No.

**Department of Local Infrastructure Development and Agricultural Roads**
**Ministry of Local Development**
**Federal Democratic Republic of Nepal**

# PREPARATORY SURVEY REPORT
# ON
# THE PROJECT
# FOR THE IMPROVEMENT OF COMMUNITY ACCESS
# IN
# FEDERAL DEMOCRATIC REPUBLIC OF NEPAL

**March 2010**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

**NIPPON KOEI CO., LTD.**

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# PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on the Project for the Improvement of Community Access in Federal Democratic Republic of Nepal.

JICA sent to Nepal a study team from March 11 to April 17, 2009 and from May 24 to July 22, 2009.

The team held discussions with the officials concerned of the Government of Nepal, and conducted field studies at the study areas. After the team returned to Japan, further studies were made. Then two missions were sent to Nepal in order to discuss a draft outline design and reference tender documents, and as these result, the present report was finalized.

I hope that this report will contribute to the promotion of the Project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the concerned officials of the Government of Federal Democratic Republic of Nepal for their close cooperation extended to the teams.

March 2010

Hiroyo SASAKI

Vice-President

Japan International Cooperation Agency

March 2010

# Letter of Transmittal

We are pleased to submit to you the preparatory survey report on the Project for the Improvement of Community Access in Federal Democratic Republic of Nepal.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from March, 2009 to March, 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nepal and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Yoshihisa YAMASHITA
Project Manager,
Preparatory Survey Team on
the Project for the Improvement of Community Access
in Federal Democratic Republic of Nepal
Nippon Koei Co., Ltd.

***Summary***

# SUMMARY

## 1. Outline of the Country

The Federal Democratic Republic of Nepal has an area of approximately 147,000 square kilometres, 80% of which is covered by hilly and mountainous terrain regions. About 50% of the total population of 27 million live in these hills and mountains and are engaged in agriculture. Annual rainfall in the region is between 1,000 mm and 4,000 mm, concentrated in the rainy season between June and September. The comparatively heavy rains and fragile terrain have caused very steep and severe terrain conditions and about 6,000 numbers of rivers with total length of 45,000 km, has obstructed the expansion of the road network and implementation of proper road maintenance.

Nepal's nominal GDP for the year 2007/08 is around US$12.6 billion and per capita nominal GDP is around US$470. The primary industry is agriculture, which contributes to about 40% of the GDP and sustains about 80% of Nepal's population. Annual budget of the Government of Nepal (GON) for the year 2007/08 is around 169 billion NRS. Out of the budget, foreign grants and loans make up for 16.2% and 10.3%, respectively, comprising approximately 26.5% in total.

The total length of the road network in Nepal is about 40,000 km, including main foot trails. However, due to the steep terrain conditions and severe weather, the all-weather road length remained only at 10,000 km. These conditions forced many communities to walk more than four hours to reach passable roads or be isolated for several months by floods at river crossing sites during the rainy season.

The poor rural road network condition would be a primary factor of the economical gap between urban and rural area and poverty of rural area which could be the causes of the improper program and internal conflicts in Nepal since 1996. The poor situation of the rural road network has become worse due to the destruction of facilities and stagnation of road construction and maintenance activities during the 11 year long conflicts.

To materialize the peace process after the armed conflict, the Government of Nepal (GON) and donor agencies have been strongly promoting rural road network improvement programs, aiming to rectify the economic gap between the urban and rural areas and reduce poverty. However, relatively large river crossings have remained without proper crossing structures because the improvement programs were planned to cover wide areas and composed of labour-based environment-friendly and participatory approaches.

As a result, even after completion of the programs, many rural societies have been isolated physically and suffered from inaccessibility to public services for several days to several months, mainly because of road closures due to floods every rainy season.

## 2. Background and Outline of the Project

After continuous armed conflicts since 1996, the GON and the Communist Party of Nepal, Maoists, agreed on the Comprehensive Peace Agreement on November 2006. Consequently, the constituent assembly elections were held on 10th April 2008. Following the successful conclusion of the constituent assembly elections, it is expected that the peace process will be realized while marking another major milestone.

The GON has implemented the reconstruction of the nation based on the Interim

Three-Year Plan (July 2007 to June 2010), which was set up after the conflict. The plan places high priority on bridging the economical gap between urban and rural areas and poverty reduction, which may have been one of the causes of the conflict. Aiming at providing certain access for the reconstruction programs of the rural societies and infrastructure, the GON and donors have been implementing rural road network improvement projects.

With this background, GON requested for assistance from the Government of Japan (GOJ) through several grant projects, including a project to construct 268 small-scale bridges in the rural areas. In response to the requests, Japan International Cooperation Agency (JICA) conducted a project formulation study called the "Community Access Improvement Project Formulation Study" (the Project Formulation Study) for five districts, namely Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk, aiming at examination of the possibility to formulate a community access improvement project.

In the Project Formulation Study, a project for the construction of river crossing structures in the five districts has been formulated and is justified by the project effects as follows:

- The five districts have suffered from bad accessibility due to their weak road network.
- Improvement of the bad accessibility will contribute to enhance economic activities and boost living standards, reduce the economical gap between urban and rural areas, and consequently, alleviate poverty reduction in the districts.

Furthermore, considering the small-scale components composed of structures using locally available construction methods and materials, the project has been proposed to be implemented under the Grant Aid for Community Empowerment Scheme.

Based on the outcome of the Formulation Study, the GON made a request for Grant Aid for Community Empowerment for the Project for the Improvement of Community Access (the Project) to GOJ in August 2008.

## 3. Outline of Basic Design and Main Feature of Project Facilities

In response to the request from GON, GOJ decided to take up the Project. JICA dispatched the Preparatory Survey Team (the Study Team) to Nepal for the period from 11th March 2009 to 17th April 2009. The Study Team confirmed the contents of the requested assistance, held discussions with GON, conducted site surveys and collected relevant documents aiming to select and determine project sites. After returning to Japan, the Study Team examined the selection criteria appropriate for the requested grant aid assistance and prepared a list of proposed project sites.

JICA dispatched the Study Team for the period from 24th May 2009 to 22nd July 2009 to discuss and finalize the list of the proposed project sites, and carry out technical field surveys such as topographical mapping and geotechnical survey for the selected sites. The Study Team and GON agreed on the list of the proposed project sites as well as on the necessity of IEE for the construction of project bridges. Subsequently, the GON side commenced the IEE. After returning to Japan, meanwhile, the Study Team appraised the project to make it appropriate for the requested grant aid assistance and determined and carried out the outline design.

JICA consequently dispatched an Outline Design Explanation Team to Nepal from the

22nd of October 2009 to the 8th of November 2009. Meanwhile, the Minutes of Discussions, which mainly covered the results of the outline design and the recipient country's obligations, were agreed by both sides. The IEEs carried out by the Nepalese side were approved and completed in November 2009.

Considering the smooth implementation of the project, JICA dispatched the Study Team to conduct a centerline survey for the project sites from the 24th of December 2009 to the 31st of December 2009. Reference tender documents were also discussed and submitted from 16th of January 2010 to 6th of January 2010.

During the site reconnaissance in the Study, 108 major river crossing sites on the 13 roads prioritized in the District Transport Master Plans have been selected as sites to be analyzed. The 108 sites are classified into three groups depending on the duration of traffic closure and the top 35 sites classified as Group A and B suffering from road closure of several months and several days in rainy season respectively. The 35 sites were selected as the sites to be taken up in the Project.

To achieve objectives, the Project was formulated to construct river-crossing structures composed of suspension bridges, truss bridges, reinforced concrete bridges and continuous box bridges as shown in the table below, at about 35 sites which have suffered from road closure of several days or several months due to flood in the rivers along 13 rural roads in five districts, namely Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk in the Central Development Region of Nepal.

| Districts | Road Name | Numbers of sites and Bridge type | | | | |
|---|---|---|---|---|---|---|
| | | Suspension Bridge | Truss Bridge | RC Bridge | Continues Box Bridge | Total |
| Mahottari | Laxmaniya-Baratpur-Raghunathpur Road | | | 1 | 1 | 2 |
| Sindhuli | Sindhulimadi-Kapilakot Road | | | 1 | 4 | 5 |
| | Sindhulimadi-Bhimsthan Road | | | | 3 | 3 |
| | Bhiman-Nilpanne-Dhansari Road | | | | 1 | 1 |
| | Katari-(Dudhauli)-Sirthuli-Dakaha Road | | | 1 | 8 | 9 |
| Ramechhap | Manthali-Ramechhap-Sangutar Road | | | | 1 | 1 |
| | Fulasi-Doramba Road | No serious river0crossing site | | | | |
| | Betali-Namadi-Khimti Road | | 4 | | 1 | 5 |
| Kavrepalanchowk | Kavrebhanjyang-Dapcha-Karkare Road | 1 | | | 1 | 2 |
| | Katunjebesi- Sipali-Bankhu Road | 1 | | | | 1 |
| | Nepalthok-Tholoparsel- Boharedovan Road | 1 | | | | 1 |
| Sindhupalchowk | Balephi-Jalbire-Kattike Road | Under improvement by the Balephi Hydro-power Project | | | | |
| | Melamchi-Bhotang Road | | 2 | | 3 | 5 |
| Total | | 3 | 6 | 3 | 23 | 35 |

## 4. Construction Period and Estimated Project Cost

The tendering procedure will take about 5.5 months and the construction period will be about 24 months. The Project period is thus estimated to be about 27 months in total. The cost to be borne by the Nepalese side, separate from Japan's Grant Aid, is estimated at about NRs 100

thousand, which includes compensation for private lands and houses, environmental mitigation and monitoring measures, and measures for local residents.

## 5. Project Evaluation and Recommendations

The following benefits are expected:

Direct Impacts and Effects:

- Suspension period of bus services on the 13 roads in the five districts, which was 14 months in total for all roads during the rainy season in 2009, will be reduced by one month.
- In total, it is estimated that the project will benefit about 359 thousand people living in the area, Mahottari 56,000, Sindhuli 114,000, Ramechhap 108,000, Kavrepalanchowk 47,000 and Sindhupalchowk 34,000 people.

Indirect Impacts and Effects:

- The project will provide a safety access to schools, hospitals and markets, and thus contributing to enhance the living standard in the area.
- The project will provide reliable access from farm to market during rainy season and thus contribute to enhance the economic activities in the area.
- The project will strengthen unity in the area and play as a basic facility to implement the programs bridging the economical gap between urban and rural areas, and for poverty reduction which may be one of the causes of the conflict.
- Traffic is closed in three roads in Sindhuli and Ramechhap Districts. Full opening of the project roads is a fundamental matter for the successful completion of the Project. The sections have to be completed timely and definitely by the end of the Project by DDCs.

The basic reason for road closures due to flooding from the rivers on each project road will be taken out by the Project. However, there are other causes of road closures in the monsoon season such as slope failure, muddy road surface and application of substandard road construction methods. To achieve the objective of the Project, it is recommended that continuous efforts to upgrade the entire road section facilities be undertaken in order to make it more sustainable against natural disasters. It is therefore important not only to allocate sufficient maintenance budget to DDCs but also improvement of the maintenance capability of DDC's should be implemented.

**PREPARATORY SURVEY ON THE PROJECT FOR THE IMPROVEMENT OF COMMUNITY ACCESS IN NEPAL**

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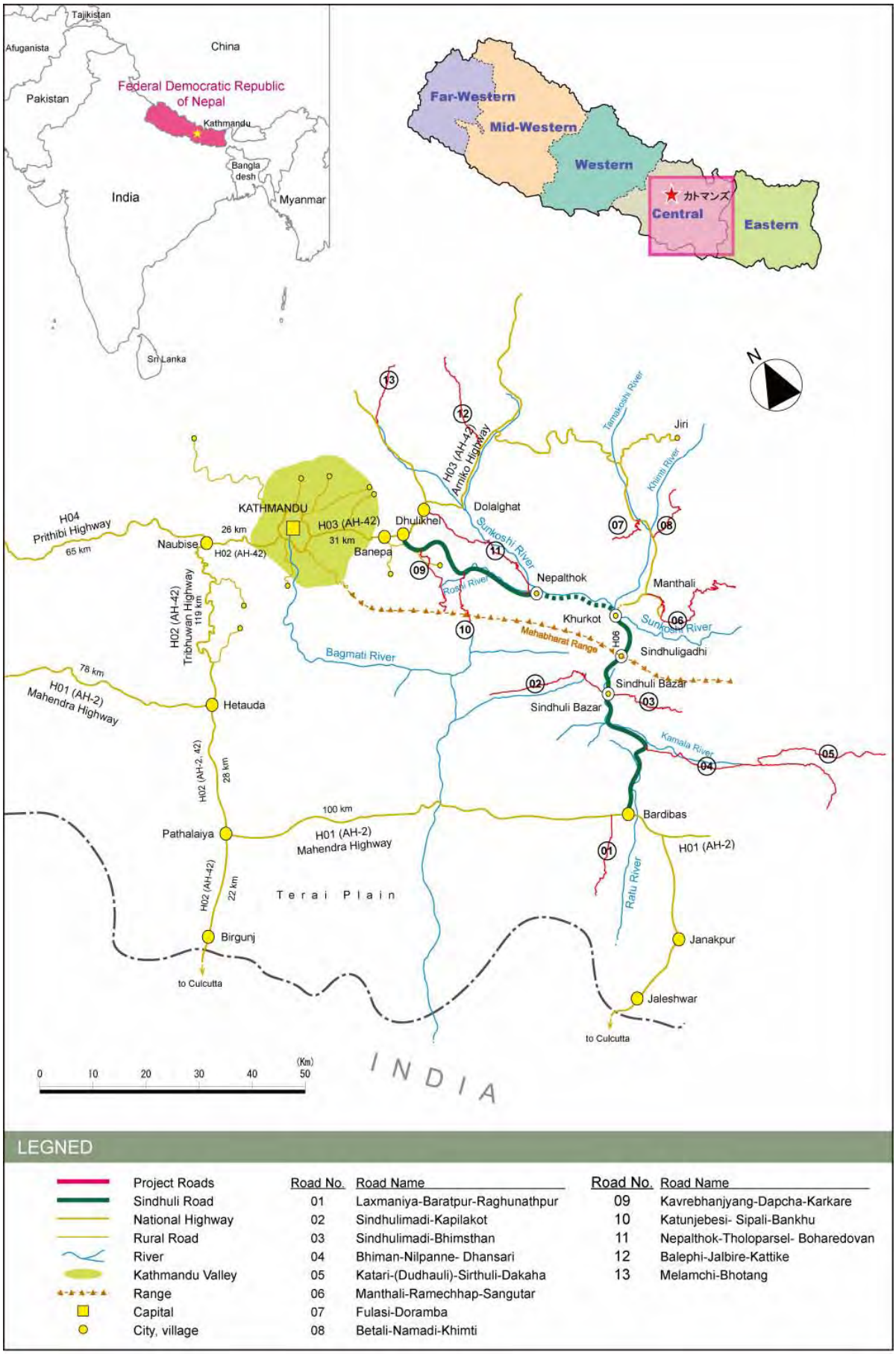


## LEGNED

| | |
|---|---|
| Project Roads | |
| Sindhuli Road | |
| National Highway | |
| Rural Road | |
| River | |
| Kathmandu Valley | |
| Range | |
| Capital | |
| City, village | |

| Road No. | Road Name |
|---|---|
| 01 | Laxmaniya-Baratpur-Raghunathpur |
| 02 | Sindhulimadi-Kapilakot |
| 03 | Sindhulimadi-Bhimsthan |
| 04 | Bhiman-Nilpanne- Dhansari |
| 05 | Katari-(Dudhauli)-Sirthuli-Dakaha |
| 06 | Manthali-Ramechhap-Sangutar |
| 07 | Fulasi-Doramba |
| 08 | Betali-Namadi-Khimti |

| Road No. | Road Name |
|---|---|
| 09 | Kavrebhanjyang-Dapcha-Karkare |
| 10 | Katunjebesi- Sipali-Bankhu |
| 11 | Nepalthok-Tholoparsel- Boharedovan |
| 12 | Balephi-Jalbire-Kattike |
| 13 | Melamchi-Bhotang |

# Location Map of Project Roads

Perspective View of the Roshi Bridge at Neplthok (Suspension Bridge 120m)

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## ABBREVIATIONS

| | | |
|---|---|---|
| AASHOTO | : | American Association of State Highway and Transportation Officials |
| ADB | : | Asian Development Bank |
| CDO | : | Chief District Officer |
| DDC | : | District Development Committee |
| DFID | : | Department for International Development |
| DOLIDAR | : | Department of Local Infrastructure Development and Agricultural Roads |
| DOR | : | Department of Roads |
| DPO | : | District Project Office |
| DTO | : | District Technical Office |
| DRSP | : | District Roads Support Programme |
| DTMP | : | District Transport Master Plan |
| G/A | : | Grant Agreement |
| GDP | : | Gross Domestic Products |
| GOJ | : | Government of Japan |
| GON | : | Government of Nepal |
| EIA | : | Environmental Impact Assessment |
| EOJ | : | Embassy of Japan |
| EPA | : | Environmental Protection Act |
| EPR | : | Environmental Protection Rules |
| E/N | : | Exchange of Notes |
| hr | : | Hour |
| IEE | : | Initial Environment Examination |
| IRC | : | Indian Road Congress |
| JICA | : | Japan International Cooperation Agency |
| JICS | : | Japan International Cooperation System |
| LDC | : | Local Development Officer |
| m | : | Meter |
| $m^2$ | : | Square Meter |
| $m^3/s$ | : | Cubic Meter per Second |
| MOLD | : | Ministry of Local Development |
| NRs | : | Nepal Rupee |
| ODA | : | Official Development Assistance |
| SDC | : | Swiss Development Program and Cooperation |
| VDC | : | Village Development Committee |
| WB | : | World Bank |

# *CHAPTER 1*

# *BACKGROUND OF THE PROJECT*

# CHAPTER 1 BACKGROUND OF THE PROJECT

## 1.1 Background of the Project

After continuous armed conflicts in Nepal since 1996, the Government of Nepal (GON) and the Communist Party of Nepal, Maoists, agreed on the Comprehensive Peace Agreement on November 2006. The constituent assembly elections were consequently held on 10th April 2008. Following the successful conclusion of the constituent assembly elections, it is expected that the peace process will materialize while achieving another major milestone.

The Government of Japan (GOJ) has implemented various projects related to supporting the peace process, under Japan's official development assistance scheme. This involves rural development programs in the medium and long term, aiming at reduction of economic gap between urban and rural areas, and poverty reduction which may cause conflict. This is thus the main objective of the Interim Three-Year Plan (July 2007 to 2010 June) of GON.

The total length of the road network in Nepal is about 40,000 km including foot trails. However, due to severe terrain and weather conditions, only within 10,000 km of the road network is passable. This has forced many communities to walk for more than four hours to reach such passable roads. These conditions have also isolated them for a long time due to floods at river crossing sites during the rainy season.

Aiming at closing the economic gap between urban and rural areas, poverty reduction due to improper program implementation and conflicts, and providing certain access for the other reconstruction programs of the rural societies and infrastructure, GON and the donors have been implementing rural road network improvement projects.

Considering the above background, the GON requested GOJ for several grant assistances including a project for constructing 268 small-scale bridges in rural areas. In response to such requests, Japan International Cooperation Agency (JICA) conducted a project formulation study entitled, "Community Access Improvement Project Formulation Study" (the Project Formulation Study) for five districts: Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk Districts. Its aim is to examine the possibility of formulating a community access improvement project.

In the Project Formulation Study, a project for the construction of river crossing structures in the five districts has been formulated with the corresponding effects justified below:

- The five districts have suffered with poor accessibility due to their weak road network.
- Improvement of the poor accessibility of roads could contribute in enhancing the economic activities and living standards in the areas as well as reducing the economic gap between urban and rural areas, and alleviating poverty.
- The improvement of the rural road network exhausted by the conflicts could contribute in acceleration of the peace process.

Furthermore, considering the small scale components composed of structures built using locally available construction methods and materials, the project has been proposed for implementation under the Grant Aid for Community Empowerment Scheme.

Based on the outcome of the Project Formulation Study, the GON requested the GOJ in August 2008 for a Grant Aid for Community Empowerment for the Project for the Improvement of Community Access (the Project).

In response to the request, GOJ decided to take up the Project and delegated the "Preparatory Survey for the Project for the Improvement of Community Access in Nepal" (the Study) to JICA to formulate the Project, aiming at reconstructing the rural societies and economy which is the main objective of the Interim Three-Year Plan of GON.

## 1.2 Social and Environmental Consideration

### 1.2.1 Legal Framework of the Environmental Study Related to the Project

There are two legal frameworks in Nepal.

- Environmental Protection Act (EPA), 1996
- Environmental Protection Rules (EPR), 1997 (amended 1999)

The necessity of an Initial Environmental Examination (IEE) for the construction of feeder roads is prescribed in the EPR. Based on this, screening criteria by project type stated in the "Environmental Assessment in the Road Sector of Nepal (Geo-Environmental Unit, Department of Roads, Ministry of Physical Planning and Works, January 2000)" classifies the following river crossing facilities that are most likely related to the Project:

- Major bridges (span length greater than 20 m) and medium bridges (total length greater than 20 m without spans of less than 20 m) and their approach roads require an IEE study;
- Construction works for minor bridges (total length of more than 6 m up to 20 m) and their approach roads are exempted from environmental study; and
- IEE is required if extraction of construction materials from river beds would amount up to 50 $m^3$/day, or an EIA is necessary for more than 50 $m^3$/day.

Therefore, IEEs have to be carried out as the Project includes bridges of more than 20 m span lengths. Out of the 35 proposed bridges, 33 require IEE studies.

### 1.2.1 Initial Environmental Examination Result

Each District Development Committee (DDC) carried out IEE studies during the months of August to November 2009, for a total number of 33 project sites.

The IEE studies carried out for the five DDCs are summarized Table 1.1.

**Table 1.1 IEE Study Results**

| Site No. | River | Type and Dimension of Bridge | | | Major Impacts on the Natural and Social Environment | Private/Public Land Acquisition | Resettlement |
|---|---|---|---|---|---|---|---|
| | | Type | Length | Width | | | |
| **1 Mahottari District** | | | | | | | |
| Road No.1 | Laxmaniya-Baratpur-Raghupur Road | | | | | | |
| 1-1 | Dholan | RC T-Girder Bridge | 50 m | 4.0 m | Approach road goes through forest area. Number of trees subject to fell are approximately 200 and average girth size of tree is 45 cm. DDC's Forest Department is in the process of issuing No-Objection Certificate for the Project. | Approximately 1,800 sq.m of government-owned forest area is subject to acquisition. | No resettlement involved |
| 1-2 | Kantawa | Multiple Box Bridge | 28.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| **2 Sindhuli District** | | | | | | | |
| Road No.2 | Sindhulimadi-Kapilakot Road | | | | | | |
| 2-1 | Marin | RC T-Girder Bridge | 142 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 960 sq.m of agricultural area subject to acquisition | No resettlement involved |
| 2-4 | Athuwa | Multiple Box Bridge | 30.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 2-5 | Devjor | Multiple Box Bridge | 30.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 2-6 | Maheswata | Multiple Box Bridge | 105.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 480 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 2-7 | Chantuli | Multiple Box Bridge | 40.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 360 sq. m of agricultural area subject to acquisition | No resettlement involved |
| Road No.3 | Sindhulimadi-Bhimsthan Road | | | | | | |
| 3-1 | Dhamile | Multiple Box Bridge | 50.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 120 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 3-2 | Basera | Multiple Box Bridge | 21.7 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 3-5 | Girgha | Multiple Box Bridge | 70.8 m | 4.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 500 sq. m of agricultural area subject filling i.e. resume farming after the construction works | No resettlement involved |

| Site No. | River | Type and Dimension of Bridge | | | Major Impacts on the Natural and Social Environment | Land Acquisition | Resettlement |
|---|---|---|---|---|---|---|---|
| | | Type | Length | Width | | | |
| Road No.4 | Bhiman-Dhansari Road | | | | | | |
| 4-43 | Dhansari | RC T-Girder Bridge | 28.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| Road No.5 | Katari Bazar-(Dudauli)-Sirthuli-Dakaha Road | | | | | | |
| 5-1 | Tamorni | Multiple Box Bridge | 42.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 360 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-2 | Thakur-1 | Multiple Box Bridge | 80.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 450 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-3 | Thakur-2 | Multiple Box Bridge | 21.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 450 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-4 | Thakur-3 | Multiple Box Bridge | 70.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 450 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-5 | Thakur-4 | Multiple Box Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 120 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-7 | Kuluwa | RC T-Girder Bridge | 50 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | 1. Approximately 400 sq. m of agricultural area subject filling i.e. resume farming after the construction<br>2. Approximately 120 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 5-8 | Talkha | Multiple Box Bridge | 78.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 5-9 | Piprahi | Multiple Box Bridge | 14.7 m | 4.0 m | IEE study is exempted as it is less than 20 m long | No major land acquisition involved. | No resettlement involved |
| 5-11 | Kartha | Multiple Box Bridge | 28.7 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 180 sq. m of agricultural area subject to acquisition | No resettlement involved |
| **3 Ramechhap District** | | | | | | | |
| Road No.6 | Manthali-Ramechhap-Sangutar Road | | | | | | |
| 6-1 | Sukhajor | Multiple Box Bridge | 60.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| Road No.8 | Betali-Namadi-Khimti Road | | | | | | |
| 8-1 | Palati | Truss Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 8-2 | Bohare | Multiple Box Bridge | 10.8 m | 4.0 m | IEE study is exempted as it is less than 20 m long | No major land acquisition involved. | No resettlement involved |
| 8-3 | Haluwa | Truss Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 8-4 | Pharpu | Truss Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 8-5 | Chatwane | Truss Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| **4 Kavrepalanchowk District** | | | | | | | |
| Road No.9 | Kavrebhanjyang-Dapcha-Kakare Road | | | | | | |
| 9-1 | Roshi - 1 | Suspension Bridge | 90 m | 3.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, major environmental effect is confined to the road side area where farming is active. | Approximately 1,150 sq. m of agricultural area on the right bank of river is subject filling i.e. resume farming after the construction works | No resettlement involved |
| 9-2 | Ambote | Vented Causeway | 27 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| Road No.10 | Katunje-Bankhu Road | | | | | | |
| 10-1 | Roshi - 2 | Suspension Bridge | 100 m | 3.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, major environmental effect is confined to the road side area where farming is active. | Approximately 1,450 sq. m of agricultural area on the right bank of river is subject filling i.e. resume farming after the construction works | No resettlement involved |
| Road No.11 | Boharedovan-Thulo Parcel Road | | | | | | |
| 11-3 | Roshi - 3 | Suspension Bridge | 120 m | 3.5 m | Because of the existing rural road is extended to cross over Roshi Khola, no major effect on the natural environment is observed. | Approximately 1,150 sq. m of agricultural area on the right bank of river is subject filling i.e. resume farming after the construction works | 2 Units, 8 families are subject to resettlement |
| **5 Sindhupalchowk District** | | | | | | | |
| Road No.13 | Melamchi-Bhotang Road | | | | | | |
| 13-1 | Anderi | Multiple Box Bridge | 20.8m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 13-6 | Khalte | Multiple Box Bridge | 20.8m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 400 sq. m of agricultural area subject to acquisition | No resettlement involved |
| 13-8 | Tipeni | Multiple Box Bridge | 20.8m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 13-10 | Mahadev | Truss Bridge | 30.8 m | 4.0 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | No major land acquisition involved. | No resettlement involved |
| 13-14 | Hadi | Truss Bridge | 71 m | 3.5 m | Because of the existing river crossing point of the rural road is changed to a bridge, no major environmental effect is observed. | Approximately 200 sq. m of agricultural area subject to acquisition | No resettlement involved |

Source: Study Team, Prepared based on the IEE report prepared by DDCs

## 1.3 Present Status of the Project Roads

In the Study, 13 district roads in 5 districts have been proposed to be taken up in the Project. Present situation of the 13 district roads are summarized in Table 1.2.

**Table 1.2 Present Status of the Project Roads**

| District | Project Road | | Present Condition and Problems |
|---|---|---|---|
| Mahottari | No.1 | Laxmaniya- Baratpur - Raghunathpur | The project road functions as the main north-south rural road in the western area of Mahottari District between the Hadi River and the Marha River, and links scattered villages of Medeshi tribe.<br>  <br>It is the only road that links this area to Janakapur, the main city of Central Terai, and provides a lifeline for the village people in the area.<br>The population along the project road is 55,660 (2002 population statistics).<br>The current road has earthen surface and is very dusty. Therefore, improvement of road surface to gravel is expected if the river crossing structures are built under this Project and can become passable throughout the year. |
| Sindhuli | No.2 | Sindhulimadi- Kapilakot | DDC Sindhuli has implemented a road development giving high priority to this road as a Second East-West Highway. The 15-km long Sindhulimadhi section and 3-km long Kapilakot section have already been opened to traffic this year. The remaining 10 km is now under construction and expected to be open at the beginning this year.<br>The new causeway structure (box culvert) across the Gwan River nearby Sindhulimadhi is now being built while geo-technical investigation on the Marin Khola, 7.0 km from Shindhulimadhi, is being conducted by Department of Roads (DOR) simultaneously.<br>DOLIDAR and DDC strongly request the Survey Team to include the bridge construction across the Marin Khola into the Project because of the important role of this road and frequent occurrence of traffic blockage due to floods with debris.<br>The village people also requested the construction of causeways nearby Kapilakot in order to secure the school roads throughout the year.<br>  |

| | | | |
|---|---|---|---|
| | | | The population along the project road is 26,240 which includes that of Mahendrajhayadi (2002 population statistics) |
| | No.3 | Sindhulimadi-Bhimsthan | DDC Sindhuli has implemented the improvement of this road with a high priority, being one of the important east-west roads in the eastern region. The road in the section's latter half between Joge area and Bimsthan is along the river bed. This section is now being improved by DRSP aiming to be completed this year.<br>The road crosses the Gadeuri Khola at 2 km from Sindhulimadhi with a vented causeway. However, it is frequently blocked for few days during the rainy seasons.<br>  <br>The population along the road is estimated at 24,640 (2002 population statistics) |
| | No.4 | Bhiman - Dhansari | The road crosses tributaries of the Kamala River covered with stone and gravel is common to Siwalik every several hundred meters as shown in the picture.<br>  <br>About 43 places of tributaries in total are often subject to short term traffic blockage due to mud flood during the rainy seasons. Improving some rivers crossings at a time may not be effective. It is instead necessary to improve all rivers crossings at once to utilize the sites.<br>The Survey team observed that the existing causeway across the Biman River located near the beginning of the road is a vented causeway which may are often subject to traffic blockage during the rainy season.<br>The population along the road is estimated at 22,080. (2002 population statistics) |
| | No.5 | Katari - (Dudauli) - Sirthuli - Dakaha | The existing causeway across the Kukur River with a length of 1.0 km can be identified as the beginning of the project road. It was constructed in 2008 in order to improve the access to the Maoist camp located at the proposed road; however, it is not passable now because that a part of it has been washed away during a |

| | | | |
|---|---|---|---|
| | | | heavy rain that occurred just after completion as shown in the picture.<br>  <br>The Survey Team recognized the importance of the causeway and a necessity of early reconstruction since it is located at the entrance to the interior of the Katari - Dakaha road.<br>The population along the road is estimated at 40,820. (2002 population statistics) |
| Ramechhap | No.6 | Manthal-Ramechhap-Sagutar | The proposed road is running along the hill area sop that no difficult sites for construction of causeway were found except the section of the foot of mountain as shown in the picture.<br>  <br>The causeway across the Likhu River located at Sangutar, the end point of the road, is now under construction by DOR.<br>The population along the road is estimated at 25,200. (2002 population statistics) |
| | No.7 | Fulasi - Doramba | No difficult sites for construction of causeway were found since the project road is running along the hillside as shown in the picture.<br>  |

| | | | |
|---|---|---|---|
| | | | The population along the road is estimated at 35,710. (2002 population statistic) |
| | No.8 | Betali - Namadi - Khimti | The 17 km long section of road at Khimti side is not yet constructed including the four proposed bridges (8-5, 8-4, 8-3, 8-2)<br>Presently, out of five bridges, only site 8-1 is accessible for construction equipment, which is located nearest to Betali.<br>At the section between the site 8-4 and site 8-2, the road construction has not yet started and only the road width of 3.0 m is secured as shown in the picture.<br>  <br>There is no access to the proposed sites of 8-5 bridge.<br>It is necessary for DDC to encourage the construction of Betali - Namadi – Khimti road and complete it by the end of this year 2009.<br>The population along the road is estimated at 47,300. (2002 population statistic) |
| Kavre-palanchowk | No.9 | Kavrebhaniyang - Dapcha - Kakare | After crossing the Roshi Khola, there is a pedestrian's path but not passable to traffic up to the proposed site of causeway 9-2 near Ambote village. After the bridge site, no road exists as shown in the picture.<br>  <br>The Survey Team did not recognize the sites where additional bridge structure is necessary along the section between Kavrebhaniyang and the Roshi Khola, via Dapcha, since the road is running along the hillside.<br>No bus services are in operation in the southern area of Dapcha.<br>The population along the road is estimated at 6,960 (2002 population statistic) |
| | No.10 | Katunjebesi - Sipali - Bankhu | The road reaches the Roshi Khola which is about 1.0 km from the Sindhuli Road. After crossing the Roshi Khola, the road up to Sipali of about 10 km long serves as a temporary road which runs along the river bed of the Pola, as shown in the picture. |

| | | | |
|---|---|---|---|
| | | |  <br>At the moment, only the half-way section between Sipali and Budhakani is open to traffic, which is half of the Sipali – Bankhu road. The Survey Team did not recognize the sites in the Sipali – Bankhu section where improvement of river crossing is necessary.<br>The population along the road is estimated at 6,960 (2002 population statistics) |
| | No.11 | Nepaltok- Thopoparsel-Boharedobvan | The LDO of Kavrepalanchowk informed that the approximately 17km road between Nepalthok and Tholoparsel will be completed within two to three years. The Survey Team recognized that the construction of bridge across the Roshi Khola is essential for the completion of the proposed road linking with Sindhuli Road at Nepalthok.<br>The Roshi Khola meets with the Sun Koshi at Nepalthok. It becomes the flooding area of Roshi Khola with the shape of an alluvial fan, where water flow is unstable and the river bed changes intensively. Thus the place where the two rivers meet is not suitable for constructing a bridge.<br>There is a pedestrian suspension bridge at this location. The proposed bridge can be constructed parallel to the existing pedestrian bridge. However, the bridge length becomes more than 150 m if constructed at said site.<br>Therefore, the Survey Team proposes the new bridge site at Mamuti, 3.0 km upstream from Nepalthok as shown in the picture.<br>  <br>The population along the road is estimated at 26,700. (2002 population statistic) |
| Sindhu-palachowk | No.12 | Balephi - Jalbire - Kattike | This road is being improved under the Balephi hydro-power construction project and therefore is deleted from the Project as shown in the picture. |

| | | | |
|---|---|---|---|
| | | |  |
| | No.13 | Melamchi - Bhotang | The road crosses some tributaries of the Indrawati Nadi having headwaters of 3000 m high and mountains carrying large amount of rocks and stones, as shown in the picture.  The population along the road is estimated at 34,010. (2002 population statistic) |

Source: Study Team

## 1.4 Suspension of Bus Service during Rainy Season

During the rainy season from June to September in 2009, it was observed that bus services on 11 project roads in the five districts, Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk Districts were suspended for a total of 14 months. This excludes the Fulasi-Doramba Road and Balephi-Kattike Road where there are proposed no candidate river crossing structures. Suspension period for each route is shown in Table 1.3.

