ENVIRONMENT IMPACT ASSESSMENT & EMP REPORT FOR

"TSOMGO PASSENGER ROPEWAY"

NOVEMBER 2015

AT

TSOMGO LAKE, DISTRICT EAST OF SIKKIM, SIKKIM

(Reference- TOR letter no. F. No. 10-12/2014-IA.III dated 17-12-2014)
Land Area- 8072 sq m
Elevation- 3764 m to 3994 m
Alignment Length- 625 m
Category- 'A'-7(g)
Cost of Project- Rs. 9 Crores

Being Developed By:

TOURISM & CIVIL AVIATION DEPARTMENT, GOVT. OF SIKKIM

Gangtok, Sikkim

Prepared By:

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CHAPTER 1: INTRODUCTION

1.1 PRELUDE

Tsomgo lake (or Changu lake), one of the spectacular landscapes of East Sikkim is located adjacent to Gangtok – Nathula Highway (Jawaharlal Nehru Marg) at a distance of 38 Km from the Capital City Gangtok. The lake is situated at an altitude of 3780 m.

Government of Sikkim (Tourism & Civil Aviation Department) as an endeavour to promote tourism, wished to install a Passenger Ropeway at Tsomgo Lake, Gangtok, Sikkim with Private Sector participation on Build, own, Operate & Transfer (BOOT) basis.

The project had already been granted **Environmental Clearance** from SEIAA, Sikkim and the project work was started and was on the verge of completion.

But, a **legal notice** was served by Shri Arunav Tewari, Advocate, Supreme Court of India and Mr. Pradeep Kumar Mittal, Advocate, Supreme Court of India, New Delhi that Environmental Clearance was issued on basis of Environment Impact Assessment Notification, 2006, instead of the notification no. S.O. 3067(E) dated 1st December 2009 according to which clearance from Ministry is required. The SEIAA examined the issue and suspended the EC.

The Project is a 625 m long aerial ropeway, covering an area of 8072 sq m (including Lower Terminal Station, Upper Terminal Station & ropeway corridor). The Lower Terminal Point (LTP) has been developed in south to the lake on right side of the existing Alpine Café and the Upper Terminal Point (UTP) has been developed on the hill top from where the picturesque view of Changu lake can be rejoiced.

1.2 LOCATION OF THE PROJECT

The ropeway is developed from the southern side of the Changu lake to the hill top.

Place- Changu Lake

District-East of Sikkim

State- Sikkim

The Land is a forest land, which falls within the Kyongnosla range.

1.3 TYPE OF PROJECT

The project being an Aerial Ropeway falls under the **activity 7 (g)** of the EIA notification, 2006 and is a designated Project as per Schedule and falls under **category A** due to the following two conditions of EIA Notification & its amendments:

I. The project site is located at an altitude above 1000 m (as per the S.O. 3067(E) dated 1st December 2009)
II. The project site falls within 10 Km radius of the Kyongnosla Wildlife Sanctuary (as pet General Conditions).

1.4 ROPEWAY SYSTEM TECHNOLOGY

Aerial Ropeway is a system in which men or material are suspended from a rope in cabins, chairs, buckets or cable cars and are hauled by another rope from one point to another. Various types of Ropeway systems are discussed in Section 3.3 of the EIA report.

The ropeway system proposed to be used in this project is **Mono-cable Fixed Grip (Jig Back) system**. Fixed grip installations are the types of ropeways whose grip is permanently fixed and tight on the rope and is not taken off the rope in the station. As the sets pass through the stations the rope speed immediately

slows and finally it comes to a halt while the passengers can de-board and board at station. Detailed description is given in Section 3.4 of the EIA report.

1.5 ABOUT PROJECT PROPONENT

Government of Sikkim (Tourism & Civil Aviation Department) in order to implement a project under the tourism infrastructure development programme requested M/s Conveyor & Ropeway Services Pvt. Ltd. (CRSPL), a specialized engineering organization engaged in concept development, feasibility study, design, manufacture, supply, erection, commissioning, operation and maintenance of Aerial Ropeway System, for both Material and Passenger transportation to undertake detailed Feasibility and Project Viability Analysis for establishment of passenger ropeway to the site. The license has been granted to M/s Conveyor & Ropeway Services Pvt. Ltd. (CRSPL) for a period of 20 years from the date of start of the commercial operation.

1.6 ENVIRONMENTAL CONSULTANTS INVOLVED IN THE PROJECT

M/s Perfact Enviro Solutions Pvt. Ltd., established by experienced environmental and related experts, provides specialized services in the field of Environment and Pollution Control for all types of Industrial, Construction, Nuclear Sciences, Bio-diversity Mining and other related fields. Our transparent and professional approach, commitment to excellent quality and service, timely deliveries have contributed to create a name in the field of environment.

M/s Perfact Enviro Solutions Pvt. Ltd. is NABET Registered vide list of accredited consultants organizations/ Rev 34/ 7th September, 2015 at S.No-115 & an ISO 9001:2008 & ISO 14001:2004 Certified Company. We have a core group of highly qualified experts from various fields like environment, chemistry, civil engineering, geology, social sciences, electronics and telecommunication with rich and diversified experience in the field of environment and pollution control.

Perfact Group management, experience, excellence, professionalism and ultimate satisfaction has helped in achieving the heights of success in their specialized field of environment.

The Environmental Monitoring for air, water, soil & noise has been conducted by in-house NABL accredited laboratory namely **M/s Perfact Researchers Pvt. Ltd.**

1.7 ENVIRONMENTAL LEGISLATIONS APPLICABLE TO THE PROJECT

The following legislations are applicable on the project. Therefore, it is the responsibility of developer to comply them:

THE FOREST (CONSERVATION) ACT 1980, WITH AMENDMENTS MADE IN 1988

Under Section 2. Restrictions on the de reservation of forests or use of forest land for non- forest purpose

Notwithstanding anything contained in any other law for the time being in force in a State, no State Government or other authority shall make, except with the prior approval of the Central Government, any order directing:

1) That any reserved forest (within the meaning of the expression "reserved forest" in any law for the time being in force in that State) or any portion thereof, shall cease to be reserved;
2) That any forest land or any portion thereof may be used for any non-forest purpose;
3) That any forest land or any portion thereof may be assigned by way of lease or otherwise to any private person or to any authority, corporation, agency or any other organisation not owned, managed or controlled by Government;
4) That any forest land or any portion thereof may be cleared of trees which have grown naturally in that land or portion, for the purpose of using it for re afforestation.

THE INDIAN WILDLIFE (PROTECTION) ACT, 1972

Under Section 9. Prohibition of Hunting. – No person shall hunt any wild animal specified in Schedule, I, II, III and IV except as provided under section 11 and section 12.

Under Section 11. Hunting of Wild animals to be permitted in certain cases.

1) Notwithstanding anything contained in any other law for the time being in force and subject to the provisions of Chapter IV –
   a) the Chief Wildlife Warden may, if he is satisfied that any wild animal specified in Sch. 1 has become dangerous to human life or is so disabled or diseased as to be beyond recovery, by order in writing and stating the reasons therefor, permit any person to hunt such animal or cause animal to be hunted;
   b) the Chief Wildlife Warden or the authorised officer may, if he is satisfied that any wild animal specified in Sch. II Sch, III or Sch. IV has become dangerous to human life or to property (including standing crops on any land) or is so disabled or diseased as to be beyond recovery, by order in writing and stating the reasons therefor, permit any person to hunt such animal or cause such animal to be hunted.
2) The killing or wounding in good faith of any wild animal in defence of oneself or of any other person shall not be an offence; Provided that nothing in this sub-section shall exonerate any person who, when such defence becomes necessary, was committing any act in contravention of any provision of this Act or any Rule or Order made there under.
3) Any wild animal killed or wounded in defence of any person shall be Government property.

Under Section 17A. Prohibition of picking, uprooting, etc., of specified plants. – Save, as otherwise provided in this Chapter, no person shall –

a) willfully pick, uproot, damage destroy, acquire or collect any specified plant from any forest land and area specified, by notification, by the Central Government,

b) possess, sell, or transfer by way of gift or otherwise, or transport any specified plant, whether alive or dead, or part or derivative thereof :

THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT 1974

Under Section 25. Restrictions on New Outlets and New Discharges

1) Applicable due to discharge of waste water from the Lower & Upper Terminal of the ropeway.

2) Under the above mentioned act, we shall take consent "consent to establish" & "consent to operate" of the State Pollution Control Board.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981

Under section 21. Restrictions on use of certain industrial plants.

1) Applicable due to provision of DG Sets which will be source of air emission to atmosphere. Stack shall be installed.

2) Under the above mentioned act, we shall take consent "consent to establish" & "consent to operate" from the State Pollution Control Board.

THE WATER (PREVENTION AND CONTROL OF POLLUTION) CESS ACT, 1977

Under Section 3: Levy and Collection of Cess

1) There shall be levied and collected a cess for the purpose of the Water (Prevention and Control of Pollution) Act, 1974 (6 of 1974) and utilization there under.

2) The cess under sub-section (1) shall be payable by—

- Every person extracting water from ground.

- Every person using supply water.

S.O.908 (E), [25/9/2000] - THE MUNICIPAL SOLID WASTES (MANAGEMENT AND HANDLING) RULES, 2000

As per this rule solid waste is to be segregated and disposed as per defined procedure at MSW approved site or within its own complex by using different solid waste disposal technologies.

HAZARDOUS WASTES (MANAGEMENT, HANDLING & TRANSBOUNDRY MOVEMENT) RULES, 2008 AMENDED IN 2010

1) Hazardous wastes shall be collected, treated, stored at isolated locations.

2) It will be given to authorized recyclers/ service providers only.

THE NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000

1) The noise levels in any area shall not exceed the ambient noise quality standards in respect of noise as specified in the schedule.
2) The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the ambient noise quality standards in respect of noise.

EIA NOTIFICATION, 2006

EIA Notification, 2006 falls under EPA, 1986 under this act any project which has probable impact on the environment is listed under 34 categories, then unit are required to take prior environmental clearance after occupying/indentifying the land for particular use.

The proposed project falls under Category A activity 7 (g) as per the notification issued on 14th September 2006 by Ministry of Environment & Forests (MoEF).

1.8 GENERAL STRUCTURE OF ENVIRONMENTAL IMPACT ASSESSMENT DOCUMENT FOR AERIAL ROPEWAY

In terms of the EIA notification of MoEF&CC dated 14th September 2006 and its subsequent amendments, the generic structure of the EIA document is as under:

1) Introduction
2) Project Description
3) Analysis of Alternatives (Technology and Site)
4) Description of the Environment
5) Anticipated Impacts and Mitigation Measures
6) Environmental Monitoring Plan
7) Additional Studies
8) Project Benefits
9) Environmental Cost Benefit Analysis
10) Environment Management Plan
11) Summary and Conclusion
12) Disclosure of Consultant Engaged

1.9 PURPOSE OF STUDY

The purpose of the study is to comply with legal requirements as per Environmental Impact Assessment (EIA) Notification, 14th September 2006 and subsequent amendments of Ministry of Environment and Forests (MOEF).

Aerial ropeway projects fall in Category 7(g) of the EIA Notification. Since the project is at an elevation more than 1000 m altitude and within 10 km radius of a wildlife sanctuary, it falls in Category 'A' of the Environmental Impact Assessment Notification.

The environmental impact assessment report has been prepared for obtaining Environmental Clearance for the proposed activity.

1.10 METHODOLOGY

This EIA/EMP report has been prepared based on the following:

1. EIA Guidance Manual for Aerial Ropeway, Ministry of Environment & forests, 2010
2. Form-I as per EIA notification, 2006 & amended
3. Additional Terms of Reference issued by MoEF vide letter no. F. No. 10-12/2014-IA.III dated 17-12-2014.
4. Observations made by M/s Perfact Enviro Solutions Pvt. Ltd. during visits to the study area and collection of primary and secondary environmental data.

The main components of the method are:

- Impact Identification
- Impact Assessment
- Impact Evaluation
- Mitigation Measures

CHAPTER 2: PROJECT DESCRIPTION

2.1 BACKGROUND OF THE PROJECT

2.1.1 About the lake

Tsomgo Lake or Changu Lake is perched within the great Indian Himalayas and is one of the famous and important tourist destinations in Sikkim. The water of the lake comes from the melting of the snow of its surrounding mountains, which is why, this lake never dries up. The lake is highly revered by the local Buddhists and Hindus as a sacred lake.

The lake is about 1 km long, 15 m deep & is oval in shape. This azure blue lake remains completely frozen during winter months upto mid April during which visitors get an opportunity to experience snowfall. In late spring, the lake is surrounded with wild flowers, which create a riot of colors which includes the rhododendrons, blue and yellow poppies, various species of primulas & irises.

The lake is also home to Brahmini Ducks and a favorite stopover to other species of migratory birds.

There is also a small temple dedicated to Lord Shiva built at the lakeside.

Changu Lake is shrouded in myths and legends. It is said that in ancient times, the Lamas (Buddhist Saints) used to predict the future by observing the lake's color. If the water of the lake had a dark tinge, they predicted the future to be dark and gloomy, full of unrest. The faith-healers of Sikkim, popularly known as Jhakhris also visit this lake during Guru Purnima to offer prayers.

2.1.2 Objective of the project

The **Main objective** of the proposed installation is to provide a facility to the Changu lake tourists to visit the mountain top and adore the panoramic scenery of the surrounding area while experiencing the ecstatic bird eye view of the surrounding greeneries & the lake.

The other objectives of the project includes:

I. To promote tourism in the state of Sikkim.
II. To facilitate the Government of Sikkim for generating added revenue to the state.

2.1.3 **Brief Description of the Project**

The Project is a 625 m long ropeway, covering an area of 8072 sq m (including Lower Terminal Station, Upper Terminal Station & ropeway corridor) of the Kyongnosla range. The Lower Terminal Point (LTP) has been developed in south to the lake on right side of the existing Alpine Café and the Upper Terminal Point (UTP) has been developed on the hill top from where the picturesque view of Changu lake can be rejoiced.

The project had already been granted **Environmental Clearance** from SEIAA, Sikkim and the construction was started & project was on the verge of completion. But, the EC was then suspended by SEIAA due to the **legal notice** served against the project that stated Environmental Clearance was issued on the basis of EIA Notification, 2006, instead of the notification no. S.O. 3067(E) dated 1st December 2009 according to which clearance from Ministry is required as the altitude of site is above 1000 m.

Hence the construction work is stopped since 2013.

2.1.4 **Construction status of the Project**

The project construction work was started in 2011 after receiving all the statutory Clearances. The construction project of the work is 95% complete and the project is at the verge of completion.

2.1.5 **Benefit of the project**

This ropeway system will enable the tourists of Changu lake to experience the beauty of the area in even more pleasing way by reaching to the hill top & enjoying the panoramic view of the hill, lake and surroundings & will boost

tourism of the State. The benefits of the project are described in detail in Chapter-9.

2.2 LOCATION DETAILS

The project is a 625 m long alignment which stretches from Southern side of the Changu lake to the Southern hill top.

The area is surrounded by dense forests and the Himalayas. The site is at a distance of approx. 38 Km from the Gangtok City in West direction & approx. 17 Km from Nathula border in East direction.

The entire alignment including the lower and upper terminal falls under the Kyongnosla Range of East of Sikkim.

The site location details are given in Table 2-1 & the location map is shown in Fig. 2-1 and 2-2.

TABLE 2-1: SITE LOCATION

Place	Changu Lake
District	East of Sikkim
State	Sikkim

Latitude and longitude of base station and terminal station are given in table 2-2:

TABLE 2-2: GEOGRAPHICAL INFORMATION OF PROJECT SITE

Station	Latitude	Longitude	Elevation
Lower Terminal station (Near Changu lake)	27°22'26.44"N	88°45'28.42"E	3764 m
Upper Terminal Station (Hill top)	27°22'7.10"N	88°45'28.10"E	3994 m

FIGURE 2-1: GENERAL LOCATION OF PROJECT SITE

FIGURE 2-2: SPECIFIC LOCATION OF PROJECT SITE

2.3 APPROACH TO SITE

2.3.1 Connectivity to site

The site is easily accesible by the metalled Gangtok – Nathula Highway (Jawaharlal Nehru Marg).

The site can be approached by Gangtok which is 38 Km away and has local travel agencies / tour operator as well as taxis also ply on hire basis on this route upto Nathula Pass.

The lower terminal Station is at 1 Km distance from Jawaharlal Nehru Marg. From the road, once can reach the LTP developed near Alpine Cafe via the cross over bridge just at the entrance of the change lake.

2.3.2 **Connectivity to Gangtok**

Transport	**Station**	**Distance**
Airport	Bagdogra Airport	126 Km
Railway Station	Siliguri Railway Station New Jalpaiguri station	114 Km 119 Km
Road	NH 31A	adjacent
	Gangtok is connected by road to Darjeeling, Kalimpong, Siliguri and also to all district Headquarters within Sikkim and can be reached via private buses, jeeps and taxies.	
Helicopter Service	Tourism Department operates an 5/8 seater Helicopter service between Bagdogra and Gangtok.	

2.4 ENVIRONMENT SENSITIVITY AT SITE

The sensitive areas within 10 Km & 15 Km area of the project site is as follows:

Forest/ Wildife Sanctuary

- Kyongnosla Range – Adjacent
- Kyongnosla Alpine Sanctuary- 200 m from LTP
- Pangolakha Wildlife Sanctuary- 8.2 km E

Water bodies

- Changu lake- Adjacent

2.5 INFRASTRUCTURE NEAR SITE

2.5.1 Existing Infrastructure

2.5.1.1 At Hill Top (UTP)

No infrastructure is available at the hill top. Only the upper terminal of the ropeway has been constructed to facilitate the visitors of Changu lake to enjoy the enchanting landscape view of the surrounding area.

2.5.1.2 At Changu lake (LTP)

- *Approach Road:-*

  The Changu lake is connected by the metalled Gangtok – Nathula Highway (Jawaharlal Nehru Marg).

- *Accomodation, Shops & Other Facilities:-*

  No accommodation is available at or near Changu lake, the visitors has to stay at Gangtok. There are small rustic markets, shopping complexes and small restaurants near the lake. Few army camps also exists near site. Electric poles are also present.

- *Water Supply:-*

  The main sources of water in the area are spring water & water of the lake.

- *Parking:-*

  Near LTP, there are two government parking areas available out of which one is being used & the other is being developed. An army helipad is also available.

2.5.2 Proposed Infrastructure

2.5.2.1 At Hilltop (UTP)

- Ropeway Tower & Terminal Station (boarding & de- boarding, control room, store room, first aid counter, waiting room, toilets)

2.5.2.2 At Changu Lake (LTP)

- Ropeway Tower & Terminal Station (boarding & de- boarding, MCC control room, Administration block, toilets)
- Waiting room
- Public convenience facilities
- Basic infrastructural facilities (sewage system, drinking water, medical facilities, electricity, telecommunication, etc.)

2.6 LAND USE AT SITE

2.6.1 Existing land use

Total site selected for the development of Lower Terminal Point (LTP) and Upper Terminal Point (UTP) including ropeway corridor for the proposed ropeway project falls under the Kyongnosla Range. Mainly the land use is Forest cover. However, agricultural, built up, barren land, roads & trek path and water bodies, river/ canal also exists.

Landuse map given in Chapter-4.

2.6.2 Proposed Land use

For the development of Ropeway, 0.8327 hectares of the forest land has been acquired for. The construction of terminal stations, line towers & the ropeway corridor has been carried out on an area of 8072 sq m (0.80 ha). Land use as per development at site is given in Table 2-3.

TABLE 2-3: PROPOSED LAND DISTRIBUTION AT SITE

Area required for	Area (Sq. m.)
Lower Terminal Station, Kadukhal	1200
Upper Terminal Station, Surkanda Devi Temple	1755

Ropeway corridor	5117
Total	**8072 sq m**

2.7 TECHNICAL DESCRIPTION

The ropeway alignment runs gradually upward to the Upper Station. Total length of the ropeway from lower to upper station is 625 meters. Based on the detailed analysis of relative advantages and disadvantages of different ropeway systems as discussed in Chapter-3 of EIA report and bearing in mind the length and the terrain of the area, **Monocable continuously circulating Gondola System** is being installed which is most suitable system for passenger ropeway both from technical as well as economical point of view.

Particulars	**Existing Details**
TOTAL AREA	8072 sq m (0.80 ha)
CAPACITY	800 PPH
TECHNOLOGY	Mono Cable Continuously Circulating Gondola system
COST OF PROJECT	Rs. 9 Crores
LENGTH	625 m
LEVEL DIFFERENCE	230 m (Approx.)
NO. OF GONDOLAS	20 Nos. (Up & Down)
NO. OF TRIPS/ Hr.	10 nos round trip per hour.
CABIN CAPACITY	6 seats
SOURCE OF POWER	Power Department, Government of Sikkim
POWER REQUIREMENT	150 kW
DG SETS	1 X 150 kVA
WATER REQUIREMENT	101 KLD

WASTE WATER GENERATION	92 KLD
STP CAPACITY	2 STPs of 55 KLD each
TOTAL SOLID WASTE GENERATED	967 kg /day

2.7.1 System Description:

The detailed description of **Monocable continuously circulating Gondola System** Ropeway is described in Section 3.4 of the EIA report.

2.7.2 List of Plant & Equipment and Specification

2.7.2.1 List of Plant & Equipment:

The list of Plant & Equipment used for smooth and trouble free operation of the plant are given in Table 2-4.

TABLE 2-4 LIST OF PLANT & EQUIPMENTS

1	The drive unit
▪	Drive sheave
▪	Open gear & pinion
▪	Worm or helical gear
▪	shafting
▪	couplings
▪	Service & emergency brakes
2	Wire rope
3	Auxiliary drive mechanism
▪	Diesel Engine
▪	Engage/ disengage mechanism
4	Rope Tensioning arrangement
▪	Sheaves
▪	Hydraulic tensioning equipments
5	Station mechanicals
▪	Rope guide/ deflection sheaves
▪	Cabin guide
▪	Locking/ unlocking modules
6	Line mechanicals
▪	Line sheaves
▪	Articulated sheave mounts
▪	Supporting pedestal/ bracket
▪	rope catcher

7	Ropeway cabin complete with carriage
8	Rope lubrication system
9	Electricals
▪	AC motor
▪	Frequency controller
▪	converter
▪	MCC
▪	Switches
▪	Power
▪	Control cables
10	Safety devices
▪	Grip testing device
▪	Rope fall down protection equipment and system
▪	The wind and the wind speed detector
▪	Rope catcher
▪	Rescue devices
11	Telecommunication & signaling system
▪	Telephones
▪	Wires
▪	Siren/ hooter
▪	Glow lamp

2.7.2.2 Specifications

The equipment specifications of the ropeway system are given in Table 2-5.

