TERMS OF REFERENCE FOR TRAFFIC SURVEY

SECTION-III
TECHNICAL SPECIFICATION

3.1. BACKGROUND AND OBJECTIVES

The Japan International Cooperation Agency (JICA) Study Team is conducting "The Study on the Road Network Development in the Kingdom of Cambodia" (hereinafter referred to as "the Study") in close cooperation with the Ministry of Public Works and Transport (MPWT) and other relevant ministries. In this study, the JICA Study Team shall engage a qualified local consultant (hereinafter referred to as "the Consultant") to execute the following three traffic surveys with the cooperation of MPWT.

- Traffic Count Survey
- Origin and Destination Interview Survey
- Travel Time Survey

These traffic surveys shall be conducted at 60 stations for Traffic Count Survey, 41 stations for OD Interview Survey and 21 roads for Travel Time Survey. These selected stations and roads cover most of major roads including one and two digit national road and three digit provincial roads in whole of the country. The data collected from these surveys shall be used for the traffic demand forecast, and road network development and maintenance planning in the Study.

Furthermore, the traffic survey training to the staff of Department of Pubic Works (DPWT) in each province is another important scope of this survey. DPWT staff shall join the survey after the instructions from the training team consists of MPWT counterpart and Senior Engineer.

3.2. SCOPE OF WORKS

3.2.1. Traffic Count Survey

(1) Survey Items

- Vehicular traffic count

(2) Survey Method

The traffic count survey shall be conducted to get the hourly traffic volume by vehicle type, by day of the week and by direction. The counted traffic volume shall be recorded every 15 minutes by vehicle type and by direction. The vehicle type shall be classified as follows:

I	Motor Cycle (MC)	1	Motorcycle, M.Tricycle
		2	Motorbike Trailer
II	Light Vehicle (LV)	3	Sedan, Wagon, Light Van
		4	Pick-up, Jeep, Light Truck (>3.5t)
		5	Mini Bus (Van type and Pick-up Type)
III	Heavy Vehicle (HV)	6	Short and Long Body Bus
		7	Short and Long Body Truck (<3.5t)
		8	Semi and Full Trailer Truck

The sample of survey forms are shown in appendices and shall be finalized in cooperation with the JICA Study Team.

The staff of Department of Public Works and Transport shall attend the survey at selected survey stations in every region. Therefore the supervisor of selected survey station shall instruct the survey objectives and method to them intelligibly.

(3) Survey Coverage

Survey points are shown in Figure 1 and Table 1. The number of survey sites and their survey time are depending on the traffic flows and tentatively planned as follows:

- 24 hours: 5 sites (from 06:00 am to 06:00 am on weekday)
- 12 hours: 42 sites (from 06:00 am to 18:00 pm on weekday)
- Border Operating Hour: Totally 12 international borders

Furthermore, 7 days – 24 hours traffic count survey shall be conducted at one site along National Road No.6A.

Survey points and survey duration shall be finalized in consultation with counterpart team of Cambodia.

Figure 1 Location of Survey Stations for Traffic Count Survey at Major Roads

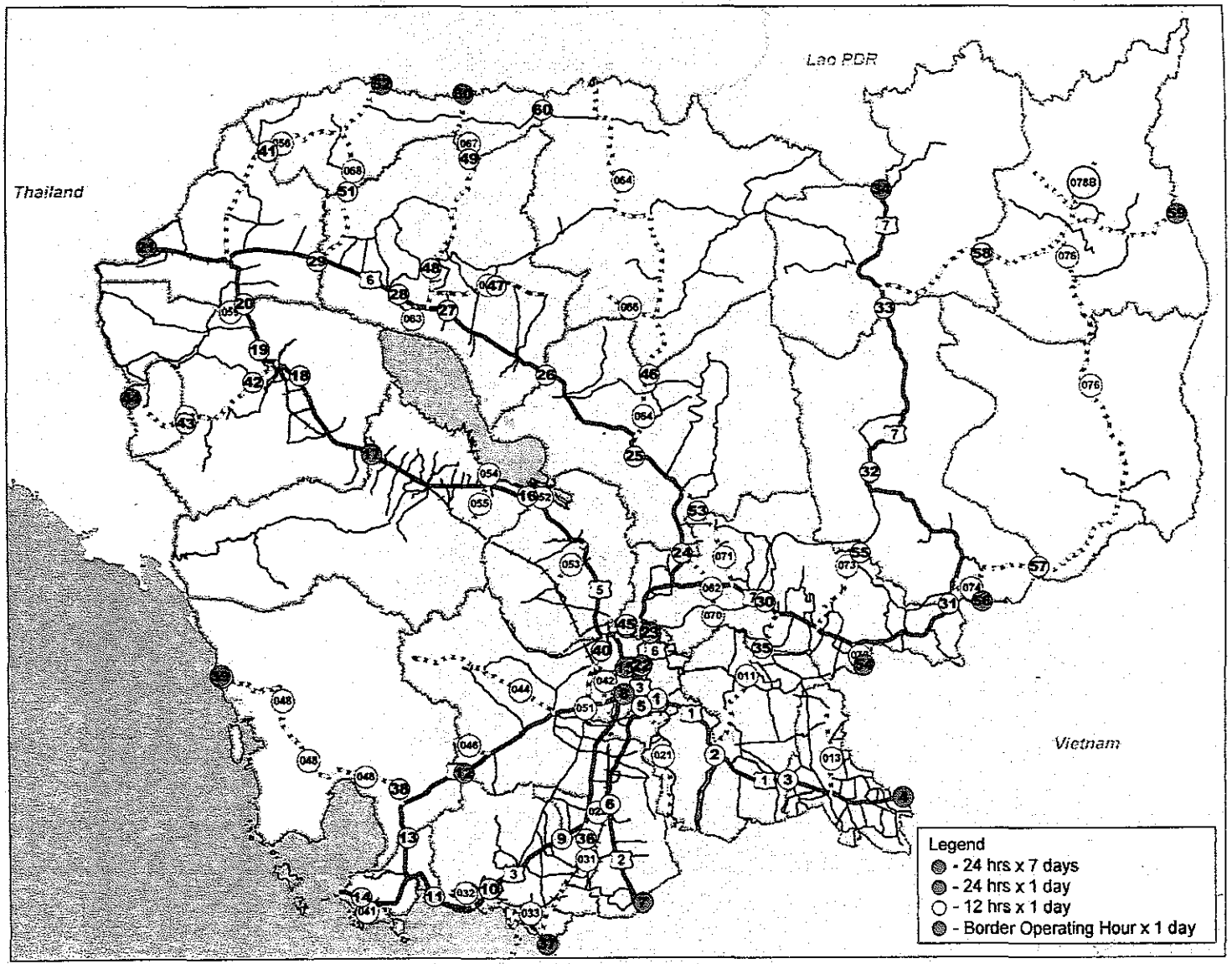


Table 1 Survey Stations for Traffic Count Survey

No.	Survey Station		Period	
	Road No.	City	Time	Day
1	1	Nirouth	12 hrs	1 Weekday
2	1	Preaek Khsay Kha	12 hrs	1 Weekday
3	1	Kraol Kou	12 hrs	1 Weekday
4	1	Vietnam Border	BOH	1 Weekday
5	2	Ta Khmau	12 hrs	1 Weekday
6	2	Lumchang	12 hrs	1 Weekday
7	2	Vietnam Border	BOH	1 Weekday
8	3	Chaom Chau	24 hrs	1 Weekday
9	3	Chhuk	12 hrs	1 Weekday
10	3	North Kampot	12 hrs	1 Weekday
11	3	Preaek Tnaot	12 hrs	1 Weekday
12	4	Ti Prammuoy	24 hrs	1 Weekday
13	4	Ta Ney	12 hrs	1 Weekday
14	4	East Sihanoukville	12 hrs	1 Weekday
15	5	Preaek Phnov	24 hrs	1 Weekday
16	5	Ponley	12 hrs	1 Weekday
17	5	Svay Doung Kaev	24 hrs	1 Weekday
18	5	South Bat Dambang	12 hrs	1 Weekday
19	5	North Bat Dambang	12 hrs	1 Weekday
20	5	Boeng Pring	12 hrs	1 Weekday
21	5	Poipet (Thai Border)	BOH	1 Weekday
22	6A	Preaek Lieb	24 hrs	1 Weekday
23	6A	Tang Krang	24 hrs	1 Week (7days)
24	6	Sampong Chey	12 hrs	1 Weekday
25	6	South Kampong Thum	12 hrs	1 Weekday
26	6	Ta Ong	12 hrs	1 Weekday
27	6	East Siem Reap	12 hrs	1 Weekday
28	6	West Siem Reap	12 hrs	1 Weekday
29	6	Kralanh	12 hrs	1 Weekday
30	7	East Kampong Cham	12 hrs	1 Weekday
31	7	Khcheay	12 hrs	1 Weekday
32	7	East Kracheh	12 hrs	1 Weekday
33	7	Prek Kandie	12 hrs	1 Weekday
34	7	Lao Border	BOH	1 Weekday
35	11	Kong Chey	12 hrs	1 Weekday
36	31	Champeir	12 hrs	1 Weekday
37	33	Vietnam Border	BOH	1 Weekday
38	48	Srae Ambel	12 hrs	1 Weekday
39	48	Koh Kong (Thai Border)	BOH	1 Weekday
40	51	Tumnob Thum	12 hrs	1 Weekday
41	56	Banteay Chhmar	12 hrs	1 Weekday

No.	Survey Station		Period	
	Road No.	City	Time	Day
42	57	Phnum Sampov	12 hrs	1 Weekday
43	57		12 hrs	1 Weekday
44	57	Thai Border	BOH	1 Weekday
45	61	Sambour	12 hrs	1 Weekday
46	64		12 hrs	1 Weekday
47	66	Boeng Mealea	12 hrs	1 Weekday
48	67	Banteay Srei	12 hrs	1 Weekday
49	67	Rumchek	12 hrs	1 Weekday
50	67	Thai Border	BOH	1 Weekday
51	68	Chong Kal	12 hrs	1 Weekday
52	68	Thai Border	BOH	1 Weekday
53	71	Sralau Toung	12 hrs	1 Weekday
54	72	Vietnam Border	BOH	1 Weekday
55	73	Kampong Reang	12 hrs	1 Weekday
56	74	Vietnam Border	BOH	1 Weekday
57	76	Sre Preah	12 hrs	1 Weekday
58	78		12 hrs	1 Weekday
59	78	Vietnam Border	BOH	1 Weekday
60	274	Tumnob Dach	12 hrs	1 Weekday

Note: 24 hrs: from 06:00 in the morning to 06:00 in the following morning
12 hrs: from 06:00 in the morning to 18:00 in the evening
BOH: Border Operating Hours
1 Weekday: Tuesday, Wednesday or Thursday

3.2.2 Origin and Destination Interview Survey

(1) Survey Items

- Trip Information of interviewee vehicle
  - Origin and destination of the trip
  - Seating capacity and number of passengers on board
  - Trip purpose
  - Contents and weight of freight
  - Vehicle registration

(2) Survey Method

The OD interview survey shall be conducted to grasp the passenger's and freight's movement by road transportation with the questionnaire shown in the appendix. The interviewee vehicle shall be selected for each vehicle type shown below at the regular sampling rate which depends on the traffic volume. The assistance of police to select the interviewee vehicle will be arranged by MPWT and the Consultant.

