## III. MASTER PLAN

## CHAPTER 1

CONCEPT FOR ESTABLISHMENT OF MASTER PLAN

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### 1.1 Introduction

The objective of establishing a Master Plan is to prioritize projects and to develop an implementation program up to 2020 to enable all roads and bridges in the study area to be passable all year round and to be capable of handling the expected increase in traffic.

The highest priority projects have been selected for possible implementation by 2007

### 1.2 Selection Process and Priorities

The southern part of the country (i.e. Champasack, Attapeu, Sekong, Saravan and Savannakhet) is expected to serve as a bridge to integrate neighboring ASEAN countries to stimulate economic growth. The poor condition of the transport network in the region hinders poverty reduction efforts and stifles economic growth.

The study focuses on the following aspects.

- Basis Access providing reliable all-weather access for people living in isolated areas, to reduce poverty,
- The role of international / regional corridor, providing new and important road links

The selection process and priority-setting applied for the Study, consists of the following two steps:

## (1) Screening:

Reduce the number of investment alternatives given budgetary constraints.
(a) targeting disadvantaged areas based on a variety of factors, including traffic level, environmental impacts, technical feasibility, and financial and economic viability.
(b) eliminating investments into low-priority projects of the network selected based on agreed criteria and projects which have already been committed for implementation.
(2) Ranking:

After screening methods have been applied to a given set of investment choices, resources are still unlikely to be sufficient to finance the balance of the remaining desirable
interventions, and hence a ranking or prioritization exercise is required.

The following three main ranking and/or prioritization methods are widely applied and the Study team has reviewed and examined the applicable method for the Study.

## (a) Multi-Criteria Analysis

Multi-criteria analysis (MCA) can incorporate not only cost + benefit + impact, but socioeconomic impacts and environmental impacts into ranking system. Criteria such as traffic level, proximity to health and education facilities and agriculture assets are given weights (points), relative to their perceived importance.
(b) Cost-Effectiveness Analysis

Cost-effectiveness analysis (CEA) also is used to rank investment programs. It compares the cost of interventions with their intended impacts.
(c) Cost-Benefit Analysis

Cost-Benefit Analysis (CBA) is a comprehensive accounting of all real costs and benefits associated with a project. In the case of road projects, this includes users and non-users, as well as road agency costs. Where the impact on non-users is negligible, a CBA of road alternatives centers around the trade-offs between total life-cycle costs of infrastructure (i.e., capital and maintenance) and user costs and benefits (e.g., vehicle operating cost and time savings). The CBA ranks alternative interventions based on the net present value (NPV), Economic Internal Rate of Return (EIRR), Benefit Cost Ratio (B/C) or First Year Benefit (FYB). The results are independent of the size of the initial investment, and can be utilized in selecting projects when taking into account regional equity.

Consumer surplus models are well established and applied, such as the Highway Development and Management Model (HDM). Basically, the methods are reliable to apply to higher-volume roads (>300VPD). Its application to low-volume road in some cases encounter problems related to the small magnitude of user benefits and the stronger influence of environment rather than traffic on infrastructure deterioration. With low traffic level, a modified and customized approach can be taken. The recently developed Roads Economic Decision Model (RED) of the World Bank is one example. Traffic on such very low volume consists of majority of non-four-wheeled vehicles. The application of HDM and RED shall require calibration process to reflect local conditions.

The Study team concludes to that the MCA approach, which integrates economic evaluation of road investments using conventional CBA, with its enhancements criteria on socioeconomic impacts, environmental impacts, etc. is appropriate.

The above concept to be applied for the Study is illustrated in the following chart.

## Step 1 ( Screening )



## Step 2 ( Ranking )



Figure 1.2.1 Selection Process and Priority Setting Method

### 1.3 Road Links to be Improved

The road improvement projects have been selected from among national road links in the southern region that are not passable for 12 months, excluding links which have already been committed for implementation i.e., Route No. 15 (Junction at Ban Phone Dou - Vietnam Border), Route No. 16 (Lamarm - Vietnam Border) and Route No.18B in the study area.

The selected roads comprise 16 routes or links of 879.5 km total length out of the 2025.1 km of national roads in the study area. The present road conditions and characteristics of these roads are summarized in Tables 1.3.1 and 1.3.2.

