

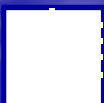
# Tehri Hydro Development Corporation Ltd

## Environmental Studies for Vishnugad-Pipalkoti Hydro Electric Project



## Environmental Screening & Analysis Report for Advanced Construction Works

November 2008



CONSULTING ENGINEERING SERVICES (INDIA) PRIVATE LIMITED  
57, Manjusha Building (5th Floor), Nehru Place New Delhi - 110 019



## TABLE OF CONTENTS

| S.NO       | DESCRIPTION   | PAGE NO.     |
|------------|---|--------------|
| <b>1.0</b> | <b>INTRODUCTION AND LEGAL FRAMEWORK</b>                         | <b>1-3</b>   |
| 1.1        | Introduction  | 1            |
| 1.2        | Background of the Study   | 1            |
| 1.3        | Objective of the Study  | 2            |
| 1.4        | Administrative and Legal Framework                              | 2            |
| 1.5        | Outline of the Report   | 3            |
| <b>2.0</b> | <b>DESCRIPTION OF THE PROJECT</b>                               | <b>4-6</b>   |
| 2.1        | Project Location  |              |
| 2.2        | Advance Construction Locations                                  |              |
| <b>3.0</b> | <b>BASELINE ENVIRONMENTAL STATUS</b>                            | <b>7-27</b>  |
| 3.1        | Introduction  | 7            |
| 3.2        | Topography  | 7            |
| 3.3        | Land Use  | 7            |
| 3.4        | Geology of the Project Area                                     | 7            |
| 3.5        | Seismology  | 8            |
| 3.6        | Soil  | 9            |
| 3.6        | Meteorology   | 10           |
| 3.8        | Hydrology   | 11           |
| 3.9        | Air Environment   | 12           |
| 3.10       | Water Quality   | 13           |
| 3.11       | Ambient Noise Level   | 14           |
| 3.12       | Agriculture   | 15           |
| 3.13       | Flora of Advanced Construction Site                             | 15           |
| 3.14       | Fauna of the Project Area                                       | 25           |
| <b>4.0</b> | <b>PUBLIC CONSULTATION</b>                                      | <b>28-30</b> |
| 4.1        | Objective   | 28           |
| 4.2        | Public Consultation for Project Roads                           | 29           |
| <b>5.0</b> | <b>ENVIRONMENTAL IMPACTS ASSESSMENT AND MITIGATION MEASURES</b> | <b>31-36</b> |
| 5.1        | Introduction  | 31           |
| 5.2        | Impact Assessment and Mitigation Measures                       | 31           |
| <b>6.0</b> | <b>ENVIRONMENTAL MANAGEMENT PLAN</b>                            | <b>37-52</b> |
| 6.1        | Environmental Management Process                                | 37           |



| S.NO | DESCRIPTION  | PAGE NO. |
|------|--|----------|
| 6.2  | Management Issues - Construction And Operation Phase | 37       |
| 6.3  | Environmental Management Plan & Responsibilities     | 41       |
| 6.4  | Environmental Monitoring Plan                        | 47       |
| 6.5  | Environmental Budget                                 | 51       |
| 6.6  | Recommendations for Advanced Construction Sites      | 51       |

### List of Tables

| Table No. | Description   |
|-----------|---|
| 3.1       | Average Meteorological Conditions in the Project Area           |
| 3.2       | Flora of Approach Road to Dam Site                              |
| 3.3       | Flora of Approach Road to Langsi Adit                           |
| 3.4       | Flora of Approach Road to Maina Adit                            |
| 3.5       | Flora of Approach Road to Powerhouse & Colony Site              |
| 3.6       | Wildlife of Advanced Construction Site and Ecological Status    |
| 3.7       | Birds of Advanced Construction Site                             |
| 5.1       | Species Recommended for Slope Protection & Reclamation of sites |
| 6.1       | Species for Avenue Plantation along Proposed Roads              |
| 6.2       | Environmental Management Plan & Responsibilities                |
| 6.2       | Environmental Monitoring Plan                                   |



## CHAPTER 1

### INTRODUCTION AND LEGAL FRAMEWORK

#### 1.1 INTRODUCTION

The Vishnugad Pipalkoti Hydroelectric Project (VPHEP) is a run-of-the river hydro power project proposed on River Alaknanda in district Chamoli in Uttarakhand. The project envisages construction of a diversion dam near village Helong (79°29' 30 E and 30°30'50" N). An underground power house is proposed at village Hat (79°24'56" E and 30°25'31"N), 3 km from Pipalkothi. The installed capacity for power generation is 444MW.

Tehri Hydropower Development Corporation (THDC) has appointed M/s Consulting Engineering Services (India) Private Limited, New Delhi to carry out the additional studies and prepare a Comprehensive EIA Document in line with the requirements of the Government of India and World Bank. The present study comprise of Environmental Screening of Advance Construction Works which include construction of four approach roads to the various work front.

#### 1.2 BACKGROUND OF THE STUDY

River Alaknanda is a major tributary of river Ganga, originating from the glacial regions of Himalayas. The river has tremendous scope for development of hydro-power, which needs to be harnessed to meet the ever-growing demand for power. At present, various hydropower schemes are in different stages of development on river Alaknanda. Vishnugad Pipalkoti is one of the various hydropower schemes envisaged in this region. The river stretch under the project is about of about 27 km from village Helong to village Birahi.

The operation of VPHEP is linked to the upstream projects on Vishnugad (by JP) and of Topovan- Vishnugad (by NTPC). Downstream of this project, further run of the river power project are planned, which will also divert water from Alakananda through headrace tunnel. The basic features of the VPHEP are as follows:

| Brief Details of the Vishnugad- Pipalkoti Hydroelectric Project |  |  |                   |
|---|--|--|-------------------|
| Location  | 30°30'50"N to 30°25'31"E ; 79°29'30"N to 79°24'56" E |  |                   |
| State   | Uttarakhand  |  |                   |
| District  | Chamoli  |  |                   |
| Hydrology   | Snowy Catchment                                      | 2896 km <sup>2</sup>                           |                   |
| Catchment area at Vishnugad                                     | 4672km <sup>2</sup>                                  | Maximum 10 daily flow: 1308.12 Cumec (average) |                   |
|   |  | Average Annual Runoff: 5682.6 MCM              |                   |
| <b>Head Race Tunnel</b>   |  | <b>U/S Surge Shaft</b>                         |                   |
| Type  | Modified Horse Shoe                                  | No.  | 01                |
| Size  | 8.8 M  | Type   | Controlledorifice |
| Length  | 13.4 KM  | Diameter/ Depth                                | U/S 2 m/ 110m     |
| <b>Tail Race tunnel</b>   |  | <b>D/S Surge Shaft</b>                         |                   |



| <b>Brief Details of the Vishnugad- Pipalkoti Hydroelectric Project</b> |                     |  |                           |
|--|---------------------|--|---------------------------|
| Type   | Modified Horse Shoe | No.  | 01                        |
| Size   | 8.8m                | Type   | Underground               |
| Length   | 3.07 km             | Diameter / Depth   | 120 x 12 x 27             |
| <b>Penstock</b>  |                     | <b>Underground Power House Complex</b>                     |                           |
| Number   | 4                   | Installed Capacity   | 111 x 4 = 444MW           |
| Size   | 5.20 M/ 3.65 M dia  | Size   | 127 x 20.3 * 50 M         |
| Type   | Circular            | Turbine  | Francis.4Generating Units |
| Length   | 351 m/36.7 m        | Gross / Net Head   | 237m/211m                 |
| <b>Switch Yard</b>   |                     | <b>Transmission of Power</b>                               |                           |
| Size and Type  | 8 Bays/GIS/420 KV   | By transmission Line Constructed by Power grid Corporation |                           |

### 1.3 OBJECTIVE OF THE STUDY

The present study consists of screening of advance construction sites. The advance sites comprises of construction of approach roads to various work fronts of the project. Four approach roads are taken under the environmental screening study with the objective as given below:

- To provide information about general baseline environmental setting of the advance construction site
- To provide information on potential impacts of the road construction and the characteristics of the impacts in terms of pre- construction, construction and operation phase of the project
- To provide appropriate mitigation measures to minimize the potential adverse impacts and enhance positive impacts.
- To provide basic information for formulating management and monitoring plan

### 1.4 ADMINISTRATIVE AND LEGAL FRAMEWORK

The Government through specific legislations regulates the environmental management system in India. The statutory bodies responsible for ensuring environmental compliances are:

- The Ministry of Environment and Forest (MoEF), Government of India
- Central Pollution Control Board (CPCB)
- State Pollution Control Board (SPCB)

#### Legal Framework

The Environment (Protection) Act, 1986, is the most comprehensive law on the subject. The law grants power to the Central Government to take all measures necessary to protect and improve the quality of environment and to prevent pollution of the environment. Following Acts, Laws, Rules and Guidelines are applicable for the study:



- Environment (Protection) Act, 1986
- EIA Notification, 14<sup>th</sup> September 2006
- Air (Prevention & Control of Pollution) Act, 1981
- Water (Prevention & Control of Pollution) Act, 1974
- Noise Pollution (Regulation & Control) Rules, 2003 and its amendments
- Forest (Conservation) Act, 1980 and its amendments
- Forest (Conservation) Rules, 2003 and its amendments
- Wildlife (Protection) Act, 1972
- Wildlife (Protection) Amendment Act, 2002
- Environmental Guidelines for Rail, Road & Highways Projects, 1989 (MoEF)
- EIA Manual published by Ministry of Environment & Forests, 2002

The present study is conducted in compliance with the MoEF and World Bank Guidelines.

## **1.5 OUTLINE OF THE REPORT**

The outline of the Environmental Screening Report for advance construction sites is given below:

**Chapter 1:** Introduction

**Chapter 2:** Description of the Project.

**Chapter 3:** Baseline Environmental Status

**Chapter 4:** Public Consultation

**Chapter 5:** Environmental Impact Assessment and Mitigation Measures

**Chapter 6:** Environmental Management Plan



## CHAPTER 2

### DESCRIPTION OF THE PROJECT

#### 2.1 PROJECT LOCATION

The project is located in District Chamoli in Uttarakhand. The state of Uttarakhand situated in the northern part of India, shares an international boundary with China in the north and with Nepal in the east. The area of the state is 53,483 km<sup>2</sup> and lies between lat 28°43' N and 31°28'N and long 77°34' E and 81°03'E. The state can be divided into three physiographic zones namely, the Himalayas, the Shiwaliks and the Terrai region. The state has a



temperate climate except in the plain area where the climate is tropical with temperature ranging from sub zero to 43°C. The average annual rainfall is 1,550 mm.

The total population of the state is 8.48 million (*Census 2001*) of which rural population is 74.33% and urban 25.67%. Population density is 159 person per km<sup>2</sup>. Population of the schedule tribe in the state is 3%. The livestock population of the states is 4.94 million (*Livestock Census 2003*).

About 19% of the area of the state is under permanent snow cover, glaciers and steep slope. The recorded forest area of the state is 34,662 km<sup>2</sup> which constitute 64.79% of its geographical area. Major forest types occurring in the state are Tropical Moist Deciduous, Tropical Dry Deciduous, Sub Tropical Pine, Himalayan Moist Temperate, Himalayan Dry Temperate, Sub Alpine and Alpine Forest. The state has 6 national Parks and 6 wildlife sanctuaries. The Nanda Devi Biosphere Reserve with an area of 0.59 million ha is located in the project district.

The location of dam site is at village Helong in Joshimath tehsil and power house site is at village Hat in Chamoli district. The nearest railway station is at Rishikesh about 225km from project site.



## 2.2 ADVANCE CONSTRUCTION LOCATION

The National Highway No. 58 is on the left bank of the river whereas all the project components are located on the right side. All material and equipment for the project will be transported from the existing road network of NH-58. The establishment of various projects units includes:

- 65m high concrete diversion dam with spillway section having 4 No. 6.6m x 15m opening
- Intake structure with 3 No. modified horse shoe shaped intake tunnel of 6m diameter
- 3 No. underground sedimentation chambers
- Silt flushing tunnel of size 3.6m x 4.0m
- 13.4 km long modified horse shoe shaped Head Race Tunnel (HRT) of 8m diameter along the right bank of the Alaknanda river
- Underground powerhouse 127m long, 21.30m wide and 44m high
- Four number of adits located at Gulabkothi village (Adit -.0), Langsi (Adit-1), Maina Adit (Adit- 2) and Adit.-3 located at Surge shaft.
- 3km long modified horse shoe shaped tail race tunnel of 8m diameter.

There is no road to reach the various work fronts. Approach road leading to work fronts is required to be constructed. Four approach roads are proposed under the project which will be taken under advance construction works.

- i. Approach Road to Dam site
- ii. Approach Road to Langsi adit)
- iii. Approach Road to Maina adit
- iv. Approach Road to Power house & Colony site



Starting point of Approach Road to Dam site



Approach Road to Langsi Adit (Old road route to Badrinath below NH 58)





- Construction work has not started for the approach road to the dam site and facility area.
- Construction work for the approach road to Langsi Adit has not started. The old road route to Badrinath below the NH-58 will be utilised upto the Bridge. New road will be constructed on right bank along with bridge over the river.
- Construction work for the approach road to Maina adit has been taken up and road cutting is completed on left bank below national highway upto the river. Construction of bridge over the river Alaknanda is in progress.
- Construction work for approach road to Power house site has not started. The route follows the track path to Haat village and Siyasen.



Approach Road to Maina Adit



Starting point of approach road to Powerhouse & colony site



## CHAPTER 3

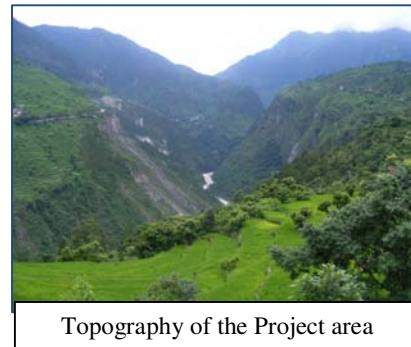
### BASELINE ENVIRONMENTAL STATUS

#### 3.1 INTRODUCTION

The improvement work includes strengthening of the existing roads on existing formation width with minor widening on the hillside. The exact RoW of roads under improvement is not available at this juncture. The field observations include data on baseline environmental conditions of all roads. The Description of the Environment of Project area is discussed below while for individual sub-projects. The environmental components are discussed with reference to physical environment and ecological resources in details as mentioned below:

#### 3.2 TOPOGRAPHY

The topography is by and large rugged, the entire region is mountainous. The cross profiles of the fluvial valleys show convex form with steep valley sides, interlocking spurs descending towards the main channel, hanging valleys, water falls and rapids and terraced agricultural fields on the gentle slopes on the valley sides. The clustering of villages is confined mainly on the gentle slopes of the ridges on the fluvial terraces.

