

Chapter 8 Summary of the Direction of Japan's Future Cooperation

8-1. Summary by Assistance Scheme

Ten project proposals that are likely future Japanese ODA projects for Bhutan are extracted through compilation and confirmation in the Study, and these projects are summarized according to the aid scheme. The list of extracted project proposals is shown in Table8-1.

<Table8-1> List of project proposals

No	Project name	Field	Aid scheme
1	Project for Reconstruction of Bridges on Primary National Highway No.4 (for five bridges)	Bridge	Grant aid
2	Project for Reconstruction of Bridges on the Southern East-West Corridor (for one bridge)	Bridge	Grant aid
3	Maukhola Bridge construction project	Bridge	Grant aid
4	Road widening project on Primary National Highway No.1 (Thomang Cliff & Namling Cliff)	Tunnel	Grant aid
5	Capacity Development in Quality Construction and Maintenance of Bridges in the country	Bridge	Technical cooperation project
6	Pavement technology and road maintenance capacity development project in the snowy cold region	Road pavement /maintenance	Technical cooperation project
7	Long-span bridge construction project	Bridge	Yen loan
8	Tunnel construction project	Tunnel	Yen loan
9	Installation of curved mirrors along PNH-1	Road safety	Grant aid
10	Grant aid for construction machinery	Construction machinery	Grant aid

Source: JICA Study Team

Details of each project proposal are summarized for each aid scheme in subsequent pages.

8-1-1. Grant Aid

(1) Project for Reconstruction of Bridges on Primary National Highway No.4 (for Five Bridges)

In an Application Form from DoR to JICA, a total of seven bridges for the bridge reconstruction project on PNH-4 were requested. As a result of prioritization of bridge reconstruction in the Study, Geleg (Aie) zam Bridge is excluded from the above seven bridges because the urgency for reconstruction is low as it is relatively new and sound with limited damage. Note that Katley III Bridge may be classified as A in terms of JICA's Environmental Category because it is located within the Biological Corridor though their reconstruction priority is high. Therefore this bridge is also excluded from the priority project. Note that according to DoR, the rule for national parks cannot be applied in the case of reconstruction of bridges within the ROW of a road even if the bridge is located in a national park area or biological corridor.

1) Outline of the Project

Reconstruction of Passang zam Bridge (40m), Beteni zam Bridge (25m), Chaplekhola Bridge (20m), Samkhara zam Bridge (61m) and Telegangchu zam Bridge (25m) on PNH-4

2) Project Goal

To ensure smooth and stable traffic on PNH-4

3) Project Achievement

Reconstruction of Passang zam Bridge, Beteni zam Bridge, Chaplekhola Bridge, Samkhara zam Bridge and Telegangchu zam Bridge, with enhanced loading capacity and widened carriageway width

4) Site

Trongsa Dzongkhag and Sarpang Dzongkhag

5) Local Authorities concerned

DoR, MoWHS

6) Rough Project Cost Estimates

Total of about 1.6 billion yen

7) Estimated Work Period

About 30 months

8) Considerations for Implementation of the Project

- It is planned to appropriate equipment procured in Japan and to reduce the project cost by assuming a blanket order for the five bridges concerned. If such appropriation of equipment is not possible, the project cost increases to a total of about 2.0 billion yen, so that careful construction planning should be developed.
- Bridges concerned are located in Sarpang Dzongkhag in the southern part of Bhutan. It is possible therefore to carry reinforcing bars and other construction materials from Phuentsholing, via Gelephu through India, to the sites. It is essential however to develop a materials/equipment transport plan by taking into account economy and safety because of high risk of labor strikes in Assam, India.

- Mandechu Hydropower plant construction project in Trongsa is currently in progress and transformers which are the heaviest pieces of equipment (105 tons, including trailer) are planned to cross Telegangchu zam when they are delivered from Phuentsholing to the project site through Thimphu. Therefore, for smooth delivery, it is preferable to complete the replacement of the bridge before the transformers are delivered. Although the schedule of the hydropower plant construction project is fluid, it needs to work closely with the project and consider the time of bridge replacement.

(2) Project for Reconstruction of Bridges on the Southern East-West Corridor (for one bridge)

1) Outline of the Project

Reconstruction of Diana Kuenphen zam Bridge on the Southern East-West Corridor (length about 311m)

2) Project Goal

To ensure smooth and stable traffic on the Southern East-West Corridor

3) Project Achievement

Reconstruction of Diana Kuenphen zam Bridge, with enhanced loading capacity and increased width

4) Site

Samtse Dzongkhag

5) Local Authorities concerned

DoR, MoWHS

6) Rough Project Cost Estimates

Total of about 1.7 billion yen

7) Estimated Construction Period

About 18 months

8) Considerations for Implementation of the Project

- The bridge concerned is located in the Sipsu-Samtse section of the Southern East-West Corridor. At present, it is difficult to verify the relevance of applying Japan's grant aid to the bridge because the road in the Samtse-Phuentsholing section is not yet connected and the existing traffic volume is small. It is therefore appropriate to set the reconstruction timing for after completion of the road in the Samtse-Phuentsholing section and the increase in the traffic volume of the Sipsu and Samtse section. Since the existing bridge is already damaged to a considerable extent, it is essential to perform monitoring of the damage continuously and to extend the service life by means of adequate repair.
- The bridge concerned is in the location where flood damage is highly likely, and river facilities, such as dykes, etc., are not well developed. Therefore, it is essential to review the length and type of the bridge concerned after a well-organized summary of river conditions. From the viewpoint of susceptibility to flood damage, it may be considered

possible to conduct assistance under the “Grant Aid for Disaster Prevention and Recovery”, instead of extending simple grant aid.

(3) Maukhola Bridge Construction Project

1) Outline of the Project

New construction of Maukhola Bridge (756m) on the Southern East-West Corridor

2) Project Goal

To ensure smooth and stable traffic on the Southern East-West Corridor

3) Project Achievement

Construction of Maukhola Bridge, contributing to opening of the entire Southern East-West Corridor

4) Site

Sarpang Dzongkhag

5) Local Authorities concerned

DoR, MoWHS

6) Rough Project Cost Estimates

Total of about 3.6 billion yen

7) Estimated Construction Period

About 32 months

8) Considerations for Implementation of the Project

- The bridge concerned is located in the Gelephu-Panbang section of the Southern East-West Corridor. At present, it is difficult to verify the relevance of applying Japan’s grant aid to the bridge because the road in this section is not yet connected. It is desirable to implement a study on the relevance of cooperation at a time when the prospect of road construction in this section is clear.

(4) Road Widening Project on PNH-1(Thomang Cliff & Namling Cliff)

1) Outline of the Project

This is to widen the road at two locations with blocky rock slopes (Thomang Cliff and Namling Cliff) along PNH-1. The construction length is 700 m for Thomang Cliff and 550 m for Namling Cliff. The construction method employed is a combination of tunneling (NATM blasting method), rock sheds, and rock fall protection nets.

2) Project Goal

To ensure smooth and stable traffic on PNH-1

3) Project Achievement

Construction of a tunnel and rock sheds, which allow widening of the road and improvement of the horizontal alignment

4) Sites

Trongsa Dzongkhag and Mongar Dzongkhag

5) Local Authorities concerned

DoR, MoWHS

6) Rough Project Cost Estimates

Total of about 2.6 billion yen

7) Estimated Work Period

About 30 months

8) Considerations for Implementation of the Project

In July 2014, the JICA “Project for Master Plan Study on Road Slope Management in Bhutan (Technical Cooperation Project)” was started. Accordingly, it is preferable that this road widening project will be formed under the leadership of DoR in the future after completion of the above technical cooperation project.

8-1-2. Technical Cooperation Project

(1) Capacity Building in Quality Construction and Maintenance of Bridges in the Country

1) Project Site

Thimphu and the sites of existing bridges and the construction sites of new bridges in the rural areas

2) Beneficiaries

DoR staff (HQ and regional offices), Staff of Bhutan Standard Bureau (BSB), Dzongkhag staffs, employees of private enterprises (construction companies, consultants), and persons concerned from universities

3) Cooperation Period

Three years from X (month), 2015

4) Rough Project Cost Estimates (Japan side)

Total about 250 million yen

5) Local Counterpart

DoR, MoWHS

6) Overall Goal

Capacity building in DoR would be achieved in terms of quality construction and maintenance of bridges that would assist in providing a reliable transport system, enhance the economy, reduce national poverty through provision and enhancement of rural accessibility, and support the socio-economic development of the country.

7) Project Purpose

Relevant engineers and researchers in Bhutan responsible for bridge construction, construction supervision and maintenance would receive practical training and experience in quality bridge construction, construction supervision and maintenance works through On-the-Job-Training (OJT).

An overall Bridge Maintenance System would be developed for DoR.

8) Outputs

- Output 1: Concerning quality construction and construction supervision of bridges, all the staff of Construction Division, DoR (totally 43 staff as of July 2014) receive training and their capacity is enhanced.
- Output 2: Concerning maintenance capacity development, a construction quality management manual is established.
- Output 3: Concerning maintenance capacity development, all the staff of the Maintenance Division, DoR (totally 151 staff as of July 2014) have received training and their capacity is enhanced.
- Output 4: Concerning maintenance capacity development, a bridge maintenance system is established.

