

Government of Nepal  
Ministry of Physical Planning and Works  
Planning and Design Branch  
**Puspalal(Mid-Hill) Highway Project**  
Babarmahal, Kathmandu Nepal

## **Preparation of Detailed Project Report of Puspalal (Mid Hill) Highway Project**



## **Final Report**

January 2011

Submitted by:



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## Abbreviation

AADG	Average Annual Daily Traffic
ADB	Asian Development Bank
APs	Affected People
APP	Agriculture Prospective Plan
BCR	Benefit Cost Ratio
CBR	California Bearing Ratio
DADO	District Agriculture Development Office
DCP	Dynamic Cone Penetration
DDC	District Development Committee
DFO	District Forest Office
DPR	Detailed Project Report
DOR	Department of Roads
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMAP	Environmental Management Action Plan
GIS	Geographical Information System
GON	Government of Nepal
GPS	Global Positioning System
HH	Household
IEE	Initial Environmental Examination
IPDF	Indigenous People Development Frame
IPDP	Indigenous People Development Plan
LA	Land Acquisition
NARC	Nepal Agriculture Research Council
NPV	Net Present Value
MHH	Mid Hill Highway
MHHP	Mid Hill Highway Project
MSA	Million Standard Axles
MoEST	Ministry of Science and Technology

MoPPW	Ministry of Physical Planning and Works
MW	Megawatt
PIP	Priority Investment Plan
PPS	Pocket Package Strategy
RAP	Rural Access Program
RFP	Resettlement Policy Framework
RoW	Right of Way
RP	Resettlement Plan
TOR	Terms of Reference
TRPAP	Tourism for Rural Poverty Alleviation Program
WB	World Bank

## Executive Summary

This report has been prepared as per the contract, between Pushpalal(Mid Hill) Highway Project, Planning and design Branch, Department of Roads as the Client and Tech Studio of Engineering (TSE) as the Consultant, made on June 1, 2010 for the preparation of Detailed Project Report (DPR) of Mid Hill (Pushpalal) Highway Project (MHHP). This final report consists of 10 chapters.

**Chapter 1** of the report highlights the general introduction, objectives project background, scope of services and the team composition of the consultant.

The 20 year road policy has aimed at connecting all district headquarters by road and to construct: i) East West Highway ii) Mid Hill East West Highway and iii) upgradation of postal roads in terai to develop as highway. Under this policy, Government of Nepal (GON) has initiated the Mid Hill Highway project to implement from the fiscal year 2064/065. The length of Mid Hill Highway (MHH) is 1776 Km approximately. Although, some stretches of the highway is constructed as different road projects in the past but a thorough highway running east to west has been envisaged under this plan. Already constructed stretches as part of different highway projects need further improvement to bring the road into set standards of the highway. Unopened stretches are to be planned as new construction meeting the required standards.

Overall objective of MHHP is to implement approximately 1776 Km of road connecting from eastern boarder to the western boarder of Nepal running through different important townships, settlements and other places of importance. Specific objective of this assignment was to prepare Detailed Project Report (DPR) for MHHP.

**Chapter 2** of the report describes the methodology of the Consultant in preparing the report. The Consultant carried out desk study, literature review and consultation with MHHP and other concerned authority in order to get know how about the proposed project. In order to prepare this report the Consultant carried out Engineering Study, Geology and Geomerphological Study, Social Study, Environmental Study and Economical Study. The Consultant also reviewed various existing report related to the project.

**Chapter 3** of the report highlights the engineering aspects of the project giving rise to the pertinent information as described below. Approximate length of the proposed Mid Hill Highway is 1776 kilometers. The highway passes through 12 zones, 24 districts, and 215 villages and serves nearly 7 million populations. The sections of roads of Mid Hill Highway and their status is below:

**Table no ES-1, Sections of Mid Hill Highway**

S. No.	Road Section	Approx. Length in Km	Present Condition	Remarks
1	Chiyobhanjyang-Ganeshchowk	59.00	New section,MHHP opening track	
2	Ganeshchowk-Jorsal	40.00	Existing Mechi Highway	
3	Jorsal-Tamor-Sankranti	34.00	New section, track already opened	
4	Sankranti-Myglung	68.00	Construction of Road is going on under RAP	
5	Myglung-Basantapur-Hile	48.00	Existing Feeder Road	
6	Hile-Leguwachhat-Bhojpur	92.00	Existing Feeder Road. Constructed by RAP and Under construction (upgrading) by other project under DOR	
7	Bhojpur-Diktal	90.00	Existing District Road, MHHP upgrading( Road width and surfacing)	
8	Diktal-Ghurmi	82.0	Under construction (upgrading) by other project under DOR	
9	Ghurmi-Khurkot	60.0	New section, MHHP opened track	
10	Khurkot-Nepalthok	37.0	BP Highway, Under construction by Japan Government	
11	Nepalthok-Dhulikhel	50.00	Existing BP Highway	
12	Dhulikhel-Kathmandu	30.00	Existing Arniko Highway	
13	Kathmandu-Pokhara	198.00	Existing TRP and Prithvi Highway	
14	Pokhara-Baglung	72.00	Existing Pokhara-Baglung Feeder Road	
15	Baglung-Burtibang	89.00	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.	
16	Burtibang-Baglung_Musikot Border	60.00	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.	
17	Baglung_Musikot Border-Rukumkot	66.00	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.	
18	Rukumkot-Musikot	39.00	Nepal Army is working in this section and about track opening works with minimum retaining and drainage structures is mostly completed.	
19	Musikot-Chourjahari	43.00	Partly track opened by DDC, however, Mid Hill Highway Project planned to open track within this F Y.	
20	Chaurjahari-Dailekh	103.00	26 km working by RAP, 11km Surkhet-Dailekh Road Section remaining is new section MHHP opening track.	
21	Dailekh-Dullu-Lainchaur	39.00	Narrow Existing track opened by DDC, however upgrading works is going on by MHHP.	

S. No.	Road Section	Approx. Length in Km	Present Condition	Remarks
22	Lainchour-Satala-Saijula	45.00	New section, MHHP opened track last FY.	
23	Saijiula-Belkhet-Mangalsen	48.00	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.	
24	Mangalsen-Silgadhi	106.00	Existing Feeder Road	
25	Silgadhi-Syule	66.00	Existing Seti Highway	
26	Syule-Satbanjh	70.00	Existing Mahakali Highway	
27	Satbanj-Jhulaghat	42.00	Existing Feeder Road	

Design standards of the Mid Hill Highway were fixed as per the discussion with client and the information provided to the consultant. The table below shows the design standards to be adopted in the MHH.

**Table no ES-2, Design Standards**

S.N	Design Parameter	Existing MHHP Standards	Recommended Standards
1	Design Speed	50 kmph	50 kmph
2	Right of Way	25m (On either side form center line)	25m (On either side form center line)
3	Carriageway Width	7.0 m	7.0 m
4	Total Formation Width	8.50 m	9.0 m
5	Shoulder Width	0.5 m valley side	0.5 m both side
6	Earthwork Excavation Width in Hill Side	3.5 + Drain Width	3.5 + Drain Width
7	Camber of Carriage way	3%	3%
8	Camber of Shoulder	5%	5%
9	Minimum Horizontal Curve Radius	15 m	15 m
10	Vertical Curve		
a.	Minimum Radius	500m	500m
b.	Minimum Length	40m	40m
11	Maximum Gradient	8%	10%
12	Average Gradient	5%	7%
13	Minimum Gradient	1%	
14	Limitation of Maximum Gradient length above average gradient		
a.	Mountainous/Steep Terrain (Percent cross slope > 25 < 60)	150m	150m
b.	Rolling Terrain (Percent cross slope > 10 < 25)	210m	210m
15	Maximum Recovery Gradient to be applied after gradient in excess of average grade for the minimum recovery length of:		

S.N	Design Parameter	Existing MHHP Standards	Recommended Standards
a.	150m in mountainous/Steep terrain	3%	3%
b.	210m in rolling terrain	4%	4%
16	Vertical clearance	5m	5m
17	Minimum stopping sight distance	65m	65m
18	Hairpin Bends:		
	Min. spacing between centers of bends	100m	100m
	Min. transition curve length	15m	15m
	Max super elevation	10%	10%
	Min. carriageway width at apex	11.50 m	11.50 m
19	Maximum super elevation	7%	7%

A traffic study has been carried out. The base year normal traffic has been estimated based on secondary sources. In the sections where there is absence of traffic data, traffic volume has been estimated based on the population served. A traffic forecast has been done considering traffic growth rates as shown in the table below:

**Table no ES-3, Traffic Growth Rate**

Period	GDP Growth (% p.a.)	Freight Traffic		Passenger Traffic					
		Elasticity	Growth (% p.a.)	Large Bus		Car & Small Bus		Motorcycle	
				Elasticity	Growth (% p.a.)	Elasticity	Growth (% p.a.)	Elasticity	Growth (% p.a.)
2010-22	4.5	1.2	5.4	1.4	6.3	1.8	8.1	2.0	9.0
2023-32	4.5	1.1	5.0	1.2	5.4	1.5	6.8	1.5	6.8

The future AADT of the sections of the alignment have been determined as follows

**Table no ES-4, Future Traffic Volume in Different Section**

S.No.	Road Section	Total AADT 2012	Total AADT 2022	Total AADT 2032
1	Chiyobhanjyang-Ganeshchowk	166	291	297
2	Ganeshchowk-Jorsal	663	1144	1883
3	Jorsal-Tamor-Sankranti	172	302	308
4	Sankranti-Myglung	344	603	615
5	Myglung-Basantapur	268	491	842
6	Basantapur-Hile	682	1250	2137
7	Hile-Leguwachhat	261	480	824
8	Leguwachhat-Bhojpur	296	536	973
9	Bhojpur-Diktal	243	425	467
10	Diktal-Ghurmi	295	542	1001
11	Ghurmi-Khurkot	299	523	570
12	Khurkot-Nepalthok	152	266	290
13	Nepalthok-Dhulikhel	395	692	754
14	Dhulikhel-Kathmandu	3655	6983	12322

S.No.	Road Section	Total AADT 2012	Total AADT 2022	Total AADT 2032
15	Kathmandu-Pokhara	2032	3691	6273
16	Pokhara-Baglung	1405	2565	4353
17	Baglung-Burtibang	200	349	388
18	Burtibang- Rukumkot	354	621	633
19	Rukumkot-Musikot	200	351	358
20	Musikot-Chourjahari	203	356	363
21	Chaurjahari-Dailekh	145	254	260
22	Dailekh-Dullu-Lainchour	190	333	363
23	Lainchour-Satala-Saijula	132	232	236
24	Saijiula-Belkhet-Mangalsen	156	273	278
25	Mangalsen-Silgadhi	597	1118	1951
26	Silgadhi-Syule	856	1616	2843
27	Syule-Satbanjh	886	1691	2989
28	Satbanj-Jhulaghat	178	331	573

The Consultant has provided typical cost effective design of structures such as retaining wall, side drains, cross drainage structures, slope protection works, pavement etc. and presented as typical designs in the drawing.

The table below presents the bridges required to be constructed along the alignment:

**Table no ES-5, List of Bridges required along the alignment**

S.No.	Name of Bridge	Approx. Length, m	Road Section	Remarks
1	Musepa Khola	20.00	Chiyo Bhanjyang-Ganesh Chowk	
2	Mewa Khola	40.00	Chiyo Bhanjyang-Ganesh Chowk	
3	Silsile	25.00	Chiyo Bhanjyang-Ganesh Chowk	
4	Sarki	25.00	Chiyo Bhanjyang-Ganesh Chowk	
5	Phalam	25.00	Chiyo Bhanjyang-Ganesh Chowk	
6	Tamor river	200.00	Jorsal-Tamor-Sankranti	
7	Koya	50.00	Sankranti-Myglung	
8	Leguwa Khola	60.00	Hile- Leguwa Ghat- Bhojpur	
9	Arun River	250.00	Hile- Leguwa Ghat- Bhojpur	
10	Sera Khola	30.00	Bhojpur-Diktel	
11	Pikhuwa Khola	30.00	Bhojpur-Diktel	



S.No.	Name of Bridge	Approx. Length, m	Road Section	Remarks
12	Hinguwa Khola	25.00	Bhojpur-Diktal	
13	Yanta Khola	30.00	Bhojpur-Diktal	
14	Dudh Koshi	40.0	Diktal-Ghurmi	
15	Sunkoshi	150.00	Diktal-Ghurmi	
16	Bahadure Khola	100.00	Ghurmi-Khurkot	
17	Sokhu Khola	100.00	Ghurmi-Khurkot	
18	Chalne Khola	20.00	Ghurmi-Khurkot	
19	Jittu Khola	25.00	Ghurmi-Khurkot	
20	Khangsang Khola	20.00	Ghurmi-Khurkot	
21	Sakhar Khola	25.00	Ghurmi-Khurkot	
22	Nihura Khola	25.00	Ghurmi-Khurkot	
23	Waksu Khola	100.00	Ghurmi-Khurkot	
24	Tyun Khola	25.00	Ghurmi-Khurkot	
25	Foshre Khola	15.00	Ghurmi-Khurkot	
26	Bittijor Khola	100.00	Ghurmi-Khurkot	
27	Banjijor Khola	100.00	Ghurmi-Khurkot	
28	Hyber Khola	40.00	Ghurmi-Khurkot	
29	Sungure Khola	25.00	Ghurmi-Khurkot	
30	Daram Khola	41.00	Baglung-Burtibang	
31	Gaudi Khola	25.00	Baglung-Burtibang	
32	Girangdi khola	35.00	Baglung-Burtibang	
33	Bhim Ghitte Khola	35.00	Baglung-Burtibang	
34	Nohare Khola	40.00	Baglung-Burtibang	
35	Burtibang Khola	40.00	Burtibang- Rukumkot	
36	Heera Khola	30.00	Burtibang- Rukumkot	

S.No.	Name of Bridge	Approx. Length, m	Road Section	Remarks
37	Triveni Khola	30.00	Burtibang- Rukumkot	
38	Dovan Khola	100.00	Burtibang- Rukumkot	
39	Mugnu Khola	60.00	Rukumkot-Chaurjahari	
40	Simle Khola	40.00	Rukumkot-Chaurjahari	
41	Jahari Khola	60.00	Rukumkot-Chaurjahari	
42	Bheri River	200.00	Chaurjahari-Kudu-Jagtipur-Dailekh	
43	Cheera Gad	60.00	Chaurjahari-Kudu-Jagtipur-Dailekh	
44	Cham Ghat Khola	25.00	Dailekh-Dullu-Saijiula	
45	Paduga Khola	100.00	Dailekh-Dullu-Saijiula	
46	Chini Khola	50.00	Dailekh-Dullu-Saijiula	
47	Ramgad	50.00	Dailekh-Dullu-Saijiula	
48	Karnali River	203.00	Saijiula-Belkhet	

**Chapter 4** of the report gives the information about geology and geomorphology of the project. As described earlier proposed Mid Hill Highway Project (MHHP) traverses around 1776 km long stretch of the Nepalese Himalaya connecting Nepal Panchthar in the east to Baitadi in the west. The road traverses different geological and physiographic regions with varying degree of engineering geological conditions. Thus, the geological and engineering geological condition along the proposed road corridor should be explored in detail in order to understand the slope stability condition at different road stretches.

The present report is basically focused to the general introduction of the geology and physiographic regions of Nepalese Himalaya. The alignment of the MHH has been overlain on the geological map as well as geomorphologic map and described accordingly. Likewise, the slope classes along the highway have been discussed including the topographical description.

Construction of roads and other infrastructures in the hilly terrain of fragile Himalayan region is always a challenging one. Since the Mid Hill road alignment traverses the entire Nepalese Himalaya from east to west, it covers various geological formations with varying lithology and physical properties. Likewise, the road either crosses or is parallel to major geological structures

at several locations. Due care should be given to the fact that relatively weaker terrain is the result of poor geological condition, which is further worsened due to the action of water.

The road alignment has been evaluated based on the physiographic condition, major geological units, geological structures, slope stability condition and slope stability condition along the alignment. It has been observed that the eastern and western part of the alignment significantly crosses the major geological structure (MCT) at several locations. At the same time the road is parallel and close to MCT at two sections, namely Ghurmi-Nepalthok and Burtibang-Musikot sections. These are the vulnerable locations regarding the road stability and smooth functioning of traffic. Necessary mitigation measures should be adopted in these places. Likewise, the bridge sites at the major river crossings should be selected at geologically and hydrologically sound locations. When the road is parallel to the major river, especially at Kathmandu-Pokhara section and Burtibang section, bank cutting problem is anticipated.

Social aspect of the project has been described in **Chapter 5** of the report. The study has analyzed the various social aspects during and after construction phases.

The proposed road serves large number of ethnic groups especially in the Eastern, Central and Western Development region. The ethnic groups present along the road are Limbu, Rais, Tamang, Magar, Gurung, Sherpa, Jirel, Thami, Chepang, Sunuwar, Majhi, Kumal, Dura, Thakali, Yakha, Bhujel, Hayu and Newar along the road stretches. However presence of ethnic groups in Mid and Far western region are nominal in comparison to Eastern and Central region. On the other hand Dalits' presence is significantly high in far and western development region.

All the ethnic groups residing in the proposed road corridor are integrated into the social, cultural and economic network of the main stream of society. Hence there will be no separate disadvantage groups different from dominant local population who are likely to be adversely affected by the project.

**Chapter 6** of the report describes environmental aspects of the project area which consists of environmental negative and positive impact, mitigation measures to be applied in different phase of implementation, environmental monitoring, environmental auditing and resources required.

There are different kinds of environmental interventions proposed during the entire project cycle of the road project and they are: landslide and slope protection, cross drainage and flood control, minimal removal of forest and vegetation, use of eco-friendly construction materials and techniques, health and safety precaution during construction and operation etc. The intervening measures are either preventive or corrective or the compensatory depending upon the nature of impact and its gravity. These interventions have to be kept in mind during the entire project cycle of the project.

**Chapter 7** highlights on the impact of the Mid Hill highway on the economy. Highways and roads are the vital lifelines of the economy. Lack of adequate road infrastructure, especially in rural

areas, results in significant limitations for communities. These limitations occur in terms of access to socio-economic and cultural centers such as schools, clinics, markets and other business centers. Completion of the construction will provide road access to the population and inter-regional connection through the hills via direct route to Kathmandu. The improved freight movements and better connectivity will certainly reduce transportation costs and travel time leading to more competitive pricing of agricultural and manufacturing goods produced in the influence area for exports to different districts and regions of the country and ultimately to the above towns. With all these impacts of the MHH opportunity for capital investments in different sectors will become more likely positively impacting the economic development of the influence area and that of the country.

Construction of proposed road promotes efficiency through adoption of new technologies, reduced costs and expanded access to markets. In addition to more traditional industrial and commercial firm location "roadside service industries" (e.g. gas stations, restaurants, hotels) and new tourism may emerge and boons to local economies. Business location/relocation that may follow highway construction is an additional potential source of regional economic impact. The proposed road. The proposed project will have direct impact on the economical improvement with development in the field of agriculture, tourism, hydroelectricity, industry and business/trade.

**Chapter 7** gives ideas on the costing of the projects. The table below shows the summary of the cost.

**Table no ES-6, Cost Estimate**

Sn	Description	Unit	Rate in NRs 000	Quantity	Amount in NRS 000
1	<b>Feasibility Study</b>	Km	7	436.00	3052
2	<b>Detailed Engineering Survey, Roads</b>	Km	48	926.00	44448
3	<b>Environmental Studies</b>	Km	15	926.00	13890
4	<b>Detailed Engineering Survey of Bridges</b>	No	800	19.00	15200
5	<b>Geo-Technical Studies</b>	No	500	45.00	22500
6	<b>Land Acquisition</b>	Sqm	0.3	9260000.00	2778000
7	<b>Construction Survey</b>	Km	20	926.00	18520
8	<b>Earthwork</b>				
8.a	Cutting	Cum	0.175	34320000.00	6006000
8.b	Filling	Cum	0.15	1607000.00	241050
9	<b>Retaining Structures including Chutes Cascade etc</b>				
9.a	Gabion	Cum	3.6	849800.00	3059280
9.b	RRM	Cum	8	321400.00	2571200
9.c	Dry Stone	Cum	2.9	160700.00	466030
9.d	RCC	Cum	20	13620.00	272400
9.e	Rock/Soil Anchoring and Doweling	Cum	15	74080.00	1111200
10	<b>Drain Construction</b>				

10.1	Earthen	Km	350	138.90	48615
10.2	Dry Stone	Km	1200	92.60	111120
10.3	RRM	Km	4000	509.30	2037200
10.4	RCC Cover Drain	Km	6000	231.50	1389000
10.5	Sub-Surface drains	Km	6000	83.34	500040
<b>11</b>	<b>Culvert Construction</b>				
11.1	Pipe Culvert	No	250	1852.00	463000
11.2	Slab Culvert	No	2500	277.80	694500
11.3	RCC Box Culvert	No	3000	185.20	555600
11.4	Causeway	No	2000	92.60	185200
<b>12</b>	<b>Bridge Construction</b>				
12.1	Construction of Major/Medium/Minor Bridges	Rm	1000	2894.00	2894000
<b>13</b>	<b>Pavement Works</b>				
13.1	Sub-Grade, Capping and Sub-base	Sqm	0.4	6945000.00	2778000
13.2	Base	Sqm	0.6	6945000.00	4167000
13.3	DBST	Sqm	0.3	6352360.00	1905708
13.4	Asphalt Concrete	Sqm	0	0.00	0
13.5	RCC Pavement	Sqm	1	129640.00	129640
<b>14</b>	<b>Road Furniture and traffic Safety</b>				
14.1	Traffic Sign	No	3.5	5556.00	19446
14.2	KM Post	No	7	926.00	6482
14.3	Guard Rail	Rm	20	138900.00	2778000
14.4	Safety Barior	Rm	7	92600.00	648200
14.5	Road Painting	Sqm	0.3	1111200.00	333360
14.6	Delinator Posts	No	3	231500.00	694500
14.7	Information Boards	No	5	3704.00	18520
	Sub Total 1				<b>38979901</b>
<b>15</b>	<b>Miscellaneous Works</b>				
15.1	Bioengineering Works and Environmental Mitigation Works(3% of Subtotal 1)				1169397.03
15.2	Maintenance during Construction(3% of Subtotal1)				1169397.03
	Sub Total 2(Sub Total 1+15.1+15.2)				<b>41318695.06</b>
15.4	Administrative Expenditures(5% of Sub Total2)				2065934.753
	Grand Total( Sub Total 2+15.2)				<b>43384629.81</b>

An section wise economical analysis has been done and presented in the **Chapter 9**. Economic Evaluation of paved sections and three earth roads namely Leguwaghat-Bhojpur, Diktel-Ghurmi and Khurkot-Nepalthok are not carried out since widening of paved sections will not have significant benefits. The following table gives the result of economic analysis.

**Table no ES-7, Financial Indicators**

S.No.	Road Sections	NPV (NPRs. In Million)	EIRR (%)	BCR
1	Chiyobhanjyang-Ganeshchowk	3136.77	24.31	2.19
2	Jorsal-Tamor-Sankranti	1932.00	25.07	2.27
3	Sankranti-Myglung	881.58	15.29	1.28
4	Bhojpur-Diktel	1412.08	16.68	1.40
5	Ghurmi-Khurkot	827.57	15.94	1.33
6	Khurkot-Nepalthok	373.14	28.95	2.16
7	Baglung-Burtibang	1895.42	18.25	1.55
8	Dailekh-Dullu-Lainchour	444.07	15.73	1.31
9	Saijula-Belkhet-Mangalsen	607.81	15.48	1.28
10	Burtibang- Rukumkot	996.97	15.70	1.32
11	Rukumkot-Musikot	2876.93	28.51	2.65
12	Musikot-Chourjahari	3453.24	28.77	2.68
13	Chaurjahari-Dailekh	3144.59	20.80	1.67
14	Lainchour-Satala-Saijula	1496.60	20.02	1.74

**Chapter 10** highlights the Conclusion and Recommendation. One of the important aims of formulating Mid Hill Highway is to provide access to the economical potential areas. This will enable to fulfill goal of 10<sup>th</sup> plan to a large extends. Apart of this aim, the MHH will help improve social and cultural environment. Hence this road will play an important role in economical growth and reduction of the poverty.

This major achievement will be obtained by the following positive aspects of the proposed road project:

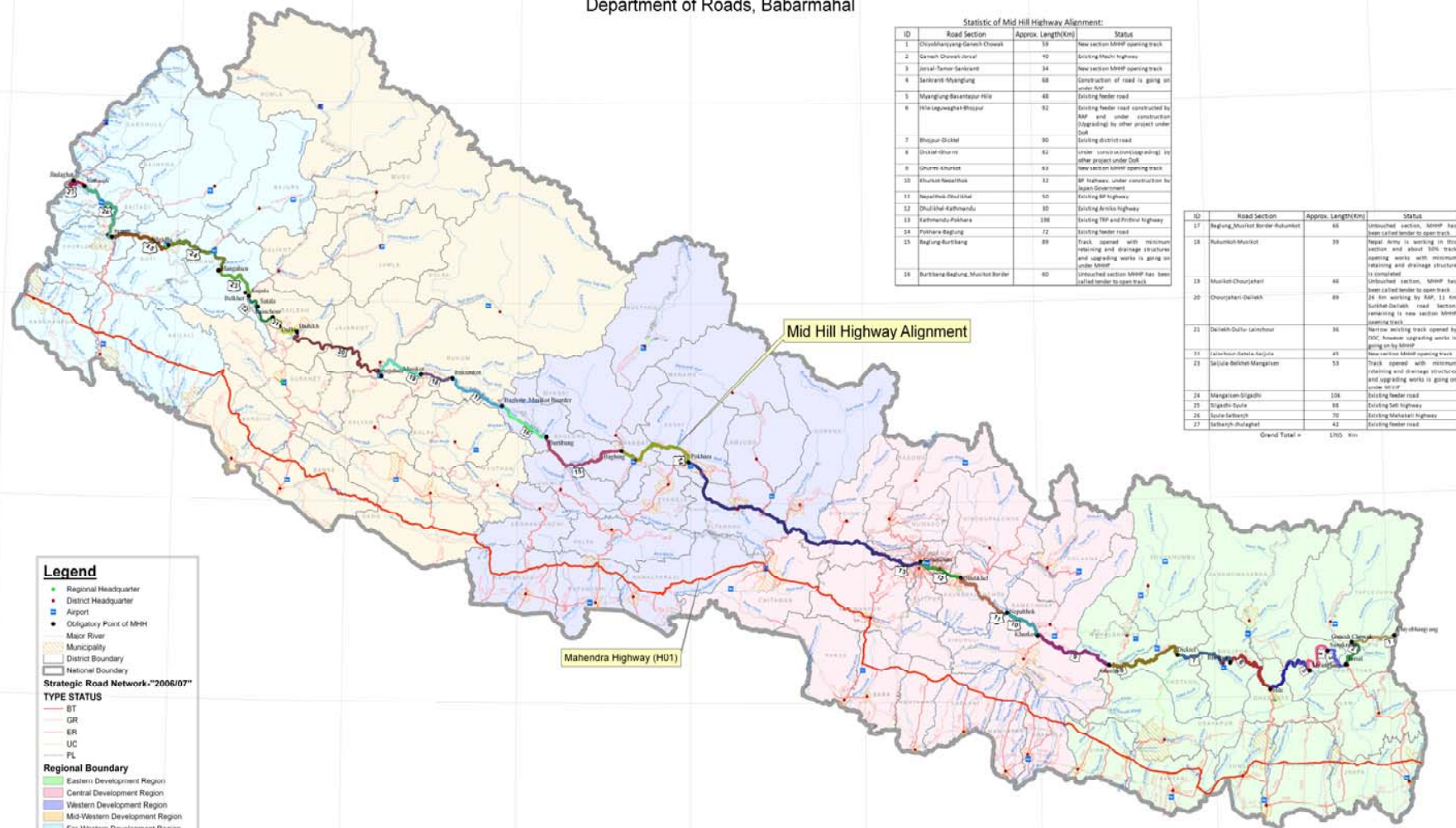
- It will develop the road network in the country with another new road linking East with West of Nepal
- It will develop social and cultural environment of not only influence area but also the whole country.
- It will establish new industries, hydroelectricity, agriculture development, tourist centre which will improve economical status of the country.
- It will enable to develop new town/cities along the corridor.

It is recommended that standards of the Mid Hill highway throughout the length should be the same. There should be coordination among the different line agencies and stakeholders during implementation of the proposed road. A study should be carried out for possibility of adopting shorter alternative alignments.

EIRR, MPV and BCR are positive for all sections of the road and hence the project is economically feasible.

## Pushpalal(Mid Hill) Highway Project

Department of Roads, Babarmahal



ID	Road Section	Approx. Length(Km)	Status
1	Chivharjyang Ganesh Chowk	58	New section MHH opening track
2	Ganesh Chowk Jorai	42	Existing MHH highway
3	Jorai-Tarai Sankar	34	New section MHH opening track
4	Sankar-Hyang	68	Current section of road is going on under foot
5	Manglung Basantapur Hill	48	Existing feeder road
6	Hilagwaghat Bhupur	92	Existing feeder road constructed by RAP and under construction (upgrading) by other project under DRR
7	Bhupur Ghat	30	Existing district road
8	Chivharjyang	82	Under construction (upgrading) by other project under DRR
9	Chivharjyang	82	New section MHH opening track
10	Muklet-Nawalpur	32	MHH highway under construction by Nepal Government
11	Nawalpur-Bharatpur	50	Existing MHH highway
12	Shivapuri-Bharatpur	30	Existing MHH highway
13	Kathmandu-Pokhara	188	Existing TPR and MHH highway
14	Pokhara-Baglung	72	Existing feeder road
15	Baglung-Bharatpur	89	Track opened with minimum retaining and drainage structure and upgrading works is going on under MHH
16	Bharatpur-Bharatpur	40	Unopened section MHH has been called tender to open track

ID	Road Section	Approx. Length(Km)	Status
17	Baglung-Muklet Border Bhaktapur	66	Unopened section, MHH has been called tender to open track
18	Muklet-Muklet	39	Nepal Army is working in this section, and about 50% track opening works with minimum retaining and drainage structure is completed
19	Muklet-Chaurjhar	40	Unopened section, MHH has been called tender to open track
20	Chaurjhar-Delkhi	89	24 km working by RAP, 11 km under-Delkhi road section remaining in new section, MHH opening track
21	Delkhi-Delkhi Lalitpur	36	Existing section track opened by DRR, however upgrading works is going on by DRR
22	Lalitpur-Delkhi-Bharatpur	45	New section MHH opening track
23	Lalitpur-Delkhi-Mangalpur	53	Track opened with minimum retaining and drainage structure and upgrading works is going on under MHH
24	Mangalpur-Sigadhi	106	Existing feeder road
25	Sigadhi-Sigadhi	66	Existing MHH highway
26	Sigadhi-Sigadhi	70	Existing MHH highway
27	Sigadhi-Bharatpur	42	Existing feeder road

Grand Total = 1700 km



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## **CHAPTER: 1 INTRODUCTION**

### **1.1 General**

This report has been prepared as per the contract, between Pushpalal(Mid Hill) Highway Project, Planning and design Branch, Department of Roads as the Client and Tech Studio of Engineering (TSE) as the Consultant, made on June 1, 2010 for the preparation of Detailed Project Report (DPR) of Mid Hill (Pushpalal) Highway Project (MHHP) in accordance with the given Terms of reference (TOR). This report is submitted as final after incorporating comments on it and editing as per the comments, suggestions and rectifications suggested by the Client.

### **1.2 Project Background**

Development of roads can be linked closely with development of human civilization. Together with human civilization it was necessary to visit and communicate between the groups of human settlements and thus resulted in the development of roads. In this context road is one of the major infrastructures that is required for overall development of a country. For a developing country like Nepal, roads play vital roles in lifting up the country's economical condition. The history of road construction in Nepal is not long. The road between Amlekhgunj and Bhimphedi constructed back in and around 1930 A. D. (1986 B. S) can be considered as the first road in Nepal. However, after the political change of 1950 (2007 B. S.) with establishment of democracy, road development was given emphasis with priority. The road strategies established after B.S 2007 included:

- Construction of road between Kathmandu and Indian Boarder;
- Construction of East –West Highway;
- Highways linking Kathmandu to Chinese boarder;
- Development of roads to connect economical potential areas;
- To connect zonal and district headquarters with East west Highway.

In accordance with the above strategy development and construction of roads in the country was going on. During the establishment of democracy the total road length in the country was only 376 km and that was increased to more than 50000 out of which 10835.02 km falls in strategic road network( SRN). At present the road network is spread throughout the country but some remote areas still remaining unconnected by the network.

Under these strategies, East –West Highway has already been implemented. Priority Investment Plan (PIP 2006) of Ministry of Physical Planning and work, Department of Roads(DOR) has envisaged that in the year 2016 there will be road head within walking distances of 2 hours in terai and 4 hours in hill respectively. Keeping the existing set policy of government in the process of road development, long term strategies and 20 years road development policies have been established. This policy has emphasized:

- To develop the roads in consideration to geographical remoteness and social justice and giving attention to poverty alleviation in a sustainable manner;
- For high and sustainable economic growth Government will play role of regulating facilitating to attract private investor;

The 20 year road policy has aimed at:

- Connecting all district headquarters by road and
- To construct the following three highways:
  - i) East-West Highway
  - ii) Mid Hill East West Highway
  - iii) Up gradation of postal roads in terai to develop as highway.

Under this policy, Government of Nepal (GON) has initiated the Mid Hill Highway project to implement from the fiscal year 2064/065. The length of Mid Hill Highway (MHH) is 1776 Km approximately. Although, some stretches of the highway is constructed as different road projects in the past but a thorough highway running east to west has been envisaged under this plan. Already constructed stretches as part of different highway projects need further improvement to bring the road into set standards of the highway. Unopened stretches are to be planned as new construction meeting the required standards.

### **1.3 Objectives**

Overall objective of MHHP is to implement approximately 1776 Km of road connecting from eastern boarder to the western boarder of Nepal running through different important townships, settlements and other places of importance. Specific objective of this assignment is to prepare Detailed Project Report (DPR) of Mid Hill Highway. The Detailed Project Report consists of the following information:

- Technical and Engineering Features
- Geology and Geomorphology

- Social Aspect
- Environmental Aspect of the project area
- Economical Aspect of the MHH
- Developmental aspects in the areas of agriculture, tourism, hydroelectricity and industry together with development of human settlements and population centers etc.
- Costing
- Economical Analysis

The DPR identifies and presents the potential areas in the vicinity of the alignment in terms of agriculture, hydropower, tourism, natural resources and others.

