OFFICE OF NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT BOARD (NESDB)

ROYAL IRRIGATION DEPARTMENT (RID)
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MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT (MNRE)

KINGDOM OF THAILAND

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

Final Report

Volume 3: Supporting Report (2/2)

September 2013

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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COMPOSITION OF FINAL REPORT

Volume 1: Summary Report

Volume 2: Main Report

Volume 3: Supporting Report (1/2)

Sector A.	GIS Database
Sector B.	Natural and Social Environment
Sector C.	Hydrological Observation and Analysis
Sector D.	Hydrological and Hydraulic Model Development and Analysis
Sector E.	Evaluation of Countermeasures with Other Rainfall Pattern
Sector F.	Study on River Channel Improvement
Sector G.	Study on Efficient Operation of Existing Dam Reservoirs

Volume 3: Supporting Report (2/2)

Sector H.	Construction of New Dams
Sector I.	Retarding and Retention Area
Sector J.	Construction of Diversion Channel
Sector K.	Controlled Inundation
Sector L.	Land Use Control in Inundation Area
Sector M.	Inland Rain Storm Drainage
Sector N.	Forest Restoration
Sector O.	Cost Estimation
Sector P.	Economic Evaluation
Sector Q.	Environment
Sector R.	Climate Change
Sector S.	Storm Surge
Sector T.	Examination of Observed Data by RID
Sector U.	Materials of Workshop on July 16-17, 2013

Addendum Report: The Flood Analysis on the Chao Phraya River with RRI Model

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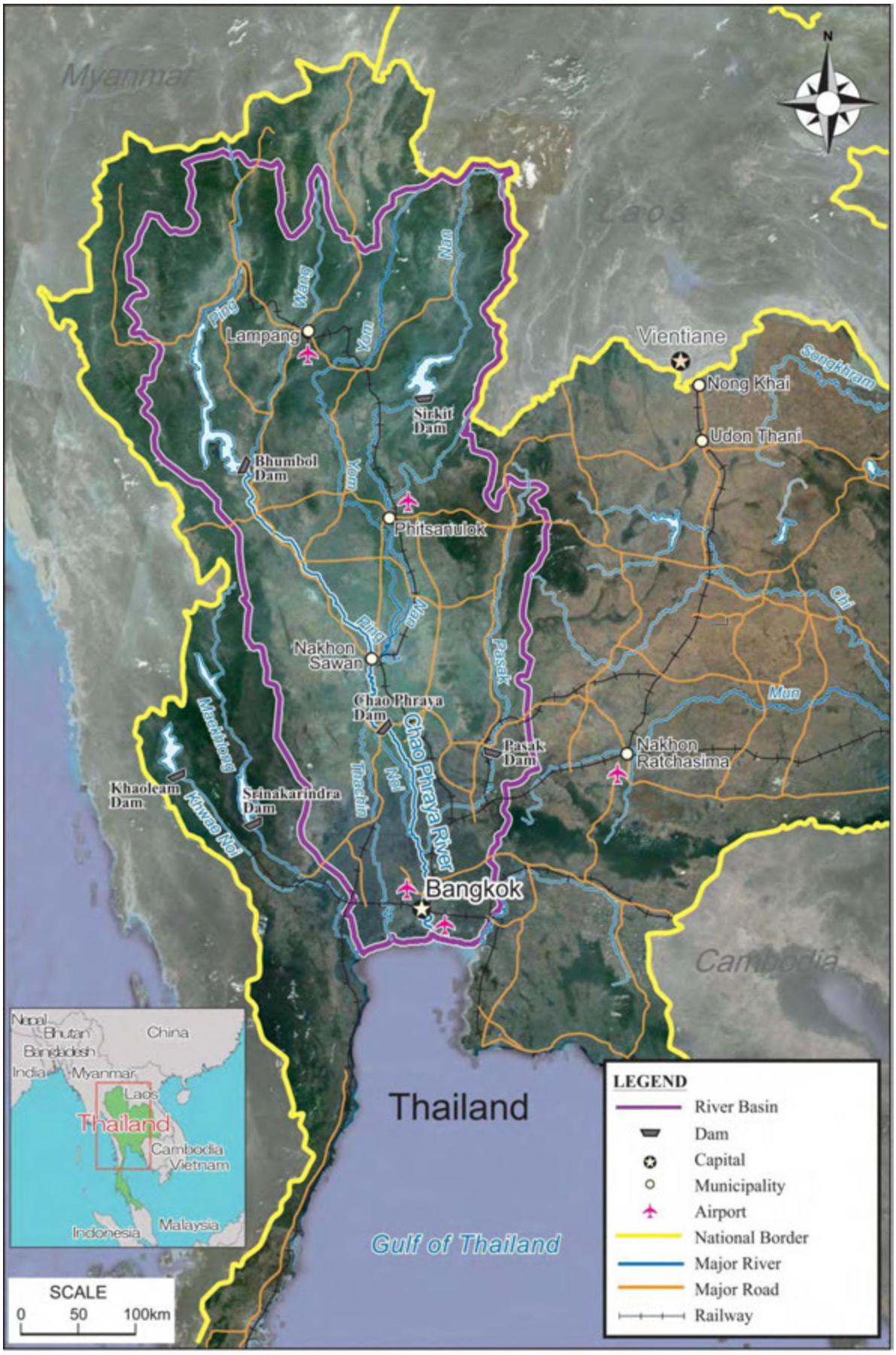

LOCATION MAP

ABBREVIATIONS

AIT	Asian Institute of Technology
ALRO	Agricultural Land Reform Office
BMA	Bangkok Metropolitan Administration
CAT	Communication Authority of Thailand
CPB	The Crown Property Bureau
DDPM	Department of Disaster Prevention and Mitigation
DDS	Department of Drainage and Sewerage, BMA
DEDP	Department of Energy Development and Promotion
DF	Department of Fisheries
DGR	Department of Groundwater Resources
DIW	Department of Industrial Works
DOH	Department of Highway
DOLA	Department of Local Administration
DOR	Department of Rural Road
DPT	Department of Public Works and Town and Country Panning
DPW	Department of Technical and Economic Cooperation
DTCP	Department of Town and Country Planning
DWR	Department of Water Resources
EGAT	Electricity Generating Authority of Thailand
FFC	Flood Forecasting Center
GISTDA	Geo-Informatics and Space Technology Development Agency
GOT	Government of the Kingdom of Thailand
ICHARM	International Center for Water Hazard and Risk Management
IEC	Irrigation Engineering Center
IMPAC-T	Integrated Study Project on Hydro-meteorological Prediction and Adaptation to Climate Change in Thailand
JETRO	Japan External Trade Organization
LAO	Local Authority Organizations
MD	Marine Department
MI	Ministry of Industry
MOAC	Ministry of Agriculture and Cooperative
MOI	Ministry of Interior
MNRE	Ministry of Natural Resources and Environment
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MST	Ministry of Science and Technology
NDPMC	National Disaster Prevention and Mitigation Committee
NESDB	National Economic and Social Development Board
NEB	National Environmental Board
NWRFPC	National Water Resources and Flood Policy Committee
NWRC	National Water Resources Committee
NSO	National Statistic Office
OBI	Office of the Board of Investment
OCS	Office of the Council of the State
OEPP	Office of Environmental Policy and Planning
ONWRFPC	Office of National Water Resources and Flood Policy Committee

OPM	Office of the Prime Minister
OSCWRM	Office of Strategic Committee for Water Resources Management
PAT	Port Authority of Thailand
PCD	Pollution Control Department
RBC	River Basin Committee
RFD	Royal Forest Department
RID	Royal Irrigation Department
RTN	Royal Thai Navy
RTSD	Royal Thai Survey Department
SCRFD	Strategic Committee for Reconstruction and Future Development
SCWRM	Strategic Formulation Committee for Water Resources Management
SRT	State Railways of Thailand
THB	Thai Baht
TMD	Thai Meteorological Department
TOT	Telecommunication Organization of Thailand
WRFMC	Water Resources and Flood Management Committee
WT	Public Works Department

MEASUREMENT UNITS

(Length)

mm	:	millimeter(s)
cm	:	centimeter(s)
m	:	meter(s)
km	:	kilometer(s)

(Time)

s, sec	:	second(s)
min	:	minute(s)
h, hr	:	hour(s)
d, dy	:	day(s)
y, yr	:	year(s)

(Area)

mm^2	:	square millimeter(s)
cm^2	:	square centimeter(s)
m^2	:	square meter(s)
km^2	:	square kilometer(s)
ha	:	hectare(s)

(Volume)

cm^3	:	cubic centimeter(s)
m^3	:	cubic meter(s)
l, ltr	:	liter(s)
MCM	:	million cubic meter(s)

(Weight)

g, gr	:	gram(s)
kg	:	kilogram(s)
ton	:	ton(s)

(Speed/Velocity)

cm/s	:	centimeter per second
m/s	:	meter per second
km/h	:	kilometer per hour

Sector H: Construction of New Dams

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

FINAL REPORT
VOLUME 3: SUPPORTING REPORT

SECTOR H: TABLE OF CONTENTS

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CHAPTER H1 CONSTRUCTION OF NEW DAMS

H1.1 General

The Government of Thailand has planned to construct several dams after the 2011 Flood. Among them Kaeng Sue Tein Dam in the Yom River Basin, Nam Kheg Dam in the Nan River Basin and Mae Wong Dam in the Sakae Krang are assessed on their flood regulation effects.

H1.2 Plan of New Dams

In the Chao Phraya River Basin there are 10 large dams with reservoir storage capacities of more than 100MCM as shown below:

Table H1.2.1 Existing Large Dam Reservoirs in Chao Phraya River Basin

River	Name	Type	Height (m)	Catchment Area (km^2)	Effective Reservoir Capacity (MCM)	Elevation of Dam Crest (m MSL)
Ping	Bhumibol	Arch	154.0	26,386	9,662.0	261.0
	Mae Ngat	Fill	59.0	1,280	243.4	404.0
	Mae Kuang	Fill	68.0	569	249.0	390.0
Wang	Kiew Lom	Gravity Concrete	26.5	1,425	102.0	277.4
	Kiew Kor Ma	Fill	43.5	1,275	163.8	355.5
Nan	Sirikit	Fill	113.6	13,130	6,660.0	169.0
	Kwae Noi	Fill	80.0	4,254	896.0	135.0
Pa Sak	Pa Sak	Fill	36.5	14,520	782.0	46.5
Sakae Krang	Tap Sa Lao	Fill	26.0	534	143.0	159.5
Tha Chin	Kra Siew	Fill	32.5	1,220	200.0	92.5

RID is presently promoting 107 dams for investigation, study or implementation. Salient features of these dams are presented in Table H1.2.2 and their location map is presented in Figure H1.2.1. While only six (6) dam reservoirs are larger than 100MCM, the others are very small with an average of 17MCM.

Table H1.2.2 Salient Features of Large Dam Reservoirs Planned by RID

(1/2)

No.	No.1	No.22	No.23
Main Features	Mae Cham Dam	Upper Yom Dam	Mae Yom Dam
River	Ping River	Yom River	Yom River
Location	Chiang Mai Province Mae Cham District Mae Na Jon Sub-district	Phrae Province Song District Sa Aieb Sub-District	Phrae Province Song District Tao Poon Sub-district
Dam Type	-	Rockfill (Concrete-faced)	Rockfill (Concrete faced)
Dam height（m）	70.00	40.00	53.00
Length of Dam （m）	520.00	254.00	1,800.00
Catchment Area（km^2）	685.00	3,305.10	5,433.50
Reservoir Area（km^2）	-	17.37	37.40
Normal High Water Level（MCM）	135.00	166.06	588.00
Storage Capacity at Lowest Water Level（MCM）	-	38.60	41.52
Effective Storage Volume（MCM）	-	127.46	546.48
Irrigation Area（rai）	71,837	674,000	
Present Status	Desk Plan	F/S Completed	

(2/2)

No.	No.21	No.40	No.100
Main Features	Kaeng Sua Ten Dam	Nam Kheg Dam	Mae Wong Dam
River	Yom River	Nan River	Sakae Krang River
Location	Phrae Province Song District Sa Aieb Sub-District	Phitsanulok Province Nakhon Thai District Baan Yang Sub-district	Nakhon Sawan Province Mae Wong District Mae Lei Sub-district
Dam Type	Rockfill (Concrete-faced)	Rockfill	Rockfill
Dam height（m）	69.00	128.0	56.00
Length of Dam （m）	540.00	757	903.02
Catchment Area（km^2）	3,538.00	936.75	612.00
Reservoir Area（km^2）	66.78	11.16	17.60
Normal High Water Level（MCM）	1,175.00	550.25	258.00
Storage Capacity at Lowest Water Level（MCM）	50.00	7.45	20.00
Effective Storage Volume（MCM）	1,125.00	542.80	238.00
Irrigation Area（rai）	774,000	50,000	251,900
Present Status	D/Dcompleted	Desk plan	D/Dcompleted

Table H1.2.3 List of Dam Reservoirs in the Chao Phraya River Basin Planned by RID

(1/2)

Basin	No.	Project	Size	Capacity (MCM)	Irrigation Area (rai)	Province
Ping River	1	Mae Cham	Large	135.00	71,837	Chiang Mai
	2	Huai Tung	Medium	44.50	7,200	Lamphun
	3	Huai Cha Lom	Medium	15.20	5,040	Tak
	4	Mae Sa Puad	Medium	8.30	2,100	Lamphun
	5	Mae Yuan Hwai	Medium	1.25	300	Lamphun
	6	Huai Mae Pa Pai	Medium	12.24	12,000	Chiang Mai
	7	Huai Mae La	Medium	40.50	15,000	Lamphun
	8	Khlong Na Both	Medium	13.50	9,600	Tak
	9	Khlong Pla Soi	Medium	33.00	13,200	Kamphaengphet
	10	Khlong Mae Ra Ka	Medium	10.20	900	Tak
	11	Huai Mai Ngam	Medium	8.10	2,100	Tak
	12	Mae Tie	Medium	10.00	3,000	Chiang Mai
	13	Mae Soi	Medium	3.80	1,620	Chiang Mai
	14	Khlong Lan	Medium	3.30	840	Kamphaengphet
	15	Pet Ja Kho	Medium	2.77	1,478	Kamphaengphet
	16	Ban Pak Kwuang	Medium	4.40	3,060	Chiang Mai
	17	Mae Khan	Medium	74.84	41,022	Chiang Mai
Wang River	18	Mae Nuang	Medium	16.40	9,000	Lampang
	19	Nam Mae Pan	Medium	11.93	7,300	Lampang
	20	Mae Soi	Medium	11.40	9,000	Lampang
Yom River	21	Kaeng Sua Ten	Large	1,175.00	774,000	Phrae
	22	Upper Yom	Large	166.06	674,000	Phrae
	23	Mae Yom	Large	588.00		Phrae
	24	Nam Mae Pee	Medium	27.81	1,067	Phayao
	25	Huai Pak Khoo	Medium	4.02	5,300	Sukhothai
	26	Mae Kam Mee	Medium	19.64	12,200	Phrae
	27	Huai Rai	Medium	7.33	3,900	Sukhothai
	28	Huai Mae Moh	Medium	4.00	3,400	Phayao
	29	Mae Kon	Medium	11.47	11,800	Phrae
	30	Nam Huai Roo	Medium	10.07	12,800	Phayao
	31	Mae Teep	Medium	28.50	17,000	Lampang
	32	Huai Pong Pak	Medium	15.07	10,200	Lampang
	33	Huai Mae Puak	Medium	11.00	8,100	Phrae
	34	Nam Ngim	Medium	16.70	13,600	Phayao
	35	Huai Mae Thun Noi	Medium	4.15	504	Sukhothai
	36	Huai Mae Kam	Medium	8.55	6,400	Phrae
	37	Huai Mae Lang	Medium	11.50	7,300	Phrae
	38	Mae Aon 2	Medium	19.10	8,500	Lampang
	39	Huai Mae Sum	Medium	4.93	2,800	Sukhothai
Nan River	40	Nam Kheg	Large	550.00	n/a	Phitsanulok
	41	Huai Prek Khing	Medium	10.21	6,000	Phitsanulok
	42	Huai Pang Nga	Medium	11.33	9,900	Uttaradit
	43	Nam Rin	Medium	4.00	4,000	Nan
	44	Nam Pad	Medium	58.90	32,250	Uttaradit
	45	Huai Ra Boei	Medium	35.38	2,300	Phitsanulok
	46	Huai Aom Sing	Medium	6.97	10,000	Phitsanulok
	47	Nam Lok	Medium	21.16	5,700	Uttaradit
	48	Huai Hin Lub	Medium	12.50	n/a	Phitsanulok
	49	Nam Yaw (East)	Medium	25.00	7,000	Nan
	50	Khlong Chom Poo	Medium	43.00	20,000	Phitsanulok
	51	Huai Saliang Hang	Medium	68.53	n/a	Phetchabun
	52	Nam Kon	Medium	97.63	15,000	Nan
	53	Nam Yaw (West)	Medium	87.20	7,000	Nan
	54	Mae Kha Ning	Medium	62.00	n/a	Nan
	55	Nam Juang	Medium	56.76	n/a	Phitsanulok
	56	Huai Lum Kra Don	Medium	46.69	71,780	Phitsanulok
	57	Huai Nam Mued	Medium	30.39	20,000	Uttaradit
	58	Nam Kui	Medium	28.00	6,000	Nan
	59	Nam Pour	Medium	27.40	14,000	Nan
	60	Nam Kueng	Medium	27.00	4,900	Uttaradit

(2/2)

Basin	No.	Project	Size	Capacity (MCM)	Irrigation Area (rai)	Province
Nan River	61	Nam Pai	Medium	16.56	n/a	Uttaradit
	62	Huai Nam Khueng	Medium	12.40	n/a	Phitsanulok
	63	Nam Fua	Medium	12.40	7,000	Phitsanulok
	64	Huai Nam Khai	Medium	12.16	6,600	Uttaradit
	65	Khlong Hin Fon	Medium	11.01	n/a	Phitsanulok
	66	Huai Lod	Medium	6.61	500	Nan
	67	Lum Nam Kan Khuang	Medium	6.50	4,000	Phitsanulok
	68	Nam Sa Ron	Medium	6.30	3,000	Nan
	69	Huai Kho	Medium	4.68	1,500	Uttaradit
	70	Huai Nam Mued	Medium	4.00	n/a	Uttaradit
	71	Sok Sab Dang	Medium	3.45	n/a	Phetchabun
	72	Khlong Kun	Medium	3.31	n/a	Phitsanulok
	73	Huai Kaew	Medium	3.20	4,000	Phitsanulok
	74	Huai Chamlia-Chamfai	Medium	3.00	n/a	Uttaradit
	75	Huai Mang	Medium	2.00	1,100	Uttaradit
	76	Huai Nam Mee	Medium	1.99	2,600	Uttaradit
	77	Huai Sai	Medium	1.10	1,000	Uttaradit
Pa Sak River	78	Klong Nam Tin	Medium	12.00	11,500	Phetchabun
	79	Huai Tha Pon	Medium	12.30	n/a	Phetchabun
	80	Baan Na Ngua	Medium	4.80	6,000	Phetchabun
	81	Huai Bong	Medium	2.20	2,000	Phetchabun
	82	Huai Yang	Medium	2.12	1,300	Phetchabun
	83	Huai Cha-em	Medium	1.50	n/a	Phetchabun
	84	Huai Nam Hiae	Medium	5.40	4,500	Phetchabun
	85	Huai Saduang Yai	Medium	14.00	10,500	Phetchabun
	86	Huai Nam Chun Noi	Medium	8.67	n/a	Phetchabun
	87	Ban Than Thip	Medium	4.60	5,000	Phetchabun
	88	Khao Wang Pae	Medium	1.84	n/a	Lopburi
	89	Khao Pang Hei	Medium	26.00	13,000	Lopburi
	90	Huai Sab Song	Medium	3.16	2,500	Lopburi
Tha Chi River	91	Huai Ta Weep	Medium	12.00	9,000	Suphan Buri
	92	Huai Mo Kho	Medium	21.70	4,500	Uthai Thani
	93	Huai Khun Kaew	Medium	41.30	35,000	Uthai Thani
	94	Nong E Ngen	Medium	0.20	5,000	Suphan Buri
	95	Pu Pla Kang	Medium	26.40	16,500	Uthai Thani
	96	Huai Hang	Medium	1.00	1,800	Uthai Thani
	97	Huai Pa Pak	Medium	1.50	5,000	Uthai Thani
	98	Tha Kuai Lang	Medium	10.00	8,000	Uthai Thani
	99	Poo Yang Daiw	Medium	1.70	2,000	Suphan Buri
Sakae Krang River	100	Mae Wong	Large	258.00	251,900	Nakhon Sawan
	101	Huai Rang	Medium	17.50	10,000	Uthai Thani
	102	Wang Ror	Medium	n/a	n/a	Uthai Thani
	103	Huai Ra Bum	Medium	7.00	4,500	Uthai Thani
	104	Hub Wai Pong	Medium	0.26	n/a	Uthai Thani
Chao Phraya River	105	Khlong Pa Mong-Krok Phra	Medium	n/a	20,000	Nakhon Sawan
	106	Khao Lak Kai	Medium	3.00	14,000	Lopburi
	107	Huai Yang	Medium	17.50	n/a	Lopburi

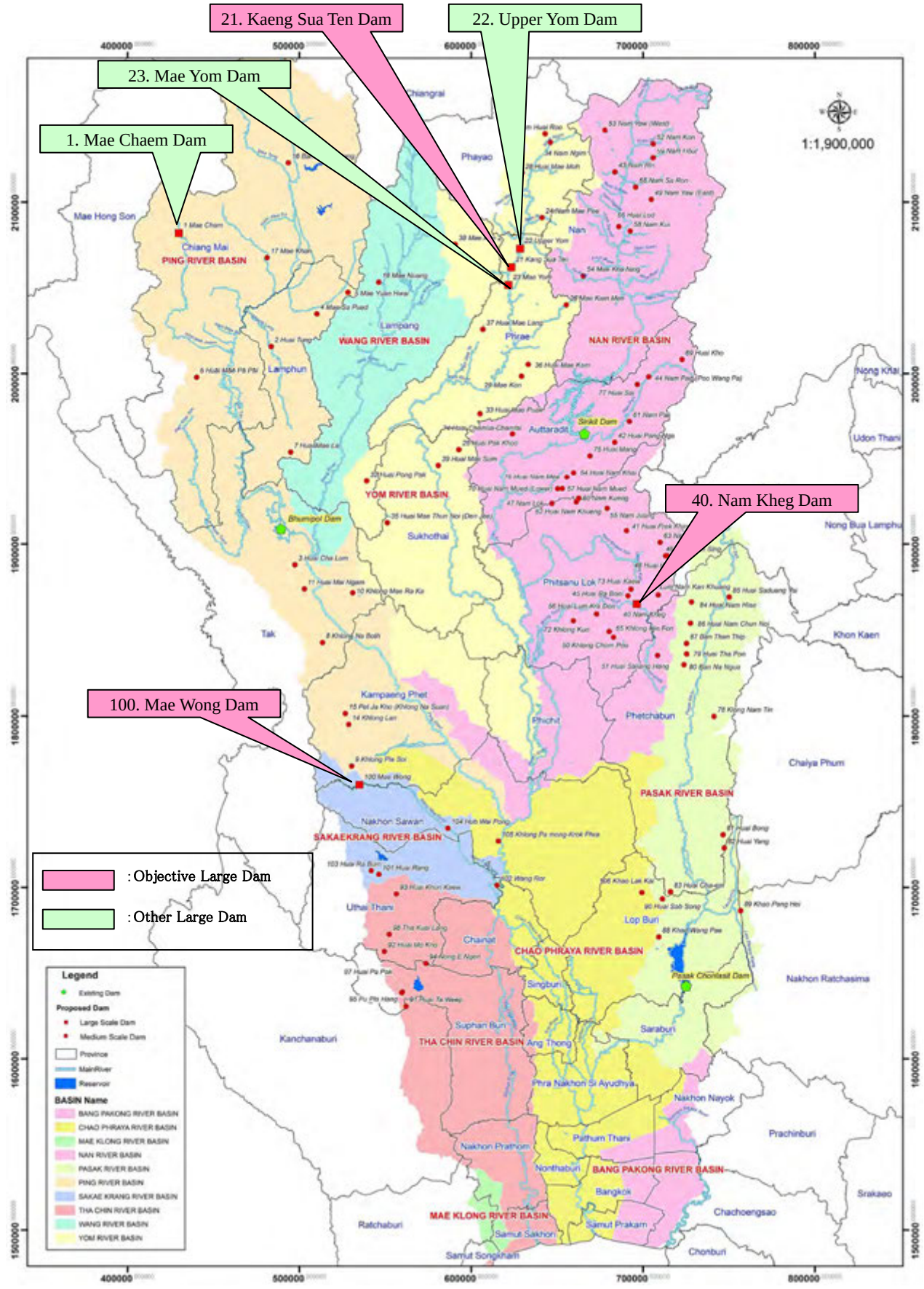

Figure H1.2.1 Location Map of Planned Dams

H1.3 Selection of Objective Dams

From the following reason, three (3) out of the six (6) large dams, Mae Cham, Upper and Lower Yom dams have been discarded and the remaining dams, Kaeng Sua Ten, Nam Kheg and Mae Wong Dams were selected as the objective dams. Salient features of the three (3) selected dams are summarized in Table H1.3.1.

- Since Mae Cham Dam is located upstream of Bhumibol Dam and its reservoir capacity is much smaller than that of Bhumibol Dam, significant flood mitigation effects are hardly expected.
- Upper Yom and Lower Yom dams are alternatives to Kaeng Sua Ten Dam.

Table H1.3.1 Salient Features of Planned Kaeng Sua Ten, Nam Kheg and Mae Wong Dams

No.	No.21	No.40	No.100
Main Features	Kaeng Sua Ten Dam	Nam Kheg Dam	Mae Wong Dam
River	Yom River	Nan River	Sakae Krang River
Dam Type	Rockfill (Concrete-faced)	Rockfill	Rockfill
Dam height（m）	69.00	128.0	56.00
Length of Dam（m）	540.00	757	903.02
Catchment Area（km^2）	3,538.00	936.75	612.00
Reservoir Area（km^2）	66.78	11.16	17.60
Elevation of Dam Crest（m M.S.L）	261.00	538.00	210.00
Normal High Water（m M.S.L）	258.00	529.50	204.50
Lowest Water Level（m M.S.L）	218.00	421.4	180.00
Storage Capacity at Normal High Water（MCM）	1,175.00	550.25	258.00
Storage Capacity at Lowest Water Level（MCM）	50.00	7.45	20.00
Effective Storage Capacity（MCM）	1,125.00	542.80	238.00
Maximum Discharge of Spillway（m^3/sec）	5,355 (Radial Gate×4)	-	1,449 (Radial Gate×3)
Elevation of Crest of Spillway（m M.S.L）	245.00	-	197.60
Maximum Discharge of Intake Conduit（m^3/sec）	-	-	-
Elevation of Center of Intake Conduit（m M.S.L）	-	-	-
Power Output（MW）	-	-	-
Irrigation Area（rai）	774,000		251,900
Present Status	D/D completed	Desk Plan	D/D Completed

Level (m.MSL)	Area (km2)	Storage (MCM)
191.50	0.000	0.000
195.00	0.180	0.500
200.00	0.430	1.220
205.00	1.720	13.110
207.50	2.360	19.060
210.00	3.000	25.000
220.00	7.300	58.100
230.00	15.970	171.710
240.00	28.000	400.000
245.00	36.000	560.000
250.00	42.860	760.000
255.00	53.500	1,000.000
258.00	66.780	1,175.000
260.00	70.000	1,360.000

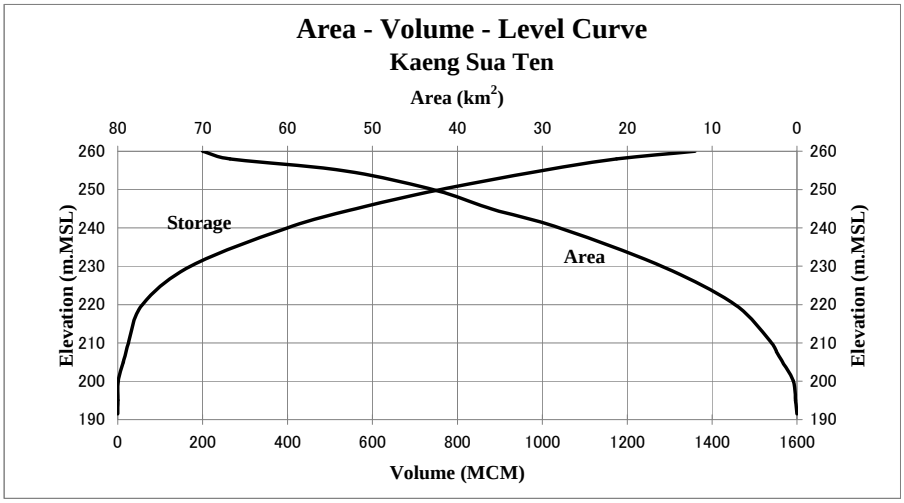

Figure H1.3.1 Water Level – Storage Volume Curve for Kaeng Sua Ten Dam

Level (m.MSL)	Area (km2)	Storage (MCM)
160.0	0.000	0.000
170.0	0.750	3.000
175.0	1.690	8.320
180.0	3.250	20.660
185.0	5.450	42.410
190.0	7.990	76.020
195.0	11.060	123.640
200.0	14.120	186.600
204.5	17.410	257.550
205.0	17.770	266.340
207.5	19.510	312.940
210.0	21.180	363.790

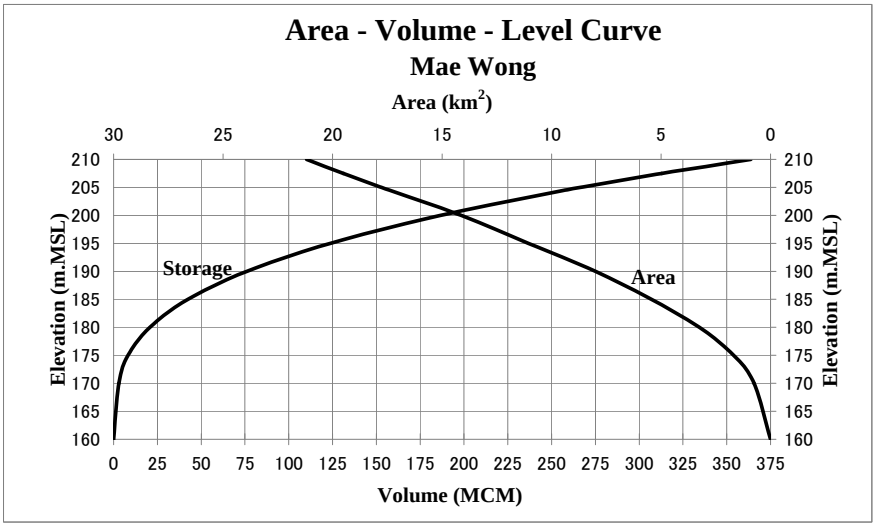

Figure H1.3.2 Water Level – Storage Volume Curve for Mae Wong Dam

H1.4 Study on Flood Mitigation Effect of Kaeng Sua Ten Dam

In the same way as the study on the reservoir operation of the existing dams, the dam reservoir operation of Kaeng Sua Ten Dam for flood mitigation has been examined.

(1) Reservoir Operation for Flood Mitigation

The reservoir operation method where flood inflow from August to October is cut by a constant outflow has been examined.

(2) Simulation Conditions

Model Flood

The 2011 flood was used as the model flood. Inflow to the reservoir was estimated by modifying the observed discharge data of the nearby station Y2.

Table H1.4.1 Inflow to Kaeng Sua Ten Dam in 2011

Dam	Inflow (MCM)					
	June	July	August	September	October	Total
Kaeng Sua Ten	416	409	916	577	372	2,690

Reservoir Operation for Flood Mitigation

Concepts of the reservoir operation for flood mitigation are as follows:

- From August to October, flood inflow discharge is stored in the reservoir with a constant outflow.
- From May to July, outflow is in principle the same as the inflow ("IN = OUT")
- The discharge capacity of the outlet conduit is so small that it is impossible to release as much water as the inflow during a flood. When the water level reaches the crest level of the spillway, 245 m MSL (Storage Capacity: 560 MCM), flood inflow is released through the spillway (4 radial gates).

Study Cases

Since the required outflow of Kaeng Sua Ten Dam in the dry season has not been determined yet, it is assumed that 80% of the effective storage capacity is assured as flood mitigation volume.

Table H1.4.2 Proposed Reservoir Operation of Kaeng Sua Ten Dam for Flood Mitigation

Dam	Case	Outflow		Storage Capacity as of May 1 (Sedimentation Capacity included)	Water Level as of May 1
		May to July	Aug.to Oct.		
Kaeng Sua Ten	Case 1	May to July: IN=OUT Excessive inflow over 100 m^3/s, capacity of outlet conduit is stored.	220m^3/s (from Spillway)	275 MCM	234.5 m MSL

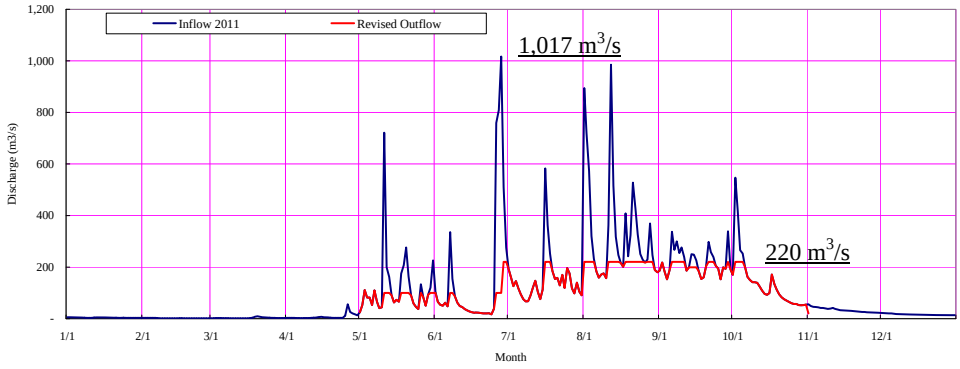

Figure H1.4.1 Proposed Flood Regulation Plan for Kaeng Sua Ten Dam (2011 Flood)

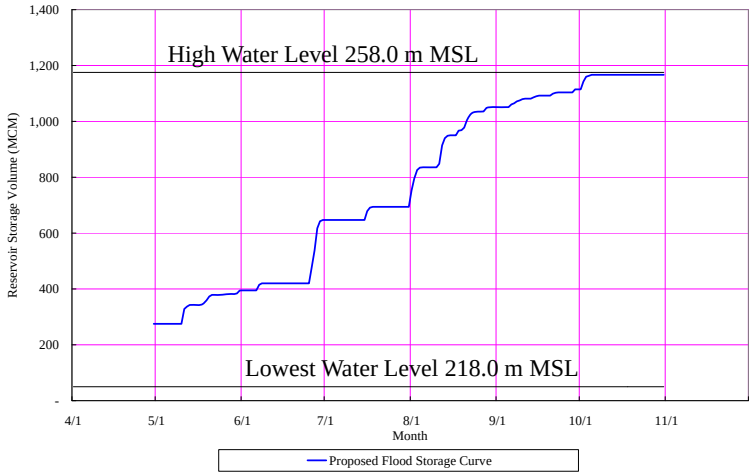

Figure H1.4.2 Proposed Reservoir Operation Plan for Flood Mitigation of Kaeng Sua Ten Dam (2011 Flood)

H1.5 Study on Flood Mitigation Effect of Nam Kheg Dam

In the same way as the study on the reservoir operation of the existing dams, the dam reservoir operation for flood mitigation of Nam Kheg Dam has been examined.

(1) Reservoir Operation for Flood Mitigation

A reservoir operation method where flood inflow from August to October is cut by a constant outflow has been examined.

(2) Simulation Conditions

Model Flood

The 2011 flood was used as a model flood. Inflow to the reservoir was estimated by modifying the observed discharge data of the nearby station N24A.

Table H1.5.1 Inflow to Nam Kheg Dam in 2011

Dam	Inflow (MCM)					
	June	July	August	September	October	Total
Nam Kheg	69	81	154	290	99	693

Reservoir Operation for Flood Mitigation

Concepts of the reservoir operation for flood mitigation are as follows:

- While Nan Kheg Dam has a reservoir capacity of 542.8 MCM, flood inflow between August to October is 543MCM. Therefore, it is possible to store almost all inflow from August to October.
- As environmental flow, the minimum outflow 15m^3/s (1.5 $m^3/s/km^2$) is ensured.

