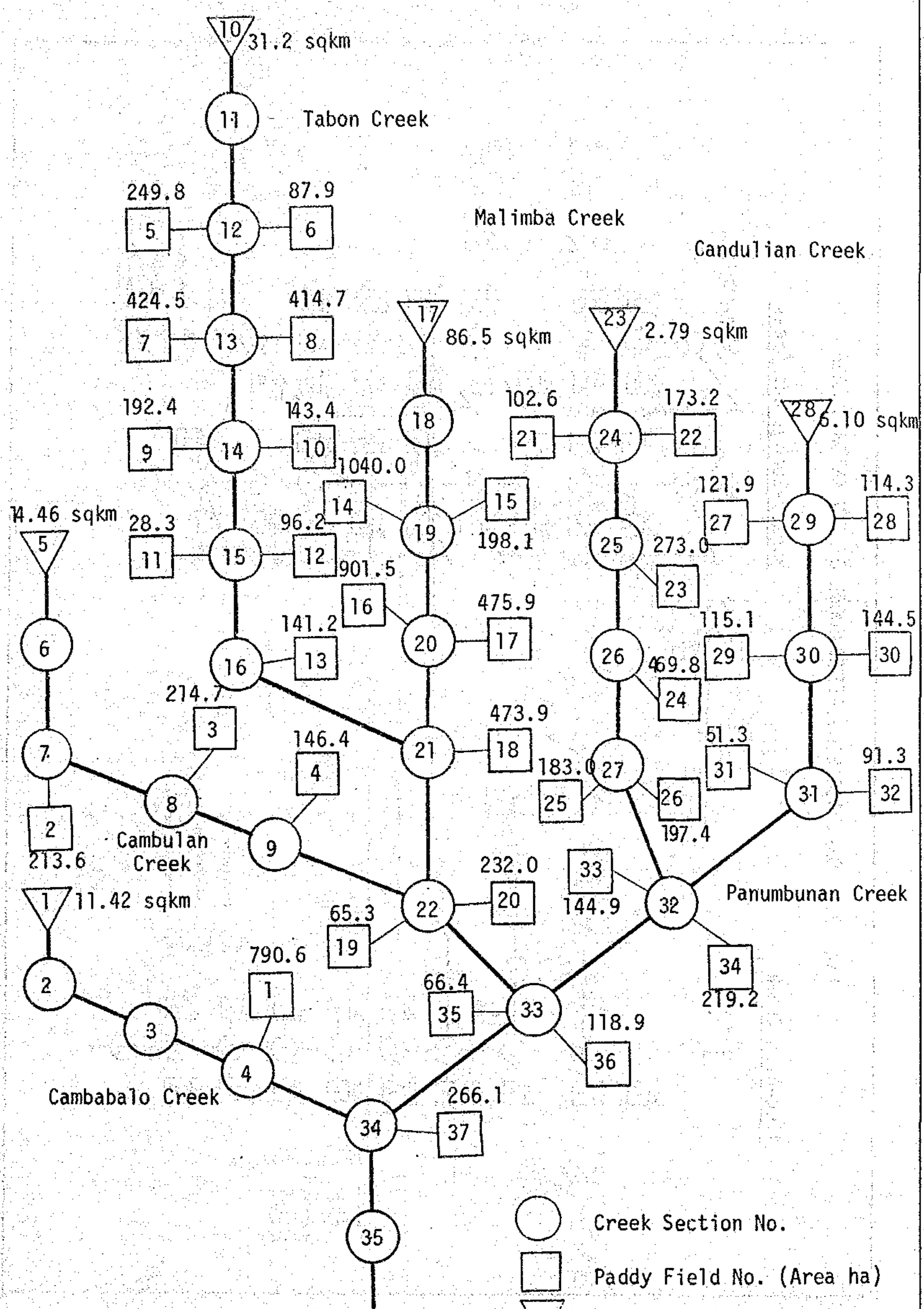


Fig. 3.7(1) FLOW PROFILE (SAN ANTONIO SWAMP 1/5 PROBABILITY)

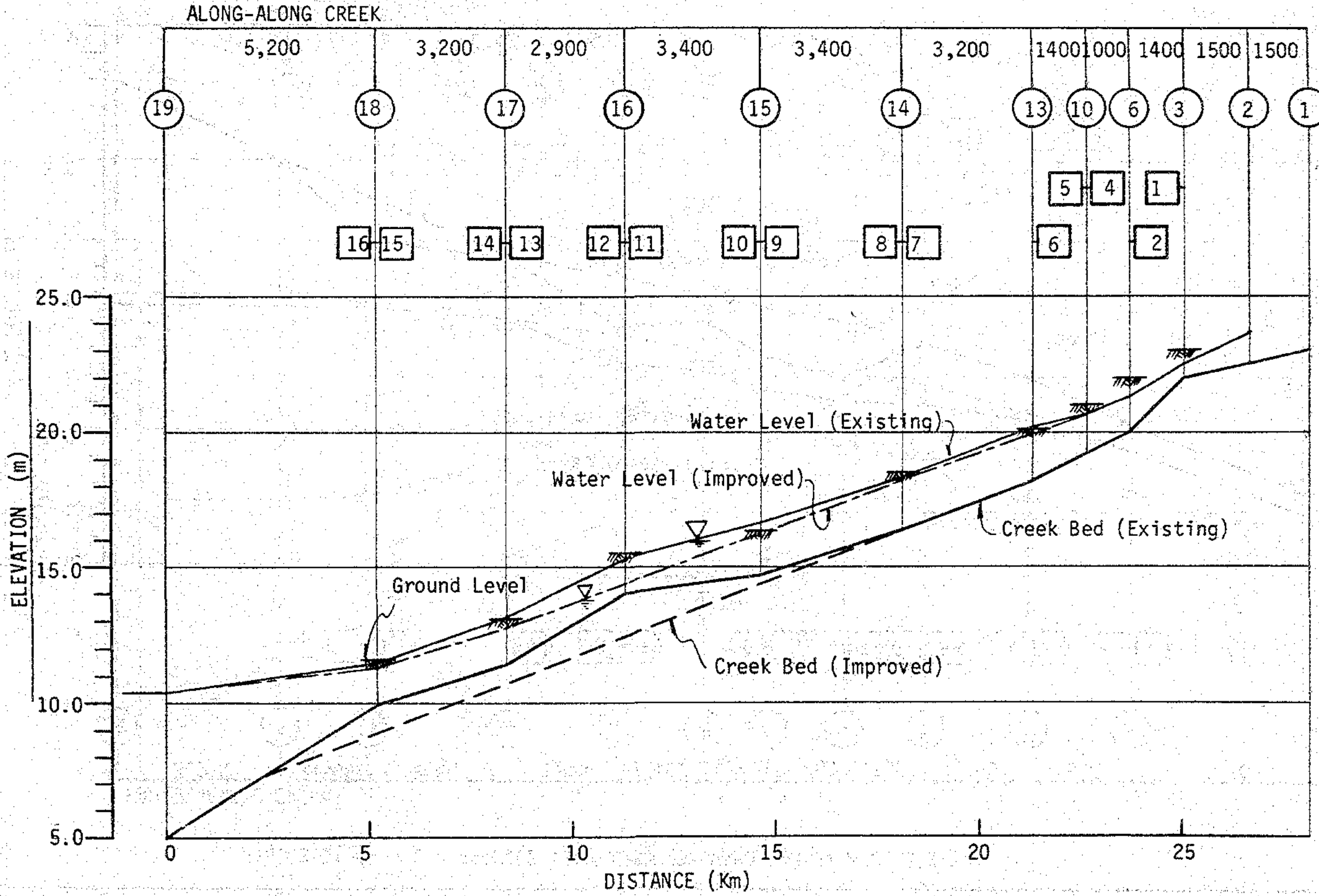


Fig. 3.7(2) FLOW PROFILE (SAN ANTONIO SWAMP 1/5 PROBABILITY)

