

表1.1 (1) 作業監理委員，担当専門家，カウンターパート

Advisory Committee

- | | |
|--------------------------|-----------------------|
| 1. Mr. Youichiro Yano | Chairman of Committee |
| 2. Mr. Toyotake Kawami | Advisor |
| 3. Mr. Kouichi Yamamoto | Advisor |
| 4. Mr. Kazunori Yoshioka | Advisor |
| 5. Mr. Ryota Ono | Coordinator |

Study Team

- | | |
|------------------------------|--|
| 1. Mr. Hiroshi Ono | Team Leader/River Planner |
| 2. Mr. Masao Matsumura | River Engineer |
| 3. Mr. Toshio Terashima | Hydrologist |
| 4. Mr. Tokio Imai | Surveying Guidance Engineer |
| 5. Dr. Masahiko Oya | Geomorphologist |
| 6. Mr. Masahiko Nakagami | Engineer for Geology & Soil-Mechanics |
| 7. Mr. Noboru Jitsuhiro | Engineer for Water Resources Development |
| 8. Mr. Ryosaku Nagata | Structure Engineer |
| 9. Mr. Yoshiaki Ishizuka | Project Economist |
| 10. Mr. Kazuhiko Takebayashi | Engineer for Urban Drainage |
| 11. Mr. Takayuki Nobe | Construction Planner |
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表 1.1 (2) 作業監理委員，担当専門家，カウンターパート

<u>Counterpart Personnel Group</u>	
1. Mr. Mustafa Ibrahim BIE	Project Manager
2. Drs. Joesni Raalin BIE	Project Manager
3. Mr. Asnawi Marzuki MSc	Counterpart Coordinator
4. Ir. Koesdayat	Team Leader/River Planner
5. Ir. O.I. San	River Engineer
6. Ir. Bambang Priyambodo	River Engineer
7. Ir. Sutrisno	Hydrologist
8. Mr. Herdy Pangow BE	Hydrologist
9. Ir. Wagiono	Surveying Engineer
10. Ir. Bambang Sulistiyono	Surveying Engineer
11. Mr. Ishak BE	Geologist
12. Ir. Agus Sutiyanto	Water Resources Engineer
13. Mr. Hendarman BE	Water Resources Engineer
14. Ir. Muryanto	Structure Engineer
15. Ir. Irfan	Project Economist
16. Ir. Sudarwanto	Project Economist
17. Ir. D. Mujahit Hasbullah	Project Economist
18. Mr. Rachyadi BE	Engineer for Urban Drainage
19. Drs. Suchyar	Construction Planner

表3.1 氣象

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
<u>Rainfall (mm)</u>													
Tabing	258	296	283	397	319	265	286	312	396	483	507	370	4,172
Gunung Nago	287	311	338	536	339	280	414	258	357	544	512	343	4,519
<u>Max. temperature (°C)</u>													
Tabing	30.5	30.6	30.6	30.6	30.7	30.7	30.3	30.2	30.0	30.1	29.9	30.1	30.4
Gunung Nago	31.8	31.8	31.9	31.8	32.4	32.0	31.5	31.6	31.8	31.6	32.4	32.1	31.9
<u>Min. temperature (°C)</u>													
Tabing	22.0	22.1	22.4	22.9	22.7	22.3	21.8	21.8	22.1	22.2	22.4	22.1	22.2
Gunung Nago	21.8	21.4	21.3	21.4	22.0	22.3	21.5	21.2	21.5	21.7	22.0	22.0	21.7
<u>Mean temperature (°C)</u>													
Tabing	26.0	25.9	26.2	26.3	26.4	26.1	25.7	25.6	25.5	25.7	25.7	25.8	25.9
Gunung Nago	27.4	27.1	27.1	27.0	27.3	27.2	26.9	26.6	26.5	26.7	26.9	27.4	27.0
<u>Sunshine hour (%)</u>													
Tabing	55	54	56	51	56	57	58	55	42	41	36	49	51
Gunung Nago	48	42	52	46	54	52	51	47	42	37	34	49	46
<u>Relative humidity (%)</u>													
Tabing	81	82	83	84	83	82	82	82	84	84	84	84	83
Gunung Nago	91	91	89	90	92	92	90	89	90	90	95	91	91
<u>Wind speed (km/hr)</u>													
Tabing	3.4	3.6	3.3	3.3	3.0	3.1	3.2	3.1	3.6	3.3	3.5	3.4	3.3
Gunung Nago	4.2	4.1	3.9	3.9	4.0	4.4	4.0	4.0	3.8	3.7	3.8	4.0	4.0
<u>Evaporation (mm)</u>													
Tabing	127	127	133	130	136	127	126	124	122	124	122	124	1,522
Gunung Nago	162	135	151	145	143	146	142	144	135	146	116	140	1,705

Source : Pusat Meteorologi dan Geofisika (1971 - 1982) and DPMA (1976 - 1982)

Note /1 : Data is from "Flood Warning Flood Forecasting" report prepared by P.T. WASKITA KARYA (1980/1981)

表 3.2 Tabing 觀測所月雨量

(Unit: mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1948	450	672	379	-	-	-	-	-	-	-	-	390	-
1949	-	321	313	334	165	120	88	239	439	398	-	-	-
1950	328	170	428	476	434	-	212	578	302	474	-	255	-
1951	319	336	-	364	282	253	201	292	368	-	597	546	-
1952	473	351	334	429	346	165	-	-	460	-	487	368	-
1953	248	236	389	302	151	258	421	233	390	653	492	538	4,311
1954	438	258	346	414	259	183	311	263	136	414	654	298	3,974
1955	189	327	389	520	448	196	252	304	424	379	294	553	4,275
1956	281	237	155	276	100	351	291	300	430	267	515	585	3,788
1957	208	249	494	429	258	290	398	281	-	325	312	642	-
1958	286	-	-	-	-	253	-	578	216	-	-	-	-
1959	173	178	405	-	233	-	-	177	-	668	586	418	-
1960	358	204	184	355	134	149	502	214	-	395	329	360	-
1961	-	-	152	121	-	426	77	84	-	-	-	158	-
1962	379	180	354	-	326	-	227	-	259	-	646	-	-
1963	-	38	96	174	369	110	376	-	-	-	-	562	-
1964	497	-	-	405	301	211	-	37	349	530	-	-	-
1965	-	-	467	252	-	96	71	-	397	-	434	-	-
1966	-	386	-	-	-	-	-	-	-	-	-	-	-
1967	-	-	137	373	-	170	260	94	-	-	613	-	-
1968	-	-	-	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	414	192	-	304	745	643	646	-
1970	291	172	-	375	332	198	385	349	-	568	349	-	-
1971	263	200	356	241	182	360	169	514	392	331	426	705	4,139
1972	187	416	247	320	782	197	213	266	264	217	706	640	4,455
1973	212	215	395	390	235	445	389	277	435	293	388	411	4,085
1974	251	154	153	616	387	454	183	464	598	314	566	266	4,406
1975	272	333	170	373	256	126	288	319	290	311	166	315	3,219
1976	161	257	178	346	105	238	352	268	349	890	465	179	3,788
1977	358	297	108	295	446	192	152	147	257	476	741	434	3,903
1978	493	341	312	207	388	387	467	364	398	685	247	145	4,434
1979	240	329	238	525	280	307	352	224	516	416	696	190	4,313
1980	276	232	363	523	278	297	254	468	355	595	807	479	4,927
1981	185	313	220	557	295	99	461	177	611	891	512	311	4,632
1982	195	464	661	369	189	75	154	253	286	381	369	359	3,755
Ave.	297	281	301	370	295	242	275	288	369	484	502	414	4,118

Source : Pusat Meteorologi dan Geofisika

表3.3 Tabing 觀測所確率日雨量

Return period (year)	Probable rainfall depth (mm)
<u>1 day rainfall</u>	
2	162.9
5	219.6
10	257.1
25	304.5
50	339.7
100	374.6
<u>2 day rainfall</u>	
2	196.1
5	256.5
10	296.5
25	347.0
50	384.5
100	421.7

Note : Gumber Method is used for the analysis

表3.4 月平均日流疊

(Unit : m³/s)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ave.
<u>/1</u>													
<u>Lb. Begalung</u>													
1972	-	-	-	-	-	-	6.6	8.8	8.3	-	15.0	16.8	-
1978	7.3	6.9	14.7	4.8	18.5	7.9	12.0	14.2	18.6	13.1	17.5	8.7	12.0
1979	9.5	16.6	7.0	21.4	9.0	11.4	13.1	11.6	16.8	9.5	27.0	9.5	13.5
1980	9.0	2.1	7.1	19.3	10.4	11.2	10.9	9.2	5.4	16.2	25.2	26.1	14.2
1981	8.3	7.1	5.5	23.4	15.3	13.3	18.9	5.1	27.0	40.7	25.7	17.7	17.3
Ave.	8.5	8.2	8.6	17.2	13.3	11.0	12.3	9.8	15.2	19.9	22.1	15.8	13.5
<u>/2</u>													
<u>Gumung Nago</u>													
1979	33.8	33.5	21.4	43.0	23.9	32.3	24.1	22.5	23.3	31.0	78.0	40.6	34.0
1980	21.9	-	17.8	38.6	25.2	23.6	24.9	22.4	9.0	34.0	-	-	-
1981	10.2	5.3	1.2	26.5	18.7	12.4	15.8	3.8	26.6	50.9	28.9	18.2	18.2
1982	3.5	5.6	30.0	22.9	19.2	0.6	0.0	0.0	0.5	2.4	8.9	18.9	9.4
Ave.	17.4	14.8	17.6	32.8	21.8	17.2	16.2	12.2	14.9	29.6	38.6	19.4	21.0
<u>Lb. Minturum</u>													
1979	-	-	-	-	5.5	9.6	10.7	9.5	11.3	11.9	34.4	18.4	-
1980	11.6	6.4	11.3	19.8	16.5	12.8	9.4	11.4	10.7	22.7	31.6	44.0	17.3
1981	13.2	10.6	8.1	20.0	16.8	12.1	14.4	8.8	16.1	32.7	24.6	15.3	16.1
1982	10.1	14.6	27.6	17.3	16.7	9.8	6.1	6.9	5.6	11.4	13.0	-	-
Ave.	11.6	10.5	15.7	19.0	13.9	11.1	10.2	9.1	10.9	19.7	25.9	25.9	15.3

Note /1 : Discharge at the downstream of the weir

/2 : Discharge overflowing the weir

表 3.5 現況河道流過能力

Channel	Carrying Capacity (m ³ /s)	
	Bankful	with 1.0 m freeboard
1. Arau River :		
Rivermouth - Jirak river	300 - 500	-
Jirak river - diversion weir	300 - 600	-
Flood relief channel	450 - 800	300 - 600
2. Kuranji river :		
Rivermouth - Nanggalo Br.	400 - 500	-
Nanggalo Br. - AWLR St. BK 3	300 - 600	-
Balimbing river :		
Kuranji r. - Laras r.	50 - 100	-
Laras r. - Kp. P.Ratus	50 - 100	-
3. Air Dingin river :		
Rivermouth - Koto Tuo weir	200 - 550	-

表 3.6 調査対象地域内の現況土地利用

Kecamatan	Residencial area	Paddy field	Up-land crops area	Open land	River	Total
Padang Selatan	247	87	0	34	57	425
Padang Barat	667	0	0	0	11	678
Padang Utara	305	398	6	66	22	797
Padang Timur	501	243	7	5	20	776
Koto Tangah	227	910	150	1,804	98	3,189
Nanggalo	211	852	175	92	87	1,417
Kuranji	514	1,882	88	93	76	2,653
Pauh	98	550	8	4	22	682
Lbk. Kilangan	70	129	11	8	32	250
Lbk. Begalung	525	857	16	93	62	1,533
Total	3,365	5,908	461	2,199	487	12,420
%	27.1	47.6	3.7	17.7	3.9	100.0

Note : Open land includes areas of sea shore, fallow area, wasted area, etc.

Source : 1/5,000 topographic map, 1/5,000 aerophoto in 1981, and information from local people.

表3.7 確率年別洪水被害額

Unit : Rp.10⁶

River	Item	Return period					
		2 - yr	5 - yr	10 - yr	25 - yr	50 - yr	100 - yr
Arau river system	House & others	761	7,851	13,308	18,827	19,444	20,470
	Agricultural products	1	5	8	13	53	187
	Sub-total	762	7,856	13,316	18,840	19,497	20,657
	Public facilities	76	786	1,332	1,884	1,950	2,066
	Direct damage	838	8,642	14,648	20,724	21,447	22,723
	Indirect damage	84	864	1,465	2,072	2,145	2,272
	Total	922	9,506	16,113	22,796	23,592	24,995
Kuranji river system	House & others	462	1,409	2,863	3,825	4,417	5,004
	Agricultural products	12	39	45	129	121	138
	Sub-total	474	1,448	2,908	3,954	4,538	5,142
	Public facilities	47	145	291	396	454	514
	Direct damage	521	1,593	3,199	4,350	4,992	5,656
	Indirect damage	52	159	320	435	500	566
	Total	573	1,752	3,519	4,785	5,492	6,222
Air Dingin river system	House & others	192	283	564	1,223	2,315	2,377
	Agricultural products	6	14	26	172	223	236
	Sub-total	198	297	590	1,395	2,538	2,613
	Public facilities	20	30	59	140	254	261
	Direct damage	218	327	649	1,535	2,792	2,874
	Indirect damage	22	33	65	153	279	287
	Total	240	360	714	1,688	3,071	3,161
Total	House & others	1,415	9,543	16,735	23,875	26,176	27,851
	Agricultural products	19	58	79	314	397	561
	Sub-total	1,434	9,601	16,814	24,189	26,573	28,412
	Public facilities	143	961	1,682	242	2,658	2,841
	Direct damage	1,577	10,562	18,496	26,609	29,231	31,253
	Indirect damage	158	1,056	1,850	2,660	2,924	3,125
	Total	1,735	11,618	20,346	29,269	32,155	34,378

表3.8 現況水収支

Month	Rain-fall at Tabing (mm/mo)	Lb. Sarik		Gn. Nago		S. Guo		Lb. Minturum	
		Qr (m ³ /s)	Qa (m ³ /s)	Qr (m ³ /s)	Qa (m ³ /s)	Qr (m ³ /s)	Qa (m ³ /s)	Qr (m ³ /s)	Qa (m ³ /s)
Jan.	193	1.23	3.58	3.26	6.05	0.74	0.55	2.40	5.13
Feb.	180	0.49	3.34	0.22	5.64	0	0.52	0	4.79
Mar.	155	0.49	2.88	0.22	4.86	0	0.45	0	4.12
Apr.	271	0.49	5.03	0.22	8.50	0	0.78	0	7.21
May	175	1.42	3.25	4.02	5.49	0.93	0.50	3.01	4.65
Jun.	126	1.59	2.34	4.69	3.95	1.09	0.36	3.53	3.35
Jul.	166	1.65	3.08	4.97	5.20	1.16	0.48	3.76	4.41
Aug.	177	1.21	3.29	3.15	5.55	0.71	0.51	2.32	4.71
Sep.	268	0.49	4.98	0.22	8.40	0	0.77	0	7.13
Oct.	314	1.14	5.83	2.87	9.84	0.65	0.90	2.10	8.35
Nov.	337	0.91	6.26	1.93	10.56	0.42	0.97	1.35	8.96
Dec.	259	1.24	4.81	3.29	8.12	0.75	0.74	2.43	6.89
D.A. (Km ²)			64		120		11		116
K-value			0.0273		0.0461		0.00422		0.0391

Notes
 Qr : Water requirement
 Qa : Available Water (= (Rainfall at Tabing) x K x 0.68)
 K : Qa / (rainfall at Tabing)

表 4.1 治水事業と海岸保全事業の実行予算

Year	Budget (Rp. 10 ³)					
	Arau R.	Flood relief Channel	Kuranji R.	Air Dingin R.	Padang Coast	Total
1969 - 70	-	8,000	6,000	-	6,320	20,320
1970 - 71	4,500	13,500	2,500	-	-	20,500
1971 - 72	866	3,900	3,184	-	30,000	37,950
1972 - 73	1,583	11,531	-	5,902	35,000	54,016
1973 - 74	4,173	16,817	-	-	40,000	60,990
1974 - 75	-	6,025	3,510	-	40,000	49,535
1975 - 76	-	22,315	5,930	-	46,000	74,245
1976 - 77	-	14,898	9,601	4,000	45,000	73,499
1977 - 78	17,850	-	14,490	-	40,000	72,340
1978 - 79	19,108	-	20,000	-	50,000	89,308
1979 - 80	52,675	-	30,565	-	59,000	142,240
1980 - 81	12,338	107,678	29,889	-	69,992	219,897
1981 - 82	8,350	223,368	13,125	-	65,035	309,878
Total	121,443	428,032	138,994	9,902	526,347	1,224,718
1982 - 83	22,242	293,527	81,800	12,872	85,000	495,441

表 5.1 Arau 川代替案

Stretch	Scheme A-1	Scheme A-2	Scheme A-3
1. Middle Arau (new railway br. - Lbk Begalung weir)	Bank protection only	Same as Scheme A-1	Same as Scheme A-1
2. Lower Arau (Lbk Begalung weir - river mouth)	Minor improvement	Improvement by diking system with bank protection	Improvement on intermediate scale between Scheme A-1 and A-2
3. Flood relief channel	Improvement as a main floodway for the whole stretch by diking system with bank protection	Minor improvement	Improvement on intermediate scale between Scheme A-1 and A-2
4. Jirak river	Improvement by diking system	Same as Scheme A-1	Same as Scheme A-1
5. Lubuk Begalung weir	Reconstruction	Same as Scheme A-1	Same as Scheme A-1
6. Drainage facilities	Construction of outlet structures for drain and pumping station in low-lying area	Same as Scheme A-1	Same as Scheme A-1

表5.2 Kuranji 川代營案

Stretch	Scheme K-1	Scheme K-2
1. Middle Kuranji		
- Stretch between Gunung Nago weir & Kalawi br.	Bank protection only	Same as Scheme K-1
- Stretch between Kalawi br. & water supply intake	Improvement by diking system. Bank protection in some length	Same as Scheme K-1
2. Lower Kuranji (water supply intake - river mouth)	Improvement by continuous dike and dredging of lower channel. Bank protection in some length	Same as Scheme K-1, but proposed channel will be smaller than Scheme K-1 owing to effects of retarding basin.
3. Balimbing and Laras rivers	Improvement by diking system	Construction of Laras retarding basin
4. Drainage facilities	Similar facilities as Scheme A-1 for Arau River.	Same as Scheme K-1

表 5.3 Air Dingin 川代替案

Stretch	Scheme D-1	Scheme D-2
1. Middle Air Dingin	Bank protection only	Same as Scheme D-1
2. Lower Air Dingin	Improvement by diking system. Bank protection in some length.	Same as Scheme D-1, but proposed channel will be smaller than Scheme D-1 owing to effects of opening of river mouth.
3. River mouth	Existing sand spit is to be left it is. Back water effects due to obstruction by sand spit will be treated by hightening dike.	Existing sand spit is to be removed. Construction of training dike to maintain river mouth.
4. Drainage facilities	Similar facilities as Scheme A-1 for Arau river.	Same as Scheme D-1

表5.4 インドネシア国内河川の計画高水流量

NO.	Name of River	Province	Catchment Area (km ²)	Design Flood (m ³ /s)	Return Period (yr)
1.	Sungai Cimanuk	West Jawa	3,006	1,440	25
2.	Kali Serang	Central Jawa	937	900	25
3.	Sungai Citanduy	West Jawa	3,680	1,900	25
4.	Sungai Ular	North Sumatra	1,080	800	30
5.	Kali Pemali	Central Jawa	1,228	1,300	25
6.	Sungai Cipanas	West Jawa	220	385	25
7.	Bengawan Solo	Central/East Jawa	3,320	2,000	40
8.	Kali Madiun	East Jawa	2,400	2,300	40
9.	Sungai Wampu	North Sumatra	3,840	1,320	20
10.	Sungai Arakundo	Aceh	5,495	2,100	50
11.	Sungai Krueng Aceh	Aceh	1,775	1,960	50
12.	Kali Brantas	East Jawa	10,000	1,500	50
13.	Sungai Bah Bolon	North Sumatra	2,776	1,200	20
14.	Sungai Walanae	South Sulawesi	3,190	2,900	20
15.	Sungai Bila	South Sulawesi	1,368	1,900	20
16.	Sungai Jeneberang	South Sulawesi	729	3,700	50

Data Source : Directorate of Rivers, DGWRD.