9) Activities

[Activity 1]

To enhance the quality control capacity for bridge construction, factorial analysis of damage is performed using heavily-damaged Diana Kuenphen zam Bridge in Samtse Dzongkhag as educational material. OJT is provided to engineers in DoR H.Q., field engineers and researchers.

[Activity 2]

To enhance the quality control capacity for bridge construction, one new-bridge construction site is selected as a pilot project site and OJT is provided to engineers in DoR H.Q. and the field engineers.

[Activity 3]

To enhance the quality control capacity for bridge construction, a construction quality management manual is prepared.

[Activity 4]

To enhance the maintenance capacity, training concerning bridge inspection is performed using heavily-damaged Diana Kuenphen zam Bridge in Samtse Dzongkhag as educational material. OJT is provided to the engineers engaged in maintenance.

[Activity 5]

To enhance the maintenance capacity, a bridge inventory and a bridge maintenance manual are prepared.

[Activity 6]

To enhance the maintenance capacity, guidance is provided to engineers of the Maintenance Division in DoR H.Q., regional office staff and site engineers concerning bridge inspection, report of inspection results, maintenance method, and how to use the bridge inventory and the bridge maintenance manual.

[Activity 7]

To enhance the maintenance capacity, a bridge maintenance system appropriate to the present state of Bhutan is prepared.

[Activity 8]

To understand the latest bridge construction technologies, overseas training (in Japan) is provided.

10) Input

Assumed input is as follows:

(A) Japan side

- Dispatch of specialists
- Training in Japan
- Provision of equipment and materials
- Local activity costs

(B) Bhutan side

- Allocation of the counterpart (DoR)
- Project office
- Provision of facilities and equipment necessary for implementation of the project
- Management and operating expenses

(2) Pavement Technology and Road Maintenance Capacity Development Project in the Snowy Cold Region

1) Project Site

Thimphu and at Thrumshing La Pass (Bumthang Dzongkhag) on PNH-1

2) Beneficiaries

DoR staff (HQ and regional offices), Dzongkhag staff, employees of private enterprises (construction companies, consultants), etc.

3) Cooperation Period

Two years from X (months). 201X

4) Rough Project Cost Estimates (Japan side)

Total about XX million yen

5) Local Counterpart

DoR, MoWHS

6) Overall Goal

Improvement of the road surface condition in the high-altitude area and alleviation of the effects of road block due to snow cover in winter, thereby contributing to economic development, reduction of poverty, and higher accessibility to the rural areas, by attempting upgrading of pavement technology and road maintenance capacities in the snow-covered cold areas in DoR

7) Project Purpose

Upgrading of pavement technology and enhancing road maintenance capacities in the snowy cold region of Bhutan by allowing Bhutanese engineers engaged in road construction and maintenance to receive practical training through OJT of technical cooperation project

8) Output

Output 1: Concerning upgrading of pavement technology in the snowy cold region, all of the Design Division/Construction Division staff of DoR (totally 52 staff as of July 2014) receives training and their capacity is upgraded.

Output 2: Concerning enhancement of road maintenance capacity in the snowy cold region, all of Maintenance Division staff of DoR (totally 151 staff as of July 2014) receives training and their capacity is upgraded.

9) Activities

[Activity 1]

To upgrade the pavement technology in the snowy cold region, OJT concerning design

and construction approaches is provided to engineers in DoR H.Q. and site engineers by using the northern slope (about 5 km long), with heavily damaged pavement, of Thrumshing La Pass of Bumthang Dzongkhag as the site of the pilot project.

[Activity 2]

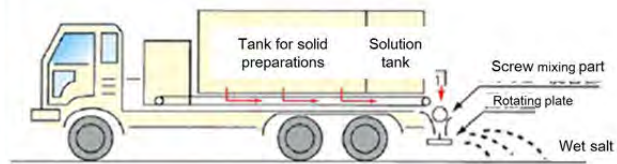
To enhance the road maintenance capacity in the snowy cold region, a review is performed on the maintenance system, including the facility layout, vehicle arrangement plan and personnel distribution plan for the engineers in DoR H.Q. and regional office engineers.

[Activity 3]

To enhance the road maintenance capacity in the snowy cold region, the road maintenance manual is established, which specifies the inspection method and road maintenance level.

[Activity 4]

To understand the latest road maintenance technologies in the snow-covered cold areas, overseas training (in Japan) is provided.



Source: NEXCO pamphlet

<Figure8-1> Anti-freezing agent spreading in Japan (left) and the conceptual view of anti-freezing agent spray vehicle (right)

10) Input

Assumed input is as follows:

(A) Japan side

- Dispatch of experts
- Training in Japan
- Provision of equipment and materials
- Local activity costs

(B) Bhutan side

- Allocation of the counterpart (DoR)
- Project office
- Provision of facilities and equipment necessary for implementation of the project
- Management and operating expenses

8-1-3. Yen Loan

(1) Long-span Bridge Construction Project

On the Southern East-West Corridor currently under construction, multiple long-span bridges of 300 m or more in length, such as Maukhola Bridge and Diana Kuenphen zam Bridge, are planned at locations crossing large rivers. However, Bhutan has no technology to plan and construct such long-span bridges independently, and it is not easy to secure the huge construction cost. It is therefore considered that in the future the Royal Government of Bhutan may request that Japan construct the long-span bridges under a Japanese yen loan. It may be proposed to group multiple bridges, such as Maukhola Bridge and Diana Kuenphen zam Bridge, which are on the Southern East-West Corridor, and additionally Lungten zam Bridge in Thimphu, to be included collectively in the scope of a yen loan, so as to increase the impact on the Bhutanese people by constructing the symbolic bridge at the entrance to the capital under Japan's aid.

However, the debt ratio of the loan is high looking at the current debt status of Bhutan. Under such circumstances, it is a fact that there are people that question the development of bridges which do not produce revenue, unlike hydroelectric power, to be yen loan targets. On the other hand, it is believed that in the future, implementation of bridge construction with an ODA loan using the Special Terms for Economic Partnership (STEP) based on the grasped proper debt situation of Bhutan and sell Japanese technology is effective because the quality of Japanese technology is highly trusted in Bhutan.



Source: JICA Study Team
<Figure8-2> Lungten zam Bridge in Thimphu

(2) Tunnel Construction Project

The Road Sector Master Plan of Bhutan is planning tunnel construction at ten locations in the future. For bypass construction to reduce the traveling distance and for avoidance of large-scale landslide areas, tunnel construction proves extremely effective and critical. However, Bhutan does not have tunnel designing and construction technologies, and it is difficult to secure the huge construction costs. It is likely that the need for tunnel construction utilizing a Japanese yen

loan will increase in the future. At present, the traffic volume on each national highway is small and actually the benefit expected by tunneling is not proportional to the required huge construction cost. The timing for cooperation in this respect will be in the far future.

Selling Japanese technology using STEP on tunnel construction is considered to be effective since expectations for the advanced technology of our country are highly similarly to the bridge construction.

8-1-4. Others

(1) Installation of Curved Mirrors along PNH-1

There are many curves where the risk of collision with oncoming vehicles is high because of failure to secure adequate sight distance. Once an accident occurs, the vehicles involved in the accident may block the narrow roadway. Besides, it will take time before arrival of the police officers, resulting in serious congestion. Accordingly, installing curved mirrors at points with blind corners to prevent accidents is critical as a means to solve the bottleneck. For example, the cooperation may be such as to provide curved mirrors as a pilot project along PNH-1 (for example, a total of 500 pieces at a rate of one every 1 km) under grant aid. Provision, at certain intervals, of curved mirrors enabling confirmation that they are provided under assistance of JICA, can enhance the advertising effect to the Bhutanese. Since there is a concern that the mirror may be broken by stone throwing in Bhutan, it is desirable that the mirrors to be introduced are made from impact-resistant materials (for example, stainless steel, polycarbonate resin, etc.).



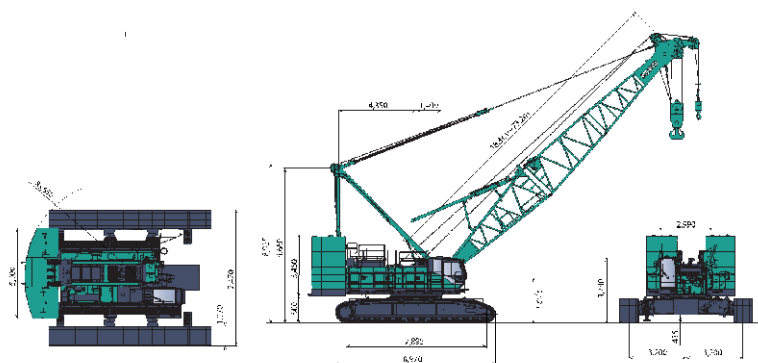
Source: Website

<Figure8-3> Example of curved mirror

(2) Grant Aid for Construction Machinery

A crane for transporting members is indispensable for construction of the bridges. The largest one available in Bhutan at present is only a 25-ton old crane owned by CDCL. With this crane, the construction method, such as erection by erection girders of the superstructure, which does not require the use of a large crane, is employed. As this method enables construction only during the dry season, the work period tends to be longer.