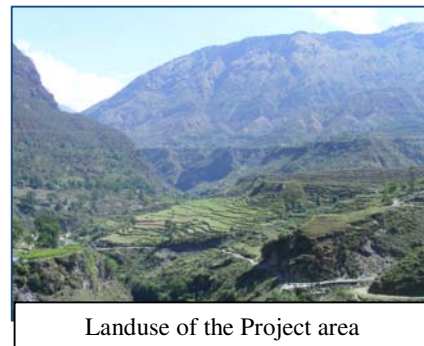


#### 3.3 LAND USE

Landuse describes how a patch of land is used (e.g. for agriculture, settlement, forest, Barren land etc.), whereas land cover describes the materials (such as vegetation, rocks or buildings) that are present on the surface. Accurate land use and land cover identification is the key to most of the planning processes.

Ground truth studies were conducted in the area to get the clear idea about land use of the project area.

All the project roads mainly passing through Open type of forest land or barren land. Few patches of Agricultural land and Community plantation can be observed.



#### 3.4 GEOLOGY OF THE PROJECT AREA

The project area forming a part of Alaknanda valley exposes rocks belonging to Garhwal Group and Central Himalayan Crystalline and are composed mainly of calc arenaceous rocks with basic intrusive and migmatite bodies, while around Helong low to medium grade metamorphic rocks are exposed.

The rocks occurring at the dam site are quartzites and along most of the length of the tunnel alignment are: quartzite with biotite schist, interbedded and interbanded grey



slates and dolomites/limestone, grey thinly bedded slates with minor interbeds of limestone, dolomitic limestone with subordinate grey slates, grey pyritous shale / slates, thinly bedded dolomitic limestones, grey slate / phyllite, white siliceous dolomite with magnesite and talc schist; light grey dolomite with stromatolitic structures, interbedded quartzite phyllite and dolomite belong to Garhwal Group. Calcareous shale and dolomitic limestone / dolomite are observed at the dam Site. Along Tail race Tunnel, dolomitic limestone, metabasics, augen gneisses and schist are observed.

### 3.5 SEISMOLOGY

State of Uttarakhand, including western part of Nepal Himalaya has been classified in to four hazard classes as very high (VHH), High (HH), moderate (MH) and (LH). (P.Pande 1996) The HH zone lying between energy contours  $10^{15}$  and  $10^{17}$  ergs  $\text{km}^{-2}$   $\text{yr}^{-1}$  occupies 36% area of Uttarakhand and encompasses major parts of Uttarkashi, Chamoli, Bageshwar, Almora, Pithoragarh and Champawat districts. Here, possibility of occurrence of earthquake of  $6 < M < 7$  exists in every 100 years. The MH zone, where there is possibility of  $5 < M < 6$  in every 100 years, spreads in 41% of the – area. Places like Puroila, Tehri, Rudraprayag, - and Haridwar fall under this zone.

GSI and BRGM France carried out an exercise on seismic hazard assessment of Northwest India in 1994-95 (P. Pandey 1996). It evaluated the Peak Ground Acceleration (PGA) values using a probabilistic approach. In Uttarakhand – West Nepal the PGA varied from  $130 \text{ cm/sec}^2$  in the Foot Hill region to  $340 \text{ cm/sec}^2$  in the Indo-Nepal border, respectively, corresponding to a return period of 475 years. These values were of the order of  $290\text{-}320 \text{ cm/sec}^2$  in the Uttarkashi- Chamoli region. The area forms a part of the seismic zone V, which corresponds to a zone factor of 0.36 (Effective Peak Ground Acceleration in terms of 'g' as per IS 1893: Part 2002) The entire state of lies within Seismic Zones V and IV as per the Seismic Zoning Map of India, outlined in IS:1893 part I (2002). The state has experienced many earthquakes in last 200 years. The list of major earthquakes that have taken place in Uttarakhand are listed as below:

- Earthquake in Upper valley of Ganga on 1<sup>st</sup> September 1803 at 1.35 hrs led to death of 200-300 people at Barabal and Badrinath was badly affected. Earthquake of magnitude of 6.5 at Richter's scale occurred in Mathura 1 hrs 5 min before the Upper Ganga event.
- Earthquake near Gangotri on 25<sup>th</sup> May 1816 that induced numerous landslides.
- Earthquake of magnitude 7.5 on Richter's Scale with epicenter in west Nepal on 28<sup>th</sup> August 1916 led to considerable damage at Dharchula.
- Earthquake at Kapkot on 28<sup>th</sup> December 1958 led to damage to a dozen houses.
- Dharchula-Bajang earthquake on 29<sup>th</sup> July 1980 with an intensity of 6.1 on Richter scale and epicentral intensity VIII on MM scale caused extensive damage in Dharchula town. The tremors induced numerous landslides and ground fissures.
- Earthquake of Uttarkashi on 20<sup>th</sup> October 1991 is the most destructive earthquake documented which took a toll of 768 human lives, caused injuries to 5000 people and damaged 45,765 houses. The earthquake also induced numerous rock slides, ground fissures and changes in hot spring chemistry.



- On 29<sup>th</sup> March 1999, a major earthquake shook Uttarakhand and inflicted moderate to heavy damage in the central part of the state. The earthquake recorded a magnitude of 6.8 at Richter's scale and an epicenter intensity of VIII. About 1.88 lakh houses were damaged in Chamoli, Rudraprayag, Tehri and Pauri districts causing death of 106 persons and injuries to 453. Numerous landslides were induced by the tremors apart from development of tension fissures.
- Uttarakhand, including the western part of Nepal Himalaya has been classified in to four hazard classes as very high (VHH), High (HH), moderate (MH) and (LH) (Pande 1996). The details are given as below:
- High (HH) zone lying occupies 36% area of Uttarakhand and encompasses major parts of Uttarkashi, Chamoli, Bageshwar, Almora, Pithoragarh and Champawat districts. The region has possibility of occurrence of earthquake of  $6 < M < 7$  exists in every 100 years.
- Moderate (MH) zone, where there is possibility of  $5 < M < 6$  in every 100 years, covers 41% of the state and cities like Purola, Tehri, Rudraprayag and Haridwar fall under this zone.

The project area lies within seismic zone V. The north dipping Main Central Thrust (MCT) lies about 2 km northeast of the proposed dam site and the seismic status of this thrust is not properly known. The Alaknanda fault and Srinagar thrust are located about 32 km and 45 km southwest respectively of the proposed dam site.

### 3.6 SOIL

Soil is the product of geological, chemical and biological interactions. The soil in the region vary according to altitude and climate. The soil in the project and the study areas, like any other region of Himalayas are young. The vegetal cover is one of the most important influencing factor characterizing the soil types in a region. Soil on the slope above 30°, due to erosion and mass wasting processes, are generally shallow and usually have very thin surface horizons. Such soils have medium to coarse texture. Residual soils are well developed on level summits of lesser Himalayas, sub-soils are deep and heavily textured. High contents of organic matter are found in its 'A' horizon and are acidic in nature.



View Landslide in the project area

Valley soils are developed from colluvium and alluvium brought down from the upper slopes and thus, are deposited in the valleys and low-lying tracts or river terraces as a process of aggradation. In general north facing slopes support deep, moist and fertile soils. The south facing slopes on the other hand, are too precipitous and well exposed to denudation.



### 3.7 METEOROLOGY

The climate of the project area can be divided into four main seasons i.e. winter season from Dec-Feb followed by pre-monsoon or mild summer season from March to May. The monsoon season begins in June and continue upto middle of Oct. The period from second half of the October to November is the post-monsoon season.

#### a. Temperature

The Temperature in the area varies with elevation. It rises rapidly after March and the month of July is the hottest month of the year with mean daily maximum temperature going up to 27-28°C. With the withdrawal of monsoons, by the end of September, there is a sharp decrease in temperatures. The months of December and January are the coolest months of the year, with mean daily minimum temperature as low as 4-5°C.

#### b. Rainfall

The average annual rainfall is about 125 cm per annum. The maximum rainfall is received in the months of July and August. About 60% of the rainfall is received under the influence of south west monsoons during the months from July to September. On an average, there are about 88 rainy days (i.e. days with rainfall of 2.5 mm) in a year.

#### c. Humidity

The average 'humidity' is about 61% Apart from the monsoon months, humidity is around 50-55% throughout the year.

The average meteorological conditions in the project area are given in Table-3.1.

**Table3.1 : Average Meteorological conditions in the Project Area**

| Month     | Mean Temp. Daily (°C) |       | Rainfall (mm) | No. of rainy days | Relative humidity (%) |       |
|-----------|-----------------------|-------|---------------|-------------------|-----------------------|-------|
|           | Max.                  | Min.  |               |                   | 8:30                  | 17:30 |
| January   | 12.79                 | 4.54  | 77.8          | 5.0               | 53                    | 48    |
| February  | 14.84                 | 5.35  | 107.6         | 6.3               | 57                    | 50    |
| March     | 18.83                 | 11.25 | 113.0         | 7.0               | 52                    | 49    |
| April     | 24.78                 | 14.88 | 59.1          | 4.8               | 49                    | 41    |
| May       | 25.86                 | 18.31 | 52.9          | 4.9               | 53                    | 44    |
| June      | 26.81                 | 20.73 | 111.5         | 8.8               | 72                    | 61    |
| July      | 27.33                 | 21.06 | 267.1         | 17.7              | 89                    | 78    |
| August    | 26.17                 | 20.37 | 232.7         | 17.7              | 91                    | 80    |
| September | 25.22                 | 10.52 | 124.3         | 10.0              | 82                    | 72    |
| October   | 23.36                 | 17.48 | 40.4          | 3.4               | 65                    | 59    |
| November  | 18.69                 | 13.84 | 14.9          | 1.3               | 51                    | 48    |
| December  | 13.55                 | 7.59  | 24.3          | 1.5               | 47                    | 43    |



### 3.8 HYDROLOGY

The river Alaknanda is the main river of the area. The total catchment of the river above the proposed Vishnugad dam is 4672sq km. The catchment of the river is drained by small tributaries. There are 5 major river confluences with river Alaknanda from Badrinath to Devprayag.

The hydrology of the project area is marked with small streams which are basically rainfed and become violent during rainy season. These streams are major concern in the approach road as they are susceptible to flooding during rain causing soil erosion and landslides.



Bridge Construction on River Alaknanda ,  
Approach road to Maina Adit



Stream near Power house site



Water flowing on the way of approach  
road to Power house and colony site

The approach road to Dam site has water out let below the road. There are no streams along the approach road.

The approach road to Langsi Adit crosses river Alaknanda. There is Tapon stream enroute to the adit site. The stream has flooding nature and causes destruction of the adjoining areas. The bridge over the Tapon Nala has been washed away several times by the stream.

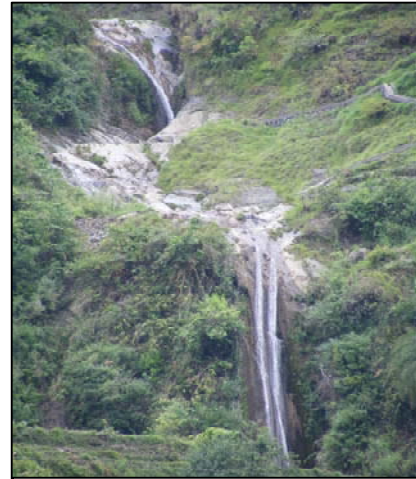
Flood is reported in River Alaknanda was in 1970, Village Belakuchi settled on the left bank of the river was washed away. The road route to Badrinath was also washed away during the flood and new road route is laid from Pakhi to Langsi.



The approach road to Maina adit has streams no stream on left side of the Alaknanda. The stream in Math village is prominent one flowing throughout the year.

The approach road to power house site has three small streams on left hand side. The road crosses the river Alaknanda and bifurcate Colony site and surge shaft area. One stream is located at the end of conlony area other is near the power house site.

Construction of drainage and culverts/ bridge will be a significant aspect along the approach road.



View of Tapon Stream , On way to Dwing Village

### 3.9 AIR ENVIRONMENT

The pristine environment and sparse population mean that most part of the district and the project area have very good air quality. Any point or non-point pollution sources of air pollution were observed throughout the survey on any of the road. None of the existing road having riding condition for vehicles. So traffic density or vehicular pollution is not considered. There are no industries in or along the roads in project area hence any source of atmospheric air pollution is not expected.

#### a. Ambient air quality

The study area represents rural environment. The sources of air pollution in the region are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The prime objective of the baseline air quality study was to establish the existing ambient air quality of the area.

This section describes the identification of sampling locations, methodology adopted for monitoring, frequency of sampling and results of monitoring during the study period.

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network. Four Ambient Air Quality Monitoring (AAQM) locations were selected taking care of above mentioned points. The location of human habitation and other sensitive areas viz. Reserved forests, etc. within the study area were also considered in selection of air quality monitoring locations.

Ambient air quality monitoring has been carried out with a frequency of two samples per week at four locations for three seasons. The baseline data of ambient air environment is generated for the mentioned parameters as given below:

- Suspended Particulate Matter (SPM)
- Respirable Particulate Matter (RPM)
- Sulphur dioxide (SO<sub>2</sub>)
- Oxides of Nitrogen (NO<sub>x</sub>).



**b. Observations on NO<sub>x</sub> levels**

The highest average NO<sub>x</sub> value of 17.45 µg/m<sup>3</sup> were observed at station located in at Pipalkoti in post-monsoon season. The highest value of 19.8 µg/m<sup>3</sup> too was also observed at the same station in winter season. The NO<sub>x</sub> level observed at various sampling stations for the three seasons was much lower than the permissible limit of 80 µg/m<sup>3</sup> for residential, rural and other areas.