Study Cases

Since the required outflow of Nam Kheg Dam in the dry season has not been determined yet, it is assumed that 80% of the effective storage capacity is assured as flood mitigation volume.

Table H1.5.2 Proposed Reservoir Operation for Flood Mitigation of Nam Kheg Dam

Dam	Case	Outflow		Storage Capacity as of May 1 (Sedimentation Capacity included)	Water Level as of May 1
		May to July	Aug.to Oct.		
Nam Kheg	Case 1	May to June: IN=OUT	15m^3/s	116 MCM	–

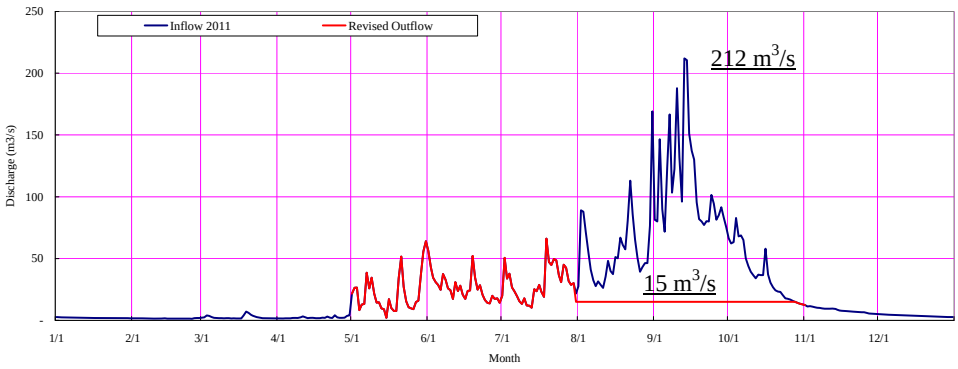

Figure H1.5.1 Proposed Flood Regulation Plan for Nam Kheg Dam (2011 Flood)

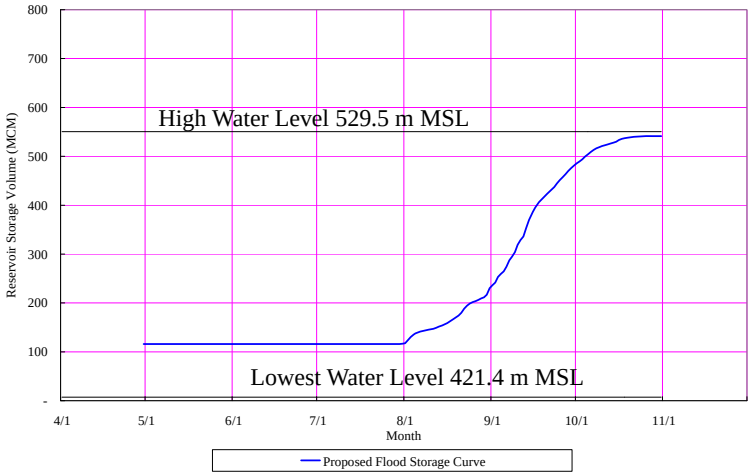

Figure H1.5.2 Proposed Reservoir Operation Plan for Flood Mitigation of Nam Kheg Dam (2011 Flood)

H1.6 Study on Flood Mitigation Effect of Mae Wong Dam

In the same way as the study on the reservoir operation of the existing dams, the dam reservoir operation for flood mitigation of Mae Wong Dam has been examined.

(1) Reservoir Operation for Flood Mitigation

A reservoir operation method where flood inflow from August to October is cut by a constant outflow has been examined.

(2) Simulation Conditions

Model Flood

The 2011 flood was used as a model flood. Inflow to the reservoir was estimated by runoff analysis.

Table H1.6.1 Inflow to Mae Wong Dam in 2011

Dam	Inflow (MCM)					
	June	July	August	September	October	Total
Mae Wong	39	58	61	131	89	378

Reservoir Operation for Flood Mitigation

Concepts of the reservoir operation for flood mitigation are as follows:

- From August to October, flood inflow discharge is stored in the reservoir with a constant outflow.
- From May to July, outflow is in principle the same as the inflow (“IN=OUT”)

Study Cases

Since the required outflow of Mae Wong Dam in the dry season has not been determined yet, it is assumed that 80% of the effective storage capacity is assured as flood mitigation volume.

Table H1.6.2 Proposed Reservoir Operation for Flood Mitigation of Mae Wong Dam

Dam	Case	Outflow		Storage Capacity as of May 1 (Sedimentation Capacity included)	Water Level as of May 1
		May to July	Aug.to Oct.		
Mae Wong	Case 1	May to July : IN=OUT	12m^3/s	67.6 MCM	188.7 m

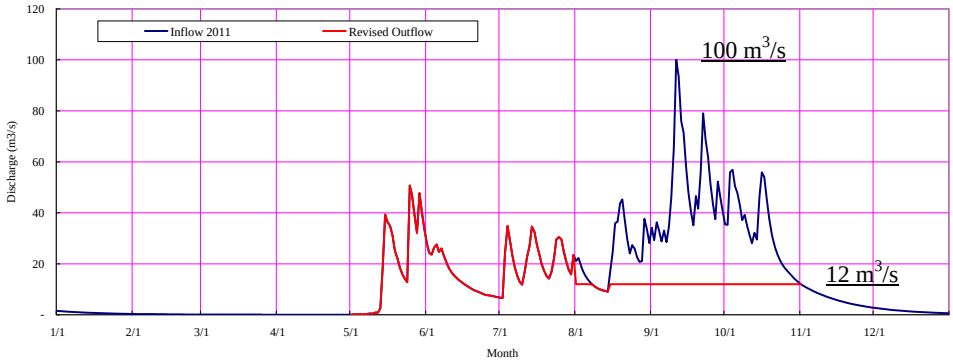

Figure H1.6.1 Proposed Flood Regulation Plan for Mae Wong Dam (2011 Flood)

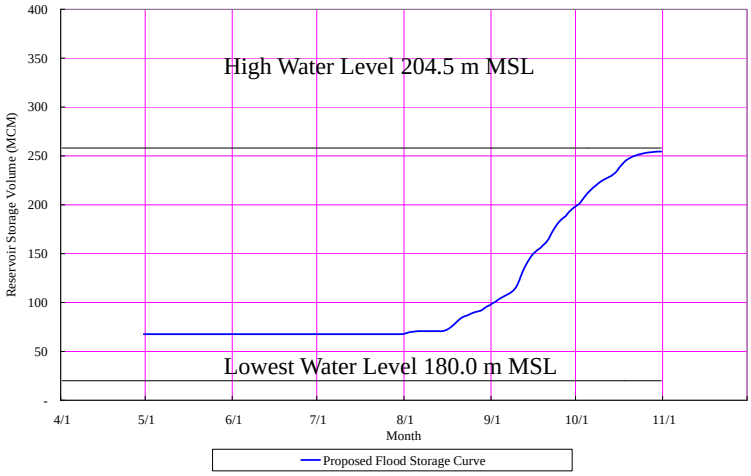

Figure H1.6.2 Proposed Reservoir Operation Plan for Flood Mitigation of Mae Wong Dam (2011 Flood)

Sector I: Retarding and Retention Area

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

FINAL REPORT
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CHAPTER I1 STUDY ON RETARDING AND RETENTION AREAS

I1.1 General

The master plan of the Government of Thailand for the upper reach of Nakhon Sawan and the vicinity of Ayutthaya retention areas (about 2,000 km²) have been planned and examined. These retarding areas are located in low-lying areas having functions as natural retarding areas.

Among the retarding areas, those areas with artificial flood control functions are called as "Monkey Cheek." Natural retarding areas have been assessed and optimum operation methods for Monkey Cheeks (methods of flood flow reduction, embankment, gates and pumps) have been studied.

As for the Lake Bung Bora Pet which is located at the northeast of Nakhon Sawan, effective improvement for the lake hae been studied to utilize the area as a retention area providing with embankment and facilities to regulate flood flows.

According to the "Feasibility Study on the Development of Flood Low Lands in Chao Phraya Basin (2009)," RID has proposed to establish a total of 13 retarding basins (Monkey Cheek) including 5 locations in the northern part of Nakhon Sawan and 8 locations in Ayutthaya and the vicinities. Table I1.1.1 summarizes the proposed retarding basins and Figure I1.1.1 shows the location of each retarding basin (Monkey Cheek).

Table I1.1.1 Design Storage Volume of Monkey Cheek

No	Retarding Basin (Monkey Cheek)		Design Storage Volume (Million m^3)		Submerged Level (m MSL)
N1	Northern Part of Nakhon Sawan	Tha Bau District (East Side)	233		25.0
N2		Tha Bau District (West Side)	238		25.5
N3		Dong Set Thi District (South Side)	240	57	30.5
				183	31.0
N4		Dong Set Thi District (North Side)	147	25	37.5
				50	37.0
				72	36.0
N5		Phai Chum Phon District	303	99	39.0
				85	38.0
				74	36.0
				45	36.0
Sub Total			1,161		
C1	Northern Part of Ayutthaya	Bang Ban District (North-West Side)	126	54	5.0
				35	5.2
				37	5.8
C2		Phak Hai District (East Side)	125	51	5.0
				74	5.0
C3		Phak Hai District (West Side)	257		4.0
C4		Bang Ban District (South Side)	279		4.0
C5		Reong Rang District	257	172	5.0
				85	8.0
C6		Maharat District	249	124	6.0
				23	7.0
				102	7.0
C7		Khok Krathiam District	259	10	6.0
				249	7.0
C8		Yang Mani District	186		7.0
Sub Total			1,738		
Total			2,899		

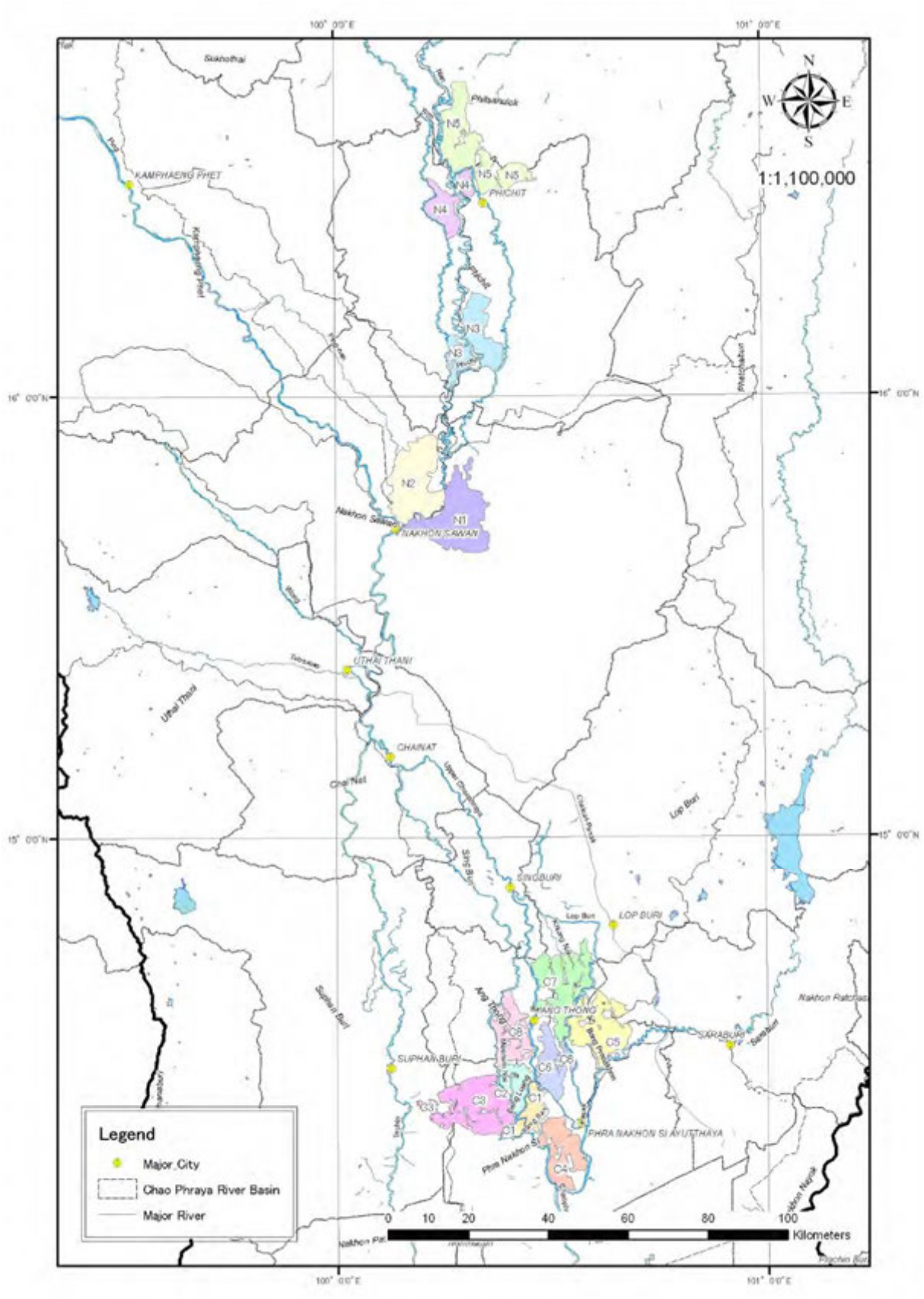


Figure I1.1.1 Location of Retention Areas Planned by RID

I1.2 Preliminary Study on Flood Control Effects

The Inundation Model (as of October 1st, 2012), which is currently under calibration phase, was used to examine the effectiveness of the retention area/retarding basin in terms of a method of flood control at Nakhon Sawan. The examination results are shown below.

- Target Flood is the 2011 Flood and calculation period is for 7 months starting from the 1st June to the 31st December.
- The operation rule of retarding basin is set as "during the 3 months flooding period starting from August to October, flooded water shall be drained from the river channels to retarding basin/retention area (1) by natural gradient and (2) by pumps.

As a result of the examination shon in Figure I1.2.1 and Figure I1.2.2, retarding basins can reduce (1) flood volume by 170 m^3/s and (2) water level by 9 cm at Nakhon Sawan.

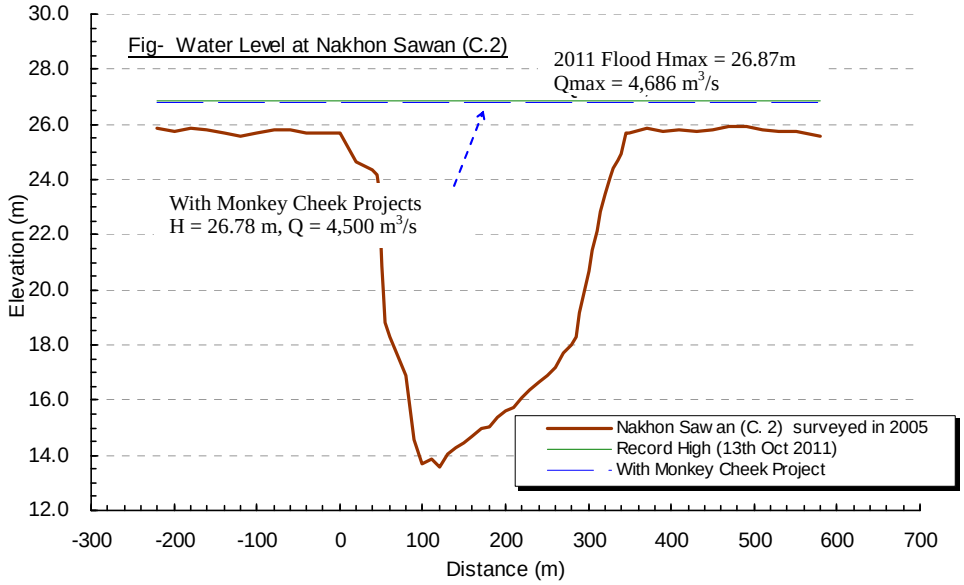


Figure I1.2.1 Flood Control Effects with Retention Areas (Results of Trial Calculation)

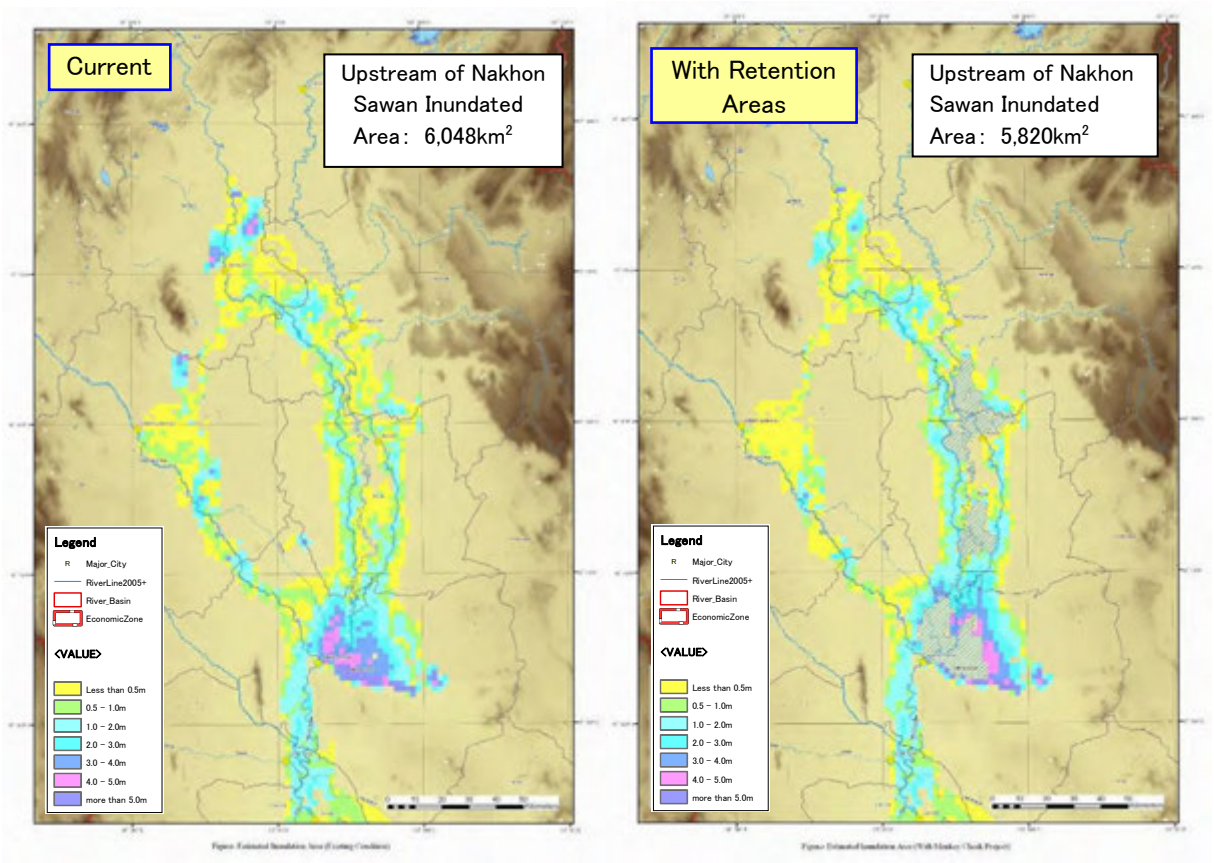


Figure I1.2.2 Assumed Inundation Area (Result of Calculation)

I1.3 Operation Rule

The Chao Phraya River tends to have a prolonged flooding period and it is challenging to estimate flood hydrographs. For such flood pattern, establishing only one operational rule on "how to operate and control the retention areas/retarding basins" is neither effective nor practical. It is also true that the operational rule set to be effective for the 2011 flood event does not always have effect or impact on the other significant flooding events such as the floods in 1995 and 2006. In addition, since the stored water in retention areas/retarding basins is often utilized for irrigation and dry-field cropping, it is not practical if the operational rule focuses only on flood control. Therefore, it is necessary to establish the operational rule which considers both flood control and irrigation usage.

The proposed retention areas/retarding basins are classified into two categories: (i) irrigated area; and (ii) rainfed paddy field area, as summarized in Table I1.3.1. The period for water storage varies based on the paddy field types; therefore, the flood control effects have been examined by applying various storage curves corresponding to each paddy field type in retention areas/retarding basins.

Table I1.3.1 Variation in Water Storage Period based on Cropping Type

Paddy Field Type	Monkey Cheeks	Water Storage Periods
Irrigated Area	N3、N4、C1~C8 (Total 10 Monkey Cheeks)	・**May to August**: cultivate rice season → Flood Control is difficult ・**September to October**: store water for dry season → capable to include flood control volume, the government recommends farmers to refrain from cropping between September to November. ・**October to November**: prepare for cropping by releasing the stored water from reservoir between the end of November to December. The retention areas/retarding basins shall be completely drained and completely dried during the dry season.
Rainfed Paddy Field Area	N1、N2、N5 (Total 3 Monkey Cheek)	・**May to August**: wet-field rice cultivation and dry-field crop season → Flood control is difficult. ・**Dry Season**: wet-field rice and cultivation and dry-field crop. In June, ploughing and irrigating the field will start. ・Water storing period is 10 months, longer than the Monkey Cheeks within the irrigated areas, starting from September to June in the next year.

I1.4 Method to Drain Flood Water into Retention Area

The methods to drain flood waters from the river channels to retarding basins are: (i) by pump; and (ii) by gates as shown in Figure I1.4.1. With the gate operation method, the model tends to be unstable having the complicated modeling procedure. To stabilize and simplify the flood analysis model, gate operation has not been considered in this study. Also, since the storage volume of the retention area fluctuats quickly due to inflow of inundated water from outside of the area, it is difficult to establish the proper pump operation rule. Therefore, virtual retarding ponds with design storage volume were built in the flood analysis model, and effectiveness of reteintion area was exmanied.

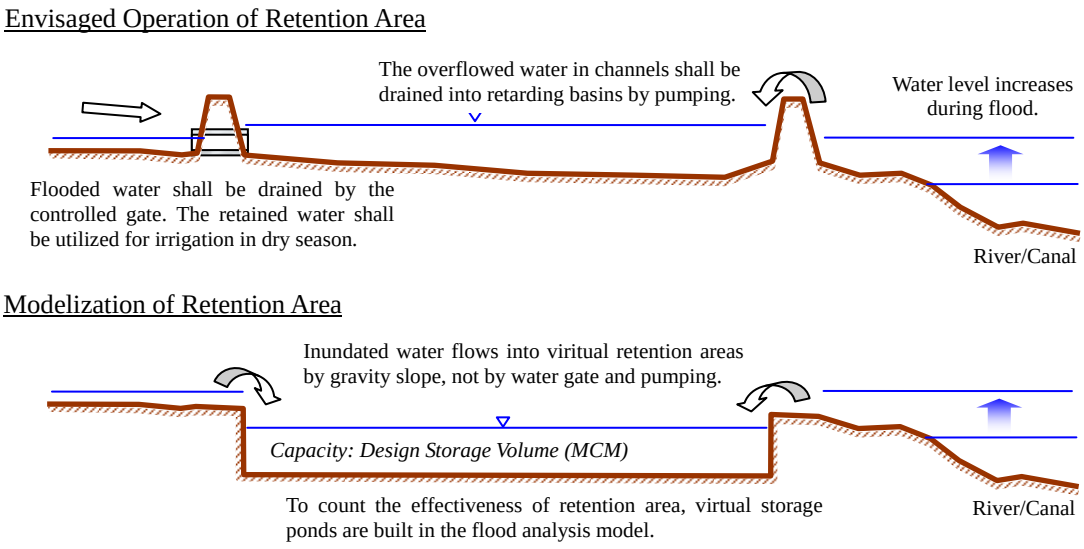
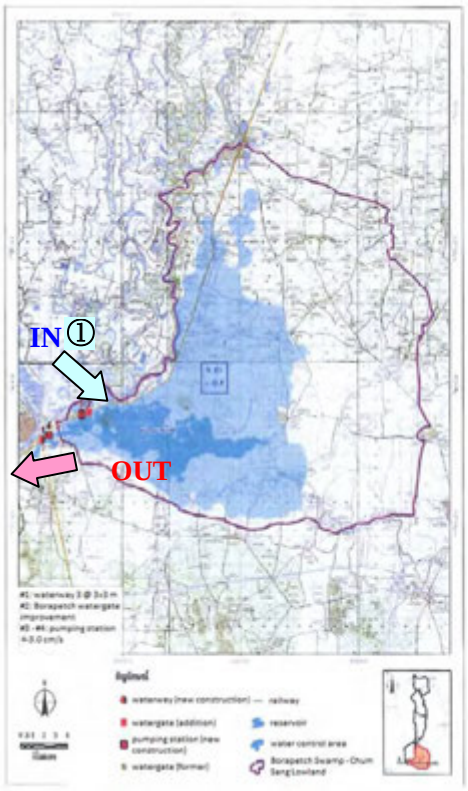
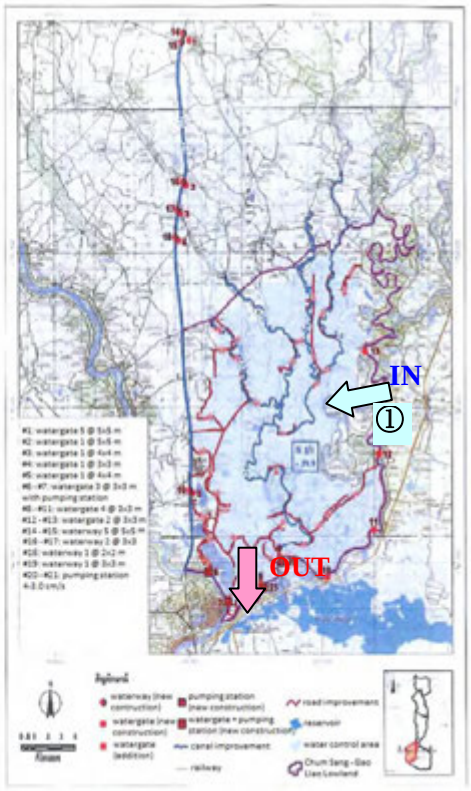


Figure I1.4.1 Method to Drain Flood Water into Retarding Basins



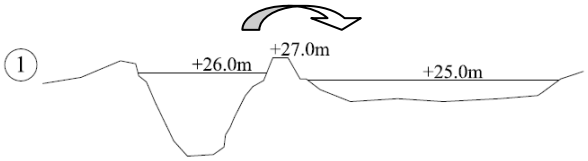


N1 Boraphet Swamp – Chum Sang

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
219	25.0	233	1.1	26.0

N2 Chum Sang – Gao Liao

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
165	26.0	238	1.4	27.0



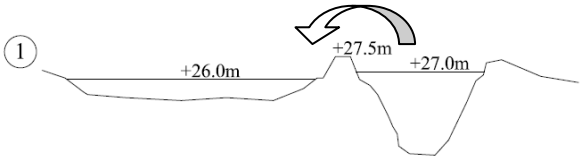
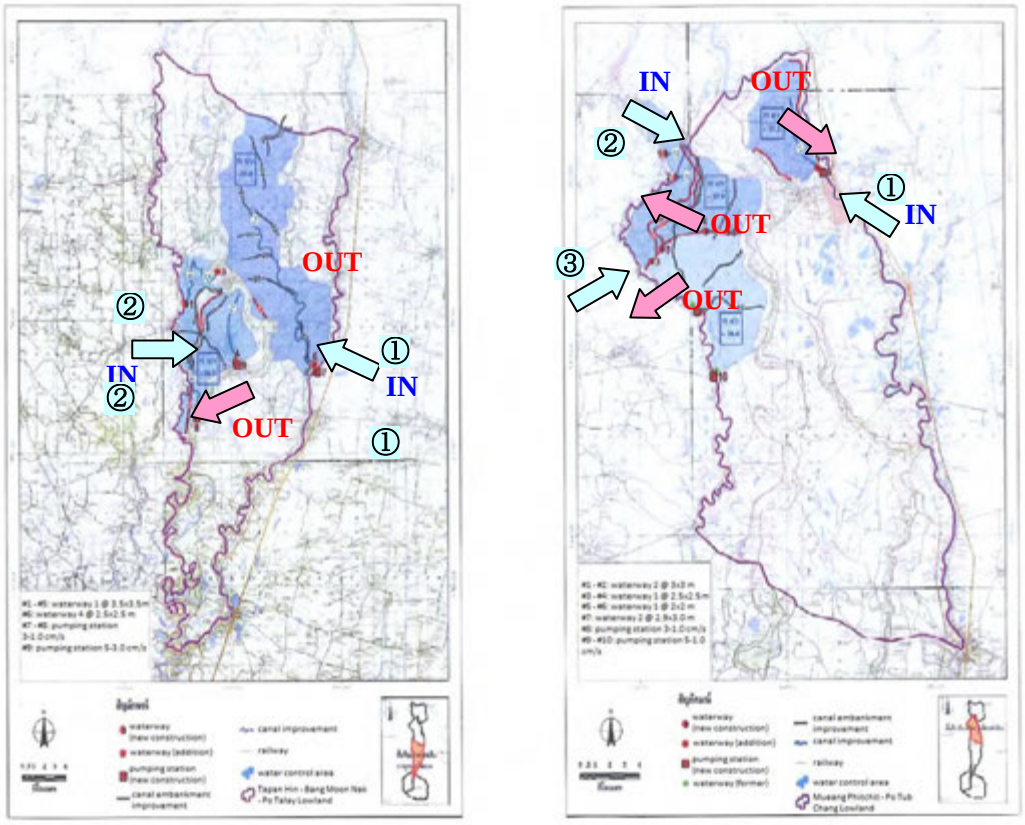


Figure I1.4.2 Retention Area Located North of Nakhon Sawan N1 and N2 (Proposed)



N3 Tapan Hin – Bang Moon Nak – Po Talay

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
147	30.5	57	1.6	31.0
	31.0	183		31.5

N4 Mueang Phitchit – Po Tab Chang

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
86	37.5	25	1.7	38.0
	37.0	50		37.5
	36.0	72		36.5

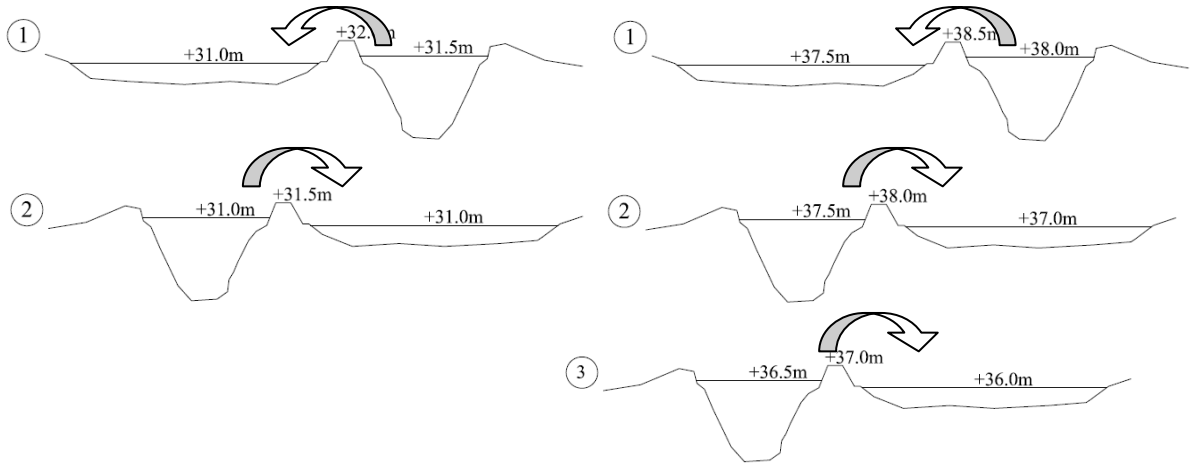
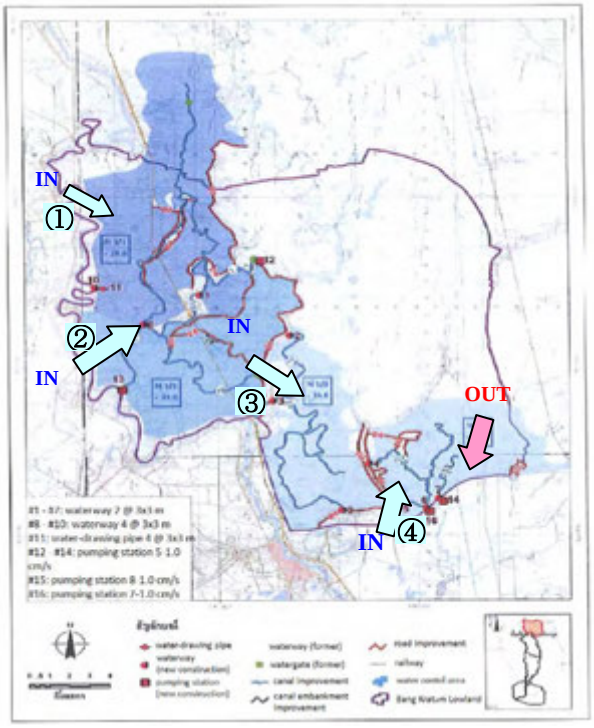


Figure I1.4.3 Retention Area Located North of Nakhon Sawan N3 and N4 (Proposed)



N5 Bang Kratum

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
209	39.0	99	1.2	39.5
	38.0	85		38.5
	36.0	74		37.5
	36.0	45		37.5

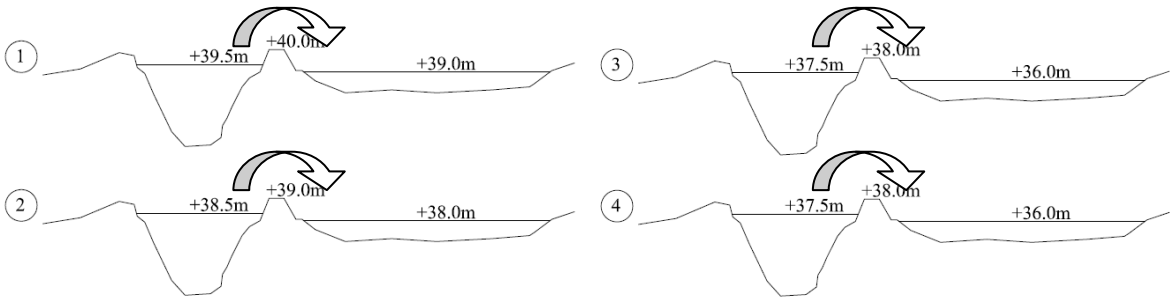
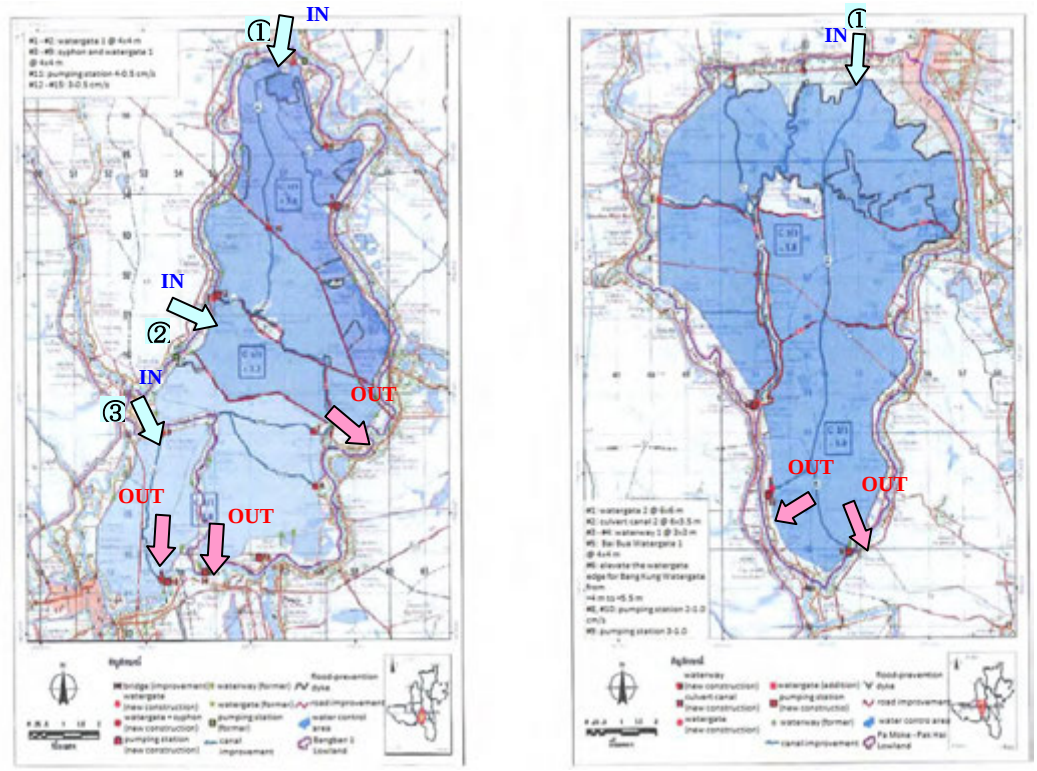