#### **1.4 Scope of Services**

To fulfill the scope of services under the present assignment, the consultant was required to:

- Collect relevant data, perform office works and field works and analyze the data;
- Consult the Employer's Division and Regional Offices as well as other relevant government offices through the Employer's Representative;
- Take into account the government policies and development plans in the transport and other sectors following the National Planning Commission's policies, transport sector vision, particularly those directed toward accelerated integrated development of the influence area.

#### **1.5 Consultant's Professional Team**

The following professional team of the consultant was deployed for the accomplishment of the present assignment:

- i) Team Leader : Highway or Transport Engineer
- ii) Bridge / Structural Engineer
- iii) Engineering geologist
- iv) Sociologist
- v) Transport economist
- vi) Environmental expert
- vii) Hydrologist

- viii) Civil Engineer
- ix) Hydropower engineer
- x) Agriculturist
- xi) Tourism Expert and
- xii) Other Support Staff as required

## **1.6 Consultant's Mobilization**

Consultant had mobilized their professional team and required refurbishment and establishment of working space were done at their office in Dilli Bazaar, Kathmandu near Charkhal, detailed address is as follows:

Dillibzar  
Kathmandu Metropolitan City -33  
Phone 4433828,  
Email: tse@ntc.net.np



## **CHAPTER: 2    APPROACH AND METHODOLOGY**

The list of tasks and brief description of methodology that applied by the Consultant to carry out the task are described as follows:

### **2.1    Desk Study**

Upon negotiation and signing of the Contract with the Client, the consultant took some days as desk study period. In this period the Team Leader worked out time and task to be allocated to each professional and support staff. A joint meeting was organized to give the team first hand information on the project.

The consultant collected relevant reports from the MHHP, latest topo sheets and arial photographs from the Department of Survey, Geological and Geographical records, Climatological record from Department of Hydrology and Meteorology. A checklist of information required during field investigation was prepared in the mean time.

Extensive discussions were carried out at the start of this period with MHHP and different authorities.

### **2.2    Consultation with MHHP and Other Concerned Authority**

The first steps of the Consultant's team was to manage a meeting with MHHP and DOR officials in order to get know how about the proposed project. Apart of this, the Consultant also consulted with different authorities related to the agriculture, tourism and hydroelectricity. Such consultation have been very beneficial for the Consultant in preparing the this DPR.

### **2.3    Technical and Engineering Study**

While preparing the DPR, the Consultant carried out technical and engineering studies under the leadership of Team Leader/Highway Engineer. The study included the followings activities;

#### **2.3.1    Study of Existing Alignment**

MHHP has already fixed the alignment of the highway. The Consultant studied the existing alignment in details. Each sections of the road were reviewed in terms of origin/destination, length, social, environmental and technical aspects.

#### **2.3.2    Study of Alternative Alignment**

Alternative alignment of some sections of the road have been proposed. The emphasis of the Consultant was given to the economical consideration as well as other issues related to the social and environment.

### **2.3.3 Design Criteria and Standard**

Design Criteria and Standards already set by the MHHP were reviewed considering expected traffic in future, terrain and category of the proposed road.

### **2.3.4 Traffic Study and Forecast**

A traffic study and analysis was carried out by using the available traffic data and assumption of generated traffic. Traffic forecast was done taking into account the growth rate applicable for hilly region.

### **2.3.5 Typical Design of Structures**

The Consultant has proposed typical design of the structures such as retaining wall, breast wall, cross drainage structures, side drains and other off road structures. While preparing the typical design of these structures, already constructed roads of similar nature were considered. The emphasis was given to the economical consideration.

### **2.3.6 Identification of Bridges**

Base on the assessment of the Consultant and the information provided by MHHP, locations of bridges along the highway were identified. Lengths of the bridges were tentatively fixed considering the nature of stream and banks type. A list of bridges required along the proposed alignment was prepared. However, already constructed bridges have not been included in the list.

### **2.3.6 Preparation of Key Plan**

A Key Plan was prepared based on the output of the study and analysis. The Key Plan shows existing alignment with its modification and other link road connecting to the main alignment. This plan was digitized and it presents all aspect of the MHH including alignment of highway and link roads, potential economical areas, bridge locations, stretch wise status of implementation.

## **2.4 Geology and Geomerphological Study and Analysis**

A geological study of the project area was carried out by Engineering Geologist. The Geologist collected relevant geological map, Arial photograph and others document for carrying out this study. This study comprised of

- structure and nature of the soil;
- regional geology;
- general geology along the road corridor
- Identification of vulnerable sections of alignment in terms of landslides, slope failures etc.
- design of cost effective measure for protection the road from landslides and

slope failures.

## **2.5 Social Study**

The Consultant carried out a social study of the project area. The study covered throughout the whole stretches of the road enclosing the influence area(approximately 2 Km on either side as mentioned in the ToR). The main focus of this study was towards:

- identification of indigenous people
- preparation of social development plan for indigenous
- identification of effected people
- preparation of tentative resettlement plan for effected people
- identification of potential area for developing cities and mega cities.

## **2.6 Environmental Study**

Main objective of this study was to prepare Environmental Management Action Plan (EMAP). For this the Consultant collected all environmental related document of this project including existing Initial Environmental Examination (IEE). While carrying out environmental study, the Consultant made close coordination with the Consultants who prepared environmental report. The possible impacts on environment by construction of MHH were identified. An EMAP was prepared which identifies key issues likely to arise from project implementation, and purposes mitigation measures, including monitoring schedule and responsibility. The EMAP outlines project description, environmental management roles and responsibilities, road design, road construction management of different activities, site supervision, monitoring and reporting, records, audits and corrective measures and improvement proposals.

## **2.7 Economical Study of the Project Area**

The Consultant identified the potential areas in the vicinity of the alignment in different fields such as agriculture, hydropower and tourism. Concerned experts worked out regarding existing and new potentialities in the vicinity of the alignment. The following tasks were carried out.

- recognition of existing area for development of agriculture, tourism and hydropower in the vicinity of the alignment
- identification of new areas of potentialities
- identification of possible cash crops to be grown in the area, indigenous crops and their protections, technologies which enable to enhance production
- finding out places for tourism development including identification of appropriate areas for rafting, trekking, golf playing, para gliding which will help to attract local as well as overseas tourist.

- formulating various schemes for self employment of the local population.

## **2.8 Costing**

A costing of the project was determined based on the typical design of structures and pavement. Quantity of the earthwork was calculated on the basis of recently constructed road of similar nature. Total cost will include;

- Cost of new roads
- Cost of upgrading of road as per new design criteria
- Cost of structures, such as retaining wall, longitudinal drains, cross drainage structures, pavement
- Cost of bridges
- Cost for mitigation of environmental impact
- Cost of miscellaneous works such as bio engineering for slope protection, traffic safety, road furniture etc.
- Cost of feasibility study, detailed design of the road
- Cost of environmental study and environmental mitigation works

## **2.9 Economic Analysis of the Project**

An economic analysis has been carried out based on the cost of the project, traffic study and the economical study as described above in the sub chapter 2.7. Main aim of this analysis is to determine economical viability of the project. The financial indicators such as IRR and NPV have been determined in order to evaluate the project economically.

## **2.10 Review of Existing Reports of the Mid Highway**

The consultant collected the relevant reports and documents related to the Mid Highway project and reviewed them in connection to the preparation of DPR

Based on the information above the consultant made their assessment of the present status of the planned mid hill highway and the information provided by the reports were pertinent to proceed forward for the present assignment.

Apart of the above mentioned documents, the Consultant had also reviewed the other relevant documents related to the hydro electricity, geology, environment, tourism and agriculture.

## **2.11 Use of Geographical Information System**

A Geographic Information System (GIS) is an innovative tool and it has diverse range of applications in various subjects. Fundamental to the concept of GIS is the integration between

tabular and cartographic data, at a variety of scales in a common platform related to location. This ability to integrate and analyze the spatial and the attribute data provide a powerful tool for the spatial analysis. GIS also provides a setting to overlay data layers and perform spatial queries, thus to create new spatial data. The results can be spatially mapped, tabulated facilitating efficient analysis. In addition, GIS is equipped with a graphical user interface, which increases the decision-maker's comprehension of the spatial information that is involved in the problem being addressed.

The data like road network, geomorphological features, and geology including the distribution of landslide, land use and so on were the basic information related to the present project for the GIS software through which various information related to multipurpose tasks were obtained and analyzed. All the above mentioned information was stored in vector database of ArcGIS software.

The existing paper maps were transformed and digitized to prepare thematic layers. The required information from existing geological map were extracted and overlay operation was done to better understand the inter-relationship between different factors like geology, geomorphology, landslides along the proposed road alignment. The main functions of GIS are given below:

- **Data Input:** All paper maps and relevant data can be transformed into GIS layers. In addition, existing digital data with spatial information can be imported in the system.
- **Data Management:** It includes the function that needed to store and retrieve data from database which depends on how the data are stored or organized in computer. Likewise, creation of a database by combining different kind of data and establishing linkage between maps and the tabular data is possible.
- **Data Manipulation and Analysis:** Users' involvement is necessary at this stage to perform analysis as per requirements.
- **Data Output:** Represents the final product of the whole system which gives alternatives or options to decision-makers/users. It could be on hard copy (paper) or soft copy (digital format).

Client provided the GIS database of the proposed road alignment (Mid Hill Highway) as well as other road network and bridge locations so as to overlay it on other thematic layers like geology, geomorphology, hydropower locations, drainage etc. for critical evaluation of the alignment. The GIS database was expected to be the following:

- **Line feature:** The thematic layer with the road network (proposed and others) in linear feature.
- **Point feature:** The thematic layer with Global Positioning System (GPS) observation points along the road alignment in point feature. It may also include the bridge locations.

- Information on the coordinate system and projection system of the data is equally important part to maintain the consistency of the data gathered from various sources. The projection system adopted by the Department of Survey, Government of Nepal is Modified Universal Transverse Mercator System (MUTM), which would be the appropriate one in the context of Nepal.

As mentioned above the Consultant was provided updated GIS database (line and/or point features) of the road alignment by the Client which made the work more effective and efficient. The Consultant evaluated and updated the database (wherever applicable) and provided to the Client in the report.

## CHAPTER: 3 ENGINEERING ASPECTS OF THE PROJECT

### 3.1 Study of Existing Alignment

Approximate length of the proposed Mid Hill Highway is 1765 kilometers. The highway passes through 12 zones, 23 districts, and 215 villages and serves nearly 7 million populations.

Out of the total length of 1776 km, nearly 820 km is completed/under construction and the government has given top priority for the completion of the remaining sections.

The alignment of Mid Hill Highway was already been fixed. As per Terms of Reference provided to the Consultant, approximate length of the proposed Mid Hill Highway was 1776 Km. The sections of roads of Mid Hill Highway and their status is below:

**Table no 3.1: Existing Alignment of Mid Hill Highway**

S. No.	Road Section	Approx. Length in Km	Present Condition	Remarks
1	Chiyobhanjyang-Ganeshchowk	59.00	New section, MHHP opening track	
2	Ganeshchowk-Jorsal	40.00	Existing Mechi Highway	
3	Jorsal-Tamor-Sankranti	34.00	New section, track already opened	
4	Sankranti-Myglung	68.00	Construction of Road is going on under RAP	
5	Myglung-Basantapur-Hile	48.00	Existing Feeder Road	
6	Hile-Leguwachhat-Bhojpur	92.00	Existing Feeder Road. Constructed by RAP and Under construction (upgrading) by other project under DOR	
7	Bhojpur-Diktel	90.00	Existing District Road, MHHP upgrading( Road width and surfacing)	
8	Diktel-Ghurmi	82.00	Under construction (upgrading) by other project under DOR	
9	Ghurmi-Khurkot	60.00	New section, MHHP opened track	
10	Khurkot-Nepalthok	37.00	BP Highway, Under construction by Japan Government	
11	Nepalthok-Dhulikhel	50.00	Existing BP Highway	
12	Dhulikhel-Kathmandu	30.00	Existing Arniko Highway	
13	Kathmandu-Pokhara	198.00	Existing TRP and Prithvi Highway	
14	Pokhara-Baglung	72.00	Existing Pokhara-Baglung Feeder Road	
15	Baglung-Burtibang	89.00	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.	
16	Burtibang-Baglung_Musikot Border	60.00	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.	
17	Baglung_Musikot Border-Rukumkot	66.00	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.	

18	Rukumkot-Musikot	39.00	Nepal Army is working in this section and about track opening works with minimum retaining and drainage structures is mostly completed.	
19	Musikot-Chourjahari	43.00	Partly track opened by DDC, however, Mid Hill Highway Project planned to open track within this F Y.	
20	Chaurjahari-Dailekh	103.00	26 km working by RAP, 11km Surkhet-Dailekh Road Section remaining is new section MHHP opening track.	
21	Dailekh-Dullu-Lainchour	39.00	Narrow Existing track opened by DDC, however upgrading works is going on by MHHP.	
22	Lainchour-Satala-Saijula	45.00	New section, MHHP opened track last FY.	
23	Saijiula-Belkhet-Mangalsen	48.00	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.	
24	Mangalsen-Silgadhi	106.00	Existing Feeder Road	
25	Silgadhi-Syule	66.00	Existing Seti Highway	
26	Syule-Satbanjh	70.00	Existing Mahakali Highway	
27	Satbanj-Jhulaghat	42.00	Existing Feeder Road	

The brief description of the each section of the alignment is presented below:

#### **Chiyobhanjyang-Ganeshchowk**

This section of the proposed road is located in Eastern Development Region, Mechi Zone, Panchthar District. The starting point Chiyabhanyang is the boarder of Nepal and India. This section having length of 59 Km ends at Ganesh Chowk via Tharpu. Ganesh Chowk to Tharpu has been implemented by the effort of the local people. The track opening of almost all stretches except 10Km has been completed.

#### **Ganeshchowk-Jorsal.**

This section of the proposed road is located in Eastern Development Region, Mechi Zone. Panchthar District. This section with the total length of 40 Km is the part of Mechi Highway. Upgrading of the existing graveled surface to the blacktop standard has been going on with financial support of Asian Development Bank. However, the road has intermittent lane. Upgrading of lane is required to bring it to the MHH standard.

#### **Jorsal-Tamor Nadi-Sankrati**

This section of the road starts at Jorsal, Phanchthar district and ends at Sankrati of Terathum District. Total length of this section is 34 Km. Detailed design of whole section has been completed. Track has already been opened. The construction of the bridge over Tamor River located along the alignment is going on.



### **Sankranti-Myglung**

This section of road located in the Terathum district has length 68 Km. The end point, Myaglung is the district headquarter of Terathum district. Construction of the road is going on at local level under DFID/RAP. This is single lane road and therefore width has to be upgraded to make it compatible to the standards of MHH. From Sankranti the road runs along the ridge through number of villages and cultivated lands. The section has sharp bends and loops.

### **Myglung-Basantapur-Hile**

Myaglung-Basantapur-Hile section of the proposed road falls under the existing feeder road. Basantapur is located in the Terathum district whereas Hile in Dhankuta district. The total length of the section is 48 Km. Most of the stretches has already been black topped and remaining section will have the same in the near future. However, the road is with intermittent lane which has to be upgraded to the MHH standards. The alignment runs through Jirikhimti and Lasune Ridge. Then it ascends to Lasune Khola and goes down to Hile Ridge via Basantapur. Hile is famous for its panoramic view and it is one of the tourist centre of eastern region.

### **Hile-Leguowaghat-Bhojpur**

The total length this section is 92 Km. This section runs from Hile, Dhankuta to Bhojpur, district head quarter of Bhojpur via Leguwaghat of Dhankuta district. Upgrading of this road has been going on under financial support of ADB. A bridge over Arun Khola located along this section is in the progress with the financial assistance of RAP. From Hile the alignment runs to Pakhribas and descends to Arun Khola. Then it starts to go up to the Shyamsila via Jaryotar and Hile Vanjyang. Jarayotar is potential for the settlement purpose. Most of the alignment passes through cultivated lands. From Shyamsila the alignment again descends and reaches Bhojpur.

### **Bhojpur-Diktel**

This section of the road having approximate length of 90 Km connects two district headquarters. The end point of the section, Diktel is district head quarter of Khotang. Light vehicles are in operation throughout the section. Upgrading of the section to the standards of MHH is required. Presently MHHP is working on this section. Passing through the cultivated land the alignment descends to Setibagar and again climbs upto Annapurna VDC. Upto the Chihane Danda it continues to run up through Jungle. However, it starts to going down from Chihane Danda to Diktel.

### **Diktel-Ghurmi**

Length of this section is about 82 Km. This section runs from Diktel to Ghurmi of Udayapur district via Halesi and Hilepani. Construction of Diktel- Halesi-Hilepani is going on. Similarly, construction Okhaldunga –Gurmi is in progress as the part of Katari-Okhaldhunga Road Project. A major bridge over Dhudh Kosi River is required to be constructed for full operation of the road. Construction of two major bridges over Dudh Koshi River and Sunkoshi River are going on. Firstly, the alignment tends to descend to the Jayaramghat. Then it runs along the bank of the Dudhkosi River upto the Ghurmi.

### **Ghurmi-Khurkot**

This is the new section. It connects Ghurmi of Udayapur district and Khurkot of Sindhuli district. The section has length of 60 Km. Detailed design of the road has already been completed. Track opening work is completed recently. This section will enable to provide easy connection between eastern hilly region and the capital, Kathmandu. For full operation, 12 numbers of bridges have to be constructed. This section runs along the bank of the Sunkoshi through jungle and cultivated lands.

### **Khurkot-Nepalthok**

37 Km long this section of MHH falls in Banepa-Sindhuli-Bardibas Highway(BP Highway). Construction of this section has been going on under financial assistance of Japanese Government. Presently, this section is in operation. Traffic volume in this section will be high. As the road has intermittent lane, traffic problem may occur in future. The road runs along the bank of the Sunkoshi River through cultivated lands.

### **Nepalthok-Dhulikhel**

This section of proposed road is part of the existing BP Highway. The length of this section is 50 Km. The section has same carriage width as in the case of Khurkot-Nepalthok section. The alignment runs through cultivated land and reaches Dhulikhel via Bhakundebsi. From Bhakundebsi to Dhulikhel the road goes along the bank of the Roshi River.

### **Dhulikhel-Kathmandu**

Dhulikhel-Kathmandu Section falls under existing Arniko Highway. The length of the section is 30 Km.

### **Kathmandu-Pokhara**

Total length of this section is 198 Km. Out of total length 22 Km(Kathmandu-Naubise) is the part of Tribhuvan Rajpath(TRP) whereas remaining section (Naubise-Mugling-Pokhara) is Prithvi Highway. Whole length of this section comprises of black top surface.

### **Pokhara-Baglung**

72 Km long Pokhara - Baglung section is the existing feeder road. Baglung is headquarter of Baglung district. The road has intermittent lane and has to be upgraded to bring it compatible to the MHH standards.

### **Baglung – Burtibang**

This section of the proposed highway is located in Baglung District. Total length of the section is about 89 Km. Track has already been opened for whole length of the section. First 25 Km road has gravel surface constructed by District Development Committee. The stretch from 25 Km to 89 Km comprises of earthen surface. Widening of narrow track from 25 Km to 89 Km is going on to make the road with two lanes as prescribed by MHH standard. Detailed design for the whole section has already been completed. From Baglung the alignment ascends to Ghodabandhe and it starts to descend to Hattiyā. After Hattiyā it runs along the bank of the Daram Khola up to the Kharbang. In the Kharbang-Burtibang stretch, the alignment

runs along the bank of Badhigadh Khola. Most of the road corridor is cultivated lands. In order to join Baglung and Burtibang completely, 5 numbers of bridges have to be constructed.

### **Buritibang-Bgalung/Musikot Border**

This section having length of 60 Km from Burtibang and the border of Balgung and Musikot is untouched section of MHH. Detailed design of whole section has already been completed. MHHP has plan to open the track of throughout the length in this fiscal year. Burtibang-Nisigaun stretch of this section runs along the bank of the Nisi Khola through cultivated land. The alignment then goes up to the Patialne through jungle.

### **Baglung/Musikot Broarder-Rukumkot**

66 Km long this section is untouched so far though the detailed design has already been completed. However, MHHP has plan to open the track in this fiscal year. Descending from Patialne to Lukumgaun, the alignment passes through jungle. Then it goes along the bank of Lukum(Damai) Khola passing through the jungle. After having little rise the alignment reaches Rukumkot.

### **Rukumkot-Musikot**

This section with length 39 Km is located in Rukum District. Musikot is the headquarter of the Rukum District. Nepal Army has been constructing this section of the road. Track opening with minimum retaining and drainage structures has already been completed. The section mostly runs along the ridge.

### **Musikot-Chaurjahari**

The total length of this section is about 43 Km among which some portions has been opened by the effort of DDC. There is plan of MHHP to open the track throughout the section in this fiscal year. Detailed design of this section of the road has already been completed. From Musikot the alignment descends and reaches Mugnu Khola. Then it runs along the bank of Sani Bheri upto Rimna where there is confluence of Sani Bheri and Thuli Bheri. The alignment then goes along the bank of the Bheri River up to Chaurjahari.

### **Chaurjahari-Dailekh**

The total length of this section is 103 Km. Construction of 26 Km stretch has been going on by RAP whereas 11 Km by Surkhet-Dailekh Road Project. MHHP has been working for opening the track in remaining portion of the section. For whole the section, detailed design has been completed. After crossing the Bheri River at Chaurjahari the alignment reaches Dailekh via Kudu, Jagatipur, Chheragad, Karkigaun and Thahal.

### **Dailekh-Dullu- Lainchour**

Detailed design of this section of 39 Km has been completed. There is existing track opened by DDC. Although there is operation of transportation modes such as jeeps and tractors, the track is rather narrow. MHHP has been working for upgrading of the narrow track. The alignment descends to the point of crossing of river called Chhamgad. After its crossing, the alignment runs up to the Dullu and it goes down to the Lainchour.

### **Lainchour-Satala-Saijula**

This is also new section with the approximate length of 45 Km. Track opening works has been carrying out by MHHP. Detailed design has already been completed for the whole section. At Lainchour, there is crossing over Paduga Khola along the alignment. After this crossing, the alignment climbs to Jambukandh. Then the alignment begins to descend to the crossing over Ramgad. The alignment reaches Saijiula via Satla.

### **Saijiula-Belkhet-Mangalsen**

This section having length of about 48 Km has already opened track and there is operation of light vehicles in dry seasons. Upgrading of this road to the highway standard has been going on by MHHP. A bridge over Karnali River is under construction by MHHP. The alignment reaches Belkhet after crossing Karnali River. Crossing the places such as Binayak, Turmakhand, the road ascends up to Thulosen. Finally it reaches Mangalsen descending from Thulosen.

### **Mangalsen-Silgadhi**

The section from Mangalsen(Achham district) to Silgadhi(Doti District) is the existing feeder road. The total length of this section is 106 Km. Construction of the road to the earthen standard has been completed from Mangalsen-Sanfebagar(39Km). Out of remaining length, about 24 Km is black topped road. Black topping works has been going on for the remaining stretch. From Mangalsen, the alignment begins to move down up to Kailash Khola crossing. After that it climbs to Jaygad and again descends to Samphebagar via Bayalpata. It passes Chaukhutte, Gamdi and Phulot Khola and finally reaches Silgadhi.

### **Silgadhi-Syule**

This section connecting Silgadhi and Syule(Dadeldhura district) falls in existing Seti Highway. The total length of the section is 66 Km. This section consist of black top surface throughout the section. The alignment moves down unless it reaches Dipayal. It runs with the bank of the Seti River up to Bangdungenes. Rising from Bandungenes it reaches Syaule.

### **Syule-Satbanjh**

70 Km long this section is the part of Mahakali Highway. It connects Syule to Satbanjh of Baitadi District. The road is already in the black top standard. The stretch Syaule-Dadeldhura-Pokhara runs along ridge. The alignment then rises up to Anarkholi and runs along ridge up to Khodpe. It moves down to reach Baitadi(Patan). Ultimately it reaches Satbanjh moving up. Most of the road corridor passes through jungle.

### **Satbanj-Jhulaghat**

This section links Satbanj to Jhulaghat, boarder of Nepal and India. Total length of the section is 42 Km. Construction of this road has already been completed to black top standard.

### **3.2 Alternatives of Existing Alignment**

The Consultant reviewed the existing alignment of Mid Hill Highway and proposed alternative to some sections of the existing alignment. The alternative alignments were identified taking into account the following aspects:

- Economical consideration minimizing the length of some stretches
- Availability of potential economical area such as hydroelectricity, tourism, agriculture etc.

Alternative alignment for the following stretches have been proposed

#### **Jorsal-Tamor-Sankrati and Sankrati-Myaglung**

The existing alignment of these two sections runs from Jorsal to Myaglung via Sankrati. The total length of these sections is 102 Km. There is possibility of aligning the road avoiding Sankrati. This will considerably reduce the length of the alignment resulting reduction of the cost of the project. Length of new Jorsal –Myaglung Section is about 33 Km. Thus some about 69 Km could be minimized. Therefore, existing sections Jorsal-Tamor-Sankrati and Sankrati-Myaglung can be replaced by a new section Jorsal-Myaglung.

#### **Myaglung –Basantapur-Hile and Hile-Leguowaghat Bhojpur**

The existing alignment connecting Myaglung and Bhojpur seems to be rather deviated. A considerable saving in terms of length could be achieved avoiding Hile. Total length of two existing sections is about 140 Km. The existing sections Myaglung-Basantapur-Hile and Hile-Leguowaghat-Bhojpur can be replaced by new sections Myaglung-Basantapur-Leguowaghat and Leguowaghat-Bhojpur. The total length of the new sections will be 121 Km . Thus saving of about 19 Km could be achieved by this replacement.

#### **Chaurjahari-Dailekh and Dailekh-Dullu-Lainchour**

The existing alignment of these two sections runs through Dailekh. Total length of these two sections is about 125 Km. In the case of avoiding Dailekh, the total length would be 118 Km. Thus saving of 7 Km would be achieved.

#### **Mangalsen –Silgadhi**

An alternative alignment for the stretch Bhajankot – Bayalpata in the section Mangalsen-Silgadhi can be proposed. This will save about 8 Km.

The existing alignment in from Sanfe to Dipayal in Manangalsen-Silgadhi Section runs through Chaukhutte with considerable loops. An alternative alignment running along the right bank of the Budhi Gandaki River to confluence of Budhi Gandaki and Seti River and then left bank of the Seti River could be proposed. This alternative alignment will not only be technically good comparatively, but also economical. The existing alignment from Sanfe to Dipayal is about 80 Km whereas some 20-25 Km could be saved in the case of alternative alignment along the river bank.

### 3.3 Review of Design Standard/Criteria's

Design standards of the Mid Hill Highway are fixed as per the discussion with client and the information provided to the consultant Table 3.2 shows the design standards to be adopted in the MHH.

**Table: 3.2 Design Standard of Mid Hill Highway Project**

S.N	Design Parameter	Existing MHHP Standards	Recommended Standards
1	Design Speed	50 kmph	50 kmph
2	Right of Way	25m (On either side form center line)	25m (On either side form center line)
3	Carriageway Width	7.0 m	7.0 m
4	Total Formation Width	8.50 m	9.0 m
5	Shoulder Width	0.5 m valley side	0.5 m both side
6	Earthwork Excavation Width in Hill Side	3.5 + Drain Width	3.5 + Drain Width
7	Camber of Carriage way	3%	3%
8	Camber of Shoulder	5%	5%
9	Minimum Horizontal Curve Radius	15 m	15 m
10	Vertical Curve		
a.	Minimum Radius	500m	500m
b.	Minimum Length	40m	40m
11	Maximum Gradient	8%	10%
12	Average Gradient	5%	7%
13	Minimum Gradient	1%	
14	Limitation of Maximum Gradient length above average gradient		
a.	Mountainous/Steep Terrain (Percent cross slope > 25 < 60)	150m	150m
b.	Rolling Terrain (Percent cross slope > 10 < 25)	210m	210m
15	Maximum Recovery Gradient to be applied after gradient in excess of average grade for the minimum recovery length of:		
a.	150m in mountainous/Steep terrain	3%	3%
b.	210m in rolling terrain	4%	4%
16	Vertical clearance	5m	5m
17	Minimum stopping sight distance	65m	65m
18	Hairpin Bends:		
	Min. spacing between centers of bends	100m	100m
	Min. transition curve length	15m	15m
	Max super elevation	10%	10%
	Min. carriageway width at apex	11.50 m	11.50 m
19	Maximum super elevation	7%	7%

The Consultant went through the each standard in details and has suggested most suitable criteria to be adopted for the proposed project. Most of existing standards are found suitable. However, the Consultant has recommended to modify some standards. The existing standard has shoulder only on valley sides. The consultant recommends 0.5m wide shoulder on the both side for the safety reason. Thus overall formation width will be 9.0 m. Similarly, according to existing standard Maximum and Average Gradient are 8 and 5% respectively. All of section of the alignment falls in hilly region. It is very difficult to achieve the gradients as stated in the existing standard. Therefore, the Consultant recommends to adopt Maximum and Average Gradient of 10 and 8% respectively.

### 3.4 Traffic Studies and Forecasts

#### 3.4.1 Introduction

It is usual to consider following four categories of traffic when making forecasts of future traffic, because the benefits accruing to each category are different:

Normal Traffic – traffic that would use the road if no construction or improvement of the road section were made;

Diverted Traffic – traffic that changes from another route or mode of transport as a result of the construction or improvement of the road, because the study road is now part of a faster or lower cost route;

Generated Traffic – travel that is associated with journeys that will only be made in response to travel cost and time savings obtained as a result of the construction or improvement of the road; and

Induced Traffic – traffic that arises because of local development that occurs only as a result of the road construction or improvement.

#### 3.4.2 Study Road Section

Traffic of following road sections of MHH are estimated to determine road user costs over the analysis period:

**Table 3.3: Existing Alignment of Mid Hill Highway**

S.No.	Road Section	Approx. Length in Km	Present Condition
1	Chiyobhanjyang-Ganeshchowk	59	New section, MHHP opening track. Detailed Design Completed
2	Ganeshchowk-Jorsal	40	Existing Mechi Highway
3	Jorsal-Tamor-Sankranti	34	New section, MHHP opening track. Detailed Design Completed
4	Sankranti-Myglung	68	Construction of Road is going on under RAP
5	Myglung-Basantapu	48	Existing Feeder Road
6	Basantapur-Hile		Existing Feeder Road

7	Hile-Leguowaghat	92	Existing Feeder Road. Constructed by RAP and Under construction (upgrading) by other project under DOR
8	Leguowaghat-Bhojpur		Feeder Road. Constructed by RAP
9	Bhojpur-Diktal	90	Existing District Road. Detailed Design Completed.
10	Diktal-Ghurmi	82	Under construction (upgrading) by other project under DOR
11	Ghurmi-Khurkot	63	Earth Road. MHHP opening track. Detailed Design Completed
12	Khurkot-Nepalthok	32	BP Highway. Under construction by Japan Government
13	Nepalthok-Dhulikhel	50	Existing BP Highway
14	Dhulikhel-Kathmandu	30	Existing Arniko Highway
15	Kathmandu-Pokhara	198	Existing TRP and Prithvi Highway
16	Pokhara-Baglung	72	Existing Pokhara-Baglung Feeder Road
17	Baglung-Burtibang	89	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.
18	Burtibang- Rukumkot	126	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.
19	Rukumkot-Musikot	39	Untouched section, however, Mid Hill Highway Project planned to open track within this Fiscal Year.
20	Musikot-Chourjahari	46	Nepal Army is working in this section and about track opening works with minimum retaining and drainage structures is mostly completed.
21	Chaurjahari-Dailekh	89	Partly track opened by DDC, however, Mid Hill Highway Project planned to open track within this F Y.
22	Dailekh-Dullu-Lainchour	36	26 km working by RAP, 11km Surkhet-Dailekh Road Section remaining is new section MHHP opening track.
23	Lainchour-Satala-Saijula	45	Narrow Existing track opened by DDC, however upgrading works is going on by MHHP.
24	Saijiula-Belkhet-Mangalsen	53	New section, MHHP opened track last FY.
25	Mangalsen-Silgadhi	106	Track opened with minimum retaining and drainage structures and upgrading works is going on under MHHP.
26	Silgadhi-Syule	66	Existing Feeder Road
27	Syule-Satbanjh	70	Existing Seti Highway
28	Satbanj-Jhulaghat	42	Existing Mahakali Highway

Source: DOR



### 3.4.3 Traffic Data Collection

#### 3.4.3.1 Collection of Normal Traffic Data

To forecast future traffic of a road section after improvement or after construction it is first necessary to estimate the level of base year normal traffic of the existing road or trail. Generally, base year volume and composition of normal traffic movements in the existing road are calculated through Classified Manual Vehicle Counts (CMVCs) and Origin and Destination (O\_D) survey in the existing trail. However, these counts and surveys require longer period of time. The scope and time frame of the present study does not permit such counts and surveys. Hence, base year normal traffics of different sections of the proposed MHH are estimated based on secondary sources.

Each year Department of Roads (DOR) organises CMVCs at different locations in national highways and feeder roads and estimate annual average daily traffic (AADT) of sections of highways and the feeder roads. DOR is found to estimate AADTs of road sections 2, 5-7, 14-16 and 25-28 of the MHH shown in Table 3.3. Table 3.4 shows the prevailing AADTs of the sections of the proposed MHH.

**Table 3.4: Annual Average Daily Traffic (AADT) in the Project Road Sections**

S.No.	Road Sections	AADT								Tractor	Total
		Truck	Mini Truck	Bus	Mini bus	Micro bus	Car	MC	Utility		
1	Ganeshchowk-Jorsal	61	358	10	7		6	60	40	53	595
2	Myglung-Basantapur	55	18	34			7	43	65	16	238
3	Basantapur-Hile	121	8	58		64	4	184	122	44	605
4	Hile-Leguwachhat	32	8	37	5		24	45	66	14	231
5	Dhulikhel-Kathmandu	519	62	361	69	35	551	242	1,336	43	3,218
6	Kathmandu-Pokhara	443	96	209	206	237	139	356	28	93	1,807
7	Pokhara-Baglung	63	71	86	171	43	127	442	192	54	1,249
8	Mangalsen-Silgadhi	95	66	44	36	31		91	125	40	528
9	Silgadhi-Syaule	139	109	51	38	72		98	188	60	755
10	Syaule-Satbanjh	113	87	65	72	69	7	146	205	16	780
11	Satbanj-Jhulaghat	33	14	19	15	11		30	25	11	158

Source: DOR Traffic Counts, 2009

Studies are already carried out to upgrade road sections 8 and 10 of the MHH shown in Table 1.1 for improvement under Connectivity Project (RCP II) and Road Improvement Project (RIP) of DOR/ADB/the World Bank. During the studies AADTs of the road sections are estimated to project future traffic of the sections. Table 3.3 shows calculated AADTs of the road sections

**Table 3.5 Annual Average Daily Traffic (AADT) in the Project Road Sections**

S.No.	Road Sections	AADT							
		Truck	Mini Truck	Bus	Mini bus	MC	Utility	Tractor	Total
1	Bhojpur-Diktal	10	12	10	12	15	10	18	87
2	Diktal-Ghurmi	4					16		20

Source: DOR, September, 2010

Currently, motorised vehicle of some sorts are operating in the road sections 11-13, 17, 22 and 24 of the MHH shown in Table 3.3. Traffic data of the sections as such are not available. Hence, transporters and drivers operating in the roads were interviewed to find out prevailing traffic level of the roads. AADTs of the road sections are estimated based on information provided by them. Table 3.6 shows AADTs of the road sections.

