

No. 1

DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
KINGDOM OF NEPAL

**BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
CONSTRUCTION OF SINDHULI ROAD
(SECTION II : SINDHULI BAZAR - KHURKOT)
IN
KINGDOM OF NEPAL

FINAL REPORT**

DECEMBER 1999

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JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

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PREFACE

In response to a request from the His Majesty's Government of Nepal, the Government of Japan decided to conduct a basic design study on the Project for Construction of Sindhuli Road (Section II : Sindhuli Bazar - Khurkot) and entrusted the study to the Japan International Cooperation Agency (JICA).

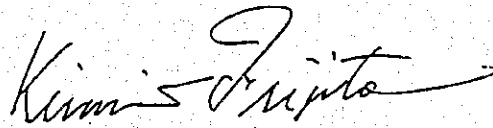
JICA sent to Nepal study teams from March 20 to May 13, 1999 and from June 27 to July 10, 1999.

The teams held discussions with the officials concerned of His Majesty's Government of Nepal, and conducted field studies at the study area. After the teams returned to Japan, further studies were made. Then, a mission was sent to Nepal in order to discuss a draft basic design, and as this 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 officials concerned of His Majesty's Government of Nepal for their close cooperation extended to the teams.

December 1999



Kimio Fujita
President
Japan International Cooperation Agency

December 1999

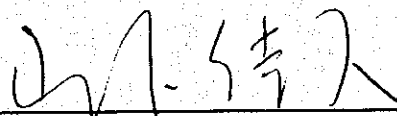
Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Construction of Sindhuli Road (Section II : Sindhuli Bazar - Khurkot) in Nepal.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from February 26, 1999 to January 10, 2000. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nepal and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

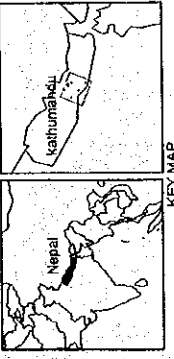
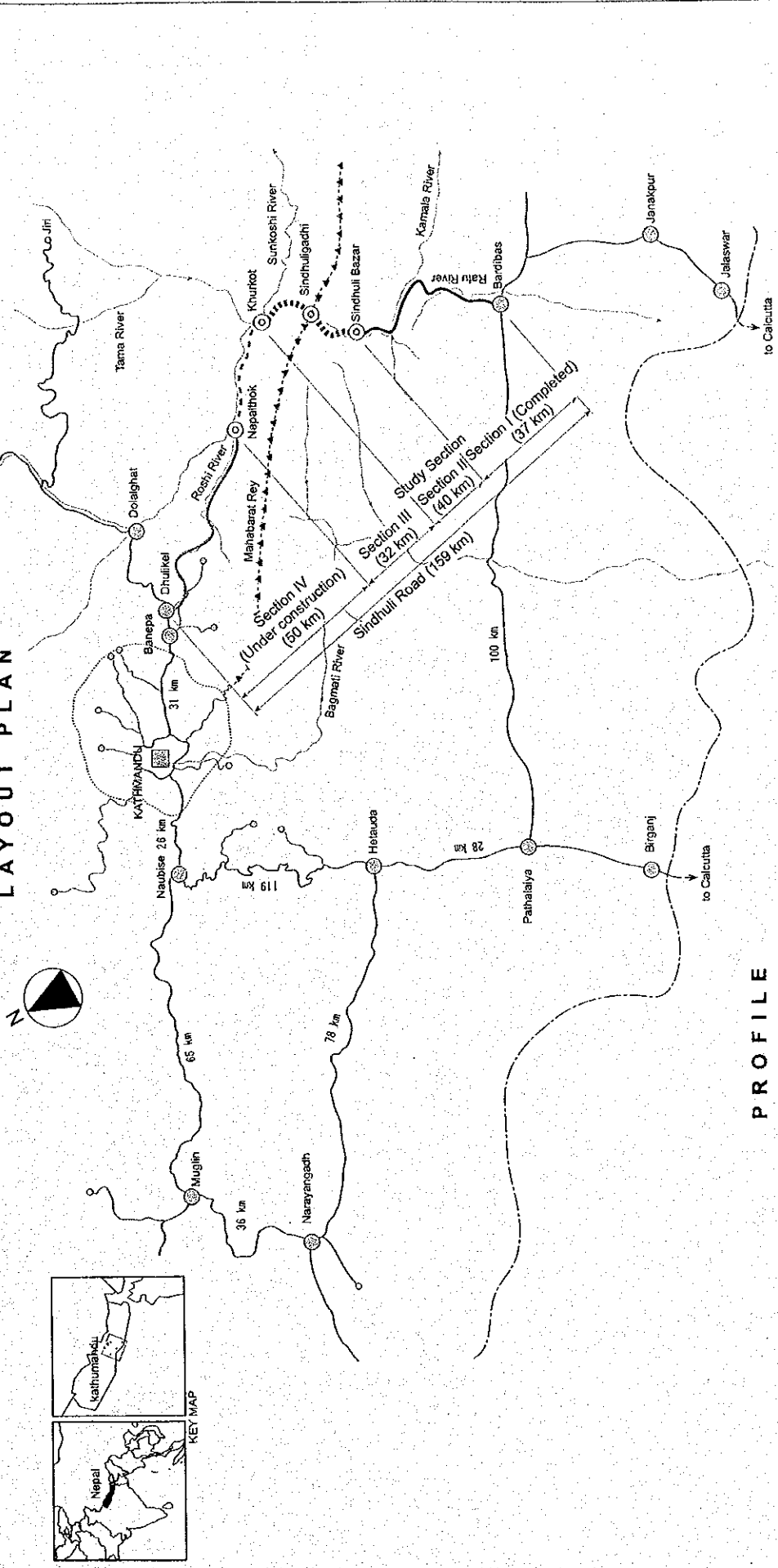
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



