Ⅳ FEASIBLITY STUDY

CHAPTER 1
INVENTORY SURVEY FOR PROJECT ROADS

Ⅳ. FEASIBILITY STUDY

CHAPTER 1 INVENTORY SURVEY FOR PROFECT ROADS

1.1 Introduction

Based on the analyses of the Master Plan, the most appropriate road improvement project to be completed by a year 2007 was selected for further detailed examination by the feasibility study. The Study Team concludes that Route 14A (Ban Houay Phek – Ban Sukhuma) and Route 16A (Paksong – Ban Lak 52) are the most appropriate routes.

As for selected 2 routes, the Study Team undertook road and road structure inventory survey for understanding the current road conditions and to serve for preliminary design and cost estimate. The survey routes are determined on the basis of the followings:

(1) Preliminary on-site survey for route selection (including socio-economic survey)
(2) Inspection on topographic maps (S = 1:50,000)
(3) Discussion with government organizations

Consequently selected routes for road inventory survey are not always made on the existing road alignment.

1.2 Road Inventory Survey

1.2.1 Objective

In the feasibility study stage, the Study Team carries out a preliminary design and cost estimate of the proposed routes, Route 14A and Route 16A. Therefore, it is crucial that a detailed road inventory survey be executed in order to understand current road conditions and determine the appropriate design and cost estimate for the object routes. It should be noted that these 2 routes have totally different characteristics. Furthermore, even on the same route, distinct characteristics can be seen on different sections. The Study Team carried out the road inventory survey to collect data on the following:

(1) Current Road Conditions
(2) Social and Environmental Conditions
(3) Geographical/Geological Conditions
(4) Control Point Locations

1.2.2 Survey Items

The survey items are described below.

(1) Current Road Conditions

1) Road Width
2) Surface Type
3) Roughness

   The Team measured surface roughness by applying vehicle-running speed. The type of vehicle used for this work is a pick-up truck with four-wheel drive.

4) Road Structure (Cut/Embankment)
5) Slope Type and Condition
6) Side Ditch Type and Condition
7) Catch-basin
8) Crossing Structure (Pipe/Box culvert)

(2) Social and Environmental Conditions

1) Roadside Land-use

   Land-use 20m from either side of the centerline for the alignments of the object routes is examined for the purposes of establishing a road reserve.

(3) Geographical/Geological Conditions

1) Terrain Composition and Locational Coordinates
2) Flooding Severity

(4) Control Point Locations

The locations of important buildings such as temples, schools, cemeteries etc. 20m from either side of the centerline for the alignments of the object routes are recorded in order to establish the alignment of the object routes in the preliminary design stage.

(5) Issue of UXO

Building up countermeasure for this issue is crucial to proceed road project in Lao P.D.R. The Study Team closely contacted with UXO Lao Champasack and UXO Lao Attapeu to collect useful information. Then location maps of UXO in Champasack Province were available. They are in ANNEX F-2.

Present removal work of UXO is being undertaken along the Route 16A.

The map was not available in their Attapeu office. According to them, present removal work on the ground was already completed with 10m from either side of the centerline in Route 16A in Attapeu province. Survey work for the underground UXO has not been commenced yet.

1.2.3 Survey Work Method

The inventory survey is executed using a Road Inventory Survey Sheet developed by the Study Team. One sheet is applicable for one kilometer of the survey route. The sheet is as shown in Figure 1.2.2. The survey was carried out based on the definitions for a typical cross section of a survey route (see Figure 1.2.1).

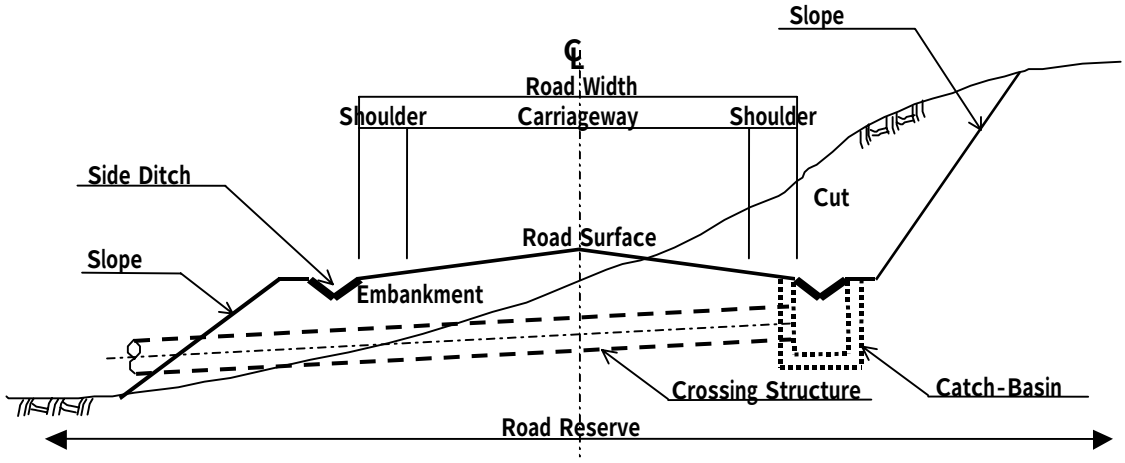

Figure 1.2.1 Typical Cross Section of Survey Routes

Measurements for each survey item are carried out as described below.

(1) Current Road Conditions

1) Road Width (m)

Road width is categorized from (i) to (v) on the basis of vehicle passing condition as follows:

(i) $W \leqq 2.5$: Smooth one-way traffic impossible
(ii) $2.5 < W \leqq 4.5$: Smooth one-way traffic possible
(iii) $4.5 < W \leqq 7.0$: Two-way traffic possible
(iv) $7.0 < W$: Smooth two-way traffic possible
(v) No Road Structure

Note that when there is a clear boundary between the carriageway and shoulder these are respectively measured.

Date: / /02 **Route No. 14A(i) / 16A** **Section: km - km**

ITEM	km				km				km
Road Width (m) Carriageway (Shoulder)									
Pavement Type A: Asphalt Concrete, D: DBST, G: Gravel, E: Earth, O: Other									
Roughness (Vehicle Speed) A: 60kmh<V, B: 60<V<40kmh, C: 40<V<20kmh, D: V<20kmh, E: Impassable									
Side Ditch Type C: Concrete, S: Stone Masonry, E: Earth, O: Other, N: Noditch, →: Water Flow Condition A: Good, B: Fair, C: Damaged									
Inlet (H×W×D) Condition A: Good, B: Fair, C: Damaged									
Crossing Structure PC: Pipe Culvert (ϕxL), BC: Box Culvert (WxHxL), BR: Bridge, RV: River →: Water Flow Condition A: Good, B: Fair, C: Damaged									
Horizontal Alignment RC: Right Curve, LC: Left Curve, ST: Straight									
Vertical Alignment U: Upward, D: Downward, F: Flat									
Road Structure F: Flat, LE: Low Embankment (0<H<1.0m), E: Embankment (1.0m<H), LC: Low Cut (0<D<1.0m), C: Cut (1.0m<D)									
Slope Type E: Earth, G: Grass, S: Stone Masonry, O: Other Condition A: Good, B: Fair, C: Damaged									
Terrain F: Flat, R: Rolling, M: Mountainous									
Control Point T: Temple, S: School, J: Major Junction C: Cemetery, O: Other									
Roadside Environment R: Residence, U: UXO, P: Paddy, V: Vegetable, C: Coffee, G: Grass, F: Forest, O: Other									
Photo (No. & →)									

Figure 1.2.2 Road Inventory Survey Sheet

2) Surface Type

(i) Asphalt Concrete

(ii) Double Bituminous Surface Treatment (DBST)

(iii) Gravel pavement

(iv) Earth Surface

3) Roughness

The Study Team measured road surface roughness using vehicle-running speed. The type of vehicle used for this work is a pick-up truck with four-wheel drive. Vehicle speed and roughness are equated as follows.

(i) A: 60km/h<V

(ii) B: 40<V≦60km/h

(iii) C: 20<V≦40km/h

(iv) D: V≦20km/h

(v) E: Impassable

(V: vehicle speed)

4) Road Structure (Cut / Embankment)

Existing road structure is categorized as follows:

(i) Level

(ii) Embankment (0<H≦1.0m)

(iii) Large Embankment (1.0m<H)

(iv) Cut (0<D≦1.0m)

(v) Large Cut (1.0m<D)

(vi) Cut and Embankment

(H: height of embankment, D: depth of cut)

5) Slope Type and Condition

Slope type is categorized as follows:

(i) Earth

(ii) Grass / Turf

(iii) Stone Masonry

At the same time, the condition of slopes is measured as follows:

(i) A: No serious structural damage and well-maintained vegetation.

(ii) B: Large amounts of vegetation but no serious structural damage.

(iii) C: Serious damage (e.g., slope failure, erosion).

6) Side Ditch Type and Condition

Side ditch type is categorized as follows:

(i) Concrete

(ii) Stone Masonry

(iii) Earth

(iv) No Ditch

At the same time, the condition of side ditches is measured as follows:

(i) A: No serious structural damage and no silting.

(v) B: Moderate silting but no serious structural damage.

(vi) C: Totally silted up and/or serious structural damage.

7) Catch-basin

The location (km from starting point) and inner size (Height x Width x Depth) of catch-basins are recorded in meters. Also, the structural condition is examined and recorded using side ditch categorizations.

8) Crossing Structure

The survey routes cross a large number of man-made structures (e.g., pipe culverts, box culverts and irrigation canals), which are mainly for drainage and irrigation. The Team recorded their locations (km from starting point) and sizes as follows.

(i) Pipe Culvert : Inner diameter and length (m)

(ii) Box Culvert : Inner size (height x width) and length (m)

(iii) Irrigation Canal : Inner size height x width or diameter (m)

Structural condition is recorded using the same categorizations as that of the side ditch.

In addition to these man-made structures, many natural rivers and streams can be found on unimproved sections of both routes. The Study Team recorded such natural water flows, which need a bridge or culvert, for consideration in the preliminary design stage.

