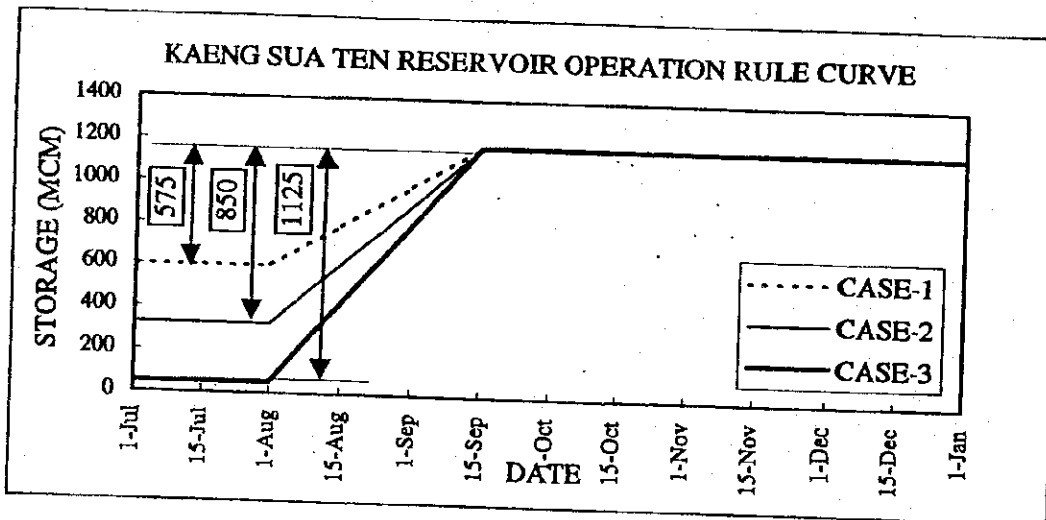
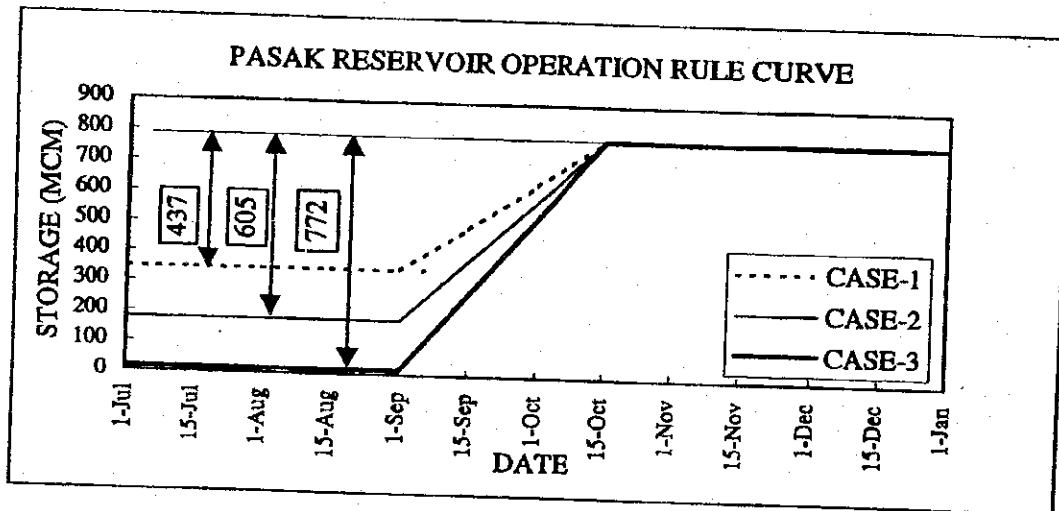
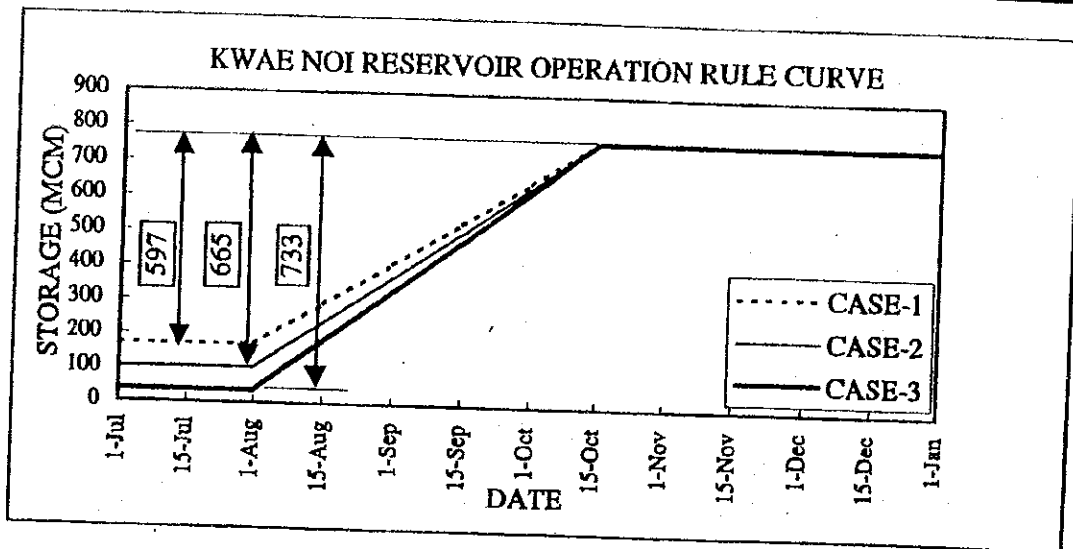


**STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN**

Fig. 3.2.1

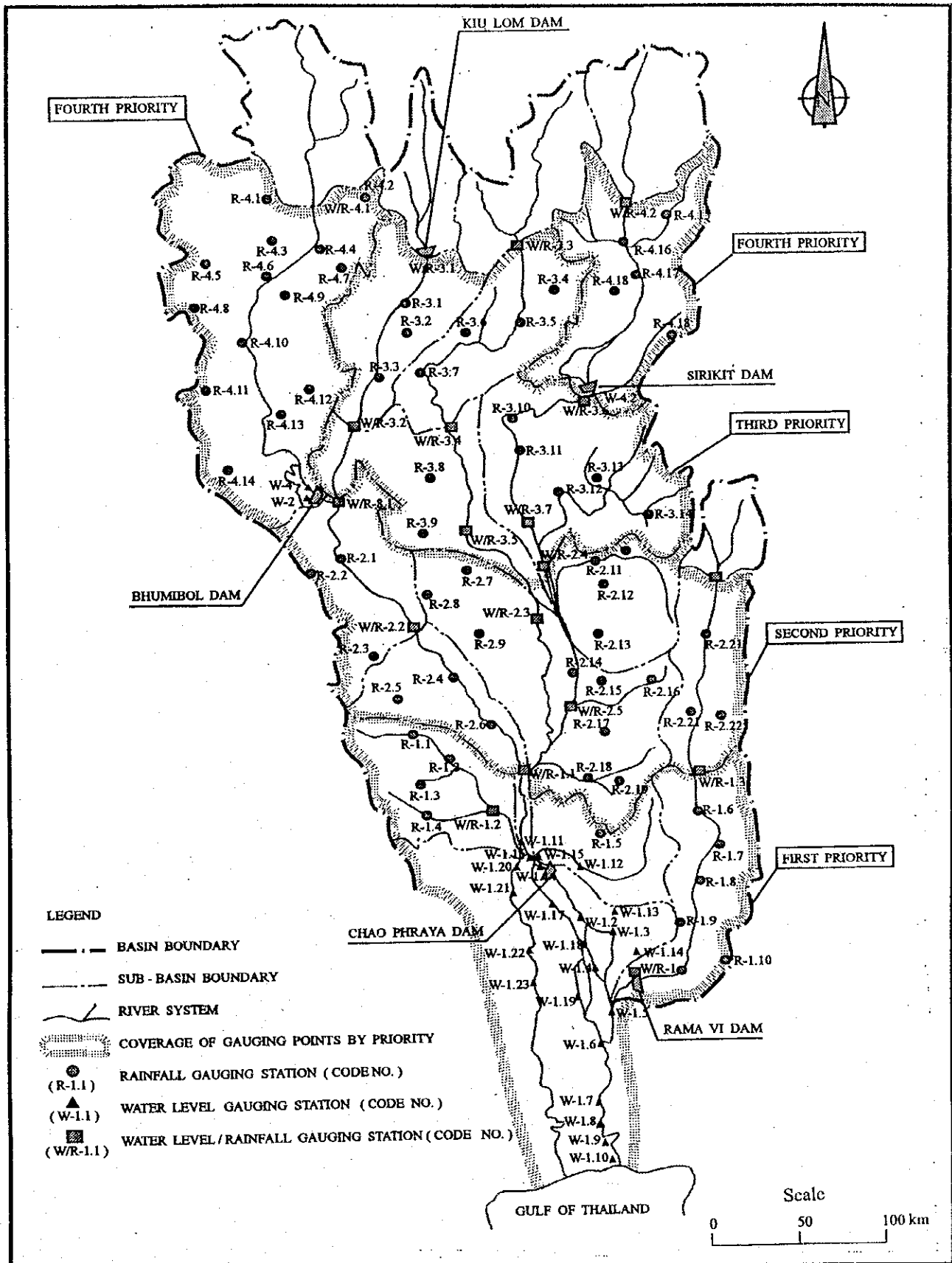
**PROPOSED UPPER RULE CURVE (SIRIKIT AND BHUMIBOL RESERVOIR)**

CTI ENGINEERING CO, LTD. AND INA CORPORATION



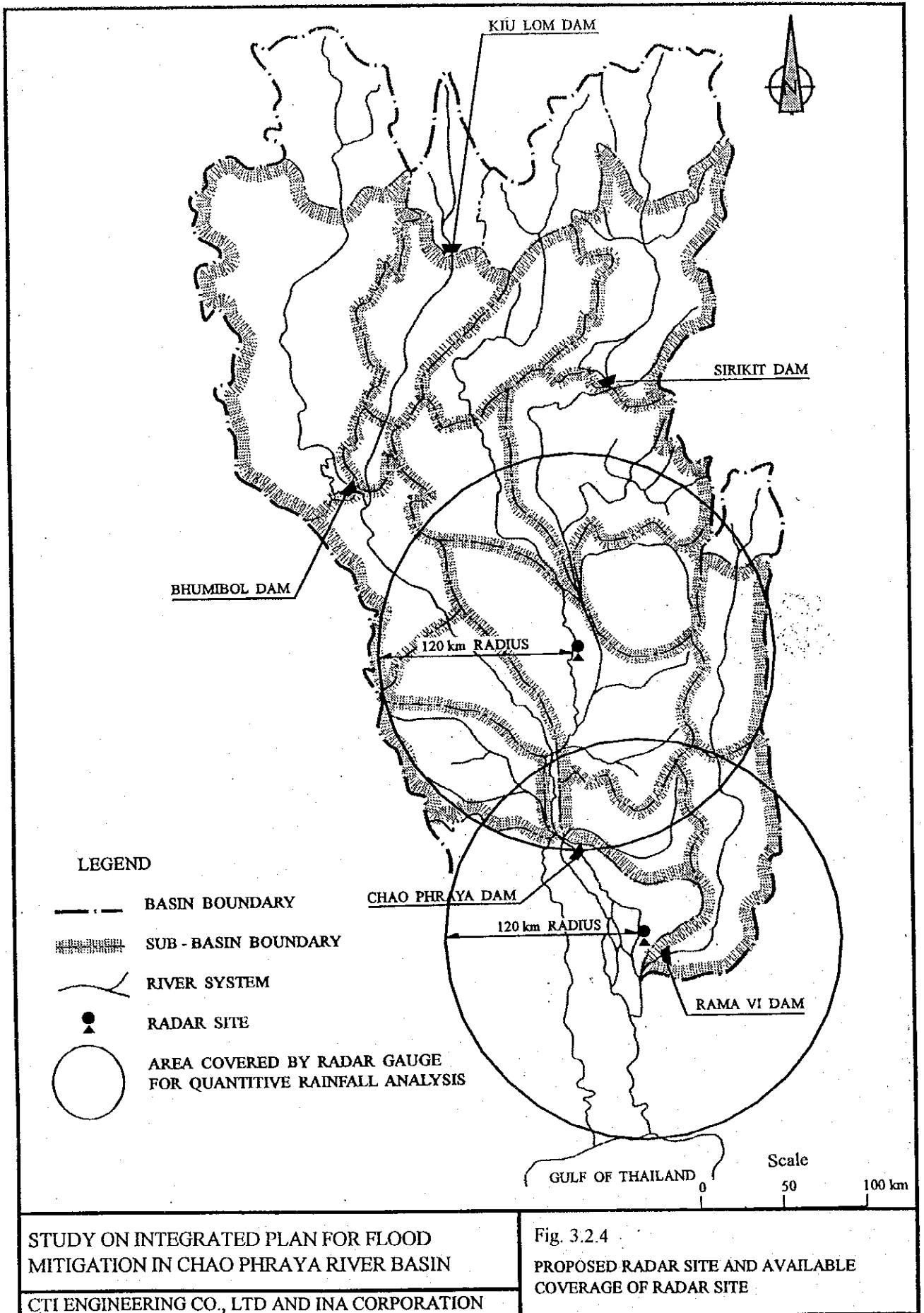
STUDY ON ON INTEGRATED PLAN FOR FLOOD  
 MITIGATION IN CHAOPHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD & INA CORPORATION

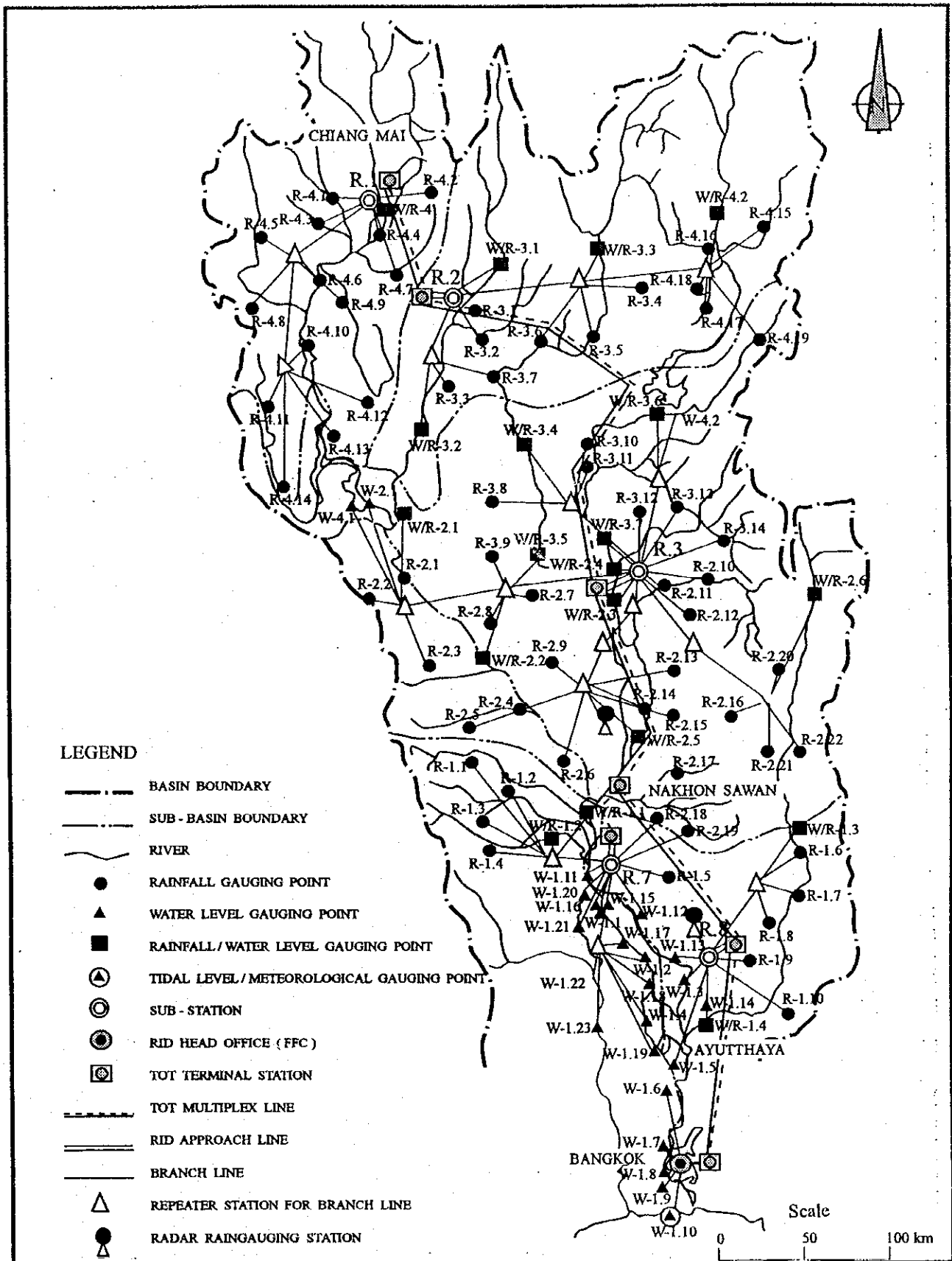
Fig. 3.2.2  
 OPERATION RULE CURVES OF THREE DAMS



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 3.2.3  
 PROPOSED AND EXISTING GAUGING





**STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN**

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 3.2.5

PROPOSED TELECOMMUNICATION NETWORK

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

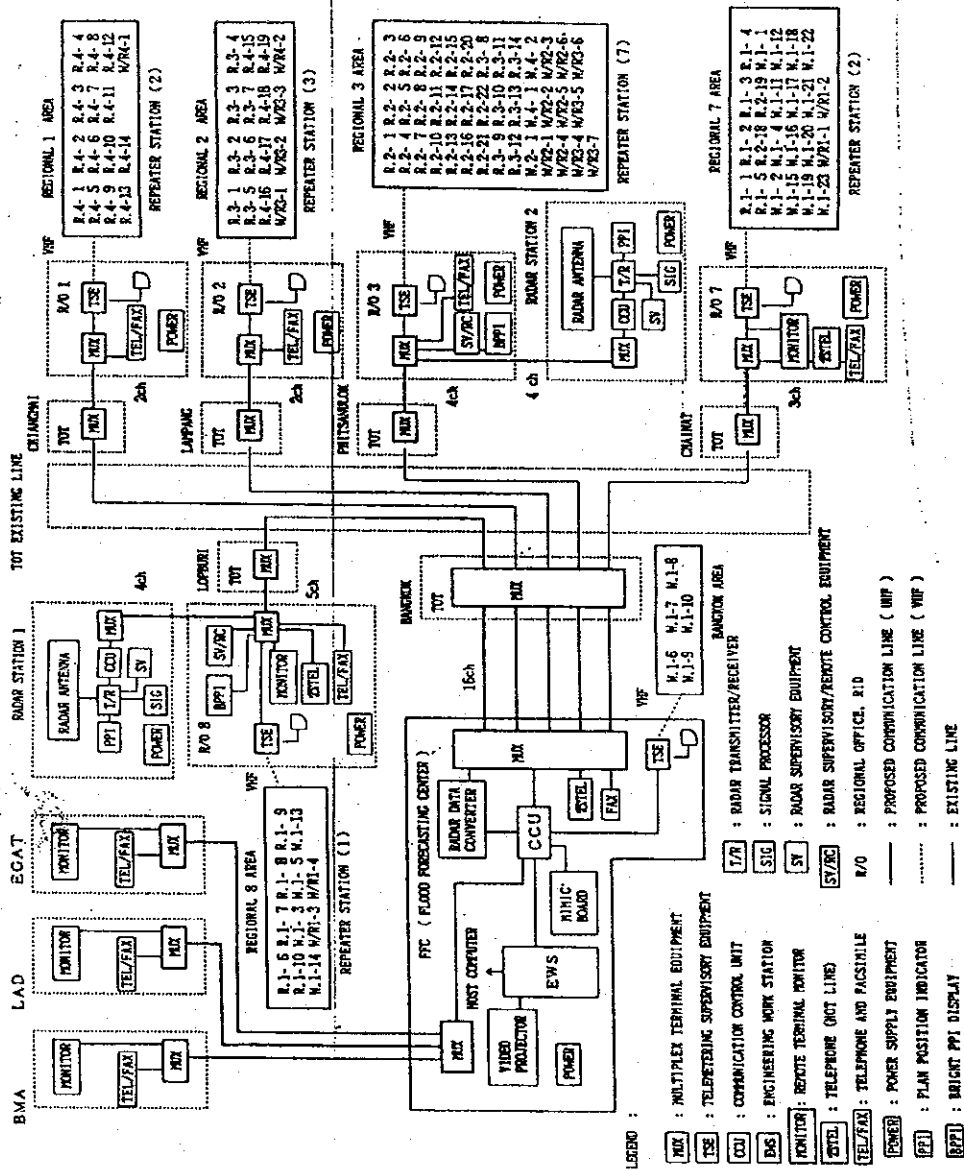
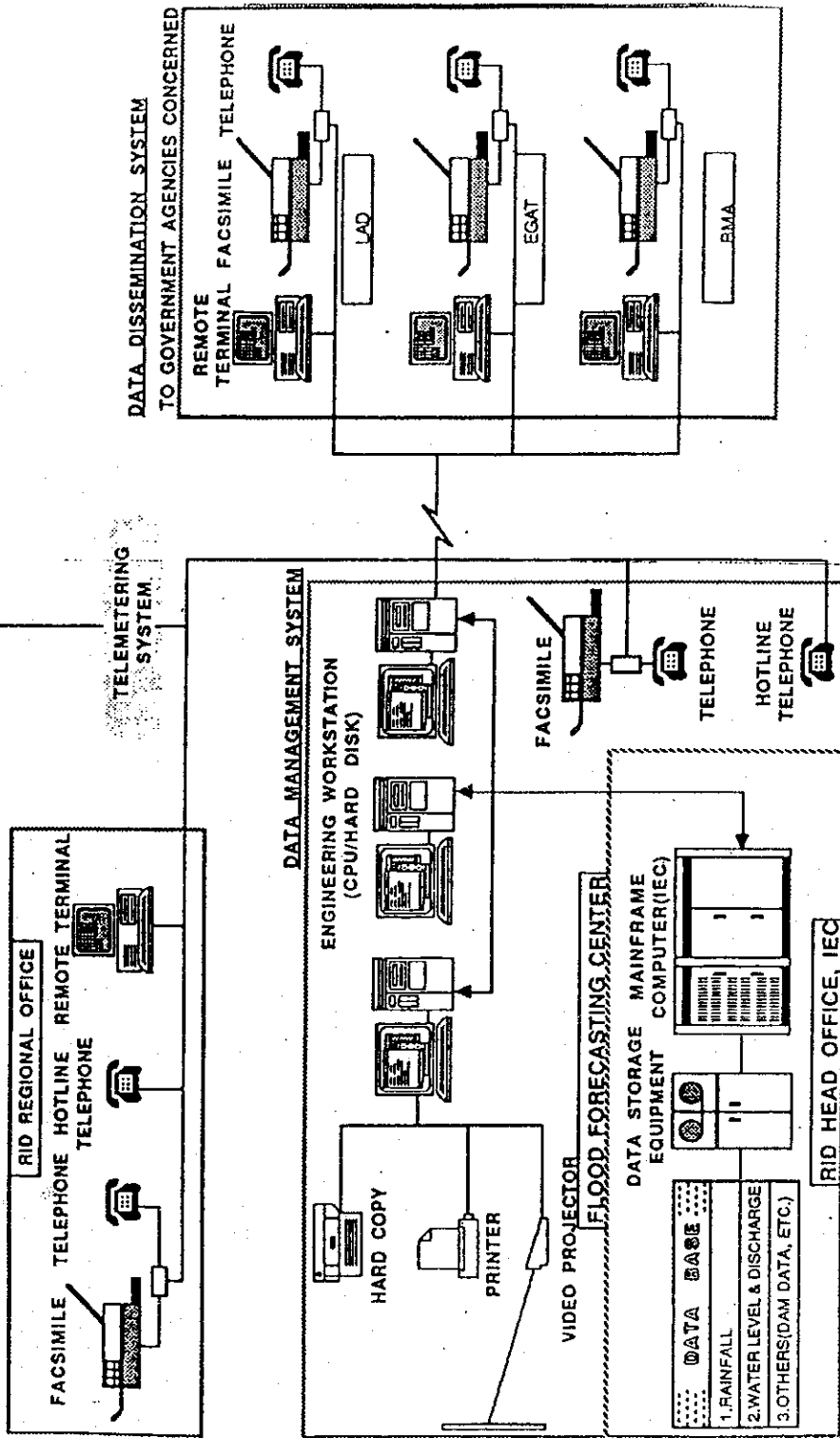


Fig. 3.2.6  
DATA MANAGEMENT SYSTEM

HYDROLOGICAL OBSERVATION NETWORK

DATA COLLECTION SYSTEM

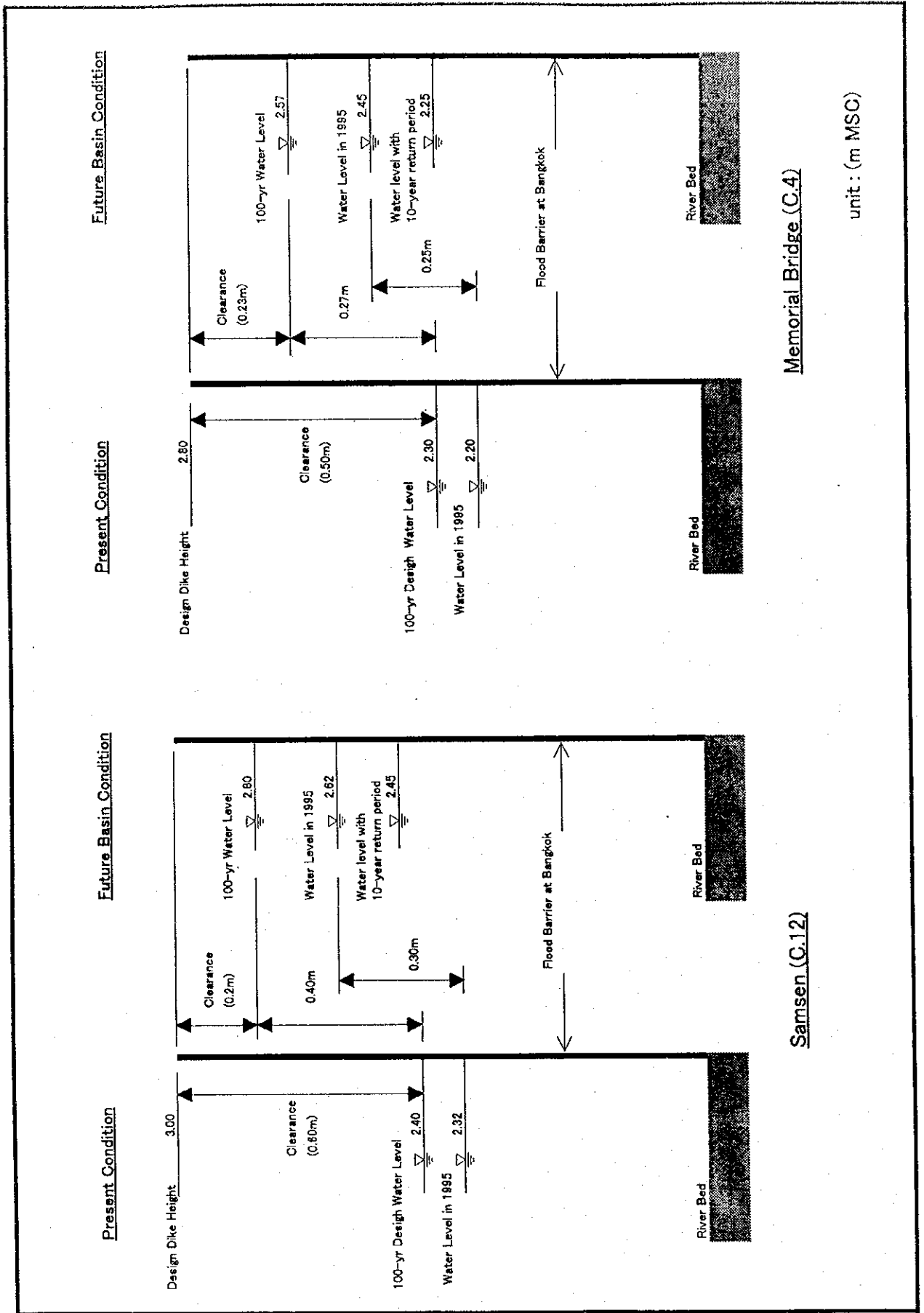


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 3.2.7

PROPOSED BLOCK DIAGRAM OF DATA MANAGEMENT

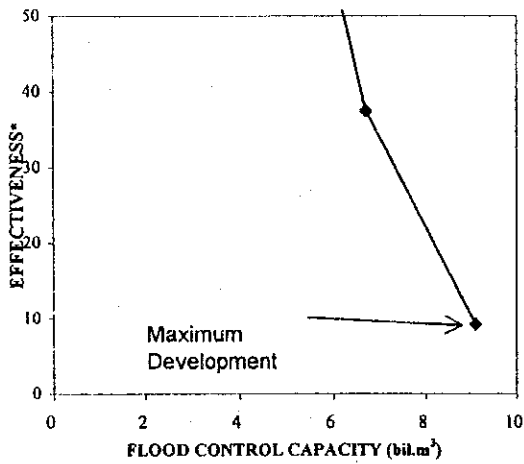


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD. AND INA CORPORATION

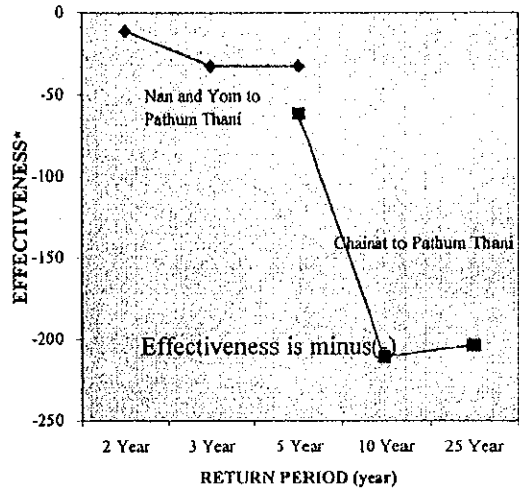
Fig.3.3.1  
 INFLUENCE TO WATER LEVEL IN BANGKOK BY FUTURE DEVELOPMENT



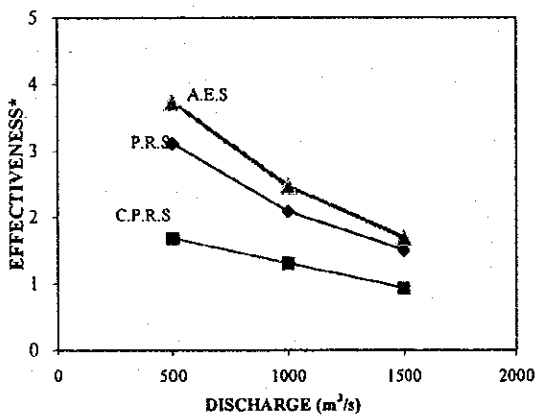
**MODIFICATION OF DAM OPERATION CURVE**



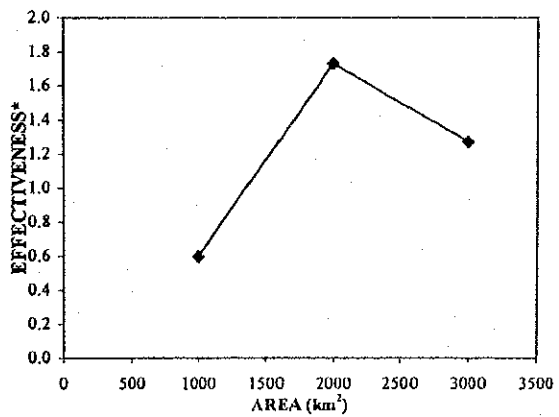
**RIVER TRAINING**



**DIVERSION**



**ARTIFICIAL RETARDING BASIN**



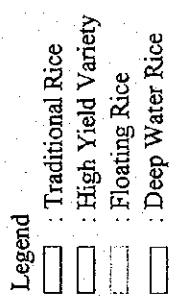
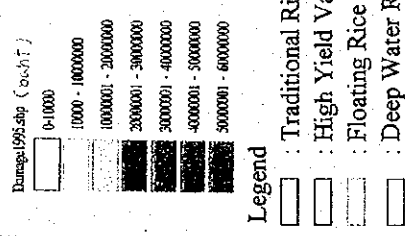
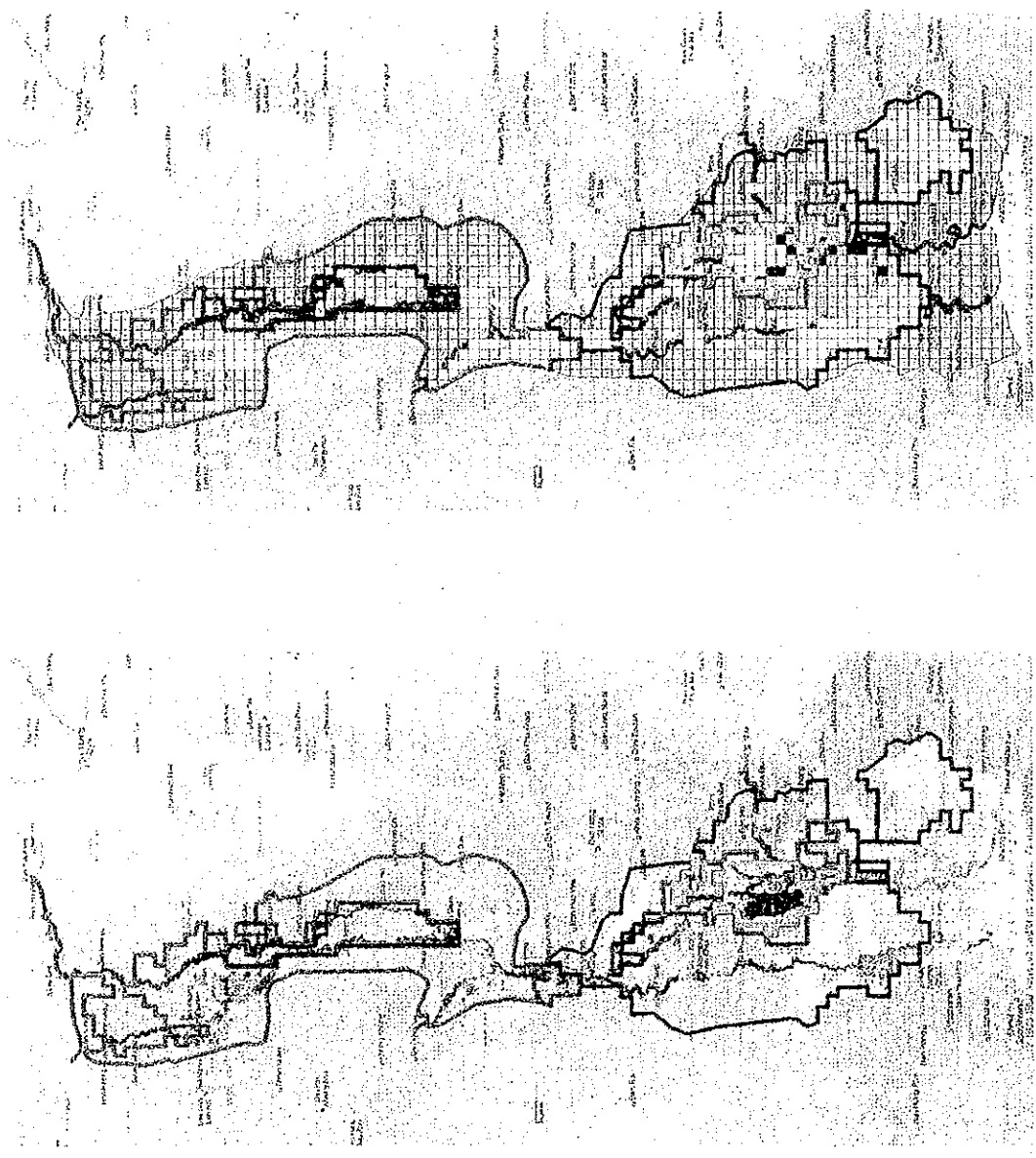
\*:Effectiveness is expressed in a manner of decrease of flood damage in 1995 by cost.