表5.5 主要地点の確率高水流量

(Unit : m³/s)

Location	Return Period (year)				
	5	10	25	50	100
<u>Arau River</u>					
Lb. Sarik	222	275	353	424	500
Kp. Baru	384	492	636	740	845
Lb. Begalung (before bifurcation)	427	531	671	773	902
After Confluence of Jirak R.	362	446	527	578	650
Rivermouth	399	482	585	660	724
<u>Tributary</u>					
Jirak R.	118	147	171	184	202
<u>Flood Relief Channel</u>					
Rivermouth	261	329	406	450	503
<u>Kuranji River</u>					
Gunung Nago	363	439	570	676	790
Kp. Melayu	377	453	574	675	774
After Confluence of Balimbing R.	639	768	926	1055	1169
Rivermouth	669	805	992	1131	1245
<u>Triburary</u>					
Balimbing R.	258	307	366	405	447
Laras R.	67	80	98	110	123
<u>Air Dingin River</u>					
Lb. Minturun	342	411	539	635	734
Rivermouth	386	464	560	653	758

表5.6 排水路改修延長と計画ポンプ規模

Drainage system	Drainage area (km ²)	Channel length to be improved (km)	Drainage	Capacity of pump (m ³ /s)	Terminal	Remarks
<u>Old urban area</u>						
Jati	2.14	4.40	Gravity	-	Arau river	Including 574 m of diversion drain.
Palinggam	0.71	1.35	- do -	-	- do -	
Anak Jati	0.62	2.45	- do -	-	- do -	Including Kelenteng drain.
Olo-Nipah	1.40	5.75	- do -	-	- do -	
Kali Mati	0.21	0.95	Pump	1.0	- do -	Excluding Nipah area.
Damar	1.15	4.00	Gravity	-	Indonesian Ocean	
Ujung Gurun	1.62	5.05	Pump	5.0	Flood relief channel	
Sub-total	7.85	23.95	-	6.0		
<u>New Urban area</u>						
Purus	1.06	2.0	Pump	3.5	Flood relief channel	
Lolong	2.65	2.05	Gravity	-	Indonesian Ocean	
Ulak Karang	1.87	3.85	Pump	5.5	Kuranji river	
Lapai	1.42	3.70	Gravity	-	- do -	
Baung	1.82	2.50	Pump	5.5	- do -	
Penjalinan	1.10	1.45	Pump	3.0	Air Dingin river	
Tabing	12.08	3.50	Gravity	-	- do -	
Sub-total	21.46	19.05	-	17.5		
Total	29.41	43.00	-	23.5		

表 5.7 全体計画事業費

Item	Local currency	Foreign currency	Eq. Total
	(Rp. 10 ⁶)	(US\$ 10 ³)	(Rp.10 ⁶)
I. Civil Works	16,074.4	36,874.7	51,843.1
Arau river	3,435.2	6,551.0	
Flood relief channel	5,762.2	11,993.0	
Kuranji river	5,107.4	13,338.5	
Air Dingin river	1,769.6	4,992.2	
II. Land Acquisition and House Compensation	2,390.4	-	2,390.4
Arau river	860.3	-	
Flood relief channel	577.2	-	
Kuranji river	683.8	-	
Air Dingin river	269.1	-	
III. Total (I + II)	18,464.8	36,874.7	54,233.5
IV. Engineering and Administration ¹	2,769.8	5,531.3	8,135.2
V. Contingency ²	2,258.4	5,190.0	7,293.3
VI. Grand Total	23,493.0	47,596.0	69,662.0

Note : 1. Price level at the beginning of June '83 was applied

2. Conversion rate : US\$ 1 = Rp. 970 = ¥ 240

3. The following lump sum costs were applied

for 1 15 % of the total costs of civil works, and land acquisition and house compensation

2 10 % of the total costs of civil works, land acquisition and house compensation, and engineering and administration

表6.1 緊急治水事業の改修対象区間

River	Whole Stretch /1		Stretch for Main Works /2	
	Stretch	Length (km)	Stretch	Length (km)
1. Mainstream of Arau river	River mouth - bypass road Br.	8.5	Suspension Br.-confluence of Jirak river	1.9
2. Flood relief channel	River mouth - Lubuk Begalung weir	6.7	River mouth - Lubuk Begalung weir	6.7
3. Jirak river	Confluence to mainstream - railway Br.	2.5	Confluence to mainstream - railway Br.	2.5
4. Mainstream of Kuranji river	River mouth - Kalawi Br.	7.5	River mouth - Kalawi Br.	7.5
5. Balimbing river	Confluence to mainstream of Kuranji - Kp. Padjang	4.2	Confluence to mainstream of Kuranji - Kp. Padjang	4.2
6. Laras river	Confluence to Balimbing river - Kp. Blantikan	1.2	Confluence to Balimbing river - Kp. Blantikan	1.2
7. Air Dingin river	River mouth - Koto Tuo weir	5.2	River mouth - Koto Tuo weir	5.2

Remarks /1 : Whole stretch subject to improvement works including bank protection and ground sill works

/2 : Stretch subject to main works such as channel excavation and embankment works.

表 6.2 用地買収面積と補償家屋数

Item	Unit	Quantity				Total
		Arau river	F.R.C.	Kuranji river	Air Dingin river	
I. River Channel Improvement Works						
Land I (residential area)	10 ³ m ²	84.8	12.5	22.9	10.0	130.2
Land II (agricultural land & others)	"	46.8	83.5	606.3	190.0	926.6
House I (permanent house)	nos	-	-	-	-	-
House II (semi permanent house)	"	5	4	-	-	9
House III (small house)	"	52	17	58	13	140
House IV (temporary house)	"	33	21	34	7	95
II. Drainage Channel Improvement Works						
Item	Unit	Olo-Nipah	Ujung Guran	Purus	Ulak Karang	Total
Land I (residential area)	10 ³ m ²	4.0	37.0	9.0	2.0	52.0
Land II (agricultural land and others)	"	-	32.0	-	6.0	38.0
House I (permanent house)	nos	-	2	1	2	5
House II (semi permanent house)	"	-	4	2	-	6
House III (small house)	"	4	6	1	-	11
House IV (temporary house)	"	-	6	30	-	36

Note: House I ; Deluxe house which is constructed by concrete or brick structures with more than 100 m² of floor area in average.
 House II ; Ordinary house which is constructed by concrete or brick structures with 60 m² of floor area in average.
 House III ; Wooden house with 40 m² of floor area in average.
 House IV ; Temporary house which is constructed by bamboo or nipah with 30 m² of floor area in average.

表7.1 工事費単価

Works	Unit	Unit Cost /1		
		Local C (Rp.)	Foreign C. (US\$)	Eq. Total (Rp.)
Excavation				
I (high water channel)	m ³	499	1.50	1,954
II (major bed)	"	294	1.78	2,021
for rock	"	1,700	6.00	7,520
Dredging	"	801	3.54	4,235
Transportation	"	788	2.13	2,855
Embankment				
I (new levee)	m ³	425	1.51	1,889
II (strengthening)	"	456	1.07	1,494
Wet masonry revetment				
I (high water channel)	m ²	9,685	13.31	22,596
II (low water channel)	"	11,410	13.74	24,739
Dry masonry	"	7,453	9.32	16,494
Gabion	m ³	7,712	14.49	21,766
Riprap	m ³	13,709	10.83	24,215
Groin	"	7,712	14.49	21,766
Sod-facing	m ²	320	0.17	485
Drainage culvert				
I (1.5 x 1.5 x 1)	nos	15,200,100	22,726	37,244,320
II (2.0 x 2.5 x 1)	"	22,444,000	35,023	56,416,310
III (2.0 x 2.5 x 2)	"	32,120,000	49,665	80,295,050
Bridge (R.C)	m ²	173,730	274.82	440,306
(Metal)	m ²	201,352	543.82	728,858
Pier protection for existing bridge (riprap)	m ³	13,709	10.83	24,215
Drop structure	place	87,196,000	192,581	212,889,570
Groundsill works	m	474,462	424.91	886,620
Diversion weir				
Flood relief channel	l.s	317,914,110	508,496	811,155,230
Arau river (urgent)	"	246,874,420	229,963	469,938,530
Syphon	Place	31,263,100	45,067	79,978,090
Disposal of excess soil	m ³	176	0.81	963
Excavation of rock	"			
Pumping station				
I (3.5 m ³ /s)	l.s	435,000,000	1,661,000	2,046,170,000
II (2.0 m ³ /s)	"	359,000,000	1,401,000	1,717,970,000
Inspection road (gravel metaling)	m	2,422	3.03	5,362

Note /1 : US\$ 1 = Rp. 970 = ¥ 240

表7.2 緊急治水計画事業費

Item	Local currency (Rp.10 ⁶)	Foreign currency (US\$ 10 ³)	Eq.Total (Rp.10 ⁶)
I. Civil Works	9,627.1	22,779.8	31,723.7
Arau river	1,311.8	2,581.6	
Flood relief channel	4,502.6	10,145.2	
Kuranji river	2,982.7	7,937.9	
Air Dingin river	830.0	2,115.1	
II. Land Acquisition and House Compensation	1,819.9	-	1,819.9
Arau river	489.4	-	
Flood relief channel	577.2	-	
Kuranji river	528.2	-	
Air Dingin river	225.1	-	
III. Total (I + II)	11,447.0	22,779.8	33,543.6
IV. Administration ^{/1}	1,144.7	-	1,144.7
V. Engineering ^{/2}	940.6	5,680.8	6,451.0
VI. Contingency ^{/3}	1,353.7	2,846.4	4,114.7
VII. Grand Total	14,886.0	31,307.0	45,254.0

Note : 1. Price level at the beginning of June '83 was applied

2. Conversion rate : US \$ 1 = Rp. 970 = ¥ 240

3. The following lump sum costs were applied

for /1 10 % of the civil works cost

/2 10 % of the total local component of civil works,
and land acquisition and house compensation

/3 10 % of the total costs of civil works, land
acquisition and house compensation, and engineering
and administration

4. Cost for civil works includes costs for preparatory works
(8 % of direct civil works) and miscellaneous works (10 %
of civil works). The cost for miscellaneous works includes
cost for telemetering facilities to establish flood fore-
casting system in future.

表9.1 緊急治水事業の費用-便益年次配分

Unit: Rp. 10⁶

Year in order	Year	Economic cost			Total	Benefit
		Construction cost	Replacement cost	O & M cost		
1	1985/86	1,323	-	-	1,323	-
2	1986/87	1,234	-	-	1,234	-
3	1987/88	6,731	-	-	6,731	-
4	1988/89	9,672	-	-	9,672	-
5	1989/90	10,545	-	25	10,570	1,223
6	1990/91	10,545	-	75	10,620	3,669
7	1991/92	3,628	-	125	3,753	6,116
8	1992/93	-	-	150	150	7,339
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31	2015/16	-	-	150	150	7,339
32	2016/17	-	1,191	150	1,341	7,339
33	2017/18	-	1,191	150	1,341	7,339
34	2018/19	-	1,195	150	1,345	7,339
35	2019/20	-	-	150	150	7,339
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57	2041/42	-	-	150	150	7,339

表9.2 緊急治水事業の所要資金

Description	L.C (Rp. 10 ⁶)	F.C Required Loan Amount (US \$ 10 ³)	Total (Rp.10 ⁶)
1. Land acquisition	1,819.9	-	1,819.9
2. Civil Works	9,627.1	22,779.8	31,723.5
(1) Arau river	1,311.8	2,581.6	3,816.0
(2) Flood relief Channel	4,502.6	10,145.2	14,343.4
(3) Kuranji river	2,982.7	7,937.9	10,682.5
(4) Air Dingin river	830.0	2,115.1	2,881.6
3. Administration	1,144.7	-	1,144.7
4. Engineering services	940.6	5,680.8	6,451.0
5. Total (1 to 4)	13,532.3	28,460.6	41,139.1
6. Physical contingency	1,353.3	2,846.3	4,114.2
7. Total (5 + 6)	14,885.6	31,306.9	45,253.3
8. Price contingency	17,600.0	12,441.2	29,668.0
9. Grand total	32,485.6	43,748.1	74,921.3

Remark : (1) Price escalation rate for F.C portion : 6 %
(2) Price escalation rate for L.C portion :15 %
(3) US \$ 1 = Rp. 970.

表9.3 年度別支出計画

(Unit: L.C. = Rp. 10⁶; F.C. = US\$ 10³)

DESCRIPTION	1985/86		1986/87		1987/88		1988/89		1989/90		1990/91		1991/92		TOTAL	
	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.
1. Land acquisition	181.9	-	546.0	-	546.0	-	546.0	-	-	-	-	-	-	-	1,819.9	-
2. Civil Works	-	-	-	-	1,162.9	2,545.4	2,348.6	5,563.1	2,971.3	7,045.6	2,680.3	6,409.1	464.0	1,216.6	9,627.1	22,779.8
(1) Arau river	-	-	-	-	262.4	516.3	328.0	645.4	393.6	774.5	327.8	645.4	-	-	1,311.8	2,581.6
(2) Flood relief channel	-	-	-	-	900.5	2,029.1	1,125.7	2,536.3	1,350.8	3,043.6	1,125.6	2,536.2	-	-	4,502.6	10,145.2
(3) Kuranji river	-	-	-	-	-	-	894.9	2,381.4	894.9	2,381.4	894.9	2,381.4	298.0	793.7	2,982.7	7,937.9
(4) Air Dingin river	-	-	-	-	-	-	-	-	332.0	846.1	332.0	846.1	166.0	422.9	830.0	2,115.1
3. Administration	229.0	-	171.7	-	171.7	-	114.5	-	114.5	-	171.7	-	171.6	-	1,144.7	-
4. Engineering	265.1	1,530.2	66.2	382.5	121.9	753.7	121.9	753.6	121.9	753.6	121.9	753.6	121.7	753.6	940.6	5,680.8
5. Total (1+4)	676.0	1,530.2	783.9	382.5	2,002.5	3,299.1	3,131.0	6,316.7	3,207.7	7,799.2	2,973.9	7,162.7	757.3	1,970.2	13,532.3	28,460.6
6. Physical contingency	67.6	153.0	78.4	38.3	200.3	330.0	313.1	631.7	320.8	780.0	297.4	716.3	75.7	197.0	1,353.3	2,846.3
7. Total (5+6)	743.6	1,683.2	862.3	420.8	2,202.8	3,629.1	3,444.1	6,948.4	3,528.5	8,579.2	3,271.3	7,879.0	833.0	2,167.2	14,885.6	31,306.9
8. Price contingency	240.2	208.1	449.3	80.4	1,649.9	950.9	3,482.0	2,348.6	4,633.0	3,594.7	5,430.4	3,971.1	1,715.2	1,287.4	17,600.0	12,441.2
9. Grand Total	983.8	1,891.3	1,311.6	501.2	3,852.7	4,580.0	6,926.1	9,297.0	8,161.5	12,173.9	8,701.7	11,850.1	2,548.2	3,454.6	32,485.6	43,748.1

Note : 1. The price level of 1983 was applied to the estimation

2. The following were applied to the conversion rate

US\$ 1 = Rp. 970

3. The following were applied to the price contingency

15 % for local currency

6 % for foreign currency

表11.1 年間発電量計算表

Power plant	Discharge (m ³ /s)	Duration (day)	head loss			Effect. head (m)	Output (kw)	Annual Product (MWh)	Total Annual Product (MWh/yr)
			h1 (m)	h2 (m)	h3 (m)				
<u>LIMAU MANIS -1</u>									
Total head	: 11.6 m		0.22	0.74	0.10	10.54	58.1	105	
Leading chan. length	: 217 m	75	0.22	0.72	0.09	10.57	57.5	28	
Penstock length	: 21 m	85	0.22	0.59	0.08	10.71	52.7	108	
Penstock diameter	: 0.50 m	95	0.22	0.36	0.06	10.96	41.9	96	
		70	0.22	0.16	0.04	11.18	28.8	48	385
<u>LIMAU MANIS -2</u>									
Total head	: 11.0 m	75	0.36	0.71	0.11	9.82	54.1	97	
Leading chan. length	: 358 m	20	0.36	0.69	0.11	9.84	53.5	26	
Penstock length	: 20 m	85	0.36	0.56	0.09	9.99	49.2	100	
Penstock diameter	: 0.50 m	95	0.36	0.34	0.07	10.23	39.1	89	
		70	0.36	0.15	0.05	10.44	26.9	45	357
<u>GUNUNG NAGO LEFT</u>									
Total head	: 5.2 m	75	0.25	0.15	0.04	4.76	71.4	128	
Leading chan. length	: 250 m	20	0.25	0.15	0.04	4.76	71.4	34	
Penstock length	: 10 m	85	0.25	0.13	0.04	4.78	65.0	133	
Penstock diameter	: 0.85 m	95	0.25	0.07	0.03	4.85	49.6	113	
		70	0.25	0.03	0.03	4.89	32.0	54	462
<u>GUNUNG NAGO RIGHT</u>									
Total head	: 6.8 m	75	0.30	0.20	0.05	6.25	108.0	194	
Leading chan. length	: 301 m	20	0.30	0.20	0.05	6.25	108.0	52	
Penstock length	: 13 m	85	0.30	0.14	0.04	6.32	92.0	188	
Penstock diameter	: 0.90 m	95	0.30	0.06	0.04	6.41	61.2	140	
		70	0.30	0.02	0.03	6.45	39.3	66	640