(2) Social and Environmental Conditions

1) Roadside Land-use

The Study Team examined and recorded the land-use in a road reserve along the alignment. The road reserve was determined referring Road Design Manual of the Ministry of Communication, Transport, Post and Construction (MCTPC).

According to the manual, traffic forecasts in 2020 for Route 14A and Route 16A require that these roads be classified as Class III roads (i.e., roads with 1,000 pcu – 3,000 pcu per day). The manual indicates that the road reserve of Class III road is 20m from either side of the centerline and a total reserve width is 40m. Currently, MCTPC plans a road reserve as 50m in width.

(3) Geographical / Geological Conditions

1) Terrain Composition and Locational Coordinates

For classification of terrain condition, the Study Team utilized the Road Design Manual of MCTPC. According to the manual, terrain is classified as follows:

(i) Level

Zero to 10 five-meter contour lines that cross per kilometer on a straight line linking the two ends of a road section.

(ii) Rolling

Eleven to 25 five-meter contour lines that cross per kilometer on a straight line linking the two ends of a road section.

(iii) Mountainous

More than 25 five-meter contour lines that cross per kilometer on a straight line linking the two ends of a road section.

Topographic maps developed by the Team were used to execute this work.

2) Flooding Severity

Flooding severity is determined from interviews with residents along the survey routes. Based on these results, the maximum water level of past floods is converted to the distance from the existing road surface.

(4) Control Point Locations

Within road reserve, the locations of buildings necessary to consider possibility of shifting the alignment in the preliminary design stage (namely, temples, schools, etc.) are recorded (km from the starting point).

1.2.4 Survey Results

Based on the above-mentioned items and methods, the Team carried out a road inventory survey. The survey results show the characteristics of each route remarkably. For example, we could see distinct characteristics over different sections of the same route. These results are very useful for drawing up improvement plans, preliminary designs and cost estimates. The characteristics for the different road sections are summarized in ANNEX F-1.

As for Route 16A, there are 2 alternatives for getting from point “c” to “d”). The alternatives are referred here to as the “Shortcut Route” and the “Existing Road Route”. In the case of the shortcut route, the total length of Route 16A is 64.50km. On the other hand, the total length of Route 16A for taking the existing road Route is 70.50km. Including Route 14A, the grand total

length of road to be surveyed is 138.25 km. The length of survey routes is in Table 1.2.1. Note that kilometer posts are based on the survey taking the shortcut Route.

Table 1.2.1 Length of Survey Routes (km)

Route		Start Point	End Point	Length (km)
Route 14A : a – g		Ban Houay Phek (Jct. of Rt. 16)	Ban Sukhuma	59.75
Route 16A	Shortcut Route: a – f	Jct. of Rt. 16 (1km from Paksong)	Ban Lak 52 (Jct. of Rt. 1I)	64.50
	Existing Road Route: a – f	Jct. of Rt. 16 (1km from Paksong)	Ban Lak 52 (Jct. of Rt. 1I)	70.50
	Alternative (i) Shortcut Section: c – d	c-point (34km)	d-point (42km)	8.00
	Alternative (ii) Existing Road Section: c – d	c-point (34km)	d-point (42km)	14.00

The characteristics of each section are summarized below.

(1) Route 14A

	Section	Main Characteristic
1)	a – b (0 – 25km)	: Missing Link
2)	b – c (25 – 29km)	: Champasack Town
3)	c – d (29 – 36km)	: Ancient City
4)	d – e (36 – 42km)	: Flat Paddy Field
5)	e – f (42 – 43km)	: Populated Town
6)	f – g (43 – 59.75km)	: Flat Paddy Field

(2) Route 16A

	Section	Main Characteristic
1)	a – b (0 – 8km)	: Large-Scale Afforestation
2)	b – c (8 – 34km)	: Minority Villages and Coffee Plantations
3)(i)	c – d (34 – 42km)	: Shortcut Section (missing link)
3)(ii)	c – d (34 – 42km)	: Existing Road
4)	d – e (42 – 58km)	: Steep Mountainous
5)	e- f (58 – 64.5km)	: Lush Forest & Rice Plantation

A summary of the survey results is shown in ANNEX F-1 as well as other findings i.e., crossing structures, villages, and control points..

1.2.5 Analysis of Findings

Based on the above survey results for Route 14A and Route 16A, an analysis is carried out to serve drawing up appropriate road improvement recommendations.

(1) Route 14A (Total Length: 59.75km)

This route starts from Ban Houay Phek (i.e., the junction with Route 16) in Champasack Province and ends at Ban Sukhuma also in Champasack Province. The entirety of the route runs over level terrain. However, the characteristics of the northern part (0–25km) and southern part (25–59.75km) of the route are very different. Generally, the southern part has a well-maintained wide road structure. On the other hand, as for the northern part except first 5.3km, which is also known as the "Missing Link Section", it is barley possible to detect any type of road structure for motorized vehicles and for all practical purposes there is no vehicular traffic. In addition, flooding is also a major issue on this section.

1) a – b (0 – 25km): Missing Link Section

Figure 1.2.3 Survey Route Map on Missing Link Section

Findings

This section starts from Ban Houay Phek (i.e., the junction with Route 16) and ends at 25km point in Champasack Town Section. Figure 1.2.4 shows the starting point. Up until the 5.3 km mark, this section consists of a route that was a former provincial road. After that, the Study Team could not detect any sort of road structure fit for motorized vehicles. Thirty-three percent of this section length consists of road constructed via labor-based methods, while the other 67 % has no road structure to speak of. Furthermore, there are no bridge structures fit for motorized traffic.

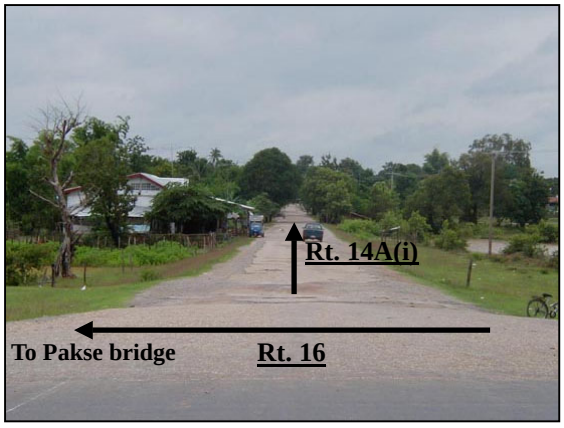

Figure 1.2.4 Present Status of Junction with Route 16

Analysis

The villages on this section, of which there are seven, are shown in Table 1.2.2. The villages' names in brackets means that the survey route runs behind those villages (see Figure 1.2.5). This is because the existing road in some villages is too narrow (less than 2.0m), with houses located at the edge of the road, and the improvement of this road would require a large number of these houses to be removed. It is therefore recommended that these roads remain as they are and that the improving road alignment in these villages should detour the villages and access from these villages to the proposed road be provided.

Table 1.2.2 List of Villages on Missing Link Section

No.	Name	Location) (km post
1	Ban Houay Phek	0.0 – 0.25
2	(Ban Takou)	5.3 – 5.55
3	(Ban Houpakho)	13.75 – 14.45
4	(Ban Khonken)	17.45 – 17.85
5	(Ban Khanneng)	20.35 – 20.75
6	(Ban Vataxay)	21.55 – 22.55
7	Ban Phatthanakham	24.45 – 24.9

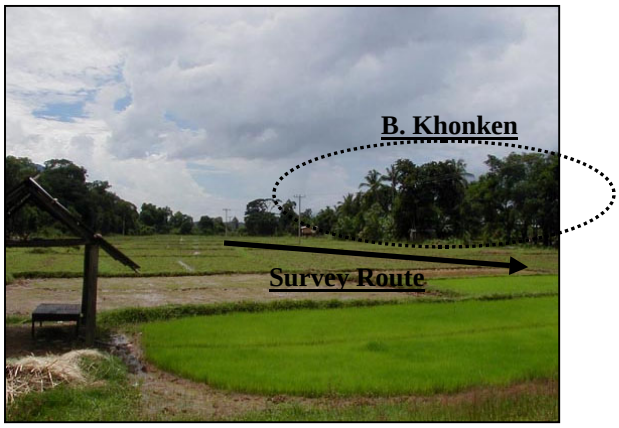

Figure 1.2.5 Survey Route behind Village (17.4km)

Large numbers of rivers and streams flow from mountains down to the area located between the 6.0 km and 13.0 km posts (see Figure 1.2.6). Especially, during the rainy season, these rivers and streams overflow and adequate drainage facilities should be designed.

Figure 1.2.6 Mountain Stream (8.0km)

Flooding is a very serious issue on this section. Sub-sections that are less than 100 m from the Mekong River are identified as borders Mekong River (see Table 1.2.3). Finally, 68 % of this section length has experienced floodwaters higher than the road surface by more than 1.0m and the construction of embankments and slope protection should be considered.

Table 1.2.3 List of Control Points on Missing Link Section

No.	Point Type	Location (km post)
1	Cemetery	0.15 – 0.25km
2	Cemetery	0.3 – 0.4km
3	Access to Village	4.8km
4	Jct. With Existing Rd.	5.3km
5	Access to Village	6.75km
6	Access to Temple	12.95km
7	School	B. Houpakho (13.9 – 14.0km)
8	School	B. Khoneken (17.0 – 17.1km)
9	School	19.35 – 19.5km
10	**Borders Mekong River ***	**18.05 – 19.95km**

11	**Borders Mekong River ***	**20.6 – 21.3km**
12	Temple	B. Vataxay (21.6 – 21.7km)
13	School	B. Vataxay (22.6 – 22.7km)
14	**Borders Mekong River ***	**22.55 – 23.7km**
15	Temple	B. Phatthanakham (24.5 – 24.55km)

* Borders Mekong River: the location is less than 100m from the Mekong River

2) b – c (25 – 29km): Champasack Town

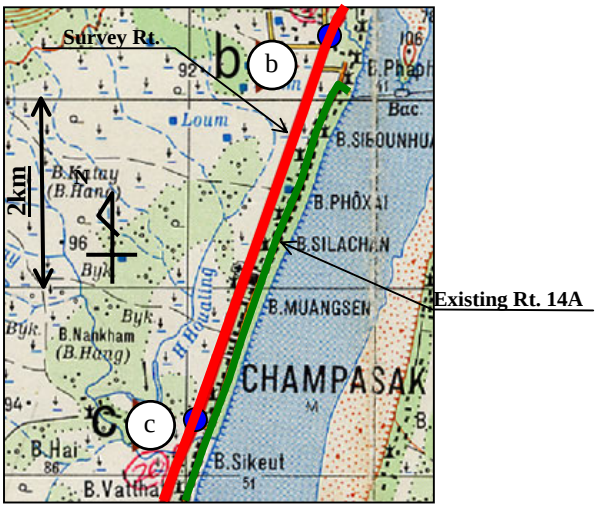

Figure 1.2.7 Survey Route Map on Champasack Town

Findings

This section of the survey route is an existing farm road, and is located approximately 150m from existing Route 14A. There are 11 access roads (earth surface, average width is 3.5m) between the farm road and Route 14A (see Figure 1.2.8). This section is characterized by 2 sub-sections consisting of paddy fields (25km–27km) and a village (27km–29km). Typical cross sections for these 2 sub-sections are shown in Figure 1.2.9.