I	Motor Cycle (MC)	1	Motorcycle, M.Tricycle
		2	Motorbike Trailer
II	Light Vehicle (LV)	3	Sedan, Wagon, Light Van
		4	Pick-up, Jeep, Light Truck (>3.5t)
		5	Mini Bus (Van type and Pick-up Type)
III	Heavy Vehicle (HV)	6	Short and Long Body Bus
		7	Short and Long Body Truck (<3.5t)
		8	Semi and Full Trailer Truck

The zone codes applied in this survey are shown in Table 2.

Table 2 Zone Code for OD Interview Survey

Code	Covered Province	Code	Covered Province	Code	Covered Province
010	Phnon Penh	160	Kampong Cham	560	Vietnam via NR78
020	Kandal	170	Kampong Thum	590	Vietnam via others
030	Prey Veaeng	180	Preah Vihear		
040	Svay Rieng	190	Siem Reap	610	Thailand via NR5
050	Takaev	200	Otdar Mean Chey	620	Thailand via NR48
060	Kampong Spueu	210	Kracheh	630	Thailand via NR57
070	Kampot	220	Mondol Kiri	640	Thailand via NR67
080	Krong Kaeb	230	Stoeng Treng	650	Thailand via NR68
090	Krong Preah Sihanouk	240	Ratanak Kiri	690	Thailand via othes
100	Koh Kong				
110	Kampong Chhanang	510	Vietnam via NR1	710	Laos via NR7
120	Pousat	520	Vietnam via NR2	790	Thailand via others
130	Bat Dambang	530	Vietnam via NR33		
140	Pailin	540	Vietnam via NR72		
150	Banteay Mean Chey	550	Vietnam via NR74		

The staff of Department of Public Works and Transport shall attend the survey at selected survey stations in every region. Therefore the supervisor of selected survey station shall instruct the survey objectives and method to them intelligibly.

(3) Survey Coverage

Survey points are shown in Figure 2 and Table 3. The number of survey sites, their survey time and sampling rate are depending on the traffic flows and tentatively planned as follows:

- 24 hours :5 sites (from 06:00 am to 06:00 am on weekday)
- 12 hours :24 sites (from 06:00 am to 18:00 pm on weekday)
- Border Operating Hour :Totally 12 international borders

Interview survey has to be conducted at the same date and period with traffic count survey.

Survey points, survey duration and sampling rate shall be finalized in consultation with counterpart team of Cambodia.

Figure 2 Location of Survey Stations for OD Interview Survey

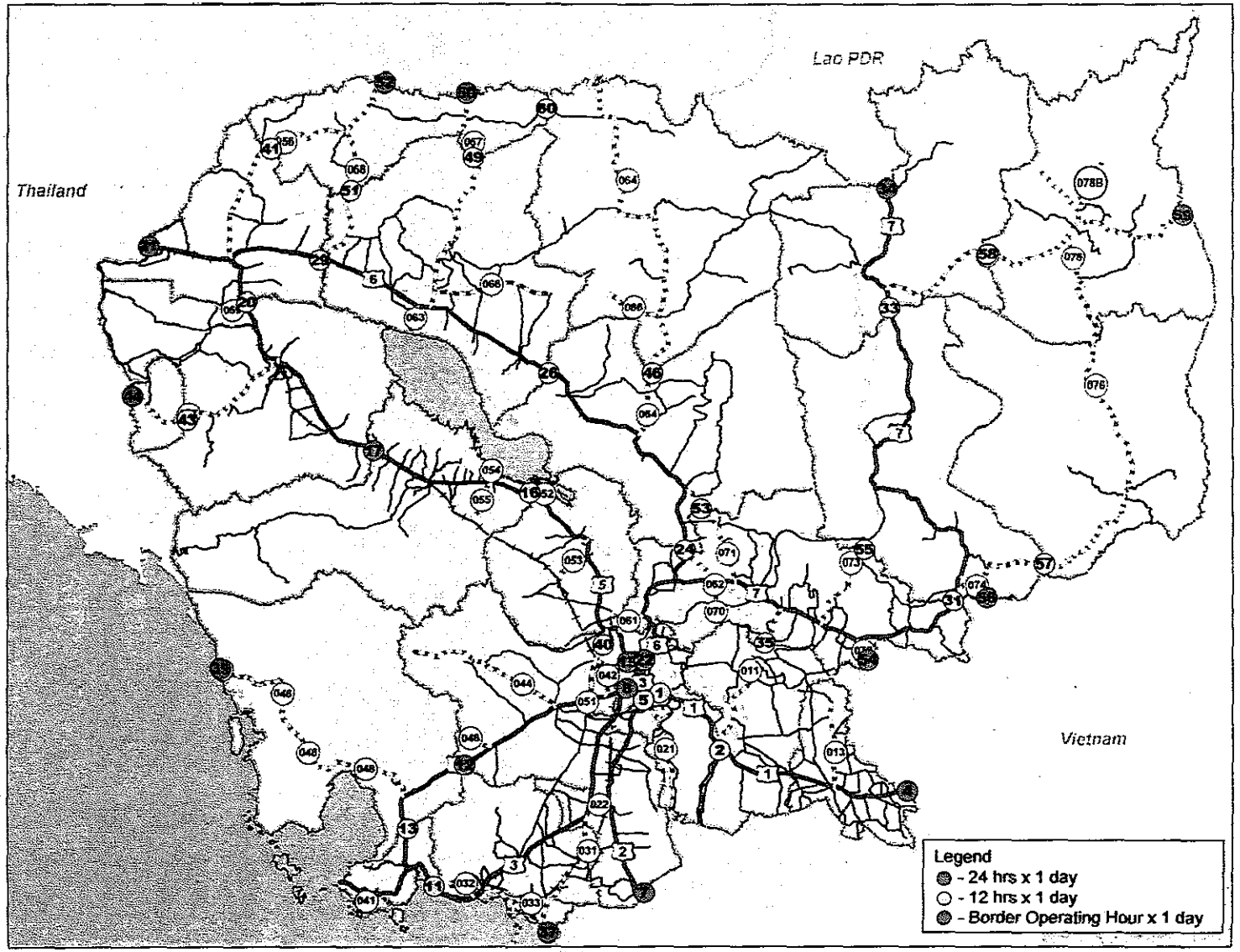


Table 3 Survey Stations for OD Interview Survey

No.	Traffic Count Station No.	Survey Station		Period		Sampling Rate (minimum)
		Road No.	City	Time	Day	
1	1	1	Nirouth	12 hrs	1 Weekday	10%
2	2	1	Preaek Khsay Kha	12 hrs	1 Weekday	20%
3	4	1	Vietnam Border	BOH	1 Weekday	30%
4	5	2	Ta Khmau	12 hrs	1 Weekday	10%
5	7	2	Vietnam Border	BOH	1 Weekday	30%
6	8	3	Chaom Chau	24 hrs	1 Weekday	10%
7	11	3	Preaek Tnaot	12 hrs	1 Weekday	30%
8	12	4	Ti Prammuoy	24 hrs	1 Weekday	20%
9	13	4	Ta Ney	12 hrs	1 Weekday	20%
10	15	5	Preaek Phnov	24 hrs	1 Weekday	10%
11	16	5	Ponley	12 hrs	1 Weekday	30%
12	17	5	Svay Doung Kaev	24 hrs	1 Weekday	30%
13	20	5	Boeng Pring	12 hrs	1 Weekday	20%
14	21	5	Poipet (Thai Border)	BOH	1 Weekday	10%
15	22	6A	Preaek Lieb	24 hrs	1 Weekday	10%
16	24	6	Sampong Chey	12 hrs	1 Weekday	20%
17	26	6	Ta Ong	12 hrs	1 Weekday	20%
18	29	6	Kralanh	12 hrs	1 Weekday	20%
19	31	7	Khcheay	12 hrs	1 Weekday	30%
20	33	7	Prek Kandie	12 hrs	1 Weekday	50%
21	34	7	Lao Border	BOH	1 Weekday	50%
22	35	11	Kong Chey	12 hrs	1 Weekday	30%
23	37	33	Vietnam Border	BOH	1 Weekday	30%
24	39	48	Koh Kong (Thai Border)	BOH	1 Weekday	30%
25	40	51	Tumnob Thum	12 hrs	1 Weekday	30%
26	41	56	Banteay Chhmar	12 hrs	1 Weekday	50%
27	43	57		12 hrs	1 Weekday	50%
28	44	57	Thai Border	BOH	1 Weekday	30%
29	46	64		12 hrs	1 Weekday	50%
30	49	67	Rumchek	12 hrs	1 Weekday	50%
31	50	67	Thai Border	BOH	1 Weekday	50%
32	51	68	Chong Kal	12 hrs	1 Weekday	50%
33	52	68	Thai Border	BOH	1 Weekday	50%
34	53	71	Sralau Toung	12 hrs	1 Weekday	50%
35	54	72	Vietnam Border	BOH	1 Weekday	30%
36	55	73	Kampong Reang	12 hrs	1 Weekday	30%
37	56	74	Vietnam Border	BOH	1 Weekday	50%
38	57	76	Sre Preah	12 hrs	1 Weekday	50%
39	58	78		12 hrs	1 Weekday	50%
40	59	78	Vietnam Border	BOH	1 Weekday	50%
41	60	274	Tumnob Dach	12 hrs	1 Weekday	50%

3.2.3 Travel Time Survey

(1) Survey Items

- Travel Information on certain road sections
  - ➢ Time of departure and arrival (start and end points of route)
  - ➢ Time of passing checkpoints
  - ➢ Time of stop/restart with reason of stopping

(2) Survey Method

Travel Time survey shall be conducted to know the travel time between major cities. This survey is conducted by the "floating car method" which requires the survey vehicle to keep the same position in the traffic flow; i.e. if the survey vehicle is overtaken by other vehicles, it should overtake the same number of vehicles.