**Table 3.6 Annual Average Daily Traffic (AADT) in the Project Road Sections**

S.No.	Road Sections	AADT						
		Truck	Bus	Car	MC	Utility	Tractor	Total
1	Bhojpur-Diktal	12	10		87	30	10	148
2	Ghurmi-Khurkot	10	12		110	37	13	182
3	Khurkot-Nepalthok	5	6		56	19	7	92
4	Nepalthok-Dhulikhel	13	16	13	145	49	17	254
5	Baglung-Burtibang	15	8		69	23	8	114
6	Dailekh-Dullu-Lainchour	6	8		70	24	8	116
7	Saijiula-Belkhet-Mangalsen	4	6		50	17	6	83

Source: Transporters and Drivers, October 2010

At present opening of earth track/road in sections 1, 3, 4, 19, and 20 of MHH shown in Table 3.3 are underway. However, sections 18 and 23 are earth trails only. In the sections currently mode of travel is walking and those of transporting goods are porter and animals. Data on the prevailing traffic movements in the sections are not available.

In the absence of traffic data of existing trail/track before new construction of a road the study of Sector Wide Road Programs and PIP Study, DoR/the World Bank, 2007 after extensive observations of traffic in the trails/tracks of Nepal and comparisons with the population of the areas served by them has derived a set of standard factors for use in estimating total freight and passenger traffic from the population numbers in the influence area (ZOI). The population in the ZOI is that population for which the trail/track is the nearest access to a road. The factors are shown in Table 3.7. Due to absence of traffic data of the sections the factors given in Table 3.7 are used to estimate non-motorised AADT of the sections. The AADTs are estimated based on an average number of journeys made, and an average weight of products consumed and exported per person per year. Table 3.8 shows the population based non-motorised daily traffic in the trail/track sections of MHH. In general a porter carries 50Kg of goods per trip.

**Table 3.7 Factors for Estimating Population Based Transport Demand**

Traffic	IZOI
Import Freight (Kg/Person/Year)	25
Passenger Trips (Trips/Person/Year)	0.4

**Table 3.8 Population Based Travel and Transport Demand in Trails/Tracks**

S.No.	Road Section	Population	Porter	Pedestrian
1	Chiyobhanjyang-Ganeshchowk	295,000	404	323
2	Jorsal-Tamor-Sankranti	289,000	419	335
3	Sankranti-Myglung	612,000	838	671
4	Burtibang- Rukumkot	378,000	863	690
5	Rukumkot-Musikot	356,000	488	390
6	Musikot-Chourjahari	361,000	495	396
7	Chaurjahari-Dailekh	258,100	354	283
8	Lainchour-Satala-Saijula	235,000	322	258

Source: Consultants' Estimates.

It is always true that after a road project pedestrians will ride buses, cars/jeeps and motorcycles and freights will be carried by trucks and tractors etc. Table 3.9 shows factors used to convert estimated total pedestrian trips and porter traffic to motorised vehicle movements after the project. Similarly, Table 3.10 shows motorised vehicle traffic calculated based on the factors given in Table 3.9

**Table 3.9 Factors Used to Convert Non-motorised Traffic to Motorised Traffic**

Main Haul Trucks with 5 ton load and empty return:	75% of import freight
Tractors with 1.5 tons load and empty return:	25% of import freight
Buses with 40 passengers per bus with return trips:	40% of passenger trips
Commercial Jeeps (Passenger) with 15 passengers per vehicle with return trips:	45% of passenger trips
Motorcycles with 1.7 passengers per vehicle with return trips:	15% of passenger trips

**Table 3.10 Normal Motorised Vehicle Traffic Converted from Non-motorised Traffic**

S.No.	Road Section	Motorcycle	Bus	Heavy Truck	Utility	Tractor	Total
1	Chiyobhanjyang-Ganeshchowk	57	6	5	19	7	95
2	Jorsal-Tamor-Sankranti	59	7	5	20	7	98
3	Sankranti-Myglung	118	13	10	40	14	196
4	Burtibang- Rukumkot	122	14	11	41	14	202
5	Rukumkot-Musikot	69	8	6	23	8	114
6	Musikot-Chourjahari	70	8	6	24	8	116
7	Chaurjahari-Dailekh	50	6	4	17	6	83
8	Lainchour-Satala-Saijula	45	5	4	15	5	75

Source: Consultants' Estimates

### **3.4.3.2 Calculation of Diverted Traffic**

Currently people of district head quarter (HQ) of one district have either to take long detour or travel for long time to reach even the district HQ of adjacent district. After the construction of MHH the hardship of people taking long detour or longer travel will be eliminated. People will divert from current hardship of taking longer detour to travel between the HQ of adjacent districts.

Estimating volume of diverted traffic in the sections of proposed alignment of MHH after its construction requires numerous origin and destination (O-D) surveys in many locations. The scope and time frame of the present study does not permit such surveys. Hence, estimation of volumes of diverted traffics to different sections of the proposed alignment of MHH are not carried out.

### **3.4.3.3 Generated Traffic**

Additional journeys can be expected as a result of lower costs of travel on the sections of the proposed alignment of MHH after construction of the highway. The principle behind generated traffic is that additional journeys will be made as a result of lower costs of travel on the improved roads. The number of additional trips is usually based on the reduction in travel and transport costs, with the response based on the price elasticity. Similar to demand elasticity, price elasticity is the proportional change in the number of trips per unit change in price. It has been measured in road appraisal studies in developing countries and usually found to fall in the range -0.6 to -2.0, with an average of about -1.0. This means that a one per cent decrease in transport costs leads, on average, to a one per cent increase in traffic. Evidence suggests that the elasticity of demand for passenger transport is well above that for freight transport. The cost reduction following improvement depends largely on the existing condition of the trail/road. Reductions of travel and transport costs by 30 to 40 percent can be expected in the case of trail or unsealed roads. With improvements to sealed roads the cost reduction will normally be below 25 percent, and it is normally considered that there is no significant generation below this level.

It is difficult to estimate generated traffic levels in Nepal using standard theoretical approaches. Where present road condition is bad the traffic levels are often very low, and the types of vehicles that operate are restricted. It is difficult to apply generation rates based on reductions in costs in these circumstances and obtain a reliable forecast of future traffic. Frequently in road studies in Nepal estimates are made of the traffic potential of roads based on the level of population served by the road. The procedure for this was developed in the Priority Investment Plan (PIP) study<sup>1</sup>. Assumed freight and passenger movements are estimated by applying annual average goods imports and passenger trips per head, and converting these to vehicle movements using a range of vehicle types and standard loads. The assumptions have been revised since PIP following more analysis of traffic levels in hill areas, with higher volumes of freight per person now assumed. This type of analysis normally shows that the potential freight traffic is largely met once a low standard road is provided, but passenger trips are greatly restricted until a sealed road is provided. This suggests that trips are highly restricted by poor road conditions, which makes travel time consuming, expensive and uncomfortable.

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<sup>1</sup> Priority Investment Plan, for Department of Roads, Final Report 1997, Wilbur Smith Associates and TAEC Consultant P) Ltd.

Keeping in mind all the above possibilities and difficulties following assumptions are made to estimate generated traffic. When a trail/track will be upgraded to sealed standard generation rates of 25 percent is assumed to current freight traffic and 50 percent to passenger traffic. When an unsealed road will be upgraded to sealed standard generation rates of 15 percent is assumed to current freight traffic and 40 percent to passenger traffic. Generated traffic is not considered for the existing paved sections of MHH.

#### **3.4.3.4 Induced Traffic**

Induced traffic can occur when the increased economic growth, as a result of the road improvement, produces additional traffic on the road. This is not generated traffic, which is additional traffic resulting directly from a lowering of transport costs, but it overlaps with generated traffic and care must be taken to avoid double counting if induced traffic benefits are calculated. The increased economic development associated with the improvement of the roads could be in the form of hydro schemes, opening up of new tourist facilities or agro industries. 10 percent of normal traffic is assumed to be induced traffic for the improvement of trail/track and unsealed sections to paved standard. Induced traffic for the paved sections of the alignment of MHH is not considered.

### **3.4.4 Traffic Growth**

#### **3.4.4.1 Traffic Growth Rate**

The demand for transport is related to the size of the economy, and normal traffic growth is therefore correlated with economic growth. Relationships between demand and either price or income are known as elasticities. Demand elasticity for transport is defined as the ratio of the percentage change in transport demand to a percentage change in income. If national income is defined as gross domestic product (GDP) then traffic growth can be expressed in the form:

$$\text{Annual Traffic Growth Rate} = (G/100 \times E) \times 100$$

Where: G is the annual real growth rate of GDP, and

E is the income elasticity of transport demand.

Thus if the real growth in GDP is 5 percent and the elasticity is 1.5, the traffic growth rate is 7.5 percent. Using such a relationship it is possible to relate future traffic growth to predicted economic growth, as measured by GDP, rather than simply extrapolating past time series traffic data. In the case of passenger transport demand the population and income effects are sometimes separated. In this case the relationship between population growth and traffic growth is assumed to be 1.0 and the income elasticity then relates to growth in average income per head. However GDP growth implicitly includes both population growth and per capita income growth, and so both freight and passenger traffic growth can be related to GDP growth in the simple form of relationship shown above.

To determine appropriate values for the elasticities for use in predicting traffic growth it is necessary to estimate historical rates of traffic growth and compare these with GDP growth over the same period. Various indicators can be used to do this. Fuel sales and vehicle registrations are often used to indicate traffic growth, although these rarely give a clear or consistent indication of growth. The preferred method

is to examine time series data of actual traffic levels. However, fluctuations in traffic levels often make it difficult to compare traffic count results to obtain realistic estimates of growth rates, unless data are available over many years or very accurate data, based on counts over seven days or longer, are available.

Automatic traffic counters (loggers) were introduced by the DoR at almost 30 sites on the national highway network during the 1990s and were used until 2001, providing data over several years at the same site in some cases. Even though these monitored traffic flows almost continuously, and so provide more accurate results than manual counts, they showed erratic growth over time at individual sites and inconsistent growth in the same year at different sites. The weighted average annual growth over a five-year period in the mid-1990s, when the security situation was normal, was 8.2 percent, but with the average affected by some very high rates over short periods. However the loggers showed that traffic levels were generally rising significantly, if erratically, and that the average normal traffic growth was at least 7 percent per year. Over this five-year period GDP growth rate averaged 4.3 percent per year in real terms. If traffic growth averaged between 7 and 8.2 percent per year over this period then the elasticity of overall transport demand is in the range of 1.6 to 1.9. This is consistent with the findings of previous studies in Nepal and with those in other countries at a similar stage in development.

The automatic counters did not classify vehicles, and so it is not possible to determine from the results if there were differences in the growth rates of different vehicle types, or even in passenger and freight vehicles. Usually passenger traffic increases more rapidly than freight traffic. Whereas freight transport usually increases only slightly above GDP growth, if GDP per head is increasing there is significantly more personal travel. The pattern is often that there is first an increase in bus traffic, followed by rapid growth in motorcycle traffic and later in car traffic as personal incomes rise to the level where there is growing ownership of private vehicles to significant levels.

There is a large amount of traffic count data available from over 100 routine count sites on the Strategic Road Network in Nepal (over the last ten years the number of sites has increased from 114 to 140). Three-day, classified manual counts were carried out at all of these sites every year. Because of the security situation there was no counting in 2002 and 2003. Counting was carried out in 2004 but there was again none in 2005 and 2006. Counts have resumed and were carried out each year over the period 2007-09. Traffic flows in this most recent period may have been affected by local disturbances to traffic. These factors, plus the fact that many roads in Nepal have low traffic, which is generally less consistent than higher volumes, and changes in the network, mean that the classified counts also show erratic growth for individual links, and no consistency between links. At some sites the total (excluding motorcycles and non-motorized traffic) more than doubles between years, at other sites it falls by more than half between the same years. The wide differences in traffic growth rates indicated by the results from these counts are beyond the range that would normally be expected and make impossible to derive precise elasticities from the counts. Even when results are aggregated to regional level there are still major differences in the growth rates. Some patterns emerge, with strong growth in car traffic and in minibus traffic, and higher growth for light trucks than heavy trucks. The apparent change to use of lower capacity vehicles makes it difficult to determine overall passenger and freight traffic growth rates. Motorcycle numbers have only been recorded since the 2004 counts and so there is less information on which to base motorcycle traffic growth rates, although it is obvious that in some areas there has been a very rapid increase in recent years.

Elasticities of 1.3 for freight traffic and 1.8 for passenger traffic are considered to be reasonable. At present most freight is carried on two-axle trucks. In recent years there has been a large expansion in the fleet of light (mini) trucks in Nepal, with a lower capacity than the traditional two-axle trucks, which has had the effect of increasing total truck traffic and causing rapid growth in light truck traffic. It is unlikely that this will continue. In the long term it is probable that the number of higher capacity three-axle and articulated vehicles will increase on some routes, but the terrain in Nepal, and the low cost of the dominant Tata two-axle trucks, means that the overall change in composition of the truck fleet will be small. Changes in the average weight of loads carried by trucks, which may increase following road improvement or decrease following more rigorous enforcement of axle load regulations, can also affect the traffic level for a given freight volume. However, the potential impact on traffic growth is small enough to be ignored. For passenger traffic it is assumed that there will continue to be significantly higher levels of growth for motorcycles and light passenger vehicles than for buses. Growth rates tend to reduce over time as economies develop and vehicle fleets stabilise and so lower levels have been assumed for the second half of the evaluation period.

In the last ten years GDP growth has been low compared with the 1990s. In 2002 the economy declined, mainly the result of drought and an upsurge in insurgency, and average annual growth was then less than 4 percent for several years. Growth averaged about 5 percent in 2008 and 2009, but is forecast by both ADB<sup>2</sup> and the World Bank to be 3.5 percent in 2010 (financial year 2010 ending 15 July 2010). The main reasons for the current low growth are cited as the weak performance of industry and agriculture, which have offset good growth in the service sector. External events in the world economy have also had an impact. Industrial growth is expected to remain low due to continued political disturbances, frequent power cuts, and fuel shortages. Poor weather has reduced agricultural growth. Long-term forecasts of economic growth are difficult, but it seems unlikely that average growth will exceed 5 percent per year, and 4.5 percent is a more realistic figure given past performance and ongoing difficulties. Forecasts are necessarily tentative. It is usual to change growth rates over time, but given the uncertainties it seems appropriate to use a single rate. There have clearly been large differences in traffic growth rates on different road sections over short periods, but there is no clear pattern to these, and there is no systematic method of forecasting normal traffic growth on a link by link basis. Therefore a national rate has been used for all road sections, in the expectation that growth on individual links will reflect this over the longer term.

Applying the forecast 4.5 percent GDP growth to the elasticities gives annual growth rates of normal traffic as shown in Table 3.11.

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<sup>2</sup> *Nepal Quarterly Economic Update, Volume VII No.1, March 2010, Asian Development Bank.*

**Table 3.11 Traffic Growth Rates**

Period	GDP Growth (% p.a.)	Freight Traffic		Passenger Traffic					
				Large Bus		Car & Small Bus		Motorcycle	
		Elasticity	Growth (% p.a.)	Elasticity	Growth (% p.a.)	Elasticity	Growth (% p.a.)	Elasticity	Growth (% p.a.)
2010-22	4.5	1.2	5.4	1.4	6.3	1.8	8.1	2.0	9.0
2023-32	4.5	1.1	5.0	1.2	5.4	1.5	6.8	1.5	6.8

Source: Consultants' Estimates

### 3.4.4.2 Traffic Forecasts

Using the analysis discussed in above paragraphs, and the forecast traffic growth rates, future traffic in the sections of the alignment of MHH are projected. The generated and induced traffics are assumed to grow similar to normal traffic. Table 3.12 gives the future AADT of the sections of the alignment of MHH.

**Table 3.12: Future AADT of the sections of the alignment of MHH After Project**

S.No.	Road Section	Total AADT 2012	Total AADT 2022	Total AADT 2032
1	Chiyobhanjyang-Ganeshchowk	166	291	297
2	Ganeshchowk-Jorsal	663	1144	1883
3	Jorsal-Tamor-Sankranti	172	302	308
4	Sankranti-Myglung	344	603	615
5	Myglung-Basantapur	268	491	842
6	Basantapur-Hile	682	1250	2137
7	Hile-Leguowaghat	261	480	824
8	Leguwaghat-Bhojpur	296	536	973
9	Bhojpur-Diktal	243	425	467
10	Diktal-Ghurmi	295	542	1001
11	Ghurmi-Khurkot	299	523	570
12	Khurkot-Nepalthok	152	266	290
13	Nepalthok-Dhulikhel	395	692	754
14	Dhulikhel-Kathmandu	3655	6983	12322
15	Kathmandu-Pokhara	2032	3691	6273
16	Pokhara-Baglung	1405	2565	4353
17	Baglung-Burtibang	200	349	388
18	Burtibang- Rukumkot	354	621	633
19	Rukumkot-Musikot	200	351	358
20	Musikot-Chourjahari	203	356	363
21	Chaurjahari-Dailekh	145	254	260
22	Dailekh-Dullu-Lainchour	190	333	363
23	Lainchour-Satala-Saijula	132	232	236
24	Saijula-Belkhet-Mangalsen	156	273	278



25	Mangalsen-Silgadhi	597	1118	1951
26	Silgadhi-Syule	856	1616	2843
27	Syule-Satbanjh	886	1691	2989
28	Satbanj-Jhulaghat	178	331	573

Source: Consultants' Estimates

### **3.5 Typical Design of Pavement and Structures**

The Consultant has provided typical cost effective design of structures such as retaining wall, side drains, cross drainage structures, slope protection works, pavement etc. and presented as typical designs in the drawing.

#### **3.5.1 Design of Pavements**

Design of pavement essentially needs the detailed information on traffic, sub-grade soil strengths, availability of pavement materials, as gravel and suitable rocks for crushing to produce the required pavement material. The life of pavement is determined in terms of million standard axles (MSA) passing through the highway in its design life. Detailed pavement design at the present study is out of scope. Further, pavement could be designed as rigid or flexible. However, for a flexible pavement indicative designs of pavement will essentially consist of sub-base, road base or base course and a suitable type of surfacing course. Similarly rigid pavement should have sub-base and a suitable layer of plain cement or reinforced cement concrete slab, which should have adequate thickness as determined by the design. Indicative typical designs of the pavements are produced in drawings.

##### **3.5.1.1 Sub grade Strength of Soils**

Sub-grade is the natural soil which may be existing local material or may be transported and placed as a fill and compacted to give added strength. The assessment of strength of the sub-grade soil is one of the most important tasks which give the design parameters for the pavements. Generally the strength of the sub-grade soil is assessed by carrying out the California Bearing Ratio (CBR) tests at the laboratory of the samples taken from the field. Sometimes, the CBR is also determined by means of Dynamic Cone Penetration (DCP) Test carried out along the road alignment. The penetration of the cone are interpreted and co-related with CBR. However, design CBR of the sub-grade is recommended to be taken from the laboratory testing as CBR interpreted through DCP lacks accuracy.

##### **3.5.1.2 Design Life of the Pavement**

Design life of a pavement is measured in terms of cumulative number of standard axles passing through the pavement in its entire life. The standard axle is considered to be 8160 kg load in an axle of a vehicle as established by the AASHO road test. The conversion factor for the measured axle load to the standard axle lies in the exponent of 4 to 5. It is taken 4.55 for Nepal as suggested by TRRL. All axle loads of commercial vehicles are converted into standard axle loads and added together to get the cumulative number expressed in million standard axles (mse) considering the annual growth of traffic for the design life of pavement which could be between 10 to 15 years for a developing country like Nepal. Sub-grade strength in one hand and the design life msa in the other the thickness of different structure layers of the pavement will be designed. There are various methods available for the design of pavement.

#### **3.5.1.3 Capping Layer or Selected Fill**

In the areas where the strength of subgrade soil is weak and has CBR below 5 %, a suitable filling material will be needed to enhance the strength of the sub-grade soil. This material should have higher CBR imported from elsewhere or improved the existing sub-grade by chemical stabilization. This selected fill also sometimes called as capping layer.

#### **3.5.1.4 Sub-base**

This forms a load distributing layer above the road base. Sub-base material essentially consists of naturally occurring gravel, gravel sand or gravel clay or the crushed rock or suitable material which meets the strength criteria and forms the lowermost layer of pavement structure. This layer serves as separating layer for the overlaying road base thus preventing contamination of the road base by the sub-grade. This has also another important role to play that it protects the sub-grade from damage from construction traffic. The thickness of sub-base is determined by the design and laid in accordance with the specified manner.

#### **3.5.1.5 Road Base**

This acts as the main load spreading layer for the pavement. This normally consists of crushed rock or gravel or of gravelly soils, decomposed rock, sands and sand clays stabilized with cement, lime or bitumen. Sometimes, premixed asphalt is also laid on top of the road base and they are called base course.

#### **3.5.1.6 Surfacing /Wearing Course**

This is the uppermost layer of the pavement and consists of the double surface dressing or a layer of premix bituminous material. The surface dressed course is called the surfacing and if it is premixed bituminous material it is called wearing course.

The pavement type along the MHH will be different for different types of traffic loading and for the economic design a thorough investigation of the sub-grade as well as traffic level will be necessary for different stretches of road. Sometimes a rigid pavement with or without reinforcement may be necessary at some stretches of road. However, the detailed design of the pavement should be carried out before actual construction. At present for the preparation of DPR the above indicative design are thought to be sufficient. Typical cross-section of the road has provided the indicative pavements in the drawing attached to this report.

### **3.5.2 Design of Protection Structures**

One of the most important features of designing a highway in the hills and mountains of Nepal is to design suitable protection structures either to retain the road as retaining walls or to protect the hill slopes as breast or revetment walls.

### **3.5.2.1 Retaining Walls**

There can be many types of retaining walls that are designed in highway project of this magnitude. Some of the retaining walls presently in use in Nepal are:

Cement mortared random rubble masonry

Gabion walls in the form of crates/boxes

Banded composite type of walls

Reinforced cement concrete walls with or without anchors

Typical designs of such walls are presented in drawings.

### **3.5.2.2 Breast/ Revetment Walls**

Similar type of construction as retaining walls is applicable in cases of breast/ revetment walls.

### **3.5.3 Road Safety Works**

A comprehensive road safety designs as delineators, guide blocks, crush barriers, road traffic signs and road marking will be given in this respect. Existing traffic and safety manual of the DOR has been followed as far as practicable. The typical design of all such structures is included in the drawing.

### **3.5.4 Bio Engineering and Landscaping**

Small scale civil engineering works combined with the bio engineering techniques are very cost effective particularly for protection of mountain slopes and against erosions during the rainy season. Existing manuals of DOR on bio engineering techniques are used to design such works

### **3.5.5 Drainage Works**

A good drainage is pre requisite for a safe mountain highway, safe discharge of collected rain water is yet another important aspect in designing a highway. Capacity of a drain is calculated by using various techniques. Use of rational formula and Manning's law for velocity calculation is widely used in the highway drainage design.

#### **3.5.5.1 Longitudinal Drains**

Rain water collected along the formation of the road as well as from the hill slopes should first be channelized through the longitudinal drains constructed along the alignment of the highway. There are many types of drain designs, all such typical designs are produced and given in the drawing form.

### 3.5.5.2 Cross Drainage Works

Cross drainage works such as culverts and cause ways are required to either safe discharge of the collected water along the road or they are required to cross the existing natural drainages such as creeks and rivulets etc. Typical designs of such structures are produced as drawings.

## 3.6 Identification of Bridges

Bridges are required to cross medium and big rivers. Detailed design of the bridges at different locations of the highway will be required at a later stage. All such crossings are taken into account and reported in the report. Length of the all bridges is determined with the help of tentative hydrological analysis of the streams. Some of the bridges along the highway have already been designed and their length has been given in the table no 3.13 below.

**Table no 3.13 Bridges Located along Proposed Alignment**

S.No.	Name of Bridge	Approx. Length, m	Road Section	Remarks
1	Musepa Khola	20.00	Chiyo Bhanjyang-Ganesh Chowk	
2	Mewa Khola	40.00	Chiyo Bhanjyang-Ganesh Chowk	
3	Silsile	25.00	Chiyo Bhanjyang-Ganesh Chowk	
4	Sarki	25.00	Chiyo Bhanjyang-Ganesh Chowk	
5	Phalam	25.00	Chiyo Bhanjyang-Ganesh Chowk	
6	Tamor river	200.00	Jorsal-Tamor-Sankranti	
7	Koya	50.00	Sankranti-Myglung	
8	Leguwa Khola	60.00	Hile- Leguwa Ghat- Bhojpur	
9	Arun River	250.00	Hile- Leguwa Ghat- Bhojpur	
10	Sera Khola	30.00	Bhojpur-Diktel	
11	Pikhuwa Khola	30.00	Bhojpur-Diktel	
12	Hinguwa Khola	25.00	Bhojpur-Diktel	
13	Yanta Khola	30.00	Bhojpur-Diktel	
14	Dudh Koshi	40.0	Diktel-Ghurmi	
15	Sunkoshi	150.00	Diktel-Ghurmi	
16	Bahadure Khola	100.00	Ghurmi-Khurkot	
17	Sokhu Khola	100.00	Ghurmi-Khurkot	
18	Chalne Khola	20.00	Ghurmi-Khurkot	
19	Jittu Khola	25.00	Ghurmi-Khurkot	
20	Khangsang Khola	20.00	Ghurmi-Khurkot	
21	Sakhar Khola	25.00	Ghurmi-Khurkot	
22	Nihura Khola	25.00	Ghurmi-Khurkot	
23	Waksu Khola	100.00	Ghurmi-Khurkot	

24	Tyun Khola	25.00	Ghurmi-Khurkot	
25	Foshre Khola	15.00	Ghurmi-Khurkot	
26	Bittijor Khola	100.00	Ghurmi-Khurkot	
27	Banjijor Khola	100.00	Ghurmi-Khurkot	
28	Hyber Khola	40.00	Ghurmi-Khurkot	
29	Sungure Khola	25.00	Ghurmi-Khurkot	
30	Daram Khola	41.00	Baglung-Burtibang	
31	Gaudi Khola	25.00	Baglung-Burtibang	
32	Girangdi khola	35.00	Baglung-Burtibang	
33	Bhim Ghitte Khola	35.00	Baglung-Burtibang	
34	Nohare Khola	40.00	Baglung-Burtibang	
35	Burtibang Khola	40.00	Burtibang- Rukumkot	
36	Heera Khola	30.00	Burtibang- Rukumkot	
37	Triveni Khola	30.00	Burtibang- Rukumkot	
38	Dovan Khola	100.00	Burtibang- Rukumkot	
39	Mugnu Khola	60.00	Rukumkot-Chaurjahari	
40	Simle Khola	40.00	Rukumkot-Chaurjahari	
41	Jahari Khola	60.00	Rukumkot-Chaurjahari	
42	Bheri River	200.00	Chaurjahari-Kudu-Jagtipur-Dailekh	
43	Cheera Gad	60.00	Chaurjahari-Kudu-Jagtipur-Dailekh	
44	Cham Ghat Khola	25.00	Dailekh-Dullu-Saijiula	
45	Paduga Khola	100.00	Dailekh-Dullu-Saijiula	
46	Chini Khola	50.00	Dailekh-Dullu-Saijiula	
47	Ramgad	50.00	Dailekh-Dullu-Saijiula	
48	Karnali River	203.00	Saijiula-Belkhet	

### 3.7 Preparation of Key Plan

Considering all above mentioned points a key plan of MHH has been prepared showing main alignment and others link roads connecting to the potential economical areas. The plan has been digitized. This plan presents all aspect of the MHH including alignment of the highway, alignment of link road, potential economical areas, bridge locations, stretch wise status of implementation.

## CHAPTER 4: GEOLOGICAL & GEOMORPHOLOGICAL STUDY

### 4.1 Introduction

The proposed Mid Hill Highway Project (MHHP) traverses around 1765 km long stretch of the Nepalese Himalaya connecting Nepal Panchthar in the east to Baitadi in the west. The road traverses different geological and physiographic regions with varying degree of engineering geological conditions. Thus, the geological and engineering geological condition along the proposed road corridor should be explored in detailed in order to understand the slope stability condition at different road stretches.

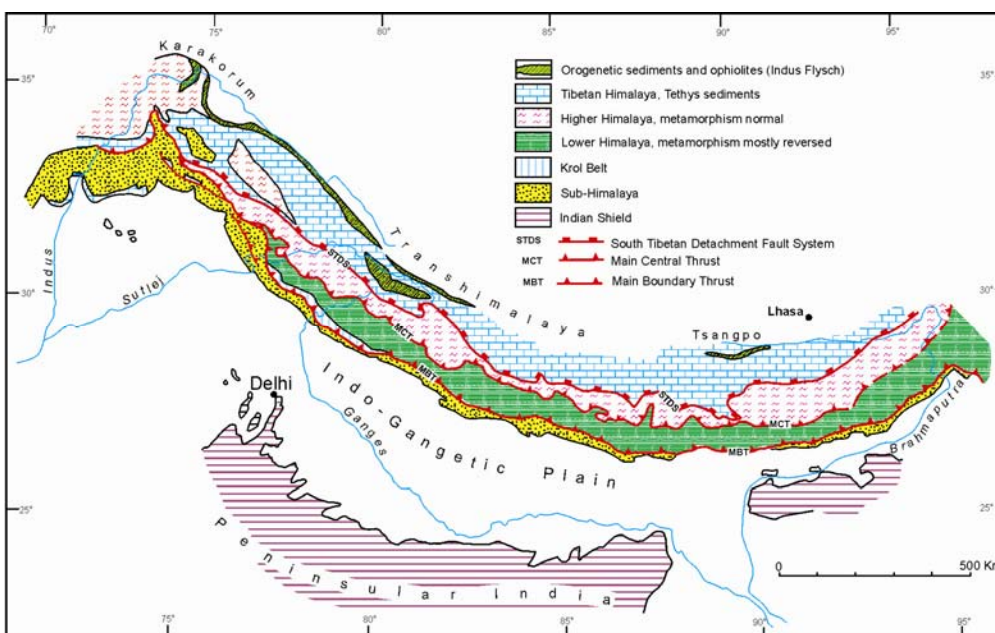
The present report is basically focused to the general introduction of the geology and physiographic regions of Nepalese Himalaya. The alignment of the MHH has been overlain on the geological map as well as geomorphological map and described accordingly. Likewise, the slope classes along the highway have been discussed including the topographical description. Since the proposed road traverses entire country from east to west, it is relevant to have a brief introduction of the Nepalese Himalaya in General.

### 4.2 Himalaya in General

The Himalaya is the largest mountain range of the world, which extends for a total length of about 2,400 km (**Fig 4.1** and **Fig 4.2**). Out of the 2400 km length of the Himalaya, Nepal occupies around 800 km length.



**Figure 4.1: The Extension of Himalayan Range**



**Figure 4.2: Geologic subdivision of Himalayan Arc**

This tremendously lengthy mountain chain is geologically divided into the five sections from west to east (Gansser, 1964). The brief descriptions are as follow:

- **Punjab Himalaya:** The Punjab Himalaya is located between the Sutlej River in east and the Indus River in west. The total length is about 550 km.
- **Kumaon Himalaya:** It borders the Mahakali River in east and the Sutlej River in west. It extends about 320 km.
- **Nepal Himalaya:** The Nepal Himalaya lies between the Mechi River in east and the Mahakali River in west. The length is about 800 km.
- **Sikkim and Bhutan Himalaya:** It starts from the Mechi River and extends along Sikkim and Bhutan for a length of about 400 km.
- **Nefa (North East Frontier Agency) Himalaya:** It stretches for anout 440 km from eastern boundary of Bhutan to the Tsangpo River in the east.

### 4.3 Regional Geology of the Nepal Himalaya

The Nepal Himalaya is situated in the central part of the Himalayan Arc (**Fig 4.1**), located between the Kumaon Himalaya in the west and the Sikkim-Bhutan Himalaya in the east, and extends about 800 km. The Nepal Himalaya has been divided into the Indo-Gangetic Plain, Sub-Himalaya (Siwalik Group), Lesser Himalaya, Higher Himalaya, and Tibetan-Tethys Himalaya from south to north (**Fig 4.3**). The different major geological units are separated by almost east-west running thrust systems that pass through the entire Himalayan region. These thrusts are Indus-Tsangpo Suture, South Tibetan

Detachment System, Main Central Thrust, Main Boundary Thrust and Main Frontal Thrust, from north to south. The General subdivision of the Himalaya is as follows:

----- Indus Tsangpo Suture-----

### Tibetan-Tethys Himalaya

----- South Tibetan Detachment System (STDS) -----

### Higher Himalaya

----- Main Central Thrust (MCT) -----

### Lesser Himalaya

----- Main Boundary Thrust (MBT) -----

### Sub-Himalaya (Siwalik Group)

----- Main Frontal Thrust (MFT) -----

### Indo-Gangetic Plain (Terai)

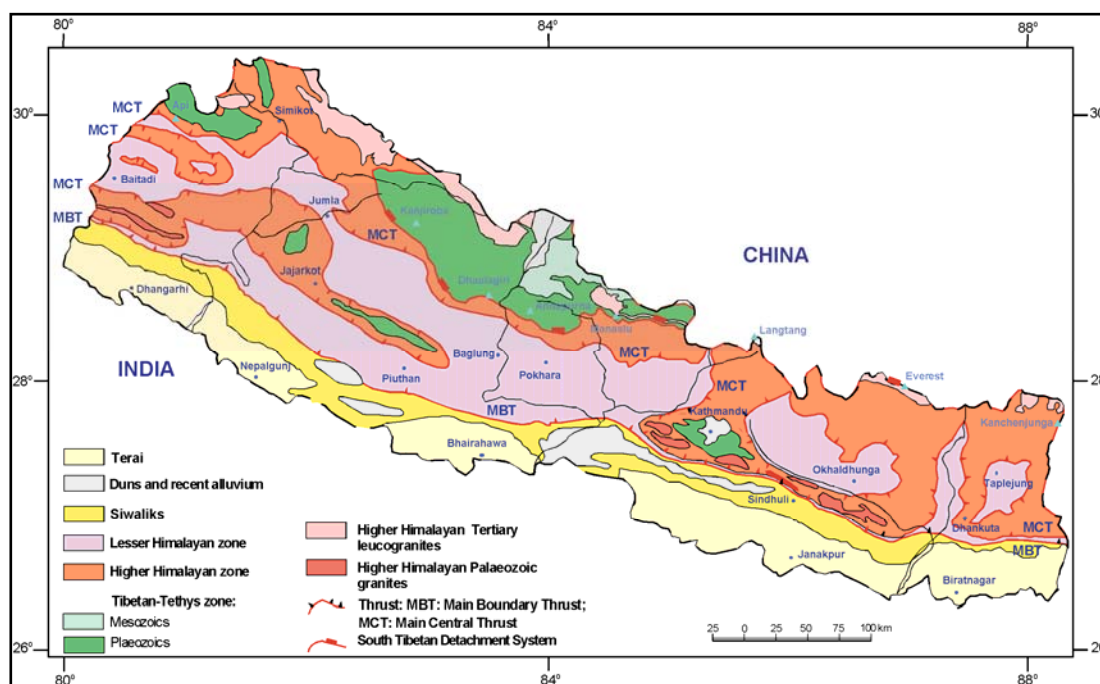


Figure 4.3: Geological subdivision of Nepal Himalaya



#### **4.3.1 Indo-Gangetic Plain or Terai Plain**

The Indo-Gangetic Plain or Terai forms the southernmost tectonic unit of the Nepal Himalaya, having elevation from 100 to 200 m from mean sea level and covering alluvial deposits of Pleistocene to recent in age. The average thickness of the deposits is about 1,500 m.

