4.2.3 Alternative 2-2: Diversion Channel

(1) Cost, Preliminary Design and Implementation Schedule

(a) Economic Cost and Benefit

It is possible to estimate economic cost and benefit for only the following components (refer to Table 4.2.4). The other components are difficult to be evaluated in monetary term.

Project Components	Cost (mil. Baht)	Benefit (mil. Baht)
Modification of Dam	40 as initial cost and 394	
Operation Rule	as annual cost	6,300/year
Distribution and Drainage	5,633 as initial cost and	
System Improvement	39 as annual cost	•
Diversion Channel	31,402 as initial cost and	
·	167 as annual cost	
River improvement	2,821 as initial cost and	
a track	71 as annual cost	
Others		<u> </u>

(b) Preliminary Design and Implementation Schedule

Among the project components, preliminary design is prepared for only structural measures; i.e., the diversion channel, river improvement and distribution and drainage systems improvement.

(i) Preliminary Design

Among the project components, preliminary design is prepared for only structural measures; i.e., the diversion channel and river improvement. As for the distribution and drainage systems improvement, only the area is shown in Fig. 3.3.7 and 3.3.8.

Preliminary design of river improvement is made in the same manner as the case for agricultural area of Alternative 1.

Preliminary design of diversion channel is made in the following manner:

Alignment

The alignment of the diversion channel is set considering the following points:

- Utilization of existing channel passing through lowland area
- Minimization of house relocation

For setting the alignment, photo mosaic map with a scale of 1/50,000 is used. The total length of diversion channel is approximately 96 km. The alignment is shown in Fig. 4.2.6.

Longitudinal Profile

The longitudinal profile is set based on the ground height along the alignment. The ground height is obtained from the topographic map with a scale of 1/50,000 and 1/20,000.

Design water level at the river mouth adopt that of the Chao Phraya river, M.S.L+1.6 m, while the design water level at diversion point is MSL+3.85m. The average gradient of high water level connecting two points is 1/43,000.

Standard Cross Section

The standard cross section is set considering the following points: stability and safety of channel and economic advantage. The compound cross section type is adopted.

Current area is mainly composed from excavated channel to have enough water depth, so that river width can be minimized.

(ii) Implementation Schedule

In principle, the implementation schedule is prepared considering the following points:

- Flood damage in paddy field playing a natural retarding function can be mitigated with less cost as long as detailed study for preparation of guideline and improvement of necessary facilities are finished. Thus, high priority is given to the implementation.
- River improvement can be implemented up to the level with 10-year return period by minimizing the adverse influence to Bangkok through the utilization of effectiveness of natural retarding basin. Thus it can be given higher priority. (In case the river improvement is implemented without distribution system improvement, it is necessary to provide a fuse to minimize the adverse influence by the river improvement.)
- However, to further enhance the protection level for agricultural areas, the river improvement should be implemented under the condition that diversion channel is completed to absorb the adverse influence to the area downstream, especially BMA.
- In this connection, the implementation of river improvement to enhance the protection level from 10-year to 25-year return period should be started after the diversion channel is ready to absorb the adverse influence.
- As for the protection works for Pathum Thani and Nonthaburi by PWD, they should be undertaken considering the progress

of diversion channel Stage 1 to assure the safety level of Bangkok.

Under the above considerations, the implementation schedule is prepared, as shown in Fig. 4.2.7.

(2) Evaluation of the Master Plan

(a) Economic Evaluation

As well as Alternative 1, the economic evaluation is made only for project components that can be evaluated in monetary term based on the economic cost and benefit mentioned above. The evaluation is made in a manner of EIRR, B-C and B/C, and the results are as shown below (refer to Table 4.2.5):

- EIRR =12.0%
- B-C = 1,427 million Baht
- B/C = 1.1

As identified, the economic viability is not so high, but the EIRR value is slightly over 12%, which is regarded as the minimum of project viability.

Also, the project brings about many intangible benefits such as stabilization of people's living condition, decrease of waterborne diseases, increase of work opportunity and so on.

From the financial point of view, the project requires about 2.6 billion Baht per annum for the implementation within 20 years, which roughly corresponds to 2.7% of the total annual budget of 96.5 billion Baht for RID (44.4 billion Baht), PWD (39.8 billion Baht) and BMA (12.3 billion Baht). Although it may be difficult to designate the allowable percentage of allocation of the total budget, it seems to be still within the financial affordability of these agencies, judging from the figure (refer to Table 4.2.3).

(b) Technical Soundness and Social Acceptability

The project components are based on the conventional structural measures such as excavation and embankment. These measures do not face any technical difficulty.

On the other hand, diversion channel and river improvement may have social issues due to relocation of inhabitants in the areas where these measures are proposed. In this connection, it is natural to obtain a favorable public opinion for the decision on project implementation through meetings and seminar, so that the inhabitants can fully understand the significance and necessity of the project. By this, it seems to be possible to receive social acceptability.

(c) Environmental Sustainability

Initial Environmental Examination (IEE) has been conducted for the structural measures of project components to confirm the environmental sustainability of the Master Plan; i.e., the natural retarding basin, river improvement and diversion channel. IEE was conducted based on the customized parameters prepared in this study.

As the result, the IEE found that natural retarding basin, river improvement and diversion channel may not have significant impacts from the ecological point of view, but may have impacts on sites and the surroundings from the social point of view. Therefore, it is crucial to pay attention to soften such social impacts and it is assumed that the solution is obtainable through continuous communication with the affected people.

4.3 Selection of Project Components for the Feasibility Study

Priority projects are selected for the Feasibility Study. As shown in the implementation schedule in Figs. 4.2.4, 4.2.5 and 4.2.7, it is proposed to implement or sustain most of the project components of the Master Plan. However, in case of Alternative 2-1, heightening of flood barrier and in case of Alternative 2-2, diversion channel (Stage 1 and Stage 2) and river improvement (Stage 2) are excluded according to the urgent necessity.

Among the project components that should be promptly implemented, some are not necessary to conduct the feasibility study, because they are now under preparation stage for implementation by the Government or they should be studied in other projects judging from the project features.

Under such consideration, the following project components are selected for the Feasibility Study:

- Nonstructural Measures: Land use control and guidance based on flood risk map, modification of reservoir operation rule, and institution and organization.
- Structural Measures: River improvement (Stage 1)

Regarding the partial protection of Pathum Thani and Nonthaburi, it is proposed that PWD conduct the project in the context of the currently ongoing study.

As for distribution and drainage systems improvement, it is recommended that the local government undertake the study for the following reasons:

- The area for distribution and drainage systems improvement covers a wide area of about 6,600 km². In the area, the irrigation and drainage systems are composed of a tremendous number of channels and the paddy field is divided into a huge number of units.
- To further examine the effectiveness of distribution and drainage systems improvement, it is necessary to prepare a detailed topographic map including such irrigation and drainage systems.

- Furthermore, a new hydraulic calculation model to reflect such area conditions needs to be developed.
- It will take a long time to cover such works including topographic survey and development of new model, while the scheduled study period is very limited, so that enough study is hardly undertaken.
- On the other hand, the effectiveness of distribution and drainage systems improvement can be confirmed through daily practice of operation and management and development of the system can be gradually promoted confirming the effectiveness. For the purpose, the basic study by area should be conducted, but it is not included in the Feasibility Study.

4.4 Study on Possibility of Water Resources Development of Structures Proposed for Flood Mitigation

In this study, the several measures are proposed for flood damage mitigation and some of them may also be used for water resources development purposes, especially irrigation. Among the proposed measures, preservation of the natural retarding area with the capacity of 16 billion m³ and the diversion channel have the potential for water resources development purposes. Since the stored water in the former measure, practically, is currently used for irrigation purposes, the former measure may not be considered as a new facility for water resources development, while the latter one is a newly proposed facility.

In this connection, the effectiveness of the diversion channel, when used for water resources development, is examined as follows:

(1) Storage Capacity of Diversion Channel

The storage capacity of diversion channel is roughly calculated in the following equation:

- $V_n = B_n \times L_n \times (h_{n1} + h_{n2})/2$
- $V = \sum V_n$

Where,

 V_n , $V(m^3)$: Storage Volume of Diversion Channel in Section (n) and the Whole Section, respectively

B_n, L_n(m): Width and Length of Diversion Channel in Section (n)

 h_{nl} , $h_{n2}(m)$: Storage Water Height at both upper and Lower Terminal End in Section (n)

According to the calculation, the proposed diversion channel can store the volume of 55 million m³.

(2) Benefit of Water Resources Development

The above storage water volume of 55 million m³ will provide benefit in a manner of increase of rice production as shown below:

- Increase of Irrigation Area: 55 million m³/21,000 m³/s (unit irrigation water supply volume) = 2,600 ha
- Increase of Rice Production: 2,600 x 5,900 Baht/ha (net benefit of rice production) = 15.3 million Baht

The benefit of 15.3 million Baht/year is expected through the water resources development using the diversion channel as the storage facility.

(3) Cost for Utilization of Diversion Channel as Storage Facility

As the major additional facility for water resources development, only the pump to extract water from diversion channel is considered. The cost of installation of the pump is estimated in the following manner:

- The required pump capacity is approximately 10 m³/s, assuming that the volume of 55 million m³ is extracted for 1,000 operation hours. (100 irrigation days x 10 hours/day)
- The cost of pump is about 120 million Baht, applying the unit cost of 12 million Baht/m³.

(4) Economic Viability

Based on the above cost and benefit, ElRR is estimated to be 12%, assuming that the construction period is 2 years. Thus, the utilization of diversion channel as storage facility for water resources development is economically viable.

Tables



Table 1.3.1 HISTORICAL CHANGE IN CHAO PHRAYA RIVER BASIN

		8		To the Desire		oQ	Domilotion		
Year	General Features of the Basin	Forest Area	Flood Protection Area*1	Cultivated Area	Urban develop- ment*2	Bangkok	River Basin	Major Hydro- logical Event	Construction of Major Facilities
before 1950	The basin was in a comparatively undeveloped state the forests in the upstream were largely untouched	166,000 km²	2,230 km²	0.7 mil. ha	51km ²				
1950 to 1970	Basin Development had been promoted converting the forest area to agricultural land		5,700 km2	1.7 mil. ha	100 km2	2,25 million in 1960	13.47 million in 1960		Construction of Chai-nat Dam (1957) and Bhumibol dam
1970 to 1980	Agriculture development had been promoted through construction of irrigation facilities and ring levee had been constructed to protect paddy field from flood		12,900 km2		200 km2	4.23 million in 1975	17.51 million in 1970		Construction of Sirikit dam and Kiu Lom đam (1972)
1980 to	Protection works for paddy field from flood had been implemented and area of traditional paddy like floating rice had been converted to high yield crops	106,000 km²	12,900 km²	3.5 mil. ha	389 km²	5.72 million in 1988	22.70 million in 1980	5.72 million 22.70 million 1986/87 Drought, in 1988 1987/88 Drought	Construction of Kho Laem Dam and King's dike (1984)
to present	Urbanization as well as industrial development has been promoted	92,000 km²	14,400 km²	·	528 km²	5.57 million in 1993	1992/93 Dro 27.42 million 1995 Flood, in 1990 1996 Flood	1992/93 Drouht 1995 Flood, 1996 Flood	

*1 : Northern and Central Regions of Thailand (Source : Chao Phraya Flood Management Review) *2 : Bangkok area only (Source : Chao Phraya Flood Managgement Review)

Table 1.3.2 MAJOR FLOOD EVENTS

Year	Maximum	Maximum	Maximum	Maximum
	Discharge at	Discharge at	Water Level at	Water Level at
	Nakhon Sawan	Chainat	Ayutthaya	Memorial
	(C.2)	(C.13)	(S.5)	Bridge
	(m^3/s)	(m³/s)	(m³/s)	(C.4) *
				(m MSL)
1942	n.a.	n.a.	5.15	2.27
1978	3,540	3,770	4.60	1.99
1980	4,350	3,800	4.70	1.92
1983	2,290	3,290	4.54	2.04
1995	4,820	4,550	5.00	2.20
1996	3,100	3,250	4.38	2.12

^{* :} After adjustment

Table 1.3.3 SUMMARY OF FLOODING CONDITION

Area	Geographical	Land Use	Flooding Condition In 1995	Cause of Flooding	Flood Damage in 1995
Upper Central Plain (Upstream of Nakhon Sawan)	Valley plain between hilly areas with gentle slope in the east and west.	Main land use. Paddy (Traditional varieties are dominant, but HYV is applied in Phitsanulok Irrigation Area protected Maixes)	Inudation Area: 5,000 km ² Depth: 0.5 to 3 m Duration: 2 to 3 month (in some depression areas inundation	Overtopping of Yom and Nan rivers Inland flood Overland flow from upstream	Agricultural Damage More than 50% of Phitsanulok project was protected 180,000 ha of paddy field was damaged. Urban Area Damage Sukho Thai, Phitsanulok, Phichit are seriously damaged.
		Uttradit, Phitsanulok, Sukhothai, Phichit	months up to January next year)] iii	Infrastructure Roads, bridges, irrigation facilities including regulators and canal embankment were damaged.
Nakhon Sawan Area (between Nakhon Sawan and Chainat)	Narrow valley plain with number of isolated mountains	Main land use. Paddy (Traditional varieties are dominant) Major urban area	Inundation Area: 500 km² Depth: 0.5 to 3 m Duration: 1 to 2 month	Overtopping of Chao Phraya River Overtopping of Sakae Krang River London Chang River River London Chang River River River London Chang River Riv	Agricultural Lamage Paddy fields of 160,000 ha and 10,000 ha were damaged in Nakhon Sawan and Uthai Thani respectively.
		Nakion Sawan, Outa mani			Nakhon Sawan and Uthai Thani were severely damaged. Infrastructure Damage Roads were damaged
Higher Delta in Lower Central Plain (between Chainat and Ayutthaya)	Natural levees and back marshes are well developed.	Main land use: Paddy (HYV is dominant but floating rice and deep water rice are dominant in habitually inundated area) Major urban area: Chainat, Sin Buri, Angthong, Ayutthaya, Supan Buri, Lop Buri	Inundation Area: 4,600 km² Depth: 0.5 to 4 m Duration: 2 to 3 month (in some depression areas inundation continued more than 3 months up to January next year)	Overtopping and dike breaches along Chao Phraya, Nan, Lopburi, Tha Chin, Pasak rivers Inland flood Overland flow from upstream	Agricultural Damage Total 190,000 ha of paddy field including 50,000 ha in Maharat Project Area was damaged. Urban Area Damage Chainat, Sin Buri, Angthong, Ayutthaya and Suphan Buri are severely damaged. Infrastructure Damage Roads, bridges, irrigation facilities including regulators and canal embankments are damaged
Lower Delta in Lower Central Plain (downstream of Ayutthaya)	Very flat	Main land use Paddy (HYV nce) is main but urban areas are expanding rapidly Major urban area Bangkok, Pathum Thani, Nonthaburi Samut Prakan	Inundation Area : 4,700 km² Depth : 0.5 to 2 m Duration : 2 to 3 month	Overtopping of Chao Phraya and Tha Chin rivers Dike breach Inland flood Overland flow from upstream	Agricultural Damage 40,000 ha of paddy field and 10,000 ha of other crop fields were damaged. Urban Area Damage Pathum Thani, Nonthaburi, Samut Prakan are damaged. Infrastructure Damage Roads, irrigation facilities including regulators and canal embankments are damaged

Table 1.4.1 LIST OF PREVIOUS PLANS FOR FLOOD MITIGATION AND DRAINAGE WORKS

	CANOT		
Study/Project			
on Flood			
Control	Contents	Agency	Year
	Two perimeter canals on the east and west side of the city,	Lidchfield, Whiting,	
Greater	Zoning to give high level of protection (Polder system).	Bowne & Ass. Adams	1
Bangkok Plan	Short cut of Chao Phraya river	Howared and Greely	1960
Camp,			1
Dresser	Polder system of 460 km2 with size of polder ranging from		
Mckee Plan	11 to 100 km2	Camp, Dresser Mckee	1968
	Protection of an area of 86 km2 on the east bank of the	Cump, Dicosci merco	1700
City Core	Chao Phraya River: Major protection barrier by 100-y	Nedeco and Land	1
Project	protection and Expected land subsidence in 5 years	Marin/Span	1984
	Parameter Superior Su	Intering Span	1984
Master Plan for Eastern			
Suburban-	A wolder avetem with anyone diversity and a control	İ	
Bangkok	A polder system with pumps, diversion gates, and retention ponds for the mastar plan area of 500 km2		
Dangava		ЛСА	1985
	Protection of a large area on the west side of the Chao		Ì
·	Phraya. The system constited of the construction of dikes		
The RID-Plan	enclosing the area between the Chao Phraya River and Tah	DVD	
·	Cini Aiva	RID	1985
Study on			
Tawee	Protection of the western side of the Chao Phraya River to] •
Wattana by AIT	the Tha Chin River for 500 km2. Polder dikes were		
M1	proposed in line with the 1985 RID Plan	AIT	1985
	By-pass channel with a 500 m3/s capacity along the east		
Alternative	bank of the Chao Phraya river from Ban Mai to the sea,		1
Flood Control	construction of dikes from Bangsia to river mouth and		
Schemes	dredging from Pakkret to the esturary	AIT	1985
C1 75			
Chao Phraya 2	Construction of diversion Channel, eastern boundary dike,	AIT and Austrarian	
	control structure at Bangsai and sea barrier structure	Consultant	1986
·			
Master Plan	• • · · · · · · · · · · · · · · · · · ·		l
for Flood	Flood protection of a study area of 432 km2 on the west		
Protection and	side of the Chao Phraya river: Construction of new or		
Drainage of	raising of existing flood barriers around the study area and		
Thonburi and Samut Prakan	construction or rehabilitation of tegulators and flood gates		
Daniut I lakan	in the Mongs.	Nedeco and Span co, ltd.	1987
F/S for the			
Lower Chao			
Phraya West			
Bank Area Development	Create in all a development of the state of	<u>_</u>	
	Sustainable development of RID West Bank projects and protection of the area by dike and drainage improvement	Team, AAC, Sanyu and	1
		AIT	1992
Chao Phraya	Identification of high priority flood management projects		
Flood	for on-going and planned flood management initiatives and		
Management Review	preparation of a conceptual program for basin-wide flood		
TC4ICW	management.	AIT, DHI and ACRES	1996
M/P for the			
flood			. [
protection and			· [
	Protection of the 650 km2 of BMA area between the Chao		
system in	Phraya river in the west and King's dike in the east by		
Eastern sub-	improving the existing barriers along the Chao Phraya		•
Urban	Th. 1 THE	Nedeco, Span co., Itd.	

