CHAPTER 10 INDUSTRIAL POTENTIAL ANALYSIS

10.1 NH54

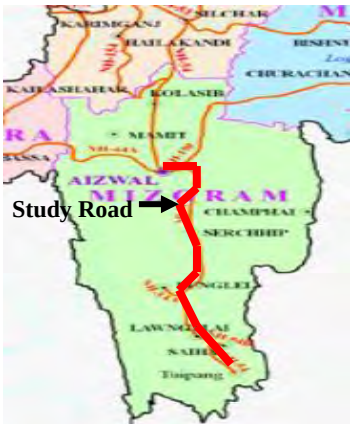
10.1.1 Present Conditions of NH54 Corridor

(1) Study Corridor

The Aizawl–Tuipang Road Section (approximately 381 km) is part of NH54, and is located in Mizoram State. Due to its location, the state assumes a prominent importance vis-à-vis the possibility of movement of goods, services, and trades with Southeast Asian countries. The integration of this road section under the construction of the Kaladan Project would open up a second major transport link to the North-East Region benefitting the southern part of the region.

In the present context, the Study Corridor is considered as an area abutting the road section (NH54) under study where the influence of the road improvement can be felt by way of supporting the overall economic activities in the corridor. It may be observed (Figure 10.1-1) that the study road alignment runs almost through the entire state and traverses through or close to all the districts of Mizoram State. Thus, all the eight districts belonging to Mizoram State has been considered to fall under the influence zone of the corridor. A brief description of the eight districts is presented in Table 10.1-1

In the following parts of this chapter, the natural conditions prevailing in the Study Corridor, the economic activities (present and potential) in Mizoram State, as well as in the eight districts of the state has been studied and analyzed.



Source: JICA Study Team

Figure 10.1-1 Study Corridor – NH54

Table 10.1-1 Description of Districts under the Study Corridor of NH54

District	Description
Aizawl	Situated between the Tlawng River Valley in the west and Tuirial River Valley in the east. It is home to the Mizo tribes who are said to have migrated from Myanmar's Chin Hills 300 years ago. Being the capital city of Mizoram, it is the political, commercial, educational, and cultural hub of the state, housing all important government offices, the state assembly and secretariat, and tourist spots, including some beautiful churches and markets.
Lunglei	It is the biggest district (21.52% of the total land area) bounded on the north by Mamit and Serchhip districts, on the south by Lawngtlai and Saiha districts, on the east by Myanmar and on the west by Bangladesh, having a dense forest area covering 524.63 km^2.
Champhai	Located near the India-Myanmar border, it serves as a gateway to all business activities between India and Myanmar. It is a fast developing venue in the Indo-Myanmar border. The famous Rihdil Lake is only about 50 km away from the town of Champhai. Champhai Valley known as "the rice bowl of Mizoram" is located towards the base of the town. A chain of green hills encircle luxuriant rice fields, which adds to the beauty of this place.
Lawngtlai	Located in the southern most part of Mizoram having common international borders with Bangladesh in the west and Myanmar in the east. It also shares common boundaries with Lunglei and Saiha districts in the north and south, respectively. Unlike other districts, it has two autonomous district councils within the district, namely; the Lai Autonomous District Council (LADC) and the Chakma Autonomous District Council (CADC) with their headquarters at Lawngtlai and Kamalanagar, respectively, and are administered in accordance with the provisions of the Sixth Schedule of the Constitution of India.

District	Description
Mamit	Mamit District was created after bifurcation of the erstwhile Aizawl District in 1998. It is bounded on the north by Assam State, on the west by Tripura State and Bangladesh, on the south by Lunglei District, and on the east by Kolasib and Aizawl districts. It is the fourth largest district in Mizoram in terms of the total area. It receives abundant rainfall. The five main big rivers are Tlawng, Tut, Teirei, Langkaih, and Khawthlangtuipui. Women play a major role in the society as well as in the family.
Kolasib	The district is bounded by Assam on the north and northwest side, on the south and east by Aizawl, and on the southwest by Mamit District. The location of the district occupies an important site as it is the main stream of road communication from the other state of Mizoram. NH54 passes through the middle of the district from north to south direction. The only rail head in the state is located in Bairabi. There are some worth visiting sites in and around the district which include Dampa Wildlife Sanctuary and the Tlawng River.
Serchhip	Serchhip is located in the central part of the state of Mizoram adjoined by Champhai District in the east, Aizawl in the north and northwest, and Lunglei District in the south. The district has the highest literacy all over India. It lies between the two very important rivers of Mat and Tuikum. While the River Tuikum is the source for drinking water for Serchhip, the River Mat is the source for irrigation water for Zawlpui, the rice bowl of Serchhip. Serchhip is also the main producer of cabbages and mustards in Mizoram.
Saiha	Saiha District is situated on the southern most fringe of the North-East Region of India and shares border with Myanmar on the eastern and southern side. Administratively, it is divided into two blocks, i.e., Saiha and Tuipang. It is the third most developed and also the third most populous town in Mizoram State apart from the state capital - Aizawl and Lunglei. It is also the capital of the third largest tribe - the Maras in Mizoram.

Source: JICA Study Team

(2) Natural Condition

Mizoram is a mountainous region sandwiched between Myanmar in the east and south and Bangladesh in the west, occupying great strategic importance in the northeastern part of India. It has a total of 722 km boundary with Myanmar and Bangladesh. It has a steep hilly terrain separated by rivers, creating deep gorges between the hill ranges. The average height of the hill is about 1,000 m. The highest peak in Mizoram is the Blue Mountain (Phawngpui) with a height of 2,210 m. It is generally cool in summer and not very cold in winter. During winter, the temperature varies from 11 ºC to 21 ºC; and in summer, it varies between 20 ºC to 29 ºC. It rains heavily from May to September and the average rainfall is 254 cm per annum. The average rainfall in Aizawl is 208 cm and Lunglei has 350 cm. Mizoram has great natural beauty and endless variety of landscape and is also very rich in flora and fauna. Almost all kinds of tropical trees and plants thrive in Mizoram.

(3) Socio-economic Conditions

1) Demography and Social Condition

The population of Mizoram is 1,091,014 (according to the 2011 Census), it is scattered over an area of 21,027 km^2, consisting of eight districts, 26 blocks, and 817 villages. The state has the density of 52 persons per km^2. The decadal growth rate of the population of the state has been observed at 22.78% over the period 2001-2011. The sex ratio of Mizoram is at 975 females to 1,000 males, which is higher than 940, the average all India figure. The literacy rate of the state is 91.58% (93.35% male and 89.27% female) as compared with the average all India literacy rate of 74.04% (82.14% male and 65.46% female). The district-wise population and social parameters are presented in Figure 10.1-2.

Figure 10.1-2 Districts of Mizoram

District	Population (2011 Census)	Population Growth (%) 2001-2011)	Area (Sq km)	Sex Ratio	Literacy (%)	Density	Pop.* (2014)
Aizawl	404,054	24.07	3,577	1,009	98.50	113	431,062
Lunglei	154,094	12.29	4,572	944	89.40	34	159,547
Champhai	125,370	15.66	3,168	981	93.51	39	130,963
Lawngtlai	117,444	59.53	2,519	945	66.41	46	135,109
Mamit	85,757	36.59	2,967	924	85.96	28	94,166
Kolasib	83,054	25.92	1,386	956	94.54	60	89,000
Serchhip	64,875	20.45	1,424	976	98.76	46	68,599
Saiha	56,366	-7.68	1,414	978	88.41	40	55,031
Mizoram	**1,091,014**	**22.78**	**21,027**	**975**	**91.58**	**52**	**1,163,476**

Source: www.census2011.co.in
** Projected/extrapolated by the JICA Study Team on the basis of the past growth rate

It may be observed from the above that more than one-third of the population of the state is concentrated in Aizawl District which also has the highest population density among the districts. Saiha District with the lowest number of people (56,366) has shown a negative growth in the decade 2001-2011. The highest decadal increase (59.53%) of population was observed in Lawngtlai District. With 28 persons per km^2, Mamit District has the lowest population density.

The sex ratio has been observed the highest (1,009) in Aizawl District and lowest (924) in Mamit District. The literacy rate is highest at 98.76% in Serchhip District and lowest at 66.41% in Lawngtlai District of Mizoram State.

2) Economy

Economic Growth

As per available data, the net state domestic product (NSDP) for the year 2012-2013 was about INR 7,556 crores, and the per capita income (PCI) during the same period was INR 63,413. It has also been observed that during the period from 2004-2005 to 2012-2013 the economy of the state grew at a compound annual growth rate of 9.30%, with the primary sector growing at 7.64%, while the secondary sector at 7.87%, and the tertiary sector at 10.30%. During the same period, the per capita income of the state grew at 6.77%. The sector-wise growth rates as well as the growth of PCI are summarized in Table 10.1-2.

Table 10.1-2 Economic Growth of Mizoram State

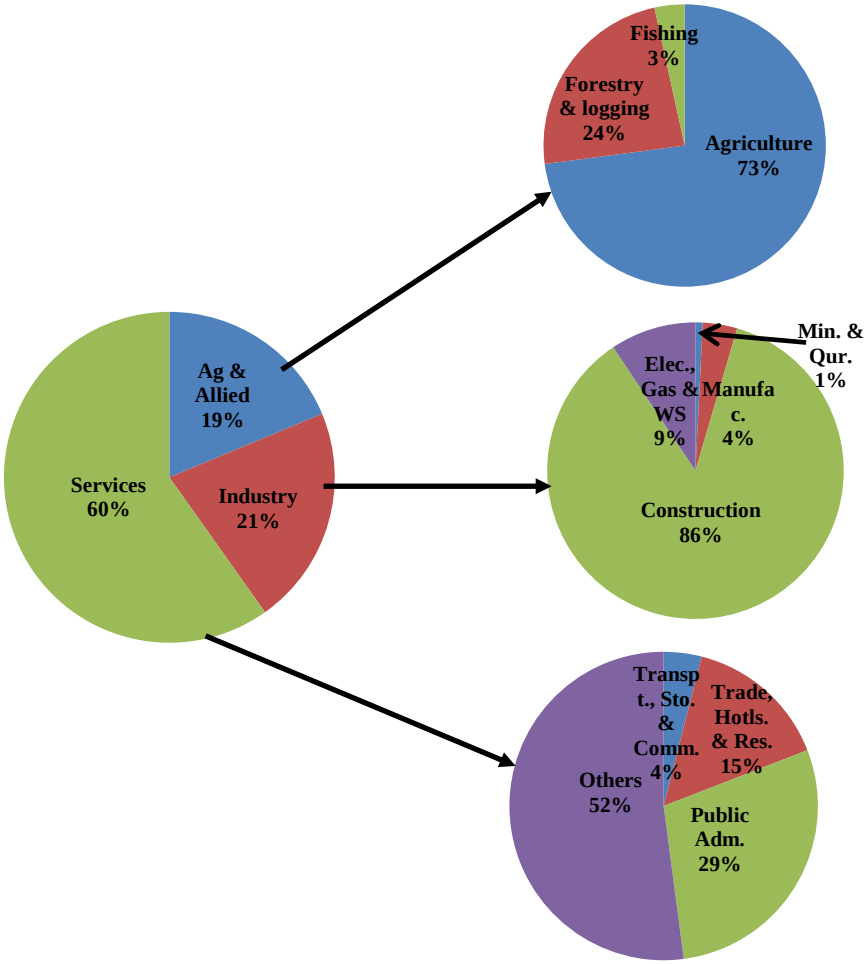
Sector	CAGR (2004-2005 to 2012-2013)
Agriculture and Allied – P (Primary Sector)	7.64%
Industry - S (Secondary Sector)	7.87%
Services – T (Tertiary Sector))	10.30%
NSDP (Net State Domestic Product)	9.30%
PCI (Per Capita Income)	6.77%

Note: CAGR – Compound Annual Growth Rate
Source: JICA Study Team

Economic Structure

The structure of Mizoram State economy for the year 2012-2013 (at current prices) is presented in Figure 10.1-3. The major share (60%) of NSDP was accounted for the service sector, followed by the secondary sector (21%), and the primary sector (19%). It can be observed that the contribution of the

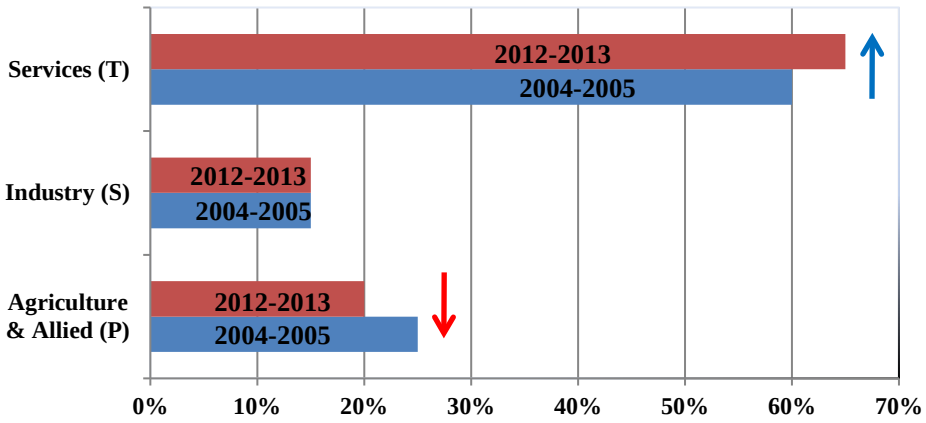
manufacturing sector to the state economy is very low at just 0.84% of the NSDP (about 4% of the secondary sector). The contribution of the transport, storage, and communications was about 2.4% of NSDP.



Source: JICA Study Team

Figure 10.1-3 Structure of the Mizoram State Economy

In addition to the above snap-shot view of the economic structure of the state for the year 2012-2013 as discussed above, a comparative analysis of the composition of the economic structure (at constant 2004-2005 prices) over the period from 2004-2005 to 2012-2013 was studied and is presented in Figure 10.1-4. It can be observed that the share of the secondary sector has remained static at 15% over the period from 2004-2005 to 2012-2013. However, the share of primary sector has decreased from 25% to 20% and that of tertiary sector has increased from 60% to 65%.



Source: JICA Study Team

Figure 10.1-4 Structural Composition of Mizoram State Economy – 2004-2015 to 2012-2013

10.1.2 Industrial and Other Potential

(1) General

Mizoram has potential for developing its horticulture and services sector as the present economy is 60% dependent on the service sector and only 21% on the industry (secondary sector). The potential for manufacturing is in the handloom, handicrafts, and paper industries. The state has also developed a new land use policy, which will have cluster-based development. The production of rubber and palm oil can be taken up in a big way in the state. Due to its abundance in bamboo cultivation there is a big potential in paper industry in the state.

The state also has potential for grapes, banana, large cardamom, ginger, pineapple, and other horticulture products but the marketing chain has hindered its growth. Once the Kaladan route becomes operationalised then these products will find their markets in other Indian states.

(2) Thrust Areas of the "Mizoram Industrial Policy 2012"

In view of the hilly terrain of the state, underdeveloped infrastructure, and present entrepreneurship level of the people, there is a limited scope for development of large enterprises, so the policy is to encourage the medium and small manufacturing enterprises (MSME) that have good scope of employment.

Thrust will be given to those industries based on value addition of locally available resources. Special incentives are available for speedy development of industrial units engaged in any of the following thrust sector enterprises:

Table 10.1-3 Mizoram Industrial Policy 2012

Forest-based Industries	The vast bamboo and other forest resources of Mizoram can be optimally harvested for setting up of industries for manufacturing of various high-value bamboo and other forest based products.
Food Processing Industries	Primary production of various food items, whether agricultural based, horticultural or livestock based, shall be linked with processing industries. Contract farming or management participation route will be encouraged to ensure proper supply chain management. Considering high cost of transportation, giving priority and favourable treatment to processing with high value content is a crucial element of food processing policy.
Handloom Industries	Handloom sector shall continue to receive serious attention from the government through improving the product quality by introducing improved design, packaging, and branding. The presence of innate designing skills of womenfolk in the rural areas will be utilized for enriching the industry.
Plantation of Fiber and Hill Brooms	Encouraging value addition and branding of hill-brooms to secure the advantage in marketing the products outside the state. Cultivation of broom grass to be properly linked with the processing industries so that the farmers will reap maximum benefits. Existence of large quantity of plantation gives ample scope towards the development of fiber materials for different application.
Tea, Rubber, Palm, and Coffee Industry	The climate and soil conditions are favourable for tea plantation. Commercial and scientific tea plantation linked with tea processing industry to receive attention from the government. Rubber, coffee, and palm-based industries to also receive due attention from the government.
Textile Related Industries	Bulk production of readymade garments will be encouraged to be market outside the state and for exports. Procurement of raw materials and accessories will be arranged through marketing efforts and eventually by way of development of local industries.
Animal Feed and Poultry Feed Industries	Thrust towards having sufficient meat and meat products for which farming has been encouraged, in addition to encouraging production of sufficient quantity of animal and poultry feeds.

Source: Derived from the "Mizoram Industrial Policy 2012"

(3) Industry

The natural resources, climatic conditions, and policy incentives in the state support investments in bamboo, sericulture, tourism, agro-products, and agro-processing sectors. Industrial units in the state primarily comprise of small-scale industries. Mizoram has industrial estates in Zuangtui, Sailamkawn, Cahmphai Hmunhmeltha, Bairabi, and Pukpui Lunglei.

Mizoram is setting up a special economic zone (SEZ) in the northeast with the assistance from the North-East Council. The SEZ will be located in Khawnuam Village in Champhai. Bamboo-based industries would play a major role in the proposed SEZ.

Mizoram has abundant reserve of bamboo forest covering 1,254,400 ha, with a yield of 3.2 M t/yr. Around 28,315 t of bamboo is harvested per year, a 99% surplus waiting to be exploited. Around 14% of bamboo stock in the country is available in Mizoram. The state grows 35 varieties of bamboo. The Cachar Paper Mill in South Assam (a unit of Hindustan Paper Corporation) is the largest consumer of bamboo resources in Mizoram. The Bamboo Development Agency of the state government has entered into a joint venture (JV) with private partners for the commercial production of bamboo floor boards, bamboo parquets, and bamboo-teakwood doors. The Mizoram Government is keen to invite foreign direct investment (FDI) in bamboo-based industries such as mat-ply, blinds, chopsticks, incense sticks, etc.

Mizoram accounts for about 12% of the total fruits produced in the Northeast India, and the yield per hectare is on the rise because of the adoption of modern horticultural practices. With abundant natural resources and supporting policies, the food processing sector offers potential for investment. Allied services such as cold-chain management also provide potential for investment. A special purpose vehicle (SPV) has been formed with private sector companies to set up a plant for processing turmeric, ginger, chili, fruits, and other horticultural products.

The state government had established one research and training institute in Zemabawk to impart training in sericulture. Mizoram has mineral deposits of shell limestone, siltstone, clay mineral, coal seam, oil, and gas. Building-quality stones are exported to Bangladesh. Several agencies are involved in oil and

gas exploration in Mizoram and have signed a memorandum of understanding (MoU) with the state government. Mizoram has numerous natural water springs and offers potential for manufacturing mineral water.

The state government has so far developed the following industrial areas with basic facilities:

- Industrial Estate in Zuangtui, Aizawl, Aizawl District;
- Industrial Estate in Bairabi, Kolasib District;
- Export Promotion Industrial Park in Lengte, Mamit District;
- Bamboo Technology Park in Sairang, Aizawl District;
- Integrated Industrial Development Centre in Pukpui, Lunglei District;
- Integrated Industrial Development Centre in Zote, Champhai District; and
- Industrial Growth Centre in Luangmual, Aizawl District.

The capacity of industrial estates in terms of number of plots available is given in Table 10.1-4. As of 2011, the average number of plots allotted for the four industrial estates was about 64%, with the highest percentage (87%) being for EPIP Lengte, followed by Zuangtui (84%), IGC Luangmual (61%), and BTP Siarang (30%). This indicates the need to strengthen the activities related to bamboo, a product that is widely available in Mizoram.

Table 10.1-4 Availability of Industrial Plot in the Industrial Areas

Sl. No.	Industrial Estate	District	No. of Plots	No. of Plots Allotted
1.	Industrial Estate, Zuangtui	Aizawl	232	196
2.	Bamboo Technology Park (BTP), Sairang	Aizawl	10	3
3.	Export Promotion Industrial Park (EPIP), Lengte	Mamit	30	26
4.	Industrial Growth Centre (IGC), Luangmual	Aizawl	99	6
Total			**371**	**236**

Source: Statistical Abstract of Mizoram, 2011

The district-wise cluster of activities and trade in the project corridor is presented in Figure 10.1-5. It can be observed that in the clusters, the main activities are linked to agriculture and support the villages located in these districts. A good road infrastructure is expected to provide and boost these activities and generate additional income to the villagers.

Table 10.1-5 District-wise Cluster of Activities and Trades

District	Major Trades	District	Major Trades
Mamit	i) Animal Husbandry and Veterinary ii) Agriculture iii) Industries	Serchhip	i) Horticulture ii) Agriculture iii) Industries
Kolasib	i) Horticulture ii) Soil and Water Conservation iii) Animal Husbandry and Veterinary	Lunglei	i) Horticulture ii) Industries iii) Agriculture
Aizawl	i) Industries ii) Animal Husbandry and Veterinary iii) Soil and Water Conservation	Lawngtlai	i) Horticulture ii) Agriculture iii) Animal Husbandry and Veterinary
Champhai	i) Horticulture ii) Animal Husbandry and Veterinary iii) Agriculture	Saiha	i) Horticulture ii) Animal Husbandry and Veterinary

Source: Mid-term Assessment Report on NLUP of the government of Mizoram, 2012-13

The number of small scale industrial (SSI) units under the Directorate of Industry and assisted by it, along with the working enterprises in Mizoram, is presented in Table 10.1-6. It is observed that the number of SSI units directly under the directorate has declined over the years, with an increase in 2013-

2014 (214 units) over 2012-2013 (122 units), whereas, the assisted SSI units by the directorate has shown an increasing trend.

Table 10.1-6 SSI Units and Working Enterprises in Mizoram

Year	SSI Units Registered Under the Directorate of Industry		No. of SSI Units Assisted	Working Enterprises	Employment
	Numbers	Employment			
2004-2005	319	1,116	566	NA	NA
2005-2006	315	1,228	740	NA	NA
2006-2007	344	1,376	871	3,715	26,032
2007-2008	205	594	161	3,941	27,616
2008-2009	487	4,113	-	4,419	30,965
2009-2010	457	3,977	-	4,919	34,469
2010-2011	203	1,310	1,800	5,403	37,860
2011-2012	131	906	1,335	NA	NA
2012-2013	122	1,032	-	NA	NA
2013-2014	214	-	-	-	-

Source: Statistical Abstract of Mizoram 2013

The further break-up of the SSI units (registered under the directorate) into the districts (Table 10.1-7) reveals higher concentration of SSI units in Champhai and Aizawl. Also there has been a drastic reduction in SSI units in Aizawl from 115 units to 29 units, from 2010-2011 to 2012-2013.

Table 10.1-7 District-wise Units Registered Under the Directorate of Industries

District	2012-2013		2010-2011	
	Units	Employment	Units	Employment
Mamit	5	35	3	18
Kolasib	16	118	2	10
Aizawl	29	511	115	814
Champhai	41	206	18	150
Serchhip	3	23	2	12
Lunglei	9	35	32	147
Lawngtlai	14	72	24	92
Saiha	5	32	7	67

Source: Statistical Abstract of Mizoram 2013

In terms of type of industrial units (SSI units under the directorate), it can be observed from Table 10.1-8 that SSI units are engaged in wood products (25.7%), hosiery and garments (22.9%), metal products (15.4%), repair services (9.4%), and food products (7.0%) accounted for 80.4% of the total SSI units (214) in the year 2013-2014.

Table 10.1-8 Number of SSI by Type of Industry (Under the Directorate of Industry)

	Type of Industry	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
1	Food Production	36	35	17	10	15	15
2	Beverages, Tobacco Production	1	-	-	-	-	-
3	Wool, Silk, Synthetic, Fibre Textile	24	-	3	-	-	-
4	Hosiery and Garment	23	72	32	28	24	49
5	Wood Production	62	55	24	36	29	55
6	Paper Products and Printing	20	23	14	3	2	3
7	Leather Product	3	-	1	-	-	-
8	Rubber and Plastic Product	3	11	10	-	1	1
9	Chemical and Chemical Products	1	21	1	2	1	-
10	Non-metallic and Mineral Product	5	34	11	7	4	7

	Type of Industry	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
11	Metal Product	149	122	34	14	17	33
12	Machinery and Parts except Electrical	-	-	-	-	-	-
13	Electrical Machinery and Apparatus	-	-	-	-	-	-
14	Misc. Manufacturing Industries	42	-	-	5	-	14
15	Water Works and Supply	-	-	1	1	2	-
16	Construction	23	-	-	-	-	-
17	Activities allied to Construction	5	-	-	-	-	5
18	Restaurants and Hotels	3	-	-	-	1	3
19	Education, Scientific and Research Services	13	-	1	-	-	1
20	Medical and Health Services	5	7	4	2	1	2
21	Personal Services	26	-	18	9	11	6
22	Repair Services	26	47	29	14	10	20
23	Services not Elsewhere Classified	7	-	-	-	-	-
24	Others	10	-	3	-	4	-
	Total	**487**	**427**	**203**	**131**	122	**214**

Source: Statistical Abstract of Mizoram 2013

The planned development of industry and industrial infrastructure is a key to the progress of industry in the North-East Region States. A summary describing the efforts of the various agencies/ programs (other than the Directorate of Industry) for the development of industry and infrastructure in Mizoram is set out in Table 10.1-9.

Table 10.1-9 Agencies Involved in the Development of Industry and Industrial Infrastructure in Mizoram

S.N	Agency/ Program	Description
A	Bamboo Development Agency (A Society Constituted by the Government of Mizoram)	The agency has set up the Bamboo Technology Park (BTP) in Sairang, which is located around 36 km from Aizawl City. Within the park, ten industrial plots were developed for utilization by bamboo-based industries on a lease basis. BTP is also used for demonstration of bamboo technology as well as research and development (R&D) purpose. The Japan Bamboo Research Team of the University of Kyoto has also conducted research on bamboo in BTP. The agency is responsible for the following schemes under the Assistance to States for Developing Export Infrastructure and Other Allied Activities (ASIDE) • Industrial Centre for Export (ICE) in Tlabung (Lunglei District) • Bamboo Industrial Centre for Export (BICE) in Bungthuam (Mamit District) • Export Promotional Industrial Park in Lengte (Mamit) • Export Import Business Training Centre in Zuangtui (Aizwal District) • Skill Development Training -cum- Product Design Centre in Lunglei (Lunglei District)
B	**Zoram Industrial Development Corporation *(ZIDCO)***	ZIDCO is a joint venture of the government of Mizoram and the Industrial Development of India (IDBI). It is responsible for the overall development of industrial infrastructure in the state. The main function of the company is financing and loan recovery. The company is also venturing into handling of steel and coal; implementation of Integrated Infrastructure Development Centre (IIDC) in Pukpui, Lunglei.
C	**Zoram Handloom and Handicrafts Development Corporation Limited (ZOHANDCO)**	Handloom and handicrafts are the most important and popular industrial activities in Mizoram. Mizoram has highly gifted skilled handloom and handicraft artisans. ZOHANDCO's main objectives are to develop, aid, advise, assist, finance, protect, and promote interest of handloom and handicrafts units in the state, whether owned or conducted by the

S.N	Agency/ Program	Description
		government, statutory body, company, firm, or individuals; and to provide them with capital, credit means of resources and technical and managerial assistance for the conduct of their methods of manufacture, management, marketing, and their techniques of production.
D	Mizoram Food and Allied Industries Corporation Ltd. (MIFCO)	MIFCO was formed to harness the limited resourcesendowment of the state, and nurtureits potential for the welfare and well-being of its people. Agro and allied food industries acquire priority due to their advantage in terms of high potential for employment generation per unit of investment, the backward and forward linkages that the development can lead to, the level of demands and capability to absorb and promote local resources, predominantly agricultural and horticultural produce. MIFCO has the following units: • Pork and Poultry Processing Plant, Zemabawk • Food Processing Plant, Sairang (Upgradation/Expansion) • Fruit Juice Concentrate Plant, Chhingchhip (Upgradation//Expansion) • Food Park, Chhingchhip It also adding Mega Food Park and Modern Abattoir
E	Mizoram Khadi and Village Industries Board (MKVIB)	MKVIB Board is a statutory and a promotional body with a power to take up trading and business activities for the benefit of its registered village industries units. The board provides for better facilities, development and regulation of Khadi and Village Industries. It is constituted to promote Khadi and Village Industries following the Gandhian principle to uplift village artisans and give employment at their doorstep. The board also promotes the following two schemes: (a) **Rural Industries Consultancy Service (RICS):** The board provides RICS facilities for the benefit of entrepreneurs and artisans by opening these at the main office. All officers of the RICS are ready to help artisan and entrepreneurs, in their efforts to start the industries. (b) **Prime Minister's Employment Generation Programme (PMEGP)**: It is a central sector scheme to be administered by the Ministry of Micro, Small and Medium Enterprises (MoMSME). The scheme is to be implemented by Khadi and Village Industries Commission (KVIC), a statutory organization under the administrative control of the Ministry of MSME as the single nodal agency at the national level. At the state level, the scheme is implemented through the State KVIC Directorates, State Khadi and Village Industries Boards (KVIBs), District Industries Centres (DICs), and banks. List of applicable trade under PMEGP scheme are: • Food Processing Industry • Forest and Agro-based Industry • Handmade Paper and Fibre Industry • Mineral-based Industry • Polymer and Chemical-based Industry • Rural Engineering and Bio Technology Industry • Textile/Service Industry
F	Tea Board	The Tea Board undertakes the following main functions: • Provide scientific and commercial tea plantation by helping small tea growers family forming a Small Tea Grower Society/Self Help Group (SHG); • Assist tea nursery and plantation activities to adopt scientific and commercial methods and practices; • Implement the Tea Board Scheme under the provision of Tea Rules – 1954 for various subsidies to growers after registering them with the Tea Board; and • Provide subsidy limited up to 25% of the total cost of plant and machinery for tea processing factory.

S.N	Agency/ Program	Description
G	New Land Use Policy (NLUP)	NLUP is the flagship programme of the state government for economic upliftment of the people. The main objectives of the programme are summarized as follows: • Provide sustainable income to farming families by weaning them away from the destructive and unprofitable shifting cultivation practice. • Provide urban poor with livelihood by encouraging small-scale industries and petty trades. • Converging schemes funded by the government of India to NLUP for better utilization of funds. • Land reclamation and forestation. • Environment protection and restoration through various means. The Industries Department is one of the eight line departments selected to implement the NLUP programme. During 2012-13, under the industry sector of NLUP, 19,579 families were assisted.

Source: Taken from various documents

(4) Forest Produce

Table 10.1-10 presents the production of major forest products during the period from 2004-2005 to 2012-2013. A significant change in bamboo production and bamboo-based products can be observed. In the year 2004-2005, about 101 million bamboos were produced and by 2012 the production fell drastically to 113,000, whereas the production of broom sticks during the same period increased from 275 quintals to 5,787 quintals. This indicates that with the fall in production of bamboos, the production of other bamboo products was stopped in favour of broom sticks. It also indicates the need to revive the production of bamboo-based products.

Table 10.1-10 Production of Forest Products – Mizoram

Year	Teak (m^3)	Round Timber (m^3)	Swan Timber (m^3)	Fire – Wood (m^3)	Bamboo ('000 Nos)	Broom Sticks (Qtls.)	Anchiri (Qtls.)
2004-05	-	-	85	-	100,800	275	-
2005-06	-	-	117	-	75,200	3,375	-
2006-07	-	-	1,924	-	72,800	4,430	-
2007-08	-	-	21,311	-	23,440	1,500	-
2008-09	3,672	74	1,217	2,115	6,126	1,280	3,127
2009-10	-	11	605	5,027	4,257	9,000	1,078
2010-11	110	39	1,203	7,165	3,586	1,727	-
2011-12	-	6	1,461	7,468	452	2,227	-
2012-13	1,681	417	2,222	73,318	113	5,787	-
Division-wise Production during 2012-13							
Aizawl	-	376	283	63,768	29	40	-
Kolasib	-	-	140	43	30	3,967	-
Mamit	-	-	186	29	3	498	-
Kawrthah (Champhai)	1681	-	192	-	2	1,065	-
Thenzawl (Serchhip District)	-	-	506	41	16	15	-
Lunglei	-	-	169	125	1	-	-
Tlabung (Lunglei District)	-	-	-	-	3	60	-
Lawngtlai	-	-	-	-	-	-	-
N. Vanlaiphai (Serchhip District)	-	-	696	683	-	-	-
Champhai	-	-	45	8,610	26		-
Darlawn (Aizawl District)	-	41	4	19	3	142	-

Source: Statistical Abstract of Mizoram 2013

(5) Sericulture

Sericulture is one of the income generation sources in the rural areas of the state. Table 10.1-11 presents the information on number of villages and families engaged in sericulture. While the numbers of families engaged in sericulture activities and area under sericulture plantation have decreased over a period, the number of sericulture villages/farms has remained almost static. The highest number of activities related to sericulture is seen in Aizawl, followed by Lunglei.

Table 10.1-11 Number of Sericulture Villages, Families Engaged in Sericulture, Areas under Sericulture Plantation and Number of Seri-farms

Year	No. of Sericulture Village	No. of Families Engaged in Sericulture Activities	Area under Sericulture Plantation (ha.)	No. of Sericulture Govt. Farms
2004-2005	153	3,913	3,399	17
2005-2006	176	5,543	4,060	17
2006-2007	176	7,293	4,200	17
2007-2008	176	7,293	4,900	17
2008-2009	176	7,293	5,000	17
2009-2010	175	7,293	5,100	17
2010-2011	175	7,000	4,300	17
2011-2012	175	2,500	6,345	17
2012-2013	175	3,880	2,972	17
District-wise 2012-2013				
Mamit	10	194	80	1
Kolasib	15	474	577	4
Aizawl	85	1,778	1,003	5
Champhai	15	419	290	2
Serchhip	10	209	311	2
Lunglei	35	772	660	2
Lawngtlai	3	22	47	-
Saiha	2	12	4	1

Source: Statistical Abstract of Mizoram: 2013

The figures related to the production of cocoons and raw silk is presented in Table 10.1-12. The silk production activity is more concentrated in Aizawl, Champhai, Serchhip, and Lunglei districts.

Table 10.1-12 Production of Cocoons, Raw Silk, and Seeds Distribution

Year	Production of Cocoons				Production of Raw Silk (t)
	Mulberry (MT)	Muga (lakh)	Eri (MT)	Oak Tasar (lakh)	
2004-2005	45	5.0	4.0	0.6	4.0
2005-2006	47	3.6	4.0	3.0	2.0
2006-2007	48	3.6	3.8	1.5	4.0
2007-2008	48	2.5	4.0	1.5	4.3
2008-2009	55	1.0	4.6	1.2	3.4
2009-2010	60	1.2	4.2	0.25	6.5
2010-2011	65	2.0	4.0	2.0	8.0
2011-2012	190	4.4	10.0	3.2	24.2
2012-2013	300	19.18	7.1	1.18	29.67
District-wise 2012-2013					
Mamit	43.02	1.23	-	-	71.5
Kolasib	16.4	9.95	1.7	-	63.0
Aizawl	151.5	8.0	3.98	-	186.4
Champhai	31.08	-	-	1.18	103.0
Serchhip	33.24	-	-	-	108.0
Lunglei	24.48	-	1.42	-	150.0
Lawngtlai	-	-	-	-	1.0
Saiha	0.28	-	-		2.1

Source: Statistical Abstract of Mizoram: 2013

(6) Trade

There are three Land Custom Stations (LCS) in Mizoram, two doing business with Bangladesh and the other one with Myanmar. The one at Kawrapuchchiah near Tengamukh in Bangladesh is not yet notified but is identified to be developed as an LCS. However, the other LCS doing business with Bangladesh in Demagiri, opposite Rangamati in Bangladesh, is already functional. The LCS with Myanmar is at Zokhawthar, opposite Rhi in Myanmar. An LCS has been recently notified by the Commerce Ministry in Zorinpui, Lawngtlai District on the Kaladan Muti Modal route. However, all these are in nascent stages of development and not suited for any major trade partnership. In the year 2011-2012, the betel nuts imports from LCS, Zokhawthar was 40 t with a value of INR 1.49 million.

(7) Mineral Resource

Being a hilly state, Mizoram is rich in minerals. The figures on production of stone and sand are set out in Table 10.1-13. The stone and sand production is mainly concentrated in Aizawl, and in Mamit, Kolasib, and Lunglei districts (Table 10.1-14).

Table 10.1-13 Number of Quarry Permit Issued and Mineral Production

Year	No. of Quarry Permit Issued	Production form Quarry (Stone) (m^3)	INR in Lakhs	Sand Production (m^3)	INR in Lakhs
2005-2006	191	NA	NA	NA	NA
2006-2007	164	NA	NA	NA	NA
2007-2008	33	312,797.083	37.54	36,176.54	18.09
2008-2009	78	418,208.316	50.19	118,585.26	59.29
2009-2010	48	261,488.330	31.38	62,611.40	31.31
2010-2011	97	212,937.325	85.18	136,303.94	68.15

Source: Statistical Abstract of Mizoram 2011

Table 10.1-14 District-wise Number of Quarry Permit Issued and Mineral Production, 2010-2011

District	No. of Quarry Permit Issued	Production form Quarry (Stone) (m^3)	INR in Lakh)	Sand Production (m^3)	INR in Lakh
Mamit	4	11,087.50	4.43	1,980.00	0.99
Kolasib	6	11,594.90	4.64	11,312.20	5.66
Aizawl	28	171,776.725	68.71	67,189.04	33.59
Champhai	15	4,913.95	1.97	29,825.70	14.91
Serchhip	8	4,799.70	1.92	5,435.00	2.72
Lunglei	31	8,294.55	3.32	20,562.00	10.28
Lawngtlai	5	470	0.19	-	-
Saiha	-	-	-	-	-
Total	**97**	**212,937.325**	**85.18**	**136,303.94**	**68.15**

Source: Statistical Abstract of Mizoram 2011

(8) Tourism

Tourism is one of the revenue generation sources depending on the availability of good road infrastructure. While there are attractive tourist spots in Mizoram, it accounted for only about 1% of the total tourists (domestic and foreign) visits in North-East Region in 2013 (Table 10.1-15). Thus, there is a need to make all possible efforts to increase the visits of tourists in the state by increasing the accessibility and developing/improving tourism-related infrastructure, including road network and condition.

Table 10.1-15 Domestic and Foreign Tourist Visits

States	2012			2013		
	Domestic	Foreign	Total	Domestic	Foreign	Total
Mizoram	64,249	744	64,993	63,377	800	64,177
NER Total	6,663,933	66,302	6,730,235	6,135,939	84,820	6,220,759
Study States Total	5,788,152	34,678	5,822,830	5,974,840	42,276	6,017,116
India Total	1,036,346,657	20,731,495	1,057,078,152	1,036,346,657	20,731,495	1,057,078,152

Source: India Tourism Statistics 2012, Ministry of Tourism, Government of India.

The important tourist attraction points/locations in Mizoram are shown in the map shown in Figure 10.1-5, along with a brief description of these spots.

Aizawl: It is a hill station at 3,715 ft above sea level, having a fair temperature throughout the year. It is surrounded on the east by deep green valley of the River Tuirial, on the west by the River Tlawng, on the north protected by high hills of Durtalang.
Bung, Paikhai, Sairang, Tamdial Lake and Hmuifang: Picnic spots with adequate facilities
Vantawng: The highest waterfall in the state, surrounded by a lush green tropical forest filled with bamboo groves.
Champhai Town: Virgin forest with view of the hills of Myanmar and has interesting village life. It is also a trade centre between India and Myanmar and the rice bowl of Mizoram.
Dampa Wildlife Sanctuary: Tiger reserve area of 500 km^2 along the international border.
Murlen National Park: Full with wildlife such as tigers, chamber deer, Himalayan bear, barking deer, serow and birds
Lunglei Town: Hill station with natural landscape, cool and pleasant climate, rich flora. The remains of the British missionaries and the first church of Mizoram are located here.
District Park Zobawk: An archetype place for the tourists craving for nature.
Chhimtuipui: Located at 4,020 ft, ideal hill station for tourists looking for solitude and clean air.
Kolodyne River: The biggest river in Mizoram, having its source coming from the eastern Myanmar after flowing through Chhimtuipui District that enters in the Bay of Bengal near Myanmar.

Source: JICA Study Team

Figure 10.1-5 Tourist Spots in Mizoram

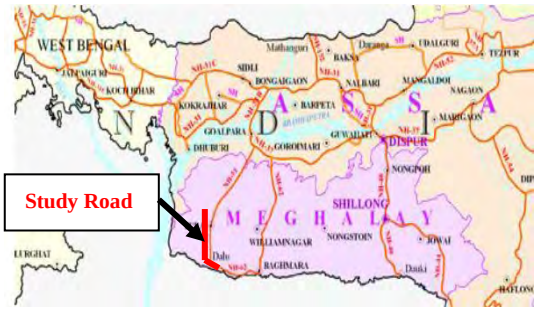
Phawngpui National Park: The highest mountain in the state at 2,157 m with an area of 3,000 m^2, this park is rich in flora and fauna. It is a home for tigers, sambar deer, hoolock gibbon, barking deer, bear, serow, and birds.
Palak Lake: An oval shaped lake, the biggest in the state, surrounded by thick forests rich in flora and fauna (including wild elephants). Various types of water lilies and birds have nested in these plants covering a large part of the waterfronts.

10.2 NH51

10.2.1 Present Conditions of NH51 Corridor

(1) Study Corridor

The Tura–Tuipang Road section (approximately 54 km) is part of NH51 and is located in Meghalaya State. Due to its location, the state assumes a prominent importance vis-à-vis the possibility of movement of goods, services, and trades with Bangladesh and Assam State, and beyond the rest of India.



Source: JICA Study Team

Figure 10.2-1 Study Corridor – NH51

For the present context, the Study Corridor is considered as an area abutting the road section (NH51), where the influence of the road improvement can be felt by way of supporting the overall economic activities in the corridor. It may be observed (Figure 10.2-1) that the road alignment runs almost through the southwest part of the state and traverses mainly through the South Garo Hills District and closes to the other two districts, viz., West Garo Hills and East Garo Hills in Meghalaya State. On 24 March 2012, the East Garo Hills District was further bifurcated to form the new district of North Garo Hills. However, for the purpose of this study and due to the availability of data, the North Garo Hills District has been considered as a part of the East Garo Hills District.

Thus, the above three districts have been considered as the influence zone of the road corridor. A brief description of the three districts is set out in Table 10.2-1.

In the remaining part of this section, the natural conditions prevailing in the Study Corridor, the industrial and other economic activities (prevailing and potential) in Meghalaya State, as well as of the three districts, are studied and analyzed.

Table 10.2-1 Description of Districts Falling in Study Corridor of NH51

District	Description
South Garo Hills	The district lies in the southern part of the state of Meghalaya with its headquarter in Baghmara, the only town in the district. It is situated between 25˚10' and 25˚35'N latitudes and 90˚15 and 91˚0' E longitude. It covers an area of 1,887 km^2. It is bounded on the north by East Garo Hills, on the east by the West Khasi Hills District, on the west by West Garo Hills District and on the south by Bangladesh. The major mineral resources include coal, limestone, uranium, quartz, etc.
West Garo Hills	The West Garo Hills is one of the largest districts of Meghalaya, having its headquarters in Tura, the second largest town after Shillong. It is situated on the western part of the state of Meghalaya bounded by the East Garo Hills District on the east, South Garo Hills on the southeast, Goalpara District of Assam on the north and northwest, and Bangladesh on the south. The district is approximately between the latitudes of 90° 30' and 89° 40' E, and the longitudes of 26° and 25° 20' N. The district is mostly hilly with plains fringing on the northern, western, and southwestern borders.
East Garo Hills	The East Garo Hills District is between 25.24º N and 26.10º N latitude and 90º E and 91.3ºE longitude. It is bounded by the South Garo Hills on the south, West Garo Hills on the west, and East Khasi Hills on the east and North Garo Hills on the north. Its new headquarters (Williamnagar) is a well planned township with all the amenities of a modern town and is the largest growth centres in Garo Hills, next to Tura.

Source: JICA Study Team

(2) Natural Condition

The state of Meghalaya is situated on the northeast part of India. It extends for about 300 km in length and about 100 km in breadth. It is bounded on the north by Goalpara, Kamrup, and Nowgong districts,

on the east by Karbi Anglong and the North Cachar Hills districts, all in Assam, and on the south and west of Bangladesh.

Meghalaya, one of the most beautiful states in the country, is blessed with abundant rainfall, sunshine, virgin forests, high plateaus, tumbling waterfalls, crystal clear rivers, and meandering streamlets. Meghalaya is subject to vagaries of the monsoon. The climate of Khasi and Jaintia Hills is neither too warm in the summer nor too cold in the winter, but over the plains of Garo Hills, the climate is warm and humid, except in the winter. The average annual rainfall is about 2,600 mm over western Meghalaya, between 2,500 to 3,000 mm over northern Meghalaya and about 4,000 mm over south-eastern Meghalaya. There is a great variation of rainfall over central and southern Meghalaya. In Sohra (Cherrapunjee), the average annual rainfall is as high as 12,000 mm, but Shillong is located at a distance of about 50 km from Sohra, which receives an average of 2,200 mm of rainfall annually.

(3) Socio-economic Conditions

1) Demography and Social Condition

According to 2011 Census, the population of Meghalaya is 2,961,001 and is scattered over an area of 22,429 km^2. The state has the density of 132 persons per km^2. The decadal growth rate of the population of the state was 27.82%, over the period of 2001-2011. The sex ratio in Meghalaya is 986 females to 1,000 males, which is higher than the average all India figure of 940. The literacy rate in the state is 75.46% as compared with the average all India literacy rate of 74.04%. The district-wise population and social parameters are presented in Figure 10.2-2.

District	Population (2011 Census)	Pop. Growth (%) 2001-2011)	Area (km^2)	Sex Ratio	Literacy (%)	Density (Person km^2)	Pop.* (2014)
East Garo Hills	317,917	26.87	2,603	972	60.44	122	344,241
West Garo Hills	643,291	24.09	3,677	984	55.76	175	690,919
South Garo Hills	142,334	33.05	1,887	945	57.65	75	156,917
Meghalaya	**2,964,001**	**27.82**	**22,429**	**986**	**75.46**	**132**	**3,089,742**

Source: www.census2011.co.in
** Projected/extrapolated by the JICA Study Team on the basis of the past growth rate

Figure 10.2-2 Districts of Meghalaya

It may be observed from the above table that about 37% of the population of Meghalaya State reside in the three districts and it covers about 36% of the total area of the state. Of the total population of the three districts, about 58% population is concentrated in West Garo Hills, about 29% in East Garo Hills and remaining 13% in South Garo Hills. In terms of area, West Garo Hills occupies about 45% (of the total area of three districts), East Garo Hills 32%, and South Garo Hills 23%.

The literacy rate in the three districts is less than the average literacy rate (75.46%) of the state. Similarly, the sex ratio is also lower than the state average of 986 (number of female population per 1,000 male population).

2) Economy

Economic Growth

The net state domestic product (NSDP) at current prices for the year 2013-2014 was about INR 18,504 crores, and the per capita income (PCI) during the same period was INR 58,522. It has also been

observed that during the period from 2004-2005 to 2013-2014, the economy of the state grew at a compound annual growth rate of 7.82%, with primary sector growing at 2.12%, secondary sector at 10.11% and the tertiary sector at 8.72%. During the same period, the per capita income of the state grew at 4.76%. The sector-wise growth rates as well as the growth of PCI are summarized in Table 10.2-2 (these figures are at constant 2004-2005 prices).

Table 10.2-2 Economic Growth of Meghalaya State

Sector	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	CAGR (%)
Agriculture and Allied (P)	14,296	15,000	15,156	14,946	15,519	15,814	15,948	16,696	16,954	17,739	2.12
Share to NSDP (%)	24%	24%	22%	21%	20%	19%	17%	16%	16%	15%	
Industry (S)	14,465	15,737	17,949	18,671	22,071	23,300	25,667	31,951	31,438	34,978	10.11
Share to NSDP (%)	25%	25%	26%	27%	28%	28%	28%	31%	30%	30%	
Services (T)	29,696	32,290	34,672	36,293	41,303	44,850	50,646	54,341	56,510	65,664	8.72
Share to NSDP (%)	51%	51%	51%	52%	52%	53%	55%	53%	54%	55%	
NSDP	58,457	63,028	67,777	69,909	78,893	83,964	92,261	102,988	104,902	118,381	7.82
Population`(in 000)	2,427	2,458	2,488	2,518	2,548	2,578	2,609	3,010	3,085	3,162	3.06
PCI (INR)	24,086	25,642	27,242	27,764	30,963	32,569	35,363	34,217	34,004	37,439	4.76

Source: Derived from the Central Statistical Origination, Government of India
Note: CAGR – Compound Annual Growth Rate

Economic Structure

The structure of Meghalaya State economy for the year 2013-14 (at current prices) indicates that the major share (53%) of NSDP is accounted by the tertiary sector (Services), followed by secondary sector (31%), and primary sector (15%). It can be observed that the contribution of manufacturing to the state economy is 4.86% of the NSDP, and the same figure for mining and quarrying is 4.15%, and that for construction activities is at 21.91%.

In addition to the above snap-shot view of the economic structure of the state for the year 2013-2014 as discussed above, a comparative analysis of the composition of the economic structure (at constant 2004-2005 prices) over the period from 2004-2005 to 2012-2013 was studied as per the data presented in Table 10.2-2. It can be observed that the share of secondary sector has increased from 25% in the year 2004-2005 to 30% in 2013-2014. During the same period the share of primary sector has decreased from 24% to 15%, and that of tertiary sector increased from 51% to 55%.

10.2.2 Industrial and Other Potential

(1) General

Meghalaya shares a stretch of 443 km long international border with Bangladesh and is rich in mineral resources. This combination puts the state in a unique advantage for setting up of industries that can tap the local resources and at the same time gain an edge in production at low cost to be competitive. Added to that, the improvement of the road network shall be an advantage that would support the industrialization process of the areas falling in the influence zone of the improved road network.

(2) Salient Features of "Meghalaya Industrial and Investment Promotion Policy 2012 (MIIPP - 2012)"

The salient features of MIIPP–2012 are listed below.

- Promoting private enterprises and healthy growth of existing industries by ensuring sustainability of existing business.
- Strictly monitoring the transfer/lease of land to the units on need-based and actual requirement basis.
- Creation of new industrial areas/estates for manufacturing and service enterprises, early completion of growth centre.
- Enterprises promoted and managed by "Woman Entrepreneur"/physically challenged will get an additional of 10% incentives on the State Capital Investment Subsidy.
- The 10 km towards the state from the international border is declared as "Priority Area" and enterprises set up within the 10 km area will be given special incentives to be known as "Border Area Subsidy".
- Meghalaya Industrial Development Corporation Ltd (MIDC) to be restructured.

Potential Areas

The following areas have been declared as potential areas in the promotion of industrial activities in the state of Meghalaya.

- Agro and Horticulture Processing Unit: Thrust on the post harvest management
- Processing of Plantation Crops: Processing of tea, rubber, including medicinal plant (into herbal medicine)
- Development of Traditional Handloom and Handicraft
- Tissue Culture and Bio-Technology: Export-oriented Orchid Cultivation (Tissue Culture) is given the status of an industry
- Spices Oleoresin and Other Essential Oils Units: Export oriented unit on spice oils, oleoresin, and other essential oils will be encouraged.
- Animal Husbandry and Meat Processing Industries: Dairy products including hygienic and scientific processing of poultry, piggery, and other meat products.
- Development of Mineral-based Industries: The following mineral-based industries will be encouraged:
  - ✓ Cement
  - ✓ Lime and hydrated lime (coal fired)
  - ✓ Precipitated and activated calcium carbonate
  - ✓ Calcium Carbide
  - ✓ Coal briquette and high temperature carbonization plant
  - ✓ Low ash metallurgical coke/coke breeze
  - ✓ Wall/floor tiles
  - ✓ Earthen-wares (crockery, novelties, etc.)
  - ✓ Stone wares (sanitary wares, etc.)
  - ✓ Fire bricks
- Electronics and Information Technology: Setting up an electronic/IT-based industries and complexes in the private sector as well as in public-private partnership (PPP) model.
- Bamboo/Reclaimed Wood based and Products: Setting up of bamboo/reclaimed wood based industries in the rural areas to encourage local entrepreneurs at the village level.
- Hotel/Nursing Homes/Captive Power Generation: Setting up hotels/nursing homes/power generation units in the private sector or in PPP model.

(3) Agriculture

Meghalaya is basically an agricultural state with about 80% of its total population depends entirely on agriculture for their livelihood. The total cropped area in the state has increased by about 42% during the last 25 years. Food grain production covers an area of over 60% of the total crop area. With the introduction of different crops of high yielding varieties in the mid-70s, a remarkable increased in food grain production has been made. A major breakthrough was achieved when high-yielding varieties of paddy, which is suitable for *Rabi* season, fitting in the multi-cropping system, have been widely cultivated all over the feasible areas of the state. Besides the major food crops of rice and maize, the

state is also renowned for its horticultural crops like orange, lemon, pineapple, guava, litchi, banana, jackfruit, and temperate fruits such as plum, pear, peach, etc. Potato, ginger, turmeric, black pepper, areca nut, tezpatta, betelvine, short-staple cotton, jute, mesta, mustard rapseed, etc., are some of the important cash crops in the state.

Apart from the above, the state has achieved success in the cultivation of non-traditional crops like tea, cashew nut, oilseeds, tomato, mushroom, wheat, etc. New emphasis is laid on pulses, oilseeds and cash crops. An autonomous board is set up to promote plantation crops; pioneering work is being done in tea cultivation, with the state having 253 small tea growers at present. Marketing of agricultural produce is facilitated by establishing the secondary regulated markets and building rural godowns.

The production, yield, and area under major crops in the year 2011-2012 are presented in Table 10.2-3. In terms of production and area, rice is the main crop in Meghalaya.

Table 10.2-3 Area, Production, and Average Yield per Hectare of Principal Crops -2011 to 12

States	**Meghalaya**			**All India**		
Commodity	**A**	**P**	**Y**	**A**	**P**	**Y**
Rice*	108.9	216.5	1,988	44,006.3	105,301	2,393
Wheat	0.4	0.6	1,564	29,864.8	94,882.1	3,177
Maize	17.4	26.5	1,529	8,781.9	21,759.4	2,478
Small Millets	2.2	1.7	771	798.8	451.5	565
Total Cereals	**128.2**	**245.3**	**1,904**	**100,292.7**	**242,197.1**	**2,415**
Gram	0.6	0.4	625	8,299.1	7,702.3	928
Tur (Arhar)	0.8	0.6	759	4,007.4	2,654.1	662
Total Pulses	**4.2**	**3.7**	**896**	**24,462.2**	**17,088.9**	**699**
Total Food Grains	**133**	**249.1**	**1,873**	**124,754.9**	**259,286**	**2,078**
Ground-nut	–	–	–	5,263.7	6,963.7	1,323
Soybean	1.1	1.8	1,694	10,109.1	12,213.5	1,208
Total Oilseeds	**9.9**	**7.6**	**766**	**26,308.2**	**29,798.7**	**1,133**
Sugarcane	0.1	0.2	2,714	5,037.7	361,036.6	71,668
Jute**	3.9	34.4	1,600	809	10,735.6	2,389

Sources: 1) 58th Fertiliser Statistics 2012-13, Fertiliser Association of India
2) Directorate of Economics and Statistics, Ministry of Agriculture
Notes: A= Area in '000 hectares; P= Production in '000 tonnes; and Y= Yield in kg/ha
*- Cleaned rice; **-'000 bales of 180 kg, each

(4) Horticulture and Agro-based Industries

The potential for agro-based industries in the state of Meghalaya is very high. The state produces substantial quantities of oranges, peaches, pineapples, pears, guavas, plums, and bananas of superb variety. It also grows plenty of potatoes, tapioca, bay leaves, ginger, maize, and jackfruit.

Meghalaya's turmeric, particularly the variety that is grown in Shangpung in Jaintia Hills, is considered the best in the world. There is enough potential for setting up a starch-based processing unit in the state. Plantation crops like coffee, rubber, black pepper, and areca nut are also becoming important products. A major breakthrough has been made in tea cultivation and tea gardens have come up in various parts of the state.

One of the areas in which there is a tremendous potential for investment and development is food processing. There is an ample scope for setting up a large-scale fruit processing unit.

(5) Mineral-based Industry

Meghalaya, with its wealth of mineral deposits, has tremendous industrial potential. There are extensive deposits of coal, limestone, granite, clay, and other minerals.

Table 10.2-4 presents information about various mineral resources in the state and the places of occurrence. It can be observed that limestone and coal are the major mineral resources available in the state.

Table 10.2-4 Mineral Reserves in Meghalaya

Minerals	Reserve (in million tonnes)				Grades	Major Places of Occurrences
	Proved	Indicated	Inferred	Total		
Limestone	9,515	41,599	3,986	15,100	Cement, Metallurgical, and Chemical	Cherrapunjee, Mawlong, Ishamati, Shella, Komorrah, Borsora, Bagli in Khasi Hills District, Lakadong, Lumshonong, Nongkhlieh in Jaintia Hills District, Darrang Era-Aning, Siju and Chokpot in Garo Hills District.
Coal	133.13	-	443.35	576.48	Sub-bituminous with medium to high sulphur	Langrin and East Darrangiri in Khasi Hills District, Bapung in Jaintia Hills District and West Darranggiri in Garo Hills District
Clay (Lithomargic)	-	-	97.0	97.0	White ware, earthen ware, furnace lining, curing soap etc.	Cherrapunjee and Mahadek in Khasi Hills District, Tongseng in Jaintia Hills District, Nangwalbibra, and Rongrenggiri in Garo Hills District
Granite	24.0	-	26.0	50.0 million m^3	Table top, wall cladding etc	Nongpoh in Ri-Bhoi, Mylliem and Mawkyrwat in Khasi Hills District, Rongjeng in East Garo Hills District
Kaolin	3.20	1.94	0.10	5.24	White ware	Mawphlang, Smit, Laitlyngkot in Khasi Hills District, Thadlaskein, Mulieh Shangpung, Mynsngat in Jaintia Hills District, and Darugiri in Garo Hills District
Iron ore	3.60	-	-	-	Low grade	West Khasi Hills and East Garo Hills District
Glass Sand	-	-	3.0	3.0	Ordinary glass ware	Laitryngew, Umstew and Kreit in Khasi Hills, Tura in Garo Hills District
Quartz	-	0.5	0.5	0.5	Ordinary ceramic grade	
Feldspar	-	-	0.127	0.127	Ceramic grade	Bonsamgiri and Rombhagiri in East Garo Hills District
Silimanite	-	-	0.045	0.045	High temp. furnace lining	Sonapahar in West Khasi Hills District
Bauxite	-	-	1.45	1.45	Low grade (40% Al2O3)	Sung Valley in Jaintia Hills District
Rock Phosphate	-	0.015	-	0.015	Low grade (15-30% P2O5)	Sung Valley in Jaintia Hills District
Phosphatic Nodule	Nominal				P2O5: 5-15%	Rewak in South Garo Hills District
Gypsum	Nominal				Crystals of salanite variety	Mahendraganj in West Garo Hills District
Uranium	AMD, Government of India, has established a reserve of 9.22 mt, higher grade 0.104% U2O3 in Domiasiat, West Khasi Hills District					
Base Metal /Trace Metal	1.14% Cu: 0.80 mt, 1.61%Zn:0.85 mt, 1.88%Pb:0.88 mt. with traces of Cd, Bi, Ag, Tenor of gold encountered in three boreholes of Tyrsad					

Source: JICA Study Team

The dispatch of limestone and coal from different regions of Meghalaya is set out, respectively, in Table 10.2-5 and Table 10.2-6. The major dispatch of limestone is from Khasi Hills, followed by Jaintia Hills and Garo Hills. Similar pattern of dispatch is observed for the movement of coal.

Table 10.2-5 Dispatch of Limestone from the State

Year	Jaintia Hills (t)	Garo Hills (t)	Khasi Hills (t)
2003-2004	190,718	34,768	496,264
2004-2005	183,091	55,197	416,685
2005-2006	580,901	51,452	411,812
2006-2007	888,264	42,383	1,202,080
2007-2008	1,253,947	68,913	799,203
2008-2009	1,485,909	69,672	2,320,328
2009-2010	1,497,360	41,687	2,343,106

Source: JICA Study Team

Table 10.2-6 Dispatch of Coal from the State

Year	Jaintia Hills (t)	Garo Hills (t)	Khasi Hills (t)
2003-2004	3,918,037	1,058,440	462,791
2004-2005	3,610,603	1,101,088	633,499
2005-2006	3,879,738	1,120,525	565,451
2006-2007	4,045,710	1,174,635	566,307
2007-2008	4,359,878	1,370,263	811,004
2008-2009	2,890,865	1,594,170	1,003,613
2009-2010	3,722,211	1,562,008	482,798

Source: JICA Study Team

(6) Industry

To facilitate prospective entrepreneurs in acquiring site for industries, industrial estates/areas, the Export Promotion Industrial Park (EPIP), and growth centres have been created, and more are likely to come in the near future. The following are the existing industrial sites:

1. Barapani Industrial Area with an area spread of over 44 ha
2. Growth Centre in Mendipathar, in East Garo Hills District
3. Industrial Estate in Shillong, Jowai, Mendipathar, Tura and Nongstoin
4. Export Promotion Industrial Park (EPIP) in Byrnihat with an area spread over 259.35 ha was in operation since April 2001.

Table 10.2-7 presents the existing industrial sites of the state. All these places are well connected, having basic facilities such as road, power, water, hospital, post and telegraph, shopping complex, school, colleges, etc.

Table 10.2-7 Existing Industrial Sites of the State

Location	Industrial Estates (Area in Acres)	Growth Centre Area (ha)	EPIP/Industrial (Area in Acres)
Shillong	10.22	-	-
Tura	19.83	-	-
Jowai	14.56	-	-
William Nagar	15.30	-	-
Mendipather	7.00	36.00	-
Nongstoin	10.00	-	-
Byrnihat	-	-	259.00 (EPIP) 51.00-Extended Area
Umiam	-	-	109.67 (IA)

Source: JICA Study Team

The figures on small scale industries registered with the Directorate of Industries are presented in Table 10.2-8. As compared with Khasi Hills, the number of small scale industries is lesser in Garo Hills. Within Garo Hills, the number of SSI is highest in East Garo Hills, followed by West Garo Hills and South Garo Hills.

Table 10.2-8 District-wise Employment in Small Scale Industries Registered with Directorate of Industries

District	2007-2008			2008-2009		
	No. of Small Scale Industries	Investment in Plants and Machinery (INR in lakh)	No. of Persons Employed	No. of Small Scale Industries	Investment in Plants and Machinery (INR in lakh)	No. of Persons Employed
East Khasi Hills	2,839	4,762.13	17,314	3,087	18,200	5,172.52
Ri-Bhoi	314	2,963.05	3,169	331	3,387	4,288.07
Jaintia Hills	816	1,239.84	3,154	836	3,292	1,309.89
West Khasi Hills	1,154	415.61	4,806	1,178	4,914	433.97
East Garo Hills	676	309.98	3,556	683	3,584	316.67
West Garo Hills	549	545.17	3,598	563	3,680	606.90
South Garo Hills	163	46.93	596	164	599	47.08

Source: Statistical Handbook Meghalaya 2008-2009

Trade Avenues

There are 11 Land Custom Stations (LCS) in Meghalaya catering to Bangladesh. Out of these, the one in Dawki is being developed into Integrated Check-post. Out of the remaining ten LCSs, four are in Ghasupara, Bholaganj, Balat, and Ryngku, which are non–functional. The remaining LCS in Borsora, Shellabazar, Dalu, Mahendraganj, Baghamara, and Kaliachar are functional.

Details of the ten LCSs in the state with the routes through which export-import business/trading activities are being carried out are mentioned in Table 10.2-9.

Table 10.2-9 Land Custom Stations in Meghalaya

District	Land Custom Station	Trade Routes
South Garo Hills	Baghmara	Someshwari River
		Baghmara - Durgapur
	Gasuapara	Gandibo-Karaitoli-Haluaghat
West Garo Hills	Mahandraganj	Mahandraganje Dhanua
		Jinjiram River
	Dalu	Bugal River
		Dalu Nalitbari Road
East Khasi Hills	Shella	Shella River
		Pharang Karuh (Maula River)
	Ichamati	Ichamati River
	Bholaganj	Dholai River
		Bholaganj to Company Ganje
		Komorrah- Chhatak Ropeway
		Darogakhal River
		Sonai River
		Duba Channel
		Dear Valley
	Balat	
West Khasi Hills	Borsora	Cherragaon quarry-Cherragaon
		Borsora- Tahirpur
		Chalitachera- Samsar Bil
		Gauripur-Samsar Bil
Jaintia Hills	Dawki	Piyan River
		Shillong-Sylhet Road

Source: JICA Study Team

The imports and exports (for the year 2012-13) of commodities through Dhubri Custom Division are given in Table 10.2-10 and Table 10.2-11, respectively. The study road is located in Dhubri Custom Division and its improvement will facilitate the movement of goods. In 2012-2013, the imports (in value terms) at LCS Mahendraganj and LCS Dalu were almost 63% of the total imports at the Dhubri Customs Division.

Table 10.2-10 Imports at Dhubri Custom Division: 2012-13

Land Custom Station (LCS)	Item/Commodity	Volume	Value (INR)
LCS Mahendraganj	Synthetic Net Fabrics	180 t	18,035,678
	Cement	2,200 t	9,334,670
	Cotton Waste	1,010 t	13,732,596
	Melamine	8,305 kg	488,813
	Chakra Ball Soap	61,960 kg	4,090,981
	Vermi Celli	2,880 kg	280,800
	Saree	3,000 pcs	504,656
	Plastic Door	1,525 kg	72,615
		Total	**46,540,809**
LCS Mankachar	Cement	5,430 t	26,024,736
	Printed Books, Calendar	3,050 kg	70,468
	Melamine	4,400 kg	281,338
	Tissue Paper	300 kg	101,240
	Religious Books	8,600 kg	462,910
	Chakra Ball Soap	86,400 pcs	545,412
		Total	**27,486,104**
LCS Dalu	Cement	4,700 t	13,977,528
	Tangai tat Sari	209,032 pcs	28,863,507
	Synthetic Net Fabric	5,000 kg	420,546
		Total	**43,261,581**
LCS Hatisar	Extra Natural Alcohol	668,000 BL	24,084,000
	Plywood/Block Board	6,146.30 m^2	1,007,603
	Dried Grain	50.75 t	710,500
		Total	**25,802,103**

Source: Commissioner of Customs (Preventive), NER, Shillong

In terms of exports, the highest percentage (in value terms) on the total exports from Dhubri Custom Division was observed in LCS Ghasuapara (53.28%), followed by LCS Hatisar (32.04%), LCS Dalu (10.89%), LCS Baghmara (2.46%), LCS Mahendraganj (1.18%), and LCS Mankachar (0.14%). Thus, it can be seen that LCS Ghasuapara and LCS Hatisar together accounted for 85.32% of the total exports (in 2012-2013) at Dhubri Custom Division.

Table 10.2-11 Exports at Dhubri Custom Division: 2012-2013

Land Customs Stations (LCS)	Item/Commodity	Volume	Value (INR)
LCS Mahendraganj	Coal	228 t	876,638
	Boulder Stone	52,825 t	23,502,055
	Fresh Ginger	852 t	11,458,575
	Betel Nuts	337 t	2,304,937
	Dry Fish	37.5t	893,758
	Tamarind	72 t	740,240
		Total	**39,776,203**
LCS Ghasuapara	Coal	467,045.9 t	1,792,385,339
		Total	**1,792,385,339**

Land Customs Stations (LCS)	Item/Commodity	Volume	Value (INR)
LCS Mankachar	Boulder Stone	2,788 t	976,174
	Coal	243 t	674,672
	Fresh Ginger	297 t	3,913,426
		Total	**4,588,098**
LCS Baghmara	Coal	22,293 t	82,842,643
		Total	**82,842,643**
LCS Dalu	Coal	95,799 t	362,898,081
	Boulder Stone	8,215 t	3,567,432
		Total	**366,465,513**
LCS Hatisar	Rectified Spirit	920,000 BL	33,369,000
	S.K.O.	1,284 KL	17,014,342
	H.S.D.O.	19,168.5 KL	770,566,821
	Empty Bottles	3,274,414 pcs	22,912,611
	Bricks	5,784,350 nos	32,205,750
	L.P.G.	63,036 nos	22,357,598
	Rice	6,879.14 t	103,690,342
	Oranges	255,967 boxes	75,632,800
		Total	**1,077,749,264**

Source: Commissioner of Customs (Preventive), NER, Shillong

(7) Tourism

Meghalaya is overwhelmingly beautiful where everything is green and alive. The rolling mists in the valleys, the undulating hills, numerous lakes, waterfalls, caves, sacred forests, exotic flora and fauna, all together make it a unique and interesting destination.

The number of domestic and foreign tourist inflows into Meghalaya for the period from 2001 to 2011 is set out in Table 10.2-12. There are about 70 tourist attraction points in the state. The cumulative average growth rate over the period from 2001 to 2011 in total tourist arrival in the state has been observed at about 11%. The number of foreign tourists is not only negligible in numbers to the total tourist arrival, but its percentage share has declined over a period of time (from 1.32% in 2001 to 0.71% in 2011).

Table 10.2-12 Number of Domestic and Foreign Tourists Inflows in Meghalaya

Year	No. of Tourist Spots	No. of Visitors		Total
		Indian	Foreign	
2001	64	178,697	2,390	181,087
2002	64	268,529	3,191	271,720
2003	64	371,953	6,304	378,257
2004	64	433,495	12,707	445,902
2005	70	375,911	5,099	381,010
2006	70	400,287	4,259	404,546
2007	70	457,685	5,267	462,952
2008	70	549,954	4,919	554,873
2009	70	591,398	4,522	595,920
2010	70	652,756	4,177	656,933
2011	70	667,504	4,803	672,307

Source: Directorate of Tourism, Government of Meghalaya

The main tourist places in the three districts falling in the Study Road corridor is listed in Table 10.2-13.

Table 10.2-13 Tourist Places in Study Corridor

East Garo Hills	1. Patogan Nengminza Memorial in Chisobibra 2. Tasek Lake 3. Nangalbibra 4. Resubelpara Hot Spring 5. Nakachikong 6. Jolding Lake 7. Rasina Falls
West Garo Hills	1. Tura Peak 2. Nokrek Biosphere 3. Dachi Lake, Anogre 4. Chibragre Picnic Spot 5. Charontolla Temple 6. Rongbagre Fish Sanctuary 7. Rombang Fall 8. Silbalgre Holookh Gibon Reserve 9. Mirjumlla Tomb, Mankachar
South Garo Hills	1. Siju Cave 2. Captain W.A. Sangma Memorial 3. Kanai River 4. Rongdong Fall near Siju 5. Rewak Viewpoint 6. Balpakram National Park

Source: Directorate of Tourism, Government of Meghalaya

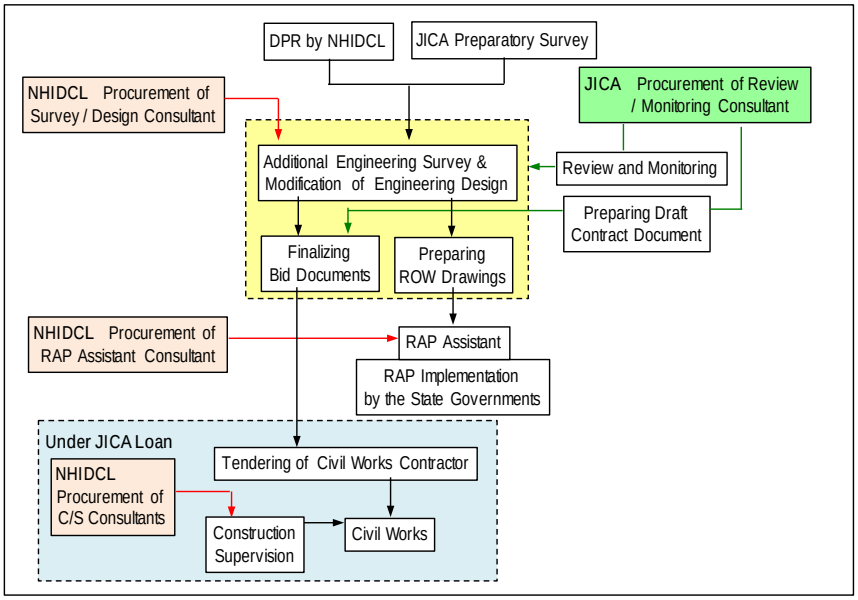
CHAPTER 11 IMPLEMENTATION PLAN

11.1 Implementation Schedule

11.1.1 Formulating Project Implementation Plan

JICA funded North – East Road States Network Improvement Project will be implemented by NHIDCL. JICA and NHIDCL schedule to sign Loan Agreement of NH-51 and NH-54 on March 2016. For examination of formulating the Project Implementation Schedule, the following control points need to consider;

i) From the development policy of North – East States by GoI, NHIDC desires to commence the construction works of NH-51 and NH-54 at least until Year-2017.
ii) DPR designs as well as the preliminary design in this study are based on the topographic survey data conduced in the DPRs, of which coverage and accuracy are not sufficient to implement proper land acquisition and construction works.
iii) Therefore, before implementing tender of civil works and land acquisition, the additional topographic survey shall be required to update the road alignment design.
iv) In order to commence the civil works from Year-2017, NHIDCL should procure the Survey / Design Consultant for updating road alignment design and preparing ROW drawings for land acquisition as soon as possible.
v) For the updating road alignment design, JICA is recommended to procure the Review / Monitoring Consultant for the Survey / Design Consultant procured by NHIDCL, since the consultant industry in India has not sufficient capability in the engineering of slope design.



Source: the JICA Study Team

Figure 11.1-1 Conceptual Framework of Implementing Procedure for NH54 and NH51

Considering with the above points, the Study Team recommend the framework of implementing procedure of the Project as shown in Figure 11.1-1.

11.1.2 Proposed Implementation Schedule

The implementation schedule of NH-51 and NH-54 is examined as North –East States Road Network Improvement Project Phase-1. The target date for commencement of civil works are May 01, 2016 for NH-51 and July 01, 20167 for NH-54. Major milestones of the said schedule are as follows;

[Updating Road Alignment Design]

- NHIDCL should procure the Survey/Design Consultant until November 2015.
- The Survey/Design Consultant should complete the modification of design and bid documents preparation for each civil works package until April 30, 2016 for NH-51 and June 30, 2016 for NH-54.
- NHIDCL should deliver the bidding documents to JICA for concurrence, and then, the bidding documents may be delivered to the bidders.

[Land Acquisition]

- The State Governments are responsible for land acquisition implementation. Accordingly, the Study Team recommends that NHIDCL procures RAP Assistant Consultant (or NGO) for RAP implement agencies of State Government until January 2016, in order to catch up the target schedule in compliance with JICA Environment Guideline.
- The Survey/Design Consultant should complete the ROW drawings until March 31, 2016 for NH-51 and May 31, 2016 for NH-54, and NHIDCL should hand over the said drawings to State Governments.
- NHIDCL should monitor to complete the Rehabilitation Plan of land acquisition by the State Governments until April 30, 2016 for NH-51 and July 31, 2016 for NH-54. NHIDCL should coordinate the budget approval from the upper ministry within 3 months after submission of the Rehabilitation Plan, and coordinate with the State Governments to complete land acquisition before the commencement of civil works.

11.1.3 Proposed Scope of Works for Survey/Design Consultant procured by NHIDCL

(1) Scope of Works

The JICA Study Team recommends the following engineering surveys shall be conducted to update the road alignment design and to finalize the bid documents for the civil works of NH-51 and NH-54;

A. Engineering Survey
   i. Additional Topographic Survey
   ii. Additional Geological / Geotechnical Survey
B. Modification of Engineering Design

Engineering design in DPR is principally pursued, and if necessary design modification resulted from the additional survey shall be incorporated into the engineer design in DPR.

JICA will procure a consultant to review and monitor entire process of the above survey and design. Survey/Design Consultant shall coordinate with JICA Consultant to accomplish the scope of works.

(2) Topographic Survey

1) Necessity of Survey

- Topographic data of DPR is not cover ground surface on valley and hill side, and X-Y coordinates of road alignment design in DPR design is not harmonized with the actual road alignment.
- Several sections of road ground surface data are difference from actual one.
- Since land acquisition will be implemented in accordance with ROW drawings to be based on the construction edge plus width of margin, the horizontal and vertical road alignment design (Plan & Profile) may not be changed during construction stage.
- At bidding stage, the each bidder should conduct the survey by themselves to estimate the cost and reduction of the risk. In case of less-accuracy topographic data to be attached in the bidding document, the bidder will add risk premium to the bidding price.

2) Scope of Survey

a. Carrying out plan topographic survey with average 25 m in total (average 15 m outside from the

most lateral survey point of hill side in DPR design, and average 10 m outside from the most lateral survey point of valley side in DPR design). Survey accuracy shall be ensured scale of 1:1,000.

Table 11.1-1 Required Area of Plan Mapping Topographic Survey

	Area of Survey		
	NH-51	NH-54	Total
Roadway	128.8 ha (L = 51.5 km)	876.8 ha (L = 350.7 km)	1,005.6 ha (L = 402.2 km)
Total:	128.8 ha	876.8 ha	1,005.6 ha

Source: JICA Study Team

b. If reference survey points by DPR are not confirmed at site and/or related documents to verify accuracy of the reference survey points by DPR are not confirmed, necessary control point survey to supplement above inadequacy shall be implemented. Scope of full scale control point survey is shown below as reference.
c. Establishing GPS Control Point with interval of 5.0 km with elevation survey from GTS Bench Mark (national bench mark).
Total 82 points (NH-51: 11 points, NH-54: 71 points)

The scopes of works for the topographic survey is as follows;

Table 11.1-2 Requirement of Topographic Survey

Item	Unit	Q'ty	Note
A. Plan Mapping Survey (S = 1:1,000)			
1) Survey for Additional Data	ha	1,005.6	- To cover average 15 m outside from the most lateral survey point of hill side in DPR design, and average 10 m outside from the most lateral survey point of valley side in DPR design - Existing utilities, road structures, house structures and social / religious objects shall be covered.
B. Control Point Survey (if reference survey points by DPR are not confirmed at site and/or related documents to verify accuracy of the reference survey points by DPR are not confirmed)			
1) Primary Control Survey (if required)	nos.	82	- To use Global Positioning System (GPS) and to integrate to the World Geographic System (WGS) 1984. - Elevation of GPS point shall be connected with the GTS Bench Mark (national bench mark).
2) Establishing GPS Monument (if required)	nos.	82	- To install concrete square monument with dimension of 30 cm x 30 cm x 60 cm with a 10 mm diameter, 60 cm long steel bar embedded at the center of the monument with i) Date Established, ii) GPS No., iii) Coordinates, iv) Elevation, v) Name of Project.
3) Establishing Secondary Traverse (if required)	nos.	1,608	- Secondary traverse will be established using Total Station instrument and will be tied to at least 2 GPS control points. - To be spaced not greater than 500m interval. - To be marked with wooden hub of dimension of 5cm X 5cm X 50cm with a common wire nail embedded at the center of the wooden hub.
4) Traverse Survey (if required)	km	402.2	- Secondary traverse will be observed and measured in accordance with the following manners; • Horizontal angles will be observed by two rounds of angle on 2 different zero setting. • The allowable linear error of closure not to exceed 0.0002 Ps where Ps is the perimeter of the control. • The angular error of closure (Azimuth) not to exceed 10"√S where S is the number of station. • Number of stations between azimuth check not to exceed 35.

Item	Unit	Q'ty	Note
			• Relative error after azimuth adjustment not less than 1:10,000.

Source: JICA Study Team

d. The above survey data shall be incorporated to the digital 3 dimensional mapping for the updating road alignment design.

3) Recommendation

- All of topographic data should be recommended to be handed over to the Contractor with the condition of the Contractor's risk.
- This consideration may lead to save the time and cost for the survey conducted by the Contractor under the civil works, consequently, the bidding price may be minimized in term of survey works.

(3) Geological / Geotechnical Survey

1) Necessity of Survey

- Due to limitation of survey schedule and budget in JICA Preparatory Survey, the slope inventory survey was carried out with interval of 100 m to 200 m.
- Under JICA Preparatory Survey, JICA Study Team identified 864 locations of slope failure section on the target route of NH-54, and the critical 99 locations out of 864 locations were examined the countermeasures against slope failure. The slope design in the biding documents is recommended to update with collecting late slope condition date.
- At biding stage, the each bidder should conduct the inventory survey by themselves to estimate the cost and reduction of the risk.
- The detailed slope inventory report to be attached in the bidding documents will be contributed proper cost estimation of bid price. Consequently, it will be avoid the risk premium in the bidding price by the bidder.
- Under JICA Preparatory Survey, the boring investigation was conducted only 3 locations out of total 99 critical sections in term of slope stability.
- According to DPR, the project area of NH-54 has very few location of the material source for aggregate to be used for concrete, asphalt, WMM and GSB. The transport distance from aggregate quarry will affect on the project cost of the said works, so that the quality of rock material from the identified quarry needs to be confirmed.

2) Scope of Survey

a. Detailed Slope Inventory Survey

[Scope]

- Preparing slope inventory sheets for both side of road with interval of 20 m to survey to identify; i) type of rock / soil, ii) degree of weathering, iii) classification of rock, iv) slope angel, v) strike and dip, vi) dislocation / landslide /spring, and to take photograph and sketch.

NH-51: 51.5 km, NH-54: 357.5 km

[Methodology of Field Survey]

- Type of Rock / Soil : to identify by visual inspection.
- Degree of Weathering : to identify by visual inspection or to confirm by using Schmidt Hammer
- Rock Classification : to classify as per Indian Standard in Rocky Stretch;Slope Angle : to measure by using survey tool (potable clinometer).
- Strike and Dip : to measured by using survey tool (portable clinometer).
- Dislocation / Landslide / Spring : to identify by visual inspection

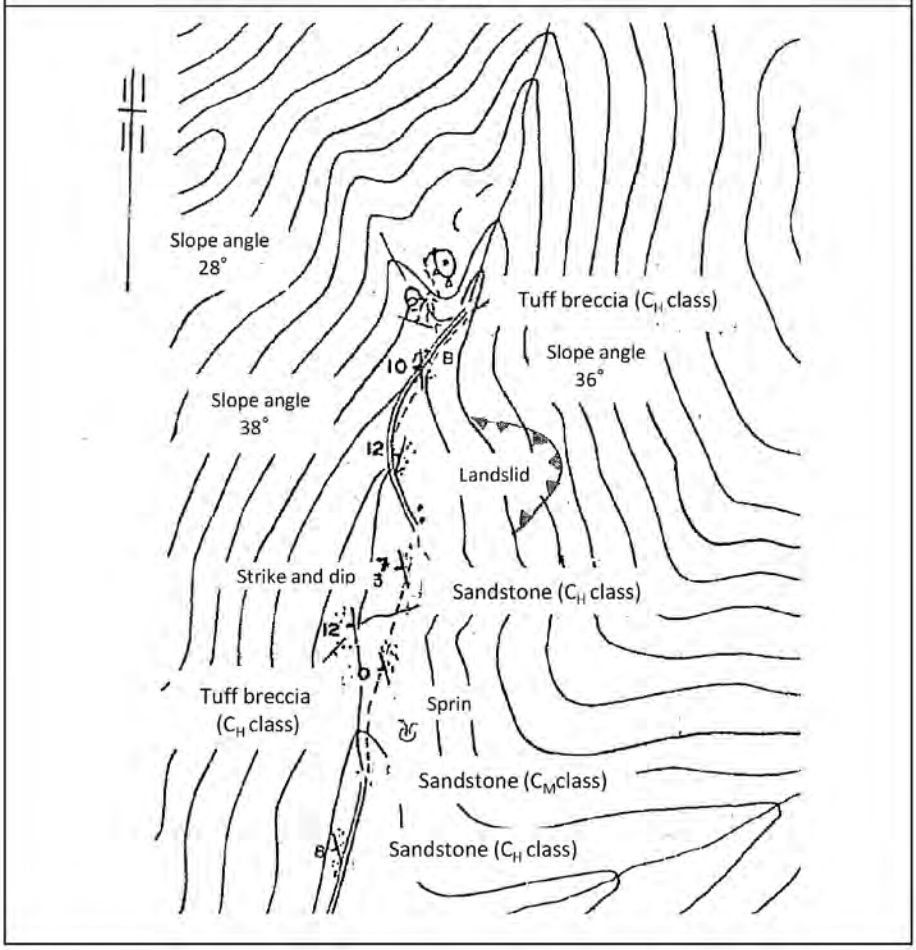
[Preparation of Inventory Sheet]

- A sample of inventory sheet for geological survey of slope surface (general section) is enclosed in Figure 11.1-2, and the inventory sheet for critical section is same format used in this study.

Field Survey Result

Section		STA. OO ~ STA. OO		
Geological Structure	①	Rock type		
	②	Degree of weathering		
	③	Rock Classification	A , B , C_H , C_M , C_L , D	
	④	Slope angle	(°)	
	⑤	Strike and Dip		
	⑥	Dislocation	YES	NO
		Landslide	YES	NO
		Spring	YES	NO

Sketch



Source: the JICA Study Team

Figure 11.1-2 Sample of Slope Inventory Sheet (General Section)

- Among 99 locations of critical failure section indentified in JICA Preparatory Survey, there were 3 locations of countermeasure against debris flow disaster. JICA Preparatory Survey has recommended considering potential flow capacity of debris in the culvert design. In detail inventory survey, the potential scale of debris flow should be updated for the review design.

b. Borehole Investigation at Landslide Section

[Scope]

- Carry out boring investigation at critical section of landslide of NH-54 and sinking section to be identified in JICA Preparatory Survey

NH-51: 3 locations: as decided during the joint survey taken by DPR consultant, JICA study team, and NHIDCL,
NH-54: to be decided based on history of frequent occurring of Landslide based on visual inspection of site and historical data of soil failure

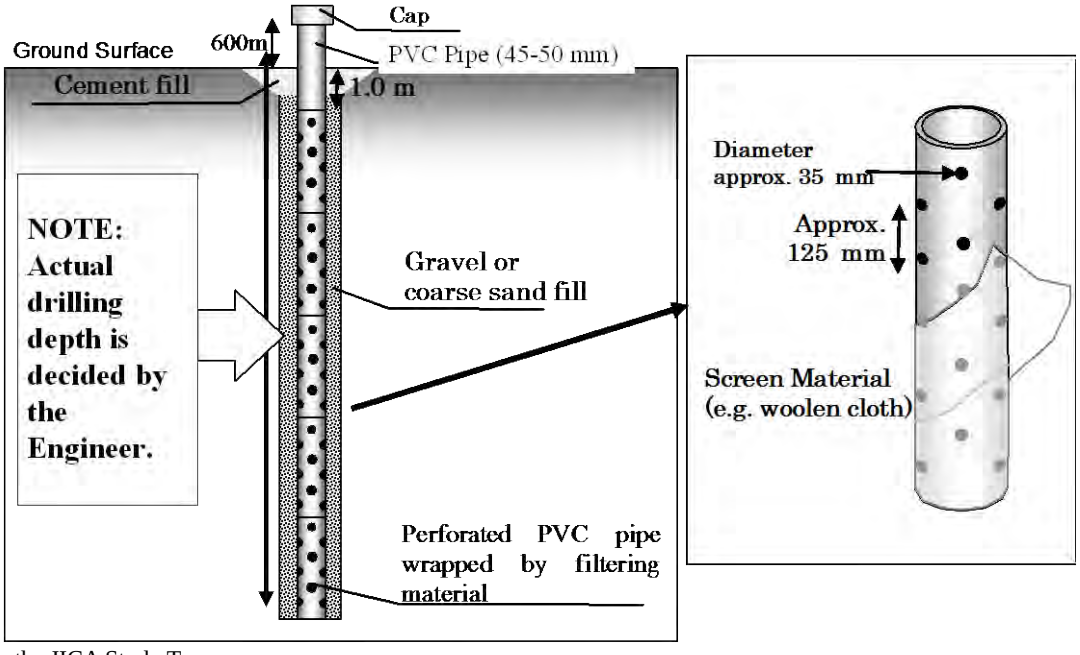
[Location of Borehole Investigation]
- List of locations for borehole investigation is enclosed in Atachement.

[Requirement of Core Sampling]
- The drilling machine shall have the drilling capacity sufficient to drill the required depth and with hole diameter of more than 66 mm. The drill bit shall be selected deliberately to meet the geological conditions for the best core recovery and efficiency.
    - For Cohesive Soil :

Thin-walled tube (φ76) should be used to obtain undisturbed samples.
    - For Rock Core :

Type : Built-in rotary sleeve double tube sampler
Outer diameter of the inner tube : φ68 (φ86)
Inner diameter of the inner tube : φ48 (φ66)
- The Sub-Consultant shall use rock coring techniques to explore and sample bedrock, and to confirm bedrock locations beneath proposed foundations. It is recommended to use double or triple tube core barrels to minimize disturbance of samples. Measure and record percent core recovery ratio (CRR) and Rock Quality Designation (RQD) as soon as the cores are recovered, and classify the rock. Cored rock samples are retrieved by rotary drilling with hollow core barrels equipped with diamond or carbide embedded bits. The core is commonly retrieved in 1.50 m lengths.
- The drilling shall aim at 100% core recovery in both rock and unconsolidated deposits. Drilling slime shall not be regarded as recovery of core samples. The recovery rate of samples in each five-meter section of the hole shall be not less than 70 % without acceptable reason.

[Monitoring Groundwater Level]
- Perforated PVC pipes with diameter 45-50 mm shall be prepared. The perforated PVC pipes shall be installed into each borehole. Details of the perforated PVC pipe are shown in Figure 11.1-3. The inside diameter of the pipes shall be not less than 40 mm.