STUDY ON ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN

CTI ENGINEERING CO. , LTD & INA CORPORATION

Fig. 3.3.2 EFFECTIVENESS OF EACH MEASURE BY SCALE

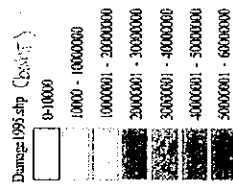
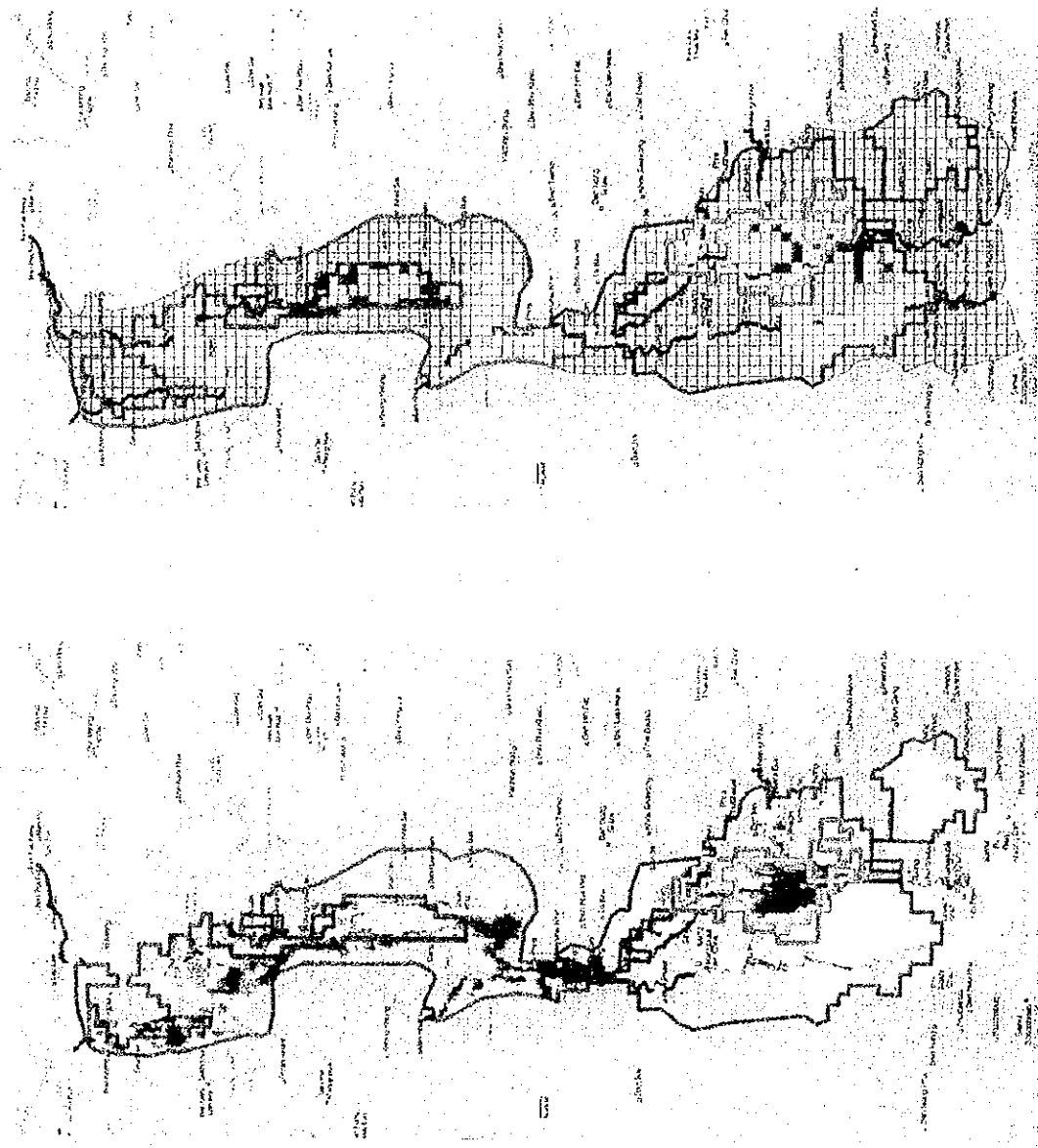
1983



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.3.3.3 (1/3)  
 INUNDATION DEPTH AND FLOOD DAMAGE

1995

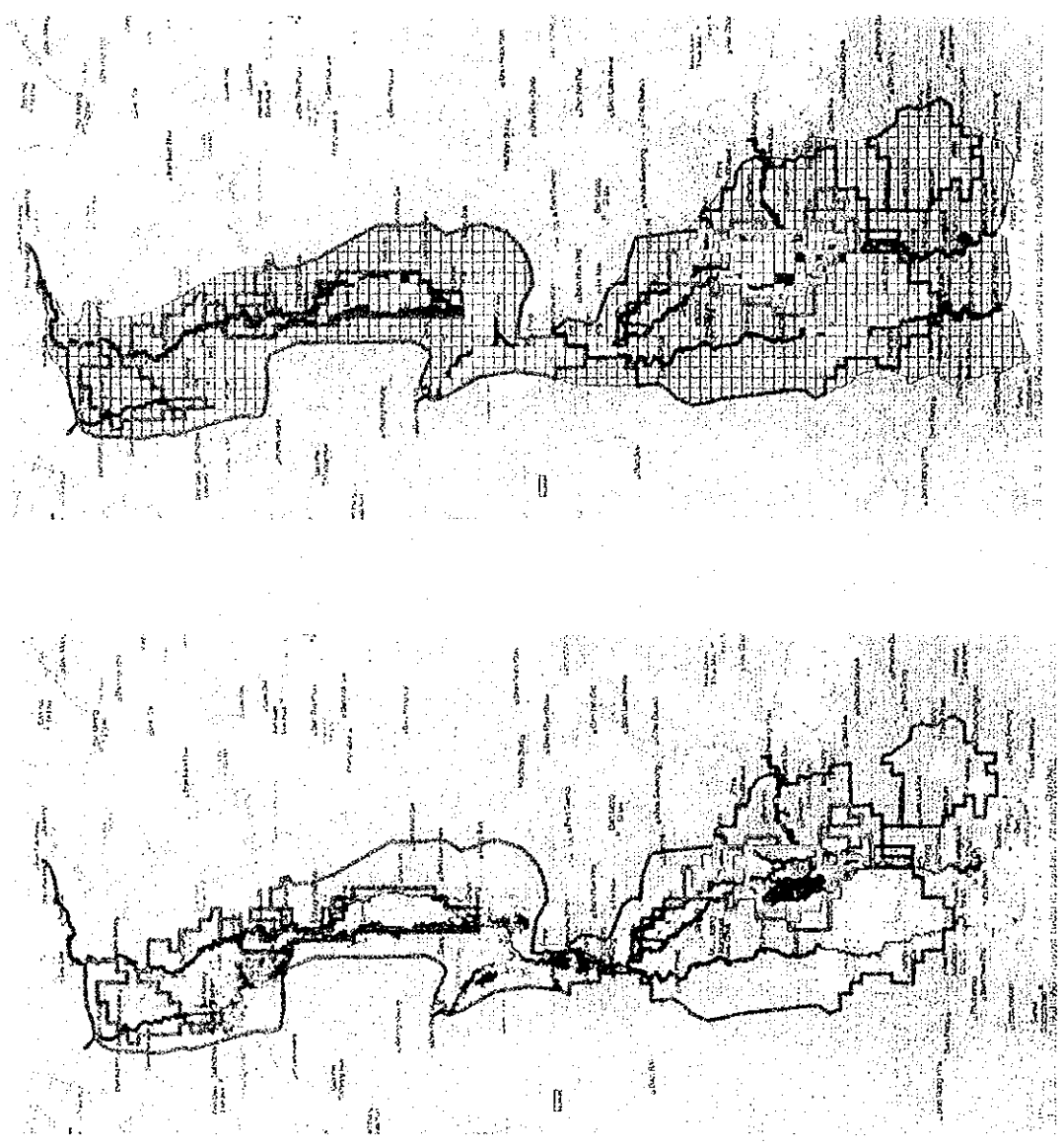


- Legend
- Traditional Rice
  - High Yield Variety
  - Floating Rice
  - Deep Water Rice

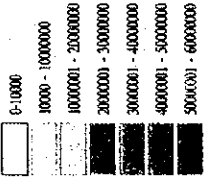
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.3.3.3 (2/3)  
 INUNDATION DEPTH AND FLOOD DAMAGE

1996



Damage:1995.shp (Dunit)



Legend

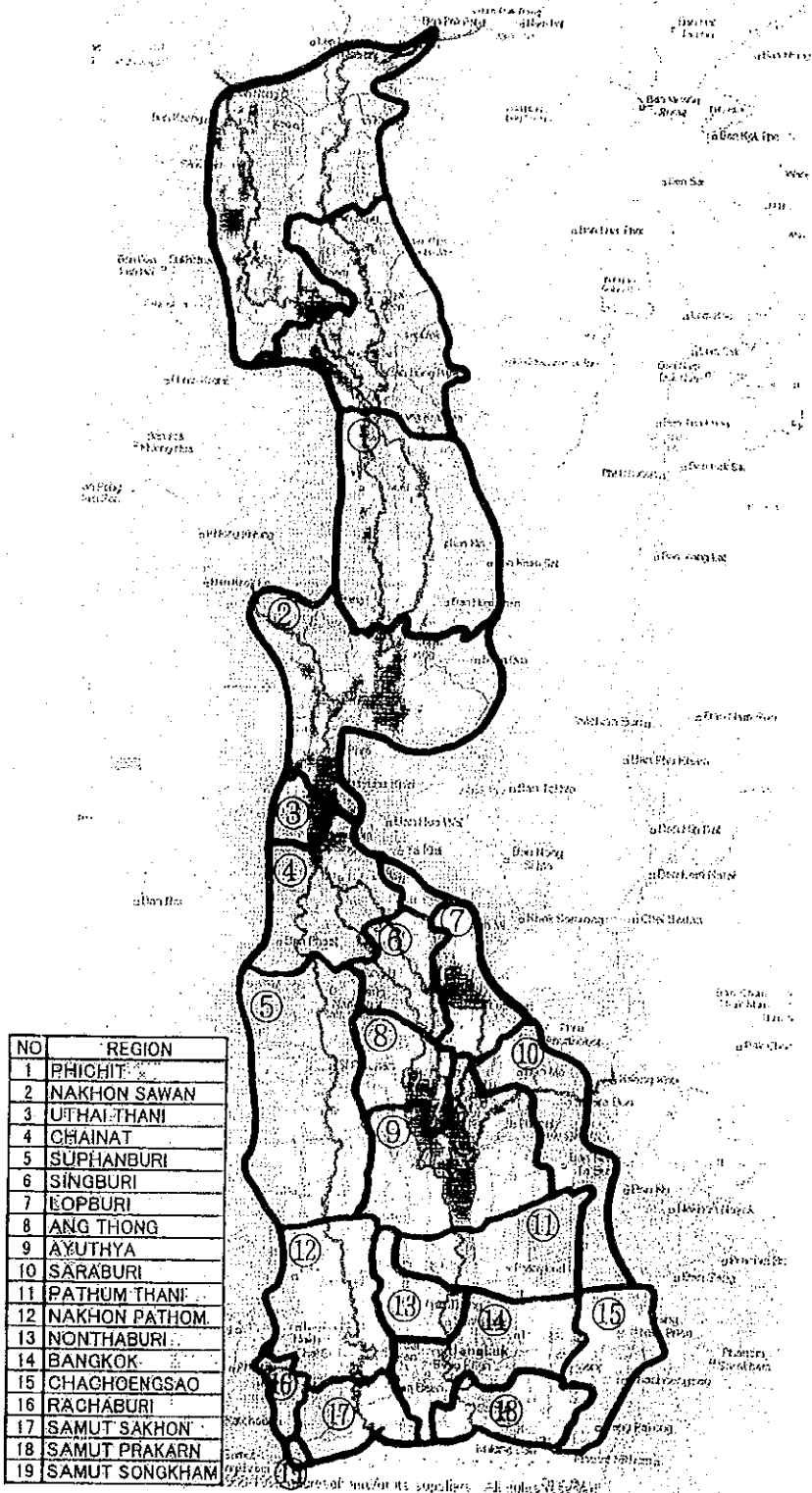
- : Traditional Rice
- : High Yield Variety
- : Floating Rice
- : Deep Water Rice

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.3.3.3 (3/3)

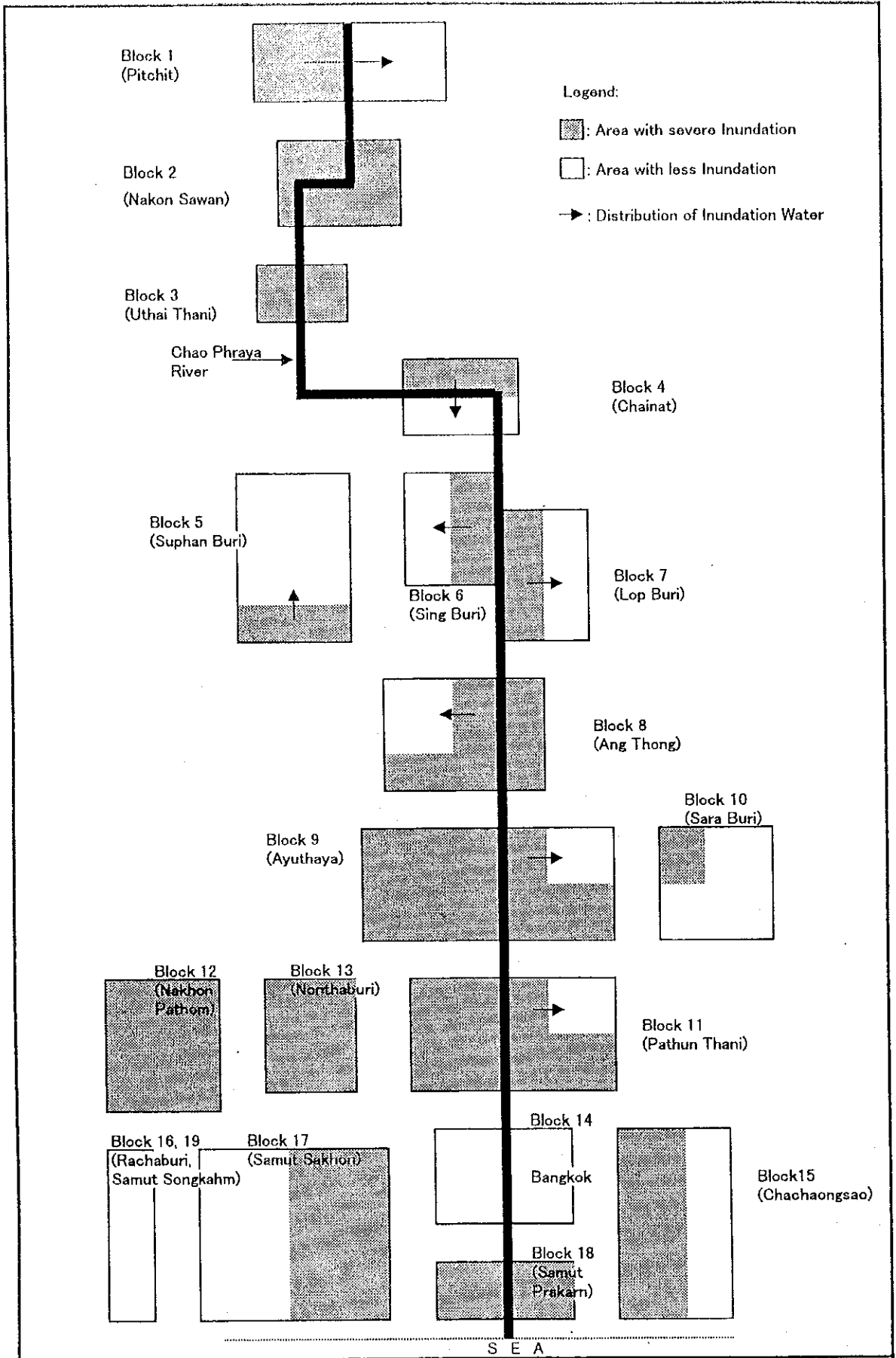
INUNDATION DEPTH AND FLOOD DAMAGE



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.3.3.4  
DISTRIBUTION OF FLOOD PLAIN

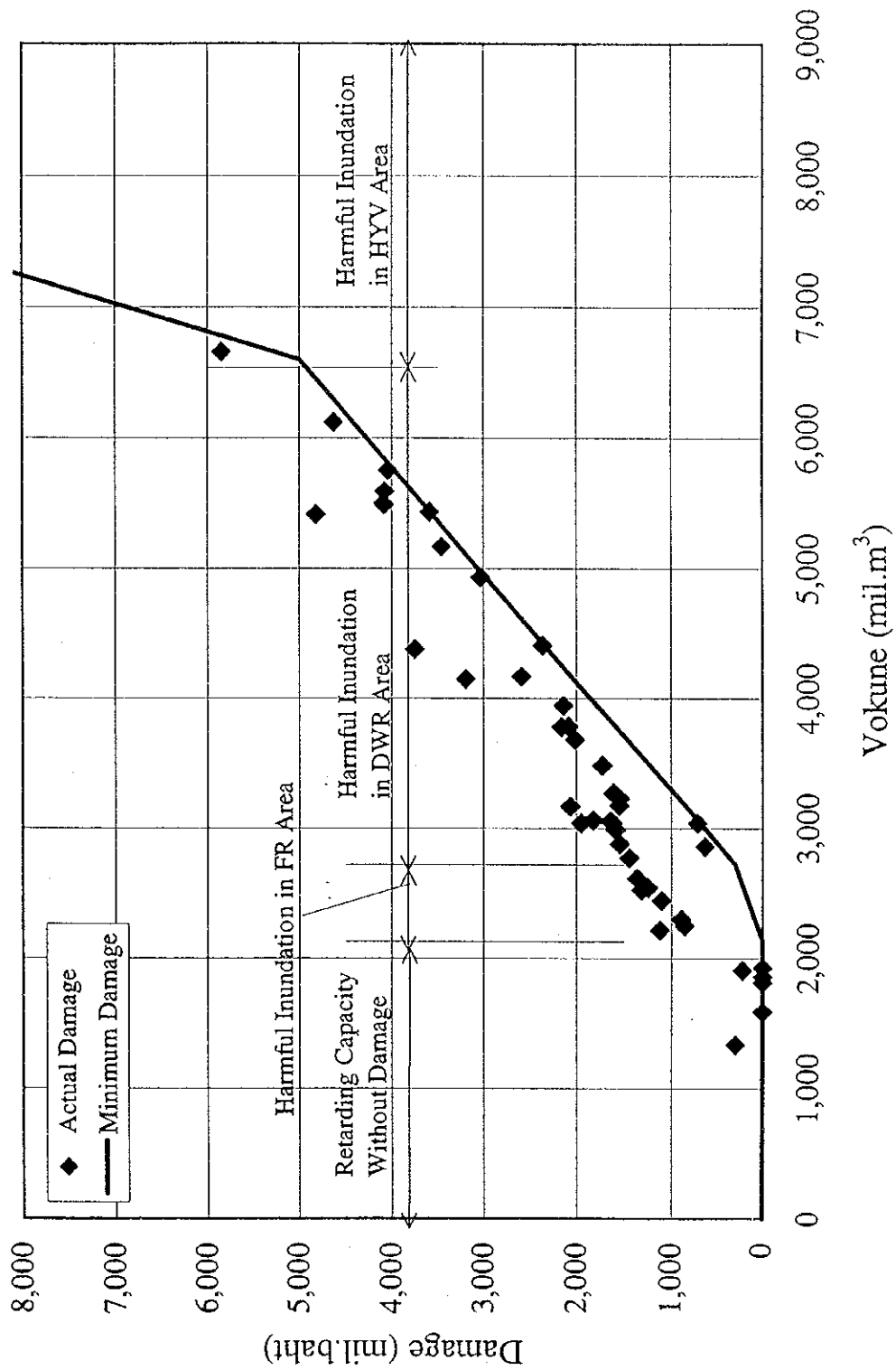


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

**Fig.3.3.5**  
DISTRIBUTION OF INUNDATION

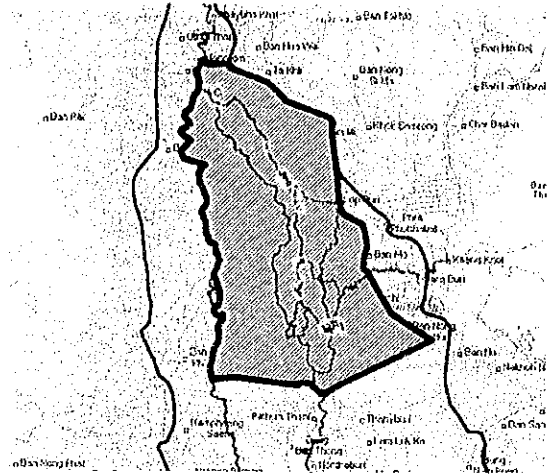
# Relation Between Inundation Volume and Flood Damage