rable 1.4	Table 1.4.2 "MAJOR FEATURES OF THE PREVIOUS PLANS FOR FLOOD MITIGATION AND DRAINAGE WORKS	THE	PREVIOUS I	LANS FOR	LOOD N	ITIGATION	AND DRAINAC	E WORKS	
		,		Return period of			Design Water	Crest Height,	Flood studied
Project	Organization	Year	Main Scheme	Bood	Target Yea	Target Yea Design Dischar Level (m)	Level (m)	Freeboard (m)	(year)
Greater Bangkok Plan	Litchfield, et al	1960							
Camp, Dresser, McKee Plan	Camp, Dresser and McKee	1968	-						
City Core Project	NEDECO, Land Marine / Span	1984		100 year			+2.27 MSL (Memorial Brdg)		
Master plan for Eastern Suburban	JICA for BMA		Drainage	100 year	0000		\$600 ±1 0 ±2 21 800		1942, 1980,
Bangkok Flood Control Management	BPI C for NFSIDB	200		100 year			+2.1 MSL (Memorial		SOAT
RID Plan	RD	1985					Ante		1983
Tawee Wattana Study	AIT for BMA	1985		100 year			+2.1 MSL (Memorial Brdg)		1978, 1980
Alternative Flood Control Schemes	AIT for NESDB	1985		10 year (mraf) 100 year (mban)			+2.2 MSL (Memorial Brdg)	0.5 (FB)	1983
Chao Phrays 2	TAC, AIT for BIMA	1986	Sea barner, Dike 1986 and Pump	100 year	2001	2001 3600 (Bangsai)	+2.2~+4.0 MSL	T. 2.	1986
Master plan for Flood						n.e. (1942 filled =75			
Protection and Dramage in Thonburi and Samut Prakan	NEDECO, Span for BMA	1987	Pump, Dasinage	100 year	2000, 201	201 3000m3/s)	+1.2~+2.3 MSL	0.3 (FB)	1983
Flood Control Bangkok and Vicinity	Sverdrup for BIMA	1988	n of	n.e.	1990 n.a.	n,a.	il.a.	n.a.	r r
Lower Chao Phraya West			1				+2.4MSL(Non		
pank Area Peveropinent project	Team, AIT etc. for RID/ADB	1992	2 Dike for rural area	10-25 year for nural area	2006	•	Thatburi) +4MSL (Bengsai)	0.50 (FB)	7
ESUB	NEDECO for BMA	1996	Flood Protection Dike Drainage 96 System	100 year and 5 year	2016	2016 Amrox 3500	+1,90~2,75MSL (Bingkok Port~Non Thebiri)	0.50(FB) +	ě
Chao Phraya Flood	THE COURT OF THE	3		100 year (urban) Less than 10 years					
Тумпыусптели	ALL TOT INCOUST WIS	1330	1990 Management	(rttra)			-		mainly 1995

Table 1.4.3 ON-GOING FLOOD PROTECTION WORK BY BMA

Crest Elevation of Flood Barrier U		
	NEDECO	RWA LIDAI
Kh. Bang Khen to Krungthon Br.	3.10 - 3.20	3.00
Krungthon Br. to Memorial Br.	3.00	2.80
Memorial Br. to Taksin Br.	2.90	2.75
Taskin Br. to Rama IX Br.	2.80	
Rama IX Br. to Wat Yothin Paradit	2.60	

Discharge of Existing Pump	(m3/s)
Core City and Eastern Sub-Urban	452.22
Tomburi (West Bank)	239.80
Total	692.02

Table 1.4.4 SUMMARY OF FLOOD PROTECTION STUDIES FOR SEVEN	VEN PROVINCES
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	Table 1.4.4 St	/MM	ARY OF I	LOOD PI	ROTECTI	ON STUL	HES FO	RSE	VEN PRO	VINCES	
Location	Municipality,	Area	Population	Pump Cap-	Dike Eleva-	Freeboard	Return Pe	riod	Construction	lmplemen-	Remarks
	Saniatary District	(km²)		acity (m/s)	tion (MSL)	(m)	Drainage	Dike	Cost (M. B)	tation Year	
	Province				}					1	
P. Capital	Nakhon Sawan	28.0	109,708		<u>[</u>				ł	1	1
F/S Area	7-Area	136.3					-		4,835.60	1998-2009	
	Nakhon Sawan	124.8	145,510		29.0	1.0	5	100	4,394,00	1998-2009	& Vicinity
	Chumsaeng Muni.	2.4	11,690					١.			Nan River
	Lat Yao SD	1.6	-	-			_	' <u>~</u>	69,00	2003-2004	Far from the Rive
	Kao Leio SD	1.5	-	-	_	-	_	-	1		Ping River
	Krok Phra SD	2.8	-	-		_					Chao Phraya Rive
;	Phayuha Khiri SD	1.8		-	-	· .	l	١.			Chao Phraya Rive
	Banphot Phian SD	1.5		_	-		_	_	l		Ping River
D/D Area	Nakhon Sawan	21.0	103,400	115.5	29.0	1.0	5	100		1998-2002	
Chainat	Province										1.1.1.1
P.Capital	Chainet	6.1	15,872			j				}	
P/S Area	2-Arce	88.8	39,989	12,2			5	100	·	 	
	Chainet	56.5	35,300	-	20.2~18.1	0.43-0.37	5	100			
	Watsing Muni.	32.3	4,689				•			•	f
DVD Area	5-Area	19.6	29,012	5.0		-	5	100			
i	Chainst	4.0	16,131	1.1					82.01	1	
	Ban Kluny	7.2	4,498	1.1					54.17	1	Chainat
	Tha Chei	3.1	2,589	1.1					63.53	1	Chainat
	Had The Sec	3.3	1,772	0.7				·	56.92		Chainet
	Watsing Muni.	2.0	4,022	1.0					62,43	1	
Sing Duri	Province								· · · · · · · · · · · · · · · · · · ·		
P.Cupital	Sing Buri	7.8	21,232	•							
F/S Area	3-Area	26.7	-	21.5			5	100	3.229.74	1998-2009	
	Sing Bari	14.9	_	15.7	13.3	0.5			2,009.76	1998-2009	
	In Buri SD	7.3	-	3.4		-				1999-2009	1
	Phoon Buri SD	4.5	_	2.4	·	_			465,15	2002-2009	}
	Sing Buri / 4-SA	11,1		14,5	13.3	0.5	5	100	1,144.00	1998-2009	SA= Sub-area
Aug Thong	Province								<u>.</u> ,		
P.Capital	Ang Thong	6.2	11,662							L	
F/S Area	2-Area	50.8	_	•							
1	Ang Thong	24.0	-	-	9.0	0.2	. 5	100	2,378.80	1999-2006	
	Pamok Muni	26.9	17,368	25.5			5		2,176.11	2001-2008	
	Ang Thong	7.0		24.0	9.0					1999-	
	Province		·								
	Ayuthaye	14.0	70,623								
	Ayotheya	37.0	76,576	75.5	6.5	0,5	5	100	1,564.00		<u> </u>
	2-Area	18.4	64,228	39.5	6.5	0.5	. 5	100		1999-2002	_
1	Ko Muang	13.0	53,200	27.5	-	-	-	-1			to Phu Kao Thong
Pathum Thani	Ayuthaya	5.4	11,028	12.0					172,52	2001-2002	
	Dealer To			}	l			ĺ			·
	Pathum Theni	7.1	14,680								
	3-Area Pothym Thomi	119.3		49.5	3.9	0,6	5	100			L. Sub:0.2 m
	Petham Theni	8.8	7	16.5	-[-	-{	-			West Bank
	Bang Pho Thai Bang Luang	71.1	"	51.0	-		1	1			West Bank
onthaburi .	TOWN TYNERS	39.5		51.0					1,226.22	2000-2002	Last Bank
	Nonthaburi	38.9	251 440	}	,		}	}			
		36.9	251,468							1000 2007	i subos
	2-Area West Bank	150 0	227.000		205 225	0.3	5	100		1998~2006	L. Sub. 10.2 m
7	1	150.0	237,000	94.5	2.85~3.35	4	ł	}			
	East Bank		<u> </u>	139.5	2.85-3.00						

Note; Return Period: Unit = year, SD= Sanitary District, M.B= Million Bahts, L. Sub. = Land Subsidence

Table 1.4.5 Disbursement for Flood Protection and Drainage Region Office 3, 7, and 8

				(r	nillion Baht)
	1995 Regular	1996 Additional	Emergency	Total	(Total)
Region 3	170,8	•	-	170.8	67.3
Region 7	153.2	662	19.9	835.1	147.1
Region 8	381	156	49.8	586.8	19.3
Equipment	. •	125.6	7.5	133.1	
Total	705	943.6	77.2	1,725.80	233.6

Source: RID

Table 1.4.6 CHARACTERISTICS OF BARRAGE KM. 205 AND BARRAGE KM. 345

Item	Barrage km. 205	Barrage km. 345
River around Headwork Area	T. Phra Ngam	T.Nam Song
	A. Phrom Buri	A. Phayuha Khiri
	C. Sing Buri	C. Nakhon Sawan
Elevation of River Bank (m. MSL)	9-10	
Elevation of River Bed (m. MSL)	-1	
River Width (m)	150	
Headwork Area		
Width of Diversion Canal (m)	•	
Upstream/Downstream	215/235	410/305
at Barrage Site	244	
Flow Control Structure		, 37
No. of Control Gates	12	2
Width of Control Gate	12.5	4 · · · · · · · · · · · · · · · · · · ·
Sill Level (m. MSL)	-1	12.
Level of Upper Edge of Shuice Gate when Closing (m. MSL)	10	i
Level of Lower Edge of Sluice Gate when Closing (m. MSL)	13	[
Drainage Capacity (m3/s)	4120	2: 456
Level of Roadway Bridge Surface	15.3	26.
Width of Roadway Bridge	6	20.
Max. Storage Level (m. MSL)	12.03	21.72
Storage Level (Dry/Rainy Season) (m. MSL)	9.00/8.00	21.00/20.00
Min. Downstream Water Level (m. MSL)	1,15	15.5
Max. Downstream Water Level (m. MSL)	11.9	21.
Max. Flow (50 years return period (m3/s))	4120	4560
Designed Flow for Downstream Demand (m3/s)	80	200
Navigation Lock (number)	1	200.
Width (m)	14	1.6
Length of Lock Chamber (m)	165	14 135
Downstream Sill Level (m)	-3	
Fish Ladder (Number)	2	11 2
Width (m)	4	
Slope	1:10	1:10
Hydropower Plant	7.10	1.10
Type of Turbine	pit turbine	pit turbine
Designed Head (m)	6	pit timothe
Designed Flow (m3/s)	160	440
Installed Capacity (MW)	8.05	440 14.76
Average Hydropower (million units/year)	47.15	
Closure Dain	47,13	98.6
Creast Level (m. MSL)	12 6	20.0
Width of Road on the Crest (m)	13.5	22.8

Table 1.5.1 GENERAL FEATURES OF STORAGE DAMS IN CHAO PHRAYA RIVER BABIN

Fig. 17 Fig. 18 Fig. 19 Fig.	ì
I, P, F I, P, F I I I I I I I I I	Krasieo
I, P, F I, P, F I I I I I I I I I	
Hing Nan Ping Ping Wang Ping Chao Ping Ping Wang Chao Ping Ping Wang Ping Chao Pinaya (km2) 26,386 13,130 1,281 569 2,700 426 1,200 and (million m3) 9,662 6,660 255 249 106 30 201 (mm) 366 508 199 438 39 70 168	
EGAT EGAT RUD RU	
Hing Nan Ping Ping Wang Ping Chao Ping Ping Hunga Chao Ping Ping Ping Ping Ping Ping Ping Ping	RED RED RED RED RED
Hing Nan Fing Fing Wang Fing Phraya Chao Phraya (km2) 26,386 13,130 1,281 569 2,700 426 1,200 line (million m3) 9,662 6,660 255 249 106 30 201 (mm) 366 508 199 438 39 70 168	Chee Basel Vom Kwae Noi Salae Wang
26,386 13,130 1,281 569 2,700 426 1,200 9,662 6,660 255 249 106 30 201 366 508 199 438 39 70 168	Direct Krang
26,386 13,130 1,281 569 2,700 426 1,200 9,662 6,660 255 249 106 30 201 366 508 199 438 39 70 168	
9,662 6,660 255 249 106 30 201 366 508 199 438 39 70 168	1,200 12,929 3,583 4,254
9,662 6,660 255 249 106 30 201 366 508 199 438 39 70 168	701
366 508 199 438 39 70 168	201 772 1,125 35 201 1 201
(mm) 366 508 199 438 39 /0 108	150 400 170 400 150
14 E	777 +10 00 001
	Q Q Q Q
2	*

MEDIUM SCALE DAMS		. !														
Name of Dam	Mac Tub	Mae Yao	Mac Tub Mae Yao Mae Arb	Mac Prik	Мас Кат	Khlong	Huai Head	Khlong	Nam Haeng	Huai Mac Khon	Huai Mac Huai Mac Khon Kon 1	Khlong Khayang	Khlong Prai	Nam Lai	Khlung	Mae Song
						,					\ \ \ \	,	ì	,	, ,	1
4	-	_	Į	Į	Ι	Н	H		×	H		-	-	4		-
Furpose	. 6	Ę	Ē	£	8	RID	E C	2	MZ CO	RID	Ø	£	E E	9	9	6 2
Under operation by	}		None W	Wand	,	Y.	Zan	Nan	Nan	Ping	Ping	Ping	Ping	Ping	Ping	Your
River	Sing.	T STREET	Sime .					3,90	100	, %	7	02	15	7	56	305
Drainage area (km2)	126	33	33	5	77.60	9	†)	Ĝ.		ξ		}	. !	,	,	
(Em adillian) complete and another the	90	3.2	7.15	3.8	9.6	9.5	2.7	25	10.2	3.7	4.85	4.6	13	13	×	23.7
me) ammo	9	; ;	714	4	162	339	28	196	37	109	110	230	254.9	202.7	189.5	174
- critto -	Sac -	;		;					ū	٥	٩	۵	۵	۵	Ы	ď
Existing/under constructing/proposed	E	E	Ε	_	4		١		٠.							
		Note: I - L	Note: I - Imgation; P -	- Power G	eneration; F	F * Flood C	Control; S =	Water Suppl	ďζ							
			,													

SMALL SCALE DAMS											-				
f Dam	Mae Tang Song	Huai Mac Song	Huni Ta Pac	Мас Мос	Wang	Mae Sai	Huai Suang	Mae	Mac Khaning	Huai Nam Kiung	Khlong Chomphu	Mac	Khlong	Huai Nam Dung	Huai Kan Yao
<u> </u>]-	-	-	-	-	-	1	I	I	I	ĭ	I	1	I	
rurpose	, E	. E	. OD	2	9	202	9	Ð	Æ	RID	Ð	Ð		RID	
Under operation by	2	,	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Y	Y.	You	You	Yom	Nan	Nan	Nan	Nan		Sakae	
Kiver	T CHI	100			!	!								Krung	
(Carry)	120	9	287	728	179	171	47	20	229	148.2	364	18		45	
Dramage area (willow ma)	28.1	4.1.	28	8	12	24.3	9.6	7.7	62	12.4	43	4.3		5	
Active storage volume (minori att.)	234	190	707	110	29	137	119	110	271	8	118	239	180	111	77
structing/	۵.	ď	بم	d,	Ь	ы	Ъ	Р	P	Ь	P	Ы	1	Ъ	
EXISTING/under constructing/proposed		- I	*	•									1		

LARGE DAM
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F.P. F.P. F.P.	Project Name	(unit)	Bhumibol	Sirilot	Mac Ngat	Mae Kuang	Kin Lom	Mae Chang	Thap Salao	Pasak		K was No.	Mae	Kiu Kho	
March Marc	Purpose	 	1. P. F.	4	-	-		Т.			Τ		Wong	Ma	MAC PUBL
Check Chec	Under operation by		TACA	į						ايم	I.F.P	F. P.		E.S.	ΓF
Character Authorise Auth	Location		TWO STATE	EGAI	KID			2	ΩΩ	Ð	QD2	ZID.	9	Ð	RID
Character Char	Local Community	-	A fam Ngo,C	ATHERAC	A Mas Tuess.C	A Dei Saine C		0.750000							
(a) 1-5 1-	f		ž	Observedit	COVERNO	COMPANY		A Prince Mon. C.	A Law And	_	A.Sung.C	A.Wit Boc	A.Ladyno. 9		Assem Pa Tong
(a) (b) (b) (b) (b) (b) (b) (b) (b) (b) (b	Kiver	-	Pint	2	Mas Ngat	Ping	N. C.	MecChan	Saicae Krama	Ē	No.	Peterpulok	Nakom Sawan		C Chiang Mai
Check Chec	Longitude	<u> </u>	17-14-31	17-16-05	19-09-45	18-56-32	18-31-19	18-18-14		!	•	TON THE COOL	Surry owner	39	Mae Khan
Check Check Size 1110 1281 550 2700 455 551 555 551 555 55	Hydrology	(a)	10-90-00	100-33-18	93-02-36	99-07-11	99-37-34	99-48-42							
CHACKEL CHAC	Dramage area	(£mm2)	762 76												
Control (min.) 1992 Card	Annual inflow	(MCM)	5,256				74	426	\$ 3		m	4,254	615	1,275	1,085
Control Cont		(mm)	199.2			•	•	7 9	202			1,449	121	265	181
(m.M.S.L) 2600 1666 4000 3150 2350 1570 400 1500 207.3 244.0	Reservoir						0/17	COKI	3/8.3	162.4	260.4	340.6	361.1	207.8	166.8
CMCMSA 1310 1320 1320 3860	Max. water leve]	(m M.S.L.)	260,0		400.0		284.0			!				-	
Checker Chec	Normal water level	(m M.S.L.)	260.0	÷			285.0		139.0	43.3	261.0	130.0	207.5		381.8
Checky C	Min Water level	(m M.S.L.)	213.0				263.0		0.701	ţ	258.0		204.5	352.0	380.0
MACMA	power operation	-	213.0		•	·	1	,	0.4	37.0	210.0	0.06	180.0		328.8
CACCAD 13,462 10,508 325 253 112 113 114 1	Stores		202.5				263.0	340.0	142.0	3 62		6	Ş		_
Coccade 1,440 1,	max water level								<u>;</u>		7.0.0	0.00	200		328.8
Checked 1,442, 1,444, 1,442, 1,444,	normal water level	(MCM)	13,462	_	325		112	•	1861		•				
Checked \$4,600 \$4,600 \$2,500 \$225 \$234 \$199.1 \$235 \$239 \$150 \$150 \$25	min. water level	(MCM)	13,462		265		112	100	160	785	1.175	740	250	5	ì
(m) (km) (km) (km) (km) (km) (km) (km) (Active storage volume	(MCM)	3,800		22		4	16	80	0	20	2	3 6	2 .	5,
(m. M.S.L.)		(mm)	790'6		255		106	30	152	£	1.125	733	3 5	3 5	d í
(m M.S.1) (m M.S.1) (m M.S.2) (m M.S	Surface area	<u></u>	2006		199.1	437.6	39.3	70.4	284.7	59.7	314	1723	7.	141	7, 631
(m M.S.1) Tennel types 2 Turnetd. (m) AS.1. Tennel types 1 Turnetd. (m) AS.1. Tennel types 2 Turnetd. (m) AS.1. Tennel types 1 Turnetd. (m) AS	Dem		310.0		[6.0]	12.0	16.0	12.3	19.0	148.8	65.0	40.5	17.5	1	136.1
(m M.S.L) 154.0	Type		Gravity arch												13.0
(m M.S.L)	Height	(E)	154.0	711	9		1								arth511
(m M.S.L.) Tannel type 2 Turnels	Crest elevation	(m M.S.L)	261.0		2.5	01.0	26.3	40,0	26.8		0.68	80.0		47.0	
Tunned type 2 Tunned 4, Tunned type 242.9 Tunned 4, Tunned 4, Tunned 5, Tu	Crest length	(m)	486.0		2	9,00	¥80.5	356.0	-	46.2	263.7	135.0	211.0		385.0
Tunnel type	Spillway								1	70.0	545.0	2630.0			
(m.M.S.L) Radial Gate 118.5	Type			2 Tunnels,						-				-	
Radial Cate Radial Cate Radial Cate Radial Cate 11.0 m(w)* 11.45m(w)* 15.0 m(w)*	Crest elevation	(m M.S.L.)	42.9		393.8			347.0	_	,		ver flow	•	-	
110 cm(w)*	Control gate			Radial Gate		•	,	?		35.0	258.0	118.5	-		380.0
W (m3/s) 17.4m(h)*4 15.0m(h)*2 15.0m (w) 1.056 (m3/s) 15.0m (w) 1.055 (m3/s) 15.0m (w) 1.055 (m3/s) 15.0m (w) 1.055 (m3/s) 15.0m (w) 1.25MW*6 (m3/s/VNIT) 12.8MW*7 (m3/s/VNIT) 12.8MW*7 (m3/s/VNIT) 12.8MW*7 (m3/s/VNIT) 15.10 (m3/s/VNIT) 15.1				11.85m(w)*		_			-		<u> </u>	adiai G.			
CMCM, 7,670 10,500 3,174 1,470 2,900 1,056 2,967 5,600 8,222 1,770	Design flood neak inflow	1.41		15.0m(h)*2							4.4	3.0H (W)			
Fixed Wheel	Design flood volume	(200	6	10,500	3,174	1,470	2,900	1,056		2,967		8 2 43	- 770		
Fixed Wheel	Max. discharge capacity	(m3/S)	0/9'/	4,643	261				1				2		
Fixed Wheel Sam (W)	Intake structure		200	3,430	1,035		3,000	440		3,497	3,300	7,046		2.385	1,610
4.2m(w)* 6.0m(w)* 6.0m(w)* 6.0m(w)* 5.5m(k)*1 5.0m(w)* 6.7m(h)*7 8.5m(k)*1 5.0m (w)* 6.7m(h)*7 8.5m(k)*1 5.0m (w)* 6.7m(h)*7 8.5m(k)*1 5.0m (w)* 6.7m(h)*7 8.5m(h)*7 12.8M*	Intake gate			Trend Wheel		•		•					-	-	
### (m3/s/UNIT) 6.7m(h)*7 8.5m(h)*1 55m(h)*1 55m(h)*1 55m(h)*1 55m(h)*1 55m(h)*1 55m(h)*1 55m(h)*2 55m(h)*3 55m(h)*3 55m(h)*3 55m(h)*4 55	Gate size	-	 !	1.0m(w)*				-+			Ē	ed Wheel	~		
TOMW*6 125AW*4 125AW*4 125AW*4 125AW*4 125AW*6 125AW*7 125AW	A Land State of the state of th			3.5m(h)*1							5.9.	-(a)			···
TOMW*6 125MW*4 +128MW	Dasc cicyanan of mict			105.75			•								
TOMW*6 125MW*4 125MW*4 125MW*6 125MW*4 125MW*1 194.3 194.3 194.3 194.3 197.0 107.0 (GWh) 1.500 1.200 1	Fower station		_		 -		_	-		-	200.01	90.0	1	-	
(m3/s/UNIT) 75.8 194.3 (m3/s/UNIT) 69.5 175.0 (GWh) 1.500 (GWh) 1.500 (GWh) 7.5 (GWh)	merce capacity		.	25MW*4				···	-			- F			
(m3/s/UNIT) 75.8 194.3 (m3/s/UNIT) 69.5 175.0 (GWh) (GWh) 1.500 1.200 (GWh) 75.0 (GWh) 7	Discharge of pawer outlet		+128MW						_	<u> </u>	_	7			
(m3/s/UNIT) 69.5 175.0 107.0 (GWl) (GWl) 1.500 1.200 1	-Atmax head	/3/-/(Diff.)				***		•	_					_	
(GWh) 1.500 1.200	- At nor. head	(INCASCIII)	R:C/	1943											
(GWh) 1,560 1,200 47 94	- At min. head	(m3/s/UNIT)	10.19	0.00				_			107.0	4			-, ,
P - Power Generation: F = Double Control	Produced Armual Energy		1,560												
		_	lote: I = Irrigation;	P - Power Gene	ration: F = Floor		-			47	94	150		_	