Source: the JICA Study Team

Figure 11.1-3 Details of Perfroated PVC Pipe for Each Borehole

- After installation of the perforated PVC pipe into each borehole, the groundwater level shall be measured twice (2) a week for five (5) weeks from installation of drilling. Groundwater levels shall be measured by using a battery-operated electrical indicator (tester).
- The results of the measurement of groundwater levels shall be recorded in Graphs and tables with rainfall. The rainfall data shall be obtained from authorized metrological agency by the Consultant.

c. Material Source Survey of Quarry

- DPR of NH-54 has identified the following 8 locations of existing quarry site;

Table 11.1-3 Location of Exiting Quarry along NH-54 as per DPR

No.	Quarry Name	Location
Section-1		
1	PC Stone Quarry	km 13+135
2	Keifang Quarry	km 35+000
3	Airport Quarry	km110+000
Section-2		
4	Maudrh Quarry	km194+000
5	Lungpuzawl Quarry	km223+300
Section-3		
6	Liapha Quarry	km473+300
7	Rulkual Quarry	km486+900
8	Kawlchaw Quarry	km506+650

Source: the JICA Study Team

- 3 samples of rock material shall be taken from each quarry, and the following laboratory material tests shall be conducted to confirm quality as aggregate.

Table 11.1-4 Required Material Test for Exiting Quarry

Laboratory Material Test	Number Test
Specific Gravity	24 samples
Water Absorption	24 samples
Soundness	24 samples
Loss Angels Abrasion	24 samples

Source: the JICA Study Team

- Besides the above exiting quarry indentified in DPR, the potential location of quarry development should be surveyed, and carry out laboratory material test with same manner of the above.

3) Recommendation

- Reports of the above survey should be recommended to be attached in the bidding documents with the condition of the Contractor's risk.
- This consideration may lead to save the time and cost for the survey conducted by the Contractor under the civil works, consequently, the bidding price may be minimized in term of survey works.

(4) Modification of Engineering Design

Engineering design in DPR is principally pursued, and if necessary design modification resulted from the additional survey shall be incorporated into the engineer design in DPR.

1) Road Alignment Design

- Road alignment design and bridge design of JICA Preparatory Survey is reviewed, and is updated in accordance with the results of topographic survey.

2) Slope Design

- The slope design of JICA Preparatory Survey is reviewed and updated in accordance with the results of detailed slope geological survey to refer to the enclosed methodology.

- For the critical slope failure section, the slope protection design shall be finalized to analyze the results of detailed slope geological survey and borehole investigation.

3) Spoil Bank Design

- In accordance with the result of topographic survey and the estimated quantity of surplus soil to be required disposal, the spoil bank shall be designed to introduce the design concept as per JICA Preparatory Survey.

4) Finalizing Bid Document

- Review and updated material source survey, quantity calculation and engineering cost estimation of civil works contract.
- Preparing design drawings and technical documents to be attached in the bidding documents.
- NHIDCL will prepare the draft contract documents (condition of contract, work requirements, technical specification) for the civil works in consultation with JICA.

11.1.4 Proposed Scope of Works for RAP Assistant Consultant procured by NHIDCL

(1) Necessity

- Implementation of land acquisition and resettlement by the State Government is the most critical path in the project implementation schedule.
- Land acquisition and resettlement shall be implemented to comply with JICA Environmental Guideline.

(2) Scope

1) Consultation with Stakeholders

- Undertake consultation at the commencement of the project as well as continuing through project implementation to inform the affected communities of i) the need for land acquisition; ii) the reasons and need for eviction of displaced households; iii) the likely consequences of the project on the community's livelihood, and iv) proposed mitigation measures.

2) Verify and Update draft RAP report

- Based on the final ROW drawing, verify and update the list of affected households and structures in draft RAP report and undertake Detailed Measurement Survey to record all Project Affected Persons (PAPs) and private and public assets to be affected by the project.
- 2Review potential difference between compensation to be determined by District Collector and actual market rate through market rate survey and propose measures to fill the gap, if any, in a revised entitlement matrix.

3) Grievance Redress Mechanism

- Make PAPs aware of the availability of Grievance Redress Mechanism (GRM) and its procedures.
- Record the grievance and bring the same to the notice of the Grievance Redress Committee (GRC)
- Accompany PAPs to the GRC meeting as necessary and help them express his/her grievance to GRC members.

4) Disbursement of Compensation and Assistance

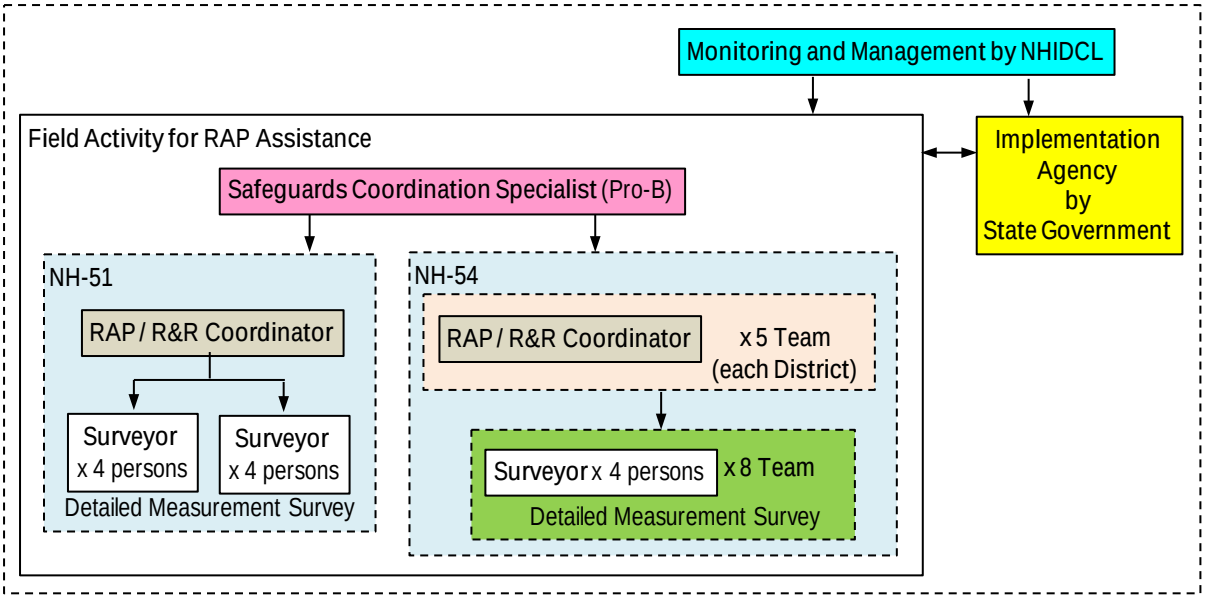
- Prepare Identity Cards for individual PAPs and distribute it to them.
- Help affected households to enter into a written agreement with NHIDCL/State Government as an acceptance to the R&R options.
- Ensure a smooth transition during the relocation of the displaced families.

5) Economic Rehabilitation

- Develop Rehabilitation Plan with inputs from PAPs and inform eligible PAPs about various economic opportunities available with the project
- Coordinate the training and capacity building program with the project and relevant government and non-government training agencies and ensure that skill level of PAPs is upgraded to help them in their income restoration process.

6) Team Organization

- Figure 11.1-4 shows the proposed organization of RAP Assistant Consultant.



Source: the JICA Study Team

Figure 11.1-4 Implemented Organization of RAP Assistant

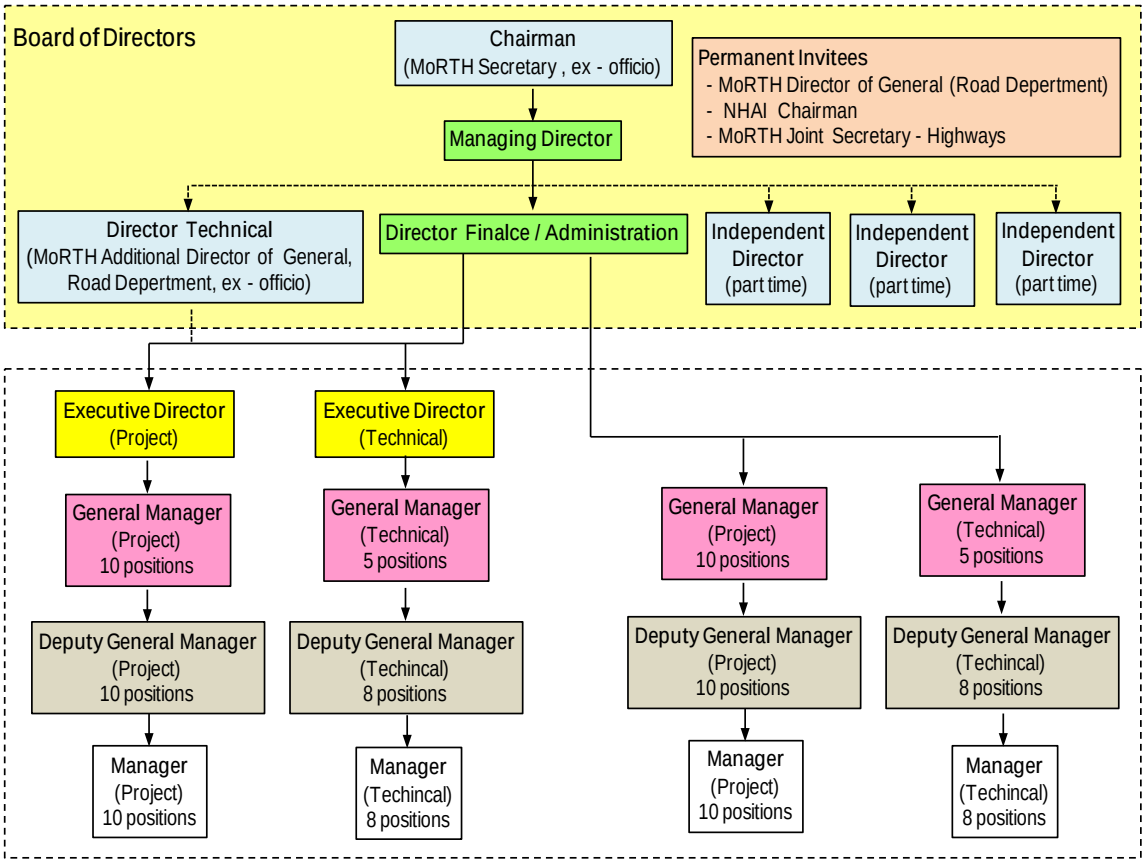
11.2 Project Implementation Framework

(1) Organization of NHIDCL

NHIDCL has established January 01, 2015 to be a fully owned company ofMoRTH. NHIDCL promotes, surveys, establishes, designs, builds, operates, maintains and upgrades National Highways and Strategic Roads including interconnecting roads in parts of the country which share international boundaries with neighboring countries. The regional connectivity so enhanced would promote cross border trade and commerce and help safeguard India's international borders. This would lead to the formation of a more integrated and economically consolidated South and South East Asia. In addition, there would be overall economic benefits for the local population and help integrate the peripheral areas with the mainstream in a more robust manner. An approximate aggregate length of 10,000 kms has been identified to begin with for development through this company.

The company also proposes to improve road connectivity and efficiency of the international trade corridor, by expanding about 500 KMs of roads in the North Bengal and Northeastern region of India to enable efficient and safe transport regionally with other South Asia Sub-regional economic Cooperation (SASEC) member countries. These projects are being funded by ADB.

Figure 11.2-1 shows the organization structure of NHIDCL.



Source: NHIDCL Web-page

Figure 11.2-1 Organization Structure of NHIDCL

(2) Implementation Organizational Structure

The general manager (to be based in Mizoram) will coordinate the implementation of all packages with inputs from the environment and social officers. Meanwhile, NH51 project will be carried out under the general manager based in Meghalaya. The implementation structure for NH54 and NH51 is shown in Figure 11.2-2.

- The Managers (or Deputy General Manager) should be assigned under the General manager, who are responsible for the site management of civil works to be assisted by the C/S Consultants.
- A Road Engineer, a Structure Engineer a Slope Engineer should be assigned under the Manager (or Deputy General Manager).
- At least one Environment & Social Office should be assigned under the General Manager (Mizoram) and General Manager (Meghalaya), who responsible to monitor the land acquisition implemented by the State Government, and to supervise and monitor the environment management plan executed by the civil works contractors to be assisted by the C/S Consultants.

(3) Examination of Contract Scheme (EPC / FIDIC)

a. Indian Procurement Practice on Similar Projects

The Government of India has decided to widen 20,000 km of less than two-lane National Highways to two-lane standard in line with the rules set out in the contract mode of Engineering, Procurement and Construction (EPC).

A model EPC contract has been published by the Planning Commission for highway projects in India based on the past experience in infrastructure development where the conventional item-rate contract are said to be generally prone to time and cost overruns, particularly in the national highway sector,

resulting in enhanced cost to the financing institutions, as also considerable delay in the completion of the projects.

To date (August 2015) there have been 36 National Highway construction projects awarded in the form of EPC contract mode since 2014 and none of them has been completed, according to the National Highway Authority of India. Among 36 projects, only one project is in the mountainous region whilst other projects are rather in gently sloping regions with short spans of hilly area.

The EPC contract mode has become the standard contract form widely accepted in the infrastructure development field in India not only for the National Highways improvement projects but also for all types of infrastructure including railways, power plants and other infrastructures in general.

b. Tender (Bidding) Method and Condition of Contract

Most of the EPC contracts in India, except for the projects financed by the Multilateral Development Banks, viz. World Bank and Asian Development Bank, awarded since 2014 seem to have been effected through Local Competitive Bidding (LCB) in accordance with the procedures used in India. Bidding period of these EPC contracts were very short; some of the contracts allowed only 45 days for site visit, surveys, inspection and investigations before submitting bids. As the result, there remain uncertain risks to bidders, particularly in respect of subsurface physical conditions due to lack of information, irrespective of information included in the Detail Project Report. Despite lack of sufficient information available before submission of bids, there is a trend that the tender price offered by bidders become low and not realistic albeit the EPC documents are very stringent in terms of the payment (fixed lump sum) and time for completion (fixed period).

JICA study team strongly recommends that the bidding period should be at least 90 days before submission of bids. Otherwise, if the bidding period is shorter, the detail Project Report should provide comprehensive and more accurate and realistic geological information that bidders can rely on.

c. Tender Method of Consultant Procurement

A supervising consultant selected by the Executing Agency thorough an international competitive bidding will discharge the functions and duties of an Authority's Engineer (AE) as per the Terms and Conditions of the EPC Agreement.

On the other hand, the Authority has an option to appoint a government-owned entity as the Authority's Engineer according to Schedule-N of some ongoing EPC contracts. However, for avoidance of doubt, JICA study team considers this option should be deleted from Schedule-N to secure a firm international competitive bidding process.

With the intention of maintaining high quality of the Works executed by the Contractor, JICA study team recommends that the Authority's Engineer should be provided with the power and authority in a manner similar to those indicated in the FIDIC Yellow Book. To properly discharge its duties (review of the Contractor's Documents within a limited short period), the Authority's Engineer, as JICA study team considers, should have a minimum 10 years professional experience in roads and bridges design of similar projects. This qualification is of vital and should be clearly mentioned in Schedule-N and Request For Proposal.

d. Tender Method of Contractor

As described in item 2 above, the EPC contracts are typically performed on the basis of a fixed price and a fixed period in a way similar to FIDIC Silver/Yellow Book, however in more stringent manners. The current EPC contract model adopted in the National Highways may need certain modifications to the extent that the risks are reasonably shared by both the Authority and the Contractor whilst maintaining the three principal elements, i.e. cost, time and quality.

The modifications suggested by the JICA study team include the item rates payment mechanism in accordance with the measurement of actual works carried out. These work items may include slope protection measures which require high technical expertise.

If uncertainties of subsurface physical conditions are dealt with in a manner that FIDIC Yellow Book provides, then it will be incentive for foreign bidders who are less familiar with the topographical and geological constraints indigenous to the local precipitous terrains.

Recommendations and proposals of the JICA study team are summarized in the tables attached hereunder. The references or sub-clause indicated in the tables are quoted from ADB financed West Bengal project and the standard EPC contract model.

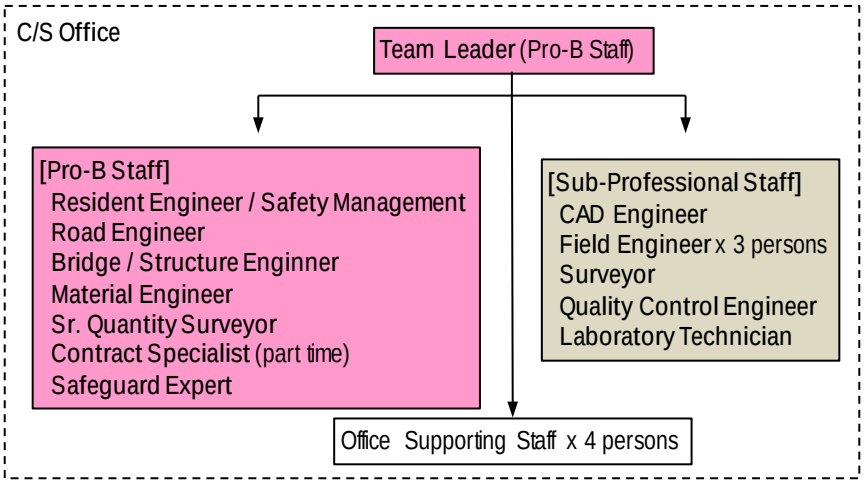
11.3 Construction Supervision Service

(1) Mode of Consultant Procurement

In the work components of NH-54, there are several advance technologies, which are not familiar in India, and are difficulties due to steep mountainous terrain. Therefore, the C/S Consultants of NH-54 should be recommended to be procured by the international competitive bid (ICB) through EOI process. On the other hand, since the topographic conditions of NH-51 is not special area in India, the C/S Consultant of NH-51 may be procured by the local competitive bid (LCB) process.

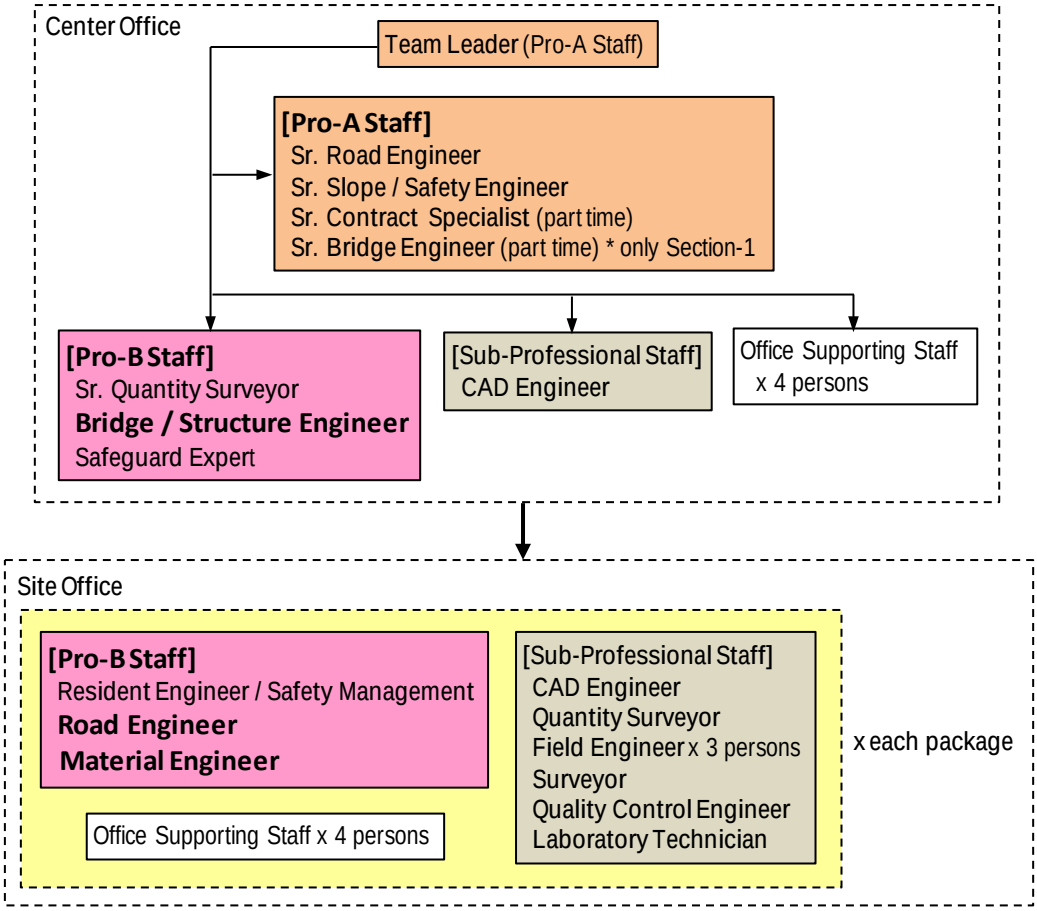
(2) Proposed Organization of C/S Consultant

The proposed organization of C/S Consultant for NH-51 and NH-54 is shown in Figure 11.3-1 and Figure 11.3-2, respectively. Organization of NH-51 C/S Consultant is supposed to be procured by LCB mode.



Source: the JICA Study Team

Figure 11.3-1 Proposed C/S Consultant Structure of NH-51



Source: the JICA Study Team

Figure 11.3-2 Proposed C/S Consultant Structure of NH-54

11.4 Operation and Maintenance Plan

(1) Operation and Maintenance (O&M) Organizational Structure

From a government policy of private sector participation, NHIDCL schedules to procure the Operation and Maintenance (O&M) Contractors and supervision consultant for O&M Contractor after the civil works contracts.

(2) Recommendations for O&M Contract

The JICA Study Team recommends the following points to be considered in the O&M Contract;

- 5 years O&M contract should be followed after finishing defect liability period of civil works contract.
- The inspection and requirement of road maintenance works should be complied with the Performance-Base, of which indicators are specified in the O&M Contract.
- The obligation of O&M Contractor should be included the requirements for i) safety, vehicle breakdown and accccident, ii) emergency de-commissioning, iii) road property management, ivI engineering improvement, v) horticultural maintenance, vi) vigilance on un-authorised encroachments etc.,
- JICA schedules to conduct a Technical Project to focus on the mountainous road development, of which scope includes technical guideline and manual for O&M of mountainous road. The said technical documents that will be prepared by JICA should be recommended to be utilized in the practice of O&M contract.

CHAPTER 12 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

12.1 Introduction

The environmental and social consideration in the preparatory study has been carried out in two-stages. In the first stage, the 10 study roads and bridges were screened from environmental and social point of view2. Along with consideration from technical and economic points of view, the process informed the selection of two priority projects (NH54 and NH51). The screening was carried out through field visits and review of literatures. For study roads in Manipur and Nagaland (5, 6, 7 in Table 12.1-1), however, the review was done only by a review of literature due to security concern in the area.

Table 12.1-1 List of Study Roads & Contents of Request

No.	Target Roads	Target Length	Request Type
①	Mizoram State, Aizawl – Tuipang Section, NH54	381km (Approx.)	Improvement
②	Meghalaya State, Dudhanal – Dalu Section, NH62	183km (Approx.)	Improvement
③	Meghalaya State, Tura – Dalu Section, NH51	54km (Approx.)	Improvement
④	Meghalaya State, Shillong – Dawki Section, NH40	84km (Approx.)	Improvement
⑤	Manipur State, Imphal – Jiribam Section, NH53	221km (Approx.)	Improvement
⑥	Manipur State, Imphal - Nagaland State, Kohima Section, NH39	138km (Approx.)	Improvement
⑦	Manipur State, Ukhrul – Tadubi Section, NH102A	115km (Approx.)	Improvement
⑧	Tripura State, Manu - Simlung Section NH44	110 km (Approx.)	New / Improvement
⑨	Assam State, Badarpurghat Bridge near Silchar	360m	Improvement
⑩	Assam State, Dhubri – Phulbari Section	Bridge: 18km (Approx.) Access Road: 21km (Approx.)	New Bridge

Source: JICA Study Team

NH54 in Mizoram and NH51 in Meghalaya were selected as propriety project[3]. In the next stage of environmental and social considerations, EIA and RAP studies for both NH51 and NH54 have been carried out based on their preliminary design.

12.2 Legal and Regulatory Issues

12.2.1 Requirement of EIA under Indian Regulation

As per EIA Notification dated 14.09.2006 (as amended in August 2013) by Ministry of Environment and Forest, any highway project falls under Category A and thus requires EIA and prior Environmental Clearance if the project entails *i) New National Highways; and ii) Expansion of National Highways greater than 100 km involving additional right of way or land acquisition greater than 40m on existing alignments and 60m on re-alignments and bypasses.*

Improvement of National Highways envisioned in this project is widening from 1-lane to 2-lane, and therefore, additional right of way or land acquisition is well below the 40m thresholds. Therefore, the project 1 to 7 will not trigger EIA requirement as per Indian regulatory framework. On the other hand, project 8 in Tripura is a combination of improvement and new construction and thus may trigger EIA requirement. Manu - Simlung Section NH44 is only partially completed and thus some section may be

2 Originally, there were 11 study roads/bridge. However, improvement of Koliabhomora Bridge near Tezpur in Assam was dropped from GOI request subsequently and thus review of environmental and social issues for this bridge has not been carried out.

3 See Chapter 6 of the report for specific criteria and ranking of study roads.

considered as "new National Highway". On the other hand, this may be considered as expansion of existing highway because the new section will still be NH44, not "new" highway. The preparation of Manu - Simlung section project is still in an early stage without a feasibility study by Indian side (Detailed Project Report), and at this stage, it is not clear whether MOEF consider this project as Category A or not. From JICA's screening criteria, however, this will be Category A project as the project involves clearing of open forest for construction of highway where none exists today.

In Indian regulation, bridge is not included in project categories that require EIA. From this point of view, EIA will not be required for project 10 (new bridge between Dhubri – Phulbari). A recent example is 675-metre Signature Bridge project across the Yamuna in Wazirabad to connect East and West Delhi for which MOEF decided that environmental clearance is not required. The decision, however, was contested and in February 2015, National Green Tribunal's principal bench ordered Delhi Tourism and Transportation Development Corporation, the project proponent, to prepare an EIA for the project. From strictly statutory point, bridge is different from road is exempt from the EIA notification. Given the recent judgment of National Green Tribunal, however, it is highly likely that EIA will be required for the new bridge project in Assam if an appeal is made.

Table 12.2-1 EIA Requirement under Indian Regulation and JICA Guidelines

No.	Target Roads	EIA under Indian Requirement	JICA Project Category*
①	Mizoram State, Aizawl – Tuipang Section, NH54	No	A
②	Meghalaya State, Dudhanal – Dalu Section, NH62	Recommended as the road traverses several reserve forests and elephant corridor.	A
③	Meghalaya State, Tura – Dalu Section, NH51	No	A
④	Meghalaya State, Shillong – Dawki Section, NH40	No	A
⑤	Manipur State, Imphal – Jiribam Section, NH53	No	A
⑥	Manipur State, Imphal - Nagaland State, Kohima Section, NH39	No	A
⑦	Manipur State, Ukhrul – Tadubi Section, NH102A	No	A
⑧	Tripura State, Manu - Simlung Section NH44	EIA may be required for part of the section where new road will be constructed, depending on the decision/ definition of MOEF about "new highway"	A
⑨	Assam State, Badarpurghat Bridge near Silchar	No	B
⑩	Assam State, Dhubri – Phulbari Section	Legally not required but it is highly likely that EIA is required if such appeal is submitted.	A

Note: * Project category is estimated based on the scope of project and preliminary review of existing environmental conditions.
Source: JICA Study Team based on EIA notification and amendment and JICA Guidelines

12.2.2 Current Status of LARR 2013

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (LARR), 2013 provides for enhanced compensation and assistances measures and adopts a more consultative and participatory approach in dealing with the Project Affected Persons. Enhanced compensation provision for land acquisition provides for 1-2 times the prevailing market rate (as determined by stipulated mechanism, primarily relying on officially recorded/registered rates) in urban areas (as determined by the state) and 2-4 times the prevailing market rate in rural areas. The original law also made provision for need for 'consent', while exempting 13 existing laws (having sections governing land acquisition processes for projects coming under its ambit). Subsequently, in

2015 an amendment bill was brought in the bill and enforced through ordinance by the current central government. Key changes made by this bill vis-à-vis the original law are:

The Bill creates five special categories of land use: (i) defence, (ii) rural infrastructure, (iii) affordable housing, (iv) industrial corridors, and (v) infrastructure projects including Public Private Partnership (PPP) projects where the central government owns the land. The LARR 2013 requires that the consent of 80% of landowners is obtained for private projects and that the consent of 70% of landowners be obtained for PPP projects. The proposed amendment to the Bill, currently under the parliamentary discussion, exempts the five categories mentioned above from this provision of the Act. If the amendment is enacted, all 10 study roads/bridges will be exempt from this consent clause as all of them are rural infrastructure project. As per the proposed amendment, projects that belong to five categories do not require social impact assessment.

The amendment has not yet passed as shown in Table below. Regardless the passage of the amendment, however, the project seeks to obtain support from the affected community in keeping with the principle of JICA Guidelines for Environmental and Social Guidelines. For widening/improvement proposal for NH51 and NH54 for which EIA and RAP study have been carried out, the consultation and the baseline survey indicate that majority of the affected people support the project.

Table 12.2-2 Process of Amending LARR 2013

Date	Action
1 January 2014	LARR 2013 comes into existence, repealing the Land Acquisition Act, 1984
31 December 2014	LARR (Amendment) Ordinance, 2014 promulgated
24 February 2015	LARR (Amendment) Bill, 2015 introduced in Lok Sabha
10 March 2015	LARR (Amendment) Bill, 2015 passed in Lok Sabha with amendments but could not be passed by the Rajya Sabha and remains pending
3 April 2015	LARR (Amendment) Ordinance, 2015 incorporating the amendments made by the Lok Sabha promulgated
10 April 2015	Public interest litigation (PIL) filed in Supreme Court to declare LARR (Amendment) Ordinance, 2015 as "unconstitutional" and ultra vires of the Constitution and as a "colorful exercise of power"
13 April 2015	Supreme Court issues notice in the PIL but refuses to stay the LARR (Amendment) Ordinance, 2015.
11 May 2015	LARR (Amendment) Second Bill, 2015 introduced in the Lok Sabha
13 May 2015	LARR (Amendment) Second Bill, 2015 referred to the Joint Committee of Parliament
30 May 2015	LARR (Amendment) Second Ordinance, 2015 promulgated. The ordinance will lapse if it is not passed by Congress within six months.

Source: JICA Study Team based on PRS Legislative Research, India

12.3 Scoping and Analysis of Alternative based on Generic Concept of Hilly Road

Scoping and preliminary analysis of alternative were undertaken during the first stage. The design of particular target road was not yet developed when the analysis was carried out. In other word, the scoping matrix and concept of alternative presented below are generic one that can be used as a reference for road sector projects in hilly and mountainous region in general. A specific scoping matrix for priority project (NH54 and NH51) has been developed based on this and is included in a separate EIA report along with analysis of alternatives.

Table 12.3-1 Generic Scoping Matrix for Hilly/Mountainous Road

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Natural Environment				
Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected.
				C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
Topography	D	B-	D	P: No impact is expected.
				C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
				O: Topographic condition will b stable after the completion of construction work which include slope protection and slope stabilization.
Geology	D	D	D	P: No impact is expected.
				C: No impact is expected.
				O: No impact is expected.
Soil Erosion	D	B-	B+/ B-	P: No impact is expected.
				C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
				O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduces the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
Hydrology	D	C-	C-	P: No impact is expected.
				C: Construction work may cause minor, temporary impacts on hydrology.
				O: Cutting and/or filling may result in changes in local hydrology. The impact should be managed through adequate drainage measures.
Groundwater	D	D	D/ B-	P: No impact is expected.
				C: The project does not envision the use of groundwater and thus no impact is expected. If the tunnel is constructed for bypass sections, however, appropriate measures should be undertaken to avoid/minimize the impact.
				O: No impact is expected during the operation stage, but measures should be undertaken if the project involves construction of tunnel.
Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected.
				C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work could affect mountain ecosystem and local flora and fauna including jhum and plantation.
				O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
Protected Areas/Forest	D	B-	B-	P: The highways proposed for expansion/improvement does not traverse or border with national parks. However, one of the proposed road (NH62 in Meghalaya) traverses reserve forest.
				C: By the construction work, some of the forest area will be opened up.
				O: Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem.
Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Landscape	D	D	B+	P: No impact is expected.
				C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
				O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region.
Natural Disaster	D	B-	B+	P: No impact is expected.
				C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
				O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment				
Air Pollution	D	B-	B-	P: No impact is expected.
				C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
				O: Air pollution is expected to increase due to increase traffic volume on the road.
Offensive Odor	D	D	D	P/C/O: No impact is expected.
Water Pollution	D	B-	B-	P: No impact is expected.
				C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
				O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
Bottom Sediment Contamination	D	D	D	P: No impact is expected.
				C: Some construction materials such as cement and sand are expected to be washed out mainly by the rain, but the impacts on bottom sediment are expected to be negligible.
				O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
Soil Contamination	D	C-	D	P: No impact is expected.
				C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
				O: No impact is expected.
Ground Subsidence	D	D	D	P/C/O: No impact is expected.
Noise/ Vibration	D	B-	B-	P: No impact is expected.
				C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
				O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Sunshine Obstruction	D	D	D	P/C/O: No impact is expected.
Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected.
				C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
				O: Waste will be generated from road users and workers of maintenance works.
Social Environment				
Involuntary Resettlement	A-	A-	A-	P: The project will result in large-scale involuntary resettlement, particularly in built-up areas where structures exist in both sides of the road. Minimizing the resettlement should be the priority for road design.
				C: Temporary relocation might be required for accommodation of construction yards and workers' camps. Resettlement may cause cultural and social conflict between resettling people and host community.
				O: Resettlement may cause cultural and social conflict between resettling people and host community.
Land Use	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.
				C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
				O: Greater traffic volume may affect the use of road and surrounding area by local residents. Uncontrolled jhum (shifting cultivation) along the road may undermine the effectiveness of slope protection/ stabilization measures and increase the risk of landslide and soil erosion.
Utilization of Local Resources	D	A-	A-	P: No impact is expected.
				C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct their utilization by the local people for other purposes.
				O: Improvement in road infrastructure may change the flow of commodity distribution, potentially impacting the use of local resources.
General, Regional /City Plans	D	D	C+/ C-	P: No impact is expected.
				C: No impact is expected.
				O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
Social Institutions and Local Decision-making Institutions	A-	A-	A-	P: Land acquisition and involuntary resettlement are likely to affect social institutions such existing as social capital and local decision-making institutions.
				C: Existing social capital and local decision-making institutions will be affected by the influx of resettling population and construction workers.
				O: Existing social capital and local decision-making institutions will be affected by the influx of resettling population.
Social Infrastructure and Services	A-	A-	A-	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.
				C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
				O: The resettlement can result in prolonged disturbance in social infrastructure and services. In the long term, however, the project is expected to improve access to social infrastructure and services by providing better road network.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Local Economy and Livelihood	A-	A-	A-	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
				C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
				O: The project may trigger unintended side effect with detrimental impact on local community, e.g. influx of non-local people and more competition in business and pressure on local natural resources. Over the long term, the project is expected to have positive impact on local economy as improved road network ensures more stable supply of essential goods. However, the end of construction work may create short-term unemployment of construction workers.
Unequal Distribution of Benefit and Damage	A-	A-	A-	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.
				C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage
				O: People residing along the road may accrue greater benefits compared with others, potentially increasing rich-poor gap within the community.
Local Conflicts of Interest	A-	A-	A-	P/C/O: Unequal distribution of benefit and damage may trigger and/or intensify local conflicts of interests in the community.
Water Usage, Water Rights and Communal Rights	C-	C-	D	P: Water usage and water rights of the affected households may be curtailed due to resettlement. However, irrigation is not common in the region and thus, the impact will be minor, if any.
				C: Disturbance to water usage, water rights and communal rights during construction work is expected to be minor and short-term in nature. However, communal rights and distribution should be carefully examined to avoid negative impacts.
				O: No impact is expected.
Cultural and Historical Heritage	C-	C-	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage. There are, however, several observation decks and memorial stones along the road which may be affected depending on the widening width.
				C: Several observation decks and memorial stones along the road which may be affected depending on the widening width.
				O: No impact is expected.
Religious Facilities	A-	A-	A-	P: Several memorial stones and graves are located along the road and may be affected depending on the widening width. Small religious facilities in built-up areas may also be affected.
				C/O: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
Sensitive Facilities (ex. hospital, school, precision machine factory)	A-	A-	A-	P: Community facilities (public halls etc.) will have to be relocated incase road widening is implemented within the built-up area.
				C: Noise and vibration during construction work may affect school and hospitals.
				O: These facilities can be affected due to noise and vibration resulting from increase in traffic volume. Also, congestion may undermine the utility of such facilities.

Item	Scoping Results			
	Pre-construction Stage	Construction Stage	Operation Stage	Rational of the Assessment
Poor People	A-	A-	A-	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures.
				C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
				P: In the long-term, economic development in the region is likely to benefit the poor, however, the poor may fail to benefit from the project due to the lack of skills and coping capacity
Ethnic Minorities/ Indigenous People	A-	A-	A-	P/C/O: North East States are home of diverse tribal groups (Scheduled Tribe) with distinct language and cultures. Preparation of RAP and livelihood restoration plan, therefore, must take into account this diversity.
Gender	D	C-	B+	P: No impact is expected.
				C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
				O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
Children's Rights	D	D	D	P: No impact is expected.
				C/O : Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
				C: Influx of construction workers is likely to increase the health risk, particularly that of STD/STI and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
				O: An increase in traffic volume and road users may have negative impact on public health.
Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
				C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
				O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Other				
Accidents	D	B-	C+/ C-	P: No impact is expected.
				C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
				O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
Climate Change	D	B-	B+/ B-	P: No impact is expected.
				C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
				O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Source: JICA Study Team

Table 12.3-2 Generic Concept of Alternatives

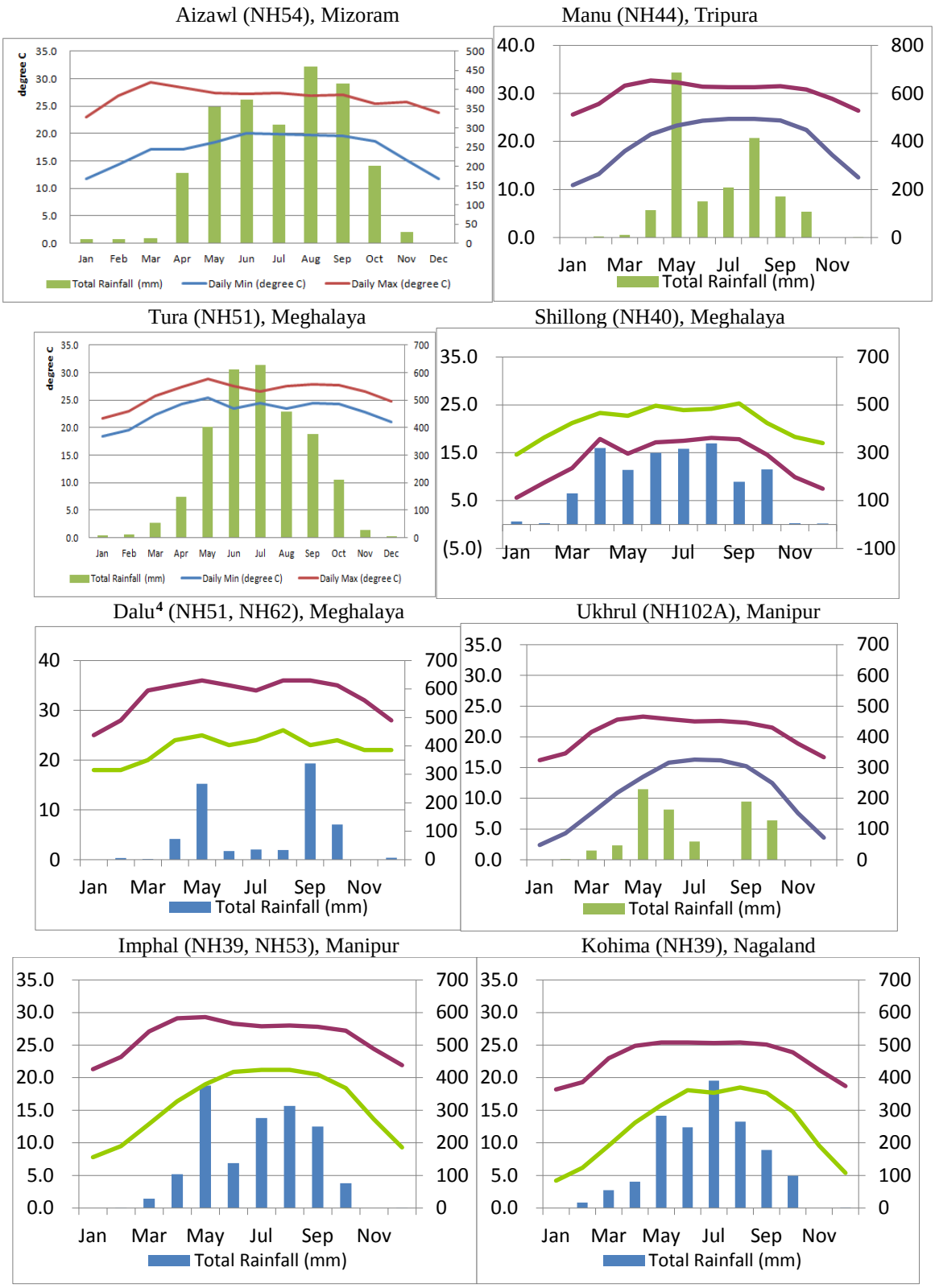
No.	Option	Contents
0	Zero-Option (without project)	Existing road and slope conditions will persist. Poor pavement condition will lead to more vehicular emissions with detrimental impacts on health and ecosystem. Also, continuation of uncontrolled encroachment will increase the risk of traffic accident in built-up areas. Poor road network continues to be a bottleneck of economic development and also undermine positive benefits of ongoing Kaladan Multimodal Transport Project, which provides additional network from Mizoram to Haldia/Kolkata ports through NH54 and Kaladan River in Myanmar.
1	Applying the same design standard across the whole stretch based on the IRC	The same standard for widening/improvement will be applied across the whole stretch irrespective to geological condition and socio-economic conditions. While the positive impact of widening is significant, the project will trigger significantly more resettlement compared with option 2. Also, geometric improvement of many hair-pin curves will trigger more cutting and filling, increasing impacts on forest and leads to higher project implementation cost. The number of traffic accident will also increase due to the increased speed of vehicles passing through built-up areas.
2	Selective widening considering social impacts	The level of widening will be minimized in heavily built-up area to reduce the scale of resettlement. This option is desirable from socio-economic point of view, but the positive impact in terms of improvement of the road network in the region may be slightly limited compared with option 1.
3	New bypass to avoid densely built-up areas	A new bypass will be constructed in densely built-up areas to avoid resettlement. The option will minimize the scale of resettlement, but the impact on forest and agricultural land (jhum) will be significant as the new road will be constructed in open forest. The bypass will be required in the longer-term to accommodate project increase in traffic demand in the future, but its environmental impact as well as economic feasibility will have to be studied in more details.

Source: JICA Study Team

12.4 Screening of 10 Study Roads from Environmental and Social Point of Views

12.4.1 Climate

The North East region of India has distinct climate variations. The rapid changes in topography result in climate changes within short distance. This is particularly evident in NH40 where significant difference in altitude exists within the stretch. Generally, the daily temperature in the plains of Assam as well as in Tripura and in the western portion of Mizoram is about 15 °C in January, whereas in other parts of the region, the temperature is between 10°C to 15°C. From April it rises and in July except the South-Eastern portion of Mizo hills and Shillong in Meghalaya (where the targeted section of NH40 begins), the mean temperature ranges from 25°C to 27.5°C. During October, daily mean temperature in the hilly areas ranges between 20°C and 25°C, whereas in Assam, Tripura and the western portion of the Mizo hills it is above 25°C. The region has distinct monsoon season, which generally begins in May and ends in October/November. The area is known for its high rainfall during the monsoon. In particular, Mawsynram in East Khasi Hills district of Meghalaya near NH40 is known to be the wettest place on Earth with an average annual rainfall of 11,872 mm. The monthly maximum and minimum temperature and rainfall of key towns in study roads are shown below.



Source: India Meteorological Department

Figure 12.4-1 Monthly Rainfall and Daily Maximum and Minimum Temperature in Project Area[5]

4 The climate data for Dalu is not available. Hence, the data for Baghmara in South Garo Hillis, about 50 km away from Dalu, is used as proxy.

5 The data for 2012-2013 except for Shillong where 2005 data is used.

12.4.2 Forest and Ecosystem

North East region of India is geographically located in one of the most biodiversity-rich regions of the world. During the past three decades, the region has been through several priority-setting processes on the initiative of the national and international conservation agencies. The region is not a homogenous entity but a highly diverse mosaic of ecological, social and physiological landscapes. The World Wildlife Fund (WWF) has identified the entire Eastern Himalayas as a priority Global 200 Eco-region. Conservation International has up-scaled the Eastern Himalaya Hotspot, which initially covered the states of Arunachal Pradesh, Sikkim, Darjeeling Hills, Bhutan, and Southern China, to the Indo Burma (Hotspot) which now includes all the eight states of North-East India, along with the neighboring countries of Bhutan, southern China and Myanmar. The region has been identified by the Indian Council of Agricultural Research as a center of rice germplasm. Meanwhile, the National Bureau of Plant Genetic Resources, India, has highlighted the region as being rich in wild relatives of crop plants. As a total, forests in the region is estimated to harbor 80,000 out of 15,000 species of flowering plants. The richness of plant species in six states where study roads/bridges are located is shown below.

Table 12.4-1 Richness of Plant Species in Study Area

No.	State	Species Richness (flowering plants)
1	Mizoram	2,200
2	Meghalaya	3,500
3	Manipur	2,500
4	Nagaland	2,250
5	Tripula	1,600
6	Assa,	3,010

Source: Review of Biodiversity in North East India, WWF-India, 2006

The list of National Park and Wildlife Sanctuary in the six states and their relevance to the target roads/bridge are shown below. As discussed below, no project roads/bridge traverses or boarder with these protected area. On the other hand, NH62 traverses four reserve forests and NH40 runs along Upper Shillong Protected Forest in the first few kilometers from the beginning of the targeted section. There are also areas identified as elephant crossing points on NH62. While these roads have not been selected as priority project, serious efforts to avoid and minimize disturbance to ecosystem is necessary should they be chosen in the future phase of the project. A brief overview of forest and ecosystem in study area is presented below.

Table 12.4-2 Richness of Plant Species in Study Area

No.	Target Roads	Traverses or borders with National Park, Wildlife Sanctuary	Traverses or borders with Protected/ Reserve Forest
①	Mizoram State, Aizawl – Tuipang Section, NH54	No	No
②	Meghalaya State, Dudhanal – Dalu Section, NH62	No	Yes
③	Meghalaya State, Tura – Dalu Section, NH51	No	No
④	Meghalaya State, Shillong – Dawki Section, NH40	No	Yes
⑤	Manipur State, Imphal – Jiribam Section, NH53	No	No
⑥	Manipur State, Imphal - Nagaland State, Kohima Section, NH39	No	No
⑦	Manipur State, Ukhrul – Tadubi Section, NH102A	No	No
⑧	Tripura State, Manu - Simlung Section NH44	No	No
⑨	Assam State, Badarpurghat Bridge near Silchar	No	No
⑩	Assam State, Dhubri – Phulbari Section	NO	No

Source: JICA Study Team

Table 12.4-3 National Park and Wildlife Sanctuary in Six States where Study Roads are Located

Name	Year	Area(km^2)	District	Name	Year	Area(km^2)	District
Mizoram[6]				Assam			
Murlen NP	1991	100.0	Champhai	Dibru-Saikhowa NP	1999	340.0	Tinsukia,Dibrugarh
Phawngpui NP	1992	50.0	Saiha	Kaziranga NP	1974	859.0	Golaghat,Nagaon
Dampa WLS	1985	500.0	Mamit	Manas NP	1990	500.0	Barpeta,Bongaigaon
Khawnglung WLS	1992	35.0	Lunglei, Serchhip	Nameri NP	1998	200.0	Sonitpur
Lengteng WLS	1999	60.0	Champhai	Orang NP	1998	78.8	Darrang,Sonitpur
Ngengpui WLS	1991	110.0	Lawngtlai	Amchang WLS	2004	78.6	Kamrup
Pualreng WLS	2004	50.0	Kolasib, Aizawl, Champhai	Barail WLS	2004	326.3	Barak Valley
Tawi WLS	2001	35.8	Aizawl, Serchhip	Barnadi WLS	1980	26.2	Darrang
Thorangtlang WLS	2002	50.0	Lunglei	Bherjan-Borajan-Podumoni WLS	1999	7.2	Tinsukia
Megharaya				Burachapori WLS	1995	44.1	Sonitpur
Balphakram NP	1985	220.0	South Garo Hills	Chakrashila WLS	1994	45.6	Dhubri
Nokrek Ridge NP	1986	47.5	East, West & South Garo Hills	Dihing Patkai WLS	2004	111.2	Dibrugarh, Tinsukia
Baghmara Pitcher Plant WLS	1984	0.0	South Garo Hills	East Karbi Anglong WLS	2000	221.8	Karbi-Anglong
Nongkhyllem WLS	1981	29.0	Ri Bhoi	Garampani WLS	1952	6.1	Karbi-Anglong
Siju WLS	1979	5.2	South Garo Hills	Gibbon WLS	1997	21.0	Jorhat
Tripura				North Karbi Anglong WLS	2000	96.0	Karbi-Anglong
Clouded Leopard NP	2007	5.1	West Tripura	Laokhowa WLS	1972	70.1	Nagaon
Gumti WLS	1988	389.5	South Tripura	Marat Longri WLS	2003	451.0	Karbi-Anglong
Rowa WLS	1988	0.9	North Tripura	Nambor WLS	2000	37.0	Karbi-Anglong
Sepahijala WLS	1987	13.5	West Tripura	Nambor Doigrung WLS	2003	97.2	Karbi-Anglong
Trishna WLS	1988	194.7	South Tripura	Pabitora WLS	1987	38.8	Marigaon
Nagaland				Pani-Dihing WLS	1995	33.9	Sibsagar
Intanki NP	1993	202.2	Dimapur	Sonai-Rupai WLS	1998	220.0	Sonitpur
Fakim WLS	1980	6.4	Tuensang	Manipur			
Puliebadze WLS	1980	9.2	Kohima	Keibul-Lamjao NP	1977	40.0	Bishnupur
Rangapahar WLS	1986	4.7	Dimapur	Yangoupokpi-Lokchao WLS	1989	184.4	Chandel

Note: NP=National Park, WLS=Wildlife Sanctuary
Source: National Wildlife Database Cell

6 The information is as of the report's publication. As of 2015, there are 10 NP and WLS in Mizoram, as discussed in the section below.

Mizoram (NH54)

The state has 10 National Parks, Wildlife Sanctuary and Tiger Reserves. As shown below, the project does not traverse or boarder with these protected areas. No government reserve forest in Mizoram will be affected by NH54 project.

Source: Department of Environment and Forests, Government of Mizoram

Figure 12.4-2 Protected Area in Mizoram

Mizoram has third highest total forest cover with 1,594,000 hectares (3,940,000 acres), and highest percentage area (90.68%) covered by forests, among the states of India, according to 2011 Forest Survey of India7. Tropical Semi Evergreen, Tropical Moist Deciduous, Subtropical Broadleaved Hill and Subtropical Pine Forests are the common vegetation types found in Mizoram. Bamboo is common in the state, typically intermixed with other forest vegetation; about 9,245 km2 (44%) of state's area is bamboo bearing. Jhum cultivation, or slash-and-burn practice, were a historic tradition in Mizoram and

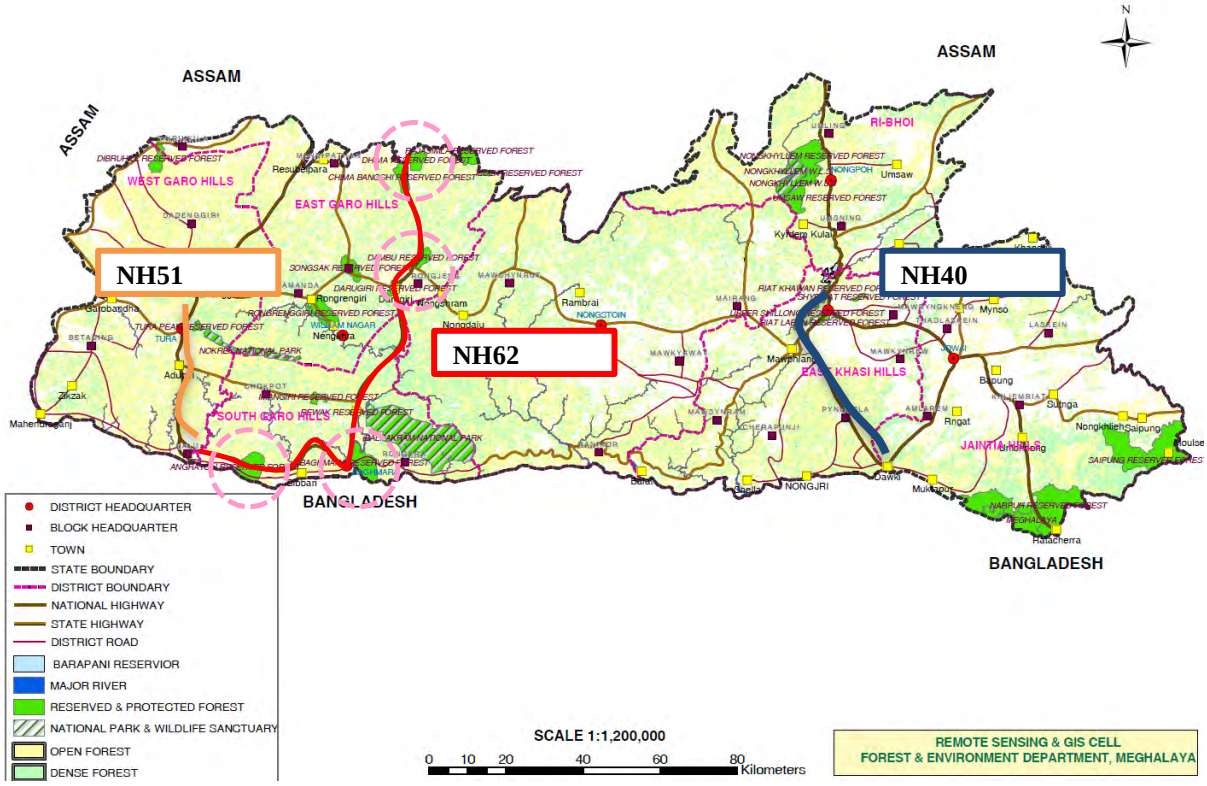
7 The figure is 79.3% in a different estimate.

a threat to its forest cover. This practice has reduced in recent decades from a government-supported initiative to support horticultural crops such as pineapple and banana plantations. Only 17% of the land is non-forested area for cultivation, industry, mining, housing and other commercial human activity.

Meghalaya (NH51, 40, 62)

The Meghalaya subtropical forest is part of a mountain subtropical moist broadleaf forest eco-region of North East India. The eco-region covers an area of 41,700 km^2, encompassing the Khasi Hills, Garo Hills, and Jaintia Hills of Meghalaya and adjacent portions of Assam state. The eco-region is one of the most species-rich place in India with a rich diversity of birds, mammals, and plants. Also, it is one of the wettest eco-regions in the world, with some places, notably Mawsynram and Cherrapunji, receiving up to eleven meters of rain in a year. As per Forest Survey of India 2011, the recorded forest area of the state is 9,496 sq.km, which is 42.34% of its geographical area. The Reserved Forests constitute 11.72%, Protected Forest 0.13% and Unclassed Forests 88.15%. Acacia, rubber and cashew plantation are commonly found along NH51. Meanwhile, cashew is the dominant plantation in most parts of NH62, interspersed with patches of natural forest. Sections near Dalu (both NH51 an NH62) are mostly interspersed with paddy fields, patches of natural forests and cashew plantations.

As discussed above, NH62 traverses four reserve forests and NH40 runs along Protected Forest in section near Shillong. Other National Park, Wildlife Sanctuary and reserve forest in Meghalaya is shown below.



Source: Forest & Environment Department, Meghalaya State

Figure 12.4-3 Protected Area in Meghalaya

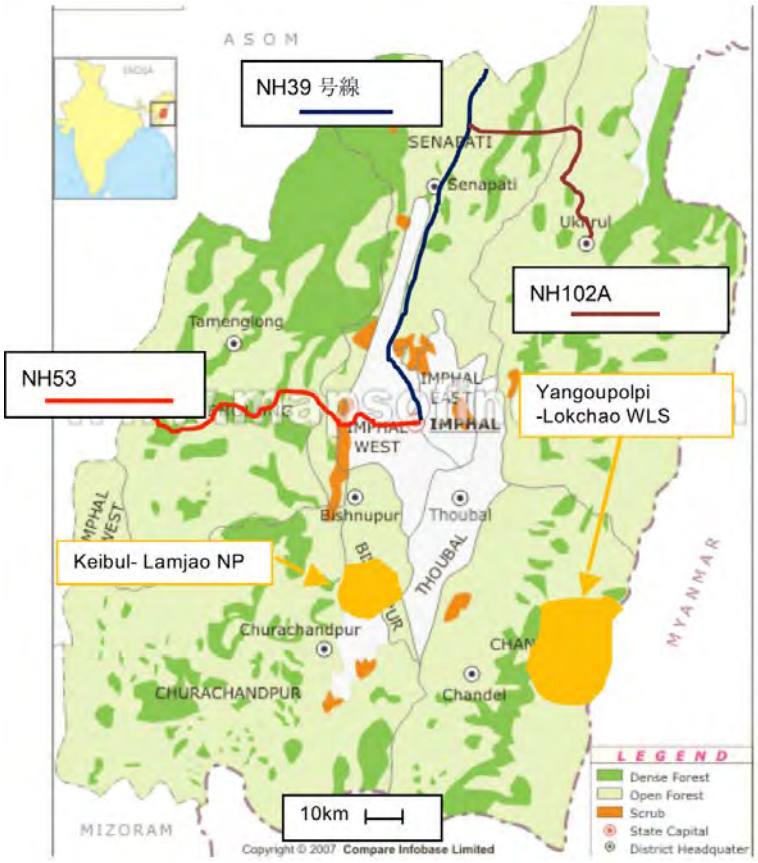
Manipur (and Nagaland) (NH39, NH53, NH102A)

Geographically, Manipur can be divided into two parts: the hills comprising five districts and the plains with four districts. The valley has an average altitude of 872 meters above MSL and the climate is subtropical and warm in the summer season. This part is the "rice bowl" of the state. The hill areas are under temperate subtropical climate at the average altitude of 3000 meters above MSL.

Shifting cultivation or Jhum (Paamlou in Manipuri language) is widely practiced in the state with more than 83,000 families are reportedly practicing the shifting cultivation or jhuming. This is particularly widespread in Tamenglong district. The vast area of bamboo growing zone of the district suitable for low-cost shifting cultivation. Bamboo land could be used for shifting cultivation. The improved method of shifting cultivation is developed by the Tribals of Machi Block of Chandel district in Manipur, because of the acute problem for acquiring agricultural land and inadequate facility for terracing. In Manipur, there is a project called 'Improved Machi Model of Shifting Cultivation', which controls Jhum cultivation in an environmental-friendly way by setting a price on different items related to the way of shifting cultivation.

the natural vegetation occupies an area of about 14,365 km² which is nearly 64% of the total geographical area of the state. The vegetation consists of a large variety of plants ranging from short and tall grasses, reeds and bamboos to trees of various species. Broadly, there are four types of forests - Tropical Semi-evergreen, Dry Temperate Forest, Sub-Tropical Pine and Tropical Moist Deciduous.

The location of National Park and Wildlife Sanctuary in Manipur is shown below. None of the three study roads in Manipur traverses or boarder with National Park or WLS.



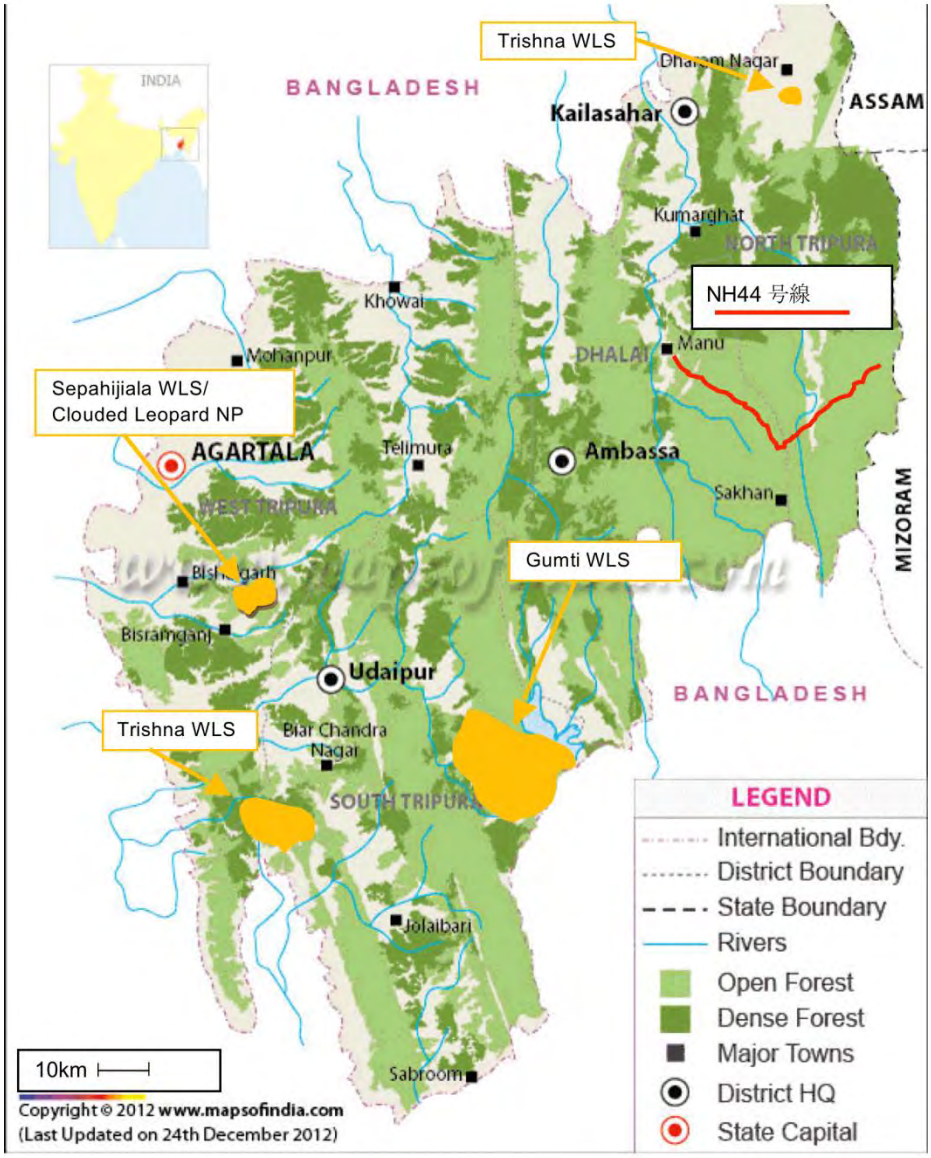
Source: JICA Study Team

Figure 12.4-4 Protected Area in Manipur

Tripura (NH44)

The forests in the state are mainly tropical evergreen, semi evergreen, and moist deciduous. The cropping pattern in Tripura is characterized by two distinct farming systems, i.e., Settled Cultivation in the plains and Shifting Cultivation in the hills. Shifting cultivation has been the main source of livelihood for communities in Tripura and a sizeable portion of population in the hills of Tripura still depending on jhum cultivation. According to the Task Force on Shifting Cultivation, Ministry of Agriculture (1983), the annual area under shifting cultivation was 223 km². As per the survey conducted

by Tribal Welfare Department (1990), around 55,000 tribal households practice jhum in Tripura. For settled cultivation, paddy, pulses and oilseeds are the major crops grown in the state. Paddy is grown in 55% of gross cropped area in three seasons viz, Aush (pre-Kharif), Aman(Kharif) and Boro(Summer). Fruits and vegetables account for 21% of gross cropped area, 10% is under rubber and 9% are under other miscellaneous crops like tea, medicinal plants etc. The major Kharif crops are rice, maize, pigeon pea, black gram, green gram, cowpea, ground nut, sesame, jute, mesta, cotton, and Kharif vegetables. Different crops taken during Rabi season are rice, wheat, pea, green gram, lentil, rapeseed-mustard, potato, and Rabi vegetables. The targeted section of NH44 is mainly forested (teak forests) with patches of tea gardens and orange orchards. The map of protected area in Tripura is shown below.

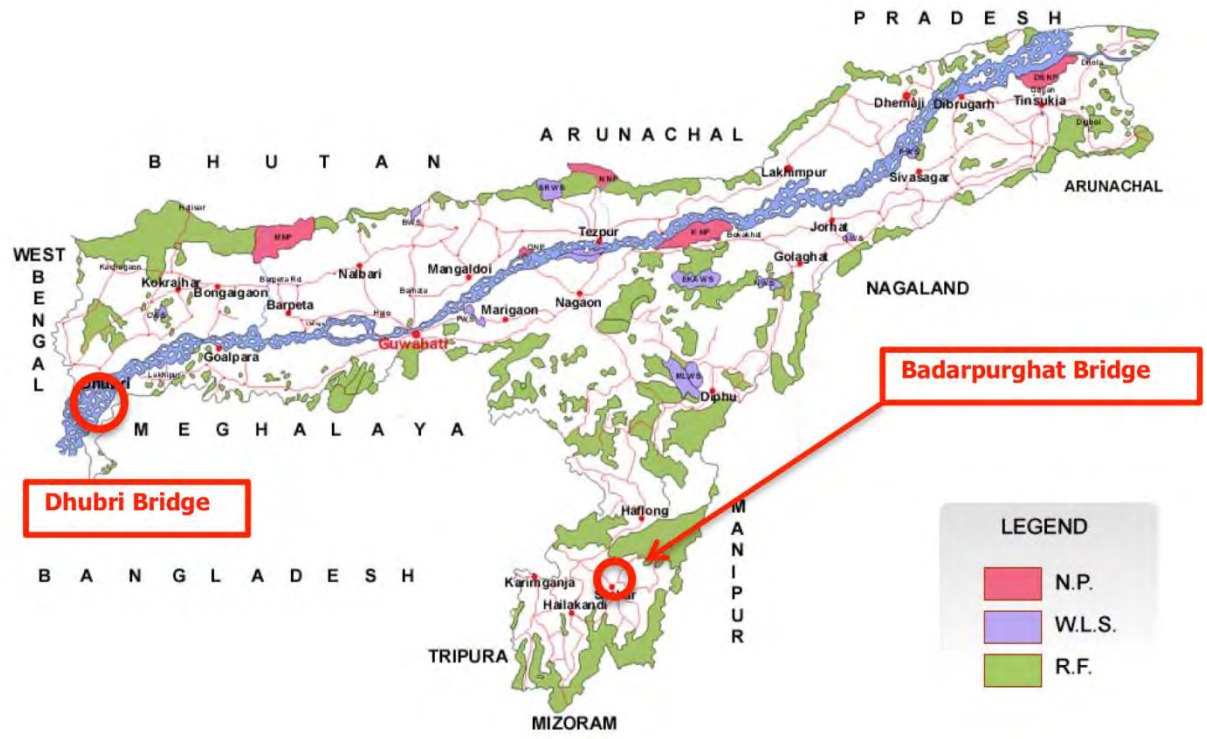


Source: JICA Study Team

Figure 12.4-5 Protected Area in Tripura

Assam (Dhubri Bridge and Badarpurghat Bridge)

The location of National Park, Wildlife Sanctuary and Reserve Forest in Assam is shown below. The two bridge projects proposed in Assam do not interfere with protected areas.



Source: JICA Study Team

Figure 12.4-6 Protected Area and Reserve Forest in Assam

12.4.3 Tribal/Ethnic Profile

Mizoram (NH54)

The Mizo people are an ethic group native to North-Eastern India. The termed 'Mizo' is made of two words, Mi means people and Zo means hill. Thus Mizo literary means "hill people". The Mizos are broadly divided into 5 major tribes and 11 minor tribes. The 5 major tribes are Lushai, Ralte, Hmar, Paite and Pawi. The minor sub tribes are known under the common name of Awzia. The Mizos (formerly Lushais) are the largest group and influenced culturally and linguistically other tribes. Most of the people living along NH54 belong to Lushai, Lai (Pawi) or Mara (Lakher).

Mizo is the official language and most widely used language for verbal interactions, but English being important for education, administration, formalities and governance, is also widely used. The Duhlian dialect, also known as the Lusei, was the first language of Mizoram and has come to be known as Mizo language. All the tribes still have their own unique languages which are slightly different from the dominant Mizo (Duhlian) language but they can speak Mizo and communicate each other either through Mizo or English.

The Mizo ancestors had no written language and the British missionaries, but today, it has one of the highest literacy rate (91%) in India. The population of Mizoram is 1,097,206 as per 2011 Census. Christianity is the dominant region in Mizoram, followed by nearly 90% of the population. Other religions include Buddhism, Hinduism, Muslim and Sikh. There are also few tribal religions such as Lalchhungkua, Lalhnam and Nunna Lalchhungkua. Also, a modernized traditional Mizo religion called Hnam sakhua put a particular emphasis on Mizo culture and seeks to revive traditional Mizo values.

Meghalaya (NH51, 40, 62)

Meghalaya is one of the three states in India to have a Christian majority. About 70% of the population practices Christianity, with Presbyterian and Catholics the more common denominations. Close to 90%

of the Garo tribe and 80% of the Khasi is Christian, while more than 97% of the Hajong, 98.53% of the Koch tribes are Hindu. The Garo people have their own religion known as Songsarek but, are followed by a very small population. Also, there are small number of Garos who follow Hindus and Buddhism. Khasi people too have their own religion followed by a large group of people and is known as Niam Shnong or Niamtre. There is also a small population of Khasi people who practice Islam. Kuki-Chin people are mostly Christians while majority of the Raba tribes are Hindu.

NH51and NH62 runs through the West Garo Hills District in Meghalaya. West Garo Hills is an administrative district in Garo Hills of the state of Meghalaya in India. Tura town is the administrative headquarters of the district. It is one of the three districts in Meghalaya currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). West Garo Hills District is divided into six blocks, after the creation of South West Garo Hills District. The six blocks are Dadenggiri, Dalu, Gambegre, Rongram, Selsella and Tikrikilla.

The majority of the inhabitants of the district are Garo. Tura has a mixed population of Garos or Achiks (as they prefer to call themselves), Bengalis, Nepalese, Assamese, members of other ethnic groups such as the Hajong, Bodo, Rabhas and Koches. The languages used in this district are Garo, English, Khasi, A'tong and Hindi. Languages in West Garo include A'tong, a Tibeto-Burman language spoken by 10,000 people in Bangladesh and India.

While the whole stretch of targeted section of NH51 falls within West Garo Hills District, NH62 runs through East Garo Hills District and South Garo Hills District too. East Garo Hills District was formed in 1976 with its headquarters at Williamnagar. The district occupies an area of 2603 km^2, comprising of 5 blocks as, which are: Dambo Rongjeng, Kharkutta, Resubelpara, Samanda and Songsak. The majority of the population is the Garos, while the other indigenous inhabitants are the Hajongs, Rabhas, Koches, Rajbansis, Kacharis and Dalus. Assamese, Bengali and Nepali are also found in this area. Garo language and English are used. East Garo's languages include A'tong language. Hindi is also used in this area.

South Garo Hills District is headquartered in Baghmara. The district occupies an area of 1850 km^2. It is divided into four blocks, namely Baghmara, Chokpot, Gasuapara and Rongara. Like other Garo Hills Districts, Garo is the main language spoken. English and Hindi are also used for communication.

Shillong is the administrative headquarter of Khasi district and the capital of Meghalaya. It is the starting point of targeted section of NH40. Khasis make up the majority of the population. All the other North East tribes are represented here as well as significant numbers of Assamese, Bengali and a bit of Nepalese. Khasi language is the official language of the district and Shillong. English is also widely used. Other languages like Hindi, Assamese, Nepali and other minor dialects are also used. Apart from Khasi district, NH40 runs through Jantia Hills District near the Bangladesh boarder. West Jaintia Hills is a home to the Pnar (or Synteng or Jaintia) tribe. War Jaintias are also found in this district. Other tribes like Hmar, Bengali, Assamese and Nepalese are also found in the hill. The common dialect in West Jaintia Hills District is Pnar, belonging to the Jaintia language. Other dialects include War Jaintia speaking to the southern part of the district and Hmar/Biate, spoken by approximately 20,000 members of its namesake tribe.

Manipur (and Nagaland) (NH39, NH53, NH102A)

Manipur has a population of 2.72 million as per 2011 census. The Meitei, people of Manipur, is the largest ethnic group. A total of 29 ST are recognized in Manipur. Altogether, they constitute 35.1% of the total population. The ST population in Manipur is predominantly rural with over 95% of them residing in rural area. The Ukhrul (NH102A), Tamenglong (NH53), Churachandpur and Chandel are predominantly tribal districts with over 90% of the districts population being ST.

While the Sanamahi (Household Deity) belief prevails over majority of the people in the valley of Manipur, particularly among the Meitei's, Christianity are more popular among people inhabiting the hilly districts. Indigenous gods are worshiped by some of the tribal communities, particularly Kabuis and Meiteis. The Meiteis believe to have 108 gods in addition to Atiya Sidaba (Sky God), Sanamahi (Household Deity) and Pakhangba (Mangang Ancestor, who later became the originator of all Salais/Clan). Today, Meitei tradition is blended with Hinduism, creating a unique hybrid of Meitei and Hindu, the process referred to as "Meiteinisation of Hinduism".

Kohima (NH39) is the capital of the Nagaland state. Kohima is the land of the Angami Naga tribe. The name Kohima was officially given by the British as they could not pronounce the Angami name Kewhima or Kewhira. It is called after the wild flowering plant Kewhi, found in the mountains. As of 2011 census, Kohima has a population of 99,039. The town's population is composed of the 16 tribes of Nagaland. The Angamis and Aos are the largest group among them. English is the official language of Kohima. The tribes have their own dialects which they used for communication among themselves.

Tripura (NH44)

Altogether there are 19 tribes in Tripura. They could be divided into 2 major groups as (i) Ab-original and (ii) Immigrants. Aboriginal tribes are Tripuri, Reang, Jamatia, Noatia, Lushai, Uchai, Chaimal, Halam, Kukis, Garos, Mog and Chakma. Other tribes like Bill, Munda, Orang, Santal, Lepcha, Khasia and Bhutias are the immigrant tribes came and settled here for economic reasons. The Tripuris, who are also called Tripuras or Tipras, are the original inhabitants of Tripura state. They constitute about 16% of the total population and about 57% of the state's tribal population. NH44 passes through Dhalai district and the North Tripura district. North Tripura district is the home to a number of tribes including Chakmas (found in Mizoram), Koloi, Tripuri and Halam.

As per 2011 census, the population of Tripura is 3,671,032. Bengali and Kokborok or Kak-Borak (also known as Tripuri) is the official languages of Tripura. As in the rest of India, English is used for official purpose. The tribal communities have their own dialect for communication. The literacy rate of Tripura in 2011 was 87.8%. Due to heavily influence from the religious doctrine of the neighboring Bengali people in Bangladesh, majority of the Tripuri people follow Hinduism. Muslim, Christianity and Buddhism are also followed in the state.

Assam (and Meghalaya)

Dhubri district is one among the many Muslim majority districts of Assam. About 75% of population is Muslim in Dhubri. The name Dhubri comes from the tale of Chand Sadagar, where the main character of the story Netai Dhubuni used to wash her clothes on the surface of a big stone at bank of the river Brahmaputra. This particular place had a name called "Netai Dhubunir Ghat".

Modern-day Dhubri district was created on 1st July, 1983 when it was split from Goalpara district.

Dhubri district occupies an area of 2,838 km2. According to 2011 census Dhubri district has a population of 1,948,632. The district has become one of the most densely populated districts in India with a density of 584 persons per km2 (as per 2001 census). Goalpariya and Bengali are the most widely spoken language in the district, although Assamese is the official language. Most of the people are Deshi (Goalpariya Assamese people which includes the Hindu and Muslim Goalpariya people) people. Only in Dhubri Town more than 50% Bengali people are present.

Phulbari is under the West Garo Hills District in Meghalaya. It is situated in the north western most corner of West Garo Hills District. It is gradually and appreciably developing into township because of its position as a station serving several routes. The River Jingiram which separates Meghalaya from Assam flows by this place. There is a ferry across the Brahmaputra connecting this place with Dhubri, some 22.4 km away. English, Khasi, Garo and A'tong are used in this area. Most of the people are Garos or Achiks, Bengalis, Assamese, Nepalese and members of other ethnic groups such as the Hajong, Rabhas, Koches and Bodo.

12.4.4 Indigenous Knowledge and Management of Natural Resources

Shifting cultivation or locally called Jhum is the most widespread type of cropping system in the North East region and is directly supported by the forest ecosystem. Jhum has been in use for centuries and still remains a major land-use practice despite recent government effort to discourage the practice (e.g. New Land Use Policy of Mizoram) and provides a basis for subsistence farming, maintenance of cultural values and social stability for the people living in low population densities. Challenges associated with jhum are often caused by the high pressure due to local population growth, rather than the inherent problem of the system itself. In recent years, local farmers are responding to the new

demands of the market economy and pressure on land by diversifying the cropping patterns. While jhum has a long tradition, its practice is not static but dynamic one that continuously evolves with the changes of outside environment. Some unique farming practice identified in the study road include the following:

Khasi tribe of Meghalaya (NH40) practices wet terrace paddy cultivation on hill slopes. This is not rain-fed but irrigated farming practice that uses local skills. Terraces are cut into slopes and carefully flooded using bamboo and locate material as water conduit. In this type of cultivation, suitable terraces are used for short-term fish farming in combination with paddy cultivation during monsoons as shown in Picture below.

Source: JICA Study Team

Figure 12.4-7 Fish Pond along NH40

In Jantia hills of Meghalaya (NH40), bamboo drip irrigation is commonly practiced as a tool for water management. It is a low-cost irrigation system using locally available material. Bamboo ducts are laid out at an elevated height supported by wooden props. The practice prevents water percolation in water scarce area. In addition, a variety of water and soil conservation methods are practices in North East region. The table below shows a set of soil conservation practices identified in the study area.

Table 12.4-4 Traditional Farming Practices in Study Area

Practice	Advantage	Disadvantage	Location
Bench Terrace	• Effectively control soil and water runoff and erosion • Trap sediment in the drainage ditch built along the terrace	• Initially disturbs the soil and reduce productivity in the first 2-3 years • Needs intensive labor, investment and skills for proper construction	NH39 (Nagaland) , NH62
Contour tillage/ planting	• Reduce runoff and soil erosion • Reduce nutrient loss	• Improperly laid out contour line can increase the risk of erosion • Maintenance is labor intensive	NH39, NH44, and Assam

Practice	Advantage	Disadvantage	Location
Cover Crop	• Improve soil fertility and physical/chemical properties • Reduce erosion and water loss • Help to retain moisture in the soil	• May compete for soil moisture and nutrients with the perennial crops • Involves additional farm labor and inputs • May result in weed problem	NH51, 62, 40, 54, and 44
Hedgerows	• Reduce soil erosion • Improve fertility and soil moisture • Provide shade for young plants • Serves as a source of fodder, fuel wood and light construction materials	• Loss of land for cultivation due to establishment of contour hedgerow • Competes with food crops planted between the row for light, soil nutrients and moisture • Hedgerow plants may be hosts to pest	NH54, 39
Ridge Terrace	• Effectively control runoff and erosion on moderate slope • Relatively low labor inputs are required • Minimum disturbance of soil	• Less effective in controlling erosion than bench terrace • Need proper maintenance	All over NE region
Diversion Ditches	• Protect cultivated land from hillside runoff • Control gully erosion	• The ditch can overflow onto the farm during heavy rain • Need support structure such as check dam and drops for effective control of erosion • Need continuous repair and de-silting	All over NE region
Drop structure	• Control the upstream water velocities to reduce erosion • Drops the water flow to a lower level and control downstream erosion	• Require skills for construction	All over NE region
Gras strip	• Control soil erosion and runoff • Provide fodder	• Require labor for management of grass strip • Mulching of grass cutting may contribute to weed problem	All over NE region
Soil barriers/traps	• Slow down surface runoff • Retain sediment behind the fences/traps • Prevent widening and deepening of gullies	• Wooded barriers do not usually last for more than 25 years • Construction requires significant labor input • Require continuous maintenance to prevent overtopping during heavy rains	All over NE region
Water harvesting	• Improve food production • Promote conservation and ecological balance • Easy to construct and allow irrigation by gravity	• Require large labor input • High seepage and evaporation is possible • Floating vegetation may infest reservoir	All over NE region

Source: Adopted from the Anthropology of North-East India, edited by T.B. Subba and G.C. Ghosh

12.4.5 Stakeholder Consultations during the Screening process

A meeting with selected officials and academia has been carried out during the screening of property projects[8]. The list of people met and their opinions/concerns/suggestions are summarized below. See section 12.5.23 (NH54) and 12.6.23 (NH51) for the details of consultation meetings targeting project-affected persons for priority projects.

Table 12.4-5 Summary of Stakeholder Consultations in the Screening Process

Date	People met	Relevant Road	Contents/Issues Discussed
02/03/15	Mr Liandawla, Chief Conservator of Forests, Chief Wildlife Warden Mizoram	NH54	Confirmed the location of National Park, wildlife sanctuary and other areas of ecological importance in the state and its distance from the study road Discussed recommended approach to protect natural environment in infrastructure project
16/05/15	Mr. A. K. Srivasata, I.F.S. PCCF, & Chairman, Meghalaya State Medicinal Plants Board	NH51, 62, 40	Collected the list of medicinal plants identified in Meghalaya and its use by local people
12/04/15	Mr. Tanmay Samajdar, Senior Scientist, Krishi Vigyan Kendra, ICAR Research Complex for NE Hill Region.	All NE (with special attention to NH51, 62, and 40)	Collected information about traditional agricultural practices in Meghalaya and NE in general Current trend of Jhum in Meghalaya and NE in general
16/05/15	Prof. (Dr.) Saroj K. Barik, HOD, Dept. of Botany, North Eastern Hill University, Shillong	All NE (with special attention to NH51, 62, and 40)	Collected information about traditional agricultural practices in Meghalaya and NE in general Current trend of Jhum in Meghalaya and NE in general
10/04/15	Mr. R. K. Marak, DFO, Social Forestry Department, MFS	NH51, 62,	Collected information about community forest along the study roads in Garo Hills and how such forest is managed
16/05/15	Dr. M. Kit, HOD, Environmental Science, MLCU, Shillong	NH51, 62, 40	Collected information about environmental conditions in Meghalaya Collected information about elephant corridor (area earmarked as a crossing point of wild elephants) along NH62
10/04/15	Chief Wild Warden, Tura, Meghalaya, MFS, Tura	NH51, 62	Confirmed the location of National Park, wildlife sanctuary and other areas of ecological importance in Garo Hills and its distance from the study road Discussed recommended approach to protect natural environment in infrastructure project
03/07/15	Mr. N. Kalita, Executive Engineer, Water Resource Department, Dhubri	Dhubri	Collected information about migratory birds in the area and other information related to river ecosystem
03/07/15	Mr. Khandakar Mustafa, Secretary, Boat Association, Jogmaya Ghat, Dhubri	Dhubri	Collected information about local livelihood of boaters in Dhubri area and discussed how the new bridge might affect their livelihood

8 It was carried out except for Manipur and Nagaland where no field visit (for environment and social considerations) was carried out due to security concerns.

Date	People met	Relevant Road	Contents/Issues Discussed
05/07/15	Mr. Pranjal Buragohain, Green Tech. Environmental Engineers & Consultants, Guwahati, Assam	Dhubri/ Badarpurghat	Discussed recommended practices in infrastructure project in general, with particular attention to bridge construction
06/07/15	Superintending Engineer, NH Division, Agartala	NH44	Discussed road condition of NH44 and surround environment

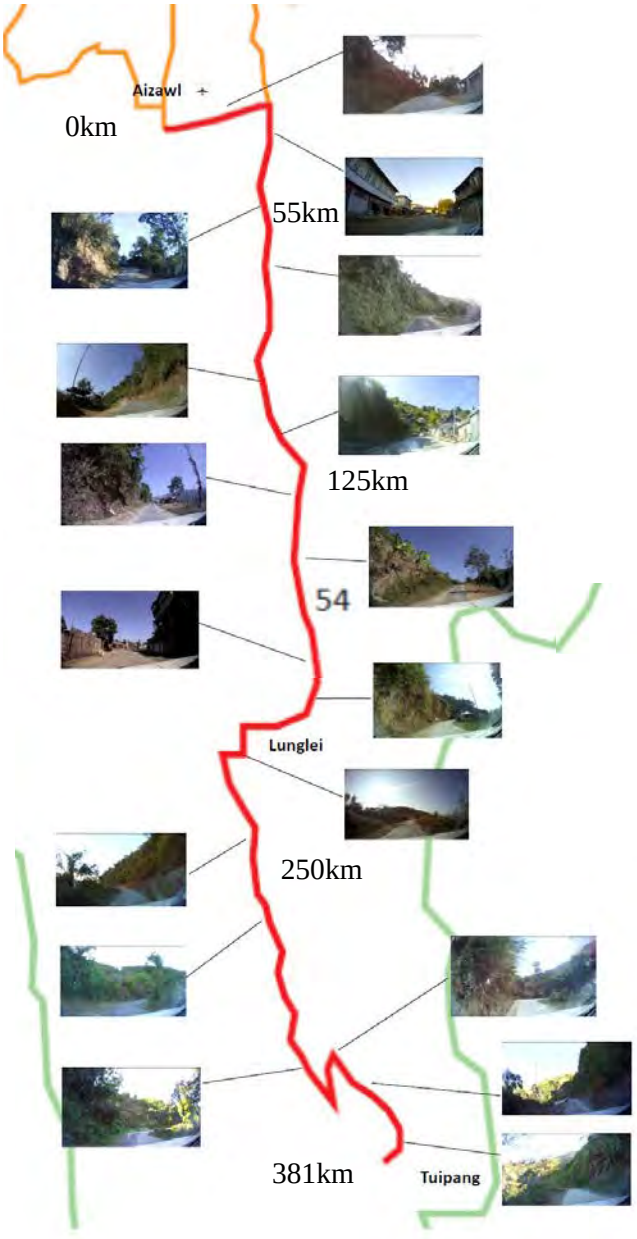
Source: JICA Study Team

12.5 EIA and RAP Study for NH54

As discussed in Section 12.2.1, EIA is not required for widening and improvement of NH54 according to Indian regulation. In line with JICA Guidelines for Environmental and Social Considerations, however, EIA has been prepared and shared with relevant MOEF as well as Mizoram State Government.

12.5.1 Scope of the Project

The targeted section of NH54 starts from Aizawl in Mizoram state to Tuipang with total length of approximately 381km. The study road mainly passes on brow of variegated mountains and alignment of the study road consists of many small horizontal and vertical curves as shown in Figures below.



Source: JICA Study Team

Figure 12.5-1 Road Alignment and Present Road Condition of NH54

The number of lanes is 1.5 lanes for the section near Aizawl and 1.0 lane for other sections. Pavement condition between Aizawl to Lunglei is fair, while section between Lunglei and Tuipang is deteriorated due to inadequate road maintenance. Existing condition of the targeted section of NH54 is shown in Table 12.5.1 below. The project involves the widening of existing one-lane road to two-lane roads with installment of proper slope protection and Landslide prevention measures, drainage and traffic safety facilities. The total width of the road including carriageway and road shoulder will be 12m except for four sections for which new bypasses are proposed. The details of the proposed improvement, including design of culvert and slope protection measures, are discussed in Chapter 7.

Table 12.5-1 Present Conditions and Provisional Improvement Cost of NH54

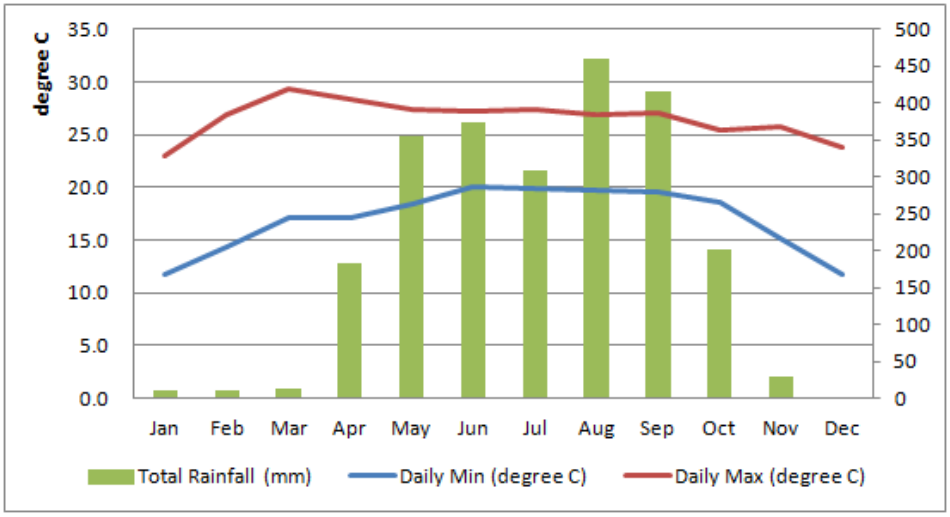
No.	Data Items	Type / Unit	Road			
			NH54 (Upper: KM distance from Aizawl, Lower: KP)			
			0-55	55-125	125-250	250-381
			181-236	236-306	306-431	431-562
1	Number of Lanes	Four (4): Carriageway Width (7m+7m), Double (2): Carriageway Width (7m/10m), Intermediate (1.5): Carriageway Width (5m/5.5m), Single (1): Carriageway Width (3.5m/3.75m) New (0)	1.5	1	1	1
2	Carriageway Width	m	5.5	3.75	3.75	3.75
3	Shoulder Width	Average in section / m	0.4	0.5	0.4	0.45
4	Shoulder Type	Paved or Unpaved	Unpaved	Unpaved	Unpaved	Unpaved
5	Average Altitude	m	714	860	724	853
6	Average Roughness	IRI	4.5	5	6.2	9.1
7	Total Area of Crack	%	6.3	7.5	25	62
8	Ravelled Area	%	6.3	10	5	4
9	No. of Pot Holes	per km	5	5	21	7
10	Edge Break Area	m2/km	50	100	50	20
11	Road Side Friction	%	50	15	10	5
12	Average Travel Speed	km/h	30	26	23	21
13	Road Capacity	PCU – IRC73-1980	5,000	1,000	1,000	1,000
14	Improvement Project Cost (W=12m: Carriageway 3.5m x 2+ Shoulder 3.5m x 2)	Mountainous (INR crore/km)	9	55 495	70 630	125 1125	131 1179
		Rolling (INR crore/km)	5.5	0 0	0 0	0 0	0 0
		Level (INR crore/km)	4	0 0	0 0	0 0	0 0
		Long Bridge (INR crore/km)	120	0 0	0 0	0 0	0 0
		Total (INR crore)		495	630	1125	1179

Source: JICA Study Team

12.5.2 Natural Environment

1) Climate

Mizoram has a mild climate, relatively cool in summer 20 to 29 °C (68 to 84 °F) and winter temperatures range from 7 to 22 °C. The region is influenced by monsoon, raining heavily from May to September with little rain in the dry-season. The climate pattern is moist tropical to moist sub-tropical, with average state rainfall 254 centimeters per annum. In the capital Aizawl, rainfall is about 215 centimeters and in Lunglei, another major town of the state, about 350 centimeters.