Table 1.3.1 Candidate Roads for Improvement

| Route | Origin | Destination | Length <br> (km) | Summary of Road Conditions |
| :--- | :--- | :--- | ---: | :--- |
| 1G | JCT. of Rt. 9 | JCT. of Rt. 15 | 130.0 | Including 32 km missing link. Bad <br> conditions through the whole section |
| 1H | JCT. of Rt. 20 | JCT. of Rt. 16 | 22.5 | Improved road with a gravel surface |
| 1J | JCT. of Rt. 18B | Border of Cambodia | 81.0 | Including 65 km missing link |
| 14A(i) | Phong Thoth Dist. | Ban Sam Kha | 54.0 | Including 25 km missing link |
| 14A(ii) | Ban Sam Kha | JCT. of Rt. 14C | 51.5 | Vehicles can pass for only 2 months at <br> Houay Kamouan River. |
| 14A(iii) | M. Moonlapamok | Border of Cambodia | 32.0 | Many rivers cross the route. |
| 14A1 | Ban Ang Kham | Ban Don Talath | 32.0 | Fair condition through the route. |
| 14B | JCT. of Rt.16 | Border of Cambodia | 149.0 | The first 11.2 km of the road has been <br> improved with gravel surface. |
| 14C | Ban Nong Nga | M. Moonlapamok | 42.0 | The road has been improved with gravel <br> surface at some sections. |
| 14C1 | Ban Hieng | Ban Sam Kha | 23.0 | The road has been improved with gravel <br> surface at some sections. |
| 14C2 | Ban Phone Photh | Ban Nong Te | 6.0 | Improved road with gravel surface. |
| 15 | JCT. of Rt. 13S | JCT. of Rt. 1H | 73.0 | Improved road with gravel surface. |
| 16A | JCT. of Rt. 16 | JCT. of Rt. 1I | 71.0 | The road passes through the mountainous <br> area. |
| 18A(i) | JCT. of Rt. 13S | Border of Province | 30.6 | Fair condition through the route |
| 18A(ii) | Border of Province | Xe Piane River | 39.7 | Two big rivers cross the route. Bad <br>  <br> londitions through the whole section |
| 18A(iii) | Xe Piane River | JCT. of Rt. 18B | 42.2 | Fair condition through the route |

Source: Study Team

Table 1.3.2 Road Conditions by Route (1/16)

| Route | $\mathbf{1 G}$ | Road <br> Length | $\mathrm{L}=130.0 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 9 | Destination | Junction of Route 15 |
| Surface Type : <br> Paved road <br> 32.0 km 1.1 km, Gravel road 33.1 km, Earth road $63.8 \mathrm{~km}, \quad$ Missing link |  |  |  |

## Terrain Conditions :

This road is mainly located in the flat terrain. Whereas the road in Savannakhet Province mainly passes in a paddy field or forest area, the road in Saravan Province passes in a copse or rice field area. There are some small villages along the route.

## Road Conditions :

The total 32 km missing link is located at a section between KM post 35 km and 67 km . The surface of the road between Junction of Route 9 and KM post 35 km in Savannakhet Province is relatively good condition with 5.0 m to 6.0 m in width. However, the section between KM post 92 km and 130 km in Saravan Province has narrow width of 2.8 m to 4.0 m , and the surface condition is fair. In addition, the section between KM post 67 km and 92 km is in the bad condition with 2.1 m to 3.0 m in width. Accordingly, the running speed in this section indicates only approximately less than $10 \mathrm{~km} / \mathrm{hr}$.

## Crossing Condition:

The total 42 rivers cross the road including Xe Bang Hieng and Xe Don with around 200m in river width. However, 16 crossing points including 2 large-scale rivers have no bridge. Therefore, those become a bottleneck and vehicles cannot pass in a rainy season. The major existing bridge type is a timber type.

## Socio-economic Conditions:

This area has little economic potential and significant need for social development. Population in 5 km range along this route is 250 persons $/ \mathrm{km}$. North and central part of this rink runs in Phine district (Savannakhet Province). Phine District has small economic potential with small GDP/capita, little work force in industry and service sector, along Route 1G. Social aspects in Phine district should be greatly improved. Rice production and education need intensive improvement. Accessibility can be gotten better with construction of missing link. The southern part of the Route 1G runs in Toomlarn district and Saravan District (Saravan Province). These two districts have a large population along Route 1G. Toomlarn District, which has large ethnic minority population, attains just $23.9 \%$ in literacy rate.

Table 1.3.2 Road Conditions by Route (2/16)

| Route | $\mathbf{1} \mathbf{H}$ | Road <br> Length | $\mathrm{L}=22.5 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 20 | Destination | Junction of Route 16 |
| Surface Type : |  |  |  |
| Paved road $\quad 1.9 \mathrm{~km}$ <br> Gravel road $\quad 20.6 \mathrm{~km}$ |  |  |  |

## Terrain Conditions :

This road runs in the flat ( 7.4 km ) and rolling ( 15.1 km ) terrain. Mainly, the road passes in the paddy field area, and there are some small villages along the road.

## Road Conditions :

The surface of the road keeps almost good condition with 4.6 m to 7.0 m in width. Therefore, the running speed in the section resulted in approx. more than $50 \mathrm{~km} / \mathrm{hr}$.
Particularly, the section from Junction of Route 20 to KM post 7.4 km , has just completed the grading with 5.5 m width.

