4.2 Comparative Study on Alternative Flood Control Plan

Supplement data in this section are as follows;

- Breakdown of work quantity and construction cost for alternatives (Table 4.2.1)
- Design discharge distributions for alternatives (Fig. 4.2.1)
- Design profiles of the Widas river for alternatives (Fig. 4.2.2)

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SCHEME

MIDES KEDUNGSOKO U LO	MIDAS	WIDAS KEDUWGSOKO	KEDUNGSOKO	9)	0 1 0	,	KUNCIR	Jakkara notakara	HANKEL	KUNDIR DIVERSION CHANNEL 70TAL	_	#1DAS	;	KEDUNESDYO		0 1 1	э.: 	PLUNCIE	אוסאס אבטראונא טואפטעט פרס גואכוש טואפטנא כאשמעז	DITERSION CLANNEL		187 A L
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7870	1	25:16		12780		13315	1	9374			65085		29423		12983		15503		65055 29423 12983 15503 7882			16138

Table 4.2.1. BREAKDOWN OF CONSTRUCTION COST (1/26)

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Table 4.2	2.I. BRE	AKDOWN	OF (CONSTRUCTION	COST	(4/26)

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GRAVEL METALLING RELOCATION OF ROAD	# #									·					- 1						
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ULB: 6.0 (MILLION, RP) DIVERSION CHAMEL TOTAL BUNNITTY COST RUNITTY COST S S S S S S S S S S S S				11 10 11 11 11 11 12 13 14		4079 2799	1845		1429	7997	180	380	1820		•		24771.	455	378	5722	20492
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RAILWAY (HOS)			8	676.7					- - }			٠.		}	Š					<u>ب</u> ب	Ę	
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DIVERSION MEIR (NOS)					<u>v</u>	657	£	450								<u>v</u>	014	ñ	757			
IRRIGATION HEAD MORKS (NOS)					3 -	3	2 ~	ì						-		2 ⊷	5	3 ~	3			
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GRAVEL METALLING (M)							:	•										•	1			
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SUB-TOTAL		23925		11381		4246		6710		4029			23456		11381		123		6710		4023	
LAND ADUISTIUM RESIDENTIAL (1000 SM) OTHENS (1000 SM)	## ## ## ## ## ## ## ## ## ## ## ## ##	5344	800	ති	240	340	612	612	981	385		## #7 #7	55	. 98	98	240	84	412	218	<u>.</u>	<u> </u>	
BUILDING COMPENSATION									-						1			٠.				
11 (NOS)	270	878	B	£	Q.	128	400	995	25	28		. 270	50	53	<i>t:</i>	Ş	921	483	290	8	78	
SUB-TOTAL		5772		87.		386		1172		214			27.65		877		388		1172		214	
				, , , , , , , , , , , , , , , , , , , ,																		1000

4.2.1. BREAKDOWN OF CONSTRUCTION COST (8/26) Table undan menenghan en per dinan bera bahan mannan binan bukan kanan unia binan kanan angan pakan bahan panan panan (MILLION, SP) ACTA MARALLIA AND INCIDENTA MARALLIA IN ARCHITETTE CONTROLO IN TOTAL MARALLIA CONTROLO IN 193 10TAU TELL PROPERTY. DIVERSION CHAMEL SUBATITY COST 58 55 53 55 88 1059 183 459 음 27 18 583 33 2100 535 110665, Q = 145 CM/SEC , V = 6.7 X MILLIGH CM , V = 0.0 X MILLIGH CM KUNCIR -- 2 30913 n 8 03 SUPPLITY 11803 32 706 1964 950 270 450 8 챬 33 23.7 2300 읈 1500 (INTIED CARRYING CAPROLITY AT K.SOKO BRIDGES, Q = CAPROLITY OF K.SOKO RETARDING BASIN
, V = (CAPROLITY OF ULO RETARDING BASIN
, V = (t: 1.3 21665 1064 - 2 COST DUANTITY 1289 2 389 33 335 2 53 33 73 3300 9 8461 55 E 8 2 -5 KEDNINGSCKO 7252 .. g - × × 900 766 S 왕 윤 왕 EURNT ITY 21739 1428 2350 28.88 1218 24 4845 3485 2735 5127 TSGO HIDAS QUARTITY 740 245 5127 2021 2031 733 MILIG. 189 1503 T 0 T A 2 COST BURNTITY 630 85 2 3 23 929 15 23 33 370 413 88 DIVERSION CHANNEL auant17Y 12330 55 ± 55 絽 8 ន្ទន 6710 32 S 1172 524 867 733 1400 612 674 535 10.8 299 1503 F3. KUNCIR 26353 26952 - 2 **QUANTITY** 238 738 512 8 3695 1246 378 620 8 450 400 240 26 366 88 1503 Ħ ----15105 \$ 29 20 ~ # - # 9 330 PURNTITY SCHERE ş 75 280 95 77 1017 3300 8 27 2163 1357 790 11281 뗞 KEDUNGSOKO - B 7683 2 S - 18 82 67 617 617 316 BUANTITY 23925 1845 1428 178 2775 5526 4052 2775 25B1 22.77 5344 5057 2537 270 1842 1842 925 PURNTITY (NOS) (NOS) (NOS) (NOS) (NOS) LAND ABUISTION
ACSIDENTIAL (1000 SR)
OTHERS (1000 SR)
BUILDING COMPENSATION I (NOS)
II (NOS)
II (NOS)
III (NOS)
III (NOS) IRRIGATION NEAD WORKS DREDGING. (1000 CM)
EXCAVATION (1000 CM)
EXPARMENT.
REVERMENT
METHASONRY (SM)
DRYMASONRY (SM)
BRIDGE
NOAD I (NOS) (SPS) SIDE DYERFLON DIKE GRAVEL KETALLING RELDCATION OF ROAD CULVERT HORE ITEN RIVER DADP STRUCTURE

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2. 28.

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C SCHEME

ULO: 6.0

RAILKAY

DRAINAGE

SUB-TOTAL

SYPHDIE

SUB-TOTÁL

Table 4.2.1. BREAKDOWN OF CONSTRUCTION COST (9/26)

	CAPACITY OF	CAPACITY OF M. SONO RETARDING BASIN , V = CAPACITY OF ULO RETARDING BASIN , V ≈	ATO THIS BAS THIS BASTA	E.	, V = 6.7 , V = 2.0		MILION CE				Capacity of K.Soko retarding basin Capacity of Ulu retarding basin	K, SOKO RE Ulu retar:	TARDING B DING BASTA	F175	* >- >-	4.5 % MILLION CH				
									CMILLIG	8			٠.						뵹	SKILLIGM, RP1
NIPAS KEUNGSOKO U.L.O	3401#	3 M	KEDUNGSOKO	# # # # # # #	010	ij	KUMCIR	TANGUER OF THE CHANNEL	OTTENNET TO TALE	#	WIDAS XEDUNGERAL XEDUNGSOXO	1 H H H H H H H H H H H H H H H H H H H	KEDUNGSOKO	ii .	Directorate contractorate cont	# # # # #	XUNCIS XUNCIS	CERTAL DIVERSION CHANNEL	0 1 1 1 1 1 1	55555455552 JOTAL
מטאר זובה אושנא	GURNTITY	COST QUANTITY	1 1	COST QUANTITY	1. \	COST QUANTITY		COST QUANTITY	COST BUANTITY	COST	BUANTITY	COST BUR	פעגאזנדץ כ	COST 43A#	QUANTITY C	CGS1 \$U\$#111Y	1	C057 CURNITY	EDST BURNITY	C02.1
DREDGING (1000 CM) EYCAVATION (1000 CM) ENERWINENT (1000 CM)	1868 (869 925	5604 411 <i>0</i> 2775	434	1523 955 770	784 362	1083 756	255 416	583 915			1736 1735 925	5203 3819 2775	435 434 308	1523 759 777	784	1083 796	297	283 735		
REVETHENT WETHESDURY (SN) DRYMASDKRY (SN)	46115	1845 1015	4550	137	19330 19330	383	36913	773 .			46116	1845 1015	4559	137	19330 19330	183	30913)73 618		
861955 8689 I (NDS) (SM)	:				280	1676									₩ 260	1676				
=	1 1130	1428			~ #g	307	E 52	1058			1190	1428			238	306	382	1658		
(SIN) III (SIN) AND IIVA	2350	2250	300	230	1064	1905	1183	1183			2350	2350	36	300	1064	1064	1183	1183		
. 050					88	1020							÷		₹.	1020				
(NOS) I (NOS)	स्च च	180 260 786		7.5	-a 143	270 195		180 65			d et R	180 260	w	ti F	w M	270		0 0 0 0 0 0		
813	-	ŝ	:. •	2	f	956	<u>e</u>	, L			,	?	•	2	Ē	0.5	ř	, E		
IRRIGATION HEAD WORKS (NOS)	_		13	3300	375	200	3 " =	2100				-	- 17	3300	3 54 %	2200	3 64 5	2, 29		
SIDE OVERFLOW DIKE (NOS)		. 194		202	ì	}	ì				3	1407	200	180						
DRUP STRUCTURE (NOS)			Ž	ŝ							;	2		2						
ROS) TOROSTORY (A0S)			٠.																	•
SYPHOME (NCS)	· ·_	٠			<u>£</u>	÷0÷	۳ د	ye.			-				~- ¢	ţ,	– §	. ¥		
GRAVEL NETALLING ()) RELOCATION OF ROAD () (2	3	2	601				٠.			?	3	2	72		
SUB-TOTAL		21358		3256	, , , , , , , , , , , , , , , , , , ,	11285	; ; ;	9125			# # # # # # # # # # # # # # # # # # #	20958	; ; ;	8256		11285		8125	1	<u>.</u>
STTICK TIAL (\$127	. 5127	7.65	766	318 318	818	589	589		1 1 1 1 1	3127	5127	765	7.5.6	316	316	639	689		
II (MDS) 11 (MDS) 111 (MDS)	245	343	ន្ធ	ĝ.	385	115	400	095			245	14.	ß	70	392	Ē	00°	260		
SUB-T014L		5470		B36		1327		1249			1 5 6 7 8 8	5470		9336		1327		1249	; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	
								***************************************	*****************	,										*****

C SCHEME III CASE : 1 1

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(SCHEKE III , CASE 1)

Table 4.2.1.

	PACITY OF U	CAPACITY OF ULO RETARDING BASIN , V =	IG BASTH		1 0 = 8.0 K	K MILLION - CH	5		CAPAC	CAPACITY OF N.SCKO RETARDING BASIN , $V=4.2$ X MILLION CX CAPACITY OF ULD RETARDING BASIN , $V=0.0$ X HILLION CX	O RETARDI Etarding	NG BASIN BASIN	•	V = 4,2 V = 0,0	X MILLION X MILLION	5 6	• •	
		1				1	: !	(HILLION, RP)		1 1 1 1 1							1	Willia.
AND THE DESIGNATION	WIDAS	NEW VEN	KEDUNGSOKO	, J	0.7.0	KUNCIR	IR	DIVERSION CHANNEL TO TAL		WIDAS	KEBUN	KEDUNGSOKO	97A		5	KUNCIS	VIDAS KEDUNGSOKO ULO KUNCIR DIVERSION CHANNEL TOTAL	19181
מטאל וובה אוטבא מטאן	DUANTITY C	COST GUANTITY COST BUANTITY	TY 005T	EU9MT17	COST	PUANTITY	. cost	GUANTITY COST QUANTITY COST	SI GUANTITY	TITY COST	GUANTITY	, cost	QUANT JTY	COST	DEANTITY	5031	BENEFITY DOST	BURNITY COST
DREBEING (1000 CM) EXCAVATION (1000 CM) FRAGENING (1000 CM)	1514	4542 3331	435 434 308 7	1573 758 7	784 1083	22 ×		563 313		2119 6257 2118 4660 233 2799	521	11 1824 21 1146 33 770	24. 83.0 84.1	2047	28.5	(83) (13)		
REVETABLY (SH) WETASONRY (SH) DRYTASONRY (SH)	46116					SS		77.7 618	<i>इ</i> न		K-1-		. 23		88			
RORD I (NCS)					1 260 1676							1 192	1 260	1676				
	1190	1 \$28					3 B82 10	1058.		1 1190 1428					85	1058	_	
(SCN) LIL (NS) VAN 1640	2350	2220	300	300 10	5 1054 1064			1133	. •	5350. 2350	ř	1 00 300	0 1064	1064	1183	1183		
		•			84 1050	0				٠		45 207	7 84	1050				-
I (NDS)	क पा	180		;	6 270 3 195	رة الآن ا		180 65		4 260		2 2 2	φM Ф.	270	- क्टू-जा. 	8 2		
DIVERSION WEIR (NOS)	a	£.		Ĉ.				£ :										
IRRIGATION HEAD WORKS (HOS)	-	٠	→ E	700	12 450	(5 t	900			۳	1 37 3700	3.25	7300	g % ह	8 8		
SIDE DVERFLOW DIKE (NOS)	, 10 h	1.000	3 7 60					3		3 3000	7					*		
DROP STRUCTURE (NOS)	2			3					-									
ADUEDUCT (ROS)																		•
SYPHONE (MDS)					\$		- ;	ý						-	£	-		
GRAVEL NETALLING (N) RELOCATION OF ROAD (M)					8			31					٤					1
SUB-TOTAL		19853	, 600	8256	11285	22	18	8125		22593	23	9079	6	11808		8125		
LAND ADVISITION RESDENTIAL (1000 SM) OTHERS BUILDING COMPENSATION	3127	5127	7. 997	3 997	918 918	16 439		589		5127 5127	7 . 768	166	6 954	954	689	689		
1 (ADS) 11 (ADS) 111 (ADS)	S	343	95	. 70	365 511	006 1:		095		245 343		50 70	395	**************************************	490	280		
SUB-TOTAL		5470		836	1327	11	;∓ 	1249		5470	ē	83,6	٠,	1507		1249		
T 0 T A L 25313 9992 [2612	,	25313	15	2668	12912			3374. 56391		28063	2 2	5166	ĻΩ	13315		4226	28092 . 9915 12215 4374 60667	20992

BREAKDOWN OF CONSTRUCTION COST (10/26)

(SCHEME 111 , CASE 1 1

÷	(da ')		ble §	4.2.	1.	BRI	EAKD	WO	'N OF	CON	ISTR	rUC1	TION CO	ST	(11/26	S)	1	
	(NETTERN) 66)	KIDAS KEDUNDSOKO ULO KUHCIR DIVERSICH CHRHEL T O T A L	BCB4717Y (1 1 4 6 1	1;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;		# ! ! ! !	
		DIVERSION CHAMEL	177 [05]											1	1 1 1 1 1 1 1			
		23AZC 23AZC	COST QUANTITY	283 215	777 618		1058		8 3 S	420	2100		89	8125	639	092	1249	
CK/SEC 11.10% CM CH. CM		KUNC18	DUANTITY C	265 415	30913 30912	*	. E & E	•	*	~ <u>55</u> 19	73		-2		689	400		
= 195 CM/SEC = 4.2 X MILLION CM = 4.0 X MILLION CM		11 11 11 11 11	cost our	1003	483 387	1678	306	1920	33,	450	2300		\$01	11285	315	\$118	1327	1
G/, 3x, 5x		ULO ULO	CURKTITY	784	19330 19330	500	288 9 9 1040	~ ₩	-a +3	- £3 ≈	23		7 0.		93.6	365		
. SOKO BRI ASIH N		0000	es rea	1582 1992 770	137	162	700	797	130 380		.3300			8546	766	70	836	
ICITY AT K Tarding B Tains basi		KEDUNDSOKO	BURNTITY	452 451 308	4550 4559	405	1 5	- £	र वे चुर	-	378				166	ន		1
RYING CAPA K.SOKO RE ULO RETAR		## ## ## ## ## ## ## ## ## ## ## ## ##	C0ST 91	5948 3395 2775	1945		1428		180 265		1785			21556	2127	12	5470	
LINITED CARRYING CAPACITY AT K.SOKO BRIDGES Gapacity of K.Soko Retadding basin Capacity of ULO Retadding basin		2000 M	PUANT 1 TY	1816 1816 725	46116	•	1130		ማ የ 17		3 2550				5127	245		
			1500															
	SMILLS	DIVERSION CHANNEL TO TALE	DUANTITY			•												
	:	CHANNEL	1500															
		DIVERSION CHANNEL	PUNATTY											1				
ខ្លួនទ		KUNCIR	rego	563 915	773 618		1058		180 65 85	420	2100		99	8125	883	260	1249	
1			DUANTITY	265	30913 30912		382 8 8				21		1.02		689	\$00		
, 0 = 4,2 % 4 ± 4,2 %			1903	1083	483	1676	706		270		2200		105	11285	818	518	1327	
		070	PUBNITTY	784 362	19330	1280	288 588 6		-0 h3	ž. 14			- 2		816	392		*****
7.5070 E 34514))))))	1263	1582 992 770	13.	162	Į.		130		3300	-		8546	766	70	828	
PACITY AT RETARDING PARDING BA		KEDUNSSOKO	BURNTITY	452 308	4560	405	1102	- \$	~ ~ ÷	•	700				766	25		
RAYING CA F KUSOKO P F ULO RET		## ## ## ### ###	1503	5835 4277 2775	1845		1428		180 260 380	-	1607			21952	5127	343	5470	
LLMITED CARRYING CRACTIT AT X.SOLD BRIDGES CARCTIT OF K.SOKJ RETARDING BASIN CARCTIT OF ULG RETARDING BASIN		***************************************	BUANTITY	1945 1944 925	46136 46115	-	1190		श्चास		2295				5127	245		
		NIDAS KEDINOSOKO ILLO	IN	(1000 CM) (1000 CM) (1000 CM)	(88)	(803) (88)	(SP3) (SP3) (SP3)	(SDN)	ERT (NOS) (HOS) (ROS)	co.			(MS) (NGS) (M) (M) RGAD (M)		04 (1000 SH) (1900 SH) ENSATION	(NDS) (NDS) (NDS)	; ; ; ; ; ;	
		secondary acoustic	And I will have a second	DREDEING (1000 CM) EXCAVATION (1000 CM) EMBANKMENT (1000 CM) REVETHENT	METRASONRY DRYMASONRY	BALUBE ROAD I	1 11	Railray	DRAINGE CULVERT I II II II II	DIVERSIBN WEIR (MOS) (M) (RRIGHTION HEAD WORK	SIDE CVERFLON DIKE	DRUP STRUCTURE AGUEDUCT	SYPKONE GRAVEL METALLING RELOCATION OF ROAD	SUB-TOTAL	LAND AQUISTION AESIDENTIAL (1000 SN) OTHERS (1000 SN) BUILDING COMPENSATION	LEE	SUB-TOTAL	

(SCHENE III , CASE 1)

KIDAS KEDUNGSOKO ULO KUMCIR, DIVERSION CHANNEL 1 D.1 A L.	COST QUANTITY COST QUANTITY COST	265 583 416 915	773 619									1 1 1 1 1 1 1 1 1 1 1 1 1	
ULQ KUMCIR DIVERSION CHANAL	QUANTITY COST QUANTITY		777 613									ļ	
UCO KUMCIR DIVERSION	QUANTITY COST		517 618									į	
ULO KUNCIR	QUANTITY COST		577 618					,					
CCO CONTRACTOR CONTRAC	1 1	265			1058		98. 25.	45.0	•	105	8125	689	260
OTO DESCRIPTION OF THE COLOR	1 1		30913 30912	P.	B82 B 1183		*	## P E	i	70		689	400
mensessessessessessessessessessessessesse	101	2047 979	542	1676	705	1050	276 195	450		50	11308	954	555
;;	DUANTITY	390	21665 21665	1260	288 9 1064	 æ	יוסי	그 Ki 다 K		48		954	392
d # C)	COST DU	2216 1393 770	21B 152	83	300	1085	150	1300	320		11627	766	73
KEDUNGSOKO	DUANTITY	633 633 308	7253 4252	1 929	36	- £	EM 143	·	2 000			766	ន
	;	6510 4772 2799	1015		1428		180 260 285	İ	1691	•	23138	5127	63 45 64
WIDAS	1 1	2179 2169 933	46116		1190		安林州	•	3420			5127	. 245
											1		
101													
ARWEL	1 1		٠										
ERSJON CH													
110	1 1	583	773 618		1058 1183		98 23 25	456	3	99	8125	689	260
KUNCIA	' !	265	30713	**	637 8 8 1183		~ ~~ ~	12 th 2	1	6		689	400
))))))))))	1 1	1083	787	1678	706	1359	270 175	450	3	30	11285	816	116
uro uro	' '	784 361	19330 19330	1 286	588 6 1054	¥5	aη	- 57 7 X	3	- 5		816	39 27
ii ii ii ii ii ii ii	, ,	1582 1992 770	137	291	300		021	9	054		8546	766	7.0
EDUNBSOKO	O YTITA	452 451 308	4550	405	202		(4 =4	· -:	2 6 2			397	ន
, and a contract of the contra		4807 3527 2775	1945.		1428		180 260 475	!	1768		20432	\$127	343
HIDAS	' !	1603 1603 925	46116		1190		ককণ		2525			5127	245
1 1 1 1 1 1 1	E I							(NOS)	(NDS)	(((() () () () () () () () (
; E	esi .	00 CH3 00 CH3 00 CH3	(RS)	(150) (151) (163)	8 8 g	(HDS)	RT (MDS) (MDS)	(NOS) (N) D NORKS				1000 SH) 1000 SH) 1000 SH)	(HDS) (HDS) (HDS)
<u> </u>	5	물분유	HETHASONRY DRYHASOMRY TIPSE				i.i	ca or	SIDE OVERFLOW D	, ≊≪.	•	1 2	
TO COLUMN THE PROPERTY OF THE	KUNCIR DIVERSION CHANNEL TOTAL WIDAS	KUNCIR DIVERSION CHARMEL TOTAL WIDAS GUANTITY COST GUANTITY COST GUANTITY COST GUANTITY COST GUANTITY COST GUANTITY COST	KUNCIR DIVERSION CHANNEL TOTAL WIDAS CURNITIY COST QUANTITY COST DUANTITY COST 245 553 2199	HIDAS KEDUMBSOKO ULO KUNCIR DIVERSION CHARMEL T 0 T A L HIDAS	HIDAS KENUMSSOKO ULO KUNCIR DIVERSION CHARMEL T 0 T A L HIDAS	HIDAS KEDUMBSOKO ULO KUNCIR DIVERSION CHARMEL T 0 T A L HIDAS	HIDAS KENUMSSOKO ULO KUNCIR DIVERSION CHARREL T 0 T A L HIDAS	HIDAS KENUMSSOKO ULO KUNCIR DIVERSION CHARREL T 0 T A L HIDAS	HIDMS KEDMHSGNCG ULD	HIDAS KEDUNESDKO ULO KUNCIR DIVERSION CHARMEL TOTAL WIDAS	HINSE FEDNMESTOR HINDER HINSE HINSE	Minuse M	

BREAKDOWN OF CONSTRUCTION COST (12/26)

Table 4.2.1.

	CAPACITY OF ULD RETARDING BASIN , V	K. SUKO 7 ULC RETI	20126 845	NIS		, V = 2.0 X MILLION CM	MILLION .	5				CAPACITY OF ULD RETARDING BASIN		480186 BS	PK.		. C	12 YETTE X 0'5 .				
									1		CHILLIDE, GP.				·						17114	W. C. 104, 823
WIDAS KEDDWGSQKO ULD KUMCIR ZIVEKSIGA CARANEL YOTAL	RIDAS		KEDUNGSOKO	8	om		KINGIK	CIR	STUCKSTON CHANGE	SAMMEL	16191	-	54	KECUMOSOKO	2	9.50		KUMUI	TAIG &	KIDAS KEDINGSOKO UAO KUNCIR DIYIRSIOM CIRNMEL	1 4 . 6 .	7 9 7 A L
MUSA, LIGHTAIVEN	BUANTITY COST	C051	SUSATITY COST	1	TT THE PER	1595	QUANTITY	CGST	DURNTITY	C63T 0L	DURNTETY COST	ודודאמטט	1583	EUASTITY	1583	QUANTITY	0031 8	QUANTITY	CGST SURNITITY	11Y 5357	2014317.77	193
DREDSING (1000 CM) ELECAVATION (1000 CM) ENERAWHERT (1000 CM)	2055 2064 725	6175 4541 2775	520 517 308	1820 1142 770	784	1083	265	583 915				1385 1885 725	5655 4147 2775	51.7 51.9 508	1326 1142 770	784	1003 776	265	583			
REVETHENT RETARBURY (SK) DRYHASGARY (SK)	46115	1345	4559	137	19330 19330	483	30913	773				46116	1845	4550	137 88	19330	181 284	30913	575			
			1 620	838	1269	1676				•				1 630	838	1260	1676					
	1190	1428	. •		288	706	26	:028				1190	8243	•		17 E	706	닯	1058			
(SE) (SE) (SE) (SE) (SE) (SE)	2350	2359	360 1	390	1064	1064	B 11	1133				2350	1015	300	300	1064	1981	- <u>2</u>	1183			
. #			70	1035	#6	1050								ድ	1085	8	1050					٠
1 (202) 11 (405) 11 (305)	4 4 4	180 260 280	0 m	120	-0 P2	270	하 ~ ~	330 83 83				eyr 42° 197	185 260 475	64 PA	55.5	w 19	233	₩	88 88 88			
813	•		•	·.	i. 63	05.4	- 43	450	÷			•	!	•		53	5	y:	: K			
SS.			™ B3	3260			17	2100						™ £3	1300	e e	2300	., M	88			
371	2. 2725	1908	500	350								2570	1799	500	350							
DROP STRUCTURE (MGS) (H) AQUECUCT (MGS)															2							
SYPHONE (HDS)		٠		٠.	** €	26	£	101								- E	50	<u></u>	301			
GRAVEL HETALLING (H) RELOCATION OF ROAD (H)	: i,				:				•							:		:				
SUB-TOTAL		22377		10253		11285		8125			4 2 2 5 5 7 6 7 6 7 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7		21929		10253		11285		8125	1		
LAND ADVISTION RESIDENTIAL (1000 SH) DTHERS (1000 SH) BUILDING-COMPENSATION	\$127	5127	766	766	\$15 15	816	689	65 27		1 5 1 1 1		5127	5127	766	766	918	818	687	£39			
(NDS) 11 (NDS) 111 (NDS)	245	5.5 5.5 5.5	ន	55	365		400	280		٠		242	r) er	ន្ត	02	365	216	400	260	-		•
SUB-TOTAL		3470		923		1327		1249					5470		<u></u>		1327		1249			
TOTAL		70747															!			:		

(SCHEME III , CASE 2 1

		To	ble	4.2.i.	BREAKDOWN OF CONSTRUCTION COST (14/26)	
	(HILLION, RY)	10141	PURNTITY CDST			15019
		DIVERSICA CHARACL	STATE COST OF			1618
			CC3. 2UR	25 85 25 85 25 85	1058 778 135 55 450 1400 1400 512 550 560	. 11
145 CH/SEC 4.8 X MILLION CH 0.0 X HILLION CH		KUNCIR	SUSHITTY C	238 394 26753 26952	897 798 709 719 700 719 719 719 719 719 719 719 719 719 719	1652 (172
+ 145 - 4.8 x 111 - 0.0 x H	į		cost au	2627 1144 751 601	1676 705 1274 1050 270 195 450 450 105 105 105 105 105	1652
DGES , B		ar.o	אנוזאשמם	1143 520 30045 30045	1280 22 588 588 1274 1274 127 15 15 15 15 15 16 16 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18	
SDKD BRI ASIN N			cast au	1777 1131 770 770 218 152	300 130 130 700 700 718	781
K TA YELDS TARDING B TOTNE BASI		KEDUNBSOKO	DURWITY	514 514 308 7253 7252	1 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	1 11 11 11 11 11 11 11 11 11 11 11 11 1
YTHG CAPP K.Soko Re Ulo Retar			COST BU	6231 4657 2799 1845 1015	1428 2380 180 285 285 22404 343 343	27760
LIMITED CARRYING-CAPACITY AT 17,50KO BRIDGES Capacity of 14,50ko betarding basin Capacity of ULO Refarding basin		WIDAS KEDUNGSOKO	į	2077 2076 933 46116 46115	1190 1190 2380 3 2020 5153 245	27760
	(MJLLJON, RP)	T 0 T A L	TY COST			24526
		9	I GUSNTITY			1
		DIVERSION CHANNEL	BUANTITY COST			
es es es			1502	583 915 777 618	1058 11183 1180 65 75 75 750 105 105 560	1249
O CHISEC MILLION CH MILLION CH		KUNCIA	, _	265 416 30913 30912	288 882 1188 882 1188 882 108 884 108	9 51 1 21 1 21 1 4 51 4 51 4 61 5 61 5 61
, V = 1.9 X MILLIGH , V = 1.9 X MILLIGH			g T203	1083 776 481 387	1676 706 1064 1050 270 195 195 11285 11285	1327
1106ES , 6		on o	CUANTITY	784 352 19330 19330	1 1 2 2 3 2 3 3 8 8 4 9 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	
K, SOKD BI Basin Sin		000) LSDC	1820 1152 770 137	838 300 130 285 3300 766 76	936
PASITY AS. RETARDING ARDING BAI		KEDUNGSOKO	QUENTLYY	520 515 358 4560 4559	25 121 32 25 25 25 25 25 25 25 25 25 25 25 25 25	1
RAYING CR F X, SOKO 1 F ULD RET		AS	COST	5229 3832 2775 1845 1015	1428 2350 185 266 475 475 2127 343 343	2470
LIMITED CARAYING CAPACITY AT X.SOMO BRIDGES , 0 = CAPACITY OF X.SOMO RETARDING BASIN , ν = CAPACITY OF ULO RETARDING BASIN , ν		HIDAS	QUANTITY	1742 1742 925 96116 96116	1 1139 9 2350 9 4 4 5 5 5 2845 2	
ل ن س		WIDAS KEDUNGSOKO ULO K		sar se	SS (NOS) (NO	
	-	CU: 0 7 10 1 2 20 1	FURN TICHTAINEN	PREDBING (1000 CM) EXCHANTION (1000 CM) EXBRANCENT (1000 CM) REVETNENT HETHADOURN (SN) DRYMASONRY (SN)	RATIOS (1003) RADINAY (103) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 111 (1045) 112 (1045) 113 (1045) 114 (105) 115 (1045) 116 (1045) 117 (1045) 118 (1045) 119 (1045) 111 (1045) 111 (105) 111 (105) 111 (105) 111 (105) 111 (105) 111 (105) 111 (105) 111 (105)	SUB-TDTAL 5470 876 1327 1249 T O T A L 28851 11089 172612 1374 59926

CAPACITY OF K.SGNO RETARDING BASIN
, Y = 4.6 X MILLION OR CAPACITY OF W.O RETARDING BASIN
, V = 4.0 X MILLION OR CAPACITY OF W.O RETARDING BASIN

GOIENE 111 , CACE 2 1

Table 4.2.1.

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LINITED CARRYING CAPACITY AT K.SOKO BRIDGES , Q = 145 KILLOR CK CAPACITY OF K.SOKO AZTANDING BACIN , Y = 4.5 X MILLIOR CK CAPACITY OF ULD RETAROING PASIN , Y = 2.0 X MILLION CH

TENNOTHES RECURGESKO SILO	Stata	e)	KEDUNGSOKD		95		runcia		. 5	GENER	0	TOTAL	A	MIDES	KEDURDSOKO	SOKO	900	0	WIDES KERNOSOKO OLO KUNCIR DYVEKSION CHANNEL I O T A L	KUKTR	DIVERSION CHANG		10181
	PURKTITY	COST EURITITY COS	ESCHITTY COST		CUANTITY COST	; i	QUANTITY (COST PR	DUANTITY	1500	BURNTITY COST	1503	DURKTITY		COST OURHITTY	COST	. :	7982	EGANTITY	COST	BURNTITY .	1532	BEANTITY COST
MEDDING (1000 CM) EXCRANTION (1000 CM) EMBRINGEN (1000 CM)	1924 1923 925	5772 4231 2775	441 308	1544 358 776	\$0 \$0 \$0	7166 887	373	25					1809	5420 5980 2775	441	1544 968 777	404	2206	23.23	524			
NETHAGONNY (SH) BRYHASONNY (SH) BRYHASONNY (SH)	46116	1845	1550	151 88	01772 27710	554	26752	529					45116	1845	4556	151 88	7 27710 6 27710	554	3 26553 4 26752	539			
ROAD X (ROS) (SM)	. 4			•	1260	1676	•						***				1250	3791					
(ARS) (ARS) (ARS)	1190	1428	130	200	538 9	706	382 5 798	1028					1196	1428	300	902	58B 9 9 0 1274	3 706	6 987 4 798	198			
RAILWAY (NGS)	-				25	1050	!	!													-		
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(N) IRRIGATION HEAD WORKS (NOS)			~ p	3300	* # ^ 6	450	- E ~ E	450	·							23300	. 2. 25 .	450	. 12 44	450			
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ABUEDUCT (NDS)											•												
SYPHONE (ROS) (ROS) (ROS) (ROS) (ROS) (ROS) (ROS) (ROS)					7.02	105	- 22	19									1 07	105	5 70	301		,	
-	1	21859		0Z\$B		13068		67.50			-			21551		8420	; ; ; ; ; ; ; ; ; ; ; ; ;	17088	62	6710			
LAND ACUISTICA. RESIDENTIAL (1000-SM) OTHERS (1000-SM) BUILDING COMPENSATION 1 (NOS)	F7	1 12 1 27 1 27 1 12 1 12 1 12	F	113	B78	878	213	612		1		1 4 2 4 8 8 8	15 15 15 15 15 15 15 15 15 15 15 15 15 1	55		27.	1	B78	£ 5	5			
11 (MOS) 111 (MOS)	10 F1	242	£5	63	415	281	65	260			i : : :	1	245	343	23		63 415	281	1 400	560			
SUB-TOTAL		5336	:	781		1459		1172						34%	ç	181	==	\$35°	Ç.	1172			,
18181		13266														:			,	4			

BREAKDOWN OF CONSTRUCTION COST (15/26)

(SCHEME 111 , CASE 2)

LINITED CARRYING CAPACITY AT K.ODGO BRIDGES , 0 = 145 CH/SEC CAPACITY OF K.ODGO RETARDING BASIN , y = 4.8 X MILLION CH CAPACITY OF ULD RETARDING BASIN , y = 6.0 X MILLION CN

CARACITY OF K.SOKO RETARDING BASIK

CARACITY OF K.SOKO RETARDING BASIK

CARACITY OF W.G RETARDING BASIK

CARACITY OF W.G RETARDING BASIK

CARACITY OF W.G RETARDING BASIK

15CHEME 111 , CASE 2)

Table 4.2.1.