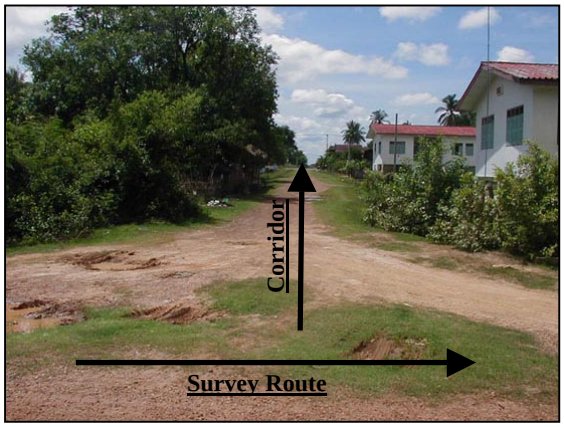

Figure 1.2.8 Access Road to Existing Route 14A (at 28.0km)

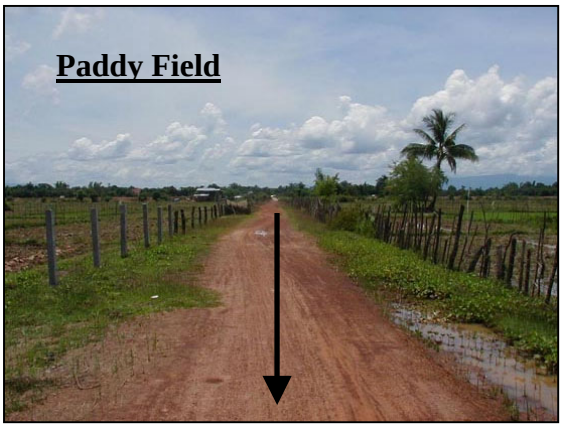

Figure 1.2.9 Typical Cross Sections (Paddy Field: at 26.5km & Village: at 27.5km)

Analysis

According to Table 1.2.4 and 1.2.5, villages and control points are densely located on the "village section". Three villages (i.e. B. Vatthong, B. Watlakhone and B. Phonepheng) can be seen from the 27.35 km post to the 29.05km post. Control points are located between the 27.1 and 28.1 km posts. Alignment and traffic safety considerations are necessary for this sub-section in design stage. Furthermore, improvement of access roads should also be considered.

Table 1.2.4 List of Villages Part of Champasack Town

No.	Name	Location (km post)
8	Ban Vatthong	27.35 – 27.75
9	Ban Watlakhone	28.25 – 28.65
10	Ban Phonepheng	28.65 – 29.05

Table 1.2.5 List of Control Points in Champasack Town

No.	Type of Point	Location (km post)
16	Empty Lot (possible telecom office & district office)	27.1 – 27.3km
17	Temple	B. Vatthong (27.45 – 27.55km)
18	School	27.55 – 27.8km
19	Temple	27.8 – 28.0km
20	Hospital	28.0 – 28.1km

In addition to the above, Champasack Province has a "Development Plan of Champasack Town (1997 – 2007)". Future land-use and existing control points are plotted in Figure 1.2.10. This is also useful for making improvement plans in the preliminary design stage.

Flooding is a very serious issue on this section due to it being very close to the Mekong River (200m – 400m from the river bank). This section has experienced floodwaters in the past more than 1.0m above the existing road surface. Embankment construction and slope protection for the proposed road should be considered.

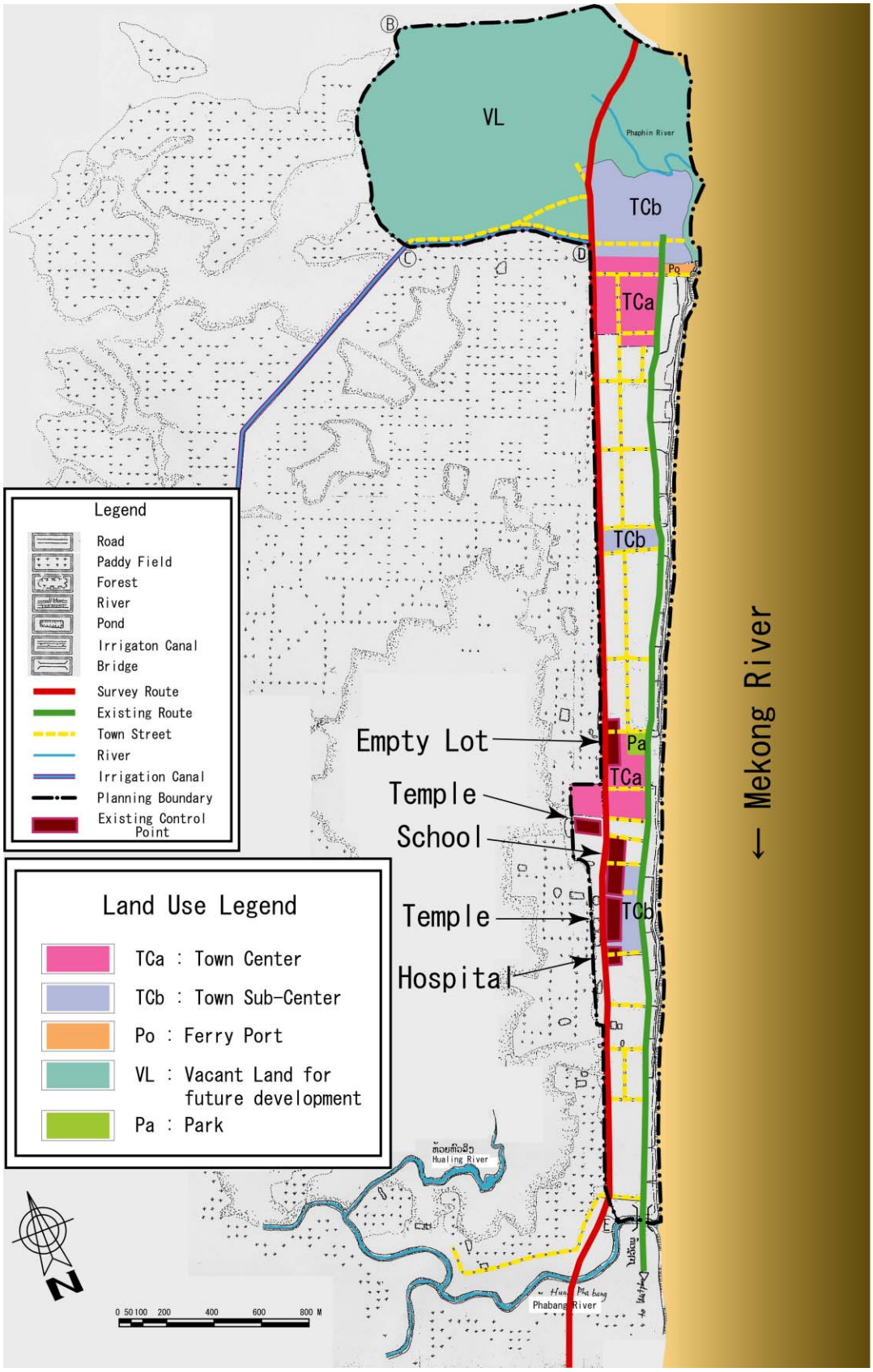

Figure 1.2.10 Development Plan of Champasack Town

3) c – d (29 – 36km): Ancient City Section

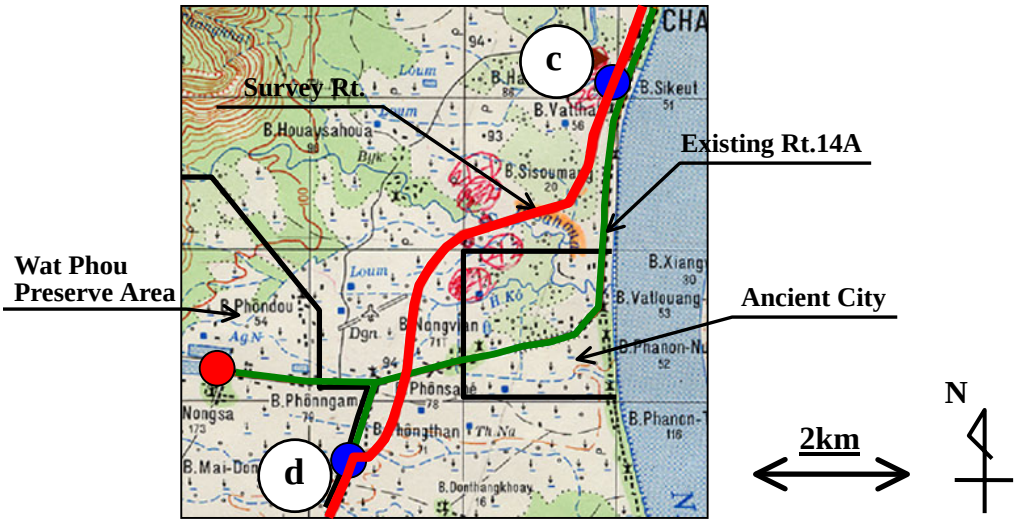

Figure 1.2.11 Survey Route Map on Ancient City Section

Findings

There are 2 large-scale historical sites; namely, Champasack Ancient City and the Wat Phou Preservation Area, which is being studied by the United Nations Educational Science and Cultural Organization (UNESCO). Existing Route 14A runs through the middle of the Ancient City. The Study Team carried out a socio-economic survey to investigate the impact of road construction on the existing route. The Team also held discussions with related organizations regarding this matter (i.e., MCTPC, DCTPC, and UNESCO). Based on the above-mentioned investigation and discussions, the proposed survey route, which originally planned on utilizing the existing route, was shifted in order to preserve this area and to encourage potential tourism. The route now goes behind the town (i.e., B. Phonngam) and connects with the existing route at the 36 km point. Typical views of this section are shown in Figure 1.2.12.