Figure I1.4.4 Retention Area Located North of Nakhon Sawan N5 (Proposed)



C1 Bang Ban 1

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
52	5.0	54	2.4	5.5
	5.2	35		6.1
	5.8	37		6.3

C2 Pa Moke – Phak Hai

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
190	5.0	51	0.7	5.5
	5.0	74		5.5

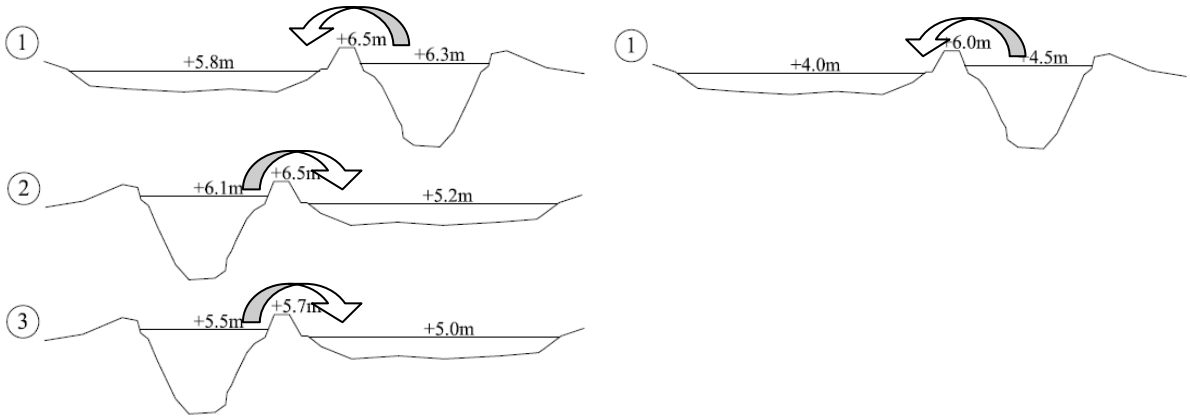
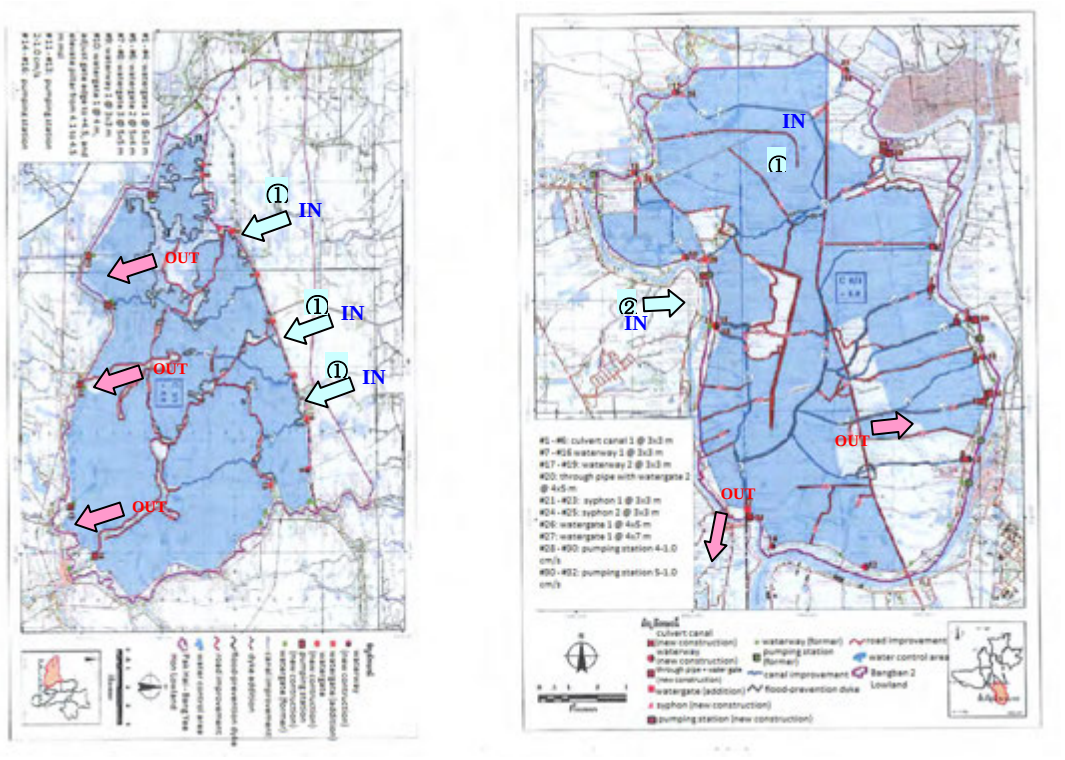


Figure I1.4.5 Retention Area Located at Vicinity of Ayutthaya C1 and C2 (Proposed)



C3 Phak Hai – Bang Yeehon

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
190	4.0	257	1.4	4.5

C4 Bang Ban 2

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
117	4.0	279	2.4	4.5

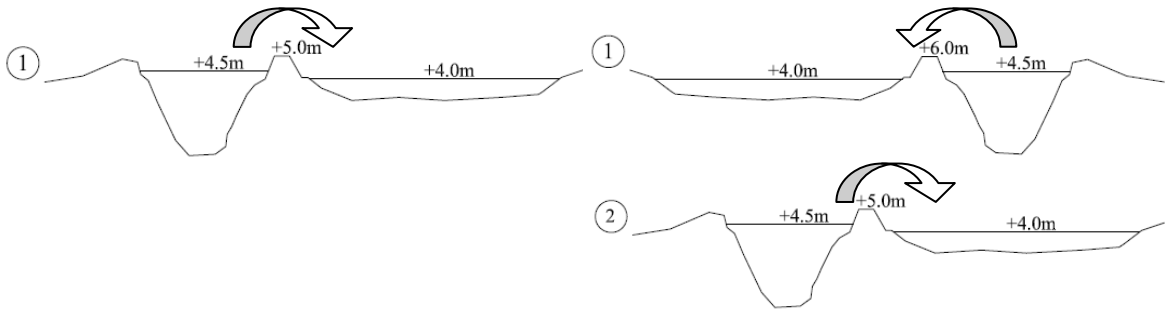
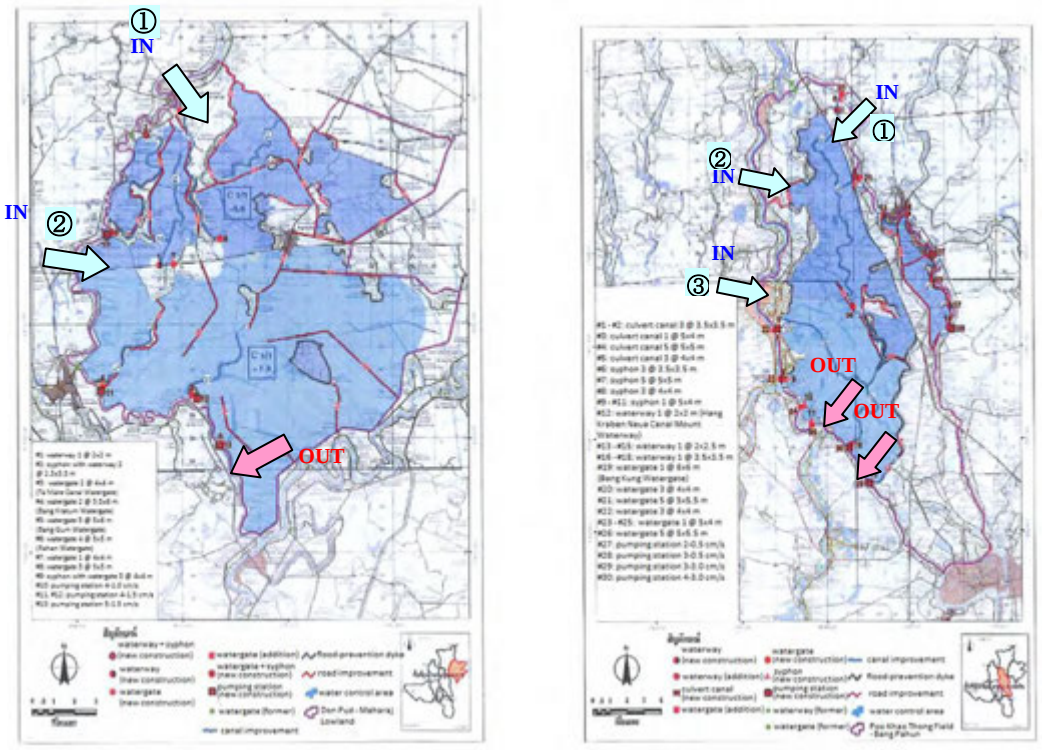


Figure I1.4.6 Retention Area Located at Vicinity of Ayutthaya C3 and C4 (Proposed)



C5 Don Pud – Maharaj

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
152	7.0	172	1.7	8.0
	8.0	85		8.5

C6 Tung Pookhao Thong–Bang Pahun

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
89	6.0	124	2.8	7.0
	7.0	23		8.0
	7.0	102		8.0

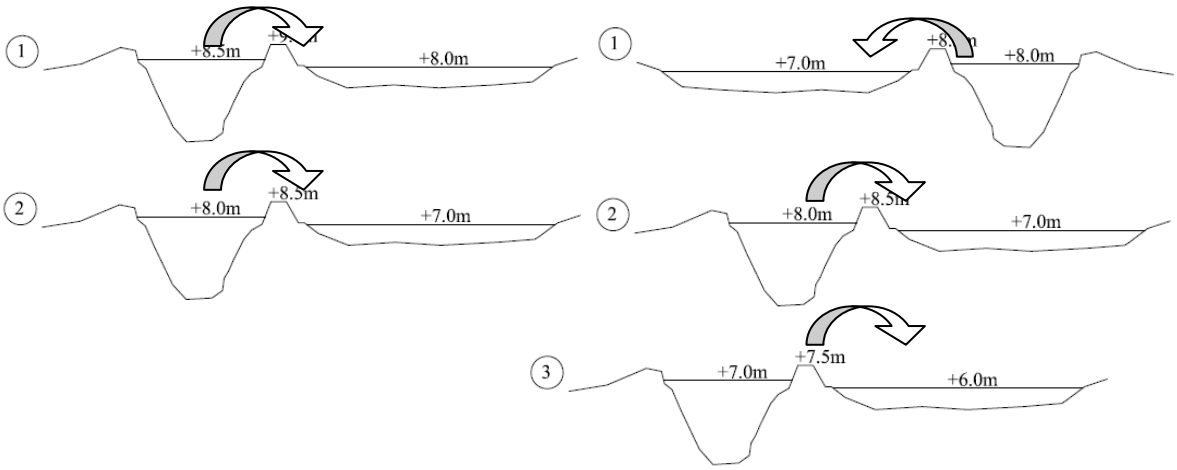
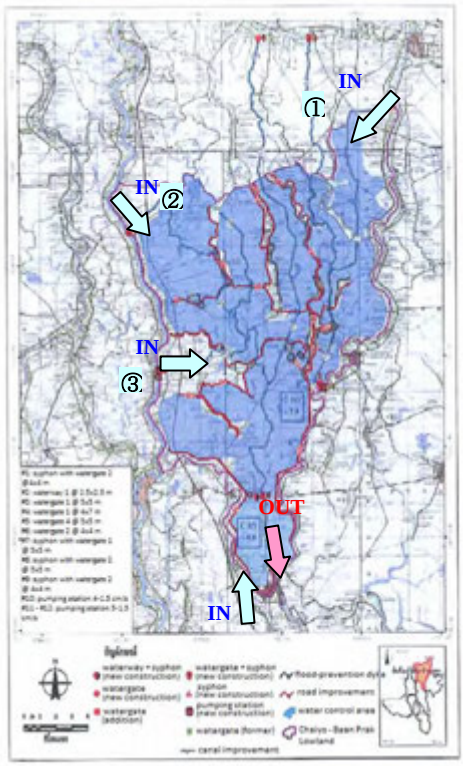
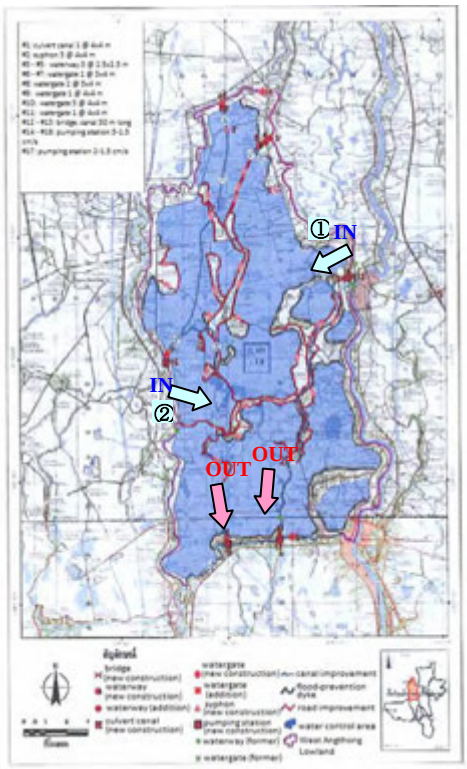


Figure I1.4.7 Retention Area Located at Vicinity of Ayutthaya C5 and C6 (Proposed)





C7 Chaiyo – Baan Prak

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
166	6.0	10	1.6	7.5
	7.0	249		8.5
	7.0			8.5

C8 Angthong (West side)

Retention Area (km^2)	Retention Level (m msl)	Capacity (MCM)	Average Water Depth (m)	River Water Level (m msl)
99	7.0	186	1.9	9.0
	7.0			8.5

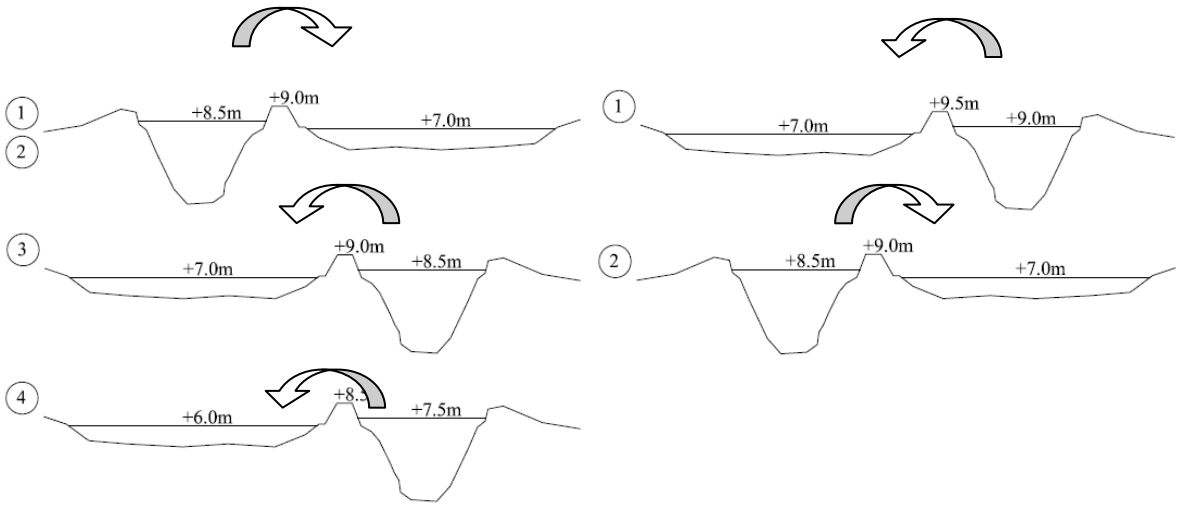


Figure I1.4.8 Retention Area Located at Vicinity of Ayutthaya C7 and C8 (Proposed)

Sector J: Construction of Diversion Channel

PROJECT FOR THE COMPREHENSIVE FLOOD MANAGEMENT PLAN FOR THE CHAO PHRAYA RIVER BASIN

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CHAPTER J1 OUTER RING ROAD DIVERSION CHANNEL

As a result of the hydraulic analyses, the Outer Ring Road Diversion Channel was proposed.

J1.1 Discharge

As defined in the hydraulic analyses, the design discharge was set at 1,000 m^3/s.

J1.2 Route

The diversion channel was designed connecting the lower part of Ayutthaya and the Gulf of Thailand. Since the layout of Outer Ring Road is not fixed at present, the diversion channel cannot be along it. Hence, the new and rectilinear route was proposed in order to apply the most effective hydraulic gradient. Geological features and land use were also considered with satellite photos, topographic maps in 1:50,000 scale, elevation data with 1:50:000 maps and LiDAR data to fix the route of the diversion channel.

J1.3 Field Reconnaissance

The preliminary route was confirmed with field reconnaissance. The findings in the field reconnaissance are bulletined and shown in the Fig. J1.3.1 and Fig. J1.3.2, then the revised route is shown in the Fig. J1.3.3.

- Major rivers around the diversion channel are connected with a canal along the coast of the Gulf of Thailand. Those rivers are drained into the gulf with pumping systems.
- The Route 34 will cross the diversion channel and the road is elevated at the crossing point.
- Railroads will be crossed at two points.
- The elevation of the middle-stream and downstream areas of preliminary route of the diversion channel is relatively low and a lot of houses and roads were submerged during the field reconnaissance.
- A lot of canals were confirmed along the preliminary route of the diversion channel. Most of them were excavated canal without an embankment. Many gates and pumps were also seen in the downstream area of the diversion channel.
- Large inhabited area, merchandise area, factories and ponds were seen in the upstream and middle-stream area. The route should be away from those area to reduce the impact of the project.

J1.4 Longitudinal Riverbed Gradient

Considering the existing ground slope and the standard cross section described below, the longitudinal river bed gradient was set at 1:44,700.

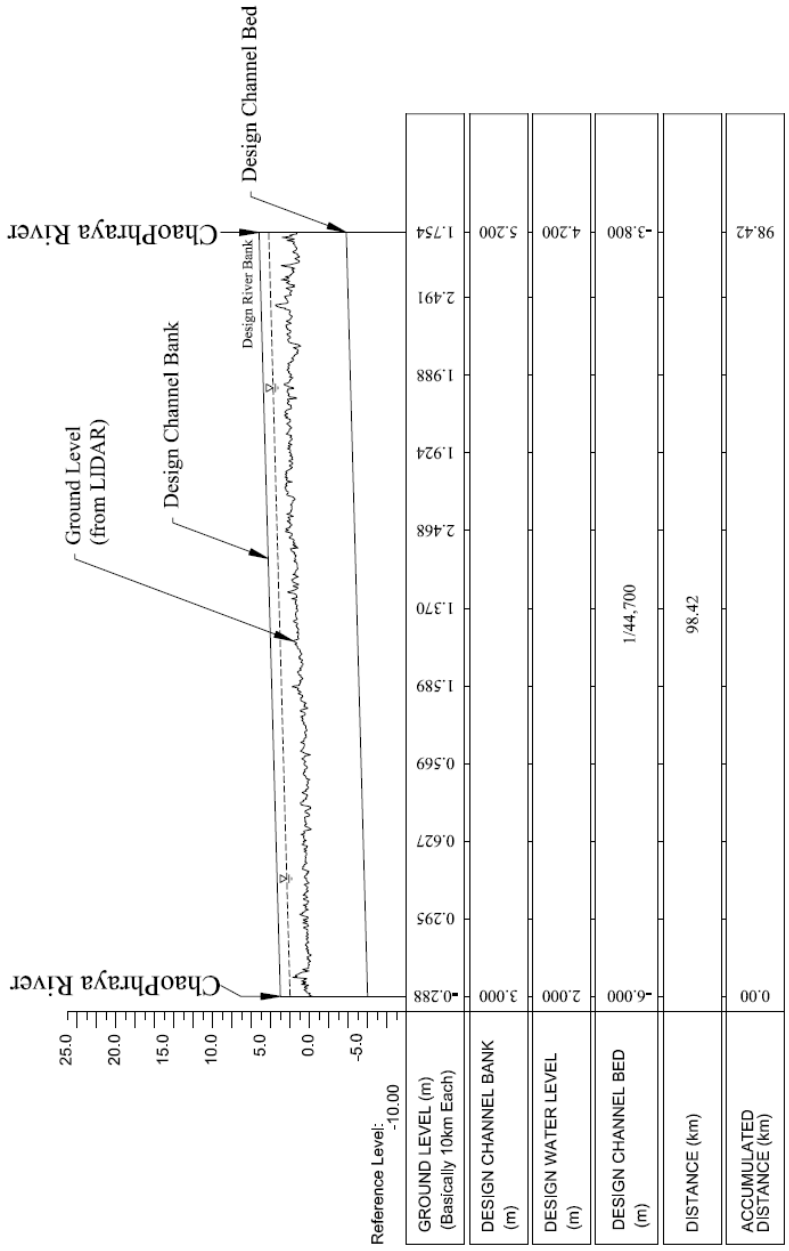

Figure J1.4.1 Longitudinal Profile of Outer Ring Road Diversion Channel

J1.5 Standard Cross Section

In order to lower the design water level, the cross section was mainly designed with excavation and small heightening of riverbanks was designed with an embankment. Lowering the water level is aiming at reducing the risk of the unexpected corruption of embankment since the rainy season in Thailand lasts for a couple of months with rise of water level. The effect of the inland storm water drainage is also large if the water level in the diversion channel is low.

J1.6 Bank Slope and Riverbed

In the feasibility study of the east floodway done by the Thai government, the slope of river bank was set at 1:2.0 in the upstream side and 1:3.0 in the downstream side, as distinguished by the Pasak River. In the Outer Ring Road Diversion Channel, the slope of the river bank was designed at 1:3.0 because the speed of water flow during floods would be small and soil of the ground is very week. Initially, two kinds of bank and river bed protection were proposed. One is the protection for only bank slope and the other is for both bank slope and river bed. Considering the difficulty of maintenance of the rigid and smooth surface of the river bed protection, the protection for only the bank slopes was selected.

J1.7 Pile Foundation

The lower part of the Chao Phraya River basin has an expansive low land with soft ground material. In the feasibility study report, a figure of soil distribution made by geotechnical and environmental research and development center in Kasetsart University, Thailand (refer to Fig. J1.7.1) was introduced and slope stability analyses were performed with additional boring sampling. According to the soil distribution figure, the lower stretches of the east floodway was covered by the Soft Bangkok Clay and the bank slopes and the roads were strengthened by two types of the foundation piles. One of the piles is a soil cemented column (SCC) with the diameter of 600mm, and the other is a stiffened deep cement mixing pile (SDCM) also with the diameter of 600mm. Details of those piles were not mentioned in the report but SDCM consists of the core (180mm x 180mm) in the center surrounded by SCC.

The other research on geomorphic characteristics of the Chao Phraya River basin done by Mr. Ohkura in National Research Center for Disaster Prevention, Japan and Ms. Haruyama in Institute of Science and Technology at Waseda University, Japan categorized the lower reach of the Chao Phraya River as lagoons and mud spits (refer to Fig. J1.7.2).

Hence, foundation piles are considered necessary to protect the stability of the bank slopes and the roads of the Outer Ring Road Diversion Channel. Since the soil distributions and the geomorphic characteristics along the Outer Ring Road Diversion Channel are similar to the one of the east floodway proposed by Thai government, the same design of the foundation piles was applied for the Outer Ring Road Diversion Channel.

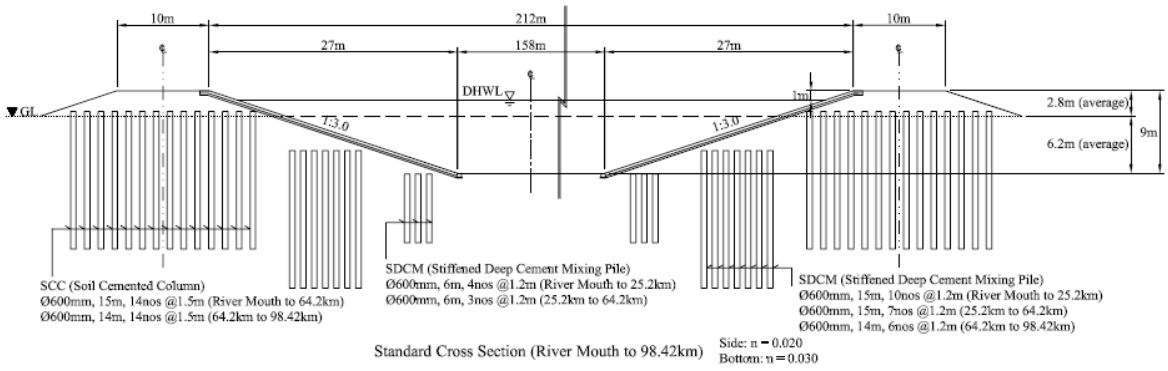

Figure J1.7.1 Standard Cross Section of Outer Ring Road Diversion Channel with Slope Protection

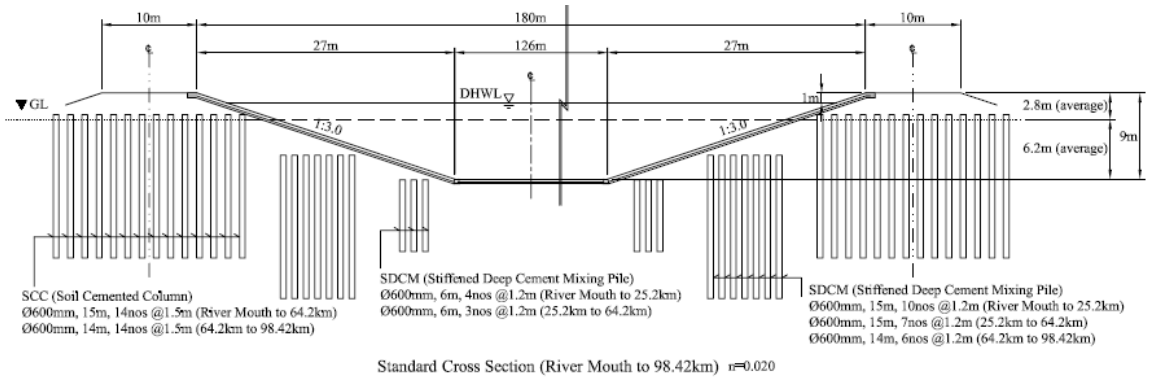

Figure J1.7.2 Alternative Cross Section of Outer Ring Road Diversion Channel with Slope and River Bed Protection

J1.8 Crossing Road

The diversion channel crosses a lot of roads so that bridges are required. Referring to the pitch of the bridges on Chainat-Pasak Irrigation Canal, which is at approximately 3km, 33 bridges along 98.3km of the diversion channel were proposed. These consist of 14 for national roads and 19 for supporting ones. The widths of bridges for the national roads were set to coincide with the crossing roads measured on the satellite photo and the ones for the supporting bridges were set at 7m, which is the minimum width for road bridge in a standard design of DOH.

J1.9 Crossing Canal and River

The diversion channel also crosses a lot of canals and rivers. All of them with the width of or more than 2m were connected with siphons. The widths of siphon were designed as those of canals and rivers. The height of the siphons was basically set at one-half of their widths and less than 10m.

Major rivers around the diversion channel are connected with a canal along the coast of the Gulf of Thailand. Those rivers are drained into the gulf with pumping systems. If the diversion channel is connected to one of the rivers or the canal, it places an extra stream on the existing pumping system. Hence, the diversion channel was connected to the Gulf of Thailand individually and the canal was connected with a siphon.

J1.10 Gate

The diversion channel is to drain river water to the sea smoothly during the flood so that the two gates, one at the diversion point and the other at the diversion channel mouth, are basically closed during ordinary time and open during the flood.

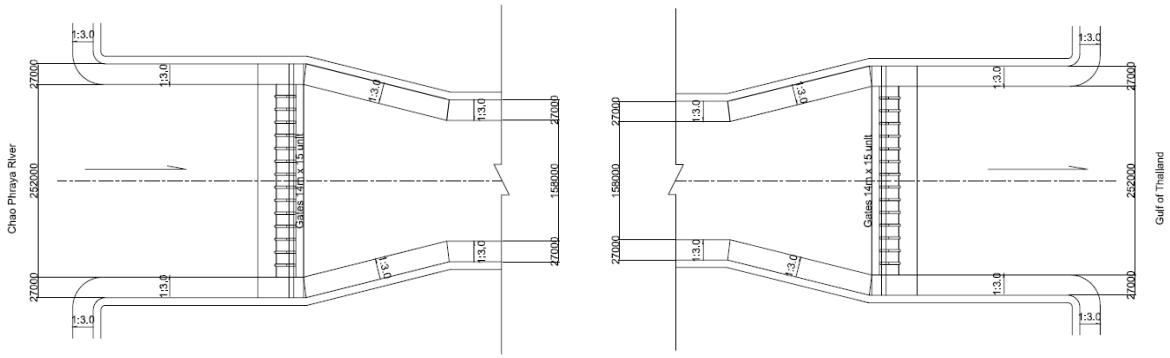

Figure J1.10.1 Gate at Diversion Point and Tidal Gate

CHAPTER J2 EAST DIVERSION CHANNEL

The design of the East Diversion Channel, which was not selected as the optimum measure in this master plan, is described in this chapter.

J2.1 Discharge

As examined in the hydraulic analyses, the design discharges were set at 1,000 m^3/s and 1,500 m^3/s.

J2.2 Route

The diversion channel was designed to connect the northern Chainat and the Gulf of Thailand. The route was proposed referring to the existing structures such as Chainat-Pasak irrigation canal, the feasibility study compiled by Thai government and geological features. Land use and the elevation of the ground were also considered with satellite photos, topographic maps in 1:50,000 scale, elevation data with 1:50:000 maps and LiDAR data to fix the preliminary route of the diversion channel. The diversion channel basically runs next to Chainat-Pasak irrigation canal and then goes to the Gulf of Thailand in a mostly linear manner.

J2.3 Field Reconnaissance

The preliminary route was confirmed with field reconnaissance. The findings in the field reconnaissance are bulletined and shown in the Fig. J2.3.1 and Fig. J2.3.2, then the revised route of the diversion channel is shown in Fig. J1.3.3.

- Upper part of the preliminary route is along the existing Chainat-Pasak irrigation canal.
- Land use around the route of diversion channel is mainly paddy field. Fishponds were seen in the downstream area.
- The Route 34 will cross the diversion channel and the road is elevated at the crossing point.
- Railroads will be crossed at three points.
- Large inhabitant area is spotted along the major roads.
- There is no significant gradient of the ground.
- The elevation of the ground in the downstream area is almost same with or up to 2m above the water level in the canals.
- Canals on the north side of Pasak River are much more likely to be with embankment and the ones on the south side of Pasak River tend to be in an excavated type.
- The route should not affect the tower of high voltage line and temples.
- There are many canals and rivers with the width of 10m to 20m.
- Large pond and industrial area with factories and transformers exists right on the north side of Pasak River and need to be circumvented.
- Lot of gates can be seen on the east side of the Chainat-Pasak irrigation canal
- Bank slope of Chainat-Pasak irrigation canal on the east side is not protected and the surface soil or grass was partially washed away.
- Government facilities, fire department, military area exist along Chainat-Pasak irrigation canal in Lop Buri city area. Those facilities should be circumvented and the route should be on the east side of them.

J2.4 Longitudinal Riverbed Gradient

Considering the existing ground slope and the standard cross section described below, the longitudinal riverbed gradients were set at 1:14,500, 1:5,300 and 1:94,000 from the top of the channel to the Gulf of Thailand.

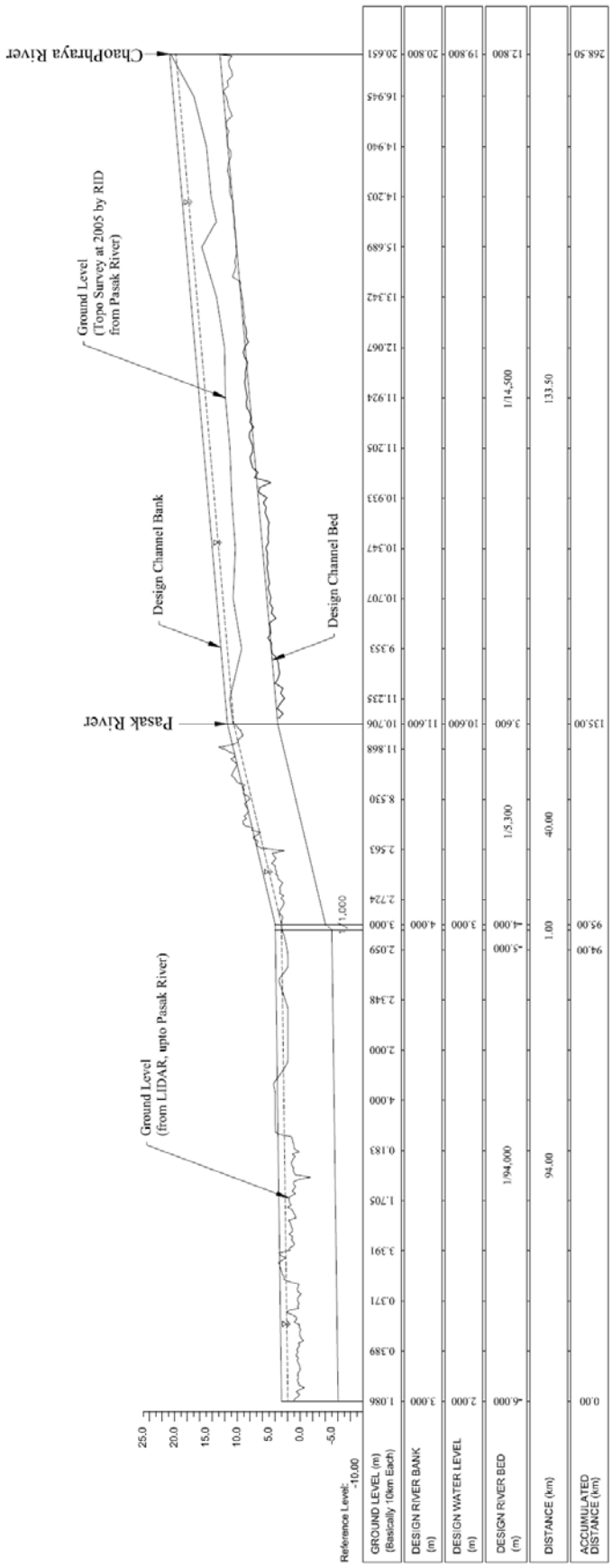

Figure J2.4.1 Longitudinal Profile of East Diversion Channel

J2.5 Standard Cross Section

For the same reason to the design of Outer Ring Road Diversion Channel, the cross section was mainly designed with excavation and small embankment.

J2.6 Bank Slope and Riverbed

In the same manner with the design of Outer Ring Road Diversion Channel, the protection only on the bank slopes was selected.

J2.7 Pile Foundation

The lower part of the Chao Phraya River basin has been evaluated in the feasibility study report of the east floodway compiled by Thai government. The same sets of pile foundation were proposed in the master plan.

J2.8 Additional Study on Cross Section

In order to reduce the excavation amount and to omit the tidal gate, the standard cross sections with more heightening by embankments and less excavation were studied. As a result, the distance of the discharge channel banks ranged from 604m to 1,724m, which is not suitable for the diversion channel since the environmental and social impact is quite large. Only for the reference purpose, the longitudinal profile and cross sections with the capacity of 1,000 m^3/s are shown in Fig. J2.8.1, Fig. J2.8.2, Fig. J2.8.3 and Fig. J2.8.4.