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		25.7	674 639 1058	13	65 35 450	1400	25	6710	617 560	1172	
renterenterenter VanCle	SURNITY COST	27. 27.4	26752 26752 3 3 882 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	<u>.</u>		a	. 01	6 6 1 1 1	612 420		
## ## ## ## ##	CDST 3UA	2629	151 601 1676 766	73 650	195 450	3000	101	13531	1029	1652	
	1 2	1143	20045 20045 126 2 2 2 538 9	₩	м <u>т</u> йс	ន្ត	10		1029		
		1935 1214 770	162	. 202	130 380	490		9259	817 73	181	
KERNINGSOYN	CURNITY COST	. 252 252 262 263 263 263 263 263 263 263 263 26	7253 7251 1 1 405	g 47	~ -	760			ž. 2		
11 52 11 11 11 11 11 11 11 11 11 11 11 11 11	COST CURY	6405 4695 2799	1845	8 8	285	1568		12860	5153	5498	
TERESTANDA STANDARD S		25 E E E E E E E E E E E E E E E E E E E	46116 46115 1 1 1190 9	3	et 19	2240		} } } } }	5153		
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noossassassassassas Plussassassassassas	ס אדודאפעס	 						-			
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XIIIIX	QUANTITY C	238	26952 26952 3 892 5			1	- 22		612	F 5 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	1
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3 (T. 1)		19 H	1628	1180	475	1866		70657	83 83 83 84 85 85	547.6	
HTRAS	ממאזזזץ כמפז	1854 1843 257	46:116 46:115 1190 3	2 41·	4 N	3 2665			5155		
320000	200		स् ^र :	1.	S		0000 0000 0000 0000 0000 0000 0000 0000 0000	-	: 	1	
andonamenebouttermentamenebouttermen	CC.	255	(50) (80) (80) (80) (80) (80) (80)	(805) (11) RT (805)	(NOS) (NOS) (NOS) (NOS) (NOS)				(1306 SH) (1309 SH) (1309 SH) (NDS) (NDS)	15000	
111111111111111111111111111111111111111	MORK ITEM/RIVER	DAEDGING (1930 CM) EXCKVATIGN (1930 CM) EMBANKENT (1900 CM) REVETNERN	HETHASOHRY DRYHASOHRY RIDGE ROAD I		II (NDS) III (NDS) DIVERSION WEIR (NDS) (A) CROSSION MERB WORK	SIDE CVERFLON DIKE DROP STRUCTURE ACHEDICI	SYPHONE SPAREL NETRILING RELOCKTIONS RELOCKTIONS	SUB-TOTAL		111 97AL	
294040	HORK T	EXCENTION EXCANTION EMBANKHENT REVETHENT	AETHASO DRYHASO RRIDSE ROAD I	RATLWAY DZATKASE I	DIVERS	SIDE CVES DROP STRI	SYPHONE CRAVEL 1 RELOCATI	SUB-TOTAL	LAIR AGUI RESIDEN OTNERS BUTLOING	SUB-TOTAL	

BREAKDOWN OF CONSTRUCTION COST (16/26)

(SCHERE III , CASE 2 !

	LAFALLIF OF DLU KEIRKOING BROIN	מיז מרם עלי	ee bicteur	E	•					2	(00)(01) (1777)	מופאם מאוזשנינט מחף וה בנדמשואה										č
A TO A TO A TO A THE TOTAL T		***************************************	ENTRUCEDAN SA	accessa.	**************************************			annoncent o	entennonnententen 1950etti	***************************************	ATTENDED TO A VINCOUS TO A STATE OF THE PROPERTY OF THE PROPER		WINDS.	HILLEN NEW PRINCESSING IN A PRINCESSING IN A PRINCESS OF A PRINCESSING OF A PRINCESSING OF A PAIR NEW PRINCESSING OF A PAI	eccourant DVA		1222200510	VMMP10.		noonakacaanoaakana nimpolon noomat		HILLIUM, OF V
NGEK ITEK/RIVER		2	N. Victoria	-	. '			ļ	choton una		- 1		į ,	rendra de	4.	7		٠, د	ļ	an an an an	ļ	a -
	TUANTITY	C0ST	PORNTITY	1502	PURKTITY	103T GI	GUANTITY	M3 1500	EUGNTITY COST	ST QUARTITY	ITTY COST	YLI NAUG	1503	BUANTITY	0 1500	GUANTITY	C037 83	GURATITY	CDST 9UA	DUANTITY DOST	T CLASTITY	177 5057
DREDSINS (1000 CM)	1997	5997	465	1.628	ŝ		T C	į				1886	2657	294	3791	950	Ž		Ē		-	
ERBENKAENT (1000 CM) PRUTHENT	725			770	404	382	265	277			-	325			776	404	388	3.5	367			
WETHASONRY (SH) DRYMASONRY (SH)	48116 46115	1245	1560	137	27710	125	26952	674 539				46116	5 1015	4560	137	27710 27710	693 554	26952	574			
RRIDGE RDAD I (NDS) (SR)			1 000	162	1260	1678								1 40S	162	1 1260	1676					
	1130	1428			2 588	706	25 25 25 25 25 25 25 25 25 25 25 25 25 2	1058				1190	1 1428			2 2 2 2 3 8 3	708	2 E	1058			
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(20)		٠	4 <u>62</u>	207	1 18	1050								42	202	- 55	1053					
DRAINNGE COLVERI I (NDS)	- ·	180			٠٥٠	27.0	rs -	33				~ -	180			٠ <u>۵</u> ٢	270	F2 *	8			
III (NDS)	र थर	380	7 4	380	· -	ę.		3 55						N 43	280 280	. .	7	→ ⊷ ⊷	3 %			
RAIGATION HEAD WORKS 1205)	(50)				범인	450	. 5	420				•				· 11 2	450	- 52 7	459			
SIDE OVERFLON DIKE (A	(N)		₽ ¬	3300	ន	3000	14	1400				М		E3	2360	유 :	3000	*	1400			
	22	1751	700	630								2790	1953	7%	490	٠.						
:	(\$ 1 (NOS)																					
N) SYPHONE (N	(H)					٠	.,				-					**1		i,				
GRAVEL HETALLING (RELOCATION OF ROAD ([85] (85)				. 70	105	70	ξο <u>.</u>								70	165	R	301			
Sus-total		22417		2621		13063		6710		,			22116		8621		13068		6713			
	12.12	127 177	. #	817	87.8	878	612		6 1 1 1 1 1 1 2 4 2 1		1 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	5153	R	8	31/	878	878	513	\$12	·	·	
(SOK) III	265	343	ŧ.	62	115	281	430	250				245	243	63 30	. 9	415	581	400	290			٠
SUB-TOTAL		925		182		1459		711	1	1			5436		181		1459		1172			

BREAKDOWN OF CONSTRUCTION COST (17/26)

Toble 4.2.1.

		Ta	ble	4.2.1.		BREAL	CDOW	N OF	CONS"	rru	CTION COS	T	(18/26))		
	(SILLIGN, AP)	10111C	16	•												\$\$7.59
	SIL	(C)	E33133) 1 1 1					10 11 11 11 11 11 11 11 11 11 11 11 11 1
		1228年51	1590								·	1		1		# # # # # # # # # # # # # # # # # # #
		DIVERSIDA CHAMA	CANTITY										•			11
មានទ		5757 C18	ije B	52.53	55		793	175 65 75 75	459		105	6710	612	290	2711	7887
y a - 200 CM/SEC y = 1.6 % MILLION CN. y = 6.0 % MILLION CN.		MUNCH KUNCH	GUANTITY	24 k3 13 tu 13 tu	26753 26952	3 588	778	~	1 2 2 2		1 70		512	460		7367 7362
1 1.6 X X		65 64 61 61 61 61	1553	833	751 601	1676	1274	270	450		105	13351	1029	23	1652	15503
		370	CUANTITY	5143	30045 30045	133	1274	מים ס	12 18		, 0T		6201	445		
KLSOKO 28 BASIN IN			C031	2271 1426 770	85	83 83	300	130	2300	350	E E 1 1 1 2 4	11126	713	28	181	11707
CITY AT TARDING L SQING BAS		KEDUNGSOKO	SERVITY	645 648 308	227	65	- 202 - 25	5 1210	- 13	200			718	ę.		11 11 12 13 14 14 15 15 16 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18
TING CAP K.SOKO RE ULG RETAK			COST 24	6003 4342 2799	3946	25 25	2380	180 260 285		1778		23415	5153	25	5496	23911
LINITED CARRING CAPLDITY AT K.50KO 89109CS CAPCLITY OF K.50KO RETABDING BASIN CARCLITY OF ULQ REFARANG BASIN		KIDAS KEDUMSSOKO ULO KUMETR DIVERSIDM CHAMILL I O 1 M.L.	QUANTITY	2201 2201 133	46116	1 200	2380	מן באי קאי		2540			5153	245	1	1907
			C051					4			}			1		90925
	IRILLION. RP)	1 0 T A L	QUANTITY											1 1 1 1 1		200000000000000000000000000000000000000
		and a section of the	DOST BUK													# # # # # # # # # # # # # # # # # # #
		DIVERSION CHANNEL	CUANTITY C											ļ		7887 . 7887
		######################################	COST GUA	524 857	539	0058	366	55 55	420 420		50 50	9119	612	260	1172	7887
5, 9 = 195 CM/SEC , V = 3.2 X MILLION CM , V = 6.0 Y MILLION CM		KUNUK	QUANTITY C	238 394	26753 26952	80 G	738	to	12 24 25		7 2		612	400		17 19 01
195 7.2 x MIL 6.0 x MIL		# 	: :	2206 887	554	1676	1274	270	450		105	13058	878	281	1459	14527
8 n H 6* 2> 2> * * * *		900 900	COST COST	959 404	27710	1 1260 2 2	27.74 12.74	± -013	2 2 2 2		- P		BB 158	415	1	11 11 11 11 11
OKO BRIDG Ca			1 1	1628 1021 770	137 2	162	200	2 5 g	3300	430		1792	718	63	781	20:5
TY AT K.S IDING BASIN IG BASIN		KEDUNGSOKO	TITY COST	485 484 308	4560 4557	1 402	- 55 - 5	Č ′∠ 4		700			7.13	£.		## ## ## ## ## ## ##
NG CATACTI CHO TETAN			T BURNTITY	5148 2773 2775	1845	6	23.80	180 260	•	2020	. ÷	71295	25.	343	5436	26795
LINITED CARRYING CARACITY AT X.50KO BRIDGES CARACITY OF K.5CKO ECTRADING BASIN CARACITY OF ULD REPARING BASIN		NIDAS :	TY COST	1716 1715 925		~ · · · · · · · · · · · · · · · · · · ·		or ≠ pr	1	2885		64	120	245		2
CAPACI		## ## ## ## ## ## ## ## ## ## ## ## ##	DURNTITY	<i>⊶</i> ~	46116	_			(405)	() 2	(SOS) (SOS) (SOS) (SOS)			·		
		 	,	888	(SR) (SR)	(KON) (KS)	(MDS) (MDS)	(ROS) (NOS) (NOS)	. TS ~ \$5				1000 SE) 1000 SE) 1000 SE) 1011 OH (RES)	(202) (203)		
		NIDAS KEDUNSSOKO VLO KUNCIR UTVERSION CHANNEL TOTAL	WORK ITEKZALVER	SREDGING (1000 CM) EXCAVATION (1000 CM) ERSHIWMENT (1000 CM)	METRASOMRY DRYMASOMRY	RDAD I	III (1 R 7 DAGINAGE CULVERI 1 (NGS) 11 (NGS)	DIVERSION WEIR (NOS) IRRIGATION HEAD WORKS (NOS)	SIDE OVERFLOW DIKE	ARDEDUCT SYPHONE SPRYEL METALLING RELOCATION OF ROAD	SUB-TGTAL	LAND ABUTSITION RESIDENTIAL (1000 SK) GTHENS (1000 SK) SULLDING CONFENSATION RUSS)	<u>=</u>	รธร-าชาล	1 G T A L 2475 5402 14527

Table 4.2.1.

15 7 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	LIMITED CARMYTRA CAPACITY AT M. SKNO BRIDGES . 0 DARKCITY OF M. SKNO ACTRADING CASH , V . CAPACITY OF ULO BETARDING BASIK	LSONO META LO RETARDI	RADING CAE INS BASTR		# # ## # ## ##	1 4 = 1.6 X MI 1 4 = 2.0 X MI	אנורוסא כא ו אנורוסא כא					CAPACIT	CAPACITY OF K. SOMO RETARDING BASIN CAPACITY OF ULO RETARDING BASIN	IO RETARDI ETARDIKG	NG 3451N BASIK	•	, V = 1.6 , V = 4.0	, V = 1.6 X MILLION CK , V = 4.0 X MILLION CK	85			
		1						(MILLION, RP)	1	8	(MILLION, RP)											(MILLION, RP)
0211 2200	#1DAS	7	KEDURBSOKO		079	1	KUNCIR	13/10	DIVERSION CHANNEL	1	TOTAL	•	KIDAS	KEDUNGSOND	3507.0	7	aro	¥(F	KUNCIR	KIDAS KEDUNGSOKO ULO KUNCIR DIVERSION CHRINEL TOTA.	WEL 1	101A:
	QUANTITY C	COST BUEN	BURNTITY CO	CDST CUA	CLIANTITY C	KNO 1500	OUSN11TY C	COST BUANTITY	TY COST	BURNTITY	TY C051	PURNTITY	וא כמפו	QUARTITY	Y COST	DUARTITY	1503 4	BENTITY	1900	PURHTITY COST	ST QUARTITY	1583
DREUSING (1000 CM) EXCRANTION (1000 CM) EXCRANXING (1000 CM)	2104 2104 925	6312 4527 2775	530 530 538	1855 1168 777	955 404	2206 889	238 394	357				17.	1790 5971 1990 4370 925 2775	1 530 70 530 5 530	0 .1855 0 1166 8 770	5 6 757 0 404	7 2206	223	524			
RETEINERI WETHREGORRY (SM) DRYMASONRY (SM)	46115	1845	4550 -	15.35	27710	573	26952 26952	674 537				46136 46115	16 1845 15 1015	5 4559	137	7 27716 8 27710	572. 0 572. 0	26953	674			
ROAD I (ROS) (SH) (SH)			630	828	1250	1676	173							~0	1 30 B38	-		ro va			÷	
(SR) (11) (NOS) (SR)	1190	1428	§ .	200	588 277	706	882 778	1058				= E	1190 1428 9 2380 2380	F-9	300	2 2	99 706 9 74 1274		778 3 778			
(AB) (AB) (AB) (AB) (AB) (AB) (AB) (AB)			- E	1085	- 	1050									, 70 1085	84.	4 1656					
ANTINGS COLVERY) II (HOS) III (HOS)	ap with high	180 260 380	212	130 285	ъ'n	270 195	ю «	335 55 55	-				4 180 4 260 5 475		2 130 5 265	. 00	5 270 3 195	W	15 g ti		•	
DIVERSION MEIR (MOS) (N) IRRIGATION HEAD WORKS (NDS)		٠	- 1		- <u> </u>	450	- 52 77	450						•								
SIDE OVERFLOW DIKE (NDS) (NDS) (NDS)	2815	1971	3 1 66	250 250 250	9	0005	:	1400				3030	3 2163	200 F	250	3	265		en en en			
												*:										
SYPHONE (N) CRAVEL METALLING (H)					~ 22	102	70	102									1 70 105	2 07	\$61 (
RELUCATION OF RUAD (K)		23175		10312		13063		01.29					22871	1.	10312	2	13068		6710		1	
LAMD AGUISITION PESIDERTIAL (1000 SH) OTHERS (1200 SH) BUILDING CORPERSATION	13 13	13	713	602	878	23	612	612				2512	22 2153	718	B122	60. EB	878	8 612	612	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		
11 (NUS) 11 (NUS) 111 (NUS)	242	64 54 1.3	ř.	29	415	281	400	280				2	245 343		45	63 415	5 581	1 400	095			•
SUB-TOTAL	: 1 1 1 1 1 1	55.55		781		1457		11.72	1	! ! ! ! !			5476	32	18.	-	1459	6	1172			
**************************************		23871		11093	•	14527		7887	; ; ;		42177	1 2	28367	1	11007		1.531	F-	7887			64014

BREAKDOWN OF CONSTRUCTION COST (19/26)

(SCUERE 111 , CASE 2 1

LINITED CARRYING CAPACITY AT K.SQTO BRIDGES , Q = 1.5 X MILLIGN CM CAPACITY OF K.SQTO RETARDING BASIN , V = 1.6 X MILLIGN CM CAPACITY OF ULO RETARDING BASIN , V = 6.0 I MILLION CM

LIMITED CARRYING CAPACITY AT K.SDIG BRIDGES , 9 = 145 CM/SEC CAPACITY OF K.SDKO RETAKDING BASIN , V = 4.9 % MILLION CM CAFACITY OF ULD RETAKDING BASIN , V = 0.0 % MILLION CM

(SCHENE 111 , CASE 3)

Table 4.2.1.

MURE TIER/RIVER	VITILA			2	2		KUNCIE		DIVERSION CHANNEL		TOTAL	34	KIDAS	KEDUNESOKO	0%	97.0		XUXCIR		STATESTON CHANGE	東部	4 1 5 1
	DUANTITY							:	,	Ì	•			*****	1		-					
		COST	CLENTITY	COST	QUARTÍTY (0021 00	OURNIITY (COST AUGN	TOO TILLY DOST	T GUANTITY	177 CDST	SUBNITTY COST	1500	GUSNTITY	COST	DUANTITY	CC37	TILKECO	1322 18	ATTEMBR.	cost aue:	auentity cost
***************************************					; ; ; ; ;										; ; ;			1				
BREDGING (1000 DM)	1340		230	1855								2194			155							-
EXCAVATION (1000 CH)	86	4049	S 5	1165	33	1303	22	:5 <u>5</u>				23:52	4354 1	¥.	33	E E	25	8	£ 5	S.	951 5	
EGREGATEM (1000 LF) REVETSENY	Ç.		9	2		G S	467	ò				36				97.	-	ar (1)	ŝ	2	9	
KETHASQNRY (SM)	43116	1345	4550	127	27710	245	2632	674				46116	345	7253	54	15135	378	23622	674	12236	370	
52,1387	44115	1015	4559	Ęū.	27,710	534	2992	5- 5- 5-				46115			152	15145	202	26752	£22	12236	260	
ENGINE T THEFT			-		-															-		
			4 629	52	0521	1676														· 85	4:3	
11 (103)			•	}	¢ 4		ю					•						13				
	1130	1428	٠.		228	706	188	1058				1196	1428					832	1058			
III (MDS)	D-				6		iv.	٠				0-		;	;	in j	į	63 j	;	4	į	
	2389	2383	60°	300	1274	1274	738	178				2681	7881		200	930	620	748	138	029 9	630 630	
RAIL SAY (NDS)			4	900	č	4341														- 22	67.7	
A M S CHIUCOT			2	1080	2	3551														3	2	
1 (808)	=1	30			٠.	57.6	₽-S	95				**	180			7	9.0	13	53	£ 4	8,	
	*	750	2	130	P9	195	,	3				4	260	.,	82				33	-	39	
111 (805)		473	K	382				35				C4	282		475			-4	95			
DIVERSION WEIR (NOS)					<u>.</u>	į	<u>u</u>	2								⊶, ñ	450	<u>v</u>	858			
T U) . TODISETTON UCAN MODISE			-		2 -	00 4	2.5	3						-		· -	90-	3 5	2			
(N)	3 -		* 13	3300	***	3000	13	1400				٠		. 13	3300	<u> ~</u>	1400	<u> </u>	1400			
SIDE OVERFLOW DIKE (NOS)			;	į								2		1 000	•							
The crementage and	(M) 5185	7230	250	3								7717			2		•					
	(X)																			· \$	120	
ABUEDUCT 1ND	(SQL)																					
																				33	47	
SYPHONE (NOS)	(50)				• F	,	F	V										- 5	6			
M - SMILLSTAM HADAS					₹ .	2	2	2										2	3			
	· -																					1
SUB-TOTAL	1 · · · · · · · · · · · · · · · · · · ·	22158		10312		13068		9129					23283		353		4330		6719		4029	
LAND ABUISTITION		 			; ; ; ; ; ; ;	• • • • •																
OTHERS (1000 SM)	 	212	718	718	67	673	13	812				5344	5344	716	E	181	182	612	\$12	38	156	
BUILDING CORPENSATION			-																			
_	245	125	₽.	13	S.	383	400	260				270	378	55	67	8	126	4	250	27	٤٩	
111 (505)										1				1								
S08: 101AL		5496		, a		1459		1172			1		\$722		78:		203		E		214	
		27852		26011		14527		7887			15117		20195		5720		32.77		400			77033

BREAKDOWN OF CONSTRUCTION COST (20/26)

LIMITED CAMPYING CAFACITY AT X.SCKO BRIDGES , 0 = 145 CH/SEC CAPACITY OF X.SCKO RETARDING BASIM , γ = 3.0 X HILLIGM CM CAPACITY OF ULC RETARDING BASIM , γ = 2.0 X HILLIGM CM

LIMITED CARRYING DARACHIY AT K.SDKO BRIDBES, P = 145 CHYSEC CARACHIY OF K.SDKO RETARDING REGIN , V = 4.0 I MILLIGN CH CARCHITY OF ULO RETARDING BASIN , V = 4.0 I MILLIGN CH

(\$CHENE 1:1 , CASE 3)

Column C	WORK ITEM/RIVER	RIDAS				~ '	- 1	Ş :	- 1	- i		i.	;	WIDAS	KEN.	KEDUMBSOKO	17	ura	\$	KUKCIR	DIVERSION CHARMEL		45 : 45 : 46 : 47 : 48 : 48 : 48 : 48 : 48 : 48 : 48 : 48
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Mail Sept	T (1000 CX)	5.5	17.77	80	775	1	34.	36	. 58	Q T	7.0											5	
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MAC	(R)					ŧ;	420	ဌ	450								_						
Marie Mari	M PEAD MORKS (MDS)							7															
(H) 2573 1677 1600 700		•			200		1450	<u>*</u>	1400					,									
MRS		2307		1040	707								·				٤						
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111.07 1AL (1900 SN) 1AL (1900 SN)	SUB-TOTAL		22270		84.20		4246		6710.		4029				154		92	7.	.e	67.1		4354	
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(NGS)	·		i.	=	183		2	96	8-7		ç	
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IN HEAD WORKS (NGS) 1 1 2 2 2 2 14 1	450 15	450					~ s	450	_	450		
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LAND ACUTGITTON FESIDENTIAL (1000 SH) STARED (1020 SH) 5344 5344 718 719 240 24 SULLSING COMPENSATION	270	981 Z19	136	4455	7.	71.8	181	13	617	612 186	99	
; (NCS) II (NUS) 270 3,76 45 63 90 III (NUS)	126 400	560 20	28	270 578	& 23	63	8	, 921	400	280 20	22	
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(SCHENE 111 , CASE 3)

Table 4.2.1.

Name		LIMITED DARRYING CAPACITY AT X. SOKO BRIDGES , B = CAPACITY OF K. SOKO RETARDING BASIN , V = CAPACITY OF ULD RETARDING BASIN , V = V	RRYING CI F K.SOKO F ULD RE	APACITY A RETARDINI TARDING BA	IT K.SOKO G BASIN HSIN	BRIDGES	3.2	5 불급	CH/SEC 10% CM		÷		LIFITED CRRPVING CRPACITY AT K.SOKO BRIDGES CAPACITY OF K.SOKO RETARDING BASIN CAPACITY OF ULD RETARDING BASIN	RRYING CAF F K.SOXO R F ULO RETA	ACLTY AT) ETARDING B RDING BASI	SOKO BRI ASIN K		= 195 CM/SEC = 3.2 X MILLION CM = 4.0 X MILLION CM	כאלפני זיניזטא כה זיניזטא כא				
String S							į					(MTLLION, RP)											(MILLION, RP)
	001100 W011	WID.	AS	KEDUNG	SOKO	M.	0.		WC18	DIVERSION	CHANNEL	T 0 1 0 T	-	57 E	KEDUNGSOR	0	0,0		KONCIS	10 01	PERSION CH	AKNEL	10101
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1 0.05 1.0 0.05 1.0	CREDBING (1000 CM) EXCAVATION (1000 CM) EMSHWYHENT (1000 CM)	2003 2003 225	6027 4420 2775	-									1862 1862 725	5586 4096 2775	465 464 308	162B 1021 770	326 116	750	233	524 857	300 40	1500 120	
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CHANGES 4 159 2 170 2 90 3 155 2 90 4 189 2 170 2 90 1 1 170	RAZLWAY (NOS)													į	- 1 3	207	i	į	<u>!</u>		k3	12 12 14	÷.
M M M M M M M M M M	DRAINAGE CULVERT I (405) 11 (405) III (405)	धार्म ग	180 380					.,	135				4 A NJ	180 760 475	F-4 +4+	130	₽.	30	P3 *** **	135 65 95	64 ==1	55	
NELOR DIRE (NGS)	DIVERSION MEIR (NOS) (N) (RELIGIOUN HEAD NORKS (NOS)			₩ £		٠		٠.	-						¤	3300	교법교통	459	~ H ~ X	450			
CUTURE MASS 120	_		1817										32850	1995	1 90	064							
(M)	UCTURE									- 6							:			•	&	129	
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(405) 1 (405) 270 378 45 63 90 124 400 560 20 28 270 378 45 63 90 124 1 (405) 5772 781 364 1172 214 5772 78: 366 28550 9402 4612 7882 4273 54719 28053 7462 4612	LAHD AGUISITION RESIDENTIAL (1000 SH) OTHERS (1000 SH) BUILDING COMPENSATION	5344	100 100 100 100 100 100 100 100 100 100	į						•	! !		45	5344	81.	718	240	240	612	\$12	781	, , , , , , , , , , , , , , , , , , ,	
5722 781 386 1172 214 5722 781 346 28550 9402 4612 7882 4273 54719 28053 1462 4612		27.0	378				-						270	378	រីប៊ី	23	940	128	400	250		£1	٠
28550 9402 4612 7882 4273 54719 28055 7402 4612	SUB-TOTAL		5722		78	_	36	٠,٥	1172		214	5 5 7 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		5722		78:		365		11.72		Ħ	
	1014.		28550		940.	2	191		788,		4273	5471		28053	21 21 21 21 21 21 21 22 24 26	1401		4612	10 11 11 11 11 11	7887	10 14 14 14 14 14 15 16 17 18 18 18 18 18 18 18 18 18 18 18 18 18	4273	54227

BREAKDOWN OF CONSTRUCTION COST (23/26)

CORDRE 111 , URSE 3 >

H.SAXO RRIDGES, G = 300 CH/SEC BASIN , V = 1.6 X MILLION CH NSIN , V = 0.0 X MILLION CH	es williss	ULD KUNDIA OTYERSICA CHANNEL	נספר במתאונוץ כמפן משאונוץ כמפי משפאווזץ במפן פעפאוויץ כמפן	2022 1272 311 715 238 C54 599 1309	170 574 554 867 40 15105 578 2655 674 12339	152 15105 363 26952 537 12330 260	5.28	3 887 1058	300 £20 620 738 798 630 £50	1085 55 473	2 52 2 53 Z		15 450 15 450	2200 14 1400 14 1400	350		1 60 47	70 165	10723 4330 6719 4359	718 183 183 612 612 186 186	63 90 126 409 560 20 28	781 309 1172 214	
LINIED CARRYING CAPACLIY AT I., SOXO RAIDGES CAPACITY OF Y., SOXO RETARDING RASIN CAPACITY OF ULO RETARDING BASIN		NIDAS KEDUNGSOKO	DUANTITY COST QUENTITY	2282 6846 578 2281 5018 578	2401	46115 1015 7252	029	1190 1428	9 1 2681 1681 300	70	QB	4 269 2 3 285 3		Pr Pr	2600 :820 500				2417	5344 5344 718	270 378 45	27.15	1
		DIVERSIGN CHANNEL TOTAL	QUANTITY COST QUANTITY COST	1500	40	529 12330 240	315 419		4 798 630 630	35 438		65 1 65	450	01		40 120 1		105	4059	612 186 186	560 20 29	214	***************************************
. 4 = 195 CH/SEC , 7 = 3.2 x Hilligh CM , V = 6.0 x Hilligh EM		CUNCIS	C05T	.4 750 228 524	378 26953	303 26952		85	5 620 799		2 90 3		1 450 15 45	14 1400 14 1400				70	4246 6710	240 612	90 126 400 56	366 1172	
LIMITED CARRYING CAPACITY AT K.50K10 BRIDGES , θ = CAPACITY OF K.50K0 RETARDING BASIN , γ = CAPACITY OF ULD RETARDING BASIN.		KEDUNGSOKO UI	PUSHITY COST EUGNITTY	465 1678	368 770 4560 137	5 4559 96 15105	1 405 162		300 300 65	1 45 207		2 130 4 380	•	33 3300	9 700 570			: 1	8421	1 718 718 240	45	187 5	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
LIMITED CARRYING (CAPACITY OF K.SONO CAPACITY OF U.O. RE		DAS	BUANTTY COST	DREDEING (1909 EM) 1680 5040. ETCHYNTION (1900 EM) 1679 3574	000 CM) 925 (SM) 46116		(KDS)	=======================================	(NDS) 9 (SN) 2681 2681	(H)	GRAIMAGE CULVERI	* 10	DIVERSION WEIR (NOS) (M) (PROSPARTION URAN EMBYE MANGE	SIDE OVERFLOW DIXE	(#) 29	DROP STRUCTURE (M) 4 AGUEDUCT (NOS)	(K)	(N) RELUCATION OF ROAD (N)	2144[LAND AGUISTTON RESIDENTAL 11000 SN) DTHERS 11000 SN) BUILDING COMPENSATION	(HOS) 270 378 (HOS) (HOS)		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,

LINITED CARRYING CAPACITY AT K.SDVD BRIDGES , Q = 300 CM/SEC CAPACITY DF K.SDVD RETARDING BASIN , V = 1.6 X MILLION CM CAPACITY OF U.C. RETARDING BASIN , V = 2.0 X MILLION CM

LINITED CARAYING CRADITY AT K.SOKO BRIDGES , B = 300 CK/SEC CRACITY OF K.SOKO RETARDING BASIN , V = 1.6 % AILLION CM CARCHITY OF ULO RETARDING BASIN , V = 4.0 % NILLION CA

(SCHENE 111 , CASE 2)

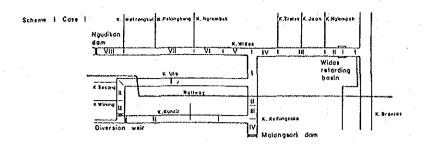
Table 4.2.1.

	212		KEDUNGSOKO	F3	NIDAS KEDUKOSOKO DLO		KUNCIA	c,	DIVERSION CHANNEL	HANNEL	KUNCIA DIVERSION CHANNEL TOTAL		WIDAS KEDURGOKO	32	KEDURGSOKO		976	14 14 14 15 16 16 16	ULO KUNTERFERENTE STATEMENTE STATEMENTE CHAMMEL	DIVERS	DIVERSION CHAMBL	ii ii	T 0 T A L
	BUAKTITY	COST BU	BUSHTITY	150	PUSNITTY	10 1500	TILL NOTE IN	1500	PUSHTITY		BURNTITY COST	T GUANTITY	7177 5057		1117 COST	ST QUANTITY	ITY COST	!	OURATITY COST	BURNTITY	TY COST	DUBNIITY	1500
DAEDBINS (1000 CM) EXCAVETION (1000 CM)	2123	5372	92.5	1855	328	715	278		8	1500			1980	5940	530	1855			1				
EMBANKNENT (1000 DM)	925	2775	8 2 2 2 2 2 3	770	315	255	334	585	2	120				2775			116	255	394 B	138	₽ ₽	120	
(KS) ASNOSTIUM	46116	1845	1560	137	15105	378	26923	674	12330	370			46116	1845	4560	137	15105	378 26953		EZ	12330	370	
	46115	2	4554	8	12102	S	26922	0- 1-7 1-1	12330	590		*			555							59:	
ROAD I (NDS)			- U.Y	67.6					1 212	-					(E)	878					1 1	6.7	
11 (308)			3	8			m		;	3			-		3	3			M				
(88)	1190	1428	•				. 862	1058	*				1190	1428	-		v		882 10	1058	•		
	2881	1681	- g	300	. 62g	950	798	BF./	P 20	539				2681	35.	200	63	620		798	. 029	929	
RATLWAY (NDS)									 ½	170					~	200						11	
DRAINAGE CULVERT									3	ę.					2	2						e e	
	₹.	180			2	8	m	135	CH	26			~ r	180			64	0.6	- -	32	. 7	. 06	
11 (NDS)	- →	380	C4 F3	282 283 283				ទ		3			er ba	422 472	ru w	285 285				ig g		5	
DIVERSION MEIR (NOS)						į	(į		! :			
(T) (RRIGATION HERD MORIS (AUS)			_		2	450	2 °	ş							-		<u>.</u> 	Ž,	13 t	450	-		
1			H	2300	* **	1400	' II	1100							. E	3300	14	1400		1400			
SIDE OVERFLOW DIKE (NOS)	, in		6	100									n		- 3	. 44							
DROP STRUCTURE (NCS)	1 207		į	350										777	5	Ş							
									9	120												120	
New North (NES)									- oş	47											09	47	
SYPHONE (MOS)							-		i	:													
GRAVEL METALLING (N) RELOCATION OF ROAD (N)				٠			2	105							•		•			105			
SUB-TOTAL		23622	,	10312	1	4245		\$175		4029	1	!		23130		10312		4246	-9	6710	*	4059	
LAND ADUISTION DESIDENTIAL (1909 CM)											! 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4]				·							
DINERS (1000 SM) BUILDING CORPERSATION	5344	5344	718	718	240	240	612	612	. 583	981			5344	5344	718	718	240	240	612	512	186	186	
I (205) II (205) III (455)	270	373	ð.	53	96	126	400	250	20	88			270	378	â	54	9,6	126	: 005	250	20	28	
SUB-T01AL		5722		787		35.6		1172		214		!	1	5722		167		366	1	1172	**************************************	214	
			-								;			20083		1007		4633		2000		**************************************	8/713

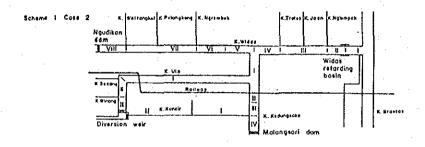
BREAKDOWN OF CONSTRUCTION COST (25/26)

CM/SEC	, V = 1.6 % MILLION CH	, V = 6.0 I MILLION CN	
300	.6 X MIL	IN X O.	
# C3	7 = 7	9 =	
LIKITED CARATING CAPACITY AT K.SOKO BRIDGES , 0 =			
AT K. SOK	NG BASEN	BASIN	
CAPACITY	C RETARDI	ETARDING	
CARRYING	CAPACITY OF K.SOKO RETARDING BASIN	CAFACITY OF ULO RETARDING BASIN	
LINITED	CAPACITY	CAFACITY	

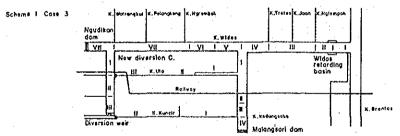
	NIDAS	뗮	KEDUMBSOKO	DKO	O.P.		<u> </u>	KUNCIR	DIVERSIDA CHANNEL			TOTAL
MURK TIEM/RIVEN	OUANTITY COST	1500	BUSNTITY	COST	9UANTITY	COST	SURNTITY	C03T	OUANTITY	TSCO	DUANTITY	720
DREBSING (1000 CM)	1862	5406		1855						٠		
EXCAPATION (1000 CM)	1802	3964	530	3116	326	720	238	524	ŝ	1500		
EMBANKKENT (1000 DM)	925	2775		770	116	255		867	Ģ	23		
	:			į						7		
SOURCESSON (SE)	91.04	4.00	200	3 6	50.51	2/2	2016	470	05551	25		
§		2		2		3		3		1		
8050 T (805)			•						-			
			630	838					315	119		
(808)	-						~		;			
	1.90	1428					882	1058				
111 (NOS)	6				'n	•	N.3					
	2681	2681	M	200	970	620	Σ.	798	63(630		
RAILHAY (NOS)			_									
()			2	1085					貿	438	_	
DRAIMAGE CULVERT												
(50H) I	••	8			~	90	r	135	7	ጽ		
	~ r ,	250	7	ន				9	_	3 9		
III (MOS)	'n	2/3		282				Ş				
DIVERSION WETR (NOS)					<u>u</u>	491		Š				
	(9)		-		ġ -	ů,		2				
	·		* E	3300	- 5	1400	7 🚆	1500				
STOR BUSERS ON DIKE	150		; -	•								
	Ř	2244	500	350								
DROP STRUCTURE (NO												
	(#)								40	130	_	
ARUEDUCT	<u> </u>											
	~ 50.5						٠		3	-		
	(ACC)						70	105				
A D BRITISTOR LEGISCO	: 3						•					
RELOCATION OF ROAD (17.)	· ~											
SUB-TOTAL		22273		10312		4246		6710		4059		
LAND AGUISTION	· · · · · · · · · · · · · ·		3 6 7 8 8 1 1 1	† •	; 1 1 1 1 1 1	; ; ; ;	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	! ! ! ! !	! ! ! ! !	1		[- -
OTHERS (1000 SH)	5344	5344	718	718	240	240	612	612	186	184		
H3dN00												
1 (NDS)	010	97.2	Ā	7.7	6	126	908	¥75	ć	ç		
;	23	i i		3		3		à		3		
SUB-TOTAL	1	5722	# C E E E E E E E E E E E E E E E E E E	781	; ; ; ; ;	366	£ £ £ 2 1 1 1 1 1	1172	·	214		