#### **4.3.2 Sub-Himalaya (Siwalik Group)**

The Siwalik Group is delimited by the Main Boundary Thrust (MBT) to the north and the Main Frontal Thrust (MFT) to the south, and lying between the Lesser Himalaya and Indo-Gangetic Plain. About 6,000 m thick Neogene molasses type sediments were accumulated into the foreland basin during middle Miocene to lower Pleistocene in age. The sediment comprises mudstone, sandstone and conglomerate.

#### **4.3.3 Lesser Himalaya**

The Lesser Himalaya lies between the Siwalik Group to the south and the Higher Himalaya to the north. Both the southern and the northern limits of the Lesser Himalaya is represented by the thrust fault; the Main Boundary Thrust (MBT) and the Main Central Thrust (MCT), to the south and north, respectively. It is represented by thick piles of the sedimentary rocks and low-grade metamorphic rocks, ranging from the Pre-Cambrian to Tertiary in age. Total thickness of the Lesser Himalayan rocks are exposed more than 14 km. Nappe, klippe and Schuppen like tectonic structures have made complexity in the Lesser Himalayan geology.

#### **4.3.4 Higher Himalaya**

The Higher Himalaya is occupied by the high mountains, and lies between the Lesser Himalaya to south and the Tibetan-Tethys Himalaya to the north, which is separated by the Main Central Thrust (MCT) in the south and north by the South Tibetan Detachment System (STDS). The Higher Himalaya is comprised of high-grade metamorphic rocks of schist with granite bodies, pelitic gneisses and migmatites, and attains 6 to 12 km in thickness.

#### **4.3.5 Tibetan-Tethys Himalaya**

The Tibetan-Tethys Himalaya is distributed in the northern part of the territory. The northern border of the Tethys Himalaya is represented by a fault called as the South Tibetan Detachment System (STDS). About 10 km thick shallow marine sedimentary rocks were deposited from Cambrian to Cretaceous in age.

The road alignment of the Mid Hill Highway Project dominantly passes through the Lesser Himalayan Region except in the eastern Nepal (Taplejung-Panchthar area) where it also traverses the Higher Himalayan zone at some locations.

### **4.4. Physiographic Subdivision of Nepal**

Physiography of the region governs the geological and engineering geological condition of the terrain and hence is an important factor to be considered during the road construction. The physiographic subdivision of the Nepalese Himalaya (**Fig 4.4**) is briefly described below:

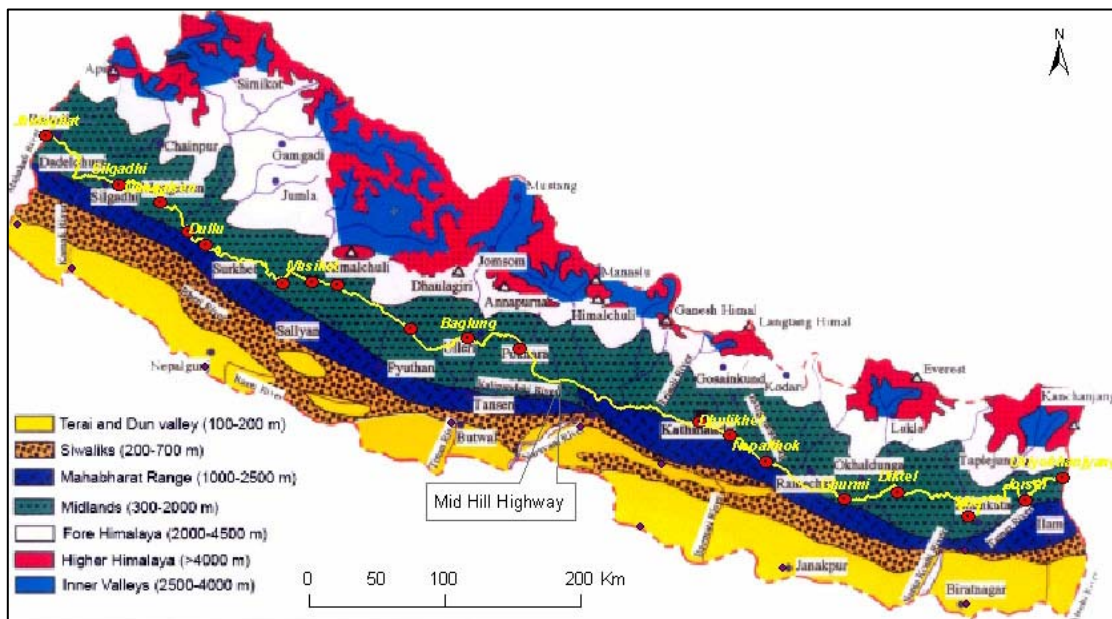


Figure 4.4: Mid Hill Highway alignment overlain on physiographic map of Nepal (Upreti, 1999).

#### 4.4.1 Terai Plain and Dun Valleys

The Terai Plain and Dun Valleys comprises of the Quaternary (Recent) sediments deposited from the surrounding mountains through the rivers traversing from the mountainous parts. In addition, there are colluvial deposits at the foothill regions. The Terai Plain (Indo-Gangetic Plain) lies south of the Siwalik while the Dun valleys are more or less plain region surrounded by the Siwalik Range. The elevation of this zone ranges from 100 m - 200 m above sea level.

#### 4.4.2 Churia Range

The Churia Range (Siwaliks) comprises the mountains lying north of the Terai Plain and the elevation ranges from 200 m -700 m above sea level. This range is consisting of sedimentary rocks, mainly mudstone, sandstone and conglomerates. The differential erosion is dominant in this region developing *cuesta* topography, principally at the Middle Siwalik.

#### 4.4.3 Mahabharat Range

North of the Siwalik range, the abruptly rising hills belong to the Mahabharat Range. The altitude of this region ranges from 1000 m - 2500 m above sea level.

#### 4.4.4 Midlands

The Midland zone lie north of the Mahabharat Range, the altitude ranges from 300 m – 2000 m above sea level. This is the most inhabited region in the Nepalese mountains due to the presence of fertile valleys and slope cultivation is dominant.

#### 4.4.5 Fore-Himalaya

This region lies at the higher elevation range (2000 m - 4500 m) than the Midland zone. It is the transition between the lesser Himalaya and Higher Himalayan region.

#### 4.4.6 Higher Himalaya

The higher Himalayan region lies above 4000 m elevation and is relatively inaccessible region, consisting of snowy mountain peaks.

#### 4.4.7 Inner Valleys

The inner valleys are the regions surrounded by the higher Himalayas. The elevation ranges between 2500 m and 4000 m above sea level. These valleys are situated mostly along the major river traversing the higher Himalayan range (e.g. Kagbeni in Kaligandaki valley).

The road alignment of the Mid Hill Highway dominantly passes through the Midland zone while at some location it also traverses the Mahabharat Range.

### 4.5 Geology and Geomorphology along the Mid Hill Highway Alignment

In order to describe the geology along the Mid Hill Highway, the alignment has been overlain on the geological map of Nepal (Fig 4.5).

The easternmost part of the road section, between Chiyobhanjyang and Hile lies in the Taplejung Window consisting of Higher Himalayan rocks surrounding the Lesser Himalayan Rocks. At this section, the alignment crosses three thrust zones (MCT).

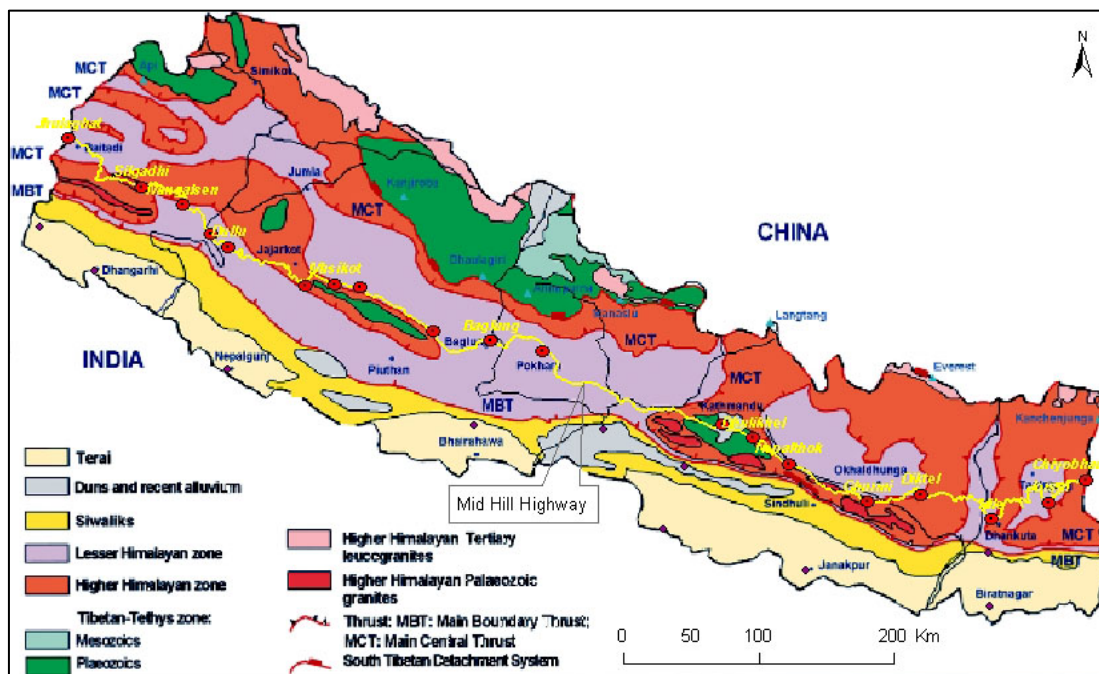


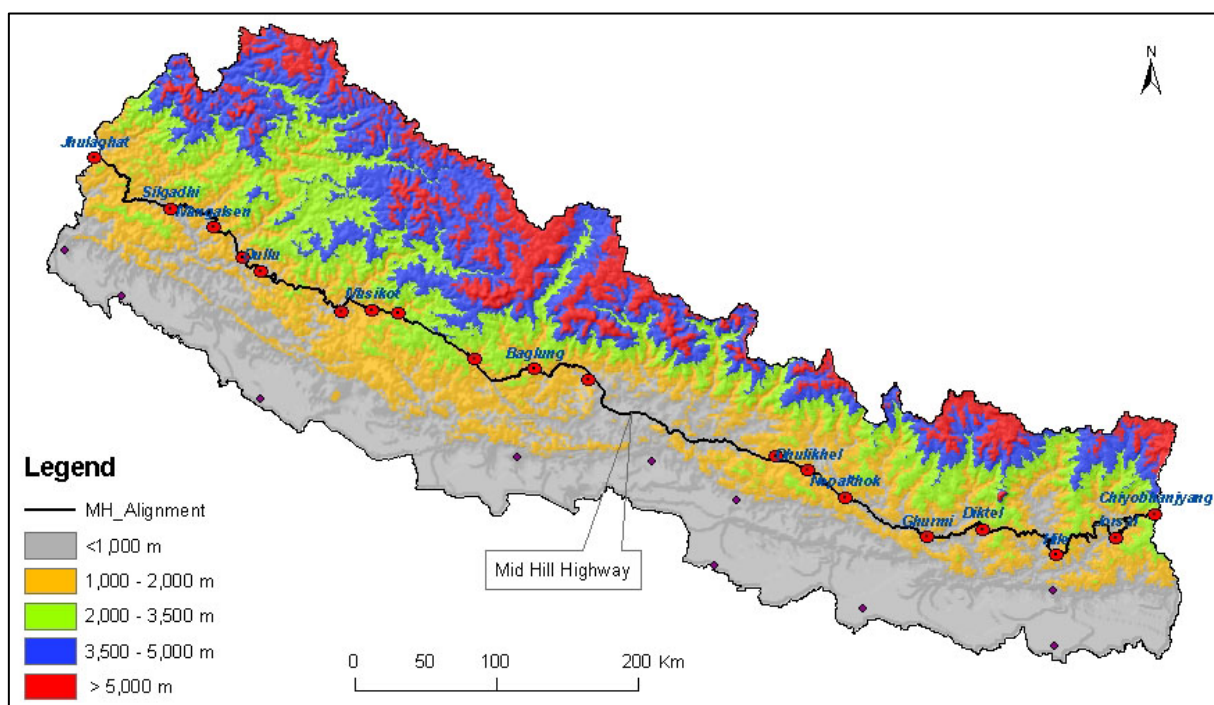
Figure 4.5: The Mid Hill Highway alignment overlain on the geological map of Nepal Himalaya

Likewise, west of Hile, the lesser Himalayan rocks are exposed and the alignment again crosses two thrust zones. The Ghurmi-Nepalthok section traverses mainly the higher Himalayan zones, almost parallel to the MCT. The alignment runs through the lesser Himalayan zone at some places, notably east of Nepalthok.

The stretch between Nepalthok and Dhulikhel entirely runs through the Higher Himalayan zone. Then, the alignment enters into the Kathmandu Nappe from Nepalthok. The section between Dhulikhel and west of Kathmandu comprises of Paleozoic rocks surrounding the Mesozoic rocks in and around the Kathmandu valley. Once the road moves out of the Kathmandu Nappe, it completely traverses the Lesser Himalayan meta-sedimentary rocks up to Burtibang in Baglung District.

The road stretch from around 9 km east of Burtibang to around 20 km west of Musikot runs almost parallel to the MCT at its close proximity except around Rukumkot where it deviates from MCT to around 5 km northwards. The higher Himalayan rocks continues upto around 40 km west of Chaurjahari. After crossing the MCT, it then enters into the Lesser Himalayan rocks up to Mangalsen. The higher Himalayan zone lies west of Mangalsen, which continues up to around 40 km east of Jhulaghat. The last stretch lies in the Lesser Himalayan zone.

Physiographically, the Mid Hill Highway alignment entirely covers the Midland zone with the elevation range of 1000-2500 m above sea level (Figure 4.6). The geomorphic features that the road crosses are mostly the mountain slopes, valley, alluvial and colluvial terrain. It slightly traverses the Mahabharat range near Kathmandu and Surkhet.



**Figure 4.6: Mid Hill Highway alignment overlain on different elevation classes.**

The highway runs through the lowest elevation between Kathmandu and Pokhara. However, in other locations, it passes through the elevation range of 1000-2000 m. Only in the Burtibang-Musikot section, the road traverses through the elevation range of 200-3500 m.

## **4.6 Natural Hazard along the Mid Hill Highway Alignment**

The road alignment traverses several critical zones from the geological perspective (**Fig 4.5**). As mentioned previously, there are several locations where the road crosses the MCT zone, which is geologically fragile and special attention needs to be given for the stability of road. More importantly, the road stretch in which it is parallel and close to the MCT need to be evaluated carefully, especially at the Ghurmi-Nepalthok and Burtibang-Musikot sections. Such sections could have been affected by geological hazards.

The hill slope is another factor responsible for the geological hazards. In order to evaluate the possible hazard due to slope condition, slope map has been prepared and the road alignment is overlain (**Fig 4.7**). It is clear that with the exception of Dhulikhel, Kathmandu valley, Mugling to Pokhara including Pokhara valley as well as other small areas, the road basically traverses the slope class 5-15 degree. However, in the easternmost part and parts of western section, the road runs along the slope class of 15-25 degree. These locations are consisting of MCT.

It is to be noted that the slope map as well as elevation maps have been prepared from contours for the whole nation with quite large interval. In this case, the resulting map may not represent the real field scenario. However, for the regional study, this information is expected to be helpful.



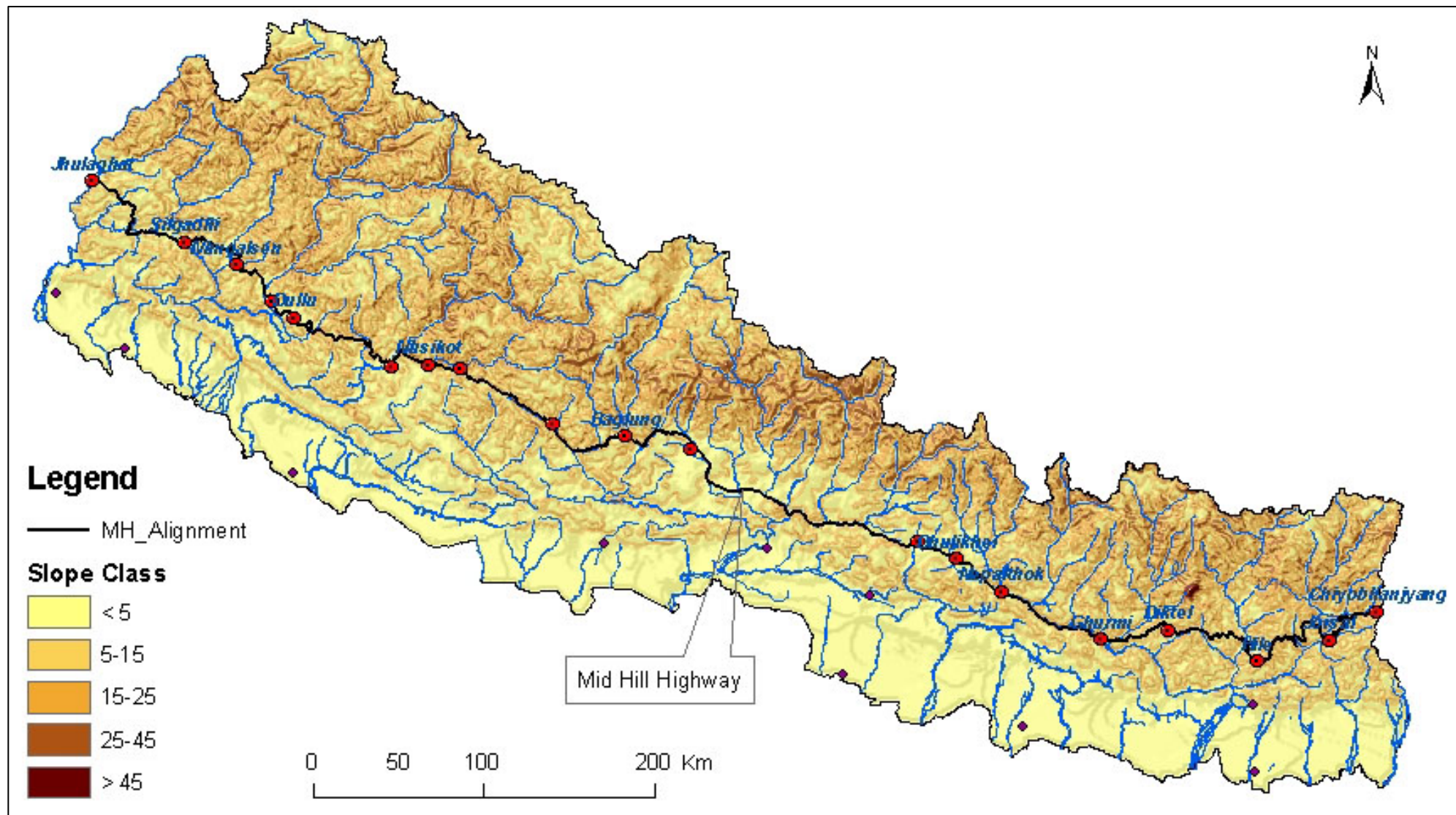


Figure 4.7: Mid Hill Highway running along the different slope classes.



The road alignment has been evaluated based on the physiographic condition, major geological units, geological structures, slope stability condition and slope stability condition along the alignment. It has been observed that the eastern and western part of the alignment significantly crosses the major geological structure (MCT) at several locations. At the same time the road is parallel and close to MCT at two sections, namely Ghurmi-Nepalthok and Burtibang-Musikot sections. These are the vulnerable locations regarding the road stability and smooth functioning of traffic. Necessary mitigation measures should be adopted in these places. Likewise, the bridge sites at the major river crossings should be selected at geologically and hydrologically sound locations. When the road is parallel to the major river, especially at Kathmandu-Pokhara section and Burtibang section, bank cutting problem is anticipated.

The present report is prepared based on the literature review that does not comprise of the field investigation and verification. The road alignment was overlain on the available maps, which are of regional scale. Therefore, there might be slight variation than that of the site specific condition. Likewise, the elevation map, slope map were prepared from the available contours at wider spacing, which may also not reflect the exact field scenario. However, it is believed that the output of the desk study would be sufficiently providing the required information at regional level.



## CHAPTER: 5 SOCIAL STUDY OF THE PROJECT AREA

A general study of social aspect of the project area has been carried out. The study will analyze the aspects during and after construction phases. The main focuses of this study are towards Indigenous People Development Plan and general Modality of preparation of the resettlement plan.

### 5.1 Indigenous People Development Plan (IPDP)

Indigenous People Development Frame (IPDF) which define the policy , institutional and implement framework to address impact on indigenous people<sup>3</sup> ,ensure meaningful consultation with these people throughout project preparation and implementation ensure that they are provided assistance in accordance with their own priorities.

Indigenous People Development Plan (IPDP) is prepared where large number of ethnic minority will directly get affected by the project intervention. The IPDF will be prepared in accordance with GON policies, including those articulated in the Tenth Plan and other IPDP related guidelines.

To the extent possible, the project will consider alternatives sites and engineering design to avoid or minimise impact on vulnerable people. Where indicates the presence of vulnerable groups or indigenous people in a subproject an Indigenous People Development (IPDP) will be prepared for which the IPDF provides overreaching guidance on principles and procedure.

The IPDP will consist of a number of activities and will include mitigation measures of potential negative impact through modification project design and development assistance to enhance the distribution of project benefit. Where there is land acquisition or structure losses in tribal community, the project will ensure that their right will not be violated and they will be compensated for the use of any part of land.

GenerallySubproject IPDP will be prepared at the planning and design stage and submitted to DoR/Midhill highway project. The main contents of IPDP are as follows:

- Subproject description
- Number of vulnerable people impacted negatively and losses from project interventions and magnitude and nature of impacts.
- Documentation of consultation with vulnerable groups to ascertain their views about project design and proposed mitigation measures
- Mechanism for targeted assistance to these groups including training and income generation activities
- Modalities to ensure regular and meaningful consultation with these groups during project preparation and implementation.

The project will give emphasis on ensuring inclusion of all indigenous and ethnic groups including women, dalit and other vulnerable groups and involve them decision making process at all levels of

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<sup>3</sup> Altogether 59 indigenous nationalities are identified and it has classified in 5 groups (referring from NEFIN list) and according to classification 10 adibasi fall in endangered groups, 12 highly marginalized groups, 20 marginalized groups 15 disadvantage groups and 2 indigenous nationalities are advantaged groups.

project cycle. Income restoration of affected indigenous people through life skills trainings and employment opportunity during construction are one of objective of IPDP preparation.

Appropriate training will be identified by carrying out consultation with indigenous people IP during project planning and some of the training identified during consultation are as follows;

- Skill training on mechanical, electrical and construction works(driving, mechanics, plumbing, house wiring, masonry, Carpentry, sewing/knitting and handicapped)
- Training on income generating activities (vegetable production, microenterprises, poultry, piggy, livestock raising etc)
- Training on safe motherhood practices
- Literacy courses to women
- Hygiene and Sanitation
- Nursery establishment, plantation of fodder and fruit trees
- Other as relevant

Local NGOs would be selected and hired to implement the IPDP and other social mobilization activities.

The proposed road serves large number of ethnic groups especially in Eastern , Central and Western Development region. The ethnic groups present along the road are Limbu,Rais, Tamang Magar Gurung,Sherpa ,Jirel,Thami, Chepang,Sunuwar Majhi, Kumal Dura,Thakali, Yakha, Bhujel, Hayu and Newar along the road stretches. However presence of ethnic groups in Mid and Far western region are nominal in comparison to Eastern and Central region. On the other hand Dalits' presence is significantly high in far and western development region.

All the ethnic groups residing in the proposed road corridor are integrated into the social, cultural and economic network of the main stream of society. Hence there will be no separate disadvantage groups different from dominant local population who are likely to be adversely affected by the project.

All the population in the project areas will benefit equally from the socio economic opportunity created by the project. It is therefore not necessary to prepare an indigenous People's Development Plan (IPDP). Nonetheless , special mitigation measures are included in Resettlement Plans(RP) to provide additional assistance to ethnic groups in the event of their being adversely affected. If any impacts are identified on indigenous people during detail design, an indigenous Peoples Development Plan should be prepared. If large number of vulnerable<sup>4</sup> people adversely affected due to the project intervention a separate Social Development Plan need to be prepared to mitigate the negative impacts. Social Development Plan consists of number of assistance programme as well as mitigation measures caused by project to reinstate the vulnerable people as per their priority and need. Under the project vulnerable groups include the following;

- All dalit and ethnic minorities/indigenous groups of terai and hill as categorised by GON and Nepal Federation NEFIN

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<sup>4</sup> Vulnerable groups consist of Indigenous People as well as other poor and dalit groups as well

- Women headed agricultural households
- Poorest of the poor(based on local wealth ranking)
- Disable and old people
- Landless/Ex-kamaiya families.

By considering the presence of people residing in eastern, central and western region of proposed the road corridor a separate Indigenous People Development Plan(IPDP) likely to be prepared On the other hand the situation is different in Mid and Far western region where large number of dalit and poor are present in the road corridor .Hence there will be a separate Social Development Plan need to be prepared.

## 5.2 Government Policies Supporting Vulnerable Communities

In Nepal the indigenous population is popularly known as Janajatis which is also recognized by the government and constitutes about 37.2 percent (8.4 million)of Nepal's total population.Some of the key characteristics of these groups are defined as ; distinct collective identity ,own language, religion ,tradition culture and civilization, own tradition egalitarian social structure, tradition homeland and geographical area, written or oral history that traces their line of decent back to the occupants of the territories before there annexation to the present Nepali frontiers.

Based on these traits , Government of Nepal has declares total 59 ethnic nationalities as Janajatis and these 59 members has been classified into 5 groups(referred NEFIN) i.e. endangered groups, highly marginalized groups, marginalized groups , disadvantage groups and advantages groups based on socioeconomic, literacy ,landownership and population.

The constitution has shown commitment for protection preservation and promotion of language, religion, and culture, affirmative action for IP and vulnerable groups. it also makes the provision of education in mother tongue up to grade five. But all have not been realised as promised in the constitution.

Nepal doesn't have a standalone policy on indigenous Peoples. However in tenth plan and significant emphasis has placed on delivering basic services to the disadvantaged and indigenous people. Dalit, women,disable and other vulnerable groups including the Adibasi/Janjati indigenous people. One of the main thrusts of Tenth plan is implementation of targeted programme for the uplift, employment and basic security of dalit, indigenous people and disabled class.The policy provision also outlines that the government should pilot strong and separate package of programme of basic security for vulnerable section of society.

GON's tenth plan is the guiding policy document for any development project to integrate programs aimed at poverty reduction; especially among the poor people. The targeted programe is one of the four strategic poverty reduction pillars upon which tenth plan is formulated and being implemented. Targeted program in the context of poverty reduction are meant to enhance the capabilities of those communities and areas which are lagging behind in the main stream of development. The plan states that targeted and empowerment programs shall be promoted to enhance the welfare of vulnerable, disadvantage and exploited groups and dalit and indigenous scheduled caste groups.

The objective of targeted programs is to raise productive capabilities of people belonging to marginalized, deprived, disadvantaged, remote and isolated areas.

The Tenth Plan also defines that the areas where more than 50 percent of population is poor and families have no extra income other than their own house production and which is sufficient for less than 9 months are designed as the poor areas. Likewise families whose income is sufficient for less than 3 months is categorised as ultra poor who need to be supported for their livelihood.

### **5.3 Resettlement Policy Frame Work and Preparation of Resettlement Plan**

Construction of Infrastructure not only brings benefit to the people but also likely to generate adverse impacts. Easy access to service, employment opportunity etc are some of the example of positive impact. On the contrary acquisition of land, loss of private and public structures and livelihood are negative impacts to be occurred due to project intervention.

Out of total 1765 km only 820 km of proposed Midhill Highway has been already constructed and Government has given high priority for the completion of the remaining section. Initial social screening survey indicates that land acquisition and/or loss of assets are unavoidable mainly remaining section of each subproject. Hence a Resettlement Plan (RP) should be prepared in accordance with Resettlement Policy Framework (RFP) to mitigate the negative impacts.

The RPF defines the legal, institutional and institutional framework to guide the compensation for lost assets, livelihood, community property, and resettlement and rehabilitation of project affected people in accordance with Land Acquisition Act(1977) and involuntary Resettlement policy of similar nature of the project funded by various donors.

Therefore resettlement activities in the development project are being guided by the policy of respective donor agencies. It is also in the sense that most of infrastructure are assisted by donor agencies as the Government policy does not cover the wide range of resettlement issues and mitigating measures. The World Bank, Asian development Bank, DfID, SDC/DRSP, GTZ are among the major donor agencies involved in infrastructure development in the country. Among them ADB and WB have their own guidelines on social and resettlement issues and their safeguard policies are almost the same.

There is lack of comprehensive national resettlement policy in the country and the existing Land Acquisition Act has not been able to deal with resettlement matters in different sectors. It means there is to be gaps on Government's resettlement policy.

Considering such gaps, the Government of Nepal also drafted a National Policy on Land Acquisition, Compensation and Resettlement in Development project (2006) with the technical assistance of ADB(TA4422 NEP) but it is yet to be approved.

Distinctively no one should be in a worse social or economic situation because of the program. This means that poor people who lose land and assets to the road must be fairly compensated in some way. However, respecting the culture of volunteerism in rural Nepal and experiences from similar nature's project such as DRILP, RRRSDP and DRSP it will follow a similar approach of promoting voluntary contribution of land within acceptable limit and compensating for loss of other structures and assets at a

fair price. For voluntary contribution of land, the principle that it shall not result in anyone being worse-off in the road corridor before the start of the project will be followed. The programme will actively facilitate voluntary contributions from the land owners. If the HHs donating the land have food sufficiency of less than 6 months and are contributing more than 10% -20% of their total land holding, they will be compensated for their loss. Voluntary donation will be confirmed through written records including “no coercion” clause verified by an independent third party. Additionally the project will assess socioeconomic status and potential impact of land donation and accept donation only those APs who do not fall below poverty line after the land donation. Considering these factors a separate Resettlement Plan will be prepared in each subproject and this shall also outline the livelihood restoration measures for e.g. life skill training with support for economic activities, priority for working on road construction activities.

The key Resettlement principles are as follows:

- I. Involuntary land acquisition and resettlement impact will be avoided or minimised through careful planning and design of the project;
- II. For any unavoidable involuntary land acquisition and resettlement, Aps will be provided compensation at replacement cost and /or assistance so that they will be as well -off as without the project;
- III. Gender and social inclusion is ensured and adhered to;
- IV. APs will not be forced for donation of their land, there will be adequate safeguard for voluntary donation;
- V. APs will be fully informed and consulted during project design and implementation particularly on land acquisition and compensation options;
- VI. The nontitled will not be bar to compensation for house, structure and trees/crops, and particular will be paid to vulnerable groups and appropriate assistance provided to help them improve their socio-economic status;
- VII. Land compensation and resettlement assistance will be completed before commencement of civil works, while other rehabilitation will continue during project construction; and
- VIII. Land acquisition will be conceived part of the project and cost related resettlement will be included in a financed out of project cost.

## **5.4 Nepal Resettlement Policy**

The Interim Constitution of Nepal establishes the right to property for every citizen to earn, use, sell and exercise their right to property under existing laws. Land Acquisition Act-1997 (LA Act) and its subsequent amendment in 1993 specify procedure of land acquisition and compensation. The Act empowers Government to acquire any land on the payment of compensation for public purpose or for the operation of any development project initiated by Government institutions. The legal provision and practices ensure that people have right to get compensation for any type of losses due to development activities to safeguard the economic feature of all affected person (APs). The acquisition of any property is subject of assessment, valuation and compensation process.

The LA Act is not adequate enough in itself to deal with and address several resettlement and associated technical issues of diverse infrastructure sector. Thus it is also being supplemented by different subsequent Acts, Rules and policies and Guidelines for example Immovable property Acquisition Act 1956 Land reform Act-1963, Water Resource Act-1992, environment protection Act-1997 Local Self

Government Act-1999 are some of the resettlement related Act. In Nepal LA Act is core document of guide on the matters related to land acquisition and resettlement issues. Therefore development project should follow the steps and processes as prescribed in LA Act. Some of the key resettlement steps/process as stipulated in LA Act is given in below.