TABLE 2-5: EQUIPMENT SPECIFICATION

S.No.	Equipment	Specification
1.	Haul rope	▪ Low elongation Haul rope of 6 x 19 construction ▪ Polypropylene core, Galvanised, Tensile stress 1770 N / sq. mm.(Imported)
2.	Cabin	▪ Cabin frame work - tubular construction having exterior body of fibre glass. ▪ Upper portion of the cabin is transparent sheet. ▪ Cabin hanger is of steel tubes or rolled sections. ▪ Cabin carriage fitted with detachable Grip mechanism- capable of gripping under most unfavorable circumstances during operation.
3.	Grip	▪ Grip mechanism of cabin- proper rope gripping under most unfavorable circumstances during Ropeway Operations.

		▪ Clamping pressure of grip onto rope shall resist sliding motion due to spring pressure and self – weight of cabin on maximum slope with factor of safety as per IS code. ▪ Each grip is equipped with twin jaw for rope clamping.
4.	Drive/ return sheave	▪ Sheaves made of high grade Cast Iron / Cast Steel/ MS Fabricated Construction. ▪ Groove are fitted with Aluminum / Neoprene Liner. ▪ Sizing of sheave- as per IS Specification.
5.	Gear box	▪ Gear boxes- for continuous operation and driving the rope at maximum specified speed and also withstanding variable torque during running.
6.	Brakes	▪ An automatic brake to stop and hold the ropeway system under the maximum load when power is shut off or when the Ropeway is stopped for any reason. ▪ There is a second brake for manually operation for application as and when necessary.
7.	Tension gear	▪ One set of mechanical parts for the automatic tension of the main rope comprising of Return – cum – Tension sheave of cast iron / cast steel / fabricated steel construction mounted on ball or roller journal and thrust bearings, trolley mounted on rollers, track for trolley and hydraulic cylinders with power pack.
8.	Auxiliary drive	▪ To operate the drive at slow speed in case of failure of the main power supply or any defect in the Drive Motor, a Diesel Engine is provided. ▪ The engine is of 4 cylinder of reputed make and is fitted with gearbox, clutch, brake mechanism, fuel tank, gauges, etc.
9.	Electrical	▪ Electric Motor of adequate rating for 415 V, 3 Phase, 50 Hz, power supply/ from a DG Set. ▪ Frequency Controller unit of reputed make for step less speed control of the system fitted with digital display unit indicating amperage, frequency, motor rpm, etc. ▪ Suitable rated Diesel Generating Set of reputed make complete with fuel tank, gauges and power

		control unit. ▪ Motor Control Centre equipped with incoming ACB, switch fuse unit, push button stations for emergency stoppages. ▪ PVC insulated, PVC seathed, armoured, aluminum conductor power cables and copper conductor multicore control cables. ▪ Earthing equipments.
10.	Structures	▪ Major Structural units in RCC Construction. ▪ Steel Structures made of Rolled sections and plates of special steel to sustain subzero temperature.
11.	Civil work	▪ Civil work essentially for station and trestle foundations.
12.	Station building	▪ Station building of steel/ RCC construction. ▪ Boarding/ Deboarding areas and major equipments are covered on roof by GC sheet. ▪ Operators' cabin is located at a place from where the operator can view adequately. ▪ Small office (about 3 m X 3m), Booking Office (2m x 1.5 m) and a store (3 m x 2.5 m) located at lower terminal station adjacent to the plant.
13.	Toilet block	▪ A toilet block consisting of 3 Urinals, one Indian Style W.C. and two wash basins for gents and two urinals, one W.C. and one wash basin for the ladies at each station.

Design & construction of the ropeway conforms to the IS codes as given in Table 2-6.

TABLE 2-6: RELEVANT INDIAN STANDARD SPECIFICATION

IS:7649	Glossary of terms used in connection with aerial ropeways and cableways.
IS:5229	Code of practice for construction of continuous movement monocable ropeway with automatic grip for transportation of passengers.
IS:2062	Weldable Structural Steel
IS:269	Ordinary and low heat portland cement

IS:456	Code of practice for plain and reinforced concrete
IS:732	Code of practice for electrical wiring installations
IS:800	Code of practice for use of structural steel in general building construction
IS:875	Code of practice for practice for structural in building, loading standards
IS:1786	Cold worked steel high strength deformed bars for concrete reinforcement
IS: 1893	Criteria for earthquake resistant design of structure
IS: 3043	Code of track for earthing
OITAF	International Code of Practice for Design and Construction of Aerial Ropeways

2.8 TOURIST FLOW TO THE REGION

As per the tourist data available with the Tourism department, Government of Sikkim, the no. of tourists visiting Sikkim was found to be between 5,00,000 to 7,00,000 in last 5 years. Most of the tourists that visit Sikkim also visits this lake as a part of their itinerary. As per the data collected from the permit issuing authority, Gangtok, the tourists visiting Changu lake was found to be 5,00,000 to 6,00,000 per year.

Considering that the tourist traffic will increase at least by 5% every year, by 2020 footfall will grow to about 8.00 lakhs.

The probable impacts due to increase in tourist traffic & their mitigation measures are given in Chapter-5 of this EIA report.

2.9 POPULATION CALCULATION & MANPOWER REQUIREMENT:

2.9.1 Tourist Population Calculation:

Nearly 90% of the tourists visit the lake during summer months and the peak traffic is experienced over 4 months a year. As such average daily traffic is

expected to reach about 7000. With a modest consideration that about 40% of the said tourist traffic would avail the ride and adding up local visitors, average daily Ropeway traffic may reach up to 3000 and corresponding hourly traffic (for the peak 4 Hours) works out to 750. **Hence capacity considered as 800 Passenger per Hour,** to be equipped initially for 400 PPH**.**

2.9.2 **Manpower Requirement:**

The construction phase shall involve about 30-40 skilled and un-skilled people.

During the operational phase, about 15 persons would be required which are given below:

Administrative Staff	
* Ropeway – in – charge	1
* Booking Clerk	1
* Accounts Assistant – cum – Store Keeper	1
* Security Guard	2
* Sub Staff	1
At Lower Station	
* Drive Operator – cum – Electrician	1
* Station Attendant	2
* Maintenance Staff	2
At Upper Station	
* Station Attendant	2
* Maintenance Staff	2
TOTAL	**15**

2.10 WATER & WASTEWATER QUANTITY

2.10.1 **Water Requirement**

During Construction Phase- 13 KLD of water was used for domestic, flushing, sprinkling & other construction purposes which was being sourced through the over flow of the lake.

*During Operation Phase***-** Total water requirement has been estimated to be 101 KLD mainly for flushing, drinking, hand washing & horticulture purposes.

2.10.2 **Wastewater generation**

During Construction Phase- 7 KLD of waste water was being generated from labors & construction activities.

During Operation Phase- Total quantity of wastewater generation will be 92 KLD.

Wastewater management has been given in Section- 9.3. Impacts & mitigation related to water are given in Section- 5.3.

2.11 POWER CONSUMPTION

During Construction Phase- DG sets of 62.5 kVA were used at site for the construction work.

During Operational Phase- The source of power will be Power Department, Government of Sikkim.

The Power consumption & DG backup details are given in Table 2-6.

TABLE 2-7: POWER REQUIREMENT & DG BACK UP

	Details
Power Load requirement	150 KW
DG Sets (back-up power)	150 kVA

2.12 SOLID AND HAZARDOUS WASTE MANAGEMENT

*During Construction phase***-** Site clearance waste, spent concrete & cement screening, steel scrap, material and equipment wrappings, Excavated soil, etc. was generated. Total 6 kg/ day of waste was being generated from labors.

During operation phase- Total 967 Kg/day solid waste will be generated from the ropeway users, employee, etc.

2 ltrs/month used oil shall be generated from the DG sets.

The management of solid & hazardous waste is given in Chapter- 10.

2.13 SITE CLEARANCE AND AFFORESTATION DETAILS

*During Construction phase***-** The alignment falls within Kyongnosla range which has been diverted for development of terminal stations & line towers. An area of 0.8273 ha of forest land has been acquired for the development of the ropeway. No trees exists under the ropeway corridor. Only herbs & shrubs were cleared at the place of LTP & UTP.

During operation phase- Green development at LTP, UTP & along the corridor will be done.

Management of the Ecological Environment is given in Section 9.7 (Environment Management Plan). Impacts & mitigation related to Ecology are given in Section 5.5 (Anticipated Impacts & mitigation Measures).

2.14 MAPS OR PLANS RELATED TO THE PROJECT

- Map showing 10 km and 15 km Radius of the project site is given as Enclosure- 3.
- Ropeway Profile Map of the ropeway is attached as Enclosure- 1.
- Layout maps of LTP & UTP are attached as Enclosure-2

2.15 TIME FRAME OF THE PROJECT

The project was started in 2011. The entire ropeway project has been developed upto 95% and is at the verge of completion. It shall take about 2 years to start commercial operations after the grant of all statuary clearances.

2.16 COST OF PROJECT

The cost of project exclusive of land cost is estimated about **Rs. 9 Crores.**

CHAPTER 3: ANALYSIS OF ALTERNATIVES (SITE & TECHNOLOGY)

3.1 ALTERNATIVE ROUTES ASSESSED

A reconnaissance survey was first conducted starting from the Lower station located near the Alpine Cafe to the area adjoining to the Hill top.

As per the survey, the site selected for the ropeway was found to be most suitable as the LTP was found to be easily accessible being near to Alpine Café, no major clearance of herbs & shrubs was required for the corridor and flat land was available on hill top for UTP.

The other basis of selection of the space is discussed in section 3.2.

3.2 SELECTED ALIGNMENT

The selected site was the most stable stretch, requiring less construction works for flattening of land and no tree cutting was required. The total length of proposed ropeway alignment works out to be 625 m. the selected ropeway alignment is shown in figure 3-1.

FIGURE 3-1 SELECTED ALIGNMENT

3.2.1 **Merits of the selected Alignment:**

3.2.1.1 Lower Station (LTP)

The LTP is developed east to the Alpine café (figure 3-2) and the area adjoining the motorable road was found most suitable for the following advantages:-

- Sufficient land was available for housing the station
- The site is easily accessible & close to the Main Road.
- Some infrastructure like refreshment kiosks, snack bar, etc. can be facilitated at this location

FIGURE 3-2: LTP

3.2.1.2 Upper Station (UTP)

The UTP is developed at the hill top south to the lake (figure 3-3). It was found to be most suitable for the following advantages:-

- Wide flattish land was available for Ropeway Station.
- Free of any encumbrances.
- Sufficient land available for housing the station.
- Ample space for development of amenities.

- A good aerial view of the lake can be relished.
- A panoramic view of the snowcapped mountains around can be enjoyed.

FIGURE 3-3: UTP

3.3 ALTERNATIVE TECHNOLOGIES ASSESSED

There are various types of ropeway technologies which are described below:

3.3.1 CHAIR LIFT SYSTEM

This system is widely used in hilly areas. In the winter resorts, all over the world, one can find a number of them. Their capacity range between 50 to 1200 passengers per hour.

It is a monocable endless system. One continuously circulating rope serves the dual purpose of supporting as well as hauling the chairs clamped to the moving rope at specific intervals. In between the terminals, the rope is supported on sheaves mounted on towers.

The most common on Chair Lift system are the Twin Seater Chair Cars. With more modern developments, Chair Lifts with cars for 3, 4, or 6 passengers have also come in use. They normally have detachable type Grip, whereas the ones with twin passenger chairs have mostly Fixed type Grips.

3.3.1.1 Advantages

- Continuous transportation of passengers.
- Low Capital Cost.
- Simple in construction.
- Low operation and maintenance cost.
- Flexibility in the system design, i.e. system can start with low transport capacity vis-à-vis less investment and then expanding the capacity with growth of demand.

3.3.1.2 Disadvantages

- For Fixed Grip type system, boarding / de boarding operation is carried out while the carriers are on motion which calls for low speed and consequently long travel time. For detachable type Grip, although speed can be made faster, but cost would go up.
- Fixed Grip type carriers normally cannot negotiate any deviation en-route, i.e. Angle Station. For negotiating angles, Detachable type grip is required.
- Maintenance of large number of Towers and Carriers.
- Large Spans between the towers are prohibited.
- System is more sensitive to high wind.

3.3.2 **Continuously Circulating Ropeway**

3.3.2.1 Continuously Circulating Mono-cable Ropeway

For aerial passenger transportation, this system has the widest use in the world both in flat and hilly terrain.

The maximum capacity achieved in this system is in the region of 2500 PPH. Its flexibility to adapt length, terrain conditions and capacity normally gives it preference while making a choice.

A Mono-cable Ropeway System comprises basically an endless rope which acts both as the carrying as well as the haulage rope to which a number of carriages are attached at regular intervals. The carriages circulate around the close system by continuous carrying-cum-haulage rope. The cabins are fully enclosed and because of this fact, the passengers inside, feel quite comfortable, even if the cabin travels at a considerable height from the ground profile. Usually the carrying capacity of each carrier varies from 2 to 8 passengers.

Mono-cable can either be fixed grip or detachable grip. Fixed grip ones can be either normal fixed grip with chairs, cabins suspended at regular intervals along the line or pulsated, in which case, a group of cabins are placed at regular intervals.

Mono-cable Ropeway Systems are deployed on a terrain which has a gentle slope or convex shape of the profile. The terrain has to be accessible by foot and pathways along the route of the ropeway system. The height of the ropeway is also limited to enable accessibility to the system for rescue, in case of any unprecedented hazard.

3.3.2.1.1 Advantages

- Continuous transportation system for passengers.

- Adjustment of speed and number of carriers according to actual requirement.
- Flexibility of the system i.e. system can start with a low transport capacity with low initial investment and expansion of capacity as the demand grows by increase of speed / additional carriers or a combination of both.
- Boarding and de-boarding operation with carriers stopped or moving at a very slow speed is possible.
- Simplicity of operation and maintenance.
- Less requirement of space for terminal stations in case of fixed grip system.

3.3.2.1.2 Constraints

- Low ground clearance necessitates a large number of trestles.
- High operation and maintenance cost.
- Maintenance of large number of carriers and towers and line trestle equipment.
- System is more sensitive to high winds.
- Spans between the towers are limited.
- Due to limitation of height of carriers from ground, Mono-cable system it is not possible to cross large valleys.

3.3.2.2 Continuously Circulating Bi-cable Ropeway

This Ropeway System basically consists of two stationary carrying track ropes and a single endless haulage rope. The track rope supports the carriers and the hauling rope hauls the carriers. At terminal stations, carriers move from track ropes to station rails and passengers board / de-board from carriers. Bi-cable system like Mono-cable system can either be fixed or detachable grip type.

The only advantage of bicable gondola system over the monocable Gondola System is where the profile justify exceptionally large span, as in case of Monocable System for long span under maximum loaded condition, the sag becomes excessive.

3.3.2.2.1 Advantages

- Theoretically there is no limit to the maximum slope, which cannot be climbed nor is there any limitation in ground clearance from underneath the carrier.
- Heavier unit load can be carried out.
- Larger spans between trestles possible.
- Comfortable boarding/ de boarding.
- Less maintenance of line trestle equipment
- System less sensitive to high wind.
- Rescue operation is easier.

3.3.2.2.2 Constraints

- Higher cost of transportation.
- System Cost higher.
- Rope replacement cost is more.
- Limited possibility of capacity expansion.
- System being sophisticated, requires qualified operation and maintenance staff.

3.3.3 Jigback System

3.3.3.1 Mono-cable Jigback

In this system one endless hauling rope supports and hauls two cabins, one in forward direction and the other in reverse direction between the terminal stations. The cabins are fixed to the rope. Once the cabins reach the terminal stations the movement of the ropeway is reversed. Mono-cable uses cabins of comparatively lower passenger carrying capacity.

3.3.3.1.1 Advantages

- Reduced terminal space requirement.
- Cost effective.
- Comfortable boarding / deboarding and ride.
- Low ground clearance not required.
- Simplicity of operation and maintenance.

3.3.3.1.2 Constraints

- Low transportation capacity.
- Limitation in capacity expansion.

3.3.3.2 Bi-cable Jigback

For Aerial passenger transportation in large capacity, this system also has a wide use in the world, particularly, in hilly terrain.

These Tramways can negotiate very high speed. The maximum achieved so far is 12M /sec and the most modern Tramway in the Jig back system has a capacity of 160 passengers, in a single cabin.

In hilly areas for negotiating large valleys, this is the ideal system as it can comfortably negotiate a span of more than 1.0 KM.

Such a system has two carrying ropes and one haulage rope with large cabins attached in either direction, attachment being made on diametrically opposite side of the haulage rope. The cabins are always fixed to the haulage rope.

While one cabin starts moving from one terminal station to the other terminal station, the other cabin simultaneously starts from the opposite terminal station. Once they reach the opposite terminals, de-boarding & boarding takes place. Then the movement of the ropeway is reversed giving the Jig Back effect.

3.3.3.2.1 Advantages

- High Transport capacity.

- Very high speed compared to other system possible.
- Can negotiate extra large span.
- System not much sensitive to high wind.

3.3.3.2.2 Disadvantages

- High capital investment, highest of all systems.
- System very sophisticated and requires qualified personnel for operation and maintenance.
- Capacity limited and can not be expanded.

3.4 PROPOSED ROPEWAY SYSTEM TECHNOLOGY

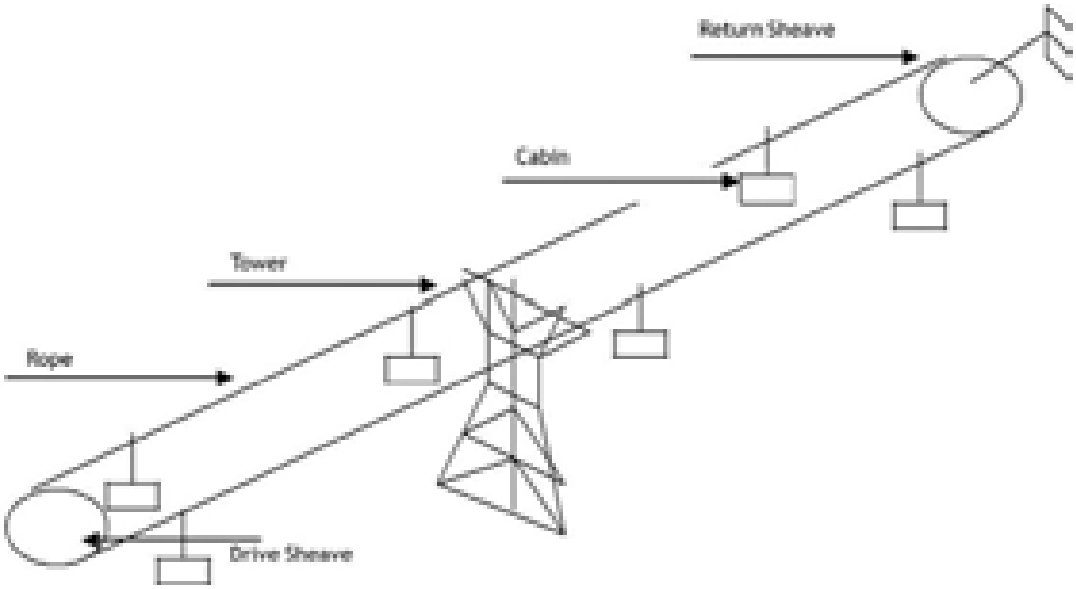
Based on the detailed analysis of relative advantages and disadvantages of different ropeway systems and bearing in mind the length and the terrain of the project, Mono-cable continuously circulating Gondola System is installed which is most suitable system for passenger ropeway both from technical as well as economical point of view for this project.

Mono-cable continuously circulating Gondola System is recommended based on the following factors:

1. Capacity requirement is high and not suitable for Chair Lift or Jig- back system.
2. Capacity is not that high that it will warrant a Bicable Gondola.
3. Ground terrain is suitable for Monocable Gondola System.
4. Comfortable boarding / deboarding operation.
5. Safe and secured travel. Passenger shall feel comfortable inside a cabin, protected from sun, rain and cold wind.
6. System is very flexible. Capacity enhancement / reduction can be done very easily.

A pictorial view of such type of Gondola system is shown in figure 3-3.

FIGURE 3-4 MONO-CABLE CONTINUOUSLY CIRCULATING GONDOLA SYSTEM



3.4.1 **System description**

Monocable Gondola System comprises of the following major items:-

- 1(one) no. endless haulage rope, driven by electric power through Sheaves at one end and tensioned at the other end by hydraulics.
- Required quantity of Passenger Cabins complete with suspender and grip.
- Ropeway drive arrangement located at lower station complete with Drive Sheave, Motor, Gearbox, Open gear & Pinion, Emergency and Service Brakes, Coupling etc.
- Terminal stations complete with required Plant & Equipment and Structures.
- Intermediate support tower complete with mechanicals.

3.4.2 **Operation of the proposed system shall be as follows:-**

In this system, an endless rope, which serves the dual purpose of supporting and hauling the cabins, moves on intermediate towers equipped with mounts and line rollers.

While traveling along the line, the cabins remain firmly gripped to the moving rope and their passage being entirely automatic, requires no attention or

operative labour on the line.

Along the alignment, under worst condition of sag and wind velocity, minimum clearance to the underside of the cabin and sufficient clearance to tower structures, respectively, will be maintained as per the provision of IS Code and Practice.

3.4.3 **Transport Capacity**

The Ropeway is designed for a maximum capacity of 800 Passenger Per Hour.

3.4.4 **Cabin & Carriage**

The proposed installation has cabins each having a seating capacity of 6 passengers. The cabin are fully enclosed with transparent cover at the top portion for viewing.

Cabin capacity has been selected based on the traffic data collected from the Permit issuing Authority. The maximum transport capacity of 800 PPH at maximum travel speed.

The Cabins shall be suspended from Rope by means of a carriage and hanger. Hanger shall be attached to the carriage in such a way that whatever be the slope of the track, the cabin always remain in plumb position.

3.4.5 **Line Speed**

A maximum speed of 3.0 M per second has been envisaged.

3.4.6 **Ropeway Drive**

For driving the Ropeway, Frequency controlled AC Motor is used. The unit has a Micro-Processor based controller for step less speed control.

