

# Initial Environmental Examination

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October 2011

## India: North Eastern State Roads Project

Nayabazar to Namchi Road Section, Sikkim (SK02) Subproject

Prepared by Ministry of Development of North Eastern Region (MDONER) for the Asian Development Bank.

## ABBREVIATIONS

ADB	-	Asian Development Bank
CPCB	-	Central Pollution Control Board
CRRRI	-	Central Road Research Institute
DoE	-	Department of Environment
EA	-	Executing Agency
EFRC	-	Environment Friendly Road Construction
EIA	-	Environmental Impact Assessment
EMMP	-	Environmental Mitigation and Monitoring Plan
GDP	-	Gross Domestic Product
GoI	-	Government of India
IEE	-	Initial Environmental Examination
IRC	-	Indian Road Congress
MDONER	-	Ministry of Development of North Eastern Region
MDRs	-	Major District Roads
MoEF	-	Ministry of Environment and Forests
MoRT&H	-	Ministry of Road Transport and Highways
MSL	-	Mean Sea Level
MW	-	Mega Watt
NEC	-	North Eastern Council
NER	-	North Eastern Region
NGO	-	Non Government Organization
NH	-	National Highway
NO <sub>x</sub>	-	Oxides of Nitrogen
NSDP	-	Net State Domestic Product
PIU	-	Project Implementation Unit
PWD	-	Public Works Department
ROW	-	Right of Way
SPM	-	Suspended Particulate Matter
SO <sub>2</sub>	-	Sulphur Dioxide
SSI	-	Small Scale Industries
SPCB	-	State Pollution Control Board
TA	-	Technical Assistance
TOR	-	Terms of Reference
WHO	-	World Health Organisation

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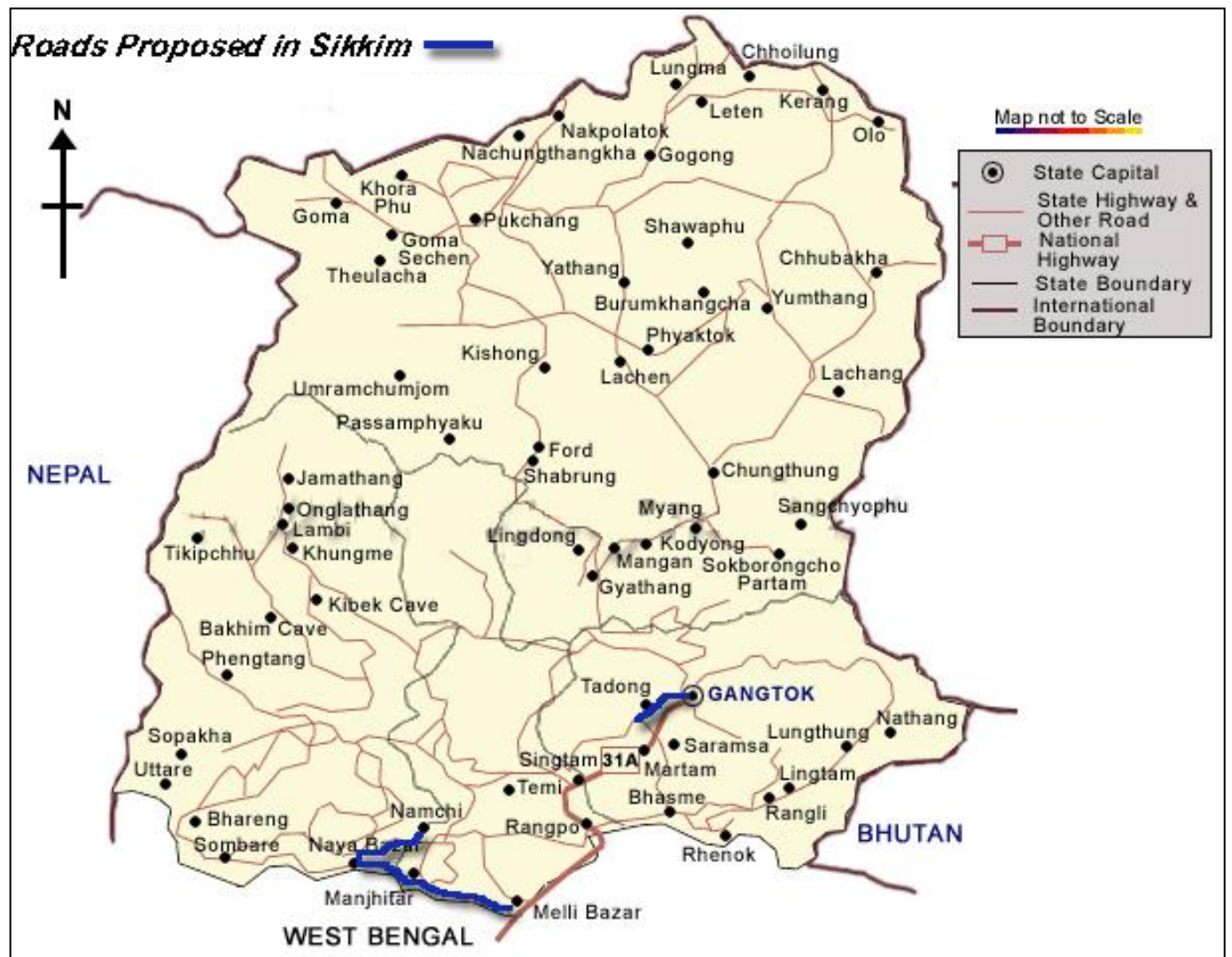
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Subproject Map

## Executive Summary

1. The environmental screening of SK02: Nayabazar-Namchi revealed the proposed improvement of the road section will not result to significant adverse environmental impacts, and all significant impacts are site-specific and can be addressed through proven mitigation measures. This road section was classified as Category B and an initial environmental examination was prepared and documented in this report.
2. SK02: Nayabazar-Namchi improvement is part of Tranche-1 of the North Eastern States Road Project which is a multitranche financing facility. The road improvement will cover 19.7kilometers of existing state road which starts in Jorenthang, Nayabazar on the eastern abutment of Aakar bridge to Namchi.
3. The road improvements will involve paving and double-laning to accommodate the increase in traffic; construction of new and strengthening of existing erosion control structures and cross drainage to ensure connectivity between the two population centers during monsoon; and improvements in horizontal, vertical geometries and installation of road safety appurtenances to minimize road crashes.
4. The significant environmental impacts attributable to the upgrading of the road sections pertains to tree cutting for the proposed widening; fauna disturbance; temporary deterioration of ambients during construction phase from land clearing, ground shaping, quarry and camp operations; and community and occupational health and safety. These impacts will be mitigated through compensatory afforestation; timing of construction activities to minimize fauna disturbance; control of noise, dust, wastewater, fuel combustion emissions, and construction debris generation through good construction practices; and implementation of road safety measures to separate road users from active construction fronts.
5. During operation stage, the main impacts are increase in mobile emissions, road safety to motorist, pedestrian and animals. Road safety measures will be implemented as per IRC guidelines. Road safety appurtenances like information, regulatory and warning signs copuled with crash barriers will reduce serious injuries to road users. Adequate cross drains and side drains and their proper maintenance will be implemented to avoid localised flooding.
6. Several consultations were organized during the project preparation to engage major stakeholder representatives and incorporate their concerns in the overall design. These consultations involved officials of executing agencies, PWD, District Rural Development Officials, Forest department officials, likely affected persons and village heads in the project area. Most of the people interviewed strongly support the project.
7. The PWD, Government of Sikkim, through its Project Implementation Unit (PIU), will ensure the effective implementation of the environmental management plan. There is a need for the PIU to organize its environmental unit to provide close support to the Project Director and ensure the contractors maintain environmental compliance. To provide regular monitoring information and technical advice to the PIU is the supervision consultant and the contractors environment and social officer.
8. This initial environmental examination (IEE) ascertains that SK02: Nayabazar-Namchi upgrading is unlikely to cause any significant environmental impacts. Few impacts were identified attributable to the proposed subproject, all of which are localized and temporary in

nature and can be easily mitigated with minor to negligible residual impacts. No additional studies or undertaking detailed EIA is envisaged at this stage.





## I. INTRODUCTION

1. The North Eastern Region (NER) is bordered Bangladesh, Bhutan, the People's Republic of China, Myanmar, and Nepal. It represents 8% of India's geographic area. It has a population of about 54 million. The region consists of the following states, namely: Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura. The NER is connected to the rest of the country through the narrow Siliguri Corridor in West Bengal.

2. Sikkim is a landlocked state with a total area of about 7,100 sq km. About 45 % of land area is covered by forest with elevation ranging from 300 m to 8,500 m resulting to a wide range of climate from sub-tropical to alpine. Roads are the only means of going around the state. The total road length is about 1,840 km. and most of these are rural roads and other district roads accounting for more than 60 % of total. All roads are single lane roads with narrow carriageways and are built along hillsides that are prone to landslides. The National Highway No. 31A is the only NH link serving the state and is under the jurisdiction of Border Roads Organisation for its development and maintenance. A few arterial roads in the north and north-western region of the state are also understood to be with the Border Roads Organisation.

3. The NER road network needs substantial improvement, through its expansion and improvement of individual road sections. This improvement will be made by widening the existing roadway, strengthening pavements, improving road geometry, raising embankments, and providing permanent structures at river-crossings. With renewed recognition that inadequate roads and bridges supporting road transport, the region's single most dominant transport mode, are the major constraints on development efforts, the government started a national investment program to improve road connectivity to remote places in the region.

4. This road improvement will be pursued in an environmentally congenial manner that avoids, minimizes or mitigates adverse environmental impacts. This IEE contains the approach, evaluation, findings, and recommendation of the environmental assessment for SK 02: Nayabazaar to Namchi, in State of Sikkim, India, in compliance to the ADB Safeguard Policy Statement 2009. This road section is a component of the Loan 2770 (IND) North Eastern State Roads Project (NESRP) which aims to upgrade and improve priority state roads in the northeast region. The NESRP is classified as environment category "B." SK 02: Nayabazaar to Namchi proposed road section (Nayabazar to Namchi) is a State Highway measuring 19 km in length located at Sikkim South District. The topography of the project area is hilly. It passes entirely through hillock in one side and river valley (perennial river Rangit) on other side.

5. This report has 9 sections following the prescribed IEE outline of the Bank and starts with this introduction and followed by:

- Policy, Legal, and Administrative Frameworks section summarizing the national and local legal and institutional frameworks that guided the conduct of the assessment
- Description of the Project and the Road Section presenting the key features and components of the proposed project
- Description of the Environment section discussing the relevant physical, biological, and socioeconomic features that may be affected by the proposed project.
- Anticipated Environmental Impacts and Mitigation Measures section presenting the environmental assessment of likely positive and adverse impacts attributed to the proposed project and concomitant mitigation measures.

- Information Disclosure, Consultation, and Participation section describing the the consultation process undertaken during the environmental examination and its results, their consideration in the project design, and manner of compliance to the ADB's Publication Policy and related national laws.
- Grievance and Redress Mechanism section describing the formal and informal redress procedures for registering, resolving, and reporting complaints.
- Environmental Management Plan section discussing the lessons from the impact assessment and translated into action plans to avoid, reduce, mitigate or compensate adverse impacts and reinforces beneficial impacts. This plan is divided into 3 sub-sections; mitigation, monitoring, and implementation arrangements.
- Conclusion and recommendation section stating whether there is a need for further environmental assessment and highlights key findings and recommendations to be implemented by the borrower.

6. A companion of this IEE Report is a stand-alone Volume II – Generic Environmental Management Plan which contains mitigation and enhancement measures mainly in the form of good management practices in plant, campsite, debris, borrow area, and quarry area management. This generic management plan applies to all road sections to be upgraded under this loan.

#### A. The North Eastern State Roads Project

7. The proposed “North Eastern State Roads Project” is a multitranche financing facility (MFF) that will: improve about 430 kilometers (km.) of priority roads in six states, namely: Assam, Manipur, Meghalaya, Mizoram, Sikkim, and Tripura in the northeastern region (NER) of India; and provide capacity building support to the executing agencies, the Ministry of Development of North Eastern Region (MDONER) and the state public works departments (PWDs) or its equivalent in the six project states. The investment program will target the secondary road network and aim to enhance the performance of state roads sector in NER through investment project implementation and dedicated capacity building measures. The improved secondary road network will provide important linkage between the primary and tertiary road networks in the region, for which there are ongoing national programs for improvement<sup>1</sup>.

Table I-1. Proposed Roads under Multitrance Financing Facility North Eastern State Roads Investment Program

Road Section Package Code	Tranche/Road Name	State	Length
	Tranche 1		
SK-01	Melli-Nayabazar	Sikkim	9.5
SK-02	Nayabazar-Namchi	Sikkim	20
AS-CW1	Bilaspara-Fakiragam	Assam	16.2
AS-37C	Kalitakuchi-Barpeta	Assam	58.5
ML-CW1	Garobadha-Dalu	Megalaya	93.3
	Sub-Total		197.5
	Tranche 2		
TR-02	Udaiphur-Melaghar	Tripura	20.3
MZ-CW2	Serchhip-Buarpi	Mizoram	55
MN-CW6	Bishnupur-Thoubal-Kasom-Khullen	Manipur	128.57

<sup>1</sup>“Proposed Multitrance Financing Facility and Administration of Technical Assistance Grant India: North Eastern State Roads Investment Program” Report and Recommendation of the President to the Board of Directors. June 2011.

AS-CW3	Barma-Tamulpur	Assam	28.9
Sub-Total			232.7
<b>Total</b>			<b>430.7</b>

8. Sikkim is the smallest state in the north eastern region having a total area of 7100 sq.km with an estimated population of 0.54 million (2001). The state has 4 districts, 8 subdivisions and 92 blocks. In the study area most of the rural population is concentrated in the valleys and mountain shoulders often in remote scattered settlements. Travel by road is the only mechanised mode of transport. Because of the mountainous terrain, the area of land suitable for agriculture is limited. This situation makes the construction and improvement of roads difficult and expensive.

9. Presently, there is no railway line in the state. The nearest railhead is Siliguri in West Bengal. Similarly, there is no airport in the state. The nearest airport is at Bagdogra in West Bengal. There is a skeleton helicopter service between Bagdogra and Gangtok (Sikkim). Two major rivers Teesta and Rangit flow through the state but are not navigable and as such inland water transport has practically no role. Roads are the only means of getting to and within the state. They are a critical input to the growth of all sectors. The length of roads is reported to be about 1840 km.

10. The National Highway No. 31A is the only NH link serving the state and is under the jurisdiction of Border Roads Organisation (BRO) for its development and maintenance. A few arterial roads in the north and north-western region of the state are also understood to be with the BRO. The stock of registered motorized vehicles in the state is around 12,000 (year 1999-2000) including about 4,000 two wheelers. Population of trucks is around 1,000. Traffic is bound to grow to meet the state objectives of economic and industrial growth. Many areas are prone to landslides. Many roads become difficult to use during the winter months and rainy season. Improvement and maintenance of the existing road network is urgently needed. Roads are considered to be key to facilitate economic development in the remote rural areas.

11. The implementation of various project items is envisaged to have the following direct benefits:

- improved quality of life for the rural population in the project influence area (state highway section between Nayabazar and Namchi: this as a result of better access to markets, health, education and other facilities; and the derived stimulus for local economic activity;
- a more efficient and safe road transport system: through reduced travel times, reduced road accidents, reduced vehicle operating and maintenance costs and reduced transportation costs for goods;
- the facilitation of tourism; and
- interstate connectivity to Sikkim South and Sikkim West Districts.

## **B. The SK02: Nayabazar to Namchi**

12. This section of the road starts in Jorethang in Nayabazar on the eastern bank abutment of Aakar bridge and is a single lane bituminous road to Namchi. Having a total section length of 19.7 km., it passes through hilly terrain interspersed with a few roadside habitations. Almost the entire road section (98%) is located inside reserve forest. The existing carriageway width varies from 3.0m to 4.0m with narrow earthen shoulder of no more than 1.0 meter on the valley side. Pavement condition is very poor with numerous cracks, settlements and ravelling. There is a

minor bridge and 42 culverts that facilitate drainage across the road. In general, the road section suffers from weak structure, steep approaches to bridges, narrow and congested stretches in built up areas, absence of CD structures, and prone to slips and landslides<sup>2</sup>.

Table I-2. Description of road sections between Nayabazar and Namchi

Road Section	Distance (km)	Districts	Summary of General Road Condition	Likely Scope of Road Improvement Works
Nayabazar to Namchi	19	Sikkim South District	The proposed road section (Nayabazar to Namchi) is a State Highway measuring 19 km in length located at Sikkim South District. The topography of the project area is hilly. It passes entirely through hillock in one side and river valley (perennial river Rangit) on other side. The land use is completely forest type. It is situated within the Reserved Forest area of Sikkim West Forest Division. Project area is covered with greenery having a vegetation density of about 0.4 to 0.5. The existing condition of the road is moterable with average carriageway width of 3.5 m. The project area is high rainfall zone. The soil is poor and unstable which leads to frequent landslides and soil erosion mainly in rainy season. Cases of landslide were observed during site visits. There are no historical places in the project area. There is no major settlement in between the project road. Jorthang (Nayabazar is the only town at the start of the project road and Namchi at end of project road are the settlements. There is no encroachment on the road and available ROW is 27 ft either side of road.	<p>The improvement work includes widening of the carriageway to intermediate lane with 5.5 m pavement and 7.5 m formation width and 0.5 m drain on hill side.</p> <p>Carriageway will be asphalt pavement followed by periodic maintenance (patching, crack repairs and sealing).</p> <p>Gabion boxes, check dams, diversion drains, toe walls, benches and chute structures will be required to avoid landslides and enhance proper drainage. Numbers of culverts need to be reconstructed.</p> <p>Few bridges need strengthen and replacing. While the radii of curves less than 25 metres will be increased.</p>

13. The proposed improvements for SK02: Nayabazar-Namchi are as follows:

- Widening of the carriageway width to 5.5 m with shoulders and side drains. Total formation width is 7.5m. The road more or less follows the existing alignment and profile.
- All sections prone to slips, landslides, and sinking will be provided with breastwalls. Existing breastwalls will be dismantled to allow widening along the hillside. A total of 26 breastwalls with an aggregate length of 11,254kms, and 12 retaining walls with a total length of 435 meters will be constructed.