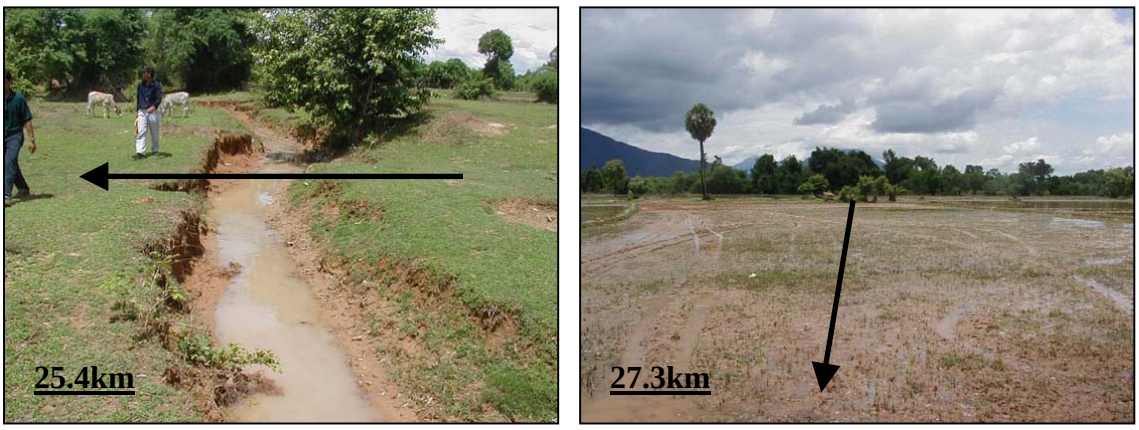

Figure 1.2.12 Typical Views of Ancient City Section

Analysis

There is no road structure from the 29.05 km to the 35.3 km mark. Eighty-nine percent of land-use along this survey route is paddy field. 2 rivers and 5 streams cross this route. Bridge construction for rivers and culvert for streams will be necessary.

The survey route crosses existing Route 14A at the 34.6 km mark and intersection design should be considered.

Regarding flooding conditions, 43% of this section has experienced floodwaters in the past greater than 1.0m in height above the ground surface, while the remaining 46% has seen floodwaters ranging from 0.5–1.0m above the ground surface. Therefore, embankment construction and slope protection for proposed road should be considered.

4) d – e (36 – 42km): Flat Paddy Field Section

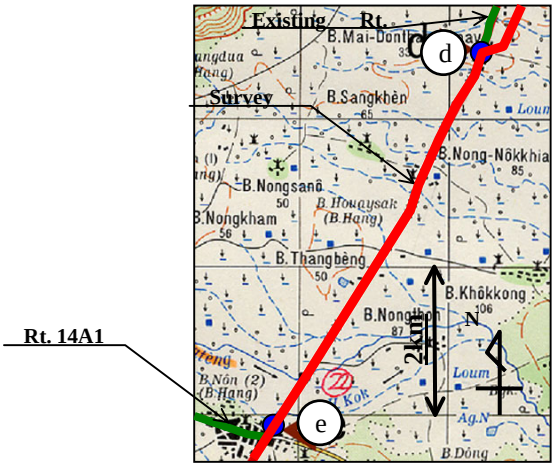

Figure 1.2.13 Survey Route Map of Flat Paddy Field Section

Findings & Analysis

The width of this section is more than 4.5m (i.e., two-way traffic is possible at present) and the earth road surface is generally well maintained. On the other hand, only 4.2% of the section is equipped with a side ditch. As for road surface roughness, it was evaluated as 'A' (60km/h<V). Roadside land-use is mainly paddy field (92% of section length). The route also passes through 4 villages (see Table 1.2.6). A typical cross section is shown in Figure 1.2.14. When there have been heavy rains in the past, water has come up to the road surface due to improperly functioning drainage facilities (e.g., side ditch, pipe culvert) and shortage of their facilities.

Table 1.2.6 List of Villages on Flat Paddy Field Section

No.	Name	Location (km post)
12	Ban Maidonthangkhouay	36.15 – 36.45
13	Ban Nong-Nokkhian	37.95 – 38.25
14	Ban Thangbeng	39.05 – 39.45
15	Ban Nongthon	40.05 – 40.25

Figure 1.2.14 Typical Cross Section (at 40.3km)

5) e – f (42 – 43km): Populated Town Section

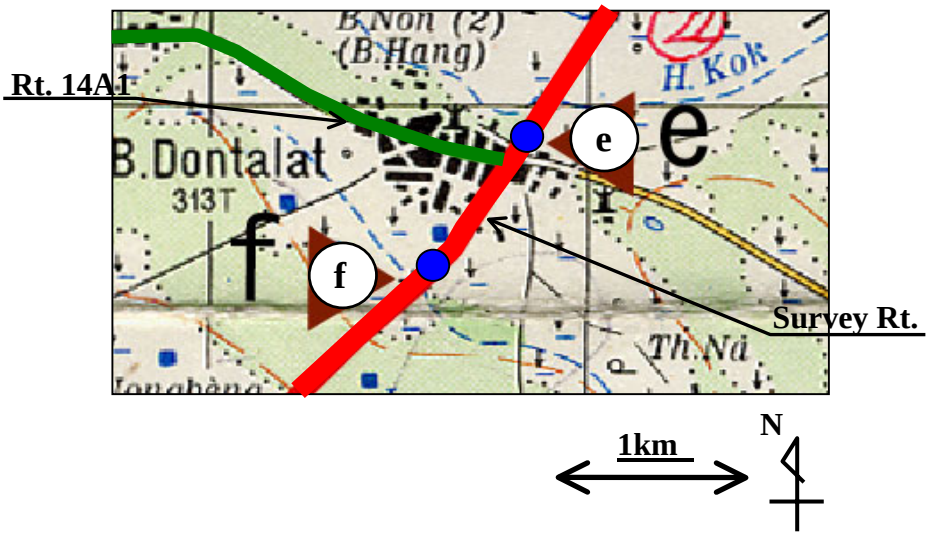

Figure 1.2.15 Survey Route Map on Populated Town Section

Findings

This section of the survey route goes through the village of Ban Dontalat and road width is more than 4.5m. However, a large number of houses border the road without any clearance. These houses also seem rather costly as compared with average village houses. Furthermore, there is a local market and storehouses. Figure 1.2.16 shows a sketch and photograph of this section. Note that two classified roads (namely, Route 14A and Route 14A1) meet at this section (42.3 km). Figure 1.2.17 gives a view of the junction.

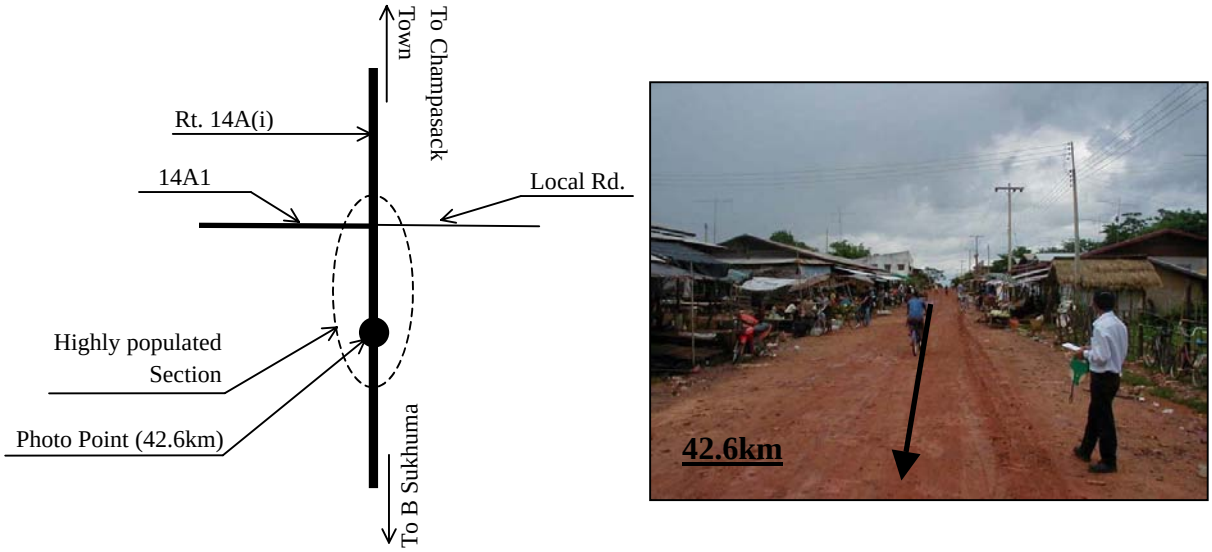

Figure 1.2.16 Sketch & Photograph of Ban Dontalat

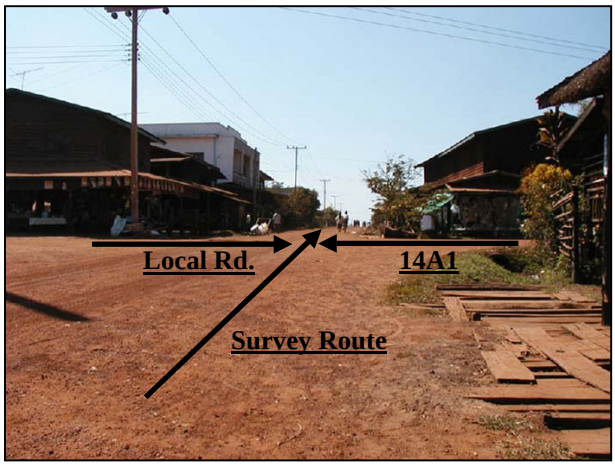

Figure 1.2.17 Present Status of Junction with Route 14A1 (at 42.3km)

Analysis

This section is crowded every weekend with local people. During the opening hours of the market, smooth traffic flow is impossible. Improving this junction would require the removal many houses . A detour route to avoid this should be considered.

