



Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

Pre-Feasibility Study And Initial Environmental Examination Two Run-of-River of the Mekong Cascade Project



Feasibility Study

Pak Chom and Ban Koum Projects

Prepared by



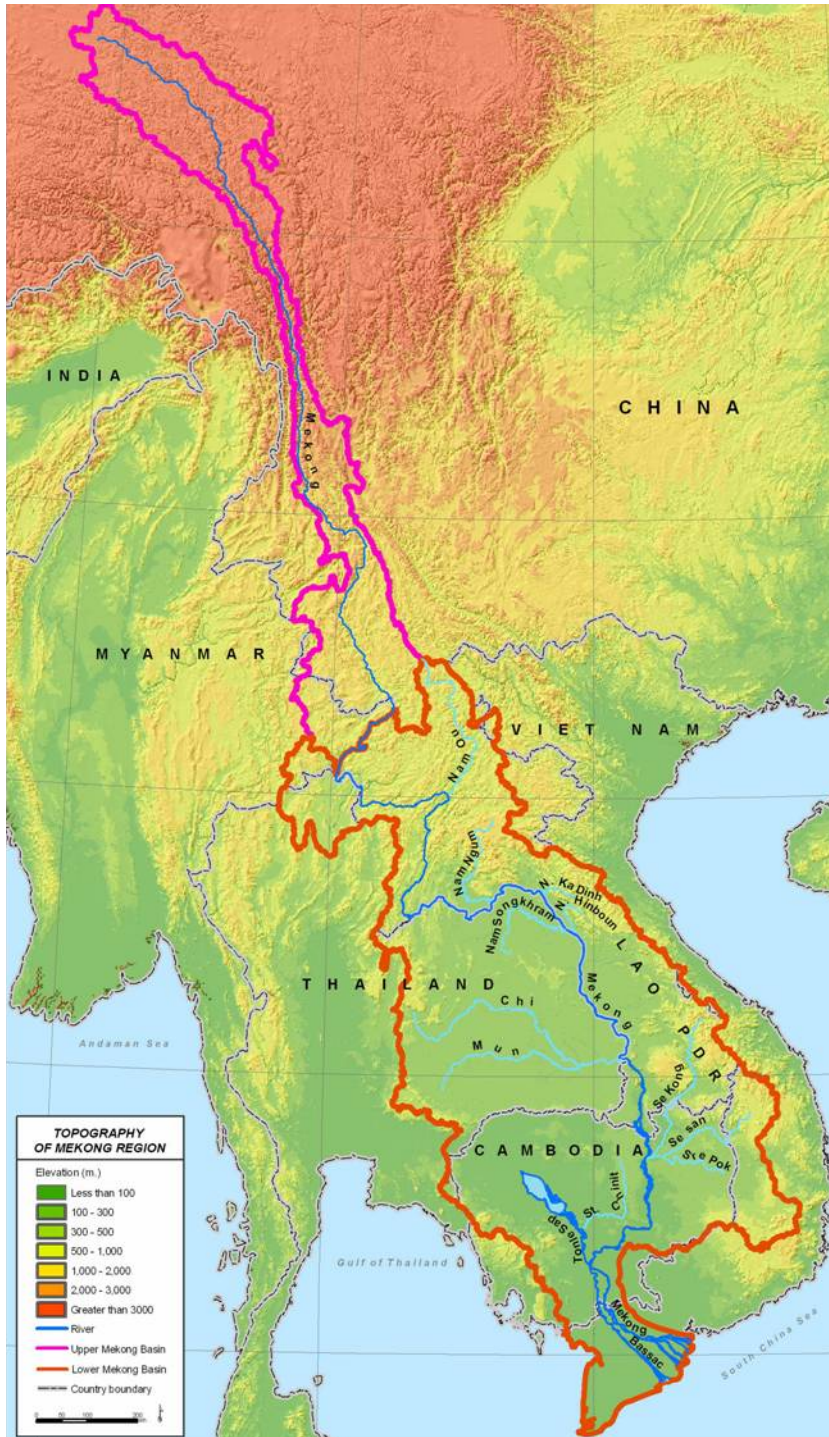
Panya Consultants Co., Ltd.



Macro Consultants Co., Ltd.

Mekong Basin

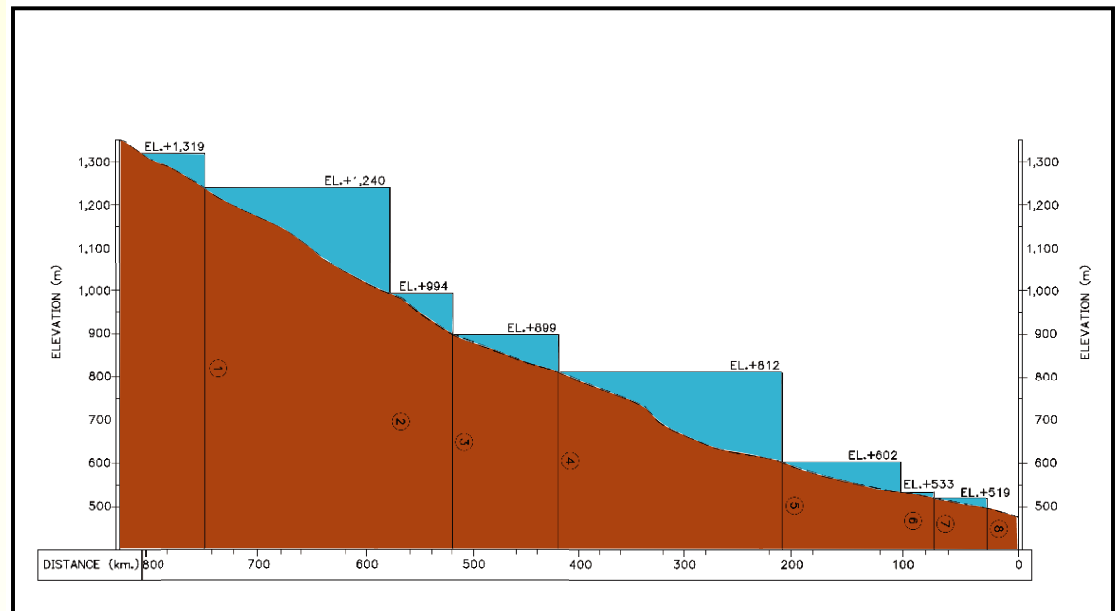
Country	Catchment area (km ²)	Catchment area (percent)	Runoff (percent)
China	166,500	20.9	16
Myanmar	22,000	2.7	2
Lao PDR	202,400	25.5	35
Thailand	184,200	23.2	18
Cambodia	154,700	19.5	18
Vietnam	65,200	8.2	11
Total	795,000	100	100



Longitudinal Section Showing the Upper Sites of Hydropower Projects (Land



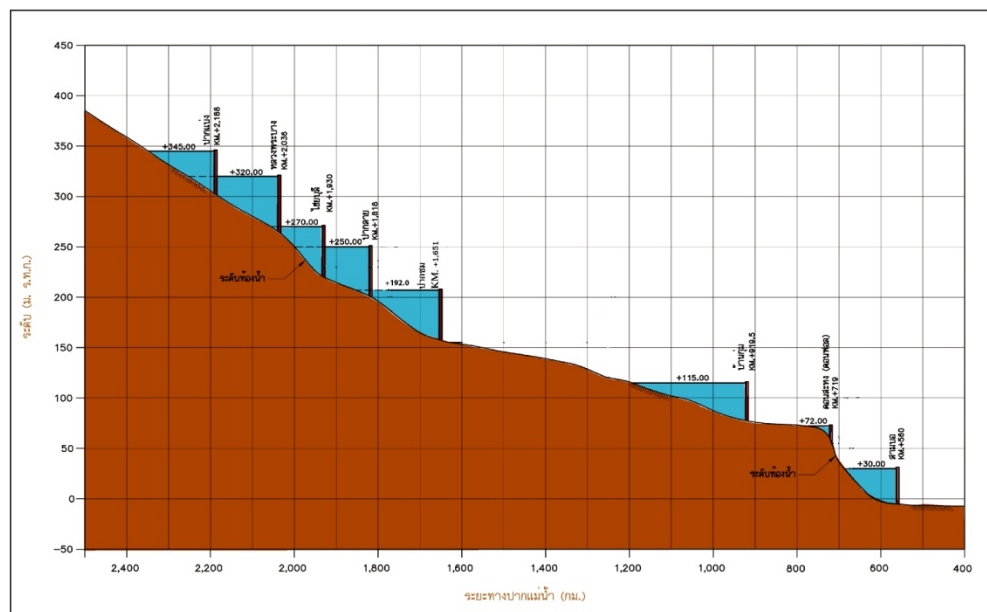
Project	Installed capacity (MW)
GONGGUOAI AO	750
XIAOWAN	4200
MANWAN	1,550
DACHAOSHAN	1,350
NUOZHADU	5,850
JINGHONG	1,750
GANLANBA	150
MENGSONG	600
Total	16,200



Projects Granted Concessions by the Lao and Cambodian Government



Project	Installed capacity (MW)
1. Don Sahong Hydropower Project, Khong District, Champasack Province	240
2. Xayaburi Hydropower Project, Xayaburi Province	1,260
3. Pak Lay Hydropower Project, Xayaburi Province	1,010
4. Pak Beng Hydropower Project, Oudomxay Province	1,230
5. Luang Prabang Hydropower Project, Luang Prabang Province	1,410
6. Sambor Hydropower Project, Kratie Province	3,300