<sup>2</sup>SMEC (2011). "Addendum to Detailed Project Report". Package: SK-CW1 Road (i) Melli-Nayabazar and (ii)SK02: Nayabazar to Namchi. Tranche-1 Roads in the State of Sikkim.

- Horizontal alignment will follow existing alignment, one side widening is proposed in some locations where land is available, no cultural heritage shifting, and in case of hill side cutting is feasible.
- Horizontal geometry will be based on IRC:38-1988 “Guidelines for Design of Horizontal Curves for Highways and Design Tables (First Revision)”
- Vertical geometry will be based on IRC:SP 23-1993.
- Formation for the 2 lane configuration will be 8.8 m uniform in general. All new structures except bridges will be 9.3 m in width.
- Carriageway width will vary from 3.75 m to 4.0 m in general and formation width from 6.5 m to 7.0 m. Road carriageway in built-up area near Nayabazar will be about 15 m in Nayabazar from Km 25.500 to 26.500.
- The existing right-of-way (ROW) between 8 m to 21 m especially in built-up area of Namchi. The ROW is limited to the formation width including drainage and retaining walls to the extent of road reserve. The State PWD have already initiated proceedings for land acquisition on hill side to accommodate widening, as required, depending upon the hill slope, strata and consequent corridor of impact.
- A total of 3 culverts will be retained, 1 to be abandoned, 6 will be widened, and 32 reconstructed, and 9 will be newly constructed.
- Pavement profile will have a 190mm, 250mm, 50mm, and 40mm thicknesses for GSBC, WMM, DBM, and BC respectively.
- All retaining walls will be preserved as no expansion on the valley side will be made. Nonetheless, additional retaining walls will be installed on approaches to cross drains.
- Road safety measures like road delineators, signages, crash barriers, and guide posts will be installed.



Figure I-1. SK-02: Nayabazar-Namchi Road Section.

14. This IEE report covers the baseline description, environmental assessment, and environmental management plan for Section SK-02: Nayabazar to Namchi section in the district of South Sikkim covering a total length of 19.7 km. This IEE is structured in accordance with the requirements of the ADB environmental guidelines.

15. The IEE study was prepared from September 2005 to January 2006, updated in 2008, and again in 2010. The work of the feasibility study has been assigned to Technoconsult International Limited, Bangladesh in association with other consultancies DLA, DPM, DCPL and VisionRI. Initial Environmental Examination study has been undertaken by national consultant from VisionRI.

## II. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORKS

16. The legal framework of the country consists of several acts, notifications, rules and regulations to protect environment and wildlife. In 1976, the 42<sup>nd</sup> Constitutional Amendment created Article 48A and 51A, placing an obligation on every citizen of the country to attempt to conserve the environment. Specifically for the Project Roads, the following environmental laws and regulations are applicable:

Table III-1. Applicable Environmental National and State Requirements

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
<b>Construction Stage (Responsibility: Contractor)</b>						
1	Establishing stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as amended	Consent-for-establishment	State Pollution Control Board	The Contractor	2-3 months
2	Operating stone crusher, hot mix plant, wet mix plant and Diesel Generator Sets	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as amended	Consent-for-operation	State Pollution Control Board	The Contractor	2-3 months
3	Use and storage of explosive for quarry blasting work	India Explosive Act 1984	Explosive licence for use and storage	Chief Controller of Explosives	The Contractor	2-3 months
4.	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	State Pollution Control Board or Local Authority (DM/DC)	The Contractor	2-3 months
5	Quarry operation	State Minor Mineral Concession Rules, The Mines Act of 1952, Indian Explosive Act of 1984, Air Act of 1981 and Water Act of 1974	Quarry Lease Deed and Quarry License	State Department of Mines and Geology	The Contractor	2-3 months
6	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor	2-3 months

Sl. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
7	Use of surface water for construction	-	Permission for use of water for construction purpose	Irrigation Department	The Contractor	2-3 months
8	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor	2-3 months

17. Before the start of civil works for the any project roads the state PWD must obtain necessary clearances /permits from the regional office of Ministry of Environment and Forests and State pollution control board. The ADB categorises projects based on their potential environmental impacts. This project has been classified as Category B according to the ADB Fact-Finding Mission undertaken in the months of May and July 2004 and affirmed during the November 2011 mission. The Rapid Environment Assessment (REA) checklist for this road section is appended as **Appendix H**.



### III. DESCRIPTION OF ENVIRONMENT

18. A brief description of the existing environment, including its physical and ecological resources, economic development of the region, and issues relating to quality of life are presented in this section. Broad aspects on various environmental parameters like geology, soil, topography, climate, land use, water resources, water quality, air quality, noise quality, tourism, cultural resources which are likely to be affected by the proposed road improvement project are described.



Figure III-1. Typical Hilly Terrain through Project Road

#### A. Physical Environment

##### 1. Topography, Geology, and Soil

19. Sikkim is a small hilly State in the eastern Himalayas with formidable physical features. Topographically, the state is divided according to land elevations (lower hills – altitude ranging from 270 to 1,500 meters, mid hills – 1,500 to 2,000 meters, higher hills – 2,000 to 3,000 meters, alpine zone - above 3,900 meters with vegetation and snow bound land – very high without vegetation up to 8,580 meters). The state is separated from the neighbouring countries by three hill ranges i.e. Singalila range – separates Sikkim from Nepal in the west, Chola range, and Pangolia range- from Bhutan. Tista and Rangit Rivers, which originates respectively, from Cholamu Lake and Rathong glacier, are the two major rivers of the state. The state receives an annual rainfall of 2,000 mm to 4,000 mm. The project road running parallel to the Rangit River on one side throughout its length. The state has the highest peak in the north eastern region with an altitude of 8,586 at Mount Kanchendzonga (third highest mountain of the world). The succeeding Figure shows the typical terrain of project road.



Figure III-2. Physical Feature Map of Sikkim State

20. Geographically the state lies in the North-Eastern Himalayas between 27°00'46" to 28°07'48" North latitude and 88°00'55" to 88°55'25" East longitude, and sprawling over 7096sq.km. The state is bounded by vast stretches of plateaus in the north, the Chunbi valley and the Kingdom of Bhutan in the east, the Kingdom of Nepal in the West and Darjeeling district of West Bengal in the south. The state account about 3 percent of the total area of the north eastern region and 1 percent in terms of population. About 10 per cent of the land resource is available for economic utilization in terms of agriculture.

21. The geological formation is of recent origin resulting by nine repetitive successions of Neocene argillaceous and argillaceous sediments gradually thrown into series of North-South trending longitudinal, plunging anti-clines and synclines. In the higher elevations argillaceous formations occur while the low-lying areas and depressions are represented by argillaceous rocks. The common rocks found are sandstone, shale, silt, stone, clay stones and slates. The rock system is weak and unstable prone to frequent seismic influence. The local geology is highly important for the success of road projects. Unstable rock formations and high precipitation combine make many areas landslide prone.

22. The state is also seismically active and characterized by frequent landslides. Hill slopes are steep and even a small geo-environmental change and sudden rainfall can destabilize the soil-rock balance and cause landslides.

23. Soils of the State are loamy sand to silty clay loam. Soil depth varied from few inches and in some places practically nil to several feet deep depending on weathering processes. Soils are acidic in nature with high organic matter content (0.36 to 5.61%). Soils are porous with poor water holding capacity deficit in potash, phosphorous, nitrogen and even humus.

## 2. Climate

24. Sikkim's climate is sub-tropical in the lower valleys, and temperate to alpine with increase in elevation. For most of the year, it is cold and humid as rainfall occurs right through the year. The area experiences heavy rainfall due to its proximity to the Bay of Bengal. The rainfall in the north district is comparatively less than the other districts. Pre-monsoon rain occurs in April-May and the south-west monsoon reigns from the month of May until early October. Climatically, the State can be divided into five ranges i.e. tropical, sub-tropical, temperate, sub-alpine, and alpine. These zones are further divided into three describing the aspects of vegetation altitude, these are:

Tropical climate	-	From MSL to 1,700 m above MSL
Temperate climate	-	From 1,700 m to 4,300 m above MSL, and
Alpine climate	-	From 4,300 to 5,000 m above MSL

25. Based on temperature, rainfall attributes and wind directions, three main seasons are clearly be recognised, these are: (i) winter extending from November to February, (ii) summer from March to May, and (iii) rainy season from May to October.

26. The mean temperature in the lower altitudinal zone varies from 1.5 to 9.5°C. The maximum temperature usually occurs during July and August and minimum during December and January. Fog is a common feature in the entire state from May to September. The summer temperature varies from maximum 20.7°C to minimum 13.1°C and winter temperature varies from 14.9°C to 7.7°C. The state receives an annual rainfall of 2,000 mm to 4,000 mm. Available rainfall data shows that the mean annual rainfall is minimum at Thangu and maximum at Gangtok.

27. North-West Sikkim gets little rainfall even less than 4.9 mm and mainly snow -covered. Rainfall is heavy and well distributed during the months from May to early October. July is the wettest month in most of the places. The intensity of rainfall during the south-west monsoon season decreases from south to north, while the distribution of winter rainfall is in the reverse order. The salient climatic features of the state are as follows:

Average Annual Rainfall	-	2,000 mm to 4,000 mm
Concentration of precipitation-		April to September
Humidity	-	79 to 96%
Cloudiness	-	Heavily clouded
Wind	-	Generally light except rainy season
Temperature	-	Summer 16.9 to 26.3°C
		Winter 5.80C to 17.5°C

### 3. Water Resources and Water Quality

28. The state has vast water resources in the form of lakes, snow-fed rivers and streams and some marshy area. It has abundant water potential both ground and surface water. The State has two major rivers, Teesta and Rangeet, with a total length of 900 km. These rivers originate from the glaciers of North and West Sikkim. The project area is drained by Rangeet River which joins Teesta River at Melli. Besides this river network, the state has 13 lakes, 9 hot springs, and glaciers. The State has minor irrigation potential of 13,000 hectares. Specific data on surface and ground water potential for the state is not available. Still, the entire NER i.e. total surface water potential of the region is 928,873 Mm<sup>3</sup> and the total ground water potential of 855 Mm<sup>3</sup>.

29. The ground water aquifers in the region occur in sediments and fractured rocks. Springs are either seasonal or perennial and are often used for irrigation and drinking purposes. There is a number of hot springs in the region which is used by the local communities for domestic and agricultural purposes and by the visiting tourists.

30. Both surface and ground water qualities in the region are reported to be well within the permissible limits. People use these waters for drinking purpose without any treatment.

### 4. Air Quality

31. Ambient air quality in the state is quite pure compared to other neighbouring states. Except for few urban centres like Gangtok and Nayabazar, the ambient air quality is good. There are no major industrial activities in the State. Dust arising from unpaved surfaces, forest fire, smoke charcoal production and domestic heating, and vehicular pollution are sources of pollution in the region. Firewood burning is the major contributor in the ambient pollution load. Industrial and vehicular pollution is mainly concentrated in the major commercial areas in State capital.

32. Vehicular pollution is a secondary source of pollution in the state as the traffic density is low. Pollution from vehicles is mainly due to use of low-grade fuel, and poor maintenance of vehicles. The level of pollution in rural areas is much lower than that of the urban areas due to lower volume of traffic. The traffic density in the state is very low. In the entire north eastern region, Sikkim has only 1% of total registered vehicles of 10,232. About 25% of the vehicles consist of two wheelers followed by cars and trucks.

33. The air quality data obtained from the Sikkim State Pollution Control Board indicates that the ambient air quality in the state is well within permissible standards. Table below presents the air quality in Sikkim.

Table III-1: Ambient Air Quality in and around Gangtok (Yearly Average) in  $\mu\text{g}/\text{m}^3$

Sl. No.	Location	Category	SPM	SO <sub>2</sub>	NO <sub>x</sub>
1	Tadong	Residential	108 (140)	16.2 (60)	15.7 (60)
2	Indra bye-pass	Commercial	137 (360)	17.4 (80)	22.6 (80)
3	Deorali	Residential	118 (140)	18.6 (60)	16.1 (60)
4	Bazar Area (Near metro point)	Commercial	145 (360)	22.3 (80)	20.4 (80)
5	Hospital Point	Sensitive	122 (70)	19.6 (15)	18.6 (15)
6	Zero Point	Sensitive	98 (70)	10.2 (15)	12.3 (15)

Source: Sikkim State Pollution Control Board

Note: Figures in ( ) indicates the permissible standards

## 5. Noise Quality

34. Noise pollution is not a current nor in the foreseeable future to be a problem as no major settlements is found along the road, and low traffic flow. However, few commercial locations in Namchi will experience increase in noise levels but still the ambient noise quality is expected to be well within the permissible limits.

35. During construction period, temporary increase in the noise levels are expected from the movement of construction machineries and construction activities. Suitable barriers and timely scheduling of construction activities will minimize these impacts.

36. The ambient noise quality in various locations in the Gangtok is presented in the succeeding Table. It can be seen that the noise levels are well within the permissible limits for all categories off the areas.

Table III-2. Ambient Noise Level in decibel (A) at Residential Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	College Valley, Tadong	Morning	74.2	34.3	51.6
		Afternoon	78.4	42.2	60.8
		Night	76.3	39.5	58.4
2	Deorali Government Quarter	Morning	71.5	35.1	55.3
		Afternoon	76.3	39.9	61.4
		Night	73.4	36.2	57.2

Table III-3. Ambient Noise Level in decibel (A) at Commercial Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	Bazar Area (M.G. Marg)	Morning	97.1	58.4	70.4
		Afternoon	105.2	61.0	74.3
		Night	-	56.2	62.1
2	Indra Bypass	Morning	93.0	52.0	68.5
		Afternoon	97.0	57.4	73.2
		Night	88.0	43.8	69.4

Table III-4. Ambient Noise Level in decibel (A) at Sensitive Area in Gangtok

Sl. No.	Location	Time	Lmax	Lmin	Leq
1	Hospital Point	Morning	74.3	38.2	50.1
		Afternoon	84.2	40.8	62.5
		Night	85.1	41.6	63.2
2	District Court	Morning	68.1	34.2	47.1
		Afternoon	72.5	38.6	49.2
		Night	64.2	34.6	44.6

Source: Sikkim: A Statistical Profile, 2004-05, Directorate of Economics, Statistics, Monitoring & Evaluation, Government of Sikkim

## B. Ecological Environment

### 1. Vegetation

37. The state is divided into three vegetation zones; tropical, temperate and alpine. The favourable rainfall, temperature and high humidity existing in the area have caused the vegetation to acquire the general characteristics of the northern tropical semi-evergreen forest.

38. The territorial area under region extends from the forest hills of Eastern Himalayas (Bhutan hills) to the flood plain area of Brahmaputra valley. Because of diversified configuration pattern of the ground and varied rainfall pattern throughout the region, different types of forest associations are found. Based on the classification pattern envisaged by Champion and Seth (Revised Survey of Forests types of India), the different type of forests occurring in the region are indicated in the succeeding Table.

Table III-5. Different Types of Forests in Sikkim

Sl. No.	Forest Types	Classification code	Remarks
1.	Eastern Sub-mountain Semi-Evergreen Forest	2B/C1b	**
2.	Sub-Himalayan light alluvial Semi-Evergreen Forest	2B/1S1	**
3.	Eastern Alluvial secondary Semi-Evergreen Forest	2B/2S2	**
4.	Sub-Himalayan secondary wet mixed Forest	2B/2S3	**
5.	Moist Sal Savannah Forest	3C/DS1	**
6.	East Himalayan moist mixed deciduous Forest	3C/CS3b	*
7.	Low alluvial Savannah wood land	3/1S1	**
8.	Eastern Hollock Forest (Terminelia-lagerstremia)	3/1S2(a)	*
9.	Eastern Hollock Forest (Terminelia-Duabanga)	3/1S2(b)	*
10.	Eastern wet alluvial grass land	4D/1S2(b)	**
11.	Khair Sissu Forest	5/1S2	*

Source: Working Plan Office, Department of Forest, Government of Assam

\* A revised survey of the forest types of India by Champion and Seth

\*\* Not described by Champion and Seth. Approximated to be grouped under the mentioned code

39. About 5,841 sq.km area is reserved and protected forests, which is 82.32% of total geographical area of the state. Percentage of tree cover and forest cover account to 45.55% of the total area. The State holds about 5,000 species of flowering plants. Out of 315 families of Angiosperms in India, more than 200 are represented in Northeast India and the state accounts for nearly 50% of the total number of plant species in India as a whole. Though the flora of this region exhibits an Indo-Malayan affinity, the floral elements of other parts of India, and of neighbouring and far off countries, have also contributed to its richness and diversity. It is of interest to note that about one third of the flora of Northeast India is endemic to this region.

40. The state is home of 550 species of Orchids, 36 species of Rhododendron, over 4,000 species of flowering plants, 300 species of ferns and allies, 9 conifers and plenty of medicinal plants and herbs.

41. The major flora found in the temperate zone includes Oak, Cherry, Alurel, Chestnut, Maple, Birch, and Rhododendron – found in alpine region. Besides this the most popular orchids found in state are Cymbidiums, Vanda, Cattaleya, Hookeriana, Farmeri, Dendrobiumaenum, Nobile orchid –which is state flower of Sikkim. The restricted trees in State are Dar, Khamari, Tooni, Panisaj, Sisum, Junifer, Mel, Bahumi Kath, Rani Chap and JatKatus. List of protected trees include Malgiri, Yew tree, Chemal, Gurans, Chewri, Tamala, Kimbu, Sinkauli, Amala, Harra, Barra, Bar, Pipal, Labar, and Siltimbur. Important medicinal plants found in Sikkim

include *Nardostachys Grandiflora* (Jatamasi), *Aconites* (Bikhma), *Artemisia Vulgaris* (Titeypati), *Piper Longum* (Pipla) and *Picrorhiza Kurrooa*. The names in brackets are local name of the plant. Dominant species of flowering plants in State are Orchidaceae, Asteraceae, Poaceae, Leguminosea, Cyperaceae, Rosaceae, Scrophulariaceae, Rubiaceae, Lamiaceae and Euphorbiaceae. Besides this Sikkim Himalaya harbours as many as 190 wild plants that are suitable for human consumption.