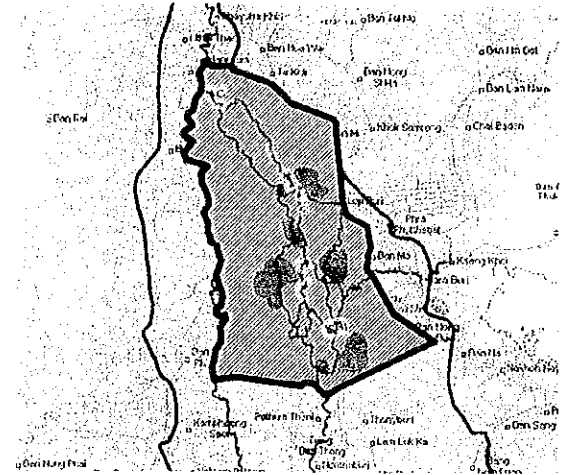
STUDY ON INTEGRATED PLAN FOR FLOOD  
 MITIGATION IN CHAOPHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD. AND INA CORPORATION

Fig. 3.3.6  
 RELATION BETWEEN INUNDATION  
 VOLUME AND FLOOD DAMAGE

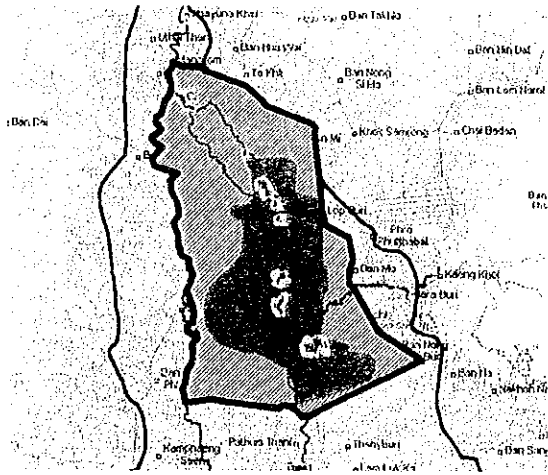
Priority 1



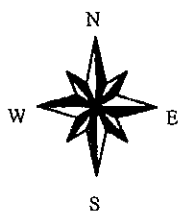
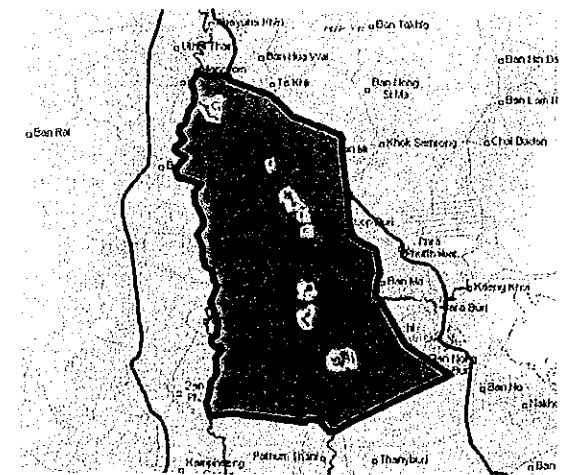
Priority 2



Priority 3



Priority 4



- REGEND**
- DISTRIBUTION AREA
  - FLOOD AREA
  - Urban Dike
  - Major Rivers
  - DISTRIBUTION WITH DAMAGE
  - DISTRIBUTION WITHOUT DAMAGE



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN

CTI ENGINEERING CO LTD., & INA CORPORATION

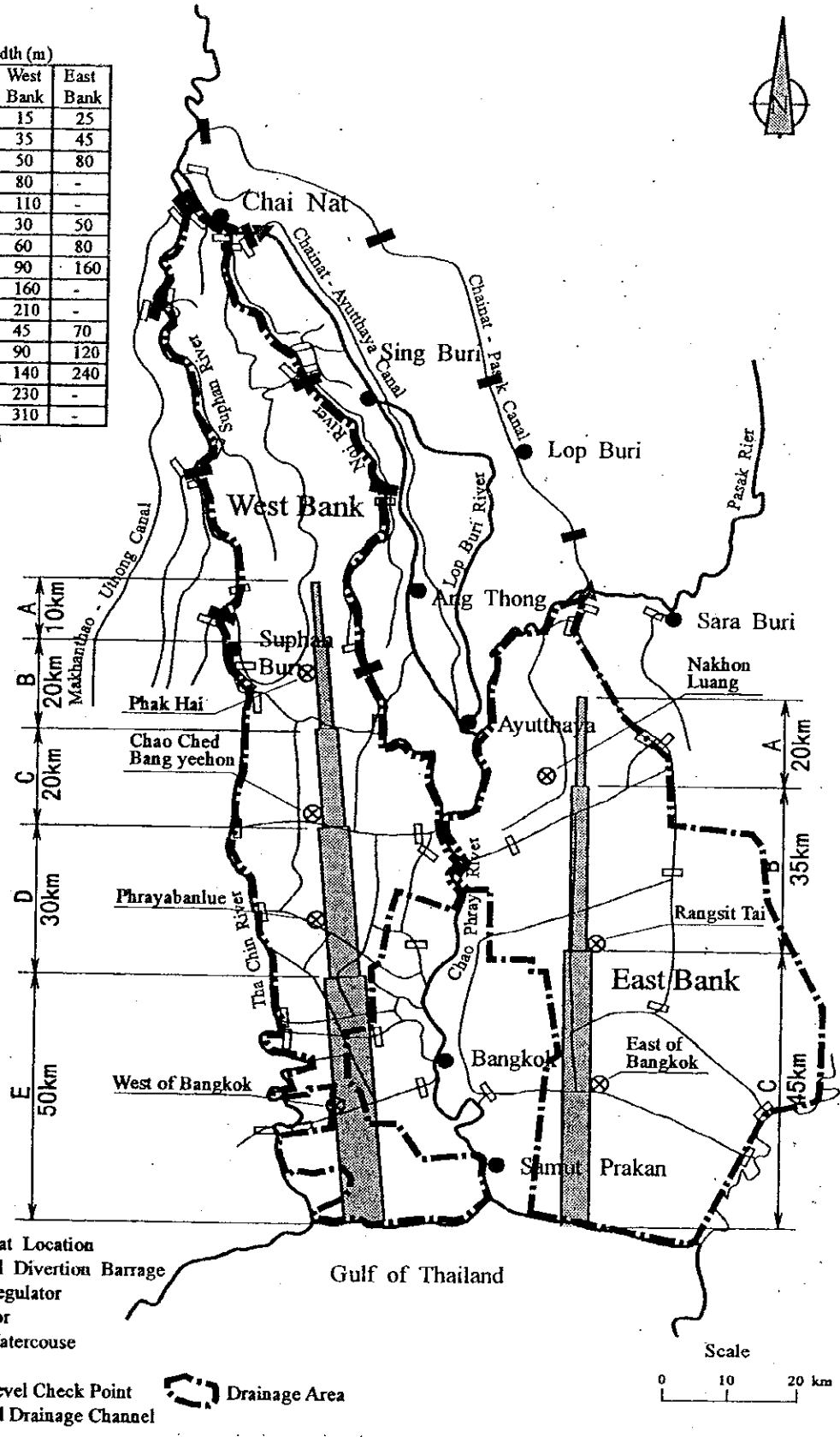
Fig. 3.3.7  
PRIORITY AREA FOR FLOOD WATER DISTRIBUTION



# CASE A

Case	Stretch	Channel width (m)	
		West Bank	East Bank
Case-A1 (Q=100 m <sup>3</sup> /s)	A	15	25
	B	35	45
	C	50	80
	D	80	-
	E	110	-
Case-A2 (Q=200 m <sup>3</sup> /s)	A	30	50
	B	60	80
	C	90	160
	D	160	-
	E	210	-
Case-A3 (Q=300 m <sup>3</sup> /s)	A	45	70
	B	90	120
	C	140	240
	D	230	-
	E	310	-

Channel Depth = 3m



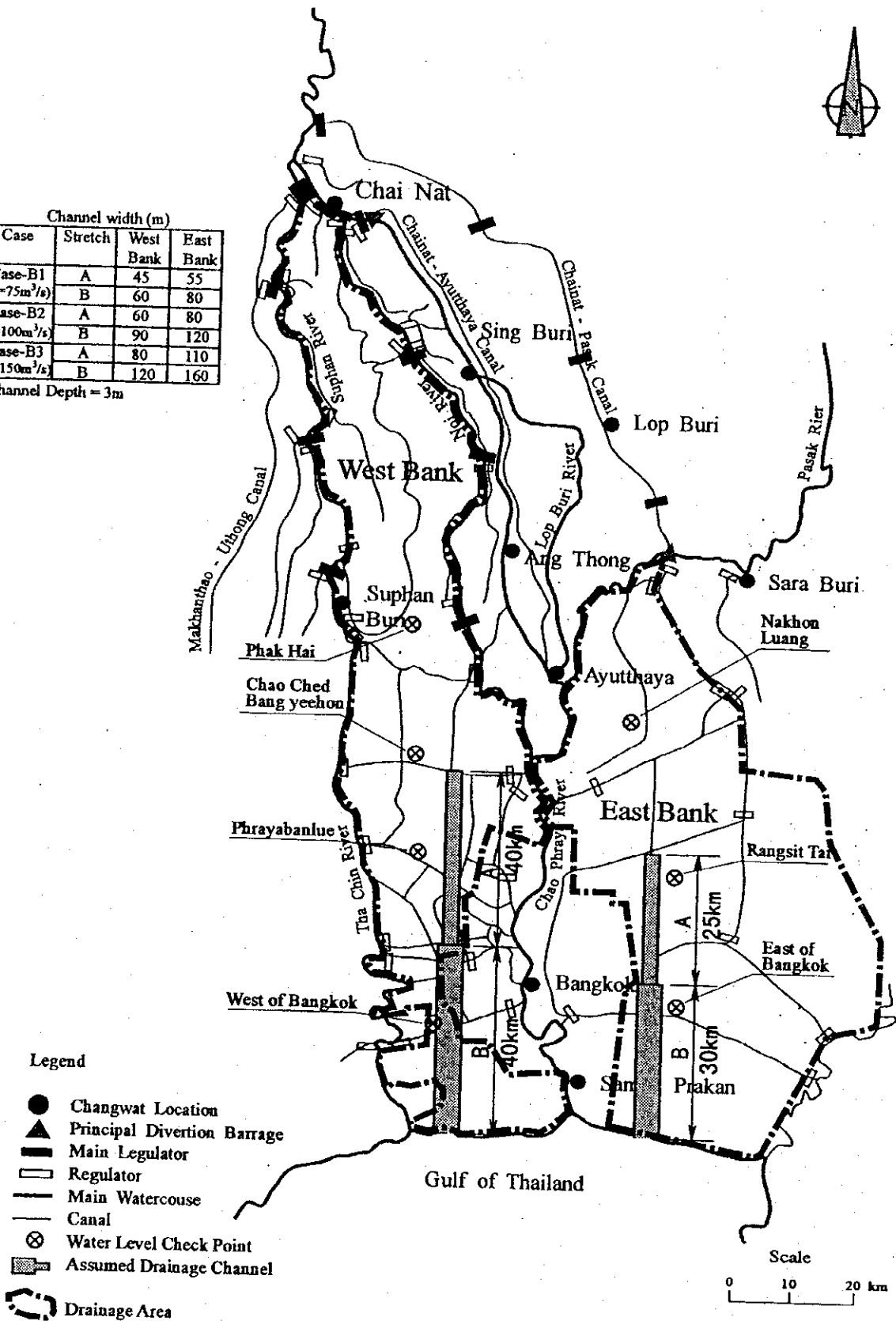
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.3.3.8 (1/2)  
 ASSUMED DRAINAGE CHANNEL

# CASE B

Case	Channel width (m)		
	Stretch	West Bank	East Bank
Case-B1 ( $Q=75m^3/s$ )	A	45	55
	B	60	80
Case-B2 ( $Q=100m^3/s$ )	A	60	80
	B	90	120
Case-B3 ( $Q=150m^3/s$ )	A	80	110
	B	120	160

Channel Depth = 3m



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

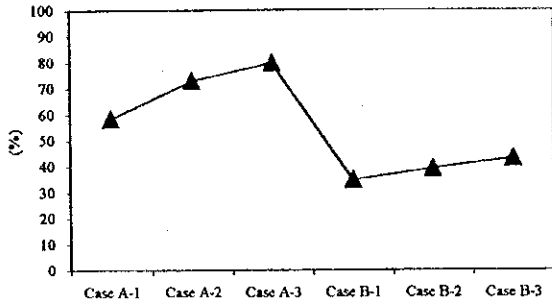
Fig.3.3.8 (2/2)

