

**THE MASTER PLAN STUDY
ON
RURAL ELECTRIFICATION
BY
RENEWABLE ENERGY
IN THE KINGDOM OF CAMBODIA**

**FINAL REPORT
VOLUME 5: APPENDICES**

June 2006

Japan International Cooperation Agency

**NIPPON KOEI CO., LTD., Tokyo
KRI INTERNATIONAL CORP., Tokyo**

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Japan International
Cooperation Agency

Ministry of Industry, Mines and
Energy in the Kingdom of Cambodia



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Abbreviations

Abbreviation	Description
ADB	Asian Development Bank
Ah	Ampere hour
ASEAN	Association of South East Asian Nations
ATP	Ability to Pay
BCS	Battery Charging Station
CBO	Community Based Organization
CDC	Council of Development for Cambodia
CDM	Clean Development Mechanism
CEC	Community Electricities Cambodia
CF	Community Forestry
CFR	Complementary Function to REF
CIDA	Canadian International Development Agency
DAC	Development Assistance Committee
DIME	Department of Industry, Mines and Energy
DNA	Designated National Authority
EAC	Electricity Authority of Cambodia
EdC	Electricite du Cambodge
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ESA	Energy Service Agent
ESCO	Energy Service Company
EU	European Union
FIRR	Financial Internal Rate of Return
FS	Feasibility Study
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographic Information System
GS	Grid Substation
GWh	Giga Watt hour (one million kWh)
ha	hectar
HQ	Head Quarters
HV	High Voltage
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
IEIA	Initial Environmental Impact Assessment
IMF	International Monetary Fund
IPP	Independent Power Producer
IRR	Internal Rate of Return
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau
kW	kilo Watt
kWe	kW-electricity
kWh	kW-hour
kWp	kW-photovoltaic

Abbreviation	Description
MDG	Millennium Development Goals
MEF	Ministry of Economy and Finance
MHP	Micro-hydro Power
MIME	Ministry of Industry, Mines and Energy
MOE	Ministry of Environment
MOI	Ministry of Interior
MOWRM	Ministry of Water Resources and Meteorology
MP	Master Plan
MRC	Mekong River Commission
MV	Medium Voltage
MW	Mega Watt
NASA	National Aeronautics and Space Administration
NEDO	The New Energy and Industrial Technology Development Organization
NGO	Non-Governmental Organization
NIS	National Institute of Statistics
O&M	Operation and Maintenance
ODA	Official Development Assistance
PAGE	Potential Area of Grid Electrification
PEC	Provincial Electricity Company
PEU	Provincial Electricity Utility
PPP	Public Private Partnership
RDB	Rural Development Bank
REE	Rural Electricity Enterprise
REF	Rural Electrification Fund
RET	Renewable Energy Technology
RFP	Request for Proposal
RGC	The Royal Government of Cambodia
RPC	Regional Power Company
SA	Special Account
Seila	Seila is a Khmer word that means a foundation stone. The Seila Program initiated officially in 1996 institutes decentralized systems and strategies for poverty alleviation and good governance at the provincial and commune levels.
SHS	Solar Home System
SMEC	Small and Medium Enterprise Cambodia (NGO)
SPC	Special Purpose Company
SW	Scope of Works
TA	Technical Assistance
UNDP	United Nations Development Program
USAID	United States Agency for International Development
VAT	Value Added Tax
VO	Village Organization
WB	World Bank
WTP	Willingness to Pay
WWII	World War II

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**FINAL REPORT
APPENDICES**

Volume 1	Summary
Volume 2	Master Plan
Volume 3	Manuals
Volume 4	Pre-feasibility Study
Volume 5	Appendices

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FINAL REPORT

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Micro Hydro Power

THE MASTER PLAN STUDY
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Appendix-A Micro Hydro Power

1. SUPPLEMENTARY INFORMATION/CONSIDERATIONS FOR FORMULATION OF MICRO HYDRO POWER SCHEMES

(1) Existing Hydro Power Stations

There are two existing hydropower stations in Cambodia, namely Kirirom I power station in Kampong Speu Province and O Chum II power station in Ratanak Kiri Province. Principal features of these two schemes are as follows:

Table AP-A.1.1 Principal Features of Existing Hydro Power in Cambodia

Scheme Name	Province	Installed Capacity	Load center	Remarks
Kirirom I	Kampong Speu	12 MW	Phnom Penh, Kampong Speu	Started operation in 2002
O Chum II	Ratanak Kiri	1 MW	Banlung provincial capital)	Started operation in 1993

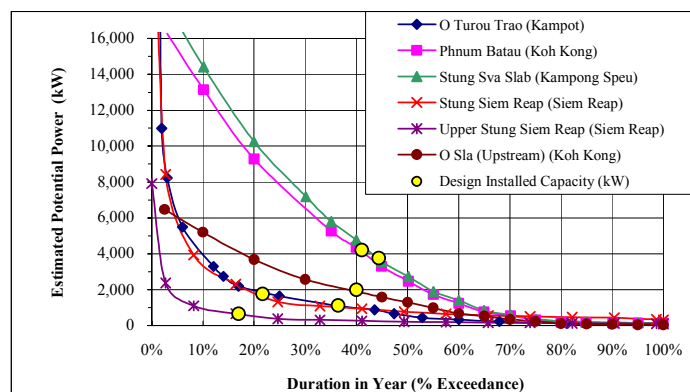
Source: MIME

Kirirom I station was built as an IPP scheme in 2002 and supplies electricity mainly to Phnom Penh. There is a substation in Kampong Speu Town on the transmission line from Kirirom I to Phnom Penh. From this substation 0.5 MW are supplied to Kampong Speu town.

O Chum II station utilizes discharge released from O Chum reservoir. O Chum reservoir is created by an earthfill dam having crest length of about 700 m and height of about 30 m. Stored water is released from its intake tower for power generation. O Chum II power station is located about 2 km downstream of O Chum reservoir. O Chum II has an installed capacity of 1MW consisting of two units of 500 kW each. There is another scheme of O Chum I proposed to utilize unused head available on the 2 km long river reaches between O Chum Reservoir and O Chum II power station.

(2) Concept of Installed Capacity Selection for Micro Hydro

Figure AP-A.1.1 shows flow duration curves and design plant discharge (a design discharge corresponding to installed capacity) planned by Meritec, 2002.



Source: Developed by the JICA Study Team based on "Development of Pipeline of Small Hydropower Projects in Cambodia", Final Pre-Investment Study Report, World Bank, Meritec, May 2002

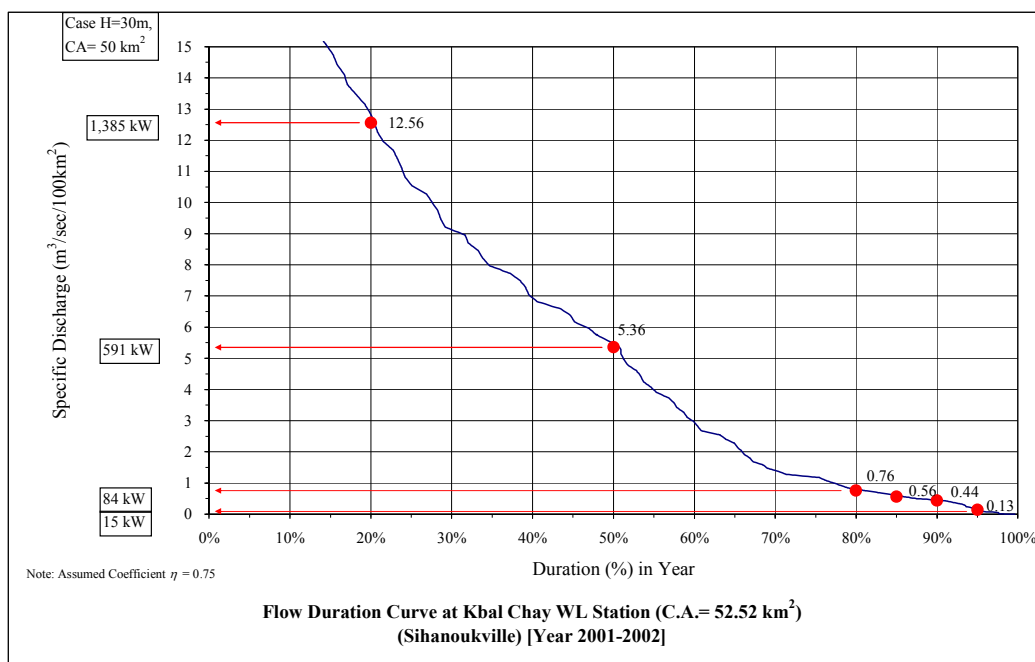
Figure AP-A.1.1 Flow Duration Curve and Installed Capacities of WB Projects

Since these projects will supply electricity to existing grids, the installed capacities were selected with exceedance probability of 15 to 45%, that is, the power output will reach the installed capacity only for 1.8 to 5.4 months a year. The main objective of these is to feed low cost energy to save high cost fuel of diesel power plants in the grids.

Because of the low dry season flow, the power output available for rural electrification in the off-grid areas will become very low compared to those installed capacities planned by Meritec for mini hydros to save fuel consumption in the rainy season. An example is shown in Figure AP-A.1.2 for a river in Sihanoukville province. The figure shows the following options for installed capacity of this micro hydro site:

- 15 kW should the output be secured for 95% of the time or 347 days per year (there would be power shortage in 18 days a year);
- 84 kW should the output be secured for 80% of the time or 292 days per year (there would be power shortage in 73 days a year);
- about 590 kW should the output be secured for 50% of the time or 6 months per year (there would be power shortage in 6 months a year);
- about 1,400 kW should the energy output be maximized to feed existing grids neglecting those output drops in the dry season.

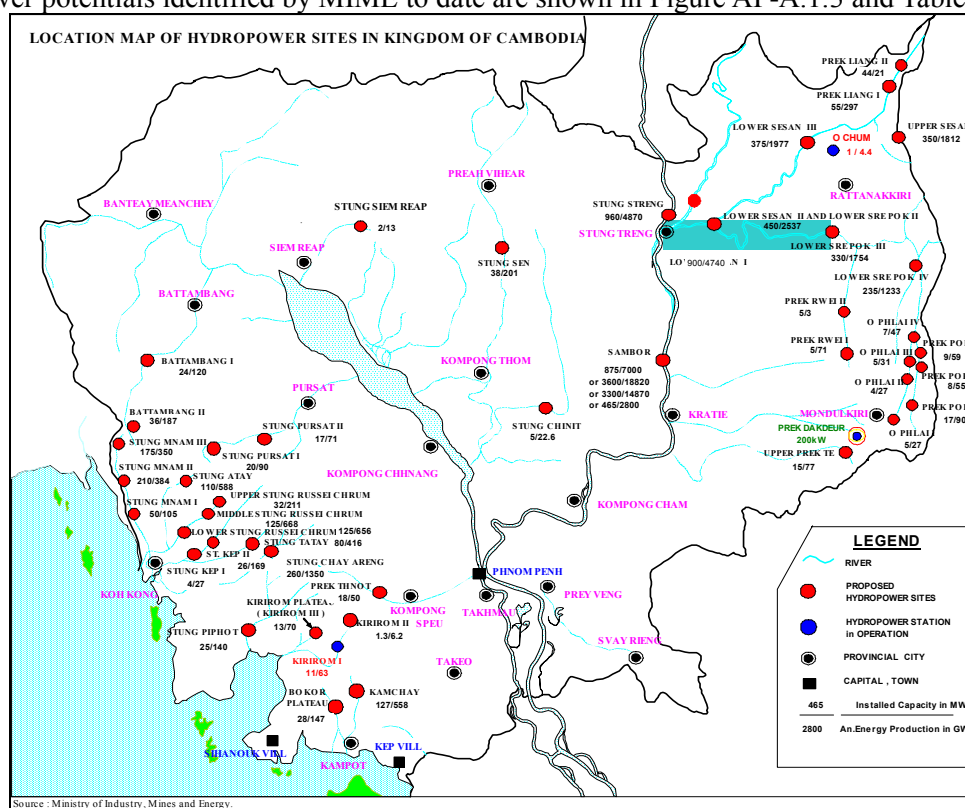
For the rural electrification in the off-grid areas, 15 kW may be adopted if it can meet the demand. If not, up to 84 kW may be adopted accepting drops in the power supply up to about 2 months a year. In view of the limited potential of micro hydro in Cambodia, villagers would be required to accept such inconvenience as to save electricity consumption in the dry season, for example to use only one light. An option to back up the drop by diesel generator is technically possible but is financially questionable unless people can afford to share such cost.



Source: JICA Study Team

Figure AP-A.1.2 Flow Duration Curve and Possible Options of Installed Capacity**(3) Existing Plans for Hydropower Development**

Hydropower potentials identified by MIME to date are shown in Figure AP-A.1.3 and Table AP-A.1.2.

**Figure AP-A.1.3 Location Map of Proposed Hydropower Projects in Cambodia**

In Cambodia, there has been a great number of medium to large scale hydropower development proposed by MRC, Russia, Japan, etc. since 1960s. However, there have been less numbers of development plans of micro hydro that can contribute to rural electrification in the off-grid area.

Of the several past studies, “Pre-Investment Study of Community Scale Hydro Projects, Cambodia” NZ Ministry of Foreign Affaires & Trade, by Meritec 2003 was for rural electrification. In this study several examinations were made on micro hydro of village scale. 45 locations were identified by desk screening in nine provinces. Further, 6 locations were selected as priority communities for site survey and socioeconomic survey. Finally, Pre-F/S was conducted for 10 schemes.

Meritec also conducted “Development of Pipelines of Small Hydropower Projects in Cambodia” funded by WB in 2002. The mini hydro will be connected to grid. Electrification of local villages was not intended. This study aims at promoting fuel saving of thermal power in the rainy season. To increase B/C (benefit by cost ratio) of mini hydro, installed capacities are optimized taking account of full power generation in the rainy season. This makes the project scales much larger than the dry season power output and lowers kWh cost. However, it may be noted their dependable power in the dry season is negligibly small compared to the installed capacity.