42. The state is rich in lichens, mosses and liverworts. These seemingly unimportant plants need to be investigated, studied, appreciated and above all, protected, as they serve vital ecological roles as soil protector, contribute to the recycling of nutrients and water, offer food and shelter to an assemblage of invertebrates, and take a part in air purification and carbon sequestration.

43. The proposed project road i.e. SK-02 passes most of the road length through reserve forests on one side of road. Except at starting from 0.0 to 1.0 at Nayabazar and few settlement locations (Namchi), where land use is mixed of agriculture and built up, the remaining portion of project road passes through Reserve forests area of Sikkim West Forest Division. The vegetation density in these forests varies from 0.4 to 0.5.

## 2. Wildlife and Protected Area Network

44. The State has rich wildlife and has long network of protected area. In order to protect the rich flora and fauna of Sikkim from the poacher, the Government has established parks and sanctuaries. The largest of these is the Khangchendzonga National Park which encompasses an area covering 1,784 sq km. It is bounded in the north by the Tent Peak and the ridge of the Zemu glacier. The eastern boundary of this park comprises the ridge of the mountain.

45. The state's protected area network is comprised of four wildlife sanctuaries and one national park. Recognizing the importance of this region as one of the hot spots, majority of the biodiversity rich areas of the state has been placed inside the protected area network system as national park and sanctuary. The total area under the protected area network is 22.5 percent and that of under national parks is 19.6 percent. The details on the forest area, forest cover and area under protected areas is presented in the succeeding Table.

Table III-6. Detail of Protected Areas in Sikkim

A	National Parks	Area in Sq. km.	Coordinates	
			Long	Lat
	Khangchendzonga National Park	1784	88° 03' to 88° 39'	27° 27' to 27° 53'
B	Wildlife Sanctuaries			
	Fambonglho Wildlife Sanctuary	51.76	88° 29' to 88° 35'	27° 10' to 27° 23'
	Maenam Wildlife Sanctuary	35.34	88° 21' to 88° 25'	27° 21' to 27° 25'
	Kyongnosla Alpine Sanctuary	31	88° 44' to 88° 45'	27° 22' to 27° 24'
	Singba Rhododendrone Sanctuary	43	88° 43' to 88° 46'	27° 43' to 27° 48'
	Barsey Rhododendrone	104	88° 02' to 88° 11'	27° 10' to 27° 13'
	Pangolakha Wildlife Sanctuary	128	88° 35' to 88° 51'	27° 09' to 27° 22'
	Kitam Bird Sanctuary	6	88° 20' to 88° 22'	27° 06' to 27° 07'
C	Reserved Forest	<b>5452.4</b>		
D	Protected Forests	<b>389</b>		



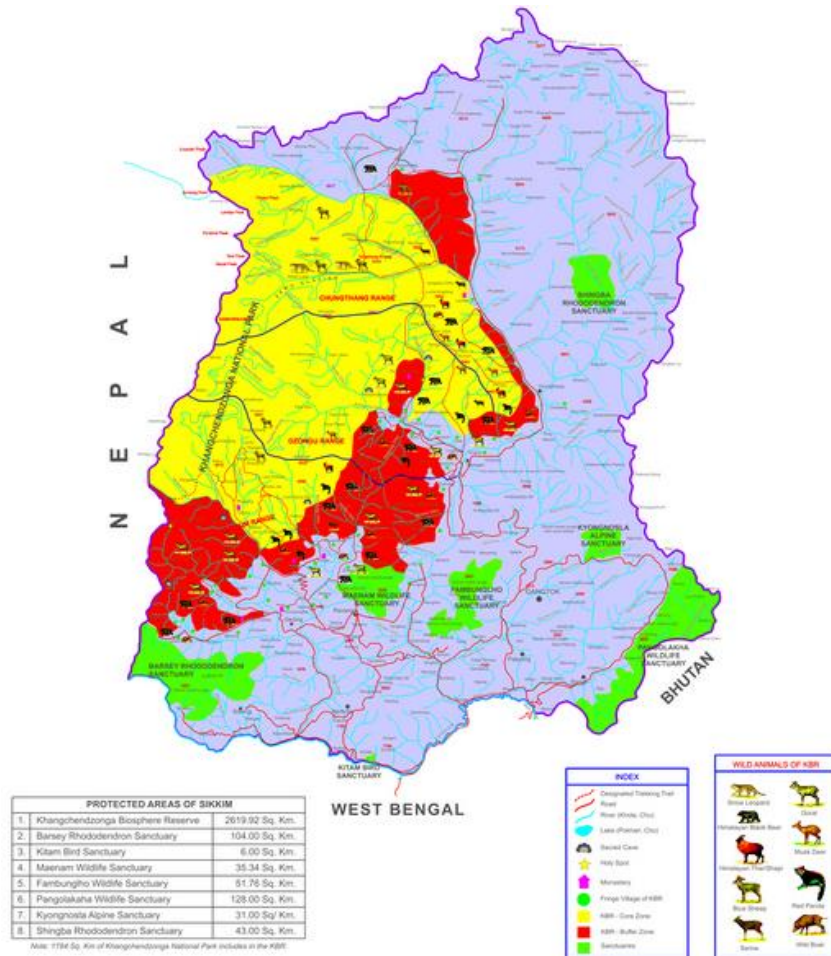


Figure III-3. Protected Areas of Sikkim

46. The entire north eastern region has been the home of a great variety of wildlife species which has a significant influence on the tradition and culture of communities' including tribal. But due to indiscriminate killing of animals in the region before and after enactment of Wildlife (Protection) Act, 1972, the animal population has gone down to a great extent. However, the Department of Environment and Forests has taken up wildlife protection schemes with a great enthusiasm by constituting protected areas for wildlife protection and preservation. Awareness in wildlife protection is necessary in the region. New development has been initiated in the wildlife wing of the Department of Environment and Forest since a couple of years ago with centrally sponsored schemes.

47. The State is home to a large number of wild fauna. It is reported that the state has 144 species of mammals, 550 species of birds, 650 species of butterflies and moths, 33 species of reptiles and 16 species of frogs. Some of the endangered mammals are Bharal, Chouded Leopard, Fiding Cat, Golden Cat, Himalayan Thar, Leopard Cat, Red Panda, Marbled Cat, Musk Deer, Nayan, Pangolin, Serow, Snow Leopard, Spotted Lingsand and Tiger.

48. Among the endangered birds are Black Nacked Crane (migratory), Blod Pheasant, Peafowl, and Siberian Crane (migratory).



## C. Socio Economic Environment

### 1. Demography

49. Sikkim is the smallest state of the north eastern region with a population of 0.54 million, 80% of which lives in the rural areas. The population density is 78 persons/km<sup>2</sup> compared to 149 persons/km<sup>2</sup> for the north eastern region. Sex ratio is also less i.e. 875 against the 936 in the region. The demographic feature of north eastern states is unique in that there are more than 100 recognized tribes, which inhabit mostly the hill areas and each with distinct culture, ethos, and traditional knowledge systems. The three major ethnic groups in the state are Bhutias, Lepchas, and Nepalis. The Nepalis owned roughly 60% of the total cultivated land in 1981. Bhutias and Lepchas share 20% each. The majority of the people survive on subsistence economy based mainly on the agriculture, supplemented with limited horticulture, animal husbandry, crafts/handloom, etc. The Table below presents the demographic features of the North eastern region.

Table III-7: Demographic Features of Sikkim and North Eastern Region as per 2001 census

State	Area (sq. km)	Population			Density	Sex Ratio
		Rural	Urban	Total		
Sikkim	7,096	480,488	60,005	540,493	76	875
NE Region	262,179	33,008,703	5,809,395	39,041,167	149	936
All India	3,287,263	741,660,293	285,354,954	1,027,015,247	312	933

Source: 1) Census of India, 2001 (Provisional), 2) Statistical Abstract of State Governments, Directorate of Economics and Statistics, 3) Where do we stand in 2003, Meghalaya & North East and India & The World, Directorate of Economics & Statistics, Government of Meghalaya

50. The State Gross Domestic Product (SGDP) of Sikkim was Rs.8169 million in 2000. The incidence of poverty continues to be high. A stagnant agriculture sector combined with poor industrial activity has severely limited employment opportunities outside the government. This has also put the government under fiscal stress as expenditure on wages and salaries, including pensions and interest payments consuming almost half of the total government expenditure.

51. The progress on industrial front has been constrained by many factors particularly the lack of appropriate infrastructure, lack of raw materials and trained manpower.

### 2. Land Resources

52. The area available for land utilization in the state is about 6,317 sq.km out of the total geographical area of 7,096 sq.km. This means about 89% of the area in the state is available under various land uses. Major portion of the land use has forest cover accounting for 77% of the land use area. About 9% area is under gross cropped area. Agriculture is the second major land use in area. The area under various land uses in the region is presented below.

Table III-8. Land use pattern in North East Region (Figure in thousand hectare)

State	Reporting area for land utilization	Forest area	Not available for cultivation	Other uncultivated land excluding fallow land	Fallow land	Gross cropped area	Net area sown	Area sown more than once	Total
Sikkim	631.7	619.9	12.4	9.8	14.5	72	62	10	800.6
NE Region	21754.5	13379	3296.8	1624	913.6	5448.6	3891.1	1557.5	30110.6

Source: www.neportal.org (Directorate of Economics and Statistics, NE states and NEC, Shillong).  
Statistical Abstract (2001-02), Sikkim, Directorate of Economics and Statistics, NE States.

### 3. Agriculture and Forestry

53. The state remains dependent on agriculture, contributing about 40% of the SGDP. The state has only 64,000 hectares of net sown area. Production of foodgrains was 103,000 tonnes in 1997-98 of which rice share was 20%. Horticulture and floriculture have very good potentials for development provided proper transport facilities and successful markets can be created. Between 1975 and 1995, for example, for which data are available showed that horticulture production including fruits, vegetables, potato, cardamom, ginger, and turmeric increased by nearly six times, from 16,000 tonnes in 1975 to 93,000 tonnes in 1995. Promotional activity in floriculture is also another area needing attention. Efforts are being made to improve production of cut flowers and bulbs. Being perishable, special arrangements for transport and good road connectivity are equally critical.

54. Forest area constitutes about 45% of the total state's area. Deciduous and ever-green forests are more commonly found in eastern and western Sikkim, northern part is dominated by coniferous forests. The Sikkim Himalayas has tremendous biological diversity contributing to the country's natural heritage and to the national ecological balance. Forests are an important source of livelihood for the people. Apart from timber, forests are also a source of herbs and plants for use as medicines. This is a potential growth area for the state. However, forests cannot be a major source of revenue because of government policy of implementing conservation measures and regulated price of forest and allied produce.

### 4. Fisheries

55. The state has great potential for fisheries development. The state abounds in perennial and seasonal water bodies which hold high promise for the growth of fishery. In the absence of properly organized fishery production and marketing system, the fishery potential has also not been adequately developed and exploited.

56. The state has vast potential for fisheries by enhancement of rivers, streams, floodplain, wetlands, reservoirs, lakes, ponds and paddy-cumfish culture. About 7 hectares of water are available for nursery and 38 hectare under rearing. Inland fish production for the year 2003-2004 was 160 tonnes. The total fish production for the year 2003-2004 was 2.8 million fry and 0.6 million fingerlings.

57. The important fishes commonly found in the region's plain and river basins are *Catla catla*, *Labeo rohita*, *Labeo calbase*, *Cirrihinus mirigale*, *Clarius*, *batrachus*, *Rita rita*,

*Heteropneustus fonilis, Notopterus nontopterus, N. Chitala, Macrobrachum rosenbergii, M. malconsoni, M. Chapral, Channa punetatus C. gaehua, and C. striatus.*

## 5. Transportation

58. Transportation system is a key factor in the socio-economic development of any state. Currently there is no railway line in the state. Nearest railhead is Siliguri in West Bengal. Similarly, there is no airport also in the state. Nearest airport is at Bagdogra in West Bengal. There is a skeleton helicopter service between Bagdogra and Gangtok (Sikkim). The Eleventh Finance Commission had recommended a grant of Rs. 500 million for the construction of an airport near Pakyong (East District). However, this is yet to materialize.

59. Two major rivers Teesta and Rangit flow through the state but are not navigable and as such inland water transport has practically no role. Roads are the only means of getting to and within the state. They are a critical input to the growth of all sectors. The length of roads is reported to be about 1840 km. Major district roads and other district roads cover the major portion of the total road network. The National Highway No. 31A, about 40 km, is the only national highway (NH) link serving the state and is under the jurisdiction of BRO for its development and maintenance.

## 6. Mineral Resources

60. The north eastern region is also endowed with reasonable mineral resources, oil, and gas. However, Sikkim state has very limited resources i.e. 1,200 tonnes of copper, zinc and lead deposits.

## 7. Industrial Situation

61. There are no major industries in the state. It has 2 industrial estates and 5 large and medium industries giving employment to only 280 persons. In addition, there are about 349 small scale industries (SSIs) giving employment to 1,815 persons. Table below gives a broad picture of the states and north eastern region's industrial statistics.

Table III-9: Number of Industries and Employment Generated

States	No. of industrial estates	No. of large and medium industries	Employment generated	No. of SSIs	Employment generated
Sikkim	2	5	280	349	1,815
NE Region	52	202	47,501	59,548	313,524
Per capita employment	-	-	109	-	5
India	-	133,345	16,425,592	3,300,000	18,600,000
Per capita employment (national)	-	-	123	-	5.6

Source: [www.databank.nedfi.com](http://www.databank.nedfi.com), [www.nic.in](http://www.nic.in)

Statistical Abstract (2001-02) of Assam, Manipur, Nagaland, Directorate of Economics and Statistics, NE states.

## **8. Aesthetic and Tourism**

62. The state is characterized by beautiful series of mountainous hills and valleys. The state is endowed with several features such as trekking, scenic spots, pilgrim centres/monastery, national parks which can be utilised for a systematic growth of the tourism industry. In 2002, the total international tourist arrival was 8,539 and domestic tourists were 160,789. Gangtok is the major destination of tourists, and of the total domestic tourists, about one-third came from West Bengal.

## **9. Cultural Resources**

63. The state has great cultural value. Festivals and cultural activities are being celebrated throughout the year in the state. The department of cultural has taken various activities like promotion of art and culture, preservation of old and historical monuments. The state has great cultural value for Buddhism. There are 11 monasteries in the state. However, project road does not affect these places. There is a temple of Goddess Durga at Rolu village in the project road which has great sentiments of local people and traveller. Besides this there are number of cultural / pilgrim centers in the state.

## **10. Energy and Electric Power Potential**

64. Firewood is still a major source of energy in the state which is available in abundance. The state is generating hydro-power which contributes about 70% of installed capacity in the state and rest is by other means. The total installed capacity in Sikkim is 36.5 MW with an average peak load of 34 MW. The available hydro-power potential in the State is huge and actions are being taken to capture it.

## **11. International Trade & Commerce**

65. There are number of agreements between India and neighbouring country to enhance the border trade across the countries. Indo-Myanmar border trade agreement in 1994, border trade agreement between India and Bangladesh in 1972 is some of the agreements signed to develop the trade relations.

66. The north eastern region has the potential to emerge as a strategic base for domestic and foreign investors to tap the potential of the contiguous markets of People's Republic of China, Myanmar, Lao PDR, Nepal and Bhutan. This calls for curbing the unauthorised trade at the policy level as well as at the ground level. The Bangladesh-India-Myanmar-Sri Lanka-Thailand Economic Cooperation (BIMST-EC) initiative is creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry, technology, human resource development, tourism, agriculture, energy, infrastructure and transportation. Various physical features along the project road are described in Table below.