**Step-1.** The government decides to acquire land for public works purpose and authorises the Project Manager of the project to initiate the survey work to determine details of the land plots to be acquired (Preliminary action) **LA clause 3, 5**

**Step-2.** Issues notice of preliminary action and affix it in specified places for public information **LA clause 6, (1)**

**Step-3** After 3 days, begins the survey of land and preparation of maps **LA clause 6(2,3)**

**Step-4** During the survey, if private properties (crops, boundary walls, trees etc) are damaged, the Project Manager determines the compensation amount and distributes to the affected owners. **LA clause 7 (1,2)**

**Step-5** In case owner is not satisfied with the compensation amount determined by the PM may complain to the CDO within 15 days. CDO gives his decision on the complaint and which is final **LA clause 7(3)**

**Step-6** Preparation and submission to CDO a report giving the details of the land plots / properties to be acquired **LA clause 8 (1,2)**

**Step-7** CDO publishes a notice giving the details of land plots / properties to be acquired with instruction to claim the compensation with ownership document within 15 days of publication of the notice. Besides copies of the notice shall be affixed at specified places **LA clause 9(1,2 & 3)**

**Step-8** After the publication of the acquisition notice, the concerned Land Administration Office (LAO) / Land Revenue Office (LRO) suspends land transaction of the affected plots / properties **LA clause 9(4)**

**Step-9** Any person who thinks that his land should not be acquired may complain to the Home Ministry through CDO within 7 days giving reasons why his land should not be acquired **LA clause 11(1)**

**Step-10** Home Ministry gives its decision within 15 days of receiving the complaint **LA clause 11 (2, 3 & 4)**

**Step-11** After the publication of the notice CDO may take possession of the affected land plots and hand them over to the project after; decision has been made on the complaint; at anytime after the expiry of the time limit for filing complaint ; In the case of houses to be acquired, 50% of the compensation amount and in the case where compensation amount has not been fixed , an advance amount sufficient to shift the household has to be paid before the houses are acquired **LA clause 12 (2)**

**Step-12** CDO forms a Compensation Fixation Committee (CFC) to determine the compensation amount **LA clause 13 (1,2& 3), 14, 15, 16(1&2), 17 & 20**

**Step-13** CDO prepares the list of the owners entitled for compensation and publishes notice to inform them **LA clause 18 (1)**

**Step-14** Any person not satisfied with the list may file a complaint to the Home Ministry within 15 days **LA clause 18 (2)**

**Step-15** The Home Ministry gives its decision within 15 days of receiving the complaint except in the case of complaint which needs to be decided by a court. In this case the compensation amount will be suspended and deposited in specified account until the case is finally settled, and the legal owner can claim the amount within 2 years **LA clause**18 (3 & 4)

**Step-16** CDO informs the government (concerned agency) about the compensation amounts payable to the affected persons **LA clause**19

**Step-17** PM starts distribution of the compensation and Income Restoration Assistance to the affected owners and the affected owners should collect the compensation within the specified time **LA clause** 10, 37

**Step-18** The ownership of the acquired land will shift to the government agency and ownership certificates will be issued and the land ownership certificates of the affected persons shall be adjusted accordingly **LA clause** 23 (1,2&3)

## 5.5 Schedule of Resettlement Activities

All RP Related activities from screening<sup>5</sup> of resettlement impact to compensation distribution and livelihood restoration need to be completed before contractors' mobilization. In the other word all the resettlement activities need to be completed for contractors mobilization. In this sense resettlement planning and implementation plays crucial role on the timely initiation of project. Resettlement activities begin from early stage of the project cycle and have to go through long process involving different stakeholders. **The facts field data can be obtained after detail design and centre line pegging hence**

**major process of RP preparation is started after detail design and centreline pegging.** Therefore, resettlement planning and processing activities need to be organised in a schedule with specific time bound tasks. Among the others, RP activities schedule also need to be consider (i) types and extent of impacts (ii) estimated number of APs and nature of impact (iii) Impact on indigenous people and other vulnerable people. Generally such resettlement issues use to be different depending upon the scope of

project. Likewise timeframe required for resettlement activities differs from one project to another project. However sample of steps and process of resettlement are depicted below.

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<sup>5</sup> Social screening will identify the potential for loss of land, assets/structures livelihood, willingness of community to voluntary donate land to the project, the presence of indigenous people/vulnerable people and any specific impacts on these people as well as other significant social impact. Social screening also enables the categorization of subproject based on their level of social impacts.

**Table no 5.1: Steps and Process of Resettlement**

Phase	Steps	Activities
Feasibility Phase	1	Walkover Survey(Collection of Preliminary Information on land acquisition and Resettlement) in each
	2	Prepare Walkover Survey Report
	3	Project categorization based on scale of Impacts: A, B and C
		Completion of Detail Design Survey and Central Line Pegging
Detail Design and construction Phase	4	Mobilization of Government Cadastral Surveyor
	5	Cadastral Survey, Alignment Plotting on Cadastral Map, Listing of affected Households
	6	Loss Assessment of Private and Public Assets(Land, Structure, Tree, Business, Income, Livelihood and
	7	Verify of Affected Land Owners/Plot Numbers, Area from Land Revenue Office/District Survey Office
	8	Public Consultation and Information Dissemination at Field
	9	Orient and Train Social Mobilizer
	10	Socio-Economic Survey followed by Resettlement Survey of Affected Households
	11	Formation of Grievance Redress Committee(GRC), Village Infrastructure Coordination
	12	Data Entry, Data Analysis and Verify Output of table
	13	Preparation of Draft Resettlement Plan
	14	Disclosure of Draft Resettlement Plan to the Affected People(Aps)
	15	Agreement of Voluntary Land Donation Papers with eligible Affected People(APs)
	16	Formation of Compensation Determination Committee (CDC) and Valuation of Affected Assets
	17	Send Final Draft Resettlement Plan to Project Coordination Unit/C for Review
	18	Land Donation Agreement by Verified by Third Party
	19	RP implementation (Distribution of Compensation and Rehabilitation to Affected People)
	20	Implementation of Life Skills Training Program
	21	Start Deed Transfer Process
	22	Verification and Monitoring of Resettlement work



## CHAPTER: 6 ENVIRONMENTAL ASPECTS OF THE PROJECT AREA

### 6.1 Background

The study of environmental aspects of Mid Hill Highway(MHH) aim to address the issues of sound and sustainable planning, designing and construction of road structures. Those issues as mentioned in the EIA reports are, but not limited to, construction materials and techniques, flood control and cross drainage, bio-engineering for slope protection, conservation of aquatic and wildlife, health and safety of construction worker and the road users etc. This part of the report has primarily been based on the primary and secondary data available from the DOR, field study and the Environmental Impact Assessment reports of the some sections availed to the Consultant.

There are different kinds of environmental interventions proposed during the entire project cycle of the road project and they are: landslide and slope protection, cross drainage and flood control, minimal removal of forest and vegetation, use of eco-friendly construction materials and techniques, health and safety precaution during construction and operation etc. The intervening measures are either preventive or corrective or the compensatory depending upon the nature of impact and its gravity. These interventions have to be kept in mind during the entire project cycle of the project. The different types of activities as the intervention measures have been suggested in the following table.

**Table 6.1: Environmental Activities at Different Phases**

SN	Phase of project	Environmental activity	Purpose
1	Pre-feasibility (new roads only)	Environmental screening	Early check to see what level of environmental assessment is required
2	Feasibility (new roads and	Initial Environmental Examination, or, if necessary, scoping followed by	The required level of environmental assessment is carried out. A full EIA must appraise alternatives, so it must be done
3	Detailed survey and design	Review of IEE or EIA (incorporation of recommendation) Environmental Management Plan	To ensure that the project design uses the recommendation of the EIA/IEE avoids or mitigates ant potential environmental problems.
4	Construction or rehabilitation	Monitoring	Checks are made to ensure that the recommendations measures, made in EIA/IEE, are carried out.
5	Maintenance (the road	Monitoring	Regular inspections (usually annually) are made to check that the mitigation measures are working satisfactorily.

Moreover this report explains comprehensively about the mitigation measures for the potential impacts envisaged in the EIA reports, monitoring and auditing of the measures employed in the projects,

Environmental Management Action Plan (EMAP) and the budgetary arrangement for implementing the EMAP.

## 6.2 The Environmental Mitigation Measures

The environmental mitigation measures have been differentiated into the following three phases:

- Design phase
- Construction phase
- Operation and maintenance phase

### 6.2.1 Road Design phase

The mitigation measures adopted during design or pre-construction phases are of preventive in nature with two basic objectives: (1) avoiding costly mitigation, and (2) awareness among the stakeholders for environment protection while constructing and operating infrastructure services.

**Route Selection:** Proper selection of appropriate route for the road alignment can be one of the major preventive environmental mitigation measures. The appropriate route selection avoids or minimizes the environmental degradation primarily in terms of loss of flora and fauna, minimum or no slope instability or soil erosion, disruption of water bodies, minimum loss of fertile cultivated land, no loss of valuable personal properties etc. Adequate measures should be taken while surveying to avoid forests, sensitive habitats, cultivable lands and settlements while carrying out alignment section or designing geometrical improvements or widening of road.

**Detailed Survey and Design:** At this stage, the survey consultants shall conduct a census survey and assess the potential impacts and losses on properties and lands, and establish the baseline data for compensation. The detailed survey and design shall include all possible preventive measures to avoid or minimize slope instability, disruption of water systems, minimize disturbance to settlements, minimize forest loss, and affecting cultural assets and the aesthetic value of the landscape. The design shall adopt the labour-intensive approach, minimizing/avoiding blasting and use of mechanized method, as far as practical. Bio-engineering can be used for slope stabilization in an environment friendly manner, and plan for using local resources and manpower.

**Inclusion of EMAP requirements in BOQ:** To become effective and verifiable, all provisions mentioned in the EMAP should be reflected in the Bill of Quantity (BOQ) explicitly while issuing Tender Document for the Contractors. The contractors must clearly quote these activities in BOQ rate, and provide beforehand any comments in case of opposing these clauses.

### 6.2.2. Construction phase

**Beneficial Impacts:** The following impacts have been identified from the EIA study reports:

- Increased Income and Employment Opportunities

- Enhancement of Technical Skills
- Enhancement of the Local Economy

**Adverse Impacts:** The adverse impacts have been analyzed categorizing them in compensatory, preventive and the Mitigating measures. Different physical, biological and socio-economical impacts have been given in the following table:

**Table 6.2. Adverse Impacts during Construction Phase**

SN	Environmental category	Impacts	Remarks
1	Physical Environment	<ul style="list-style-type: none"> <li>• Addressing Changes in Land-use and Loss of Land</li> <li>• Coping with Slope Failure and Erosion</li> <li>• Addressing Destabilizations of Slopes</li> <li>• Precaution Measures during Slope Cutting Activities</li> <li>• Avoiding Hazards due to Unsafe Spoil Disposal</li> <li>• Avoiding Hazards due to Water Flow Diversion</li> <li>• Avoiding Hazards originating from Quarry and Borrow Activities</li> <li>• Address Risks associated with Stone Crushing Plants</li> <li>• Addressing Issues associated with Stockpiling of Materials</li> <li>• Avoiding Water Pollution</li> <li>• Avoid Air Pollution</li> <li>• Control of Noise Pollutions</li> <li>• Handling Hazardous Materials</li> <li>• Avoiding Hazards caused by the use of Bitumen</li> </ul>	Compensatory, mitigating and preventive
2	Biological Environment	<ul style="list-style-type: none"> <li>• Clearing of Forest Land and Habitat Damage or Loss</li> <li>• Avoiding Habitat Fragmentation</li> <li>• Control of Illegal Harvest of Forest Products and Poaching on Wildlife</li> </ul>	Compensatory, mitigating and preventive
3	Socio-Economic and Cultural Environment	<ul style="list-style-type: none"> <li>• Loss of Properties and Productive Land</li> <li>• Avoid Impacts on Indigenous People</li> <li>• Damages to Community Infrastructure and Social Life Quality</li> <li>• Observation of Occupational Health and Safety (OHS)</li> <li>• Avoiding Impacts on Cultural and Historical Properties</li> </ul>	Compensatory, mitigating and preventive

### 6.2.3 Operation and maintenance phase

**Beneficial Impacts:** The following impacts have been identified from the EIA study reports:

- Improved Access to Services and Facilities
- Promotion of Small Scale Businesses
- Enhancement of Quality of Life

**Adverse Impacts:** The adverse impacts have been analyzed categorizing them in compensatory, preventive and the Mitigating measures. Different physical, biological and socio-economical impacts have been given in the following table:

**Table 6.3 Adverse Impacts during Operation and Maintenance Phase**

SN	Environmental category	Impacts	Remarks
1	Physical Environment	<ul style="list-style-type: none"> <li>• Slope Instability and Erosion</li> <li>• Control Air, Noise and Water Pollution</li> <li>• Control of Cross-Drainage Outfall and Gullies</li> </ul>	mitigating and preventive
2	Biological Environment	<ul style="list-style-type: none"> <li>• Depletion of Forest Resources</li> <li>• Collision and Disturbance Afflicting vegetation and Wildlife</li> </ul>	mitigating and preventive
3	Socio-Economic and Cultural Environment	<ul style="list-style-type: none"> <li>• Road Safety and Speed Limit Controls</li> <li>• Control of Ribbon Settlement along the Road and the RoW</li> </ul>	mitigating and preventive

The mitigation measures for the respective impacts have been summarized in the following table:

**Table 6.4: Interventions to Environmental Impacts**

SN	Category	Potential problem	Interventions
1	Slope stability	<ul style="list-style-type: none"> <li>• Landslide and other types of mass instability in the slope</li> </ul>	<ul style="list-style-type: none"> <li>• Geological/geo-morphological study conducted to investigate and recommend best available option</li> <li>• Civil engineering structures and bio-engineering works</li> <li>• Quarrying prohibited in river bed where increased flood discharge velocity can give rise to subsequent damage</li> </ul>
		<ul style="list-style-type: none"> <li>• Development of erosion and gulling</li> </ul>	<ul style="list-style-type: none"> <li>• Check dam and bio-engineering works used as necessary</li> </ul>
2	Spoil disposal	<ul style="list-style-type: none"> <li>• Road crosses major areas of deep seated instability</li> </ul>	<ul style="list-style-type: none"> <li>• Width and surfacing standards relaxed for short lengths as required</li> </ul>
			<ul style="list-style-type: none"> <li>• Minimize spoil by balancing cut and fill wherever possible</li> </ul>

		<ul style="list-style-type: none"> <li>Spoil tipped away from designated area</li> </ul>	<ul style="list-style-type: none"> <li>Safe tipping areas identified and enforced</li> </ul>
		<ul style="list-style-type: none"> <li>Spoil falling or being washed onto farm land</li> </ul>	<ul style="list-style-type: none"> <li>Spoil trap constructed</li> <li>Land owner compensated</li> </ul>
3	Water management	<ul style="list-style-type: none"> <li>Scour and erosion below unprotected drainage outfall</li> </ul>	<ul style="list-style-type: none"> <li>Mattresses and check dams and others protection measures constructed as necessary</li> <li>Cascade constructed, to be as long as necessary</li> </ul>
		<ul style="list-style-type: none"> <li>Disruption of drinking and irrigation water supplies</li> </ul>	<ul style="list-style-type: none"> <li>Measures to resolve these problems incorporated in project work or owner compensated</li> </ul>
4	Land use	<ul style="list-style-type: none"> <li>House to be removed</li> </ul>	<ul style="list-style-type: none"> <li>House owner compensated</li> </ul>
		<ul style="list-style-type: none"> <li>Loss of agricultural land</li> </ul>	<ul style="list-style-type: none"> <li>Land owner compensated</li> <li>Check impacts are limited to acquired land</li> </ul>
		<ul style="list-style-type: none"> <li>Loss of forest land</li> </ul>	<ul style="list-style-type: none"> <li>Forest users group are compensated for the trees and product lost</li> <li>Check impacts are limited to trees and products</li> </ul>
5	Plants and wildlife	<ul style="list-style-type: none"> <li>Large numbers of trees being removed</li> </ul>	<ul style="list-style-type: none"> <li>Felled trees replaced using same species if appropriate</li> <li>Trees planted where land is available</li> </ul>
		<ul style="list-style-type: none"> <li>Disturbance to wildlife</li> </ul>	<ul style="list-style-type: none"> <li>Damage to wildlife avoided as far as possible</li> <li>Habitat re-created in marginal roadside land</li> </ul>
6	Quarries and borrow pits	<ul style="list-style-type: none"> <li>Pollution, disturbance and danger from quarry operation</li> </ul>	<ul style="list-style-type: none"> <li>Construct bund to screen noise and dust</li> <li>Enforce access restriction</li> </ul>
		<ul style="list-style-type: none"> <li>Safety risks from abandoned quarries or borrow pits</li> </ul>	<ul style="list-style-type: none"> <li>Quarries made safe by re-grading slope and installing structures as necessary</li> </ul>
		<ul style="list-style-type: none"> <li>Land seriously disturbed or lost from production</li> </ul>	<ul style="list-style-type: none"> <li>Quarries and borrow areas rehabilitated to productive plantation using bio-engineering techniques</li> </ul>
		<ul style="list-style-type: none"> <li>Quarries continue to be used by unauthorized persons</li> </ul>	<ul style="list-style-type: none"> <li>Unauthorized quarrying stopped wherever possible working with DDC</li> </ul>
7	Stone crushing and asphalt plant	<ul style="list-style-type: none"> <li>Dust and noise pollution</li> </ul>	<ul style="list-style-type: none"> <li>Plant re-sited or compensation arranged if pollution is caused</li> <li>Large earth bunds is constructed and vegetated to reduce hazard</li> </ul>
8	Hazardous materials	<ul style="list-style-type: none"> <li>Spoils, leaks and injury from any types of hazardous materials (bitumen, cement, paint, explosives, fuels, lubricants etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Check to ensure that storage is good and there is no leakage and loss</li> <li>Check to ensure protective clothing and safety measures are used</li> </ul>
		<ul style="list-style-type: none"> <li>Bleeding bitumen</li> </ul>	<ul style="list-style-type: none"> <li>Appropriate chipping are spread and rolled into the affected areas</li> </ul>
9	Camp operation	<ul style="list-style-type: none"> <li>Pollution from work and labour camp</li> </ul>	<ul style="list-style-type: none"> <li>Check to ensures that labors are not polluting neighboring areas with sewerage and rubbish disposal</li> </ul>
		<ul style="list-style-type: none"> <li>Labours cut trees for firewood</li> </ul>	<ul style="list-style-type: none"> <li>Kerosene stoves and kerosene provided to labourers</li> </ul>
		<ul style="list-style-type: none"> <li>Land remains damaged after</li> </ul>	<ul style="list-style-type: none"> <li>Check to ensure that camp areas are fully restored including re-topsoiling and plantation if appropriate</li> </ul>

		construction	
10	Dust and noise	<ul style="list-style-type: none"> <li>Dust generated from construction work and construction vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Speed control using speed bump, if water is available, the road surface sprayed on a frequent schedule</li> </ul>
		<ul style="list-style-type: none"> <li>Dust from road with earth and gravel surface</li> </ul>	<ul style="list-style-type: none"> <li>Permanent bumps are installed in villages and bazaars to reduce traffic speed in inhabited areas</li> <li>Bituminous surface is constructed in bazaars with speed controls</li> <li>Dense vegetation planted on roadside</li> </ul>
		<ul style="list-style-type: none"> <li>Noise from large work site</li> </ul>	<ul style="list-style-type: none"> <li>Large earth bunds constructed and vegetated to reduce noise</li> <li>Work scheduled to minimize disturbance</li> </ul>
11	Social issues	<ul style="list-style-type: none"> <li>Positive impacts of road limited to wealthier section of society</li> </ul>	<ul style="list-style-type: none"> <li>Other agencies encouraged to develop activities beneficial to poor and excluded section of society</li> </ul>
		<ul style="list-style-type: none"> <li>Local people excluded from project activities</li> </ul>	<ul style="list-style-type: none"> <li>Designs incorporate the methods within the skills of the locals</li> <li>Contractors encouraged to use the local people wherever possible</li> </ul>
		<ul style="list-style-type: none"> <li>Promises were made to local people during feasibility and planning phase</li> </ul>	<ul style="list-style-type: none"> <li>Checks to ensure that the promises are fulfilled, if they prove to be not possible, reasonable alternatives must be negotiated</li> </ul>
		<ul style="list-style-type: none"> <li>Significant disparities emerges in levels of compensation</li> </ul>	<ul style="list-style-type: none"> <li>Compensation levels rationalized to ensure reasonable parity</li> </ul>
12	Road safety	<ul style="list-style-type: none"> <li>Faster traffic resulting from new smoother road surface</li> </ul>	<ul style="list-style-type: none"> <li>Traffic safety measures installed, such as warning signs, delineators and barriers.</li> <li>Awareness of road safety raised among affected communities</li> <li>Road safety audits carried out and recommendations implemented</li> </ul>

### 6.3 Environmental Management Action Plan

Environmental Management Plan (EMP) provides a basis for the implementation of Environmental Protection Measures (EPMs). This includes project monitoring, auditing, project management issues and the verification of predicted environmental impacts actually arising from the project implementation, institutional arrangement for implementation. It also incorporates the estimated budget for implementing the EMP.

The Environmental Protection Measures (EPMs) of this project will be implemented during the preconstruction or design phase, construction phase and operational and maintenance stages of the project. The implementation of the mitigation measures will be the responsibility of the proponent. All preparatory activities related to site clearance and design works will be completed during the pre-construction stages. The proponent will continue its environmental protection activities during the post construction or the operational stage as well.

### 6.3.1 Environmental Monitoring

Environmental monitoring is an integral part of the EIA report and the project as well. The sub-section focuses on baseline, compliance and impact monitoring.

**Baseline Monitoring:** Baseline Monitoring is required to compile and maintain the database on environmental conditions prior to the implementation of the project. The primary concern during this phase will be to implement field data collection programs to obtain the baseline conditions, such as scientific and sociological information needed to finalize the design and cost of the mitigation measures. This is especially important if the project is delayed due to unforeseen circumstances. Such data recorded before the project implementation will facilitate the comparison of information obtained in monitoring activities conducted during project construction.

**Table 6.5 Baseline Monitoring**

Parameter	Indicator	Method	Location	Schedule
Slope Failures and Landslides	Stability of slopes	Site observation, pillars	Near unstable slope Areas	Before, during and after monsoon
Water Quality	Temperature, hardness, turbidity, oil and grease, coliform, NaCl, TSS, DSS, pH, DO, BOD, COD, P, S, Pb, Ar	Water sampling, testing and comparison to ambient standards	Water bodies receiving waste water discharge and solid waste and run-offs from the construction and workforce housing areas	Monthly for one full year during the construction phase; monthly during construction phase and Annually for 5 years during operation phase
Climate, Air Quality and Noise	Total suspended solid Particulate matters, vehicular emission, dust accumulation from construction activities in house, vegetation, surrounding areas	Low-volume sampler, inspection, measurement, and comparison of data with ambient standards	In and around carriageway	During the construction phase
Watershed	Roskslides and landslides and erosion	Site observation and pillars	Nearby the right of way	During the construction phase
Sedimentation	Sediment load, rise in bed level	Site observation Measurement of sediment load in water	At road cross drainage and rivers	During the construction phase
Spoil Handling	Volume of spoil	Site observation Angle of repose	Nearby the right of way	During the construction Phase

Parameter	Indicator	Method	Location	Schedule
and Disposal		Slope of cross drainage		
Forest and Vegetation	Forest management, Number of plant species	Discussions with user groups, local people and District Forest Office, field observation	In and around ROW	As per requirement but not less than once a year
Wildlife	Number and type of wildlife and changes in migratory habits	observation, keeping records on wildlife	Community Forests and wildlife habitats	At least three times a year
Aquatic life	Aquatic management, Number of aquatic species	Sampling of aquatic Species, discussion with locals	Downstream side of river crossing	At least three times a year
Land use	Land use and land holding pattern	ACRP study, discussions with the local/displaced people and the project management	Project area	Before construction phase
Agriculture Production	Arable land and crop yield	Discussions with the local people, VDCs and observation	Project area	During the construction and operation phase
Income of displaced people	Living standards of the local people	Discussions with the local people, VDCs and observation	Project area	During the construction and operation phase
Social Activities	Day to day activities	Discussions with the local people, VDCs and observation	Project area	Quarterly during construction phase and once a year during operational phase



Parameter	Indicator	Method	Location	Schedule
Law and order	Social harmony and incidents of crimes, prostitution and conflict	Discussion with local administration, no of cases registered in Police and courts	Project area	Before construction

**Compliance Monitoring:** Compliance Monitoring employs a continuous recording of specific environmental quality indicators or pollution levels in order to ensure project compliance with recommended environmental protection standards. Compliance covers the work to be done by the contractor as specified in various contract clauses. Basically, compliance and impact monitoring would be carried out at site.

**Table 6.6 Compliance Monitoring**

Parameter	Indicator	Method	Schedule	Phase
Implementation of EIA recommendations	Incorporating EIA recommendations into project documents	Review of detailed design, project specification and tender documents	Following completion of tender documents	Construction/ Operation
Incorporation of the environmental consideration in the tender documents into the proposed work plan	The presence of each of the environmental consideration in the work plan included in the tender documents	Review of tender document	During approval of contract document	
Construction logistics	Arrangements regarding labour camps materials storage and construction activities	Site observation and allocation	Beginning of the construction period	Construction/ Operation
Implementation of all environmental conditions mentioned in the tender documents	Slope protection arrangement, pollution prevention, protection of vegetation, wildlife, use of local labors, safe construction, public health and public relations	Site observation and discussion with project management and local people using a checklist	Continuous	Construction
Clean-up and reinstatement of the project area	Completion of the different aspects of project clean-up	Site observation	At the end of the Construction period	Construction
Watershed management	Water and soil retention	Observation	Once during monsoon period	Construction/ Operation

**Impact Monitoring:** Impact Monitoring measures the physical, biological, socio-economic and cultural parameters within the project area during the construction and operation phases in order to detect environmental changes that occurred as a result of project implementation. It involves actual

measurement of the impacts of construction activities on the environment, such as water quality samples being taken at regular intervals to assess pollution concentrations in the river from construction work camps, after mitigation steps are taken. Impact monitoring is scientific data collection, analysis interpretation and follow-up of mitigation works. It is designed to assess actual impact vs. predicted impact and the effectiveness of the mitigation measures.

**Table 6.7 Impact Monitoring**

Parameter	Indicator	Method	Location	Schedule	Phase
Slope Failures and Landslides	Stability of slopes	Sieve analysis and Atterberg Limit Test	Near unstable slope areas	Before, during and after monsoon	Construction
Water Quality	Temperature, hardness, turbidity, oil and grease, coliform, NaCl, TSS, DSS, pH, DO, BOD, COD, P, S, Pb, Ar	Water sampling, testing and comparison to ambient standards	In drinking water standposts and river stem from the discharge of wastewater and run-offs from the construction and work force housing areas	Weekly for 1 full yr. during the preconst. phase; monthly during const. phase and monthly for 5 years during opert. phase	Construction/ Operation
Climate, Air Quality and Noise	Total suspended solid particulate, vehicular emission, dust accumulation from const. activities in house, vegetation, surrounding areas	Low-volume sampler, inspection, measurement, and comparison of data with ambient standards	In and around construction sites and along the roads	Continuous and twice a year water sampling	Construction/ Operation
Watershed	Rockslides and landslides	Site observation and pillars	Nearby the ROW	Twice a yr. during const. and once during operation.	Construction/ Operation
Sedimentation	Sediment load, rise in bed level	Site observation Measurement of sediment load in water	Downstream of river crossing	Once a year	Construction/ Operation
Spoil Handling and Disposal	Volume of spoil	Site observation Angle of repose Slope of cross drainage	Along ROW	Once a week	Construction
Forest and Vegetation	Number of plant species	Discussion with user groups, local people, DFO, field observation	In and around construction sites, access roads, markets	As per requirement but not less than once a year	Construction/ Operation
Wildlife	Number of animal species and changes in migratory habits	Sampling of animal species	Community Forests and wildlife habitats	At least once a year	Construction

Aquatic life	Number of aquatic species	Sampling of aquatic species	Downstream of major bridges	At least three times a year	Construction/Operation
Land Acquisition	Use of compensation record	ACRP study, discussion with the displaced people and the project management, HH survey	Project area	Once a year	Construction/Operation
Water use and water right	No conflict	observation	Project area	Once a year	Construction/Operation
Relocation	Social, cultural and ritual places	Discussions with the local people, Distric/VDC profile HH survey	Project area	Before commencing construction	Construction
Agriculture Production	Arable land and crop yield	Measurement of arable land and its yield, HH survey	Project area	Once a year	Construction/Operation
Income of displaced people	Average yearly income	Observation and recording., HH survey	Project area	Once a year	Construction/Operation

The responsibility of monitoring rests upon the promoter, especially Department of Roads. The third party monitoring (TPM) has been recommended for the validity of the monitoring report. Organizational setup for EIA monitoring has been given in the subsequent paragraphs.

**Table 6.8: Environmental Management Plan for Augmenting Beneficial Impacts**

Phase	Likely Impacts	Benefit augmenting measures	Schedule	Method	Location	Responsibility
Construction Phase	Employment and income generation for local people	<ul style="list-style-type: none"> <li>• Employment to local people PAF and SPAF will be ensured as more as possible</li> <li>• Compensation for land and productivity will be provided</li> </ul>	Pre-construction and at the start of Construction	Screening the application and interviews	At the site	Proponent
	Enterprise Development and Commercialization	<ul style="list-style-type: none"> <li>• Local goods and materials will be bought</li> <li>• Use of local construction materials and technology will be practised</li> </ul>	During construction	Screening for suppliers selection	At the site	Proponent
	Skill Enhancement	<ul style="list-style-type: none"> <li>• Skill dev. training to PAF &amp; SPAF will be given</li> <li>• Entrepreneurship training to PAF and SPAF will be provided</li> </ul>	During construction	Attaching new persons with experts	At the site	Proponent
	Improved stability	<ul style="list-style-type: none"> <li>• Road structures will be maintained as per design</li> <li>• Check dams will be constructed and bioengineering will be applied</li> </ul>	During construction	As per design and drawing	Road alignment	Proponent
Operation Phase	Increase in public service	<ul style="list-style-type: none"> <li>• Coordination with local authorities and communities for enhancing transportation services will be done</li> <li>• Support for public amenity services will be provided</li> </ul>	Just before operation	Coordinate with local authorities	Road alignment	Proponent
	Enhanced tourism	<ul style="list-style-type: none"> <li>• Information regarding tourism development will be provided to concerns.</li> <li>• Affiliated agencies for tourism promotion will be encouraged by all means.</li> </ul>	Just before operation/during operation	Coordination with users group and officials	Road alignment	DDC
	Improved Access	<ul style="list-style-type: none"> <li>• Entrepreneurship training will be provided to peoples intending</li> </ul>	Just before operation/during operation	Coordinate with local authorities	Road alignment	Proponent
	Rise of land values	<ul style="list-style-type: none"> <li>• guidelines to expand settlement will be formulated</li> </ul>	Just before operation/during operation	Coordinate with local authorities	Road alignment	DDC/VDC
	Women empowerment	<ul style="list-style-type: none"> <li>• Recruitment of woman will be ensured</li> <li>• Equal wage to women will be provided</li> <li>• Affiliated agencies will be promoted</li> </ul>	Just before the commencement of operation	Public awareness and legal arrangements	Road alignment	Proponent
	Enriched Biodiversity	<ul style="list-style-type: none"> <li>• Information will be provided to conserve biodiversity</li> <li>• affiliated agencies will be promoted for conservation activities</li> </ul>	Just before operation/during operation	Coordination with users group and officials	Road alignment	Proponent

**Table 6.9: Environmental Management Plan for Mitigating Adverse Impacts**

Phase	Possible Impacts	Mitigation Measures	schedule	Method	Location	Responsibility
<b>Construction Phase</b>	Change in land use	<ul style="list-style-type: none"> <li>• Compensation for infrastructures and farm products will be provided</li> </ul>	Before and during construction	Coord and consultation with local authorities and communities	Construction sites	Proponent
	Stock piling of construction material	<ul style="list-style-type: none"> <li>• Protection from rain, seepage and bad weather will be done to check spillage and</li> <li>• Watchmen will be deputed to look after</li> </ul>	During construction	Water proof and seepage proof storage Strong fencing and guarding	Construction sites	Proponent
	Noise pollution and vibration effect	<ul style="list-style-type: none"> <li>• Provision for, Regular maintenance of vehicle, Vehicular operation in day times, compensation for cracks and provision for safety measures will be made</li> </ul>	During construction	Use of standard procedures and standard safety instrument and appliances	Construction sites	Proponent
	Water pollution	<ul style="list-style-type: none"> <li>• The impact of bitumen on the available resources will be minimized by handling them safely and disposing them at designated sites.</li> <li>• The existing courses of the river and or streams will be maintained at all the locations.</li> <li>• Most of the culverts, crossings will be retained and widening has generally been proposed on the downstream side to prevent increased siltation.</li> <li>• Fuel storage and re-fueling sites will be kept away from drainage channels and Rivers/ Rivulets crossing the subject roads.</li> <li>• Safe disposal of wastewater and other constructional waste would be maintained.</li> </ul>	During construction	Coordination with local people Safe disposal of waste water and solid waste Control leakage from vehicles Control bituminous entry to water Provide safe drinking water	Construction sites	Proponent
	Haphazard spoil disposal	<ul style="list-style-type: none"> <li>• Retaining wall, check dams, cross drainage and bioengineering will be applied</li> </ul>	During construction	Dispose only in designated place Protect from flooding	Construction sites	Proponent
	Spoil disposal on private land	<ul style="list-style-type: none"> <li>• Site will be selected far from settlement having low land and low fertile area</li> <li>• Impact assessment will be carried out</li> </ul>	During construction	Coordination and consultation with geologists and local people	Construction sites	Proponent
	Landslide and soil	<ul style="list-style-type: none"> <li>• Compensatory plantation, construction of</li> </ul>	During	Coordination with users	Construction	Proponent

Phase	Possible Impacts	Mitigation Measures	schedule	Method	Location	Responsibility
	erosion	vegetative structure and appropriate Civil structures will be carried out	construction	group and locals	sites	
	Landscape Disturbance	<ul style="list-style-type: none"> <li>Bioengineering will be applied</li> </ul>	During construction	Coordination and consultation with locals	Construction sites	Proponent
	Air Pollution	<ul style="list-style-type: none"> <li>Monitor air pollution as per monitoring plan</li> <li>The asphalt plants, crushers and the batching plants will be at least 1km downwind of the nearest human settlement.</li> <li>Construction vehicles and equipment will be maintained and refueled in such a manner that spillage would not contaminate the soil.</li> </ul>	During construction	Coordination with project in-charge	Construction sites	Proponent
	Loss of Vegetation and Forest Resources	<ul style="list-style-type: none"> <li>Re-plantation of 25 trees for single tree cut</li> <li>Compensation will be provided for private tree cut</li> <li>Supervision of aforestation will be done</li> </ul>	During construction	Coordination with users group and DFO, Supervision and monitoring	Construction sites	Proponent
	Disturbance of Natural Habitats	<ul style="list-style-type: none"> <li>Signs and symbols for speed horns etc will be provided.</li> </ul>	During construction	Coordination with local people and authorities	Construction sites	Proponent
	Decline in Occupational Health and Safety condition	<ul style="list-style-type: none"> <li>Provision for aprons, globes and masks</li> <li>Provision of safety instruments helmet and boots will be made compulsory</li> <li>Health check up facilities will be provided</li> </ul>	During construction	Coordination and counselling to workers	Construction sites	Proponent
	Loss of Farm Land	<ul style="list-style-type: none"> <li>Compensation for land and production will be provided as per market price</li> </ul>	During construction	Coordination and consultation with PAF and local authorities	Construction sites	Proponent
	Loss of Private Properties and Infrastructures	<ul style="list-style-type: none"> <li>Compensation will be provided according to resettlement plan</li> </ul>	During construction	Coordination and consultation with PAF and local authorities	Construction sites	Proponent
	Loss of Forest Area	<ul style="list-style-type: none"> <li>25 trees for one tree cut shall be planted and it shall be monitored for five years.</li> </ul>	During construction	Coord. and consultation with CFUGs and local authorities	Construction sites	Proponent
	Conflicts due to Influx of Construction Workers	<ul style="list-style-type: none"> <li>Disciplinary code of conduct for labor will be displayed</li> <li>Keep labour in camp</li> </ul>	During construction	Coordination and consultation with CBOs and local authorities	Construction sites	Proponent
	Uncontrolled	<ul style="list-style-type: none"> <li>public amenity services will be upgraded</li> </ul>	During	Coordination and	Construction	Proponent

Phase	Possible Impacts	Mitigation Measures	schedule	Method	Location	Responsibility
	development of New Settlement		construction	consultation with CBOs and local authorities	sites	
	Pressure on Social Service Facilities	<ul style="list-style-type: none"> <li>Separate amenity services for construction camps will be developed</li> </ul>	During construction	Coordination and consultation with CBOs and local authorities	Construction sites	Proponent
	Nuisance from Construction Camps	<ul style="list-style-type: none"> <li>Provision will be made for sanitation facility solid waste disposal and waste water disposal facility at construction camps</li> </ul>	During construction	Coordination and counselling to workers	Construction sites	Proponent
	Conversion in farm land in to others	<ul style="list-style-type: none"> <li>Formulate settlement regulation at local level</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
Operation Phase	Noise Pollution and Vibration Affects	<ul style="list-style-type: none"> <li>Symbols for the institutional areas and no horn shall be placed.</li> </ul>	Prior and during operation	Counselling and support to construction crews	Construction site	Proponent
	Change in land use	<ul style="list-style-type: none"> <li>Guidelines for the induced settlement will be formulated.</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
	Air Pollution	<ul style="list-style-type: none"> <li>Vehicles will be maintained frequently</li> <li>emission standard will be maintained</li> </ul>	Prior and during operation	Counselling and support to construction crews	Project area	Proponent
	Water Pollution	<ul style="list-style-type: none"> <li>chemicals draining into the adjacent water and soil will be prevented</li> <li>Provide vehicle cleaning places</li> <li>For control of water quality the haphazard cleaning of Prevent leakage of fuels and lubricants into these water channels</li> </ul>	Prior and during operation	Counselling and support to construction crews	Project area	Proponent
	Loss of Vegetation and forest	<ul style="list-style-type: none"> <li>users group will be provided with support to check indiscriminate cutting of trees</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
	Disturbance of Natural Habitats	<ul style="list-style-type: none"> <li>Symbols for no horn and speed limits will be provided where ever necessary.</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
	Uncontrolled dev of settlements	<ul style="list-style-type: none"> <li>integrated settlement planning will be formulated</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
	Increase in Traffic Accidents	<ul style="list-style-type: none"> <li>Traffic signal for road cross section speed limits and other destination will be provided</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent
	Social Conflicts	<ul style="list-style-type: none"> <li>CBOs will be invited to provide counselling</li> <li>Increased police patrolling will be requested</li> </ul>	Prior and during operation	Coordination with local CBOs and authorities	Project area	Proponent

## 6.4. Environmental Auditing

Environmental Auditing is also an important part of the environmental management. It assesses the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures and the functioning of monitoring mechanisms. The Ministry of Environment, Science and Technology (MoEST) and Ministry of Physical Planning and Works (MoPPW) or Ministry of Forest and Soil Conservation (MFSC) are responsible for deciding on behalf of GoN. Local NGOs and National NGOs may also be entrusted to carry out the task, if they are engaged to do so by the government. Environment Protection Act, 2054 requires the Environmental Audit to be undertaken after the project has been in operation for two years.