## Crossing Condition:

No bridge in this section

## Socio-economic Conditions:

This 25 km long link runs in Thateng District (Sekong Province) and Saravan District (Saravan Province). These two districts are rather rich with enough rice production/person and coffee production. Population along the road counts 6,348 persons, and $84.7 \%$ of them are ethnic minorities. Literacy rate is $39.8 \%$ for Thateng and $53.2 \%$ for Saravan. Since Route 1 H is already in a fair condition, significant upgrading of area accessibility is not expected by the improvement of this link.

[^0]Table 1.3.2 Road Conditions by Route (3/16)

| Route | $\mathbf{1}$ J | Road <br> Length | L = 81.0 km |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 18B | Destination | Border of Cambodia |

## Surface Type :

Gravel road 16.0 km , Missing link 65.0 km

## Terrain Conditions :

The first 16 km of the road is located in the flat terrain, with the copse area. In addition, the road passes through some small villages. The section in the rolling or mountainous terrain after KM post 16 km is missing link.

## Road Conditions :

The 65 km missing link is located at the section between KM post 16 km and 81 km . The road surface of the first 16 km section keeps fair condition with 3.5 m to 4.2 m in road width. Vehicles can run through this section with the normal speed of approx. $40 \mathrm{~km} / \mathrm{hr}$ because regravelling or grading activities were executed recently in some sections,

## Crossing Condition:

There are 8 small to large rivers are located in the first 16 km section. On 7 rivers among 8 rivers, the temporary timber bridges exist. However, there is no bridge at Xe Kong river with approx. 200 m width and a ferry, which accommodate $4-5$ sedan vehicles, is operating through a year. There is some small rivers except for Nam Kong River in the section after 16 km , but with no bridges.

## Socio-economic Conditions:

This road starts Samakhixay District (Attapeu Province) and goes down through one of the poorest district in the study area - Phouvong. There is no road in $80 \%$ of the link length. Population within 5 km is 179 person/km, including Samakhixay part. Vehicle ownership is negligible. In Phouvong district, population of ethnic minorities is dominant. Rice production is $128 \mathrm{~kg} /$ person, far below the survival level. Literacy rate is $28.1 \%$, one of the worst in the study area. Since accessibility is very outrageous, improvement will greatly affect social development of the area.
Source: Study Team

Table 1.3.2 Road Conditions by Route (4/16)

| Route | $\mathbf{1 4}$ A (i) | Road <br> Length | L=54.0 km |
| :---: | :--- | :---: | :--- |
| Origin | Phone Thong Dist. <br> (JCT. of Route 16) | Destination | Ban Sam Kha <br> (Junction of Route 14 C1) |

## Surface Type :

Paved road 13.8 km , Gravel road 15.2 km , Missing link 25.0 km
This link is the beginning section of Route 14 A .

## Terrain Conditions :

This road runs through the flat terrain with paddy field. There are some small villages along the road, especially some residences concentrates at the beginning of the missing link $(25 \mathrm{~km})$ section. In the Champasack town section, there are many houses along the existing road.

## Road Conditions :

The 25 km of the missing link is located at the section between JCT of Route 16 and KM post 25 km . The road surface between Km post 25 and Wat-phou (KM post 38.8) is a pave road and keeps very good or good conditions with 5.0 m to 7.9 m in width. The section between KM post 38.8 km and 54.0 km is a gravel road and has the larger width of 9.0 m . The surface condition is fair. The average running speed is approx. more than $50 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

There are four small to medium scale rivers without bridge, ranging from 12 to 70 m in width in the missing section. In addition, 4 small rivers cross the road with a bailey bridge in the section after missing link

## Socio-economic Conditions:

This is the northern part of Route 14A and runs in Phonthong, Champasack, and Sukhuma Districts of Champasack Province. This route goes through rice rich and densely populated area along the Mekong River. These three districts have considerable size of fork force in industrial and service sector. Wat Phou, a ruin of ancient Kumer civilization with World Heritage status, generate more traffic from Thailand into this route. No significant problem is found with the social aspects of this area.

Table 1.3.2 Road Conditions by Route (5/16)

| Route | $\mathbf{1 4}$ A (ii) | Road <br> Length | $\mathrm{L}=51.5 \mathrm{~km}$ |
| :---: | :--- | :---: | :--- |
| Origin | Ban Sam Kha <br> (Junction of Route 14 C1) | Destination | Junction of Route 14 C |

## Surface Type :

Gravel road 19.1 km , Earth road 32.4 km
This road is second section of Route 14A.

## Terrain Conditions :

This road is mainly located in the flat terrain comprising the paddy field or forest area. In addition, the road in the first 19.1 km passes through some residence area. In the section after 19.1 km , there is no residence.

## Road Conditions :

The surface of the first 19.1 km section keeps fair condition with 9.0 m in width. Accordingly, the running speed in this section indicated approx. more than $40 \mathrm{~km} / \mathrm{hr}$.
However, the section after KM post 19.1 km is in the bad condition with an earth surface and 2.5 m in width. The running speed in this section indicated approx. less than $10 \mathrm{~km} / \mathrm{hr}$.