Table 1.5.3 DAM RESERVOIR VOLUME IN THE CHAO PHARAYA RIVER BASIN

	Drainage	Number of	Total Dam	Total Dam
River Basin	Area of	Dam	Redervoir Volume	Redervoir
		Reservoirs in	(MCM)	Volume/Drainage
Ping	39,880	5 (13)	10,268 (10,853)	257.4 (272.1)
Yom	23,550	2(12)	13 (248)	0.6 (10.5)
Wang	11,240	4 (5)	123 (313)	10.9 (27.8)
Nan	31,830	4 (9)	6,693 (7,482)	210.3 (235.1)
Pask	18,200	0 (1)	0 (875)	0 (43.0)
Chao Phraya	16,200	16 (45)	17,298 (19,989)	106.7(123.3)

Note: value in parentheses is total value of exitting and proposed dam reservoirs

Table 1.5.4 FORECAST OF FUTURE WATER DIVERSION REQUIREMENT (MCM) IN 2016

	Present 1996	NESDB/WB Best	NESDB/WB Safe	NESDB/RID /JICA	Combination of Maximum
Domestic	1,482	1,282	1,282	1,236	1,282
Industry	273	581	581		581
Agriculture	21,916	(-)6,336	0	2,760	2,760
Total	23,671	(-)4,473	1,863	3,996	4,623

Source: NESDB/World Bank in 1997 and NESDB/RID/JICA in 1996

Table 2.2.1 THE TARGET COMPLETION YEAR OF CURRENT RELATED DEVELOPMENT PROJECTS

Sector	Project	Target Year
Flood Mitigation	Chao Phraya Flood Management Review	2016
Plan	Flood Protection and Drainage in Eastern Suburban	2006 for Flood Protection and 2016 for Drainage
	Flood Protection of 7 towns in Chao Phraya Basin	2016
·	National Flood Protection Master Plan	2016
Water Resources	Chao Phraya Basin Water Management Strategy	2006, 2016, 2026
Development, etc.	Kok-Ing-Nan Water Diversion Project	2016
	Bangkok Environmental Improvement Program	2012

Table 2.2.2 EXISTING AND PLANNED DRAINAGE PUMP CAPACITY FROM URBAN AREAS -CHAO PHRAYA RIVER-

Province	Protection	on Arc	A	Purup (Capacity ((a\ ^t m	S. Capacity	Population	Remarks
	Name	km²	Population		Planned		(m³/s/km²)		
Sukhothai	Sukhothai	3.5					0.70		
	Sawankelok	6.5			5*		0.70	,	•
Phitsanulok	Phitsanulok	18.3	78,469	None	13*	13	0.70		
Phichit	Phichit	12.0	24,832	None	8*	8	0.65	2,069	
	Taphan Hin	5.2	22,066	None	4*	4	0.70	4,243	
	Bang Mun Nek	2.5	10,258	None	2*	2	0.70	4,103	
Nakhon Sawan	Nakhon Sawan	124.8	145,510	3.0**	131.7	134.7	1.08		
	Chumsteng	2.4	11,690	None	2*	2	0.70	4,871	
	Krok Phra	2.8	-	None	2*	2	0.70		
	Phayuha Khiri	1.8	-	None	I*	I	0.70		
Chainat	Chainet	56.5	35,300	None	15*	15	0.26	625	
	Watsing	32.3	4,689	None	6*	6	0.20	145	
Sing Buri	Sing Buri	14.9	21,232	0.3++	15.7	16	1.07	-	
	ln Buri	7.3	-	None	3.0	. 3	0.41	-	
	Phrom Buri	4.5		None	2.0	2.	0.44		
Ang Thong	Ang Thong	24.0	11,662	None	29.0	29	1.21	•	
	Pamok	26.9	17,368	None	26.0	26	0.97	647	
Ayuthaya	Ayuthnya	37.0	76,576	None	76.0	76	2.05	2,070	
Pathum Thani	Pathum Thani	8.8	14,680	None	17.0	17	1.94	-	
·	Beng Pho Thei	71.1	-	None	51.0	51	0.72		
	Bang Luang	39.5		None	51.0	51	1.29	-	
Nonthaburi	East Bank	89.0	390,335	None	140.0	140	1.57	4,386	
	West Bank	150.0	237,000	None	95.0	95	0.63	1,580	
Bangkok	East Bank	650.0	•	452.2	101.0	553	0.85		
	West Bank	240.0	-	221.8	70.0	292	1.29		
Carrat Dayler	77 - 4 79 - 45	224.0		18.0	0.0	18			Drained to the Sea
Samut Praken	East Bank	236.0		55#	0	55	0.28	•	#12m²/s pumps under const. are included
	WAD.uk	144.4	1	12.0	0	12			Drained to the Sea
Total d		124.0	<u> </u>	59#	0	59	0.48		#16m³/s pumps under const. are included
total (Chao Phraya River)		1	791.6	858.1	1,659	ائرا		

AHT-	CHIN	RI	ER

Province	Protection	on Area	1	Pump (Capacity (m³/s)	S. Capacity	Population	Remarks
	Name	kra²	Population				(m²/s/km²)	Density	
Supenburi	Supenburi	9.0	27,788	None	6*	6	0.70	3,084	
	Songpeenong	10.4	12,848	None	5+	5	0.50	1,235	'
Samutsakom	Samutsakorn	10.3	54,335	0.1*	7.2*	7.3	0.70	5,275	
	Ketumban	2.2	14,677	None	1.5*	1.5	0.70	6,671	
	Aomnoy	30.0	29,882	None	15*	15.0	0.50	996	
To	tal (The Chin River)			0.1	34.7	35		4.1	

-PASAK RIVER

	TA FRANCISCO AND 7 AMEN'								· · · · · · · · · · · · · · · · · · ·
Province	Protecti	on Are	3.	Pump (Capacity (m³/s)	S. Capacity	Population	Remarks
	Name	km²	Population	Existing	Planned	Total	(m³/s/km²)	Dépaity	
Sacabori	Sezaburi	20.1	57,410	None	14*	14	0.70	2,856	
	Phaphattabat	29.6	36,021	None	15*	15	0.50	1,217	
	Nongkhea	5.0	8,769	None	3+	3	0.62	1,754	•
	Keangkoy	4.1	13,648	None	_3•	3	0.70	3,329	
	Total (Pasak River)			0.1	34.7	35			

Note; S. Capacity = Specific Capacity, Population Density = Capita per square kilometer, *= Pump capacity estimated from Specific capacity
-Population density Curve, ** = Pump capacity estimated from pump's diameter

Table 2.2.3 SIMULATION CASE FOR IDENTIFICATION OF INFLUENCE BY FUTURE DEVELOPMENT

			Basi	Basin Condition	ition		Γ		Simulation	Simulation Results (1995 Flood)	195 Flood)		
Case	esent Condition	an Development	Change of Agricultural Cultivation	socialization of the second control of the s	msG		Loop Cut	Flood Discharege at Nakon Sawan	Flood Discharge at Bang	Water Level at Samsen (C.12)		Total Inundation Volume	Remarks
A	ч а	ዋብ			Existing Planned	anned		(m3/s)	(m3/s)	(MSL+m)	(C.4) (MSL+m)	(C.4) (MSL+m) (billion m3)	
Reappearance of Present Condition	0							4,600	4,150	2.32	2.20	15.9	
Influence by Urban Development (Providing Ring Levee with Drainage Pump)		0	2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		0			4,430	4,070	2.80	2.57	16.0	
Influence by Change of Agricultural Cultivation (in combination with Urban Development)		0	0	•	0			4,430	4,070	2.81	2.57	16.1	
Influence by Land Subsidence (in combination with Urban Development and Change of Agricultutal Cultivation)	·	0	0	0	0		-	4,430	4,070.	2.81	2.56	16.2	***************************************
Influence by Construction of Dam(in combination with Urban Development and Change of Agricultutal Cultivation)		0	0	0	©	O		4,110	4,000	2.77	2.53	14.7	
Influence by Construction of Loop Cut (in combination with Urban Development, Change of Agricultural Cultivation and Construction of Dam.)		. 0	0	O	©	0	. 0	4,110	3,980	2.62	2.45	14.1	Future Basin Condition
Influence by Large Scale of Agricultural Development (in combination with Urban Development)		0	0		0			4,430	4,570	3.13	2.83	15.9	

© : Actual outflow is applied for Bhumipol Dam, but Sirikit Dam outflow is assumed to be regulated with a conduit newly added after the 1995 flood accrding to the current operation rulr, resulting in no spillage.

Table 2.3.1 CONCEIVABLE MEASURES

Area	Geographical Features	Land Use	Flood Damage in 1995	Conceival	Conceivable Measures
				Structural Measure	Non-structural Measure
Upper Central Plain	Valley plain	Main land use	Agricultural Damage	For agricultural area	Flood Plain Management
(Upstream of Nakhon	en Sen	Paddy (Traditional varieties	More than 50% of Phitsanulok project was	River Training	(Strengthening of Control
Sawan)	areas with	inant, t	protected 40,000 ha of paddy field was damaged.		and Guidance, Flood
	odors a	applied in Phitsanulok	Urban Area Damage		Disaster Response and
	the east and	Irrigation Area protected by	Sukho Thai, Phitsanulok, Phichit are seriously	For urban area	
	west.	dikes)	damaged.	Ring Levee	Watershed Management
		ban area			Institution and Organization
		Ottradit, Phitsanulok,	Roads, bridges, irrigation facilities including		Modification of Reservoir
Nakhan Sawan Area	Variation violen	Main land use	regulators and canal embankment were damaged.		Operation Rule
Coetween Nakhon		Doddy (Traditional surjection	Actioning Damage	For agricultural area	agen
d Cha		are dominant)	raduy neig of about 30,000 na was gamaged in this	Kiver Training	gthening of C
		Maior unhan and	77.1. A A		and Guidance, Flood
	montaine	Nother County 14th Thesi			Disaster Response and
	TITO WITH WITH	I Adamon Sawan, Cinal I nam	naknon Sawan and Uthai Ihani were severely	For uraban area	Financial Response)
			damaged.	Ring Levee	Institution and Organization
			Intrastructure Damage		Modification of Reservoir
	1		Roads were damaged		Operation Rule
Higher Delta in	ra F	Main land use	Agricultural Damage	For agiricultural area	Flood Plain Management
Chemical Claim	•	Paddy (HY V is dominant but	Total 190,000 ha of paddy field including 50,000 ha	River Training	(Strengthening of Control
(Uctween Chamat and	marsnes are	floating rice and deep water	in Maharat Project Area was damaged.	Retarding Basin	and Guidance, Flood
Ay on may a)	wen developed.	rice are planted in nabitually	Urban Area Damage	Diversion Channel	Disaster Response and
		inundated area)	Chainat, Sin Burl, Angthong, Ayutthaya and Suphan	For urban area	Financial Response)
		Chairt Sir Deed	Buri are severely damaged.	King Levee	
		Chamat, Sin buri, Angriong,	initastructure Damage		Institution and Organization
		Ayuttnaya, Supan Burt, Lop Buri	Roads, bridges, irrigation facilities including		
Lower Delta in	Very flat	Main land use	Agricultural Damage	Towns and the second	i i
Lower Central Plain	•	Paddy (HYV rice) is main	40.000 ha of naddy field and 10 000 ha of other cron	River Training	riood Flain Management
(downstream of			fields were damaged.	Retarding Basin	(Strongthoning of Caster)
Ayutthaya)		expanding rapidly	Urban Area Damage		
-			Pathum Thani, Nonthaburi, Samut Prakan are	For a bigger-scale Flood	ster Resnonse
	•	Bangkok, Pathum Thani,		Ring Levee	Response)
		Nonthaburi Samut Prakan	Infrastructure Damage	Diversion Channel	Institution and Organization
			Roads, irrigation facilities including regulators and	Tidal Barrage with Pump)
			canal embankments are damaged		:

Table 2.4.1 CUSTOMIZED IEE PARAMETERS

	Changes expected in	Diversion	Retarding	River
	Changes expected in	Channel	Basin	Training
Physical	Surface water Quantities (hydrology)	X	X	
Resources	Surface water Quality	X	X	
	Ground water	X	X	
	Soil Fertility	Х	Х	
	Geology / Seismology			
	Sediments and Erosion	X	X	
	Climate			
Ecological	Agriculture	х	X	
Resources	Fisheries	X	X	
	Aquatic Biology	х	X	х
	Wildlife (Terrestrial Fauna)	X	X	1
	Forests			
	Reservoir Ecology			
Human	Water Supply	Х	X	
Use	Aquaculture		1	
Values	Navigation	X	X	Х
	Flood Control			
	Mineral Development			
	Highways/ Railways	X	X	
	Land Uses	X	X	1
Quality of	Socio-Economics	X	X	
Life	Resettlement	X	X	
Values	Public Health	X	X	
	Nutrition			
	Recreation and Aesthetics			X
	Archaeology and Historical Treasures	Х	X	

Note: X is parameter to be examined.