Yoshihisa Yamashita
Project Manager
Basic design study team on
the Project for Construction of Sindhuli Road
(Section II : Sindhuli Bazar - Khurkot)
Nippon Koei Co., Ltd.

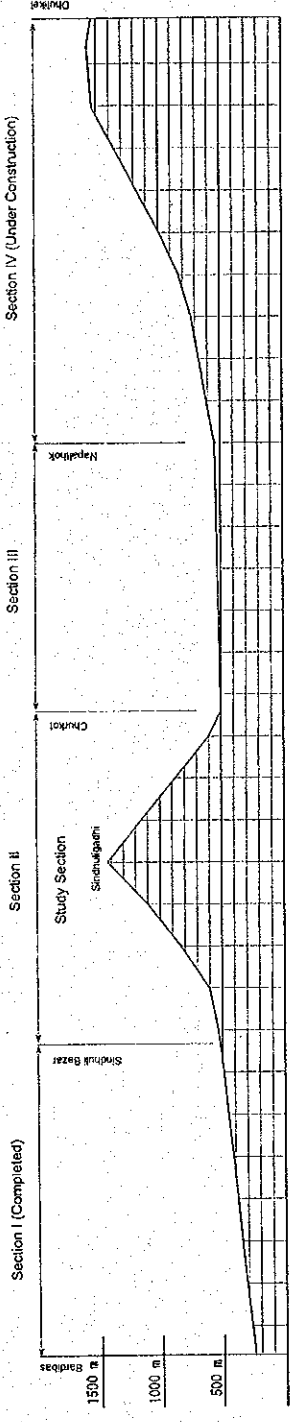
LAYOUT PLAN



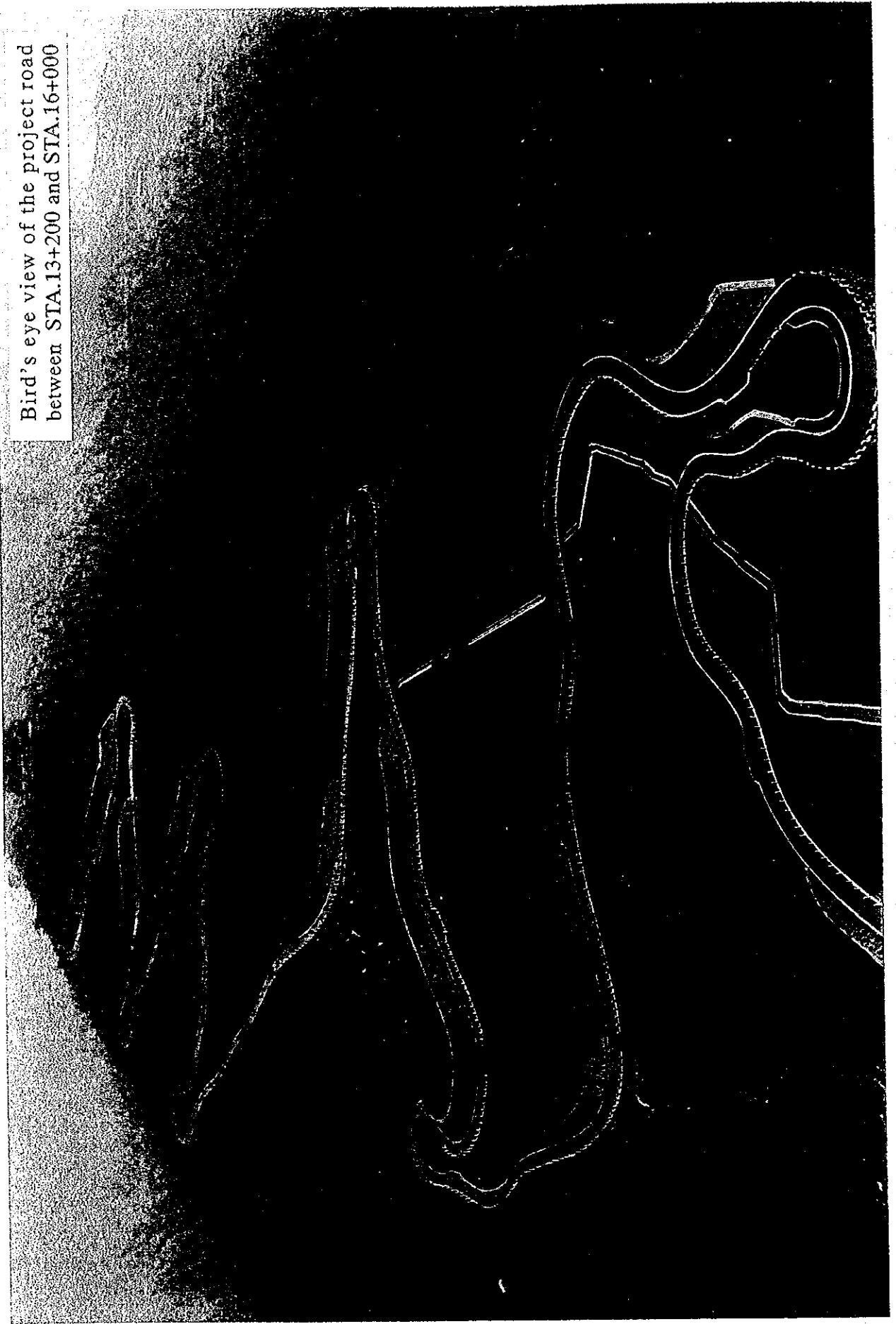
ROUTE MAP OF THE SINDHULI ROAD



PROFILE



Bird's eye view of the project road
between STA.13+200 and STA.16+000



Summary

The Kingdom of Nepal is a landlocked country, bordered on the north by China and on east, west and south by India. The population in 1991 was estimated to be 18.5 million. The country is divided into three topographical regions: the Mountain Region, the Hill Region and Terai Plain, and also comprises of 75 Districts. The Districts are regrouped into five Development Regions divided by south-north borders.

The national economy of Nepal depends heavily on agricultural sector, which amounts to about 40 percent of the Gross Domestic Product and shares about 80 percent of the economic active population. The Terai Plain is a main agricultural production area.

The road sub-sector has leading role in the national transport system in Nepal. The development of road networks started from the 1950, and expanded its network 13,223 km in length by 1998. However, the service level of the road network is insufficient as 70 percent of roads have been unpaved and 14 Districts have still no motorble roadway at all. In order to achieve the National Plan and reduce the traffic cost of the national, the expansion of the road network and maintaining and improvement of the exiting roads are one of the main subjects in Nepal.

Presently, there are the two transport routs connecting Kathmandu with Terai Plain for imports from India and agricultural products from Terai; namely, the Tribhuban Highway and the Prithiri Highway which meet at Naubise located about 26 km in the west of Kathmandu and afterward come into the Kathmandu. The Tribhuban Highway is not used as a main truck line because of its narrow road width and winding alignment. The Prithiri Highway, which has a two-lane width and acceptable alignment, is being used as a main transport route.

Although, Prithiri Highway is a main transport route, it is still in risk of interrupting the traffic flow due to landslides and/or bank erosions prone to occur in rainy season as the one which happened in July 1993 which disrupted the traffic to and from Kathmandu for 20 days. The Prithiri Highway is roundabout way traversing about 200 km to the western side of Kathmandu for the traffic between Kathmandu and Eastern Region of Nepal.