Table AP-A.1.2 List of Identified MHP Sites in Cambodia

Site No.	Hydro Project Name	Province	Load Centre	Load Centre Demand	Installed Capacity (1)	Distance from Demand Centre to Power House	Distance from Existing Transmission Line	Catchment Area	Mean Annual Rainfall	Mean Annual Evapotranspiration	Run-off Coefficient	Mean Annual Flow	Power Flow	Net Head	Dam Crest Length	Reservoir Area	Note			
																	Meritec List	MIME List	NEDO Study	JICA 事前
1	O Chum 2	Ratanak Kiri	Ban Lung	1.0	300	8	3	0.3	-	1,200		3.8	3.8	10			○	○		
2	O Katieng	Ratanak Kiri	Ban Lung	1.5	1,076	10	10	44	3,000	1,000		2.8	3	43.05			○	○		
3	O Kachagn	Ratanak Kiri			224			42.9	2,200		0.50	1.5		20	500	1.512	○	○		
4	O Chum III	Ratanak Kiri			82			31.2	2,200		0.50	1.1		10	350	1.325	○	○		
5	Ta Ang	Ratanak Kiri			74			22.7	2,200	1,000		1.4	1.3	8.96			○	○		
6	Bay Srok	Ratanak Kiri			10			19	2,200	1,000		0.7	0.07	23.91			○	○		
7	Prek Dak Deur	Mondul Kiri			201			139	2,600	1,200		4.4	0.68	17.99			○	○		
8	Prek Dak Deur (MIME List)	Mondul Kiri			113			53.65	2,100		0.42	1.5	0.62	25.81			○	○		
9	Prek Dak Deur (5)	Mondul Kiri	Sen Monorom	0.5	200	11.3	11.3	53	2,600	1,200		2.4	1.6	14.3			○	○		
10	Prek Dak Deur (Meritec site) (5)	Mondul Kiri	Sen Monorom	0.5	721	13	13	102	2,800	1,000		5.8	5	17.52			○	○		
11	O Phlai	Mondul Kiri	Sen Monorom	0.5	3,478	27	27	95	2,800	1,000		5.4	4.5	92.78			Selected	○		
12	Prek Por	Mondul Kiri	Sen Monorom	0.5	4,800	30	30	198	2,800	1,000		11.3	15	38.53			Selected	○		
13	Busra	Mondul Kiri			54			198	2,600	1,200		8.8	0.15	56.9			○	○		
14	O Moleng (a)	Mondul Kiri			148			56.64	2,200		0.50	2.0		10	400	0.3125	○	○		
15	O Moleng (b)	Mondul Kiri			50			47.55	2,100		0.42	1.3		5	200	0.325	○	○		
16	O Romiss	Mondul Kiri			91			43.26	2,100		0.42	1.2		10	120	0.1	○	○		
17	O Yong Ngol	Mondul Kiri			68			32.23	2,100		0.42	0.9		10	110	0.362	○	○		
18	Preak Antap	Kampong Cham			844			234.81	2,400		0.42	7.5		15	700	4.875	○	○		
19	Preak Lpeak (Irrig. Weir)	Kampong Cham			42			41.25	1,600		0.27	0.6		10	320	1.7	○	○	Selected	
20	Preak Chv (Irrig. Weir)	Kampong Cham															○	○	Selected	
21	Chom Ta Hung (Irrig. Weir)	Kampong Cham						4.4									○	○	Selected	
22	Toek Char (Irrig. Weir)	Kampong Cham															○	○	Selected	
23	Chroch Takok	Kampong Cham						1.2									○	○	Selected	
24	Siem Reap No.1 (extg French Irrigation Weir)	Siem Reap	Siem Reap Town	3.3	-	15	11.9	600	1,200	1,000		3.8	0	0			○	○		
25	Siem Reap No.2 (Disused Irrigation Weir)	Siem Reap	Siem Reap Town	3.3	-	0	0.2	670	1,200	1,000		4.2	0	0			○	○		
26	Siem Reap No.3 (extg Western Irrigation Reservoir)	Siem Reap	Siem Reap Town	3.3	-	17.7	7.8	600	1,200	1,000		3.8	0	0			○	○		
27	Stung Siem Reap (5)	Siem Reap	Siem Reap Town	3.3	1,732	47.9	44	115	1,600	1,000		2.2	3	69.25			Selected	○		
28	Upper Stung Siem Reap (5)	Siem Reap	Siem Reap Town	3.3	656	52.7	48.8	86	1,600	1,000		1.6	3	26.22			Selected	○		
29	Phnum Kulen	Siem Reap			1,561			123.75	1,700		0.39	2.6		80	450	0.35	○	○		○
30	Phnum Kbal Spean	Siem Reap			18			80.15	1,700		0.39	0.2		15			○	○		
31	Preak Thum	Siem Reap			506			117.9	1,700		0.39	1.7		40	80	0.7	○	○		
32	O Sam Raeng	Siem Reap			149			49.95	1,700		0.39	1.1		10	310	3.75	○	○		
33	Stung Touch	Siem Reap			79			211.6	1,700		0.39	4.5		10	620	3.6	○	○		
34	O Sam Kaong	Siem Reap			334				1,700		0.39						○	○		
35	Stung Chi Kreng	Siem Reap									0.39						○	○		
36	Tum Nup Baraeng	Siem Reap			1,500												○	○		
37	Barray Reservoir	Siem Reap															○	○		
38	Stung Muong No.1	Battambang	Muong District Town	0.4	400	34	34	546	1,800	1,000	0.51	13.9	4	20			○	○		
39	Stung Muong No.2	Battambang	Muong District Town	0.4	400	18.8	18.8	550	2,000	1,000	0.51	14.0	13	4			○	○		
40	O Samrel	Battambang						12									○	○		
41	Ta Taok	Battambang						14									○	○		
42	Kampong Lpov	Battambang						8	2,200	1,000		0.3					○	○		
43	Stung Pursat No.1	Pursat	Pursat Town	1.0	100	40	40	700	1,600	1,000		13.3	4	2			○	○		
44	Stung Prey Klong	Pursat	Phnom Krovanh District Town	0.5	100	20	20	555	1,600	1,000		10.6	3	2			○	○		
45	Stung Prey Klong'	Pursat			886			862	1,600		0.27	11.8		10	950	7.125	○	○		
46	O Pramoe	Pursat			36			75	2,200	1,000		2.9	0.3	20			○	○		
47	Stung Kraing Ponley	Kampong Chhnang			221			483.1	1,600		0.24	5.9		5	570	1.9	○	○		
48	Stung Boribour	Kampong Chhnang			813			791.05	1,600		0.27	10.8		10	180	0.8	○	○		
49	Stung Bammak	Kampong Chhnang			403			392.4	1,600		0.27	5.4		10	210	1.3	○	○		
50	Stung Kbal Siem	Kampong Chhnang							1,600		0.27			10	440	0.75	○	○		
51	Kirrom III	Koh Kong	Phnom Penh / Kampong Speu	80.0	8,342	140	40	98	2,500	1,000		4.7	5	250.36			○	○		
52	Phnom Batou Downstream	Koh Kong	Phnom Penh / Kampong Speu	80.0	4,197	140	44	105	2,500	1,000		5.0	5	100.78			Selected	○		
53	Phnom Tunsang Unstream (5)	Koh Kong	Phnom Penh / Kampong Speu	80.0	3,143	140	2	32	2,500	1,000		1.5	2	188.66			Selected	○		
54	Phnom Tunsang Downstream (5)	Koh Kong	Phnom Penh / Kampong Speu	80.0	3,002	140	7	53	2,500	1,000		2.5	4	90.11			Selected	○		
55	O Sla Upstream	Koh Kong	Phnom Penh / Kampong Speu	80.0	1,953	140	3	54	2,800	1,000		3.1	3	78.15			Selected	○		
56	O Sla Downstream	Koh Kong	Phnom Penh / Kampong Speu	80.0	4,483	140	7	75	2,800	1,000		4.3	5	107.64			○	○		
57	Prek Toek Chhu	Kampot	Kampot Town	1.0	762	15.6	4.8	710	3,500	1,100	0.57	54.0	5	18.28	200	0.15	Selected	○		
58	O Turou Tao	Kampot	Kampot Town	1.0	1,122	13.1	2.7	20	3,500	1,100	0.57	1.5	1	134.73			Selected	○		○
59	Bokor Plateau	Kampot	Kampot Town	1.0	1,000	13.1	2.7	44	3,500	1,100		3.3	3	40			Selected	○		
60	Bokor	Kampot			4,509			14.4	3,500		0.57	0.9		660	800	2.95	○	○		
61	Upper Kamchay	Kampot	Kampot Town	1.0	3,132	26	13	243	3,500	1,100	0.57	18.5	10	37.6			Selected	○		
62	Sare Cheng	Kampot						36									○	○		
63	Tommup Kuon Satv	Kampot			100			77.45	3,500		0.57	2.3		5	225	1.25	○	○	Selected	
64	Snam Prampir	Kampot			101			21.25	3,500		0.57	1.3		10			○	○		
65	Preak Kaoh Touch	Kampot			317			21.65	1,800		0.57	5.4		60	120	0.08	○	○	Selected	
66	Churub Rokar	Kampot, Takeo			119			32.55	1,800		0.57	1.1		15	900	2.2	○	○		
67	Stung Tras	Kampot, Kampong Speu			243			266.1	1,600		0.24	3.2		10	480	5.7	○	○		
68	Stung Sva Slab	Kampong Speu	Phnom Penh / Kampong Speu	80.0	3,804	80	30	205	2,200	1,000		7.8	8	56.66			Selected	○		
69	Takeo Waterfall	Takeo	Takeo Town	1.0	30	40	40	5	1,481	1,000		0.1	0.067	60			○	○		
70	O Chhleung	Takeo			30			5	1,481		0.27	0.1		60			○	○		
71	Khalil Chay	Sihanoukville	Sihanoukville Town	8.0	312	17.1	8.5	45	3,500	1,100	0.51	3.4	3	12.49	190	0.65	Selected	○		

Notes

- 1 Determined by Peak Demand at Load Centre
- 2 Cost does not include financing costs or O & M.
- 3 Projects are in a cascade and development is interdependent
- 4 Production costs determined from 20% discount rate and an operating life of 30 years

Source: Compiled by the JICA Study Team, individual source is given in the rightmost column.

Table AP-A.1.3 List of MHP Sites Identified through Map Study (1/4)

Revision 1 (June 2005)																			Efficiency of Turbine, Generator				0.7
No.	MHP ID No.	Province	Scheme	River	Power (kW) (n=0.7)	C. Area (km ²)	Specific Discharge (m ³ /s/km ²)	Discharge (m ³ /s)	Height (m)			Canal (km)	Access		Village		Coordination		Map No.	Note			
									Total	EL Intake	EL PH		Road	Distance (km)	Name	Distance (km)	X	Y					
1	1-1	Battambang	Tributary of Stung Cra Nhung	Tributary of Stung Cra Nhung	330	244 ¹⁾	0.0020 ⁷⁾	0.488 ⁶⁾	100.0 ⁹⁾	275	175	3.5	B	0.3	Ta Taok Commune, Kampong Lpou Commune etc.	1	263,500	1,373,700	5533				
2	1-2	Battambang	Sangke (D/S)	Stung Sangke	59	696 ¹⁾	0.0017 ⁸⁾	1.150 ¹⁾	7.5 ⁶⁾	-	-	0.98	B	0.5	Ratanak Mondul District Samlout District, etc	15	268,875	1,411,162	5534				
3	1-3	Battambang	Sangke (U/S)	Stung Sangke	85	499 ¹⁾	0.0017 ⁸⁾	0.824 ⁶⁾	15.0 ⁶⁾	-	-	-	B	0.5	Ditto	15	255,200	1,402,400	5534				
4	1-4	Battambang	O Samrel	O Samrel	7	12 ³⁾	0.0030 ⁸⁾	0.036 ¹⁾	28.0 ¹⁾	-	-	-	-	-	Potential Target Villages covered with the scheme 1-1	-	268,866	1,381,692	5534	Meritec Study (2003) [33kW] *3)			
5	1-5	Battambang	Ta Taok	O Chum	29	14 ³⁾	0.0043 ⁸⁾	0.060 ¹⁾	71.4 ¹⁾	-	-	-	-	-	Ditto	-	265,898	1,376,917	5534	Meritec Study (2003) [37.5kW] *3)			
6	1-6	Battambang	Kampong Lpov	Ou Daem Chek	14	8 ³⁾	0.0033 ⁸⁾	0.026 ¹⁾	78.7 ¹⁾	-	-	-	-	-	Ditto	-	271,928	1,383,174	5534	Meritec Study (2003) [31kW] *3)			
7	2-1	Kampong Chhnang	Stung Spean Ta Khum	Stung Spean Ta Khum	14	13 ¹⁾	0.0020 ⁷⁾	0.026 ⁶⁾	80.0 ⁹⁾	-	-	1.2	B	-	No village	-	415,500	1,342,500	5833				
8	2-2	Kampong Chhnang	Stung Oukhliley	Stung Oukhliley	8	14 ¹⁾	0.0020 ⁷⁾	0.028 ⁶⁾	40.0 ⁹⁾	-	-	0.5	B	-	No village	-	421,000	1,333,000	5833				
9	2-3	Kampong Chhnang	Stung Thum	Stung Thum	14	100 ¹⁾	0.0020 ⁷⁾	0.200 ⁶⁾	10.0 ⁹⁾	-	-	1.8	B	-	Kos Khtum	12	429,500	1,332,800	5833				
10	3-1	Kampong Speu	Ou Chambak	Ou Chambak	36	12 ¹⁾	0.0020 ⁷⁾	0.024 ⁶⁾	220.0 ⁹⁾	-	-	1.5	-	-	No village	-	402,500	1,256,000	5831				
11	3-2	Kampong Speu	Ou Ta Saek	Ou Ta Saek	14	10 ¹⁾	0.0020 ⁷⁾	0.020 ⁶⁾	100.0 ⁹⁾	-	-	0.8	B	-	No village	-	402,200	1,248,000	5831				
12	3-3	Kampong Speu	Stung Srae Chhlong	Stung Srae Chhlong	26	12 ¹⁾	0.0020 ⁷⁾	0.024 ⁶⁾	160.0 ⁹⁾	-	-	1.3	B	-	No village	-	401,500	1,245,000	5831				
13	3-5	Kampong Speu	Ou Voa Rovieng	Ou Voa Rovieng	10	35 ¹⁾	0.0020 ⁷⁾	0.070 ⁶⁾	20.0 ⁹⁾	100	80	1	C	-	(No Village ?)	-	402,000	1,281,000	5832	Low water, Low Output			
14	3-6	Kampong Speu	Tributary Stung Areang	Tributary Stung Areang	20	12 ¹⁾	0.0020 ⁷⁾	0.024 ⁶⁾	120.0 ⁹⁾	-	-	1	B	-	No village	-	403,600	1,327,800	5833				
15	4-1	Kampong Thom	O Kmdny	O Kmdny	9	63 ¹⁾	0.0020 ⁷⁾	0.126 ⁶⁾	10.0 ⁹⁾	40	30	1.5	B	0	Village too far	-	565,500	1,414,800	6134				
16	5-1	Kampot	Ou Treb Da	Ou Treb Da	165	40 ¹⁾	0.0050 ⁷⁾	0.200 ⁶⁾	120.0 ⁹⁾	220	100	2	B	-	Stung Chhay (Koh Kong)	-	386,900	1,205,200	5730				
17	5-2	Kampot	Ou TrebDa (Alternative)	Ou Treb Da	247	40 ¹⁾	0.0050 ⁷⁾	0.200 ⁶⁾	180.0 ⁹⁾	220	40	3.6	B	-	Stung Chhay (Koh Kong)	-	386,900	1,205,200	5730				
18	5-3	Kampot	Preak Kaoh Touch	Kaoh Touch	-	22 ⁴⁾	-	0.000 ¹⁾	60.0 ⁴⁾	-	-	-	-	-	Kilou Dabpir village + Kaou Touch (Preak Chek)	-	399,035	1,171,179	5830	MIME List [317kW] (River dried up)			
19	5-4	Kampot	Upper Kamchay Left Tributary A	Prek Tuek Chhu	722	263 ¹⁾	0.0050 ⁷⁾	1.315 ⁶⁾	80.0 ⁹⁾	240	160	3.2	B	-	No Village near, for Kampot	-	401,800	1,198,900	5830				
20	5-5	Kampot	Upper Kamchay Right Tributary B	Prek Tuek Chhu	410	299 ¹⁾	0.0050 ⁷⁾	1.495 ⁶⁾	40.0 ⁹⁾	200	160	3	C	-	No Village near, for Kampot	-	398,800	1,196,000	5830				
21	5-6	Kampot	O Turou Trao	O Turou Trao	55	20 ²⁾	0.0026 ⁸⁾	0.052 ¹⁾	154.3 ¹⁾	-	-	3	B	-	Kampot	-	401,427	1,180,460	5830	Meritec Study (2001) [1.12MW] *2)			
22	5-7	Kampot	O Turou Trao (Alternative)	Small Tributary of Prek Tuek Chhu Bouk Koul Platou	129	34 ¹⁾	0.0040 ⁷⁾	0.135 ⁶⁾	140.0 ⁹⁾	220	80	5.5	-	-	Kampot	-	396,700	1,178,200	5830	Additional Intake site at Bouk Koul Platou			
23	5-8	Kampot	Ou Thum Irrigation Dam	Ou Thum	1	65 ¹⁾	0.0010 ⁷⁾	0.065 ⁶⁾	2.0 ⁷⁾	-	-	0.01	-	-	Koun Sat Village	-	422,200	1,172,000	5830	Existing Dam Head by Dam Up, Pico Hydro			
24	5-9	Kampot	Srae Cheng (Srat Cheng)	Srae Cheng (Srat Cheng)	6	36 ⁴⁾	0.0005 ⁸⁾	0.017 ¹⁾	55.0 ¹⁾	-	-	0.6	-	-	Pong Tuek village, Srae Chaeng, Prey Khley, Kamnab	-	431,151	1,218,070	5831	Height measurement by Altimeter, Low output			
25	6-1	Koh Kong	Preak Koun	Preak Koun	10	35 ¹⁾	0.0040 ⁷⁾	0.140 ⁶⁾	10.0 ⁹⁾	20	10	-	-	-	No Village	-	309,100	1,269,200	5631				
26	6-2	Koh Kong	Trib. Stung Trapeang Rung	Tributary of Stung Trapeang Rung	4	13 ¹⁾	0.0040 ⁷⁾	0.052 ⁶⁾	10.0 ⁹⁾	30	20	-	-	-	Ditto	-	315,000	1,263,200	5631				
27	6-3	Koh Kong	Trib. Preak Santung	Tributary of Preak Santung	14	17 ¹⁾	0.0040 ⁷⁾	0.066 ⁶⁾	30.0 ⁹⁾	50	20	-	-	-	Ditto	-	322,900	1,261,400	5631				
28	6-4	Koh Kong	Preak Santung	Preak Santung	31	28 ¹⁾	0.0040 ⁷⁾	0.112 ⁶⁾	40.0 ⁹⁾	80	40	-	-	-	Ditto	-	327,600	1,265,000	5631				
29	6-5	Koh Kong	Trib. Preak Ta Chan	Tributary Preak Ta Chan	7	12 ¹⁾	0.0040 ⁷⁾	0.048 ⁶⁾	20.0 ⁹⁾	40	20	-	-	-	Ditto	-	310,300	1,243,900	5631				
30	6-6	Koh Kong	Preak Khou Khav	Preak Khou Khav	15	28 ¹⁾	0.0040 ⁷⁾	0.110 ⁶⁾	20.0 ⁹⁾	30	10	0.9	-	-	-	-	300,000	1,237,000	5631				
31	6-7	Koh Kong	Stung Ko	Stung Ko	12	14 ¹⁾	0.0040 ⁷⁾	0.056 ⁶⁾	30.0 ⁹⁾	70	40	-	-	-	No Village	-	306,800	1,229,600	5631				
32	6-8	Koh Kong	Stung Russei-1	Stung Russei	198	90 ¹⁾	0.0040 ⁷⁾	0.360 ⁶⁾	80.0 ⁹⁾	500	420	-	-	-	Ditto	-	330,700	1,323,800	5632				
33	6-9	Koh Kong	Stung Russei-2	Stung Russei	1,690	1540 ¹⁾	0.0040 ⁷⁾	6.160 ⁶⁾	40.0 ⁹⁾	180	140	-	-	-	Ditto	-	294,300	1,313,500	5632				
34	6-10	Koh Kong	Stung Russei-3	Stung Russei	2,585	1570 ¹⁾	0.0040 ⁷⁾	6.280 ⁶⁾	60.0 ⁹⁾	80	20	-	-	-	Ditto	-	291,200	1,303,000	5632				
35	6-11	Koh Kong	Tributary of Stung Russei	Tributary of Stung Russei	72	44 ¹⁾	0.0040 ⁷⁾	0.176 ⁶⁾	60.0 ⁹⁾	300	240	-	-	-	Ditto	-	299,900	1,315,700	5632				
36	6-12	Koh Kong	Tatai (D/S)	Stung Tatai	59	423 ¹⁾	0.0007 ⁸⁾	0.284 ¹⁾	30.2 ¹⁾	-	-	1.5	-	-	Kokir Chrum, Trapeang Chuetrav Villages	-	325,927	1,289,335	5632				
37	6-13	Koh Kong	Tatai (U/S)	Stung Tatai	6	158 ¹⁾	0.0002 ⁸⁾	0.031 ¹⁾	28.0 ¹⁾	-	-	-	-	-	Kandal, Trapeang Khna, Spean Kdar Villages	-	340,963	1,307,608	5632				
38	6-14	Koh Kong	Stung Kep	Stung Kep	549	500 ¹⁾	0.0040 ⁷⁾	2.000 ⁶⁾	40.0 ⁹⁾	140	100	-	-	-	No Village near, 20km 134HHs	-	310,400	1,288,900	5632				
39	6-15	Koh Kong	Stung Sala Munthun	Stung Sala Munthun	417	190 ¹⁾	0.0040 ⁷⁾	0.760 ⁶⁾	80.0 ⁹⁾	220	140	-	-	-	No Village near, 25km 200-300HHs	-	299,800	1,292,500	5632				