Source: Mizoram Statistical Handbook 2014

Figure 12.5-2 Monthly rainfall and daily maximum and minimum temperature in Aizawl (2013-2014)

2) Topography, Geology, and Soil

Mizoram has the most variegated hilly terrain in eastern part of India. Mizoram is mostly covered with hills. The hills are steep and are separated by rivers, which flow either to the north or south, creating deep gorges between the hill ranges. Eastern sector is higher than western sector. Average height of the hills is about 900 meters. The highest peak in Mizoram is the Blue Mountain (Phawngpui) with a height of 2210 meters.

The Geology of Mizoram consists of a repetitive succession of Neogene (Tertiary) arenaceous and argillaceous sediments occurring in a series of approximately North- south trending longitudinal plunging anticlines and synclines. The topography of the area is often a good indication of lithology and argillaceous groups of rocks occur in relatively lower altitudes as compared to arenaceous rocks. The parent materials are predominantly shales and siltstone, with a reasonable percentage of day minerals. As the rocks are relatively impermeable, the dry months provide opportunity of desiccation of the upper topsoil creating some weak bond by geo-chemical processes (laterisation, limonisation, or sometimes kaolinisation). The common rocks found are sandstone, shale, silt, stone, clay stones and slates. The rock system is weak and unstable prone to frequent seismic influence.

Soil texture, in general, varies from sandy loams, clayey loams to clay. Although the soils are mature, profuse rainy spells in the region coupled with the high gradients have accelerated the problem of leaching of the loose soils. These soils are highly porous with low water holding capacity and this is the main cause of the low water table in Mizoram. The soils of Mizoram are deficient in potassium, phosphorous, nitrogen and humus. The traditional jhum cultivation has adversely affected the productivity. Although superficial greenery is observed owing to the profuse rainfall, the tract is actually in the process of fast degradation. The pH of these soils is acidic to neutral due to excessive leaching.

3) Flora and Fauna

Mizoram is the highest forest cover state in the India, having about 90 % of the total geographical area is under forest (India State Forest Report FSI, 2013). In flora assessment, 57 tree species, 30 shrubs species & 52 herb species recorded from the study area. There is no unique faunal community within the project area. No “Endangered” species as per IUCN Red List has been identified during the field survey, but one “Vulnerable” species, Slow Loris, has been found in the project area. In addition to common species including toad, frog, crow, sparrow and myna, several insects like moths, stick insects, dragonflies, beetles, cockroaches, grasshoppers were also found.

4) Protected Area and Forest

There are a total of ten protected area (National Park, Wildlife Sanctuary, Tiger Reserve) in Mizoram, but the targeted section of NH54 does not traverse or border with any of them. According to the discussion with the official in State Environment and Forest Department, two Wildlife Sanctuaries, namely Tawi WLS and Khawnglung are closest to the road but they are approximately 10 km away from the road and project will not cause direct impact to WLS.

Source: Department of Environment and Forests, Government of Mizoram

Figure 12.5-3 Protected Area in Mizoram

Similarly, no reserve forest will be affected by the project. However, the project runs through open forest, jhum land (shifting cultivation) and abandoned jhum area. Given that the forest and forest produces play an important role in local livelihood, efforts are needed to minimize deforestation and to disturbance during construction stage.

12.5.3 Social Environment

Mizoram name derived from Mi (Peoples), Zo (Hills) & Ram (Land) thus Mizoram implies '*land of the hilly peoples*'. The meaning itself shows social structure of the Mizoram state. The Mizos are broadly divided into 5 major tribes and 11 minor tribes. The 5 major tribes are Lushai, Ralte, Hmar, Paite and

Pawi. Mizo is the official language and most widely used language for verbal interactions, but English being important for education, administration, formalities and governance, is also widely used. The Duhlian dialect, also known as the Lusei, was the first language of Mizoram and has come to be known as Mizo language. All the tribes still have their own unique dialects; they are slightly different from the dominant Mizo (Duhlian), but they can understand each other without problems. As per 2011 census, total population of Mizoram is 1,097,206. Out of these, the number of male and female are 555,339 and 541,867 respectively. The Lushai tribes constituted the majority of the Mizo population. Population density of Mizoram is 52 per km^2. The literacy rate in Mizoram is 91.3% as per 2011 census.

The majority of the Mizo people are Christian. The major Christian denominations are Presbyterian, Baptist, United Pentecostal Church, Roman Catholic, the Salvation Army, Congregational Church of India (Maraland), Seventh-day Adventist, among others. There are other religions like Buddhism, Hinduism, Muslim and Sikh. There are few people who practice Judaism claiming to be one of the lost Judaic tribe group Bnei Menashe and a modernized traditional Mizo religion called Hnam sakhua, which put a particular emphasis on Mizo culture and seeks to revive traditional Mizo values. There are also few tribal religions such as Lalchhungkua, Lalhnam and Nunna Lalchhungkua.

The summary of each district in Mizoram is shown below. Five districts where the targeted section of NH54 passes through are highlighted.

Table 12.5-2 Snapshot of District in Mizoram

District	Description
Aizawl	Situated between the Tlawng River valley in the West and Tuirial River valley in the East. It is home to the Mizo tribes who are said to have migrated from Myanmar's Chin Hills 300 years ago. Being the capital city of Mizoram it is a political, commercial, educational and cultural hub of the state, housing all important government offices, the State assembly and secretariat, and tourist spots, including some beautiful churches and markets.
Lunglei	It is the biggest district (21.52 % of the total land area) bounded on the north by Mamit and Serchhip Districts, on the south by Lawngtlai and Saiha districts, on the east by Myanmar and on the west by Bangladesh, having dense forest area covering 524.63 sq.kms.
Champhai	Located near the India-Myanmar border, it serves as a gateway of all business activities between India and Myanmar. It is a fast developing venue on the Indo-Myanmar border. The famous Rihdil Lake is only about 50 kms away from the town of Champhai. Champhai valley known as "The Rice bowl of Mizoram" is located towards the base of the town. A chain of green hills encircle luxuriant rice fields, which add to the beauty of this place.
Lawngtlai	Located in the southern most part of Mizoram having common international borders with Bangladesh in the west and Myanmar in the east. It also shares common boundaries with Lunglei and Saiha District in the north and south respectively. Unlike other districts, it has two Autonomous District Councils within the District, namely the Lai Autonomous District Council (LADC) and the Chakma Autonomous District Council (CADC) with their headquarters at Lawngtlai and Kamalanagar respectively, and are administered in accordance with the provisions of the Sixth Schedule of the Constitution of India.
Mamit	Mamit District was created after bifurcation of the erstwhile Aizawl District in 1998. It is bounded on the north by Assam state, on the west by Tripura state and Bangladesh, on the south by Lunglei district, and on the east by Kolasib and Aizawl districts. It is 4th largest district in Mizoram in terms of total area. It receives abundant rainfall. The five main big rivers are Tlawng, Tut,Teirei, Langkaih and Khawthlangtuipui. Women Play major role in the society as well as in the family.
Kolasib	The District is bounded by Assam on the north and north west side, on the south and east by Aizawl, and on the south west by Mamit District. The location of the district occupies an important site as it is the main stream of road communication from other state of Mizoram. NH 54 passes through the middle of the district from north to south direction. The only Rail head in the state located at Bairabi. There are some worth visiting sites in and around the district which include Dampa Wildlife Sanctuary and Tlawng River.
Serchhip	Serchhip is located in the central part of the state of Mizoram; adjoined by Champhai District in the East, Aizawl in the North and North West, and Lunglei District in the South. The district has the highest literacy all over India. It lies between the two very important rivers of Mat and

District	Description
	Tuikum. While River Tuikum is source for drinking water for Serchhip, River Mat is source for irrigation water for Zawlpui, the rice bowl of Serchhip. Serchhip is also the main producer of cabbages and mustards in Mizoram.
Saiha	Saiha District is situated on the southern-most fringe of the North-eastern region of India and shares border with Myanmar on the eastern and southern side. Administratively, it is divided into two blocks-Saiha and Tuipang. It is the third most developed and also the third most populous town in Mizoram State apart from the state Capital - Aizawl and Lunglei. It is also the capital of the third largest tribe - the Maras in Mizoram.

Source: JICA Study Team

The Net State Domestic Product (NSDP) for the year 2012-13 was about Rs 7,556 Crores, and the Per Capita Income (PCI) during the same period was Rs. 63,413. It has also been observed that during the period 2004-05 to 2012-13 the economy of the state grew at a compound annual growth rate of 9.3%, with Primary Sector growing at 7.6%, Secondary Sector at 7.9% and the Tertiary Sector at 10.3%. During the same period the per capita income of the state grew at 6.8%. The main occupation of the people is agriculture. About 80% of the population are agriculturist. Rice is the main crop of Mizoram and besides rice, maize, potato, ginger, tumeric, black pepper, chilies and a variety of fruits are grown. In Mizoram, the ownership of land is vested with the government, which issues periodic pattas to individual cultivators. The Village Council distributes the plots of land among the villagers for cultivation every year. The agricultural system practiced is of the primitive type of 'jhum' or 'slash and burn', a practice that has been regarded as detrimental to the top layer of the soil, rendering it to become loose and soft and susceptible to frequent soil erosion. The government is attempting to bring about a change to the practice of 'jhum' by introducing 'terrace cultivation' which is ideal for the hill slope. The main horticulture crops are fruit crops like Mandarin orange, banana, passion fruit, grapes, hatkora, pineapple, papaya, etc. and flowers like anthurium, bird of paradise, orchid, rose and other subsidiary seasonal flowers. People have also started extensive cultivation of oil palm, medicinal and aromatic plants.

12.5.4 Legal Framework for Environmental Considerations

While Environmental Clearance is not required for this project, various clearance will be required for setting up hot-mix plants, batching plants, etc., under the Air and the Water Acts. Clearance from the State Department of Mining is required for establishing quarries. Clearance from the Sate Ground Water Boards/Authorities is required for establishment of new tube-wells/bore-holes in case they are required during construction work. Also, the provisions as laid down in the Factories Act, 1948, Labor Act, 1988 and the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 with respect to hygiene and health during the construction stage would apply for this project. With limited possibility, the provisions of the Hazardous Wastes (Management and Handling) Rules, 1989 and the Chemical Accidents (Emergency Planning, Preparedness and Response) Rules, 1996 may also apply during the construction and the operation periods. The applicability of environmental and other relevant rules and acts is shown in Table 12.5-3 below.

Table 12.5-3 Clearance Requirements

No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Pre-Construction Stage (Responsibility: MORTH)						
2	Road-side tree cutting and clearing forest for resettlement sites and surplus soil dumping	Forest Conservation Act1980 & MOEF Letter Dt.18.02.1998	Permission for Road-side tree cutting	State and Central Government	MORTH	2-3 months

No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
3	Filling of Roadside water bodies (ponds and borrow pits)	State Fisheries Policy Draft Wetlands (Conservation & Management) Rules, 2008	Permission for filling of water bodies	State Irrigation Department State Fisheries Department State Wetlands Conservation Committee	MORT&H	2-3 months
Construction Stage (Responsibility: Contractor)						
1	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-forest abolishment	States Pollution Control Boards for respective section	The Contractor	2-3 months
2	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as Amended	Consent-for operation	States Pollution Control Boards for respective section	The Contractor	2-3 months
3	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
4	Storage of fueloil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	States Pollution Control Boards for respective section and or Local Authority (DC)	The Contractor	2-3 months
5	Quarry Operation	State Minor Mineral Concession Rules, The Mines Act of1952, Indian Explosive Act of1984, Air Act of1981 and WaterAct of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	2-3 months
6	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water foruse in road construction activities	State Ground Water Board	The Contractor	2-3 months
7	Engagement of labor	Labor Act	Labor license	Labor Commissioner	The Contractor	2-3 months

Source: JICA Study Team

Mizoram has its own biodiversity rules (Mizoram Biodiversity Rules 2010) and forest act (the Mizoram Forest Act, 1955 and its amendment), but they do not trigger additional requirements in terms of environmental and social considerations other than those already prescribed in national-level legislation.

12.5.5 Institutional Setup

The environmental regulations, legislation, policy guidelines and control that may impact this project, are the responsibility of a variety of government agencies. In all, following agencies would play important roles in this project.

(1) Ministry of Environment and Forests (MOEF)

The primary responsibility for administration and implementation of the Government of India's (GOI) policy with respect to environmental management, conservation, ecologically sustainable development and pollution control rests with the Ministry of Environment and Forests (MOEF). Established in 1985, the MOEF is the agency primarily responsible for the review and approval of EIAs pursuant to GOI legislation.

(2) MOEF Regional Offices

The Ministry of Environment and Forests (MOEF) has set up regional offices, with each region having an office. The office that cover North Eastern zone including Mizoram is located at Shillong, Meghalaya. This office is responsible for collecting and furnishing information relating to EIA of projects, pollution control measures, methodology and status, legal and enforcement measures and environmental protection in special conservation areas such as wetlands, mangroves and biological reserves.

(3) Central Pollution Control Board (CPCB)

Statutory authority attached to the MOEF and located in New Delhi, the main responsibilities include inter alia the following:

- Planning and implementing water and air pollution programs;
- Advising the Central Government on water and air pollution programs;
- Setting air and water standards; and
- Coordinating the various State Pollution Control Boards.

The role of the CPCB, (for this project) will only be in an advisory capacity while the project shall adhere to the norms and standards set up by the Mizoram State Pollution Control Board (MSPCB).

(4) Departments of Environment and Forests (DOEF)

They perform the functions similar to the MOEF at the state level.

(5) Mizoram State Pollution Control Board (M-SPCB)

The M-SPCB has the mandate for environmental management at the state level, with emphasis on air and water quality. The board is responsible for:

- Planning and executing state-level air and water initiatives;
- Advising state government on air, water and industry issues;
- Establishing standards based on National Minimum Standards;
- Enforcing and monitoring of all activities within the State under the Air Act, the Water act and the Cess Act, etc.;
- Conducting and organizing public hearings for projects as defined by the various Acts and as stipulated by the Amendment (April 1997) to the EIA Act; and,

- Issuing No-objection Certificates (NOC) for industrial development defined in such a way as to include road projects as the Third National Highway Project.

(6) Mizoram State Forest Department

The Mizoram State Forest Department is responsible for the protection and managing the forest designated areas within the state. The Forest Department works out Forest Working Plans for the various forest divisions to manage and protect the forest resources. These plans form the basis for managing the forest resources and for chalking out specific plans and policies with respect to the conservation, protection and development of the forest areas. The Forest department will be responsible for granting clearances for forest areas that need to be cleared for the project, according to the provisions of the Forest (Conservation) Act, 1980.

12.5.6 Analysis of Alternatives

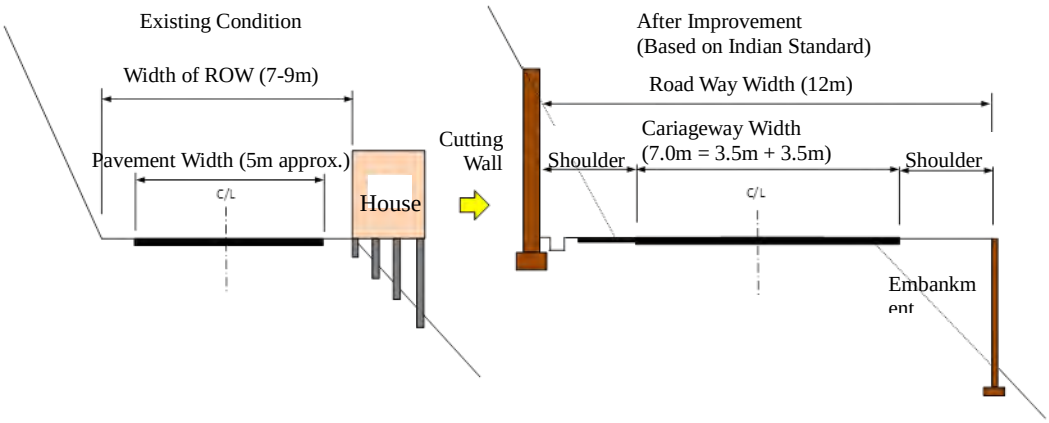
The scope for alternative is limited due to hilly nature of the terrain and the nature of the project, which essentially aims to improve and widen existing road. In developing a proposed preliminary road design, three concepts of alternatives have been as shown below.

Table 12.5-4 Concepts of Alternatives

No.	Option	Contents
0	Zero-Option (without project)	Existing road and slope conditions will persist. Poor pavement condition will lead to more vehicular emissions with detrimental impacts on health and ecosystem. Also, continuation of uncontrolled encroachment will increase the risk of traffic accident in built-up areas. Poor road network continues to be a bottleneck of economic development and also undermine positive benefits of ongoing Kaladan Multimodal Transport Project, which provides additional network from Mizoram to Haldia/Kolkata ports through NH54 and Kaladan River in Myanmar.
1	Applying the same design standard across the whole stretch based on the IRC	The same standard for widening/improvement will be applied across the whole stretch irrespective to geological condition and socio-economic conditions. While the positive impact of widening is significant, the project will trigger significantly more resettlement compared with option 2. Also, geometric improvement of many hair-pin curves will trigger more cutting and filling, increasing impacts on forest and leads to higher project implementation cost. The number of traffic accident will also increase due to the increased speed of vehicles passing through built-up areas.
2	Selective widening considering social impacts	The level of widening will be minimized in heavily built-up area to reduce the scale of resettlement. This option is desirable from socio-economic point of view, but the positive impact in terms of improvement of the road network in the region may be slightly limited compared with option 1.
3	New bypass to avoid densely built-up areas	A new bypass will be constructed in densely built-up areas to avoid resettlement. The option will minimize the scale of resettlement, but the impact on forest and agricultural land (jhum) will be significant as the new road will be constructed in open forest. The bypass will be required in the longer-term to accommodate project increase in traffic demand in the future, but its environmental impact as well as economic feasibility will have to be studied in more details.

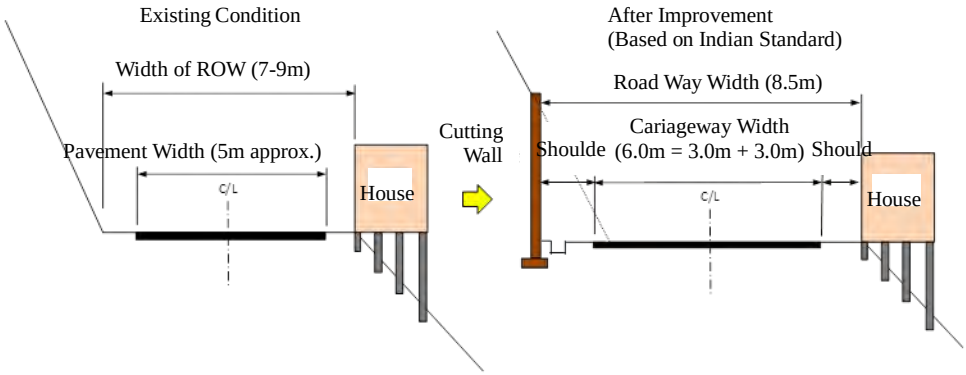
Source: JICA Study Team

The illustrative images of widening concepts are shown below.



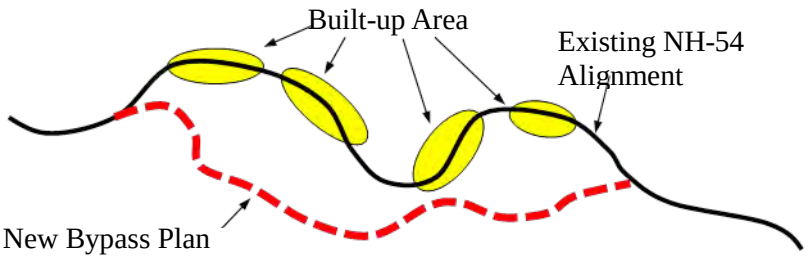
Source: JICA Study Team

Figure 12.5-4 Alternative One (Widening based on IRC Standard)



Source: JICA Study Team

Figure 12.5-5 Alternative Two (Limited Widening)



Source: JICA Study Team

Figure 12.5-6 Alternative Three (New Bypass)

A comparison of three options is provided in Table 12.5-5.

Table 12.5-5 Review of Alternatives

Alternative	Zero Option	One	Two	Three
General Objective	No project. Continue business as usual without intervention.	Follow Indian standard and ensure road capacity will be sufficient over the long-run	Minimize the scale of resettlement	Avoid resettlement
Resettlement	N/A	× Trigger significant resettlement. Preliminary assessment suggest that expansion beyond 15 m can result in resettlement of more than 5,000 households.	○ ROW 12m will be adopted in general, except for hair pin curves. Impact will be reduced compared with Option One. 1,937 households will be affected in total.	◎ Minimum impact, but create negative impact on natural environment
Impact on natural environment	△ No immediate impact, but slope failure and soil erosion without proper management will eventually degrade natural environment	◎ Limited impact as the engineering work will be limited in the side of existing road	◎ Limited impact as the engineering work will be limited in the side of existing road	× A more detailed analysis is needed to assess potential impact for new bypass to be constructed in open forest
Pollution	× No immediate impact, but poor road and growing level of congestion will lead to elevated pollution level in the long-run, particularly in built-up area	○ The option leads to least level of congestion and thus least to relatively small increase in vehicular emissions.	△ More congestion will be expected compared with option one, but still leads to better situation compared with without project scenario.	◎ Traffic will not pass through densely built up area and thus the health impact associated with greater vehicular emission will be minimized.
Traffic Safety	× Likely to deteriorate further as no safety measures will be implemented.	○ Proper safety measures inc. traffic signs will be required as the speed of vehicles passing through built-up area is likely to increase.	○ Proper safety measures inc. traffic signs will be required as the speed of vehicles passing through built-up area is likely to increase.	◎ The traffic does not pass through densely built-up area and thus the risk of accident will be reduced.
Construction cost	N/A	△ Require significant cost associated with land acquisition and resettlement.	◎ The cost associated with land acquisition and resettlement will be less than option one.	× While the cost associated with resettlement will be least among three options, cost of constructing new bypass will be significant.
Overall Evaluation	4	3	1	2

Alternative	Zero Option	One	Two	Three
(Ranking in bracket)	Given the vulnerability of existing road against landslide and the importance as the key infrastructure in the state, it is not recommended to keep the condition as it is.	The option will trigger significant resettlement. Given the limited availability of open and flat land, preparation of new resettlement site will be necessary.	The scale of widening is compromised in some areas, but this level of widening will be sufficient for caring existing and projected traffic volume in mid-terms.	The scale of resettlement will be minimum, but the high cost associated with bypass construction will undermine economic viability of the project.

Note: ◎: most desirable, best among the option; ○: desirable but better option is available; △: other option is preferable; × should be avoided

Source: JICA Study Team

Option two has been identified as the most viable option for this project. However, considerable expectation for new bypasses has been observed during consultation meetings, particularly from residents in large village in which widening is likely to trigger significant resettlement. Meanwhile, the construction of new bypass requires various additional studies, including topographic survey and environmental assessment, particularly review of forest fauna and flora. After a review of likely resettlement impact, future traffic volume and economic viability of the project in the long-term, and feasibility from engineering g point of view, four major villages with over 4,000 population, namely: Chhiahtlang, Serchhip, Hnathial and Lawngtlai, have been selected for bypass construction. Since the detailed environmental assessment for four bypass options is outside the scope of this EIA, a separate study for proposed bypass sections, including detailed flora and fauna survey, will be carried out. Preliminary drawing of Bypass route is included in Chapter 7.

For sections where bypass is under consideration, it is proposed that the project will only improve existing road (e.g. install new drainage, improve pavement) without widening. One of the main rational of constructing new bypass is to avoid disturbance to local livelihood in densely built-up area. From the traffic demand of point of view, the new bypass will have sufficient capacity to hand additional traffic volume in the future and thus widening (and resettlement associated with it) will not be necessary for section where bypass is proposed. Nevertheless, to improve traffic flow and safety, and increase resilience against natural disaster, improvement, such as installing proper drainage, will be carried out.

12.5.7 Scoping of Environmental Impact

Building on the generic Scoping Matrix (Table 12.3-1), Scoping Matrix for NH54 widening and improvement has been prepared as below. Items for which larger negative impacts are expected as compared with the generic scoping are highlighted.

Table 12.5-6 Scoping Matrix for NH54 Widening and Improvement

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
Natural Environment					
1.1	Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
1.2	Topography	D	B-	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
					O: Topographic condition will be stable after the completion of construction work which include slope protection and slope stabilization.
1.3	Geology	D	D	D	P/C/O: No impact is expected as the project does not alter geological condition of the area.
1.4	Soil Erosion	D	B-	B+/B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
					O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
1.5	Hydrology	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Construction work may cause minor, temporary impacts on hydrology.
					O: Cutting and/or filling may result in changes in local hydrology. New drainage and culvert will be installed, taking into account the likely water flow in the area.
1.6	Groundwater	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: The project does not envision the use of groundwater and thus no impact is expected. However, appropriate measures should be undertaken to properly manage effluent during construction.
					O: No impact is expected during the operation stage.
1.7	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected. No unique/endangered species have been identified during assessment.
					C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work will affect mountain ecosystem and local flora and fauna including jhum and plantation.
					O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
1.8	Protected Areas/Forest	D	B-	B-	P: The targeted section of NH54 does not traverse or border with national parks or protected forest.
					C: By the construction work, some of the forest (including plantation and village forest) area will be affected.
					O: Increases in emissions due to greater traffic volume will negatively affect forest and surrounding ecosystem. Monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary.
1.9	Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests.
1.10	Landscape	D	D	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
					O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region. Bus bay and other road amenities also help improve aesthetic conditions of the road.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
1.11	Natural Disaster	D	B-	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
					O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment (Pollution Control)					
2.1	Air Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
					O: Air pollution is expected to increase due to increase traffic volume on the road. Relevant data (e.g. actual/projected traffic volume) shall be shared with relevant State authority so that mitigation measures can be developed.
2.2	Offensive Odor	D	D	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
2.3	Water Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
					O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
2.4	Bottom Sediment Contamination	D	B-	D	P: No impact is expected.
					C: The project involves construction of new small bridges. Silt-trap will be used to avoid construction materials such as cement and sand being washed out during construction work.
					O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
2.5	Soil Contamination	D	D	D	P: No impact is expected as no engineering activity will be carried out at this stage
					C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
					O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
2.6	Ground Subsidence	D	D	B+	P/C: No impact is expected as existing conditions will not be altered.
					O: The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
2.7	Noise/ Vibration	D	B-	B-	P: No impact is expected.
					C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
					O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
2.8	Sunshine Obstruction	D	D	D	P/C/O: No impact is expected.
2.9	Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected.
					C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
					O: Waste will be generated from road users and workers of maintenance works.
Social Environment					
3.1	Involuntary Resettlement	A-	D	D	P: The project will result in large-scale involuntary resettlement at villages along the road. Minimizing the resettlement should be the priority for road design.
					C: Resettlement will be completed before construction begins and thus no resettlement is expected during operation
					O: No impact is expected as relocation is completed before relocation.
3.2	Land Use	A-	A-	D	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.
					C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
					No impact is expected as sufficient slope protection/stabilization measures to protect land use.
3.3	Utilization of Local Resources	D	A-	D	P: No impact is expected.
					C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.
					O: No impact is expected as use of local resources is not expected during operation.
3.4	General, Regional /City Plans	D	D	D	P: No impact is expected.
					C: No impact is expected.
					O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
3.5	Social Institutions and Local Decision-making Institutions	D	D	D	P/C/O: No impact is expected as there will be no change in social institutions and local decision-making institutions such as village councils and women groups
3.6	Social Infrastructure and Services	A-	A-	B+	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
					C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
					O: The project is expected to improve access to social infrastructure and services by providing better road network.
3.7	Local Economy and Livelihood	A-	A-	B+	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
					C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
					O: The project will have positive impact on local economy as improved road network ensures more stable supply of essential goods. In the long-term, this will lead to regional economic development with more job and business opportunities. Meanwhile, it is suggested that a proposal will be made to Village/District Council to ensure that improved infrastructure network will not lead to uncontrolled development and deforestation.
3.8	Unequal Distribution of Benefit and Damage	A-	A-	D	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.
					C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage.
					O: No impact is expected as the project is an improvement of an existing road and the road will continue as before to accrue benefits to those along the road.
3.9	Local Conflicts of Interest	D	D	D	P/C/O: No impact is expected as the project is an improvement of an existing road and structures/services will be equally restored
3.10	Water Usage, Water Rights and Communal Rights	D	D	D	P/C/O: No impact is expected as rain water is used for both household and agricultural use
3.11	Cultural and Historical Heritage	C-	D	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage.
					C/O: No impact is expected as the project will not affect cultural and historical heritages
3.12	Religious Facilities	A-	A-	D	P: Several memorial stones located along the road may be affected. Small religious facilities in built-up areas may also be affected.
					C: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
					O: No impact is expected as sufficient noise control measures will be implemented.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
3.13	Sensitive Facilities (ex. hospital, school, precision machine factory)	B-	B-	D	P: Small community facilities (public halls etc.) may have to be relocated incase road widening is implemented within the built-up area.
					C: Noise and vibration during construction work may affect school and hospitals but the impacts are expected to be minor.
					O: Greater traffic volume is expected to increase noise and vibration level, but adequate mitigation measures will be implemented.
3.14	Poor People	A-	A-	D	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures to be included in rehabilitation plan.
					C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
					P: No impact is expected. In the long-term, economic development in the region is likely to benefit the poor.
3.15	Ethnic Minorities/ Indigenous People	A-	A-	D	P/C: Aizawl-Tuipan section is inhabited by several different clans of Mizo people. Different groups tend to live together in relatively developed part of the section between Aizawl to Lunglei, but in Lawngtlai and Saiha district, Lai and Mara people occupy majority of the population respectively. Preparation of RAP and livelihood restoration plan, therefore, must take into account this factor.
					O: No impact is expected as the project is an improvement of an existing road and lifestyles of the project affected people will not be altered
3.16	Gender	D	C-	B+	P: No impact is expected.
					C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
					O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
3.17	Children's Rights	D	D	D	P: No impact is expected.
					C/O : Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
3.18	Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
					C: Influx of construction workers is likely to increase the health risk, particularly that of STD and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
					O: An increase in traffic volume and road users may have negative impact on public health.
3.19	Occupational Health and Safety (OHS)	D	B-	B-	P: No impact is expected.
					C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
					O: Maintenance and repair work should take into account the occupational health and safety of the workers.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
Others					
4.1	Accidents	D	B-	B+/ B-	P: No impact is expected as the project at this stage does not alter existing condition.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
					O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
4.2	GHG emissions	D	B-	B+/B -	P: No impact is expected.
					C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
					O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
Source: JICA Study Team

12.5.8 Anticipated Environmental Impact and Mitigation Measures

The proposed project will have both positive and negative impacts on the surrounding environment during different stages of the project planning and implementation. For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

Natural Environment

(1) Climate

Pre-Construction and Construction Phase

Since the proposed project is only widening and strengthening to 2 lane road, no change in the macroclimate i.e. precipitation, temperature and wind is envisaged. However, there will be localized, temporary impact due to vegetation removal and the creation of paved surface for road. There may be an increase in daytime temperature around alignment due to loss of vegetation. The impact will be more prominent at locations where the cutting of trees is in clusters.

Operation Phase

During operation phase, increased traffic plying will lead to increase in temperature levels locally along the carriageway though it will be insignificant and temporary.

(2) Topography and geology

Pre-Construction and Construction Phase

The change in topography (that of existing) is envisaged to some extent at various places along the entire length of the road while developing 2 lane standard. The change in topography will also happen due to operation of borrow areas. The construction of material handling yards and labor camps will also alter the existing topography temporarily.

Operation Phase

During the operation phase, there will be probable induced developments in the form of tourism and commercial establishments along the highway. During monsoon, the change in topography will also be visible due to landslide and damage to side slope and breast wall. The benefits in the form of land leveling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

Mitigation Measures

During construction phase, the existing vegetation including shrubs and grasses along the route (except within the strip directly under embankment or cutting) will be properly maintained. The borrow areas shall be operated and closed as per the specifications for road and bridge construction manual of MORTH. The borrow areas shall be filled with the rejected waste/material, spoil and then finally a layer of topsoil shall be spread over it before carrying out plantation and turfing.

During operation phase, maintenance of embankment will be carried out to avoid soil erosion. The slope protection/ retaining wall if damaged due to Landslide will be repaired promptly. The slope protection will also be established/strengthened regularly through plantation of shrubs and vegetation.

(3) Soil Erosion

Pre-Construction and Construction Phase

Site preparation will involve demolition of building, clearing of brushwood, tree removal and temporary re-routing of utilities. This brings risks of erosion to the exposed ground and topsoil. The soil erosion in construction stage may take place at the slope of the embankments, construction sites of cross drainage structures, at borrow areas and at construction sites which will be cleared.

Operation Phase

The soil erosion in operation stage may take place during operation at side slopes of road and near the approaches to bridges and interchanges. The risk is higher during monsoon.

Mitigation Measures

To control roadside soil erosion, turfing with grasses and shrubs will be carried out in accordance with the recommended practice in IRC guidelines. At the locations of steep slopes near crossings of highway with major rivers suitable protection measures such as stone pitching will be adopted. The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent erosion control measures to prevent soil erosion that will adversely affect construction operations, damage adjacent properties or cause contamination of nearby streams or other watercourses, village ponds or water bodies etc. The green belt will be developed simultaneously along with construction activities to control the erosion process. In addition, gabion and apron concrete will be installed at the outlet of culverts to avoid soil erosion due to water runoff.

During the operation phase, the slope protection measures like sodding, turfing shall be done and monitored regularly. The green belt will be monitored and replantation for the loss of plants species will be done immediately. The side ditch on road is designed as concrete lined ditch for all section of cut side to prevent damage from water runoff.

(4) Hydrology

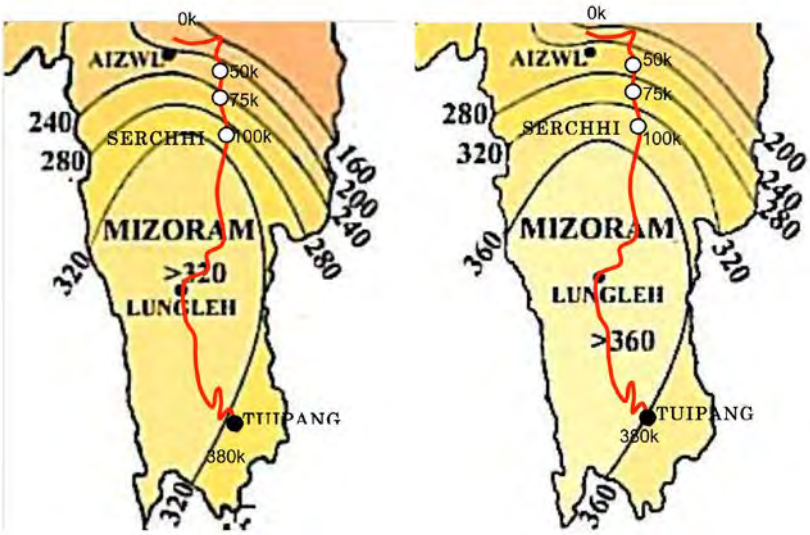
The hydrological study is conducted based on IRC:SP:13 “Guidelines for the design of small bridges and culverts” which is well used technical standard for hydrological study in Indian highway design.

The long-term rainfall intensity is modeled as shown below, which have informed the design of drainage and culverts.

Table 12.5-7 Rainfall Intensity for Each Section of NH54

From	To	25Years- 24hours Rainfall intensity (mm)	50Years- 24hours Rainfall intensity (mm)
Aizawl (SectionA.0 k)	Tlungvel (SectionA.50 k)	240 mm	280 mm
Tlungvel (SectionA.50 k)	Chhingchhip (SectionA.75k)	280 mm	320 mm
Chhingchhip (SectionA.75k)	Serchhip (SectionA.100 k)	320 mm	360 mm
Serchhip (SectionA.100 k)	Tuipang (SectionD. last)	360 mm	400 mm

Source: JICA Study Team



Source: ATLAS of Statewise Generalised ISOPLUVIAL (Return Period) Maps of Eastern India (Part – II)

Figure 12.5-7 Detailed isopluvial map with project location for NH54 for 25 Years (L) and 50 Years (R)

Pre-Construction and Construction Phase

Potential impact on hydrology will be minor, as the project does not involve diversion or re-routing of existing water resources. However, the existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

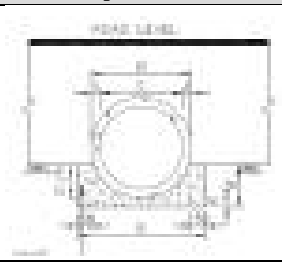
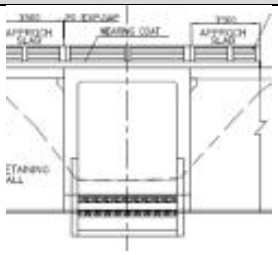
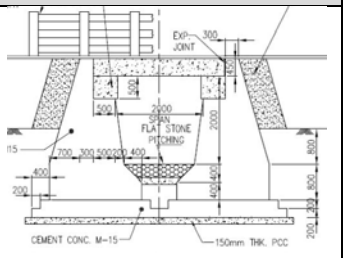
Operation Phase

The projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies.

Mitigation Measures

The new drainage system is designed by based on hydrological calculation result. Based on obtained location of water crossing and water discharge, dimension and locations for drainage system are determined. For cross drainage structure, appropriate culvert type is selected by taking account of economy, construction workability, and maintenance ability. Comparison of different culvert types is shown below. In principle, pipe culvert is used where the water discharge is comparably small. BOX culvert is proposed where the water discharge is comparable large. The size is determined to satisfy the water discharge obtained by hydrological calculation.

Table 12.5-8 Comparison of Culver Type

	Pipe culvert	BOX culvert	Slab culvert
Layout			
Economy	◎	○	△
East of Construction	◎	○	△
Durability	○	○	△
Capacity	○	◎	◎
Comment	To be applied for small discharge point	To be applied for large discharge point	Not applied

Source: JICA Study Team

(5) Groundwater

No tunnel is proposed in this project and as such, the project will not affect groundwater level or quality in the area. If contractor propose to use water from under surface water source, however, permission from the Water Resource Department and Local Administration is mandatory. The contractor is expected to properly manage effluents and waste water during the construction stage to avoid potential influence to the groundwater.

(6) Ecosystem, Flora, Fauna and Biodiversity

Mizoram is the highest forest cover state in the India, having about 90 % of the total geographical area is under forest (India State Forest Report FSI, 2013). Mizoram is a hilly region receiving heavy rainfall with soil characteristics conducive for luxuriant growth. Flora and fauna assessment were carried out for all the five districts that the targeted section of NH54 passes through. Floral/Vegetation assessment carried out through quadrate methods; for trees 10 m x 10 m, for shrubs 5 m x 5 m and for Herbs 1 m x 1 m square shaped quadrates were used. Quadrates were laid randomly in the corridors upside and downside of the road. All species in the quadrates were recorded & ecological parameters such as density and frequency were calculated. Faunal species were recorded with the visual observation during site visits, secondary data from the forest department and local information from peoples. While impacts on river and river ecosystem are expected to be negligible, aquatic ecosystem of Turial River and Mat River – two major rivers that NH54 passes through – has been studies based on a review of literature.

Being part of India-Burma biodiversity hotspot, Mizoram is known for its rich biodiversity. Meanwhile, no pristine ecosystem remains in the areas along NH54, the main road network of the State, due to human activities. As such, there are significant differences in the level of biodiversity and richness of flora/faunal community between in the area the proximity of NH54 and in Natural Park and Protected Areas of the State. The main impact on flora involves the removal of trees and grubbing of vegetative cover for construction and a clear zone within the Right of Way (ROW) and for spoil bank. Widening of the 1-lane to 2 lanes would have negative impact on plant species by way of cutting the trees and shrubs for construction activities. The types of impacts on flora can be as follows:

- Loss of trees;
- Loss of canopies;
- Compaction of vegetation, and
- Pollution and dust accumulation on vegetation.

Floral/Vegetation assessment has been carried out through quadrate methods; for trees 10 m x 10 m, for shrubs 5mx5m and for Herbs 1m x1m square shaped quadrats were used. Quadrates were laid randomly

in the corridors upside and downside of the road. All species in the quadrats were recorded & ecological parameters such as density and frequency were calculated. Faunal species were recorded with the visual observation during site visits, secondary data from the forest department and local information from peoples. There is no unique faunal community within the project area, except most common ones discussed earlier. No endangered or threatened fauna species were reported in the area close to the project highway.

Mitigation Measures

In the process of finalizing ROW, efforts to minimize the scale of forest clearing and impacts associated with construction activity shall be made. Also, it is essential that all locally procured construction materials will be procured in certified sites where operation is authorized. The contractor shall review/renew relevant permit as necessary and fully cooperate with inspection by relevant authority.

During the construction stage, signboards will be used to make sure that workers will be aware of the vulnerable and other important species. Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with State Environment and Forest Department with which the project authority will discuss potential measures to promote conservation and monitoring of ecosystem shall be carried out as was undertaken during the EIA study.

The tree plantation felled will be replaced and compensated according to the Compensatory Afforestation Policy under the Forest Conservation Act, 1980. Apart from trees earmarked for feeling, no additional tree clearing within the ROW will be allowed. All construction workers should adhere to this rule.

Plantation of shrubs and under trees in the median shall be undertaken to prevent the glare of the vehicles coming in the opposite direction. Construction vehicles, machinery and equipment will move or be stationed in the (ROW) to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil will be avoided.

Construction of road will involve removal of topsoil and cutting resulting in clearing of vegetation cover and felling of trees. However such impacts will primarily occur at the project site during initial period of the construction phase and will be minimized through adoption of mitigation measures. It is recommended that the lost trees will be compensated at 1:3 ratio. The site of compensatory afforestation will be specified by the Forest Department during the process of obtaining forest clearance. As per its guidance, the project proponent will plant saplings (types and number to be specified) at designated location (either degraded forest or vacant/abandoned jhum area).

Following measure will be taken during construction phase.

- It is suggested that regular monitoring by the forest department should be done. In keeping view of likely increase in vehicular emissions in the future, the monitoring should include the assessment of impact due to greater air pollution;
- A suitable landscaping plan for the project road has been prepared to enhance the ecological status of the area;
- It was noticed, that the project road did not have tree cover at few locations (Jhum lands) tree plantation at these location will enhance the aesthetics as well as reduce the pollution level of the area; and
- Initiative should be taken to remove the impacted small girth size trees with the help of Forest Department and replanted them at designed place. Though cost involvement against this type of work can be high, it will save the life of growing plants.

(7) Protected Areas/Forest

Pre-Construction and Construction Phase

The project road does not traverse or border with national park, wildlife sanctuary or reserved forest. As discussed above, however, the project will cause deforestation due to removal of trees and grubbing

of vegetative cover for construction and a clear zone within ROW. Based on the field survey and satellite data, forest area accounts about 60% of the area to be acquired (or 375 ha out of 625 ha).

Operation Phase

Increases in traffic volume are likely to have negative impact on forest ecosystem.

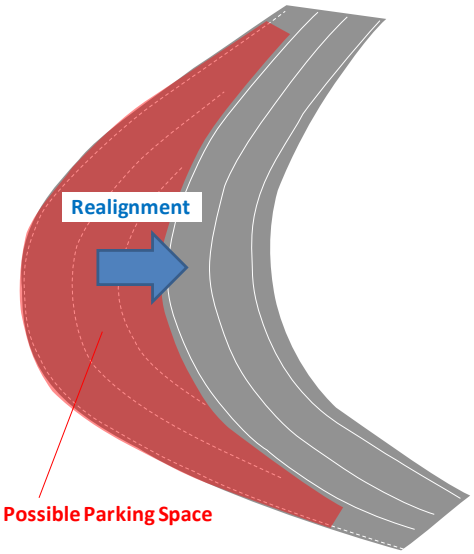
Mitigation Measures

At the planning stage, efforts to avoid or minimize the number of trees to be cut have been done as part of the design for widening of the road. There will also be measures including replanting the trees at suitable location during the construction stage. Further the plantation at the Jhum lands can also be taken up as a part of plantation program for the loss of tress.

During the operation stage, monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary. All data related to increased traffic volume and emissions shall be shared with relevant state authorities. In addition, improved road network may trigger poaching. At the moment, educational activities and removal of traps by rangers are undertaken to reduce poaching. While NHIDCL is not responsible for the control of poaching, a proposal shall be made to relevant authority regarding the potential increase in poaching and the necessity of adequate management system, such as restriction of precious wildlife trade.

(8) Landscape

For sites where good view can attract tourists, parking spaces/viewpoints can be developed utilizing flat spaces which are produced by improvement of the horizontal alignment to be made especially in sharp curves as illustrated in below Figure. In the preliminary design, about twenty such locations can be developed along NH54.



Source: JICA Study Team

Figure 12.5-8 Concept for Parking Site/Viewpoints Development

In addition, road and traffic markings to be installed in accordance with IRC:35-1997 will ensure smooth and orderly flow of traffic and contributes to better aesthetic condition of the road by reducing congestion. Buses standing indiscriminately on the carriageway to drop or pick-up passengers can seriously affect capacity of the roadway, besides being a source of accidents. It is, therefore, desirable that on all busy non-urban highways, consideration should be given to the construction of bus lay-byes of suitable design at required locations to ensure orderly movement of the through traffic. For

convenience of tourists, it is also proposed that bus bay will be equipped with amenities including public toilets and bazar shed.

At the moment, no regular garbage collection is carried out outside the village. Educational activities or awareness raising campaign shall be carried out to reduce littering and promote garbage collection in partnership with State Urban Development & Poverty Reduction Department (UDPA), villages near such facilities and NGOs active in this field.

Table 12.5-9 Proposed Bus Bay Locations for NH54

No.	Section	Location	Distance from Aizawl (km)	Section Length (km)	No.	Section	Location	Distance from Aizawl (km)	Section Length (km)
1	1	Aizawl	-		22	2	Dawn	206	16
2	1	Zemabawk	4	4	23	2	Zobawk	219	13
3	1	Tuirial	22	18	24	2	Hrangchalkawn	222	3
4	1	Seling	38	16	25	2	Bualte	231	9
5	1	Thingsulthliah	42	4	26	2	Thualthu	243	12
6	1	Darlawng	53	11	27	3	Tawipui N-II	251	8
7	1	Tlungvel	57	4	28	3	Tawipui N-I	256	5
8	1	Phulmawi	61	4	29	3	Tawipui S	264	8
9	1	Khumtung	63	2	30	3	Thingfal	277	13
10	1	Baktawng	67	4	31	3	Lawngtlai	292	15
11	1	Chhingchhip	77	10	32	3	Saikah	311	19
12	1	Chhiahtlang	97	20	33	3	Paithar	314	3
13	1	Serchhip	107	10	34	3	Chawitlangpui I	316	2
14	2	Keitum	122	15	35	3	Sihtlangpui	319	3
15	2	Bungtlang	130	8	36	3	Kawlchaw	324	5
16	2	Rawpui	135	5	37	3	Zero Point	337	13
17	2	Pangzawl	148	13	38	3	Maubawk	354	17
18	2	Thiltlang	158	10	39	3	Theiva	355	1
19	2	Hnahthial	169	11	40	3	Theiri	363	8
20	2	Leite	182	13	41	3	Tuipang	379	16
21	2	Maudarh	190	8					

Source: JICA Study Team

(9) Natural Disaster

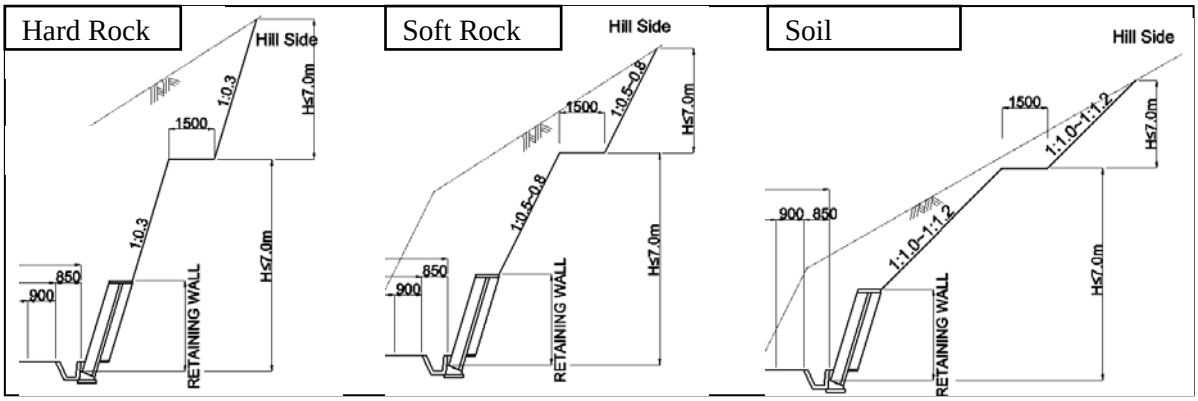
Slope along NH54 is covered by very loose quaternary alluvium. It is concerned that slope failure and erosion have frequently occurred on cut slope along NH54. Therefore, such loose soil slope shall be cut with 1:1.2 gentler than IRC standard for landslide prevention as shown below. The cut slope shall be greened by seeding and mulching consisting of jute netting including seeds which cover all over the slope and prevent erosion by rain water.

Table 12.5-10 Design Criteria of Cut Slope and Slope Protection Work

IRC Standard*		JICA Study Team Rock/Soil Classification			Cut Grade	Slope Protection Work
Classification	Cut Grade					
Hard Rock	80 ~ 90 degree	Rock	Very Hard		1:0.2	No protection work
			Hard	No Risk	1:0.3	No protection work
				Landslide Risk		Crib work
Ordinary Soft Rock	1:0.25 ~ 1:0.125		Soft	Non-Dip Slope	1:0.5	No protection work
				Dip Slope	1:0.8	Hydroseeding (t=5 cm)
Ordinary Soil/ Heavy Soil	1:1.0 ~ 1:0.5	Soil	Dense Soil		1:1.0	Seeding and Mulching
			Loose Soil		1:1.2	Seeding and Mulching

*IRC: SP:48:1948 Clause 7.4

Source: JICA Study Team



Source: JICA Study Team

Figure 12.5-9 Typical Cross Section of Cut Slope

Frequency and intensity of heavy rain is likely to increase due to climate change. In the project area, an increase of annual rainfall is predicted to be 5-15% for the period from 2021 to 2050. The design of various components of the road (slope protection, drainage etc.) takes into account likely effect of climate change. With increase of the rainfall frequency and intensity, river water and groundwater level are expected to be high, which could cause inundation and damage to the road facilities. Therefore, spring water points have been carefully studied and subsurface drainage is proposed where necessary. Flood marker was checked in site reconnaissance and interview survey for the disaster countermeasure design to inform the road design. The table below shows adaptation measures for climate change taken into consideration in this road design.

Table 12.5-11 Adaption Measures for Climate Change in NH54

Factor	Design Policy considering Adaptation
Side Slope	· Retaining wall is built all along the road. · Slope protection work is constructed on some weathered and loosen slopes. · Cut slope is covered with vegetation works to prevent erosion and collapse. · Replacement of subgrade and subsurface drainage are planned as countermeasure against sinking.
Embankment	· Drain filter is sandwiched in embankment. · Flood level is confirmed in site reconnaissance and interview survey near river bank in south of NH54.
Bridge & Drainage System	· Rainfall intensity is carefully determined based on the authorized data : ATLAS of Statewise Generalised ISOPLUVIAL MAPs of Eastern India published by Indian Meteorological Department. The isopluvial value from higher edge of counter range is applied. · The capacity of all structures is determined to be capable for the discharge of 50 years return period.
Pavement	· Super elevation is installed properly. · Pavement material is examined not to rise over 60 °C on the surface.
Road Sign	· Wind load and visibility is taken into consideration.

Source: JICA Study Team

Living Environment

(1) Air Pollution

Being on hill, towns and villages along NH54 generally have good ambient air quality. The project road alignment also has no polluting industry along it. There is congestion due to traffic in major the built up. This leads to vehicular exhaust emissions and deterioration for which the proposed widening will have positive impact.

During the preparation of Detailed Project Report (DPR) by Indian Consultants, ambient air sampling was carried out in eight locations along the project road in February 2011. The monitoring data for dry

season shows that all parameters are under the threshold by CPCB/MOEF. Additional monitoring for pre-monsoon season has been carried out in April 2015 to establish base line ambient air quality in the project area and surroundings. Monitoring was carried out along the project corridor at 15 locations at a frequency of twice in a month, adopting a continuous 24-hours schedule in the month of April 2015 as per guidelines of Central Pollution Control Board and MOEF requirements. The locations of ambient air quality monitoring are shown below.

Table 12.5-12 Locations Ambient Air Quality Monitoring

Station Code	Location	GPS
AAQ1	Puspak Junction	$23^0$44'23"N $92^0$44'30"E
AAQ2	Tuirial Village	$23^0$43'08"N $92^0$47'56"E
AAQ3	Tiungvel Village	$23^0$36'22"N $92^0$51'14"E
AQ 4	Baktawng	$23^0$32'11"N $92^0$50'57"E
AAQ 5	Chhiahtlang	$23^0$22'39"N $92^0$50'35"E
AAQ 6	Serchhip	$23^0$19'57"N $92^0$51'17"E
AAQ 7	Keitum	$23^0$13'55"N $92^0$54'40"E
AAQ 8	Rawpui	$23^0$08'44"N $92^0$53'52"E
AAQ 9	Thiltlang	$23^0$01'14"N $92^0$55'16"E
AAQ 10	Leite	$23^0$54'06"N $92^0$54'41"E
AAQ 11	S. Tawipui	$22^0$40'22"N $92^0$50'43"E
AAQ 12	Thingfal	$22^0$37'08"N $92^0$50'20"E
AAQ 13	Lawngtlai	$22^0$31'33"N $92^0$53'47"E
AAQ 14	Kawlchaw E	$22^0$24'01"N $92^0$57'28"E
AAQ 15	Zero Point	$22^0$27'48"N $92^0$57'27"E

Source: JICA Study Team

The air quality in the project area is less polluted. The AAQ of the project area is given below. The survey results indicate that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards except the particulate matter PM_{10} at Puspak Junction where the figure is slightly higher than permissible limit i.e.118 to 120µg/m^3. The maximum concentration of $PM_{2.5}$ is 52.00µg/m^3 at Puspak Junction while the minimum concentration is 20.80 µg/m^3 at Thingfal. The maximum concentration of SO_2 is 7.30 µg/m^3 recorded at Puspak Junction while minimum concentration is recorded < 4.0 µg/m^3 at various locations. The maximum & minimum concentration of NO_X is 30 µg/m^3& 8.50 µg/m^3 at Puspak Junction and Leite respectively. CO concentration is found to be well below the permissible limit.

Table 12.5-13 Results of Ambient Air Quality Monitoring

Station Code	Date of Monitoring	Parameters (µg/m^3) & Test Method				
		$PM_{2.5}$	PM_{10}	SO_2	NO_X	CO
		Gravimetric Method	Gravimetric Method	Improved West &Gaeke Method	Jacob &Hochheiser Modified Method	NDIR Spectroscopy Method
AQ1	15.04.15 to 16.04.15	52.00	120.50	7.30	30.00	0.6
	22.04.15 to 23.04.15	48.50	118.50	6.80	28.50	0.45
AQ2	15.04.15 to 16.04.15	32.50	65.20	<4.0	15.00	<100
	22.04.15 to 23.04.15	30.00	65.20	<4.0	12.50	<100
AQ3	16.04.15 to 17.04.15	35.00	72.50	<4.0	12.50	<100
	21.04.15 to 22.04.15	31.50	68.10	<4.0	10.00	<100
AQ4	16.04.15 to 17.04.15	38.50	72.50	<4.0	16.50	<100
	21.04.15 to 22.04.15	32.80	68.20	<4.0	15.00	<100
AQ5	17.04.15 to 18.04.15	32.50	72.50	<4.0	15.00	<100
	20.04.15 to 21.04.15	28.50	68.20	<4.0	12.50	<100
AQ6	17.04.15 to 18.04.15	36.80	80.10	5.30	20.10	0.3
	20.04.15 to 21.04.15	32.10	72.50	4.50	15.00	0.2
AQ7	18.04.15 to 19.04.15	28.10	62.10	<4.0	12.50	<100
	19.04.15 to 20.04.15	24.50	58.10	<4.0	10.00	<100
AQ8	18.04.15 to 19.04.15	28.50	58.20	<4.0	12.50	<100
	19.04.15 to 20.04.15	21.50	52.80	<4.0	9.50	<100
AQ9	24.04.15 to 25.04.15	31.50	72.50	<4.0	15.00	<100
	30.04.15 to 01.05.15	28.50	65.20	<4.0	11.50	<100
AQ10	24.04.15 to 25.04.15	23.50	56.20	<4.0	10.00	<100
	30.04.15 to 01.05.15	22.80	51.80	<4.0	8.50	<100
AQ11	25.04.15 to 26.04.15	28.50	56.20	<4.0	12.50	<100
	29.04.15 to 30.04.15	21.80	51.80	<4.0	10.00	<100
AQ12	15.04.15 to 16.04.15	25.10	68.50	<4.0	11.50	<100
	22.04.15 to 23.04.15	20.80	61.40	<4.0	8.50	<100
AQ13	15.04.15 to 16.04.15	36.50	86.50	5.10	20.10	0.35
	22.04.15 to	32.80	76.20	4.50	15.00	0.2

Station Code	Date of Monitoring	Parameters (µg/m^3) & Test Method				
		$PM_{2.5}$	PM_{10}	SO_2	NO_X	CO
		Gravimetric Method	Gravimetric Method	Improved West &Gaeke Method	Jacob &Hochheiser Modified Method	NDIR Spectroscopy Method
	23.04.15					
AQ14	15.04.15 to 16.04.15	23.50	52.80	<4.0	11.50	<100
	22.04.15 to 23.04.15	20.10	56.10	<4.0	9.50	<100
AQ15	15.04.15 to 16.04.15	31.20	81.20	4.80	18.50	0.3
	22.04.15 to 23.04.15	28.50	76.50	4.50	16.50	0.25
24 Hourly National Ambient Air Quality (NAAQ) Standards & CO (8 Hourly)		60	100	80	80	2000

Source: JICA Study Team

Pre-Construction and Construction Phase

The short-term and localized degradation of air quality will occur from dust generation due to procurement and transport of raw materials from quarries and borrow pits, site clearance, use of heavy vehicles, machinery/ equipment, stone crushing handling and storage of aggregates and generation of fine particulate matter (smoke) in asphalt processing. Dust would be generated from haulage of materials and detouring of traffic on non-permanent, temporary pavement etc.

Hot mix plants contribute substantially to the deterioration of air quality due to emissions of oxides of Sulphur, Hydrocarbons and particulate matter. During the construction period, temporary impacts include generation of Odor from construction activities as well as from construction camps. During construction of road, the movement of different types of construction machinery and vehicle will be increased. This in other way increases the fuel consumption.

From the results of the ambient air quality monitoring conducted along the road, it is noticed that the monitoring parameters are within the standards as prescribed by the Central Pollution Control Board The concentration of the air pollutants will further increase during construction period but for limited period only. The impacts on air quality during construction will be mostly localized and concentrated within the ROW. The impacts due to dust generation may felt downwind of the site rather than the site itself due to local wind pattern.

Operation Phase

The project road is mostly passing through the rural areas with alluvial soil. Dust generation due to movement of vehicles is envisaged along the project road, but not in significant amount. Due to increase in speed and volumes of vehicular traffic on the project corridor, marginal increase in the air pollutant levels is expected but not significant. Widening of road will attract larger community to use this corridor which in-turn increase the fuel consumption and has direct impact on national economy and local ecosystem.

Mitigation Measures

The hot mix plants, crushers and the batching plants will be sited at least 500 m in the downwind direction from the nearest settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers and batching plants will be taken up. The hot mix plant will be fitted with dust extraction system. Asphalt and concrete plants will be operated in conformity with government pollution control legislation, and located away from the settlements as far as possible. All vehicles,

equipment and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. Regular monitoring of particulate Matter at crusher sites, during the construction, will be conducted. Regular water sprinkling will be done on the cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork, water will be sprayed to prevent dust emission. The vehicles delivering construction material will be covered to avoid spilling. Planting of trees/vegetation on the periphery of the construction site will be taken up.

During the operation stage of the project, vehicular emissions of critical pollutants (RSPM, CO, HC, SO_2, and NO_x) will be monitored and roadside tree plantation will be maintained. Over the long-term, projected increase in traffic volume, particularly ones of heavy trucks, may pose health threat in roadside community. The peak hourly estimated traffic volumes for the years 2020 and 2035 have been considered to project future air quality scenarios to provide an indication of long-term variations in air quality. The future level of air pollution, modeled based on the projected increase in traffic volume indicates that the level of pollution (CO and NOx levels) will remain below the standard during the projected period (2035). Nevertheless, mitigation measures such as introducing speed limit and other measures to control congestion in built-up area may be necessary in the longer term. Also, local communities should be well informed of the risk of air pollution. Awareness raising campaign may include distribution of facemask to mitigate risk of air pollution and other information kit.

(2) Water Pollution

The project road traverses through mountainous and steep terrains with several natural drainages such as deep gorges, depressions, etc., where perennial water and rainwater runoff are collected. River Tuirial, Tuichang, Mat, ChimTui Pui and tributaries are located within the study area. Besides, there are many nullahs and stream crossing the project road and many ponds are available near the project road.

Pre-monsoon water quality of the project corridor has been analyzed by collecting water samples along the Project road between April and May in 2015. Meanwhile, the monitoring survey for dry season (winter) was carried out in February 2011 during DPR preparation. In both seasons, parameter such as Iron, Total Coliform Organisms and Faecal Coliform Organisms are beyond permissible limits of Drinking water Standards (IS: 10500) and thus it is not fit for drinking purpose. The surface water quality monitoring location and the analysis results are shown below.

Table 12.5-14 Surface Water Quality

Parameters	Tuirial river	Tuichang river (Near Keitum village	Mat river (Near Leite village)	ChimTuiPui river (Kalchaw E)	Limits IS: 10500
pH	6.78	6.82	7.17	6.68	6.6 to 8.5
Color (Hazen unit)	1	1	1	1	-
Suspended Solid (mg/l)	11	12	<10	18	-
DO	5.4	5.6	5.6	5.2	-
BOD (mg/l)	23	20	18	25	-
COD (mg/l)	87.48	68.04	68.04	87.48	-
Total Kjeldahl Nitrogen (mg/l)	6.5	4.5	5.5	7.5	-
Total Hardness (mg/l)	40	30	20	30	300
Calcium (mg/l)	8.42	6.41	4.41	7.21	75
Magnesium (mg/l)	4.56	3.36	2.16	2.88	30
Ammonia (mg/l)	2.5	1.8	2	2.8	-
Electric Conductivity	277.7	154.3	107	169.6	-
Chloride (mg/l)	16.97	11.32	11.32	10.37	250
Sulphate (mg/l)	39	5	6	17.5	200
Phosphate (mg/l)	0.8	0.7	0.75	0.9	-
Nitrate (mg/l)	4.8	3.5	5.2	3	45

Parameters	Tuirial river	Tuichang river (Near Keitum village	Mat river (Near Leite village)	ChimTuiPui river (Kalchaw E)	Limits IS: 10500
Fluoride (mg/l)	<0.1	<0.1	<0.1	<0.1	1
Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	0.05
Lead (mg/l)	<0.088	<0.088	<0.088	<0.088	-
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	0.05
Phenols (mg/l)	<0.001	<0.001	<0.001	<0.001	-
Cyanides (mg/l)	<0.05	<0.05	<0.05	<0.05	-
Total Dissolved solid (mg/l)	178	99	69	109	500
Iron (mg/l)	0.49	0.31	0.36	4.34	0.3
Total Coliform / 100 ml	1.6×10^3	1.2×10^3	1.5×10^3	1.8×10^3	
Faecal Coliform/ 100 ml	5.1×10^2	4.3×10^2	4.8×10^2	6.2×10^2	

Note: <1 indicate No Colony developed in 1 ml. Sample
<10 indicate No Colony developed in 0.1 ml. Sample
<100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

Ground water has been found to be an important source for catering to the local needs of water consumption for various purposes, mainly domestic. Therefore, any kind of deterioration in the quality of ground water owing to the developmental activities will pose threat to the concerned population and attention needs to be paid towards maintaining the quality of water using all possible tools such as monitoring with spontaneous remedial suggestions, if required. Keeping in view the importance of ground water to the local population, monitoring of ground water quality was carried out in five villages along NH54 as shown inTable 12.5-15.

Analysis of groundwater samples shows that the water is alkaline in nature (pH <8). The total dissolved solids (TDS) in five locations are below the permissible limit (500 mg/l). Chloride concentration is well below the desirable limit (250 mg/l) in all locations. This is also the case for ground water monitoring during the dry season, undertaken in DPR preparation stage. Sulphate and Nitrate concentrations are low and within the permissible limit and thus indicate low degree of organic pollution. Amongst the cations, Calcium (Ca) and Magnesium (Mg) are below the permissible limit (200 mg/l). Concentration of iron is above the desirable limit of 0.3 ml/l in all samples. Groundwater in general is soft in the area and the Hardness is below the permissible limit of 600 mg/l. Groundwater samples are free from heavy metals like cadmium, arsenic, lead, chromium etc. Bacterial quality of groundwater shows all samples are free form faecal coliform and total coliform and hence the water samples are suitable for human consumption after treatment process.

Table 12.5-15 Ground Water Quality

Parameters	Tuirel village	Keitum village	Thiltlang village	Leite village	Lawngtlai village	Desirable Limit as per BIS 10500	Permissible limit as per BIS 10500 in absence of alternate source
pH	7.02	6.25	6.69	7.34	6	6.5-8.5	No Relaxation
Color (Hazen unit)	1	1	1	1	1	-	-
Odor	Odorless	Odorless	Odorless	Odorless	Odorless	-	-
Electric Conductivity	510.9	170	461	503.1	213.3	-	-
Total Dissolved solid (mg/l)	327	109	295	322	250	500	2000
Bicarbonate (mg/l)	59.78	30.5	51.24	74.42	80	-	-
Total Hardness (mg/l)	45	40	50	60	50	300	600
Calcium (mg/l)	10.02	8.82	11.2	14.03	11.62	-	-
Magnesium (mg/l)	4.8	4.32	5.28	6	5.04	30	100
Chloride (mg/l)	14.14	16.97	17.92	10.37	15.08	250	1000
Sulphate (mg/l)	4.5	5.5	5.5	10	19.5	200	400
Phosphate (mg/l)	0.6	0.8	0.86	0.5	0.8	-	-
Nitrate (mg/l)	4.5	3.8	4	3.5	4	45	100
Fluoride (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	1.0	1.50
Arsenic (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Lead (mg/l)	<0.088	<0.088	<0.088	<0.088	<0.088	0.05	No relaxation
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	-	-
Phenols (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
Cyanides (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Iron (mg/l)	7.4	9.74	1.56	4.05	13.82	0.30	1.00
Total Colirom / 100 ml	<100	<100	<100	<100	<100	-	-
Faecal Coliform/ 100 ml	<100	<100	<100	<100	<100	-	-

Note: <100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

In addition to surface water and ground water monitoring, the water samples from three community water tanks have been collected. As shown below, the results indicates that water quality of community water tanks is good and suitable for human consumption.

Table 12.5-16 Water Quality of Community Water Tank

Parameters	Serchhip	Tawpui village	Zero point	Standard (IS10500)
pH	7.49	7.47	7.38	6.5-8.5
Color (Hazen unit)	1	1	1	5
Odor	Odorless	Odorless	Odorless	Unobjectionable
Electric Conductivity	170.9	408.5	173.6	
Total Dissolved solid (mg/l)	110	262	111	500
Bicarbonate (mg/l)	29.28	50.02	29.28	
Total Hardness (mg/l)	20	30	20	300
Calcium (mg/l)	4.81	7.21	4.01	75
Magnesium (mg/l)	1.92	2.88	2.4	30
Chloride (mg/l)	7.54	7.54	12.26	250
Sulphate (mg/l)	6	30	6.5	150
Phosphate (mg/l)	0.81	0.68	0.86	
Nitrate (mg/l)	1.5	2.8	1.5	45
Fluoride (mg/l)	<0.1	<0.1	<0.1	0.6-1.2
Arsenic (mg/l)	<0.01	<0.01	<0.01	0.05
Lead (mg/l)	<0.088	<0.088	<0.088	0.1
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	0.001
Phenols (mg/l)	<0.001	<0.001	<0.001	0.001
Cyanides (mg/l)	<0.05	<0.05	<0.05	0.05
Iron (mg/l)	0.06	0.15	0.21	0.3
Total Colirom / 100 ml	<100	<100	<100	Must not be detected
Faecal Coliform/ 100 ml	<100	<100	<100	Must not be detected

Note: <100 indicate No Colony developed in 0.01 ml. Sample
Source: JICA Study Team

Pre-Construction and Construction Phase

There are 4 major rivers and numerous streams that cross the NH54 highway alignment under consideration. Road projects may marginally lead to increased run-off during construction stages, which will increase sediment accumulation in nearby water bodies. Though most of the natural watercourses are perennial in nature, the impacts due to the increased run-off would be negligible due to the project road. During construction, the disposal of solid and liquid waste from labor camps, fuel and lubricant spills or leaks from construction vehicles, pollution from fuel storage and distribution sites and that from hot-mix plants is likely to affect water quality unless adequate mitigation measures are designed. The existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, change in natural drainage pattern is very insignificant from the present state of the project.

Use of water for construction activities such as compaction, suppression, concrete work may pose pressure on local water supplies; the demand would be met from surface water bodies like ponds, canal and rivers. Municipal water supply will be used only for drinking purposes (for construction camps), if available and if permitted by the local municipal authority. No local/municipal water supply would be used for construction purpose.

Operation Stage Impacts

Road projects may marginally lead to increased run-off during operational stages due to increase in impervious surface and sediment will be accumulation in nearby water bodies. Though most of the natural watercourses are non-perennial in nature, the impacts due to the increased run-off would be negligible due to the project road and will be restricted only during monsoon and early part of post-monsoon seasons.

In the operation stage, pollutants from vehicles, and accidental fuel spills may make their way into the receiving environment. The major pollutants of concern are suspended solids, oil and grease, lead etc. All the rivers present at this road section are non-perennial surface water bodies. No adverse direct impact on the water quality (both underground and surface water bodies) is expected during the operation period. The change in natural drainage pattern is very insignificant from the present state of the project.

Mitigation Measures

To avoid contamination of the various water bodies and drainage channels, construction work close to the canals or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per the State Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to approve disposal sites.

To avoid contamination of the water body and drainage channels from fuel and lubricants, the vehicles and equipment will be properly maintained and re-fuelled only at designated places. The slopes of embankment leading to water bodies will be modified and re-canalized so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water.

Discharge of oil and grease is most likely from construction vehicle parking area, vehicle repair area and workshops. An oil interceptor shall be provided to ensure that all wastewater flows into the interceptor prior to its discharge. The device has a chamber for separation of oil and water and can handle 200 L/hour of wastewater. The oil float appearing on the surface is removed by periodic cleaning once a week by skimming off the oil film from the surface.

The sewage system (including septic tanks and soak pits) for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse. The workplace will have proper medical approval by local medical, health or municipal authorities. The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Due to the non-availability of water required for construction, if a new tube-well is to be bored, prior sanction and approval by the Central Ground Water Board (CGWB) will be obtained. Wastage of water during the construction will be minimized.

In most cases, effluents from existing public toilet along NH54 are discharged without any treatment. For new public toiles to be constructed in bus bays/viewpoints or replacement of existing toilets that will be affected by the road widening, septic tack or toilet with an opening for collecting night soil will be installed to reduce negative impacts.

(3) Bottom Sediment Contamination

It is proposed that three existing bridge with poor conditions to be replaced with the new ones. During engineering work of the bridges over the rivers, sediment pollution may occur. As one of the mitigation measures, silt fencing will be provided to restrict runoff into the water during construction phase.

(4) Soil Contamination

Pre-Construction and Construction Phase

The contamination of soil during construction stage is primarily due to construction and allied activities. The soil contamination may take place due to solid waste from the labor camps set- up during construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. The sites where construction vehicles are parked and serviced are likely to be contaminated

because of leakage or spillage of fuel and lubricants. The contamination of soils can also occur at the site of hot-mix plants from leakage or spillage of asphalt or bitumen. At the site of batching plants, because of spillage of cement, leakage of curing agents the soil contamination can occur. The contamination of soil may take place due to dumping of solid waste in unscientific manner, leaching of fuel/oil & grease from workshops, petrol stations and DG sets.

Operation Stage Impacts

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can belong term and irreversible depending upon the extent of spill.

Mitigation Measures

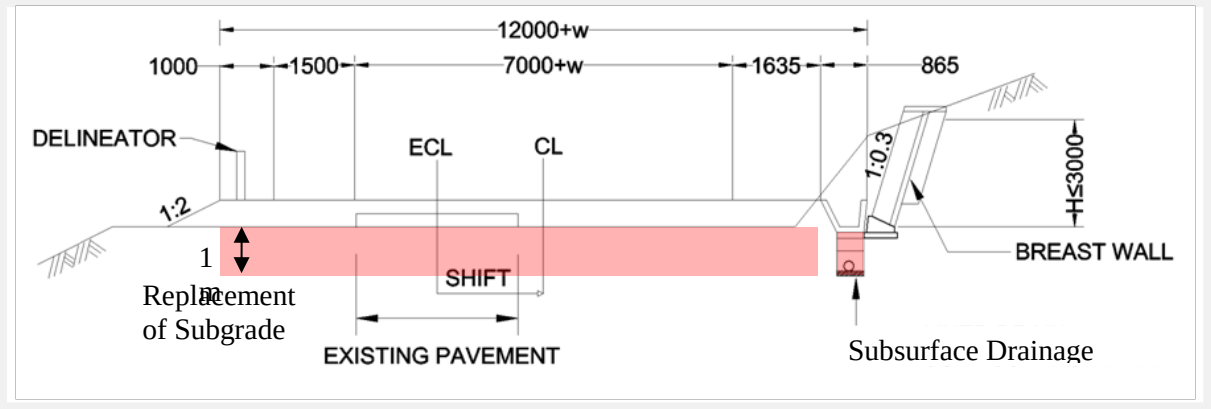
At construction yards, the vehicles/equipment will be maintained and re-fuelled in such a fashion that oil/diesel spillage does not occur and contaminate the surrounding soil. It will be ensured that the fuel storage and re-fuelling sites are kept away from drainage channels and important water bodies. At the washdown and re-fuelling areas, "Oil Water Separators" shall be provided. All spills and discarded petroleum products shall be disposed off in accordance to the Hazardous Waste Management and Handling Rules. Fuel storage and re-fuelling areas will be located at least 500 m from all water bodies near the road alignment. The fuel storage and re-fuelling areas shall not be located on agricultural lands or productive lands to avoid topsoil contamination. The earthwork will be carried out strictly in accordance with the design so that no excess earth is borrowed. The construction waste generated will be reused in the construction of highway.

Bituminous waste will be used after milling and in case bituminous waste is required to be disposed off it shall be disposed in secured way by providing 50 mm tick clay layer. The solid waste generated during construction phase which includes municipal waste both organic & inorganic in nature which shall be stored/treated/disposed off in accordance with Municipal Solid Waste (Management & Handling) Rules. The hazardous waste may include oil waste, biomedical waste, E-waste etc. This shall be disposed off in accordance with the Hazardous Waste (Management, Handling & Transboundary Movement) Rules, Biomedical Waste (Management and Handling) Rules and E-Waste (Management and Handling) Rules respectively.

In the operation stage, the petrol pumps & vehicle washing area located along the ROW will be monitored regularly for any spillages and corrective remedial measures like spread of sand, provision of oil & greases separators for passing wash water of petrol pumps & vehicle washing area before diverting it to water bodies shall be done regularly. The solid waste generated from the way side amenities will include Municipal Waste both organic and inorganic, hazardous waste (like used batteries), will be treated in accordance with Municipal Solid Waste (Management & Handling) Rule and Hazardous Waste (Management, Handling & Transboundary Movement) Rules.

(5) Ground subsidence

Many road subsidence sites have been identified in the slope inventory survey, which was assumed to occur due to consolidation of loosen subsurface soil and high groundwater level except for embankment sliding. Replacement of subgrade with 1.0 m thick and subsurface drainage is planned as countermeasures of sinking as shown in below Figure, which will significantly improve the existing condition.



Source: JICA Study Team

Figure 12.5-10 Typical Cross Section of Countermeasure for Sinking

(6) Noise and vibration

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. During DPR preparation, noise level monitoring was carried out in 19 locations in February 2011 (dry season). For pre-monsoon monitoring, fifteen monitoring sites were identified for to characterize the baseline noise levels in the project area. The results in both seasons shows that the ambient noise level of the project areas in some locations are over the standard prescribed by the Central Pollution Control Board, indicating the need for speed limit and other measures to reduce noise level, particularly in areas near sensitive receptors such as hospitals.

Table 12.5-17 Ambient Noise Level

Sr. No.	Location	Ambient Noise Level Leq.dB(A)					
		Day Time (07.00 AM to 11.00 PM)			Night Time (10.00 AM to 12.00 PM)		
		L_{min}	L_{max}	L_{eq}	L_{min}	L_{max}	L_{eq}
1	Pushpak Junction	58.4	70.5	66.51	46.2	53.8	48.16
2	Tuirel village	52.5	64.2	60.22	35.1	46.3	35.28
3	Tlungvel village	52	66	61.22	36.8	47.2	38.5
4	Bktawang village	52.9	65.3	60.52	37.8	46.5	40.18
5	Chhiahtlang village	50.4	65.7	60.81	34.2	43.8	36.28
6	Serchhip (NT)	54.6	65.1	60.25	42.3	51.2	46.2
7	Keitum village	56.5	65	61.79	35.2	41.8	36.28
8	Rawpui village	55.8	64.7	61.13	34.2	48.5	38.12
9	Thiltlang village	50.4	60.4	56.78	32.5	41.8	37.5
10	Leite village	45.9	54.8	50.66	34.2	42.6	38.12
11	S. Tawipui village	53	59.1	56.48	32.5	41.5	35.18
12	Thingfal village	51	61.3	57.25	34.8	43.5	37.78
13	Lawngtlai (NT)	54.3	62.4	58.68	46.2	53.2	48.5
14	Zero point village	52.8	64.5	58.88	32.8	43.8	35.12
15	Kawlchaw village	54.8	64.5	59.63	38.5	42.5	40.18

Source: JICA Study Team

Table 12.5-18 Noise Level Limits of GoI [in LeqdB(A)]

Area/Class	Day Time (6.00 AM to 9.00 PM)	Night Time (9.00 PM to 6.00 AM)
	Standard	Standard
Industrial	75	70
Commercial	65	55
Residential	55	45
Silence	50	40

Source: CPCB

Pre-Construction and Construction Phase

During the construction, the major sources of noise pollution are movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A). The major work will be carried out during the daytime. The noise levels in the project area during the construction stage will be intermittent and temporary in nature. Typical noise levels associated with the various construction activities and construction equipment are presented below.

Table 12.5-19 Typical Noise Levels of Construction Equipment

Construction Equipment	Noise Level dB(A)
Bulldozer	80
Front end loader	72-84
Jack hammer	81-98
Crane with ball	75-87
Crane	75-77
Bulldozer	80
Backhoe	72-93
Front end loader	72-84
Cement & Dump trucks	83-94
Jack hammer	81-98
Scraper	80-93
Welding generator	71-82
Grader	80-93
Roller	73-75
Concrete mixer	74-88
Concrete pump	81-84
Concrete vibrator	76
Paver	86-88
Truck	83-94
Tamper	74-77
Air compressor	74-87
Pneumatic tools	81-98

Source: U.S. Environmental Protection Agency, noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. 300.1. December 31, 1971

At the moment, noise level is within the desired level. The noise level will be increased during construction period, which have significant impact for a limited period on the surrounding environment. The noise levels in the working environment are compared with the standards prescribed by Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by Government of India through Model rules framed under the Factories Act. The acceptable limits for each shift being of 8 hour duration, the equivalent noise level exposure during the shift is 90 dB(A).

Hence noise generated due to various activities in the construction camps may affect workers, if equivalent 8 hour exposure is more than the safety limit. ACGIH (American Conference of Government Industrial Hygienists) proposed an 8 hour Leq limit of 85 dB(A). Exposure to impulses or impact noise should not exceed 140 dB(A). The workers in general are likely to be exposed to an equivalent noise level of 80-90 dB(A) in an 8 hour shift for which all statutory precautions as per laws should be taken into consideration.

Operation Stage Impacts

During the operation stage of the project, reduction of vehicular engine noise (as a result of reduced congestion from earlier, smoother flow of traffic due to 2 separate lanes), vehicular body noise (as a result of reduced development roughness) and reduction of blowing of horns will bring the noise levels down, but as volume of traffic, mainly heavy duty traffic will be increase in future due to rapid development and industrialization along the road corridor this may increase noise slightly.

Mitigation Measures

The high noise levels may cause discomfort to local residents and workers. Following mitigation measures shall be adopted to keep the noise and vibration levels under control.

- The plants and equipment used for construction will strictly conform to Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to minimum;
- Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than90dB(A);
- In construction sites within 150 m of human settlements, noisy construction will be stopped between 10 PM and 6 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement;
- Hot mix plant, batching or aggregate plants shall not be located within 500 m of sensitive land use as schools and hospitals;
- Near to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used;
- Phase demolition, earthmoving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately
- Construction machinery will be located away from the settlements;
- Careful planning of machinery operation and scheduling of operations can reduce the noise levels. Use of equipment, emitting noise not greater than 90 dB(A) for the eight-hour operations shift and locating of construction yards at a distance of at least 500 m from any residential areas can be adhered to;
- Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures, which should be followed by the contractors during the civil works;
- The noise control measures include limitations on allowable grades. Open-graded asphalt and avoidance of surface dressings to reduce tire noise in sensitive areas. Maintenance of proper road surface repairs also helps in reducing noise levels;
- Use of air horns should be minimized on the highway during nighttime. During daytime use of horns should be restricted at few sensitive locations. This can be achieved through the use of sign boards along the roadside;
- Future development along the road should follow correct land use norms so that sensitive receptors are not located along the road, specifically along the bypasses; and
- Development of greenbelt along the main road can also bring about considerable reduction in noise levels. The area available on both sides of the road should be used to develop green belt comprising selected species of trees with high canopy to provide added attenuation of noise

(7) Wastes/Hazardous Materials

Types of construction waste to be generated include asphalt chunks, chunks of concrete, surplus soil, construction scrap materials and organic waste generated by construction workers. The amount and percentage composition of construction waste will depend on the final design and the schedule of the construction, and thus generic mitigation measures proposed in EMP should be updated once the final ROW drawing is completed. All other construction wastes are also planned to comply with relevant Center or State laws pertaining to waste management.

Table 12.5-20 Required Volume for Spoil Bank

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH54	S1	Cut Soil	cu.m	3,442,909	0.9	3,098,618	2,400,495
		Fill Soil	cu.m			698,123	
	S2	Cut Soil	cu.m	3,710,629	0.9	3,339,566	2,437,522
		Fill Soil	cu.m			902,044	
	S3	Cut Soil	cu.m	3,560,596	0.9	3,204,536	2,465,129
		Fill Soil	cu.m			739,407	
	Total						7,303,146

Source: JICA Study Team

The volume of surplus soil is estimated as below. Candidate locations with sufficient and necessary conditions for spoil bank construction have been screened with following criteria:

- ❖ To minimize transport of surplus soil, spoil bank should be located at every 5km distance along NH54 with following condition;
  - Ground shape with concavity topography
  - Less ground gradient than 22 degree which is assumed as average angle of spoil bank slope with necessary steps
  - No built-up area
  - No national sanctuary area
- ❖ To be able to construct the spoil bank in less than 30 m height

Based on the above criteria, 115 locations in 381 km stretch of NH54 has been identified for spoil bank construction. There are 41, 32 and 42 spoil bank with about 2.43, 2.90 and 2.51 million cu.m capacities in Section 1, 2 and 3 respectively.

Socio-Economic Environment

(1) Involuntary Resettlement

As per the preliminary ROW design, the project will affect 2,037 households (1,971 households whose houses will be affected and 66 households whose businesses will be affected). The total number of affected people is 8,230. Out of these, 1307 households (1,265 households whose houses will be affected and 42 households whose businesses will be affected) will have to be relocated. Based on the preliminary ROW design, remaining 730 households will be affected but relocation will not be necessary.

(2) Land Use

The project does not lead to large-scale change in land use as the engineering work will be constrained mostly along the existing road. On the other hand, development of resettlement site to accommodate

relocated households and construction of spoil bank is likely to cause changes in land use pattern, potentially affecting existing agricultural and plantation activities. Also, jhum cultivation, which is practiced in roadside as in Photo below, will be affected by slope protection/embankment work. The jhum practice directly next to the road is likely to have negative impacts from the road maintenance point of view and thus measures will be developed to shift existing jhum to areas far from the road or transform jhum to other agriculture practice.

For sections where NH54 passes through community forest, jhum area and plantation, engineering work should be scheduled in a way that minimize disruption of access by local people. At the same time, proper management of effluent and soil erosion shall be carried out to avoid negative impact on such resources.

(3) Utilization of Local Resources (3.3) and Local Economy and Livelihood

Significant volume of local resources such as sand may be used for construction work. This could cloud out the use of such resources for other purposes in the short-term. In the long-term, the better road network may attract new business, possibly from outside the state with detrimental impact on local business/traders. While the project overall will have significant positive impacts on the local and regional economy, the better transport network may put some groups at risk at least in the short and medium-term. These potential high-risk groups should be identified in the preparation of R&R plan to ensure that they will not be in a disadvantaged position due to the project.

(4) General, Regional /City Plans

The project will create new opportunities for village and district-level development planning. In particular, the construction of spoil bank will create large area of flat land where such surface is a scarce commodity. The development of spoil bank, therefore, should be coordinated with the village/district's development plan so that the land will benefit the community. Similarly, development of resettlement site should be well coordinated with village development plan to ensure proper supply of basic utilities and integration of new sites with the existing village area.

(5) Social Institutions and Local Decision-making Institutions

Except for Lawngtlai and Saiha district where Lai and Hmar population account for the majority of the population respectively, different tribes of Mizo people co-exist across the stretch of NH54 without tribe-rooted conflicts. To minimize potential disturbance and avoid the risk of conflicts, however, the resettlement will be planned within the village where relocation takes place. Being a tribal state, district and village council and traditional community leaders have significant influence on decision-making process in the area. As such, their support and cooperation is critical in smooth implementation of the project, particularly activities related to resettlement. The implementation of EMP as well as RAP/R&R should be built on existing social institutions and will be best guided by local people, rather than outside experts.

(6) Social Infrastructure and Services

For most people residing along NH54, the highway is the only route of access to social infrastructures such as schools and hospitals. Construction activity is likely to cause temporary disturbance to their access to such infrastructure and service and therefore, schedule and timing of the engineering activity should be developed in consultation with the local community. When road blockage is necessary, e.g. for blasting, the local community should be informed in advance so that they can make alternate plan accordingly.

(7) Unequal Distribution of Benefit and Damage (3.8) and Local Conflicts of Interest

Roadside location offers critical advantages for local business (tea stalls, restaurant, petty shops). Resettlement from roadside to inner part o the village may significantly undermine the viability of these businesses, and therefore, business owners to be affected may be worse off compared with farmers to be relocated. Likewise, allocation of plot in resettlement site may become a source of conflicts among affected households who wish to be relocated to more advantageous plots. Sound arbitration and conflict resolution mechanism by local leaders should be in place for smooth implementation of RAP and R&R activity.

(8) Water Usage, Water Rights and Communal Rights

Irrigation is not practiced along the project area and thus water is not likely to become a source of conflicts in the course of project implementation.

(9) Cultural and Historical Heritage

No sites of cultural or historical significance have been identified along the project road.

(10) Religious and Sensitive Facilities

It is expected that the project will affect 8 small churches along the road. Given the importance of religion and religious belief in the project area, the project should explore options avoid/minimize impacts to such facilities during the detailed design once additional topographic data is obtained. Also, access to these facilities, particularly Sunday mass, should not be disturbed by construction activities. Similarly, more stringent standard for noise and vibration and air quality should be adopted where sensitive facilities such as school and hospitals are located.

(11) Poor People

The baseline survey has identified gap between official poverty level and poverty level as reported by the people. R&R activity should take into account the limited coping capacity of the local community and develop measures that leads to sustainable income generation of the affected people, rather than one-off payment of compensation and assistance.