**Table 1.3 Suspension Period of Bus Services on the Project Roads during the Rainy Season in 2009**

| District | Route No. | Proposed Road | Suspension Period of Bus Services |
|---|---|---|---|
| Mahottari | 1 | Laxmaniya-Baratpur-Raghunathpur | 78 days |
| Sindhuli | 2 | Sindhulimadi-Kapilakot | 83 days |
| | 3 | Sindhulimadi-Bhimsthan | 72 days |
| | 4 | Bhiman-Dhansari | 0 days |
| | 5 | Katari-(Dudauli)-Sirthuli-Dakaha | 85 days |
| Ramechhap | 6 | Manthali-Ramechhap-Sangutar | 15 days |
| | 7 | Fulasi-Doramba | - |
| | 8 | Betali-Namadi-Khimti | Road construction incomplete |
| Kavrepalanchowk | 9 | Kavrebhanjyang-Dapcha-Kakare | No bus operation after Dapcha |
| | 10 | Katunjebesi- Sipali-Bankhu | 76 days |
| | 11 | Nepalthok-Tholoparsel-Boharedovan | Road construction incomplete |
| Sindhupalachowk | 12 | Balephi-Jalbire-Kattike | - |
| | 13 | Melamchi-Bhotang | 8 days |

Source: Study Team

# *CHAPTER 2*

# *CONTENTS OF THE PROJECT*

# CHAPTER 2 CONTENTS OF THE PROJECT

## 2.1 BASIC CONCEPT OF THE PROJECT

### (1) Overall Goal and Project Purpose

GON prepared the First Five-Year Plan in 1956. Since then, ten plan periods have been completed. Meanwhile, the Interim Three-Year Plan (July 2007 to July 2010) is currently being implemented. Said interim plan has been settled after the conflict and gave high priority on reconstructing the rural societies and economy which were affected by the conflict.

GON prepared the Local Infrastructure Development Plan 2061(2004) covering seven sectors including rural transport. For transport accessibility, it has set the basic needs of access road as it takes two hours to reach a nearby passable road in the plain Terai region, four hours through the hills and six hours through the mountain regions.

The Project has been formulated based on the request from GON, to contribute in achieving sustainable economic growth and reduce poverty in the Project area. In addition to the objective, the Project will support and ensure the peace process after the armed conflicts in Nepal.

### (2) Outline of the Project

To achieve the objective, the Project will include construction of river-crossing structures at about 35 sites, which have suffered from road closure due to flooding from the rivers. The sites are located along 13 rural roads in five Districts, Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk, in the Central Development Region of Nepal.

During the site reconnaissance in the Study, 108 major river crossing sites on the 13 roads prioritized in the District Transport Master Plans have been selected as sites to be analyzed. The 108 sites are classified into three groups depending on the duration of traffic closure and the top 35 sites classified as Group A and B suffering from road closure of several months and several days in rainy season respectively.

River crossing structures will be composed of single-lane suspension bridges, truss bridges, reinforced concrete bridges and continuous box bridges which are common in Nepal as shown in the Table 2.1. The Project will be implemented under the Grant Aid for Community Empowerment scheme of the GOJ.

**Table 2.1 Project Roads and Type of River Crossing Structures Proposed**

| Districts | Road Name | Number of sites and Bridge types | | | | |
|---|---|---|---|---|---|---|
| | | Suspension Bridge | Truss Bridge | RC Bridge | Continuous Box Bridge | Total |
| Mahottari | Laxmaniya-Baratpur-Raghunathpur Road | | | 1 | 1 | 2 |
| Sindhuli | Sindhulimadi-Kapilakot Road | | | 1 | 4 | 5 |
| | Sindhulimadi-Bhimsthan Road | | | | 3 | 3 |
| | Bhiman-Nilpanne-Dhansari Road | | | | 1 | 1 |
| | Katari-(Dudhauli)-Sirthuli-Dakaha Road | | | 1 | 8 | 9 |
| Ramechhap | Manthali-Ramechhap-Sangutar Road | | | | 1 | 1 |
| | Fulasi-Doramba Road | No serious river-crossing site | | | | |
| | Betali-Namadi-Khimti Road | | 4 | | 1 | 5 |
| Kavrepalanchowk | Kavrebhanjyang-Dapcha-Karkare Road | 1 | | | 1 | 2 |
| | Katunjebesi- Sipali-Bankhu Road | 1 | | | | 1 |
| | Nepalthok-Tholoparsel- Boharedovan Road | 1 | | | | 1 |
| Sindhupalchowk | Balephi-Jalbire-Kattike Road | Under improvement by the Balephi Hydro-power Project | | | | |
| | Melamchi-Bhotang Road | | 2 | | 3 | 5 |
| Total | | 3 | 6 | 3 | 23 | 35 |

Source: Study Team

## 2.2 OUTLINE DESIGN OF THE REQUESTED ASSISTANCE FROM GOJ

### 2.2.1 Design Policy

#### (1) Basic Policy

The 13 roads selected in the Project have been given priority in the District Transport Master Plan (DTMP) prepared by DDCs. However, the daily traffic volume on the roads is less than 100 vehicles, and the pressure due to population along the roads is small. Therefore, it is recommended to formulate the Project with the minimum possible cost from the view point of cost effectiveness.

On the other hand, the natural condition of the rivers on which the river crossing structures have been proposed is usually very severe, suffering from debris flow and flood that claims extensive and expensive damage to structures.

To address the above concerns, the structural design will be carried out based on the following concepts:

- Adopt the suspension and truss bridge design with the live load calculated under a condition that only one vehicle can pass at a time.
- Apply steel bridges using the steel members and types common in Nepal.
- Consider reinforced concrete bridges which are very common to Nepalese contractors.

Furthermore, to comply with the fund restrictions, continuous box bridge which has been applied in Sindhuli Road Construction Project will be applied in the Project to minimize the cost taking into account the possible damage by unforeseen scale of flood and debris-flow.

#### (2) Policy on Natural Environment

1) Rainfall Intensity and Discharge Volume

From the calculation result of the rainfall intensities considering 50-years-return-period, 228 mm/hr at Sindhuli Gadhi Station and 87mm/hr at Manthali Station were determined. This clearly indicates that there is a considerable climate variance, particularly the rainfall intensities in the Project sites. Therefore, the calculation of the high-water level used for bridge design will be carried out based on specific rainfall data obtained from the station nearby respective river crossing sites.

2) Topography and Geology

The topographic condition and geology of the upstream of the river-crossing sites will be considered to estimate the possibility of debris-flow and for estimating the behavior of flood flow around the sites.

3) Earthquakes

As the sites are located at a seismic zone subject to highest risk based on the Indian Standard Criteria for Earthquake Resistant Design Structure, Third Revision, 1989, importance to earthquakes have been given due consideration in the design of bridges.

#### (3) Policy on Social Environment

1) Diversions

Route diversions have to be considered at sites where existing traffic is disturbed by construction activities. The diversions will be constructed taking into account the buses operating along the road.

2) Compensation for Existing Irrigation Canal

The compensation for existing irrigation canal located at sites and affected by construction activities shall be carried out by replacing them at other locations or re-construction to original shape and function.

**(4) Policy on Procurement of Material and Equipment**

1) Technical Guideline and Specifications

A design standard and specification for the roads and bridges, "Standard Specifications for Road and Bridge Works, July 2001", has been issued by the DOR, Ministry of Physical Planning & Works. Department of Local Infrastructure and Agricultural Roads (DOLIDAR) has also issued another design standard and specification for the roads and bridges, entitled "Technical Specification for Agricultural and Rural Road", February 1998, DOLIDAR, Ministry of Local Development (MOLD).

Nevertheless, the standard issued by DOR will be used as design guideline and specification, taking into account the scale of the structures in the Project.

2) Procurement of Materials and Equipment

All construction materials and equipment, except for the wire cable system of the suspension bridge, will be procured in Nepal. Therefore, no consideration regarding the availability and difficulty of procurement of materials and equipment will be taken in the design.

**(5) Policy on Application of Local Consultant**

Nepalese consulting engineers will be employed for the supervision works through direct appointment by the main consulting firm (Japanese). They may also be indirectly appointed by local consulting firms based on availability due to the following reasons:

- There are very few Nepalese consulting firms who have experience in conducting supervision works as a principal consulting firm in Nepal, since domestic construction projects have been supervised by the Client.
- Permanent staff as supervising engineers is very few. Local consulting firms have used associate members on project basis instead of appointing permanent staff.

**(6) Policy on Application of Local Contractor**

The "Bridge Construction Association" is an association composed of major construction firms in Nepal. Thirty two member firms who answered a questionnaire prepared by the Survey Team were evaluated based on the following criteria:

- Financial status, number of engineers and construction equipment
- Experience in bridge construction
- Experience in suspension bridge, truss bridge and steel girder bridge

Out of the 32 firms, 22 were evaluated as capable and can be involved in the Project as a main firm. Annual turnover of transactions of the firms between 2005 and 2007 is in the range between NRs 40 Million and NRs 400 Million, (excluding the maximum and lowest amount, the average is NRs 140 Million).

Besides the bridge construction firms, six capable steel structure fabricators were identified in Nepal.

Therefore, it can be judged that appropriate numbers of capable Nepalese contractors are available in Nepal and can be involved in the Project. Moreover, the design of bridges common in Nepal such as suspension bridge, truss bridge and reinforced concrete bridge can be done without special consideration of the capacity of the contractors.

However, estimation of the construction period will be carried out considering the average annual turnover of NRs 140 Million to avoid exceeding the contractors' capacity.

**(7) Policy on Implementation Agency for Management and Maintenance**

1) DOLIDAR

DOLIDAR under the MOLD will act as the implementing agency for the Project and will serve as the co-coordinating agency between JICA and other donor agencies. DOLIDAR have enough experience for implementing of the projects financed by the donor agencies such as ADB and SDC.

DOLIDAR will coordinate with the five District Development Committees to solve and address the issues that arise during the Project execution such as those concerning land acquisition and any compensation matters, if necessary.

2) DDC

The five DDCs will be responsible for coordination and settlement of matters that arises at the Project site in coordination with DOLIDAR. After completion of the Project, DDC will be responsible for the maintenance of the facilities constructed under the Project. Appropriate budget from the Road Fund under Nepal Road Board should be allocated for each DDC for maintenance activities.

**(8) Policy on Grades of Facilities**

In the Nepal Road Standards (2027) (First Revision 2045), the road system in Nepal is divided into four classes: (i) national highways, (ii) feeder roads, (iii) district roads/Panchayat roads, (iv) city roads/streets, which are further classified into four terrain conditions: (i) plain, (ii) rolling, (iii) hilly, and (iv) steep. Based on these classifications, the 13 project roads are classified as shown in Table 2.2 below.

**Table 2.2 Classification of the Project Roads**

| District | Road Name | | Class | Terrain | Remarks |
|---|---|---|---|---|---|
| Mahottari | 1 | Laxmaniya-Baratpur-Raghunathpur Road | DR | Plain | |
| Sindhuli | 2 | Sindhulimadi-Kapilakot Road | FR | Hilly | Feeder road 057 |
| | 3 | Sindhulimadi-Bhimsthan Road | FR | Hilly | Feeder road 057 |
| | 4 | Bhiman-Nilpanne-Dhansari Road | DR | Hilly | |
| | 5 | Katari-(Dudhauli)-Sirthuli-Dakaha Road | DR | Hilly | |
| Ramechhap | 6 | Manthali-Ramechhap-Sangutar Road | DR&FR | Hilly | Feeder road 159 |
| | 7 | Fulasi-Doramba Road | DR | Hilly | |
| | 8 | Betali-Namadi-Khimti Road | DR | Hilly | |
| Kavrepalanchowk | 9 | Kavrebhanjyang-Dapcha-Karkare Road | DR | Hilly | |
| | 10 | Katunjebesi- Sipali-Bankhu Road | DR | Hilly | |
| | 11 | Nepalthok-Tholoparsel- Boharedovan Road | DR | Hilly | |
| Sindhupalchowk | 12 | Balephi-Jalbire-Kattike Road | DR | Hilly | |
| | 13 | Melamchi-Bhotang Road | DR | Hilly | |

Source: Study Team, FR: Feeder road DR: District road

Therefore, the No.2: Sindhulimadi-Kapilakot Road, the No.3: Sindhulimadi-Bhimstan Road and part of the No.6: Manthali-Ramechhap-Sangutar Road classified as feeder roads will be designed based on the Design Standards for Feeder Road (Third Revision), DOR. Other project roads classified as district roads will be designed based on relevant criteria described in the Nepal Road Standards (2027).

**(9) Policy on Construction Methods and Construction Period**

As discussed in Clause 2.2.1 (6) above, the average annual turnover of Nepalese contractors is about NRs 140 Million. The number of construction equipment owned by them is limited and insufficient to complete the construction works in a short duration.

Therefore, construction period of each sub-project package will be determined considering both the actual financial capability of the Nepalese contractors and the site conditions.

### 2.2.2 Basic Plan

#### (1) Determination and Evaluation of Project Sites

1) Project Roads

The 13 project roads requested by GON have been selected in the Project Formulation Study in selected five districts of Nepal considering the following points.

- High priority in the District Transport Master Plan prepared by DDCs.
- Feeder road for the Sindhuli Road.
- Existing roads or to complete the entire section within few years
- Population along the roads
- Existence of environmental issue (s)

In the Study, the role of the 13 project roads was discussed with DDC offices. It was confirmed that all these routes are given high priority by each district.

2) Identification of the Sites to be taken up in the Study

During the site reconnaissance in the Study, 108 major river crossing sites on the 13 roads (excluding sites where river-crossing structures already exist and are under construction by the DPR, DDCs and a private hydropower project), have been selected as sites to be analyzed and prioritized.

3) Magnitude of the Traffic Disturbance during Rainy Seasons

The 108 river crossing sites can be classified into the following three groups based on the magnitude of traffic disturbance as claimed by villagers living near the sites:

- Group A: Crossing the river site is difficult for 2-3 months during the rainy season
- Group B: Crossing the river site is difficult for 2-3 days during and after heavy rains
- Group C: Crossing the river site is difficult during heavy rains

The grouping of the site considering the duration of road closure is based on interviews. This was further reviewed based on the extent of catchment area for each site, to avoid overestimation obtained from personal views as shown in Table 2.3.

**Table 2.3 Evaluation of the Magnitude of Traffic Disturbance**

| Grouping based on the hearing at site | Catchment area ($km^2$) | Final Grouping considering the claim from villager and catchment area |
|---|---|---|
| A | > 5 | A |
| | 3-5 | A |
| | < 3 | B |
| B | > 5 | A |
| | 3-5 | B |
| | < 3 | C |
| C | > 5 | A |
| | 3-5 | C |
| | < 3 | C |

Source: Study Team

## (2) Priority Order of the Selected River Crossing Sites

1) Basic Concept of the Evaluation and Prioritization of the Sites

To implement the Project under the Grant Aid for Community Empowerment scheme which requires constructing facilities based on priority considering the limited budget, it is necessary to determine the priority order of the 108 river crossing sites. The priority of the site has been determined through the following steps:

First Step : Determination of the priority of the Project roads

Second Step : Determination of the priority of the sites

2) Priority of the Project Roads

The priority of the 13 project roads were evaluated taking into consideration the following three items and criteria:

a. Role of the project road in the Rural Road Network in the medium-term

Criteria: High rating is given to the road if it is constructed at the road network linking Sindhuli Road with other important highways, such as Jiri Road and Kodari Road.

b. Operation of the public bus services along the Project road

Criteria: High rating is given to the road if public bus service is operated along the road.

c. Population along the project road

Criteria: Priority is given to the road sequentially based on the number of population order.

As a result of the first step, the priority order of the 13 project roads are summarized in Table 2.4

**Table 2.4 Priority Order of the Project Roads**

| District | Project Road | | Role of the Project Road in the Rural Road Network | Operation of Bus Services | Population (*) along the Project Road | Priority of the Project Road |
|---|---|---|---|---|---|---|
| Mahottari | 1 | Laxmaniya-Baratpur-Raghunathpur Road | Branch road | Yes | 55,660 | 3 |
| Sindhuli | 2 | Sindhulimadi-Kapilakot Road | Branch road | Yes | 26,240 | 7 |
| | 3 | Sindhulimadi-Bhimsthan Road | Branch road | Yes | 24,640 | 9 |
| | 4 | Bhiman-Dhansari Road | Branch road | Yes | 22,080 | 10 |
| | 5 | Katari-(Dudauli)-Sirthuli-Dakaha Road | Branch road | Yes | 40,820 | 4 |
| Ramechhap | 6 | Manthali-Ramechhap-Sangutar Road | Branch road | Yes | 25,200 | 8 |
| | 7 | Fulasi-Doramba Road | Branch road | Yes | 35,710 | 5 |
| | 8 | Betali-Namadi-Khimti Road | Road linking Jiri Road and Sindhuli Road | Yes | 47,300 | 1 |
| Kavre-palanchowk | 9 | Kavrebhanjyang-Dapcha-Kakare Road | Branch road | Non Dapcha-Roshi | 6,960 | 12 |
| | 10 | Katunjebesi- Sipali-Bankhu Road | Branch road | Yes | 9,490 | 11 |
| | 11 | Nepalthok-Tholoparsel-Boharedovan Road | Trunk road linking Kodari Road and Sindhuli Road | Yes | 30,710 | 2 |
| Sindhu-palchowk | 12 | Balephi-Jalbire-Kattike Road | – | – | – | – |
| | 13 | Melamchi-Bhotang Road | Branch road | Yes | 34,010 | 6 |

Source: Study Team , (*) Population Senses 2002

3) Priority of the Sites

The 108 sites are classified into three groups depending on the duration of traffic closure:

Group A: Traffic closure is continued for several months

Group B: Traffic is possible throughout the year, but closed for a few days during and after heavy rains

Group C: Traffic is possible throughout the year, but closed for a few hours during heavy rains

Priority of the sites for implementation is given in accordance with the degree of traffic closure as follows:

First Priority: Group A

Second Priority: Group B

Third Priority: Group C

For the sites along the same route, priority order is determined based on the proximity to the nearest highway as shown in Figure 2.1.

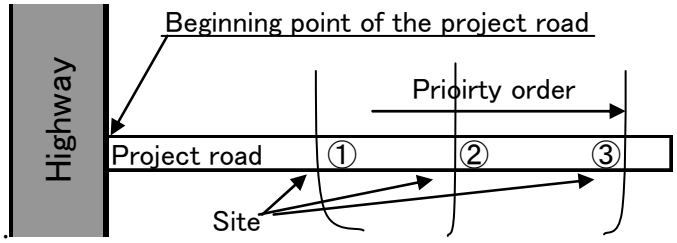



**Figure 2.1 Priority Orders of the Sites Along the Same Route**

Source: Study Team

4) Priority Order of the Sites

Based on the above procedure, the priority order has been determined as shown in Table 2.5 and Figure 2.2.

Table 2.5 shows top 35 sites classified as Group A and B based on the duration of traffic closure. These sites were selected as the Project sites taking into account the fund restrictions.

**Table 2.5 Priority of Selected 35 Project Sites**

| DISTRICT | ROADS | S. No. | SITE NO | | Priority Order of Roads | MAGNITUDE OF ROAD CLOSURE A:2-3 months B:2-3 days C:During heavy rain | | | | Priority Order in Same Road | Proposed Priority Order of Sites |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Site No | River | | Visual & Hearing | Catchment Area (km2) | Remarks | Evaluation | | |
| RAMECHHAP | No.8 Betali-Namadi Khimti | 84 | 8-1 | Palati | 1 | A | 6.42 | | A | | 1 |
| RAMECHHAP | No.8 Betali-Namadi Khimti | 86 | 8-3 | Haluwa | 1 | A | 9.06 | | A | | 2 |
| RAMECHHAP | No.8 Betali-Namadi Khimti | 87 | 8-4 | Pharpu | 1 | A | 15.93 | | A | | 3 |
| RAMECHHAP | No.8 Betali-Namadi Khimti | 88 | 8-5 | Chhatauni | 1 | A | 7.72 | | A | | 4 |
| KAVREPALANCHOWK | No.11 Bhore Dovan Thulo Parcel | 94 | 11-3 | Roshi-3 | 2 | A | 545 | | A | | 5 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MAHOTTARI | No.1 Laxmaniya-Baratpur-Raghunathpur | 1 | 1-1 | Dholan | 3 | A | 11.84 | | A | | 6 |
| MAHOTTARI | No.1 Laxmaniya-Baratpur-Raghunathpur | 2 | 1-2 | Kantawa | 3 | A | 0.93 | Pond | A | | 7 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 70 | 5-11 | Karltha | 4 | A | 14.05 | | A | 1 | 8 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 67 | 5-8 | Talkha | 4 | A | 5.52 | | A | 2 | 9 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 66 | 5-7 | Kuruwa | 4 | A | 3.68 | | A | 3 | 10 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 64 | 5-5 | Thakur-4 | 4 | A | 101.17 | Thakur River | A | 4 | 11 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 63 | 5-4 | Thakur-3 | 4 | A | 101.17 | Thakur River | A | 5 | 12 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 62 | 5-3 | Thakur-2 | 4 | A | 101.17 | Thakur River | A | 6 | 13 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 61 | 5-2 | Thakur-1 | 4 | A | 101.17 | Thakur River | A | 7 | 14 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 60 | 5-1 | Tamorni | 4 | A | 12.81 | | A | 8 | 15 |
| SINDHUPALCHOWK | No.13 Melamchi-Bhotang | 100 | 13-6 | Khalte | 6 | A | 10.27 | | A | | 16 |
| SINDHUPALCHOWK | No.13 Melamchi-Bhotang | 102 | 13-8 | Tipeni | 6 | A | 16.28 | | A | | 17 |
| SINDHUPALCHOWK | No.13 Melamchi-Bhotang | 104 | 13-10 | Mahadev | 6 | A | 15.51 | | A | | 18 |
| SINDHUPALCHOWK | No.13 Melamchi-Bhotang | 108 | 13-14 | Hadi | 6 | A | 48.75 | | A | | 19 |
| SINDHULI | No.2 Sindhulimadi-Kapilakot | 3 | 2-1 | Marin | 7 | A | 138.79 | | A | | 20 |
| SINDHULI | No.2 Sindhulimadi-Kapilakot | 7 | 2-5 | Devjor | 7 | A | 10.66 | | A | | 21 |
| SINDHULI | No.2 Sindhulimadi-Kapilakot | 8 | 2-6 | Maheswata | 7 | A | 12.03 | | A | | 22 |
| SINDHULI | No.2 Sindhulimadi-Kapilakot | 9 | 2-7 | Chantuli | 7 | A | 14.64 | | A | | 23 |
| RAMECHHAP | No.6 Manthali-Ramechhap-Sanguta | 71 | 6-1 | Sukhajor | 8 | B | 22.78 | | A | | 24 |
| SINDHULI | No.3 Sindhulimadi-Bhimsthan | 10 | 3-1 | Dhamile | 9 | A | 14.18 | | A | | 25 |
| SINDHULI | No.3 Sindhulimadi-Bhimsthan | 14 | 3-5 | Girgha | 9 | A | 38.31 | | A | | 26 |
| SINDHULI | No.4 Bhiman-Dhansari | 59 | 4-43 | Dhansari | 10 | A | 4.03 | Back water from Kamara | A | | 27 |
| KAVREPALANCHOWK | No.10 Katunjebesi-Bankhu | 91 | 10-1 | Roshi-2 | 11 | A | 392 | | A | | 28 |
| KAVREPALANCHOWK | No.9 Kavrebhanjyang-Dapcha-Kakare | 89 | 9-1 | Roshi-1 | 12 | A | 357 | | A | | 29 |
| KAVREPALANCHOWK | No.9 Kavrebhanjyang-Dapcha-Kakare | 90 | 9-2 | Andheri | 12 | A | 17.13 | | A | | 30 |
| RAMECHHAP | No.8 Betali-Namadi Khimti | 85 | 8-2 | Bohore | 1 | A | 2.54 | | B | | 31 |
| SINDHULI | No.5 Dakaha-Sirthauli-Dudhauli-Katari | 68 | 5-9 | Piprahi | 4 | A | 1.06 | | B | | 32 |
| SINDHUPALCHOWK | No.13 Melamchi-Bhotang | 95 | 13-1 | Andheri | 6 | B | 4.56 | | B | | 33 |
| SINDHULI | No.2 Sindhulimadi-Kapilakot | 6 | 2-4 | Athuwa | 7 | A | 1.05 | | B | | 34 |
| SINDHULI | No.3 Sindhulimadi-Bhimsthan | 11 | 3-2 | Basera | 9 | C | 3.50 | | B | | 35 |

Source: Study Team

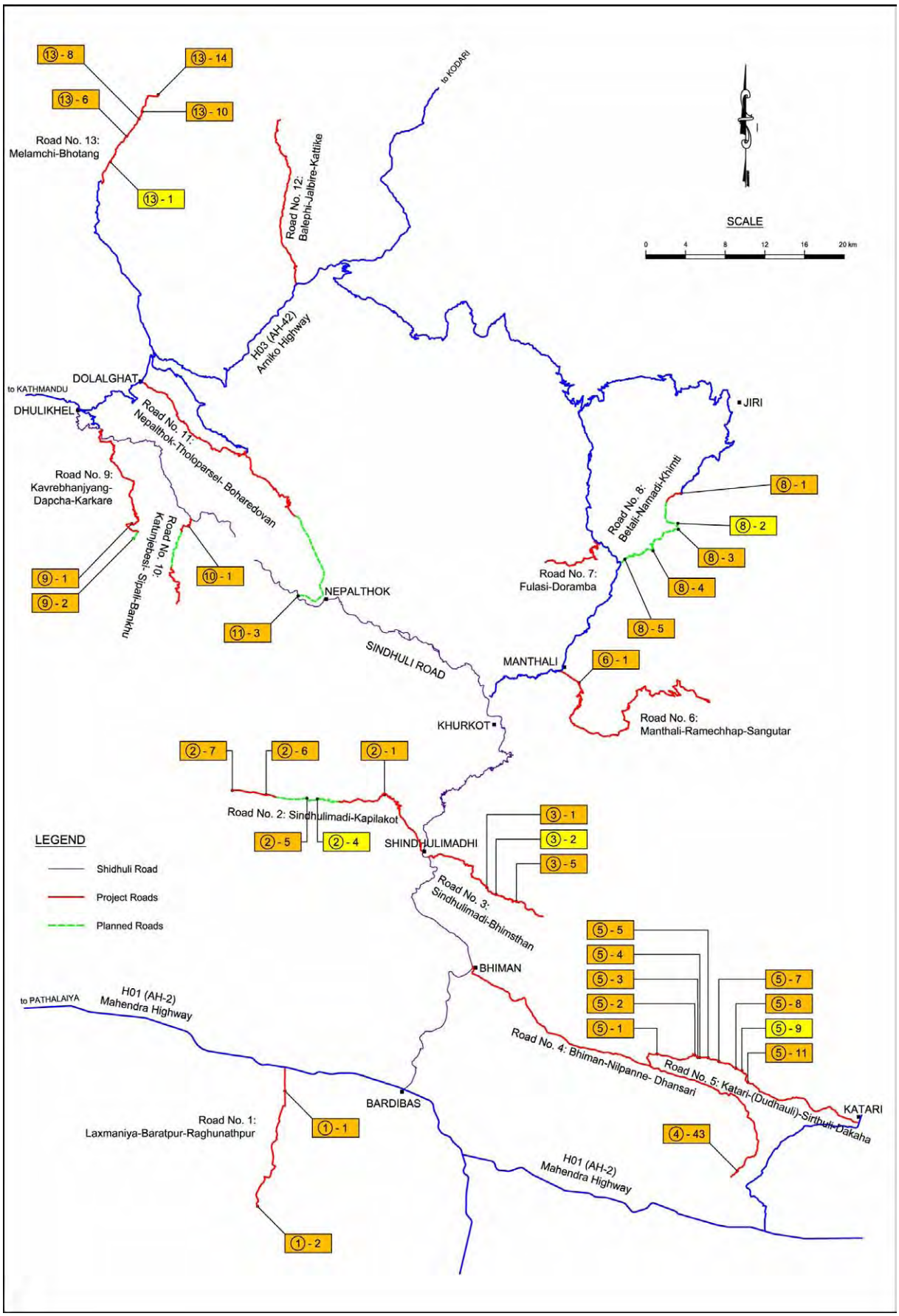



**Figure 2.2 Location of the Selected 35 Project Sites**
Source: Study Team

5) Conditions to be considered for the Project to materialize

In addition to the priority order of the sites, the following conditions shall have to be fulfilled or be committed by Nepalese side before commencement of the Project.

i) Restoration of the existing causeway across the Kukur Khola, which is located at Katari, the entrance of the project road should be carried out as soon as possible.

- No. 5 Katari-(Dudauli)-Sirthuli-Dakaha Road.

ii) Access to the following construction sites should be provided before starting the Project.