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	244	190
1,500	351	297

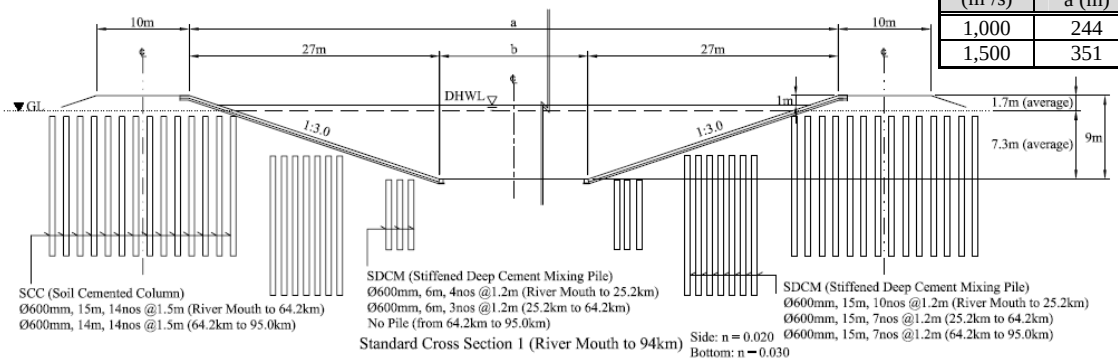

Figure J2.8.1 Standard Cross Section of East Diversion Channel with Slope Protection (0km to 94km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	113	65
1,500	156	108

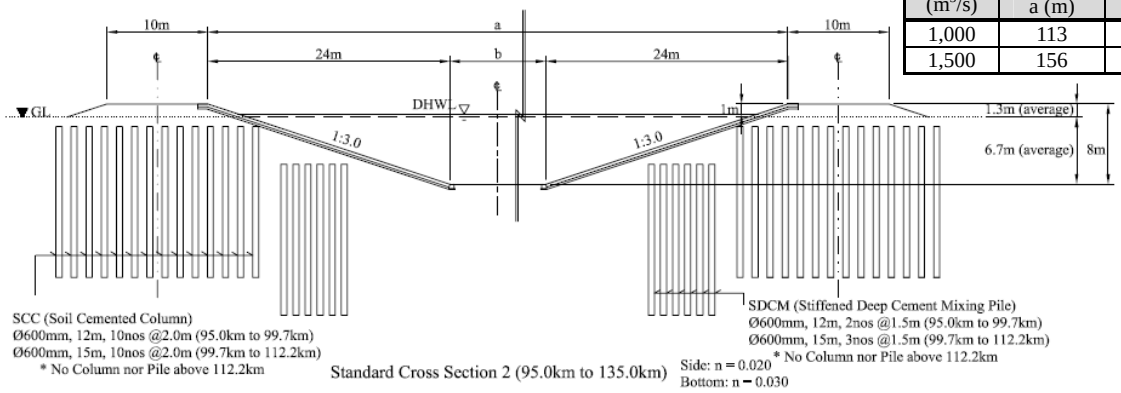

Figure J2.8.2 Standard Cross Section of East Diversion Channel with Slope Protection (95km to 135km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	163	115
1,500	231	183

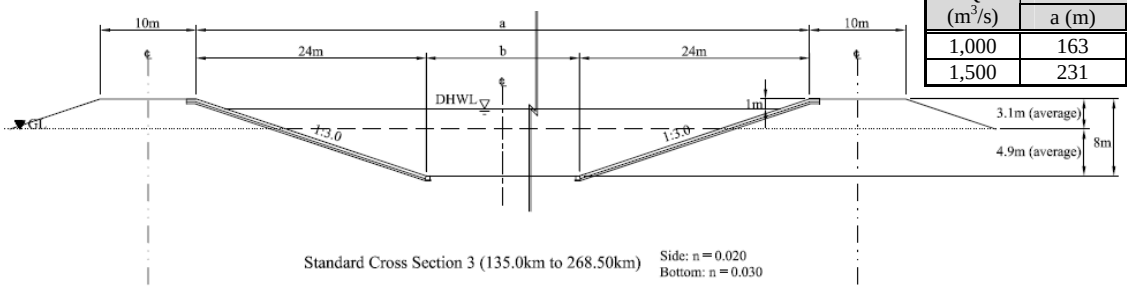

Figure J2.8.3 Standard Cross Section of East Diversion Channel with Slope Protection (135km to Diversion Point)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	204	150
1,500	291	237

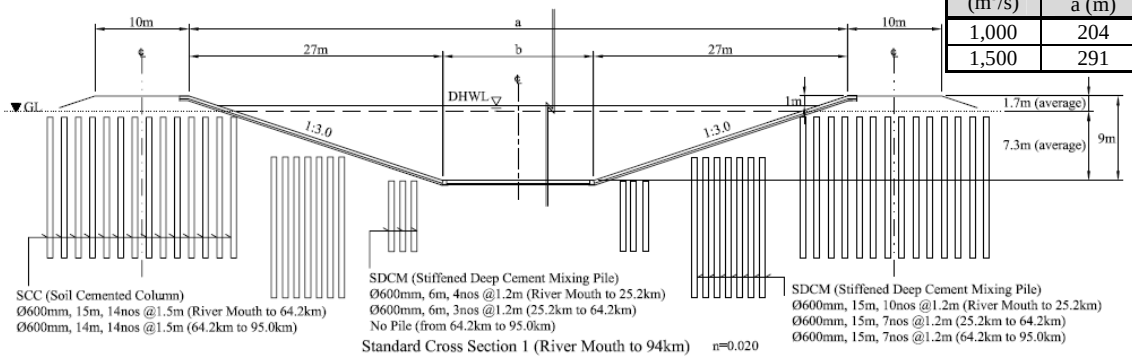

Figure J2.8.4 Alternative Cross Section of East Diversion Channel with Slope and Riverbed Protection (0km to 94km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	98	50
1,500	134	86

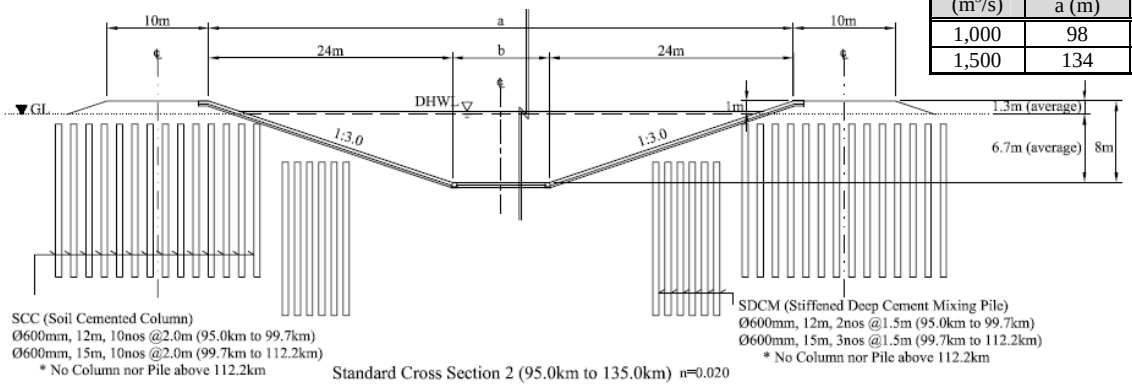

Figure J2.8.5 Alternative Cross Section of East Diversion Channel with Slope and Riverbed Protection (95km to 135km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	138	90
1,500	194	146

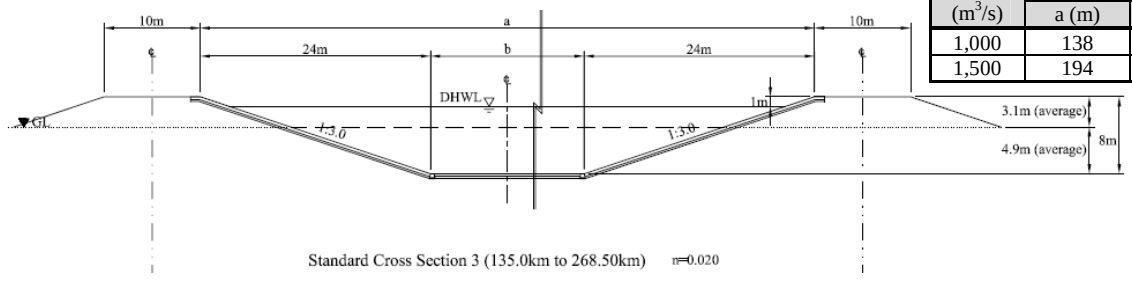

Figure J2.8.6 Alternative Cross Section of East Diversion Channel with Slope and Riverbed Protection (135km to Diversion Point)

J2.9 Crossing Road

The crossing roads were treated in the same manner to the ones for Outer Ring Road Diversion Channel. 89 bridges along 268.5km of the diversion channel were proposed. All of the national roads totaling 72 were connected with newly proposed bridges and additional 17 supporting bridges were also proposed (not defining the location). The widths of bridges for the national roads were set to coincide with the crossing roads measured on the satellite photo and the ones for the supporting bridges were set at 7m, which is the minimum width for Road Bridge in the standard of DOH.

J2.10 Crossing Canal and River

The diversion channel also crosses a lot of canals and rivers as Outer Ring Road Diversion Channel does. In the same manner with Outer Ring Road Diversion Channel, all of them with the width of or more than 2m were connected with siphons. The width of the canals and rivers were measured on the satellite photos and those were applied to the ones of siphons. The height of the siphons was basically set at one-half of their widths and less than 10m.

Major rivers around the diversion channel are connected with a canal along the coast of the Gulf of Thailand. Those rivers are drained into the gulf with pumping systems. If the diversion channel is connected to one of the rivers or the canal, it places an extra stream on the existing pumping system. Hence, the diversion channel was connected to the Gulf of Thailand individually and the canal was connected with a siphon.

J2.11 Gate

4 gates on the East Diversion Channel and 1 gate in the Pasak River were proposed. 4 gates on the diversion channel were basically closed during the ordinary time and opened during floods. Figure J2.11.1 and Figure J2.11.2 show the gates for the diversion channel whose capacity is at 1,000 m^3/s.

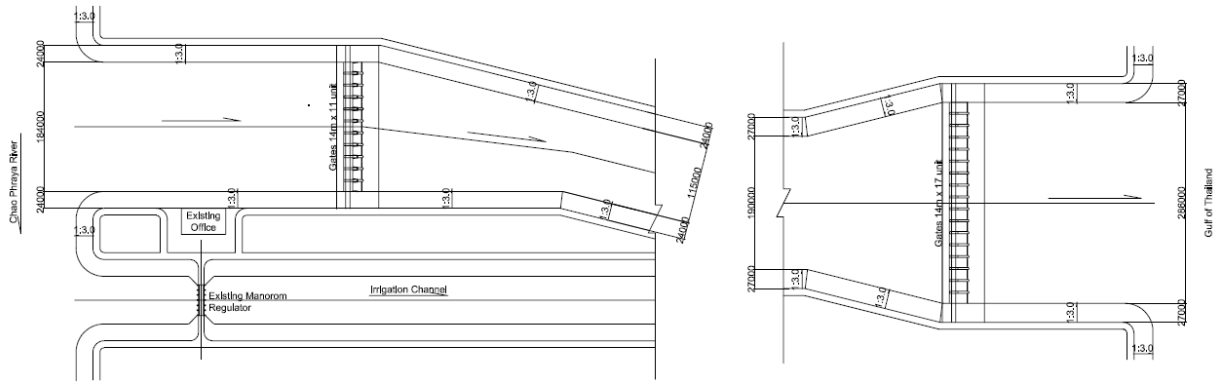

Figure J2.11.1 Gate at Diversion Point and Tidal Gate

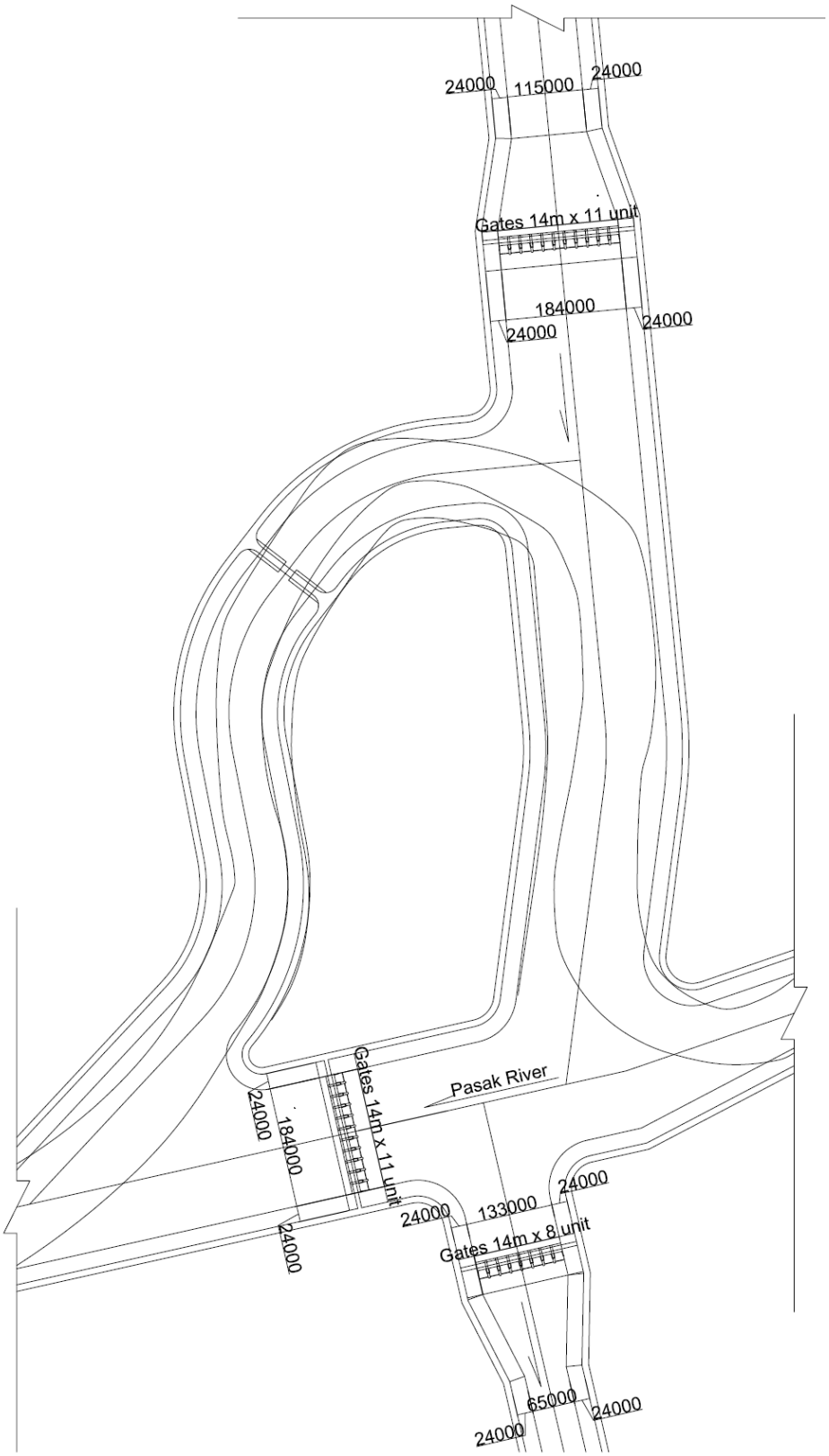

Figure J2.11.2 Gate at Confluence with Pasak River

CHAPTER J3 WEST DIVERSION CHANNEL

The design of the West Diversion Channel, which was not selected as the optimum measure in this master plan, is described in this chapter.

J3.1 Discharge

As examined in the hydraulic analyses, the design discharges were set at 1,000 m^3/s and 1,500 m^3/s.

J3.2 Route

The diversion channel was designed to connect the northern Chainat and the Gulf of Thailand. The route was proposed considering the existing structures such as irrigation canals and the geological features. Land use and the elevation of the ground were also considered with satellite photos, topographic maps in 1:50,000 scale, elevation data with 1:50:000 maps and LiDAR data to fix the preliminary route of the diversion channel.

J3.3 Field Reconnaissance

The preliminary route was confirmed with field reconnaissance. The findings in the field reconnaissance are bulletined and shown in the Fig. J3.3.1 and Fig. J3.3.2, then the revised route of the diversion channel is shown in Fig. J1.3.3.

- Upper and middle part of the preliminary route is along Makhamthao-Uthong Irrigation Canal.
- Land use around the route of diversion channel is mainly paddy field. Fishponds and salt pans were seen in the downstream area.
- Large inhabitant area is spotted along the major roads.
- There is no significant gradient of the ground so that Wat Slug pump station at the inlet of an irrigation canal and embankments in the upstream area of it make a relatively large hydraulic gradient.
- The elevation of the ground in the downstream area is almost same with or up to 2m above the water level in the canals.
- Canals in the upstream area of the diversion channel are much more likely to be with embankment and the ones in the downstream area tend to be in an excavated type.
- The route should not affect the tower of high voltage line and temples.
- There are many canals and rivers with the width of 10m to 20m.
- The ground material is categorized into mainly silt and clay. Those are reddish and merely contain sand.
- In order to circumvent some hills, relocation of inhabitant area is unavoidable.
- In the on-going feasibility study of west floodway by Thai government, discharge into the Mae Klong River is being studied. There are some cities and areas with high elevation along the Mae Klong River so that the outlet of the floodway should be carefully selected.

J3.4 Longitudinal Riverbed Gradient

Considering the existing ground slope and the standard cross section described below, the longitudinal riverbed gradients were set at 1:9,800 and 1:69,500 from the top of the channel to the Gulf of Thailand.

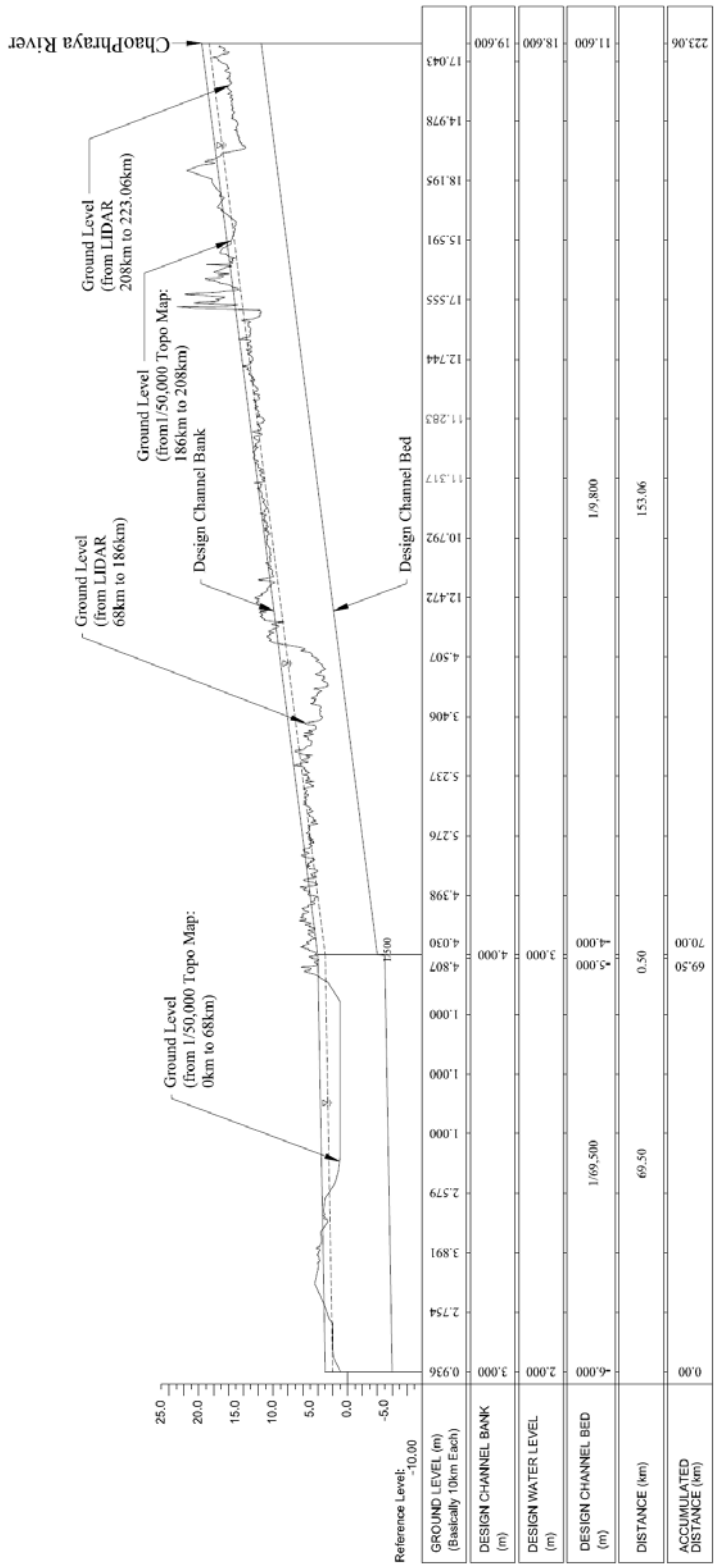

Figure J3.4.1 Longitudinal Profile of West Diversion Channel

J3.5 Standard Cross Section

For the same reason to the design of Outer Ring Road Diversion Channel, the cross section was mainly designed with excavation and small embankment.

J3.6 Bank Slope and Riverbed

In the same manner with the design of Outer Ring Road Diversion Channel, the protection only on the bank slopes was selected.

J3.7 Pile Foundation

The lower part of the Chao Phraya River basin has been evaluated in the feasibility study report of the east floodway compiled by Thai government. Referring to the soil distribution shown in Fig. J1.7.1, the same sets of pile foundation were proposed in the master plan.

J3.8 Additional Study on Cross Section

In order to reduce the excavation amount and to omit the tidal gate, the standard cross sections with more heightening by embankments and less excavation were studied. As a result, the distances of the discharge channel banks is 694m and 1,524m, which are not suitable for the diversion channel since the environmental and social impact is quite large. Only for the reference purpose, the longitudinal profile and cross sections with the capacity of 1,000 m^3/s are shown in Fig. J3.8.1, Fig. J3.8.2, and Fig. J3.8.3.

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	214	160
1,500	306	252

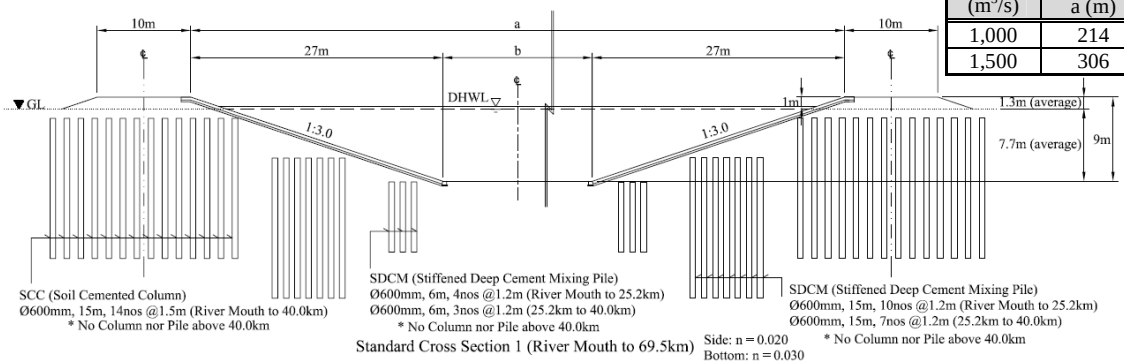

Figure J3.8.1 Standard Cross Section of West Diversion Channel with Slope Protection (0km to 69.5km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	143	95
1,500	201	153

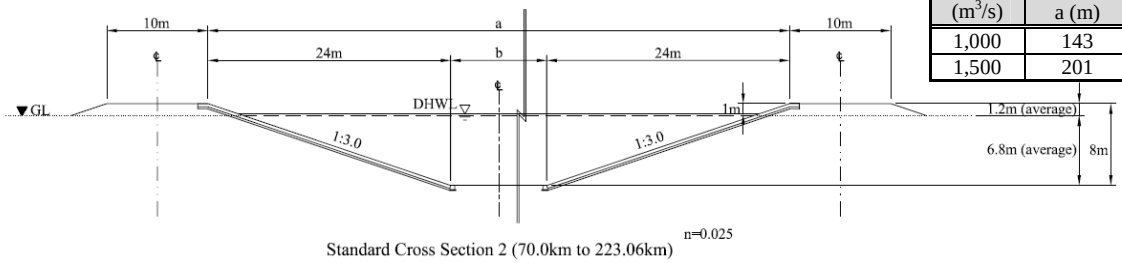

Figure J3.8.2 Standard Cross Section of West Diversion Channel with Slope Protection (70.0km to Diversion Point)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	184	130
1,500	261	207

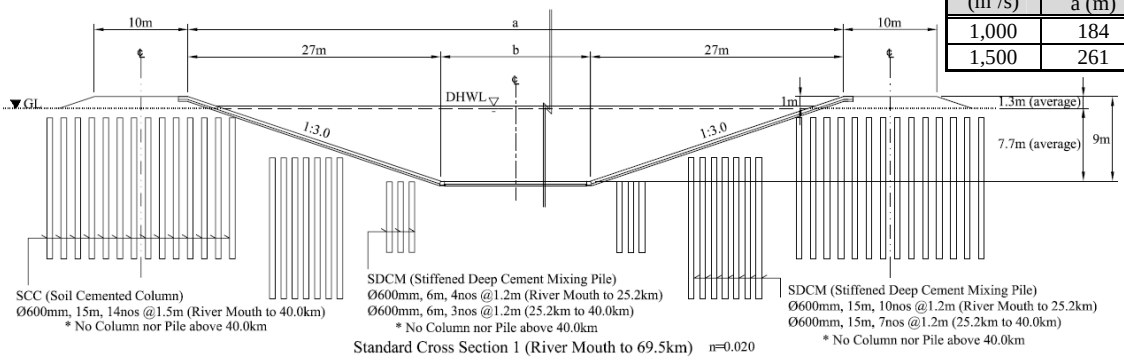

Figure J3.8.3 Alternative Cross Section of West Diversion Channel with Slope and Riverbed Protection (0km to 69.5km)

Q (m^3/s)	River Bed Width	
	a (m)	b (m)
1,000	123	75
1,500	171	123

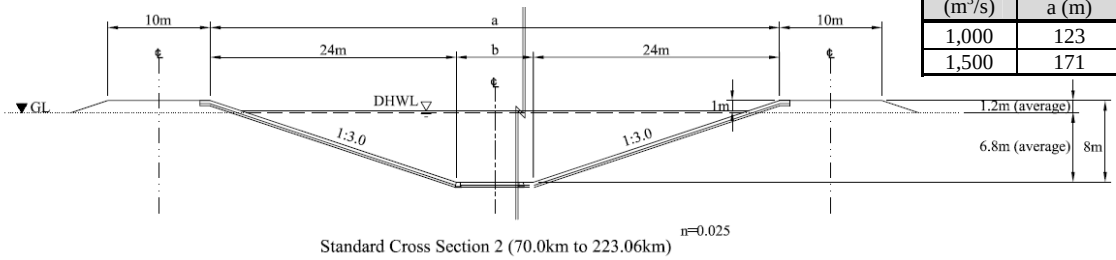

Figure J3.8.4 Alternative Cross Section of West Diversion Channel with Slope and Riverbed Protection (70.0km to Diversion Point)

J3.9 Crossing Road

The crossing roads were treated in the same manner to the ones for Outer Ring Road Diversion Channel. 74 bridges along 223.1km of the diversion channel were proposed. All of the national roads totaling 21 were connected with newly proposed bridges and additional 53 supporting bridges were also proposed (not defining the location). The widths of bridges for the national roads were set to coincide with the crossing roads measured on the satellite photo and the ones for the supporting bridges were set at 7m, which is the minimum width for Road Bridge in the standard of DOH.

J3.10 Crossing Canal and River

The diversion channel also crosses a lot of canals and rivers as Outer Ring Road Diversion Channel does. In the same manner with Outer Ring Road Diversion Channel, all of them with the width of or more than 2m were connected with siphons. The width of the canals and rivers were measured on the satellite photos and those were applied to the ones of siphons. The height of the siphons was basically set at one-half of their widths and less than 10m.

J3.11 Gate

Two gates on West Diversion Channel were proposed. Those were basically closed during the ordinary time and opened during floods. Figure J3.11.1 shows the gates for the diversion channel whose capacity is at 1,000 m^3/s.

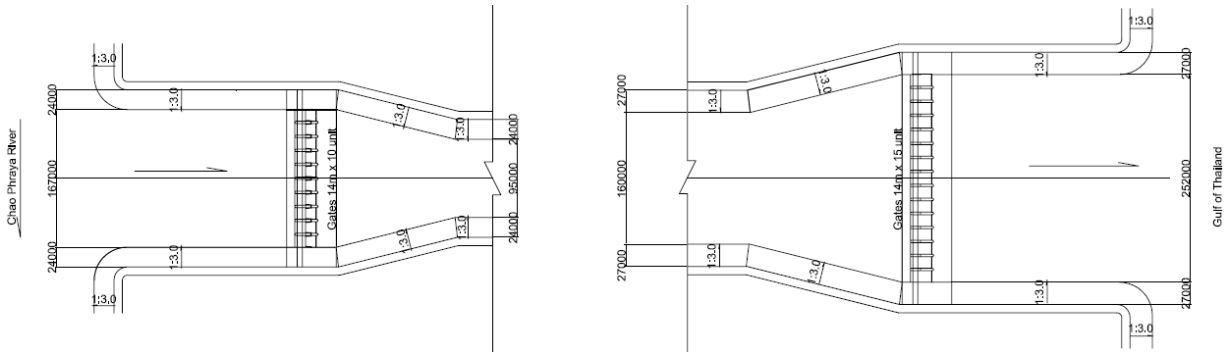

Figure J3.11.1 Gate at Diversion Point and Tidal Gate

SECTOR J: TABLE

Tab. J1.1.1 Summary on Quantity for Construction of Outer Ring Road Diversion Channel

Channel	Q(m3/s)	Alternative	Distance Mark	Roughness Coefficient	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (million m2)	Lining at Bottom (m^2)	Sodding (m^2)	Siphon Length(m)
Outer Ring Road Diversion Channel	500	Ait-1	0km-98km	0.025	52,987,000	4,919,000	5,292,000	15.427	0	1,593,000	170
		Ait-2	0km-98km	0.02	43,123,000	4,919,000	5,292,000	13.859	4,998,000	1,593,000	155
	1,000	Ait-1	0km-98km	0.025	109,090,000	4,919,000	5,292,000	24.345	0	1,593,000	261
		Ait-2	0km-98km	0.02	89,362,000	4,919,000	5,292,000	21.209	12,348,000	1,593,000	230

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Tab. J1.1.2 Quantity for Construction of Outer Ring Road Diversion Channel (Q = 500 m^3/s, Alt-1)

Section Number	Accumu-lated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	-	67	3.288	5.712	481	66	54	161	19.728	-	-	-	-	-
2	10	10	-5.776	3.224	0.295	67	2.929	6.071	517	56	54	159	17.574	4,989,565	610,000	540,000	1.6	186,510
3	20	10	-5.551	3.449	0.627	67	2.822	6.178	528	53	54	158	16.932	5,228,786	545,000	540,000	1.585	172,530
4	30	10	-5.327	3.673	0.569	67	3.104	5.896	499	60	54	160	18.624	5,138,748	565,000	540,000	1.59	177,780
5	40	10	-5.102	3.898	1.589	67	2.309	6.691	583	40	54	155	13.854	5,409,630	500,000	540,000	1.575	162,390
6	50	10	-4.878	4.122	1.37	67	2.752	6.248	536	51	54	158	16.512	5,591,670	455,000	540,000	1.565	151,830
7	60	10	-4.653	4.347	2.468	67	1.879	7.121	629	30	54	152	11.274	5,824,808	405,000	540,000	1.55	138,930
8	70	10	-4.429	4.571	1.924	67	2.647	6.353	547	48	54	157	15.882	5,879,829	390,000	540,000	1.545	135,780
9	80	10	-4.204	4.796	1.988	67	2.808	6.192	530	52	54	158	16.848	5,383,098	500,000	540,000	1.575	163,650
10	90	10	-3.98	5.02	2.491	67	2.529	6.471	559	45	54	156	15.174	5,445,326	485,000	540,000	1.57	160,110
11	98	8	-3.8	5.2	1.754	67	3.446	5.554	465	71	54	162	20.676	4,095,350	464,000	432,000	1.272	143,400
Total or Average		98	-	-	-	-	2.774	6				158		52,986,810	4,919,000	5,292,000	15.427	1,592,910

*Siphon length (170 m) was based on the average width of the site clearance (158 m) and twice of excavation depth (6.00 x 2).

Tab. J1.1.3 Quantity for Construction of Outer Ring Road Diversion Channel (Q = 500 m^3/s, Alt-2)

Section Number	Accumu-lated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	-	51	3.288	5.712	389	66	54	145	19.728	-	-	-	-	
2	10	10	-5.776	3.224	0.295	51	2.929	6.071	420	56	54	143	17.574	4,046,925	610,000	540,000	1.44	186,510
3	20	10	-5.551	3.449	0.627	51	2.822	6.178	430	53	54	142	16.932	4,248,866	545,000	540,000	1.425	172,530
4	30	10	-5.327	3.673	0.569	51	3.104	5.896	405	60	54	144	18.624	4,172,828	565,000	540,000	1.43	177,780
5	40	10	-5.102	3.898	1.589	51	2.309	6.691	476	40	54	139	13.854	4,402,670	500,000	540,000	1.415	162,390
6	50	10	-4.878	4.122	1.37	51	2.752	6.248	436	51	54	142	16.512	4,556,550	455,000	540,000	1.405	151,830
7	60	10	-4.653	4.347	2.468	51	1.879	7.121	515	30	54	136	11.274	4,755,288	405,000	540,000	1.39	138,930
8	70	10	-4.429	4.571	1.924	51	2.647	6.353	445	48	54	141	15.882	4,801,909	390,000	540,000	1.385	135,780
9	80	10	-4.204	4.796	1.988	51	2.808	6.192	431	52	54	142	16.848	4,379,498	500,000	540,000	1.415	163,650
10	90	10	-3.98	5.02	2.491	51	2.529	6.471	456	45	54	140	15.174	4,432,286	485,000	540,000	1.41	160,110
11	98	8	-3.8	5.2	1.754	51	3.446	5.554	376	71	54	146	20.676	3,325,750	464,000	432,000	1.144	143,400
Total or Average		98	-	-	-	-	2.774	6.226				142		43,122,570	4,919,000	5,292,000	13.859	1,592,910

*Siphon length (155 m) was based on the average width of the site clearance (142 m) and twice of excavation depth (6.23 m x 2).

Tab. J1.1.4 Quantity for Construction of Outer Ring Road Diversion Channel (Q = 1,000 m^3/s, Alt-1)

Section Number	Accumu-lated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	-	158	3.288	5.712	1,000	66	54	252	19.728	-	-	-	-	
2	10	10	-5.776	3.224	0.295	158	2.929	6.071	1,070	56	54	250	17.574	10,350,830	610,000	540,000	2.51	186,510
3	20	10	-5.551	3.449	0.627	158	2.822	6.178	1,091	53	54	249	16.932	10,802,081	545,000	540,000	2.495	172,530
4	30	10	-5.327	3.673	0.569	158	3.104	5.896	1,036	60	54	251	18.624	10,632,418	565,000	540,000	2.5	177,780
5	40	10	-5.102	3.898	1.589	158	2.309	6.691	1,191	40	54	246	13.854	11,136,715	500,000	540,000	2.485	162,390
6	50	10	-4.878	4.122	1.37	158	2.752	6.248	1,104	51	54	249	16.512	11,478,915	455,000	540,000	2.475	151,830
7	60	10	-4.653	4.347	2.468	158	1.879	7.121	1,277	30	54	243	11.274	11,907,703	405,000	540,000	2.46	138,930
8	70	10	-4.429	4.571	1.924	158	2.647	6.353	1,125	48	54	248	15.882	12,010,499	390,000	540,000	2.455	135,780
9	80	10	-4.204	4.796	1.988	158	2.808	6.192	1,093	52	54	249	16.848	11,091,073	500,000	540,000	2.485	163,650
10	90	10	-3.98	5.02	2.491	158	2.529	6.471	1,148	45	54	247	15.174	11,206,991	485,000	540,000	2.48	160,110
11	98	8	-3.8	5.2	1.754	158	3.446	5.554	970	71	54	253	20.676	8,472,450	464,000	432,000	2	143,400
Total or Average		98	-	-	-	-	2.774	6				249		109,089,675	4,919,000	5,292,000	24.345	1,592,910

*Siphon length (261m) was based on the average width of the site clearance (249 m) and twice of excavation depth (6.00 m x 2).