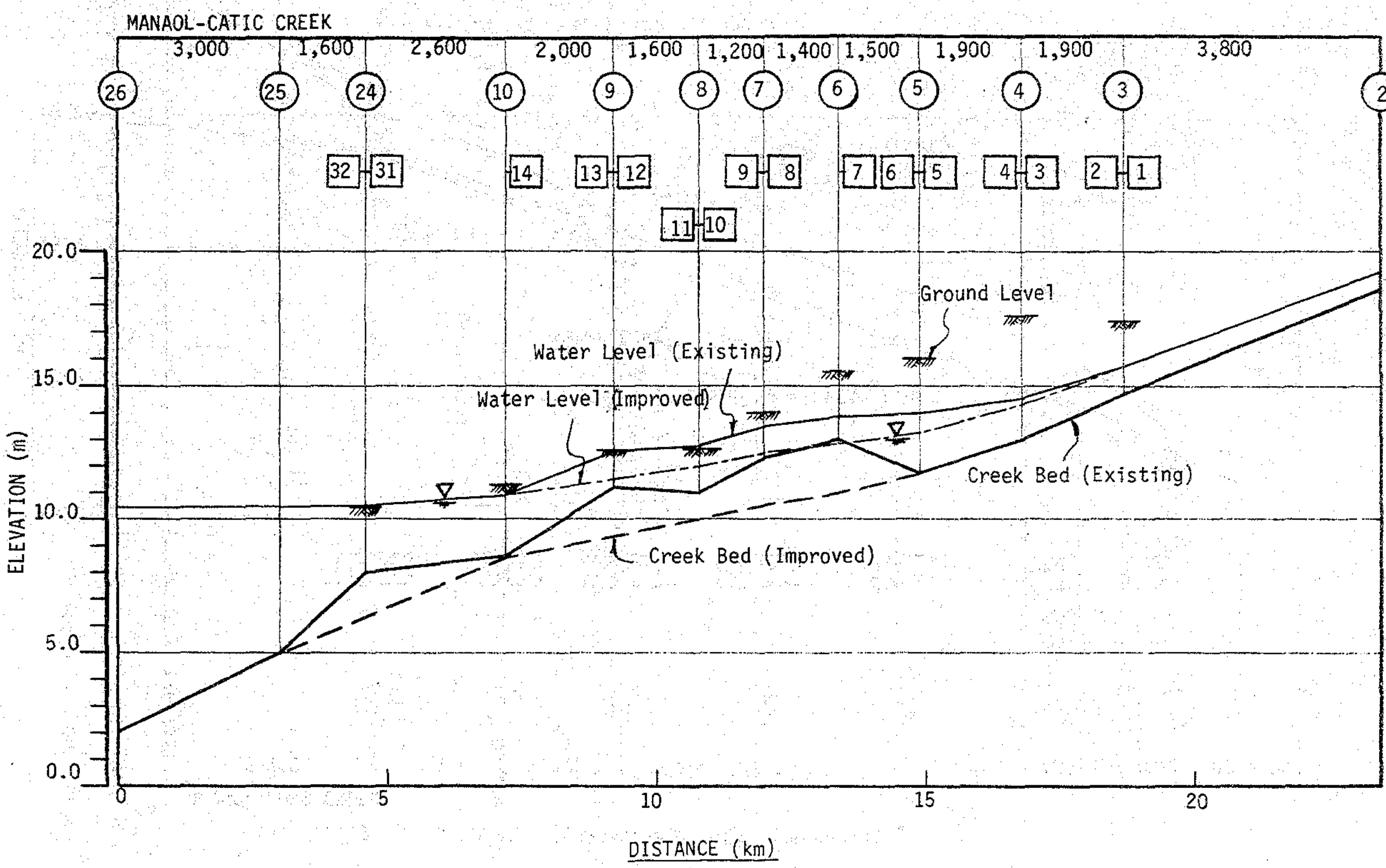


Fig. 3.7(3) FLOW PROFILE (SAN ANTONIO SWAMP 1/5 PROBABILITY)

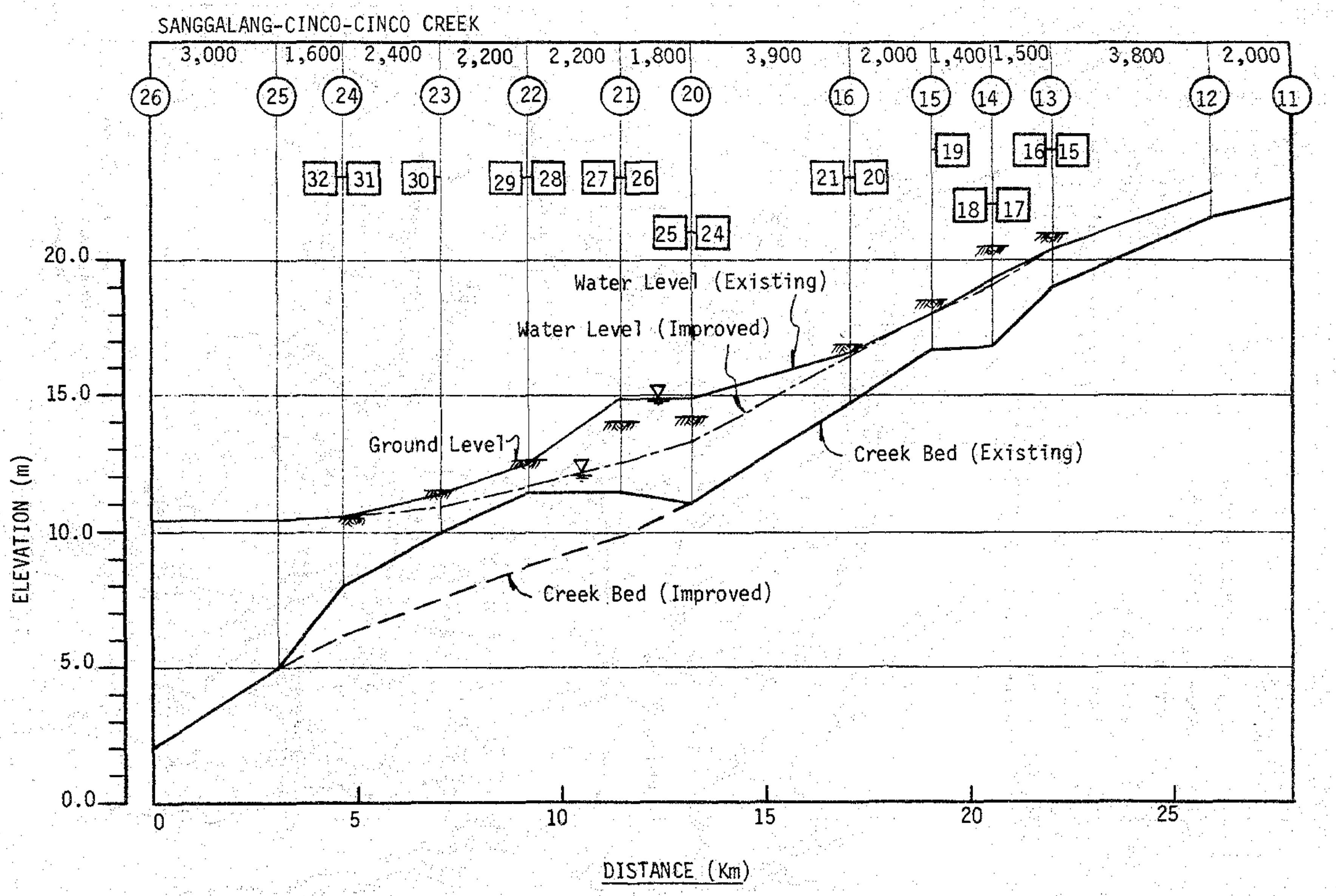


Fig. 3.8 INUNDATION AREA IN SAN ANTONIO SWAMP - Present and Improved Condition

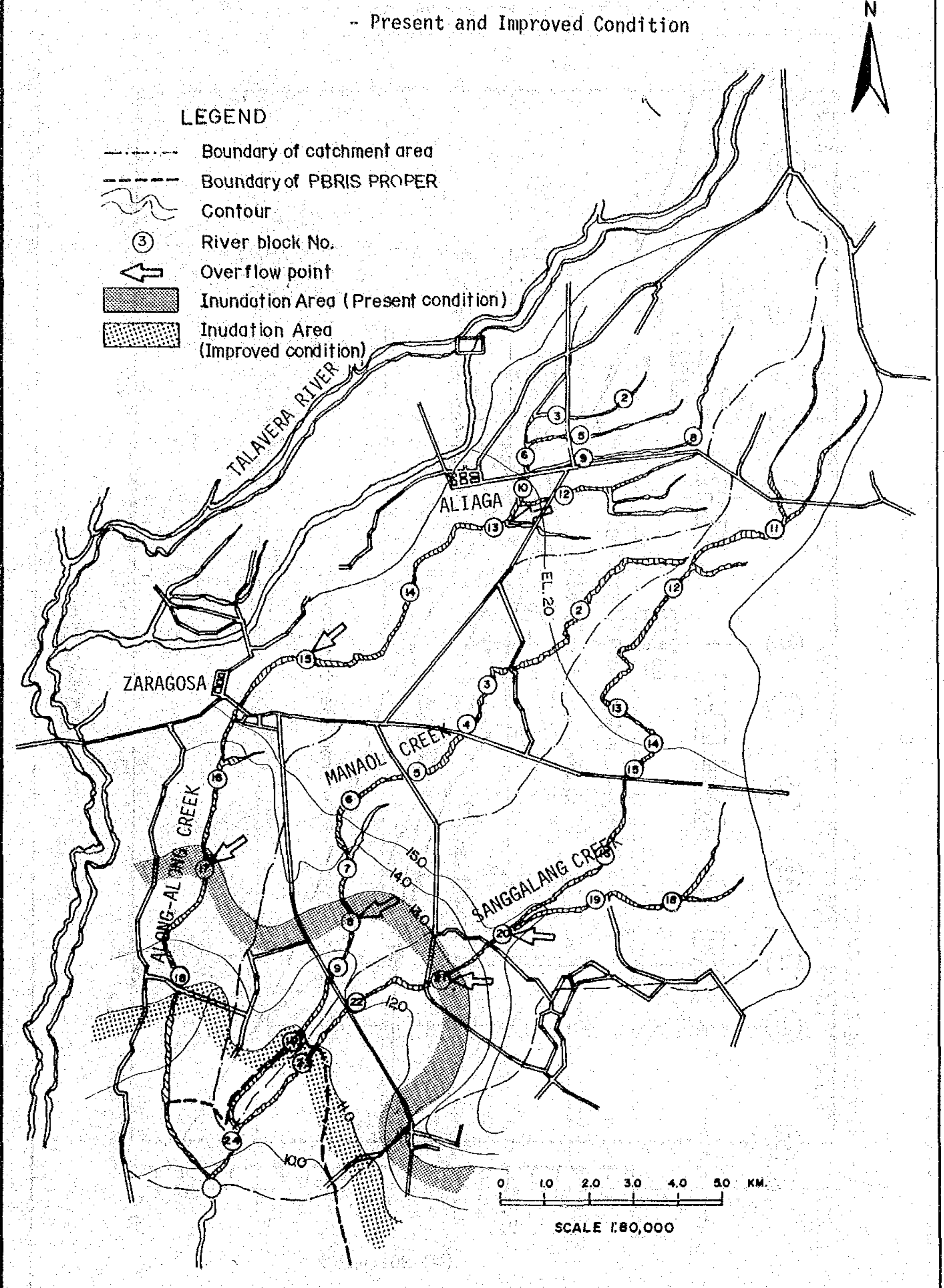


Fig. 3.9(1) FLOW PROFILE (SAN ANTONIO SWAMP 1/10 PROBABILITY)