Table AP-A.1.3

List of MHP Sites Identified through Map Study (2/4)

Revision 1 (June2005)																			Efficiency of Turbine, Generator				0.7
No.	MHP ID No.	Province	Scheme	River	Power (kW) (η=0.7)	C. Area (km ²)	Specific Discharge (m ³ /s/km ²)	Discharge (m ³ /s)	Height (m)			Canal (km)	Access		Village		Coordination		Map No.	Note			
									Total	EL Intake	EL PH		Road	Distance (km)	Name	Distance (km)	X	Y					
40	6-16	Koh Kong	Kirirom- III (Dam) (China F/S)	3rd Tributary of St. Kaong	828	104 ¹⁾	0.0040 ⁷⁾	0.416 ⁶⁾	290.0 ⁹⁾	320	30	2.2	C	-	-	Grid Connect to Kirirom-I (for Kompong Speu & Phnom Penh)	-	370,200	1,243,500	5731			
41	6-17	Koh Kong	Phnom Batau (Run off-River Type)	3rd Tributary of St. Kaong	359	109 ¹⁾	0.0040 ⁷⁾	0.436 ⁶⁾	120.0 ⁹⁾	160	40	0.8	-	-	-	Grid Connect to Kirirom-I (for Kompong Speu & Phnom Penh)	-	372,000	1,241,800	5731			
42	6-18	Koh Kong	O Sla U/S (Meritec Proposed)	Ou Sla	126	54 ¹⁾	0.0040 ⁷⁾	0.216 ⁶⁾	85.0 ⁹⁾	280	195	2	C	-	-	Kampong Seila	15	377,474	1,243,116	5731	Meritec Study (2001) [1.96MW] *2)		
43	6-19	Koh Kong	O Sla D/S	Ou Sla	283	86 ¹⁾	0.0040 ⁷⁾	0.344 ⁶⁾	120.0 ⁹⁾	140	20	4	-	-	-	Kampong Seila	-	376,880	1,238,770	5731			
44	6-20	Koh Kong	Prek Kampong Leu Tributary	Prek Kampong Leu Tributary	81	37 ¹⁾	0.0040 ⁷⁾	0.148 ⁶⁾	80.0 ⁹⁾	100	20	1.3	C	-	-	Kampong Seila	-	380,000	1,236,000	5731			
45	6-21	Koh Kong	St. Kampong Ta Chev	St. Kampong Ta Chev	144	131 ¹⁾	0.0040 ⁷⁾	0.524 ⁶⁾	40.0 ⁹⁾	120	80	2	C	-	-	No Village	-	376,600	1,259,500	5731			
46	6-22	Koh Kong	Prek Santung	Prek Santung	82	120 ¹⁾	0.0050 ⁷⁾	0.600 ⁶⁾	20.0 ⁹⁾	80	60	1.2	-	-	-	Tuek Lak	-	338,000	1,263,300	5731			
47	6-23	Koh Kong	Stung Dah	Stung Dah	31	91 ¹⁾	0.0050 ⁷⁾	0.453 ⁶⁾	10.0 ⁹⁾	50	40	0.1	B	-	-	No Village, covered with the other scheme	-	345,300	1,260,500	5731			
48	6-24	Koh Kong	Prek Tatai-1	Prek Tatai	530	138 ¹⁾	0.0040 ⁷⁾	0.552 ⁶⁾	140.0 ⁹⁾	580	440	-	-	-	-	Ditto	-	344,000	1,311,000	5732			
49	6-25	Koh Kong	Chay Areng D/S	Stung Chay Areng	15	890 ¹⁾	0.0004 ⁸⁾	0.367 ¹⁾	6.0 ¹⁾	-	-	1.2	B	-	-	Chmnoab, Pralay and Thma Donpov Communes	-	340,171	1,285,782	5732	Access is only by Motor Bike		
50	6-26	Koh Kong	Khang Sa	-	214	78 ¹⁾	0.0040 ⁷⁾	0.312 ⁶⁾	100.0 ⁹⁾	380	280	-	-	-	-	No Village, covered with the other scheme	-	359,800	1,303,300	5732			
51	6-27	Koh Kong	O Toc Thola	O Toc Thola	92	84 ¹⁾	0.0040 ⁷⁾	0.336 ⁶⁾	40.0 ⁹⁾	280	240	-	-	-	-	No Village	-	359,500	1,286,500	5732			
52	6-28	Koh Kong	O Trapang Kholay	O Trapang Kholay	240	73 ¹⁾	0.0040 ⁷⁾	0.292 ⁶⁾	120.0 ⁹⁾	400	280	0.2	-	-	-	Ph. Tap Kholay	-	359,000	1,291,000	5732			
53	6-29	Koh Kong	Trib. Prek Kampong Saom	Trib. Prek Kampong Saom	99	18 ¹⁾	0.0040 ⁷⁾	0.072 ⁶⁾	200.0 ⁹⁾	400	200	-	-	-	-	No Village	-	363,500	1,282,000	5732			
54	6-30	Koh Kong	O Toc Srac	O Toc Srac	59	24 ¹⁾	0.0040 ⁷⁾	0.095 ⁶⁾	90.0 ⁹⁾	340	250	-	-	-	-	Ditto	-	344,800	1,279,200	5732			
55	6-31	Koh Kong	O Ruxay Xroc	O Ruxay Xroc	22	10 ¹⁾	0.0040 ⁷⁾	0.040 ⁶⁾	80.0 ⁹⁾	360	280	-	-	-	-	Ditto	-	342,400	1,278,000	5732			
56	6-32	Kaoh Kong	Stung Kaoh Sla	Stung Kaoh Sla	8	14 ¹⁾	0.0020 ⁷⁾	0.028 ⁶⁾	40.0 ⁹⁾	-	-	1	B	-	-	Ditto	-	402,000	1,232,000	5831			
57	6-33	Kaoh Kong	Tributary Prek Kampong Leu	Tributary Prek Kampong Leu	81	37 ¹⁾	0.0040 ⁷⁾	0.148 ⁶⁾	80.0 ⁹⁾	-	-	0.4	B	-	-	No Target Village, a lot of MHP Schemes near.	-	380,000	1,236,000	5831			
58	6-34	Koh Kong, Kampong Speu	Prek Cong Pong Xom (S)	Prek Cong Pong Xom	22	40 ¹⁾	0.0040 ⁷⁾	0.160 ⁶⁾	20.0 ⁹⁾	60	40	-	-	-	-	No Village	-	377,500	1,276,500	5732			
59	6-35	Kaoh Kong, Kampong Speu	Stung Sva Slab	Stung Sva Slab	56	205 ²⁾	0.0005 ⁸⁾	0.096 ¹⁾	85.0 ²⁾	-	-	1	-	-	-	Chambak	8-15	395,710	1,261,360	5831	Meritec Study (2001) [3.80MW] *2) Almost no water in dry season.		
60	7-1	Kratie	Prek Krieng	Prek Krieng	2	25 ¹⁾	0.0020 ⁷⁾	0.050 ⁶⁾	5.0 ⁹⁾	45	40	0.9	B	4	-	No Village	-	598,300	1,402,000	6134			
61	7-2	Kratie	O Dambal	O Dambal	1	155 ¹⁾	0.0003 ⁸⁾	0.050 ¹⁾	3.6 ¹⁾	-	-	2.3	B	0	-	Ph Prelay Triek	1.5	619,706	1,352,202	6233	JST (2005), x 6 time available if peak generation for 4 hrs		
62	7-3	Kratie	O Dambal Lower	O Dambal	1	212 ¹⁾	0.0003 ⁷⁾	0.068 ⁶⁾	3.0 ⁷⁾	-	-	-	B	0	-	Ph Sre Soach	1.2	617,200	1,347,000	6233	Low output		
63	7-4	Kratie	Prek Kat Dai	Prek Kat Dai	9	50 ¹⁾	0.0025 ⁷⁾	0.125 ⁶⁾	10.0 ⁹⁾	80	70	1.2	B	0	-	Ph Vatt Snuol	3.5	660,700	1,340,700	6233	Low output		
64	7-5	Kratie	Ph Thpong Cham	Prek Kat Dai	-	4 ¹⁾	0.0004 ⁷⁾	0.002 ⁶⁾	5.0 ⁷⁾	-	-	-	A	1	-	Ph Thpong Cham	0	654,000	1,336,200	6233	Existing MHP in Poi Pot regime Assumed almost no water in dry season.		
65	7-6	Kratie	Stung Samleng	Stung Samleng	9	53 ¹⁾	0.0025 ⁷⁾	0.133 ⁶⁾	10.0 ⁹⁾	60	50	2	B	0	-	S'at	1	644,600	1,333,000	6233	Assumed almost no water in dry season.		
66	7-7	Kratie	Prek Prey	Prek Prey	0	165 ¹⁾	0.0000 ⁸⁾	0.007 ¹⁾	5.0 ⁷⁾	-	-	-	A	1.8	-	Prek Prey (4 Army camp' families only)	-	668,328	1,337,375	6333			
67	7-8	Kratie	O Chrei Meing	O Chrei Meing	25	180 ¹⁾	0.0040 ⁸⁾	0.719 ¹⁾	5.0 ⁷⁾	-	-	0.05	A	4.5	-	Cheung Khle	-	664,149	1,335,908	6333	JST (2005), Dam (H=10m, DCL=400m) and Large flood protection will be required.		
68	8-1	Mondul Kiri	O Rang Tributary	O Rang Tributary	5	10 ¹⁾	0.0040 ⁷⁾	0.040 ⁶⁾	20.0 ⁹⁾	200	180	0.5	A	1.5	-	No Village	-	706,100	1,370,700	6333			
69	8-2	Mondul Kiri	Prek Pua	Prek Pua	49	90 ¹⁾	0.0040 ⁷⁾	0.360 ⁶⁾	20.0 ⁹⁾	180	160	1	B	0.8	-	51HHs more than 10km far	-	712,000	1,364,300	6333			
70	8-3	Mondul Kiri	Prek So Long Tributary	Prek So Long Tributary	11	20 ¹⁾	0.0040 ⁷⁾	0.080 ⁶⁾	20.0 ⁹⁾	180	160	0.8	D	-	-	No Village	-	714,500	1,358,000	6333			
71	8-4	Mondul Kiri	Prek So Long Upper	Prek So Long	11	20 ¹⁾	0.0040 ⁷⁾	0.080 ⁶⁾	20.0 ⁹⁾	220	200	1.2	D	-	-	Ditto	-	717,000	1,356,800	6333			
72	8-5	Mondul Kiri	Prek So Long Lower	Prek So Long	42	76 ¹⁾	0.0040 ⁷⁾	0.304 ⁶⁾	20.0 ⁹⁾	140	120	3	B	0	-	Srelavi, Srae Preah	0	713,000	1,350,500	6333			
73	8-6	Mondul Kiri	Prek Te	Prek Te	494	900 ¹⁾	0.0040 ⁷⁾	3.600 ⁶⁾	20.0 ⁹⁾	150	130	2	B	1	-	Chorkcha, Pohoum	8	699,000	1,397,000	6334			
74	8-7	Mondul Kiri	Prek Te Tributary	Prek Te Tributary	41	150 ¹⁾	0.0040 ⁷⁾	0.600 ⁶⁾	10.0 ⁹⁾	140	130	2	B	3	-	No Village	-	692,000	1,405,000	6334			
75	8-8	Mondul Kiri	Prek Chhung	Prek Chhung	21	150 ¹⁾	0.0020 ⁷⁾	0.300 ⁶⁾	10.0 ⁹⁾	90	80	1.5	B	1.5	-	Ditto	-	674,000	1,401,500	6334			
76	8-9	Mondul Kiri	O Bumpa	O Bumpa	33	40 ¹⁾	0.0030 ⁷⁾	0.120 ⁶⁾	40.0 ⁹⁾	280	240	1	B	1.5	-	Potential Target Villages covered with the scheme 8-6	-	717,000	1,385,200	6334			