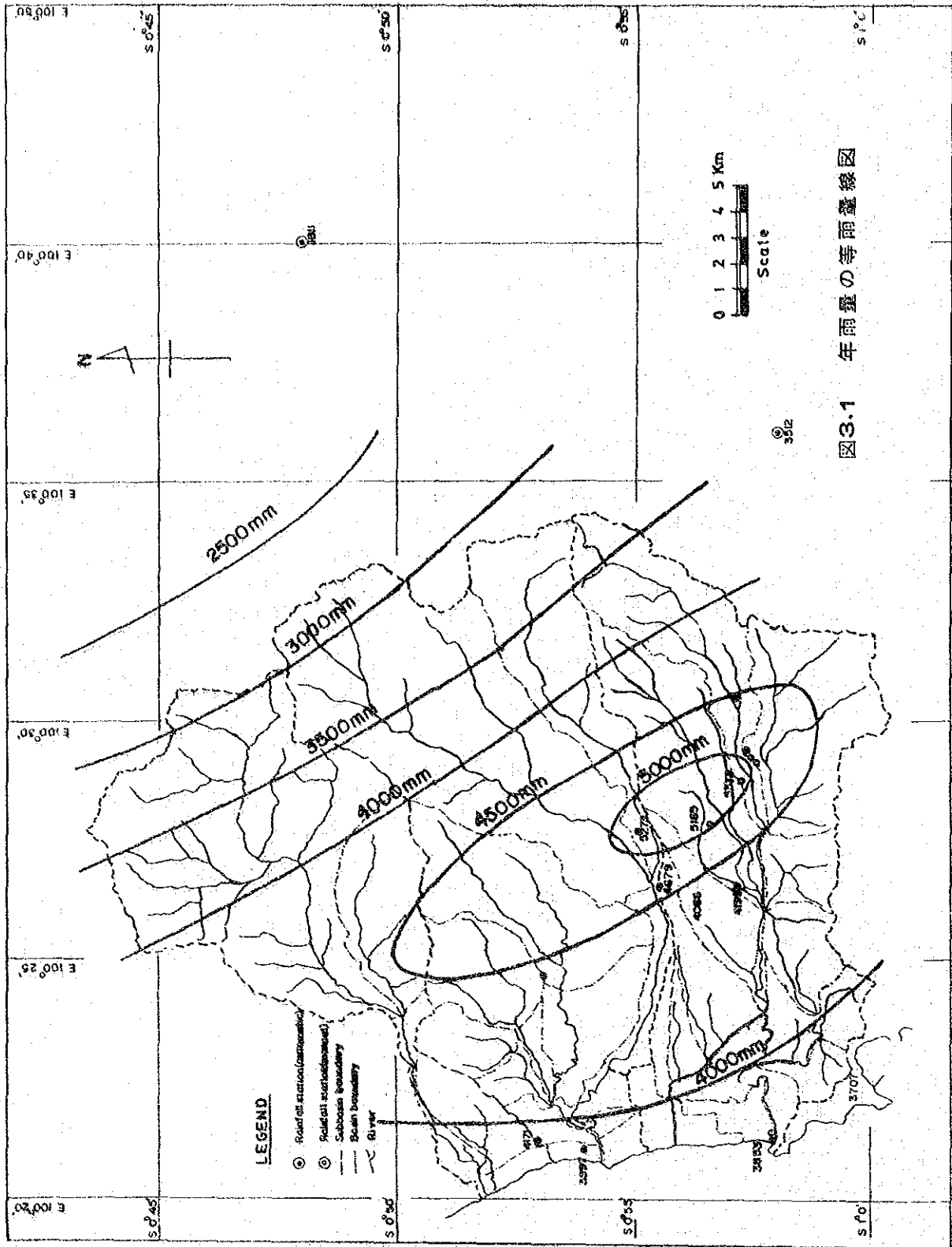


図3.1 年雨量の等雨量線図

图3.2 Tabing 観測所月雨量图

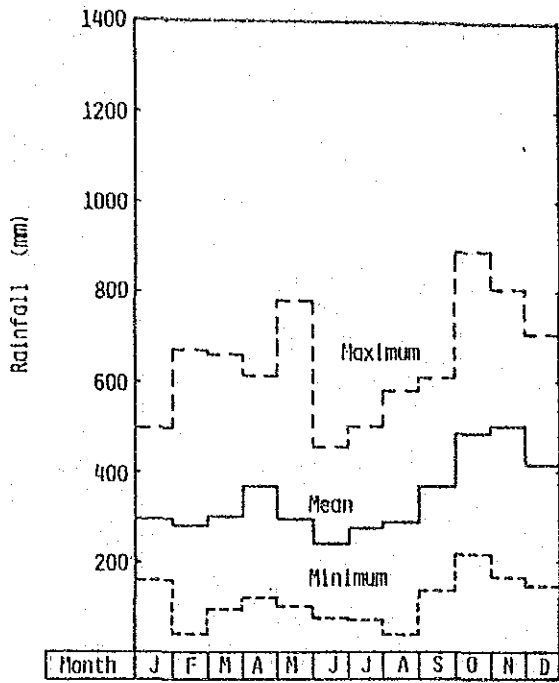


图3.3 月平均日流量图

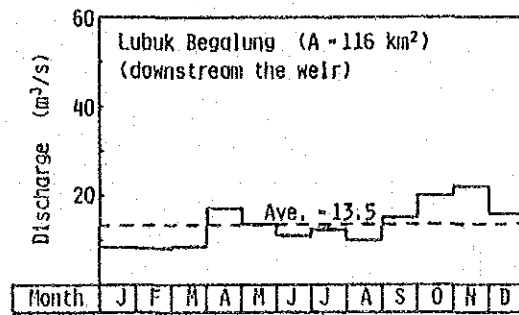
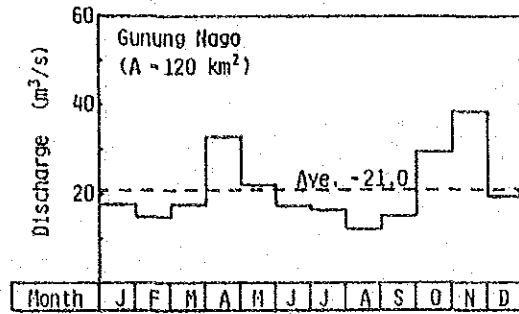
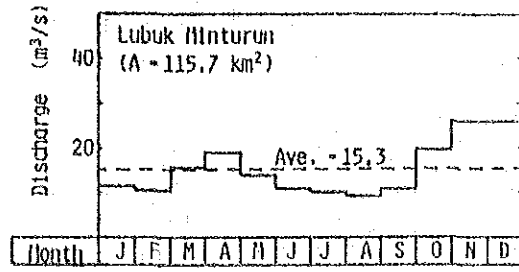


图3.4 流域图

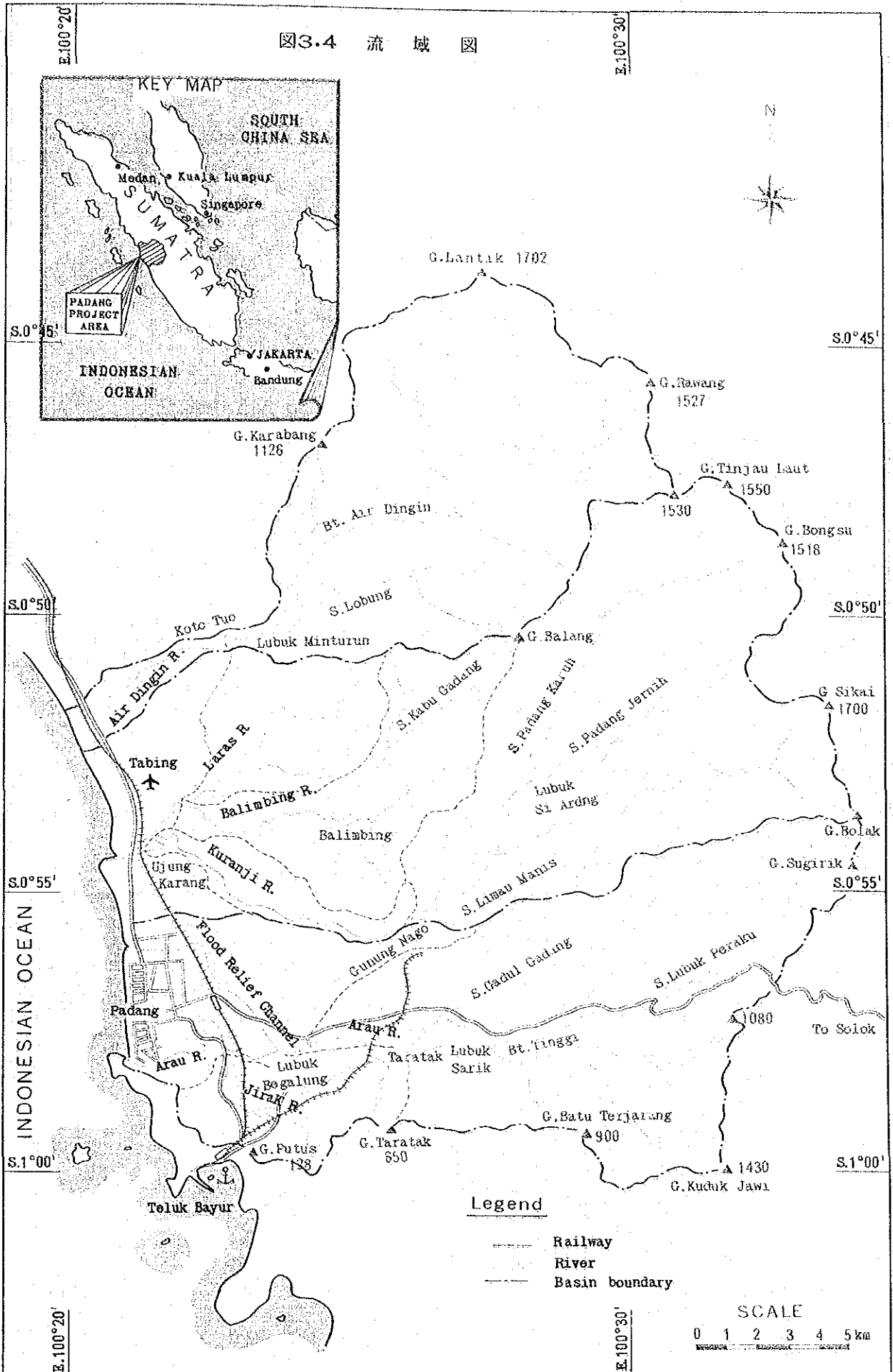


図3.5 河川縦断図

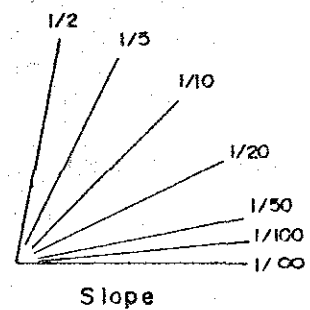
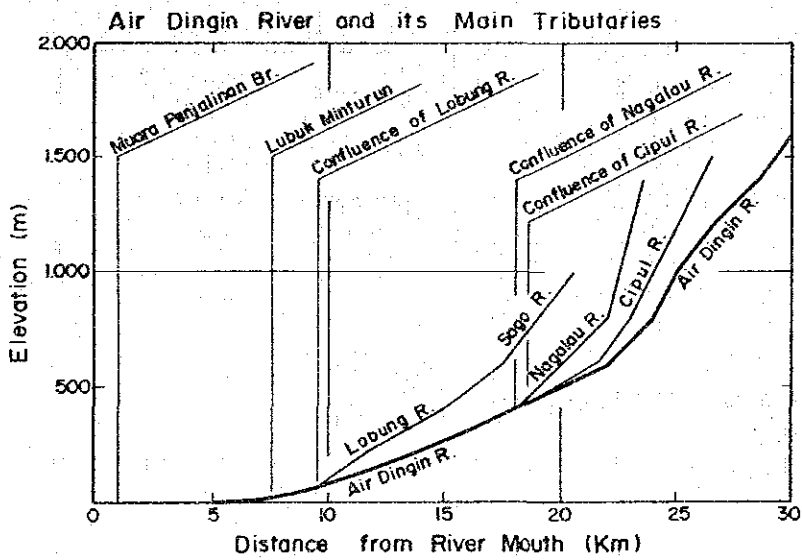
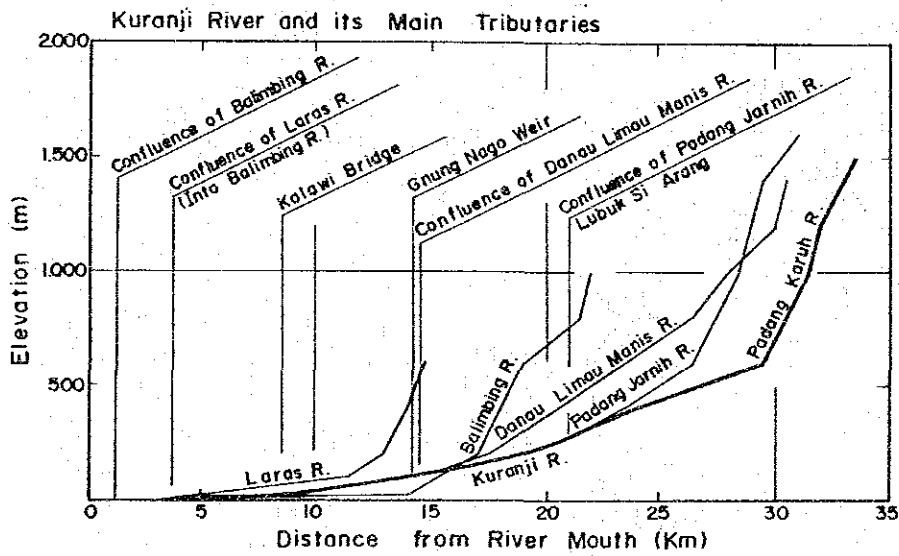
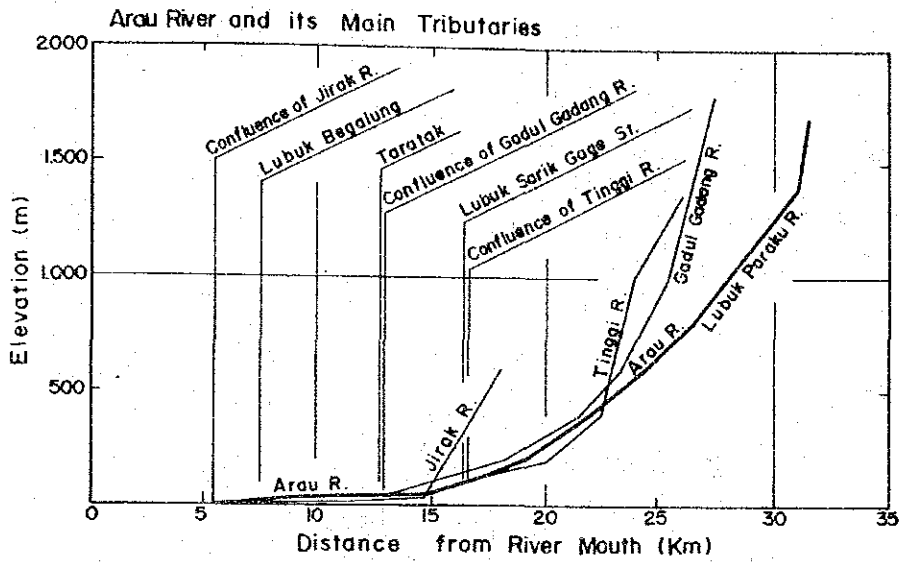
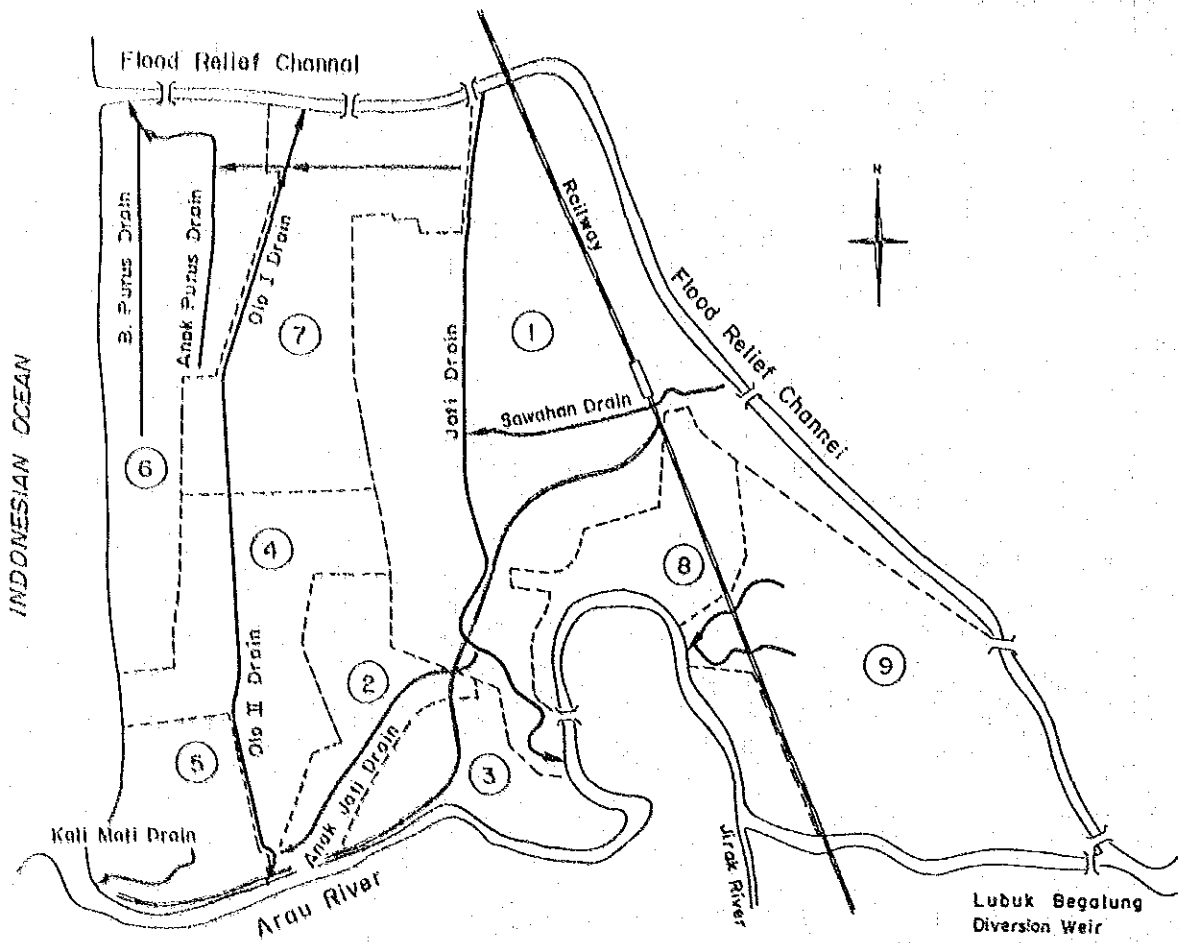
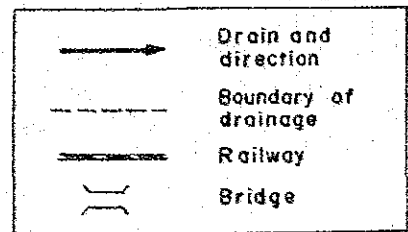


圖3.6 旧市街地現况排水系統圖



	(ha)
1 Jati Drainage	: 300
2 Anak Janti Drainage	: 50
3 Palinggam Hakim Drainage	: 50
4 Olo II Drainage	: 90
5 Kali Mati Drainage	: 55
6 B. Purus/Anak Purus Drainage	: 120
7 Olo I- Purus Kebun Drainage	: 120
8 Ganting/Parak Gadang Drainage	: 60
9 Aur Duri Drainage	: 150