The sedan car shall be used for the vehicle survey (If road condition is too hard for sedan, 4WD shall be used.).

The detail survey form is shown in appendix and survey form will be finalized in cooperation with the JICA Study Team.

(3) Survey Coverage

Survey points are shown in Table 4. Totally 21 survey routes are identified to cover the typical road and traffic condition in Cambodia. For each route, the survey shall be conducted 2 times (1 round trip).

The survey shall be conducted in daytime only. If the survey vehicle cannot come to the destination before sunset, suspend and re-start from the suspended point in the next morning.

Table 4 Survey Stations for Travel Time Survey

	Road No.	Origin and Destination	Check Point
1	1	From P.P to Border	Phum Thum, Kampong Phnum, Preaek Khsay Kha and Svay Rieng
2	2	From P.P to Border	Ta Khmau and Takaev
3	3	From P.P to Veal Renh	Tram Kak, NR31, Kampot and NR32
4	4	From P.P to Sihanoukville	NR42, NR51, Kampong Spueu, NR46, NR48, Veal Renh and NR41
5	5	From P.P to Poipet	NR51, Kampong Chhnang, NR52, NR54, Pousat, Moung Ruessei, Bat Danbang, NR59, Mongkol Borei and Sisophon
6	6	From P.P to Sisophon	NR61, Sukoun, NR62, NR71, Kampong Thum, NR64, Stoung, Kouk Thlok Kraom, Siem Reap and NR68
7	7	From Sukoun to Border	NR62, NR71, Kampong Cham, NR11, NR73, NR72, NR74, NR76, Kracheh, NR78 and Stoeng Treng
8	11	From NR1 to NR7	Prey Veaeng, PR316 and Kong Chey
9	31	From NR3 to NR33	PR114, PR115, PR113 and PR117
10	33	From NR3 to Border	Damnak Changaeur and NR31
11	48	From NR4 to Border	Srae Ambel, Andoung Tuek, Trapeang Rung and Peam Krasoap
12	51	From NR5 to NR4	Khsem Khsan
13	56	From Sisophon to Samraong	Treas, Thma Puck and Banteay Chhmar
14	57	From Bat Danbang to Border	Snoeng and Pailin
15	64	From Kampong Thum to Border	PR220, PR219, PR213, Tbaeng Mean Chey, Kulen and PR212
16	67	From Siem Reap to Border	Banteay Srei, Sre Noy, Rumchek, Anlong Veaeng and Phum Phaav
17	68	From Kraalnh to Border	PR202, Srei Snam, Chong Kal and Samraong
18	71	From NR7 to NR6	Bos Knaor and Chamkar Leu
19	73 & 308	From Kandol Chrum to Kracheh	Dambae and Chloung
20	76	From NR7 to Sen Monorom	Sre Preah
21	78	From NR7 to Border	Ban Lung

3.3. DATA PROCESSING

Collected data and information shall be checked and processed by the Consultants according to the format specified by the JICA Study Team.

3.4. SURVEY SCHEDULE

The survey shall be conducted due to the schedule presented in Table 5.

All the supervisors and surveyors have to have an instruction and training program before the implementation of the survey. This program consists from two times of seminars; the first is for MPWT counterpart, senior engineers and supervisors, and the second is for surveyors. The first seminar is instructed by JICA study team and the second is instructed by senior engineer and supervisors with supervision of JICA study team.

Table 5. Survey Schedule

Procedure	Week						
	1	2	3	4	5	6	7
Preparation							
Instruction and Training							
Field Survey							
Data Input and Processing							
Data Analysis and Reporting							

3.5. SURVEY IMPLEMENTATION

The survey including survey preparation, instruction and training of supervisor and surveyor, data processing and reporting shall be completed within 7 weeks after the signing of the contract. The survey shall be conducted under the supervision of MPWT and the JICA Study Team. It is intended that the survey shall be undertaken with following basic organization set-up:

1) Chief Counterpart Chief Counterpart who will assigned from MPWT shall responsible for the request to the police for the assistance in the survey, the announcement of the survey to mass media and the coordination of the participation of DPWT staff to the survey.

2) Chief Engineer Chief Engineer shall be responsible for overall survey activities and reporting works including the recruitment of surveyor, arrangement of mobilization and accommodation of survey team.. He/She will have to keep close contact with the JICA Study Team in the course of the study.

3) Senior Engineer: Senior Engineer shall be assigned to each survey items, namely, Traffic Count Survey, OD Interview Survey, Travel Time Survey. He/She will assist the Chief Engineer and responsible for each survey item. The Senior Engineer of Traffic Count Survey and OD Interview Survey also responsible for the instruction and training of DPWT staff of each province.

4) Counterpart Counterpart assigned from MPWT shall assists Chief Counterpart and Senior Engineer. He/She will mainly assist Senior Engineer in the instruction and training of DPWT staff.

5) Supervisor: Supervisors will assist Survey Coordinator and Chief Supervisor in the course of the survey and be mainly responsible for field survey, training and supervising surveyors. One supervisor shall be assigned for each survey team.

6) Surveyors: Surveyors shall be employed for the field survey;

7) Encoders: Encoders shall be employed for the data processing.

3.6. OUTPUT

The survey output shall be included as follows:

1) Accomplished survey forms, coding sheets;

2) Survey reports including survey description, records of major activities and complied data and information;

3) Organized data in diskette form; and

4) Organized information in other forms such as maps and pictures.

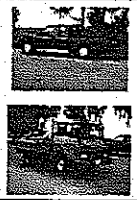
APPENDIX

SURVEY FORM

- A1 Traffic Count Survey
- A2 OD Interview Survey
- A3 Travel Time Survey

A1 Traffic Count Survey

Survey Title	Traffic Count Survey		
Survey Station	No:	Survey Execution	Date:
	Road No: Km:		Weather:
Direction	From:		Surveyor:
	To:		Supervisor:

	I : Motorcycle (MC)		II : Light Vehicle (LV)			III : Heavy Vehicle (HV)		
Vehicle Type / Time Period	Motorcycle/ M. Tricycle	Motorbike Trailer	Sedan/ Wagon/ Light Van	Pick-up/ Jeep/ Light Truck	Mini Bus	Short & Long Body Bus	Short & Long Body Truck	Semi & Full Trailer Truck
								
From: To:								

A2 OD Interview Survey

Survey Title	OD Interview Survey		
Survey Station	No:	Survey Execution	Date:
	Road No: Km:		Weather:
Direction	From:		Surveyor:
	To:		Supervisor:

	1	2	3	4	5
1. Survey Time					
2. Vehicle Type 1) Motorcycle / M.Tricycle 2) Motorbike Trailer 3) Sedan/Wagon/ Light Truck 4) Pick-up/Jeep/ Light Truck 5) Mini Bus 6) Short & Long Body Bus 7) Short & Long Body Truck 8) Short & Long Body Trailer Truck					
3. Seating Capacity (Vehicle Type 1,2,3,5 and 6 only)					
4. No. of Passengers on Board (Incl. driver, Vehicle Type 1,2,3,5 and 6 only)					
5. Major Commodity (Vehicle Type 4,7 and 8 only) 1) Agriculture (Rice, Vegetable, Fruit, etc) 2) Forest (Log, Timber, Plywood, etc.) 3) Marine (Fish, Shell, Seaweed, etc.) 4) Mineral (Coal, Copper, Iron, Salt, etc) 5) Metal & Machine (Steel, Generator, Car & Bike, etc) 6) Chemical (Petroleum, Cement, Alcohol, Acid, etc) 7) Light Industry / Electronics (Machine Parts, IC, Electronic Appliances, etc) 8) Miscellaneous Industry (Garment, Shoes, etc) 9) Construction (Sand, Gravel, Asphalt, Concrete, Re-Bar, Beam, etc) 10) Others					
6. Load Factor (Vehicle Type 4, 6 and 7 only) 1) Full 2) 3/4 3) 1/2 4) 1/4 5) 1/4> 6) Empty					
7. Origin	City/District Province	City/District Province	City/District Province	City/District Province	City/District Province
8. Destination	City/District Province	City/District Province	City/District Province	City/District Province	City/District Province
9.Trip Purpose 1) To Home 2) To Work 3) To School 4) At work / Business 5) Private					
10.Estimated Travel Time (Hours)					
11.Vehicle Registration (Yes / No)					

A3 Travel Time Survey

Survey Title	Travel Time Survey		
Survey Route	No:	Survey Execution	Date:
	Road No:		Weather:
Direction	From:		Surveyor:
	To:		Supervisor:

Check Point (Intersection etc.)	Time Started/ Passed	Delay 1			Delay 2			Delay 3			Delay 4		
		DA	Stop Time	Restart Time	DA	Stop Time	Restart Time	DA	Stop Time	Restart Time	DA	Stop Time	Restart Time
1.													
2.													
3.													
4.													
5.													
6.													
7.													
8.													
9.													
10.													
11.													
12.													
13.													
14.													
15.													

Symbols for Delay Cause:

LT: Left Turn
RT: Right Turn
SS: Sunset
BP: Bus Loading/Unloading
T: General Congestion
HR: Having a Rest
S1: Traffic Signal
S2: Traffic Enforcer
OT: Others

ROAD USER COST CALCULATION

APPENDIX FOR CHAPTER MP-A-12 ROAD USER COSTS

1 INTRODUCTION

1.1 Background

Road user costs (RUC) are the costs borne by the people through use of the road network facility. A road infrastructure project involves three (3) types of cost in its life: They are construction cost, maintenance cost and road user cost. While the construction and maintenance costs are incurred by the concerned road development agency, the road user costs are borne by the users of road improvement. Of three (3) components of life-cycle cost, the road user cost occupies the major proportion depending on the volume of traffic.