- No.2 Sindhulimadi-Kapilakot Road, Construction site No.2-4, 2-5
- No.9 Kavrebhanjyang-Dapcha-Kakare Road, Construction site No. 9-2
- No.8 Betali-Namadi-Khimti Road, Construction site No.8-2, 8-3, 8-4, 8-5

iii) A concrete improvement plan of non-opening to traffic road sections as shown below should be committed by Nepalese side.

- No.2 Sindhulimadi-Kapilakot Road
- No.3 Sindhulimadi-Bhimsthan Road
- No.8 Betali-Namadi-Khimti Road
- No.9 Kavrebhanjyang-Dapcha-Kakare Road
- No.10 Katunjebesi- Sipali-Bankhu Road
- No.11 Nepalthok-Tholoparsel-Boharedovan Road

The construction works will commence based on the priority order in principle. However, implementation of the above listed sites or roads will be canceled if there are no actual progress, improvement, actions or concrete commitment on the above issues, prior to the commencement of the tender process.

**(3) Concept of Application of the Continuous Box Bridge**

As described in Section 2.2.1, continuous box bridges at sites where possible damage is expected due to unforeseen scale of flood and debris-flow will be applied in the Project to minimize the cost and comply with fund restrictions. These are based on the following conditions:

1) Application of the Continuous Box bridge at Rivers with Flowing Debris

"The Study for the Design Criteria on the Transit Roads over Devastated Rivers, 1982, Technical Center for Sediment Control and Landslide, Japan" recommended a design policy for the bridges to be constructed at rivers with debris-flow. It classified debris-flows as shown in Table 2.6.

**Table 2.6 Incline of River Bed and Debris-flow Type**

| Incline of River Bed | Debris-flow Type |
|---|---|
| 1/3（33%） | Debris-flow occurrence section |
| 1/5（20%） | Debris-flow flowing section |
| 1/20（5%） | Debris-flow stopping section |
| 1/60（1.7%） | Mud-flow section |
| | Flood-flow section |

Source: The Study for the design criteria on the transit roads over devastated rivers, 1982, Technical Center for Sediment Control and Landslide, Japan

The characteristics of each type of debris flow are described in Table 2.7.

**Table 2.7 Characteristics of Debris-flow Type**

| Flow Type | Characteristics |
|---|---|
| Debris flow | • Existence of very big boulders at tip<br>• Existence of big boulders dia.1-1.5m<br>• 凸 shaped cross section<br>• Existence of trace of flow straight down<br>• Thick deposit layer |
| Mud flow | • Existence of layer upon layer deposit<br>• Studding of boulder dia. 0.5－1.0m<br>• Existence of fine materials<br>• Existence of sprayed deposits widely |
| Flood | • Flat layer with even size<br>• Existence of layer upon layer deposits<br>• Existence of boulder dia. 0.1－0.2m<br>• Thin but spread widely |

Source: The Study for the design criteria on the transit roads over devastated rivers, 1982, Technical Center for Sediment Control and Landslide, Japan

Furthermore, the possibility of constructing bridge piers at locations of debris flow is recommended as shown in Table 2.8.

**Table 2.8 River Condition and Pier Construction**

| Type of debris | Type of flow | Possibility of constructing pier in river |
|---|---|---|
| Debris-flow | Flowing section | Not recommendable |
| | Stopping section | Not recommendable |
| Mud-flow | Mud flow section | Practicable |

Source: The Study for the design criteria on the transit roads over devastated rivers, 1982, Technical Center for Sediment Control and Landslide, Japan

The main reason for those remarked as “Not recommendable” is the degree of difficulty in estimating the loads for the pier due to debris-flow. Based on this, the following design concept for the continuous box bridge is applied.

At rivers with debris-flow estimated based on the conditions in Table 2.6 and 2.7, taking into account the remarks shown in Table 2.8, suspension bridge or truss bridge with no pier will be applied. This leads to recommendation of avoiding the application of the continuous box bridge at the “debris flowing section” and “debris stopping section” of the river. For the mud-flow section, the continuous box bridge will be applied positively.

However, application of the suspension or truss bridge requires raising the road elevation by more than 5 m from the existing ground. This can cause inconvenience and negative impacts to the villagers living nearby the river. In such case, although classified as “debris-flowing section” and “debris-stopping section”, a continuous box bridge will be adopted.

The continuous box bridge will be applied where possible damage by unforeseen scale of flood and debris-flow is expected, to minimize the cost. Therefore, the continuous box bridge will be designed considering simple structural configuration of separating the vertical wall and top-slab, as it will also facilitate future repairs when necessary.

2) Application of the Continuous Box bridge at Rivers with Insufficient Sectional Area located in Alluvial Fan-Shaped Catchment Area

Rivers with small sectional area located in alluvial fan-shaped catchment causes frequent flooding in the area. This means that the area is not stable from the flooding and unsuitable for bridge construction.

In this case, the continuous box bridge with 5-10 m spans will be applied flexibly anticipating any possible damage to the structure, approach road and the surrounding area caused by unforeseen scale of flood or debris-flow.

3) Application of the Continuous Box Bridge at Rivers Having Wide Flood Plain

At wide rivers having flood plain, existing roads have been constructed on the flood plain area, which suffer from flooding once in 20-30 years.

In this case, to maximize the number of site improved by reducing the cost, the continuous box bridge with 10-m spans will be adopted only at the stream section. This will be done instead of constructing a bridge considering scouring and washing away of the approach road and surrounding area due to unforeseen scale of flood or debris-flow once in 20-30 years.

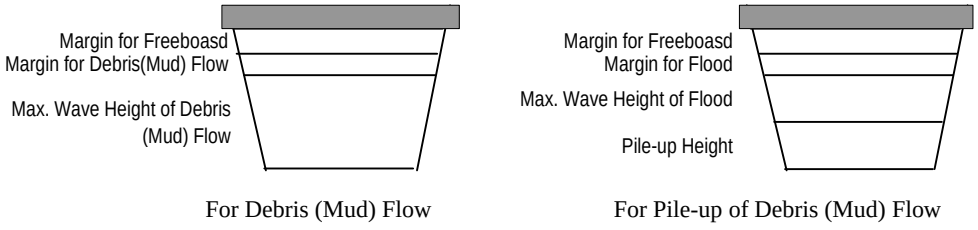
### (4) Clearance of Bridges Considering Debris Flow

"The Study for the Design Criteria on the Transit Road over Devastated River, Technical Centre for Sediment Control and Landslide, February 1982" recommends securing clearance shown in Table 2.9.

**Table 2.9 Flow Type and Clearance to be Secured**

| Flow Type | State of Flow at River Crossing Point | Clearance to be Secured considering Debris Flow (Mud Flow) | Clearance to be Secured considering Pile-up of Debris Flow (Mud Flow) |
|---|---|---|---|
| Debris Flow | Flowing | Maximum wave height of debris flow （5-10m）<br>Margin for debris flow （1-3m）<br>Margin for Freeboard （0.6-1.0m） | Pile-up height （5-6m）<br>Maximum wave height of flood (based on analysis)<br>Margin for flood （0.6-0.8m）<br>Margin for Freeboard （0.6-1.0m）<br>*（At 200m upstream from the end of flowing section）* |
| | Stopping | Maximum wave height of debris flow （5-10m）<br>Margin for debris flow （1-3m）<br>Margin for Freeboard （0.6-1.0m） | Pile-up height（5-6m）<br>Maximum wave height of flood (based on analysis)<br>Margin for flood （0.6-0.8m）<br>Margin for Freeboard （0.6-1.0m） |
| Mud Flow | Mud Flow | Maximum wave height of mud flow<br>Margin for mud flow （0.6-0.8m）<br>Margin for Freeboard （0.6-1.0m） | Pile-up height （2-Xm）<br>Maximum wave height of flood (based on analysis)<br>Margin for flood （0.6-0.8m）<br>Margin for Freeboard （0.6-1.0m） |

Source: The Study for the design criteria on the transit roads over devastated rivers, 1982, Technical Center for Sediment Control and Landslide, Japan




For Debris (Mud) Flow　　For Pile-up of Debris (Mud) Flow

**Figure 2.3 Clearance to be Secured**

In the design of suspension bridge, truss bridge and reinforced-concrete bridge, proposed heights are planned considering the clearances as shown in Table 2.9.

On the other hand, for the continuous box bridges which are designed under the policy that "allow overflow or damages of concrete members caused by the flood and debris flow with scales that exceed supposition", clearance is set as the sum of maximum wave height of flood and margin for freeboard. Meanwhile, debris-flow and pile-up are not considered.

### (5) Calculation of High-water Level and Wave Height of Debris Flow

1) Return Period of Rainfall

A 50-year return period of rainfall for the design of high water levels and wave height of debris flows will be adopted referring to the design condition of causeways and bridges in the Sindhuli Road Construction Project.

2) Frequency Analysis of Rainfall

Annual maximum daily rainfall for 50-year return period of 21 stations around the Project area have been calculated using the Lognormal(LN) distribution fitting as shown in Table 2.10.

**Table 2.10 Design 50-year Daily Rainfall of Stations**

| S. N. | Station No. | Location | District | Latitude (N) | Longitude (E) | Elevation (m) | 50-year Daily Rainfall (mm) |
|---|---|---|---|---|---|---|---|
| 1 | 1006 | Gumthang | Sindhpalchowk | 27°52' | 85°52' | 2000 | 215 |
| 2 | 1008 | Nawalpur | Sindhupalchowk | 27°48' | 85°37' | 1592 | 154 |
| 3 | 1009 | Chautara | Sindhpalchowk | 27°47' | 85°43' | 1660 | 145 |
| 4 | 1016 | Sarmathang | Sindhpalchowk | 27°57' | 85°36' | 2625 | 198 |
| 5 | 1017 | Dubachaur | Sindhpalchowk | 27°52' | 85°34' | 1550 | 144 |
| 6 | 1018 | Bahunepati | Sindhpalchowk | 27°47' | 85°34' | 845 | 147 |
| 7 | 1023 | Dolalghat | Kavrepalanchowk | 27°38' | 85°43' | 710 | 134 |
| 8 | 1024 | Dhulikhel | Kavrepalanchowk | 27°37' | 85°33' | 1552 | 177 |
| 9 | 1025 | Dhap | Sindhupalchowk | 27°55' | 85°38' | 1240 | 157 |
| 10 | 1027 | Bahrabise | Sindhupalchowk | 27°47' | 85°54' | 1220 | 183 |
| 11 | 1028 | Pachuwarghat | Kavrepalanchowk | 27°34' | 85°45' | 633 | 124 |
| 12 | 1049 | Panauti | Kavrepalanchowk | 27°35' | 85°31' | 1517 | 175 |
| 13 | 1104 | Melung | Dolakha | 27°31' | 86°03' | 1536 | 172 |
| 14 | 1107 | Sindhuligadhi | Sindhuli | 27°17' | 85°58' | 1463 | 423 |
| 15 | 1108 | Bahuntilpung | Sindhuli | 27°11' | 86°10' | 1417 | 327 |
| 16 | 1110 | Tulsi | Dhanusa | 27°02' | 85°55' | 457 | 289 |
| 17 | 1112 | Chisapani | Dhanusa | 26°55' | 86°10' | 165 | 279 |
| 18 | 1115 | Nepalthok | Sindhuli | 27°27' | 85°49' | 1098 | 218 |
| 19 | 1117 | Hariharpurgadhi | Sindhuli | 27°20' | 85°30' | 250 | 475 |
| 20 | 1119 | Gaushala | Mahottari | 26°53' | 85°47' | 200 | 184 |
| 21 | 1123 | Manthali | Ramechhap | 27°28' | 86°05' | 495 | 161 |

Source: Study Team

3) Rainfall Intensity Analysis

The short duration rainfall depths are necessary for the peak discharge estimation in rivers. For this purpose, the design short duration rainfall depths of Kathmandu Airport station are used as reference. The frequency analyses of short duration rainfall depths of 10-min and 60-min and 24-hour rainfall of Kathmandu Airport cited in the report is presented in Table 2.11.

**Table 2.11 Design Short Duration Rainfall Depths of the Stations**

| Station | Duration | Return period (year) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 5 | 10 | 25 | 50 |
| Sindhuli Gadhi | 24-hour Rainfall (mm) | 169 | 206 | 245 | 300 | 368 | 423 |
| | 60-min Rainfall (mm) | 95 | 113 | 135 | 165 | 199 | 228 |
| | 30-min Rainfall (mm) | 71 | 90 | 109 | 134 | 162 | 188 |
| | 15-min Rainfall (mm) | 48 | 62 | 77 | 97 | 118 | 139 |
| | 10-min Rainfall (mm) | 35 | 47 | 59 | 75 | 92 | 110 |
| | 5-min Rainfall (mm) | 20 | 28 | 36 | 46 | 56 | 69 |
| Nepalthok | 24-hour Rainfall (mm) | 86 | 106 | 126 | 154 | 190 | 218 |
| | 60-min Rainfall (mm) | 48 | 58 | 69 | 85 | 103 | 118 |
| | 30-min Rainfall (mm) | 36 | 46 | 56 | 69 | 84 | 97 |
| | 15-min Rainfall (mm) | 24 | 32 | 40 | 50 | 61 | 72 |
| | 10-min Rainfall (mm) | 18 | 24 | 30 | 39 | 48 | 57 |
| | 5-min Rainfall (mm) | 10 | 15 | 18 | 23 | 29 | 35 |
| Melung | 24-hour Rainfall (mm) | 72 | 86 | 102 | 124 | 151 | 172 |
| | 60-min Rainfall (mm) | 40 | 47 | 56 | 68 | 82 | 93 |
| | 30-min Rainfall (mm) | 30 | 37 | 45 | 55 | 67 | 76 |
| | 15-min Rainfall (mm) | 20 | 26 | 32 | 40 | 48 | 57 |
| | 10-min Rainfall (mm) | 15 | 20 | 24 | 31 | 38 | 45 |
| | 5-min Rainfall (mm) | 9 | 12 | 15 | 19 | 23 | 28 |
| Bahuntilpung | 24-hour Rainfall (mm) | 122 | 151 | 182 | 225 | 283 | 327 |
| | 60-min Rainfall (mm) | 68 | 83 | 100 | 124 | 153 | 177 |
| | 30-min Rainfall (mm) | 52 | 66 | 81 | 101 | 125 | 145 |
| | 15-min Rainfall (mm) | 34 | 46 | 57 | 72 | 91 | 108 |
| | 10-min Rainfall (mm) | 26 | 35 | 44 | 56 | 71 | 85 |
| | 5-min Rainfall (mm) | 15 | 21 | 26 | 34 | 43 | 53 |
| Tulsi | 24-hour Rainfall (mm) | 136 | 161 | 185 | 218 | 258 | 289 |
| | 60-min Rainfall (mm) | 76 | 89 | 102 | 120 | 139 | 156 |
| | 30-min Rainfall (mm) | 57 | 70 | 82 | 97 | 114 | 128 |
| | 15-min Rainfall (mm) | 38 | 49 | 58 | 70 | 83 | 95 |
| | 10-min Rainfall (mm) | 29 | 37 | 44 | 55 | 65 | 75 |
| | 5-min Rainfall (mm) | 16 | 22 | 27 | 33 | 40 | 47 |
| Chisapani | 24-hour Rainfall (mm) | 107 | 132 | 158 | 194 | 242 | 279 |
| | 60-min Rainfall (mm) | 60 | 73 | 87 | 107 | 131 | 151 |
| | 30-min Rainfall (mm) | 45 | 57 | 70 | 87 | 107 | 124 |
| | 15-min Rainfall (mm) | 30 | 40 | 50 | 62 | 78 | 92 |
| | 10-min Rainfall (mm) | 22 | 30 | 38 | 49 | 61 | 73 |
| | 5-min Rainfall (mm) | 13 | 18 | 23 | 29 | 37 | 45 |
| Gaushala | 24-hour Rainfall (mm) | 73 | 90 | 107 | 130 | 161 | 184 |
| | 60-min Rainfall (mm) | 41 | 50 | 59 | 72 | 87 | 99 |
| | 30-min Rainfall (mm) | 31 | 39 | 48 | 58 | 71 | 82 |
| | 15-min Rainfall (mm) | 21 | 27 | 34 | 42 | 52 | 61 |
| | 10-min Rainfall (mm) | 15 | 21 | 26 | 33 | 40 | 48 |
| | 5-min Rainfall (mm) | 9 | 12 | 16 | 20 | 25 | 30 |
| Manthali | 24-hour Rainfall (mm) | 80 | 93 | 106 | 124 | 146 | 161 |
| | 60-min Rainfall (mm) | 45 | 51 | 58 | 68 | 79 | 87 |
| | 30-min Rainfall (mm) | 34 | 40 | 47 | 55 | 64 | 72 |
| | 15-min Rainfall (mm) | 23 | 28 | 33 | 40 | 47 | 53 |
| | 10-min Rainfall (mm) | 17 | 21 | 25 | 31 | 37 | 42 |
| | 5-min Rainfall (mm) | 10 | 13 | 15 | 19 | 22 | 26 |
| Dhap | 24-hour Rainfall (mm) | 100 | 111 | 121 | 132 | 147 | 157 |
| | 60-min Rainfall (mm) | 56 | 61 | 67 | 73 | 79 | 85 |
| | 30-min Rainfall (mm) | 42 | 48 | 54 | 59 | 65 | 70 |
| | 15-min Rainfall (mm) | 28 | 34 | 38 | 42 | 47 | 52 |
| | 10-min Rainfall (mm) | 21 | 26 | 29 | 33 | 37 | 41 |
| | 5-min Rainfall (mm) | 12 | 15 | 18 | 20 | 23 | 25 |

Source: Study Team

4) Peak Discharge

The peak discharges of the rivers are estimated using the Rational method. Basin area, basin rainfall intensity of T-min duration (equivalent to time of concentration of runoff) and runoff coefficient are used for estimating the peak discharges in the rivers. The relation used

for peak discharges estimation in the rivers is presented below. The overland flow travel time of runoff is estimated using Kerby's equation:

$$Q_P = \frac{C \cdot I_B \cdot A}{3.6}$$

Where,

$Q_P$ = Peak discharge of the river ($m^3/s$)
$I_B$ = Basin rainfall intensity of T-min duration (mm/hr)
A = Basin area ($km^2$)
C = Runoff coefficient

5) Roshi Khola Discharge Analysis

The annual maximum daily discharges of Roshi Khola at Panauti were analyzed based on the design specific discharges at Panauti Gasing Station. The design specific discharge of Roshi Khola at Panauti is 1.93 $m^3/s/km^2$ (50-year). The design discharges of Roshi Khola at bridges sites are determined based on the design specific discharge at Panauti and are presented in Table 2.12.

**Table 2.12 Design Discharges of Roshi Khola at Bridges Sites**

| Site No. | River | Basin Area at Bridge Site ($km^2$) | 50-year Specific Discharge | | 50-year Q at Bridge Site ($m^3/s$) |
|---|---|---|---|---|---|
| | | | Station | Sp. Q. ($m^3/s/km^2$) | |
| 9-1 | Roshi | 357 | Panauti | 1.93 | 690 |
| 10-1 | Roshi | 392 | | | 757 |
| 11-3 | Roshi | 545 | | | 1052 |

Source: Study Team

6) Peak Discharge of Debris Flow

Based on the data experienced in Japan as described in "The Study for the Design Criteria on the Transit Roads over Devastated Rivers, 1982, Technical Center for Sediment Control and Landslide, Japan", the peak discharges of debris flows were calculated as presented below.

Peak discharge of large sized debris flow:

$$Q_{DF} = 4.7 Q_P$$

Peak discharge of normal debris flow:

$$Q_{DF} = (1 + \beta) Q_P$$

Where,

$Q_{DF}$ = Peak discharge for debris flow ($m^3/s$)
$Q_P$ = Peak discharge of 50-year normal flood flow ($m^3/s$)

The value of $\beta$ is based on gradient of river as presented below:

| Value | River Gradient |
|---|---|
| $\beta = 0.3$ | > 1/20 |
| $\beta = 0.2$ | 1/60 - 1/20 |

7) River Flow Simulation

HEC-RAS, developed by the Hydrologic Engineering Center, US Army Corps of Engineers, is a professional engineering software package for simulating river flows. HEC-RAS is a fully dynamic, one-dimensional modeling tool for detailed analysis, design and management of both simple and complex river systems. The unsteady flow simulation module of HEC-

RAS solves the Saint Venant equations for conservation of continuity and momentum. Therefore, one-dimensional river flows and water levels are generated using fully dynamic flow routing procedure. The continuity equation of conservation of mass is expressed as:

$$\frac{\partial A}{\partial t} + \frac{\partial Q}{\partial x} = q$$

The momentum equation is:

$$\frac{\partial Q}{\partial t} + \frac{\partial (Q^2 / A)}{\partial x} + gA(\frac{\partial h}{dx} + S_f) = 0$$

The friction slope $S_f$ is estimated using Manning's equation given as:

$$S_f = \frac{n^2 \mid Q \mid Q}{A^2 R^{4/3}}$$

Where,

| | | |
|---|---|---|
| Q | = | River flow ($m^3/s$) |
| A | = | Cross-sectional area of flow ($m^2$) |
| q | = | Lateral inflow per unit distance ($m^3/s/m$) |
| x | = | Longitudinal distance (m) |
| t | = | Time elapsed (s) |
| $S_f$ | = | Friction slope |
| h | = | Water surface elevation (m) |
| R | = | Hydraulic radius (m) |
| n | = | Manning's friction coefficient |
| g | = | Acceleration due to gravity ($m/s^2$) |

**(6) High Water Level and Wave Height of Debris Flow and Bridge Elevation**

Bridge elevations were determined based on the high water levels and wave heights of debris flows as shown in Table 2.13.

## Table 2.13 High Water Level and Wave Height of Debris Flow and Bridge Elevation

| Priority Order | Route | Site | River | River-bed Gradient (%) | Max. Size of Boulder (m) | Catch-ment Area (km2) | Discharge (m3/s) | Flow Type in terms of Debris Flow (D/F) | ① Lowest Riverbed Level (m) | ② Maximum Wave Height of Debris Flow (m) | ③ Margin for Debris Flow (m) | ④ Pile-up Height of Debris Flow (m) | ⑤ Maximum Wave Height of Flood (m) | ⑥ Margin for Flood (m) | ⑦ Maximum Wave Height of Mud Flow (m) | ⑧ Margin for Mud Flow (m) | ⑨ Pile-up Height of Mud Flow (m) | ⑩ Margin for Freeboard (m) | ⑪ Margin not considering Debris (Mud) Flow (m) | ⑫ Lower Surface Level of Girder for Debris Flow (m) | ⑬ Lower Surface Level of Girder for Pile-up of Debris Flow (m) | ⑭ Lower Surface Level of Girder for Mud Flow (m) | ⑮ Lower Surface Level of Girder for Pile-up of Mud Flow (m) | ⑯ Lower Surface Level of Box Bridge not considering Debris (Mud) Flow (m) | ⑰ Lower Surface Level of Girder not considering Debris (Mud) Flow (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ⑧ Betali-Namadi-Khimli | ⑧-1 | Palati | 29.9 | 2.0 | 6.4 | 188 | D/F (Flowing section) | 485.87 | 491.73 | 2 | 5 | 489.26 | 1.70 | — | — | — | 0.5 | — | 494.23 | 496.46 | | | | |
| 2 | ⑧ Betali-Namadi-Khimli | ⑧-3 | Haluwa | 19.6 | 3.0 | 9.1 | 258 | D/F (Flowing section) | 493.73 | 499.09 | 3 | 5 | 497.12 | 1.70 | — | — | — | 0.5 | — | 502.59 | 504.32 | | | | |
| 3 | ⑧ Betali-Namadi-Khimli | ⑧-4 | Pharpu | 8.8 | 3.0 | 15.9 | 384 | D/F (Stopping section) | 495.31 | 501.41 | 3 | 5 | 498.53 | 1.29 | — | — | — | 0.5 | — | 502.91 | 505.32 | | | | |
| 4 | ⑧ Betali-Namadi-Khimli | ⑧-5 | Chatwane | 11.0 | 1.0 | 7.7 | 189 | D/F (Stopping section) | 499.22 | 503.12 | 1 | 5 | 501.15 | 0.97 | — | — | — | 0.5 | — | 504.62 | 507.62 | | | | |
| 5 | ⑪ Bhore Dovan-Thulo Parcel | ⑪-3 | Roshi | 1.2 | 0.3 | 545.0 | 1052 | Mud flow | 898.65 | — | — | — | 901.93 | 0.82 | 902.16 | 0.88 | 2.0 | 0.5 | — | | | 903.54 | 905.25 | | |
| 6 | ① Laxmaniya-Baratpur-Raghunathpur | ①-1 | Dholan | 0.8 | sand | 11.8 | 204 | No risk of D/F | 98.20 | — | — | — | 100.11 | — | — | — | — | — | 0.8 | | | | | | 100.91 |
| 7 | ① Laxmaniya-Baratpur-Raghunathpur | ①-2 | Kantawa | 0.2 | sand | 0.9 | 29 | No risk of D/F | 93.49 | — | — | — | 95.61 | — | — | — | — | — | 0.6 | | | | | | 96.21 |
| 8 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-11 | Kolta | 0.6 | 1.0 | 14.1 | 495 | No risk of D/F | In alluvial fan, Determined the height by interview. | | | | 300.70 | — | — | — | — | — | 0.6 | | | | | | 302.32 |
| 9 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-8 | Talko | 1.0 | 0.3 | 5.5 | 249 | No risk of D/F | 198.57 | — | — | — | 200.18 | — | — | — | — | — | 0.8 | | | | | | 200.98 |
| 10 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-7 | Kuruwa | 2.3 | 1.0 | 3.7 | 184 | Mud Flow | 97.85 | — | — | — | 99.59 | 0.6 | 99.73 | 0.80 | 2.0 | 0.5 | — | | | 101.03 | 102.69 | | |
| 11 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-5 | Thakur-4 | 0.9 | 0.3 | 404.7 | 1851 | No risk of D/F | In alluvial fan, Determined the height by interview. | | | | 498.50 | — | — | — | — | — | 0.8 | | | | | | 499.30 |
| 12 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-4 | Thakur-3 | 1.5 | 1.0 | | | Mud Flow | In alluvial fan, Determined the height by interview. | | | | 498.19 | — | — | — | — | — | 0.8 | | | | | | 499.00 |
| 13 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-3 | Thakur-2 | 0.1 | 0.5 | | | No risk of D/F | In alluvial fan, Determined the height by interview. | | | | 499.00 | — | — | — | — | — | 0.8 | | | | | | 499.80 |
| 14 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-2 | Thakur-1 | 0.7 | 0.5 | | | Flood | In alluvial fan, Determined the height by interview. | | | | 500.00 | — | — | — | — | — | 0.8 | | | | | | 500.80 |
| 15 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-1 | Tamorni | 0.3 | gravel | 12.8 | 498 | No risk of D/F | In alluvial fan, Determined the height by interview. | | | | 300.00 | — | — | — | — | — | 0.8 | | | | | | 300.80 |
| 16 | ⑬ Melamchi-Bhotang | ⑬-6 | Khalte | 8.4 | 3.0 | 10.3 | 231 | D/F (Stopping section) | 995.49 | 998.83 | 3 | 5 | 997.07 | 0.8 | — | — | — | 0.5 | 0.8 | 1002.33 | 1003.37 | | | 998.67 | |
| 17 | ⑬ Melamchi-Bhotang | ⑬-8 | Tipeni | 12.0 | 3.0 | 16.3 | 293 | D/F (Stopping section) | 1043.44 | 1048.46 | 3 | 5 | 1046.29 | 1.43 | — | — | — | 0.5 | 0.8 | 1051.96 | 1053.22 | | | 1048.52 | |
| 18 | ⑬ Melamchi-Bhotang | ⑬-10 | Mahadev | 6.2 | 2.0 | 15.5 | 262 | D/F (Stopping section) | 1098.39 | 1102.68 | 2 | 5 | 1100.44 | 0.82 | — | — | — | 0.5 | | 1105.18 | 1106.76 | | | | |
| 19 | ⑬ Melamchi-Bhotang | ⑬-14 | Hadi | 10.9 | 5.0 | 48.8 | 661 | D/F (Stopping section) | 1195.30 | 1200.77 | 3 | 5 | 1198.31 | 1.81 | — | — | — | 0.5 | | 1204.27 | 1205.62 | | | | |
| 20 | ② Sindhulimadi-Kapilakot | ②-1 | Marin | 1.3 | 1.5 | 138.8 | — | Flood | 401.80 | — | — | — | 406.73 | — | — | — | — | — | 1.0 | | | | | | 407.73 |
| 21 | ② Sindhulimadi-Kapilakot | ②-5 | Deojar | 4 | 5.0 | 10.7 | 618 | Mud Flow | 491.67 | — | — | — | 496.07 | 1.76 | 496.36 | 1.88 | 2.0 | 0.5 | | | | 498.74 | 500.33 | 498.36 | |
| 22 | ② Sindhulimadi-Kapilakot | ②-6 | Maheshot | 2.0 | 1.0 | 12.0 | 636 | Mud Flow | 197.07 | — | — | — | 199.67 | 0.80 | 199.85 | 0.80 | 2.0 | 0.5 | 1.0 | | | 201.15 | 202.97 | 201.47 | |
| 23 | ② Sindhulimadi-Kapilakot | ②-7 | Chatuuli | 1.2 | 1.0 | 14.6 | 817 | Flood | In alluvial fan, Determined the height by interview. | | | | 200.00 | — | — | — | — | — | 1.0 | | | | | | 201.00 |
| 24 | ⑥ Manthali-Ramechhap-Sangutar | ⑥-1 | Sukhajor | 3.8 | 0.2 | 22.8 | 415 | Mud Flow | 497.47 | — | — | — | 499.31 | 0.80 | 499.52 | 0.82 | 2.0 | 0.5 | 0.8 | | | 500.84 | 502.61 | 500.91 | |
| 25 | ③ Sindhulimadi-Bhimsthan | ③-1 | Dhamile | 1.9 | 1.0 | 14.2 | 674 | Mud Flow | 498.20 | — | — | — | 500.87 | 0.80 | 501.06 | 0.80 | 2.0 | 0.5 | 0.8 | | | 502.36 | 504.17 | 502.47 | |
| 26 | ③ Sindhulimadi-Bhimsthan | ③-5 | Jirghaha | 1.3 | 0.5 | 38.3 | 1153 | Flood | 98.36 | — | — | — | 101.57 | — | — | — | — | — | 1.0 | | | | | | 102.57 |
| 27 | ④ Bhiman-Dhansari | ④-43 | Dhansari | 1.3 | sand | 4.0 | 148 | No risk of D/F | 93.79 | — | — | — | 95.91 | — | — | — | — | — | 0.6 | | | | | | 96.51 |
| 28 | ⑩ Katunjebesi-Bankhu | ⑩-1 | Roshi | 1.1 | 0.5 | 392.0 | 757 | Mud Flow | 998.95 | — | — | — | 1002.57 | 0.91 | 1002.91 | 0.99 | 2.0 | 0.5 | | | | 1004.40 | 1005.98 | | |
| 29 | ⑨ Kavrebhanjyang-Dapcha-Kakare | ⑨-1 | Roshi | 1.5 | 0.5 | 357.3 | 690 | Mud Flow | 1097.28 | — | — | — | 1100.10 | 0.80 | 1100.32 | 0.80 | 2.0 | 0.5 | | | | 1101.62 | 1103.40 | | |
| 30 | ⑨ Kavrebhanjyang-Dapcha-Kakare | ⑨-2 | Ambote | 6.7 | 2.0 | 17.1 | 384 | D/F (Stopping section) | 1194.61 | 1199.78 | 2 | 5 | 1197.62 | 1.20 | — | — | — | 0.5 | 0.8 | 1202.28 | 1204.32 | | | 1199.62 | |
| 31 | ⑧ Betali-Namadi-Khimli | ⑧-2 | Bohore | 19.7 | 2.0 | 2.5 | 99 | D/F (Stopping section) | 497.61 | 500.18 | 2 | 5 | 498.96 | 0.68 | — | — | — | 0.5 | 0.6 | 502.68 | 505.14 | | | 500.24 | |
| 32 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | ⑤-9 | Piprie | 3.3 | gravel | 1.1 | 63 | Mud Flow | 397.06 | — | — | — | 398.21 | 0.60 | 398.29 | 0.60 | 2.0 | 0.5 | 0.6 | | | 399.39 | 401.31 | 399.41 | |
| 33 | ⑬ Melamchi-Bhotang | ⑬-1 | Anderi | 9.9 | 1.0 | 4.6 | 115 | D/F (Stopping section) | 993.34 | 996.66 | 1 | 5 | 995.15 | 0.72 | — | — | — | 0.5 | 0.6 | 998.16 | 1001.37 | | | 996.47 | |
| 34 | ② Sindhulimadi-Kapilakot | ②-4 | Ancho | 6.5 | 0.5 | 1.1 | 121 | D/F (Stopping section) | 694.38 | 696.94 | 0.5 | 5 | 695.69 | 0.60 | — | — | — | 0.5 | 0.6 | 697.94 | 701.79 | | | 696.89 | |
| 35 | ③ Sindhulimadi-Bhimsthan | ③-2 | Besare | 0.1 | gravel | 3.5 | 244 | No risk of D/F | 199.10 | — | — | — | 201.73 | — | — | — | — | — | 0.8 | | | | | | 202.53 |

Note:

① All elevations are relative to level of temporary bench mark established at each site.