Legend



Source: Inception Report on Padang DRIP, Dec. 1982

圖3.7 新市街地現況排水系統圖

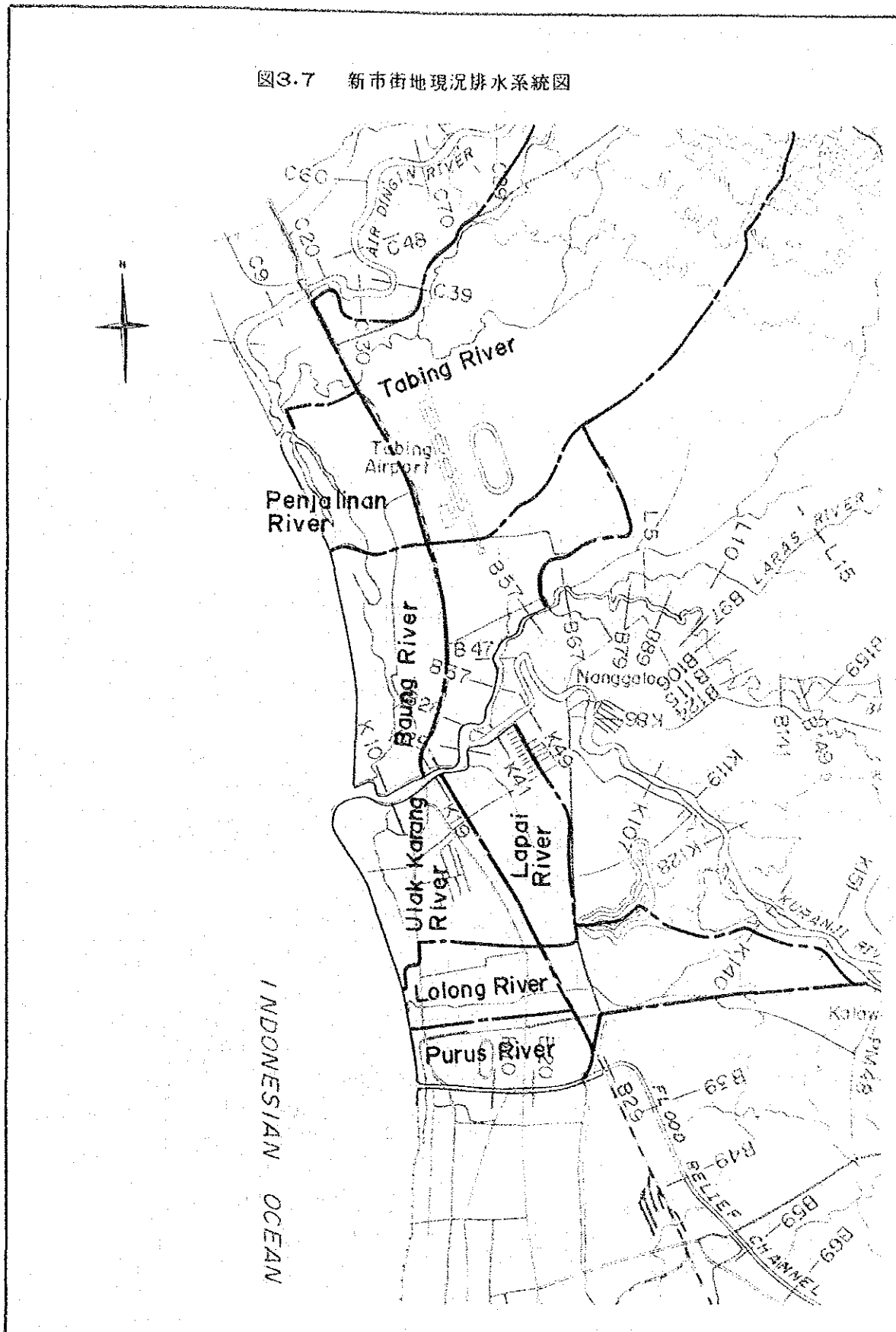


图3.8 Lubuk Begalung 分流堰

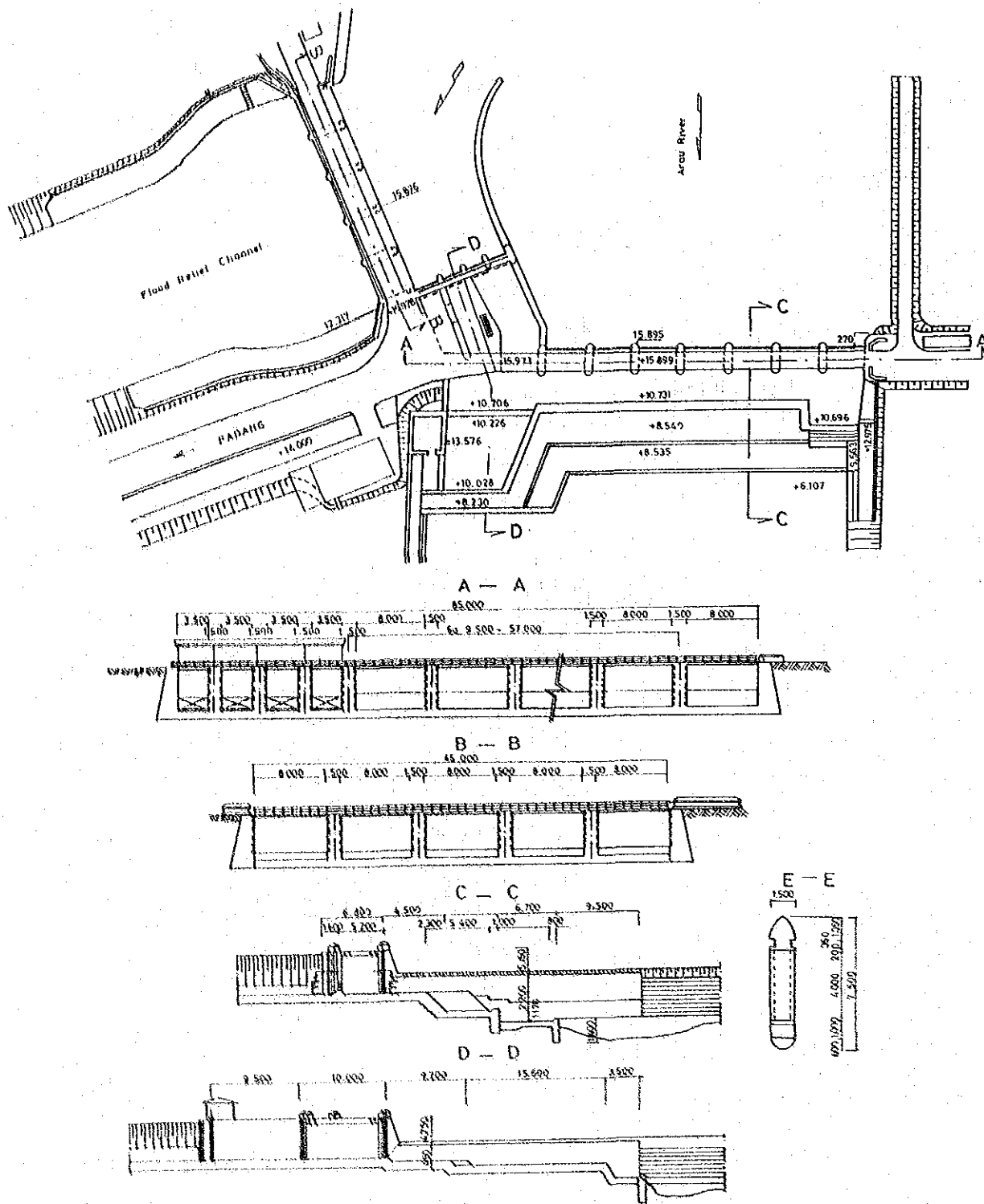


図3.9 Lubuk Begalung 堰下流の現況床固め

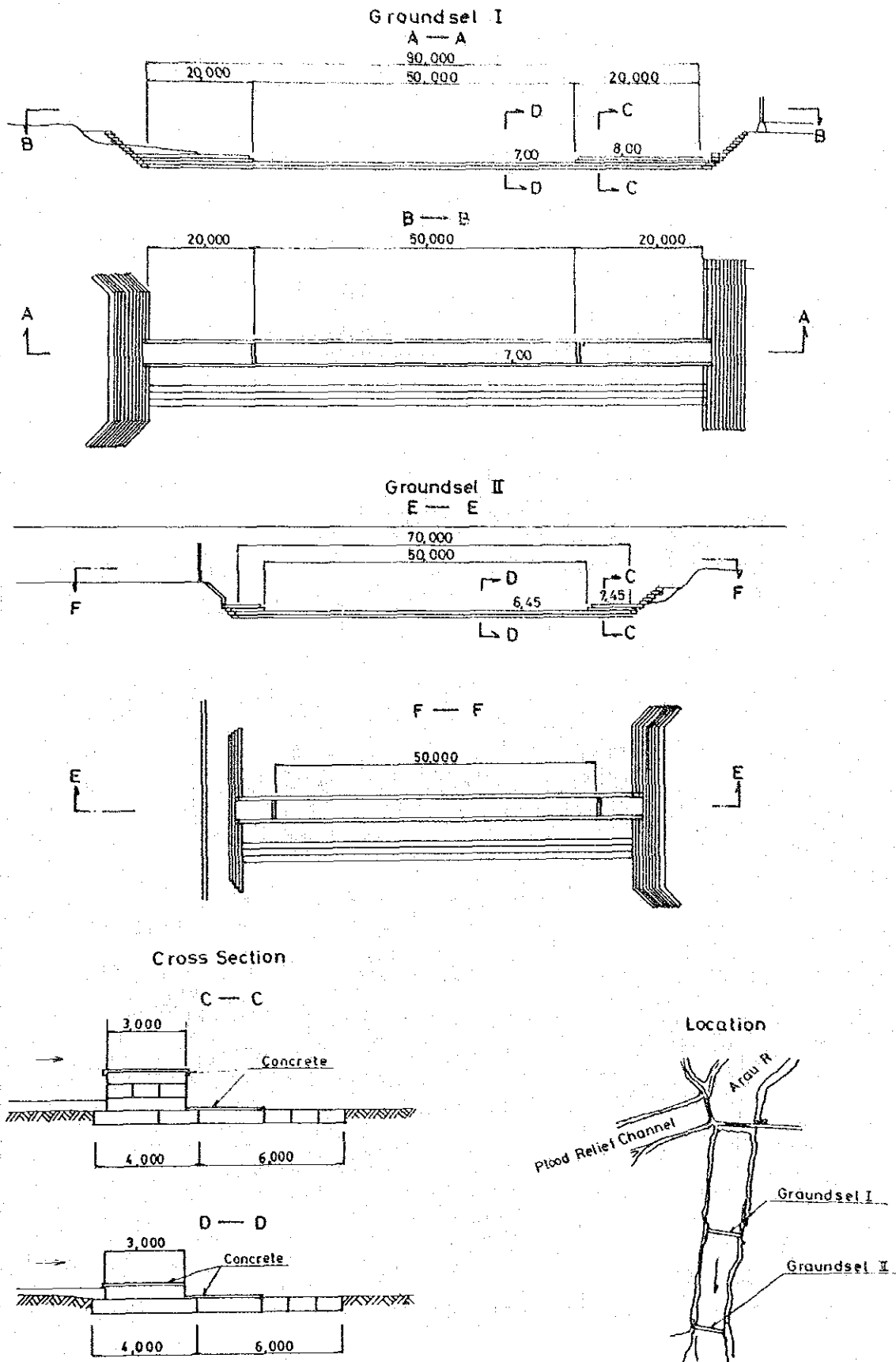


図3.10 現況護岸工位置図

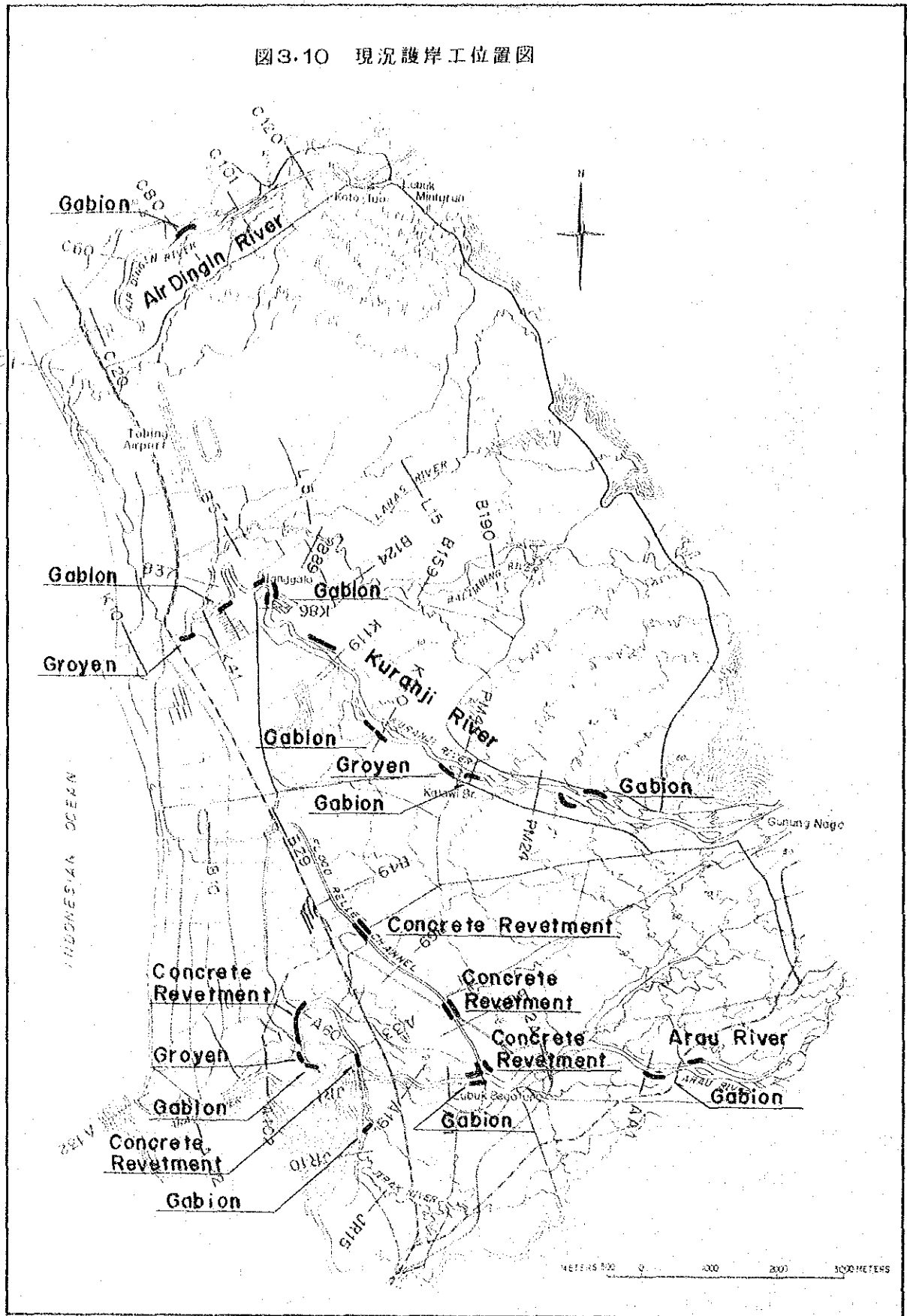


図3.11 現況排水施設位置図

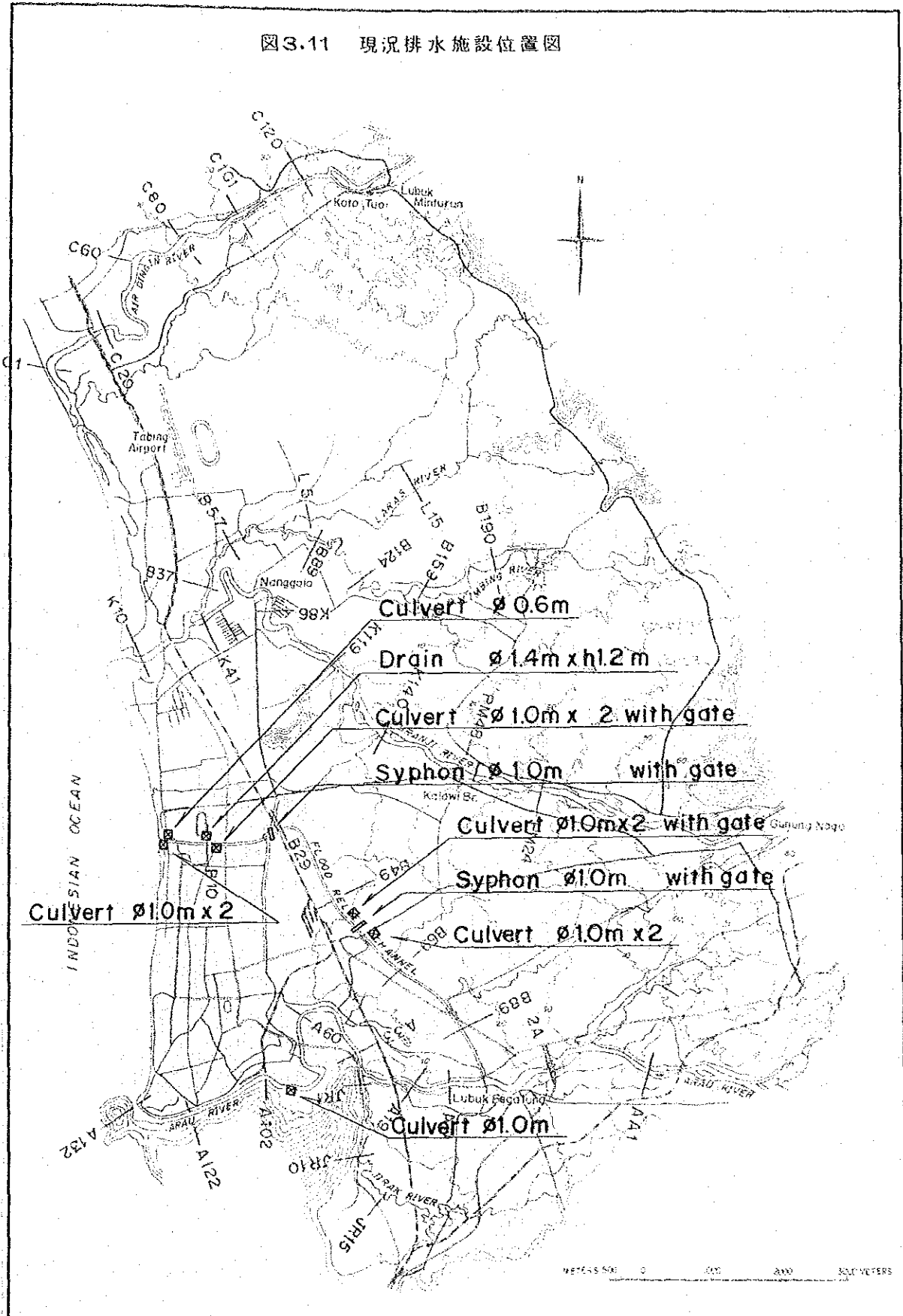


图3.13 現況土地利用圖