1.2 RUC Components

RUC consists of the following two (2) major components:

- Vehicle operating costs (VOC), that is, the physical costs of operating a vehicle such as fuel, lubricants, spare parts, deprecation, crew costs, etc;
- Travel time costs (TTC), that is the value of time spent in traveling that could be used in the other activities

In RUC component, accident cost (ACC), that is the physical costs of an accident and the value of injuries and fatalities, is sometimes taken into accounts. However, ACC is not taken into accounts in this study. This is reasons why saving in ACC is comparatively small in amount compared with the saving in VOC and TTC.

1.3 Presumption of RUC Estimation

(1) Standard Vehicle Class and Typical Vehicle Models

Taking into account vehicle classification made in the traffic survey, the following vehicle classes are adopted in this study:

- Motor Cycles	Honda 100
- Car	Toyota Corolla 1500
- Pick up	Toyota Hilux 2 WD
- Mini Bus	Toyota Hiace Commuter
- Big Bus	Hyundai Bus Aero Space LD 45 Seater
- Light Truck	Isuzu N Series
- Medium Truck	Isuzu F Series
- Heavy Truck	Isuzu H Series

(2) Economic versus Financial Cost

Economic appraisals of a road project should always be undertaken in economic terms. This

requires that both construction and maintenance costs and vehicle operating costs are quoted net of all taxes, duties, effects of shortage of skilled labor and foreign exchange. Where a good is traded internationally this can be undertaken easily by identifying tax and duty (or subsidy) elements of retail prices and removing these tax and duty. The residue is economic prices, including an element of profit for traders where markets are competitive.

However, many goods are not traded internationally, either because they cannot be transported or they have no value outside the country such as vehicle crew cost and passenger time saving. In these cases different methods of estimating economic prices are required. Two (2) typical methods are by estimating the shadow wage factor (SWF) for unskilled labor and a standard conversion factor (SCF).

(3) Identification of Tax and Duty Price Elements

For the purpose of the analysis, the economic prices have been calculated in each case from first principles, involving the build up of the different price elements from published sources. Firstly the retail prices have been estimated based on the survey of suppliers detailed below.

From these retail prices, elements of import duties, value added tax and retailers margin have been identified. By this method, the CIF or border prices for each goods have been estimated.

Information on import duties and value added tax (VAT) has been extracted from "The Feasibility Study on the Improvement of National Road No. 1 (Phnom Penh – Neak Loueng Section)" March 2003 by JICA and these are partially updated in this study.

(4) Use of Shadow Wage Rate

Labor markets are often distorted by the Government policies, including minimum wage legislation, restrictions on import of certain types of skilled and semi-skilled labor so on. Each of these can lead to a divergence between the wage rate and its economic worth. The effects of these policies and restrictions will tend to be for different types of labor.

Three (3) general types of labor are usually defined within such an analysis, skilled, semi-skilled and unskilled. The former of these is generally highly mobile both within a country and internationally. It is therefore safe to assume that no market distortions can be exist in this area.

The semi-skilled labors are however generally mobile, certainly within a country, but often internationally. As with skilled workers it is therefore reasonable to assume that wage rates tend towards economic wage rates in these areas.

The unskilled laborers are however generally immobile. In these cases, wage rates are likely to be subject to market distortions. The most appropriate way to measure the economic wage of unskilled labor is to undertake an analysis of the opportunity cost i.e. how much would be the laborers earning alternative employment. Since most of the construction unskilled workers are employed in agriculture, the opportunity cost of this labor can therefore be considered to be its

agricultural output.

The shadow wage rates for Cambodia calculated is shown in **Table 1.1**.

Table 1.1 Shadow Wage Rate

	Skilled or Semi-skilled	Unskilled
Index	1.00	1.00
Average Agriculture production Loss	0	0.52
Shadow Wage Rate Factor	1.00	0.48

(5) Use Standard Conversion Factor (SCF)

The Standard Conversion Factor (SCF) is a standard method of incorporating the effects of shortage of foreign exchange, the effects of market distortions, and the implications of protectionist trade policies within the economic appraisals. Since individual analysis of all of these effects is often a time consuming and fruitless process, the SCF avoids the need to undertake detailed analysis.

The factor takes into account the effect of import duties, VAT on imports and export taxes in assessing the true value of goods. These are calculated as alongside observed exchange rates to develop a conversion factor to be applied to price elements which are not subject of individual study.

The SCF can be calculated using a standard set of formula. The calculation for Cambodia is shown in **Table 1.2**.

(6) Exchange Rate

For the purpose of the study an exchange rate of US$ 1.00 = Riels 4,000 has been used. This represents an average of the rate prevailing in Phnom Penh in January 2006.

Table 1.2 Calculation of Standard Conversion Factor

Items	Variable/Equations	2000	2001	2002	2003	2004
Imports						
Total Imports	TQM	8,697.9	9,390.4	10,547.7	11,737.8	14,879.3
Duty Free Imports		469.1	509.5	466.0	341.9	301.2
Net Imports	QM=TQM	8,228.8	8,880.9	10,081.7	11,395.9	14,578.1
Exports						
Total Exports	TQX	7,019.7	8,213.9	9,238.7	10,149.5	12,704.1
Re-exports	RXX	454.2	427.7	434.4	464.2	211.4
Net Exports	QX=TQM-RXX	6,565.5	7,786.2	8,804.3	9,685.3	12,492.7
Balance of Trade		1,663.3	1,094.7	1,277.4	1,710.6	2,085.4
Import Duties						
Total Import Duties	TID	327.1	390.0	346.6	493.0	404.2
Import Excise Duties	TR	134.7	130.0	181.2	164.2	255.2
Import Taxes and Duties	TR	364.1	413.0	407.8	374.9	491.3
Import Tariff Rate	ITR=(IT+TR)/QM	0.095	0.099	0.089	0.088	0.077
Total Duties and Taxes on Imports	T=TID-TED	825.9	933.0	935.6	1,032.1	1,150.7
Export Duties						
Total Duties and Taxes on Exports	TED	10.0	14.0	14.4	17.9	19.3
Export Tax Rate	ETR=TED/QX	0.002	0.002	0.002	0.002	0.002
Elasticties and Weights						
Elasticity of Supply	Es	1	1	1	1	1
Elasticity of Demand	Nd	-1	-1	-1	-1	-1
Weight on Supply	Ws=Es/(Es-(Nd*(QM/QX)))	0.444	0.467	0.466	0.459	0.461
Weight on Demand	Wd=(Nd*(QM/QX))/(Es-(Nd*(QM/QX))	-0.556	-0.533	-0.534	-0.541	-0.539
Official Exchange Rate	OER	3,854	3,924	3,920	3,980	4,023
Standard Conversion Factor						
Fraction of Current BOP Deficit Sustainable	F	90%	90%	90%	90%	90%
Equilibrium Norminal Exchange Rate	EER=OER*(1+((1-F)*dQ)/(Es*QX-Nd*QI	4,283	4,179	4,183	4,300	4,330
Shadow Exchange Rate	SER=EER*(Ws*(1-TX)+Wd(1+TM)	4,507	4,397	4,378	4,501	4,507
Shadow Exchange Rate Factor	SERF=SER/OER	1.052	1.052	1.047	1.047	1.041
Standard Conversion Factor	SCF=OER/SER	0.855	0.892	0.895	0.884	0.893

Source: JICA Study Team

2 INPUTS FOR VEHICLE OPERATING COSTS

2.1 Vehicle Prices

The vehicle prices have been estimated on the basis of average prices for new vehicles from new vehicle dealers. Most of vehicles are imported to Cambodia as second hand reconditioned vehicles. However, the new vehicle prices are used in this study.

For the purpose of calculating the economic price of each vehicle these taxes and import duty have been subtracted from retail price. The resulting economic price incorporates elements of CIF price, retailer's margin, and covering transport cost. **Table 2.1** shows the economic cost of the vehicle price.

Table 2.1 Vehicle Prices

(US $)

Type	Typical Model	CIF	Import Duty /	Retail	Financial	Economic
Motor Cycle	Honda 100	607	182	61	850	668
Car	Corolla 1600	14,969	17,264	1,467	33,700	16,436
	Toyota Hilux	13,166	5,154	2,680	21,000	15,846
Mini Bus	Toyota Hiace Commuter	25,124	9,836	4,540	39,500	29,664
Big Bus	Hyundai Bus	51,958	20,342	10,391	82,690	62,350
Light Truck	Isuzu NPR 55 E	17,767	6,957	1,777	26,500	19,963
Medium Truck	Isuzu FSR 33	33,523	13,124	3,352	50,000	36,875
Heavy Truck	Isuzu CYR 80	58,196	22,784	11,639	86,800	69,835

Source: Interview from various dealers

2.2 Tire Costs

The economic costs of tires have been assessed in the same way as vehicle prices. Various suppliers in Phnom Penh are surveyed to assess average prices of different types of tire.

New tires are subject to import duty, and VAT. The rate of these vary from different types of tire. Import duty is principally charged at 15 % of the CIF of value of the tire. The current rate of VAT is 10 % of all types of tire.

For the purpose of calculating the economic price of each vehicle tires, these taxes and import duty have been subtracted from retail price. The resulting economic price incorporates elements of CIF price, retailer's margin, and covering transport cost. **Table 2.2** shows the economic cost of the vehicle tire price.

Table 2.2 Tire Cost

(US $)

Type	Tire Size	No. of Tire	CIF	Import Duty / VAT	Retail Margin	Financial Cost	Economic Cost
Motor Cycle	100/17	2	12.6	3.1	1.3	17.0	13.9
Car	185/70	4	91.8	55.1	9.2	156.0	100.9
Small Bus	195/80	4	118.5	29.6	11.9	160.0	130.4
Big Bus	11.00-20	6	653.3	163.3	65.3	882.0	718.7
Light Truck	7.50-16	4	198.5	49.6	19.9	268.0	218.4
Medium Truck	8.25-16	6	373.4	93.3	37.3	504.0	410.7
Heavy Truck	11.00-20	10	1,088.9	272.2	108.9	1,470.0	1,197.8

Source: Interview from various suppliers

2.3 Fuel and Lubricants Costs

Fuel and lubricants prices have been estimated based on a survey of prices in Phnom Penh.