Table AP-A.1.3

List of MHP Sites Identified through Map Study (3/4)

Efficiency of Turbine, Generator																	0.7			
No.	MHP ID No.	Province	Scheme	River	Power (kW) (η=0.7)	C. Area (km ²)	Specific Discharge (m ³ /s/km ²)	Discharge (m ³ /s)	Height (m)			Canal (km)	Access		Village		Coordination		Map No.	Note
									Total	EL Intake	EL PH		Road	Distance (km)	Name	Distance (km)	X	Y		
77	8-10	Mondul Kiri	O Long Mang	O Long Mang	123	56 ¹⁾	0.0040 ⁷⁾	0.224 ⁶⁾	80.0 ⁹⁾	680	600	4	B	0	Ph Pu Cheng etc.	2	764,000	1,371,000	6433	Access difficult. 13km over mountains
78	8-11	Mondul Kiri	O Dak Dam	O Dak Dam	2	4 ¹⁾	0.0050 ⁸⁾	0.020 ¹⁾	17.0 ¹⁾	-	-	-	A	0	-	-	751,859	1,372,642	6433	A lot of villages, but output poor
79	8-12	Mondul Kiri	O Moleng	O Moleng	82	50 ¹⁾	0.0040 ⁷⁾	0.200 ⁶⁾	60.0 ⁹⁾	600	540	2	A	1.2	Sen Monorom	3	735,000	1,376,200	6433	JICA Mondulkiri Study (2005) [130kW]
80	8-13	Mondul Kiri	O Romis	O Romis	19	35 ¹⁾	0.0040 ⁷⁾	0.140 ⁶⁾	20.0 ⁹⁾	640	620	1	A	0.1	Pu Rotang Sen Monorom	2.5 5	737,500	1,372,500	6433	JICA Mondulkiri Study (2005) [130kW]
81	8-14	Mondul Kiri	Prek Dak Deurr	Prek Dak Deurr	33	60 ¹⁾	0.0040 ⁷⁾	0.240 ⁶⁾	20.0 ⁹⁾	620	600	1	A	1	Pu Rotang Sen Monorom	0.5 8	737,200	1,368,700	6433	JICA Mondulkiri Study (2005) [110kW]
82	8-15	Mondul Kiri	Prek Dak Deurr D/S	Prek Dak Deurr	123	150 ¹⁾	0.0040 ⁷⁾	0.600 ⁶⁾	30.0 ⁹⁾	580	550	3.5	B	0	Pu Rotang Sen Monorom	1.5 8	734,100	1,370,800	6433	c
83	8-16	Mondul Kiri	Bu Sra	Prek Por	70	197 ¹⁾	0.0008 ⁸⁾	0.150 ¹⁾	68.0 ¹⁾	-	-	1	B	0	Busra commune	-	764,312	1,390,088	6434	Meritec (2003) [54kW] *3, 23m & 42m for 1st & 2nd fall. Supply to Busra Commune
84	8-17	Mondul Kiri	O Phlai	O Phlai	91	302 ¹⁾	0.0011 ⁸⁾	0.330 ¹⁾	40.0 ⁷⁾	-	-	1 - 5	A	-	Busra commune	-	758,800	1,387,700	6434	
85	8-18	Mondul Kiri	Prek Rwei	Prek Rwei	27	195 ¹⁾	0.0020 ⁷⁾	0.390 ⁶⁾	10.0 ⁹⁾	330	320	0.6	A	7	Phum Pucheichong, Phum Putang	1.6 2	747,600	1,403,000	6434	
86	8-19	Mondul Kiri	Prek Chbar Lower	Prek Chbar	66	120 ¹⁾	0.0040 ⁷⁾	0.480 ⁶⁾	20.0 ⁹⁾	240	220	1	B	2	No Village	-	727,500	1,412,500	6434	
87	8-20	Mondul Kiri	Prek Chbar Upper	Prek Chbar	33	60 ¹⁾	0.0040 ⁷⁾	0.240 ⁶⁾	20.0 ⁹⁾	320	300	1.5	B	1.5	Ph Trinh Nhang	7	737,500	1,395,500	6434	No Access
88	9-1	Pursat	Xtung Tun Po	Xtung Tun Po	55	101 ¹⁾	0.0040 ⁷⁾	0.404 ⁶⁾	20.0 ⁹⁾	220	200	0.7	-	-	Cat Ong, Ph. Tumpo	-	296,600	1,364,300	5633	
89	9-2	Pursat	Xtung Po Xat	Xtung Po Xat	691	1260 ¹⁾	0.0040 ⁷⁾	5.040 ⁶⁾	20.0 ⁹⁾	100	80	-	-	-	No Village	-	321,000	1,363,000	5633	
90	9-3	Pursat	Xtung Po Xat Trib. Lower	Xtung Po Xat Tributary	140	85 ¹⁾	0.0040 ⁷⁾	0.340 ⁶⁾	60.0 ⁹⁾	200	140	-	-	-	Ditto	-	317,500	1,358,800	5633	a few villages farther than 20km
91	9-4	Pursat	Xtung Po Xat Trib. Upper	Xtung Po Xat Tributary	79	48 ¹⁾	0.0040 ⁷⁾	0.192 ⁶⁾	60.0 ⁹⁾	520	460	-	-	-	Ditto	-	322,500	1,350,000	5633	
92	9-5	Pursat	O Pramiole	Xtung Tun Po	31	75 ³⁾	0.0030 ⁷⁾	0.225 ⁶⁾	20.0 ³⁾			-	-	-	Ditto	-	292,300	1,370,500	5633	Meritec Study (2003) [36kW] *3)
93	9-6	Pursat	O Leach Meas	O Leach Meas	35	29 ¹⁾	0.0030 ⁷⁾	0.086 ⁶⁾	60.0 ⁹⁾	110	50	1	C	-	Ph. Chumnop, Kamraonh, Ph. Rovieng, Veal Angkroeng	-	337,700	1,365,200	5733	
94	9-7	Pursat	Sala Village MHP	?	8	14 ¹⁾	0.0020 ⁷⁾	0.028 ⁶⁾	40.0 ⁹⁾	100	60	2	C	-	Potential Target Villages covered with the scheme 9-6	-	345,000	1,357,000	5733	
95	9-8a	Pursat	Tributary of St. Santre	Tributary of St. Santre	7	24 ¹⁾	0.0020 ⁷⁾	0.048 ⁶⁾	20.0 ⁹⁾	240	220	0.15	C	-	No Village	-	390,200	1,336,500	5733 (a 5732)	
96	9-8b	Pursat	Tributary of St. Santre (Alt)	Tributary of St. Santre	33				100.0 ⁹⁾	240	140	1.7				-	390,200	1,336,500		
97	9-9	Pursat	St. Mongri	St. Mongri	9	32 ¹⁾	0.0020 ⁷⁾	0.064 ⁶⁾	20.0 ⁹⁾	120	100	0.6	C	-	Ditto	-	339,000	1,344,800	5733	
98	9-10	Pursat	St. Kam Rang	St. Kam Rang	5	6 ¹⁾	0.0020 ⁷⁾	0.012 ⁶⁾	60.0 ⁹⁾	180	120	0.9	C	-	Ditto	-	344,000	1,345,000	5733	
99	9-11	Pursat	Upper St. Arai	St. Arai	30	24 ¹⁾	0.0030 ⁷⁾	0.072 ⁶⁾	60.0 ⁹⁾	220	160	0.4	C	-	Ditto	-	347,800	1,339,200	5733	
100	9-12	Pursat	Lower St. Arai	St. Arai	97	235 ¹⁾	0.0030 ⁷⁾	0.705 ⁶⁾	20.0 ⁹⁾	80	60	0.7	C	-	Ditto	-	359,000	1,345,000	5733	
101	9-13	Pursat	St. Sa	St. Sa	31	15 ¹⁾	0.0030 ⁷⁾	0.045 ⁶⁾	100.0 ⁹⁾	220	120	1	C	-	Ditto	-	351,500	1,333,000	5733	
102	9-14	Pursat	St. Peam	St. Peam	62	150 ¹⁾	0.0030 ⁷⁾	0.450 ⁶⁾	20.0 ⁹⁾	140	120	1.8	B	-	Ditto	-	372,500	1,329,500	5733	
103	9-15	Pursat	St. Svay Mul	St. Svay Mul	28	68 ¹⁾	0.0030 ⁷⁾	0.204 ⁶⁾	20.0 ⁹⁾	140	120	1	B	-	Ditto	-	373,500	1,336,700	5733	
104	9-16	Pursat	Ou Phleung	Ou Phleung	22	20 ¹⁾	0.0020 ⁷⁾	0.040 ⁶⁾	80.0 ⁹⁾			0.5	B	-	Ditto	-	408,200	1,340,000	5833	
105	9-17	Pursat	Stung kaoh	Stung Kaoh	21	15 ¹⁾	0.0020 ⁷⁾	0.030 ⁶⁾	100.0 ⁹⁾			1.5	B	-	Ditto	-	410,200	1,341,000	5833	
106	9-18	Pursat / Kampong Chhnang	Stung Preak Choar	Preak Choar	15	56 ¹⁾	0.0020 ⁷⁾	0.112 ⁶⁾	20.0 ⁹⁾	-	-	0.2	B	-	Chheu Tom	13	410,700	1,345,300	5833	
107	9-19	Pursat	Xtung Cran	Xtung Cran	25	90 ¹⁾	0.0020 ⁷⁾	0.180 ⁶⁾	20.0 ⁹⁾	520	500	2	B	0.5	-	1	305,900	1,334,900	5633	
108	10-1	Ratanak Kiri	O Kachan	O Kachan	32	31 ⁴⁾	0.0112 ⁸⁾	0.350 ¹⁾	13.2 ¹⁾	-	-		A	0.5	Kachan II	-	715,659	1,514,518	6336	MIME List [82kW] *2)
109	10-2	Ratanak Kiri	O Katieng	O Katieng	40	43 ⁴⁾	0.0096 ⁸⁾	0.410 ¹⁾	14.1 ¹⁾	-	-		A	0.5	Katieng I, II	-	714,128	1,511,427	6336	Meritec Study (2001) [1076kW] *2), MIME List [224kW]
110	10-3	Ratanak Kiri	O Katieng (D/S)	O Katieng	126	43 ¹⁾	0.0096 ⁸⁾	0.410 ¹⁾	44.7 ¹⁾	-	-	2-3	B	0.5-3	Katieng I & II, Kam Pleng, Kateng	-	714,128	1,511,427	6336	New Proposed Scheme by JICA Study Team
111	10-4	Ratanak Kiri	Ta Ang	O Cheng	12	19 ⁴⁾	0.0037 ⁸⁾	0.070 ¹⁾	25.0 ³⁾	190	165	1	A	1	Ta Ang Muoy, Ta Kab, Sek	-	709,708	1,511,423	6336	Meritec Study (2003) [10kW] *3)
112	10-5	Ratanak Kiri	Prek Banpong	Prek Banpong	42	38 ¹⁾	0.0040 ⁷⁾	0.152 ⁶⁾	40.0 ⁹⁾	220	180	2	C	-	Ph Banpong	12	715,200	1,564,700	6337	
113	10-6	Ratanak Kiri	Tributary of prek Lalay	Tributary of prek Lalay	23	42 ¹⁾	0.0040 ⁷⁾	0.168 ⁶⁾	20.0 ⁹⁾	180	160	1	C	-	No Village	-	709,500	1,564,000	6337	
114	10-7	Ratanak Kiri	O Houei Lalay	O Houei Lalay	198	180 ¹⁾	0.0040 ⁷⁾	0.720 ⁶⁾	40.0 ⁹⁾	180	140	1.7	C	-	Ditto	-	696,800	1,572,000	6337	
115	10-8	Ratanak Kiri	Tributary of o Houei Lalay	Tributary of o Houei Lalay	14	13 ¹⁾	0.0040 ⁷⁾	0.052 ⁶⁾	40.0 ⁹⁾	200	160	0.6	B	4	Ditto	-	693,200	1,571,000	6337	
116	10-9	Ratanak Kiri	O Chum I	O Chum	93	23 ²⁾	0.0661 ⁸⁾	1.500 ¹⁰⁾	9.0 ²⁾	-	-	-	A	0	Ta Long (Tharang Chong), Ou Chum, Svay	-	716,437	1,524,726	6436	Meritec Study (2001) [74kW] *2)

Table AP-A.1.3

List of MHP Sites Identified through Map Study (4/4)