R	ETARDING (: .	bE:	SIGN O	tscau	UCE	(= ³ /s	ec }								
ulo.	WEDAS	KED. SOKO			MIDYS	RĮVE	R.				KEC	. \$0×0	BIAES		ULO) KIVE	R	KUN REV			CHYRRE DIAEK	
<u> </u>	1.1	1.1	ī	11	m	14	v	1V	VII	VIII	ī	11	lii	īv	1	ŧı	111	t	11	1	11	. 17
	9.2		270	613	405	573	346	544	559	433	448	453	420	460	219	156	94	101	-			



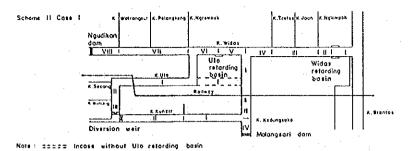
3.6	TARDING (DES	ICN C	15CKA	RCE (m³/*	e)								
ULO 2.3		KED.SOKO			A10Y	. ALVE	E A				KEO	.sox0	RIVE		UŁO	RIVZI	k	KUNC			DIVER UNNEL	
			1	11	111	14	¥	VΙ	411	VIII	1	11	311	Į¥	I	11	111	1	11	L	11	11
	9.3		270	450	609	576	566	544	559	433	446	455	465	460	223	216	188	94	. 0			



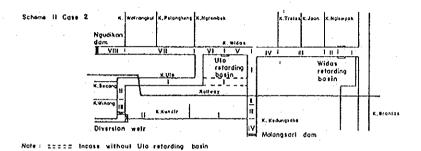
Note: ::::: Incase without allo retarding basin

)	TARDING 6								ÔΣ	51GH 0	15CH	IRGE (m ³ /s:	ić)							Ξ.	
uto 3.8		KED. SOKO			VIDAS	AIV	ER				KE	, soko	RIVE	·	ULO	RIVE	a.	KUN			DIVE	RS10N
			1	11	111	ΙV	٧	1V	VII	1117	I	11	111	1¥	1	11	111	ı	11	1	11	111
	9. 4		270	457	657	613	584	(640)	586	433	125	455	465	460	33	33		94	0	223		188

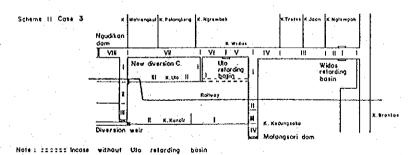
Fig. 4.2.1 DESIGN DISCHARGE DISTRIBUTIONS FOR SCHEME 1 (1/5)



R.E	TARDING C								DE	STON D	ISCH	IRCE {	n ³ /se	c)								
ELO A.3	VIDAS	RED.SOKO			WIDAS	RIVE	R				XE	, sox Q	RIVER	١.	VŁO	RIVE	ι	RIVE			HANNE	
				11	111	19	_v	νį	VII	VIII	I	II	111	Ι¥	1	11	111	ī	11	ī	11	111
0.0	9.2		270	549	606	573	541	344	359	433	448	463	470	460	219	156	94	101	94			
2.0	9.2		270	432	627	393	450	614	559	433	122	463	и	ir	**		n	h	н			
4.0	9.2		*1	451	604	569	360			41	**			н	n	**	1+		a			
5.0	8.4		**	4 37	562	311	285	41	*	**		**			н	**		**	14			

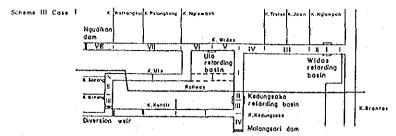


	TARDING (· 		DES	ICH D	ISCH	RCE (· 3/4	ec)								
ULO A.B		KED. SOKO			VIDAS	RIVE	R .				×ει	. soko	R1V8	.	u	.O R1V	ER .	KUN R19	CIR IER		dive;	
			ī	11	ш	14	٧	A I	Aft	. VIII	τ	11	111	14	1	11	111	1	. 11	I	11	11
0.0	9.3		270	430	609	576	566	344	559	433	466	455	465	460	223	216	188	94	0			
2.0	9.3		*	453	630	396	460	621	H	H	318	н	14	*1	Ħ	ю	**	se.				
6.0	9.3			453	613	376	375	"		H	**	**	**	-		**	.,	"				
6.0	8.7			444	560	528	310				**	*	t•		21	**	n	**	**			



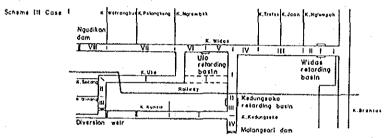
),	TARDING CAP 8 106 x)				·				DE	SICH D	SEKA	RCE	(= ³ /	rec)								
ULO	ALDY2 K	ED. SOKO			VIDAS	RIVE	*				KE	o.sox	O RIVI	ER	VŁ.O	RIVER		KON			DIVER	
<u> </u>	. N.B	k.I	ı	11	111	ĮV	V	٧I	VII	VIII	1	11	111	ĮV	ı	11	111	ī	II	ī	- 1 [111
0.0	9.4		270	457	657	622	584	544 (640)	586	433	325	455	465	460	33	33	o d	94	0	223	216	188
2.0	9.4		H.	458	656	622	455	591 (640	" .		318	** .	"	** .			"	"	к	, 10	•	
4.0	9.3			456	615	563	370	**	•			ч.	*	••	. 4	"	**		"		**	4.
6,0	8.6		14	446	561	5 30	370		"		ŧ	٧.	" .		H	н .	н .		"	"		"

Fig. 4.2.1 DESIGN DISCHARGE DISTRIBUTIONS FOR SCHEME II (2/5)



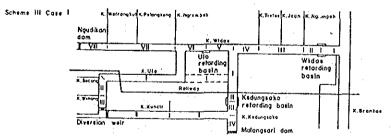
Note: 22222 Incose without Uto retarding basin

,	ETARDING								DE	SICN I	H SCHA	RCS	(*3/	esc)								· .
tlo L. J	PAGIV	KED.SOKO			u tos	S RIV	/EA				XEL	,soko	r (V)	'A	ψı	O RIVE	R .	RUN	CLR ER		CHANN	
			1.	Ħ	111	IV	¥	٧ŧ	¥11	AIII	-	11	Ħ	11	1	11	111	ī	11	ī	11	111
0.0	6.4	4.7	270	410	333	495	344	(606)	339	433	233	145	470	460	219	156	94	101	94			
2.0	6.4	**		409	549	510	450	614	×	•	138	н				4	×	н	*			
4.0	6.4		**	404	513	480	160	•	16	16	*1	**	н	*1	4	н	l4	H	te			
5.0	5.7	ю	ш	189	445	413	285	*	41	41		**		Ħ	•	*	10	**	**			



Note: 2:227 Incose without Uto relarding bosin

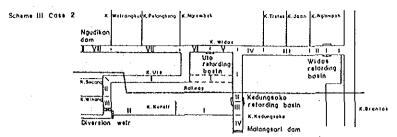
	RETARDING 106 z)								bi	ESICN) I \$C \	NCE	(a ³ /	sec]								
ULO 4.1	VIDAS R.B	KED. SOKO	•		VIO	LS RI	ŽR				¥ E E). SOK	D RIVE	R	Ųl	.0 kiv	ER	KU:	icia /er		DIVE CRANS	
			ī	it	111	IA	٧	14	VII	ALII	1	11	111	IV	į	11	111	I	11		īī	111
0.0	7.4	4.2	270	421	555	514	346	544 (606)	539	(3)	261	195	470	460	219	136	94	101	91			
2.0	7.4	••	**	-21	372	535	450	616	••	19	167		**	111	71	51	n	**	**			
4.0	7.3	**	Y	420	5 39	503	350	ıt	**	**	*1	**	-	Þŧ		**	н	*	**			
6.0	6.3			403	484	664	285	· r	**	٠. ٠			**	••	н	*	24	11	н			



Note: IIIII Incose without Uto retording basin

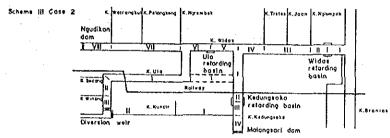
	RETARDING (x 10 ⁶									ESICH	DISCH	ARCE	(p3,	lec ;) 							
ULO 2.a	¥IDA\$	KED. SCKO	•		A1D	G RE	VER				KE	, soke	KIVI	A.	01	O RIV	ER	KU:	ICIR /ER		7 DIVE	ERS JON
				11	111	14	V	AL	VII	VIII	ī	11	111	įv		11	Iti	1	11:	- ī	ii	111
0.0	E. 6	1.9	270	440	589	554	366	544	557	433	39.8	. 100	470	460	249	156	94	101	94			
2.0	8,9	••		443	609	374	430	614		"	234		"		**	"	"	.,	**			
4.0	7.4		и	426	563	529	360	**	20	**			PF		,	17	11	11	и			
5.0	7.5			425	509	459	285	**	74	0	**	41		10	.,	٠,			0 .			

Fig. 4.2.1 DESIGN DISCHARGE DISTRIBUTIONS FOR SCHEME III (3/5)



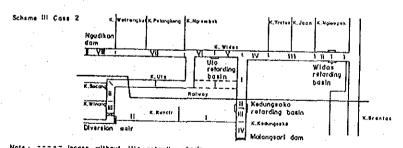
Note: 22222 Incase without Uto retarding bosin

	RETARDING								pre	IGN D	ESCUA	KGE (· · · · · ·	ec)		····						
ĽLO	VIDAS	KED. SCKO			Ý1DAS	KIVER					KE	o-soke) R1YE	ж .	ULC	RIVE	à	KUN Riv			DIVER	
2,5	R.3	3.0	1	11	111	17	٧	¥l	AlI	VIII	. 1	11	111	17	1	11	111	I	11	1	11	111
ú.0	7.2	4.8	270	419	543	506	564	544 (606)	559	433	256	143	465	460	323	516	168	94	0			
2.0	2.2		w	423	563	371	460	621	*	tr.	143	**	. *	**	**	**		-4	*			
4.0	1.2	*		423	538	501	375	•	*	**	"	**	*1	н	*	**	**	*	**			
6.0	6.7	• .	*	412	473	441	310	•	"	10	14		**	"	*	н		*	**			



Note: 11711 Incase without Uso retarding basin

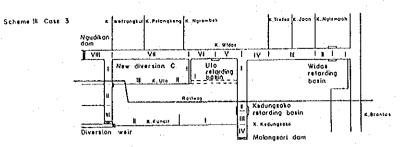
	RETARDING 1 001 ±)								DE!	IEN DI	SCHAR	CE 1	13/1	ŧc)								
ULO R.B	VIDAS 1.1		2AO1V	RIVE	ik.				XžC	.soxo	21YE	R	ULO	RIVE	ĸ	RUN R1V			DIVE CHANN			
			1	11	Hi	IV	-	71	VII	VIII	ı	11	111	ĨΑ	1	11	111	Ĭ	11	I	īl	111
0.0	8.0	3.2	270	431	363	529	566	344 (606)	559	633	293	195	465	460	223	216	188	94	c			
2.0	8.0	**	*	435	586	546	460	621	H		179	М.	**	70	16	ы	-	**	-			
6.0	8.0	м.	#	435	361	323	375		-		н		*	**	4	н	**	**	*			
6.0	7.4		**	624	504	472	310	14	н	*	*	17			**	н	. 41	*				



Note: 22222 Incose without Ulo relarding basin

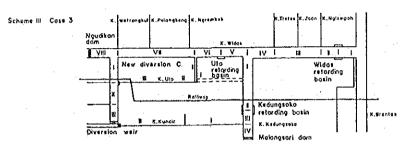
	705 x 106								DI:	SIGN D	SCILL	GE ((= 3/.	ec)								
01.0	VIDAS R.B	KED.SOKO			911	DAS R	IVER				KE).50KC	RIV	ER	٥Lc	RIVE	R	KUN			D1VE CHANN	XSION EL
			1	11	III	Ι¥	¥	٧ž	VII	VIII	1	11	III	IV	I.	11	111	1	11	1	ΙΊ	111
0.0	9.0	1.6	270	446	598	563	544	544 (696)	359	433	J90	300	465	460	223	216	188	94	0			
2.0	9.0	••		450	619	563	460	62 L	*	**	239		.,	75	м			м				
4.0	9.0	. •	H	450	599	561	375		12	**	н		۱r		.,	**	4+					
4,0	A, 6	lr .		660	346	514	310	**		21	"	14	.,	.,	**		,,					

Fig. 4.2.1 DESIGN DISCHARGE DISTRIBUTIONS FOR SCHEME III (4/5)



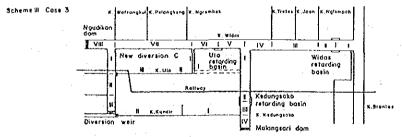
Note: ::::: Incose without Ula relarding basin

RE	TARDING C	APACITY							DES	ICH DI	EHARG	ε (* 1/1)								
rto	(x 106 VIDAS		_		KIDYZ	#1VE	 R				XED	.50XC	RIVE	i A	ULO	RIVE		KUNC 1 I EVER			DIVER ANNEC	
	R			-11	111	- _{IV}	-	VI	110	VIII	1	ii	111	14	ī	11	111	1	11	1	21	12
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Note: ::::: Incase without Ulo retording basin

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Note: ::::: Incose without Ulo retarding basin

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Fig. 4.2.1 DESIGN DISCHARGE DISTRIBUTIONS FOR SCHEME III (5/5)

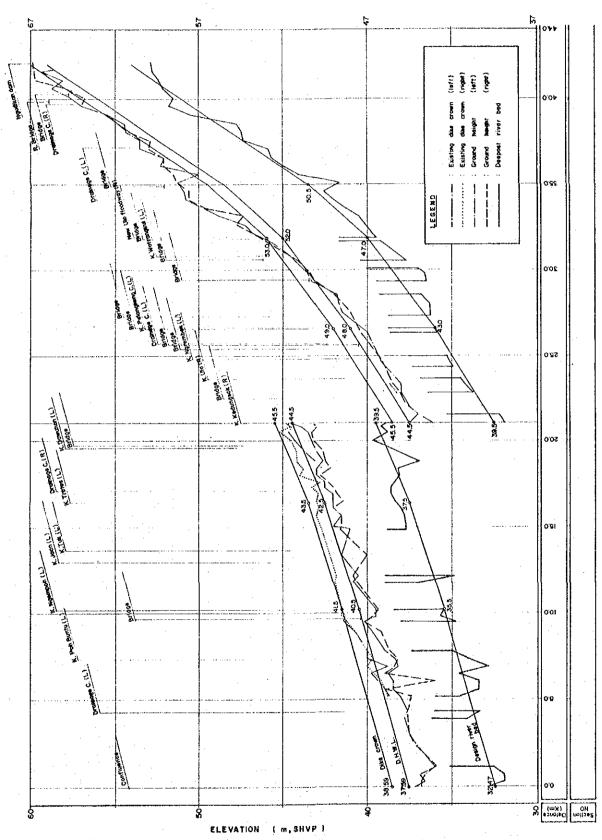
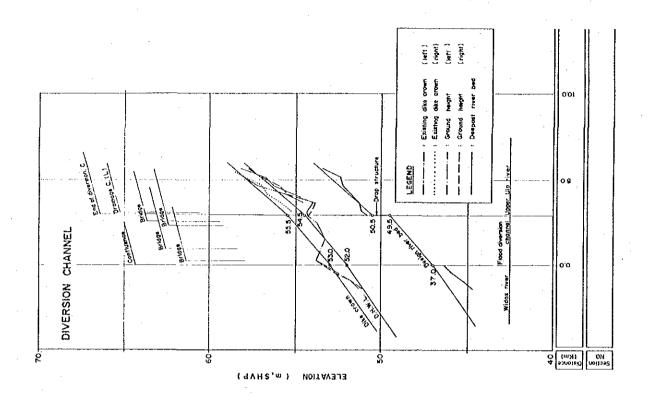


Fig. 4.2.2 DESIGN PROFILE OF THE WIDAS RIVER ([/3)



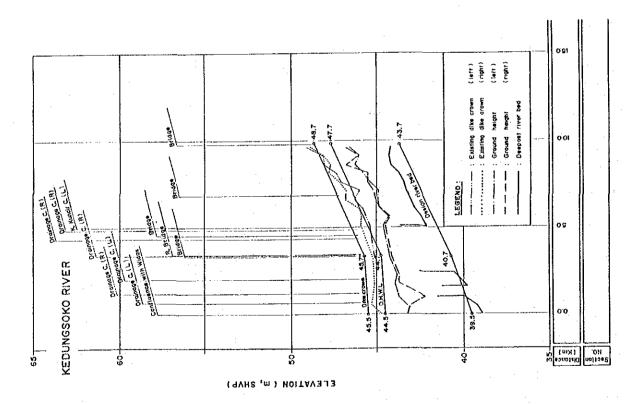
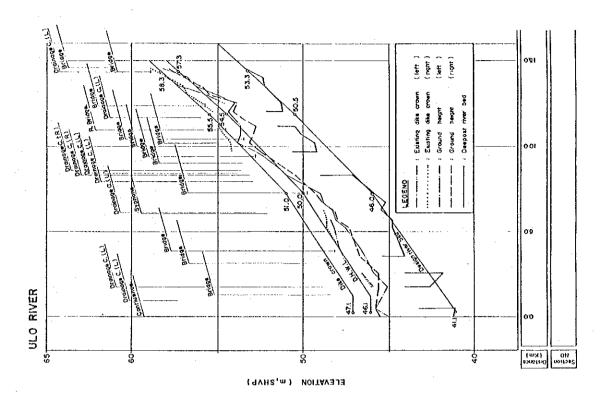


Fig. 4.2.2 DESIGN PROFILE OF THE KEDUNGSOKO AND NEW DIVERSION CHANNEL (2/3)



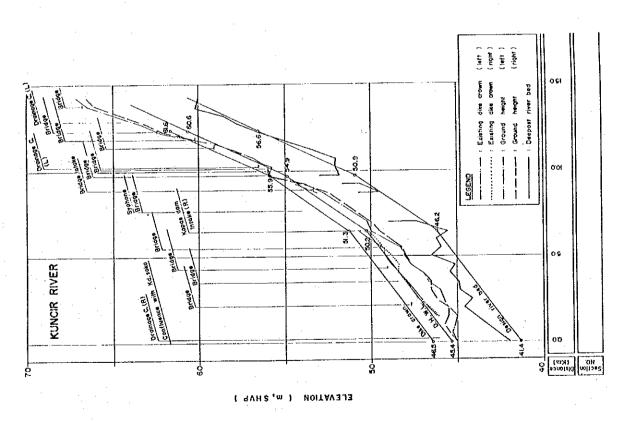


Fig. 4.2.2 DESIGN PROFILE OF THE KUNCIR AND ULO RIVERS (3/3)

- 4.3 Hydraulic study on retarding basin
- 4.3.1 Side overflow dike
- (1) General

Side overflow dike is to be constructed on the alignment of river dike as a lower part of river dike to reduce flood peaks immediately downstream in the river. The degree of flood peak reduction is determined by the location, the length, and the crest elevation of the side overflow dike. These dimensions are studied here on the Widas, the Ulo and the Kedungsoko retarding basins to satisfy the design flood discharge distribution in the Widas river basin river system for the 25-yr probable flood.

(2) Fundamental equations

Fundamental equations used for flood routing at a retarding basin with side overflow dike are as follows:

In a river :

(a) Continuity equation

$$\frac{dQ}{dx} = -q$$

Equation of motion of non-uniform flow

$$\frac{dH}{dx} = \frac{1 - \frac{Q^2}{c^2 R A^2} + \frac{\cancel{\alpha} \cdot Q^2 \cdot \cancel{\partial} A}{g \cdot A^3 \cdot \cancel{\partial} x} + \frac{\cancel{\alpha} \cdot q \cdot Q}{g \cdot A^2}}{1 - \frac{\cancel{\alpha} \cdot Q^2}{g \cdot A^3} \frac{\cancel{\partial} A}{\cancel{\partial} H}}$$

In a retarding basin :

(a) Continuity equation

$$\frac{dV}{dt} = q$$

At a side overflow dike :

(a) Discharge equation

q = K.
$$\sqrt{2g}$$
 h^{3/2} (perfect overflow)
= K'.h₂ $\sqrt{2g}$ (h₁ - h₂) (submerged overflow)

Here, Q: discharge in a river (m^3/s)

: distance along the river (m)

q : overflow discharge (m³/s)

H : water depth (m)

: slope of the river bed : Chezy's coefficient

hydraulic mean radius

A : cross sectional area (m2)

g: gravity acceleration (m/sec2)

V: storage volume in the retarding basin (m^3)

t : time

K : coefficient of perfect overflow
K' : coefficient of submerged overflow

h : water depth over the crest of side overflow dike
 h 1 , h 2 : water depths over the crest of side overflow dike
 in the river and the retarding basin

(3) Routing method

Flood routing is conducted to get the flood discharge hydrograph in the river immediately downstream of the side overflow dike and the variation of water level in the retarding basin due to the overflow discharge over the side overflow dike, to a given probable flood discharge hydrograph in the river immediately upstream of the side overflow dike.

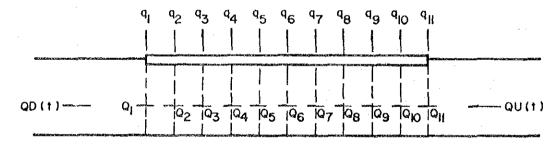
The procedure to calculate the streamflow downstream QD (t) from the streamflow upstream QU (t) of the side overflow dike at a time point t is as follows.

- (a) The reach of the side overflow dike is divided into ten reaches along the river course, and accordingly eleven cross sections are considered in the reach of the side overflow dike. Number is given to the cross sections from 1 to 11, from the downstream to the upstream.
- (b) The value of \mathbf{Q}_1 as the discharge at the cross section 1 most downstream is assumed.
- (c) The water depth ${\rm H_1}$ at the cross section 1 is calculated with ${\rm Q_1}$ through the stage discharge relation at the cross section 1.
- (d) Overflow discharge q_1 at the cross section 1 is calculated with H_1 and the water level in the retarding basin H_B through the overflow discharge equation.
- (e) The water depth ${\rm H_2}$ at the cross section 2 is calculated with ${\rm Q_1}$, ${\rm q_1}$ and ${\rm H_1}$ through the equation of motion of non-uniform flow.
- (f) Overflow discharge ${\bf q}_2$ at the cross section 2 is calculated with ${\bf H}_2$ and ${\bf H}_B$ through the overflow discharge equation.
- (g) The discharge Q_1 at the cross section 2 is calculated with Q_1 , q_1 and q_2 through the equation : $Q_2 = Q_1 + (q_1 + q_2)/2 \times \Delta x$, where Δx is the distance between the cross section 1 and 2.
- (h) The water depth ${\rm H_3}$ at the cross section 3 is calculated with ${\rm Q_2}$, ${\rm q_2}$ and ${\rm H_2}$ through the equation of motion of non-uniform flow.

- (1) The above same procedure is repeated up to the cross section 11, the cross section most upstream.
- (j) The calculated discharge Q₁₁ at the cross section most upstream with the above procedure is checked if Q₁₁ is equal to the given hydrograph discharge QU (t).
- (k) When the discharge Q_{11} is not equal to QU (t), a new value Q_1 is assumed again and the procedure from (c) to (j) is conducted again.
- (1) When the calculated discharge Q_{11} is equal to QU (t), then Q_1 is the discharge downstream of the side overflow dike,QD (t).

After getting the value QD (t), the streamflow downstream of the side overflow dike, the water level in the retarding basin is calculated through the following procedure.

- (a) The additional volume of overflow discharge over the side overflow dike is calculated.
- (b) The accumulated volume of stored flood water in the retarding basin is calculated.
- (c) The water level in the retarding basin is calculated through the relation between the elevation and the volume capacity of the retarding basin.



(4) Widas retarding basin

The needed function of the Widas retarding basin is determined through the study on the optimum flood control plan of the Widas river systems. The Widas retarding basin should reduce the flood peak of about 410 m 3 /s of the Widas river for 25-year probable flood to less than 240 m 3 /s. This comes from the limit of 270 m 3 /s allowed to inflow to K. Brantas. The remaining 30 m 3 /s is the outflow from Al canal.

At the same time, the maximum storage volume of the Widas retarding basin is determined around 13.6 x 10^6 m³ for 25-year probable flood through the study on the optimum flood control plan.

The dimensions of side overflow dike of the Widas retarding basin are determined on the basis of the above criteria as follows.

(a) Storage capacity and area

Storage capacity and area curves used for the flood routing of the Widas recarding basin are shown in Table 4.3.1 and Fig. 4.3.1. The curves are obtained from the topographic map of the scale 1/10,000.

In measuring the area, the design plan of the retarding basin shown in Fig. 4.4.4 is considered.

(b) Stage discharge relation

Stage discharge relation at the downstream end of the side overflow dike is calculated by the unifrom flow formula.

The longitudinal profile and the river cross section used for the calculation is shown in Figs. 4.3.2 and 4.3.3.

The calculated stage discharge relation is shown in Table 4.3.2 and Fig. 4.3.4.

(c) River cross section

River cross section in the reach of the side overflow dike is assumed to be the same as that in the reach downstream of the side overflow dike except the side overflow dike.

(d) Location

The location of the side overflow dike of the Widas retarding basin is determined in view of the necessary storage capacity of the retarding basin and the design alignment of the river dike. When the location of the side overflow dike is too downstream near to the confluence with K. Brantas, the design high water level in the retarding basin inevitably becomes lower ang the storage capacity of the retarding basin could not be enough for the necessary flood peak reduction of the Widas river.

The location is determined at the same time selecting the reach where the alignment of the river dike is straight.

Thus the downstream end of the side overflow dike is determined to be 4,900 m from the confluence with K. Brantas.

(e) Slope of river bed

The slope of river bed in the reach of the side overflow dike is planned to be the same with that in the downstream reach. The slope of design river bed downstream of the side overflow dike is 1/3,400.

(f) Dead volume of retarding basin

The dead volume of the Widas retarding basin is assumed to be the storage volume of the retarding basin when the water level in the retarding basin is as high as the design high water level of K. Brantas 37.59 m, from the conservative viewpoint.

(g) Length and crest elevation

The longer the side overflow dike is, the less the discharge in the river downstream of the side overflow dike becomes, and the more the storage volume in the retarding basin becomes. And this relation is the function of the crest elevation of the side overflow dike. With certain length of the side overflow dike, the heigher the crest is, the more the discharge downstream in the river becomes and the less the storage volume of the retarding basin becomes.

These relations are shown in Fig. 4.3.5.

In consideration of these relations shown in Fig. 4.3.5 and that the maximum overflow depth over the crest of side overflow dike should be at least around 0.5 m from the practical view point, and the criteria for the Widas retarding basin aforementioned, the length and the crest elevation of the side overflow dike is determined as follows:

L = 400 m W = 4.4 m

where L is the length and W is the relative height of the crest to the design river bed.

(h) Cross-section and longitudinal profile

The design river cross-section and the longitudinal profile in the reach of the side overflow dike is shown in Figs. 4.3.2 and 4.3.3.

(i) Flood routing

Flood routing is conducted with the dimensions of the side overflow dike decided in the above and the other features of the design of the river and the retarding basin on the following conditions.

(i) River condition

River cross section for 25-year probable flood and that for 10-year probable flood.

(11) Flood hydrograph

Flood hydrograph with the return periods of 25-year, 10-year, 5-year, 2-year and 1.05-year.

The results are given in Table 4.3.4 and Figs. 4.3.7 - 4.3.9 the summary is given in Tables 4.3.5 - 4.3.6.

The results for 25-year river cross-section and for 25-yr flood is as follows.

- (1) Flood peak $410.3 \text{ m}^3/\text{s}$
- (ii) Reduced flood peak 210.9 m³/s
- (111) Peak cut volume $9.88 \times 106 \text{ m}^3$
- (iv) Maximum water level in the retarding basin 38.6 m SHVP
- (v) Maximum inundation area in the retarding basin 13.2 km²

(j) Supplement

Stage discharge relation

Stage discharge relation at the downstream end of the side overflow dike used for determining the dimensions of side overflow dike is calculated by the uniform flow formula. Actual stage discharge relation varies according to the water level in K. Brantas at the confluence with the Widas river. Some stage discharge relations are made depending on the water levels in K. Brantas by using non-uniform formula. The results are shown in Fig. 4.3.10 , showing that the stage discharge relation made by the uniform formula has a substantial basis for designing the side overflow dike.

Flood hydrograph

Flood hydrograph used for designing the side overflow dike is only of one type, the type that the flood peak is almost in the midst of a flood, center concentrated type so to speak. Flood routing is also conducted assuming other two types of flood hydrographs. The one is of a flat type and the other is of a type that the flood peak occurs in the end of a flood. They are named type 1 for the former and type 2 for the latter and the results of flood routing are shown in Fig. 4.3.11.

The comparison is given below briefly.

	Original type	Type I	Type 2	
Peak discharge	$410 \text{m}^3/\text{s} 211 \text{m}^3/\text{s}$	$325m^3/s - 201m^3/s$	499m ³ /s 221m ³ /s	
Max. water level	38.57 m SHVP	38.60 m SHVP	38.62 ₪ SHVP	

Left and right retarding basins

In the calculation of overflow discharge, the following are assumed.

- (i) The overflow discharge is twice of the discharge calculated in the equation previously given because the side overflow dike is planned on the both sides of the river.
- (ii) Although the storage capacity of the Widas retarding basin is different on the left side and the right side, the water levels on the both sides will be raised on the same rate.

Actually, because of the difference of the storage capacity of the retarding basin on the left side and the right side, the water levels are different on the left and the right sides. Accordingly in the hydraulic condition of submerged overflow, the total overflow discharge can not be the twice of the overflow discharge calculated with the said equation on the above assumption.

For the confirmation of the adequacy of the result obtained on the

said assumption the flood routing for 25-yr probable flood and 25-yr cross section is conducted with the final dimensions of the side overflow dike for left and right sides and the comparison is given below.

Assumption : same water level

- (i) Q peak : $210.9 \text{ m}^3/\text{s}$ (ii) V max. : $13.57 \times 10^6 \text{ m}^3$ (iii) H max. : 38.57 m SHVP
- Different water level
 - (i) Q peak : $215.9 \text{ m}^3/\text{s}$ (ii) V max. : $13.37 \times 10^6 \text{ m}^3$ (iii) H_{L} , max. : 38.69 m SHVP H_{R} , max. : 38.56 m SHVP

where; Q peak : peak discharge downstream in river

V max. : maximum storage volume

H max. : maximum water level in retarding basin

V max. : maximum total **stor**age volume in retarding basin \mathbf{H}_{L} max. : maximum water level in the left retarding basin \mathbf{H}_{R} max. : maximum water level in the right retarding basin

(5) Ulo retarding basin

The needed function of the Ulo retarding basin is determined through the study on the optimum flood control plan of the Widas river systems as well as that of the Widas retarding basin as follows.

- (i) The flood peak of about $591~\text{m}^3/\text{s}$ of the Widas river for 25-year probable flood should be reduced to less than $370~\text{m}^3/\text{s}$.
- (ii) The maximum storage volume of the Ulo retarding basin should be around 4.8×10^6 m³ for 25-year probable flood.

The dimensions of side overflow dike along the Widas river of the Ulo retarding basin are determined on the basis of the above criteria as follows.

(a) Storage capacity and area

Storage capacity and area curves used for the flood routing of the Ulo retarding basin are shown in Table 4.3.1 and Fig. 4.3.1.

The curves are obtained from the topographic map of the scale 1/10,000.

In measuring the area, the design plan of the retarding basin shown in Fig. 4.4.4 is considered.

(b) Stage discharge relation

Stage discharge relation at the downstream end of the side overflow dike is calculated by the uniform flow formula. The longitudinal profile and the river cross section used for the calculation is shown in Figs. 4.3.2 and 4.3.3.

The calculated stage discharge relation is shown in Table 4.3.2 and Fig. 4.3.4.

(c) Cross section

River cross section in the reach of the side overflow dike is assumed to be the same as that in the reach downstream of the side overflow dike except the side overflow dike.

(d) Location

The location of the side overflow dike of the Ulo retarding basin is determined in consideration that the site should be as downstream as possible so long as the storage capacity is enough for the flood peak reduction and that the crest elevation of the side overflow dike should be heigher than the design high water level in the Widas river at the confluence with the Kedungsoko river.

The downstream end of the side overflow dike is thus determined to be 700~m from the confluence with the Kedungsoko river.

(e) Slope of river bed

The slope of river bed in the reach of the side overflow dike is planned to be the same with that in the downstream reach. The slope of design river bed downstream of the side overflow dike is 1/1,590.

(f) Dead volume of retarding basin

The dead volume of the Ulo retarding basin is assumed to be zero because the river course of the Ulo river is planned to be changed to join the Widas river before coming into the Ulo retarding basin. Accordingly the drainage area of the Ulo retarding basin is so small as same as about $5~\rm km^2$.

(g) Length and crest elevation

The relations between the length of the side overflow dike, the crest elevation of the side overflow dike, the discharge in the river downstream of the side overflow dike, and the storage volume in the retarding basin are as mentioned in the part of the Widas retarding basin. And such relations are shown in Fig. 4.3.5.

In consideration of these relations shown in Fig. 4.3.5 and that the maximum overflow depth over the crest of side over-

flow dike should be at least arround 0.5 m from the practical view point, and the criteria for the Ulo retarding basin, the length and the crest elevation of the side overflow dike is determined as follows;

L = 550 m W = 4.5 m

where L is the length and W is the relative height of the crest to the design river bed.

(h) Cross section and longitudinal profile

The design river cross section and the longitudinal profile in the reach of the side overflow dike is shown in Figs. 4.3.6 and 4.3.2.

(i) Flood routing

Flood routing is conducted with the dimensions of the side overflow dike decided in the above and the other features of the design of the river and the retarding basin on the following conditions.

(i) River condition

River cross section for 25-year probable flood and that for 10-year probable flood.

(ii) Flood hydrograph

Flood hydrograph with the return periods of 25-year, 10-year, 5-year, 2-year and 1.05-year.

The results are given in Table 4.3.4 and Figs. 4.3.7 - 4.3.9 and the summary is given in Tables 4.3.5 - 4.3.6.