ASSUMED DRAINAGE CHANNEL

CTI ENGINEERING CO., LTD AND INA CORPORATION

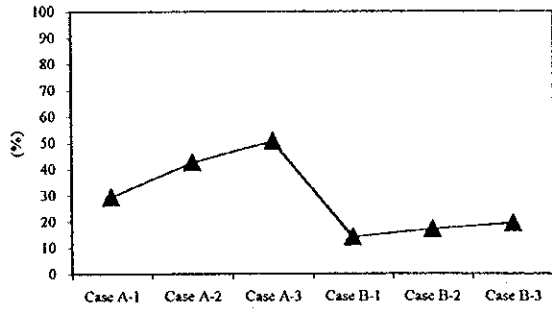
West Bank

**Decrease of Inundation Volume**

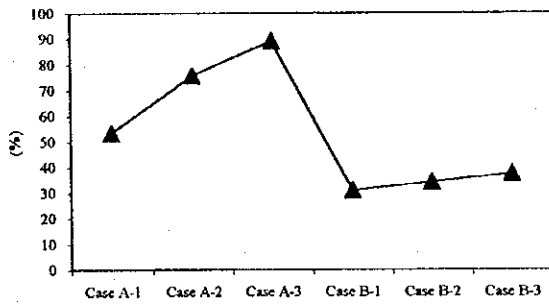


East Bank

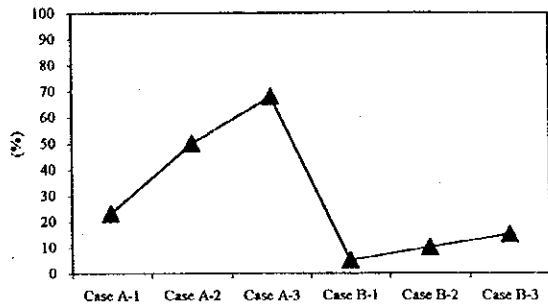
**Decrease of Inundation Volume**



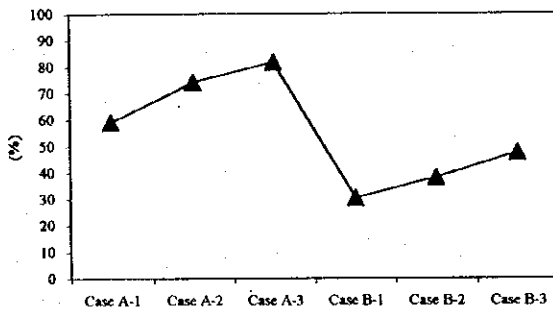
**Decrease of Inundation Duration**



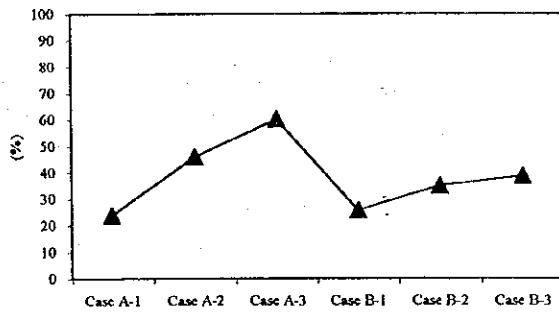
**Decrease of Inundation Duration**



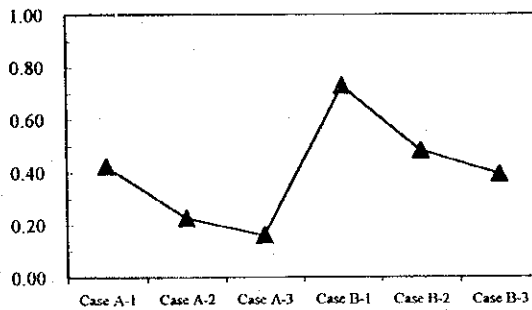
**Decrease of Flood Damage**



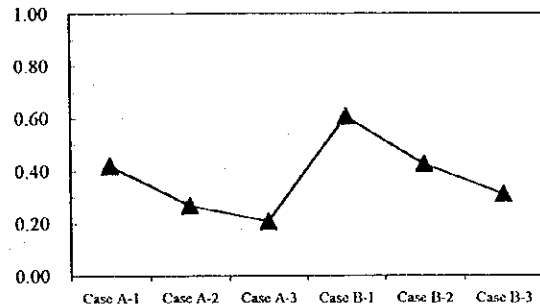
**Decrease of Flood Damage**



**Decreased Damage by Cost**

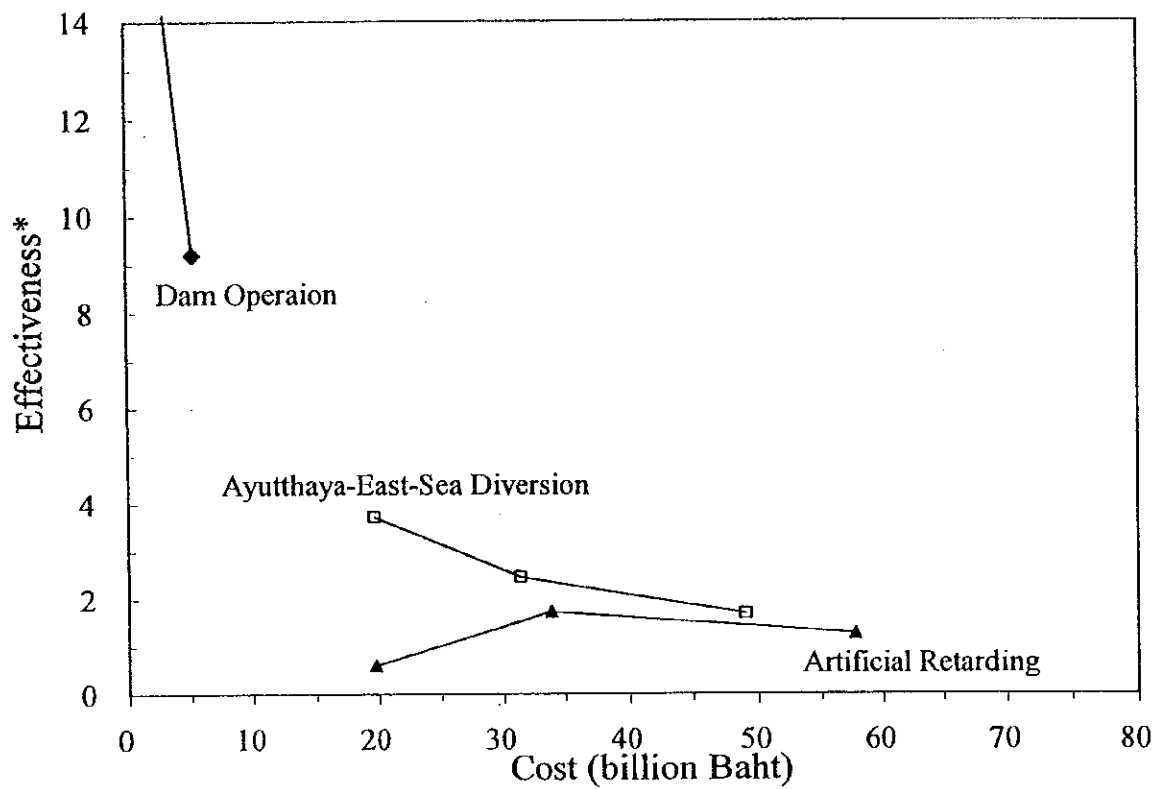


**Decreased Damage by Cost**



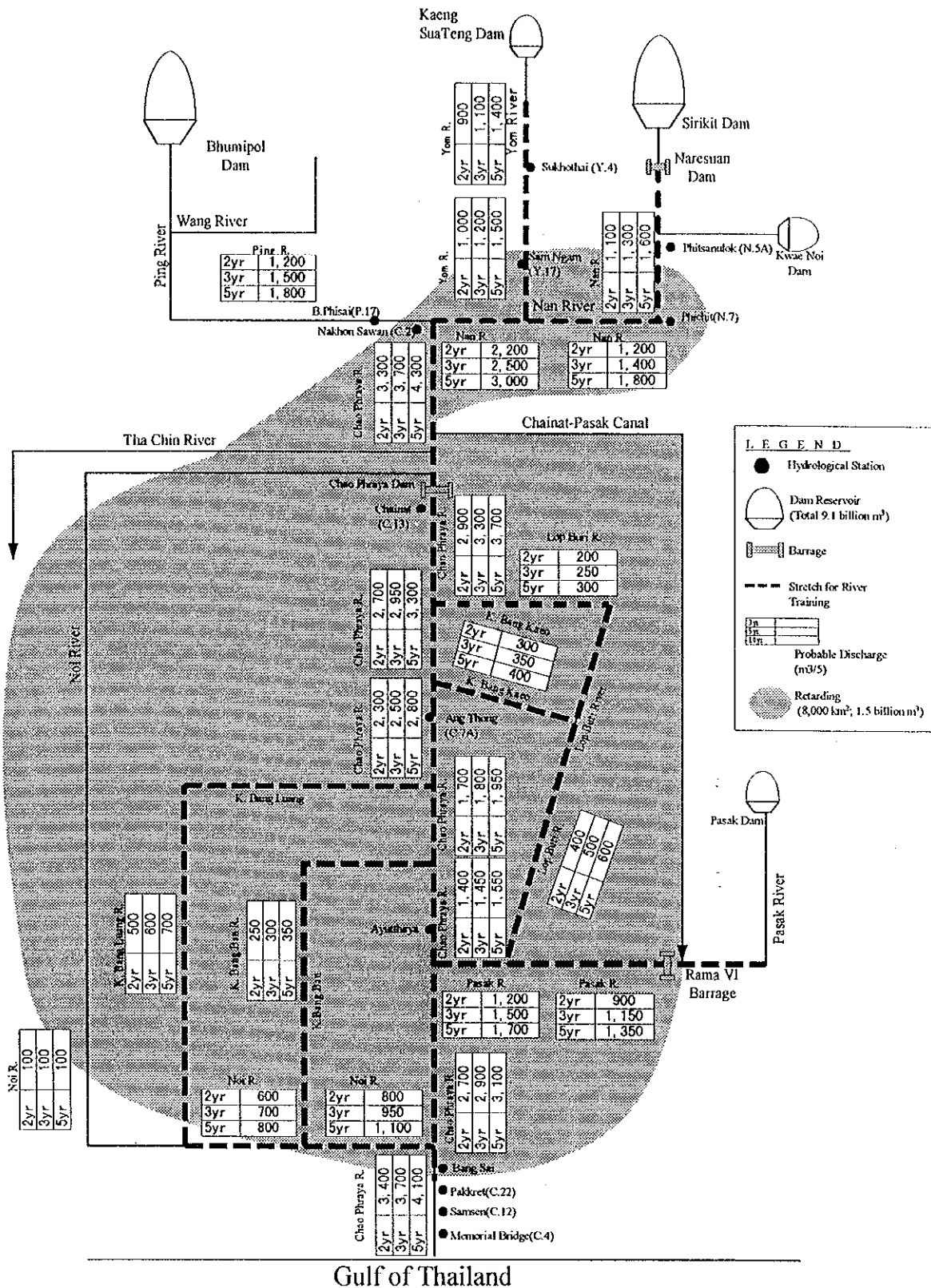
STUDY ON ON INTEGRATED PLAN FOR FLOOD  
MITIGATION IN CHAOPHRAYA RIVER BASIN  
CTI ENGINEERING CO., LTD & INA CORPORATION

Fig. 3.3.9  
EFFECTIVENESS OF DRAINAGE  
CHANNEL IMPROVEMENT



\* : Effectiveness is expressed in a manner of decrease of damage in 1995 flood by cost

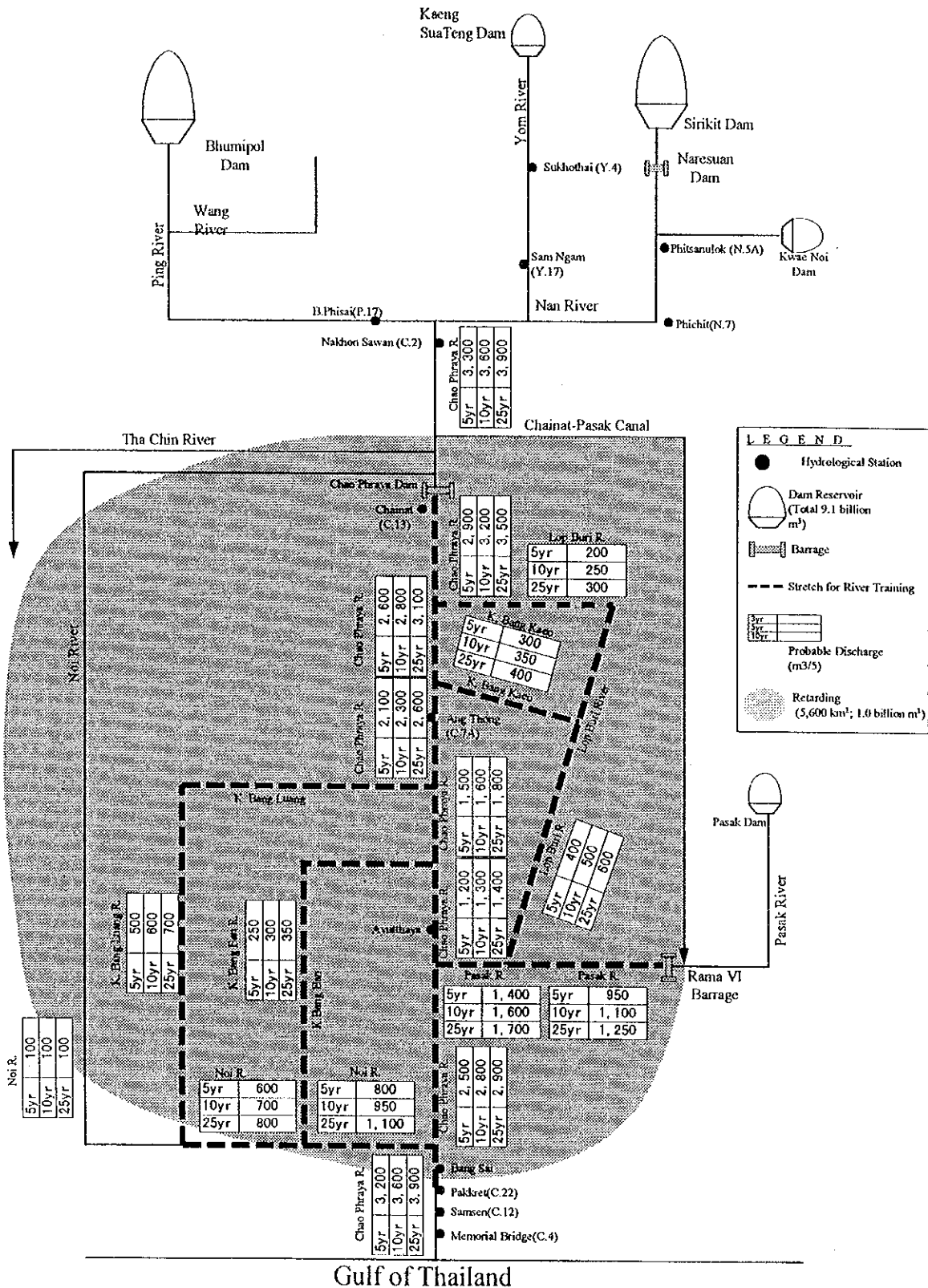
# From Nan and Yom to Pathum Thani



STUDY ON ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD & INA CORPORATION

Fig. 4.1.1 (1/2)  
 DISCHARGE DISTRIBUTION FOR RIVER IMPROVEMENT WITH RETARDING

# From Chainat to Pathum Thani

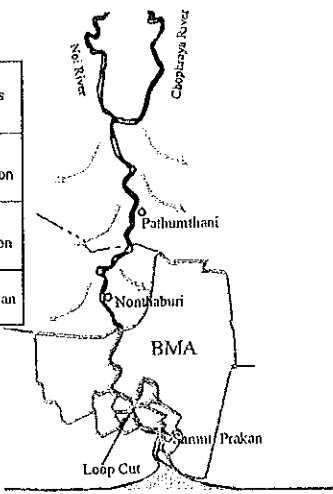


STUDY ON AN INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD & INA CORPORATION

Fig. 4.1.1 (2/2)  
 DISCHARGE DISTRIBUTION FOR RIVER IMPROVEMENT WITH RETARDING

Protection Level

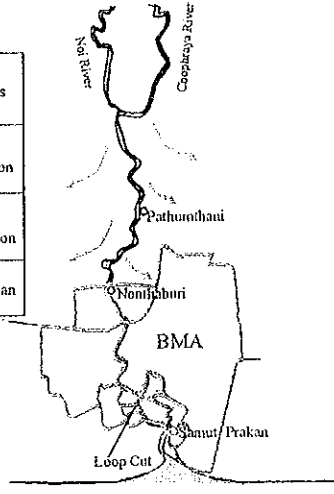
Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	2 to 3	Present Condition
Northa Buri (N.B.)	2 to 3	Present Condition
BMA	125	BMA Plan



Option 1: Suspension of P.T. & N.B. Protection Works

Protection Level

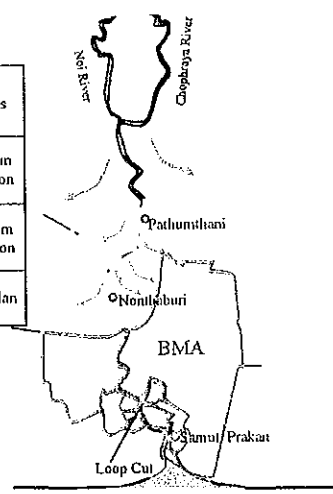
Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	2 to 3	Present Condition
Northa Buri (N.B.)	2 to 3 and 100	Partical Protection
BMA	100	BMA Plan



Option 4: Partial Protection of N.B

Protection Level

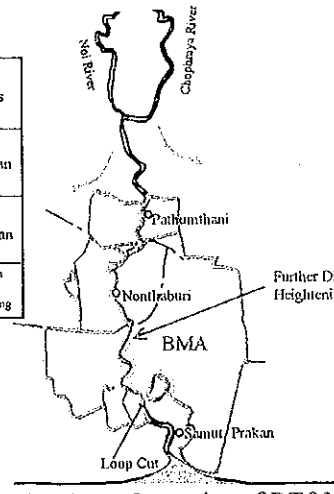
Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	5	Minimum Protection
Northa Buri (N.B.)	5	Minimum Protection
BMA	100	BMA Plan



Option 2: Minimum Protection of P.T. & N.B.

Protection Level

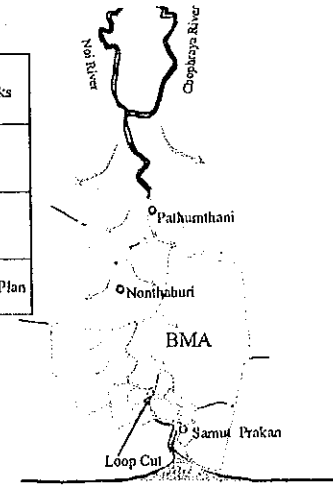
Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	100	PWD Plan
Northa Buri (N.B.)	100	PWD Plan
BMA	100	BMA Plan + Dike Heightening



Option 5: 100 year Protection of P.T. & N.B. with Further Dike Heightening in BMA

Protection Level

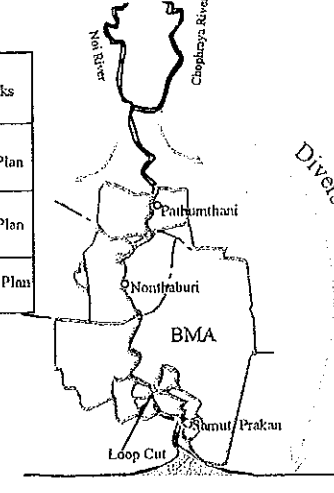
Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	7	
Northa Buri (N.B.)	7	
BMA	50	BMA Plan



Option 3: Lowering of Protection Level in BMA with Higher Protection in P.T. & N.B

Protection Level

Area	Return Period (year)	Remarks
Pathum Thani (P.T.)	100	PWD Plan
Northa Buri (N.B.)	100	PWD Plan
BMA	100	BMA Plan

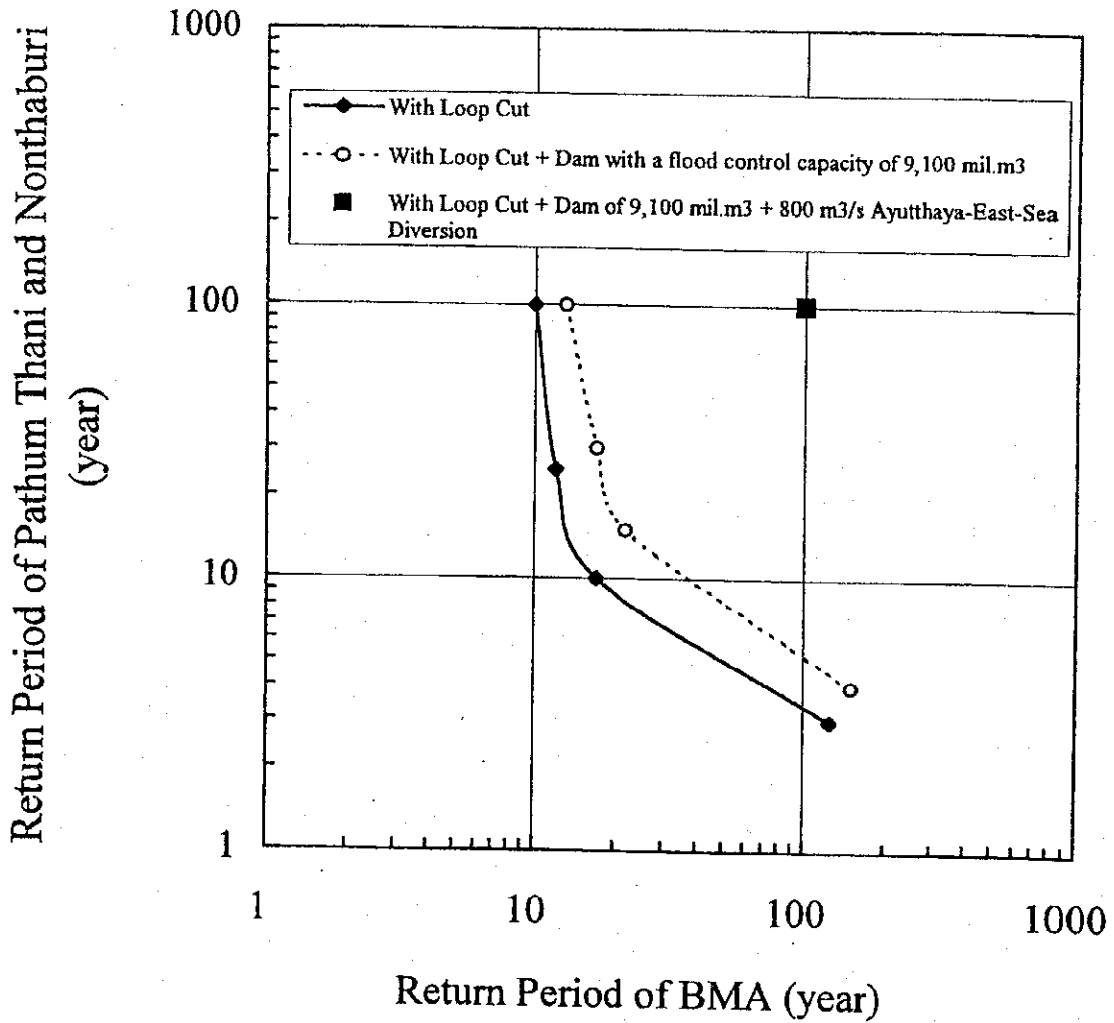


Option 6: 100 year Protection of P.T. & N.B. with Diversion Channel

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.1.2  
 COMBINATION OPTION OF PROTECTION OF BMA, NONTHABURI AND PATHUM THANI

### Relationship of Protection Level between BMA and Pathum Thani & Nonthaburi

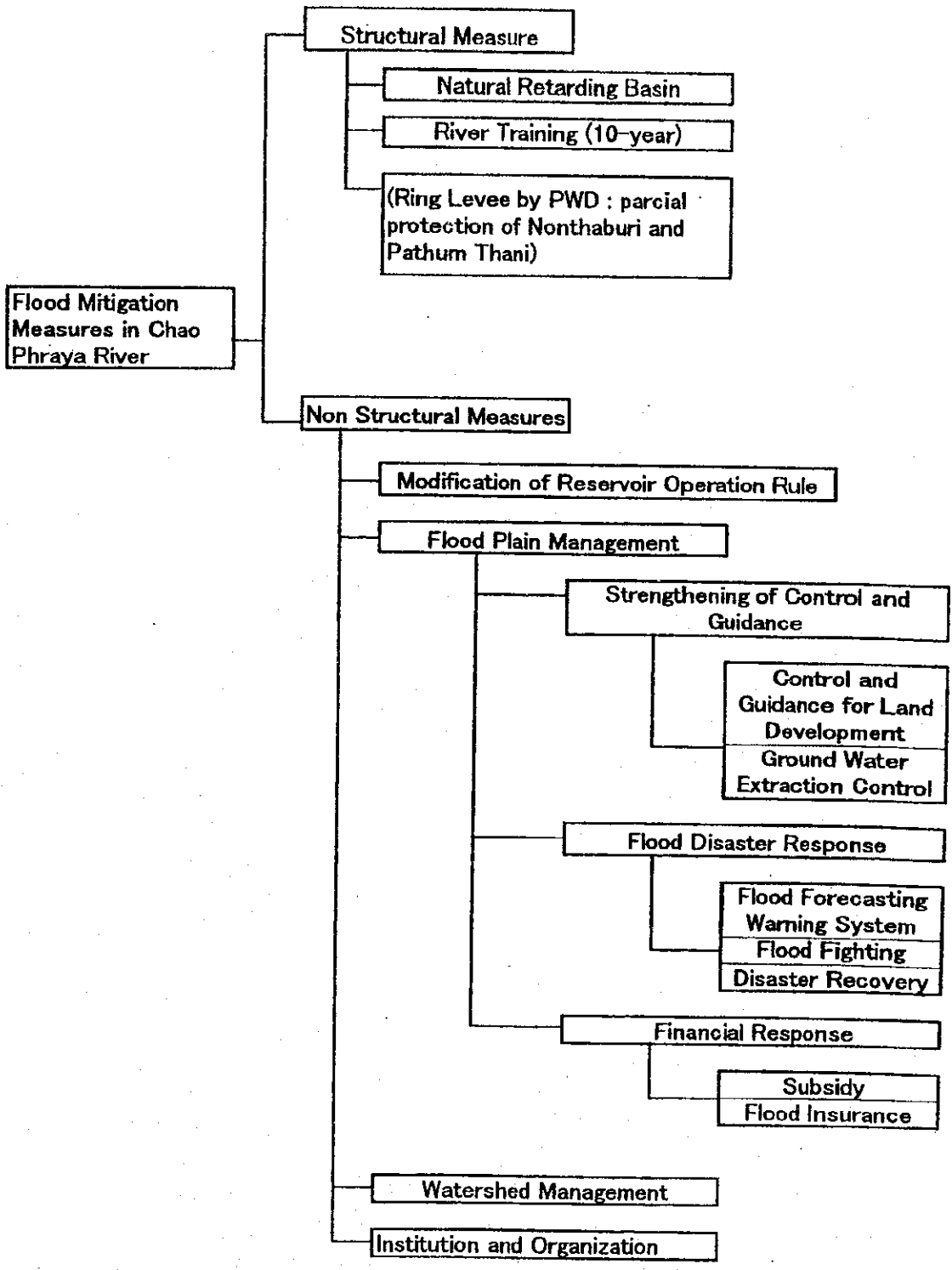


Note : BMA Area is assumed to have been protected by the flood barrier dike which is currently under construction.