On the other hand, a crane may be procured in Japan under grant aid, which however requires extremely high rent. For example, in the case of the use of a 200-ton crane, the cost incurred for hiring will be approximately equivalent to the case of purchasing and importing a new crane from Japan. Accordingly, provision of a 200-ton crane (including the assembling crane and trailer) to DoR under grant aid will improve the bridge construction conditions in Bhutan dramatically. There will be many opportunities for using such crane for construction of long-span bridges along the Southern East-West Corridor, for example.



Source: Website

<Figure8-4> 200-ton crane

8-2. Review of the Timing of Implementing the Aid

The previous section summarized ten project proposals according to the aid scheme. This section summarizes them on the basis of the implementation timing of the project proposals. As shown in Table8-2, the implementation timing is classified into the “Short-term (started in five years),” “Middle-term (started five years to ten years from the present),” and “Long-term (started later than 10 years from the present).” Then the priority projects are extracted from the viewpoint of the Study Team, for which the “high” preference is assigned. The highly preferred among them are **“Project for Reconstruction of Bridges on Primary National Highway No.4 (for five bridges)”** and **“Capacity Development in Quality Construction and Maintenance of Bridges in the country”**.

<Table8-2> List of project proposals

No	Project name	Aid scheme	Priority by JICA study team
Short-term (started in five years)			
1	Project for Reconstruction of Bridges on Primary National Highway No.4 (for five bridges)	Grant aid	High
2	Capacity Development in Quality Construction and Maintenance of Bridges in the country	Technical cooperation	High
3	Pavement technology and road maintenance capacity development project in the snowy cold region	Technical cooperation	
4	Project for Reconstruction of Bridges on the Southern East-West Corridor (for one bridge)	Grant aid	High
5	PNH1 road widening project (Thomang Cliff & Namling Cliff)	Grant aid	
6	Installation of curved mirrors along PNH-1	Grant aid	
7	Grant aid for construction machinery	Grant aid	
Middle-term (started five years to ten years from the present)			
1	Maukhola Bridge construction project	Grant aid	High
Long-term (started later than 10 years from the present)			
1	Long-span bridge construction project	Yen loan	
2	Tunnel construction project	Yen loan	

Source: JICA Study Team

8-3. Conclusions

All 10 project proposals proposed by the JICA Study Team are important even though there are differences in their priority. These project proposals can be classified into three categories in implementation timing , “Short-term“, “Middle-term” and “Long-term” considering size, exigency, maturity level of road sector in Bhutan, etc.

A four-day meeting was held in DoR from 22nd July 2014 and the Prime Minister Tshering Tobgay made a speech in the meeting to DoR staff on road condition in Bhutan. Contents of the speech which are shown below are important (quoted from the article in KUENSEL, July 26, 2014).

- Regardless of what type of road it is, potholes emerge after two to three years.
- The budget being allocated for new roads has to be used instead for the repair and maintenance of existing roads.
- Road conditions deteriorate rapidly either because contractors have not done the work well or engineers have not supervised sufficiently.
- The quality of the new road under construction at Dochula is satisfactory. The quality and specification of road work at the Dochula, Thimphu could be an example for other road work. This is because the road is meeting the required construction standards and specifications.
- The government has already planned how and where national highways will be built on priority basis.
- New roads will be built and existing ones consolidated with the Indian government’s Project Tie Assistance (PTA) and national budget. Discussion on obtaining financial assistance from the World Bank and the ADB are also ongoing.
- Roads are a major reason why Bhutan is progressing socially and economically. However, despite the progress, better roads still need to be built.
- If Bhutan is to achieve self-sustainability, agriculture must be promoted and that is done through building roads to communities and economic development, hydropower, agriculture, tourism, microbusinesses, and the mining industry all depend on roads.

As the Prime Minister mentioned in the speech, it is essential for Bhutan’s self-independence and development to promote agriculture and collaboration between agriculture and road/bridge construction is important in order to promote it. And as for Japan’s past assistance for Bhutan, agriculture promotion and bridge construction were the two main pillars and it seems that these will also be the main pillars of Japan’s future assistance. In order to promote agriculture, it is very important to develop the southern area of Bhutan where broad and fertile lands exist. Therefore, construction of the Southern East-West Corridor is very important and the

government of Bhutan is now constructing the road with high priority. In the project proposals, the “Project for Reconstruction of Bridges on the Southern East-West Corridor (for one bridge)” is included as a short-term grant aid project and “Maukhola Bridge construction project” is included as a middle-term grant aid project.

Furthermore, maintenance work will be more important in the future as well as new road development. On 15th July 2014, the cabinet decided to introduce a fuel tax. If revenue from the tax can be used for proper road maintenance, implementation of systematic maintenance will be possible.

It is desirable to contribute to the economic development of Bhutan and improve the quality of people’s lives by implementing the project proposals put forth in the Study at an appropriate time.

Appendix- 1 :

Result of Traffic Demand Forecast

Population transition and future forecast for each PNH

Year	PNH-1							PNH-2		PNH-3			PNH-4			PNH-5			Total population of Bhutan	
	Thimphu	Punakha	Wangduephodrang	Trongsa	Bumthang	Mongar	Trashigang	Thimphu	Chhukha	Trashigang	Pemagatshel	Samdrupjongkhar	Trongsa	Zhemgang	Sarpang	Wangduephodrang	Tsirang	Sarpang	Population	Growth rate from last year
2005	98,676	17,715	31,135	13,419	16,116	37,069	48,783	98,676	74,387	48,783	13,864	41,149	13,419	18,636	41,549	31,135	18,667	41,549	634,982	1.000
2006	95,107	23,890	31,755	13,671	16,398	37,768	49,523	95,107	75,749	49,523	22,585	34,554	13,671	18,924	37,916	31,755	18,979	37,916	646,851	1.019
2007	97,326	24,323	32,384	13,927	16,682	38,480	50,271	97,326	77,132	50,271	22,817	35,229	13,927	19,213	38,740	32,384	19,294	38,740	658,888	1.019
2008	99,587	24,762	33,022	14,187	16,966	39,197	51,024	99,587	78,529	51,024	23,179	35,915	14,187	19,503	39,581	33,022	19,612	39,581	671,083	1.019
2009	101,880	25,205	33,668	14,448	17,258	39,922	51,780	101,880	79,944	51,780	23,476	36,607	14,448	19,798	40,436	33,668	19,933	40,436	683,407	1.018
2010	104,217	25,650	34,320	14,712	17,544	40,653	52,536	104,217	81,364	52,536	23,777	37,307	14,712	20,090	41,300	34,320	20,254	41,300	695,822	1.018
2011	106,568	26,096	34,974	14,977	17,837	41,386	53,293	106,568	82,784	53,293	24,075	38,008	14,977	20,380	42,170	34,974	20,576	42,170	708,265	1.018
2012	108,933	26,541	35,587	15,240	18,127	42,119	54,036	108,933	84,206	54,036	24,363	38,674	15,240	20,672	43,042	35,587	20,894	43,042	720,679	1.018
2013	111,306	26,981	36,196	15,501	18,411	41,852	54,768	111,306	85,609	54,768	24,645	39,336	15,501	20,957	43,778	36,196	21,209	43,778	733,004	1.017
2014	113,151	27,428	36,796	15,758	18,716	42,546	55,676	113,151	87,028	55,676	25,053	39,988	15,758	21,304	44,504	36,796	21,561	44,504	745,153	1.017
2015	114,956	27,866	37,383	16,009	19,015	43,224	56,564	114,956	88,416	56,564	25,453	40,626	16,009	21,644	45,214	37,383	21,905	45,214	757,042	1.016
2016	116,708	28,290	37,952	16,253	19,304	43,883	57,426	116,708	89,764	57,426	25,841	41,245	16,253	21,974	45,903	37,952	22,238	45,903	768,577	1.015
2017	118,392	28,699	38,500	16,487	19,583	44,516	58,254	118,392	91,059	58,254	26,214	41,840	16,487	22,291	46,565	38,500	22,559	46,565	779,666	1.014
2018	119,993	29,087	39,021	16,710	19,848	45,119	59,043	119,993	92,291	59,043	26,569	42,406	16,710	22,593	47,195	39,021	22,864	47,195	790,215	1.014
2019	121,503	29,453	39,511	16,921	20,098	45,686	59,785	121,503	93,452	59,785	26,903	42,939	16,921	22,877	47,789	39,511	23,152	47,789	800,154	1.013
2020	122,906	29,793	39,968	17,116	20,330	46,214	60,476	122,906	94,531	60,476	27,213	43,435	17,116	23,141	48,341	39,968	23,419	48,341	809,397	1.012
2021	124,269	30,123	40,411	17,306	20,555	46,726	61,146	124,269	95,579	61,146	27,515	43,917	17,306	23,398	48,877	40,411	23,679	48,877	818,370	1.011
2022	125,585	30,442	40,839	17,489	20,773	47,221	61,794	125,585	96,591	61,794	27,807	44,382	17,489	23,645	49,394	40,839	23,930	49,394	827,038	1.011
2023	126,852	30,749	41,251	17,666	20,982	47,697	62,417	126,852	97,566	62,417	28,087	44,829	17,666	23,884	49,892	41,251	24,171	49,892	835,379	1.010
2024	128,064	31,043	41,645	17,834	21,183	48,153	63,014	128,064	98,498	63,014	28,355	45,258	17,834	24,112	50,369	41,645	24,402	50,369	843,363	1.010
2025	129,220	31,323	42,021	17,995	21,374	48,588	63,583	129,220	99,387	63,583	28,611	45,666	17,995	24,330	50,824	42,021	24,622	50,824	850,976	1.009
2026	130,349	31,597	42,388	18,153	21,561	49,012	64,138	130,349	100,255	64,138	28,861	46,065	18,153	24,542	51,268	42,388	24,838	51,268	858,410	1.009
2027	131,450	31,864	42,746	18,306	21,743	49,426	64,680	131,450	101,102	64,680	29,105	46,454	18,306	24,750	51,701	42,746	25,047	51,701	865,662	1.008
2028	132,528	32,125	43,097	18,456	21,921	49,832	65,210	132,528	101,931	65,210	29,344	46,835	18,456	24,953	52,125	43,097	25,253	52,125	872,759	1.008
2029	133,583	32,381	43,440	18,603	22,096	50,228	65,729	133,583	102,743	65,729	29,577	47,208	18,603	25,151	52,540	43,440	25,454	52,540	879,707	1.008
2030	134,618	32,632	43,776	18,747	22,267	50,617	66,239	134,618	103,539	66,239	29,807	47,574	18,747	25,346	52,947	43,776	25,651	52,947	886,523	1.008