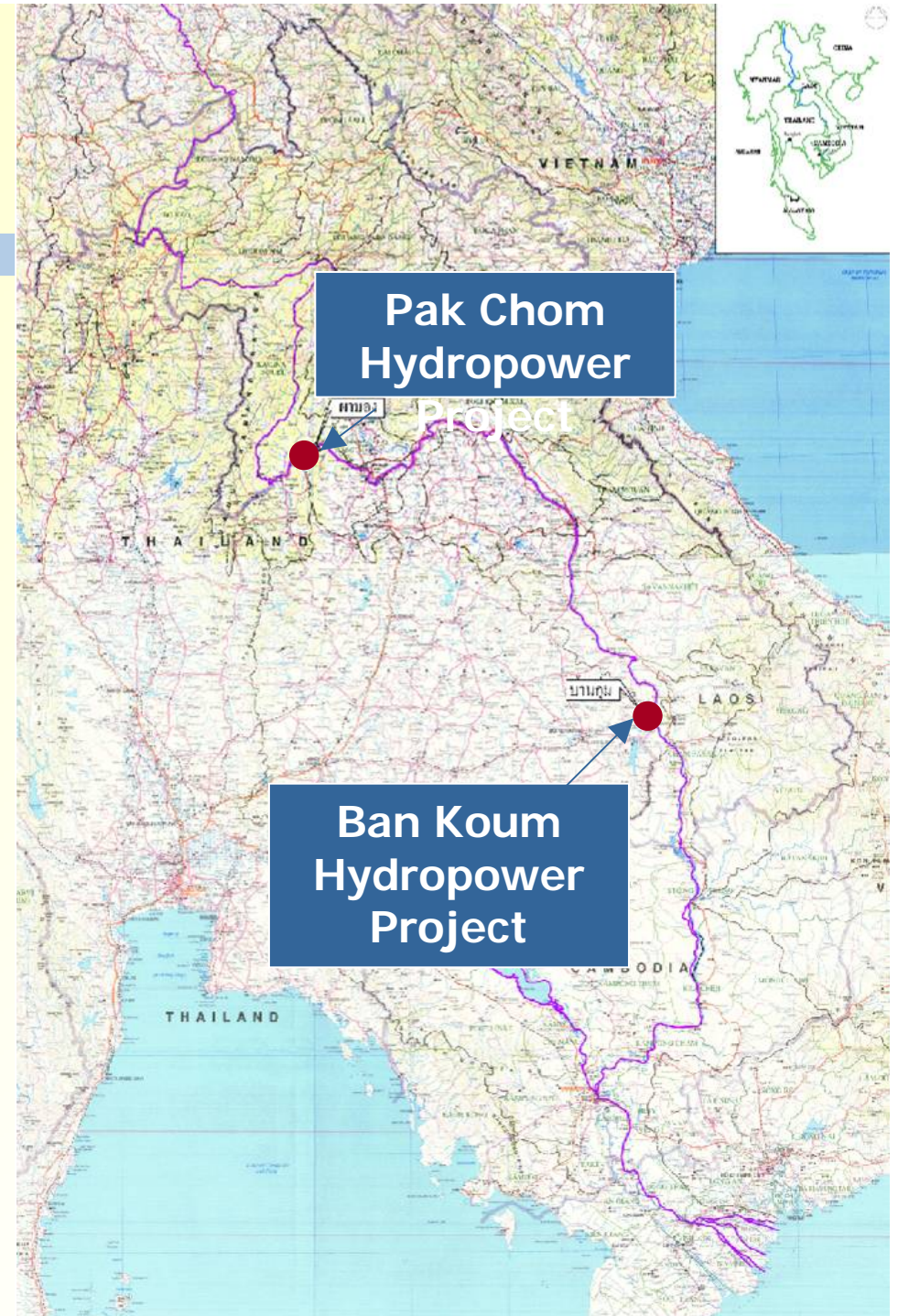
Projects along Thailand-Lao

Pak Chom Hydropower Project

Located at KM 1651 from the mouth of the Mekong River and adjacent to Ban Huai Khop, Loei Province, Thailand and to Ban Huai Hang, Sangthong District, Vientiane Capital, Lao PDR

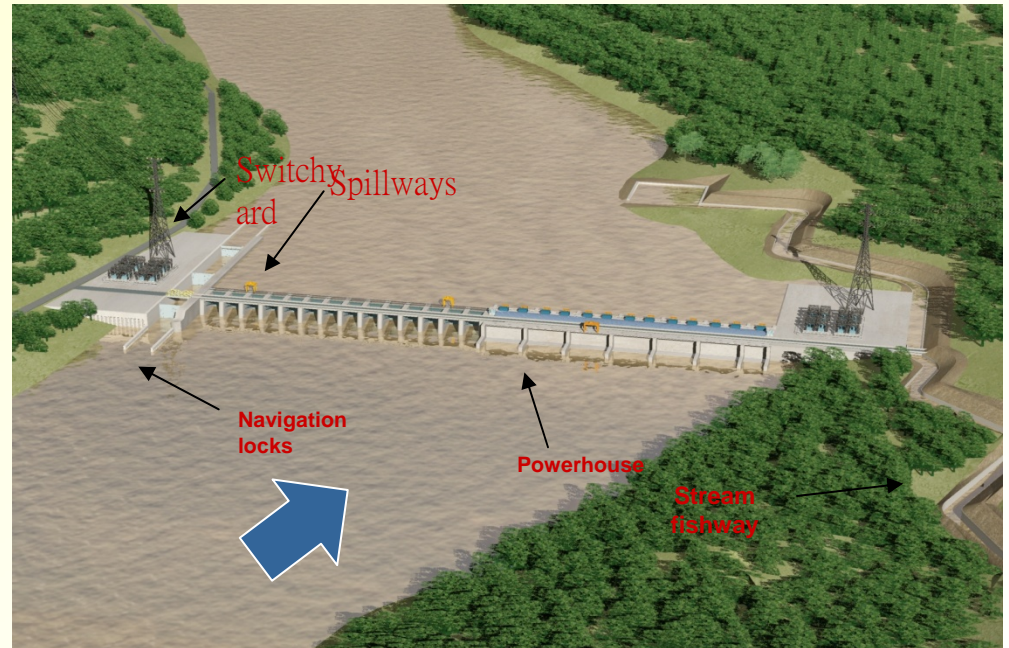
Ban Koum Hydropower Project

Located at KM 928.5 from the mouth of the Mekong River and adjacent to Ban



Feature of Pak Chom Hydropower Project

Location	Adjacent to Ban Huai Khop, Hat Khamphi Sub-District, Pak Chom District, Loei Province and to Ban Huai Hang, Vientiane Capital		
Catchment area	295.500	km ²	
Average annual runoff	138,303	MCM	
100 year return period flood	33,526	m ³ /sec	
Normal high water level (NWL)	+192.0	m MSL	
Storage capacity at NWL	807.7	MCM	
- Upstream water surface	50,217	rai	
- Water surface area of the Mekong River	46,090	rai	
- Flooded area on the river bank	4,127	rai	
in Thailand	1,897	rai	
in Lao PDR	2,230	rai	
Spillway (number x width x height)	14x20.00x25.50	m	
Navigation lock (number x width x length)	2x20.00x200.00	m	
Powerhouse (width x length)	75.00x325.00	m	
Design flow	13x440 (5,720)	m ³ /sec	
Design head	22.02	m	
Turbine type	Bulb		
Installed capacity	13x83 (1,079)	MW	
Voltage	500	kV	
Distance from the transmission line to Udon Thani Substation 3	185	km	
Environmental impacts	Thailand	Lao PDR	Total
- Flood			
• Number of villages affected	1	1	2
• Number of households affected	70	37	107
- Upstream water surface affecting Ban Non Sawan			

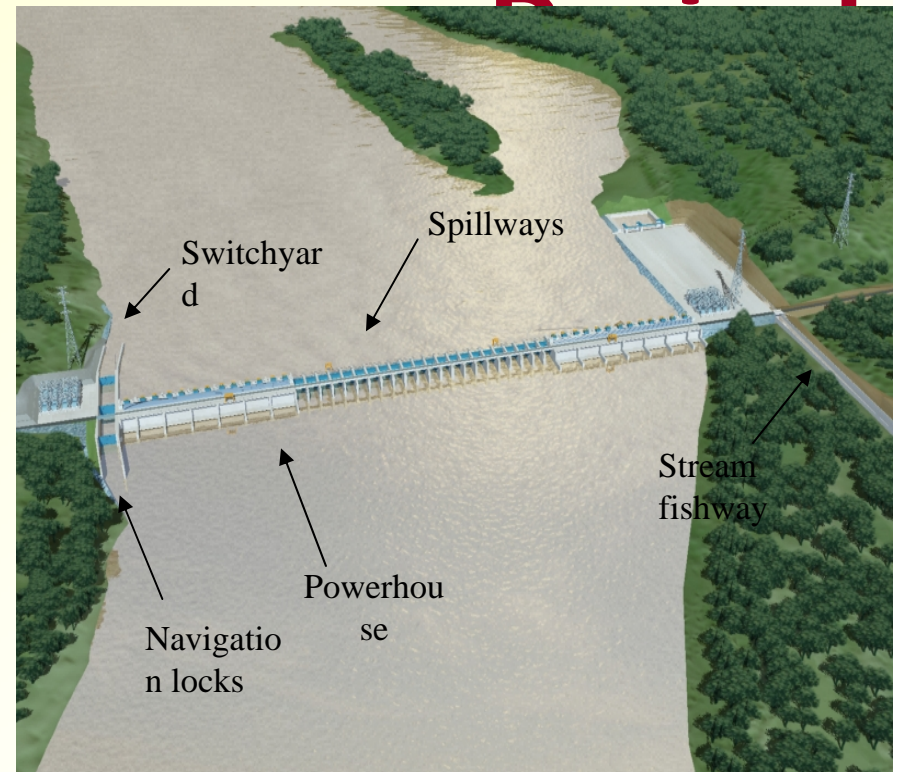


Feature of Ban Koum Hydropower

Location Adjacent to Ban Tha Long, Huai Phai Sub-district, Khong Chiam District, Ubon Ratchathani Province, Thailand and to Ban Koum Noi, Sanasomboon District, Champasack Province, Lao PDR

Catchment area	418,400	km ²
Average annual runoff	288,535	MCM
100 year return period flood	60,972	m ³ /sec
Normal high water level (NWL)	115.00	m MSL
Storage capacity at NWL	2,111	MCM
- Upstream water surface	86,774	rai
- Water surface area of the Mekong River	73,391	rai
- Flooded area on the river bank	13,382	rai
in Thailand	5,313	rai
in Lao PDR	8,069	rai
Spillway (number x width x height)	22x20.00x25.50	m
Navigation lock (number x width x length)	2x20.00x200.00	m
Powerhouse left and right bank (width x length)	75.00x325.00/75.00x325.00	m
Design flow	26x450 (11,700)	m ³ /sec
Design head	18.62	m
Turbine type	Bulb	
Installed capacity	26x72 (1,872)	MW
Voltage	500	kV
Distance from the transmission lines to Chaiyaphum Substation 2	434	km

Environmental impacts	Thailand	Lao PDR	Total
- Flood			
• Number of villages affected	1	3	4
• Number of households affected	29	215	244
- Upstream water surface affecting Ban Kwan Tha Kwian			