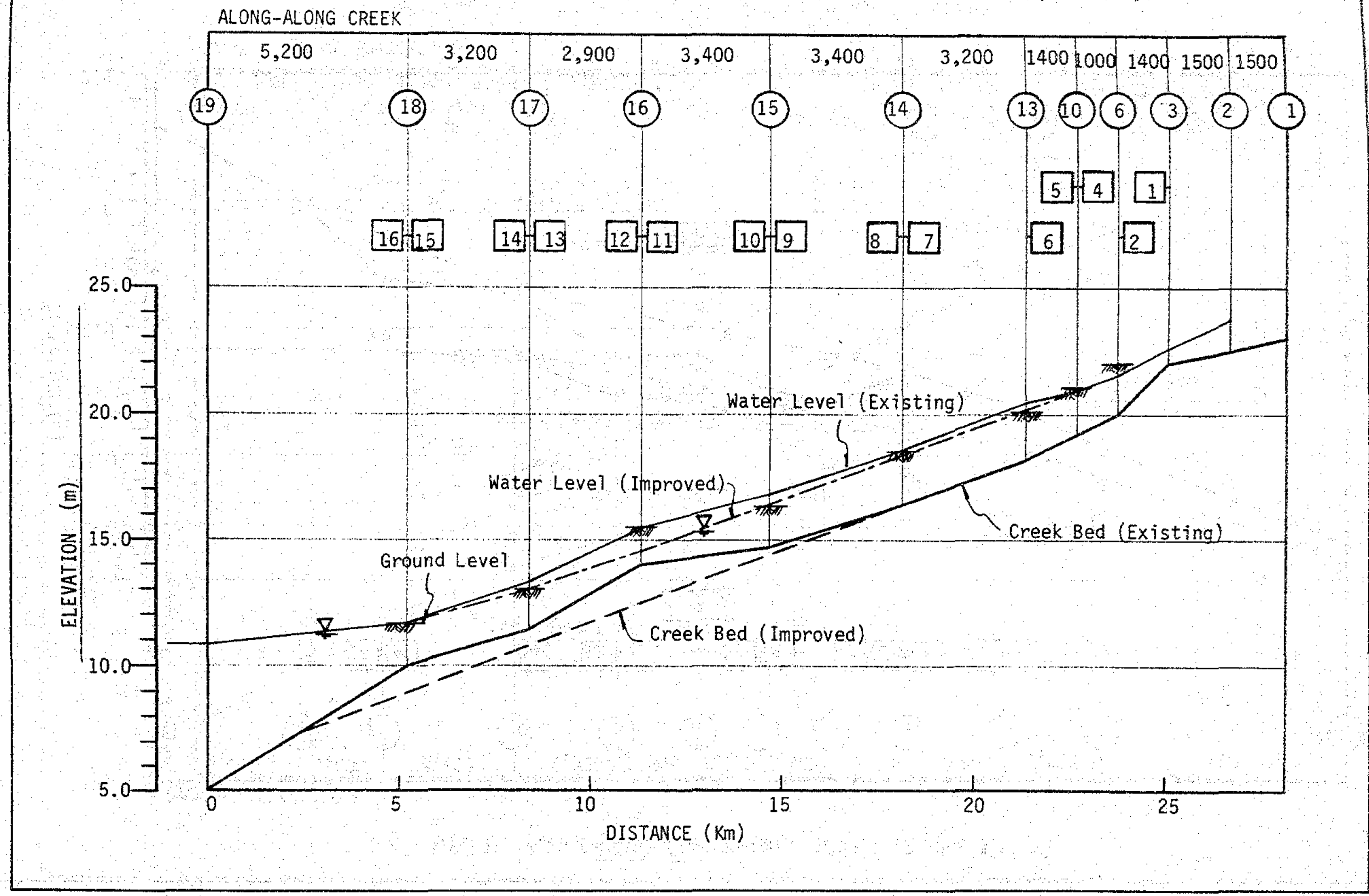


Fig. 3.9(2) FLOW PROFILE (SAN ANTONIO SWAMP 1/10 PROBABILITY)

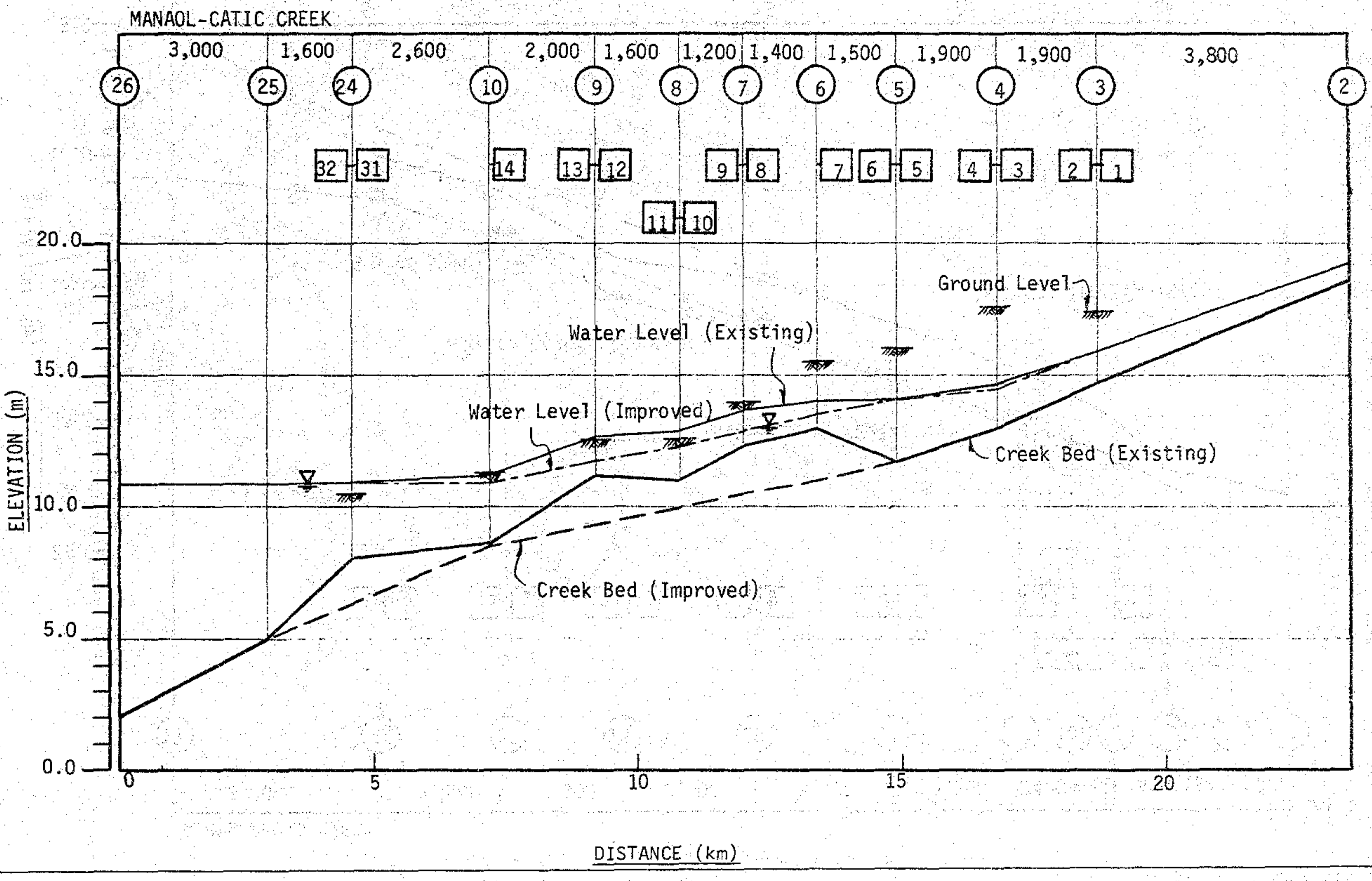


Fig. 3.9(3) FLOW PROFILE (SAN ANTONIO SWAMP 1/10 PROBABILITY)