Tab. J1.1.5 Quantity for Construction of Outer Ring Road Diversion Channel (Q = 1,000 m^3/s, Alt-2)

Section Number	Accumu-lated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	-	126	3.288	5.712	818	66	54	220	19.728	-	-	-	-	
2	10	10	-5.776	3.224	0.295	126	2.929	6.071	876	56	54	218	17.574	8,465,550	610,000	540,000	2.19	186,510
3	20	10	-5.551	3.449	0.627	126	2.822	6.178	893	53	54	217	16.932	8,842,241	545,000	540,000	2.175	172,530
4	30	10	-5.327	3.673	0.569	126	3.104	5.896	847	60	54	219	18.624	8,700,578	565,000	540,000	2.18	177,780
5	40	10	-5.102	3.898	1.589	126	2.309	6.691	977	40	54	214	13.854	9,122,795	500,000	540,000	2.165	162,390
6	50	10	-4.878	4.122	1.37	126	2.752	6.248	904	51	54	217	16.512	9,408,675	455,000	540,000	2.155	151,830
7	60	10	-4.653	4.347	2.468	126	1.879	7.121	1,049	30	54	211	11.274	9,768,663	405,000	540,000	2.14	138,930
8	70	10	-4.429	4.571	1.924	126	2.647	6.353	922	48	54	216	15.882	9,854,659	390,000	540,000	2.135	135,780
9	80	10	-4.204	4.796	1.988	126	2.808	6.192	895	52	54	217	16.848	9,083,873	500,000	540,000	2.165	163,650
10	90	10	-3.98	5.02	2.491	126	2.529	6.471	941	45	54	215	15.174	9,180,911	485,000	540,000	2.16	160,110
11	98	8	-3.8	5.2	1.754	126	3.446	5.554	792	71	54	221	20.676	6,933,250	464,000	432,000	1.744	143,400
Total or Average		98	-	-	-	-	2.774	6.226				217		89,361,195	4,919,000	5,292,000	21.209	1,592,910

*Siphon length (230 m) was based on the average width of the site clearance (217 m) and twice of excavation depth (6.23 m x 2).

Tab. J1.1.6 Number of Affected House and Factory Along Outer Ring Road Diversion Channel

Area	Alt-1		Alt-2	
	House	Factory	House	Factory
Whole	1301	8	1045	6

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Tab. J1.1.7 Number of SCC and SDCM for Outer Ring Road Diversion Channel

Area	Alt-1			Alt-2		
	SCC	SDCM-1	SDCM-2	SCC	SDCM-1	SDCM-2
0km to 25.2km	3,528,000	504,000	3,150,000	3,528,000	504,000	3,150,000
25.2km to 64.2km	5,460,000	585,000	3,412,500	5,460,000	585,000	3,412,500
64.2km to 98.42km	4,471,413	0	2,395,400	4,471,413	0	2,395,400
Total	13,459,413		10,046,900	13,459,413		10,046,900

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Tab. J1.1.8 Number of Affected Major Road (Outer Ring Road Diversion Channel, Q = 500 m^3/s)

No.	Route	X	Y	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
1	3477	671256.5628	1577909.13	13	-	121	105	1,573	1,365
2	32	674055.485	1576978.167	75	2,950	121	105	9,075	7,875
3	1	679340.3403	1570833.348	60	8,105	121	105	7,260	6,300
4	305	691773.9978	1552453.324	34	22,191	121	105	4,114	3,570
5	3312	692954.6331	1542629.091	20	9,895	121	105	2,420	2,100
6	TMM	694456.3413	1531993.28	8	Combined with TLW	121	105	968	840
7	TLW	694617.9973	1531680.829	18	11,074	121	105	2,178	1,890
8	304	697456.9661	1527238.234	30	5,272	121	105	3,630	3,150
9	TCK	696705.4506	1523991.297	32	3,333	121	105	3,872	3,360
10	TTLK	699795.8814	1515282.892	34	9,241	121	105	4,114	3,570
11	7	698895.9399	1512351.148	90	3,067	121	105	10,890	9,450
12	34	696217.5751	1503438.721	77	9,306	121	105	9,317	8,085
13	3268	695765.301	1501547.645	30	1,944	121	105	3,630	3,150
14	3	693988.5461	1494496.615	23	7,271	121	105	2,783	2,415
Total								65,824	57,120

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Tab. J1.1.9 Number of Affected Major Road (Outer Ring Road Diversion Channel, Q = 1,000 m^3/s)

No.	Route	X	Y	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
1	3477	671256.5628	1577909.13	13	-	212	180	2,756	2,340
2	32	674055.485	1576978.167	75	2,950	212	180	15,900	13,500
3	1	679340.3403	1570833.348	60	8,105	212	180	12,720	10,800
4	305	691773.9978	1552453.324	34	22,191	212	180	7,208	6,120
5	3312	692954.6331	1542629.091	20	9,895	212	180	4,240	3,600
6	TMM	694456.3413	1531993.28	8	Combined with TLW	212	180	1,696	1,440
7	TLW	694617.9973	1531680.829	18	11,074	212	180	3,816	3,240
8	304	697456.9661	1527238.234	30	5,272	212	180	6,360	5,400
9	TCK	696705.4506	1523991.297	32	3,333	212	180	6,784	5,760
10	TTLK	699795.8814	1515282.892	34	9,241	212	180	7,208	6,120
11	7	698895.9399	1512351.148	90	3,067	212	180	19,080	16,200
12	34	696217.5751	1503438.721	77	9,306	212	180	16,324	13,860
13	3268	695765.301	1501547.645	30	1,944	212	180	6,360	5,400
14	3	693988.5461	1494496.615	23	7,271	212	180	4,876	4,140
Total								115,328	97,920

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Tab. J1.1.10 Location and Dimension of Canal and River for Siphon Structure Crossing Outer Ring Road Diversion Channel Route

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m²)
1	673551.477	1577040.57	12	6	7.5	90
2	674607.588	1576617.117	24	10	12.5	300
3	675555.007	1575721.362	16	8	10	160
4	675752.55	1575528.658	16	8	10	160
5	676658.382	1574671.868	10	5	6.3	63
6	676649.192	1574660.298	6	3	3.8	23
7	677112.857	1574226.345	24	10	12.5	300
8	677856.719	1573078.22	26	10	12.5	325
9	678267.753	1572510.095	5	2.5	3.1	16
10	678657.434	1571927.981	3	1.5	1.9	6
11	679244.535	1571000.126	16	8	10	160
12	679549.934	1570461.676	46	10	12.5	575
13	681180.029	1569495.611	10	5	6.3	63
14	681251.401	1569402.851	2	1	1.3	3
15	681346.601	1569258.64	2	1	1.3	3
16	681492.441	1569028.205	2	1	1.3	3
17	681863.056	1568458.285	2	1	1.3	3
18	682079.684	1568136.189	38	10	12.5	475
19	682478.796	1567545.624	2	1	1.3	3
20	683098.511	1566634.253	2	1	1.3	3
21	683102.372	1566629.556	2	1	1.3	3
22	683352.472	1566257.893	11	5.5	6.9	76
23	683390.459	1566204.962	3	1.5	1.9	6
24	684173.323	1565050.536	5	2.5	3.1	16
25	684561.723	1564476.54	35	10	12.5	438
26	685775.457	1562687.199	14	7	8.8	123
27	686720.795	1561289.938	5	2.5	3.1	16
28	686800.941	1561173.691	4	2	2.5	10
29	686947.03	1560961.547	29	10	12.5	363
30	687166.724	1560638.745	3	1.5	1.9	6
31	687250.577	1560510.47	3	1.5	1.9	6
32	688252.756	1559033.77	10	5	6.3	63
33	688401.996	1558810.829	2	1	1.3	3
34	689529.864	1557148.224	40	10	12.5	500
35	689993.956	1556466.559	10	5	6.3	63
36	690439.572	1555807.986	3	1.5	1.9	6
37	690823.305	1555243.349	11	5.5	6.9	76
38	691770.632	1552402.728	47	10	12.5	588
39	691949.067	1549064.494	23	10	12.5	288
40	692241.089	1547553.939	3	1.5	1.9	6
41	692385.415	1546808.446	6	3	3.8	23
42	692987.117	1542419.134	45	10	12.5	563
43	693170.693	1541174.86	4	2	2.5	10
44	693227.457	1540746.2	6	3	3.8	23
45	693324.074	1540005.166	4	2	2.5	10
46	693361.852	1539728.458	4	2	2.5	10
47	693487.324	1538791.384	12	6	7.5	90
48	693480.102	1537337.021	4	2	2.5	10
49	693383.235	1537052.09	7	3.5	4.4	31
50	693191.319	1536486.45	12	6	7.5	90
51	692880.023	1535065.522	12	6	7.5	90
52	694535.581	1531839.203	25	10	12.5	313
53	694801.019	1531101.068	11	5.5	6.9	76
54	695404.96	1530513.877	15	7.5	9.4	141
55	695589.654	1530333.865	6	3	3.8	23
56	697463.049	1527312.799	10	5	6.3	63
57	696972.122	1526401.496	14	7	8.8	123
58	696779.299	1525984.007	5	2.5	3.1	16
59	696601.138	1524377.172	11	5.5	6.9	76
60	696801.463	1523678.049	20	10	12.5	250
61	697280.312	1522900.313	6	3	3.8	23
62	697363.865	1522761.773	4	2	2.5	10
63	697375.027	1522748.317	4	2	2.5	10
64	697569.956	1522430.784	19	9.5	11.9	226
65	698228.099	1520962.899	19	9.5	11.9	226
66	698795.477	1519295.349	11	5.5	6.9	76
67	699158.296	1518234.129	4	2	2.5	10
68	699447.8	1517382.211	3	1.5	1.9	6
69	699810.959	1516320.672	5	2.5	3.1	16
70	699839.385	1515574.941	63	10	12.5	788
71	698990.916	1512624.891	17	8.5	10.6	180
72	698584.285	1511457.286	14	7	8.8	123
73	698234.331	1510457.215	23	10	12.5	288
74	697740.151	1509036.829	17	8.5	10.6	180
75	697307.646	1507796.404	28	10	12.5	350
76	696648.038	1505901.095	14	7	8.8	123
77	696290.993	1504320	8	4	5	40
78	696243.32	1503750.883	11	5.5	6.9	76
79	695993.09	1502104.369	48	10	12.5	600
80	694710.99	1498359.752	15	7.5	9.4	141
81	694529.067	1497297.296	18	9	11.3	203
82	694482.003	1496660.738	8	4	5	40
83	694412.057	1495893.169	7	3.5	4.4	31
84	693995.342	1494526.716	37	10	12.5	463
85	693856.266	1494019.676	25	10	12.5	313
Sum						11,963

Tab. J2.1.1 Summary on Quantity for Construction of East Diversion Channel

Channel	Q (m3/s)	Alternative	Distance Mark	Roughness Coefficient	Excavation (m3)	Embankment(m3)	Bank Slope (m2)	Site Clearance (million m2)	Lining at Bottom (m^2)	Sodding (m^2)	Siphon Length* (m)
East Diversion Channel	1,000	Alt-1	0km-95km	0.025	145,847,000	2,867,000	5,103,000	25.802	0	984,000	289
			95km-135km		23,636,000	1,404,000	2,021,000	5.968	0	410,000	157
			135km-268.5km		78,879,000	9,999,000	6,413,000	27.229	0	2,761,000	212
			Total		248,362,000	14,270,000	13,537,000	58.999	0	4,155,000	658
		Ait-2	0km-95km	0.02	118,388,000	2,867,000	5,103,000	22.042	14,250,000	984,000	249
			95km-135km		19,519,000	1,404,000	2,021,000	5.342	2,000,000	410,000	141
			135km-268.5km		63,667,000	9,999,000	6,413,000	23.889	12,015,000	2,761,000	187
			Total		201,574,000	14,270,000	13,537,000	51.274	28,265,000	4,155,000	577
		Ait-3	0km-95km	0.035	41,622,000	10,615,000	2,160,000	159.49	0	2,539,000	77
			95km-135km		47,896,000	3,689,000	1,112,000	36.825	0	819,000	55
			135km-268.5km		54,910,000	10,207,000	3,207,000	86.165	0	2,801,000	59
			Total		144,428,000	24,511,000	6,479,000	282.48	0	6,159,000	191
	1,500	Alt-1	0km-95km	0.025	219,299,000	2,867,000	5,103,000	35.86	0	984,000	396
			95km-135km		35,408,000	1,404,000	2,021,000	7.759	0	410,000	200
			135km-268.5km		120,256,000	9,999,000	6,413,000	36.312	0	2,761,000	280
			Total		374,963,000	14,270,000	13,537,000	79.931	0	4,155,000	876

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening
Siphons in Alt-3 go through under the dikes in both sides only, not under the channel.

Tab. J2.1.2 Quantity for Construction of East Diversion Channel (Q = 1,000 m^3/s, Alt-1)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest(m)	Elevation of Ground Level(m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	1.086	190	1.914	7.086	1,497	31	54	275	11.484	-	-	-	-	
2	10	10	-5.894	3.106	0.389	190	2.717	6.283	1,312	50	54	280	16.302	14,045,863	405,000	540,000	2.775	138,930
3	20	10	-5.787	3.213	0.371	190	2.842	6.158	1,284	53	54	281	17.052	12,979,906	515,000	540,000	2.805	166,770
4	30	10	-5.681	3.319	3.391	190	-	9.072	1,971	0	54.44	264	0	16,271,833	265,000	542,200	2.725	85,260
5	40	10	-5.574	3.426	1.705	190	1.721	7.279	1,542	27	54	274	10.326	17,562,726	135,000	542,200	2.69	51,630
6	50	10	-5.468	3.532	0.183	190	3.349	5.651	1,169	68	54	284	20.094	13,557,265	475,000	540,000	2.79	152,100
7	60	10	-5.362	3.638	4	190	-	9.362	2,042	0	56.18	266	0	16,056,063	340,000	550,900	2.75	100,470
8	70	10	-5.255	3.745	2	190	1.745	7.255	1,536	27	54	274	10.47	17,890,382	135,000	550,900	2.7	52,350
9	80	10	-5.149	3.851	2.348	190	1.503	7.497	1,593	22	54	273	9.018	15,647,001	245,000	540,000	2.735	97,440
10	90	10	-5.043	3.957	2.059	190	1.898	7.102	1,501	30	54	275	11.388	15,468,702	260,000	540,000	2.74	102,030
11	94	4	-5	4	2.876	190	1.124	7.876	1,683	16	54	271	6.744	6,366,459	92,000	216,000	1.092	36,264
Total or Average							1.671	7.329				274		145,846,200	2,867,000	5,102,200	25.802	983,244
12	95	1	-4	4	3	65	1	7	602	13	48	139	6	1,142,268	14,500	51,000	0.205	3,000
13	100	5	-3.05	4.95	2.724	65	2.226	5.774	475	38	48	146	13.356	2,693,319	127,500	240,000	0.713	48,390
14	110	10	-1.15	6.85	2.563	65	4.287	3.713	283	99	48	159	25.722	3,790,157	685,000	480,000	1.525	195,390
15	120	10	0.75	8.75	8.53	65	0.22	7.78	687	3	48	134	1.32	4,849,947	510,000	480,000	1.465	135,210
16	130	10	2.65	10.65	11.868	65	-	9.218	854	0	55.31	140	0	7,706,849	15,000	516,550	1.37	6,600
17	134.9	4.9	3.581	11.581	10.139	65	1.442	6.558	555	21	48	142	8.652	3,452,973	51,451	253,110	0.691	21,197
Total or Average							1.326	6.674				143		23,635,513	1,403,451	2,020,660	5.968	409,787
18	135	0.1	3.6	11.6	10.706	115	0.894	7.106	969	12	48	188	5.364	76,199	1,650	4,800	0.016	268
19	140	5	3.945	11.945	11.235	115	0.71	7.29	998	9	48	187	4.26	4,916,146	52,500	240,000	0.938	24,060
20	150	10	4.634	12.634	9.353	115	3.281	4.719	609	66	48	203	19.686	8,036,371	375,000	480,000	1.95	119,730
21	160	10	5.323	13.323	10.707	115	2.616	5.384	706	47	48	199	15.696	6,578,072	565,000	480,000	2.01	176,910
22	170	10	6.012	14.012	10.347	115	3.665	4.335	555	77	48	205	21.99	6,305,121	620,000	480,000	2.02	188,430
23	180	10	6.701	14.701	10.933	115	3.768	4.232	540	81	48	206	22.608	5,476,556	790,000	480,000	2.055	222,990
24	190	10	7.39	15.39	11.205	115	4.185	3.815	482	95	48	208	25.11	5,113,986	880,000	480,000	2.07	238,590
25	200	10	8.079	16.079	11.924	115	4.155	3.845	487	94	48	208	24.93	4,844,574	945,000	480,000	2.08	250,200
26	210	10	8.769	16.769	12.067	115	4.702	3.298	412	114	48	211	28.212	4,492,138	1,040,000	480,000	2.095	265,710
27	220	10	9.458	17.458	13.342	115	4.116	3.884	492	92	48	208	24.696	4,519,084	1,030,000	480,000	2.095	264,540
28	230	10	10.147	18.147	15.689	115	2.458	5.542	729	43	48	198	14.748	6,106,939	675,000	480,000	2.03	197,220
29	240	10	10.836	18.836	14.203	115	4.633	3.367	421	111	48	211	27.798	5,753,432	770,000	480,000	2.045	212,730
30	250	10	11.525	19.525	14.94	115	4.585	3.415	428	109	48	211	27.51	4,244,634	1,100,000	480,000	2.11	276,540
31	260	10	12.214	20.214	16.945	115	3.269	4.731	611	65	48	203	19.614	5,194,619	870,000	480,000	2.07	235,620
32	268.5	8.5	12.8	20.8	20.651	115	0.149	7.851	1,088	2	48	184	0.894	7,220,715	284,750	408,000	1.645	87,159
Total or Average		268.5	-	-	-	-	3.146	4.854				202		78,878,586	9,998,900	6,412,800	27.229	2,760,697

*Siphon length was based on the average width of the site clearance and twice of excavation depth.

Tab. J2.1.3 Quantity for Construction of East Diversion Channel (Q = 1,000 m^3/s, Alt-2)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest(m)	Elevation of Ground Level(m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	1.086	150	1.914	7.086	1,214	31	54	235	11.484	-	-	-	-	
2	10	10	-5.894	3.106	0.389	150	2.717	6.283	1,061	50	54	240	16.302	11,372,063	405,000	540,000	2.375	138,930
3	20	10	-5.787	3.213	0.371	150	2.842	6.158	1,037	53	54	241	17.052	10,491,706	515,000	540,000	2.405	166,770
4	30	10	-5.681	3.319	3.391	150	-	9.072	1,608	0	54.44	224	0	13,225,833	265,000	542,200	2.325	85,260
5	40	10	-5.574	3.426	1.705	150	1.721	7.279	1,251	27	54	234	10.326	14,292,526	135,000	542,200	2.29	51,630
6	50	10	-5.468	3.532	0.183	150	3.349	5.651	943	68	54	244	20.094	10,971,265	475,000	540,000	2.39	152,100
7	60	10	-5.362	3.638	4	150	-	9.362	1,667	0	56.18	226	0	13,053,463	340,000	550,900	2.35	100,470
8	70	10	-5.255	3.745	2	150	1.745	7.255	1,246	27	54	234	10.47	14,566,982	135,000	550,900	2.3	52,350
9	80	10	-5.149	3.851	2.348	150	1.503	7.497	1,293	22	54	233	9.018	12,696,601	245,000	540,000	2.335	97,440
10	90	10	-5.043	3.957	2.059	150	1.898	7.102	1,217	30	54	235	11.388	12,548,902	260,000	540,000	2.34	102,030
11	94	4	-5	4	2.876	150	1.124	7.876	1,367	16	54	231	6.744	5,168,219	92,000	216,000	0.932	36,264
Total or Average							1.671	7.329				234		118,387,560	2,867,000	5,102,200	22.042	983,244
12	95	1	-4	4	3	50	1	7	497	13	48	124	6	932,248	14,500	51,000	0.178	3,000
13	100	5	-3.05	4.95	2.724	50	2.226	5.774	389	38	48	131	13.356	2,214,294	127,500	240,000	0.638	48,390
14	110	10	-1.15	6.85	2.563	50	4.287	3.713	227	99	48	144	25.722	3,078,632	685,000	480,000	1.375	195,390
15	120	10	0.75	8.75	8.53	50	0.22	7.78	571	3	48	119	1.32	3,987,972	510,000	480,000	1.315	135,210
16	130	10	2.65	10.65	11.868	50	-	9.218	716	0	55.31	125	0	6,431,999	15,000	516,550	1.22	6,600
17	134.9	4.9	3.581	11.581	10.139	50	1.442	6.558	457	21	48	127	8.652	2,873,205	51,451	253,110	0.617	21,197
Total or Average							1.326	6.674				128		19,518,350	1,403,451	2,020,660	5.342	409,787
18	135	0.1	3.6	11.6	10.706	90	0.894	7.106	791	12	48	163	5.364	62,398	1,650	4,800	0.014	268
19	140	5	3.945	11.945	11.235	90	0.71	7.29	816	9	48	162	4.26	4,016,396	52,500	240,000	0.813	24,060
20	150	10	4.634	12.634	9.353	90	3.281	4.719	492	66	48	178	19.686	6,535,246	375,000	480,000	1.7	119,730
21	160	10	5.323	13.323	10.707	90	2.616	5.384	572	47	48	174	15.696	5,315,197	565,000	480,000	1.76	176,910
22	170	10	6.012	14.012	10.347	90	3.665	4.335	447	77	48	180	21.99	5,090,246	620,000	480,000	1.77	188,430
23	180	10	6.701	14.701	10.933	90	3.768	4.232	435	81	48	181	22.608	4,405,681	790,000	480,000	1.805	222,990
24	190	10	7.39	15.39	11.205	90	4.185	3.815	387	95	48	183	25.11	4,108,111	880,000	480,000	1.82	238,590
25	200	10	8.079	16.079	11.924	90	4.155	3.845	390	94	48	183	24.93	3,887,074	945,000	480,000	1.83	250,200
26	210	10	8.769	16.769	12.067	90	4.702	3.298	329	114	48	186	28.212	3,599,263	1,040,000	480,000	1.845	265,710
27	220	10	9.458	17.458	13.342	90	4.116	3.884	395	92	48	183	24.696	3,621,334	1,030,000	480,000	1.845	264,540
28	230	10	10.147	18.147	15.689	90	2.458	5.542	591	43	48	173	14.748	4,928,689	675,000	480,000	1.78	197,220
29	240	10	10.836	18.836	14.203	90	4.633	3.367	337	111	48	186	27.798	4,639,807	770,000	480,000	1.795	212,730
30	250	10	11.525	19.525	14.94	90	4.585	3.415	342	109	48	186	27.51	3,396,884	1,100,000	480,000	1.86	276,540
31	260	10	12.214	20.214	16.945	90	3.269	4.731	493	65	48	178	19.614	4,176,369	870,000	480,000	1.82	235,620
32	268.5	8.5	12.8	20.8	20.651	90	0.149	7.851	892	2	48	159	0.894	5,883,878	284,750	408,000	1.432	87,159
Total or Average		268.5	-	-	-	-	3.146	4.854				177		63,666,573	9,998,900	6,412,800	23.889	2,760,697

*Siphon length was based on the average width of the site clearance and twice of excavation depth.

Tab. J2.1.4 Quantity for Construction of East Diversion Channel (Q = 1,000 m^3/s, Alt-3)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest(m)	Elevation of Ground Level(m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	2	6	1.086	1700	4.914	-	0	122	24	1,773	29.484	-	-	-	-	
2	10	10	2.105	6.105	0.389	1700	5.716	-	0	156	24	1,778	34.296	0	1,390,000	240,000	17.755	318,900
3	20	10	2.211	6.211	0.371	1700	5.84	-	0	161	24	1,779	35.04	0	1,585,000	240,000	17.785	346,680
4	30	10	2.316	6.316	3.391	1700	2.925	1.075	1,831	55	24	1,762	17.55	9,154,835	1,080,000	240,000	17.705	262,950
5	40	10	2.421	6.421	1.705	1700	4.716	-	0	114	24	1,772	28.296	9,154,835	845,000	240,000	17.67	229,230
6	50	10	2.526	6.526	0.183	1700	6.343	-	0	185	24	1,782	38.058	0	1,495,000	240,000	17.77	331,770
7	60	10	2.632	6.632	4	1700	2.632	1.368	2,331	48	24	1,760	15.792	11,656,072	1,165,000	240,000	17.71	269,250
8	70	10	2.737	6.737	2	1700	4.737	-	0	115	24	1,772	28.422	11,656,072	815,000	240,000	17.66	221,070
9	80	10	2.842	6.842	2.348	1700	4.494	-	0	106	24	1,771	26.964	0	1,105,000	240,000	17.715	276,930
10	90	10	2.947	6.947	2.059	1700	4.888	-	0	121	24	1,773	29.328	0	1,135,000	240,000	17.72	281,460
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total or Average							4.721	-				1,772		41,621,814	10,615,000	2,160,000	159.49	2,538,240
12	95	5	3	7	3	700	4	-	0	88	24	768	24	0	522,500	120,000	6.353	60,000
13	100	5	3.588	7.588	2.724	700	4.864	-	0	120	24	773	29.184	0	520,000	120,000	3.853	132,960
14	110	10	4.763	8.763	2.563	700	6.2	-	0	178	24	781	37.2	0	1,490,000	240,000	7.77	331,920
15	120	10	5.938	9.938	8.53	700	1.408	2.592	1,835	21	24	752	8.448	9,172,777	995,000	240,000	7.665	228,240
16	130	10	7.113	11.113	11.868	700	-0.755	4.755	3,396	0	28.53	749	0	26,154,428	105,000	262,650	7.505	42,240
17	134.9	4.9	7.688	11.688	10.139	700	1.549	2.451	1,734	23	24	753	9.294	12,568,629	56,351	128,699	3.68	22,770
Total or Average							2.878	1.122				763		47,895,834	3,688,851	1,111,349	36.825	818,130
18	135	0.1	7.7	11.7	10.706	580	0.994	3.006	1,771	13	24	630	5.964	175,216	1,800	2,400	0.069	298
19	140	5	8.041	12.041	11.235	580	0.806	3.194	1,883	11	24	629	4.836	9,134,283	60,000	120,000	3.148	27,000
20	150	10	8.722	12.722	9.353	580	3.369	0.631	367	68	24	644	20.214	11,251,497	395,000	240,000	6.365	125,250
21	160	10	9.404	13.404	10.707	580	2.697	1.303	761	49	24	640	16.182	5,640,040	585,000	240,000	6.42	181,980
22	170	10	10.086	14.086	10.347	580	3.739	0.261	152	80	24	646	22.434	4,562,089	645,000	240,000	6.43	193,080
23	180	10	10.767	14.767	10.933	580	3.834	0.166	96	83	24	647	23.004	1,239,736	815,000	240,000	6.465	227,190
24	190	10	11.449	15.449	11.205	580	4.244	-	0	97	24	649	25.464	481,814	900,000	240,000	6.48	242,340
25	200	10	12.131	16.131	11.924	580	4.207	-	0	96	24	649	25.242	0	965,000	240,000	6.49	253,530
26	210	10	12.812	16.812	12.067	580	4.745	-	0	115	24	652	28.47	0	1,055,000	240,000	6.505	268,560
27	220	10	13.494	17.494	13.342	580	4.152	-	0	94	24	649	24.912	0	1,045,000	240,000	6.505	266,910
28	230	10	14.176	18.176	15.689	580	2.487	1.513	884	44	24	639	14.922	4,422,038	690,000	240,000	6.44	199,170
29	240	10	14.857	18.857	14.203	580	4.654	-	0	112	24	652	27.924	4,422,038	780,000	240,000	6.455	214,230
30	250	10	15.539	19.539	14.94	580	4.599	-	0	110	24	652	27.594	0	1,110,000	240,000	6.52	277,590
31	260	10	16.221	20.221	16.945	580	3.276	0.724	421	65	24	644	19.656	2,107,463	875,000	240,000	6.48	236,250
32	268.5	8.5	16.8	20.8	20.651	580	0.149	3.851	2,278	2	24	625	0.894	11,473,144	284,750	204,000	5.393	87,338
Total or Average		268.5	-	-	-	-	3.197	0.803				643		54,909,358	10,206,550	3,206,400	86.165	2,800,716

*Siphon length was based on the average width of the site clearance and twice of excavation depth.

Tab. J2.1.5 Quantity for Construction of East Diversion Channel (Q = 1,500 m^3/s, Alt-1)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest(m)	Elevation of Ground Level(m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	1.086	297	1.914	7.086	2,255	31	54	382	11.484	-	-	-	-	
2	10	10	-5.894	3.106	0.389	297	2.717	6.283	1,984	50	54	387	16.302	21,198,278	405,000	540,000	3.845	138,930
3	20	10	-5.787	3.213	0.371	297	2.842	6.158	1,943	53	54	388	17.052	19,635,841	515,000	540,000	3.875	166,770
4	30	10	-5.681	3.319	3.391	297	-	9.072	2,941	0	54.44	371	0	24,419,883	265,000	542,200	3.795	85,260
5	40	10	-5.574	3.426	1.705	297	1.721	7.279	2,321	27	54	381	10.326	26,310,511	135,000	542,200	3.76	51,630
6	50	10	-5.468	3.532	0.183	297	3.349	5.651	1,774	68	54	391	20.094	20,474,815	475,000	540,000	3.86	152,100
7	60	10	-5.362	3.638	4	297	-	9.362	3,043	0	56.18	373	0	24,088,018	340,000	550,900	3.82	100,470
8	70	10	-5.255	3.745	2	297	1.745	7.255	2,313	27	54	381	10.47	26,780,477	135,000	550,900	3.77	52,350
9	80	10	-5.149	3.851	2.348	297	1.503	7.497	2,395	22	54	380	9.018	23,539,321	245,000	540,000	3.805	97,440
10	90	10	-5.043	3.957	2.059	297	1.898	7.102	2,261	30	54	382	11.388	23,279,167	260,000	540,000	3.81	102,030
11	94	4	-5	4	2.876	297	1.124	7.876	2,525	16	54	378	6.744	9,571,751	92,000	216,000	1.52	36,264
Total or Average							1.671	7.329				381		219,298,062	2,867,000	5,102,200	35.86	983,244
12	95	1	-4	4	3	108	1	7	903	13	48	182	6	1,714,134	14,500	51,000	0.28	3,000
13	100	5	-3.05	4.95	2.724	108	2.226	5.774	724	38	48	189	13.356	4,066,524	127,500	240,000	0.928	48,390
14	110	10	-1.15	6.85	2.563	108	4.287	3.713	442	99	48	202	25.722	5,829,862	685,000	480,000	1.955	195,390
15	120	10	0.75	8.75	8.53	108	0.22	7.78	1,022	3	48	177	1.32	7,320,942	510,000	480,000	1.895	135,210
16	130	10	2.65	10.65	11.868	108	-	9.218	1,250	0	55.31	183	0	11,361,419	15,000	516,550	1.8	6,600
17	134.9	4.9	3.581	11.581	10.139	108	1.442	6.558	837	21	48	185	8.652	5,114,975	51,451	253,110	0.902	21,197
Total or Average							1.326	6.674				186		35,407,856	1,403,451	2,020,660	7.759	409,787
18	135	0.1	3.6	11.6	10.706	183	0.894	7.106	1,452	12	48	256	5.364	114,459	1,650	4,800	0.022	268
19	140	5	3.945	11.945	11.235	183	0.71	7.29	1,494	9	48	255	4.26	7,363,466	52,500	240,000	1.278	24,060
20	150	10	4.634	12.634	9.353	183	3.281	4.719	930	66	48	271	19.686	12,119,431	375,000	480,000	2.63	119,730
21	160	10	5.323	13.323	10.707	183	2.616	5.384	1,072	47	48	267	15.696	10,013,092	565,000	480,000	2.69	176,910
22	170	10	6.012	14.012	10.347	183	3.665	4.335	850	77	48	273	21.99	9,609,581	620,000	480,000	2.7	188,430
23	180	10	6.701	14.701	10.933	183	3.768	4.232	828	81	48	274	22.608	8,389,336	790,000	480,000	2.735	222,990
24	190	10	7.39	15.39	11.205	183	4.185	3.815	742	95	48	276	25.11	7,849,966	880,000	480,000	2.75	238,590
25	200	10	8.079	16.079	11.924	183	4.155	3.845	748	94	48	276	24.93	7,448,974	945,000	480,000	2.76	250,200
26	210	10	8.769	16.769	12.067	183	4.702	3.298	636	114	48	279	28.212	6,920,758	1,040,000	480,000	2.775	265,710
27	220	10	9.458	17.458	13.342	183	4.116	3.884	756	92	48	276	24.696	6,960,964	1,030,000	480,000	2.775	264,540
28	230	10	10.147	18.147	15.689	183	2.458	5.542	1,106	43	48	266	14.748	9,311,779	675,000	480,000	2.71	197,220
29	240	10	10.836	18.836	14.203	183	4.633	3.367	650	111	48	279	27.798	8,782,492	770,000	480,000	2.725	212,730
30	250	10	11.525	19.525	14.94	183	4.585	3.415	660	109	48	279	27.51	6,550,514	1,100,000	480,000	2.79	276,540
31	260	10	12.214	20.214	16.945	183	3.269	4.731	933	65	48	271	19.614	7,964,259	870,000	480,000	2.75	235,620
32	268.5	8.5	12.8	20.8	20.651	183	0.149	7.851	1,622	2	48	252	0.894	10,856,913	284,750	408,000	2.223	87,159
Total or Average		268.5	-	-	-	-	3.146	4.854				270		120,255,984	9,998,900	6,412,800	36.312	2,760,697

*Siphon length was based on the average width of the site clearance and twice of excavation depth.