3.4.7 **Stand –by Drive Arrangement**

A suitably rated Diesel Engine coupled to the Main Drive through a clutch system

is provided. The engine shall be operated at a slow speed to bring the cabins to the respective stations in the event of power failure. Operation would also be possible with the Diesel Engine Drive but at a lower capacity. Normal operation shall be resumed after resumption of electric power.

3.4.8 **System Control**

The Ropeway shall be operated through variable voltage variable Frequency Controller. Acceleration, deceleration and stoppage shall be controlled. In the event of over speeding, Dynamic Braking shall automatically be energized to prevent the system speeding up.

3.4.9 **Ropes**

Haulage rope is stranded low elongation **imported steel wire rope with Polypropylene main core.**

3.4.10 **Ropeway Clearance**

The profile design of the Ropeway System has taken into consideration minimum statutory clearance from the ground, permanent structures, roads, power / telephone line crossing as stipulated in Indian / International codes and standards.

3.4.11 **Terminal Stations**

Lower Terminal Station

The lower Terminal Station shall be ground level Structure. Speed of an incoming cabin, on approaching the station passing through the Unlocking Module getting detatched from the moving haulage rope automatically and the cabins shall come to a dead halt at a predetermined area. After deboarding of the passengers, who will arrive from the Upper Terminal and boarding of new passengers waiting in the station, the station attendant shall put the cabin to the locking module, where the cabin will get engaged with the rope and go into the line and shall proceed to the Upper Terminal.

Upper Terminal Station

The Upper Terminal Station shall also be a ground level structure. Operation at this shall be similar as described for Lower Terminal.

3.4.12 **Electricals**

Power, requirement for the Ropeway installation inclusive of lighting shall be 150 KW approximately.

3.4.13 **Communication**

Communication between terminal stations shall be provided by means of telephone and public address system.

CHAPTER 4: DESCRIPTION OF THE ENVIRONMENT

4.1 INTRODUCTION

EIA report should contain a description of existing environment that would be or might be affected directly or indirectly by proposed project. Environmental baseline monitoring is a very important stage of EIA. Environmental baseline monitoring, during the operational phase, helps in judging the success of mitigation measures in protecting the environment.

Environmental facets that are considered in relation to passenger ropeway project can be categorized into following groups:

a) Ambient air quality
b) Noise quality
c) Water quality
d) Soil quality
e) Land use
f) Biological Environment
g) Socio-economic status
h) Traffic density

The intention of environmental baseline monitoring is not just to describe all baseline conditions but to focus the collection and description of baseline data on those environmental conditions that are important and are likely to be affected by the proposed project activities and is included in impact assessments. The project will be located at Tsomgo Lake, East of Sikkim, Sikkim. At present baseline of the area is discussed in this chapter.

4.2 TOPOGRAPHY

East district of Sikkim is totally hilly region and the areas bordering China is usually covered with snow. Almost three fourth area of the district is forest area. The topography of the district is totally mountainous, hilly terrain.

4.3 METHODOLOGY

For the present study, all the sampling locations are marked with the help of goggle earth and topographical maps. The land use/ land cover map has been generated on 1:50,000 scale using Satellite imagery, topographical maps,

Survey of India and ground truth information. The baseline environmental quality has been assessed during March 2015 to May 2015. Meteorological data of IMD station at Gangtok, Sikkim has been used for the study. Samples of air, water and soil from the site and nearby areas has been collected and analysed for the study of existing condition. Primary and secondary data collection has been done by the Ecology and Biodiversity team for the study of flora and fauna in the core and Buffer Zone.

The baseline data is generated through field studies within the impact zone (Core Zone and Buffer Zone) for various components of the environment viz. Air, Noise, Water, Land, Ecology and Socioeconomic. The baseline environmental quality has been assessed during March 2015 to May 2015 in a study area of 10 Km radius distance from the project site. While generating the baseline status of physical and biological environment of the study area, the concept of impact zone has been considered. The impact zone selection is based on preliminary screening and modelling studies. For demography and socioeconomics, block wise data has been collected and used for the assessment of impacts. Meteorological data of IMD station at Gangtok has been used for the study. The important parameters considered are temperature, humidity, wind speed, wind direction and rainfall. The ambient air quality monitoring was done to assess the ambient air quality in one season. Monitoring was carried out from the month of March 2015 to May 2015. The guidelines for selections of ambient air monitoring stations given in IS – 5182 part 14, 2000 were followed. To assess the water quality of the proposed area, sampling was done as per the standard practice. Grab and composite sampling was done for ground and surface water. Water samples were taken as per the Standard Methods (IS & APHA, 22nd Edition 2012). Necessary precautions were taken for preservation of samples. The physical parameters viz. pH, temperature and conductivity were measured at site using portable water analyser. At each station noise level was monitored for 24-hours simultaneously. For each measurement, dB (A) readings was taken for every 15 minutes for 24 hrs once in a season to get Leq values. For soil, augur method was used and samples were collected at 15 cm depth after removing the upper crust.

4.4 METEREOLOGY

The proposed project area is located in East of Sikkim, Sikkim. Meteorological data of IMD station at Gangtok, Sikkim has been used for the study. The meteorological data of last Eleven years (2001-2013), as recorded at Gangtok, Sikkim are given below in the tables with graphical representation of it:

4.4.1 **Temperature:**

The Maximum temperature of the area in 11 Years, was recorded as 29.3 ^{0}C in August 2005, whereas the minimum temperature of the area was recorded as 0.2^{0}C in December 2004. Data of the maximum and minimum temperature are given below.

Months	Year	MMax	Year	H Max	Year	MMin	Year	L Min
January	2010	14.9	2003-2013	17.9	2012	4.4	2005	1.5
February	2006	16.7	2005	21.3	2007	6.2	2007	1.6
March	2013	19.1	2004,2010	25.5	2003	9.1	2012	5.6
April	2001	20.9	2006	25.5	2001	12.2	2004	7
May	2007,2012	22.8	2002	25.9	2005	14	2005	10.2
June	2009	22.7	2003	25.3	2003	16.8	2002	14
July	2003,2006,2010	22.4	2009	28.8	2004	17.3	2002	15.5
August	2003	22.9	2005	29.3	2002	17.3	2,002	15.3
September	2009	23	2002,2005	26.5	2002	16.2	2004	13.6
October	2009	21.3	2007	25.7	2004	12.8	2013	9.1
November	2002	18.4	2002	22.1	2012	9.2	2012	4
December	2005	15	2001	19.1	2010,2012	7	2004	0.2

HMAX-HIGHEST MAXIMUM, LMIN-LOWEST MINIMUM, M MAX- MEAN MAX, LMIN-LOWEST MIN

TABLE 4-1; TEMPERATURE RECORD, (SOURCE: IMD, GANGTOK)

4.4.2 **Relative Humidity**

From the data, the Maximum relative humidity was recorded as 95% in July 2006 & 2007. Minimum relative humidity was recorded as 69 % in January 2013.

Months	Year	Max	Year	Min
January	2012	82	2013	69
February	2007	88.5	2002	76
March	2005	83	2006,2012	72
April	2004	86	2006	76
May	2013	89	2012	78.5
June	2006	93.5	2005,2010	90
July	2006,2007	95	2010	92.5
August	2001,2005,2010	94	2002,2012	91
September	2003	94	2002	87
October	2003	90.5	2012	81
November	2003	89	2013	73.5
December	2013	83	2005	72

TABLE 4-2; RELATIVE HUMIDITY RECORD. (SOURCE: IMD, GANGTOK)

4.4.3 **Rainfall**

The maximum rainfall was recorded in June (upto 867.3 mm) in 2002. From data it is clear that the June, July & August are the wettest months and are considered as monsoon season. The Average Annual Rainfall is 3542.3 mm.

Month	Year	Max.	Year	Min.	AV. Rainfall
January	2002	50.9	2010	6	18.5
February	2007	162.9	2002	206	58.5
March	2002,2010	244.5	2012	47.9	133.2
April	2003	504.6	2006	232.4	380.2
May	2013	670.4	2012	224.9	487
June	2002	867.3	2009	463.5	628.1
July	2010	687	2009	492.4	641
August	2001	668.6	2013	395.7	551.9
September	2012	518.9	2002	302.1	403.6
October	2013	368.9	2006	73.4	196.4
November	2013	84.8	2012	0.2	29.8
December	2001	48.9	2010	0.2	14.1

TABLE 4-3; RAINFALL RECORD. (SOURCE: IMD, GANGTOK)

4.4.4 **Wind Speed:**

Wind speed normally was in the range of 0.2 to 0.7 km/hr.

MONTHS	YEAR	Wind Speed
January	2001,2003,2005,2010	0.2
February	2003	0.5
March	2006,2007	0.6
April	2005	0.6
May	2007	0.7
June	2004	0.4
July	2005	0.2
August	2006,2007	0.2
September	2007	0.4
October	2002	0.3
November	2007	0.3
December	2013	0.4

TABLE 4-4; WIND RECORD. (SOURCE: IMD, GANGTOK)

4.5 MICRO-METEOROLOGICAL DATA

A weather station was installed near the site for hourly monitoring of temperature, humidity & wind speed for the month of March 2015 to May 2015. Average data is given below:

Month	Temperature(ºC)			Humidity (%)			Wind speed (Km/hr)		
	Max.	Min.	Av.	Max	Min	Av.	Max.	Min.	Av.
1st March-31st March 2015	23.0	1.0	12.0	93.0	10.0	24.0	25.9	1.9	14.0
1st April-30th April 2015	23.0	3.0	14.0	93.0	10.0	24.0	24.1	1.9	13.0
1st May- 31st May 2015	28.0	7.0	19.0	94.0	24.0	25.0	29.0	1.9	16.0

TABLE 4-5; MICRO METEOROLOGICAL DATA

i) Temperature: Temperature of the area varied from 1.0 ^{0}C to 28.0 ^{0}C. The Average temperature varied from 12.0^{0}C to 19.0 ^{0}C.

ii) Relative Humidity: Humidity of the area varied from 10.0 % to 94.0%. The average humidity varied from 24.0 % to 25.0 %.

iii) Wind Speed: Wind speed was in the range of 1.9 Km/hr to 29.0 Km/hr. The wind speed was almost close to each other during the whole study period. The average wind speed varied from 13.0 Km/hr to 16.0 Km/hr.

WIND ROSE DIAGRAM:

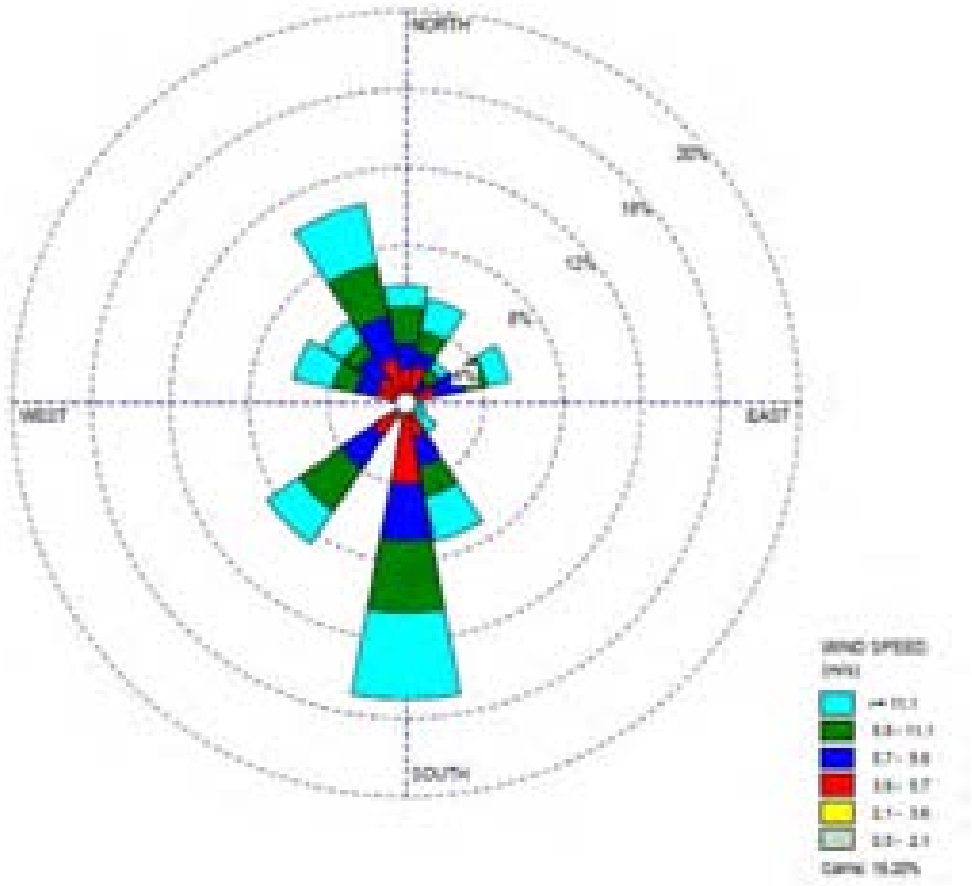


FIGURE 4-1; SEASONAL WIND ROSE DIAGRAM

4.6 AMBIENT AIR QUALITY

The ambient air quality monitoring was done to assess the ambient air quality in one season. Monitoring was carried out at four stations for the month of March 2015 to May 2015.

The guidelines for selections of ambient air monitoring stations given in IS – 5182 part 14, 2000 were followed. These guidelines state that, "when the objective of air sampling is to identify the contribution from specific sources of pollution, the sampling locations should be located in upwind and the downwind of such sources".

The location of air quality monitoring stations should satisfy the following conditions:

1. The site should be representative of the area selected;
2. The station should be set up and operated so as to yield data that can be compared with those from stations within the network; and,
3. Certain physical requirements should be satisfied at the site.

To select the air sampling locations, meteorological data with respect to temperature, relative humidity, wind speed and direction plays a vital role. Predominant wind direction plays an important role in determining location of monitoring stations. The monitoring station will be located in area that is downwind from the source. Location of Air sampling stations is shown below.

4.6.1 **Sampling Stations**

Station No.	Location	Distance & Direction from project area	Environmental Sitting
A1	Onsite LTP	------	Existing air quality at core zone
A2	Onsite UTP	------	
A3	Changu Village	1.15 Km, NE	Existing air quality at Buffer Zone
A4	Thengu Village	1.41 Km, NW	
A5	Chipsu Village	6.56 Km, SW	

TABLE 3-6; SAMPLING LOCATIONS FOR AMBIENT AIR QUALITY

To study the present ambient air quality scenario at project site two onsite i.e. UTP & LTP air monitoring location were selected. Jawaharlal Nehru Road is 0.14 Km away from site in North direction of

Changu Village is the nearest habitat. Thengu village is located in NW direction & Chipsu village is in South west direction in buffer zone.

4.6.2 **Ambient Air Sampling Locations**

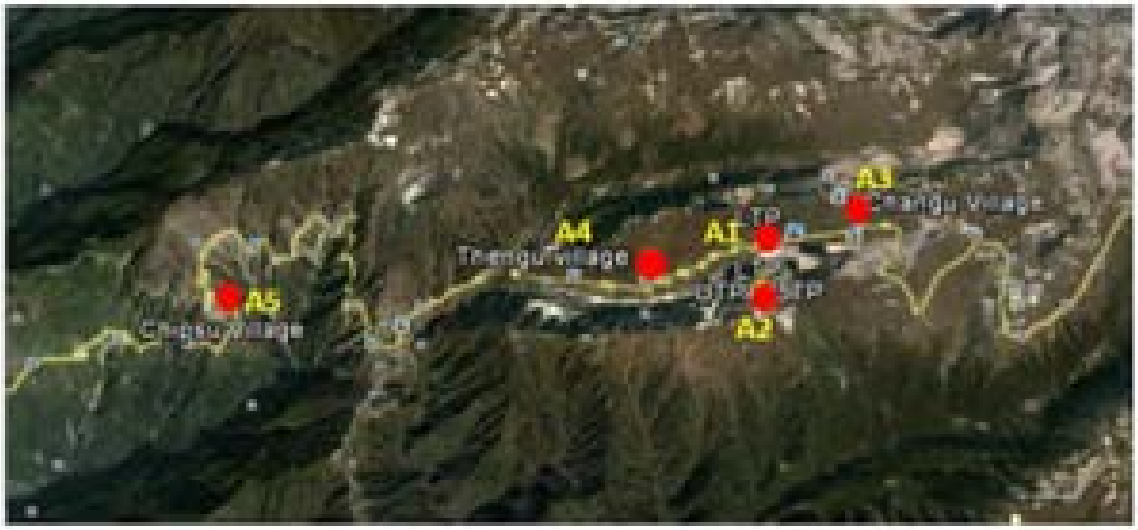


FIGURE 4-2; AMBIENT AIR SAMPLING LOCATIONS ON 10 KM GOOGLE MAP

4.6.3 **Sampling Procedure**

Time averaged in – situ sampling was adopted by passing a known volume of air through a trap, and a collecting medium (filter paper and bubbler). Respirable Dust Sampler was used for the purpose.

This procedure was adopted because there are no short-term variations and low concentration of gaseous pollutants was expected.

4.6.4 **Analytical methods followed for ambient air quality monitoring:**

I. **Particulate Matter ($PM_{2.5}$): (USEPA Quality Assurance Hand Book (Vol.II) Part II, Quality Assurance Guideline Document,2.12):** Particulate Matter ($PM_{2.5}$) was analyzed by Gravimetric Method. Particulate matter was collected on the 37 mm dia glass micro fiber Filter Paper. $PM_{2.5}$ value is determined from the values of volume of air passes through Ambient Fine Dust Sampler.

II. **Particulate Matter (PM_{10}) (IS: 5182 Part 23:2006):** Particulate Matter (PM_{10}) was carried out by Respirable Dust sampler as per IS: 5182(Part 23):2006. Particulate matter was collected on the GF/A Filter Paper. Particles with aerodynamics diameter less than the cut-point of the inlet

are collected by the filter. The mass of these particles is determined by the difference in filter weight prior to and after sampling.

III. **Sulphur dioxide (SO_2) (IS: 5182; Part – II – 2001):** Sulphur dioxide is absorbed by aspirating a measured air sample through a solution of Potassium or sodium tetrachloromercurate, TCM. This procedure results in the formation of a dichloro sulphite mercurate complex. The Sulphite Ion produced during sampling is reacted with sulphamic acid, formaldehyde and pararosaniline to form an azo dye and then determined colorimetricaly.

IV. **Nitrogen Oxides (IS: 5182; Part – VI – 2006):** Nitrogen dioxide is collected by bubbling air through a sodium hydroxide- sodium arsenite solution to form a stable solution of sodium Nitrite. The Nitrite Ion Produced during sampling is reacted with hydrogen peroxide, Sulphanilamide and NEDA to form an azodye and then determined calorimetrically.

4.6.5 **Ambient Air Quality Results**

TABLE 4-7; AMBIENT AIR QUALITY RESULTS OF $PM_{2.5}$ & PM_{10}

Location	Min.	Max.	98 Percentile	Mean	Min.	Max.	98 Percentile	Mean
	$PM_{2.5}$ (Standard – 60 µg/m^3)				PM_{10} (Standard – 100 µg/m^3)			
A1	15.3	24.1	22.9	19.8	31.5	48.7	45.6	39.4
A2	13.8	21.7	20.7	17.9	28.4	43.9	41.1	35.6
A3	16.2	25.6	24.3	21.0	33.4	51.6	48.3	41.8
A4	18.8	29.7	28.3	24.4	38.8	60.0	56.1	48.6
A5	17.1	27.1	25.8	22.2	35.3	54.7	51.2	44.3

TABLE 4-8; AMBIENT AIR QUALITY RESULTS OF SO_2& NO_X

Location	Min.	Max.	98 Percentile	Mean	Min.	Max.	98 Percentile	Mean
	SO2 (Standard – 80 µg/m^3)				NOx (Standard – 80 µg/m^3)			
A1	2.3	4.6	3.7	3.3	9.3	13.9	12.8	11.4
A2	2.1	4.2	3.4	3.0	8.4	12.5	11.6	10.3
A3	2.4	4.9	3.9	3.5	9.9	14.8	13.6	12.1
A4	2.8	5.7	4.6	4.0	11.5	17.1	15.8	14.0
A5	2.6	5.2	4.2	3.7	10.5	15.6	14.4	12.8

(SOURCE OF STANDARDS: G.S.R 826(E) DATED 16TH NOVEMBER 2009 OF MOEF, LABORATORY ENGAGED: M/S PERFACT RESEARCHERS PVT.LTD. (NABL ACCREDITED))

4.6.6 **Data Interpretation**

The ambient air quality results are summarized in above tables.

Core Zone: PM_{10} (35.6 to 39.4 µg/m^3), $PM_{2.5}$ (17.9 to 19.8 µg/m^3), SO_2 (3.0 to 3.3 µg/m^3) and NOx (10.3 to 11.4 µg/m^3), all are within the National ambient air quality standards.

Buffer Zone: PM_{10} (41.8 to 48.6 µg/m^3), $PM_{2.5}$ (21.0 to 24.4 µg/m^3), SO_2 (3.5 to 4.0 µg/m^3) and NOx (12.1 to 14.0 µg/m^3) of buffer zone are also within the National ambient air quality standards.

4.7 NOISE QUALITY

Noise Measurement Locations: To assess the noise level of the proposed area, following stations were selected. **Location of Noise sampling stations** are described below and location are given below.

LOCATIONS OF NOISE SAMPLING STATION

Station No.	Location	Distance & Direction from project area	Project area / study area	Environmental Sitting
N1	Onsite LTP	------	Commercial Area	Existing Noise quality at core zone
N2	Onsite UTP	------	Commercial Area	
N3	Changu Village	1.15 Km, NE	Residential Area	Existing Noise quality at Buffer zone
N4	Thengu Village	1.41 Km, NW	Residential Area	
N5	Chipsu Village	6.56 Km, SW	Residential Area	
N6	Jawaharlal Nehru Road	0.14 Km, North	Commercial area	

TABLE 4-9; SAMPLING LOCATION FOR NOISE QUALITY

To study the present ambient noise level at project site two onsite i.e. UTP & LTP noise monitoring location were selected. Jawaharlal Nehru Road is passing at a distance of 0.14 Km in North direction of Site.

Changu Village is the nearest habitat. Thengu village is located in NW direction & Chipsu village is in South west direction in buffer zone.