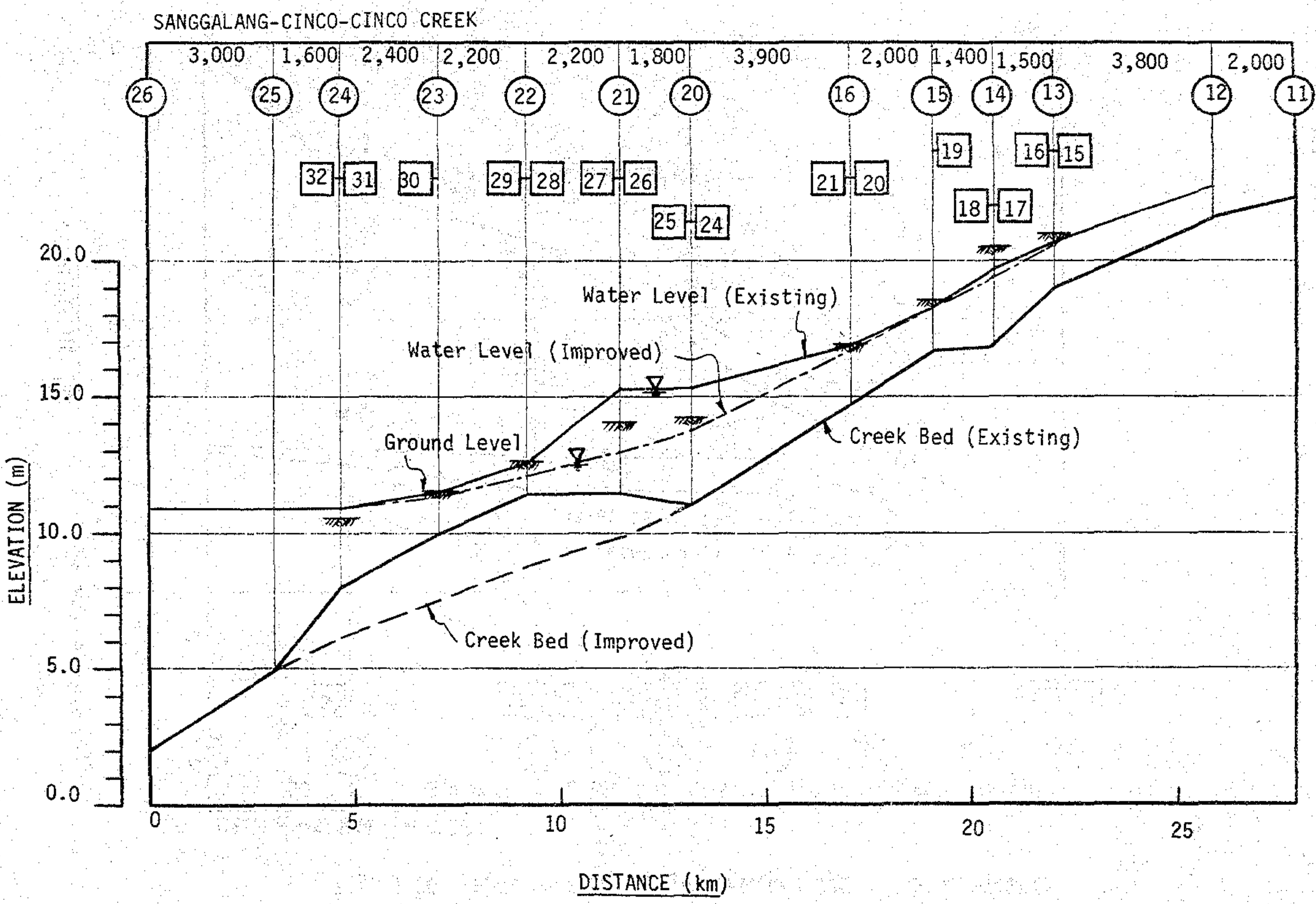


Fig. 3.10 FLOW PROFILE (NORTH CANDABA SWAMP 1/5 PROBABILITY)

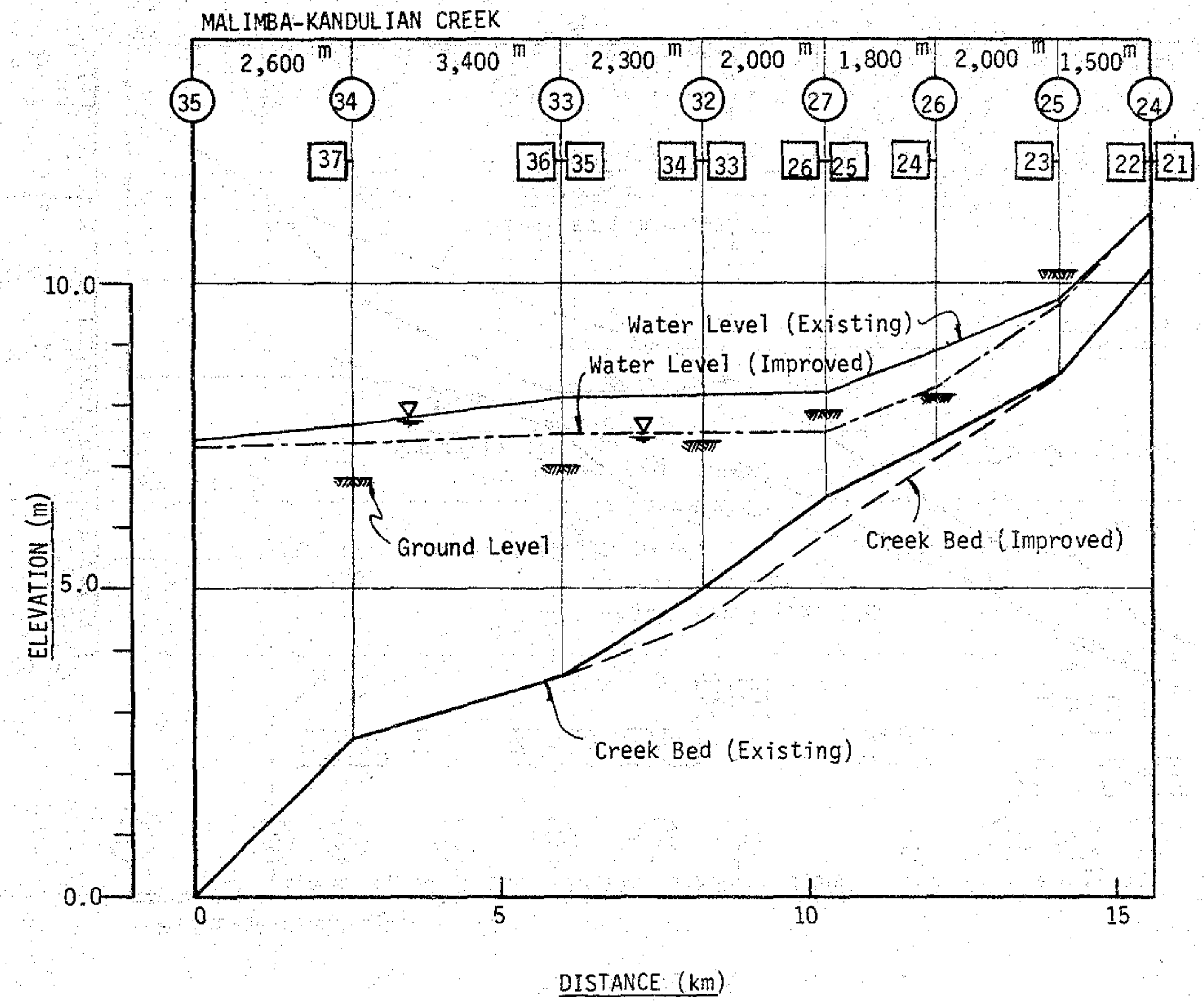


Fig. 3.11 INUNDATION AREA IN NORTH CANDABA SWAMP - Present and Improved Condition

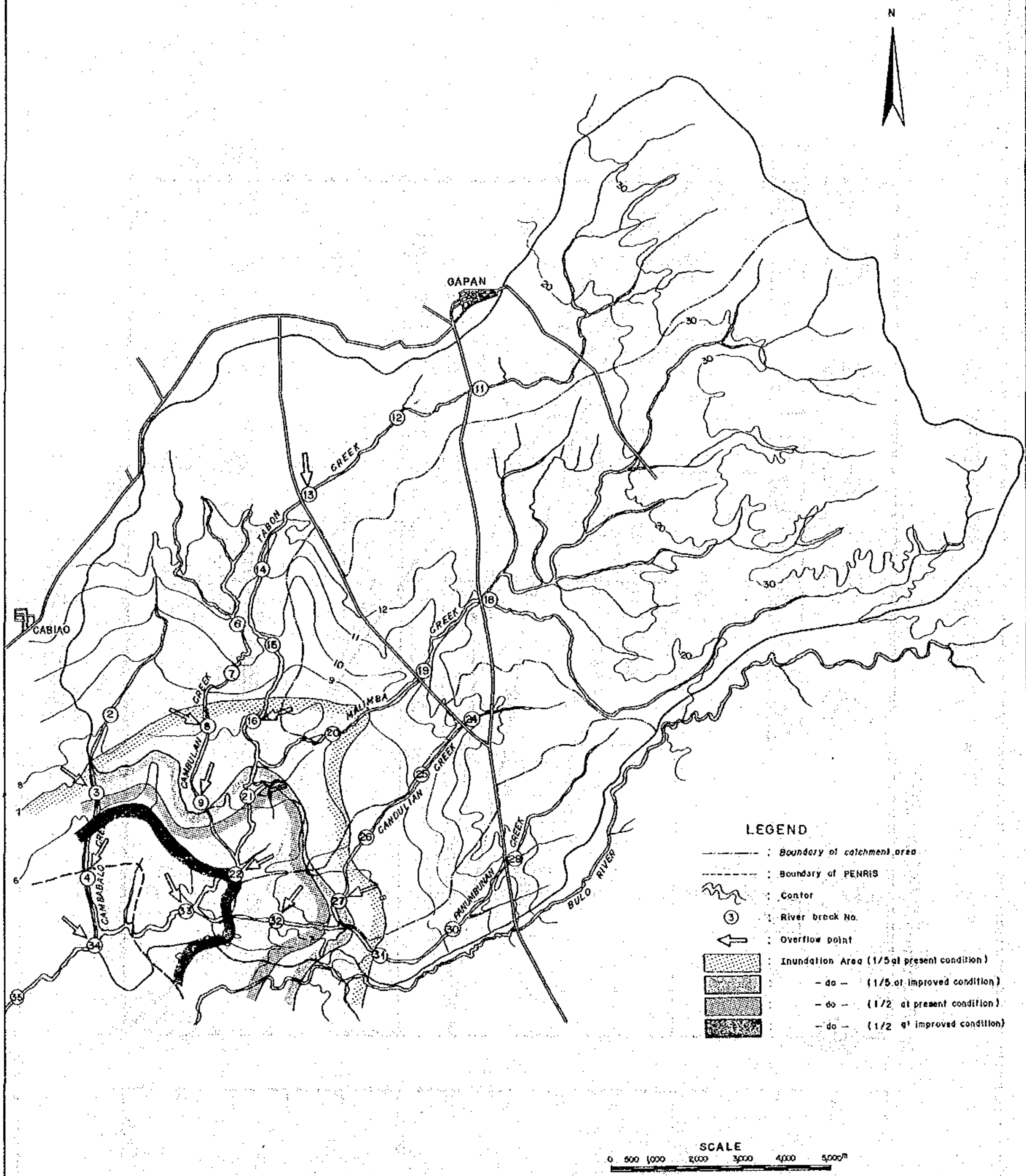


Fig. 3.12 FLOW PROFILE (NORTH CANDABA SWAMP 1/2 PROBABILITY)