Efficiency of Turbine, Generator																			0.7	
No.	MHP ID No.	Province	Scheme	River	Power (kW) ($\eta=0.7$)	C. Area (km ²)	Specific Discharge (m ³ /s/km ²)	Discharge (m ³ /s)	Height (m)			Canal (km)	Access		Village		Coordination		Map No.	Note
									Total	EL Intake	EL PH		Road	Distance (km)	Name	Distance (km)	X	Y		
117	10-10	Ratanak Kiri	Bay Srok	O Sien Ler (O Paling Thom)	66	115 ⁴⁾	0.0036 ⁸⁾	0.410 ¹⁾	23.3 ¹⁾	176	152.7	0.7	B	0	Bay Srok, New Ka Laeng, New Sayos	-	726,215	1,503,449	6436	Meritec Study (2003) [78kW] *3)
118	10-11	Ratanak Kiri	O Ta Phlai	O Ta Phlai	26	62 ¹⁾	0.0030 ⁷⁾	0.186 ⁶⁾	20.0 ⁹⁾	200	180	0.6	B	1	Ping, Prak	2	728,500	1,531,700	6436	
119	10-12	Ratanak Kiri	O Pyol	O Pyol	11	14 ¹⁾	0.0093 ⁸⁾	0.130 ¹⁾	12.6 ⁹⁾	-	-	-	-	-	Ka Chut	-	752,917	1,538,257	6436	
120	10-13	Ratanak Kiri	Prek Liang	Prek Liang	768	700 ¹⁾	0.0040 ⁷⁾	2.800 ⁶⁾	40.0 ⁹⁾	200	160	2	B	15	Ta Ngach, Ke Kuong	7.5	742,500	1,576,500	6437	
121	10-14	Ratanak Kiri	Stung Khampha	Stung Khampha	549	250 ¹⁾	0.0040 ⁷⁾	1.000 ⁶⁾	80.0 ⁹⁾	260	180	1.5	B	5	No Village	-	728,500	1,578,300	6437	No demand
122	11-1	Stung Treng	O Baign Kla D/S	O Baign Kla	7	35 ¹⁾	0.0060 ⁸⁾	0.210 ¹⁾	5.0 ⁷⁾	-	-	1.2	-	-	Srae Krasan	-	607,817	1,475,073	6135	
123	11-2	Stung Treng	O Siembok	O Siembok	27	400 ¹⁾	0.0020 ⁷⁾	0.800 ⁶⁾	5.0 ⁹⁾	65	60	2	B	0	Doung	2.5	582,200	1,479,200	6135	
124	11-3	Stung Treng	O Lung	O Lung	28	405 ¹⁾	0.0020 ⁷⁾	0.810 ⁶⁾	5.0 ⁹⁾	55	50	1.5	B	3	Tonsang, Siem Bouk	5.5	590,900	1,465,700	6135	
125	11-4	Stung Treng	Tributary of O Talas	Tributary of O Talas	2	16 ¹⁾	0.0020 ⁷⁾	0.032 ⁶⁾	10.0 ⁹⁾	90	80	2	B	2.7	No Village	-	579,700	1,540,300	6136	Assumed almost no water in dry season.
126	11-5	Stung Treng	O Kong Kang	O Kong Kang	3	22 ¹⁾	0.0020 ⁷⁾	0.043 ⁶⁾	10.0 ⁹⁾	110	100	1	B	0	Ditto	-	569,200	1,522,700	6136	
127	11-6	Stung Treng	O Trel	O Trel	5	33 ¹⁾	0.0020 ⁷⁾	0.066 ⁶⁾	10.0 ⁹⁾	100	90	1.6	B	3.5	Ditto	-	579,100	1,511,400	6136	
128	11-7	Stung Treng	O Kaak	O Kaak	1	18 ¹⁾	0.0020 ⁷⁾	0.036 ⁶⁾	5.0 ⁹⁾	60	55	0.5	A	5.5	Ditto	-	604,200	1,508,300	6136	
129	11-8	Stung Treng	O Chap	O Chap	1	15 ¹⁾	0.0020 ⁷⁾	0.030 ⁶⁾	5.0 ⁹⁾	55	50	1.4	B	1	Ditto	-	622,700	1,493,700	6136	Assumed almost no water in dry season.
130	11-9	Stung Treng	O Chrop	O Chrop (O Samtit)	1	16 ¹⁾	0.0019 ⁸⁾	0.030 ¹⁾	5.0 ⁷⁾	-	-	0.8	A	0.5	Kirivongsa Leu	-	642,492	1,488,053	6235	
131	11-10	Stung Treng	O Chrolong	O Chrolong (O Sralang)	10	128 ¹⁾	0.0025 ⁸⁾	0.320 ¹⁾	4.8 ¹⁾	-	-	2.4	B	0	O Ruessei Kandal	0	619,514	1,476,863	6235	
132	11-11	Stung Treng	Prek Khimin	Prek Khimin	4	32 ¹⁾	0.0020 ⁷⁾	0.064 ⁶⁾	10.0 ⁹⁾	65	55	1.8	B	3.5	No Village	-	623,300	1,529,400	6236	
133	11-12	Stung Treng	Prek Kmeng	Prek Kmeng	1	11 ¹⁾	0.0020 ⁷⁾	0.022 ⁶⁾	5.0 ⁹⁾	55	50	0.8	B	2	Ditto	-	628,000	1,504,000	6236	Proposed by DIME, Survey by JST (2005), Low Potential
134	11-13	Stung Treng	Tributary of Stung Molu	Tributary of Stung Molu	58	47 ¹⁾	0.0030 ⁷⁾	0.141 ⁶⁾	60.0 ⁹⁾	160	100	1	A	12	Ditto	-	658,000	1,585,000	6237	
135	11-14	Stung Treng	Tributary of Tonle Kong	Tributary of Tonle Kong	6	14 ¹⁾	0.0030 ⁷⁾	0.042 ⁶⁾	20.0 ⁹⁾	100	80	0.8	A	3.5	Ditto	-	658,200	1,598,500	6237	
136	11-15	Stung Treng	Tributary of Stung Tin Hiang	Tributary of Stung Tin Hiang	4	20 ¹⁾	0.0030 ⁷⁾	0.060 ⁶⁾	10.0 ⁹⁾	90	80	0.8	C	-	Ditto	-	637,000	1,591,200	6237	
137	11-16	Stung Treng	O Pou Chhuk	O Pou Chhuk	68	62 ¹⁾	0.0040 ⁷⁾	0.248 ⁶⁾	40.0 ⁹⁾	240	200	1.5	B	2	Ditto	-	683,500	1,563,800	6337	Proposed by DIME, Survey by JST (2005)
138	11-17	Stung Treng	O Chrum	O Chrum	13	12 ¹⁾	0.0040 ⁷⁾	0.048 ⁶⁾	40.0 ⁹⁾	220	180	0.3	B	0	Ditto	-	673,000	1,577,300	6337	
139	11-18	Stung Treng	Tributary of O Chrum	Tributary of O Chrum	12	11 ¹⁾	0.0040 ⁷⁾	0.044 ⁶⁾	40.0 ⁹⁾	240	200	0.8	B	0.5	Ditto	-	669,300	1,579,000	6337	
140	11-19	Stung Treng	O Smang	O Smang	73	265 ¹⁾	0.0020 ⁷⁾	0.530 ⁶⁾	20.0 ⁹⁾	120	100	2.5	-	-	-	-	674,500	1,566,700	6337	
141	12-1	Shihanouk Ville	Kbal Chay W.F.	Preak Tuek Sab	28	55 ¹⁾	0.0050 ⁷⁾	0.273 ⁶⁾	15.0 ⁹⁾	30	15	0.5	-	-	Kbal Chay W.F. Tourist Spot	-	348,300	1,179,900	5730	MIME/JICA Study *11) 110kw
142	13-1	Preah Vihear	Tributary of O Kdak	Tributary of O Kdak	73	38 ¹⁾	0.0020 ⁷⁾	0.076 ⁶⁾	140.0	240	100	2	A	10	Sralay, Chhuk, Baribour	10	486,600	1,519,800	5936	
143	14-1	Siem Riap	Stung Siem Reap U/S	Stung Siem Reap U/S	73	84 ¹⁾	0.0042 ¹⁾	0.353 ⁶⁾	30.0 ¹⁾	-	-	-	B	1.5	Preas Anghom, etc	10	403,200	1,499,600	5836	
144	14-2	Siem Riap	Stung Siem Reap D/S	Stung Siem Reap D/S	348	115 ¹⁾	0.0042 ¹⁾	0.483 ⁶⁾	105.0 ¹⁾	-	-	-	B	0.2	Khnar Roveas, Khun Ream, etc	10	402,900	1,501,600	5836	
145	14-3	Siem Riap	Ou Andong Thna	Ou Andong Thna	7	25 ¹⁾	0.0042 ¹⁾	0.105 ⁶⁾	10.0 ⁹⁾	70	60	2	B	2	Sakmot	8	393,500	1,538,200	5836	MIME/JICA Study *11) 1,200kw

Sources:

- 1) JICA Study Team (JST) Surveyed
- 2) "Pipeline Development Program of Small Hydropower Project in Cambodia", WB / Meritec, (2001).
- 3) "Pre-Investment Study of Community-Scale Hydro Projects, Cambodia", NZ MoFA&T, Meritec (2003).
- 4) MIME
- 5) SEILA GIS Data Base
- 6) Estimated figures

- 7) Assumed
- 8) Calculated from surveyed value
- 9) JST checked by Topo Map.
- 10) Eye measurement
- 11) "Basic Study for Mini-Hydropower Project for Rural Electrification - in the Province of Siem Reap Cambodia", MIME, JICA/KCEC, (2005)

Notes:

- A : National road, Wide road
- B : Small road or foot path
- C : No access road
- D : Unidentified road

*1 : Village name unconfirmed

Table AP-A.1.4 Details of Selected 44 Micro Hydro Schemes (1/2)

No	MHP Reference No	ID No. of RE Scheme	Name of RE Scheme	Target Villages					Micro Hydro						Remarks			
				Sub No	Province	District	Commune Name	Village Name	ID No. by Sella ¹⁾	Potential Dry Season Power (kW)	Nos. of house-holds	Nos. of HH to be Electrified	Total Demand incl. loss (kW)	Backup Capacity P _{max} (kW)		Length of MV Trans. Lines (km)		
1*	1-2	HB0209-01	Sangka D/S	1	Battambang	Rotanak Mondul	Treang	Chen Montrei	2070403	59	6,786	5429	706	562	115.0	Hybrid with Biomass		
	1-3	HB0209-02	Sangka U/S	2	Battambang	Rotanak Mondul	Treang	Kchea	2070401	85								
			3	Battambang	Rotanak Mondul	Treang	Phecheav	2070402										
			4	Battambang	Rotanak Mondul	Treang	Chi Sang	2070404										
			5	Battambang	Rotanak Mondul	Treang	Svay Sa	2070406										
			6	Battambang	Rotanak Mondul	Treang	Ta Krok	2070407										
			7	Battambang	Rotanak Mondul	Phloem Meas	Chi Pan	2070304										
			8	Battambang	Rotanak Mondul	Phloem Meas	Ou Treng	2070305										
			9	Battambang	Rotanak Mondul	Phloem Meas	Tuck Sab	2070303										
			10	Battambang	Rotanak Mondul	Phloem Meas	Sek Sak	2070302										
			11	Battambang	Rotanak Mondul	Phloem Meas	Phloem Meas	2070301										
			12	Battambang	Rotanak Mondul	Phloem Meas	Ou Lman	2070307										
			13	Battambang	Samlout	Mean Cheay	Sre Sda	2090401										
			14	Battambang	Samlout	Mean Cheay	Sre Chi Pao	2090403										
			15	Battambang	Samlout	Mean Cheay	Ambob	2090405										
			16	Battambang	Samlout	Mean Cheay	Ta Non	2090406										
			17	Battambang	Samlout	Mean Cheay	Kampong Tuk	2090402										
			18	Battambang	Rotanak Mondul	Phloem Meas	Ou Du	2070306										
			19	Krong Paolin	Paolin	Ou Tavau	Kra Chab	24010206										
			20	Battambang	Samlout	Ou Samre	Ou Samre	2090206										
			21	Battambang	Samlout	Ou Samre	Ou Ramech Leu	2090202										
			22	Battambang	Samlout	Ou Samre	Ou Samre Leu	2090209										
			23	Battambang	Samlout	Ou Samre	Ou Ramech Kraom	2090201										
			24	Battambang	Samlout	Ou Samre	Chamlang Rameang Kra	2090203										
			25	Battambang	Samlout	Ou Samre	Chamlang Rameang Kra	2090204										
			26	Battambang	Samlout	Mean Cheay	Kam Chat	2090404										
			27	Battambang	Samlout	Ta Sanch	Donn Treck	2090702										
			28	Battambang	Samlout	Ta Sanch	Prey Ramech	2090705										
			29	Battambang	Samlout	Ta Sanch	Ou Sagot	2090703										
			30	Battambang	Samlout	Ta Sanch	Ou Tonim	2090704										
			31	Battambang	Samlout	Ta Sanch	Aeloug Peak	2090701										
			32	Battambang	Samlout	Ta Sanch	Ta Sanch Khang Chhuang	2090706										
			33	Battambang	Samlout	Ta Sanch	Ta Sanch Khang Thong	2090707										
			34	Battambang	Samlout	Sung	Kam Chhang	2090603										
			35	Battambang	Samlout	Sung	Shoung Muoy	2090607										
			36	Battambang	Samlout	Sung	Shoung Pir	2090608										
			37	Battambang	Samlout	Sung	Kandal	2090602										
			38	Battambang	Samlout	Sung	Sre Reach	2090606										
			39	Battambang	Samlout	Samlout	Bueng Run	2090506										
			40	Battambang	Samlout	Samlout	Kamrat	2090502										
			41	Battambang	Samlout	Samlout	Samlout	2090504										
			42	Battambang	Samlout	Sung	Chamkar Chik	2090601										
			43	Battambang	Samlout	Samlout	Chhar Rokat	2090501										
			44	Battambang	Samlout	Samlout	Sre Andong Moy	2090505										
			45	Battambang	Samlout	Samlout	Ou Chhab	2090503										
2*	1-2	HB0209-03	Sangka D/S Alternative	1	Battambang	Rotanak Mondul	Phloem Meas	Phloem Meas	2070301	59	1,324	1059	138	79	13.0	Small scale of scheme 1 Target village overlapped Hybrid with Biomass		
			2	Battambang	Rotanak Mondul	Phloem Meas	Sek Sak	2070302										
			3	Battambang	Rotanak Mondul	Phloem Meas	Tuck Sab	2070303										
			4	Battambang	Rotanak Mondul	Phloem Meas	Ou Treng	2070305										
			5	Battambang	Rotanak Mondul	Phloem Meas	Chi Pan	2070304										
			6	Battambang	Rotanak Mondul	Treang	Phecheav	2070402										
			7	Battambang	Rotanak Mondul	Treang	Kchea	2070401										
3*	10-10	MH1605-02	Bay Srok	1	Ratanak Kiri	Lumphat	Ka Laeng	Bay Srok	16050204	65	560	448	58	0	3.0	Target village		
			2	Ratanak Kiri	Lumphat	Ka Laeng	New Ka Laeng	16050205										
			3	Ratanak Kiri	Lumphat	Ka Laeng	New Sayon	16050206										
			4	Ratanak Kiri	Lumphat	Ka Laeng	New Sayon	16050206										
4*	8-17	MH1104-01	Bu Sra	1	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Muoy	11040401	91	899	719	93	2	25.0	Use Water Fall or O Phlai River		
			2	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Pir	11040402										
			3	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Bei	11040403										
			4	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Baen	11040404										
			5	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Pram	11040405										
			6	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Pramuoy	11040406										
			7	Mondul Kiri	Pech Chenda	Bu Sra	Phum Lekh Prampri	11040407										
			8	Mondul Kiri	Pech Chenda	Srae Ampum	Phum Lekh Muoy	11040301										
			9	Mondul Kiri	Pech Chenda	Srae Ampum	Phum Lekh Pir	11040302										
			10	Mondul Kiri	Pech Chenda	Srae Ampum	Phum Lekh Bei	11040303										
5*	6-19	MH0908-01	O Sla D/S	1	Koh Kong	Kampong Seila	Kampong Seila	Krang at	9080202	283	1,249	999	130	0	15.0			
			2	Koh Kong	Kampong Seila	Kampong Seila	Cham Sei	9080201										
			3	Koh Kong	Kampong Seila	Kampong Seila	Vyal	9080204										
			4	Koh Kong	Kampong Seila	Kampong Seila	Thmei	9080203										
6*	9-1	MH1506-02	Xtong Tun Po	1	Pursat	Vyal Veang	Pramuoy	Sveng Thmei	15060403	55	451	361	47	0	11.0			
			2	Pursat	Vyal Veang	Pramuoy	Tumpor	15060405										
			3	Pursat	Vyal Veang	Pramuoy	Pramuoy	15060404										
7*	5-9	HB0704-01	Srae Cheng	1	Kampot	Chum Kiri	Srae Chueng	Pong Tuk	7040404	6	284	227	30	24	8.0	Landmine Hybrid with Biomass		
8*	6-12	MH0907-01	Tatai D/S	1	Koh Kong	Thma Bang	Ruessei Chum	Kokir Chum	9070404	62	155	124	16	0	10.0			
9*	1-1	MH0209-01	Tributary Stung Cra Nhung	2	Koh Kong	Thma Bang	Ruessei Chum	Trapeang Chheu Trae	9070403									
			1	Battambang	Samlout	Ta Taek	Peam Ta	2090104	330	844	675	88	0	33.0				
			2	Battambang	Samlout	Ta Taek	Ou Treang	2090103										
			3	Battambang	Samlout	Ta Taek	Vyal Rokeum	2090108										
			4	Battambang	Samlout	Ta Taek	Ou Nonoung	2090101										
			5	Battambang	Samlout	Ta Taek	Ta Tak	2090107										
			6	Battambang	Samlout	Ta Taek	Peam	2090105										
			7	Battambang	Samlout	Ta Taek	Ou Ta Taek	2090106										
			8	Battambang	Samlout	Ta Taek	Phum Rai	2090109										
			9	Battambang	Samlout	Kampong Lpou	Ou Deum Chok	2090302										
			10	Battambang	Samlout	Kampong Lpou	Svay Chum	2090301										
			11	Battambang	Samlout	Kampong Lpou	Ou Chum Leu	2090306										
			12	Battambang	Samlout	Kampong Lpou	Ou Chum Kandal	2090304										
		13	Battambang	Samlout	Kampong Lpou	Kandal	2090307											
10*	9-6	MH1504-01	O Leach Meas	14	Battambang	Samlout	Kampong Lpou	Ou Chom Kraom	2090305									
			1	Pursat	Phnum Kravanh	Samraeng	Reveang	15040710	35	164	131	17	0	13.0				
			2	Pursat	Phnum Kravanh	Samraeng	Ougheang	15040711										
11*	8-5	MH1101-01	Prek So Long Lower	1	Mondul Kiri	Kaey Seima	Srae Kham	Siedevi	11010403	42	286	229	30	0	14.0			
			2	Mondul Kiri	Kaey Seima	Srae Preah	Srae Preah	11010505										
			3	Mondul Kiri	Kaey Seima	Srae Kham	Srae Kham	11010407										
			4	Mondul Kiri	Kaey Seima	Srae Kham	Stompil	11010404										
			5	Mondul Kiri	Kaey Seima	Srae Preah	Pa Char	11010502										
12*	2-3	MH0408-01	Stung Thum	1	Kampong Cham	Tuek Phos	Chiech	Kon Kham	4080211	14	107	86	11	0	2.5			
13*	5-1	MH1002-01	Ou Treb Da	1	Krong Preah Sihanouk	Prey Nib	Cheung Kou	Aeang Krapiou	18020407	165	61	49	6	0	8.0			
14*	8-12	MH1105-01	O Moking	1	Mondul Kiri	Saen Monourom	Monourom	Deum Sril	11050101	82	1,434	1147	149	15	5.0		B/D on going by Japanese Grant Back up necessary	
15*	8-13	MH1105-02	O Koms	2	Mondul Kiri	Saen Monourom	Monourom	Chrey Sam	11050102	19				1.5				
16*	8-14	MH1105-03	Prek Dak Deurr	3	Mondul Kiri	Saen Monourom	Sokh Dom	Mean Leuph	11050201	33				9.0				
17*	8-15	MH1105-04	Prek Dak Deurr D/S	4	Mondul Kiri	Saen Monourom	Sokh Dom	Dakh Kraom	11050202	206	1,434	1147	149	0	4.5	Will be sent to Seimonourom mini-grid. The villages with "*" were not included in the demand case. They are a little far from the site.		
			5	Mondul Kiri	Saen Monourom	Sokh Dom	Svay Chek	11050203										
			6	Mondul Kiri	Saen Monourom	Sokh Dom	Laeng	11050204										
			7	Mondul Kiri	Saen Monourom	Spean Mean Chey	Ou Spean	11050301										
			8	Mondul Kiri	Saen Monourom	Spean Mean Chey	Chambak	11050302										
			9	Mondul Kiri	Saen Monourom	Spean Mean Chey	Kandal	11050303										
			10	Mondul Kiri	Saen Monourom	Spean Mean Chey	Chamkar Tae	11050304										
			11	Mondul Kiri	Saen Monourom	Romeneia	Pa Tang	11050402										
			12	Mondul Kiri	Saen Monourom	Romeneia	Pa Tang *	11050401										
			13	Mondul Kiri	Saen Monourom	Romeneia	Pa Tang *	11050403										
			14	Mondul Kiri	Saen Monourom	Romeneia	Srae P*	11050404										
	18*	10-2	MH1605-01	O Kating	1	Ratanak Kiri	Lumphat	La Bang Muoy	Ka Treng	16050303	40	295	236	31	0		6.5	By UNIDO
			2	Ratanak Kiri	Lumphat	La Bang Muoy	Ka Lang	16050304										
			3	Ratanak Kiri	Lumphat	La Bang Muoy	Kam Phleng	16050301										
		4	Ratanak Kiri	Lumphat	La Bang Pir	Ka Tame	16050401											