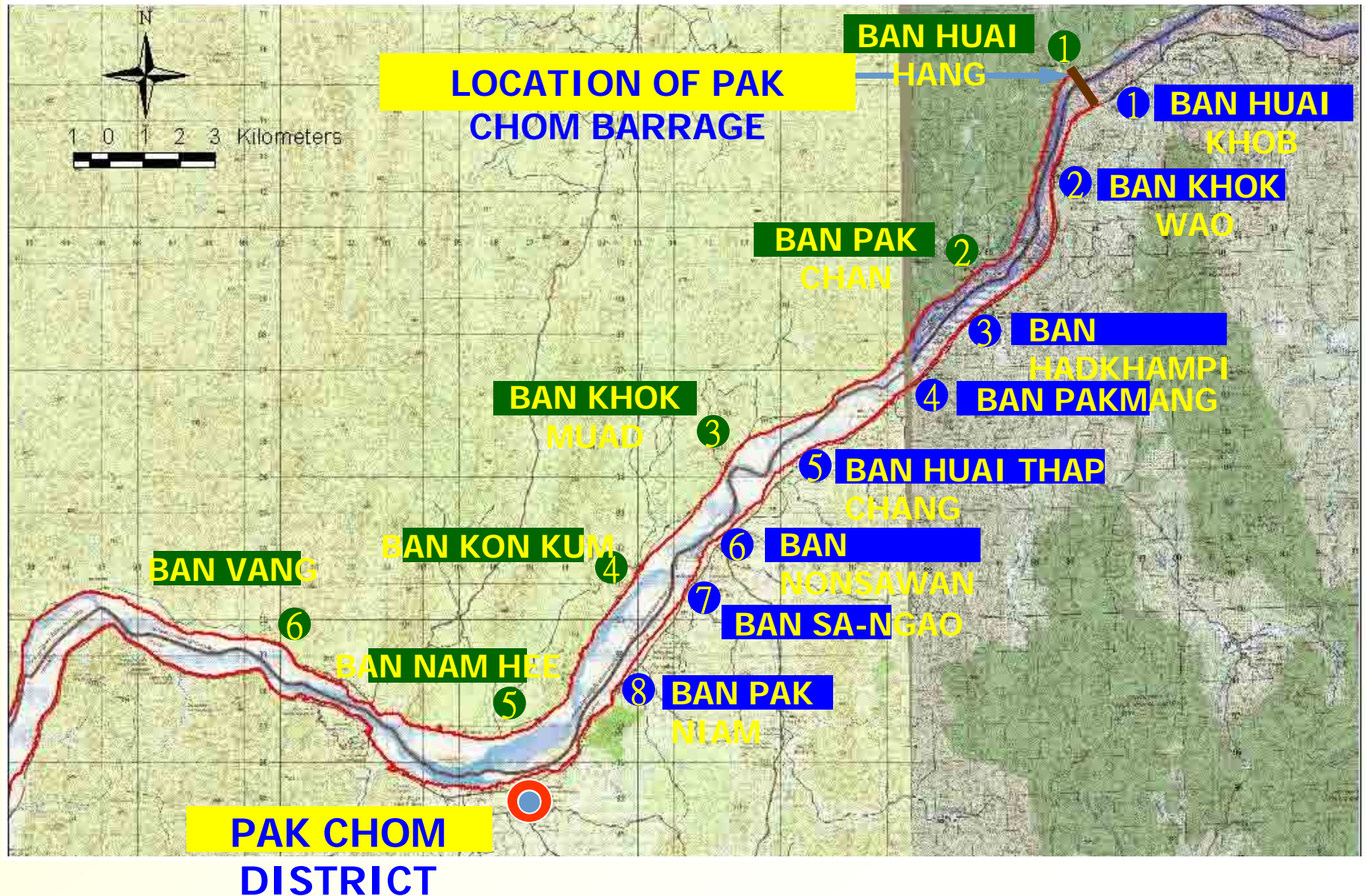
INITIAL ENVIRONMENTAL EXAMINATIONS (IEE)

MAJOR ENVIRONMENTAL ISSUES

1. PAK CHOM BARRAGE :

**(PAK CHOM DISTRICT, LOEI
PROVINCE, THAILAND
SANGTHONG DISTRICT,
VIENTIANE CAPITAL, LAO PDR)**

VILLAGES ALONGSIDE STORAGE LEVEL OF PAK



1.1 SOCIAL EFFECTS

(1) THAILAND

- FLOODED PART OF BAN KHOK WAO,
70 HOUSEHOLDS,
1 TEMPLE, 1 SCHOOL.

MEASU

RE

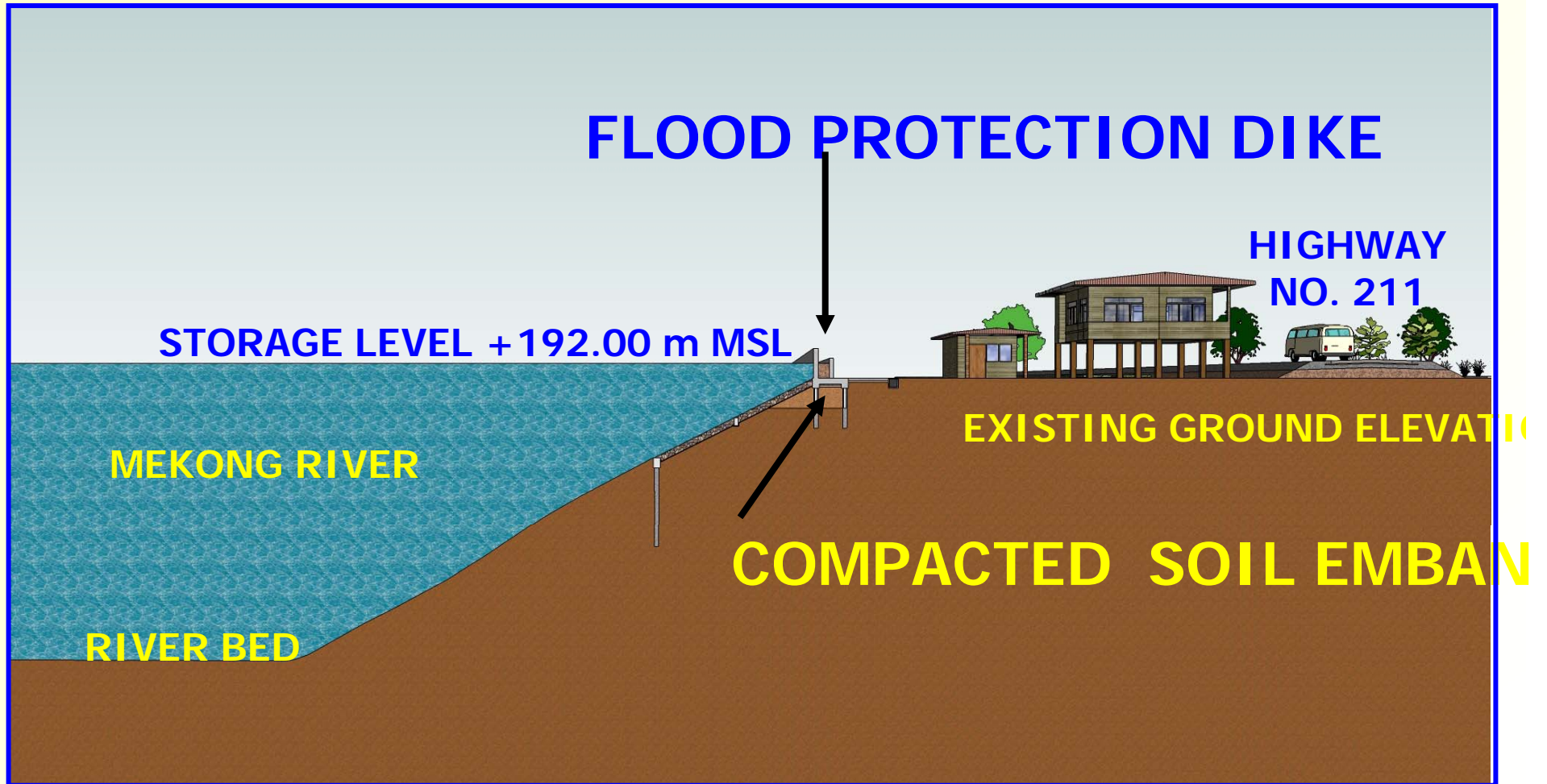
- CONSTRUCT 1.3 KM FLOOD
PROTECTION DIKE TO AVOID
RESETTLEMENT.

FLOOD PROTECTION DIKE FOR BAN KHOK WAO

BAK CHUM LOE



DESIGN OF FLOOD PROTECTION DIKE FOR BAN KHOC PAK CHOM, LOEI



(2) LAO PDR

- PAK CHOM BARRAGE SITE WORK : AFFECTS PART OF BAN HUAI HANG (37 HH), SANGTHONG DISTRICT, VIENTIANE CAPITAL.

MEASU

RE

- RELOCATE AFFECTED HOUSEHOLDS TO NEARBY UPSTREAM AREA.

- COMPENSATE LAND AND HOUSE FOR AFFECTED HOUSEHOLDS

RELOCATION OF BAN HUAI HANG, LAO PDR, PAK CHOM BARRAGE TO NEARBY UPSTREAM AR



1.2 EFFECTS ON INFRASTRUCTURE

(1) THAILAND

- FLOODED 1.1 KM ROAD BETWEEN BAN KHOK WAO AND BAN HAT KHAMPHI
 - FLOODED 4 BRIDGES
- MEASURE** RAISE ELEVATIONS OF ROAD AND BRIDGE.

(2) LAO PDR

- **MEASURE** AFFECT 1.60 KM ROAD AND 1 BRIDGE AT SITE WORK.

1.5 EFFECTS ON AGRICULTURAL LAND (1) THAILAND

- AFFECT AGRICULTURAL LAND
ALONGSIDE MEKONG RIVER
MEASUR E TARIARIES (CANALS).

E

CONSTRUCT FLOOD

PROTECTION WALL

AND PUMP STATIONS.

- **MEASUR** E AFFECT AGRICULTURAL LAND
ALONGSIDE MEKONG RIVER BANK
SLOPE 800 RAI (128 HA) OF 160 HH.