Table 3.1.1 THE OUTLINE OF THE ALTERNATIVE ROUTES OF DIVERSION

Case	Diversion	Beginning Point	Ending Point	Distance (km)	Water level at Diversion Point (MSL+m)	Bed Eleva-tion at the Mouth (MSL+m)	Bed Slope (i=1/I)
7	Tachin River Div.	Chainat	Tha Chin	Mouth to 319	185.71	9-	I=119,000, 9,500*
2	Chainat-Pasak-Raphipat-Sea Div.	Chainat	near Khlong Dan	Mouth to 260	18.00 at Chainat	9-	13,500,16,700**
. 3]	Chainat-Pasak-Raphipat-Ban Pakong 3 Div.	Chainat	Ban Pakong	Mouth to 362	18.00 at Chainat	9-	163,000, 13,500, 16,700***
4	Pasak-Raphipat-Sea Div	RamaVI Валаде	near Khlong Dan	Mouth to 127	9.5 at Pasak	9-	13,500
	Pasak-Raphipat-Ban Pakong Div.	RamaVI Barrage	Ban Pakong	Mouth to 229	9.5 at Pasak	9-	163,000, 13500
9	Ayutaya - West Bank - Sea Div	Sena	near Khlong Samaedam	Mouth to 105	4	9-	46,000
7.1	Ayuthaya- West Bank - Tha Chin 7 Div.	Sena	Tha Chin	Mouth to 160	4	9-	119,000 46,000
∞	Ayutthaya-East Bank-sea Div.	Bang-Pa-Ing	near Khlong Ban Thai	Mouth to 94	3.81	9-	45,000
6	Chaophraya II Div	Pathum Thani Chao Phraya		Mouth to 57	2.73	9-	56,000
10	10 Green Belt Div.	Pathum Thani Ban Thai		Mouth to 78	2.73	9-	76,000

*: Slope from mouth to 180 km (1/119,000) and upstream from 180 km (1/9,500) **: Slope from mouth to Pasak (1/13,500) and Pask to Chainat (1/16,700)

^{***:}Slope from mouth to Nakhon Nayok (1/163,000) and Nakhon Nayok to pasak (13,500)

Table 3.1	.2 (1/3) CC	Table 3.1.2 (1/3) COST AND BENEFIT OF A	IT OF ALTERN	ATIVE FLC	LTERNATIVE FLOOD DIVERSION CHANNEL (1,500m3/s)	ON CHANN	VEL (1,500m3	1/s)		
Case	Case I	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
Diversion	Thachin River Diversion	Chainat-Se	Chainat-Pasak-Raphipat -Ban Pakong Diversion	Pasak-Raphipat- Sea Diversion	Raphipat-Ban Pakong Diversion	Ayuthaya-West- Sea Diversion	Ayuthaya-West- Tha Chin Diversion	Ayuthaya-East- Sea Diversion	Chaophraya-II Diversion	Greenbelt Diversion
Distance (km)	319	260	362	127	229	105	160	96	57	8 6
Expropriation Area (m²)	30,771,810	54,837,921	76,092,941	27,042,690	48,297,710	32,685,300	32,595,400	29,850,588	18,534,750	30,236,328
Ratio of Expropriation Cost *1	28.0	1.00	1.06	0.51	0.57	6.99	0.82	1.06	1.40	1.80
Excavation Volume (m3) Order	344,390,580	229,587,521	560,900,581	117,601,110	448,914,170	216,145,050	313,890,300	172,428,603	138,181,860	193,420,045
Embankment Volume (m3) Order	21,598,200	24,289,185	32,810,595 10	13,086,640	21,608,050	2,808,700	12,512,200 5	4,009,455 4	754,830 1	2,692,605
Number of House Relocation Order	9	2,400	3,000	1,400	2,000	3,200	3,60 0 8	1,600 2	11,000	2,500 5
Water Height in Diversion from Mean Ground Level (m) Order	0~2.0	1.5-2.5	0.5~2.5	2.0~2.5	0.5~2.5	1.0~2.0	1.0~2.0	1.0~2.0	0~2.0	$0 \sim 2.0$
Beneficial People (B) *2 Order	9,305,000	9,305,000	9,305,000	8,450,000	.8,450,000	7,751,000	7,751,000	7,751,000 3	7,239,000	7,239,000
Assumed Water Quality *4 Order	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-7 2	BOD 1-7 2
Construction Cost *3 (Million Baht) (C) Order	81,210	88,244 8	98,500 10	44,121 1	77,527 5	71,734	81,533	59,060 2	77,375	91,098
Possible Water Volume for Use (MCM)	226	148 5	330 1	60	260 2	77	158	70	9 6	27 7
(C) / (B) (Baht) Order	8,728	9,484	10,586 10	5,221	9,175	9,255 4	10,519	7,620	10,689	12,584

*1 : (Chainat-Pasak) = 1.0

^{*2:} Source; Statistical Yearbook Thailand, 1995
*3: Inclusive of Land Expropriation Cost and House Resettlement (Refer to Table 3.1.3). Exclusive of Price Contingency
*4: Information from "Draft Final Report of Feasibility Study of Damming Chao Phraya and Nan Rivers for Improvement of Navigation"

A ADIC OLL	Z (Z/3) CO	Table 3.1.2 (2/3) COST AND BENEFIT OF A	II OF ALIEKN	AIIVEFL	JOD DIVERSIO		LTERNATIVE FLOOD DIVERSION CHANNEL (1,000m3/s)		=	
Case	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9	Case 10
Diversion	, cr	Chainat-Pasak-Raphipat Chainat-Pasak-Raphipat -Sea Diversion -Ban Pakong Diversion	Chainat-Pasak-Raphipat -Ban Pakong Diversion	Pasak-Raphipat- Sea Diversion	Raphipat-Ban Pakong Diversion	Ayuthaya-West- Sea Diversion	Ayuthaya-West- Tha Chin Diversion	Ayuthaya-East- Sea Diversion	Chaophraya-II Diversion	Greenbelt Diversion
Distance (km)	319	260	362	127	229	105	160	3	57	% rı
Expropriation Area (m²)	18,825,550	36,818,494	49,172,974	19,981,490	32,335,970 8	23,118,700	20,905,900	21,233,088	12,903,150 1	21,287,303 6
Ratio of Expropriation Cost *1	0.67	1.00	1.00	0.55	0.55 1	1.05	9.69	1.12	1.47	2.01
Excavation Volume (m3) Order	196,327,460 8	149,364,751	368,696,791	79,907,500	299,239,540 9	147,605,950 5	192,265,100	116,911,285 3	94,193,410 2	131,070,050
Embankment Volume (m3) Order	25,288,190	24,787,433	30,636,823	13,086,640 5	18,936,030	2,808,7 00 3	14,709,900 6	4,009,455 4	754,830 I	2,692,605
Number of House Relocation Order	4,000	2,200	2,800	1,200	1,900	2,900 8	2,500 6	1,500	8,000	2,300 5
Water Height in Diversion from Mean Ground Level (m) Order	0~2.0 1	1.5~2.5	0.5~2.5	2.0~2.5	0.5~2.5	1.0~2.0	1.0~2.0	1.0~2.0	0~2.0	0~2.0
Beneficial People (B) *2 Order	9,305,000 1	9,305,000	9,305,000	8,450,000 2	8,450,000	7,751,000 3	7,751,000	7,751,000 3	7,239,000	7,239,000
Assumed Water Quality *4 Order	BOD 1-3	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-3 1	BOD 1-7	BOD 1-7 2
Construction Cost *3 (Million Baht) (C) Order	42,151 6	45,012 8	65,49 5 10	22,538	44,013 7	39,254 3	40,081	34,479 2	40,471 5	\$0,216 9
Possible Water Volume for Use (MCM)	137	103 5	235	48	190	53 6	, 109 4	84.8	31 9	50
(C) / (B) (Baht) Order	4,530	4,837	7,039 10	2,667	5,209	5,064 5	5,171 6	4,448	5,591 8	6,937

^{*1: (}Chainat-Pasak) = 1.0
*2: Source, Statistical Yearbook Thailand, 1995
*3: Inclusive of Land Expropriation Cost and House Resettlement (Refer to Table.3.1.3). Exclusive of Price Contingency
*4: Information from "Draft Final Report of Feasibility Study of Damming Chao Phraya and Nan Rivers for Improvement of Navigation

					, ,	,			0.55	02.000
Case	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case /	Case &	Casey	Case to
Diversion	Thachin River Diversion	Chainat-Pasak-Raphipat	Chainat-Pasak-Raphipat Chainat-Pasak-Raphipat -Sea Diversion -Ban Pakong Diversion	Pasak-Raphipat- Sea Diversion	Raphipat-Ban Pakong Diversion	Ayuthaya-West- Sea Diversion	Ayuthaya-West- Tha Chin Diversion	Ayuthaya-East- Sea Diversion	Chaophraya-11 Diversion	Diversion
Distance (km)	319	260	362	127	229	105	160	96	57	78
Order	9	8	10	\$	7	4	9	3	-	-1
Expropriation Area (m²)	8,352,120	18,855,053	24,118,833	12,818,690	18,082,470	13,774,900	10,488,100	12,587,813	7,225,610	12,299,403
Order	2	8	6	9	5	7	2	o		+
Datio of Communication Cont #1	. 0	5	700	0.66	090	1.26	69.0	1.31	1.64	2.35
order Order	2.65	5.	4) (c)		9	2	7	80	6
Excavation Volume (m3)	57,064,000	68,739,296	191,304,186	41,933,300	164,498,190	78,219,800	78,370,900	61,272,883	49,848,290	68,359,330
Order	3	9	10	1	6	7	*	4	7	o
Embankment Volume (m3) Order	28,312,090	24,787,433 8	31,412,433 10	13,086,640 5	19,711,640	2,808,700 3	18,664,400 6	4,009,455 4	754,830 1	2,692,605
Number of House Relocation	1,500	1,700	2,000	1,000	1,300	2,200	1,500	1,400	5,700	2,300
Order	4	5	9	1	2	_	4	c	2	٥
Water Height in Diversion from Mean Ground Level (m)	0~2.0	1.5~2.5	0.5~2.5	2.0-2.5	0.5~2.5	1.0~2.0	1.0~2.0	1.0~2.0	0~2.0	0~2.0
ionio .										
Beneficial People (B) *2 Order	9,305,000 1	9,305,000 1	9,305,000 1	8,450,000 2	8,450,000	7,751,000 3	7,751,000	7,751,600	7,239,000	7,239,000
Assumed Water Quality *4	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-3	BOD 1-7	BOD 1-7
Order	-	1		I		→	1	Ť	7	
Construction Cost *3 (Million Baht) (C)	20,093	26,492	37,597	14,501	26,980	24,269	27,717	18,781	24,511	30,847
Order	3	9	10	I	7	2	8	7	*	,
Possible Water						•				
Volume for Use (MCM)	80	95	158	77	133	28	61	56	17	26
	3	22	1	80	2	9	4	7	6	7
(C) / (B) (Baht)	2,159	2,847	4,040	1,716	3,193	3,131	3,576	2,423	3,386	4,261
Order	•	_	-	_	_		9	•	•	4

*1 : (Chainat-Pasak) = 1.0

^{*2:} Source; Statistical Yearbook Thailand, 1995
*3: Inclusive of Land Expropriation Cost and House Resettlement (Refer to Table.3.1.3). Exclusive of Price Contingency
*4: Information from "Draft Final Report of Feasibility Study of Damming Chao Phraya and Nan Rivers for Emprovement of Navigation

Table 3.1.3 (1/3) FINANCIAL CONSTRUCTION COST IN CASE OF 1,500M3/S
Ayutthaya-East-Sea-Diversion 2
As a sample fi

	(a/a)	7	Ayutthaya-East-Sea-Diversion 2	iversion 2		As a sample for cost estimation	or cost estima	ıtion
				Cost(Local)	.ocal)		Cost(Forign)	orign)
Item	Unit	Quantity		(Million Baht)	ı Baht)		(Million Baht)	ı Baht)
			Skilled	Unskilled	Material	Machine	Material	Machine
DIRECT CONSTRUCTION COST	LSC							
Preparation Work 2%	L.S.	-	7	10	62	99	106	158
Excavation	m3	116,856,660	191	373	945	2,375	2,025	5,456
Embankment	m3	2,772,420	4	1	2	15	7	35
Land Surface Smoothing	m2	19,486,600	54	18	18	139	09	314
Land Surface Smoothing	m2	2,176,300	11	22	12	15	7	32
Diversion Point Weir	piece	1	26	26	616	51	1,232	616
INDIRECT CONSTRUCTION COST	COST							
Irrigation Weir with Lock	piece	2	18	18	580	54	725	529
Small Irrigation Regulator	piece	40	6	6	189	18	123	92
Large	piece	8						
Bridge Medium	piece	17						
Small	piece	29	75	38	1,580	113	1,128	827
OTHERS								
Miscellaneous 2%	L.S.	1	7	10	80	57	108	161
Temporary Work 10%	L.S.	1	37	52	410	289	552	822
Subtotal			410	577	4,512	3,181	6,075	9,044
Resettlement	·	1,480		570	0,			
Land Price	m2	22,278,640		16,041)41			
Total (1)				25,291	291		15,119	19
Tax (VAT) 10%				2,529	29		1,512	12
Total (2)				27,820	320		16,631	531
Sale of Soil		29,473,292						
Grand Total				27,820	320		16,631	331

Table 3.1.3 (2/3) FINANCIAL CONSTRUCTION COST IN CASE OF 1,000M3/S
Ayutthaya-East-Sea-Diversion 2
As a sample fi

Labi	Lable 3.1.3 (2/3) F		Avutthava-East-Sea-Diversion 2	iversion 2	5	As a sample f	As a sample for cost estimation	ation
				Cost(Local)			Cost(Forign)	orign)
Item	Unit	Quantity		(Millio	Million Baht)		(Million Baht)	ı Baht)
			Skilled	Unskilled	Material	Machine	Material	Machine
DIRECT CONSTRUCTION COST	JST							
Prenaration Work 2%	L.S.		5	7	99	38	75	108
	m3	79,217,560	109	253	641	1,610	1,373	3,699
Embankment	m3	2,772,420	4	1	2	15	7	35
Land Surface Smoothing	m2	13,661,900	38	13	13	97	42	220
Land Surface Smoothing	m2	2,176,300	11	22	12	15	7	32
Diversion Point Weir	piece	1	18	18	435	36	869	435
INDIRECT CONSTRUCTION COST	COST		·					
Irrigation Weir with Lock	piece	2	13	13	409	38	511	294
Small Irrigation Regulator	piece	40	6	6	189	18	123	92
Large	piece	8						
Bridge Medium	piece	17						1
	piece	29	53	27	1,115	80	797	584
OTHERS								.,,,,
Miscellaneous 2%	L.S.	1	5	7	57	39	76	
Temporary Work 10%	L.S.	1	27	37	293	199	388	
Subtotal			292	406	3,222	2,185	4,268	6,170
Resettlement		1,397		5.	539			
Land Price	m2	16,413,520		12,	12,565	·		
Total (1)				19,	19,209		10,	10,438
Tax (VAT) 10%				1,9	1,921		1,0	1,044
Total (2)				21,	21,129		11,	11,482
Sale of Soil		21,169,094						
Grand Total				21,	21,129		11,	11,482

Table 3.1.3 (3/3) FINANCIAL CONSTRUCTION COST IN CASE OF 500M3/S

		Ayutthaya	Ayutthaya-East-Sea-Diversion 2	iversion 2		As a sample f	As a sample for cost estimation	ation
				Cost(Local)	ocal)		Cost(Forign	orign)
Item	Unit	Quantity		(Million Baht)	n Baht)		(Million Baht)	n Baht)
			Skilled	Unskilled	Material	Machine	Material	Machine
DIRECT CONSTRUCTION COST	LSC		e e					
Preparation Work 2%	L.S.	ľ	3	4	34	21	43	149
Excavation	m3	41,456,960	57	132	335	842	718	1,936
Embankment	m3	2,772,420	4	1	2	15	7	35
Land Surface Smoothing	m2	7,785,400	22	7	7	99	24	126
Land Surface Smoothing	m2	2,176,300	11	22	12	51	7	32
Diversion Point Weir	piece	I	11	11	255	21	510	255
INDIRECT CONSTRUCTION COST	COST							
Irrigation Weir with Lock	piece	2	8	8	240	23	300	173
Small Irrigation Regulator	piece	40	6	6	189	18	123	92
Large	piece	8						
Bridge Medium	piece	17						
Small	piece	29	31	15	651	46	465	341
OTHERS								
Miscellaneous 2%	L.S.	1	m	4	35	21	44	63
Temporary Work 10%	L.S.		16	21	176	108	224	320
Subtotal			173	235	1,936	1,185	2,466	3,522
Resettlement		1,310		510	0			
Land Price	m2	9,704,720		6,895	95			
Total (1)				10,933	33		5,988	88
Tax (VAT) 10%				1,093	93		599	6
Total (2)				12,027	727		6,587	87
Sale of Soil		11,452,686						
Grand Total				12,027	127		6.587	87
								7

Table 3.3.1 EFFECTIVENESS OF MEASURES WHEN SOLELY APPLIED

Турс		Alternative Measures	Discharge at Nakhon Sawan* ¹ in 1995 Flood (m3/s)	Discharge at Bang Sai in 1995 Flood (m3/s)	Water Level at Samsen (C.12) in 1995Flood (m MSL)	Water Level at Mem. Bridge (C.4) in 1995Flood (m. MSL)	Total Inundation Flood Damage Volume in 1995 in 1995 (billion m3) (mil. Baht)		Decrease of Damage in 1995 (mil. Baint)	Cost*2 (mil.Baht)	Decrease of Damage in 1995 by Cost
	Future Basin C	Future Basin Condition in 2018 (Without Project)	4,110	3,980	2.62	2.45	14.1	143,535			
		Casel Flood Control Canadiv of 4 400 mil. m ³	4,020	3,960	2.59	2.43	13.7	132,829	10,706	muninim	infinite
Non-structure	Non-structure Modification of Dam	Occasion Front Control Connects of 5 700 mil m	3,890	3,950	2.58	2.42	13.4	125,467	18,068	185*3	97.66
	Operation voice	Case: Flood Control Capacity of 9,100 mil. m	3,526	aze, ž	15.2	241	111	112,987	30.548	-1834	1649
			4,250	4,570	2.97	2.97	13.2	540,234	-396,699	10,430	-38.03
	River Improvement from Nan and Yom		4,290	5,200	3.33	3.33	13.9	1,543,899	-1,400,364	15,240	-91.89
	to Pathum Thani	Case3: 5-vear Return Period	4,350	5,400	3,46	3.46	13.7	2,034,769	-1,891,234	21,710	-87.11
	,		4,110	4,350	3.01	2.52	13.8	398,755	-255,220	3,490	-73.13
	from Chainat to	Case2: 10-year Return Period	4,110	4,690	3.11	2.67	13.9	874,567	-731,032	4,170	-175.31
	Pathum Thani	Case3: 25-year Return Period	4,110	4,860	3.12	2.75	14.3	1,093,588	-950,053	4,850	-195.89
		Case]: O= 500 m3/s	4,110	3,750	2.47	2.33	13.5	89,651	53,884	19,100	2.82
Structure	Pasak-Raphipat-Sea Diversion		4,110	3,450	2.39	2.32	13,4	53,465	90,651	32,000	2.83
		Case3: Q= 1,500 m3/s	4,110	3,320	2.39	2.32	13,3	52,258	91,538	45,000	2.03
	See of series	Case1: Q= 500 m3/s	4,110	3,790	2.51	2.35	12.9	98,527	45,008	33,000	1.36
	Raphipat-Sea	Case2: Q=1,000 m3/s	4,110	3,540	2.38	2.24	11.9	46,397	97,138	60,000	1.62
	Diversion	Case3: Q= 1,500 m3/s	4,110	3,170	2.18	2.13	10.9	43,049	100,486	88,000	1.14
		Case1: Q= 500 m3/s	4,110	3,550	2.38	2.31	13.7	51,543	566,16	19,700	4.67
	Ayutthaya-East-Sea Diversion		4,119	3,130	2.22	2.19	13.4	45,359	38,100	31,430	3.06
		Case3: Q= 1,500 m3/s	4,110	2,670	2.10	2.10	13.3	41,254	101,414	49,000	2.07

*1: C.2 Station

^{*2:} Financial Capital Cost (exclusive of price contingency)

^{*3:} Net Present Value of Annual Financial Cost

Table 3.3.2 SIMULATION RESULT FOR TYPICAL RIVER TRAINING IN 1995 FLOOD

	Maximum Dis	scharge (m³/s)	Maximum
Case	Nakhon Sawan C.2	Bang Sai	Water Level in Bangkok*
Full Confinement in River	4,850	6,420	3.87
20 cm Dike Heightening	4,110	4,180	2.70

^{*:}RID Samsen Station C.12

Table 3.3.3 DIKE HEIGHTENING COST FOR BANGKOK

Heightening Height (m)	Cost (Million Baht)	Running Cost (mil.Baht/year)
0.1	128	3
0.3	261	5
0.5	359	6
1.0	946	16
2.0	2,059	34

Table 3.3.4 EFFECT OF DISTRIBUTION SYSTEM IMPROVEMENT (1995 FLOOD)