Taking into account the condition of the present road network linking Kathmandu and the Terai Plain, His Majesty's Government of Nepal (HMG/N) recognized the necessity of a second life line which connect Kathmandu and Terai Plain, and thus formulated the Sindhuli Road Construction Project (the Project).

The Project has been planned to connect Bardibas on the East-West Highway with Dhulikel on the Kodari Road, locating 31 km eastern side of Kathmandu. The Project road is divided into four sections: Section I: Bardibas and Sindhuli Bazar with a total length of 37 km, Section II: Sindhuli Bazar and Khurkot with a total length of 40 km, Section III: Khurkot and Nepalthok with a total length of about 32km and Section IV: Nepalthok and Dhulikel with a total length of 50 km.

In response to a request from HMG/N, the Government of Japan (GOJ) decided to conduct a Feasibility Study (F/S) for the Project. Japan International Cooperation

Agency (JICA) carried out the F/S from 1986 to 1988. The Final Report concluded that the Project is both economically and technically feasible, yet the Project has not implemented for the budgetary reason and for a political conflict, which lies between Nepal and India.

In response to the request from HMG/N, GOJ decided to conduct a study aiming at formulation of practical and realistic development schemes and of implementation program based on the review of the previous F/S; namely, "the Aftercare Study". Which was carried out from 1992 to 1993 by JICA. The final report of the Aftercare Study recommended the optimum development scheme to minimize initial construction cost by introducing a stage-wise construction concept. Based on the recommendation by the Aftercare Study, GOJ conducted basic design studies for the Project for Construction of Sindhuli Road (Section I: Bardibas - Sindhuli Bazar) (the Project Section I) and the Project for Construction of Sindhuli Road (Section IV: Nepalthok - Dhulikel) (the Project Section IV).

The Project Section I, consisting of the construction of 9 bridges and 17 causeways including procurement of maintenance equipment for the road, was implemented during the period between 1996 and 1998. The Project Section IV, consisting of the road construction with total length of 50 km including procurement of maintenance equipment for the project road, started in 1997.

HMG/N, giving high priority on the Sindhuli Road Construction Project continuously as the Project account for 10 percent of new road construction which is a target of the road sub-sector in the Ninth Plan (1997-2002), requested GOJ a grant aid for the Sindhuli Road Construction Project (Section II: Sindhuli Bazar - Khurkot) in September 1998. In response to the request, GOJ decided to conduct a basic design study for the Project Section II.

JICA dispatched two basic design study teams during the period between March 20 and May 13, 1999 and between June 27 and July 10, 1999. The study teams discussed with HMG/N officials regarding to the contents of the Project Section II and scope of works to be implemented under Japanese Grant Aid Program, and carried out the field survey including site investigation, traffic survey and so on. Basic agreements were then signed and exchanged.

After returning to Japan, based on the results of the field surveys, the study team carried out the basic design including the road design, bridge design, causeway design and slope protection design, and prepared a draft basic design report containing contents of the Project Section II, implementation program, scope of works to be done by HMG/N and so on.

JICA dispatched a mission to explain the draft report to HMG/N during the period between October 5 and October 16, 1999. A basic agreement was signed and exchanged after the contents of the draft basic design report were verified and agreed upon by the both parties.

The scope of works determined in the basic design study is summarized as follows:

| Description | | Specifications | |
|-----------------------|--|---|--|
| Road Construction | Section between Sindhuli Bazar and Khurkot | a) Length b) Design speed c) Road width d) Pavement | 39.7 km 20 kmph 4.75 m (single lane), 6.5m (dual lane section) (*1) Double bituminous surface treatment |
| Bridge Construction | Gwang bridge | a) Bridge length b) Road width c) Super-structure d) Sub-structure | 48.0 m 4.25 m Simple steel plate girders Reverse T type abutments |
| Causeway Construction | No.1 Causeway | a) Length b) Road width c) Structure type | 60 m 7.5 m (dual lane section) Continuous box-culvert |
| | No.2 Causeway | a) Length b) Road width c) Structure type | 60 m 7.5 m (dual lane section) Continuous box-culvert |
| | No.3 Causeway | a) Length b) Road width c) Structure type | 130 m 4.75 m Continuous box-culvert |
| | No.4 Causeway | a) Length b) Road width c) Structure type | 30 m 4.75 m Continuous box-culvert |
| | No.5 Causeway | a) Length b) Road width c) Structure type | 50 m 4.75 m Continuous box-culvert |

(*1) Dual lane will be adopted as exceptional case at Sindhuli Bazar area.