Table AP-A.1.4 Details of Selected 44 Micro Hydro Schemes (2/2)

No	MHP Refer ence No.	ID No. of RE Scheme	Name of RE Scheme	Target Villages					ID No. by Seila ¹⁾	Micro Hydro					Remarks		
				Sub No.	Province	District	Commune Name	Village Name		Potential Dry Season Power (kW)	Nos. of house- holds	Nos. of HH to be Electrified	Total Demand incl. loss (kW)	Backup Capacity P _{max} (kW)		Length of MV Trans. Lines (km)	
19*	6-35	HB0506-01	Stung Sva Slab	1	Kampong Speu	Phnum Sraoch	Chambak	Krang Chek	5060101	56	665	532	69	13	12.0	Dry season little water Hybrid with Biomass	
				2	Kampong Speu	Phnum Sraoch	Chambak	Beng	5060102								
				3	Kampong Speu	Phnum Sraoch	Chambak	Chambak	5060104								
				4	Kampong Speu	Phnum Sraoch	Chambak	Thmei	5060103								
20*	14-1	MH1713-01	Stung Siem Reap U/S	1	Siem Reap	Svay Leu	Khang Phnum	Preas Angthom	17130308	73	604	483	63	0	23.0	MIME/JICA Study on going Sightseeing Spot	
				2	Siem Reap	Svay Leu	Khang Phnum	Thmey	17130307								
				3	Siem Reap	Svay Leu	Khang Phnum	Popel	17130306								
				4	Siem Reap	Svay Leu	Khang Phnum	Khla Khnum	17130302								
				5	Siem Reap	Svay Leu	Khang Phnum	Anlong Thum	17130305								
				6	Siem Reap	Svay Leu	Khang Phnum	Thma Chruoth	17130303								
				7	Siem Reap	Svay Leu	Khang Phnum	Sangkae Lak	17130304								
				8	Siem Reap	Svay Leu	Khang Phnum	Ta Penh	17130301								
21*	14-2	MH1703-01	Stung Siem Reap D/S	1	Siem Reap	Banteay Srei	Khun Ream	Khmar Rovass	17030201	348	3,697	2958	385	37	55.0	MIME/JICA Study on g Back up necessary TL from Thai ?	
				2	Siem Reap	Banteay Srei	Khun Ream	Khun Ream	17030203								
				3	Siem Reap	Banteay Srei	Khun Ream	Kamprum	17030202								
				4	Siem Reap	Banteay Srei	Khun Ream	Chukser	17030204								
				5	Siem Reap	Banteay Srei	Khmar Sanday	Toul Kralanh	17030106								
				6	Siem Reap	Banteay Srei	Khmar Sanday	Banteay Srei	17030101								
				7	Siem Reap	Banteay Srei	Khmar Sanday	Kakos Chum	17030105								
				8	Siem Reap	Banteay Srei	Khmar Sanday	Khmar	17030102								
				9	Siem Reap	Banteay Srei	Khmar Sanday	Prei	17030103								
				10	Siem Reap	Banteay Srei	Khmar Sanday	Sanday	17030104								
				11	Siem Reap	Banteay Srei	Preak Dak	Ta Koh	17030305								
				12	Siem Reap	Banteay Srei	Thaeng	Srah Khvor	17030604								
				13	Siem Reap	Banteay Srei	Thaeng	Kulen Thmey	17030605								
				14	Siem Reap	Banteay Srei	Thaeng	Thaeng Lech	17030602								
				15	Siem Reap	Banteay Srei	Thaeng	Thaeng Kasut	17030601								
				16	Siem Reap	Banteay Srei	Thaeng	Vsoat	17030603								
				17	Siem Reap	Banteay Srei	Rumchek	Roveng Ta Tum	17030403								
				18	Siem Reap	Banteay Srei	Rumchek	Rumchek	17030401								
				19	Siem Reap	Banteay Srei	Rumchek	Sala Kravan	17030402								
22	8-6	MH1101-02	Prek Te	1	Mondul Kiri	Kaev Seima	Srae Chhuk	Chochcha	11010302	494	1,101	881	115	0	27.0		
				2	Mondul Kiri	Kaev Seima	Chong Phlah	Pohom	11010102								
				3	Mondul Kiri	Kaev Seima	Me Mang	Tout	11010205								
				4	Mondul Kiri	Kaev Seima	Me Mang	Pognov	11010202								
				5	Mondul Kiri	Kaev Seima	Me Mang	Pongol	11010201								
				6	Mondul Kiri	Kaev Seima	Me Mang	Pocha	11010203								
				7	Mondul Kiri	Kaev Seima	Me Mang	Pokes	11010204								
				8	Mondul Kiri	Kaev Seima	Chong Phlah	Putang	11010101								
				9	Mondul Kiri	Kaev Seima	Chong Phlah	Khong	11010103								
23	10-13	MH1608-01	Prek Liang	1	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Ta Ngech	16080207	768	1,014	811	105	0	42.0		
				2	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Ke Kaong	16080206								
				3	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Phav	16080208								
				4	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Pha Yang	16080205								
				5	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Sieng Say	16080204								
				6	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Kaoh Pong	16080203								
				7	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Tumpoon Rosing Thum	16080201								
				8	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Tumpoon Rosing Thum	16080209								
				9	Ratanak Kiri	Ta Veang	Ta Veang Kraom	Veng Chan	16080210								
				10	Ratanak Kiri	Ta Veang	Ta Veang Leo	Ta Veang	16080111								
				11	Ratanak Kiri	Ta Veang	Ta Veang Leo	Phlaen Touch	16080110								
				12	Ratanak Kiri	Ta Veang	Ta Veang Leo	Saah	16080106								
				13	Ratanak Kiri	Ta Veang	Ta Veang Leo	Ke Kaong	16080107								
				14	Ratanak Kiri	Ta Veang	Ta Veang Leo	Phlaen Thum	16080109								
				15	Ratanak Kiri	Ta Veang	Ta Veang Leo	Rieng Vinh	16080108								
				16	Ratanak Kiri	Ta Veang	Ta Veang Leo	Bangkot	16080105								
				17	Ratanak Kiri	Ta Veang	Ta Veang Leo	Ta Bok	16080104								
				18	Ratanak Kiri	Ta Veang	Ta Veang Leo	Chay	16080103								
				19	Ratanak Kiri	Ta Veang	Ta Veang Leo	Chan	16080102								
24	6-22	MH0907-02	Prek Santung	1	Koh Kong	Thma Bang	Chi Phat	Chi Phat	9070601	82	491	393	51	0	12.0		
				2	Koh Kong	Thma Bang	Chi Phat	Sam Lort	9070604								
				3	Koh Kong	Thma Bang	Thmor Donpove	Kaoh	9070501								
25	8-18	HB1104-01	Prek Rwei	1	Mondul Kiri	Pech Chenda	Bu Chri	Phum puchichongchhang	11040204	27	374	299	39	12	11.0		
				2	Mondul Kiri	Pech Chenda	Bu Chri	Phum putang	11040203								
				3	Mondul Kiri	Pech Chenda	Bu Chri	Phum pucharyang	11040201								
				4	Mondul Kiri	Pech Chenda	Bu Chri	Phum behai	11040202								
26	13-1	MH1304-01	O Kdak Tributary	1	Preah Vihear	Kulaen	Phnum Thbaeng Pir	Sralay	13040502	73	361	289	38	0	12.0		
				2	Preah Vihear	Kulaen	Phnum Thbaeng Pir	Chhak	13040501								
				3	Preah Vihear	Kulaen	Phnum Thbaeng Pir	Barbour	13040503								
27	5-6	MH0707-01	O Turou Trao	1	Kampot	Kampot	Meakprang	Mortpeam	7070903	55	352	282	37	0	6.5		
				2	Kampot	Kampot	Meakprang	Bat Khl damrei	7070902								
28	11-19	MH1903-01	O Smang	1	Stung Treng	Siem Pang	Santepheap	Kirivongsa Leu	19030301	73	339	271	35	0	11.0		
				2	Stung Treng	Siem Pang	Santepheap	Kirivongsa Kraom	19030302								
				3	Stung Treng	Siem Pang	Sekong	Samma	19030204								
29	7-6	HB1005-01	Stung Samieng	1	Kracheh	Snuol	Srae Char	Sat	10050406	9	294	235	31	22	0.6		
30	10-11	MH1606-01	O Ta Phlai	1	Ratanak Kiri	Ou Chum	Samaeki	Pang	16060605	26	235	188	24	0	7.0		
				2	Ratanak Kiri	Ou Chum	Samaeki	Prak	16060603								
				3	Ratanak Kiri	Ou Chum	Samaeki	Ba Nhak	16060604								
31	9-19	MH1506-01	Xtong Cram	1	Pursat	Veal Veang	Ou Saom	Chhay Louk	15060103	24.7	203	162	21	0	9.0		
				2	Pursat	Veal Veang	Ou Saom	Kandal	15060102								
				3	Pursat	Veal Veang	Ou Saom	Ou Saom	15060101								
				4	Pursat	Veal Veang	Ou Saom	Kien Chongruk	15060104								
32	9-18	HB1503-01	Preak Choar	1	Pursat	Krakor	Chheu Tom	Khal Teahen	15030409	15	202	162	21	6	11.0		
33	10-5	MH1609-01	Prek Banpong	1	Ratanak Kiri	Veun Sai	Kaoh Pang	Lam av	16090502	42	159	127	17	0	15.0		
				2	Ratanak Kiri	Veun Sai	Kaoh Pang	Pa Tang	16090501								
				3	Ratanak Kiri	Veun Sai	Kaoh Pang	Pa Hay	16090503								
34	11-3	MH1902-02	O Lung	1	Stung Treng	Siem Bouk	Siem Bouk	Tonsang	19020603	28	158	126	16	0	12.0		
				2	Stung Treng	Siem Bouk	Siem Bouk	Siem Bouk	19020601								
35	6-28	MH0907-04	O Trapang Kholay	1	Koh Kong	Thma Bang	Pralay	Toap Khley	9070204	401	148	118	15	0	15.0		
				1	Koh Kong	Thma Bang	Pralay	Pralay	9070202								
				1	Koh Kong	Thma Bang	Chummoab	Chrak Raeset	9070302								
				1	Koh Kong	Thma Bang	Chummoab	Chummoab	9070301								
				1	Koh Kong	Thma Bang	Pralay	Samraeng	9070203								
36	11-2	MH1905-01	O Siembok	1	Stung Treng	Thala Barivat	Kang Cham	Doang	19050302	27	127	102	13	0	8.5		
				2	Stung Treng	Thala Barivat	Kang Cham	Kaes	19050301								
37	7-8	MH1005-02	O Chrei Meing	1	Kracheh	Snuol	Pir Thua	Cheung Khle	10050201	25	114	91	12	0	0.5		
38	11-10	MH1902-01	O Chrolong	1	Stung Treng	Siem Bouk	Ou Raeset Kandal	Ou Raeset Kandal	19020502	10.5	103	82	11	1	3.0		
39	10-4	MH1604-01	Ta Ang	1	Ratanak Kiri	Koun Mom	Ta Ang	Sek	16040304	12	98	78	10	0	1.5		
40	10-1	HB1604-01	O Kachang	1	Ratanak Kiri	Koun Mom	Srae Angkrong	Phum Pir	16040202	32	98	78	10	0	1.0	Waterfall	
41	6-6	MH0902-01	Preak Khou Khav	1	Koh Kong	Kiri Sakor											

2. RESULTS OF FIELD SURVEY OF MICRO HYDRO POWER STUDY

During the 1st field survey (November and December 2004) and 2nd field survey (January and February 2005), the Study Team conducted several site surveys with the following schedule. The location and schedule of field survey are shown in the **Figure AP-A.2.1**.