STUDY ON ON INTEGRATED PLAN FOR FLOOD  
MITIGATION IN CHAOPHRAYA RIVER BASIN  
CTI ENGINEERING CO., LTD & INA CORPORATION

Fig.4.1.3 RELATIONSHIP OF PROTECTION  
LEVEL BETWEEN BMA AND  
PATHUM THANI & NONTHABURI



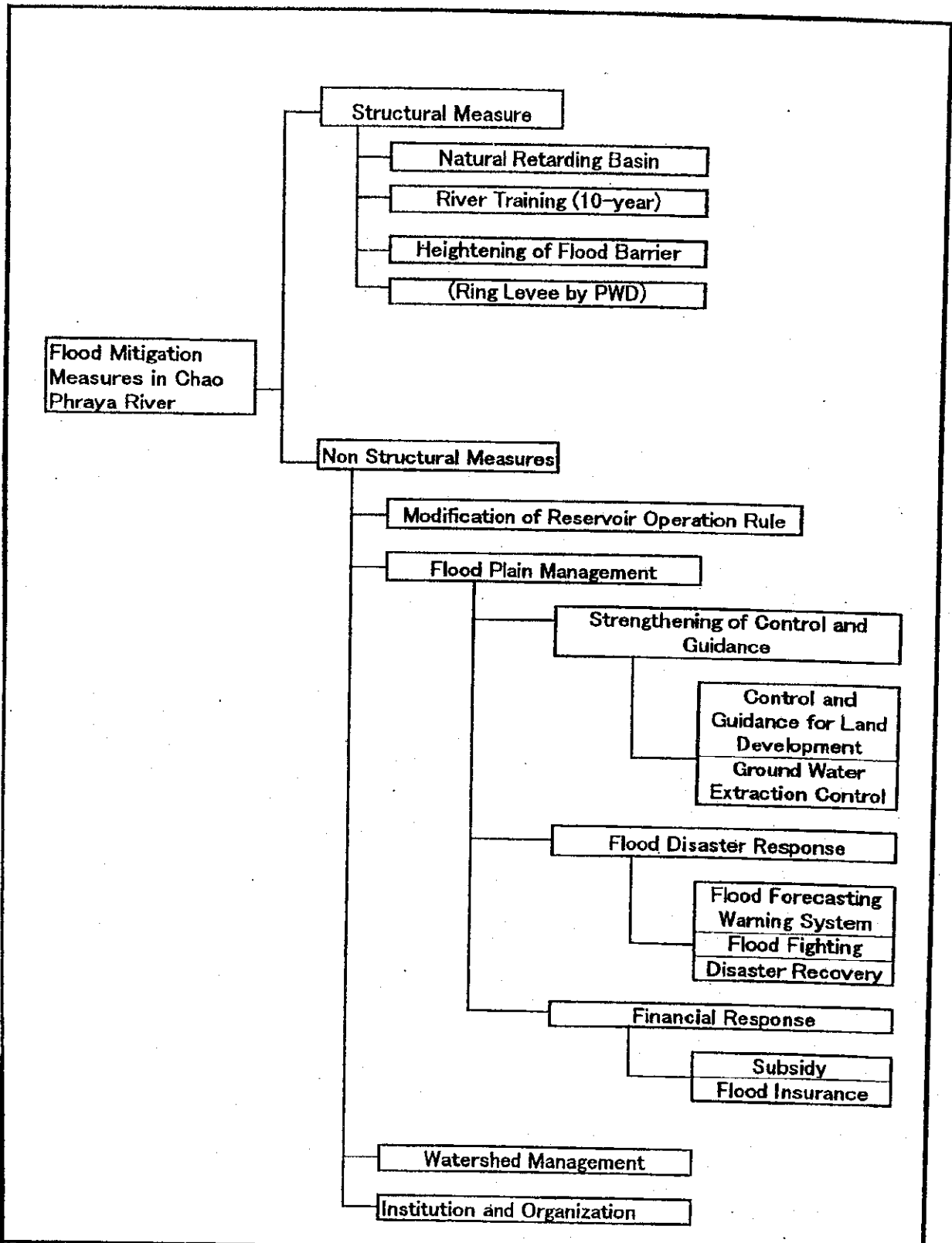


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.1.4 (1/3)

COMPOSITION OF MASTER PLAN (Alternative-1)



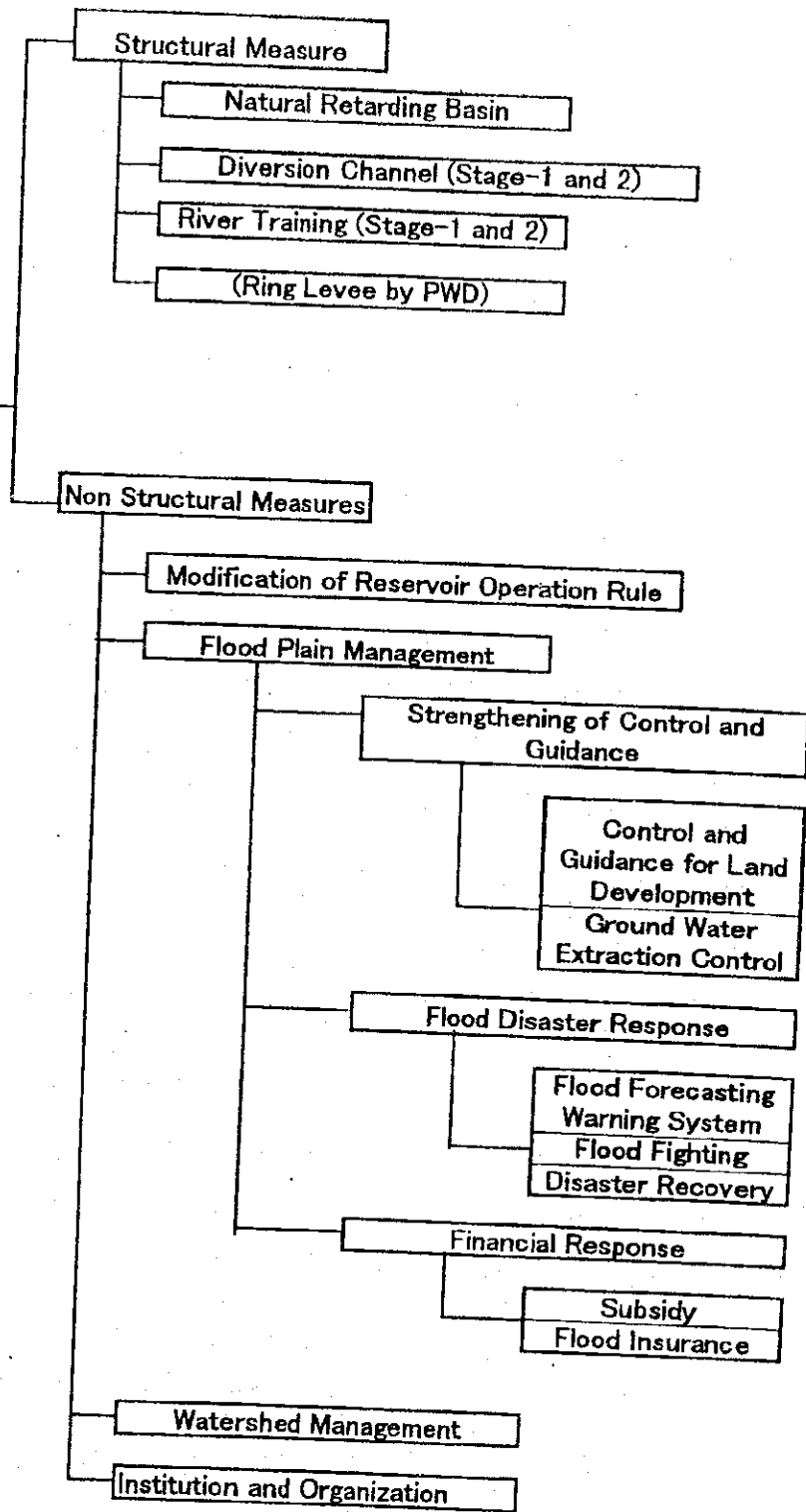
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.1.4 (2/3)

COMPOSITION OF MASTER PLAN (Alternative-2-1)

Flood Mitigation Measures in Chao Phraya River

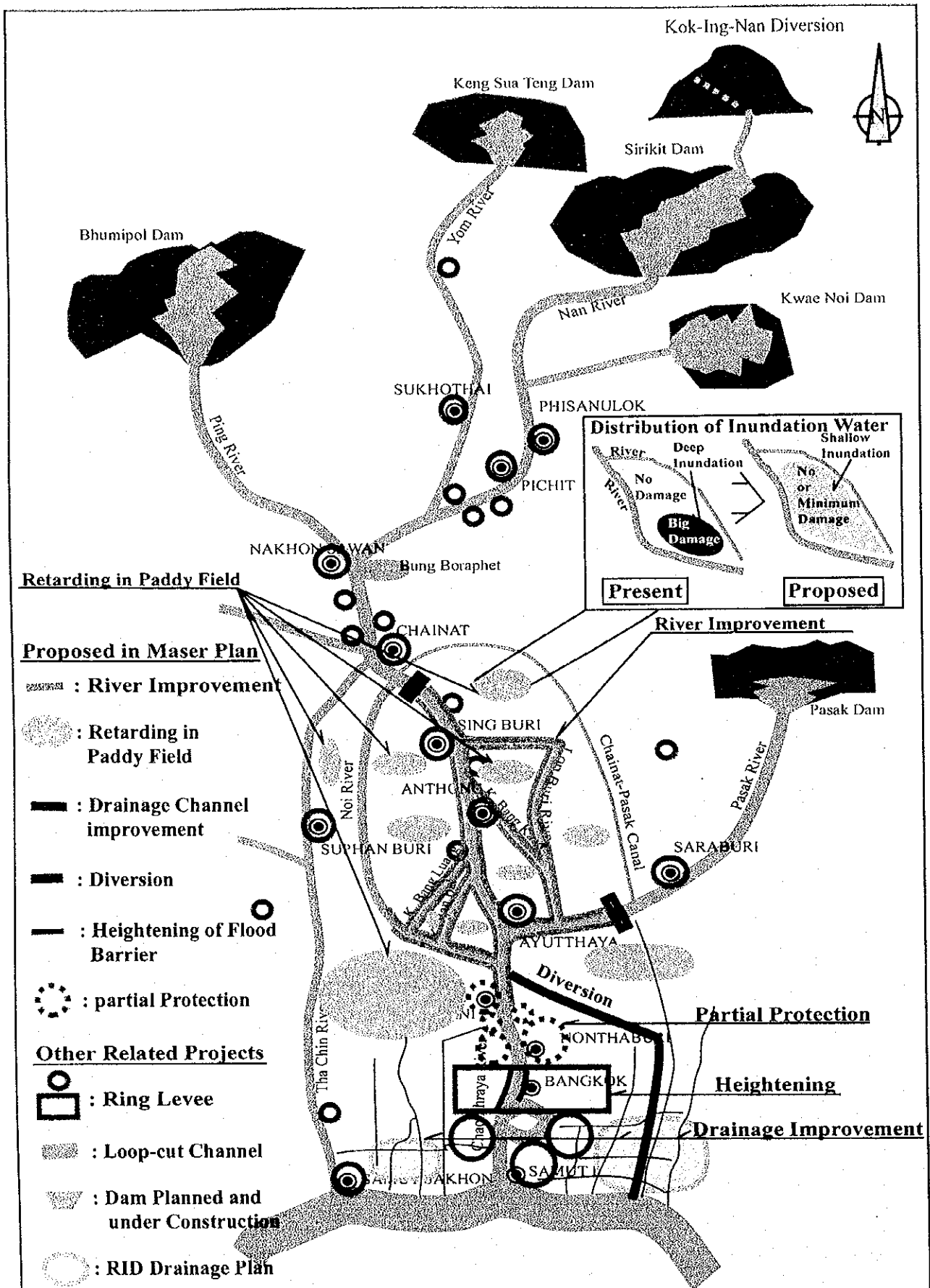


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.1.4 (3/3)

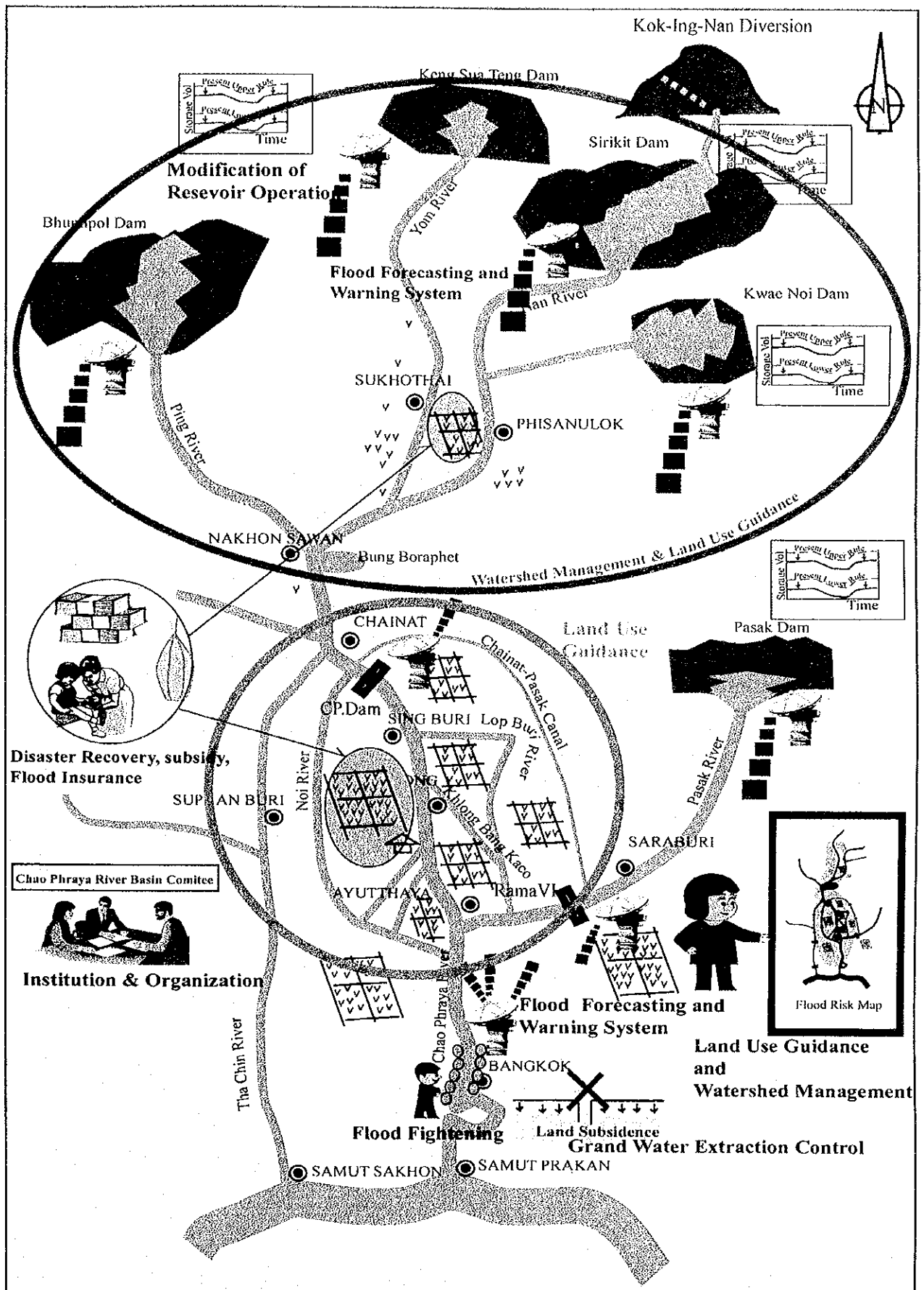
COMPOSITION OF MASTER PLAN (Alternative-2-2)



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig. 4.1.5 PROPOSED STRUCTURAL MEASURES FOR MASTER PLAN

CTI ENGINEERING CO., LTD AND INA CORPORATION

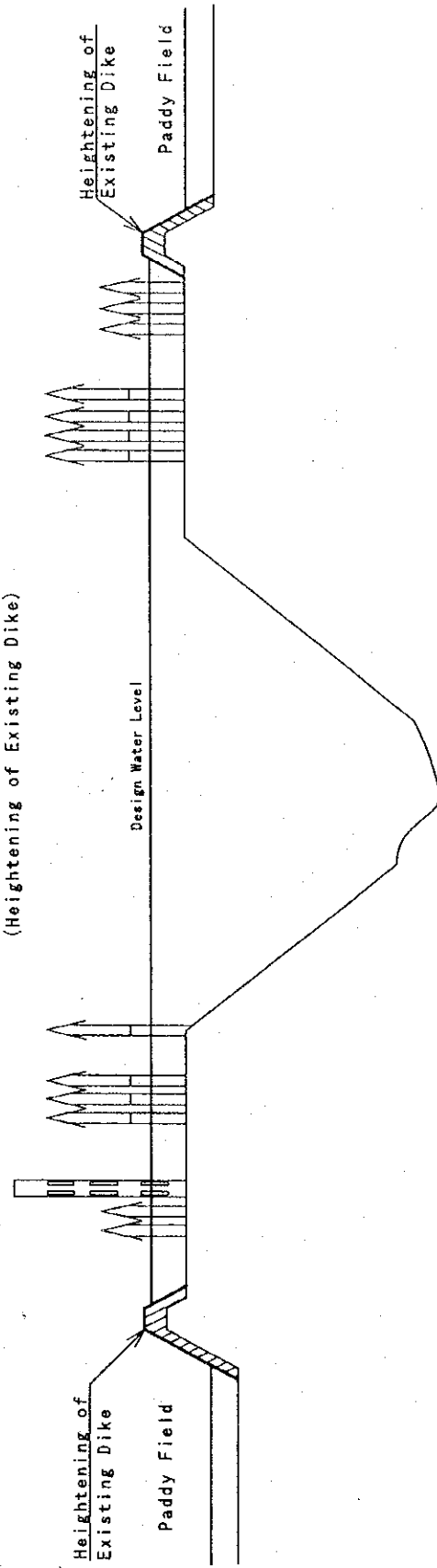


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig . 4.1.6  
 PROPOSED NON-STRUCTURAL MEASURES FOR MASTER PLAN