4.7.1 **Locations of Noise Sampling Stations**

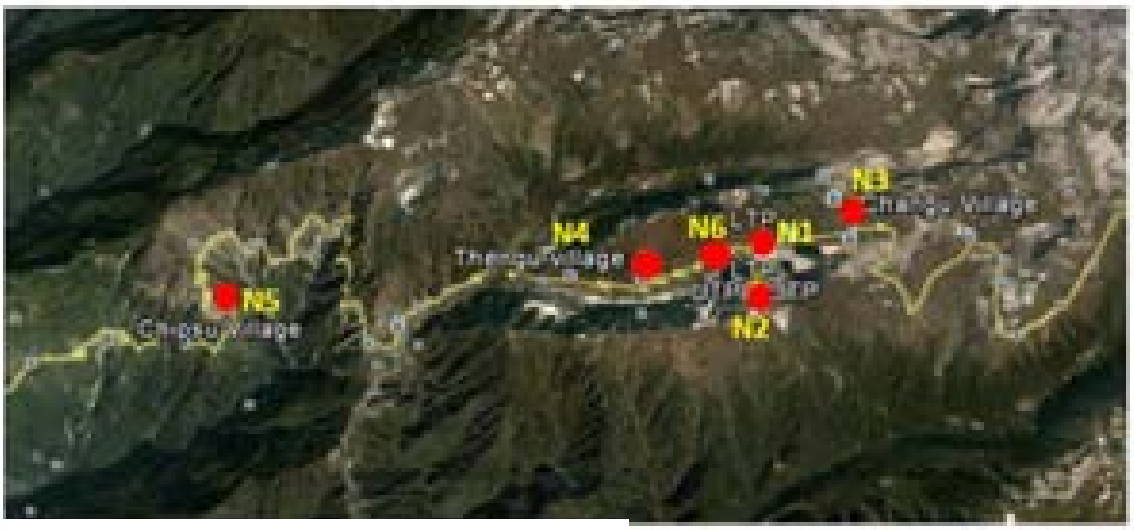


FIGURE 4-3; NOISE SAMPLING LOCATIONS ON 10 KM GOOGLE MAP

4.7.2 Methodology

At each station noise level was monitored for 24-hours simultaneously. For each measurement, dB (A) readings was taken for every 15 minutes for 24 hrs ones in a season to get Leq values.

S. No.	Locations	Class	L_{eq} Day noise level dB(A)	L_{eq} Night noise level dB(A)	Day time (6.00 A.M to 10.00P.M)	Night time (10.00 P.M to 6.00A.M)
					Standard (L_{eq} in dB(A)	Standard (L_{eq} in dB(A)
Core zone noise quality						
1	Onsite LTP	Commercial Area	53.2	43.1	65.0	55.0
2	Onsite UTP	Commercial Area	54.3	44.2	65.0	55.0
Buffer zone noise quality						
3	Changu Village	Residential Area	54.6	43.8	55.0	45.0
4	Thengu Village	Residential Area	54.1	44.2	55.0	45.0
5	Chipsu Village	Residential Area	55.6	44.5	55.0	45.0

6	Jawaharlal Nehru Road	Commercial area	61.2	46.8	65.0	55.0

TABLE 4-10; NOISE QUALITY RESULTS

(SOURCE OF STANDARDS: CPCB STANDARDS FOR NOISE POLLUTION (REGULATION & CONTROL) RULES, LABORATORY: M/S PERFACT RESEARCHERS PVT. LTD. (NABL ACCREDITED)

4.7.3 **Data Interpretation:**

Results are summarized above**.**

Core Zone: The ambient noise level at the proposed project site ranges from 53.2 dB (A) to 54.3 dB (A) which is within the standard limit of Commercial area are ~ 65 dB (A). During night the noise level at the project site ranges from 43.1 dB (A) to 44.2 dB (A) which is within the night-time noise standard limit of 55.0 dB (A).

Buffer Zone: The ambient noise level in residential area ranges from 54.1 dB (A) to 55.6 dB (A) which is slightly higher than the standard limit of residential area are ~ 55 dB (A) due to the local village activities. During night the noise at buffer zone ranges from 43.8 dB (A) to 44.5 dB (A) which is within the night-time noise standard limit of ~ 45.0 dB (A).

The noise level of Jawaharlal Nehru road is 61.2 dB (A) which is within the standard limit of commercial areas of ~ 65 dB (A). During night the noise level is 46.8 dB (A) which is also within the standard limits of commercial area ~ 55 dB (A).

4.8 **WATER QUALITY**

4.8.1 **Geohydrology**

Geologically, the area comprises of high grade massive gneiss. The major portion of area comprises of high grade Garnetiferous- Quartzo- Felspathic gneiss along with thin calc- granulite bands at places. Seventy five parent of the area along south is covered with the genessic rock sequence and two interbands of calc granulite occur towards the western portion of mapped area. The area under study comprised mainly of sequence of high grade gneissic rocks

associated with few interbands of calc- granulite of Central Crystalline Axial belt of Sikkim Himalayas. This completely granatised terrain that has undergone a polyphase deformation and metamorphism.

Ground water occurs in largely disconnected localized bodies under favourable geological structures, such as joints, fractured zones in various lithological units, weathered zones in the phyllite, schist, gneisses and quartzite. The ground water is available from source perennial springs from nallas present in all geological formations in the area. Due to higher relief and steep gradient of the area, the subsurface flow of ground water is intercepted with manifest as seepages and springs. The area is characterized by high rainfall which is primary source of ground water. The springs are not deep seated. Direct infiltration and rainfall through joints, fracture, weathered zones of the rocks and through soil covers is the principal mode of recharge of the springs. Due to steep slope most of the precipitation in the area is lost as surface run off through streams, kholas and intermittent springs which are tapped through pipe lines and distributed by gravity method for domestic use. Precipitation is the main source of recharge of ground water but glacier melt water is also recharging the ground water considerably. Discharge of the springs occurring in different types of rock formations in the area varies from 0.25 to 1.8 lps though the discharge decreases generally from December-January to May and maximum discharge is recorded during post monsoon period i.e., September to November.

4.8.2 **Sampling Stations:**

Station No.	Location	Distance & Direction from Project area	Environmental Sitting
SW1	Onsite (Lake)	----	Existing water quality at Core zone
SW2	Changu Village (Spring Water)	1.15 Km, NE	Existing water quality at Buffer zone
SW3	Thengu Village (Spring Water)	1.41 Km, NW	
SW4	Chipsu Village (Spring water)	6.56 Km, SW	

To assess the water quality of the proposed area, following 4 stations (Surface water) were selected. **Location of Water sampling stations** is described below and location below:

TABLE 4-11; SAMPLING LOCATIONS FOR WATER QUALITY

Criteria of Selection of sampling Locations:

Water sampling locations were selected on the basis of following criteria: source of water, flow of water, geological structure (hydrogeology), use of water etc. So, the water was collected from Changu village (spring water), Thengu village (spring water) & Chipsu village (Spring water) were used in drinking and other household activities.

Surface water was collected from Lake to study the chemical parameters. During surface water sampling flow of water pays an important role.

4.8.3 Sampling Locations:

FIGURE 4-4; WATER SAMPLING LOCATIONS ON 10 KM GOOGLE MAP

4.8.4 Sampling Frequency and Sampling Techniques:

As per the standard practice grab sampling was done for 4 locations and composite sampling was done for Lake. Water samples were taken as per the Standard Methods (IS & APHA, 22nd Edition 2012). Necessary precautions were taken for preservation of samples.

The physical parameters viz. pH, temperature and conductivity were measured at site using portable water analyzer.

As evident from the sampling locations for water quality assessment represented surface and groundwater. The results of water quality assessment are presented below:

SURFACE WATER QUALITY RESULTS (CORE ZONE)

S.No.	Parameters	Unit	SW1 Onsite (Lake)	IS: 10500 (Drinking Water Standard)	CPCB Surface water quality criteria				
					Class 'A'	Class 'B'	Class 'C'	Class 'D'	Class 'E'
1	Colour	Hazen	< 1	5	-	-	-	-	-
2	Odour	--	Agreeable	Agreeable	-	-	-	-	-
3	Turbidity	NTU	< 0.5	< 1	-	-	-	-	-
4	pH Value	--	7.3	6.5-6.8	6.5-6.8	6.5-8.5	6-9	6.5-8.5	6-8.5
5	Temperature	ºC	20.2	-	-	-	-	-	-
6	Conductivity	µmhos/cm	65.0	-	-	-	-	-	2250
7	Total Dissolved Solids	mg/l	35.0	500	-	-	-	-	-
8	Chloride (as Cl)	mg/l	3.0	250	-	-	-	-	-
9	Fluoride (as F)	mg/l	BDL	1.0	-	-	-	-	-
10	Total Hardness	mg/l	8.5	200	-	-	-	-	-
11	Calcium (as Ca)	mg/l	2.6	75	-	-	-	-	-
12	Magnesium (as Mg)	mg/l	0.5	30	-	-	-	-	-
13	Iron (as Fe)	mg/l	0.1	0.3	-	-	-	-	-
14	Sulphate (as SO4)	mg/l	4.9	200	-	-	-	-	-

15	Nitrate Nitrogen	mg/l	10.4	45	-	-	-	-	-
16	Nitrite Nitrogen	mg/l	BDL	-	-	-	-	-	-
17	Alkalinity	mg/l	16.0	200	-	-	-	-	-
18	Aluminium (as Al)	mg/l	BDL	0.03	-	-	-	-	-
19	Boron	mg/l	BDL	0.5	-	-	-	-	2
20	Phosphate	mg/l	BDL	-	-	-	-	-	-
21	Sodium (as Na)	mg/l	3.1	-	-	-	-	-	-
22	Potassium (as K)	mg/l	0.4	-	-	-	-	-	-
23	Nickel (as Ni)	mg/l	BDL	0.02	-	-	-	-	-
24	Manganese (as Mn)	mg/l	BDL	0.1	-	-	-	-	-
25	Copper (as Cu)	mg/l	BDL	0.05	-	-	-	-	-
26	Cadmium (as Cd)	mg/l	BDL	0.003	-	-	-	-	-
27	Lead (as Pb)	mg/l	BDL	0.01	-	-	-	-	-
28	Zinc (as Zn)	mg/l	BDL	5	-	-	-	-	-
29	BOD	mg/l	6.0	-	≤2	≤3	≤3		
30	COD	mg/l	14.0	-	-	-	-	-	-
31	DO	mg/l	5.8	-	≥6	≥5	≥4	-	-
32	Ammonical Nitrogen	mg/l	BDL	-	-	-	-	-	-
33	Total Suspended Solids	mg/l	3.2	-	-	-	-	-	-
34	Total Coliform	MPN/100ml	48.0	-	≤50	≤500	≤5000	-	-
35	Fecal Coliform	MPN/100ml	18.0	-	-	-	-	-	-

36	Chromium	mg/l	BDL	0.05	-	-	-	-	-
38	Phenols	mg/l	BDL	0.001	-	-	-	-	-
39	Arsenic	mg/l	BDL	0.01	-	-	-	-	-
40	Cyanide	mg/l	BDL	0.05	-	-	-	-	-
41	Selenium	mg/l	BDL	0.01	-	-	-	-	-
42	Mercury	mg/l	BDL	0.001	-	-	-	-	-
43	PAH	mg/l	BDL	0.0001	-	-	-	-	-
44	PCB	mg/l	BDL	0.0005	-	-	-	-	-

4.8.5 **Interpretation of surface water quality (Core zone):**

The Surface water quality of the core zone (Lake) shows that all the parameters are within the limits for EPA discharge standards and CPCB Water Quality Criteria (Class of water 'A', 'B', 'C', 'D' & 'E') except BOD (6.0 mg/l) which is higher than Class 'A', 'B', 'C' of CPCB water quality criteria.

GROUND WATER QUALITY RESULTS (BUFFER ZONE)

S.No.	Parameter	Unit	IS: 10500 Drinking Water Standards	W2 Changu Village (Spring Water)	W3 Thengu Village (Spring Water)	W4 Chipsu Village (Spring Water)
1	**Colour**	**Hazen**	**5**	<1	< 1	< 1
2	**Odour**	**--**	**Agreeable**	Agreeable	Agreeable	Agreeable
3	**Turbidity**	**NTU**	**1**	< 0.5	<0.5	<0.5
4	**pH Value**	**--**	**6.5-8.5**	7.6	7.6	7.4
5	**Temperature**	**ºC**	**-**	20.5	20.5	20.3
6	**Conductivity**	**µmhos/cm**	**-**	18.5	18.0	65.8
7	**Total Dissolved Solids**	**mg/l**	**500**	11.8	11.0	36.0
8	**Chloride (as Cl)**	**mg/l**	**250**	2.1	2.0	3.2

9	**Fluoride (as F)**	**mg/l**	**1.0**	BDL	BDL	BDL
10	**Total Hardness**	**mg/l**	**200**	4.0	3.8	8.6
11	**Calcium (as Ca)**	**mg/l**	**75**	1.3	1.2	2.4
12	**Magnesium (as Mg)**	**mg/l**	**30**	0.2	0.2	0.6
13	**Iron (as Fe)**	**mg/l**	**0.3**	0.12	0.1	0.12
14	**Sulphate (as SO_4)**	**mg/l**	**200**	0.7	0.6	5.0
15	**Nitrate Nitrogen**	**mg/l**	**45**	1.8	1.7	10.5
16	**Boron**	**mg/l**	**0.5**	<0.5	<0.5	<0.5
17	**Alkalinity**	**mg/l**	**200**	6.4	6.0	16.4
18	**Sodium (as Na)**	**mg/l**	**-**	1.4	1.2	3.3
19	**Potassium (as K)**	**mg/l**	**-**	0.2	0.1	0.2
20	**Nickel (as Ni)**	**mg/l**	**0.02**	BDL	BDL	BDL
21	**Manganese (as Mn)**	**mg/l**	**0.001**	BDL	BDL	BDL
22	**Copper (as Cu)**	**mg/l**	**0.05**	BDL	BDL	BDL
23	**Cadmium (as Cd)**	**mg/l**	**0.003**	BDL	BDL	BDL
24	**Lead (as Pb)**	**mg/l**	**0.01**	BDL	BDL	BDL
25	**Zinc (as Zn)**	**mg/l**	**5**	BDL	BDL	BDL
26	**Total Chromium**	**mg/l**	**0.05**	BDL	BDL	BDL
27	**Lithium**	**mg/l**	**--**	BDL	BDL	BDL
28	**Phosphate**	**mg/l**	**--**	BDL	BDL	BDL
29	**Aluminium**	**mg/l**	**0.03**	BDL	BDL	BDL

TABLE 4-12: LABORATORY: M/S PERFACT RESEARCHERS PVT. LTD (NABL ACCREDITED)

4.8.6 **Data Interpretation of Ground water quality (Buffer zone):**

As per the results mentioned above, it is observed that the pH of surface water ranges from 7.4 to 7.6. Other parameters like conductivity (18.0 to 65.8 µmhos/

cm); T.D.S. (11.0 to 36.0 mg/l); Total hardness (3.8 to 8.6 mg/l); Calcium (1.2 to 2.4 mg/l); Magnesium (0.2 to 0.6 mg/l) and Alkalinity (6.0 to 16.4 mg/l) are within the limits of drinking water standards.

4.9 SOIL QUALITY

To assess the soil quality of the proposed area, following stations were selected. Soil profile and quality was studied at 5 different locations. Location of Soil sampling stations is described below.

Sampling location:

Station No.	Location	Distance & Direction from Project area	Project area / Study area	Environmental Sitting
S1	Onsite LTP	----	Vacant Land	Existing Soil quality at core zone
S2	Onsite UTP	-----	Vacant Land	
S3	Changu Village	1.15 Km, NE	Vegetative Land	Existing Soil quality at Buffer zone
S4	Thengu Village	1.41 Km, NW	Vegetative Land	
S5	Chipsu Village	6.56 Km, SW	Vegetative Land	

TABLE 4-13; SAMPLING LOCATION FOR SOIL QUALITY

4.9.1 **Locations of soil sampling stations**

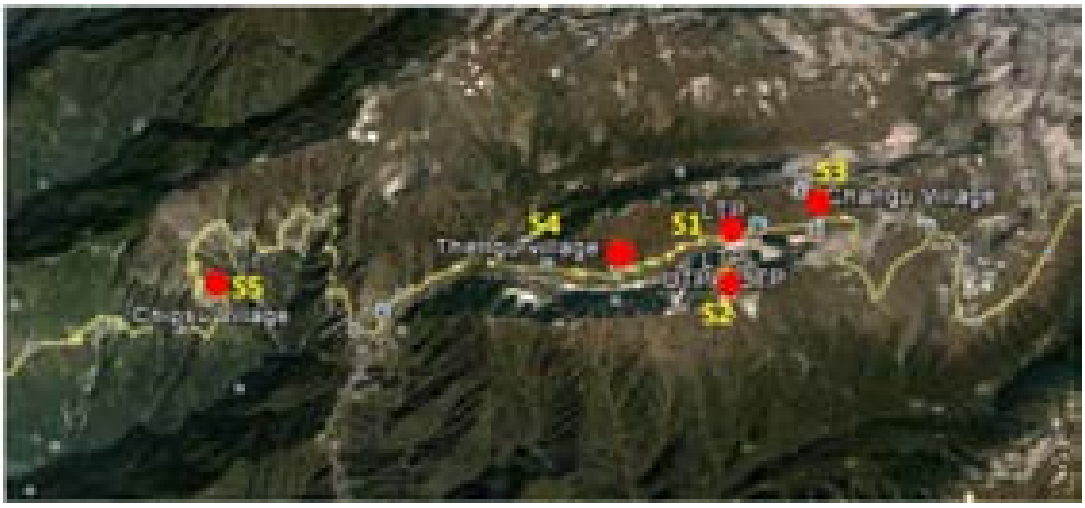


FIGURE 4-5; SOIL SAMPLING LOCATIONS ON 10 KM GOOGLE MAP

4.9.2 Sampling procedure & Analysis**:**

Augur method was used and samples were collected at 15 cm depth after removing the upper crust. Sample from each spot were well mixed with hand on a clean polythene sheet. About 1 kg of soil was retained after process of quartering. This sample was kept for some time for air-drying at room temperature, stored in polythene bag with label at the top. Samples were analysed for bulk density, pH, nitrogen, phosphorus, calcium, magnesium and organic contents. Soil Quality Results are summarized below.

ONSITE PHYSICAL & CHEMICAL PROPERTIES OF SOIL

S. No.	Parameter	S1 Onsite LTP	S2 Onsite UTP	Minimum Detection Limit
Physical Properties				
1	Colour	Brown	Brown	**1-10 Munsell Chart**
2	Composition (%)	Sand :23.8 Silt:53.9 Clay:22.6	Sand :21.1 Silt: 54.5 Clay:24.2	**Sand : 0-100% Silt: 0-100% Clay: 0-100%**

3	Moisture Content (%)	5.5	5.2	**0.1**
4	Conductivity (µS/cm)	24.2	28.1	**1**
Chemical Properties				
1	Texture	**Silt Loam**	**Silt Loam**	**--**
2	pH	5.5	4.9	**1**
3	Available Nitrogen (mg/kg)	19.6	25.2	**5**
4	Available P (mg/kg)	<5	0.4	**5**
5	Available K (mg/kg)	36.0	26.0	**5**
6	Ca (mg/kg)	36.0	32.0	**5**
7	Mg (mg/kg)	16.0	8.0	**10**
8	Organic matter (%)	0.3	0.4	**0.1**
9	Nitrate Nitrogen (mg/kg)	23.5	27.5	**5**
10	Chloride (mg/kg)	26.3	45.5	**5**
11	Available Sulphur (mg/kg)	14.6	15.6	**10**
12	Exchangeable Sodium (mg/kg)	14.5	9.5	**5**
13	Cation Exchange Capacity(meq/100gm)	16.6	20.2	**5**
14	Bi carbonate(mg/kg)	12.2	36.6	**2**
15	Orthophosphate(mg/kg)	0.1	<5	**5**

TABLE 4-14; ONSITE SOIL QUALITY RESULTS (LABORATORY: M/S PERFACT RESEARCHERS PVT. LTD (NABL ACCREDITED)

BUFFER ZONE PHYSICAL & CHEMICAL PROPERTIES OF SOIL

TABLE 4-15; SOIL QUALITY RESULTS (BUFFER ZONE) (LABORATORY: M/S PERFACT RESEARCHERS PVT. LTD (NABL ACCREDITED)

S. No.	Parameter	S2 Changu Village (Vegetative Land)	S3 Thengu village (Vegetative Land)	S4 Chipsu village (Vegetative Land)	Minimum Detection Limit
Physical Properties					
1	Colour	Dark Brown	Brown	Brown	**1-10 Munsell Chart**
2	Composition (%)	Sand :56.3 Silt: 19.5 Clay:24.1	Sand :22.3 Silt: 54.3 Clay:23.1	Sand :23.1 Silt:54.2 Clay:22.6	**Sand:0-100%**

					Silt: 0-100% Clay: 0-100%
3	Moisture Content (%)	5.8	6.2	5.0	**0.1**
4	Conductivity (µS/cm)	26.4	83.4	54.0	**1**
Chemical Properties					
1	Texture	**Sandy Clay Loam**	**Silt Loam**	**Silt Loam**	**--**
2	pH	5.9	4.5	5.5	**1**
3	Available Nitrogen(mg/kg)	22.4	5.6	16.8	**5**
4	Available P(mg/kg)	3.2	1.6	1.2	**5**
5	Available K (mg/kg)	29.5	32.5	21.5	**5**
6	Ca (mg/kg)	40.0	32.0	28.0	**5**
7	Mg (mg/kg)	20.0	12.0	12.0	**10**
8	Organic matter (%)	0.2	2.6	0.3	**0.1**
9	Nitrate Nitrogen (mg/kg)	8.5	9.3	17.7	**5**
10	Chloride (mg/kg)	35.0	43.8	35.0	**5**
11	Available Sulphur (mg/kg)	23.0	23.6	0.8	**10**
12	Exchangeable Sodium (mg/kg)	8.0	20.0	23.5	**5**
13	Cation Exchange Capacity(meq/100gm)	13.8	25.8	26.7	**5**
14	Bi carbonate(mg/kg)	36.6	24.4	24.4	**2**
15	Orthophosphate(mg/kg)	<5	<5	0.3	**5**

Fertility of Soil at Onsite

Parameters	**Result in mg/kg (0-15 cm)**	**Low mg/kg (0-15 cm**	**Medium mg/kg (0-15 cm)**	**High mg/kg (0-15 cm)**	**Remarks**
Nitrogen	19.6 to 25.2	<156	157-313	>314	Low
Potassium	26.0 to 36.0	<67	67.1-156	>156	Low

Phosphorus	<5 to 0.4	<5.5	5.6-13.9	>14.0	Low

TABLE 4-16; ONSITE FERTILITY STATUS OF SOIL

(SOURCE: LABORATORY: M/S PERFACT RESEARCHERS PVT. LTD. (NABL ACCREDITED)

4.9.3 **Data Interpretation**

Core Zone: Texture of soil is silt Loam (soil that contains 50-80% silt and less than 12% clay). Soil texture is one of the most important physical properties of soil that affects its fertility and productivity. The whole soil environment is regulated by soil texture. Soil texture governs most of the properties of the soil, its permeability, its capacity to retain water, its degree of aeration, its ability to make the nutrients stored in the clay-humus complex available to plants, its ability to withstand mechanical working of the top soil, and finally, its ability to support a permanent plant cover. In present case soil texture clearly indicates that the soil in core zone contains high percentage of silt which cannot hold water and nutrients and makes soil less fertile. So, the trees which can grow in these conditions can be planted.