**c. Observation on ambient SO<sub>2</sub> levels**

The maximum SO<sub>2</sub> level of 12.3 µg/m<sup>3</sup> was observed at station located at Pipalkoti in winter season. The average SO<sub>2</sub> level of 11.2 µg/m<sup>3</sup> was observed to be highest at this station during winter season. The SO<sub>2</sub> level observed at various stations for the three seasons was much lower than the permissible limit of 80 µg/m<sup>3</sup> specified for residential, rural and other areas.

**d. Observations on ambient SPM levels**

The maximum SPM level of 168.9 µg/m<sup>3</sup> was observed at station located at Pipalkoti which was observed during post-monsoon season. The average SPM level at various monitoring stations ranged from 110.3 (Dam site) to 156.25 (Pipalkoti) µg/m<sup>3</sup>. At all the ambient air quality monitoring stations, the SPM level was much below the permissible limit of 200 µg/m<sup>3</sup>, specified for residential, rural and other areas.

**e. Observations on ambient RPM levels**

The average RPM levels as observed at various stations in the study area ranged from 36.72 to 48.2 µg/m<sup>3</sup>, 36.0 to 42.8 µg/m<sup>3</sup> and 33.2 to 40.7 µg/m<sup>3</sup> during post-monsoon, winter and summer seasons respectively. The highest RPM value was recorded at station located at Pipalkoti. All the values of RPM monitored during the field survey were well within the permissible limit of 100 µg/m<sup>3</sup> specified for residential, rural and other areas.

**Findings**

Based on the findings of the ambient air quality survey, conducted for the post-monsoon season, it can be concluded that the ambient air quality is quite good in the area. Values of various parameters, e.g. SPM, RPM, SO<sub>2</sub> and NO<sub>x</sub> were well within the permissible limits specified for residential and rural areas. The absence of pollution sources and low population density in the area are the attributable factors for excellent quality of ambient air in the area. No significant variation was observed in the level of various parameters in post-monsoon and winter seasons.

**3.10 WATER QUALITY**

The proposed project is located in an area with low population density with no major sources of pollution. The major source of water in the project area are rivers or nallahs which flow adjacent to the habitations. The water is conveyed to the point of consumption. The sewage so generated, too outfalls into various streams or nallahs flowing adjacent to the settlements. The effluent generated from domestic sources ultimately reaches river Alaknanda through various streams/channels outfalling into





the river. Even for minimum flow condition, there is sufficient water available in river Alaknanda, for dilution of untreated sewage generated from domestic sources. There are no industries in the area. The area under agriculture is quite less, which coupled with negligible use of agro-chemicals, means that apart from domestic sources, pollution loading from other sources is virtually negligible. Thus, water quality in such settings is expected to be excellent in the project area.

As a part of the field studies, water samples from river Alaknanda and other tributaries from various locations were collected and analysed for various physico-chemical parameters. The various sampling locations are listed as below:

|    |   |   |
|----|---|---|
| W1 | - | River Karmnasha                               |
| W2 | - | River Alaknanda, about 0.5 km upstream of dam |
| W3 | - | 1.5 km downstream of dam                      |
| W4 | - | Garudganga                                    |
| W5 | - | Near Tail race tunnel                         |

The total hardness in various water samples ranged from 37-40 mg/l, 40-47 mg/l and 35-38 mg/l in post-monsoon, winter and summer seasons respectively. The low calcium and magnesium levels are responsible for soft nature of water. The carbonate hardness (for water with alkalinity level as observed in the study area) is equal to the alkalinity level. The non-carbonate hardness accounts for the balance hardness. Normally non-carbonate hardness can be removed by boiling. However, hardness level in the area does not warrant any treatment.

The low EC and TDS values indicate the lower concentration of cations and anions. This is also reflected by the fact that the concentration of most of the cations and anions are well within the permissible limit. The fluorides level was lower than the permissible limit (1 mg/l) for drinking purposes.

The BOD and COD values are well within the permissible limits, which indicate the absence of organic pollution loading. This is mainly due to the low population density and absence of industries in the area. The marginal quantity of pollution load which enters river Alaknanda, gets diluted. In fact, even for the minimum flow, there is more than adequate water available for dilution.

The Total Coliform is higher than permissible limits. However, in past, no major water-borne epidemic has been reported in the area.

It can be concluded that apart from coliform level, water quality was observed to be quite good.

### 3.11 AMBIENT NOISE LEVEL

Noise is not a problem in the project area. The noise levels were monitored continuously for 12 hours at each location and hourly equivalent noise level was measured. Sound Pressure Level (SPL) measurement in the ambient environment was made using sound pressure level meter. The ambient noise level monitoring results, which were observed during the field survey are within permissible limit.

The noise level at various sampling stations ranged from 32 to 40 dBA, which were very well within permissible limits specified for residential area. The Equivalent day noise level at various sampling stations ranged from 33.1 to 35.7, and 33.7 to 35.7



and 34.3 to 35.7 dB(A) in post-monsoon, winter and summer seasons respectively, which were well within the permissible limit specified for residential area.

### 3.12 AGRICULTURE

The agriculture of Garhwal Himalayas exhibits a great deal of variability in crop diversity, crop composition and crop rotation. The region can be divided into the following three agro-climatic zones along the elevation gradient:

- Lower altitude (500 m to 1000 m)
- Middle altitude (1000 m to 1800 m)
- Higher altitude (> 1800 m)

The project area is located in the middle altitude area. The cropping pattern in this zone is built around two major cropping seasons, viz. kharif (April-October) and rabi (October-April). Paddy, maize and pulses are the major kharif crops. During rabi season, crops such as wheat, barley, mustard, peas are grown.

According to the traditionally accepted criteria agricultural land in the region is identified either as the rainfed (locally known as *Ukhar*) or the irrigated (known as *Seva*). Only 15% of the cropped area is irrigated.

Irrigated land is often confined to the river valleys at lower altitudes and sometimes in terraced agricultural fields of middle altitude where water is available. Traditionally, water is channelled from the river through gools to the agricultural fields.

There are agricultural fields are located at the following locations along the proposed road:

- **Proposed Road to Langsi Adit** - On the left side of river Alaknanda agriculture fields are located along old road route to Badrinath and on right hand side of river agriculture fields are near Tapon and Dwing Village.
- **Proposed road to Maina Adit** - Near, Tenduli, Math and Guniyala village
- **On the proposed road Power house site** - agricultural field were observed on left side of river (before crossing the river, starting from the NH-58)

There are no agricultural fields along the approach road to Dam site.

### 3.13 FLORA OF ADVANCED CONSTRUCTION SITE

#### i Approach Road to Dam Site

The approach road to Dam site will be diverted from NH-58 near Helong village. The approach road to dam site passes through the forest area. The study is based on extensive field survey. Flora of the area is dominated by tree species of Forest Trees. Total 36 plant species were observed out of which 10 species of trees, 12 of shrubs, 9 of herbs 2 grass 1 climber and 2 pteridophytes were recorded. Dominant species comprise of Pine (*Pinus roxburghii*), Utis (*Alnus nepalensis*), Bhandir (*Albizia lebbek*), Surai (*Cupressus torulosa*), Bakel (*Princepia utilis*) and Kilmora (*Berberies aristata*). The table given below presents the Flora of the area and its



ecological status as per the Red Data Book of India by Nayar and Shastri and (1987-90) and IUCN Red List. All the species found at the site are common in occurrence.



**Table 3.2: Flora of Approach Road to Dam Site**

| S. No         | Botanical Name                | Local Name | Family         | Ecological Status |        |
|---------------|-------------------------------|------------|----------------|-------------------|--------|
|               |                               |            |                | IUCN              | RDB    |
| <b>Trees</b>  |                               |            |                |                   |        |
| 1.            | <i>Albizia lebbek</i>         | Bhandir    | Mimosaceae     | Common            | Common |
| 2.            | <i>Alnus nepalensis</i>       | Utis       | Betulaceae     | Common            | Common |
| 3.            | <i>Bauhinia variegata</i>     | Kuiral     | Caesalpinaceae | Common            | Common |
| 4.            | <i>Cedrella toona</i>         | Tun        | Meliaceae      | Common            | Common |
| 5.            | <i>Celtis australis</i>       | Kharik     | Ulmaceae       | Common            | Common |
| 6.            | <i>Cupressus torulosa</i>     | Surai      | Cupressaceae   | Common            | Common |
| 7.            | <i>Ficus palmata</i>          | Bedu       | Urticaceae     | Common            | Common |
| 8.            | <i>Grevillea robusta</i>      | Silver Oak | Proteaceae     | Common            | Common |
| 9.            | <i>Melia azaderach</i>        | Dhenkan    | Meliaceae      | Common            | Common |
| 10.           | <i>Pinus roxburghii</i>       | Chir       | Coniferae      | Common            | Common |
| <b>Shrubs</b> |                               |            |                |                   |        |
| 11.           | <i>Agave americana</i>        | Rambans    | Cactaceae      | Common            | Common |
| 12.           | <i>Berberies aristata</i>     | Kilmora    | Berberidaceae  | Common            | Common |
| 13.           | <i>Cannabis sativa</i>        | Bhang      | Cannabinaceae  | Common            | Common |
| 14.           | <i>Coriaria nepalensis</i>    | Makhoi     | Coriariaceae   | Common            | Common |
| 15.           | <i>Eupatorium adenophorum</i> | Kala bansa | Asteraceae     | Common            | Common |
| 16.           | <i>Princepia utilis</i>       | Bekal      | Rosaceae       | Common            | Common |
| 17.           | <i>Pyracantha crenulata</i>   | Ghingaroo  | Rosaceae       | Common            | Common |
| 18.           | <i>Rubus ellipticus</i>       | Hinsalu    | Rosaceae       | Common            | Common |



| S. No                | Botanical Name                  | Local Name  | Family          | Ecological Status |        |
|----------------------|---------------------------------|-------------|-----------------|-------------------|--------|
|                      |                                 |             |                 | IUCN              | RDB    |
| 19.                  | <i>Rumex hastatus</i>           | Almora      | Polgonaceae     | Common            | Common |
| 20.                  | <i>Urtica parviflora</i>        | Kandali     | Urticaceae      | Common            | Common |
| 21.                  | <i>Ziziphus mauritiana</i>      | Ber         | Rhamnaceae      | Common            | Common |
| 22.                  | <i>Zanthoxylum alatum</i>       | Timru       | Rutaceae        | Common            | Common |
| <b>Herbs</b>         |                                 |             |                 |                   |        |
| 23.                  | <i>Artemisia capillaris</i>     | Pati        | Asteraceae      | Common            | Common |
| 24.                  | <i>Bidens bipinnata</i>         | Kuru        | Asteraceae      | Common            | Common |
| 25.                  | <i>Cestrum verutum</i>          | Kanjalu     | Solanaceae      | Common            | Common |
| 26.                  | <i>Fragaria indica</i>          | Bhumla      | Rosoideae       | Common            | Common |
| 27.                  | <i>Galinsoga parviflora</i>     | Marchya     | Asteraceae      | Common            | Common |
| 28.                  | <i>Oxalis corniculata</i>       | Bhilmora    | Oxilidaceae     | Common            | Common |
| 29.                  | <i>Parthenium hysterophorus</i> | Gajar ghas  | Asteraceae      | Common            | Common |
| 30.                  | <i>Sonchus asper</i>            | Dudhi       | Convolvulanceae | Common            | Common |
| 31.                  | <i>Tridax procumbens</i>        | Ground weed | Amaranthaceae   | Common            | Common |
| <b>Grasses</b>       |                                 |             |                 |                   |        |
| 32.                  | <i>Chrysopogan fulvus</i>       | Godia       | Gramineae       | Common            | Common |
| 33.                  | <i>Eulaliopsis binata</i>       | Babula      | Gramineae       | Common            | Common |
| <b>Climbers</b>      |                                 |             |                 |                   |        |
| 34.                  | <i>Cryptolepis buchananii</i>   | Dudhi       | Asclepiadaceae  | Common            | Common |
| <b>Pteridophytes</b> |                                 |             |                 |                   |        |
| 35.                  | <i>Adiantum spp</i>             | Fern        | Adiantaceae     | Common            | Common |
| 36.                  | <i>Dryopteris</i>               | Fern        | Dryopteridaceae | Common            | Common |

## ii Approach Road to Langsi Adit

The Approach road to Langsi adit starts from NH -58 and crosses River Alaknanda and ends near Dwing village. The section of the road from starting point on NH-58 to Alaknanda river consist of old road route to Badrinath which is abandoned now. The Road was washed by flood in 1970 and new road was constructed from Pakhi to Langsi Village agricultural area. On right side after crossing Alaknanda it crosses Tapon stream which is vulnerable



View of Approach Road (old road to Badrinath)



to flood. The Bridge on Tapon stream was washed away three times in 2004.