COMPENSATE OPPORTUNITY

(2) LAO PDR

- **FLOODED 553 RAI (88.5 HA)**

AGRICULTURAL LAND

MEASU

RE

**COMPENSATE AFFECTED LAND AT
12,000 BAHT/RAI OR 75,000
BAHT/HA.**

1.4 EFFECTS ON MIGRATION OF FISH IN MEKONG RIVER

- CONSTRUCTION OF PAK CHOM BARRAGE WILL OBSTRUCT

MIGRATION OF FISH
MEASUREMENT

CONSTRUCT FISHWAY TO FACILITATE FISH MIGRATION

1.5 EFFECTS ON NAVIGATION BETWEEN UPSTREAM AND

- DOWNSTREAM AREAS OF
BARRAGE SITE

CONSTRUCTION OF PAK CHOM
BARRAGE WILL OBSTRUCT WATER
TRANSPORTATION BETWEEN
UPSTREAM AND DOWNSTREAM
AREAS

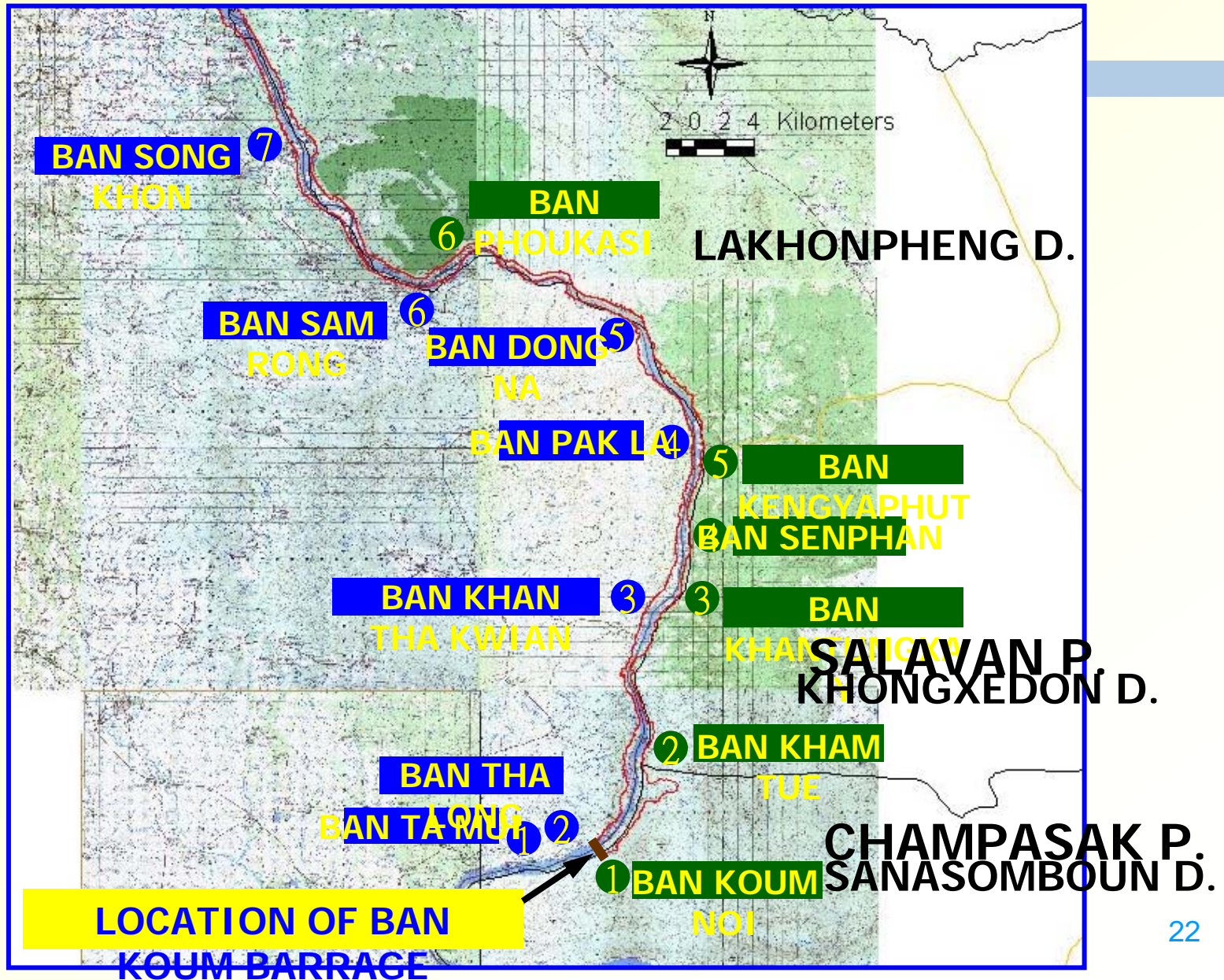
MEASU
RE

PROVIDE 20 M WIDE

2. BAN KOUM BARRAGE :

**(KHONG CHIAM DISTRICT, UBON
RATCHATHANI
PROVINCE, THAILAND
SANASOMBOUN DISTRICT,
CHAMPASAK PROVINCE, LAO
PDR)**

VILLAGES ALONGSIDE STORAGE LEVEL OF BAN



2.1 SOCIAL EFFECTS

(1) THAILAND

- FLOODED PART OF BAN KHAN THA KWIAN, 29 HOUSEHOLDS, 1 MULTI-PURPOSE HALL, 1 SCHOOL.

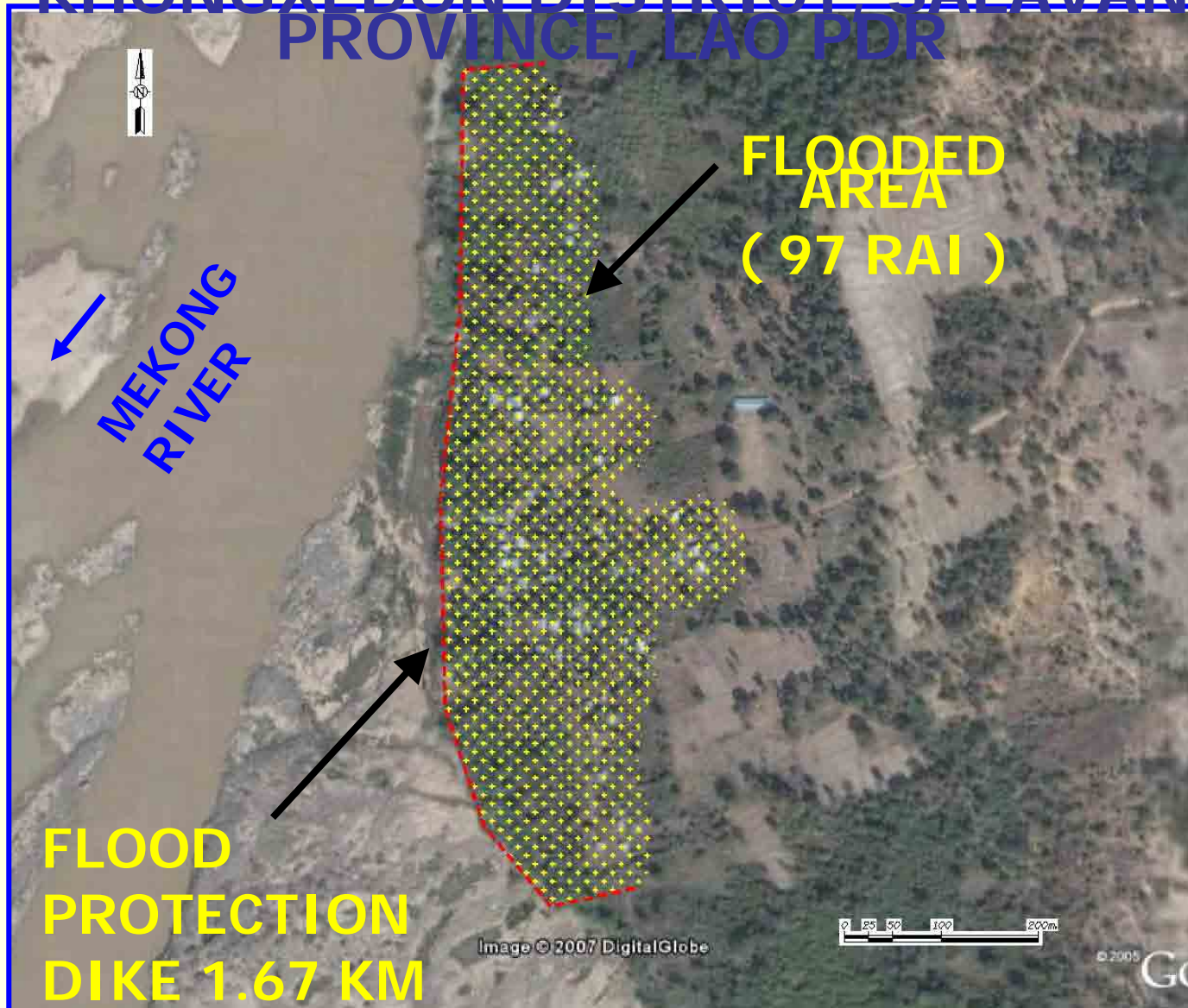
MEAS

URE

- CONSTRUCT 1.0 KM FLOOD PROTECTION DIKE TO AVOID DESTRUCTION

FLOOD PROTECTION DIKE FOR BAN KHAM TUE

KHONGXEDON DISTRICT, SALAVAN PROVINCE, LAO PDR



LONG

(2) LAO PDR

- FLOODED BAN KHAM TUE 98 HOUSEHOLDS, KHONGXEDON DISTRICT, SALAVAN PROVINCE

MEAS

URE

KM FLOOD

CONSTRUCT 1.67

PROTECTION DIKE TO AVOID RESETTLEMENT

- FLOODED BAN KHANTUNGXAY 73 HOUSEHOLDS, KHONGXEDON DISTRICT, SALAVAN PROVINCE

MEAS

URE

CONSTRUCT 1.00

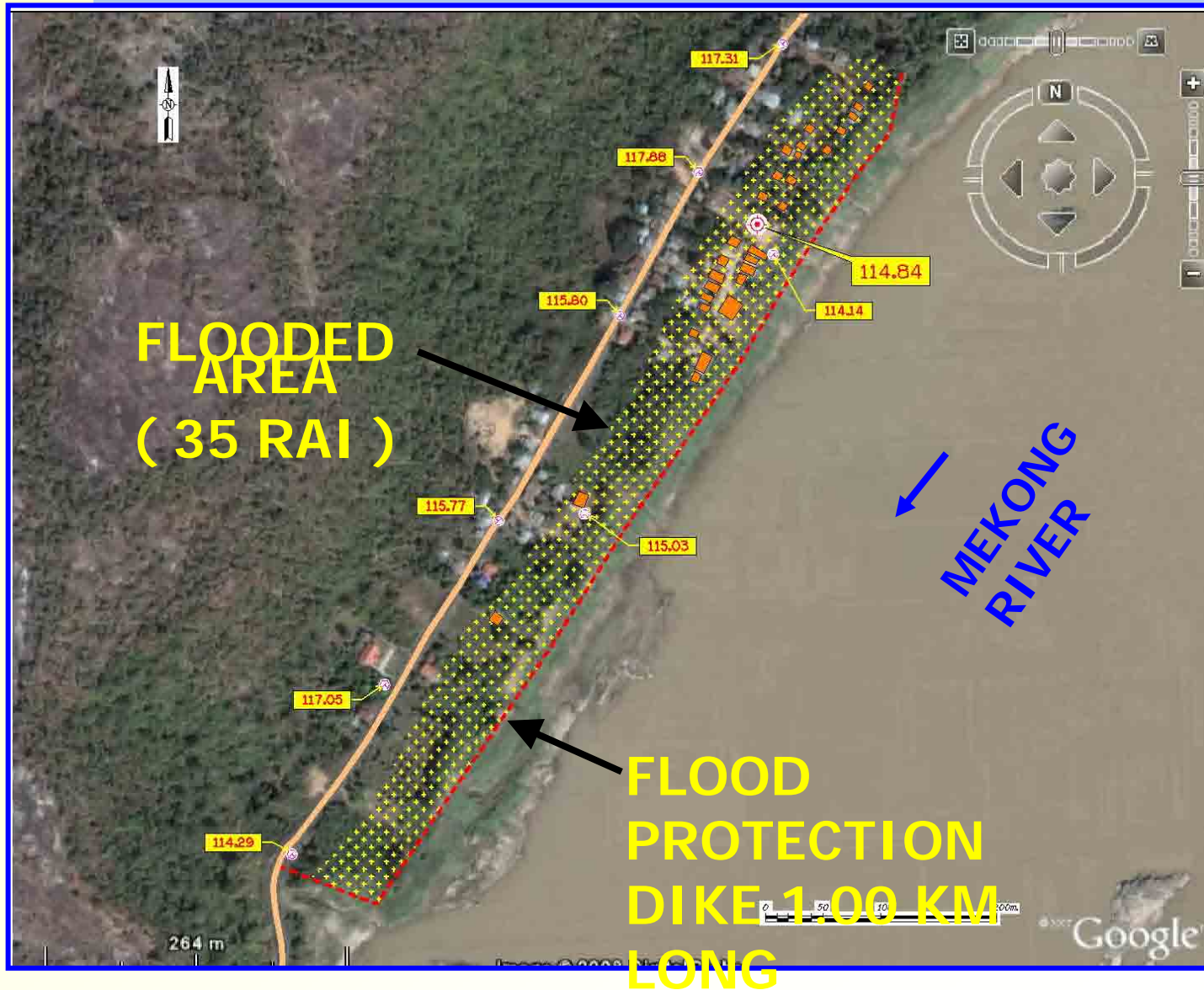
- **BAN KOUM BARRAGE SITE WORK AFFECTS PART OF BAN KOUM NOI (44 HH), SANASOMBOUN DISTRICT, CHAMPASAK PROVINCE**