The result shows that colour of soil is Brown, pH ranges from 4.9 to pH 5.5. The availability of many plant nutrients in the soil changes as a result of reactions in the soil, which are largely controlled by soil pH.

Amount of primary nutrients like Organic matter ranges from 0.3 % to 0.4 %, the available nitrogen ranges from 19.6 mg/kg to 25.2 mg/kg which is lower in range, the available phosphorus ranges from <5 mg/kg- 0.4 mg/kg is lower in range while available potassium 26.0 mg/kg to 36.0 mg/kg which is also lower in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen, Phosphorous and potassium. Nitrogen is the most important fertilizer element. Plants respond quickly to application of nitrogen. This element encourages above ground vegetative growth and gives a deep green colour to the leaves, available phosphorous is inevitable for the vital growth processes in plants & Potassium is the third essential fertilizer element and it is essential for photosynthesis, for protein synthesis, for starch formation and for the translocation of sugars. So, the addition of bio fertilizers will enhance the fertility of soil.

Buffer Zone: The result shows that texture varies from silt loam to sandy clay loam. Colour is Brown to Dark brown, pH ranges from 4.5 to 5.9. Amount of primary nutrients like Organic matter 0.2 % to 2.6 %, the available nitrogen 5.6 mg/kg to 22.4 mg/kg, the available phosphorus 1.2 mg/kg- 3.2 mg/kg is lower in range & available potassium 21.5 mg/kg to 32.5 mg/kg is lower in range, Primary nutrient profile shows that soil is low in fertility due to the availability of low amount of nitrogen, available potassium.

4.10 LAND USE

Our project site falls in East of Sikkim, Sikkim and Landuse map is given below:

Land Use Map

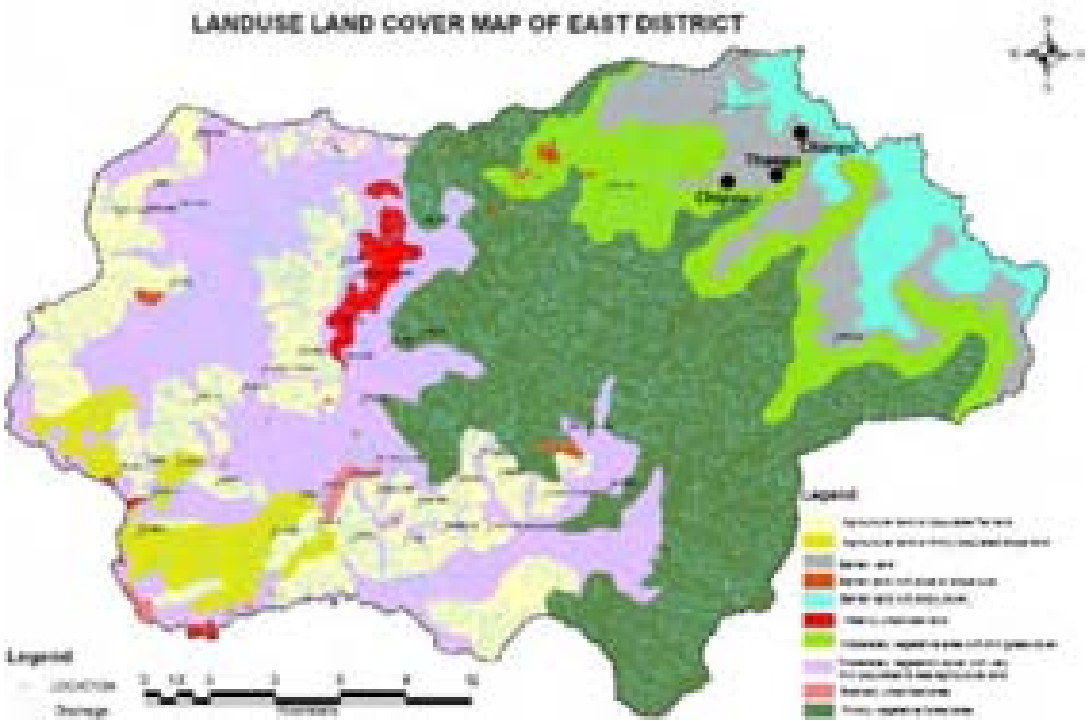


FIGURE 4-6; LANDUSE MAP

4.11 FLORA AND FAUNA

The biological fauna and flora existing at a site is the culmination of constant interaction between physical, chemical and biological environment. The chains of events/ interaction are complex and reflect in the density and composition.

Plants/animals and environment are inter related to each other. With the change in environmental conditions, the vegetation cover as well as animals reflects several changes in its structure, density and composition. The present study was carried out in two separate headings for floral and faunal community respectively. A Forest Map of Sikkim is shown below, the project is located in East Sikkim.

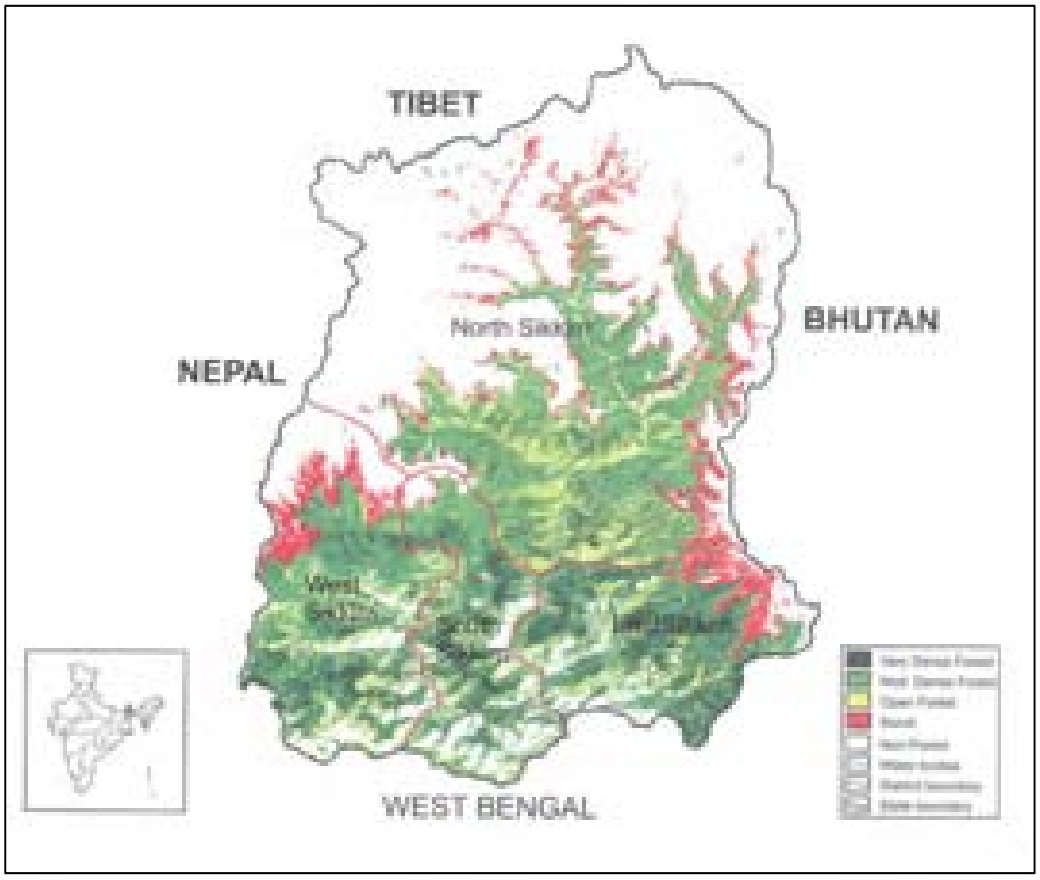


FIG. 3.7 FOREST MAP OF SIKKIM

- **Biological Environment: Flora and Fauna**

The Project is a 625 m long ropeway, covering an area of 8072 sq m (including Lower Terminal Station, Upper Terminal Station & ropeway corridor). The

Lower Terminal Point (LTP) has been developed in south to the lake and the Upper Terminal Point (UTP) has been developed on the hill top from where the picturesque view of Changu lake can be rejoiced. The Ropeway Project lies outside the Kyongnosla Alpine Sanctuary & Pangolakha Wildlife Sanctuary and that the project does not involve any diversion of land from the Wild Life Sanctuary.

Core Zone: For the purpose of EIA study and reports, the area covered by the Terminals (stations) and the 625 m long alignment which stretches from Southern side of the Changu lake to the Southern hill top

Buffer Zone: The areas lying within 10 km radius from the said "core zone" is called the “Buffer Zone”.

Bird: Birds are watched during dawn.

Nocturnal and Burrowing animals: After Sunset.

Animals: Morning & Evening

General Vegetation Pattern: The prevailing vegetation cover over the area have been surveyed and presented below for core and buffer zone.

Flora in Core Zone of EIA study:

Core zone is considered, length from lower to upper station of 625 meters approx. and lower and upper terminal of area 1200 sqm & 1755 sqm respectively.

The entire alignment including the lower and upper terminal falls under the Kyongnosla Range of East of Sikkim.

Flora studied in core zone- The core zone is dominated by Deciduous Alpine Scrub like *Betula, Berberis* sp, *Anaphalis triplinervis, Bergenia cilata, Rhododendron lepidotum* and flowering plants like *Allium wallichii, Codonopsis ovate etc.* There is no tree in core zone

Flora Study in Buffer Zone of EIA report:

The vegetation is comprised of moist alpine Scrub in the lower altitudes of the project area. In the upper reaches Dry alpine scrub are prevalent. The entire area of project falls in the the Kyongnosla Range of East of Sikkim.

The forest types in buffer zone has been described as per the classification of Champion and Seth (1968).

Type of Forests	**Altitude (m)**
5(a) Moist alpine Scrub	
Birch-Rhododendron scrub forests	Above 3600
Deciduous alpine scrub	3600-3900
Dwarf Rhododendron Scrub	Above 3600
Alpine pastures	Above 4000
5(b) Dry alpine scrub	
Dwarf Juniperus scrub	Above 3600
Dry alpine scrub	Above 4000

Buffer zone is considered as 10 km from the alignment of the ropeway, 10 km has following wild life sanctuaries and dense jungles, they are as follows,

Kyongnosla Alpine Sanctuary (200 m), Pangolakha Wildlife Sanctuary (more than 5 km), Mixed jungles etc.

The forests present in the buffer zone have been grouped into different forest types following the classification of Champion & Seth (1968). The major forest types found are discussed below.

ALPINE SCRUBS AND PASTURES

These are meadows lying below the snowline all along the higher Himalayan parts of North, East and West Sikkim. Very heavy snowfall is received in the winter season and summers are mild with a short growing season. The vegetation of this group consists of the following forest types:

Alpine Scrub Forest

This is low evergreen forest dominated by *Rhododendron* and some deciduous species. These forest are found in the alpine areas of North, East and West Sikkim. The important species are *Acer capadocicum, A. campbellii, Betula utilis, Rhododedron decipiens, R. maddenii, R. sikkimensis, R. vaccinnioides* and *Sorbus foliolosa*.

Dwarf Rhododendron Scrub

This scrub vegetation is dominated by the *Rhododendron anthopogon, R. cilliatum, R. lepidotum, R. lanatum, R. nivale* and *R.setosum*. These scrubs are found in Chola, Dzongri, Nathula, Lachen, Lachung, Yumthang and Kupup areas.

Alpine Pastures

These are meadows lying below the snowline and above 3,600 m where the tree line ends all along the higher Himalaya in Sikkim. In open meadows, the gentle mountain slopes composed of many perennial mesophytic herbs and some grasses. Important herbs are species of *Aconitum, Allium, Anemone, Delphinium, Caltha, Cassiope, Fragaria, Fritillaria, Geum, Gentiana, Iris, Juncus, Podophyllum, Potentilla, Primula* and *Ranunculus*.

Dry Alpine Scrub

This is an alpine xerophytic formation in which dwarf scrubs predominate. These are found at high elevations in the Chhangu in East Sikkim. Important dwarf scrubs are *Berberis angulosa, Ephedra gerardiana, Juniperus recurva, Rosa sericea, Rhododendron anthopogon, R. nivale,* etc.

Dwarf Juniper Scrub

Juniperus recurva grows in bushy formations in East Sikkim particularly on the exposed sunny hill slopes around Thangu and Chhangu between 4,200 – 4,300 m elevation. Other dwarf junipers are *Junipers squamata* and *J. pseudosabina* in the alpine region.

SPECIES OF PRIMULA AVAILABLE IN BUFFER ZONE	
Scientific Name	Altitude (m)
Primula vaginata	2740-3650
Primula geraniifolia	2740-3660
Primula irregularis	3050-3960
Primula drummondiana	2440-3960
Primula elongata	3050-4720
Primula dickieana	3200-4260
Primula sikkimensis	2745-4420
Primula reticulata	3500-4265
Primula concinna	4265-4880
Primula primulina	3860-4920
Primula walshii	3960-4570
Primula bellidifolia	3650-4570
Primula soldanelloides	4100-4730
Primula wattii	3800-4400

ENDEMIC, VULNERABLE & THREATENED SPECIES (AS PER RED DATA BOOK)			
Scientific Name	Family	Altitude (m)	Status
Angelica nubigena	Apiaceae	3668-3900	Endemic
Crawfordia puberula	Gentianaceae	3753	Endemic
Phoenix rupicola	Arecaceae	1500	Endemic
Panax pseudoginseng	Araliaceae	2900-4000	Vulnerable
Arenaria thangoensis	Cryophyllaceae	3659	Threatened
Juncus sikkimensis	Juncaceae	3659-4000	Threatened
Lactuca cooperi	Asteraceae	4000	Threatened

PROTECTED AREAS:

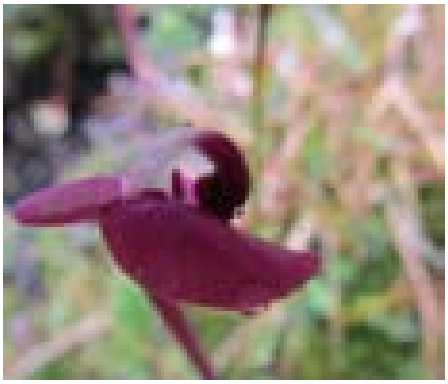
Kyongnosla Alpine Sanctuary is located to the east of Gangtok *en route* to Nathula Pass at a distance of about 31 km. The sanctuary area is rich in flora which starts from 15th mile and extends up to Chhangu (Tsomgo) lake. Among important forests found in the sanctuary area are Sub-alpine, Mixed coniferous forest and alpine scrub and alpine pasture. The Sub-alpine forest of this area start above El. 3,000 m and are comprised of mixture of conifers and rhododendrons. Important trees in the canopy are *Abies densa, Acer campbellii, Betula utilis, Juniperus recurva* and *Rhododendron arboreum*. In Alpine scrub forest, *Betula utilis, Rhododendron anthopogon, R. ciliatum, R. vaccinniodes* and *Sorbus foliosa* are found. The species of *Aconitum, Allium, Delphinium, Caltha, Cassiope, Geum, Gentiana, Iris, Podophyllum, Primula*, *Saussurea*, etc. are the predominant herbaceous flora of this area. Above Tsomgo lake the vegetation is characterized by typical Alpine moorland forest type except in Menmoi Chho area in Sherathang forest range. Menmoi Chho lake area is situated loer slopes of Sherathang and comprised of dense Mixed sub-alpine type of forest. *Abies densa, Acer campbellii, Betula utilis, Juniperus recurva, Prunus* spp*., Rhododendron* spp., *Sorbus* spp., etc. are found in the tree canopy. In the under storey of this forest, endemic plant species of Himalaya such as *Aconitum bisma, A. ferox, A. elwesii, Angelica nubigena, Meconopsis* spp*., Podophyllum hexandrum,* etc. were recoded.

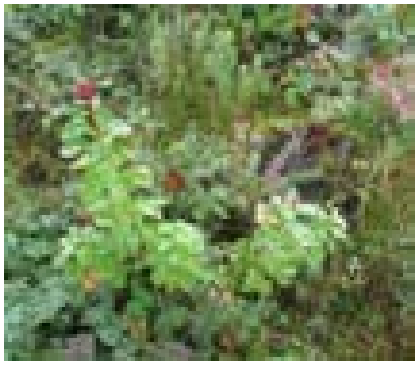
Many rare and endangered medicinal plants such as *Podophyllum hexandrum*, *Aconitum* spp. and *Nardostachys grandiflora* occur in the sanctuary. The orchid *Cypripedium elegans* is endemic to this area. *Abies densa* is the predominant tree along with a wide variety of rhododendrons that are found in the sanctuary. Dense bushes of bamboos at the lower altitudes, mostly belonging to *Arundinaria* spp. form an ideal habitat for animals like the Red panda. Sub-alpine forest, alpine pastures, Birch-Rhododendron scrub and Deciduous alpine scrub are the predominant forest types found in the sanctuary.

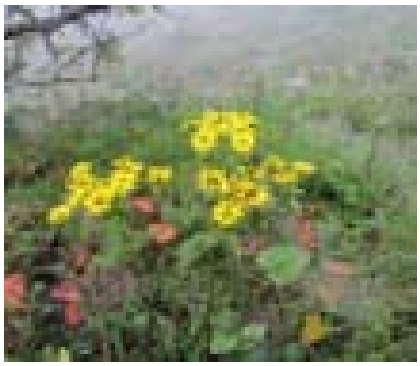
Beyond Tsomgo lake and above Menmoi Chho and higher elevations alpine vegetation i.e. without trees. Near Baba Dham the trek route is bifurcated and one goes for Nathula pass and other to Kupup areas. Both areas are located at very high range of elevation i.e. above 4,000 m and consist of typical scrub and alpine meadow vegetation. Nathula area has very rugged topography and shows only some herbs on glacial deposited morains. While Kupup area has a luxuriant vegetation of herbs and some stunted shrubs. Among shrubs are *Cassiope fastigata, Juniperus recurva, Rhododendron ciliaris, Ribes* sp*., Rosa sericea*, etc. A number of herbaceous species form a thick carpet of beautiful flowers. *Aconitum novoluridum, A. bisma, Allium wallichii, Chamaesium novem-jugum, Codonopsis ovata, Fritillaria cirrhosa, Heracleum sublineare, Juncus sikkimensis, Lilium oxypetalum, Lactuca cooperi, Primula* spp*., Saussurea aitchisonii*, etc. are the important herbs of these meadows.

Pangolakha Wildlife Sanctuary established in 2002, lies in the eastern part of Sikkim, The altitude varies from 1,200 m to 4,757 m. The Pangolakha range separates Sikkim from Bhutan in the southeast, where Red panda, Gaur and Tibetan wolf occur.

PHOTOGRAPHS OF FLORA SEEN IN BUFFER ZONE




Fauna of Core & Buffer Zone

Faunal diversity in buffer zone include *inter alia*, the red panda, (*Ailurus fulgens*), leopard (*Panthera pardus*), Kalij pheasants, (*Lophurs leucomelana*) and Himalayan Vulture, Himalayan black bear (*Selenarctos thebetanus*), Jungle cat, (*Felis chaus*), flying squirrels, fox (*Vulpes bengalensis*), Goral (*Nemorhaedus spp*), Wild pig (*Susscrofa*), Musk Deer (*Moschus moschiferus*), Indian bison etc. Tibetan fox (Vulpes ferrilatus) etc.

Bird diversity is represented by different types of laughing thrushes in shrubs and on the forest floor; the blue whistling thrush, redstarts and forttails near waterfalls and hill-streams; warblers, tit-babblers, tree creepers, white-eyes, wrens, rose finches, red billed choughs, yellow- bellied fantail flycatchers, mynas, yuhanas, black eagle, black winged kite and kestrels, griffon vulture. The pheasants such as monal and blood pheasant are also found here.

Schedule-1 Animals and Birds in this region:

There are following Schedule I species found in buffer zone: red panda, (*Ailurus fulgens*), leopard (*Panthera pardus*), Kalij pheasants, (*Lophurs leucomelana*), Himalayan Vulture (*Gyps himalayensis*), Musk Deer (*Moschus moschiferus*), Tibetan fox (*Vulpes ferrilatus*)

4.12 SOCIO-ECONOMIC SCENARIO

The project falls under the east Sikkim District of Sikkim. A socio-economic survey in the buffer zone of 10 Km radius was undertaken to feel and understand the present socio-economic scenario based on census data 2011.

Only 6 villages were found with in the 10 Km radius of proposed area which are as follows:

1. Changu Village
2. Chipsu Village
3. Thegu Village
4. Kupup village
5. Gnathang village
6. Bhusuk Village

District map of East Sikkim is given in fig. below:

However, total 134 villages lie in the East Sikkim District. The project falls under the Gangtok Tehsil of East Sikkim District which is formed of 75 villages.

The demographic profile of the Gangtok Tehsil is given in table 4-23.