Table III-10: Physical Features along the project road SK02: Nayabazar-Namchi

Chainage Km wise	Left Side	Offset (m)	Right Side	Offset (m)
0-1	Bus shelter	3	Hill with drain (Throughout)	2 to 3
1-2	Valley (th)	2.5 to 4	Hill with drain (throughout)	2.5 to 4
	Boundary wall of Institute of rural development		drain/water crossing	
	Fencing of Plantation by SPWD	3.5		
2-3	Valley (th)	2.5 to 5	Hill (Th)*	1 to 3.5
	Banana and Banana Plantation	1 to 3.5	water crossing (2)	
3-4	Valley (th)	2 to 7	Hill (Th)	2.5 to 4
	Amboti Chisopani Village		water crossing (3)	
4-5	Hot Mix Plant	10	Hill with drain (Th)	2 to 4.5
	Agricultural area mixed with Residential area	2.5 to 4	water crossing (2)	
	Valley	2.5 to 3.5		
5-6	Hill with drain (th)	2.5 to 3	Valley (Th)	2.5 to 6
			water crossing (2)	
			Govt. Primary School	6
			Tinik Chisopani Village	
6-7	Hill with drain ( 400 m)	2 to 2.5	Valley ( 800m)	2 to 5 m
	Agricultural Area	2.5	water crossing (3)	
	Valley ( 600m)	2.5 to 4	Hill with drain ( 200m)	
	Agricultural Area	3 to 4		
	Chisopani Village			
7-8	Valley (th)	2.5 to 4	Hill with drain (Th)	2 to 3.5
	Agricultural area( 150 m)	3 to 4	water crossing (2)	
8-9	Valley ( 500 m)	3.5 to 6	hill with drain (th)	2 to 6
	Nandu Gaon		Nandu Gaon	
	Agricultural area	2.5 to 4.5	water crossing	
9-10	Valley (th)	3 to 4	Hill with drain (th)	2 to 4
	water tank	6	water crossing	
	Built-up cum agricultural area	3 to 4		
10-11	Valley (th)	3 to 4	Hill with drain	2 to 4
	Agricultural area with sparse built-up area	3 to 4	water crossing (2)	
11-12	Valley (th)	3 to 4.5	hill with drain (th)	2 to 3
	Bus shelter	5	water crossing	
	Agricultural area	3 to 4		
12-13	Valley ( 100 m)		hill with drain ( 200m)	2 to 2.5
	Denchung Village		valley ( 800m)	2 to 6
	Hill with drain ( 800)	2 to 3	water crossing	
	Concrete Wall of 30 m length	2.5		
	Agricultural area ( 100m)	2 to 2.5		
13-14	Hill with drain (th)	2.5 to 3	valley (th)	2 to 4
	Concrete wall	3	water crossing	
	wall to protect hill ( netting with stone)	2.5	water crossing	
14-15	Hill with drain ( 500 m)	2.5 to 3	valley (200m)	2 to 3.5
	Valley ( 500 m)	2.5 to 4	9th mile village	
	rest house	3	hill with drain ( 800m)	2.5 to 3
	Agricultural land	3 to 4	Steps	2.5
15-16	Valley ( th)	3.5 to 4	hill with drain (th)	2 to 3
			water crossing (2)	
16-17	Valley ( th)	2.5 to 4	hill with drain (th)	2 to 3
			slaughter house	12
			water crossing	
17-18	Valley ( th)	3 to 4	hill with drain (th)	2 to 3
			Steps	4

Chainage Km wise	Left Side	Offset (m)	Right Side	Offset (m)
			water crossing (4)	
18-19	Valley ( th)	2 to 4.5	hill with drain (th)	2 to 3
			water pipe (th)	
			water/drain crossing	
19-20	Valley (th)	2 to 5	hill with drain (th)	2 to 4
	Shops (Garage)	5 to 6	water pipe (th)	
	Namchi Village, Built up area			
	Stack of Stones from Hill cutting	3.5	Boundary wall of Hansa Kriti Dham	3
	Built-up area		Namchi Village	
	Stack of Stones from Hill cutting	3.5	Settlement Area	
	Built-up area		Stack of Stones from Hill cutting	2
	Bazar Area		Petrol Pump	3
			Motor Garage	3
			Bazar Area	
*th – Throughout				

#### IV. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

67. This chapter presents key environmental issues associated with various aspects of the proposed project. Identification and assessment of the potential environmental impacts are based on secondary information supplemented by field visits. Impacts on various environmental components have been assessed at four different stages, namely:

- the project location;
- design;
- construction; and
- operation stages.

68. A few short and long-term negative effects, mainly at the construction and operation stages, are, nonetheless, anticipated. These can be kept in check through proper planning and adopting environment friendly road construction methods and the appropriate regulatory measures.

##### A. Identification and Assessment of Impacts

##### 1. Positive Environmental Impacts due to improvement of road section between Nayabazar and Namchi in South Sikkim District

69. The following are the expected positive impacts from the improvement of the Nayabazar-Namchi road section includes:

- reduction in travel time and lower vehicle operating cost will reduce fuel consumption and emissions of pollutants
- provide the better access to other parts of the state by connecting National Highway 31C at Melli via. Nayabazar which is a major route connecting state with West Bengal and supply route of the State, and connecting state capital Gangtok
- enhance the trade and commerce between Sikkim South and Sikkim West districts

##### 2. Negative Environmental Impacts due to improvement of state highway section between Nayabazar and Namchi in South Sikkim District

70. The following negative environmental impacts are expected from the improvement of the road section:

- cutting of road site trees that falls within formation width i.e. 7.5 m may reduce the ecological balance of the area and also increase soil erosion problem.
- road may become a barrier to the natural movements of fauna.
- noise, air and water pollution and disposal of waste, during construction, will negatively impact both local residents and wildlife. These latter effects should, however, only be temporary/reversible.
- a number of quarries and other sources will be established and scar the landscape. However, the operation of quarries is an independent and already regulated activity. Negative impacts on water quality of river Rangit in the form of silt deposition and runoff during construction are expected. However, this is short term and will be taken care by controlled construction activities.

- improvements on road and construction of bridges, although limited, may enhance soil erosion, landslips and reduce the micro-level ecological balance of the area. Construction will also disturb the habitation of a large number of fauna living in this area. These should, however, be only temporary/reversible effects. The widening will also require the cutting of a large number of trees (about 350).
- Minor impacts of noise and air quality for those now living and workings close to the project road (mainly at Namchi and Jorthong) will deteriorate during the construction period and afterwards during operation.

### 3. Negative Impacts Related to Project Location, Preliminary Planning and Design

#### a. Forest Clearing and Tree Felling

71. Most of the project road passes through forest areas. This forest land is not categorized as protected forest. Since, improvement work will be limited to the available ROW, minimal adverse impacts due to diversion of forest land. Nonetheless, land clearing will involve cutting of a large number of trees. Problem of soil erosion is expected in some locations. To minimize loss of trees, the following mitigation measures will be adopted during the detailed design and construction stage of the project:

- widening proposal will consider option with minimal tree cutting.
- identify areas prone to erosion and include land stabilization measures.
- strictly enforce the environmental conditions put as part of the environmental clearance by the MoEF and SPCB.
- adopting Environmental Friendly Road Construction (EFRC) methods.

72. The improvements of the proposed road will largely be confined on the existing alignment. At some locations, improvements to the geometry may involve cutting, filling, and the need to cut vegetation along most of the project road length. This will have more significant impact and this matter is discussed in the sections which follow.

73. In forests areas, it is particularly important that the road improvement works should minimise environmental impacts from inadequate drainage and/or slope failures and should assist in maintaining, or repairing, forest cover. Wildlife should be protected and hunting will be restricted.

74. From the previous assessment in September 2006 of 350 trees to be cleared along SK02: Nayabazar-Namchi, this has increased to 3,079 trees based on the June 2008 field survey. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting) or 9,237 trees. At sensitive locations such as schools, colleges and hospitals along the project roads noise barrier shall need to be provided.

Table IV-1. Number, Location, and Type of Trees to be cleared along SK02: Nayabazar-Namchi

Location	LHS	RHS	Types of trees
0+1	21	65	Silver Oak, Chekrassi, Kadam, Segun, Lampatey, Dudhilo, Bhogate, Gulmohor, Jarul, Chatiun, Pipul, Totala, Cabra, Nebaro, Pakhasaj, Jarul, Mayna
2+3	18	37	Goyelo, Sindurey, segun, Akhani, Jarul, Siris, Hallore, Silver Oak, Lampatey, Gulmohor, Akashmani, Chatiun



Location	LHS	RHS	Types of trees
8+9	31	69	Sal, Segun, Jarul, Goyelo, Buro Dhayeri, Dudhilo, Aamla, Pakhasaj, Aambake, Bhogate, Batalbrush, Chillauney, Lampatey, Siris, Aam, Cabra, Barra, Hallore
11+12	13	0	Gulmohor, Segun, Cabra, Sal, Jarul, Dudhilo, Aam
19+20	50	120	Sal, Khirra, Chatiun
20+21	68	53	Sal, Pakasaj, Hallore, Kaizal, Dabdabe, Lampatey, Khanue, Amaroo, Bar, Panisaj, Segun, Bakaina, Jarul, Akashmani, Siris, Barra, Cabra, Burudhayeri
21+22	42	3	Dudhelo, Segun, Chatiun, Akashmani, Barra, Pakasaj, Siris, Lampatey, Cabra, Sal, Khanue, Jarul, Hallore
25+26	10	0	Sal, Siris, Jarul
26+27	47	62	Silver Oak, Akashmani, Aam, Nebaro, Pipul, Gulmohor, Siris, Barra, Chillauni, Lapsei, Segun, Bel, Chatiun
<b>Sub-Total</b>	<b>300</b>	<b>409</b>	
<b>Total</b>	<b>709</b>		

Table IV-2. Section of SK02: Nayabazar-Namchi Passing Through Reserve Forest

Sl. No.	Reserve Forest	District	From Chainage (Km) to Chainage (Km)
1	Karfactor Reserve Forest (Both sides)	South Sikkim	0.0-1.0
2	Protected Forest (Khasmal, hill side)	South Sikkim	1.0-1.81
3	Protected Forest(Khasmal, valley side)	South Sikkim	2.33-2.54
4	Protected Forest (Khasmal, hill side)	South Sikkim	2.51-2.54
5	Protected Forest (Khasmal, valley side)	South Sikkim	2.78-2.81
6	Protected Forest (Khasmal, valley side)	South Sikkim	10.9-11.09
7	Protected Forest (Khasmal, hill side)	South Sikkim	10.84-11.72
8	Protected Forest (Khasmal, hill side)	South Sikkim	12.81-13.81
9	Protected Forest (Khasmal, valley side)	South Sikkim	12.81-13.96
10	Protected Forest (Khasmal, both side)	South Sikkim	16.09-19.18
<b>Total Length (Km) of Project road SK-02 passing through Reserve forest</b>			<b>7.36 Km</b>

### b. Borrow Pits and Quarries Operation

75. There is a need to establish construction camps and related facilities, such as borrow pits and quarries. These must be located in environmentally sound and socially safe areas. It is expected that construction materials for the road works will be mined only from approved quarries. The following criteria must be applied when locating borrow areas:

- borrow areas are not established in ecologically sensitive areas;
- villagers are consulted in regard to the design and location of all borrow areas – these should ensure the safety of local communities and, if possible, should incorporate beneficial post construction features for the villages;
- located away from the road and hill slopes as well as settlements facing the road, so as to minimise visual impacts;
- In case of reserve forest areas, construction facilities such as temporary workers camp, hot mix plants, and concrete batching plant and stone crushers should not be established in stretches that passes through reserve / protected forests. Consult forest department / village forest management committees before locating temporary project facilities such as construction camps and workers camp;

- construction camps for labourers should be located at least 500 m away from settlements;
- living accommodation and ancillary facilities should be erected and maintained to standards and scales approved by the Engineer-in-Charge; and
- toilets and urinals should be provided in accessible places away from the asphalt plant and mixing yard.

### c. Cultural Heritage

76. There are no adverse impacts expected on historical places/monuments. However, there are few small shrines along the road. Care must be taken to avoid any damage to these structures. Earthworks, as associated with the road construction/improvement works, or deriving from secondary sites such as quarries or borrow pits, may reveal sites or artifacts of cultural/archaeological significance. In the event of such discovery, the proper authorities should be informed and the requirement to take such action should be incorporated in contract documents.

## 4. Other Impacts deriving from the Project Preliminary Planning and Design Process

77. During preliminary planning and design of this project, the Consultant should take into account the need for:

- optimum siting and control of quarries;
- reduced incidence of slope failures due to inadequate drainage;
- providing adequate culverts/drains;
- providing side-drainage structures;
- mechanised construction methods and thereby, for example, reduced use of firewood for heating bitumen;
- maximising safety and thereby reducing traffic accidents;
- reducing travel times and, thereby, fuel consumption and emissions;
- increased accessibility for residents to education and health facilities, markets etc., and for others who might come for tourist or other purposes; and
- improving the socio-economic conditions of residents in the project areas of influence.

78. As part of the engineering works for this work, the following have been the guiding principles in determining preliminary alignments:

<b>Environmental Issue</b>	<b>Measures to be taken</b>
Alignment	Final alignment should be determined so as to minimise land take, air pollution and the impact on people and animals and to avoid unfavourable geological condition and cultural relics.
Balancing cut and fill	The design should attempt to equalise cut and fill. The centreline should be aligned so that on all slopes below 60 degrees, half cut and half fill can be achieved.
Soil erosion	Temporary and permanent drainage systems should be designed to minimise the soil erosion.
Dust and air pollution	Borrow sites, waste disposal sites and asphalt mixing sites should be identified – keeping in mind environmental issues such as dust.

Cultural heritage	Any archaeological sites identified along the alignment should be excavated prior to construction.
Wildlife Habitat	Care should be taken in preservation of wildlife and construction workers should be educated on wildlife protection.

### 5. Construction: Permits and Environmental Impacts to be taken into Particular Account during Construction

79. As a requirement of Environmental Impact Assessment Notification, April 1994, by Government of India, any development activities should not be taken in any part of country unless it has granted clearance from Ministry of Environment and Forests, Government of India.

80. Highways are classified as one of the project, listed in said notification, which require prior clearance. However, an amendment to this notification clarifies, that the highway improvement project are excluded from this list unless they pass through environmentally sensitive areas.

81. Indian Road Congress and Ministry of Road Transport and Highways published guidelines for environmental considerations into highway projects. Accordingly, for the proposed road improvement project, implementing authority has to apply for the environmental clearance from the regional office of Ministry of Environment and Forests, located in Shillong.

82. At present, no clearances for any of the project road has been obtained so far. Prior to applying for environmental clearance, a number of resource-specific clearances and permits have to be obtained. The following table outlines the type of clearances and permits and the authorised bodies that issue them along with the procedures involved.

**Table IV-3. Environmental Clearances and Permits Required for SK02: Nayabazar-Namchi**

Sl. No.	Clearance/permit	Authorised body	Procedures involved	Time involved
1	Clearance from Forest Department	Regional Office of MoEF, Principal Chief Conservator of Forests, Gangtok, Sikkim	Detailed proposal in appendix specified in Forest (Conservation) Act, 1980 along with project report and necessary details of tree felling. Local division office will forward after joint verification of site and preliminary scrutiny of proposal to PCCF office for approval. Joint verification and enumeration of trees to be cut shall be done by division office and after approval shall be allowed to cut.	Approximately 6 months or more
2	NOC from Sikkim State Pollution Control Board, Gangtok	Member Secretary, Sikkim State Pollution Control Board	Application in prescribed form along with project report and required fee shall be submitted to pollution control board. After scrutiny of application if required,	Between 6 month to 1 year

Sl. No.	Clearance/permit	Authorised body	Procedures involved	Time involved
			concerned pollution control board shall conduct public hearing in particular district involving state authorities and forest department and affected persons. After fulfilling the requirement SPCB may issue the NOC with specific conditions.	
3	Clearance for quarry sites	Department of Geology and Mines, Govt. of Sikkim, Gangtok	Submission of application for quarry site to mining department. Department of mines and geology after scrutiny of application and consultation with forest department and revenue department together with site verifications will give approval with specific conditions.	Takes between 3 months and six months.
4	Clearance for blasting	State Mining department, Gangtok	Detailed application with blasting locations and amount of blasting shall be submitted to DoM. Mining department may issue the conditional approval.	2 to 6 months

83. Any felling of trees requires forestry clearance and appropriate permits. The procedures necessary to obtain such permits will require liaison with local territorial forestry offices and their head office in Gangtok. No clearance is required for the use of surface sand and stone from the river banks as for commercial purposes they can only be purchased in an open auction carried out by the forestry office. It is imperative that all necessary clearances and permits be obtained before commencement of work.

## B. Physical Environment

### 1. Topography, Geology and Soil

84. During the improvement works for the road section, the cutting of hill slope, filling, the cutting of trees, stone quarrying, and construction of structures, the micro-level topography may change. With proper planning, these topographical impacts can be kept within acceptable limits and sometimes even used to enhance local aesthetics. Any negative impacts on topography (existing or new), particularly soil erosion due to a lack of drainage facilities, will be minimised with the provision of proper drainage facilities such as culverts, causeways etc. The overall impact on topography is, therefore, anticipated to be insignificant.

85. The terrain and geological conditions of area are such that, even with reasonable care exercised during final design, during construction the interaction between proposed road features and existing land features may reveal/result in significant land instabilities.

86. During the construction phase the following restrictions should be imposed:

- existing vegetation including shrubs and grasses along the road (except within the strip directly under embankments or cuttings) should be properly maintained;
- sites for quarrying, borrowing and disposal of spoils are to be confirmed according to the applicable laws and regulations in the state and the practices followed in recent/ongoing internationally funded road projects should be continued;
- controlled and environmentally friendly quarrying techniques should be applied to minimise erosions and landslides;
- blasting should not be carried out during busy periods; and
- cut material should be disposed of in suitable depressions;

87. It is also important to:

- maintain adequate vegetative cover above and below the road;
- maintain the natural course of water bodies (that is as far as possible) and avoid throwing debris into stream courses;
- construct proper drainage structures to avoid erosion; and
- minimise the construction of hair-pin bends that are close to each other: as this often adds to instability.

88. Given the existence of high slope and high rainfall in almost entire project area and weak geology in some areas, it is inevitable that some sites will face problems of erosion, mostly debris slides.

## **2. Erosion, Silt Run-Off and Landslides**

89. Virtually all road construction in state is through mountainous terrain with steep and unstable slopes. Much of Sikkim is geologically young, resulting in soft/fragile substrates. Another complicating factor is the high monsoon rainfall throughout most parts of the state. These factors mean that states conditions are amongst the most difficult in the world for road construction. Landslides frequently caused by inappropriate construction techniques, slope instability, and inadequate drainage are major problems and are associated with all types of road construction. It should be noted that a significant number of landslides that occur in the vicinity of roads are caused by factors/features only indirectly linked to the road itself – frequently, irrigation channels, logging, quarrying and cultivation practices. To control these, following measures are suggested by local environmental authorities:

- logging immediately above roads should be restricted to reduce erosion/landslide potential;
- quarrying along road ROW should be restricted;
- excavated material should be properly disposed of and not simply dumped downhill;
- adequate reclamation (e.g. fertilisation and reseeding) along denuded ROW should be implemented;
- particular care should be given to providing adequate drainage;
- careful supervision/training of blasting technicians is required; and
- to the largest extent possible, care should be taken to avoid sacred and religious sites.

90. Previous studies by the Border Road Organisation and CRRI indicate the need to incorporate the following measures:

- balance cut and fill: with a prohibition on the dumping of spoil over the road edge – thus minimising erosion;
- more frequent use of retaining walls - to control landslips;
- improved drainage - again so that erosion is minimised;
- controlled blasting in rock-cut areas - to minimise erosion; and
- use of bioengineering technique for slope protection: use of native species of plants and shrubs for slope stabilisation.