(12) Ethnic Minorities/ Indigenous People

In the state of Mizoram, the tribal (Scheduled Tribe: ST) population constitutes about 95% of the total population. Overwhelming majority of the affected people also belong to ST, and hence they are not minority. While tribal groups in project area holds traditional culture, including shifting cultivation in forest called jhum, they freely interact and share their sources of water, folklore, food, infrastructure and other belongings with the non-ST and other tribal population within and outside community. This is particularly evident in the section between Aizawl and Lunglei where differnet sub-tribe of Mizo, including Lushai, Lai and Mara and non-Mizo people co-exist peacefully without ethnicity-related tensions. Moreover, ST population in project area is not isolated from outside and they are open to new ideas such as family planning and formal education.

(13) Gender

Tribal and non-tribal women in North East States enjoy a relatively higher position in the society than what their non-tribal counterparts do, which is reflected in their high literacy rate. Mizo women are largely involved in household work, collection of forest produce, firewood collection, cultivation and other agricultural activities and thus they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in women in which options to facilitate women's participation in project

implementation and various opportunities to be created by the project is discussed. In particular, women shall have preferential access to specific types of project-related job opportunities, including light-duty work and part-time jobs that do not interfere with women's responsibility at home. In addition, efforts should be made ensure participation of women in consultation meetings to be carried out during the implementation of RAP.

(14) Public Health and Occupational Health and Safety (OHS)

The health and safety measures at design, construction and operation phase are given below.

Table 12.5-21 Health and Safety Measures

Design Stage	
Geometric Correction at Critical Curves	Critical curves have been rectified to maintain project design speed and visibility. (IRC-86-1983 " Geometric Design for Road in Plains")
Construction Stage	
Health hazard to workers due to bad water and sanitation	At every workplace, good and sufficient potable water (as per IS) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. Adequate drainage, sanitation and waste disposal shall be provided at workplaces. Preventive Medical care shall be provided to workers.
Health/ social hazard, sexual harassment to female workers	Segregation of male and female areas in labor camp shall be executed.
Hygiene at Construction Camps	The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour to standards and scales approved by the resident engineer. There shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act. Except in workplaces provided with water-flushed latrines connected with a well designed septic tank, all latrines shall be provided with low cost 'Twin Pit Latrine' system. The pit can be closed after the construction is over. There shall be adequate supply of water, close to latrines and urinals. All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force. On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.
Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees. If the quarry site is porous, it shall be used by groundwater recharging.
Risk from Operations	The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this project. The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.

Risk from Electrical Equipment	Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.
Risk at Hazardous Activity	All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the siteshall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product.
Risk of Lead Pollution	No man below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. Face masks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
Risk caused by Force' Majure	All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.
Risk from Explosives	Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.
Malaria risk	The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him
Loss of Access	At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.
Traffic Jams and Congestion	Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. Special consideration shall be given in the preparation of the traffic control plan to the safety of

	pedestrians and workers at night. The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.
Traffic Control and Safety	The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. All signs, barricades, pavement markings shall be as per the MORT&H specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer. Excavated pits shall be filled to avoid falling of animals/ human beings.
Operation Phase	
Dwellers in settlements may rush to high way and meet accident	Specially design urban section and footpath sections shall be applied to the necessary locations.
Vehicles parked in settlements may lead to narrow carriageway	Specially designed parking areas shall be executed at the required locations.
Fast moving vehicles may threat safety in settlements.	Specially designed pedestrian crossings shall be constructed at required locations.
Accidents involving hazardous materials.	The rules s defined Hazardous waste handling Act shall be compiled. Vehicles delivering hazardous substances shall be printed with appropriate signs. In case of spillage, the report to relevant departments will be made and instructions followed in taking up the contingency measures.
Other Safety Measures	Traffic Management plan shall be developed especially along congested locations. Traffic control measures including speed limits will be enforced strictly. Further growth of encroachment and squatting within row shall be discoursed.

Source: JICA Study Team

Other Issues

(1) Accidents

Construction Phase Impacts

The project will improve the road safety through design measures identified during the various road surveys. Road safety will be enhanced in the project through engineering (design), enforcement (safety measures, signage, etc.) and education. The issue of road safety is one of the key issues that may surface in construction stage. During the construction stage, dismantling of structure, cutting of trees, haulage material obstructing vision, spillage of lubricants on road making it slippery is generally the cause of road accidents. Similarly, in operation stage, increase in traffic and increase in speed would tend to increase in accidents. In spite of these, the social benefits from the project are quite significant.

It is likely that there will be some concern of safety for highway users during construction period, as haulage of material and other equipment would restrict movement of vehicles. Highway patrolling system with ambulance facility and crane will render assistance to users in distress and disabled vehicles which in-turn will improve the safety level.

Operation Phase Impacts

The proposed project implementation would improve the road safety for the highway users as well as locals living by the side of the road. In operation stage, increase in traffic and increase in speed would tend to increase in accidents. In-spite of these, the social benefits from the project are quite significant.

In operation phase, increase in vehicle speed may cause thereof to the safety of pedestrians and for cattle for crossing road.

Mitigation Measures

Street furniture known as road studs, blinker or cat's eye include equipment installed on road or roadside to assist visibility of road alignment/structures. They are retro-reflective safety devices used in road marking. Generally, it consists of two pairs of reflective glass spheres set into a white rubber dome, mounted in a cast-iron housing. This is the kind that marks the center of the road, with one pair of devices showing in each direction. A single-ended form has become widely used in other colors at road margins and as lane dividers.

Since the NH54 is located in mountainous region, hair-pin bends are unavoidable from the viewpoint of cost and environmental impact. Design speed of 20 km/h is applied for hair-pin bends, while design speed of 30 km/h is adopted in general. Small horizontal curves such as R20 m-R25m are used in steep terrain to avoid large-scale earthwork and/or demolition of houses. At those sub-standard sections, securing traffic safety by applying combination of facilities shall be considered.

In hair-pin bends, it is difficult to secure overtaking sight distance and thus, the section shall be designated as no-overtaking section. In order to inform that to drivers, the double centre line with marking of pair of solid lines is applied. Cats eyes to delineate road alignment are to be installed on the centre line and lane edges so that drivers will be able to identify the direction he should go before entering into the curve. Furthermore, traffic signs and Guardrails shall be properly equipped to avoid hazardous accidents. The Figure below shows an example of combined traffic safety facilities to be installed at hair-pin bends.

In the locations where the existing bridges are to be utilized with rehabilitation works, carriageway width becomes narrower than that of earthwork sections due to the difference in shoulder width. It is, therefore, proposed to install facilities that notify drivers the decrease in carriageway width and existence of concrete curb.

The project road passes through 48 villages and there are a lot of buildings, shops or houses at roadside as well as pedestrians going along the sidewalk and crossing the road. Furthermore, more road facilities such as bus stops are necessary than rural sections. Therefore, drivers have to handle much information on roads/traffic and decide their maneuvers in a short time at built-up areas. In order to assist road users in obtaining information, appropriate traffic signs and road markings shall be provided properly.

(2) GHG emissions

There is a possibility of increased GHG emission due to the operation of heavy vehicles as well as traffic jams incidental to the construction works, this impact will be temporary. On the other hand, it is expected that the GHG emission will be increase due to increase traffic volume. The increase will be mitigated by keeping good road conditions which will reduce consumption of extra fuel and congestion, thereby mitigating GHG emissions over time.

State Urban Development & Poverty Reduction Department (UDPA) is reviewing several options, such as parking restriction, to curb emissions and air pollution in urban areas including Aizawl. The monitoring result and other relevant data (e.g. actual/projected traffic volume) shall be shared with UDPA, SPCB and other relevant authorities to elaborate mitigation measures.

12.5.9 Environment Management Plan

Based on the assessment above, environment mitigation and enhancement measures during different stages of the project have been developed as shown below.

Table 12.5-22 Environmental Management Plan for Pre-Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P1	Relocation of Project Affected Persons (PAP)	• All requirements of the RAP as applicable shall be complete before start of construction stage. The activities broadly include acquisition of land and structures, relocation of utilities, payment of compensation and provision assistance	All areas	Before construction begins	Government of Mizoram, District Revenue authorities, Village Councils, NGO	PIU, SC
P2	Removal of vegetation	• Minimize the scale of vegetation clearing by factoring vegetation/forest cover in the final design of the road alignment process • Removal of trees to be carried out after forest clearance is obtained • Reforestation/replantation of trees at a term as instructed by the Forest Dept.. or by the Forest Dept. • Activity shall be supervised to avoid poaching of animals	All areas	Before construction begins (Reforestration/replantation may extend to during/after construction)	PIU, Contractor, Forest Dept.	PIU, SC, Forest Dept.
P3	Setting up construction camps	• Camps shall be located at least 500 m away from the nearest built-up area. • Sewage system for a construction laborer's camp shall be designed, built and operated so that no pollution to ground or adjacent water bodies/ watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. • In relation to underground water resources, the contractor shall take all necessary precaution to prevent interference with such water resources. • All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	All construction campsite identified by the contractor and approved by SC	During Establishment, Operation and Dismantling of Such Camps.	Contractor	PIU, SC
P4	Setting up hot mix plants	• Hot mix plants and batching plants shall be located sufficiently away from habitation and agricultural operations. • Where possible such plants will be located at least	All hot-mix and batching plants	During Erection, Testing, Operation and Dismantling of Such Plants.	Contractor	PIU, SC

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		1000 m away from the nearest habitation.				
P5	Finalizing sites for surplus soil dumping	• Location of dumping sites shall be finalized. The sites shall meet following conditions: i) dumping does not impact natural drainage courses; ii) no endangered/rare flora is impacted by such dumping	All areas identified as potential dumping sites	During mobilization	Contractor	PIU, SC
P6	Identification of hazard-prone locations	• The contractor shall identify locations sensitive to landslides (in addition to the ones that area already identified) and shall duly report these to the Supervision Consultant (SC) and to PIU.	All area	During mobilization	Contractor	PIU, SC
P7	Identify and prepare relocation sites	• Location of relocation sites shall be identified in consultation with district/village authorities and PAPs. • Sites to be developed including provision of necessary utilities such as water and electricity.	Near villages with large-scale resettlement		PIU	PIU

Source: JICA Study Team

Table 12.5-23 Environmental Management Plan for Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Soil						
C1	Soil Erosion in Borrow Pits	• The depth of borrow pits shall be restricted so that sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank. (if applicable)	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C2	Loss of top soil in Borrow pits	• Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable topsoil shall be preserved and used for tree plantation. (if applicable)	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C3	Compaction of Soil	• Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil.	Throughout corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C4	Soil erosion in embankments	• Pitching shall be done for slope stabilization as per the IRC guidelines (if applicable)	At the places of embankments	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C5	Contamination of soil from fuel and lubricants	• Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be minimum. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near Labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C6	Contamination of land from construction waste and quarry materials	• Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments. • Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. • Construction waste including non- bituminous and bituminous waste shall be dumped in approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.	Solid waste dump Site identified and approved by SPCB. or competent authority. Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
C7	Loss of top soil in land acquisition	• Topsoil shall be stripped, stored and shall be laid on ground for landscaping purpose. (if feasible)	Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
Water						
C8	Contamination of water by fuel/ oil spillage of vehicle	• Construction vehicles / equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C9	Contamination of stagnant water body	• Labor camp shall not be allowed near any of the water bodies.	Preapproved locations away from the water	Construction Stage	Contractor and Supervision	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	by fecal matters from labor camp.	• The proper sanitation facilities shall be provided.	bodies.		Consultant	
C10	Deposition of dust in open wells near construction site	• The mouth/opening of the well shall be covered with suitable material during any of the construction activity so as to prevent dust entering in the well.	All the wells along the project corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C11	Using drinking water for construction purpose	• The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. • Wastage of water shall be kept minimum during construction.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C12	Hand pump close to road may get affected in widening	• All the Hand pumps shall be relocated to suitable alternate place.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C13	Wells or water stoarge system may get affected in widening	• Alternate arrangements will be made for all the Wells or water storage system.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C14	Altering flow of natural drains	• Drain shall be channelized with Slope protection - Gabion Structure.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C15	Sanitation of waste disposal in construction camps	• The construction of camps will be done with sufficient buffer from habitation. • At construction sites and labor camps sufficient no of latrines will be provided. • The sewage generated from the camps will be properly disposed off so that it does not affect water bodies	Wherever labor camp is located	Construction Stage	Contractor and Supervision Consultant	PIU
Air						
C16	Emission from construction vehicles and machinery.	• All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. • Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles,	Wherever the hot mix plant and batching plant is setup.	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		equipment and machinery.				
C17	Air pollution from various plants affecting settlements	• The asphalt plants, crushers and batching plants shall not be sited at least 500 m in leeward direction from nearest human settlement	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
C18	Air pollution may exceed the limits prescribed by Central Pollution Control Board.	• Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan.	Locations given in Environmental Monitoring Plan.	Construction Stage	Contractor and Supervision Consultant	PIU
C19	Vehicles will generate dust and suspended particles.	• The dust generated by vehicles on site shall be arrested using a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.	Wherever the plants are setup and sensitive locations as suggested in monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
Noise						
C20	Noise levels from vehicles. Asphalt plants and equipment	• The plants and equipment used for construction shall confirm to CPCB norms. • Vehicles and equipment used shall be fitted with silencer. • Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. • All equipment and plants shall strictly be placed away from educational institutes and hospitals. • Regular monitoring of noise parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan.	Wherever the plants are setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C21	Noise from blasting operations	• Blasting as per Indian Explosives act will be carried out. • People living near such blasting operation sites shall be informed before the operational hours. • Workers at blasting sites shall be provided with earplugs.	At the sites where the blasting is required and in quarry sites	Construction Stage	Contractor and Supervision Consultant	PIU
C22	Noise barriers	• Construction of noise barriers in the form of walls at Sensitive locations upon consultation with	All along the corridor wherever the sensitive	Construction Stage	Contractor and Supervision	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		stakeholders..	locations like schools, hospitals and other community places are located.		Consultant	
Flora and Fauna						
C23	Tree cutting for widening	• Three trees shall replace each tree cut for the purpose. • The Engineer shall approve such felling only when the NHIDCL receives a "clearance" for such felling from the MOEF, as applicable. • Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
C24	Damage or Loss of Important Flora	• During construction, at any point of time, if a rare/ threatened/endangered flora species is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineer shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.	Throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU
Health and Hygiene						
C25	Health hazard to workers due to bad water and sanitation	• At every workplace, good and sufficient potable water (as per IS 10500) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. • Adequate drainage, sanitation and waste disposal shall be provided at workplaces. • Preventive Medical care shall be provided to workers.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C26	Health hazard to workers by various construction activity	• Personal protective equipment shall be provided to worker as per the Factories Act.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant	PIU
C27	Health/ social hazard, sexual harassment to female workers	• Segregation of male and female areas in labor camp shall be executed.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C28	Hygiene at Construction Camps	• The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the resident engineer. • These shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. There shall be adequate supply of water, close to latrines and urinals. • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C28	Hygiene at Construction Camps	• On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.				
C29	Abandoned Quarry	• Reclamation measure shall be adopted with garland	All quarry locations.	Construction Stage	Contractor and	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	will accumulate water and act as a breading ground for disease vectors.	of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.			Supervision Consultant	
Safety						
C30	Safety of vehicles plying on road while the construction activity is going on.	• Prior arrangement/traffic diversion for safe passage of vehicles shall be made with proper direction and signage at the construction site. • Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.	Throughout the project area	Construction stage	Contractor and Supervision Consultant	PIU
C31	Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. • The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C32	Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. • All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.				
C33	Risk at Hazardous Activity	• All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. • The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day's notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product. This should comply with Hazardous Material Act.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C34	Risk of Lead Pollution	• Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. • Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C35	Risk caused by Force'	• All reasonable precaution will be taken to prevent	All construction Site	Construction stage	Contractor and	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	Majure	danger of the workers and the public from fire, flood, drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.			Supervision Consultant	
C36	Risk from Explosives	• Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable. • The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. • The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.	Place of use of Explosives	Construction stage	Contractor and Supervision Consultant	PIU
C37	Malarial risk	• The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him	All construction sites, particularly beyond Lunglei district	Construction stage	Contractor and Supervision Consultant	PIU
C38	First Aid	• At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided.	At the construction site /labor camp	Construction stage	Contractor	PIU
Disruption to Users						
C39	Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property	Throughout the project area, particularly in built-up areas	During Construction.	Contractor	Engineer

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		accesses connecting the project road. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. ● The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.				
C40	Traffic Jams and Congestion	● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. ● Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. While approving temporary diversion construction, the Engineer will seek endorsement from the PIU. ● Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. ● The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. ● The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.	Throughout Corridor	During Construction.	Contractor	Engineer
C41	Traffic Control and Safety	● The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs,	Throughout the project area	During Construction.	Contractor	Engineer

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. • All signs, barricades, pavement markings shall be as per the MORTH specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer as per EMP. Excavated pits shall be filled to avoid falling of animals/ human beings.				
Environment Enhancement						
C42	Hand pumps enhancement/relocation for ground water recharging	• Hand pumps within Right of Way shall be enhanced/relocated.	At the respective locations along the corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C43	Roadside landscape development	• Avenue plantation of foliage trees mixed with flowering trees, shrubs and aromatic plants shall be carried out where ever land is available between ditches and Right of Way.	Throughout the corridor	Construction Stage	Contractor and Supervision Consultant	PIU
C44	Providing better bus bays	• Bus shelters shall be provided at given locations	As per traffic plan	Construction Stage	Contractor and Supervision Consultant	PIU
C45	Better sitting arrangements where small space is available	• Designed sitting arrangements shall be provided.	As per the design	Construction Stage	Contractor and Supervision Consultant	PIU
C46	Landscaping of junctions	• All rotary junctions shall be landscaped suitably	As per landscape design at the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C47	Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	• The abandoned quarry locations shall be planted suitably as the plan	Wherever quarries are located and abandoned	Construction Stage	Contractor and Supervision Consultant	PIU
C48	Erosion of	• Earthworkss specifications will include provision	At the respective	Construction Stage	Contractor and	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	embankments, shoulders, side slopes, and pavement leading to deterioration and affecting stability and integrity of road	for stable slope construction, compacting and laying out turf including watering until ground cover is fully established ● Proper construction of Breast wall and retaining wall at the locations identified by the design team to avoid soil erosion ● The measures proposed for slope stabilization are: Discharge zones of drainage structures (culverts and minor bridges) provided with riprap ● Construction in erosion and flood prone areas will not be in monsoon /season. ● Side slopes will be kept flatter wherever possible, and in case of steeper slopes it will be supported by the retaining wall.	locations throughout the project area.		Supervision Consultant	

Source: JICA Study Team

Table 12.5-24 Environmental Management Plan for Operation Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
O1	Water quality degradation due to road-run-off	● Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off ● Monitoring shall be carried out as specified in the monitoring plan	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O2	Soil and water contamination from accidental spills	● Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals ● Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level by early operation stage	PIU, SPCB, Local Government Bodies	PIU
O3	Air quality degradation due to increases in traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Q4	Increases in noise and vibration due to greater traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Install noise barrier (wall etc.) in sensitive areas, if necessary	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O5	Traffic safety	● Traffic control measures including speed limits to be enforced strictly. ● Local government bodies and development authorities will be encouraged to control building development along the highway.	All area	Throughout operation stage	PIU, Local Government Bodies	PIU
O6	Accidents involving hazardous materials	● Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including: ✓ For delivery of hazardous substances, permit license, driving license and guidance license will be required. ✓ These vehicles will only be harbored at designated parking lots. ✓ In case of spill of hazardous materials, the relevant departments will be notified at once to deal with it with the spill contingency plan.	All area	Manual/guideline to be prepared during early operation stage	PIU	PIU
O7	Roadside tree plantation, flora and fauna	● Trees planted along the corridor shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence every year for 3 years and all necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU

Source: JICA Study Team

12.5.10 EMP Implementation Cost

Based on the above, the cost for implementation of EMP is estimated as below.

Table 12.5-25 Budget for EMP Implementation

Item	Detail	Unit	Unit Cost	Quantity	Total (Rs)
I. Monitoring					
Air	Monitoring near hot mix plant locations approved by the Engineer as per NAAQS ,2009 CPCB	No.	5,000	80	400,000
Water	At locations specified in the monitoring plan as per IS 10,500 & IS 2296	No.	5,000	60	300,000
Noise	At equipment yards as directed by Engineer as per CPCB guideline 1989	No.	2,000	80	160,000
Flora and Fauna	Monitoring of impact on biodiversity	No.	50,000	24	1,200,000
Sub-Total (I)					2,060,000
II. Afforestation	Compensatory afforestation, in accordance with Forest Conservation Act (1980) as per guideline provided in EMP	No.	200	50,000	10,000,000
Sub-Total (II)					10,000,000
III. Institutional Cost					
Expert fees	Lump sum				6,000,000
Staff training	Lump sum				1,500,000
Ext. monitoring	Lump sum				2,000,000
Information disclosure	Lump sum				500,000
Sub-Total (III)					10,000,000
Sub-Total (I+II+III)					22,060,000
Contingency (10%)					2,206,000
Total					24,226,000

Source: JICA Study Team

12.5.11 Environment Monitoring Plan

To ensure effective implementation of the EMP, it is essential that an effective monitoring plan be designed and carried out. The environmental monitoring plan provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggest further actions that need to be taken to achieve the desired effect. The monitoring includes: i) Visual observations; ii) Selection of environmental parameters at specific locations; and iii) Sampling and regular testing of these parameters.

Monitoring methodology covers the following key aspects: Components to be monitored; parameters for monitoring of the above components; monitoring frequency; monitoring standards; responsibilities for monitoring; direct responsibility, overall responsibility; and monitoring costs. Environmental monitoring of the parameters involved and the threshold limits specified are discussed below.

Ambient air quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM 2.5, Carbon Monoxide (CO), Oxides of Nitrogen (NO_X), Sulphur Dioxide (SO_2) and Lead (Pb). These will be monitored at designated locations starting from the commencement of construction

activity. Data should be generated at all identified locations in accordance to the National Ambient Air Quality Standards, 2009. The location, duration and the pollution parameters will be monitored and the responsible institutional arrangements are detailed out in the Monitoring Plan.

Water quality

The physical and chemical parameters recommended for analysis of water quality relevant to road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc and cadmium. The location, duration and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan. The monitoring of the water quality is to be carried out at all identified locations in accordance to the Indian Standard Drinking Water Specification – IS 10500: 1991.

Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance to the Ambient Noise Standards formulated by Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the Environmental Monitoring Plan

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized below.

Table 12.5-26 Environmental Monitoring Plan

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M1	Air	Construction	SPM, RSMP, SO_2, NOx, CO, HC	• Dust sampler to be located 50 m from the plan in the downwind direction. • Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M2		Construction	SPM, RSPM	• Dust sampler to be located 50 m from the earthworks site downwind direction. Follow CPCD method for analysis	Air (P&CP) Rules, CPCB, 1994	Stretch of road where construction is underway	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M3		Operation	SPM, RSMP, SO_2, NOx, CO, HC	• Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling location specified in EIA report	Twice a year for one year	Continuous 24 hours	PIU	PIU
M4	Water	Construction	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Sample collected from source and analyze as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for three years		Contractor through approved monitoring agency	PIU
M5		Operation	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Grab sample collected • from source and analyze as per Standard Methods for Examination of Water • and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for one year		PIU	PIU
M6		Operation	Cleaning of drains and water bodies	• Choked drains, water bodies undergoing siltation and subject to debris disposal should be monitored under cleaning operations	To the satisfaction of the engineer (PWD)	All area	Post-monsoon		PIU	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M7	Noise and vibration	Construction	Noise levels on dB (A) scale	• Free field at 1m from the equipment whose noise levels are being determined	Noise standards by CPCB	At equipment yard	Once every 3 Month (max) for three years, as required by the engineer	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	PIU
M8		Operation	Noise levels on dB (A) scale	• Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement	Noise standards by CPCB	At maximum 15 sites inc. those listed in EIA report for noise monitoring locations	Twice a year for 1 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	PIU	PIU
M9	Soil erosion	Construction	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall	Pre-monsoon and post-monsoon for three years		Contractor	PIU
M10		Operation	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	As directed by the engineer	Pre-monsoon and post-monsoon for one year		PIU	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M11	Construction camp	Construction	Monitoring of: 1.Storage Area; 2. Drainage Arrangement 3. Sanitation in Camps	• Visual Observations and as directed by the engineer	To the satisfaction of the engineer and Water quality standards	At storage area and construction workers' camp	Quarterly during construction stage		PIU	PIU
M12	Afforestation	Construction and operation	Plant survival	• The success of tree planting. Monitor the rate of survival after six months, one year and 18 months in relation to total numbers of trees planted		All area	Minimum three years after planting		NGO, PIU	PIU
M13	Flora and Fauna	Construction and Operation	Condition of ecosystem	• Comparison to pre-project flora and fauna	As specified in TOR	As specified in TOR	Twice a year for three years		PIU	PIU

Source: JICA Study Team

12.5.12 Land Acquisition and Resettlement

The project requires land acquisition for the proposed widening and other works including slope protection and stabilization. For a project involving involuntary displacement of 400 or more families en masse in plain areas, or 200 or more families en masse in tribal or hilly areas, the National Rehabilitation and Resettlement Policy of 2007 (NRRP, 2007) requires the administrator for Rehabilitation and Resettlement (R&R) to undertake a baseline survey and census for identification of the persons and families likely to be affected (Sec. 6.2). This will be carried out by the state government who is responsible for rehabilitation once the final ROW is determined based on the additional topographic survey. Meanwhile, this RAP report has been prepared based on the preliminary design with the aim of informing the R&R-related discussion between the state government and NHIDCL to ensure that land acquisition and involuntary resettlement for this project be carried out in a manner that is consistent with the JICA Guidelines for Environmental and Social Considerations.

In the state of Mizoram, the tribal (Scheduled Tribe: ST) population constitutes about 95% of the total population. While tribal groups in the project area holds traditional culture, including shifting cultivation in a forest called jhum, they freely interact and share their sources of water, folklore, food, infrastructure, and other belongings with the non-ST and other tribal population within and outside the community. This is particularly evident in the section between Aizawl and Lunglei where different sub-tribe of Mizo, including Lushai, Lai and Mara, and non-Mizo people co-exist peacefully without ethnicity-related tensions. Moreover, ST population in the project area is not isolated from outside and they are open to new ideas such as family planning and formal education. Given that the mainstream population of the area is tribal, elements of an Indigenous People Plan (IPP) as described in the World Bank OP4.10 have been incorporated into this report. No separate IPP has been prepared for this project.

12.5.13 Legal Framework for Land Acquisition and Resettlement

The Land Acquisition Act of 1894 has so far served as the base policy document on which the state government passes resolution to acquire land for different projects. This act is superseded by a new act (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013), which took effect on January 1, 2014. However, the State Government of Mizoram issued a notification (No. H. 11018/8/2010-REV, dated January 5, 2015) stating that the new act will not be used in Mizoram on the ground that being under the sixth schedule of the Constitution, the land within the state belongs to individuals and not to the government. The government is in the process of developing its own rule and has drafted the draft Mizoram (Land Acquisition, Rehabilitation, and Resettlement) Bill in 2015. However, this has not been finalized yet as of August 2015. The proposed bill generally follows the LARR 2013 but there are differences in terms of the additional benefits to rural area and solatium to be added to the compensation. In keeping view of the requirement under JICA Guidelines, the resettlement policy and entitlement proposed in a RAP report will be adopted in this project. Applicable acts, notifications, and policies relevant in the context of the project are discussed below.

Table 12.5-27 Applicable Acts and Policies

No.	Acts, Notifications, and Policies	Relevance and Applicability to the Project
1	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013 (LARR 2013)	Provides for enhanced compensation and assistance measures and adopts a more consultative and participatory approach in dealing with the Project Affected Persons (PAPs). The act took effect in January 2014, however, the state of Meghalaya opposes to the provisions on the ground that being under the sixth schedule of the Constitution, the land within the state belongs to individuals and not to the government.
2	National Rehabilitation and Resettlement Policy, 2007 (NRRP 2007)	Provides limited benefits to affected families (an ex-gratia payment of not less than INR 20,000/- and in case a land-holder becomes landless or a small or marginal farmer, in such cases, other rehabilitation benefits will be applied as applicable.

No.	Acts, Notifications, and Policies	Relevance and Applicability to the Project
3	National Tribal Policy, 2006	Provides an environment conducive to the preservation of traditional and customary systems and regime of rights and concessions enjoyed by different ST communities.
4	Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	Provides for the recognition of forest rights to Scheduled Tribes in occupation of forest land prior to December 13, 2005 and to other traditional forest dwellers who are in occupation of the forest land for at least three generations i.e., 75 years, up to maximum of four hectares. These rights are heritable but not alienable or transferable.
5	Right to Information Act, 2005	Provides for setting out the practical regime of right to information for citizens to secure access to information under the control of public authorities in order to promote transparency and accountability in the performance of every public authority, the Constitution of a Central Information Commission and State Information Commissions and for matters connected therewith or incidental thereto.
6	World Bank OP 4.12 – Involuntary Resettlement	The project requires additional land area for widening and strengthening, junction improvements, realignments, safety provisions, etc. It will also affect structures mainly used for residences, business units, cattle sheds, and livelihood of people. Some of them are without any valid pass/permit. All affected under the project, irrespective of a valid pass/permit shall be supported under the project to improve their quality of life or at least restore to pre-project standards.
7	OP 4.10 – Indigenous Peoples	Over 90% of the population in the state belongs to the tribal community and almost all affected households belong to ST. While a separate IPP report is not prepared, the issues discussed in RAP takes into account this fact and address issues related to indigenous peoples in the RAP. The project shall ensure broad community support for the project based on free prior and informed consultation.
8	JICA Guidelines for Environmental and Social Considerations	See Box 3.1 below

Source: JICA Study Team

The LARR 2013 exempted 13 laws, including the National Highways Act from its purview. However, the LARR 2013 required that the compensation, rehabilitation, and resettlement provisions of these 13 laws be brought in consonance with the LARR 2013 within a year of its enactment (that is, by January 1, 2015), through a notification. The bill brings the compensation, rehabilitation, and resettlement provisions of these 13 laws in consonance with the LARR Act, 2013. The bill creates five special categories of land use: (i) defence, (ii) rural infrastructure, (iii) affordable housing, (iv) industrial corridors, and (v) infrastructure projects including public private partnership (PPP) projects where the central government owns the land. The LARR 2013 requires that the consent of 80% of landowners is obtained for private projects and that the consent of 70% of landowners be obtained for PPP projects. The proposed amendment to the bill, currently under the parliamentary discussion, exempts the five categories mentioned above from this provision of the act. Being a rural infrastructure project, the above requirement does not technically apply to this project. As per the proposed amendment, projects that belong to five categories do not require social impact assessment. The amendment has not yet passed, but regardless of the passage of the amendment, the project has sought to obtain support from the affected community in keeping with the JICA Guidelines for Environmental and Social Guidelines. The key principle of the JICA Guidelines in terms of land acquisition and involuntary resettlement is shown in the box below.

The key principle of JICA policies on involuntary resettlement is summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
II. When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported so that they can improve or at least restore their standard of living, income opportunities, and production levels to pre-project levels.
IV. Compensation must be based on the full replacement cost as much as possible.
V. Compensation and other kinds of assistance must be provided prior to displacement.
VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy.
VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by the World Bank OP 4.12, since it is stated in the JICA Guidelines that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principles based on World Bank OP 4.12 are as follows:

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits.
XI. Eligibility of Benefits include the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who do not have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
XIII. Provide support for the transition period between displacement and livelihood restoration.
XIV. Particular attention must be given to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc.
XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.
XVI. In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan, institutional framework for implementation, monitoring and evaluation mechanism, time schedule for implementation, and detailed financial plan, etc.

Source: JICA Guidelines for Environmental and Social Considerations, 2010

Figure 12.5-11 Principle of JICA Policies on Involuntary Resettlement Right

Table 12.5-28 summarizes key deviations between two sets of legal and policy frameworks i.e., JICA policies and the existing Indian policies relevant to this project. The table also makes recommendations for measures to plug these gaps.

Table 12.5-28 Key Gaps between JICA and Indian Regulations

Sl. No.	JICA Guidelines (2010)	Applicable Policy (LARR and NRRP)	Gaps Between JICA's Guidelines and LARR and NRRP	Proposed Gap Filling Measures
1	Involuntary resettlement should be avoided wherever possible.	Stated aim to minimize large-scale displacement. Encourages projects to be set up on waste land, degraded land, un-irrigated land. (NRRP 2007, #1.4, Chapter 1)	No	
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	If unavoidable, the government should consider different alternatives to minimize displacement, total land acquired, and total agricultural land acquired for non-agricultural use (NRRP 2007, #1.4, Chap 1), LARR has provision for compensation for losses incurred.	No	
3	People who must be settled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported so that they can improve or at least restore their standard of living, income opportunities, and production levels to pre-project levels.	Provisions made for R&R benefits to all, but subject to condition that non-titleholders must be residing or drawing livelihood in the affected area for a period not less than three years preceding the date of declaration of the affected area. (NRRP, #3.1.b.iii)	Yes, non-titleholders need to be residing continuously or drawing livelihood from the affected area for a period not less than three years preceding the date of declaration. LARR is silent on compensation rights of non-titleholders for loss of land (illegally occupied), structures. R&R benefits such as housing improvement, development benefits, loss of crops, trees, transitional support, etc., to be provided only if residing/ drawing livelihood for a continuous three-year period in the area, preceding the declaration of 'affected area'.	Recognize claims of non-title holders (as identified by census survey and irrespective of their residing period status) and in respect of: - Compensation for structures, trees - Structure transfer assistance - Structure reconstruction assistance - Shifting assistance for residential house owner - Tenant shifting allowance Assistance to be provided at par with similar R&R support extended to familiar titleholder
4	Compensation must be based on the full replacement cost as much as possible.	Compensation made on market rate as determined or recognized by the state.	Yes, market rate as calculated by the government is usually far below the actual prevailing market rates.	Compensation to be provided at full replacement cost based on prevailing market rates and additional allowances.
5	Compensation and other kinds of assistance must	Provisions exist in NRRP.		-

Sl. No.	JICA Guidelines (2010)	Applicable Policy (LARR and NRRP)	Gaps Between JICA's Guidelines and LARR and NRRP	Proposed Gap Filling Measures
	be provided prior to displacement.			
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	Requirement for RAP is mentioned subject to number of displaced exceeding 400 families in plains or 200 in hilly/tribal areas or Desert Development Programme (DDP) blocks.	Yes, numerical condition (400 in plain area, 200 in tribal, hilly or DDP blocks) attached. JICA requires this to be implemented if PAH number is higher than 50.	RAP to be prepared for this project.
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	Specific mention provided in NRRP.	No	-
8	When consultation held, explanation must be given in a form, manner, and language that are understandable to the affected people	Provision made	No	-
9	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	Specified	No	-
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	Specified	Yes, R&R Committee to be set-up only if in the project area of more 400 families (in plains) or 200 in tibal/hilly areas are to be displaced.	- GRM to be set up. Should be accessible to PAHs- to be constituted at the district level for issues around land acquisition R&R benefits. Similar body to exist at the state level for monitoring and supervision - R&R implementing NGO/consultant to have presence in each project affected district and facilitate and inform PAHs about GRM and its processes.
11	Affected people are to be identified and recorded as early as possible in order to	Specified under NRRP for identification of all affected persons.	No	-

Sl. No.	JICA Guidelines (2010)	Applicable Policy (LARR and NRRP)	Gaps Between JICA's Guidelines and LARR and NRRP	Proposed Gap Filling Measures
	establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socio-economic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefit.			
12	Eligibility of benefits includes the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who do not have formal legal rights to land at the time of census but have a claim to such land or assets, and the PAPs who have no recognizable legal right to the land they are occupying.	Specified- R&R benefits to non-titleholders provisioned by and subject to the residing/ drawing livelihood for a period not less than three years in the project affected area (from the date of formal declaration).	Yes, non-titleholders if residing or drawing livelihood for a period less than three years are not eligible for R&R benefits.	- All non-titleholders (as identified on the date of the census survey) will also be eligible for R&R benefits.
13	Preference should be given to land–based on resettlement strategies for displaced persons whose livelihood is land based.	Specified	No	-
14	Provide support for the transition period (between displacement and livelihood restoration)	Specified	Yes, no such benefits provision for non-titleholder residing/drawing livelihood for a period less than three years	- Transition benefits to be provided to all non-titleholders (displaced and livelihoods impacted) who have been identified as per census survey.
15	Particular attention must be given to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities, etc.	Mentioned for vulnerable groups as defined under NRRP. Specific mention of additional provisions for SC and ST community mentioned under #7.21 of the NRRP. Requirement of a separate tribal development plan to be prepared if the number	No	- Special R&R assistance to SC community. - Special attention to be made by the R&R implementing NGO, the vulnerable PAH/persons receive R&R support as made out for them in the RAP.

Sl. No.	JICA Guidelines (2010)	Applicable Policy (LARR and NRRP)	Gaps Between JICA's Guidelines and LARR and NRRP	Proposed Gap Filling Measures
		of displaced tribal families exceeds 200 families.		

Source: JICA Study Team

12.5.14 Scale of Land Acquisition and Resettlement

(1) Demographic Profile

The project road stretching over 381 km passes through 48 villages in five districts. The number of villages per district are the following: Aizawl: 11, Serchhip: 8, Lunglei: 17, Lawngtlai: 6 and Saiha: 6. In these villages, the baseline survey has identified and surveyed 2,037 households (1,971 households whose houses will be affected and 66 households whose businesses will be affected). The total number of affected people is 8,230. The average household size is 4.1, which is below the state average of 4.8. Out of these, 1,307 households (1,265 households whose houses will be affected and 42 households whose businesses will be affected) will have to be relocated. Based on the preliminary ROW design, remaining 730 households will be affected but relocation will not be necessary.

The social categories of affected households per five districts are shown below. Overwhelming majority of the affected population is Mizo.

Table 12.5-29 District-Wise Social Category of Affected Households

District	ST	SC	OBC	General	Preferred Not to Answer	Total
Aizawl	421	0	0	0	215	636
Serchhip	244	0	1	1	238	484
Lunglei	415	0	0	0	252	667
Lawngtlai	40	0	0	0	49	89
Saiha	119	0	0	0	42	161
Total	1,239	0	1	1	796	2,037

Source: Baseline Survey

The result of religious affiliation overlaps closely with the respondents' social category. The result confirmed that Christianity is the dominant religious belief among Mizo.

Table 12.5-30 District-Wise Religious Affiliation of Affected Households

District	Christian	Hindu	Muslim	Buddhist	Other	Preferred Not to Answer	Total
Aizawl	419	2	0	0	0	215	636
Serchhip	246	0	0	0	0	238	484
Lunglei	413	1	0	0	1	252	667
Lawngtlai	40	0	0	0	0	49	89
Saiha	119	0	0	0	0	42	161
Total	1,237	3	0	0	1	796	2,037

Source: Baseline Survey

The educational attainment of household heads is shown below.

Table 12.5-31 Educational Attainment of Household Heads

Educational Attainment	Aizawl	Serchhip	Lunglei	Lawngtlai	Saiha	Total
No Education	30	16	43	3	13	105
Below Elementary	138	92	191	13	24	458
Completed Elementary	64	35	45	10	20	174

Educational Attainment	Aizawl	Serchhip	Lunglei	Lawngtlai	Saiha	Total
Below High School	136	70	72	5	27	310
Completed High School	27	16	27	6	17	93
Not completed College	8	9	12	2	10	41
Finished College (graduate or higher)	18	8	25	1	8	60
No Answer	215	238	252	49	42	796
Total	636	484	667	89	161	2,037

Source: Baseline Survey

(2) Vulnerability

According to the Reserve Bank of India, the share of the poor in Mizoram was 23% in the rural area and 7.9% in the urban area in 2012. However, the survey found out that over 40% of respondents or 446 households considered themselves as BPL household which may reflect their real coping capacity against negative impacts. Also, the project should take into account the fact that over 230 households are headed by women when the details of the rehabilitation plan is developed to ensure women's participation.

Table 12.5-32 Vulnerability Status of Affected Households

District	Women-Headed HH	HH Head Over 50	Widow In HH	Poverty Line*		
				Below Poverty Line	Above Poverty Line	Do Not Know/Not Aware
Aizawl	77	155	14	145	240	36
Serchhip	46	131	24	81	162	3
Lunglei	84	204	21	147	256	12
Lawngtlai	11	18	0	17	21	2
Saiha	15	54	7	56	62	1
Total	**233**	**562**	**66**	**446**	**741**	**54**

Note: BPL figure is based on self-judgment of respondents and may not be accurate.
Source: Baseline Survey

(3) Land Ownership Status of Affected Households

The land ownership in North East States including Mizoram can be broadly classified into following categories:

- Private Land with Land Settlement Certificates (LSC): Land holding of the owners is certified with land settlement certificate;
- Periodic Patta: A prescribed land settlement document setting agricultural land periodically whereby an individual has entered an agreement with the government to pay land revenue and taxes at the rate legally assessed or imposed in respect to the land being leased out;
- Village Council Pass (or Garden Pass): Issued by the village council which have traditionally acted as certificates of land ownership for agricultural purposes within the council's territory; and
- Government Land: Land owned by the government

The land ownership status of affected households is shown below.

Table 12.5-33 Land Ownership Status of Affected Household

Ownership Status	Aizawl	Serchhip	Lunglei	Lawngtlai	Saiha	Total
LSC	272	140	262	27	99	800
Periodic Patta	49	15	39	7	6	116
Home Site	18	36	5	1	1	61
Village Council Pass	82	55	108	4	13	262
Government Land	0	0	1	1	0	2

Ownership Status	Aizawl	Serchhip	Lunglei	Lawngtlai	Saiha	Total
No Answer	215	238	252	49	42	796
Total	**636**	**484**	**667**	**89**	**161**	**2,037**

Source: Baseline Survey

It has been observed that majority of the affected households has been living in the project areas for a period 11 to 30 years. This is in line with the fact that land transfer is not common in Mizoram which should be taken into account in the calculation of solatium.

(4) Occupation and Income of Affected Households

Table 12.5-34 Primary Occupation of Household Heads

Primary Occupation	Aizawl	Serchhip	Lunglei	Lawngtlai	Saiha	Total
Agriculture	73	42	117	5	1	238
Allied Agriculture	54	6	10	0	0	70
Dairy	2	4	20	0	4	30
Forestry	5	15	20	0	5	45
Household/Cottage Industry	1	3	3	1	1	9
Business/Trader/Shop Owner	108	40	36	4	4	192
Skilled Profession	74	36	32	4	6	152
Unskilled Labor	38	38	91	14	59	240
Private Service	19	6	12	4	3	44
Government Service	32	20	47	5	29	133
Retired/Pensioner	13	17	18	2	5	55
Unemployed But Capable To Work	0	17	2	0	2	21
Too Young To Work/Disabled/Student	1	0	3	1	0	5
Other	1	2	2	0	0	5
Total	421	246	413	40	119	1,239

Source: Baseline Survey

The monthly income of affected households has been summarized below. About 40% of the surveyed households have a monthly income between INR 5,000 and 10,000 while about 23% of them has a monthly income less than INR 5,000.

Table 12.5-35 Month Household Income

District	Average Monthly Income (INR)
Aizawl	9,879
Serchhip	12,791
Lunglei	14,024
Lawngtlai	15,515
Saiha	12,736
Average	**12,989**

Source: Baseline Survey

The baseline survey has identified a gap between official poverty level and poverty level as reported by the people. R&R activity should take into account the limited coping capacity of the local community and develop measures that lead to sustainable income generation of the affected people, rather than a one-off payment of compensation and assistance.

(5) Gender

Tribal and non-tribal women in North East States enjoy a relatively higher position in the society than what their non-tribal counterparts do, which is reflected in their high literacy rate. Mizo women are largely involved in household work, collection of forest produce, firewood collection, cultivation, and other agricultural activities and thus they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in the RAP (Chapter 10) in which options to facilitate women's participation in project implementation and various opportunities to be created by the project is discussed.

(6) Cut-off Date

The preliminary cut-off date for land acquisition is May 14, 2015, which is the completion date of the baseline survey, and was informed to the project affected households during the survey. Formal cut-off date for the Project will be announced to the project affected villages/households through notification during the final inventory survey after the final ROW drawing is developed.

(7) Impact on Affected Households and Structures

Out of 1,971 households, 1,265 will have to be resettled while 706 will be partially affected. Meanwhile, 42 business structures will have to be relocated whereas 24 such structures will be partially affected. The types of affected structures per block are shown below.

Table 12.5-36 Type of Affected Structures Per District

District	Housing	Shop[1]	Public Building	Religious Structures	Utilities[2]	Total
Aizawl	602	34	29	2	35	702
Serchhip	473	11	19	2	19	524
Lunglei	658	9	25	2	45	739
Lawngtlai	86	3	3	1	5	98
Saiha	152	9	6	1	20	188
Total[2]	1,971	66	82	8	124	2,251

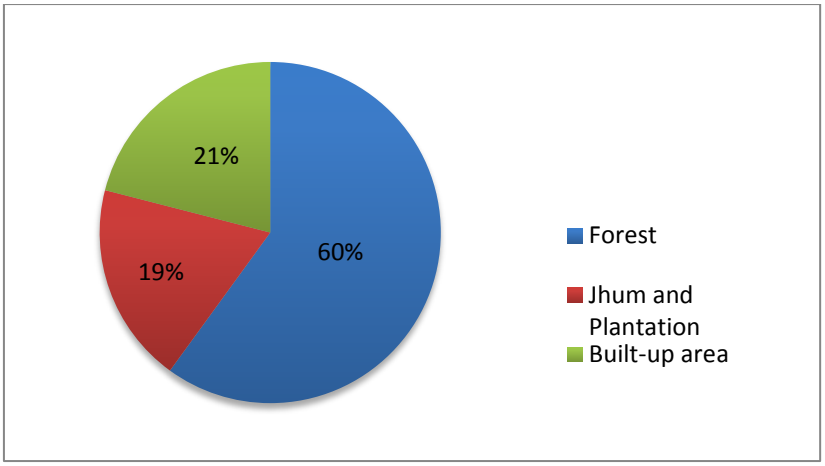
Note: [1] Tea stall, restaurant, petty shop; [2] Well and toilet
Source: Baseline Survey

Based on the baseline survey, all households are considered as titleholder (i.e., in possession of (LSC, periodic patta, village council pass) except for two households (one in Lunglei and the other in Lawngtlai) who reside on government land[9].

(8) Impact on Land

The project requires additional land area of 624.6 ha, out of which 435.5 ha is required for widening and improvement work. In addition, 160.3 ha is needed for disposing surplus soil and 28.8 ha for construction of resettlement sites. The candidate locations for surplus soil disposal have been identified during the preliminary design and the budget for disposal, including measures to prevent soil erosion, have been included in the project cost. However, the sites will have to be verified after the additional topographic survey and in consultation with affected community as well as state/district government. The breakdown of land to be acquired by type based on the field survey and satellite data is shown below.

9 For those who did not answer land-holding status, they are assumed to be titleholders based on the land-holding conditions of their neighbor.



Source: JICA Study Team

Figure 12.5-12 Breakdown of Affected Land to by Type

The proper disposal of surplus soil is critical to avoid soil erosion and damage to productive land and forest. At the same time, the disposal sites must be located near the sites where surplus soil is generated to save on transport cost and reduction in related emissions/noise. The candidate sites should satisfy the following conditions:

a) Ground shape with concavity topography;
b) Ground gradient less than 22 degrees which is assumed as the average angle of spoil bank slope with necessary steps, and the height is less than 30 m; and
c) Not close to the built-up area.

Along the 381 km stretch, a total of 115 locations have been identified that have enough capacity to handle surplus soil generated from this project. The distance between each site is less than 5 km.

(9) Impact on Trees and Crops

Jhum land and bamboo plantations, as well as wild trees along the road, will be affected by the project. Fruit bearing trees (banana, mango, jackfruit, other citrus fruit, etc.) will also be affected. Since the ROW drawing for the widening and improvement is yet to be finalized, the counting exercise of affected trees has not been carried out at this stage. Indeed, the rationale of counting exercise should be reviewed again given the widespread of jhum practice along the road. The forest area, immediately after burning (for jhum), will be without trees and if counting method will be used as the basis of compensation, the trees in the jhum area will not be compensated. Should counting exercise be carried out in the detailed design stage, it should take into account the cycle of jhum to avoid such underestimation. Meanwhile, the budget for compensating trees and crops has been provisionally estimated based on the affected area (approximately 125 ha. Social Impact based on the estimate shown in Section 5.3) and weighted average price of trees/crops are identified during the survey.

12.5.15 Resettlement Policy

The World Bank-funded Regional Transport Connectivity Project, a RAP report targeting the state highway in Lunglei and Lawngtlai districts was prepared in 2014. This RAP was prepared as per World Bank's Safeguard Policy, and as such, broadly in line with the requirements of JICA. The resettlement policy and entitlement matrix proposed in this RAP builds on a WB-funded project with revisions/updates based on changes/differences in socioeconomic conditions and new provisions laid out in LARR 2013.

In this backdrop, the resettlement policy framework aims to:

- Update the resettlement policy that was followed in the previous project in Meghalaya/West Garo

Hills in line with the provisions of new relevant acts and rules and other projects being implemented with financial support from multilateral funding agencies with safeguard policies comparable to that of JICA;
- Bring together and build upon the previous experiences and good project implementation practices;
- Enhance institutional capacity at the project level for implementation of RAP and livelihood restoration activities; and
- Establish mechanism and processes for fair grievances redress with respect to land acquisition and compensation and any other matters associated with RAP.

For the above objectives, the policy framework builds on the following principles:
- Involuntary resettlement shall be avoided to the extent possible or minimized where feasible, exploring all viable alternative project designs and also take due precautions to minimize disturbance to habitations and places of cultural and religious significance;
- Where displacement is unavoidable, people losing assets, livelihood or other resources shall be assisted in improving or at a minimum regaining their former status of living at no cost to themselves; ensure that the socioeconomic conditions of the project affected persons (PAPs) actually improve after implementation of the project;
- Share information, consult, and involve PAPs and local persons from preparation stage in issues of land acquisition, loss of livelihood, and in identifying social issues likely to arise during project implementation;
- Ascertain broad community support based on free, prior, and informed consultation;
- Pay special attention to marginalized and vulnerable groups and secure their participation;
- Ensure payment of compensation and assistance to PAPs at replacement cost prior to any displacement or start of civil works;
- The common property resources will be replaced if feasible and assistance will be provided at replacement value to the group;
- All land acquisitions will be carried out after issuance of notifications for harvesting of crops;
- Ensure that project does not involve any kind of activities involving child labor; and
- Ensure equal opportunities and wage to women/female workers.

12.5.16 Entitlement Matrix

The entitlement matrix has been developed in accordance with the principles adopted and analysis of initial identification of project impacts. The entitlement matrix recognizes and lists various types of losses associated with the project and provides the basic tools and guidelines for preparation of compensation and resettlement packages.

Table 12.5-37 Entitlement Matrix

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Agricultural Land	Titleholder	Household	Compensation at Replacement Value and Assistance	a) Land for land, as much as possible or cash compensation for the land at replacement cost, which will be determined by the district collector. b) If the compensation amount is less than the replacement cost mentioned above, the difference amount will be paid as assistance. c) If the residual land is unviable for agriculture, PAPs shall have the following three options: ● Compensation for affected land and continue on the remaining unaffected plot of land; or ● If eligible person surrenders the residual plot, then compensation and assistance given for the entire plot of land; or ● Replacement land, if so wished by eligible persons, subject to availability of land that is at least equally productive. d) Resettlement allowance of INR 50,000 will be provided to those who do not get land for land, irrespective of the size of land. e) Subsistence grant equivalent to INR 3,000 (MAW: Minimum Agricultural Wage) per month for six months. f) In case of severance of cultivable land, an additional grant of 10% shall be paid over and above the amount paid for land acquisition. g) Four (4) months' notice to harvest standing crops shall be given. However, if the notice cannot be given then compensation for these crops shall be paid at market value.
	Periodic Patta Holder/Temporary Village Pass Holder		Assistance	a) Land for land, if available, if not, replacement value of land as determined by the district collector shall be given to land owners/holders. b) Resettlement allowance of INR 50,000 will be provided to those who do not get land for land, irrespective of the size of land. c) Subsistence grant equivalent to INR 3,000.00 per month (MAW) for six months. d) Four (4) months' notice to harvest standing crops shall be given. However, if the notice cannot be given then compensation for these crops shall be paid at market value.
Non- Agricultural Vacant Land (Homestead, Commercial, and Others)	Titleholder	Household	Compensation for Structure at Replacement Cost Plus Assistances	a) Replacement cost for structure at the latest basic schedule of rates (BSR) without depreciation with a minimum of INR 150,000.00 b) Two (2) months' notice for removal of structure. c) In case of partially affected structures and the remaining structure continues to be viable, in such case an additional assistance equivalent to 25% of the

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
				replacement cost will be paid towards repair/restoration of the structure. d) Right to salvage materials from the demolished structure e) For the displaced eligible persons whose remaining structure is unviable, the following shall be payable: ● Subsistence grant of INR 3,000 per month for a period of twelve (12) months from the date of displacement. ● One time resettlement allowance of INR 50,000 ● Transportation cost of INR 50,000.00 for shifting family, building materials, domesticated animals, etc. ● Lumpsum assistance amount of INR 7,500 for re-establishing other basic facilities such as electricity connection and water supply pipeline. ● All fees, taxes, and other registration charges incurred for the replacement structure. f) Compensation in a form of residential/commercial lot at the resettlement site if opted by 15 or more PAPs with payment and free of cost for vulnerable groups will be provided. The size of the lots will be equal to the area lost or a minimum of 35 m^2 for house and 15 m^2 for shop.
	Periodic Patta Holder/Temporary Village Pass Holder			For Land ● Subsistence grant equivalent to INR 3,000.00 per month of MAW for six months. ● Four (4) months' notice to harvest standing crops/trees shall be given. However, if the notice cannot be given then compensation for these crops shall be paid at market value. For Structure ● Replacement cost for structure at the latest basic schedule of rates (BSR) without depreciation with a minimum of INR 150,000.00 ● Two (2) months' notice for removal of structure. ● Right to salvage materials. ● Lump sum transportation cost of INR 50,000.
Loss of Plants/Trees	Owner/Occupant	Household	Compensation	Revenue Department or special committee to determine the current cost. For perennial fruit bearing trees such as pineapples, jackfruits, etc., the average productivity of such trees is 20 years.
Loss of Cattle Shed, Poultry Shed or Any Other Shed for Domestic Animals	Owner/Occupant	Household	Compensation	INR 600 per m^2 for thatched roof and INR 1,000 per m^2 for GCI sheet roof (to be paid as per revised/latest available updated basic schedule of rates for buildings). In case of non-revision, a 10% premium per year will be added to the latest rate available.

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Loss of Residence/Commercial Unit	Tenant	Household	Assistance	a) The amount of deposit or advance payment paid by the tenant to the landlord or the remaining amount at the time of expropriation (this will be deducted from the payment to the landlord). b) Subsistence grant of INR 3,000 per month for a period of twelve (12) months from the date of displacement c) Lump sum shifting allowance of INR 15,000
Loss of Kiosk	Owner/Occupant	Household	Assistance	a) Lump sum shifting allowance of INR 7,500 b) Right to salvage materials from the existing structure
Loss of employment	Wage Earner	Household	Assistance	a) Economic rehabilitation grant equivalent to twenty-five (25) days of MAW per month for a period of three months. b) Priority work opportunities in the project construction work. c) INR 20,000 towards vocational/skill improvement as per choice.
Loss of Livelihood (losing commercial unit, losing agricultural land, and with balance land below MEH)	Titleholder/Periodic Patta holder/Village Pass holder	Household	Assistance	d) Priority work opportunities in the project construction works. e) INR 20,000 towards vocational/skill improvement as per choice. The amount will cover daily stipend equivalent to MAW for the duration of training and shall also cover costs towards boarding, lodging, transportation, etc.
Additional Support to Vulnerable Groups	Titleholder/ Periodic Patta holder/ Village Pass holder	Household	Assistance	One time additional financial assistance of INR 25,000 as economic rehabilitation grant towards income generation.
Loss of Jhum/Fallow Land	Village	Village	Compensation at 'Replacement Value'	Replacement value for the common property transferred/acquired shall be paid to the village council and the amount will be utilized through participatory planning by the villagers within six months from date of release of payment. PIU shall monitor its utilization
Loss of Common Property Resources	Village	Village	Enhancement of Community Resources	Replacement/restoration or augmentation of existing infrastructure and provision of additional infrastructure facilities based on identified needs.
Loss of Access	Village	Village	Alternate Access	Provision of access path(s), steps, and footpaths at identified locations in consultation with the community.
Temporary and Unforeseen Impacts	Affected Entity	Household	Mitigation Measures in line with Principles of the Resettlement Policy Framework	Unforeseen and temporary impacts during construction will be documented and dealt with on a case-to-case basis through the GRM in accordance with the principles laid down in the resettlement policy framework.

Source: JICA Study Team

12.5.17 Grievance Redress Mechanism (GMS)

The Grievance Redress Mechanism (GMS) involves formation of Grievance Redress Committee (GRC). The main objective is to provide a step-by-step process of registering and addressing the grievances with respect to land acquisition. It is expected that this mechanism will ensure redress of disputes through participative process. The mechanism and principles of GMS are built on the provisions laid out in the Right to Information Act, 2005 (see below).

Right to Information Act, 2005
The Right to Information Act, 2005 provides for setting out the practical regime of right to information for citizens. Under the provisions of the Act, any citizen may request information from a "public authority" (a body of government or "instrumentality of state") which is required to reply expeditiously or within thirty (30) days.

The Act also requires every public authority to computerize their records for wide dissemination and to proactively publish certain categories of information so that the citizens need minimum recourse to request for information formally. Thus, under the Act, citizens have right to seek information from concerned agencies by following the set procedures.
Source: Right to Information Act, 2005

Source: JICA Study Team

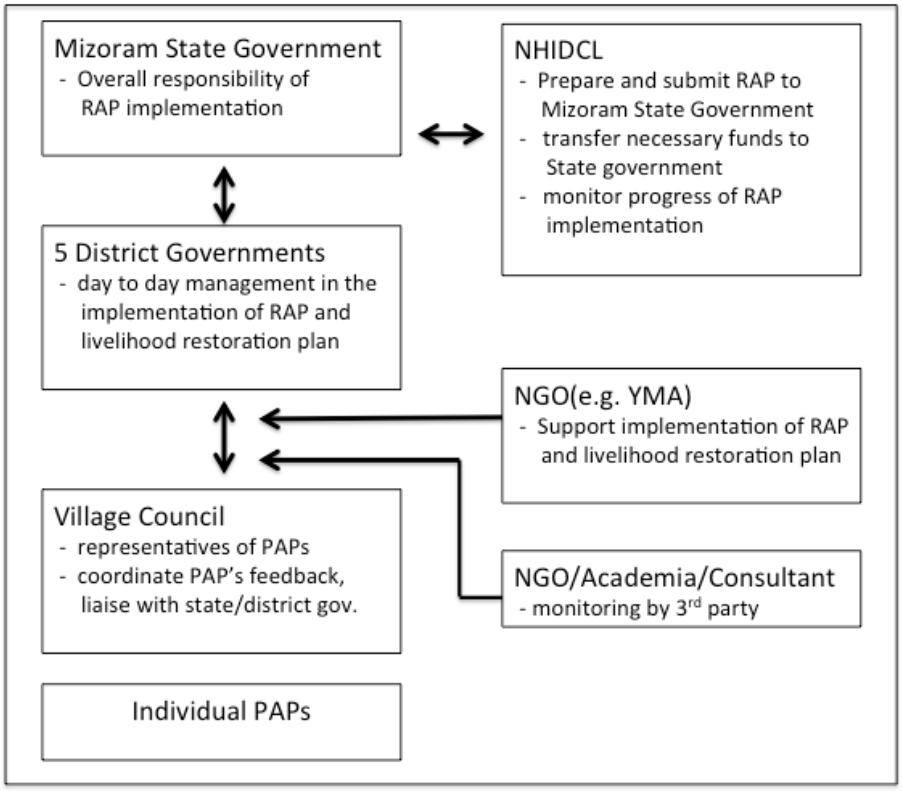
Figure 12.5-13 Right to Information Act, 2005

The first tier of GMS takes place at a village/block level and involves a physical verification and certification upon receipt of any grievance such as inaccurate measurement of impacted asset, loss of access, and damage to structures and/or crops during construction. The verification and certification will be carried out by the RAP implementation agency, *Nokma* and/or members of the village council, in the presence of PAPs who file the grievance, and appropriate documentation would be done. Response would be provided to the concerned PAP within 7-10 days from the receipt of the grievance. Financial implications of any changes would be presented to the GRC for consideration and approval.

The second tier of resolution will be undertaken by GRC. A district-level GRC will be formed by the project authority within one month from the date of mobilization of RAP implementation agency at the site. The GRC will comprise a project director, NHIDCL; PWD; deputy commissioner of West Garo Hills; representatives of the concerned village council or his/her authorized representative, PAPs, and RAP implementation agency. Grievances of PAPs in writing will be brought to GRC for redress by the RAP implementation agency. The RAP implementation agency will provide necessary assistance to PAPs in presenting his/her case before GRC. The GRC will respond to the grievance within seven days. The GRC will meet once in 15 days but may meet more frequently depending upon the number of such cases. However, after convening the first GRC meeting, it will not hold any meeting until such time any grievance is brought to GRC for redressal. Grievances brought to GRC shall be redressed within a time period of one month (30 days) from the date of receipt of the grievance. The decision of GRC will not be binding to PAPs. In other words, the decision of GRC does not bar PAPs in taking recourse to a court of law.

12.5.18 Institutional Arrangement for RAP Implementation

As per the Indian regulatory framework, activities related to resettlement and rehabilitation will be carried out by the state government. Given the autonomous characteristics of Mizoram and its district, it is proposed that the district, as well as village council and traditional village leaders, also play a major role in implementing RAP. At the moment, NHIDCL has regional offices in Guwahati, Assam, and for this project, it is expected that a project office (Project Implementation Unit: PIU) will be set up in Tura. A dedicated NHIDCL staff (or expert hired by NHIDCL) will work closely with the state and district/village officials to ensure that the implementation of RAP is in line with JICA Guidelines for Environmental and Social Considerations. Institutional arrangement includes provisions to strengthen the capacity of PIU and PWD with regard to land acquisition and implementation of RAP and management of other social issues. The project institutional arrangement is shown below.



Source: JICA Study Team

Figure 12.5-14 Institutional Arrangement for RAP Implementation

12.5.19 RAP Monitoring and Evaluation

Monitoring and evaluation are important activities of any infrastructure development project, and even more so for projects involving involuntary resettlement. It helps make suitable changes, if required, during the course of RAP implementation and also to resolve problems faced by the PAPs. Monitoring is periodical checking of planned activities and provides midway inputs, facilitates changes, if necessary, and provides feedback to project authority for better management of the project activities. On the other hand, evaluation assesses the resettlement effectiveness, impact, and sustainability. In other words, evaluation is an activity aimed at assessing whether the activities have actually achieved their intended goals and purposes. Thus, monitoring and evaluation of RAP implementation are critical in order to measure the project performance and fulfillment of project objectives.

Table 12.5-38 Summary of Monitoring Activity

Type	Frequency	Prepared by	For	Report Contents
Internal RAP Monitoring	Quarterly	PIU	NHIDCL/ State Government	A 10-15 page report (plus supporting documentation) summarizing progress against the RAP, outline of any issues and agreed related actions, summary schedule of grievance status, minutes of any stakeholder or affected people consultations or meetings.
External Monitoring	Half-yearly	Expert Panel	NHIDCL/ State Government	A 25-35 page report (plus supporting documentation) summarizing assessment of progress towards living standard restoration, livelihood restoration, compliance with JICA Guidelines, discussions of any RAP issues of concern, identification of any areas of non-compliance and agreed corrective actions, and summary or resettlement status.
Completion Audit	One-off	Expert Panel	NHIDCL/ State Government	RAP Completion Audit to verify NHIDCL has complied with undertakings defined by the RAP and that land acquisition and compensation has been completed in accordance with JICA Guidelines.

Source: JICA Study Team

12.5.20 Rehabilitation Plan

The socioeconomic survey of the PAPs (the details can be found in a RAP report) indicates that the main sources of income in the project influence area are agriculture and small business enterprises. The population has limited capacity to benefit from the livelihood opportunities created under the development projects or any government sponsored program. One of the key principles of the RAP is to ensure that the livelihood of PAPs will be improved, or at least restored compared with the pre-project level. The project will provide income restoration opportunities by way of skills development training and linkage with the ongoing government schemes for this purpose. The rehabilitation plan will therefore aim to support PAPs to regain their previous living standards by creating income generation opportunities as well as improving PAPs capacity to benefit from various economic opportunities developed by the project. The rehabilitation plan will be developed and implemented by the state government in the course of this project and the details of the plan should be tailored with inputs from stakeholders in the later stage of the project. Keeping JICA and World Bank policies in perspective, their guidelines and principles are proposed for inclusion to the rehabilitation plan.

Shared Market Place

While the road widening and improvement proposed under the project are expected to facilitate trade across borders, these roads also may have the potential to boost local level trade and improving linkages of the villages in the interiors with the local and regional markets. At the same time, relocation is likely to cause negative impact on households along the road who have benefited from the roadside location suitable for business. It is recommended that project creates benefit sharing arrangements with communities along the project roads and build capacity for increasing the production and trade potential, for example, through construction of common market place in a convenient location along the road where community members can buy and sell agricultural goods and engage in small businesses.

Backyard Poultry

Many households rear chicken for their own consumption but rarely doing it commercially. Small marketing effort may work to the benefit of the producer.

Support for Expanding Plantation

Insufficient supply of saplings is a barrier for initiative towards better methods of farming. Productivity of cashew, rubber and other plantations along NH54 can be enhanced through supply of quality saplings.

12.5.21 Resettlement Budget

The resettlement budget comprises estimated value of compensation for land, structures, trees, various resettlement assistances, cost of CPRs, institutional cost, contingency, hiring of RAP implementation agency, HIV/AIDS awareness generation, capacity building, external monitoring and evaluation consultant, among others. The total resettlement cost for the project road is estimated at about INR 3,889,710,000.

The resettlement and rehabilitation budget has been estimated based on the information, data collected from field, and other secondary sources. The budget shall be updated and adjusted as per the market rate of various items as the project continues. The compensation amount for assets shall be determined by the land acquisition officer of the project to be hired for the implementation of RAP. The breakdown of budget for different components is provided in Table 12.5-39 below.

Table 12.5-39 Resettlement Budget

Item	Unit	Unit Cost	Quantity	Total (Rs)
I. Compensation				
Land (construction)	ha.	900,000	435	391,500,000
Land (surplus soil)	ha.	700,000	160.3	112,210,000
Rural area multiplier	*the land price will be double for compensation of rural area land			503,710,000
Structure	Sq. m	7,500	20,000	150,000,000
Public toilet, water point	No.	50,000	20	1,000,000
Crops	No.			90,000,000
Solatium	*100% of compensation as per LARR 2013			1,248,420,000
Sub-Total (I)				2,496,840,000
II. Allowance				
Moving allowance	Household	50,000	1500	75,000,000
Subsistence allowance	Household	18,000	2000	36,000,000
Assistance to vulnerable	Household	20,000	1000	20,000,000
Training	Household	20,000	2000	40,000,000
Sub-Total (II)				171,000,000
III. Implementation				
Expert fees	Lump sum			20,000,000
Staff training	Lump sum			3,000,000
External monitoring	Lump sum			5,000,000
Information disclosure	Lump sum			1,500,000
Livelihood restoration	Lump sum			15,000,000
Sub-Total (III)				44,500,000
Sub-Total (I+II+III)				2,712,340,000
Contingency (10%)				271,234,000
Total				2,983,574,000

Source: JICA Study Team

12.5.22 Resettlement Schedule

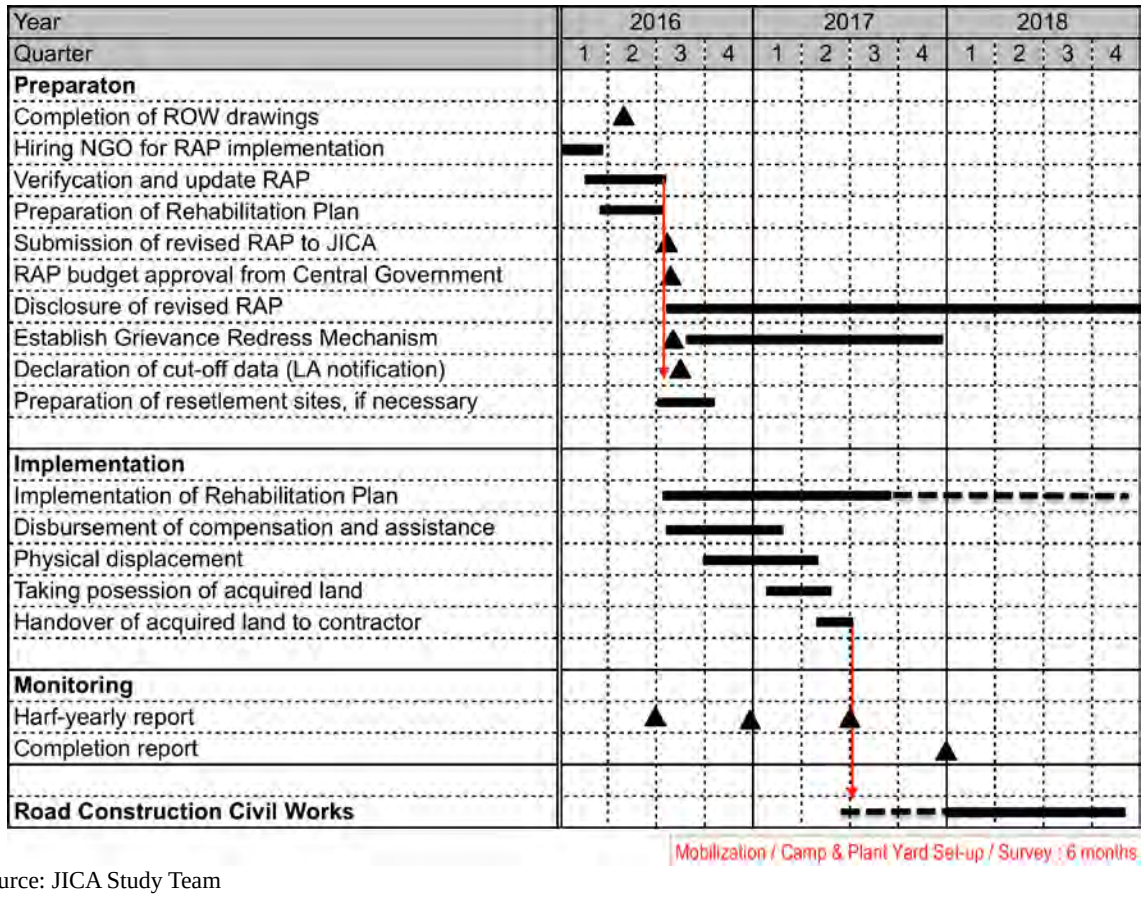
The implementation of RAP consists of following major activities:

- Deployment of required staff (at PIU and village/block level);
- Information dissemination activities by holding consultations, distributing leaflets containing salient features of resettlement policy, and entitlement matrix in Garo language;
- Verify and update the list of PAPs and their status through detailed measurement survey (DMS), list, and measure all properties and assets affected and their estimation;
- Preparation of micro plan (RAP implementation at the village/block level);
- Disburse of R&R assistance to PAPs, which may include preparation and distribution of identity

card and opening of back account;
- Relocation and rehabilitation of CPRs; and
- Preparation for relocation of PAPs.

Considering the long rainy season prevaling in the project area and in the whole state, approximately a period of 5-6 months (May-October), during these times, the area is not available for construction works. The RAP implementation period is proposed to be for 24 months, but this needs to be scheduled in a manner so that initial activities such as verification, measurement, etc., can be completed during the dry period. The other activities such as preparation of microplan, approval, disbursement, and other necessary documentation can be completed during the rainy season. RAP implementation activities to be carried and respective agencies likely to be involved for each activity are presented in the Table below.

Table 12.5-40 Resettlement Schedule



Source: JICA Study Team

12.5.23 Stakeholder Consultations

Stakeholder consultation is an important method of involving various stakeholders particularly the local community with reference to the proposed development initiatives. Consultations provide a platform to participants to express their views, concerns, and apprehensions that might affect them positively or negatively. This process is of particular importance for this project given the high ST share among the affected population. The World Bank OP 4.10 on Indigenous Peoples emphasizes “a process of free, prior, and informed consultation (FPIC) with the affected Indigenous People’s communities at each stage of the project, and particularly during project preparation, to fully identify their views and ascertain their broad community support for the project." Consultations for this project adopted the following framework to ensure a process of FPIC:

a) Conduct appropriate gender and inter-generationally inclusive consultations with the Project affected peoples’ communities, affected peoples' organizations (village council, women's groups, etc.), and other local civil society organizations (NGOs) identified by the affected peoples'

communities;

b) Use consultation methods appropriate to the social and cultural values of the affected peoples' communities and their local conditions (including using local languages, allowing time for consensus building, and selecting appropriate venues) and give special attention to the concerns of women and their access to development opportunities and benefits; and

c) Provide the affected peoples' communities with all relevant information about the project (including an assessment of potential adverse effects of the project) in a culturally appropriate manner.

The purpose of consultations was to inform people about the project, take note of their issues, concerns, preferences, and allow them to make meaningful choices. It ensured participation of potential Project Affected Persons (PAPs), local community, and other stakeholders. People in general were informed in advance through invitation letter and phone calls and allowed to participate in a free and fair manner. During these consultations, PAPs were informed about the project, likely scale of resettlement, its resettlement policy, including compensation based on full replacement cost, resettlement assistance, schedule, and grievance mechanism. Consultations provided meaningful contributions with regard to appropriate compensation, sufficient allowance for resettlement, livelihood restoration, reducing adverse impacts, address safety issues, etc. Most stakeholders expressed their needs for compensation at a full replacement cost and some stakeholders expressed their concerns regarding assistance for relocation; however, no objections were raised concerning the implementation of the project and to compensations based on replacement cost during both stakeholder consultations and door-to-door census surveys. The following sections present details of the consultations:

(1) First Round of Consultations with the Communities

The first round of district level meetings was held in all five districts. It witnessed participation from Project Affected Persons, representatives from district level line departments, elected representatives, civil society, local NGOs, and other opinion leaders. These consultations/meetings were used as a platform for dissemination and disclosure of key information about the project, key components, alignment, affected villages, applicable laws and policies related to environmental and social considerations. It also sought to capture the participants' perception about the project, concerns and suggestions with respect to proposed alignment, and existing policies and practices for management of environmental issues. The type and number of participants to each meeting is shown below. To ensure sufficient participation of PAP during consultation, village representatives from each affected village who attended the consultation agreed to share the meeting contents with other members in the village and share their feedback, if any.

Table 12.5-41 Participation Details of First Round of Consultation

District	Date	Total No. of Participants			Representation (No.) from					
		Total	M	F	Govt. Dept.	Village Council	NGO	MCHP*	District Taxi Union	Affected HHs
Aizawl	14-May-15	25	22	3	4	3	3	3	1	11
Serchhip	08-May-15	90	75	15	6	12	14	8	2	48
Lunglei	05-May-15	144	110	34	7	25	22	19	2	69
Lawngtlai	16-Apr-15	46	40	6	2	11	10	6	1	16
Saiha	13-Apr-15	58	42	16	3	8	7	12	1	27

Note: * Mizo Hmeichhe Inswikhawm Pawl (MHIP) is a women group presenting across Mizoram.
Source: JICA Study Team

(2) Second Round of Consultations with the Communities

The second round of district level meetings was held in all five districts. Reflecting the number of villages in Lunglei District, two meetings were held in Lunglei this time. The type and number of participants to each meeting are shown in Table 12.5-42 below.

Table 12.5-42 Participation Details of Second Round of Consultation

District	Date	Total No. of Participants			Representation (No.) from					
		Total	M	F	Govt. Dept.	Village Council	NGO	MCHP*	District Taxi Union	Affected HHs
Aizawl	26-Aug-15	37	34	3	2	13	9	6	2	15
Serchhip	24-Aug-15	85	60	25	3	26	22	14	1	32
Lunglei	13-Aug-15	78	55	23	4	28	19	10	2	34
	17-Aug-15	90	64	26	1	31	28	22	1	38
Lawngtlai	16-Aug-15	56	40	16	2	18	18	8	2	18
Saiha	20-Aug-15	52	39	13	3	19	14	6	1	16

Note: * Mizo Hmeichhe Inswikhawm Pawl (MHIP) is a women group presenting across Mizoram.
Source: JICA Study Team

(3) Supplementary Consultation with Village Council to identify preference on resettlement

In addition to the 2-round consultations, a supplementary consultation targeting Village Council members of the affected villages was carried out to identify preference of PAPs about compensation mode. Majority of the VC said that PAPs would prefer cash compensation to land-for-land compensation as the former gives PAPs more flexibility in terms of where to resettle, while several VC members noted that the answer would depend on the amount of cash compensation.

The summary of discussion outcomes from the district level stakeholder consultation/meetings is presented in Table 12.5-43.

(4) Outcome of Consultations

The summary of discussion outcomes from the district level stakeholder consultation/meetings is presented in Table 12.5-43.

Table 12.5-43 Summary of District-level Consultations

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
Aizawl	General: About the project, alignment, components and its significance • Participants, specifically the line department officials present in the meeting, underscored the significance of the project and the advantages that will come with the widening and improvement of the existing highway. • A public representative suggested that road widening should not be uniformed across the entire length and it should also consider the habitation pattern and its density and design accordingly. • A public VC representative from Tlangnuam, extended support to the community despite this affecting several houses if it was for the benefit of the society and the state. • Another representative from Tuirial, opined that the	The degree of widening will be modified depending on the geographical conditions and development status of the area.

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
	state will any way be providing compensation for losses, it is still better for the residents to prepare themselves for the impacts, positive or negative. A sentiment from the representatives from Tlangnuam who believed that the community should also join in and provide support for the project if they desire for development. Project Concerns and Issues: On Land Acquisition, R&R Processes and Impacts • Some of the participants, from among the potentially affected households, cited challenges that they would face if their houses are to be demolished because of the project. A widow pointed out that she alone fends for herself and that it will be difficult for her to construct a new house on her own. Few others suggested that Affected People's consent should necessarily be acquired before the government decides on the project and that such decisions should be in the interest of the property owners. • One of the participants suggested that for every village there should be a group of people identified for coordination of project activities and that one of them be appointed as public relations officer (and with some honorarium attached for his/her role functions). • Some of the participants also shared their expectation that the compensation should be made at market/replacement cost. • Few others suggested that Few others suggested that there should first be a public hearing in each of the villages before commencement of the project execution. Others • A representative from a local drivers' union suggested that there should be a coordination committee set-up for the execution of the project that will also keep away greedy and opportunistic elements away from siphoning of the benefits of the project. The union will be in full support of the project. • Recognizing the benefits of the project, participants highlighted the need for awareness campaign as part of community mobilization and preparedness for the project, to make them aware about the project and its benefits. This would require rounds of public meetings and consultations, and also a sound compensation award system. In summary, the project finds a positive response from the people with broad suggestions after going around and engaging with local affected community, their representatives, discussing about compensation at market value, and efforts to minimize environmental impact. The affected otherwise are willing to cooperate and support the infrastructure development project.	Vulnerable groups, such as widows, will be entitled to receive additional support, including allowance and assistance in income restoration and rehabilitation. The consent of local community will be secured before the project approval. To be reflected in the implementation of RAP The compensation will be made as replacement cost. Village-level consultation will be held in preparation of the final RAP and R&R plan
Serchhip	General: About the Project, Alignment, Components, and its Significance • Public representatives in general appreciated the	

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
	project and significance it will have in people's life. • Similar sentiments were made by other participants and specifically in the context of Serchhip Town, for which they wanted it to be diverted away from the main town area. Project Concerns and Issues: On Land Acquisition, R&R Processes, and Impacts • One of the participants (from YMA) pointed out at 'Compensation' as the major challenge for projects of this nature. He suggested that to get over this, the project should consider bypassing the major settlement areas which will also reduce compensation costs. • Another YMA representative highlighted the need for adequate awareness generation among people. He also cautioned against unwanted political and bureaucratic hurdles/vested interest that sometimes come in the way of development projects. He therefore suggested the project proponents to work towards earning goodwill and trust among people for this project. • VC representatives present in the meeting too shared the opinions expressed by YMA around engaging with people. And more importantly the need to be fair and diligent in compensation awards and identification of award beneficiaries. • Further on the issue of compensation, village representatives wanted the award to be completed before commencement of physical works as people will have time to resettle to new location. • Participants also suggested for a public meeting in each village that will also enable amicable resolution, if any, that will arise and related to the project. • Participants from Darlawng too highlighted the need for public hearing as 2-3 villages in their vicinity will be affected because of the project. • Meeting also discussed the need for a fair and reasonable compensation while efforts should be made to minimize property and land loss. Others • Participants in general suggested a public meeting in the village to know about their opinion, concerns, and suggestions related to alignment. They also wanted the alignment to minimize blind curves by construction of bridges or cutting. They also want minimal damage to environment and ecology in their villages. In summary, the project is expected to find support among the people. Suggestions include the need to have public meeting in each village, need for fair compensation policy, and practice and ensuring minimal damage to environment.	Four bypasses are proposed to avoid densely built-up area including Serchhip. Local community will be informed of throughout the preparation and implementation of the project. Community engagement will continue through the preparation of final RAP and R&R plan. Award of compensation will be made before construction work begins. Village-level consultation will be held in preparation of final RAP and R&R plan The preliminary ROW drawing makes the best effort to avoid impact on existing structures.
Lunglei	General: About Project, alignment, components and its significance • Representatives from YMA while sharing their opinions recognized the importance of the project but at the same shared their belief that the project is	

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
	being executed as part country's strategic defense policy. Project Concerns and Issues: On Land Acquisition, R&R Processes, and Impacts • Highlighting the critical issue of compensation, the YMA representative wanted the compensation award estimation to factor in actual loss to people, keeping in mind that each house will have different internal furnishing and hence the amount cannot be decided just on the basis of super structure. This issue will crop up as a major hurdle and that there should be no vested interest or partisan politics played by the state on these aspects. • Representatives from a women organization while welcoming the project for its development benefits, also cautioned on associated risks that it will bring primarily because of increased traffic and influx of outside element that may damage the culture and environment of the area. • For a student representative, present in the meeting, it was difficult to imagine the project impacts. He however, suggested that widening the road uniformally may cause extensive damage and hence it may be reduced a little considering the topography of the region. Related suggestion from few others was that the widening should be done only outside the village (settlement) peripheries and not within. • Issues of compensation and need for fairness in amount of compensation and award process were raised by few participants. Participants wanted award to be given in cash and the amount to be acceptable to affected households. While few other participants suggested that the government should buy some unaffected private land where affected households can be relocated. • Participants also wanted the R&R policy be designed in view of large number of households that will be affected. Others • The forest department representative also highlighted that the road construction needs to be of good quality and should use stone chips brought from other states as the soil and the rock type in the state is very soft in texture and strength and not suitable for construction. He cited an example of one road constructed by the Tantia Group in the past. He further suggested that adding asphalt to construction materials would add to the strength and life of the road constructed. • An ex-MLA expressed his apprehension emanating from corruption that may hit the quality aspects of the project although the project in itself is about the good of people. Similar sentiments were expressed by some other participants as well mainly identifying state administration for this practice. Participants were visibly unhappy about the road condition in the state especially when compared with the road quality in some of other Indian states.	Appropriate safety measures will be implemented. The degree of widening will be modified depending of geographical conditions and development status of the area. ' The compensation will be made in the replacement cost. The project will prepare resettlement site, but PAPs can take cash compensation should they choose so. R&R will be developed in consultation with local community.

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
	Meeting discussion suggested for overall approval and appreciation for the project. However, corruption and compensation were two major discussion points. Furthermore, concerns around landslide, dumping of excavated soil, etc., were raised by the participants. The width of road was another item discussed in the meeting and suggestions made on the necessity of widening it by 12 m unifomally across the length of the road.	
Lawngtalai	General: About Project, Alignment, Components and its Significance • Participants in general shared positive opinions during the discussion. They, nonetheless, had some concerns about compensation and environmental and health hazard (mentioned below). Project Concerns and Issues: On Land Acquisition, R&R Processes and Impacts • One of the major discussion points was around widening of the road within the town area of Lawngtlai. Some of the public representatives shared the opinion that the NH54 may have a diversion from AOC (using MMTP road) and connecting directly to Nalkawn, thereby bypassing the core town area. • Another suggestion in this regard from another participant was that the diversion should be from AOC2, western side of circuit house via power house to tourist lodge. • One of the participants also shared his concern around compensation issue and shared the experience from MMTP road constructed in the past. As per him, more than 100 affected families have not received compensation till date and that this project should have system in place to avoid such incidences. Similar delays were also experienced by few families when NH54 was being constructed in the 1970s. • Another participant (a public representative) while supporting the project mentioned that the implementing agency should assign good public relation officer or grievance cell and should not repeat the mistakes and the practice done the past MMTP and World Bank project. He also suggested for entrusting the revenue department instead of the line department like PWD for compensation and R&R activities. • Queries were made regarding types and extent of help that the state will provide the affected households in R&R. Participants broadly have positive views about the project and its significance. They, however, have bad experiences regarding compensation award process from similar projects in the past. This was the major discussion point during the meeting.	A bypass will be constructed to avoid impact in Lawngtlai Compensation will be paid before construction work begins. A dedicated grievance redress mechanism will be established for this project.
Saiha	General: About Project, Alignment, Components, and its Significance • Meeting proceedings began with some of the public representatives exhorting all present to extend	

Districts	Key Outcomes/Concerns/Suggestions from the Meeting	Response
	support to the project. Almost all participants expressed their opinion in support of the project, particularly in view of the poor condition of the existing road. Project Concerns and Issues: On Land Acquisition, R&R Processes and Impacts • Expressing his support for the project, a representative from VC, Theiva, shared concern over the loss of 55 houses, besides other basic amenities, if road is to be widened as proposed. • Participants from Kawlchaw too shared similar situation where there are more than 60 houses along the road and a newly constructed church that will be affected because of road widening. • One of the participants wanted to know about the stand of the government if some of the families would not want to relocate. • Participants also shared that some of the households may not have legally recognized document but are actual occupants of the houses. Such families should be provided such legal documents before determining claimant status for compensation award purposes. • Participants in general requested for implementing agency to provide and construct all basic amenities like water sources as part of R&R activities. Overall, the participants had very positive opinion about the project, particularly in view of the bad condition of the existing road.	The preliminary ROW drawing (and final ROW to be prepared) tries to minimize the impact as much as possible. Affected households are eligible for assistance irrespective to their land-holding status. Basic utilities will be equipped at the resettlement site.

Note: The consultation was carried out with hypothetical widening of 15 m for both sides (since the first round of consultation was carried out without the development of preliminary design), hence, the likely impact of resettlement discussed above tend to be higher than the one associated with the proposed ROW design.

Source: JICA Study Team

Stakeholder Meeting in Aizwal

Stakeholder Meeting in Serchip

Stakeholder Meeting in Lunglei Stakeholder Meeting in Lawngtlai

Source: JICA Study Team

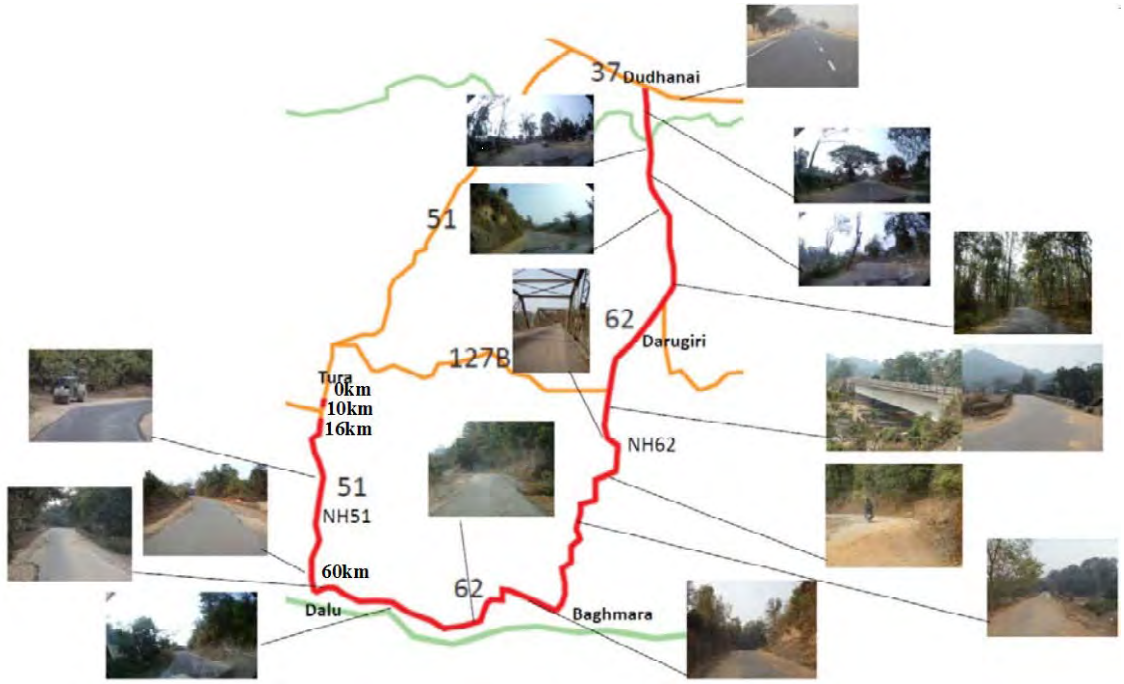
Figure 12.5-15 Selected Pictures of Consultation Meetings

12.6 EIA and RAP Study for NH51

As discussed in Chapter 12.2.1, EIA is not required for widening and improvement of NH51 according to Indian regulations. In line with the JICA Guidelines for Environmental and Social Considerations, however, EIA has been prepared and shared with relevant MOEF as well as the Meghalaya State government.

12.6.1 Scope of the Project

The study road of NH51 starts from Tura to Dalu in Meghalaya State with a total length of approximately 54 km. The study road passes mostly on rolling terrain and alignment of the study road consists of combination of medium horizontal and vertical curves as shown below. The number of existing lane is one for the entire section. Pavement condition is rather deteriorated in the whole section due to inadequate road maintenance. The project aims to improve the road network by widening and improvement of targeted section of NH51 and thereby contributing to accelerated economic growth and poverty reduction in the region.