						A - oc strictly	Immedation*		Effec	Effectiveness	
			Area with Laur	Inundation		Area without Illumation	Himmanon	Docemble		(
NO. of	Area(km2)		Maior Cultivation of	Present Inundation	Present Inundation	Ares Arm ²)	Major Cultivation	Distributed	① Damage Reduced	ğ	2-0 Balance(mil. Baht)
Blocks		Area(km [*])	Paddy Field		Damage (mil. Baht)		in Paddy Freid	water volume	(mil. Baht)	(mil. Bab	,
			23.4.0	1 000	735	300	HYV	0.0	0.0	0'0	0.0
-	1875	co/	٥١٥	1,000		C		0.0	0.0	0.0	0.0
2	502	1,163	GIV	8/8,7				00	0.0	0.0	0.0
æ	328	1,553	GTV	317	34			200	3.6	2.5	-1.1
4	1053	366	ΛλΗ	570	19	007		2000	000	00	0.0
\$	620	624	HYV	458	23	0		0.0	0.0	5 6	20-
9	635	305	DR	669	91	125		25.0	0.4	J.C. 0	
7	696	533	DR.FR	1,035	148	50		10.0	0.0	0.5	
×	773	376	_	749	. 53	50	HYV	10.0	4.0	0.0	'
0	1691	1 424		3,447	723	0	•	0.0	0.0	0.0	
0	758	050		567	20	0	•	0.0	0.0	0.0	
2];	200	004	17/1	783	82	0	,	0.0	0.0	0.0	0.0
11	1/4	nnc	V I H	507	•			00	0 0	0.0	0.0
12	1360	. 663	HYV	767	7			0.00		90	
13	225	225	HYV	292	06	0		0.0	0.0	0.0	
14	387	367	HYV	209	27	0	D	0.0	0.0	0.0	
1	808	671	HYV	153	9	0		0.0	0.0	0.0	
1 1	096	15		26	14	0	1	0.0	0.0	0.0	
17	009			308	174	0		0.0	0.0	0.0	
10	118		ИМЛ	236	9	0		0.0	0.0	0.0	
01	OT L	١		14.078	₹ 400	775		95.0	12.2	9.1	. .
IOIALI	14,511	10,203		0,0,7				0.50	66:	9	-3.1
TOTAL2	6.577	3,758		7,519	1,077	4/5		73.0	7:71		
									,		

TOTAL1 (Block NO.1-NO.18) TOTAL2 (Block NO.4-NO.10)

*Area, where the inundation water is possibly distributed from the inundation area

Table 3.3.5 DISTRIBUTION OF INYNDATION WATER IN PADDY FIELD

	<u> </u>		3 - 1		
X 7 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	VOLUME	DAMAGE	Minimum	DAMAGE	
YEAR	(mil.m ³)	(mil.Bhat)	DAMAGE	REDUCED	RATE(%)
			(mil.Bhat)	(mil.Bhat)	
1952	3,040	1,621	687	934	57.6
1953	2,774	1,447	365	1,082	74.8
1954	4,932	3,033	2,979	54	1.8
1955	3,054	1,643	705	938	57.1
1956	4,169	2,589	2,055	534	20.6
1957	5,501	4,089	3,668	421	10.3
1958	2,988	1,590	624	966	60.7
1959	5,488	4,080	3,653	427	10.5
1960	2,525	1,318	201	1,117	84.8
1961	3,485	1,727	1,227	500	29.0
1962	5,592	4,076	3,779	297	7.3
1963	4,149	3,189	2,031	1,158	36.3
1964	5,751	4,043	3,972	71	1.8
1965	2,250	861	61	800	92.9
1966	3,778	2,161	1,581	580	26.8
1967	2,542	1,247	210	1,037	83.2
1968	1,335	300	0	300	100.0
1969	3,944	2,137	1,783	354	16.6
1970	4,407	2,362	2,343	19	0.8
1971	2,878	1,545	491	1,054	68.2
1972	3,040	1,950	687	1,263	64.8
1973	3,039	720	687	33	4.6
1974	3,169	2,062	844	1,218	59.1
1975	5,167	3,458	3,264	194	5.6
1976	3,784	2,083	1,589	494	23.7
1977	2,446	1,104	161	943	85.4
1978	6,123	4,630	4,421	209	4.5
1979	1,860	0	0	0	- 1
1980	5,432	3,593	3,585	8	0.2
1981	2,860	635	469	166	26.1
1982	2,300	894	86	808	90.3
1983	5,415	4,825	3,564	1,261	26.1
1984	1,906	223	0	223	100.0
1985	3,174	1,551	850	701	45.2
1986	1,813	0	0	0	_
1987	3,270	1,615	966	649	40.2
1988	3,684	2,015	1,468	547	27.1
1989	2,216	1,125	44	1,081	96.1
1990	3,061	1,824	713	1,111	60.9
1991	1,926	0	0	0	÷ .
1992	2,617	1,362	247	1,115	81.8
1993	1,590	0	0	0	-
1994	3,230	1,546	918	628	40.6
1995	6,659	5,851	5,277	574	9.8
1996	4,379	3,751	2,309	1,442	38.4
AVERAGE	3,528	2,042	1,435	607	29.7

Table 3.3.6 EFFECTIVENESS OF DRAINAGE CHANNEL IMPROVEMENT

	١.	_
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Ç	ď	1
*	_	

(1) Tense Tense											
	Decrease	Decrease of Inundation Volume	olume	Decrease	Decrease of Inundation Duration	Duration	Decreas	Decrease of Flood Damage	mage	tso	Ratio of
ese	Average Vol.*1	Decreased Vol.	Rate of Decrease	Average Duration*2	Decreased Period (day)	(%)	Average Damage (mil.baht)	Decreased Damage (mil.Baht)	(%)	(mil.Baht)	Damage by Cost
Future Basin	663	-	-	100	1		7,076	1	1	,	,
Case A-1	468	195	29	11	23	23	5,387	1,690	24	4,040	
Case A-2	380	283	43	50	50	50	3,810	3,266	46	12,230	
Case A-3	327	336	51	32	89	89	2,819	4,258	09	20,580	
Case B-1	695	94	14	95	5	5	5,245	1,832	26	3,020	ŀ
Case B-2	550	113	17	06	10	10	4,598	2,478	35	5,840	
Case B-3	534	129	70	85	15	15	4,336	2,741	39	8,860	0.309
		,		70011 1001							

* 1 : Average inundation volume for three years, 1983, 1995 and 1996

* 2: Average inundation period of three points for three years, 1983, 1995 and 1996

(2) West Bank

ATTIMET YOUR (T)					***						
	Decrease of	Decrease of Inundation Volume	olume	Decrease or	Decrease of Inundation Duration	uration *	Decrease	Decrease of Flood Damage	mage *		Ratio of
	Average	Decreased	Rate of	Average	Doggood	-	Average	Decreased		Cost	Decreased
	Vol.*1	Vol.	Decrease	Duration*2	Deriod (day)	8	Damage	Damage	%	(mil.Baht)	Damage by
Case	(mil. m3)	(mil.m3)	(%)	(day)	r crock (day)		(mil.baht)	(mil.Baht)			Cost
Future Basin	766						7.437		•	•	J
Condition	07/		ı ·	120	1	ı	, , ,		1		
Case A-1	303	423	58	56	64	53	3,045	4,391	59	10,400	0.422
Case A-2	197	529	73	29	16	76	1,925	5,512	74	24,500	0.225
Case A-3	147	579	80	13	107	68	1,357	6,079	82	38,280	0.159
Case B-1	474	252	35	83	37	31	5,181	2,256	30	3,100	0.728
Case B-2	442	284	39	62	41	34	4,603	2,834	38	5,900	0.480
Case B-3	413	313	43	52	45	38	3,909	3,528	47	9,020	0.391

* 1 : Average inundation volume for three years, 1983, 1995 and 1996

* 2 : Average inundation period of three points for three years, 1983, 1995 and 1996

Table 3.3.7 CONSTURUCTION COST OF DISTRIBUTION OF INUNDATION WATER

Item	unit	Quantity	unit cost (million baht)	Cost (million baht)
Connection Canal	km	40	0.8	32
Expansion of Main Canal				
Gate	place	5	18	90
Regulator (Small Sluice)	place	15	3	45
Siphon	place	3	20	60
Administration	L.S.			3
Engineering	L.S.			18
Physical Contingency	L.S.			11
Price Contingency	%			26
Total		·		285

Table 3.3.8 PROJECT COST OF DRAINAGE IMPROVEMENT

UNIT of PROJECT COST

Range		Method	Unit Cost Unit	Unit
East Bank	$0 \sim 120 \text{ m}^2$	Minor	0.1	0.1 million baht/m2/km
	$120 \sim 300 \text{m}2$	Major	0.5).5 including all.
	over 300 m2	New Canal	0.7	0.7 (tax, profit, etc.)
Lower of West Bank $0 \sim 120 \text{ m}$ 2	$0 \sim 120 \text{ m}2$	Minor	0.1	
	$80 \sim 300 \text{m}2$	Major	0.5	
	over 300 m2	New Canal	0.7	

Note: Unit costs are quoted from similar projects of agency concerned.

CONSTRICTION COST

COLOTINA	CONSTRUCTION COST	10.1					
Case	Area	Stretch	Distance	Regired Canal Area	Minor Improvement	Major Improvement	Total
		*	(km)	Minor Major	(km) Minor Major (miilion baht) (miilion baht)	(miilion baht)	(miilion baht)
				(m2)			
B1	East Bank A	A	25	120 45	300	563	863
		В	30	120 120	360	1,800	2,160
	Subtotal(1)						3,023
	West Bank A	A	40	80 55	320	1,100	1,420
		В	40	120 60	480	1,200	1,680
	Subtotal(2)						3,100
Total							6,123
Price Contingency	ingency						612
Grand Total	al						6,735

Note: *1 Refer to Sector I "Hydrology" regarding A and B

Table 3,3.9 CONSTRUCTION COST OF ARTIFICIAL RETARDING BASIN

Case-I	1 2	ഥവ	しっつ

Enclosure	Dike Cons	ruction				
	Distance	Improvement	Туре	Heightening Height	Unit Cost	Cost
No.	(m)	Length (m)		(m)	(Bart/m)	(million balit)
1	40,000	2,500	Al	3	15,700	39
2	10,000	10,000	A2	1	6,000	60
3	25,500	25,500	A1	3	15,700	400
4	7,500	7,500	C1	1 1	5,200	39
5	29,000	29,000	C1	1 1	5,200	151
6	54,000	54,000	C1	1 1	5,200	281
7	27,500	27,500	C1	1	5,200	143
8	13,500	13,500	C1	1	5,200	70
9	8,500	8,500	C1	1	5,200	44
Total	215,500					1,228
Small Sh	iice Gate	2m x2m x2 x	10	1.0	million baht/m2	80
Pumping	600					
Over Flo	6,400					
Road Improvement 42km x 112 x 0.6m heightening x 6m wide						22,109
House R	elocation	3,000km2 x	35 house/ki		mill. baht/house	26,250
Total				· · · · · · · · · · · · · · · · · · ·		56,666
, , , , , ,					1	million baht
Running	Corl				million baht / year	620
r/munik	COST				minon care year	020

Case-2 2,000km2

2,00001112				 		
Dike Const	nuction					
Distance	Improvement	Type	Heightening Height	Unit Cost	Cost	
(m)	Length (m)		(m)	(Bart/m)	(million baht)	
9,000	9,000	C1	1	5,200	47	
7,500	7,500	C 1	1	5,200	39	
29,000	29,000	Cl	1	5,20D	151	
54,000	54,000	C1	1	5,200	281	
27,500	27,500	Cl	1	5,200	143	
11,500	11,500	Cl	1	5,200	60	
19,000	19,000	Cl	1	5,200	99	
157,500					819	
ice Gate	2m x2m x2 x	7	1.0		56	
	1.		million baht/m2		million baht	
Station	5m3/s x	7	12		420	
million baht/m3						
Overflow Weir 1km wide x 2m high x 2 places						
D 11 (10) (0) (0) (1) (1)						
Road Improvement 42km x 50 x 0.6m heightening x 6m wide						
location	2,000km2 x	35	0.25	mill. baht/house	17,500	
		house/kr	n2			
					31,865	
				· i	million baht	
Cost				million baht / year	290	
	Distance (m) 9,000 7,500 29,000 54,000 27,500 11,500 19,000 157,500 sice Gate Station Weir	Distance	Distance	Distance	Distance	

Case-3 1,000km2

Enclosure	Dike Cons	truction				
	Distance	Improvement	Туре	Heightening Height	Unit Cost	Cost
No.	(m)	Length (m)		(m)	(Bart/m)	(million baht)
1	20,500	20,500	C)	0.5	3,100	64
Total	20,500	·				64
Small Slu	ice Gate	2m x2m x2 x	5	1.0		40
				million baht/m2		million baht
Pumping	Station	5m3/s x	5	12 million baht / m3		300
Overflow	Weir	1km wide x 2	m high x			1,600
Road Imp		6,909				
House Ro	clocation	1,000km2 x	35 house/kr		mill baht/house	8,750
Total						17,663
						million baht
Running	Cost				million baht / year	- 150

Note 1 : Aforementioned Cost is Financial Cost.

^{2 :} Exclusive of Price Contingency

	Measures Structural Measures	Ring levee with drainage pump by PWD	River Training	Ring levee with drainage pump by PWD	River Training	Ring levee with drainage pump by PWD	River Training and natural retarding basin with damage mitigation in agricultural area and diversion (Ayutbaya-E.Bank-Sea route)	Ring levee with drainnage pump by PWD/ Diversion Channel/ other option (Heightening)	Nnatural retarding basın with damage mitigation in agricultural areas and Diversion(Ayuthaya- E.Bank-Sea route)
TABLE MEASURES	Conceivable Measures Non-structural Measures	shed	- op -	- op -	- op -	- op -	- do -	Control of ground water extraction in addition to the above non-structural measures	Control of ground water extraction in addition to the above non-structural measures
MAJOR ISSUES AND POINT TO SELECT SUITABLE MEASURES	Major points to select suitable measures	To follow the protection works for urban area by PWD.	To seek for measures to mitigate flood damage to agricultural area but not to cause the adverse influenc to downstream.	To follow the protection works for urban area by PWD.	To seek for measures to mitigate flood damage to agricultural area but not to cause the adverse influenc to downstream.	To control and guide the change of land use condition. /To follow the protection works for urban area by PWD.	To control and guide the change of land use condition./ To seek for measures to mitiagate the flood damage in paddy field maintaing the natural retarding effect.	To seek the measures to cope with the adverse Control of ground water extraction in Ring levee with drainnage pump influence./ To control and guide the change of addition to the above non-structural by PWD/ Diversion Channel/land use condition. other option (Heightening)	guide the change of land use seek measures to mitigate flood ly field maintaing the natural
Table 3.4.1 MAJOR ISS	Features of Flood Condition	Damage to urban area Protection works for urban area will not bring about severe influence to downstream.	Protection for agricultural aera may cuase adverse influence to down stream	Nakon Swan Damage to urban area Protection works for urban area will Area downstream.	Protection for agricultural aera may cuase adverse influence to down stream.	Damage to urban area Protection works for urban area will not bring about severe influence to downstream.	Protection for agricultural aera may To control and guide it cuase adverse influence to down stream. Change of land use results in the flood damage in paincrease of flood damage and reduction natural retarding effect of natural retarding effect.	influence to down Expansion of urban increase of flood	Protection for agricultural aera may To control and cuase adverse influence to down condition./ To stream/ Change of land use results in damage in pade increase of flood damage and reduction retarding effect of natural retarding effect.
	Contents of Major Flood Issue	Damage to urban area	Damage to agricultural area	Damage to urban area	Damage to agricultural area	Damage to urban area	Damage to agricultural area/ Change of land use/ Reservation of retarding effect	Damage to urban area/ expantion of urban area	Damage to agricultural area/ Change of land use/ Reservation of retarding effect
	Area divided	Higher Central Plain		Nakon Swan Area		Higher delta in lower Central Plain		Lower delta in lower Central Plain	

Table 4.1.1 EFECTIVENESS OF THE DIVERSION FOR AGRICULTURAL AREA

Diversion Route		Ayutthaya-East-Sea
Flow Capacity		300 m3/s
Financial Initial Cost (million baht)		11,525
Financial O/M Cost (million baht/year)		106
Economic Initial Cost (million baht)		9,230
Economic O/M Cost (million baht/year)		101
Benefit (million baht/year)	Q	314
Net Present Value (12% discount rate)		-2,840
B/C (12% discount rate)		0.16
EIRR (%)		0.68

Table 4.1.2 COST COMPARISON BETWEEN CHAINAT-PASAK-SEA DIVERSIONAND RIVER IMPROVEMENT

	Chainat-Pasak-Sea Diversion	River Improvement
Required Capacity Equipment and Financial Cost (exclusive of O&M cost)	800 m3/s	10-year
(million baht)	26,000	1,425

Table 4.1.3 COMPARISON OF OPTION TO MITIGATE FLOOD DAMAGE

	0.50	1000		
	Salcty	Salciy Level	•	
		Fathum		
Option	Danslert.	Than and	Description	Advantage and Disadvantage
	Dangkok Nontha	Nontha		
7		אחבו		
	125-year	2-3 year	Suspension of planned protection works by	From technical, economical and environmental point of view, there may be no issues.
present condition of	retum	return	PWD	From social point of view, inhabitants in urban areas, Pathum Thani and Nonthaburi, will not accept to
Fathum I nani and	period	period	****	maintain the present safety level in the future.
Nontha Buri			···	The option can not cope with the situation to enhance the protection level of agricultural area in the upstream
			1	in the future.
(2) To enhance the	100	5		From technical, economical and environmental point of view, there may be no issues.
safety level up to the				From social point of view, inhabitants in urban areas, Pathum Thani and Nonthaburi, will not accept to
allowable level				naintain the present safety level in the future.
			safety level of Pathum Tham and Nontha Burn	The option can not cope with the situation to enhance the protection level of agricultural area in the upstream
				in the future.
(3) To lower the	20	7	The safety level of Bangkok will be reduced to	From technical, economical and environmental point of view, there may be no issues.
safety level at			50-year return period for example, while those of	while those of From social point of view, inhabitants in urban areas, Pathum Thani and Nonthaburi, will not accept to
Bangkok			Pathun Thani and Nontha Buri be enhanced to 7	maintain the present safety level in the future.
1			•	The option can not cope with the situation to enhance the protection level of agricultural area in the upstream
			į	in the future.
(4) To narrow the	100	100, and	The protection area of Pathum Thani and Nontha	The protection area of Pathum Thani and Nontha From technical, economical and environmental point of view, there may be no issues.
protection area of		2-3	Buri is narrowed down to the extent, in which	
Pathum Thani and		1		From social point of view, inhabitants in urban areas may oppose delineation of protected and not protected
Nontha Buri				areas in the same municipatify level in the future.
				The option can not cope with the situation to enhance the protection level of agricultural area in the upstream
				in the future,
(5) To heighten the	100	100	To further heighten the flood barrier at Bangkok	To further heighten the flood barrier at Bangkok From the technical and economical point of view, the works will not involve serious issues.
flood barrier at			from ongoing project.	From environmental and social points of view, this option will cause serious issues.
Bangkok			157	The option can not cope with the situation to enhance the protection level of agricultural area in the upstream
			<u> </u>	in the future.
(6) To provide	001	100	ion channel to absorb the	
diversion channel			adverse influence.	
			: MT	From economical point of view, this works will require a huge burden to the country.
				From social point of view, this option will cause issues for land acquisition and house evacuation.
				This option can be used for enhancement of the safety level of agricultural areas.

Table 4.1.4 REQUIRED CAPACITY OF AYUTTHAYA-EAST-SEA DIVERSION

Capaciy of AES	Combinat	ion of Applica	ble Measures	Discharge at	Discharge at	Water Level at	Water Level at Memorial	Total Inundation
Diversion (m3/s)	Dam	Retarding	River Improvement	Nakhon Sawan* ¹ in 1995 (m3/s)	Bang Sai in 1995 (m3/s)	Samsen (C.12) in 1995 (m MSL)	Bridge (C.4) in 1995 (m MSL)	
800 m3/s	14,600 mil. M3	5,600 km2	10yr (Chainat to Pathum Thani)	3,820	3,230	2.26	2.20	12.4
1,100 m3/s	14,600 mil. M3	5,600 km2	25yr (Chainat to Pathum Thani)	3,820	3,490	2.32	2.18	11.6

Note: The required capacity has been estimated so that the water levels at Samsen and the Memorial Bridge could be lowered below the actual levels in 1995, namely 2.32 and 2.20 m MSL respectively.