TABLE 4-5; DEMOGRAPHIC COMPOSITION

Demographic composition of the study area based on census data 2011													
S.No.	Name	HH	Total Population	Male	Female	SC	ST	Literate			Illiterate		
								Total	Male	Female	Total	Male	Female
1.	Rakdong	510	2409	1261	1148	74	887	1750	991	759	659	270	389
2.	Tintek	384	1778	950	828	74	321	1309	749	560	469	201	268
3.	Kambal	202	1049	542	507	71	349	764	428	336	285	114	171
4.	Samdong	481	2125	1090	1035	57	544	1492	831	661	633	259	374
5.	Raley-Khese	391	1712	853	859	88	226	1204	653	551	508	200	308
6.	Tumen	589	2974	1522	1452	211	1044	1847	990	857	1127	532	595
7.	Chadey	57	256	120	136	18	160	143	71	72	113	49	64
8.	Simik	55	302	170	132	1	113	249	146	103	53	24	29
9.	Aritar (Dung-Dung)	99	556	290	266	26	69	422	235	187	134	55	79
10.	Lingzey (Simik)	75	384	200	184	9	256	269	152	117	115	48	67
11.	Patuk	446	2236	1234	1002	122	549	1643	980	663	593	254	339
12.	Singbel	388	1979	1004	975	119	571	1310	722	588	669	282	387

13.	Dung-Dung	418	2194	1130	1064	148	407	1550	855	695	644	275	369
14.	Budang Thangsing	128	677	355	322	192	244	445	235	210	232	120	112
15.	Beng	109	535	289	246	0	1	329	194	135	206	95	111
16.	Khamdong	424	1669	896	773	29	518	1230	715	515	439	181	258
17.	Sherwani	304	1489	792	697	343	364	1076	643	433	413	149	264
18.	Sakyong	80	386	189	197	56	166	247	140	107	139	49	90
19.	Chisopani	623	2719	1374	1345	345	549	1966	1053	913	753	321	432
20.	Tshalumthang	300	1405	732	673	71	431	1005	573	432	400	159	241
21.	Rapdang	72	424	216	208	78	164	307	176	131	117	40	77
22.	Namgeythang	83	451	224	227	56	276	296	160	136	155	64	91
23.	Byang	92	495	253	242	42	271	321	168	153	174	85	89
24.	Phengyong	222	1256	647	609	22	443	947	523	424	309	124	185
25.	Tirkutam	62	327	173	154	0	222	224	130	94	103	43	60
26.	Nazitam	150	810	422	388	2	278	498	277	221	312	145	167
27.	Martam	776	3720	2001	1719	303	1359	2450	1387	1063	1270	614	656
28.	Mangthang	124	575	306	269	0	156	386	213	173	189	93	96
29.	Sumen	244	1305	680	625	29	684	650	363	287	655	317	338
30.	Lingzey (Sumen)	192	962	481	481	2	127	604	320	284	358	161	197
31.	West Pendam	1286	6587	3529	3058	797	1046	4659	2698	1961	1928	831	1097
32.	Central Pendam	1149	5434	2764	2670	606	851	3909	2118	1791	1525	646	879
33.	Sajong	164	908	460	448	78	200	714	381	333	194	79	115
34.	Chuba	251	1178	651	527	43	255	773	461	312	405	190	215
35.	Namli	261	1203	634	569	107	360	872	484	388	331	150	181
36.	Tumlabung	82	383	193	190	38	171	327	172	155	56	21	35
37.	Namin	63	304	144	160	57	32	207	112	95	97	32	65
38.	Samlik-Marchak	466	2306	1231	1075	178	754	1738	983	755	568	248	320
39.	Shyagyong-Rumtek	391	1897	1045	852	75	1057	1270	711	559	627	334	293
40.	Rawate-Rumtek	346	1573	809	764	196	202	1232	666	566	341	143	198
41.	Chinze	114	517	273	244	22	121	420	241	179	97	32	65
42.	Ranka	135	609	306	303	4	30	426	228	198	183	78	105
43.	Sangtong	168	822	396	426	33	450	562	287	275	260	109	151
44.	Barbing	274	1276	635	641	57	576	1015	540	475	261	95	166
45.	Temphyak Mendu	115	552	296	256	0	370	452	252	200	100	44	56
46.	Rey	121	594	295	299	8	490	521	261	260	73	34	39
47.	Lingdum	423	2589	1634	955	189	643	2078	1422	656	511	212	299
48.	Nampong	207	965	504	461	26	541	676	374	302	289	130	159
49.	Lingdok	182	896	469	427	16	324	688	387	301	208	82	126
50.	Navey	143	678	352	326	4	569	530	300	230	148	52	96
51.	Shotak	209	1541	1251	290	11	295	1302	1118	184	239	133	106
52.	Penlong	237	1022	521	501	11	527	829	444	385	193	77	116
53.	Luing	413	2019	1037	982	41	243	1496	816	680	523	221	302
54.	Parbing	85	459	237	222	0	82	310	170	140	149	67	82
55.	Rongyek	651	3169	1672	1497	79	1695	2349	1329	1020	820	343	477

56.	Tathangchen	209	936	480	456	6	554	709	389	320	227	91	136
57.	Syari	885	3826	1984	1842	134	1778	2743	1542	1201	1083	442	641
58.	Nandok	809	3604	1850	1754	229	1126	2781	1537	1244	823	313	510
59.	Naitam	283	1265	628	637	22	536	898	489	409	367	139	228
60.	Namok	105	442	236	206	9	205	312	172	140	130	64	66
61.	Pam	25	94	50	44	12	45	58	31	27	36	19	17
62.	**Bhusuk**	**79**	**374**	**206**	**168**	**18**	**161**	**244**	**139**	**105**	**130**	**67**	**63**
63.	**Gnathang**	**913**	**8860**	**7455**	**1405**	**272**	**1614**	**7926**	**7032**	**894**	**934**	**423**	**511**
64.	Assam	379	1686	874	812	6	415	1188	643	545	498	231	267
65.	Lingzey (Assam)	430	2055	1065	990	191	626	1474	800	674	581	265	316
66.	Kyongnosla Forest Block	12	46	26	20	0	11	21	11	10	25	15	10
67.	Gnathang Forest Block	0	0	0	0	0	0	0	0	0	0	0	0
68.	Pangthang Forest Block	87	399	208	191	0	136	294	164	130	105	44	61
69.	Gangtok Forest Block	73	352	189	163	17	266	221	131	90	131	58	73
70.	Ranipool Forest Block	0	0	0	0	0	0	0	0	0	0	0	0
71.	Rumtek Forest Block	0	0	0	0	0	0	0	0	0	0	0	0
72.	Tumen Forest Block	0	0	0	0	0	0	0	0	0	0	0	0
73.	Sang Forest Block	0	0	0	0	0	0	0	0	0	0	0	0
74.	Singtam Forest Block	4	18	11	7	0	4	11	7	4	7	4	3
75.	Rangpo Forest Block	44	249	122	127	3	55	164	87	77	85	35	50
	Total	**20353**	**102846**	**57118**	**45728**	**6183**	**31165**	**75332**	**45202**	**30130**	**27514**	**11916**	**15598**

(SOURCE: CENSUS 2011) (HH: HOUSE HOLD, LIT- LITERATE, ILL- ILLITERATE, M: MALE, F: FEMALE)

Occupational status of the area is given in Table below

TABLE 4-6: OCCUPATIONAL STATUS OF THE EAST SIKKIM

		Worker			Main Worker							Marginal Workers							Non worker		
S.No.	**Name**	Total Population	Total Male	Total Female	Persons	Male	Female	Cultivation	Agricultural labour	House hold industry	Others	Persons	Male	Female	Cultivation	Agricultural labour	House hold industry	Others	Persons	Male	Female
1.	Rakdong	1480	791	689	961	624	337	431	113	89	328	519	167	352	204	135	32	148	929	470	459
2.	Tintek	1038	583	455	787	499	288	383	71	19	314	251	84	167	132	88	10	21	740	367	373
3.	Kambal	689	360	329	367	275	92	189	22	2	154	322	85	237	292	12	2	16	360	182	178
4.	Samdong	1139	665	474	890	578	312	436	191	10	253	249	87	162	170	35	6	38	986	425	561
5.	Raley-Khese	1064	568	496	642	423	219	261	127	8	246	422	145	277	53	335	3	31	648	285	363
6.	Tumen	1792	967	825	1244	786	458	668	193	9	374	548	181	367	280	205	12	51	1182	555	627
7.	Chadey	179	92	87	137	77	60	77	40	0	20	42	15	27	26	14	0	2	77	28	49
8.	Simik	180	100	80	170	95	75	145	0	0	25	10	5	5	10	0	0	0	122	70	52
9.	Aritar (Dung-Dung)	346	179	167	326	169	157	242	0	4	80	20	10	10	2	0	0	18	210	111	99
10.	Lingzey (Simik)	223	114	109	218	113	105	167	0	0	51	5	1	4	5	0	0	0	161	86	75
11.	Patuk	1575	909	666	896	666	230	435	54	2	405	679	243	436	259	361	1	58	661	325	336
12.	Singbel	1188	611	577	835	507	328	512	74	8	241	353	104	249	50	94	12	197	791	393	398
13.	Dung-Dung	1342	716	626	900	642	258	640	27	13	220	442	74	368	373	31	16	22	852	414	438
14.	Budang Thangsing	362	195	167	215	141	74	138	2	0	75	147	54	93	125	0	0	22	315	160	155
15.	Beng	282	149	133	276	145	131	234	7	0	35	6	4	2	4	0	0	2	253	140	113
16.	Khamdong	875	587	288	611	450	161	258	10	8	335	264	137	127	228	18	0	18	794	309	485
17.	Sherwani	655	437	218	269	238	31	3	6	6	254	386	199	187	23	282	41	40	834	355	479
18.	Sakyong	242	116	126	119	81	38	76	1	0	42	123	35	88	88	17	1	17	144	73	71
19.	Chisopani	1356	850	506	1118	724	394	298	23	23	774	238	126	112	97	12	10	119	1363	524	839
20.	Tshalumthang	741	446	295	625	395	230	203	17	3	402	116	51	65	26	18	1	71	664	286	378
21.	Rapdang	274	141	133	191	103	88	148	12	1	30	83	38	45	55	12	8	8	150	75	75
22.	Namgeythang	273	142	131	246	128	118	157	1	11	77	27	14	13	5	1	0	21	178	82	96
23.	Byang	382	191	191	175	121	54	115	2	1	57	207	70	137	203	2	0	2	113	62	51
24.	Phengyong	815	421	394	301	198	103	56	39	6	200	514	223	291	340	68	9	97	441	226	215
25.	Tirkutam	163	97	66	89	78	11	19	37	1	32	74	19	55	6	55	11	2	164	76	88
26.	Nazitam	404	224	180	235	177	58	116	8	2	109	169	47	122	139	6	0	24	406	198	208
27.	Martam	2089	1204	885	1731	1067	664	777	96	43	815	358	137	221	137	65	3	153	1631	797	834
28.	Mangthang	309	176	133	222	150	72	3	152	3	64	87	26	61	9	74	0	4	266	130	136

29.	Sumen	600	364	236	199	170	29	85	31	21	62	401	194	207	265	114	11	11	705	316	389
30.	Lingzey (Sumen)	518	280	238	414	262	152	292	13	3	106	104	18	86	75	11	1	17	444	201	243
31.	West Pendam	3312	2089	1223	2603	1890	713	855	152	91	1505	709	199	510	495	35	17	162	3275	1440	1835
32.	Central Pendam	2378	1475	903	2004	1329	675	581	142	29	1252	374	146	228	106	93	8	167	3056	1289	1767
33.	Sajong	460	226	234	207	187	20	180	8	2	17	253	39	214	17	230	0	6	448	234	214
34.	Chuba	631	383	248	555	369	186	311	23	5	216	76	14	62	8	19	8	41	547	268	279
35.	Namli	803	431	372	528	311	217	191	81	1	255	275	120	155	41	121	18	95	400	203	197
36.	Tumlabung	307	157	150	182	104	78	9	4	3	166	125	53	72	3	0	0	122	76	36	40
37.	Namin	225	110	115	163	84	79	121	7	1	34	62	26	36	58	1	0	3	79	34	45
38.	Samlik-Marchak	1258	746	512	1103	688	415	423	2	20	658	155	58	97	123	7	2	23	1048	485	563
39.	Shyagyong-Rumtek	793	490	303	654	415	239	108	105	17	424	139	75	64	16	48	2	73	1104	555	549
40.	Rawate-Rumtek	736	455	281	573	402	171	40	42	8	483	163	53	110	74	26	3	60	837	354	483
41.	Chinze	182	138	44	166	130	36	43	4	0	119	16	8	8	3	7	0	6	335	135	200
42.	Ranka	330	187	143	233	140	93	104	9	0	120	97	47	50	25	7	1	64	279	119	160
43.	Sangtong	284	218	66	217	168	49	21	7	2	187	67	50	17	13	14	0	40	538	178	360
44.	Barbing	619	375	244	313	227	86	165	5	13	130	306	148	158	183	26	18	79	657	260	397
45.	Temphyak Mendu	242	167	75	134	95	39	58	4	0	72	108	72	36	37	60	1	10	310	129	181
46.	Rey	285	147	138	283	145	138	208	0	3	72	2	2	0	1	0	0	1	309	148	161
47.	Lingdum	1411	969	442	1167	919	248	377	61	19	710	244	50	194	170	33	1	40	1178	665	513
48.	Nampong	578	336	242	371	280	91	148	55	2	166	207	56	151	41	116	0	50	387	168	219
49.	Lingdok	507	260	247	392	229	163	194	21	2	175	115	31	84	19	67	0	29	389	209	180
50.	Navey	335	196	139	282	162	120	90	3	5	184	53	34	19	2	0	0	51	343	156	187
51.	Shotak	1216	1124	92	991	914	77	21	24	0	946	225	210	15	2	1	0	222	325	127	198
52.	Penlong	405	297	108	377	279	98	5	7	3	362	28	18	10	7	1	3	17	617	224	393
53.	Luing	923	537	386	759	461	298	452	24	2	281	164	76	88	84	15	2	63	1096	500	596
54.	Parbing	130	120	10	120	112	8	52	22	2	44	10	8	2	9	1	0	0	329	117	212
55.	Rongyek	1215	849	366	1108	807	301	59	38	4	1007	107	42	65	5	10	1	91	1954	823	1131
56.	Tathangchen	340	253	87	314	243	71	24	3	15	272	26	10	16	3	0	3	20	596	227	369
57.	Syari	1734	1173	561	1307	934	373	137	28	7	1135	427	239	188	72	36	3	316	2092	811	1281
58.	Nandok	1465	966	499	1138	786	352	80	52	8	998	327	180	147	50	45	1	231	2139	884	1255
59.	Naitam	731	394	337	527	320	207	309	69	5	144	204	74	130	44	51	44	65	534	234	300
60.	Namok	183	119	64	123	77	46	81	3	0	39	60	42	18	12	10	3	35	259	117	142

61.	Pam	53	30	23	3	1	2	0	0	1	2	50	29	21	0	4	2	44	41	20	21
62.	**Bhusuk**	199	119	80	164	108	56	1	0	0	163	35	11	24	0	1	0	34	175	87	88
63.	**Gnathang**	7629	6914	715	7231	6708	523	94	80	12	7045	398	206	192	7	5	6	380	1231	541	690
64.	Assam	912	504	408	693	439	254	266	69	15	343	219	65	154	146	10	0	63	774	370	404
65.	Lingzey (Assam)	1278	691	587	784	476	308	364	38	13	369	494	215	279	270	102	18	104	777	374	403
66.	Kyongnosla Forest Block	33	21	12	31	20	11	0	3	0	28	2	1	1	0	0	0	2	13	5	8
67.	Gnathang Forest Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
68.	Pangthang Forest Block	157	107	50	152	106	46	10	38	2	102	5	1	4	0	1	1	3	242	101	141
69.	Gangtok Forest Block	182	112	70	182	112	70	9	16	3	154	0	0	0	0	0	0	0	170	77	93
70.	Ranipool Forest Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
71.	Rumtek Forest Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
72.	Tumen Forest Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
73.	Sang Forest Block	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
74.	Singtam Forest Block	7	6	1	4	4	0	0	0	0	4	3	2	1	0	0	0	3	11	5	6
75.	Rangpo Forest Block	193	96	97	190	95	95	175	1	3	11	3	1	2	3	0	0	0	56	26	30
	Total	**57236**	**36662**	**20574**	**43737**	**31358**	**12379**	**13930**	**2619**	**614**	**26574**	**13499**	**5304**	**8195**	**5830**	**3268**	**356**	**4045**	**45610**	**20456**	**25154**

A socioeconomic survey within the Core Zone & Buffer Zone was conducted of Perfact Enviro Solutios Pvt. Ltd. survey covered 58 households in the buffer zone of Changu village, Chipsu Village & Thegu Village. The result of the survey are summarized as below:

TABLE 4-7; MICRO LEVEL VILLAGE INFORMATION

		Micro level village information based on field survey & census data 2011		
	Parameter	Name of the village		
Sr.no.	Particular	Changu Village	Chipsu Village	Thegu Village
1.	House Holds Approximate	50-60	60-70	30-40
2.	Occupation or source of income	Labour/ Sevice/ private business/ tourism	Labour/ Sevice/ private business/ tourism	Labour/ Sevice/ private business/ tourism
3.	Total Population	332	386	173
4.	Actual population (due to migration)	100-150	100-150	60-70
5.	Literacy Rate %	75%	80%	70%
6.	School	Nil	Nil	Primary school
7.	Hospital	Nil	Primary Hospital	Nil
8.	Market	Pvt. shop	Pvt. shop	Pvt. Shop
9.	Electricity	Yes	Yes	Yes
10.	Source of water	Lake, Spring	Spring	Spring
11.	Toilet facilities	yes	yes	yes
12.	Spring in the village	yes	yes	yes
13.	Transport system	Pvt. Transport	Pvt. Transport	Pvt. Transport

(SOURCE - FIELD SURVEY)

Data interpretation of survey conducted:

Housing - The housing condition in the buffer zone was found better than many of the rural areas. The site had semi pucca & pucca houses.

Population- The actual population of the village was found to be lower than the total population of the village due to migration of the people.

Electricity- The villages within the area were mostly electrified.

Drinking Water- Drinking water facility was available through the lake in Changu village & spring supply in all the other villages.

Education status- Education status was found not good in the area only 20-25% people were found literate.

Primary occupation- Private business (taxi driving, private shops), labor & service were found to be the main sources of income.

4.13 TRAFFIC DENSITY

Preliminary Traffic Assessment: The estimated traffic in the proposed project is driven by the trip generated by the proposed land use within the project area. The estimated traffic is then appropriately assigned on the networks to obtain the quantum of traffic that will be handled by the road network. The following key issues are identified by the Government:

Strengthening and development of system of roads.

Development of alternate road link.

Developing of parking facilities.

With an ever-increasing urbanization, road traffic is also increasing.

PCU Values

PCU values are used to convert various vehicles in to one standard vehicles i.e. Passenger car units (PCU). The PCU values as per IRC are as given below:

S. No.	VEHICLE TYPE	PCU VALUE
1	Car	1
2	Two wheeler	0.5
3	Truck or bus	4.5
4	Auto	1.2
5	LCV	2
6	Tractor and Trailor	5
7	Cycle rickshaw	0.5

The Traffic density for NH-8 Road (Road width –12m, 2 lane highway):

The traffic density for Jawahar lal Nehru marg (Road width – 12m, 2 lane highway) is given below in the table:

Time	Car/LTV	Truck/Bus	Two Wheeler	Others	PCU/hr
JAWAHAR LAL NEHRU MARG					
06.00 to 12.00	100	405	45	-	92
12.00 to 17.00	250	450	50	-	150
17.00 to 21.00	-	-	-	-	-
21.00 to 6.00	-	-	-	-	-
Total in 24 hr	350	855	95	-	54

The project being hilly terrain, only cars, jeeps, etc. mostly frequented to this place. Trucks & buses are also found in the area. Very less two wheelers are seen. No other vehicles like rickshaw, auto etc. were seen in the area around the project site.

Carrying capacity of Jawahar Lal Nehru Marg (Road width – 12m,2 lane highway)

Carrying capacity at Jawahar Lal Nehru Marg = 4500 PCU/day

Average Existing traffic density at Jawahar Lal Nehru Marg = 242 PCU/day

Proposed traffic density (Assuming 20% traffic increase

After ropeway installation) = 48 PCU/day

Total Traffic density after installation will be = 290 PCU/day

The proposed traffic volume from site is very minimal. Hence, it is concluded that since carrying capacity of Jawaharlal Nehru Marg is much higher than the proposed traffic volume. Therefore the proposed project will not create any traffic congestion.

CHAPTER 5: ANTICIPATED IMPACT AND MITIGATION MEASURES

This chapter focuses on identification of pollution sources due to the proposed project activity. The pollutants generated during the construction and operation phase have been assessed and quantified to estimate the level of impact and thus formulate environment management measures to mitigate theses impacts.

Chapter 4 provides the information on the baseline environmental conditions at the project site for various parameters.

This chapter discusses the various pollution loads and stresses that could impact the environment and the incremental environmental impacts on the environmental parameters during the operation phase of the project and also discuss the mitigation measures to reduce these impacts.

5.1 LAND ENVIRONMENT

As per the Land use land cover study of the area discussed in Chapter-4 of the EIA report, the land cover is mainly a forest land. The impacts on land environment occur in three ways as given below:

1. Impact on Land use
2. Impact on Topography
3. Impact on Soil

5.1.1 During Construction phase

The construction of the project is on the verge of completion and 95% of the construction work has been completed.

The anticipated impacts during the construction of the proposed project and mitigation measures are given in Table 5-1.

TABLE 5-1: IMPACT & MITIGATION FOR LAND ENVIRONMENT DURING CONSTRUCTION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
Impact on Land use		

1.	Total site selected for the development of Lower Terminal Point (LTP) and Upper Terminal Point (UTP) including ropeway corridor for the proposed ropeway project comprises of forest land. Hence the forest land is being used for non-forest purposes.	Only 0.8237 ha of forest land has been diverted for the construction of terminal stations & ropeway towers. As there are no big trees on the hill, only herbs & shrubs have been cleared from the site with prior approval from forest department. Hence, minimum diversion has been done which does not include any tree cutting. As per the diversion approval, State Govt. shall raise compensatory afforestation over 1.65 ha of degraded forest land identified at Yali Reserve Forest for which Funds have been deposited to the Forest department.
Impact on Soil		
2.	The development activity lead to temporary stockpiling on site which could have lead to soil contamination during windy days & rainy days.	Temporary stockpiling of the raw materials & debris was done by covering the stockpile with plastic sheeting or traps. A berm was installed around the stockpile to prevent runoff from leaving the area. Hence no soil contamination was seen.

3.	The excavation activity may cause erosion of base soil & generation of excess soil.	As per the geotechnical study, the project site is 75% gnesis rock sequence. Construction of towers have been mostly done where rocks are present. Hence, no major soil excavation was performed. The excavation was only done to provide foundation. The excavated soil was reused in the project development.
Impact on Topography		
4.	Development of terminal stations & intermediate towers resulted in slight change in topography & contours.	Construction activities were planned such that minimum impact on topography & contour occurs. However, impact was confined to a limited area which. Manual level difference has been maintained for the natural flow of drainage.
5.	The surface drainage pattern of the area may change due to the construction of terminal stations & line towers.	As shown in the layout plan attached as Enclosure-1, the towers have been developed mainly where stone is present & hence no change in surface drainage pattern is envisaged. Proper drainage network has been developed on LTP & UTP.