Source: JICA Study Team

Figure 12.6-1 Road Alignment and Present Condition of NH51

The existing condition of the targeted section of NH51 is shown below. The project involves the widening of existing one-lane road to two-lane roads with installment of proper slope protection and landslide prevention measures, drainage, and traffic safety facilities. The total width of the road including carriageway and road shoulder will be 12 m.

Table 12.6-1 Present Conditions and Provisional Improvement Cost of NH51

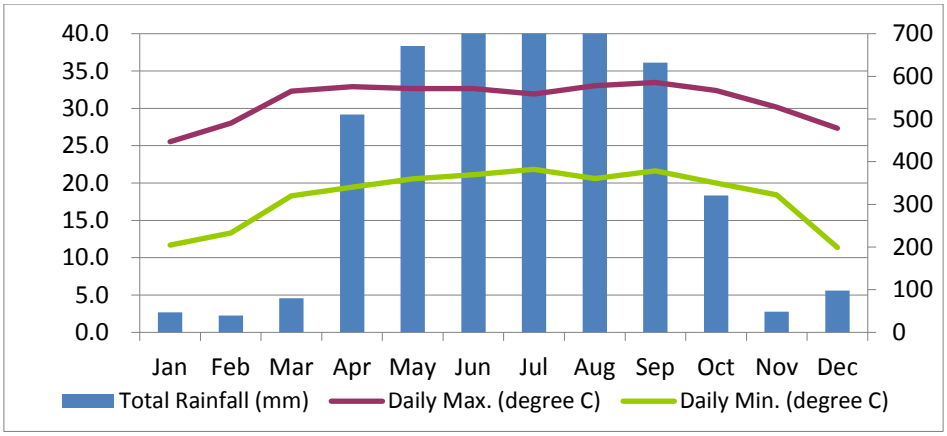
No.	Data Items	Type / Unit		Road	
				NH51 (Upper: KM distance from Tura, Lower: KP)	
				0-10	16-60
				85-95	101-145
1	Number of Lanes	Four (4): Carriageway Width (7 m+7 m), Double (2): Carriageway Width (7 m/10 m), Intermediate (1.5): Carriageway Width (5 m/5.5 m), Single (1): Carriageway Width (3.5 m/3.75 m) New (0)		1	1
2	Carriageway Width	m		3.75	3.75
3	Shoulder Width	Average in section/m		1	1
4	Shoulder Type	Paved or Unpaved		Unpaved	Unpaved
5	Average Altitude	m		258	110
6	Average Roughness	IRI		5.2	6.5
7	Total Area of Crack	%		25	32
8	Ravelled Area	%		1.5	2
9	No. of Pot Holes	per km		30	24
10	Edge Break Area	m^2/km		162	162
11	Road Side Friction	%		40	27
12	Average Travel Speed	km/h		21	36
13	Road Capacity	PCU – IRC73-1980		1,000	1,000
14	Improvement Project Cost (W=12 m: Carriageway 3.5 m x 2+ Shoulder 2.5 m x 2)	Mountainous (INR crore/km)	9	0	0	0	0
		Rolling (INR crore/km)	5.5	10	55	44	242
		Level (INR crore/km)	4	0	0	0	0
		Long Bridge (INR crore/km)	120	0	0	0	0
		Total (INR crore)			55		242

Source: JICA Study Team

12.6.2 Natural Environment

(1) Climate

Meghalaya experiences tropical monsoon climate which varies from the western to eastern parts of the plateau. The Garo Hills District, which lies in the western part of the state, has a tropical climate characterized by high rainfall and humidity, generally warm summer, and moderately cold winter. For the entire state, the mean summer temperature is 26 °C and the mean winter temperature is 9 °C. The mean annual rainfall varies from 2,000-4,000 mm with most rainfall occur during May to September. The maximum rainfall of 12,000 mm has been recorded in the southern slope of Khasi Hills along the Cherrapunjee-Mawsynram belt. The monthly total rainfall and maximum/minimum temperature of Tura is presented below.



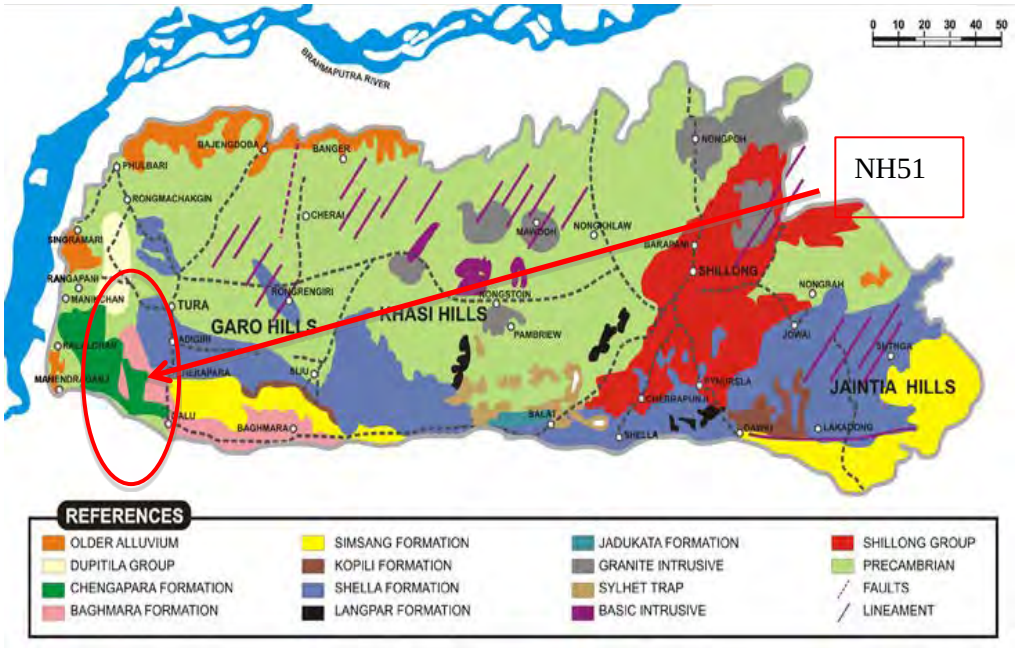
Source: West Garo Hills District Statistical Handbook 2015

Figure 12.6-2 Monthly Rainfall and Daily Maximum and Minimum Temperature in Tura (2011-2013)

(2) Topography, Geology, and Soil

The geology of Meghalaya consists of older and stable rock types which are resistant to weathering mostly belonging to the periods of Archean Gnessic complex, Shillong Groups of rocks, Lower Gondwana rocks, Sylhet Traps, and Cretaceous-Tertiary sediments. The layers of land surface in the project area mainly comprise schist, gneisses, quartzite, sand stone, shale, limestone, granite, granodiorite, and pegmatite.

The West Garo Hills District shows different types of soil as the provenance differs. Red Gravelly Soil and Red Sandy Loam in the hilly slopes and Clayey Loam in the plains are the common soil types in the project area. The soils are acidic in nature and comparatively rich in organic matter and nitrogen, but poor in phosphorous. Tura, the district capital, is a valley located at the foothills of the Tura Hills and right below the Tura Peak. The elevation of Tura is approximately 350 m. It is filled with small rivulets and green valleys all around. Meanwhile, Dalu, located 33 km north east of Tura at the end of NH51 and NH62, has an elevation of about 20 m. The geological map of Meghalaya is shown below.



Source: Department of Mining and Geology, Government of Meghalaya

Figure 12.6-3 Geological Map of Meghalaya

(3) Flora and Fauna

The community/village forest along the targeted section of NH51 is home to various flora and fauna. The Meghalaya Government records showed the following flora and fauna. Floral/vegetation assessment carried out through quadrate methods: for trees 10 m x 10 m, for shrubs 5 m x 5 m, and for herbs 1 m x1 m square shaped quadrats were used. Quadrates were laid randomly in the corridors upside and downside of the road. All species in the quadrates were recorded and ecological parameters, including density and frequency, were calculated. Faunal species were recorded through visual observation during site visits, secondary data from the Environment and Forest Department and local information from local community.

FAUNA

1) Mammalian Fauna

Hoolock gibbon, stump-tailed macaque, rhesus macaque, Assamese macaque, slow loris, golden langur, capped langur, common monkey, golden cat, leopard cat, jungle cat, large Indian civet, masked palm civet, Indian grey mongoose, Indian fox, Himalayan black bear, yellow throated marten, yellow-bellied weasel, Indian flying squirrel, Malayan giant squirrel, bandicoot rat, Indian crested porcupine, lesser bamboo rat, different species of bat, etc.

2) Avian Fauna

Indian black baza, barred jungle owlet, peafowl, red jungle-fowl, thick-billed green pigeon, blue throated barbet, long-tailed broadbill, grey-headed myna, Jjngle myna, green magpie, Indian house crow, red winged crested cuckoo, large green-billed malkoha, crow pheasant, red headed trogon, redwattled lapwing, Burmese roller, etc.

3) Reptile Fauna

Different varieties of lizards, snakes, turtle/tortoises, geckos are recorded. Different species of snakes include blind snakes, Indian gamma, checkered keelback, red necked keelback, and others. Important poisonous species include Indian cobra and vipers.

FLORA

1) Tall Trees

Schima wallichii, Terminalia belirilia, Engelhardtia spicata, Aesculus assamica, Aporusa wallichii, Bridelia retusa, Cryptocarya andersonii, Talauma hodgsonii, Lagerstroemia parviflora, Gmelina arborea, and Shorea robusta.

2) Lower Canopy

Miliusa velutina, Hibiscus macrocarpus, Zizyphus rugosa, Helicia robusta, Engelhardtia spicata var. Colebrooliana and Ficus prostrata.

3) Shrubby Species

Capparis zeylanica, Garcinia lancifolia, Bauhinia acuminata, Mimosa himalayayana, Mussaenda roxburghii, Eupatorium modiflorum, Solanum kurzii and Phlogacanthus tubiflorus.

4) Intertwining Trees

Dysolobium grande, Mucuna bracteata, Fissistigma wallichii, Paederia scanders, Solena heterophylla and Aristolocjia saccata.

5) Epiphytic Climbers

Rhaphidophora spp., members of Loranthaceae, *Cuscuta reflexa* and few species of epiphytic orchids like *Rhynchostylis retusa*, and *Cleisostoma simondii* are also present.

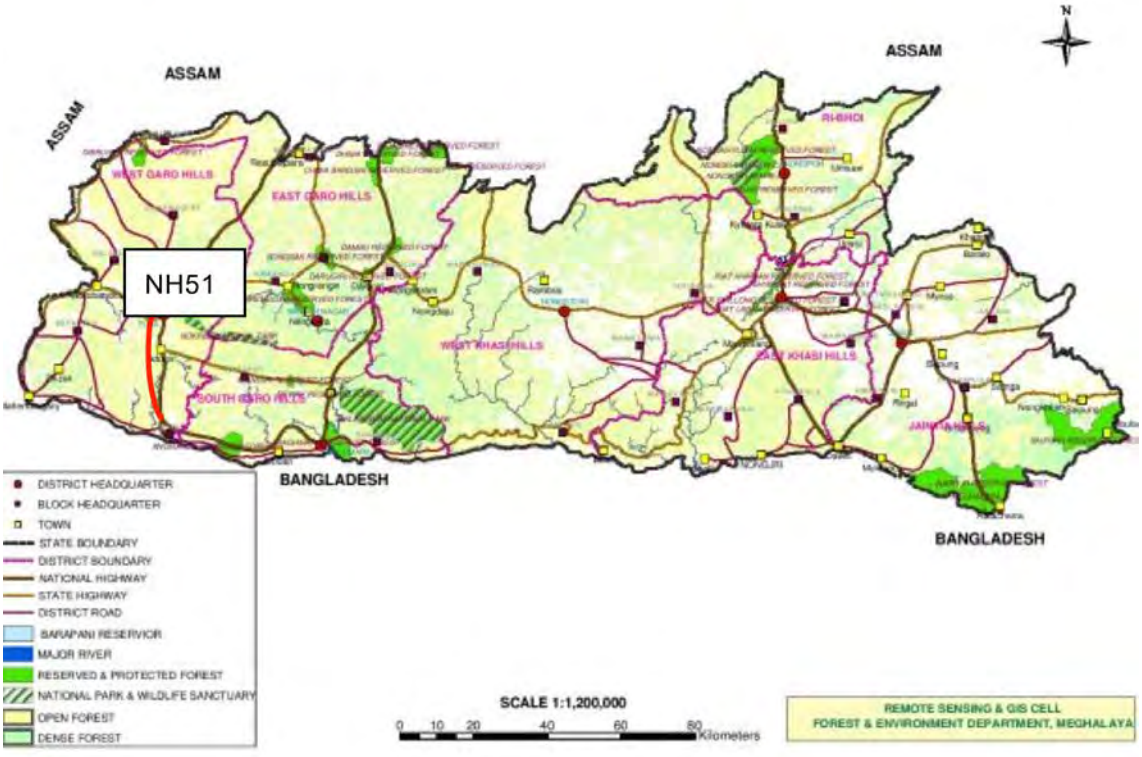
6) Herbaceous Plants

Acanthaceae, *Aneilema scaberrimum*, Anemone spp Burmania Sp., Coiictyospermum, Dictyospermum, Coix sp. Cyprus spp., Ericcaulon, Fabaceae, *Oxalis corniculate*, and Poaceae are noticed. Ferns and fern-allies, liverworts, and mosses are also seen on old tree trunks and stones near water sources and in shady places.

(4) Protected Area and Forest

The forest of Western Garo Hills can be broadly classified into tropical, subtropical, and temperate forests. The Indian Institute of Remote Sensing has classified vegetation of Meghalaya into following categories: tropical evergreen, tropical semi-evergreen, tropical mosit deciduous, subtropical broad leaved, subtropical pine and temperate forest types, grasslands, and savanna.

As shown below, the target section of NH51 does not pass through or border with existing national park, wildlife sanctuary, and protected/reserved forest. Being a sixth schedule state, the forest area is under the village council and is known as community forest/village forest. The targeted section of NH51 passes through the forest and plantation (teak, rubber and cashews) for which appropriate measures to mitigate negative impacts due to road widening will be required.



Source: Forest and Environment Department, Meghalaya

Figure 12.6-4 Map of Protected/Reserved Forest, National Park, and Wildlife Sanctuary

12.6.3 Social Environment

According to the 2011 Census, the population of Meghalaya was 2,967,000. Out of these, 86% belong to scheduled tribe. A total of 17 notified STs are recognised in the state with the Khasi, Garo and Jaintia[10] being the three major tribes. The Khasi constitutes more than half of the total ST population of the state (56.4%), and Garo accounts for 34.6%. Altogether, they constitute more than 90% of the total ST population. The Khasi, Garo, and Jaintia had their own kingdoms until they came under the British administration in the 19th century. Other tribes include the Koch, the Biate of Saipung Constituency and Jowai, the related Rajbongshi, Boro, Hajong, Dimasa, Hmar, Paite, Kuki, Lakhar, Karbi, Rabha, and Nepali. All of them were generally known as "hill tribes" by the British. English is the official and widely spoken language of the state. Other principal languages are Khasi, Pnar, and Garo. Hindi and Bengali are also widely spoken in the state.

The West Garo Hills is one of the largest districts of Meghalaya located in the western part of the state. The Garo Hills District was divided into two districts, vis-à-vis West Garo Hills District and East Garo Hills District in October 1976. The West Garo Hills District was further divided into West and South Garo Hills in June 1992. The West Garo Hills District is headquartered in Tura, which, with the population of 74,858 people as per 2011 Census, is the second largest town in Meghalaya after Shillong. The proposed project falls in the three blocks namely: Rongram, Dalu and Gambegre development blocks. Block-wise population data as per 2011 Census is shown in Table 12.6-2 below.

Table 12.6-2 Block-wise Population of West Garo Hills District per Gender

Block	Male	Female	Total
Rongram	67,114	66,642	1,33,756
Selsella	88,349	86,857	1,75,206
Dalu	27,351	26,744	54,095
Dadenggre	20,842	20753	41,595
Betasing	36,340	35,763	72,103
Zikzak	37,867	36,735	74,602
Tikrikilla	29,267	29,121	58,388
Gambegre	17,029	16,517	33,546
Total	3,24,159	3,19,132	6,43,291

Noted: Blocks where the project road is located are heighted.
Source: District Statistical Handbook 2015

Table 12.6-3 Block-wise Population of West Garo Hills District per Caste

Block	ST	SC	Other	Total
Rongram	106,987	2,701	24,068	13,3756
Selsella	78,715	3,046	93,445	175,206
Dalu	47,108	464	6,523	54,095
Dadenggre	40,351	41	1,203	41,595
Betasing	65,776	305	6,022	72,103
Zikzak	49,862	1,703	23,037	74,602
Tikrikilla	52,729	507	5,152	58,388
Gambegre	32,484	43	1,019	33,546
Total	474,012	8,810	1,604	643,291

Source: District Statistical Handbook 2015

Meghalaya is primarily a rural-agrarian economy with 80% of the population residing in rural areas and around 62.8% of the working population engage in agriculture and allied activities.

10 Jaintia (Synteng or Pnar) is listed both as a sub-tribe under Khasi and as a separate ST.

12.6.4 Legal Framework for Environmental Considerations

No state-level policy and regulations trigger additional requirements in terms of environmental and social considerations other than those already prescribed in the national-level legislation. As such, the legal framework for environmental consideration of NH51 project will be the same as NH54 project as discussed in Chapter 11.5.4.

12.6.5 Institutional Set-up

The institutional set-up for environmental consideration of NH51 is also the same as NH54, except that the State Government of Meghalaya and its departments, instead of Mizoram, will be in-charge of various state-level responsibilities.

12.6.6 Analysis of Alternative for NH51

The scope for alternative is limited due to the hilly nature of the terrain and the nature of the project which essentially aims to improve and widen existing road. In this study, two alternative options (without project scenario (zero option)) and another widening/improvement option based on a different concept) have been reviewed and compared with the proposed option.

1. Without Project (Zero Option)

The existing road has roadside settlements particularly in and around two major built-up areas – Tura and Dalu. The traffic flow is impacted by conflicts between the locals and the traffic, which is further compounded by various land use conflicts including uncontrolled development along the highway and encroachment. Given the current level of population growth and economic development, traffic volume is likely to expand further, adding more pressure to the already constrained road capacity.

The without project scenario entails that existing road and slope conditions will persist. Poor pavement condition will lead to more vehicular emissions with detrimental impacts on health and ecosystem. Also, continuation of uncontrolled encroachment will increase the risk of traffic accident in the built-up areas, particularly in Dalu, where street vendors market daily goods on the road during the day. In addition, landslide will be more frequent in this scenario, depriving the local population along NH51 from supply of essential commodities and undermine the potential of economic growth. In particular, NH51 serves as one of the major trade routes connecting Meghalaya and Bangladesh and as such, the blockage of NH51 will negatively affect the potential of mineral and horticultural product exports to Bangladesh.

2. Widening and Improvement Option 1 (As Proposed In DPR)

A design proposal for widening and improvement for NH51 is proposed in DPR and prepared by Indian Consultants. While the project is expected to bring positive benefits, the design proposed in DPR is likely to cause significant environmental impacts which can be avoided or mitigated. Some of the issues include:

- Widening is proposed only towards the hill side resulting in higher volume of cut soil;
- Proposal of re-installing all existing culverts is made without hydrological analysis. Drainage without proper runoff estimate can cause soil erosion and damage the road; and
- Reconstruction was proposed for one minor bridge and rehabilitation was proposed for ten minor bridges without information about damage condition and specific details of rehabilitation.

Comparison of with and without project scenario is provided below.

Table 12.6-4 Comparison of Alternatives

Component	Without Project	DPR	Proposed Design
Social Impact	No change in the short term but congestion and poor road quality will undermine the road utility over the long term.	30 m ROW is proposed and thus more than double the land is required compared with the proposed design. Three churches, one police station, and one fire station will be affected.	12 m ROW is adopted in general. The required acquisition of 67 ha of land for ROW and 11.6 ha for spoil bank. 367 households will be affected.
Widening	N/A	Hill side only	Both sides as appropriate
Cut Grade	N/A	Same across the entire strech	Decide based on classification of rock and soil
Surplus soil	N/A	Significant	Minimized
Landslide	High risk	High risk (no slope protection measures proposed)	Landslide sites identified and slope protection measures proposed
Congestion in Built-up Area	Continue to deteriorate		
Impact on Forest	N/A	Larger due to the need of disposing greater volume of surplus soil	Minimized by balancing cut and fill. Candidate sites for spoil bank proposed
Safety	Existing risks remain unresolved	No information	Proper traffic signs and safety facilities to be installed
Road-side Amenities	N/A	KM stone, bus bay, etc.	KM stone, bus bay, public toilet, etc.
Environmental Quality	Continue to deteriorate due to higher emissions caused by poor road condition.	Greater traffic volume may cause higher emissions	Greater traffic volume may cause higher emissions

Source: JICA Study Team

The proposed project has two sections (85 km–95 km and 101 km to 148 km) and avoids intervention with densely built-up section of Tura Town. Preliminary design and concept of the Tura bypass have been proposed in DPR report with additional proposal for ROB(Road Over Bridge)/flyover to smoothen traffic flow in a major intersection in the town. However, the proposed ROB/flyover passes through areas known as the Christian Compound, which accommodate sensitive and important facilities such as church, school, and hospital and there is already anti-ROB/flyover sentiment among the local population. As such, it is found that the potential benefits of ROB/flyover cannot justify negative impacts associated with it particularly in places where Christianity is deeply rooted in the life of the local people. Measures to mitigate congestions in Tura are required in the long term, but it is recommended that a more detailed study be carried out to identify optimal route for bypass and ROB/flyover with respect to environmental and social impacts. Hence, the bypass and ROB/flyover have been dropped from the scope of the preparatory study and EIA.

12.6.7 Scoping of Environmental Impact

Building on the generic scoping matrix (Table 12.6-5), the Scoping Matrix for NH51 widening and improvement has been prepared as shown in Table 12.6-5 below. Items for which larger negative impacts are expected as compared with the generic scoping are highlighted.

Table 12.6-5 Scoping Result

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
Natural Environment					
1.1	Climate/ Meteorological Phenomena	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C/O: The impacts on micro-climate and micro meteorological phenomena are negligible because the project-related structures will not disturb wind path.
1.2	Topography	D	B-	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: Changes in topographic conditions are expected due to the requirement of cutting filling work. Balancing the volume of cutting and filling is recommended to minimize the volume of spoil soil.
					O: Topographic condition will be stable after the completion of construction work which include slope protection and slope stabilization.
1.3	Geology	D	D	D	P/C/O: No impact is expected as the project does not alter geological condition of the area.
1.4	Soil Erosion	D	B-	B+/B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Soil erosion is expected particularly during the monsoon period. Construction work should avoid the monsoon period.
					O: Poor condition of drainage causes soil erosion in existing road. The project is expected to improve the condition and thus reduce the risk of soil erosion, but measures for slope protection and stabilization and prevent soil erosion, particularly during the monsoon period, must be in place and regularly monitored.
1.5	Hydrology	D	B-	B-	P: No impact is expected as no engineering work is carried out at this stage.
					C: Construction work may cause minor, temporary impacts on hydrology.
					O: Cutting and/or filling may result in changes in local hydrology. New drainage and culvert will be installed, taking into account the likely water flow in the area.
1.6	Groundwater	D	D	D	P: No impact is expected as no engineering work is carried out at this stage.
					C: The project does not envision the use of groundwater and thus no impact is expected. However, appropriate measures should be undertaken to properly manage effluent during construction.
					O: No impact is expected during the operation stage.
1.7	Ecosystem, Flora, Fauna and Biodiversity	D	B-	B-	P: No impact is expected. No unique/endangered species have been identified during assessment.
					C: The project will not affect pristine ecosystem as the work will be carried out along the existing road. However, construction work will affect mountain ecosystem and local flora and fauna including jhum and plantation.
					O: Increases in traffic volume will have negative impact ecosystem and flora and fauna along the road.
1.8	Protected Areas/Forest	D	B-	B-	P: The targeted section of NH54 does not traverse or border with national parks or protected forest.
					C: By the construction work, some of the forest (including plantation and village forest) area will be affected.
					O: Increases in emissions due to greater traffic volume

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
					will negatively affect forest and surrounding ecosystem. Monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary.
1.9	Coastal Zone	D	D	D	P/C/O: No impacts are expected, because the alignment is far away from the coastal zone and the planned alignment will not pass the tidelands and the mangrove forests which are peculiar to the coastal region.
1.10	Landscape	D	D	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Changes in landscape during the construction work will be minor and temporary. The project should explore possibilities to utilize scenic/view points along the road to strengthen tourism potential in north eastern region of India.
					O: Improved road network facilitates access to scenic places and tourist attractions, thereby positively contributing tourism in the region. Bus bay and other road amenities also help improve aesthetic conditions of the road.
1.11	Natural Disaster	D	B-	B+	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Many areas of the road are prone to landslide and thus appropriate measures should be in place during the construction work to avoid accidents. Construction during the monsoon period is risky and should be avoided.
					O: Slope protection/stabilization measures and drainage are expected to significantly reduce the risk of natural disaster.
Living Environment (Pollution Control)					
2.1	Air Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Some negative impacts are expected due to operation of construction equipment and vehicles. One of these is the dust incidental to earthwork especially during the dry season.
					O: Air pollution is expected to increase due to increase traffic volume on the road. Relevant data (e.g. actual/projected traffic volume) shall be shared with relevant State authority so that mitigation measures can be developed.
2.2	Offensive Odor	D	D	D	P/C/O: No impact is expected as the project does not involve the use of chemical and other materials that may cause offensive odor.
2.3	Water Pollution	D	B-	B-	P: No impact is expected since the project at this stage does not alter existing condition.
					C: Turbid water due to the earthworks, bridge pier construction work and wastewater effluents from construction workers' camps/yards are expected to pollute the surrounding rivers/canals to some extent.
					O: Some impacts on water quality in surrounding water bodies are expected due to water discharge from road users and wastewater from maintenance activities.
2.4	Bottom Sediment Contamination	D	B-	D	P: No impact is expected.
					C: The project involves construction of new small bridges. Silt-trap will be used to avoid construction materials such

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
					as cement and sand being washed out during construction work.
					O: Some wastewater will be generated from maintenance activities along the road, the impacts on bottom sediment from the wastewater will be negligible.
2.5	Soil Contamination	D	D	D	P: No impact is expected as no engineering activity will be carried out at this stage
					C: Impacts on soil from deposition of pollutants from construction materials in the construction site are expected to be small. Since there is no major industrial activity along the road, it is unlikely that soil along the road is already polluted.
					O: No impact is expected except for the risk of accidental spillage of oil and lubricant, which will be managed by proper safety measures.
2.6	Ground Subsidence	D	D	B+	P/C: No impact is expected as existing conditions will not be altered.
					O: The project will improve subsidence/damaged area of existing road and will install measures to prevent future subsidence.
2.7	Noise/ Vibration	D	B-	B-	P: No impact is expected.
					C: Noise and vibration are generated by operation of construction equipment and vehicles, although they are temporary. Construction schedule should take into account the location of schools, hospitals and religious facilities that require silence in part of the day.
					O: Noise and vibration level are likely to increase due to greater traffic volume along the road. Specific measures may be required to minimize impacts on schools, hospitals and religious facilities.
2.8	Sunshine Obstruction	D	D	D	P/C/O: No impact is expected.
2.9	Wastes/Hazardous Materials	D	B-	B-	P: No impact is expected.
					C: Waste from construction workers' camps are expected to be generated. Waste generated from construction and demolition work may include hazardous materials that must be treated before final disposal.
					O: Waste will be generated from road users and workers of maintenance works.
Social Environment					
3.1	Involuntary Resettlement	A-	D	D	P: The project will result in large-scale involuntary resettlement, particularly in built-up areas near Tura and Dalu where structures exist in both sides of the road. Minimizing the resettlement should be the priority for road design.
					C: Resettlement will be completed before construction begins and thus no resettlement is expected during operation
					O: No impact is expected, as relocation will be completed before construction begins.
3.2	Land Use	A-	A-	D	P: Land acquisition and involuntary resettlement are likely to cause changes in existing land use pattern.
					C: The project will be carried out along the existing road, and as such, changes in land use associated with construction work are relatively minor, and land clearance for construction yards and workers' camps is temporary.
					No impact is expected as sufficient slope

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
					protection/stabilization measures to protect land use.
3.3	Utilization of Local Resources	D	A-	D	P: No impact is expected.
					C: Mass-scale use of local resources such as sand and quarrying for the construction activities may obstruct there utilization by the local people for other purposes.
					O: No impact is expected as use of local resources is not expected during operation.
3.4	General, Regional /City Plans	D	D	D	P: No impact is expected.
					C: No impact is expected.
					O: Better infrastructure network may trigger influx of outsiders and economic development in the region.
3.5	Social Institutions and Local Decision-making Institutions	D	D	D	P/C/O: No impact is expected as there will be no change in social institutions and local decision-making institutions such as village councils and women groups
3.6	Social Infrastructure and Services	A-	A-	B+	P: Communal facilities such as public hall may be affected by the project, which negatively affect social infrastructure and services.
					C: Access to social infrastructure and services may be temporarily affected due to construction of construction yard and accommodation for workers as well as traffic jams due to the operation of construction vehicles.
					O: The project is expected to improve access to social infrastructure and services by providing better road network.
3.7	Local Economy and Livelihood	A-	A-	B+	P: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood.
					C: Loss of income source and livelihood due to involuntary resettlement are expected to negatively affect the local economic and livelihood. On the other hand, construction work will have positive impact on local economy by creating employment and business opportunities in the project area.
					O: The project will have positive impact on local economy as improved road network ensures more stable supply of essential goods. In the long-term, this will lead to regional economic development with more job and business opportunities.
3.8	Unequal Distribution of Benefit and Damage	A-	A-	D	P: Land acquisition and involuntary resettlement will lead to unequal distribution of benefits and damage between groups who are directly affected by the project and who are not.
					C: While resettling households bear much of the damage, others may even enjoy benefits from new business opportunities created by construction work, resulting in unequal distribution of benefit and damage.
					O: No impact is expected as the project is an improvement of an existing road and the road will continue as before to accrue benefits to those along the road.
3.9	Local Conflicts of Interest	D	D	D	P/C/O: No impact is expected as the project is an improvement of an existing road and structures/services will be equally restored
3.10	Water Usage, Water Rights and Communal Rights	D	D	D	P/C/O: No impact is expected as rain water is used for both household and agricultural use

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
3.11	Cultural and Historical Heritage	C-	D	D	P: The targeted roads do not traverse or runs near major ruins and/or cultural heritage.
					C/O: No impact is expected as the project will not affect cultural and historical heritages
3.12	Religious Facilities	A-	A-	D	P: Several memorial stones located along the road may be affected. Small religious facilities in built-up areas may also be affected.
					C: Roadside religious facilities may be affected by noise and vibration during construction and operation due to construction work and greater traffic volume.
					O: No impact is expected as sufficient noise control measures will be implemented.
3.13	Sensitive Facilities (ex. hospital, school, precision machine factory)	B-	B-	D	P: Small community facilities (public halls etc.) may have to be relocated incase road widening is implemented within the built-up area.
					C: Noise and vibration during construction work may affect school and hospitals but the impacts are expected to be minor.
					O: Greater traffic volume is expected to increase noise and vibration level, but adequate mitigation measures will be implemented.
3.14	Poor People	A-	A-	D	P: Given the limited coping capacity of the poor, it is necessary to assess their vulnerability and develop appropriate mitigation measures to be included in rehabilitation plan.
					C: The poor may bear disproportionally higher burden due to their limited coping capacity, although they can be benefited from employment opportunities during construction work.
					P: No impact is expected. In the long-term, economic development in the region is likely to benefit the poor.
3.15	Ethnic Minorities/ Indigenous People	A-	A-	D	P/C/O: Tura-Dalu section of NH51 is mainly inhabited by Garo people, registered Scheduled Tribe in India, with distinct culture and language. Preparation of RAP and livelihood restoration plan, therefore, must take into account this factor.
3.16	Gender	D	C-	B+	P: No impact is expected.
					C: Equal opportunity should be sought for employment during construction work. Prevailing social and cultural norms must be carefully studied to avoid gender-related conflict.
					O: Better road condition is expected to reduce the burden of girls and women who carry water and fuel wood and improve their safety.
3.17	Children's Rights	D	D	D	P: No impact is expected.
					C/O : Child labor is unlawful according to article 24 of Indian Constitution. Only adult is eligible for potential employment opportunity created by the project.
3.18	Public Health (sanitation and infectious diseases)	D	B-	B-	P: No impact is expected.
					C: Influx of construction workers is likely to increase the health risk, particularly that of STD and HIV/AIDS. The risk of malaria should be properly managed in construction work in areas where malaria is prevalent.
					O: An increase in traffic volume and road users may have negative impact on public health.
3.19	Occupational	D	B-	B-	P: No impact is expected.

Sl. No.	Item	Scoping Result			Rational of Assessment
		P	C	O	
	Health and Safety (OHS)				C: Occupational health and safety of construction work should be properly managed through adequate Environment Management Plan.
					O: Maintenance and repair work should take into account the occupational health and safety of the workers.
Others					
4.1	Accidents	D	B-	B+/B-	P: No impact is expected as the project at this stage does not alter existing condition.
					C: Increase of risks of accidents associated with construction activities is expected due to the operation of heavy equipment and vehicles.
					O: Risks of accidents is expected to increase due to greater traffic volume and speed. On the other hand, installment of accident-prevention measures (such as mirrors at curves) will reduce the risk of accidents.
4.2	GHG emissions	D	B-	B+/B-	P: No impact is expected.
					C: The use of construction machines and operation of vehicles will result in an increase in GHG emissions, though the impact is small and short-term.
					O: The GHG emission will increase due to an increase in traffic volume. The project is expected to improve the resilience of road against climate change by factoring long-term climate change (changes/increase in precipitation etc.) into the road design.

Note: P: Pre-Construction; C: Construction; and O: Operation
A: Significant impact is expected (+: Positive impact, -: Negative impact),
B: Some impact is expected (+: Positive impact, -: Negative impact),
C: Extent of impact is unknown, further examination will be required (+: Positive impact, -: Negative impact),
D: No impact is expected,
Source: JICA Study Team

12.6.8 Anticipated Environmental Impact and Mitigation Measures

The proposed project will have both positive and negative impacts on the surrounding environment during different stages of the project planning and implementation. For the assessment of impacts, the baseline information has been supplemented by the field visits and the primary surveys of the various environmental components carried out during the study.

Natural Environment

(1) Climate

Pre-construction and Construction Phase

Since the proposed project is only widening and strengthening to a two-lane road, no change in the macroclimate i.e., precipitation, temperature, and wind is envisaged. However, there will be localized, temporary impact due to vegetation removal and the creation of paved surface for road. There may be an increase in daytime temperature around the alignment due to loss of vegetation. The impact will be more prominent at locations where the cutting of trees is in clusters.

Operation Phase

During operation phase, increased traffic plying will lead to increase in temperature levels locally along the carriageway, although it will be insignificant and temporary.

(2) Topography and Geology

Pre-construction and Construction Phase

The change in topography (that of existing) is envisaged to some extent at various places along the entire length of the road while developing the two-lane standard. The change in topography will also happen due to operation of borrow areas. The construction of material handling yards and labor camps will also alter the existing topography temporarily.

Operation Phase

During the operation phase, there will be other induced development in the form of tourism and commercial establishments along the highway. During monsoon, the change in topography will also be visible due to landslide and damage to side slope and breast wall. The benefits in the form of land leveling and tree plantations in the vicinity of the project road shall enhance the local aesthetics.

Mitigation Measures

During the construction phase, the existing vegetation including shrubs and grasses along the route (except within the strip directly under embankment or cutting) will be properly maintained. The borrow areas shall be operated and closed as per the specifications for Road and Bridge Construction Manual of MORTH. The borrow areas shall be filled with the rejected waste/material, spoil, and then finally a layer of topsoil shall be spread over it before carrying out plantation and turfing.

During the operation phase, the maintenance of embankment will be carried out to avoid soil erosion. The slope protection/retaining wall, if damaged due to landslide, will be repaired promptly. The slope protection will also be established and strengthened regularly through plantation of shrubs and vegetation.

(3) Soil Erosion

Pre-construction and Construction Phase

The site preparation will involve demolition of building, clearing of brushwood, tree removal, and temporary re-routing of utilities. This brings risks of erosion to the exposed ground and topsoil. The soil erosion in the construction stage may take place at the slope of embankments, construction sites of cross drainage structures, at borrow areas, and at construction sites which will be cleared.

Operation Phase

The soil erosion in the operation stage may take place during operation at the side slopes of the road and near the approaches to bridges and interchanges. The risk is higher during monsoon.

Mitigation Measures

To control roadside soil erosion, turfing with grasses and shrubs will be carried out in accordance with the recommended practice in IRC guidelines. At the locations of steep slopes near crossings of highway with major rivers, suitable protection measures such as stone pitching will be adopted. The surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent erosion control measures to prevent soil erosion that will adversely affect construction operations, damage adjacent properties, or cause contamination of nearby streams or other watercourses, village ponds, or water bodies, etc. The green belt will be developed simultaneously along with the construction activities to control the erosion process. In addition, gabion and apron concrete will be installed at the outlet of culverts to avoid soil erosion due to water runoff.

During the operation phase, the slope protection measures like sodding; turfing shall be done and monitored regularly. The green belt will be monitored and replantation for the loss of plants species will be done immediately. The side ditch on road is designed as concrete lined ditch for all sections of cut side to prevent damage from water runoff.

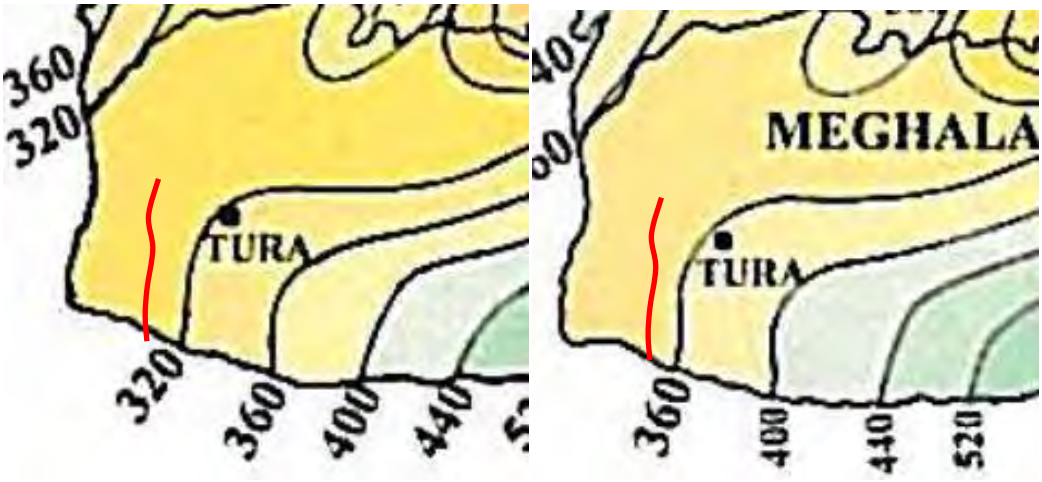
(4) Hydrology

The long-term rainfall intensity is modeled as shown in Table 12.6-6 below, which have informed the design of drainage and culverts.

Table 12.6-6 Rainfall Intensity for Each Section in NH51

From	To	25 Years- 24 Hours Rainfall Intensity (mm)	50 Years- 24 Hours Rainfall Intensity (mm)
KP90 of NH51, Tura	KP148, Dalu	360 mm	400 mm

Source: JICA Study Team



Source: ATLAS of Statewise Generalised Isopluvial (Return Period) Maps of Eastern India (Part – II)

Figure 12.6-5 Detailed Isopluvial Map with Project Location for NH51 for 25 Years (L) and 50 Years (R)

Pre-construction and Construction Phase

The potential impact on hydrology will be minor as the project does not involve diversion or re-routing of existing water resources. However, the existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, a change in natural drainage pattern is very insignificant from the present state of the project.

Operation Phase

The projects may marginally lead to increased runoff during operational stages due to increase in impervious surface and sediment will be accumulated in nearby water bodies.

Mitigation Measures

The new drainage system is designed based on hydrological calculation result. Based on the obtained location of water crossing and water discharge, dimension, and locations for drainage system are determined. For cross drainage structure, appropriate culvert type is selected by taking into account the economy, construction workability, and maintenance ability. The comparison of different culvert types is shown below. In principle, pipe culvert is used where the water discharge is comparably small. Box culvert is proposed where the water discharge is comparably large.

(5) Groundwater

No tunnel is proposed in this project and as such, the project will not affect groundwater level or quality in the area. If the contractor propose to use water from under surface water source, a permission from the Water Resource Department and Local Administration is mandatory. The contractor is expected to

properly manage effluents and waste water during the construction stage to avoid potential influence to the groundwater.

(6) Ecosystem, Flora, Fauna, and Biodiversity

The main impact on flora involves the removal of trees and grubbing of vegetative cover for construction and a clear zone within the right of way (ROW) and for spoil bank. Widening of the one-lane to two lanes would have negative impact on plant species by way of cutting the trees and shrubs for construction activities. The types of impacts on flora can be as follows:

- Loss of trees;
- Loss of canopies;
- Compaction of vegetation, and
- Pollution and dust accumulation on vegetation.

A detailed field observation of the study area was done in June and August 2015. Extensive study was done in four locations/spots. They are chosen as the site that features different ecological characteristics of the project area. The observations are enumerated below.

1) Paddy Field (KM post 144-145)

In the paddy field land preparation was going on and seeding was done for transplantation of rice seedlings. Small fishes like Channa spp., Colisa spp., Puntius spp., Noemacheilus spp. Rasbora spp., crane and Indian common crow were seen in the rice field.

2) Amongpara Village Forest (KM post 125-126)

It is a vast area with diverse floral vegetation. The commonly seen species are Albizza spp., Ammora spp., *Artocarpus heterophyllus*, Bambuseae, Bauhinia spp., *Bombax ceiba*, Colocasia spp., Dalbergia, Ficus spp., Gmelina spp., Lagerstroemia spp., *Mimosa pudica*, Musa spp., *Paederia scandens*, Phoebe spp, *Phlogacanthus tubiflorus*, *Shorea robusta*, *Tectona grandis*, Terminalia spp., *Cuscuta reflexa* and few species of epiphytic orchids like *Rhynchostylis retusa*, *Cleisostoma simondii* were also found. Bryophytes and liverworts were also seen in the trunk of old trees. In certain areas of the community forest, the natural vegetation was cleared; teak and areca plantation was done.

3) Jhum Cultivation (KM post 119)

Terrestial observation was carried out in the area. Floral species of Dactyloctenium aegyptium, Manihot esculenta, Matricaria discoidea, Mimosa pudica, Musa spp., Oryza sativa, Taraxacum officinale, Urochloa mutica, and Zea may. Faunal species of Hirudinea and Rhopalocera were observed. Mixed cropping of maize, banana, rice, and tapioca was carried out.

4) Rubber, Areca Plantation (KM post 107-109)

In many areas of the community forest, the natural vegetation was cleared and commercial plantation of rubber and areca nut was carried out on the slopes. The lower canopy was covered with grasses. Cashewnut were also commercially cultivated in many pockets throughout the road. Sparrow, butterfly, lizards, owl, common monkey, golden langur, red jungle-fowl, Indian black baza, thick-billed green pigeon, and cobra were encountered during the field survey. The sound of Gryllidae was heard in abundance. There is a citrus garden of the Department of Agriculture and Ganol Ecopark. During the field survey, it was noticed that shifting cultivation/ *'jhum'* practice is very common and in many areas the forest/natural vegetation are cleared and secondary monoculture of cashewnut, Sal (*Shorea robusta*), and Teak (*Tectona grandis*) are established. Rice, maize, banana, and pineapple cultivation are done in pockets. Several species of bamboo (Bambuseae spp.), stretch for long distances forming thickets of secondary vegetation.

Based on the observations mentioned above, there is no unique faunal community within the project area. No endangered or threatened species were reported in the area close to the project highway.

Mitigation Measures

In the process of finalizing ROW, efforts to minimize the scale of forest clearing and impacts shall be made. Also, it is essential that all locally procured construction materials will be procured in certified sites where operation is authorized. The contractor shall review/renew relevant permit as necessary and fully cooperate with inspection by relevant authority.

During the construction stage, signboards will be used to make sure that workers will be aware of the vulnerable and other important species. Relevant information (e.g. encounter with vulnerable species during engineering work) shall be shared with State Environment and Forest Department with which the project authority will discuss potential measures to promote conservation and monitoring of ecosystem shall be carried out as was undertaken during the EIA study.

The felling of trees will be replaced and compensated according to the Compensatory Afforestation Policy under the Forest Conservation Act, 1980. Apart from trees earmarked for clearing, no additional tree clearing within the ROW will be allowed. All construction workers should adhere to this rule.

Plantation of shrubs and under trees in the median shall be undertaken to prevent the glare of the vehicles coming in the opposite direction. Construction vehicles, machinery, and equipment will move or be stationed in the ROW to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling, or any other construction-related or incidental activities, it will be ensured that the trampling of soil will be avoided.

Construction of road will involve removal of topsoil and cutting resulting in clearing of vegetation cover and felling of trees. However, such impacts will primarily occur at the project site during initial period of the construction phase and will be minimized through adoption of mitigation measures. It is recommended that the lost trees will be compensated at a 1:3 ratio. The site of compensatory afforestation will be specified by the Forest Department during the process of obtaining forest clearance. As per its guidance, the project proponent will plant saplings (types and number to be specified) at designated location (either degraded forest or vacant/abandoned jhum area).

Following measures will be taken during construction phase:

- It is suggested that regular monitoring by the Forest Department should be done. In keeping view of a likely increase in vehicular emissions in the future, the monitoring should include the assessment of impact due to greater air pollution;
- A suitable landscaping plan for the project road has been prepared to enhance the ecological status of the area;
- It was noticed, that the project road did not have tree cover at few locations (jhum lands) tree plantation at these location will enhance the aesthetics as well as reduce the pollution level of the area; and
- Initiative should be taken to remove the impacted small girth size trees with the help of Forest Department and replanted them at a designed place. Although cost involvement against this type of work can be high, it will save the life of growing plants.

During the operation stage, monitoring shall be carried out to check the impact of increased emissions on forest/plantation and measures (e.g. additional plantation) shall be undertaken to mitigate negative impacts as necessary. All data related to increased traffic volume, emissions and quality of forest shall be shared with relevant state authorities. In addition, improved road network may trigger poaching. At the moment, educational activities and removal of traps by rangers are undertaken to reduce poaching. While NHIDCL is not responsible for the control of poaching, a proposal shall be made to relevant authority regarding the potential increase in poaching and the necessity of adequate management system, such as restriction of precious wildlife trade.

Improved road network may trigger poaching. At the moment, educational activities and removal of traps by rangers are undertaken to reduce poaching. While NHIDCL is not responsible for the control of poaching, a proposal shall be made to relevant authority regarding the potential increase in poaching and the necessity of adequate management system, such as restriction of precious wildlife trade.

(7) Landscape

No site of significant scenic value has been identified along the targeted section of NH51. However, road and traffic markings will be be installed in accordance with IRC:35-1997 that will ensure smooth and orderly flow of traffic and contributes to better aesthetic condition of the road by reducing congestion.

Buses standing indiscriminately on the carriageway to drop or pick-up passengers can seriously affect capacity of the roadway, besides being a source of accidents. It is, therefore, desirable that on all busy non-urban highways, consideration should be given to the construction of bus lay-bys of suitable design at required locations to ensure orderly movement of the traffic. For the convenience of tourists, it is also proposed that bus bay will be equipped with amenities including public toilets and bazar shed.

(8) Natural Disaster

The slope along NH51 is covered by very loose quaternary alluvium. It is concerned that slope failure and erosion have frequently occurred on cut slope along NH51. Therefore, such loose soil slope shall be cut with 1:1.2 gentler than IRC standard for landslide prevention as shown below. The cut slope shall be greened by seeding and mulching consisting of jute netting including seeds which cover all over the slope and prevent erosion by rain water.

The frequency and intensity of heavy rain is likely to increase due to climate change. In the project area, an increase of annual rainfall is predicted to be 5-10% for the period from 2021 to 2050. The design of various components of the road (slope protection, drainage, etc.) takes into account the likely effect of climate change. With the increase of rainfall frequency and intensity, river water and groundwater level are expected to increase which could cause inundation and damage to the road facilities. Therefore, spring water points have been carefully studied and subsurface drainage is proposed where necessary. A flood marker was checked in the site reconnaissance and interview survey for disaster countermeasures was planned for the road design. The table below shows adaptation measures for climate change taken into consideration in this road design.

Table 12.6-7 Adaption Measures for Climate Change in NH51

Factor	Design Policy Considering Adaptation
Side Slope	· Retaining wall is built all along the road. · Slope protection work is constructed on some weathered and loosen slopes. · Cut slope is covered with vegetation works to prevent erosion and collapse. · Replacement of subgrade and subsurface drainage are planned as countermeasures against sinking.
Embankment	· Drain filter is sandwiched in embankment. · Flood level is confirmed in site reconnaissance and interview survey near the river bank in the south of NH51.
Bridge and Drainage System	· Rainfall intensity is carefully determined based on the authorized data: ATLAS of Statewise Generalised Isopluvial Maps of Eastern India published by the Indian Meteorological Department. The isopluvial value from higher edge of counter range is applied. · The capacity of all structures is determined to be capable for discharge with a 50-year return period.
Pavement	· Super elevation is installed properly. · Pavement material is examined and temperature not to rise over 60 °C on the surface.
Road Sign	· Wind load and visibility are taken into consideration.

Source: JICA Study Team

Living Environment

(1) Air Pollution

Being a rural area without a major industrial activity, there are no major sources of air pollution along the project road except for vehicular traffic. As shown in Table 12.6-8 below, it is evident that concentrations of all pollutants are well within the prescribed limits of the National Ambient Air Quality Standards.

Table 12.6-8 Results of Ambient Air Quality Monitoring

Station Code	Date	Parameters				
		Respirable Suspended Particulate Matter (as PM10 (μg/m^3)	Suspended Particulate Matter (μg/m^3)	Sulphur Dioxide (as SO_2) (μg/m^3)	Oxides of Nitrogen (as NO_2) (μg/m^3)	Lead (as Pb) (μg/m^3)
AAQ1	5/30-5/31	75	190	22	24	0.05
	6/1-6/2	70	165	22	24	0.06
	6/2-6/3	72	185	22	24	0.07
	6/11-6/12	68	179	22	23	0.08
	6/12-6/13	77	168	22	23	0.05
	6/18-6/19	71	155	18	21	0.03
	6/20-6/21	52	164	19	23	0.03
	6/25-6/26	68	165	17	23	0.06
	6/27-6/28	72	188	20	23	0.04
	6/29-6/30	69	176	22	25	0.04
AAQ2	5/30-5/31	75	190	22	24	0.05
	6/1-6/2	65	155	23	25	BDL
	6/2-6/3	52	130	21	23	BDL
	6/11-6/12	59	148	22	25	BDL
	6/12-6/13	50	134	17	21	BDL
	6/18-6/19	47	150	12	17	BDL
	6/20-6/21	39	140	15	23	BDL
	6/25-6/26	48	130	19	22	BDL
	6/27-6/28	44	136	14	18	BDL
	6/29-6/30	75	190	22	24	0.05
AAQ3	5/30-5/31	78	170	24	26	0.03
	6/1-6/2	75	185	24	26	0.05
	6/2-6/3	68	160	21	23	0.06
	6/11-6/12	70	185	22	24	0.04
	6/12-6/13	70	155	20	28	0.06
	6/18-6/19	70	170	19	21	BDL
	6/20-6/21	70	170	19	21	0.05
	6/25-6/26	70	170	19	21	0.05
	6/27-6/28	69	166	20	24	0.06
	6/29-6/30	78	170	24	26	0.03
CPCB Limit		100	200	80	80	1.0

Source: JICA Study Team

Pre-construction and Construction Phase

The short-term and localized degradation of air quality will occur from dust generation due to procurement and transport of raw materials from quarries and borrow pits, site clearance, use of heavy vehicles, machinery/equipment, stone crushing handling, and storage of aggregates and generation of fine particulate matter (smoke) in asphalt processing. Dust would be generated from haulage of materials and detouring of traffic on non-permanent, temporary pavement, etc.

Hot mix plants contribute substantially to the deterioration of air quality due to emissions of oxides of sulphur, hydrocarbons, and particulate matter. During the construction period, temporary impacts include generation of odor from construction activities as well as from construction camps. During construction of road, the movement of different types of construction machinery and vehicle will be increased. This, in other way, increases fuel consumption.

From the results of the ambient air quality monitoring conducted along the road, it is noticed that the monitoring parameters are within the standards as prescribed by the Central Pollution Control Board. The concentration of the air pollutants will further increase during the construction period but for a limited period only. The impacts on air quality during construction will be mostly localized and concentrated within the ROW. The impacts due to dust generation may be felt on a downwind direction of the site rather than at the site itself due to the local wind pattern.

Operation Phase

The project road mostly passes through the rural areas with alluvial soil. Dust generation due to movement of vehicles is envisaged along the project road, but not in significant amount. Due to increase in speed and volumes of vehicular traffic on the project corridor, marginal increase in the air pollutant levels is expected but not significant. The widening of road will attract larger community to use this corridor which in-turn increases the fuel consumption and has direct impact on the national economy and local ecosystem.

Mitigation Measures

The hot mix plants, crushers, and the batching plants will be sited at least 500 m in the downwind direction from the nearest settlement. All precautions to reduce the level of dust emissions from the hot mix plants, crushers, and batching plants will be implemented. The hot mix plant will be fitted with dust extraction system. Asphalt and concrete plants will be operated in conformity with the government pollution control legislation and located away from the settlements as far as possible. All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that the pollution emission levels conform to the SPCB norms. Regular monitoring of particulate matter at crusher sites, during the construction, will be conducted. Regular water sprinkling will be done on the cement and earth mixing sites, asphalt mixing site and temporary service and access roads. After compacting the earthwork, water will be sprayed to prevent dust emission. The vehicles delivering construction material will be covered to avoid spilling. Planting of trees/vegetation on the periphery of the construction site will be done.

During the operation stage of the project, vehicular emissions of critical pollutants (RSPM, CO, HC, SO_2, and NO_x) will be monitored and roadside tree plantation will be maintained. In the long term, the projected increase in traffic volume, particularly the heavy trucks, may pose health threats in the roadside community. The peak hourly estimated traffic volumes for the years 2020 and 2035 have been considered to project future air quality scenarios to provide an indication of long-term variations in air quality. The future level of air pollution, modeled based on the projected increase in traffic volume indicates that the level of pollution (CO and NOx levels) will remain below the standard during the projected period (2035). Nevertheless, mitigation measures, such as introducing speed limit and other measures to control congestion in built-up area, may be necessary in the longer term. Also, local communities should be well informed of the risk of air pollution. Awareness raising campaign may include distribution of facemask to mitigate risk of air pollution and other information kit.

(2) Water Pollution

There are no major pollution sources in the area and water quality along the road is good as per the report by the Public Heath Engineering Department, Shillong. In order to find out the existing condition, monitoring of ground and surface water quality was carried out in February 2011 (dry season) during

the DPR preparation. The data from seven sites for groundwater testing (KM post 93+950, 115+200 and 142+450) and four surface water monitoring showed that water quality is fair within the desirable limits.

The water quality for pre-monsoon and monsoon period in the project area has been analyzed by collecting surface water sample along the road in June and July 2015. The analysis of the samples showed that the water is alkaline in nature (pH <8), is soft in the area and the hardness is below the permissible limit. Chloride concentration is well below the desirable limit in all locations. Sulphate and nitrate concentrations are low and within the permissible limit and thus indicate low degree of organic pollution. Iron level is higher than the desirable standard, reflecting local soil condition in the area.

Table 12.6-9 Ground and Surface Water Quality

Parameters	Duragre Locality (South of Tura)	River at Around Halfway Between Tura and Dalualu	Tibapara Locality (Noth of Dalu)	Dalu	Limits IS: 10500
	GW1	SW1	GW2	SW2	
Temperature	32.1	32.1	32.3	32.1	
pH	7.49	7.46	7.03	7.64	6.6 to 8.5
Color (Hazen unit)	<5	<5	<5	<5	-
Odor and Smell	Agreeable	Agreeable	Agreeable	Agreeable	
Suspended Solid (mg/l)	24	17	33	2.0	-
BOD (mg/l)	Nil	Nil	Nil	Nil	-
COD (mg/l)	Nil	Nil	Nil	Nil	-
Total Hardness (mg/l)	68	24	80	20	300
Calcium (mg/l)	25.65	6.41	11.22	4.81	75
Magnesium (mg/l)	0.97	1.94	5.83	1.94	30
Electric Conductivity	174.6	85.7	126.9	73	-
Chloride (mg/l)	8.11	2.02	6.08	2.02	250
Sulphate (mg/l)	4	5.71	33.52	3.24	200
Nitrate (mg/l)	1.2	1.51	0.37	0.37	45
Fluoride (mg/l)	0.17	0.12	0.04	0.19	1
Total Dissolved Solid (mg/l)	110	54	80	46	500
Iron (mg/l)	33.52	4.07	2.0	0.1	0.3
Coliform Organism / 100 ml	Absent	Absent	Absent	Absent	

Note: GW stands for groundwater, SW stands for surface water
Source: JICA Study Team

Pre-construction and Construction Phase

The Tura-Dau section of NH51 traverses one small stream and passes through a paddy area near Dalu. Road projects may marginally lead to increased runoff during construction stages which will increase sediment accumulation in nearby water bodies. Although most of the natural watercourses are perennial in nature, the impacts due to the increased runoff would be negligible due to the project road. During construction, the disposal of solid and liquid waste from labor camps, fuel, and lubricant spills or leaks from construction vehicles, pollution from fuel storage and distribution sites, and that from hot mix plants are likely to affect water quality unless adequate mitigation measures are designed. The existing drainage will be slightly obstructed during the construction period, but for a limited period. Hence, a change in natural drainage pattern is very insignificant from the present state of the project.

The use of water for construction activities such as compaction, suppression, concrete work may pose pressure on local water supplies; the demand would be met from surface water bodies like ponds, canal, and rivers. Municipal water supply will be used only for drinking purposes (for construction camps), if

available and if permitted by the local municipal authority. No local/municipal water supply would be used for construction purpose.

Operation Stage Impacts

Road projects may marginally lead to increased runoff during operational stages due to increase in impervious surface and sediment will be accumulated in nearby water bodies. Although most of the natural watercourses are non-perennial in nature, the impacts due to the increased runoff would be negligible due to the project road and will be restricted only during monsoon and early part of post-monsoon seasons.

In the operation stage, pollutants from vehicles, and accidental fuel spills may make their way into the receiving environment. The major pollutants of concern are suspended solids, oil and grease, lead, etc. All rivers present at this road section are non-perennial surface water bodies. No adverse direct impact on the water quality (both underground and surface water bodies) is expected during the operation period. The change in natural drainage pattern is very insignificant from the present state of the project.

Mitigation Measures

To avoid contamination of various water bodies and drainage channels, construction work close to the canals or other water bodies will be avoided especially during the monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per the State Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored, and will be taken to approved disposal sites.

To avoid contamination of the water body and drainage channels from fuel and lubricants, the vehicles and equipment will be properly maintained and re-fuelled only at designated places. The slopes of embankment leading to water bodies will be modified and re-canalized so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations to prevent contamination of water.

Discharge of oil and grease is most likely from construction vehicle parking area, vehicle repair area, and workshops. An oil interceptor shall be provided to ensure that all wastewater flow into the interceptor prior to its discharge. The device has a chamber for separation of oil and water and can handle 200 L/hour of wastewater. The oil float appearing on the surface is removed by periodic cleaning once a week by skimming off the oil film from the surface.

The sewage system (including septic tanks and soak pits) for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse. The workplace will have proper medical approval by local medical, health or municipal authorities. The contractor will make arrangements for water required for construction in such a way that the water availability and supply to nearby communities remain unaffected. Due to the non-availability of water required for construction, if a new tube-well is to be bored, prior sanction and approval by the Central Ground Water Board (CGWB) will be obtained. Wastage of water during the construction will be minimized.

In most cases, effluents from existing public toilet along NH51 are discharged without any treatment. For new public toiles to be constructed in bus bays/viewpoints or replacement of existing toilets that will be affected by the road widening, septic tack or toilet with an opening for collecting night soil will be installed to reduce negative impacts.

(3) Bottom Sediment Contamination

It is proposed that one 6 m long bridge will be replaced with a new one and the super structure of seven small bridges will be replaced. During engineering work of the bridges over the rivers, sediment pollution may occur. As one of the mitigation measures, silt fencing will be provided to restrict runoff into the water during the construction phase.

(4) Soil Contamination

Pre-construction and Construction Phase

The contamination of soil during construction stage is primarily due to construction and allied activities. The soil contamination may take place due to solid waste from the labor camps set-up during the construction stage. This impact is significant at locations of construction camps; stockyards, hot mix plants, etc. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. The contamination of soils can also occur at the site of hot-mix plants from leakage or spillage of asphalt or bitumen. At the site of batching plants, because of spillage of cement, leakage of curing agents and soil contamination can occur. The contamination of soil may take place due to dumping of solid waste in unscientific manner, leaching of fuel/oil and grease from workshops, petrol stations, and DG sets.

Operation Stage Impacts

During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment should they occur. These impacts can be long term and irreversible depending on the extent of the spill.

Mitigation Measures

At construction yards, the vehicles/equipment will be maintained and re-fuelled in such fashion that oil/diesel spillage does not occur and contaminate the surrounding soil. It will be ensured that the fuel storage and re-fuelling sites are kept away from drainage channels and important water bodies. At the washdown and re-fuelling areas, “Oil Water Separators” shall be provided. All spills and discarded petroleum products shall be disposed off in accordance with the Hazardous Waste Management and Handling Rules. Fuel storage and re-fuelling areas will be located at least 500 m from all water bodies near the road alignment. The fuel storage and re-fuelling areas shall not be located on agricultural lands or productive lands to avoid topsoil contamination. The earthwork will be carried out strictly in accordance with the design so that no excess earth is borrowed. The construction waste generated will be reused in the construction of the highway.

Bituminous waste will be used after milling and in case bituminous waste is required to be disposed off it shall be disposed in a secured way by providing 50 mm thick clay layer. The solid waste generated during the construction phase, which includes municipal waste both organic and inorganic in nature, shall be stored/treated/disposed off in accordance with the Municipal Solid Waste (Management and Handling) Rules. The hazardous waste may include oil waste, biomedical waste, E-waste, etc. This shall be disposed off in accordance with the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, Biomedical Waste (Management and Handling) Rules, and E-Waste (Management and Handling) Rules, respectively.

In the operation stage, the petrol pumps and vehicle washing area located along the ROW will be monitored regularly for any spillages and corrective remedial measures like spread of sand, provision of oil and greases separators for passing wash water of petrol pumps, and vehicle washing area before diverting it to water bodies, shall be done regularly. The solid waste generated from the way side amenities will include municipal waste, both organic and inorganic, hazardous waste (like used batteries), will be treated in accordance with the Municipal Solid Waste (Management and Handling) Rule and Hazardous Waste (Management, Handling, and Transboundary Movement) Rules.

(5) Ground Subsidence

Many road subsidence sites have been identified in the slope inventory survey, which was assumed to occur due to the consolidation of loosen subsurface soil and high groundwater level except for

embankment sliding. Replacement of subgrade with 1.0 m thick and subsurface drainage is planned as countermeasures for sinking, which will significantly improve the existing condition.

(6) Noise and vibration

Noise is an important environmental attribute in all road projects because vehicular traffic is a source of noise pollution. During DPR preparation, noise level monitoring was carried out in six locations in February 2011 (dry season). Apart from the areas near Tura and Dalu Town, the project road mostly passes through open forest and plantation and thus noise is not a major issue and the monitoring result were within the limit prescribed by PCPB. The monitoring for pre-monsoon and monsoon seasons has been carried out as part of the preparatory study in three locations. The noise level near a school in Dalu Town is within the limit of residential area (55 dB for daytime and 45 dB for nighttime, but slightly above the limit for silence zone (50 dB for daytime and 40 dB for nighttime), indicating the need for proper noise level mitigation measures around sensitive facilities. The figures in other locations are within the limit.

Table 12.6-10 Ambient Noise Level

Sr. No.	Location	Ambient Noise Level Leq.dB(A)					
		Day Time (07:00 AM to 11:00 PM)			Night Time (10:00 AM to 12:00 PM)		
		L_{min}	L_{max}	L_{eq}	L_{min}	L_{max}	L_{eq}
Monitoring 1. Date: May 30, 2015 to May 31, 2015							
1	GK Sangma Petrol Pump	70	52	60	58	46	47
2	Near Woodland School, Barengapara, Dalu	71	53	58	55	44	46
3	Forest Gate, Chokpot, Tura	68	51	57	53	47.2	38.5
Monitoring 2. Date June 29, 2015 to June 30, 2015							
1	GK Sangma Petrol Pump	70	46	52	54	41	43
2	Near Woodland School, Barengapara, Dalu	70	46	51	54	40	42
3	Forest Gate, Chokpot, Tura	69	50	52	53	40	40
Standard for Commercial Area For Residential Area For Silence Zone		- - -	- - -	65 55 50	- - -	- - -	55 45 40

Source: JICA Study Team

Pre-construction and Construction Phase

During the construction, the major sources of noise pollution are movement of vehicles transporting the construction material to the construction yard and the noise generating activities at the yard itself. Mixing, casting, and material movement are primary noise generating activities in the yard and will be uniformly distributed over the entire construction period. Construction activities are expected to produce noise levels in the range of 80 - 95 dB (A). The major work will be carried out during the daytime. The noise levels in the project area during the construction stage will be intermittent and temporary in nature. Typical noise levels associated with the various construction activities and construction equipment are presented below.

Table 12.6-11 Typical Noise Levels of Construction Equipment

Construction Equipment	Noise Level dB(A)
Bulldozer	80
Front-End Loader	72-84
Jack Hammer	81-98
Crane with Ball	75-87

Construction Equipment	Noise Level dB(A)
Crane	75-77
Bulldozer	80
Backhoe	72-93
Front-End Loader	72-84
Cement and Dump Trucks	83-94
Jack Hammer	81-98
Scraper	80-93
Welding Generator	71-82
Grader	80-93
Roller	73-75
Concrete Mixer	74-88
Concrete Pump	81-84
Concrete Vibrator	76
Paver	86-88
Truck	83-94
Tamper	74-77
Air Compressor	74-87
Pneumatic Tools	81-98

Source: U.S. Environmental Protection Agency, Noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. 300.1. December 31, 1971

At the moment, the noise level is within the desired level. The noise level will be increased during the construction period which have significant impact for a limited period on the surrounding environment. The noise levels in the working environment are compared with the standards prescribed by the Occupational Safety and Health Administration (OSHA-USA) which in-turn are being enforced by the Government of India through model rules framed under the Factories Act. The acceptable limits for each shift being on an eight hour duration, the equivalent noise level exposure during the shift is 90 dB(A). Hence, noise generated due to various activities in the construction camps may affect workers, if equivalent to an eight-hour exposure is more than the safety limit. ACGIH proposed an eight-hour Leq limit of 85 dB(A). Exposure to impulses or impact noise should not exceed 140 dB(A). The workers, in general, are likely to be exposed to an equivalent noise level of 80-90 dB(A) in an eight-hour shift for which all statutory precautions as per laws should be taken into consideration.

Operation Stage Impacts

During the operation stage of the project, reduction of vehicular engine noise (as a result of reduced congestion as mentioned earlier and smooth flow of traffic due to having two separate lanes), vehicular body noise (as a result of reduced development roughness), and reduction of blowing of horns will bring the noise levels down, but as volume of traffic, mainly heavy duty traffic will increase in the future due to rapid development and industrialization, along the road corridor may increase noise. The noise prediction at different scenarios indicate that the noise levels can exceed the noise standards of 55 dB(A) for daytime and 45 dB(A) for nighttime at several receptor locations without a barrier scenario.

Mitigation Measures

The high noise levels will cause discomfort to local residents and workers. The following mitigation measures shall be adopted to keep the noise and vibration levels under control:

- The plants and equipment used for construction will strictly conform to the Central Pollution Control Board (CPCB) noise standards. Vehicles, equipment, and construction machinery shall be monitored regularly with particular attention to silencers and mufflers to maintain noise levels to a minimum;
- Workers in the vicinity of high noise levels must wear ear plugs, helmets and should be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB(A);
- In construction sites within 150 m of human settlements, noisy construction will be stopped

between 10:00 PM and 6:00 AM except in case of laying of cement concrete pavement for which lower working temperature is a requirement;

- Hot mix plant, batching, or aggregate plants shall not be placed within 500 m of sensitive land use like schools and hospitals;
- Near to the sensitive receptors such as hospitals and schools, noise barriers such as earth, concrete, wood, metal or double-glazing of windows for façade insulation shall be used;
- Phase demolition, earthmoving, and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could significantly be less when each vibration source operates separately;
- Construction machinery will be located away from the settlements;
- Careful planning of machinery operation and scheduling of operations can reduce the noise levels. Use of equipment, emitting noise not greater than 90 dB(A) for the eight-hour operations shift, and placing of construction yards at a distance of at least 500 m from any residential areas can be adhered to;
- Use of noise shields to construction machinery and provision of earplugs to the heavy machine operators are some of the mitigation measures which should be followed by the contractors during the civil works;
- The noise control measures include limitations on allowable grades. Open-graded asphalt and avoidance of surface dressings to reduce tire noise in sensitive areas. Maintenance of proper road surface repairs also helps in reducing noise levels;
- Use of air horns should be minimized on the highway during nighttime. During daytime, the use of horns should be restricted in few sensitive locations. This can be achieved through the use of sign boards along the roadside;
- Future development along the road should follow correct land use norms so that sensitive receptors are not located along the road specifically along the bypasses; and
- Development of greenbelt along the main road can also bring about considerable reduction in noise levels. The area available on both sides of the road should be used to develop green belt comprising selected species of trees with high canopy to provide added attenuation of noise

(7) Wastes/Hazardous Materials

The types of construction waste which are expected to be generated include asphalt chunks, chunks of concrete, surplus soil, construction scrap materials, and organic waste generated by construction workers. The amount and percentage composition of construction waste will depend on the final design and the schedule of the construction, and thus, generic mitigation measures proposed in EMP should be updated once the final ROW drawing is completed. All other construction wastes are also planned to comply with the relevant centre or state laws pertaining to waste management.

Table 12.6-12 Required Volume for Spoil Bank

Highway No.	Sec.	Item	Unit	Volume of Generated Soil	Coefficient of Compation	Volume of Compacted Soil	Required Volume of Spoil Bank
				Cu.m		Cu.m	Cu.m
NH51	1	Cut Soil	cu.m	698,411	0.9	628,570	290,292
		Fill Soil	cu.m			338,278	
	Total						290,292

Source: JICA Study Team

The volume of surplus soil is estimated below. Candidate locations with sufficient and necessary conditions for spoil bank construction have been screened with the following criteria:

- ❖ To minimize the transport of surplus soil, spoil bank should be located at every 5 km distance along NH51 with following conditions:

- Ground shape with concavity topography
- Less ground gradient than 22 degrees which is assumed as the average angle of spoil bank slope with necessary steps
- No built-up area
- No national sanctuary area

❖ To be able to construct the spoil bank in less than 30 m in height.

Based on the above criteria, nine locations along the stretch of NH51 have been identified for spoil bank construction with the total capacity of about 342 cm3. The list of each candidate site is shown below.

Table 12.6-13 List of Spoil Banks

No.	Section	Sta.	Capacity of Spoil Bank
			Cu.m
1	Sta. 85-94	88+000	47,120
2	STA.101-143	105+805	4,620
3		110+000	86,190
4		110+550	58,260
5		119+340	16,856
6		124+800	77,440
7		130+800	15,526
8		135+420	22,806
9		139+100	12,883
Total in NH-51			341,701

Source: JICA Study Team

Socio-Economic Environment

(1) Involuntary Resettlement

As per the preliminary ROW design, 367 households (173 households whose houses will be affected and 194 households whose businesses will be affected) will be affected by the project. The total number of people is 1,820. Out of these, 319 households (161 households whose houses will be affected and 158 households whose businesses will be affected) will have to be relocated. The remaining 48 will be partially affected but relocation will not be necessary. More details about resettlement impact, resettlement policy, and proposed compensation package can be found in the RAP report.

(2) Land Use

The project does not lead to large-scale change in land use as the engineering work will be constrained mostly along the existing road. On the other hand, the construction of spoil bank is likely to cause changes in land use pattern, potentially affecting the existing agricultural and plantation activities. In particular, several plantations is located by the road and installment of retaining walls, embankment, and slope protection measures not only affect the land but potentially alter the long-term productivity by changing micro-level hydrology. This issue should be taken into account when the compensation for agricultural land/plantation next to the existing road is finalized by the district collector.

(3) Utilization of Local Resources and Local Economy and Livelihood

Significant volume of local resources such as sand may be used for construction work. This could cloud out the use of such resources for other purposes in the short term. In the long term, the better road network may attract new business, possibly from outside the state with detrimental impact on local business/traders. While the project overall will have significant positive impacts on the local and regional economy, the better transport network may put some groups at risk at least in the short and medium term. This is of particular concern because Dalu is at the border with Bangladesh. For example,

if the travel time is reduced, thanks to the improved road condition, truck drivers may stop taking rest in Dalu or in other places negatively affecting local businesses in the project area. These potential high-risk groups should be identified in the preparation of R&R plan to ensure that they will not be in a disadvantaged position due to the project.

(4) General, Regional/City Plans

The project will create new opportunities for village and block-level development planning. In particular, the construction of spoil bank will create large area of flat land where such surface is a scarce commodity. The development of spoil bank, therefore, should be coordinated with the village/block development plan so that the land will benefit the community.

(5) Social Institutions and Local Decision-Making Institutions

Being a tribal state, block, and village council and traditional community leaders called Nokma have significant influence on decision-making process in the area. As such, their support and cooperation is critical in the smooth implementation of the project, particularly, activities related to resettlement. The implementation of EMP as well as RAP/R&R should be built on existing social institutions and will be best guided by local people, rather than outside experts.

(6) Social Infrastructure and Services

For most people residing along NH51, the highway is the only route of access to social infrastructures such as schools and hospitals. Construction activity is likely to cause temporary disturbance to their access to such infrastructure and service and therefore, schedule and timing of the engineering activity should be developed in consultation with the local community. When road blockage is necessary, e.g., for blasting, the local community should be informed in advance so that they can make alternate plan accordingly.

(7) Unequal Distribution of Benefit and Damage and Local Conflicts of Interest

Roadside location offers critical advantages for local business (tea stalls, restaurant, petty shops). Resettlement from roadside to the inner part of the village may significantly undermine the viability of these businesses, and therefore, business owners may experience the worse compared with the farmers once they are relocated. Likewise, allocation of plot in resettlement site may become a source of conflicts among affected households who wish to be relocated to more advantageous plots. Sound arbitration and conflict resolution mechanism by local leaders should be in place for smooth implementation of RAP and R&R activity.

(8) Water Usage, Water Rights, and Communal Rights

Irrigation is not practiced along the project area, thus, water is not likely to become a source of conflicts in the course of project implementation.

(9) Cultural and Historical Heritage

No sites of cultural or historical significance have been identified along the project road.

(10) Religious and Sensitive Facilities

The project will not affect religious facilities, but the access to churches may be impaired during the construction stage. Given the significance of religious belief in the area, access to these facilities, particularly during Sundays, should not be disturbed by construction activities. Similarly, more stringent

standards for noise and vibration and air quality should be adopted where sensitive facilities, such as schools and hospitals, are located.

(11) Poor People

The baseline survey has identified a gap between the official poverty level and poverty level as reported by the people. R&R activity should take into account the limited coping capacity of the local community and develop measures that lead to sustainable income generation of the affected people, rather than one-off payment of compensation and assistance.

(12) Ethnic Minorities/Indigenous People

In the state of Meghalaya, the tribal (Scheduled Tribe: ST) population constitutes about 85% of the total population. Most of affected people belong to Garo Tribe except for the Dalu Town with a sizable Bengali community. Majority of the affected people also belong to ST, and hence, they are not a minority. While tribal groups in the project area hold traditional culture, including shifting cultivation in forest called jhum, they freely interact and share their sources of water, folklore, food, infrastructure, and other belongings with the non-ST and other tribal population within and outside community. This is clear from the fact that Bengali and Garo communities along NH51 co-exist peacefully without ethnicity-related tensions. Moreover, ST population in project area is not isolated from outside and they are open to new ideas such as family planning and formal education.

(13) Gender

Tribal and non-tribal women in the North East States enjoy a relatively higher position in the society than what their non-tribal counterparts do, which is reflected in their high literacy rate. Garo women are largely involved in household work, collection of forest produce, firewood collection, cultivation and other agricultural activities and thus, they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in this RAP in which options to facilitate women's participation in project implementation and various opportunities to be created by the project is discussed. In particular, women shall have preferential access to specific types of project-related job opportunities, including light-duty work and part-time jobs that do not interfere with women's responsibility at home. In addition, efforts should be made ensure participation of women in consultation meetings to be carried out during the implementation of RAP.

(14) Public Health and Occupational Health and Safety

The same measures as NH54 will be adopted for mitigating the negative impacts on public and occupational health and safety issues (see Table 12.5 21).

Other Issues

(1) Accidents

Construction Phase Impacts

The project will improve the road safety through design measures identified during the various road surveys. Road safety will be enhanced in the project through engineering (design), enforcement (safety measures, signage, etc.) and education. The issue of road safety is one of the key issues that may surface in the construction stage. During the construction stage, the dismantling of structure, cutting of trees, haulage material obstructing vision, spillage of lubricants on road making it slippery is generally the cause of road accidents. Similarly, in the operation stage, increase in traffic and increase in speed would tend to increase accidents. In spite of these, the social benefits from the project are quite significant.

It is likely that there will be some concern in terms of safety for highway users during the construction period as the haulage of material and other equipment would restrict movement of vehicles. Highway

patrolling system with ambulance facility and crane will render assistance to users in distress and disabled vehicles which in-turn will improve the safety level.

Operation Phase Impacts

The proposed project implementation would improve the road safety for the highway users as well as the locals living by the side of the road. In the operation stage, the increase in traffic and speed would tend to increase accidents. Inspite of these, the social benefits from the project are quite significant. In the operation phase, an increase in vehicle speed may cause thereof to the safety of pedestrians and for cattles for crossing the road.

Mitigation Measures

Street furniture known as road studs, blinker, or cat's eye include equipment installed on road or roadside to assist visibility of road alignment/structures. They are retro-reflective safety devices used in road marking. Generally, it consists of two pairs of reflective glass spheres set into a white rubber dome, mounted in a cast-iron housing. This is located at the centre of the road, with one pair of device showing each direction. A single-ended form has become widely used with different colors as road margins and lane dividers.

Since the NH51 is located in a mountainous region, hair-pin bends are unavoidable from the viewpoint of cost and environmental impact. A design speed of 20 km/h is applied for hair-pin bends, while a design speed of 30 km/h is adopted in general. Small horizontal curves such as R20 m-R25 m are used in steep terrain to avoid large-scale earthwork and/or demolition of houses. In substandard sections, securing traffic safety by applying a combination of facilities shall be considered.

In hair-pin bends, it is difficult to secure overtaking sight distance and thus, the section shall be designated as a no-overtaking section. In order to inform the drivers, the double centre line with a pair of marking of solid lines is applied. Cat's eyes to delineate road alignment are to be installed on the centre line and lane edges so that drivers will be able to identify the direction he should go before entering into the curve. Furthermore, traffic signs and Guardrails shall be properly equipped to avoid hazardous accidents. In the locations where the existing bridges are to be utilized with rehabilitation works, carriageway width becomes narrower than that of earthwork sections due to the difference in shoulder width. It is, therefore, proposed to install facilities that notify drivers the decrease in carriageway width and existence of concrete curb.

In built-up areas near Tura and Dalu, there are a lot of buildings, shops, or houses at roadside as well as pedestrians going along the sidewalk and crossing the road. Furthermore, more road facilities such as bus stops are necessary than the rural sections. Therefore, drivers have to handle much information on roads/traffic and decide their maneuvers in a short time at built-up areas. In order to assist road users in obtaining information, appropriate traffic signs and road markings shall be provided properly.

(2) Greenhouse Gas (GHG) Emissions

There is a possibility of increased GHG emission due to the operation of heavy vehicles as well as traffic jams incidental to the construction works, although this impact will be temporary. On the other hand, it is expected that there will be elevated GHG emission due to increase traffic volume. The increase will be mitigated by keeping good road conditions which will reduce consumption of extra fuel and congestion thereby mitigating GHG emissions over time.

12.6.9 Environment Management Plan

Based on the assessment above, environment mitigation and enhancement measures during the different stages of the project have been developed as shown below.

Table 12.6-14 Environmental Management Plan for Pre-construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
P1	Relocation of Project Affected Persons (PAP)	• All requirements of the RAP as applicable shall be complete before start of construction stage. The activities broadly include acquisition of land and structures, relocation of utilities, payment of compensation and provision assistance	All areas	Before construction begins	Government of Meghalaya, District Revenue authorities, Nokma and NGO/Consultant/ Academica	PIU, SC
P2	Removal of vegetation	• Minimize the scale of vegetation clearing by factoring vegetation/forest cover in the final design of the road alignment process • Removal of trees to be carried out after forest clearance is obtained • Reforestation/replantation of trees at a term as instructed by the Forest Dept. or by the Forest Dept. • Activity shall be supervised to avoid poaching of animals	All areas	Before construction begins (Reforestration/replantation may extend to during/after construction)	PIU, Contractor, Forest Dept.	PIU, SC, Forest Dept.
P3	Setting up construction camps	• Camps shall be located at least 500 m away from the nearest built-up area. • Sewage system for a construction laborer's camp shall be designed, built and operated so that no pollution to ground or adjacent water bodies/ watercourses takes place. Garbage bins shall be provided in the camps and regularly emptied and the garbage disposed off in a hygienic manner, to the satisfaction of the relevant norms and the Engineer. • In relation to underground water resources, the contractor shall take all necessary precaution to prevent interference with such water resources. • All relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996 shall be adhered to.	All construction campsite identified by the contractor and approved by SC	During Establishment, Operation and Dismantling of Such Camps.	Contractor	PIU, SC
P4	Setting up hot mix plants	• Hot mix plants and batching plants shall be located sufficiently away from habitation and agricultural operations.	All hot-mix and batching plants	During Erection, Testing, Operation and Dismantling of	Contractor	PIU, SC

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		• Where possible such plants will be located at least 1000 m away from the nearest habitation.		Such Plants.		
P5	Finalizing sites for surplus soil dumping	• Location of dumping sites shall be finalized. The sites shall meet following conditions: i) dumping does not impact natural drainage courses; ii) no endangered/rare flora is impacted by such dumping	All areas identified as potential dumping sites	During mobilization	Contractor	PIU, SC
P6	Identification of hazard-prone locations	• The contractor shall identify locations sensitive to landslides (in addition to the ones that area already identified) and shall duly report these to the Supervision Consultant (SC) and to PIU.	All area	During mobilization	Contractor	PIU, SC
P7	Identify and prepare relocation sites	• Location of relocation sites shall be identified in consultation with district/village authorities and PAPs. • Sites to be developed including provision of necessary utilities such as water and electricity.	Near villages with large-scale resettlement		PIU	PIU

Source: JICA Study Team

Table 12.6-15 Environmental Management Plan for Construction Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Soil						
C1	Soil Erosion in Borrow Pits	• The depth of borrow pits shall be restricted so that sides of the excavation shall have a slope not steeper than 1:4, from the edge of the final section of the bank.	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C2	Loss of top soil in Borrow pits	• Agricultural fields or productive land shall be avoided for borrowing earth. If unavoidable topsoil shall be preserved and used for tree plantation.	On approved locations of borrow pits.	Construction Stage	Contractor and Supervision Consultant	PIU
C3	Compaction of Soil	• Construction equipment and vehicles shall be restricted to move only within designated area to avoid compaction of productive soil.	Throughout corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C4	Soil erosion in embankments	• Pitching shall be done for slope stabilization as per the IRC guidelines	At the places of embankments	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C5	Contamination of soil from fuel and lubricants	• Construction vehicles and equipment shall be operated and maintained in such a manner so that soil contamination due to its spillage shall be minimum. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near Labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C6	Contamination of land from construction waste and quarry materials	• Debris generated due to the dismantling of the existing pavement structure and the cutting of the hillside for the widening shall be suitably reused in the proposed construction, such as for fill materials for embankments. • Debris and other material obtained from existing embankment shall be dumped in approved landfill site already identified by concerned agency. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over. • Construction waste including non- bituminous and bituminous waste shall be dumped in approved landfill site identified by State Pollution Control Board (SPCB) or competent authority. All spoils shall be disposed off as desired and the site shall be fully cleaned before handing over.	Solid waste dump Site identified and approved by SPCB or competent authority. Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
C7	Loss of top soil in land acquisition	• Topsoil shall be stripped, stored and shall be laid on ground for landscaping purpose.	Throughout the area	Construction Stage	Contractor and Supervision Consultant	PIU
Water						
C8	Contamination of water by fuel/ oil spillage of vehicle	• Construction vehicles / equipment shall be operated and maintained in such a manner to avoid contamination of water bodies due to oil spillage. • Fuel storage shall only be done on wasteland and will be kept away from drainage channels and natural water bodies.	Near labor camp and sites of installation of Construction machineries.	Construction Stage	Contractor and Supervision Consultant	PIU
C9	Contamination of stagnant water body by fecal matters from labor camp.	• Labor camp shall not be allowed near any of the water bodies. • The proper sanitation facilities shall be provided.	Preapproved locations away from the water bodies.	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
C10	Deposition of dust in open wells near construction site	• The mouth/opening of the well shall be covered with suitable material during any of the construction activity so as to prevent dust entering in the well.	All the wells along the project corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C11	Using drinking water for construction purpose	• The contractor shall make arrangements for water required for construction in such a way that water availability and supply to nearby community is unaffected. • Wastage of water shall be kept minimum during construction.	At respective planned construction sites	Construction Stage	Contractor and Supervision Consultant	PIU
C12	Hand pump close to road may get affected in widening	• All the Hand pumps shall be relocated to suitable alternate place.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C13	Wells or water storage system may get affected in widening	• Alternate arrangements will be made for all the Wells or water storage system	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C14	Altering flow of natural drains	• Drain shall be channelized with Slope protection - Gabion Structure.	At the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C15	Sanitation of waste disposal in construction camps	• The construction of camps will be done with sufficient buffer from habitation. • At construction sites and labor camps sufficient no of latrines will be provided. • The sewage generated from the camps will be properly disposed off so that it does not affect water bodies	Wherever labor camp is located	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
Air						
C16	Emission from construction vehicles and machinery.	• All vehicles, equipment and machinery shall be selected to meet recognized international and national standards for emissions and shall be maintained and operated in a manner that ensures relevant air, noise and discharge rules. • Only unleaded petrol and low sulphur diesel or sulphur free diesel shall be used as fuel for vehicles, equipment and machinery.	Wherever the hot mix plant and batching plant is setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C17	Air pollution from various plants affecting settlements	• The asphalt plants, crushers and batching plants shall not be sited at least 500 m in leeward direction from nearest human settlement	Locations near Settlement	Construction Stage	Contractor and Supervision Consultant	PIU
C18	Air pollution may exceed the limits prescribed by Central Pollution Control Board.	• Regular monitoring or air quality parameters during the construction period as envisaged in the Environmental Monitoring Plan.	Locations given in Environmental Monitoring Plan.	Construction Stage	Contractor and Supervision Consultant	PIU
C19	Vehicles will generate dust and suspended particles.	• The dust generated by vehicles on site shall be arrested using a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding.	Wherever the plants are setup and sensitive locations as suggested in monitoring plan.	Construction Stage	Contractor and Supervision Consultant	PIU
Noise						
C20	Noise levels from vehicles. Asphalt plants and equipment	• The plants and equipment used for construction shall confirm to CPCB norms. • Vehicles and equipment used shall be fitted with silencer. • Any vehicle and machinery shall be kept in good working order and engines turned off when not in use. • All equipment and plants shall strictly be placed away from educational institutes and hospitals. • Regular monitoring of noise parameters (Leq) during the construction period as envisaged in the Environmental Monitoring Plan.	Wherever the plants are setup.	Construction Stage	Contractor and Supervision Consultant	PIU
C21	Noise from blasting operations	• Blasting as per Indian Explosives act will be carried out. • People living near such blasting operation sites shall	At the sites where the blasting is required and in	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		be informed before the operational hours. ● Workers at blasting sites shall be provided with earplugs.	quarry sites			
C22	Noise barriers	● Construction of noise barriers in the form of walls at Sensitive locations upon consultation with stakeholders.	All along the corridor wherever the sensitive locations like schools, hospitals and other community places are located.	Construction Stage	Contractor and Supervision Consultant	PIU
Flora and Fauna						
C23	Tree cutting for widening	● Three trees shall replace each tree cut for the purpose. ● The Engineer shall approve such felling only when the NHIDCL receives a "clearance" for such felling from the MOEF, as applicable. ● Trees felled shall be replaced as per the compensatory afforestation criteria in accordance with the Forests (Conservation) Act, 1980.	Throughout the project area	Construction Stage	Contractor and Supervision Consultant Forest Dept.	PIU
C24	Damage or Loss of Important Flora	● During construction, at any point of time, if a rare/ threatened/endangered flora species is found, it shall be conserved in a suitable manner in consultation with authorities. The Engineer shall approve detailed conservation processes, plans and designs as well as associated modification in the project design.	Throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU
Health and Hygiene						
C25	Health hazard to workers due to bad water and sanitation	● At every workplace, good and sufficient potable water (as per IS 10500) supply shall be ensured to avoid water-borne diseases and to secure the health of workers. ● Adequate drainage, sanitation and waste disposal shall be provided at workplaces. ● Preventive Medical care shall be provided to workers.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C26	Health hazard to workers by	● Personal protective equipment shall be provided to	Throughout the	Construction Stage	Contractor and	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
	various construction activity	worker as per the Factories Act.	project area		Supervision Consultant	
C27	Health/ social hazard, sexual harassment to female workers	• Segregation of male and female areas in labor camp shall be executed.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C28	Hygiene at Construction Camps	• The Contractor during the progress of work will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labor to standards and scales approved by the resident engineer. • These shall be provided within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, separately for each for these, as per standards set by the Building and other Construction Workers (regulation of Employment and Conditions of Service) Act, 1996. There shall be adequate supply of water, close to latrines and urinals. • All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing. The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs and no pollution to the air, ground or adjacent watercourses takes place. Compliance with the relevant legislation must be strictly adhered to. Garbage bins must be provided in the camp and regularly emptied and the garbage disposed off in a lined landfill sites. Construction camps are to be sited away from vulnerable people and adequate health care is to be provided for the work force.	Wherever labor camp is setup	Construction Stage	Contractor and Supervision Consultant	PIU
C28	Hygiene at Construction Camps	• On completion of the works, the whole of such temporary structures shall be cleared away, all rubbish burnt, excreta or other disposal pits or trenches filled in and effectively sealed off and the				

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		whole of the site left clean and tidy, at the Contractor's expense, to the entire satisfaction of the Engineer.				
C29	Abandoned Quarry will accumulate water and act as a breading ground for disease vectors.	• Reclamation measure shall be adopted with garland of trees around the periphery. The quarry dust and waste shall be used for refilling. The remaining portion should be covered with trees.	All quarry locations.	Construction Stage	Contractor and Supervision Consultant	PIU
Safety						
C30	Safety of vehicles plying on road while the construction activity is going on.	• Prior arrangement/traffic diversion for safe passage of vehicles shall be made with proper direction and signage at the construction site. • Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day.	Throughout the project area	Construction stage	Contractor and Supervision Consultant	PIU
C31	Risk from Operations	• The Contractor is required to comply with all the precautions as required for the safety of the workmen as far as those are applicable to this contract. • The contractor shall supply all necessary safety appliances such as safety goggles, helmets, masks, etc., to the workers and staff. The contractor has to comply with all regulation regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C32	Risk from Electrical Equipment	• Adequate precautions will be taken to prevent danger from electrical equipment. No material or any of the sites will be so stacked or placed as to cause danger or inconvenience to any person or the public. • All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian	All construction Site	Construction stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the Engineer.				
C33	Risk at Hazardous Activity	• All workers employed on mixing asphaltic material, cement, lime mortars, concrete etc., will be provided with protective footwear and protective goggles. Workers, who are engaged in welding works, would be provided with welder's protective eye-shields. Stone-breakers will be provided with protective goggles and clothing and will be seated at sufficiently safe intervals. • The use of any herbicide or other toxic chemical shall be strictly in accordance with the manufacturer's instructions. The Engineer shall be given at least 6 working day's notice of the proposed use of any herbicide or toxic chemical. A register of all herbicides and other toxic chemicals delivered to the site shall be kept and maintained up to date by the Contractor. The register shall include the trade name, physical properties and characteristics, chemical ingredients, health and safety hazard information, safe handling and storage procedures, and emergency and first aid procedures for the product. This should comply with Hazardous Material Act.	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C34	Risk of Lead Pollution	• Nobody below the age of 18 years and no woman shall be employed on the work of painting with products containing lead in any form. No paint containing lead or lead products will be used except in the form of paste or readymade paint. • Facemasks will be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C35	Risk caused by Force' Majure	• All reasonable precaution will be taken to prevent danger of the workers and the public from fire, flood,	All construction Site	Construction stage	Contractor and Supervision	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		drowning, etc. All necessary steps will be taken for prompt first aid treatment of all injuries likely to be sustained during the course of work.			Consultant	
C36	Risk from Explosives	• Except as may be provided in the contract or ordered or authorized by the Engineer, the Contractor shall not use explosives. Where the use of explosives is so provided or ordered or authorized, the Contractor shall comply with the requirements of the following Sub-Clauses of this Clause besides the law of the land as applicable. • The Contractor shall at all times take every possible precaution and shall comply with appropriate laws and regulations relating to the importation, handling, transportation, storage and use of explosives and shall, at all times when engaged in blasting operations, post sufficient warning flagmen, to the full satisfaction of the Engineer. • The Contractor shall at all times make full liaison with and inform well in advance and obtain such permission as is required from all Government Authorities, public bodies and private parties whatsoever concerned or affected or likely to be concerned or affected by blasting operations.	Place of use of Explosives	Construction stage	Contractor and Supervision Consultant	PIU
C37	Malarial risk	• The Contractor shall, at his own expense, conform to all anti-malarial instructions given to him by the Engineer, including filling up any borrow pits which may have been dug by him	All construction sites	Construction stage	Contractor and Supervision Consultant	PIU
C38	First Aid	• At every workplace, a readily available first aid unit including an adequate supply of sterilized dressing material and appliances will be provided.	At the construction site /labor camp	Construction stage	Contractor	PIU
Disruption to Users						
C39	Loss of Access	• At all times, the Contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock to and from side roads and property accesses connecting the project road. Work that affects the use of side roads and existing accesses	Throughout the project area, particularly in built-up areas	During Construction.	Contractor	Engineer

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		shall not be undertaken without providing adequate provisions to the prior satisfaction of the Engineer. ● The works shall not interfere unnecessarily or improperly with the convenience of public or the access to, use and occupation of public or private roads, railways and any other access footpaths to or of properties whether public or private.				
C40	Traffic Jams and Congestion	● Detailed Traffic Control Plans shall be prepared and submitted to the Site Engineer/ Project Director for approval 5 days prior to commencement of works on any section of road. The traffic control plans shall contain details of temporary diversions, details of arrangements for construction under traffic and details of traffic arrangement after cessation of work each day. ● Temporary diversion (including scheme of temporary and acquisition) will be constructed with the approval of the designated Engineer. While approving temporary diversion construction, the Engineer will seek endorsement from the PIU. ● Special consideration shall be given in the preparation of the traffic control plan to the safety of pedestrians and workers at night. ● The Contractor shall ensure that the running surface is always properly maintained, particularly during the monsoon so that no disruption to the traffic flow occurs. As far as possible idling of engines shall be avoided to curb pollution. ● The temporary traffic detours shall be kept free of dust by frequent application of water, if necessary.	Throughout Corridor	During Construction.	Contractor	Engineer
C41	Traffic Control and Safety	● The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through	Throughout the project area	During Construction.	Contractor	Engineer

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		the section of the highway under improvement. ● All signs, barricades, pavement markings shall be as per the MORTH specification. Before taking up construction on any section of the highway, a traffic control plan shall be devised to the satisfaction of the Engineer as per EMP. Excavated pits shall be filled to avoid falling of animals/ human beings.				
Environment Enhancement						
C42	Hand pumps enhancement/relocation for ground water recharging	● Hand pumps within Right of Way shall be enhanced/relocated.	At the respective locations along the corridor.	Construction Stage	Contractor and Supervision Consultant	PIU
C43	Roadside landscape development	● Avenue plantation of foliage trees mixed with flowering trees, shrubs and aromatic plants shall be carried out where ever land is available between ditches and Right of Way.	Throughout the corridor	Construction Stage	Contractor and Supervision Consultant	PIU
C44	Providing better bus bays	● Bus shelters shall be provided at given locations	As per traffic plan	Construction Stage	Contractor and Supervision Consultant	PIU
C45	Better sitting arrangements where small space is available	● Designed sitting arrangements shall be provided.	As per the design	Construction Stage	Contractor and Supervision Consultant	PIU
C46	Landscaping of junctions	● All rotary junctions shall be landscaped suitably	As per landscape design at the respective locations	Construction Stage	Contractor and Supervision Consultant	PIU
C47	Abandoned Quarry will accumulate water and act as a breeding ground for disease vectors.	● The abandoned quarry locations shall be planted suitably as the plan	Wherever quarries are located and abandoned	Construction Stage	Contractor and Supervision Consultant	PIU
C48	Erosion of embankments, shoulders, side slopes, and pavement leading to deterioration and affecting stability and integrity of road	● Earthworkss specifications will include provision for stable slope construction, compacting and laying out turf including watering until ground cover is fully established ● Proper construction of Breast wall and retaining wall at the locations identified by the design team to avoid soil erosion ● The measures proposed for slope stabilization are:	At the respective locations throughout the project area.	Construction Stage	Contractor and Supervision Consultant	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		Discharge zones of drainage structures (culverts and minor bridges) provided with riprap ● Construction in erosion and flood prone areas will not be in monsoon /season. ● Side slopes will be kept flatter wherever possible, and in case of steeper slopes it will be supported by the retaining wall.				