Table 4.1.5 (1/3) MEASURES SELECTED FOR MASTER PLAN Alternative-1

*	Major Flood	Con	Conceivable Measures	Prop	Proposed Measures	Remarks
Areas	Problems	Structural Measures	Non-structural Measures	Structural Measures	Non-structural Measures	·
Upper Central Plain	- Flood damage in urban Areas	Ring levee with drainage pump	ion and	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	River improvement	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, modification of reservoir operation and others	(2 ~ 10-year)
Nakon Sawan Area	- Flood damage in urban Areas	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	River improvement	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, modification of reservoir operation and others	(2 ~ 10-year)
Higher Delta in Lower Central Plain (Chainat- Ayuthaya)	- Flood damage in urban Areas	Ring levee with drainage pump	Land use control and guidance, Ring levee with modification of reservoir operation and drainage pump others	_	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	River improvement, distribution system improvement* and diversion channel	Land use control and guidance, River improvement modification of reservoir operation and distribution system others improvement*	pure	River improvement and Land use control and guidance, distribution system modification of reservoir operation improvement* and others	10-year
Lower Delta in Lower Central Plain (Down stream of Ayuthaya)	- Flood damage in urban Areas and Bangkok	Ring levee with drainage pump, diversion channel and heightening of flood barrier at Bangkok	Land use control and guidance, modification of reservoir operation and Nonthaburi and Pathum modification of reservoir operation than by ring levee with and others drainage pump and Ring levee with drainage pump of other PWD and BMA	Parcial protection of Land use of Nonthaburi and Pathum modificant than by ting levee with and others drainage pump and Ring levee with drainage pump of other PWD and BMA	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year) and BMA Plan
	- Flood damage in agricultural areas	River improvement and distribution system improvement*	and Land use control and guidance, River improvement modification of reservoir operation and distribution system others improvement*	and	River improvement and Land use control and guidance, distribution system modification of reservoir operation improvement*	10-year

*: Damage mitigation measures in agriculuital area are included.

Table 4.1.5 (2/3) MEASURES SELECTED FOR MASTER PLAN

Alternative-2-1

			T TATABATATATA	·		
Vest	Major Flood	Con	Conceivable Measures	Prop	Proposed Measures	Remarks
VI Cass	Problems	Structural Measures	Non-structural Measures	Structural Measures	Non-structural Measures	
Upper Central Plam	- Flood damage in Ring levee with urban Areas drainage pump	Ring levee with drainage pump	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and others		Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	Flood damage in River improvement	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, $(2 \sim 10\text{-year})$ modification of reservoir operation and others	(2 ~ 10-year)
Nakon Sawan Area	- Flood damage in Ring levee with urban Areas drainage pump	Ring levee with drainage pump	ioi		Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	- Flood damage in River improvement agricultural areas	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, modification of reservoir operation and others	(2 ~ 10-year)
Higher Delta m Lower Central Plain (Chainat-		Ring levee with drainage pump	ion		Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
Ayuthaya)	- Flood damage in agricultural areas	- Flood damage in River improvement, agricultural areas distribution system improvement* and diversion channel	Land use control and guidance, River Improvem modification of reservoir operation and distribution and others system improvement*	ent	Land use control and guidance, 10-year modification of reservoir operation and others	10-year
Lower Delta in Lower Central Plain (Down stream of Ayuthaya)		Ring levee with drainage pump, diversion chamnel and heightening of flood barrier at Bangkok	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and and others heightening of floor barrier at Bangkok	71	Land use control and guidance, Based on PWD Plan modification of reservoir (100-year) and BMA operation and others Plan	Based on PWD Plan (100-year) and BMA Plan
	- Flood damage in River improvem agricultural areas and distribution system improvement*	ent	Land use control and guidance, River improvem modification of reservoir operation and distribution and others system improvement*	ent	Land use control and guidance, modification of reservoir operation and others	10-year

*. Damage mitigation measures in agriculutral area are included.

Table 4.1.5 (3/3) MEASURES SELECTED FOR MASTER PLAN Alternative-2-2

			7-7-24 Hellering AC-7-7-	7.		
	Major Flood	Con	Conceivable Measures	Prop	Proposed Measures	Remarks
Areas	Problems	Structural Measures	Non-structural Measures	Structural Measures	Non-structural Measures	
Upper Central Plain	- Flood damage in Ring levee with urban Areas drainage pump	Ring levee with drainage pump	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and others	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Based on PWD Pian (100-year)
	- Flood damage in agricultural areas	Flood damage in River improvement agricultural areas	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, (2 ~ 10-year) modification of reservoir operation and others	(2 ~ 10-year)
Nakon Sawan Area	- Flood damage in Ring levee with urban Areas drainage pump	Ring levee with drainage pump	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and others	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
	- Flood damage in agricultural areas	Flood damage in River improvement agricultural areas	Land use control and guidance, modification of reservoir operation and others	Not applicable	Land use control and guidance, $(2 \sim 10$ -year) modification of reservoir operation and others	(2 ~ 10-year)
Higher Delta in Lower Central Plain (Chainat-	n - Flood damage in Ring levee with l urban Areas drainage pump	Ring levee with drainage pump	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and others	Ring levee with drainage pump	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year)
Ayuthaya)	*	- Flood damage in River improvement, agricultural areas distribution system improvement* and diversion channel	Land use control and guidance, River Improvement modification of reservoir operation distribution system and others diversion channel		Land use control and guidance, modification of reservoir operation and others	First stage: 10-year, Second Stage: 25- year
Lower Delta in Lower Central Plain (Down stream of	 	ಕ್ಟ್ರಿಕ್ಟ	Land use control and guidance, Ring levee with modification of reservoir operation drainage pump and and others	Ring levee with drainage pump and diversion chamel	Land use control and guidance, modification of reservoir operation and others	Based on PWD Plan (100-year) and BMA plan
Ayumaya)	- Flood damage in agricultural areas	River improvement and distribution system improvement;	Land use control and guidance, River Improvem modification of reservoir operation and distribution and others system improvement*	River Improvement and distribution system improvement*	Land use control and guidance, modification of reservoir operation and others	First stage: 10-year, Second Stage: 25- year
, ,	- -					

*: Damage mitigation measures in agriculutral area are included.

Table 4.1.6 (1/3) FEATURES OF SELECTED MEASURES FOR MASTER PLAN

(Altenative-1)

	(711)	enative-1)	04/ 711	. 1 1 () 40
Measures	Location of Measures	Dimension		on bahts) *3
			Initial	O&M
	Five dams	14,600 mil. m3 of storage	Economic	Economic
Reservoir		capacity for flood control	Cost	Cost
Operation	Bumipol	5,500 mil. m3	40	394
	Sirikit	6,500 mil. m3	Financial	Financial
	Pasak	772 mil. m3	Cost	Cost
	Kwae Noi	733 mil. m3	46	451
	Kaeng Sua Teng	1,125 mil. m3		
River Training	Main Stretch between Phatum	400 km in total with 10-year	Economic	Economic
	Thani and Chainat	return period	Cost	Cost
	Chao Phraya River (between	180 km		
	Pathumthani and Chainat)	100 km	1,234	31
	Lop Buri River	100 km		
	Noi River (between Bang Sai	30 km	Financial	Financial
	and Pakhai)	JO KIII	Cost	Cost
	,	501	Cost	Cost
·	Pasak River (between	50 km	1,425	34
	Ayutthaya and Rama VI)		1,120	3.
	Bang Bal Canal	15 km		
·	Bang Luang Canal	15 km		
	Bang Keao Canal	15 km		
Distribution and	Flood pron area in higher delta in	5,600 km2 of paddy field with	Economic	Economic
Drainage System	lower central plain	drainage channels*1	Cost	Cost
Improvement		improvement of 75 m3/s each	5,632	39
including Damage		in total capacity and 80 km of	Financial	Financial
Mitigation		stretch in west bank and 55 km	Cost	Cost
Measures		of it in east bank	7,020	44
1	Nanthaburi and Pathum Thani	Parcial protection by ring levee		;
by Ring Levee		with drainage pump	-	- '
Protection of	Major urban areas: BMA, 12	Ring levee with drainage pump	***************************************	
Urban Area	provincial capitals and 16	to cope with 100-year return		
	municipalities exclusive of	period flood in Chao Phraya		
	Nonthaburi and Pathum Thani	River	-	-

^{*1 :} Drainage channels are provided in lower delta in lower central plain both of east and west.

^{*2 :} Apply the existing operation rule

Table 4.1.6 (2/3) FEATURES OF SELECTED MEASURES FOR MASTER PLAN

(Altenative-2-1)

	(7110)	nauve-z-1)		
Measures	Location of Measures	Dimension	Cost (millio	
TVICUSUICS	Booking of Frontier		Initial	O & M
Modification of	Five dams	14,600 mil. m3 of storage	Economic	Economic
Reservoir		capacity for flood control	Cost	Cost
Operation	Bumipol	5,500 mil. m3	40	394
	Sirikit	6,500 mil. m3	Financial	Financial
	Pasak	772 mil. m3	Cost	Cost
	Kwae Noi	733 mil. m3	46	451
	Kaeng Sua Teng	1,125 mil. m3		
River Training	Main Stretch between Phatum	400 km in total with 10-year	Economic	Economic
	Thani and Chainat	return period	Cost	Cost
	Chao Phraya River (between	180 km		
1	Pathumthani and Chainat)		1,234	31
	Lop Buri River	100 km		
	Noi River (between Bang Sai	30 km	Financial	Financial
	and Pakhai)		Cost	Cost
•	Pasak River (between	50 km	Cost	Ouse
	Ayutthaya and Rama VI)	JO KIII	1,425	34
	Bang Bal Canal	15 km		
	Bang Luang Canal	15 km		
	Bang Keao Canal	15 km	<u> </u>	
Distribution and	Flood pron area in higher delta in	5,600 km2 of paddy field with	Economic	Economic
Drainage System	lower central plain	drainage channels*1	Cost	Cost 39
Improvement		improvement of 75 m ³ /s each	5,632	1 '
including Damage		in total capacity and 80 km of	Financial	Financial
Mitigation		stretch in west bank and 55 km	Cost	Cost
Measures		of it in east bank	7,020	44
Heightening of	Bankok Metropolitan Area	Heightening of flood barrier	EC 1,492	EC 31
Flood Barrier		with 30 cm on an average	FC 1,840	FC 34
Protection of	Major urban areas: BMA, 14	Ring levee with drainage pump		
Urban Area	provincial capitals and 18	to cope with 100-year return		
]	municipalities	period flood in Chao Phraya		
·		River		-

^{*1:} Drainage channels are provided in lower delta in lower central plain both of east and west.

^{*2:} Apply the existing operation rule

Table 4.1.6 (3/3) FEATURES OF SELECTED MEASURES FOR MASTER PLAN

(Altenative-2-2)

Measures	Location of Measures	Dimension	Cost (millio Initial	n bahts) *3 O & M
Modification of	Five dams	14,600 mil. m3 of storage	Economic	Economic
Reservoir	1170 dams	capacity for flood control	Cost	Cost
Operation	Durational	5,500 mil. m3	40	394
Op ora tion	Bumipol Sirikit	6,500 mil. m3	Financial	594 Financial
	Pasak	772 mil. m3	Cost	Cost
	Kwae Noi	772 mt. m3 733 mil. m3	46	451
	Kaeng Sua Teng	1,125 mil. m3	40	7.71
River Training	Main Stretch between Phatum	400 km in total with 10-year	Economic	Economic
(Stage-1)	Thani and Chainat	return period	Cost	Cost
(blugo 1)		180 km	Cost	Cost
	Chao Phraya River (between Pathumthani and Chainat)	1 60 кпі	1,234	31
	Lop Buri River	100 km		
	Noi River (between Bang Sai	30 km	Financial	Financial
	and Pakhai)		Cost	Cost
	Pasak River (between	50 km		
·	Ayutthaya and Rama VI)		1,425	34
	Bang Bal Canal	15 km		
	Bang Luang Canal	15 km		
	Bang Keao Canal	15 km		
River Training	Main Stretch between Phatum	400 km in total with 25-year	Economic	Economic
(Stage-2)	Thani and Chainat	return period	Cost	Cost
	Chao Phraya River (between Pathumthani and Chainat)	180 km	1,588	40
i .	Lop Buri River	100 km		
	Noi River (between Bang Sai	30 km	 Financial	Financial
	and Pakhai)	JO KIII	Cost	Cost
	Pasak River (between	50 km		
	Ayutthaya and Rama VI)		1,834	44
	Bang Bal Canal	15 km		
	Bang Luang Canal	15 km		
	Bang Keao Canal	15 km		
Distribution and	Flood pron area in higher delta in	5,600 km2 of paddy field with	Economic	Economic
Drainage System	lower central plain	drainage channels* l	Cost	Cost
Improvement		improvement of 75 m3/s each	5,632	39
including Damage		in total capacity and 80 km of	Financial	Financial
Mitigation		stretch in west bank and 55 km	Cost	Cost
Measures		of it in east bank	7,020	44
	Ayuthaya-East Bank-Sea	800 m3/s of flow capacity with	EC 24,989	EC 127
(Stage-1)		the stretch of 95 km	FC 33,684	FC 141
Diversion Channel	Ayuthaya-East Bank-Sea	Increase of flow capacity from	EC 6,143	EC 40
(Stage-2)		800 m3/s to 300 m3/s with the	FC 8,645	FC 45
		stretch of 95 km	10 0,043	FC 43
Protection of	Major urban areas: BMA, 14	Ring levee with drainage pump	•	• • • • • • • • • • • • • • • • • • • •
Urban Area	provincial capitals and 18	to cope with 100-year return		
	municipalities	period flood in Chao Phraya		
		River		-

^{*1:} Drainage channels are provided in lower delta in lower central plain both of east and west.

^{*2 :} Apply the existing operation rule

Table 4.2.1 FINANCIAL AND ECONOMIC COST AND BEENFIT OF ALTERNATIVE-1

Benefit	(million baht/	yeawr)
General	Agriculture	Total
1,997	196	2,193

excluding benefit of Dam

Cost Evaluation (Unit : baht I,000,606)

Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F,C	Total
Construction cost	101	123	224	1	Construction cost	88	112	199
1) Material and Equipment	86	123	208		1) Material and Equipment	75	112	186
2)Skilled Labor	4	0	4		2)Skilled Labor	4	0	. 4
3)Unskilled Labor	11	0	11		3)Unskilled Labor	10	0	16
2 Land acquisition & House I	3	0	3	2	Land acquisition & House Relox	2	0	:
3 Administration	3	0	3	3	Administration	2	0	;
4 1)Engineering serviceD/D	1	5	6	4	1)Engineering serviceD/D	0	5	:
2)Engineering serviceS/V	1	11	13		2)Engineering serviceS/V	1	10	1
5 Phisical contingency	4	7	11	5	Phisical contingency	4	6	1
Sub-total	113	146	259		Sub-total	98	133	23
6 Price Contingency	12	14	26	6	Price Contingency	0	0	
Grand total	125	160	285		Grand total	98	133	23
OM Cost			2	_	OM Cost			

	Draiange Improvement :Thai (I	inancial)				Draiange Improvement : Thai (Eco	nomic)		
	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Total
1	Construction cost	2,112	2,327	4,439	1	Construction cost	1,838	2,117	3,955
	1) Material and Equipment	1,837	2,327	4,163		1) Material and Equipment	1,603	2,117	3,721
	2)Skilled Labor	92	0	92		2)Skilled Labor	80	0	80
		184	0	184		3)Unskilled Labor	155	0	155
2)Unskilled Labor and acquisition & House R	612	O	612	2	Land acquisition & House Reloc	486	0	486
~	Administration	61	0	61		3 Administration	53	0	53
4	1)Engineering serviceD/D	31	122	153		1 1)Engineering serviceD/D	27	111	138
•	2)Engineering serviceS/V	61	306	367		2)Engineering serviceS/V	53	279	332
ς.	Phisical contingency	245	245	490		Phisical contingency	214	223	437
,	Sub-total	3,122	3,000	6,123		Sub-total	2,671	2,730	5,401
6		312	300	612		6 Price Contingency	0	0	. (
۰	Grand total	3,435	3,300	6,735		Grand Iotal	2,671	2,730	5,401
	OM Cost			42	_	OM Cost			37

River Improvement 10-year (Chainat-Pathum Thani: Thai (Financial

River Improvement 10-year (Chainat-Pathum Thani : Thai (Economic

	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Telal
1	Construction cost	507	602	1,109		Construction cost	441	548	989
	1) Material and Equipment	432	602	1,034		1) Material and Equipment	. 377	548	925
	2(a) Skilled Labor	40		40		2)(a) Skilled Labor	35	0	35
	(b) Unskilled Labor	35		35		(b) Unskilled Labor	29	0	29
2	and acquisition	20		20	2	Land acquisition	16	0	16
3	Administration	22		22	. 3	Administration	19	0	19
4	1)Engineering service D/D	. 8	59	66	4	1)Engineering service D/D	7	53	60
	2)Engineering service S/V	6	56	62		2)Engineering service S/V	5	51	56
5	Physical contingency	45	60	105	;	Physical contingency	39	55	94
	Sub-total	607	776	1,384		Sub-total	528	707	1,234
6	Price Contingency	18	23	41		5 Price Contingency	0	0	0
	Grand total	625	800	1,425	_	Grand total	528	707	1,234
	OM Cost			34		OM Cost		31	31

Dam Compensation Cost : Thai (Financial

Dam Compensation: Thai (Economic)

	Classification of cost	L.C.	F.C	Total	-	Classification of cost	L.C.	F.C	Total
1	Construction cost	0	0	0	1	Construction cost	0 -	0	0
	1) Material and Equipment	. 0	0	0		i) Material and Equipment	0	0	0
	2)(a) Skilled Labor	0	0	. 0		2)(a) Skilled Labor	. 0	0	0
	(b) Unskilled Labor	0	0	0		(b) Unskilled Labor	0	0	C
2	Land acquisition	0	0	0	2	Land acquisition	0	0	0
3	Administration	0	0	0	. 3	Administration	0	0	. 0
4	Engineering service	Ü	0	0	4	Engineering service	0	0	. 0
5	Physical contingency	46	0	46		Physical contingency	40	0	40
	Sub-total	46	0	46		Seb-total	40	0	-40
6	Price Contingency	0	0	. 0	. (Frice Contingency	0	0	(
	Grand total	46	. 0	.46	·	Grand total	40	. 0	-40
	OM Cost	451	. 0	451		OM Cost	394	0	394

Note: Physical contingency of Dam means initial cost of necessary expences for preparation.