The Project Section II will be implemented by three phase. For the implementation of the Project Section II under the Japanese Grant Aid Program, the detailed design and the construction of each phase will be commenced after the Exchange of Notes between GOJ and HMG/N respectively. The detailed design and the construction period for each phases were estimated as follows:

| Description | | Phase-1 | Phase-2 | Phase-3 | Total |
|------------------------------------|----------|------------------------|-------------------------|-------------------------|------------------------|
| Contents of the Project Section II | Section | STA.0+000 - STA.12+500 | STA.12+500 - STA.26+000 | STA.26+000 - STA.39+700 | STA.0+000 - STA.39+700 |
| | Length | 12.5 km | 13.5 km | 13.7 km | 39.7 km |
| | Bridge | 1 nos. | - | - | 1 nos. |
| | Causeway | 2 nos. | - | 3 nos. | 5 nos. |
| Detailed design period | | 6 months | 2 months | 2 months | - |
| Construction period | | 29 months | 41 months | 29 months | - |

The direct effect of the completion of entire sections of the Sindhuli Road is to reduce the travel distance by about 200 km in the trip between Kathmandu and Eastern Development Region. This will reduce the traffic cost and induce the round trip between Kathmandu and middle Terai area within one day. A great number of populations will receive the benefit from the road. About 1.17 million people in the

districts along the route, 5.44 million population in the Kathmandu Valley and in Eastern Region as well as the passengers of busses and trucks travelling Kathmandu and Eastern Development Region which are estimated at 30 thousands per day and totaling 10 million per year, will receive benefit.

Besides the above, the following effects will be anticipated.

- To provide alternative route of transportation of materials from Terai to Kathmandu, in parallel with now functioning Birgandi - Hetauda - Kathmandu route,
- To expand the sphere of market economy, encouraging of cash crop plantation in the areas where market accessibility is expected to be improved due to opening of the project road,
- To secure the supply of such daily materials as salt, rice and oil, which are unstably supplied at present to the hilly areas by such means as porters or animals due to lack of motorable roads,
- To enhance the welfare of rural people with the opening of hospitals and public facilities in the area where there have been no these facilities at all,
- To reduce the burden of labour of women and children in the transportation of such materials as agriculture products, fuel and grasses for domestic animals and so on, with the opening of the motorable road,
- To induce leisure and tourism development, such as rafting at Sunkosh river, in the areas where one-day trip from Kathmandu become possible with the opening of the road, and
- To enable spherical area development in the areas neighboring to the project road with the opening of access roads and bridges connecting to the former in a long term.

Due to the nature of the Sindhuli Road that traverse mountainous terrain, the Road is requested to be performed adequate maintenance works to protect slope failures and debris flows in every year. Therefore, the importance of the maintenance and strengthening of present maintenance capability of DOR including establishment of maintenance office, education of maintenance staff and procurement of maintenance equipment have been undertaken as a part of the Project as described in the Basic Design Reports on the Project Section I and the Project Section IV.

The alignment of the Section II has been planned so as to minimize negative effects on the surrounding environment including regional partition, destruction of forest, damage on the existing irrigation channels, acceleration of slope failures. The Environmental Impact Assessment was carried out by the DOR and concluded that there is no serious environmental impact.

The construction period of the Project Section II Project is six years. Therefore, in order to meet the condition of the Japanese Grant Aid Program and to realize smooth implementation, phased implementation program which consists Phase-1 (3 years), Phase-2 (4 years) and Phase-3 (3years) shall be adopted.

As mentioned above, the Sindhuli Road Construction Project will be produced great impacts to the nation and will enhance the basic human need to the surrounding areas. Therefore, it is recommendable that the Project Section II, which will promote

the early connection of the whole of the Sindhuli Road, should be implemented under Japanese Grant Aid Program. However, in order to ensure the smooth performance of the Project Section II, it is recommended that HMG/N should undertake the following items of works:

- To carry out a judicial procedure of land acquisition and houses compensation before the construction progress.
- To establish the efficient implementation body to ensure smooth implementation.
- To carry out appropriate mitigation measures for the negative environmental impacts.
- To ensure the security of the Project Section II site during the construction.
- To maintain the road conditions passable at the section between Bardibas and Sindhuli Bazar.