## Crossing Condition:

Although there are 2 small and big rivers on the road, only 1 bridge has been constructed. At Houay Khamuan River, a vehicle can pass for only 2 months in a year. Therefore, this section can be regarded as a missing link.

## Socio-economic Conditions:

This route runs in Sukhuma and Moonlapamok District. East side of the districts, where this route serves, is more prosperous than the other part of them. The area produces more than sufficient rice for their population. The area has higher economic potential and smaller need for social development. Since the road condition is in very bad condition, its improvement may contribute to economic development of the area.

[^1]Table 1.3.2 Road Conditions by Route (6/16)

| Route | $\mathbf{1 4}$ A (iii) | Road <br> Length | $\mathrm{L}=32.0 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | M. Moonlapamok | Destination | Border of Cambodia |
| Surface Type : <br> Gravel road $2.5 \mathrm{~km}, \quad$ Earth road $\quad 29.5 \mathrm{~km}$ <br> This road is third section of Route 14A. |  |  |  |

## Terrain Conditions :

This road mainly runs through the flat terrain, comprising mainly the paddy field or residential area.

## Road Conditions :

The first 2.5 km section is a gravel road and its surface keeps a good or fair condition. The road width ranges from 5.0 to 8.7 m . The section after 2.5 km has an earth surface with 4.0 m in width and keeps the fair condition. The average running speed in this section is approx. less than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Condition:

Although 22 small and large rivers are located on the road, only 2 temporary bridges were constructed. Therefore, at the crossing points, vehicles cannot pass in a rainy season.

## Socio-economic Conditions:

This route runs in Moonlapamok District of Champasack Province. Population in 5km range counts 18,389 persons or 575 persons/km. Total ethnic minorities are 505 persons along this road. This district has around 3,000 work forces in industrial and service sector, and $63.3 \%$ of literacy rate.

Table 1.3.2 Road Conditions by Route (7/16)

| Route | $\mathbf{1 4}$ A1 | Road <br> Length | L=32.0 km |
| :--- | :--- | :---: | :--- |
| Origin | Ban Ang Kham | Destination | Ban Don Talath |

## Surface Type :

Gravel road 32.0 km

## Terrain Conditions :

This road mainly runs through a flat terrain, which is mainly consisted of a paddy field and residence area.

## Road Conditions :

The road has a gravel surface with fair conditions. The road width of this section ranges from 4.0 to 8.0 m . The average running speed in this section is approx. less than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

There are 8 small and large-scale rivers on the road, and the temporary bridges were constructed at all crossing points.

## Socio-economic Conditions:

This road link runs in rice-rich districts; Phonthong and Champasack District of Champasack Province. These two districts have a big workforce ( 8,789 persons) in industrial and service sector. This link has a population of 38,130 in its 5 km range with 1,192 person/km. Wat Phou in Champasack District will generate a significant tourist traffic through this road. Rice production is sufficient enough. Literacy rates of the districts are $80.8 \%$ and $73.9 \%$ and enough higher than the average of the study area. Population of ethnic minorities is very small. The above figures summarize that Route 14 A 1 is serves very prosperous area with high economic potential and social condition.

[^2]Table 1.3.2 Road Conditions by Route (8/16)

| Route | $\mathbf{1 4}$ B | Road <br> Length | $\mathrm{L}=149.0 \mathrm{~km}$ |
| :---: | :--- | :---: | :--- |
| Origin | Junction of Route 16 | Destination | Border of Cambodia |

## Surface Type :

Gravel road 11.2 km , Earth road 137.8 km

## Terrain Conditions :

This road is located in either the flat ( 142.9 km ) or rolling ( 6.1 km ) terrain. The road mainly passes in a paddy field or forest area and there are some small villages along the road.

## Road Conditions :

The 11.2 km section between Junction Route 16 and Junction of Route 14A1 has a gravel surface, and it keeps relatively good condition because this section is under improvement with the gravel surface. Therefore, The running speed indicated approx. more than $50 \mathrm{~km} / \mathrm{hr}$. However, the section between Junction 14A1 and the border of Cambodia are an earth road and their surface are fair or bad conditions. Accordingly, the average running speed in this section is approx. more than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

Although the road crosses over 30 small and medium rivers, bridges have not constructed at the some crossing points. Especially, at the rivers after KM post 53.8 km , there is no bridge at all. Accordingly, vehicles cannot pass at some crossing points in rainy season.