The results for 25-year river cross section and for 25-year flood is as follows;

(i) Flood peak $590.7 \text{ m}^3/\text{s}$

- (ii) Reduced flood peak 364.0 m³/s
- (iii) Peak cut volume $4.78 \times 10^6 \text{ m}^3$
- (iv) Maximum water level in the retarding basin 44.4 m SHVP
- (v) Maximum inundation area in the retarding basin 6.3 km^2

(j) Supplement

Stage discharge relation

In consideration of the same matters described in the section of the Widas retarding basin, the stage discharge relation made by the uniform flow formula and some stage discharge relations made by non-uniform flow formula depending on some water levels in the Widas river at the confluence with the Kedungsoko river are compared in Fig. 4.3.10. This also shows that the stage

discharge relation made by the uniform flow formula has a substantial basis for designing the side overflow dike.

Flood hydrograph

As discussed in the section of the Widas retarding basin, flood routing is conducted for other types of flood hydrograph and the result is shown in Fig. 4.3.11. The brief comparison is given below.

	Original type	Type l	Type 2
Peak discharge	591m ³ /s 364m ³ /s	$426 \text{ m}^3/\text{s} 330 \text{ m}^3/\text{s}$	$665 \text{ m}^3/\text{s} 378 \text{ m}^3/\text{s}$
Max. water	44.36 m SHVP	44.30 m SHVP	44.43 m SHVP

(6) Kedungsoko retarding basin

The needed function of the Kedungsoko retarding basin is determined through the study on the optimum flood control plan of the Widas river systems as well as that of the other retarding basins as follows.

- (i) The flood peak of about 455 m³/s of the Kedungsoko river for 25-year probable flood should be reduced to less than 200 m³/s.
- (ii) The maximum storage volume of the Kedungsoko retarding basin should be around $4.8 \times 10^6 \text{ m}^3$ for 25-year probable flood.

The dimensions of side overflow dike along the Kedungsoko river of the Kedungsoko retarding basin are determined on the basis of the above criteria as follows.

(a) Storage capacity and area

Storage capacity and area curves used for the flood routing of the Kedungsoko retarding basin are shown in Table 4.3.1 and Fig. 4.3.1.

The curves are obtained from the topographic map of the scale of 1/10,000. In measuring the area, the design plan of the retarding basin shown in Fig. 4.4.4 is considered.

(b) Stage discharge relation

Stage discharge relation at the downstream end of the side overflow dike is calculated by the uniform flow formula. The longitudinal profile and the river cross section used for the calculation is shown in Figs. 4.3.2 and 4.3.3.

The calculated stage discharge relation is shown in Table 4.3.2 and Fig. 4.3.4.

(c) Cross section

River cross section in the reach of the side overflow dike is assumed to be the same as that in the reach downstream of the side overflow dike except the side overflow dike.

(d) Location

The location of the side overflow dike of the Kedungsoko retarding basin is determined in consideration of the topographic conditions. The Kedungsoko retarding basin should reduce the flood peaks of the Kedungsoko river and the Kuncir river.

Thus the location of the side overflow dike should be downstream of the confluence of the Kuncir river with the Kedungsoko river. And at the same time the side overflow dike can not be so near to the railway bridge. The distance between the two is only about 1.3 km.

The location is determined at around the middle of this reach. The downstream end of the side overflow dike is thus determined to be 500 m from the railway bridge.

(e) Slope of river bed

The slope of river bed in the reach of the side overflow dike is planned to be the same with that in the downstream reach. The slope of design river bed downstream of the side overflow dike is 1/1,950.

(f) Dead volume of retarding basin

The dead volume of the Kedungsoko retarding basin is assumed to be $1.0 \times 10^6 \mathrm{m}^3$ on the basis of the run-off analysis result because the Kedungsoko retarding basin has its own drainage area of about $34~\mathrm{km}^2$.

(g) Length and crest elevation

The relations between the length of the side overflow dike, the crest elevation of the side overflow dike, the discharge in the river downstream of the side overflow dike, and the storage volume in the retarding basin, are as mentioned in the preseding part of the other retarding basins. And such relations are shown in Fig. 4.3.5.

In consideration of these relations shown in Fig. 4.3.5 and that the maximum overflow depth over the crest of side overflow dike should be at least around 0.5 m from the practical view point, and the criteria for the Kedungsoko retarding basin aforementioned, the length and the crest elevation of the side overflow dike is determined as follows;

L = 360 m W = 3.5 m

where L is the length and W is the relative height of the crest to the design river bed.

(h) Cross section and longitudinal profile

The design river cross section and the longitudinal profile in the reach of the side overflow dike is shown in Figs. 4.3.6 and 4.3.2.

(i) Flood routing

Flood routing is conducted with the dimensions of the side overflow dike decided in the above and the other features of the design of the river and the retarding basin on the following conditions.

(i) River condition

River cross section for 25-year probable flood and that for 10-year probable flood.

(ii) Flood hydrograph

Flood hydrographs with the return periods of 25-year, 10-year, 5-year, 2-year and 1.05-year.

The results are given in Table 4.3.4 and Figs. 4.3.7 - 4.3.9 and the summary is given in Tables 4.3.5 - 4.3.6.

The result for 25-year river cross section and for 25-year probable flood is as follows;

- (i) Flood peak $455.3 \text{ m}^3/\text{s}$
- (ii) Reduced flood peak 196.6 m³/s
- (iii) Peak cut volume $4.12 \times 10^6 \text{ m}^3$
- (iv) Maximum water level in the retarding basin 44.6 m SHVP
 - (v) Maximum inundation area in the retarding basin 6.5 km^2

(j) Supplement

Stage discharge relation

As well as the other retarding basins, the stage discharge relation made by the uniform flow formula and some stage discharge relations made by non-uniform flow formula depending on some water levels in the Widas river at the confluence with the Kedungsoko river are compared in Fig. 4.3.10. This also shows that the stage discharge relation made by the uniform formula has a substantial basis for designing the side overflow dike.

Flood hydrograph

As well as the other retarding basins, flood routing is conducted for other types of flood hydrograph, and the result is shown in Fig. 4.3.11. The brief comparison is given below.

	Original	type	Type 1		Type 2	
Peak 455	,3/s ===	197 m3/s	322 m3/s	179 m ³ /e	491 m3/s	201 m3/c
discharge	at 75	10/0	- 111 / 5	/ 3	14-7-5	111-73
Max. water level	44.59 r	n SHVP	44.66 m	SHVP	44.66	m SHVP

Left and right retarding basins

The side overflow dike of the Kedungsoko retarding basin is planned on the both sides of the Kedungsoko river similar to the Widas retarding basin. Accordingly the same problem on the overflow discharge over the side overflow dike and the water level in the retarding basin on the left side and on the right side exists. But in the case of the Kedungsoko retarding basin, because of the locational constraint the side overflow dike is planned in the reach where the alignment of the river dike is convex to the right. It can be said that the overflow discharge to the right side retarding basin would be more than that to the left side because of the design alignment of the river dike convex to the right.

And the storage capacity of the right side retarding basin is about 4 times of that of the left side retarding basin. The effect of the bend of river dike alignment is not included in the equation of overflow discharge. This should be later confirmed by model test on the stage of detailed design.

(7) Summary

The fundamental dimensions of the three retarding basins are given below for summary, and partly shown in Fig. 4.3.12.

- (a) Widas retarding basin
 - (1) Length of side overflow dike

L = 400 m on both sides of the Widas river

(ii) Relative height of the crest of side overflow dike to the design river bed

W = 4.4 m

(iii) Design flood peak cut : $455.3 \text{ m}^3/\text{s}$ ---- 210.9 m³/s

(iv) Design dead volume : $3.7 \times 10^6 \text{ m}^3$

(v) Design maximum storage volume $13.6 \times 10^6 \text{ m}^3$

(vi) Design peak cut volume : $9.9 \times 10^6 \text{ m}^3$

(vii) Design maximum inundation area : 13.2 km²

(viii) Design maximum inundation depth: 2.4 m

(ix) Design high water level : 38.6 m SHVP

- (b) Ulo retarding basin
 - (i) Length of side overflow dike

L = 550 m on the right side of the Widas river

(ii) Relative height of the crest of side overflow dike to the design river bed

W = 4.5 m

- (iii) Design flood peak cut : $590.7 \text{ m}^3/\text{s}$ ---- $364.0 \text{ m}^3/\text{s}$
- (iv) Design dead volume : $0.0 \times 10^6 \text{ m}^3$
- (v) Design maximum storage volume : 4.8 x $10^6~\mathrm{m}^3$
- (vi) Design peak cut volume: $4.8 \times 10^6 \text{ m}^3$
- (vii) Design maximum inundation area: 6.3 km²
- (viii) Design high water level : 44.4 m.SHVP
- (c) Kedungsoko retarding basin
 - (i) Length of side overflow dike

L = 360 m on the both sides of the Kedungsoko river

(ii) Relative height of the crest of side overflow dike to the design river bed

W = 3.5 m

- (iii) Design flood peak cut : $455.3 \text{ m}^3/\text{s}$ ---- $196.6 \text{ m}^3/\text{s}$
- (iv) Design dead volume : $1.0 \times 10^6 \text{ m}^3$
- (v) Design maximum storage volume : $5.1 \times 10^6 \text{ m}^3$
- (vi) Design peak cut volume: 4.1 x 10⁶ m³
- (vii) Design maximum inundation area : 6.5 km²
- (viii) Design high water level : 44.6 m.SHVP

4.3.2 Drainage sluice

(1) General

Flood water stored in a retarding basin should be drained as soon as practicable after a flood. Because the storage capacity of the retarding basin should be reserved for a next coming flood during a rainy season.

The rate of draw down of the retarding basin depends on the dimensions of drainage sluice to be constructed to the retarding basin.

The dimensions of drainage sluices of the Widas, the Ulo and the Kedungsoko retarding basins are studied here.

(2) Fundamental equations

Fundamental equations for emptying a retarding basin with a drainage sluice used here are as follows;

(a) Continuity equation

$$\frac{dV}{dt} = -Q$$

(b) Discharge equation

Q =
$$C1 \cdot B \cdot W \cdot \sqrt{2g \cdot \Delta H}$$

(pipe flow, submerged)
Q = $C2 \cdot B \cdot h2 \cdot \sqrt{2g \cdot \Delta H}$
(open channel, submerged)
Q = $C3 \cdot B \cdot h1 \cdot \sqrt{2g \cdot h1}$

 $Q = C1 \cdot B \cdot W \cdot \sqrt{2g \cdot h1}$ (pipe flow, perfect flow)

Here; V: storage volume in the retarding basin (m^3)

t : time

Q : discharge through drainage sluice (m³/s)

C1,C2,C3: constants

B : width of sluice (m)
W : height of sluice (m)

: gravity acceleration (m/s^2)

 ΔH : H1 - H2 (m)

Hl : water level in the retarding basin

H2 : water level in the river

hl : water depth in the retarding basin

(3) Drainage calculation

Drainage calculation is carried out to get the draw down conditions of the retarding basin and the discharge hydrograph through the drainage sluice. On the condition that the drainage sluice would be opened after a flood, it is assumed that there is no inflow to the retarding basin in the drainage calculation.

The procedure to calculated the draw down of the retarding basin and the discharge hydrograph through the drainage sluice is as follows.

- (a) At a time point t, the water level in the retarding basin HB(t) is assumed.
- (b) Then the outflow discharge through drainage sluice QO(t) is calculated with the discharge equation by using HB(t) and the water level in the river HR(t).
- (c) The average outflow discharge is calculated with QO(t) and the outflow discharge at a preceding time point QO(t-1).
- (d) The storage volume in the retarding basin at a time point t is calculated with the equation;

$$V(t) = V(t-1) - (QO(t) + QO(t-1)) / 2.0 \times \Delta t$$

where Δt is the time interval.

- (e) The water level in the retarding basin $HB^{1}(t)$ is calculated with V(t) through the volume curve of the retarding basin.
- (f) When HB'(t) is not equal to HB(t), then the new value HB(t) is assumed, and the procedure from (b) to (e) is again conducted.
- (g) When these two values are the same, then the water level in the retarding basin at time point t is obtained as HB(t).
- (h) In the above calculation, the influence of the outflow discharge in the river is taken into account.

(4) Widas retarding basin

The dimensions of the drainage sluice of the Widas retarding basin are determined here so as to drain the storage volume of about $13.6 \times 10^6 \, \text{m}^3$ in about 2-3 days. The storage volume of $13.6 \times 10^6 \, \text{m}^3$ is the design storage volume for 25-year probable flood. In determining the dimensions of the drainage sluice, it is taken into account that the flow velocity in the drainage sluice does not exceed $3.5 \, \text{m/sec}$ as a standard.

The dimensions are determined as follows;

(a) Storage capacity and area

Storage capacity and area curves used here are the same ones

used in the study of overflow dike and are shown in Fig. 4.3.1.

(b) Discharge hydrograph in river

In the case of the Widas retarding basin, actually there are two retarding basins on the left side and on the right side of the Widas river. But in the drainage calculation, it is assumed that the retarding basin is just one and the stored flood water in the retarding basin is released to K. Brantas.

The design flood discharge hydrograph in K. Brantas is shown in Table 4.3.8.

(c) Stage discharge relation

Stage discharge relation in K. Brantas is the one in K. Brantas of the Brantas River Middle Reach Improvement Project, and is shown in Table 4.3.7.

(d) Dimensions of sluice

The dimensions of the sluice discussed here are the bed elevation, width and the height of the opening of the sluice.

By assuming some values on these dimensions, drainage calculations are carried out. And the relations between these values and the necessary time to empty the retarding basin and the maximum **flow** velocity through the sluice are obtained and shown in Fig. 4.3.13.

In consideration of the relations shown in Fig. 4.3.13 and the criteria for determining the dimensions of sluice aforementioned, the dimensions of the drainage sluice are determined and the drawdown of the water level in the retarding basin and the outflow discharge hydrograph are shown in Fig. 4.3.14.

The dimensions of the sluices are determined as follows;

The left side

bed elevation 35.0 m SHVP height 4.0 m width 3.0 m x 2 gates

The right side

bed elevation 35.0 m SHVP height 4.0 m width 4.0 m x 2 gates

Necessary time to empty the retarding basin is 1.8 days.

In determining the dimensions of the sluices on the left side and the right side, the following are considered.

(i) The necessary width is divided into two approximately

proportional to the storage volume of the retarding basins on the left and right sides.

- (ii) In consideration of an emergency case, each sluice should have two gates.
- (iii) When the width of a gate is too narrow, obstacles would be stopped at the gate and the smooth flow through the sluice would be disturbed.

The locations of the sluices are shown in Fig. 4.4.4.

(5) Ulo retarding basin

The design storage volume of the Ulo retarding basin is 4.8×10^6 m³. The same criteria as those of the Widas retarding basin to determine the dimensions of the sluice are used here for the Ulo retarding basin.

(a) Storage capacity and area

Storage capacity and area curves used here are the same ones used in the study of side overflow dike and are shown in Fig.4.3.1.

(b) Discharge hydrograph in river

The flood water stored in the Ulo retarding basin is to be released to the Kedungsoko river at the confluence of the existing Ulo river and the Kedungsoko river. But the confluence is not so far from the confluence of the Kedungsoko river with the Widas river.

And the distance is about 1.3 km and the design river bed slope is 1/2,800. Accordingly, taking into account the influence of the backwater from the Widas river, the 25-yr probable flood hydrograph in the Widas river is used here. The hydrograph is shown in Table 4.3.8.

(c) Stage discharge relation

In consideration of the above mentioned matter, the stage discharge relation is calculated in Table 4.3.7.

(d) Dimensions of sluice

The dimensions of the sluice of the Ulo retarding basin are determined with the same procedure as that of the Widas retarding basin.

The relations between the bed elevation, width, height of the opening of the sluice, and, necessary time to empty the retarding basin and maximum flow velocity through the sluice are shown in Fig 4.3.13.

With the same consideration as in the case of the Widas retarding basin, the dimensions of the sluice of the Ulo retarding basin

are determined and the drawdown hydrograph of the basin and the outflow discharge hydrograph are shown in Fig. 4.3.14.

The dimensions are as follows;

bed elevation

42.0 m SHVP

height

3.0 m

width

4.0 m x 2 gates

Necessary time to empty the retarding basin is 2.2 days.

The location of the sluice is shown in Fig. 4.4.4.

(6) Kedungsoko retarding basin

The design storage volume of the Kedungsoko retarding basin is 5.1 x $10^6 \ \mathrm{m}^3$.

The same criteria as the other retarding basins to determine the dimensions of the sluice are used here for the Kedungsoko retarding basin.

(a) Storage capacity and area

Storage capacity and area curves used here are the same ones used in the study of side overflow dike and are shown in Fig. 4.3.1.

(b) Discharge hydrograph in river

The flood water stored in the Kedungsoko retarding basin is to be released to Kedungsoko river after a flood.

Accordingly the discharge hydrograph in the Kedungsoko river for 25-yr probable flood is used and shown in Table. 4.3.8.

(c) Stage discharge relation

Stage discharge relation in the Kedungsoko river at the planned location is calculated in uniform flow and shown in Table 4.3.7.

(d) Dimensions of sluice

The dimensions of the sluice of the Kedungsoko retarding basin are determined with the same procedure as that of the other retarding basins. The relations between the bed elevation, width, height of the opening of the sluice, and, necessary time to empty the retarding basin and maximum flow velocity through the sluice are shown in Fig. 4.3.13.

With the same consideration as in the other retarding basins, the dimensions of the sluices of the Kedungsoko retarding basin are determined and the drawdown hydrograph and the outflow discharge hydrograph are shown in Fig. 4.3.14.

The dimensions of the sluices are as follow.

The left side

bed elevation 41.0 m SHVP

height 2.0 m width 2.0 m x 2 gates

The right side :

bed elevation 41.0 m SHVP

height

2.5 m

width

 $2.5 m \times 2 gates$

Necessary time to empty the retarding basin is 1.8 days.

In determining the dimensions of the sluices on the left side and the right side, the same consideration is given as in the case of the Widas retarding basin.

The locations of the sluices are shown in Fig. 4.4.4.

4.3.3 Drainage canal

(1) General

Flood water stored in a retarding basin should be drained as soon as practicable after a flood. In this case, it is needed to provide a drainage canal so as to lead the flood water smoothly to the drainage sluice.

The drainage canal also functions as a canal to drain the runoff in the retarding basin even when there occurs no overflow over the side overflow dike.

(2) Widas retarding basin

In the case of the Widas retarding basin the drainage condition is not in a condition that the flood water stored in the retarding basin can smoothly reach the location of planned drainage sluices.

Accordingly new drainage canals are planned as shown in Fig. 4.3.15.

(a) Canal width

The design width of the canal is principally based on the width of the drainage sluice.

(b) Slope of canal bed

The design slope of the canal bed is principally based on the design bed slope of the Widas river.

(3) Ulo retarding basin

The downstream reach of the existing Ulo river is planned to change the river course to join the Widas river in the upstream of the Ulo retarding basin in order to minimize the dead volume of the retarding basin. Accordingly the existing Ulo river in the Ulo retarding basin can be used as the drainage canal. The other existing drainage canals, presently joining the Kedungsoko river separately are to be connected to the existing Ulo river in front of the planned drainage sluice of the Ulo retarding basin as shown in Fig. 4.4.4.

A new canal to connect the drainage sluice to the location of side overflow is also planned as shown in Fig. 4.4.4 in consideration of the existing drainage canals.

(4) Kedungsoko retarding basin

Kedungsoko retarding basin has two retarding basins on the left and the right sides of the Kedungsoko river.

As for the left side, the existing Kuncir river is planned to join the Kedungsoko river rather upstream of the existing confluence. Accordingly the existing Kuncir river near the drainage sluice can be used as a drainage canal. Therefore no new drainage canal is planned on the left side.

As for the right side, there exist irrigation and drainage canals in the Kedungsoko retarding basin presently joining the Kedungsoko river. Accordingly no new drainage canal is planned on the side except the connecting canal of these canals to lead them to the drainage sluice as shown in Fig. 4.4.4.

4.3.4 Sediment volume

(1) General

Sediment volume in the retarding basins is studied here. Though the sediment discharge formula for the Widas river is not available, a sediment discharge formula is studied for K. Brantas because the sediment measurement has been carried out in K. Brantas. It is said that the sediment load in the Widas river is less than that in K. Brantas because of the vegetation condition in the basin. For the study of sediment volume of the retarding basins in the Widas river basin, the sediment discharge formula in K. Brantas is employed here.

(2) Sediment discharge formula

Sediment volume in retarding basin is mainly expected from the suspended load and wash load contained in flood water overflowing the side overflow dike of a retarding basin.

It is assumed here that the bed load will not overflow the side overflow dike.

According to the hydrological analysis result, the sediment discharge formula for suspended load and wash load is

$$q_{sw} = 4.901 \times 10^{-3} \times (h \times U_{x}^{2})^{0.733}$$

where; q_{cw} : suspended load + wash load ($m^3/s/m$)

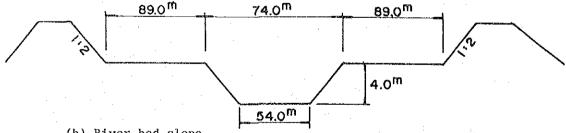
h : water depth (m)

U, : friction velocity (m/s)

(3) Widas retarding basin

(a) Cross section of the Widas river

Design cross-section of the Widas river in the upstream reach of the side overflow dike of the Widas retarding basin is as follows.



(b) River bed slope

Design river bed slope is planned to be 1/3,400.

(c) Manning's coefficient of roughness

Design coefficient of roughness is 0.03 for low water channel

and 0.05 for high water channel.

(d) Hydraulic characteristics

Assuming the uniform flow in the channel, the hydraulic characteristics are as follows.

(i) Low-water channel

h	P	Ą	. R	Q ·
(m)	(m)	(m ²)	(m)	(m³/s)
4.0	75.54	256.0	3.389	330.2
4.5	75.54	293.0	3.389	413.5
5.0	75.54	330.0	4.369	504.1

(ii) High-water channel

h (m)	P (m)	(m ²)	R (m)	Q (m ³ /s)
4.0	0	0	0 .	0
4.5	180.7	89.6	0.496	19.3
5.0	183.4	180.5	0.984	61.3

In the above,

h : water depth (m),

P : wetted perimeter (m),

A : cross sectional area (m^2) ,

R : hydraulic mean radius (m),

Q : discharge (m3/s)

Although the flood discharge in this reach of the Widas river varies during a flood, the design peak discharge is 410.3 m 3 /s. The water depth corresponding to this discharge in the above table is 4.405 m.

Hydraulic characteristics to this water depth for low-water channel and high water channel are as follows.

(i) Low-water channel

h	R	Q	B	υ ²	h.U ²
(m)	(m)	(m ²)	(m)	(m ³ /s)	(m ³ /s ²)
4 405	3.786	397.1	54	0.01091	0.04807

(ii) High water channel

h.	R	Q	. В.	${\tt u}^2$	$(h-4).U_{*}^{2}$ $(m3/s2)^{*}$
(m)	(m)	(m^2)	(m)	(m^3/s)	$(m3/s2)^{\circ}$
4.405	0.402	13.6	178	0.001159	0.0004693

(e) Sedimentation in the Widas retarding basin

(i) Sediment discharge

(i) Sediment discharge

Substituting the hydraulic values obtained in the above to the sediment discharge formula previously mentined, the sediment discharge to the design flood peak $410.3~\mathrm{m}^3/\mathrm{s}$ is obtained as follows.

$$Q_{sw1} = q_{sw1} \times B_* = 0.02861$$
 : low water channel $Q_{sw2} = q_{sw2} \times B_* = 0.003169$: high water channel

Accordingly the total sediment discharge Q_{SW} is as follows.

$$Q_{sw} = Q_{sw1} + Q_{sw2} = 0.0318 \text{ m}^3/\text{s}$$

Therefore ;

$$Q_{sw}/Q = 0.0318/410.3 = 7.7452 \times 10^{-5}$$

(ii) Sediment volume

Assuming that the retarding basin is filled with the flood water when the flood discharge is 410.3 m³/s, the sediment volume and the mean depth of the sediment of the Widas retarding basin are.

$$V_{sw} = 7.745 \times 10^{-5} \times 13.6 \times 10^{6} \text{ m}^{3} = 1053.3 \text{ m}^{3}$$
 $h_{sw} = 1053.3 \text{ m}^{3}/13.2 \text{ km}^{2} = 0.08 \text{ mm}$
Where;

V_{sw}: volume of sediment (m³) h_{sw}: mean depth of sediment (mm)

Even when the retarding basin is fully filled with the 25-yr probable flood every year, the sediment depth is only 0.08~mm per year.

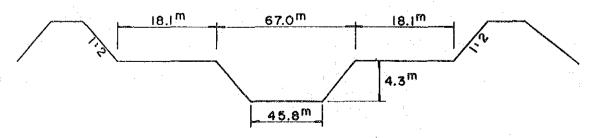
Accordingly it is concluded that there is no need to take into account the design dead volume due to sediment, though the very local sedimentation in the retarding basin should be taken care of.

(4) Ulo retarding basin

With the same procedure as that of the Widas river, the sediment volume in the Ulo retarding basin is calculated as follows.

(a) Cross-section

Design cross-section of the Widas river in the upstream reach of the side overflow dike of the Ulo retarding basin is as follows.



(b) River bed slope

Design river bed slope is planned to be 1/1,590.

(c) Manning's coefficient of roughness

Design coefficient of roughness is 0.03 for low water channel and 0.05 for high water channel.

(d) Hydraulic characteristics

For the design flood peak discharge 590.7 m^3/s , the hydraulic characteristics are as follows.

(i) Low-water channel

h	R	. Q	B	u ²	h.∪ <mark>²</mark>
(m)	(m)	(a/ϵ_m)	(m)	(m/s)	(m^3/s^2)
4.813	4.015	584.8	45.8	0.02475	0.1191

(ii) High-water channel

h R Q
$$B_*$$
 U_*^2 (h-4.3). U_*^2
4.813 0.494 6.0 36.2 0.003045 0.001562

- (e) Sedimentation in the Ulo retarding basin
- (i) Sediment discharge

Substituting the hydraulic values in the sediment discharge formula, the sediment discharge to the design flood peak 590.7 $\rm m^3/s$ is obtained as follows.

$$Q_{sw1} = q_{sw1} \times B_{*} = 0.0472$$
 : low-water channel
 $Q_{sw2} = q_{sw2} \times B_{*} = 0.001556$: high-water channel

The total sediment discharge is then,

$$Q_{sw} = Q_{sw1} + Q_{sw2} = 0.04876 \text{ m}^3/\text{s}$$

Therefore,

$$Q_{SW}/Q = 0.04876/590.7 = 8.2539 \times 10^{-5}$$

(ii) Sediment volume

On the same assumption as that of the Widas retarding basin, the sediment volume and the mean depth of the sediment in the Ulo retarding basin per year are,

$$V_{sw} = 8.2539 \times 10^{-5} \times 4.8 \times 10 = 396.2 \text{ m}^3$$

 $h_{sw} = 396.2 \text{ m}^3/6.3 \text{ km}^2 = 0.06 \text{ mm}$

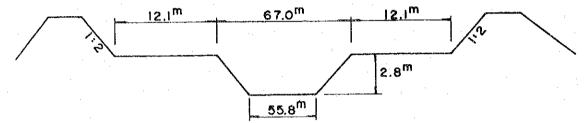
Accordingly it is concluded that there is no need to take into account the design dead volume due to sediment.

(5) Kedungsoko retarding basin

With the same procedure, the sediment volume in the Kedungsoko retarding basin is calculated as follows.

(a) Cross-section

Design cross-section of the Kedungsoko river in the upstream reach of the side overflow dike of the Kedungsoko retarding basin is as follows.



(b) River bed slope

Design river bed slope is planned to be 1/1,950.

(c) Manning's coefficient of roughness

Design coefficient of roughness is 0.03 for low-water channel and 0.05 for high water channel.

(d) Hydraulic charactiristics

For the design flood peak discharge 455.3 \rm{m}^3/\rm{s} , the hydraulic characteristics are as follows.

(i) Low-water channel

h	R	Q	B_{\star}	${\tt U}_{\star}^2$	$\mathtt{h.U}_{\star}^2$
(m)	(m)	(m ³ /s)	(m)	(m^2/s^2)	(m^3/s^2)
3.94	3.634	443.0	55.8	0.01826	0.07194

(ii) High-water channel

$\mathbf{h}^{-\frac{1}{2}}$	R	Q	В*	∪ <mark>2</mark>	$h.u_{\star}^2$
(m)	(m)	(m^3/s)	(m)	(m^2/s^2)	(m^3/s^2)
3,94	1.030	13.947	24.2	0.00518	0.00591

(e) Sedimentation in the Kedungsoko retarding basin

(i) Sediment discharge

Substituting the hydraulic values in the sediment discharge formula, the sediment discharge to the design flood peak 455.3 m³/s

is obtained as follows.

$$Q_{sw1} = q_{sw1} \times B_{\star} = 0.03973$$
 : low-water channel $Q_{sw2} = q_{sw2} \times B_{\star} = 0.00276$: high-water channel

Accordingly the total sediment discharge
$$Q_{sw}$$
 is, $Q_{sw} = Q_{sw1} + Q_{sw2} = 0.04249 \text{ m}^3/\text{s}$

Therefore ,

$$Q_{sw}/Q = 0.04249/455.3 = 9.3323 \times 10^{-5}$$

(ii) Sediment volume

On the same assumption as that of the Widas retarding basin, the sediment volume and the mean depth of the sediment in the Kedung-soko retarding basin per year are,

$$V_{sw} = 9.3323 \times 10^{-5} \times 5.1 \times 10^{6} \text{ m}^{3} = 475.9 \text{ m}^{3}$$

 $h_{sw} = 475.9 \text{ m}^{3}/6.5 \text{ km}^{2} = 0.07 \text{ mm}$

Accordingly it is concluded that there is no need to take into account the design dead volume due to sediment.

Table 4.3.1 STORAGE CAPACITY AND AREA OF WIDAS RETARDING BASIN (1/3)

Table 4.3.1 STORAGE CAPACITY AND AREA OF KEDUNGSOKO RETARDING BASIN (3/3)

1.	Right sid	e		1.	Right side		
	H (m)	A (km ²)	v (x10 ⁶ m ³)		H (m)	A (km ²)	⊽ (x106 m ³)
	36.2	0.0	0.0		43.50	2,858	0.0
	37.0	1.222	0.489		44.00	2.858	1.429
	38.0	7.051	4.625		45.00	7.591	6.653
	39.0	10.394	13.348		•	•	* * *
	. *						
2.	Left side			2.	Left side		. •
ė.	H (m)	A (km ²)	(x106 m ³)		H (m)	A (km ²)	⊽ (x10 ⁶ m ³)
	36.4	0.0	0.0		43.2	0.0	0.0
	37.0	0.992	0.298		44.0	0.399	0.160
	38.0	3.268	2.428		45.0	2.754	1.736
	39.0	4.751	6.437				
3.	Total			3,	Total		
	H (m)	A (km²)	⊽ (x10 ⁶ m ³)		H (m)	A (km ²)	⊽ (x106 m³)
	36.2	0.0	0.0		43.2	0.0	0.0
:	37.0	2.214	0.786	1	44.0	3.257	1.589
	38.0	10.319	7.053		45.0	10.345	8.389
	39.0	15.145	19.785				

Table 4.3.1 STORAGE CAPACITY AND AREA OF ULO RETARDING BASIN (2/3)

4.102

H (m)	A (km ²)	⊽ (x106 m ³)
43.0	0.0	0.0
44.0	5.589	2.794
45.0	7.505	9.341
46.0	9.553	17.870

Table 4.3.2 STAGE DISCHARGE RELATION OF WIDAS RIVER AT WIDAS RETARDING BASIN (1/3)

Cross-section	for	25-year	probable	flood
ししひろう うさんしょりほ	TOL	4J - Y C A L	DIODGDIC	13000

h	(m)	3.9	4.0	4.4	4.8	5.2	5.6	6.0
Q	(m ³ /s)	133.4	141.1	171.3	220.3	269.2	323.5	383.0

Table 4.3.2 STAGE DISCHARGE RELATION OF WIDAS RIVER
AT DOWNSTREAM OF ULO RETARDING BASIN (2/3)