There are a number of suppliers in here operating competitively. Three (3) types of fuel are available, gasoline which can subdivide into two (2); super and regular, and diesel.

Fuels are subject to import duty, special tax, surcharge, and VAT.

For the purpose of calculating the economic price of fuel and lubricants, these taxes and import duty have been subtracted from retail price. The resulting economic price incorporates elements of CIF price, retailer's margin, and covering transport cost. **Table 2.3** shows the economic cost of the Fuel and Lubricants Costs.

Table 2.3 Fuel and Lubricants Costs

(US $)

Type	CIF	Import Duty / Special Tax	Retail Charge	Retail Price	Economic Cost
Gasoline Super	0.66	0.26	0.08	1.00	0.74
Gasoline Regular	0.65	0.26	0.08	0.99	0.73
Diesel	0.51	0.21	0.06	0.78	0.57
Lubricant	1.78	0.71	0.21	2.70	1.99

Source: Interview from various suppliers

2.4 Vehicle Maintenance Costs

(1) Spare Parts Costs

The spare parts costs have been estimated based on a survey of necessary average maintenance costs per year.

Table 2.4 shows the spare parts cost.

Table 2.4 Spare Parts Cost

(US $)

	Motor Cycle	Car	Pick-up	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
Vehicle price (Economic Cost)	850	33,700	21,000	39,500	82,691	41,676	66,060	72,440
Vehicle price (Economic cost)	668	16,436	15,846	29,664	62,350	31,425	49,810	54,620
Spareparts rate (%)	1.00	0.83	0.83	1	1	0.83	0.83	0.83
Spareparts cost (Financial cost)	8.50	279.71	174.30	395.00	826.91	345.91	548.30	601.25
Spareparts csot (Economic cost)	6.68	136.42	131.52	296.64	623.50	260.83	413.42	453.35

Source: JICA Study Team

(2) Maintenance Labor Cost

The maintenance costs have been estimated based on a survey of average monthly cost of skilled supervisor and semi-skilled mechanics in Phnom Penh. Applied to average working hours of 200 hours per month, proportion of working time and the Shadow Wage Rate Factor (SWRF), it is calculated and is shown in **Table 2.5**.

Table 2.5 Maintenance Labor Cost

(US $)

	Motor Cycle	Car	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
Wages per month							
Supervisor	300	300	300	300	300	300	300
Mechanic	125	125	125	125	125	125	125
Owner	0	0	0	0	0	0	0
Maintained by (%)							
Supervisor	10	25	25	50	25	50	50
Mechanic	40	50	50	50	50	50	50
Owner	50	25	25	0	25	0	0
Maintenance hours per year	40	70	250	300	250	300	350
Average hourly rate for services	0.23	0.51	1.81	2.19	1.81	2.19	2.56
Shadow wage rate factor	1	1	1	1	1	1	1
Economic rate	0.23	0.51	1.81	2.19	1.81	2.19	2.56

Source: JICA Study Team

2.5 Crew Cost

The crew costs have been estimated based on a survey of that of unit costs per drivers and conductor or helpers, number of staff per vehicle, and number of hours per vehicle. In Cambodia, unit costs for drivers are estimated at around US$ 150 to $ 200 per worker depend on the type of vehicle, while conductors or helpers are estimated to be one half of the average monthly cost of skilled supervisor and semi-skilled worker in Phnom Penh. Applied to average working hours of 200 hours per month, proportion of working time and the Shadow Wage Rate Factor (SWRF), it is calculated and is shown in **Table 2.6**.

Table 2.6 Crew Cost

(US $)

	Motor Cycle	Car	Pick-up	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
Number of divers	0.25	0.5	0.75	1	1	1	1	1
Average monthly wage rate	150	200	200	200	200	200	200	200
Working Hour	200	200	200	200	200	200	200	200
Average hourly rate for driver	0.188	0.500	0.750	1.000	1.000	1.000	1.000	1.000
Skilled wage factor - Semi-skilled	1	1	1	1	1	1	1	1
Driver cost (Economic)	0.188	0.500	0.750	1.000	1.000	1.000	1.000	1.000
Number of conductors	0	0	0	0.5	1	1	1	1
Average monthly wage rate	100	100	100	100	100	100	100	100
Working Hour	200	200	200	200	200	200	200	200
Average hourly rate for conductor	0.000	0.000	0.000	0.250	0.500	0.500	0.500	0.500
Skilled wage factor – Unskilled	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Conductor cost (Economic)	0.000	0.000	0.000	0.120	0.240	0.240	0.240	0.240

Source: JICA Study Team

2.6 Vehicle Utilization and Depreciation

The depreciation cost can be expressed as a percent of new vehicle cost and is given by following formula:

Car per 1,000 veh-km = DEP/ New vehicle prices

A vehicle is a medium-term asset. Its purchase costs represents an investment which yields services over several years. The market value of the asset declines with both the passenger of time and with amount and type of usage.

It is this loss of market value that represents vehicle depreciation. The vehicle depreciation per km is a function of the average annual depreciation and annual utilization.

DEP = ADEP/AKM

Where: ADEP: Average annual depreciation, expressed as % of average new vehicle cost

ADEP: (1 / LIFE)*100

LIF is average vehicle service life

AKM: Average number of kilometers driven per vehicle per year

The annual kilometers and hours driven are used as shown in **Table 2.6**.

The interest rate is applied at 12% per year taking into account of the opportunity capital of Cambodia.

2.7 Summary of Basic VOC

Based on the above mentioned discussions and estimations, the basic vehicle operating costs (BVOC) are calculated and shown in **Table 2.7.**

Table 2.6 Vehicle Characteristics

Type	Abbreviation	Fuel Type	Number of Axles	Number of Wheels	Aerodynamic Drag Coeff.	Projected Frontal Area	Operating Weight	Annual Utilization	Service Life	Hour Worked	Occupancy
Motor Cycle	MC	P	2	2	0.70	0.8	0.2	7,200	10	400	2.5
Moto-Dop	MD	P	2	2	0.70	0.8	0.2	10,000	10	400	3.5
Moto-Rumok	MR	P	2	4	0.70	0.8	0.4	10,000	10	400	20.0
Passenger Car	PC	P	2	4	0.42	1.9	1.2	20,000	15	550	2.5
Light Bus	LB	D	2	4	0.50	4.0	2.5	30,000	15	750	15.0
Heavy Bus	HB	D	2	6	0.55	5.0	6.0	30,000	15	1750	30.0
Light Truck	LT	D	2	4	0.55	4.0	2.0	30,000	15	1300	3.1
Medium Truck	MT	D	2	6	0.70	8.5	9.0	40,000	15	1200	3.1
Heavy Truck	HT	D	3	10	0.80	9.0	11.0	60,000	15	2050	3.1
Van/Pickup	VA	P	2	4	0.50	2.0	1.5	30,000	15	1300	2.5

Table 2.7 Basic Vehicle Operating Cost by Vehicle Types, 2006 Prices

US $/1000 km

Type	Item	Motor Cycle	Car	Pick-up	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
Distance related VOC	Fuel cost	145.3	2,543.5	3,052.1	3,270.2	11,973.8	3,877.2	14,710.6	14,710.6
	Lubricant cost	8.0	19.9	29.9	39.8	348.3	123.8	359.4	359.4
	Tire cost	6.9	63.1	75.7	97.8	1006.1	174.7	706.4	2060.2
	Maintenance cost	6.7	136.4	131.5	296.6	623.5	199.6	306.1	579.6
	Depreciation cost	0.4	8.5	9.8	18.3	38.5	10.3	16.3	30.8
	S-total	167.3	2,771.3	3,299.0	3,722.7	13,990.2	4,385.6	16,098.8	17,740.7
	Overhead cost	0.0	0.0	329.9	372.3	1,399.0	438.6	1,609.9	1,774.1
	Total	167.3	2,771.3	3,628.9	4,095.0	15,389.2	4,824.2	17,708.7	19,514.7
Time related VOC	Crew cost	75.0	275.0	412.5	1,344.0	2,170.0	1,488.0	2,542.0	2,542.0
	Maintenance cost	2.3	5.1	5.1	18.1	21.9	18.1	21.9	25.6
	Insurance cost	20.0	493.1	475.4	296.6	623.5	199.6	368.8	698.4
	Depreciation cost	0.2	4.6	5.3	9.9	20.7	5.5	8.8	16.6
	S-total	97.6	777.7	898.2	1,668.6	2,836.1	1,711.2	2,941.4	3,282.5
	Overhead cost	0.0	0.0	89.8	166.9	283.6	171.1	294.1	328.3
	Total	97.6	777.7	988.0	1,835.4	3,119.8	1,882.3	3,235.6	3,610.8
Total		264.9	3,549.0	4,616.9	5,930.4	18,509.0	6,706.5	20,944.3	23,125.5
VOC /1000 km		26.5	142.0	153.9	197.7	264.4	167.7	243.5	268.9

Source: JICA Study Team

2.8 VOC by Surface Type and IRI

Condition of the surface type and road roughness is very important factor to calculate the VOC. The empirical studies carried out has already found out the relationship between International Roughness Index (IRI) and VOC or between travel time and VOC. Based on these relationships, VOC by road roughness is computed and shown in **Table 2.8** and **Figure 2.1** and VOC by travel time is shown in **Figure 2.2**.