No. of Site Survey	Date	Province	Target Scheme	Study Team Member in charge
1st	Dec. 04, 2004	Kampong Speu	Sva Slab	Mr. K. Hirata (Small Hydro-1, JST) Mr. Nong Sareth (MIME)
2nd	Dec. 06 to 09, 2004	Kampot	Kaoh Touch Koun Sat Irrigation Dam Srat Cheng Merek Irrigation Dam	-ditto-
3rd	Jan. 04 to 10, 2005	Battambang	O Samrel Ta Taok O Chum Kampong Lpov O Daem Chek Stung Kronnung Stung Muong Prek Chik Ba Sak Kamping Puoy Irrigation Dam (Exsisting)	Mr. K. Hirata (Small Hydro-1, JST) Mr. N. Hashimoto (JICA Expert) Mr. Nong Sareth (MIME)
4th	Jan 17 to 28, 2005	Kratie,	O Dambal O Chrei Meing Prek Prey	Mr. K. Hirata (Small Hydro-1, JST) Mr. T. Okamura (Small Hydro-2, JST) Mr. R. Ohno (Environment, JST) Mr. N. Kawato (Small Hydro, JST) Mr. N. Hashimoto (JICA Expert) Mr. Chan Socheat (MIME) Mr. Nong Sareth (MIME) Mr. Suon Ponnararith (MIME)
		Stung Treng	O Pou Mong O Chrolong O Chap O Chrop O Baign Kla	
		Ratanak Kiri	O Chum I O Chum II P/S (Exising) O Kachang O Katieng O Katieng Downstream Bay Srok O Pyol Ta Ang	
		Mondul Kiri	O Dak Dam O Phlai Bu Sra	
5th	Feb. 04 to 06, 2005	Battambang	Stung Sangke Downstream Stung Sangke Upstream	Mr. T. Okamura (Small Hydro-2, JST) Mr. N. Kawato (Small Hydro, JST) Mr. Suon Ponnararith (MIME)
6th	Feb. 10 to 15, 2005	Koh Kong	Stung Tatai Downstream Stung Tatai Upstream Stung Chhay Areng	Mr. T. Okamura (Small Hydro-2, JST) Mr. Nong Sareth (MIME) Mr. Kimnhan Chan Amrin (MIME)

(JST: JICA Study Team)

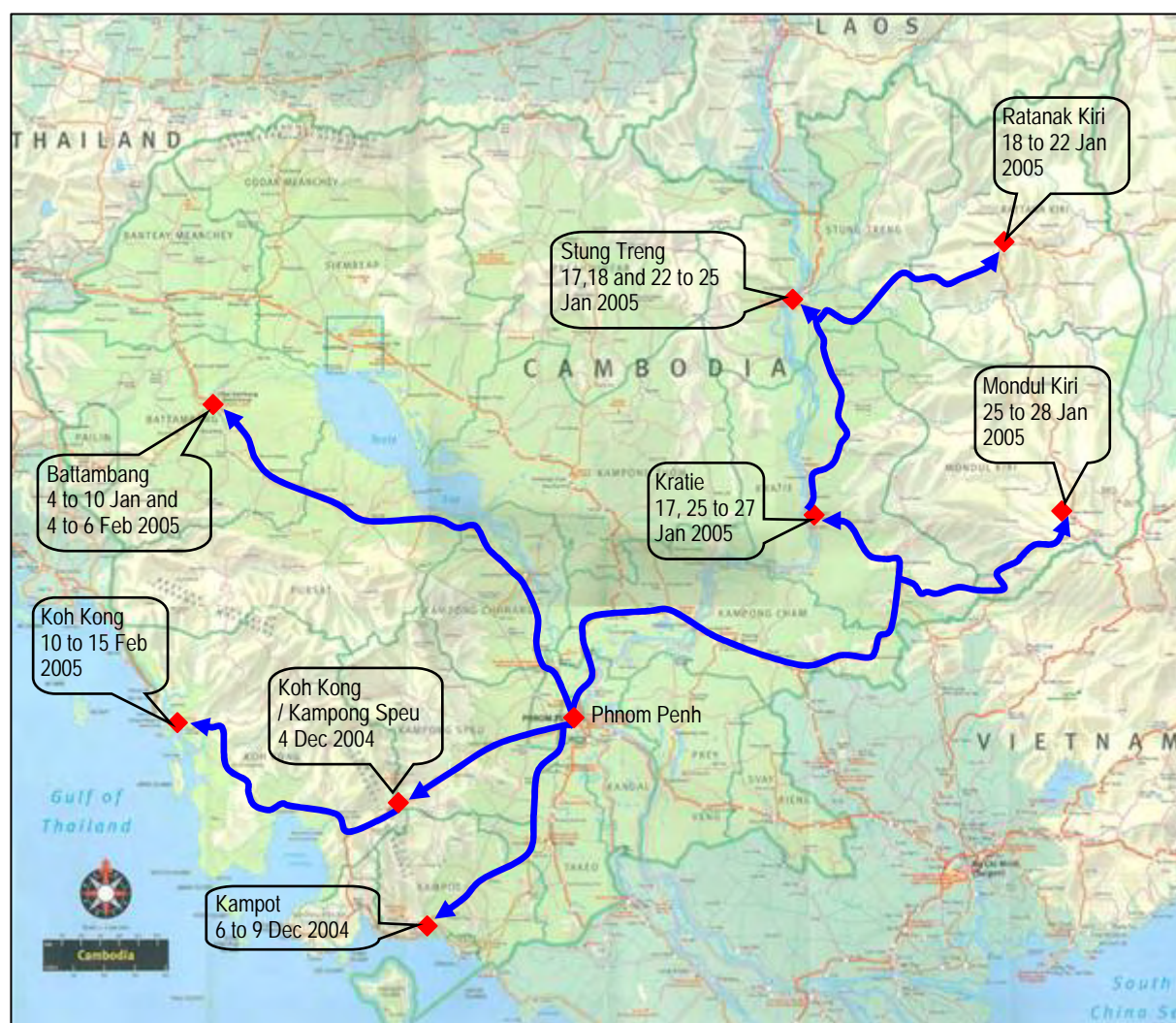


Figure AP-A.2.1 Location and Schedule of Micro Hydro Field Survey (Dec 2004 – Feb 2005)

Detailed description of site survey in each province is given as follows:

(1) KAMPONG SPEU PROVINCE

a) General

In Kampong Speu Province, there is an existing hydro power namely Kirirom I power station (11 MW). The Kirirom I scheme was developed as an Independent Power Producer (IPP) in 2002 and supplies electricity mainly to Phnom Penh. There is a substation in Kampong Speu town on the way from Kirirom I to Phnom Penh transmission line. From this substation only 0.5 MW is supplied to Kampong Speu Town. Some of micro/mini hydro power schemes were studied by Meritec financed by World Bank (WB)¹ in 2002. Stung Sva Slab hydro power project (3.8 MW) was selected and evaluated as a pre-investment level.

b) Involvement of DIME

On December 04, 2004, after arrival at Kampong Speu town, the Study Team visited DIME Kampong Speu for a meeting with DIME staff. A staff of DIME, a chief Kampong Speu provincial police and some other people from village joined the field survey on micro hydro potential sites.

c) Site Survey

1) Stung Sva Slab (date of survey: December 04, 2004)

According to the WB/Meritec Study (2002), the installed capacity of this scheme was designed to be 3.8MW. This scheme was developed aiming at supplying electricity to the grid for Phnom Penh during the rainy season. By using the current meter, Meritec Study measured the discharge on 21 April 2001 at 0.2 m³/s. The gross head of Meritec proposed site was measured by GPS and altimeter to be 60m.

Maeda Corporation themselves conducted the detailed topographic profile survey from intake site to powerhouse site at Stung Sva Slab River. As a result of survey, the total head of 85 m was found to be possible to develop.

On our field survey, the discharge measurement was conducted near the intake site proposed by Meritec. The observed discharge was 0.096m³/s (C.A. = 205km²). In Cambodia the discharge in the rainy season is more than 10 times of that in the dry season. It is said that the flow in the rainy season reaches top of the river section (W=30m, WL=2m) at the proposed intake site.

There are some villages of Being, Chambak, Traeng Trayueng, which are the demand centers of electricity. Each village has BCS with small diesel generator and most of households seem to have batteries. Many antennas could be seen in houses that have monochrome TVs.

¹ "Development of Pipeline of Small Hydropower Projects in Cambodia", Final Pre-Investment Study Report, World Bank, Meritec, May 2002.

Stung Sva Slab river near the proposed intake site	Discharge measurement at Stung Sva Slab near the proposed intake site

2) Existing Peam Pul Irrigation Dam (date of survey: December 04, 2004)

After the survey of Stung Sva Slab scheme, the Study Team visited existing Peam Pul Dam constructed during Pol Pot regime. As there had been almost no maintenance works, the ground still downstream of the dam and the gate board became deteriorated, and rehabilitation is necessary. There was no equipment like winch for gate operation. The leakage was observed from the sluice gate board. The rehabilitation is scheduled to start in 2005 by MOWRAM and Army.

The reservoir water level was quite low because of the dry season. Due to little storage in the dry season, there was no flow release from the dam. Therefore, micro hydro potential using the dam is not likely, as the head is only for the height of the dam.

Existing Peam Pul Dam (from upstream)	Existing Peam Pul Dam (from downstream)

(2) KAMPOT PROVINCE

a) General

Up to present, power generation in Kampot town is by private power company Wanhe Limited. Total installed capacity of diesel generators of this private power station is around 1.5 MW. Wanhe Limited sells electricity wholesale to EDC (Kampot) whom then distribute and sell the electricity to the residential, commercial, industrial and public sectors. It is scheduled to be upgraded of distribution systems and new generation facilities (total 4 MW) in 2005 provided under the "Update of Power Rehabilitation II Project" and "8 Provincial Power Supply Project" by Asian Development Bank

(ADB). There are also plans to construct the Kamchay hydroelectric power project (120/180 MW) on the Prek Tuuk Chhu river in Kampot. The Kamchay HEP project will start in 2005 as an IPP project by Chinese company and the construction will be completed in 2009.

b) Involvement of DIME



On December 06, 2004, after arrival at Kampot town, the Study Team visited DIME Kampot for a meeting with director of DIME and other staffs. Mr. Korl Sokha, chief energy office of DIME Kampot, district officers and village people joined the field survey on micro hydro potential sites.

c) Site Survey

1) Prek Kaoh Touch (date of survey: December 06, 2004)

This scheme was identified by MIME and NEDO studies. A run-of-river type power station was proposed to use the head of the river flowing through the Damrei Mountains, which is located 10 km to the west of Kampot city. The net head is at about 60m with catchment area of 21.65 km². Access to the site is located left bank of Prek Kaoh Touch River from Kirou Dabpir village along the national road No.3.

On December 6, 2005, there is no flow near the proposed power house site in the Prek Kaoh Touch River. The riverbed was dried up but with large boulders. Longitudinal riverbed slope is steep and the flood flow is supposed to be large according to the flood mark. Hence there is no hydropower potential in dry season and it is difficult to protect from flood water. It is also necessary to examine the development scale of this hydropower potential because there is a possibility for this hydro to connect to the grid in the future.

	
<p>Perk Kaoh Touch River near river mouth (effected section of back water from sea)</p>	<p>Riverbed of Prek Kaoh Touch River in the dry season (no surface water observed)</p>

2) Srae Cheng (date of survey: December 07, 2004)



This scheme was studied by Meritec (2003)². The proposed site of Srae Cheng community

² Pre-Investment Study of Community-Scale Hydro Projects, Cambodia”, NZ Ministry of Foreign Affairs & Trade, Meritec, June 2003.

hydroelectric power is located in Chum Kiri district of Kampot province. The villages to be electrified by the proposed project are; Srae Cheng, Khnop Run, Pong Tuek, Kamnab and Prey Khley villages in Chum Kiri district. The proposed site of this project is located on the Stung Trapeang Reang River (Srae Cheng River) in Chumkiri district and is about 90km northeast of Kampot town. Summary of the proposed scheme by Meritec is as follows;

Catchment Area	Gross Head	Power Flow	Installed Capacity	Annual Energy Production	Load Factor	Water Way Length	Penstock Length	Electrified Household
48.0 km ²	45m	0.45 m ³ /s	126 kW (65kW x 2)	330 GWh/yr	41%	500m (pipeline)	80m	1,487 (2002)

There is an existing vehicular access road to the (lower) Stung Pei irrigation dam (to be rehabilitated) and is about 5km from the intake. From the lower Stung Pei irrigation dam there are several access tracks/roads to the intake site. These access tracks/roads are in poor condition.

	
Destroyed existing Pol Pot irrigation dam upstream of Stung Trapeang Reang River (Srae Cheng River) near intake site	Discharge measurement at Srae Cheng River near proposed power house site

There is also an existing irrigation dam named (upper) Stung Dong Pei irrigation dam at near proposed intake site in the upstream of Stung Trapeang Reang River (Srae Cheng River) that was constructed and also destroyed in Pol Pot regime (1977). The maximum height of dam (concrete & fill-dam) is around 10m and width is around 50m. At present, the dam was not in use without any rehabilitation.

The discharge measurement was conducted at near the proposed power house site by the JICA Study Team on December 7, 2004. Observed discharge was 0.017 m³/sec. This discharge is only 3.7% of proposed design power flow (0.45 m³/sec) by Meritec study. Gross head measured by JICA Study Team by using altimeter is around 55m. The primary MV transmission line is required about 7.3km long. Land mine clearance is necessary for detail survey in this area.

3) Koun Sat (Kaum Stav) Existing Irrigation Dam (date of survey: December 6 and 9, 2004)

Existing irrigation reservoir named Koun Sat (Kaum Stav) dam is located 13 km to the east of the Kampot town. Earth-fill and concrete combined dam constructed in 1977 was provided with two sites of concrete dams with 4 gates each to discharge irrigation water. The reservoir was used to supply water for a few thousands ha of irrigation area at the construction. However, the area has been reduced to around 10 ha. Release water for irrigation in rainy season would be available for power generation.

During our visit on December 6th and 9th, 2005, there was no release water from the gates (only seepage from slice gate plates of about less than $0.1\text{m}^3/\text{sec}$). The power generation would be reduced because the power generation depends on the irrigation discharge that will be limited in the dry season. Therefore, the study on the irrigation water rights will be essential.



4) O Trou Trau (date of survey: December 08, 2004)



This scheme was proposed by WB/Meritec study (2002)³ to supply power for the grid of Kampot town. The project is located on the O Turou Trao stream, a tributary of the Prek Tuuk Chhu (Kamchay) River, which flows off the eastern side of the Bokor Plateau. The proposed powerhouse site is approximately 11.2km northwest from Kampot town. The gorge along the tributary located on the right bank of the Prek Tuuk Chhu (Kamchay) River will be used for development of a mini hydropower scheme. Catchment area is 20km^2 , head 130m, installed capacity about 1,100 kW. There is an existing perennial access road as close as 300m to the proposed powerhouse site. The existing access road was built in the 1960's and begins at the Kamchay pump-house, which supplies potable water to Kampot town.

Kampot town have been electrified with diesel generators. The power distribution area should be determined based on the power demand forecast of adjacent villages. It may be considered that this small hydropower project be developed as alternative to the diesel by increasing the installed capacity.

³ "Development of Pipeline of Small Hydropower Projects in Cambodia", Final Pre-Investment Study Report, World Bank, Meritec, May 2002.

There is a plan to construct the Kamchay hydroelectric power project (180 MW) on the Prek Tuuk Chhu river in Kampot.

The Study Team conducted field investigation on December 8, 2004. The observed discharge near proposed intake site was 0.052 m³/sec and measured head by using hand-level was 154.3m.

	
Topographic survey by using hand-level (near proposed intake site)	Discharge measurement at O Turou Trao River near proposed intake site

(3) BATTAMBANG PROVINCE

a) General

Site survey in Battambang Province was conducted for two times in January and February 2005. There are still many mines remaining in Battambang Province, therefore, the Study Team obtained mine map from CMAC (Cambodia Mine Action Center) and examined it prior to the site survey.

b) Involvement of DIME

For both site survey in January and in February, Mr. Ros Visith of DIME Battambang assisted the site survey works. For safety, the Study Team decided to take security guard from Ratanak Mondul Town for site survey works.

c) Site Survey





1) O Samrel (Ou Tek Souk River) (date of survey: January 05, 2005)

This scheme was proposed by Meritec study (2003). The proposed site is located in Samlot district of Battambang province. The village to be electrified by the proposed project is Ou Khroch village (old name O Samrel village) of Ta Taok commune, Samlot district. The proposed site of this project is located on the Ou Tek Souk (O Samrel) River. Summary of the proposed scheme by Meritec is as follows;

Catchment Area	Gross Head	Power Flow	Installed Capacity	Annual Energy Production	Load Factor	Water Way Length	Penstock Length	Electrified Household
12 km ²	30m	0.18 m ³ /s	32 kW (2 x 16kW)	75 GWh/yr	37%	600m (pipeline)	80m	153 (2002)

In 2004, number of household in O Kroch village is 121 families (decreasing). There is an existing

vehicular road for an access to Ou Khroch (O Samrel) village from Samlot district centre; it is required to cross the Stung Krahung river on the way. In the rainy season the village is isolated as there is currently no bridge crossing the Stung Krahung river to Ou Khroch village. From Ou Khroch village there is an existing track to proposed power house site, approximately 3 km long. A new road/track, approximately 600-800 m long, to the intake would be required from the power house site. The new access road would require land-mine clearance by CMAC as the Samlot area is heavily mined. The Team conducted field investigation on January 05, 2005. The observed discharge near proposed intake site (just d/s of water fall) was $0.036 \text{ m}^3/\text{sec}$ and measured head by using hand-level was 28m.