Cross-section for 25-year probable flood

h (m)	4.3	4.4	4.8	5.2	5.6	6.0
$Q (m^3/s)$	265.9	278.2	341.8	416.4	500.6	593.7

Cross-section for 10-year probable flood

		~~~~~~		<del> </del>		~	
h (m)	4.3	4.4	4.8	5.2	5.6	6.0	
$Q (m^3/s)$	218.4	230.2	286.8	354.4	431.7	517.8	

Table 4.3.2 STAGE DISCHARGE RELATION OF KEDUNGSOKO RIVER OF KEDUNGSOKO RETARDING BASIN (3/3)

# Cross-section for 25-year probable flood

h (m)	3.1	3.4	3.8	4.2	4.6	5.0
Q (m ³ /s)	112.8	139.0	182.1	232.8	290.3	354.2

# Cross-section for 10-year probable flood

h (m)	3.1	3.4	3.8	4.2	4.6	5.0
Q (m ³ /s)	98.3	122.3	162.4	210.1	264.6	325.5

# Legend

h = elevation from the design low-water channel bed

Q = discharge

Table 4.3.3 PROBABLE FLOOD AT WIDAS RETARDING BASIN (1/3)

	<del> </del>			River Cond				D
			For 25-ye	·		10-year		Return Period
0 2	10	5	2	01	5	2	1.05	Time
,5 119	106,5	97.1	79.4	106.5	97.0	79.4	60.1	1 .
5 151	135.5	122.8	99.5	135.2	122.6	99.5	75.4	. 2
4. 195	178.4	164.0	135.7	177.6	163.4	135.6	102.7	3.
4 249	230.4	213.8	182.0	227.9	212.6	181.7	137.6	4
.9 275	267.9	261.0	232.0	266.0	260.4	231.4	175.2	5
.3 300	289.3	278.7	264.2	285.5	277.5	263.8	199.8	6
.6 325	311.6	297.8	277.6	305.6	295.8	276.9	209.7	7
.2 348	332.2	316.0	291.0	324.3	313.2	289.8	219.5	8
.3 367	350.3	332.4	303.3	340.9	328.9	301.6	228.4	9
5 384	365.5	346.2	313.6	354.8	341.9	311.5	235.9	10
.3 397	377.3	356.5	321.2	365.5	351.5	318.8	241.4	11 %
.2 406	385.2	362.8	325.6	372.3	357.2	322.8	244.5	12
.5 410	388.5	364.7	326.5	374.7	358.5	323.5	245.0	13
.9 410	386.9	362.5	323.9	372.6	356.2	320.7	242.9	14
.7 405	380.7	356.2	317.9	366.5	349.9	314.3	238.0	15
.6 395	370.6	346.5	306.7	356.8	339.9	302.8	229.3	16
3 381	356.3	331.6	290.0	342.4	324.6	286.1	216.7	17
.3 362	336.3	310.9	270.2	322.5	304.0	266.4	201.8	18
.0 338	312.0	287.5	231.5	299.1	281.1	220.9	167.3	19
.5 311	286.5	264.0	176.8	274.9	258.2	170.4	129.1	20
.0 284	262.0	207.2	140.8	238.5	191.5	137.0	103.8	21
.2 259	200.2	158.0	116.8	177.8	148.8	114.5	86.7	22
.1 192	153.1	127.2	100.9	140.0	121.7	99.7	75.5	23
.3 148	124.3	107.7	91.3	116.5	104.5	90.6	68.6	24
.9 122	106.9	96.6	84.8	102.3	94.9	84.3	63.8	25
.2 108	98.2	90.9	81.2	95.8	89.9	80.9	61.3	26
9 103	95.9	89.7	80.8	94.3	89.0	80.6	61.0	27

Table 4.3.3 PROBABLE FLOOD AT ULO RETARDING BASIN (2/3)

		Return Pe	riod (yr)	Un	it : m ³ /s
Time (hr)	1.05	2	5	10	25
1	25.4	40.0	47.1	52.1	56.3
2	32.0	50.5	63.0	73.2	81.3
3	63.1	99.6	133.9	161.2	186.5
4	121.8	192.1	254.6	304.7	352.8
5	179.2	282.7	366.5	434.8	494.9
6	215.8	340.5	436.8	515.1	570.0
7	234.7	370.3	468.6	547.4	590.7
8	238.1	375.6	467.6	539.8	584.1
9	225.6	355.9	435.8	497.1	554.0
10	200.0	315.6	380.7	430.5	498.1
11	168.1	265.2	315.6	354.2	424.8
12	136.2	214.9	251.9	281.3	348.3
13	108.8	171.7	197.2	218.8	278.7
14	87.0	137.3	154.4	169.8	219.6
15	70.7	111.5	122.7	134.1	173.1
16	59.3	93.5	101.2	109.1	138.6
17	50.8	80.2	86.1	92.2	113.6

Table 4.3.3 PROBABLE FLOOD AT KEDUNGSOKO RETARDING BASIN (3/3)

			Return Perio	d (yr)		Unit: m ³ /s
Time	(hr)	1.05	2	5 .	10	2,5
1	· · · · ·	14.0	18.2	21.9	24.1	27.3
2		28.4	37.0	47.1	54.5	64.0
3	ı	63.3	82.5	107.9	128.0	152.5
4	4	114.2	148.9	195.0	230.6	274.3
5		166.3	216.9	280.2	326.9	384,5
6		206.4	269.2	341.3	392.4	455.3
7	.*	217.0	283.0	351.0	<b>3</b> 98.3	455.2
8		189.4	247.1	298.7	333.8	374.8
9		146.2	190.7	224.1	246.9	272.1
10		111.1	144.9	166.7	181.6	197.2
11		88.1	114.9	130.4	140.7	151,2
12		73.2	95.5	107.3	115.1	123.0
13		62.4	81.4	90.8	97.0	103.6
14		53.4	69.8	77.5	82.6	88.0
15		46.4	60.5	66.8	71.1	75.5

Table 4.3.4 FLOOD ROUTING IN THE WIDAS RETARDING BASIN (1/7)

		( Q-1.05)	yr 4 River 10	)-yr }					(Q-2yr s	kiver 10-	yr)		
u/s	H _U /s	Q _{d/s}	n _{u/s}	g*	745	-08	0/1	Х _{0/5}	Q _{d/1}	H _{0/s}	Q#	ю	
3/11	(*)	(a ³ /s)	(A)	(=3/1)	(*)	10 ⁶ a ³ )	<u> 1e³/11</u>	(n)	(*)/1	(=)	(2/5)	{m}	(110 ⁶ a))
0,1	36.937	60.1	36. 873	0	37.59	3.69	79.4	37,204	22.4	37, 120	0	37.59	3.69
3.4	37.149	75.4	37.069	0	37,59	3.69	99.5	37, (73	99.5	37,378	0	37,59	3.69
2.7	37.521	102.7	37,419	0	37.59	3.69	135,6	37,958	135.6	37.840	6	37.59	1.69
7.4	37.984	137.6	17,856	9	37.59	3.69	181.6	38,444	178.9	38.326	2.7	37.59	3.69
5.1	38.405	175.1	36.267	Q	37.59	3.69	231.3	38.525	188.4	38.414	42.9	37,59	3.70
9, 6	38,480	183.1	38, 365	16.7	37.59	3.69	263,7	38,563	193.1	38,458	70.6	37.61	3.85
9.7	38.696	184,9	15. 36?	24.8	37.60	3.75	276.9	38.577	194.9	38.425	82.0	37.64	4.11
9,4	16, 509	186.5	16.397	32.9	37.61	3.44	289.4	38.590	196.6	38.490	93.2	37.68	4.41
8.4	38.521	185.0	38,410	40.4	37.63	3.96	301.6	38,602	198.1	18.504	103.5	37.72	4.74
5.9	38.531	159.1	38,421	46.8	37.64	4.11	311,5	38.611	199.3	30.516	112.2.	37,73	5. I I
1.4	38.326	189.9	38,428	51.5	37,66	. 4.27	318,7	38,818	200,2	30.254	110.5	32.82	
4.5	38,541	199.4	38.433	54.1	37.69	4,44	322.8	38.621	200.7	38.529	122.1	37.47	5.94
3.0	38.342	190,5	38,433	52.3	37,71	4.65	323.5	38.622	200.	11,530	122,7	37.92	
2.0	14.539	190, 1	38.430	52.7	37,74	4.85	320, 7	38,619	200.5	38.326	120.2	37,98	6.83
\$.0	18.333	189.4	38, 476	42.6	37,74	5.04	314.3	38,614	199.7	38.519	114.6	18.02	
9. 2	38.322	188.1	38.411	41.1	37.74	5.21	302.8	18,493	198.2	38.596	104.6	18.06	7,67
6.6	11.506	1,66.1	30.393	30.5	37.40	5.35	286.0	38.586	196. [	14.486	89.9		8.05
t. #	38.443	183.5	38.368	12.3	37.81	5,47	265.4	18,556	193.5	35.461	72.9	38,13	0.37
7.2	38.318	167.7	38.200	0	37.82	5.56	220. 2	38.511	186.8	38, 199	34.0	38, 15	8.63
7. 1	37.#73	125.1	37.757	0	37,82	5,54	170.3	36, 352	170.3	38.234	0		1.74
3.1	37.336	103.1	37.433	o.	37.82	5.34	137.6	37,974	137.0	37.858	0	35, 16	B. 76
6.7	37, 304	86.7	37, 214	0	37,82	3.54	114.5	37.679	114.5	32,370	0	38,16	8.76
3. 1	37, 151	25.5	37.620	0	37.82	5.56	99.7	37,441	99,7	37.380	0	14, 16	9,16
Legend 1							Ungand a					-	
Q.,/.	: dlache	erge upate	esa of side	overflow d	ike		Q./.				overflow a		
W./.	t vates	leval upo	streem of sid	e overfler	dike		¥ _{u/a}				a overflow		
Q _{d/1}	: dischi	itse dever	trans of aid	e overflor	41ke		Q4/e				• overflow		
14/8	1 Arres	level do	metress of s	1de overf!	ow dike		H _{4/} *	1 VACAT 1	evel downs	tress of a	ide overfl	ow dike	
44	1 overf1	lov dlacha	rg*				qu		n grecysta				
ЖÞ	1 48541	af feral	recarding be	ala.			нь	: water 1	evel in ce	tatding ba	2 <b>5</b> 6		
n	; store;	le Angrae	in retarding	bestu			Vb	1 atotate	volume in	retarding	basin		
			Sye i kivar i	0-ve )				1	Q-10yr &	Miver 10-j	r)		
Q _{efs}	H _{V/5}	Q _{d/s}		Q#	ИБ	Vb	0,/1	H _{U/s}	06/5	H _{U/s}	Q₩.	H6	ΥЬ
(* ³ /*)_	(=)	(n ³ /s)	(a)	(n ³ /s)	(e)	(x10 ⁶ = ³ )	(n ³ /s)	(a)	(m ³ /s)	(m)	(= ³ /s)	{ <b>a</b> }	(=10 ⁶ m ³ )
74 151							106.5	37.572	104.5	37.467	0	37.39	7.69
97,0	37.4	44 97.	0 37.346	0	37.5	9 3.69	135.2	37,953	135.2	37. #35	ō	37.59	
122.4	37,7		5 37, £74	0	37.5	9 3.69	177.3	38, 430	177.4	38,317	ŏ	37.59	
143,3	38, 2	76 163.	30, 157	0	37.5	9 . 3,69	227,9	38,521	167.9	38,409	40.0	37.59	
212,6	34.5	00 185,	4 38, 386	27.2	37,5	9 3,49	265.0	38.565	193.4	35.461	72.6	37.61	
260.3	18,5	59 192,	5 38,454	47,7	37.6	0 3.79	285.4	38,586	176.0	38.485	89.4	37.64	
277.5	35, 5	76 195.	0 38.475	B2.5	37.6	4.03	305.4	14,605	198.6	38,509	107.0	37,68	
295,#	38.5	96 197.	3 38,497	98.3	37,4	7 4.33	324.3	38,62)	200.9	38.530	123.4	37,17	
313.2	35,5	13 199,	3 38,518	113.7	37,7	2 4.69	310,9	34, 637	202.9	38.549	138,0	37,74	
328.9	38.4	27 201.	5 38, 536	127.4	17.7	7 5.09	Jev. 1	34.437	402.9	20. 249	1,10,0	21.24	3.23

Q _{0/5}	H _{V/5}	Q _{d/s}	X _{U/s}	Q.	Иб	Yb.
(n ³ /1)	(=)	(* ³ /s)	(a)	(m ³ /s)	<u>{e}</u>	(x10 ⁶ m ³ )
97,0	37,444	97.0	37.346	0	37.59	3.69
122.4	37, 787	122.6	37,474	0	37.59	3.69
141.3	38, 276	163.3	38. 157	0	37.59	3,69
212,6	34, 500	185,4	38.386	27.2	37,59	3,49
260.3	38,539	192.5	32,454	47.7	37,60	3.79
277.5	35, 576	195.0	38.475	82.5	37.66	1.03
295,#	38,594	197.3	38,497	98.3	37.47	4.33
313.2	35,513	199,3	38.318	113.7	37,72	4,69
328.9	18,427	201.5	30, 536	127,4	37.77	3.09
341.9	38,634	303.0	18,550	138.9	37,42	3.53
351.3	38,642	204,2	38.561	147.3	37.41	6.03
357.1	34.651	204.8	38.367	132.3	37.95	4.52
356.4	38,052	205.0	38.368	133,4	38.01	7.13
256.1	18,450	204,7	38,559	151,4	30.04	7,68
349.9	38,445	204.0	35, 559	145.9	38.11	1.23
339.9	38.632	202.6	34.548	137.1	18.16	8.75
324.4	34,623	200.9	34, 531	123.7	38,21	9.25
303.9	38.604	198.4	38, 507	105.5	38.23	9.49
281.1	36, 581	195.4	38.460	65.7	38,29	10.07
258.1	38, 337	192.3	38,451	45,4	30.31	10.18
191.3	38,465	101.4	14, 349	10,1	38,34	10.62
142,4	38, 127	149.9	33.004	-1,1	38.34	10.44
121.2	37.749	122.8	37.576	-1.1	34.34	
104.5	37, 359	105.6	37.455	-1.1	34.34	
94.9	37,429	95.9	37,322	-1.0	38, 36	
89.9	37.361	90,9	37.267	-1.0	39.34	

Quis ; discharge upstream of side overflow dike:

Nuls ; discharge downstream of side overflow dike
Quis ; discharge downstream of side overflow dike
Quis ; water level downstream of side overflow dike
Quis ; overflow discharge

B ; yater level in cetarding basin

Qu/s	Hu/s	6/5	"u/s	da.	no	10
(a ³ /s)	(=)	(= ³ /s)	(m)	(= ³ /s)	{a}(	±10 ⁶ n ³ )
106.5	37.572	104.5	37.467	. 0	37.59	3.69
135.2	37,953	135.2	37. #35	0	37.59	3.49
177.3	38.430	177.4	38.317	0	37.59	3.69
227.9	38,521	187.9	35,409	40.0	37,59	3,69
265.0	38.565	193.4	35.461	72.6	37.61	3.84
285.4	38.585	196.0	38.485	£9, L	37.64	4.10
305.4	34,605	198.6	38,509	107.0	37,68	4.42
324.3	38.62)	200.9	38.530	123.4	37, 23	4.81
310.9	34.437	202.9	38.549	138.0	37,78	5.25
354.7	38,449	204.5	38, 564	150.2	37.85	3.75
345.4	34.658	205.6	38, 576	139.6	37,98	6.45
372.3	38,664	205.5	34.583	165.7	37.98	6,86
374.7	38.666	206,9	38,584	147.8	38.04	7.46
372.6	38,664	206.6	38.584	151.0	38.10	8.06
365.4	38.639	205.9	38.577	160.5	38, 15	8.66
356.7	38.631	204.8	34.567	151.9	38,21	9.24
342,4	38,639	203, 1	38.551	139.3	28,76	9.78
322.5	38,621	200.7	34.528	121.8	38.31	10.29
299.1	38.599	197,8	38,501	101.3	38 35	10.72
274.9	18,575	194,4	36,472	60.3	38.35	11.09
231.5	38, 535	149.6	36.424	48.9	18.41	11.38
177.8	38.474	181.4	38.368	-5.5	38.42	11.55
139.9	38.250	161.3	38.334	-21,6	31.42	11,33
116.5	34, 531	135.2	37, 835	-10.7	38,41	11.44
102.3	37.734	118.8	37.625	-16.5	38.61	11.39
95.8	37, 623	110.1	37,319	-14.7	14,40	11.33
96.3	37.580	107.4	37.479	-13.1	36.40	11.24
98.4	37.616	110.0	37.512	-11.6	34, 39	11.23
102,4	37,747	119.0	37.437	-10.4	34.39	11.19

One : discharge upstream of eide overflow dike have : water level upstream of side overflow dike the control of the state overflow dike the control overflow discharge downstream of side overflow discharge dike the control overflow discharge the control overflow discharge the control overflow discharge the control overflow discharge without the control overflow discharge without as retarding basin the control overflow discharge without as retarding basin.

			er & River	23-yr )						(Q-Syr L s	iver 25-ye	}	
0/1	H _{0/1}	00/5	Xu/1	qw .	1-5	AR	0./1	R _{U/1}	9/1	R _{0/5}	4-	18	- 48
·3/5)	(n)	(a)/1)	(0)	(a ³ /1)	_(=)	(×10 ⁶ × ³ )	(n ³ /s)	(m)	(=1/1)	[9]	(* /1)	(a)	(= 10 6m) }
9.4	37.304	19.4	37.120	. 0	37.59	3.69	97-1	37.446	97.1	37.347	0	37.59	3.69
5.5	37.478	95.5	37, 374	0	37.59	3.69	122.6	37.790	122.8	37.676	0	37.59	3.69
35.7	37.960	33.7	37,842	Q	37.59	3.69	163.9	38.282	163.9	38.163	0	37.59	3.69
31.9	38,445	179.0	18, 327	7.9	31.59	3.69	213.8	34.502	185.6	18.388	28.7	37.59	3.69
12.0	38.376	144.5	18.415	43.5	37.59	3.70	260.9	18.360	192.7	38.454	68.2	37.61	3. 19
4.1	38.563	193.2	38,459	70.9	37.61	3.86	278.7	38.579	195.1	38.437	83.6	37.66	4,94
7.6	38.578	195.0	38, 475	52.6	37.44	4.11	297.8	38.598	197.6	38.500	100.3	37.67	4.34
1.0	39.591	196.7	38.492	94.3	37.68	4,41	315,9	38.615	199.9	38.521	116.0	37.72	4.70
3.2	38.66)	198.3	38,506	104.3	37.72	4,75	332,4	38.630	201.9	38.540	130.5	37.77	5.12
13.6	38.613	199.6	38.518	114.0	37,76	5.13	346.2	38.642	203.5	18.555	142.7	37.83	5.59
1,2	39,620	200.5	38,527	120.7	37.82	3.54	356.4	14.651	204.7	34.566	151.7	37.89	6.10
15.6	38.624	201.1	38.532	124.5	37.47	5.97	361.1	38.656	205.5	38.573	157.2	37.96	6.65
4.5	38.625	201.2	38.625	125.3	37.93	6.42	354,5	38.638	205.7	34.575	158.9	38.02	7.21
3.9	38.672	100.8	38,530	123.1	37.98	6.87	362.4	36.656	205.4	38.573	157.0	38.07	7.29
7.8	38.417	200.1	38, 523	117,7	39.03	7.32	336, [	38,650	204.7	33.566	151.4	38.13	8.35
1.34	18.606	198.7	18,310	108.0	38.07		346.5	38.642	203,6	38.555	112.9	38.18	8,90
0,0	38.590	196,6	38.490	\$3.4	38,11	4.13	331.6	38.629	. 201.8	38,539	129.6	38,22	9.41
0.2	38.570	194.0	38.466	76.2	38,14	8,47	310.9	33.610	199.2	38.515	111.2	38.27	9.88
11.4	38.523	148.4	38.413	43.0		8.74	247,4	38.586	198.3	38.487	91.1	38.31	10.28
6.7	38,422	176.7	38.304	0	38.18		263.9	38,563	193.1	18.438	70.8	38.34	10.61
0.8	38,005	140.8	37, 957	o o	36.18	•	207.1	38,492	184.4	38.374	22.7	38,36	10.88
16.8	37.710	116.5	37, 599	0	26.18		157.9	38.267	162.7	18.149	- 4.8	38.37	10.93
×).9	37.497	100.9	37. 396	0	38.18	4,49	127,2	37,905	131.7	27.750	- 6.5	36. 37	10.93
1.3	37.347	91.3	37,213	0	38.10	1.49	107.7	37.647	111.9	17.534	- 4.7	38.36	10.91
14,8	37.278	81.8	37,189	0	30,18	4.42	76.6	37,490	100.5	37.391	- 3.9	38. 35	10.90
11.2	37,229	41.2	37,143	ō	38.18	8. 19	10.9	37.410	94.5	37.315	~ 3.7	38.36	10.88
10.1	37,224	80.8	37,135		38.18		49.7	37.391	93.2	37.291	- 3.5	38.36	10.87
Lages		****		-	30.10	,	Lagend :						
9	I/S : dis- i/S : wat- i/S : dis- i/S : wat- i/S : Qva >   wat-	er level ( tharge don er level ( eflow ôle: er level !	upstream of downstream charge in retardin	Ide overflo side overf side everf of side ove g basin ding basin	low dike	•	Qu/s N/s Od/s Hd/s qu/s Hb Yb	1 Vater   1 dischar 1 vater   1 overfle 1 vater	tevel ups tgs downs tevel dow by dische level in	esa of side tream of si tream of si natrama of rge retarding h in retardin	de overflo elde overflo elde overf	w čike	

ţ	Q+10yr	4	Rivig	25-ye	}	

0.75	475	09/5	H _{V/s}	Qu'	- 1£;	
(43/1)	(u)	(n ³ /n)	(=)	{m³/s}	(a)	(:19 ⁶ m ³ )
106.5	37.572	106.5	37,467	0	37.39	3.69
135.5	37.957	135.5	37, #19	0	37.59	3.69
178.3	38,433	177.5	38.316	0.5	37.59	3.69
230.3	38.524	186.3	38.413	42.0	37.59	3.69
267.9	34.567	193.7	33.463	74.2	37.61	3.45
289.3	38.590	196.5	38,490	92.5	37.64	4.11
311.6	38.61%	199.3	38.514	112.3	37.69	6.43
332,2	38.630	201.9	38.539	130.3	37.74	4.85
330.3	38.646	204.0	38.560	146.3	37.79	5.32
365.4	38.658	205.8	38.576	139.8	37.16	3.83