## Socio-economic Conditions:

This route runs in four districts of Champasack Province, namely, Phonthong, Champasack, Sukhuma and Moonlapamok Districts. Even though these four districts are rich with sufficient rice production and dense population, there is a distinguished disparity between west part and east part of these districts. Generally speaking, east part (i.e. along Mekong River) of these districts is more prosperous. Total population in 5 km range of the road is 12,565 persons and per km population is just 84 persons $/ \mathrm{km}$. The Route 14A, that runs east part of the same provinces, has 524 persons $/ \mathrm{km}$. However, population of ethnic minorities in 5 km range is 4,129 persons, which claims $33 \%$ of the total population. This area has smaller economic potential and larger need for social development. Accidents of mine explosion in road construction site have been reported in 2001.
Source: Study Team

Table 1.3.2 Road Conditions by Route (9/16)

| Route | $\mathbf{1 4 ~ C}$ | Road <br> Length | L = 42.0 km |
| :---: | :--- | :---: | :--- |
| Origin | Ban Nong Nga <br> (Junction of Route 14 B) | Destination | M. Moonlapamok |

## Surface Type :

Gavel road 9.4 km , Earth road 32.6 km

## Terrain Conditions :

This road is almost located in the flat terrain. Mainly, the road passes in a paddy field or forest area and some small villages are located along the road

## Road Conditions :

Improvement has been undertaken at three sections of the total length 10.2 km . In these sections, the road width is approx. 11.0 m and the surface keeps good or fair conditions. The running speed in these sections indicated approx. more than $40 \mathrm{~km} / \mathrm{hr}$.
In other sections, the surface is in fair or bad conditions with 3.5 m to 6.7 m . in width Accordingly, the running speed showed approx. more than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

8 small and big rivers cross the road and temporary bridges were constructed at all crossing points. However, one bridge, Houay Kaddannai Bridge, was broken due to over-loaded vehicle.

## Socio-economic Conditions:

This route runs in Moonlapamok District. This road connects richer east part and poorer west side with 42 km length. Population in 5 km range is 6,194 persons or 147 person/km. Ethnic minorities claim $70 \%$ of the population. This infers smaller literacy rate than the district average of $63.3 \%$. West part of this route has little economic potential and larger need for social development, while east part has higher economic potential and smaller need for social development. Improvement of this route may work for mitigating disparity between west and east.

[^3]Table 1.3.2 Road Conditions by Route (10/16)

| Route | $\mathbf{1 4}$ C1 | Road <br> Length | L=23.0 km |
| :---: | :--- | :---: | :--- |
| Origin | Ban Hieng <br> (Junction of Route 14 B) | Destination | Ban Sam Kha <br> (Junction of Route 14 A) |

## Surface Type :

Earth road 23.0 km

## Terrain Conditions :

This road mainly runs through the flat terrain, which mainly comprises a paddy field and forest area. There are some small villages along the road.

## Road Conditions :

Since this road has been improved by grading, the road surface keeps good condition with 10.5 m to 11.5 m . in width There was some sections with one meter height embankment. The running speed indicated approx. more than $40 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

2 small and big rivers are located on the road and temporary bridges exist at all crossing points. Therefore, the whole route is passable through a year.

## Socio-economic Conditions:

Route 14C1 runs in Sukhuma District in Champasack Province, and has similar situation with Route 14 C . Population in 5 km range is 10,756 persons or 468 person/km. Ethnic minorities count 2,504 persons. Concentration of ethnic minorities is rather observed in the east part of the district. Literacy rate for whole district is $61.6 \%$. There supposed to be no significant social disparity between east and west.

[^4]Table 1.3.2 Road Conditions by Route (11/16)

| Route | $\mathbf{1 4 ~ C 2}$ | Road <br> Length | L=6.0 km |
| :---: | :--- | :---: | :--- |
| Origin | Ban Phong Photh <br> (Junction of Route 14 B) | Destination | Ban Nong Te <br> (Junction of Route 14 A1) |

## Surface Type :

Earth road 6.0 km

## Terrain Conditions :

This road is almost located in the flat terrain and mainly passes in the paddy field or small village.

## Road Conditions :

Since this road is under improvement by grading, the surface showed good or fair conditions, and the road width is 14.0 m . In improvement works, pipe culverts are installed at some small waterways. The average running speed in this section is approx. more than $40 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

Although there is one small river, 25 m in width, on the road, a bridge has not been constructed. Therefore, vehicles can pass only for 9 months a year.

## Socio-economic Conditions:

This route runs in Champasack District of Champasack Province. The area of this very short route has almost the same socio-economic characters of 14A1. This road has 3,765 persons in its 5 km range. Ethnic minorities count just 454 persons. Since the area is away from the Mekong and major water resources, rice productions per person may be smaller than the district average $375 \mathrm{~kg} /$ person.