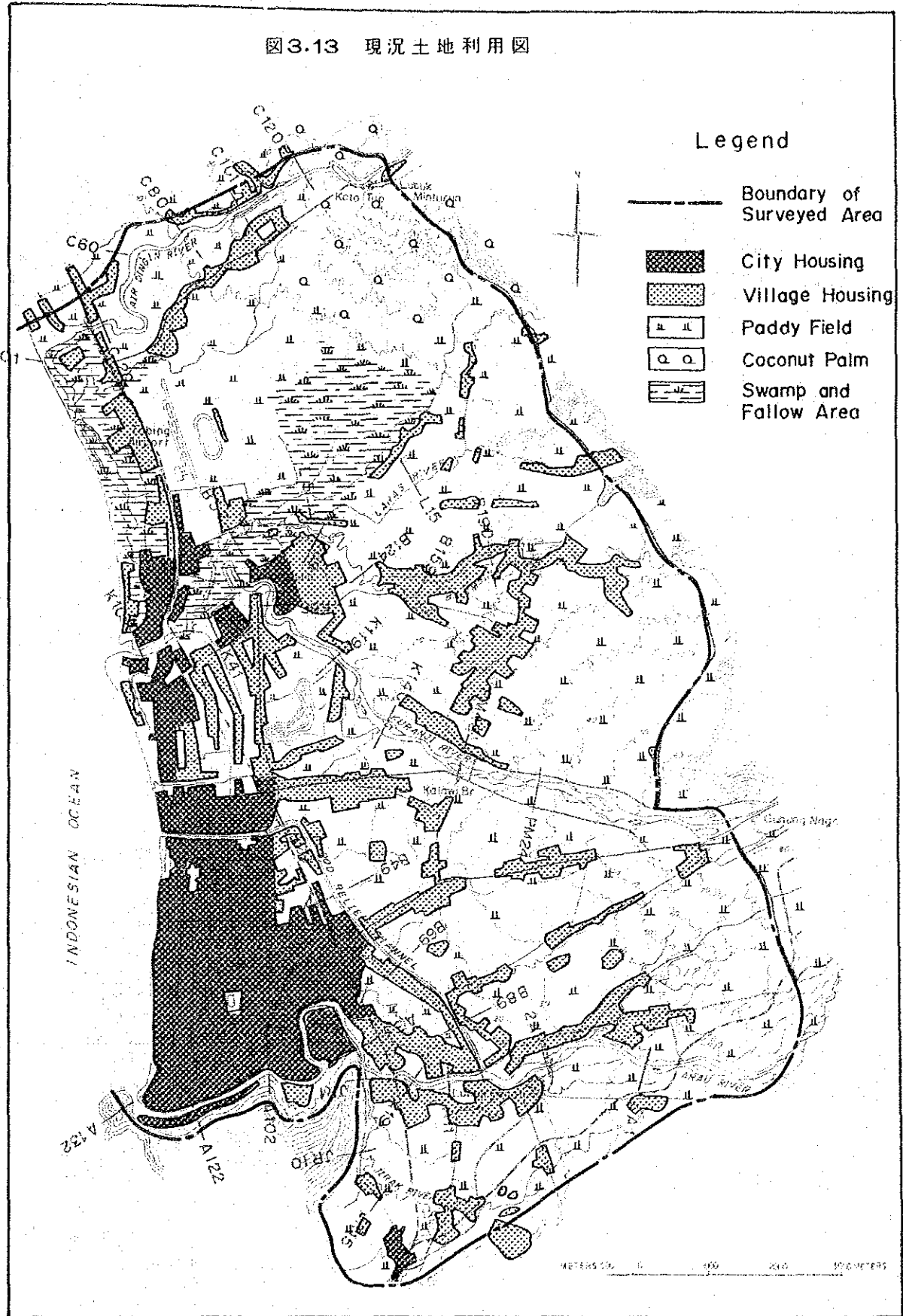


図3.14 地質縦断模式図

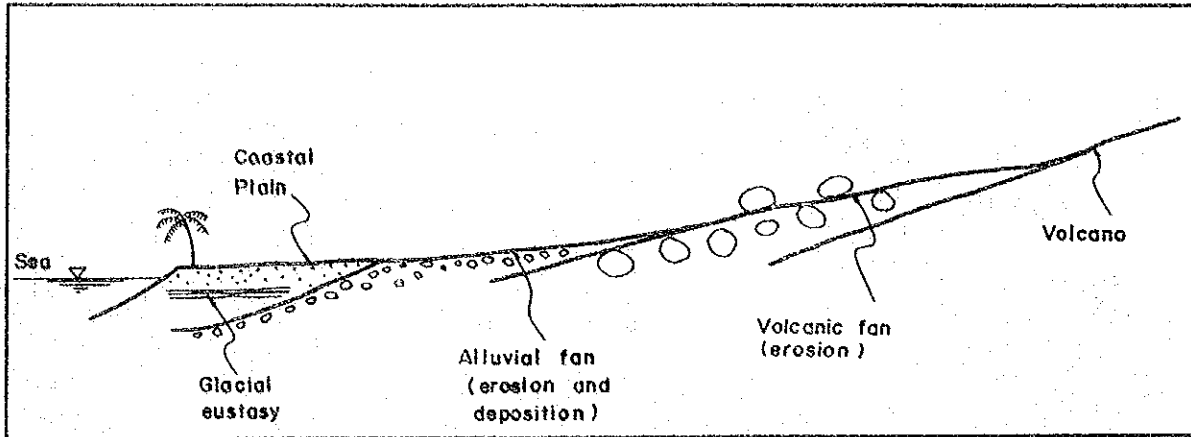


図3.15 Kp.Baru 地点の火山山麓

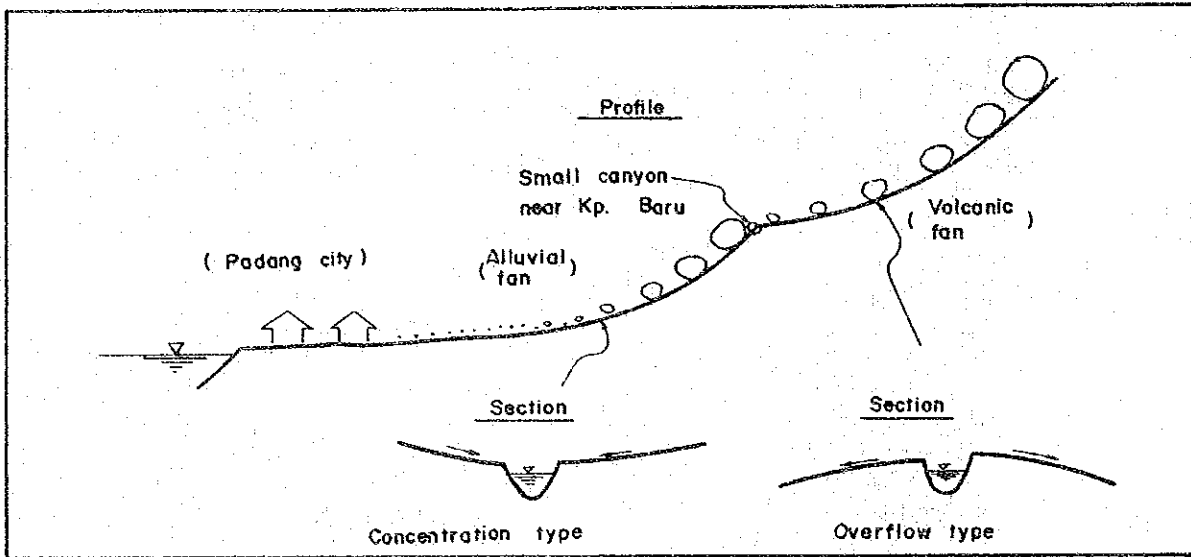


図3.16 海岸平野縦断模式図

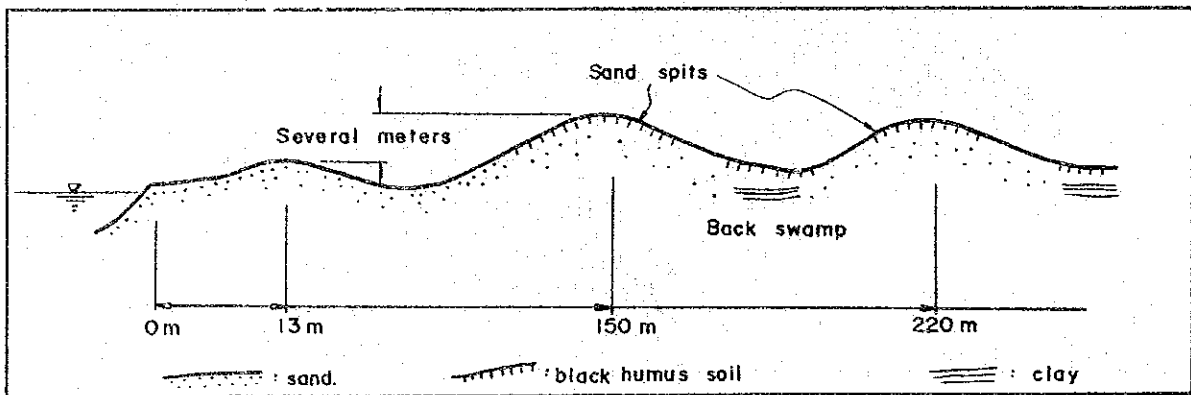


図3.17 現況かんがい系統図

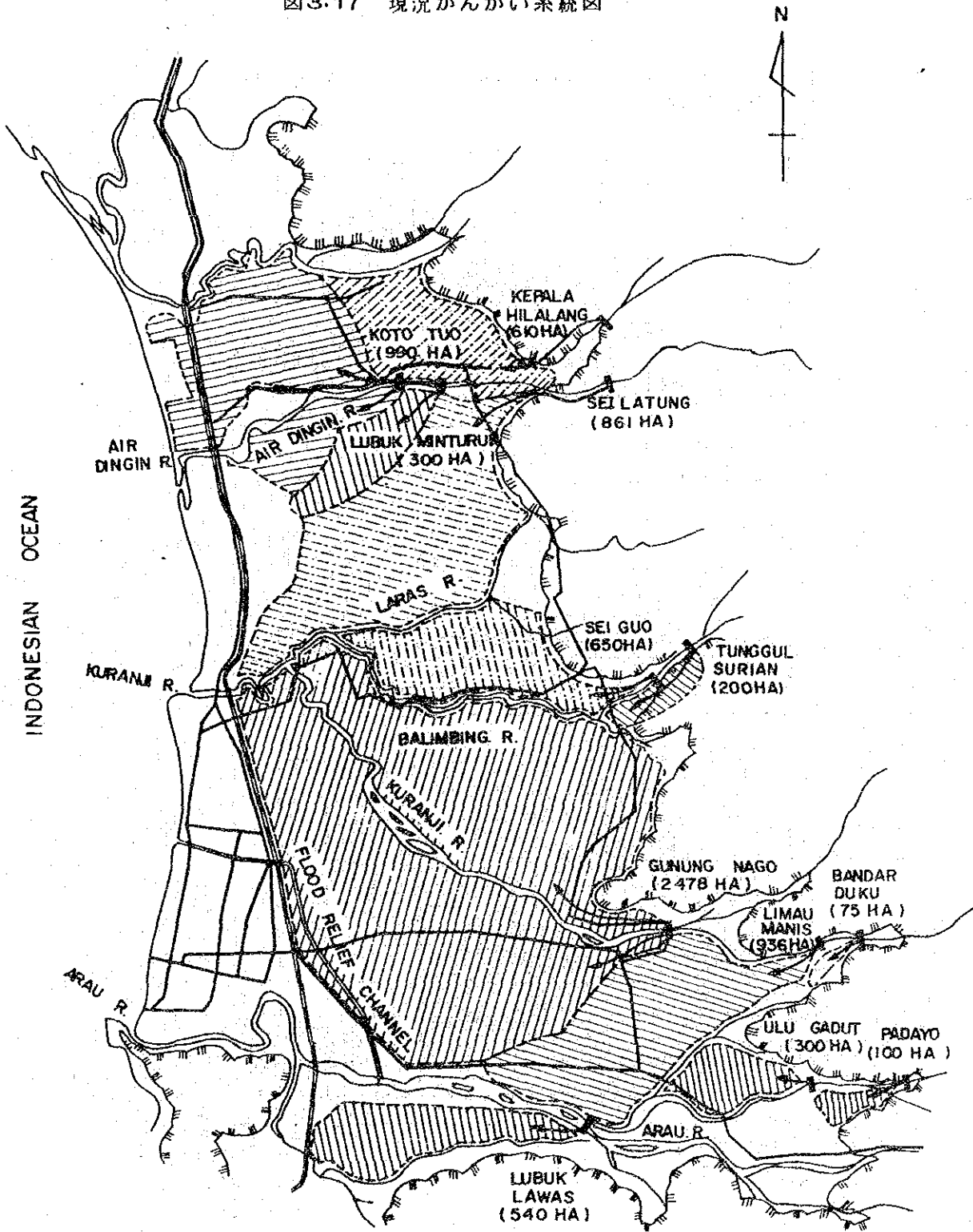


图3.18 現況水収支图

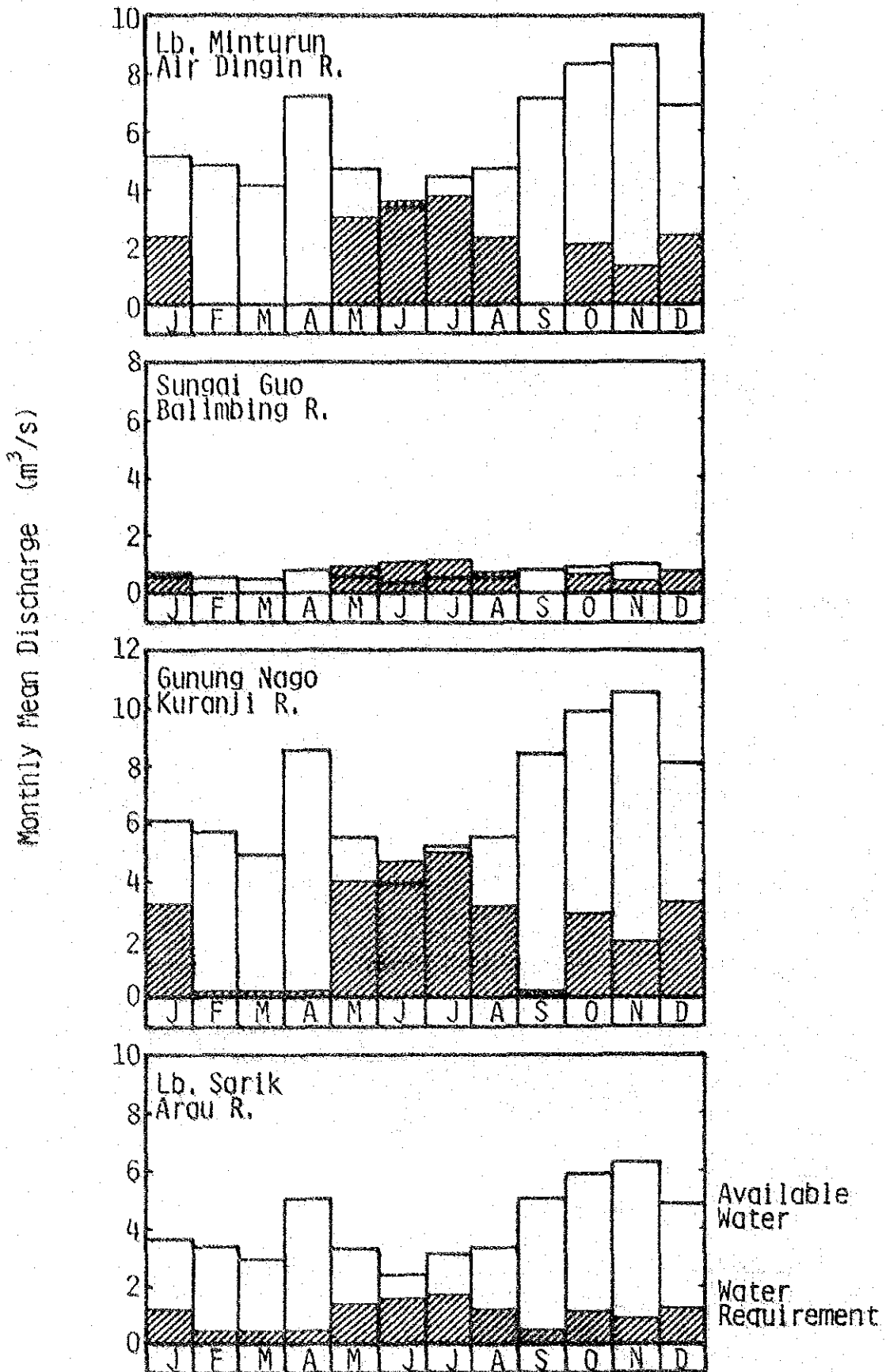
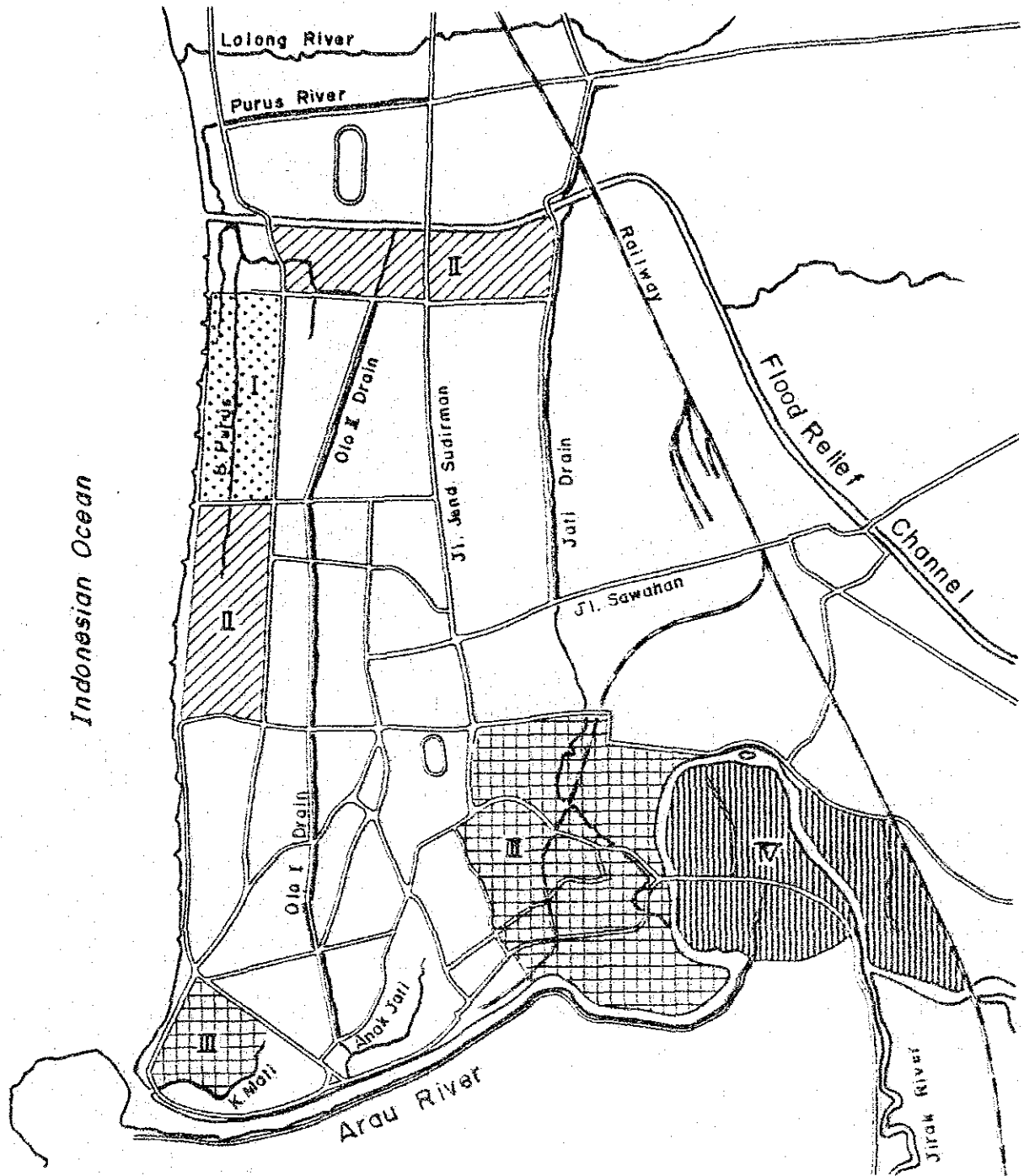