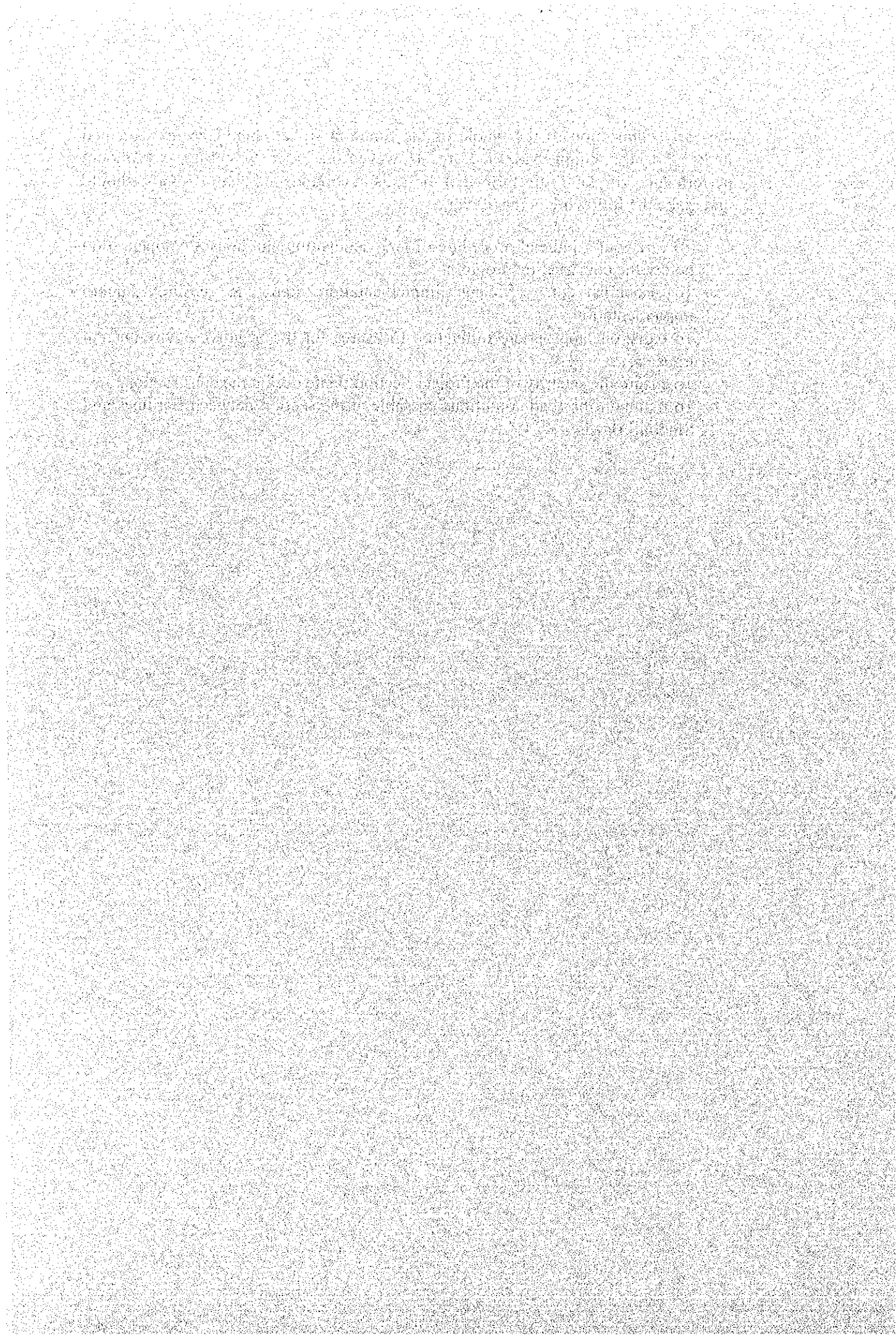


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CHAPTER 1
BACKGROUND OF THE PROJECT

PROBLEM 10 (1982)

CHAPTER 1 BACKGROUND OF THE PROJECT

The Kingdom of Nepal is a landlocked country, bordered on the north by China and on east, west and south by India. The population in 1991 was estimated to be 18.5 million. The country is divided into three topographical regions such as the Mountain Region, the Hill Region and Terai Plain, and also comprises of 75 Districts. The Districts are regrouped into five Development Regions divided by south-north borders.