Table 4.2.2 PROJECT EVALUATION OF ALTERNATIVE 1

	extigui	ng Dams) Economic cos	:1		Fee	momic bei	Unit: millon	081111
		souloune co.	·		General,	лилис ост	Economic	T(17)(C) Benefit-
		Construction	O&M	Total	etc.	Agri.	Benefit	Cost
Year 1	1998	(A) L	(B) 0	(C)	(D) 0	(E) 0	(F) 0	(G)
2	1999	56	ő	56	0	0	0	-5
3	2000	87	O	87	0	ő	ŏ	-8
4	2001	99	0	99	0	0	ŏ	-9
5	2002	627	0	627	ō	ō	Ö	-62
6	2003	1,199	0	1,199	ō	ō	ŏ	-1,19
7	2004	1,939	0	1,939	0	Ö	0	-1,93
8	2005	1,602	. 2	1,604	78	15	93	-1,51
9	2006	765	33	798	969	49	1,018	22
10	2007	479	33	512	969	49	1,018	50
11	2008	0	70	70	1,997	177	2,174	2,10
12	2009	0	70	70	1,997	177	2,174	2,10
13	2010	0	70	70	1,997	177	2,174	2,10
14	2011	0	70	70	1,997	177	2,174	2,10
15	2012	0	70	70	1,997	177	2,174	2,10
16	2013	0	70	70	1,997	196	2,193	2,12
17	2014	0	70	70	1,997	196	2,193	2,12
18	2015	0	70	70	1,997	196	2,193	2,12
19	2016	0	70	70	1,997	196	2,193	2,12
20	2017	0	70	70	1,997	196	2,193	2,12
21	2018	0	70	70	1,997	196	2,193	2,12
22	2019	0	70	70	1,997	196	2,193	2,12
23	2020	0	70	70	1,997	196	2,193	2,12
24	2021	0	70	70	1,997	196	2,193	2,12
25	2022	0	70	70	1,997	196	2,193	2,12
26	2023	0	70	70	1,997	196	2,193	2,12
27	2024	0	70	70	1,997	196	2,193	2,12
28	2025	. 0	70	70	1,997	196	2,193	2,12
29	2026	0	70	70	1,997	196	2,193	2,12
30	2027	0	70	70	1,997	196	2,193	2,12
31	2028	0	70	70	1,997	196	2,193	2,12
32	2029	0	70	70	1,997	196	2,193	2,12
33	2030	0	70	70	1,997	196	2,193	2,12
34	2031	0	70	70	1,997	196	2,193	2,12
35	2032	0	70	70	1,997	196	2,193	2,12
36	2033	0	70	. 70	1,997	196	2,193	2,12
37	2034	0	70	70	1,997	196	2,193	2,12
38	2035	0	70	70	1,997	196	2,193	2,12
39	2036	. 0	70	70	1,997	196	2,193	2,12
40	2037	0	70	70	1,997	196	2,193	2,12
41	2038 2039	0	70	70	1,997	196	2,193	2,12
42 43		0	70	70	1,997	196	2,193	2,12
43 44	2040	0	70 70	70 70	1,997	196	2,193	2,12
44	2041 2042	0	70 70	70	1,997 1,997	196	2,193	2,12
46	2042	0	70	70 70		196 196	2,193	2,12
47	2044	0	70	70	1,997		2,193	2,12
48	2044	0	70 70	70	1,997 1,997	196 196	2,193 2,193	2,12
49	2045	0	70	70	1,997	196	2,193 2,193	2,12
50	2040	0	. 70	70	1,997	196	2,193	2,12 2,12
51	2047	0	70	70	1,997	196	2,193	2,12
52	2049	0	70	70	1,997	196	2,193	2,12
53	2050	0	70	70	1,997	196	2,193	2,12
54	2051	0	70	70	1,997	196	2,193	2,12
55	2052	Ü	70	70	1,997	196	2,193	2,12
56	2053	ő	70	70	1,997	196	2,193	2,12
57	2054	ő	70	70	1,997	196	2,193	2,12
58	2055	ő	70	. 70	1,997	196	2,193	2,12
59	2056	ŏ	70	70	1,997	196	2,193	2,12
60	2057	ő	70	70	1,997	196	2,193	2,12
61 .	2058	ő	70	70	1,997	196	2,193	2,12
62	2059	0	70	70	1,997	196	2,193	2,12
63	2060	0	70	70	1,997	196	2,193	2,12
64	2061	. 0	70	70	1,997	196	2,193	2,12
65	2062	0	70	70	1,997	196	2,193	2,12
66	2063	ő	70	70	1,997	196	2,193	2,12
67	2064	o	70	70	1,997	196	2,193	2,12
68	2065	0	70	70	1,997	196	2,193	2,12
69	2066	0	70	70	1,997	196	2,193	2,12
70	2067	· o	70	70	1,997	196	2,193	2,12
71	2068	o	70	70	1,997	196	2,193	2,12
		6,853	4,332	11,185			_,	124,60

Table 4.2.3 FINANCIAL CONSIDERATION

Unit: million baht

	Unit: million baht	
Item	Amount	Remark
I. Budget :		
Gov.Thailand	984,000	
Ministry of Agriculture and		
Cooperative	.	
RID	44,436	
Ministry of Interior]	
PWD	39,813	
BMA	12,264	
Other Related Agency	1	
HD (Harbour Dept.)	2,301	
DOH (Dept. of Highway)	78127	
(1) Total of RID, PWD and BMA	96,513	
(1) Total of (1), HD and DOH	176,941	
(1) Total of (1), 11D and Doff	170,741	
II. Cost:		
(a) Cost Requirement (Alternative-1)		
Distrubution System Improvement	14	285/20=14
Drainage System Improvement	337	6,735/20=337
River Improvement	71	1425/20=71
	453	40/20+451=453
Modification of Dam Operation Rule	875	40/201431-433
(2) Total Cost requirement/year	0.9	
(2)/(1) %	1	
(2)/(1)' %	0.5	*
(b) Cost Provingment (Alternative 2.1)		
(b) Cost Requirement (Alternative 2-1)	14	285/20=14
Distrubution System Improvement	337	6,735/20=337
Drainage System Improvement		1,840/20=92
Heightening of Flood Barrier	92 71	
River Improvement		1,425/20=7
Modification of Dam Operation Rule	453	40/20+451=45
(3) Total Cost requirement/year	967	
(3)/(1) %	1.0	
(3)/(1)' %	0.5	
(Alternative 2.2)	2,992	
(b) Cost Requirement (Alternative 2-2)	· · · · · · · · · · · · · · · · · · ·	205/20-1
Distrubution System Improvement	14	285/20=1
Drainage System Improvement	337	-,
Diversion Channel	2,116	1 '
River Improvement	71	1,425/20=7
Modification of Dam Operation Rule	453	40/20+451=45
(4) Total Cost requirement/year	2,992	
(4)/(1) %	3.1	
(4)/(1)' %	1.7	<u> </u>

Note: Budget for 1997 from the source of Statiatical Yearbook Thailand, 1996.

Table 4.2.4 FINANCIAL AND ECONOMIC COST AND BENEFIT OF ALTERNATIVE-2-1

Benefit	(million baht/y	сацт)
General	Agriculture	Total
3,568	196	3,764
excluding benefit of D	am	

.

Cost Evaluation (Unit : bakt 1,008,000)

	Classification of cost	LC.	F.C	Total		Classification of cost	L.C.	F.C	Total
_							L .C.		10.22
1	Constructions cost	101	123	224	ŧ	Construction cost	88	112	199
	1) Material and Equipment	86	123	208		1) Material and Equipment	75	. 112	186
	2)Skilled Labor	4	0	4		2)Skilled Labor	4	0	4
	3)Unskilled Labor	11	o	n		3)Unskilled Labor	10	0	10
2	Land acquisition & House F	3	o	3	2	Land sequisition & House Relo-	2	0	2
3	Administration	3	0	3	3	Administration	2	0	2
4	1)Engineering serviceD/D	1	5	6	4	1)Engineering serviceD/D	û	5	5
	2)Engineering serviceS/V	1	11	13		2)Engineering serviceS/V	1	10	12
5	Phisical contingency	4	7	12	5	Phisical contingency	4	6	10
	Sub-total	113	146	259		Sub-total	98	133	231
6	Price Contingency	12	14	26	6	Price Contingency	O	٥	0
	Grand total	125	160	285		Grand total	98	133	231
	OM Cost			2		OM Cost			2

	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Total
_									1000
ı	Construction cost	2,112	2,327	4,439	1	Construction cost	1,838	2,117	3,95
	1) Material and Equipment	1,837	2,327	4,163		1) Material and Equipment	1,603	2,117	3,721
	2)Skilled Labor	92	0	92		2)Skilled Labor	80	o	80
	3)Unskilled Labor	164	0	184		3)Unskilled Labor	153	0	155
2	Land acquisition & House F	612	0	612	2	Land acquisition & House Reloc.	486	0	486
3	Administration	61	0	61	3	Administration	53	0	5:
4	1)Engineering serviceD/D	31	122	153	4	1)Engineering serviceD/D	27	113	138
	2)Engineering serviceS/V	6l	306	367		2)Engineering serviceS/V	53	279	333
5	Phisical contingency	245	245	490	5	Phisical contingency	214	223	437
	Sub-total	3,122	3,000	6,123		Sub-total	2,671	2,730	5,40
6	Price Contingency	312	300	612	6	Price Contingency	0	o	
	Grand total	3,435	3,300	6,735		Grand total	2,671	2,730	5,40
	OM Cost			42		OM Cost			33

Bangkok Dike along Chao Phraya River (Heightening=0.3m); Thai (Financial)

Bangkok Dike along Chao Phraya River (Heightening=0.3m); Thai (Economic)

	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Total
1	Construction cost	653	791	1,445	ı	Construction cost	568	720	1,288
	1) Material and Equipment	552	791	1,344		1) Material and Equipment	482	720	1,202
	2)Skilled Labor	28	0	28		2)Skilled Labor	24	0	24
	3)Unskilled Labor	74	0	74		3)Unskilled Labor	62	٥.	62
2	Land acquisition & House F	18	. 0	18	2	Land acquisition & House Rela	15	0	15
3	Administration	18	0	18	3	Administration	16	0	16
4	1)Engineering serviceD/D	4	33	37	4	1)Engineering serviceD/D	3	30	33
	2)Engineering serviceS/V	9	74	83		2)Engineering serviceS/V	8	67	75
5	Phisical contingency	28	44	72	5	Phisical contingency	2.4	10	61
	Sub-total	731	942	1,673		Sub-total	634	858	1.492
6	Price Contingency	75	92	167	6	Price Contingency	0	0	. 0
	Grand total	806	1,034	1,840		Grand total	634	858	1,492
	OM Cost			13		OM Cost			12

River Improvement 10-year (Chainal-Pathum Thani : Thai (Eisancial

River Improvement 10-year (Chainat-Pathum Thani: Thai (Economic)

	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Total
									
1	Construction cost	507	602	1,109	1	Construction cost	411	548	989
	1) Material and Equipment	432	602	1,034		1) Material and Equipment	377	548	925
	2)(a) Skilled Labor	40		40		2)(a) Skilled Labor	35	0	35
	(b) Unskilled Labor	35		35		(b) Unskilled Labor	29	0	29
2	Land acquisition	20		20	2	Land acquisition	16	0	16
3	Administration	22 .		22	3	Administration	19	0	19
4	1)Engineering service D/D	8	59	66	4	1)Engineering service D/D	7	53	60
	2)Engineering service S/V	6	36	62		2)Engineering service S/V	5	51	56
5	Physical contingency	45	60	105	5	Physical contingency	39	55	9.1
	Sub-total	607	176	1,384		Sub-total	528	707	1,234
6	Price Contingency	18	23	. 41	6	Price Contingency	0	0	0
	Grand total	625	800	1,425		Grand total	528	707	1,234
	OM Cost			34	_	OM Cost		31	31

Dam Compensation Cost : Thai (Financial)

Dam Compensation: That (Economic)

	Dam Compensation Cost : The	ii (Ferancial)				Dam Compensation: That (Eco	nomic)		
	Classification of cost	L.C.	F.C	Total		Classification of cost	L.C.	F.C	Total
ı	Construction cost	. 0	0	0	1	Construction cost	a	0	0
	1) Material and Equipment	0	0	0		1) Material and Equipment	0	0	0
	2)(a) Skilled Labor	0	0	0		2)(a) Skilled Labor	o	0	0
	(b) Unskilled Labor	0 .	0	0		(b) Unskilled Labor	o	0	0
2	Land acquisition	0	0	0	. 2	Land acquisition	0	. 0	0
3	Administration	. 0	0	0	3	Administration	0	0	0
4	Engineering service	0	0	D	4	Engineering service	0	0	0
5	Physical contingency	46	0	16	. 5	Physical contingency	40	o	40
	Sub-lotal	46	. 0	-16		Sub-total	. 40	0	40
6	Price Contingency	0	0	. 0		Price Contingency	0	Ð	0
_	Grand total	46	. 0	.16	· · _	Grand total	40	0	40
	OM Cost	451	0	451		OM Cost	394	0	394

Note: Physical contingency of Dant means initial cost of necessary expenses for preparation.

Table 4.2.5 PROJECT EVALUATION OF ALTERNATIVE 2-1

		Economic cost			General,	Vennemia	(r)-(c) Benefit-	
		Construction	O&M	Total	ctc.	Agri.	Economic Benefit	Cost
/ear		(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	1998	1	0	1	0	0	0	-1
2	1999	56	0	56	0	0	0	-56
3 4	2000 2001	87 103	0	87 103	0	0	0	-87 -103
5	2002	640	0	640	0	0	0	-640
6	2003	1,216	ő	1,216	ŏ	ŏ	Õ	-1,216
7	2004	2,097	0	2,097	0	0	0	-2,097
8	2005	2,109	2	2,111	78	15	93	-2,018
9	2006	1,270	33	1,303	285	48	333	-970
10	2007	768	33	801	285	48	333	-468
11	2008	0	82	82	3,037	177	3,214	3,132
12	2009	0	82	82 82	3,446	- 177 177	3,624	3,542
13 14	2010 2011	0	82 82	82	3,446 3,446	177	3,624 3,624	3,542 3,542
15	2012	0	82	82	3,446	177	3,624	3,542
16	2013	0	82	82	3,568	196	3,764	3,682
17	2014	0	82	82	3,568	196	3,764	3,682
18	2015	0	82	82	3,568	196	3,764	3,682
19	2016	0	. 82	82	3,568	196	3,764	3,682
20	2017	0	82	82	3,568	196	3,764	3,682
21	2018	0	82	82	3,568	196	3,764	3,682
22 23	2019 2020	0	82 82	82 82	3,568 3,568	196 1 9 6	3,764 3,764	3,682 3,682
24	2021	0	82	82	3,568	196	3,764	3,682
25	2022	0	82	82	3,568	196	3,764	3,682
26	2023	0	82	82	3,568	196	3,764	3,682
27	2024	0	82	82	3,568	196	3,764	3,682
28	2025	0	82	82	3,568	196	3,764	3,682
29	2026	0	82	82	3,568	196	3,764	3,682
30	2027	0	82	82	3,568	196	3,764	3,682
31 32	2028	0	82 82	82 82	3,568	196 196	3,764	3,682
33	2029 2030	0	82	82 82	3,568 3,568	196	3,764 3,764	3,682 3,682
34	2031	0	82	82	3,568	196	3,764	3,682
35	2032	0	82	82	3,568	196	3,764	3,682
36	2033	0	82	82	3,568	196	3,764	3,682
37	2034	0	82	82	3,568	196	3,764	3,68
38	2035	0	82	82	3,568	196	3,764	3,682
39	2036	0	82	82	3,568	196	3,764	3,682
40 41	2037 2038	0	82 82	82 82	3,568 3,568	196 196	3,764 3,764	3,682 3,682
42	2039	0	82	82	3,568	196		3,68
43	2040	ő	82	82	3,568	196	3,764	3,68
44	2041	0	82	82	3,568	196		3,68
45	2042	0	82	82	3,568	196	3,764	3,68
46	2043	0	82	82	3,568	196		3,68
47	2044	0	82	82	3,568	196		3,68
48	2045	. 0	82 83	82	3,568	196	3,764	3,68
49 50	2046 2047	0	82 82	82 82	3,568 3,568	196 196		3,68 3,68
51	2048	0	82 82	82	3,568	196		3,68
52	2049	0	82	82	3,568	196		3,68
53	2050	0	82	82	3,568	196		3,68
54	2051	0	82	82	3,568	196	3,764	3,68
55	2052	0	82	82	3,568	196		3,68
56	2053	0	82	82	3,568	196		-
57	2054	0	82 82	82	3,568	196	-	3,68
58 59	2055 2056	0	82 82	82 82	3,568 3,568	196 196		3,68 3,68
60	2050	0	82 82	82 82	3,568	. 196		
61	2058	0	82	82	3,568	196		
62	2059	0	82		3,568	196		
63	2060	0	82	82	3,568	196	3,764	3,68
64	2061	. 0	82		3,568	196		
65	2062	0			3,568	196		
66	2063	0			3,568	196		
67	2064	0			3,568	196		
68 69	2065 2066	0			3,568 3,568	196 196		
70	2067	0			3,568	196		
71	2068	0			3,568	196	-	
		8,346			217,278	11,955		
		EIRR	24.02%					

Table 4.2.6 FINANCIAL AND ECONOMIC COST AND BENEFIT OF ALTERNATIVE-2-2

Benefit (million baht/yeawr)
General Agriculture
3,568 196
excluding benefit of Dam

Cost Evaluati	ion (L'ult :	bakt 2,000,600)