91. Unstable, uncompacted road embankment materials and exposed material can result to soil erosion, clogging of side drains and the spillover of rainwater runoff onto the road surface and down slopes. These cause landslides, and hinders traffic movement. These problems can be mitigated by maintaining the batter gradients as specified in the MoRT&H guidelines. The existing vegetation on slopes outside the immediate area of construction must remain undisturbed during construction and/or upgrading. Bioengineering techniques will be used to prevent barren slopes and to stop soil erosion and to protect the animals from grazing animals. Support structures will be installed where slope failures are anticipated or may have occurred previously. Slope failures should be monitored and remedial actions initiated at the earliest possible time.

92. Construction involving rock/soil cutting of hillsides may render hill slopes unstable and increase vulnerability to landslides. Blasting of rocks may also result in landslides.

93. All hill/soil cutting areas should be revegetated as soon as construction activities are completed. At more vulnerable locations, selected bioengineering techniques should be adopted - a combination of bioengineering techniques and engineering solutions such as rock bolting and the provision of bank drains may be required. Solutions will, however, need to be individually tailored by the geo-technical/ environmental experts of the Supervision Consultant. Figure below shows the typical landslide on project road.



Figure IV-1. Landslide prone location along the road

94. Excavation and earthworks should be undertaken during the dry season when the risks from erosion and silt run-off are least. The materials used for surface dressing will consist of aggregates and gravel which do not contain silt. Internationally accepted best practice engineering approaches to minimise landslide and erosion risks and silt run-off will be incorporated into contract documents and monitored during construction.

95. In order to minimise erosion, silt run off and landslides, it will also be important to:

- ensure all embankment grades are not too steep and prone to erosion;
- waste material is not thrown into nearby river Rangit and cross cutting water bodies;
- temporary retention ponds, interception drains, and silt traps are installed to prevent silt laden water from entering adjacent water bodies;
- topsoil of borrow areas is preserved and used for re-vegetation;
- borrow areas are provided with gentle side slope that are re-vegetated and connected to the nearest drainage channel to avoid the formation of cess pools during the rainy season; and
- control the disposal and ensure the vegetative stabilisation of spoil.

### **3. Climate**

96. The proposed improvement/construction works will be localised activities and the Project will not have significant impact on climatic conditions, such as rainfall, temperature and humidity in the project area.

### **4. Surface and Ground Water and Drainage and Hydrology**

97. Given the presence of river Rangit and project road running parallel to this river, and small streams crossing the project road, improvement of road may result in disruptions to the natural hydrology and water mismanagement and lead to further problems of soil erosion.

98. The natural courses of Rangit River will be maintained. Appropriate temporary diversions of streams will be made and brought back to their natural course as soon works are completed in that section. No disposal of construction debris in streams and rivers is allowed.

99. Minor impacts on water resources are expected during the construction phase. The rehabilitation of existing bridges may also cause soil erosion and turbidity in downstream water bodies. To mitigate this, river-bank slope stabilities will be monitored and, if necessary, appropriate remedial measures applied throughout the construction period. Construction work at bridges during rainy season will be minimized to avoid erosion and sedimentation.

100. The likely impacts of surface water movements are changes in the natural drainage systems, downstream scour, and erosion due to constriction in flows. If suspended solid concentrations in the water are affected, this could also affect aquatic river ecology.

101. To mitigate these impacts the following should be implemented:

- chemicals and oils are stored in secure, impermeable containers, and disposed of well away from surface waters;
- no vehicle cleaning activity is allowed within 300 m of water bodies/ drains;
- construction camps are equipped with sanitary latrines that do not pollute surface waters;
- the work on bridges and culverts is limited to dry seasons, when many of the smaller streams will have low water - water diversion works can be minimised and the original course restored immediately after the work has been completed;
- drivers are made aware of diversions and other works at bridge construction sites to avoid accidents;
- drainage structures are properly designed to accommodate forecast discharges;
- side drain waters must be discharged at every available stream crossing to minimize volume and prevent erosion at discharge point;
- provide lined drainage structures;
- where an increased discharge of surface water endangers the stability of the water outlet, erosion protection measures such as bioengineering measures, ripraps, and check dams are incorporated;
- in areas with high water tables, seepage may occur and side drains and up-slope catch drains must always been lined to avoid percolation; and
- all debris and vegetation, clogging culverts are regularly cleared.

102. Ground water pollution is not envisaged in this project.

## 5. Air Quality

103. During construction air quality may be degraded for short periods due to (i) the exhaust emissions from the operation of construction machinery; (ii) fugitive emissions from brick, concrete, and asphalt plants; (iii) the dust generated from the haulage of materials, exposed soils and material stockpiles; (iv) cutting and filling of hill slope; (v) cleaning of the road; (vi) material loading; (vii) unloading; and (viii) blasting activities. The impact is expected to be localised, temporary and confined to construction areas.

104. Negative air quality impacts during construction are likely to result from three main sources; (i) emissions from construction equipment, including delivery trucks; (ii) fugitive dust from earth-moving operations and demolition; and (iii) localised increased traffic congestion in construction areas.

105. The negative impacts on air quality during construction stage were classified in the following Table. There are two types of pollution, dust pollution and pollution from harmful gases.

**Table IV-4. Impact on Air Quality during Construction Stage**

	<b>Impact</b>	<b>Source</b>
1	Generation of Dust (SPM)	Cutting of slopes towards hillsides Transportation and tipping of cut material - while the former will occur over the entire stretch between the cutting location and disposal site, the latter is more location specific and more intense; Blasting operations; Activation of landslides and rock falls etc.;; Transportation of raw materials from quarries and borrow sites;



	Impact	Source
		Stone crushing, handling and storage of aggregates in asphalt plants; Site levelling, clearing of trees, laying of asphalt, construction of bridges; Concrete batching plants; Asphalt mix plants – due to the mixing of aggregates with bitumen; and Construction of structures and allied activities
2	Generation of polluting gases including SO <sub>2</sub> , NO <sub>x</sub> and HC	Hot mix plants; Large construction equipment, trucks and asphalt producing and paving equipment; The movement of heavy machinery, oil tankers etc. on steep slopes will cause much higher emissions of gases; Toxic gases released through the heating process during bitumen production; and Inadequate vehicle maintenance and the use of adulterated fuel in vehicles.

106. On the Nayabazar-Namchi road, it is expected that air quality will be affected to some minor extent by dust and particulate matters generated by construction, vehicular movements, site clearance, earth filling and material loading and unloading. The impacts are expected to be localised, temporary and confined to construction areas. Care should, however, be taken at sensitive urban locations so that harmful impacts can be minimised.

107. As it is expected that suspended particulate matter (SPM) levels will increase during construction, certain mitigation measures are suggested in order to bring down these levels to prescribed standards. The following actions should be implemented:

- regular check-up and maintenance of construction equipment and long idling of engines are discouraged;
- mixing plants i.e. asphalt, concrete, and bricks, should be operated within the permissible limits of CPCB, and located away from settlements;
- the contractor will submit a dust suppression and control programme to the PWD prior to construction – this plan details actions to be taken to minimise dust generation and identify equipment to be used;
- vehicles delivering loose and fine materials should be covered to reduce spills;
- controlled blasting should be carried out and such only with the prior approval of the site Engineer and, if required, PWD;
- bitumen emulsion should be used wherever feasible, and
- bitumen heaters should be used and the use of wood for fuel prohibited.

## 6. Noise Levels

108. With the exception of the Nayabazar and Namchi centers, the ambient noise level along the road sections is within standards. During the construction period, noise will be generated from the operation of heavy machinery, blasting works, the haulage of construction materials to the construction yard and the general activities at the yard itself. Concrete mixing and material movements will be the primary noise generating activities and will be uniformly distributed over the entire construction period. These construction activities are expected to produce noise levels in the range of 80 – 95 dB(A). Piling, if necessary, will also cause vibration. Noise and vibration from this source will be unavoidable but the impact will only be temporary and affect people living or working near piling locations. In construction sites within 500 metres of a

settlement, noisy operations should cease between 22:00 and 06:00 hrs. Regular maintenance of construction vehicles and machinery must also be undertaken to reduce noise. The impact and sources of noise and vibration are summarised in succeeding Table.

**Table IV-5. Likely Impact on Noise Quality in the Vicinity of Project Area**

<b>Impact</b>	<b>Source</b>
Increased Noise Levels causing discomfort to local residents, workers and local fauna	<ul style="list-style-type: none"> <li>• Mobilisation of heavy construction machinery;</li> <li>• Accelerations/decelerations/gear changes – though the extent of impact will depend on the level of congestion and smoothness of the road surface;</li> <li>• Use of blasting to cut into hill sides;</li> <li>• Excavation work for foundations and grading;</li> <li>• Construction of structures and other facilities;</li> <li>• Crushing plants, asphalt production plants; and Loading, transportation and unloading of construction materials.</li> </ul>

109. Typical noise levels associated with various construction activities and equipment are presented below:

**Table IV-6: Typical noise levels of principal construction equipments  
(Noise Level in db (A) at 50 Feet)**

<b>Clearing</b>		<b>Structure Construction</b>	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88
Grading and Compaction		Landscaping and clean-up	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94

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

110. The noise levels indicated for various construction activities/equipment, while far exceeding permissible standards, will occur only intermittently. Still, these extremely high sound levels present real risk to the health of workers on- site.

111. Since the anticipated post-construction volumes of traffic on the project road is expected to be low, impacts from higher noise levels will have little significance even though present noise levels in these areas are low. In these areas, the noise produced during construction will also not have a significant impact, if proper mitigation measures are taken. Mitigation measures should include:

- construction machinery should be located away from settlements;
- careful planning of machinery operation and the scheduling of such operations;
- controlled blasting should only be carried out with prior approval from the Engineer in charge;
- contractors should be required to fit noise shields on construction machinery and to provide earplugs to the operators of heavy machines;
- blasting should be conducted only during day-light hours; and
- only controlled blasting should be conducted.

## 7. Topography and Appearance

112. Construction activities of the project roads will bring permanent changes in the local-level topography and appearance of the project site. There will be loss in aesthetic beauty of the project area mainly due to the earthwork. The following table elaborates potential effects on the topography and appearance and appropriate mitigation measures.

**Table IV-7. Potential Effects on Topography by the Proposed Road Section Upgrading**

SII	Construction activity	Potential effect on topography and appearance	Mitigation
1	Clearing of vegetation and cutting of hillside for widening of the road	Scarring of landscape from cutting and potential landslides (short term and long term) may be caused. There may be minor permanent changes in the landscape.	Cut material should be used to widen the road or disposed off at proper disposal sites. Cut slopes should be re-vegetated immediately after widening activities.
2	Stone quarrying	Scarring of landscape and potential landslides (rock slides/falls). There may be permanent changes in the landscape.	Stone quarrying should only be undertaken in legally approved areas. Controlled and environmental friendly quarrying should be carried out to minimise landslides and erosion
4	Earthwork from borrow areas	Scarring of landscape due to unearthing activities. Minor but permanent changes in landscape	Borrow areas should be in legally approved locations. As soon as construction activities are complete, they should be re-vegetated and brought back as far as possible to their previous appearance.
5	Waste disposal	Disposal of cut soils and debris at improper locations such as hillside below the road will make the area look untidy and unattractive	Cut off material should be used to widen the road or disposed of at proper disposal sites
6	Establishment of labour camps	Disposal of waste and litter at improper locations and deforestation for fire-wood will make the area look dirty and unattractive.	Provision and allocation of proper waste disposal bins and sites are required. A supply of cooking gas should be provided by the contractor to eliminate the use of fire wood.

## **8. Ecological Resources**

### **a. Wildlife**

113. The existence of rich biodiversity and micro climatic conditions, the state is home to a number of important wildlife species. However, in the project area presence of wild animals is very rare. Also, the project road travels through foothills and will not have any impacts on movement of wild animals. Though no studies of the impacts of development activities on wildlife have been conducted in state so far, the work on this road may have low-level impacts on wildlife, except on sections passing through dense forest.

114. The improvement works to the existing alignment involve limited tree felling.

115. Limited indirect ecological degradation may occur from wildlife poaching, by construction workers and outsiders due to greater accessibility and as a result of increased local demand for food. In order to avoid such impacts the contract document should include the following:

- project staff and work crews should not be allowed to have fire-arms and animal traps etc.;
- construction facilities such as workers camp, construction camp, hot mix plant, batching plant should be located at least 1 km away from the forest stretches.
- employment agreements should specify heavy penalties for illegal hunting, trapping and wildlife trading – all other ancillary works should also agree not to participate in such activities.

### **b. Vegetation**

116. The project mostly passes through the forest area of West Sikkim Forest Division. The density of vegetation in forest is 0.4 to 0.5. Removal of the existing vegetative cover and the uprooting of 350 trees is an unfortunate activity, which will reduce the ecological balance in the areas. This will also affect the wildlife habitat and enhance soil erosion. About 57,000 sq m (3 m strip for entire length 19 km) of scrub forests and vegetation will probably be removed for improvement of road between Nayabazar and Namchi. The loss of vegetative cover will mostly be permanent and only some might be revived through mitigation efforts. Another impact from road construction activities and deriving from the cutting of hillsides, quarrying, preparation and transfer of stone chips and other earthwork, is the accumulation of dust on the surrounding vegetation. This leads to deterioration of the vegetative health, which in turn will affect the ecology as well as the aesthetic beauty of the area. Induced impacts may result from the following:

- increased forest harvesting for fire-wood, construction timber, forage, medicinal plants and other products;
- increased earth and rock extraction;
- construction crew demands for wood as a fuel and for building materials;
- construction crew demands for food and recreational hunting and fishing;

117. To minimise negative impacts on the vegetative cover the contract documents should specify that:

- all wood building material for workers' housing should be brought from outside the project area;
- workers should be supplied with non-wood fuels such as kerosene or liquefied petroleum gas for the duration of the contract;
- all contract equipment and plants should be cleaned to the satisfaction of the project engineer in charge prior to their relocation to project sites;
- during site clearance, care should be taken to ensure that the minimum area of vegetation area is affected; and
- water sprinkling of trucks used as construction vehicles should be properly and regularly undertaken, so that dust deposition problem on vegetation are minimised.

## **9. Human Use Values**

118. Field reconnaissance surveys of the project roads were conducted on October 2005 to assess the environmental and social conditions. It was noted that the relocation of structures will be required at few locations. These structures made of light materials i.e. compacted earth, timber and corrugated iron sheets. The widening options have been devised to minimise impacts of structures.

119. The survey also found that there is one temporary structure and one temple likely to be affected due to widening of road. A short resettlement plan is prepared to address this issue. The affected people will be compensated and rehabilitated as per the provisions of the Resettlement Plan.

120. There will be negligible land acquisition as the proposed widening will be accommodated within existing ROW i.e. 27 ft either side of the road.

121. At certain locations on the road, particularly at bridge sites, traffic will be temporarily diverted from the existing carriageway while construction is in progress and temporary traffic diversions will be managed within the ROW. In other instances, traffic may have to be diverted across adjacent private land, in which case compensation will be paid for any loss of crops or the replacement of damaged structures. In other situations, most frequently not at bridge sites, for example when bitumen surfacing is in progress, it may be required to close the road temporarily. In these circumstances, adequate radio and press releases should be made beforehand and a date/time given for the re-opening.

122. Most construction will be undertaken during the dry season when few crops are planted. Losses should be minimised.

## **10. Sensitive Location Such as School, College and Hospital along the Project Road**

123. The sensitive location such as school, college and hospital along SK-02: Nayabazar-Namchi within 100 meter from the edge of the existing road has not been identified is given below.

**Table IV-8. School & College located 100 meter from the edge of the existing Project road (SK-02)**

Sl.	Name of School/ College/ Hospital	Approx Chainage (Km)	Distance and Direction (LHS/RHS) from existing road edge	Name of the village
1	Chisupani Govt. primary School	4.93 km	8.9 m from RHS (valley side)	Chisupani
2	Primary Royal Academic School	6.12 km	0 m from LHS (valley side)	Chisupani
3	Nandugaon Secondary School	8.72 km	35 m from RHS (hill side)	Nandugaon
4	Primary Health Sub Centre	9.03 km	30 m from RHS (hill side)	Nandugaon

### 11. Health, Safety and Hygiene for Construction Workers

124. Construction of the road will result in the generation of waste. In isolated places, the amount of waste generated may be greater than normal because of substandard subsoil materials, which will need to be replaced.

125. The Contractor will be required to control the construction site, keep it clean and provide facilities such as dust bins and collectors for the temporary storage of all waste. This waste should be adequately stored to avoid pollution of water supplies and water sources and to avoid dust formation. The Contractor will be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals.

126. All necessary safeguards should be taken to ensure the safety, welfare and good health of all persons entitled to be on the sites and to ensure that works are carried out in a safe and efficient manner. All personnel working at vulnerable site locations will wear safety helmets and strong footwear. It should be ensured that all workmen and staff employed on site use proper safety equipment – for example, eye protectors, ear plugs, safety helmets, the designated safety equipment when working over water - and that proper rescue equipment is available. Fire extinguishers and first-aid equipment will be kept at all sites.

127. The construction camps are anticipated to house up to 300 people for two to three years. With this concentration of people, the potential for the transmission of diseases and illnesses will increase. The main health and safety risks during construction will arise from:

- inadequate sanitation facilities in worker camps;
- introduction of sexually transmitted, and other diseases, by immigrant workers; and
- outbreaks of malaria, typhoid, cholera etc. amongst the labour force.

128. The following actions will be undertaken at construction camps and stipulated in construction contracts:

- submit and obtain approval for a health and safety plan prior to the commencement of work;
- provision of adequate health care facilities; and

- workers will be required to undergo pre-employment medical screening and treatment (if required) and periodic health checks thereafter.

129. The project will support a public health education programme for workers and villagers covering road safety, malaria, hygiene, and sexually transmitted diseases. The district health departments will be enjoined to participate in monitoring and education of communities and workers affected by the project.