Source : Annual Dzongkhag Statistics

PNH-1 Thimphu - Wangdue

Data used

Sectional traffic volume	Population	Year	City
Y	X		
904	98,676	2005	Thimphu
770	95,107	2006	Thimphu
679	97,326	2007	Thimphu
722	99,587	2008	Thimphu
1,015	101,880	2009	Thimphu
1,358	106,568	2011	Thimphu
954	111,306	2013	Thimphu
1,327	113,151	2014	Thimphu

Result of regression analysis (PNH1 Thimphu - Wangdue)

Response variable traffic volume
 Predictor variable population
 Number of data 8
 Traffic volume = 0.0295*population-2075.9725

Contribution 0.5766
 Multiple correlation coefficient 0.7594

PNH-1 Wangdue - Jakar

Data used

Sectional traffic volume	Population	Year	City
Y	X		
229	31,135	2005	Wangduephodrang
290	31,755	2006	Wangduephodrang
222	32,384	2007	Wangduephodrang
152	16,116	2005	Bumthang
188	16,398	2006	Bumthang
208	16,682	2007	Bumthang
186	16,966	2008	Bumthang

Result of regression analysis (PNH1 Wangdue - Jakar)

Response variable traffic volume
 Predictor variable population
 Number of data 7
 Traffic volume = 0.0042*population+114.0296

Contribution 0.6177
 Multiple correlation coefficient 0.7859

PNH-1 Jakar - Trashigang

Data used

Sectional traffic volume	Population	Year	City
Y	X		
81	37,069	2005	Mongar
33	37,768	2006	Mongar
54	38,480	2007	Mongar
63	39,197	2008	Mongar
75	39,922	2009	Mongar
108	40,653	2010	Mongar
119	41,386	2011	Mongar
39	48,783	2005	Trashigang
148	49,523	2006	Trashigang
138	50,271	2007	Trashigang
149	51,024	2008	Trashigang

Result of regression analysis (PNH1 Jakar - Trashigang)

Response variable traffic volume
 Predictor variable population
 Number of data 11
 Traffic volume = 0.0048*population-115.1933

Contribution 0.3840
 Multiple correlation coefficient 0.6196

PNH-2**Data used**

Sectional traffic volume	Population	Year	City
Y	X		
715	98,676	2005	Thimphu
1,011	95,107	2006	Thimphu
900	99,587	2008	Thimphu
1,278	111,306	2013	Thimphu
1,028	113,151	2014	Thimphu

Result of regression analysis (PNH2)

Response variable traffic volume
 Predictor variable population
 Number of data 5
 Traffic volume = 0.0157*population-634.9391

Contribution 0.3827
 Multiple correlation coefficient 0.6186

PNH-3**Data used**

Sectional traffic volume	Population	Year	City
Y	X		
175	48,783	2005	Trashigang
232	49,523	2006	Trashigang
266	50,271	2007	Trashigang
353	53,293	2011	Trashigang
387	54,036	2012	Trashigang
606	55,676	2014	Trashigang

Result of regression analysis (PNH3)

Response variable traffic volume
 Predictor variable population
 Number of data 6
 Traffic volume = 0.0520*population-2362.2942

Contribution 0.8918
 Multiple correlation coefficient 0.9444

PNH-4**Data used**

Sectional traffic volume	Population	Year	City
Y	X		
93	41,549	2005	Sarpang
107	37,916	2006	Sarpang
92	38,740	2007	Sarpang
118	39,581	2008	Sarpang
196	41,300	2010	Sarpang
240	44,504	2014	Sarpang

Result of regression analysis (PNH-4)

Response variable traffic volume
 Predictor variable population
 Number of data 6
 Traffic volume = 0.0207*population-697.6247

Contribution 0.6292
 Multiple correlation coefficient 0.7932

PNH-5**Data used**

Sectional traffic volume	Population	Year	City
Y	X		
126	37,916	2006	Sarpang
127	38,740	2007	Sarpang
171	39,581	2008	Sarpang
184	40,436	2009	Sarpang
179	41,300	2010	Sarpang
167	42,170	2011	Sarpang

Result of regression analysis (PNH-5)

Response variable traffic volume
 Predictor variable population
 Number of data 6
 Traffic volume = 0.0125*population-340.2776

Contribution 0.5903
 Multiple correlation coefficient 0.7683

Appendix-2 :

The Letter regarding the Statement of the King on the
Construction in the Royal Manas National Park



དཔལ་ལྷན་འབྲུག་གཞུང་། འབྲུག་རྒྱལ་ཁབ་ལྷན་ཁག་།
ROYAL GOVERNMENT OF BHUTAN
MINISTRY OF WORKS & HUMAN SETTLEMENT
DEPARTMENT OF ROADS
THIMPHU: BHUTAN



"Towards Quality Infrastructure"

DoR/DIR/2012-13/ 46/5

April 9, 2013

Hon'ble Secretary
GNH Commission Secretariat
Tashi Chhodzong, Thimphu

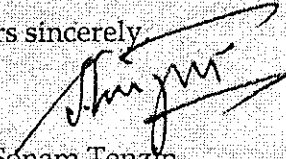
Sub: **Royal Command for construction of Gelephu-Panbang road**

Dear Dasho,

I would like to take this opportunity to inform Dasho that I had a great fortune of having an audience with His Majesty the King on April 5, 2013. I had sought the audience to apprise His Majesty the King about various issues related to the Ministry of Works and Human Settlement. During the audience, His Majesty the King kindly inquired about the 11FYP programs for the Ministry of Works and Human Settlement. Out of many submissions that I made, I was able to elaborate more about the southern east-west highways to His Majesty the King. I am pleased to inform you that the Royal Command for construction of Gelephu-Panbang road via Manas National Park was granted during the audience. In this regard, I would like to request Dasho to kindly inform other stakeholders about the Royal Command so that the Department of Roads is provided with necessary support as it prepares for the construction of the highway.

With best wishes,

Yours sincerely


Dr. Sonam Tenzin
(SECRETARY)

- Copy: 1. Hon'ble Zhabtog Lyonpo, MoWHS for kind information;
2. Cabinet Secretary, for information;
3. Secretary, Ministry of Finance for information;
4. Secretary, Ministry of Agriculture for information; and
5. Secretary, National Environment Commission for information.