② Maximum Wave Height of Debris Flow: Estimated based on water level calculated from discharge with return period of 50 years multiplied by 4.7

③ Margin for Debris Flow: Maximum size of boulder is assumed to be 3 m.

④ Pile-up Height of Debris Flow is assumed to be 5 m.

⑤ Maximum Wave Height of Flood: Estimated based on water level calculated from discharge with return period of 50 years

⑥ Margin for Flood: Larger figure of 0.6m (-200m³/s) / 0.8m (200-500m³/s) or Water depth calculated from riverbed gradient

⑦ Maximum Wave Height of Mud Flow: Estimated by water level calculated from discharge with return period of 50 years multiplied by 1.2

⑧ Margin for Mud Flow: Larger figure between 0.6 m (-200m³/s) / 0.8m (200-500 m³/s), or Water depth calculated from riverbed gradient

⑨ Pile-up Height of Mud Flow is assumed to be 2 m.

⑩ Margin for Freeboard: 0.5 m is adopted

⑪ Margin not considering Debris (Mud) Flow: 0.6m (-200m3/s) / 0.8m (200-500m3/s) / 1.0m (500-2000m3/s)

⑫ Lower Surface Level of Girder for Debris Flow: ⑫＝②＋③＋⑩

⑬ Lower Surface Level of Girder for Pile-up of Debris Flow: ⑬＝④＋⑤＋⑥＋⑩

⑭ Lower Surface Level of Girder for Mud Flow: ⑭＝⑦＋⑧＋⑩

⑮ Lower Surface Level of Girder for Pile-up of Mud Flow: ⑮＝⑤＋⑥＋⑨＋⑩

⑯ Lower Surface Level of Box Bridge not considering Debris (Mud) Flow: ⑯＝⑤＋⑥＋⑪

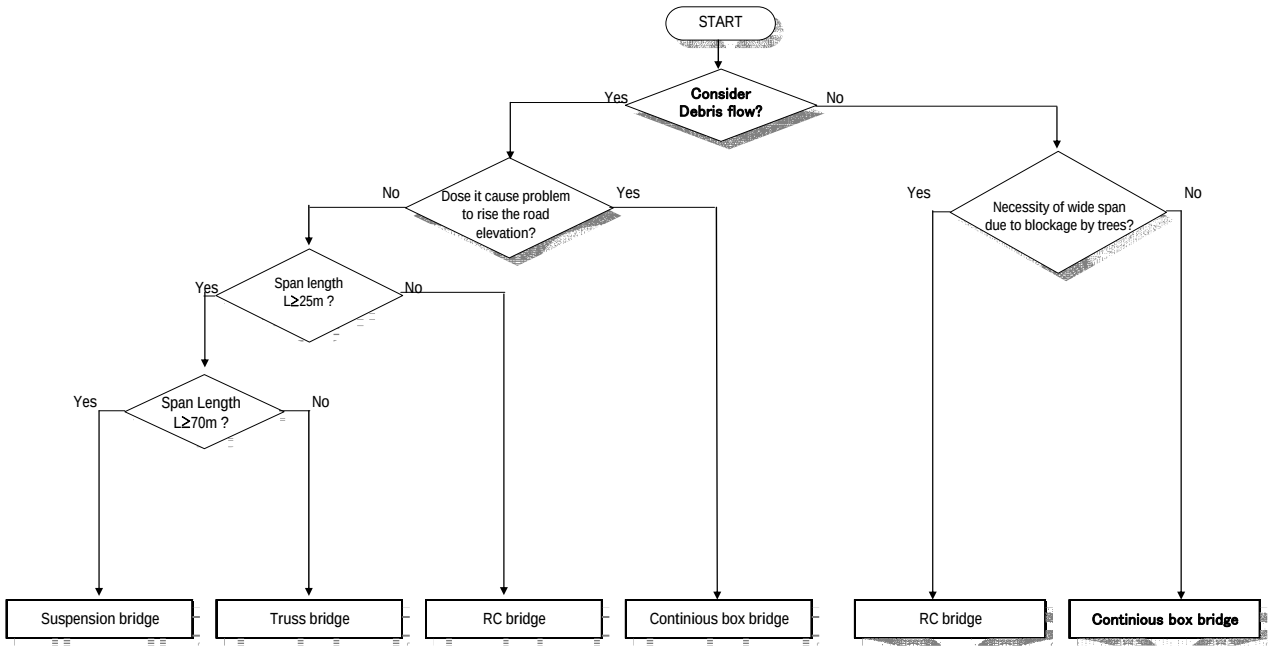
⑰ Lower Surface Level of Girder not considering Debris (Mud) Flow: ⑰＝⑤＋⑪

**(7) Types of Structure to be applied in the Project and Selection Flow**

Since the Project will be implemented by the Grant Aid for Community Empowerment Scheme of GOJ, a Nepalese main contractor will be involved for the construction. Therefore, the following structures common and familiar to Nepalese contractors will be applied for the Project as shown below.

- Motorable Suspension Bridge （One 20 ton class vehicle at a time, 50m - 120m in length)
- Truss Bridge (One 20 ton class vehicle at a time, 50m - 70m in length)
- Truss Bridge (30m – 40m in length)
- Reinforced Concrete T-girder Bridge (15m – 25m in length)
- Continuous Box Bridge (Span 5-10m in length)
- Continuous Box Bridge (Vented causeway type)

Selection bridge type at each site will be carried out following the selection flow as shown in Figure 2.4, taking into account the possibility of debris flow, river width, surrounding circumstances and the policy on the application of the continuous box bridge.




Source: Study Team

**Figure 2.4 Selection Flow of the Bridge Type**

The types of bridges selected at each site and justifications for the selection are summarized in Table 2.14.

## Table 2.14 River Condition and Applicable Bridge Type

| Priority Order | Route | Site | River | Riverbed Gradient (%) | Max. Size of Boulder (m) | Discharge (m3/S) | Flow Type | Structure Type Selection | Applied Structure Type |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 8. Betali-Namadi-Khimti | 8-1 | Palati | 29.9 | 2.0 | 188 | Debris flow Flowing section | Due to debris flow, piers should not be planned in the river. Truss bridge is applied considering securing of clearance, transportation of members and connection with existing access road. | Truss bridge |
| 2 | 8. Betali-Namadi-Khimti | 8-3 | Haluwa | 19.6 | 3.0 | 258 | Debris flow Flowing section | Due to debris flow, piers should not be planned in the river. Truss bridge is applied considering securing of clearance, transportation of members and connection with existing access road. | Truss bridge |
| 3 | 8. Betali-Namadi-Khimti | 8-4 | Pharpu | 8.8 | 3.0 | 384 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Truss bridge is applied considering securing of clearance, transportation of members and connection with existing access road. | Truss bridge |
| 4 | 8. Betali-Namadi-Khimti | 8-5 | Chatwane | 11.0 | 1.0 | 189 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Truss bridge is applied considering securing of clearance, transportation of members and connection with existing access road. | Truss bridge |
| 5 | 11. Bhore Dovan-Thulo Parcel | 11-3 | Roshi | 1.2 | 0.3 | 1052 | Mud flow | Although flow type is not debris flow but mud flow at this point, piers should not be planned in the river since rapid degradation of the riverbed of Roshi River due to collection of sand and gravel, fluctuation in riverbed and gusty partial scouring due to meandering and confluence of branch rivers' debris flow are anticipated. Therefore, 120-m class suspension bridge is applied. | Suspension bridge |
| 6 | 1. Laxmaniya-Baratpur-Raghunathpur | 1-1 | Dholan | 0.8 | sand | 204 | No risk of debris flow | Since the river runs through forest areas without establishing banks, it is likely that driftwood will flow down the river. Therefore, although discharge is not quite large, RC-T girder bridge with span length of 25m is applied. | RC-T girder bridge |
| 7 | 1. Laxmaniya-Baratpur-Raghunathpur | 1-2 | Kantawa | 0.2 | sand | 29 | No risk of debris flow | Although discharge is quite small, the river becomes like a pond due to its topographic conditions during the rainy season. The possibility of blockage due to driftwood or soil is low. Therefore, continuous box bridge with span length of 7m is applied. | Continuous box bridge |
| 8 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-11 | Kolta | 0.6 | 1.0 | 495 | No risk of debris flow | The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 9 | 5. Dakaha-Sirthauli-Dudhauli -Katari | 5-8 | Talko | 1.0 | 0.3 | 249 | No risk of debris flow | The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway and continuous box bridges with span length of 5m are applied to both side of all-season waterway. | Continuous box bridge |
| 10 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-7 | Kuruwa | 2.3 | 1.0 | 184 | Mud flow | Although flow type is not debris flow but mud flow at this point, there is a large-scale collapse in the upstream. As a result of interview survey to local residents, it was revealed that when slope failure and flood occur simultaneously, boulder flow could be observed. It is likely that driftwoods flow down the river. Therefore, although discharge is not quite large, RC-T girder bridge with spans of 25m is applied. | RC-T girder bridge |
| 11 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-5 | Thakur-4 | 0.9 | 0.3 | 1851 | No risk of debris flow | Slab culvert with span length of about 5m exists in the upstream. The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 12 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-4 | Thakur-3 | 1.5 | 1.0 | | Mud flow | The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 13 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-3 | Thakur-2 | 0.1 | 0.5 | | No risk of debris flow | The river, located at a low point in a plain alluvial fan, plays the role of an irrigation channel and is in spate when large flood occurs. Therefore, continuous box bridge with span length of 5m is applied. | Continuous box bridge |
| 14 | ⑤ Dakaha-Sirthauli-Dudhauli-Katari | 5-2 | Thakur-1 | 0.7 | 0.5 | | Flood | The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 15 | 5. Dakaha-Sirthauli-Dudhauli- Katari | 5-1 | Tamorni | 0.3 | gravel | 498 | No risk of debris flow | The river, located in a plain alluvial fan, is in spate when large flood occurs. River crossing point becomes like a pond in flood. Therefore, continuous box bridge with span length of 7m is applied. | Continuous box bridge |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 16 | 13.Melamchi-Bhotang | 13-6 | Khalte | 8.4 | 3.0 | 231 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. If truss bridge is applied, proposed height of bridge section becomes higher than existing road by more than 5m. It results in that the access road cannot be connected to the one in front of settlement. Therefore, to avoid adverse effect to local daily life and lower the proposed height, continuous box bridge which, for rare occasions, suffers damage caused by debris flow, is applied. | Continuous box bridge |
| 17 | 13. Melamchi-Bhotang | 13-8 | Tipeni | 12.0 | 3.0 | 293 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. If truss bridge is applied, proposed height of bridge section becomes higher than existing road by more than 5m. It results in that the access road cannot be connected to the one in front of settlement. Therefore, to avoid adverse effect to local daily life and to lower proposed height, continuous box bridge which, for rare occasions, suffers damage caused by debris flow, is applied. | Continuous box bridge |
| 18 | 13. Melamchi-Bhotang | 13-10 | Mahadev | 6.2 | 2.0 | 262 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Truss bridge is applied considering securing of clearance, transportation of members and connection with existing access road. | Truss bridge |
| 19 | 13. Melamchi-Bhotang | 13-14 | Hadi | 10.9 | 5.0 | 661 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Local residents give testimony that gusty debris flow actually occurs frequently. It is difficult to adopt suspension bridge which needs to establish anchorages on the slopes due to steep valley and weak geological condition. Three alternative routes were compared between the existing river crossing point and suspension bridge for pedestrians at downstream. As a result, 70m-class truss bridge at existing river crossing point which can be considered safest from debris flow and slope failure is applied. In addition, number of vehicles which pass the bridge simultaneously is restricted to one. | Truss bridge |
| 20 | 2. Sindhulimadi-Kapilakot | 2-1 | Marin | 1.3 (0.6) | 1.5 | 2837 | Flood | There are some large boulders which were flushed by debris flow in the area of the river crossing point and downstream. As a result of interview survey of local residents, it was revealed that large-scale floods have occurred every about 20 years. As a river crossing point, existing crossing point where the river width was about 150m and point at downstream from there by 400m where the river width was about 100m were proposed. In addition, at existing river crossing point, detailed design of RC-T girder bridge was carried out by DOR.<br>【Existing river crossing point, RC-T girder bridge】<br>• Sedimentation of debris flow possibly occurs.<br>• Maybe difficult to excavate for substructure<br>【400m downstream, Suspension bridge】<br>• No risk of sedimentation of debris flow because no pier is planned.<br>• Twice the cost of RC-T girder bridge<br>• Need to land acquisition for about 300m approach road for both sides (adverse effect to social environment)<br>To these two alternatives,<br>• As a result of interview survey to local residents, it was confirmed that the debris flow which brought pile up of large boulders was caused by the heavy rain in the year of 1941, and that although same-scale flood occurred, debris flow has not occurred since then.<br>• In addition, the result of topographic survey conducted by DOR revealed that riverbed gradient of the crossing point is as mild as 0.6%.<br>• As a result of discussion with representatives of ten major contractors in Nepal regarding construction of substructure, it was found that they can carry out the construction works of RC-T girder bridge.<br>Therefore, RC-T girder bridge at existing river crossing point is applied. | RC-T girder bridge |
| 21 | 2. Sindhulimadi-Kapilakot | 2-5 | Deojar | 4 | 5.0 | 618 | Mud flow | Damage rarely caused by debris flow may be allowed and continuous box bridge with span length of 10m is applied. | Continuous box bridge |
| 22 | 2. Sindhulimadi-Kapilakot | 2-6 | Maheshot | 2.0 | 1.0 | 636 | Mud flow | As a result of interview survey of local residents, it was found that debris flow caused by the heavy rain in the year 1993 is piled up. The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with | Continuous box bridge |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | span length of 10m is applied to all-season waterway and continuous box bridges with span length of 5m are applied to both side of all-season waterway. | |
| 23 | 2. Sindhulimadi-Kapilakot | 2-7 | Chatuuli | 1.2 | 1.0 | 817 | Flood | As a result of interview survey of local residents, it was found that debris flow caused by the heavy rains in 1993 has piled up. The river, located in a plain alluvial fan, is in spate when large flood occurs. Therefore, continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 24 | 6. Manthali-Ramechhap-Sangutar | 6-1 | Sukhajor | 3.8 | 0.2 | 415 | Mud flow | Enormous soil is piled up in the dry riverbed of the river. Continuous box bridge with span length of 10m is applied | Continuous box bridge |
| 25 | 3. Sindhulimadi-Bhimsthan | 3-1 | Dhamile | 1.9 | 1.0 | 674 | Mud flow | Damage rarely caused by debris flow may be allowed and continuous box bridge with span length of 10m is applied. | Continuous box bridge |
| 26 | 3. Sindhulimadi-Bhimsthan | 3-5 | Jirghaha | 1.3 | 0.5 | 1153 | Flood | The river has vast dry riverbed. Continuous box bridge with span length of 10m is applied to all-season waterway. | Continuous box bridge |
| 27 | 4. Bhiman-Dhansari | 4-43 | Dhansari | 1.3 | sand | 148 | No risk of debris flow | The flow velocity of the river influenced by Kamala River is slow and the possibility of blockage due to driftwood or soil is low. Therefore, continuous box bridge with span length of 7m is applied. | Continuous box bridge |
| 28 | 10. Katunjebesi-Bankhu | 10-1 | Roshi | 1.1 | 0.5 | 757 | Mud flow | Although flow type is not debris flow but mud flow at this point, since rapid degradation in riverbed of Roshi River due to collection of sand and gravel, fluctuation in riverbed and gusty partial scouring due to meandering and confluence of branch rivers' debris flow are anticipated, piers should not be planned in the river. Therefore, 100m-class suspension bridge is applied. | Suspension bridge |
| 29 | 9. Kavrebhanjyang-Dapcha- Kakare | 9-1 | Roshi | 1.5 | 0.5 | 690 | Mud flow | Although flow type is not debris flow but mud flow at this point, since rapid degradation in riverbed of Roshi River due to collection of sand and gravel, fluctuation in riverbed and gusty partial scouring due to meandering and confluence of branch rivers' debris flow are anticipated, piers should not be planned in the river. Therefore, 90m-class suspension bridge is applied. | Suspension bridge |
| 30 | 9. Kavrebhanjyang-Dapcha-Kakare | 9-2 | Ambote | 6.7 | 2.0 | 384 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Therefore 70m-class truss bridge and suspension bridge are candidate structures, however, considering that the access road to the site is substandard and that further roads from the site have not been developed, stage-wise construction is adopted and as the first step, vented causeway is applied. | Vented causewa |
| 31 | 8. Betali-Namadi-Khimti | 8-2 | Bohore | 19.7 | 2.0 | 99 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Truss bridge is a candidate structure, however, large-scale failure is observed on the slope just above the bridge. Therefore continuous box bridge with span length of 10m which, for rare occasions, suffers damage caused by debris flow is applied considering discharge is small. | Continuous box bridge |
| 32 | 5. Dakaha-Sirthauli-Dudhauli-Katari | 5-9 | Piprie | 3.3 | gravel | 63 | Mud flow | Continuous box bridge with span length of 10m is applied. | Continuous box bridge |
| 33 | 13. Melamchi-Bhotang | 13-1 | Anderi | 9.9 | 1.0 | 115 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. If truss bridge is applied, proposed height of bridge section becomes higher than existing road by more than 5m. It results in that the access road can not be connected to the one in front of settlement. Therefore, to avoid adverse effect to local daily life and to lower proposed height, continuous box bridge which, for rare occasions, suffers damage caused by debris flow is applied. | Continuous box bridge |
| 34 | 2. Sindhulimadi-Kapilakot | 2-4 | Ancho | 6.5 | 0.5 | 121 | Debris flow Stopping section | Due to debris flow, piers should not be planned in the river. Truss bridge is a candidate structure, however, the site is not appropriate point for construction of bridges since proposed abutments have to be planned on the pile up of debris flow and slope failures are observed near the site. Therefore continuous box bridge which, for rare occasions, suffers damage caused by debris flow is applied considering discharge is small. | Continuous box bridge |
| 35 | 3. Sindhulimadi-Bhimsthan | 3-2 | Besare | 0.1 | gravel | 244 | No risk of debris flow | The possibility of blockage due to driftwood or soil is low. Therefore, continuous box bridge with span length of 7m is applied. | Continuous box bridge |

## (8) Suspension, Truss and Reinforced Concrete Bridge Design

1) Basic Concept and Design Criteria

i) Width

Width of bridges located along roads classified as “Feeder Road” will be 5.7 m (0.6+4.5+0.6) in accordance with the Design Standards for Feeder Roads (Third revision). Width of the bridges located along the district roads will be 4.5m (0.25+3+1+0.25) based on the Nepal Road Standards (2027).

For suspension bridges and the 70m long truss bridge, width of 4.0m (0.25+3.5+0.25) will be applied referring to the Dobila Motorable Suspension Bridge under construction by DOLIDAR.

ii) Applicable Design Standards and Live Roads

The bridge design will be basically carried out based on the Standard Specifications and Code of Practice for Road Bridges, The Indian Roads Congress. However, for the interim on live loads, AASHTO provisions will be adopted based on the Nepal Road Standards (2027) as follows:

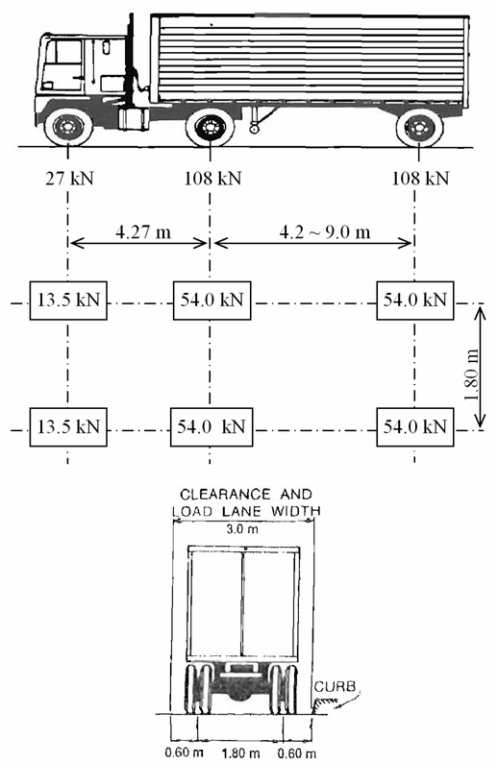
- Major bridge: HS20-44
- Medium and Minor bridges and culvert: HS14-44
- Suspension bridges and long truss bridges: HS15-44 (one vehicle at a time) as a special case

iii) Design Standards

The bridges are designed in accordance with the standards below:

- Classification and Design Standards for Feeder Roads (Second Revision), 1994, Department of Roads
- Standard Specifications for Road and Bridge Works, 2001, Department of Roads。
- Standard Specifications and Code of Practice for Road Bridges, The Indian Roads Congress (IRC)
- Standard Specifications for Highway Bridges(AASHTO 17th Edition)

HS15-44 : Span Length < 25m




HS 20-44 :Span Length > 25m

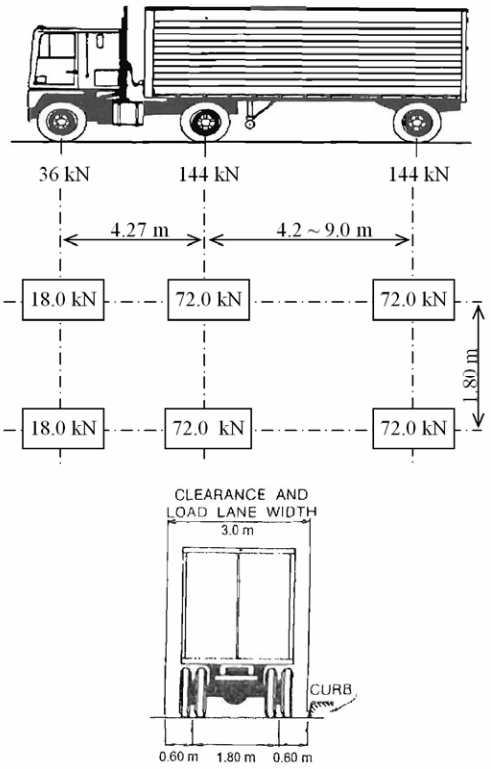



**Figure 2.5 Live Load (HS20-44 and HS15-44)**

2) Design Calculation

i) Major Design Criteria

The main criteria for design are shown below.

a. Design Live Load

- AASHTO HS15-44 : Span Length less than 25m:
- AASHTO HS20-44 : Span Length more than 25m:
- AASHTO HS20-44 with people load for suspension and long truss bridges

b. Impact Factor Fraction

- for concrete bridge, $I = 4.5/ (6+S)$
- for steel bridge, $I = 9/ (13.5+S)$

c. Seismic Load

- Design horizontal seismic coefficient k=0.1

d. Material

- Concrete for Reinforced Girder : $fc = 30\ N/mm^2$
- Concrete for Deck Slab: $fc = 30\ N/mm^2$
- Concrete for Sub-structure: $fc = 25\ N/mm^2$
- Reinforcing Bar: Yield Strength = $415\ N/mm^2$
- Structural Steel : Yield Strength = $415\ N/mm^2$

ii) Design Cases

Table 2.15 shows the specifications of the designed bridge

**Table 2.15 List of Bridge Type to be Calculated**

| Bridge Type | Bride Width | Span Length | Applied Live Load | Site No |
|---|---|---|---|---|
| Suspension bridge | 3.5m | 90m | HS15-44 (1truck) with people load | 9-1 |
| Suspension bridge | 3.5m | 100m | HS15-44 (1truck) with people load | 10-1 |
| Suspension bridge | 3.5m | 120m | HS15-44 (1truck) with people load | 11-3 |
| Truss bridge | 4.0m | 30m | HS20-44 | 8-1,8-3,8-4,8-5,13-10 |
| Truss bridge | 3.5m | 70m | HS15-44 (1truck) with people load | 13-14 |
| RC-T girder | 4.5m | 23m | HS15-44 | 2-1 |
| RC-T girder | 4.0m | 24.2m | HS15-44 | 1-1,5-7 |

Source: Study Team

iii) Load Cases

The load for the design of the bridge and the load combinations are as follows:

D： Dead Load
LI： Live Load and Impact
SH： Drying Shrinkage（It corresponds to the temperature descending 15℃）
E： Earth Pressure（Coulomb's earth pressure ）
HP： Stream flow pressure
W： Wind Load（Design wind velocity V=30m/s）
T1： Temperature Effect（rising +20℃、down -15℃）
T2： Temperature Difference of Girder (RC-T girder)
EQ： Seismic Load（Design seismic coefficient $k_h$=0.10）
U： Buoyancy

**Table 2.16 Load Combination**

| Case. | | D | LI | SH | E | HP | W | T1 | T2 | EQ | Overdressing factor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Dead load+ Live load | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | - | - | - | 1.00 |
| 2 | Temperature Effect(1) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | - | 1.15 |
| 3 | Temperature Effect(2) | 1.0 | 0.5 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | - | 1.15 |
| 4 | Wind Load | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | - | - | 1.33 |
| 5 | Temperature +WIND | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.33 |
| 6 | Seismic Load | 1.0 | 0.5 | 1.0 | 1.0 | 1.0 | - | 1.0 | 1.0 | 1.0 | 1.50 |

note：1.Temperature Effect(1) : Temperature effect + Live load(100%)
2.Temperature Effect(2) : Temperature effect + Live load(50%)
3.The buoyancy is considered when becoming a result on the safety side in the state of each combination load.

3) Outline of Suspension Bridge Design

i) Justification for Considering Suspension Bridge at the Roshi River Crossings

As experienced in the Sindhuli Road Construction Project, although flow type is not debris but mud, since rapid degradation in riverbed of Roshi River due to collection of sand and gravel, fluctuation in riverbed and gusty partial scouring due to meandering and confluence of branch rivers, it is anticipated that the piers could be subject to unforeseen forces. Therefore, three 100-m class suspension bridges are applied for the Roshi River Crossing.

ii) Structural Details

The design of suspension bridge will be carried out referring to the existing suspension bridge constructed by the Nepalese contractor. Concrete main tower will be applied as used for the Dobila Motorable Suspension Bridge. The height of the tower was designed relatively higher than the standard design considering the capacity of the main cable using five numbers of 48 mm wire cables on flat position.

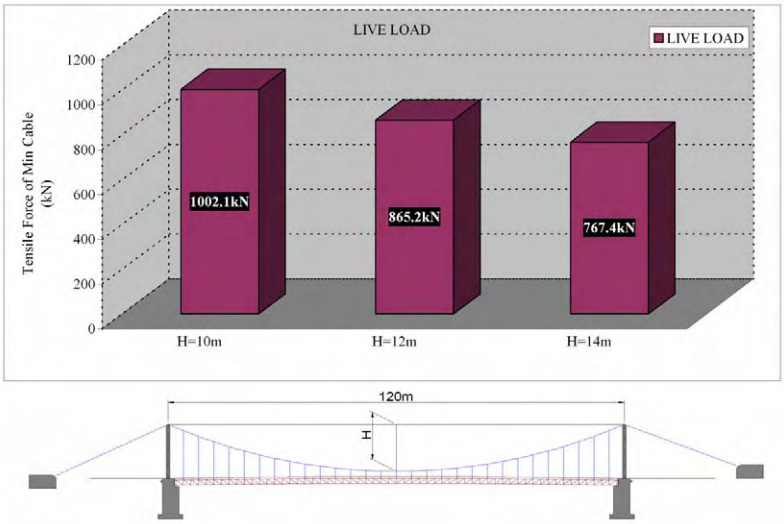



**Figure 2.6 Tensile Force of Main Cable and Tower Height**
Source: Study Team

The flat placing with maximum five number of cables configuration will be used in consideration of its availability in the market and capability of the Nepalese fabricator and contractor in assembling the bundled type main cable. Steel truss girder using steel materials produced based on the Indian Standard will be adopted. Steel deck consisting of checkered plate as applied in the Dobila Motorable Suspension Bridge will be used considering weight and flexibility.

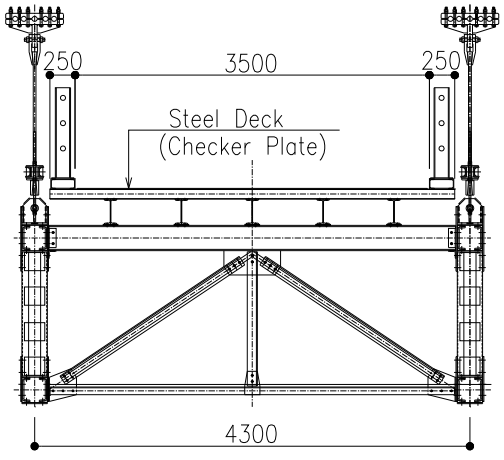



**Figure 2.7 Standard Cross Section of Suspension Bridge**

Source: Study Team

iii) Structural Analysis

Structural analysis was carried out using a 3-D frame analysis method and the model is shown in Figure 2.8 below.

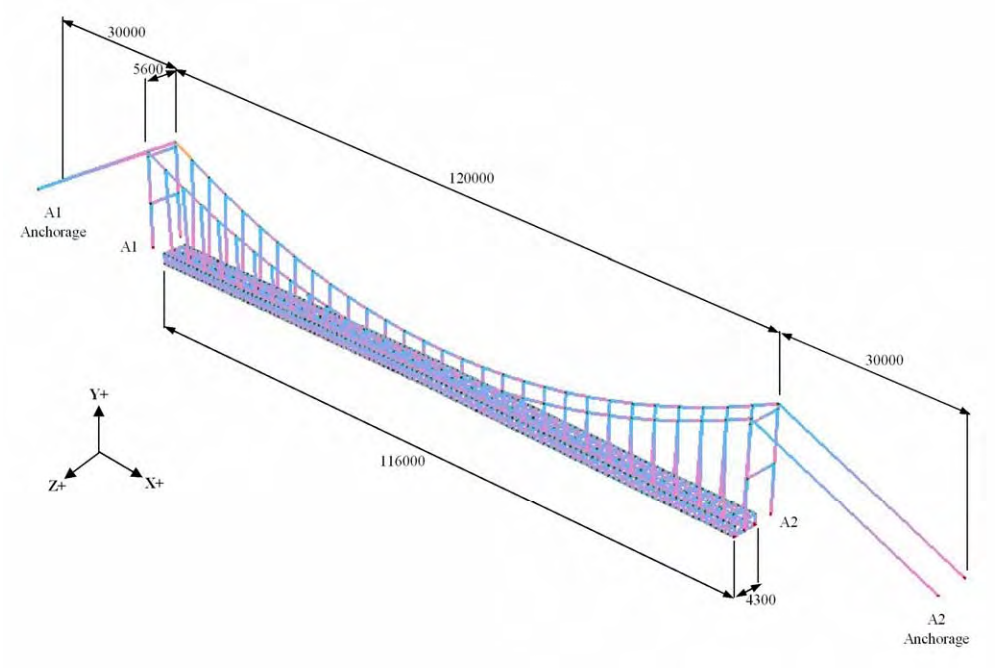


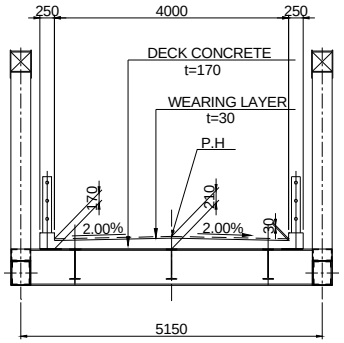

**Figure 2.8 3-D Frame Model**
Source: Study Team

4) Outline of Truss Bridge Design

i) Applicable Truss Type

Pony type truss bridge (25-40 m) and Warren type truss (40-70 m) will be applied in the Project as shown in Figure 2.9.