Table 2.8 Vehicle Operating Cost by Road Roughness

(US$/1000 km)

IRI	Motor Cycle	Car	Pick Up	Mini Bus	Large Bus	Light Truck	Medium Truck	Heavy Truck
2	26.5	142.0	153.9	197.7	264.4	167.7	243.5	268.9
3	26.7	142.8	155.2	199.4	267.1	168.5	245.6	271.1
4	27.4	148.2	163.2	209.6	285.3	174.0	255.9	282.6
5	28.4	154.5	171.4	220.2	304.1	181.6	266.3	293.9
6	29.5	161.5	179.7	230.8	321.8	192.2	275.3	303.9
7	30.8	169.7	187.7	241.0	339.0	203.8	282.5	311.9
8	32.0	178.6	195.9	251.6	357.8	216.0	291.5	321.9
9	33.4	188.1	204.7	262.9	378.4	228.3	302.5	334.0
10	35.0	197.9	214.0	274.8	400.1	240.5	315.1	347.9
11	36.6	207.9	223.8	287.5	422.8	252.6	329.1	363.3
12	38.4	218.0	233.9	300.4	445.8	264.4	343.5	379.3
13	40.0	228.0	244.0	313.4	469.1	275.8	358.6	395.9
14	41.8	238.1	254.4	326.7	492.6	287.0	373.9	412.7
15	43.6	247.8	264.7	340.1	516.1	297.7	389.4	430.0

Source: JICA Study Team

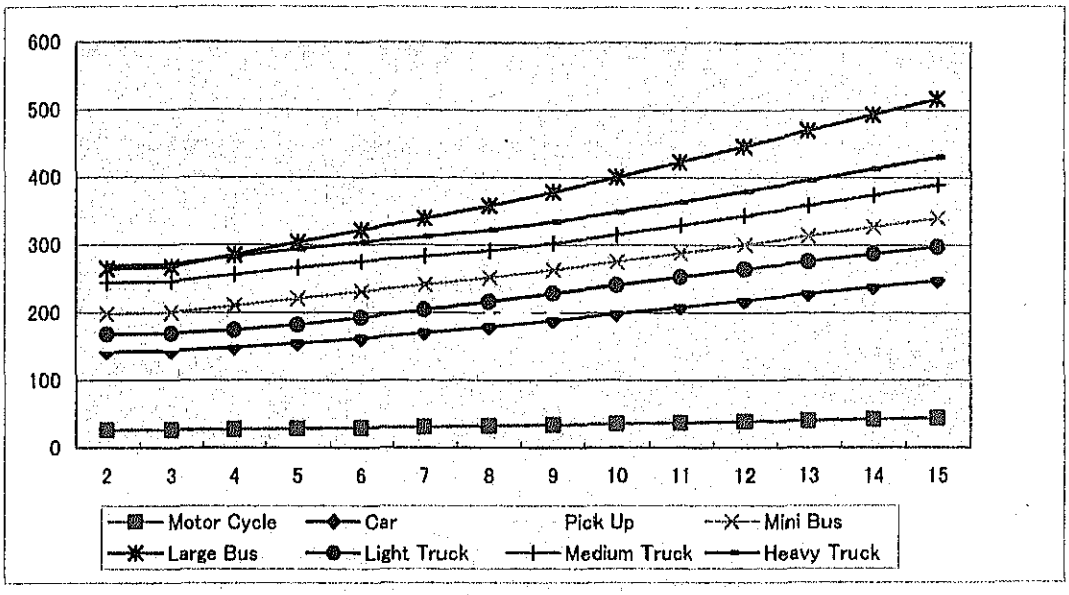


Figure 2.1 Relationship between Vehicle Operating Cost and Road Roughness

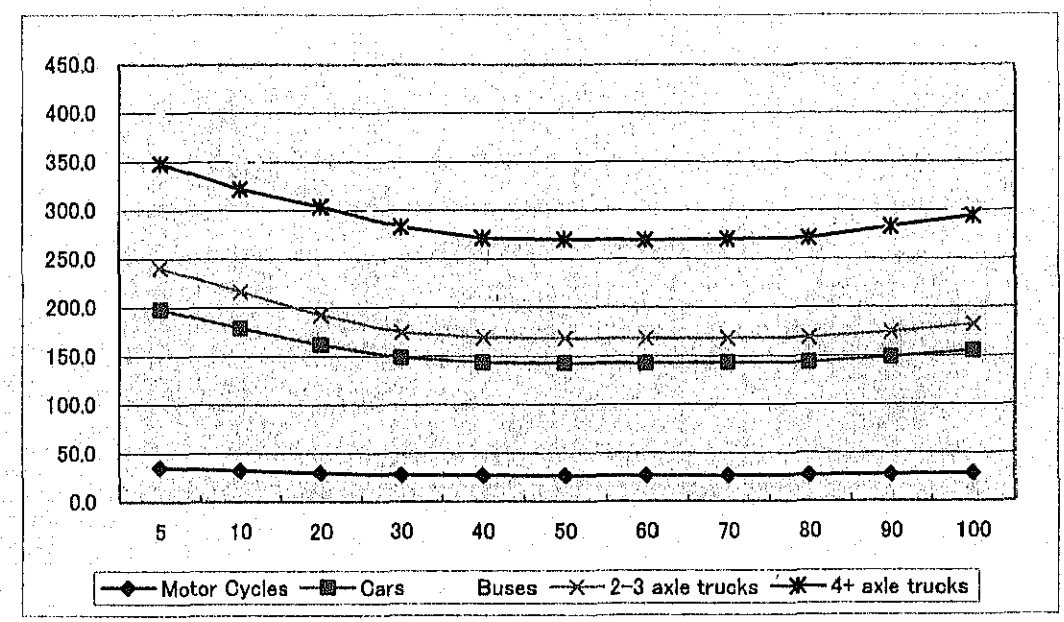


Figure 2.2 Relationship between Vehicle Operating Cost and Travel Speed

2.9 VOC W/O and W/ Project

Based on VOC set up above, unit VOC in cases of with and without improvement is estimated in **Table 2.10**. This VOC is calculated on the basis of vehicle composition as shown in **Table 2.9**.

Table 2.9 Vehicle Composition

	M/Cycle	LV	HV	Total
Vehicle Base	0.669	0.264	0.067	1.000
PCU Base	0.239	0.472	0.289	1.000

Source: Traffic count survey conducted in this study

Table 2.10 VOC W/O and W/ Project

US $/1000 km

Surface Type	Asphalt Concrete (AC)	DBST	Literate Road		Earth Road	
			Dry	Rainy	Dry	Rainy
W/O Improvement	164.6	171.1	177.6	185.0	185.0	202.0
Notes	IRI=5	IRI=6	IRI= 7	IRI=8	IRI=8	IRI=10
Surface Type	Asphalt Concrete (AC)			DBST		
W/ Improvement	151.6			155.1		
Notes	IRI=2.5			IRI=3.5		

Source: JICA Study Team

3 TRAVEL TIME COST (TTC)

3.1 General

Travel time costs (TTC) also referred to as Value of Time (VOT) are an important components of road user costs (RUC). The concept of travel time costs is based on a premise that the time spent in traveling has an ' opportunity cost" and could be used in an alternative activity which also produce or may produce some significant utility (benefit). If the alternative activity can have monetary value assigned to it, this can be used as a part of RUC in the economic appraisal of the projects, particularly road improvement project.

TTC may vary from country to country, even from project to project in the same country. This can vary in amount from below 20 % of total RUC to over 80 % of the same in the economic appraisal of the projects depending on the extent of time delays involved in cases of the project. Value of time will be much higher in the developed counties than that in a developing country.

3.2 Methodology

To estimate the travel time costs, the Average Wage Approach method is taken into consideration. The wage rates of vehicle occupants are assessed and then their average rates is estimated to reflect the value of time of occupants in different vehicles. An assessment of umber of travelers in working time and non-working time is made for each vehicle type.

The TTC for working time is then as the estimated wage rate and that for non-working time is not taken into accounts in this study.

3.3 Forecast of Time Value

Table 3.1 shows the monthly income of workers. For this analysis it is chosen different measure of the time valus for motor-cycle, light vehicle (LV) and heavy vehicle (HV). For LV, it is chosen average income of top three (3) deciles of monthly income. For motor cycle, it is chosen average income of next three (3) deciles (200,000- 7500,000 Riels) of monthly income.

Table 3.1 Number of Employment by Monthly Wages, 2001

Monthly Wages	No of Workers	Percent
49,900 or less	129,055	12.6
50,000 – 99,900	305,966	30.2
100,000-149,900	177,101	17.5
150000-199,900	190,095	18.8
200,00-299,900	125,057	12.3
300,000-499,900	66,485	6.6
500,000-749,900	9,785	1.0
750,000-999,900	5,690	0.6
1,000,000-1,999,000	3,025	0.3
2,000,000 or over	1,295	0.1
Total	1,013,554	100.0

Source Statistical Yearbook 2005

Table 3.2 Composition of Trip Purpose

Trip Purpose	Percent
To Home	21.5
To Work	19.3
To School	7.7
Shop	12.6
Business	31.0
Private	7.9
Total	100.0

Source: Traffic Survey conducted in this study

Table 3.3 Per Capita GDP and its Growth Rate

	2001	2002	2003	2004	2005
Per Capita GDP	293	303	314	328	341
Growth Rate (%)	1.9	3.4	3.6	4.6	4.0

Table 3.4 Estimation of Time Value Computation by Vehicle Type

	M/Cycle	LH	Bus
Hourly Income in 2001 in Riel	1,300	5,257	814
Hourly Income in 2001 in US $	0.33	1.34	0.21
Deflator from 2001 to 2005	1.16	1.16	1.16
Time Value in 2005 in US $	0.38	1.56	0.24
Occupancy	1.87	2.97	29.48
Time Vale per Vehicle	0.32	2.39	3.17

Source: JICA Study Team

Table 3.5 Per Capita GDP and its Growth Rate,2001-2005

	2001	2002	2003	2004	2005
Per Capita GDP	293	303	314	328	341
Growth Rate (%)	1.9	3.4	3.6	4.6	4.0

Table 3.6 Future Per Capita GDP and its Growth Rate, 2005-2020

	2005	2010	2015	2020
GDP (US $ Million)	4,929	6,605	9,247	13,501
Population ('000)	13,800	15,300	16,900	18,700
Pre Capita (U$ $)	357	432	547	722
Growth Rate	1.00	1.21	1.53	2.02

Source: JICA Study Team

Table 3.7 Forecast of Time Value per vehicle by Vehicle Type

US $ / hour

	2005	2010	2015	2020
Motor Cycle	0.321	0.388	0.491	0.648
LV	2.394	2.897	3.663	4.836
Bus	3.166	3.831	4.844	6.395

Source: JICA Study Team

REFERENCE FOR ENVIRONMENTAL AND SOCIAL CONSIDERATION

ENVIRONMENTAL AND SOCIAL CONSIDERATION FOR THE IMPROVEMENT OF NR.57

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR NR.57

1 Introduction

1.1 Introduction

The annex of sub decree No.72.ANRK.BK, 11 August 1999, on the environmental impact assessment process, stipulates the type of projects that require environmental impact assessments (EIA). According to the sub decree, construction projects for national roads exceeding 100 km in length require a full scale EIA. The project length for NR.57 is 104 km, which exceeds the 100 km limit. Therefore a full scale EIA is required for the construction project for NR.57.