図4.1 パダン地域生活環境改善計画(KIP)概要図

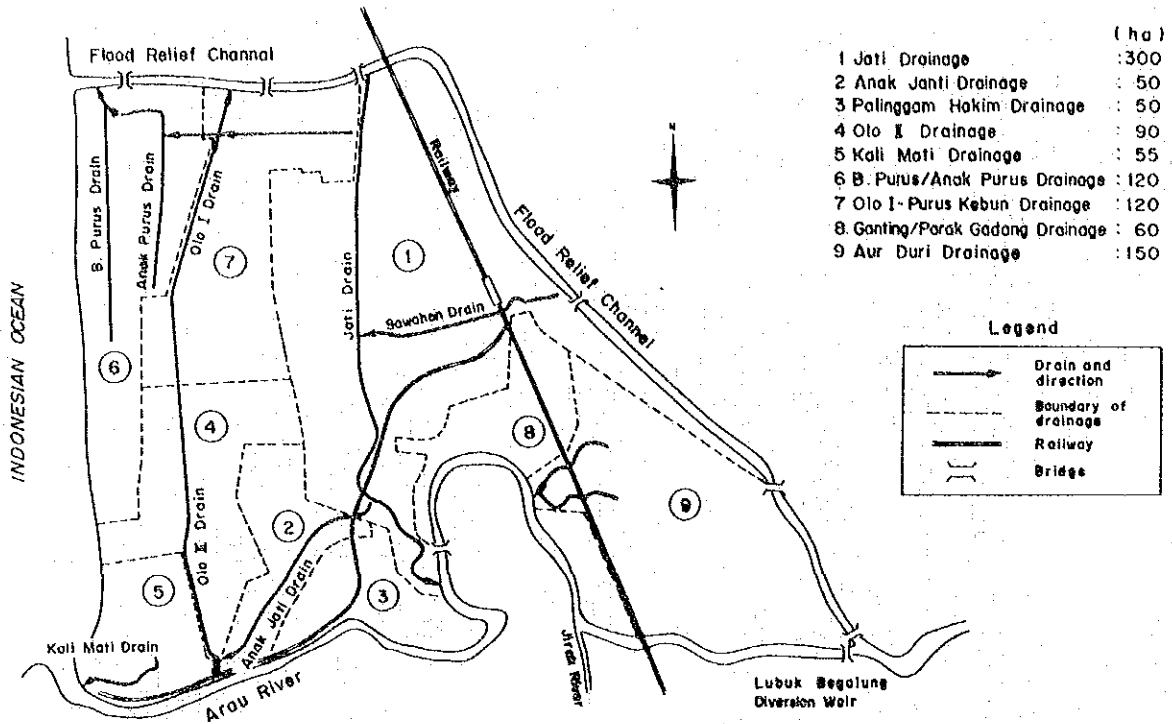


Legend

-  KIP Area Phase I
-  KIP Area Phase II
-  KIP Area Phase III
-  KIP Area Phase IV

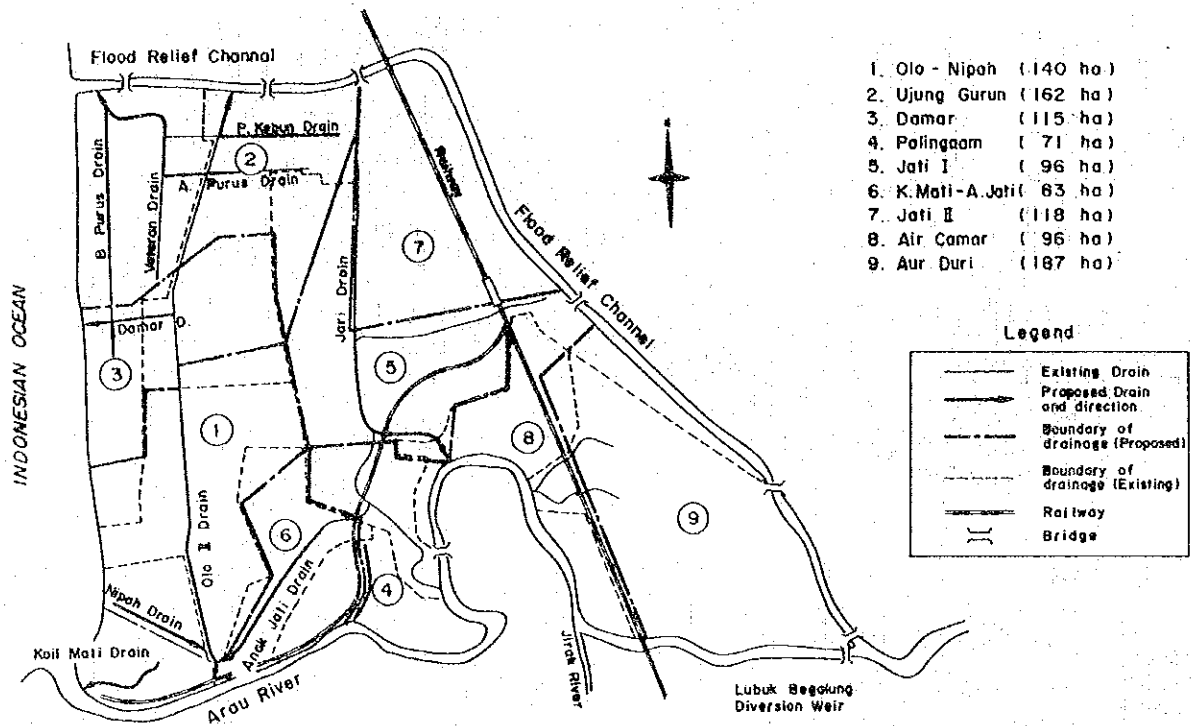
Source:
Padang KIP Feasibility Study
1980

图4.2 旧市街現況排水系統圖



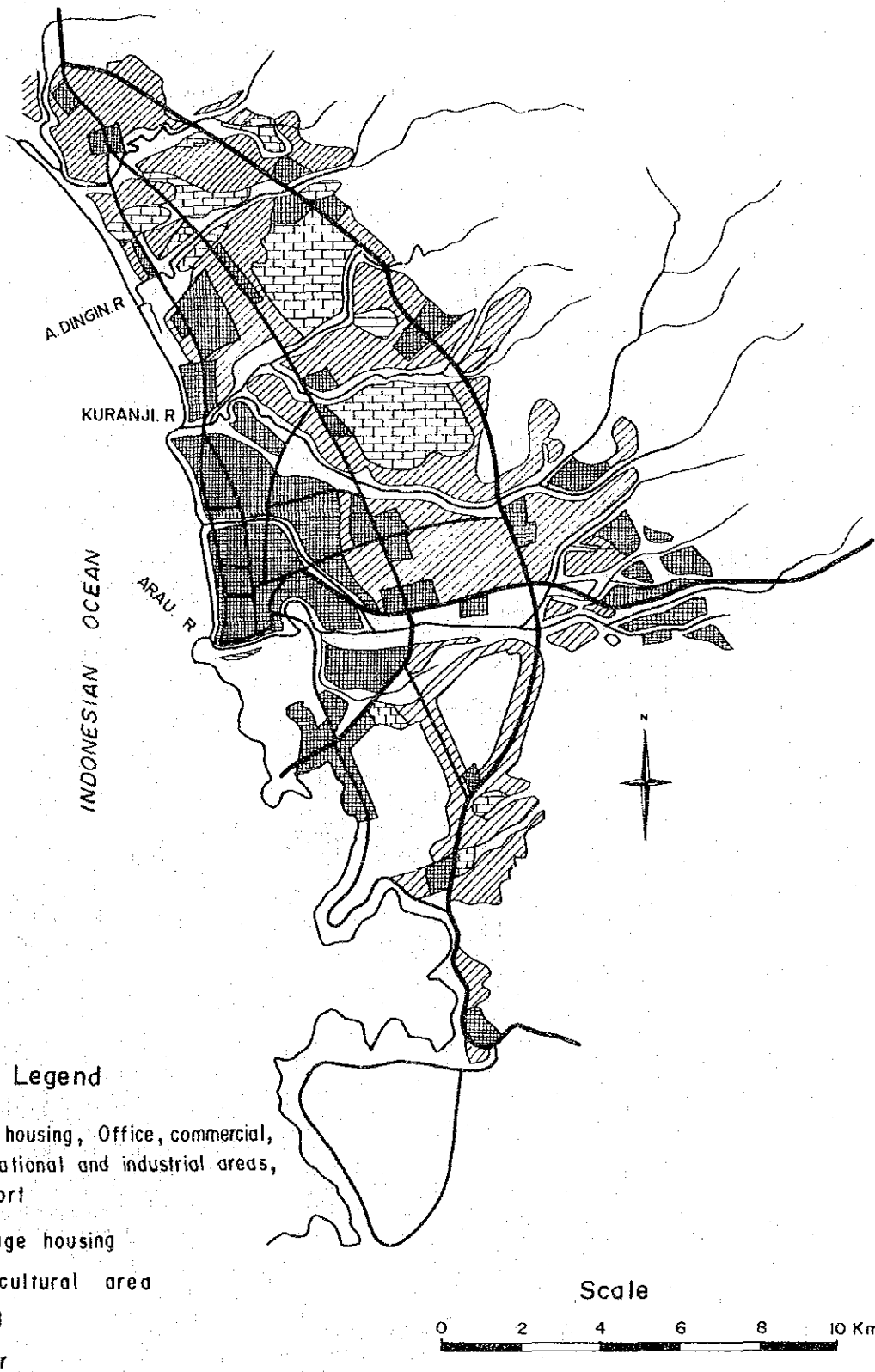
Source : Inception Report on Padang DRIP, Dec. 1982

图4.3 旧市街計畫排水系統圖



Source : Padang Drainage Improvement Project

図4.4 パダン市マスタープラン概要図



Source : Rencana Induk Kota Padang 1983 - 2003

図5.1 治水排水全体計画の改修対象区域図

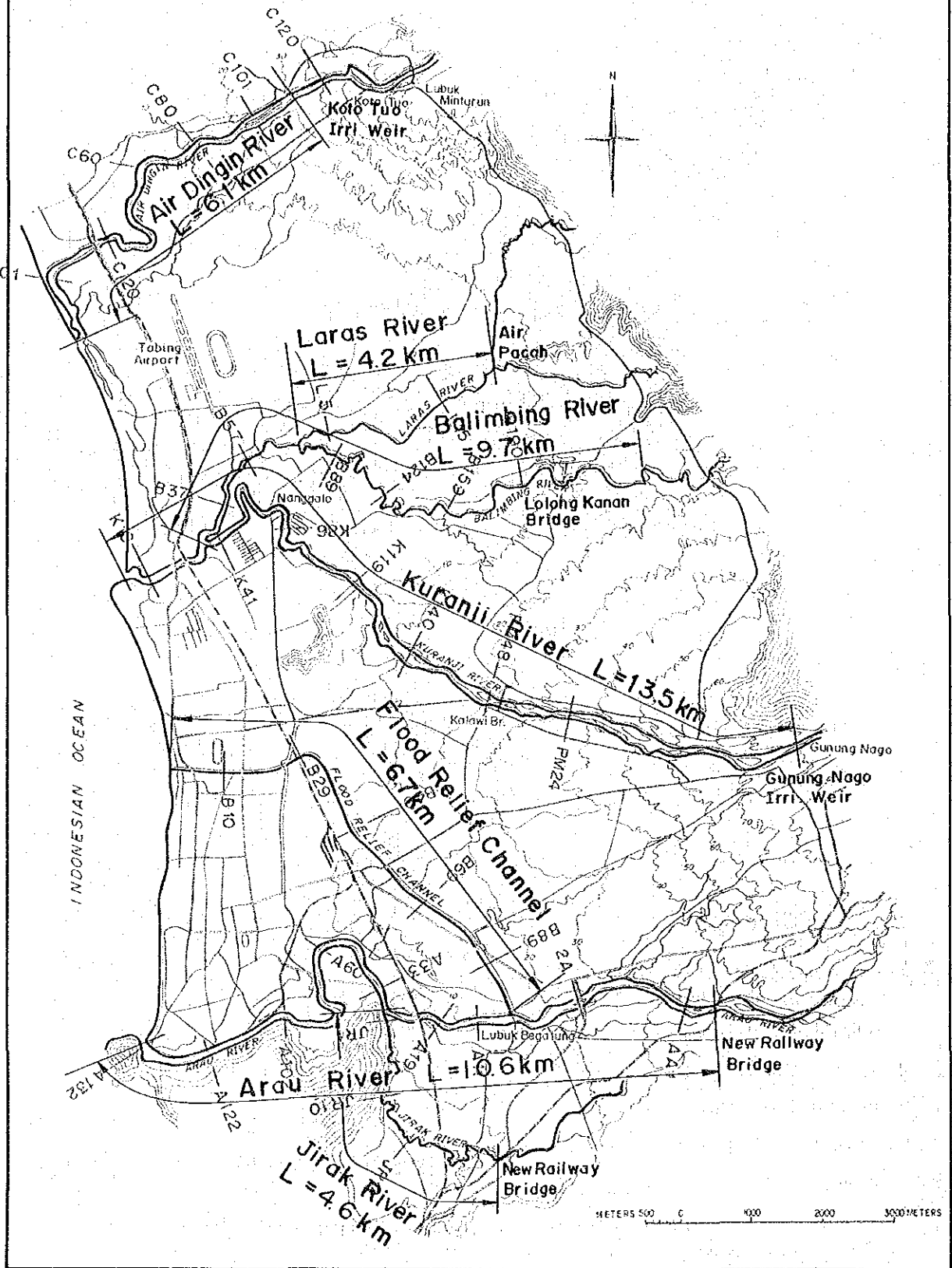
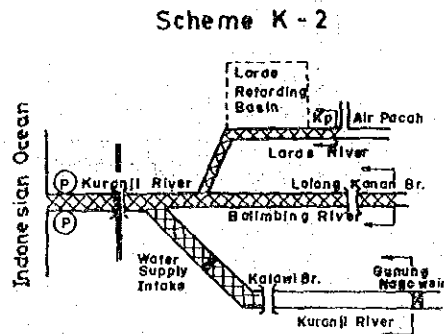
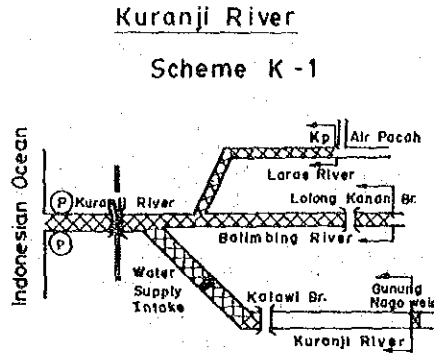
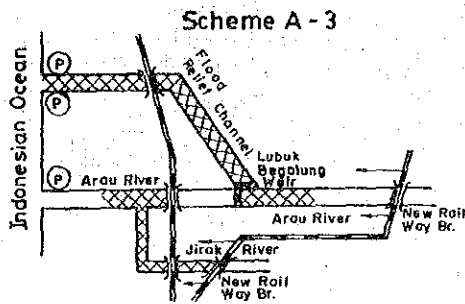
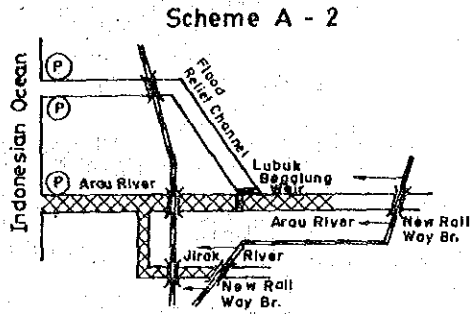
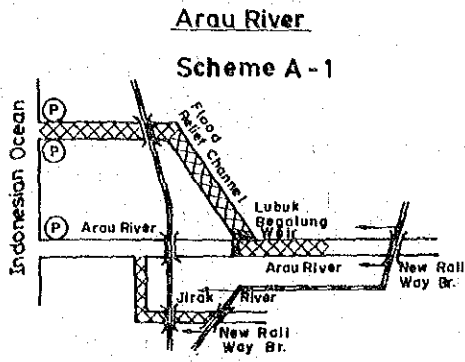
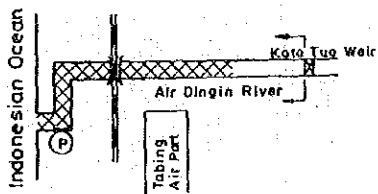


図5.2 治水排水全体計画の代替案模式図

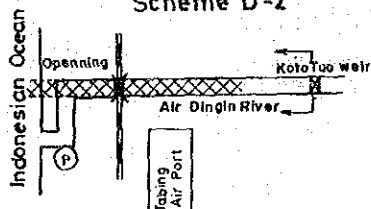


Air Dingin River

Scheme D - 1



Scheme D - 2



Legend

- Objective stretch for Comprehensive plan
- Stretch to be improved
- Pumping station