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HMG/N has kept to give high priority to the Project and requested GOJ of a grant aid assistance for the Project which includes following:

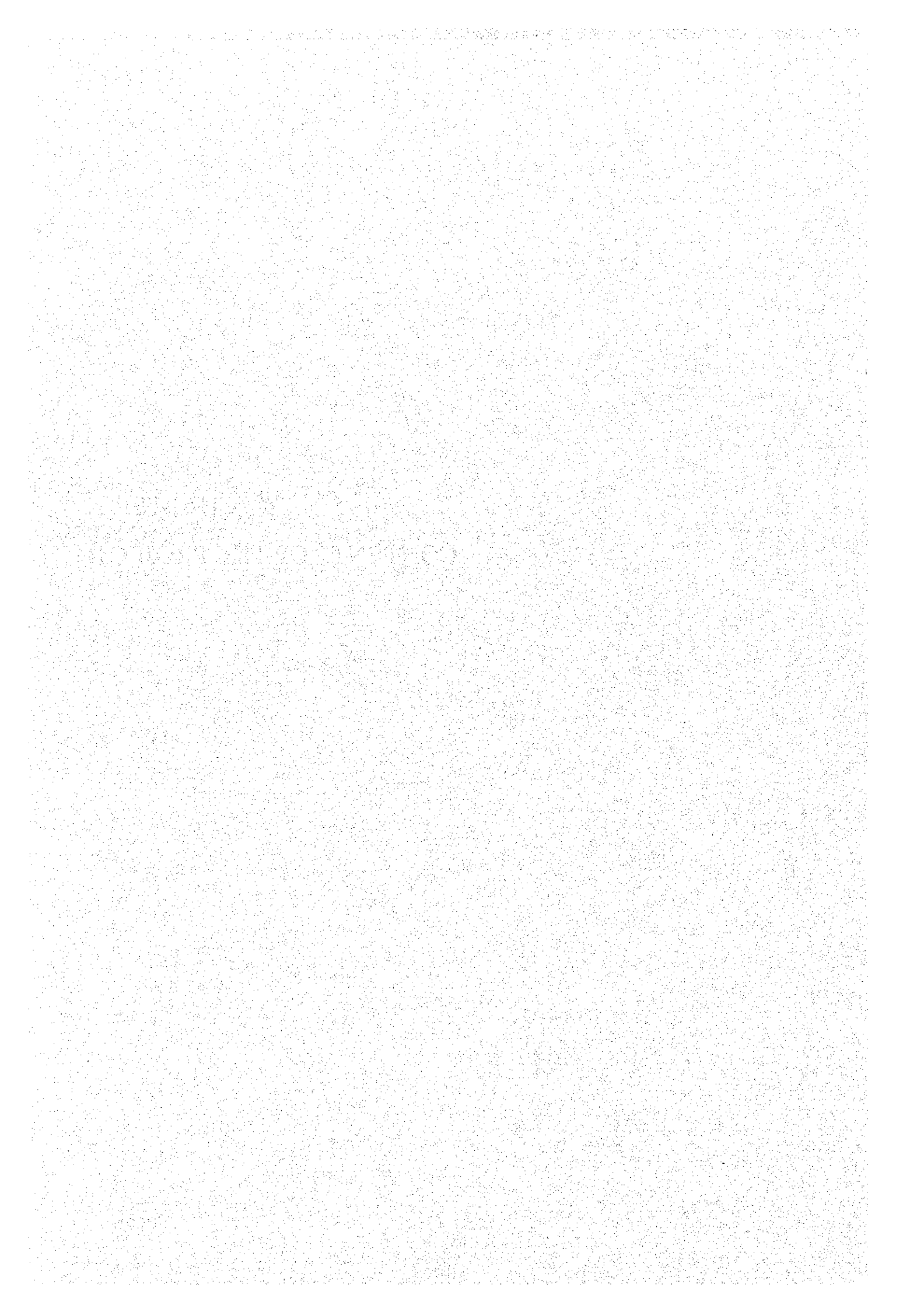
- Review of the Feasibility Study
- Construction of bridges and its approach roads in Section I
- Procurement of construction equipment and materials for Section II, Section III and Section IV
- Procurement of consulting services for the Project

In response to the request from HMG/N, GOJ decided to conduct a study aiming at formulating practical and realistic development schemes and implementation program based on the review of the previous F/S, namely the Aftercare Study. JICA carried out the Aftercare Study during the period between 1992 and 1993. The final report of the Aftercare Study recommended the optimum development scheme minimizing initial construction cost by introducing a stage wise construction concept. Based on the recommendation of the Aftercare Study, GOJ conducted basic design studies for the Project for Construction of Sindhuli Road (Section I: Bardibas - Sindhuli Bazar) (the Project Section I) and the Project for Construction of Sindhuli Road (Section IV: Nepalthok - Dhulikel) (the Project Section IV).