Total 44 plant species are recorded out of which 17 are trees, 13 shrubs, 8 herbs, 2 grass, 2 climbers and 2 pteridophytes species were recorded. Fruit trees of Aru (*Prunus persica*), Dalim (*Punica granatum*) Akrot (*Juglans regia*) Lemon (*Citrus limon*) and Banana (*Musa paradisiaca*) were observed near Tapon and Dwing villages on agricultural land. All species found are common and found abundantly in the area

**Table 3.3: Flora of Approach Road to Langsi Adit**

| S.No | Botanical Name                   | Local Name | Family        | Ecological Status |        |
|------|----------------------------------|------------|---------------|-------------------|--------|
|      |                                  |            |               | IUCN              | RDB    |
|      | <b>Trees</b>                     |            |               |                   |        |
| 1.   | <i>Boehmeria regulosa</i>        | Genthi     | Urticaceae    | Common            | Common |
| 2.   | <i>Cedrella toona</i>            | Tun        | Meliaceae     | Common            | Common |
| 3.   | <i>Citrus limon</i>              | Nimu       | Rutaceae      | Common            | Common |
| 4.   | <i>Citrus spp</i>                | Malta      | Rutaceae      | Common            | Common |
| 5.   | <i>Cupressus torulosa</i>        | Surai      | Cupressaceae  | Common            | Common |
| 6.   | <i>Emblica officinalis</i>       | Amla       | Euphorbiaceae | Common            | Common |
| 7.   | <i>Ficus auriculata</i>          | Timal      | Urticaceae    | Common            | Common |
| 8.   | <i>Ficus palmata</i>             | Bedu       | Urticaceae    | Common            | Common |
| 9.   | <i>Grevillea robusta</i>         | Silver Oak | Proteaceae    | Common            | Common |
| 10.  | <i>Juglans regia</i>             | Akrot      | Juglandaceae  | Common            | Common |
| 11.  | <i>Melia azaderach</i>           | Dhenkan    | Meliaceae     | Common            | Common |
| 12.  | <i>Musa paradisiaca</i>          | Kela       | Musaceae      | Common            | Common |
| 13.  | <i>Phoenix humilius</i>          | Khajoor    | Palmae        | Common            | Common |
| 14.  | <i>Pinus roxburghii</i>          | Chir       | Coniferae     | Common            | Common |
| 15.  | <i>Prunus persica</i>            | Aru        | Rosaceae      | Common            | Common |
| 16.  | <i>Punica granatum</i>           | Dalim      | Lythraceae    | Common            | Common |
| 17.  | <i>Pyrus pashia</i>              | Mehal      | Rosaceae      | Common            | Common |
|      | <b>Shrubs</b>                    |            |               |                   |        |
| 18.  | <i>Berberies aristata</i>        | Kilmora    | Berberidaceae | Common            | Common |
| 19.  | <i>Cannabis sativa</i>           | Bhang      | Cannabinaceae | Common            | Common |
| 20.  | <i>Colebrookia oppositifolia</i> | Bindu      | Labiatae      | Common            | Common |
| 21.  | <i>Coriaria nepalensis</i>       | Makhoi     | Coriariaceae  | Common            | Common |
| 22.  | <i>Debregeasia hypoleuca</i>     | Sihanru    | Artocarpeae   | Common            | Common |
| 23.  | <i>Eupatorium adenophorum</i>    | Kala bansa | Asteraceae    | Common            | Common |
| 24.  | <i>Euphorbia royleana</i>        | Shuru      | Euphorbiaceae | Common            | Common |



| S.No                 | Botanical Name                  | Local Name   | Family          | Ecological Status |        |
|----------------------|---------------------------------|--------------|-----------------|-------------------|--------|
|                      |                                 |              |                 | IUCN              | RDB    |
| 25.                  | <i>Princepia utilis</i>         | Bekal        | Rosaceae        | Common            | Common |
| 26.                  | <i>Pyracantha crenulata</i>     | Ghingaroo    | Rosaceae        | Common            | Common |
| 27.                  | <i>Rubus ellipticus</i>         | Hinsalu      | Rosaceae        | Common            | Common |
| 28.                  | <i>Rubus niveus</i>             | Kala Hinsalu | Rosaceae        | Common            | Common |
| 29.                  | <i>Rumex hastatus</i>           | Almora       | Polgonaceae     | Common            | Common |
| 30.                  | <i>Urtica parviflora</i>        | Kandali      | Urticaceae      | Common            | Common |
| <b>Herbs</b>         |                                 |              |                 |                   |        |
| 31.                  | <i>Artemisia capillaris</i>     | Pati         | Asteraceae      | Common            | Common |
| 32.                  | <i>Bidens bipinnata</i>         | Kuru         | Asteraceae      | Common            | Common |
| 33.                  | <i>Cestrum verutum</i>          | Kanjalu      | Solanaceae      | Common            | Common |
| 34.                  | <i>Galinsoga parviflora</i>     | Marchya      | Asteraceae      | Common            | Common |
| 35.                  | <i>Oxalis corniculata</i>       | Bhilmora     | Oxilidaceae     | Common            | Common |
| 36.                  | <i>Parthenium hysterophorus</i> | Gajar ghas   | Asteraceae      | Common            | Common |
| 37.                  | <i>Sonchus asper</i>            | Dudhi        | Convolvulanceae | Common            | Common |
| 38.                  | <i>Tridax procumbens</i>        | Ground weed  | Amaranthaceae   | Common            | Common |
| <b>Grasses</b>       |                                 |              |                 |                   |        |
| 39.                  | <i>Chrysopogan fulvus</i>       | Godia        | Gramineae       | Common            | Common |
| 40.                  | <i>Cynadon dactylon</i>         | Dhub         | Gramineae       | Common            | Common |
| <b>Climbers</b>      |                                 |              |                 |                   |        |
| 41.                  | <i>Bauhinia vahlii</i>          | Malo         | Leguminosae     | Common            | Common |
| 42.                  | <i>Ipomea purpurea</i>          | Besharam     | Convovulaceae   | Common            | Common |
| <b>Pteridophytes</b> |                                 |              |                 |                   |        |
| 43.                  | <i>Adiantum spp</i>             | Fern         | Adiantaceae     | Common            | Common |
| 44.                  | <i>Dryopteris</i>               | Fern         | Dryopteridaceae | Common            | Common |



*Rubus ellipticus* (Hinsalu)



*Citrus spp* (Malta)



### iii Approach Road to Maina Adit

The approach road to Maina Adit starts from NH-58 near Pipalkoti. The road crosses river Alaknanda. There are three village enroute to Maina Adit -Tenduli, Maath and Guniyala village. Vegetation on Left side of river is sparse with some scattered bushes. All the species occurring are common in nature and found abundantly throughout the valley. On the right side after crossing the river some plantation was observed. The flora of the area constitute of Pine forest, fruit trees, thorny and shrubs.



There is a dense forest after Guniyala villages as the road approaches the Maina Adit site. Three herb species *Berginia ligulata* (silpara), *Hedychium spicatum* (Banhaldi) and *Thalictrum foliolosum* (Mamiri) are reported in the forest area near Maina adit, these species fall in vulnerable category as per IUCN Red list. However these species are common in India in Himalayan region and are found in altitudinal range from 1000 to 3000 m. These species are in common category and does not fall in threatened list of Red Data Book of Indian Flora. Total 51 plant species were observed in the area out of which 16 trees; 15 shrubs, 12 herbs, 3 grasses, 3 climber and 2 fern.

Table 3.4: Flora of Approach Road to Maina Adit

| S<br>N<br>o | Botanical Name            | Local<br>Name | Family      | Ecological Status |        |
|-------------|---------------------------|---------------|-------------|-------------------|--------|
|             |                           |               |             | IUCN              | RDB    |
|             | <b>Trees</b>              |               |             |                   |        |
| 1.          | <i>Albizzia lebbek</i>    | Bhandir       | Leguminosae | Common            | Common |
| 2.          | <i>Alnus nepalensis</i>   | Utis          | Betulaceae  | Common            | Common |
| 3.          | <i>Bauhinia purpurea</i>  | Kuiral        | Leguminosae | Common            | Common |
| 4.          | <i>Boehmeria regulosa</i> | Genthi        | Urticaceae  | Common            | Common |
| 5.          | <i>Cedrella toona</i>     | Tun           | Meliaceae   | Common            | Common |

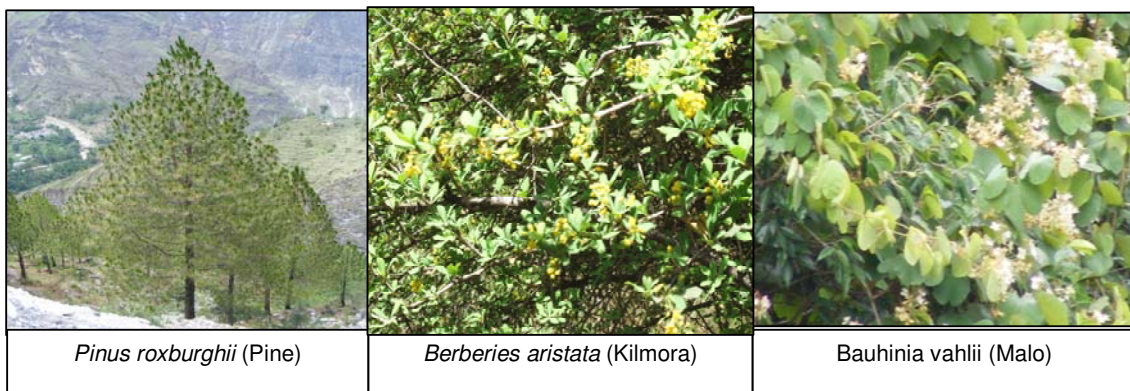


| S<br>N<br>o | Botanical Name                    | Local<br>Name   | Family        | Ecological Status |        |
|-------------|-----------------------------------|-----------------|---------------|-------------------|--------|
|             |                                   |                 |               | IUCN              | RDB    |
| 6.          | <i>Celtis australis</i>           | Kharik          | Ulmaceae      | Common            | Common |
| 7.          | <i>Cinnamomum tamala</i>          | Dalchini        | Luraceae      | Common            | Common |
| 8.          | <i>Cupressus torulosa</i>         | Surai           | Cupressaceae  | Common            | Common |
| 9.          | <i>Emblica officinalis</i>        | Amla            | Euphorbiaceae | Common            | Common |
| 10.         | <i>Ficus auriculata</i>           | Timal           | Urticaceae    | Common            | Common |
| 11.         | <i>Ficus palmata</i>              | Bedu            | Urticaceae    | Common            | Common |
| 12.         | <i>Grevillea robusta</i>          | Silver oak      | Proteaceae    | Common            | Common |
| 13.         | <i>Mallotus philippinensis</i>    | Ruina           | Euphorbiaceae | Common            | Common |
| 14.         | <i>Pinus roxburghii</i>           | Chir            | Coniferae     | Common            | Common |
| 15.         | <i>Prunus communis</i>            | Alu<br>bukhara  | Rosaceae      | Common            | Common |
| 16.         | <i>Toona serrata</i>              | Kakuru          | Meliaceae     | Common            | Common |
|             | <b>Shrubs</b>                     |                 |               |                   |        |
| 17.         | <i>Agave americana</i>            | Rambans         | Cactaceae     | Common            | Common |
| 18.         | <i>Berberies aristata</i>         | Kilmora         | Berberidaceae | Common            | Common |
| 19.         | <i>Cannabis sativa</i>            | Bhang           | Cannabinaceae | Common            | Common |
| 20.         | <i>Colebrookia oppositifolia</i>  | Bindu           | Labiatae      | Common            | Common |
| 21.         | <i>Coriaria nepalensis</i>        | Makhoi          | Coriariaceae  | Common            | Common |
| 22.         | <i>Debregeasia hypoleuca</i>      | Sihanru         | Artocarpeae   | Common            | Common |
| 23.         | <i>Eupatorium<br/>adenophorum</i> | Kala bansa      | Asteraceae    | Common            | Common |
| 24.         | <i>Princepia utilis</i>           | Bekal           | Rosaceae      | Common            | Common |
| 25.         | <i>Pyracantha crenulata</i>       | Ghingaroo       | Rosaceae      | Common            | Common |
| 26.         | <i>Rubus ellipticus</i>           | Hinsalu         | Rosaceae      | Common            | Common |
| 27.         | <i>Rubus niveus</i>               | Kala<br>Hinsalu | Rosaceae      | Common            | Common |
| 28.         | <i>Rumex hastatus</i>             | Almora          | Polgonaceae   | Common            | Common |
| 29.         | <i>Urtica parviflora</i>          | Kandali         | Urticaceae    | Common            | Common |
| 30.         | <i>Woodfordia floribunda</i>      | Dhaura          | Lythraceae    | Common            | Common |
| 31.         | <i>Ziziphus mauritiana</i>        | Ber             | Rhamnaceae    | Common            | Common |
|             | <b>Herbs</b>                      |                 |               |                   |        |
| 32.         | <i>Artemisia capillaris</i>       | Pati            | Asteraceae    | Common            | Common |
| 33.         | <i>Bidens bipinnata</i>           | Kuru            | Asteraceae    | Common            | Common |
| 34.         | <i>Berginia ligulata</i>          | Silphara        | Saxiferaeaa   | Vulnerable        | Common |
| 35.         | <i>Cestrum verutum</i>            | Kanjalu         | Solanaceae    | Common            | Common |
| 36.         | <i>Galinsoga parviflora</i>       | Marchya         | Asteraceae    | Common            | Common |
| 37.         | <i>Hedychium spicatum</i>         | Banhaldu        | Zingiberacea  | Vulnerable        | Common |





| S<br>N<br>o          | Botanical Name                  | Local Name  | Family          | Ecological Status |        |
|----------------------|---------------------------------|-------------|-----------------|-------------------|--------|
|                      |                                 |             |                 | IUCN              | RDB    |
| 38.                  | <i>Oxalis corniculata</i>       | Bhilmora    | Oxilidaceae     | Common            | Common |
| 39.                  | <i>Parthenium hysterophorus</i> | Gajar ghas  | Asteraceae      | Common            | Common |
| 40.                  | <i>Polygonum chinensis</i>      | Syaru       | Polgonaceae     | Common            | Common |
| 41.                  | <i>Sonchus asper</i>            | Dudhi       | Convolvulaceae  | Common            | Common |
| 42.                  | <i>Thalictrum foliolosum</i>    | Mamiri      | Ranunculaceae   | Vulnerable        | Common |
| 43.                  | <i>Tridax procumbens</i>        | Ground weed | Amaranthaceae   | Common            | Common |
| <b>Grasses</b>       |                                 |             |                 |                   |        |
| 44.                  | <i>Apluda mutica</i>            | Tachula     | Gramineae       | Common            | Common |
| 45.                  | <i>Chrysopogon fulvus</i>       | Godia       | Gramineae       | Common            | Common |
| 46.                  | <i>Cynadon dactylon</i>         | Dhub        | Gramineae       | Common            | Common |
| <b>Climbers</b>      |                                 |             |                 |                   |        |
| 47.                  | <i>Bauhinia vahlii</i>          | Malo        | Leguminosae     | Common            | Common |
| 48.                  | <i>Clematis connata</i>         | Konya       | Ranunculaceae   | Common            | Common |
| 49.                  | <i>Ipomea purpurea</i>          | Besharam    | convolvulaceae  | Common            | Common |
| <b>Pteridophytes</b> |                                 |             |                 |                   |        |
| 50.                  | <i>Adiantum spp</i>             | Fern        | Adiantaceae     | Common            | Common |
| 51.                  | <i>Dryopteris</i>               | Fern        | Dryopteridaceae | Common            | Common |





#### iv Approach Road to Powerhouse & Colony Site

The approach road to powerhouse and colony starts from NH-58 near Pipalkoti and crosses river Alaknanda on ends near Haat village at the Power house site. The Road traverses through agricultural and barren area. Some part of the old foot route to Badrinath on Right bank of the river is present which is in used by people of Haat to communicate. Total 49 plant species were observed in the area out of which 16 are trees, 19 shrubs, 8 herbs, 2 grasses, 2 climber and 2 fern species. All the species are common in occurrence.