Source: JICA Study Team

Table 12.6-16 Environmental Management Plan for Operation Stage

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
O1	Water quality degradation due to road-run-off	● Silt fencing, oil & grease traps, etc. shall be provided at sensitive water bodies to ensure that the water quality is not impaired due to contaminants from road run-off ● Monitoring shall be carried out as specified in the monitoring plan	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O2	Soil and water contamination from accidental spills	● Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals ● Monitoring shall be carried out as specified in the Monitoring Plan	All area and as specified in the monitoring plan	Plan to be developed at state/district level by early operation stage	PIU, SPCB, Local Government Bodies	PIU
O3	Air quality degradation due to increases in traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Share air quality data with SPBC and relevant agencies and discuss options for mitigate air quality degradation associated with greater traffic volume	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
Q4	Increases in noise and vibration due to greater traffic volume	● Monitoring shall be carried out as specified in the Monitoring plan ● Install noise barrier (wall etc.) in sensitive areas, if necessary	As specified in the monitoring plan	As per monitoring plan	PIU, SPCB	PIU
O5	Traffic safety	● Traffic control measures including speed limits to be enforced strictly. ● Local government bodies and development authorities will be encouraged to control building	All area	Throughout operation stage	PIU, Local Government Bodies	PIU

Sl. No	Environmental Impacts/Issues	Mitigation Measures	Location	Time Frame	Responsibility	
					Implementation	Supervision
		development along the highway.				
O6	Accidents involving hazardous materials	● Compliance with the Hazardous Wastes (Management and Handling) Rules, 1989 including: ✓ For delivery of hazardous substances, permit license, driving license and guidance license will be required. ✓ These vehicles will only be harbored at designated parking lots. ✓ In case of spill of hazardous materials, the relevant departments will be notified at once to deal with it with the spill contingency plan.	All area	Manual/guideline to be prepared during early operation stage	PIU	PIU
O7	Roadside tree plantation, flora and fauna	● Trees planted along the corridor shall be maintained for a period of three years. Maintenance works include, watering of the saplings, replacement of the bamboo fence every year for 3 years and all necessary measures for survival of the sapling. ● Monitoring of flora and fauna along the highway shall be carried out to assess conditions of ecosystem against the baseline	All area and as per the monitoring plan	Immediately from the planting of sapling, and as per monitoring plan	PIU, NGO	PIU

Source: JICA Study Team

12.6.10 Environment Monitoring Plan (EMP) Implementation Cost

Based on the above, the cost for implementation of EMP is estimated below.

Table 12.6-17 Budget for EMP Implementation

Item	Detail	Unit	Unit Cost	Quantity	Total (INR)
I. Monitoring					
Air	Monitoring near hot mix plant locations approved by the engineer as per NAAQS, 2009 CPCB	No.	5,000	80	400,000
Water	At locations specified in the monitoring plan as per IS 10,500 and IS 2296	No.	5,000	60	300,000
Noise	At equipment yards as directed by engineer as per CPCB guideline 1989	No.	2,000	80	160,000
Flora and Fauna	Monitoring of impact on biodiversity	No.	50,000	24	1,200,000
Subtotal (I)					2,060,000
II. Afforestation	Compensatory afforestation, in accordance with Forest Conservation Act (1980) as per guideline provided in EMP	No.	200	50,000	10,000,000
Subtotal (II)					10,000,000
III. Institutional Cost					
Expert Fees	Lump sum				6,000,000
Staff Training	Lump sum				1,500,000
External Monitoring	Lump sum				2,000,000
Information Disclosure	Lump sum				500,000
Subtotal (III)					10,000,000
Subtotal (I+II+III)					22,060,000
Contingency (10%)					2,206,000
Total					24,226,000

Source: JICA Study Team

12.6.11 Environment Monitoring Plan (EMP)

To ensure effective implementation of the EMP, it is essential that an effective monitoring plan be designed and carried out. The environmental monitoring plan provides such information on which management decision may be taken during construction and operational phases. It provides basis for evaluating the efficiency of mitigation and enhancement measures and suggests further actions that need to be taken to achieve the desired effect. The monitoring includes: i) visual observations; ii) selection of environmental parameters at specific locations; and iii) sampling and regular testing of these parameters.

Monitoring methodology covers the following key aspects: components to be monitored, parameters for monitoring of the above components, monitoring frequency, monitoring standards, responsibilities for monitoring, direct responsibility, overall responsibility, and monitoring costs. Environmental monitoring of the parameters involved and the threshold limits specified are discussed below.

Ambient Air Quality

Ambient air quality parameters recommended for monitoring road transportation developments are PM10, PM 2.5, carbon monoxide (CO), oxides of nitrogen (NO_X), sulphur dioxide (SO_2), and lead (Pb).

These will be monitored at designated locations starting from the commencement of construction activity. Data should be generated at all identified locations in accordance with the National Ambient Air Quality Standards, 2009. The location, duration, and the pollution parameters will be monitored and the responsible institutional arrangements are detailed out in the monitoring plan.

Water Quality

The physical and chemical parameters recommended for analysis of water quality relevant to the road development projects are pH, total solids, total dissolved solids, total suspended solids, oil and grease, COD, chloride, lead, zinc, and cadmium. The location, duration, and the pollution parameters to be monitored and the responsible institutional arrangements are detailed in the environmental monitoring plan. The monitoring of the water quality is to be carried out at all identified locations in accordance with the Indian Standard Drinking Water Specification – IS 10500: 1991.

Noise

The measurements for monitoring noise levels would be carried out at all designated locations in accordance with the Ambient Noise Standards formulated by the Central Pollution Control Board (CPCB) in 1989. Noise should be recorded at an "A" weighted frequency using a "slow time response mode" of the measuring instrument. The location, duration, and the noise pollution parameters to be monitored and the responsible institutional arrangements are detailed in the environmental monitoring plan

The monitoring plan for the various performance indicators of the project in the construction and operation stages is summarized below.

Table 12.6-18 Environmental Monitoring Plan

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M1	Air	Construction	SPM, RSMP, SO_2, NOx, CO, HC	• Dust sampler to be located 50 m from the plan in the downwind direction. • Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Hot mix plant/ batching plant	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M2		Construction	SPM, RSPM	• Dust sampler to be located 50 m from the earthworks site downwind direction. Follow CPCD method for analysis	Air (P&CP) Rules, CPCB, 1994	Stretch of road where construction is underway	Twice a year for three years	Continuous 24 hours	Contractor through approved monitoring agency	PIU
M3		Operation	SPM, RSMP, SO_2, NOx, CO, HC	• Use method specified by CPCB for analysis	Air (P&CP) Rules, CPCB, 1994	Sampling location specified in EIA report	Twice a year for one year	Continuous 24 hours	PIU	PIU
M4	Water	Construction	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Sample collected from source and analyze as per Standard Methods for Examination of Water and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for three years		Contractor through approved monitoring agency	PIU
M5		Operation	pH, BOD, COD, TDS, TSS, DO, Oil & Grease and Pb	• Grab sample collected • from source and analyze as per Standard Methods for Examination of Water • and Wastewater	Water quality standards by CPCB	Sampling locations specified in EIA report	Twice a year for one year		PIU	PIU
M6		Operation	Cleaning of drains and water bodies	• Choked drains, water bodies undergoing siltation and subject to debris disposal should be monitored under cleaning operations	To the satisfaction of the engineer (PWD)	All area	Post-monsoon		PIU	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M7	Noise and vibration	Construction	Noise levels on dB (A) scale	• Free field at 1m from the equipment whose noise levels are being determined	Noise standards by CPCB	At equipment yard	Once every 3 Month (max) for three years, as required by the engineer	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged	Contractor through approved monitoring agency	PIU
M8		Operation	Noise levels on dB (A) scale	• Equivalent Noise levels using an integrated noise level meter kept at a distance of 15 m from edge of Pavement	Noise standards by CPCB	At maximum 5 sites inc. those listed in EIA report for noise monitoring locations	Twice a year for 1 years	Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged.	PIU	PIU
M9	Soil erosion	Construction	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	At locations of stream crossings and at locations of retaining wall and breast wall	Pre-monsoon and post-monsoon for three years		Contractor	PIU
M10		Operation	Turbidity in Storm water; Silt load in ponds, water courses	• Visual observations during site visits	As specified by the engineer / Water quality standards	As directed by the engineer	Pre-monsoon and post-monsoon for one year		PIU	PIU

Sl. No	Item	Project Stage	Parameters	Guidance	Standards	Location	Frequency	Duration	Responsibility	
									Implementation	Supervision
M11	Construction camp	Construction	Monitoring of: 1.Storage Area; 2. Drainage Arrangement 3. Sanitation in Camps	• Visual Observations and as directed by the engineer	To the satisfaction of the engineer and Water quality standards	At storage area and construction workers' camp	Quarterly during construction stage		PIU	PIU
M12	Afforestation	Construction and operation	Plant survival	• The success of tree planting. Monitor the rate of survival after six months, one year and 18 months in relation to total numbers of trees planted		All area	Minimum three years after planting		NGO, PIU	PIU
M13	Flora and Fauna	Construction and operation	Condition of ecosystem	• Comparison to pre-project flora and fauna	As specified in TOR	As specified in TOR	Twice a year for three years		PIU	PIU

Source: JICA Study Team

12.6.12 Land Acquisition and Resettlement

The project requires land acquisition for proposed widening and other work including slope protection and stabilization. For a project involving involuntary displacement of 400 or more families en masse in plain areas, or 200 or more families en masse in tribal or hilly areas, the National Rehabilitation and Resettlement Policy, 2007 (NRRP, 2007) requires the administrator for Rehabilitation and Resettlement (R&R) to undertake a baseline survey and census for identification of the persons and families likely to be affected (Sec.6.2). This will be carried out by the state government who is responsible for rehabilitation once the final ROW is determined based on the additional topographic survey. Meanwhile, this RAP report has been prepared based on the preliminary design with the aim of informing the R&R-related discussion between the state government and NHIDCL to ensure that land acquisition and involuntary resettlement for this project be carried out in a manner that is consistent with the JICA Guidelines for Environmental and Social Considerations.

In the state of Meghalaya, the tribal (Scheduled Tribe: ST) population constitutes some 86% of the total population. In West Garo Hills District, where the targeted section of NH51 is located, the share of ST population is 73.7%. While tribal groups in project area holds traditional culture centered on the Nokma, or traditional village leader, and social system of inheritance, they freely interact and share their sources of water, folklore, food, infrastructure, and other belongings with the non-ST and other tribal population within and outside the community. This is particularly evident in the section near the Bangladesh border where ST population and Bengali group co-exist peacefully without ethnicity-related tensions. Moreover, ST population in the project area is not isolated from outside and they are open to new ideas such as family planning and formal education. Given that the mainstream population of the area is tribal, elements of an Indigenous People Plan (IPP) as described in the World Bank OP4.10 have been incorporated into this report. No separate IPP has been prepared for this project.

12.6.13 Legal Framework for Land Acquisition and Resettlement

The Land Acquisition Act 1894 has so far served as the base policy document on which the state government passes resolution to acquire land for different projects. This act is superseded by a new act (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013), which took effect on January 1, 2014. Being a tribal state, the management of land in Meghalaya, as defined under the Sixth Schedule of the Indian Constitution, is under the Autonomous District Councils. Based on this stipulation, the State Government of Meghalaya has not adopted the LARR, 2013. In keeping view of the requirements under JICA guidelines, the resettlement policy and entitlement proposed in this RAP report will be adopted in this project. Other applicable acts, notifications, and policies relevant in the context of the project are the same as the ones discussed for NH54 project in the previous section.

12.6.14 Scale of Land Acquisition and Resettlement

(1) Demographic Profile

The baseline survey has identified and surveyed 367 households (173 households whose houses will be affected and 194 households whose businesses will be affected). The total number of people is 1,820. Out of these, 319 households (161 households whose houses will be affected and 158 households whose businesses will be affected) will have to be relocated. The remaining 48 will be partially affected but relocation will not be necessary. The average household size is 4.9, ranging from the maximum thirteen to the minimum one person. The social categories of affected households per three development blocks are shown below. Except for the Dalu Block near the border with Bangladesh, almost all affected households belong to ST (Garo Tribes). The Development Block has been the basic unit of the survey but it can be divided further into smaller locality. The numbers of such affected localities in each block are as follows: Dalu – 15; Gambegre – 23; and Rongram – 10.

Table 12.6-19 Block-Wise Social Category of Affected Households

Block	ST	SC	OBC	General	Preferred Not to Answer	Total
Dalu	103	2	17	33	7	162
Gambegre	75	0	0	0	3	78
Rongram	116	0	1	2	8	127
Total	294	2	18	35	18	367

Source: Baseline Survey

The result of religious affiliation overlaps closely with the respondents' social category. The result confirms that Christianity is the dominant religious belief among Garo people while the population near the Bangladesh border follows Hindi.

Table 12.6-20 Block-Wise Religious Affiliation of Affected Households

Block	Christian	Hindu	Muslim	Preferred Not to Answer	Total
Dalu	103	53	2	4	162
Gambegre	75	1	0	2	78
Rongram	117	6	1	3	127
Total	295	60	3	9	367

Source: Baseline Survey

The educational attainment of household heads is shown below. Being a sensitive question, the share of "no answer" is rather high, but no respondents had difficulties in reading the questionnaire form and communicating with the surveyors in elaborating their answers.

Table 12.6-21 Educational Attainment of Household Heads

Educational Attainment	Dalu	Gambegre	Rongram	Total
Below Elementary	16	6	9	16
Completed Elementary	29	16	18	29
Below High School	4	8	13	4
Completed High School	31	6	23	31
Not Completed College	8	8	10	8
Graduate and Above	8	2	17	8
No Answer	71	32	37	71
Total	167	78	127	167

Source: Baseline Survey

(2) Vulnerability

The vulnerability was screened based on the definition of the vulnerable in the NRRP, 2007. The NRRP, 2007 defines vulnerable persons as disabled, destitute, orphans, widows, unmarried girls, abandoned women or persons above 50 years of age, who are not provided or cannot immediately be provided with alternative livelihood, and who are not otherwise covered as part of a family (para 6.4 (v), NRRP, 2007).

According to the Reserve Bank of India, the share of the poor in Meghalaya was 12.5% in rural area and 9.3% in urban area in 2012. However, the survey found out that over 40% of respondents considered themselves as BPL household which may reflect their real coping capacity against negative impacts. Also, the project should take into account the fact that 35% of households are headed by women when the details of the rehabilitation plan are developed to ensure women's participation.

Table 12.6-22 Vulnerability Status of Affected Households

Block	Total HH	Women-headed HH	HH Head over 50	Disabled in HH	Widow in HH	Below Poverty Line*
Dalu	167	43	55	1	2	92

Block	Total HH	Women-headed HH	HH Head over 50	Disabled in HH	Widow in HH	Below Poverty Line*
Gambegre	78	37	33	2	0	30
Rongram	122	49	25	0	1	29
Total	367	129	113	3	3	151

Note: BPL figure is based on self-judgment of respondents and may not be accurate.
Source: Baseline Survey

(3) Land Ownership Status of Affected Households

Land ownership in North East States including Meghalaya can be broadly classified into following categories:

- Private Land with Land Settlement Certificates (LSC): Land holding of the owners is certified with a land settlement certificate;
- Periodic Patta: A prescribed land settlement document setting agricultural land periodically whereby an individual has entered an agreement with the government to pay land revenue and taxes at the rate legally assessed or imposed with respect to the land being leased out;
- Village Council Pass (or Garden Pass): Issued by the village council which have traditionally acted as certificates of land ownership for agricultural purposes within the council's territory; and
- Government Land: Land owned by the government

The land ownership status of affected households is shown below.

Table 12.6-23 Land Ownership Status of Affected Household

Ownership Status	Dalu	Gambegre	Rongram	Total
LSC	55	30	16	101
Periodic Patta	41	9	54	104
Village Council Pass	16	7	3	26
Government Land	41	12	28	81
No Answer	9	20	26	55
Total	162	78	127	367

Source: Baseline Survey

(4) Occupation and Income of Affected Households

Tea stalls, restaurant, and petty shops are major primary occupation of the respondents. This reflects the fact that the target section of NH51 is located near the international border (where truck drivers take rest) and near the busy area of Tura Town.

Table 12.6-24 Primary Occupation of Household Heads

Block	Agriculture	Shop[1]	Business	Government	Misc[2]	Retired/Unemployed
Dalu	16	101	7	9	6	7
Gambegre	4	43	9	4	1	3
Rongram	4	101	5	20	1	10
Total[3]	24	245	21	33	8	20

Note: [1] Tea stall, restaurant, petty shop; [2] Driver, cottage industry (craft); [3] This does not add up because several respondents answered more than one primary occupations while a few others did not answer this question.
Source: Baseline Survey

The monthly income of affected households has been summarized in Table 12.6-25 below. It is found that most of the households with a monthly income below INR 2,500 reside in Gambegre Block, which is a more rural part of the section between Dalu and Tura.

Table 12.6-25 Monthly Household Income

Educational Attainment	Dalu	Gambegre	Rongram	Total
2,500 and below	2	5	1	8
2,501 – 5,000	40	10	22	72
5,001 – 10,000	49	23	33	105

Educational Attainment	Dalu	Gambegre	Rongram	Total
10,001 – 20,000	31	6	22	59
20,001 – 50,000	13	7	19	39
50,001 and above	2	3	2	7
No answer	25	24	28	77
Total	162	78	127	367

Source: Baseline Survey

(5) Gender

The tribal and non-tribal women in North East States enjoy a relatively higher position in the society than that of their non-tribal counterparts which is reflected in their high literacy rate. Garo women are largely involved in household work, collection of forest produce, firewood collection, cultivation, and other agricultural activities and thus, they will be affected in a way that is different from their male counterpart. In order to ensure that affected women will not be disadvantaged, a dedicated chapter on gender issue is included in this RAP in which options to facilitate women's participation in project implementation and various opportunities to be created by the project is discussed.

(6) Cut-off Date

The preliminary cut-off date for land acquisition is July 6, 2015, which is the completion date of the baseline survey, and this was informed to the project affected households during the survey. The formal cut-off date for the project will be announced to the project affected villages/households through notification during the final inventory survey after the final ROW drawing is developed.

(7) Impact on Affected Households and Structures

As discussed above, the project shall impact 376 households. Of these households, 173 households will have their housing structures affected[11] and 194 households whose business structures such as tea stalls and petty shops will be affected by the project. Out of 173 households, 161 households will have to be resettled while 12 households will be partially affected. Meanwhile, 148 business structures will have to be relocated whereas 36 such structures will be partially affected[12.] The types of affected structures per block are shown below. Based on the baseline survey, about 75% of the affected households and business are considered as titleholders (i.e., in possession of LSC, periodic patta, village council pass)[13].

Table 12.6-26 Type of Affected Structures per Block

Block	Housing	Shop[1]	Workshop	Public Str.[2]	Total
Dalu	53	88	5	1	147
Gambegre	35	31	1	0	67
Rongram	51	73	0	1	125
Total[3]	139	192	6	2	339

Note: [1] Tea stall, restaurant, petty shop; [2] Well and toilet; [3] This does not match to the number of affected households and businesses because there are cases where a single structure is shared by multiple households. Also, there are several street vendors without structures to be affected by the project.

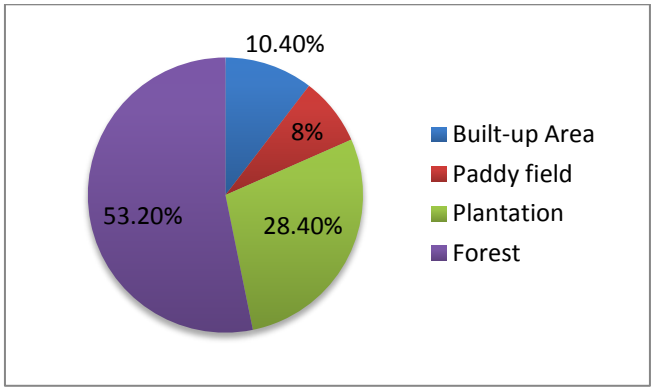
Source: Baseline Survey

(8) Impact on Land

The project requires additional land area of 78.6 ha, out of which 67 ha is required for widening and improvement work and 11.6 ha is needed for disposing surplus soil. The candidate locations for surplus soil disposal have been identified during the preliminary design and the budget for disposal, including measures to prevent soil erosion, have been included in the project cost. However, the sites will have to

11 This is based on the preliminary ROW design and will have to be verified once the final ROW drawing is established.
12 This is based on the preliminary ROW design and will have to be verified once the final ROW drawing is established.
13 Based on the baseline survey. For those who did not answer to the question about land-holding status, the share of title holder and non-titleholder is assumed to be the same as the group who answered the question.

be verified after the additional topographic survey and in consultation with the affected community as well as the state/district government. The breakdown of land to be acquired by type based on the field survey and satellite data is shown below.



Source: JICA Study Team

Figure 12.6-6 Breakdown of Affected Land to be Acquired by Type

(9) Impact on Trees and Crops

The plantations of areca nut, rubber, and cashew as well as wild trees along the road will be affected by the project. Toward the end of the section near Dalu, the road also runs through a paddy area. Other affected trees include fruit bearing trees (banana, mango, jackfruit, other citrus fruit, etc.) and bamboo. Since the ROW drawing for the widening and improvement is yet to be finalized, the counting exercise of affected trees has not been carried out at this stage. This will be carried out after the final ROW drawing is prepared based on the additional topographic data. Meanwhile, the budget for compensating trees and crops has been provisionally estimated based on the affected area (approximately 28.6 ha based on the estimate shown in Section 5.3) and weighted average price of trees/crops identified during the survey[14].

12.6.15 Resettlement Policy

The resettlement policy to be applied for NH51 project is the same as the one adopted for NH54 project as discussed in Section 12.5.15.

12.6.16 Entitlement Matrix

The entitlement matrix has been developed in accordance with the principles adopted and analysis of initial identification of project impacts. The entitlement matrix recognizes and lists various types of losses associated with the project and provides the basic tools and guidelines for preparation of compensation and resettlement packages.

14 Weighted average price of tree/crops is derived as follows: 1) derived average price of tree/crop based on the Basic Schedule Rate (e.g., bamboo: 10-200; banana: 100-200; jackfruit 2,500-3,000; tea: 100-1,900); 2) estimate the average number of such trees/crops per ha.; and 3) multiply 1 and 2 to obtain estimated cost for compensation.

Table 12.6-27 Entitlement Matrix

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Agricultural land	Titleholder	Household	Compensation at replacement value and assistance	h) Land for land, if available, or cash compensation for the land at replacement cost[15], which will be determined by the district collector. i) If the compensation amount is less than the replacement cost mentioned above, the difference amount will be paid as assistance. j) If the residual land is unviable for agriculture, PAP shall have the following three options: ● Compensation for affected land and continue on the remaining unaffected plot of land; or ● If the eligible person surrenders the residual plot, then compensation and assistance shall be given for the entire plot of land; or ● Replacement land, if so wished by eligible persons, subject to availability of land that is at least equally productive k) Resettlement allowance of INR 50,000 will be provided to those who do not get land for land, irrespective of the size of land. l) Subsistence grant equivalent to INR 3,000 (MAW: Minimum Agricultural Wage) per month for six months. m) In case of severance of cultivable land, an additional grant of 10% shall be paid over and above the amount paid for land acquisition. n) Four (4) months' notice to harvest standing crops shall be given. However, if notice cannot be given then compensation for these crops shall be paid at market value
	Periodic Patta Holder/Temporary Village Pass Holder		Assistance	e) Land for land, if available, if not, replacement value of land as determined by the district collector shall be given to land owners/holders. f) Resettlement allowance of INR 50,000 will be provided to those who do not get land irrespective of its size. g) Subsistence grant equivalent to INR 3,000.00 per month (MAW) for six months. h) Four (4) months' notice to harvest standing crops shall be given. However, if notice cannot be given then compensation for these crops shall be paid at market value.

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Non- agricultural vacant land (homestead, commercial, and others)	Titleholder	Household	Compensation for structure at replacement cost plus assistance	g) Replacement cost for structures at the latest basic schedule of rates (BSR) without depreciation with a minimum amount of INR 150,000.00 h) Two (2) months' notice for removal of structures. i) In case of partially affected structures and the remaining structure continues to be viable, in such case, an additional assistance equivalent to 25% of the replacement cost will be paid towards repair/restoration of structures. j) Right to salvage materials from the demolished structures. k) For the displaced eligible persons whose remaining structures is unviable, the following shall be payable: ● Subsistence grant of INR 3,000 per month for a period of twelve (12) months from the date of displacement. ● One time resettlement allowance of INR 50,000. ● Transportation cost of INR 50,000.00 for shifting family, building materials, domesticated animals, etc. ● Lumpsum assistance amount of INR 7,500 for re-establishing other basic facilities such as electricity connection and water supply pipeline. ● All fees, taxes, and other registration charges incurred for the replacement structure. l) Compensation in the form of residential/commercial plot at resettlement site, if so, opted by 15 or more PAPs on payment and free of cost for vulnerable groups will be provided. The size of the plots will be equal to the area lost or a minimum of 35 m^2 for house and 15 m^2 for shop.
	Periodic patta holder/temporary village pass holder			For land ● Subsistence grant equivalent to INR 3,000.00 per month of MAW for six months ● Four (4) months' notice to harvest standing crops/trees shall be given. However, if notice cannot be given then compensation for these crops shall be paid at market value For structure ● Replacement cost for structure at the latest basic schedule of rates (BSR) without depreciation with a minimum amount of INR 150,000.00 ● Two (2) months' notice for removal of structure ● Right to salvage materials ● Lump sum transportation cost of INR 50,000

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Loss of plants/trees	Owner/occupant	Household	Compensation	The Revenue Department or Special Committee will determine the current cost. For perennial fruit bearing trees such as pineapples, jackfruits, etc., the average productivity of such trees is 20 years.
Loss of cattle shed, poultry shed, or any other shed for domestic animals	Owner/occupant	Household	Compensation	INR 600 per m^2 for thatched roof and INR 1,000 per m^2 for GCI sheet roof (to be paid as per revised/latest available updated basic schedule of rates for buildings). In case of non-revision, 10% premium per year will be added to the latest rate available.
Loss of residence/ commercial unit	Tenant	Household	Assistance	d) The amount of deposit or advance payment paid by the tenant to the landlord or the remaining amount at the time of expropriation (this will be deducted from the payment to the landlord). e) Subsistence grant of INR 3,000 per month for a period of twelve (12) months from the date of displacement. f) Lump sum shifting allowance of INR 15,000
Loss of kiosk	Owner/occupant	Household	Assistance	c) Lump sum shifting allowance of INR 7500 d) Right to salvage materials from the existing structure
Loss of employment	Wage earner	Household	Assistance	d) Economic rehabilitation grant equivalent to twenty-five (25) days of minimum agricultural wages (MAW) per month for a period of three months. e) Priority work opportunities in the project construction work. f) INR 20,000 towards vocational/skill improvement as per choice.
Loss of livelihood (losing commercial unit, losing agricultural land and with balance land below MEH)	Titleholder/ periodic patta holder/ village pass holder	Household	Assistance	f) Priority work opportunities in the project construction works. g) INR 20,000 towards vocational/skill improvement as per choice. The amount will cover daily stipend equivalent to MAW for the duration of the training and shall also cover costs towards boarding, lodging, transportation, etc.
Additional support to vulnerable groups	Titleholder/ periodic patta holder/ village pass holder	Household	Assistance	One time additional financial assistance of INR 25,000 as economic rehabilitation grant towards income generation.
Loss of jhum/fallow land)	Village	Village	Compensation at 'replacement value'	The replacement value for the common property transferred/acquired shall be paid to the village council and the amount will be utilized through participatory planning by the villagers within six months from the date of release of payment. PIU shall monitor its utilization.

Type of Loss	Occupant of Property	Unit of Entitlement	Entitlement	Details of Entitlement
Loss of common property resources	Village	Village	Enhancement of community resources	Replacement /restoration or augmentation of existing infrastructure and provision of additional infrastructure facilities based on identified need.
Loss of access	Village	Village	Alternate access	Provision of access path(s), steps, and footpaths at identified locations in consultations with community.
Temporary and unforeseen impacts	Affected entity	Household	Mitigation measures in line with principles of resettlement policy framework	Unforeseen and temporary impacts during construction will be documented and dealt with on a case to case basis through the GRM in accordance with the principles laid down in the resettlement policy framework

Source: JICA Study Team

12.6.17 Grievance Redress Mechanism (GMS)

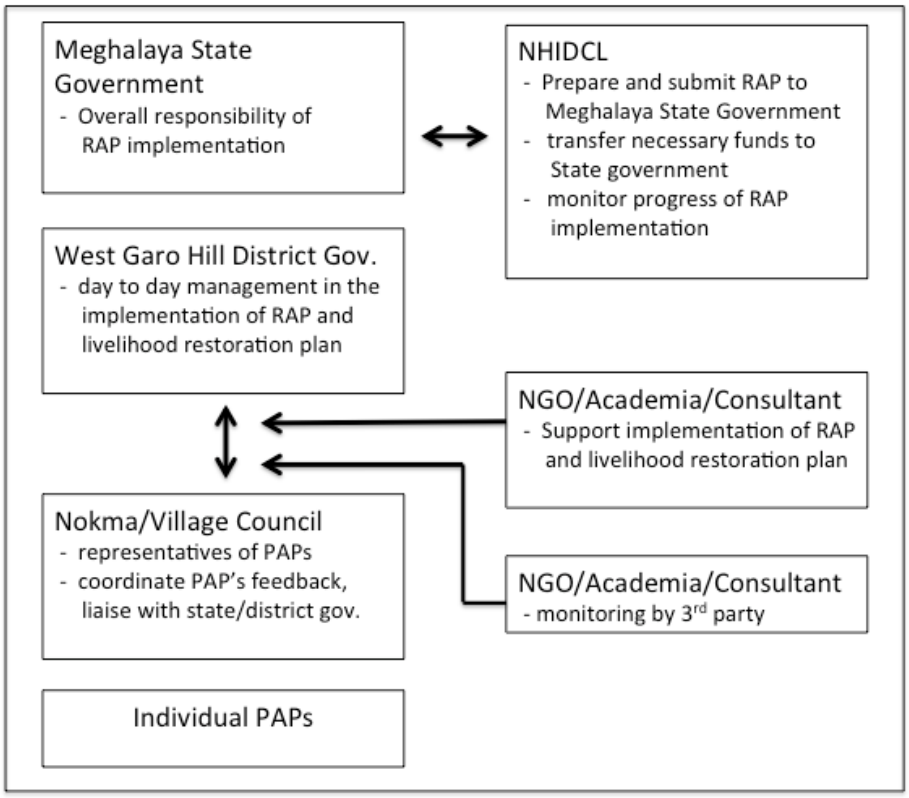
The Grievance Redress Mechanism (GMS) involves the formation of Grievance Redress Committee (GRC). The main objective is to provide a step-by-step process of registering and addressing the grievances with respect to land acquisition. It is expected that this mechanism will ensure redress of disputes through participative process.

The first tier of GMS takes place at the village/block level and involves physical verification and certification upon receipt of any grievances such as inaccurate measurement of impacted asset, loss of access, damage to structures and/or crops during construction. The verification and certification will be carried out by the RAP implementation agency, Nokma, and/or members of the village council in the presence of PAPs who file the grievance and appropriate documentation would be done. The response would be provided to the concerned PAP within 7-10 days of receipt of grievance. The financial implications of any changes would be presented to the GRC for consideration and approval.

The second tier of resolution will be undertaken by the GRC. A district-level GRC will be formed by the project authority within one month from the date of the mobilization of RAP implementation agency at the site. The GRC will comprise a project director, NHIDCL; PWD; deputy commissioner of West Garo Hills; representatives of the concerned village council or his/her authorized representative, PAPs, and RAP implementation agency. The grievances of PAPs in writing will be brought to GRC for redress by the RAP implementation agency. The RAP implementation agency will provide necessary assistance to PAPs in presenting his/her case before the GRC. The GRC will respond to the grievance within seven days. The GRC will meet once in 15 days but may meet more frequently, depending upon the number of such cases. However, after convening the first GRC meeting, it will not hold any meeting until such time any grievances are brought to the GRC for redressal. Grievances brought to the GRC shall be redressed within a time period of one month (30 days) from the date of receipt of grievance. The decision of the GRC will not be binding to PAPs. In other words, the decision of the GRC does not bar PAPs taking recourse to court of law.

12.6.18 Institutional Arrangement

As per Indian regulatory framework, activities related to resettlement and rehabilitation will be carried out by the state government. Given the autonomous characteristics of West Garo Hills District, however, it is proposed that the district council as well as Nokma, traditional village leaders, also play a major role in implementing RAP. At the moment, NHIDCL has regional offices in Guwahati, Assam, and for this project, it is expected that a project office (Project Implementation Unit: PIU) to be set up in Tura. A dedicated NHIDCL staff (or expert hired by NHIDCL) will work closely with the state and district officials as well as with Nokma to ensure that implementation of RAP is in line with the JICA Guidelines for Environmental and Social Considerations. Institutional arrangement includes provisions to strengthen the capacity of PIU and PWD with regard to land acquisition and implementation of RAP and management of other social issues. The project institutional arrangement is shown below.



Source: JICA Study Team

Figure 12.6-7 Institutional Arrangement for RAP Implementation

12.6.19 Monitoring and Evaluation

Monitoring and evaluation are important activities of any infrastructure development project, and even more so for projects involving involuntary resettlement. It helps make suitable changes, if required, during the course of RAP implementation and also to resolve problems faced by the PAPs. Monitoring is periodical checking of planned activities and provides midway inputs, facilitates changes, if necessary, and provides feedback to project authority for better management of the project activities. On the other hand, evaluation assesses the resettlement effectiveness, impact, and sustainability. In other words, evaluation is an activity aimed at assessing whether the activities have actually achieved their intended goals and purposes. Thus, monitoring and evaluation of RAP implementation are critical in order to measure the project performance and fulfillment of project objectives.

The summary of various monitoring and evaluation activities to be carried out on the course of project implementation is summarized below.

Table 12.6-28 Summary of Monitoring Activity

Type	Frequency	Prepared by	For	Report Contents
Internal RAP Monitoring	Quarterly	PIU	NHIDCL/ State Government	10-15 page report (plus supporting documentation) summarizing progress against the RAP; outline of any issues and agreed related actions; summary schedule of grievance status; minutes of any stakeholder or affected people consultations or meetings.
External Monitoring	Harf-yearly	Expert Panel	NHIDCL/ State Government	25-35 page report (plus supporting documentation) summarizing assessment of progress towards living standard restoration, livelihood restoration; in compliance with JICA Guidelines; discussions of any RAP issues of concern; identification of any areas of non-compliance and agreed corrective actions; and summary or resettlement status.
Completion Audit	One-off	Expert Panel	NHIDCL/ State Government	RAP Completion Audit to verify NHIDCL has complied with undertakings defined by the RAP and that land acquisition and compensation has been completed in accordance with JICA Guidelines

Source: JICA Study Team

12.6.20 Rehabilitation Plan

The socioeconomic survey of the PAPs (see details in Chapter 4) indicates that the main sources of income in the project influence area are agriculture and small business enterprises. The population has limited capacity to benefit from the livelihood opportunities created under the development projects or any government sponsored program. One of the key principles of the RAP is to ensure that the livelihood of PAPs will be improved, or at least, restored compared with the pre-project level. The project will provide income restoration opportunities by way of skill development training and linkage with ongoing government schemes for this purpose. The rehabilitation plan will therefore aim to support PAPs to regain their previous living standards by creating income generation opportunities as well as improving PAPs capacity to benefit from the various economic opportunities developed by the project. The rehabilitation plan will be developed and implemented by Meghalaya State government in the course of this project, and the detail of the plan should be tailored with inputs from stakeholders in a later stage of the project. Keeping JICA and World Bank policies in perspective, however, the following options and principles are proposed for inclusion to the rehabilitation plan.

Shared Market Place

While the road widening and improvement proposed under the project are expected to facilitate trade across borders, these roads also may have the potential to boost local level trade and improving linkages of the villages in the interiors with the local and regional markets. At the same time, relocation is likely to cause negative impact on households along the road who have benefited from the roadside location suitable for business. It is recommended that project creates benefit sharing arrangements with communities along the project roads and build capacity for increasing the production and trade potential, for example, through construction of common market place in a convenient location along the road where community members can buy and sell agricultural goods and engage in small businesses.

Backyard Poultry

Many households rear chicken for their own consumption but rarely doing it commercially. Small marketing effort may work to the benefit of the producer.

Support for Expanding Plantation

Insufficient supply of saplings is a barrier for initiative towards better methods of farming. Productivity of cashew, rubber, and other plantations along NH51 can be enhanced through supply of quality saplings.

The proposed TOR for NGO/consultants/university to be involved in the implementation of R&R activities, including development and finalization of rehabilitation plan, is included in the appendix of the RAP report. The implementing agency, with support from PIU, will assist PAPs in making a choice for feasible income generation activities. Market feasibility study and training needs assessment shall be undertaken by the implementing agency to devise feasible and practical rehabilitation plan that matches the PAPs needs in the local context.

12.6.21 Resettlement Budget

The resettlement budget comprises estimated values of compensation for land, structures, trees, various resettlement assistances, cost of CPRs, institutional cost, contingency, hiring of RAP implementation agency, HIV/AIDS awareness generation, capacity building, external monitoring and evaluation consultant, among others. The total resettlement cost for the project road is estimated at about INR 454,300,000.

The resettlement and rehabilitation budget has been estimated based on the information and data collected from field and other secondary sources. The budget shall be updated and adjusted as per the market rate of various items as the project continues. The compensation amount for assets shall be determined by the land acquisition officer of the project to be hired for the implementation of RAP. The breakdown of budget for different components is provided below.

Table 12.6-29 Resettlement Budget

Item	Unit	Unit Cost	Quantity	Total (INR)
I. Compensation				
Land (construction)	ha.	500,000	67	33,500,000
Land (surplus soil)	ha.	400,000	11.6	4,640,000
Rural area multiplier	*the land price will be double for compensation of rural area land as per LARR 2013			38,140,000
Structure	Sq. m	4,000	3,000	12,000,000
Public toilet, water point	No.	50,000	5	250,000
Crops	No.			45,000,000
Solatium	*100% of compensation as per LARR 2013			178,530,000
Subtotal (I)				312,060,000
II. Allowance				
Moving allowance	Household	50,000	330	16500000
Subsistence allowance	Household	18,000	380	6840000
Assistance to vulnerable	Household	20,000	200	4000000
Training	Household	20,000	380	7600000
Subtotal (II)				34,940,000
III. Implementation				
Expert fees	Lump sum			7,000,000
Staff training	Lump sum			1,000,000
External monitoring	Lump sum			2,000,000
Information disclosure	Lump sum			1,000,000
Livelihood restoration	Lump sum			10,000,000
Subtotal (III)				21,000,000
Subtotal (I+II+III)				368,000,000
Contingency (10%)				36,800,000
Total				404,800,000

Source: JICA Study Team

12.6.22 Resettlement Schedule

The implementation of RAP consists of the following major activities:

- Deployment of required staffs (at the PIU and village/block level);
- Information dissemination activities by holding consultations, distributing leaflets containing salient features of resettlement policy and entitlement matrix in Garo language;
- Verify and update the list of PAPs and their status through detailed measurement survey (DMS), list, and measure all properties and assets affected and their estimation;
- Preparation of microplan (RAP implementation at village/block level);
- Disbursement of R&R assistance to PAPs, which may include preparation and distribution of identity cards and opening of bank accounts;
- Relocation and rehabilitation of CPRs; and
- Preparation for relocation of PAPs.

Considering the long rainy season prevalent in the project area and the whole state, approximately a period of 5-6 months (May-October) is not available for construction works. The RAP implementation period is proposed to be 24 months, but this needs to be scheduled in a manner so that initial activities such as verification, measurement, etc., can be completed during the dry period. The other activities such as preparation of microplan, approval, disbursement, and other necessary documentation can be completed during the rainy season. The RAP implementation activities to be carried out and respective agencies likely to be involved for each activity are presented below.

Table 12.6-30 Resettlement Schedule

Year	2016				2017				2018			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Preparaton												
Completion of ROW drawings		▲										
Hiring NGO/Consultant/Academia for RAP implementation	■											
Verifycation and update RAP	■	■										
Preparation of Rehabilitation Plan		■	■									
Submission of revised RAP to JICA			▲									
RAP budget approval from Central Government			▲									
Disclosure of revised RAP			■	■	■	■	■	■	■	■	■	■
Establish Grievance Redress Mechanism			■	■	■	■	■	■	■	■	■	■
Declaration of cut-off data (LA notification)			▲									
Implementation												
Rehabilitation			■	■	■	■	■	■	-	-	-	-
Disbursement of compensation and assistance			■	■								
Physical displacement				■	■							
Taking posession of acquired land					■	■						
Handover of acquired land to contractor						■						
Monitoring												
Harf-yearly report			▲			▲						
Completion report							▲					
Road Construction Civil Works					■	■	■	■	■	■	■	■
Mobilization / Camp & Plant Yard Set-up / Survey												

Source: JICA Study Team

12.6.23 Stakeholder Consultations

Stakeholder consultation is an important method of involving various stakeholders particularly the local community in reference to the proposed development initiatives. Consultations provide a platform to participants to express their views, concerns, and apprehensions that might affect them positively or negatively. This process is of particular importance for this project given the high ST share among the

affected population. The World Bank OP 4.10 on Indigenous Peoples emphasizes “a process of free, prior, and informed consultation (FPIC) with the affected indigenous people’s communities at each stage of the project, and particularly during project preparation, to fully identify their views and ascertain their broad community support for the project." Consultations for this project adopted the following framework to ensure a process of FPIC:

a) Conduct appropriate gender and intergenerationally inclusive consultations with the project affected peoples’ communities, the affected peoples' organizations (village council, women's groups, etc.), and other local civil society organizations (NGOs) identified by the affected peoples' communities;
b) Use consultation methods appropriate to the social and cultural values of the affected peoples’ communities and their local conditions (including using local languages, allowing time for consensus building, and selecting appropriate venues) and give special attention to the concerns of women and their access to development opportunities and benefits; and
c) Provide the affected peoples’ communities with all relevant information about the project (including an assessment of potential adverse effects of the project) in a culturally appropriate manner.

The purpose of consultations was to inform people about the project, take note of their issues, concerns, and preferences, and allow them to make meaningful choices. It ensured participation of potential project affected persons (PAPs), local community, and other stakeholders. People, in general, were informed in advance through invitation letter and phone calls and allowed to participate in a free and fair manner. During these consultations, PAPs were informed about the project, likely scale of resettlement, its resettlement policy, including compensation based on full replacement cost, resettlement assistance, schedule, and grievance mechanism. Consultations provided meaningful contributions with regard to appropriate compensation, sufficient allowance for resettlement, livelihood restoration, reducing adverse impacts, address safety issues, etc. Most stakeholders expressed their needs for compensation at a full replacement cost and some stakeholders expressed their concerns regarding assistance for relocation; however, no objections were raised concerning the implementation of the project and to compensations based on replacement cost during both stakeholder consultations and door-to-door census surveys. The following sections present details of the consultations.

(1) 1st Round Consultations with Communities

The initial briefing was made to every village representative (Nokma) prior to the commencement of the baseline survey. The MLCU Team, as well as the environmental and social expert of the JICA Study Team, visited villages along the targeted section of NH51 to inform them of the project, seek their support to the survey, and to verify the validity of the survey questionnaire. The first round of consultations was held in conjunction with the baseline survey. Initially, it was planned that one consultation meeting to be held in each development block at this stage. However, after such meeting in Rongram Block, there were requests from the PAPs to hold follow-up meetings for community members so that more members can be engaged in the process. Responding to this request, two additional meetings were held in Rongram Block, providing opportunities for more stakeholders to voice their opinions about the project. The details of the meeting are summarized below.

Table 12.6-31 Participation Details of First Round of Consultation

District	Date	Total No. of Participants	Representation (No.) from		
			Govt. Dept.	Nokma/ Village Rep.	Affected Persons
Dalu	May 21, 2015	17	2	11	4
Gambegre	May 22, 2015	36	2	11	23
Rongram	June 26, 2015	11	3	8	0
Follow-up Meeting 1	June 29, 2015	67	2	4	61
Follow-up Meeting 2	July 4, 2015	74	2	0	72

Source: JICA Study Team

(2) Second Round Consultations with the Communities

The second round of consultation meetings with communities was held from September to October 2015. The meetings have been delayed due to prolonged heavy rain and local election; however, over 800 PAPs attended the meetings and, as described in the next section, the PAPs voiced their support to the project. In addition to the meetings at Block level, a separate session targeting Bengali vendors in Dalu area, was carried out in order to identify their vulnerability and incorporate their specific needs and concerns.

Table 12.6-32 Participation Details of 2nd Round of Consultation

District	Date	Total No. of Participants	Representation (No.) from		
			Govt. Dept.	Nokma/ Vilalge Rep	Affected Persons
Dalu*	Sep 27st, 2015	127	0	0	127
Rongram	Oct 19th, 2015	109	2	12	95
Tura	Oct 21st, 2015	80	2	8	70
Dalu	Oct 27th, 2015	303	3	11	289
Gambegre	Oct 31st, 2015	238	2	11	225

* A special session targeting Bengali vendors, including informal encroachers.
Source: JICA Study Team

(3) Consultation Outcome

While the 1st round of meetings mainly targeted Nokma and other representatives of PAPs, who then who then shared the meeting contents with other members in the village. Meanwhile, the 2nd round of meetings invited wider community members to share them the result of the EIA and RAP study and discuss next steps. PAPs concerns mainly center on issues related to compensation and assistance (which is discussed in a RAP report for this project), but the summary of environment-related discussion from these stakeholder consultations is presented below.

Table 12.6-33 Summary of Block-level Consultations

Blocks	Key Outcomes/Concerns/Suggestions from Meeting	Response
Rongram/ Tura	General: About Project, alignment, components and its significance • PAPs in general appreciated the project and significance it will have in people's life. They noted that the project has been on the government agenda for quite some time and they have long waited for its implementation. • Some expressed their concerns that the project can affect important facilities within Tura town. Project Concerns and Issues: Environment and Ecology	The Road-over-bridge is not included in the scope of this project and thus there will be no impact. Appropriate slope protection

Blocks	Key Outcomes/Concerns/Suggestions from Meeting	Response
	• PAPs requested that proper retaining walls to be installed. They noted that inadequate slope protection in past road project causes soil erosion and damages to their asset. • Spoil soil should not be dumped randomly; as such practice will negatively affect land and land use. In summary, the project finds a positive response from the people partly because the widening has been on government agenda for quite some time and PAPs are waiting for it.	measures will be installed, and outlet of culverts will be equipped with gabion to avoid potential damages from water runoff. Surplus soil will be dumped in a designated site.
Gambegre	General: About Project, alignment, components and its significance • PAPs in general appreciated the project and significance it will have in people's life. They expect better road will significantly improve their well-being. Project Concerns and Issues: Environment and Ecology • Most of the NH51 stretch in this block runs through forest and plantation, and hence, several PAPs voiced concerns about pollution and disruption of access during the construction phase. • Areas adjacent to NH51 are being used for plantation and other purposes. PAPs noted that disturbance and negative impacts should be minimized. • Some highlighted that soil erosion, particularly erosions in valley side of the highway is a major concern. Overall, the project has broad support of the community. Management of soil erosion and potential damage to productive land such as plantation will be essential to minimize negative impact.	Adequate measures will be undertaken to minimize pollution in all phases of the project. Also, the loss of forest will be compensated through plantation. The preliminary ROW is designed in a way that minimizes environmental and social impacts. This principle will be applied when the ROW is finalized after the topographic survey. Appropriate slope protection measures will be installed, and outlet of culverts will be equipped with gabion to avoid potential damages from water runoff.
Dalu (including comments raised in a meeting with Bengali community)	General: About Project, alignment, components and its significance • PAPs expressed their support to the project. They noted that Dalu area, being close to the international boarder, will significantly benefit from improvement of road condition. • The project may affect paddy field in the area. Some wonders if the ROW can be reduced to reduce the impacts. Project Concerns and Issues: Environment and Ecology • A few Nokmas voiced concern about the Sima (pillar) of the Nokmas which abutted the road and noted that there are certain rituals and the expenses to be paid in shifting such 'Simas'. • There are schools near NH51. Proper safety measures shall be taken to prevent accidents • HIV/AIDS, malaria and other heath risk may increase • Cutting and filling should not exacerbate soil erosion. Also, surplus soil should be properly managed.	The preliminary ROW is designed in a way that minimizes environmental and social impacts. This principle will be applied when the ROW is finalized after the topographic survey. The proposed ROW is not likely to affect Sima, but it will be verified in the joint survey once the alignment is fixed. Both safety and noise/pollution control measures will be installed, particularly near the sensitive facility such as schools. EMP includes provisions to address health-related issues of the project. The project also include awareness raising/ educational program for

Blocks	Key Outcomes/Concerns/Suggestions from Meeting	Response
		HIV/AIDS Appropriate slope protection measures will be installed, and outlet of culverts will be equipped with gabion to avoid potential damages from water runoff. Surplus soil will be dumped in a designated site only.

Source: JICA Study Team

Source: JICA Study Team

Figure 12.6-8 Consultation at Gambegre Block (L)
and Rongram Block (Follow-up Meeting 2) (R)

CHAPTER 13 PROJECT EVALUATION

13.1 Project Evaluation

Project evaluation and monitoring is an essential and integral part to any investment made for the creation infrastructure projects. It is more important to evaluate infrastructure projects (such as the present two road projects under study) in terms of their perceived benefits accruing to the society at large, during the project cycle period, against certain intended benchmarks/targeted outcomes or performance indicators.

For a project such as roads, the capital investment and project gestation period are normally high, it becomes crucial to set a timeframe for evaluation as well as identify the performance indicators that need to be evaluated at regular intervals. Normally, the evaluation of the performance indicators (PAs) is done in three phases:

(a) Ex-ante Evaluation (just before the implementation of the project)
(b) During Project Implementation (mid-way in the project implementation and/or at the completion stage to determine issues relating to project implementation and intended project purposes)
(c) Ex-post Evaluation (one or two years or more after project implementation, normally more than once (repetitive) at a certain defined interval)

Normally, during ex-ante evaluation, the current values and intended values (expected after one or two or more years of project implementation) are defined for performance indicators. The intended values of the performance indicators are then evaluated through specialized surveys and studies during ex-post evaluation, and compared against the intended values set at the ex-ante evaluation. This exercise provides valuable information to the investing agency about:

(a) The divergence (if any) between the actual and intended values of the performance indicators;
(b) The extent to which the project has performed;
(c) Lessons for future evaluation of similar projects in terms of methodology adopted for evaluation (particularly in defining the intended values of PAs during ex-ante evaluation stage); and
(d) Selection of PAs.

The project evaluation being discussed in this chapter relates to ex-ante evaluation for the following two road sections:

1) Aizawl-Tuipang Road Section (approximately 381 km), part of NH54, in Mizoram State
2) Tura-Tuipang Road Section (approximately 54 km) part of NH51, in Meghalaya State

The performance indicators considered are both quantitative and qualitative in nature. The present values (for year 2015) of the quantitative indicators are based on the surveys performed by the JICA Study Team and the indicative values (for year 2022, after construction of the project) are based on the study and analysis done by the consultants. As part of the ex-post evaluation, these values for the year 2022 need to be estimated on the basis of the surveys and studies in the year 2022.

The construction period is expected to be for four years, with the start year being 2017. Thus, it is expected that by 2020/21 both roads will be constructed, and by 2022, the ex-post evaluation can be done for these roads. After the completion of the construction of the project roads, it will be put into at least four years of repairs and maintenance under contractors and supervised by consultants (maintenance consultant). Thus, it is expected that until the next four to five years after the construction, the condition of the roads is expected to be good. Therefore, the ex-post evaluation should also include, to a sufficient extent, a period after completion of operations and maintenance (O&M) contract of these two roads.

As indicated above, the performance indicators/targeted benefits of the two road projects are of two types: (a) Quantitative Indicators and (b) Qualitative Indicators.

Quantitative Indicators: Performance indicators that can be quantified through survey or any scientific means are defined as qualitative indicators. These indicators can be quantified and attained certain values that changes over a period of time as per the performance of the road sections. The quantitative indicators used for ex-ante evaluation is described in Table 13.1-1.

Table 13.1-1 Quantitative Indicators Used for Ex-Ante Evaluation

Performance Indicators	Ex-Ante Estimation Method	Ex –Post Evaluation Method
Average Daily Traffic (ADT) in PCUs	Conducting classified traffic count surveys at defined locations on project road continuously for 7 / 3 days	Same as exe-ante estimation method
Average Speed of Vehicles (km per hr)	Has been obtained during survey on project road for vehicle Scorpio (Mahindra)	Can be obtained through surveys (speed-delay) on project roads
Average Vehicle Operating Cost (VOC) per km	The vehicle-wise operating costs are estimated through HDM-4 package. The average VOC is based on the vehicle-wise VOC	Can be estimated through HDM- 4 Package. The average VOC can be based on the vehicle-wise VOCs
International Roughness Index (IRI)	IRI is an indicator of road surface roughness that has direct impact on vehicle performance. It was estimated through a survey on project road	Shall be estimated through survey on project road
Number of Accidents on project road in a year	Data available with Police Department/ Transport Department located in the Study Road Area	Data available with Police Department/ Transport Department located in the Study Road Area
Number of landslides on hilly roads in a year	Data available with Public Works Department located in the Study Road Area	Data available with Public Works Department located in the Study Road Area

Source: JICA Study Team

Qualitative Indicators: These indicators are subjective in nature and are difficult to quantify. Generally qualitative benefits of a project relate to reduction in adverse impact on the environment, reduction in noise pollution due to improved road design; etc.

13.2 JICA Project Evaluation Framework

The JICA's project evaluation framework includes the following three main components.

- Pre−implementation Stage Evaluation (Ex-ante Evaluation)
- Implementation Stage Evaluation
- Post-implementation Stage Evaluation (Ex-post Evaluation and Ex-post Monitoring)

The above three components are elaborated in the subsequent sections.

13.2.1 Pre-implementation Stage Evaluation (Ex-ante Evaluation)

The pre-implementation stage evaluation (ex-ante evaluation) is conducted prior to the project implementation to confirm the needs and priorities of the project, as well as verify the outline of the project and anticipated outcomes/performance indicators. At the ex-ante evaluation stage, JICA also confirms implementations of appropriate safeguard procedures based on the review of environmental and social considerations, as well as reflections of lessons learned from past projects.

The results from the ex-ante evaluation conducted are reflected in the subsequent decision-making regarding project design and project approach. Once the project commences, evaluations are conducted based on the evaluation plan and indicators set at the time of the ex-ante evaluation.

13.2.2 Implementation Stage Evaluation

JICA conducts the mid-term review and terminal evaluation (at a time near the completion of project construction) for ongoing projects. These are intended to study the attainability of the project purpose, contributing or impending factors of the project's implementation, as well as their respective trends in terms of effectiveness and efficiency. The evaluation results are utilized in revising the project plan and project management system, and decision-making on the termination or continuation of the project. Lessons learned from the evaluation are used for improving similar projects in the future.

Mid-term Review: The purpose of the mid-term review of technical cooperation projects and ODA loan projects which have a comparatively long period of implementation is to verify the relevance of the project for a fixed term from the beginning. It also verifies and analyzes the attainability of the project goals in terms of effectiveness and efficiency as well as the project's promoting factors and obstacles and their respective trends. The results of the mid-term review are utilized to review project framework and design and they are also used to improve project management.

Terminal Evaluation: Terminal evaluation is conducted for technical cooperation projects about six months prior to the project termination. The purpose is to verify mainly the attainability of the project goal, efficiency, and sustainability, so that JICA can draw up the project plan for the remaining period of the project, with the recipient government, and decide on the appropriateness of terminating the project and/or necessary follow-ups for the future, among other matters. The terminal evaluation is an evaluation and monitoring scheme that is unique to technical cooperation projects. This verifies the effectiveness during the project's implementation phase.

13.2.3 Post Implementation Stage Evaluation (Ex-post Evaluation and Ex-post Monitoring)

JICA performs the ex-post evaluation and ex-post monitoring after project completion in order to evaluate completed projects comprehensively and monitor if the project's effectiveness, impact, and sustainability will continue to materialize after project completion.

Compared with other evaluation schemes, evaluations conducted at the post implementation stage places more importance on the aspect of accountability. Therefore, external evaluations, whereby an external third-party makes evaluation judgments, are conducted for projects over a certain size. At the stage after the completion of each project, JICA conducts a comprehensive evaluation using the Five Development Assistance Committee (DAC) Criteria (Table 13.2-1) formulated by the Organization for Economic Co-ordination and Development (OECD).

One distinctive feature of the detailed ex-post evaluation is the application of a rating system in order to present the evaluation results in a way that is easy to understand.

Table 13.2-1 Five DAC Criteria for Evaluating Development Assistance

Relevance	Examines the extent to which the aid activity is suited to the priorities donor: Does the goal of the aid activity meet the needs of beneficiaries? Are the activities and outputs of the program consistent with the overall goal and the attainment of its objectives?
Effectiveness	Measures the extent to which a program or a project attains its objectives.
Impact	Examines positive and negative changes as a result of the project. This includes direct and indirect effects and expected and unexpected effects.
Efficiency	Measures the outputs in relation to the inputs to determine whether the aid uses the least costly resources possible to achieve the desired results.
Sustainability	Sustainability relates to whether the benefits of the project are likely to continue after the closure of the project.

Source: JICA Study Team

13.3 Project Evaluation of NH-54 Road Section (Mizoram)

13.3.1 Description of the Project

The Aizawl-Tuipang Road Section (approximately 381 km) is part of NH54 and is located in Mizoram State. Due to its location, the state assumes a prominent importance vis-à-vis the possibility of movement of goods, services, and trades with South-East Asian countries. The integration of this road section with the under completed Kaladan Project would open up a second major transport link to the North East Region, benefitting the southern part of the region.

The project road is located in the hilly region and the carriageway width mainly ranges from 3.75 m to 5.5 m (single/intermediate lane) causing restrictions in traffic movement. The state experiences heavy rainfall to which landslides occur and it causes damage to road and affects the traffic flow on the road.

After the improvement of roads, it is expected that the carriageway width shall be 10 m with improved road design (at turning/urban areas, etc.) and adequate slope protection measures would be in place. Thus, it is expected the following benefits: the road capacity and speed of vehicles would increase, operating cost of vehicles shall reduce, the slope of the road shall be protected against possible landsides during rainy season, air and noise pollution is expected to reduce, etc.

13.3.2 Targeted Outcome

(1) Quantitative Effects

The quantitative effects of the improvement of NH54 road section has been evaluated in Table 13.3-1. The value for five performance parameters was estimated for the base year (2015) and the target year 2022, shortly after the completion of the improvement works.

Table 13.3-1 Targeted Outcome for Study Road Section of NH54

Performance Indicators	Baseline (2015) Value	Target Year (2022) - Value
Average Travel Speed (km/hour)	12	40
Average Annual Vehicle Operating Cost (INR/ Vehcle - km)	24	15
Traffic Volume (PCU / day)	835	3,103
Landslide beside Road (Time / year)	Year 2013: No data Year 2014: No data	-
Accidents (Fatality Rate per Traffic Volume)	Year 2013: 0.01268% Year 2014: 0.02052%	50% reduction in accidents
Economic Internal Rate of Return (%) - EIRR	12.43%	

Source: JICA Study Team

(2) Qualitative Effects

1) The road widening shall be done within the ROW of the existing road corridor, with no or minor deviations. Thus the proposed improvement of road will not pose any environmental and social issues related to construction activities.

2) The improvement of road in terms of capacity and design will result in lowering the fuel consumption by vehicles and thereby reducing the adverse impact on the environment.

3) The above improvement measures shall also result in lowering noise pollution created by moving vehicles.

13.4 Project Evaluation of NH-51 Road Section (Meghalaya)

13.4.1 Description of the Project

The Tura-Tuipang Road Section (approximately 54 km) is part of NH51 and is located in Meghalaya State. Due to its location, the state assumes a prominent importance vis-à-vis the possibility of movement of goods, services, and trades with Bangladesh and Assam State and beyond to the rest of India.

The project road is located in a hilly and rolling terrain and the carriageway width mainly ranges from 3.75 m to 5.5 m (single/intermediate lane) causing restrictions in traffic movement. The state experiences heavy rainfall to which landslides occur and it affects the traffic flow on the road and also cause damages to road.

After the improvement of roads, it is expected that the carriageway width shall be 10 m with improved road design (at turning/urban areas, etc.) and adequate slope protection measures would be in place. Thus, it is expected the following benefits: the road capacity and speed of vehicles would increase, operating cost of vehicles shall reduce, the slope of the road shall be protected against possible landsides during rainy season, air and noise pollution is expected to reduce, etc.

13.4.2 Targeted Outcome

(1) Quantitative Effects

The quantitative effects of the improvement of NH51 road section have been evaluated in Table 13.4-1. The value for five performance parameters was estimated for the base year (2015/ 2017) and the target year 2022, shortly after the completion of the improvement works.

Table 13.4-1 Targeted Outcome for Study Road Section of NH51

Performance Indicators	Baseline (2015) Value	Target Year (2022) - Value
Average Travel Speed (km/hour)	15	40
Average Annual Vehicle Operating Cost (INR/ Vehicle - km)	30	15
Traffic Volume (PCU / day)	3,023	5,577
Landslide beside Road (Time / year)	Year 2013: 15 Year 2014: 53	90% reduction
Accidents (Fatality Rate per Traffic Volume)	Year 2013: 0.00041% Year 2014: 0.00010%	50% reduction in accidents
Economic Internal Rate of Return (%) - EIRR	14.38%	

Source: JICA Study Team

(2) Qualitative Effects

1) The road widening shall be done within the ROW of the existing road corridor, with no or minor deviations. Thus, the proposed improvement of road will not pose any environmental and social issues related to construction activities.

2) The improvement of road in terms of capacity and design will result in lowering the fuel consumption by vehicles and thereby reducing the adverse impact on the environment

3) The above improvement measures shall also result in lowering noise pollution created by moving vehicles

CHAPTER 14 CONCLUSIONS AND RECOMMENDATIONS

14.1 Effects of the Project on Development and Road Network in North Eastern States

1) The JICA Study Team examined the viability of NH51 and NH54 projects by reviewing the contents of DPR study as well as by linking it to the present traffic conditions, as of 2015. As a result, the JICA Study Team confirmed that the project properly met the SARDP-NE targets of development of the region through improvement of connectivity. The possibility of access from NH54 project to Kaladan Multimodal Transit Transport Project was confirmed. In this regard, NH54 project can be a prospective one to work with not only on road networks in the region but also with other transport systems.

2) According to the results of the traffic study, project costs and economic analysis of the project, EIRR of the base case of NH54 and NH51 projects are estimated at 12.43% and 13.64%, respectively.

14.2 Confirmation of Appropriateness of the Project Components

1) The JICA Study Team reviewed the outcomes of DPR and environmental-related documents for the NH54 and NH51 projects and confirmed that some contents of the outcome had not been prepared in accordance with the JICA procurement guidelines.

2) After the JICA Study Team reviewed the preliminary design in DPR, it was confirmed that the design concept for alignment design does not well consider the environmental impact and natural disaster prevention. The JICA Study Team introduced the design concept for the environment and disaster prevention such as earth balanced alignment design and advanced slope protection design as introduced in developed countries, as well as spoil bank to provide flat land for promotion of effective use of disposal soil.

3) After checking the number of design drawings, it was found that the area of topographic data is not sufficient on transverse direction and ground line is not accurate. Therefore, the JICA Study Team recommended to DPR Consultant to supplement and improve the topographic data. It was likewise recommended for DPR Consultant to revise DPR design based on the improved topographic data and the recommended design concept by the JICA Study Team. The DPR Consultant agreed to do so.

4) As a result of the review of the cost estimate prepared by DPR Consultant, some assumed the conditions such as material transportation, etc. are not unified. The JICA Study Team provides the cost data of advanced slope protection works which is introduced to the DPR Consultant for their cost estimate. The DPR Consultant corrected the estimates based on the comments made by the JICA Study Team.

5) The JICA Study Team examined the construction and implementation plans.

6) The JICA Study Team conducted surveys on NHIDCL's institutional structure, annual budget, and maintenance of the existing roads under their administration. As a result of the surveys, it was confirmed that NHIDCL has just started their organizational functions; and the maintenance system by NHIDCL is under consideration. Therefore, the JICA Study Team proposes an institutional structure for maintenance of the project road in consideration of importance of maintenance aiming to disaster prevention.

7) The JICA Study Team reviewed the EIA related activities on environment and social consideration, and confirmed the present condition of the environment (water quality, air, noise, vibration). In addition, the JICA Study Team carries out identification of PAPs based on the site survey with the use of design drawings, and social interview survey along the project road to prepare the draft RAP. The draft EIA and RAP are prepared in accordance with the JICA Environmental Guideline. To ensure smooth implementation of RAP works during project implementation, preparation of an accurate RAP drawing is essential.

14.3 Recommendations

1) As a whole, the JICA Study Team confirmed the outcomes of the DPR design made by the DPR Consultant. It is desirable for NHIDCL to implement bid document preparation based on the improved topographic data through procurement of competent consultants that consist of qualified engineers having experiences in design and construction supervision on advanced slope protection, of which construction will be the first in India.
2) In relation to the revision of design for the bid documents based on improved topographic data, preparation of accurate RAP drawing is essential to ensure smooth implementation of RAP works during project implementation.

Appendix

Appendix - 1: Past Traffic Data on Project Road Network/ Sections

No.	Road Section	Survey Location/ Chainage	Survey Date	Total PCUs	Cars	Buses	LCVs	Trucks	MAV	M/ Cycles	Cycles	Animal Cart	Agri. Tractor	Others
1	NH 54, Aizawl – Tuipang, Mizoram, 389 km	Aizawl/ km 169	Jan - June 2004	5191	786	64	586	807	130	645	1	0	1	0
		Vairengte/ km 43	Jan - June 2004	1950	378	93	450	203	2	0	0	0	0	0
		Silt Lawgtla/ km 72	Jan - June 2004	1769	942	30	163	164	0	0	0	0	0	0
		Hnathiar/ km 172	Jan - June 2004	981	117	98	138	100	14	0	0	0	0	0
	From DPR NH 54, MORTH	Hnahthial/ km 179	Feb. 2010	775	108	23	65	59	63	80	0	0	0	0
	From DPR NH 54, MORTH	Dawn/ km 209	Feb. 2010	1378	330	23	88	219	25	154	0	0	0	0
	From DPR NH 54, MORTH	Hrangchal Kawn/ km 225	Feb. 2010	1270	404	25	135	161	2	192	0	0	0	0
2	NH 62, 'Dudhanal- Dalu, Meghalaya, 150 km	Dainadur/ 20 km	July - Dec. 2003	3709	61	58	56	1057	0	67	30	10	20	0
		Barengapara/ 199 km	July - Dec. 2003	613	169	31	68	35	2	102	149	0	2	0
		Siju/ 121 km	Jan - June. 2005	1420	66	35	33	367	4	55	25	0	9	0
		Baghmara/ 141.200 KM	Jan - June. 2005	2953	723	91	760	61	2	736	478	0	4	0
		Barengapara/ 199 km	Jan - June. 2005	593	149	31	68	35	2	102	149	0	2	0
		Karukol/ KM 121	07th - 14th March - 2006	1658	63	22	99	422	2	108	35	2	4	0
		Konegittim/ km 141	04th - 11th March - 2006	2215	411	27	457	280	2	273	44	2	3	0
		Dimapara/ km 199	04th - 11th March - 2006	948	182	30	47	57	2	151	304	23	3	0
3	NH 51, Tura - Dalu, Meghalaya, 60 km	Krishna/ 21.820 km	Jan - June. 2005	2720	702	150	125	115	0	530	735	34	9	20
		Mankachar. 97.295 KM	Jan - June. 2005	13766	9730	285	380	171	0	4074	5	0	9	4
		Tura/ 117 km	Jan - June. 2005	838	228	54	96	59	0	173	45	0	0	4
		Tura/ 146 km	Jan - June. 2005	1535	275	60	334	72	0	236	355	0	0	15
		Bajengdoba/ km 22	04th - 11th March - 2006	1316	291	88	126	121	0	373	45	0	0	0
		Rongram/ km 83	04th - 11th March - 2006	1688	454	72	266	143	0	365	15	0	0	0
		Babupara/ km 97	04th - 11th March - 2006	13972	8551	338	844	241	2	4756	3	2	3	0
		13 mile/ km 117	04th - 11th March - 2006	1212	188	61	93	195	0	174	58	0	0	0
		Dalu/ km 146	04th - 11th March - 2006	1850	374	30	21	147	0	446	1381	0	0	0
	DPR NH 51, MORTH	km 93	2010	3675	1177	335	258	238	1	712	0	0	7	0
	DPR NH 51, MORTH	km 104	2010	1095	607	48	35	0	0	583	0	0	0	0
	DPR NH 51, MORTH	km 144	2010	1565	679	49	58	81	4	781	0	0	0	0
4	NH 40, Shillong – Dawki, Meghalaya, 80 km	Nongpoh/ 7 km	Jan - June. 2005	12896	3427	337	119	2465	36	360	644	0	23	26

No.	Road Section	Survey Location/ Chainage	Survey Date	Total PCUs	Cars	Buses	LCVs	Trucks	MAV	M/ Cycles	Cycles	Animal Cart	Agri. Tractor	Others
		Shillong/ 47 km	Jan - June. 2005	16413	2488	1364	250	3122	7	83	20	0	2	0
		Shillong/75 km	Jan - June. 2005	30235	4977	2493	774	5310	9	1080	142	0	8	0
		Shillong/ 82 km	Jan - June. 2005	30261	5833	2209	541	5287	0	1570	75	0	68	0
		Shillong/ 102 km	Jan - June. 2005	7214	736	277	247	1281	272	271	120	0	3	0
		Shillong/ 129 km	Jan - June. 2005	1207	220	123	117	142	0	24	8	0	0	0
		Byrnihat/ 7 km	06th - 13th March - 2006	18991	3888	418	403	4008	134	720	328	1	8	11
		Umran. 47 km	08th - 15th March - 2006	15628	2933	324	139	3814	4	83	1	1	1	0
		Mawlai Noungkwar/ 75 km	07th - 14th March - 2006	19703	5587	691	374	3535	74	774	134	0	20	0
		Umshyrpi/ 82 km	17th - 24th March - 2006	9398	5629	435	250	530	0	996	1	0	0	0
		Umtyngar/ km 102	07th - 14th March - 2006	5674	1173	226	377	905	94	181	30	0	3	0
		Pynursla/ km 129	07th - 13th March - 2006	2502	1089	129	163	250	0	62	0	0	0	0
5	NH 53, Imphal – Jiribam, Manipur, 220 km													
6	NH 39, Imphal - Kohima, Manipur/Nagaland, 125 km	Senapati / 260 km	20th - 27th March - 2006	3460	1381	139	354	277	27	285	53	0	2	0
		Kangpokpi / 275 km	20th - 27th March - 2006	1672	289	143	104	228	8	90	22	1	3	0
		Chingmeirong / 317.400 km	21st - 28th March - 2006	24507	7325	719	1560	1695	6	8605	6307	5	16	1
		Canchipur / 326 km	21st - 28th March - 2006	10390	2945	478	769	447	2	5104	1833	2	5	0
		Pallel / 366 km	20th - 27th March - 2006	3321	760	149	209	233	2	882	1121	4	13	0
		Tengnoupal/ 390 km	20th - 27th March - 2006	1603	300	145	41	179	0	213	236	5	1	0
	NH 39, Nagaland State	Medziphema/ km 130	July - Dec. 2004	13766	1080	1002	480	2885	0	157	453	0	0	0
	NH 39, Nagaland State	Kohima/ km 164.500	July - Dec. 2005	10942	836	762	330	2429	0	28	47	0	0	0
	NH 39, Nagaland State	Kohima/ km 182	July - Dec. 2006	15186	1276	1422	464	2976	0	40	0	0	0	0
	NH 39, Nagaland State	Kohima/ km 199	July - Dec. 2007	11218	858	920	327	2352	0	88	19	0	0	0
10	NH 37, Koliabhomora Bridge near Tezpur. Assam, 2.5 km	Jakhalabanda/ 325 km	18th - 25th Feb - 2006	7216	1163	410	388	1052	86	250	1077	2	4	0
		Behora, Numaligarh/ 402 km	20th - 27th March - 2006	9592	1526	616	481	1158	240	709	1043	1	11	2

Source: NHAI Web Site

Appendix - 2: Zoning & Zone Codes for RSI Analysis

Zone No	Description	District	State
1	Dhuburi, Golakganj, South Salmara, Patakata, Mankachar, Laughrabita, Fakirganj Gouripur, Tamarhat, Bilasipara, Salkocha, Chapar, Sapatgram, Agamani, Basbari, Bagripari	Dhuburi	Assam
2	Kokrajhar, Gossaigaon, Haltugaon, Detnia, Garubhasa, Raimana, Kochugaon, Patgaon, Ranikhata, Sidli, Anguri bazar, Bijni, Agrong, Kunda, Amtika, Deosri, Saralpara	Kokrajhar	
3	Jogighopa,Bongaigaon, Abhayapuri, North salmaria	Bongaigaon	
4	Lakhipur, Chunara, Agia, Kadomiola, Rangjuli, Dhupdhara, Khutal, Tiplai, Dalgoma, Kharmousa, Gaolpara, Pancharatna, Dudhnai, Krishnai	Gaolpara	
5	Baghbor, Bohari, Balikuri, Sorbhog, Raha, Houli, Burikhamar, Sarthebari, Bhawampur, Barbang,Hazuwa,Kunguri,Patacharkuchi,Tarabari, Nalbari,Tihu,Mukalmuva,Tamulpur,Dhamdhama,Barma,Jagar,Belsor,Subhankhata	Barpeta, Nalbari	
6	Boko, Chhaygaon, Ranigodam, Bhodhpur, Barduwar, Palasbari, Guwahati, Noonmati, Khetri, Dispur, Sonapur, Paltanbazar, Jalukbari, Hazo, Kamalpur,Rangia	Kamrup	
7	Kalaighor,Dalgaon,Mangaldai,Mazbath,Udalguri,Paneri,Nalbari,Rawta, Marigaon,Nakhola,Jagiroad,Mayong,Aujari,Dharamtul	Darrang, Marigaon	
8	Minser,Khainduli,Minser, Sirtiso, Baitha longso, Baut bazar, Hang hahai, Haflong, Gunjong, Mahur, Maibong, Darangibra, Malanpa, Bagha,Langting, Garampani, Langding	Karbi Anglong, North Chacharhills	
9	Dhalai, Silcha, Udarband, Lakhipur, Rajabazar, Katogora, Barakhola, Lalsang, Kumbhir, Dwarband	Cachar	
10	Karimgang, Sonbill, Ratabari, Anipur , Patarkhandi, Abdullapur, Chargola, Neelambazar	Karimgang	
11	Hylakandi, Badarpur, Lala, Katlichara	Hylakandi	
12	Kampur, Jamunamukh, Singinarigaon, Raha, Barrozpiya, Khatetali, Lamding, Lankha, Murajhar, Moudanga, Mikirgaon, Dhing, Bardhoa, Nagaon, Rupohi, Samaguri, Kalyabor, Silghat, Jakhalbanda ,Salana,Misa	Nagaon	
13	Tezpur, Dhekiajuli, Singri, Bihuguri, Rangpara, Balipara, Bindukuri, Gohpur, Helem, Dirji, Beheli, Viswanath, Jamaguri, Gamani	Sonitpur	
14	Diphu, Dhansipi, Dhangiri, Paklagaon, Burakek, Howraghat, Dengaon, Bokajal, Jengpata, Erdankrams, Sarhed, Kalyani, Barphatar, Jangpeta, Merapani, Saruphatar, Rengmapathar, Barugaon, Golaghat, Garampani, Barjan, Bokhakhat, Dergaon, Numaligaon, Dhansirimukh	Karbianglong, Golaghat	
15	Northlakhimpur,Bihipuria,Diju,Dulahatgaon,Dhakuakhana, Phatalipum,Jagaldubhi,Makhova,Dhemaji,Jonai,Silapathar, Sonarigaon	Lakhimpur,Dhemaji	
16	Jorhat,Teok,Anguri,Narmija,Sibsagar,Kokilamukh,Neemati, Maryani,Anguri,Nazira,Sonari,Barhat, Dibrughar, Tinsukiya, Digboy, Margerita, Dandama, Bardubi, Sadiya, Bordubi	Jorhat, Sibsagar, Dibrughar, Tinsukiya	
17	Dalu, Barengapara, Dingkajhora, Adugachol, Rembigiri, Rongohugiri, Rongram,Dadenggiri,Rongmachokgiri,Phulbari, Tura, Selsella, Garobadha, Adugiri, Akongrre, Dobasipara, Anabagre, Chenguburigri, Rongbakre	West Garo Hills	Meghalaya
18	Zikzak, Genapara, Kherapara, Jongohetpara, Batasing,	West Garo Hills	

Zone No	Description	District	State
	Mankachar		
19	Barengapara, Baghmara, Songmong, Ringkhap, Chokpat, Chengbagiri, Wacholgiri	South Garo Hills	
20	Rongra, Wagekona, Agatchikona, Badimbari, Taraibari, Nolbari, Rangasora	south Garo Hills	
21	WilliamNagar,Renggiri, Balsrigittim, Sampalgre, Songsak, Samanda, Resubelpara, Bangsi, Dhamra	East Garo Hills	
22	Dynadubi,Chibogh,Dumboo, Rongjeng,Cheran, Bajengdonba, Thikrikila, Raksamgre, Ajagar pahar	East Garo Hills	
23	Panikunda, Sangaik, Riangdo, Patharkhnang	West khasi Hills	
24	Nongstoin,Phlangmauupra,Jakrem,Mawkyrwat, Rambrai, Nongkhlaw, Mawdob ,Mairang	West khasi Hills	
25	Shella,Balat,Mawsynram,Mawphlang, Mylliem,Laitlyngkoi	East Khasi Hills	
26	Barapani,Shillong,Mawlyngkneng, Nongroug,Pynursla, Serrarim,Sohra, Pamramda, Wakhaliar, Mawdon	East Khasi Hills	
27	Nartiang,Nongbah,Thadlaskein,Laskein,Barato	Jaintia Hills	
28	Jowai,Dauki,Jarain,Amlaren,Lakadong, Sutnga, Khliehriat, Shangpung	Jaintia Hills	
29	Barhnhat, Umling, Donmatia, Umsing, Nongpoh, Margang, Diwon, Ksehkima Bazar, Mawhati, Kyrdem	Ri Bhoi	
30	Bahadurpara,Kanchanpur, Sakhan, Serhmun, Gunamanipara,Rabiraipara, Chaumanu, Purba Chammanu, Jagannathpur, Kulai	Dhalai	
31	Ambasa,Manu, Kanchanpur, Dab bari, Michiuria, Dhumaccata, Karatichara, Halhali,Kamalpur,Salema	Dhalai	
32	Sakhan,Phuldungsei,Vangmuri, Damchera, Kanhmun, Narendra nagar, Luimavi, Piplachara, Bhungtuem, Kailashnagar,Dharmanagar,Unakoti,Fatikrai,Kumarghat	North Tripura	
33	Khowai,Kalyanpur, Ganki, Chebri, Raj anagr, Sidhai,Chnadrasachubari,Ranirbazar,Narayanpur, Teliamura, Uttar Gakul nagar, Taidu	West Tripura	Tripura
34	Agartala, Takarjala, Jambai, Bisalgarh, Barjala, Melaghar, Sonamura, Jatrapur, Kathalia	West Tripura	
35	Sipahijala, Udaipur, Nagraibari, Ampibazar, Sabedabari, Mogiabari, Matraibari	South tripura	
36	Puranrajbari Rajh nagar, Chauddragram, radha nagar, Krishna pur, Laogangbazar,Lungthung,Manubazar,Sabrum, Palangphabari, Tirthamukh	South tripura	
37	Belonia,Kakraban,Radhakishorepur, Nutanbazar, Dumbur, Amarpur,Hirapur, Ampibazar ,Sabedabari,Mogiabari,Matraibari	South tripura	
38	Aizawal, Paikhal, Zobawk, Bukpui, Tuirial, Melriat, Muallungthu, Aibawk, Falkawn, Kelsei, Sateek, Seling,Lumtui,Khawthlir, Ruallung, Keifang, Saitual, Rulchawn, Hnaltu,Hrnuntha, Maite, Mualpheng, Lenchim, Tawizo, Hmuntha, Khumtung	Aizawl	
39	Neihbawi,Nisapur,Tawkzawi, Sentlawng, Lungdai, Relek, Sairang, Thak,Sialsuk,Thenzawl	Aizawl	
40	Lurgpho,Vancheng,Khawhai, Chekawn,Vantaiphai, Sialsir, Lungchhuan, Bawktlang, North Vanlaiphai, Rawpui, Serchip,Keitnnikawn, Matphai, Keitum, South zote	Serchip	Mizoram
41	Lunglei,Lungsen,Tiabung,Tuiehong,Hruizam,Laisawrai,Bu arpur, Sairep,Tawipui,Thingeal,Chawngte	Lunglei	
42	Saza,Hawlawng,Ramlaitiu, Zotuitlang, Ralvawng, Hawlaung, Zobawk,Leite,Thingsai,Boinu	Lunglei	
43	Saiha, Sangau, Siachangkown, Tiosumpui, Rawmibauk,	Chhimtuipui	

Zone No	Description	District	State
	Phalrrang, Mamte, South Langpher, Langban, Ainak, Tuipang, Zawngling		
44	Serkawn,Kaisi, Theiri, Lower Theiva, Vahal,Tawngkalawng, Phura, Tongkolong, Lehri	Chhimtuipui	
45	Kaladan,Lawngtelai,Saizawh, Shermun, Bungtlang, Diltlang, Uiphum, Mualbn, Kawnpui,Tuidang	Lawngtlai	
46	Champhai,Dilkawn,Lungdar,Khawbung,Farkawn,Tuisen, Ngur,Neihdawn,Kawlkulh,Hnahlan,Saichal	Champai	
47	Phullen,Zawngin,Chiahpui,Phulbuang	Champai	
48	Sabual,Sibutalang,Pukzing,Lallen,Phaileng, Mamith,Tukkalh,Saitlaw,Rengdil,Hriphaw	Mamit	
49	Kolasib,Chhimluang,Bilkhawtlair,Mualvum,Bhuvalpui, Phileng,Darlawn,Ratn,Thingsat	Kolasib	
50	Imphal, KanglaTonghi, Phumlou, Lamshang, Mongjam, Khamran, Kangpokpi, Saparmania, Lhangjol, Keithelmangbi, Samurou, Mayang, Buribazar, Wango, Meijrao, Nambol, Changangai, Taobungkhok, Ghari	West Imphal	Manipur
51	Sagolmang,Yangangpokpi, Waiton, Sawombang, Keibi Heikak Mapal, Paurabi, Phaknang, Nungoi, Lamlai, Kangla sipai, Kharasom	East Imphal	
52	Thoubal,Kakching,Wangjing,Wabagai,Shuganu, Irengbam, Keirak, Kharungpat, Hiyanglam, Kakching, Hangool, Yairipok, poirou Thangkhul, Tulihal, Pechi, Top chinhta, Huikop	Thoubal	
53	Kumbi,Thanga,Moirang,Ningthoukhong,Bishnupur,	Bishnupur	
54	Lunhpou, Deurali, Daili, Tumuyon Khunou, Wilong,Maosongsang,Kanchong, Khridziiphi, New Magaimai	Senapati	
55	Maram,Karong,Tadubi,Gaziphema, Shajouba, Kaibi, Tungham Khullen, Tunhjoy, Saranamai, Tungam Makhufii, Senapati,Khamson,Saikul,Laphulak	Senapati	
56	Tallui,Ukhrul,Humpum,Leishan, Jessami,Chingai,Kuiri, Paorei, Peh, Lunghar, tusam khullan	Ukhrul	
57	Molvailup,Maiti,Mairing,Phungyar,Kamjong,Chassad, Boljang,Kasom,Khullem,Bongubakhullen	Ukhrul	
58	Palel, Kampang, Sebong, Chandel,Chalong,Moreh,Thengnoupal, Chakpikarong,Mombinew,Khongtol	Chandel	
59	Churachandrapur,Mulanil,Hangtam,Thinghat,Molnom,Tonglon,Hanship,Senven,Thanlon,Mongzungkai, Phaiphengmun, Henglep, Tinaong, Parbung, Sangsong	Churachandrapur	
60	Lagairong,Tairenpokpi,Nungbah,Longpi,Oinamlong, Tamenglong, Kataug,Tousem,Phellong,Pobram, Khebuching,Tamei,Tamma,Thouglang,Chaton,Langga	Tamenglong	
61	Ankhasu, Jeikhan, Tuisen, Lower Kharkuplien, upper Kharkhupkien, Jirebam, Nghahmumpai, Kaiphundai	East Imphal	
62	Tasangki,Phikulum,Henima,Meehangbung, Peren, Intanki, Lakema,Pulomi,Vishvema, Sechu, Jaluki, Khonoma	Kohima	Nagaland
63	Kohima,Tseminyu, Tesophenyu, Ziphenyu, Lazami,Narhema, Zakhama, Tuophema	Kohima	
64	Chimakudi, Dhansiripar, Chumukedima, Dimakur,Nichuguard, Chedumi	Dimapur	
65	Kekrima,Chizami,Chenwesumi,Dhulhami,Kilami,Chipeketemi,Phek, Meluri,Akhegwo	Phek	
66	Rangazubmi,Wokha,Sanees, Longsa, Pangti,Bhandari, Lakhuti, Sakhalu,Zunheboto, Sakhai,Baimbo,Aoehugelime	Wokha, Zunheboto	

Zone No	Description	District	State
67	Sirere,Purorr,Cheshorr,Tuensang, Laruri,Sampure,Thonokyu,Panso,Noklak,Chen, Tamlu, Kangching, Ungma,Chungtia,Mokokchung,Chongymsen, Chantogia,Merangkong	Tuensang, Mokokchung	
68	Naginimara,Lapa,Borgan, Kongnyu, Wangla, Mon, Nyasia, Wakching	Mon	
69	Tawang, khat, Jang, Bomdila, Gohaintan, Seppa, Dirji, Noju, Itanagar, Riang, Khereva, Palin, Ziro, Tali, Daporijo, Along, Basar, Karko, Ingkong, Pasighat, Kebang, Komaing, Mariang, Dalbuing, Anini, Roing, Embrongo	Tawang, West Kameng, East Kameng, Lower subansiri, Upper subansiri, Papum pare, West siang, East siang, Upper siang, Dibang valley	Arunachal pradesh
70	Khonsa, Wakka, Pongchau, Changlang, Nampong, Manmao, Namdpah, Tezu, Wakro	Khonsa, Changlang, Lohit	
71	Sikkim, West bengal, Bihar, Jharkhand		States
72	Orissa, Chattisgarh, Andhra Pradesh, Telangana, Tamilnadu, Kerala		States
73	Karnataka, Maharashtra, Gujarat		States
74	Madhya Pradesh, Uttar pradesh, Rajasthan, Haryana, Punjab		States
75	Uttarakhand, Himachal pradesh, Jammu and Kashmir		States

Source: JICA Study Team

Appendix - 3: Slope Inventory Survey

1. OBJECTIVE

The slope inventory survey was conducted for the following purposes,

- To identify existing landslide areas and potential landslide risks along the road,
- To measure topography of slope on both side of the road, and
- To clarify geological and geotechnical condition of the slope along the road.