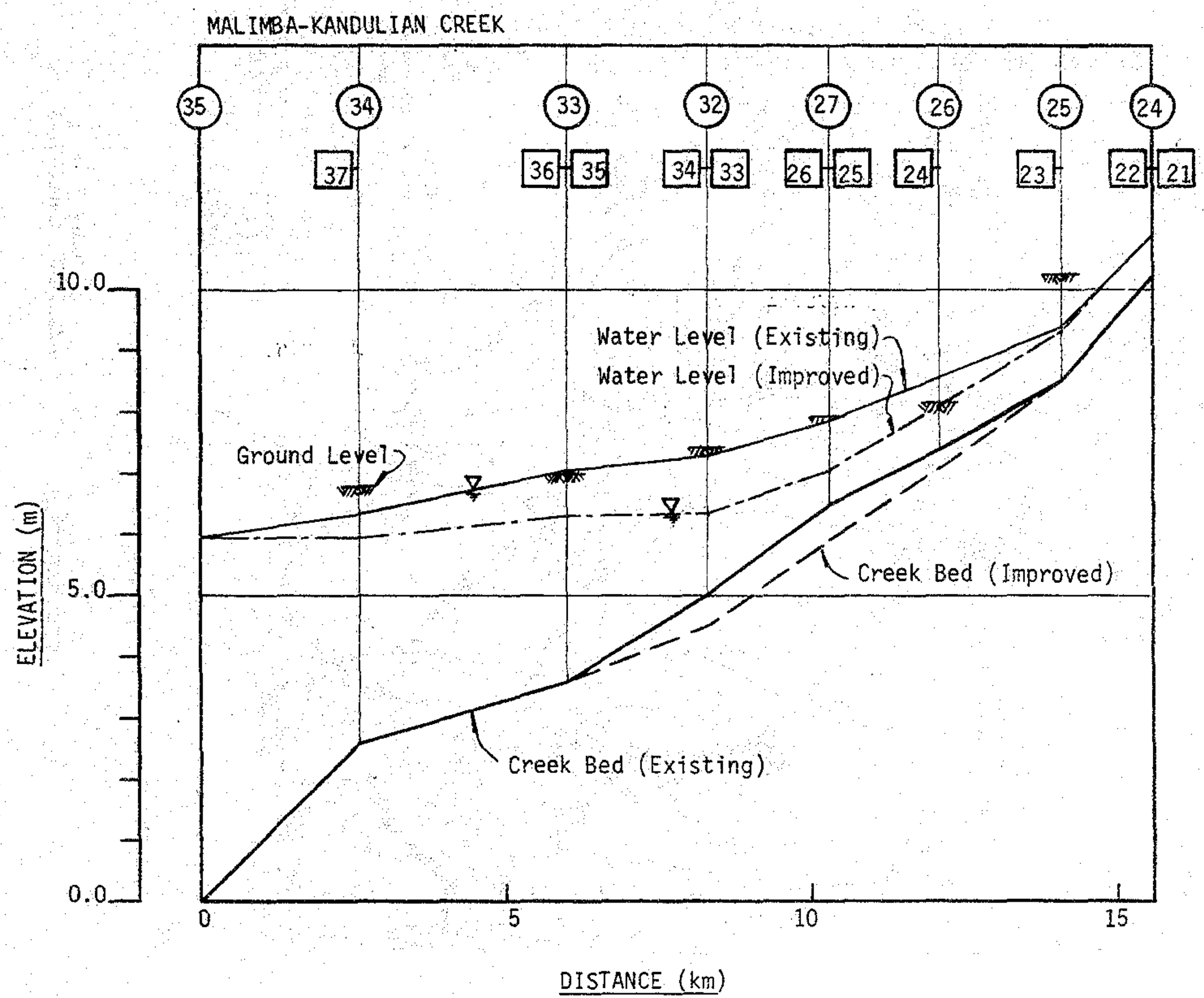
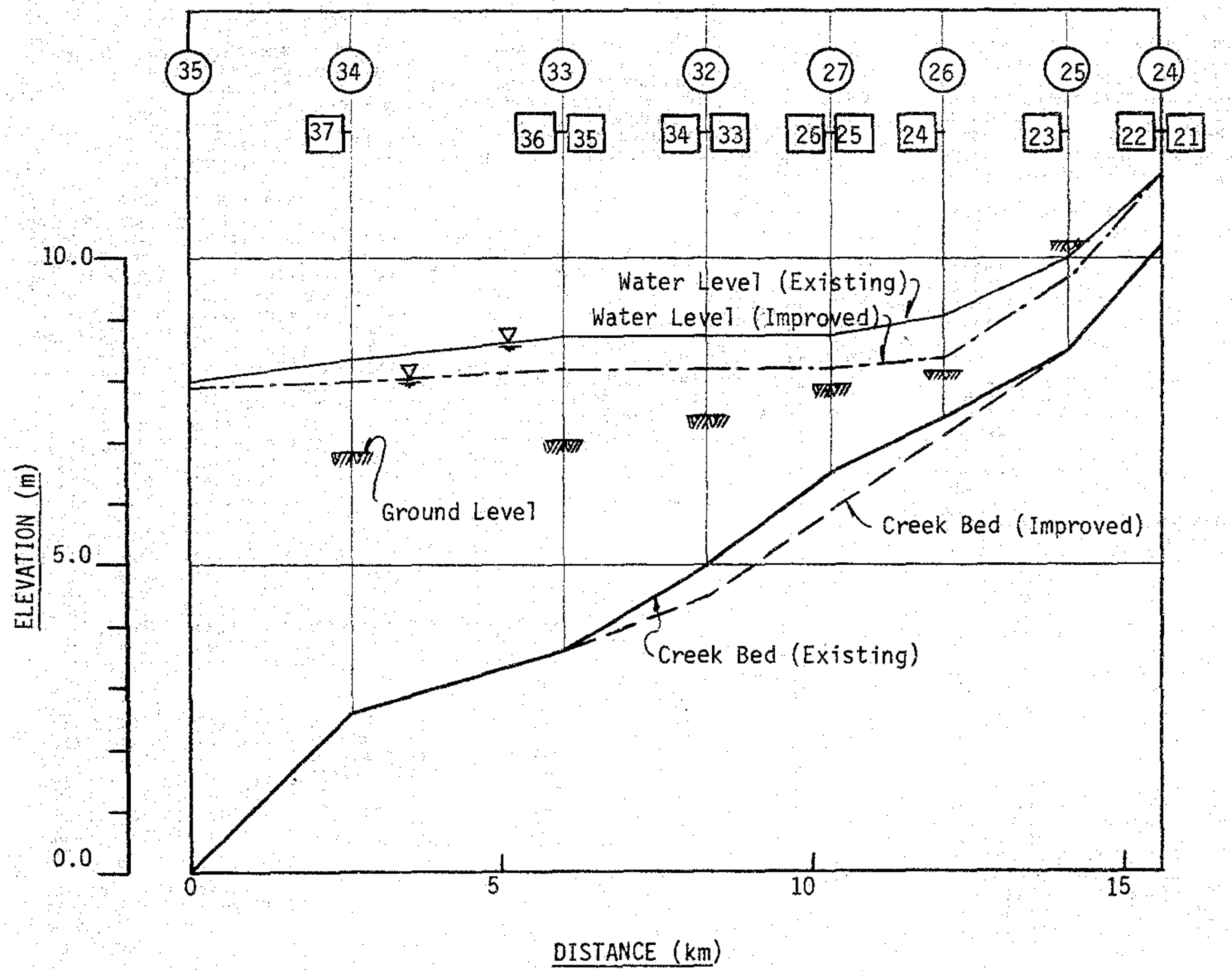


Fig. 3.13 FLOW PROFILE (NORTH CANDABA SWAMP 1/10 PROBABILITY)