View of Approach Road to Power House Site

Table 3.5: Flora of Approach Road to Powerhouse & Colony Site

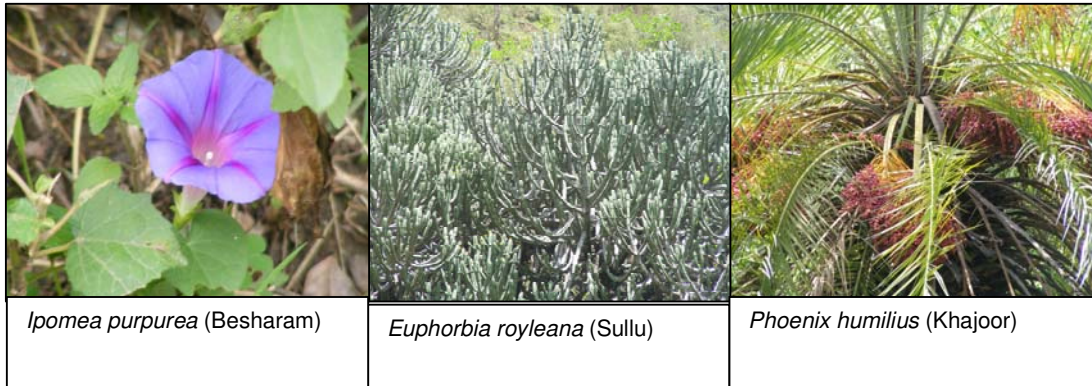
| S. No         | Botanical Name            | Local Name | Family        | Ecological Status |        |
|---------------|---------------------------|------------|---------------|-------------------|--------|
|               |                           |            |               | IUCN              | RDB    |
| <b>Trees</b>  |                           |            |               |                   |        |
| 1.            | <i>Aegle marmelos</i>     | Bel        | Rutaceae      | Common            | Common |
| 2.            | <i>Bahunia variegata</i>  | Kwiryal    | Leguminosae   | Common            | Common |
| 3.            | <i>Bombax ceiba</i>       | Semal      | Bombaceae     | Common            | Common |
| 4.            | <i>Cedrella toona</i>     | Tun        | Meliaceae     | Common            | Common |
| 5.            | <i>Citrus limon</i>       | Nimu       | Rutaceae      | Common            | Common |
| 6.            | <i>Ficus auriculata</i>   | Timla      | Urticaceae    | Common            | Common |
| 7.            | <i>Ficus palmata</i>      | Bedu       | Urticaceae    | Common            | Common |
| 8.            | <i>Ficus religiosa</i>    | Pipal      | Urticaceae    | Common            | Common |
| 9.            | <i>Mangifera indica</i>   | Aam        | Anacardiaceae | Common            | Common |
| 10.           | <i>Melia azaderach</i>    | Dhenkan    | Meliaceae     | Common            | Common |
| 11.           | <i>Phoenix humilius</i>   | Khajoor    | Palmae        | Common            | Common |
| 12.           | <i>Pinus roxburghii</i>   | Chir       | Coniferae     | Common            | Common |
| 13.           | <i>Prunus persica</i>     | Adu        | Rosaceae      | Common            | Common |
| 14.           | <i>Punica granatum</i>    | Danim      | Lythraceae    | Common            | Common |
| 15.           | <i>Sapindus mukurossi</i> | Ritha      | Sapindaceae   | Common            | Common |
| 16.           | <i>Sapium insigne</i>     | Khinna     | Urticaceae    | Common            | Common |
| <b>Shrubs</b> |                           |            |               |                   |        |
| 17.           | <i>Adhatoda vasica</i>    | Basinga    | Acanthaceae   | Common            | Common |
| 18.           | <i>Agave americana</i>    | Rambans    | Cactaceae     | Common            | Common |
| 19.           | <i>Berberies aristata</i> | Kilmora    | Berberidaceae | Common            | Common |



| S. No                | Botanical Name                  | Local Name   | Family         | Ecological Status |        |
|----------------------|---------------------------------|--------------|----------------|-------------------|--------|
|                      |                                 |              |                | IUCN              | RDB    |
| 20.                  | <i>Cannabis sativa</i>          | Bhang        | Cannabaceae    | Common            | Common |
| 21.                  | <i>Calotropis gigantea</i>      | Aak          | Asclepiadaceae | Common            | Common |
| 22.                  | <i>Colebrokia oppositifolia</i> | Bindu        | Labiatae       | Common            | Common |
| 23.                  | <i>Debregeasia hypoleuca</i>    | Siyaru       | Artocarpeae    | Common            | Common |
| 24.                  | <i>Eupatorium adenophorum</i>   | Kala bansa   | Asteraceae     | Common            | Common |
| 25.                  | <i>Euphorbia royleana</i>       | Sullu        | Euphorbiaceae  | Common            | Common |
| 26.                  | <i>Jatropha curcas</i>          | Arand        | Euphorbiaceae  | Common            | Common |
| 27.                  | <i>Lantana camara</i>           | Kuri         | Verbeaceae     | Common            | Common |
| 28.                  | <i>Opuntia dillenii</i>         | Nagphani     | Cactaceae      | Common            | Common |
| 29.                  | <i>Princepia utilis</i>         | Bekal        | Rosaceae       | Common            | Common |
| 30.                  | <i>Pyracantha crenulata</i>     | Ghingaroo    | Rosaceae       | Common            | Common |
| 31.                  | <i>Rosa brunonii</i>            | Kunj         | Rosaceae       | Common            | Common |
| 32.                  | <i>Rubus ellipticus</i>         | Hinsalu      | Rosaceae       | Common            | Common |
| 33.                  | <i>Rubus niveus</i>             | Kala Hinsalu | Rosaceae       | Common            | Common |
| 34.                  | <i>Urtica parviflora</i>        | Kandali      | Urticaceae     | Common            | Common |
| 35.                  | <i>Ziziphus mauritiana</i>      | Ber          | Rhamnaceae     | Common            | Common |
| <b>Herbs</b>         |                                 |              |                |                   |        |
| 36.                  | <i>Argemone mexicana</i>        | Satyanasi    | Papaveraceae   | Common            | Common |
| 37.                  | <i>Artemisia capillaris</i>     | Pati         | Asteraceae     | Common            | Common |
| 38.                  | <i>Cassia tora</i>              | Chakunda     | Caesalpinaceae | Common            | Common |
| 39.                  | <i>Cestrum verutum</i>          | Kanjalu      | Solanaceae     | Common            | Common |
| 40.                  | <i>Oxalis corniculata</i>       | Bhilmora     | Oxilidaceae    | Common            | Common |
| 41.                  | <i>Parthenium hysterophorus</i> | Gajar ghas   | Asteraceae     | Common            | Common |
| 42.                  | <i>Polygonum chinensis</i>      | Syaru        | Polgonaceae    | Common            | Common |
| 43.                  | <i>Tridax procumbens</i>        | Ground weed  | Amaranthaceae  | Common            | Common |
| <b>Grasses</b>       |                                 |              |                |                   |        |
| 44.                  | <i>Apluda mutica</i>            | Tachula      | Gramineae      | Common            | Common |
| 45.                  | <i>Cynodon dactylon</i>         | Dhub         | Gramineae      | Common            | Common |
| <b>Climbers</b>      |                                 |              |                |                   |        |
| 46.                  | <i>Bauhinia vahlii</i>          | Malo         | Leguminosae    | Common            | Common |
| 47.                  | <i>Ipomea purpurea</i>          | Besharam     | Convolvulaceae | Common            | Common |
| <b>Pteridophytes</b> |                                 |              |                |                   |        |
| 48.                  | <i>Adiantum spp</i>             | Fern         | Adiantaceae    | Common            | Common |



| S. No | Botanical Name    | Local Name | Family          | Ecological Status |        |
|-------|-------------------|------------|-----------------|-------------------|--------|
|       |                   |            |                 | IUCN              | RDB    |
| 49.   | <i>Dryopteris</i> | Fern       | Dryopteridaceae | Common            | Common |



### 3.14 FAUNA OF THE PROJECT AREA

The Advance construction site starts from NH-58 and passes close to settlement and track routes to villages on the Right bank. The wildlife is not found near the highway. However across the river on right bank wildlife movement has been reported. Public consultation was carried in the villages and incidence of domestic animals (cows & dogs) lifting by Leopard and Bear has been reported.

Study of fauna is based on public consultation and secondary data review from Forest Department. Fauna of the project area is mainly represented by reptiles, birds and mammals. The reptiles were represented by Common Lizard. The mammals were represented by domestic animals such as cow, buffalo, donkey, horses, mules, sheeps, goats and dogs. The common wildlife reported by local people during discussion were the Leopard, Bear, Monkey, Deer etc. The wildlife recorded in the area is given below:

**Table 3.6 Wildlife of Advanced Construction Site and Ecological Status**

| Scientific Name            | Common Name | Family          | Status    |       |
|----------------------------|-------------|-----------------|-----------|-------|
|                            |             |                 | IWPA 1972 | IUCN  |
| <i>Panthera Pardus</i>     | Leopard     | Felidae         | Sch I     | LC    |
| <i>Ursus arctos</i>        | Brown Bear  | Ursidae         | Sch I     | LR/lc |
| <i>Macaca mulatta</i>      | Monkey      | Cercopithecidae | Sch II    | LR/nt |
| <i>Mus booduga</i>         | Field mouse | Muridae         | Sch V     | LR/lc |
| <i>Caprolagus hispidus</i> | Hispid Hare | Cervidae        | -         | -     |
| <i>Canis aureus</i>        | Siyar       | Canidae         | Sch II    | LC    |



| Scientific Name            | Common Name    | Family          | Status    |       |
|----------------------------|----------------|-----------------|-----------|-------|
|                            |                |                 | IWPA 1972 | IUCN  |
| <i>Muntiacus muntjak</i>   | Kakad          | Cercopithecidae | Sch III   | LR/lc |
| <i>Vulpes bengalensis</i>  | Fox            | Canidae         | Sch II    | LC    |
| <i>Suncus murinus</i>      | Chuchunder     | Soricidae       | -         | LC    |
| <i>Presbytis entellus</i>  | Langur         | Cercopithecidae | Sch II    | LR/lc |
| <i>Sus scrofa</i>          | Wild Boar      | Suidae          | Sch III   | LR/lc |
| <i>Lepus nigrocolis</i>    | Khargosh       | Leporidae       | -         | -     |
| <i>Varanus bengalensis</i> | Monitor Lizard | Varanidae       | -         | LC    |
| <i>Calotes spp</i>         | Calotes        | -               | -         | -     |

V: Vulnerable LC: Least Concern LR/lc or LC: Least Concern LR/nt: Near Threatened

Birds were identified with binox. The common birds recorded during the survey were Myna, Magpai, Pigeon, Black Drongo, Grey Shrike and White Cheek Bulbul. The list of birds found in the area is given below

**Table 3.7 : Birds of Advanced Construction Site**

| Scientific Name                 | Common Name              | Family       |
|---------------------------------|--------------------------|--------------|
| <i>Acridotheres tristis</i>     | Indian Myna              | Sturnidae    |
| <i>Alectoris Chukar</i>         | Chukor Partridge         | Phasianidae  |
| <i>Corvus corax</i>             | Common raven             | Carvidae     |
| <i>Cissa flavirostris</i>       | Yellow build blue Magpie | Corvidae     |
| <i>Corvus splendens</i>         | House Crow               | Carvidae     |
| <i>Dicrurus adsimilis</i>       | Black Drongo             | Dieruridae   |
| <i>Dendrocopos himalayensis</i> | Wood pecker              | Picidae      |
| <i>Lanius excubitor</i>         | Grey Shrike              | Campehagidae |
| <i>Milvus migrans</i>           | Pariah Kite              | Acciptridae  |
| <i>Motacilla maderatensis</i>   | Large pied wagtail       | Motacillidae |
| <i>Passer domesticus</i>        | House Sparrow            | Passeridae   |
| <i>Passer montanus</i>          | Eurasian Tree Sparrow    | Passeridae   |
| <i>Pycnonotus cafer</i>         | Red vented Bulbul        | Pycnonotidae |
| <i>Pycnonotus leucogenys</i>    | White Cheeked Bulbul     | Pycnonotidae |
| <i>Sexicoloides fulicate</i>    | Indian Robin             | Muscicapidae |
| <i>Sopsychus saularis</i>       | Magpie Robin             | Muscicapidae |
| <i>Streptopelia orientalis</i>  | Spotted dove             | Columbidae   |
| <i>Turdoides caudatus</i>       | Common babbler           | Muscicapidae |
| <i>Turdus merula</i>            | Blackbird                | Turninae     |



As per IUCN Red List most of the wildlife fall in “LC“ least concern category. As per wildlife Protection Act (1972) two species *Panthera pardus* and *Ursus arctos* fall in Schedule I category. Schedule I species are the species which are most critical and require appropriate protection measures.



## CHAPTER 4

### PUBLIC CONSULTATION

Public participation and community consultation has been taken up as an integral part of the environmental and social assessment process of the Project. Public participation has been viewed as a continuous two way process, involving promotion of public understanding of the processes and mechanisms through which developmental problems and needs are investigated and solved. Consultation was used as a tool to inform stakeholders about the proposed action both before and after the development decisions were made. It assisted in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process enabled the participation of the local people in the decision making process. The involvement of the various stakeholders ensured that the affected population and other stakeholders are informed, consulted and allowed to participate at various stages of project preparation.