Auditing refers to a general class of environmental investigations that are used to verify past and current environmental performance. The Environment Protection Regulation (1997) and the National EIA Guidelines (1993) specify that an Environmental Audit is required after the project operation for some time and that other types of environmental auditing are optional as to be decided by GoN. In the context of the environmental management of a project, environment impact auditing may assess the actual environmental impact, accuracy of prediction, effectiveness of environmental impact mitigation and enhancement measures and functioning of pre-construction, construction and operation phase monitoring mechanisms.

**Types of Auditing:** The environmental auditing types given below are of more general in nature and can be very well tuned to the specific need. Some environmental audit uses only one type, while others use several modules. As stated in the National EIA Guidelines, the types of auditing that may be carried out are as follows:

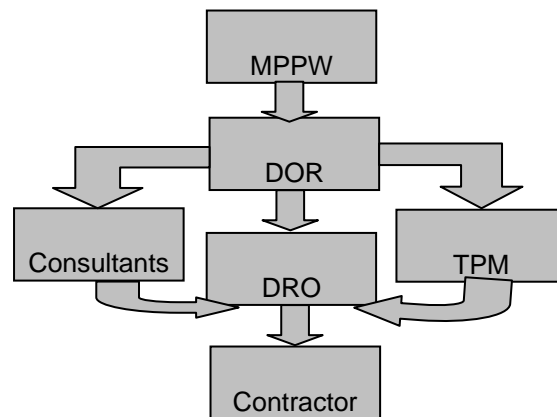
- **Decision Point Auditing:** It examines the effectiveness of environmental impact assessment as a decision making tool.
- **Implementation Auditing:** It ensures that conditions of consent have been met.
- **Performance Auditing:** It examines the effectiveness of project implementation and management.
- **Project Impact Auditing:** It examines environmental changes arising from project implementation.
- **Predictive Technique Auditing:** It examines the accuracy and utility of predictive techniques by comprising actual against predicted environmental effects.
- **EIA Procedures Auditing:** It critically examines the methods and approach adopted during the environmental impact assessment.

**Environmental Auditing Plan:** The auditing plan includes the parameters to be audited, indicators, methods to be used, locations of auditing and its sources. Environmental Auditing will be carried out following the construction and operation of Road to assess actual environmental impacts, the accuracy of predicted parameters, and the effectiveness of adopted and described mitigation measures by EIA and monitoring during implementation.

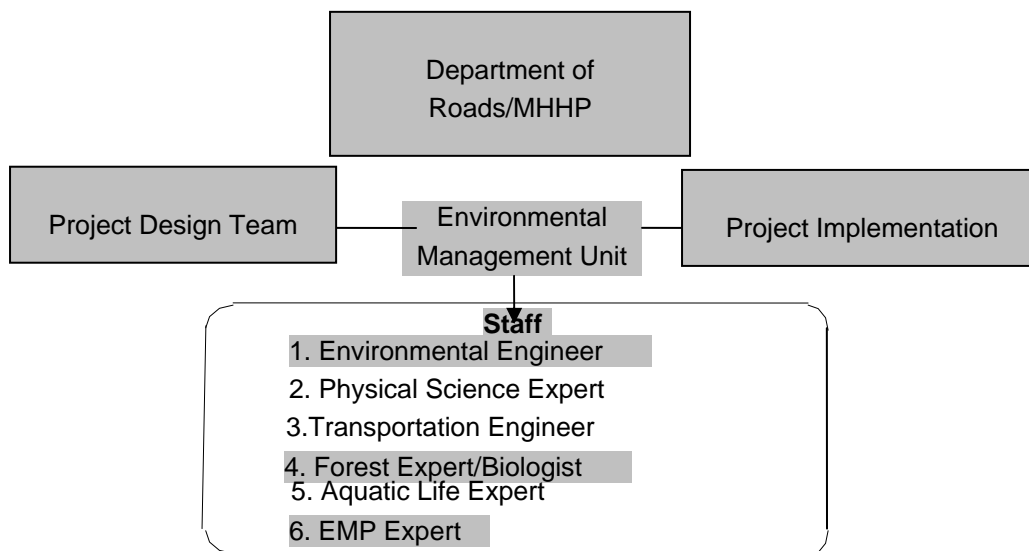


## 6.5 Resources

**Institutional and human resources:** The Department of Road will be the authority to execute the environmental and social management plan. Since it is less effective to look after the field level activities from the center, the Division Road offices will oversee the respective stretches of road, the construction and operation and the monitoring and auditing of the interventions. The proposed institutional set-up has been proposed under DOR for this:



The consultant or the third party monitoring team will work under the following organizational set with the professional staff listed in the organogram.



**Financial resources:** The implementation of the project needs execution of constructional activities taking care of the recommendation of the EIA report, operation and maintenance of the road and environmental monitoring and auditing. The construction and operation and maintenance of the road come under the project cost whereas the environmental protection measure also is a component of the project cost. However, in most of the project monitoring and auditing cost is not accounted for.

## **CHAPTER 7:ECONOMICAL ASPECT OF THE PROJECT AREA**

### **7.1 Introduction**

Highways and roads are the vital lifelines of the economy. They are the most preferred modes of transportation and considered most cost effective mode of transportation. They are easily accessible to each individual and facilitate movements of both men and materials anywhere within a country and abroad providing linkages to other modes of transportation like railways, air ways, and shipping, etc. Roads help to bring national integration.

Lack of adequate road infrastructure, especially in rural areas, results in significant limitations for communities. These limitations occur in terms of access to socio-economic and cultural centers such as schools, clinics, markets and other business centers. Limited access to schools hamper educational access for learners, lack of access to clinics hamper health development and limited access and mobility to markets and other business centers places limits on trade opportunities, and subsequently also limits the potential opportunity for earning an income and a subsequent improvement in the day-to-day living standard. The result is a poor socio-economic development standard.

Road infrastructure provides accessibility and mobility, leading in turn to increased transport operations, economic activities, subsequent economic growth and ultimately a healthy and sound economy. An adequate road infrastructure network also provides an advantage to a country in terms of improved regional integration, which helps to promote regional and international trade and significantly enhances the economic growth and development of a country and consequently alleviates poverty.

The road transportation also affects the location of economic activities such as businesses, jobs and housing, and therefore the value of land and buildings. Improving access to areas with undeveloped resources (including land for housing or businesses, and tourism activities) tends to increase economic development.

It is notable that about 680km out of total length of 1776km corridor of the MHH need new construction. The influence area of the 680km corridor comprising population of over 10 millions still does not have road access. Completion of the construction will provide road access to the population and inter-regional connection through the hills via direct route to Kathmandu. The MHH will also provide inter-district connections through the north south national and feeder roads which will be intercepted by the highway. The national and feeder roads will also provide connections with Indian towns in the south and Chinese towns on the north. Ultimately these improvements will provide population of the influence area of the whole length of MHH access to developed accessibility and mobility, leading in turn to increased transport services, economic activities, subsequent economic growth and ultimately a healthy and sound economy.

The improved freight movements and better connectivity will certainly reduce transportation costs and travel time leading to more competitive pricing of agricultural and manufacturing goods produced in the influence area for exports to different districts and regions of the country and

ultimately to the above towns. With all these impacts of the MHH opportunity for capital investments in different sectors will become more likely positively impacting the economic development of the influence area and that of the country.

## **7.2. Impacts of MHH**

The sources of economic impacts attributable to the completion of MHH construction could generally be placed into three categories – direct impacts, user benefits and increased economic efficiency.

### **7.2.1 Direct Impacts**

The direct impacts are most commonly associated with the new construction and widening of existing road sections, whereby employment and income created by construction jobs contribute positively to local economy. This type of impact is concentrated most heavily in the short-term and reduced significantly upon completion of the highway.

The new construction and widening of the existing road sections of MHH will require a lot of work force and local materials. Studies of previous completed highway projects in Nepal reveal that about 10% and 40% of total investment costs (Draft, ADB TA 7411-NEP Road Connectivity Project, 2010) go for unskilled labor and local materials respectively. Most of them will be fulfilled through locally available labor force and resources. Currently, the cost of construction of a highway in average is NRs.44.0 million/Km which means about NRs.4.4.0 million in unskilled labor and NRs.17.6 million in local materials need to be spent. This will funnel large amount of cash into the local economy. Similarly, during the construction period concentration of large number of work forces in different areas along the MHH corridor will demand large volumes of food grains, vegetables, livestock products such as milk, ghee, eggs and meat, consumption goods etc. These will give impetus to local people for opening of grocery shops, restaurants, tea stalls, and lodges and also growing of vegetables, livestock and poultry farming etc. All these will attract a lot of money in the local economy even if it will be for shorter period time.

After the completion of the construction of MHH the above labor force concentration areas will be developed into permanent market centers.

### **7.2.2 User Benefits**

The second category impact of highway/road construction encompasses direct user benefits accruing to traders and travelers, including time savings and transport cost reductions.

Currently, in the 680km of corridor of the MHH where new constructions are needed modes of transport of goods are porters and animals such as mule and travel of people is walking. When the constructions will be completed the modes will be shifted to trucks and tractors for transporting goods and bus and jeeps for traveling of people.

The recent study of RSDP2, DoR/the World Bank, Sept 2010, has estimated the net cost saving by modal shift to trucks and tractors from either porter or mule transport modes at NRs.250 per

ton-km. The same study has also estimated the value of time saving at NRs.20.0 per hour. It is note worthy that millions of rupees would be saved every year only in transporting goods and traveling of people after the construction of MHH.

Currently, lot of people need to travel long distance to visit even nearby districts. As an example if a person of Panchthar wants to visit Dhankuta for business purpose and transport goods he needs to travel first to Charali, then to Itahari and Dharan to reach Dhankuta. The recent study of RRRSDP, DoLIDARADB, 2010 has estimated the average vehicle operating costs (VOC) of buses, passenger jeeps and trucks at about NRs.40.0 per km, NRs.20.0 per km and NRs.52 respectively. The proportion of fuel consumptions in the VOCs are 53%, 49% and 54% respectively. When the construction of MHH will be completed the distance will be dramatically reduced so on VOCs and then fuel consumptions. The reductions in fuel consumptions means savings of millions of rupees required for importing the fuel every year.

The savings from reduced imports of fuel due to reduced consumptions could be invested in other development works of the country. Similarly, savings of time of people would be used for other productive uses.

### **7.2.3 Increased Economic Efficiency**

The third category impact of highway/road construction covers local, regional and national economic developments through establishment of industries, expansion of trade and promotion of businesses.

Road construction promotes efficiency through adoption of new technologies, reduced costs and expanded access to markets. In addition to more traditional industrial and commercial firm location “roadside service industries” (e.g. gas stations, restaurants, hotels) and new tourism may emerge and boons to local economies. Business location/relocation that may follow highway construction is an additional potential source of regional economic impact.

## **7.1 Agriculture**

### **7.1.1 Role of Mid Hill Highway in Agriculture Development**

Modernising agriculture is a central goal of Nepal’s government, with 68% of the population relying on the sector for both their income and livelihood. However, output has not grown in line with past state-set targets, leaving persistently high levels of rural poverty.

The improved freight movements and better connectivity and access to markets will deliver broad benefits by increasing farm gate prices and incomes for small and medium-sized farmers and traders, while reducing post-harvest losses due to good food rots in the field because the farmers lack the means to transport it to market on time. It will also provide direct jobs within value chains and other indirect employment opportunities for the landless poor and other vulnerable groups.

As access costs to markets decrease, agricultural households are seen to adjust their production activities as a reaction to the reduction in transport costs. Improved access also increases the

availability of yield-increasing inputs in reduced prices. Commercial fertilisers, for example, can supplement natural compost.

An effect of lower cost of access to markets encourages agricultural households to produce higher value-added marketable crops. It had been a major assumption of previous studies, namely: Priority Investment Plan (PIP), Rural Infrastructure Development Project (RIDP-1) and Rural Access Program (RAP), that as markets become more accessible there will occur either an expansion of the cultivated area as higher value added crops are produced or in areas where arable land is already fully cultivated, induced value-added is created by a switch from lower value cereal crops to higher value fruit, vegetable and pulse production.

The study of PIP in 2007, after intensive surveys had come to the conclusion that in immediate zone of influence in the hills (4 hours walking distance on either side of a road) farmers tend to cultivate or bring under cultivation 1 percent of land under vegetables, 1 percent under pulses and 2 percent under fruits after the construction of a road or a highway.

It is notable that about 0.3 million hectare of land will come under the direct influence area of about 680km corridor of the MHH after the completion of construction of the MHH. It means farmers of the area are likely to cultivate about 4 thousand hectares of new land under vegetables, 4 thousand under pulses and 8 thousands hectare under fruits. SRIDP in 2001 had estimated annual net economic returns of NRs.125000/ha of fruits, NRs.180000/ha of vegetables and NRs.12000/ha of pulses cultivation at the price of 2010 resulting from a road construction in the influence area. If the farmers of the influence area of the 680Km of MHH would go for the cultivation of fruits, vegetables and pulses as the same extent mentioned above shifting from traditional cereal crop cultivation they will make huge cash incomes.

Diverse agro-climatic conditions and production niches in the influence area of the MHH corridor provide opportunity to produce vegetables during which terai of Nepal and bordering parts of India cannot produce the same. Though these vegetables are considered as off-season vegetables in the major consumption areas, they are produced in the main season in the production pockets. That is, there are no forcing techniques used in the production. Hence, the products have the natural looks and are of high quality.

There is wide range of climatic zones in the influence area suitable for the production of vegetable seeds such as Radish, Carrot, Cauliflower and Onion. Similarly, tea, cardamom, ginger and bouquet grass are being grown as high value crops which have already shown their comparative advantage in the area. Experts opine that there is tremendous scope of expanding coffee area. The hilly influence area is suitable for citrus production, especially very good quality junar, orange, apple, and walnut receive premium price in Nepalese and nearby Indian markets. Beans and green peas are also being grown in the area as high value crops.

The construction of the MHH can be expected to lure local people to exploit above mentioned agricultural resources using modern technologies and increase their income level through the exports of the produces. The expansion of agricultural practices and cropping intensity will also create new employment opportunities to the local people and help raising their income level as

well. All these developments in agriculture will help in alleviating poverty of the people and over all economic condition of the area.

### 7.1.2 Improving agricultural production and cropping pattern

In general, subsistence farming is the dominant system in the mid and high hills. Easy access to a larger and relatively better marketing outlet would facilitate input supply and product marketing and encourage the farmers to increase and improve their production for higher farm income. One of the main goals of the Agriculture Perspective Plan of the Government of Nepal is to change existing traditional subsistence farming to a profitable and market oriented farming system. To achieve this goal, some priority crops/commodities have been identified for mid and high hill areas, and a few of them are apple and honey for high hills and citrus fruits, off- season vegetables, ornamental flowers and vegetable seeds for mid hill areas.

Table 7.1 provides information about area under cultivation and irrigated area in mid and high hill districts in different regions. The traditional cropping pattern is cultivation of mostly degenerated

**Table 7.1, Area under Cultivation and Irrigation in High and Mid-Hill Districts**

Development Region	Total cultivated area (ha)	Irrigated area (ha)	%of total area
Eastern High hill	130913	12865	9.8
Mid hill	454175	52884	11.6
Central High hill	85349	6477	7.6
Mid hill	328768	107828	32.8
Western High hill	4909	3526	71.8
Mid hill	415065	53357	12.8
Midwest High hill	65064	7649	11.7
Mid hill	169843	18541	10.8
Far west High hill	68273	13325	14.5
Mid hill	110560	34072	30.8
Total High hill	354508	43842	12.3
Mid hill	1478411	266682	18.0

Source: Annual Progress Reports published by the respective Regional Agriculture Directorates

local varieties of cereal such as wheat, barley, naked barley and maize, potato and a few trees of

apple as subsistence farming in high hill areas. The table no 7.2 presents the district wise cultivated area along the proposed alignment.

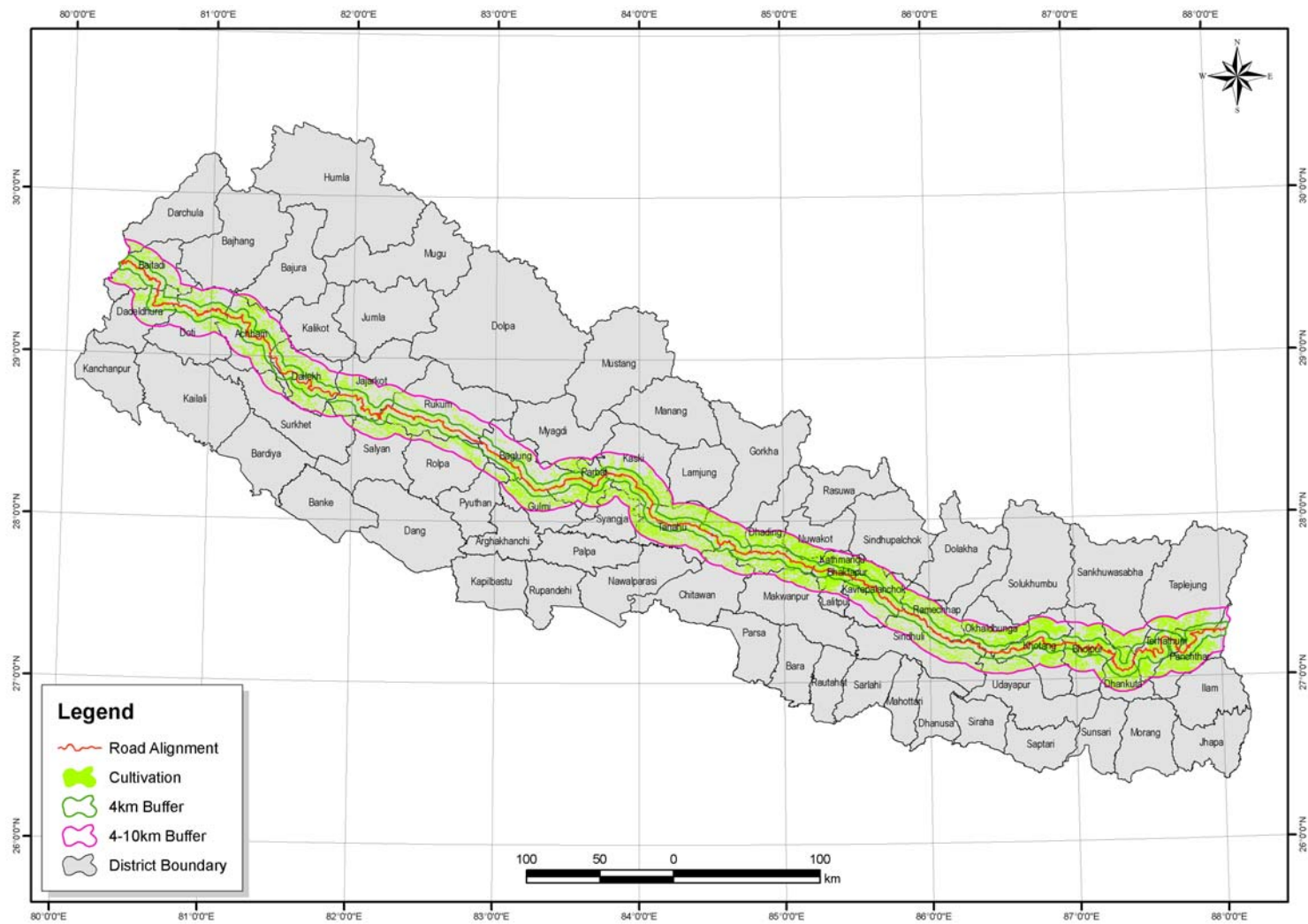
**Table no 7.2, District wise area of cultivated lands along the alignment**

District	Area (ha) 4km Buffer	District	Area (ha) 4km Buffer
Achham	21735	Bhaktapur	7509
Baglung	25353	Bhojpur	21882
Baitadi	10346	Chitawan	2319
Dadeldhura	8637	Dhading	24742
Dailekh	21247	Dhankuta	14165
Doti	13908	Gorkha	8383

Gulmi	3727	Kaski	13310
Jajarkot	12451	Kathmandu	7650
Kaski	8874	Kavrepalanchok	20415
Myagdi	23	Khotang	24078
Parbat	8365	Lalitpur	2141
Rolpa	262	Makwanpur	66
Rukum	16859	Nuwakot	447
Salyan	835	Okhaldhunga	5481
Surkhet	5	Panchthar	15030
		Ramechhap	6571
		Sankhuwasabha	694
		Sindhuli	8742
		Tanahu	20907
		Taplejung	2802
TOTAL	395961		

In mid hill area, the cropping pattern practiced is rice based followed by winter crops in low lying flat land and maize based cropping pattern in upland areas with an exception of tea and cardamom plantation in Eastern Region, orange-Junar in Central Region, mandarin orange-Suntala in Western, Mid western and Far western Regions and apple orchard in Western and Mid western Regions.

Department of Agriculture with its five Regional Directorates, one each in every region and 75 District Agriculture Development Offices, one each in every district is responsible for the development of agriculture sector through agriculture extension activities. To achieve the goal set by the Agriculture Perspective Plan (APP), the DADOs are following Pocket Package Strategy in their respective district.



**Fig no 7.1, Cultivated Land Along the Road Alignment**



Pocket Package Strategy (PPS) is implemented in areas, which have potential for higher farm income from specific crop/commodity. Micro climate, geography, source of irrigation, accessibility to appropriate market for input supply and produce marketing, social aspect etc are considered in PPS implementation. It is, therefore, evident that Mid-hill Highway project would encourage and intensify adoption of commercial crop production with high yielding crop varieties, appropriate production technologies and easy market access both for input supply and produce marketing. It is anticipated that the farmers would use high yielding varieties, appropriate production technologies with adequate levels of inputs resulting in higher production and increase their farm income, all facilitated by road accessibility.

### **7.1.2 Identification of Cash Crops**

APP and the long term agriculture development plan of the Government of Nepal have identified several crops/commodities, which have potential for commercial production and increased farm income.

The followings are some of the crops/commodities, which have potential for expansion and/or introduction in mid hill areas. (Source: Annual Progress Reports of Regional Agri Directorates)

#### **Eastern Region**

- expansion of cardamom cultivation in Taplejung, Ilam, Panchthar and Sakhawasabha districts
- expansion of off-season vegetable production in Dhankuta, Ilam, Panchthar, and Tehrathum districts
- expansion of citrus orchard in Dhankuta, Ilam and Panchthar districts

#### **Central Region**

- expansion of citrus (Junar) orchard in Sindhuli and Ramechhap districts
- introduction and expansion of fresh vegetable production in all the hill and high hill districts

#### **Western Region**

- expansion of apple orchard in Manang and Mustang districts
- expansion of orange orchard in Kaski, Lamjung, Gorkha, Syangja and Tanahun districts
- expansion of ginger cultivation in Gulmi and Arghakhanchi districts
- expansion of honey production in Palpa and Myagdi districts

#### **Mid western Region**

- introduction and expansion of off- season vegetable production in Rolpa, Salyan, Pyuthan, Dailekh and Surkhet districts
- introduction and expansion of vegetable seed production in Rolpa, Salyan, Jumla, Dolpa and Pyuthan districts
- expansion of orange orchards in Jajarkot and Dailekh Districts

- expansion of apple and other temperate fruit orchards in Rolpa, Mugu, Dolpa, Humla, Kalikot and Jumla districts

#### **Far western Region**

- introduction and expansion of vegetable seed production in Doti, Achham, Baitadi and Dandeldhura districts
- expansion of orange and apple orchards and honey production in Bajhang, Bajura and Darchula districts

#### **7.1.3 Potential farm development area**

District Agriculture Development Office (DADO) of each district is responsible for providing necessary agricultural extension support to the farmers to increase their farm income. Because of micro-climatic differences in hill areas, specific pocket area needs to be identified for a specific program. Area selected under PPS must be climatically suitable for the crops/commodities proposed and have additional potentials like irrigation, access to road, market potential both for input supply and produce marketing etc. Thus the area in the closer proximity to the Mid-hill Highway would have a greater potential to be covered under PPS.

#### **7.1.4 Protection and development of indigenous crops/commodities**

Indigenous crop varieties and/or technologies practiced at a particular location, in general, are time tested and are best suited to that particular location or environment. Cultivation of tea and cardamom in Ilam district, orange orchards in Dhankuta, Kaski and Dailekh districts, Junar orchards in Sindhuli and Ramechhap districts, coffee cultivation in Gulmi, cold tolerant rice variety Jumli Marshi are some of the examples of indigenous crops/commodities. The Mid-hill Highway would facilitate their adoption and spread in relatively larger area having similar type of agro-ecological condition for the benefit of a larger group of farmers.

#### **7.1.5 Employment generation in agriculture sector**

The construction of Mid-hill Highway is going to change existing agricultural practices. With change in cropping pattern, cropping intensity, availability of appropriate production technologies and access to relatively better marketing outlet, the farm income is sure to increase. Easy market access would encourage owner farmers as well as farm labors into transport and marketing of produce themselves for more profit, resulting in overall higher farm income. Apart from additional employment opportunities in farming operations, access to near by market, would also provide opportunity for marketing of farm products and farm inputs creating additional employment in the locality.

#### **7.1.6 Identification of technology for increment in production and profit**

Environment directly affects output from the technology used. It is, therefore, very important to select location specific technology for higher production and higher farm income. A technology

successful at a particular environment may not be successful at another environment and hence must be tested before its wider extension. Some of the technologies which could, immediately, be extended in relatively larger area in mid and high hills are described below:

***-Organic production of crops.***

Nepal does not produce any agricultural chemical and all the chemicals from fertilizers to plant protection chemicals are imported. These chemicals are expensive and quite often are not available on time. The supply situation is more erratic in hills. Cost of chemicals, supply situation and subsistence level of majority of hill farmers makes it very difficult for them to use these in proper doses. Presently organic products – grown without any chemical, are in great demand in Nepal as well as in other countries. Organic products fetch a higher price and have a good potential for export also. Organic commodities thus produced, would have competitive advantage over the traditional ones and could easily be transported to appropriate marketing outlet using Mid-hill Highway.

**Off-season vegetable production.**

In high and mid hill area various types of micro climatic conditions exist even within a very short distance. The variations are caused by factors like altitude, slope, facing etc. Vegetables fetch the lowest price during the peak season of production as supply often exceeds the demand. Microclimates in the hill allow cultivation of vegetables at a time when its growing season in the main production area is either yet to start or is over. Such vegetables fetch a premium price in urban markets. Fresh vegetables, being perishable, need to be transported quickly to the market where Mid-hill Highway would have an important role to play.

## **7.2 Tourism**

### **7.2.1 Introduction**

Hemmed between two largest populations of the world, China and India, Nepal's topography and culture stands quite unique. Ranging from the highest point on earth 8848 meter to 70-meter altitude from the sea level, the flora and fauna have a special place for the tourists visiting Nepal. Nepal's rich cultural heritage consisting of 91 different languages and 101 ethnic communities provides a blend of unparalleled cultural identity of different dresses, deities, architecture and festivals -making Nepal a special tourist destination. Due to topographical variation from the high Himalayas, mid-hill and plains of the Terai belt, the variation of tourism potential is found quite attractive. But Nepal has not been able to exploit her tourism potential in the fullest extent. After Nepal's 1972 Tourism Master Plan, many institutional, promotional and developmental activities in the field of tourism took place, but foreign exchange earning from tourism sector could not attain a height of its real potential even though employment generation and earning do possess a special place in the Nepalese service industrial sector.

Why Nepal could not earn much from the tourism sector is a very important question? Nepal started her tourism activities only at post-1950 period by opening the door to the outer world. Its beginning effort was as a Tourist Office in 1956 in that time government establishing a separate

Ministry of Tourism only in 1975. Therefore, formation and implementation of proper Tourism Policy remained a big challenge in exploring virgin areas of Nepal's wonderful tourism potential. Until late 80's Nepal depended upon foreign agents for selling this destination. The tourism mostly was concentrated in the urban areas and areas identified by the 1972 Master Plan. Besides that, Nepal could not diversify tourism in her unaccountable virgin areas. That is how **the length of stay** of tourists could not reach its target of 13 days for 2009/2010, which comparatively during 2007 reached 11.96 days. For increasing length of stay diversifying tourism outside urban areas is very important. It is the trekkers and mountaineers and other adventure tourists, contribute mainly to increase the average length of stay. That is how the role of MHH stands very significant **-diversifying tourism to the mid-hills** in between high Himalayas and plains of Terai naturally and culturally. Nepal observed VNY1998 on surface without much preparation and at the helm of the People's War staged in 1996.

Sometimes the leaders used to speak at lighter veins, e.g., Nepal targeted one million tourists as per a Tourism Minister's speech in 1987. It took already many decades to reach that goal for Nepal targeting one million tourists in VNY 2011. The infrastructure development for tourism activities is very vital. Therefore, the role of the MHH and its vicinity is quite significant in enhancing Nepal's tourism sector further to meet the national target of exceeding one million target in the days to come.

### **7.2.2 Identification of Existing Places for Tourism:**

The most important step launched by the Government of Nepal nine years ago on 1st September 2001 is its TRPAP program- Tourism for Rural Poverty Alleviation Program. It has identified six major existing Tourist Destinations and they are:

East of Pokhara segment of the MHH fall: Kanchanjungha, Solukhumbu, Langtang and Chitwan. Only two destinations are noted under TRPAP west of Pokhara segment under this category and they are Lumbini and Dolpa. The TRPAP is supported by UNDP, DFID and SNV. It was supposed to be handed over to would be formed Sustainable Tourism Development Unit of the government of Nepal. Altogether, the TRPAP covers 48 V D C's, 28337 households and 160, 732 people. The target was to involve poor and marginalized social groups of grassroots people in the decision making process.

#### Government Recognized Existing Tourist Places

##### **East of Pokhara Section**

General identification of the existing tourist places East of Pokhara Segment starting from the Far East: Ilam (11677m) for its Green Tea Gardens, Antu Danda (1677m) for the view of Mt. Everest and Kanchanjungha, unmatched sunrise and sunset view, 3-hour trek and also motor able facilities, Dhankuta, Hile, Barah Kshetra, Biratnagar, Janakpur and Dhanushadham. Similarly to the northern belt include Namchebazar, Charikot/Jiri, Kodari, Helambu, Gosainkunda, Bandipur and coming to the middle hills the Katmandu Valley, Chitwan and Devghat etc.

### **West of Pokhara Section**

Pokhara, Ghale Gaun, Manang, Baglung. Panchamal, Sirubari, Mukti Nath/Jomsom, Mustang Dolpa, Jumla, Humla and Khaptad.