MEAS

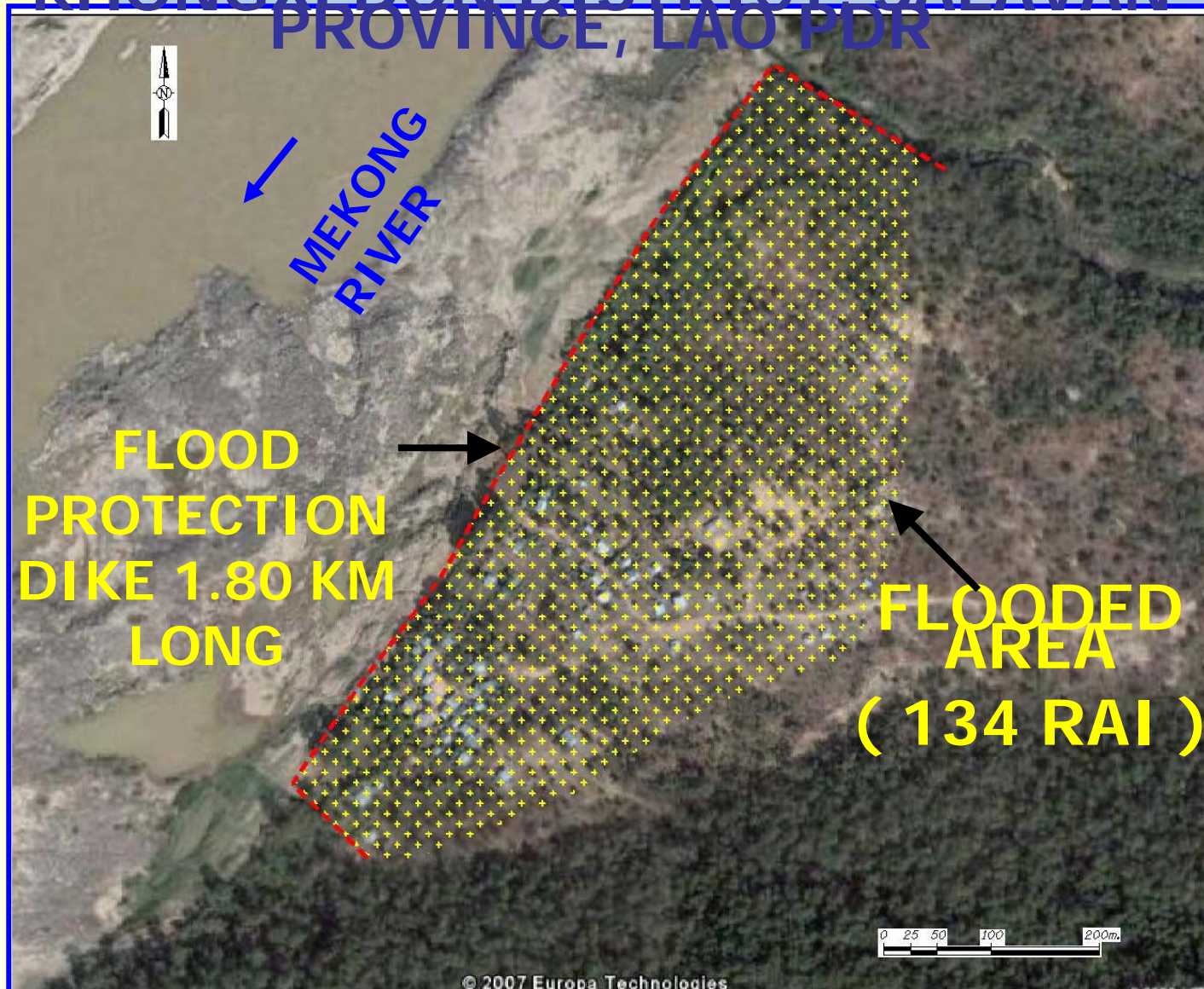
URE

- **RELOCATE AFFECTED HOUSEHOLDS TO NEARBY UPSTREAM AREA.**
- **COMPENSATE LAND AND HOUSE FOR AFFECTED HOUSEHOLDS.**

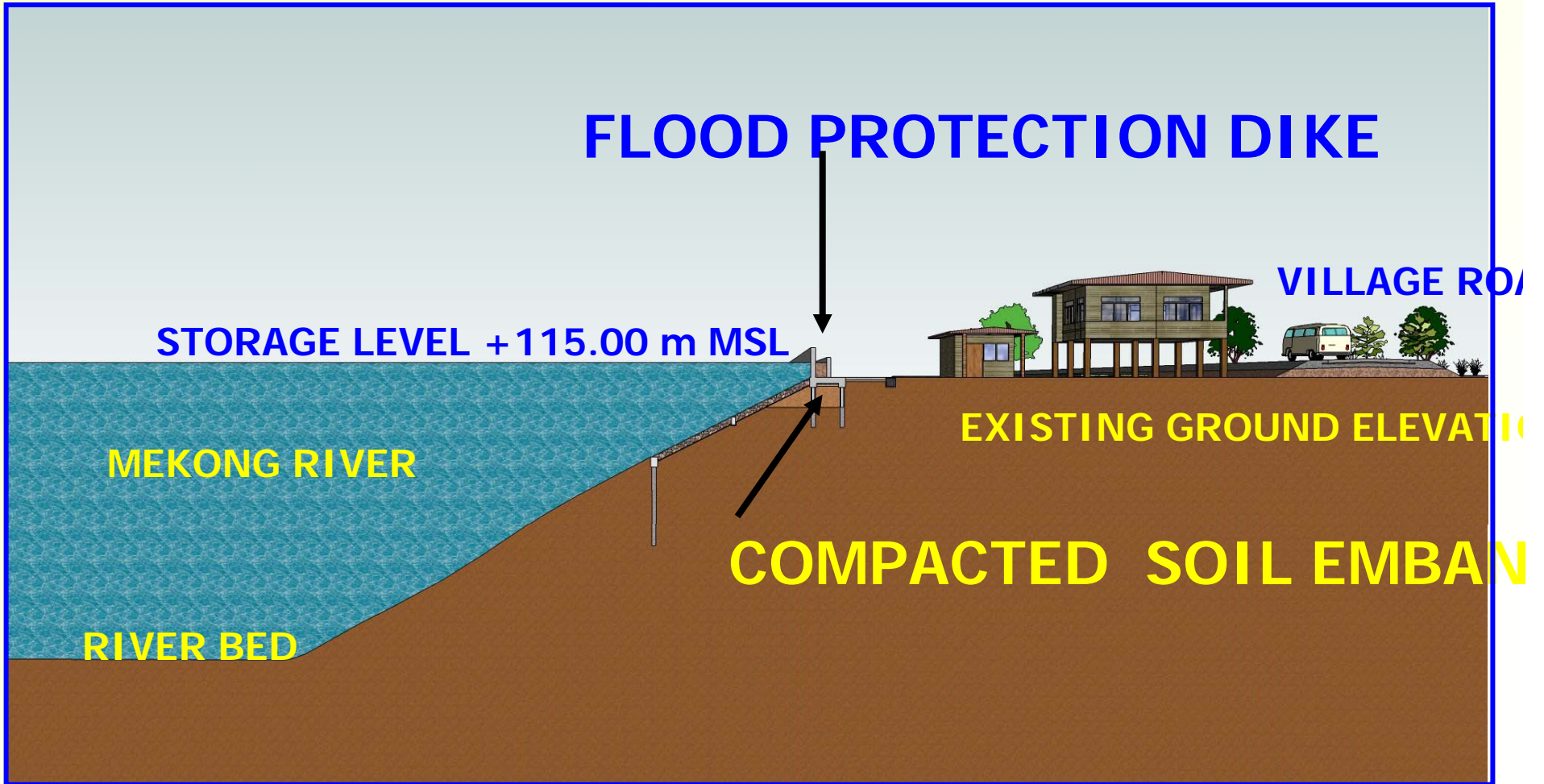
FLOOD PROTECTION DIKE FOR BAN KHAN THA KWIAN KHONG CHIAM, UBON RATCHATHANI



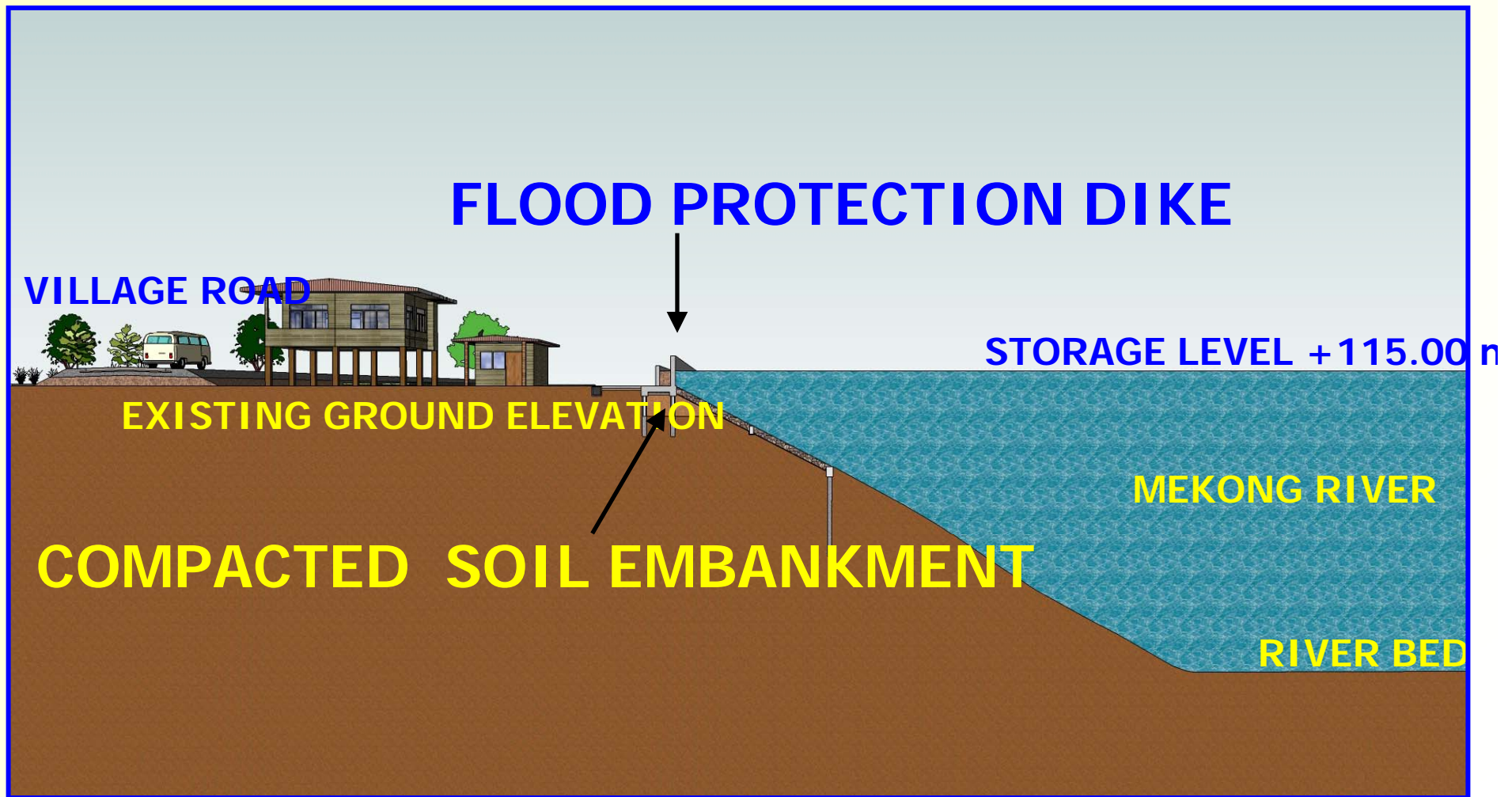
FLOOD PROTECTION DIKE FOR BAN KHANTUNGXAY KHONGXEDON DISTRICT, SALAVAN PROVINCE, LAO PDR