図5.3 代替案の計画高水流配分図

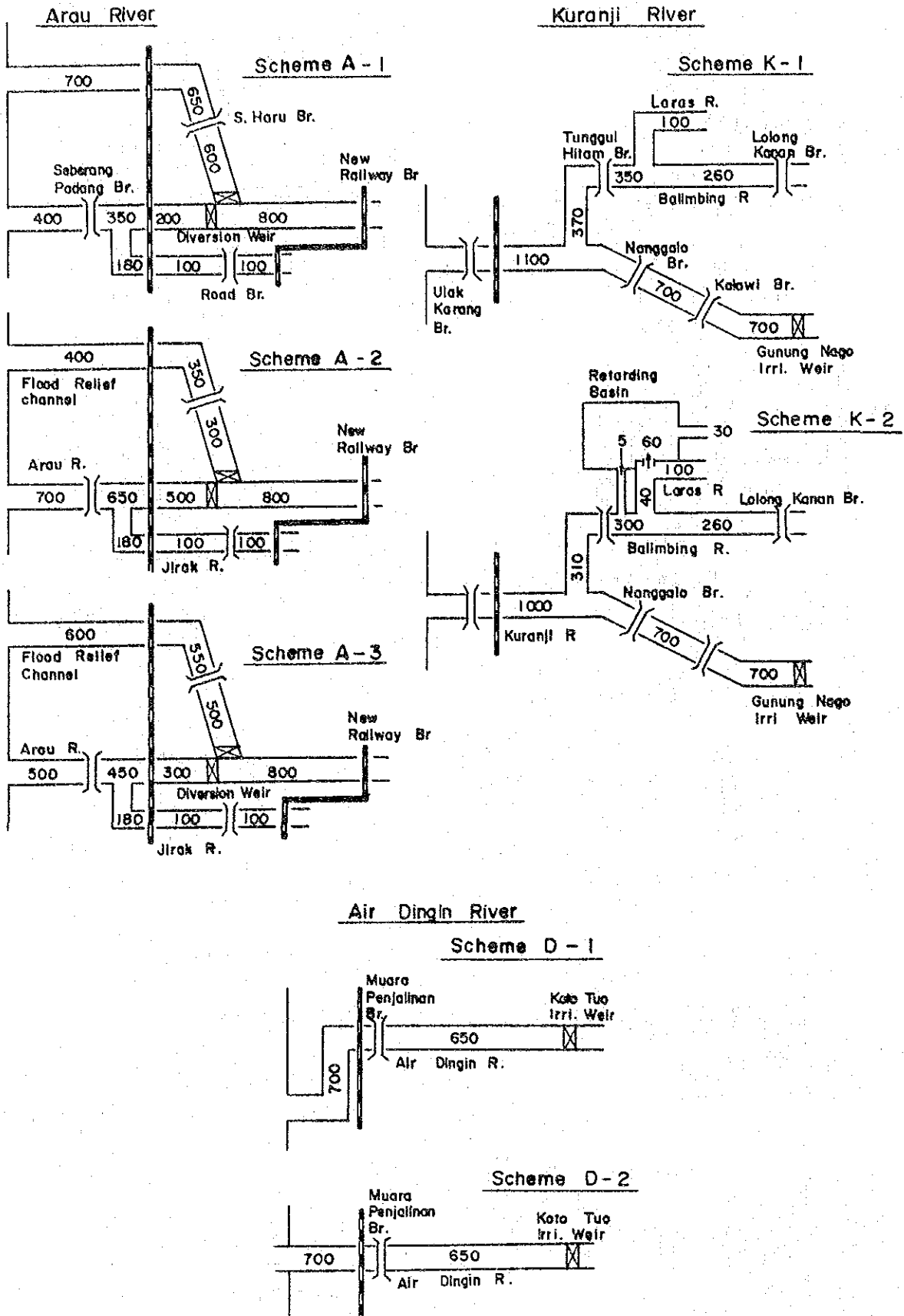


図6.4 全体計画の計画流量配分図

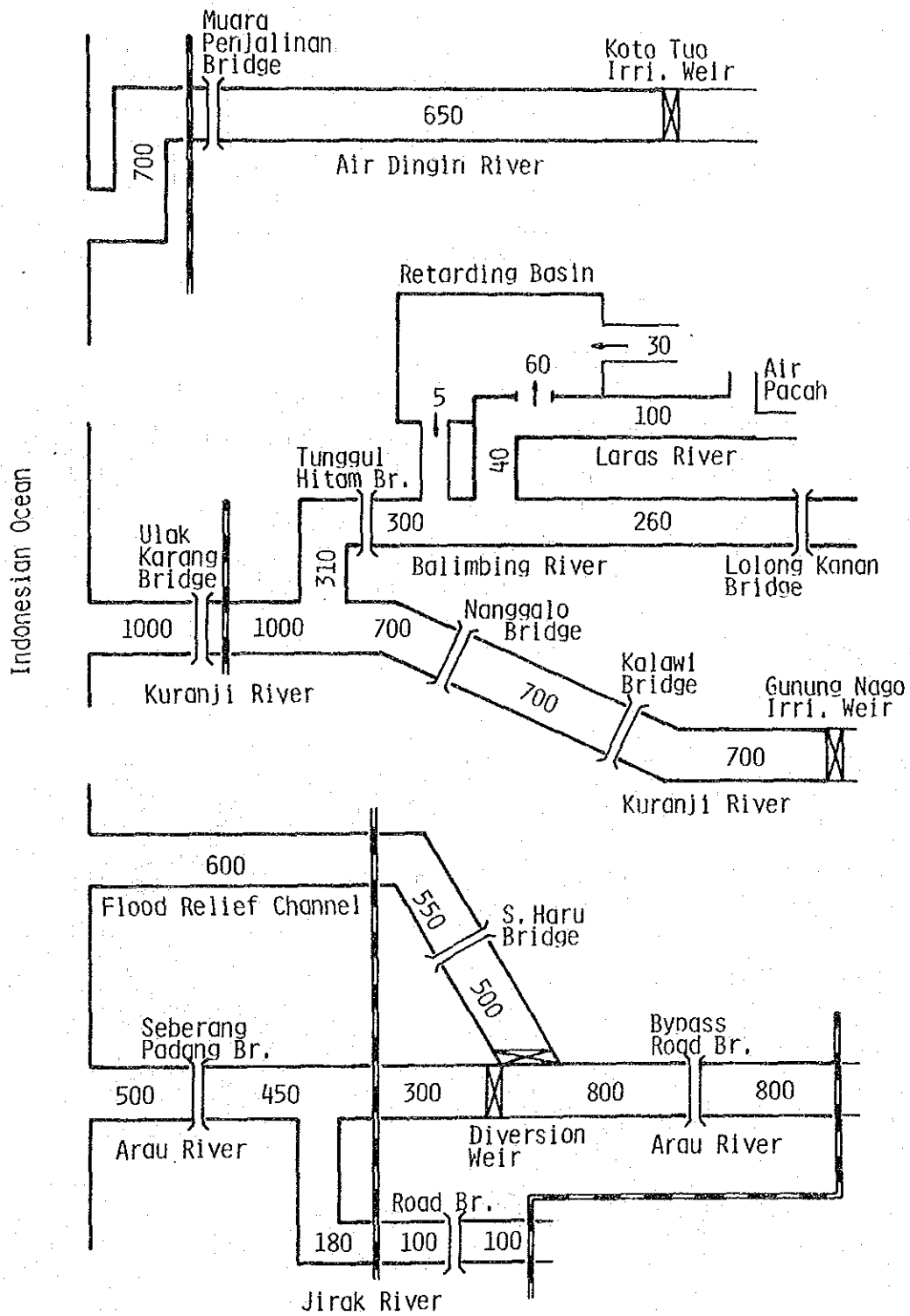

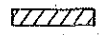




図5.5 全体計画の河道法線図

- Legend
-  Dike Alignment
 -  Cutoff Channel
 -  Pump Station
 -  Bridge

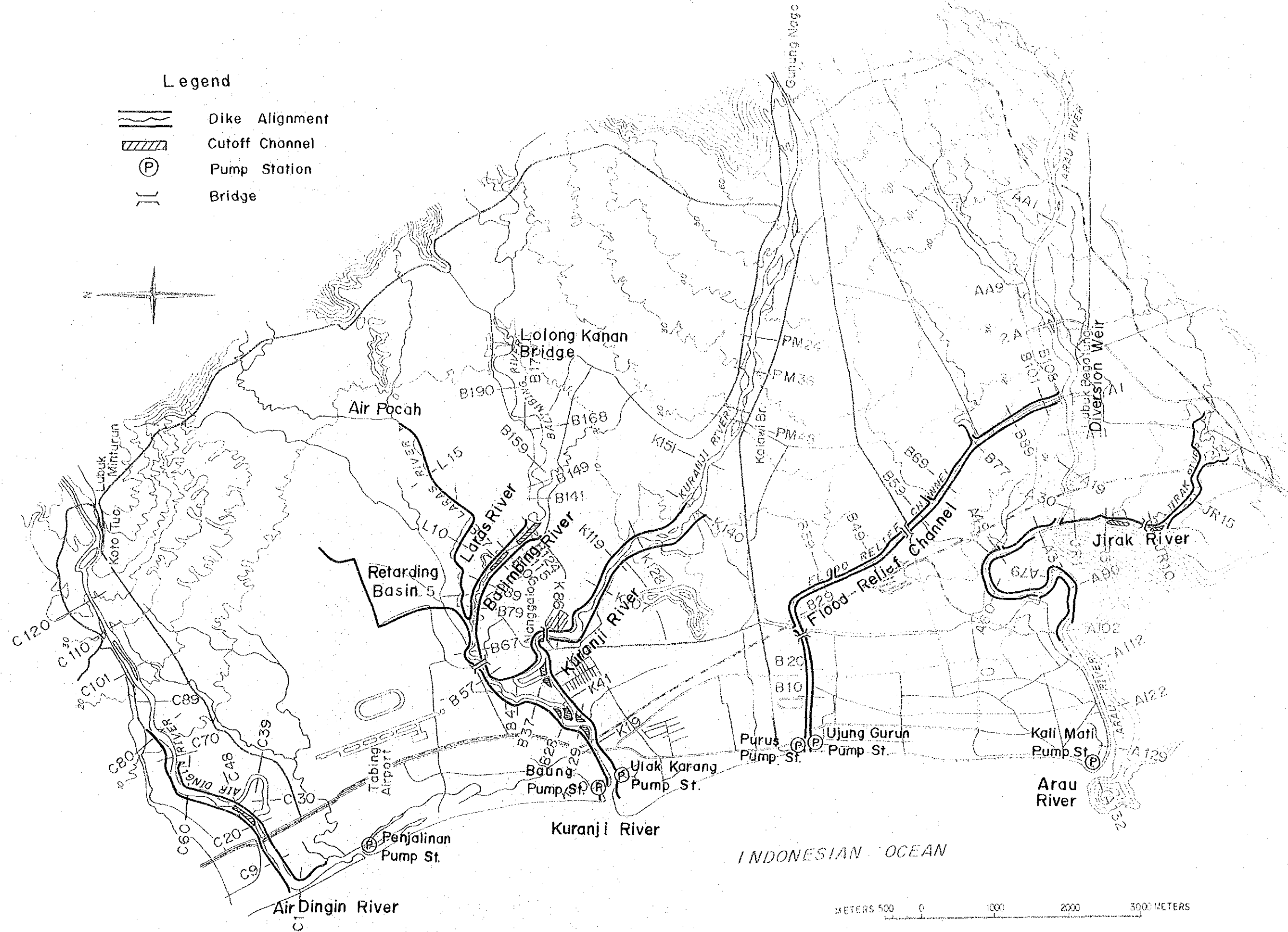


图 5.6 Lubuk Begalung 分流堰改修设计图 (全体设计图)

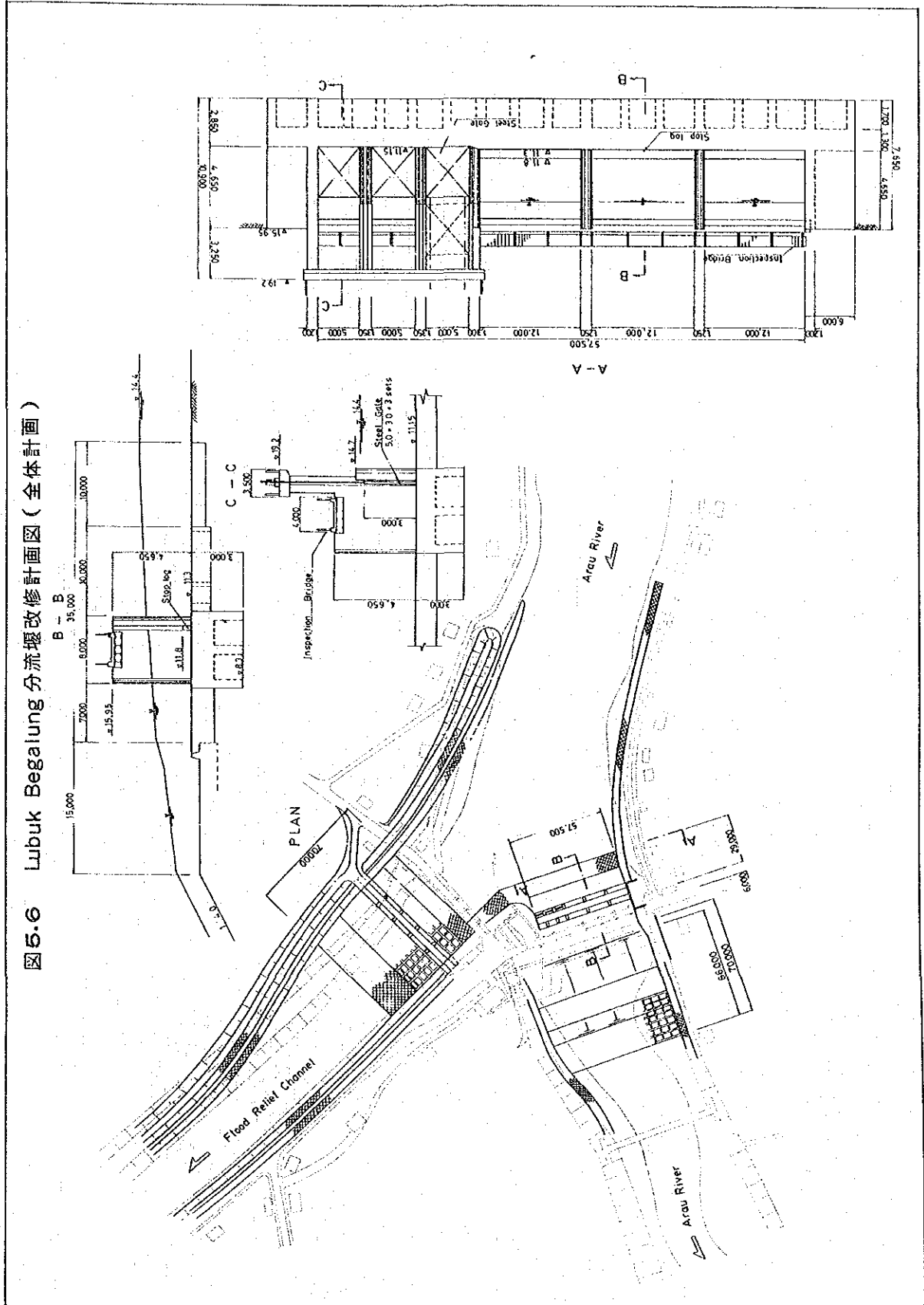


図6.1 緊急治水計画の計画高水流量配分図

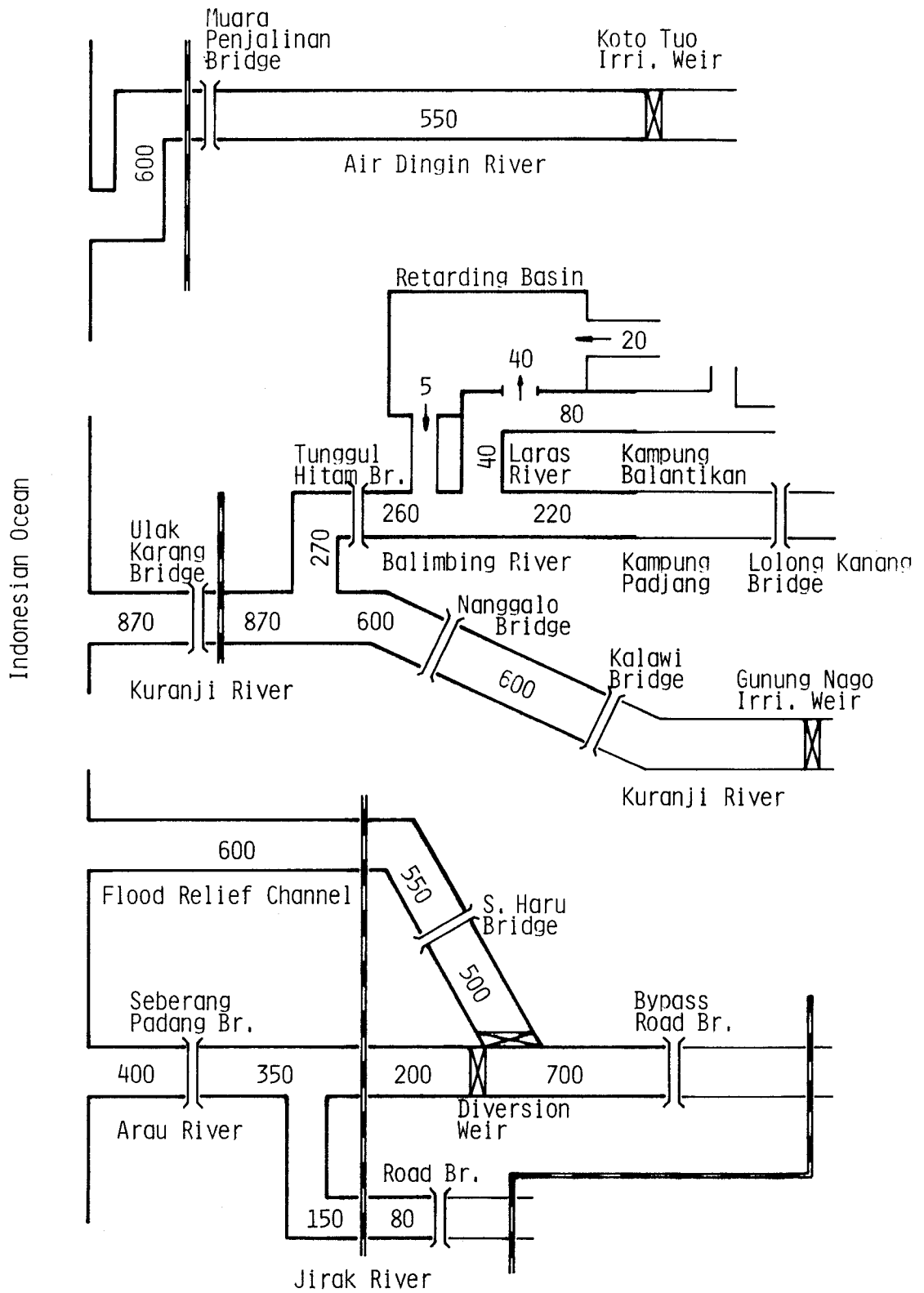
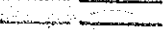
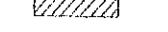

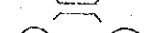

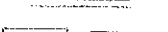
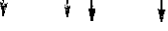


図6.2 緊急治水計画の河道法線図

Legend

-  Dike Alignment (Urgent, Comprehensive)
-  Cutoff Channel (Urgent)
-  Bank Protection (Existing, Urgent, Comprehensive)
-  Bridge to be Reconstructed (Urgent)
-  Pump Station (Urgent, Comprehensive)
-  Drainage Channel (Urgent)
-  Objective Stretch to be Improved (Urgent, Comprehensive)