### Alternative-1

(Heightening of Existing Dike)

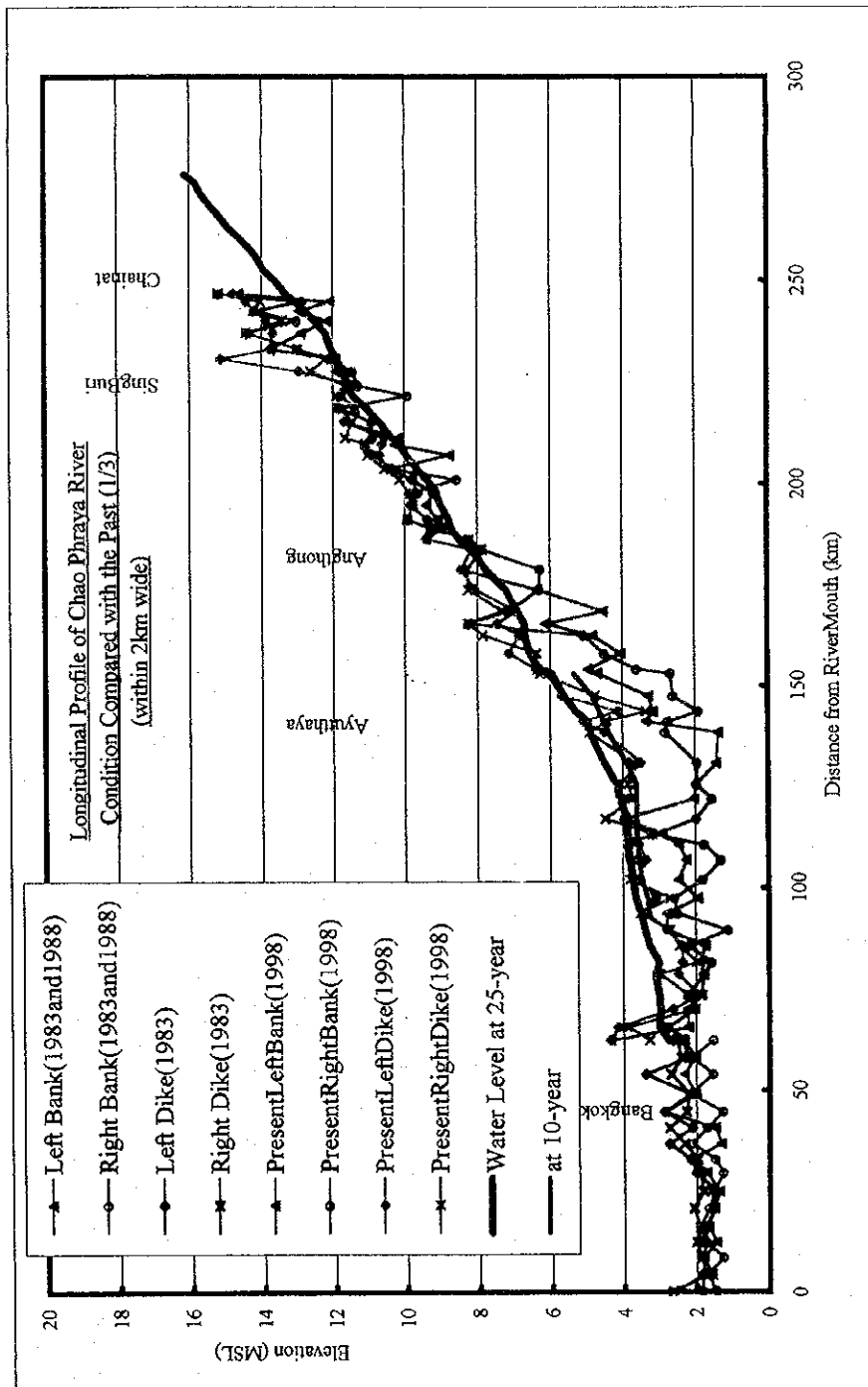


STUDY ON INTEGRATED PLAN FOR FLOOD  
MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.2.1

STANDARD OF IMPROVEMENT FOR RIVER  
IMPROVEMENT

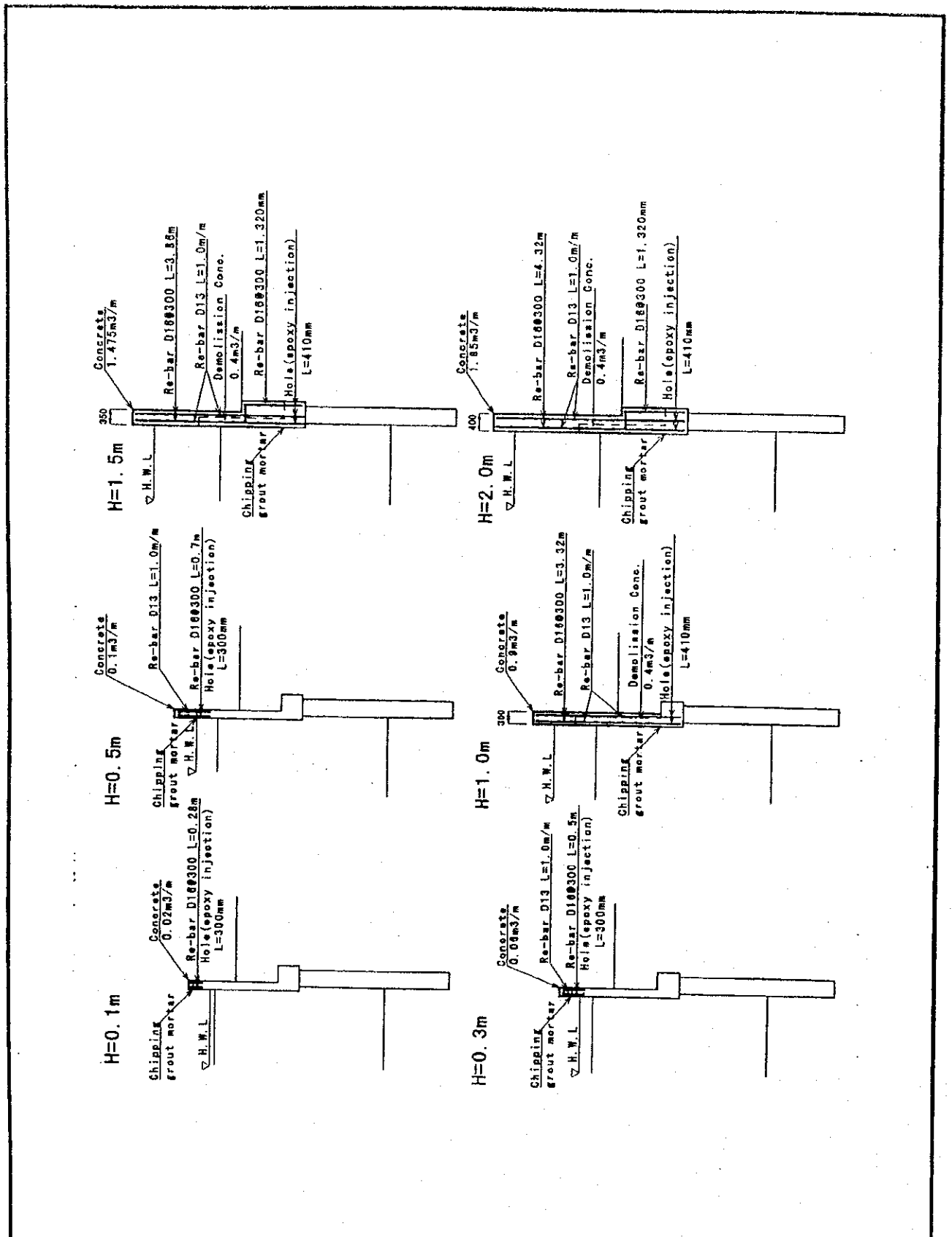


STUDY ON INTEGRATED PLAN FOR FLOOD  
MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.2.2

LONGITUDINAL PROFILE FOR RIVER  
IMPROVEMENT OF CHAO PHRAYA RIVER



STUDY ON ON INTEGRATED PLAN FOR FLOOD  
 MITIGATION IN CHAOPHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD & INA CORPORATION

Fig.4.2.3  
 DETAIL OF IMPROVEMENT FOR BMA FLOOD  
 PROTECTION WALL

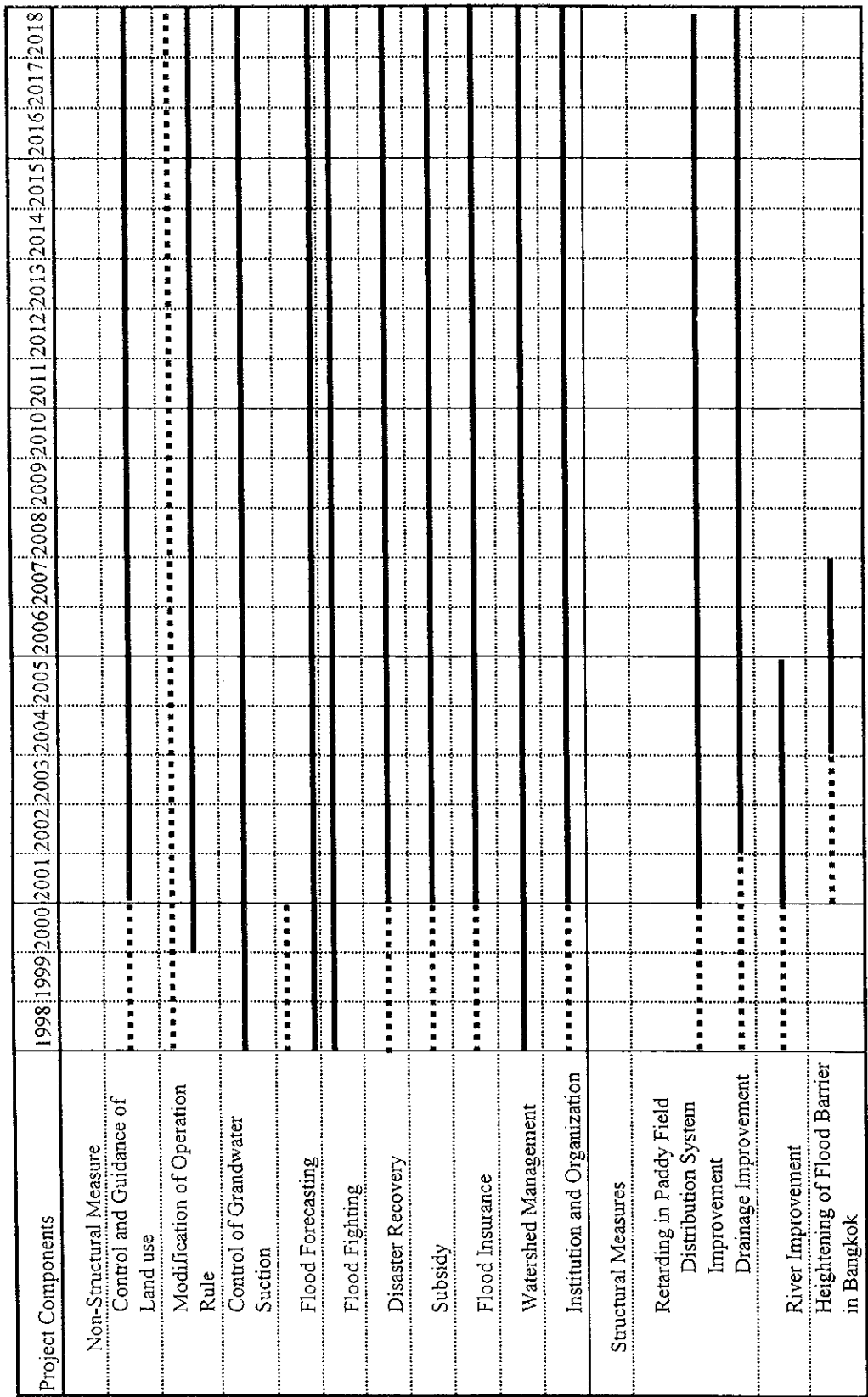


Project Components	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Non-Structural Measure																					
Control and Guidance of Land use	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Modification of Operation Rule	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Control of Grandwater Suction	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flood Forecasting	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flood Fighting	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Disaster Recovery	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Subsidy	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flood Insurance	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Watershed Management	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Institution and Organization	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Structural Measures																					
Retarding in Paddy Field	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Distribution System Improvement	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Drainage Improvement	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
River Improvement	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

.....: Study Period  
 —: Implementation Period

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

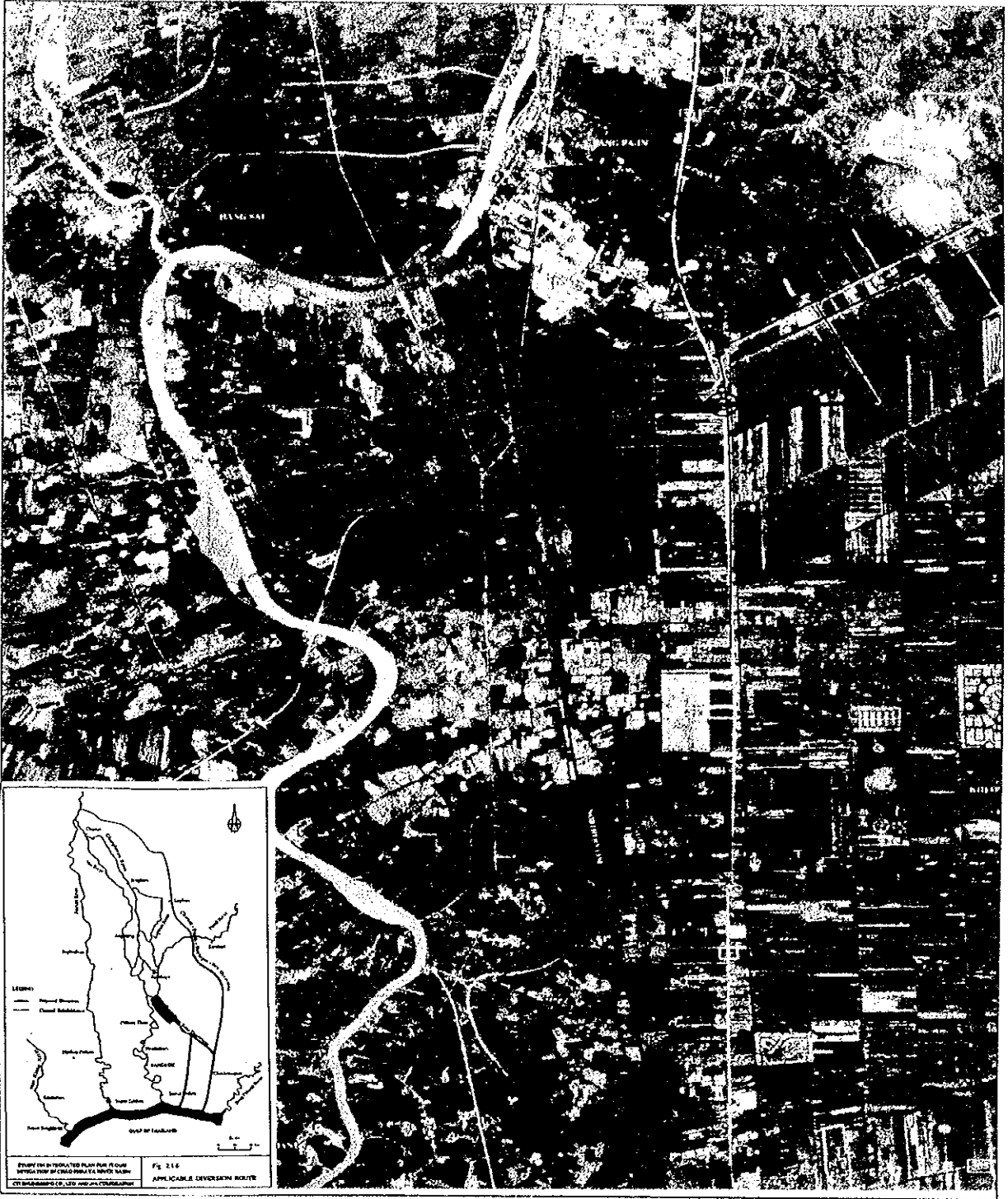
Fig 4.2.4  
 IMPREMENTATION SCHEDULE OF THE MASTER PLAN (Alternative-1)



..... : Study Period  
 ————— : Implementation Period

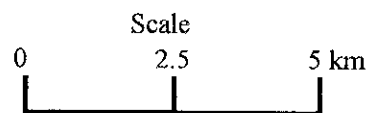
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig 4.2.5  
 IMPLEMENTATION SCHEDULE OF THE MASTER PLAN (Alternative-2-1)



**Legend**

- : Diversion Channel Route
- : Large Scale Road & Railway
- ⊙ : Built-up Area
- : Large Scale Canal

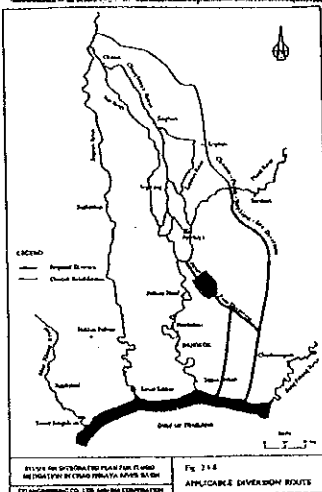
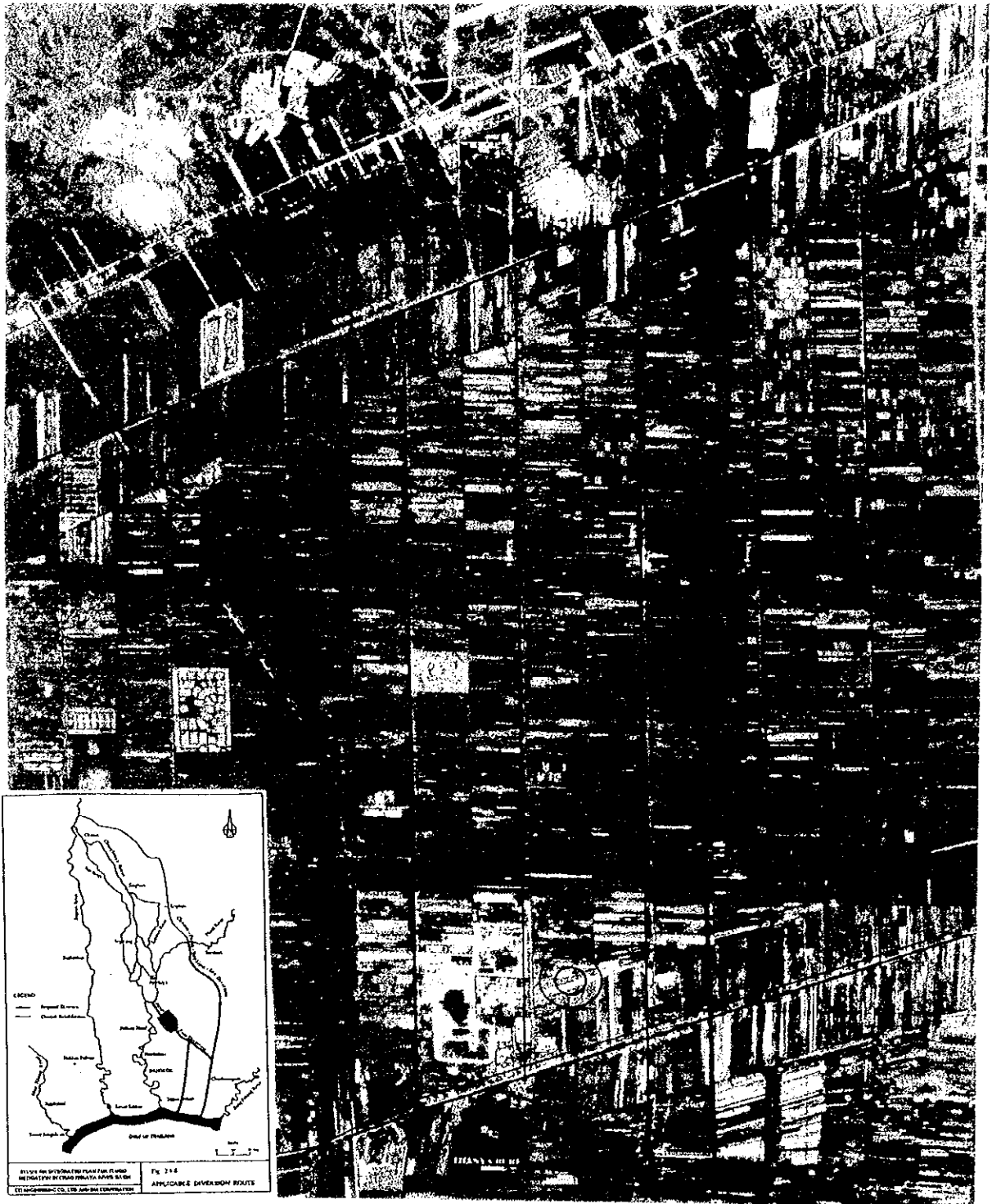