377.3	38.668	207.2	38.589	170.1	37.9)	6.62
335.2	34,674	208.1	38.579	177.1	38.00	1.63
384.5	38.477	208.4	38,601	180.1	38.05	7.01
386,9	38.675	208.3	34.599	178.6	34.12	8,32
180.7	38.671	207.4	38.592	173.1	34.18	8.94
370.6	38.663	206,4	38,582	164.2	38.24	9.59
356.2	38.451	204.7	38.566	151.5	38.30	10.18
336.3	38.633	202.3	38.544	134.0	18.35	10.72
312.0	38.613	199.4	38.516	112.6	34.39	11.20
284.5	38.587	196.1	38.484	90.4	35.42	11.61
162.0	38.564	193.5	38.467	68.5	38.45	11.94
200.3	38.523	189,.7	38.424	10.4	38.47	12.18
153.0	38.496	185.7	38, 389	-32,2	38.47	12.22
124.3	38.342	171.3	34.245	-47.0	38.46	12.E0
106,9	18.076	143.4	37.959	-18.5	18.45	11.93
98.2	37.888	130.2	37.772	-32.0	38.44	11.79
95.9	37.790	123.0	37.676	-27.1	38.43	11.66

Queen the discharge upstream of aide overflow dike the vater lavel upstream of aide overflow dike the vater lavel upstream of aide overflow dike the vater lavel downstream of aide overflow dike the vater lavel downstream of aide overflow dike the vater lavel in retarding basin to storage volume in retarding basin

( 0-25vs	4	Liver	23-91 3

		( Q-2	ys A Miver	25-yr }			
Q _{U/s}	H _{o/s}	00/1	H _{u/s}	Q+	16	49	
(1/2)	(*)	(a ³ /5)	(4)	(a ³ /s)	(e)	(.106.3)	
151,4	38,144	151.4	38.023	0	37.59	3.69	
195,8	38,473	182.3	38.358	13.5	37.59	3.69	
249,6	38.547	191.1	18,440	38.3	37.60	3.74	
275.7	38,576	195.7	38.473	81.0	37.62	3.74	
300.9	38.601	198.0	38.503	102.9	37.68	4.24	
325.0	38.601	201.3	18.532	124.7	37.71	4.61	
368.1	38.854	201.1	38.557	144.)	37,76	5.08	
367.7	38,650	203.8	38.574	161.7	37,45	3.08	
384.3	38.674	208.0	38.594	176.3	37.90	5.38 6.16	
397.3	38,664	209.4	38.610	187.9	37.98	6.50	
406.3	38.691	210.5	38.519	193.8	38.01	7.47	
410.3	38.694	210.9	38.624	199.1	38.11	9.10	
410. I	38,694	210.9	38.623	199.1	38.18	4.50	
403.0	38.690	210.7	38.618	194.7	38.24	9.61	
393.0	30.682	209.1	35.608	183,8	38.31	10.32	
361.3	36.671	207.6	38.593				
362.5	18.456	203.4	38.373	173.7	38.37	10.98	
302.5	34.635	203.4			38.42	11.61	
311.1			38,366	135.5	38,47	12.15	
288.4	38.616	200.6	38.327 18.326	110.3	38.50	12,66	
259.5	38.611	201.1	38.532	#3.# .38,4	38.55	13.06	
192.4					18.56	13.16	
143.6	34.401	199.5	38.517	7.1	18.57	13.57	
122.8	38.569 38.571	197.2	38.497	-48.6	38.57	13.55	
			30,471	-71.7	38.55	13.37	
103.7	38.547	191.1	38.439	-82.4	18.54	13.11	
103.5	34.519	187.2	38,403	-83.7	38.52	12.12	
107.0	38.430	177.5	38, 313	-70.5	35.17	12.52	
117.9	38.387	173.6	38,270	-55.7	18.47	15.36	
131.2	38.435	178.2	38.319	-45.0	34,46	12.06	
140.3	38.466	181.6	38.351	-33.3	38.45	11.90	
161.3	28.471	182.7	38. 361	-21.4	38.44	11.78	
171.0	38.477	189.5	34.368	-12.5	38.63	11.70	
176.6	38.480	0.+51	38.373	- 7,4	38.43	11.66	٠,
177.2	38.440	183.9	38.372	- 6.7	38.43	11.63	
172.4	38.473	183.0	30.354	-10.4	34.47	11.61	
163.0	36.457	180.9	38, 343	-17.9	36.42	11.57	
153.0	38.382	173.4	38.248	-20.4	38.47	11.51	
144.5	36.262	167.4	18.146	-17.9	31.41	11.43	
133.7	31,142	151.5	38.026	-15.6	38.41	11.37	
125. 8	31.011	140.0	37,276	-14.2	31,40	, 11.31	
115,4	37,836	128.1	37.745	-12.5	34.40	11.26	-
105.9	37.710	117.0	37.607	-11.1	34.39	11.21	
97.4	37.581	107.4	37,439	-10.0	38.39	11.17	
89.E	37.465	98.8	37.369	- 9.0	30.32	11.14	
\$3.0	37, 361	91.2	37.271	- 4.2	38.38	, man	
77.3	37.274	84.8	37,189	- 7.5	30.38	11.08	1.
73.1	37.208	50.0	37.127	- 6.9	35,38	11.05	
71.4	37.178	77.7	37.098	- 6.3	31.37	11.03	
73.4	37.204	79.4	37,123	- 5.8	31.37	11.00	
\$1.3	37, 302	86.7	37.214	- 5,6	34.37	10.94	
93.5	37,443	98.4	37.346	- 5.1	38.37	10.76	
108.5	37.650	113.2	37.554	- 4.7	35.37	10.94	
122.8	37.847	127.2	37,733	4.4	38.37	10.93	
132.6	37.972	134.€	37.455	- 4.2	34.35	10.91	
					•		

i discharge upstream of eide overflow dike i water lavel upstream of eide overflow dike i discharge downstream of eide overflow dike i vater lavel downstream of eide everflow dike i vater lavel in ratarding basis i vater lavel in ratarding basis i etorage volume in ratarding basis

		( q-2)	yt & River	10-yr )						( 0-3yr &	Kiver 10-y	<b>( )</b>	
(e)/s)	N _{U/\$}	0 _{d/s} {a ³ /s}	N _U /s (α)	qs (a ³ /1)	96 (±)	(10 ⁶ a ³ )	0 _{0/1} (a ³ /s)	H _{U/s} (a)	(a ³ /s)	Η _{υ/ε} (*)	(m ³ /s)	[e] [	75 710 ⁶ m³)
192. 1	44,352	192.1	8511,23	. 0	63.00		133.*	43.807	133.9	43,559	0	43.00	0
242.4	44.882	257.0	44.530	25.6	43,00	0	254.5	44.872	248.4	44.414	6.1	43.00	0
340.4	44.978	220.2	11./21	69,7	43.04	0,09	346.5	45.016	270.7	44.65)	90.3	43.01	0.02
370.3 .	45.022	277.0	44.662	93.3	43,16	0.36	434.7	45.111	289.6	44.765	147.1	43.16	0. 35
375.4	45.029	278.0	44.669	97.4	43.31	0.48	461.6	45.151	295.3	44.787	173.3	43.40	0.88
355.8	45.001	274.0	44.442	41.4	43.48	1.03	467.6	45.150	795. i	44.781	172.5	43,65	1.30
315.5	44,939 .	265.2	2434	50, 3	.43.61	1.33	435.8	45.110	289.4	44,744	146.4	43,82	2.12
263.2	44.847	231,9	\$4,497	13.3	43.66	1.51	319.7	65.036	779.0	\$6.875	101,1	43.95	2.05
214.9	44.553	214.9	16./12		43.47	3.55	315.5	44.939	265.2	44.384	30,3	44.04	3.01
171.7	44.163	171.7	43,463	0	43.67	1.55	251.9	44.815	247.4	44.467	4.5	44.07	1.20
137.3	43.640	137.3	43.546	0	43,47	1.53	197.2	14. 197	197.2	44,069	0	44.07	3.21
ļitis,	43,568	111.5	43,378	٥	43.67	1.55	154.4	44,000	154.4	43.724	•	44.07	3.21
93.5	43,407	93.5	43.231	٥	43.67	1.33	122.7	\$3.69 <b>8</b>	122.7	43.468	0	44.07	3.21
40.2	43,271	20.2	43.125	٥	43.67	1.55	101.2	43,485	101.2	41.295	٥	44.07	3.21
							84.1	43.332	85.1	43.175	0	11.07	3.21

( Q-10ye & Miver 10-ye )	(	Q- LÖye	6	Ner	10-TF	1
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#### ( Q-25yr & River 10-yr )

0/5	H _{U/5}	06/1	H _{w/s}	Q=	16	Vb ·	Q _{u/s}	Н _{0/s}	00/5	H _{U/s}	Q=		VB-
( <del>**</del> /\$)	(=)	(n³/s)	(+)	(e ³ /5)	(=)	(x10 ⁶ = ³ )	(= ³ /s)	(a)	<del></del>	(*)	(n ³ /s)	(*)	(±10 ⁶ m ³ )
61.2	44.067	151,2	43.779	0	43.00		186.5	46.300	186.5	43.983	٥	43.00	0
04.6	44.921	262.6	44.567	42.0	43,00	0	332.4	44.997	. 273.4	44.638	79.4	43.00	0
34.4	45.109	289.3	44.743	145.5	43.07	0.15	494.9	45.183	299.8	44.812	195.1	43.13	0.79
15. 1	41.207	303.2	44.834	216.9	43.31	0,61	\$70.0	45.271	312.0	44.892	251.0	43,46	0.29
7.4	45.745	308.4	44.869	239.0	43.64	1.44	590.7	45.295	315.3	44.914	274.4	43.76	1,92
9. \$	45,236	307.2	44.860	232,4	43,87	2,30	584,1	65,287	314.2	44.907	269.9	44.0Z	2.91
7.1	45.186	300.1	44.814	197,0	46,06	3.14	354,0	45,253	309.5	46.875	244.5	44,70	3.6%
0,4	45,103	244.3	44,737	143.9	44.19	3,44	493. i	45.187	300.3	44.815	197.8	14.35	1.74
4.2	45,999	273.7	46.640	\$0.3	44.28	4.36	424.0	45,035	287,4	44.731	127.4	44.47	3.17
11.2	44,879	256.6	64.528	24.6	44,34	4.65	341.3	44.990	272.4	66,633	25.9	44,34	5.97
8. 0	44,589	214.4	44.243	0	44.35	4,73	278.8	44.881	258.6	44,542	20.2	44.18	6.24
). I	44,147	149.8	43.848	0	44.35	4.73	219.5	46.583	232.3	64.352	-12.8	44.59	6.31
<b>4.</b> 1	43,509	134,1	43.560	•	44, 35	4.73	123.1	44.269	184.6	43.968	-11.5		1,22
9.1	43.564	109.1	43.359	0	44.35	4.73	134.6	43.937	149.1	43.681	-10.5	44.57	6.72
92.2	43.394	92.2	43.222	0	44.35	4.73	113.6	43.437	123.2	43,472	-9.6	44.57	6.19

## ( Q-lyr 6 Alver 25-yr )

0 _{0/6}	H _{U/s}	Q _{6/1}	H _{U/\$}	d4	16	Y5	Q _{u/s}	Я,,
(m ³ /s)	(a)	(a ³ /s)	(+)	[a ³ /s]	(+)	(±10 ⁶ = ³ )	(e ³ /5)	{a
192.1	43.951	192.1	43,640	0	43,00	0	133,9	43,4
282.6	44.716	282.6	44.369	0	43.00	0	254,6	44.45
340.4	64.891	309.5	44.348	30.9	43.00	. 0	366.4	44.9
370.3	46.936	317.3	44.393	53.0	43,03	0.11	435.8	45,0
375.6	45.946	318.7	44.601	36.9	43, 14	9.30	468,6	45,0
155,4	44.916	313.4	44.571	42,2	43,23	0.51	467,4	45,0
315.4	44.843	302.3	44.499	13.3	43.30	0.44	435,4	45,0
265.2	44,580	245.2	44.734	. 0	43.33	0.71	180.7	45.95
216.9	44.151	214.9	63.875	0	43.33	0.71	315.6	. 44.80
171.7	43.768	171.7	43.474	0	43.33	0.71	251.9	44,40
137.3	43,449	137.3	43.184	G	43,33	.0,71	197.2	44.99
111.5	43.200	111.5	42.985	0	43,33	0.21	154.4	43.60
93.5	43.021	93.5	42.832	6	43,33	0.71	122.7	43.30
80.2	42.885	80.2	42.720	0	43.33	0.71	101.2	43.09
							44.1	**

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Lee e pod	

- agend i  $Q_{u/q} = 1 \text{ discharge upstrain of side overflow dike}$   $M_{u/q} = 1 \text{ water level upstrain of side overflow dike}$  1 water level downstrain of side overflow dike  $M_{d/q} = 1 \text{ water level downstrain of side overflow dike}$  1 water level downstrain of side overflow dike 1 water level in raterding basin 1 storage volume in retarding basin

(a)/s	Я _{ш/}} (м)	0 _{d/s} (a ³ /s)	H _{u/s} (a)	(= ³ /s)	785 [m]	(=10 ⁶ = ³ )
7= 151	197	1~ />/				1210 8
133,9	. 43,416	133.9	43.167	0	43,00	•
234,6	44,491	254.6	46,148	0	43,00	0
366.4	44.932	318.4	44.387	50.0	43.00	
435.8	45,029	332.7	44.68	104.1	43,08	0.18
468,6	45,068	339.4	44, 225	129.2	43.76	0. 55
467,4	45,047	339,2	44,724	124.4	63, 47	1.02
435, 8	45,021	132.3	44,684	103.3	43.65	1.46
380.7	45,953	319.9	44 908	60.8	43.75	1.85
315.6	44.865	302.2	44.499	13.3	43,81	2.07
251.9	44,468	251.9	44.126	0	43,82	2.12
197.2	44.996	197.2	43.481	. 0	43.82	2.12
154.4	43,509	154.4	43.333	0	41.42	2.12
122.7	43.309	122,2	41.074	0	43.12	2.12
101,2	43.098	101.2	42.901	0.	43.82	2.12
84.1	47.946	14,1	42.778	0	43.42	2.12

- od i discharge upatrana of side overflow dike R_{ufa} s water lovki upatrana of side overflow dike Odfa i discharge downstream of side overflow dike N_{dfa} i water level downstream of side overflow dike question of side overflow dike question discharge No i water level in retarding basin

- I storage volume in retarding havin

Table 4.3.4 FLOOD ROUTING IN THE ULO RETARDING BASIN (5/7)

		( 0-10	yr & River	25-yr )				25-yr }	r )				
(m)/1)	)(u/s (m)	0 _{d/s} (m ³ /s)	H _{U/S} (#1	Q≠ {π ³ /s}	(m)	Vb (a 10 ⁶ m ³ )	(m ³ /s)	H _{u/s}	Q _{d/s} (n ³ /s)	и _{и/s} (a)	qv (a ³ /s)	HS (=)	(x10 ⁶ a ³ )
161.2	41.672	161.1	43, 389	0	43,00	٥	186.5	43,901	186.5	43.394	0	43.00	0
304.6	46.871	294.5	44.474	6.1	12,00	Ď	352,7	44,911	312.4	46.366	39.9	63.00	o
434.6	45.024	332.2	44.683	102.6	43.01	0.02	494.9	45.099	346.8	44.757	150.1	43.07	0.14
515.1	43,122	349.0	44.380	\$66.1	43.18	Ų. <b>39</b>	370.0	45,147	360.0	44 841	210.0	43.32	0.68
\$47.4	45,158	335.5	418.41	191.9	43,46	0,95	\$90.7	65,206	384.0	44,863	224.2	43.64	1.44
235.8	43,150	354.0	44,508	185.8	43.70	1,68	584.1	45.197	162.7	44,456	221.4	43.85	2.16
497.1	45,101	345.3	44.759	142,8	43.14	2.35	333.9	45,165	356.8	44,823	197.1	44.05	3.05
430.5	45.020	331.3	44.677	99,2	44.02	2.89	498.1	45,102	345.5	44.760	132.6	44.16	3,76
354.2	44,913	313.7	64.568	10,9	44.08	3. 25	424.8	45.013	1.01	64,669	94.7	44.27	4.31
281,2	44,706	281.2	44.360	Ð	44.11	3.40	348.2	44.904	371.6	44.559	36.6	44.34	4.65
210.4	44,125	218.8	43.857	0	44.11	3,40	270.4	44,689	278.6	44,343	0	44.38	4.78
169.4	43,751	169.8	43.459	0	44,11	3.40	219.6	44.192	219.6	43,884	0	66.36	4.78
134.1	43.413	134.1	43.168	0	44.11	3,40	173.1	43.781	173.1	43.486	0	44.36	4.78
109.1	43,176	109.1	43.905	0	44.11	3.40	136.6	43,461	118.6	43.205	0	44.36	4.71
92.2	43,005	92.2	42.828	9	4,11	3,40	117.4	43,720	110.4	43.007	• .	44,36	4,73

Table 4.3.4 FLOOD ROUTING IN THE KEDUNGSOKO RETARDING BASIN (6/7)

( Q-1.03yr & River 4D-yr )							( Q-7yr 6 River 10-yr )						
V/5	× _{v/s}	00/1	K _{0/1}	4-	36	Yb	Q _{u/s}	R _{U/s}	06/1	N _{U/s}	Q=	ж-	- AP
(a ³ /s)	(*)	(n ³ /1)	(a)	(e ³ /s)	(•)	(x10 ⁶ m ³ )	(e ³ /s)	(-)	(* /s)	(-)	(0)(1)	(-)	(=10 ⁶ = ³ )
114.3	44,433	114.2	44.269	8	43.45	0.39	146.8	44, 699	136.3	44,513	17,3	43.85	0.99
144.3	44,732	139.5	66.547	26.5	43, 83	0.99	215.7	44.809	147.3	64,623	49,4	43,84	1.05
206,4	66,794	145.8	44.609	10.4	45.87	1.10	249.2	44.875	154.5	44,491	114,7	43.92	1.30
217.0	44.509	147.4	44.623	49.4	43.93	1.31	283.0	44,492	155.7	44.707	126.8	44.02	1.71
159.4	44,375	143.2	44, 334	46.2	43.99	1.57	267.0	44.44	151.3	44.443	95,5	44.11	2.16
146.2	46,693	135.B	44.508	10.4	41.03	1.23	190,7	44,771	143,4	44.584	47.3	44.10	2.51
111.1	44.418	111.1	44.232	0	44,03	1.77	164.9	44.490	135.5	44.505	5.4	44.21	7.68
68.1	44.101	88.1	43.926	0	44.03	1.73	115.9	44,463	114.9	44.278	0	44.22	2.71
73.2	43.678	23.2	13,720	•	44.03	1.77	83, 3	44.210	\$5.5	44.027	ø	44.22	7.71
67.4	43,712	62.4	43.572	٥	64.03	1.77	81,4	41.001	81.4	43.833	0	44,32	2.71
33.5	43.573	53.5	43,419	•	44.03	1,77	49,2	43.824	69.8	43.674	0	44,22	2.21
46.4	43,459	44.4	. 43,352	0	44.03	1.77	60.5	43,602	60.5	43.544	. 0	44,22	2.21
												•	
	{ Q-5yr & River 10-yr }						( Q-loyr & River 19-yr )						
Q _{0/s}	H _{U/3}	90/5	×e/s	Q.v	Нь	W5	0,/5	N _{U/\$}	96/1	W/1	Qv	нь	V6
[= /5]	(a)	(= ³ /3)	(=)	(# ³ /1)	(4)	(±10 ⁶ e ³ )	(e ³ /s)	(n)	(a /s)	(=)	(= /s)	(*)	(+10 ⁶ m ³ )
195.G	44,778	144.1	44.592	50.9	43.85	0.99	127.9	44.610	127.9	44.423	0	43.45	0.99
280.2	44,889	155.9	44.704	124.3	43,90	1.16	250.5	44.827	149.3	16,661	J1, 2	43,45	0.99
341.3	64,958	163.4	44.275	177.9	44.01	1.43	326.9	44,942	161.6	44.759	165.2	43.92	1.79
331.0	44,968	164.4	44.785	185.4	44.13	2.27	392.3	45,012	169.7	44.830	222.6	44.66	1.49
298.6	44.910	158.2	44.726	140.4	44.24	2.94	298.2	45.01#	170.3	44.836	227.7	44.21	2.69
224,1	64, \$17	168.4	44.473	75.7	44.34	3,45	333.0	44,950	142.5	64.767	171.3	44,33	3.31
166.7	44,733	139.5	44,547	27.2	44,39	3.71	246.8	24,848	151,5	44,663	95.3	64.45	4.13
197.3	46.634	130.1	44,450	0	44.40	3,42	181.6	44.757	141.9	44.577	39,7	44.30	4,47
\$0. B	44,372	90.8	46, 187	0	44.40	3, 82	140.4	64,653	135.1	44,501	. 5. 5	44.52	6.6;
17.5	43.943	77.5	43,740	0	46,40	3.62	115.1	46,696	117. 8	44,312	- 2.7	44.52	4.63
46.4	43.740	66.8	43,432	0	44,40	3. 62 3. 62	97.0	44.264	99.6	44.083	- 2.6	44,52	4.43
	43.740	****	43.425	٠	**.**	3. 42	22.6	44.052	85.0	43.883	- 2.4	44.32	4.61
Legend	4 .						71,1	43.477	73.4	43.723	- 2.3	66.31	4.60
Q _{ufs} : discharge upatrees of side overflow dike B _{ufs} : water level upatrees of side overflow dike							foliant in a flactuaries of a side analytics dike						
Que a graculate government of side examples dige							ufa I water lavel uppercam of side overflow dike						
H _{d/s} I water level downstream of side overflow dike qv t swerflow discharge							Q _{dfo} : discharge downstream of side overflow dike						
e Fa			ierge A roterdios	h			Wafe I water level downstream of side overflow dike						
			-				dn I manijon gracperka						
To ; storage volume in reterding bearing						Mb ; water level in reterding besin							