Pony type truss




Warren type truss

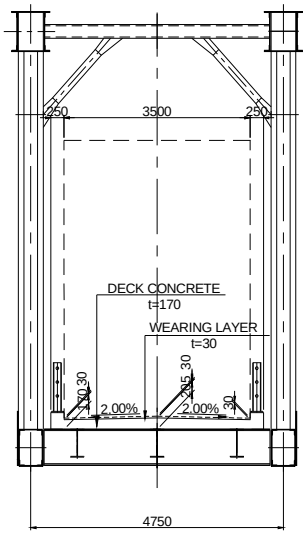



**Figure 2.9 Applicable Truss Types**
Source: Study Team

ii) Structural Details

The design will be done using the steel members based on the Indian Standard which are available in Nepal. Concrete slab will be used instead of steel deck slab taking durability into consideration. Abrasion layer of 3 cm thickness will be adopted for the concrete slab.

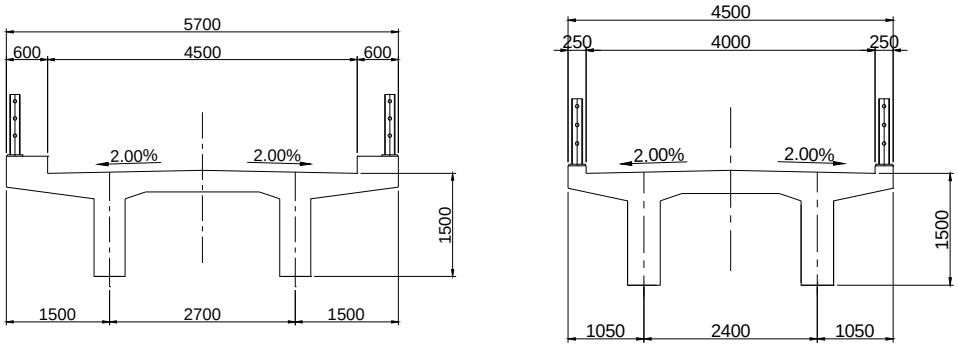
iii) Structural Analysis

Structural analysis was carried out using 3-D frame analysis method

5) Outline of Reinforced Concrete Bridge Design

i) Cross Section

Bridge widths of 4.5m and 4.0m will be applied for bridges on feeder road and district road respectively, as shown in Figure 2.10.




For Feeder Road For District Road

**Figure 2.10 Applicable Bridge Width**
Source: Study Team

ii) Structural Details

Span length of reinforced concrete bridges will be limited by 25 m with 1.5 m beam height. Single span type will be used instead of the continuous type taking into account the possible unbalanced ground subside and easy construction.

6) Design Results

The following Table 2.17 shows the design structural sizes of the bridge at each site.

**Table 2.17 Structural Dimension of Bridges**

| Site No | River name | Bridge Width (m) | Bridge Type | Bridge Length (m) | Skew angle (°) | Arrangement of spans (m) | Girder height (m) | Type of Abutment | Height of Abutment (m) | Type of Pier | Height of Pier (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-1 | Dholan | 4.0 | RC-T girder | 50.0 | 90 | 24.2×2 | 1.5 | Reversed T type | 10.0 | Wall type | 8.5 |
| 2-1 | Marin | 4.5 | RC-T girder | 142.0 | 90 | 23.0×6 | 1.5 | Reversed T type | 11.0 | Wall type | 11.0 |
| 5-7 | Kantawa | 4.0 | RC-T girder | 50.0 | 90 | 24.2×2 | 1.5 | Reversed T type | 8.0 | Wall type | 8.5 |
| 8-1 | Palati | 4.0 | Truss bridge | 30.8 | 90 | 30.0 | 3.5 | Reversed T type | 8.0 | --- | --- |
| 8-3 | Haluwa | 4.0 | Truss bridge | 30.8 | 90 | 30.0 | 3.5 | Reversed T type | 10.0 | --- | --- |
| 8-4 | Pharpu | 4.0 | Truss bridge | 30.8 | 90 | 30.0 | 3.5 | Reversed T type | 10.5 | --- | --- |
| 8-5 | Chhatauni | 4.0 | Truss bridge | 30.8 | 90 | 30.0 | 3.5 | Reversed T type | 10.0 | --- | --- |
| 9-1 | Roshi-1 | 3.5 | Suspension bridge | 90.0 | 90 | 86.0 | 1.5 | Reversed T type | 10.5 | Pylon height 12.5m | |
| 10-1 | Roshi-2 | 3.5 | Suspension bridge | 100.0 | 90 | 96.0 | 1.5 | Reversed T type | 9.5 | Pylon height 14.0m | |
| 11-3 | Roshi-3 | 3.5 | Suspension bridge | 120.0 | 90 | 116.0 | 1.5 | Reversed T type | 12.0 | Pylon height 16.1m | |
| 13-10 | Mahadev | 4.0 | Truss bridge | 30.8 | 90 | 30.0 | 3.5 | Reversed T type | 12.0 | --- | --- |
| 13-14 | Hadi | 3.5 | Truss bridge | 71.0 | 90 | 70.0 | 7.5 | Reversed T type | 10.5 | --- | --- |

note： The truss bridges are all steel-made and structural height indicate the main truss height.

Suspension bridge: The suspension bridge is stiffening girder type.
Stiffening girder is a steel truss structure, and the girder height indicates main truss height.
The pier column indicates pylon height.
The height of abutments indicates the height of highest abutment in both sides.
Source: Study Team

**(9) Continuous Box Bridge Design**

1) Selection of structural type

The selection policy of a structural type of multiple box bridge is shown below.

i) Span length 10m / Bearing support

This structure type is applied under the following flood conditions:

- The bridge is in an area subject to debris flow, stops, and flood flows.
- The flood is expected to overflow the bridge

There is a possibility that the opening could be blocked with soil materials and others. Connection with the bearing is suitable between the superstructure and sub-structure, because in a big flood, superstructure is most possibly subjected to damage and of easy repairing.

ii) Span length of 7-m / Rigid-connection

This configuration is applied under the following flood condition:

- At sections where possibility of debris flow is generated, while the risks of that the openings are blocked with soil materials and others are less.

Superstructure and sub-structure are with rigid connection because the possibility of the damage to the superstructure due to the flood is unlikely, and the member size is reduced as much as possible.

iii) Span length of 5-m / Rigid-connection

This configuration is arranged parallel to the main opening side. Connection between the superstructure and sub-structure is the same as the structures for the main opening.

**Table 2.18 Selection of Structural Type**

| Type of flood | Possibility of overflow | Possibility of blockage of opening | Span length | Bearing system |
|---|---|---|---|---|
| Stop & flowing section of debris flow | Yes | Yes | 10 m | Bearing |
| Flowing section of mud flow | Yes | Yes | 10 m | Bearing |
| Flood flowing section | Yes | Yes | 10 m | Bearing |
| No risk section of debris flow | No | No | 7 m | Rigged |

Source: Study Team

iv) Vented Causeway

Vented Causeway is applied occasionally under the following conditions, although truss bridge of 70 m is preferable as site number 9-2 is a section where debris flow stops.

- The grade of the road to access it to this region is considerably low
- Because the road has been completed only up to the construction site of the bridge at present, a phased construction is preferable.

Since the structural scale is small, structural calculation is not performed.

2) Structural Calculation

i) Design Criteria

The main criteria for design are as follows:

a. Design Live Load

- AASHTO HS15-44 : For span lengths of less than 25 m:

b. Impact Factor

- for concrete bridge I = 4.5/ (6+S)

c. Seismic Load

- Design horizontal seismic coefficient k=0.1

d. Material

- Concrete for Reinforced Girder: fck = 30 N/mm$^2$
- Concrete for Sub-structure :fck = 25 N/mm$^2$
- Reinforcing Bar : Yield Strength = 415 N/mm$^2$

ii) Structural model and applicable bridge

The selection policy of the calculation model in the design of continuous box bridge is indicated below:

- In the structural calculation, it is assumed that the widths of the members of the model are 1 m for analysis purposes. Therefore, neither the actual width nor the structural angles of the bridge are simulated in the model for calculation.
- The calculation executes two structural models. One is a model considering superstructure and pier are integrated, and, on the other hand, a model of the footing on an elastic base.
- In the analysis of the box bridge where members are rigidly connected, the structural calculation will be done through an integral model of all members.

The list of continuous box bridge for design is shown in Table 2.19.

**Table 2.19 List of Box Bridge for design**

| Span Length (m) | Bearing system | Number of Span | End Wall Height (m) | Number of End Wall | Model Name | Site No |
|---|---|---|---|---|---|---|
| 10 | Bearing | 1 | - | - | 10-1C | 3-1,3-5,5-2,5-4,6-1,8-2 |
| | | 2 | 8.0 | - | 10-2C-h8 | 3-1,6-1,13-8 |
| | | | 6.0 | - | 10-2C-h6 | 5-4,13-1,13-6 |
| | | 3 | 9.0 | - | 10-3C-h9 | 2-5,3-5 |
| | | | 6.0 | - | 10-3C-h6 | 2-4,3-5,5-2,5-5,6-1 |
| | | 4 | 8.0 | - | 10-4C-h8 | 2-6,2-7,5-2,5-4 |
| 7 | Bearing | 1 | - | - | 7-1C | 5-1 |
| | Rigid | 2 | 6.0 | 1 | 7Rb-2C-h6 | 5-1,5-9 |
| | | 3 | 6.0 | 2 | 7Ra-3C-h6 | 3-2,5-3 |
| | | | 7.0 | 1 | 7Rb-3C-h7 | 5-1 |
| | | 4 | 7.0 | 2 | 7Ra-4C-h7 | 1-2,4-43,5-11 |
| | | | 6.0 | 1 | 7Rb-4C-h6 | 5-8 |
| 5 | Bearing | 1 | - | - | 5-1C | 2-6,5-8 |
| | | 2 | 6.0 | - | 5-2C-h6 | 2-6 |
| | | 4 | 6.0 | - | 5-4C-h6 | 2-6 |
| | Rigid | 4 | 5.0 | 1 | 5Rb-4C-h5 | 5-8 |

Note: - Legend of Model Name -

（Span Length） — （Number of Span） C — h （End Wall Height）

Ra : Rigid support,and 2 End Walls(both sides)

Rb : Rigid support,and 1 End Wall(one side)

1C : Only Superstructure(simple beam)

・"End Wall Height"means height of from road surface to top of bottom slab

Source: Study Team

iii) Design Loads

The load for the design of the bridge and the load combination are shown below:

D： Dead Load

LI： Live Load and Impact

SH： Drying Shrinkage（It corresponds to the temperature descending 15℃）

E： Earth Pressure（Coulomb's earth pressure ）

T： Temperature Effect（rising +20℃、down -15℃）

EQ： Seismic Load（Design seismic coefficient $k_h$=0.10）

U： Buoyancy

**Table 2.20 Load Combination**

| Case. | D | LI | SH | E | T | EQ | Overdressing factor |
|---|---|---|---|---|---|---|---|
| Dead load+ Live load | 1.0 | 1.0 | 1.0 | 1.0 | - | - | 1.00 |
| Temperature Effect(1) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | - | 1.15 |
| Temperature Effect(2) | 1.0 | 0.5 | 1.0 | 1.0 | 1.0 | - | 1.15 |
| Seismic Load | 1.0 | 0.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.50 |

Source: Study Team

iv) Coefficient of sub-grade reaction

Coefficient of sub-grade reaction is calculated according to the Japanese standard. N value of the bearing stratum is assumed to be N=30. Table 2.21 indicates vertical sub-grade reaction coefficient of each computing model.

$$k_v = k_{v0}\left(\frac{B_v}{0.3}\right)^{-\frac{3}{4}} = \frac{1}{0.3}\alpha E_0\left(\frac{\sqrt{A_v}}{0.3}\right)^{-\frac{3}{4}}$$

**Table 2.21 List of Vertical Sub-grade Reaction Coefficient**

| Span Length Ls (m) | Road Classification | Number of Span N (m) | Bottom Slab Length L (m) | Bottom Slab Width B (m) | Loading Area Av ($m^2$) | Converted Width Bv=√Av (m) | Coefficient of sub grade reaction | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | kv ($kN/m^3$) | Kv ($kN/m^2$) |
| 10 | Feeder | 2 | 20.00 | 5.70 | 114.0 | 10.677 | 19,200 | 19,200 |
| | | 3 | 30.00 | 5.70 | 171.0 | 13.077 | 16,500 | 16,500 |
| | | 4 | 40.00 | 5.70 | 228.0 | 15.100 | 14,800 | 14,800 |
| | District | 2 | 20.00 | 4.50 | 90.0 | 9.487 | 21,000 | 21,000 |
| | | 3 | 30.00 | 4.50 | 135.0 | 11.619 | 18,000 | 18,000 |
| | | 4 | 40.00 | 4.50 | 180.0 | 13.416 | 16,200 | 16,200 |
| 7 | Feeder | 2 | 14.00 | 5.70 | 79.8 | 8.933 | 22,000 | 22,000 |
| | | 3 | 21.00 | 5.70 | 119.7 | 10.941 | 18,900 | 18,900 |
| | | 4 | 28.00 | 5.70 | 159.6 | 12.633 | 16,900 | 16,900 |
| | District | 2 | 14.00 | 4.50 | 63.0 | 7.937 | 24,000 | 24,000 |
| | | 3 | 21.00 | 4.50 | 94.5 | 9.721 | 20,600 | 20,600 |
| | | 4 | 28.00 | 4.50 | 126.0 | 11.225 | 18,500 | 18,500 |
| 5 | Feeder | 2 | 10.00 | 5.70 | 57.0 | 7.550 | 24,900 | 24,900 |
| | | 3 | 15.00 | 5.70 | 85.5 | 9.247 | 21,400 | 21,400 |
| | | 4 | 20.00 | 5.70 | 114.0 | 10.677 | 19,200 | 19,200 |
| | District | 2 | 10.00 | 4.50 | 45.0 | 6.708 | 27,200 | 27,200 |
| | | 3 | 15.00 | 4.50 | 67.5 | 8.216 | 23,400 | 23,400 |
| | | 4 | 20.00 | 4.50 | 90.0 | 9.487 | 21,000 | 21,000 |

Note: ・Feeder Road : Road No.2 and No.3
・Discrict Road : Except Road No.2 and No.3

Source: Study Team

v) Design Results

Table 2.22 shows the structural size of the bridge designed for each site.

**Table 2.22 Structural Dimension of Bridges**

| Site No | River Name | Type of Flood | Bridge Width (m) | Bridge Type | Bearing System | Bridge Length (m) | Skew Angle (°) | Number of Span | Span Length (m) | Height (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1-2 | Kantwa | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 28.7 | 70 | 4 | 4x7 | 6.3 |
| 2-4 | Athuwa | Stop section of debris flow | 4.5 | Multiple Box Bridge | Bearing | 30.8 | 90 | 3 | 3x10 | 5.9 |
| 2-5 | Devjor | Flowing section of sediment flow | 4.5 | Multiple Box Bridge | Bearing | 30.8 | 90 | 3 | 3x10 | 10.6 |
| 2-6 | Maheswata | Flowing section of sediment flow | 4.5 | Multiple Box Bridge | Bearing | 105.8 | 90 | 17 | 5+5+4x10+5+4x5+5+2x5+5+2x5 | 8.2 |
| 2-7 | Chantuli | Flowing section of flood flow | 4.5 | Multiple Box Bridge | Bearing | 40.8 | 90 | 4 | 4x10 | 6.9 |
| 3-1 | Dhamile | Flowing section of sediment flow | 4.5 | Multiple Box Bridge | Bearing | 50.8 | 90 | 5 | 2x10+10+2x10 | 8.2 |
| 3-2 | Basera | Flowing section of no debris flow | 4.5 | Multiple Box Bridge | Rigid | 21.7 | 75 | 3 | 3x7 | 6.8 |
| 3-5 | Girgha | Flowing section of flood flow | 4.5 | Multiple Box Bridge | Bearing | 70.8 | 90 | 7 | 3x10+10+3x10 | 8.7 |
| 4-43 | Dhansari | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 28.7 | 90 | 4 | 4x7 | 6.8 |
| 5-1 | Tamorni | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 42.7 | 90 | 6 | 2x7+7+3x7 | 6.9 |
| 5-2 | Thakur-1 | Flowing section of flood flow | 4.0 | Multiple Box Bridge | Bearing | 80.8 | 90 | 8 | 3x10+10+4x10 | 7.4 |
| 5-3 | Thakur-2 | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 21.7 | 90 | 3 | 3x7 | 6.0 |
| 5-4 | Thakur-3 | Flowing section of sediment flow | 4.0 | Multiple Box Bridge | Bearing | 70.8 | 90 | 7 | 2x10+10+4x10 | 8.7 |
| 5-5 | Thakur-4 | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Bearing | 30.8 | 70 | 3 | 3x10 | 5.6 |
| 5-8 | Talkha | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 78.7 | 90 | 14 | 4x5+5+4x7+5+4x5 | 5.6 |
| 5-9 | Piprahi | Flowing section of sediment flow | 4.0 | Multiple Box Bridge | Rigid | 14.7 | 90 | 2 | 2x7 | 5.6 |
| 5-11 | Kartha | Flowing section of no debris flow | 4.0 | Multiple Box Bridge | Rigid | 28.7 | 70 | 4 | 4x7 | 7.3 |
| 6-1 | Sukajor | Flowing section of sediment flow | 4.0 | Multiple Box Bridge | Bearing | 60.8 | 90 | 6 | 2x10+10+3x10 | 7.3 |
| 8-2 | Bohare | Stop section of debris flow | 4.0 | Multiple Box Bridge | Bearing | 10.8 | 90 | 1 | 10 | 8.8 |
| 9-2 | Andheri | Stop section of debris flow | 4.0 | Vented Causeway | — | 27.0 | 90 | — | number of void: □1.5m-10 | 3.0 |
| 13-1 | Andheri | Stop section of debris flow | 4.0 | Multiple Box Bridge | Bearing | 20.8 | 90 | 2 | 2x10 | 6.3 |
| 13-6 | Khalte | Stop section of debris flow | 4.0 | Multiple Box Bridge | Bearing | 20.8 | 90 | 2 | 2x10 | 6.5 |
| 13-8 | Tipeni | Stop section of debris flow | 4.0 | Multiple Box Bridge | Bearing | 20.8 | 90 | 2 | 2x10 | 8.4 |

Note: "Height"means maximum height of from road surface to top of bottom slab

Source: Study Team

## (10) Approach Road Design

1) Design Criteria

The major design criteria based on the Nepal Road Standards (2027) and Design Standards for Feeder Roads (Third Revision) shown in Table 2.23 will be applied for the approach road design.

**Table 2.23 Major Design Criteria for Approach Roads**

| Descriptions | Criteria |
|---|---|
| Road width (m) | 4.5 |
| Lane width (m) | 4.5 |
| Shoulder width (m) | - |
| Cross fall (%) | 4 |
| Minimum radius of horizontal curve (m) | 12.5 |
| Minimum radius of vertical curve (m) | 300 |
| Maximum gradient (%) | 12 |
| Minimum diameter of pipe (mm) | 600 |

Source: Study Team

However, because the actual condition of existing roads are sub-standard, smaller radius of horizontal and vertical curve and gradient will be used as exceptional cases, with the condition that at least 20-seater bus operating on the roads can pass at low speed.

2) Pavement

Gravel pavement of 0.3m thick will be applied taking account of the existing road condition.

3) Slope protection

Planting rooted grass slips will be applied for embankment slopes of less than 5 m height, at bridge approach roads.

4) Retaining Wall

Retaining walls made of grouted rip-rap will be applied at the river side. Gabion wall of high water permeability will be applied at locations where dry condition is common. At the foot of the river side wall, appropriate protection will be installed to mitigate anticipated scouring as carried out in the Sindhuli Road Project.

5) Drainage

U-shaped ditch (0.5m width x 0.3m depth) will be adopted as road side ditch. Minimum diameter of cross drain pipe will be 0.6 m.

### 2.2.3 Outline Design Drawings

The outline design drawings for the 35 river crossing structures are provided in Appendix-6.

### 2.2.4 Implementation Plan

#### (1) Packaging of the Project Sites

The 35 river crossing structures will be packaged into two regional groups and 12 lots taking into account the priority order, bridge type, access, numbers of sites, costs of lot and fund restriction as shown in Table 2.24, Table 2.25 and Figure 2.11.

Taking into account the implementation of the Project under fund restriction and limited budget, special arrangement for taking up the 5 sites, which are between priorities No.31 and 35 and categorized as the B group, road closed for 2-3 days will be considered. The five B group sites will be taken up after implementing the 30 A group sites by adding in the designated lots through variation orders, if funding is available.

The 12 lots will be implemented by priority order within the budget. Therefore, it is anticipated that there are various low priority lots unimplemented considering the result of the tender process. Furthermore, in case that the balance amount is not enough to cover the lot, the next lot or the 5 B group sites will be taken up for implementation.

**Table 2.24 Packaging of the Project Sites**

The 30 A group sites, "The site difficult to cross the rover for 2-3 months during the rainy season will be packaged into 12 lots.

| Area | Lot No. | District | Road No. | Site No. | Suspension Bridge | Truss Bridge | RC Bridge | Continious Box Bridge | Total |
|---|---|---|---|---|---|---|---|---|---|
| North Area | Lot 1 | Ramechhap | Road No. 8 | 8-1、8-3、8-4 | | 3 | | | 3 |
| | Lot 2 | Ramechhap | Road No. 8 & 6 | 6-1、8-5 | | 1 | | 1 | 2 |
| | Lot 3 | Kavrepalanchowk | Road No. 11 | 11-3 | 1 | | | | 1 |
| | Lot 7 | Sindhupalachowk | Road No. 13 | 13-6、13-8、13-10、3-4 | | 2 | | 2 | 4 |
| | Lot 11 | Kavrepalanchowk | Road No. 10 | 10-1 | 1 | | | | 1 |
| | Lot 12 | Kavrepalanchowk | Road No. 9 | 9-1、9-2 | 1 | | | 1 | 2 |
| | (6 Lot) | | (6 Road No.) | 13 Sites | 3 | 6 | 0 | 4 | 13 |
| South Area | Lot 4 | Mahottari | Road No. 1 | 1-1、1-2 | | | 1 | 1 | 2 |
| | Lot 5 | Sindhuli | Road No. 4 & 5 | 4-43、5-7、5-8、5-11 | | | 1 | 3 | 4 |
| | Lot 6 | Sindhuli | Road No. 5 | 5-1、5-2、5-3、5-4、5-5 | | | | 5 | 5 |
| | Lot 8 | Sindhuli | Road No. 2 | 2-1 | | | 1 | | 1 |
| | Lot 9 | Sindhuli | Road No. 2 | 2-5、2-6、2-7 | | | | 3 | 3 |
| | Lot 10 | Sindhuli | Road No. 3 | 3-1、3-5 | | | | 2 | 2 |
| | (6 Lot) | | (5 Roads) | 17Sites | 0 | 0 | 3 | 14 | 17 |

The 5 B group sites, "The sites difficult to closs the river 2-3 days during and after heavy rain" will be taken up after implementing the 30 A group sites by adding in the designated lots by variation order, if the fund is available.

| Area | Lot No. | District | Road No. | Site No. | Suspension Bridge | Truss Bridge | RC Bridge | Continious Box Bridge | Total |
|---|---|---|---|---|---|---|---|---|---|
| North Area | Lot 2 | Ramechhap | Road No. 8 | 8-2 | | | | 1 | 1 |
| South Area | Lot 5 | Sindhuli | Road No. 5 | 5-9 | | | | 1 | 1 |
| North Area | Lot 7 | Sindhupalachowk | Road No. 13 | 13-1 | | | | 1 | 1 |
| South Area | Lot 9 | Sindhuli | Road No. 2 | 2-4 | | | | 1 | 1 |
| South Area | Lot 10 | Sindhuli | Road No. 3 | 3-2 | | | | 1 | 1 |

Source: Study Team

## Table 2.25 Contents of the Lots

| S.No. | Lot No. | District | Project Road | | Project Sites | | Type of Bridge | Dimensions | | Evaluation Result and Priority Order | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Site No. | River | | Length (m) | Width (m) | | | |
| 1 | Lot 1 | Ramechhap | No.8 | Betali-Namadi-Khimti | 8-1 | Palati | Truss Bridge | 30.8 | 4.0 | A | 1 | |
| 2 | | | | | 8-3 | Haluwa | Truss Bridge | 30.8 | 4.0 | A | 2 | |
| 3 | | | | | 8-4 | Phapu | Truss Bridge | 30.8 | 4.0 | A | 3 | |
| 4 | Lot 2 | Ramechhap | No.8 | Betali-Namadi-Khimti | 8-5 | Chhatauni | Truss Bridge | 30.8 | 4.0 | A | 4 | |
| 5 | | | No.6 | Manthali-Ramechhap-Sangutar | 6-1 | Sukhajar | Continuous Box Bridge | 60.8 | 4.0 | A | 24 | |
| 6 | Lot 3 | Kavrepalanchowk | No.11 | Bhore Dovan-Thulo Parcel | 11-3 | Roshi | Suspension Bridge | 120.0 | 3.5 | A | 5 | |
| 7 | Lot 4 | Mahottari | No.1 | Laxmaniya-Baratpur-Raghunathpur | 1-1 | Dholan | RC-T Girder Bridge | 50.0 | 4.0 | A | 6 | |
| 8 | | | | | 1-2 | Kantwa | Continuous Box Bridge | 28.7 | 4.0 | A | 7 | |
| 9 | Lot 5 | Sindhuli | No.4 | Bhiman-Dhansari | 4-43 | Dhansari | Continuous Box Bridge | 28.7 | 4.0 | A | 27 | |
| 10 | | | No.5 | Dakaha-Sirthauli-Dudhauli-Katari | 5-11 | Kolta | Continuous Box Bridge | 28.7 | 4.0 | A | 8 | |
| 11 | | | | | 5-8 | Talko | Continuous Box Bridge | 78.7 | 4.0 | A | 9 | |
| 12 | | | | | 5-7 | Kuruwa | RC-T Girder Bridge | 50.0 | 4.0 | A | 10 | |
| 13 | Lot 6 | Sindhuli | No.5 | Dakaha-Sirthauli-Dudhauli-Katari | 5-5 | Thankur-4 | Continuous Box Bridge | 30.8 | 4.0 | A | 11 | |
| 14 | | | | | 5-4 | Thankur-3 | Continuous Box Bridge | 70.8 | 4.0 | A | 12 | |
| 15 | | | | | 5-3 | Thankur-2 | Continuous Box Bridge | 21.7 | 4.0 | A | 13 | |
| 16 | | | | | 5-2 | Thankur-1 | Continuous Box Bridge | 80.8 | 4.0 | A | 14 | |
| 17 | | | | | 5-1 | Tamori | Continuous Box Bridge | 42.7 | 4.0 | A | 15 | |
| 18 | Lot 7 | Sindhupalachowk | No.13 | Melamchi-Bhotang | 13-6 | Khalte | Continuous Box Bridge | 20.8 | 4.0 | A | 16 | |
| 19 | | | | | 13-8 | Tipeni | Continuous Box Bridge | 20.8 | 4.0 | A | 17 | |
| 20 | | | | | 13-10 | Mahadev | Truss Bridge | 30.8 | 4.0 | A | 18 | |
| 21 | | | | | 13-14 | Hadi | Truss Bridge | 71.0 | 3.5 | A | 19 | |
| 22 | Lot 8 | Sindhuli | No.2 | Sindhulimadi-Kapilakot | 2-1 | Marin | RC-T Girder Bridge | 142.0 | 4.5 | A | 20 | |
| 23 | Lot 9 | Sindhuli | No.2 | Sindhulimadi-Kapilakot | 2-5 | Deojar | Continuous Box Bridge | 30.8 | 4.5 | A | 21 | |
| 24 | | | | | 2-6 | Maheshot | Continuous Box Bridge | 105.8 | 4.5 | A | 22 | |
| 25 | | | | | 2-7 | Chadauli | Continuous Box Bridge | 40.8 | 4.5 | A | 23 | |
| 26 | Lot 10 | Sindhuli | No.3 | Sindhulimadi-Bhimsthan | 3-1 | Dhamile | Continuous Box Bridge | 50.8 | 4.5 | A | 25 | |
| 27 | | | | Sindhulimadi-Bhimsthan | 3-5 | Jirghaha | Continuous Box Bridge | 70.8 | 4.5 | A | 26 | |
| 28 | Lot 11 | Kavrepalanchowk | No.10 | Katunjebesi-Bankhu | 10-1 | Roshi | Suspension Bridge | 100.0 | 3.5 | A | 28 | |
| 29 | Lot 12 | Kavrepalanchowk | No.9 | Kavrebhanjyang-Dapcha-Kakare | 9-1 | Roshi | Suspension Bridge | 90.0 | 3.5 | A | 29 | To be taken up based on availability of budget |
| 30 | | | | Kavrebhanjyang-Dapcha-Kakare | 9-2 | Anderi | Continuous Box Bridge | 27.0 | 4.0 | A | 30 | |
| 31 | Lot 1 | Ramechhap | No.8 | Betali-Namadi-Khimti | 8-2 | Bohore | Continuous Box Bridge | 10.8 | 4.0 | B | 31 | To be added in Lot 1 based on availability of budget |
| 32 | Lot 5 | Sindhuli | No.5 | Dakaha-Sirthauli-Dudhauli-Katari | 5-9 | Piprie | Continuous Box Bridge | 14.7 | 4.0 | B | 32 | To be added in Lot 5 based on availability of budget |
| 33 | Lot 7 | Sindhupalachowk | No.13 | Melamchi-Bhotang | 13-1 | Anderi | Continuous Box Bridge | 20.8 | 4.0 | B | 33 | To be added in Lot 7 based on availability of budget |
| 34 | Lot 9 | Sindhuli | No.2 | Sindhulimadi-Kapilakot | 2-4 | Ancho | Continuous Box Bridge | 30.8 | 4.5 | B | 34 | To be added in Lot 9 based on availability of budget |
| 35 | Lot 10 | Sindhuli | No.3 | Sindhulimadi-Bhimsthan | 3-2 | Besare | Continuous Box Bridge | 21.7 | 4.5 | B | 35 | To be added in Lot 10 based on availability of budget |