[^5]Table 1.3.2 Road Conditions by Route (12/16)

| Route | $\mathbf{1 5}$ | Road <br> Length | $\mathrm{L}=73.0 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 13 S | Destination | Junction of Route I H |
| Surface Type : <br> Gravel road 73.0 km |  |  |  |
| Terrain Conditions : <br> This road is mainly located in the flat terrain with mainly a copse area. The road also <br> passes through some small villages. |  |  |  |

## Road Conditions :

The road surface in all the sections indicated fair condition because the road has been improved with the gravel surface. As the road width ranges from 4.1 m to 6.9 m , it is regarded as 2 lane carriageway. The average running speed resulted in approx. more than $40 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

Although there are the total 19 small and large-scale rivers on the road, bailey bridges have been constructed at 18 crossing points. There is one submergible bridge with 60 m in length, crossing over Xe Don River. A ferry operates at this point in the rainy season.

## Socio-economic Conditions:

Route 15 runs through rich paddy land in Khongxedone, Vapy and Saravan District of Saravan Province. Population within 5km of the road counts 806 person/km. Minority population is not small ( 6,580 person), however, they claim just $11.2 \%$ of the total population along this route. Since the road link is in a fair condition, there is some work force of industry and service sector developed along it. Rice production of these three districts is enough to feed the population. Literacy rate and student ratio is not so serious in comparison with the surrounding counterparts.
Source: Study Team

Table 1.3.2 Road Conditions by Route (13/16)

| Route | $\mathbf{1 6}$ A | Road <br> Length | L=71.0 km |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 16 | Destination | Junction of Route 1 I |

## Surface Type :

Gravel road 71.0 km

## Terrain Conditions :

This road runs through either a flat ( 32.1 km ), rolling ( 17.9 km ) or mountainous ( 21.0 km ) terrain mainly covered with copse. There are some small villages along the road.

## Road Conditions :

The road surface in the first 40 km section is in the good or fair conditions because improvement with the gravel surface has been executed. The average running speed in this section is more than $40 \mathrm{~km} / \mathrm{hr}$. As the road width is 4.7 m to 7.0 m , it is regarded as a 2 lane carriageway.
The section between KM post 40.0 km and 60.7 km is located in the mountainous area, and the surface in the first 2.1 km section has a bad condition. This section has narrow width $(2.5 \mathrm{~m})$ and also the horizontal curve is small. In general, the road width in the mountainous section ranges from 3.5 m to 3.9 m .

## Crossing Condition:

The total 6 small and medium-small rivers are located on the road, and the permanent bridges were constructed at 5 crossing points and a bailey type is at one river. Therefore, the whole road section is passable through a year.

## Socio-economic Conditions:

This road link serves the Boloven Plateau area including Paksong District (Champasack Province) and Saysettha District (Attapeu Province). Population along 5km from the road is 192 person/km. Eastern part of this link is down-slope and has little population along it. Ethnic minorities hold majority of the population and counts 12,675 persons along the link. Literacy rate of the district is $62.3 \%$ and student ratio is $22.5 \%$. Cash crops like coffee are cultivated here rather than rice. Accessibility to the market is already secured with the connection to Thai border through Pakse. Route 16A rather contributes to the connection of Attapeu and Sekong province to the west part of the country. Upon the completion of Route 16 east that runs to the Vietnamese border, Route 16A will contribute to transmit traffic from Vietnam to Pakse and to Thai.

Table 1.3.2 Road Conditions by Route (14/16)

| Route | $\mathbf{1 8}$ A (i) | Road <br> Length | $\mathrm{L}=30.6 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | Junction of Route 13 S | Destination | Border of province <br> (Xe Kham Pho river) |

## Surface Type :

Gravel road 30.6 km
This road is first section of Route 18A.

## Terrain Conditions :

This road is located in the flat ( 19.7 km ) or rolling ( 10.4 km ) terrain and the road mainly passes in the copse area. There are some small villages along the road.

## Road Conditions :

The road surface keeps a fair condition. The road width ranges from 5.2 m to 8.0 m in the flat section and 3.5 m to 4.0 m in the rolling section. The average running speed is more than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

There are 7 small rivers on the road and temporary bridges exist at 5 rivers but there is no bridge at 2 crossing points. Xe Khampho River is not included in this section.

## Socio-economic Conditions:

This part of Route 18A runs in Pathoomphone District (Champasack Province). Even though two NBCA occupied big land area in this district, this district has adequate rice production, and big work force in industry and service sector. Factories of building material are located here. Population within 5 km along the route is 445 person $/ \mathrm{km}$. From the social aspects, this district in not the poorest among the poor. Literacy rate of Pathoomphone district is $67.4 \%$ and student ratio is $18.8 \%$. There is some tourism potential with elephant villages and stone ruins called Phuasa. Good accessibility from Pakse helps development of industry and service sector.

Table 1.3.2 Road Conditions by Route ( $15 / 16$ )

| Route | $\mathbf{1 8}$ A (ii) | Road <br> Length | $\mathrm{L}=39.7 \mathrm{~km}$ |
| :---: | :--- | :---: | :--- |
| Origin | Border of province <br> (Xe Kham Pho river) | Destination | Xe Piane River |

## Surface Type :

Earth road 39.7 km
This road is second section of Route 18A.