5.1.2 **During operation phase**

The anticipated impacts and mitigation measures during the operation phase are given in Table 5-2.

TABLE 5-2: IMPACT & MITIGATION FOR LAND ENVIRONMENT DURING OPERATION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
Impact on Land use		
1.	Due to introduction of ropeway, tourist influx will increase. Due to increase in visitor influx, infrastructural development will occur in the area which includes hotels, commercial activities, parking facility, roads/ road widening etc. As the site is mostly a forest land, further construction will lead to change in land use/ land cover of the area.	The project site is approx. 38 km from the capital city Gangtok which is a well-developed city with all amenities and the site is visited on permit basis & no accommodations are available at the site. Also the site is already connected with a well-developed wide highway. Hence, infrastructural development is not envisaged. However, development of ropeway will lead to cumulative yearly increase in no. of tourists. Hence, if required, it may be a long term impact. Further, if required, for any future development, site selection analysis shall be followed.
Impact on Soil		
2.	Soil contamination due to project activities. (Detected or undetected leaks and spills, Iridescent sheens (like oil or	Minimum onsite storage shall be kept. Removal of contaminated material and hazardous material on exteriors of transport vehicles

	diesel) on soil, non-natural materials and wastes.)	shall be practiced. Collection of water from decontamination procedures and treatment or disposal at an appropriate disposal site shall be followed. All treatment and disposal options shall comply with all relevant guidelines and legislation.
3.	The load of the ropeway project can weaken the soil of the site & can lead to landslides in the area.	The ropeway development has been done after getting the geo technical study of the area done. As per the geotechnical report of the project. The soils are invariable course grained and are of high shear strength.
Impact on Topography		
4.	Storm water falling continuously near the pillars, towers, etc. may erode the soil, weaken the rocks, and lead to instability of the structures.	At lower & upper terminals, proper channelization of rainwater will be done. The collected water will be stored in the tank near lower terminal.

5.2 AIR ENVIRONMENT

As the Ropeway operation is considered to be an environment friendly non-polluting transport system, some of the anticipated impacts & their mitigation measures are discussed in the following sub- sections.

5.2.1 **During construction phase**

TABLE 5-3: IMPACTS & MITIGATION MEASURES FOR AIR ENVIRONMENT DURING CONSTRUCTION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	Particulate emission was generated during the construction of terminal stations & line towers.	As the construction was in limited area, thus the particulate emissions was minimal and short term in nature due to localized meteorological conditions. Since, the project is in hilly area, the hills act as wind breakers. Most of the construction was done using steel & tin & very less RCC is used, the area being earthquake prone. Hence, less emissions were generated. Construction material was kept covered with the tarpaulin /Cloth cover. The terminal stations under construction were kept covered with the green cloth. Sprinkling of water was practiced to reduce the dust emissions.
2.	The transportation of construction material to the base station lead to dust emissions & vehicular emission.	Trucks/other vehicles bringing/taking away the construction material at site were kept fully covered to avoid the dust emission and only vehicles having valid copy of Pollution Under Check (PUC) Certificate were used.

		The transportation of material to the upper terminal was done by a temporary material transport ropeway.
3.	Drilling & manual stone cutting was adopted in place of blasting for rock cutting & excavation, hence dust generation occured.	Wet jet system was used for stone cutting to avoid the emission from the dry stone cutting. JCB dust collectors were used for collection of the dust generated due to drilling. Rest, sprinkling was done.

5.2.2 **During operation phase**

No air impacts are envisaged during the operation of the project as ropeway is considered to be an environment friendly transport system.

The only impact that may occur is due to the pollutants such as SO_2, NOx and CO that may be generated due to diesel-operated mechanical equipments.

However, the impact of pollutants such as SO_2, NO_x and CO mainly released from mechanical driven equipments is very negligible and of short term duration.

Moreover, standard machineries of reputed make will be used and all plants shall be operated and maintained in such a manner so as to minimize the emissions of hydrocarbons and particulate.

5.3 WATER ENVIRONMENT

Being a hilly area the main source of water is springs and the change lake itself.

5.3.1 During construction phase

TABLE 5-4: IMPACTS & MITIGATION MEASURE FOR WATER QUALITY DURING CONSTRUCTION PHASE

S. No.	Anticipated Impacts	Mitigation Measures
1.	The construction activities involved disposal of slurry. Runoff was being generated from the site during the rainy days.	Storage facilities for construction materials, construction waste and oil and grease were maintained. The runoff was being collected, treated & reused in the project.
2.	7 KLD of waste water was being generated during the construction phase due to labors & construction activities.	Waste water was being discharged to septic tank followed by soak pit.

5.3.2 During Operation Phase

The Teesta river is at more than 10 & 15 Km distance from the site and hence no impact is envisaged on the river.

However, the major impacts on water quality of the area and mitigation measures are discussed in Table 5-3.

TABLE 5-5: IMPACTS & MITIGATION MEASURE FOR WATER QUALITY DURING OPERATION PHASE

S. No.	Anticipated Impacts	Mitigation Measures
1.	Exploitation of the Change lake & spring water which are the only source of water at present.	Only fresh water requirement of 29 KLD shall be fulfilled by the over flow of Changu lake. Rest of the water requirement of 72 KLD shall be fulfilled by the treated water from 2 no. of STPs (details given in Section 9.3 of EIA).

2.	Pollution to changu lake due to waste disposal by visitors of ropeway.	Proper dustbins will be provided at terminal stations & surrounding area. Biodegradable waste will be composted by vermicomposting. A boundary wall will be constructed to avoid visitors from polluting the lake.
3.	92 KLD of waste water shall be generated during the operation phase due to activities like domestic, flushing and miscellaneous activities.	During the operation phase, proper toilets shall be made for the visitors at each terminal of the project. The waste water discharged shall be treated in 2 STPs (each of capacity 55 KLD), the details of which are given in Section 9.3 of EIA report.

5.4 NOISE & VIBRATION ENVIRONMENT

No human settlements are found in the vicinity of the project corridor & hence, noise impacts are not considered to cause any damage to the humans.

Other anticipated impacts & mitigation measures are discussed in Table 5-6.

TABLE 5-6: IMPACTS & MITIGATION FOR NOISE & VIBRATIONS DURING CONSTRUCTION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	The noise emission sources during the construction phase were construction machineries/ equipments employed at site & other construction activities like drilling, cutting, hammering, etc.	Standard methods and machineries were used. The noise levels during construction phase were not significant since the project didn't involve extensive construction works & no blasting was involved.

		Besides, Construction activities were performed in day time only & temporary noise barriers were also provided around the construction area.
2.	The project involved transportation of raw material to the project site which had some Noise & Vibrational impacts.	The vehicles for bringing raw material had noise levels in the range of 75-85 dB (A) and were restricted to be used during the day time only.

5.4.1 **During operation phase**

TABLE 5-7: IMPACTS & MITIGATION FOR NOISE & VIBRATIONS DURING CONSTRUCTION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	During operation phase, source of Noise pollution are the machineries used to run the ropeway and the DG sets proposed for backup power supply.	Standard Ropeway machineries will be used & will be maintained timely. DG Sets will be bought acoustically enclosed and will be installed with proper anti vibration pads. The DG sets will be used as a stand-by only at the time of power failure. Although the DG sets approved by the CPCB are expected to be noise free, the noise pollution due to operation of DG set can be controlled by installation of silent cowling to a value of 65 dB (A).
2.	During operation phase, operation of Ropeway and transportation may also have noise & Vibration impacts on the surrounding environment.	The normal ropeway operations are always lower than 50 dB (A) of noise level. Proper maintenance of the ropeway as discussed in chapter-7 during the operational phase will be done to ensure low

		or no noise and environmental impacts.
3.	Increase in tourist vehicles through the Gangtok- Nathula highway may further increase the Noise & Vibrations. These vibrations may weaken the road structure, if exceeds the bearing capacity of the road & may lead to cracks, rock falls, landslides, etc.	Since the area is only permitted for visit during day hours, the visitor vehicle's having noise level 70-75 dB (A) will also be limited to day time only. The Gangtok- Nathula highway is a well-developed highway and as per the traffic survey discussed in Section 4.13, the traffic load on the road will remain below its bearing capacity of the region. Hence, impacts due to vibrations will be insignificant.

5.5 SOLID AND HAZARDOUS WASTE

The anticipated impacts & mitigation measures during construction as well as operation phase are given in Table 5-8 & Table 5-9.

TABLE 5-8: IMPACTS & MITIGATION FOR SOLID & HAZARDOUS WASTE DURING CONSTRUCTION PHASE

S. No.	Anticipated Impacts	Mitigation Measures
1.	The solid waste generated during construction phase was site clearance & garbage/ biodegradable waste.	The waste generated from the site was collected and was given to the NGO (PSS – Pokhari Sangrakshan Samiti) working for the sanitation of the area.
2.	Excavation during pillar foundations lead to generation of excess soil.	As discussed in section 5.1, the excavated soil was used as a raw material in construction for filling purposes.

		Top soil has been stored & will be used for landscaping at UTP & LTP and along the corridor.

5.5.1 During Operation phase

TABLE 5-9: IMPACTS & MITIGATION FOR SOLID & HAZARDOUS WASTE DURING OPERATION PHASE

S. No.	Anticipated Impacts	Mitigation Measures
1.	During operation phase, 967 kg/ day waste will be generated including biodegradable & recyclable waste. Impact from solid waste may arise owing to the dumping of waste in to or near Changu lake or on land ultimately causing environmental deterioration, increase in transportation and disposal cost.	677 kg/ day of biodegradable waste will be disposed by vermicomposting method & 290 kg/ day of recyclable waste will be given to approved recycler. No disposal of the construction waste on land and to the lake will be done. Proper Collection bins will be provided at each terminal stations of the ropeway to avoid spread of waste on land or in the lake.
2.	Used oil from ropeway machineries & DG sets can cause contamination of soil, changu lake and ultimately can cause health risks to animals, birds and humans.	The waste oil generated from D.G sets and other machineries will be stored in leak proof containers and will be sent to registered recyclers for hazardous waste authorized by SPCB/CPCB.

5.6 ECOLOGICAL ENVIRONMENT

The Flora & Fauna of the core zone & buffer zone is given in Section 4.11 of the EIA report.

The project falls under the Kyongnosla range. Kyongnosla alpine sanctuary & Pangolakha wildlife sanctuary exists within the 10 km radius of the project site.

5.6.1 **During construction phase**

The impacts & mitigations for the Ecological Environment are given in Table 5-10.

TABLE 5-10: IMPACTS & MITIGATION FOR ECOLOGICAL ENVIRONMENT DURING CONSTRUCTION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	The entire alignment falls within the Kyongnosla Range. Diversion of this land has been done for the construction of terminal stations & line towers.	The alignment has been chosen in such a way that no tree cutting has been done in the project. Only removal of herbs & shrubs has been done at the location of terminal stations & towers. Hence no major harm to flora is done. Further, as per the diversion approval, State Govt. shall raise compensatory afforestation over 1.65 ha of degraded forest land identified at Yali Reserve Forest for which Funds have been deposited to the Forest department.
2.	Impact of construction of project on the wildlife sanctuaries within 10 km radius to the project site.	The LTP of the project exists at a distance of 200 m in South direction from the Kyongnosla alpine sanctuary and more than 5 km in NW direction from the Pangolakha Sanctuary. However, gazette notifications have been published by the Sikkim Government for both the wildlife sanctuaries declaring the eco sensitive area around the sanctuaries. The declared eco sensitive zone on southern side of the Kyongnosla sanctuary is 25 m and that of Pangolakha sanctuary in Northern & western side is 25 Km & 50 km respectively. Hence, no impact is seen on the sanctuaries.

3.	The noise emissions during construction phase may have a minor impact on the fauna in the surrounding areas.	As discussed in Section 5.4, proper noise control measures were adopted to ensure minimum or no disturbance to the fauna of the area.
4.	Habitat fragmentation	The alignment has been selected by keeping in sight that no infringement to habitation is caused. No migratory route has been observed at sections of this alignment.

5.6.2 **During operation phase**

No major impact is envisaged during the operation phase, the only probable impact & its mitigation measure is given in Table 5-11.

TABLE 5-11: IMPACTS & MITIGATION FOR ECOLOGICAL ENVIRONMENT DURING OPERATION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	Potential impacts of project operation on ecology include increased noise and disturbance from the operation of the cable car including maintenance, glare/lighting impact of structures (towers and cables) on bird species.	Although Ropeway is an environment friendly & noise free mode of transportation, efforts will be made to ensure minimum or no disturbance to the ecology of the area. Moreover, to enhance the terrestrial ecology, plantation will be done along the terminal stations and line towers and within the ropeway corridor.

5.7 SOCIO ECONOMIC ENVIRONMENT AND OCCUPATIONAL HEALTH

5.7.1 During construction phase

It includes the impact of construction on the local populace of the area as well as the impact of the construction on the workers of the project.

There are no habitation in the area however few army camps exists there as the site is near to the Nathula border. The only people that could be affected due to the project are the shopkeepers & the yalk porters on site. But, since there are no shops under the route of ropeway & no yalk porters work on the route to hill top, no negative socio economic impact is envisaged.

Rather the project will have positive impacts for the local people, visitors & the state which are discussed below:

I. It will increase tourism in the area.

II. Operation of the plant being pollution free shall save the local people and surrounding greeneries from fuming vehicles, if the area is developed by any other means of transportation.

III. Very few people visit the hill top due to the bad trek condition & no other way of transportation. The ropeway installation will add ease to the visitors to reach the hill top & enjoy the enhanced scenic beauty of the area.

IV. Easy and fast means of evacuation in emergency situation. Monitoring of environment at the higher altitudes can be done by concerned officials more frequently by using the ropeway system.

V. It will increase employment in the area. The jobs from which local community can be benefited, will be —

- Restaurant services
- Medical services
- Routine repair & Maintenance services
- Security services
- Parking & Traffic management

VI. As per the requirement of The Companies Act, 2013, the company will spend at-least 2% of their average net profit in the last three years on CSR

activities under a **Corporate Social Responsibility Program** which is discussed in detail in Section 9.8.

5.7.1.1 Impact on the health of workers

The construction workers were provided with the following facilities so that no impact on health of workers would occur.

- Personal Protective Equipment (PPE) were provided.
- Safety helmets, safety boots, eye and ear protection, and snug fitting gloves as appropriate were provided.
- Masks and dust-proof clothing were provided
- Hygienic conditions were maintained like proper storage facilities for raw material, waste material; proper disposal of waste water, etc.
- Safe Drinking Water facility was provided for construction workers
- Children and pregnant women were not allowed to work under any circumstances.
- Well-equipped first aid facility was provided at site for their regular medical checkups.

5.7.2 During operation phase

Only positive impacts as discussed in the previous sub section are envisaged & no negative socio impact is foreseen due to the project.

5.8 INFLUX OF PEOPLE & ASSOCIATED DEVELOPMENTS AND TRAFFIC INCREMENT

5.8.1 During Construction Phase

Influx of people & associated development is a long term impact which may happen due to cumulative yearly increase in the tourist after the installation of ropeway. However, as discussed in Section 5.1, the project site is not supposed to be developed for accommodation purposes and accommodations are to be handled by the Gangtok city which is already well developed.

No such impact of the development traffic was seen during the construction phase.

5.8.2 **During operation phase**

However, it is a long term impact, the probable impacts associated with increase in traffic, influx of people & associated development are mentioned in Table 5-14:

TABLE 5-12: IMPACTS & MITIGATION FOR INFLUX OF PEOPLE & ASSOCIATED DEVELOPMENTS DURING OPERATION PHASE

S.No.	Anticipated Impacts	Mitigation Measures
1.	The heavy influx of tourists, especially in the peak season leads to problems in management of resources like accommodation, catering, sewage, water supply, etc.	The project site is not provided with any accommodation facilities and the tourists stay at Gangtok City which is a well-developed area & is acquainted with all the resources. Moreover, the visit to Changu lake is based on permit systems being near to Nathula border. Hence, a limited no. of tourists will be allowed to visit the site. Hence, increased influx will not cause much impact.
2.	Increase in tourists may give rise to increase in vehicles at LTP (Changu lake) which will result in shortage of parking spaces.	Two government parking spaces are already available for parking of vehicles. The space is sufficient enough to accommodate the vehicles of the visitors. The permit based system will help in management of traffic to manage the one time load on the area in terms of traffic as well as in terms of environment load. Hence, parking needs will be fulfilled in the provided spaces.

CHAPTER 6: ENVIRONMENTAL MONITORING PLAN

An Environment Monitoring Plan is prepared for construction as well as the operation phase. It provides a delivery mechanism to address the adverse environmental impacts of a project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project works. An environmental monitoring program is important as it provides useful information and helps to:

- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures, and
- Define the responsibilities of the project proponents, contractors and environmental monitors and provides means of effectively communicating environmental issues among them.
- Define monitoring mechanism and identify monitoring parameters.
- Evaluate the performance and effectiveness of mitigation measures proposed in the Environment Management Plan (EMP) and suggest improvements in management plan, if required,
- Identify training requirement at various levels.

Environment monitoring plan for the proposed Ropeway project during the construction phase is given in Table 6-1 and for operation phase is given in Table 6-2.

TABLE 6-1 ENVIRONMENTAL MONITORING PLAN DURING CONSTRUCTION PHASE

Monitoring Parameters	Frequency of Monitoring	Methodology	Location	Cost
Meteorology				
		A weather station shall be installed near the site for hourly monitoring of temperature, humidity, wind velocity, wind direction and rainfall data		
Ambient Air Quality				

Ambient Air Quality	Six Monthly	• **Particulate Matter ($PM_{2.5}$):** (USEPA Quality Assurance Hand Book (Vol. II) Part II, Quality Assurance Guideline Document 2.12 Publication 1998) • **Particulate Matter (PM_{10}):** (IS:5182; Part 23:2006) • **Sulphur Oxides (SO2):** (IS: 5182; Part – II – 2001, Reaffirmed 2006). • **Nitrogen Oxides** (IS: 5182; Part – VI – 2006)	Four Locations • UTP • Middle point • LTP • Nearest Habitat (shopping complex)	Rs. 4500/- (each location)
D G Stack				
DG Stack Monitoring	Six Monthly	**Particulate Matter :** IS: 11255 Part-1, 1985; Reaffirmed 2009 **Sulphur Dioxide(SO_2):** IS : 5182 Part 2-1985; Reaffirmed 2009 **Oxides of Nitrogen** : IS: 11255 Part-7: 2005	DG sets used during Construction phase	Rs. 4500/-
Water & Wastewater				
1. Water Quality Monitoring drinking purposes		**As per IS 10500**	One drinking water sample	Rs 6000/-
2. Water Quality Monitoring for Construction purpose as IS-	Six Monthly	**As per IS 456**	Construction Water	Rs. 6000/-
Ambient Noise				

Day & Night level Noise Monitoring	Six Monthly	Level will be monitored for 24-hours simultaneously.	Sample from two location	Rs. 1500/-
DG Noise				
DG Noise	Six Monthly	30 Minutes	DG sets used during Construction phase	1500/-
Soil				
Soil Monitoring	Six Monthly	Qualitative & quantitative Analysis.	Four samples	Rs. 3000/-
Solid Waste Generation Monitoring / Record Keeping				
• Records of generation, handling, storage, transportation and disposal/treatment of other solid, aqueous and organic hazardous wastes as required by hazardous waste authorization • Construction Debris	To be updated daily	Manual record keeping	Storage area	

TABLE 6-2 ENVIRONMENT MONITORING PLAN DURING OPERATION PHASE

Monitoring	Frequency of Monitoring	Methodology	Location	Cost
Air & Stack				

Ambient Air Quality at appropriate location for PM_{10}, $PM_{2.5}$, SO_2, NOx	Annually	• **Particulate Matter ($PM_{2.5}$):** (USEPA Quality Assurance Hand Book (Vol. II) PartII, Quality Assurance Guideline Document,2.12) Publication 1998 • **Particulate Matter (PM_{10}):** (IS:5182 Part 23:2006) • **Sulphur Oxides (SO2):** (IS: 5182; Part – II – 2001; Reaffirmed 2006) • **Nitrogen** Oxides (IS: 5182; Part – VI – 2006	4 Locations	Rs. 4500/(each location)
Stack emission for point sources PM, SO_2, NOx & CO.	Annually	• **Particulate Matter** (IS: 11255; Part – I – 1985; Reaffirmed 2009) • **Sulphur dioxide (SO_2)** (IS: 5182; Part – II – 1985 Reaffirmed 2009) • **Nitrogen** Oxides (IS: 11255; Part – 7 – 2005)	DG Stack	Rs 4500/- per stack
<u>Water & Wastewater</u>				
Water Quality Monitoring for relevant parameters of IS - 10500	Annually	As per IS 10500	Source of drinking water (One sample)	Rs 6000/- (each Sample)
Waste Water Quality (Treated & Untreated) for pH , TSS, Oil &	Daily till stabilization of STP	Standard sampling techniques as per the Standard IS Methods and follow General	STP inlet and outlet	Rs. 1300/- (each Sample)

Grease, BOD & COD		standard for Discharge of Environmental Pollutants as per EPA		
Waste water quality, pH, TSS, oil & Grease. BOD, COD	Weekly till one month then Six monthly		STP inlet and outlet	Rs 1300/- (each Sample)
Ambient Noise				
Day & Night level Noise Monitoring	Annually	Level will be monitored for 24-hours simultaneously.	Sample from two location	Rs 1500/-
DG Noise				
DG Noise	Annually	30 Minutes	DG sets used during Construction phase	1500/-
Soil				
Soil Monitoring,	Annually	Qualitative and quantitative testing/analysis to check the soil fertility, porosity, texture, water holding capacity etc.	Four Locations	Rs 3000/- per sample
Other monitoring required				
1. Records of generation, handling, storage, transportation and disposal of other solid, aqueous and organic hazardous wastes as required by hazardous waste authorization	To be updated daily	Manual record Keeping		
2. 2.Green belt & plantation monitoring	Six monthly	Manual		
3. 3.RWH		Manual record.		

4. Visitors monitoring	Daily	Manual		
5. Maintenance schedule of ropeway	Three monthly	Manual		

An internal monitoring team shall be constituted for implementing the Monitoring plan as described above.