Source: Study Team

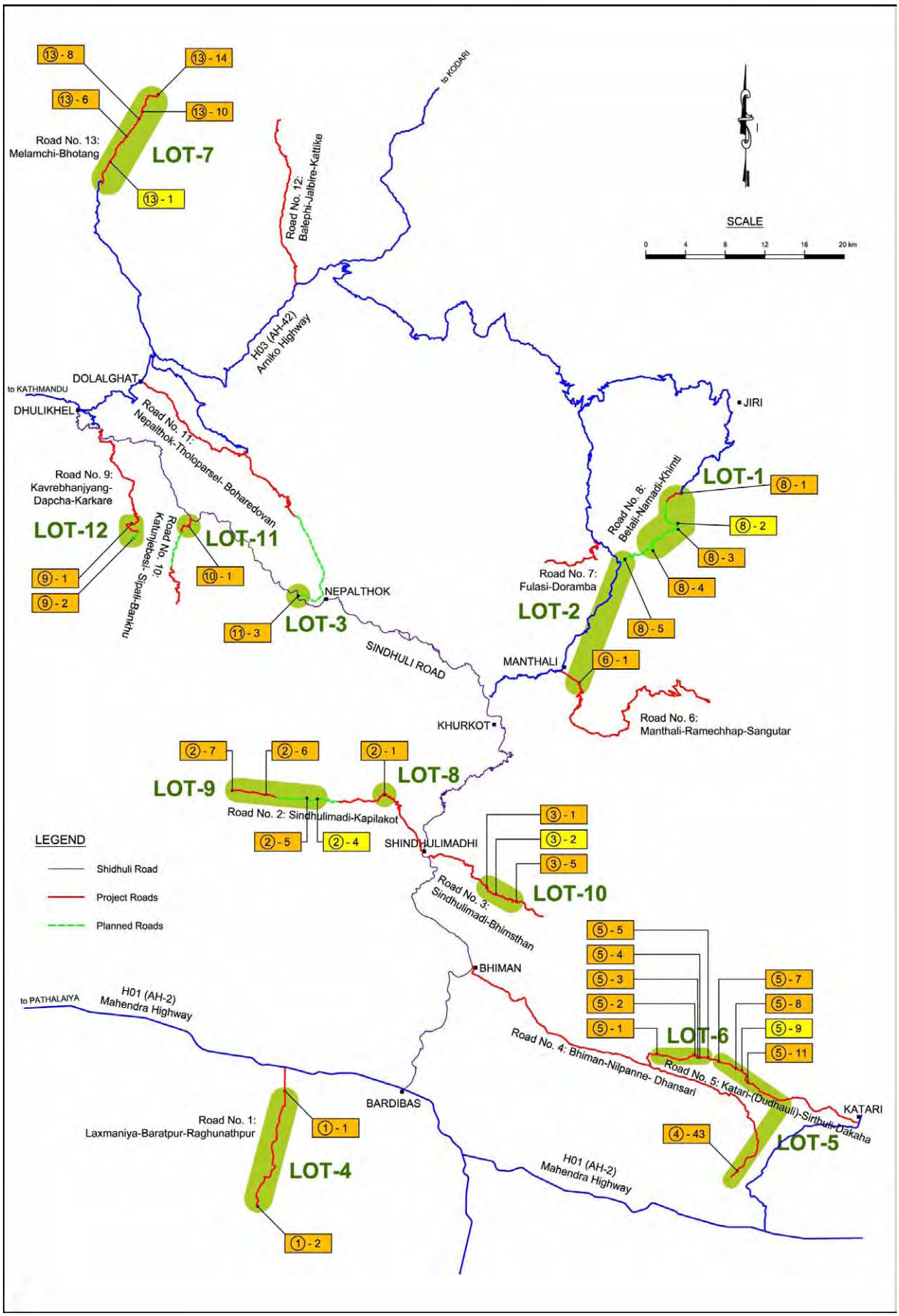



**Figure 2.11 Location of the Lots**
Source: Study Team

**(2) Procurement Agent**

1) Task of the Agent

Based on the Exchange of Notes (E/N) to be signed between GOJ and GON, and the Grant Agreement (G/A) to be signed between GON and JICA, the Agent Agreement (A/A) will be signed between MOLD/DOLIDAR and Japan International Cooperation System (JICS). JICS will carry out the procurement of the consultant and the contractors under the Grant Aid for Community Empowerment Scheme. Figure 2.12 shows the implementing structure under the scheme. Tasks of the agent are also shown as follows:

- Procurement of the consultant
- Preparation of tender documents
- Procurement of the contractors
- Administration of the Project fund
- Variation order, quality control, supervision of construction works

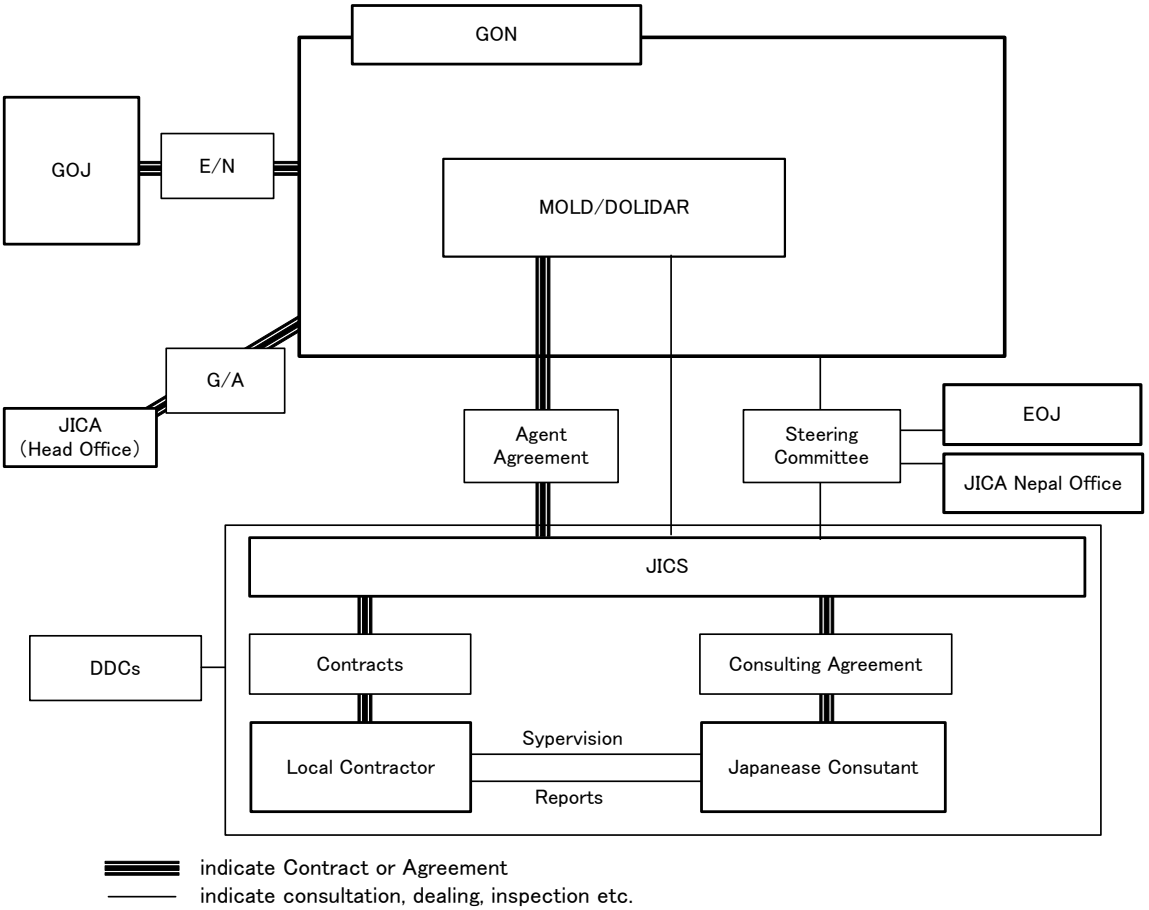



**Figure 2.12 Implementing Structure under the Grant Aid for Community Empowerment Scheme**

Source: Study Team

2) Staffing of the Agent

Staffing of the agent will be as follows:

- Project Manager (PM): Responsible for overall management of the agent's activities

- Assistant Project Manager (APM): Supports the PM and responsible for overall management of the agent's activities during the absence of the PM
- Administrator: Responsible in administering the contracts and the project accounts in Japan

**(3) Consultant Supervision**

1) Task of Consultant

Tasks of the Consultant are as follows:

- Provide support in preparing tender documents and conducting tender process
- Supervise the variation, quality control and supervision of construction works

2) Staffing and Organization of the Consultant's Team

The structure of the consultant's team will be established based on the distribution of lots and accessibility to the sites as follow:

**Kathmandu Office**:

The Consultant Central Office will be responsible for controlling and unifying the overall consulting activity and contact with the Client and relevant authorities.

- Staffing:

Team Leader, Steel Bridge Expert (part-time basis), Contract Specialist (part-time basis), and Chief Administrator

**Dhulikel Resident Engineer's Office**:

The Resident Engineer's Office will be responsible in supervising the variations, quality control and construction works in Rapechhap, Kavrepalanchowk and Sindhupalchowk.

- Staffing:

Resident Engineer (This post will be held by the Team Leader.), 3 Assistant Resident Engineers, 4 Technical Officers and Administrator

**Bardibas Resident Engineer's Office**:

The Resident Engineer's Office will be responsible in supervising the variations, quality control and construction works in Mahottari and Sindhuli.

- Staffing:

Resident Engineer, 2 Assistant Resident Engineers, 4 Technical Officers and Administrator

Figure 2.13 shows the organization chart of the Consultant Team.

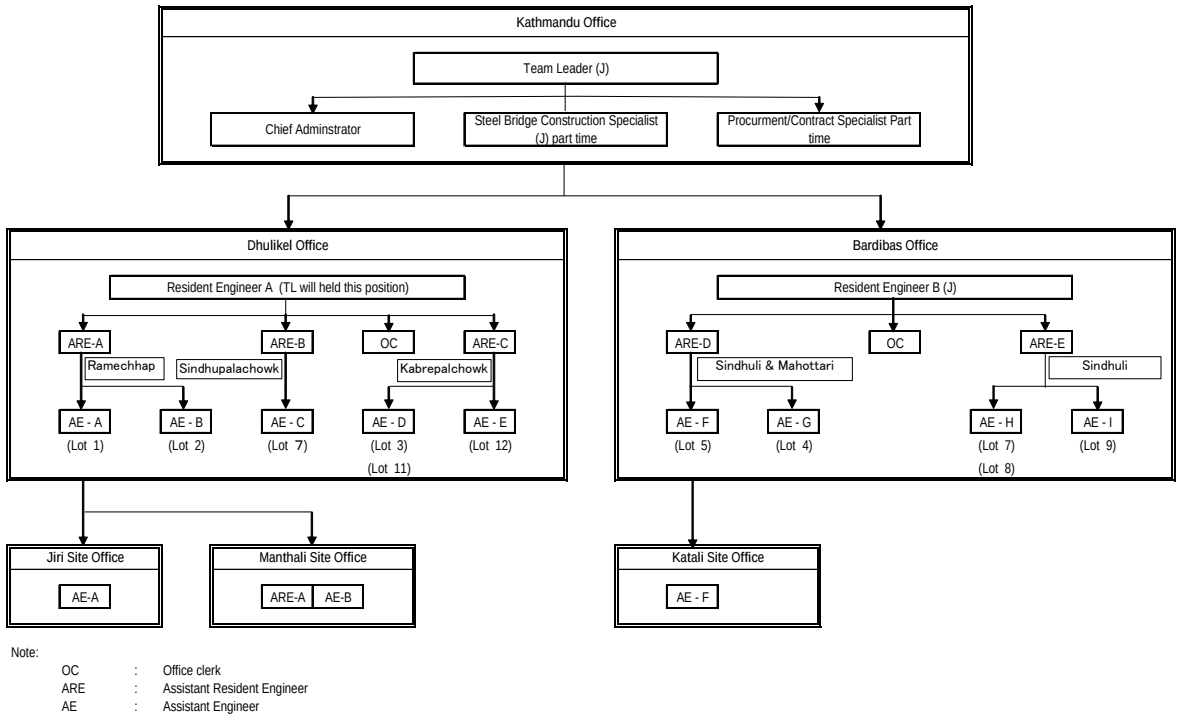



**Figure 2.13 Organization Chart of the Consultant Team**

Source: Study Team

### (4) Procurement Plan

Natural construction materials (aggregates, stones, embankment materials, timber) and cement are available in Nepal. Steel members and reinforcing bars are also available in the local markets. However, the wire cables for suspension bridges are not available in Nepal and have to be imported from India. Construction equipment to be used in the Project is also available in Nepal.

Indicative procurement of construction materials and equipment is summarized in Table 2.26.

**Table 2.26 Indicative Procurement of Construction Materials/Equipment**

| Items of Materials/Equipment | Nepal | India | Japan | Note |
|---|---|---|---|---|
| Materials | | | | |
| Cement | ○ | ○ | | Nepalese/Indian product available |
| Aggregate | ○ | | | |
| Concrete admixture | ○ | ○ | | Nepalese/Indian product available |
| Re-bar | ○ | ○ | | Nepalese/Indian product available |
| Gabion wire | ○ | | | |
| Bituminous materials | ○ | ○ | | Nepalese/Indian product available |
| Wire cable for suspension bridge | | ○ | | |
| Wood/Plywood | ○ | | | |
| Fuel | ○ | ○ | | Imported items available |
| Steel Materials | ○ | ○ | | Imported items available |
| Equipments | | | | |
| Bulldozer | ○ | | | |
| Backhoe | ○ | | | |
| Dump truck | ○ | | | |
| Vibration roller | ○ | | | |
| Road roller | ○ | | | |
| Grader | ○ | | | |
| Concrete batching plant | ○ | | | |
| Truck crane | ○ | | | |

### (5) Quality Control Plan

Adequate quality control plan is prepared for the Project as shown in Table 2.27 referring to the Japanese Guidelines and Specifications.

**Table 2.27 Quality Control Tests Plan**

| Item | | | Test Method | Frequency |
|---|---|---|---|---|
| Concrete | Material | Cement | Quality guarantee, Chemical & Physical analysis | Every material lot |
| | | Water | Chemical analysis | Every source |
| | | Admixture | Quality certificate, Chemical analysis | Every lot |
| | | Fine aggregate | Bulk specific dry gravity, Water absorption, | Every material site |
| | | | Sieve gradation, Fines modulus | |
| | | | Clay and friable particles | |
| | | Coarse aggregate | Bulk specific dry gravity, Water absorption, | Every material site |
| | | | Sieve gradation, Clay and friable particles | |
| | | | Sodium sulfate soundness | |
| | Mixing test | | Compressive strength | Every mixing test |
| | Placing | | Slump, Temperature, Air content | Every batch |
| | Test | | Compressive strength (7days and 28 days) | Daily |
| Re-bar | | Material | Mill sheet, Tensile strength | Every lot |
| Steel member, Galvanization | | Material | Mill sheet, Galvanizing wait | Every lot |

Source: Study Team

In the construction of suspension bridge, special consideration has to be paid for the precision of the tower to avoid serious problems in setting of wire cables. To maintain accuracy in the erection of steel members and towers, a suspension bridge construction specialist will be appointed in the Project.

### (6) Safety Plan

In terms of safety in the Project, the following special attention should be taken during the construction.

- During the rainy season from June to September, works on rivers should be avoided due to the occurrence of unforeseen flood in Nepal. It is advisable that contractors prepare their construction plan to avoid such works and limit the activities on land.
- Since erection works of the suspension bridges is a very special work, experienced specialist should be involved. Moreover, adequate safety measures should be designed during the construction works.
- The safety diversion should be considered appropriately so that no conflicts with villagers will be caused.
- Basic safety considerations against noise, vibration, dust, drinking water etc. should be taken into account by the contractors.

As a traffic safety measure after completion of the Project, it is recommended to take the following countermeasures.

- Install indicators to show the narrow width of the bridges when 3.5 meter bridge width is applied.
- Install humps at bridge approaches to slow down motorists.

## (7) Implementation Schedule

After the signing of the E/N between GON and GOJ concerning the Project, G/A will be signed between GON and JICA. Based on the G/A, the A/A will be signed between MOLD /DOLIDAR and JICS. Based on the A/A, JICS will procure the consultant based on the G/A and the JICA guideline. Procurement of the contractors for the Project will also commence. The required duration for the construction of the Project is 24 months as shown in Table 2.28. The schedule was prepared based on the following assumptions.

- Tenders will be carried out through post-qualification method.
- Period of tenders will be three months.
- Taking into consideration the fund restriction, tenders will be carried out into two batches according to priority order.
- Mobilization and de-mobilization periods are three months and one month respectively
- No major works will be done during the rainy season.
- Estimated average monthly progress by Nepalese Contractor is NRs 6 Million.
-

**Table 2.28 Tentative Implementation Programme**

| Items | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Procurment of Consultant | | | | | | | | | | | | | | | | | | | | | | | | | |
| (2) Procurment of Contractor | | | | | | | | | | | | | | | | | | | | | | | | | |
| North Area | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot 1 | Road No.8 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -2 | Road No.8-5 & 6-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -3 | Road No.11-3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -7 | Road No.13 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -11 | Road No.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -12 | Road No.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| Siuth Area | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -4 | Road No.1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -5 | Road No.4 & 5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -6 | Road No.5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -8 | Road No.2-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -9 | Road No.2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -10 | Road No.3 | | | | | | | | | | | | | | | | | | | | | | | | |
| (3) Construction | | | | | | | | | | | | | | | | | | | | | | | | | |
| North Area | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -1 | Road No.8 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -2 | Road No.8-5 & 6-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -3 | Road No.11-3 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -7 | Road No.13 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -11 | Road No.10 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -12 | Road No.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| South Area | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -4 | Road No.1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -5 | Road No.5 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -6 | Road No.5& 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -8 | Road No.2-1 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -9 | Road No.2 | | | | | | | | | | | | | | | | | | | | | | | | |
| Lot -10 | Road No.3 | | | | | | | | | | | | | | | | | | | | | | | | |

Source: Study Team

## 2.3 OBLIGATION OF RECIPIENT COUNTRY

### 2.3.1 Common Items of Japan's Aid Scheme

For smooth implementation of the Project, the government of the recipient country shall fulfill the following undertakings:

- Secure the land necessary for the Project site (for the road, spoil bank, borrow pit, construction yard and restoring of materials and equipment);
- Clear, level and reclaim the land prior to the commencement of the Project;
- Open a bank account under the government's name, in a bank in Japan (B/A), and issue the authorization to pay (A/P) ;
- Ensure all the expenses for, and prompt execution of, unloading and customs clearance;
- Exempt Japanese nationals from customs duties, local taxes and other fiscal levies imposed in the recipient country, with respect to the supply of the products and services under the verified contracts;
- Entrust the administration of the project fund, payments for the consultant and contractors and overall project management to the Agent;
- Ensure proper maintenance, management and preservation of the facilities provided under Japan's Grant Aid;

### 2.3.2 Special Items of the Project

**(1) Before Construction**

- Complete the site clearance following the compensation of private residents along the right-of-way,
- Complete all procedures related to tree-cutting works at the site including transportation and management, and
- Relocate affected public utilities on-ground/overhead and those buried below the proposed road.

**(2) During Construction**

- Provide the right to use river gravel without royalties,
- Conduct all procedures regarding diversion of traffic from the existing road and pedestrian tracks, and secure land for the required diversion,
- Broadcast to the public through mass media, the detour road and traffic diversion from the existing roads and pedestrian tracks, during construction period,
- Conduct all procedures regarding diversion of water supply and power line from the existing facilities, and to implement such required diversion,
- Conduct environmental monitoring through the DDCs,
- Maintain existing roads utilized as access road, and
- Arbitrate between residents and the contractors.

**(3) After Handover**

- Maintain the facilities constructed under the Project by DDCs.

## 2.4 PROJECT OPERATION PLAN

### 2.4.1 Project Operation

#### (1) Basic Policy

JICS entrusted the administration of the Project fund, payments for the consultant and contractors and overall project management to MOLD/DOLIDAR will procure the Japanese consultant to provide tender assistance, supervise construction supervision and procure contractors through local competitive bidding with post pre-qualification method.

The 35 sites will be packaged into 12 lots considering the priority order, location, access roads and will be taken up to construction stage according to priority order and availability of budget. The shortage of budget may cause low priority sites to remain un-implemented.

Following the guidelines issued by the Ministry of Law, Justice and Parliamentary Affaires will be applied for the procurement of the contractor, with modifications to meet the requirements of the JICA guideline.

- The Public Procurement Act, 2063 (2007)
- The Public Procurement Regulation, 2064 (2008)
- Standard Bidding Document, Procurement of Works, Medium Contracts

#### (2) Organization Structure

The Project will be implemented according to the organization chart as shown in Figure 2.14. Main points of the organization chart are as follows:

1) Establishment of Steering Committee (SC):

The SC will be chaired by the Secretary of MOLD and composed of the representatives from the Embassy of Japan, JICA Nepal Office, DOLIDAR, JICS and other relevant organizations. It will be responsible for performing the overall management of the Project. SC meetings will be held once a year or as required.

2) Establishment of Project Implementation and Coordination Committee (PICC):

The PICC will be chaired by the Director General of DOLIDAR and composed of representatives from JICA Nepal Office, JICS, Consultant and Deputy Director Generals of concerned DOLIDAR Divisions and Project Coordinator (PC). It will be responsible for the implementation and coordination of the Project. PICC meetings will be held every three months or as required.

3) Establishment of Project Coordination Unit (PCU)

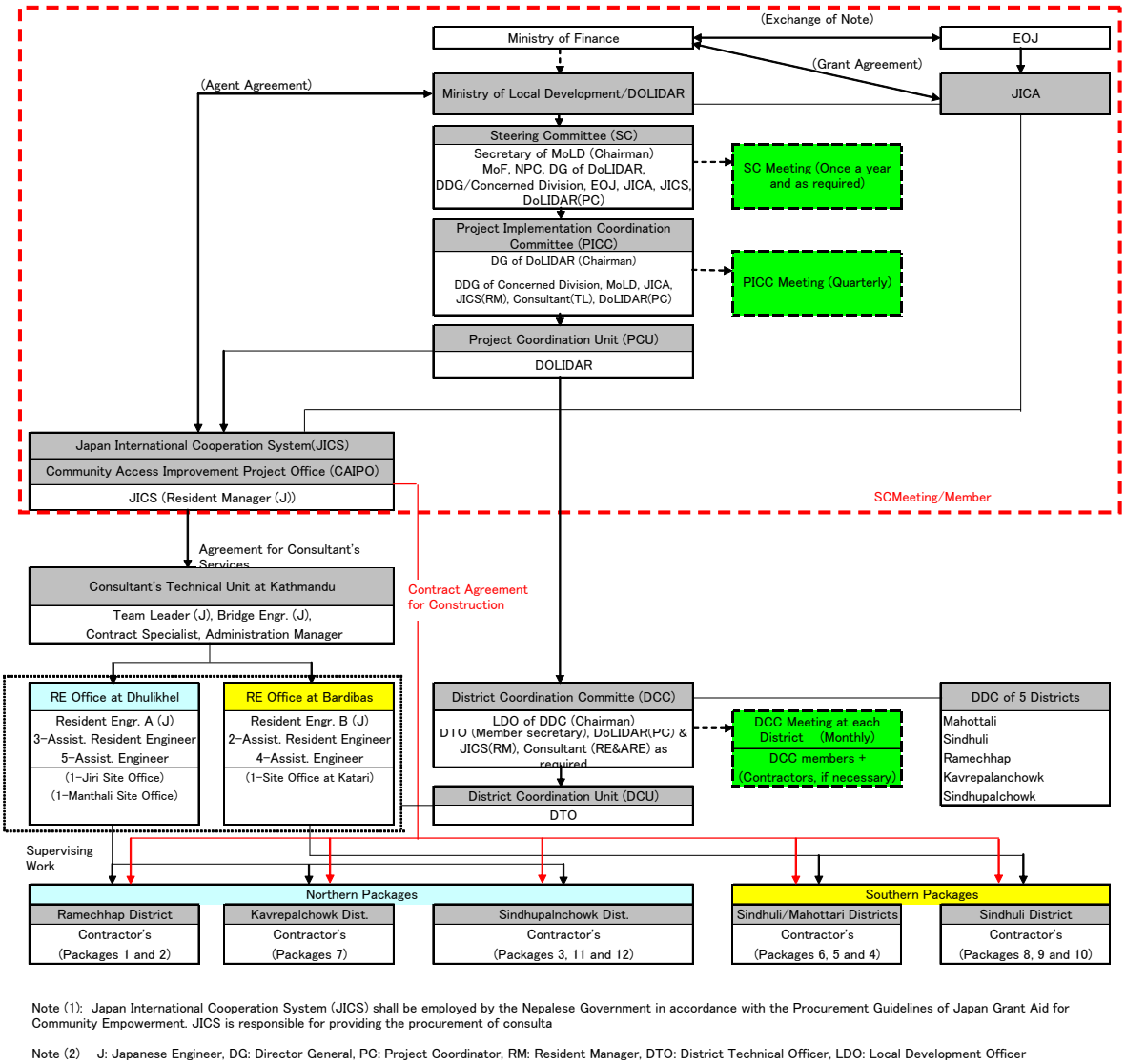
A PCU will be established in DOLIDAR and responsible for the coordination of the Project among the five DCCs.

4) Establishment of District Coordination Committee (DCC) at each District:

The DCC will be chaired by Local Development Officer of DDC and composed of representatives from the District Technical Office (DTO), DOLIDAR, JICS and consultant. It will be responsible for the coordination of the Project. The contractor will attend the meeting, if necessary. DCC meetings will be held on a monthly basis.

5) Establishment of District Coordination Unit at each District

The District Coordination Unit will be established in DTO and responsible in coordinating the Project in the district.




Note (1): Japan International Cooperation System (JICS) shall be employed by the Nepalese Government in accordance with the Procurement Guidelines of Japan Grant Aid for Community Empowerment. JICS is responsible for providing the procurement of consulta

Note (2) J: Japanese Engineer, DG: Director General, PC: Project Coordinator, RM: Resident Manager, DTO: District Technical Officer, LDO: Local Development Officer

**Figure 2.14 Organization Chart of the Project**
Source: Study Team

### (3) Procurement of the Contractors

Tenders will be carried out through local competitive bidding with the post qualification method to expedite the project completion as much as possible.

Tender documents will be prepared based on "The Public Procurement Act, 2063 (2007), The Public Procurement Regulation, 2064 (2008), Standard Bidding Document, Procurement of Works, Medium Contracts" and also to meet the requirements as stated in the JICA guideline.

Tender period as described below will be 3-4 months.

1) Preparation of tender documents
2) Approval of the tender documents
3) Tender announcements on a newspaper
4) Distribution of the tender documents
5) Site orientation
6) Receiving questionnaires
7) Preparation of answers and addenda if necessary
8) Approval for the answers and addenda

9) Answer to questionnaires and issuance of addendum, if necessary
10) Determination of the ceiling price
11) Approval for the ceiling price
12) Submission of tenders
13) Opening of tenders
14) Evaluation of tenders
15) Approval of the tender evaluation result
16) Designation of the prioritized negotiator
17) Negotiation
18) Designation of the successful tenderer
19) Notification of award
20) Signing on the Contract
21) Verification of the Contract by JICA

**(4) Budget Control**

The Project will be implemented under the G/A for Community Empowerment Scheme with a limited budget, and contractors will be procured through competitive bidding. Considering this and that, any modification in the design will be anticipated during the construction stage due to change in site conditions, contingency in the budget will be taken into account.

To cope with the issue, the two batch implementation method is applied in the procurement of the contractors. In addition to the method, it is recommended that the amount of contingency, 10% initial stage and 3% ending stage, should be kept within the budget.

### 2.4.2 Maintenance of the Facilities Constructed

**(1) Maintenance of Existing Roads during Construction**

Since the existing condition of the project roads used as access roads are poor due to existence of very steep sections, the existing roads used as access should be kept passable to avoid claims from the contractors.

**(2) Maintenance necessary after completion**

Maintenance activities of the bridges constructed on a daily basis include repair of damaged portion by traffic accident or flood, removal of trees and other obstructions and stabilization of the scoured area around the piers and abutments.

Special inspection of the steel members of the suspension and truss bridges damaged by traffic accidents should be done timely by the DTO of the Ramecahhap, Kavrepalanchowk and Sindupalchowk districts.

**(3) Periodic maintenance**

Since the suspension bridges and truss bridges are constructed using galvanized steel members, for short and mid-term, periodic maintenance for the suspension and truss bridges is not basically necessary.

For the reinforced concrete bridges and the continuous box bridges, it is not necessary to conduct periodic maintenance except during the time it is subjected to serious flood or debris flow.

**(4) Urgent Rehabilitation works**

Because of the severe circumstances, it is anticipated that it will be subjected to unexpected serious flood or debris flow, seriously damaging the facilities. Against these unforeseen disasters, it is recommended that DDCs should have proper facilities and a special budget in the annual budget to cope with the incident.

## 2.5 PROJECT COST ESTIMATION

### 2.5.1 Initial Cost Estimation

The project costs required for the undertakings by the GON are shown in Table 2.29.

**Table 2.29 Project Cost Required for the Undertakings by GON**

| Classification | Contents | Approxiimate Cost | |
|---|---|---|---|
| | | x 1,000 NRS | x1,000 JPY |
| Acquisition of Construction area | To be procured by voluntary basically | - | - |
| Banking arrangement fee | Fee for the banking arrangement and payment | 100 | 125 |
| Total | | 100 | 125 |

Source: Study Team

The Nepalese side will be responsible for the acquisition and compensation of private houses, private lands, relocation of public utilities, and environmental monitoring before, during and after the Project implementation, and the related costs.

The above requires an indicative amount of NRs 100,000 (Japanese Yen 125,000), estimated on the assumption that the acquisition and compensation of private houses and private lands will be done on voluntary basis. Moreover, relocation of the utilities is very less, and corresponds to less than 1% of the DOLIDAR's budget for the fiscal year 2006/2007. Therefore, the annual disbursement should be available.

### 2.5.2 Operation and Maintenance Cost

Since the facilities to be constructed by the Project are suspension bridges and truss bridges made up of galvanized steel members, reinforced concrete bridges and continuous box bridges, maintenance costs would be very small in amount.

Daily maintenance cost for the roads in the five districts would be about NRs 3,600,000 (Japanese Yen 4,500,000) in total per annum. Since this corresponds to less than 2% of the DDC's road development and maintenance budget for the fiscal year 2006/2007, annual disbursement is expected to be available.

**Table 2.30 Maintenance Costs for Whole Sites**

| Classification | Contents | Approximate Cost | |
|---|---|---|---|
| | | x 1,000 NRS | x1,000 JPY |
| (1) Routine maintenance | Daily observation | 420 | 523 |
| (2) Annual maintenance | Repair of gabion foot protection and etc. | 1,610 | 2,006 |
| (3) Periodic maintenance | Repair of damaged structure, painting & etc | 1,610 | 2,006 |
| (4) Urgent repair | Removal of deposit and tree & repair of damaged structure | - | - |
| Total | | 3,640 | 4,535 |

Source: Study Team

However, the Project roads have suffered from various problems such as non-paved surface, lack of proper drainage system, unstable slope, very steep gradient, etc., it is strongly recommended that the overall maintenance operation throughout the roads should be discussed by DDCs and DOLIDAR to ensure the objective of the Project ("to improve the isolation of area by road closure during the rainy season") is achieved.

# *CHAPTER 3*

# *PROJECT EVALUATION AND RECOMMENDATIONS*

# CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATION

## 3.1 Project Effect

According to information related to socio-economic, field survey and the outline design result executed under the Study, the Project implementation would generate the following impacts and effects:

| Present Status and Issues | Countermeasures Taken by the Project | Direct Impacts and Effects | Indirect Impacts and Effects |
|---|---|---|---|
| To materialize the peace process after the armed conflict, GON and Donor Agencies have been promoting the rural road network improvement programs strongly aiming at closing the economic gap between urban and rural area and reduce poverty.<br><br>However, comparatively large river crossings have remained without proper crossing structures. Hence, improvement programs were planned to extend coverage and require initiation of labour-based works.<br><br>As a result many rural societies have been isolated physically and suffered from no access to public services for several days or several months due to road closure caused by flood during every rainy season even after completion of the programs | Construct following river crossing structures at about 35 locations in the five districts, Mahottari, Sindhuli, Ramechhap, Kavrepalanchowk and Sindhupalchowk Districts, where the rural roads have been suffered for road closure several days and months in rainy season.<br><br>Suspension bridge:<br>3 numbers<br>Truss bridge:<br>6 numbers<br>Reinforced concrete bridge:<br>3 numbers<br>Continuous box bridge:<br>23 numbers | Suspension period of bus service on the 13 roads in the five districts, which was 14 months in total of all roads during the rainy season in 2009, will be reduced by one month.<br><br>It is estimated that the project will benefit to about 359 thousand people living in the area, Mahottari 56,000, Sindhuli 114,000, Ramechhap 108,000, Kavrepalanchowk 47,000 and Sindhupalchowk 34,000 people respectively. | The project will provide safety access to school, hospital and etc. and thus contribute to enhance the living standards in the area.<br><br>The project will provide reliable access from farm to market during the rainy season and thus, contribute to enhance the economic activity in the area.<br><br>The project will strengthen/unify the area and play as the basic facility to implement the programs to close the economic gap between urban and rural area and reduce poverty which may be a cause of the conflict. |

## 3.2 Recommendation

Traffic is closed at three roads in Sindhuli and Ramechhap Districts. Fully opening the Project roads is a fundamental concern for the successful completion of the Project. The sections have to be completed timely and definitely by the DDCs at the end of the Project.