	
Interview to villagers at O Kroch village (nearest village to O Samrel scheme)	Ou Tek Souk (O Samrel) river near powerhouse site (looking upstream)
	
O Samrel waterfall	Discharge measurement at downstream of O Samrel water fall

2) Ta Taok (O Chum/O Thmar Kandor River) (date of survey: January 06, 2005)

This scheme was also proposed by Meritec study (2003). The villages to be electrified by the proposed project are Peam Ta, Ta Touk, Peam, Ou Nonoung, Veal Roleum, O Tre Ang and Ou Ta Tea villages within Ta Taok commune, Samlot district of Battambang province. Summary of the proposed scheme by Meritec is as follows;

Catchment Area	Gross Head	Power Flow	Installed Capacity	Annual Energy Production	Load Factor	Water Way Length	Penstock Length	Electrified Household
14 km ²	60 m	$0.10 \text{ m}^3/\text{s}$	38 kW (2 x 20 kW)	91.8 GWh/yr	40%	400m (pipeline)	100m	318 (2002)

There is an existing vehicular road to Veal Roling village in Ta Taok commune from Samlot district centre. There is a cable stayed boat across the Stung Krahung river ("Battambang river"). A new road to the power house site would be required starting 1 km from this across site. The new access road would require land-mine clearance by CMAC as the Samlot area is heavily mined. The Study Team conducted field investigation on January 6, 2005. The observed discharge at near proposed intake site (at top of water fall) was $0.06 \text{ m}^3/\text{sec}$ and measured head by using hand-level was 71.4m.





	
Discharge measurement at O Chum river	Flood water level near powerhouse site

3) Kampong Lpov (Ou Daem Chek River) (date of survey: January 07, 2005)

This scheme was also proposed by Meritec study (2003). The villages to be electrified by the proposed project are Ou Dam Chek, Kampong Lpov, Svay Chrum/Chamlang Romonea villages within Kampong Lpov commune, Samlot district. There is an existing vehicular road to Ou Dam Chek village. From Ou Dam Chek village there is an existing logging track to the proposed power house site, approximately 2 km long. Summary of the proposed scheme by Meritec is as follows;

Catchment Area	Gross Head	Power Flow	Installed Capacity	Annual Energy Production	Load Factor	Water Way Length	Penstock Length	Electrified Household
8 km ²	50 m	0.10 m ³ /s	32 kW (2 x 16 kW)	69.5 GWh/yr	34%	700m (pipeline)	100m	323 (2002)



The Study Team conducted field investigation on January 7, 2005. The observed discharge at near proposed intake site (approx 50m upstream from top of water fall) was 0.026 m³/sec and measured head by using hand-level was 78.7m from proposed intake site to power house site. The head part of which is developed over 2 cascading waterfall each between 5 and 10m high over a distance of 300 m.

	
Ou Daem Chek village (non-electrified village)	Waterfall of Kampong Lpov
	
Q.Obs. at top of waterfall (Q = 0.026 m ³ /sec)	Ou Daem Chek river near powerhouse site

4) Stung Sangke Downstream (date of survey: February 05, 2005)

In Ratanak Mondul (about one hour from center of Battambang Town), the Study Team was assisted by a military police to go to Stung Sangke River. According to CMAC mine map, the potential area was indicated as a dangerous zone for mines. Due to such danger of mines, leveling survey was not conducted. Instead, height check was done by distance meter and clinometer in one point. Height between measured ground height and water surface was 9.6m (near the in a photograph below).



Discharge measurement was made where river flow concentrates in one location of about 6 m width as shown photograph below. Discharge was measured as 1.15 m³/sec, which is a significant amount for the dry season. In this scheme on the right bank, a very flat land continues about 1 km from an intake site to powerhouse site, which will provide a good route for headrace channel and head tank.

	
Discharge measurement at Stung Sangke Downstream (Q = 1.15m ³ /sec)	Rock outcrops on the riverbed just upstream of discharge measurement point

By assuming a head at 9.6m between the intake and the powerhouse sites, about 120 kW of power output could be expected even in the dry season. There is Dan Tong Bridge on Sangke River near Dan Tong Village. On this bridge a water level gauge was installed by a Korean company for development. But it seemed that measurement was not done due to project cancellation.

5) Stung Sangke Upstream (date of survey: February 05, 2005)

Taking the road from Dan Tong Bridge southward then westward, about one hour, the Study Team reached Stung Sangke upstream site. Due to limit of time and as there are not adequate site, discharge measurement was not made. From proposed intake site a flat farm land continues for about 2 km, which can be the route for a headrace channel.

	
Near proposed intake site (Looking upstream)	Flat land on the right bank, suitable for headrace

(4) KRATIE PROVINCE

a) General

As a result of map study, it was realized that Kratie Province had less potential of micro hydro because of rather flat geography. In fact it was difficult to find potential site that had more than 10 m head in this province. Potential sites could only be found on the rivers that has a large area of catchment.

b) Involvement of DIME

On January 17, 2005, the Study Team stopped at Kratie DIME office to get information on potential sites in the Province. Discussions were made to get information on potential sites. On January 25, 2005, the Study Team visited DIME office again to organize site surveys for potential sites.



After the meeting the Study Team, MIME and DIME jointly conducted site survey on January 26 and 27. Mr. Iv Samith (Director of DIME) and his staff Mr. Heng Vantholien assisted the site survey works.

c) Site Survey

1) O Dambal (date of survey: January 26, 2005)



This site was proposed by DIME Kratie and local community (Phum Kroch, Prolay Tiek villages., Domorey commune, Chhlong District). Proposed site is located on O Dambal River approx 30km southeast from Kratie town. Number of household and population of Domorey commune is 872 families and 4,068 people, respectively. Proposed intake site on O Dambal River is approx 20m downstream from confluence point of Prek Kroch (main stream) and Prek Chor (tributary). The catchment area is 155km² according to the 1/100,000 topographic map. On January 26, 2005. there was no water in Prek Chor near the confluence point.

The Study Team conducted field investigation on January 26, 2005. The observed discharge near proposed intake site on O Dambal River, which approximately 20-30 m downstream from confluence point of Prek Kroch (main stream) and Prek Chor (tributary), was 0.050 m³/sec. Measured head by using hand-level was 3.6m from proposed intake site to wooden bridge site at Prolay Tiek village. The slope of river bed is gentle and there is a possibility of back-water effect from flood water of downstream Prek Chhlong River. River cross section near the proposed intake site in O Dambal River approximately 30 km is 10 m width and 2.5 m depth from river side ground. It is low potential for micro hydro power development at this site due to small discharge and gentle slope.

	
Discharge measurement ($Q = 0.05 \text{ m}^3/\text{sec}$)	Leveling by DIME staff along waterway route



2) O Chrei Meing (date of survey: January 27, 2005)

As seen in the photographs below, there is about 5 m difference of water level between the dry season and rainy season. Rainy season water mark can be seen on the pier of the bridge. Further, flood water mark can be seen 4 to 5 m above rainy season water mark.

	
O Chrei Meing river under the bridge. Flood water mark can be seen on the pier of the bridge.	Discharge measurement at O Chrei Meing ($Q = 0.72 \text{ m}^3/\text{sec}$)

3) Prek Prey (date of survey: January 27, 2005)

As seen in the photographs below, Prek Prey River has very little to almost zero discharge in the dry season. Due to shallow water level, discharge measurement was only possible by observing surface velocity using a leaf.

	
Prek Prey River under the bridge of main road	River water was stagnant and the discharge was almost zero ($Q = 0.007 \text{ m}^3/\text{sec}$).

(5) STUNG TRENG PROVINCE

a) General

Through the map study, it was realized that Stung Treng Province had less potential of micro hydro because of rather flat geography. It was difficult to find potential site that had more than 10 m head like in Kratie Province. Major potential site could be found on the left bank (eastern side) of Mekong River. Right bank (western side) of Mekong River was not surveyed due to less potential and poor accessibility.



b) Involvement of DIME

On January 18, the Study Team visited Stung Treng DIME office to check questionnaire sheets before the Team moved to Ratanak Kiri Province. On January 22, the Study Team visited DIME office again to check and discuss about potential sites. From January 22 to 23, the Study Team, MIME and DIME jointly conducted site survey in Stung Treng. Mr. Nin Soksdai and Mr. Shythat of DIME Stung Treng assisted the site survey.

c) Site Survey


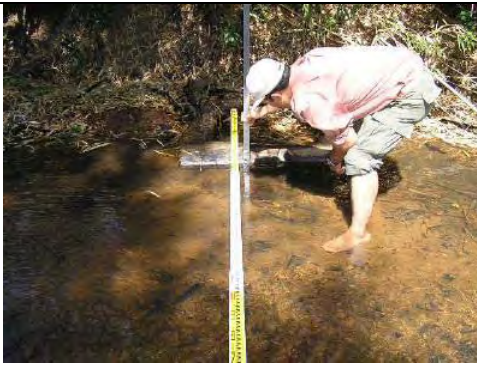
1) O Chrolong (date of survey: January 23 and 24, 2005)

This scheme has a relatively large catchment area of about 128 km². The Study Team conducted discharge measurement and leveling of the scheme on January 23, 2005. Discharge was measured at 0.45 m³/sec near intake site, which corresponds to 3.5 liter/sec/km². Taking into account of relatively low rainfall in Stung Treng Province compared with other provinces, this specific discharge is judged dependable. Leveling result shows that the head is about 5m. Though the head is small, considering good amount of discharge, the Study Team installed staff gauge for water level observation. After installation of the gauge, with assistance of DIME, the commune chief was nominated as a gauge reader. Mr. San Socheat of MIME instructed how to read the staff gauge and record on the sheet. Gauge reading was started from the end of January 2005.

	
Near proposed intake site of O Chrolong (from right bank)	Staff gauge installed near proposed intake site



2) O Chrop (date of survey: January 24, 2005)

O Chrop River has a very gentle slope with little discharge. As seen in the photographs below, many leaves stack on the surface of the river, proving that the flow is stagnant. On the other hand, judging from riverbank erosion status and water marks, flood water level is supposed to be as high as 4 to 5 m from the dry season water level.

	
<p>O Chrop River looking downstream. Due to slow velocity, many leaves stack on the water surface.</p>	<p>Water depth measurement by MIM staff prior to discharge measurement</p>

3) O Baign Kla (date of survey: January 24, 2005)

O Baign Kla means Tiger Shooting in Khmer Language. This scheme was identified through map study at 1:50,000 scale. The Study Team conducted discharge measurement at about 2 km upstream of its confluence with Mekong River. Discharge was measured at 0.21 m³/sec. Due to limit of time and bushy land and dense forest, leveling could not be made. By eye observation, at least 5 m of height can be considered for this scheme.

	
<p>Discharge measurement on O Baign Kla River Q = 0.21 m³/sec, river width = 6 ~ 7 m</p>	<p>DIME staff Mr. Shythat indicating flood water level about 0.7m higher than the present water level according to the village people</p>

(6) RATANAK KIRI PROVINCE

a) General

Provincial capital town Ban Lung is located on a plateau in the center of Ratanak Kiri Province. Several rivers are originated from this plateau. Ban Lung town is being developed as a tourism center.




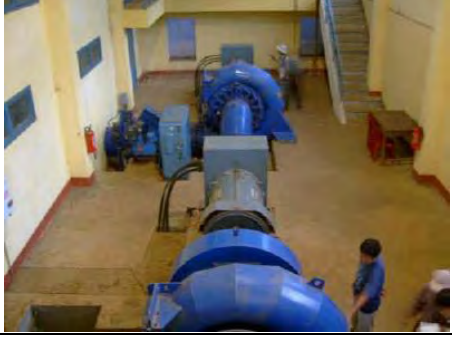
b) Involvement of DIME

On January 18, 2005, after arrival at Ban Lung, the Study Team visited DIME Ratanak Kiri for a meeting and exchanged information with DIME staff. Mr. Hem Van Thron (Director) and Mr. Hun Bunthan (Deputy Director) and some other staff joined the meeting to get basic information on existing schemes and potential micro hydro.

c) Site Survey





1) Existing O Chum Hydropower Station (date of survey: January 18, 2005)

O Chum Hydropower Scheme with DIME and EdC. O Chum Hydropower Scheme consists of Ochum Reservoir and an existing hydropower station (O Chum II hydropower station) with 1 MW installed capacity. O Chum hydropower scheme is located northwest of Ban Lung. It took about 10 to 15 minutes by car from Ban Lung Town. O Chum hydropower scheme started construction in December 1990 with fund from Cambodian Government. Construction completed in 1993 and operation started. O Chum reservoir is an earth-fill dam having crest length of about 700 m. Stored water in O Chum reservoir is released for power generation at O Chum II hydropower station.

	
Existing O Chum reservoir and its intake tower	Intake weir of existing O Chum II power station
	
Existing Ochum II power station tailrace	2 x Francis turbines 500 kW



2) O Kachang scheme (date of survey: January 19, 2005)

O Kachang waterfall is located southwest of Ban Lung. It takes about 20 to 30 minutes by car to get to the site. The study team conducted discharge measurement at about 1 km upstream of the waterfall. Leveling was also done to survey the head. Photographs of field survey are shown below:

	
O Kachang waterfall (height: 13m)	Discharge measurement upstream of O Kachang waterfall (river width = 6 to 7 m, $Q=0.3 \text{ m}^3/\text{sec}$)
	
Checking of GPS coordinates at power house site of O Kachang scheme (right bank)	Checking of flood water level indicated by DIME staff



3) O Katieng (date of survey: January 19, 2005)

O Katieng waterfall is located about 3 km downstream of O Kachang Waterfall. The Study Team conducted discharge measurement and leveling.

	
O Katieng Waterfall (height: 14m)	From O Katieng Waterfall looking upstream

4) O Katieng Downstream (date of survey: January 19 and 21, 2005)









Downstream of O Katieng waterfall, there continues several rapids of about 40 m in total height over the 2 km long river reach. Leveling was made to check the head available for the scheme.

	
Leveling works from O Katieng Waterfall to O Katieng Downstream Scheme - Joint survey of MIME/DIME/JST	Continuous rapid of O Katieng Downstream Scheme (looking upstream)

5) Bay Srok (date of survey: January 20 and 22, 2005)









Bay Srok scheme is located about 25 km southeast of Ban Lung. The scheme was identified through Meritec Study. The scheme is located on O Sien Ler River. Sometimes the scheme is called as “O Sien Ler scheme” or “Seven Cascade scheme” as there are seven cascades of small waterfalls. The Study Team conducted discharge measurement and leveling.

There continues very flat land of more than 30 m in width on the right bank of the river, which provides good route location for headrace channel and head tank. As this location has high potential, the Study Team installed staff gauge for water level observation. At the same time, with help of DIME Director, the Study Team recruited a gauge reader and instructed him how to read and record.

	
Bay Srok scheme on O Sien Ler River (looking upstream)	Intake site (from downstream)
	
Looking right bank, head tank site (near the car)	From right bank looking down O Sien Ler River along proposed penstock route (head is around 30 m)
	
Installed staff gauge near intake site (on the right bank)	Instruction of gauge reading by Mr. Socheat (MIME, left)
	
Center of Bay Srok village with mini-grid distribution line powered by diesel generator	Television set sold in a shop of Bay Srok village

6) O Pyol (date of survey: January 21, 2005)

O Pyol scheme is located on tributary of Se San River. From Ban Lung, it takes about two hours by car to reach the Se San River crossing point. After crossing the river by small boat, the road was only accessible by motor bike. The Study Team headed by T. Okamura together with other three members conducted field survey including discharge measurement and leveling.

	
Access road to O Pyol Site	Village of Kachut II, 44 families
	
Only one diesel generator in the Kachut II Village	Discharge measurement upstream of O Pyol waterfall
	
Near proposed intake site, river width is 4 to 5 m, bedrock exposed over the river width	O Pyol waterfall from downstream (height: 13 m)
	
Leveling works at the bottom of waterfall	Ferry boat crossing Se San River (river width =about 330m)