Tab. J2.1.6 Number of Affected House and Factory Along East Diversion Channel

Area	Alt-1		Alt-2		Alt-3	
	House	Factory	House	Factory	House	Factory
0km-95km	380	10	324	9	4650	38
95km-Pasak River	85	1	73	1	1205	7
Pasak River-Top	900	4	765	4	4933	11

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Tab. J2.1.7 Number of SCC and SDCM for East Diversion Channel

Area	Alt-1			Alt-2			Alt-3		
	SCC	SDCM-1	SDCM-2	SCC	SDCM-1	SDCM-2	SCC	SDCM-1	SDCM-2
0km to 25.2km	3,528,000	504,000	3,150,000	3,528,000	504,000	3,150,000	0	0	1,050,000
25.2km to 64.2km	5,460,000	585,000	3,412,500	5,460,000	585,000	3,412,500	0	0	1,137,500
64.2km to 95.0km	4,024,533	0	2,156,000	4,024,533	0	2,156,000	0	0	898,333
95.0km to 99.7km	282,000	0	75,200	282,000	0	75,200	0	0	31,333
99.7km to 112.2km	937,500	0	375,000	937,500	0	375,000	0	0	125,000
Subtotal (0km to 95.0km)	13,012,533		9,807,500	13,012,533		9,807,500	0		3,085,833
Subtotal (95.0km to 112.2km)	1,219,500		450,200	1,219,500		450,200	0		156,333
Total	14,232,033		10,257,700	14,232,033		10,257,700	0		3,242,167

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Tab. J2.1.8 Number of Affected Major Road (East Diversion Channel, Upstream, North Side of Pasak River, Q =1,000m^3/s, 1/2)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)			Area of Bridge Girder (m^2)		
						Alt-1	Alt-2	Alt-3	Alt-1	Alt-2	Alt-3
1	Phahonyothin Road	1300	267+200	20	-	163	138	604	3,260	2,760	-*
2	Nakarat Rangsan	9357	259+143	9	8,057	163	138	604	1,467	1,242	-*
3	3212	12500	256+0	9	3,143	163	138	604	1,467	1,242	5,436
4	Car Bridge	17100	251+400	7	4,600	163	138	604	1,141	966	-*
5	Asia Route Road	18200	250+300	19	1,100	163	138	604	3,097	2,622	-*
6	Car Bridge	24560	243+940	7	6,360	163	138	604	1,141	966	-*
7	Phahonyothin Road	27000	241+500	8	2,440	163	138	604	1,304	1,104	-*
8	Car Bridge	33200	235+300	7	6,200	163	138	604	1,141	966	-*
9	Car Bridge	36993	231+507	7	3,793	163	138	604	1,141	966	-*
10	Car Bridge	40100	228+400	7	3,107	163	138	604	1,141	966	-*
11	Car Bridge	44280	224+220	7	4,180	163	138	604	1,141	966	-*
12	Wat Kok Kao	45793	222+707	7	1,513	163	138	604	1,141	966	-*
13	11	46112	222+388	9	319	163	138	604	1,467	1,242	5,436
14	Wat Lat Tippayarot	53934	214+566	7	7,822	163	138	604	1,141	966	-*
15	Wat Nong Ta Ko	56986	211+514	7	3,052	163	138	604	1,141	966	-*
16	Wat Tai Lat	59089	209+411	7	2,103	163	138	604	1,141	966	-*
17	Wat Nong Pho	61400	207+100	10	2,311	163	138	604	1,630	1,380	-*
18	Ban Nong Mueang	64612	203+888	7	3,212	163	138	604	1,141	966	-*
19	CHP- 21	65923	202+577	7	1,311	163	138	604	1,141	966	-*
20	205	69575	198+925	10	3,652	163	138	604	1,630	1,380	6,040

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening
Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.9 Number of Affected Major Road (East Diversion Channel, Upstream, North Side of Pasak River, Q =1,000m^3/s, 2/2)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)			Area of Bridge Girder (m^2)		
						Alt-1	Alt-2	Alt-3	Alt-1	Alt-2	Alt-3
21	3124	74717	193+783	11	5,142	163	138	604	1,793	1,518	6,644
22	Nong Sai Kao	75900	192+600	7	1,183	163	138	604	1,141	966	-*
23	Car Bridge	76320	192+180	7	420	163	138	604	1,141	966	-*
24	Wat Ban Khok	80413	188+87	7	4,093	163	138	604	1,141	966	-*
25	Car Bridge	84597	183+903	7	4,184	163	138	604	1,141	966	-*
26	3019	86652	181+848	7	2,055	163	138	604	1,141	966	4,228
27	CHP- 5	93361	175+139	7	6,709	163	138	604	1,141	966	-*
28	CHP- 23	94874	173+626	7	1,513	163	138	604	1,141	966	-*
29	CHP- 6	98026	170+474	9	3,152	163	138	604	1,467	1,242	-*
30	CHP- 7	99038	169+462	10	1,012	163	138	604	1,630	1,380	-*
31	Car Bridge	99418	169+82	14	380	163	138	604	2,282	1,932	-*
32	CHP- 8	101093	167+407	7	1,675	163	138	604	1,141	966	-*
33	CHP- 9	103456	165+44	7	2,363	163	138	604	1,141	966	-*
34	311	104489	164+11	10	1,033	163	138	604	1,630	1,380	6,040
35	CHP- 24	109640	158+860	7	5,151	163	138	604	1,141	966	-*
36	CHP- 25	112392	156+108	7	2,752	163	138	604	1,141	966	-*
37	CHP- 10	115810	152+690	7	3,418	163	138	604	1,141	966	-*
38	CHP- 26	118634	149+866	7	2,824	163	138	604	1,141	966	-*
39	Car Bridge	121383	147+117	7	2,749	163	138	604	1,141	966	-*
40	3022	126459	142+41	8	5,076	163	138	604	1,304	1,104	4,832
41	Car Bridge	127686	140+814	10	1,227	163	138	604	1,630	1,380	-*
42	3034	130337	138+163	10	2,651	163	138	604	1,630	1,380	6,040
43	3048	133000	135+500	8	2,663	163	138	604	1,304	1,104	-*
Subtotal (Upstream)									59,658	50,508	44,696

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.10 Number of Affected Major Road (East Diversion Channel, Middle Stream, South Side of Pasak River, Q =1,000m^3/s)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)			Area of Bridge Girder (m^2)		
						Alt-1	Alt-2	Alt-3	Alt-1	Alt-2	Alt-3
1	Reua-Sao Hai	325	134+675	7	-	113	98	724	791	686	-*
2	3041	4884	130+116	7	4,559	113	98	724	791	686	5,068
3	3069	9570	125+430	7	4,686	113	98	724	791	686	5,068
4	3041	13797.93	121+202	7	4,228	113	98	724	791	686	5,068
5	3009	14779	120+221	7	981	113	98	724	791	686	5,068
6	329	19377	115+623	9	4,598	113	98	724	1,017	882	6,516
7	3043	21928	113+72	8	2,551	113	98	724	904	784	5,792
8	1	24630	110+370	58	2,702	113	98	724	6,554	5,684	41,992
9	4001	30167	104+833	7	5,537	113	98	724	791	686	5,068
10	3067	32029.11	102+971	7	1,862	113	98	724	791	686	5,068
11	3045	35190	99+810	7	3,161	113	98	724	791	686	5,068
12	Along Klong Sam Sip Sam	38418	96+582	7	3,228	113	98	724	791	686	-*
Subtotal (Middle Stream)									21,528	13,524	89,776

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.11 Number of Affected Major Road (East Diversion Channel, Downstream, South Side of Pasak River, Q =1,000m^3/s)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)			Area of Bridge Girder (m^2)		
						Alt-1	Alt-2	Alt-3	Alt-1	Alt-2	Alt-3
13	Along Klong Sam Sip Song	41760.53	93+239	7	3,343	244	204	1724	1,708	1,428	-*
14	Along Klong Sam Sip Et	46233.4	88+767	7	4,473	244	204	1724	1,708	1,428	-*
15	Along Klong Sam Sip	49940.22	85+60	7	3,707	244	204	1724	1,708	1,428	-*
16	305	57207.56	77+792	22	7,267	244	204	1724	5,368	4,488	37,928
17	Along klong Yi Sip Si	62541.95	72+458	7	5,334	244	204	1724	1,708	1,428	-*
18	Along Klong Yi Sip Sam	65779.71	69+220	7	3,238	244	204	1724	1,708	1,428	-*
19	Along klong Yi Sip Song	69028.6	65+971	7	3,249	244	204	1724	1,708	1,428	-*
20	3369	71494.47	63+506	7	2,466	244	204	1724	1,708	1,428	12,068
21	3312	73312	61+688	7	1,818	244	204	1724	1,708	1,428	12,068
22	Entrance of Ban Saladaeng	86974	48+26	7	13,662	244	204	1724	1,708	1,428	-*
23	3841	89137	45+863	7	2,163	244	204	1724	1,708	1,428	12,068
24	Entrance of Kwang Canal	96861.19	38+139	7	7,724	244	204	1724	1,708	1,428	-*
25	304	99544.54	35+455	20	2,683	244	204	1724	4,880	4,080	34,480
26	Road of Prawet Burirom Canal	111936.04	23+64	7	12,392	244	204	1724	1,708	1,428	-*
27	7	117219	17+781	32	5,283	244	204	1724	7,808	6,528	55,168
28	34	123120	11+880	65	5,901	244	204	1724	15,860	13,260	112,060
29	3	133593.605	1+406	7	10,474	244	204	1724	1,708	1,428	12,068
Subtotal (Downstream)									56,120	46,920	287,908

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening
Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.12 Number of Affected Major Road (East Diversion Channel, Upstream, North Side of Pasak River, Q =1,500m^3/s, 1/2)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
1	Phahonyothin Road	1300	267+200	20	-	231	194	4,620	3,880
2	Nakarat Rangsan	9357	259+143	9	8,057	231	194	2,079	1,746
3	3212	12500	256+0	9	3,143	231	194	2,079	1,746
4	Car Bridge	17100	251+400	7	4,600	231	194	1,617	1,358
5	Asia Route Road	18200	250+300	19	1,100	231	194	4,389	3,686
6	Car Bridge	24560	243+940	7	6,360	231	194	1,617	1,358
7	Phahonyothin Road	27000	241+500	8	2,440	231	194	1,848	1,552
8	Car Bridge	33200	235+300	7	6,200	231	194	1,617	1,358
9	Car Bridge	36993	231+507	7	3,793	231	194	1,617	1,358
10	Car Bridge	40100	228+400	7	3,107	231	194	1,617	1,358
11	Car Bridge	44280	224+220	7	4,180	231	194	1,617	1,358
12	Wat Kok Kao	45793	222+707	7	1,513	231	194	1,617	1,358
13	11	46112	222+388	9	319	231	194	2,079	1,746
14	Wat Lat Tippayarot	53934	214+566	7	7,822	231	194	1,617	1,358
15	Wat Nong Ta Ko	56986	211+514	7	3,052	231	194	1,617	1,358
16	Wat Tai Lat	59089	209+411	7	2,103	231	194	1,617	1,358
17	Wat Nong Pho	61400	207+100	10	2,311	231	194	2,310	1,940
18	Ban Nong Mueang	64612	203+888	7	3,212	231	194	1,617	1,358
19	CHP- 21	65923	202+577	7	1,311	231	194	1,617	1,358
20	205	69575	198+925	10	3,652	231	194	2,310	1,940

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection
Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.13 Number of Affected Major Road (East Diversion Channel, Upstream, North Side of Pasak River, Q =1,500m^3/s, 2/2)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
21	3124	74717	193+783	11	5,142	231	194	2,541	2,134
22	Nong Sai Kao	75900	192+600	7	1,183	231	194	1,617	1,358
23	Car Bridge	76320	192+180	7	420	231	194	1,617	1,358
24	Wat Ban Khok	80413	188+87	7	4,093	231	194	1,617	1,358
25	Car Bridge	84597	183+903	7	4,184	231	194	1,617	1,358
26	3019	86652	181+848	7	2,055	231	194	1,617	1,358
27	CHP- 5	93361	175+139	7	6,709	231	194	1,617	1,358
28	CHP- 23	94874	173+626	7	1,513	231	194	1,617	1,358
29	CHP- 6	98026	170+474	9	3,152	231	194	2,079	1,746
30	CHP- 7	99038	169+462	10	1,012	231	194	2,310	1,940
31	Car Bridge	99418	169+82	14	380	231	194	3,234	2,716
32	CHP- 8	101093	167+407	7	1,675	231	194	1,617	1,358
33	CHP- 9	103456	165+44	7	2,363	231	194	1,617	1,358
34	311	104489	164+11	10	1,033	231	194	2,310	1,940
35	CHP- 24	109640	158+860	7	5,151	231	194	1,617	1,358
36	CHP- 25	112392	156+108	7	2,752	231	194	1,617	1,358
37	CHP- 10	115810	152+690	7	3,418	231	194	1,617	1,358
38	CHP- 26	118634	149+866	7	2,824	231	194	1,617	1,358
39	Car Bridge	121383	147+117	7	2,749	231	194	1,617	1,358
40	3022	126459	142+41	8	5,076	231	194	1,848	1,552
41	Car Bridge	127686	140+814	10	1,227	231	194	2,310	1,940
42	3034	130337	138+163	10	2,651	231	194	2,310	1,940
43	3048	133000	135+500	8	2,663	231	194	1,848	1,552
Subtotal (Upstream)								84,546	71,004

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.14 Number of Affected Major Road (East Diversion Channel, Middle Stream, South Side of Pasak River, Q =1,500m^3/s)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
1	Reua-Sao Hai	325	134+675	7	-	156	134	1,092	938
2	3041	4884	130+116	7	4,559	156	134	1,092	938
3	3069	9570	125+430	7	4,686	156	134	1,092	938
4	3041	13797.93	121+202	7	4,228	156	134	1,092	938
5	3009	14779	120+221	7	981	156	134	1,092	938
6	329	19377	115+623	9	4,598	156	134	1,404	1,206
7	3043	21928	113+72	8	2,551	156	134	1,248	1,072
8	1	24630	110+370	58	2,702	156	134	9,048	7,772
9	4001	30167	104+833	7	5,537	156	134	1,092	938
10	3067	32029.11	102+971	7	1,862	156	134	1,092	938
11	3045	35190	99+810	7	3,161	156	134	1,092	938
12	Along Klong Sam Sip Sam	38418	96+582	7	3,228	156	134	1,092	938
Subtotal (Middle Stream)								21,528	18,492

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection

Note: The location of the major roads was listed in the local report and this table is made of those information.
-* Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.15 Number of Affected Major Road (East Diversion Channel, Downstream, South Side of Pasak River, Q =1,500m^3/s)

No.	Route	Distance Mark in Local Report	Distance Mark	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
13	Along Klong Sam Sip Song	41760.53	93+239	7	3,343	351	291	1724	2,457
14	Along Klong Sam Sip Et	46233.4	88+767	7	4,473	351	291	1724	2,457
15	Along Klong Sam Sip	49940.22	85+60	7	3,707	351	291	1724	2,457
16	305	57207.56	77+792	22	7,267	351	291	1724	7,722
17	Along klong Yi Sip Si	62541.95	72+458	7	5,334	351	291	1724	2,457
18	Along Klong Yi Sip Sam	65779.71	69+220	7	3,238	351	291	1724	2,457
19	Along klong Yi Sip Song	69028.6	65+971	7	3,249	351	291	1724	2,457
20	3369	71494.47	63+506	7	2,466	351	291	1724	2,457
21	3312	73312	61+688	7	1,818	351	291	1724	2,457
22	Entrance of Ban Saladaeng	86974	48+26	7	13,662	351	291	1724	2,457
23	3841	89137	45+863	7	2,163	351	291	1724	2,457
24	Entrance of Kwang Canal	96861.19	38+139	7	7,724	351	291	1724	2,457
25	304	99544.54	35+455	20	2,683	351	291	1724	7,020
26	Road of Prawet Burirom Canal	111936.04	23+64	7	12,392	351	291	1724	2,457
27	7	117219	17+781	32	5,283	351	291	1724	11,232
28	34	123120	11+880	65	5,901	351	291	1724	22,815
29	3	133593.605	1+406	7	10,474	351	291	1724	2,457
Subtotal (Downstream)								80,730	66,930

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection
Note: The location of the major roads was listed in the local report and this table is made of those information.
-*Only road with route number became candidate of bridge in Alt-3.

Tab. J2.1.16 Location and Dimension of Canal and River for Siphon Structure Crossing East Diversion Channel Route (1/2)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
1	619145.9405	1695156.458	15	7.5	9.375	141
2	626355	1692566	22	10	12.5	275
3	630822	1687726	14	7	8.75	123
4	631662	1687736	14	7	8.75	123
5	634697	1687671	4	2	2.5	10
6	636249	1687050	18	9	11.25	203
7	636447	1686970	4	2	2.5	10
8	636631	1686897	3	1.5	1.875	6
9	636875	1686797	4	2	2.5	10
10	638872	1685987	6	3	3.75	23
11	639170	1685865	2	1	1.25	3
12	640744	1685226	13	6.5	8.125	106
13	641333	1684987	3	1.5	1.875	6
14	641891	1684761	6	3	3.75	23
15	642293	1684598	4	2	2.5	10
16	643875	1683938	2	1	1.25	3
17	643971	1683870	3	1.5	1.875	6
18	644381	1683485	4	2	2.5	10
19	645147	1682677	2	1	1.25	3
20	645617	1682184	30	10	12.5	375
21	651095	1677798	7	3.5	4.375	31
22	651700	1675761	10	5	6.25	63
23	651838	1675350	20	10	12.5	250
24	652111	1674336	3	1.5	1.875	6
25	654097	1673054	6	3	3.75	23
26	657330	1673700	2	1	1.25	3
27	657762	1673516	3	1.5	1.875	6
28	658848	1673070	2	1	1.25	3
29	659649	1672782	2	1	1.25	3
30	659688	1672764	2	1	1.25	3
31	663634	1671656	2	1	1.25	3
32	664634	1671369	2	1	1.25	3
33	665282	1671192	2	1	1.25	3
34	665307	1671181	2	1	1.25	3
35	666515	1670325	2	1	1.25	3
36	667126	1668601	3	1.5	1.875	6
37	667246	1668182	8	4	5	40
38	667342	1667869	8	4	5	40
39	667987	1665688	6	3	3.75	23
40	668512	1663922	8	4	5	40
41	668790	1662996	2	1	1.25	3
42	668800	1662966	2	1	1.25	3
43	669090	1661979	2	1	1.25	3
44	670149	1658384	10	5	6.25	63
45	670457	1657307	9	4.5	5.625	51
46	670719	1656402	13	6.5	8.125	106
47	670884	1655797	2	1	1.25	3
48	670911	1655431	2	1	1.25	3
49	670939	1655057	4	2	2.5	10
50	671001	1654231	5	2.5	3.125	16
51	671305	1652993	5	2.5	3.125	16
52	671521	1652361	10	5	6.25	63
53	671742	1651705	5	2.5	3.125	16
54	672048	1650809	3	1.5	1.875	6
55	672116	1650606	4	2	2.5	10
56	672080	1648026	11	5.5	6.875	76
57	672045	1647743	8	4	5	40
58	672039	1647713	8	4	5	40
59	672039	1647071	2	1	1.25	3
60	672181	1646461	6	3	3.75	23
61	673314	1645645	2	1	1.25	3
62	674087	1645091	5	2.5	3.125	16
63	675223	1644314	11	5.5	6.875	76
64	676312	1643904	5	2.5	3.125	16
65	676389	1643827	18	9	11.25	203
66	677650	1642932	8	4	5	40
67	684934	1626747	6	3	3.75	23
68	685121	1626387	5	2.5	3.125	16
69	685266	1626103	6	3	3.75	23
70	685899	1624866	5	2.5	3.125	16
71	686780	1624163	3	1.5	1.875	6
72	686995	1624014	8	4	5	40
73	687008	1624004	4	2	2.5	10
74	687188	1623878	9	4.5	5.625	51
75	687513	1623194	4	2	2.5	10
76	687540	1623043	4	2	2.5	10
77	687579	1622817	3	1.5	1.875	6
78	688064	1619863	2	1	1.25	3
79	686943	1616731	9	4.5	5.625	51
80	688695	1614818	49	10	12.5	613
81	691523	1612947	21	10	12.5	263
Subtotal (Upstream)						4,073
82	692999.2511	1609142.778	3	1.5	1.875	6
83	693412.5206	1607891.082	14	7	8.75	123

Tab. J2.1.17 Location and Dimension of Canal and River for Siphon Structure Crossing East Diversion Channel Route (1/2)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
84	693704.0832	1607226.082	20	10	12.5	250
85	694255.7754	1606212.871	3	1.5	1.875	6
86	694945.2239	1604949.301	6	3	3.75	23
87	695124.6318	1604622.117	20	10	12.5	250
88	695323.905	1604251.726	3	1.5	1.875	6
89	696327.1941	1602410.088	2	1	1.25	3
90	696535.4274	1602029.022	2	1	1.25	3
91	696754.1675	1601623.53	5	2.5	3.125	16
92	698875.9433	1597733.626	10	5	6.25	63
93	699583.2884	1596679.41	2	1	1.25	3
94	699600.8213	1596659.152	2	1	1.25	3
95	700557.5414	1595402.839	2	1	1.25	3
96	701204.954	1594154.638	3	1.5	1.875	6
97	701240.1022	1593692.922	8	4	5	40
98	701242.604	1593665.727	7	3.5	4.375	31
99	701270.1081	1593315.076	3	1.5	1.875	6
100	701421.0967	1591354.056	6	3	3.75	23
101	703769.2854	1588148.778	3	1.5	1.875	6
102	704411.0784	1587832.642	12	6	7.5	90
103	706248.6948	1586930.206	5	2.5	3.125	16
104	706368.5321	1586694.994	5	2.5	3.125	16
105	706726.1414	1585862.707	3	1.5	1.875	6
106	706651.7932	1584598.924	10	5	6.25	63
107	706667.5905	1583970.408	9	4.5	5.625	51
108	707373.8512	1582546.679	11	5.5	6.875	76
109	708097.295	1581088.339	35	10	12.5	438
110	708817.7453	1579635.408	6	3	3.75	23
111	708952.2076	1579359.575	8	4	5	40
112	709210.2505	1578840.33	6	3	3.75	23
113	710068.5396	1577107.008	10	5	6.25	63
114	710253.3362	1576739.976	44	10	12.5	550
Subtotal (Middle Stream)						2,325
115	712236.8898	1560099.797	48	10	12.5	600
116	712439.8036	1556519.903	34	10	12.5	425
117	712817.0917	1554927.605	33	10	12.5	413
118	712841.2815	1551693.958	39	10	12.5	488
119	712863.2519	1548451.713	28	10	12.5	350
120	712462.0142	1546768.466	4	2	2.5	10
121	711648.23	1545910.594	30	10	12.5	375
122	710627.9282	1544838.784	40	10	12.5	500
123	709950.7332	1531469.632	21	10	12.5	263
124	710070.041	1531095.598	26	10	12.5	325
125	710510.6539	1529704.893	8	4	5	40
126	710799.7422	1528786.907	21	10	12.5	263
127	711197.1782	1528303.878	48	10	12.5	600
128	715728.6949	1524449.038	32	10	12.5	400
129	715826.0573	1524241.067	10	5	6.25	63
130	716077.7568	1522992.222	28	10	12.5	350
131	715506.0456	1521900.245	17	8.5	10.625	181
132	714788.1921	1520993.689	7	3.5	4.375	31
133	714591.7523	1520740.448	4	2	2.5	10
134	713737.2159	1519647.416	29	10	12.5	363
135	711711.4018	1516986.195	20	10	12.5	250
136	711298.2666	1516392.299	8	4	5	40
137	710904.1824	1515828.529	21	10	12.5	263
138	710089.4995	1514661.873	3	1.5	1.875	6
139	709905.6355	1514398.283	12	6	7.5	90
140	708460.4132	1512330.098	31	10	12.5	388
141	708271.9012	1512057.076	10	5	6.25	63
142	707361.3243	1510755.321	28	10	12.5	350
143	707096.4909	1509989.5	6	3	3.75	23
144	706999.1905	1509470.412	19	9.5	11.875	226
145	706973.9902	1508408.023	29	10	12.5	363
146	707154.1871	1506947.455	6	3	3.75	23
147	706832.6697	1506287.167	24	10	12.5	300
148	706334.8821	1505274.191	30	10	12.5	375
149	705649.1628	1503872.199	18	9	11.25	203
150	705551.4954	1503673.453	6	3	3.75	23
151	704859.206	1501129.667	11	5.5	6.875	76
152	704143.9256	1500724.907	39	10	12.5	488
153	703383.3605	1499460.772	10	5	6.25	63
154	702395.5556	1496521.352	22	10	12.5	275
155	702369.4063	1495655.823	15	7.5	9.375	141
156	701820.8263	1492212.068	35	10	12.5	438
157	701804.8902	1492143.112	8	4	5	40
Subtotal (Downstream)						13,346

Tab. J3.1.1 Summary on Quantity for Construction of West Diversion Channel

Channel	Q (m^3/s)	Alternative	Distance Mark	Roughness Coefficient	Excavation (m^3)	Embankment (m^3)	Bank Slope (m^2)	Site Clearance (million m^2)	Lining at Bottom (m^2)	Sodding (m^2)	Siphon Length* (m)
West Diversion Channel	1,000	Ait-1	0km-70km	0.025	97,677,000	1,817,000	3,813,000	16.933	0	622,000	260
			70km-223km		124,292,000	4,415,000	7,710,000	26.763	0	1,367,000	188
			Total		221,969,000	6,232,000	11,523,000	43.696	0	1,989,000	448
		Ait-2	0km-70km	0.02	81,725,000	1,817,000	3,813,000	14.848	9,100,000	622,000	230
			70km-223km		103,125,000	4,415,000	7,710,000	23.691	11,475,000	1,367,000	168
			Total		184,850,000	6,232,000	11,523,000	38.538	20,575,000	1,989,000	398
		Ait-3	0km-70km	0.035	48,551,000	7,386,000	1,668,000	109.101	0	1,812,000	72
			70km-223km		183,498,000	9,766,000	3,836,000	112.528	0	2,561,000	52
			Total		232,049,000	17,152,000	5,504,000	221.629	0	4,373,000	124
	1,500	Ait-1	0km-70km	0.025	146,598,000	1,817,000	3,813,000	23.327	0	622,000	352
			70km-223km		185,688,000	4,415,000	7,710,000	35.675	0	1,367,000	246
			Total		332,286,000	6,232,000	11,523,000	59.001	0	1,989,000	598

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening
Siphons in Alt-3 go through under the dikes in both sides only, not under the channel.

Tab. J3.1.2 Quantity for Construction of West Diversion Channel (Q = 1,000 m^3/s, Alt-1)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	0.936	160	2.064	6.936	1,254	34	54	246	12.384	-	-	-	-	
2	10	10	-5.856	3.144	2.754	160	0.39	8.61	1,600	5	54	236	2.34	14,270,403	195,000	540,000	2.41	73,620
3	20	10	-5.712	3.288	3.891	160	-0.603	9.603	1,813	0	57.62	238	0	17,065,646	25,000	558,100	2.37	11,700
4	30	10	-5.568	3.432	2.579	160	0.853	8.147	1,503	11	54	239	5.118	16,578,869	55,000	558,100	2.385	25,590
5	40	10	-5.424	3.576	1	160	2.576	6.424	1,152	46	54	249	15.456	13,271,421	285,000	540,000	2.44	102,870
6	50	10	-5.281	3.719	1	160	2.719	6.281	1,123	50	54	250	16.314	11,374,782	480,000	540,000	2.495	158,850
7	60	10	-5.137	3.863	1	160	2.863	6.137	1,095	54	54	251	17.178	11,091,106	520,000	540,000	2.505	167,460
8	69.5	9.5	-5	4	4.807	160	-0.807	9.807	1,858	0	58.85	239	0	14,024,661	256,500	536,038	2.328	81,596
Total or Average							1.257	7.743				244		97,676,888	1,816,500	3,812,238	16.933	621,686
9	70	0.5	-4	4	4.03	95	-0.03	8.03	956	0	48.18	163	0	703,487	0	26,758	0.101	0
10	80	10	-2.98	5.02	4.398	95	0.622	7.378	864	8	48	167	3.732	9,102,537	40,000	480,900	1.65	18,660
11	90	10	-1.961	6.039	5.276	95	0.763	7.237	845	10	48	168	4.578	8,544,261	90,000	480,000	1.675	41,550
12	100	10	-0.941	7.059	5.237	95	1.822	6.178	701	29	48	174	10.932	7,730,253	195,000	480,000	1.71	77,550
13	110	10	0.078	8.078	3.406	95	4.672	3.328	349	113	48	191	28.032	5,254,000	710,000	480,000	1.825	194,820
14	120	10	1.098	9.098	4.507	95	4.591	3.409	359	110	48	191	27.546	3,540,528	1,115,000	480,000	1.91	277,890
15	130	10	2.118	10.118	12.472	95	-2.354	10.354	1,305	0	62.13	177	0	8,319,824	550,000	550,650	1.84	137,730
16	140	10	3.137	11.137	10.792	95	0.345	7.655	903	4	48	165	2.07	11,041,341	20,000	550,650	1.71	10,350
17	150	10	4.157	12.157	11.317	95	0.84	7.16	834	11	48	168	5.04	8,685,095	75,000	480,000	1.665	35,550
18	160	10	5.176	13.176	11.283	95	1.893	6.107	692	30	48	174	11.358	7,630,241	205,000	480,000	1.71	81,990
19	170	10	6.196	14.196	12.744	95	1.452	6.548	751	21	48	172	8.712	7,213,702	255,000	480,000	1.73	100,350
20	180	10	7.216	15.216	17.555	95	-2.339	10.339	1,303	0	62.04	177	0	10,267,894	105,000	550,200	1.745	43,560
21	190	10	8.235	16.235	15.591	95	0.644	7.356	861	8	48	167	3.864	10,820,210	40,000	550,200	1.72	19,320
22	200	10	9.255	17.255	18.195	95	-0.94	8.94	1,089	0	53.64	169	0	9,751,116	40,000	508,200	1.68	19,320
23	210	10	10.275	18.275	14.978	95	3.297	4.703	513	66	48	183	19.782	8,011,053	330,000	508,200	1.76	98,910
24	220	10	11.294	19.294	17.043	95	2.251	5.749	645	38	48	177	13.506	5,792,239	520,000	480,000	1.8	166,440
25	223	3	11.6	19.6	17.077	95	2.523	5.477	610	45	48	178	15.138	1,883,424	124,500	144,000	0.533	42,966
Total or Average		223	-	-	-	-	1.18	6.82				174		124,291,205	4,414,500	7,709,758	26.763	1,366,956

*Siphon length was based on the average width of the site clearance and twice of excavation depth.

CTI Engineering International Co., Ltd.
Oriental Consultants Co., Ltd.
Nippon Koei Co., Ltd.
CTI Engineering Co., Ltd.

Tab. J3.1.3 Quantity for Construction of West Diversion Channel (Q = 1,000 m^3/s, Alt-2)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	0.936	130	2.064	6.936	1,046	34	54	216	12.384	-	-	-	-	
2	10	10	-5.856	3.144	2.754	130	0.39	8.61	1,342	5	54	206	2.34	11,938,503	195,000	540,000	2.11	73,620
3	20	10	-5.712	3.288	3.891	130	-	9.603	1,525	0	57.62	208	0	14,333,696	25,000	558,100	2.07	11,700
4	30	10	-5.568	3.432	2.579	130	0.853	8.147	1,258	11	54	209	5.118	13,916,369	55,000	558,100	2.085	25,590
5	40	10	-5.424	3.576	1	130	2.576	6.424	959	46	54	219	15.456	11,085,771	285,000	540,000	2.14	102,870
6	50	10	-5.281	3.719	1	130	2.719	6.281	935	50	54	220	16.314	9,469,032	480,000	540,000	2.195	158,850
7	60	10	-5.137	3.863	1	130	2.863	6.137	911	54	54	221	17.178	9,228,406	520,000	540,000	2.205	167,460
8	69.5	9.5	-5	4	4.807	130	-	9.807	1,563	0	58.85	209	0	11,752,641	256,500	536,038	2.043	81,596
Total or Average							1.257	7.743				214	0	81,724,418	1,816,500	3,812,238	14.848	621,686
9	70	0.5	-4	4	4.03	75	-	8.03	796	0	48.18	143	0	589,784	0	26,758	0.088	0
10	80	10	-2.98	5.02	4.398	75	0.622	7.378	717	8	48	147	3.732	7,561,737	40,000	480,900	1.45	18,660
11	90	10	-1.961	6.039	5.276	75	0.763	7.237	700	10	48	148	4.578	7,082,761	90,000	480,000	1.475	41,550
12	100	10	-0.941	7.059	5.237	75	1.822	6.178	578	29	48	154	10.932	6,388,753	195,000	480,000	1.51	77,550
13	110	10	0.078	8.078	3.406	75	4.672	3.328	283	113	48	171	28.032	4,303,400	710,000	480,000	1.625	194,820
14	120	10	1.098	9.098	4.507	75	4.591	3.409	291	110	48	171	27.546	2,866,828	1,115,000	480,000	1.71	277,890
15	130	10	2.118	10.118	12.472	75	-	10.354	1,098	0	62.13	157	0	6,943,524	550,000	550,650	1.64	137,730
16	140	10	3.137	11.137	10.792	75	0.345	7.655	750	4	48	145	2.07	9,240,441	20,000	550,650	1.51	10,350
17	150	10	4.157	12.157	11.317	75	0.84	7.16	691	11	48	148	5.04	7,203,595	75,000	480,000	1.465	35,550
18	160	10	5.176	13.176	11.283	75	1.893	6.107	570	30	48	154	11.358	6,303,541	205,000	480,000	1.51	81,990
19	170	10	6.196	14.196	12.744	75	1.452	6.548	620	21	48	152	8.712	5,948,202	255,000	480,000	1.53	100,350
20	180	10	7.216	15.216	17.555	75	-	10.339	1,096	0	62.04	157	0	8,579,194	105,000	550,200	1.545	43,560
21	190	10	8.235	16.235	15.591	75	0.644	7.356	714	8	48	147	3.864	9,050,710	40,000	550,200	1.52	19,320
22	200	10	9.255	17.255	18.195	75	-	8.94	910	0	53.64	149	0	8,121,516	40,000	508,200	1.48	19,320
23	210	10	10.275	18.275	14.978	75	3.297	4.703	419	66	48	163	19.782	6,646,753	330,000	508,200	1.56	98,910
24	220	10	11.294	19.294	17.043	75	2.251	5.749	530	38	48	157	13.506	4,747,039	520,000	480,000	1.6	166,440
25	223	3	11.6	19.6	17.077	75	2.523	5.477	501	45	48	158	15.138	1,546,644	124,500	144,000	0.473	42,966
Total or Average		223	-	-	-	-	1.18	6.82				154		103,124,422	4,414,500	7,709,758	23.691	1,366,956

Tab. J3.1.4 Quantity for Construction of West Diversion Channel (Q = 1,000 m^3/s, Alt-3)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	2	6	0.936	1500	5.064	-	0	128	24	1,574	30.384	-	-	-	-	
2	10	10	2.143	6.143	2.754	1500	3.389	0.611	918	69	24	1,564	20.334	4,588,100	985,000	240,000	15.69	253,590
3	20	10	2.286	6.286	3.891	1500	2.395	1.605	2,415	42	24	1,558	14.37	16,664,241	555,000	240,000	15.61	173,520
4	30	10	2.429	6.429	2.579	1500	3.85	0.15	225	83	24	1,567	23.1	13,201,478	625,000	240,000	15.625	187,350
5	40	10	2.571	6.571	1	1500	5.571	-	0	149	24	1,577	33.426	1,125,338	1,160,000	240,000	15.72	282,630
6	50	10	2.714	6.714	1	1500	5.714	-	0	156	24	1,578	34.284	0	1,525,000	240,000	15.775	338,550
7	60	10	2.857	6.857	1	1500	5.857	-	0	162	24	1,579	35.142	0	1,590,000	240,000	15.785	347,130
8	69.5	9.5	2.993	6.993	4.807	1500	2.186	1.814	2,731	37	24	1,557	13.116	12,971,641	945,250	228,000	14.896	229,226
Total or Average							4.253	-				1,569		48,550,798	7,385,250	1,668,000	109.101	1,811,996
9	70	0.5	3	7	4.03	670	2.97	1.03	693	57	24	732	17.82	856,039	23,500	12,000	0.572	4,455
10	80	10	3.824	7.824	4.398	670	3.426	0.574	386	70	24	735	20.556	5,394,256	635,000	240,000	7.335	191,880
11	90	10	4.647	8.647	5.276	670	3.371	0.629	423	68	24	734	20.226	4,040,927	690,000	240,000	7.345	203,910
12	100	10	5.471	9.471	5.237	670	4.234	-	0	97	24	739	25.404	2,113,085	825,000	240,000	7.365	228,150
13	110	10	6.294	10.294	3.406	670	6.888		0	212	24	755	41.328	0	1,545,000	240,000	7.47	333,660
14	120	10	7.118	11.118	4.507	670	6.611		0	198	24	754	39.666	0	2,050,000	240,000	7.545	404,970
15	130	10	7.941	11.941	12.472	670	-0.531	4.531	3,097	0	27.19	717	0	15,486,800	990,000	255,950	7.355	198,330
16	140	10	8.765	12.765	10.792	670	1.973	2.027	1,370	32	24	726	11.838	22,338,881	160,000	255,950	7.215	59,190
17	150	10	9.588	13.588	11.317	670	2.271	1.729	1,167	39	24	728	13.626	12,689,073	355,000	240,000	7.27	127,320
18	160	10	10.412	14.412	11.283	670	3.129	0.871	586	61	24	733	18.774	8,766,222	500,000	240,000	7.305	162,000
19	170	10	11.235	15.235	12.744	670	2.491	1.509	1,018	44	24	729	14.946	8,018,536	525,000	240,000	7.31	168,600
20	180	10	12.059	16.059	17.555	670	-1.496	5.496	3,773	0	32.98	723	0	23,953,997	220,000	284,900	7.26	74,730
21	190	10	12.882	16.882	15.591	670	1.291	2.709	1,837	18	24	722	7.746	28,049,921	90,000	284,900	7.225	38,730
22	200	10	13.706	17.706	18.195	670	-0.489	4.489	3,068	0	26.94	717	0	24,525,648	90,000	254,700	7.195	38,730
23	210	10	14.529	18.529	14.978	670	3.551	0.449	301	74	24	735	21.306	16,847,591	370,000	254,700	7.26	106,530
24	220	10	15.353	19.353	17.043	670	2.31	1.69	1,141	40	24	728	13.86	7,211,516	570,000	240,000	7.315	175,830
25	223	3	15.6	19.6	17.077	670	2.523	1.477	996	45	24	729	15.138	3,205,505	127,500	72,000	2.186	43,497
Total or Average		223	-	-	-	-	2.619	1.381				732		183,497,997	9,766,000	3,835,100	112.528	2,560,512

Tab. J3.1.5 Quantity for Construction of West Diversion Channel (Q = 1,500 m^3/s, Alt-1)