The basic cause of closure of the related roads due to river flooding in the monsoon season will be solved by the Project. However, there are other issues that cause road closure in the monsoon season. This includes slope failure, muddy road surface and low quality standards during road constructions. To achieve the objective of the Project, it is recommended that continuous effort on upgrading the entire section of road facilities to all-weather trafficable condition. It is therefore necessary not only to provide proper maintenance budget to DDCs, but also to initiate improvement of DDC's maintenance capability.

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# *APPENDIX*

# *1. MEMBER LIST OF THE STUDY TEAM*

# 1. Member List of Study Team

- First Field Survey（From 10 March 2009 to 18 April 2009）

| Name | Job Title | Occupation |
|---|---|---|
| Noriaki MIWA | Leader | Chief Representative, JICA Nepal Office<br>Japan International Cooperation Agency |
| Satoru TAKAHASHI | Grant Aid Cooperation Planning | Deputy Director, Grant Aid and Technical Cooperation Division, International Cooperation Bureau, Ministry of Foreign Affairs |
| Keizo INOUE | Procurment Planner (Grant Aid for Community Empowerment) | Japan International Cooperation System |
| Hidetaka SAKABE | Project Coordinator | Assistant Director, Transport and ICT Division 3, Economic Infrastructure Department, Japan International Cooperation Agency |
| Yoshihisa YAMASHITA | Chief Consultant ／ Road Traffic Planner | Nippon Koei Co., Ltd |
| Shigeyoshi KIGUCHI | Structure Design I | Nippon Koei Co., Ltd |
| Hiroaki UEYAMA | Structure Design II/Natural Condition Survey I (Topography & Geography) | Nippon Koei Co., Ltd |
| Lamsal KHADANANDA | Natural Condition Survey II (Metrology & Hydrogy)) | Nippon Koei Co., Ltd |
| Shusuke MINATO | Environmental and Social Considerations | Nippon Koei Co., Ltd |
| Hiroki SHINKAI | Survey for Construction Activities/Construction Plan/Operation & Maintenance | Nippon Koei Co., Ltd |
| Madan Gopal Maleku | Survey Team Coodinator | Nippon Koei Co., Ltd |

- Second Field Survey（From 23 May 2009 to 23 July 2009）

| Name | Job Title | Occupation |
|---|---|---|
| Noriaki MIWA | Leader | Chief Representative, JICA Nepal Office<br>Japan International Cooperation Agency |
| Hidetaka SAKABE | Project Coordinator | Assistant Director, Urban and Regional Development Division 1, Economic Infrastructure Depelopment,<br>Japan International Cooperation Agency |
| Yoshihisa YAMASHITA | Chief Consultant ／ Road Traffic Planner | Nippon Koei Co., Ltd |
| Shigeyoshi KIGUCHI | Structure Design I | Nippon Koei Co., Ltd |
| Hiroaki UEYAMA | Structure Design II/Natural Condition Survey I (Topography & Geography) | Nippon Koei Co., Ltd |
| Lamsal KHADANANDA | Natural Condition Survey II (Metrology & Hydrogy)) | Nippon Koei Co., Ltd |
| Shusuke MINATO | Environmental and Social Considerations | Nippon Koei Co., Ltd |
| Hiroki SHINKAI | Survey for Construction Activities/Construction Plan/Operation & Maintenance | Nippon Koei Co., Ltd |

| | | |
|---|---|---|
| Kiyohito YAMAZAKI | Procurment Planner/Cost Estimation | Nippon Koei Co., Ltd |
| Madan Gopal Maleku | Survey Team Coodinator | Nippon Koei Co., Ltd |

- Draft Report Explanatory Survey（From 21 October 2009 to 9 November 2009）

| Name | Job Title | Occupation |
|---|---|---|
| Yoshio FUKUOKA | Leader | Senior Representative, Nepal Office<br>Japan International Cooperation Agency |
| Yoshihisa YAMASHITA | Chief Consultant ／ Road Traffic Planner | Nippon Koei Co., Ltd |
| Shigeyoshi KIGUCHI | Structure Design I | Nippon Koei Co., Ltd |
| Shusuke MINATO | Environmental and Social Considerations | Nippon Koei Co., Ltd |

- Center Line Survey (From 23 December 2009 to 1 January 2010）

| Name | Job Title | Occupation |
|---|---|---|
| Yoshihisa YAMASHITA | Structure Design II/Natural Condition Survey I (Topography & Geography) | Nippon Koei Co., Ltd |

- Reference Tender Documents Expanatory Survey（From 15 January 2010 to 7 February 2010）

| Name | Job Title | Occupation |
|---|---|---|
| Touru TAKE | Leader | Senior Representative, Nepal Office<br>Japan International Cooperation Agency |
| Hidetaka SAKABE | Project Coordinator | Assistant Director, Urban and Regional Development Division 1, Economic Infrastructure Depelopment,<br>Japan International Cooperation Agency |
| Yoshihisa YAMASHITA | Chief Consultant/Road Traffic Planner | Nippon Koei Co., Ltd |
| Shigeyoshi KIGUCHI | Structure Design I | Nippon Koei Co., Ltd |
| Madan Gopal Maleku | Survey Team Coordinator | Nippon Koei Co., Ltd |

## *2. STUDY SCHEDULE*

## 2. Study Schedule

### 2.1 First Field Survey

| No. | Date | | | Leader<br>Mr. Noriaki MIWA | Grant Aid Cooperation Planning<br>Mr. Satoru TAKAHASHI | Procurment Planner<br>Mr. Keizo INOUE | Project Coordinator<br>Mr. Hidetaka SAKABE | Chief Consultant/Road Traffic Planner<br>Mr. Yoshihisa YAMASHITA | Other Consultant members |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Mar. | 10 | T | | | | | NRT-BKK | |
| 2 | | 11 | W | | | | | BKK-KTM | |
| 3 | | 12 | T | | | | | Discussion with DOLIDAR | |
| 4 | | 13 | F | | | | | Site survey | |
| 5 | | 14 | S | | | | | | |
| 6 | | 15 | S | | | | | | |
| 7 | | 16 | M | | | | NRT-BKK | Discussion with DDCs | |
| 8 | | 17 | T | | | | BKK-KTM、Discussion with EOJ & JICA | | |
| 9 | | 18 | W | | NRT-BKK | NRT-BKK | Site inspection、Discussion with SDC | | |
| 10 | | 19 | T | | BKK-NRT | BKK-NRT | Discussion with DOLIDAR | | |
| 11 | | 20 | F | | Site Survey | | | | NRT-BKK |
| 12 | | 21 | S | | | | | | BKK-NRT |
| 13 | | 22 | S | | | | | | Data correction・Preparation for field survey |
| 14 | | 23 | M | Discussion with DOLIDAR/MOLD | | | | | |
| 15 | | 24 | T | | | | | | |
| 16 | | 25 | W | Signing on MD, Report to EOJ & JICA | | | | | |
| 17 | | 26 | T | | KTM-BKK | Data correction | KTM-BKK | Data correction・Preparation for field survey | |
| 18 | | 27 | F | | BKK-NRT | Data correction | BKK-NRT | | |
| 19 | | 28 | S | | | KTM-BKK | | Site survey | |
| 20 | | 29 | S | | | BKK-NRT | | | |
| 21 | | 30 | M | | | | | | |
| 22 | | 31 | T | | | | | | |
| 23 | Apr. | 1 | W | | | | | | |
| 24 | | 2 | T | | | | | | |
| 25 | | 3 | F | | | | | | |
| 26 | | 4 | S | | | | | | |
| 27 | | 5 | S | | | | | | |
| 28 | | 6 | M | | | | | | |
| 29 | | 7 | T | | | | | | |
| 30 | | 8 | W | | | | | | |
| 31 | | 9 | T | | | | | | |
| 32 | | 10 | F | | | | | Discussion with JICA | |
| 33 | | 11 | S | | | | | Preparation of field survey report | |
| 34 | | 12 | S | | | | | | |
| 35 | | 13 | M | | | | | Discusion with DOLIDAR・DDC | |
| 36 | | 14 | T | | | | | Preparation of field survey report | |
| 37 | | 15 | W | | | | | Discussion with JICA | |
| 38 | | 16 | T | | | | | Discussion with DOLIDAR | |
| 39 | | 17 | F | | | | | KTM-BKK | |
| 40 | | 18 | S | | | | | BKK-NRT | |

### 2.2 Second Field Survey

| No | Date | | | Leader<br>Mr. Noriaki MIWA | Project Coordinator<br>Mr. Hidetaka SAKABE | Chief Consultant/Road Traffic Planner<br>Mr. Yoshihisa YAMASHITA | Structure Design I<br>Mr. Shigeyoshi KIGUCHI | Structure Design II/Natural Condition Survey I (Topography & Geography)<br>Mr. Hiroaki UEYAMA | Natural Condition Survey II (Metrology & Hydrogy))<br>Mr. Lamsal KHADANANDA | Environmental and Social Considerations<br>Mr. Shusuke MINATO | Survey for Construction Activities/Construction Plan/Operation & Maintenance<br>Mr. Hiroki SHINKAI | Procurment Planner/Cost Estimation<br>Mr. Kiyohito YAMAZAKI | Survey Team Coodinator<br>Mr. Madan Gopal Maleku |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | May | 23 | S | | | NRT-BKK | | | | | | | |
| 2 | | 24 | S | | | BKK-KTM | | | | | | | |
| 3 | | 25 | M | | | Selection of surveyer | | | | | | | Support of selection of surveyer |
| 4 | | 26 | T | | | | | | | | | | |
| 5 | | 27 | W | | | | | | | | | | |
| 6 | | 28 | T | | | Instruction to surveyer | | | | | | | Instruction to surveyer |
| 7 | | 29 | F | | | | | | | | | | |
| 8 | | 30 | S | | NRT-BKK | | | | | | | | |
| 9 | | 31 | S | | BKK-KTM、Discussion with EOJ & JICA | | | | | | | | |
| 10 | June | 1 | M | Discussion with DOLIDA | | | | | | | | | Discussion with |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | DOLIDAR |
| 11 | | 2 | T | Discussion with MOLD & DDC | | | | | | | | | Discussion with MOLD & DDC |
| 12 | | 3 | W | Signing on MD, Report to EOJ & JICA | | | | | | | | | Signing MD |
| 13 | | 4 | T | | KTM-BKK | Instruction to surveyers | | | | | | | Instruction to surveyers |
| 14 | | 5 | F | | BKK-NRT | | KTM-BKK | | | | KTM-BKK | KTM-BKK | |
| 15 | | 6 | S | | | | BKK-NRT | | | | BKK-NRT | BKK-NRT | |
| 16 | | 7 | S | | | | Discussion in team | | | | Discussion in team | | |
| 17 | | 8 | M | | | Preparation of survey report | Outline design of the structures | | | | Data correction | | Support of data coeection |
| 18 | | 9 | T | | | | | | | | | | |
| 19 | | 10 | W | | | | | | | | | | |
| 20 | | 11 | T | | | | | | Hydrological analysis | | Site survey | | |
| 21 | | 12 | F | | | | | | | | Site survey (suspension bridge) | | |
| 22 | | 13 | S | | | | | | | | Data correction | | Support of data coeection |
| 23 | | 14 | S | | | | | | | | | | |
| 24 | | 15 | M | | | | | | | | | | |
| 25 | | 16 | T | | | | | | | | | | |
| 26 | | 17 | W | | | | | | | | | | |
| 27 | | 18 | T | | | | | Checking of topo-maps | | | | | |
| 28 | | 19 | F | | | | | | | | | | |
| 29 | | 20 | S | | | | | | | | | | |
| 30 | | 21 | S | | | | | | | | | | |
| 31 | | 22 | M | | | | | | | | | | |
| 32 | | 23 | T | | | | | | | | | | |
| 33 | | 24 | W | | | | | | | Karachi-KTM | | | |
| 34 | | 25 | T | | | | | | | TOR of IEE | | | |
| 35 | | 26 | F | | | | | | | | Discussion with DOLIDAR | | |
| 36 | | 27 | S | | | | | | | TOR of IEE | Preparation of survey report | | Support of data coeection |
| 37 | | 28 | S | | | Site survey | | | | | Site survey | | |
| 38 | | 29 | M | | | | | | | Discussion with DOLIDAR | | | |
| 39 | | 30 | T | | | | | | | | | | |
| 40 | July | 1 | W | | | Preparation of survey report | | | | Instruction of IEE works at sites | Preparation of survey report | Preparation of survey report | Support of data coeection |
| 41 | | 2 | T | | | Discussion with DOLIDAR & SDC | | | | | Discussion with DOLIDAR & SDC | | Discussion with DOLIDAR & SDC |
| 42 | | 3 | F | | | KTM-BKK | | | | | KTM-BKK | KTM-BKK | |
| 43 | | 4 | S | | | BKK-NRT | | | | | BKK-NRT | BKK-NRT | |
| 44 | | 5 | S | | | | | | | | | | |
| 45 | | 6 | M | | | | | | | Discussion with DOLIDAR | | | |
| 46 | | 7 | T | | | | | | | Modify of TOR of IEE | | | |
| 47 | | 8 | W | | | | | | | | | | |
| 48 | | 9 | T | | | | | | | | | | |
| 49 | | 10 | F | | | | | | | Discussion with DOLIDAR | | | |
| 50 | | 11 | S | | | | | | | Modify of TOR of IEE | | | |
| 51 | | 12 | S | | | | | | | Discussion with DOLIDAR & MOPE | | | |
| 52 | | 13 | M | | | | | | | Discussion with DOLIDAR | | | |
| 53 | | 14 | T | | | | | | | Modify of TOR of IEE | | | |
| 54 | | 15 | W | | | | | | | | | | |
| 55 | | 16 | T | | | | | | | Discussion with DOLIDAR | | | |
| 56 | | 17 | F | | | | | | | | | | |
| 57 | | 18 | S | | | | KTM-BKK | | | Modify of TOR of IEE | | | |
| 58 | | 19 | S | | | | BKK-NRT | | | | | | |
| 59 | | 20 | M | | | | | | | Discussion with DOLIDAR & DDC | | | |
| 60 | | 21 | T | | | | | | | | | | |
| 61 | | 22 | W | | | | | | | KTM-BKK | | | |
| 62 | | 23 | T | | | | | | | BKK-NRT | | | |

## 2.3 Draft Report Explanation

| No. | Date | | | Leader<br>Mr. Yoshio FUKUOKA | Chief Consultant／Road Traffic Planner<br>Mr. Yoshihisa YAMASHITA | Structure Design I<br>Mr. Shigeyoshi KIGUCHI | Environmental and Social Considerations<br>Mr. Shusuke MINATO |
|---|---|---|---|---|---|---|---|
| 1 | Oct | 21 | W | | NRT-BKK | NRT-BKK | Karachi-KTM |
| 2 | | 22 | T | | BKK-KTM, Discussion with DOLIDAR | | Discussion with DOLIDAR |
| 3 | | 23 | F | | Discussion with DOLIDAR | Discussion with DOLIDAR | Checking of IEE report |
| 4 | | 24 | S | | Checking of design by NEPECON & GEOCE | | Discussion with DOLIDAR |
| 5 | | 25 | S | | Discussion with DOLIDAR | Discussion with DOLIDAR | I Checking of IEE report |
| 6 | | 26 | M | | Discussion with DOLIDAR & NEPECON | | Discussion with DOLIDAR |
| 7 | | 27 | T | | Discussion with fabricator | | Checking of IEE report |
| 8 | | 28 | W | Signing on MD, Report to EOJ & JICA | | Checking of design by NEPECON & GEOCE | |
| 9 | | 29 | T | | Site survey | Site survey | |
| 10 | | 30 | F | | | | |
| 11 | | 31 | S | | | Checking of design by NEPECON & GEOCE | |
| 12 | Nov. | 1 | S | | | | Prepare IEE summary report |
| 13 | | 2 | M | | | | |
| 14 | | 3 | T | | Discussion with JICA and GEOCE | | KTM-BKK |
| 15 | | 4 | W | | Discussion with NEPECON | | BKK-NRT |
| 16 | | 5 | T | | Discussion with NEPECON | | |
| 17 | | 6 | F | | Discussion with DOLIDAR | | |
| 18 | | 7 | S | | Discussion with GEOCE | | |
| 19 | | 8 | S | | KTM-BKK | KTM-BKK | |
| 20 | | 9 | M | | BKK-NRT | BKK-NRT | |

## 2.4 Center-line Survey

| No. | Date | | | Structure Design II/Natural Condition Survey I (Topography & Geography)<br>Mr. Yoshihisa YAMASHITA |
|---|---|---|---|---|
| 1 | Dec. | 23 | W | NRT-BKK |
| 2 | | 24 | T | BKK-KTM |
| 3 | | 25 | F | Selection of surveyer |
| 4 | | 26 | S | Selection of surveyer |
| 5 | | 27 | S | Discussion with DOLIDAR |
| 6 | | 28 | M | Discussion with fabricator |
| 7 | | 29 | T | Site survey (suspension bridge) |
| 8 | | 30 | W | Selection of surveyer |
| 9 | | 31 | T | KTM-BKK |
| 10 | Jan. | 1 | F | BKK-NRT |

## 2.5 Reference Tender Documents Explanation

| No. | Date | | | Leader<br>Mr. Touru TAKE | Project Coordinator<br>Mr. Hidetaka SAKABE | Chief Consultant／Road Traffic Planner<br>Mr. Yoshihisa YAMASHITA | Structure Design I<br>Mr. Shigeyoshi KIGUCHI | Survey Team Coodinator<br>Mr. Madan Gopal Maleku |
|---|---|---|---|---|---|---|---|---|
| 1 | Jan. | 15 | F | | | NRT-BKK | NRT-BKK | |
| 2 | | 16 | S | | ISB-KTM | BKK-KTM | BKK-KTM | Supporting work (*1) |
| 3 | | 17 | S | Discussion with DOLIDAR | | | | |
| 4 | | 18 | M | Workshop regarding the outcome of the Study | | | | |
| 5 | | 19 | T | | KTM-BKK、Report EOJ and JICA | | | |
| 6 | | 20 | W | | BKK-NRT | Discussion with NEPECOM | | |
| 7 | | 21 | T | | | Promotion of Center-line survey | Checking of design by NEPECON & GEOCE | |
| 8 | | 22 | F | | | | | |
| 9 | | 23 | S | | | | Checking of design by NEPECON & GEOCE | |
| 10 | | 24 | S | | | | | |
| 11 | | 25 | M | | | | | |
| 12 | | 26 | T | | | | | |
| 13 | | 27 | W | | | | | |
| 14 | | 28 | T | | | | | |
| 15 | | 29 | F | | | | | |
| 16 | | 30 | S | | | Ramechhap site survey | | Ramechhap site survey |
| 17 | | 31 | S | | | | | |
| 18 | Feb. | 1 | M | | | Promotion of Center-line survey | | Supporting work (*1) |
| 19 | | 2 | T | | | Discussion with DOLIDAR | | |
| 20 | | 3 | W | | | Promotion of Center-line survey | NRT-BKK | |
| 21 | | 4 | T | Signing on MD | | Signing on MD | BKK-KTM | |
| 22 | | 5 | F | | | Report to JICA | | |
| 23 | | 6 | S | | | NRT-BKK | | |
| 24 | | 7 | S | | | BKK-KTM | | |

(*1) Part-time base

## *3. LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY*

## 3. List of Parties Concerned in the Recipient Country

| | | |
|---|---|---|
| 1. | MOLD: Ministry of Local Development | |
| | Mr. Dinesh K Thapalia | Joint Secretary, Planning and Foreign Cooperation Division |
| | Mr Resmi Raj Pandey | Under Secretary, Planning Section |
| 2. | DOLIDAR: Department of Local Infrastructure Development and Agricultural Roads） | |
| | Mr Dhana Bdr Tamang | Director General |
| | Mr Bhupendra Bdr Basnet | Deputy Director General |
| | Mr Neeraj Shah | SDE, Bridge Section |
| | Mr D Ulak | Er. Bridge Section |
| | | |
| 3 | District Development Committees | |
| | Mr Ram Mani Bhattarai | LDO,DDC,Sindhuli |
| | Mr Krishna Pd Aryal | LDO, DDC, Sindhupalanchowk |
| | Mr Megh Nath Kafle | LDO,DDC,Kavrepalanchowk |
| | Mr Kaushal Ghimire | Planning Officer,DDC, Ramechhap |
| | Mr Hari Chand Baral | Sub-Er. DDC, Ramechhap |
| | | |
| 4. | Embassy of Japan | |
| | Mr. Yasuhiro NOMURA | Second Secretary |
| | | |
| 5. | JICA Nepal Office | |
| | Noriaki MIWA | Chief Representative |
| | Yoshio FUKUOKA | Deputy Chief Representative |
| | Touru TAKE | Deputy Chief Representative |
| | Yusuke TSUMORI | Assistant Resident Representative |
| | Sourab Rana | Program Officer |
| | | |

# *4 MINUTES OF DISCUSSIONS*

*4.1 Field Survey (March 25, 2009)*

*4.2 Second Field Survey (June 3, 2009)*

*4.3 Draft Report Explanation (October 28, 2009)*

*4.4 Explanation of Reference Bid Document (February 4, 2010)*

**Minutes of Discussions**
**on the Preparatory Survey**
**on the Project for the Improvement of Community Access**
**in Nepal**
**(the First Field Survey)**

In response to a request from the Government of Nepal, the Government of Japan decided to conduct a Preparatory Survey on the Project for the Improvement of Community Access (hereinafter referred to as "the Project") and entrusted the survey to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Nepal the Preparatory Survey Team for the First Field Survey (hereinafter referred to as "the Team"), which is headed by Mr. Noriaki NIWA, Chief Representative of JICA Nepal Office, and is scheduled to stay in the country from March 11, 2009 to April17, 2009.

The Team held discussions with the officials concerned of the Government of Nepal and conducted a field survey at the study area.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Interim Report.

Kathmandu, March 25, 2009

| | |
|---|---|
| Noriaki NIWA<br>Leader<br>Preparatory Survey Team<br>Japan International Cooperation Agency | Dinesh Kumar Thapaliya<br>Joint Secretary<br>Ministry of Local Development<br>The Government of Nepal |

## ATTACHMENT

1. Purposes of the First Field Survey

The purposes of the First Field Survey are described as follows;

(1) To reconfirm the contents of the requested Project.

(2) To discuss with the Nepalese side, conduct the site survey and collect the necessary data and information for the screening of the requested sites.

(3) To explain the Japan's Grant Aid scheme for Community Empowerment to the Nepalese side.

2. Objective of the Project

Both sides confirmed that the objective of the Project is to secure more smooth and reliable transportation by installation of river-crossing structures on rural roads in central region.

3. Project sites

The sites of the Project are shown in Annex-1.

4. Responsible and Implementing Organization

4-1. The responsible and executing organization is Ministry of Local Development, and its organization chart is shown in Annex-2.

4-2. The implementing organization at central level is the Department of Local Infrastructure Development and Agricultural Roads: DoLIDAR, Ministry of Local Development, and its organization chart is shown in Annex-3.

4-3. The implementing organization at local level is participating District Development Committee: DDC, where the Project sites are located in.

5. Items requested by the Government of Nepal

5-1. After discussions with the Team, construction of river-crossing structures on 13 rural roads, which are shown in Annex-1 is finally requested by the Nepalese side.

JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5-2. Both sides confirmed that the "procurement of 4WD vehicles", which was described in the original application for the Project, is excluded from the Project by the advice from the Team based on the objective of the Project.

6. Japan's Grant Aid Scheme for Community Empowerment

6-1. The Nepalese side understands the Japan's Grant Aid scheme explained by the Team, as described in Annex-4.

6-2. The Nepalese side will take the necessary measures, as described in Annex-5, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

7. Environmental and Social Consideration

7-1. The Team explained the outline of the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "the JICA Guidelines"), and the Nepalese side agreed to take the JICA Guidelines into consideration.

7-2. The Nepalese side agreed to obtain basic agreement from the Project Affected Persons (PAPs) including land owners regarding the Project, and to arrange the budget allocation for land acquisition, resettlement and compensation for PAPs before the approval of the Project by the Government of Japan, in case any PAPs would be identified at the Project sites.

7-3. The Nepalese side will examine and define the PAPs and report the result to JICA Nepal Office. JICA will confirm it whether the process of the definition is not out of the JICA Guidelines.

7-4. Both sides confirmed that the Nepalese side shall conduct any procedures on environmental clearance for the Project at the Nepalese own expenses and complete them before the Project approval by the Government of Japan in case procedures are required under the relevant law and regulations relating to the environmental considerations.

8. Schedule of the Study

8-1. The consultants will proceed to further studies in Nepal until April 18, 2009.

8-2. JICA will prepare the Interim report in English, which describes the result of examination for priority of the site to be improved under the Project, and dispatch a mission for the second field survey in order to explain its contents around June, 2009.

8-3. Both sides confirmed that chiefs of District Development Committees: DDCs, and District Technical Offices: DTOs, where the Project sites are located, will gather in Kathmandu and join the discussion with the Team for the second field survey.

9. Other relevant issues

9-1. The Nepalese side confirmed that the following undertakings should be taken by the Nepalese side at the Nepalese expenses under the Project.

(1) Improvement, operation and maintenance for access roads to each structure to be constructed under the Project.

(2) Relocation and/or removal of existing utilities (power lines, water lines, etc.) from the Project site, if necessary.

(3) Necessary arrangement for traffic control at necessary sections.

(4) Necessary arrangement for exemption/refunding of import tax, VAT, internal taxes and other fiscal levies.

(5) Securing and clearance of the temporary yard.

(6) Securing of site for disposal of waste.

9-2. The Nepalese side shall secure enough budget and personnel necessary for the operation and maintenance of the bridges constructed by the Project, including the periodical maintenance work after the taking over the facilities to be constructed under the Project.

9-3. The Nepalese side requested to the Team the capacity building and technical transfer to the Nepalese side relating to the Project. The Team answered to convey the request to JICA Head Quarters.

9-4. The Nepalese side shall provide necessary numbers of counterpart personnel to the Team during the period of their studies in Nepal.

9-5. The Nepalese side shall submit answers to the Questionnaire, which the Team handed to the Nepalese side, by April 10, 2009.

- List of Annexes

Annex-1: Project Site

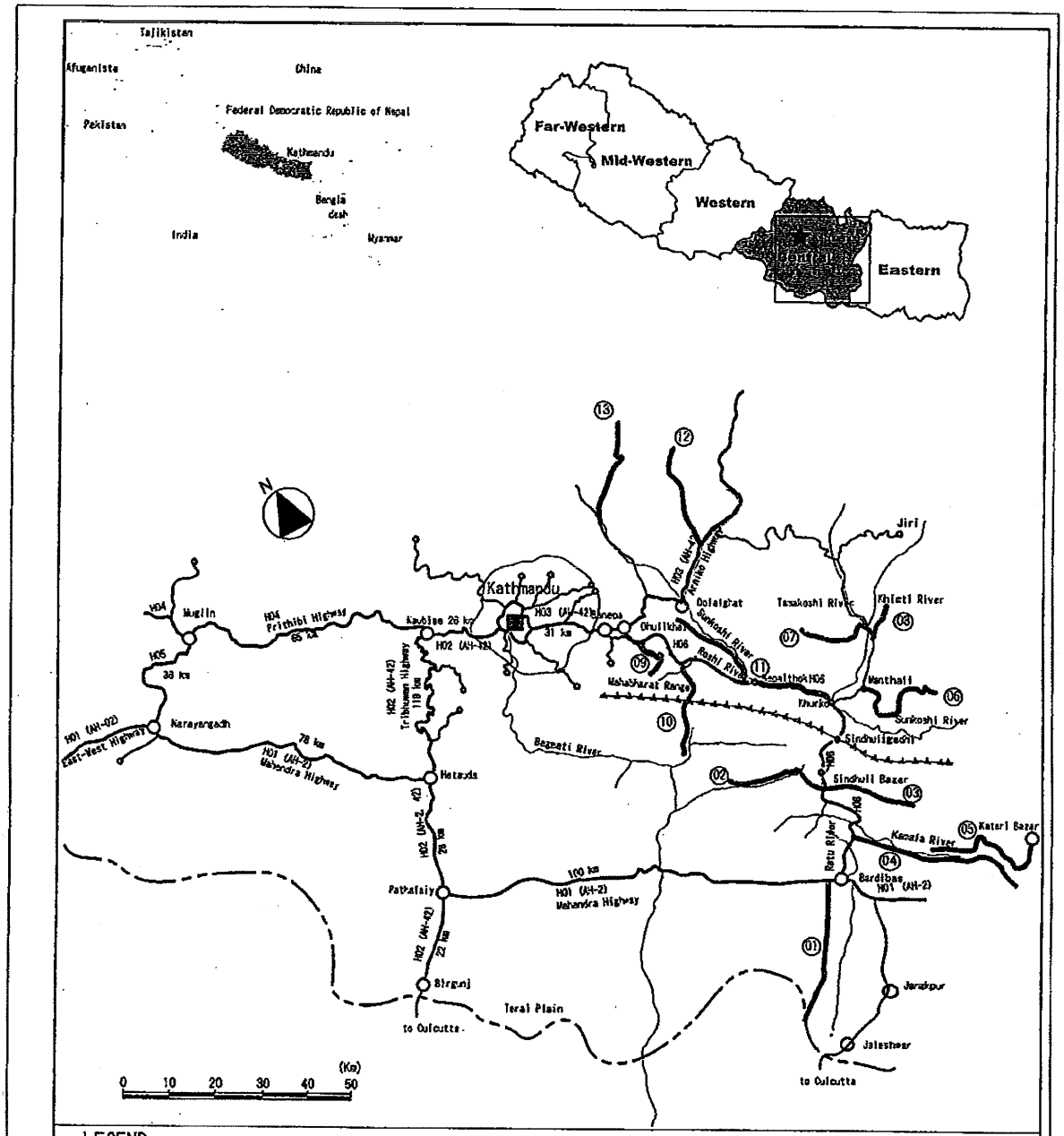
Annex-2: Organization Chart of MoLD

Annex-3: Organization Chart of DoLIDAR

Annex-4: Japan's Grant Aid Scheme for Community Empowerment (Tentative)

Annex-5: Major Undertakings to be taken by Each Government

(Annex-1)