Tele: 00975-2-327998/328173/326793/322182/325171

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Po Box: 791

Appendix-3 :









Bridge Inventory Prepared by JICA Study Team



Bridge Name		A-1.Semtokha Flyover		PNH	No.1	Date	2014/4/19
Photo Location	from Thimphu side			Photo Location	from Trashigang side		
							
Photo Location	Semtoka to Thimphu side			Photo Location	Thimphu to Semtoka side		
							
Photo Location	Ramp (earth work)			Photo Location			
							
Photo Location				Photo Location			

Site Condition Photo




Bridge Name		A-1.Semtokha Flyover		PNH		No.1		Date	2014/4/19
Member	Railing			Member	Abutment				
Type of damage	Deformation	Damage level	c	Type of damage	Other	Damage level	-		
Condition	Damaged by vehicles			Condition	Improved				
									
Member	Deck slab			Member	Pavement surface				
Type of damage	-	Damage level	a	Type of damage	-	Damage level	a		
Condition	soundness			Condition	soundness				
									
Member	Railing			Member	Entire bridge				
Type of damage	Damaged	Damage level	c	Type of damage	Other	Damage level	-		
Condition	Crack and peeling off			Condition	桁の補強及び交差道路掘削工事中である。				
									
Member				Member					
Type of damage		Damage level		Type of damage		Damage level			
Condition				Condition					

Damage photo









Bridge Name		A-2.Prakhdrang II		PNH		No.1		Date		2014/4/17		
Site Condition Photo	Photo Location	from Thimphu side				Photo Location	from Trashigang side					
												
	Photo Location	from down stream of Thimphu side				Photo Location	from down stream of Trashigang side					
												
	Photo Location	from up stream of Thimphu side				Photo Location	from up stream of Trashigang side					
												
	Photo Location	down stream direction				Photo Location	up stream direction					
												




Bridge Name		A-2.Prakhadrang II		PNH	No.1	Date	2014/4/17	
Damage photo	Member	Pavement		Member	Truss			
	Type of damage	Unevenness	Damage level	e	Type of damage	-	Damage level	a
	Condition	Restriction (use former road) of heavy vehicles		Condition	Soundness			
								
	Member			Member				
	Type of damage		Damage level		Type of damage		Damage level	
	Condition			Condition				
	Member			Member				
	Type of damage		Damage level		Type of damage		Damage level	
	Condition			Condition				
Member			Member					
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					
Member			Member					
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					

Bridge Name		A-3.Namling zam		PNH		No.1		Date		2014/4/16		
Site Condition Photo	Photo Location	from Thimphu side				Photo Location	from Trashigang side					
												
	Photo Location	from down stream of Thimphu side				Photo Location	from down stream of Trashigang side					
												
	Photo Location	from up stream of Thimphu side				Photo Location	from up stream of Trashigang side					
												
	Photo Location	down stream direction				Photo Location	up stream direction					
												

Bridge Name	A-3.Namling zam			PNH	No.1	Date	2014/4/16
Member	Pavement of approach section			Member	Upstream side of Sabo dam		
Type of damage	Unevenness	Damage level	e	Type of damage	Other	Damage level	-
Condition	Space/damage at joint section			Condition	Bailey bridge improved at existing location after past flooding		
							
Member	Detour			Member			
Type of damage	Other	Damage level	-	Type of damage		Damage level	
Condition	Restriction (use former road) of heavy vehicles			Condition			
							
Member				Member			
Type of damage		Damage level		Type of damage		Damage level	
Condition				Condition			
Member				Member			
Type of damage		Damage level		Type of damage		Damage level	
Condition				Condition			








Damage photo









Bridge Name		A-4.Gektong zam		PNH		No.1 Nangar-Ura bypass		Date		2014/4/16		
Site Condition Photo	Photo Location	from Thimphu side				Photo Location	from Trashigang side					
												
	Photo Location	from down stream of Thimphu side				Photo Location	from down stream of Trashigang side					
												
	Photo Location	from up stream of Thimphu side				Photo Location	from up stream of Trashigang side					
												
	Photo Location	down stream direction				Photo Location	up stream direction					
												

Bridge Name		A-4.Gektong zam		PNH	No.1 Nangar-Ura bypass	Date	2014/4/16	
Damage photo	Member	Surface		Member	Truss			
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a
	Condition	Soundness		Condition	Soundness			
								
	Member	Abutment		Member				
	Type of damage	-	Damage level	a	Type of damage		Damage level	
	Condition	Soundness		Condition				
								
	Member			Member				
	Type of damage		Damage level		Type of damage		Damage level	
Condition			Condition					
Member	部材名		Member	部材名				
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					






Bridge Name	A-5.Tangchu zam		PNH	No.1	Date	2014/4/17
Photo Location	from Thimphu side		Photo Location	from Trashigang side		
Photo Location	from down stream of Thimphu side		Photo Location	from down stream of Trashigang side		
Photo Location	from up stream of Thimphu side		Photo Location	from up stream of Trashigang side		
Photo Location	down stream direction		Photo Location	up stream direction		








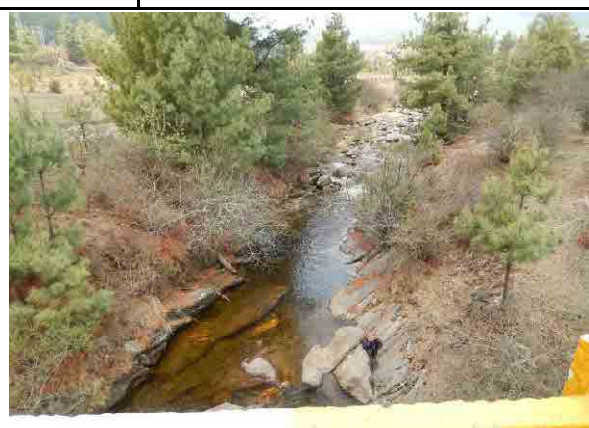
Site Condition Photo

Bridge Name		A-5.Tangchu zam			PNH	No.1	Date	2014/4/17
Damage photo	Member	Railing			Member	Abutment wall		
	Type of damage	Loss of concrete	Damage level	c	Type of damage	Peeling off	Damage level	d
	Condition	Peeling off/rebar exposure			Condition	Partly rebar exposure		
								
	Member	Deck slab			Member	Bearing shoe		
	Type of damage	-	Damage level	a	Type of damage	Clogging	Damage level	e
	Condition	Soundness			Condition	Clogging surrounding shoe		
								
	Member	Drainage facilities			Member	Body wall		
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a
Condition	Soundness			Condition	Soundness			
								
Member	Railing			Member				
Type of damage	Crack	Damage level	c	Type of damage		Damage level		
Condition	Partly cracking			Condition				
								







Bridge Name		A-6.Rabten Zam		PNH	No.1	Date	2014/4/16
Photo Location	from Thimphu side			Photo Location	from Trashigang side		
							
Photo Location	from down stream of Thimphu side			Photo Location	from down stream of Trashigang side		
							
Photo Location	from up stream of Thimphu side			Photo Location	from up stream of Trashigang side		
							
Photo Location	down stream direction			Photo Location	up stream direction		
							









Site Condition Photo








Bridge Name		A-6.Rabten Zam		PNH	No.1	Date	2014/4/16	
Damage photo	Member	Body		Member	Deck slab			
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a
	Condition	Soundness		Condition	Soundness			
								
	Member	Bearinmg shoe		Member	Pavement			
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a
	Condition	Soundness		Condition	Soundness			
								
	Member	Entire Bridge		Member				
	Type of damage	Scouring	Damage level	a	Type of damage		Damage level	
Condition	Scouring measurement has been carried out		Condition					
								
Member			Member					
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					



Bridge Name		A-7.Gaytsa Zam		PNH		No.1		Date		2014/4/16	
Photo Location		from Thimphu side				Photo Location		from Trashigang side			
				Photo Location		from down stream of Thimphu side		Photo Location		from down stream of Trashigang side	
				Photo Location		from up stream of Thimphu side		Photo Location		from up stream of Trashigang side	
				Photo Location		down stream direction		Photo Location		up stream direction	
											

Site Condition Photo






Bridge Name		A-7.Gaytsa Zam			PNH	No.1	Date	2014/4/16		
Damage photo	Member	Girder			Member	Drainage facilities				
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a		
	Condition	Soundness			Condition	Soundness				
										
	Member	Railing			Member	Expansion joint				
	Type of damage	Rebar exposure	Damage level	c	Type of damage	-	Damage level	a		
	Condition	Partly rebar exposure			Condition	Soundness				
										
	Member	Surface			Member	Body				
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a		
Condition	Soundness			Condition	Soundness					
										
Member				Member						
Type of damage		Damage level		Type of damage		Damage level				
Condition				Condition						









Bridge Name		A-8.Bong Zam		PNH		No.1		Date		2014/4/16		
Site Condition Photo	Photo Location	from Thimphu side				Photo Location	from Trashigang side					
												
	Photo Location	from down stream of Thimphu side				Photo Location	from down stream of Trashigang side					
												
	Photo Location	from up stream of Thimphu side				Photo Location	from up stream of Trashigang side					
												
	Photo Location	down stream direction				Photo Location	up stream direction					
												

Bridge Name		A-8.Bong Zam			PNH	No.1	Date	2014/4/16
Damage photo	Member	Deck slab			Member	Girder		
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a
	Condition	Soundness			Condition	Soundness		
								
	Member	Pavement surface			Member	Parapet wall		
	Type of damage	Crack	Damage level	c	Type of damage	-	Damage level	a
	Condition	Cracks on Joint and Approach road			Condition	Soundness but moss		
								
	Member	Railing			Member	Abutment		
	Type of damage	Rebar exposure	Damage level	c	Type of damage	Water leakage	Damage level	c
Condition	Partly rebar exposure			Condition	Water leakage but almost soundness			
								