## **12. Nuisance to nearby properties**

130. Nuisance to nearby properties is likely to result from:

- noise and vibration from mechanical devices and construction plant;
- dust during quarrying, construction and the trafficking of new surfaces prior to sealing;
- gaseous emissions from heavy equipment; and
- fumes from asphalt boiling sites.

131. Much of the project road pass through forest areas and presently air/dust pollution is not a major issue. Nonetheless, there will be regular watering of the road surfaces or the application of emulsion coats near villages, where dust is a nuisance. Noise generating equipment such as power generators and concrete mixers will be kept away from populated/commercial areas. Provisions will be incorporated into the contractor's contract to require the use of dust suppression measures.

## **13. Interference with Utilities and Traffic**

132. On the project road, utilities interfere with the ROW at few locations that will have to be moved prior to construction. This should not be a major problem.

133. Traffic may experience minor delays when diverted around active construction areas, but will be more severely hampered at the locations where temporary road closures are necessary. Such hazard points will have proper signs indicating the nature of the problem envisaged.

## **14. Community Impacts**

134. There will be minor widening work on entire road length - in which case the resettlement problem will be minor.

135. Construction camps may put stress on local resources and the infrastructure in nearby communities resulting to people raising grievances. This sometimes leads to aggression between residents and migrant workers. To prevent such problems, the contractor should provide the construction camps with facilities such as health care clinics, places of worship, and occasional entertainment. The use of local labourers during the construction will be promoted to minimise these problems.

## **15. Quality of Life**

136. The impact of the improvements of project road on the socio-economic environment will be significantly beneficial. Improved access and reduced travel times and costs will be major

stimuli to economic growth, particularly in rural areas. Better access of agricultural goods to market will be important and a major contributor to poverty reduction.

137. Increased labour mobility will occur. This has both positive and negative impacts. Increased access is a two-way phenomenon, and the corollary to increased access to the project areas is increased access for the residents of these areas to more urban life-styles. Out-migration may result. There is also the likelihood of the relocation of homes and businesses to new road-side locations.

138. During construction, benefits to local people can be maximised if the contractor recruits construction workers locally regardless of gender. Where possible, he/she should also not discriminate in the employment of women.

## **16. Construction Materials**

139. The use of proper sources for stone and aggregates has become a major issue in most states. Historically, stone has been collected from the roadside or from shallow surface workings. Small quarries on steep slopes are often enlarged by blasting or excavation at the base. This is dangerous and can cause slope failures. Roadside stone collection continues in some districts despite its proven negative impacts on road safety and stability. Sand and gravel are often obtained from river deposits. Jurisdiction over stone and aggregates is shared between the Geological Survey of India and the State Forest Department. The Geological Survey of India issues licences for major mineral developments while the Forest Department issues permits for stone quarrying and for sand and gravel extraction. This is largely because these are mostly found on forest lands. Roadside quarrying is officially discouraged, but unofficially continues, invariably by petty contractors.

140. Road maintenance, repair and new construction will continue to cause large demands for construction materials. There is a clear need for a better materials supply policy in each district to minimise environmental impacts of small-scale, poorly managed operations and improve the quality and reliability of supply. In some districts, it may be appropriate to develop centralised quarries, if an operator can be attracted. In any case, pre-designation of sources would give contractors a level playing field for bidding and minimise incentives for environmentally damaging cost cutting.

141. As a prior requirement of projects, every quarry and borrow area should be subjected to a site specific environmental investigation, work according to an approved plan; and should be left in a safe condition or restored to a productive land use. Subject to these conditions, obtaining construction materials for projects will not cause unacceptable impacts.

142. Quarry and borrow pits may be filled with rejected construction waste and afterwards should be given a vegetative cover. If this is not possible, then the excavated slopes will be filled in such a way that they resemble an original ground surface.

143. Mitigation for Quarries

- aggregates will be sourced only from licensed quarry sites that comply with environmental and other applicable regulations;
- occupational safety procedures/practices for the work force will be adhered to in all quarries;



- quarry and crushing units will be provided with adequate dust suppression measures; and
- regular monitoring of the quarries by concerned authorities to ensure compliance with environmental management and monitoring measures.

#### 144. Mitigation of Borrow Areas

- prior approval will be obtained from concerned authorities and all local environmental regulations be complied with;
- within all identified borrow areas, the actual extent of area to be excavated will be demarcated with signs and access to the operational area controlled;
- borrow pit plant and machinery will conform to EPA noise emission regulations;
- protective gear will be provided to the workforce exposed to noise levels beyond threshold limits and there should be proper rotation of such personnel; and
- all operation areas will be water sprinkled to control dust levels to national ambient air quality standards.

145. The project will require large amounts of bitumen or bitumen emulsion usually stored in drums. These empty bitumen drums are generally recycled as steel sheeting, or used in road construction as parapets or for bank stabilisation. When supplied and used in this manner, bitumen is not regarded as a significant environmental hazard.

146. The project will require the import, transport and use of fuel and oils. Minor diesel spills are common in region, especially around fuel stations. The project provides an opportunity to assist the PWD and contractors in improving fuel handling practices so as to minimise future fuel spillage.

### **C. Environmental Effects Related to Operation**

#### **1. Noise Vibration, Air Pollution, Runoff, Spoils of Hazardous Materials**

147. The current low traffic flows along the project road is expected to increase because of improved economic activities associated with better access. The larger numbers of vehicles will be an additional source of noise and gaseous emissions. Repairs to culverts and new drainage work will eliminate/reduce the soil erosion problems presently caused by poor cross drainage. Also, the situation will remain good because this road pass through area that are largely forested and trees and plants have the capacity to absorb gaseous as well as noise pollutants. Bioengineering techniques may also help to absorb pollution.

148. The project road is linked to national highway at Melli which carry a variety of goods and materials. With the road improvements including safety measures, it is envisaged that overall road safety will improve resulting to reduced risk of accidental spillages.

149. Stone and sand quarries, and water sources along the Project road are provided in the **Appendix A**.

#### **2. Land Use and Settlements**

150. The likely impacts on land use and settlement patterns are limited. Improved access will lead to increased migration, but this will occur gradually and over a prolonged period. There will

be time for new residential areas to be established. There will be a need to control ribbon development.

### **3. Social Impacts**

151. Specific benefits to local people will include:

- easier communication;
- easier access to markets (both internally and regionally) with savings in travel times and costs;
- enhanced market efficiency through better distribution and accelerated deliveries etc.;
- improved access to health, education and other social services;
- employment generation;
- improved technical skills; and
- enhanced economic activity.

152. Likely adverse social impacts will include:

- increased chances of exposure to communicable diseases, particularly during construction;
- influxes of new settlers leading to increased pressure on natural resources causing hardship to local communities relying on local/forest resources; and
- rural-to-urban migration causing labour shortages in the depleted rural areas and other negative impacts in the urban areas.

### **D. Potential Environmental Enhancement/Protection Measures**

153. Volume II of this IEE Report presents good environmental management practices and guide documents in the following aspects of road construction:

- Plant Management
- Campsite Management
- Debris Disposal Management
- Borrow Area Management
- Air Standards
- Environmental Clearances

## V. INFORMATION DISCLOSURE, CONSULTATION, AND PARTICIPATION

154. In accordance with the ADB's environmental safeguards policy, public consultation were held as part of IEE study with beneficiaries, local /government officials, community leaders, NGO's, and other stakeholders in corridor of impact. Brief description of the project and its activities were presented, preliminary environmental screening results were discussed, and comments were solicited and noted to be considered in the engineering design and preparation of mitigation measures. The PWD also took the opportunity to foster co-operation among officers of PWD, forest department, the community and the stakeholders to achieve a cordial working relationship for smooth implementation of the project.

155. Most of the people interviewed strongly support the project. People living in the entire project area expect the different project elements to facilitate transport, employment, boost economic development and thereby provide benefits to them.

156. In order to document likely impacts on affected persons, an interview survey has been carried out. A sample of PAPs was selected and interviewed through a designed questionnaire. Precaution has been exercised during the survey to ensure that the sample interviewed is truly representative of the affected groups and the questions are worded so as not to generate a bias response. Figure below shows one such interview survey.



Figure V-1.View of consultation with PAPs

157. It is envisaged from the interview survey that there is increased environmental awareness among the people. It can also be seen from the table that more than 70% of the persons believes the existing environmental conditions of the area is good. Over 90% of the people agreed that the quality of air, water and noise in the area is good; whereas, about 6% respondent feel that the environmental quality is being deteriorated. Poor road condition and vehicular emissions are the major sources they feel responsible for this. In case of presence of archaeological / historical the responses are very few. The area has great cultural significance as 80% people say that there are places of cultural significance in the region. The area experiences natural disasters i.e. floods,

earthquake etc. as it also envisaged that 73% of respondent reported history of natural disaster. About 70% people indicated that there are rare and endangered species of fauna in the forests of the region. Overall, the general environmental conditions in the region are good and people have increased environmental awareness. Table below shows the result of public opinion survey carried out in the region.

**Table V-1. Peoples' Perception about Environment Degradation**

Sl. No.	Question asked about	No. of people interviewed	Positive response (%)	Negative response (%)	No response (%)
1.	Water quality of rivers, ponds, wells, and canals	15	94	6	0
2.	Noise quality of the area	15	87	13	0
3.	Air quality of the area	15	94	6	0
4.	Archaeological sites	15	82	6	12
5.	Natural disaster	15	73	27	0
6.	Rare species of animals and birds	15	70	30	0
7.	Cultural sites i.e. market, melas	15	88	6	6

*Note: Positive response shows that the overall environmental scenario in the area is good and wise versa*

158. The IEE report will be disclosed in MDONER, PWD and ADB websites. The full reports will also be available to interested parties on request from office of PWD, Sikkim.

## VI. GRIEVANCE AND REDRESS MECHANISM

159. All the three parties involved in project implementation i.e. contractor, engineer, and employer will maintain complaint registers at their following respective offices:

- Contactor's main site offices i.e. office of the Project Manager;
- SC's main site office i.e. office of the Engineer's Representative; and
- Executive Engineer's office i.e. Employer's field office

160. All public complaints regarding environmental issues received by any of the above mentioned offices will be entered into the register with specific details such as name and address of the person or representative of the community registering a complaint, the details of complaint, and time. The Executive Engineer and Engineer's Representative will immediately communicate the details of the complaint to the Contractor. The Environment and Safety Officer (ESO) of the contractor will promptly investigate and review the environmental complaint and implement appropriate corrective actions to mitigate the cause of the complaints. The Engineer's Representative will decide on the exact time frame within which the action will be taken on case-to-case basis depending on the nature and sensitivity of the same. However, in all the cases, it will be responsibility of the contractor to take action immediately upon receiving any complaint. The contractor will report to Engineer's Representative about the action taken on the complaint, within 48 hours of receiving the complaint, for his further intimating to PMU and the Executive Engineer. The person making a complaint would be intimated by the complaint receiving person or his representative, about the action taken, within 48 hours, along with his/her feedback.

## **VII. ENVIRONMENTAL MANAGEMENT PLAN**

161. The Environmental Management Plan (EMP) consists of a set of mitigation, monitoring and institutional measures to avoid, minimize and mitigate adverse environmental impacts and enhance positive impacts.

162. The major components of the EMP are the mitigation of potentially adverse impacts, monitoring of EMP implementation during project implementation and operation; and Institutional arrangements to implement the EMP.

### **A. Summary of Impacts**

163. Following are anticipated potential adverse environmental impacts:

- Impacts on surrounding area due to tree cutting for the proposed widening;
- Impacts on cultural properties and common property resources for the proposed widening;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
- Impact on biophysical environment due to quarry operation;
- Impacts on roadside flora and fauna;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road ;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all onsite and offsite construction works.

### **B. Impacts, Mitigation and Institutional Responsibilities**

164. The identified environmental issues and suggested mitigation measures with institutional arrangements for implementation, supervision and monitoring have been provided in matrix format in **Appendix D**. These mitigation measures will be implemented as applicable for this subproject.

### **C. Specific Environmental Management Plan**

165. A Generic Environmental Management Plan (GEMP) applicable for all sub projects of Tranche-1, Tranche-2 and Tranche-3 of North Eastern State is appended as Volume II. This GEMP details the good practices and mitigation measures on plant, campsite, debris, borrow areas, and quarry management. The GEMP also provides guide to contractors on air standards and environmental clearances required. However, a Specific Environmental Management Plan provides project-specific measures to be implemented particularly during the construction phase. The succeeding section presents the specific Environmental Management Plan for SK02: Nayabazaar-Namchi.

#### **1. Compensatory tree plantation**

166. As per compensatory afforestation, the tree plantation will be done three times of tree cutting (1:3 of tree cutting).

No.	From	To	Tranche	Length (km)	Tree to be cut in the project road	Proposed tree to be planted in the project area in consultation with Forest Dept. (1:3 of tree cutting)
SK02	Jorethang	Namchi (edge of town)	1	19.7	3,079	9,237

## 2. Bio-Engineering Measures

167. The bio-engineering measures are suitable for slope protection in hill roads. The following items have been suggested as bio-engineering measures for slope protection in hill roads.

- Turning of slopes through rough grassing; and
- Tree plantation along the hill section (slopes) of the project road to control the soil erosion.

## 3. Proposed Noise Barrier at sensitive location

168. Noise barrier has not suggested at sensitive location along the project road, because the available sensitive location is in valley or hill side, where direct impact due to traffic noise will not be observed on sensitive location.

## 4. Excavated Road Side Debris and its disposal

169. The provision has been made in cost estimate to use the roadway excavated materials as necessary for the construction of road, which are as follows.

- (i) For all types of soil, such as ordinary rock, hard rock and
- (ii) Excavation from drain and foundation of other structures.

170. As per above description, the Contractor will use the excavated road side material for construction of road. The unsuitable material will be disposed properly. The Contractor will not dispose the excavated unsuitable material generated from hill section to other side (valley side) of the project road. Proper disposal plan will be prepared by the Contractor to dispose the unsuitable material generated from hill cutting/ road excavation.

## 5. Water Bodies to be Protected

171. The surface water bodies in the project road require protection during construction phase of the project road. The Contractor shall not disturb/ pollute the surface water due to construction activities of the project road. The Contractor will be responsible to protect the surface water and extra payment for the same will not be given.

## 6. Re-development of Borrow Area

172. The items for redevelopment of borrow area such as preservation of top soil and re-application of stored top soil has been considered in proposed EMP cost. The Contractor will re-

develop the borrow areas before closing of same. The estimated quantities for preservation and re-application of the top soil has been considered for redevelopment of borrow area.

## 7. Environmental Monitoring Plan

173. Environmental monitoring is an essential tool for environmental management as it provides the basic information for rational management decisions. To ensure the effective implementation of mitigation measures and environmental management plan during construction and operation phase of the up gradation of project road, it is essential that an effective Environmental Monitoring Plan be designed and followed. Monitoring will be undertaken on selected parameters of air, water, noise, soil and performance monitoring on tree plantation as mentioned in **Appendix E**. The stipulated standards for various environmental attributes are given in **Volume II-F** Air Standards and **G** Clearances Required

## 8. Institutional Requirements

174. The PWD, Government of Sikkim, through its Project Implementing Unit (PIU), is the Executive Agency of the Project. The Project Director is overall responsible for EMP implementation. The following key players are involved in EMP implementation during construction stage:

- PIU and its environmental unit;
- Construction Supervision Consultant (SC) i.e. Engineer and his representatives; and
- Contractor

175. There is a need to establish Environmental and Social Management Unit (EMSU) within the PIU. Since it is not envisage that significant environmental impacts will result from the road upgrading, it is recommended that one of the senior officers of PIU will be designated as Environmental and Social Officer for monitoring implementation of proposed safeguard measure. EMSU will be headed by the Project Director but coordinating and supervising implementation of safeguard measures will be undertaken by the designated Environmental and Social Officer. There is a need for capacity building of environmental unit through various trainings.

176. The Project Director of PIU with the assistance of designated Environmental and Social Officer will be overall responsible for ensuring compliance of safeguard measures and will be reporting to the regulatory bodies and ADB certifying that relevant environmental safeguard measures have been complied with during project implementation. At the field level, the Executive Engineer with his Assistant Engineer/s will supervise implementation of safeguard measures for this subproject and submit monthly reports to PIU.

177. PIU may engage independent agencies for carrying out pollution monitoring activities. The Supervision Consultant (SC) will be interacting with these agencies and facilitate them in carrying out such activities.

178. The SC will liaise with PIU environment unit to ensure that Contractor complies with the requirements of various environmental safeguard measures through supervision, monitoring and reporting. Efforts must be made by SC to ensure that environmental mitigation and good-construction-practices are implemented as integral component of each civil activity.



Implementation of environmental safeguard measures needs team effort and as such the Team Leader of SC will delegate the responsibilities to each member of the supervision team with respect to their core responsibilities. The project should have a provision of part time input of Environmental Specialist within SC to supervise implementation of safeguard measures. His role would be more on advisory. He will assist the Team Leader of SC on the following:

- Advise PIU on preparing reports to ADB and other statutory bodies;
- Preparing procedures for implementing EMP;
- review Contractor's EMP, traffic management plan and safety plan and recommend for its approval / improvements, to the Team Leader;
- provide training to PIU, SC and Contractors' staff on implementing environmental safeguard measures;
- advise on obtaining various statutory environmental clearances on time;
- conduct periodic field visits to examine environmental compliances and suggest corrective actions ; and
- any other issues as will be required to ensure environmental compliance.

179. Besides, the Team Leader of SC will nominate a senior engineer from the site office responsible for day-to-day supervision of EMP implementation. He will provide guidance to the field staff of SC and Contractor for implementing each of the activities of the EMP. He will be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist Engineer for submitting reports to PIU. He will maintain a close co-ordination with the Contractor and PIU for successful implementation of the environmental safeguard measures.

180. To ensure the EMP is properly implemented, Contractor shall appoint a full time qualified and experienced Environmental and Safety Officer (ESO) from the commencement to completion of the project. The qualification and responsibilities of ESO as stipulated below should be considered. The qualification of ESO will be as given below:

- Diploma or Graduate in Civil Engineering with post graduate specialization in Environmental Engineering or Environmental Science or equivalent;
- 5 to 10 years of total professional experience; and
- About 3 to 5 years of experience in similar projects i.e. management of environmental issues in design and construction of road / highway / flyover / bridge projects.