#### 4.1 OBJECTIVE

Public consultations in the project area was undertaken with objectives, which may be grouped as given below:

- Sharing of information
- Appraisal and assessment of community need
- Development of specific solutions and enhancement measures

##### Information Sharing

- To promote public awareness about the project.
- To solicit the views of affected communities/individuals on environmental components and the significance of impacts;
- To serve as an important tool for collecting information about natural and the human environments, much of which would not be accessible through more traditional approaches of data collection;
- To ensure involvement of local community in the decision making process
- To achieve the basis for an Environment Management Plan for the project, with the incorporation of felt needs, views and preferences of the people likely to be impacted.

##### Appraisal & Assessment

- To inform Project Affected Communities about the provision of work, and to settle their felt need with mutual consent and to assist them during relocation of community property, if any
- Deduce information from the people about the local environmental issues and their dependence upon them.
- Collect peoples' perceptions about the project and how the adverse effects of the project may be mitigated.

### Devising Specific Solutions

- To solicit the views of affected communities/individuals on environmental and social problems.
- Receive suggestions from the affected communities with regard to the preferences and options about the project in general and avoidance measures, mitigation/compensation measures, and benefits being provided, in particular.
- To ensure lessening of public resistance to change by providing them a platform in the decision making process.

The participation by the local community can influence not only environmental impact of the project area, but also the costs, success and duration of the project itself.

### 4.2 PUBLIC CONSULTATION FOR PROJECT ROADS

The public consultation involved discussion with Local people. Issues discussed with the local people, recommendation of the local people and their suggestion has been given below.



Public consultation at Hat Village



Public consultation at Math Village

#### Issues Discussed:

- Problem faced by the local people to meet up their daily requirement due to improper road network.
- Dependency of Forest area.
- Impact on the local environment (flora and fauna) due to construction and strengthening of the road.
- Health problem due to construction
- Scope of employment generation due to construction activity





### **Stakeholder's Response:**

- Local villagers are facing problem to reach nearest town due to improper road network. Due to Earthen and gravel road no vehicular service is there to connect these villages to the main road so local people travel upto 6 to 8 km on their feet to get a vehicle. Especially in rainy season things are getting more difficult for villagers.
- The people are dependent on forest for meeting mostly fuel and fodder.
- Local people are aware about the environmental degradation due to felling of trees and cutting of hills but they think there will be negligible impact for construction of a road. Villagers also think for better livelihood and overall development proper road network is necessary.
- Villagers want deployment of local village people for local road construction
- Construction activity is not causing any major health hazard. Generation of dust is only temporary and limited to site.

### **Recommendations & Suggestions:**

- Local people in favour of road construction as it will provide access to the market place at Pipalkoti.
- Land required for road construction must be properly compensated
- Damage caused to agricultural field due to construction activity must be compensated
- Maintenance of the roads must be taken on regular basis as during rain the roads are susceptible to landslide.
- Local people are interested to protect the forest and conserve the natural environment.
- Job opportunities must be provided to locals in the project in skilled and unskilled tasks.



## CHAPTER 5

### ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

#### 5.1 INTRODUCTION

Based on the existing baseline environmental condition of the area, through reconnaissance survey, various project activities during preconstruction, construction and operation phases of the project, environmental impact are assessed. Mitigation measures are suggested to minimize/compensate/ eliminate the negative impacts and enhance positive impact. The project activities considered during preconstruction stage are location of construction camp, obtaining appropriate clearances from regulatory bodies prior executing construction work, determination of Right of Way and road safety measures.

The environmental impacts during construction phases are temporary and reversible in nature. Important product activities considered are establishment of labors camps, removal of vegetation, cutting of hill slope, borrow and quarrying operation. Crushing of stone and transportation of construction material, road surfacing activities, construction of cross-drainage works, operational moments of construction machineries, equipment, vehicles and water supply are other activities involved in construction.

#### 5.2 IMPACT ASSESSMENT & MITIGATION MEASURES

There are no historical / cultural monuments recorded along the proposed roads, which would be affected by the proposed construction programme. Hence, no significant impact on cultural/ historical community resources of the area is expected. The proposed project will also rehabilitate existing roads and will connect new locations for local people through new alignments. No major impacts on existing natural environment are expected.

The significant impacts of project are during the construction phase of the project, which are temporary and reversible in nature.

##### 5.2.1 Hill Cutting

The construction of new roads and upgradation of the old roads involve hill cutting which leads to soil erosion & landslides, scarring of landscape, generation of solid wastes in the form of debris, dust pollution, disturbance of local drainage, siltation in nearby water bodies and noise & disturbance to wildlife due to blasting. The hill cutting is also likely to trigger landslide in the area.

##### **Mitigation Measures**

In order to mitigate these impacts, suggested mitigation measures are;

- Minimize hill cutting by following restricted RoW to the maximum extent,



- Use of full cut method, use of debris as construction material based on their suitability and unused material should be disposed at pre-identified disposal sites.
- Appropriate bio-engineering techniques must be used immediately after cutting to maintain stability of slope above and below ROW.
- Work may be restricted during rainy season.
- Controlled blasting techniques must be used. Warning must be given to the inhabitants to stay away from the site to avoid any mis-happening.

### 5.2.2 Impact on Flora

The proposed project roads are passing through community forest, dense forest and open area. The construction activities affect forest by loss of vegetation due to tree cutting. Three herbaceous species *Berginia ligulata* (silpara), *Hedychium spicatum* (Banhaldi) and *Thalictrum foliolosum* (Mamiri) are found in the advance construction area ON THE APPROACH ROAD TO Maina adit these species fall in vulnerable category in IUCN Red list and requires proper conservation.

Other species which are affected are *Pinus roxburghii* (Pine), *Cedrela toona* (Tun) . *Bauhinia variegata* (Kachnar), *Melia azaderach*(Dhenk), *Ficus palmata* (Bedu), *Sapium insigne* (Khinna), *Phoenix humilis* (Khajoor) and *Mallotus philippinensis* (Kamela), Shrubs such as *Berberies aristata* (Kashmoi), *Eupatorium adenophorum* (Kala bansa) *Euphorbia royleana* (Shuru), *Princepia utilis* (Bhekal) *Zanthoxylum alatum*(Timru) and *Rubus ellipticus* (Hinsar) etc The dominant weeds recorded are *Colebrookia oppositifolia* (Bindu), *Calotropis gigantea* (Aak), *Lantana camera* (Lantana) *Urtica parviflora* (Kandali) and *Rumex hastatus* (Bhilmora) etc.

### Mitigation Measures

Loss of vegetation can be minimized by carefully designing RoW and by implementing compensatory afforestation programme as per the State Forest Department Govt. of Uttarakhand regulations.

- Compensatory Afforestation may be carried to compensate the loss of trees. Double no. of trees may be planted in lieu of trees felled. Implementation of approved Compensatory Afforestation Plan in accordance with Forest (conservation) Act 1980 and Uttarakhand Forest Policy must be undertaken.
- The vulnerable species *Berginia ligulata* (silpara), *Hedychium spicatum* (Banhaldi) and *Thalictrum foliolosum* (Mamiri) found in the area must be developed in separate herbal garden. THDC must undertake development of Herbal garden at suitable place in consultation with forest department and propagation of the species must be taken. Besides the three species other species of medicinal value may be also encouraged.
- Proper protection measures should be taken for the plantation work carried under the project. Van Panchayats may be involved in afforestation activity and monitoring of the plantation work.
- Proper compensation must be given to Van Panchayats for the land and standing crops. Compensation must be provided before initiating construction activity



- Compensation for fruit bearing trees may be compensated including cost of fruit yield of 5 years.
- Trees falling outside the ROW should not be felled.

### 5.2.3 Impact on Fauna

The wildlife is likely to be disturbed during construction phase due to various activities.

- The construction activity is likely to affect the movement of the animal
- Increase in noise may affect the feeding, breeding and movement of wildlife near forest area. Felling of trees is likely to affect the avifauna.
- Fragmentation of the habitat is not envisaged as the road does not divide any habitat area the area which will restrict the movement of animals on either side.

#### ***Mitigation Measures***

- Construction activities may be avoided during night hours near forest area.
- Poaching must be strictly banned in the Forest area. It may be ensured by the Contractor that no hunting is practiced at the site by any of the worker and that all site personnel are aware of the location, value and sensitivity of the wildlife resources
- The project area is located in the transitional zone of Nanda Devi Biosphere reserve. Movement of wildlife is reported in the area therefore check post may be established in the project sites in consultation with Forest Department.
- Plantation of tree species which are major sources of fodder for wildlife in consultation with forest department in degraded and open areas.
- Awareness program on Environment and Wildlife Conservation may be provided to the work force. Forest Act and Wildlife Act may be strictly adhered to.

### 5.2.4 Impact on Land and Soil

The construction activities may lead to soil erosion and landslide. Extraction of rocks and sand for the construction work from quarry sites which is likely to degrade the area.

#### ***Mitigation Measures***

- Proper bioengineering measures must be applied for slope stabilization.
- Plantation of grasses, shrubs and trees must be undertaken for slope stabilization
- Provision for culverts must be given in design near water bodies.
- Proper drainage must be provided along the road
- The extraction of material should be done from the identified quarry site only.
- If new quarry sites are required then prior permission has to be taken from the owner.



- The quarry area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized.
- Top soil removed during excavation work should be stored separately in bunded area and may be utilized during plantation or refilling of excavated area.
- Construction work may be avoided during rainy season to evade erosion and spreading of loose material.

Plant Species recommended for slope stabilization and rehabilitation of quarry and borrow areas are given in the table below

**Table 5.1: Species Recommended for Slope Protection & Reclamation of sites**

| S. No. | Scientific name                  | Common Name |
|--------|----------------------------------|-------------|
| 1      | <i>Agave americana</i>           | Rambans     |
| 2      | <i>Eupatorium adenophorum</i>    | Basinga     |
| 3      | <i>Euphorbia royleana</i>        | Shuru       |
| 4      | <i>Opuntia dilleni</i>           | Nagphani    |
| 5      | <i>Carisa spinarium</i>          | Karonda     |
| 6      | <i>Zizyphus mauritiana</i>       | Ber         |
| 7      | <i>Rumex hastatus</i>            | Bhilmora    |
| 8.     | <i>Murraya koengi</i>            | Kath Neem   |
| 9      | <i>Colebrookea oppositifolia</i> | Bindu       |
| 10.    | <i>Bauhinia variegata</i>        | Kachnar     |

### 5.2.5 Impact on Air Quality

The construction activity is likely to impact the air quality due to generation of dust and emission from equipments and vehicles. However the impact will be temporary and limited to construction site.

#### **Mitigation Measures**

- All exiting approach road used by vehicles must be kept clean and clear of dust
- Adequate dust suppression measures such as regular water sprinkling on construction sites, haul & unpaved roads particularly near habitation must be undertaken to control fugitive dust
- Trucks carrying soil, sand and stone may be duly covered to avoid spilling.
- Plants, machinery and equipment must be handled so as to minimize generation of dust.
- All crusher used in construction shall conform to relative dust emission devises
- The machineries, vehicles and equipments use in construction shall strictly confirm to CPCB standard.



### 5.2.6 Noise Level

The noise level of the construction site is likely to increase due to various activities, which may cause disturbance to the inhabitants and fauna in the area. However this impact would be insignificant as the increase in noise shall be intermittent and temporary

#### ***Mitigation Measures***

- The machineries, vehicles and equipments use in construction shall strictly confirm to CPCB standard.
- All vehicles equipment machinery used in construction shall be fitted by exhaust silencers.
- Equipments should be maintained regularly and soundproof gadgets should be used.
- Head phones, ear plugs to be provided to the workers at construction site.
- Blasting shall be carried out as per the statutory laws, regulation and rules pertaining to acquisition, transport, storage, handling and use of explosives

### 5.2.7 Water Quality

The water bodies near the construction site are likely to be polluted due to runoff from the construction site or spilling of construction material. Turbidity of the water is likely to rise however the impact will be temporary and reversible. Four bridges are proposed over river Alaknanda, the quality of the river is likely to be affected during construction.

#### ***Mitigation Measures***

- Provision of temporary drainage arrangement due to construction activities must be made by Contractor and clause must be incorporated in General Conditions of Contract document for its effective implementation.
- Silt fencing may be provided near water bodies.
- Discharge of waste from construction/labour camp into water bodies may be strictly prohibited.
- Construction methodologies with minimum or no impact on water quality may be adopted, disposal of construction wastes at designated sites and adequate drainage system may be provided.
- Construction activity may be prohibited during rainy season near water bodies.
- Water quality monitoring may be conducted during construction phase.

### 5.2.8 Impact due to Establishment of Labour Camp

During construction phase Construction / Labour Camp will be located along the project area. Large numbers of labor population is likely to influx in the project area. The establishment of labour camps is likely to have significantly affects environment through improper waste (Solid & Garbage /Sewage) disposal, negative impacts on



public health unfriendly use of community resources, poaching of wildlife by laborers, and leaving dirty and waste material after shifting from one site to another site. Laborers may cut trees for cooking purpose.

### **Mitigation Measures**

- In order to mitigate these impacts suggested, mitigation measures are;
- Construction of camps should be located at least 500 meters away from habitation and forest areas,
- Adequate supply of fuel in the form of kerosene or LPG may be provided to construction laborers to avoid felling of trees for cooking and other household activities. A common community kitchen can be also established. No open fires may be allowed in camps.
- Adequate sanitary facilities may be provided within every camp. The place must be cleaned daily and kept in strict sanitary condition. Separate latrine must be provided for women. Adequate supply of water must be provided
- Reference to the illegally cutting trees, hunting and other prohibited activities in community areas to be included in the contract document and
- On completion of work ensure that clean area left behind.
- During construction laborers/ workers may be hired from local communities also or other part of the villages as far as possible to avoid social conflict in the construction camp and thereby minimizing resources conflict.