When there have been heavy rains in the past, water has come up to the road surface due to improperly functioning drainage facilities (e.g., side ditch, pipe culvert) and shortage of their facilities. Therefore, the improvement and/or adequate maintenance of such facilities will be necessary.

6) f – g (43 – 59.75km): Flat Paddy Field Section

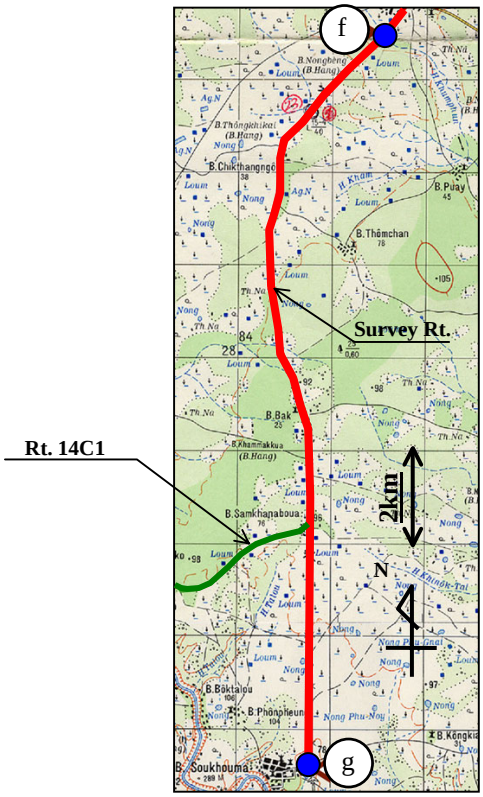

Figure 1.2.18 Survey Route Map on Flat Paddy Field Section

Findings

Seventy-three percent of this section has a road width more than 7.0 m (i.e., smooth two-way traffic is possible at present), with the remaining 27% being more than 4.5 m in width. Roadside land-use is mainly for paddy fields (79% of section length). This section passes through 6 villages (see Table 1.2.7). A photograph of the section is as shown in Figure 1.2.19 and ends at an intersection with a district road in Ban Sukhuma (59.75 km). The southern part of this point is a national road and was designated as Route 14A(ii) by the Study Team in Master Plan of the Study.

Table 1.2.7 List of Villages on Flat Paddy Field Section

No.	Name	Location (km post)
17	Ban Chikthango	46.5 – 47.3
18	Ban Nong Bouakhao	47.55 – 48.0
19	Ban Bak	52.1 – 52.4
20	Ban Samkha	54.45 – 54.95
21	Ban Samyak	55.45 – 55.75
22	Ban Sukhuma	59.55 – 59.75

Figure 1.2.19 Present Status of Flat Paddy Field Section (at 58.4km)

Analysis

The road surface is earth and generally well maintained. Surface roughness for the entire section is evaluated as 'A', which is due to effective drainage system, e.g., the large number of side ditches (76% of section length). On sub-sections with no side ditches, surface water flows into the roadside paddy fields; thereby, avoiding any serious damage to the road.

There is a junction with Route 14C1 at the 55.55 km mark in Ban Samyak. Improvement of this junction should be considered in the design stage. Figure 1.2.20 shows the present state of the junction.

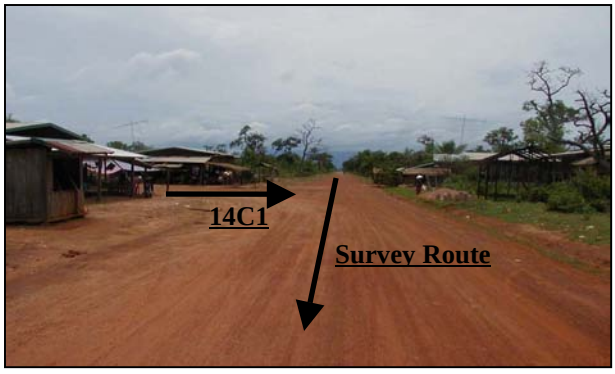

Figure 1.2.20 Present Status of Junction with Route 14C1 (at 55.55km)

Regarding flooding, when there are heavy rains, water has come up to road surface due to improperly functioning drainage facilities (e.g., side ditch, pipe culverts). Therefore, plans for the improvement and/or adequate maintenance of these facilities will be necessary.

(2) Route 16A
(Total Length: Shortcut Route = 64.5 km, Existing Road Route = 70.5km)

This route starts from the junction with Route 16 located at the 1.0 km mark east of Paksong in Champasack Province and ends at Ban Lak 52, or the junction with Route 1I in Attapeu Province. This route has 2 alternatives regarding the section from point “c” to point “d”. These alternatives are referred to as the “Shortcut Route ” and the “Existing Road Route”. The total length of Route 16A is “64.5km” in the case of the Shortcut Route. On the other hand, the length of the “Existing Road Route” that does not coincide with the Shortcut Route is 14.0 km. These 2 alternatives separate at point c (i.e., 34.0km from start point) and meet at point d (42.0km). Note that kilometer posts are based on the survey for the Shortcut Route.
This route can be roughly divided into 4 sections. The first section, which is 34 km (a – c) in length, has a road width of more than 4.5 m (i.e., two-way traffic is possible at present . The, second section, which is 8 km in length (i.e., the shortcut section: c – d), has no road structure. The third section, which is 22.5 km (d – f) in length, has a road width of less than 4.5 m and there are variations in the horizontal and vertical alignments. The fourth section, existing road section (c – d) has another characteristics namely wide road width and various changes in vertical and horizontal alignment. One of the biggest issues of this route is the design regarding the vertical and horizontal alignments. Detail of the findings and analysis are described below.

1) a – b (0 – 8km): Large Scale Afforestation Section

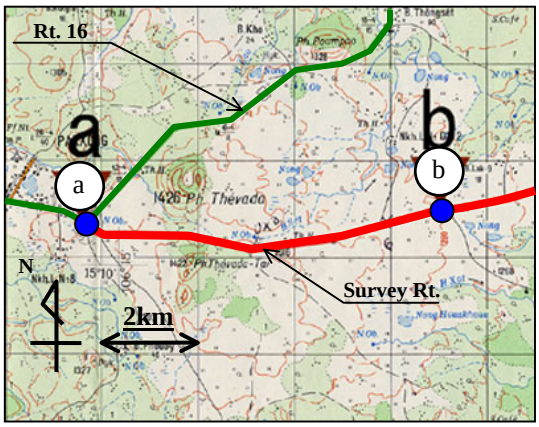

Figure 1.2.21 Survey Route Map on Large-Scale Afforestation Section

Findings

The survey route starts at the junction with Route 16 located at the 1.0 km post east of Paksong town. Based on the Road Design Manual of MCTPC, the terrain is designated as level. There are no villages on this section, and 94% of the section length has no side ditches. Road width is more than 4.5 m, and the present status of this section is as shown in Figure 1.2.22.
Most land-use on this section is for ‘Afforestation’ (84% of the section length). Private

companies were planting young trees in cleared areas, and there is a boundary fence 10m from the road edge. There is also an access road to an UXO disposal site at the 4.55 km point.

Figure 1.2.22 Present Status of Large-Scale Afforestation Section (at 3.4km)

Analysis

As for the junction with Route 16, it has already been improved to a DBST paved road. On the other hand, Route 16A is still a gravel road. Route 16 shall be designated as a major road and Rt. 16A as a minor road at this junction. In the process of the design stage, the redesign of this junction structure should be considered. A sketch of this present junction is as shown in Figure 1.2.23.

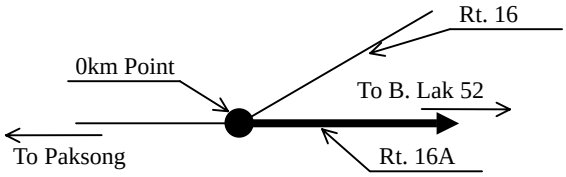

Figure 1.2.23 Sketch of Junction with Route 16

Surface roughness is evaluated as B (i.e. 40km/h<V), in spite of there being no side ditches and rutting on both sides of the road. This condition is due to surface water flows that have eroded the surface (see Figure 1.2.24).

Figure 1.2.24 Damaged Surface – Rutting (at 2.0km)

2) b – c (8 – 34km); Minority Villages and Coffee Plantation Section

Figure 1.2.25 Survey Route Map on Minority Villages and Coffee Plantation Section

Findings

Road width is more than 4.5m on 89% of this section, and there are no side ditches. Surface roughness is evaluated as A and B, but some rutting and ravelling was found on the road surface and aggregate is visible on some portions of the road (see Figure 1.2.26). Based on the Road Design Manual, 97% of the terrain is designated as level and 3% as rolling. Residents of villages on this section are from a minority called 'Lao Theuang'. They plant and harvest coffee beans to make their living. Twenty-nine percent of land-use is for coffee plantations and 46% is forests and bush .