The result of the survey is utilized for design of road alignment and slope protection works.

2. METHODDORLOGY

The survey was conducted by local engineers and geologists directly managed by the JICA study team from February to April 2015. The road of NH-54 is divided into four sections as shown below. Planned bypass sites are not included in this survey.

Table 1 Survey Sections

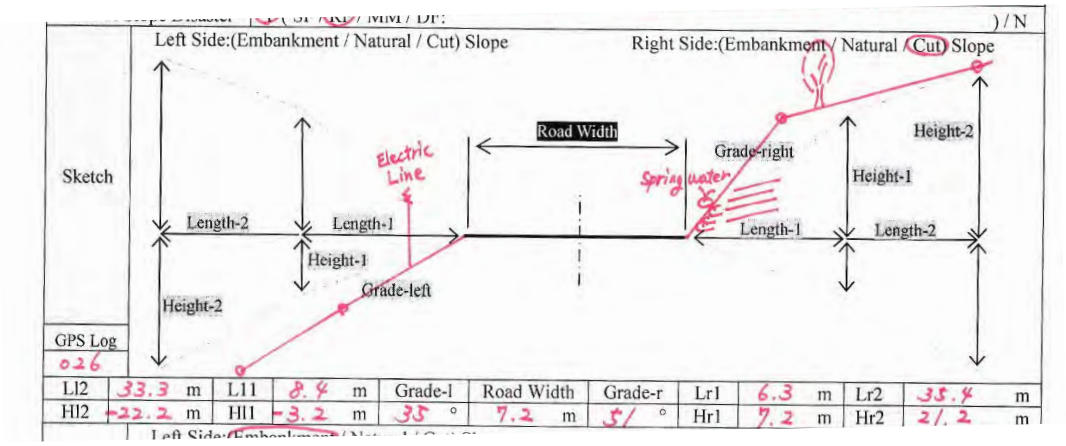
Section		From	To	Length (km)
NH-54	A	Aizawl	Serchhip	102.93
	B	Serchhip	Hrangchalkawn	112.52
	C	Hrangchalkawn	Lawngtlai	72.40
	D	Lawngtlai	Tuipang	85.56
NH-51	-	Tura	Daru	57.84

Source: JICA Study Team

The survey consists of 1) cross-section measurement, 2) verification of geological and geotechnical condition, and 3) identification of landslide risk.

2.1 Cross-Section Survey

The cross-section measurement measured road width and length and height, and grade of slope on both right and left side along the road using a measuring tape, laser distance meter, and inclinometer. And we sketched the topography of slopes including specific features and recorded the location of cross-section by portable GPS device. Since DPR study, because they planned widening on hill side mainly, doesn't include enough topographic data on valley side, these data in this survey is utilized for road design as well. Figure 1 shows an example of sketch in the survey.



Source: JICA Study Team

Figure 1 Example of Sketch in Cross-section Survey

2.2 Verification of Geological/GEOTECHNICAL Condition

For design of cut grade on hill side slope with widening, checking out outcrops along the road, the surveyors verified geology and geotechnical condition on each slope. In order to standardize the category

of geology and classification of geotechnical condition, the training for the surveyors was held at the beginning of the survey and provided the chart for soil and rock classification as shown in Table 2. At the same time, they also inspected whether there are specific features which may cause landslide such spring water and dip slope or not. Dip slope means the slope which has same or almost same dip direction as that of geological layer.

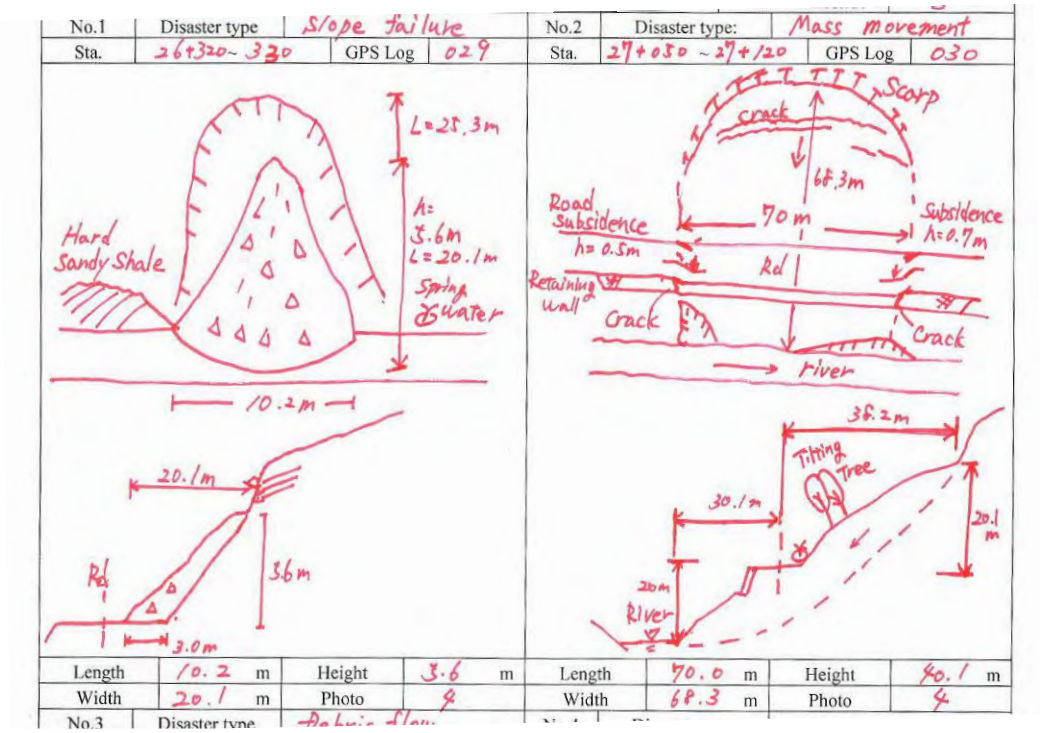
Table 2 Example of Rock Classification

Soft	Hard	Very Hard
 	 	 
Strongly weathered and very soft. Can Break easily. Many crack, joint and schistosity. Relatively gentle slope	Slightly weathered. Can break by hammer Steep slope	Fresh and Intact Hard to break Very steep slope

Source: JICA Study Team

2.3 Identification of Landslide Risk

To plan countermeasures against landslides which give the road severe damage, the surveyors checked location of landslide using portable GPS device, and drew a sketch and measure its dimensions (width, length, and height) as shown in Figure 2.



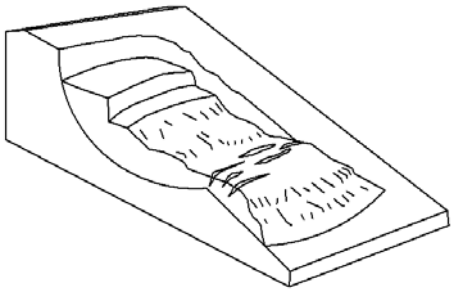
Source: JICA Study Team

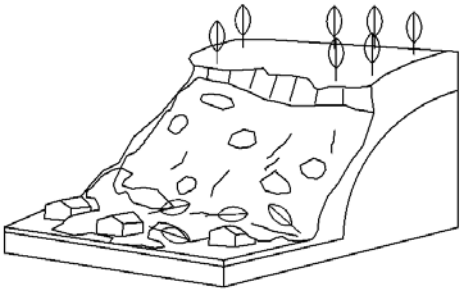
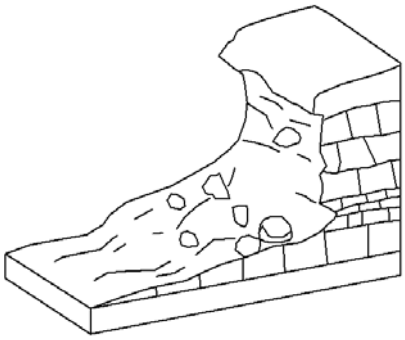
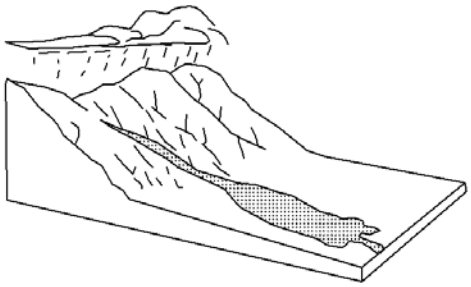
Figure 2 Example of Sketch of Landslide

It is very important for appropriate design of landslide countermeasure to understand type of landslide properly; namely, mass movement, slope landslide, rockfall, and debris flow. Table 3 shows the landslide classification based on the landslide mechanism. The landslides identified in site were categorized by the classification in Table 3 which was given to the surveyors prior to the survey similarly.

The Hill Road Manual (IRC: SP: 48-1988) also refers a classification by Vernes, 1978, which finely classified landslides by those mechanisms. However, because it does not connect to landslide countermeasure selection, the classification was simplified as shown in Table 4.

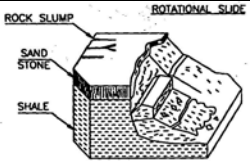
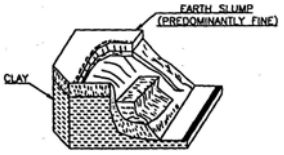
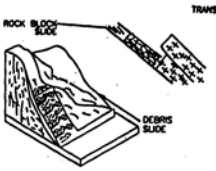
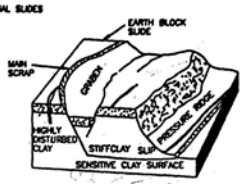
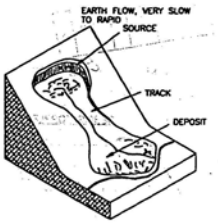
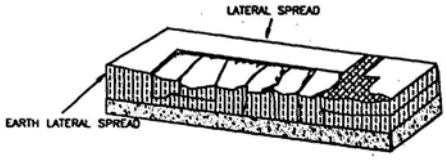
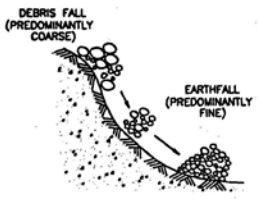
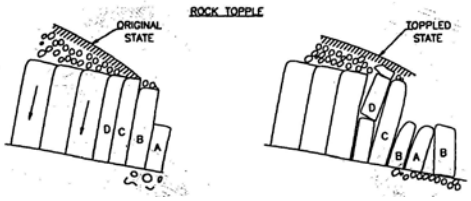
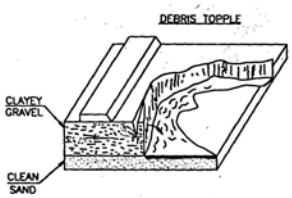
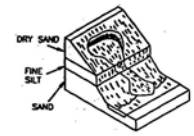
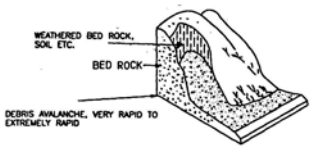
Table 3 Landslide Type Classification

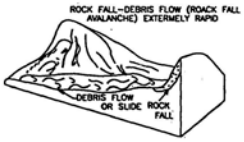
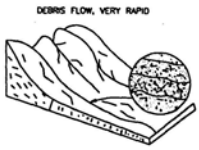
Type	Schematic Image	Example
Mass Movement (MM)		

Slope Failure (SF)		
Rock Fall (RF)		
Debris Flow (DF)		

Source: JICA Study Team

Table 4 Comparison with Landslide Classification in IRC

Type	Classification in IRC (Verns, 1978) (Typical Countermeasure against each Landslide Type)
Mass Movement (MM)	    Rotational Slide Earth Slump Transitional Slides Groundwater Drainage, Earth Removal, Counterweight Fill, Anchor work (Rock-bolt work), Pile   Earth Flow Lateral Spread
Slope Failure (SF)	  Debris Fall Rock Topple     Debris Topple Earth Flow (Wet sand) Mud Flow Dry Sand Flow  Earth Removal, Rock-bolt work (Anchor work), Soil Retaining Wall, Vegetation work Debris Avalanche

Type	Classification in IRC (Verns, 1978) (Typical Countermeasure against each Landslide Type)
Rock Fall (RF)	 Rockfall Rockfall Prevention Fence/Wall Wire Netting, Removal, Bonding
Debris Flow (DF)	 Rockfall-Debris Flow  Debris Flow Box Culvert, Bridge, Check Dum, Groundsill

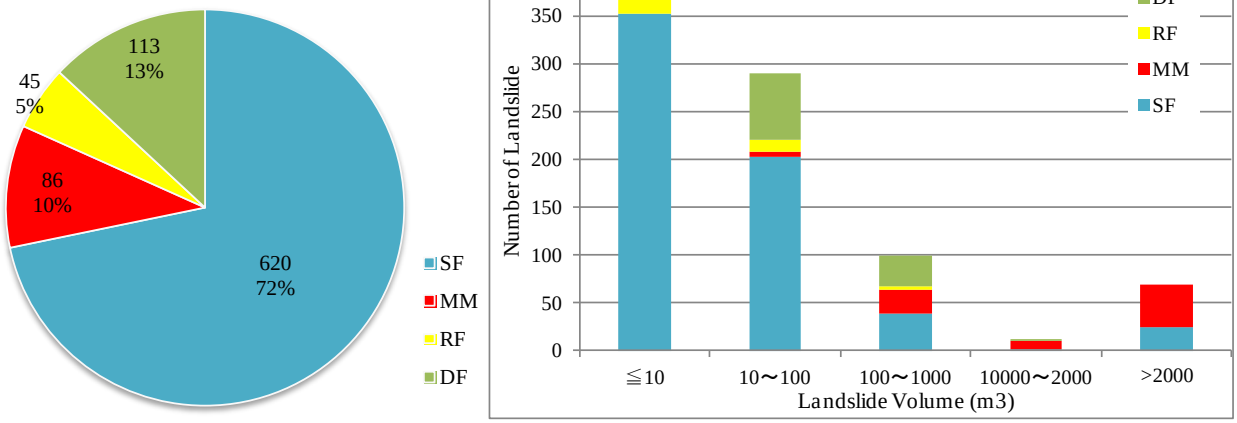
Source: JICA Study Team

3. SURVEY RESULT

The survey results of cross-section measurement, verification of geological/geotechnical condition, and identification of landslide were summarized in tables attached at the end of this appendix.

3.1 NH-54

Due to steep mountainous and high rainfall area in NH-54, there are many landslides located along the road. Figure 3 presents the number of landslide and landslide soil volume assumed by its dimensions. The number of landslide identified along NH-54 exceeds 850 including very large mass movement (MM) and small rockfall (RF). Among them, slope failure (SF) is most frequent disaster along NH-54 followed by debris flow (DF). Because existing cut slope was excavated with steep grade of 60~80 degree without any protection work when the road was constructed, surface failure often occurs on dip slope and at where weathered rock is exposed. However, volume of most of slope failure is small and less than 100 m3. Large landslide which is more than 1000 m3 with volume and can be hazardous for road construction is mainly composed of mass movement. Those mass movement and large-scale slope failure need be taken care as the critical slope.



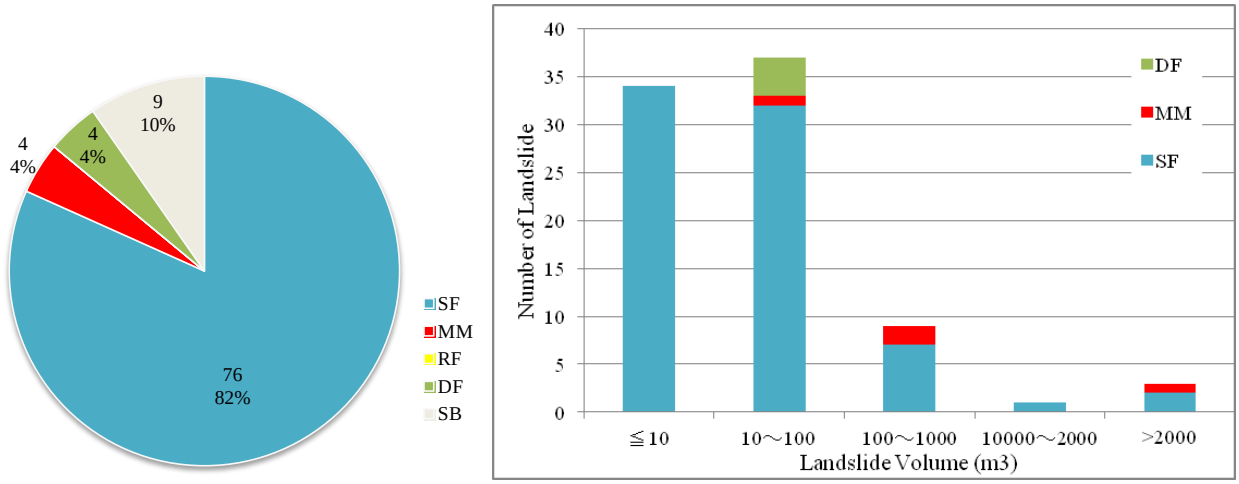
Source: JICA Study Team

Figure 3 The Number (Left) and Volume (Right) of Landslide in NH-54

3.2 NH-51

Topography around NH-51 is relatively gentle and is composed of young geology such as tertiary and quaternary sedimentary layers. Therefore, there are less slope failures and large mass movements and no rockfall unlike NH-54. On the other hand, due to the unconsolidated, loose and erosive foundation layer, road subsidence (SB) and erosions can be identified along the road more frequently. The road subsidence has often occurred at where road embankment was built at valley or depressed area and cracks caused by

the subsidence have occurred at the boundary between cut and fill. Therefore, subsidence is associated with soft foundation at the bottom of embankment and inflow of rainwater into subsurface loosing road embankment due to poor road drainage system.



Source: JICA Study Team

Figure 4 Number (Left) and Volume (Right) of Landslide in NH-51

Appendix - 4: Cross Drainage List

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
8+110	Re-construction	385	1.72	Pipe culvert dia 1.2m	4.17
8+180	New	9,917	2.33	Pipe Culvert dia 1.2m	4.17
8+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
8+590	Re-construction	488	1.73	Pipe culvert dia 1.2m	4.17
8+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
8+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
9+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
9+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
9+355	Re-construction	2,660	1.87	Pipe culvert dia 1.2m	4.17
9+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
9+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
9+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+070	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+550	New	551	1.73	Pipe culvert dia 1.2m	4.17
10+590	Re-construction	350	1.72	Pipe culvert dia 1.2m	4.17
10+710	Re-construction	264	1.72	Pipe culvert dia 1.2m	4.17
10+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
10+975	Re-construction	1,365	1.78	Pipe culvert dia 1.2m	4.17
11+035	Re-construction	240	1.71	Pipe culvert dia 1.2m	4.17
11+220	Re-construction	101,743	7.91	Box Culvert of 2X2	15.88
11+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
11+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
11+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
11+745	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
11+820	Re-construction	33,638	3.80	Pipe Culvert dia 1.2m	4.17
12+000	Re-construction	7,906	2.20	Pipe Culvert dia 1.2m	4.17
12+125	Re-construction	200	1.71	Pipe culvert dia 1.2m	4.17
12+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
12+360	Re-construction	2,060	1.83	Pipe culvert dia 1.2m	4.17
12+590	Re-construction	3,866	1.94	Pipe culvert dia 1.2m	4.17
12+730	New	4,361	1.98	Pipe culvert dia 1.2m	4.17
12+930	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
13+135	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
13+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
13+390	Re-construction	9,303	2.28	Pipe Culvert dia 1.2m	4.17
13+530	Re-construction	10,273	2.34	Pipe Culvert dia 1.2m	4.17
13+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
13+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+365	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+440	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+800	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
14+955	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
15+205	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
15+485	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
15+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
15+790	New	585	1.74	Pipe culvert dia 1.2m	4.17
16+070	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
16+250	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
16+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
16+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
16+710	Re-construction	1,618	1.80	Pipe culvert dia 1.2m	4.17
16+890	Re-construction	1,034	1.77	Pipe culvert dia 1.2m	4.17
16+940	New	3,866	1.94	Pipe culvert dia 1.2m	4.17
17+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
17+280	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
17+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
17+745	Re-construction			Box Culvert of 2X2	15.88
18+025	Re-construction			Box Culvert of 2X2	15.88
18+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+395	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
18+980	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
19+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
19+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
19+660	Re-construction	15,844	2.70	Pipe Culvert dia 1.2m	4.17
19+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
19+960	New	1,067	1.77	Pipe culvert dia 1.2m	4.17
20+060	Re-construction	1,115	1.77	Pipe culvert dia 1.2m	4.17
20+220	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+695	Re-construction	365,983	22.64	Box culver of 3x3	36.19
20+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
20+990	New	1,971	1.83	Pipe culvert dia 1.2m	4.17
21+020	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
21+140	New	1,485	1.79	Pipe culvert dia 1.2m	4.17
21+290	New	3,659	1.93	Pipe culvert dia 1.2m	4.17
21+330	Re-construction	2,313	1.85	Pipe culvert dia 1.2m	4.17
21+500	New	373	1.72	Pipe culvert dia 1.2m	4.17
21+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
21+650	Re-construction	435,435	27.21	Box culver of 3x3	36.19
21+710	Re-construction	842	1.75	Pipe culvert dia 1.2m	4.17
21+770	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
22+020	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
22+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
23+085	Re-construction	1,170	1.77	Pipe culvert dia 1.2m	4.17
23+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
23+380	New	4,339	1.97	Pipe culvert dia 1.2m	4.17
23+480	New	283	1.72	Pipe culvert dia 1.2m	4.17
23+520	Re-construction	30,429	3.57	Pipe Culvert dia 1.2m	4.17
23+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
23+945	Re-construction	13,603	2.54	Pipe Culvert dia 1.2m	4.17
24+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
24+390	Re-construction	54,933	5.01	Box Culvert of 2X2	15.88
24+520	New	27,138	3.42	Pipe Culvert dia 1.2m	4.17
24+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
24+670	New	9,229	2.29	Pipe Culvert dia 1.2m	4.17
24+810	New	1,578	1.80	Pipe culvert dia 1.2m	4.17
24+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+490	Re-construction	519	1.73	Pipe culvert dia 1.2m	4.17
25+735	Re-construction	1,135	1.77	Pipe culvert dia 1.2m	4.17
25+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+840	New	51,107	4.84	Box Culvert of 2X2	15.88
25+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
25+970	Re-construction	13,381	2.54	Pipe Culvert dia 1.2m	4.17
26+040	Re-construction	3,429	1.92	Pipe culvert dia 1.2m	4.17
26+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
26+240	New	234	1.71	Pipe culvert dia 1.2m	4.17
26+380	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
26+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
26+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
26+640	New	10,237	2.34	Pipe Culvert dia 1.2m	4.17
26+720	Re-construction	3,838	1.94	Pipe culvert dia 1.2m	4.17
26+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
27+010	New	223	1.71	Pipe culvert dia 1.2m	4.17
27+180	Re-construction	553	1.74	Pipe culvert dia 1.2m	4.17
27+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
27+445	Re-construction	8,530	2.23	Pipe Culvert dia 1.2m	4.17
27+530	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
27+715	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
28+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
28+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
28+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
28+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
28+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
29+005	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
29+120	New	1,279	1.78	Pipe culvert dia 1.2m	4.17
29+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
29+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
29+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
29+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
30+030	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
30+300	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
30+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
30+710	Re-construction	1,427	1.79	Pipe culvert dia 1.2m	4.17
30+975	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
31+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
31+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
31+620	Re-construction	2,685	1.87	Pipe culvert dia 1.2m	4.17
31+760	New	3,673	1.93	Pipe culvert dia 1.2m	4.17
31+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
31+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
32+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
32+275	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
32+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
32+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
32+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
32+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
33+240	Re-construction	N/A	1.71	Pipe culvert dia 1.2m	4.17
33+310	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
33+600	New	N/A	1.71	Pipe culvert dia 1.2m	4.17
33+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
33+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
34+120	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
34+335	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
34+455	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
34+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
34+900	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
35+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
35+390	New	N/A	1.71	Pipe culvert dia 1.2m	4.17
35+690	Re-construction	N/A	1.71	Pipe culvert dia 1.2m	4.17
35+770	New	5,710	2.06	Pipe Culvert dia 1.2m	4.17
35+950	Re-construction	2,190	1.84	Pipe culvert dia 1.2m	4.17
36+010	Re-construction	22,562	3.09	Pipe Culvert dia 1.2m	4.17
36+135	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
36+230	New	917	0.96	Pipe culvert dia 1.2m	4.17
36+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
36+655	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
36+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
37+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
37+190	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
37+360	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
37+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
38+040	Re-construction	232	1.71	Pipe culvert dia 1.2m	4.17
38+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
38+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
38+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
38+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
39+085	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
39+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
39+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
39+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
39+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
40+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
40+300	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
40+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
40+695	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
40+895	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
41+150	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
41+380	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
41+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
41+885	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+300	New	N/A	1.74	Pipe culvert dia 1.2m	4.17
42+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
42+930	Re-construction	596	1.74	Pipe culvert dia 1.2m	4.17
43+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
43+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
43+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
43+530	New	494	1.73	Pipe culvert dia 1.2m	4.17
43+760	New	1,244	1.78	Pipe culvert dia 1.2m	4.17
43+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
43+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
44+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
44+080	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
44+200	New	N/A	1.70	Pipe culvert dia 1.2m	4.17
44+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
44+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
44+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
44+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
45+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
45+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
45+620	New	606	1.74	Pipe culvert dia 1.2m	4.17
45+825	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+360	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+555	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
46+880	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+225	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+395	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+585	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
47+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
48+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
49+065	Re-construction	410	1.73	Pipe culvert dia 1.2m	4.17
49+225	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
49+310	New	N/A	1.70	Pipe culvert dia 1.2m	4.17
49+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
49+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
49+760	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
49+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
50+050	New	232	1.71	Pipe culvert dia 1.2m	4.17
50+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
50+250	New	337	1.72	Pipe culvert dia 1.2m	4.17
50+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
50+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
50+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
51+075	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
51+400	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
51+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
52+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
52+300	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
52+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
52+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
52+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+050	New	219	1.71	Pipe culvert dia 1.2m	4.17
53+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+185	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+430	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
53+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
54+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
54+250	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
54+505	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
54+640	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
54+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
55+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
55+265	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
55+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
55+690	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
55+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
56+070	New	379	1.72	Pipe culvert dia 1.2m	4.17
56+120	New	743	1.73	Pipe culvert dia 1.2m	4.17
56+370	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
56+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
56+645	Re-construction	156	1.75	Pipe culvert dia 1.2m	4.17
56+750	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
56+835	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
56+915	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
57+060	Re-construction	212	1.71	Pipe culvert dia 1.2m	4.17
57+210	Re-construction	159	1.72	Pipe culvert dia 1.2m	4.17
57+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
57+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
57+745	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
57+840	New	559	1.71	Pipe culvert dia 1.2m	4.17
57+860	Re-construction	3,946	1.74	Pipe culvert dia 1.2m	4.17
57+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
58+100	Re-construction	3,389	1.99	Pipe culvert dia 1.2m	4.17
58+150	New	642	1.94	Pipe culvert dia 1.2m	4.17
58+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
58+440	Re-construction	398	1.75	Pipe culvert dia 1.2m	4.17
58+570	Re-construction	4,115	1.73	Pipe culvert dia 1.2m	4.17
58+660	New	288	1.72	Pipe culvert dia 1.2m	4.17
58+770	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
58+875	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
59+025	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
59+115	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
59+280	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
59+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
59+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
59+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
60+080	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
60+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
60+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
60+775	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
61+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
61+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
61+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
61+560	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
61+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+070	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+435	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
62+935	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
63+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
63+300	New	111	1.71	Pipe culvert dia 1.2m	4.17
63+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
63+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
63+820	Re-construction	402	1.73	Pipe culvert dia 1.2m	4.17
63+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+110	Re-construction	173	1.71	Pipe culvert dia 1.2m	4.17
64+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+670	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
64+780	Re-construction	3,361	1.94	Pipe culvert dia 1.2m	4.17
64+860	Re-construction	161	1.71	Pipe culvert dia 1.2m	4.17
64+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
65+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
65+240	New	677	1.75	Pipe culvert dia 1.2m	4.17
65+300	Re-construction	3,268	1.94	Pipe culvert dia 1.2m	4.17
65+350	New	2,438	1.88	Pipe culvert dia 1.2m	4.17
65+425	Re-construction	6,815	2.19	Pipe culvert dia 1.2m	4.17
65+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
65+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
65+995	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
66+120	Re-construction	2,055	1.85	Pipe culvert dia 1.2m	4.17
66+240	New	1,183	1.79	Pipe culvert dia 1.2m	4.17
66+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
66+540	Re-construction	6,418	2.16	Pipe culvert dia 1.2m	4.17
66+690	Re-construction	7,500	2.24	Pipe culvert dia 1.2m	4.17
66+785	Re-construction	5,348	2.09	Pipe culvert dia 1.2m	4.17
66+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
67+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
67+225	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
67+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
67+420	Re-construction	N/A	1.70	Pipe culvert dia 1.2m	4.17
67+550	New	184	1.71	Pipe culvert dia 1.2m	4.17
67+595	Re-construction	1,749	1.83	Pipe culvert dia 1.2m	4.17
67+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
68+005	Re-construction	217	1.72	Pipe culvert dia 1.2m	4.17
68+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
68+265	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
68+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
68+740	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
68+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
69+230	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
69+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
69+580	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
69+760	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
69+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
70+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
70+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
70+535	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
70+715	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
70+845	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+220	Re-construction	156	1.71	Pipe culvert dia 1.2m	4.17
71+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
71+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+340	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+495	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
72+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+385	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
73+865	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
74+920	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
75+065	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
75+220	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
75+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
75+580	Re-construction	N/A	0.74	Pipe culvert dia 1.2m	4.17
75+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
75+870	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+220	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+680	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
76+885	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
77+015	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
77+210	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
77+460	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
77+625	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
77+860	Re-construction	601	1.75	Pipe culvert dia 1.2m	4.17
78+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
78+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
78+240	New	N/A	0.77	Pipe culvert dia 1.2m	4.17
78+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
78+460	New	4,962	2.10	Pipe culvert dia 1.2m	4.17
78+570	Re-construction	2,729	1.92	Pipe culvert dia 1.2m	4.17
78+620	New	1,747	1.84	Pipe culvert dia 1.2m	4.17
78+680	Re-construction	4,102	2.04	Pipe culvert dia 1.2m	4.17
78+760	Re-construction	1,504	1.82	Pipe culvert dia 1.2m	4.17
78+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
78+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
79+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
79+305	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
79+550	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
79+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
79+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+065	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+360	Re-construction	197	1.72	Pipe culvert dia 1.2m	4.17
80+445	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
80+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+135	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+400	New	21,784	3.40	Pipe Culvert dia 1.2m	4.17
81+520	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
81+950	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
82+130	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
82+355	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
82+585	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
82+695	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
82+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+585	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+750	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
83+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
84+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
84+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
84+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
84+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
84+840	New	810	1.77	Pipe culvert dia 1.2m	4.17
84+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+020	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+460	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+290	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+520	New	906	1.77	Pipe culvert dia 1.2m	4.17
86+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+695	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+980	Re-construction	1,875	1.85	Pipe culvert dia 1.2m	4.17
87+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+565	Re-construction	3,775	2.01	Pipe culvert dia 1.2m	4.17
87+755	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+340	New	4,684	2.08	Pipe culvert dia 1.2m	4.17
88+385	Re-construction	10,493	2.53	Pipe culvert dia 1.2m	4.17
88+480	Re-construction	N/A	1.71	Pipe culvert dia 1.2m	4.17
88+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+950	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
89+760	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+090	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+755	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+295	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+635	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
91+905	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+400	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+180	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+390	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+625	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
95+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
95+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
95+470	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
95+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+740	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
96+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+280	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
97+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+455	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+630	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+750	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
98+920	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+130	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
99+965	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
100+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
100+330	Re-construction	280	1.72	Pipe culvert dia 1.2m	4.17
100+540	Re-construction	678	1.76	Pipe culvert dia 1.2m	4.17
100+640	New	2,525	1.91	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
100+700	New	702	1.76	Pipe culvert dia 1.2m	4.17
100+745	Re-construction	281	1.72	Pipe culvert dia 1.2m	4.17
100+880	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+125	Re-construction	1,227	1.80	Pipe culvert dia 1.2m	4.17
101+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+620	Re-construction	2,714	1.92	Pipe culvert dia 1.2m	4.17
101+875	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+300	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+455	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+825	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+195	Re-construction	5,761	2.23	Pipe culvert dia 1.2m	4.17
103+240	Re-construction	152	1.71	Pipe culvert dia 1.2m	4.17
103+430	New	17,727	3.32	Pipe culvert dia 1.2m	4.17
103+490	Re-construction	303	1.73	Pipe culvert dia 1.2m	4.17
103+560	Re-construction	385	1.74	Pipe culvert dia 1.2m	4.17
103+640	New	282	1.73	Pipe culvert dia 1.2m	4.17
103+780	New	30,065	4.37	Box Culvert 2x2m	15.88
103+890	Re-construction	61,680	7.09	Box Culvert 2x2m	15.88
104+160	New	2,214	1.90	Pipe culvert dia 1.2m	4.17
104+285	Re-construction	5,411	2.19	Pipe culvert dia 1.2m	4.17
104+510	New	8,231	2.44	Pipe culvert dia 1.2m	4.17
104+575	Re-construction	1,845	1.87	Pipe culvert dia 1.2m	4.17
104+740	New	385	1.74	Pipe culvert dia 1.2m	4.17
104+865	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+370	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+625	Re-construction	94,592	9.72	Box Culvert 2x2m	15.88
105+680	Re-construction	8,835	2.50	Pipe culvert dia 1.2m	4.17
105+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+690	New	1,152	1.80	Pipe culvert dia 1.2m	4.17
106+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+965	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+135	Re-construction	670	1.76	Pipe culvert dia 1.2m	4.17
107+340	New	150	1.71	Pipe culvert dia 1.2m	4.17
107+425	Re-construction	199	1.72	Pipe culvert dia 1.2m	4.17
107+670	Re-construction	263	1.72	Pipe culvert dia 1.2m	4.17
107+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+960	New	136	1.71	Pipe culvert dia 1.2m	4.17
108+030	Re-construction	427	1.74	Pipe culvert dia 1.2m	4.17
108+170	Re-construction	1,165	1.81	Pipe culvert dia 1.2m	4.17
108+210	New	1,160	1.81	Pipe culvert dia 1.2m	4.17
108+315	Re-construction	187	1.72	Pipe culvert dia 1.2m	4.17
108+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
108+600	Re-construction	8,192	2.44	Pipe culvert dia 1.2m	4.17
108+710	Re-construction	10,351	2.64	Pipe culvert dia 1.2m	4.17
108+875	Re-construction	5,500	2.20	Pipe culvert dia 1.2m	4.17
109+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+060	New	6,428	2.28	Pipe culvert dia 1.2m	4.17
109+185	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+410	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+565	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+160	Re-construction	2,189	1.90	Pipe culvert dia 1.2m	4.17
110+260	Re-construction	1,778	1.86	Pipe culvert dia 1.2m	4.17
110+330	New	3,222	1.99	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S1)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
110+400	New	3,822	2.05	Pipe culvert dia 1.2m	4.17
110+505	Re-construction	2,136	1.89	Pipe culvert dia 1.2m	4.17
110+600	Re-construction	294	1.73	Pipe culvert dia 1.2m	4.17
110+680	New	3,404	2.01	Pipe culvert dia 1.2m	4.17
110+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+855	Re-construction	133	1.71	Pipe culvert dia 1.2m	4.17
111+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
111+160	New	1,017	1.79	Pipe culvert dia 1.2m	4.17
111+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
111+640	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
111+820	Re-construction	368	1.73	Pipe culvert dia 1.2m	4.17
111+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
111+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+090	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+415	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+610	New	204	1.72	Pipe culvert dia 1.2m	4.17
112+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+925	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+430	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+585	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+875	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+950	New	150	1.71	Pipe culvert dia 1.2m	4.17
113+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+050	New	1,183	1.81	Pipe culvert dia 1.2m	4.17
114+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+510	Re-construction	18,106	3.29	Pipe culvert dia 1.2m	4.17
114+565	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+640	New	135	1.71	Pipe culvert dia 1.2m	4.17
114+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+910	Re-construction	1,831	1.87	Pipe culvert dia 1.2m	4.17
115+040	New	2,966	1.97	Pipe culvert dia 1.2m	4.17
115+130	New	1,336	1.82	Pipe culvert dia 1.2m	4.17
115+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+310	Re-construction	3,018	1.97	Pipe culvert dia 1.2m	4.17
115+450	Re-construction	3,261	1.99	Pipe culvert dia 1.2m	4.17
115+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+550	New	4,551	2.12	Pipe culvert dia 1.2m	4.17
115+580	Re-construction	221	1.72	Pipe culvert dia 1.2m	4.17
115+660	New	6,721	2.30	Pipe culvert dia 1.2m	4.17
115+720	Re-construction	306	1.73	Pipe culvert dia 1.2m	4.17
115+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+190	Re-construction	2,701	1.95	Pipe culvert dia 1.2m	4.17
116+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
125+020	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+220	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+300	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+350	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+420	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+460	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+610	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+830	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
125+980	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+225	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+260	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+480	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+525	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+630	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+690	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+840	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
126+900	Re-construction	-	-	Pipe culvert dia 1.2m	4.17
127+070	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+200	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+735	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+010	New	171	1.71	Pipe culvert dia 1.2m	4.17
128+060	New	947	1.79	Pipe culvert dia 1.2m	4.17
128+260	Re-construction	7,329	2.37	Pipe culvert dia 1.2m	4.17
128+350	Re-construction	1,895	1.87	Pipe culvert dia 1.2m	4.17
128+440	New	143	1.71	Pipe culvert dia 1.2m	4.17
128+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+785	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+535	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+250	New	147	1.71	Pipe culvert dia 1.2m	4.17
130+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+215	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+155	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+290	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+780	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+435	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+975	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+195	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+640	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+890	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
135+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+580	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+830	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+970	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+510	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+550	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+750	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+190	Re-construction	206	1.72	Pipe culvert dia 1.2m	4.17
137+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+715	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+895	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+120	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+345	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+565	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+815	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+015	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+220	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+470	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+720	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+200	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+970	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+170	Re-construction	232	1.72	Pipe culvert dia 1.2m	4.17
141+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+550	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+900	Re-construction	460	1.74	Pipe culvert dia 1.2m	4.17
142+025	Re-construction	4,957	2.15	Pipe culvert dia 1.2m	4.17
142+145	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+295	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+865	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+550	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+980	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
144+190	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
144+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
144+410	New	1,548	1.84	Pipe culvert dia 1.2m	4.17
144+560	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
144+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+245	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
145+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
146+095	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
146+205	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
146+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
146+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
146+820	Re-construction	14,726	3.02	Pipe culvert dia 1.2m	4.17
146+850	New	4,105	2.07	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
146+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
147+050	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
147+200	Re-construction	4,465	2.10	Pipe culvert dia 1.2m	4.17
147+270	Re-construction	10,107	2.61	Pipe culvert dia 1.2m	4.17
147+340	New	1,010	1.79	Pipe culvert dia 1.2m	4.17
147+400	New	2,416	1.92	Pipe culvert dia 1.2m	4.17
147+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
147+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
147+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
147+880	New	2,104	1.89	Pipe culvert dia 1.2m	4.17
147+940	Re-construction	1,422	1.83	Pipe culvert dia 1.2m	4.17
148+020	New	5,535	2.20	Pipe culvert dia 1.2m	4.17
148+090	Re-construction	2,767	1.95	Pipe culvert dia 1.2m	4.17
148+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
148+245	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
148+440	New	1,986	1.88	Pipe culvert dia 1.2m	4.17
148+675	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
148+705	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
148+860	New	4,433	2.10	Pipe culvert dia 1.2m	4.17
148+905	Re-construction	4,844	2.14	Pipe culvert dia 1.2m	4.17
148+950	New	4,902	2.14	Pipe culvert dia 1.2m	4.17
149+095	Re-construction	485	1.74	Pipe culvert dia 1.2m	4.17
149+280	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
149+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
149+545	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
149+700	Re-construction	307	1.73	Pipe culvert dia 1.2m	4.17
149+755	Re-construction	233	1.72	Pipe culvert dia 1.2m	4.17
149+800	New	179	1.72	Pipe culvert dia 1.2m	4.17
149+845	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+235	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+425	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+680	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
150+930	Re-construction	8,063	2.42	Pipe culvert dia 1.2m	4.17
151+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
151+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
151+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
151+645	Re-construction	333	1.72	Pipe culvert dia 1.2m	4.17
151+900	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+135	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+300	Re-construction	4,990	2.15	Pipe culvert dia 1.2m	4.17
152+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+440	New	1,204	1.81	Pipe culvert dia 1.2m	4.17
152+505	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+675	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+720	Re-construction	861	1.78	Pipe culvert dia 1.2m	4.17
152+845	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
152+900	Re-construction	5,163	2.17	Pipe culvert dia 1.2m	4.17
153+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
153+180	New	4,403	2.10	Pipe culvert dia 1.2m	4.17
153+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
153+345	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
153+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
153+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
153+825	New	550	1.75	Pipe culvert dia 1.2m	4.17
153+925	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
154+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
154+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
154+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
154+590	New	223	1.72	Pipe culvert dia 1.2m	4.17
154+630	Re-construction	1,266	1.82	Pipe culvert dia 1.2m	4.17
154+710	New	186	1.72	Pipe culvert dia 1.2m	4.17
154+860	New	1,734	1.86	Pipe culvert dia 1.2m	4.17
154+915	Re-construction	801	1.77	Pipe culvert dia 1.2m	4.17
155+220	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
155+515	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
155+590	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
155+680	Re-construction	708	1.76	Pipe culvert dia 1.2m	4.17
155+890	New	1,809	1.87	Pipe culvert dia 1.2m	4.17
155+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
156+040	New	7,884	2.41	Pipe culvert dia 1.2m	4.17
156+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
156+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
156+520	Re-construction	3,510	2.02	Pipe culvert dia 1.2m	4.17
156+670	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
156+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
157+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
157+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
157+555	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
157+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
157+870	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
158+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
158+210	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
158+440	New	294	1.73	Pipe culvert dia 1.2m	4.17
158+530	Re-construction	698	1.76	Pipe culvert dia 1.2m	4.17
158+740	New	1,797	1.86	Pipe culvert dia 1.2m	4.17
158+880	New	679	1.76	Pipe culvert dia 1.2m	4.17
158+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
158+980	New	6,650	2.29	Pipe culvert dia 1.2m	4.17
159+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
159+160	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
159+240	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
159+300	Re-construction	32,654	4.60	Box Culvert 2x2m	15.88
159+450	Re-construction	1,232	1.81	Pipe culvert dia 1.2m	4.17
159+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
159+640	New	1,375	1.83	Pipe culvert dia 1.2m	4.17
159+680	New	598	1.75	Pipe culvert dia 1.2m	4.17
159+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
159+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
160+240	New	1,060	1.80	Pipe culvert dia 1.2m	4.17
160+460	New	159	1.71	Pipe culvert dia 1.2m	4.17
160+500	New	4,653	2.12	Pipe culvert dia 1.2m	4.17
160+750	Re-construction			Pipe culvert dia 1.2m	4.17
160+945	New			Pipe culvert dia 1.2m	4.17
161+100	Re-construction			Pipe culvert dia 1.2m	4.17
161+400	Re-construction			Pipe culvert dia 1.2m	4.17
161+600	New			Pipe culvert dia 1.2m	4.17
161+705	New			BOX culvert 2x2m	15.88
161+995	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
162+035	New	315	1.73	Pipe culvert dia 1.2m	4.17
162+145	New	6,163	2.25	Pipe culvert dia 1.2m	4.17
162+290	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
162+470	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
162+750	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
162+865	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
163+045	Re-construction	735	1.77	Pipe culvert dia 1.2m	4.17
163+145	Re-construction	1,903	1.87	Pipe culvert dia 1.2m	4.17
163+360	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
163+530	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
163+590	Re-construction	236	1.72	Pipe culvert dia 1.2m	4.17
163+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
163+840	Re-construction	872	1.78	Pipe culvert dia 1.2m	4.17
163+900	New	338	1.73	Pipe culvert dia 1.2m	4.17
163+980	New	5,517	2.20	Pipe culvert dia 1.2m	4.17
164+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
164+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
164+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
164+400	Re-construction	3,703	2.03	Pipe culvert dia 1.2m	4.17
164+580	New	978	1.79	Pipe culvert dia 1.2m	4.17
164+660	Re-construction	605	1.76	Pipe culvert dia 1.2m	4.17
164+770	Re-construction	2,578	1.93	Pipe culvert dia 1.2m	4.17
164+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
165+190	Re-construction	1,491	1.84	Pipe culvert dia 1.2m	4.17
165+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
165+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
165+585	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
165+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
165+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
166+270	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
166+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
166+605	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
166+830	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
167+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
167+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
167+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
167+610	New	947	1.79	Pipe culvert dia 1.2m	4.17
167+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
167+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+790	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
168+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
169+190	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
169+460	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
169+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
169+780	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
169+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
170+220	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
170+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
170+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
170+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
171+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
171+185	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
171+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
171+370	Re-construction	459	1.74	Pipe culvert dia 1.2m	4.17
171+520	Re-construction	245	1.72	Pipe culvert dia 1.2m	4.17
171+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
171+950	New	14,176	2.98	Pipe culvert dia 1.2m	4.17
172+180	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
172+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
172+570	Re-construction	14,894	3.04	Pipe culvert dia 1.2m	4.17
172+620	New	703	1.76	Pipe culvert dia 1.2m	4.17
172+705	New	2,839	1.96	Pipe culvert dia 1.2m	4.17
172+845	Re-construction	5,133	2.16	Pipe culvert dia 1.2m	4.17
172+915	Re-construction	630	1.76	Pipe culvert dia 1.2m	4.17
173+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
173+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
173+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
173+460	New	4,597	2.11	Pipe culvert dia 1.2m	4.17
173+560	New	24,637	3.87	Pipe culvert dia 1.2m	4.17
173+600	Re-construction	1,224	1.81	Pipe culvert dia 1.2m	4.17
173+730	Re-construction	818	1.77	Pipe culvert dia 1.2m	4.17
173+780	New	2,656	1.94	Pipe culvert dia 1.2m	4.17
173+820	New	20,662	3.52	Pipe culvert dia 1.2m	4.17
173+910	Re-construction	2,033	1.88	Pipe culvert dia 1.2m	4.17
174+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+190	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
174+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
175+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
175+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
175+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
175+510	Re-construction	249	1.72	Pipe culvert dia 1.2m	4.17
175+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
175+990	Re-construction	280	1.73	Pipe culvert dia 1.2m	4.17
176+160	New	6,303	2.24	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
176+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
176+520	Re-construction	17,394	3.25	Pipe culvert dia 1.2m	4.17
176+640	New	1,859	1.87	Pipe culvert dia 1.2m	4.17
176+840	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
176+940	Re-construction	888	1.78	Pipe culvert dia 1.2m	4.17
177+120	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
177+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
177+320	Re-construction	440	1.74	Pipe culvert dia 1.2m	4.17
177+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
177+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
177+720	Re-construction	3,397	1.99	Pipe culvert dia 1.2m	4.17
177+830	New	5,776	2.21	Pipe culvert dia 1.2m	4.17
178+040	New	6,913	2.31	Pipe culvert dia 1.2m	4.17
178+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
178+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
178+410	Re-construction	3,573	2.02	Pipe culvert dia 1.2m	4.17
178+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
178+930	New	25,459	3.94	Pipe culvert dia 1.2m	4.17
179+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
179+170	Re-construction	5,525	2.19	Pipe culvert dia 1.2m	4.17
179+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
179+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
179+720	Re-construction	8,865	2.49	Pipe culvert dia 1.2m	4.17
179+820	Re-construction	4,431	2.10	Pipe culvert dia 1.2m	4.17
180+120	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
180+320	Re-construction	3,758	2.04	Pipe culvert dia 1.2m	4.17
180+360	New	2,808	1.95	Pipe culvert dia 1.2m	4.17
180+515	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
180+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
180+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
180+995	Re-construction	3,821	2.05	Pipe culvert dia 1.2m	4.17
181+040	New	2,077	1.89	Pipe culvert dia 1.2m	4.17
181+100	New	6,020	2.24	Pipe culvert dia 1.2m	4.17
181+230	New	4,664	2.12	Pipe culvert dia 1.2m	4.17
181+270	Re-construction	3,920	2.05	Pipe culvert dia 1.2m	4.17
181+495	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
181+630	New	393	1.74	Pipe culvert dia 1.2m	4.17
181+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
181+975	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
182+160	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
182+390	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
182+480	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
182+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
182+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
183+080	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
183+170	New	1,151	1.80	Pipe culvert dia 1.2m	4.17
183+240	New	5,344	2.18	Pipe culvert dia 1.2m	4.17
183+340	Re-construction	8,525	2.46	Pipe culvert dia 1.2m	4.17
183+390	New	10,334	2.64	Pipe culvert dia 1.2m	4.17
183+430	Re-construction	46,371	5.59	Box Culvert 2x2	15.88
183+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
183+720	Re-construction	7,971	2.42	Pipe culvert dia 1.2m	4.17
183+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
184+180	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
184+360	Re-construction	8,525	2.46	Pipe culvert dia 1.2m	4.17
184+580	Re-construction	168	1.72	Pipe culvert dia 1.2m	4.17
184+790	Re-construction	10,334	2.64	Pipe culvert dia 1.2m	4.17
184+960	Re-construction	46,371	5.59	Box Culvert 2x2	15.88
185+040	Re-construction	1,713	1.86	Pipe culvert dia 1.2m	4.17
185+210	New	54,764	6.44	Box Culvert 2x2	15.88
185+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
185+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
185+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+360	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+425	Re-construction	290	1.73	Pipe culvert dia 1.2m	4.17
186+495	Re-construction	7,646	2.39	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
186+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
186+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
187+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
187+095	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
187+355	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
187+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
187+850	Re-construction	1,029	1.79	Pipe culvert dia 1.2m	4.17
187+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
188+170	Re-construction	17,159	3.23	Pipe culvert dia 1.2m	4.17
188+300	Re-construction	484	1.74	Pipe culvert dia 1.2m	4.17
188+590	New	346	1.73	Pipe culvert dia 1.2m	4.17
188+770	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
188+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
189+035	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
189+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
189+200	New	1,460	1.83	Pipe culvert dia 1.2m	4.17
189+290	Re-construction	984	1.79	Pipe culvert dia 1.2m	4.17
189+520	Re-construction	401	1.74	Pipe culvert dia 1.2m	4.17
189+695	Re-construction	2,654	1.94	Pipe culvert dia 1.2m	4.17
189+780	Re-construction	3,234	1.99	Pipe culvert dia 1.2m	4.17
189+820	New	8,013	2.42	Pipe culvert dia 1.2m	4.17
189+880	New	8,385	2.45	Pipe culvert dia 1.2m	4.17
189+940	Re-construction	5,918	2.23	Pipe culvert dia 1.2m	4.17
190+070	Re-construction	5,569	2.21	Pipe culvert dia 1.2m	4.17
190+240	New	9,491	2.54	Pipe culvert dia 1.2m	4.17
190+345	Re-construction	2,095	1.89	Pipe culvert dia 1.2m	4.17
190+530	Re-construction	7,590	2.38	Pipe culvert dia 1.2m	4.17
190+720	Re-construction	1,209	1.81	Pipe culvert dia 1.2m	4.17
190+940	Re-construction	38,630	4.84	Box Culvert 2x2m	15.88
191+040	New	2,255	1.90	Pipe culvert dia 1.2m	4.17
191+200	Re-construction	25,235	3.89	Pipe culvert dia 1.2m	4.17
191+300	Re-construction	7,287	2.35	Pipe culvert dia 1.2m	4.17
191+340	New	719	1.76	Pipe culvert dia 1.2m	4.17
191+430	Re-construction	7,129	2.34	Pipe culvert dia 1.2m	4.17
191+660	New	80,079	8.66	Box Culvert 2x2m	15.88
191+780	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
192+000	Re-construction	165	1.71	Pipe culvert dia 1.2m	4.17
192+200	New	4,871	2.14	Pipe culvert dia 1.2m	4.17
192+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
192+490	New	5,443	2.19	Pipe culvert dia 1.2m	4.17
192+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
192+820	New	177,925	14.99	Box Culvert 2x2m	15.88
192+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
192+980	New	147	1.71	Pipe culvert dia 1.2m	4.17
193+100	New	258,475	22.03	Box Culvert 3x3m	36.19
193+630	Re-construction	41,446	5.32	Box Culvert 2x2m	15.88
193+825	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
193+910	New	1,280	1.82	Pipe culvert dia 1.2m	4.17
194+090	Re-construction	523	1.75	Pipe culvert dia 1.2m	4.17
194+180	New	4,004	2.06	Pipe culvert dia 1.2m	4.17
194+230	New	4,109	2.07	Pipe culvert dia 1.2m	4.17
194+285	Re-construction	3,469	2.01	Pipe culvert dia 1.2m	4.17
194+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
194+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
194+670	Re-construction	3,509	2.02	Pipe culvert dia 1.2m	4.17
194+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
195+100	Re-construction	360	1.73	Pipe culvert dia 1.2m	4.17
195+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
195+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
195+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
195+580	New	8,324	2.45	Pipe culvert dia 1.2m	4.17
195+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
196+020	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
196+165	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
196+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
196+550	Re-construction	877	1.78	Pipe culvert dia 1.2m	4.17
196+720	Re-construction	2,199	1.90	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
196+900	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
197+120	New	249,795	22.60	Box Culvert 3x3m	36.19
197+330	Re-construction	349,554	33.38	Box Culvert 3x3m	36.19
197+440	New	296,185	26.94	Box Culvert 3x3m	36.19
197+550	Re-construction	263,012	24.34	Box Culvert 3x3m	36.19
197+680	Re-construction	626	1.76	Pipe culvert dia 1.2m	4.17
197+750	Re-construction	1,336	1.82	Pipe culvert dia 1.2m	4.17
197+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
197+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
198+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
198+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
198+220	Re-construction	147	1.71	Pipe culvert dia 1.2m	4.17
198+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
198+430	Re-construction	1,533,068	119.52	Box culvert 4x6m	166.95
198+575	Re-construction	4,670	2.12	Pipe culvert dia 1.2m	4.17
198+700	New	882	1.78	Pipe culvert dia 1.2m	4.17
198+770	New	687	1.76	Pipe culvert dia 1.2m	4.17
198+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
199+050	Re-construction	874	1.78	Pipe culvert dia 1.2m	4.17
199+195	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
199+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
199+540	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
199+820	Re-construction	10,406	2.62	Pipe culvert dia 1.2m	4.17
199+970	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
200+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
200+430	Re-construction	238	1.72	Pipe culvert dia 1.2m	4.17
200+495	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
200+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
200+860	New	179	1.72	Pipe culvert dia 1.2m	4.17
200+990	New	80,544	8.55	Box Culvert 2x2m	15.88
201+255	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
201+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
201+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
201+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
201+710	New	214	1.72	Pipe culvert dia 1.2m	4.17
201+845	Re-construction	2,908	1.96	Pipe culvert dia 1.2m	4.17
201+945	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
202+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
202+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
202+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
203+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
203+210	New	600	1.75	Pipe culvert dia 1.2m	4.17
203+465	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
203+580	New	136	1.71	Pipe culvert dia 1.2m	4.17
203+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
204+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
204+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
204+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
204+510	Re-construction	234	1.72	Pipe culvert dia 1.2m	4.17
204+740	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
204+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
205+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
205+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
205+380	New	5,182	2.17	Pipe culvert dia 1.2m	4.17
205+650	Re-construction	831	1.78	Pipe culvert dia 1.2m	4.17
205+900	Re-construction	1,153	1.80	Pipe culvert dia 1.2m	4.17
206+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
206+100	Re-construction	122	1.71	Pipe culvert dia 1.2m	4.17
206+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
206+495	Re-construction	31,895	4.55	Box culver 2x2m	15.88
206+610	Re-construction	664	1.76	Pipe culvert dia 1.2m	4.17
206+735	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
206+930	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+365	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
207+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
208+095	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
208+425	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
208+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
208+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
208+965	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
209+200	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
209+360	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
209+600	Re-construction	612	1.76	Pipe culvert dia 1.2m	4.17
209+690	Re-construction	918	1.78	Pipe culvert dia 1.2m	4.17
209+790	Re-construction	623	1.76	Pipe culvert dia 1.2m	4.17
209+990	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
210+150	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
210+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
210+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
210+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
211+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
212+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
212+205	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
212+305	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
212+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
212+745	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
213+010	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
213+185	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
213+500	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
213+680	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
213+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
214+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
214+425	Re-construction	311	1.73	Pipe culvert dia 1.2m	4.17
214+715	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
214+790	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
214+980	New	305	1.73	Pipe culvert dia 1.2m	4.17
215+125	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
215+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
215+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
215+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
216+190	Re-construction	9,281	2.51	Pipe culvert dia 1.2m	4.17
216+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
216+710	Re-construction	188	1.72	Pipe culvert dia 1.2m	4.17
216+820	Re-construction	237	1.72	Pipe culvert dia 1.2m	4.17
216+940	Re-construction	9,081	2.50	Pipe culvert dia 1.2m	4.17
217+025	Re-construction	73,730	8.42	Box Culvert 2x2	15.88
217+170	Re-construction	21,767	3.60	Pipe culvert dia 1.2m	4.17
217+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
217+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
217+705	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
217+800	Re-construction	93,975	9.44	Box Culvert 2x2	15.88
217+920	Re-construction	161,093	14.96	Box Culvert 2x2	15.88
218+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
218+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
218+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
218+490	New	3,682	2.03	Pipe culvert dia 1.2m	4.17
218+670	Re-construction	1,385	1.83	Pipe culvert dia 1.2m	4.17
218+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
218+955	Re-construction	1,475	1.83	Pipe culvert dia 1.2m	4.17
219+270	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
219+385	Re-construction	253	1.72	Pipe culvert dia 1.2m	4.17
219+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
219+705	Re-construction	3,302	2.00	Pipe culvert dia 1.2m	4.17
219+850	Re-construction	11,021	2.70	Pipe culvert dia 1.2m	4.17
219+940	Re-construction	6,850	2.32	Pipe culvert dia 1.2m	4.17
220+040	New	697	1.76	Pipe culvert dia 1.2m	4.17
220+135	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
220+235	Re-construction	5,660	2.21	Pipe culvert dia 1.2m	4.17
220+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
220+605	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
220+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
220+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
221+140	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
221+470	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
221+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
222+025	Re-construction	5,808	2.22	Pipe culvert dia 1.2m	4.17
222+270	Re-construction	3,505	2.01	Pipe culvert dia 1.2m	4.17
222+370	Re-construction	30,731	4.31	Box Culvert 2x2	15.88
222+470	Re-construction	15,635	3.09	Pipe culvert dia 1.2m	4.17
222+650	New	2,238	1.91	Pipe culvert dia 1.2m	4.17
222+760	Re-construction	467	1.74	Pipe culvert dia 1.2m	4.17
222+900	New	467	1.74	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
223+080	New	2,679	1.95	Pipe culvert dia 1.2m	4.17
223+240	New	15,001	3.04	Pipe culvert dia 1.2m	4.17
223+310	Re-construction	5,684	2.20	Pipe culvert dia 1.2m	4.17
223+460	Re-construction	214,105	20.07	Box Culvert 3x3	36.19
223+550	New	63,263	4.33	Box Culvert 2x2	15.88
223+610	Re-construction	57,796	6.64	Box Culvert 2x2	15.88
223+740	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
223+905	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
224+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
224+340	Re-construction	55,562	6.52	Box Culvert 2x2	15.88
224+500	New	4,968	2.14	Pipe culvert dia 1.2m	4.17
224+555	Re-construction	6,475	2.28	Pipe culvert dia 1.2m	4.17
224+765	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
224+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+090	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+335	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
225+770	Re-construction	3,947	2.06	Pipe culvert dia 1.2m	4.17
225+930	Re-construction	1,190,320	95.31	Box Culvert 4x6	166.95
226+060	Re-construction	219,856	20.49	Box Culvert 3x3	36.19
226+150	New	34,567	3.13	Pipe culvert dia 1.2m	4.17
226+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
226+290	Re-construction	21,558	2.59	Pipe culvert dia 1.2m	4.17
226+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
226+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
226+915	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
227+110	Re-construction	10,730	2.14	Pipe culvert dia 1.2m	4.17
227+340	New	8,378	2.05	Pipe culvert dia 1.2m	4.17
227+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
227+570	Re-construction	328,353	15.34	Box Culvert 3x3	36.19
227+670	New	19,261	2.50	Pipe culvert dia 1.2m	4.17
227+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
227+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
228+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
228+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
228+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
228+600	Re-construction	57,585	4.09	Box Culvert 2x2	15.88
228+660	New	17,741	2.44	Pipe culvert dia 1.2m	4.17
228+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
229+030	Re-construction	24,745	2.73	Pipe culvert dia 1.2m	4.17
229+215	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
229+370	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
229+480	Re-construction	168,882	8.72	Box Culvert 4x4	95.71
229+630	Re-construction	740,870	32.48	Box Culvert 4x4	95.71
229+760	New	2,667	1.81	Pipe culvert dia 1.2m	4.17
229+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
230+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
230+360	Re-construction	38,232	3.29	Pipe culvert dia 1.2m	4.17
230+530	New	13,799	2.27	Pipe culvert dia 1.2m	4.17
230+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
230+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
231+120	Re-construction	875	1.74	Pipe culvert dia 1.2m	4.17
231+200	Re-construction	42,396	3.46	Pipe culvert dia 1.2m	4.17
231+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
231+535	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
231+750	Re-construction	193	1.71	Pipe culvert dia 1.2m	4.17
231+965	Re-construction	875	1.74	Pipe culvert dia 1.2m	4.17
232+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
232+180	New	2,819	1.82	Pipe culvert dia 1.2m	4.17
232+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
232+440	Re-construction	223,552	10.99	Box Culvert 2x2	15.88
232+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
232+600	New	526	1.72	Pipe culvert dia 1.2m	4.17
232+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
232+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
232+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
233+165	Re-construction	1,736	1.77	Pipe culvert dia 1.2m	4.17
233+260	Re-construction	18,348	2.46	Pipe culvert dia 1.2m	4.17
233+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
233+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
233+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
233+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
234+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
234+305	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S2)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
234+390	New	645	1.73	Pipe culvert dia 1.2m	4.17
234+610	Re-construction	27,761	2.85	Pipe culvert dia 1.2m	4.17
234+710	Re-construction	6,075	1.95	Pipe culvert dia 1.2m	4.17
234+890	Re-construction	2,983	1.82	Pipe culvert dia 1.2m	4.17
234+980	Re-construction	645	1.73	Pipe culvert dia 1.2m	4.17
235+165	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
235+260	Re-construction	1,684,589	147.63	Box Culvert 4x6	166.95
235+355	Re-construction	95,120	10.32	Box Culvert 2x2	15.88
235+400	New	2,507	1.93	Pipe culvert dia 1.2m	4.17
235+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
235+670	New	17,665	3.25	Pipe culvert dia 1.2m	4.17
235+880	New	2,453	1.92	Pipe culvert dia 1.2m	4.17
236+080	Re-construction	3,350	2.01	Pipe culvert dia 1.2m	4.17
236+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
236+500	Re-construction	189,615	18.28	Box Culvert 3x3	36.19
236+550	Re-construction	1,285	1.81	Pipe culvert dia 1.2m	4.17
236+680	Re-construction	4,754	2.13	Pipe culvert dia 1.2m	4.17
236+770	Re-construction	5,726	1.94	Pipe culvert dia 1.2m	4.17
236+980	Re-construction	23,217	3.79	Pipe culvert dia 1.2m	4.17
237+050	Re-construction	727	1.77	Pipe culvert dia 1.2m	4.17
237+220	New	1,855	1.87	Pipe culvert dia 1.2m	4.17
237+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
237+665	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
237+760	New	3,775	2.04	Pipe culvert dia 1.2m	4.17
237+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
238+090	Re-construction	85,354	9.22	Box Culvert 2x2	15.88
238+240	Re-construction	41,369	5.52	Pipe culvert dia 1.2m	15.88
238+370	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
238+500	New	20,461	3.56	Pipe culvert dia 1.2m	4.17
238+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
238+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
238+920	Re-construction	3,294	2.00	Pipe culvert dia 1.2m	4.17
239+160	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
239+315	Re-construction	2,316	1.91	Pipe culvert dia 1.2m	4.17
239+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
239+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
239+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
239+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
240+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
240+280	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
240+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
240+695	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
240+905	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+065	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+275	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+375	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+565	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+885	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
241+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+195	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
242+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
243+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
431+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
431+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
431+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
431+805	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
432+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
432+100	New	2,099	1.89	Pipe culvert dia 1.2m	4.17
432+185	Re-construction	2,644	1.94	Pipe culvert dia 1.2m	4.17
432+385	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
432+585	Re-construction	10,086	2.60	Pipe culvert dia 1.2m	4.17
432+620	New	2,898	1.96	Pipe culvert dia 1.2m	4.17
432+660	Re-construction	7,301	2.36	Pipe culvert dia 1.2m	4.17
432+785	Re-construction	4,050	2.07	Pipe culvert dia 1.2m	4.17
432+945	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
433+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
433+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
433+300	Re-construction	1,724	1.86	Pipe culvert dia 1.2m	4.17
433+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
433+870	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
434+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
434+170	Re-construction	125,195	11.84	Box Culvert 2x2	15.88
434+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
434+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
434+685	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
434+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
435+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
435+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
435+495	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
435+630	Re-construction	560	1.75	Pipe culvert dia 1.2m	4.17
435+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
435+975	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+295	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
436+975	Re-construction	787	1.77	Pipe culvert dia 1.2m	4.17
437+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
437+280	New	48,331	5.97	Box Culvert 2x2	15.88
437+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
437+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
437+660	Re-construction	38,527	5.23	Box Culvert 4x4	95.71
437+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+005	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+765	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
438+970	Re-construction	4,256	2.09	Pipe culvert dia 1.2m	4.17
439+130	Re-construction	13,382	2.93	Pipe culvert dia 1.2m	4.17
439+230	Re-construction	33,894	4.67	Box Culvert 2x2	15.88
439+300	New	727	1.77	Pipe culvert dia 1.2m	4.17
439+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
439+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
439+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
439+895	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
440+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
440+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
440+355	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
440+535	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
440+840	Re-construction	2,639	1.94	Pipe culvert dia 1.2m	4.17
440+900	New	17,923	3.31	Pipe culvert dia 1.2m	4.17
441+020	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
441+130	Re-construction	1,344	1.82	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
441+340	New	7,915	2.42	Pipe culvert dia 1.2m	4.17
441+510	Re-construction	2,682	1.95	Pipe culvert dia 1.2m	4.17
441+600	Re-construction	15,920	3.13	BOX culvert 2x2	15.89
441+715	Re-construction	N/A	2.84	Pipe culvert dia 1.2m	4.17
441+880	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
442+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
442+310	Re-construction	1,249	1.81	Pipe culvert dia 1.2m	4.17
442+405	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
442+470	Re-construction	1,878	1.87	Pipe culvert dia 1.2m	4.17
442+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
442+790	Re-construction	16,849	3.22	Pipe culvert dia 1.2m	4.17
442+960	Re-construction	4,160	2.08	Pipe culvert dia 1.2m	4.17
443+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
443+280	Re-construction	989	1.79	Pipe culvert dia 1.2m	4.17
443+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
443+625	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
443+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
443+860	New	399	1.74	Pipe culvert dia 1.2m	4.17
444+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
444+175	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
444+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
444+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
444+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
444+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
445+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
445+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
445+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
445+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
445+935	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
446+105	Re-construction	869	1.78	Pipe culvert dia 1.2m	4.17
446+200	New	15,275	3.07	Pipe culvert dia 1.2m	4.17
446+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
446+365	Re-construction	3,047	1.98	Pipe culvert dia 1.2m	4.17
446+460	New	791	1.77	Pipe culvert dia 1.2m	4.17
446+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
446+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
446+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
447+130	Re-construction	16,827	3.21	Pipe culvert dia 1.2m	4.17
447+245	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
447+480	Re-construction	312	1.73	Pipe culvert dia 1.2m	4.17
447+675	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
447+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
448+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
448+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
448+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
448+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
448+875	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
449+000	Re-construction	3,104	1.98	Pipe culvert dia 1.2m	4.17
449+120	New	6,732	2.31	Pipe culvert dia 1.2m	4.17
449+200	Re-construction	5,094	2.16	Pipe culvert dia 1.2m	4.17
449+370	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
449+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
449+485	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
449+765	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
449+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
450+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
450+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
450+545	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
450+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
450+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
451+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
451+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
451+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
451+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
451+830	New	7,109	2.35	Pipe culvert dia 1.2m	4.17
452+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
452+330	Re-construction	454	1.74	Pipe culvert dia 1.2m	4.17
452+360	Re-construction	1,435	1.83	Pipe culvert dia 1.2m	4.17
452+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
452+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
452+760	New	3,959	2.06	Pipe culvert dia 1.2m	4.17
452+930	Re-construction	9,145	2.53	Pipe culvert dia 1.2m	4.17
453+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
453+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
453+440	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
453+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
453+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
453+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+340	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+685	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
454+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
455+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
455+380	Re-construction	7,291	2.37	Pipe culvert dia 1.2m	4.17
455+580	Re-construction	6,431	2.27	Pipe culvert dia 1.2m	4.17
455+650	Re-construction	11,701	2.75	Pipe culvert dia 1.2m	4.17
455+780	New	4,682	2.12	Pipe culvert dia 1.2m	4.17
455+950	Re-construction	7,505	2.38	Pipe culvert dia 1.2m	4.17
456+040	Re-construction	1,648	1.85	Pipe culvert dia 1.2m	4.17
456+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+160	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+310	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+550	New	1,895	1.87	Pipe culvert dia 1.2m	4.17
456+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+700	New	2,556	1.93	Pipe culvert dia 1.2m	4.17
456+805	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
456+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
457+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
458+090	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
458+245	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
458+540	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
458+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
458+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
459+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
459+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
459+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
459+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
460+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
460+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
460+560	Re-construction	3,043	1.98	Pipe culvert dia 1.2m	4.17
460+720	New	4,371	2.09	Pipe culvert dia 1.2m	4.17
460+825	Re-construction	10,471	2.65	Pipe culvert dia 1.2m	4.17
460+915	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
461+000	New	9,891	2.60	Pipe culvert dia 1.2m	4.17
461+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
461+260	New	18,764	3.41	Pipe culvert dia 1.2m	4.17
461+355	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
461+590	Re-construction	1,800	1.86	Pipe culvert dia 1.2m	4.17
461+750	Re-construction	3,171	1.99	Pipe culvert dia 1.2m	4.17
461+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
462+050	New	5,706	2.22	Pipe culvert dia 1.2m	4.17
462+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
462+380	New	3,344	2.00	Pipe culvert dia 1.2m	4.17
462+520	Re-construction	891	1.78	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
462+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
462+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
463+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
463+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
463+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
463+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
463+845	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+240	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
464+925	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
465+090	New	3,043	1.98	Pipe culvert dia 1.2m	4.17
465+225	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
465+400	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
465+555	Re-construction	22,929	3.77	Pipe culvert dia 1.2m	4.17
465+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
465+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
466+130	Re-construction	3,458	2.02	Pipe culvert dia 1.2m	4.17
466+215	Re-construction	19,897	3.50	Pipe culvert dia 1.2m	4.17
466+275	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
466+435	Re-construction	978	1.79	Pipe culvert dia 1.2m	4.17
466+555	Re-construction	397	1.74	Pipe culvert dia 1.2m	4.17
466+790	Re-construction	569	1.75	Pipe culvert dia 1.2m	4.17
466+915	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
467+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
467+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
467+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
467+750	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
468+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
468+220	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
468+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
468+700	Re-construction	447	1.74	Pipe culvert dia 1.2m	4.17
468+820	New	780	1.77	Pipe culvert dia 1.2m	4.17
468+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
469+005	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
469+110	New	407	1.74	Pipe culvert dia 1.2m	4.17
469+335	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
469+580	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
469+735	Re-construction	44,732	5.61	Box Culvert 2x2	15.88
469+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
470+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
470+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
470+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
470+780	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
470+980	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
471+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
471+350	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
471+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
471+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
471+780	Re-construction	217	1.72	Pipe culvert dia 1.2m	4.17
471+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
472+160	Re-construction	318	1.73	Pipe culvert dia 1.2m	4.17
472+285	Re-construction	2,146	1.89	Pipe culvert dia 1.2m	4.17
472+380	New	1,163	1.81	Pipe culvert dia 1.2m	4.17
472+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
472+985	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
473+180	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
473+385	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
473+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
473+900	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
474+180	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
474+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
474+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
474+840	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
475+115	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
475+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
475+595	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
475+760	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
475+965	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
476+140	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
476+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
476+400	New	3,648	2.03	Pipe culvert dia 1.2m	4.17
476+650	Re-construction	452	1.74	Pipe culvert dia 1.2m	4.17
476+780	Re-construction	6,908	2.32	Pipe culvert dia 1.2m	4.17
477+060	New	13,728	2.94	Pipe culvert dia 1.2m	4.17
477+140	Re-construction	2,905	1.97	Pipe culvert dia 1.2m	4.17
477+220	New	6,101	2.26	Pipe culvert dia 1.2m	4.17
477+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
477+520	New	3,228	1.99	Pipe culvert dia 1.2m	4.17
477+590	Re-construction	2,407	1.92	Pipe culvert dia 1.2m	4.17
477+780	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
477+960	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
478+060	New	637	1.76	Pipe culvert dia 1.2m	4.17
478+205	Re-construction	18,387	3.32	Pipe culvert dia 1.2m	4.17
478+340	Re-construction	9,466	2.57	Pipe culvert dia 1.2m	4.17
478+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
478+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+060	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+605	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+760	Re-construction	427	1.74	Pipe culvert dia 1.2m	4.17
479+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
479+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
480+050	New	212	1.72	Pipe culvert dia 1.2m	4.17
480+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
480+270	Re-construction	1,461	1.83	Pipe culvert dia 1.2m	4.17
480+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
480+550	New	3,832	2.05	Pipe culvert dia 1.2m	4.17
480+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
480+785	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
480+950	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
481+170	Re-construction	652	1.76	Pipe culvert dia 1.2m	4.17
481+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
481+330	New	830	1.78	Pipe culvert dia 1.2m	4.17
481+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
481+690	Re-construction	389	1.74	Pipe culvert dia 1.2m	4.17
481+960	New	609	1.76	Pipe culvert dia 1.2m	4.17
482+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
482+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
482+425	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
482+715	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
482+840	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+085	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+280	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
483+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
484+100	New	13,210	2.89	Pipe culvert dia 1.2m	4.17
484+250	Re-construction	134,424	13.38	Box culvert 2x2	15.88
484+370	Re-construction	10,577	2.65	Pipe culvert dia 1.2m	4.17
484+520	Re-construction	1,686	1.85	Pipe culvert dia 1.2m	4.17
484+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
484+740	Re-construction	2,251	1.90	Pipe culvert dia 1.2m	4.17
484+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
484+990	New	2,316	1.91	Pipe culvert dia 1.2m	4.17
485+210	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
485+320	New	4,984	2.15	Pipe culvert dia 1.2m	4.17
485+400	Re-construction	31,566	4.50	Box culvert 2x2	15.88
485+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
485+730	New	751	1.77	Pipe culvert dia 1.2m	4.17
485+815	Re-construction	1,272	1.82	Pipe culvert dia 1.2m	4.17
485+920	New	13,268	2.88	Pipe culvert dia 1.2m	4.17
486+015	New	12,395	2.82	Pipe culvert dia 1.2m	4.17
486+120	Re-construction	28,893	4.33	Box culvert 2x2	15.88
486+345	Re-construction	17,643	3.27	Pipe culvert dia 1.2m	4.17
486+435	Re-construction	710	1.76	Pipe culvert dia 1.2m	4.17
486+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
486+760	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
486+940	Re-construction	148,674	14.33	Box culvert 2x2	15.88
487+160	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
487+265	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
487+545	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
487+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
488+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
488+330	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
488+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
488+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
488+980	Re-construction	428	1.74	Pipe culvert dia 1.2m	4.17
489+110	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
489+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
489+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
489+650	New	3,490	2.02	Pipe culvert dia 1.2m	4.17
489+830	Re-construction	1,053	1.80	Pipe culvert dia 1.2m	4.17
489+900	New	15,904	3.12	Pipe culvert dia 1.2m	4.17
490+000	New	20,908	3.53	Pipe culvert dia 1.2m	4.17
490+110	Re-construction	26,444	4.02	Box culvert 2x2	15.88
490+160	New	4,424	2.11	Pipe culvert dia 1.2m	4.17
490+260	Re-construction	55,494	6.52	Box culvert 2x2	15.88
490+375	Re-construction	867	1.78	Pipe culvert dia 1.2m	4.17
490+440	New	1,175	1.81	Pipe culvert dia 1.2m	4.17
490+540	Re-construction	17,167	3.26	Pipe culvert dia 1.2m	4.17
490+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
490+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
491+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
491+280	Re-construction	320,429	28.39	Box culvert 3x3	36.19
491+440	Re-construction	395,465	34.34	Box culvert 3x3	36.19
491+650	Re-construction	230,896	20.10	Box culvert 3x3	36.19
491+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
491+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
492+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
492+315	Re-construction	304,607	26.62	Box culvert 3x3	36.19
492+370	Re-construction	513,839	48.93	Box Culvert 4X4	95.71
492+520	New	59,097	6.81	Box Culvert 2x2	15.88
492+635	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
492+760	New	13,196	2.84	Pipe culvert dia 1.2m	4.17
493+030	New	100,443	9.94	Box Culvert 2x2	15.88
493+175	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
493+305	Re-construction	146,484	13.68	Box Culvert 2x2	15.88
493+420	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
493+535	Re-construction	576	1.75	Pipe culvert dia 1.2m	4.17
493+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
493+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
494+190	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
494+290	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
494+440	Re-construction	3,109	1.98	Pipe culvert dia 1.2m	4.17
494+600	New	9,306	2.53	Pipe culvert dia 1.2m	4.17
494+740	Re-construction	578,042	52.51	Box Culvert 4X4	95.71
494+925	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
495+215	Re-construction	27,022	4.08	Box Culvert 2x2	15.88
495+520	New	710	1.76	Pipe culvert dia 1.2m	4.17
495+655	New	4,610	2.11	Pipe culvert dia 1.2m	4.17
495+845	New	237,195	20.75	Box culvert 3x3	36.19
496+010	Re-construction	492,881	44.04	Box Culvert 4X4	95.71
496+200	New	47,628	5.82	Box Culvert 2x2	15.88
496+420	Re-construction	18,405	3.36	Pipe culvert dia 1.2m	4.17
496+550	New	1,148	1.80	Pipe culvert dia 1.2m	4.17
496+620	New	10,153	2.61	Pipe culvert dia 1.2m	4.17
496+825	Re-construction	100,372	10.26	Box Culvert 2x2	15.88
496+900	Re-construction	26,150	4.07	Box Culvert 2x2	15.88
497+160	Re-construction	20,968	3.52	Pipe culvert dia 1.2m	4.17
497+210	New	381,311	33.15	Box Culvert3x3	36.19
497+275	Re-construction	2,070	1.87	Pipe culvert dia 1.2m	4.17
497+395	Re-construction	47,417	5.90	Box Culvert 2x2	15.88
497+505	Re-construction	13,847	2.92	Pipe culvert dia 1.2m	4.17
497+600	New	34,682	4.80	Box Culvert 2x2	15.88
497+780	Re-construction	878,655	74.23	Box Culvert 4X4	95.71
498+080	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
498+340	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
498+560	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
498+690	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
498+885	Re-construction	823	1.78	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
498+985	Re-construction	797	1.77	Pipe culvert dia 1.2m	4.17
499+120	New	8,917	2.50	Pipe culvert dia 1.2m	4.17
499+340	New	2,185	1.90	Pipe culvert dia 1.2m	4.17
499+470	Re-construction	634	1.76	Pipe culvert dia 1.2m	4.17
499+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
500+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
500+200	Re-construction	948	1.79	Pipe culvert dia 1.2m	4.17
500+260	Re-construction	209,268	19.73	Box Culvert 3x3	36.19
500+340	New	27,755	4.12	Box Culvert 2x2	15.88
500+460	Re-construction	30,651	4.23	Box Culvert 2x2	15.88
500+540	Re-construction	101,019	10.05	Box Culvert 2x2	15.88
500+620	New	251,661	22.58	Box Culvert 3x3	36.19
500+670	Re-construction	747	1.77	Pipe culvert dia 1.2m	4.17
500+940	New	271,365	23.87	Box Culvert 3x3	36.19
501+050	New	4,969	2.15	Pipe culvert dia 1.2m	4.17
501+300	Re-construction	148,928	14.36	Box Culvert 2x2	15.88
501+375	Re-construction	133,252	13.12	Box Culvert 2x2	15.88
501+510	Re-construction	128,782	12.64	Box Culvert 2x2	15.88
501+580	New	39,231	5.04	Box Culvert 2x2	15.88
501+835	Re-construction	19,306	3.36	Pipe culvert dia 1.2m	4.17
501+870	New	77,668	8.46	Box Culvert 2x2	15.88
502+000	Re-construction	19,238	3.38	Pipe culvert dia 1.2m	4.17
502+150	New	43,900	5.55	Box Culvert 2x2	15.88
502+230	Re-construction	40,530	5.23	Box Culvert 2x2	15.88
502+380	New	120,742	12.18	Box Culvert 2x2	15.88
502+475	Re-construction	15,292	3.08	Pipe culvert dia 1.2m	4.17
502+550	New	28,376	4.29	Box Culvert 2x2	15.88
502+680	New	12,477	2.84	Pipe culvert dia 1.2m	4.17
502+815	Re-construction	8,037	2.44	Pipe culvert dia 1.2m	4.17
503+040	New	30,636	4.51	Box culvert 2x2	15.88
503+105	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
503+800	New	13,049	2.86	Pipe culvert dia 1.2m	4.17
503+870	Re-construction	51,360	6.24	Box culvert 3x3	36.19
504+040	Re-construction	158,175	14.76	Box culvert 2x2	15.88
504+300	New	29,864	4.33	Box culvert 2x2	15.88
504+470	New	12,591	2.80	Pipe culvert dia 1.2m	4.17
504+630	Re-construction	58,351	6.75	Box culvert 2x2	15.88
504+720	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
504+880	New	101,516	10.27	Box culvert 2x2	15.88
504+950	New	11,061	2.68	Pipe culvert dia 1.2m	4.17
505+230	Re-construction	7,839	2.40	Pipe culvert dia 1.2m	4.17
505*320	Re-construction	5,969	2.24	Pipe culvert dia 1.2m	4.17
505+430	Re-construction	7,350	2.35	Pipe culvert dia 1.2m	4.17
505+490	Re-construction	6,201	2.26	Pipe culvert dia 1.2m	4.17
505+610	New	20,660	3.54	Pipe culvert dia 1.2m	4.17
505+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
505+745	Re-construction	19,321	3.39	Pipe culvert dia 1.2m	4.17
505+830	Re-construction	49,190	5.96	Box culvert 2x2	15.88
505+880	Re-construction	3,573	2.03	Pipe culvert dia 1.2m	4.17
505+910	Re-construction	75,347	8.26	Box culvert 2x2	15.88
506+040	New	6,072	2.25	Pipe culvert dia 1.2m	4.17
506+110	Re-construction	888,017	71.26	Box culvert 4x6	166.95
506+145	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
506+310	New	20,537	3.50	Pipe culvert dia 1.2m	4.17
506+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
506+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
506+630	New	9,460	2.55	Pipe culvert dia 1.2m	4.17
506+680	New	49,521	6.04	Box culvert 2x2	15.88
506+800	Re-construction	51,066	6.20	Box culvert 2x2	15.88
506+900	New	8,802	2.47	Pipe culvert dia 1.2m	4.17
506+980	Re-construction	35,343	4.79	Box culvert 2x2	15.88
507+065	Re-construction	1,535	1.83	Pipe culvert dia 1.2m	4.17
507+365	Re-construction	783	1.77	Pipe culvert dia 1.2m	4.17
507+540	Re-construction	5,350	2.18	Pipe culvert dia 1.2m	4.17
507+635	Re-construction	52,231	6.35	Box culvert 2x2	15.88
507+735	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
507+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
508+020	Re-construction	2,037	1.89	Pipe culvert dia 1.2m	4.17
508+080	Re-construction	966,820	78.82	Box culvert 4x6	166.95