181. The responsibilities of ESO of Contractor will include the following:

- Directly reporting to the Project Manager of the Contractor;
- Discussing various environmental issues and environmental mitigation, enhancement and monitoring actions with all concerned directly or indirectly;
- Preparing Contractor's EMP, traffic management plan and safety plan as part of their Work Program;
- Ensuring contractor's compliance with the EMP stipulations and conditions of statutory bodies;
- Assisting his project manager to ensure environmentally sound and safe construction practices;

- Assisting his project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures;
- Conducting periodic environmental and safety training for contractor's engineers, supervisors and workers;
- Preparing a registers for material sources, labour, pollution monitoring results, public complaint and as may be directed by the Engineer;
- Assisting the PIU on various environmental monitoring and control activities including pollution monitoring; and
- Preparing and submitting monthly reports to SC on status of implementation safeguard measures.

182. As mentioned above, there is a need for capacity building of PIU on various environmental and social aspects of the project through various environmental training. Recently, there has been change of statutory requirements for this similar projects based on new EIA Notification. This has changed the landscape of legal and administrative framework for implementing the projects. Thus, there is a need for the PIU staff to updating the information and keeping abreast with the changing legal and administrative requirement. The requirements of various statutory permits and clearances are mentioned in **Appendix D**. For successful implementation of EMP, it is essential to orient engineers of PIU, SC and Contractor who would be mobilized for this project. One day environmental orientation workshop will be conducted at Gangtok by PIU, once most of the staff has been mobilized. The training program is included in **Appendix F**.

### **9. Proposed Environmental Budget**

183. The proposed EMP budget is **Rupees5,832,400**. The environmental budget including cost of environmental training is detailed in **Appendix G**.

## VIII. CONCLUSION AND RECOMMENDATION

184. The proposed SK02: Nayabazar-Namchi road section improvement has been categorized as Category 'B' based on environmental screening and assessment of likely impacts while the initial environmental examination ascertains that it is unlikely to cause any significant environmental impacts. Few impacts were identified attributable to the proposed subproject, all of which are localized and temporary in nature and easy to mitigate.

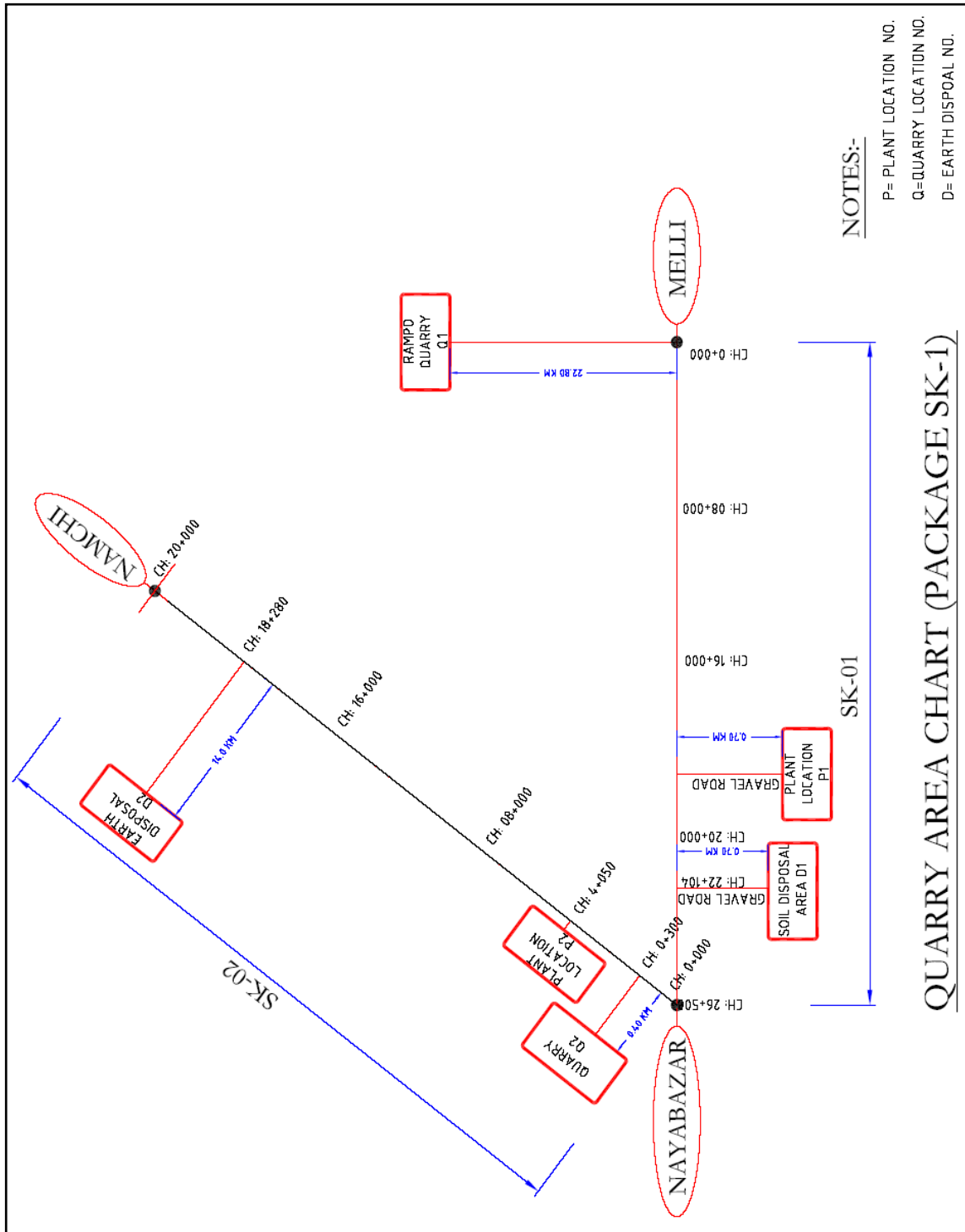
185. The road section improvement does not pass through or located nearby any national park, wildlife sanctuary, reserved forests, or any other ecologically sensitive or areas. No archaeological/protected monument is located in the project vicinity. The land use pattern around the alignment is predominantly forestland.

186. The significant adverse impacts of the road section upgrading are:

- Impacts on surrounding area due to tree cutting for the proposed widening;
- Impacts on cultural properties and common property resources for the proposed widening;
- Temporary impact on land and air environment due to locating construction camp;
- Temporary impact on land, air and water environment due to establishing and operating construction plants (Hot Mix Plant and Diesel Generator [DG] sets);
- Impact on biophysical environment due to quarry operation;
- Impacts on roadside flora and fauna;
- Impact on air quality, water quality, drainage, road users due to construction activities of project road ;
- Impact on land and water environment due to disposal of waste materials; and
- Impact on occupational health and safety due to all onsite and offsite construction works

187. In general, the subproject received immense support from local people. The local people appreciated that besides providing an all-weather efficient connectivity to large rural populations and improving the traffic scenario in the region, it will bear out several other socio-economic positive benefits.

188. The initial environmental examination of the subproject ascertains that the project is unlikely to cause any significant environmental impacts. No additional studies or need of undertaking detailed EIA is envisaged at this stage. The Executing Agency shall ensure that EMP and EMoP are included in Bill of Quantity (BOQ) and forms part of bid document and civil works contract. The same shall be revised if necessary during project implementation or if there is any change in the project design and with approval of ADB.



Location of Stone Quarry along SK01 and SK02

### List of Officials and Consulted and Issues Discussed During the Field Visit

Sl. No.	Name of Official Consulted	Department	Issue discussed	Date
1	Mr. D.T. Lepcha	Chief Engineer, PWD Sikkim, Gangtok	Existing conditions of state roads, Major problems of State roads, Treatment to landslides, Flora & fauna & road safety	15th June 2005
2	Mr. Amrit Singh	Add. Officer, State Aids Control Society, Sikkim, Gangtok	HIV/AIDS status of state, preventive and care activities in state, active NGO's in control activities	15th June 2005
3	Director	Directorate of Economics & Statistics, Govt. of Sikkim, Gangtok	Economic indicator in the State, Likely impacts of NESRP on economy of State	15th June 2005
4	Mr. T.R. Poudyal	PCCF cum Wildlife Warden, Directorate of Environment & PCCF office, Govt. of Sikkim, Gangtok	Scope of IEE, Impacts on Wildlife and forest, Wildlife status in state, flora & fauna species, Environmental aspects of hilly roads	15th June 2005
5	Mr. Manjeet Singh	Chief Conservator of Forests, Directorate of Environment & PCCF office, Govt. of Sikkim, Gangtok	Scope of IEE, Impacts on Wildlife and forest, Wildlife status in state, flora & fauna species, Environmental aspects of hilly roads	15th June 2005
6	Mr. C.S. Rao	Conservator of Forests (Working Plan), PCCF office, Gangtok	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project	15th June 2005
7	Mr. Gopal Pradhan	Sr. Scientist, State Pollution Control Board, Govt. of Sikkim, Gangtok	Status of Air, Water and Noise Quality in State, Available resources to monitor environmental quality, scope of IEE, sources of pollution in state	15th June 2005
8	Mr. Sharma	Team Leader, North Eastern Region Urban Infrastructure Development Study	Environmental Issues of urban areas in North Eastern Region, Solid Waste Management, Water Supply, Transportation facilities, Proposed project, Scope of IEE	10th June 2005
9	Chinpal Raunier	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005
10	Mr. Madhusudan Mitra	Consultant (GDS), ADB TA Preparation of Northeastern States Trade and Investment Creation	Potential of trade & economy in the North Eastern Region, Impacts of road sector on trade & economy, factors affecting trade & economy	6th May 2005
<b>Additional Officers consulted during field visits</b>				
11.	Mr. Shailendra Sharma	SE Planning PWD, Gangtok	Scope of IEE, Existing conditions of state roads, Major problems of State roads, Treatment to landslides, Flora & fauna & road safety	August 2006
12.	Mrs. Karuna Rai	Asst. Executive Engineer PWD Office Jorhang	Existing conditions of state roads, Major problems of State roads, Treatment to landslides	August 2006

<b>Sl. No.</b>	<b>Name of Official Consulted</b>	<b>Department</b>	<b>Issue discussed</b>	<b>Date</b>
13.	Mr. Puran Sharma	Divisional Forest Officer Divisional Forest Office Namchi Forest Division Namchi	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project	August 2006
14.	Mr. Damar Rai	Forest Block Officer Forest Block Office Nayabazar, Jorthong	Details of Flora & Fauna, Forest Resources, Scope of IEE, potential impacts due to proposed project	August 2006
15.	Mr. Dawa Tang	Forest Guard Divisional Forest Office Namchi Forest Division Namchi	Presence of Flora & Fauna in the forests, Forest Resources	August 2006

### Photographs during Stake Holders' Consultation

 A photograph showing four men standing behind a desk cluttered with papers. From left to right: a man in a blue shirt, a man in a blue striped shirt, a man in a red shirt, and a man in a black and red jacket. A timestamp '17/04/2008 11:04' is visible at the bottom.	 A photograph of three men in an office. One man is seated at a desk with papers, while two others stand behind him. A large window in the background shows a view of trees. A timestamp '17/04/2008 11:55' is visible at the bottom.
<p>Photo: Mr. M. Gurung (Sikkim PWD)</p>	<p>Photo: Mr. B. Prasad (Sikkim PWD)</p>
 A photograph of three men in an office. One man is seated at a desk, while two others stand behind him. A timestamp '17/04/2008 15:18' is visible at the bottom.	 A photograph of three men in an office. One man is seated at a desk writing, while two others stand behind him. A timestamp '17/04/2008 15:48' is visible at the bottom.
<p>Photo: Dr. G. Pradhan (SPCB, Gangtok)</p>	<p>Photo: Mr. S. Sengupta (GSI, Gangtok)</p>
 A photograph of two men in an office. One man is standing, and the other is seated at a desk. A timestamp '17/04/2008 15:18' is visible at the bottom.	 A photograph of a woman sitting at a desk, wearing a colorful sari. She is looking towards the camera. A timestamp '17/04/2008 15:48' is visible at the bottom.
<p>Photo: Mr. N. Sherpa (DMMG, Gangtok)</p>	<p>Photo: Mrs. K. Rai (PWD, Jorthan)</p>

### Environmental Management Action Plan (EMAP)

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
<b>Pre-Construction Phase</b>					
1	Tree cutting	Cutting of about 3,788 nos. trees during site clearance	<ul style="list-style-type: none"> <li>Restricting tree cutting within construction limit</li> <li>Avoiding tree cutting at ancillary sites</li> <li>Providing and maintaining compensatory tree plantation of 11,364 numbers i.e. three times of cutting</li> </ul>	Forest Dept. / PIU	PIU
2	Removal of utilities	Work site clearance	<ul style="list-style-type: none"> <li>Necessary planning and coordination with concerned authority and local body</li> <li>Prior notice to and consultation with concerned authority, local body and public to be affected so as to ensure that work does not get affected and impact on public is minimum</li> </ul>	Concerned utility agencies / PIU	SC/ PIU
3	Religious places	Work site	<ul style="list-style-type: none"> <li>Suitable mitigation measures have been incorporated in Social report.</li> </ul>	PIU	SC / PIU
<b>Construction Phase</b>					
1	Air Pollution	Construction plants, equipment and vehicles	Refer <b>Appendix A.1</b> and <b>Appendix A.2</b>	Contractor	SC/PIU
		Temporary diversion	<ul style="list-style-type: none"> <li>Maintaining diversion and detour for road traffic in good shape and traffic regulated.</li> <li>Regular sprinkling of water, as necessary.</li> </ul>	Contractor	SC/PIU
		Dust during earth works or from spoil dumps	<ul style="list-style-type: none"> <li>Maintaining adequate moisture at surface of any earthwork layer completed or non-completed unless and until base course is applied, to avoid dust emission.</li> <li>Stockpiling spoil at designated areas and at least 5 m away from traffic lane.</li> <li>Refer <b>Appendix A.3</b></li> </ul>	Contractor	SC/PIU
		Borrow pits and haul road	Refer <b>Appendix A.4</b>	Contractor	SC/PIU
		Storage of construction materials	<ul style="list-style-type: none"> <li>Sprinkling of water as necessary.</li> </ul>	Contractor	SC/PIU