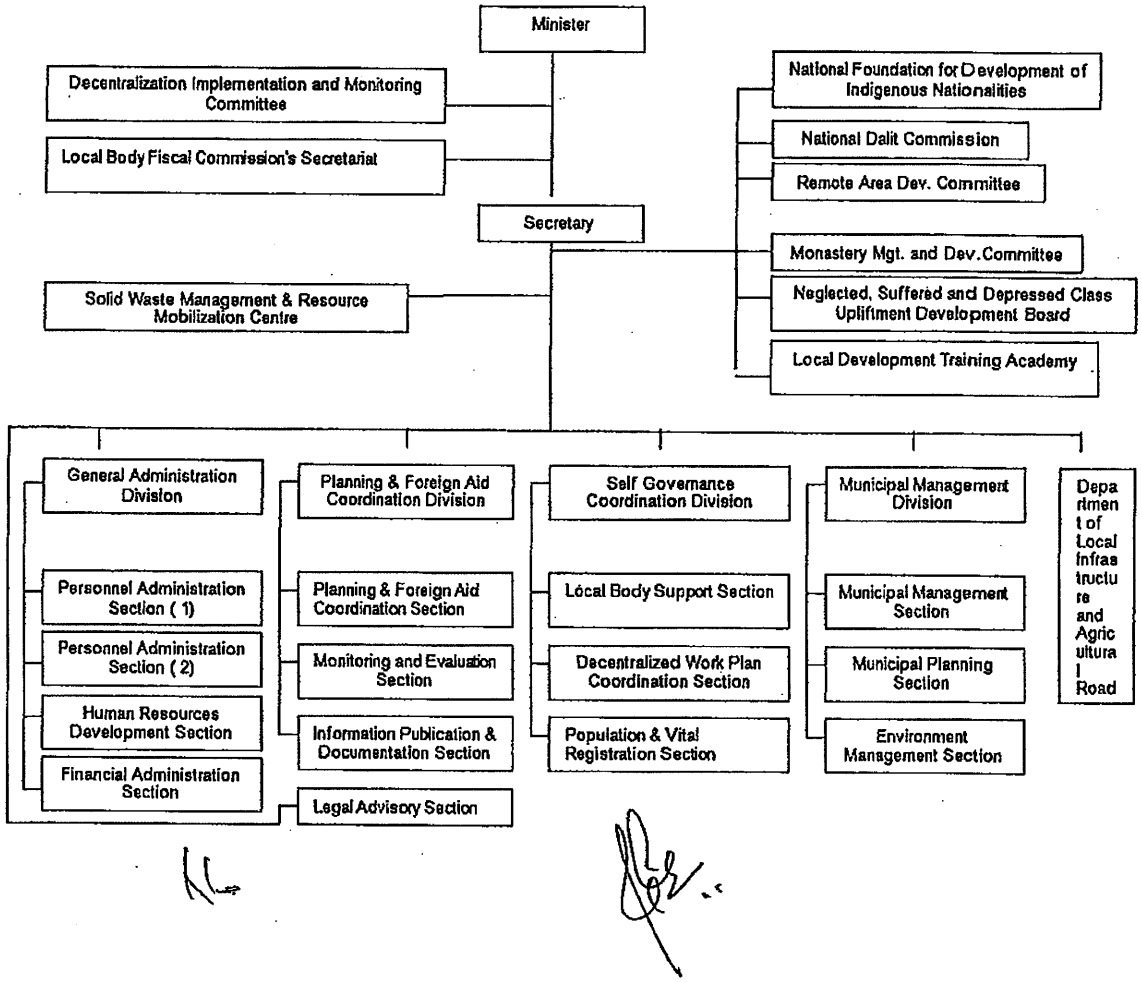

LEGEND

- Capital
- City
- Village
- Study Section
- National Highway
- H01 ~H06
- AH-2, 42 Asian Highway
- Rural Road
- River
- Kathmandu Valley
- Range

| Road No. | Road Name |
|---|---|
| 01 | Laxmaniya - Baratpur - Raghupur |
| 02 | Sindhulimadi - Kapilakot |
| 03 | Sindhulimadi - Bhimsthan |
| 04 | Bhiman - Dhansari |
| 05 | Dakaha - Sirthauli - Dudhaul - Katari Bazar |
| 06 | Manthali - Ramechhap - Sangutar |
| 07 | Fulasi - Doramba |
| 08 | Khimti - Namadi - Betali |
| 09 | Kavrebhanjyang - Dapcha - Kakare |
| 10 | Katunje - Bankhu |
| 11 | Bohare Dovan - Thulo Parcel |
| 12 | Balephi - Jalbire - Kattike |
| 13 | Melamchi - Bhotang |

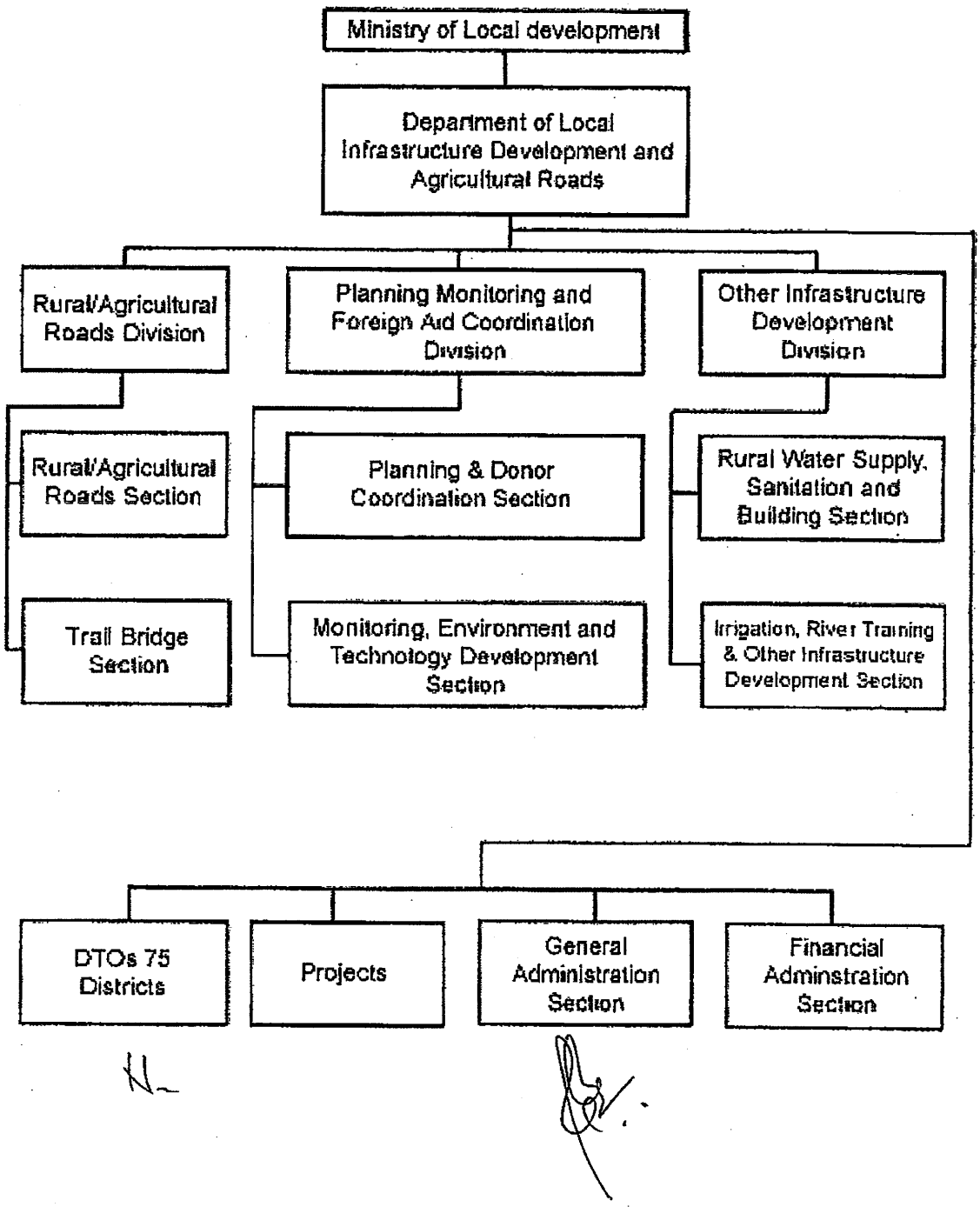
(Annex-2)

# Organization Chart of Ministry of Local Development



(Annex-3)

# Organization Chart of DoLIDAR



## Japan's Grant Aid Scheme for Community Empowerment (Tentative)

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as part of this realignment, JICA was reorganized on October 1, 2008. After the reorganization of JICA, following the decision of the GOJ, Grant Aid is extended by JICA.

Grant Aid is non-reimbursable fund to the government of the recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

The Grant Aid scheme for Community Empowerment (hereinafter referred to as "GACE") aims toward development of communities by empowering their capability as a whole to assure the sustainable development and overcome various threats, thus seeks to enhance human security. Multiple components can be combined to effectively meet the needs of communities. Contractors, suppliers or consultants are not confined to Japanese firms only, and construction can be done based on the local method, which leads to cost reduction.

### 1. Grant Aid Procedure

The Japanese Grant Aid is conducted as follows-

- Preparatory Survey (hereinafter referred to as "the Survey")
  - the Survey conducted by JICA
- Appraisal &Approval
  - Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Determination of Implementation
  - The Notes (hereinafter referred to as "the E/N") exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

1) Contents of the Survey

The aim of the Survey is to provide a basic document necessary for the appraisal of the Project by JICA and the GOJ. The contents of the Survey are as follows:

(1) Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies and communities concerned of the recipient country necessary for the implementation of the Project.
(2) Evaluation of the appropriateness of the Project to be implemented under the GACE from a technical, financial, social and economic point of view;
(3) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
(4) Preparation of an outline design of the Project.
(5) Estimation of cost for the Project.

The contents of the original request by the government of the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed considering the guidelines of Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For smooth implementation of the Survey, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after The firm(s) selected carry(ies) out the Survey and write(s) a report, based upon terms of reference set by JICA. The appropriateness of the Project is confirmed, JICA recommends to the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

1) The E/N and G/A

After the project approved by the Cabinet of Japan, the E/N will be signed between the GOJ and the Government of the recipient country to make a plea for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

2) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

3) Major undertakings to be taken by the Government of the recipient country

In the implementation of the Grant Aid Project, the government of the recipient country is required to undertake such necessary measures as Annex-5.

4) "Proper Use"

The Government of the recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

5) "Export and Re-export"

The products purchased under the Grant Aid should not be exported and re-exported from the recipient country.

6) Banking Arrangements (B/A)

The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

7) Social and Environmental Considerations

The recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-

environmental guideline.

4. Implementation of GACE after the E/N and the G/A

1) Procedural details

Essential points to be agreed upon are outlined as follows:

a) JICA executes the Grant by making payments of the amount agreed upon in the E/N and pays serious attention to ensure the accountability on proper and effective use of the Grant for the Project / the Programme.

b) The products and services shall be procured and provided in accordance with "Procurement Guidelines for Grant Aid for Community Empowerment".

c) The Government of the recipient country shall conclude an employment contract with the Agent.

d) The Government of the recipient country shall designate the Agent as the representative acting in the name of the Government of the recipient country concerning all transfers of funds to the Agent.

2) Focal Points of "Procurement Guidelines for Grant Aid for Community Empowerment"

a) The Agent

The Agent is the organization which provides procurement services of products and services on behalf of the Government of the recipient country according to the Agent Agreement with the Government of the recipient country. The Agent is recommended to the Government of the recipient country by JICA and agreed between the two Governments in the Agreed Minutes (A/M) of the E/N.

b) Agent Agreement

The Government of the recipient country shall conclude an Agent Agreement, within two month after the date of entry into force of the G/A. The scope of the Agent's services shall be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement

The Agent Agreement, which is prepared as two identical documents, shall be submitted to JICA by the Government of the recipient country through the Agent. JICA confirms whether or not the Agent Agreement is concluded in conformity with the E/N and the G/A and the Procurement Guidelines for Grant Aid for Community Empowerment, and approves the contract.

The Agent Agreement concluded between the Government of the recipient country and the Agent shall become effective after the approval by JICA in a written form.

d) Payment Methods

The Agent Agreement shall stipulate that "regarding all transfers of the fund to the Agent, the Government of the recipient country shall designate the Agent to act on behalf of the Government of the recipient country and issue a Blanket Disbursement Authorization ("the BDA") to conduct the transfer of the fund (Advances) to the Procurement Account from the Recipient Account."

The Agent Agreement shall clearly state that the payment to the Agent shall be made in Japanese yen from the Advances and that the final payment to the Agent shall be made when the total Remaining Amount become less than 3 % of the Grant and its accrued interest.

e) Products and Services Eligible for Procurement

Products and services to be procured shall be selected from those defined in the G/A.

f) Firm

In principle, a Firm of any nationality could be contracted as long as the Firm satisfies the conditions specified in the tender documents.

g) Method of Procurement

In implementing procurement, sufficient attention shall be paid so that there is no unfairness among tenderers who are eligible for the procurement of products and services.

For this purpose, competitive tendering shall be employed in principle.

h) Tender Documents

The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GACE.

The rights and obligations of the Government of the recipient country, the Agent and the Suppliers of the products and services should be stipulated in the tender documents to be prepared by the Agent. Besides this, the tender documents shall be prepared in consultation with the Government of the recipient country.

i) Pre-qualification Examination of Tenderers

The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether or not the prospective tenderers have the capability of accomplishing the contracts concerned without fail. In this case, the following points should be taken into consideration:

(1) Experience and past performance in contracts of a similar kind
(2) Property foundation or financial credibility
(3) Existence of offices, etc. to be specified in the tender documents.

j) Tender Evaluation

The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenders which substantially conform to the technical specifications, and are responsive to other stipulations of the tender documents, shall be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price shall be designated as the successful tenderer.

The Agent shall prepare a detailed tender evaluation report clarifying the reasons for the successful tender and the disqualification and submit it to the Government of the recipient country to obtain confirmation before concluding the contract with the successful tenderer.

The Agent shall, before a final decision on the award is made, furnish JICA with a detailed evaluation report of tenders, giving the reasons for the acceptance or rejection of tenders.

k) Additional Procurement

If there is an additional procurement fund after competitive and / or selective tendering and / or direct negotiation for a contract, and the Government of the recipient country would like an additional procurement, the Agent is allowed to conduct an additional procurement, following the points mentioned below:

(1) Procurement of the same products and services

When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged to be disadvantageous, the additional procurement can be implemented by a direct contract with the successful tenderer of the initial tender.

(2) Other procurements

When products and services other than those mentioned above in (1) are to be procured, the procurement should be implemented through a competitive tendering. In this case, the products and services for additional procurement shall be selected from among those in accordance with the E/N and G/A.

l) Conclusion of the Contracts

In order to procure products and services in accordance with the E/N and the G/A, the Agent shall conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment

The contract shall clearly state the terms of payment. The Agent shall make payment from the "Advances", against the submission of the necessary documents from the Firm on the basis of the conditions specified in the contract, after the obligations of the Firm have

been fulfilled. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

END

# Major Undertakings to be taken by Each Government

| No. | Items | | To be covered by Grant Aid | To be covered by Recipient Side |
|---|---|---|---|---|
| 1 | To secure land | | | ● |
| 2 | To clear, level and reclaim the site when needed | | | ● |
| 3 | To construct structures | 1) Within the site | ● | |
| | | 2) Outside the site | | ● |
| 4 | To bear the advising commission of BDA to the Japanese foreign exchange bank for the banking services based upon the B/A | | | ● |
| 5 | To ensure unloading and customs clearance at port of disembarkation in recipient country | 1) Marine (Air) transportation of the products from Japan to the recipient country | ● | |
| | | 2) Tax exemption and custom clearance of the products at the port of disembarkation | | ● |
| | | 3) Internal transportation from the port of disembarkation to the project site | ● | |
| 6 | To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contact such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their works. | | | ● |
| 7 | To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the contracts. | | | ● |
| 8 | To maintain and use properly and effectively the facilities constructed and equipment provided under the Japan's Grant after the taking over to the recipient country. | | | ● |
| 9 | To bear all the expenses, other than those to be borne by the Japan's Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment. | | | ● |

(B/A: Banking Arrangement, BDA: Blanket Disbursement Authorization)

**Minutes of Discussions**
**on the Preparatory Survey**
**on the Project for the Improvement of Community Access**
**in Nepal**
**(the Second Site Survey)**

In March 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Survey Team for Design (the First Field Survey) on the Project for the Improvement of Community Access (hereinafter referred to as "the Project") to Nepal, and through discussion, field survey, and technical examination of the results in Japan, JICA prepared an interim report of the survey.

In order to explain the contents of the interim report to the Government of Nepal and confirm fundamental conditions for the further studies, JICA sent to Nepal the Preparatory Survey Team for Design (hereinafter referred to as " the Team"), which is headed by Noriaki Niwa, Chief Representative for JICA Nepal Office from May 24, 2009 to July 23, 2009

As a result of discussions, both parties confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the draft final report.

Kathmandu, June 3, 2009

Noriaki Niwa
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Dinesh Kumar Thapaliya
Joint Secretary
Ministry of Local Development
The Government of Nepal

Dhana B. Tamang
Director General
Department of Local Infrastructure
Development and Agricultural Roads
(DoLIDAR)
Ministry of Local Development
The Government of Nepal

## ATTACHMENT

1. Contents of the Interim Report

The Nepalese side agreed and accepted in principle the contents of the interim report explained by the Team.

2. Priority of the Site

Regarding the Priority of the site, both sides confirmed the following items.

2-1. The Nepalese side agreed and accepted the result of the prioritization of the sites shown in the Interim Report.

2-2. The Team will conduct outline design only for 35 sites, which are rated as A or B on "Magnitude of Road Closure" as shown in Annex-1.

2-3. DoLIDAR shall explain the result of the prioritization of the sites to District Development Committees: DDCs and District Technical Offices: DTOs, where the Project sites are located, and obtain agreement from them by the end of June, 2009.

3. Environmental and Social Considerations

3-1. The Nepalese side shall confirm the necessity of procedures on environmental matters for the Project based on the Nepalese laws and regulations, e.g. IEE (Initial Environmental Examination), EIA (Environmental Impact Assessment) etc., by the end of June, 2009 and report its result to JICA Nepal office.

In case procedures are required for the Project implementation, the Nepalese side shall conduct any procedures at the Nepalese own expenses and complete them and report its result to JICA Nepal Office before the Project approval by the Japanese Cabinet.

3-2. The Nepalese side will conduct the IEE together with the Team, which is described in JICA Environmental and Social Guidelines.

3-3. Both sides reconfirmed that the Nepalese side will obtain basic agreement from the Project Affected Persons (PAPs) including land owners regarding the Project, and to arrange the budget allocation for land acquisition, resettlement and compensation for PAPs before the approval of the Project by the Government of Japan, in case any PAPs would be identified at the Project sites.

3-4. The Nepalese side shall complete to secure sites and compensation for the PAPs by the commencement of the Project, if necessary.

4. Schedule of the Survey for Design

4-1. The consultants will proceed to further studies in Nepal until July 23, 2009.

4-2. JICA will prepare the draft report in English and dispatch a mission in order to explain its

contents around October, 2009.

5. Other Relevant Issues

5-1. The Nepalese side requested to add two (2) roads in Kavrepalanchok district for the Project. The Team answered its request could not be accepted because of the delayed request.

5-2. Regarding to the road improvement conducted by the Nepalese side, both sides confirmed the following items:

(1) To complete the improvement of the access to the construction site for No.2, No.8 and No.9 before the commencement of the Project, that is necessary for construction of facilities under the Project.

(2) To complete the improvement of the Road No.2, No.3, No.8, No.9, No.10 and No.11 before the completion of the Project.

(3) To complete the reconstruction of the existing causeway across the Kukur Khola which is located at Katari, that is the entrance of the Project Road No.5.

5-3. The Nepalese side reconfirmed that the following undertakings should be taken by the Nepalese side at the Nepalese expenses.

(1) Removal of the existing buildings within the Project sites, if necessary.

(2) Relocation and/or removal of existing utilities (power lines, water supply lines, etc.) from the Project site.

(3) Necessary arrangement for the tax exemption of imported materials, equipment and vehicles, and reimbursment of other levies in Nepal for the Project.

(4) Necessary arrangement for the securing of borrow pit, if necessary.

(5) Securing and clearance of temporary yard, if necessary.

(6) Securing of site for disposal of waste, if necessary.

5-4. The Nepalese side shall secure enough budget and personnel necessary not only for the Project implementation, including the stage of the Preparatory Survey, but also for the operation and maintenance of the facilities constructed by the Project, including the periodical maintenance work after the completion of the Project.

(END)

Annex-1: Priority of the 35 sites selected for the Outline Survey

ANNEX-1

# Priority Order of the Selected 35 Project Sites

| DISTRICT | ROADS | S. No. | SITE NO | | Priority order of roads | MAGNITUDE OF ROAD CLOSURE A:2-3 months B:2-3 days C:During heavy rain | | | | Priority Order in same road | Proposed Priority order of sites |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Site No | River | | Visual & hearing | Catchment Area (km2) | Remarks | Evaluation | | |
| RAMECHHAP | ⑧ Betali-Namadi-Khimti | 84 | ⑧-1 | Palati | 1 | A | 8.42 | | A | | 1 |
| RAMECHHAP | ⑧ Betali-Namadi-Khimti | 86 | ⑧-3 | Haluwa | 1 | A | 8.86 | | A | | 2 |
| RAMECHHAP | ⑧ Betali-Namadi-Khimti | 87 | ⑧-4 | Pharpu | 1 | A | 15.93 | | A | | 3 |
| RAMECHHAP | ⑧ Betali-Namadi-Khimti | 88 | ⑧-5 | Chatwane | 1 | A | 1.74 | | A | | 4 |
| KAVREPALANCHOWK | ⑩ Bhore Dovan-Thulo Parsel | 94 | ⑩-3 | Roshi | 2 | A | 4.5 | | A | | 5 |
| MAHOTTARI | ① Laxmaniya-Baratpur-Raghunathpur | 1 | ①-1 | Dhalan | 3 | A | 11.84 | | A | | 6 |
| MAHOTTARI | ① Laxmaniya-Baratpur-Raghunathpur | 2 | ①-2 | Kantawa | 3 | A | 0.93 | Pond | A | | 7 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 70 | ⑤-11 | Kolta | 4 | A | 14.05 | | A | 1 | 8 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 67 | ⑤-8 | Talko | 4 | A | 3.93 | | A | 2 | 9 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 66 | ⑤-7 | Kuruwa | 4 | A | 3.66 | | A | 3 | 10 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 64 | ⑤-5 | Thakur-4 | 4 | A | 10.12 | Thakur River | A | 4 | 11 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 63 | ⑤-4 | Thakur-3 | 4 | A | 9.16 | Thakur River | A | 5 | 12 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 62 | ⑤-3 | Thakur-2 | 4 | A | 7.71 | Thakur River | A | 6 | 13 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 61 | ⑤-2 | Thakur-1 | 4 | A | 6.11 | Thakur River | A | 7 | 14 |
| SINDHULI | ⑤ Daksha-Sirthauli-Dudhauli-Katari | 60 | ⑤-1 | Tamorni | 4 | A | 3.96 | | A | 8 | 15 |
| SINDHUPALCHOWK | ⑲ Melamchi-Bhotang | 100 | ⑲-6 | Khalte | 6 | A | 10.01 | | A | | 16 |
| SINDHUPALCHOWK | ⑲ Melamchi-Bhotang | 102 | ⑲-8 | Tipani | 6 | A | 10.3 | | A | | 17 |
| SINDHUPALCHOWK | ⑲ Melamchi-Bhotang | 104 | ⑲-10 | Mahadev | 6 | A | 9.61 | | A | | 18 |
| SINDHUPALCHOWK | ⑲ Melamchi-Bhotang | 108 | ⑲-14 | Hadi | 6 | A | 4.72 | | A | | 19 |
| SINDHULI | ② Sindhumadi-Kapilakot | 3 | ②-1 | Marin | 7 | A | 10.05 | | A | | 20 |
| SINDHULI | ② Sindhumadi-Kapilakot | 7 | ②-5 | Daojar | 7 | A | 6.68 | | A | | 21 |
| SINDHULI | ② Sindhumadi-Kapilakot | 8 | ②-6 | Maheshot | 7 | A | 7.03 | | A | | 22 |
| SINDHULI | ② Sindhumadi-Kapilakot | 9 | ②-7 | Chadauli | 7 | A | 4.66 | | A | | 23 |
| RAMECHHAP | ⑥ Manthali-Ramechhap-Sangutar | 71 | ⑥-1 | Sukhajor | 8 | B | 23.75 | | A | | 24 |
| SINDHULI | ③ Sindhumadi-Bhimsthan | 10 | ③-1 | Dhamja | 9 | A | 4.08 | | A | | 25 |
| SINDHULI | ③ Sindhumadi-Bhimsthan | 14 | ③-5 | Jaghaha | 9 | A | 9.84 | | A | | 26 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SINDHULI | ④ Bhiman-Dhansari | 59 | ④-43 | Dhansari | 10 | A | 4.03 | Back water from Kamara | A | | 27 |
| KAVREPALANCHOWK | ⑭ Katurjebasi-Bankhu | 91 | ⑭-1 | Roshi | 11 | A | | | A | | 28 |
| KAVREPALANCHOWK | ⑨ Kavrebhanjyang-Dapcha-Kakare | 89 | ⑨-1 | Roshi | 12 | A | 357.28 | | A | | 29 |
| KAVREPALANCHOWK | ⑨ Kavrebhanjyang-Dapcha-Kakare | 90 | ⑨-2 | Ambote | 12 | A | 17.13 | | A | | 30 |
| RAMECHHAP | ⑧ Belati-Namadi-Khimti | 85 | ⑧-2 | Bohore | 1 | A | 2.54 | | B | | 31 |
| SINDHULI | ⑤ Dakaha-Sithauli-Dudhauli-Ketari | 68 | ⑤-9 | Piprie | 4 | A | 1.06 | | B | | 32 |
| [illegible] | ⑬ Melamchi-Bholang | 95 | ⑬-1 | Andari | 6 | B | 4.56 | | B | | 33 |
| SINDHULI | ② Sindhulimadi-Kapilakot | 6 | ②-4 | Ancho | 7 | A | 1.05 | | B | | 34 |
| SINDHULI | ③ Sindhulimadi-Bhimsthan | 11 | ③-2 | Besare | 9 | C | 3.50 | | B | | 35 |

**Minutes of Discussions**
**on Preparatory Survey**
**on the Project for the Improvement of Community Access**
**in Nepal**
**(Explanation of Draft Report)**

In March and April 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for the Improvement of Community Access (hereinafter referred to as "the Project") to Nepal (hereinafter referred to as "Nepal"), and through discussions, field survey and technical examination of the results in Japan, JICA prepared a draft report of the survey.

In order to explain and to consult with the concerned officials of the Government of Nepal on the contents of the draft report, JICA sent to Nepal the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Mr. Yoshio Fukuda, Senior Representative of JICA Nepal Office, from October 22 to November 8, 2009.

As a result of discussions, both sides confirmed the main items described in the attached sheets.

Kathmandu, October 28, 2009

Yoshio Fukuda
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Dinesh Kumar Thapaliya
Joint Secretary
Ministry of Local Development
The Government of Nepal

Dhana B. Tamang
Director General
Department of Local Infrastructure
Development and Agricultural Roads
(DoLIDAR)
Ministry of Local Development
The Government of Nepal

## ATTACHMENT

1. Components of the Draft Report
The Nepalese side agreed and accepted in principle the contents of the Draft Report of Preparatory Survey October 2009 by the Team.

2. Cost Estimation
Both sides agreed that the Project Cost Estimation as attached in Annex-1 should never be duplicated or released to any third parties before the signing of all the Contract(s) for the Project.

3. Japan's Grant Aid Scheme for Community Empowerment

3-1. The Nepalese side understood the Japan's Grant Aid scheme for Community Empowerment explained by the Team as described in Annex-4 of the Minutes of Discussions signed on March 25, 2009 (hereinafter referred to as "the Signed Minutes").

3-2. The Nepalese side will take necessary measures, as described in Annex-5 of the Signed Minutes, for smooth implementation of the Project as a condition for the Japan's Grant Aid to be implemented.

3-3. The Japanese side explained to the Nepalese side that the number of bridges/structures to be improved under the Project is subjected to the total budget, the result of tender and the other conditions. The Nepalese side understood it.

4. Schedule of the Survey

4-1. Based on the results of discussions of the draft report, JICA will proceed to further examination of the survey results in Japan until January 2010.

4-2. JICA will prepare a draft final report in English and dispatch a mission in order to explain its contents around the end of January 2010.

5. Other Relevant Issues

5-1. The Nepalese side explained to the Team that procedures for environmental clearance would be completed by November 15, 2009. The Nepalese side shall report its result to JICA Nepal Office immediately after the completion of procedures.

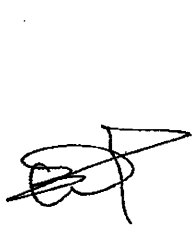
5-2. Regarding to the road improvement conducted by the Nepalese side, both sides reconfirmed the following items:

(1) To complete the improvement of the access to the construction site for No.2, No.8 and No.9 before the commencement of the Project, that is necessary for construction of facilities under the Project.

(2) To complete the improvement of the Road No.2, No.3, No.8, No.9, No.10 and No.11 before the completion of the Project.

(3) To complete the reconstruction of the existing causeway across the Kukur Khola which is located at Katari, that is the entrance of the Project Road No.5.

5-3. The Nepalese side shall secure enough budget and personnel necessary for the operation and maintenance of the facilities improved by the Project, including the periodical maintenance work after the completion of the Project.



Note: The Annex-1 was deleted due to a confidential document.

**Minutes of Discussions**
**on Preparatory Survey**
**on the Project for the Improvement of Community Access**
**in Nepal**
**(Explanation of Reference Bid Document)**

In October 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Draft Report Explanation Team on the Project for the Improvement of Community Access (hereinafter referred to as "the Project") to Nepal, and through discussion, field survey, and technical examination of the study results in Japan, JICA prepared a reference bid document for the Project.

In order to explain and to consult the Nepalese side on the components of the reference bid document, JICA sent to Nepal the Explanation Team (hereinafter referred to as " the Team "), which is headed by Toru Take, Senior Representative from January 16 to February 3, 2010.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Kathmandu, February 4, 2010

Toru Take
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Dinesh Kumar Thapaliya
Joint Secretary
Ministry of Local Development
The Government of Nepal

Dhana B. Tamang
Director General
Department of Local Infrastructure
Development and Agricultural Roads
(DoLIDAR)
Ministry of Local Development
The Government of Nepal

## ATTACHMENT

1. Components of the Draft Report

The Team submitted a reference bid document and explained its contents to the Nepalese side. Both sides confirmed that the bid document will be finalized after the conclusion of agent agreement.

2. Japan's Grant Aid Scheme for Community Empowerment

2-1. The Nepalese side understood the Japan's Grant Aid scheme for Community Empowerment explained by the Team as described in Annex-4 of the Minutes of Discussions signed on March 25, 2009 (hereinafter referred to as "the Signed Minutes").

2-2. The Nepalese side will take necessary measures, as described in Annex-5 of the Signed Minutes, for smooth implementation of the Project as a condition for the Japan's Grant Aid to be implemented.

3. Designated Authority

The Nepalese side explained to the Team that DoLIDAR is designated authority for the Project and will be a signatory for Agent Agreement for the Project with referring of the laws and regulations of the Government of Nepal. The Japanese side understood and agreed it.

4. Environmental and Social Considerations

4-1. Land acquisition

(1) The Nepalese side shall obtain agreement from land owners affected by the Project, who will be confirmed by result of the centerline survey, before the tendering of the Project.

(2) The Nepalese side shall complete the acquisition, compensation and resettlement substantially before commencement of construction work, if necessary.

4-2. Environmental monitoring plan

Both sides confirmed that appropriate environmental monitoring shall be planned and implemented as the Annex-1 by the Nepalese side based on Initial Environment Examination (IEE) report of the Project, JICA Environmental and Social Considerations Guidelines, and other relevant standards, if necessary.

5. Schedule of the Survey

JICA will prepare a final report for the Preparatory Survey in English and send it to the Nepalese side in March, 2010.

6. Access Road improvement to be carried out by the Nepalese side

6-1. Both sides reconfirmed the importance of the road improvements by the Nepalese side and also the Nepalese side shall carry out the improvement works as follows:

(a) To complete the improvement of the access road to the construction site for No.2, No.8 and No.9 before the tendering of the Project, which are necessary for construction of facilities under the Project.

(b) To complete the improvement of the Road No.2, No.3, No.8, No.9, No.10 and No.11 before the completion of the Project.

(c) To complete the reconstruction of the existing causeway across the Kukur Khola which is located at Katari, that is the entrance of the Project Road No.5.

6-2. The Nepalese side shall confirm actual progress of the road improvements, formulate a plan based on the actual progress and submit the plan to JICA Nepal Office by February 15, 2010.

Annex-1: Items and frequency of the monitoring

Annex-1

Items and frequency of the monitoring

| | Items | Points | Frequency | | | Remarks |
|---|---|---|---|---|---|---|
| | | | At the start of construction | During Construction | After opening | |
| 1 | Air (Dust caused by construction works) | In the sites | - | Monthly | - | - To mobilize water sprinklers for dust control in and around the site. |
| 2 | Illegal cutting of trees by Labors | Around the sites | Once* | Monthly | - | |
| 3 | Over excavation (Changes on the River Bed, River Side Areas) | In and around the sites | Once* | Monthly | Periodically** | |
| 4 | Waste water quality from construction site | Around the sites | - | As needed | - | |
| 5 | Disposal of solid waste | In and around the sites | - | Monthly | - | |

Notes:

* To be conducted for the verification of actual situations.

**DDC (District Development Committee) should not allow quarrying of sand, aggregates and stones in and around the Project sites.