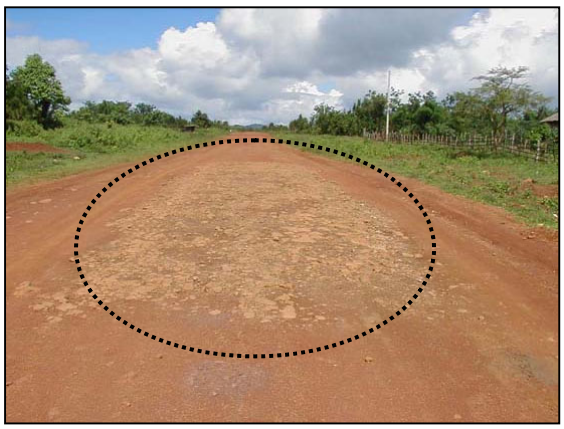

Figure 1.2.26 Damaged Surface – Ravelling (at 8.9km)

Analysis

Table 1.2.8 show that there are 4 cemeteries for the "Lao Theuang" that are located in the forests. The alignment should be designed to avoid them.

At Ban Chansavang village (16.5 – 17.8km), there is a school, temple and dispensary center close to each other. Figure 1.2.27 shows their layout. Traffic safety should be taken into

account for this area.

Table 1.2.8 List of Control Points on Minority Villages & Coffee Plantation Section

No.	Point Type	Location (km post)
5	School	B. Nonchan (8.1 – 8.25km)
6	School	B. Lak 11 (10.35 – 10.5km)
7	School	B. Lak 12 (12.7 – 12.8km)
8	School	B. Bak (7.35 – 7.45km)
9	Temple	B. Nong Bouakhao (11.8km)
10	Cemetery	14.55 – 14.7km
11	Access Rd. to School	B. Lak 15 (15.5km)
12	School	B. Chansavang (17.2 – 17.3km)
13	Temple	B. Chansavang (17.3 – 17.4km)
14	Dispensary Center	B. Chansavang (17.35km)
15	School	B. Nongkhaung (21.45 – 21.6km)
16	Cemetery	23.1 – 23.2km
17	Access Rd. to Village	23.8km
18	School	23.9 – 24.0km
19	Cemetery	24.6 – 24.9km
20	Cemetery	31.1 – 31.25km
21	Jct. with Existing Rd.	B. Nong I-Oy (33.8km)

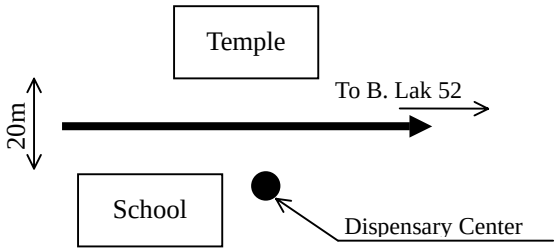

Figure 1.2.27 Layout of Control Points at Ban Chansavang Village

3)(i) c – d (34 – 42km): Alternative (i) – Shortcut Section

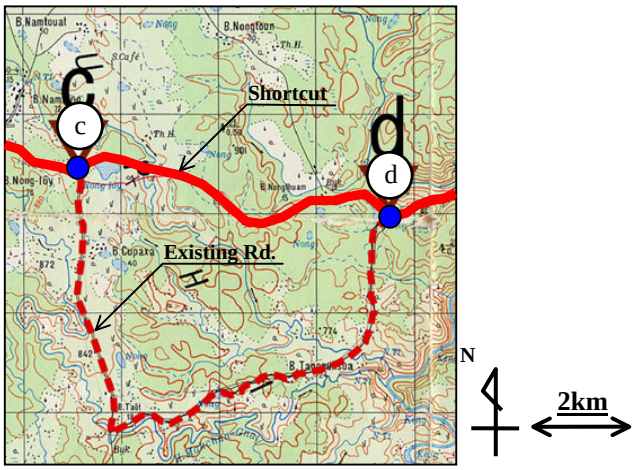

Figure 1.2.28 Survey Route Map on Shortcut Section

Findings

Eighty percent of this section does not have a road structure and the other 20% is a very narrow road (less than 2.0m in width). Land-use consists namely of forest (88%) and coffee plantations (12%). Typical views of this section are shown in Figure 1.2.29. The survey route crosses 1 river (possibly a bridge is required) and 3 streams (possible culverts are required) on this section. The shortcut section joins up with existing road at the 42.2 km point. The present status of this junction is as shown in Figure 1.2.30.

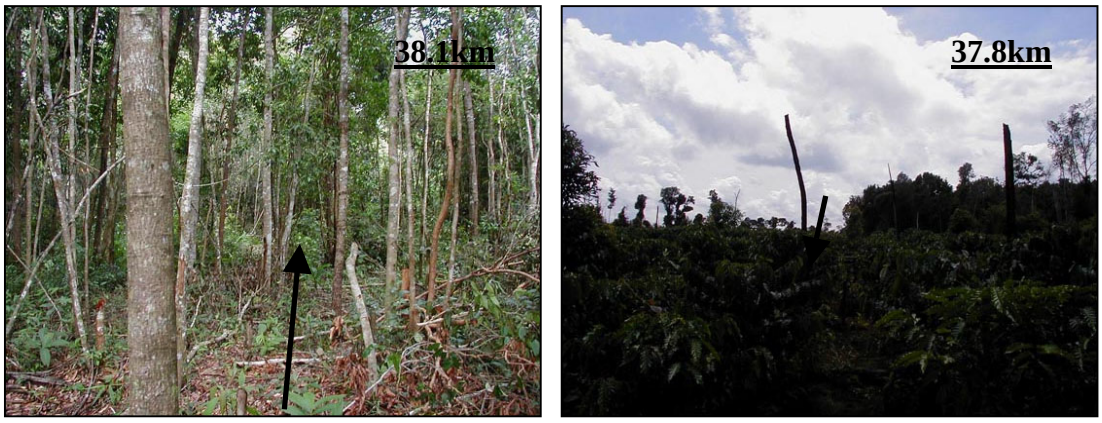

Figure 1.2.29 Present Status of Shortcut Section (Forest & Coffee Plantation)

Figure 1.2.30 Present Status of Junction with Existing Road (42.2km)

Analysis

The survey route is divided into 2 alternatives namely (i) Shortcut Section and (ii) Existing Road Section, which vary at the 33.8 km point into a 'Shortcut Section' and 'Existing Road Section'. Both of these routes will be compared with each other considering the following.

- Vertical and horizontal alignment design
- Environmental impact
- Land acquisition
- Construction cost
- Travel time saving

The junction with the existing road should be improved to ensure sight distance and should be taken up in the design stage.

3)(ii) c – d (34 – 42km): Alternative (ii) – Existing Road Section (L = 14.0km)

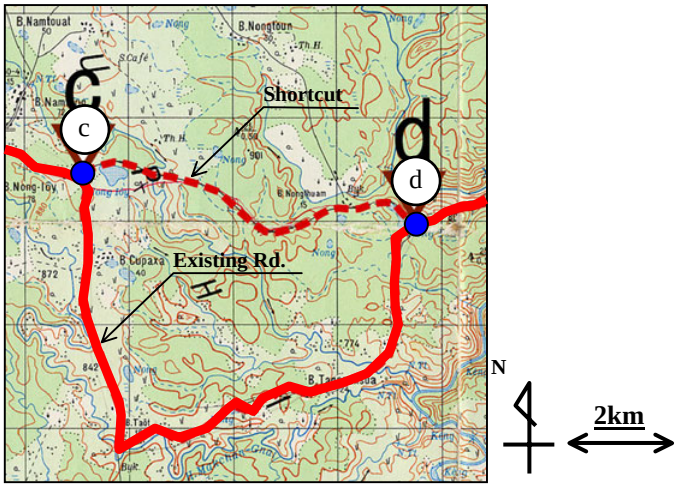

Figure 1.2.31 Survey Route Map of Existing Road Section

Findings

Road width is more than 4.5m over 67% of the section length, and surface roughness has been evaluated as either A or B for 96% of the section. Table 1.2.9 shows that there are 4 villages on this section. Villages no. 3 and 4 are for resettlement of people due to a new hydro-dam project. Village No. 3 is especially quite large in scale. This existing route is an access for them. Figure 1.2.32 shows a typical cross section and resettlement village.

Table 1.2.9 List of Villages on Existing Road Section

No.	Name	km
1	Ban Oupaxa	1.8 – 2.0
2	Ban Ta-Ot	5.2 – 5.5
3	Ban Tagnuksua	7.2 – 7.7
4	Resettlement Village	10.7 – 11.7

Figure 1.2.32 Typical Cross Section & Resettlement Village

Analysis

Regarding the existing bridge between the 10.3 – 10.7 km mark, improvement to the vertical and horizontal alignments should be considered. Figure 1.2.33 shows the layout of the existing bridge approach and improved alignment. A photograph indicating the present status of the bridge approach is shown in Figure 1.2.34.

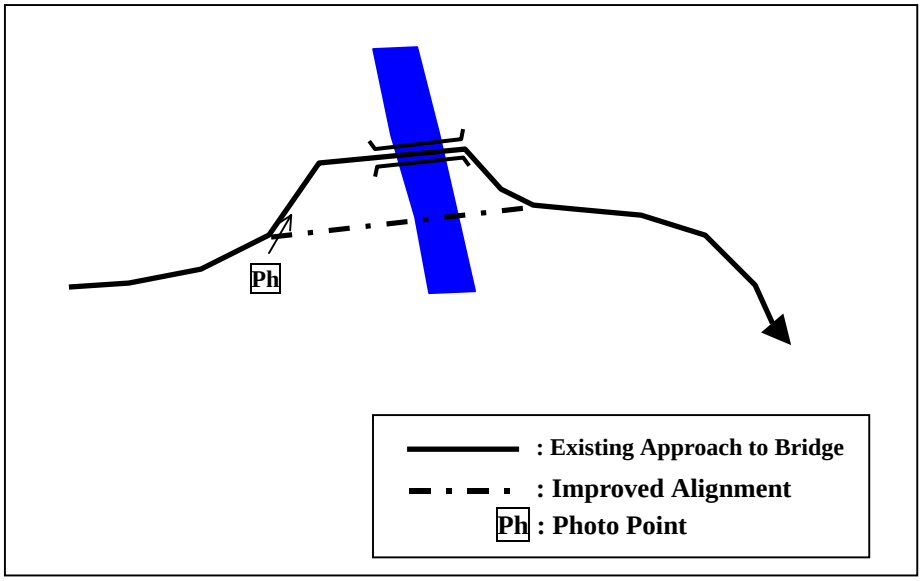

Figure 1.2.33 Layout of Bridge Approach

Figure 1.2.34 Present Status of Bridge Approach (10.3km)