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CHAPTER 2
CONTENTS OF THE PROJECT



CHAPTER 2 CONTENTS OF THE PROJECT

2.1 OBJECTIVE OF THE PROJECT

One of the main objectives of the Ninth Plan (1997-2002) is to allocate poverty and so it set priority on developing the following sectors:

- Agriculture and Forestry
- Water Resources
- Human Resource and Social Development
- Industrialization, Tourism Development and International Trade
- Physical Infrastructures

The Ninth Plan has put special focus on developing physical infrastructures such as roads, bridges, and air transport and communication facilities as these are essential preconditions for reducing poverty.

In the road sub-sector of transport sector, a total of 1290km of new road construction linking the present road network and isolated district headquarters will be constructed during the Ninth Plan including Sindhuli Road. The Sindhuli Road account for 10 percent of new road construction.

The experience of the disaster that happened on July 1993 due to heavy rain, which disrupted traffic to and from Kathmandu for 20 days, traffic flow on the main transport route connecting Kathmandu and Terai plain is still at in rainy season. The route is a roundabout way covering about 200km for the traffic between Kathmandu and Eastern Region of Nepal.

Taking into account this situation in the present road network, His Majesty's Government of Nepal (HMG/N) recognized the necessity of ensuring the steady supply of daily commodities for Kathmandu Valley and promoting the development of the Eastern part of Terai, and thus formulated the Sindhuli Road Construction Project. The objectives of the Sindhuli Road Construction Project are as follows:

- To ensure the national security and further economic development through the utilization of the project road as an alternative trunk way, a "second back bone", which connects Kathmandu and the frontier to India via Terai Plain.
- To reduce the travel distance/time of the traffic between the Kathmandu Valley and Eastern Terai Plain, especially of the traffic conveying agricultural products.
- To upgrade and stimulate social and economic activities in the remote hill areas of the Central Development Region, particularly in the Sindhuli, Ramechhap and Kavrepalanchok Districts, and, consequently, to satisfy the basic human needs of the villagers living in the areas.

Section II of the Sindhuli Road Construction Project, from Sindhuli Bazar to Khurkot, approximately 40km long, is a third step towards the goal of the Project completion, following the implementation of the Project Section I which has already completed by March 1998 and the Project Section IV has started from May

1998.

2.2 BASIC CONCEPT OF THE PROJECT SECTION II

2.2.1 Concept of Road Planning for the Project Section II

(1) Concept of Road Planning

The area of the Project Section II has steep terrain, fragile geology and heavy rainfall with high risks of possible slope failures and debris flows. If the road is to have a high service level and be free from disasters, it would require high embankments and cuttings. This would cause a massive interference with the environment. As well, large scale structures and disaster prevention facilities would be needed resulting in a high total cost of the project.

Projects implemented under Japanese Grant Aid scheme are formulated with careful considerations on the budgetary constraints and have to be sustainable and achieve the objectives of the project. The scope of the Project Section II, expected to be implemented under Japanese Grant Aid, would be planned along the same lines.

Therefore, the first priority will be given simply to opening the entire length of the road section as sustainable, and then improving road conditions as much as possible according to budgetary constraint and natural conditions.

Following this policy, the Project Section II will be formulated by adopting the following measures to materialize a realistic road plan and road features harmonizing with the surrounding environment.

- Application of the stage wise construction method,
- Application of low cost structures such as causeways and partial and mitigative slope protection works, and
- Application of design speed of 20km/hr.

(2) Introduction of Stage Wise Construction

The Project Section IV has been implemented based on the stage wise construction concept, First a single lane is constructed; second, the road will be widened by covering the side ditch; and finally, a full scald dual lane road will be constructed. This concept of stage wise construction will be adopted in the Project Section II without any change since future traffic demand estimated by the supplemental traffic survey had not increased from that estimated in the Basic Design Study for the Project Section IV.

2.2.2 Basic Concept of the Project Section II

Thus, the Project Section II, from Sindhuli Bazar to Khurkot of approximately 40km length, is to be implemented as a 4.75m single lane road applying design speed of 20km/hr at the initial stage of the stage construction, following construction of the Project Section I and Section IV.