## Terrain Conditions :

This road runs through the rolling terrain and mainly passes through the forest or copse area. There are some small villages along the road.

## Road Conditions :

This section is regarded as a missing link because vehicles can pass for only 2-3 months a year. The road width is also very narrow with 1.5 m to 3.0 m . The road surface is in a bad condition. The average running speed in this section is approx. less than $10 \mathrm{~km} / \mathrm{hr}$. The horizontal curvature of the existing road is very small in some sections.

## Crossing Conditions:

Although 10 small to large-scale rivers cross the road, there are no bridges at all crossing points. Therefore, this section become impassable in a rainy season. This section includes two large-scale rivers; Xe Kham Pho river with 130 m in width and Xe Piane River with 100 m in width.

## Socio-economic Conditions:

This Route runs between two big rivers without bridges. Xe Khampho River and Xe Pian River really separate this area from the rest of the region. This area has little population (79 person $/ \mathrm{km}$ ) and almost negligible work force in industry and service sector. Rice cultivation with slush and burn method still persists in the area. Physical isolation causes problems in education health, and accessibility. Literacy rate of the district is $46.9 \%$. Since this figure include the richer part of the district (the east part of Xe Pian River), reality of the isolated area is much worse. Not only the two big rivers but also many streams from Boloven Plateau disturb traffic during rainy season. Route 18A runs along the north edge of the Xe Pian NBCA, so big scale land development might be restricted. Distinguished expected function of this road link is connectivity. If this link is improved, it will complete the connection from Vietnam to Pakse after the completion of Route 18B. Also, remote province of Attapeu could have two-ways (north and west) connection with the other part of the national territory.

[^6]Table 1.3.2 Road Conditions by Route ( $\mathbf{1 6} / 16$ )

| Route | 18 A (iii) | Road <br> Length | $\mathrm{L}=42.2 \mathrm{~km}$ |
| :--- | :--- | :---: | :--- |
| Origin | Xe Piane River | Destination | Junction of Route 18 B |
| Surface Type : <br> Gravel road $37.6 \mathrm{~km}, \quad$ Earth road $\quad 4.6 \mathrm{~km}$ <br> This road is third section of Route 18A. |  |  |  |

## Terrain Conditions :

This road mainly runs through the flat terrain, covered with a copse or forest area. The road also passes in some small villages.

## Road Conditions :

The road surface of the section between Xe Piane River and KM post 74.9 km is a bad condition with 4.0 m to 4.2 m in road width. However, the section between KM post 74.9 km and Junction of Route 18 B keeps a fair condition with 4.0 m to 6.7 m in width. The average running speed in this section is approx. more than $30 \mathrm{~km} / \mathrm{hr}$.

## Crossing Conditions:

There are 15 small and medium-scale rivers on the road, ranging from 10 m to 85 m in width, and temporary timber bridges exist at all crossing points. Xe Piane River is not included in this section.

## Socio-economic Conditions:

This Route runs between Xe Pian River and Samakhixay Town (the capital of Attapeu Province). This road serves two districts, Sanaxay and Samaxhixay of Attapeu Province. Study team observed that this route run with dense population and rich paddy land along it. Population is 683 persons $/ \mathrm{km}$. More than $50 \%$ of the population along this route is ethnic minorities. Large villages of ethnic minorities are found in a narrow strip between this route and Boloven Plateau. Rice production is just self-sufficient. Literacy rate of Sanaxay is $46.9 \%$ and that of Samakhixay is $72.3 \%$. Since this road link is already 12 months passable function, improving may not significantly contribute to the accessibility of the area.

Source: Study Team

### 1.4 Bridges and Structures for Improvement

### 1.4.1 Improvement Goal for Bridges and Crossing Structures

The goal of the improvement plan for bridges crossing rivers until 2020 is to provide at least a permanent bridge with 2-lane carriageway at all crossing points, which are passable all a year and can accommodate the increase in traffic volume up to the design year. In addition, the load capacity of a bridge should meet an international standard for a trunk road, which can carry a 25 ton class trailer safely.

### 1.4.2 Bridges and Structures

In total 12 roads or 16 links have been evaluated to establish a Master Plan. These roads have not been improved to all-weather road, including crossing structures. The existing crossing condition at all crossing points is summarized in Table 1.4.1, based on the inventory survey results.