4) d – e (42 – 58km): Steep Mountain Section

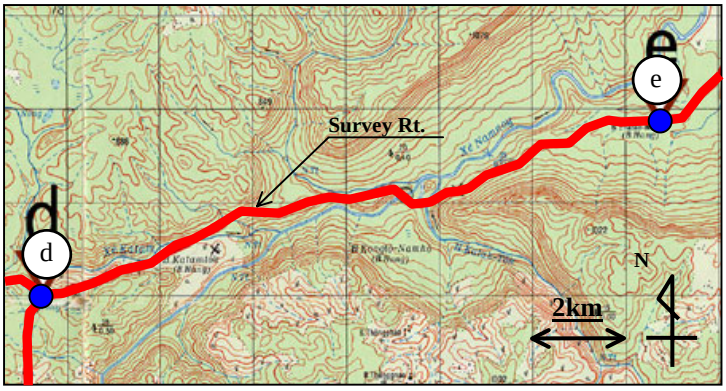

Figure 1.2.35 Survey Route Map of Steep Mountainous Section

Findings

The present road structure of this section is inadequate for heavy traffic or high-speed travel. Road width is less than 4.5m over 88% of the section, and the horizontal and vertical alignment does not ensure proper sight distance. A typical cross section of this section is shown in Figure 1.2.36.

Figure 1.2.36 Typical Cross Section on Steep Mountain Section (at 53.9km)

Table 1.2.10 indicates the characteristics of the road structure on this section very clearly. That is, the road is in between a steep mountain surface and a deep cliff. A sketch of the road structure on this section is shown in Figure 1.2.37.

Analysis

This section is designated as mountainous in accordance with the MCTPC Road Design Manual. The horizontal and vertical alignments are quite limited. The alignment for the bridge section (No. 25 and 32 in Table 1.2.10) should be carefully studied in the design stage.

Table 1.2.10 List of Control Points on Steep Mountainous Section

No.	Point Type	Location (km post)
22	Cliff (Left)	42.0 – 44.2km
23	Steep Mountain Surface (Right)	42.0 – 44.3km
24	Cliff (Left)	44.8 – 44.9km
25	Inadequate Alignment (Bridge Section)	45.7 – 46.1km
26	Steep Mountain Surface (Left)	46.1 – 46.3km
27	Cliff (Right)	46.0 – 46.4km
28	Steep Mountain Surface (Left)	47.0 – 47.8km
29	Cliff (Right)	47.6 – 47.8km
30	Steep Mountain Slope (Right)	49.0 – 51.2km
31	Cliff (Left)	49.0 – 51.2km
32	3 Bridges Section	51.5 – 52.5km
33	Steep Mountain Slope (Right)	52.3 – 54.9km
34	Cliff (Left)	52.3 – 55.2km

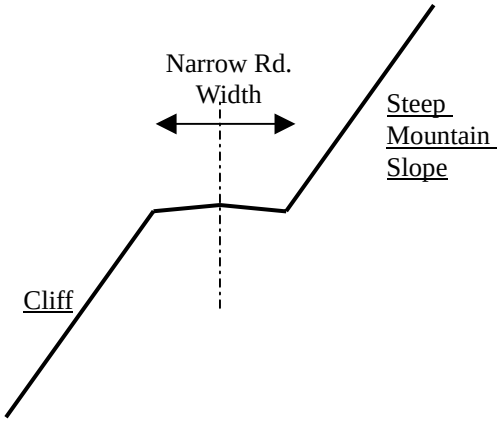

Figure 1.2.37 Sketch of Typical Cross Section

5) e – f (58 – 64.5km): Forest and Rice Plantation Section

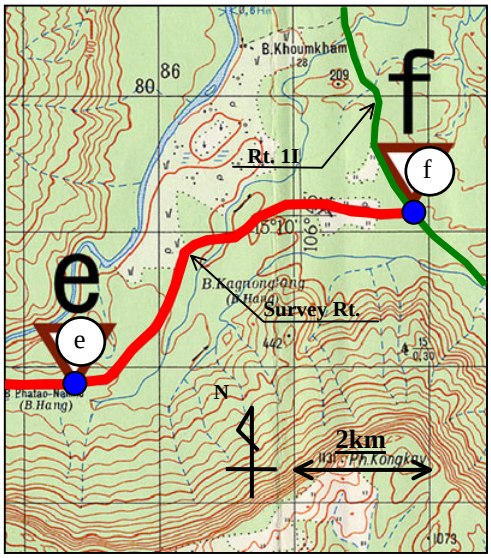

Figure 1.2.38 Survey Route Map on Forest & Rice Plantation Section

Findings & Analysis

Road width is less than 4.5m over 76% of this section, and surface roughness has been evaluated as C (40<V<20km/h) for 82% of the section. As for the terrain, it is designated as flat.

There are 2 major land-uses along the section and they are forestry (59%) and rice plantations (41%). The latter land-use is different than that of the paddy fields seen along Route 14A(i). It is called dry-land rice. A typical cross section and photograph of a rice farm is shown in Figure 1.2.39. No villages were found on this section except for Ban Lak 52 village at the end point. An access to the proposed road should be considered for the transport of crops.

Figure 1.2.39 Typical Cross Section & Rice Plantation

The survey route ends at the junction with Route 1I at Ban Lak 52. Structural improvement for the junction should be discussed in the design stage. Figure 1.2.40 shows the present status of the junction.

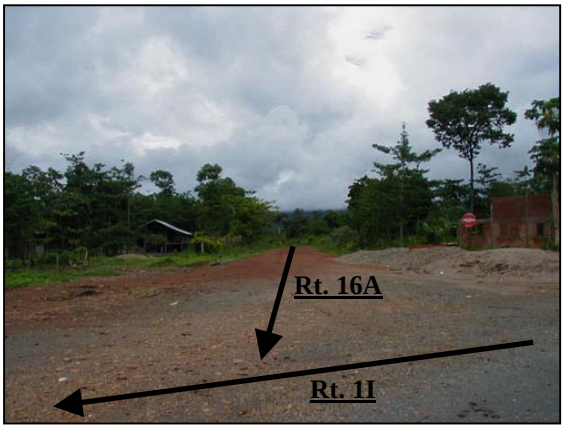

Figure 1.2.40 Present Status of Jct. with Route 1I (64.5km)

1.3 Bridge Inventory Survey

1.3.1 Objective

The bridge inventory survey shall be undertaken to provide necessary information for damage diagnose of the existing bridges and improvement plan of those bridges. Where a new bridge is required due to lack of crossing structure, the information on river condition and characteristics shall be gathered in order to establish a new bridge plan.

1.3.2 Survey Scope

(1) General

All rivers and streams with more than 5m in width on the study routes are the subjects to be investigated for the bridge inventory survey. As a result of the survey, 25 rivers or streams on Route 14A and 7 rivers on Route16A were identified as bridge inventory survey respectively.
Items to be investigated are different according to whether or not a crossing structure exists on the river or stream. Where the existing bridge is located on the crossing point, the survey mainly focused to gather general information about the bridge and river, and grasp the damage condition of a bridge. On the other hand, at the crossing point without a bridge, the survey concentrates grasping the river condition and its characteristics to make a new crossing structure plan. Survey items describe below in detail and show in a bridge inventory survey sheet in ANNEX F-3.

(2) Survey Items at Crossing Points with Bridge

The following information was gathered at the existing bridge sites:

1) **Bridge location**: Route name, Km- post, village name
2) **Bridge general information** : Total length, span arrangement, carriageway & pedestrian width, superstructure type, load capacity, girder information (depth, arrangements), substructure type (Pier and abutment), protection work
3) **Damage condition** : Girder, slab, substructure, bank protection, others
4) **River Conditions**: Yearly low water level, Yearly high water level, Highest water level, river width, riverbed material, river gradient, river depth
5) **Surrounding Conditions**: Land use, number of housed affected by new bridge plan, UXO
6) **Other information**: information from local people
7) **Engineers Comments**: necessity of replacement, points to be considered in a

new bridge plan,

(3) Survey Items at Crossing Points without Crossing Structure

The following information was gathered at the proposed crossing points:

1) **River location**: Route name, Km- post, village name
2) **River Conditions**: Yearly low water level, Yearly high water level, Highest water level, river width, riverbed material, river gradient, river depth
3) **Surrounding Conditions**: Land use, number of housed affected by new bridge plan, UXO
4) **Other information**: information from local people
5) **Engineers Comments**: necessity of replacement, points to be considered in a new bridge plan,

1.3.3 Survey Work Method

The bridge inventory and relevant information was collected by mainly on-site investigation, and checked by the topographical survey results. In addition to this, relevant information for bridge planning such as water levels of a river or stream was gathered by interviewing local people near the existing bridge or proposed bridge sites.

1.3.4 Survey Results

(1) General

All information collected through the bridge inventory survey was summarized in the bridge inventory survey sheets shown in ANNEX F-3. The major characteristics of the crossing points are summarized in Table 1.3.1.

(2) Route 14A

1) Crossing Condition

Through the bridge inventory survey, 24 rivers or streams with more than 5 m in width were originally identified on the proposed new route of Route 14A. However, one location, i.e., No.23 stream, was added to the list through the investigation in this rainy season. At this crossing point, although two-pipe culverts of 0.8 m in diameter were originally installed, it replaced by a Bailey bridge because the stream overflowed on the road and washed away the embankment at this point.