							Th	I SECTAS	ı Yolume i	n retarding	basto		

#### ( 0-25vr & River 10-vr )

		, 4	,,, , ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	10-11		
q _{0/s}	7 XU/5	$0_{d/s}$ $(a^3/s)$	Wu/s	(n ³ /s)	) (m)	(#10 ⁶ # ³ )
(m²/+)	(a)	7571	(n)			(3.0 - 7
152.4	44.704	137.0	44.521	15.4	43.83	0.99
274.3	44.882	155.1	44.697	119.2	~ 63.06	1.06
384.4	45,004	168.8	44.822	215.6	43.97	3.48
455.3	43.027	177.2	44.895	278.1	44.13	2.26
455.2	45.014	177.2	44.495	275.0	44.36	3.26
374.8	44.994	167.6	44.411	207.2	44.47	4.26
272.0	44.579	154.8	46.691	117.2	44.57	3.01
197.1	44.747	145.9	44.619	50.2	44,63	5.43
151.2	44,740	144.2	44,393	7.0	44,45	3.41
123.0	44.713	141.6	44.369	-18.6	44.46	3.44
103.5	44.687	138.4	44.535	-34.9	44.63	3.57
47.9	44,556	125.0	44.395	-37.1	46.63	3.44
75.5	44.307	103.9	44.143	-28,4	44,61	5,31
. 65.7	44.084	48.4	43.929	-22.7	44.60	5.21
37.9	43.905	76.3	43.763	-18.4	44,59	5.13
31.3	43,760	66.8	43.632	-13.3	44.58	5.04
44.1	43.441	59.1	43.576	-11.0	44.57	5.01

44.57

44,58

44.53

44.55

44,54 44,54 44,54

-11.2

- 9.7

- 8.6 - 2.7

- 4,2 - 5,4 - 5,7

4.56

4,92

4.11

4,83

4.83

4,80 4,28

#### ( Q-2yr & River 25-yr )

43.438

43.364

43,303

43,253

43,212

43.175 43.186

43.324

41,5 37,6

34.3 31,6

29.4

27.6

29.7

39.2

43.541

43,437

43.317 43.329

43.231

43.239

43.252

43,416

52.7

47,3

42.9 39.3

33.6 34.3 44.4

Q _{U/\$}	9/1	00/5	H _{u/s}	9.4	16	10	_
(a ³ /1)	(•)	(e ³ /s)	(=)	(= ³ /s)	(=)	(x10 ⁶ = ³ )	
140.8	44.645	148.8	44,461	0	43.85	0	
216.9	44.779	163.2	44.599	53.7	45.43	0	
259.2	44.843	171.3	44.670	97.9	43.96	1.19	
283.0	44.861	173.3	44.687	109.7	43.99	1.55	
217.1	44,816	168.0	14.643	79.1	44.07	1,94	
190.7	44.740	151.7	44.558	32.0	44,13	2.23	
144.8	44.607	144.8	44.422	۰	44.15	2.34	
116.9	44,278	114.9	44,093	0	46,15	2,34	
95.5	44.023	93.5	43.452	٥	44:15	2.34	
\$1.4	43.822	31.4	43.076	٥	44.15	2.34	
45.5	43.572	69.0	43.532	0	44.15	2,36	
60.3	43,540	60.5	43.416	٥	44.13	2.34	

#### ( Q-10yr & River 25-yr )

0,/1	H _{v/s}	04/1	N _{U/s}	d.	ю	Vb
(* ³ /\$)	(=)	(= ³ />)	(=)	(= ³ /s)	(4)	(x10 ⁶ m ³ )
128.0	44,431	128.0	44.245	0	43.45	0.99
230.6	44.797	163.4	44.618	45.2	43.85	0.95
324.9	44.908	120.3	44.741	147.6	43.91	1.23
392.4	44.975	144.2	45.316	204.2	44.03	1.77
398.2	44.581	149.0	11.122	209.2	64.18	2.50
333.8	44.914	180.2	44.749	131.4	44.33	3.25
216.5	44.818	168.0	88.640	78.9	44,40	3,41
101.6	44,725	157.1	44.542	24.5	44.44	4.09
140.6	44.566	140.6	44.381	Q.	44.45	6,18
115,1	44,280	115.1	44.095	0	44,45	4.14
97.0	44.043	97.0	43.876	0	46.45	4.18
42.4	43.849	82.6	43.491	0	44.45	4.10
21.1	63.490	71.1	43,548	0	44.45	4.18

- Qu/s : discharge upstress of side overflow dike Bu/s : water level upstress of side overflow dike
- Que z discharge downstream of mide overflow dike
- Q_{d/a} = disthergs downstream of side overflow dike
  W_{d/a} : water lawel downstream of side overflow dike
  v : overflow discharge
  Wh : veter level in retarding basin
  Wh : storage volume in retarding basin

#### ( Q-1.05yr 6 Miver 25-yr )

Qu/s	H _{V/5}	04/4	У ₀ /1	4-	146	V6
(* ¹ /5)	(•)	(= ³ /5)	(m)	(4)/1)	(A)	(x10 ⁶ m ³ )
114.2	44.269	114.2	44.084	0	43.85	¢
166.3	44,697	154.1	44.513	12.2	43,85	0.99
106.4	46.764	161.5	44.583	66.9	43.86	1.04
217.0	44.779	163.3	44.599	53,7	43.90	1.21
169.4	44.738	158.5	46.356	30.9	43.95	1.40
146.1	44.620	146.1	44.435	.0	43.98	1.51
111.1	44.229	111.1	44.045	0	43.98	1.51
88. L	43.923	88.1	43.740	0	43.98	1.51
73.2	43.567	73.2	43,440	0	43,98	1.51
42.4	43.567	62.4	13,140	0	43.98	1.51
53.5	43,440	53.5	43.329	0	43.98	1.51
44.4	43.337	46.4	43.741	. 0	43.95	1.51

#### ( Q-3yr & Alver 25-yr )

0./1	H _{U/s}	04/5	Ч _{у/s}	Q≠	η.	119
(e)/3)		(a ³ /s)	<u>[0]</u>	(=1/5)	(e)	(110 ⁵ m ³ )
194,9	41,747	139.3	44.365	35.4	43.45	0.19
280.2	44.852	172.9	46.684	107.3	43.45	1.13
341.3	44.923	181.2	44,758	140.1	43.98	1,51
351.0	44.933	142.5	44.769	164.5	41.10	7.09
298.7	44,878	175.5	44.707	123.2	44.22	2.70
224.1	44,789	164.4	41,409	59.7	44.29	3.14
144.7	44.698	134.2	44.514	12.3	44.33	3.36
130.4	44,457	130.4	44,271	9	44.33	3.40
107.3	44.179	107.3	43,996	٥	44,33	3,40
90,8	43,960	50.4	43,793	0	44.33	3.40
77.5	43.779	27.5	43,624	٥	45.33	3,40
45.5	43.430	46.3	43,495	0	44.33	3.40

#### ( Q-25yc & River 25-yr )

0 _{0/5} [n ³ /5] 153.4	{0} 44,664	0 _{d/s} (m ³ /s)	(*)	(a ³ /s)	(=)	(x10 ⁶ a ³ )
152.4		110 1			~ ~~	(xio, m.)
		150.6	14,479	1.4	43,45	0.99
274.3	44.451	172.0	46.578	102.3	43.45	1.01
384.5	44.967	167.2	44.807	197.3	43.94	1.37
455.7	45.035	198.4	44,484	258.7	44,10	2.09
455.2	45.033	196.5	11,150	258,7	44.17	3.02
374.8	44,957	185.8	44.794	189.0	44.42	3.95
272. L	44,448	171.7	44,474	100.4	44.52	4.63
197.3	44.752	160.3	44.574	34.7	44.57	4.99
131.1	44.491	155.2	44.524	- 4.1	44.59	5.17
123.0	44.351	140.4	46,379	-17.4	44.39	5.11
103.6	44.306	111.1	44,133	-16.5	44,50	5.04
89.0	44,077	100,4	43.913	-12,4	44.57	4.99
73.5	43,886	44.2	43,736	-10,J	44.36	4.95
45,7	43.733	75.1	43.398	- 9.4	46.56	4.91
57.9	43.609	46.2	43,448	- 4.3	44.35	4.47
51.5	13.507	34.9	43, 297	- 7.4	46.55	1.14
46.1	43.419	52.8	43,320	- 4.7	44.55	4.42
41,5	43,343	47.3	43.235	- 4.0	41.34	4.79
37.6	43.279	43.1	43,200	- 5.5	44.54	4,27
34.3	43.224	39.3	43.153	- 3.0	44,34	4.75
31.6	43.179	34.2	43.115	- 4.4	44.53	4,73
29.4	43.141	33.7	41,013	- 4.3	44.53	4.72
27.4	43,107	31,4	43.034	- 4.0	46,53	4,70
28.7	43.123	32.6	43.067	- 1.7	46,53	1,69
39.2	43.275	42.4	43.194	- 3.6	44.57	4,47
44.1	45.431	47.3	43.501	- 3.2	44.53	4.45
92.5	44.019	95.5	43.852	+ i.0	44.52	4,45

- $\hat{Q}_{M/0}$  2 discharge upstream of side overflow dita.  $\hat{R}_{M/0}$  1 water level upstream of side everflow dita.  $\hat{Q}_{M/0}$  1 discharge downstream of side everflow dita.
- All a vater level downstreem of side overflow disa-que i overflow discharge

  Bb : water level in retarding basis
- The storage volume to retending basis

Table 4.3.5 FLOOD PEAK REDUCTION AND ITS VOLUME

Widas Retarding Bas	sin
---------------------	-----

River	Return Period	ge	Volume	
Cross-section	of Flood (Year)	Before reduction (m ³ /s)	After reduction (m ³ /s)	(x10 ⁶ m ³ )
	10	37.5	207	7.86
10-yr plan	5	358	205	6.97
	2	324	201	5.07
	1.05	245	191	1.85
	25	410	211	9.88
25-yr plan	10	389	208	8.53
	- 5	365	206	7.26
	2	327	201	5.20

Ulo Retarding Basin

River	Return Period	Peak Discha	Peak Discharge				
Cross-section	of Flood (Year)	Before reduction (m ³ /s)	After reduction (m ³ /s)	(x10 ^b m ³ )			
	10	547	308	4.73			
10-yr plan	5	469	295	3.21			
·	2	376	278	1.55			
	25	591	364	4.78			
25-yr plan	10	547	356	3.39			
	5	469	339	2.12			
	2	376	319	0.71			

Kedungsoko Retarding basim

Return Period	Peak Discl	Volume.	
of Flood (Year	Before reduction (m ³ /s)	After reduction (m ³ /s)	(X10 ⁶ m ³ )
10	398	171	3.63
5	351	165	2.82
2	283	156	1.71
1.05	217	147	0.77
25	455	197	4.12
10	398	189	3.18
5	351	183	2.40
2	283	173	1.34
1.05	217	163	0.51
	of Flood (Year 10 5 2 1.05 25 10 5	of Flood (Year (m³/s)  10 398 5 351 2 283 1.05 217  25 455 10 398 5 351 2 283	of Flood (Year         Before reduction (m³/s)         After reduction (m³/s)           10         398         171           5         351         165           2         283         156           1.05         217         147           25         455         197           10         398         189           5         351         183           2         283         173

Table 4.3.6 MAXIMUM WATER LEVEL, INUNDATION AREA AND STORAGE VOLUME IN RETARDING BASIN (Cross-section for 10-year probable flood) (1/2)

Th			R	etardi	ng Basi	in			
Return Period (Year)		Widas	1	U I o			Ked	ungsoko	
	Hb (m)	Vb (x10 ⁶ m ³ )	A (km2)	Hb (m)	Vb (x10 ⁶ π	A n ³ )(km ² )	Hb (m)	Vb (x106 _m 3	A )(km ² )
1.05	37.82	5.54	9.15		_	-	44.03	1.77	3.35
2	38.46	8.76	11.15	43.67	1.55	4.20	44.22	2.71	4.25
-5	38.34	10.66	12.08	44.07	3.21	5.75	44.40	3.82	5.30
10	38.42	11.55	12.45	44.35	4.73	6.25	44.52	4.63	6.05

#### Legend :

Hb : maximum water level in retarding basinVb : maximum storage volume in retarding basin

A : maximum inundation area

Table 4.3.6 MAXIMUM WATER LEVEL, INUNDATION AREA AND STORAGE VOLUME IN RETARDING BASIN (Cross-section for 25-year probable flood) (2/2)

Return			. 1	Retardi	ing Bas	in				
Period		Widas		U 1 o				Kedungs	dungsoko	
(Year)	Hb (m)	Vb (x106 _m 3)	A (km ² )	Hb (m)	Vb (х10 ⁶ п	A 13)(km²)	Hb (m)	Vb (x10 ⁶ m ³	A )(km ² )	
1.05	-		-	·	-	_	43.98	1.51	3.20	
2	38.18	8.89	11.25	43.33	0.71	2.20	44.15	2.34	3.90	
5 .	38.37	7 10.95	12.25	43.82	2.12	4.90	44.33	3,40	4.85	
10	38.47	12.22	12.70	44.11	3.40	5.80	44.45	4.18	5.60	
25	38.57	13.57	13.20	44.36	4.78	6.30	44.59	5.12	6.50	

#### Legend :

Hb : maximum water level in retarding basin
Vb : maximum storage volume in retarding basin

A : maximum inundation area

Table 4.3.7 STAGE DISCHARGE RELATION IN K. BRANTAS USED FOR STUDY ON DRAINAGE SLUICE OF WIDAS RETARDING BASIN (1/3)

Elevation (m)	Q (m3/s)		
34.00	100.00		
34.55	200.00		
35.26	400.00		
35.83	600.00		
36.30	800.00		
36.72	1000.00		
37.10	1200.00		
37.45	1400.00		
37.59	1500.00		
37.60	1600.00		

Table 4.3.7 STAGE DISCHARGE RELATION IN THE KEDUNGSOKO RIVER USED FOR STUDY ON DRAINAGE SLUICE OF ULO RETARDING BASIN (2/3)

Elevation (m)	Q.(m3/s)	
39.50	0	
40.50	31.71	
41.50	101.85	
42.50	202.92	
43.50	332.66	
43.70	361.96	
44.00	419.38	
44.50	536.36	
45.00	674.69	
45.50	831.97	

Table 4.3.7 STAGE DISCHARGE RELATION IN THE KEDUNGSOKO RIVER USED FOR STUDY ON DRAINAGE SLUICE OF KEDUNGSOKO RETARDING BASIN (3/3)

Elevation (m)	Q (m3/s)
40.75	0
41.75	15.92
42.75	52.18
43.75	106.35
43.85	112.75
43.95	120.79
44.15	139.04
44.35	159.57
44.55	182.12
44.75	206.56
44.95	232.78
45.15	260.70
45.35	290.28
45.55	321.45
45.75	354.20

Table 4.3.8 DESIGN FLOOD DISCHARGE HYDROGRAPH IN K. BRANTAS USED FOR STUDY ON DRAINAGE SLUICE OF WIDAS RETARDING BASIN (1/3)

No.	Q (m ³ /s)	No.	Q (m ³ /s)	No.	Q (m ³ /s)
1	1198.1	25	895.2	49	895.2
2	1180.8	26	895.2	50	895.2
3	1163.1	27	895.2	51	895.2
4	1145.0	28	895.2	52	895.2
5	1126.6	29	895.2	53	895.2
6	1107.9	30	895.2	54	895.2
7	1089.1	31	895.2	55	895.2
. 8	1070.2	32	895.2	56	895.2
9	1051.2	33	895.2	57	895.2
10	1032.1	34	895.2	58	895.2
11	1013.1	35	895.2	59	895.2
12	994.3	36	895.2	60	895.2
13	959.0	37	895.2	61	895.2
14	895.2	38	895.2	62	895.2
15	895.2	39	895.2	63	895.2
16	895.2	40	895.2	64	895.2
17	895.2	41	895.2	65	895.2
18	895.2	42	895.2	66	895.2
19	895.2	43	895.2	67	895.2
20	895.2	44	895,2	68	895.2
21	895.2	45	895.2	69	895.2
22	895.2	46	895.2	70	895.2
23	895.2	47	895.2	71	895.2
24	895.2	48	895.2	72	895.2
			•		

Table 4.3.8 25-YEAR PROBABLE FLOOD HYDROGRAPH IN THE WIDAS RIVER AT THE CONFLUENCE WITH THE KEDUNGSOKO RIVER (2/3)

No.	Q (m ³ /s)	No.	Q (m ³ /s)	No.	$Q (m^3/s)$
1	263.0	20	203.0	39	100.7
2	224.9	21	202.2	40	133.9
3	193.0	22	180.6	41	155.5
4	163.9	23	172.5	.42	161.8
5 .	138.3	24	150.3	43	160.3
6 -	115.3	25	129.0	44	157.3
7 .	87.2	26	112.5	45	152.1
8	86.2	27	99.9	46	144.0
9, ,	78,7	28	89.5	47	132.0
10	73.1	29	80.6	48	121.0
11	68.8	30	73.0	49	107.0
12	65.8	31	66.5	50	92.0
13	66.1	: 32	61.2	51	80.0
14	73.1	33	56.4	52	70.0
15	87.9	34	52.2	53	61.0
16	109.9	: 35	49.0	54	54.0
17	136.4	36	48.3	55	52.0
18 .	165.1	37	53.6	56	51.0
19	189.9	38	70.6	•	•

Table 4.3.8 25-YEAR PROBABLE FLOOD HYDROGRAPH IN THE KEDUNGSOKO RIVER (3/3)

No.	Q (m ³ /s)	No.	$q (m^3/s)$
1	151.2	24	147.4
2	123.0	25	135.0
3.	103.6	26	117.4
4	88.0	27	101.0
⁻ 5	75.5	28	88.5
6	65.7	29	78.4
7	57.9	30	69.5
8	51.5	31	61.6
9	46.1	32	54.7
10	41.5	33	48.8
11	36.6	34	43.8
12	34.3	35	39.6
13	31.6	36	36.1
14	29.4	37	36.9
15	27.4	38	50.3
16	28.7	39	70.7
17	39.2	40	79.1
18	64.1	41	72.9
19	92.5	42	65.1
20	114.1	43	60.8
21	134.0	44	58.1
22	149.0	45	55.2
23	152.8	46	51.3

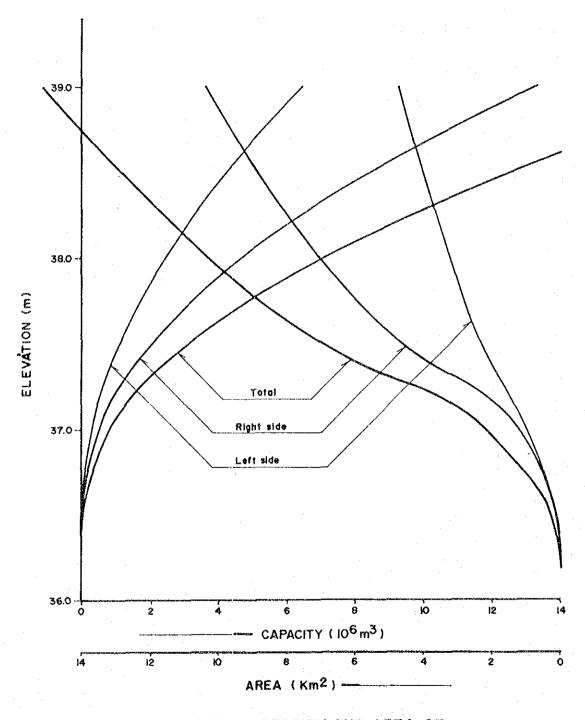


Fig. 4.3.1 STORAGE CAPACITY AND AREA OF WIDAS RETARDING BASIN (1/3)

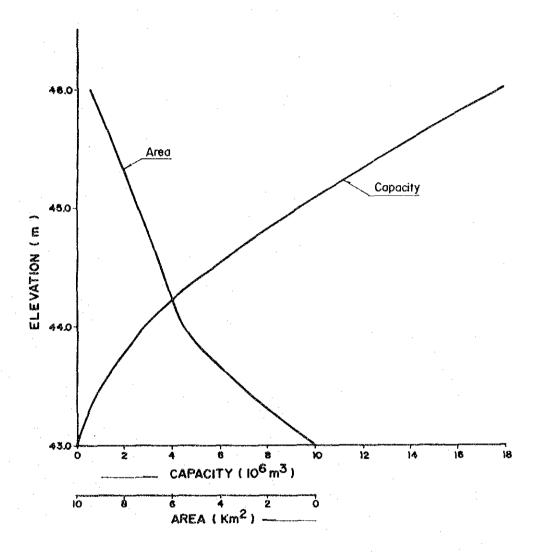


Fig. 4.3.1 STORAGE CAPACITY AND AREA OF ULO RETARDING BASIN (2/3)

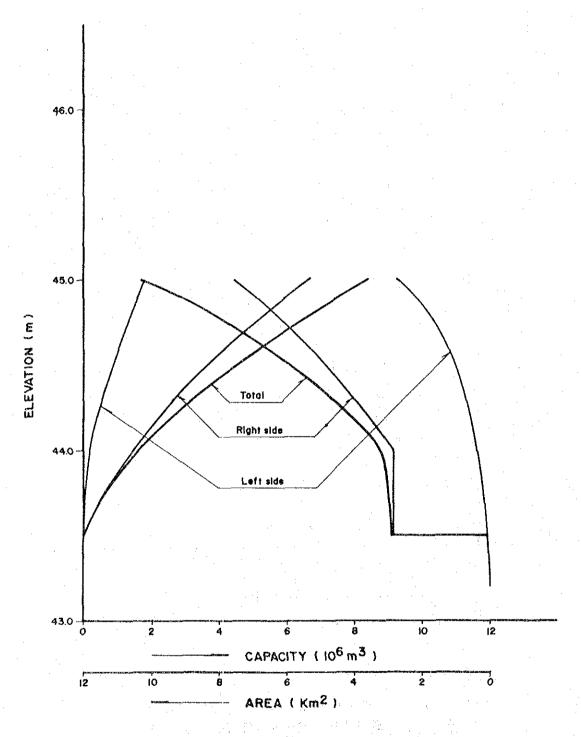


Fig. 4.3.1 STORAGE CAPACITY AND AREA OF KEDUNGSOKO RETARDING BASIN (3/3)

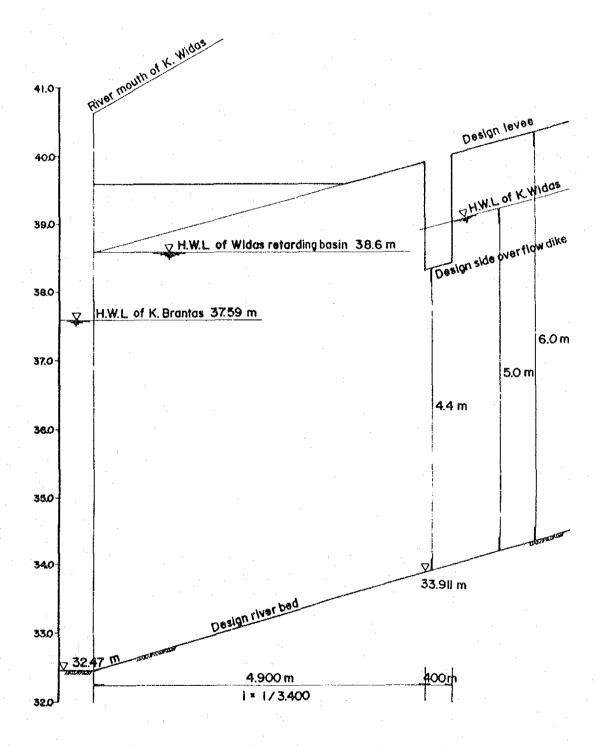


Fig. 4.3.2 LONGITUDINAL PROFILE OF WIDAS RIVER AT WIDAS RETARDING BASIN (1/3)

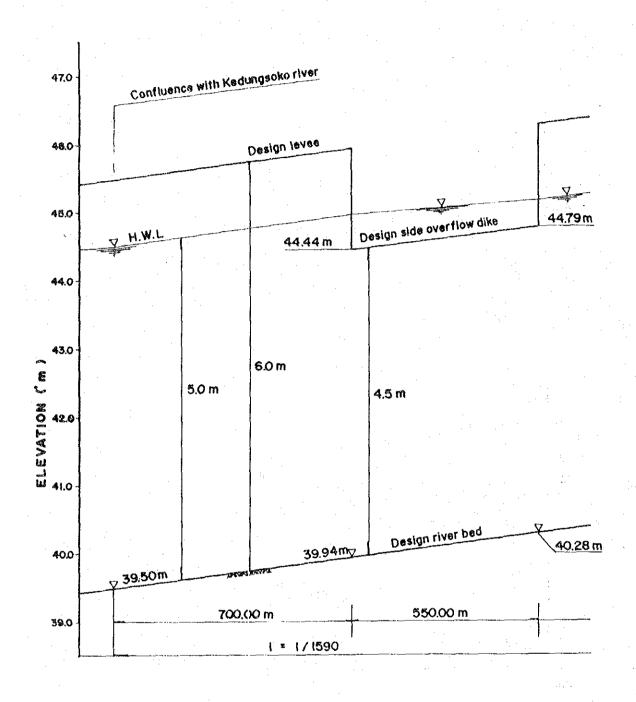


Fig. 4.3.2 LONGITUDINAL PROFILE OF WIDAS RIVER AT ULO RETARDING BASIN (2/3)

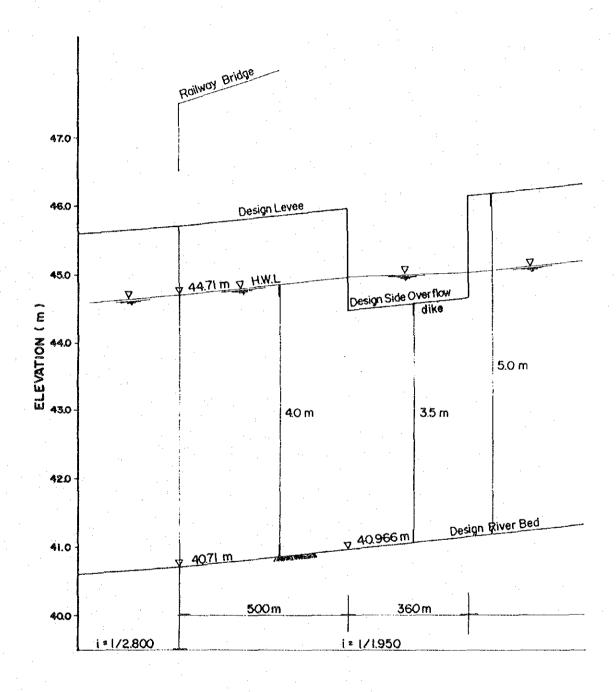
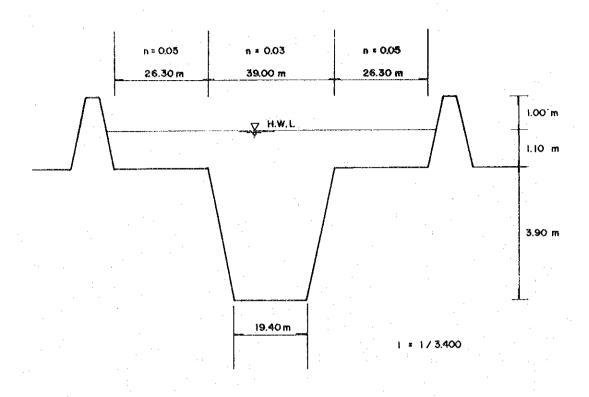
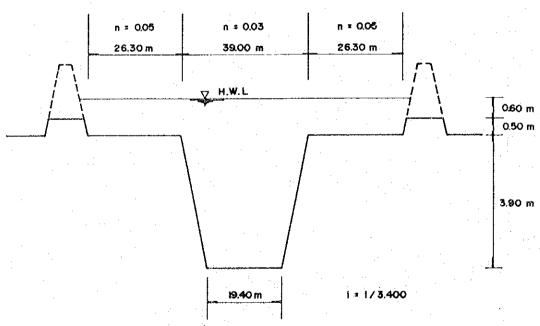


Fig. 4.3.2 LONGITUDINAL PROFILE OF KEDUNGSOKO RIVER AT KEDUNGSOKO RETARDING BASIN (3/3)



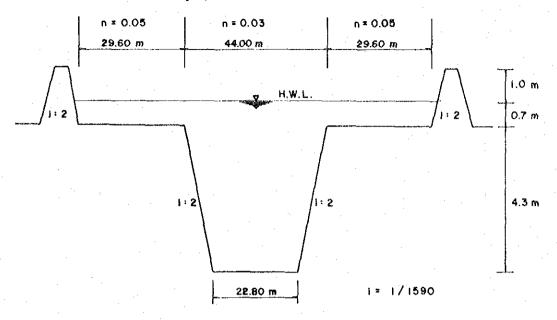


n : Manning's coefficient of roughness

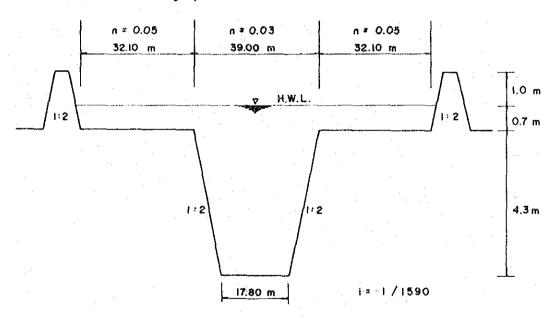
i : Slope of design river bed

Fig. 4.3.3 DESIGN CROSS - SECTION OF WIDAS RIVER IN THE REACH OF WIDAS RETARDING BASIN (1/3)

## I. Cross-section for 25-yr probable flood



### 2. Cross-section for IO-yr probable flood

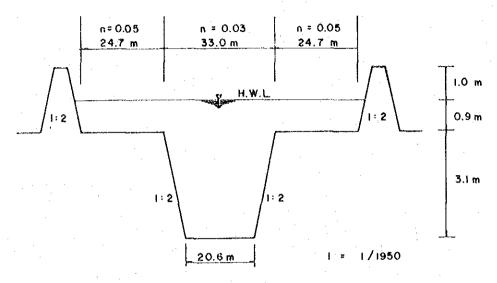


n : Manning coefficient of roughness

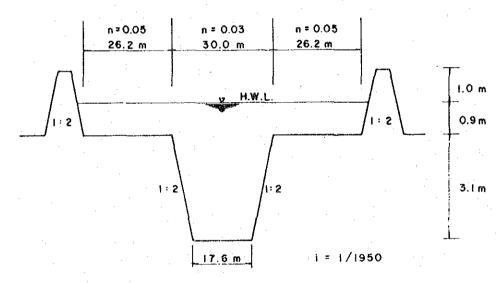
i : Slope of design river bed

Fig. 4.3.3 DESIGN CROSS-SECTION OF WIDAS RIVER
DOWNSTREAM OF ULO RETARDING BASIN (2/3)

# 1. Cross-section for 25-yr probable flood



# 2. Cross-section for IO-yr probable flood



n : Manning's coefficient of roughness

i : Slope of design river bed

Fig. 4.3.3 DESIGN CROSS-SECTION OF KEDUNGSOKO RIVER
DOWNSTREAM OF KEDUNGSOKO RETARDING BASIN (3/3)

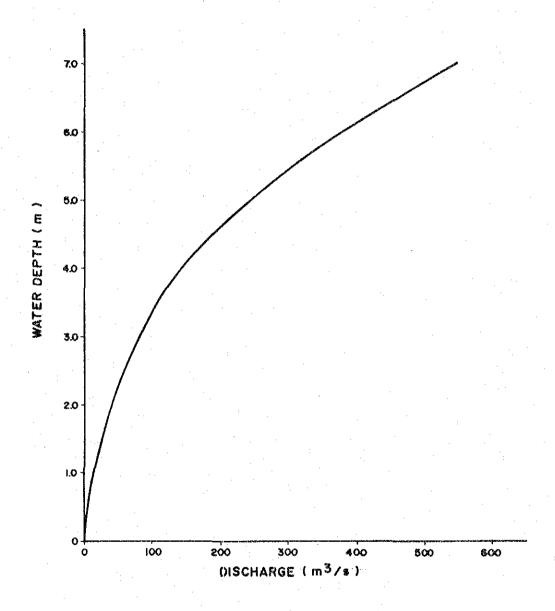


Fig. 4.3.4 STAGE DISCHARGE RELATION OF WIDAS RIVER DOWNSTREAM OF WIDAS RETARDING BASIN (1/3)

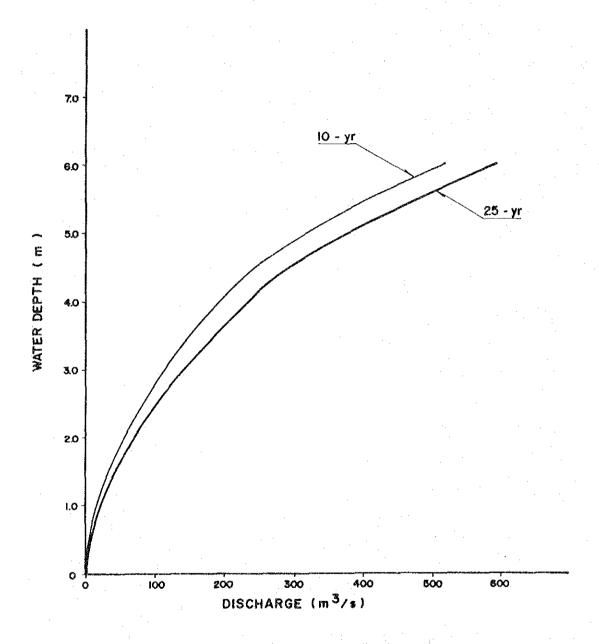


Fig. 4.3.4 STAGE DISCHARGE RELATION OF WIDAS RIVER DOWNSTREAM ULO RETARDING BASIN (2/3)

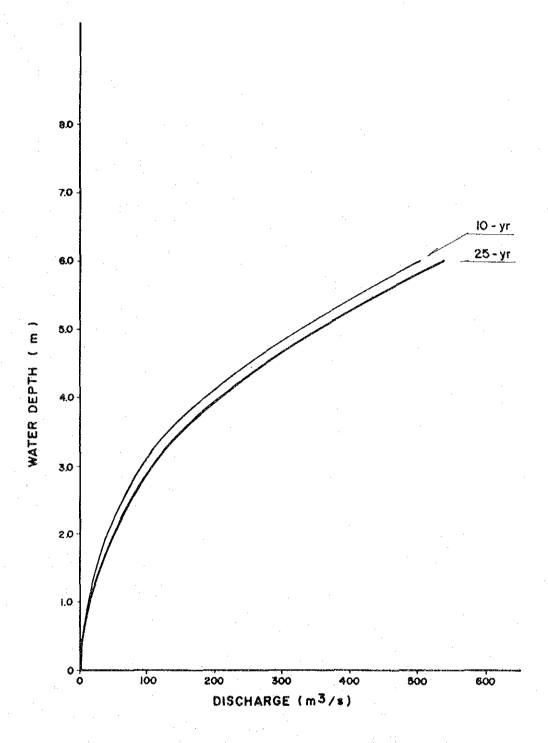


Fig. 4.3.4 STAGE DISCHARGE RELATION OF KEDUNGSOKO RIVER DOWNSTREAM OF KEDUNGSOKO RETARDING BASIN (3/3)

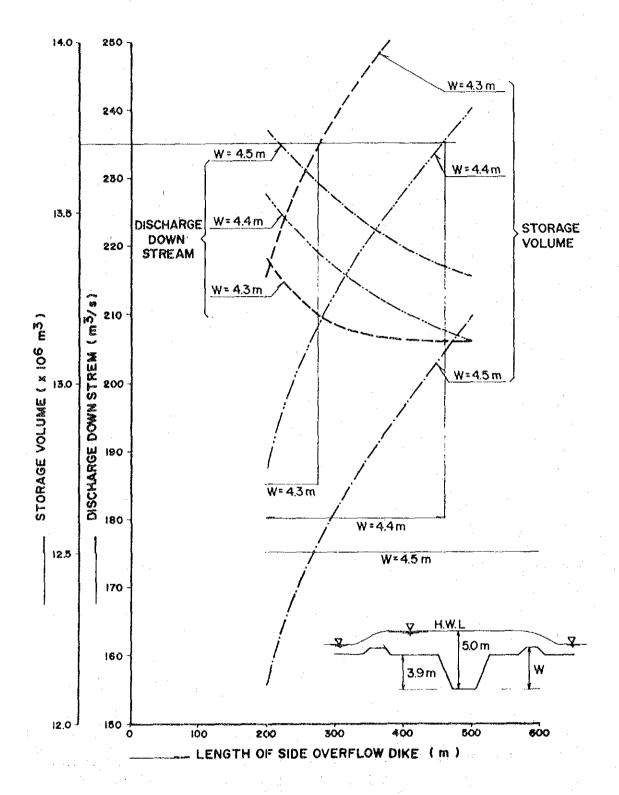


Fig. 4.3.5 FUNCTION OF SIDE OVERFLOW DIKE OF WIDAS RETARDING BASIN (1/3)

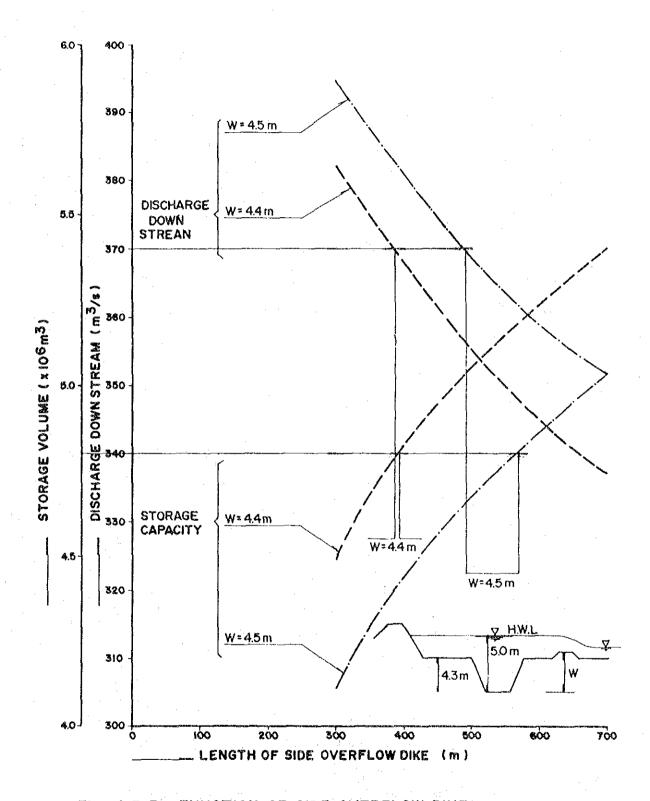


Fig. 4.3.5 FUNCTION OF SIDE OVERFLOW DIKE OF ULO RETARDING BASIN (2/3)

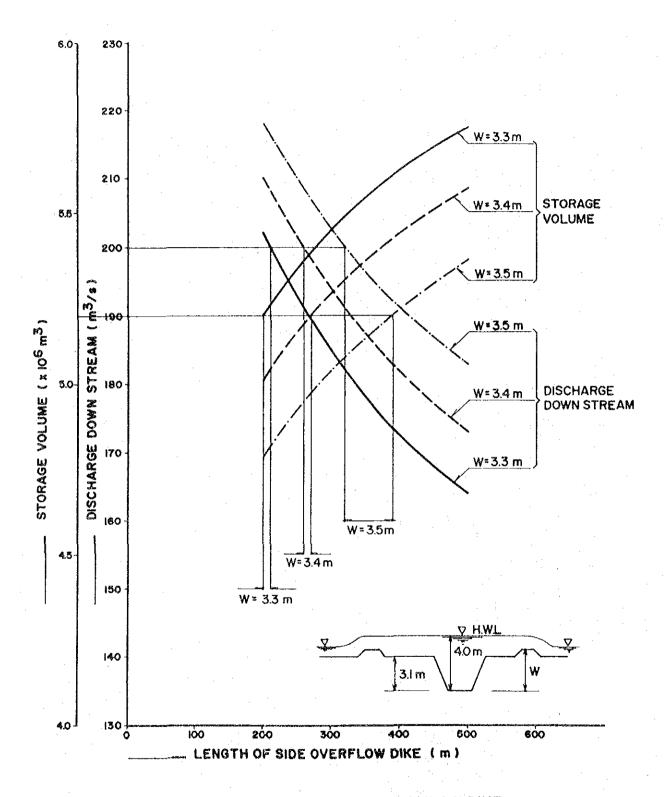
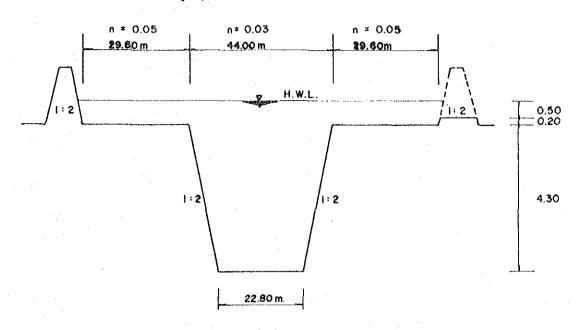


Fig. 4.3.5 FUNCTION OF SIDE OVERFLOW DIKE OF KEDUNGSOKO RETARDING BASIN (3/3)