Table 1.4.1 List of Bridges on by Road

|  | Rd. No | 1G | 1H | 1J |  | 14A |  | 14A1 | 14B | 14C | 14C1 | 14C2 | 15 | 16A |  | 18A |  | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | i | ii | iii |  |  |  |  |  |  |  | i | ii | iii |  |
| Existing | Nos. | 26 | 0 |  | 4 | 0 | 2 | 8 | 15 | 8 | 2 |  | 19 | 6 | 3 | 0 | 14 | 115 |
| Bridge | L (m) | 532 | 0 | 98 | 140 | 0 | 55 | 148 | 200 | 120 | 125 | 25 | 564 | 207 | 55 | 0 | 445 | 2,723 |
| Rivers | Nos. | 16 | 0 | 6 | 4 | 2 | 20 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 2 | 19 | 0 | 84 |
|  | L (m) | 767 | 0 | 450 | 165 | 70 | 675 | 0 | 580 | 0 | 0 | 0 | 0 | 0 | 80 | 710 | 0 | 3,497 |
| Total | Nos. | 42 | 0 | 13 | 8 | 2 | 22 | 8 | 30 | 8 | 2 |  | 19 | 6 | 5 | 19 | 14 | 199 |
|  | L (m) | 1,299 | 0 | 548 | 305 | 70 | 730 | 148 | 789 | 120 | 125 | 25 | 564 | 207 | 135 | 710 | 445 | 6,220 |

*1: There is no bridge on the paved section of Route 1 H .
*2: The existing bridges on Route 14B and 15 include 5 and one submergible type in the number respectively.
Source: Study Team

This table shows that 199 crossing points, of approximately $6,200 \mathrm{~m}$ total length, are identified. Among them, since 57 crossing points have no crossing structure, requiring approximately $3,500 \mathrm{~m}$ total length of bridges to be newly constructed at those crossing points.

All existing bridges listed in the table should be improved in order to meet the improvement goal mentioned above. Because, whereas the major structural types of the existing bridge, which are timber type or and bailey, have only one-lane carriageway and insufficient load capacity for a 25 ton class trailer. The reinforced concrete bridges and steel- I girder bridges, which are a minority among existing bridges, are assumed to have sufficient load capacity, but
only one-lane carriageway.

### 1.4.3 Bridges and Structures to be Improved on Other Roads

Besides the bridges on the 12 selected roads, there are some bridges or crossing points to be improved on the already paved national roads in the study area to meet the improvement policy for bridges. Four bridge sites or crossing points are identified as a bridge to be improved. A brief description of these projects is given in Table 1.4.2.

## Table 1.4.2 List of Bridge Projects

| Project Name |  | Reasons |
| :---: | :---: | :---: |
| Bridge (Route <br> 1I) Houay <br> Lamphan  <br> Bridge  | 3 span bailey bridge with 60 m in total length, constructed in 1996. | Since that bridge was constructed at similar time of the commencement of ADB-6/4 road improvement project on Route 16(1I), ADB eliminated that bridge from the bridge list to be improved in the project. |
| Bridge (Route <br> 16) Houay <br> Phakkud Bridge  | One span bailey bridge with 24 m in the total length, originally constructed in 1995 but replaced in 2001 due to the collapse by the over landed vehicle passing | Since that bridge was constructed at similar time of the commencement of ADB-2 road improvement project on Route 16, ADB eliminated that bridge from the list to be improved in the project. |
| Bridge (Route 16) Xe-Kong river | No existing bridge at the crossing point of Xe-Kong River with approximately 200 m in width. One ferry accommodating 4-5 sedan vehicles has been operating almost through a year. | The Xe-Kong River bridge is excluded from the committed road improvement project from Sekong to Vietnam border on Route 16 undertaken by the Malaysian private group. |
| Bridge (Route 20) 19 bridges | 19 small and medium-scale bailey bridges, from 9 m to 69 m in the bridge length, on Route 20 including 5 bridges on Route 1 H , with 20 tons load capacity | All bridges were constructed at the same time of road improvement project completed in 1994. Due to the budget limitation and low traffic volume, a bailey type was applied. |

In addition to these projects, the following bridge project was included in response to a request from the Lao side.

Table 1.4.3 Additional Bridge Project

| Project Name | Crossing Condition | Reasons not to have been improved |
| :--- | :--- | :--- |
| Pakse- Xe-don | Five span steel truss bridge with 210m in <br> Bridge <br> the total length and 4.5m in width over <br> Xe-Don River in Pakse. 1m foot path <br> was provided at each side of the <br> carriageway, constructed in the 1960s. | The Route 13S bypass was constructed to reduce <br> the traffic burden of the original Route13S in the <br> city area. Accordingly, heavy vehicles use the <br> bypass, but increase in local traffic, congestion <br> and delays have increased. Due to the budget |
| Due to the narrow bridge width, signal |  |  |
| operation is being undertaken. It allows |  |  |
| only one way traffic and traffic going to |  |  |
| limitation, improvement has not been |  |  |
| implemented. |  |  |
| minutes before the bridge. |  |  |


[^0]:    Source: Study Team

[^1]:    Source: Study Team

[^2]:    Source: Study Team

[^3]:    Source: Study Team

[^4]:    Source: Study Team

[^5]:    Source: Study Team

[^6]:    Source: Study Team