MALIMBA-KANDULIAN CREEK



Reference 3.1(1) PROGRAM LIST OF DRAINAGE SIMULATION MODEL

```
C     DRAINAGE SIMULATION BY STORAGE MODEL
C     DATA INPUT AND OUTPUT
      DIMENSION RHN(2,100),RQN(2,100),PHN(2,100),PQN(2,100),
     +          RHM(5,100),RQM(5,100),PHM(5,100),PQM(5,100),
     +          Z(100),BD(100),GA(100),GB(100),ZP(100),AP(100),BP(100),
     +         NU(20),JNN(20),R(300),QS(70),IM(100),JX(100),K(100)
     +         ,NP1(100),NP2(100),I1(50),I2(50),AQ(100),BQ(100),
     +          CH(100),DH(100),QINF(300),ASQ(100),BSQ(100),CSQ(100),
     +          DX(100),Y(100,100),YY(100),A(20),CM(100),JY(4300),RENH
     +          (300)
      READ(5,1000)  (A(N),N=1,20)
      WRITE(6,1000) (A(N),N=1,20)
      READ(5,1010)  (A(I),I=1,20),N,NKSH,JN,NP,NST,NSTW
      WRITE(6,1010) (A(I),I=1,20),N,NKSH,JN,NP,NST,NSTW
      READ(5,1080)  (A(I),I=1,20),DT,GAMMA,EPSSS,BCG,SBA
      WRITE(6,1080) (A(I),I=1,20),DT,GAMMA,EPSSS,BCG,SBA
      READ(5,1070)  (A(I),I=1,20),(DX(J),J=1,N)
      WRITE(6,1070) (A(I),I=1,20),(DX(J),J=1,N)
      READ(5,1020)  (A(I),I=1,20),(CM(J),J=1,N)
      WRITE(6,1020) (A(I),I=1,20),(CM(J),J=1,N)
      READ(5,1080)  (A(I),I=1,20),((Z(J),BD(J),GA(J),GB(J)),J=1,N)
      WRITE(6,1080) (A(I),I=1,20),((Z(J),BD(J),GA(J),GB(J)),J=1,N)
      READ(5,1420)  (A(I),I=1,20),((ZP(J),AP(J),BP(J)),J=1,NP)
      WRITE(6,1420) (A(I),I=1,20),((ZP(J),AP(J),BP(J)),J=1,NP)
      READ(5,1010)  (A(I),I=1,20),(NU(J),J=1,NKSH)
      WRITE(6,1010) (A(I),I=1,20),(NU(J),J=1,NKSH)
      READ(5,1010)  (A(I),I=1,20),(JNN(J),J=1,JN)
      WRITE(6,1010) (A(I),I=1,20),(JNN(J),J=1,JN)
      READ(5,1020) (A(I),I=1,20),(R(J),J=1,NSTW)
      WRITE(6,1020)(A(I),I=1,20),(R(J),J=1,NSTW)
      READ(5,1020)  (A(I),I=1,20),(RENH(J),J=1,NSTW)
      WRITE(6,1020) (A(I),I=1,20),(RENH(J),J=1,NSTW)
      READ(5,1020)  (A(I),I=1,20),((RHN(1,J),RQN(1,J)),J=1,N)
      WRITE(6,1020) (A(I),I=1,20),((RHN(1,J),RQN(1,J)),J=1,N)
      READ(5,1020)  (A(I),I=1,20),((PHN(1,J),PQN(1,J)),J=1,NP)
      WRITE(6,1020) (A(I),I=1,20),((PHN(1,J),PQN(1,J)),J=1,NP)
      DO 10 I=1,NKSH
      NL=NU(I)
      READ(5,1080)  (A(J),J=1,20),(QS(NL))
   10 WRITE(6,1080) (A(J),J=1,20),(QS(NL))
      READ(5,1020)  (A(J),J=1,20),(QINF(I),I=1,NSTW)
      WRITE(6,1020) (A(J),J=1,20),(QINF(I),I=1,NSTW)
      READ(5,1000)  (A(I),I=1,20)
C     READING OF COMBINATION
      WRITE(6,1000) (A(I),I=1,20)
      I=0
  340 I=I+1
      DO 330 IJ=1,NKSH
      IF(I.EQ.NU(IJ)) GO TO 350
  330 CONTINUE
      GO TO 360
  350 I=I+1
  360 DO 310 II=1,JN
      IF(I.EQ.JNN(II)) GO TO 320
  310 CONTINUE
      READ(5,1030) IM(I),JX(I),K(I),NP1(I),NP2(I)
      WRITE(6,1030) IM(I),JX(I),K(I),NP1(I),NP2(I)
      GO TO 300
  320 READ(5,1030) I1(I),I2(I),JX(I),K(I),NP1(I),NP2(I)
      WRITE(6,1030) I1(I),I2(I),JX(I),K(I),NP1(I),NP2(I)
  300 IF(I.EQ.N) GO TO 375
      GO TO 340
C     INITIAL CONDITIONS
  375 NN=1
      NY=1
      WRITE(6,1060)
      DO 376 I=1,NP
  376 BP(I)=BP(I)*BCG
      NPAGE=0
  370 IN=1
      M=1
      DO 100 I=1,N
      RHM(M,I)=RHN(NN,I)
      RQM(M,I)=RQN(NN,I)
  100 CONTINUE
      DO 110 I=1,NP
      PHM(M,I)=PHN(NN,I)
      PQM(M,I)=PQN(NN,I)
  110 CONTINUE
  700 CALL HOKAN(R,NY,NSTW,DT,RAN,INDER)
      IF(INDER.EQ.1) GO TO 999
      DO 50 I=1,N
      DO 50 J=1,N
      Y(J,I)=0.0
   50 CONTINUE
C     DISCHARGE FROM PADDY FIELD
  190 DO 120 IJ=1,NKSH
      IF(IN.EQ.NU(IJ)) GO TO 130
  120 CONTINUE
      GO TO 140
  130 IN=IN+1
  140 KS=0
      IP=NP1(IN)
      IJ=JX(IN)
      IF(IP.EQ.0) GO TO 200
  180 CALL HANTEI(PHN(NN,IP),RHN(NN,IJ),ZP(IP),KR)
      ADP=AP(IP)
      IF(KR.EQ.0) GO TO 160
      IF(KR.EQ.2) GO TO 150
      CALL ETSURU(PQN(NN,IP),PHN(NN,IP),PHM(M,IP),RHM(M,IJ),ZP(IP),
     +ADP,BP(IP),RAN,DT,AQ(IP),BQ(IP),CH(IP),DH(IP))
      GO TO 170
```

```
  150 IF(PHM(M,IP).EQ.RHM(M,IJ)) GO TO 160
      CALL SENRU(PQN(NN,IP),PHN(NN,IP),PHM(M,IP),RHM(M,IJ),ZP(IP),
     +ADP,BP(IP),RAN,DT,AQ(IP),BQ(IP),CH(IP),DH(IP))
      GO TO 170
  160 AQ(IP)=0.0
      BQ(IP)=0.0
      CH(IP)=0.0
      DH(IP)=(AP(IP)*RAN/360-PQN(NN,IP))*DT/(AP(IP)*10000)+PHN(NN,IP)
  170 IF(KS.EQ.1) GO TO 200
      IP=NP2(IN)
      IJ=JX(IN)
      IF(IP.EQ.0) GO TO 200
      KS=1
      GO TO 180
  200 IN=IN+1
      IF(IN.EQ.N+1) GO TO 400
      GO TO 190
C
C     COEFFICIENT MATRIX FOR WATER LEVEL
C
  400 IN=1
  405 DO 410 I=1,NKSH
      IF(IN.EQ.NU(I)) GO TO 420
  410 CONTINUE
      GO TO 430
  420 CALL HOKAN(QINF,NY,NSTW,DT,RQM(M,IN),INDER)
      RQM(M,IN)=RQM(M,IN)*QS(IN)
      IF(INDER.EQ.1) GO TO 999
      RQN(NN,IN)=RQM(M,IN)
C   * ****  Q(M+1,J)=ASQ(J)*H(M+1,J)+BSQ(J)*H(M+1,K)+CSQ(J)   *****
      ASQ(IN)=0.0
      BSQ(IN)=0.0
      CSQ(IN)=RQM(M,IN)
      Y(IN,IN)=1.0
      Y(IN+1,IN)=-1.0
      YY(IN)=0.0
      IN=IN+1
  430 DO 440 I=1,JN
      IF(IN.EQ.JNN(I)) GO TO 450
  440 CONTINUE
      JI=IM(IN)
      JJ=JX(IN)
      JK=K(IN)
      IP1=NP1(IN)
      IP2=NP2(IN)
      F1=(RHN(NN,JJ)-RHN(NN,JK))/DX(JJ)
      SX=(Z(JJ)-Z(JK))/DX(JJ)
      IF(SX.LT.0) GO TO 460
      IF(F1.LT.SX) GO TO 460
      CALL TORYU(RHM(M,JJ),RHN(NN,JJ),SX,GA(JJ),GB(JJ),RQM(M,JJ),DT,
     +RQN(NN,JJ),RQN(NN,JI),Z(JJ),BD(JJ),CM(JJ),DX(JJ),ASQ(JJ),BSQ(JJ),
     +CSQ(JJ),ASQ(JI),BSQ(JI),CSQ(JI),IP1,IP2,AQ,BQ,Y(JI,IN),Y(JJ,IN)
     +,Y(JK,IN),YY(IN))
      GO TO 500
  460 CALL FUTORY(Z(JJ),BD(JJ),CM(JJ),ASQ(JJ),BSQ(JJ),CSQ(JJ),ASQ(JI),
     +BSQ(JI),CSQ(JI),DX(JJ),RHM(M,JJ),RHM(M,JK),GA(JJ),GB(JJ),
     +RHN(NN,JJ),RQN(NN,JJ),RQN(NN,JI),AQ,BQ,IP1,IP2,Y(JI,IN),Y(JJ,IN)
     +,Y(JK,IN),YY(IN),DT)
      IF(IP1.EQ.1000) GO TO 998
      GO TO 500
  450 JI1=I1(IN)
      JI2=I2(IN)
      JJ=JX(IN)
      JK=K(IN)
      IP1=NP1(IN)
      IP2=NP2(IN)
      F1=(RHN(NN,JJ)-RHN(NN,JK))/DX(JJ)
      SX=(Z(JJ)-Z(JK))/DX(JJ)
      WJM=(BD(JJ)+2*CM(JJ)*(RHM(M,JJ)-Z(JJ)))*DX(JJ)/2
     ++(BD(JI1)+2*CM(JI1)*(RHM(M,JI1)-Z(JI1)))*DX(JI1)/2
     ++(BD(JI2)+2*CM(JI2)*(RHM(M,JI2)-Z(JI2)))*DX(JI2)/2
      WJN=(BD(JJ)+2*CM(JJ)*(RHN(NN,JJ)-Z(JJ)))*DX(JJ)/2
     ++(BD(JI1)+2*CM(JI1)*(RHN(NN,JI1)-Z(JI1)))*DX(JI1)/2
     ++(BD(JI2)+2*CM(JI2)*(RHN(NN,JI2)-Z(JI2)))*DX(JI2)/2
      X0=ASQ(JI1)
      X1=ASQ(JI2)
      IF(IP1.EQ.0) GO TO 485
      IF(IP2.EQ.0) GO TO 490
      X2=AQ(IP1)+AQ(IP2)+BSQ(JI1)+BSQ(JI2)
      X3=CSQ(JI1)+CSQ(JI2)+BQ(IP1)+BQ(IP2)
      GO TO 495
  485 X2=BSQ(JI1)+BSQ(JI2)