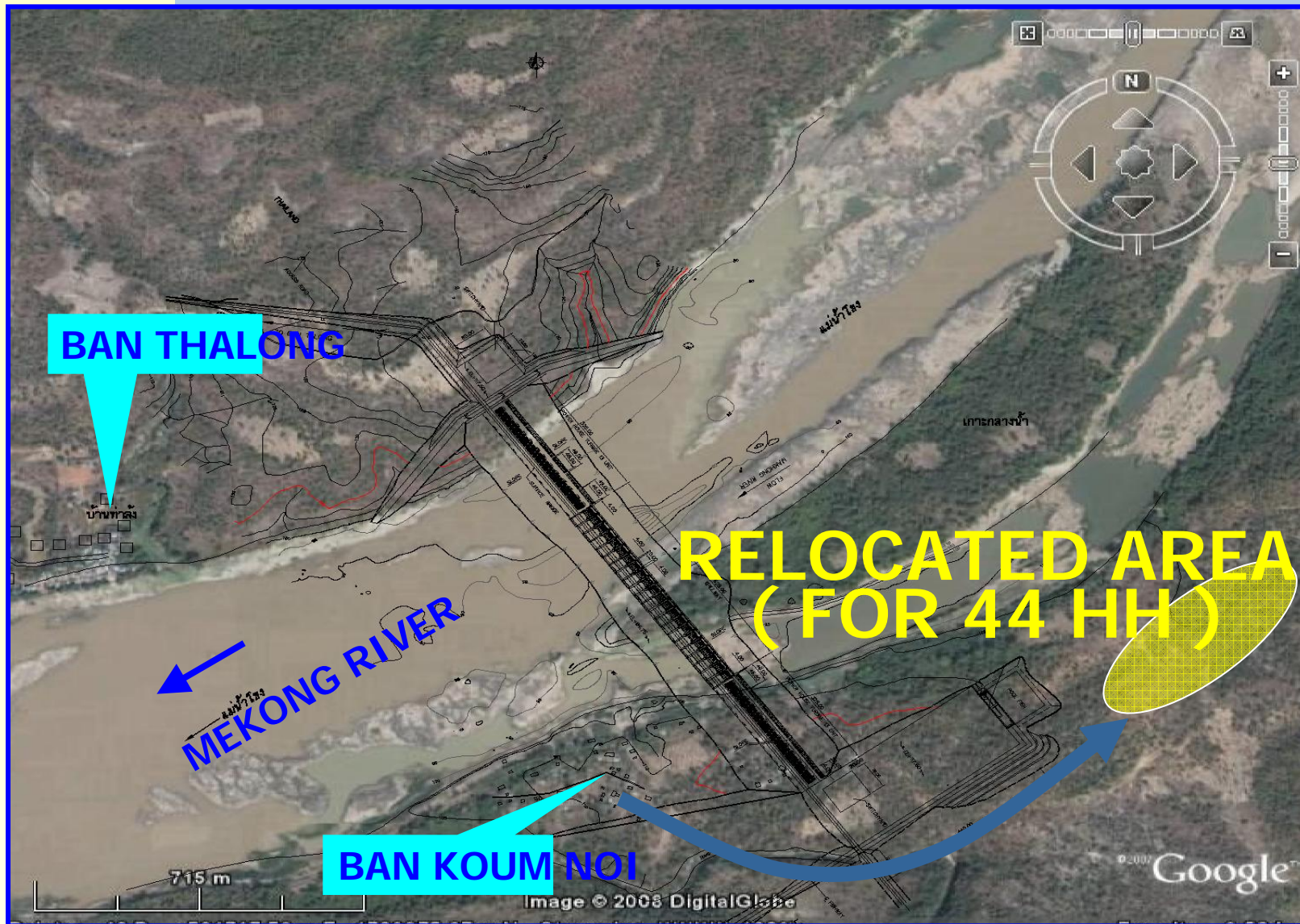
DESIGN OF FLOOD PROTECTION DIKE FOR BAN KHAN THA KHONG CHIAM , UBON RATCHATHANI



SKETCH OF FLOOD PROTECTION DIKE FOR BAN KHAM TUE AND BAN KHANTUNGXAY, KHONGXEDON



RELOCATION OF BAN KOUM NOI, LAO PDR, AT BAN KOUM BARRAGE TO NEARBY UPSTREAM AREA



2.2 EFFECTS ON AGRICULTURAL LAND (1) THAILAND

- AFFECT AGRICULTURAL LAND ALONGSIDE MEKONG RIVER TRIBUTARIES (CANALS).
MEASURE CONSTRUCT FLOOD PROTECTION WALL AND PUMP STATIONS.
- AFFECT AGRICULTURAL LAND ALONGSIDE MEKONG RIVER BANK SLOPE 900 RAI (144 HA) OF 180 HH.
MEASURE COMPENSATE OPPORTUNITY LOSS TO 180

(2) LAO PDR

- FLOODED 1,241 RAI (198.6 HA)
AGRICULTURAL LAND

MEAS

URE

COMPENSATE

AFFECTED LAND AT

**12,000 BAHT/RAI OR 75,000
BAHT/HA.**

2.3 EFFECTS ON MIGRATION OF FISH MEKONG RIVER

- CONSTRUCTION OF BAN KOUM BARRAGE WILL OBSTRUCT

MIGRATION OF FISH

MEAS
URE

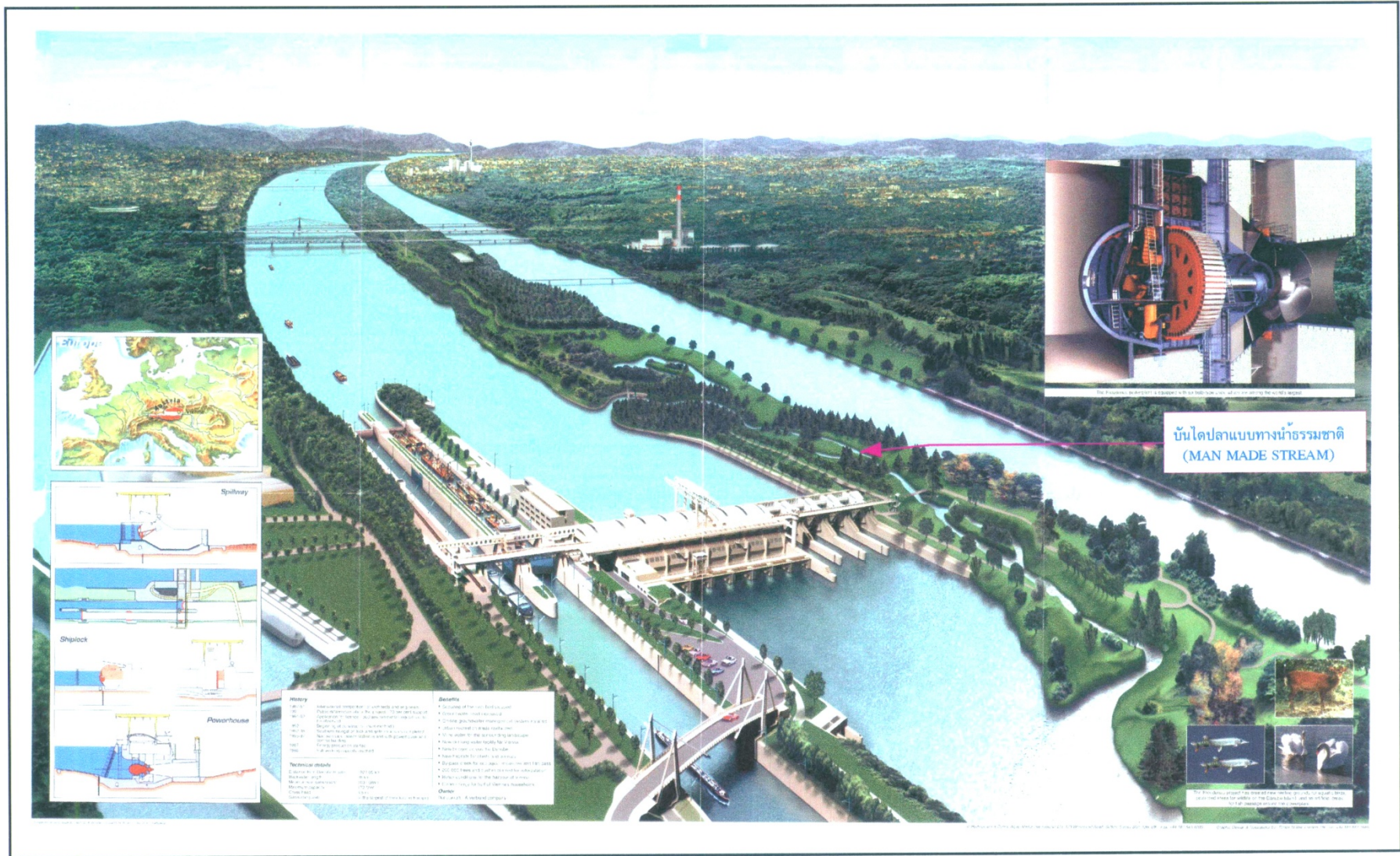
CONSTRUCT FISHWAY TO FACILITATE FISH MIGRATION.