In order to conduct the EIA, a detailed survey of several items, including the consideration of social aspects, is necessary. In consideration of the situation in Cambodia, however, the necessary survey could not be conducted at the same time as the pre-feasibility study for NR.57. There are several reasons why the EIA could not be conducted.

One of the reasons is that illegal squatting and land speculation might be encouraged if the survey is conducted at this time, as the date for implementation of the project has not yet been decided. If the time span between the date for project implementation and the EIA survey is longer, there is an even greater risk of illegal squatting and land speculation. While if the time span is shorter, the risk is lower. The ineffective law enforcement and land management situation in Cambodia allows for such illegal squatting and land speculation.

Another reason is the validity of EIA. According to information gained in an interview with the director of the EIA department of MOE, the validity of an EIA is two (2) years after approval. Therefore if the project implementation commences more than two (2) years after EIA approval, the EIA has to be conducted again in order to update the current situation. Therefore it is not effective to conduct the EIA at a time when the date of the project implementation is not known.

In this context, it is recommended that the EIA should be conducted as soon as possible after the project implementation date has been decided. However, this chapter still aims to prepare information and clarify the process for conducting the EIA.

The information in this chapter is based on the data and information available at the master plan level. Therefore, it is recommended that all of the information should be confirmed and clarified when the EIA is conducted.

1.2 General

The project impacts can be divided into two (2) types: impacts observed during the project implementation, including those occurring during the design and construction period; and impacts occurring after project implementation. Impacts occurring during the project implementation are generally caused by land acquisition and construction works, such as earthworks, construction

machines and equipment.

Impacts occurring after the project completion include increased traffic volumes and speeding vehicles. The project does not involve the development of a new road but the improvement of an existing road, which includes pavement upgrading from laterite to AC and road widening. Therefore, the traffic and infrastructure systems will basically remain the same. The major changes incurred as a result of the project will relate to safety, stability, serviceability and the width of the road. There may also be some increase in vehicle speeds.

It is anticipated that traffic volumes will increase following the project completion. This increase will not be caused directly by the project but will be the result of an increase in population and economic development in the future. Whether the existing road is improved or not, all vehicles will have to pass this road as there are no alternative roads. Therefore, traffic volumes with or without the project will be basically the same, although the project will contribute to the economic development of the area. The traffic volume in 2005 and the estimated volume in 2020 are shown in the table below. Based on the traffic survey and demand forecast conducted by the JICA Study Team the traffic volume in each section will have increased several times by 2020.

Table 1 Traffic Volume (PCU)

Section No.	2005	2010	2015	2020
42	1,731	2,163	2,594	4,555
43	475	544	612	2,189
44	569	834	1,284	2,397

2 Scoping Study

The following table is a checklist for the scoping study, based on the JICA guidelines.

Table 2 Checklist for the Scoping Study

No	Impacts	Category	Description
Social Environment: *The impacts on "Gender" and "Children's Rights" are likely to be related to all of the Social Environment criteria.			
1	Involuntary Resettlement	C (A)	A measurement survey is necessary to clarify the affected properties and impacts, however a large degree of involuntary resettlement is expected.
2	Local economy such as employment and livelihood, etc.	B	Several shops/restaurants will be relocated due to the land acquisition and some vendors along the road will also be affected. The socio-economic conditions might change indirectly as a result of the socio-economic development through the project.
3	Land use and utilization of local resources	B	Some parts of the cultivated land in PRW will be affected by the land acquisition. Disordered development and land use changes might be caused by the project indirectly.

Table 2 Checklist for the Scoping Study

No	Impacts	Category	Description
4	Social institutions such as social infrastructure and local decision-making institutions	C	The survey should be conducted after the decision has been made for the project implementation.
5	Existing social infrastructure and services	C	The survey should be conducted after the decision has been made for the project implementation.
6	The poor, indigenous and ethnic people	C	The survey should be conducted after the decision has been made for the project implementation.
7	Unequal distribution of benefits and damage	C	The survey should be conducted after the decision has been made for the project implementation.
8	Cultural heritage	C	The survey should be conducted after the decision has been made for the project implementation.
9	Local conflict of interests	C	The survey should be conducted after the decision has been made for the project implementation.
10	Water usage or water rights and rights of common	C	The survey should be conducted after the decision has been made for the project implementation.
11	Sanitation	C	The survey should be conducted after the decision has been made for the project implementation.
12	Hazards (risks) e.g. infectious diseases such as HIV/AIDS	B	Infection diseases might be increased by construction workers during the construction period.
Natural Environment			
13	Topography and Geographical features	no	
14	Soil Erosion	no	
15	Groundwater	no	
16	Hydrological Situation	B	Water flow difficulties in river during the construction period.
17	Coastal Zone	no	There is no coastal zone along the road.
18	Flora, Fauna and Biodiversity	B	Wildlife, birds, fish and other aquatic animals might be disturbed during the construction period.
19	Meteorology	no	
20	Landscape	no	
21	Global Warming	no	
Pollution			
22	Air Pollution	B	- Dust during construction period. - Air pollution after construction with the increase in the future traffic volumes.
23	Water Pollution	B	Risk of water pollution during construction.
24	Soil Contamination	no	
25	Waste	B	- Construction and demolition waste from existing bridge - Waste from construction yard.
26	Noise and Vibration	B	- Noise and vibration during construction period. - Noise and vibration after construction with the increase in the future traffic volumes.
27	Ground Subsidence	no	
28	Offensive Odors	no	
29	Bottom sediment	B	Benthos might be disturbed during the construction period.
30	Accidents	B	- Traffic accidents might occur due to the speed of vehicles after construction. - Traffic accidents might occur during the construction period due to the detour road.
31	Others	B	- UXOs

Table 2 Checklist for the Scoping Study

No	Impacts	Cate gory	Description
			- Landmines

Rating:
A: Serious impact is expected.
B: Some impact is expected.
C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.)
No Mark: No impact is expected. IEE/EIA is not necessary.

Many of the items fall within category C. Therefore the necessary surveys must be conducted after the decision has been made for the project implementation. Even though some items fall within category B, these should be examined when the EIA is conducted.

3 Social Impacts

(1) Involuntary Resettlement

ROW

The ROW for NR-57 is 25 m from the center line. Many properties, which should be confirmed through a survey, are located in the ROW.

PRW

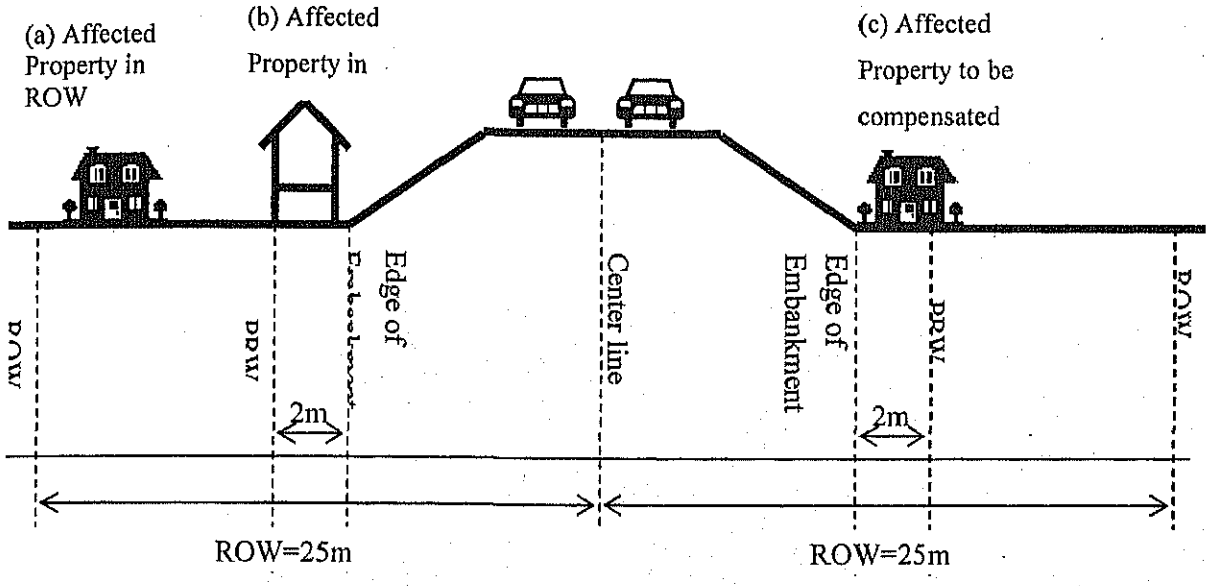
The provisional road width (PRW) has been set at 2 m from the edge of the embankment in terms of engineering and construction and in consideration of the experience gained through the NR-1 C-1 section (Japanese grant), in which the PRW was 2-3 m. This 2 m width is necessary for the construction work, such as allowing access by construction machines and truck passing bays. Therefore, properties within the PRW will need to be removed for the construction to proceed. A survey is necessary in order to clarify how many properties are within the PRW.

Compensation

Basically, the properties affected by the project will be paid compensation. However, if the dwelling can be easily moved (such as a cottage, etc.), compensation will not be paid.

PAPs

The project affected persons (PAPs) should also be clarified through the survey.



Involuntary resettlement is one of the most serious effects of the project and needs to be carried out effectively and considerately. In the more populated areas in the center of Battanbong and Pailin, the necessary measures relating to the required resettlement need to be considered and formulated in a resettlement action plan (RAP), which would include the number of PAPs, compensation, a detailed measurement survey (DMS), negotiation, grievance mechanisms, a relocation site if required, and monitoring.