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
508+375	Re-construction	36,693	4.94	Box culvert 2x2	15.88
508+630	Re-construction	23,854	3.68	Pipe culvert dia 1.2m	4.17
508+670	Re-construction	12,953	2.85	Pipe culvert dia 1.2m	4.17
508+755	Re-construction	8,510	2.46	Pipe culvert dia 1.2m	4.17
508+840	New	3,348	2.00	Pipe culvert dia 1.2m	4.17
508+920	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
509+020	Re-construction	7,355	2.36	Pipe culvert dia 1.2m	4.17
509+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
509+425	Re-construction	526,073	49.43	Box culvert 4x4	95.71
509+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
509+805	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
509+915	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
510+060	Re-construction	68,179	7.62	Box culvert 2x2	15.88
510+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
510+310	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
510+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
510+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
510+790	New	4,075	2.07	Pipe culvert dia 1.2m	4.17
510+980	New	913	1.78	Pipe culvert dia 1.2m	4.17
511+120	Re-construction	16,566	3.17	Pipe culvert dia 1.2m	4.17
511+190	Re-construction	514,133	44.80	Box culvert 4x4	95.71
511+460	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
511+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
511+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
511+990	Re-construction	8,232	2.46	Pipe culvert dia 1.2m	4.17
512+255	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
512+360	New	13,632	2.92	Pipe culvert dia 1.2m	4.17
512+480	Re-construction	15,491	3.12	Pipe culvert dia 1.2m	4.17
512+615	Re-construction	31,084	4.48	Box culvert 2x2	15.88
512+770	New	5,400	2.19	Pipe culvert dia 1.2m	4.17
512+850	Re-construction	24,089	4.48	Box Culvert 2x2	15.88
513+050	Re-construction	3,877	4.46	Box Culvert 2x2	15.88
513+260	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
513+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
513+590	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
513+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
513+970	Re-construction	55,446	6.54	Box culvert 2x2	15.88
514+100	New	33,508	4.70	Box culvert 2x2	15.88
514+205	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
514+505	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
514+640	Re-construction	3,348	2.00	Pipe culvert dia 1.2m	4.17
514+720	New	15,721	3.13	Pipe culvert dia 1.2m	4.17
514+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
515+130	New	31,630	4.47	Box culvert 2x2	15.88
515+395	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
515+540	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
515+810	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
516+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
516+215	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
516+355	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
516+540	Re-construction	7,424	2.38	Pipe culvert dia 1.2m	4.17
516+665	Re-construction	N/A	2.32	Pipe culvert dia 1.2m	4.17
516+915	Re-construction	17,349	3.24	Pipe culvert dia 1.2m	4.17
517+000	New	5,225	2.17	Pipe culvert dia 1.2m	4.17
518+095	Re-construction	10,976	2.69	Pipe culvert dia 1.2m	4.17
518+180	Re-construction	562	1.75	Pipe culvert dia 1.2m	4.17
518+325	Re-construction	1,437	1.83	Pipe culvert dia 1.2m	4.17
518+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
518+700	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
518+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
518+230	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
518+395	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
518+590	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
519+790	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
519+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
519+140	New	10,294	2.64	Pipe culvert dia 1.2m	4.17
519+310	Re-construction	9,039	2.52	Pipe culvert dia 1.2m	4.17
519+450	Re-construction	4,762	2.13	Pipe culvert dia 1.2m	4.17
519+685	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
519+880	Re-construction	942	1.79	Pipe culvert dia 1.2m	4.17
520+045	Re-construction	1,739	1.86	Pipe culvert dia 1.2m	4.17
520+245	Re-construction	2,080	1.89	Pipe culvert dia 1.2m	4.17
520+485	Re-construction	1,280	1.81	Pipe culvert dia 1.2m	4.17
520+685	Re-construction	4,370	2.10	Pipe culvert dia 1.2m	4.17
520+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
520+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
521+080	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
521+300	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
521+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
521+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
521+860	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
522+085	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
522+370	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
522+600	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
522+800	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
522+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
523+090	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
523+235	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
523+430	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
523+570	New	4,457	2.11	Pipe culvert dia 1.2m	4.17
523+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
524+170	Re-construction	1,065	1.80	Pipe culvert dia 1.2m	4.17
524+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
524+375	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
524+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
524+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
524+745	Re-construction	1,703	1.86	Pipe culvert dia 1.2m	4.17
524+930	New	4,880	2.14	Pipe culvert dia 1.2m	4.17
525+035	Re-construction	31,403	4.54	Box Culvert 2x2	15.88
525+140	Re-construction	4,480	2.11	Pipe culvert dia 1.2m	4.17
525+240	New	4,960	2.15	Pipe culvert dia 1.2m	4.17
525+385	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
525+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
525+800	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
525+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
526+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
526+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
526+515	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
526+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
526+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
527+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
527+240	Re-construction	38,127	5.03	Box Culvert 2x2	15.88
527+485	Re-construction	15,559	3.12	Pipe culvert dia 1.2m	4.17
527+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
527+890	Re-construction	4,563	2.11	Pipe culvert dia 1.2m	4.17
528+010	Re-construction	8,612	2.48	Pipe culvert dia 1.2m	4.17
528+160	New	2,808	1.96	Pipe culvert dia 1.2m	4.17
528+330	Re-construction	13,081	2.88	Pipe culvert dia 1.2m	4.17
528+395	Re-construction	11,475	2.74	Pipe culvert dia 1.2m	4.17
528+525	Re-construction	14,338	2.99	Pipe culvert dia 1.2m	4.17
528+570	New	7,361	2.37	Pipe culvert dia 1.2m	4.17
528+780	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
528+930	Re-construction	29,760	4.34	Box Culvert 2x2	15.88
529+035	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
529+240	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
529+425	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
529+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
529+800	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
529+975	Re-construction	12,192	2.82	Pipe culvert dia 1.2m	4.17
530+100	Re-construction	18,871	3.38	Pipe culvert dia 1.2m	4.17
530+185	Re-construction	60,584	6.98	Box Culvert 2x2	15.88
530+240	New	12,933	2.88	Pipe culvert dia 1.2m	4.17
530+420	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
530+510	New	30,557	4.39	Box Culvert 2x2	15.88
530+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
530+760	New	54,394	6.52	Box Culvert 2x2	15.88
530+870	New	40,714	5.34	Box Culvert 2x2	15.88
531+000	New	11,902	2.77	Pipe culvert dia 1.2m	4.17
531+140	New	29,576	4.35	Box Culvert 2x2	15.88
531+350	Re-construction	28,904	4.28	Box Culvert 2x2	15.88
531+620	Re-construction	31,310	4.50	Box Culvert 2x2	15.88
531+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
531+890	Re-construction	2,652	1.94	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
532+000	New	460	1.74	Pipe culvert dia 1.2m	4.17
532+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
532+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
532+620	New	5,778	2.22	Pipe culvert dia 1.2m	4.17
532+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
532+925	Re-construction	29,920	4.37	Box Culvert 2x2	15.88
533+070	Re-construction	18,165	3.32	Pipe culvert dia 1.2m	4.17
533+255	New	32,045	4.59	Box Culvert 2x2	15.88
533+380	New	10,036	2.61	Pipe culvert dia 1.2m	4.17
533+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
533+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
533+945	Re-construction	11,988	2.78	Pipe culvert dia 1.2m	4.17
534+080	New	751	1.77	Pipe culvert dia 1.2m	4.17
534+230	Re-construction	2,962	1.97	Pipe culvert dia 1.2m	4.17
534+350	New	7,149	2.35	Pipe culvert dia 1.2m	4.17
534+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
534+685	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
535+005	New	2,907	1.97	Pipe culvert dia 1.2m	4.17
535+080	New	2,775	1.95	Pipe culvert dia 1.2m	4.17
535+320	Re-construction	1,564	1.84	Pipe culvert dia 1.2m	4.17
535+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
535+760	Re-construction	9,424	2.55	Pipe culvert dia 1.2m	4.17
535+900	Re-construction	20,145	3.51	Pipe culvert dia 1.2m	4.17
536+010	Re-construction	19,921	3.48	Pipe culvert dia 1.2m	4.17
536+170	New	2,978	1.97	Pipe culvert dia 1.2m	4.17
536+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
536+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
536+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
536+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
537+025	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
537+200	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
537+480	Re-construction	10,593	2.67	Pipe culvert dia 1.2m	4.17
537+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
537+710	Re-construction	2,454	1.92	Pipe culvert dia 1.2m	4.17
537+805	Re-construction	6,037	2.25	Pipe culvert dia 1.2m	4.17
537+900	New	11,753	2.76	Pipe culvert dia 1.2m	4.17
537+965	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
538+050	New	7,799	2.40	Pipe culvert dia 1.2m	4.17
538+230	Re-construction	7,851	2.41	Pipe culvert dia 1.2m	4.17
538+370	Re-construction	1,946	1.88	Pipe culvert dia 1.2m	4.17
538+570	Re-construction	745	1.77	Pipe culvert dia 1.2m	4.17
538+630	New	7,919	2.41	Pipe culvert dia 1.2m	4.17
538+730	Re-construction	7,798	2.40	Pipe culvert dia 1.2m	4.17
538+850	Re-construction	2,188	1.90	Pipe culvert dia 1.2m	4.17
539+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
539+165	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
539+470	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
539+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
539+940	Re-construction	603	1.75	Pipe culvert dia 1.2m	4.17
540+120	New	4,243	2.09	Pipe culvert dia 1.2m	4.17
540+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
540+455	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
540+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
540+700	New	2,071	1.89	Pipe culvert dia 1.2m	4.17
540+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
541+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
541+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
541+555	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
541+610	New	14,131	2.97	Pipe culvert dia 1.2m	4.17
541+710	New	1,848	1.87	Pipe culvert dia 1.2m	4.17
541+830	Re-construction	7,268	2.36	Pipe culvert dia 1.2m	4.17
542+000	Re-construction	7,465	2.37	Pipe culvert dia 1.2m	4.17
542+080	Re-construction	5,343	2.19	Pipe culvert dia 1.2m	4.17
542+230	Re-construction	20,954	3.57	Pipe culvert dia 1.2m	4.17
542+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
542+530	New	6,378	2.29	Pipe culvert dia 1.2m	4.17
542+590	Re-construction	17,927	3.30	Pipe culvert dia 1.2m	4.17
542+670	Re-construction	42,221	5.46	Box Culvert 2x2	15.88
542+740	New	24,744	3.90	Pipe culvert dia 1.2m	4.17
542+870	New	48,106	6.02	Box Culvert 2x2	15.88
542+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
543+215	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
543+350	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
543+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH54 S3)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
543+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
543+685	Re-construction	100,310	10.93	Box Culvert 2x2	15.88
543+770	Re-construction	80,466	8.66	Box Culvert 2x2	15.88
543+870	New	3,705	2.03	Pipe culvert dia 1.2m	4.17
543+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
544+205	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
544+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
544+505	Re-construction	12,444	2.85	Pipe culvert dia 1.2m	4.17
544+580	Re-construction	12,698	2.84	Pipe culvert dia 1.2m	4.17
544+825	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
544+965	Re-construction	224,928	22.14	Box Culvert3x3	36.19
545+100	Re-construction	28,127	4.20	Box Culvert 2x2	15.88
545+250	Re-construction	6,644	2.31	Pipe culvert dia 1.2m	4.17
545+430	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
545+655	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
545+725	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
545+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
546+195	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
546+430	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
546+550	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
546+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
547+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
547+260	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
547+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
547+840	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
548+050	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
548+295	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
548+405	Re-construction	5,069	2.17	Pipe culvert dia 1.2m	4.17
548+485	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
548+565	New	4,588	2.12	Pipe culvert dia 1.2m	4.17
548+645	Re-construction	13,693	2.92	Pipe culvert dia 1.2m	4.17
548+700	New	28,500	4.31	Box Culvert 2x2	15.88
548+765	Re-construction	15,518	3.10	Pipe culvert dia 1.2m	4.17
548+900	Re-construction	17,613	3.26	Pipe culvert dia 1.2m	4.17
549+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
549+345	Re-construction	17,365	3.28	Pipe culvert dia 1.2m	4.17
549+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
549+630	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
549+805	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
549+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
550+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
550+350	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
550+410	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
550+570	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
550+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
551+040	Re-construction	23,619	3.86	Pipe culvert dia 1.2m	4.17
551+210	New	1,022	1.79	Pipe culvert dia 1.2m	4.17
551+515	Re-construction	1,131	1.80	Pipe culvert dia 1.2m	4.17
551+610	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
551+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
552+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
552+230	Re-construction	1,842	1.87	Pipe culvert dia 1.2m	4.17
552+300	New	8,398	2.47	Pipe culvert dia 1.2m	4.17
552+370	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
552+510	Re-construction	11,348	2.72	Pipe culvert dia 1.2m	4.17
552+620	Re-construction	6,136	2.25	Pipe culvert dia 1.2m	4.17
552+675	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
552+870	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
553+090	Re-construction	235	1.72	Pipe culvert dia 1.2m	4.17
553+160	Re-construction	324	1.73	Pipe culvert dia 1.2m	4.17
553+280	Re-construction	68	1.71	Pipe culvert dia 1.2m	4.17
553+350	Re-construction	214	1.72	Pipe culvert dia 1.2m	4.17
553+660	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
553+920	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
554+170	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH51)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
85+190	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+390	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+590	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+795	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
85+990	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+200	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
86+570	Re-construction	898,275	76.34	Box culvert 4x4	95.71
86+725	New	2,637	1.92	Pipe culvert dia 1.2m	4.17
86+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+000	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+205	Re-construction	932	1.78	Pipe culvert dia 1.2m	4.17
87+300	New	23,678	3.67	Pipe culvert dia 1.2m	4.17
87+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
87+850	Re-construction	16,697	3.09	Pipe culvert dia 1.2m	4.17
87+885	Re-construction	80,401	8.38	Box culvert 2x2	15.88
87+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+200	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+530	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+640	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
88+850	New	102,637	10.23	Box culvert 2x2	15.88
89+100	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+305	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+505	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+695	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
89+915	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+185	Re-construction	1,289	1.82	Pipe culvert dia 1.2m	4.17
90+395	Re-construction	569,853	54.31	Box Culvert 4x4	95.71
90+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
90+930	Re-construction	1,753	1.86	Pipe culvert dia 1.2m	4.17
91+020	New	38,628	4.37	Box Culvert 2x2	15.88
91+120	New	79,986	9.08	Box Culvert 2x2	15.88
91+620	New	1,176	1.81	Pipe culvert dia 1.2m	4.17
91+720	New	4,415	2.11	Pipe culvert dia 1.2m	4.17
91+970	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+100	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+220	Re-construction	680	1.76	Pipe culvert dia 1.2m	4.17
92+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+600	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+790	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
92+935	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+080	Re-construction	76,662	8.77	Box culvert 2x2	15.88
93+150	Re-construction	244	1.72	Pipe culvert dia 1.2m	4.17
93+325	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+490	Re-construction	145,099	15.08	Box Culvert3x3	36.19
93+620	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
93+910	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
94+060	New	5,372	2.20	Propose Pipe Culvert 1.2m	4.17
101+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+475	New	366	1.73	Pipe culvert dia 1.2m	4.17
101+630	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
101+760	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+250	Re-construction	9,226	2.55	Pipe culvert dia 1.2m	4.17
102+325	Re-construction	6,632	2.31	Pipe culvert dia 1.2m	4.17
102+515	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+695	New	7,249	2.37	Pipe culvert dia 1.2m	4.17
102+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
102+855	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+045	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+590	Re-construction	14,069	3.00	Pipe culvert dia 1.2m	4.17
103+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+800	Re-construction	6,698	2.32	Pipe culvert dia 1.2m	4.17
103+890	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+930	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
103+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
104+210	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
104+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH51)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
104+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
104+820	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+070	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+320	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+590	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
105+960	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+220	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+420	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+560	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
106+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+150	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+710	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
107+995	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
108+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
108+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
108+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
108+975	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+225	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+425	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+625	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+765	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
109+965	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+140	New	1,001	1.79	Pipe culvert dia 1.2m	4.17
110+440	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+740	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+370	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+670	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
110+970	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
111+270	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+520	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+645	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
112+985	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+205	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+320	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+490	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+685	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
113+940	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+000	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+130	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+240	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+300	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+635	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
114+935	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+145	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+400	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+540	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+680	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
115+840	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+140	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+330	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+670	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+860	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
116+955	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH51)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
117+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+190	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+365	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+550	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+575	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+630	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+800	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
117+895	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+135	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+325	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+505	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
118+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+130	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+330	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+570	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+830	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
119+865	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+040	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+250	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+510	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+750	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+850	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
120+985	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
121+185	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
121+285	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
121+510	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
121+710	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
121+910	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+265	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+540	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+605	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
122+990	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+155	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+380	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+480	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+500	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+885	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
123+975	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+070	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+165	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+250	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+310	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+420	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+665	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+720	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
124+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+030	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+110	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+180	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+315	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+390	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+475	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+540	Re-construction	247	1.72	Pipe culvert dia 1.2m	4.17
125+645	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+785	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
125+970	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Cross-Drainage List (NH51)

Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
126+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
126+455	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
126+580	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
126+650	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
126+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
126+880	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+040	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+660	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
127+770	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+060	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+270	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+440	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+525	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
128+945	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+120	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+420	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
129+720	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+020	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+230	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+385	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+635	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
130+835	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+035	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+235	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+435	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+690	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
131+805	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+030	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+230	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+430	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+630	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
132+830	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+030	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+230	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+420	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+665	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
133+815	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+015	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+215	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+415	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+740	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
134+940	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+140	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+555	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+730	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
135+980	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+170	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+215	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+440	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+615	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
136+820	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+140	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+340	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
137+540	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+010	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+150	Re-construction	970.671	91.32	Box culvert 4x4	95.71
138+290	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+470	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+730	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+900	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
138+950	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+050	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+225	New	52.495	6.55	Box culvert 2x2	15.88
139+450	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+700	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
139+910	Re-construction	402.207	38.84	Box culvert 4x4	95.71
140+210	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+410	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
140+910	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
141+310	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

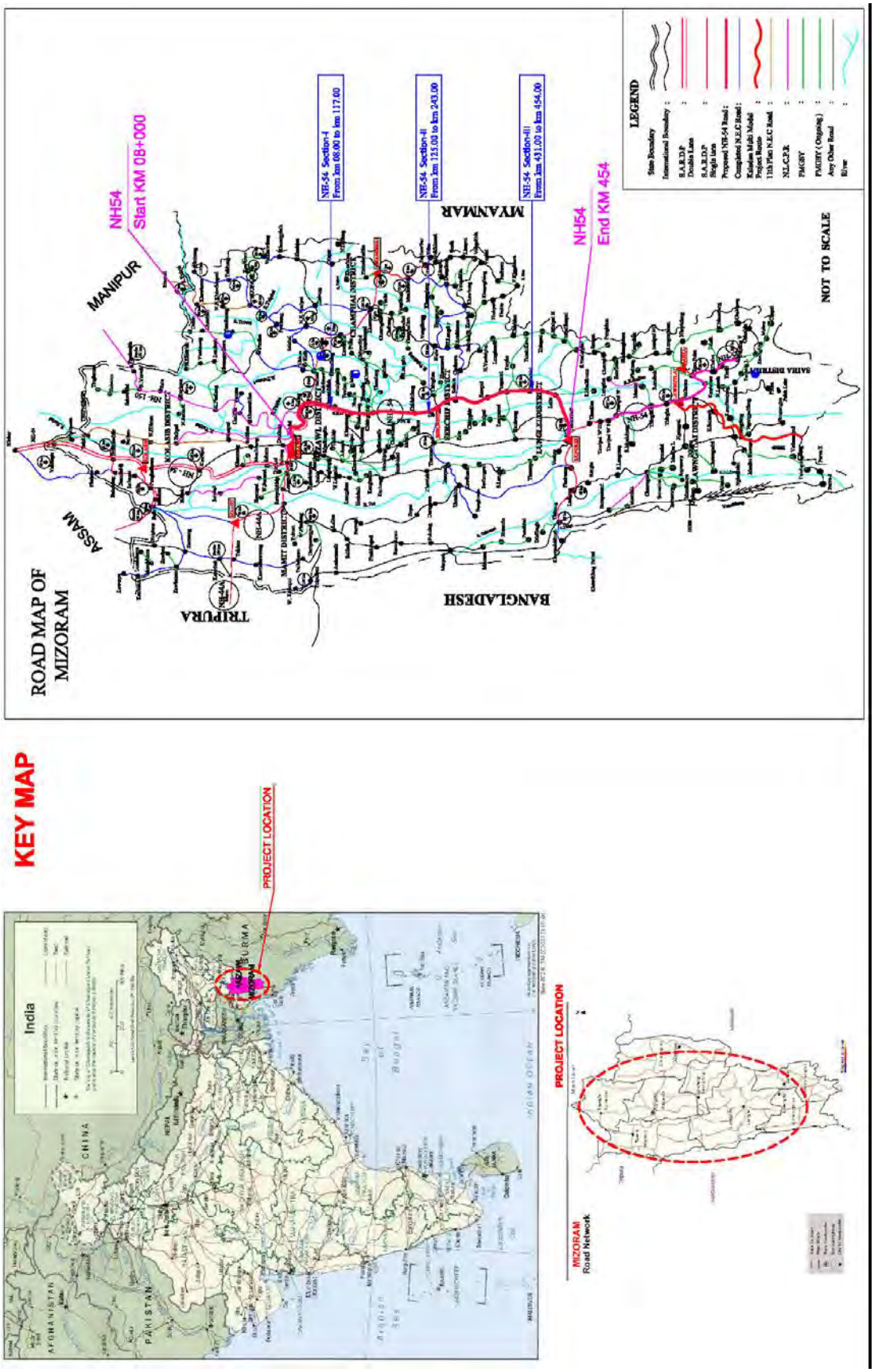
Source: JICA Study Team

Cross-Drainage List (NH51)

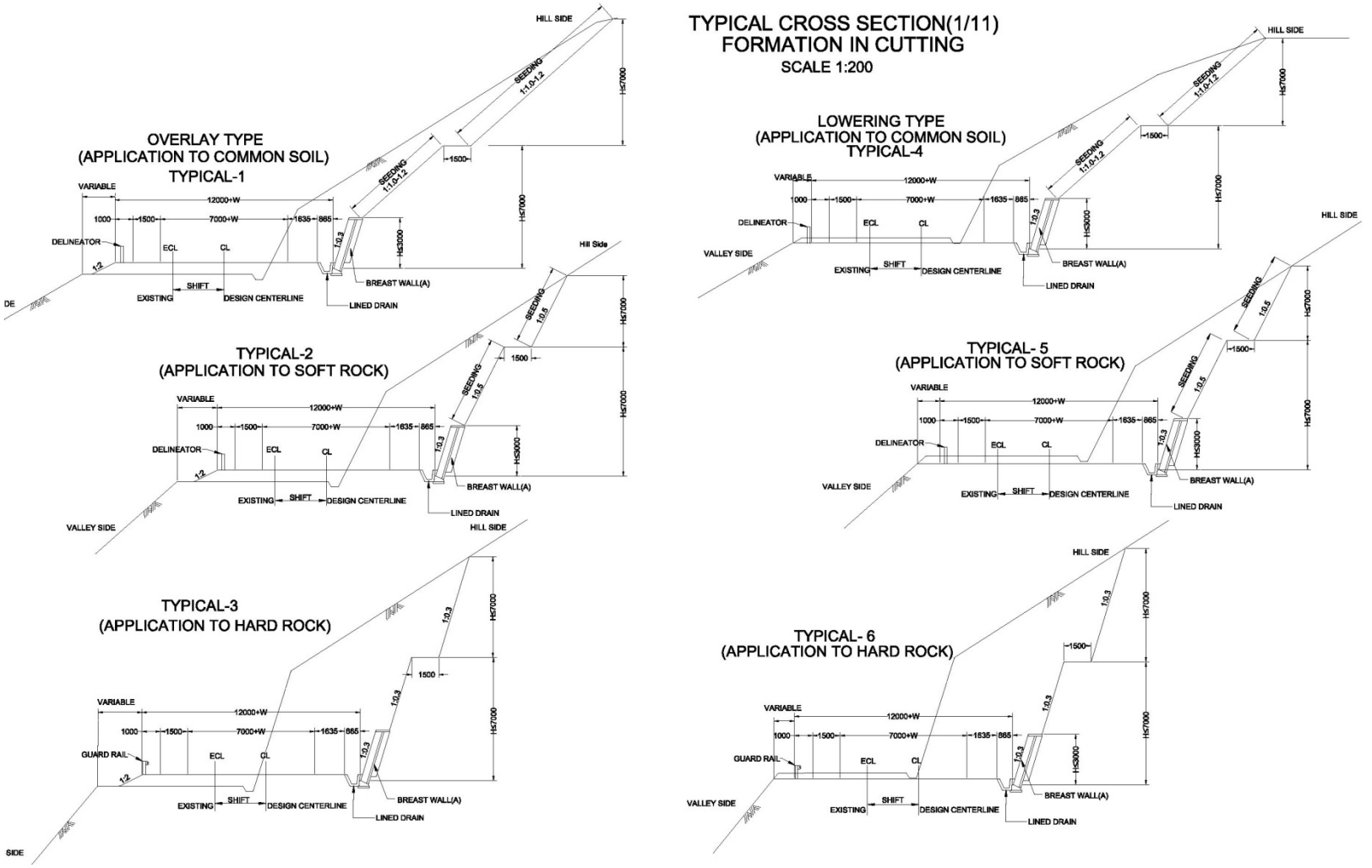
Cheinage (Project Alignment)	Re-construction / New construction	Additonal Catchment Area (m2)	Discharge Qd (m3/s)	Propose Structure	Drain Capacity (m3/s)
141+560	New	700,998	66.42	Box culvert 4x4	95.71
141+660	New	10,899	2.70	Pipe culvert dia 1.2m	4.17
141+977	New	983	1.79	Pipe culvert dia 1.2m	4.17
142+140	Re-construction	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+277	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+432	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+677	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
142+877	New	N/A	0.96	Pipe culvert dia 1.2m	4.17
143+177	New	N/A	0.96	Pipe culvert dia 1.2m	4.17

Source: JICA Study Team

Appendix - 5: Summary of Preliminary Design Drawings

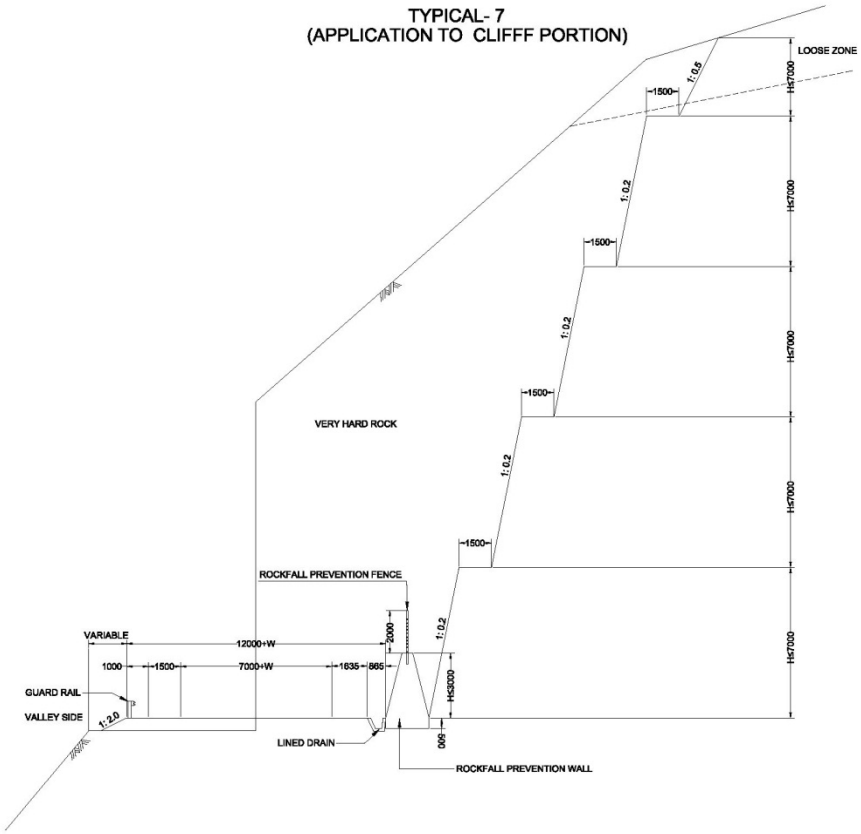


Source: JICA Study Team

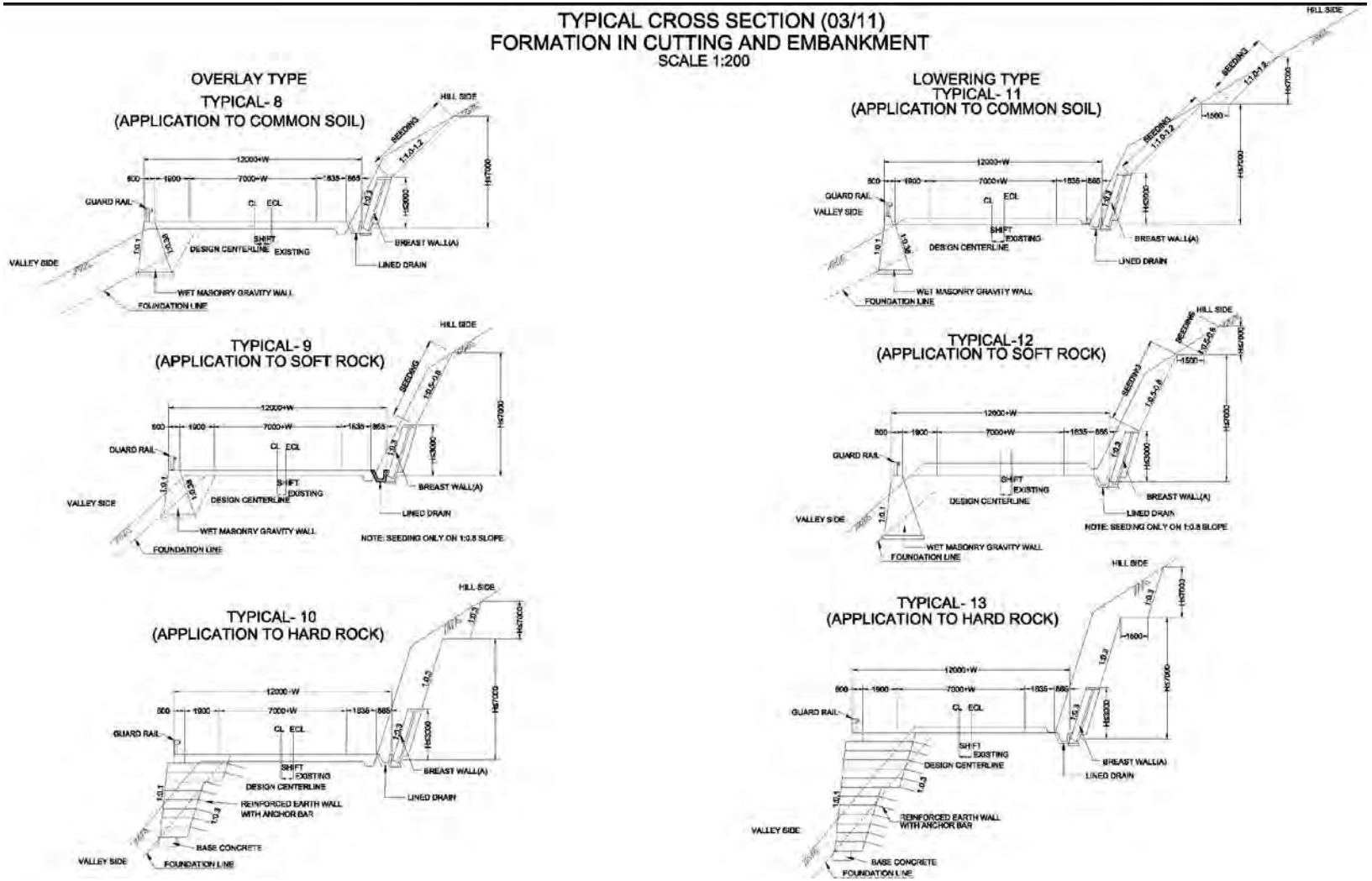


Source: JICA Study Team

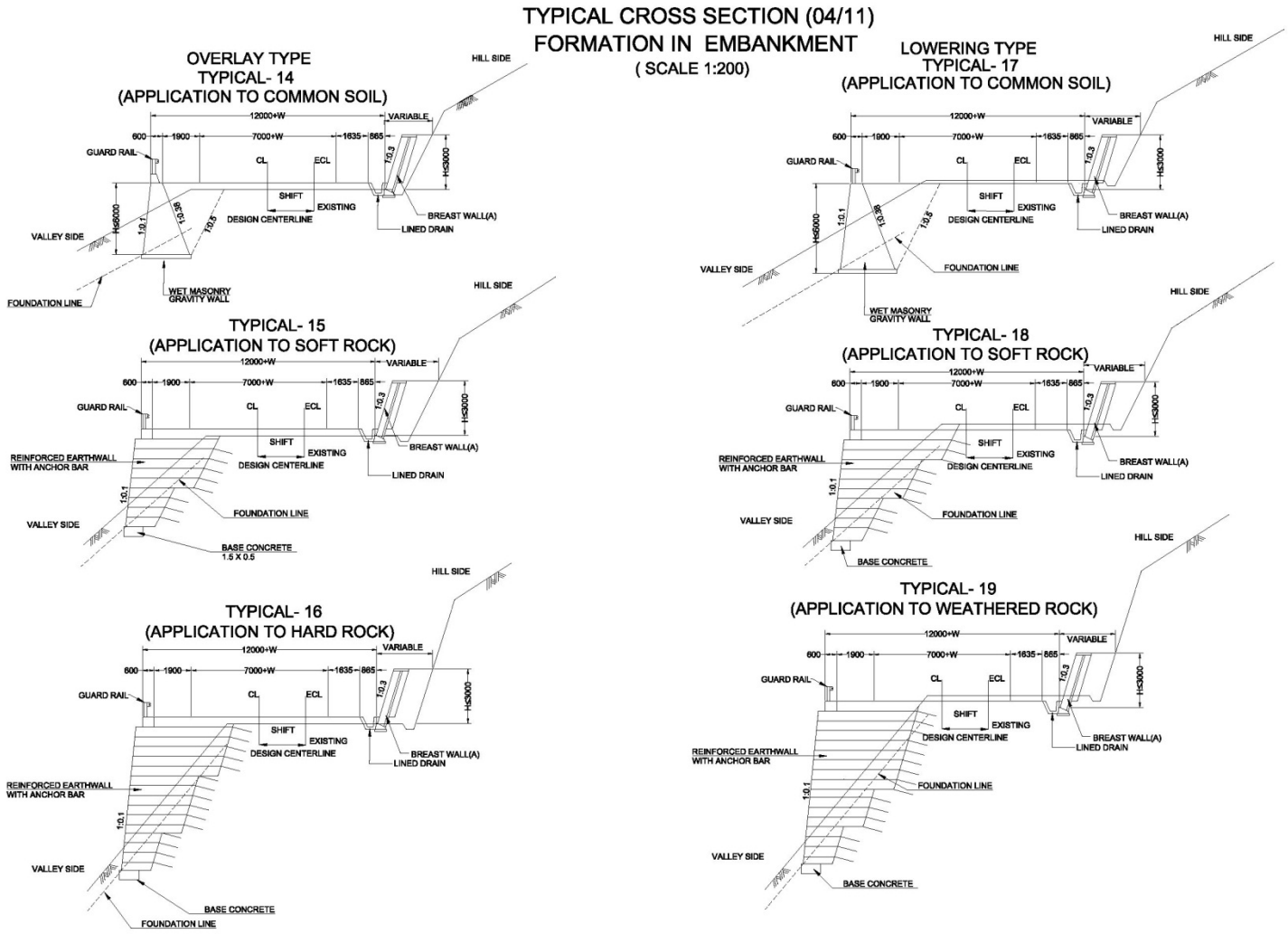
TYPICAL CROSS SECTION (02/11)
FORMATION IN CUTTING
SCALE 1:200



Source: JICA Study Team

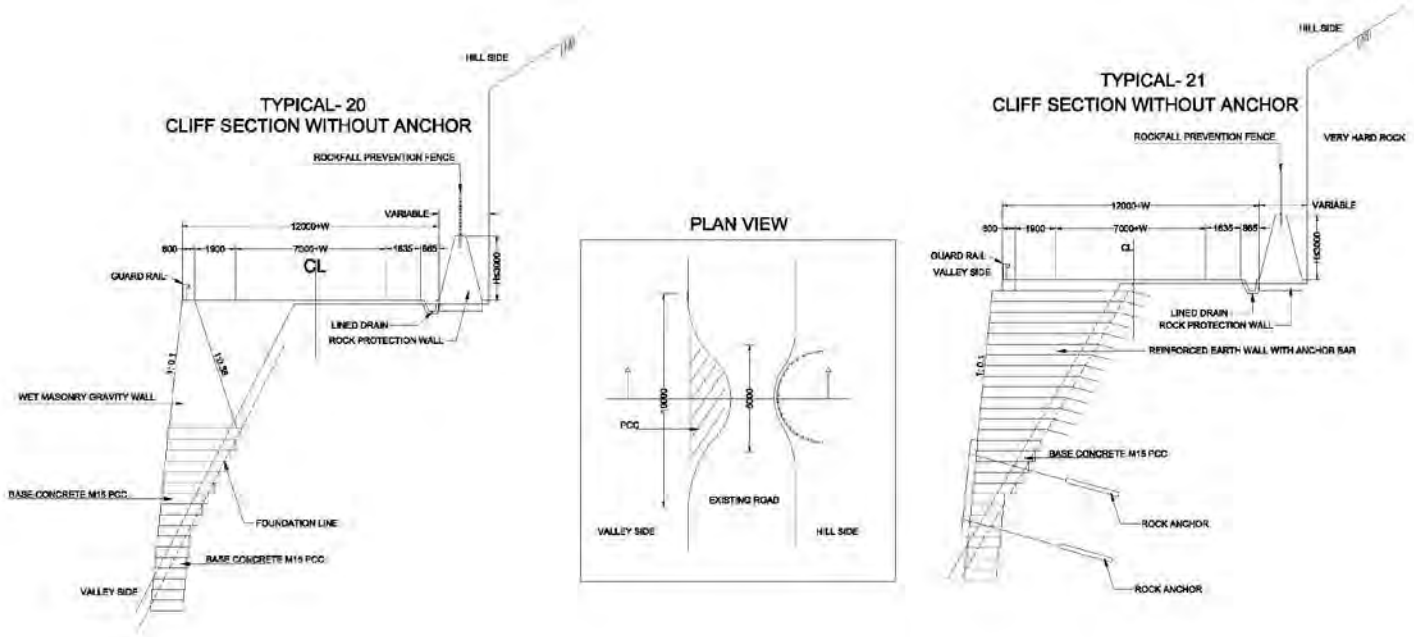


Source: JICA Study Team



Source: JICA Study Team

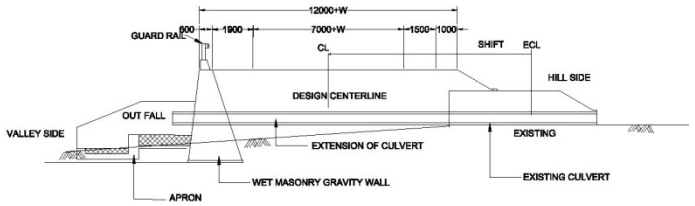
TYPICAL CROSS SECTION (05/11)
FORMATION IN EMBANKMENT AT CLIFF SECTION
SCALE 1:200



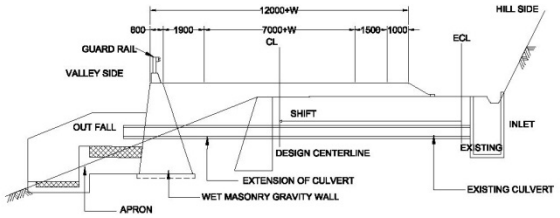
Source: JICA Study Team

TYPICAL CROSS SECTION (06/11)
FORMATION IN EMBANKMENT AT HAIRPIN BEND WITH CULVERT
(SCALE 1:200)

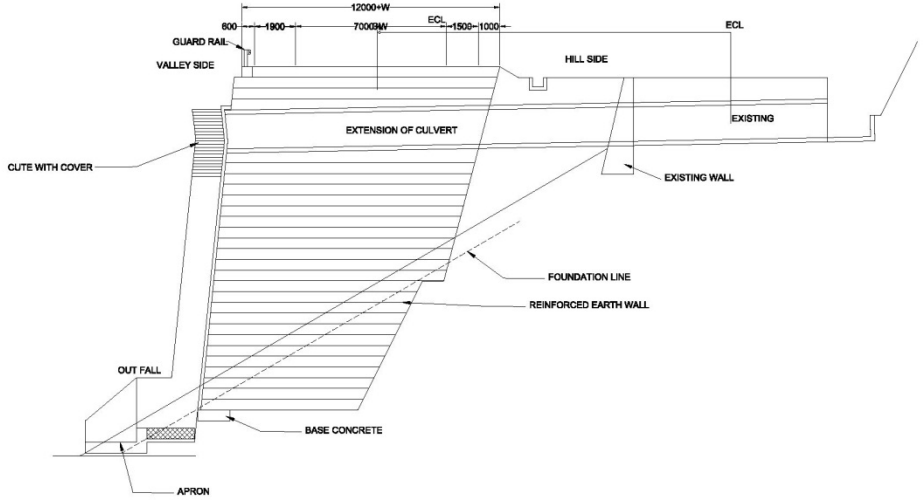
TYPICAL- 22



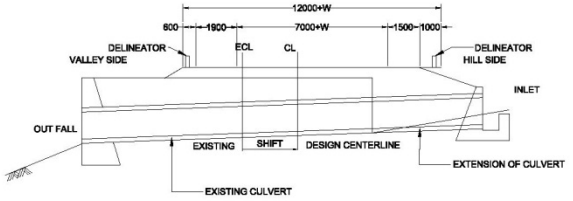
TYPICAL-24



TYPICAL- 23

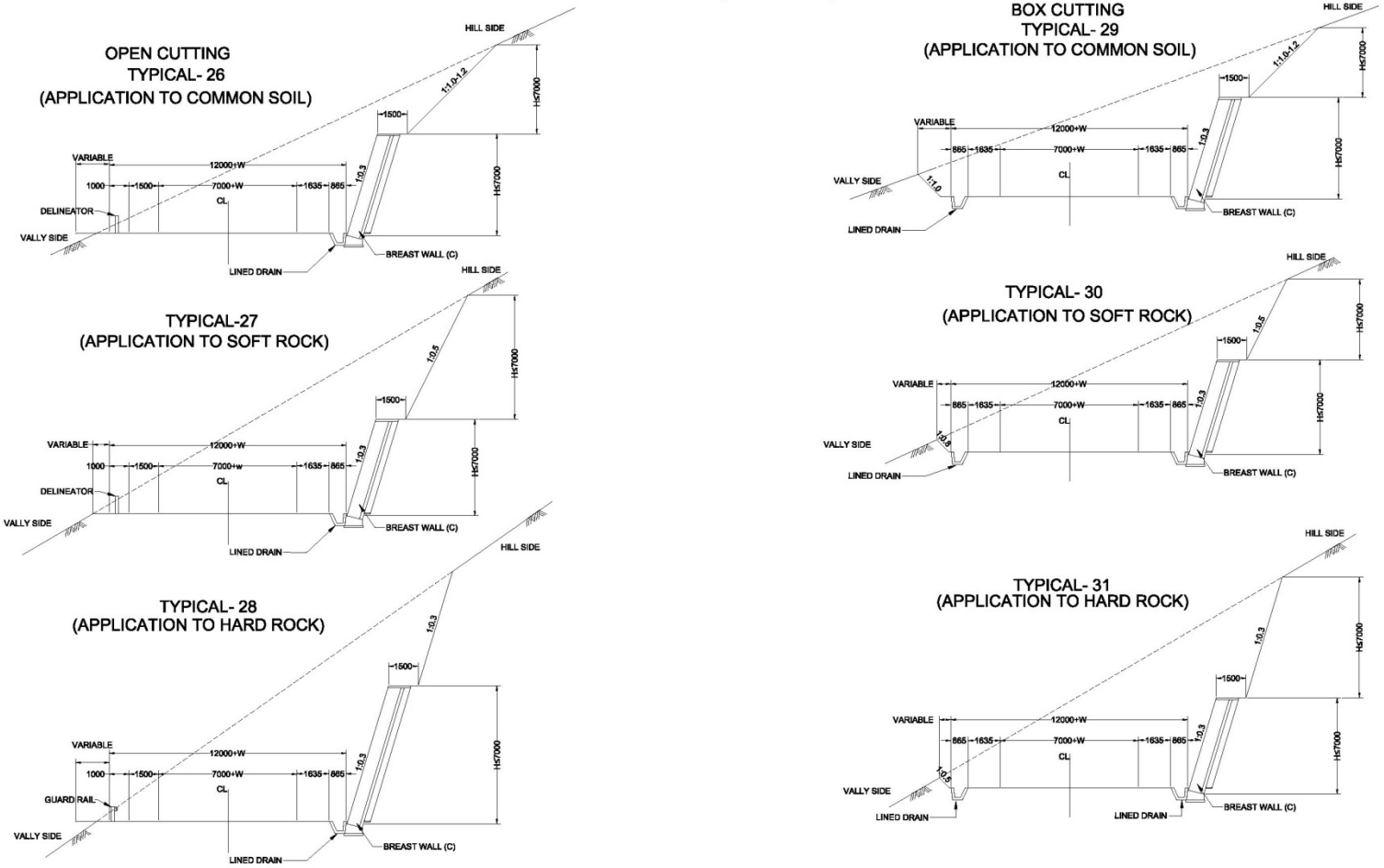


TYPICAL-25



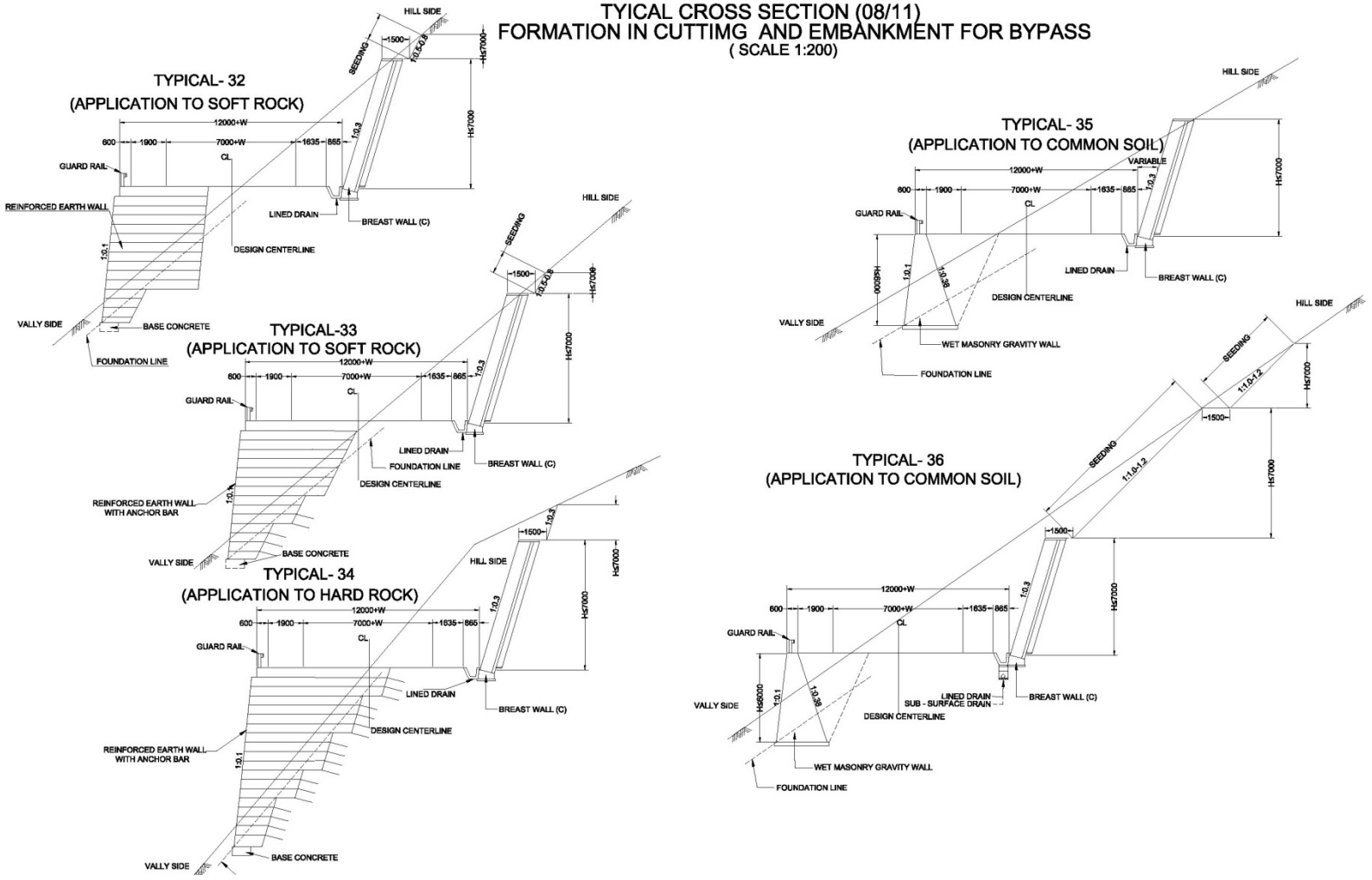
Source: JICA Study Team

TYPICAL CROSS SECTION (07/11)
FORMATION IN CUTTING AT SHORT-CUT
(SCALE 1:200)



Source: JICA Study Team

TYICAL CROSS SECTION (08/11)
FORMATION IN CUTTIMG AND EMBANKMENT FOR BYPASS
(SCALE 1:200)

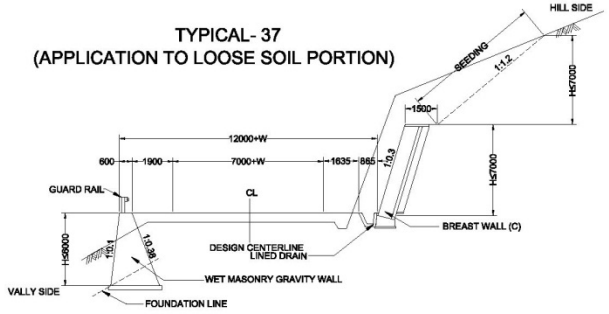


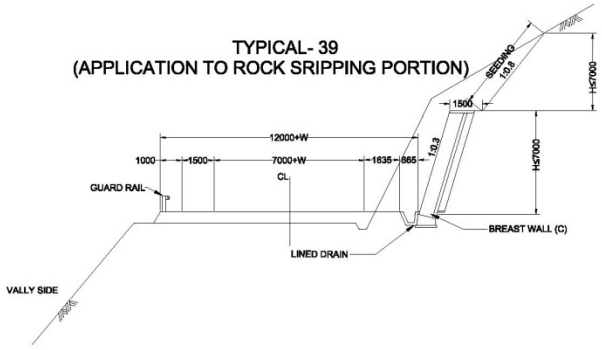
Source: JICA Study Team

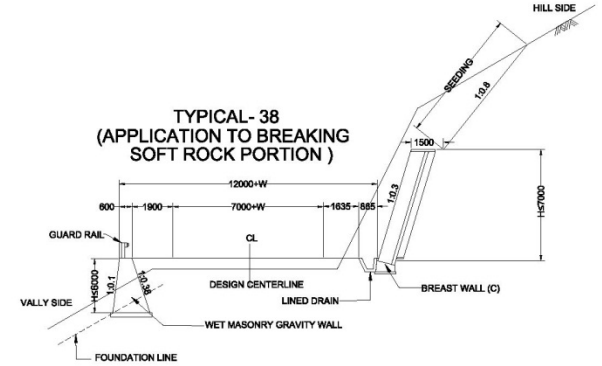
TYPICAL CROSS SECTION (09/11)

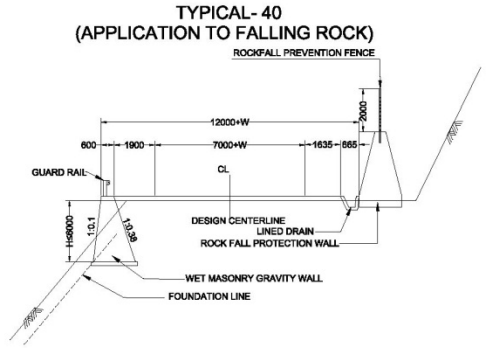
FORMATION IN UNSTABLE SLOPE

(SCALE 1:200)





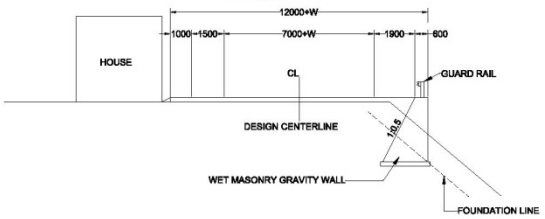




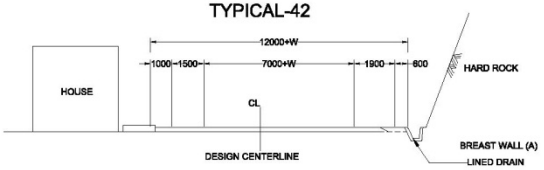
Source: JICA Study Team

TYPICAL CROSS SECTION (10/11)
FORMATION IN SETTLEMENT AREA
(SCALE 1:200)

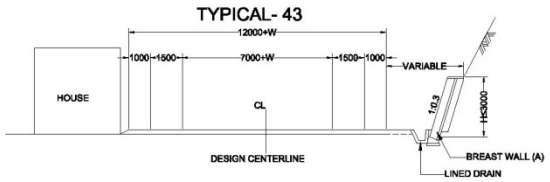
TYPICAL-41



TYPICAL-42



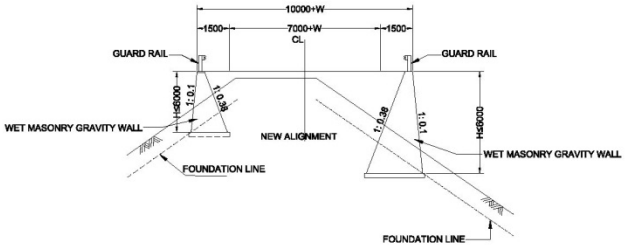
TYPICAL- 43



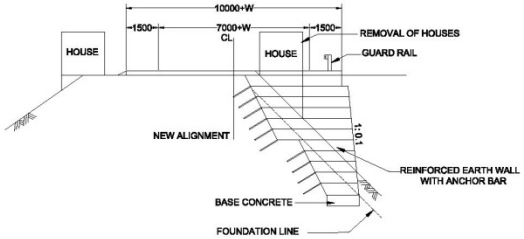
Source: JICA Study Team

TYICAL CROSS SECTION (11/11)
FORMATION IN SETTLEMENT ARER
(SCALE 1:100)

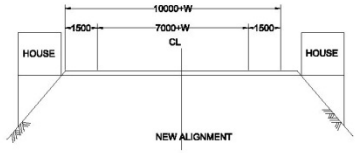
TYPICAL- 44



TYPICAL- 45



TYPICAL- 46



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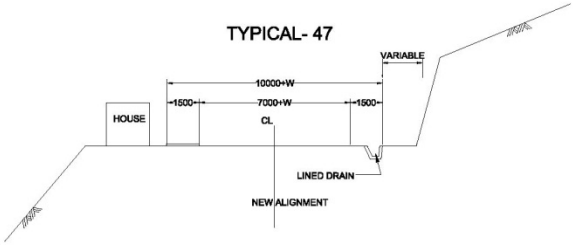
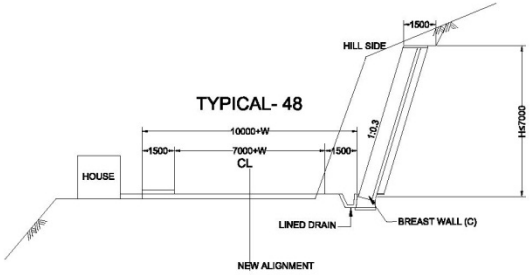
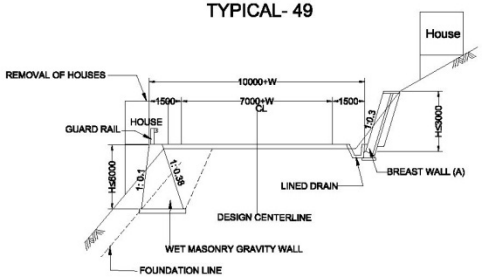


TYPICAL- 48



TYPICAL- 49



Source: JICA Study Team

TYPICAL PAVEMENT DETAIL

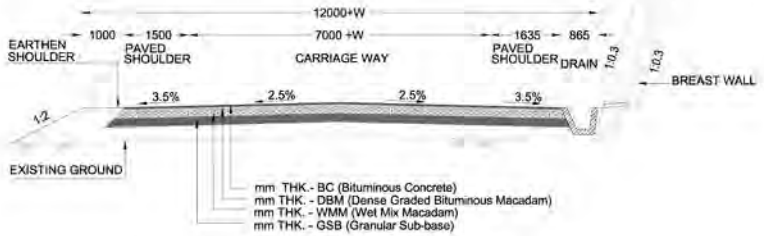
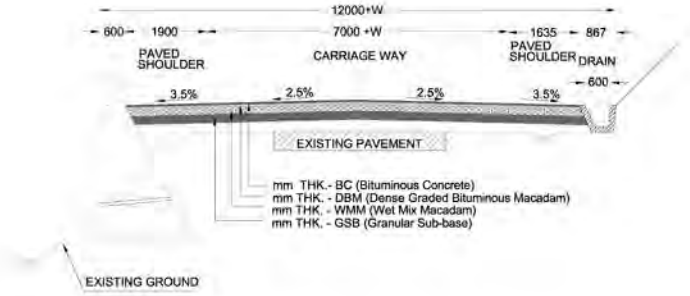


TABLE SECTION OF PAVEMENT DESIGN

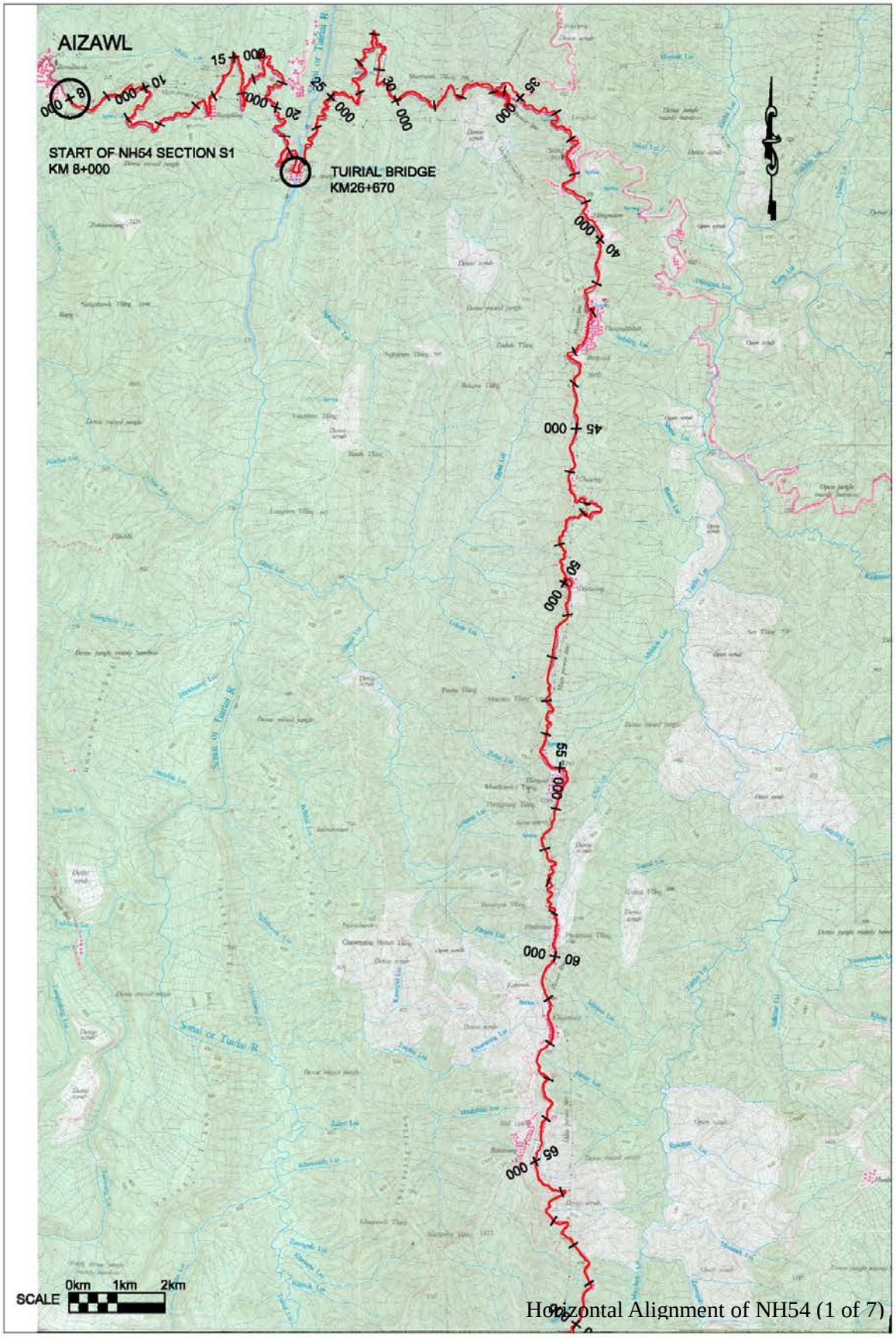
TYPE	THICKNESS (mm)
	KM0+000- - End
BC	40
DBM	100
WMM	250
GSB	300



EXCEPTIONAL WIDTH IN S2

S.NO	WIDTH OF ROAD AT KM					
	FROM KM	TO KM	CARRIAGEWAY WIDTH	PAVED SHOULDER	UN-PAVED SHOULDER	TOTAL
1	145+100	147+780	7	2 X0.9	2 X0.6	10
2	156+140	157+460	7	2 X0.9	2 X0.6	10
3	193+600	197+360	7	2 X0.9	2 X0.6	10
4	200+240	204+800	7	2 X0.9	2 X0.6	10
5	231+380	236+980	7	2 X0.9	2 X0.6	10

Source: JICA Study Team

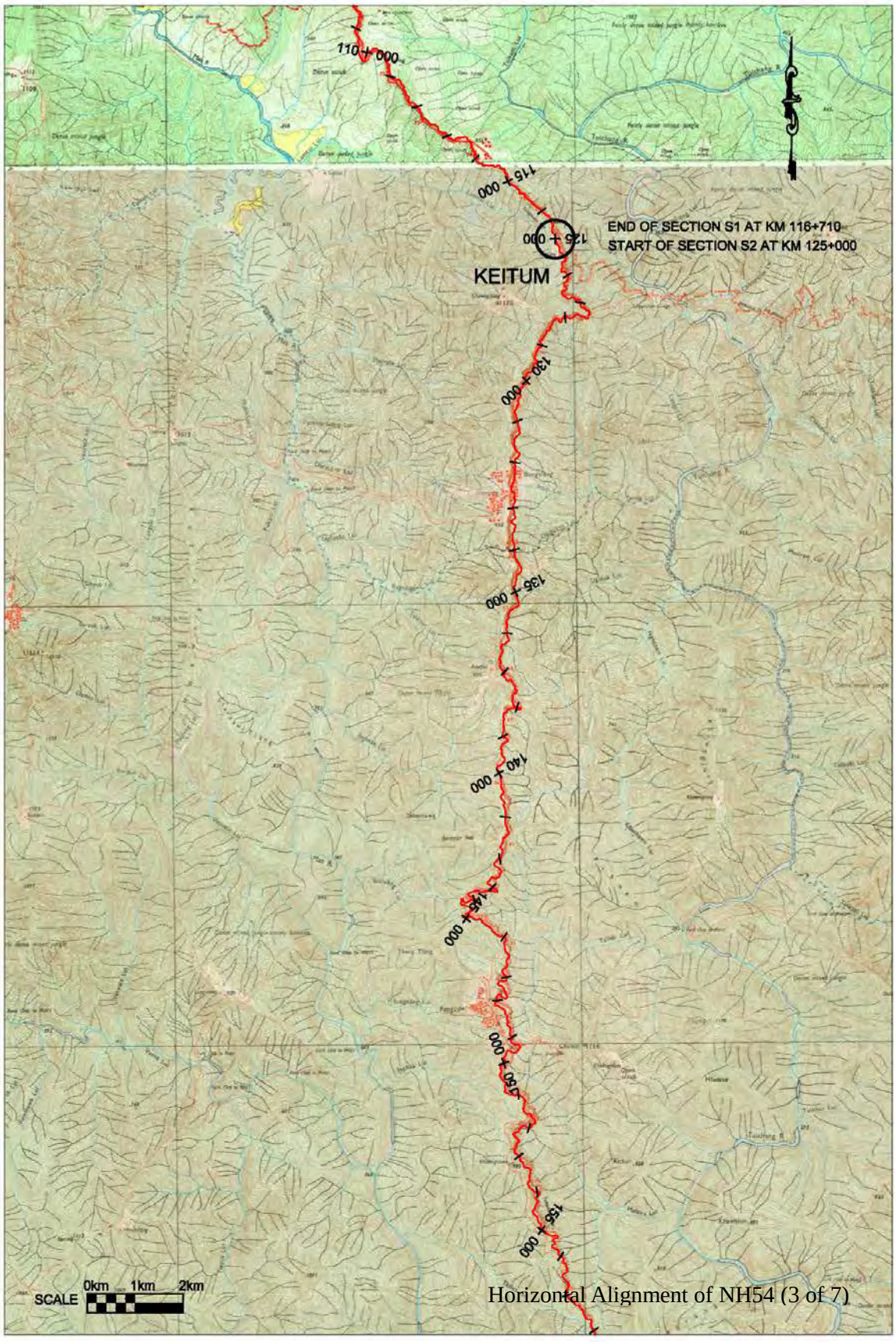


Horizontal Alignment of NH54 (1 of 7)

Source: JICA Study Team

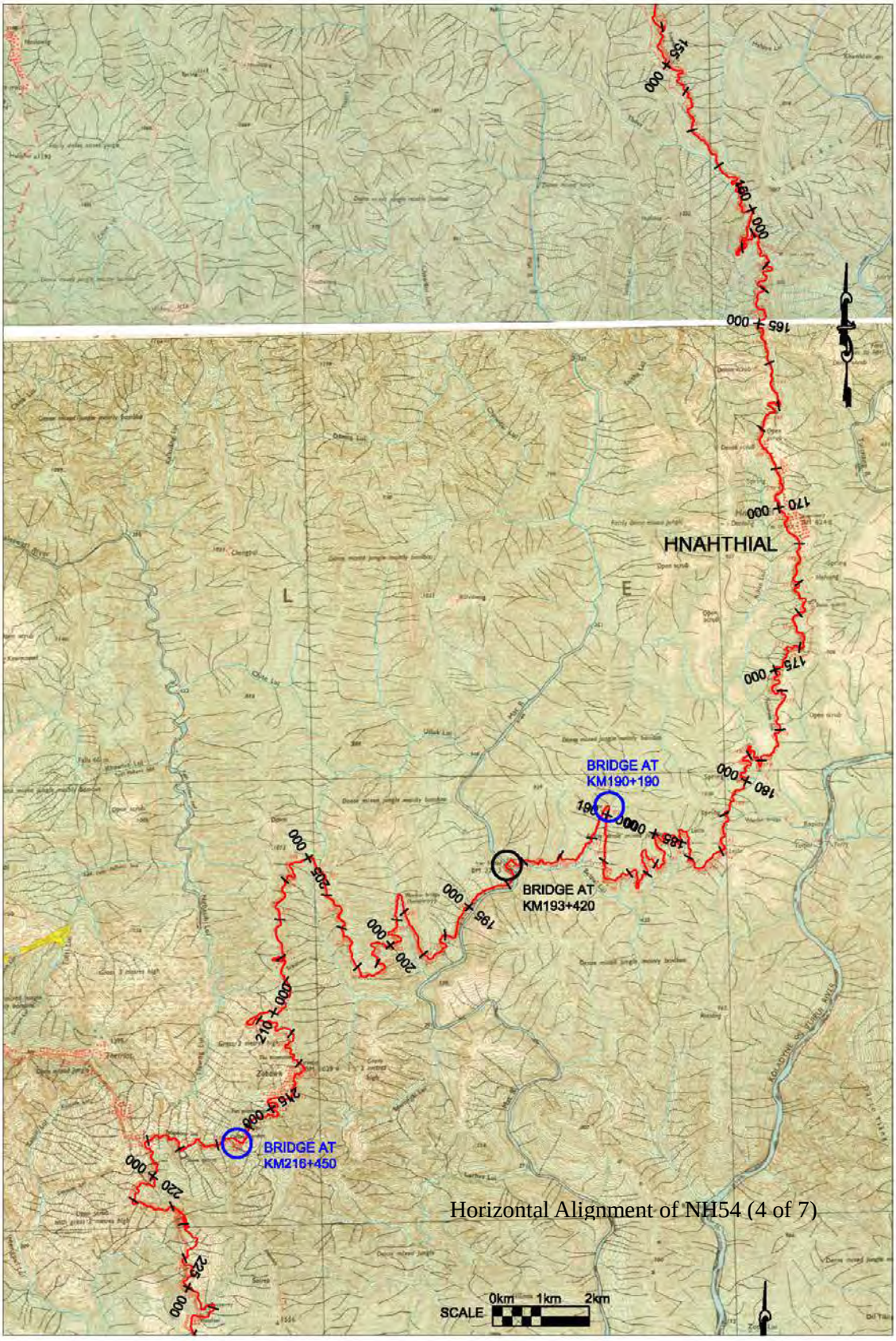
Horizontal Alignment of NH54 (2 of 7)

Source: JICA Study Team



Horizontal Alignment of NH54 (3 of 7)

Source: JICAeam

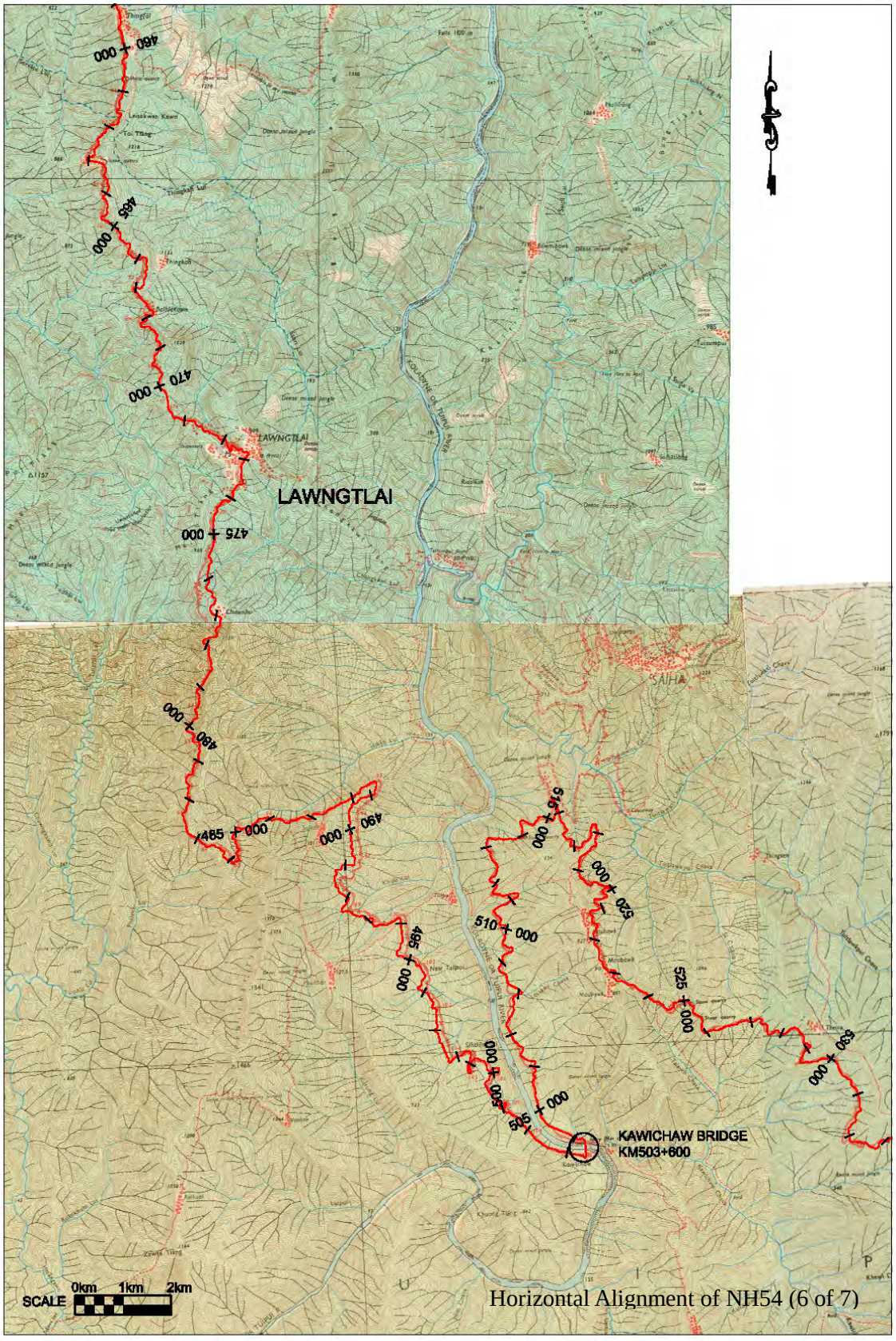


Horizontal Alignment of NH54 (4 of 7)

Source: JICA Study Team

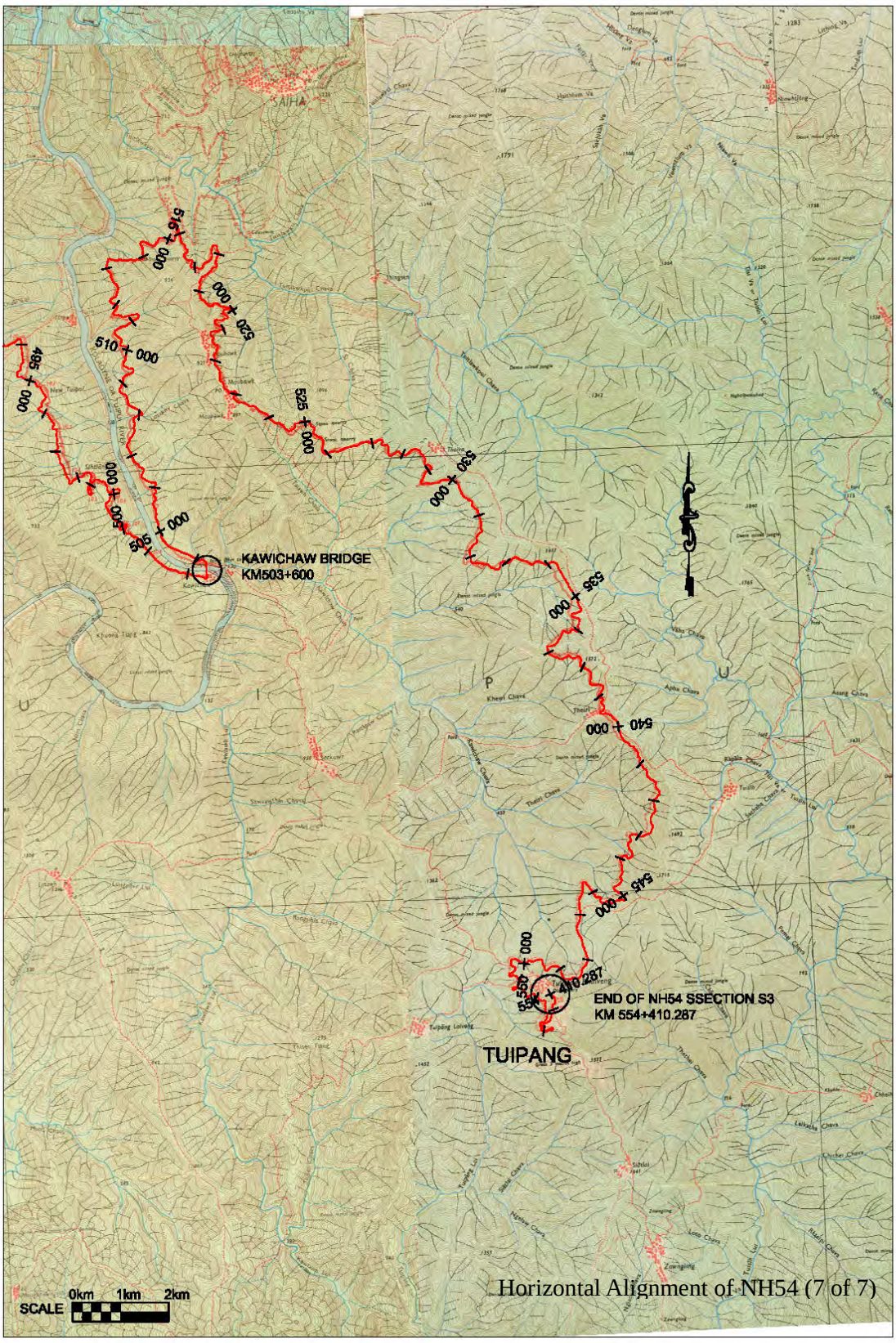
Horizontal Alignment of NH54 (5 of 7)

Source: JICA Study Team



Horizontal Alignment of NH54 (6 of 7)

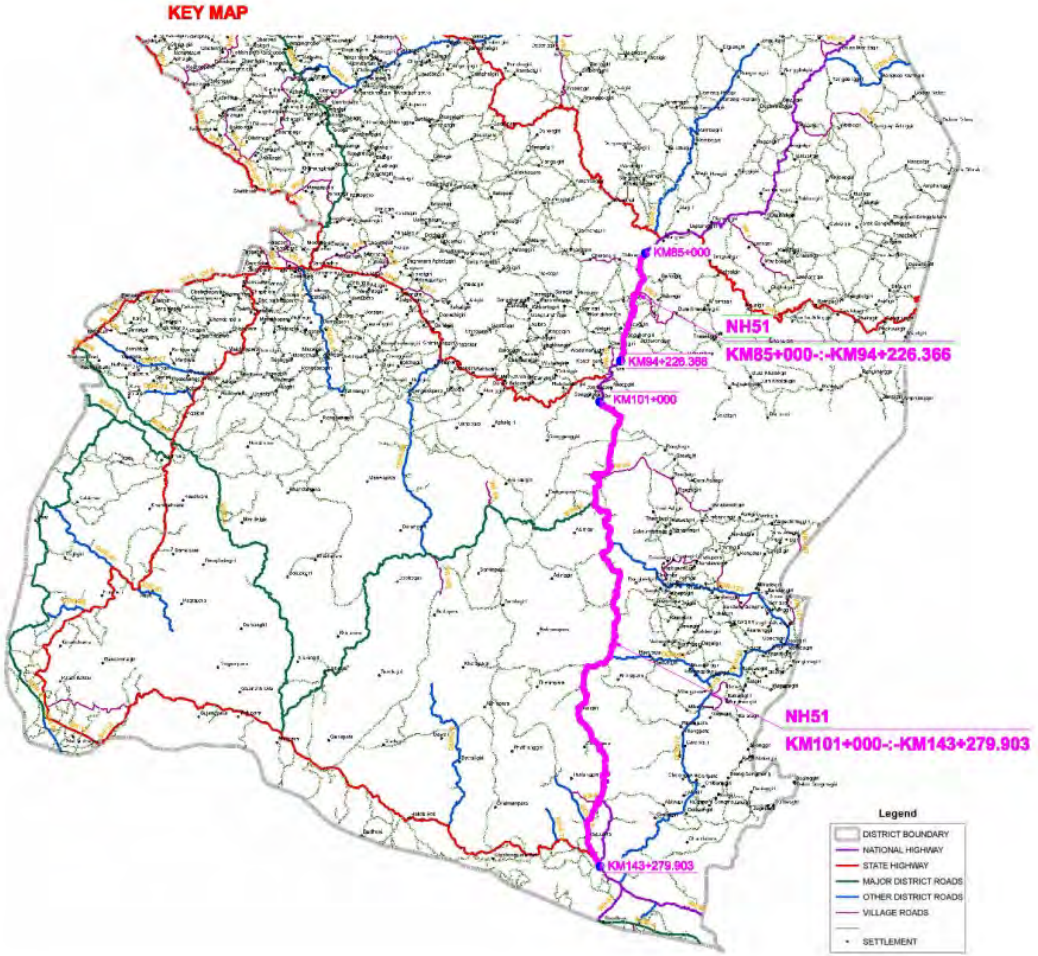
Source: JICA Study Team



Horizontal Alignment of NH54 (7 of 7)

Source: JICA Study Team

PROJECT LOCATION



Source: JICA Study Team

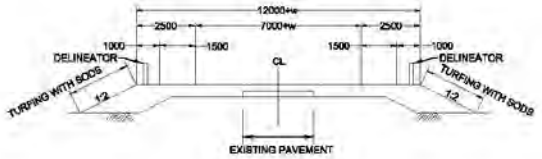
TYPICAL CROSS SECTION (1/2)

SCALE 1:200

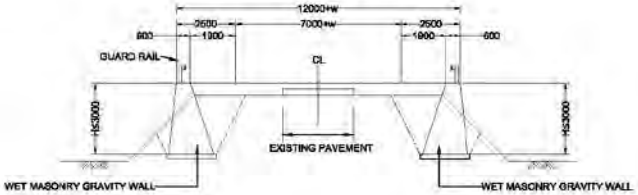
PLAIN AND ROLLING TERRAIN SECTION

FORMATION IN EMBANKMENT

TYPICAL-1

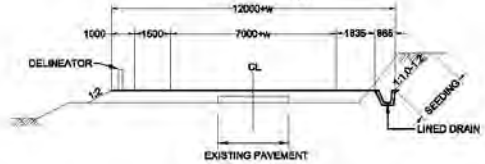


TYPICAL-2



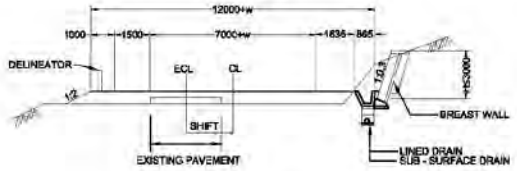
FORMATION IN CUTTING AND EMBANKMENT

TYPICAL-3

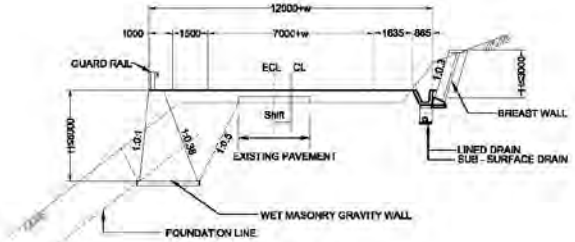


MOUNTAINOUS AND STEEP TERRAIN SECTION

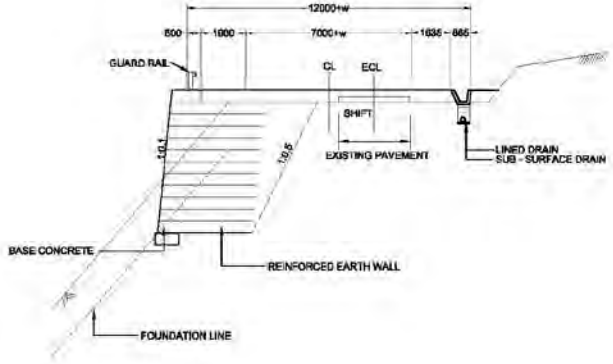
TYPICAL-4



TYPICAL-5



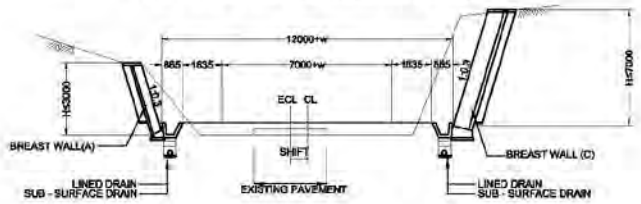
TYPICAL-6



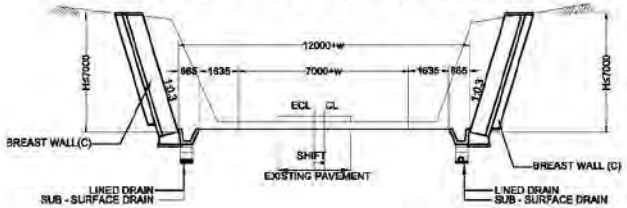
Source: JICA Study Team

TYPICAL CROSS SECTION (2/2)
MOUNTAINOUS AND STEEP TERRAIN SECTION
SCALE 1:200

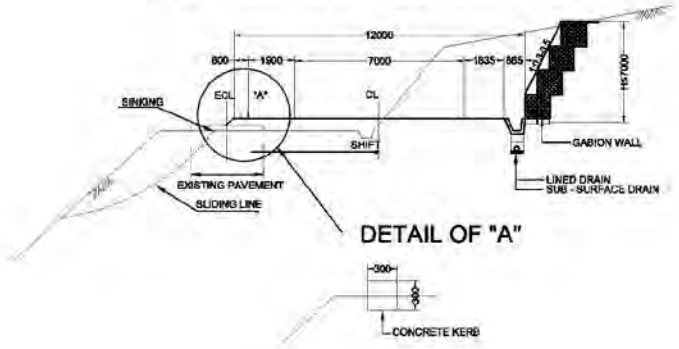
TYPICAL-7
(APPLICATION TO COMMON SOIL)



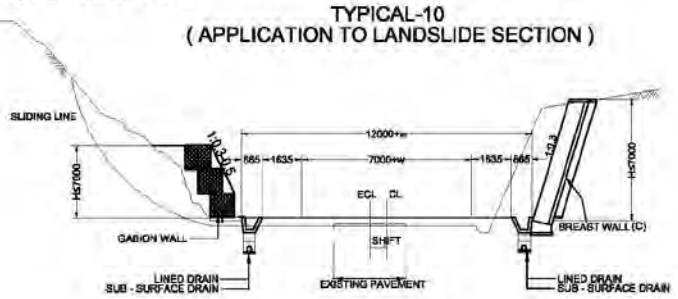
TYPICAL-8
(APPLICATION TO COMMON SOIL)



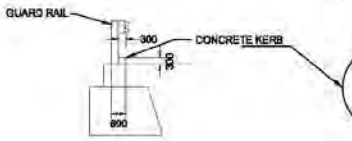
TYPICAL-9
(APPLICATION TO LANDSLIDE SECTION)



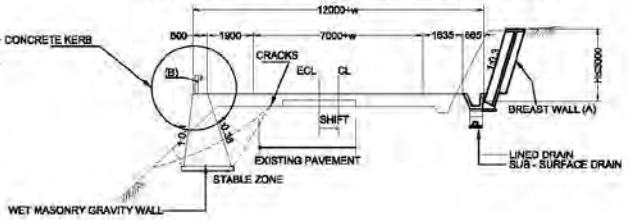
TYPICAL-10
(APPLICATION TO LANDSLIDE SECTION)



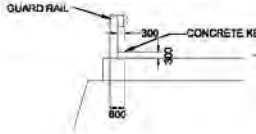
DETAIL OF "B"



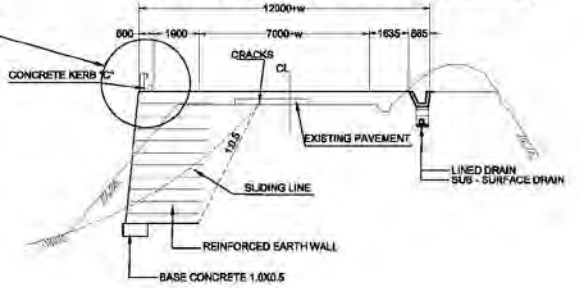
TYPICAL-11
(APPLICATION TO LANDSLIDE SECTION)



DETAIL OF "C"



TYPICAL-12
(APPLICATION TO LANDSLIDE SECTION)



Source: JICA Study Team

TYPICAL PAVEMENT DETAIL (2/2)

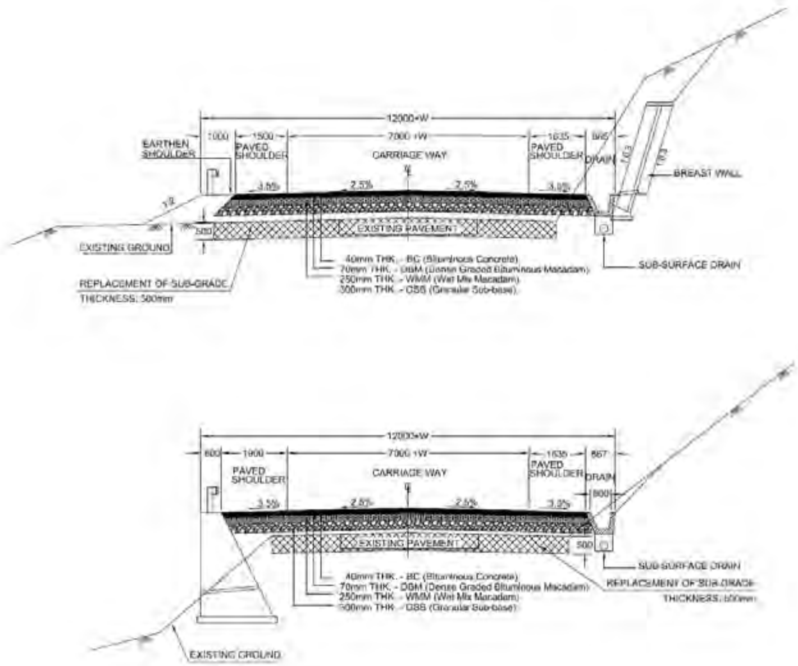


TABLE SECTION OF REPLACEMENT OF SUB-GRADE

STATION	to	STATION	LENGTH (M)
Km112+500	~	Km112+800	300
Km114+000	~	Km114+100	100
Km114+500	~	Km114+600	100
Km115+240	~	Km125+240	9500
Km127+600	~	Km133+600	6000
Km135+080	~	Km138+080	3000

Source: JICA Study Team