      X3=CSQ(JI1)+CSQ(JI2)
      GO TO 495
  490 X2=BSQ(JI1)+BSQ(JI2)+AQ(IP1)
      X3=CSQ(JI1)+CSQ(JI2)+BQ(IP1)
  495 IF(SX.LT.0) GO TO 480
      IF(F1.LT.SX) GO TO 480
      IF(RHM(M,JJ).LT.Z(JJ)) RHM(M,JJ)=Z(JJ)+0.1
      DUJ=SQRT(SX)*GA(JJ)*GB(JJ)*(RHM(M,JJ)-Z(JJ))**(GB(JJ)-1)
      ASQ(JJ)=DUJ
      BSQ(JJ)=0.0
      CSQ(JJ)=RQM(M,JJ)-DUJ*RHN(NN,JJ)
      Y(JI1,IN)=X0
      Y(JI2,IN)=X1
      Y(JJ,IN)=X2-(WJM+WJN)/DT-DUJ
      Y(JK,IN)=0.0
      YY(IN)=(X3+(WJM+WJN)*RHN(NN,JJ)/DT+DUJ*RHM(M,JJ)-RQM(M,JJ)
     ++RQN(NN,JI1)+RQN(NN,JI2)-RQN(NN,JJ))*(-1.0)
      GO TO 500
  480 DGJ=(RHM(M,JJ)-RHM(M,JK))/(SQRT(DX(JJ))*SQRT(ABS(RHM(M,JJ)-
     +RHM(M,JK))))
```

```
      IF(RHM(M,JJ).LT.Z(JJ)) RHM(M,JJ)=Z(JJ)+0.1
      DGJ=DGJ+GA(JJ)*GB(JJ)*(RHM(M,JJ)-Z(JJ))**(GB(JJ)-1)
      DFJ=0.5/(SQRT(DX(JJ))*SQRT(ABS(RHM(M,JJ)-RHM(M,JK))))
      DFJ=DFJ*GA(JJ)*(RHM(M,JJ)-Z(JJ))**GB(JJ)
      ASQ(JJ)=DGJ+DFJ
      BSQ(JJ)=-1.0*DFJ
      CSQ(JJ)=(DFJ-DGJ)*RHM(M,JJ)-DFJ*RHM(M,JK)
      Y(JI1,IN)=X0
      Y(JI2,IN)=X1
      Y(JJ,IN)=X2-(WJM+WJN)/DT-DGJ-DFJ
      Y(JK,IN)=DFJ
      YY(IN)=((WJM+WJN)*RHN(NN,JJ)/DT+(DGJ-DFJ)*RHM(M,JJ)+DFJ*RHM(M,JK)
     ++RQN(NN,JI1)+RQN(NN,JI2)+X3-RQN(NN,JJ))*(-1.0)
  500 IN=IN+1
      IF(IN.EQ.N) GO TO 510
      GO TO 405
  510 CALL HOKAN(RENH,NY,NSTW,DT,RAN,INDER)
      IF(INDER.EQ.1) GO TO 999
      YY(IN)=RAN
      Y(IN,IN)=1.0
      CALL SOLV(Y,YY,N)
      DO 610 I=1,N
      IF(YY(I).LT.0.0) IP1=1000
      IF(YY(I).LT.0.0) GO TO 998
      RHM(M+1,1)=YY(I)
  610 CONTINUE
      EVP=0.0
      MSM=0
  625 NG=N-1
      DO 615 I=1,NG
      DO 626 II=1,NKSH
  626 IF(I.EQ.NU(II)) GO TO 615
      IP1=NP1(I)
      IP2=NP2(I)
      JJ=JX(I)
      JK=K(I)
      RQM(M+1,I)=ASQ(I)*RHM(M+1,JJ)+BSQ(I)*RHM(M+1,JK)+CSQ(I)
      IF(IP1.EQ.0) GO TO 615
      PHM(M+1,IP1)=CH(IP1)*RHM(M+1,JJ)+DH(IP1)
      PQM(M+1,IP1)=AQ(IP1)*RHM(M+1,JJ)+BQ(IP1)
      IF(IP2.EQ.0) GO TO 615
      PHM(M+1,IP2)=CH(IP2)*RHM(M+1,JJ)+DH(IP2)
      PQM(M+1,IP2)=AQ(IP2)*RHM(M+1,JJ)+BQ(IP2)
  615 CONTINUE
      DO 628 II=1,NKSH
      IQ=NU(II)
  628 RHM(M+1,IQ)=RHM(M+1,IQ+1)-Z(IQ+1)+Z(IQ)
      RQM(M+1,N)=RQM(M+1,N-1)
      IF(MSM.EQ.1) GO TO 630
      DO 606 I=1,NG
      DO 627 II=1,NKSH
  627 IF(I.EQ.NU(II)) GO TO 606
      IF(ABS(RHM(M+1,I)-RHM(M,I)).GT.EPSSS) EVP=1.0
  606 CONTINUE
      IF(EVP.EQ.0.0) GO TO 630
      IF(M.EQ.4) GO TO 640
      M=M+1
      IN=1
      GO TO 700
  640 DO 645 I=1,NG
      RHM(M+1,I)=RHM(M,I)+GAMMA*(RHM(M+1,I)-RHM(M,I))
  645 CONTINUE
      MSM=1
      GO TO 625
  630 DO 635 I=1,N
      RHN(NN,1)=RHM(M+1,I)
      RQN(NN,I)=RQM(M+1,I)
  635 CONTINUE
      DO 650 I=1,NP
      PHN(NN,I)=PHM(M+1,I)
      PQN(NN,I)=PQM(M+1,I)
  650 CONTINUE
 1000 FORMAT(20A4)
 1010 FORMAT(20A4/(10I8))
 1020 FORMAT(20A4/(10F8.3))
 1030 FORMAT(10I8)
 1035 FORMAT(14I8)
 1040 FORMAT(10F8.3)
 1045 FORMAT(14F8.3)
 1050 FORMAT(/)
 1060 FORMAT(1H1)
 1070 FORMAT(20A4/(10F8.2))
 1080 FORMAT(20A4/(8F10.4))
 1420 FORMAT(20A4/(9F8.2))
 1090 FORMAT(7F10.3,1X)
 1100 FORMAT(//)
 1110 FORMAT(4X,5HRHM( ,I1,I2,3H )=,F10.3,5X,5HRHN( ,I1,I2,3H )=,F10.3)
 1120 FORMAT(4X,5HRQM( ,I1,I2,3H )=,F10.3,5X,5HRQN( ,I1,I2,3H )=,F10.3)
 1130 FORMAT(4X,5HPHM( ,I1,I2,3H )=,F10.3,5X,5HPHN( ,I1,I2,3H )=,F10.3)
 1140 FORMAT(4X,5HPQM( ,I1,I2,3H )=,F10.3,5X,5HPHN( ,I1,I2,3H )=,F10.3)
 1150 FORMAT(5X,11HPHN(NN,IP)=,2I2,F10.3,2X,11HRHN(NN,IJ)=,2I2,F10.3,2X,
     +7HZP(IP)=,I2,F10.3)
 1160 FORMAT(5X,3HNN=,I3,2X,3HIP=,I3,2X,2HM=,I3,2X,3HIJ=,I3)
 1170 FORMAT(5X,11HPQN(NN,IP)=,F10.3,2X,11HPHN(NN,IP)=,F10.3,2X,
     +10HPHM(M,IP)=,F10.3,2X,10HRHM(M,IJ)=,F10.3)
 1180 FORMAT(5X,7HZP(IP)=,F10.3,2X,7HAP(IP)=,F10.3,2X,7HBP(IP)=,F10.3,2X
     +,4HRAN=,F10.3)
 1190 FORMAT(5X,7HAQ(IP)=,F10.3,2X,7HBQ(IP)=,F10.3,2X,7HCH(IP)=,F10.3,
     +2X,7HDH(IP)=,F10.3)
 1200 FORMAT(5X,2HM=,I2,2X,3HJJ=,I2,2X,3HNN=,I2,2X,3HJI=,I2,2X,3HIN=,I2,
     +2X,3HJK=,I2)
 1210 FORMAT(5X,8HASQ(JJ)=,F10.3,2X,8HBSQ(JJ)=,F10.3,2X,8HCSQ(JJ)=,
```

```
     +F10.3,2X,3HJJ=,I2)
1220 FORMAT(5X,8HASQ(JI)=,F10.3,2X,8HBSQ(JI)=,F10.3,2X,8HCSQ(JI)=,
     +F10.3,2X,3HJI=,I2)
1230 FORMAT(5X,2HY(,2I2,2H)=,F10.3,3X,2HY(,2I2,2H)=,F10.3,3X,2HY(,2I2,
     +2H)=,F10.3,3X,3HYY(,I2,2H)=,F10.3)
1240 FORMAT(5X,10HRHM(M,JJ)=,F10.3,5X,11HRHN(NN,JJ)=,F10.3)
1250 FORMAT(5X,11HRQN(NN,JJ)=,F10.3,5X,11HRQN(NN,JI)=,F10.3)
1260 FORMAT(5X,10HRQM(M,JJ)=,F10.3,5X,6HZ(JJ)=,F10.3)
1270 FORMAT(5X,10HRHM(M,JK)=,F10.3,5X,6HZ(JJ)=,F10.3)
1280 FORMAT(5X,11HRHM(M,JI1)=,F10.3,5X,11HRHM(M,JI2)=,F10.3,5X,
     +4HJI1=,I2,2X,4HJI2=,I2,2X,2HM=I2)
1290 FORMAT(5X,12HRHN(NN,JI1)=,F10.3,5X,12HRHN(NN,JI2)=,F10.3,5X,
     +4HJI1=,I2,2X,4HJI2=,I2,2X,3HNN=,I2)
1300 FORMAT(5X,10HRHM(M,JJ)=,F10.3,5X,11HRHN(NN,JJ)=,F10.3,5X,
     +3HNN=,I2,2X,3HJJ=,I2,2X,2HM=I2)
1310 FORMAT(5X,4HWJM=,F10.3,5X,4HWJN=,F10.3)
1320 FORMAT(5X,4HJI1=,I2,2X,4HJI2=,I2,2X,3HJJ=,I2,2X,3HJK=,I2,2X,3HIN=,
     +I2)
1330 FORMAT(5X,10HY(JI1,IN)=,F10.3,3X,10HY(JI2,IN)=,F10.3,3X,
     +9HY(JJ,IN)=,F10.3,3X,9HY(JK,IN)=,F10.3,3X,7HYY(IN)=,F10.3)
 800 NUM=1
     DO 810 I=1,N
     DO 815 II=1,NKSH
 815 IF(I.EQ.NU(II)) GO TO 810
     JY(NUM)=I
     NUM=NUM+1
 810 CONTINUE
     WRITE(6,1050)
     TO = NY* DT
     DTIM=TO/3600
     SXS=DTIM/SBA
     MXS=DTIM/SBA
     IF((SXS-MXS).GT.0) GO TO 860
     MTH=DTIM
     MTM=(DTIM-MTH)*60
     MTS=TO-MTH*3600-MTM*60
     IF(MTS.EQ.60) MTM=MTM+1
     IF(MTS.EQ.60) MTS=0
     IF(MTS.EQ.60) MTH=MTH+1
     IF(MTM.EQ.60) MTM=0
     WRITE(6,1030) MTH,MTM,MTS
     NUMX=NUM-1
     NTEP=0
     NCL=NUMX/14+1
 840 NBN=1+14*NTEP
     NCON=14+14*NTEP
     IF(NCON.GT.NUMX) NCON=NUMX
     WRITE(6,1035) (JY(I),I=NBN,NCON)
     WRITE(6,1045) (RHN(NN,JY(I)),I=NBN,NCON)
     WRITE(6,1045) (RQN(NN,JY(I)),I=NBN,NCON)
     NTEP=NTEP+1
     NPAGE=NPAGE+1
     IF(NPAGE.EQ.10) WRITE(6,1060)
     IF(NPAGE.EQ.10) NPAGE=0
     WRITE(6,1050)
     IF(NTEP.LT.NCL) GO TO 840
     NTEP=0
     NCL=NP/14+1
 850 NBN=1+14*NTEP
     NCON=14+14*NTEP
     IF(NCON.GE.NP) NCON=NP
     WRITE(6,1035) (KK,KK=NBN,NCON)
     WRITE(6,1045) (PHN(NN,I),I=NBN,NCON)
     WRITE(6,1045) (PQN(NN,I),I=NBN,NCON)
     NTEP=NTEP+1
     NPAGE=NPAGE+1
     IF(NPAGE.EQ.10) WRITE(6,1060)
     IF(NPAGE.EQ.10) NPAGE=0
     WRITE(6,1050)
     IF(NTEP.LT.NCL) GO TO 850
 860 NY=NY+1
     IF(NY.EQ.NST) GO TO 999
     GO TO 370
 998 WRITE(6,1030)IP1
 999 STOP
     END
```