Member	Drainage facilities			Member				
Type of damage	sand clogging	Damage level	c	Type of damage		Damage level		
Condition	Partly sand/soil clogging			Condition				
								








Bridge Name	A-9.Nangni zam		PNH	No.1	Date	2014/4/15
Photo Location	from Thimphu side		Photo Location	from Trongsa side		
						
Photo Location	from down stream of Thimphu side		Photo Location	from down stream of Trongsa side		
						
Photo Location	from up stream of Thimphu side		Photo Location	from up stream of Trongsa side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						









Site Condition Photo

Bridge Name		A-9.Nangni zam			PNH	No.1	Date	2014/4/15
Damage photo	Member	Deck slab/girder			Member	Bearing shoe/mortar		
	Type of damage	-	Damage level	a	Type of damage	Dysfunction	Damage level	e
	Condition	Soundness			Condition	Dysfunction after water leakage		
								
	Member	Railing			Member	Drainage facilities		
	Type of damage	Deformation	Damage level	e	Type of damage	Water leakage	Damage level	e
	Condition	-			Condition	Splash to the girder due to no drain pipe		
								
	Member	Foundation			Member			
	Type of damage	Scouring	Damage level	e	Type of damage		Damage level	
Condition	Collapse of sounding foundation			Condition				
								
Member				Member				
Type of damage		Damage level		Type of damage		Damage level		
Condition				Condition				





Bridge Name	A-10.Nikachu zam		PNH	No.1	Date	2014/4/15
Photo Location	from Thimphu side		Photo Location	from Trongsa side		
						
Photo Location	from down stream of Thimphu side		Photo Location	from down stream of Trongsa side		
						
Photo Location	from up stream of Thimphu side		Photo Location	from up stream of Trongsa side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						

Site Condition Photo









Bridge Name		A-10.Nikachu zam			PNH	No.1	Date	2014/4/15		
Damage photo	Member	Deck slab/girder			Member	Body wall				
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	a		
	Condition	Soundness			Condition	Soundness				
										
	Member	Parapet wall			Member	Bearing shoe				
	Type of damage	Crack	Damage level	d	Type of damage	-	Damage level	-		
	Condition	Large crack width			Condition	Different elevation of opposite side				
										
	Member	Railing			Member	Pavement/Expansion joint				
	Type of damage	Deformation	Damage level	e	Type of damage	Unevenness	Damage level	c		
	Condition	-			Condition	-				
										
	Member	Drainage facilities			Member					
	Type of damage	Water leakage	Damage level	e	Type of damage		Damage level			
	Condition	Splash to the girder due to no drain pipe			Condition					
										

Bridge Name	A-11.Chuzomsa zam		PNH	No.1	Date	2014/4/15
Photo Location	from Thimphu side		Photo Location	from Trongsa side		
						
Photo Location	from down stream of Thimphu side		Photo Location	from down stream of Trongsa side		
						
Photo Location	from up stream of Thimphu side		Photo Location	from up stream of Trongsa side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						









Site Condition Photo

Bridge Name		A-11.Chuzomsa zam		PNH	No.1	Date	2014/4/15	
Damage photo	Member	Deck slab/girder			Member	Body wall		
	Type of damage	-	Damage level	a	Type of damage	Peeling off/exposure	Damage level	d
	Condition	Soundness			Condition	Parapet wall of Trongsa side		
								
	Member	Pavement/ Expansion joint			Member	Drainage facilities		
	Type of damage	Unevenness	Damage level	c	Type of damage	Water leakage	Damage level	e
	Condition	-			Condition	Splash to the girder due to no drain pipe		
								
	Member				Member			
	Type of damage		Damage level		Type of damage		Damage level	
	Condition				Condition			
	Member				Member			
	Type of damage		Damage level		Type of damage		Damage level	
	Condition				Condition			







Bridge Name		B-1.Passang zam		PNH		No.4		Date		2014/4/17		
Site Condition Photo	Photo Location	from Trongsa side				Photo Location	from Gelephu side					
												
	Photo Location	from down stream of Trongsa side				Photo Location	from down stream of Gelephu side					
												
	Photo Location	from up stream of Trongsa side				Photo Location	from up stream of Gelephu side					
												
	Photo Location	down stream direction				Photo Location	up stream direction					
												









Bridge Name	B-1.Passang zam			PNH	No.4	Date	2014/4/17
Member	Deck slab			Member	Deck slab		
Type of damage	Peeling off	Damage level	c	Type of damage	Crack	Damage level	b
Condition	Cause by water leakage from drain			Condition	Necessity of detailed design		
							
Member	Main girder (steel)			Member	Abutment		
Type of damage		Damage level	c	Type of damage	Deformation	Damage level	e
Condition	Necessity of detailed design			Condition	Spalling		
							
Member	Bearing shoe			Member	Pavement		
Type of damage	Clogging soil	Damage level	e	Type of damage	Deformation	Damage level	e
Condition	Soil surrounding shoe			Condition	Crack on cold joint		
							
Member	Drainage facilities			Member	Entire bridge		
Type of damage	Peeling off	Damage level	e	Type of damage	Other	Damage level	
Condition	Splash to the girder due to no drain pipe			Condition	Bird nest		
							

Damage photo






Bridge Name	B-2.Beteni zam		PNH	No.4	Date	2014/4/17
Photo Location	from Trongsa side		Photo Location	from Gelephu side		
						
Photo Location	from down stream of Trongsa side		Photo Location	from down stream of Gelephu side		
						
Photo Location	from up stream of Trongsa side		Photo Location	from up stream of Gelephu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						

Site Condition Photo

Bridge Name		B-2.Beteni zam			PNH	No.4	Date	2014/4/17
Damage photo	Member	Deck slab			Member	Abutment		
	Type of damage	-	Damage level	a	Type of damage	Crack	Damage level	d
	Condition	Soundness			Condition	Crack on cold joint		
								
	Member	Bearing shoe			Member	Pavement		
	Type of damage	Soil surrounding shoe	Damage level	e	Type of damage	Unevenness	Damage level	e
	Condition	Soil surrounding shoe			Condition	Dents on surface		
								
	Member	Expansion joint			Member			
	Type of damage	Abnormal of joint	Damage level	e	Type of damage		Damage level	
	Condition	No space			Condition			
								
	Member	Entire bridge			Member			
	Type of damage	-	Damage level		Type of damage		Damage level	
	Condition	Unused			Condition			
								









Bridge Name	B-3.Katley III		PNH	No.4	Date	2014/4/17
Photo Location	from Trongsa side		Photo Location	from Gelephu side		
						
Photo Location	from down stream of Trongsa side		Photo Location	from down stream of Gelephu side		
						
Photo Location	from up stream of Trongsa side		Photo Location	from up stream of Gelephu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						

Site Condition Photo









Bridge Name		B-3.Katley III			PNH	No.4	Date	2014/4/17
Damage photo	Member	Deck slab			Member	Abutment		
	Type of damage	-	Damage level	a	Type of damage	-	Damage level	e
	Condition	Soundness			Condition	Large space of joint (necessity of detailed survey)		
								
	Member	Railing			Member	Expansion joint		
	Type of damage	Deformation	Damage level	c	Type of damage	Deformation	Damage level	c
	Condition	-			Condition	-		
								
	Member	Drainage facilities			Member			
	Type of damage	Water leakage	Damage level	e	Type of damage		Damage level	
Condition	Splash to the girder due to no drain pipe			Condition				
								
Member				Member				
Type of damage		Damage level		Type of damage		Damage level		
Condition				Condition				

Bridge Name	B-4.Chaplekhola		PNH	No.4	Date	2014/4/16
Photo Location	from Trongsa side		Photo Location	from Gelephu side		
						
Photo Location	from down stream of Trongsa side		Photo Location	from down stream of Gelephu side		
						
Photo Location	from up stream of Trongsa side		Photo Location	from up stream of Gelephu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						





Site Condition Photo









Bridge Name	B-4.Chaplekhola			PNH	No.4	Date	2014/4/16
Member	Undersurface of deck slab			Member	Uppersurface of deck slab		
Type of damage	-	Damage level	a	Type of damage	Crack	Damage level	c
Condition	Soundness			Condition	Necessity of detailed survey		
							
Member	Girder			Member	Lateral		
Type of damage	Peeling off	Damage level	d	Type of damage	Crack	Damage level	-
Condition	Peeling off/rebar exposur			Condition	Damage on latral member		
							
Member	Bering shoe			Member	railing		
Type of damage	Dysfunction	Damage level	e	Type of damage	Deformation	Damage level	e
Condition	Corrosion			Condition	-		
							
Member	Pavement			Member	Drainage facilities		
Type of damage	Unevenness	Damage level	c	Type of damage	Clogging soil	Damage level	e
Condition	-			Condition	-		
							

Damage photo






Bridge Name	B-5.Geleg(Aie) zam		PNH	No.4	Date	2014/4/17
Photo Location	from Trongsa side		Photo Location	from Gelephu side		
						