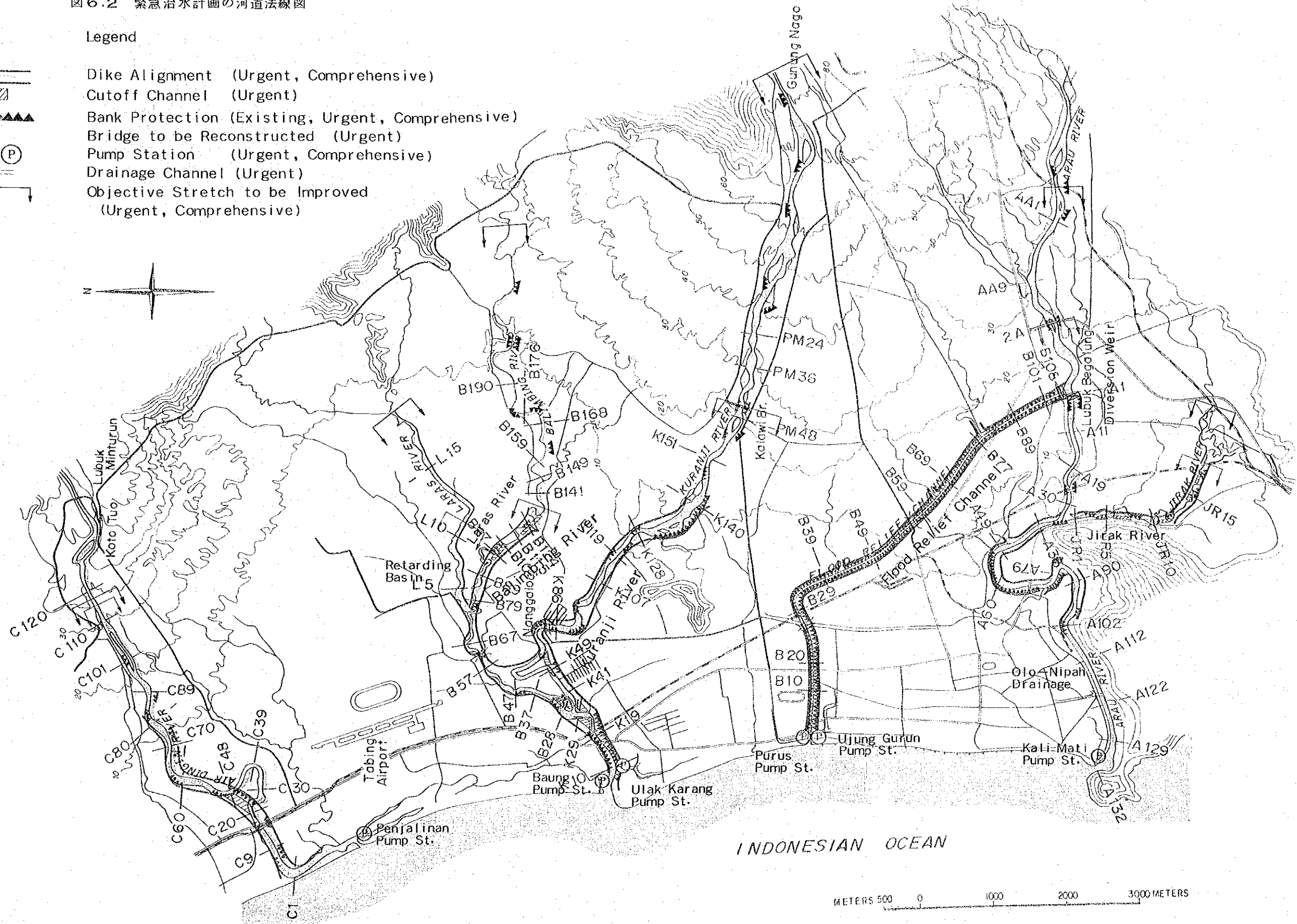


図6.4 市内排水計画概要図

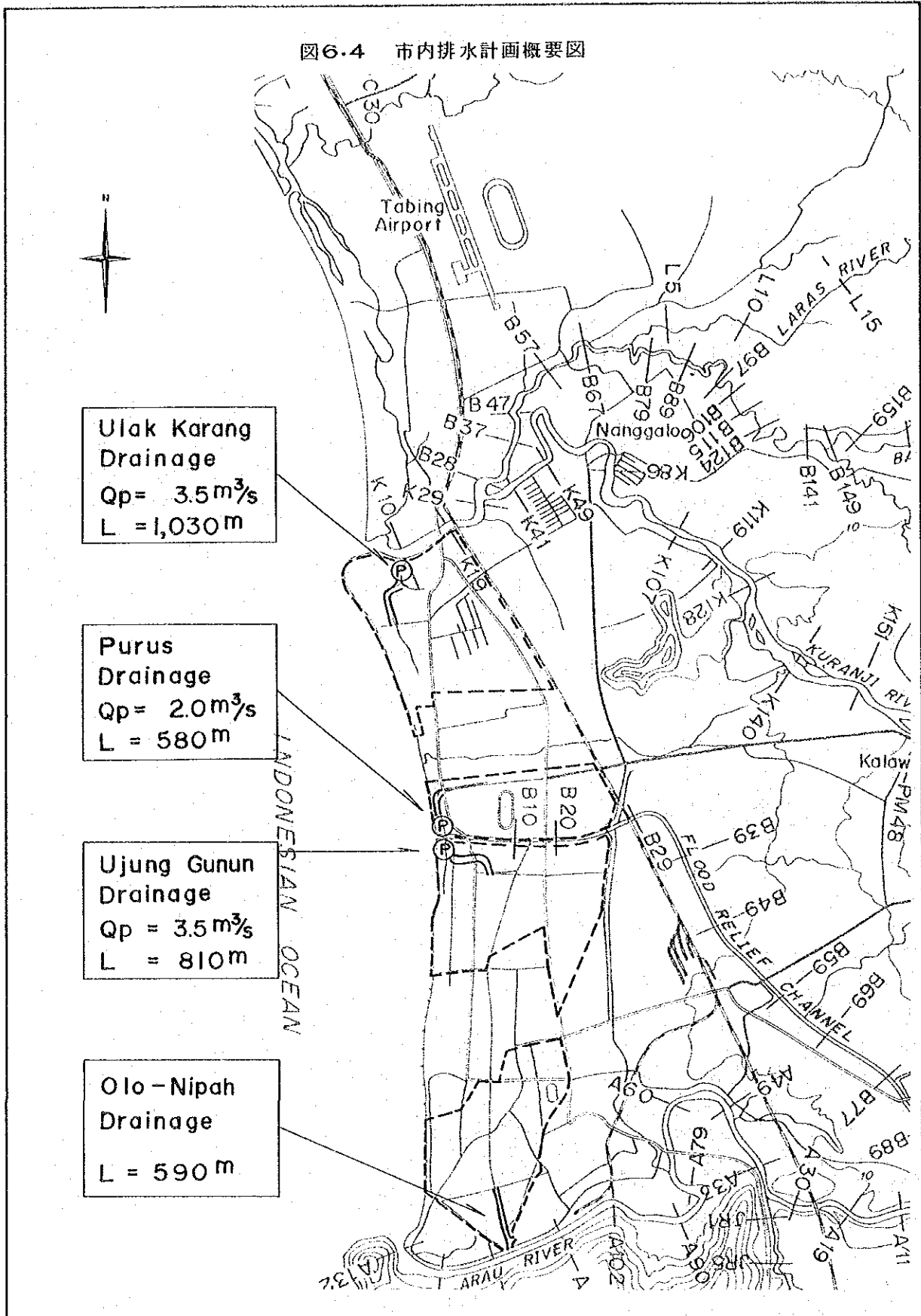


図8.1 治水事業の現況組織図

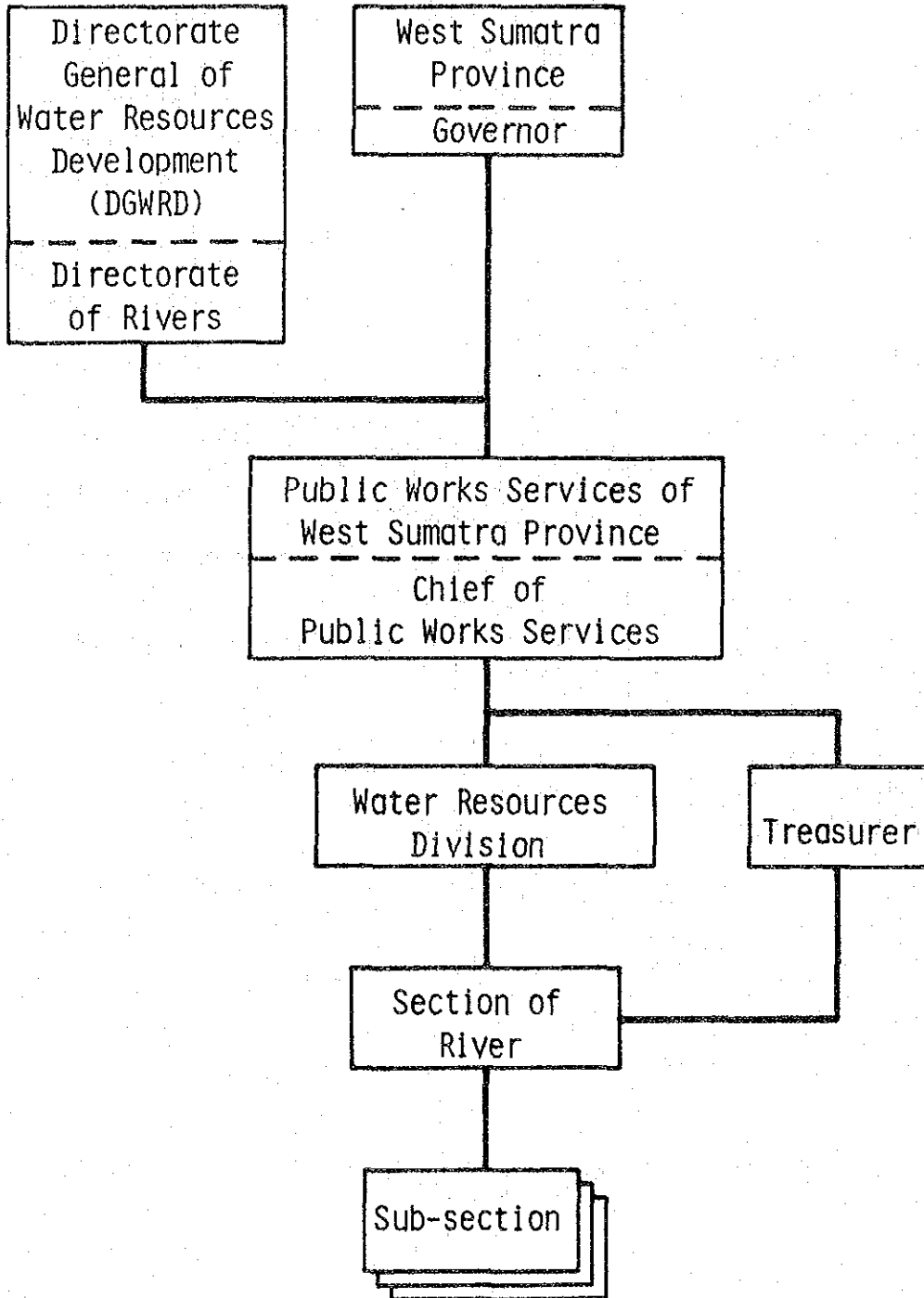


図8.2 事業実施のための組織図（建設工事段階）

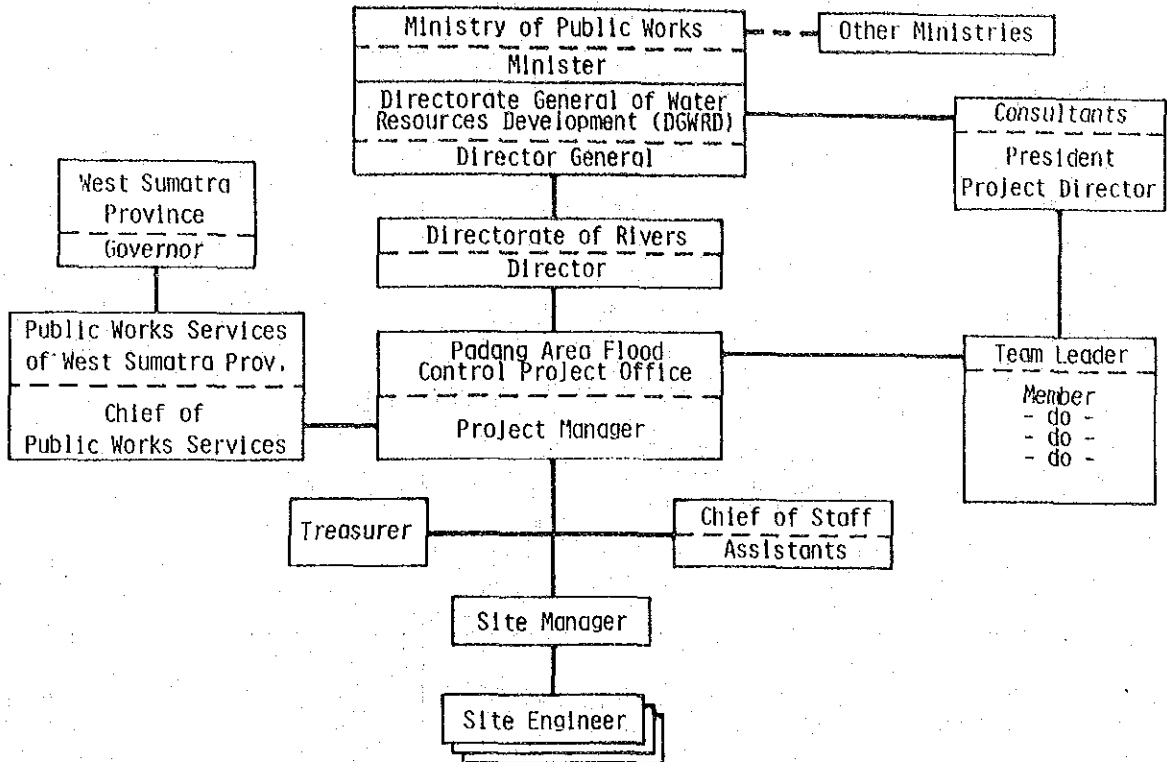


図8.3 維持管理のための組織図

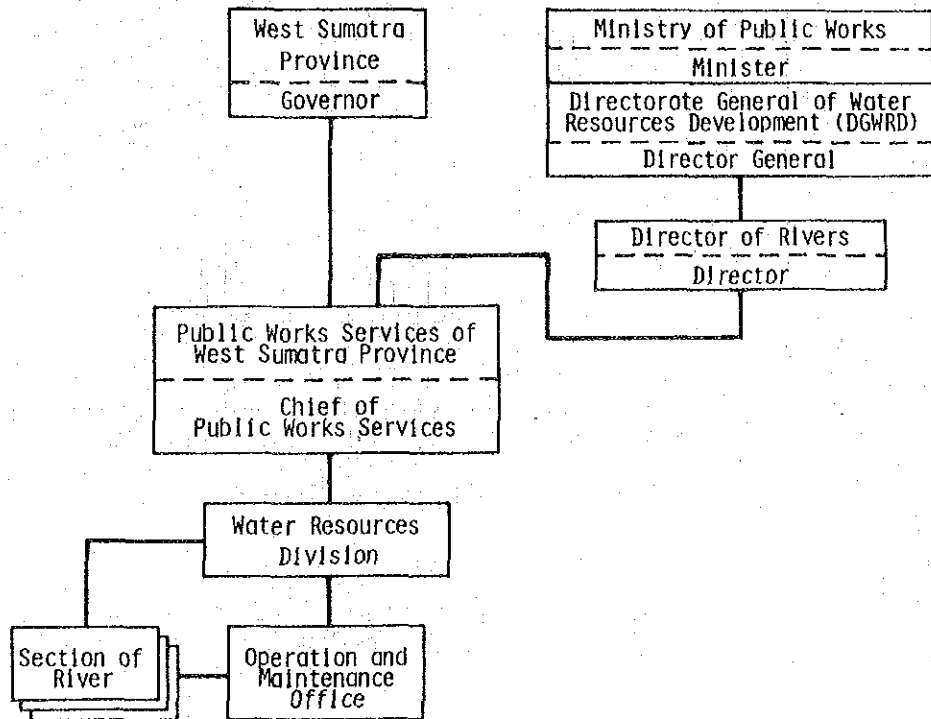


図9.1 緊急治水事業の内部収益率の感度分析図

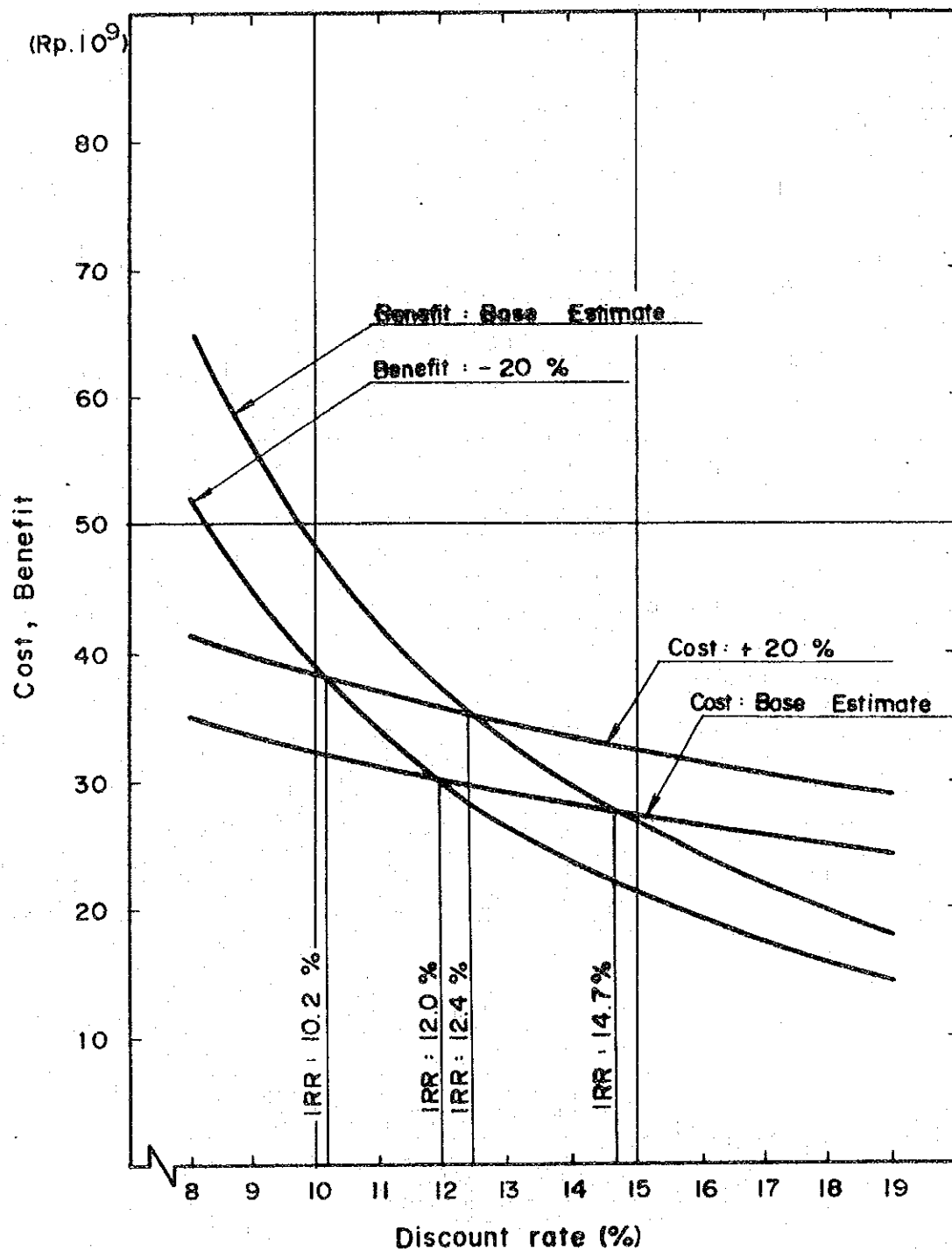
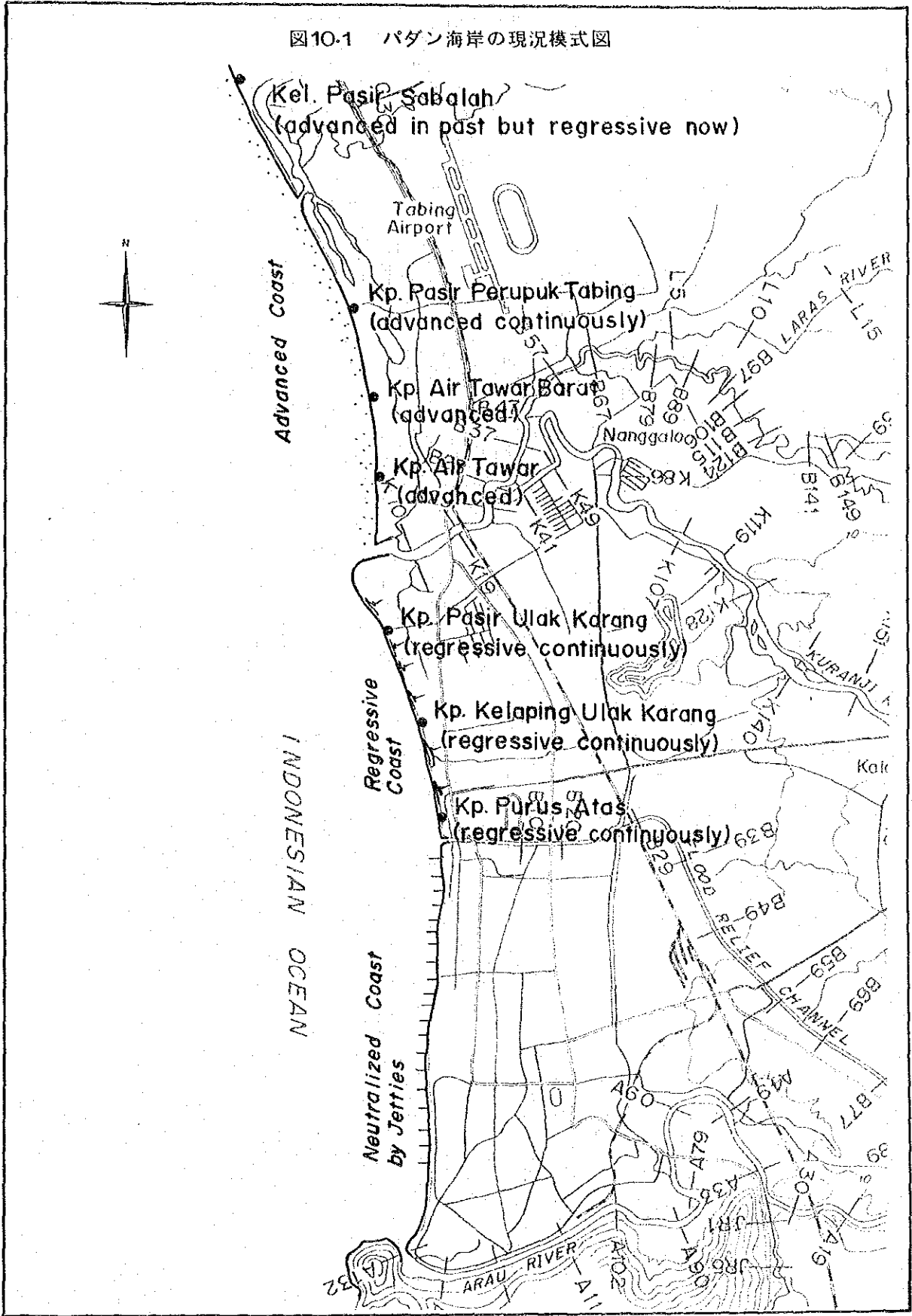


図10-1 パダン海岸の現況模式図



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