2.4 EFFECTS ON NAVIGATION BETWEEN UPSTREAM AND DOWNSTREAM

AREAS OF BARRAGE SITE

MEAS
URE

- CONSTRUCTION OF BAN KOUM BARRAGE WILL OBSTRUCT WATER TRANSPORTATION BETWEEN UPSTREAM AND DOWNSTREAM AREA



รูปเขื่อนไฟฟ้าพลังน้ำ FREUDENAU ที่แม่น้ำ DANUBE ใกล้กรุงเวียนนา ประเทศออสเตรีย มีบันไดปลาแบบ MAN MADE STREAM ดังลูกศรชี้ในรูป

Construction Schedule for Pak Chom and Ban Koum Hydropower Projects

No.	Item	Construction Schedule for Pak Chom Hydropower Projects											
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10		
1	Feasibility Study, detail design, and tender documentation preparation	█											
2	Environmental and mitigation plan				█								
3	Bidding and preliminary works				█								
4	Construction of Pak Chom and Ban Koum Hydropower Projects				█								
5	Electro-mechanical and hydraulic equipment with tests						█						
6	Transmission line						█		█				
7	Flood mitigation and water resources development project			█	█	█	█						
8	Work approval and delivery											█	

Benefits of Pak Chom and Ban Koum Hydropower Projects

Hydropower project	Output				
	Average annual energy (GWh)	Agriculture (rai)	Water transportation (million tons/km)	Fishery (ton/year)	Reduction of carbon dioxide (million tons/year)
Pak Chom	5,051.9	17,362	28.0	4,328.0	3.46
Ban Koum	8,012.2	59,826	70.0	9,323.0	5.49

Hydropower Project	Benefit (million baht)					Total
	Average annual energy (GWh)	Agriculture (rai)	Water transportation	Fishery	Reduction of carbon dioxide	
Pak Chom	8,941.86	38.55	54.32	125.52	1,210	10,371.28
Ban Koum	14,181.54	125.62	135.80	270.37	1,920	16,633.05

Economic Analysis

Hydropower project	Economic internal rate of return (EIRR)	Net present value (NPV) (million baht)	Benefit-cost ratio (B/C ratio)	Energy cost (baht/kWh)
1st case: Energy benefits				
Pak Chom	13.90%	10,129	1.38	1.28
Ban Koum	13.08%	13,612	1.31	1.35
2nd case: Energy, agricultural, water transportation and fishery benefits				
Pak Chom	14.23%	11,047	1.42	1.28
Ban Koum	13.56%	15,848	1.36	1.35
3rd case: Energy, agricultural, water transportation, fishery and carbon dioxide reduction benefits				
Pak Chom	15.94%	15,997	1.61	1.28
Ban Koum	15.18%	23,698	1.53	1.35

Financial Cost

Item	Pak Chom	Ban Koum
1. Project investment costs	56,163	96,866
2. Price contingencies	11,206	19,453
3. Interest during construction	5,402	8,933
Overall investment costs	72,770	125,252
Equity (30 %)	21,831	37,576
Loan (70 %)	50,939	87,676

Financial Analysis Including Carbon Credits

Financial indicators	Unit	Pak Chom		Ban Koum	
		Base case	Sale of carbon credits	Base case	Sale of carbon credits
Return on investment (ROI)		8.60%	10.08%	7.81%	9.23%
Return on equity (ROE)		18.93%	22.27%	17.31%	20.57%
Net present value (NPV)	Million baht	13,053	18,540	17,789	26,491
Benefit-cost ratio (B/C ratio)		1.52	1.74	1.42	1.62
Payback period	Year	11	10	12	11

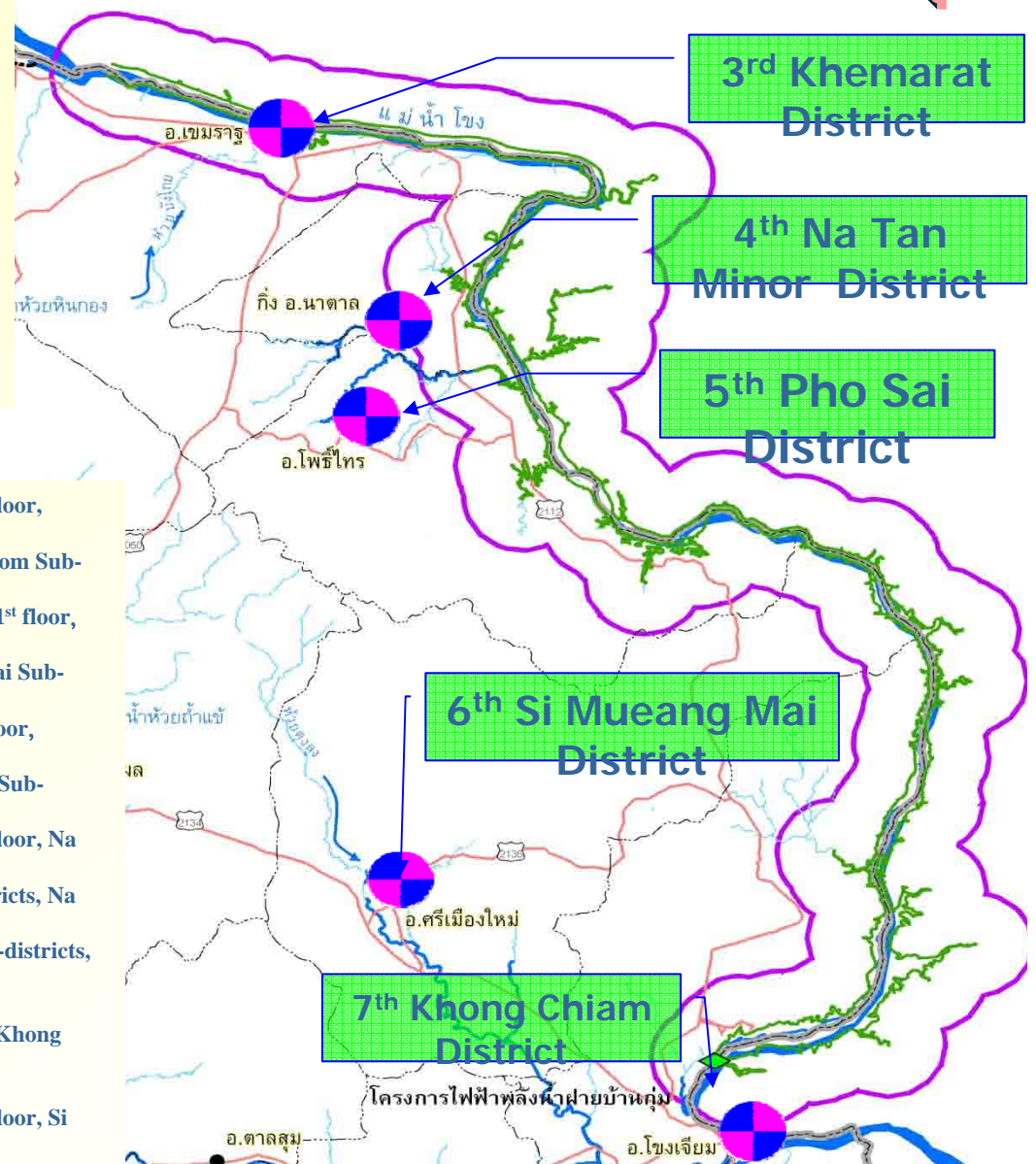
First Local Participation (in 7 Districts)

- 3rd forum : On October 4, 2007 from 13.30-16.30 at the Meeting Room, 2nd floor, Khemarat District Office, Ubon Ratchathani Province
Target group: People in Khemarat, Na Waeng and Nong Nok Tha Sub-district
- 4th forum : On October 5, 2007 from 09.00-12.00 at the Meeting Room, 2nd floor, Na Tan District Office, Ubon Ratchathani Province
Target group: People in Na Tan, Phalan and Kong Phon Sub-districts
- 5th forum : On October 8, 2007 from 13.30-16.30 at the Meeting Room, 2nd floor, Pho Sai District Office, Ubon Ratchathani Province
Target group: People in Samrong, Song Khon and Lao Ngam Sub-districts
- 6th forum : On October 9, 2007 from 09.00-12.00 at the Community Portal, Khong Chiam District Office, Ubon Ratchathani Province
Target group: People in Na Pho Klang and Huai Phai Sub-districts
- 7th forum : On October 9, 2007 from 13.30-16.30 at the Meeting Room, 2nd floor, Si Mueang Mai District Office, Ubon Ratchathani Province

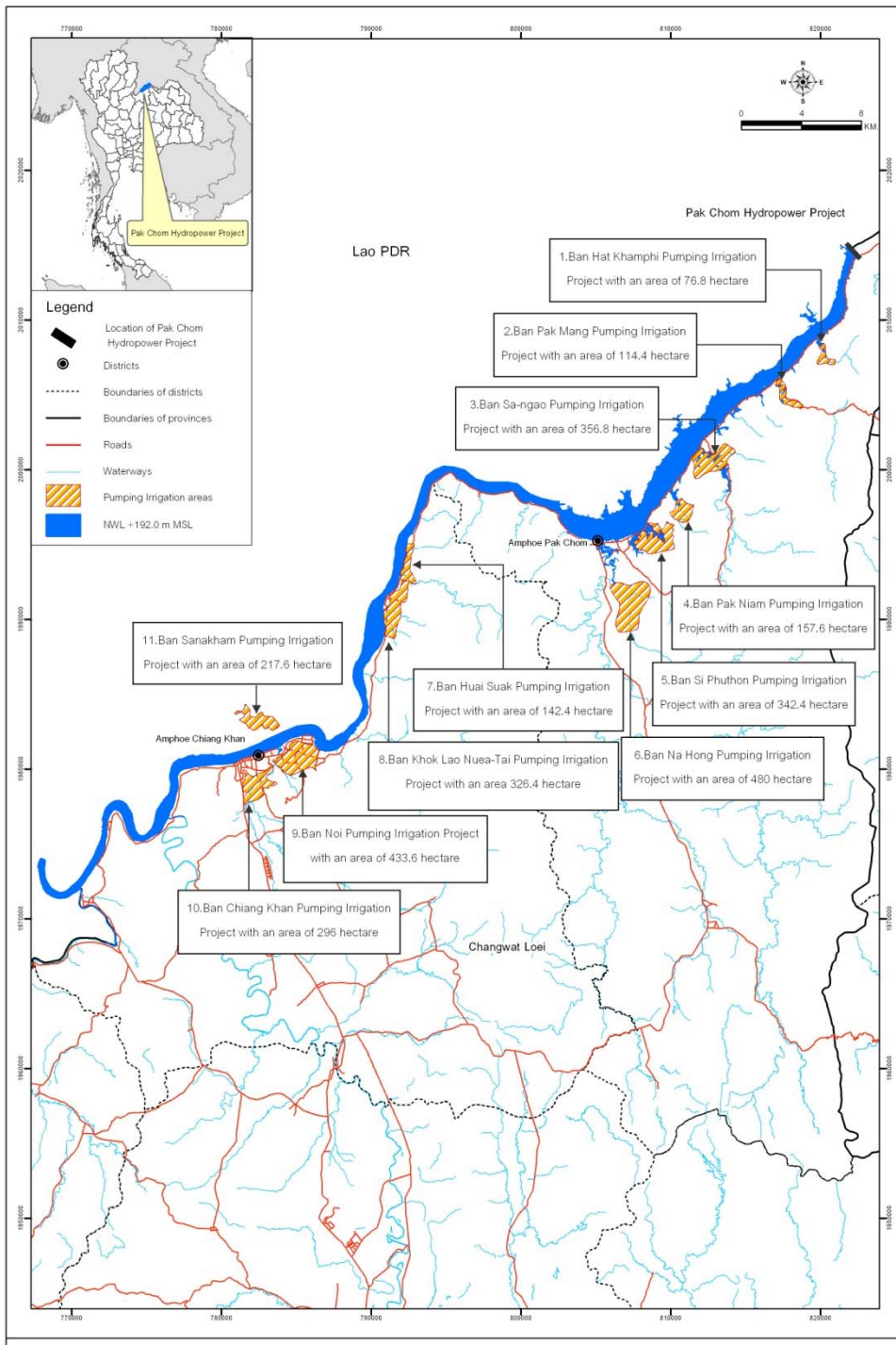
Second Local Participation (in 7 Districts)