Photo Location	from down stream of Trongsa side		Photo Location	from down stream of Gelephu side		
						
Photo Location	from up stream of Trongsa side		Photo Location	from up stream of Gelephu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						


Site Condition Photo







Bridge Name		B-5.Geleg(Aie) zam		PNH	No.4	Date	2014/4/17	
Damage photo	Member	Deck slab		Member	Main girder			
	Type of damage	-	Damage level	a	Type of damage	Deterioration of protection against corrosion	Damage level	e
	Condition	Soundness		Condition	Entirely peeling of paint on main girder			
								
	Member	Abutment		Member	Bearing shoe			
	Type of damage	Crack/free lime	Damage level	e	Type of damage	Deformation	Damage level	e
	Condition	Free lime on abutment wall		Condition	Deformation/moss			
								
	Member			Member				
	Type of damage		Damage level		Type of damage		Damage level	
Condition			Condition					
Member			Member					
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					









Bridge Name	B-6.Samkhara zam		PNH	No.4	Date	2014/4/17
Photo Location	from Trongsa side		Photo Location	from Gelephu side		
						
Photo Location	from down stream of Trongsa side		Photo Location	from down stream of Gelephu side		
						
Photo Location	from up stream of Trongsa side		Photo Location	from up stream of Gelephu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						

Site Condition Photo






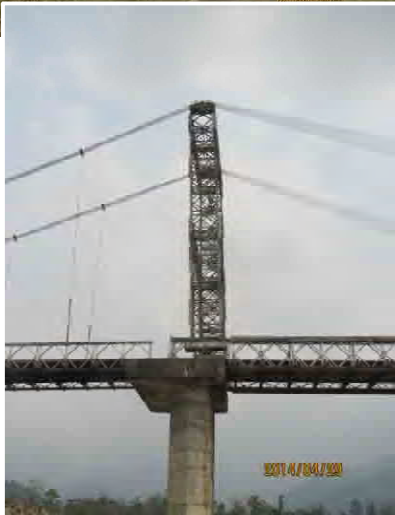

Bridge Name		B-6.Samkhara zam			PNH	No.4	Date	2014/4/17		
Damage photo	Member	Side of deck slab			Member	Undersurface of deck slab				
	Type of damage	Free lime	Damage level	d	Type of damage	Crack	Damage level	d		
	Condition	Free lime has occurred			Condition	Thin cover				
										
	Member	Main girder			Member	Bearing shoe				
	Type of damage	Deterioration of protection against corrosion	Damage level	e	Type of damage	clogging soil	Damage level	e		
	Condition	Peeling of paint			Condition	-				
										
	Member	Pavement			Member					
	Type of damage	Unevenness	Damage level	e	Type of damage		Damage level			
	Condition	-			Condition					
										
	Member				Member					
	Type of damage		Damage level		Type of damage		Damage level			
	Condition				Condition					

Bridge Name		B-7.Telegangchu zam		PNH		No.4		Date		2014/4/16			
Photo Location		from Trongsa side				Photo Location		from Gelephu side					
Site Condition Photo													
		Photo Location		from down stream of Trongsa side				Photo Location		from down stream of Gelephu side			
													
		Photo Location		from up stream of Trongsa side				Photo Location		from up stream of Gelephu side			
													
		Photo Location		down stream direction				Photo Location		up stream direction			
													









Bridge Name		B-7.Telegangchu zam			PNH	No.4	Date	2014/4/16
Damage photo	Member	Deck slab			Member	Main girder		
	Type of damage	Repar exposure	Damage level	e	Type of damage	Repar exposure	Damage level	d
	Condition	Peeling off/rebar exposure at edge of deck slab			Condition	Caused by poor constructio		
								
	Member	Abutmnt			Member	Bearing shoe		
	Type of damage	-	Damage level	a	Type of damage	Dysfunction	Damage level	e
	Condition	Soundness			Condition	Dysfunction after water leakage		
								
	Member	Railing			Member	Pavement/Expansion joint		
	Type of damage	Deformation	Damage level	c	Type of damage	Unevenness	Damage level	c
Condition	-			Condition	Unevenness on pavement surface			
								
Member				Member				
Type of damage		Damage level		Type of damage		Damage level		
Condition				Condition				

Bridge Name	C-1.Diana Kuephen zam		PNH	Samtse-Sipsu	Date	2014/4/29
Photo Location	from Samtse side		Photo Location	from Siptu side		
						
Photo Location	from down stream of Samtse side		Photo Location	from down stream of Siptu side		
						
Photo Location	from up stream of Samtse side		Photo Location	from up stream of Siptu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						





Site Condition Photo








Bridge Name	C-1.Diana Kuephen zam			PNH	Samtse-Sipsu	Date	2014/4/29
Member	Deck slab/main girder			Member	Substructure (Main tower)		
Type of damage	-	Damage level	-	Type of damage	Crack	Damage level	c
Condition	Soundness			Condition	Crack on undersurface of over hung part		
							
Member	Substructure (upper surface of tower)			Member	Substructure (Anchorage)		
Type of damage	Crack	Damage level	c	Type of damage	Crack	Damage level	c
Condition	Crack such as arrow direction			Condition	Crack on the circle mark		
							
Member	Entire bridge			Member			
Type of damage	Incline	Damage level	e	Type of damage		Damage level	
Condition	Each main tower inclines			Condition			
  							

Damage photo







Bridge Name	C-2.Dramzang zam		PNH	Samtse-Sipsu	Date	2014/4/29
Photo Location	from Samtse side		Photo Location	from Siptu side		
						
Photo Location	from down stream of Samtse side		Photo Location	from down stream of Siptu side		
						
Photo Location	from up stream of Samtse side		Photo Location	from up stream of Siptu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						









Site Condition Photo

Bridge Name		C-2.Dramzang zam		PNH	Samtse-Sipsu	Date	2014/4/29	
Damage photo	Member	Deck slab/main girder		Member	Abutment			
	Type of damage	-	Damage level	-	Type of damage	Crack/free lime	Damage level	d
	Condition	Soundness		Condition	-			
								
	Member	Abutment		Member	Besring shoe			
	Type of damage	Crack/free lime	Damage level	d	Type of damage	Clogging soil	Damage level	e
	Condition	Repaired		Condition	Dysfunction after clogging soil			
								
	Member			Member				
	Type of damage		Damage level		Type of damage		Damage level	
Condition			Condition					
Member			Member					
Type of damage		Damage level		Type of damage		Damage level		
Condition			Condition					









Bridge Name	C-3.Jitti zam		PNH	Samtse-Sipsu	Date	2014/4/29
Photo Location	from Samtse side		Photo Location	from Siptu side		
						
Photo Location	from down stream of Samtse side		Photo Location	from down stream of Siptu side		
						
Photo Location	from up stream of Samtse side		Photo Location	from up stream of Siptu side		
						
Photo Location	down stream direction		Photo Location	up stream direction		
						

Site Condition Photo

Bridge Name		C-3.Jitti zam		PNH	Samtse-Sipsu	Date	2014/4/29	
Damage photo	Member	Main girder			Member	Abutment		
	Type of damage	-	Damage level	a	Type of damage	Peeling off	Damage level	c
	Condition	Soundness			Condition	Peeling off on the surface		
								
	Member	Pavement			Member	Carrageway Surface		
	Type of damage	Unevenness	Damage level	c	Type of damage	-	Damage level	a
	Condition	Unevenness at road side			Condition	Soundness		
								
	Member	Railing			Member	Pier column		
	Type of damage	Crack	Damage level	c	Type of damage	Crack	Damage level	c
	Condition	Partly crack			Condition	Crack/peeling off on the surface		
								
	Member				Member			
	Type of damage		Damage level		Type of damage		Damage level	
Condition				Condition				

Bridge Name	E-1.Dopshari zam		PNH		Paro pref.		Date	2014/4/19
Photo Location	from West side			Photo Location	from East side			
								
Photo Location	from down stream of West side			Photo Location	from down stream of East side			
								
Photo Location	from up stream of West side			Photo Location	from up stream of East side			
								
Photo Location	down stream direction			Photo Location	up stream direction			
								

Site Condition Photo

Bridge Name		E-1.Dopshari zam			PNH	Paro pref.	Date	2014/4/19
Damage photo	Member	Abutment			Member	Pier		
	Type of damage	-	Damage level	a	Type of damage	Damage	Damage level	
	Condition	Soundness			Condition	Damaged by debris flow		
								
	Member	Joint			Member	Deck slab/girder		
	Type of damage	Unevenness	Damage level	e	Type of damage	-	Damage level	a
	Condition	Different elevation on road surface			Condition	Soundness		
								
	Member	Pier			Member	Railing		
	Type of damage	Scouring	Damage level	c	Type of damage	Rebar exposure	Damage level	c
Condition	Scouring			Condition	Partly rebar exposure			
								
Member	Guardrail			Member	Drainage facilities			
Type of damage	Damage	Damage level	c	Type of damage	-	Damage level	a	
Condition	Partly damaged			Condition	Soundness			
								

Appendix-4 :