To minimize these impacts construction work should be carried out in an environmentally sound manner by sprinkling of water and proper maintenance of construction equipment machineries and vehicles. Proper cover for construction vehicles, machineries & equipment transporting stone & material, confined stone crushing & transportation activities during daytime, use of bitumen emulsion wherever possible, use of diesel fuelled asphalt mixing plants when bitumen heating is required, log and boulder barriers to control slipping of excavated materials, slope stabilization techniques etc.



## CHAPTER 6

### ENVIRONMENTAL MANAGEMENT PLAN

Environmental Management Plan is an implementation plan to mitigate and offset the potential adverse environmental impacts of the project and enhance the positive impacts. Based on the environmental baseline conditions, planned project activities and impacts assessed earlier, this section enumerates the set of measures to be adopted to minimize the adverse impacts. Process of implementing mitigation and compensatory measures, execution of these measures agencies responsible for the implementation of these measures and indicative costs is discussed in this chapter.

The construction work entails civil work including excavation, filling, construction of bridge over river Alaknanda at three locations & cross drainage structures and four approach roads which are likely to cause adverse impacts on natural environment. The impacts due to construction activities cannot be fully avoided however appropriate mitigation measures are suggested to minimize and compensate the potential adverse impacts and enhance positive impacts. Most of the impacts are temporary in nature and are limited to construction phase only which can be minimized and managed by proper planning and execution. The environmental management plans includes activities for pre-construction phase, construction phase and operation phase.

#### 6.1 ENVIRONMENTAL MANAGEMENT PROCESS

Environmental management is based on the potential impacts assessed for the project. The implementation of Environmental Management Plan requires the following:

- An organizational structure
- Assign responsibilities
- Define timing of implementation
- Define monitoring responsibilities

#### 6.2 MANAGEMENT ISSUES - CONSTRUCTION AND OPERATION PHASE

The project activities will be executed in phased manner, Pre-construction Phase, Construction Phase and Operation phase. The major activities to be undertaken are:

##### 6.2.1 Construction Phase

The environmental issues during construction stage generally involve safety and public health issue. The construction agency is required to comply with the laws with respect to Environment protection, Pollution Prevention, Forest Conservation, Resettlement and safety and any other applicable law. Environmental pollution during the construction phase will be less but control of pollution during this phase is of considerable importance. The activities are to be guided, controlled, monitored and managed as per the provision provided. Following activities require attention during construction phase.





## **i Emission and Dust Management Plan**

Fugitive dust from site works and emission from vehicles and plants (eg crushing and concrete batching) have the potential to affect the air quality. The contractor must implement prevention method to control dust resulting from construction related activities including quarry sites, crushing and concrete batching plants, haulage material and construction camps.

- The asphalt plant used for during road construction must be equipped with dust collectors
- Water sprinklers must be used to reduce particulate matter emission.
- Speed limit must be maintained by the trucks and dumpers
- The machinery and vehicles must be inspected with regard to their exhaust system and emission level
- Vehicles carrying fine materials such as cement, soil etc must be covered
- Central Pollution Control Board norms for emissions must be complied with.

## **ii Construction / Labour Camp Management**

- During construction phase Construction / Labour Camp will be located along the project area. Labor population is likely to influx in the project area. A proper Construction Camp Development Plan has to be formulated to control degradation of the surrounding landscape due to the location of the proposed construction camp. The contractor must provide, erect and maintain necessary living condition and ancillary facilities that must be included in contract document provided to the Contractor.
- Sufficient supply of potable water may be provided at camps and working sites. If the drinking water is obtained from the intermittent public water supply then storage tanks must be provided. All water supply storage may be at least 15m away from the toilets or drains.
- Adequate washing and bathing facility must be provided in clean and drained condition.
- Adequate sanitary facilities may be provided within every camp. The place must be cleaned daily and kept in strict sanitary condition. Separate latrine must be provided for women. Adequate supply of water must be provided.
- Collection of domestic waste and its suitable disposal may be carried out on timely basis.
- The contractor must ensure that proper drainage system to avoid creation of stagnant water bodies.
- Periodic health check ups may be conducted. These activities may be provided by the construction contractor in consultation with State Public Health Department.
- At every Camp first aid facility may be provided Suitable transport must be provided to take injured or ill person to the nearest hospital.
- Adequate supply of fuel in the form of kerosene or LPG may be provided to construction labours to avoid felling of trees for cooking and other household activities. No open fires may be allowed in camps.
- The construction contractor may ensure that all construction equipments and vehicle machinery may be stored at a separate place/yard. Fuel storage and refilling areas may be located 500m away from the water bodies and from other cross drainage structures.



- All the construction workers should be provided with proper training to handle potential occupational hazards and on safety and health which include the following:
  - ❖ Environmental Awareness program
  - ❖ Medical surveillance
  - ❖ Engineering controls, work practices and protective equipment
  - ❖ Handling of raw and processed material
  - ❖ Emergency response
- Construction / labour camps may be located away from forest areas, settlements, cultural heritage & historical sites and water bodies & dry stream beds.
- It should be ensured by the construction contractor that area of the construction camp be cleared of the debris and other wastes deposited on completion of construction. The land should be restored back to its original form and condition as it was prior to the establishment of the construction camps.

### iii Borrow Area Management Plan

An appropriate Borrow Area Management Plan will be formulated to control degradation of the surrounding landscape due to the excavation work. The national standard which applies to the manual borrowing of earth is the IRC-10 : 1961 .

- Borrowing of earth will be carried out upto depth of 150cm from existing ground level and shall not be done continuously. Slopes of edges shall be maintained not steeper than 1:4.
- Top soil (20cm) from all areas may be preserved in stockpiles and utilized for redevelopment of borrow / quarry areas. Topsoil shall be stripped to a depth of 200 mm from areas proposed and stockpiled to a height of 400 mm in pre – designated areas for preservation and shall be reapplied to site during plantation of the proposed vegetation. Measures should be applied to control erosion of preserved top soil. Top soil shall be separated from sub-soil debris and stones larger than 50 mm diameter.
- Borrow pit should be developed as far as possible from the river side, where the inner edge of any borrow pit should be not less than 15m away from the toe bank.
- Borrowing of earth shall not be carried out on productive land in the event of such an occasion, contractor has to obtain permission of the engineer incharge.
- No borrow areas will be opened without the prior permission from the local administrative bodies like Village Panchayats, State Department of Irrigation, Agriculture and State Pollution Control Boards etc.
- Reclamation of borrow area should be mandatory and must be included in the agreement made with the Construction Contractor
- Borrow pits may be located away from the villages and settlements.
- All borrow pits may be reclaimed.
  - The quarry and borrow area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized.
  - Spoils may be dumped with an overlay of stocked piled top soil with respect to MoEF/SPCB guidelines.
  - Borrow and Quarry pits can be also developed as park or picnic spots.
  - Landscaping of borrow and quarry area may be done and grasses, shrubs & tree species may be planted around the reclaimed area. Ornamental plants may be planted on the access route.



#### iv Public Health and Safety

The contractor is required to comply with all the precautions as required for the safety of the workmen. The contractor must comply with all regulation regarding scaffolding, ladders, working platform, excavation etc.

- The contractor must supply safety goggles, helmets, earplugs and masks etc. to the workers and staff.
- Adequate precaution must be taken to prevent danger from electrical equipments. Necessary light and fencing must be provided to protect the public.
- All machines & equipments used in the construction must conform to relevant Indian Standard (IS) Codes, must be free from patent defects, in good working condition, regularly inspected and properly maintained as per IS provisions.
- All workers employed on mixing of asphaltic material, cement, lime mortars, concrete etc. may be provided with protective footwear and protective goggles. Workers involved in welding work may be provided with welder's protective eye shields.
- No men below age of 18 years or women will be employed on the work of painting with products containing lead in any form. Face mask may be supplied to for use to the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
- All necessary steps must be taken to prompt first aid treatment of all injuries likely to sustain during the course of work.

#### 6.2.2 Operation Phase

During Operation phase maintenance of water quality and distribution of water along DFC alignment and command area is most important task besides other activities

#### i Green Belt Development

Green belt development may be undertaken along Road near settlements to augment air quality, vegetation and aesthetic value of the area. Green belt with selected plant species attenuates the air pollution levels and are resistant to dust, CO, SO<sub>2</sub> and NO<sub>x</sub> and control air pollution impacts. On this basis a Green Belt Development Plan should be formulated. The major objectives of the plantation would be:

- (i) Attenuation of gases and particulates
- (ii) Will act as noise barrier/buffers for reduction of noise levels
- (iii) Plantation along the road side for shade, beautification and aesthetics

**Table 6.1: Species for Avenue Plantation along Proposed Roads**

| S. No. | Scientific name                 | Common Name  | Colour of Flower |
|--------|---------------------------------|--------------|------------------|
| 1      | <i>Albizzia lebbek</i>          | Siris        | Yellowish white  |
| 2      | <i>Bombax ceiba</i>             | Semul        | Orange/ Red      |
| 3      | <i>Callistemon lantecolatus</i> | Bottle Brush | Red              |
| 4      | <i>Bauhinia verigata</i>        | Kachnar      | Purple           |



|    |                                |            |        |
|----|--------------------------------|------------|--------|
| 5  | <i>Melia azaderach</i>         | Baken      | White  |
| 6  | <i>Delonix regia</i>           | Gulmohar   | Red    |
| 7  | <i>Jacarana mimosifolia</i>    | Jacaranda  | Purple |
| 8  | <i>Grevillea robusta</i>       | Silver Oak | Yellow |
| 9  | <i>Mallotus philippinensis</i> | Kamala     | Red    |
| 10 | <i>Cedrela toona</i>           | Toon       | Yellow |

Besides the above mentioned plants fruit bearing trees may be also planted. The plantation carried under the project will have provision for maintenance for at least three years.

### 6.3 ENVIRONMENTAL MANAGEMENT PLAN & RESPONSIBILITIES

**Table 6.2** presents summary of Environmental Management Plan with the objective of minimization of adverse environmental impacts. The table covers all possible environmental issues involved in the project and necessary mitigation measures. Undertaking appropriate mitigation measures for the construction phase is the responsibility of the Construction Contractor and the Site incharge / Environmental incharge of THDC.

The mitigation measures during the operation phase will be implemented by Environmental incharge of THDC. Thus the overall responsibility for the implementation of mitigation measures will be with the Construction Contractor during the construction phase and THDC during operation phase. The details of Environmental Management Program are discussed in the subsequent paragraphs.

**Table 6.2: Environmental Management Plan & Responsibilities**

| S. No                     | Environmental Issue | Actions to be Taken   | Implementation Agency   | Supervision Agency                          |
|---------------------------|---------------------|---|-------------------------|---|
| <b>Construction Phase</b> |                     |   |                         |   |
| 1.                        | Hill Cutting        | <ul style="list-style-type: none"><li>Minimize hill cutting by following restricted RoW to the maximum extent,</li><li>Use of full cut method, use of debris as construction material based on their suitability and unused material should be disposed at pre-identified disposal sites.</li><li>Appropriate bio-engineering techniques must be used immediately after cutting to maintain stability of slope above and below ROW.</li><li>Work may be restricted during rainy season.</li></ul> | Construction Contractor | Site Incharge /Environmental incharge, THDC |



| S. No | Environmental Issue | Actions to be Taken  | Implementation Agency   | Supervision Agency   |
|-------|---------------------|--|-------------------------|--|
|       |                     | <ul style="list-style-type: none"><li>Controlled blasting techniques must be used. Warning must be given to the inhabitants to stay away from the site to avoid any mis-happening.</li></ul>   |                         |  |
| 2.    | Flora               | <ul style="list-style-type: none"><li>Compensatory Afforestation may be carried to compensate the loss of trees. Double no. of trees may be planted in lieu of trees felled. Implementation of approved Compensatory Afforestation Plan in accordance with Forest (conservation) Act 1980 and Uttarakhand Forest Policy must be undertaken.</li><li>The vulnerable species <i>Berginia ligulata</i> (silpara), <i>Hedychium spicatum</i> (Banhaldi) and <i>Thalictrum foliolosum</i> (Mamiri) found in the area must be developed in separate herbal garden. THDC must undertake development of Herbal garden at suitable place in consultation with forest department and propagation of the species must be taken. Besides the three species other species of medicinal value may be also encouraged.</li><li>Proper protection measures should be taken for the plantation work carried under the project. Van Panchayats may be involved in afforestation activity and monitoring of the plantation work.</li><li>Proper compensation must be given to Van Panchayats for the land and standing crops. Compensation must be provided before initiating construction activity</li><li>Compensation for fruit bearing trees may be compensated including cost of fruit yield of 5 years.</li><li>Trees falling outside the ROW should not be felled.</li></ul> | Construction Contractor | Forest Dept/<br>Environmental incharge,<br>THDC              |
| 3.    | Fauna               | <ul style="list-style-type: none"><li>Construction activities may be avoided during night hours near forest area.</li><li>Poaching must be strictly banned in</li></ul>  | Construction Contractor | Forest Dept/<br>Environmental incharge,<br>Project Authority |



| S. No | Environmental Issue      | Actions to be Taken   | Implementation Agency   | Supervision Agency           |
|-------|--------------------------|---|-------------------------|------------------------------|
|       |                          | <p>the Forest area. It may be ensured by the Contractor that no hunting is practiced at the site by any of the worker and that all site personnel are aware of the location, value and sensitivity of the wildlife resources</p> <ul style="list-style-type: none"> <li>▪ The project area is located in the transitional zone of Nanda Devi Biosphere reserve. Movement of wildlife is reported in the area therefore check post may be established in the project sites in consultation with Forest Department.</li> <li>▪ Plantation of tree species which are major sources of fodder for wildlife in consultation with forest department in degraded and open areas.</li> <li>▪ Awareness program on Environment and Wildlife Conservation may be provided to the work force. Forest Act and Wildlife Act may be strictly adhered to.</li> </ul>             |                         |                              |
| 4.    | Land & Soil conservation | <ul style="list-style-type: none"> <li>▪ Proper bioengineering measures must be applied for slope stabilization.</li> <li>▪ Plantation of grasses, shrubs and trees must be undertaken for slope stabilization</li> <li>▪ Provision for culverts must be given in design near water bodies.</li> <li>▪ Proper drainage must be provided along the road</li> <li>▪ The extraction of material should be done from the identified quarry site only.</li> <li>▪ If new quarry sites are required then prior permission has to be taken from the owner.</li> <li>▪ The quarry area should be reclaimed back. The pits formed should be backfilled by construction waste and site should be stabilized.</li> <li>▪ Top soil removed during excavation work should be stored separately in bunded area and may be utilized during plantation or refilling of</li> </ul> | Construction Contractor | Environmental incharge, THDC |