S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
2	Water Pollution	Construction of Bridges or Culverts - Earthwork and marginal spillage of construction materials causing temporary turbidity and suspended solids	<ul style="list-style-type: none"> <li>Constructing and maintaining diversion channel, sedimentation basin, dykes, etc. as may be required to temporarily channelise water flow of streams / river</li> <li>Storage of construction material and excavated soil above high flood level</li> </ul>	Contractor	SC/PIU
		Construction vehicles	<ul style="list-style-type: none"> <li>Strictly avoiding cleaning / washing of construction vehicle in any water body</li> </ul>	Contractor	SC/PIU
		Soil erosion from construction site	<ul style="list-style-type: none"> <li>Proper planning of site clearing and grubbing so as not to keep the cleared site before working for long duration.</li> <li>Providing temporary side drains, catch water bank or drains, sedimentation basin, as necessary to avoid or minimize erosion and prevent sedimentation to receiving water bodies</li> </ul>	Contractor	SC/PIU
		Seepage from Construction Debris	<ul style="list-style-type: none"> <li>Refer <b>Appendix A.3</b></li> </ul>		
		Construction camp and workers' camp	Refer <b>Appendix A.2</b>	Contractor	SC/PIU
3	Ground water Pollution	Wastewater logging	<ul style="list-style-type: none"> <li>All wastewater will be diverted to a ditch that will be managed for the period of construction and after construction such ditches will be filled and restored to original condition.</li> </ul>	Contractor	SC/PIU
		Borrow pit excavation	<ul style="list-style-type: none"> <li>Excavation of borrow pit should not touch the aquifer</li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
		Human wastes and wastewater at construction camp	<ul style="list-style-type: none"> <li>• Providing septic tanks for treating sewage from toilets before discharging through soak pits</li> <li>• Locating soak pits at least 50m from any ground water sources</li> <li>• Decanting and or controlled disposal of oil and grease as collected at collection tanks of maintenance yard and chemical storage areas</li> <li>• Refer <b>Appendix A.2</b></li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
4	Noise Pollution and Vibration	Vehicles and Construction machinery	<ul style="list-style-type: none"> <li>• <b>Site Controls:</b> Stationary equipment will be placed along un-inhabited stretches as per distance requirements computed above as far as practicable to minimize objectionable noise impacts.</li> <li>• <b>Scheduling of Project Activities:</b> Operations will be scheduled to coincide with period when people would least likely be affected. Construction activities will be avoided between 9 P.M. and 6 A.M. near residential areas.</li> <li>• <b>Protection devices</b> (ear plugs or ear muffs) will be provided to the workers operating in the vicinity of high noise generating machines.</li> <li>• Construction equipment and machinery should be fitted with silencers and maintained properly.</li> <li>• Source-control through proper maintenance of all equipment.</li> <li>• Use of properly designed engine enclosures and intake silencers.</li> <li>• Noise measurements should be carried out along the road to ensure the effectiveness of mitigation measures.</li> <li>• Vehicles and equipment used should conform to the prescribed noise pollution norms.</li> <li>• Constructing noise barriers as proposed for schools and hospitals prior to taking up road construction activities at those sections.</li> <li>• Movements of heavy construction vehicles and equipment near public properties will be restricted.</li> <li>• Comply with siting criteria for stone crushers, Hot Mix Plant/s (HMP) and concrete batching plant/s (CBP), and installations and maintenance of pollution control devices as mentioned in <b>Appendix A.2</b>.</li> <li>• Refer <b>Appendix A.5</b> for identification, and operation of quarry areas and adopting controlled blasting</li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
5	Land Pollution	Spillage from plant and equipment at construction camp	<ul style="list-style-type: none"> <li>• Providing impervious platform and oil and grease trap for collection of spillage from construction equipment vehicle maintenance platform</li> <li>• Collection oil and lubes drips in container during repairing construction equipment vehicles</li> <li>• Providing impervious platform and collection tank for spillage of liquid fuel and lubes at storage area</li> <li>• Providing bulk bituminous storage tank instead of drums for storage of bitumen and bitumen emulsion</li> <li>• Providing impervious base at bitumen and emulsion storage area and regular clearing of any bitumen spillage for controlled disposal</li> <li>• Reusing bitumen spillage</li> <li>• Disposing non-usable bitumen spills in a deep trench providing clay lining at the bottom and filled with soil at the top (for at least 0.5 m)</li> <li>• Refer <b>Appendix A.1</b> and <b>A.2</b></li> </ul>	Contractor	SC/PIU
		Domestic solid waste and liquid waste generated at camp	<ul style="list-style-type: none"> <li>• Collecting kitchen waste at separate bins and disposing of in a pit at designated area/s</li> <li>• Collecting plastics in separate bins and disposing in deep trench at designated area/s covering with soil</li> <li>• Collecting cottons, clothes etc. at separate bins and burning in a pit (with sand bed)</li> </ul>	Contractor	SC/PIU
		Borrow pits	<ul style="list-style-type: none"> <li>• Controlled operation and redevelopment of borrow pits to avoid water logging and land contamination</li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
6	Loss of topsoil	All construction sites	<ul style="list-style-type: none"> <li>The topsoil from all areas of cutting and all areas to be permanently covered shall be stripped to a specified depth of 150 mm and stored in stockpiles. At least 10% of the temporarily acquired area shall be earmarked for storing topsoil.</li> <li>The stockpile shall be designed such that the slope does not exceed 1:2 (vertical to horizontal), and the height of the pile be restricted to 2m. To retain soil and to allow percolation of water, the edges of the pile shall be protected by silt fencing.</li> <li>Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin.</li> <li>It shall be ensured by the contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles.</li> <li>Such stockpiled topsoil will be returned to cover the disturbed area and cut slopes. Residual topsoil will be distributed on adjoining/proximate barren/rocky areas as identified by the SC in a layer of thickness of 75mm – 150mm. Top soil shall also be utilized for redevelopment of borrow areas, landscaping along slopes, medians and incidental spaces.</li> </ul>	Contractor	SC/PIU
7	Compaction of soil	All construction sites	<ul style="list-style-type: none"> <li>Construction vehicle, machinery and equipment shall move or be stationed in the designated area (RoW or Col, as applicable) only. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, topsoil from agricultural land will be preserved as mentioned above.</li> </ul>	Contractor	SC/PIU
8	Ecology	Site clearance	<ul style="list-style-type: none"> <li>Restricting tree cutting within corridor of impact</li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Location/sources	Mitigation Measures	Implementing Agency	Supervising & Monitoring Agency
		Ancillary sites	<ul style="list-style-type: none"> <li>Minimizing tree cutting and vegetation clearance during site selection</li> <li>Preservation of trees within ancillary sites and avoiding impact on forest resources by providing buffer area from boundary of PF, RF, national park and wildlife sanctuary of 1km for locating construction plants, construction camp, and quarry and 500 m for borrow areas</li> <li>Preservation of trees of ecological, socio-cultural importance</li> <li>Providing cooking at camp for discouraging and prohibiting use of fire-wood i.e. cutting of trees by the workers.</li> </ul>	Contractor	SC/PIU
9	Occupational health and safety of workers	Construction camp	<ul style="list-style-type: none"> <li>Water supply, sanitation, drainage and medical health facilities at campsite</li> <li>Providing and using PPEs</li> <li>Using working reverse horn for all construction equipment and vehicles</li> <li>Providing earth link circuit breaker (ELCB) for all electrical connections</li> <li>Maintaining first aid at construction sites</li> <li>Maintaining emergency response system</li> <li>Refer <b>Appendix A.2</b></li> </ul>	Contractor	SC/PIU
10	Accidents and safety	Construction sites	<ul style="list-style-type: none"> <li>Providing and maintaining traffic management comprising diversion; warning, guiding and regulatory signage; channelisers and delineators; lighting, flagmen; dust control system etc. as specified in the contract.</li> <li>Providing adequate light at construction zone if working during night time is permitted by the Engineer</li> <li>Conducting induction and periodic training for all workers and supervisors</li> </ul>	Contractor	SC/PIU
		Construction camp	<ul style="list-style-type: none"> <li>Conducting periodic mock drilling on critical accident prone activities</li> <li>Conducting periodic training for all personnel working at plant site</li> </ul>	Contractor	SC/PIU

S. No.	Environmental Issue	Source of Pollution	Mitigation Measures	Implementing Agency	Supervision / Monitoring Agency
<b>Operation Phase</b>					
1	Air Pollution	Vehicular gaseous emission	<ul style="list-style-type: none"> <li>Periodicals monitoring of air pollutants and if values exceed the standard limits, suitable mitigation measures to be taken.</li> </ul>	PIU	SPCB and Traffic Police
2	Noise Pollution	Vehicular	<ul style="list-style-type: none"> <li>Periodical monitoring of noise level will be carried out. If values exceed the standard limits, suitable measures will be taken.</li> <li>Providing and maintaining signage on noise regulation at silence zones</li> </ul>	PIU	SPCB
3	Road Safety	Traffic and Vehicles	Maintenance of standard Highway Safety Signage and Traffic Management.	PIU	PIU and Traffic Police
		Slow moving traffic			
		Lighting	Maintenance of road / flyover lighting.	PIU	PIU/Traffic police
4	Tree plantation	-	Roadside tree plantation three times of cutting	Forest Dept. / PIU	PIU
5	Contamination of Soil and Water Resources from Spills due to traffic & Accidents	Vehicular Traffic	<ul style="list-style-type: none"> <li>Contingency plans to be in place for cleaning up of spills of oil, fuel and toxic chemicals.</li> <li>Spill of oil, fuel and automobile servicing units without adequate preventive systems in place to be discouraged.</li> </ul>	PIU	PIU
6	Soil Erosion and Sedimentation		<ul style="list-style-type: none"> <li>Maintaining the slope protection measures provided at stretches of high embankment and protection measures for bed scouring at cross drainage locations as per maintenance manual to be prepared before operation</li> </ul>	PIU	PIU

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Responsible party
<b>A. Physical Environment</b>				
i) Air and Noise	Level of SPM, SO <sub>2</sub> and NO <sub>x</sub>	Before starting of any construction activities.	At selected locations	PIU, PWD
	Noise levels on dB (A) scale	Once in every section while construction is ongoing.		
		Once after completion of construction activities.		
ii) Topography and Soil	Number and scale of soil erosion and landslide sites.	Before starting of construction activities.	Full length of project road where work will be undertaken	PIU, PWD
		Once a year during construction activities.		
		Once after completion of construction activities thereafter once every year for the next 5 to 10 years depending on budget availability.		
	Number of properly bioengineered sites.	Once every summer during construction activities.	Wherever bio-engineering technique have been done	PIU, PWD
		Once after completion of construction activities and thereafter once every year for the next 5 to 10 years depending on budget availability.		
iii) Water Bodies	Concentration of sediments and presence of construction debris.	Before starting of construction activities.	Major water bodies and perennial streams	PIU, WPD
		During construction activities in the vicinity of each water body.		
		Once after completion of construction activities.		
	PH, BOD, COD, DO, TDS, MM, NO <sub>3</sub> and Coliform	Same as above.		
	Length of line drainage structures constructed and strengthened.	During construction activities in the vicinity of each water body.	Full length of project road	PIU, PWD
	Length of damaged or missing line drains.	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once after completion of construction activities.		
	Total number, type and lengths of cross drainage structures including bridges constructed or strengthened	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once a year during construction activities		
		Once after completion of all construction activities.		
	Number of weak cross drainage structures.	Before starting of construction activities.	Full length of project road	PIU, PWD
		Once after completion of construction activities.		
iv) Geology and	Number of rock slides.	Before starting of construction activities.	Full length of project	PIU, PWD, DoM&G



Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Responsible party
Seismology		Once a year during construction activities.	road	
		After completion of construction activities.		
	Number of cases of illegal quarrying or mining	Once a year after completion of construction activities.	Entire project length.	PIU, PWD, DoM&G
<b>B. Ecological Resources</b>				
i) Flora	Total area of vegetative cover	Before starting of construction activities.	Entire project section	PIU, PWD, Forest Department
		Once after completion of construction.		
	Total number of trees	Same as above.		
	Average tree density	Before starting of construction activities.	Full length of project road	PIU, PWD, Forest Department
		During construction (once a year per section)		
		Once after completion of construction activities and thereafter once every year for 5 to 10 years depending on budget availability.		
	Number of cases of illegal tree felling	Once a year during construction activities	Full length of project road	PIU, PWD, Forest Department
		Once after completion of all construction activities.		
ii) Fauna				
Wild Animals	Approximate number of animals seen, frequency of presence. Months and time of sighting. Location of sighting	Before starting construction activities.	Full length of project road	PIU, PWD, Forest Department
		During construction activities (throughout the year).		
		Once after completion of construction activities and thereafter once every three years.		
<b>C. Social Environment</b>				
i) Health	Number of accidents amongst construction workers.	During construction activities.	All construction sites along project road	PIU, PWD, Contractor, local health officials,
	Number of accidents due to moving traffic amongst local community members	Before starting construction activities.	All villages along project road	PIU, PWD, Contractor, local health officials,
		Once a year during construction activities.		
		Once every year after completion of construction activities.		
ii) Travel time	Time taken to travel within each road section.	Before starting construction activities.	Full length of project road	PIU, PWD, Contractor, local health officials,
		After construction activities and thereafter once		

Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Responsible party
		every year for the next 5 to 10 years depending on budget availability.		
	Number and extent of travel delays	During construction activities (throughout the year).	Full length of project road	PIU, PWD, Contractor,
iii) Traffic count	CVC and speed delay	3 day hourly count annually three years during operation period	Full length of project road	PIU, PWD, Contractor

Module	Title	Objectives	Duration (Day)	Participants
1	Environmental Legislations and Bank's Safeguard Policies	<ul style="list-style-type: none"> <li>• Brush up latest on environmental legislations</li> <li>• Brush up safeguard policies</li> </ul>	1	PIU and SC staff
2	Environmental Supervision and Monitoring	<ul style="list-style-type: none"> <li>• EMP requirements</li> <li>• Implementation, Supervision and Monitoring Mechanism</li> <li>• Provision made in Contract Documents for Works</li> <li>• Provision made in contract Agreement for Supervision Services</li> </ul>	1	PIU and SC staff
3	Orientation Workshop on EMP Implementation	<ul style="list-style-type: none"> <li>• EMP requirements</li> <li>• Implementation, Supervision and Monitoring Mechanism</li> <li>• Roles and Responsibilities of Contractors and SCs</li> </ul>	1	PIU, Contractors and SCs
4	Focused Training on Specific Issue/s (three during course of implementation)	<ul style="list-style-type: none"> <li>• Analyzing problems, referring stipulations in Contract and EMP and agreed to feasible solution within specified timeframe</li> </ul>	0.5	PIU, Contractors and SCs

SL. NO.	ITEM DESCRIPTION	QUANTITY	UNIT	RATE (Rs.)	AMOUNT (Rs.)	RESPONSIBILITY	
A	<b>Forest Clearance and Compensatory Afforestation</b>						
A.1	Payment of Forest Compensation for diversion of Forest land of 2.606 ha forest land for SK-01 and diversion of 1.030 ha of forest land for SK-02					PIU through Forest Department	
A.1.1	Crop Compensation ( <b>Melli-Nayabazar-SK01</b> )				544,825		
A.1.2	Compensatory Afforestation				865,000		
A.1.3	Net Present Value (NPV)				1,675,000		
A.1.4	Crop Compensation ( <b>Nayabazar-Namchi-SK02</b> )				712,375		
A.1.5	Compensatory Afforestation				408,500		
A.1.6	Net Present Value (NPV)				662,200		
<b>Total (Rupees) Amount Deposited by PWD, Sikkim as per letter N0-210/PWD(R&amp;B)/(SC)08-09, dated 3/10/08</b>					<b>4,867,900</b>		
B	<b>Environmental Monitoring</b>						
B.1	Ambient air quality monitoring as per <b>Appendix B of EMP</b> (2 location in the interval of 3 months for 3 Years)	24	No.	4,000	96,000	PIU through Approved Monitoring Agency	
B.2	Ambient noise level monitoring as per <b>Appendix B of EMP</b> (2 location in the interval of 3 months for 3 Years)	24	No.	500	12,000		
B.3	Water quality monitoring of surface water as per <b>Appendix B of EMP</b> (2 location in the interval of 3 months for 3 Years)	24	No.	3,500	84,000		
B.4	Water quality monitoring of drinking water from construction camp as per <b>Appendix B of EMP</b> (1 location in the interval of 6 months for 3 Years)	6	No.	3,750	22,500		
E	<b>Noise Barrier at sensitive location</b>						
E.1	Provide the Noise barrier at sensitive areas like schools and hospitals. The noise barrier of hollow brick wall/reinforced concrete panels with height of 3.5m. The design of the noise barrier shall be approved by the engineer in charge.	120	Rm	4,000	480,000	Contractor through BOQ	
F	<b>Enhancement of cultural properties as per directed by the engineer including the following items</b>						
F.1	Provision and erection of cement concrete, standard sitting benches including clearing of the area around the benches.	30	No.	1,000	30,000		
F.2	Boundary fencing with barbed wire fencing of approved make and specification including provision and erection of struts	300	Rm.	550	165,000		
G	<b>Environmental Training</b>						
G.1	Training at site as per <b>Appendix E of EMP</b> .	1	Lump Sum	75,000	75,000	PIU through Supervision Consultant	
<b>Grand Total (Rupees)</b>					<b>5,832,400</b>		

### Rapid Environmental Assessment (REA) Checklist - SK 02 Section

**Country/Project Title:** INDIA: North Eastern State Roads Project

**Sector Division:** Roads and Highways

**Road Section:** SK-02: Navabazar – Namchi sections in the State of Sikkim - 19 km

SCREENING QUESTIONS	Yes	No	REMARKS
<b>A. Project Siting</b> Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
• Cultural heritage site		X	
• Protected Area	X		The project road is passing through the reserved forest area of Sikkim West Forest Division. A detail assessment and specific mitigation measures with respect to flora and fauna shall be worked out and shall be followed strictly.
• Wetland		X	
• Mangrove		X	
• Estuarine		X	
• Buffer zone of protected area		X	
• Special area for protecting biodiversity		X	
<b>B. Potential Environmental Impacts</b> Will the Project cause...			
• encroachment on historical/cultural areas; disfiguration of landscape by road embankments, cuts, fills, and quarries?	X		The project road is running along the river Rangit on one side and forest hillocks on other side. It is a landslide prone alignment. Impacts of landslide, of road embankments, cuts and fills are anticipated. Proper management plan for will be required during construction to sustain the quarries.
• encroachment on precious ecology (e.g. sensitive or protected areas)?		X	
• alteration of surface water hydrology of waterways crossed by roads, resulting in increased sediment in streams affected by increased soil erosion at construction site?	X		Project road is running along the perennial river Rangit though out its length. Impacts on surface hydrology are expected during construction. Controlled construction activities will ensure sediment discharge into streams to the extent.
• deterioration of surface water quality due to silt runoff and sanitary wastes from worker-based camps and chemicals used in construction?	X		Adverse impacts due to silt runoff are expected. During construction period suitable mitigation measures will be required to control the silt runoff. Adequate Sanitary facilities and drainage in the workers camps will help to avoid this possibility. As the construction activity in this project will not contain any harmful ingredients, no impact on surface water quality is anticipated.

SCREENING QUESTIONS	Yes	No	REMARKS
<ul style="list-style-type: none"> <li>increased local air pollution due to rock crushing, cutting and filling works, and chemicals from asphalt processing?</li> </ul>	X		With appropriate mitigation measures and use of most modern environment friendly equipments/machineries air pollution shall be reduced to permissible levels.
<ul style="list-style-type: none"> <li>noise and vibration due to blasting and other civil works?</li> </ul>	X		Short term minor impact may occur during construction period, Suitable mitigation measures will be required to minimize the adverse effects
<ul style="list-style-type: none"> <li>dislocation or involuntary resettlement of people</li> </ul>		X	
<ul style="list-style-type: none"> <li>other social concerns relating to inconveniences in living conditions in the project areas that may trigger cases of upper respiratory problems and stress?</li> </ul>		X	Imposing of appropriate mitigation measures in contract agreement to keep the air pollution within permissible levels will keep a check on this problem.
<ul style="list-style-type: none"> <li>hazardous driving conditions where construction interferes with pre-existing roads?</li> </ul>		X	To minimized the impact suitable traffic management plan will be required
<ul style="list-style-type: none"> <li>poor sanitation and solid waste disposal in construction camps and work sites, and possible transmission of communicable diseases from workers to local populations?</li> </ul>	X		Proper provisions for sanitation, health care and solid waste disposal facilities will be available in the contract documents to avoid such possibility. Workers will be made aware about communicable diseases
<ul style="list-style-type: none"> <li>creation of temporary breeding habitats for mosquito vectors of disease?</li> </ul>		X	
<ul style="list-style-type: none"> <li>dislocation and compulsory resettlement of people living in right-of-way?</li> </ul>		X	No encroachment
<ul style="list-style-type: none"> <li>accident risks associated with increased vehicular traffic, leading to accidental spills of toxic materials and loss of life?</li> </ul>		X	Adoption of suitable traffic signage system at sensitive places will reduce such possibility.
<ul style="list-style-type: none"> <li>increased noise and air pollution resulting from traffic volume?</li> </ul>		X	Due to improvement in Riding Quality & Comfort in driving due to unidirectional traffic such pollution will be reduced. Mitigation measures along with monitoring plan will be required
<ul style="list-style-type: none"> <li>increased risk of water pollution from oil, grease and fuel spills, and other materials from vehicles using the road?</li> </ul>	X		Controlled construction activities and proper drainage system will reduce this possibility.