The Result of Abbreviated Scoping for Each Priority

Projects

A-2 Prakhdrang II

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river improvement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblity of landslides and rockfall since the slope around the road is steep and there is a possibility that the rocks are exposed or weathered,.
3 Social Environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

A-3 Namling zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consntruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	2	4	It is located in Thrumshingla National Park. Major impact on natural environment is not expected since it is repacement work and the scope of consturction is limited. However, reconfirmation of impact and the relevant procedure for deveelopment <u>such as envionmental assessment is required.</u>
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consntruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river imrovment works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep and there is a possibility that <u>the rocks are exposed or weathered.</u>
3 Social Environemnt	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near project site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is exepcted in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-1 Passang zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river improvement works is not expected.
	7	Topography and geology	2	4	During construction phase, due to the construction work of substructure, small topografic modification might be expected.
3 Social Environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-2 Beteni zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river imovement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep.
3 Social Environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-3 Katley III

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	2	4	It is located in the Biological Corridor between Jigme Singye Wangchuck National Park,Royal Manas National Park and Phipsoo Wildlife Sanctuary. Major impact on natural environment is not expected since it is replacement work and the scope of consruction is limited. However, reconfirmation of impact and the relevant procedure for deveelopment such as envionmental assessment is required.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river improvement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep.
3 Social Environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-4 Chaplekhola

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the <u>traffic volume is still limited.</u>
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	2	4	It is located in the ,Royal Manas National Park. Major impact on natural environment is not expected since it is repacement work and the scope of consruction is limited. However, reconfirmation of impact and the relevant <u>procedure for deveelopment such as envionmental assessment is required.</u>
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of construction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river imrovement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep and there is a <u>possibility that the rocks are exposed or weathered.</u>
3 Social Environemnt	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-6 Samkhara zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river imrovement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep.
3 Social environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expeected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

B-7 Telegangchu zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river improvement works is not expected.
	7	Topography and geology	2	2	During construction phase, due to the construction work of substructure, small topografic modification might be expected. Further, there is possiblility of landslides and rockfall since the slope around the road is steep.
3 Social Environemnt	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

C-1 Diana Kuephen zam

Category	No	Impact Items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited because it is replacement work.
	6	Hydrology	4	4	No impacts are expected since this is replacement work and river imrovement works is not expected.
	7	Topography and geology	2	4	During construction phase, due to the construction work of substructure, small topografic modification might be expected.
3 Social Environment	8	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	9	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work.
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope is expected. No impact is exepcted in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

E-1 Maukhola zam

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the <u>traffic volume is still limited.</u>
	2	Water pollution	2	4	The water pollution caused by sediment influx due to the work in substructure is expeted during construction phase. No major impact is expeced in operation phase.
	3	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural Environment	4	Protected area	4	4	No protected area was observed.
	5	Ecosystem	4	4	No particular rare speicies is obserbed near project site. In addition, there is no environment which animals and plants are mainly living such as forests near project site. Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is <u>limited because it is replacement work.</u>
	6	Hydrology	2	4	Bank protection and river improvement work is required. Measures for swollen river during rainy season is necessary. There might be decrease in the risk of flood because the measurement of swollen river will be taken.
	7	Topography and geology	2	4	During construction phase, due to the construction work of substructure, small topografic modification might be expected.
3 Social Environemnt	8	Involuntary resettlement	2	4	Resettlement is not expected since there is no residence in project site. However, depending on design and construction, approach road might pass farmlandlocated in both banks. Therefore, land aquisition might be expected to be <u>caused although it is not a large scale.</u>
	9	Living and Livelihood	4	4	Few impact is expected since there is no activities such as traffic regulation. Currently, people needs to use a detour route or creat a temporary timber bridge in dry season. In rainy season , people occasionally needs to use boats to pass the river and it is very dangerous situation. Therefore, in theoperation phase the bidge connects the shotest route and provide the safe route regardless of the <u>season</u>
	10	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	11	Landscape	4	4	No impacts are expeced.
	12	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	13	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place is expected. No impact is expected in operation phase.
4 Others	14	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	15	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

Tunnel (Thomang Cliff)

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	4	4	No imact is expxpected since no river is observed near the poject site.
	3	Waste	2	4	During construction, lage amount of rocks and sediment are generated by ecavation of road slope. Therefore it is necessary to prepare the site for dispose them properly.During operation phase no waste is generated.
	4	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural environment	5	Protected area	4	4	No protected area was observed neartarget project site.
	6	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited.
	7	Hydrology	2	4	Topographic modification and the change in the flow of surface water might be caused by the new tunnel construction, however the impact can be decreased depending on the design of drainage.
	8	Topography and geology	2	4	During construction phase, due to the new construction of tunnel small topografic modification might be expected. Further, there is possiblity of landslides and rockfall since the slope around the road is steep. The risk of rockfall is reduced by the tunnel construction in operation phase.
3 Social environment	9	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	10	Living and Livelihood	2	4	During construction, temporary traffic regulation is expected. Therefore, minor impact on economic activity is expected because no detour is existing.
	11	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	12	Landscape	4	4	No impacts are expeced.
	13	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	14	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	15	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	16	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

Tunnel (Namling Cliff)

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
	2	Water pollution	4	4	No imact is expxpected since no river is observed near the poject site.
	3	Waste	2	4	During construction, lage amount of rocks and sediment are generated by ecavation of road slope. Therefore it is necessary to prepare the site for dispose them properly.During operation phase no waste is generated.
	4	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected imact is small since the traffic volume is still limited.
2 Natural environment	5	Protected area	2	4	It is located in Thrumshingla National Park. Reconfirmation of impact and the relevant procedure for development such as envionmental assessment is required.
	6	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited.
	7	Hydrology	2	4	Topographic modification and the change in the flow of surface water might be caused by the new tunnel construction, however the impact can be decreased depending on the design of drainage.
	8	Topography and geology	2	4	During construction phase, due to the new construction of tunnel small topografic modification might be expected. Further, there is possiblity of landslides and rockfall since the slope around the road is steep. The risk of rockfall is reduced by the tunnel construction in operation phase.
3 Social environment	9	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed.
	10	Living and Livelihood	2	4	During construction, temporary traffic regulation is expected. Therefore, minor impact on economic activity is expected because no detour is existing.
	11	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	12	Landscape	4	4	No impacts are expeced.
	13	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	14	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers need to be considered since work in high place and slope and the rockfall is expected. No impact is expected in operation phase.
4 Others	15	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	16	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.

Improvement of Pavement (Thrumshingla Pass)

Category	No	Impact items	Rating		Reasons of rating
			Pre/ During Construction	Operation Phase	
1 Pollution control	1	Air pollution	2	4	Generatin of dust is expected due to consruction work. In the operation phase, the generation of traffic is expected. However, the expected impact is small since the traffic volume is still limited.
	2	Water pollution	4	4	No impact is expxpected since no river is observed near the poject site.
	3	Waste	2	4	It is necessary to pay attention to the disposal of the aggregate and pavement materials for the improvement. During operation phase no waste is generated.
	4	Noise and vibration	2	4	Noise and vibration generation is expected due to works of construction machines and equipment. In the operation phase, the generation of traffic is expected. However, the expected impact is small since the traffic volume is still limited.
2 Natural environment	5	Protected area	2	4	It is located in Thrumshingla National Park. Reconfirmation of impact and the relevant procedure for deveelopment such as envionmental assessment is required.
	6	Ecosystem	2	4	Impact on ecosystem such as habitats of animals and plants and their movement paths is limited and expected to be few since the area of consruction is limited.
	7	Hydrology	4	4	No impact on hydrogy is expected since it is imrovment of pavement.
	8	Topography and geology	2	2	No impact is expcted. However, there is possiblility of landslides and rockfall since the slope around the road is steep.
3 Social environment	9	Involuntary resettlement	4	4	Involuntary resettlemnet is not expected since there were no residence and private land obserbed. Further no land acquisition is expected since it is improvement of pavement.
	10	Living and Livelihood	2	4	During construction, minor impact on economic activityis expected due to the temporary traffic regulation for construction work. However the extent of impact is limited since traffic regulation might not be necessary because of the measures taken such as one-side construction.
	11	Cultural heritage	4	4	No cultural heritage was observed near proect site.
	12	Landscape	4	4	No impacts are expced.
	13	Indigenous and ethnic people	4	4	No indigenous and ethnig people were observed near project site.
	14	Labor environment	2	4	Construction work environment needs to be considered in accordance with relevant laws and regulations. Also, safety measuers for rockfall needs to be considered. No impact is exepected in operation phase.
4 Others	15	Impacts during Construction	3	4	Mitigaion measuers for each type of works needs to be prepared. In addition, impact in traffic regulation for construction work needs to be considered.
	16	Monitoring	3	4	It needs to request contractor to prepare and conduct monitoring plan (means, frequency and framework) and reporting regarding expeted pollution control during construction.

1 : Serious impact is expected.

2 : Some impact is expected.

3 : Extent of impact is unknown (Detailed survey is required)

4 : Few impacts are expected.