# 1. Cross-section for 25-yr probable flood



# 2. Cross-section for IO-yr probable flood

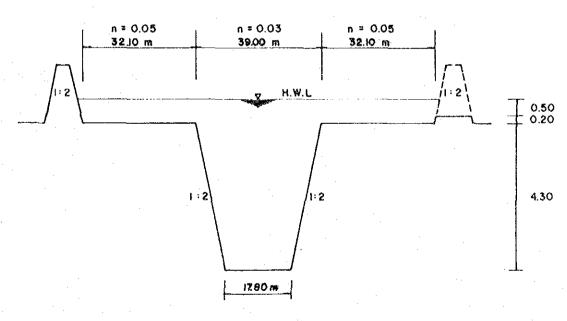
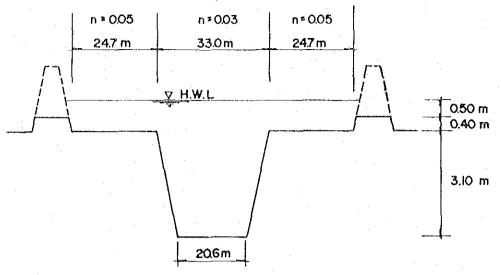


Fig. 4.3.6 DESIGN CROSS-SECTION OF WIDAS RIVER AT SIDE OVERFLOW DIKE OF ULO RETARDING BASIN (1/2)

# I. CROSS SECTION FOR 25 - yr PROBABLE FLOOD



# 2. CROSS SECTION FOR 10 - yr PROBABLE FLOOD

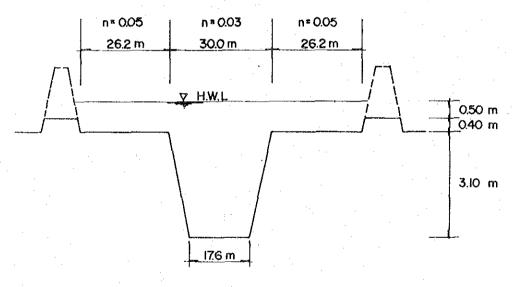


Fig. 4.3.6 DESIGN CROSS SECTION OF KEDUNGSOKO RIVER AT SIDE OVERFLOW DIKE OF KEDUNGSOKO RETARDING BASIN (2/2)

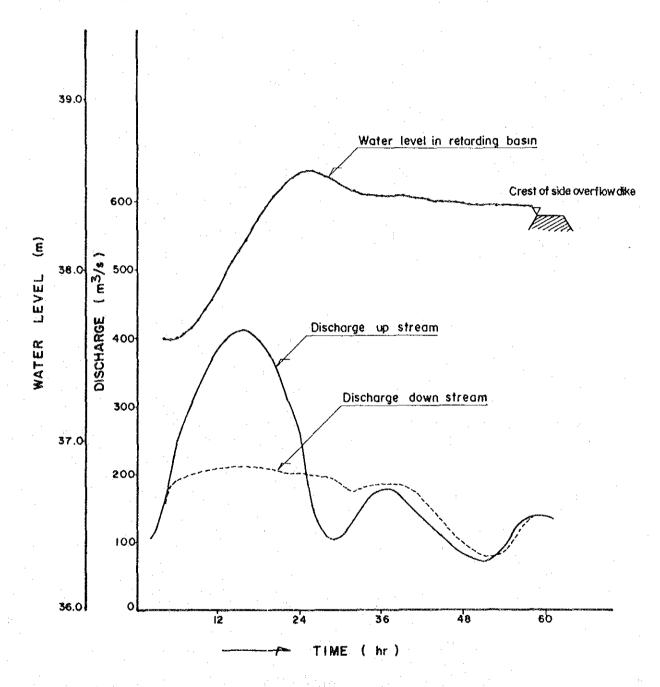


FIG. 4.3.7 FLOOD ROUTING IN THE WIDAS RETARDING BASIN (1/3)

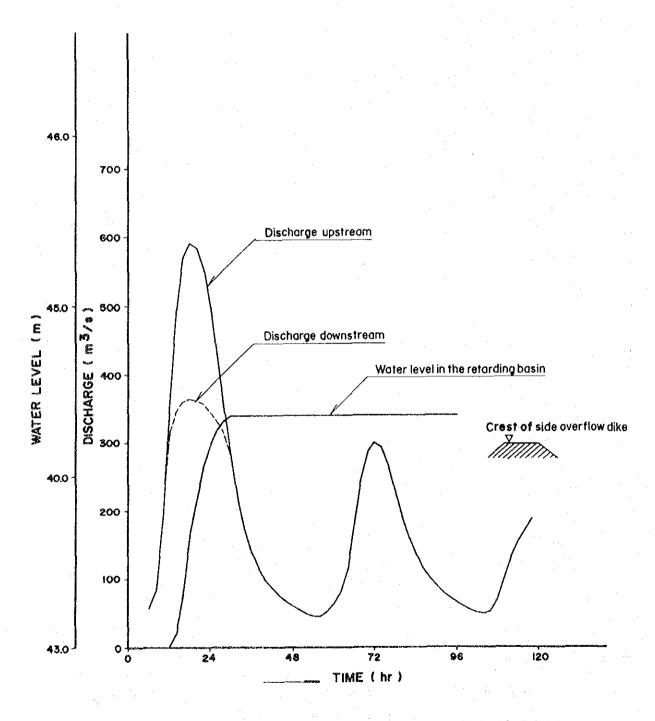


FIG. 4.3.7 FLOOD ROUTING IN THE ULO RETARDING BASIN (2/3)

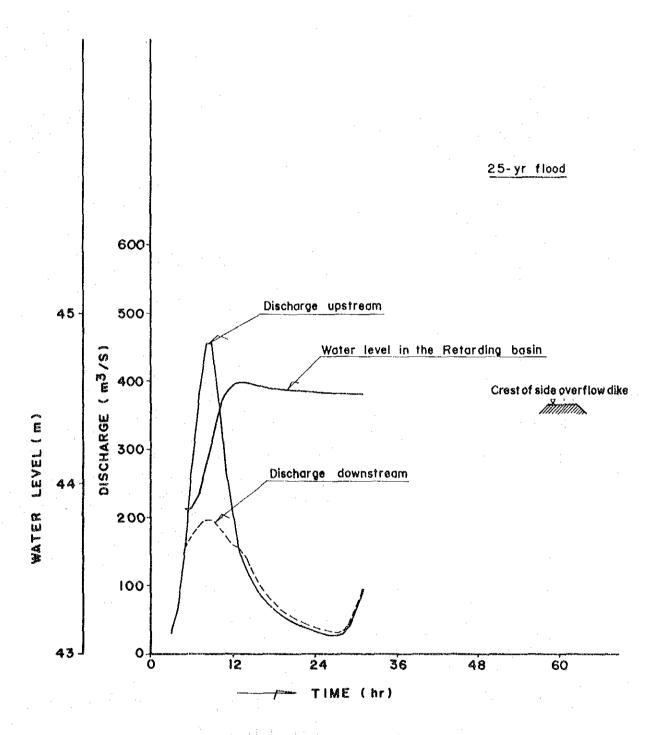


Fig. 4.3.7 FLOOD ROUTING IN THE KEDUNGSOKO RETARDING BASIN (3/3)

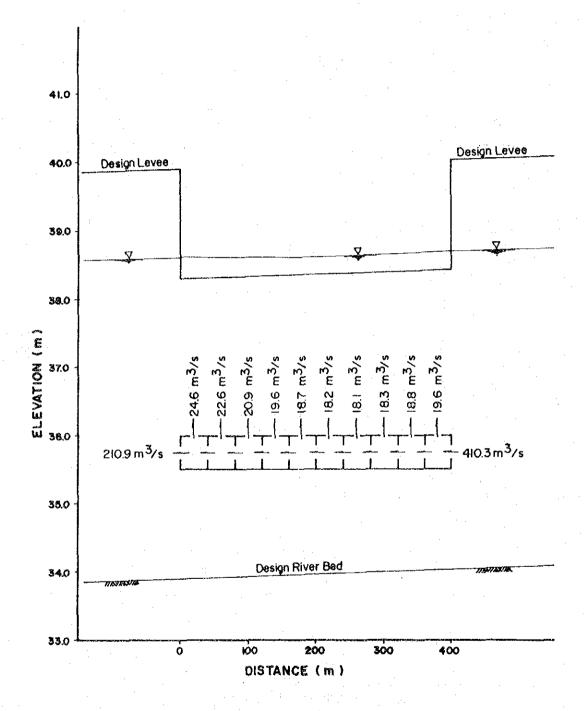


Fig. 4.3.8 WATER LEVEL AND DISCHARGE AT SIDE OVERFLOW DIKE OF WIDAS RETARDING BASIN (1/3)

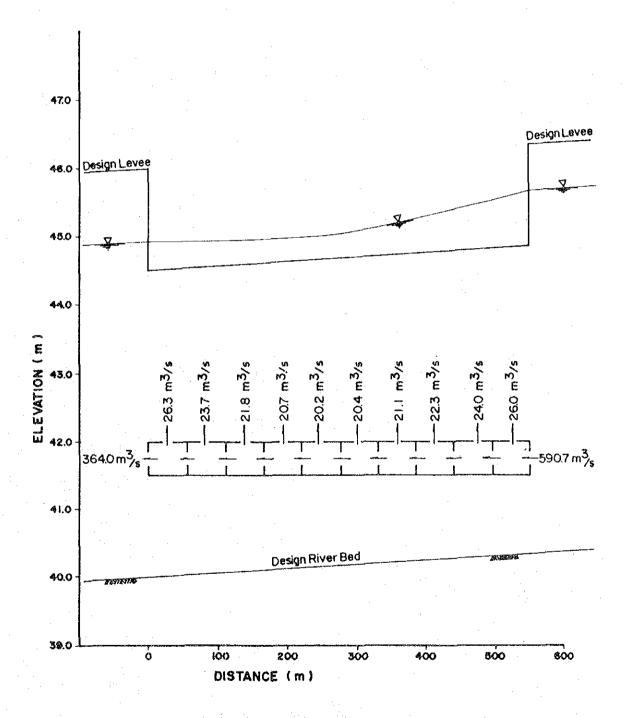


Fig. 4.3.8 WATER LEVEL AND DISCHARGE AT SIDE OVERFLOW DIKE OF ULO RETARDING BASIN (2/3)

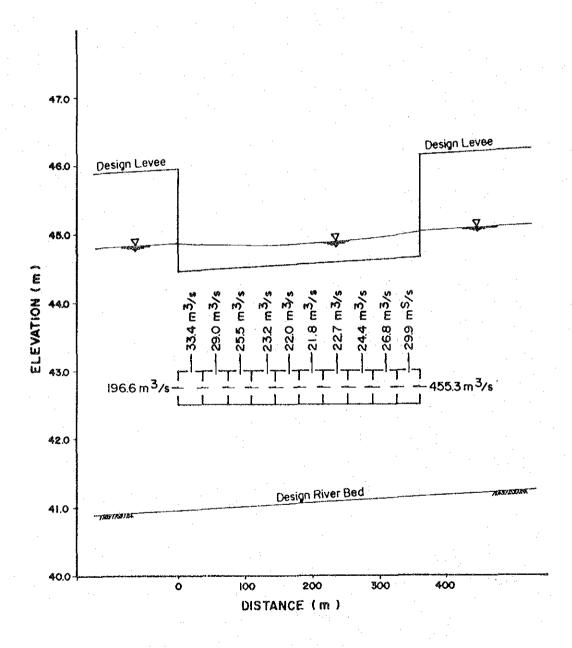
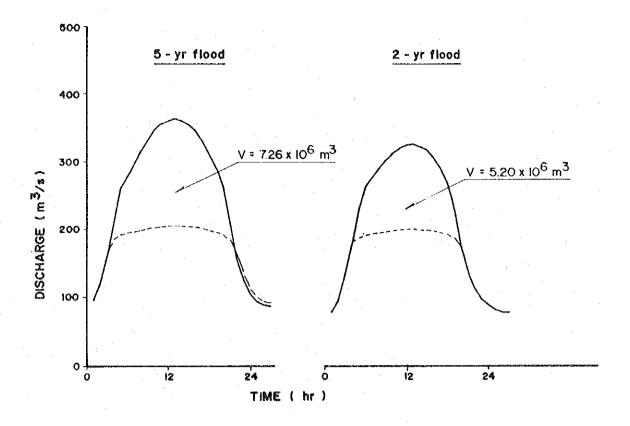


Fig. 4.3.8 WATER LEVEL AND DISCHARGE AT SIDE OVERFLOW DIKE OF KEDUNGSOKO RETARDING BASIN (3/3)



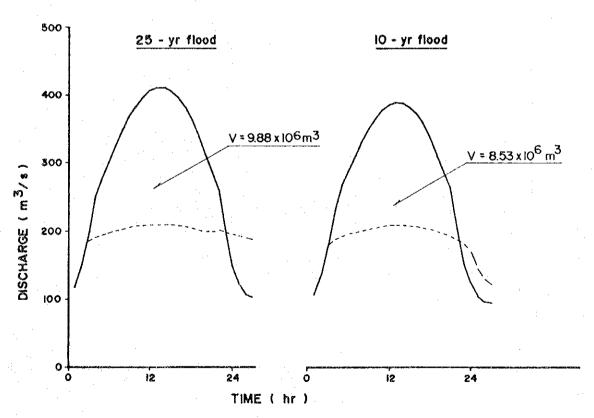
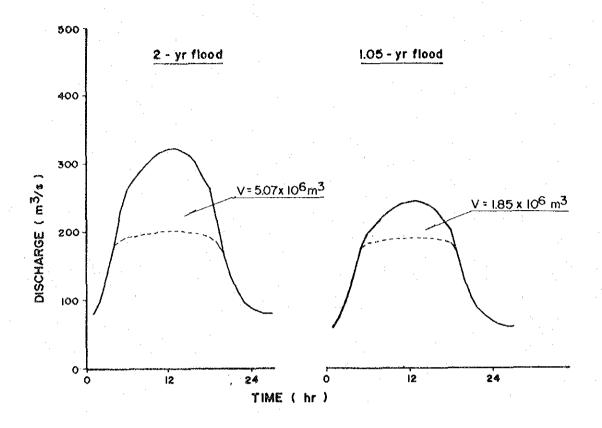


Fig. 4.3.9 REGULATING EFFECT OF WIDAS RETARDING BASIN
( River cross - section for 25 - yr probable flood ) (1/6)



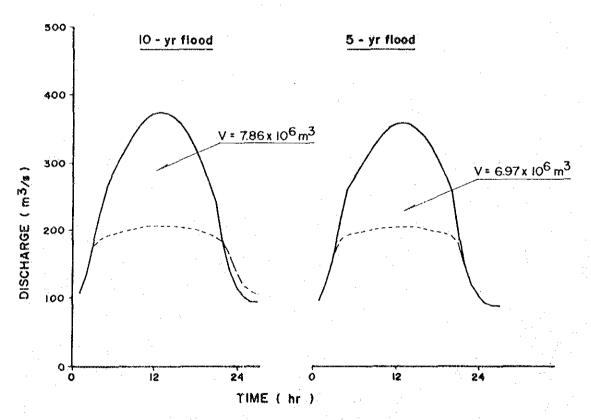


Fig. 4.3.9 REGULATING EFFECT OF WIDAS RETARDING BASIN
( River cross - section for IO - yr probable flood ) ( 2/6 )

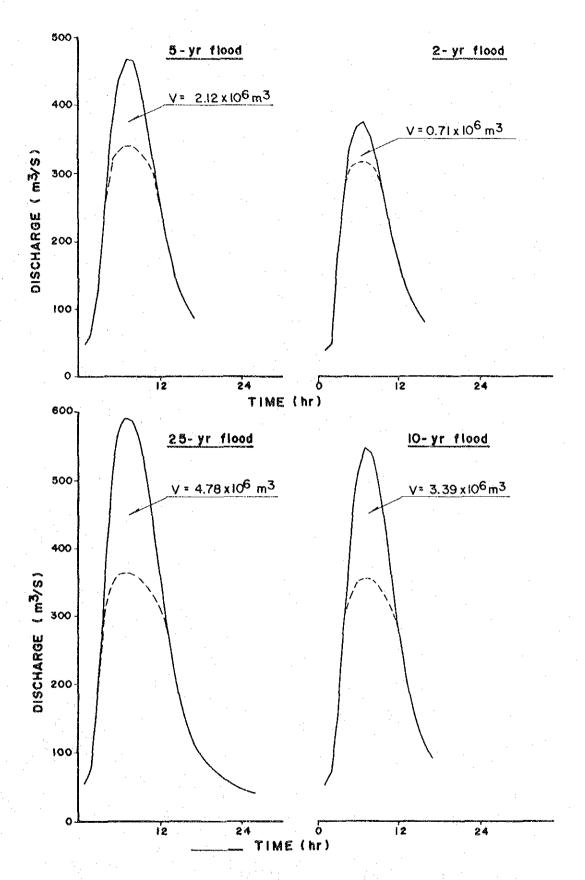


Fig. 4.3.9 REGULATING EFFECT OF ULO RETARDING BASIN (River cross-section for 25-yr probable flood) (3/6)

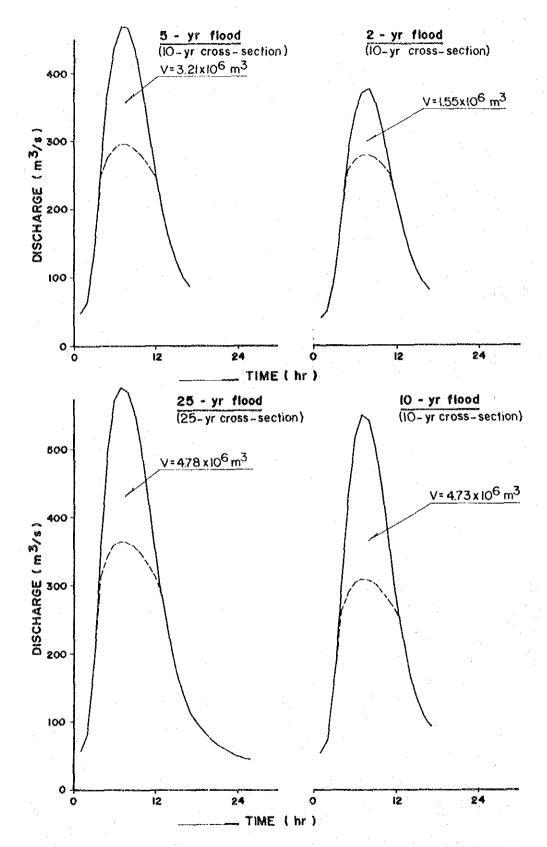
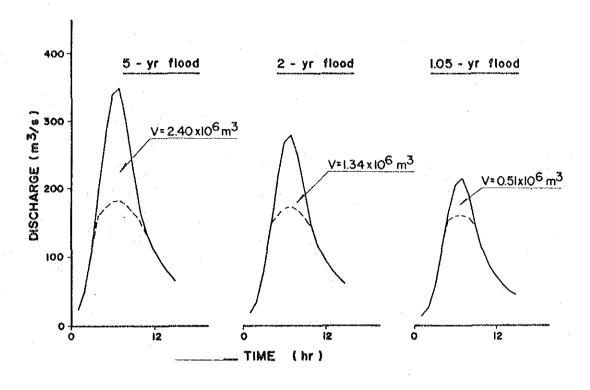


Fig. 4.3.9 REGULATING EFFECT OF ULO RETARDING BASIN
( River cross - section for IO - yr probable flood ) (4/6)



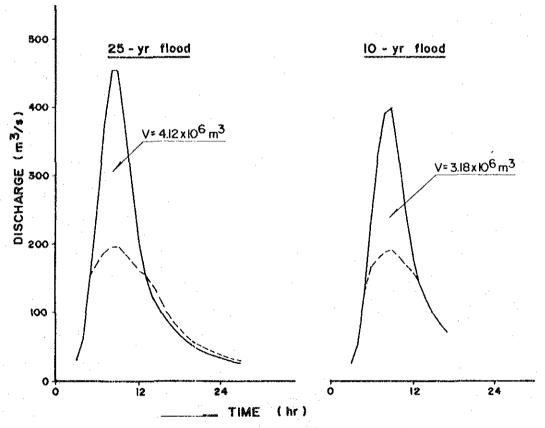


Fig. 4.3.9 REGULATING EFFECT OF KEDUNGSOKO
RETARDING BASIN
(River cross - section for 25 - yr probable flood) (5/6)

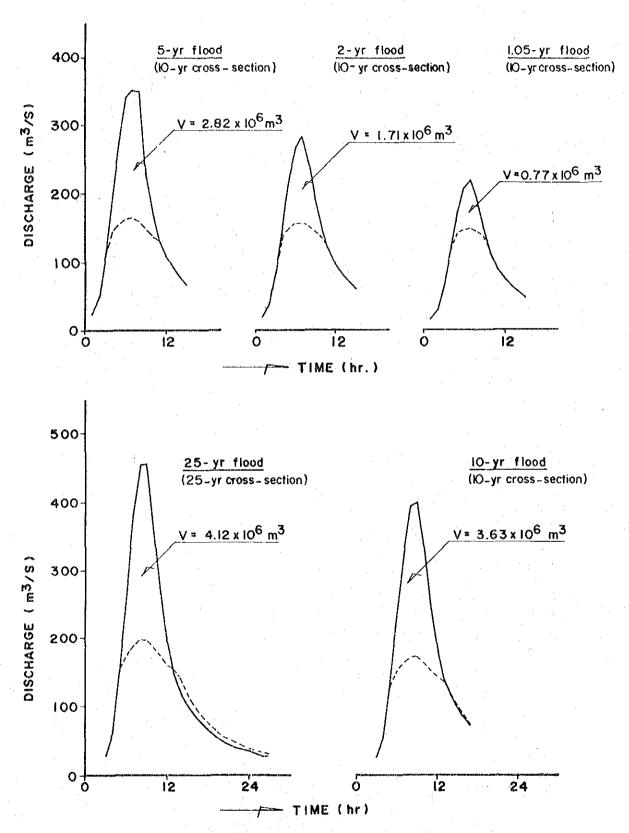


Fig. 4.3.9 REGULATING EFFECT OF KEDUNGSOKO
RETARDING BASIN
( River cross - section for IO - yr probable flood ) ( 6/6 )

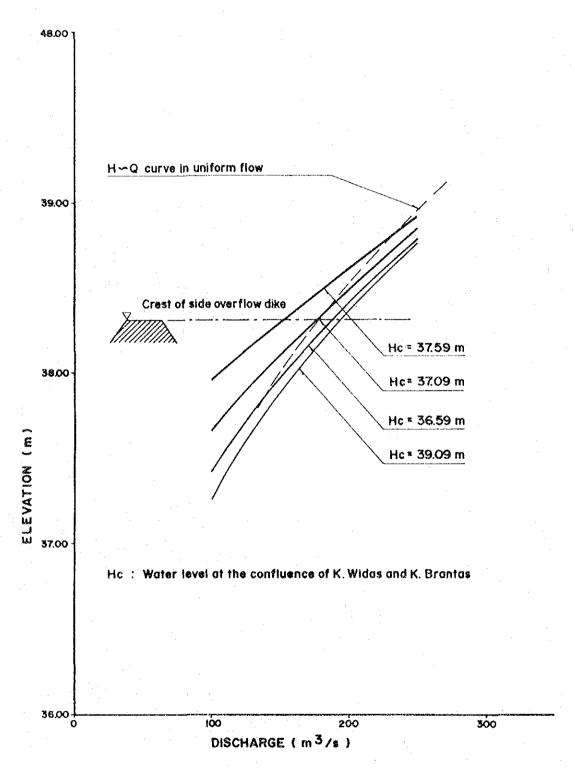


Fig. 4.3.10 STAGE DISCHARGE RELATION OF K. WIDAS AT DOWNSTREAM END OF SIDE OVERFLOW DIKE OF WIDAS RETARDING BASIN (1/3)

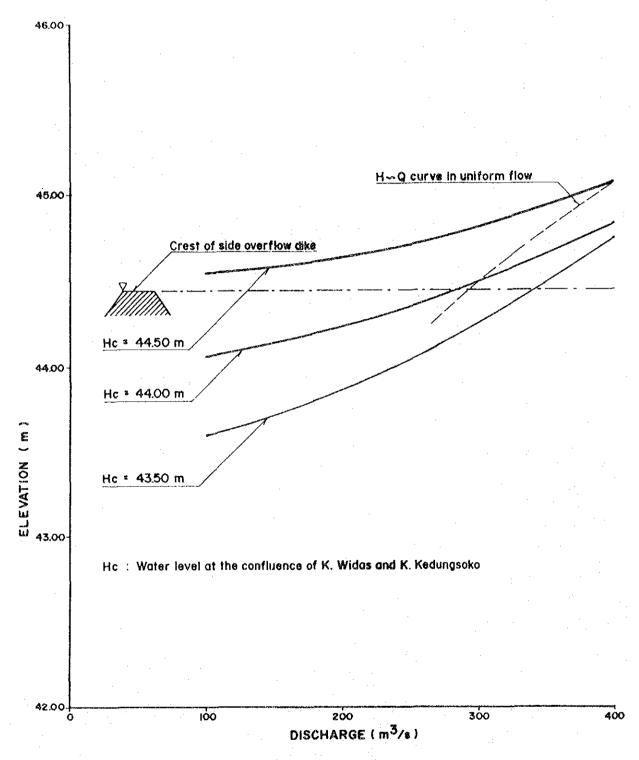


Fig. 4.3.10 STAGE DISCHARGE RELATION OF K. WIDAS AT DOWNSTREAM END OF SIDE OVERFLOW DIKE: OF ULO RETARDING BASIN (2/3)

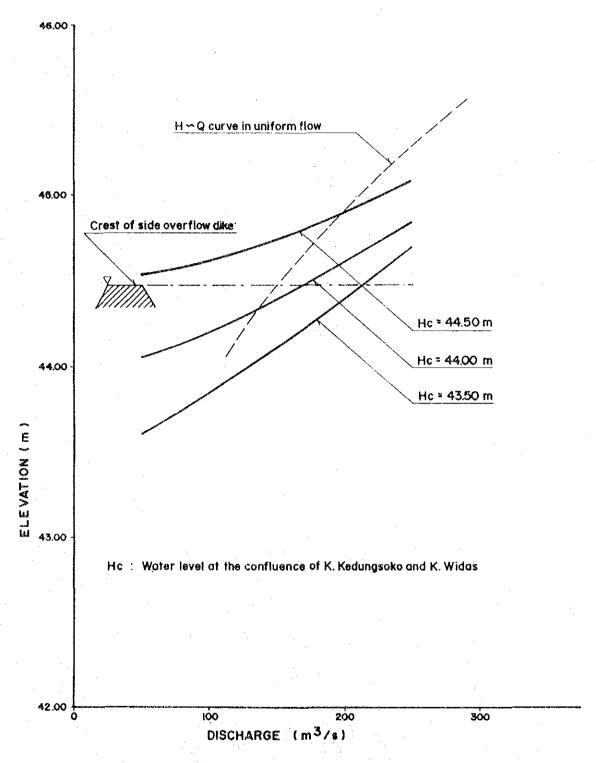


Fig. 4.3.10 STAGE DISCHARGE RELATION OF K. KEDUNGSOKO AT DOWNSTREAM END OF SIDE OVERFLOW DIKE OF KEDUNGSOKO RETARDING BASIN (3/3)

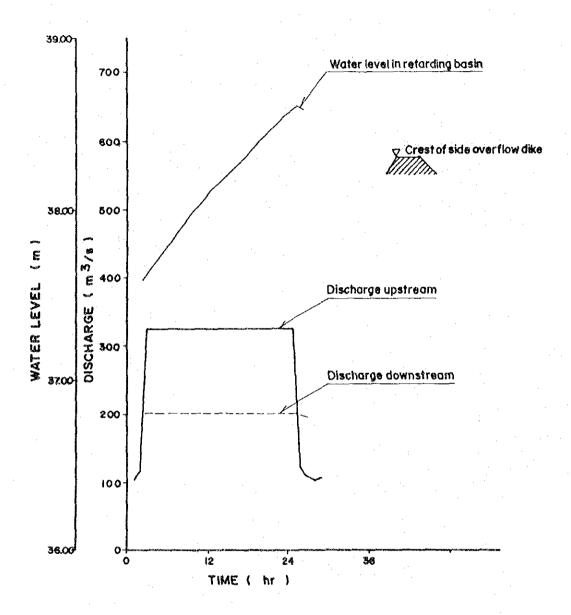


Fig. 4.3.11 FLOOD ROUTING IN THE WIDAS RETARDING BASIN (Flood hydrograph: type I) (1/6)

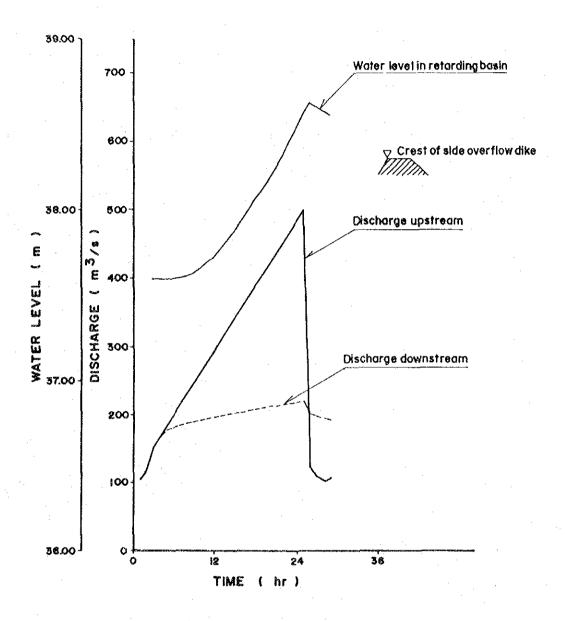


Fig. 4.3.11 FLOOD ROUTING IN THE WIDAS RETARDING BASIN (Flood hydrograph: type 2)(2/6)

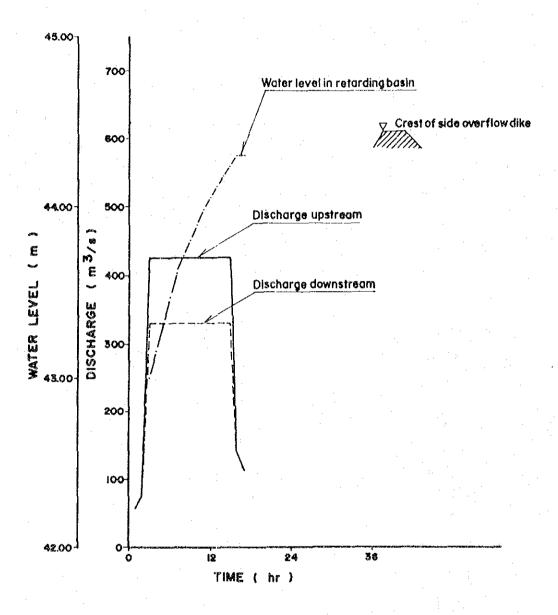


Fig. 4.3.11 FLOOD ROUTING IN THE ULO RETARDING BASIN (Flood hydrograph: type I) (3/6)

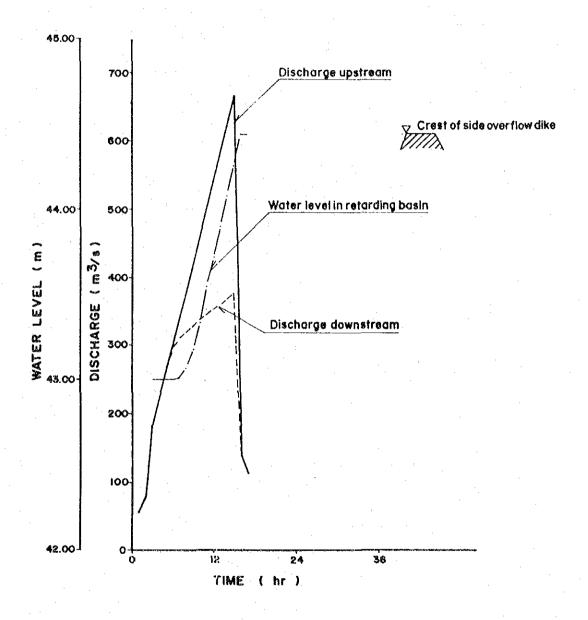


Fig. 4.3.II FLOOD ROUTING IN THE ULO RETARDING BASIN (Flood hydrograph: type 2)(4/6)

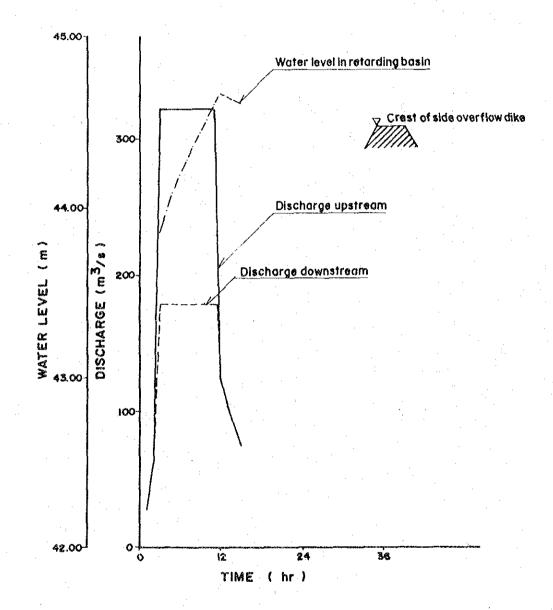


Fig. 4.3.11 FLOOD ROUTING IN THE KEDUNGSOKO RETARDING BASIN (Flood hydrograph: type I) (5/6)

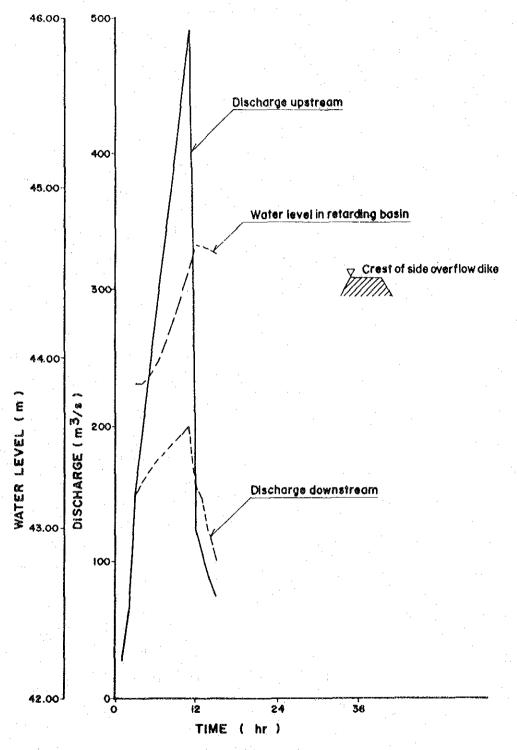


FIG. 4.3.11 FLOOD ROUTING IN THE KEDUNGSOKO RETARDING BASIN
(Flood hydrograph: type 2)(6/6)

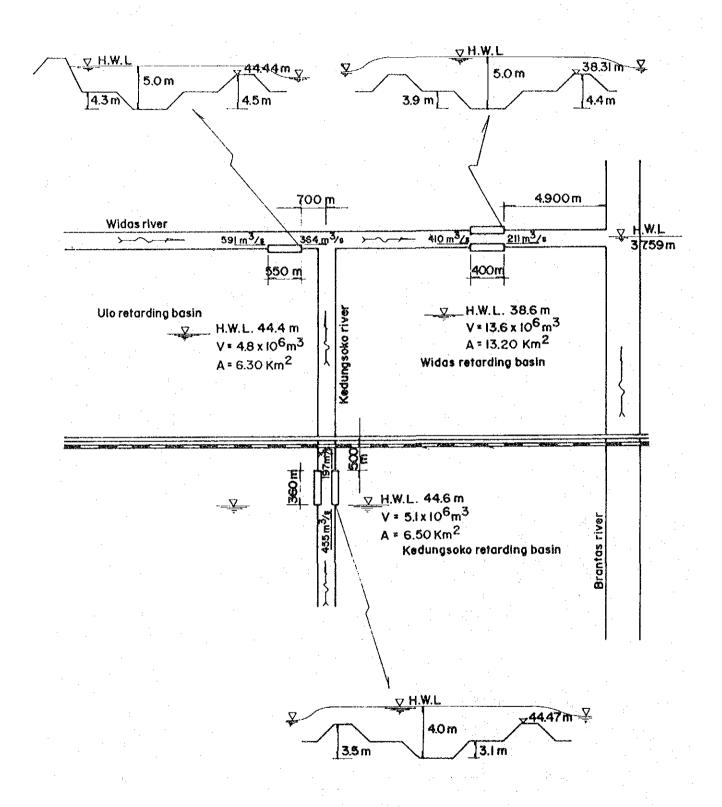


Fig. 4.3.12 LOCATION DIAGRAM OF RETARDING BASINS

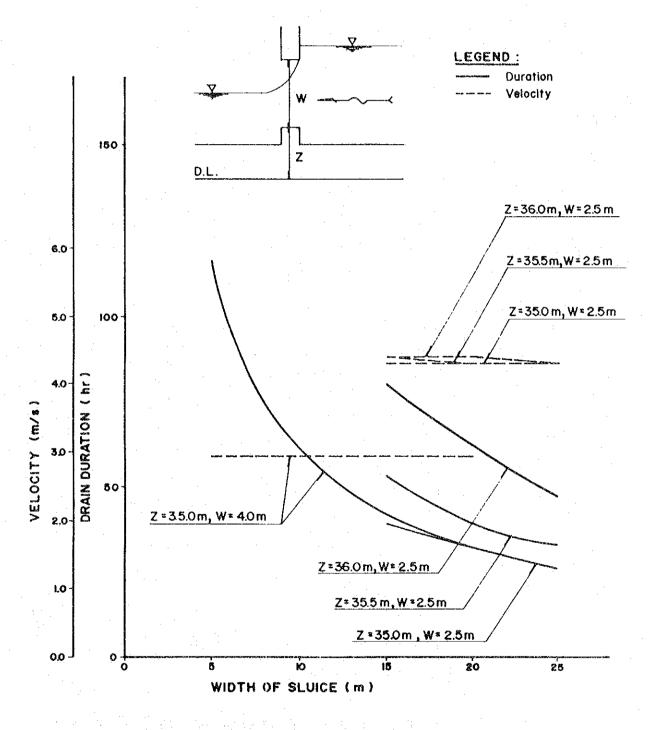


Fig. 4.3.13 DRAIN DURATION AND MAXIMUM DRAIN VELOCITY OF WIDAS RETARDING BASIN (1/3)

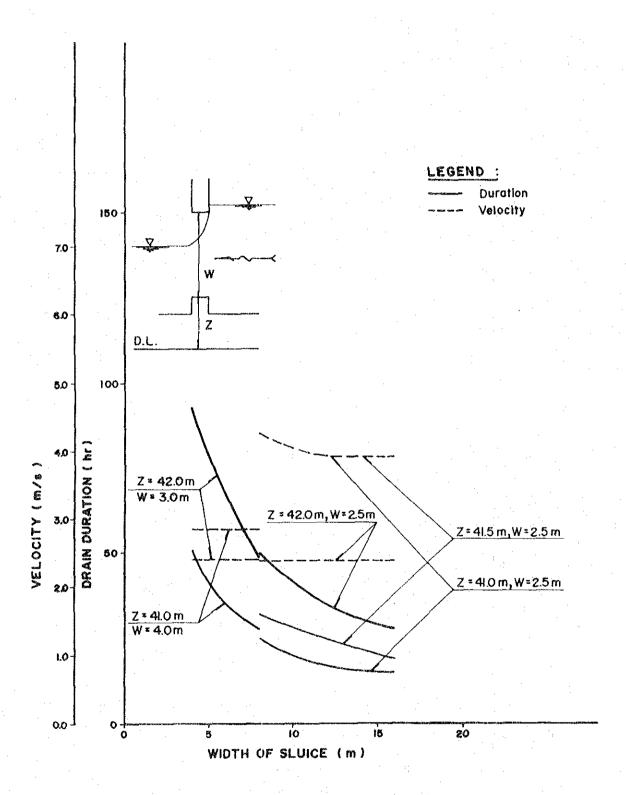


Fig. 4.3.13 DRAIN DURATION AND MAXIMUM DRAIN VELOCITY OF ULO RETARDING BASIN (2/3)

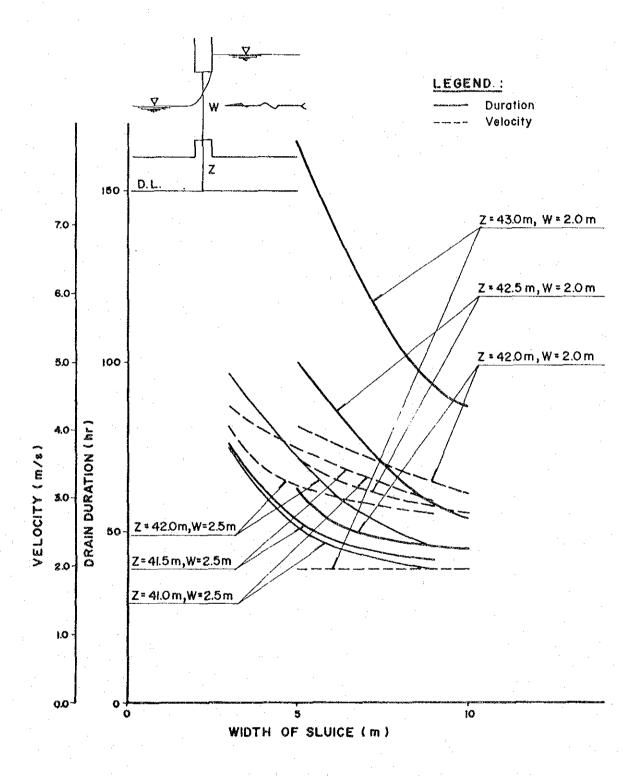


Fig. 4.3.13 DRAIN DURATION AND MAXIMUM DRAIN VELOCITY OF KEDUNGSOKO RETARDING BASIN (3/3)

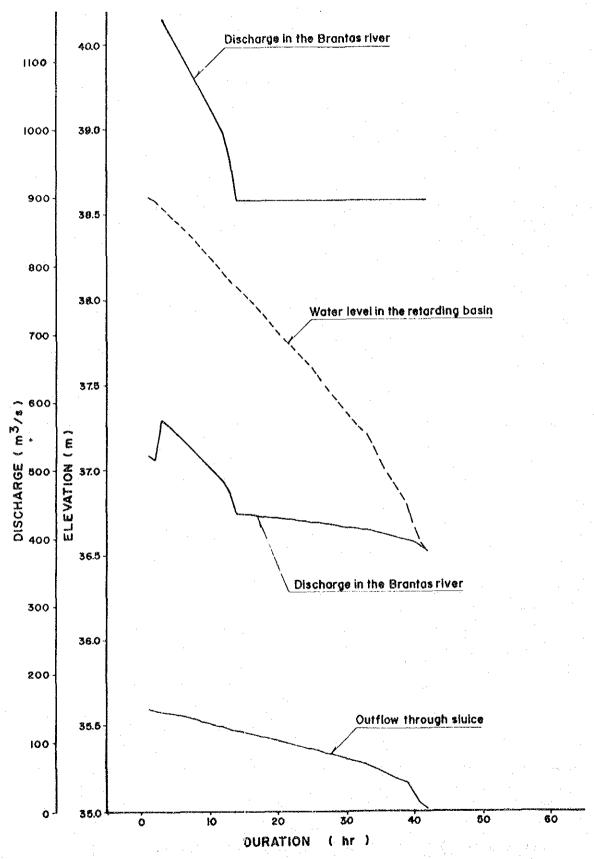


Fig. 4.3.14 FLOOD WATER DRAINAGE THROUGH SLUICE OF WIDAS RETARDING BASIN (1/3)

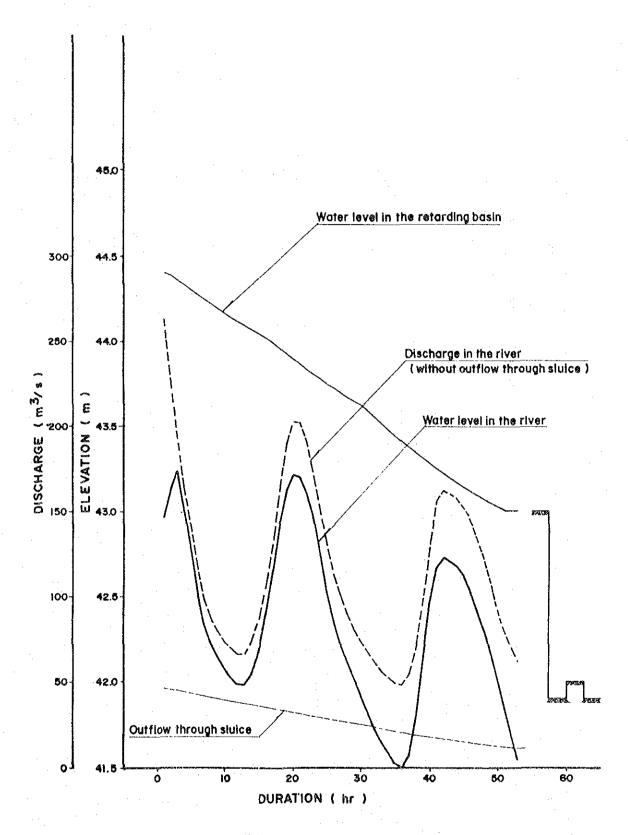


FIG. 4.3.14 FLOOD WATER DRAINAGE THROUGH SLUICE OF ULO RETARDING BASIN (2/3)

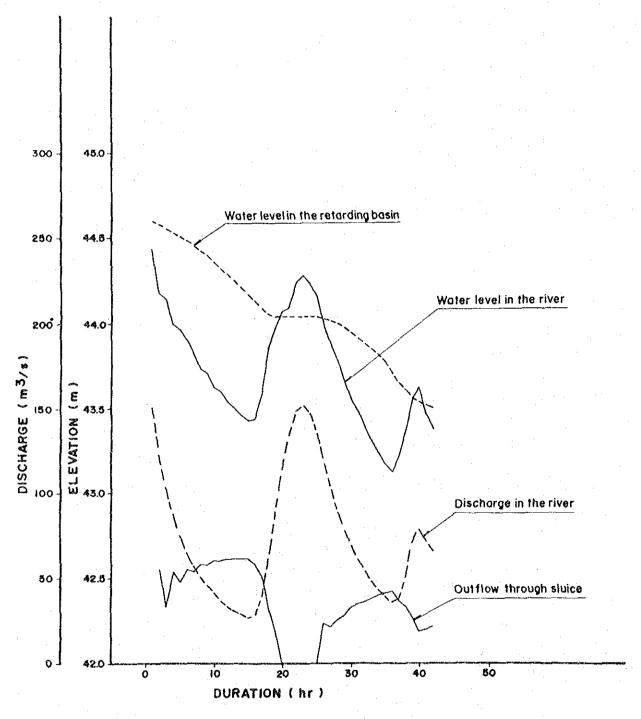


Fig. 4.3.14 FLOOD WATER DRAINAGE THROUGH SLUICE OF KEDUNGSOKO RETARDING BASIN (3/3)

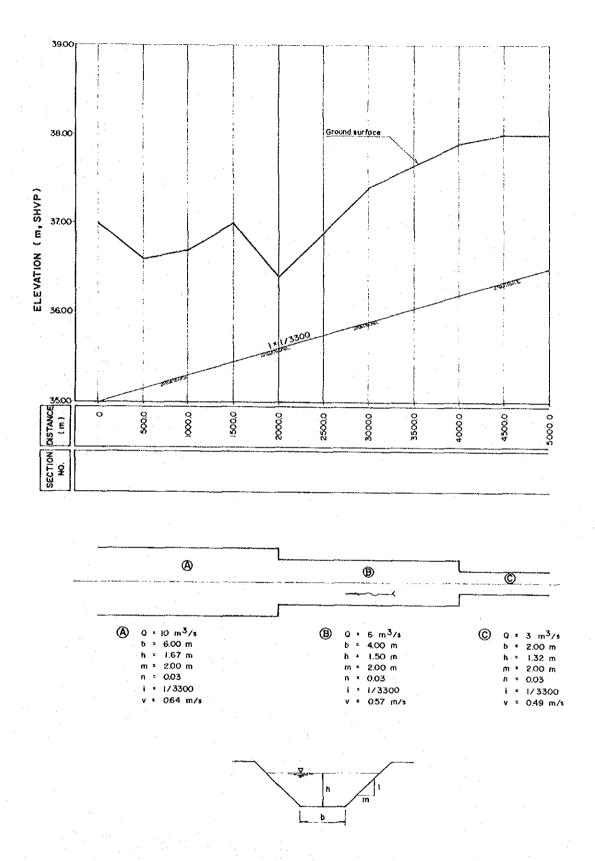


Fig. 4.3.15 LONGITUDINAL PROFILE AND STANDARD CROSS - SECTION OF DRAINAGE CANAL OF LEFT WIDAS RETARDING BASIN (1/3)

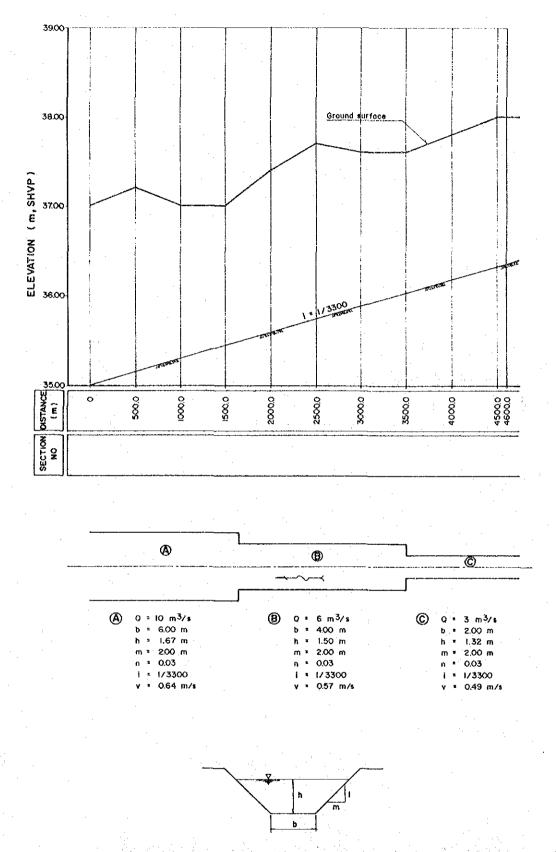


Fig. 4.3.15 LONGITUDINAL PROFILE AND STANDARD CROSS - SECTION OF DRAINAGE CANAL FROM SIDE OVERFLOW DIKE TO DRAINAGE SLUICE OF RIGHT WIDAS RETARDING BASIN (2/3)

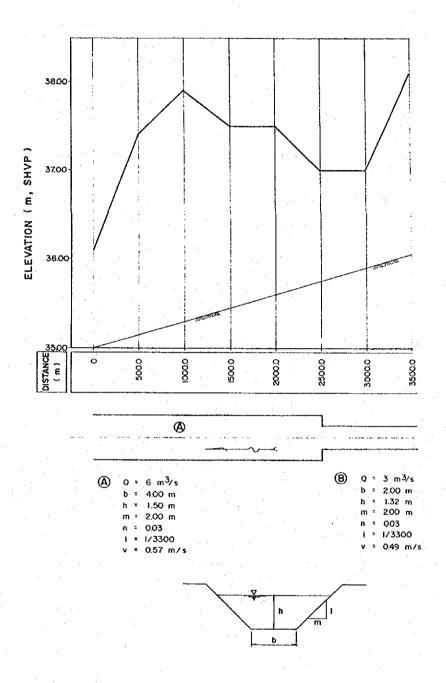


Fig. 4.3.15 LONGITUDINAL PROFILE AND STANDARD CROSS - SECTION OF DRAINAGE CANAL IN UPSTREAM REACH OF RIGHT WIDAS RETARDING BASIN (3/3)

# 4.4 Proposed River Channel Improvement

#### 1. River width

In general, river width is determined based on not only scale of design discharge but also river channel profile, topography, geology, land use in the riparian area and so on.

In this plan, river width is determined considering the following aspects of design standard and present condition.

# Design standard of rivers in Japan

Design standard in Japan is as follows;

Design discharge ( m ³ /s )	River width (m)
300	40 - 60
500	60 - 80
1000	90 - 100

On the other hand, actual river width which currently designed and/or under construction and/or constructed is given on Fig. 4.4.1 showing relationship among river width, design discharge and basin area.

# Present river width

Out of the objective rivers, the upper reach of Kedungsoko river has been improved essentially involving construction of flood dikes on the both banks. In this plan, these existing dikes are fully utilized by strengthening and heightening. For the others, the river width including high-water channel has been not yet fixed and varies depending on the scale of flood discharges.

In some rivers especially Widas river, excessive meandering, are remarkable in locations and such excessive ones are smoothened by cut-off channel considering stability of river channel. In determination of river width, it is considered to cover such large meandering of river course, that is, river width is determined considering the extent of the large meandering of the existing river course.

Under the above considerations, river width of the respective rivers is determined as shown below.

By basin	area	By design	discharge	Present	Proposed
Area	River	Design	River	average	river
	width	discharge	width	river	width
(km ² )	(m)	$(m^3/s)$	(m)	width (m)	(m)
1350-1200	350-310	570-530	9080	300-400	300-100
690- 230	250-150	640-440	100-70	100- 50	110- 50
230- 220	150-140	230-190	50	Upper Ulo	50
				٠٠.	•
500	210	470-200	75-50	100	100- 90
60	70	95	50	30	40
	Area (km ² ) 1350-1200 690- 230 230- 220 500	Area (km²) River width (m)  1350-1200 350-310  690- 230 250-150  230- 220 150-140  500 210	Area (km²) River discharge (km²) (m) (m³/s)  1350-1200 350-310 570-530 690-230 250-150 640-440 230-220 150-140 230-190 500 210 470-200	Area (km²)         River width (m)         Design discharge width (m²/s)         River width (m³/s)           1350-1200         350-310         570-530         90-80           690- 230         250-150         640-440         100-70           230- 220         150-140         230-190         50           500         210         470-200         75-50	Area (km²)         River width (m)         Design discharge width (m)         River width (m)         average river width (m)           1350-1200         350-310         570-530         90-80         300-400           690- 230         250-150         640-440         100-70         100- 50           230- 220         150-140         230-190         50         Upper Ulo 40           500         210         470-200         75-50         100

## 2. Longitudinal profile

Design profile is determined considering profile of the existing river channel. The river bed elevation is set at the average upper line of the deepest river bed in the existing channel.

Design high-water level is determined based on the following criteria. For rivers which diking system have been employed or are to be employed, the high-water level is set not so as to heighten the existing flood water level or max. flood level in the past, in principle. For rivers which are improved by excavation of low-water channel without diking system, it is set below average existing ground height as low as possible.

The design elevations of dike crown, high-water level and river bed are shown in Table 4.4.1.

#### 3. River cross-section and its cross-sectional area

Double section consisting of high-water channel and low-water channel is adopted to river channel section considering large fluctuation of river discharge and stability in principle. However, also single section with berm is adopted to the lower Ulo which is newly connected to the middle Widas river,

The required cross-sectional area is estimated by uniform flow method. The adopted Manning's coefficient roughness "n" is as follows;

n = 0.03 for low-water channel
n = 0.05 for high-water channel

The major proposed dimensions of typical cross-section for comprehensive plan and first stage plan are given in Table 4.4.2. Those typical cross-sections are shown on Figs. 4.4.2 and 4.4.3 respectively.

Based on the above design profile and typical cross-section, the river cross-sections at the respective surveyed cross-sections are proposed as explained later (Fig. 4.4.5). For reference, carrying capacity of the proposed river channel of the comprehensive plan is checked by non-uniform flow calculation and the results are shown in Table 4.4.3. According to

the Table 4.4.3, it shows that the proposed river channel can be flown design discharge below the design HWL for almost whole stretches.

### 4. Bank protection works

The bank protection works consisting of wetmasonry and gabion are provided at flow attacking places and/or along densely populated areas. The right bank of the new diversion channel and Upper Ulo river is protected by wetmasonry type revetment for almost whole stretches to prevent Nganjuk urban area from breach of flood dike due to flow attacking.

Length and area of bank protection works are shown in Table 4.4.4 and locations of major bank protection works are shown on Fig. 4.4.4. Approximate 40% of total bank protection works for comprehensive plan is constructed by first stage plan considering existing condition.

## 5. Layout of proposed dike alignment and related river structures

Feasibility designs for comprehensive plan and first stage plan are made based on the typical cross-section and longitudinal profile. The proposed dike alignment, controllable retarding basin, related structures and river cross-sections are given on Figs. 4.4.4 and 4.4.5.

The controllable retarding basins and related river structures are described in the sections of 4.3 and 4.5 in this ANNEX-4, respectively.

## 6. Design discharge and river width of secondary tributaries

The secondary tributary is improved mainly by construction of backwater levee including minor excavation. The objective tributaries are 12 rivers in total. Such tributaries are improved for 5-yr flood for comprehensive plan and first stage plan.

The design discharges of the above tributaries are estimated based on the specific discharges which were calculated by hydrological study and those are summarized below.

Net Area (km²)		Specific discharge (m ³ /s/km ² )	Design discharge (m ³ /s)	
Lower Widas				
Pohbuntu	61	1.38	85	
Ng1empoh	13	1.87	25	
Jaan	11	1.87	25	
Tributary	10	1.44	15	
Tretes	31	1.44	45	
Jpper Widas		•	10 mg 20 mg	
Ngrembek	46	1.27	60	
Tributary	6	1.27	10	
Pelangkengi	72	2,49	180	
Wotrangkul	44	1.63	75	
Jpper Ulo	•			
Secong	63	1.51	100	
Winong	11	2.18	25	
Kuncir				
Gonggang - Malar	ig 37	0.54	20	

For the above design discharges, the following proposed river width and length are provisionally adopted to tributary improvement for cost estimate considering existing river width and its carrying capacity. The "n" values of 0.035 for low-water channel and 0.05 for high-water channel are adopted.

	Existing	Condition	n Design Condition				
River	Average	Average	Design	Design	Design	Length	
KIVCI	River	Carrying	HWL of	Dike Crown	River	to be	
	width	Capacity	Conf.	of Conf.	Width	Improved	
	( m )	(m ³ /s)	(m.SHVP)	(m.SHVP)	(m)	( km )	
Lower Widas					.*	;	
Pohbuntu	20	_	39.13	40.13	30	0.9	
Ng1empoh	10	15	40.50	41.50	20	1,6	
Jaan	20	35	41.39	42.39	30	1.3	
Tributary	10.	-	41.55	42.55	20	1,2	
Tretes	25	15	42.50	43.50	35	1,5	
Upper Widas				-			
Ngrembek	35	180	46.86	47.86	45	1.5	
Tributary	25	40	47.24	48.24	35	1.5	
Pelangkengi	50	180	47.80	48.80	60	2.9	
Wotrangkul	45	120	50.93	51.93	55	2.5	
Upper Ulo							
Secong	30	40	54.50	55.50	40	1.5	
Winong	20	90	57.30	58.30	30	0.5	
Kuncir		•			4		
Gonggang-Malang	10	10	45.83	46.63	20	0.8	

Al canal a main drainageway in Warujayeng irrigation area is to be improved for 5-yr flood of 70  $\rm m^3/s$  by Waru-Turi Project.

7. Merit and demerit of construction of surrounding dike of retarding basin

Surrounding dike of a retarding basin essentially aims protect the inland from flood water retarded in the retarding basin. But even without the surrounding dike, the inundation condition of the retarding basin would be improved with the construction of river dike and side overflow dike than in the present condition, depending on the hydrological and topographical features.

Here are the brief discussions on whether to construct surrounding dikes or not.

## (1) Cost

In the case of construction of surrounding dike, the following costs are needed.

- (a) Land acquisition cost
- (b) Construction cost of dike
- (c) Construction cost of sluices or culverts
- (d) Operation and Maintenance cost