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig.4.2.6 (1/6)

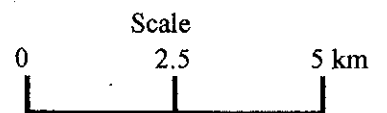
ALIGNMENT OF DIVERSION

CTI ENGINEERING CO., LTD AND INA CORPORATION



Legend

- : Diversion Channel Route
- : Large Scale Road & Railway
- ⊙ : Built-up Area
- : Large Scale Canal

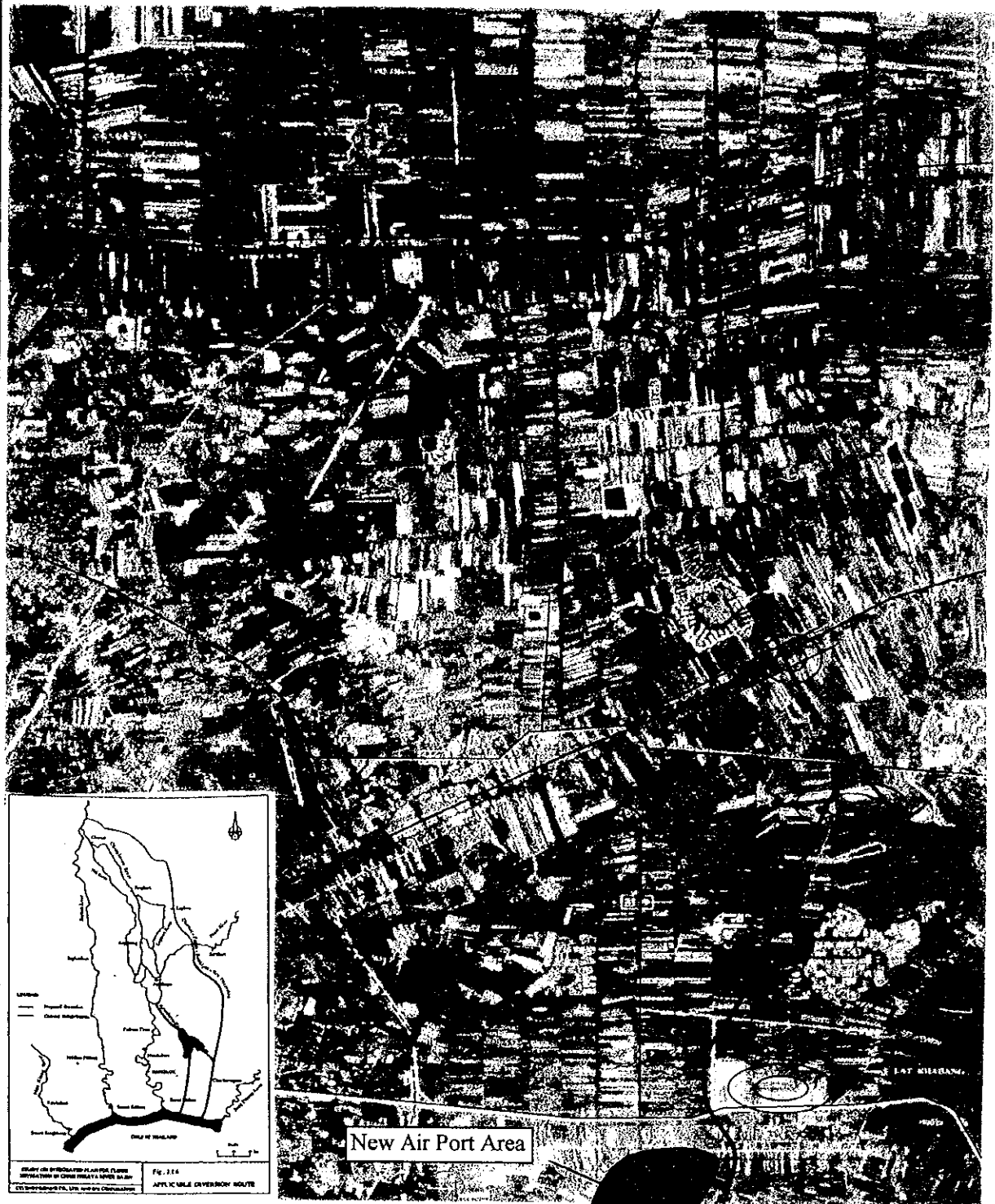


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig.4.2.6 (2/6)

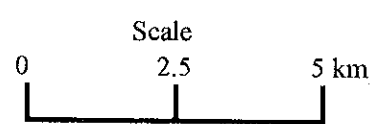
ALIGNMENT OF DIVERSION

CTI ENGINEERING CO., LTD AND INA CORPORATION



Legend

- : Diversion Channel Route
- : Large Scale Road & Railway
- ⊙ : Built-up Area
- : Large Scale Canal



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

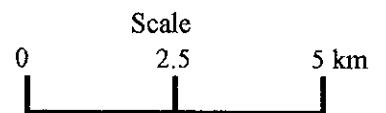
Fig.4.2.6 (3/6)  
ALIGNMENT OF DIVERSION

CTI ENGINEERING CO., LTD AND INA CORPORATION



Legend

- : Diversion Channel Route
- : Large Scale Road & Railway
- ⊙ : Built-up Area
- : Large Scale Canal

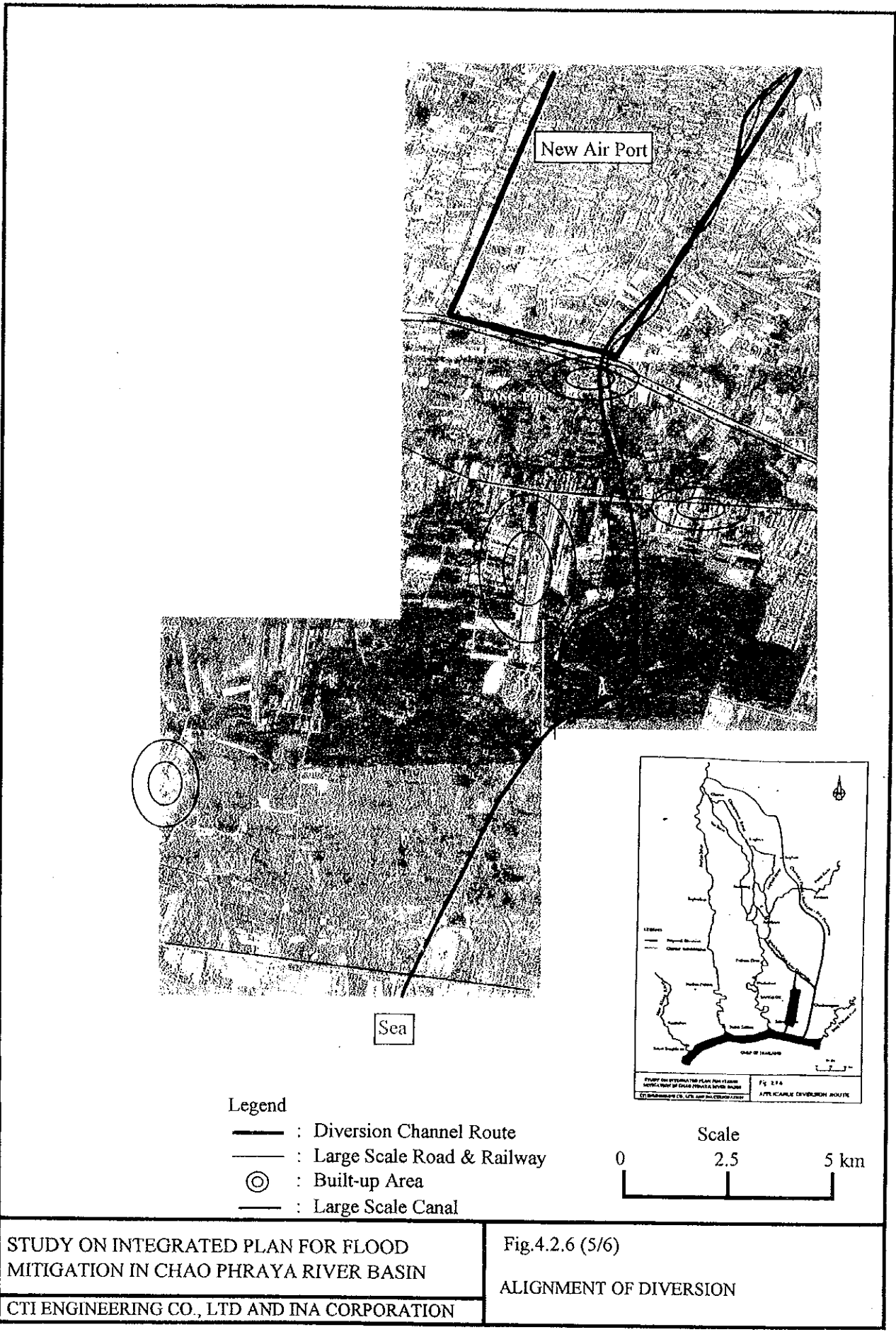


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig.4.2.6 (4/6)

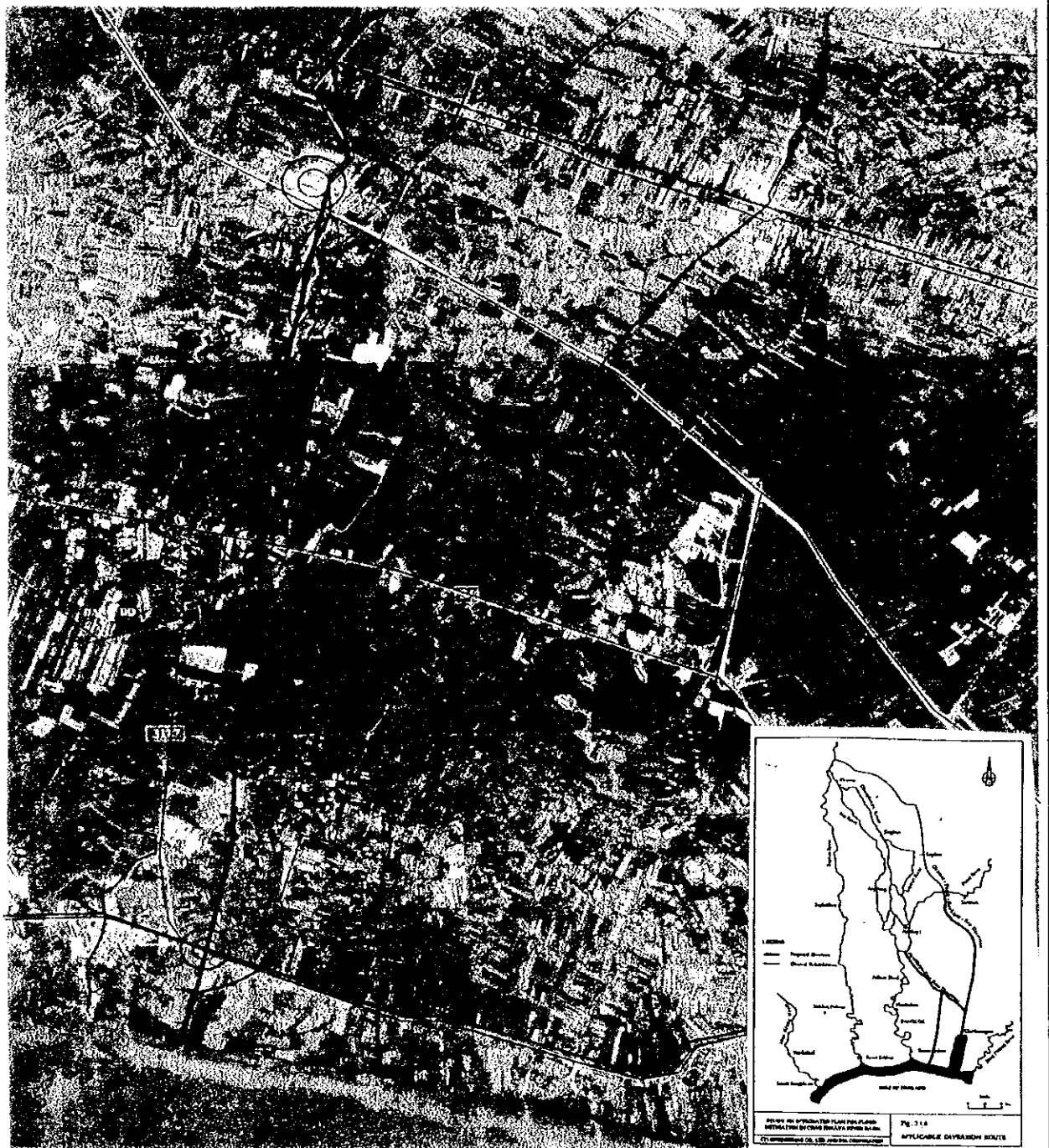
ALIGNMENT OF DIVERSION

CTI ENGINEERING CO., LTD AND INA CORPORATION



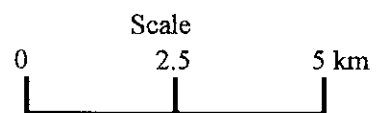
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.2.6 (5/6)  
 ALIGNMENT OF DIVERSION



**Legend**

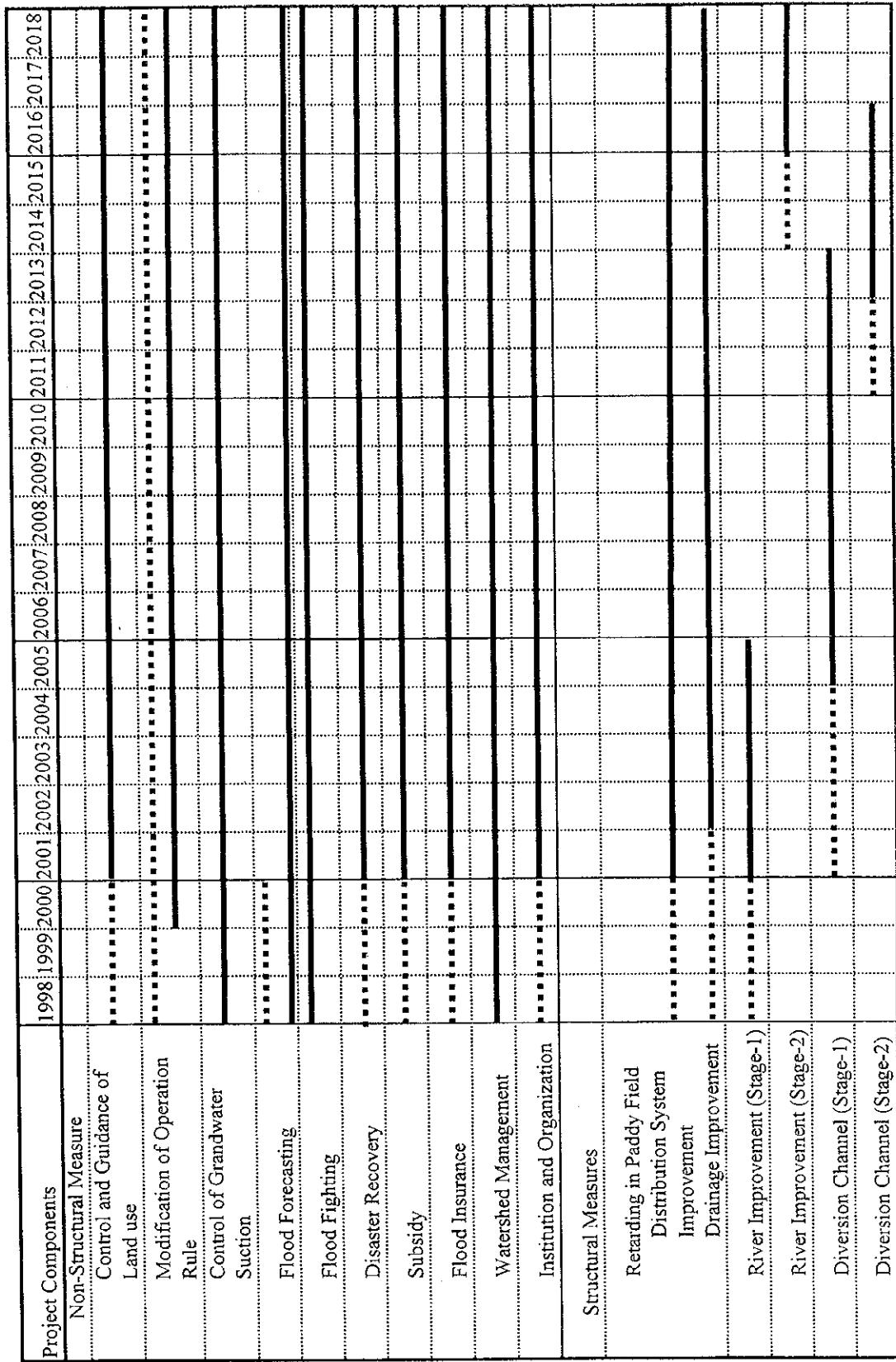
- : Diversion Channel Route
- : Large Scale Road & Railway
- ⊙ : Built-up Area
- : Large Scale Canal



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN  
 CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig.4.2.6 (6/6)  
 ALIGNMENT OF DIVERSION





..... : Study Period  
 ————— : Implementation Period

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig 4.2.7  
 IMPLEMENTATION SCHEDULE OF THE MASTER PLAN (Alternative-2-2)

CTI ENGINEERING CO., LTD AND INA CORPORATION