Section Number	Accumulated Distance (km)	Distance (km)	Elevation of Design River Bed (m)	Elevation of Design Crest (m)	Elevation of Ground Level (m)*	Width of River Bed (m)	Dike Height (m)	Excavation Depth (m)	Excavation (m2)	Embankment (m2)	Bank Slope (m)	Site Clearance (m)	Sodding (m)	Excavation (m3)	Embankment (m3)	Bank Slope (m2)	Site Clearance (km2)	Sodding (m2)
1	0	-	-6	3	0.936	252	2.064	6.936	1,892	34	54	338	12.384	-	-	-	-	
2	10	10	-5.856	3.144	2.754	252	0.39	8.61	2,392	5	54	328	2.34	21,421,563	195,000	540,000	3.33	73,620
3	20	10	-5.712	3.288	3.891	252	-0.603	9.603	2,697	0	57.62	330	0	25,443,626	25,000	558,100	3.29	11,700
4	30	10	-5.568	3.432	2.579	252	0.853	8.147	2,252	11	54	331	5.118	24,743,869	55,000	558,100	3.305	25,590
5	40	10	-5.424	3.576	1	252	2.576	6.424	1,743	46	54	341	15.456	19,974,081	285,000	540,000	3.36	102,870
6	50	10	-5.281	3.719	1	252	2.719	6.281	1,701	50	54	342	16.314	17,219,082	480,000	540,000	3.415	158,850
7	60	10	-5.137	3.863	1	252	2.863	6.137	1,660	54	54	343	17.178	16,803,386	520,000	540,000	3.425	167,460
8	69.5	9.5	-5	4	4.807	252	-0.807	9.807	2,760	0	58.85	331	0	20,992,189	256,500	536,038	3.202	81,596
Total or Average							1.257	7.743				336		146,597,796	1,816,500	3,812,238	23.327	621,686
9	70	0.5	-4	4	4.03	153	-0.03	8.03	1,422	0	48.18	221	0	1,045,483	0	26,758	0.138	0
10	80	10	-2.98	5.02	4.398	153	0.622	7.378	1,292	8	48	225	3.732	13,570,857	40,000	480,900	2.23	18,660
11	90	10	-1.961	6.039	5.276	153	0.763	7.237	1,264	10	48	226	4.578	12,782,611	90,000	480,000	2.255	41,550
12	100	10	-0.941	7.059	5.237	153	1.822	6.178	1,060	29	48	232	10.932	11,620,603	195,000	480,000	2.29	77,550
13	110	10	0.078	8.078	3.406	153	4.672	3.328	542	113	48	249	28.032	8,010,740	710,000	480,000	2.405	194,820
14	120	10	1.098	9.098	4.507	153	4.591	3.409	556	110	48	249	27.546	5,494,258	1,115,000	480,000	2.49	277,890
15	130	10	2.118	10.118	12.472	153	-2.354	10.354	1,906	0	62.13	235	0	12,311,094	550,000	550,650	2.42	137,730
16	140	10	3.137	11.137	10.792	153	0.345	7.655	1,347	4	48	223	2.07	16,263,951	20,000	550,650	2.29	10,350
17	150	10	4.157	12.157	11.317	153	0.84	7.16	1,249	11	48	226	5.04	12,981,445	75,000	480,000	2.245	35,550
18	160	10	5.176	13.176	11.283	153	1.893	6.107	1,046	30	48	232	11.358	11,477,671	205,000	480,000	2.29	81,990
19	170	10	6.196	14.196	12.744	153	1.452	6.548	1,130	21	48	230	8.712	10,883,652	255,000	480,000	2.31	100,350
20	180	10	7.216	15.216	17.555	153	-2.339	10.339	1,903	0	62.04	235	0	15,165,124	105,000	550,200	2.325	43,560
21	190	10	8.235	16.235	15.591	153	0.644	7.356	1,288	8	48	225	3.864	15,951,760	40,000	550,200	2.3	19,320
22	200	10	9.255	17.255	18.195	153	-0.94	8.94	1,608	0	53.64	227	0	14,476,956	40,000	508,200	2.26	19,320
23	210	10	10.275	18.275	14.978	153	3.297	4.703	786	66	48	241	19.782	11,967,523	330,000	508,200	2.34	98,910
24	220	10	11.294	19.294	17.043	153	2.251	5.749	979	38	48	235	13.506	8,823,319	520,000	480,000	2.38	166,440
25	223	3	11.6	19.6	17.077	153	2.523	5.477	928	45	48	236	15.138	2,860,086	124,500	144,000	0.707	42,966
Total or Average		223	-	-	-	-	1.18	6.82				232		185,687,133	4,414,500	7,709,758	35.675	1,366,956

Tab. J3.1.6 Number of Affected House and Factory along West Diversion Channel

Area	Alt-1		Alt-2		Alt-3	
	House	Factory	House	Factory	House	Factory
0km-70km	783	10	700	9	6225	67
70km-Top	798	11	697	9	4945	30

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Tab. J3.1.7 Number of SCC and SDCM of West Diversion Channel

Area	Alt-1			Alt-2			Alt-3		
	SCC	SDCM-1	SDCM-2	SCC	SDCM-1	SDCM-2	SCC	SDCM-1	SDCM-2
0km to 25.2km	3,528,000	504,000	3,150,000	3,528,000	504,000	3,150,000	0	0	1,050,000
25.2km to 40.0km	2,072,000	222,000	1,295,000	2,072,000	222,000	1,295,000	0	0	431,667
Total	5,600,000		5,171,000	5,600,000		5,171,000	0		1,481,667

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening

Tab. J3.1.8 Number of Affected Major Road (West Diversion Channel, Q =1,000m^3/s)

No.	Route	X	Y	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)			Area of Bridge Girder (m^2)		
						Alt-1	Alt-2	Alt-3	Alt-1	Alt-2	Alt-3
1	3183	613536.4758	1683753.576	9	-	143	123	694	1,287	1,107	6,246
2	3350	609747.5827	1644032.337	10	39,902	143	123	694	1,430	1,230	6,940
3	3502	607574.0022	1636697.636	9	7,650	143	123	694	1,287	1,107	6,246
4	3365	609127.9733	1632563.428	10	4,417	143	123	694	1,430	1,230	6,940
5	3264	606284.817	1618551.809	13	14,297	143	123	694	1,859	1,599	9,022
6	333	598547.4989	1604988.766	11	15,615	143	123	694	1,573	1,353	7,634
7	333	597405.9113	1593884.083	12	11,163	143	123	694	1,716	1,476	8,328
8	321	599793.4444	1590931.519	28	3,797	143	123	694	4,004	3,444	19,432
Subtotal (Upstream)									20,502	12,546	70,788
9	321	594651.0766	1583024.208	28	9,432	214	184	1524	5,992	5,152	42,672
10	3275	596664.4082	1573387.692	10	9,845	214	184	1524	2,140	1,840	15,240
11	3440	597266.2563	1571329.621	10	2,144	214	184	1524	2,140	1,840	15,240
12	3387	602898.9445	1564674.869	12	8,719	214	184	1524	2,568	2,208	18,288
13	321	606442.3363	1561411.551	32	4,817	214	184	1524	6,848	5,888	48,768
14	321	607028.1968	1552044.012	32	9,386	214	184	1524	6,848	5,888	48,768
15	3040	607006.4152	1551910.393	20	135	214	184	1524	4,280	3,680	30,480
16	346	606476.016	1548691.483	18	3,262	214	184	1524	3,852	3,312	27,432
17	4	605678.5764	1525681.142	35	23,024	214	184	1524	7,490	6,440	53,340
18	3236	614572.4668	1507914.606	8	19,868	214	184	1524	1,712	1,472	12,192
19	3404	620800.8409	1497126.064	7	12,457	214	184	1524	1,498	1,288	10,668
20	3423	620877.6628	1496880.849	9	257	214	184	1524	1,926	1,656	13,716
21	35	622020.798	1493254.12	39	3,803	214	184	1524	8,346	7,176	59,436
Subtotal (Downstream)									55,640	47,840	396,240

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection, Alt-3: Cross Section with Emphasis of Heightening
Note: The location of the major roads was listed in the local report and this table is made of those information.

Tab. J3.1.9 Number of Affected Major Road (West Diversion Channel, Q =1,500m^3/s)

No.	Route	X	Y	Road Width (m)	Distance from Previous Bridge (m)	Channel Width (m)		Area of Bridge Girder (m^2)	
						Alt-1	Alt-2	Alt-1	Alt-2
1	3183	613536.4758	1683753.576	9	-	201	171	1,809	1,539
2	3350	609747.5827	1644032.337	10	39,902	201	171	2,010	1,710
3	3502	607574.0022	1636697.636	9	7,650	201	171	1,809	1,539
4	3365	609127.9733	1632563.428	10	4,417	201	171	2,010	1,710
5	3264	606284.817	1618551.809	13	14,297	201	171	2,613	2,223
6	333	598547.4989	1604988.766	11	15,615	201	171	2,211	1,881
7	333	597405.9113	1593884.083	12	11,163	201	171	2,412	2,052
8	321	599793.4444	1590931.519	28	3,797	201	171	5,628	4,788
Subtotal (Upstream)								20,502	12,546
9	321	594651.0766	1583024.208	28	9,432	306	261	8,568	7,308
10	3275	596664.4082	1573387.692	10	9,845	306	261	3,060	2,610
11	3440	597266.2563	1571329.621	10	2,144	306	261	3,060	2,610
12	3387	602898.9445	1564674.869	12	8,719	306	261	3,672	3,132
13	321	606442.3363	1561411.551	32	4,817	306	261	9,792	8,352
14	321	607028.1968	1552044.012	32	9,386	306	261	9,792	8,352
15	3040	607006.4152	1551910.393	20	135	306	261	6,120	5,220
16	346	606476.016	1548691.483	18	3,262	306	261	5,508	4,698
17	4	605678.5764	1525681.142	35	23,024	306	261	10,710	9,135
18	3236	614572.4668	1507914.606	8	19,868	306	261	2,448	2,088
19	3404	620800.8409	1497126.064	7	12,457	306	261	2,142	1,827
20	3423	620877.6628	1496880.849	9	257	306	261	2,754	2,349
21	35	622020.798	1493254.12	39	3,803	306	261	11,934	10,179
Subtotal (Downstream)								79,560	47,840

Where Alt-1: Standard Cross Section, Alt-2: Cross Section with Slope and Channel Bed Protection
Note: The location of the major roads was listed in the local report and this table is made of those information.

Tab. J3.1.10 Location and Dimension of Canal and River for Siphon Structure Crossing West Diversion Channel Route (1/2)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
1	613739.2655	1683894.779	30	10	12.5	375
2	612698.8672	1682856.633	9	4.5	5.6	50
3	612118.8154	1681871.958	5	2.5	3.1	16
4	611538.0225	1680875.973	7	3.5	4.4	31
5	611097.7394	1680117.326	7	3.5	4.4	31
6	610200.6514	1678578.618	10	5	6.3	63
7	609969.9397	1678183.617	4	2	2.5	10
8	609854.1072	1677984.782	4	2	2.5	10
9	609660.6664	1677650.244	4	2	2.5	10
10	609542.5594	1677447.938	7	3.5	4.4	31
11	609391.5624	1677188.536	4	2	2.5	10
12	609198.1087	1676859.576	3	1.5	1.9	6
13	609118.1485	1676719.368	3	1.5	1.9	6
14	609009.363	1676534.001	2	1	1.3	3
15	608926.375	1676390.127	2	1	1.3	3
16	608850.826	1676262.694	3	1.5	1.9	6
17	608713.8268	1676026.235	2	1	1.3	3
18	608607.9079	1675842.468	2	1	1.3	3
19	608527.1662	1675709.171	2	1	1.3	3
20	608317.63	1675346.433	2	1	1.3	3
21	608212.6945	1675167.559	4	2	2.5	10
22	608047.7025	1674881.486	4	2	2.5	10
23	607929.9702	1674681.593	2	1	1.3	3
24	607797.5747	1674455.655	2	1	1.3	3
25	607550.4466	1674027.465	10	5	6.3	63
26	607079.9444	1673126.865	4	2	2.5	10
27	606575.7346	1671396.97	3	1.5	1.9	6
28	606481.6432	1671078.388	3	1.5	1.9	6
29	606373.6966	1670707.604	4	2	2.5	10
30	606320.1674	1670524.329	2	1	1.3	3
31	606229.2658	1670213.094	3	1.5	1.9	6
32	606151.4566	1669943.732	2	1	1.3	3
33	606106.8713	1669790.843	3	1.5	1.9	6
34	606045.4946	1669584.344	13	6.5	8.1	105
35	605985.8147	1669212.788	2	1	1.3	3
36	605937.301	1668783.398	3	1.5	1.9	6
37	604711.6595	1666841.168	12	6	7.5	90
38	604507.4248	1664086.33	3	1.5	1.9	6
39	604530.8071	1663723.644	4	2	2.5	10
40	604573.0793	1663071.177	3	1.5	1.9	6
41	604637.7216	1662083.019	9	4.5	5.6	50
42	604719.0271	1660841.298	4	2	2.5	10
43	604763.495	1660156.602	7	3.5	4.4	31
44	604787.339	1659800.253	2	1	1.3	3
45	604808.0355	1659454.223	6	3	3.8	23
46	604839.3685	1658989.67	6	3	3.8	23
47	604897.3082	1658363.205	4	2	2.5	10
48	605234.0414	1656692.937	2	1	1.3	3
49	605310.7522	1656312.947	3	1.5	1.9	6
50	605316.1981	1656284.745	11	5.5	6.9	76
51	605402.2438	1655860.947	5	2.5	3.1	16
52	605504.9911	1655355.174	9	4.5	5.6	50
53	605622.4171	1654770.582	3	1.5	1.9	6
54	605722.1558	1654412.575	11	5.5	6.9	76
55	605930.1735	1653698.148	7	3.5	4.4	31
56	606016.8102	1653405.86	7	3.5	4.4	31
57	606239.7464	1652630.958	15	7.5	9.4	141
58	606437.7202	1652109.327	4	2	2.5	10
59	606662.9003	1651708.639	5	2.5	3.1	16
60	606798.2846	1651305.801	4	2	2.5	10
61	607968.3276	1649150.211	12	6	7.5	90
62	608219.4627	1648809.666	2	1	1.3	3
63	608356.7839	1648624.841	3	1.5	1.9	6
64	610106.4292	1645736.396	2	1	1.3	3
65	609997.3442	1645607.914	7	3.5	4.4	31
66	609925.7226	1644654.572	2	1	1.3	3
67	609802.3837	1644199.02	7	3.5	4.4	31
68	609569.6333	1643502.886	2	1	1.3	3
69	609428.7879	1643081.044	4	2	2.5	10
70	609319.1022	1642750.648	2	1	1.3	3
71	608973.1531	1641713.445	2	1	1.3	3
72	608877.5273	1641475.285	24	10	12.5	300
73	608500.9188	1640001.768	5	2.5	3.1	16
74	608378.3888	1639469.547	3	1.5	1.9	6
75	607917.4496	1637834.901	2	1	1.3	3
76	607822.6928	1637524.485	10	5	6.3	63
77	607704.408	1637146.385	3	1.5	1.9	6
78	607575.0098	1636723.931	10	5	6.3	63
79	607761.6638	1636199.064	2	1	1.3	3
80	608025.4518	1635497.869	7	3.5	4.4	31
81	608336.2574	1634669.379	4	2	2.5	10
82	608447.9288	1634371.881	8	4	5	40
83	608486.8876	1634185.867	3	1.5	1.9	6
84	608619.8586	1633914.009	2	1	1.3	3

Tab. J3.1.11 Location and Dimension of Canal and River for Siphon Structure Crossing West Diversion Channel Route (1/3)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
85	608872.8473	1633249.369	2	1	1.3	3
86	608949.5969	1633038.04	2	1	1.3	3
87	609109.9891	1632613.293	11	5.5	6.9	76
88	609491.013	1631596.669	2	1	1.3	3
89	609684.638	1631088.353	5	2.5	3.1	16
90	609879.4986	1630571.05	5	2.5	3.1	16
91	610010.7784	1630219.599	2	1	1.3	3
92	610208.1936	1629690.166	5	2.5	3.1	16
93	610243.7034	1629593.464	4	2	2.5	10
94	610340.3369	1629336.153	4	2	2.5	10
95	610520.9817	1628322.621	6	3	3.8	23
96	610380.6137	1627966.298	3	1.5	1.9	6
97	610019.6732	1627099.434	6	3	3.8	23
98	609817.0025	1626607.018	3	1.5	1.9	6
99	609607.0115	1626097.459	5	2.5	3.1	16
100	609255.3358	1625238.67	2	1	1.3	3
101	609120.5588	1624913.495	2	1	1.3	3
102	609026.8131	1624683.812	3	1.5	1.9	6
103	608758.6542	1624031.736	6	3	3.8	23
104	608140.6524	1622525.828	6	3	3.8	23
105	607470.7977	1620896.601	3	1.5	1.9	6
106	607339.1151	1620575.697	2	1	1.3	3
107	607308.5954	1620501.389	5	2.5	3.1	16
108	607101.045	1619997.684	5	2.5	3.1	16
109	606826.2117	1619463.111	3	1.5	1.9	6
110	606720.3199	1619284.021	3	1.5	1.9	6
111	606616.1671	1619107.854	4	2	2.5	10
112	605808.7589	1617750.41	9	4.5	5.6	50
113	605635.4754	1617460.125	6	3	3.8	23
114	605204.2443	1616736.094	9	4.5	5.6	50
115	604902.3442	1616229.031	4	2	2.5	10
116	604643.0943	1615788.904	4	2	2.5	10
117	604502.3755	1615554.212	4	2	2.5	10
118	604277.3392	1614729.893	3	1.5	1.9	6
119	604209.9749	1614456.944	3	1.5	1.9	6
120	604090.0731	1613948.636	6	3	3.8	23
121	603992.046	1613547.571	8	4	5	40
122	603967.9063	1613443.956	2	1	1.3	3
123	603847.2573	1612940.426	5	2.5	3.1	16
124	603761.2299	1612582.444	8	4	5	40
125	603505.8771	1611528.233	8	4	5	40
126	603303.4184	1611194.23	3	1.5	1.9	6

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
127	602876.7728	1610757.144	3	1.5	1.9	6
128	602477.6593	1610348.846	3	1.5	1.9	6
129	602053.3284	1609914.198	7	3.5	4.4	31
130	601502.2503	1609181.823	4	2	2.5	10
131	600914.2732	1608222.247	12	6	7.5	90
132	600572.003	1607658.912	5	2.5	3.1	16
133	600017.3032	1606754.537	9	4.5	5.6	50
134	599970.4198	1606679.049	3	1.5	1.9	6
135	599486.2392	1605885.955	3	1.5	1.9	6
136	598912.0239	1605314.563	7	3.5	4.4	31
137	598789.0438	1605204.441	2	1	1.3	3
138	596610.342	1602534.81	3	1.5	1.9	6
139	596604.1003	1602517.266	3	1.5	1.9	6
140	596163.9916	1601153.784	10	5	6.3	63
141	596701.5784	1594758.579	20	10	12.5	250
142	596730.8491	1594721.558	11	5.5	6.9	76
143	597155.0519	1594193.147	12	6	7.5	90
144	598132.7373	1592985.619	2	1	1.3	3
145	598763.4039	1592204.232	4	2	2.5	10
146	599196.4991	1591671.604	3	1.5	1.9	6
147	599337.5501	1591496.008	16	8	10	160
148	599850.6976	1590703.275	23	10	12.5	288
149	599834.859	1589655.332	4	2	2.5	10
150	599732.531	1589152.727	6	3	3.8	23
151	599603.8987	1589002.695	22	10	12.5	275
152	599130.0471	1588443.157	6	3	3.8	23
153	599112.8356	1588421.802	6	3	3.8	23
154	598338.1177	1587508.238	8	4	5	40
155	598299.0644	1587459.75	10	5	6.3	63
156	596893.8869	1585801.537	9	4.5	5.6	50
157	595925.3913	1584656.87	3	1.5	1.9	6
158	595670.6969	1584356.425	5	2.5	3.1	16
159	595033.3526	1583604.37	6	3	3.8	23
160	594801.9332	1583330.854	17	8.5	10.6	180
161	594767.8042	1582438.231	17	8.5	10.6	180
162	595199.7878	1580298.015	2	1	1.3	3
163	595254.8405	1580032.952	15	7.5	9.4	141
164	595402.013	1579301.06	10	5	6.3	63
165	595635.2827	1578142.114	15	7.5	9.4	141
166	595803.2915	1577312.265	7	3.5	4.4	31
167	596161.6776	1575531.638	14	7	8.8	123
168	596395.693	1574372.011	4	2	2.5	10

Tab. J3.1.12 Location and Dimension of Canal and River for Siphon Structure Crossing West Diversion Channel Route (2/3)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
169	596541.9842	1573803.624	9	4.5	5.6	50
170	596681.8196	1573323.681	11	5.5	6.9	76
171	597149.9249	1571733.26	4	2	2.5	10
172	597571.6131	1570292.727	4	2	2.5	10
173	597739.2592	1569723.868	6	3	3.8	23
174	598380.7769	1568834.222	21	10	12.5	263
175	598660.2731	1568574.938	22	10	12.5	275
176	600160.5474	1567193.53	6	3	3.8	23
177	600536.0929	1566851.211	14	7	8.8	123
178	601134.064	1566294.094	5	2.5	3.1	16
179	601762.7107	1565721.582	11	5.5	6.9	76
180	601862.8886	1565630.146	10	5	6.3	63
181	602449.9122	1565090.078	10	5	6.3	63
182	602697.5236	1564862.6	16	8	10	160
183	602731.6187	1564832.469	22	10	12.5	275
184	603418.4453	1564197.265	16	8	10	160
185	603634.6944	1563995.891	4	2	2.5	10
186	603938.7309	1563716.582	17	8.5	10.6	180
187	604128.2756	1563543.669	13	6.5	8.1	105
188	605391.9878	1562379.705	14	7	8.8	123
189	606787.1688	1561097.636	11	5.5	6.9	76
190	606859.3892	1561029.396	6	3	3.8	23
191	607131.8696	1560777.994	8	4	5	40
192	607746.4654	1559410.046	10	5	6.3	63
193	608207.562	1557967.78	6	3	3.8	23
194	608403.9386	1557352.003	4	2	2.5	10
195	608464.2519	1557104.093	3	1.5	1.9	6
196	608159.8581	1556156.931	20	10	12.5	250
197	608122.1782	1556036.179	17	8.5	10.6	180
198	607690.1915	1554687.942	11	5.5	6.9	76
199	607039.5595	1552111.648	34	10	12.5	425
200	606993.1353	1551836.389	27	10	12.5	338
201	606954.1347	1551597.467	6	3	3.8	23
Subtotal (Upstream)						9,334
202	606617.4939	1549546.997	12	6	7.5	90
203	606487.5222	1548745.635	45	10	12.5	563
204	606402.13	1548236.048	35	10	12.5	438
205	605547.9161	1543046.975	6	3	3.8	23
206	605516.3883	1542853.952	17	8.5	10.6	180
207	605402.779	1542159.617	21	10	12.5	263
208	605304.8436	1541572.559	3	1.5	1.9	6
209	605300.8893	1541543.002	11	5.5	6.9	76

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
210	604989.2646	1538455.811	7	3.5	4.4	31
211	605115.0489	1536122.688	8	4	5	40
212	605134.4707	1535754.206	5	2.5	3.1	16
213	605157.2735	1535325.488	14	7	8.8	123
214	605279.6408	1533065.958	9	4.5	5.6	50
215	605311.238	1532441.185	5	2.5	3.1	16
216	605370.1513	1531366.852	3	1.5	1.9	6
217	605445.6041	1529967.818	19	9.5	11.9	226
218	605449.391	1529894.239	9	4.5	5.6	50
219	605606.3841	1526990.269	19	9.5	11.9	226
220	605650.9081	1526132.285	15	7.5	9.4	141
221	605673.2854	1525707.744	21	10	12.5	263
222	605731.9882	1524656.401	18	9	11.3	203
223	605750.6769	1524303.093	22	10	12.5	275
224	605769.4494	1523943.513	3	1.5	1.9	6
225	605793.6323	1523489.096	3	1.5	1.9	6
226	605907.7037	1521378.938	6	3	3.8	23
227	605963.1307	1520343.372	16	8	10	160
228	606042.2862	1518840.241	14	7	8.8	123
229	606080.233	1517726.588	9	4.5	5.6	50
230	606106.9949	1516973.136	19	9.5	11.9	226
231	606119.4748	1516579.847	14	7	8.8	123
232	607708.0385	1513527.78	11	5.5	6.9	76
233	608134.9303	1513178.077	22	10	12.5	275
234	609012.8145	1512460.988	19	9.5	11.9	226
235	609877.7506	1511755.236	10	5	6.3	63
236	610079.6218	1511587.262	8	4	5	40
237	610698.1526	1511082.697	5	2.5	3.1	16
238	610808.3624	1510993.222	4	2	2.5	10
239	610882.3048	1510932.532	9	4.5	5.6	50
240	611208.692	1510665.562	12	6	7.5	90
241	611780.8499	1510197.671	14	7	8.8	123
242	612532.4926	1509583.209	13	6.5	8.1	105
243	613100.5533	1509118.346	4	2	2.5	10
244	613830.4478	1508522.799	13	6.5	8.1	105
245	614490.0471	1507982.422	15	7.5	9.4	141
246	615956.0413	1506185.436	13	6.5	8.1	105
247	616660.9744	1505029.792	3	1.5	1.9	6
248	616953.6791	1504552.899	9	4.5	5.6	50
249	617211.0921	1504127.591	13	6.5	8.1	105
250	617474.2785	1503696.979	19	9.5	11.9	226
251	618524.1068	1501974.539	24	10	12.5	300

Tab. J3.1.13 Location and Dimension of Canal and River for Siphon Structure Crossing West Diversion Channel Route (3/3)

No.	X	Y	Canal/River		Culvert	
			Width (m)	Depth (m)	Required Height (m)	Required Area (m^2)
252	619209.4668	1500852.067	19	9.5	11.9	226
253	619280.6678	1500734.243	9	4.5	5.6	50
254	619757.2771	1499952.188	7	3.5	4.4	31
255	620088.6132	1499387.716	8	4	5	40
256	620326.3701	1498633.854	20	10	12.5	250
257	620886.4802	1496852.168	20	10	12.5	250
258	621154.9692	1496005.815	8	4	5	40
259	621216.6241	1495805.864	10	5	6.3	63
260	621405.4462	1495203.636	9	4.5	5.6	50
261	621511.7311	1494866.155	7	3.5	4.4	31
262	621622.9948	1494514.977	20	10	12.5	250
263	621798.44	1493959.434	6	3	3.8	23
264	622012.9786	1493283.966	7	3.5	4.4	31
265	622032.9124	1493219.587	23	10	12.5	288
266	622248.2967	1492534.149	11	5.5	6.9	76
267	622404.721	1492039.558	38	10	12.5	475
268	622587.5174	1491455.386	12	6	7.5	90
Subtotal (Downstream)						8,408

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SECTOR J: FIGURE

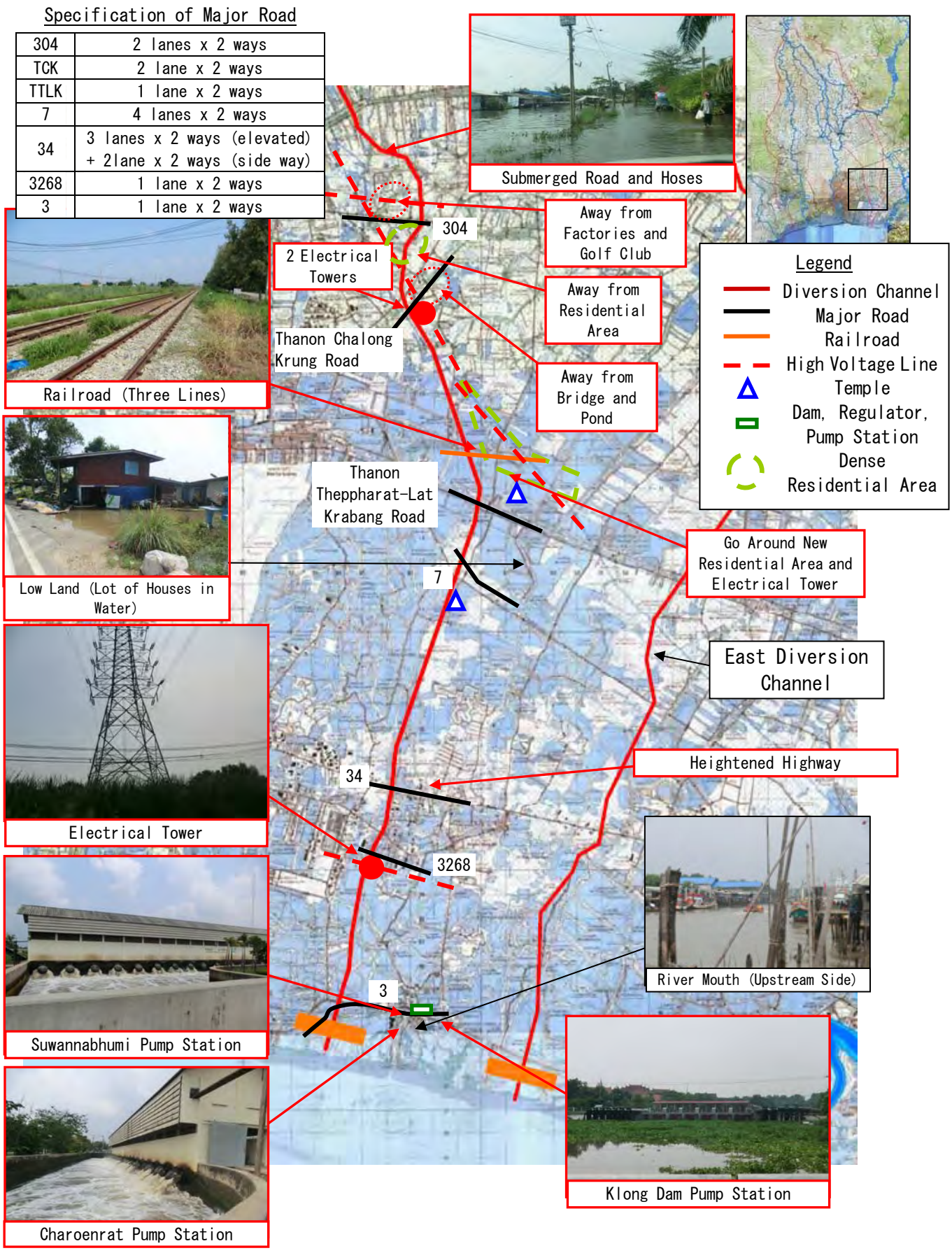


Fig. J1.3.1 Result of Field Reconnaissance (Outer Ring Road Diversion Channel, Downstream)

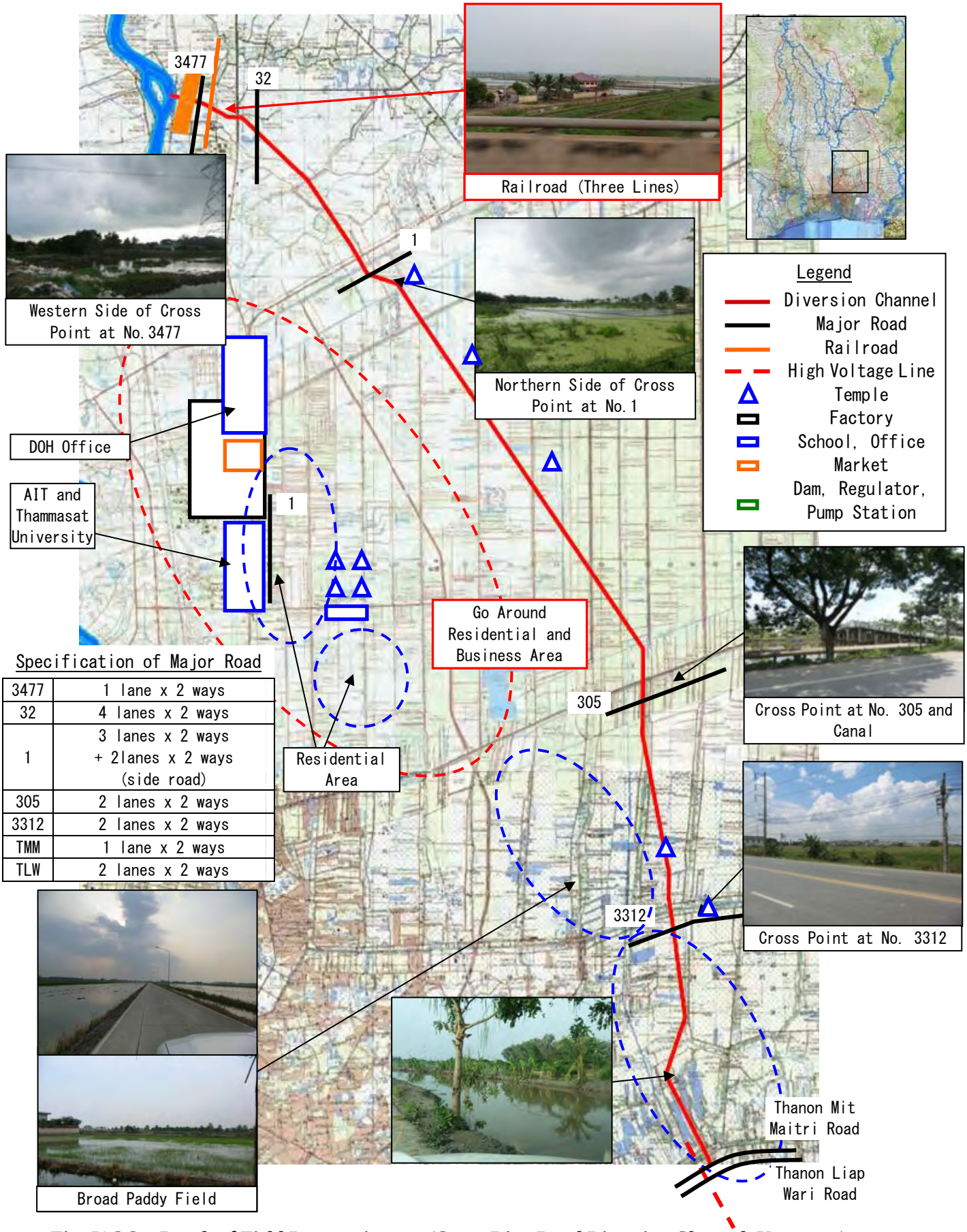


Fig. J1.3.2 Result of Field Reconnaissance (Outer Ring Road Diversion Channel, Upstream)