Table 1.3.1 River List of Route 14A

No	River Name	Km post	Village Name	Existence	Existing Bridge				River Conditions		
				of Bridge	L(m)	Width(m)	No. of Span	Br. Type	Width(m)	HWL	Affect of back water of Mekong
1	Huay Thok	5.39		No	-	-	-	-	22	6.0	Yes
2	Huay Maknao	7.45		No	-	-	-	-	5	1.0	No
3	Huay Namxam	7.95		No	-	-	-	-	8	1.5	Yes
4	No Name	8.45		No	-	-	-	-	5	1.0	No
5	No Name	9.05		No	-	-	-	-	5	1.0	No
6	Huay Gnang	9.38		No	-	-	-	-	6	1.0	No
7	No Name	9.48		No	-	-	-	-	8	1.0	No
8	Huay Imet	11.00		No	-	-	-	-	10	3.0	Yes
9	Hauy Kaunam	11.40		No	-	-	-	-	8	1.0	No
10	Huay Khao dam	12.12		No	-	-	-	-	8	4.4	Yes
11	Huay Thakhong	13.63	B.Thaphakkha	No	-	-	-	-	20	5.0	Yes
12	Huay Tabxan	14.54	B.Houapakho	No	-	-	-	-	40	4.7	Yes
13	Hauy Khone liao	15.82		No	-	-	-	-	20	6.0	Yes
14	Huay Khonken	17.04	B.Khonken	No	-	-	-	-	30	9.0	Yes
15	Huay Hong	18.32	ditto	No	-	-	-	-	20	9.0	Yes
16	Huay He	19.00	South B.Khonken	No	-	-	-	-	25	8.5	Yes
17	Huay Dua	19.89	B.Khangneng	No	-	-	-	-	10	5.5	Yes
18	Huay Sai	21.43	B.Vatxai	No	-	-	-	-	50	7.0	Yes
19	Huay Phaphin	24.35	North champasack	No	-	-	-	-	15	7.0	Yes
20	Huay Phabang	29.44	Champasack	No	-	-	-	-	50	7.0	Yes
21	Huay Sahoua	32.21	ditto	No	-	-	-	-	35	7.0	Yes
22	Huay Sahoua	32.62		No	-	-	-	-	10	4.1	Yes
23	No Name	39.60	North B.Dontalat	Yes	18.5	3.5	1	Bailey	10	2.0	No
24	Huay Thateng	40.61	North B.Dontalat	Yes	18.5	3.9	1	Bailey	18	2.7	No
25	Huay Manpha	45.49	B.Nongbeng	Yes	24.5	4.5	1	Bailey	24	2.5	No

Among them, there are only 2 existing bridges at the crossing points on the proposed alignment. Although on Huay Phabang river and Huay Sahoua river in Champasack town, there has been an existing bailey bridge crossing over the rivers, those bridges are not subjects to be surveyed because of change in route alignment. However, the information of these bridges can be utilized to make a bridge plan on the new route.

There is no crossing structure at other 22 out of 24 crossing points at the moment.

2) Characteristics of Existing Bridges

The bridge type of two existing bridges is a bailey type with wooden slab, supported by RC frame abutment. The total length of these are 18.5m and 24.5m with 4m in width respectively. Although the load capacity is not indicated at site, it is assumed 8 to15 ton from other examples. These structures are observed to be still structurally sound against the limited load less than 15 ton, although these bailey bridges had minor damages such as minor corrosion on cross beams and braising and loss of small parts of wooden slab.

3) Characteristics of Rivers

There are only small and medium scale rivers with relatively short river length and small catchment area, less than 6 km2, on the proposed route of Route 14A. The river width ranges from 5m to 70m with 1 to 6m in water depth. All rivers have almost no water in dry season but high water level in rainy season from June to October. The difference in the water level reaches to approximately 6-7 m.

The characteristics of those rivers can be also categorized by presence of a backwater affect of Mekong River in rainy season. 16 out of 24 rivers have an affect of backwater from Mekong River, and the high water levels are dominated by the high water level of Mekong River. The rest of the rivers have no affect of it and their high water levels will be determined by rainfall in their catchment areas. The presence of a backwater affect from Mekong River is indicated in Table 1.3.1.

(3) Route 16A

1) Crossing Conditions

Through the bridge inventory survey, total 7 rivers and streams with more than 5m in width were identified on Route 16A. Originally, 6 rivers were listed as a study river to examine the necessity of a bridge as a result of the site investigation undertaken in dry season. However, one river was added to the list through the survey in this rainy season because the overflow of the stream due to heavy rain was observed at No.7 crossing point (see Table 1.3.2), and it was reported that the overflowed area spread over around 20m in length and 1 m in the maximum depth on the road.

There are six crossing structures including five bridges and one pipe culvert at six rivers among seven rivers. The profile of these crossing structures is indicated in Table 1.3.2. There is only one river without crossing structure in the short cut section, which is newly planed between Km 33.8 and Km 42.2 in this feasibility study to shorten the total road length of Project.

Table 1.3.2 River List of Route 16A

No	River Name	Km post	Village Name	Existence of Bridge	Existing Bridge				River Conditions			Remarks
					L(m)	Width(m)	No. of Span	Br. Type	Width(m)	HWL(m)	Gradient	
1	Huay Mckchan-Guna	17+575	Ban Chansavang	Yes	25.0	4.5	1	Bailey	25.0	2.9	1/100	
2	Huay Namtang	35+550		No	—	—	—	—	27.0	4.7	1/100	
3	Xe Katam	45+997		Yes	48.4	4.5	4	Steel-I	45.0	6.2	1/50	
4	Xe Namnoy 1	51+655		Yes	60.4	4.5	4	Steel-I	60.0	7.7	1/50	
5	Xe Namnoy 2	51+845		Yes	24.2	4.5	2	Steel-I	24.0	3.5	1/500	
6	Huay Ho	52+175		Yes	24.2	4.5	2	Steel-I	24.0	5.4	1/50	
7	No name	61+473	Ban Lak56	Yes	-	4	-	Curvert	10.0	GL+1.0	1/50	φ2.0m Pipe

2) Characteristics of Existing Bridges

All existing bridges belong to the small-medium size bridge, ranging from 24m to 60m in the total length and with 4.5m in width.

On the other hand, those bridges are categorized in to two types; namely, a Bailey bridge type and steel-I beam one, consisting of one Bailey type and four steel-I beam type.

The steel-beam bridges are equipped with the minimum bridge accessories including a railing, bearing, expansion joint and drainage pipes. Those accessories are observed to keep their function at the moment. These bridges were constructed in the middle of 1990th to provide an access road for the construction of hydroelectric power plant by a Korean private company as BOT project.

Regarding the damage level of those bridges, it can be judged that both the Bailey type and steel-I beam type keep relatively sound condition although minor damages and corrosion are observed on structural members and slabs.

3) Characteristics of Rivers

The rivers crossing over Route 16A are generally characterized by rapid flow and the riverbed consisting of large boulders or rocks. However, each river has own characteristics described below:

Huay Macchan-Guna River

This river has constant discharge through a year with relatively rapid flow. The highest water level never overflows the bridge surface, and its level is 1.2 m below from the bridge elevation. Since the river run through in the village, local people usually utilize the river water for daily usage.

Xe Namnoy 1 River

This river has a large catchments area of approximately 1,100 km2. Accordingly, the discharge at flooding rises around 6-7 m from the water level in dry season. The maximum high water level after bridge construction is reported to be 1m below under the girder elevation. Since there is the Xe Nomnoy Bridge on Route 1I, which is newly constructed in 2000, at approximately 10km downstream side, its hydrological analysis can be referred to the analysis.

Xe Namnoy 2 River

This is a water channel naturally build to detour the overflowed water of the main stream of Xe Namnoy River at approximately 100 m upstream of No.4 Xe Namnoy1 Bridge. When the water level reaches to elevation 261m, the river water starts detouring the channel.

Consequently, this channel has no water almost through a year.

Huay Ho River

A dam for electricity generation was constructed in the middle 1990th at 19km upstream of the No.6 bridge site. As a result of the site investigation on dam structure, it can be said that it is little possibility of the water in the dam reservoir to overflow the gate. Consequently, only the catchment area of downstream side from the dam can be considered to calculate discharge of the river at the bridge site.

1.3.5 Analysis of Findings

As a result of the analysis on the bridge inventory results, the following findings can be raised to make an appropriate bridge plan.

(1) Route 14A

1) Necessity of Replacement of Existing Bridges

Two existing Bailey bridges should be replaced by new permanent bridge due to lack of required carriageway width for road class III, sufficient load capacity and sufficient freeboard from the high water level.

2) Necessity of New Construction of Crossing Structure in Missing Link Section

There are no crossing structures on 19 rivers in the Missing Link Section between Km 4.75 and Km 25. Almost all the rivers have an affect of backwater from Mekong River and its water level rises around 6m in rainy season between July and October. This water level rise impedes local people from accessing to market, hospital, school and district center.

From the viewpoint of social development of the villages in the missing link section, new crossing structures are required to built on those rivers. The structure type, a bridge or culvert, will be studied in the design stage, in consideration with river characteristics and conditions described in the survey result sheets.

3) Consideration of Backwater Affect from Mekong River

16 rivers are identified as a river to have a backwater affect of Mekong River at the proposed crossing structure site. The high water level of those rivers are partially or completely dominated by the one of Mekong River. Accordingly, determination of the high water level at the proposed bridge site should be carefully examined the affect of Mekong River at each return period.

Furthermore, the high water level of Mekong River results in the overflow of the branch river water to surrounding area. Consequently, determination of the appropriate bridge length shall be one of the issues on a bridge planning.

(2) Route 16A

1) Necessity of Replacement of Existing Bailey Bridge (No.1 bridge)

No.1 existing Bailey bridge should be replaced by new permanent bridge due to lack of required carriageway width for road class III, sufficient load capacity and sufficient freeboard from the high water level.

2) Necessity of New Bridge Construction at Huay Namtang River

Huay Namtang River runs through a valley with approximately 30m in river width and 4.7m in depth at flooding. From these river conditions, a bridge structure shall be appropriate to cross over this river.

3) Necessity of Examination of Steel-I Girder Bridge to be Restored

There are four steel-I girder bridges, recently constructed by a Korean private company, on Route 16A. Although those bridges have only one-lane with 4.5m in width, it can be judged that those bridges keep relatively sound conditions, with no cracks on the slab and minor corrosion on beams. Consequently, it is recommended that those bridges should be examined whether or not being utilized as it is.