- 1st forum : On February 11, 2008 from 09.00-12.00 at the Meeting Room, 2nd floor, Chiang Khan District Office, Loei Province
Target group: People in Chiang Khan, Na Sao, Pak Tom and Bu Hom Sub-districts
- 2nd forum : On February 11, 2008 from 13.30-16.30 at the Community Portal, 1st floor, Pak Chom District Office, Loei Province
Target group: People in Pak Chom, Hat Khamphi and Huai Phichai Sub-districts
- 3rd forum : On February 13, 2008 from 09.00-12.00 at the Meeting Room 2nd floor, Khemarat District Office
Target group: People in Khemarat, Na Waeng and Nong Nok Tha Sub-district
- 4th forum : On February 13, 2008 from 13.30-16.30 at the Meeting Room, 2nd floor, Na Tan District Office, Ubon Ratchathani Province
-Target group: People in Na Tan, Phalan and Kong Phon Sub-districts, Na Tan District, Ubon Ratchathani Province
-Target group: People in Samrong, Song Khon and Lao Ngam Sub-districts, Pho Sai District, Ubon Ratchathani Province
- 5th forum : On February 14, 2008 from 09.00-12.00 at the Community Portal, Khong Chiam District Office, Ubon Ratchathani Province
Target group: People in Na Pho Klang and Huai Phai Sub-districts
- 6th forum : On February 14, 2008 from 13.30-16.30 at the Meeting Room, 2nd floor, Si Mueang Mai District Office, Ubon Ratchathani Province
Target group: People in Nam Thaeng Sub-district

San Koum Hydropower Project



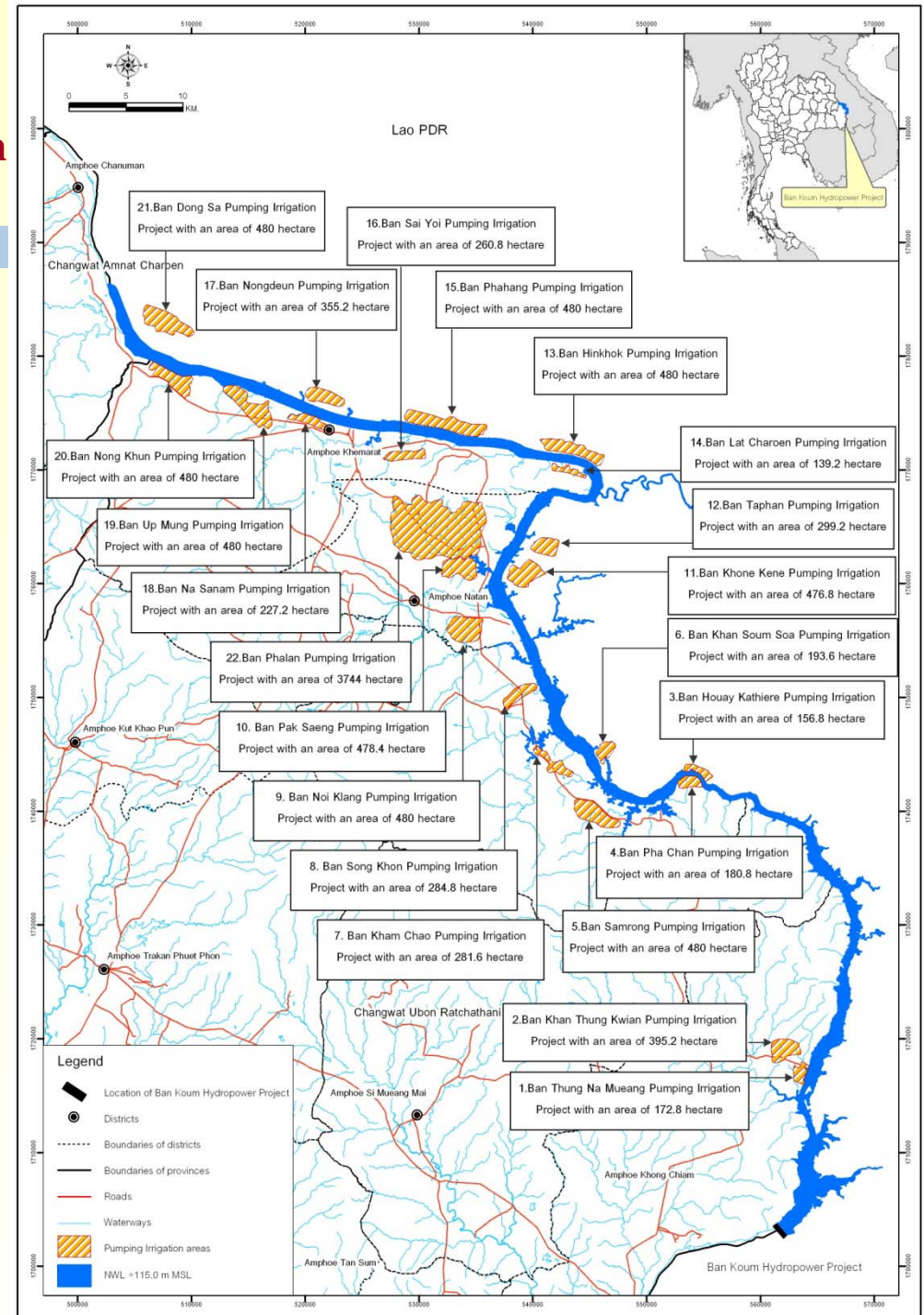
**Water resources development projects
comprise 11 pumping irrigation projects
with a total area of 18,400 rai and
irrigation area of 17,362 rai**



No.	Pumping irrigation project	Country	Project area (hectare)	Irrigation area (hectare)	Project cost (MB)
1	Ban Hat Khamphi, Hat Khamphi Sub-district, Pak Chom District	Thailand	480	420	8.186
2	Ban Pak Mang, Hat Khamphi Sub-district, Pak Chom District	Thailand	715	645	11.476
3	Ban Sa-ngao, Huai Phichai Sub-district, Pak Chom District	Thailand	2,230	1,784	16.933
4	Ban Pak Niam, Huai Phichai Sub-district, Pak Chom District	Thailand	985	788	14.258
5	Ban Si Phuthon, Pak Chom Sub-district, Pak Chom District	Thailand	2,140	2,140	19.688
6	Ban Na Hong, Pak Chom Sub-district, Pak Chom District	Thailand	3,000	3,000	20.87
7	Ban Huai Suak, Bu Hom Sub-district, Chiang Khan District	Thailand	890	890	14.392
8	Ban Khok Lao Nuea-Tai, Bu Hom Sub-district, Chiang Khan District	Thailand	2,040	1,775	20.759
9	Ban Noi, Chiang Khan Sub-district, Chiang Khan District	Thailand	2,710	2,710	24.954
10	Ban Sanakham, Sanakham Province	Lao PDR	1,360	1,360	14.642
11	Ban Chiang Khan, Chiang Khan Sub-district, Chiang Khan District	Thailand	1,850	1,850	19.690
	Total		18,400	17,362	185.847

Water resources development projects comprise 22 pumping irrigation projects with a total area of 68,790 rai and irrigation area of 59,826 rai

Nb.	Pumping Irrigation Project	Country	Project area (rai)	Irrigation area (rai)	Project cost (M\$)
1	Ban Thung Na Mueang	Thailand	1,080	1,080	12,403
2	Ban Khan Thung Kwian	Thailand	2,470	1,976	16,778
3	Ban Huay Kathiere	Lao PDR	980	784	14,429
4	Ban Pa Oan	Thailand	1,130	904	12,752
5	Ban Samrong	Thailand	3,000	2,400	24,571
6	Ban Khan Soum Soa	Lao PDR	1,210	968	23,053
7	Ban Kham Chao	Thailand	1,760	1,408	23,391
8	Ban Song Khon	Thailand	1,780	1,424	16,345
9	Ban Noi Klang	Thailand	3,000	2,580	19,513
10	Ban Pak Saeng	Thailand	2,990	2,392	20,355
11	Ban Khone Kene	Lao PDR	2,980	2,384	21,444
12	Ban Taphan	Lao PDR	1,870	1,870	18,272
13	Ban Hinkhok	Lao PDR	3,000	2,400	26,771
14	Ban Lat Charoen	Thailand	870	696	13,485
15	Ban Phahang	Lao PDR	3,000	2,400	30,827
16	Ban Sai Yoi	Thailand	1,630	1,304	22,097
17	Ban Nongdeun	Lao PDR	2,220	2,220	21,306
18	Ban Na Sanam	Thailand	1,420	1,136	18,054
19	Ban Up Mung	Thailand	3,000	2,880	26,441
20	Ban Nong Khun	Thailand	3,000	2,400	27,127
21	Ban Dong Sa	Lao PDR	3,000	2,920	28,674
22	Ban Phelan	Thailand	23,400	21,300	92,555
	Total		68,790	59,826	530,644



Summary of the Results of the 1st Local Participation

From September 24-25, 2007 and from October 4-9, 2007

Summary of the results of the 1st local participation

- 1) Project development: Most agreed with the project development ?**
- 2) Environmental, agricultural, fishery and tourist impacts**
- 3) Small-scale development projects in streams**
- 4) Social impacts and acquisition**
- 5) Organize village society meetings**

Summary of the Results of the 2nd Local Participation

From February 11-14, 2008

Summary of the results of the 2nd local participation

- 1) Most agreed with project development ?**
- 2) Most understood and agreed with the solution guidelines**
- 3) Solving social impacts with prevention of evacuation of local people and protection of agricultural areas**
- 4) Request for local participation**
- 5) Compensation for the opportunity cost for the cultivation on the banks of the Mekong River**
- 6) Occupational promotion for local people**

PROJECT DEVELOPMENT FRAMEWORK

- 1) Joint Investment on Infrastructure Project in Thailand (BTO/BOT)**
- 2) Joint Investment on Infrastructure Project in Lao PDR (BOT)**

National Participation

- 1) Participation in Vientiane, Lao PDR on March 11, 2008**
- 2) Seminar on Pak Chom and Ban Koum Hydropower Projects in Bangkok, Thailand on March 26, 2008**

Next Step Studies

- Feasibility Study
- Environmental Impact Assessment
(EIA)
- Social Impact Assessment
(SIA)

THANK

YOU

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