| S. No | Environmental Issue | Actions to be Taken   | Implementation Agency   | Supervision Agency           |
|-------|---------------------|---|-------------------------|------------------------------|
|       |                     | <p>excavated area.</p> <ul style="list-style-type: none"><li>Construction work may be avoided during rainy season to evade erosion and spreading of loose material.</li></ul>   |                         |                              |
| 5.    | Air Quality         | <ul style="list-style-type: none"><li>All exiting approach road used by vehicles must be kept clean and clear of dust</li><li>Adequate dust suppression measures such as regular water sprinkling on construction sites, haul &amp; unpaved roads particularly near habitation must be undertaken to control fugitive dust</li><li>Trucks carrying soil, sand and stone may be duly covered to avoid spilling.</li><li>Plants, machinery and equipment must be handled so as to minimize generation of dust.</li><li>All crusher used in construction shall confirm to relative dust emission devises</li><li>The machineries, vehicles and equipments use in construction shall strictly confirm to CPCB standard.</li><li>Trucks carrying soil, sand and stone may be duly covered to avoid spilling.</li><li>Low emission construction equipment, vehicles and generator sets may be used</li><li>Plants, machinery and equipment should be handled so as to minimize generation of dust.</li><li>All crusher used in construction should confirm to relative dust emission devises</li><li>Air quality monitoring may be conducted at construction sites.</li></ul> | Construction Contractor | Environmental incharge, THDC |



| S. No | Environmental Issue | Actions to be Taken  | Implementation Agency   | Supervision Agency           |
|-------|---------------------|--|-------------------------|------------------------------|
| 6.    | Noise               | <ul style="list-style-type: none"><li>▪ Modern technologies producing low noise may be used during construction.</li><li>▪ Construction equipment's and vehicles must be in good working condition, properly lubricated and maintained to keep noise within permissible limit as prescribed by CPCB.</li><li>▪ Head phones, ear plugs to be provided to the workers at construction site.</li><li>▪ All vehicles, equipment and machinery used in construction should be fitted by exhaust silencers, mufflers or acoustic cover.</li><li>▪ Noise level monitoring must conducted during construction phase.</li></ul>   | Construction Contractor | Environmental incharge, THDC |
| 7.    | Water Quality       | <ul style="list-style-type: none"><li>▪ Provision of temporary drainage arrangement due to construction activities must be made by Contractor and clause must be incorporated in General Conditions of Contract document for its effective implementation.</li><li>▪ Silt fencing may be provided near water bodies.</li><li>▪ Discharge of waste from construction/labour camp into water bodies may be strictly prohibited.</li><li>▪ Construction methodologies with minimum or no impact on water quality may be adopted, disposal of construction wastes at designated sites and adequate drainage system may be provided.</li><li>▪ Construction activity may be prohibited during rainy season near water bodies.</li><li>▪ Water quality monitoring may be conducted during construction phase</li></ul> | Construction Contractor | Environmental incharge, THDC |





| S. No                  | Environmental Issue    | Actions to be Taken   | Implementation Agency        | Supervision Agency           |
|------------------------|------------------------|---|------------------------------|------------------------------|
| 8.                     | Solid Waste            | <ul style="list-style-type: none"> <li>▪ Construction work must be carried in such a way that minimum or no solid waste is generated at construction site.</li> <li>▪ Adequate number of dustbin/ container must be provided</li> <li>▪ Solid waste must be collected and disposed properly taking permission from concerned authority.</li> <li>▪ Domestic waste must be collected separately. Toxic waste (oil, solvents, paints, acids, additives) should not be collected with solid waste.</li> <li>▪ Project personnel must be trained on collection and disposal method for different waste.</li> <li>▪ Illegal dumping at construction site, camp area or into river will not be allowed</li> </ul> | Construction Contractor      | Environmental incharge, THDC |
| 9.                     | Safety measures        | <ul style="list-style-type: none"> <li>▪ Warning and safety signs must be provided all around the sites</li> <li>▪ An ambulance must be provided which is ready to mobilize, on site for 24 hrs for emergency situation</li> <li>▪ First aid facility must be available at site</li> <li>▪ Extra precaution must be taken while working with flammable material. Flammable liquid leaks and spills must be cleaned immediately.</li> <li>▪ Adequate Fire extinguishers must be provided at site and workshop. All workers must know the use of extinguisher.</li> <li>▪ Emergency preparedness plan must be formulated</li> </ul>   | Construction Contractor      | Environmental incharge, THDC |
| <b>Operation Phase</b> |                        |   |                              |                              |
| 1.                     | Maintenance Plantation | <ul style="list-style-type: none"> <li>▪ Provision for maintenance of plantation must be made for at least three years.</li> <li>▪ Plantation may be taken to replace dead sapling. Survey of survival of plants may be taken periodically. Species of local importance must be planted.</li> </ul>   | Environmental in-charge THDC | Forest Dept                  |



| S. No | Environmental Issue     | Actions to be Taken   | Implementation Agency        | Supervision Agency    |
|-------|-------------------------|---|------------------------------|-----------------------|
|       |                         | <ul style="list-style-type: none"><li>Awareness programs should be held for the stakeholders to develop concern for conservation of biodiversity in the area.</li></ul>   |                              |                       |
| 3     | Safety System           | <ul style="list-style-type: none"><li>Proper communication network system in project area</li><li>Awareness program for the staff and local inhabitants</li><li>Emergency Action Plan</li></ul>                   | Environmental in-charge THDC | Project Incharge THDC |
| 4     | Maintenance of Drainage | <ul style="list-style-type: none"><li>It must be ensure that all drains are periodically cleaned specially before monsoon smooth flow of water and to avoid flooding and resulting mud flow/land slides</li></ul> | Environmental in-charge THDC | Project Incharge THDC |

#### 6.4 ENVIRONMENTAL MONITORING PLAN

The Environmental Monitoring plan will guide the environmental measures to be carried out by Project Authority with support from the project implementation units, contractor and other parties concerned with mitigating possible environmental impact of the project roads. The institutional requirement, monitoring activities and who will carry out them in given in details in subproject specific Environmental Monitoring Plan below. The Project Authority will ensure the following

- (i) All mitigation measure that need to be incorporated into the project design are passed on to the engineering consultants,
- (ii) The bidding document for the contractor contains all required mitigation measures to be implemented during the construction period and the obligation for the contractor to implement the EMP during the construction period
- (iv) The environmental clearance is obtained before any civil work contract is granted,
- (v) Implementation of the EMP is monitored regularly and the annual report on the implementation of the EMP is well documented,
- (vi) There is coordination with other parties and the government agencies in implementation the EMP at all stages of the subproject,
- (vii) Remedial action is undertaken in response to unpredicted environmental impact.

To ensure that the contractor complies with the EMP, the following specification should be incorporated into all construction bidding documents: (i) environmental mitigation measures and environmental monitoring that need to be implemented by the contractor, and (ii) environmental clauses for the contract condition and specification. The monitoring activity to be undertaken is given in the Table 6.3.



**Table 6.3 Environmental Monitoring Plan**

| Environment component | Project Stage      | Regular Monitoring Parameters                |                          |  |                                    |  |   | Institutional Responsibilities                |                               |
|-----------------------|--------------------|--|--------------------------|--|------------------------------------|--|---|---|-------------------------------|
|                       |                    | Parameters                                   | Standards                | Location   | Frequency                          | Duration   | Action plan in case criteria exceeds  | Implementation                                | Supervision                   |
| Air                   | Construction stage | SPM, RSPM, SO <sub>2</sub> , NO <sub>x</sub> | As per CPCB standards    | Wherever the supervisor contractor decides to locate the Hot mix plant | Once in a season excluding monsoon | Continuous 24 hours/ or for 1 full working day   | Check and modify control devices like bag filter/cyclones of hot mix plant. | Contractor through approved monitoring agency | THDC/Super vision Consultant, |
|                       |                    | SPM, RSPM, SO <sub>2</sub> , NO <sub>x</sub> | As per CPCB standards    | near residential areas   | Once in a season excluding monsoon | Continuous 24 hours/ or for 1 full working day   | Check and modify control devices like bag filter/cyclones of hot mix plant. | Contractor through approved monitoring agency | THDC/Super vision Consultant  |
|                       | Operation Stage    | SPM, RSPM, SO <sub>2</sub> , NO <sub>x</sub> | As per CPCB standards    | near residential areas   | Once in a season excluding monsoon | Continuous 24 hours/ or for 1 full working day   | -   | Contractor through approved monitoring agency | THDC/Super vision Consultant  |
| Noise Levels          | Construction stage | Noise levels on dB (A) scale                 | Noise standards by CPCB. | At equipment yards and near residential areas                          | One in each season                 | Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged | Check muffler system & maintenance schedule of equipments.                  | Contractor through approved monitoring agency | THDC/Super vision Consultant  |



| Environment component | Project Stage      | Regular Monitoring Parameters  |  |   |                                    |   |   | Institutional Responsibilities                |                               |
|-----------------------|--------------------|--|--|---|------------------------------------|---|---|---|-------------------------------|
|                       |                    | Parameters   | Standards                              | Location                                  | Frequency                          | Duration  | Action plan in case criteria exceeds                        | Implementation                                | Supervision                   |
| Water Quality         | Operation stage    | Noise levels on dB (A) scale   | Noise standards by CPCB                | At residential locations                  | One in each season                 | Readings to be taken at 15 seconds interval for 15 minutes every hour and then averaged | Check muffler system & maintenance schedule of equipments.  | Contractor through approved monitoring agency | THDC/Super vision Consultant, |
|                       | Construction stage | PH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total, Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, Iron.<br>COD, BOD, Iron, Total Coliform, fecal coliform | Ground Water quality standards by CPCB | At surface water & ground water locations | Once in a season excluding monsoon | -   | Check and modify petrol interceptors, Silt fencing devices. | Contractor through approved monitoring agency | THDC/Super vision Consultant  |



| Environment component | Project Stage   | Regular Monitoring Parameters  |  |                        |                                    |          |   | Institutional Responsibilities                |                              |
|-----------------------|-----------------|--|--|------------------------|------------------------------------|----------|---|---|------------------------------|
|                       |                 | Parameters   | Standards                              | Location               | Frequency                          | Duration | Action plan in case criteria exceeds                        | Implementation                                | Supervision                  |
| Water quality         | Operation stage | PH, Temperature, Conductivity, TSS, TDS, Alkalinity, Total, Hardness, Calcium, Magnesium Chloride, Phosphate, Sulphate, Nitrate, Iron.<br><br>COD, BOD, Iron, Total Coliform, fecal coliform | Ground Water quality standards by CPCB | At required locations* | Once in a season excluding monsoon | -        | Check and modify petrol interceptors, Silt fencing devices. | Contractor through approved monitoring agency | THDC/Super vision Consultant |



## 6.5 ENVIRONMENTAL BUDGET

Tentative Environmental Budget of Rs. 3,93,000/- (Three lakh ninety three thousand only) has been estimated. (It is envisaged that other mitigation measures are part of the engineering design such as slope stabilization, culverts, dust suppression, etc.). This provides for the following components:

- a. Monitoring cost for Air Rs. 108,000/- (4 locations @ Rs. 3000/- per sample) where seasonal monitoring will be done for three years.  

Monitoring cost for Noise Rs. 18,000/- (4 locations @ Rs. 500/- per sample) where seasonal monitoring will be done for three years.

Monitoring cost for surface water Rs. 72,000/- (2 locations @ Rs. 4000/- per sample) where seasonal monitoring will be done for three years.
- b. Cost for Roadside Plantation (50 trees per km.) Rs. 195,000/-. Cost taken for plantation and maintenance of trees for three years at the rate of Rs. 300/-.

## 6.6 RECOMMENDATIONS FOR ADVANCED CONSTRUCTION SITES

### 1 Slope Stabilization

Occurrence of landslide is the most critical aspect in road construction. Cutting of road, clearing vegetation and movement of men & machines is likely to trigger landslide. Slope stabilization measures are recommended. Both vegetative and engineering measures may be followed.

Vegetative measures include plantation of soil binding and quick growing plants. Species such as *Agave americana* (Rambans) *Eupatorium adenophorum* (Basinga) *Rumex hastatus* (Bhilmora) *Euphorbia royleana* (Shuru), etc may be planted. Seeds of grasses may be also sprinkled on the slopes as grasses grow quickly and binds the soil.

Engineering structures include surface drainage, toe protection, construction of check dams etc. Depending on the slope gabion or stone check dams may be constructed. Vegetative check dams may be also constructed wherever feasible.

### 2. Drainage

Construction of drainage is essential along the approach roads. The project area has an average rainfall of 125 cm per annum. The water flowing without proper drainage causes soil erosion and increases maintenance cost of roads. The drainage constructed along the roads must be properly lined and cleaned regularly to prevent blockage

### 3. Culverts and Bridges

Besides construction of bridges over river Alaknanda along the proposed roads there are many small channels /streams flowing in the area. Most of them are dry during lean season however during rainy season they are prone flooding. Hence proper



culverts / bridges may be constructed at the waterfall/stream to avoid any accident during operation phase.

#### **4 Wildlife Conservation**

The project area is located in the transitional zone of Nanda Devi Biosphere reserve. Movement of wildlife is reported in the area therefore check post may be established in the project sites in consultation with Forest Department.

#### **5. Herbal Garden**

It is suggested that a Herbal Garden must be developed by THDC at suitable place in consultation with Forest Department under the project. Propagation of the species *Berginia ligulata* (Silpara), *Hedychium spicatum* (Banhaldi) and *Thalictrum foliolosum* (Mamiri) found in the advance construction area must be taken up. Besides the three species other native herbal species of medicinal value may be also grown.