#### Existing National Parks

### **East of Pokhara Section**

Sagarmatha National Park (1148 sq. km.), Makalu Barun National Park and Conservation Area (2330 sq. km.), Shivapuri National Park (1144 sq. km.), Langtang National Park (1710 sq. km.).

### **West of Pokhara Section**

Rara National Park (106 sq. km.), Shey Phoksundo National Park (3555 sq. km.), Khaptad National Park (225 sq. km)

#### Existing Conservation Areas(CA) and Wildlife Reserves(WR)

### **East of Pokhara Section**

Kanchanjungha CA (2035 sq. km.), Makalu Barun NP & CA (2330 sq. km.), Koshi Tappu WR (175 sq. km.), Gauri Shanker / Rolwaling CA (recently added).

### **West of Pokhara Section**

There are only two West of Pokhara Section government recognized Conservation Areas and they are Manaslu CA (1683 sq. km.) and Annapurna CA (7629 sq. km.). There is only one hunting reserve in Nepal and that is Dhorpatan Hunting Reserve. This falls in this section

#### World Heritage Sites

### **East of Pokhara Section**

Out of nine World Heritage Sites, eight fall in this section and they are Sagarmatha National Park, Bhaktapur Durbar Square, Changu Narayan Temple, Patan Durbar Square, Kathmandu Durbar Square, Baudha Nath Stupa, Pashupati Nath Temple and Chitwan Wildlife Reserve.

### **West of Pokhara Section**

There is only one World Heritage Site in this Zone and that is Lumbini that also falling to the southern belt of MHH.

### **7.2.3 Identification of New Tourist Attraction Places**

Hundreds of Tourist Attraction places so far unexplored fall along the MHHP trail stretching from east to west. It needs a separate tourism research project (DPR) to explore the potentiality in this zone. Very few of them are extracted below.

### Identification of the New Tourist Attraction Places

#### **East of Pokhara Section**

The places such as Olangchung Gola of Taplejung, Phidim, Kechana Kalan, the lowest point of Nepal from the sea level (70m) of Jhapa, Ghopa Camp of Dharan, Gai Ghat, Bhojpur, Sindhuli Gadhi, Nepal Thok, Namobudha, Shailung, Hanumante, Lamabagar, Bigu, Kuti Pass, Charnawati Temple, Kalinchowk, Magnesite Point of Dolakha, Dolakha Bhimsen, Tshorolpa and Beding, Namadi-Betali, Dhading Bazar, Bandipur, Paanchkhaal UNPKF Training Camp, Ghyalchok, Shyaprubesi, etc. can be attraction places in the vicinity of the alignment.

#### **West of Pokhara Section**

Birethanti can be developed as an organized ethnic village like Ghale Gaon. The most important area needs to be developed further is the Rara area. This could be the central attraction of the Nepal tourism in the west of Pokhara section. Similarly Khaptad has been already identified but if planned tourism is developed in this spot it will be a boom. Some other possibilities are Humla, Jumla, Dipayal and Silgadhi, Achham, Cainpur of Bajhang, Saipal, Simikot, Taklakot, Surmaa Sarovar, Khudpe, Baitadi, Dharchula, Chaughanpata, Thalara, Patans, etc.

#### **7.2.4 Trekking and Rafting Links Identification**

Thousands of new and short and long range trekking can be developed along the vicinity of MHH. Some important new identifications are explained below.

#### Trekking and Rafting Links Identification

#### **East of Pokhara Section**

The most important new trekking trail could be linked to Olangchung Gola of Taplejung. This point is not only important for domestic tourism but also for international/cross country trekking to Tibet of China. Second Cross Country Trekking could be developed from Lamabagar, where the country's most important Upper Tamakoshi, Tamakoshi-II and Tamakoshi-III hydropower generation is being launched. Third Cross Country Trekking could be developed from the historic trade route of Kuti Pass. Plenty of domestic Trekking Links can be made to major Trekking Routes like Kanchanjunga Himalayan Region, Khumbu Himalayan Region, Rolwaling Himalayan

Region, Ganesh Himalayan Region and Langtang Himalayan Region.

#### **West of Pokhara Section**

Plenty of short Trekking Trails can be developed connecting to the ACAP region particularly to Mustang and Manag landscapes. One of the very beautiful lake - Tilicho Lake has not been well explored. This could be done linking the trails. Rara and Khaptad could be Base Camps for developing linking trekking trails. For instance, one week trek from Jumla to Shey Phoksundo in the Dolpa Region lying between Dhorpatan Hunting Resort and Rara could be one of the best

treks of the world. Taklakot could be common point connecting many trails including to the Base Camp of the beautiful Mt. Saipal leading to Mt. Kailash of China

Plenty of new links to the major rivers for these purposes can be developed adjoining the MHH trail. Some major river systems are described below.

#### Identification of New Rafting, Kayaking and Canoeing Links

The following new rafting and Kayaking and Canoeing Links can be developed

#### **East of Pokhara Section**

- *The Arun River:* Tumlingtar to Chatara Section
- *The Tamakaoshi River:* Busti to Chatara Section: Grade 4-6, most adventurous.
- *The Sunkoshi River:* Baseri to Chatara Section
- *The Trishuli River:* Trishuli to Narayan Ghat Section

#### **West of Pokhara Section**

- *The Kali Gandaki River:* Kusma to Tiger Tops
- *The Budhi Gandaki River:* Arughat to Trishuli
- *The Bheri River:* Damauli to Tiger Tops
- *The Seti River:* Damauli to Tiger Tops
- *The Karnali River:* Karaleghat to Chisapani
- *The Seti River:* Saipal Base to Dipayal

#### **7.2.5 Identification of Areas for Golf Playing, Para Gliding, Mountain Climbing and Link for Mountain Cycling**

Most of the specified areas need separate projects for the preparation of the DPR in the concerned sector. But important areas are identified and explained in the 'E' section together with the scope, activities, role and summary of the tourism sector below.

#### **7.2.6. Role of Mid Hill Highway in Development of Tourism Activities in the Country**

To highlight the role, **Political stability** also after the construction of MHHP is very important, because if we compare the data after 1996-2006 and later there is a vast difference of achievements. If compared from 2006 to 2009 after the Comprehensive Peace Accord between the UCPN (Maoist) and the then government together with seven other political parties the year 2007 could be taken as the best example of the need of the political stability in the country. In 2007, total number of 526,705 tourists visited Nepal with an increase of 37.2% in comparison to 2006, the ceasefire year of the Maoists. The Asian share was 57.6%, Western Europe 26.7%, North America 7.1%, Eastern Europe and Australia was 3.2%.

This shows that the MHH can attract more tourists from Asian tourist markets than others. **Pilgrimage Tourism** based on **Hinduism and Buddhism** could be major tourist market. Latest

statistics show that more than 3.5 million Chinese tourists visit every year to Tibet and its only 10.0% share to Nepal could be 350 000. This figure could find new entry points like in Olangchung Gola in Taplejung close to Panchthar, Lamabagar close to Bhakundebesi besides traditional route of Kodari High Way to Dhulikhel and Kathmandu and further. A package via Pokhara could be made to Lumbini and via Silgadhi to Chainpur of Bajhang district further to Kailash via Taklakot. There are hundreds of opportunities for the Chinese Buddhist tourists to engage them in this road system for the extension of their stay in Nepal to reach the target of 13 days by 2010 and further.

Another potential, tourist market is **Hindu Pilgrimage Tourism**. There is no need to go far away to the expensive markets. Every year, some 5.00 million tourists come out for domestic tourism in India. Its 10% comes to be 500 000 tourists from India every year. There are so many Hindu temples and shrines along the MHH. Simply the government needs to plan to facilitate the private sector to develop infrastructure particularly targeting Hindu pilgrimage tourism along MHH. Special packages could be developed to Barakhshetra, Jata Pokhari, Doodh Pokhari, Dolakha Bhimsen, Kalinchok, Shailungeswori Mahadev, Pashupati Nath, Mukti Nath, Khaptad, Surma Sarowar and Kailash and vice versa.

On an average, 32% tourists enter to Nepal by land route. These tourists certainly like to travel by road and government can develop packages MHH. Out of the total arrival, on an average it is supposed that some 41.4% tourists come for **Recreation**. Some 68.0% tourists enter Nepal by air. This section of the tourists could be attracted to MHH because this is the touch of the plain of south and altitudes of the north in all variations and amalgamation of culture and nature. For recreation and other purposes, the private sector could develop tourism infrastructure together with **Village Resorts** in the less explored areas like Olangchung Gola of Taplejung, Ilam Phidim, Antoodaandaa area of Ilam, Tea Estates, Jarayotar, Bhojpur, Ghurmi Kshetra, Bhakunde Bensi, Kurintaar, Kushmaa, Burtibaang, Rukumkot, Chaurajahaari, Surkhet, Raakam Belkhet, Saanfe Bagar and the vicinity, Dipaayal, Silgadhi, Khaptad, Baitadi Paatan and many more beautiful areas en-route.

If we see the base year of 2007 and later the average trekking figure are around 101,320 and some plus or minus. Nearly 60.00% trekkers are attracted to Annapurna area followed by Everest and Langtang region. In fact **easy trekking routes** for a certain class of tourists like in Namo Baudha and Panauti could be developed. Thousands of such probabilities exist along the MHH. From a destination point, **nature walk, pony trek, birds view tour, culture tour, education tour, home-stay, sun-rise and sun-set view tours, aarati in different temples like in Varanasi and a small one also in Pashupati Nath every evening etc** could be developed.

**Home Stay** promotion would be of great attraction both to the purpose of tourism promotion and the interest and attraction for the local people giving them opportunity for employment, economic benefit, cultural exchange and knowledge and skill sharing from the people of different civilizations.

Since mid-hill climate is neither very cold nor very hot, another important attraction could be **Altesheim-** the international and national **senior people take care centers** development. **Health Care Centers of the Senior Citizen** could be a business boon in this climate zone along MHH.



In fact, countries like Japan could be best market origins of the senior people who can afford the prices for their healthy and quality stay of their rest of life. This concept, even private sector, has not borrowed well in Nepal. When peace prevails, this zone could attract thousands of senior people who have money but are helpless in their own country.

The year 2008 witnessed perhaps around 700 000 tourists. The tourist data also is a chronic problem for countries like Nepal. To increase the figure, new techniques and market concentration are vital in the tourist originating markets. Due to income from the remittance, perhaps the foreign exchange earning share from tourism sector declined in percentage but not in volume. Even the worst hit aftermath effect also 2008 had a 2-3% GDP share from tourism sector and the 2006-2007 total foreign exchange was equivalent to NRs.10.13 and 2008 had only slightly higher, i.e. NRs.10.89 billion not crossing a double digit foreign exchange share like earlier. This indicates Nepal needs to develop new techniques of promoting tourism potential besides the traditional one. This could be started from the MHH **paradigm shift in vision and practice** in developing new dimensions and attractions of tourism along with MHH particularly in identified new tourism attractions.

In **Adventure Tourism, Rafting, Kayaking, Canoeing, Water Sports like Boating, Swimming, Fishing, River Inns, River Resorts and sports etc.** could be developed along the MHH in the rivers like Mechi, Tamor, Arun, Dudh Pokhari, Sunkoshi, Trishuli, Karnali, Seti and Mahakali. Tough test for technology high speed ferries also could be developed in some of the above mentioned rivers by **Doppel Schlues System** barring rivers for the water recreations.

For **Mountaineering**, since the eastern and mid-western and other regions are already very popular but the mountains in the Far Western Region -beautiful mountains like Mt. Saipal are less explored. It was time, when expeditions had to use Indian Railways from Kathmandu via Sunauli to arrive Nepalgunj and from Nepalgunj to Saipal for **cross-country-trekking** using the road to Khudpe to go to the base camp via Chainpur of Bajhang district but after the construction of MHH, the expeditions can be directly driven to the nearest points of the base camps like of Mount Saipal. Mountaineering Schools could be viable in different points of such regions along with MHH and the vicinity.

Other very popular sports in **Adventure Tourism** are **Paragliding, Hang Gliding and Soaring**. Haveli Daandaa of Dhulikhel, Sallyaan Daanda and Dhampus Daandaa are the first hills in Nepal, which had the maiden flights of **paragliding** in the early eighties. Now it is very popular in Pokhara and the vicinity but other beautiful hills along with the MHH must be developed for the maiden flights and publicity of the virgin regions attracts the adventure tourists.

Similarly, **Golf Courses** like in Bhakunde Besi, Khaptad(Chhannaa), Baitadi Paatan etc. could be surveyed and developed. Similarly, popular **mountain cycling** like in the Everest Region, many routes can be developed along with MHH.

**In summary**, the MHH belt consists of tremendous tourism potential -places like Dhulikhel, Kathmandu and Pokhara already world-renowned destinations, side by side, the identification of new destinations recommended above, shows that Nepal can develop further tourist destinations providing alternative opportunities to the tourist industry. It can boost employment opportunities,

tourism and related industries, cultural conservation and exchange, increase per capita income of the people, provides opportunity to the people to understand the world civilization, and finally will be a corner stone for the poverty alleviation of the people of Nepal.

## **7.3 Hydroelectricity**

### **7.3.1 General**

Literatures show that Nepal has the hydropower potential of 83,000 Megawatt (MW). At present, the share of hydropower in Nepal's power system is approximately 632 MW installed capacity. Harnessing hydropower in a sustainable manner significantly contributes to the overall development and economic prosperity of the country. In Nepal, topography of the mid hill region favors for generation of hydroelectricity. Therefore, survey works of majority of the hydropower projects are concentrated within that region.

Hydropower development is capital intensive. Limited development of infrastructures and transmission networks are some of the important elements that are affecting the generation cost of hydroelectricity. Reports reveal that the generation cost of hydroelectricity in the projects varies from US\$ 2000 to US\$ 3500 per Kilowatt installed capacity. Higher installed capacity cost in some of the hydropower projects are also due to the inclusion of the entire cost of road that leads to the hydropower construction sites in the hydropower project cost.

Transportation of building materials, machines are key tasks of hydropower projects which requires good and dependable roads. Construction of roads costs a lot of money and requires lots of time in planning and operation. At present constructing an all weather road required for transporting building materials, machines etc of a hydropower project is estimated at about NRs.40.0 million per Kilometer. Hence, construction of an access road of a hydropower project consumes huge money requiring very high investment costs and ultimately higher cost of energy production. Due to the higher costs of constructing access roads hydropower project developers are cautious to invest and go for construction.

Construction of the MHH will reduce much of the cost to be incurred in constructing the access roads for the hydropower sites particularly to those projects that falls within the alignment and will create conducive environment for the power developers. This probably will attract investors to rethink for exploring potential hydropower projects and establish in the influence area of MHH.

These projects will provide electricity to every household in the area and even will allow country to sell electricity to other countries to earn foreign-revenue which will certainly help in alleviating poverty in the area.

The projects will require a lot of work force and local materials for construction. Studies of previous completed hydropower projects reveal 15% and 10% of total investment costs go for unskilled labor and local materials respectively. Most of them will be fulfilled locally just funneling large amount of cash into the local economy. Similarly, during the construction period concentration of large number of work force will demand large volumes of foods, vegetables, livestock products such as milk, ghee, eggs and meat etc. These will give impetus to local people

for opening restaurants, tea stalls, lodges, growing vegetables, livestock and poultry farming and other crops. All these will attract a lot of money in the local economy even if it will be for shorter time period.

### 7.3.2 Proposed Highway Alignment and Hydro-electricity Projects

This report has attempted to list out the potential hydropower projects within or vicinity of the proposed Mid Hill Highway alignment, which contributes in reducing the cost of the hydro-electricity projects substantially. For analysis purpose, data available from Government of Nepal, Department of Electricity on potential hydro-electricity projects for which the survey and/or generation licenses have been issued, are considered.

Considering the alignment of the proposed Highway, the hydro-electricity projects are categorized into three groups.

- i. Hydro-electricity projects within the alignment of the highway
- ii. Hydro-electricity projects buffering 10 km from the alignment of the highway
- iii. Hydro-electricity projects between 10 km to 15 km from the alignment of the highway

#### 7.3.2.1 Hydro Electricity Projects Within the Alignment of the Highway

The hydro-electricity projects under this category lies within the alignment of the proposed mid-hill highway. At present, there are 14 projects of capacities varying from less than 1 MW to 30 MW. Table 7. 3 shows the name and capacity of the power projects (Refer figure 7.2).

**Table 7.3: Hydropower Projects within the Alignment**

S.N	Project	Capacity(MW)	District	Development Region
1	Lower Igwa Khola	4.00	Panchthar	Eastern
2	Iwa Khola	2.60	Panchthar	Eastern
3	Hewa Khola 'A'	15.00	Panchthar	Eastern
4	Upper Hewa Khola	10.00	Panchthar	Eastern
5	Lower Hewa Khola	8.00	Panchthar	Eastern
6	Kabeli-A Hydropower Project	30.00	Terhathum	Eastern
7	Lower Khorunga	2.80	Terhathum	Eastern
8	Belkhu Khola	0.33	Dhading	Central
9	Upper Seti-1	9.90	Kaski	Western
10	Middle Modi	4.88	Parbat	Western
11	Lower Modi Khola	20.00	Parbat	Western
12	Sawane-A	1.50	Gulmi	Western
13	Taman Khola	3.50	Baglung	Western
14	Naudhari SHP	0.60	Rukum	Mid-Western
	TOTAL	112.51		

Construction of the proposed highway will compliment the hydro-electricity projects that lie within the alignment, by providing an easy access to the project sites. This results less financial impact to the hydropower developers in the road construction components.

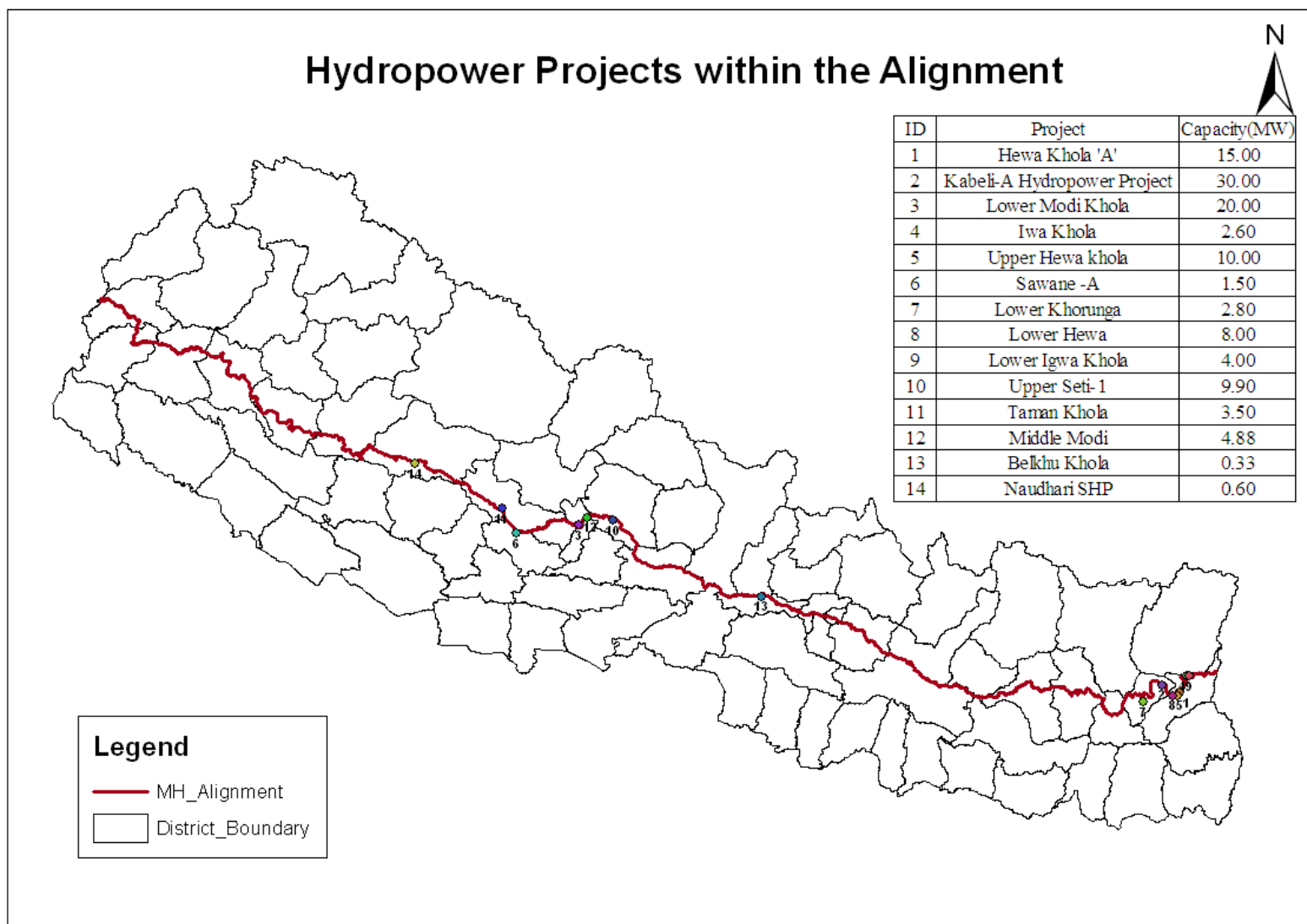


Figure no 7.2, Hydropower Project along the Alignment

### 7.3.2.2 Hydro Electricity Projects Buffering 10 km from the Alignment of the Highway

The projects under this groups lie within the buffer of 10 km, excluding the projects listed within the alignment of the proposed highway. The table below provides the listing of the projects (Refer figure 7.3 and 7.4).

**Table 7.4: Hydropower Projects at 10km buffer of the Alignment**

S.N	Project	Capacity(MW)	District	Development Region
1	Hewa Khola 'B'	5.00	Panchthar	Eastern
2	Upper PHEME Khola	2.50	Panchthar	Eastern
3	Feme khola	1.00	Panchthar	Eastern
4	Middle PHEME	0.15	Panchthar	Eastern
5	Teliya Khola SHP	1.00	Terhathum	Eastern
6	Lower Tamor	22.80	Panchthar	Eastern
7	Khorunga Khola	2.00	Terhathum	Eastern
8	Likhu A HPP	5.00	Okhaldhunga	Eastern
9	Kabeli B - 1	9.80	Panchthar	Eastern
10	Upper Maya Khola	3.10	Sankhuwasabha	Eastern
11	Upper Khoranga Khola HPP	7.50	Terhathum	Eastern
12	Pikhuwa Khola	2.50	Bhojpur	Eastern
13	Rawa Khola	3.00	Khotang	Eastern
14	Upper Ingwa Khola	9.70	Taplejung	Eastern
15	Down Puluwa	9.50	Sankhuwasabha	Eastern
16	Upper Lambu Khola	2.10	Terhathum	Eastern
17	Lower PHEME Khola	2.20	Panchthar	Eastern
18	Miya Khola	0.98	Khotang	Eastern
19	ThotneKhola	0.48	Okhaldhunga	Eastern
20	Upper Leguwa	0.50	Dhankuta	Eastern
21	Leguwa Khola	0.22	Dhankuta	Eastern
22	Taksar Pikuwa	0.93	Bhojpur	Eastern
23	Naubise Khola	0.67	Dhading	Central
24	Hugdi Khola SHP	0.50	Dhading	Central
25	Upper Belkhu SHP	0.64	Dhading	Central
26	Sali Nadi	0.40	Kathmandu	Central
27	Dariyal Khola	0.61	Dhading	Central
28	Lower Roshi Khola Small	4.70	Kabhrepanchok	Central
29	Upper Rigdi Khola	4.00	Chitwan	Central
30	Mel Khola	1.05	Makawanpur	Central
31	Roshi Khola	3.00	Kabhrepanchok	Central
32	Dapcha Roshi Small	5.00	Kavrepalanchok	Central
33	Devighat Cascade HPP	9.60	Nuwakot	Central
34	Trisuli Galchhi	10.00	Nuwakot	Central
35	Rigdi Khola	1.94	Chitwan	Central

S.N	Project	Capacity(MW)	District	Development Region
36	Naubise Khola A	0.50	Dhading	Central
37	Seti Khola	0.49	Chitwan	Central
38	Roshi (Lower) Khola SHP	1.00	Kavrepalanchok	Central
39	Super Trishuli	75.00	Chitwan	Central
40	Trishuli Nadi	20.10	Dhading	Central
41	Mahesh Khola	1.90	Dhading	Central
42	Super Pati Khola	0.57	Parbat	Western
43	Nisi Khola	2.00	Baglung	Western
44	Bhurungdi Khola	0.90	Kaski	Western
45	Wardi Khola	0.55	Kaski	Western
46	Kathe Khola	0.99	Baglung	Western
47	Saiti Khola Small	0.65	Kaski	Western
48	Sardi Khola-2	0.75	Kaski	Western
49	Sardi Khola-1	0.80	Kaski	Western
50	Myagdi Khola	50.00	Myagdi	Western
51	Beni Kaligandaki	50.00	Baglung	Western
52	Upper Daram-II	2.75	Baglung	Western
53	Sardi Khola	3.50	Kaski	Western
54	Badigad	7.00	Gulmi	Western
55	Idi Khola SHP	0.98	Kaski	Western
56	Badigad -A	5.00	Baglung	Western
57	Daram Khola-A	2.50	Baglung	Western
58	Badigad HPP	5.00	Baglung	Western
59	Upper Daram A	6.00	Baglung	Western
60	Bhuji Khola	4.70	Baglung	Western
61	Seti (scheme A)	6.00	Kaski	Western
62	Upper Badigad	5.00	Gulmi	Western
63	Theule Khola	1.50	Baglung	Western
64	Madi-2	7.00	Kaski	Western
65	Theule Khola	0.96	Baglung	Western
66	Nisi Khola HEP-1	6.00	Baglung	Western
67	Madi seti	86.00	Lamjung	Western
68	Serpu Daha - Sani Bheri Nadi (PS)	30.10	Rukum	Mid-Western
69	Lukum Khola	0.95	Rukum	Mid-Western
70	Upper Karnali St-1	184.00	Kalikot	Mid-Western
71	Tame Khola SHP	1.25	Dailekh	Mid-Western
72	Lohare Khola	4.50	Dailekh	Mid-Western
73	Katti Khola	2.98	Dailekh	Mid-Western
74	Rukum gad	5.00	Rukum	Mid-Western
75	Lahu Khola	4.08	Rukum	Mid-Western

S.N	Project	Capacity(MW)	District	Development Region
76	Mujkot Khola	0.97	Jajarkot	Mid-Western
77	Satya Khola SHP	0.94	Jajarkot	Mid-Western
78	Super Saru	0.96	Jajarkot	Mid-Western
79	Suwa Gad	0.96	Jajarkot	Mid-Western
80	Igdigad	4.61	Achham	Far-Western
81	Upper Gaddi Gad	3.85	Doti	Far-Western
82	Gaddi Gad HPP	4.00	Doti	Far-Western
83	Middle Gaddi Gad	3.50	Doti	Far-Western
84	Ruwa Khola SHP	1.00	Dadeldhura	Far-Western
	TOTAL	743.81		

The proposed highway will be the starting point from where the roads of varying lengths (Approximately 10 km to 20 km) for different hydro-electricity project sites needs to be constructed. Hence, the highway is instrumental in reducing the cost of the road construction component associated with the hydropower projects by limiting the length of construction to approx. 10 km to 20 km for different projects.



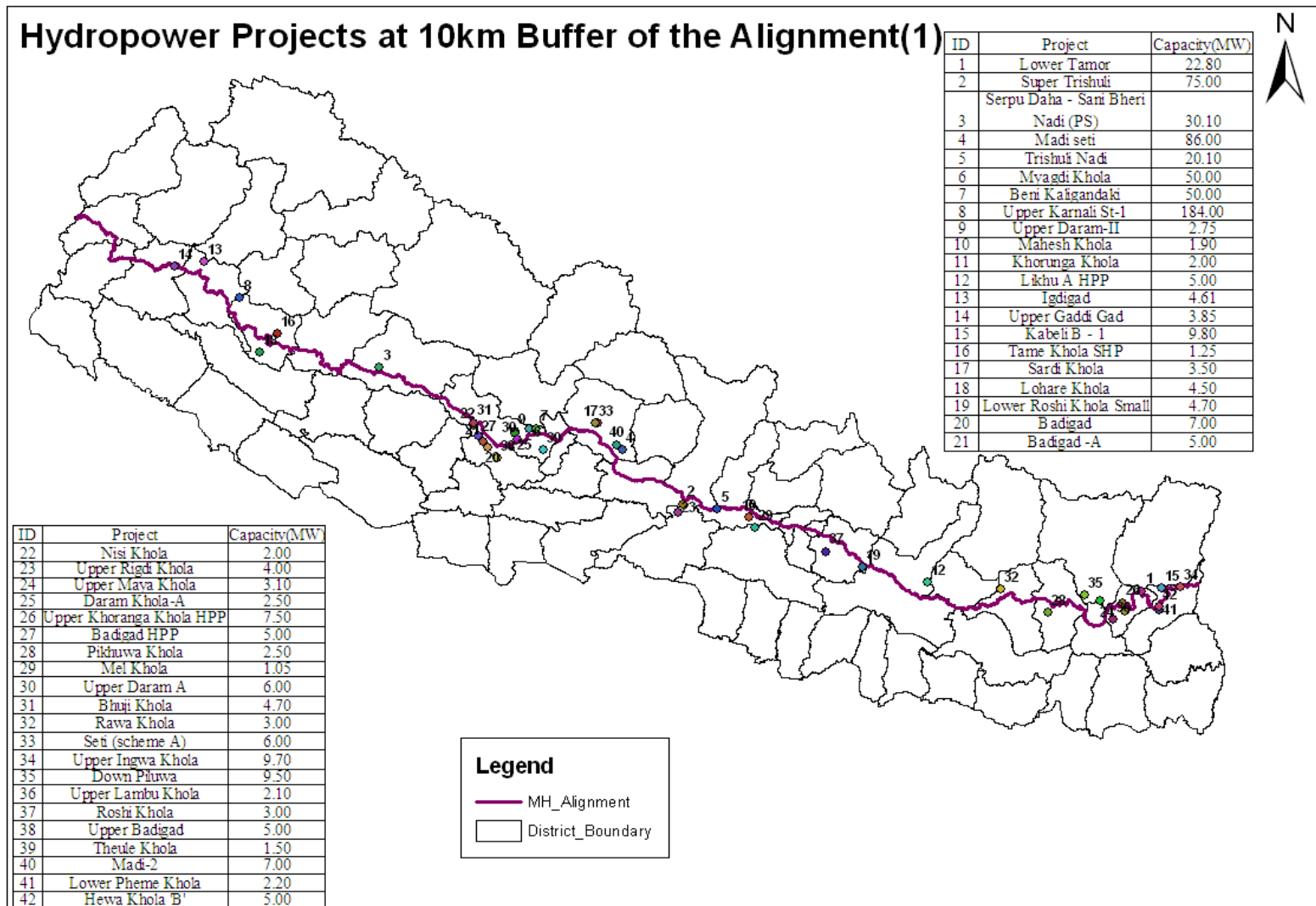


Figure no 7.3, Hydropower Project within the 10Km Buffer

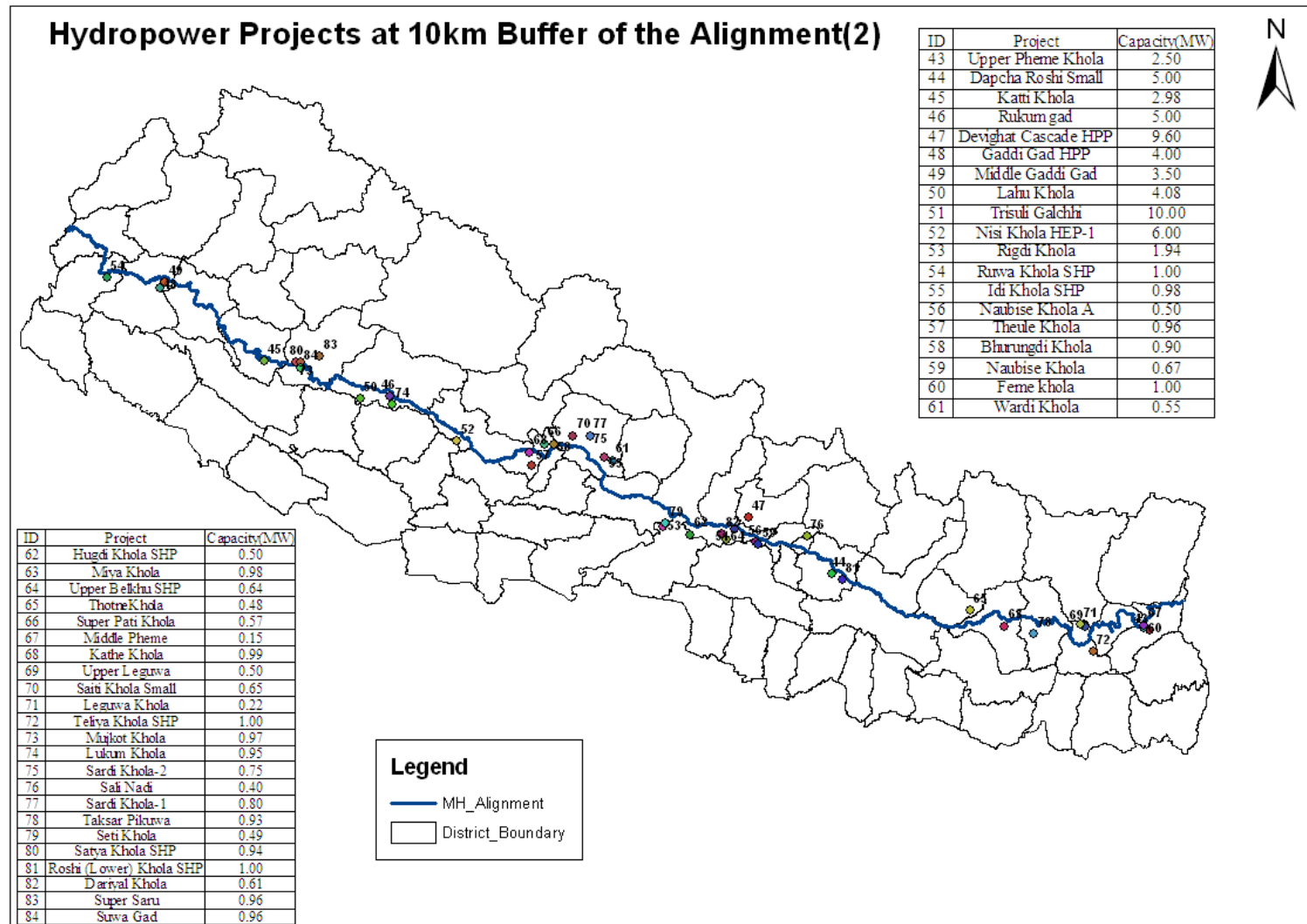


Figure no 7.4, Hydropower Project within the 10Km Buffer

### 7.3.2.3 Hydro Electricity Projects Between 10 km to 15 km from the Alignment of the Highway

The projects under this groups lie between 10 km to 15 km from the alignment of the proposed highway. The table below provides the listing of the projects (Refer Figure no 7.5).