(2) Local Economy, Land Use and Local Resources

A number of shops/restaurants, vendors and some sections of cultivated land will be affected by the project. Compensation should be paid for these properties where necessary.

A portion of NR.57 is on the border line of the protected Samlot multiple use area, which is stipulated in declaration (Parkas) No.1033 on protected areas, 3 June 1944. The unique characteristics of the protected area are described in Annex E of the declaration as follows.

It is an evergreen forest area within the watershed of the Battambang River. It has been denuded by mining operations causing severe erosion and increased sedimentation of the river FIGURE DELETED which flows into the Tonle Sap Lake.

Investigation and necessary mitigation measures should be considered in order to protect the environment in the area together with MOE.

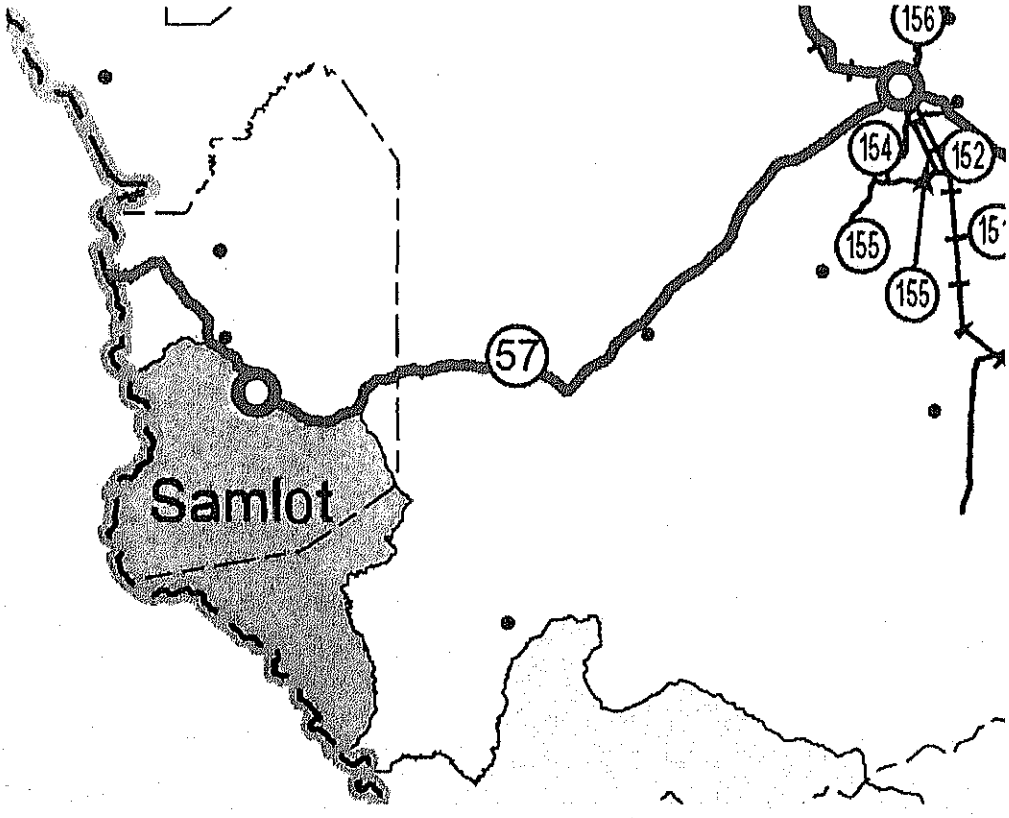


Figure 1 Samlot Multiple Use Area

(3) Water Usage

River water usage may be affected by the construction works. The construction method needs to be considered in relation to minimizing changes in the water flows and usage. The continuation of the river discharge must be ensured, and consequently the substructure should be constructed in the dry season so that the impacts can be minimized.

(4) Infectious Diseases

Cases of infectious diseases, such as HIV/AIDS, might increase in the construction workers during the construction period. Many construction workers will come to the project sites from outside of the area.

Educational training on HIV/AIDS and other infectious diseases should be conducted for the construction workers. NGOs who are involved in these activities should conduct the training.

4 Natural Impacts

(1) Hydrological Situation

During the construction period, the hydrological situation might be impacted in the river crossing areas. The hydrological situation will not be impacted in the long term by the construction

works (i.e the situation after the construction will not be different than the situation before the construction works) even though riverbed protection works will be carried out. In order to ensure the continuation of the river discharge, a construction method should be applied to minimize the impacts during the construction period.

(2) Flora, Fauna and Biodiversity

Wildlife, birds, fish and other aquatic animals may be disturbed during the construction period. In particular, fish and other aquatic animals may be affected during the construction period. A construction method should be adopted that will minimize such impacts, for example utilizing methods to avoid the occurrence of muddy water.

(3) Air Pollution

Dust will appear during the construction period due to the earthworks and detour roads. Periodic sprinkling and covering the detour roads with gravel will be necessary, especially in the populated areas.

Following the construction works, there may be an increase in air pollution due to the increase in future traffic volumes, although this is considered to be an indirect impact.

The improvement of the pavement conditions and road widening will contribute towards smoothing the traffic flows as cars will not need to stop or drive slowly in the bumpy areas. This improvement in traffic flows may contribute towards decreasing emissions.

(4) Water Pollution

Water pollution may occur during the construction period, due to wastewater being produced from the construction works, such as from cement. Such wastewater will need to be adequately treated prior to disposal.

Water quality monitoring is necessary, including a baseline survey prior to construction. If the monitoring results exceed the standards, mitigation measures will need to be promptly administered.

(5) Waste

Three (3) types of waste will be created during the construction works; construction waste, demolition waste from the existing bridges, and waste from the construction yards. The demolition waste from the existing superstructure of the bridges should be returned to the MPWT. The demolition waste from the existing substructure of the bridges should be broken into pieces and then disposed of into a designated site. The construction waste, and waste from the construction yards, should be disposed of properly.

(6) Noise and Vibrations

Noise and vibrations will occur during the construction period. These are caused mainly by the machines and earthworks. There are many houses in the populated areas, especially in Battanbang and Pailin.

The construction method and the construction machines should be selected to minimize noise and vibrations, especially in these areas.

Monitoring of noise and vibrations is necessary, including a baseline survey before the construction commences. If the results of the monitoring exceed the environmental standards, mitigation measures should be promptly administered.

(7) Bottom Sediment

A portion of the bottom sediment will change due to the riverbed protection works. The ecological system, however, will not be affected even though benthos might be disturbed during the construction period.

(8) Accidents

The number of traffic accidents might increase both during and after the construction period. Accidents may occur during the construction period due to the detour road. Therefore, during the construction period traffic safety measures should be undertaken such as flag men, traffic sign boards, etc.

Basically, the improvement of the existing road will contribute towards improving traffic safety due to widening of the road such that cars in the opposite lane can drive safely. As a result of these improvements there may be an increase in the speed of vehicles. Even though the road improvements will not contribute towards a direct increase in the traffic volumes, an increase in traffic volumes in the future might contribute towards an increase in the number of traffic accidents. In this sense, the increase in traffic accidents caused by the increased traffic volumes in the future can be considered as an indirect impact.

(9) Others

There are a large number of landmines and UXOs in the project area. In order to avoid accidents due to the landmines and UXOs, they should be cleared in cooperation with the Cambodian Mine Action Centre (CMAC).

5 Indirect Impacts

Indirect impacts may appear in the future, such as air pollution and traffic accidents caused by the increase in traffic volumes. Disordered development may also occur in the future based on the increase in traffic volumes.

It is difficult to predict the indirect impacts. Therefore, monitoring of the project, together with the maintenance of the bridge and road, is important in order to realize the impacts. If some impacts are realized through the monitoring, necessary measures should be considered together with the relevant governmental organizations or other organizations concerned, including NGOs.

The land use plan for the area along the road should be formulated in cooperation with the Ministry of Land Management, Urban Planning and Construction (MLMUPC) and local authorities such that disordered development and land speculation is controlled where possible.

6 Environmental Management Plan

The environmental management plan (EMP) needs to be included in the tender documents so that the contractor can monitor the impacts and undertake the necessary mitigation measures. A baseline survey needs to be conducted during the basic design (B/D) stage for the purpose of comparing with the situation before the project.

The monitoring items include; air pollution, water pollution, noise, vibrations and the accident and resettlement process, which includes the negotiation process and living standards after resettlement.

7 Necessary Actions to be taken

After implementation of the project has been confirmed by the government, the following actions should be promptly carried out.

(1) Public Consultation

Public consultation should be conducted for the people around the project sites for the purpose of disclosing the project information so that the people can understand both the positive and negative impacts of the project.

In addition, the project procedure, laws and regulations should be introduced to the people through the public consultation process as most of the people will not know their rights and ROW, which are stipulated in the laws and regulations in Cambodia. The people should also be informed about the grievance mechanisms. In addition, they will not be aware of the procedure for undertaking the construction works, resettlement and compensation and consequently these procedures should also be introduced during the public consultation process.

Public consultation meetings should be conducted on several occasions, such as before the public awareness survey and the DMS.

(2) Public Awareness Survey (Simple Survey)

The public awareness survey is necessary for the people around the project site for the purpose of confirming their basic agreement with the project. If many people oppose the project, the project should be reconsidered. In addition to gaining their basic agreement to the project, their

needs and social situations should be clarified through the survey. The survey should be conducted at the same time as the cut-off date.

(3) Cut-off Date

The cut-off date must be declared when the project implementation date is decided so as to protect the ROW against illegal squatters aiming for compensation.

(4) Formulation of the Resettlement Action Plan (RAP)

The prompt formulation of the resettlement action plan (RAP) is crucial after the project implementation date has been decided. The most important aspect of the RAP is to ensure that the PAPs maintain the same standard of living as they had before the project. In this sense, the necessary measures should be planned in the RAP, and the monitoring plan for after the resettlement should also be formulated in the RAP.

(5) Finalization and Submission of EIA

The MPWT, as the project owner, has to conduct a survey to prepare and finalize the EIA and submit the EIA to MOE for the project approval. The necessary additional surveys, such as the household survey, which forms part of the public awareness survey (simple survey), should be conducted properly and promptly.