Reference 3.1(5) PROGRAM LIST OF DRAINAGE SIMULATION MODEL

```
      SUBROUTINE HOKAN (QRAIN,NN,NST,DT,RAN,INDER)
      DIMENSION QRAIN(300)
      T=NN*DT/3600
      I=1
   10 IF(T.LT.I) GO TO 20
      I=I+1
      IF(I.EQ.NST+1) GO TO 30
      GO TO 10
   20 RAN=(QRAIN(I+1)-QRAIN(I))*(T-(I-1))+QRAIN(I)
      INDER=0
      GO TO 40
   30 INDER=1
   40 RETURN
      END
```

```
      SUBROUTINE ETSURU(PQNN,PPHN,PPHM,RRHM,ZZP,AAP,BBP,RR,DT,A,B,C,D)
      AAP=AAP*10000
      RX=AAP*RR/3600000
      IF(PPHM.GT.RRHM) GO TO 120
      SUH=RRHM
      IF(SUH.LE.ZZP) GO TO 140
      DW1=1.5*1.5495*BBP*SQRT(SUH-ZZP)*(PPHM-RRHM)/ABS(PPHM-RRHM)
      GO TO 130
  140 DW1=0.0
      GO TO 130
  120 SUH=PPHM
      IF(SUH.LE.ZZP) GO TO 150
      DW2=1.5*1.5495*BBP*SQRT(SUH-ZZP)*(PPHM-RRHM)/ABS(PPHM-RRHM)
      GO TO 130
  150 DW2=0.0
  130 A1=2.0*AAP/DT
      D1=A1*PPHN-PQNN+2.0*RX
      IF(PPHM.GE.RRHM)  GO TO 100
      A=DW1
      B=-1.0*DW1*(RRHM+2.0*ZZP)/3.0
      C=-1.0*DW1/A1
      D=(DW1*(RRHM+2.0*ZZP)/3.0+D1)/A1
      GO TO 110
  100 A=DW2+A1
      B=DW2*(PPHM+2.0*ZZP)/3.0+D1
      C=0.0
      D=B/A
      A=0.0
      B=DW2*D-DW2*(PPHM+2.0*ZZP)/3.0
  110 RETURN
      END
```

```
      SUBROUTINE SENRU(PQNN,PPHN,PPHM,RRHM,ZZP,AAP,BBP,RR,DT,A,B,C,D)
      AAP=AAP*10000
      RX=RR*AAP/3600000
      SUL=RRHM
      IF(RRHM.GT.PPHM) SUL=PPHM
      DJ=4.0258*BBP*(SUL-ZZP)/(2.0*SQRT(ABS(PPHM-RRHM)))
      T=2.0*DJ/(2*AAP/DT+2.0*DJ)
      A=2.0*DJ*(T-1.0)
      B=T*(2.0*AAP*PPHN/DT-PQNN+2.0*RX)
      C=2.0*AAP/DT+2.0*DJ
      D=2*AAP*PPHN/DT-PQNN+2*RX
      D=D/C
      C=2.0*DJ/C
      RETURN
      END
```

```
      SUBROUTINE HANTEI(PPH,RRH,ZZP,K)
      DH1=PPH*ZZP
      DH2=RRH-ZZP
      IF(DH1.EQ.DH2) GO TO 10
      IF(DH2.LE.0.0) GO TO 40
      IF(DH1.LE.0.0) GO TO 20
      IF(DH1.GT.DH2) GO TO 50
      RDH=DH1/DH2
      IF(RDH.LE.0.0667) GO TO 20
      GO TO 30
   50 RDH=DH2/DH1
      IF(RDH.LE.0.6667) GO TO 20
      GO TO 30
   40 IF(DH1.GT.0.0) GO TO 20
   10 K=0
      GO TO 100
   20 K=1
      GO TO 100
   30 K=2
  100 RETURN
      END
```

```
      SUBROUTINE TORYU(RDM,RDN,SX,GAS,GBS,RQ,DT,QJ,QI,ZZ,BD,CMS,
     +DX1,AS,BS,CS,A1,B1,C1,IP1,IP2,AQ,BQ,Y1,Y2,Y3,Y4)
      DIMENSION AQ(100),BQ(100)
      FUNC(Z1,Z2,Z3,Z4,Z5)=(Z3+2.0*Z4*(Z1-Z2))*Z5
      IF(RDM.LT.ZZ) RDM=ZZ+0.1
      DUJ=SQRT(SX)*GAS*GBS*(RDM-ZZ)**(GBS-1.0)
      AS=DUJ
      BS=0.0
      CS=RQ-DUJ*RDN
      WJM=FUNC(RDM,ZZ,BD,CMS,DX1)
      WJN=FUNC(RDN,ZZ,BD,CMS,DX1)
      X1=A1
      IF(IP1.EQ.0) GO TO 10
      IF(IP2.EQ.0) GO TO 20
      X2=B1+AQ(IP1)+AQ(IP2)
      X3=C1+BQ(IP1)+BQ(IP2)
      GO TO 30
   10 X2=B1
      X3=C1
      GO TO 30
   20 X2=B1+AQ(IP1)
      X3=C1+BQ(IP1)
   30 Y1=X1
      Y2=X2-DUJ-(WJM+WJN)/DT
      Y3=0.0
      Y4=(X3+(WJM+WJN)*RDN/DT+DUJ*RDM+QI-QJ-RQ)*(-1.0)
      RETURN
      END

      SUBROUTINE FUTOPY(ZZ,BD,CMS,AS,BS,CS,A1,B1,C1,DX1,RDM,RKM,GAS,
     +GBS,RDN,QJ,QI,AQ,BQ,IP1,IP2,Y1,Y2,Y3,Y4,DT)
      DIMENSION AQ(100),BQ(100)
      IF(RDM.LT.ZZ) RDM=ZZ+0.1
      IF(RDM.EQ.RKM) RDM=RDM+0.01
      DGJ=(RDM-RKM)/(SQRT(DX1)*SQRT(ABS(RDM-RKM)))
      DGJ=DGJ*GAS*GBS*(RDM-ZZ)**(GBS-1)
      DFJ=0.5/(SQRT(DX1)*SQRT(ABS(RDM-RKM)))
      DFJ=DFJ*GAS*(RDM-ZZ)**GBS
      AS=DGJ+DFJ
      BS=-1.0*DFJ
      CS=(DFJ-DGJ)*RDM-DFJ*RKM
      WJM=(BD+2.0*CMS*(RDM-ZZ))*DX1
      WJN=(BD+2.0*CMS*(RDN-ZZ))*DX1
      X1=A1
      IF(IP1.EQ.0) GO TO 10
      IF(IP2.EQ.0) GO TO 20
      X2=B1+AQ(IP1)+AQ(IP2)
      X3=C1+BQ(IP1)+BQ(IP2)
      GO TO 30
   10 X2=B1
      X3=C1
      GO TO 30
   20 X2=B1+AQ(IP1)
      X3=C1+BQ(IP1)
   30 Y1=X1
      Y2=X2-(WJM+WJN)/DT-DGJ-DFJ
      Y3=DFJ
      Y4=(X3+(WJM+WJN)*RDN/DT+(DGJ-DFJ)*RDM+DFJ*RKM+QI-QJ)*(-1.0)
   40 RETURN
      END

      SUBROUTINE SOLV(VW,VF,N)
      DIMENSION VW(100,100),VF(100)
      DO 10 J=1,N
      DO 20 I=J,N
      IF(VW(J,I).EQ.0.0) GO TO 20
      WF=VW(J,I)
      DO 30 KC=J,N
      VW(KC,I)=VW(KC,I)/WF
   30 CONTINUE
      VF(I)=VF(I)/WF
   20 CONTINUE
      IF(J.EQ.N) GO TO 100
      JX=J+1
      DO 40 I=JX,N
      IF(VW(J,I).EQ.0.0) GO TO 40
      DO 50 KC=J,N
      VW(KC,I)=VW(KC,I)-VW(KC,J)
   50 CONTINUE
      VF(I)=VF(I)-VF(J)
   40 CONTINUE
   10 CONTINUE
  100 I=N
      DO 70 KS=1,N
      XYZ=0.0
      DO 80 J=1,N
      IF(J.EQ.I) GO TO 80
      XYZ=VW(J,I)*VF(J)+XYZ
   80 CONTINUE
      VF(I)=VF(I)-XYZ
      I=I-1
   70 CONTINUE
      RETURN
      END
```