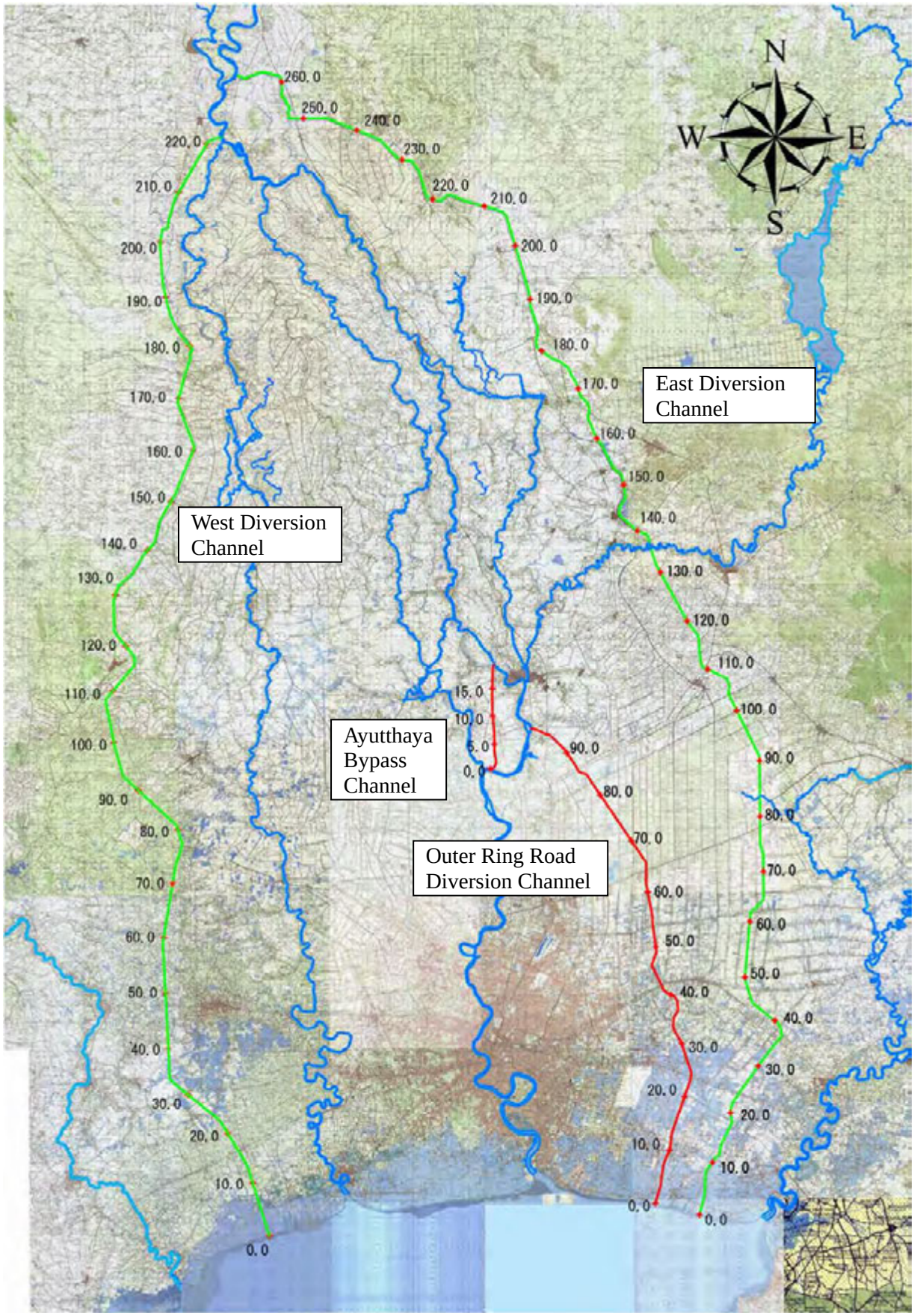
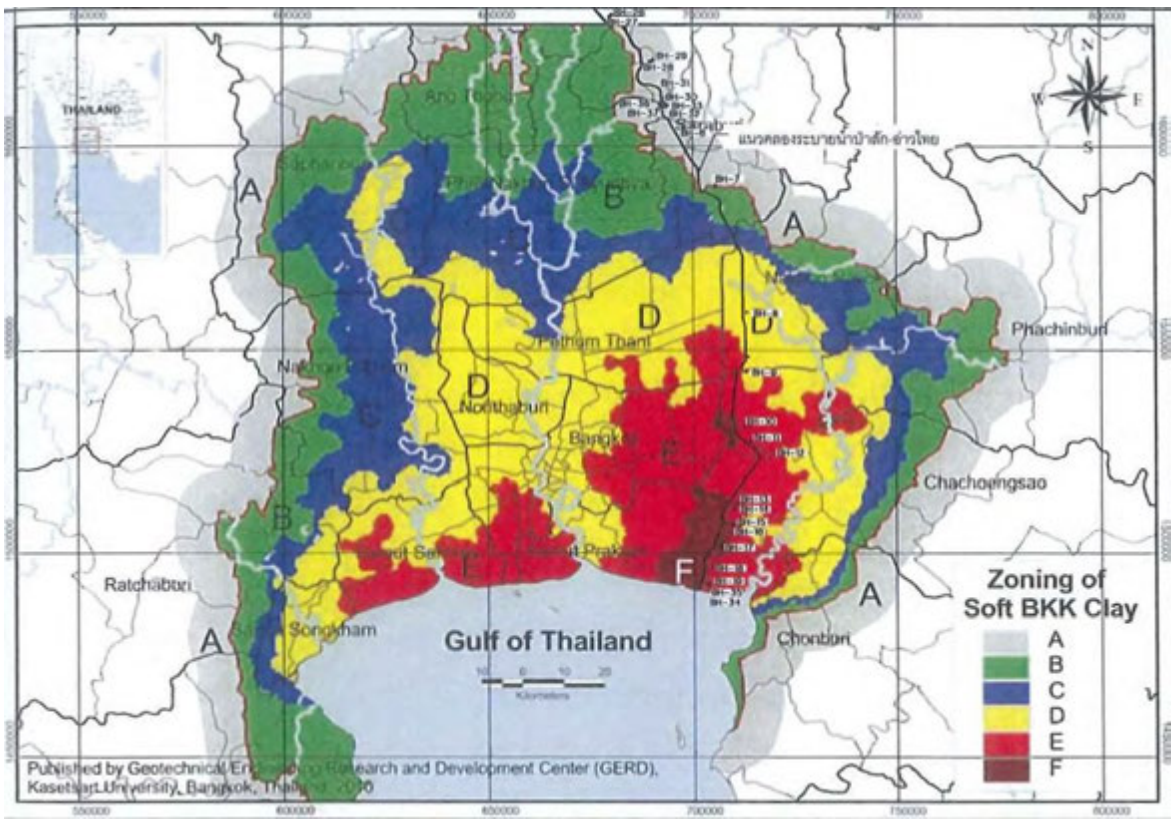
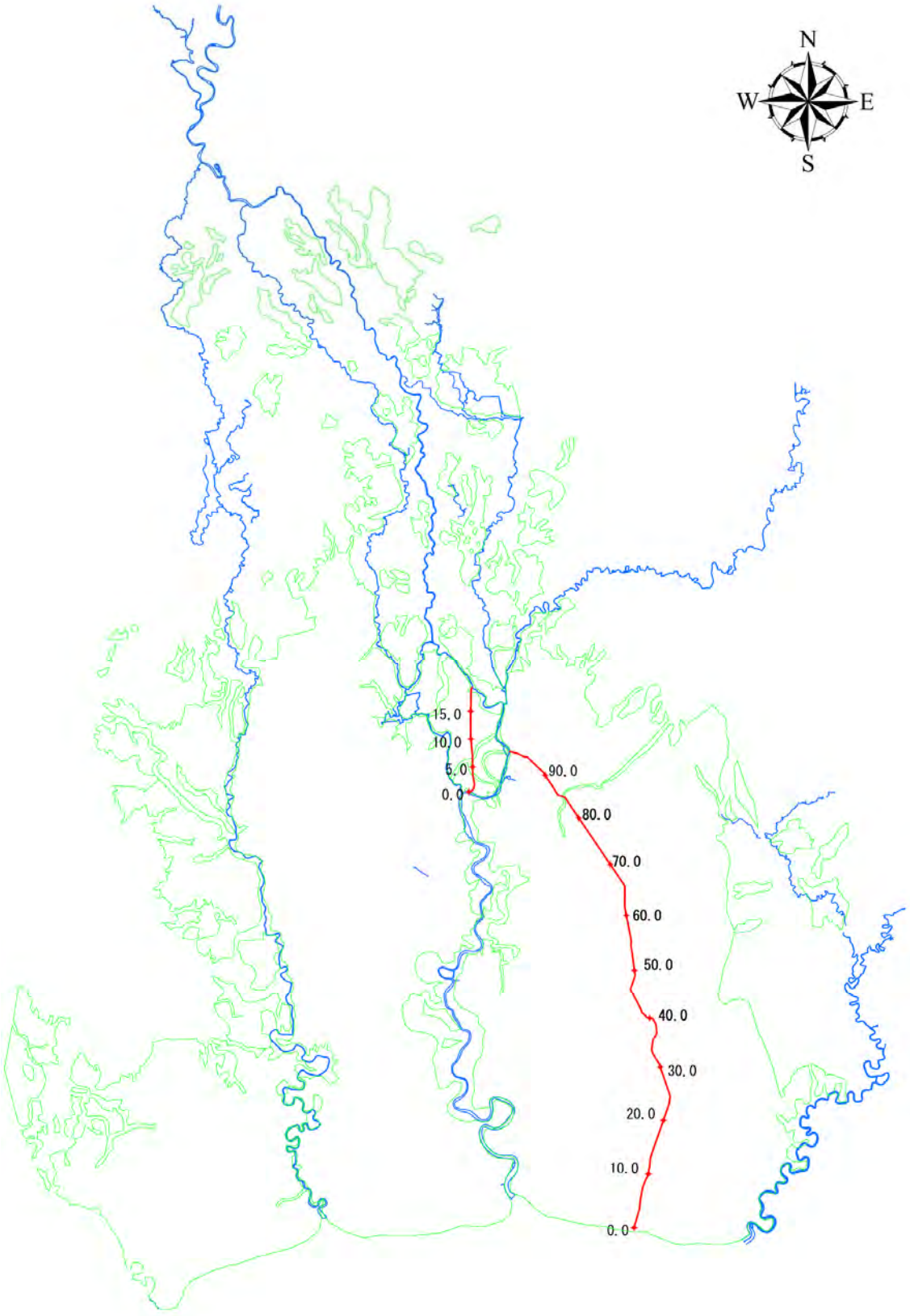


Fig. J1.3.3 Route of Diversion Channels and Ayutthaya Bypass Channel



(Reference: Report for Feasibility Study of East Floodway)

Fig. J1.7.1 Distribution of Soft Bangkok Clay



(Reference: Ms. Shigeko HARUYAMA, "Recent Changes of Flooding in the Central Plain of Thailand," Journal Article, Mie University Scholarly E-Collections)

Fig. J1.7.2 Layout of Outer Ring Road Diversion Channel and Distribution of Lagoon and Mud Spit

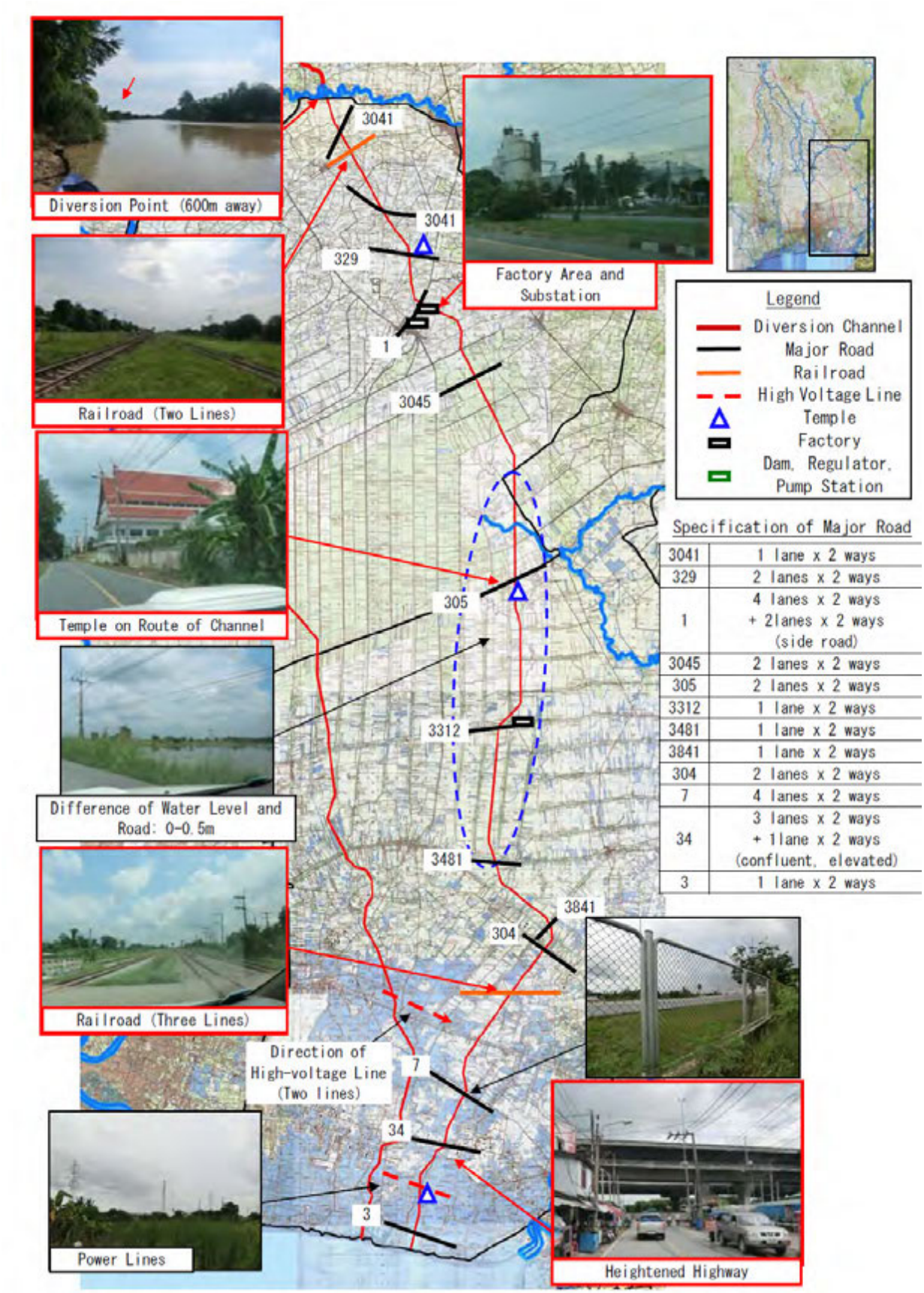


Fig. J2.3.1 Result of Field Reconnaissance (East Diversion Channel, Downstream)

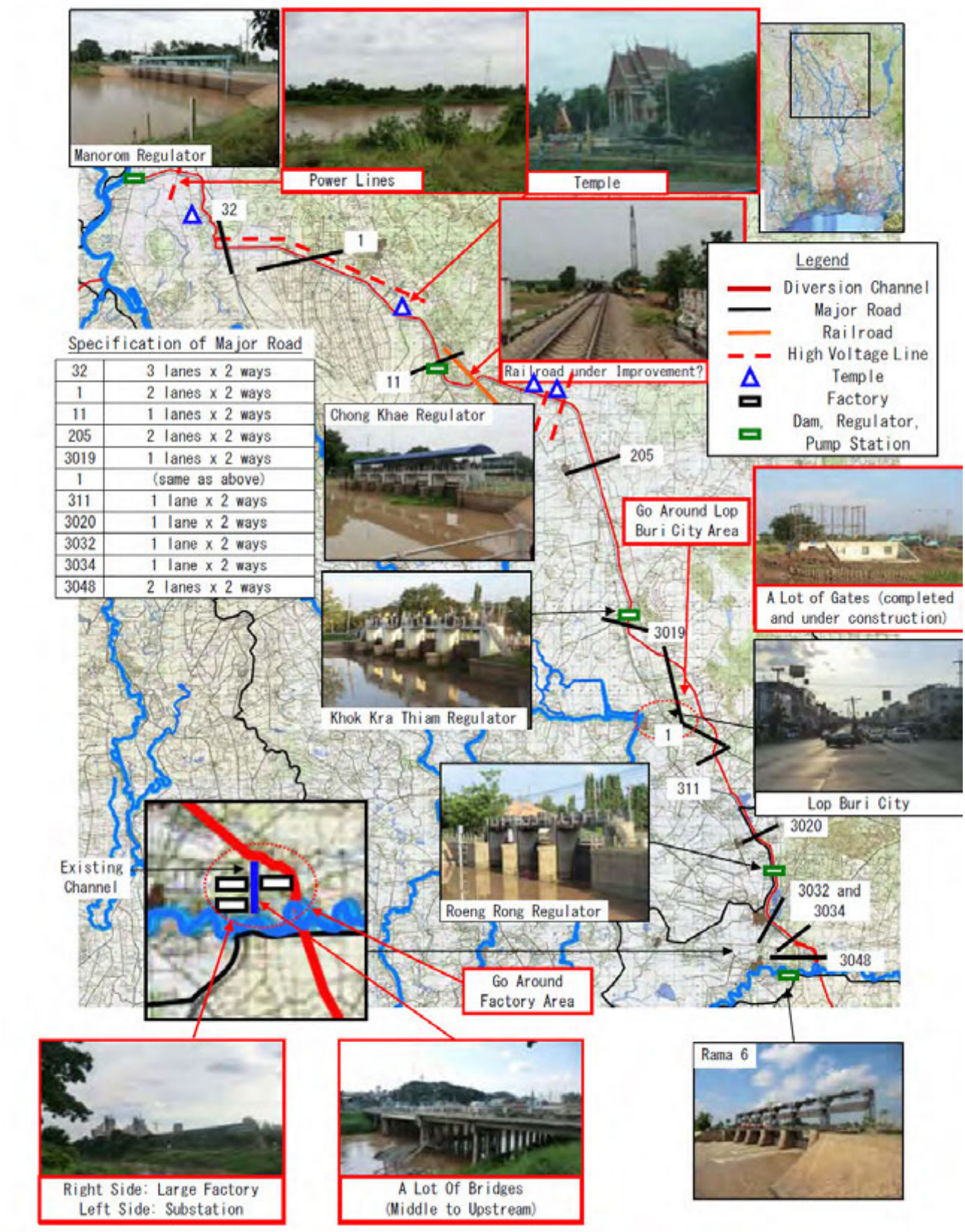


Fig. J2.3.2 Result of Field Reconnaissance (East Diversion Channel, Upstream)

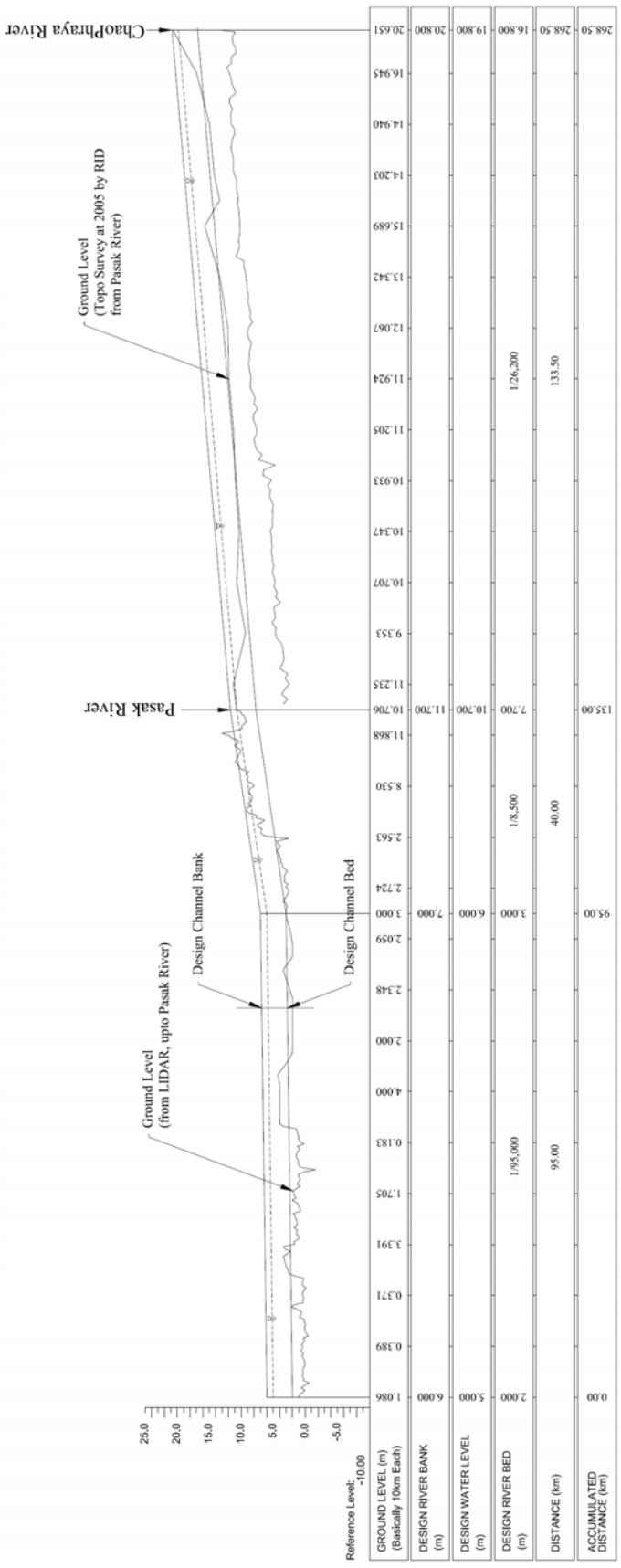


Fig. J2.8.1 Longitudinal Profile of East Diversion Channel (Emphasis on Less Excavation)

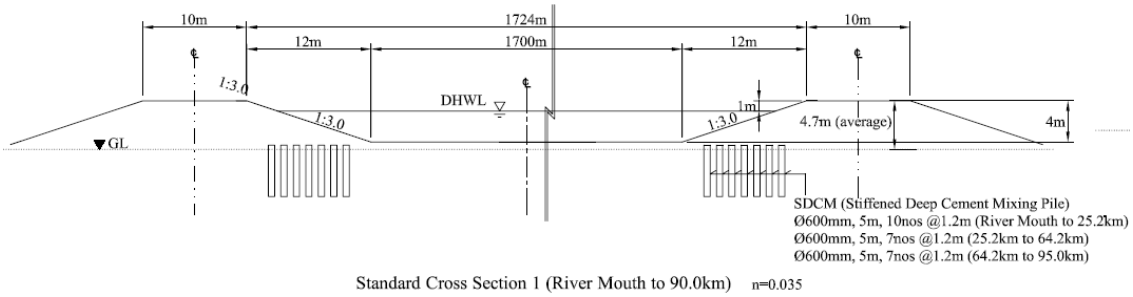


Fig. J2.8.2 Standard Cross Section of East Diversion Channel with Slope Protection (0km to 94km)

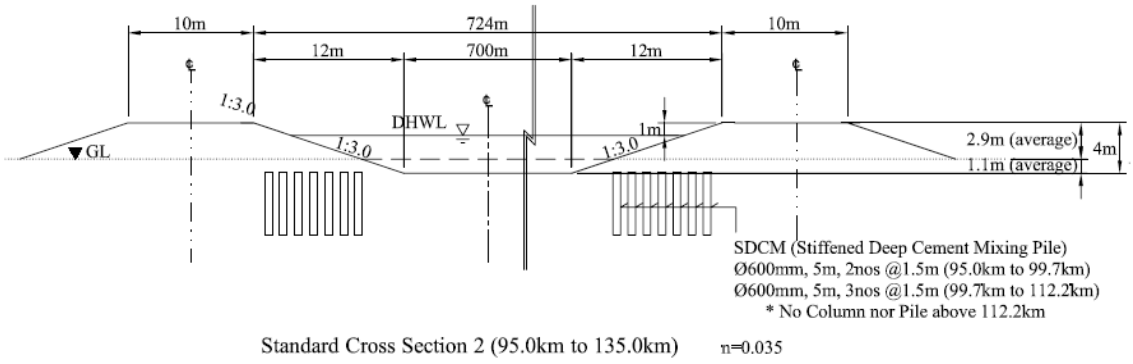


Fig. J2.8.3 Standard Cross Section of East Diversion Channel with Slope Protection (95km to 135km)

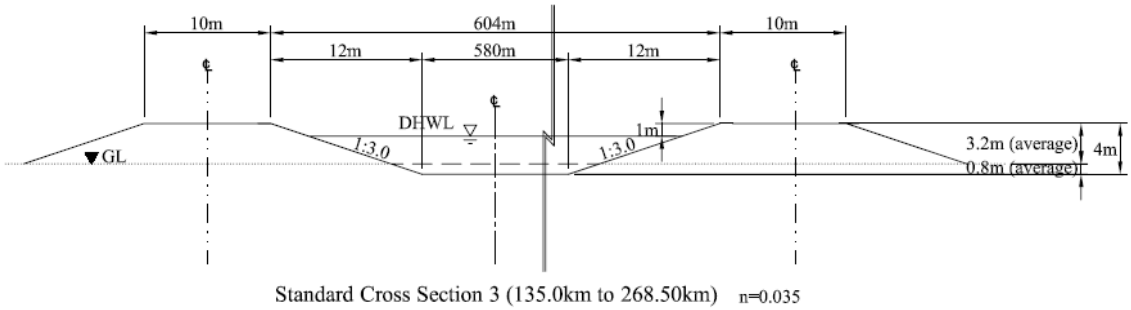


Fig. J2.8.4 Standard Cross Section of East Diversion Channel with Slope Protection (135km to Diversion Point)

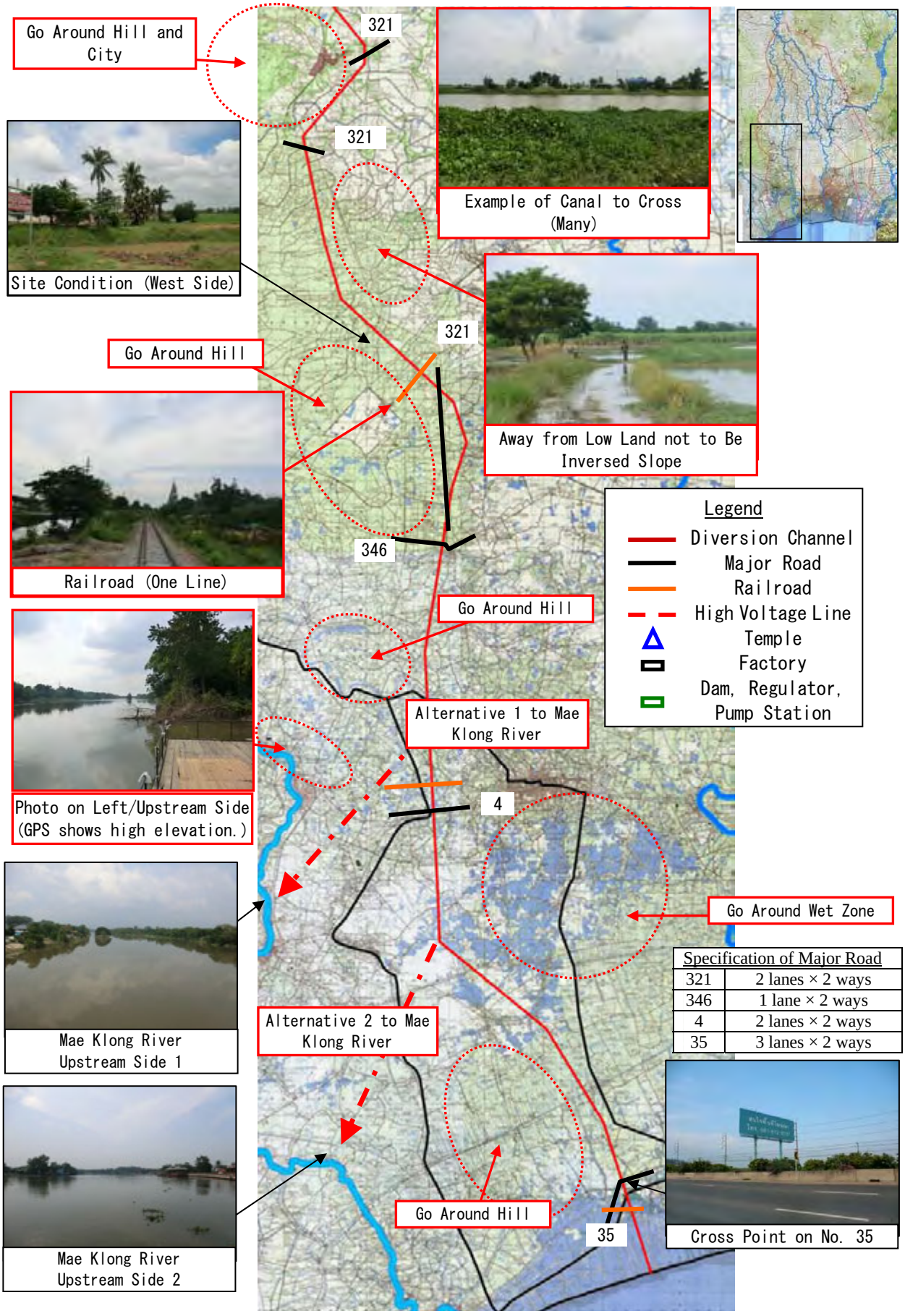


Fig. J3.3.1 Result of Field Reconnaissance (West Diversion Channel, Downstream)

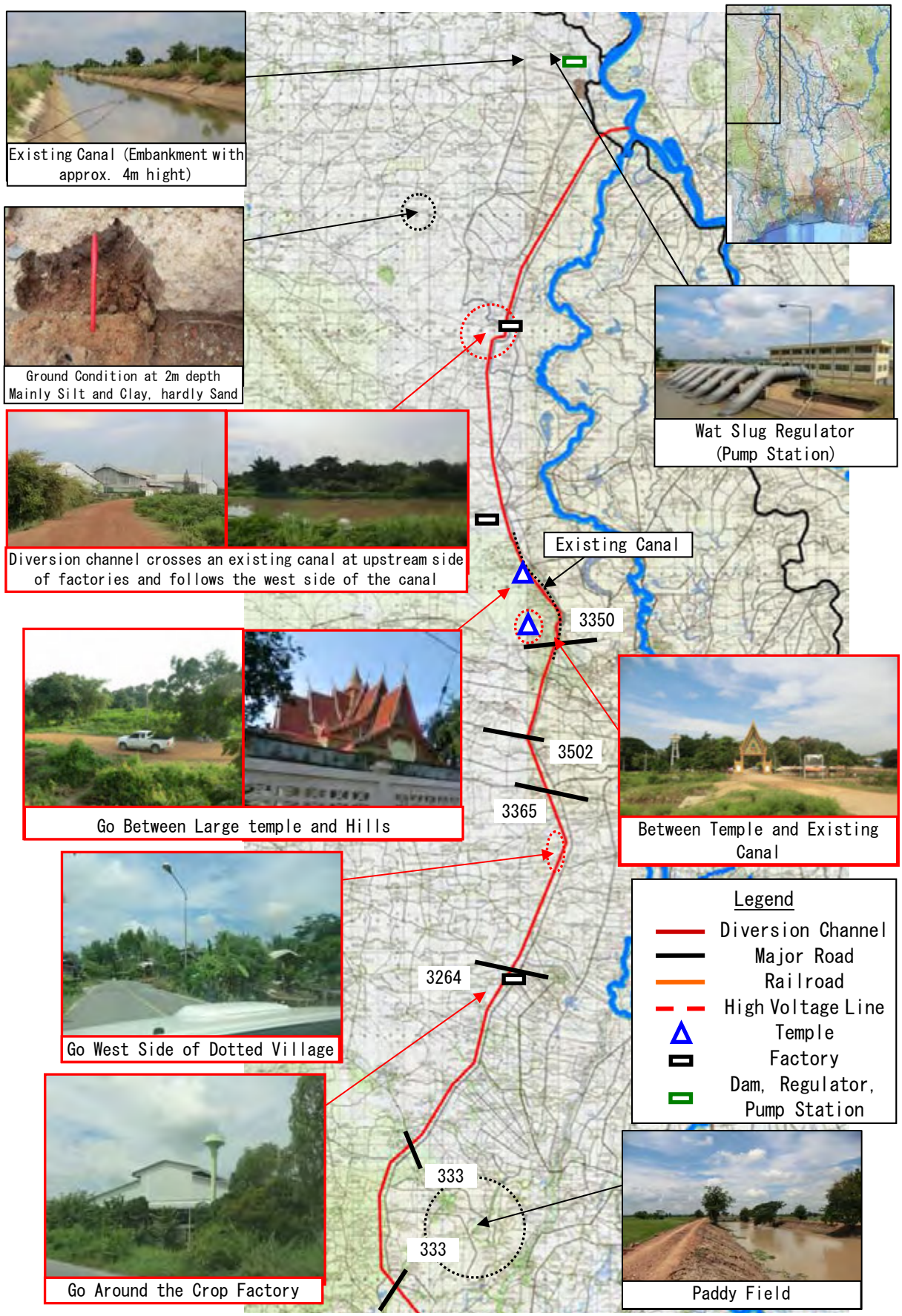


Fig. J3.3.2 Result of Field Reconnaissance (West Diversion Channel, Upstream)

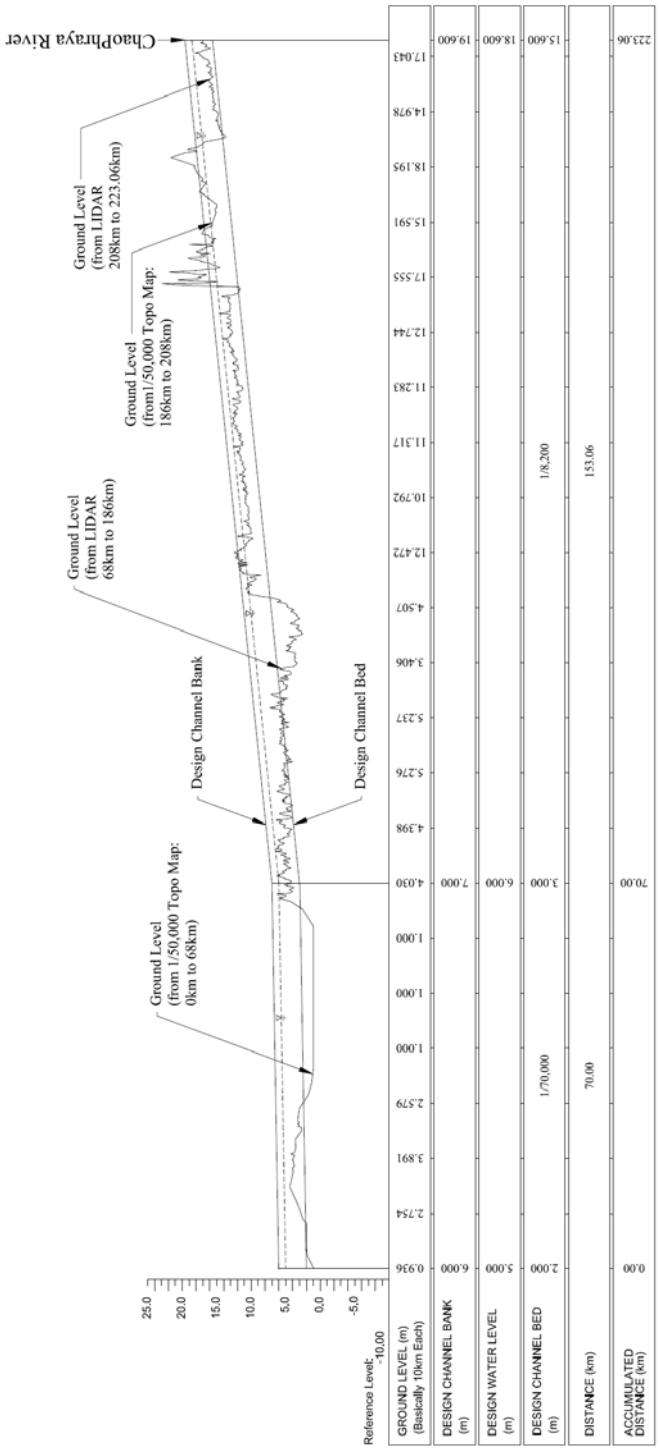


Fig. J3.8.1 Longitudinal Profile of West Diversion Channel (Emphasis on Less Excavation)

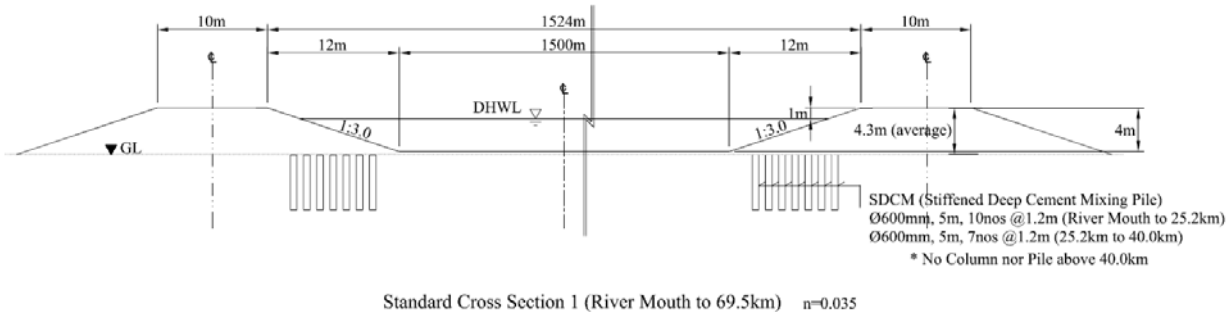


Fig. J3.8.2 Cross Section of West Diversion Channel with Emphasis of Heightening (0km to 69.5km)

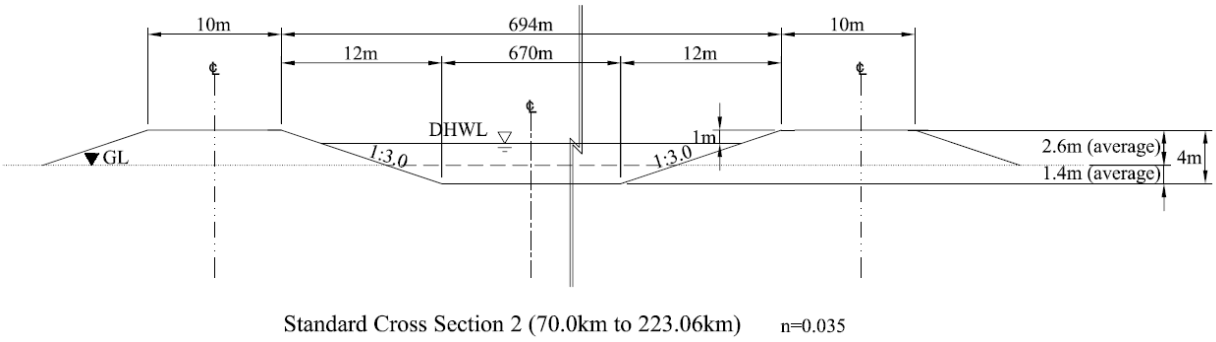


Fig. J3.8.3 Cross Section of West Diversion Channel with Emphasis of Heightening (70.0km to Diversion Point)