Ayuthaya-East-Sea-2 Diversion(Ayuthaya Fast-Sea Diversional, 100			
Classification of cost	LC.	F.C	Total	Classification of cost	LC.	F.C	Total
Constructions cost	7,152	12,289	19,441	I Construction cost	6,219	11,183	17,4
1) Material and Equipment	6,335	12,289	18,624	1) Material and Equipment	5,531	11,183	16,7
2)Stilled Labor	311	0	311	2)Skilled Labor	298	0	2
3)Unskilled Labor	476	. 0	476	3)Unstalled Labor	400	0	- 7
Land acquisition & House F	15,186	ő	15,186	2 Land acquisition & House Relo	12,013	ŏ	12,0
•		ŏ	759	3 Administration	663	ó	12,0
Administration	759 10	87	97		8	80	,
I)Engineering serviceD-D	97	875	977	DEngineering serviceD/D	85		
2)Engineering serviceS/V				2)Engincering serviceS/V	•••	796	
Phisical contingency	136	223	353	5 Phisical contingency	113	203	
Sub-total	23,334	13,474	36,808	Sub-total	19,841	12,262	31,4
Price Contingency	3,500	7,021	5,521	6 Price Contingency	,0	0	
Grand total	26,834	15,495	42,329	Grand total	19,141	12,262	31,4
OM Cost			186	OM Cost			
tribution System Improvement :Th Classification of cost	ai (Financial) L.C.	F.C	Total	Distribution System Improvement That Classification of cost	(Economic) L.C.	F.C	Total
Construction cost	101	123	224	1 Constructions cost	88	112	1
1) Afaterial and Equipment	86	123	208	Material and Equipment	75	112	i
2)Skilled Labor	4		4	2)Skilled Labor	4		
	11	0	11	3)Onskilled Labor	10	0	
3)Unskilled Labor						4	
Land sequisition & House F	3	0	3	2 Land equisition & House Relo	2	-	
Administration	3	0	3	3 Administration	2	¢	
I)Engineering serviceD/D	ŧ	5	6	4 1)Engineering service D/D	0	5	
2)Engineering serviceS/V	i	11	13	2)Engineering serviceS/V		10	
Phisical contingency	4	7	£1	5 Phisical contingency	4	6	
Sub-total	113	146	259	Sub-total	98	133	:
Price Contingency	12	14	26	6 Price Contingency	0	0	
Grand total	125	160	285	Grand total	98	133	
Old Cost			2	OM Cost			
Draiange Improvement Thai (Fr				Draiange Improvement : That (Eco		25	
Classification of cost	L.C.	F.C	Total	Classification of cost	L.C.	F.C	Total
Construction cost	2,112	2,327	4,439	1 Constructioin cost	1,838	2,117	3,
I) Material and Equipment	1,837	2,327	4,163	1) Material and Equipment	1,603	2,117	3,
7)Skilled Labor	92	0	92	2)Skilled Labor	80		-,
3)Unskilled Labor	184	0	184	3)Unskilled Labor	155	. 0	
Land acquisition & House F	612	å	617	2 Land acquisition & House Relo	486	ŏ	
Administration	61	0	61	3 Administration	53	ő	
						111	
I)Engineering serviceD/D	31	122	153	4 1)Engineering serviceD/D	27		
1)Engineering serviceS/V	61	306	367	2)Engineering serviceS/V	53	279	
Phisical contingency	245	245	490	5 Phisical contingency	214	223	
Sub-total	3,122	3,000	6,123	Sub-total	2,671	2,730	5,
	312	300	612	6 Price Contingency	0	0	
Price Contingency Grand total OM Cost River Improvement 10-year (Chastification of cost	3,435	3,360 nani : Thai (Fina	6,735 42 ncial)	Grand total Ohl Cost River Improvement 10-year (Chain	2,671 al-Pathun Thar	2,730 : Thai (Econo	mic)
Grand total OM Cost River Improvement 10-year (Ch Classification of cost	3,435	3,300 nani : Thai (Fina F.C	6,735 42 ncial)	Grand total OM Cost River Improvement 10-year (Chain Classification of cost	2,671	ui : Thai (Econo	mic) Total
Grand total OM Cost River Improvement 10-year (Ct Classification of cost Construction cost	3,435 sainet-Pethum TI L.C. 507	3,300 nani : Thai (Fina F.C 602	6,735 42 ncial) Total	Grand total OSI Cost River improvement 10-year (Chain Classification of cost 1 Construction cost	2,671 at~Pathum Thar L.C.	ai : Thai (Econo	mic) Total
Grand total OM Cost River Improvement 10-year (Ct Classification of cost Construction cost 1) Material and Equipment	3,435 L.C. 507 432	3,300 nani : Thai (Fina F.C	6,735 42 acial) Total 1,109 1,034	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment	2,671 at~Pathum Thar L.C. 441 377	ai : Thai (Econo F.C 548	mic)
Grand total OM Cost River Improvement 10-year (Cb Classification of cost Construction cost) Material and Equipment 2(a) Skilled Labor	3,435 L.C. 507 432 40	3,300 nani : Thai (Fina F.C 602	6,735 42 notal) Total 1,109 1,034 40	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor	2,671 at~Pathum Thar L.C. 441	zi : Thai (Econo F.C 548 548	mic) Total
Grand total ONI Cost River Improvement 10-year (Ct Chassification of cost Construction cost 1) Material and Equipment 2(x) Skilled Labor (b) Unskilded Labor	3,435 L.C. 507 432 40 35	3,300 nani : Thai (Fina F.C 602	6,735 42 Accial) Total 1,109 1,034 40 35	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Shilled Labor (b) Unskilled Labor	2,671 ad-Pathum Than L.C. 441 377 35 29	F.C 548 548 0	mic) Total
Grand total ON Cost River Improvement 10-year (Cb Classification of cost Construction cost 1) Material and Equipment 2(a) Salled Labor (b) Unskilled Labor 1 and acquisition	3,435 L.C. 507 432 40 25 20	3,300 nani : Thai (Fina F.C 602	6,735 42 ncial) Total 1,109 1,034 40 35 20	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor Labor Land acquisition	2,671 ad-Pathum Than L.C. 411 377 35 29 16	F.C 548 548 0 0 0	mic) Total
Grand total OM Cost River Improvement 10-year (Cb Classification of cost Construction cost 1) Matrial and Equipment 2(a) Skilled Labor (b) Unskilled Labor Land acquisited Administration	3,435 L.C. 507 432 40 35 20 22	3,300 nani : Thai (Fina F.C 602 602	6,735 42 notal) Total 1,109 1,034 40 35 20 22	Grand total ONI Cost River Improvement 10 year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration	2,671 at-Pathum Thar L.C. 441 377 35 29 16 19	F.C 548 548 0 0 0 0 0 0	mic) Total
Grand total OM Cost River Improvement 10-year (Ch Chassification of cost Construction cost 1) Material and Equipment 2(x) Skilled Labor (b) Unskilled Labor (c) Unskilled Labor 1 Jiffightering service DD	3,435 L.C. 507 432 40 35 20 22 8	3,300 nani : Thai (Fina F.C 602 602	6,735 42 neial) Total 1,109 1,034 40 35 20 22 66	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 [Hagineering service D/D)	2,671 ad - Pathum Thar L.C. 411 377 35 29 16 19 7	si : Thai (Econo F.C 548 548 0 0 0	mic) Total
Grand total ON Cost River Improvement 10-year (Cl Classification of cost Construction cost Natural and Equipment (S) Stalled Labor (b) Unskilled Labor I and acquisition Administration Plingineering service DTD Expressive SVV	3,435 L.C. 507 432 40 35 20 22 8 6	3,300 F.C 602 602 59 56	6,735 42 Acial) Total 1,109 1,034 40 35 20 22 66 62	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 1)Engineering service D/D 2)Engineering service S/V	2,671 L.C. 411 377 35 29 16 19 7 5	548 548 0 0 0 0 53	mic) Total
Grand total OM Cost River Improvement 10-year (Cb Classification of cost 1) Matrial and Equipment 2(a) Skilled Labor (b) Unskilled Labor Land acquisition Administration Administration JiEngineering service D/D 2)Engineering service S/V Physical contingency	3,435 L.C. 507 432 40 25 20 22 8 6 45	3,300 F.C	6,735 42 Acial) Total 1,109 1,034 40 35 20 22 66 62 105	Grand total ONI Cost River Improvement 10 year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 Ufengineering service DID 2)Engineering service S/V 5 Physical contingency	2,671 ad-Pathum Thar L.C. 441 377 35 29 16 19 7 5 39	548 548 0 0 0 0 53 51 55	Total
Grand total ON Cost River Improvement 10-year (Ch Chastification of cost Chastification of cost Construction cost Note: The Construction cost Note: The Construction cost State Chabor On Unstalled Labor Construction Administration Administration Ellinguisering service DTD Sillinguisering service SV Physical contingency Sub-total	3,435 L.C. 507 432 40 35 20 22 8 6 45 607	3,300 F.C	6,735 42 Accial) Total 1,109 1,034 40 35 20 22 66 62 105 1,324	Grand total ONI Cost River Improvement 10 year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 [Figineering service DID 2) Engineering service SIV 5 Physical confingency Sub-total	2,671 ad-Pathum Thar L.C. 441 377 35 29 16 19 7 5 39 528	F.C 548 548 0 0 0 53 51 55 707	mic) Total
Grand total OM Cost River Improvement 10-year (Ch Chastification of cost Construction cost 1) Matrial and Equipment 2(a) Stalled Labor (b) Unskilled Labor I and acquistion Administration JiEngineering service DD 2)Engineering service SV 5 Physical contingency Sub-total 5 Price Confingency	3,435 beingt-Pathum Ti LC. 507 432 40 20 22 8 6 45 607 18	3,300 E.C. 602 602 602 59 56 60 776 23	6,735 42 Total 1,109 1,034 40 35 20 22 66 62 105 1,384 41	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 ()Engineering service D/D 2)Engineering service S/V 5 Physical contingency Sub-total 6 Price Contingency	2,671 at-Pathum Thar L.C. 411 377 35 79 16 19 7 5 39 528 0	548 548 0 0 0 0 9 53 51 55 707	Total
Grand total OM Cost River Improvement 10-year (Ch Classification of cost Construction cost 1) Material and Equipment 2(x) Skilled Labor (b) Unskilled Labor (c) Unskilled Labor 13 Engineering service DD 2)Engineering service SV 5-Physical contingency Sub-total	3,435 L.C. 507 432 40 35 20 22 8 6 45 607	3,300 F.C	6,735 42 Accial) Total 1,109 1,034 40 35 20 22 66 62 105 1,324	Grand total ONI Cost River Improvement 10 year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 [Figineering service DID 2) Engineering service SIV 5 Physical confingency Sub-total	2,671 ad-Pathum Thar L.C. 441 377 35 29 16 19 7 5 39 528	F.C 548 548 0 0 0 53 51 55 707	Total
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Grand total OM Cost River Improvement 10-year (CN Classification of cost Construction cost 1) Material and Equipment 2(s) Sidled Labor (b) Unsidial Labor (c) Unsidial Labor (d) Unsidial Labor 1) Engineering service DD 2)Engineering service DD 2)Engineering service SV Physical contingency Sub-total OM Cost River Improvement 25-year (CI Classification of cost 1 Construction cost 1) Material and Equipment 2(s) Sidled Labor (b) Unsidial Labor Land sequisition 3 Administration 4 () Engineering service DD 2)Engineering service DD 2)Engineering service DD 2)Engineering service DD 3 Physical contingency Sub-total 6 Price Confingency Grand total OM Cost Dam Compensation Cost 1 Construction of cost 1 Construction	3,435 L.C. 507 432 40 35 20 22 8 6 6 45 607 18 635 50 10 L.C. 552 552 45 26 10 8 58 781 23 805 L.C. 0 0 0 0 0	3,300 F.C 602 602 59 56 60 776 23 800 E.C 775 775 775 775 775 78 999 30 1,029	(6,735 42 42 43 44 44 44 44 45 47 46 47 47 47 47 47 47 47 47 47 47 47 47 47	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 Uffigurening service DrD 2) Engineering service SrV 5 Physical contingency Sub-total 6 Price Contingency Grand total OM Cost River Improvement 25-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor (c) Unskilled Labor (d) Unskilled Labor (e) Unskilled Labor (f) Unskilled Labor (g) Unskilled Labor (h) Unskilled Labor	2,671 atl-Pathum That L.C. 411 377 35 79 16 19 7 5 39 35 8 0 528 at-Pathum That L.C. 568 45 38 20 20 25 97 51 679 679 L.C.	ii: Thai (Econe F.C 548 548 0 0 0 0 707 707 31 ii: Thai (Econe F.C 705 705 70 909 0 0 0 0 0 0 0 0 0 0 0	I, L. Total
Grand total ONI Cost River Improvement 10-year (Ch Chassification of cost Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor (c) Unskilled Labor (l) Land acquisition Administration 1) Engineering service D/D 2)Engineering service S/V Physical contingency Sub-total 5 Price Confingency Grand total OMI Cost Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor (b) Unskilled Labor 2 Land acquisition 4 (Figure System Cost 2 Land acquisition 4 (Figure System Cost 2 Land acquisition Condition Cost 1 Dann Contingency Sub-total Price Contingency Sub-total OMI Cost Dann Compensation Cost: The Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Skilled Labor 2 Land acquisition 1 (b) Unskilled Labor 2 Land acquisition 3 Administration 4 Engineering service 5 Physical contingency (a) Unskilled Labor 2 Land acquisition 3 Administration 4 Engineering service 5 Physical contingency 5 Physical contingency (c) Unskilled Labor 2 Land acquisition 3 Administration 4 Engineering service 5 Physical contingency	3,435 L.C. 507 432 40 35 20 22 8 6 45 627 18 625 L.C. 652 45 26 45 28 10 8 8 781 10 8 8 781 23 20 21 L.C. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3,300 F.C	6,735 42 acial) Total 1,109 1,034 40 35 20 22 26 66 62 105 34 11,225 34 11,225 34 11,225 34 11,230 22 45 28 85 79 135 1,781 50 1,834 44 Total 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Shilled Labor (b) Unskilled Labor 2 Land sequinition 3 Administration 4 (Figure-ring service DID 2) Engineering service DID 2) Engineering service SIV 5 Physical contingency Sub-total 6 Price Contingency Grand total OM Cost River Improvement 25-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Shilled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 (Figure-ring service DID 2) Engineering service SIV 5 Physical contingency Sub-total 6 Price Contingency Grand total OM Cost Durn Compensation: Thai (Econo Classification of cost 1 Construction cost 1) Material and Equipment 2(a) Shilled Labor Construction cost 1) Material and Equipment 2(b) Shilled Labor (c) Unskilled Labor (d) Unskilled Labor (e) Unskilled Labor (e) Unskilled Labor (f) Unskilled Labor (h) Unskilled Labor (h) Unskilled Labor (l) Unskilled Labor	2,671 atl-Pathum That L.C. 411 377 35 16 19 7 5 39 18 0 528 L.C. 568 45 38 20 1.C. 568 45 18 20 679 Tuic) L.C. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ii: Thai (Econe F.C 548 548 548 0 0 0 0 33 51 55 707 707 31 ni: Thai (Econe F.C 705 705 0 0 0 69 65 75 79 909 39	Total 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
Grand total OM Cost River Improvement 10-year (CN Classification of cost Construction cost 1) Material and Equipment 2(x) Skilled Labor (b) Unskilled Labor (c) Unskilled Labor (d) Unskilled Unskilled (e) Unskilled Unskilled (e) Unskilled Labor (f) Unskilled Labor	3,435 L.C. 507 432 40 35 20 22 8 6 6 45 607 188 625 52 45 628 10 10 8 58 781 23 805 L.C. 0 0 0 0 0 0 0 0 46 46 46	3,300 F.C 602 602 603 59 56 60 776 23 800 775 775 775 775 775 71 78 999 30 1,029	6,735 42 Acial) Total 1,109 1,034 40 35 70 22 66 62 105 1,321 41 1,425 34 Total 1,427 1,330 52 45 26 28 85 79 135 1,781 44 Total 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Grand total ONI Cost River Improvement 10-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(s) Stalled Labor (b) Unskilled Labor 2 Land acquisition 3 Administration 4 liftingineering service DrD 2)Engineering service SrV 5 Physical contingency Sub-total 6 Price Contingency Grand total ONI Cost River Improvement 25-year (Chain Classification of cost 1 Construction cost 1) Material and Equipment 2(s) Stilled Labor (c) Unskilled Labor (d) Unskilled Labor 4 liftingineering service DrD 2)Engineering service 5 Physical contingency Sub-total 6 Price Contingency Grand total OMI Cost Duan Compensation: Thai (Econo Classification of cost 1 Construction cost 1) Material and Equipment 2(s) Stilled Labor (b) Unskilled Labor (c) Unskilled Labor (d) Unskilled Labor (e) Unskilled Labor (f) Unskilled Labor (h) Material and Equipment 2(s) Stilled Labor (h) Unskilled Labor (h) Unskilled Labor 2 Land acquisition 3 Administration 4 Engineering service 9 Hysical contingency Sub-total	2,671 atl-Pathum That L.C. 411 377 35 29 16 19 7 5 39 528 0 528 0 528 0 528 0 528 0 679 528 0 679 679 679 679 679	## That (Economics of the Conomics of the Cono	I, L. Total

Table 4.2.7 PROJECT EVALUATION OF ALTERNATIVE 2-2

		ding Dams.) Economic cost			Unit: millon baht Economic benefit			
					T(I (F)-(C)			
		Construction	O&M	Total	General, etc.	Agri.	Economic Benefit	Benefit- Cost
ear		(A)	(B)	(C)	(D)	(E)	(F)	(G)
l	1998	1	0	1	0	0	0	-l
2	1999	56	0	56	0	0	0	-56
3	2000	87	0	87	0	0	0	-87
4	2001	104	0	104	0	0	0	-104
5	2002	653	0	653	0	0	0	-653
6	2003	1,225	0	1,225	0	0	0	-1,225
7	2004	1,948	0	1,948	0	0	0	-1,948
8	2005	2,636	2	2,638	78 285	15 48	93 333	-2,545 -1,499
9 10	2006 2007	1,799 1,513	33 33	1,832 1,546	285	48	333	-1,499
10 11	2008	1,034	70	1,104	1,313	232	1,545	441
12	2009	2,245	70	2,315	1,313	232	1,545	-770
13	2010	2,422	70	2,492	1,313	232	1,545	-947
14	2011	4,169	70	4.239	1,313	232	1,545	-2,694
15	2012	6,120	70	6,190	1,313	232	1,545	-4,645
16	2013	6,109	70	6,178	1,313	232	1,545	-4,633
17	2014	2,303	70	2,373	4,634	201	4,835	2,462
18	2015	1,955	70	2,025	4,634	201	4,835	2,810
19	2016	2,193	70	2,263	4,634	201	4,835	2,572
20	2017	399	237	636	5,529	224 229	5,752 6,092	5,116 5,722
21	2018	133	237 280	370 280	5,863 5,851	227	6,078	5,79
22 23	2020	0	280	280	5,851	227	6,078	5,798
24	2021	ŏ	280	280	5,851	227	6,078	5,798
25	2022	0	280	280	5,851	227	6,078	5,798
26	2023	0	280	280	5,851	227	6,078	5,79
27	2024	0	280	280	5,851	227	6,078	5,79
28	2025	0	280	280	5,851	227	6,078	5,79
29	2026	0	280	280	5,851	227		5,79
30	2027	0	280	280	5,851	227	6,078	5,79 5,79
31	2028 2029	0	280 280	280 280	5,851 5,851	227 227	6,078 6,078	5,79
32 33	2030	0	280	280	5,851	227	6,078	5,79
34	2031	ő	280	280	5,851	227	6,078	5,79
35	2032	0	280	280	5,851	227	6,078	5,79
36	2033	0	280	280	5,851	227	6,078	5,79
37	2034	0	280	280	5,851	227	6,078	5,79
38	2035	0	280	280	5,851	227	6,078	5,79
39	2036	0	280	280	5,851	227	6,078	5,79
40 41	2037	0	280 280	280 280	5,851 5,851	227 227	6,078 6,078	5,79 5,79
41	2038 2039	0	280	280	5,851	227		5,79
43	2040	ő	280	280	5,851	227		5,79
44	2041	0	280	280	5,851	227		5,79
45	2042	0	280	280	5,851	227		5,79
46	2043	0	280	280	5,851	227	6,078	5,79
47	2044	0	280	280	5,851	227		5,79
48	2045	0	280	280	5,851	227		5,79
49	2046	0		280	5,851	227		5,79
50	2047 2048	0		280 280	5,851 5,851	227 227		5,79 5,79
51 52	2048	0		280	5,851	227		5,79
53	2050	o		280	5,851	227		5,75
54	2051	0		280	5,851	227		5,79
55	2052	0	280	280	5,851	227	6,078	5,79
56	2053	0	280	280	5,851	227	6,078	5,79
57	2054	0		280	5,851	227		5,79
58	2055	0		280	5,851	227		5,79
59	2056	0		280	5,851	227		5,79
60	2057	0		280	5,851	227		5,7° 5,7°
61 62	2058 2059	0		280 280	5,851 5,851	227 227		
63	2060	0		280	5,851	227		
64	2061	. 0		280	5,851	227		
65	2062	Ö		280	5,851	227		5,7
66	2063	C			5,851	227		
67	2064	C			5,851	227		5,7
68	2065	0			5,851	227		
	2066	(5,851	22		
69								5.71
70	2067	(5,851	22		
	2067 2068	39,103	280	280	5,851 326,370	22 13,90	7 6,078	5,7

| Py | NPV | 15 | 0.77 | 7,306 | 5,658 | -1,648 | 12 | 1.01 | 9,944 | 10,036 | 92 | 10 | 1.24 | 12,395 | 15,345 | 2,950 | 5 | 2.40 | 23,120 | 55,511 | 32,390 | 3 | 3.40 | 31,116 | 105,851 | 74,735