**Table 7.5: Hydropower Projects between 10 km to 15km from the Alignment**

S.N	Project	Capacity(MW)	District	Development Region
1	Upper Piluwa Khola-2 SHP	2.48	Sankhuwasabha	Eastern
2	Sapsu Khola	2.78	Khotang	Eastern
3	Upper Piluwa 1	3.00	Sankhuwasabha	Eastern
4	Yandeli Khola	2.73	Taplejung	Eastern
5	Lower Piluwa	0.99	Sankhuwasabha	Eastern
6	Muwa Khola	1.00	Panchthar	Eastern
7	Lower Likhu	16.00	Ramechhap	Central
8	Tamakoshi -1	100.00	Dolakha & Ramechhap	Central
9	Tamakoshi-3 TA-3	880.00	Dolakha	Central
10	Upper Chauri Khola	3.16	Kabhrepalanchok	Central
11	Upper Thoppal Khola A	0.98	Dhading	Central
12	Jhyari Khola	0.70	Sindhupalchok	Central
13	Sankhamul Khola (Daman) SHP	0.65	Makawanpur	Central
14	Chakhel Khola Small	0.23	Makawanpur	Central
15	Upper Ladku	0.59	Kabhrepalanchok	Central
16	Sano Milti SHP	0.76	Ramechhap	Central
17	Bhaise Khola	0.31	Kabhrepalanchok	Central
18	Thado khola	0.95	Sindhupalchok	Central
19	Marsyangdi 3	42.00	Lamjung	Western
20	Super Madi	44.00	Kaski	Western
21	Kaligandaki Upper	72.50	Myagdi	Western
22	Madi-Bhorletar	9.00	Kaski	Western
23	Chhaldi Khola	4.96	Gulmi	Western
24	Upper Hugdi	2.63	Gulmi	Western
25	Rudi Khola	3.97	Kaski	Western
26	Chepe Khola	2.98	Gorkha	Western
27	Paundi Khola	0.25	Lamjung	Western
28	Labdi Khola Small	0.93	Tanahu	Western
29	Aul Khola	1.00	Myagdi	Western
30	Tara Khola SHP	0.75	Baglung	Western
31	Rahughat	27.00	Myagdi	Western

32	Dwari Khola SHP	0.99	Dailekh	Mid-Western
33	Prajuli Khola	2.30	Dailekh	Mid-Western
34	Paraiuli Khola-1	2.15	Dailekh	Mid-Western
35	Padam Khola	3.50	Dailekh	Mid-Western
36	Dotigad	3.83	Dadeldhura	Far-Western
37	Lower Surnayagad	5.00	Baitadi	Far-Western
38	Malagad	5.31	Bajura	Far-Western
39	Barjugad Mini	1.00	Bajura	Far-Western
	TOTAL	1253.36		

The road of varying length ranging from 15 km to 30 km or more need to be constructed depending upon the location of the power projects provided in the above table. The proposed highway will help in reducing the construction cost of some of the projects, however remarkable effect in financial implication will not be observed to the other remaining projects in this category.

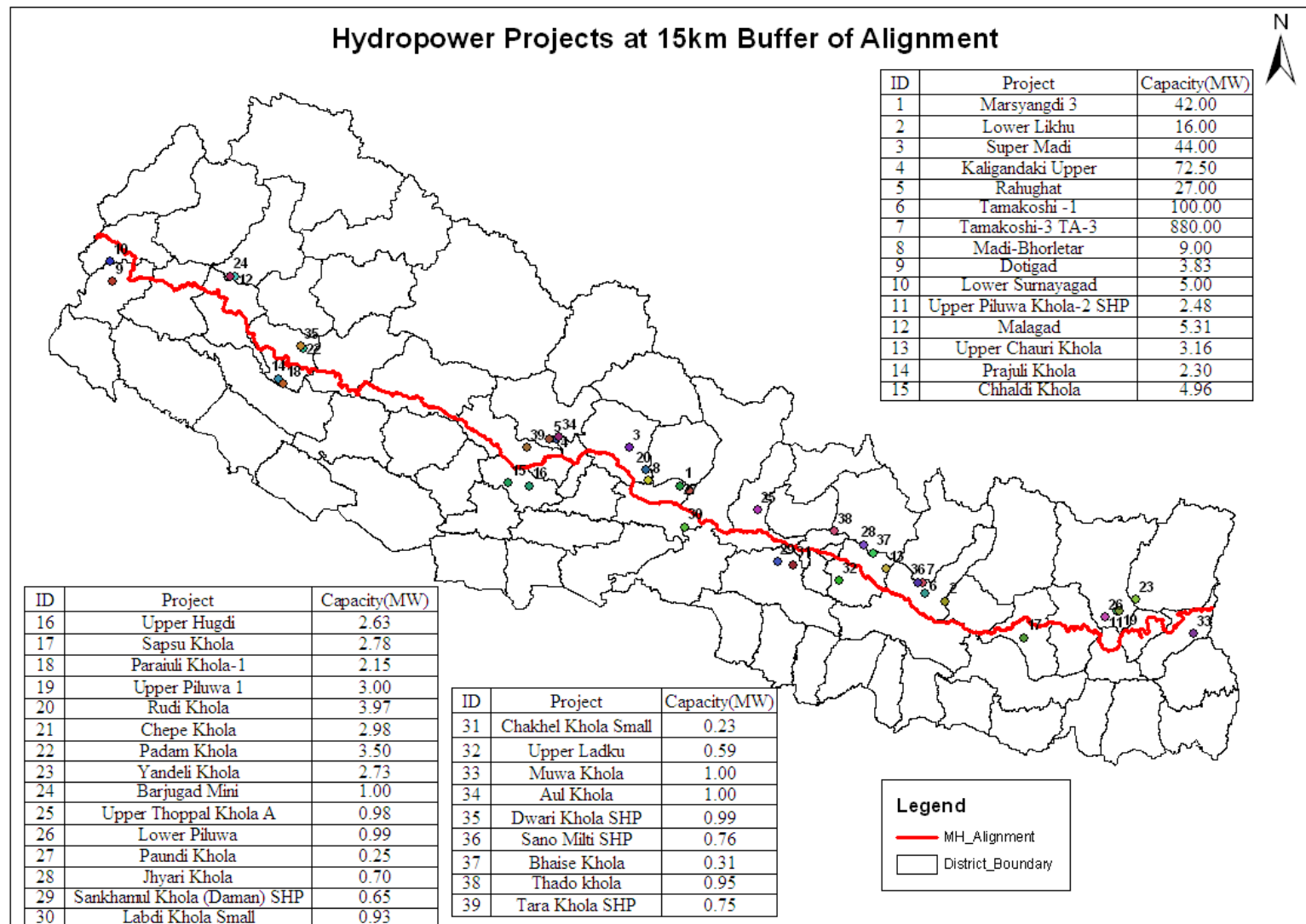


Figure no 7.5, Hydropower Project within the 10-15Km Buffer

### **7.3.3 Role of Mid Hill Highway in Development of Hydro-electricity**

Proposed mid hill highway will contribute substantially is addressing the current challenge of the government and the Independent Power Producers to reduce the cost of hydroelectricity development. Construction of the highway results exclusion of the cost incurred in constructing the road for the hydropower sites particularly to those projects that falls within the alignment. To other currently under study and potential hydropower projects, the highway helps in reducing the cost for the road construction components, thus creates the conducive environment for the power developers.

## **7.4 Industrial Development**

Although economic development objectives have often played a role in investment decisions, but the impact on industrial development has seldom been considered.

A number of studies have shown that industries do get benefits with highway constructions, but some industries benefit more than others. Those industries that are more heavily rely on transportation, namely freight-intensive sectors and those industries where workers often commute especially benefit.

Highways allow resources to be delivered to factories, employees to commute to worksites, goods to be delivered to markets, and customers to access stores and other commercial services in nominal costs. According to location theory, transportation costs are one of the key determinants of industrial site choice.

Studies undertaken in USA and other countries reveal average production cost savings of all industries combined is \$180,000 per year as a result of \$1-million investment in highway network development.

Currently, industrial activities are not a strong feature of the influence area of stretches totaling 680Km of MHH corridor with small and scattered activities such as food processing, beverage production, forest based, metallic based, non-metallic mineral based activities, traditional textile, carpet etc.

The limited prospects of industrial development in the area will change significantly after completion of construction of the stretches whereupon the comparative advantage will be in the areas of manufacturing. There are great prospects in the development in furniture, agro processing, coffee processing, processing of herbs and medicinal plants, consumer goods, construction materials, handicrafts and retail industries. Export-processing zone and industrial areas with necessary utilities will developed with the construction of MHH.

The industries will require a lot of work force during construction as well as operation. Most of the work force will be fulfilled from locally available manpower just funneling large amount of cash into the local economy. Similarly, during the construction and operation periods concentration of large number of work force will demand large volumes of foods, vegetables, livestock products such as milk, ghee, eggs and meat etc. These will give impetus to local people for opening

restaurants, tea stalls, lodges, growing vegetables, livestock and poultry farming and other crops. All these will attract a lot of money in the local economy.

The exports of the industrial products from the area to other parts of the country and sometimes to sell other countries will enable to bring large amount of revenue into the area which will certainly help in alleviating poverty in the area and economic development.

## **7.5 Development of Trade and Business**

An efficient and well-established network of highways/roads fulfills the needs of a sound transportation system and is desired for promoting trade and commerce in any country for sustained economic development.

Currently, the influence area of about 680Km of the corridor of MHH lags behind in trading and business. Trading and business activities are limited to meet local basic needs. The area is the net receiver of trade inflows with very small proportion of trade outflows. In the sense, the external dependence of the area is very high. Trading pattern and flows move mainly via settlement lines generating mainly from the terai cities more specifically from Biratnagar, Birgunj, Kathmandu, Bhairahawa and Nepalgunj.

Business/market infrastructures to increase or facilitate trade and business are lacking in the area. Development of market centers and flow of goods are limited due to lack of thorough road network. Development of market centers and flow of goods are limited by the extent and condition of road. Many of the market centers operating are seasonal in nature, operating only in dry season. This has major implication on trade and business.

Construction of MHH is expected to develop permanent business/market infrastructures along the highway. This development together with increase in agricultural and industrial productions as envisaged above will boost the prospect of exporting goods thus improving trading and business situation.

The exports of agricultural and industrial productions and increased employment of local labor in agriculture and industries will bring a lot of cash money in the area which in turn will increase consumptions leading to the increased imports.

The increased trade and business will boost local economy thus providing impetus to the local economic development.

## CHAPTER 8. COST ESTIMATE

A costing of the project has been calculated based on the typical design of structures and pavement. The quantities of the earthworks, structures and pavements have been determined considering the recent road and bridge projects. The cost does not include already constructed roads. Total cost will include;

- Cost of detailed studies such as feasibility study, detailed design, environmental study, design of bridges, geotechnical investigation and construction survey.
- Cost of earthworks
- Cost of cross drainage structures such pipe culvert, box culvert, slab culvert and causeway
- Cost of longitudinal drains
- Cost of pavement
- Cost of bridges
- Cost of traffic sign and safety
- Cons of bio engineering and environmental mitigation works
- Cost of maintenance during construction and
- Administration cost

Details of the cost estimate is presented in the Appendix-1. The summary of cost is presented in the table below:

**Table no 8.1 Summary of Cost**

Sn	Description	Unit	Rate in NRs 000	Quantity	Amount in NRS 000
1	<b>Feasibility Study</b>	Km	7	436.00	3052
2	<b>Detailed Engineering Survey, Roads</b>	Km	48	926.00	44448
3	<b>Environmental Studies</b>	Km	15	926.00	13890
4	<b>Detailed Engineering Survey of Bridges</b>	No	800	19.00	15200
5	<b>Geo-Technical Studies</b>	No	500	45.00	22500
6	<b>Land Acquisition</b>	Sqm	0.3	9260000.00	2778000
7	<b>Construction Survey</b>	Km	20	926.00	18520
8	<b>Earthwork</b>				
8.a	Cutting	Cum	0.175	34320000.00	6006000
8.b	Filling	Cum	0.15	1607000.00	241050
9	<b>Retaining Structures including Chutes Cascade etc</b>				
9.a	Gabion	Cum	3.6	849800.00	3059280
9.b	RRM	Cum	8	321400.00	2571200



9.c	Dry Stone	Cum	2.9	160700.00	466030
9.d	RCC	Cum	20	13620.00	272400
9.e	Rock/Soil Anchoring and Doweling	Cum	15	74080.00	1111200
<b>10</b>	<b>Drain Construction</b>				
10.1	Earthen	Km	350	138.90	48615
10.2	Dry Stone	Km	1200	92.60	111120
10.3	RRM	Km	4000	509.30	2037200
10.4	RCC Cover Drain	Km	6000	231.50	1389000
10.5	Sub-Surface drains	Km	6000	83.34	500040
<b>11</b>	<b>Culvert Construction</b>				
11.1	Pipe Culvert	No	250	1852.00	463000
11.2	Slab Culvert	No	2500	277.80	694500
11.3	RCC Box Culvert	No	3000	185.20	555600
11.4	Causeway	No	2000	92.60	185200
<b>12</b>	<b>Bridge Construction</b>				
12.1	Construction of Major/Medium/Minor Bridges	Rm	1000	2894.00	2894000
<b>13</b>	<b>Pavement Works</b>				
13.1	Sub-Grade, Capping and Sub-base	Sqm	0.4	6945000.00	2778000
13.2	Base	Sqm	0.6	6945000.00	4167000
13.3	DBST	Sqm	0.3	6352360.00	1905708
13.4	Asphalt Concrete	Sqm	0	0.00	0
13.5	RCC Pavement	Sqm	1	129640.00	129640
<b>14</b>	<b>Road Furniture and traffic Safety</b>				
14.1	Traffic Sign	No	3.5	5556.00	19446
14.2	KM Post	No	7	926.00	6482
14.3	Guard Rail	Rm	20	138900.00	2778000
14.4	Safety Barior	Rm	7	92600.00	648200
14.5	Road Painting	Sqm	0.3	1111200.00	333360
14.6	Delinator Posts	No	3	231500.00	694500
14.7	Information Boards	No	5	3704.00	18520
	Sub Total 1				<b>38979901</b>
<b>15</b>	<b>Miscellaneous Works</b>				
15.1	Bioengineering Works and Environmental Mitigation Works(3% of Subtotal 1)				1169397.03
15.2	Maintenance during Construction(3% of Subtotal1)				1169397.03
	Sub Total 2(Sub Total 1+15.1+15.2)				<b>41318695.06</b>
15.4	Administrative Expenditures(5% of Sub Total2)				2065934.753
	Grand Total( Sub Total 2+15.2)				<b>43384629.81</b>

## **CHAPTER 9. ECONOMIC ANALYSIS**

### **9.1 Introduction**

#### **9.1.1 Background**

The approach used for the economic analysis of the different sections of MHH project follows the methodology and models used during the feasibility study. The approach is the conventional appraisal methodology used for road projects. It compares 'Without Project Situation', the situation, where there is already a gravel road with 'With Project Situation', the paved situation, which will occur with the implementation of the project and its vehicle traffic has the same origin and destination as in 'Without Project Situation'.

The methodology takes into account only those factors, which can be quantified such as project implementation and maintenance costs, forecast volume of traffic in 'Without' and 'With' project situations, potential benefits in terms of cost savings to road users, quantified development and social benefits and residual value of the project investment.

#### **9.1.2 Analysis Parameters**

Implementation of the project is assumed to start in the beginning of 2011 and complete by the end of 2012. The life of the project is assumed to be 20 years up to 2032. Annual costs and benefit streams are considered to the year 2032 beginning from 2013 and converted to represent 2010 values using a social discount rate of 12 percent per annum. The social discount rate is the economic opportunity cost of capital which is used for the economic evaluation.

Costs and benefits are estimated in economic prices. Economic price reflects the resource cost or value of an item to the country. The economic prices are obtained by excluding every tax, duty or subsidy included in the financial prices.

#### **9.1.3 Economic Indicators**

Three indicators of economic viability namely: Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) are calculated to test the viability of the project.

#### **9.1.4 Evaluation**

At present eleven sections of MHH project are paved, nine are earthen roads and eight sections are earthen trail or track. Some of the paved sections require widening, the earthen road sections require upgrading and the eight trails/tracks require new construction to the designed standard of the highway. Economic Evaluation of paved sections and three earth roads namely Leguwaghat-Bhojpur, Diktel-Ghurmi and Khurkot-Nepalthok are not carried out since widening of paved sections will not have significant benefits and the three earth sections are being upgraded by other projects. Economic Evaluation of seven earth roads and eight trails/tracks shown in Table 1.1 are carried out to assess economic viability of upgrading and new construction to the paved design standard respectively.

## 9.2 Project Costs

### 9.2.1 Pricing Assumptions

The economic evaluation uses first quarter 2010 prices for both capital and maintenance cost estimates. A shadow exchange rate factor (SERF) of 1.12 is used to convert border prices to domestic economic prices for the foreign exchange component of the cost. This has been taken from the recent DoR projects.

With a financial exchange rate of US\$1 = NRs. 75.0, this gives a shadow exchange rate of US\$1 = NRs.84.0. This is used to derive the economic cost of the principal tradable items.

**Table 1.1 The Project Road Sections Selected for Economic Analysis**

S.No.	Road Sections	Standard
1	Bhojpur-Diktel	Earth
2	Ghurmi-Khurkot	Earth
3	Khurkot-Nepalthok	Earth
4	Nepalthok-Dhulikhel	Earth
5	Baglung-Burtibang	Earth
6	Dailekh-Dullu-Lainchour	Earth
7	Saijiula-Belkhet-Mangalsen	Earth
8	Chiyobhanjyang-Ganeshchowk	Trail/Track
9	Jorsal-Tamor-Sankranti	Trail/Track
10	Sankranti-Myglung	Trail/Track
11	Burtibang- Rukumkot	Trail/Track
12	Rukumkot-Musikot	Trail/Track
13	Musikot-Chourjahari	Trail/Track
14	Chaurjahari-Dailekh	Trail/Track
15	Lainchour-Satala-Saijula	Trail/Track

All other cost items are valued at domestic prices less taxes with the exception of unskilled labor. Cost of unskilled labor is estimated at a shadow wage rate<sup>6</sup> of 0.7 (i.e. 70 percent of the estimated wage rate of the Project). This is significant, but it reflects the low productivity of unskilled labor drawn specifically from poor areas. In Nepal unskilled labor cost is a significant amount in the project's total costs, over 30 percent, especially when local materials (aggregate and sand) are used.

Different customs duties are levied on foreign construction goods. Contractors must pay 13 percent VAT on the total contract price; this is taken out at source. In addition contractors pay either 1.5 percent on total income (again deducted at source) or 25 percent on profits, whichever is the greater.

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<sup>6</sup> A "shadow" price represents the opportunity cost to the economy of using resources. A shadow wage rate factor of 0.70 implies that hiring an additional unskilled person on a project only displaces output worth 70 percent of the wage paid. That is, without the project, the unskilled person would be producing relatively little (e.g. working on the land) – his or her opportunity cost to the economy would thus be lower than the prevalent rate for unskilled labor.

Shadow exchange and wage rates, customs duties. VAT, income taxes etc are considered to derive economic capital and maintenance costs from financial costs. The calculated total economic cost becomes 0.92 of the estimated financial cost excluding VAT but includes provisional costs and physical contingency.

### **9.2.2 Economic Capital Costs**

The economic capital cost of upgrading the earth road sections and construction of roads in the trails/tracks include base engineering cost, physical contingency and provisional sum (provided this is actual expenditure), costs of environmental mitigations and cost of resettlement. Estimated economic capital cost is NRs.42.903 million for the upgrading and NRs.52.113 for the new construction.

### **9.2.3 Project Residual Value**

To account for the value of the project remaining at the end of the evaluation period, a negative cost is included in 2032 equivalent to the remaining unused portion of the project's life (i.e. its residual value). A weighted life of 30 years has been used for the project as a whole, based on the assumptions about the life of individual project components: 50 years for land and earthworks; 50 years for structures; 20 years for lower pavement; 10 years for upper pavement etc.

### **9.2.4 Project Maintenance Costs**

Estimation of benefits arising from the implementation of a project requires comparison of "With Project" situation with "Without Project" situation. The latter is, therefore, critical in that it determines the level from which incremental benefits from the implementation of a project are derived.

Presently the seven earth roads and eight trails/tracks are receiving inadequate maintenance and are deteriorating over time. For simplification of economic evaluation of the project, 'Without Project' situation is assumed to be the situation where quality of service provided by them is maintained at its present level by sustaining their condition in the current level. Any further deterioration is controlled by maintenance activities aimed at sustaining the present situation. The level of expenditure on maintenance activities in order to ensure the situation is defined as 'holding maintenance' cost. The holding maintenance cost is assumed to include routine and recurrent maintenance costs.

Since, the earthen sections presently are very bad the roughness level of their surface is estimated at IRI 9 m/km and is assumed to remain in the same level in the future with the treatments of holding maintenance.

The economic holding maintenance cost per kilometer of the earth road sections is estimated at NRs.150000.0 and NRs.50000.0 respectively.

Standard maintenance measures have been assumed for "With Project" situation also, the paved high way standard road sections. The suggested maintenance activities of annual regular and

recurrent maintenances and a periodic resealing in every fifth year are assumed adequate to keep the condition of the road surface in average to IRI 6m/km over the project life (although the road roughness would worsen between reseals the average IRI would remain equal to IRI 6m/km). The deterioration of the road overtime under the traffic loadings and environment is, therefore, not considered for economic evaluation.

The estimated economic maintenance costs are given in Table 9.2.

**Table 9.2 Economic Maintenance Costs**

Activities	(Rs./Km/Annum)
Routine and Recurrent Maintenance	120000.0
Periodic Maintenance in every 5 <sup>th</sup> Year	1500000.0
Holding Maintenance for Earth Road	150000.0
Holding Maintenance for Trails/Tracks	50000.0

Source: Consultants' Estimate

### 9.2.5 Road Users' Costs

#### (I) Vehicle Operating Cost (VOC)

For the calculation of VOC, RED<sup>7</sup> model (HDM-4<sup>8</sup> module calibrated to Nepali condition) is used. The RED model is more suitable for evaluation of low traffic volume roads. In order to evaluation of the improvement of the project road the VOC and speed values calculated by the RED model are transferred to a spread sheet for economic evaluation.

VOCs are estimated for all types of vehicle likely to use the project road, now and in the future. RED calculates VOCs for up to 9 classes of vehicles, not all of which are used on the Project Road. For this Study, following 5 vehicle classes are considered for VOC calculation:

1. Motorcycle
2. Jeep
3. Truck
4. Bus
5. Tractor

As it is not possible to estimate operating cost of each individual vehicle in the fleet, representative vehicles are selected for the analysis. These are the vehicles whose characteristics are typical of an entire class of vehicles. The representative vehicles may be actual vehicles or composite vehicles whose characteristics are average of all vehicles in class. Economic prices of the representative vehicles, tires, fuel, lubricants, crew cost, labor cost etc are estimated excluding all taxes, duties and subsidies from the financial costs prevailed in late 2010.

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<sup>7</sup> Roads Economic Decision Model

<sup>8</sup> Highway Design and Maintenance Standards Model, the World Bank

Based on the economic prices of vehicles, tires, fuel, lubricants, crew cost, labor cost etc and assumed characteristics of earth roads and trails/tracks VOCs of the representative vehicles in 'Without Project' and 'With Project' situations are calculated using the RED model and presented in Table 9.3.

In the trails/tracks transporting of goods at present is carried out by the porters. The prevailing freight of porters in average is NRs.0.50 per Kg per Km.

### **(II) Travel Time Costs (Value)**

Since the existing condition of the project road has bad alignment and poor surface the improvements of the road condition will reduce travel times quite significantly. VOCs embody the value of the travel time saved by vehicle drivers and crews, but not that of passengers in cars and buses. The values placed by travelers (passengers in cars and buses) on travel time savings are best established using revealed or stated preference surveys. In the absence of survey results, there are two approaches to valuing time savings:

- use of an empirical relationship between VOT and GDP per head derived using regression between pairs of values from stated and revealed preference studies; or
- use of appropriate income levels.

The latter approach is used. The value of time for work or business trips is assumed to be related more to urban incomes for cars, and more to average regional incomes for buses. Non-work trips are given no value. The value of passenger travel time will increase as income rises. Table 9.4 and Table 9.5 respectively set out the values and vehicle speeds used for 'Without Project' and 'With Project' situations.

**Table 9.3 VOC in the Project Road (NRs/Km)**

<b>Vehicle Types</b>	<b>Without Project Situation Earth/Gravel (IRI 12 m/km)</b>	<b>With Project Situation Paved (IRI 6 m/km)</b>
Motorcycle	3.70	2.45
Bus	45.64	36.79
Truck	62.61	52.67
Utility	21.14	14.64
Tractor	19.67	17.06

Source: Consultants' Observations and RED Model

**Table 9.4 Personal Travel Time Values**

Passenger Vehicle	Monthly Income per Passenger Traveling for Work Purposes	Percent of Passengers Traveling in Work Time	Value of Time Savings per Average Passenger-Hour	Passengers per Vehicle	Value of Passenger Time Savings per Vehicle-Hour
Motorcycle	6,000	10%	3.75	1.7	6.70
Bus	3,600	20%	4.5	40	180.0
Jeeps (Passenger)	3,600	20%	4.5	25	113.0

Source: Drivers, Passengers and Consultant's Estimates

**Table 9.5 Vehicle Speeds in the Three Alignments of Project Road (Km/hr)**

Vehicle	Without Project Situation (IRI 9 m/km)	With Project Situation (IRI 4 m/km)
Motorcycle	24.52	34.66
Bus	21.67	27.48

Source: RED Model Calibrated to Nepali Conditions, August 2007

In the trails/tracks the means of travel of people is walking. In the hills a person can walk in average 3Km per hour. The value of time of a pedestrian is estimated at NRs.4.50 per hour.

## 9.3 Project Benefit

### 9.3.1 Users' Benefits

The earth road sections of MHH are open to vehicular traffic for only 275 days during dry season in a year. During the road closure time of 90 days in rainy season means of movements of people and goods are walking and porters respectively.

Road users' benefits from the upgrading of the earth road sections will arise from savings in vehicle operating costs of both the goods vehicle traffics and passenger vehicle traffics and travel time savings of the passenger vehicle traffics for 275 days, savings in porter transport costs and travel time savings of the pedestrians for 90 days and benefit from the induced and generated traffic.

Since, currently means of transport and travel in the trails/tracks are porter and walking road users' benefits from the construction of new paved roads will arise from savings in porter transport costs and travel time savings of the pedestrians for the whole 365 days and benefit from the induced and generated traffic.

The economic benefit arising from the generated traffic is calculated as half the benefit to an equal amount of normal traffic<sup>9</sup>.

Details of estimates of normal, induced and generated traffic of the earth road sections and trails/tracks before and after MHHP and their projections are given in the traffic chapter mentioned before.

### **9.3.2 Development Benefits**

Development benefits commonly called as Producer Surplus Benefits generally occur when the reduction in transport costs associated with upgrading of a road or construction of a new road is large enough to induce an increase in output of the area of influence.

In the Sector Wide Road Program and PIP study, 1996, the World Bank/DoR a review was made of the attempts of earlier studies to forecast agricultural development benefits and of the empirical evidence of actual responses in the area where road access had been provided. The study found evidences of benefits from increased productions (agricultural) after the construction/upgrading of roads in Nepal. The estimation of such benefits requires lots of surveys and longer period of time. The duration and scope of the present study does not permit such surveys and time period. Hence, 15 percent of users' cost savings from after the upgrading/ construction of the roads are assumed to be development benefits from the implementation of the MHHP.

### **9.3.3 Social Benefits**

Till date there have been no studies in Nepal for quantification of part of the social benefits (in addition to transport cost savings). However, such studies have been carried out in India, Bhutan and Bangladesh. From the studies it were found that in overall, about 30% of the project benefits come from quantifiable social benefits after the construction or upgrading of a rural road. The careful study of the outcomes of the studies it is concluded that 30% of the project benefits must come from quantifiable social benefits after the construction or upgrading of a rural road in Nepal also. Hence, for the present economic analysis 30% of the project benefits are estimated to be those from social benefits.

## **9.4 Economic Evaluation**

### **9.4.1 Results of Economic Evaluation**

The results of economic evaluation of the upgrading/ construction of the roads are set out in Table 9.6. The results show economic internal rates of return (EIRR) is above the 12 percent threshold rate. The net present values (NPV) obtained using the 12 percent discount rate is positive and Benefit Cost Ratios (BCR) are also more than 1. The results show that upgrading/ construction of the roads and trails/tracks are economically feasible.

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<sup>9</sup> This is sometimes called the "rule of a half". The benefit of generated traffic is measured by the consumer surplus triangle, which is half the area of the equivalent rectangle.



**Table 9.6 Results of Economic Evaluation**

S.No.	Road Sections	NPV (NPRs. inMillion)	EIRR (%)	BCR
1	Bhojpur-Diktel	1412.08	16.68	1.40
2	Ghurmi-Khurkot	827.57	15.94	1.33
3	Khurkot-Nepalthok	373.14	28.95	2.16
5	Baglung-Burtibang	1895.42	18.25	1.55
6	Dailekh-Dullu-Lainchour	444.07	15.73	1.31
7	Saijiula-Belkhet-Mangalsen	607.81	15.48	1.28
8	Chiyobhanjyang-Ganeshchowk	3136.77	24.31	2.19
9	Jorsal-Tamor-Sankranti	1932.00	25.07	2.27
10	Sankranti-Myglung	881.58	15.29	1.28
11	Burtibang- Rukumkot	20705.51	45.41	4.70
12	Rukumkot-Musikot	2876.93	28.51	2.65
13	Musikot-Chourjahari	3453.24	28.77	2.68
14	Chaurjahari-Dailekh	3144.59	20.80	1.67
15	Lainchour-Satala-Saijula	1496.60	20.02	1.74

Source: Consultants' Calculations

## **CHAPTER 10. CONCLUSION AND RECOMMENDATION**

One of the important aims of formulating Mid Hill Highway is to provide access to the economical potential areas. This will enable to fulfill goal of 10<sup>th</sup> plan to a large extends. Apart of this aim, the MHH will help improve social and cultural environment. Hence this road will play an important role in economical growth and reduction of the poverty. New educational, cultural and health centers will have an easy access thus making high living standards and quality life of the population. Apart from developing the existing socio-economic structures, it has great potential to develop many population centers along the potential important locations of the highway. Thus the existing migration trends of the hill population are expected to change dramatically.

With this new development of migration to these potential places there will be communal harmony among the different ethnic population, thus creating new culture of communal tolerances and cultural enhancement. Many tourist destinations are expected to be developed in the route corridor with the advent of this highway. Income generation of the hill population will be greatly enhanced through creating new avenues like trade commerce and industry as well tourism and other industries. Similarly, it is expected that the agricultural patterns of the corridor will be changed from subsistence farming to the commercial type of farming. Horticulture, animal husbandry and dairy industries will be developed along the route corridor. Mine and mineral based industries like cement, iron and copper are expected to grow in the potential areas along the highway corridor. Many agro based industries will be developed and the farmers will be attracted towards cash crop productions. With the easier access to the potential hydropower developing location it will add immensely to the hydropower development harnessing the important natural sources of water. This will create the country from an energy deficit state to the power exporting country to its neighbor. Other means of transportation facilities, like cable car electrically running trolley buses and eclectic trains can be developed.

This major achievement will be obtained by the following positive aspects of the proposed road project:

- It will develop the road network in the country with another new road linking East with West of Nepal
- It will develop social and cultural environment of not only influence area but also the whole country.
- It will establish new industries, hydroelectricity, agriculture development, tourist centre which will improve economical status of the country.
- It will enable to develop new town/cities along the corridor.

Apart from the benefits described above there are a few recommendations for developing the Mid Hill Highway considering engineering point of view. They include:

### **Standards of Highway:**

It is recommended that the Standards of the Mid Hill highway throughout the length should be the same. Some of the sections of the road are already constructed by DOR and other different agencies adopting different standards, and it is a real challenge to bring these sections under single design standards. Utmost care is required to upgrade in the given standards. In order to meet the required standards, in a few places of such roads, realignment may not be ruled out. Similarly reconstruction of already constructed section may have to be given due consideration. The standards differ in the road geometry, in terms of formation widths and horizontal curvatures in one hand and the vertical gradient in the other hand. A lot of extra land may have to be acquired in the process and due attention should be given for acquiring the required land with proper planning within the existing policy of the government.

In the above discussed design criteria and standards it will not be out of context to bring into discussion the existing Khurkot- Dhulikhel section of the road , which does not meet the standards set by the MMH, an alternative solution could be to make another one way highway parallel to the existing one. This is rather a policy decision and the Government may have to decide in this respect.

### **Coordination among the Stakeholders**

Since the highway aims at developing many areas such as agriculture, tourism hydropower, population centers, trade and industry, coordination among the line agencies and the stakeholders will be needed. In order to achieve the desired goal, meeting from time to time, seminars and interactions among the stakeholders may be necessary. Government may have to give a thought to make a high level committee representing the concerned agencies and stakeholders.

### **Proposals for Alternative Alignments**

Length of some of sections of the mid hill highway could be shortened reducing the cost of the highway. The alignment of Jorsal-Tamor-Sankrati and Sankrati-Myaglung can be replaced by Jorsal-Myaglung which will same about 69 Km. Similarly, 19 Km can be minimized avoiding Hile while joining Myaglung and Bhojpur. Saving of 7 Km would be achieved if Dailekh is avoided in the section Chaurjahari-Dullu-Lainchaour. An alternative alignment of the stretch Bhajankot-Bayalpate and Sanfe-Dipayal in the section Mangalsen-Silgadhi will reduce about 5 Km and 20-25 Km respectively. However, detailed studies on the above mentioned alignment have to be carried out prior to use them.

### **Economic Evaluation**

The results of economic evaluation of the upgrading/ construction of all the sections located in Mid Hill Highway show that the project is economically feasible. All of the sections have Economic Internal Rate of Return (EIRR) more than 15 percent with a minimum of 15.29% and a maximum of 45.41%. Similarly, Benefit Cost Ratio (BCR) more than 1.0. with a minimum of 1.28 and a maximum of 2.27. The Net Present Value (NPV) is positive for all the sections.



## **APPENDIX -2**

### **PHOTOGRAPHS**