CHAPTER 7: ADDITIONAL STUDIES

7.1 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN

7.1.1 Risk & Its Assessment

Risk is the probability or severity of occurrence of a harmful consequence due to hazards.

Hazard is a situation that poses a level of threat to life, health or environment.

Disaster is a natural or man-made hazard resulting in an event of substantial extent causing significant physical damage or distraction loss of life or drastic change in environment.

Risk Assessment: Qualitative and quantitative measurement of the potential loss of life, personal injury, economic injury, and property damage resulting from hazards.

Risk assessment involves the following:

7.1.1.1 Hazard Identification

7.1.1.2 Vulnerability Analysis

7.1.1.3 Risk Analysis

7.1.1.4 Emergency Plan

The main objective of this Risk Assessment (RA) study for the ropeway project is to identify the disasters due to natural causes, human caused occurrences & technical failures and to provide risk mitigating measures to reduce associated hazards.

7.1.1.1 Hazard Identification

Aerial ropeway at Changu (Tsomgo) Lake will present a number of hazards to the general public, operating and maintenance staff. Ropeway will be liable to suffer from two types of disasters:

Natural Disasters

Natural disasters include earthquakes, landslides, rock falls, floods, storms, avalanche, lightening etc. Risk Analysis due to Natural Hazards are discussed in section 7.1.3.1 of this chapter.

Human -caused occurrences

Man-made occurrences includes:

- *Fire*
- *Electrical faults*
- *Technical faults* like rope with broken wires in service, drive / return sheave shaft failure / tension system failure, mount assembly parts failure, over speeding of ropeway / brake failure, rollback, slippage / fall of cabin, entanglement of cabin, swinging of cabin resulting in fall of passengers outside cabin, cabin derailment at station etc.
- *Security threat*

Hazard analysis for the Natural & Man-made Disasters is discussed in the Table 7-1

TABLE 7-1 HAZARD ANALYSIS

Hazards	**Severity (1-5)**	**likelihood (1-5)**	**Severity x likelihood (1-25) (Hazards scoring 1-12 are less serious hazards & 13-25 are very serious hazards & need prior attention)**
Natural hazard			
Earthquake	5	3	15
Landslides	5	4	20
Flood	2	1	2
Wind & cyclone	2	2	4
Man-made hazard			
Fire & explosion	5	2	10
Electrical	3	4	12
Technical/ Accident	4	5	20
Security	3	1	3

7.1.1.2 Vulnerability Analysis

As the construction stage is successfully over, no such disaster/ accident took place during the construction phase.

The vulnerability analysis during operation phase is given for natural as well as man-made hazards are shown in Table 7-2 & table 7-3 respectively.

TABLE 7-2 VULNERABLE LOCATIONS/ AREAS FOR NATURAL HAZARDS

Hazard	Vulnerability
Earthquake	Damage to Towers, Terminal Stations, Cable Cars
Landslides	Damage to Towers if slope stability is not maintained.
Flooding	Near Tsomgo lake (due to the lake itself)
Wind & cyclone	There are very moderate chances of wind & cyclone; this can cause damage to cable car.

TABLE 7-3 VULNERABLE LOCATIONS OF DIFFERENT MAN-MADE HAZARDS

Hazard	Vulnerable Locations
Fire	Cable car, Terminal Stations, Control Room
Electrical	Cable Car, Transformer, Control room
Mechanical/ Accident	Cable car, Ropes, Terminal Stations, Ropeway Towers
Technical	Ropeway, Cable car, Terminal Stations
Security	Terminal Stations, Parking, Population at site

7.1.1.3 Risk Analysis

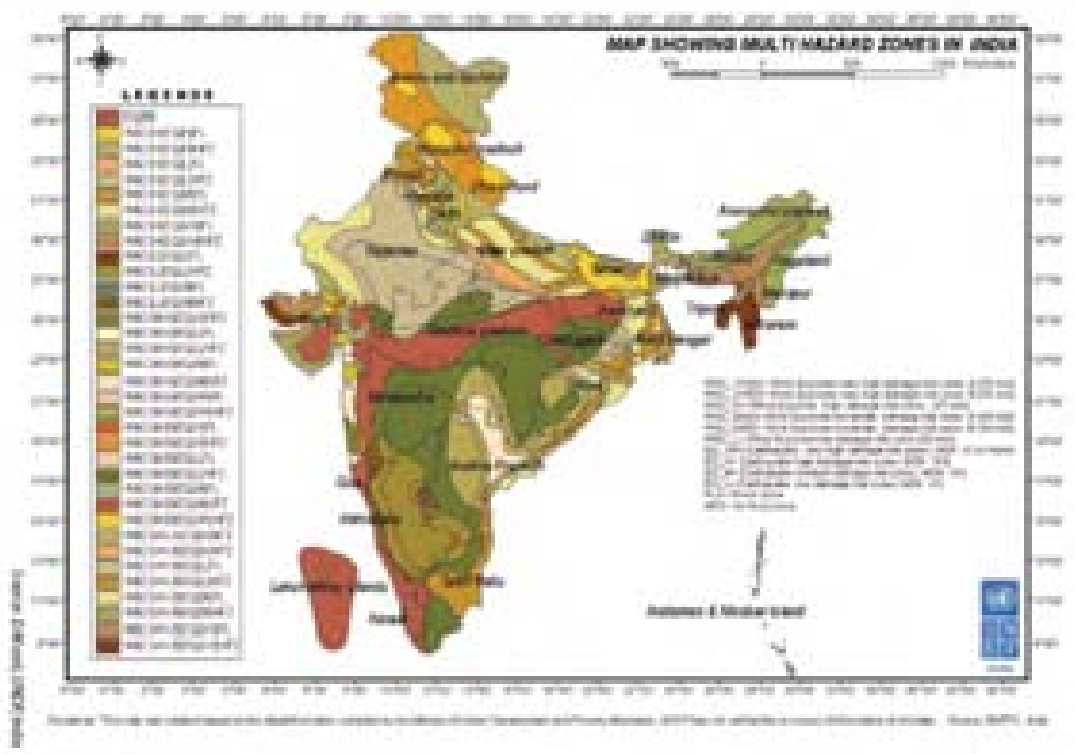
7.1.1.3.1 Environmentally Induced Risks and Hazards

Natural Calamity Hazard Profile

As per the Hazard profile map of India (published by Home Ministry of India as a part of document 'Disaster Management Plan in India') depicted in figure 7-1, the region having project site is prone to following Hazards:

- Earth Quake
- Landslides
- Flooding
- Wind & Cyclone

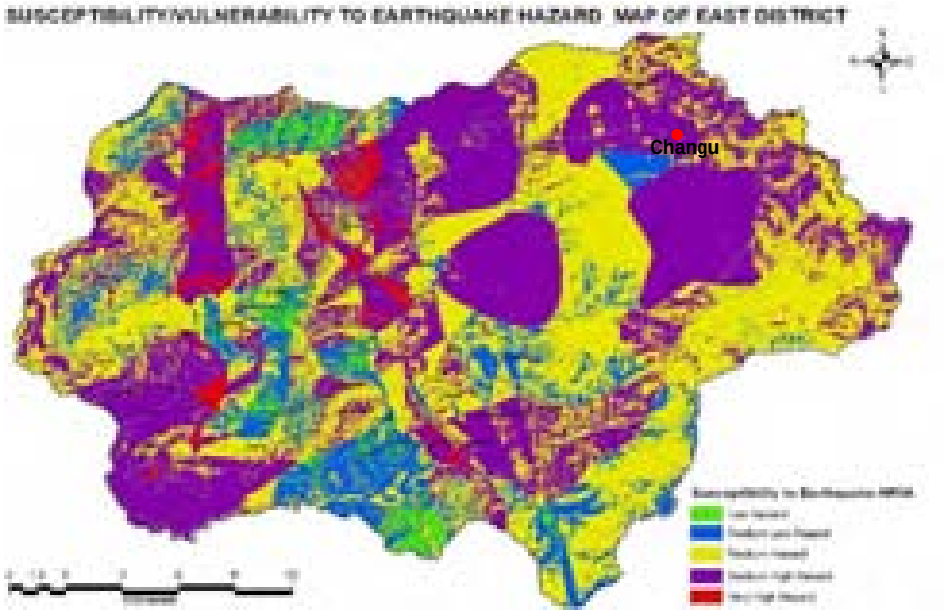
FIGURE 7-1 NATURAL CALAMITY HAZARD PROFILE OF INDIA



7.1.1.3.1.1 Seismicity

As per fig. 7- 2 and as per National Disaster Management Authority's database, the project site is located in (East Sikkim) seismic zone IV which indicates high damage risk zone.

FIGURE 7-2 SEISMIC MAP OF EAST SIKKIM *(SOURCE: SSDMA)*

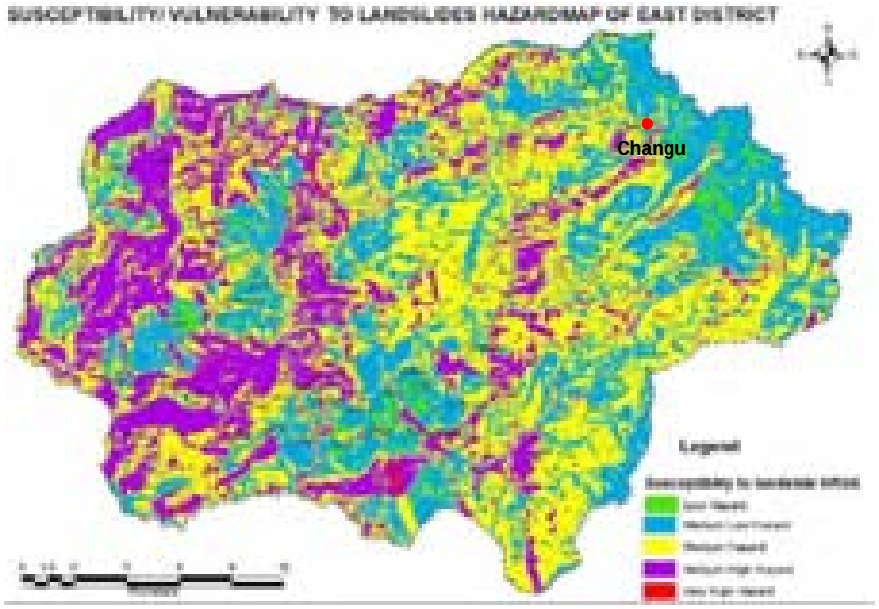


7.1.1.3.1.2 Landslides

As per the Physiography, topography & terrain of the area and the landslide hazard map of East Sikkim shown in fig. 7-3, the area is medium to high prone to Landslides.

Landslides may occur at the project site, if, slope stability is not maintained.

FIGURE 7-3 LANDSLIDES MAP OF EAST SIKKIM (*SOURCE- SSDMA*)



7.1.1.3.1.3 Flooding

Since Sikkim receives a high amount of annual rainfall, especially during the monsoons and landslides occur frequently, flash floods are a common phenomenon and pose a constant threat to life & property. Also the presence of large dams in Sikkim, poses a great danger of flash floods in case of dam breakage.

As per Flood Hazard map of India given in fig. 7-4 & topography of the project, the site falls under medium flood prone area.

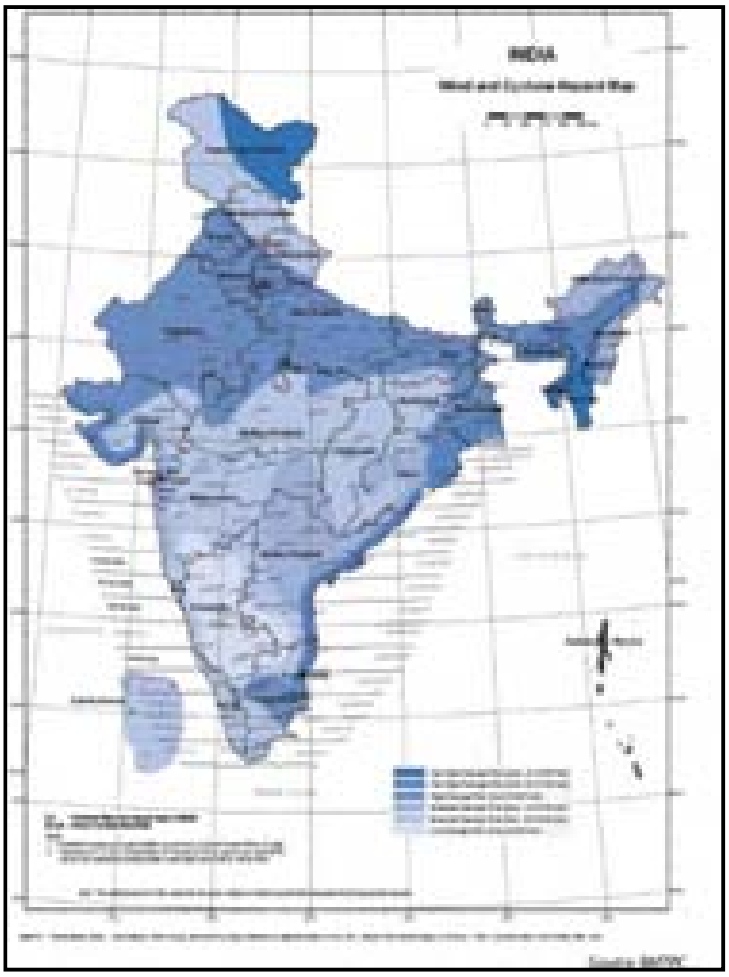
The project is installed near Changu Lake which itself could be a source of flood in the region.

Figure 7-4 Flood map of India

7.1.1.3.1.4 Wind & Cyclone

The Cyclone hazard map of India as depicted in the Figure 7-5, gives the vulnerability map of hazard due to cyclone. As per this map, the project area falls under a zone where high wind & cyclone is seen.

FIGURE 7-5 WIND & CYCLONE MAP OF INDIA



7.1.1.3.2 Human Induced Risks and Hazards

7.1.1.3.2.1 Fire & Explosion:

Since it is a ropeway project, fire can mainly cause due to electric spark in electrical room, fire in the surrounding forest area, fire in fuel storage places, etc.

The Fire & explosion can cause suffocation due to harmful gases generation & panic in people.

7.1.1.3.2.2 Electrical:

The ropeway will run on electricity & hence electrical current can pass through cable cars & wires due to inadequate insulation or accidently.

7.1.1.3.2.3 Technical Failures/ Accident:

As the ropeway consists of cable cars, ropes & big & heavy machineries, technical failures as discussed in Section 7.1.1 can cause risks to people working in the area during construction phase & people who will travel through the ropeway in operation phase.

Consequences of the discussed hazards may result into accident.

7.1.1.3.2.4 Security Threat:

War, crisis & terrorists can cause panic among public and staff.

7.1.1.4 Emergency Plans

7.1.1.4.1 Classification of Emergencies

Level of emergency should be declared as per criteria given hereunder:

- **Level 1 Emergency**
  - No immediate danger to public or environment;
  - Incident is confined to the lease or company property;
  - Low potential for situation to escalate;
  - Handled by company personnel; etc
- **Level 2 Emergency**
  - Potential for risk to the public/environment; the emergency could extend beyond company property;
  - Control of incident is still possible;
  - May require the involvement of external emergency services, federal, provincial or local agencies; etc
- **Level 3 Emergency**
  - There exists an immediate danger to the public or environment;

- Control of the situation has been lost;
- Extensive involvement of external emergency services, federal and/or provincial agencies;
- Emergency extends beyond company property;

Proposed ropeway shall involve Level-1 and Level-2 emergencies. However, in case of natural calamity such as earth quake, it may have Level-3 emergency.

A definite plan will be made for marshalling passengers for safe loading and unloading. The ropeway manager will establish and draw up any special instructions necessary to be observed by staff to ensure the safety of children and elderly persons riding the ropeway, and shall ensure that such instructions are implemented and enforced by the staff.

Loading attendants are to ensure that passengers do not embark on chairs, or in cars or cabins, with equipment which will in any way be a hazard to the safety of themselves or other passengers.

7.1.1.4.2 Communication

Both an audible signal system and a two-way voice communication system shall be maintained between the drive station and all loading and unloading stations. If only one system fails to operate, the ropeway may continue to run, provided the remote attendant stop system is fully operational. In the event of the failure of both communication systems, the ropeway shall not be operated. In the latter event, provided that adequate special precautions are taken, the ropeway may be run for the purpose of evacuation only.

No ropeway shall be operated without a functioning dedicated communication system.

7.1.1.4.3 Disaster management

1. Establish direct contact with district administration and District Disaster Management Authority (DDMA) for any update on forecast (warning);
    - Follow up agencies for forecast and keep records :
    - Indian Metrological Department for cyclone and earthquake;
    - Central water commission for flood forecast;

2. Establish an in-house rescue team of volunteers from each unit and impart training as per DDMA;
3. Establish a first aid team of volunteers from each unit and impart training as per DDMA;
4. Organize mock drills in association with DDMA;
5. Establishment of Central Control Room for communication with Government agencies;
6. Updated contact details should be kept for the following:
    - District Magistrate
    - District Police Administration
    - DDMA
    - District Fire Service
    - District Hospital
    - District electricity Supply Agency
    - District Water Supply Agency
7. Development of Standard Operating Procedures for role and responsibility of individual of response team.
8. Warning System
9. Inspection of design of buildings and towers with respect to severity of hazards presents;
10. Removal of encroachments and keeping basic infrastructure like roads, power & water supply, waste and storm water drainage system, parking etc. in healthy conditions;
11. Demarcation of assembly points and evacuation routes for workers and general public in case of emergency;
12. Planning for risk reduction measures;
13. Assessment of impacts and design & implementation of remedial measures; etc

An Emergency management Cell will be developed, which is discussed in Section 7.1.6.

7.1.2 **Preventive Measures**

7.1.2.1 Natural Occurrences

7.1.2.1.1 Earthquake:

The project is situated in Seizmic zone-IV area. Special attention shall be given to the structural design of foundation, elements of masonry, timber, plain concrete, reinforced concrete, pre-stressed concrete, and structural steel. Designing of the ropeway terminals & towers have been done in accordance with that capable of bearing Seismic Zone V impacts.

All applicable guidelines will also be followed in this regard to ensure safety of the building.

7.1.2.1.2 Landslides:

The area where ropeway is proposed is highly prone to landslides. Structural stability & safety is must to prevent ropeway damage due to landslides. Slope stability in the area shall be maintained at 45^0.

7.1.2.1.3 Flooding:

- As the site is adjacent to the Tsomgo (Changu) Lake, the main source of flood in the area can be the lake itself, however, the elevation at the lake is 3753 and that at LTP is 3763 m, i.e. approximately 10 m level difference, hence chances of flooding at the ropeway terminal is less. However, proper drainage system has been installed.
- All the waste water from ropeway users & other sources shall be disposed off to soak pits.
- Structures are built in such a way that no harm occurs to the people & structures due to flooding.

7.1.2.2 Man-made Occurrences

7.1.2.2.1 Fire and Life Safety:

- Smoking must be prohibited.
- Electrical equipment are bought explosion-proof & are kept in a closed room to meet national electrical code requirements.

- Dry chemical extinguishers should be accessible for small fires. An adequate supply of handheld and wheeled types should be available.
- Hydrants should be strategically placed with adequate hoses.
- Small spills should be remediated with sand, earth, or other non-combustible absorbent material, and the area then flushed with water.

7.1.2.2.2 Technical Faults & Accidents

- General safety provisions shall be in accordance with the stipulation laid in Indian Codes.
- The Gondolas will be provided with door lock which cannot be opened by the passengers.
- Protection against over speeding of cabins and against reversal of rotation will be provided.
- The ropeway system will be provided with minimum of two braking system- Normal/ Emergency Brake and Service Brake. The emergency brake shall be weight operated & thrustor released brake which should be provided on brake ring fitted on drive sheave. The service brake shall be weight operated thrustor released brake shall be provided on high speed brake drum coupling. In case of Power failure, the emergency brake shall automatically be active and stop the Drive.
- A Grip Testing Device shall be provided at the exit point of each terminal station which will ensure proper locking of carriage grips with the Rope. In the event of improper gripping, Ropeway drive shall be automatically tripped.
- Line safety shall be ensured by providing suitable rope gauge with a view to having adequate clearance between Cabins while crossing each other during normal wind condition.
- The project shall be provided with anemometers to monitor the wind speed and to provide trip signals to main drive in case wind speed exceeds a pre-determined set speed.

  The ropeway main drive motors to be tripped if:

  - Set rope speed exceed by 5 %

- Wind speed exceeds the set limit

- Rope catcher will be provided on mount beams on line trestle, P.F. and Stations to arrest/ support the hauling rope in case of de-ropement and at the same time trip the drive.
- Electrical protection shall be provided by way of Thermal Overload Relay, Under Voltage Relay, Single Phasing Preventor, HRC Fuse, Earthing / Grounding of equipments etc.
- In the event of electrical power failure, standby diesel engine shall be started to drive the Ropeway and bring the cabins to the respective stations.
- Emergency push buttons will be provided at stations to stop the ropeway, if required.
- Each station will have a first-aid medical facility.

7.1.3 **Maintenance & Management of Ropeway**

7.1.3.1 Maintenance Record

The ropeway operator will ensure that:

- Written procedures are developed for operating the equipment under all reasonably foreseeable conditions, and that all safety requirements are incorporated into these procedures.
- Records are kept of every critical safety stage in the operation of ropeway.
- Operating procedures and all other relevant operating records are freely available to any person who operates the equipment.
- All operational data are available for inspection by any authorised person who is involved with the ropeway, including equipment inspectors.

7.1.3.2 Daily Operational Requirements

Starting of ropeway: The ropeway will be started by the competent person authorised by the management.

Daily inspections: Prior to transporting passengers, a daily inspection will be conducted by competent personal. As a minimum, the inspection will consist of the following:

- Inspect visually each terminal, station, and the entire length of the ropeway, including grips, hangers and carriers:
- Note the position of tension carriages and counterweights, and ensure that the tensioning system is free to move in both directions.
- Test the operation of all manual and automatic switches in terminals, stations, and loading and unloading areas, as per the manufacturer's specifications.
- Test the operation of main drive and all braking systems.
- Test the operation of communication systems.
- Note the general condition of the hauling rope.

Termination of Daily Operations: Procedures will be established for terminating daily operations to ensure that passengers shall not be left on the ropeway after it has been shut down.

7.1.3.3 Operation Log

- A daily operational log shall be maintained for each ropeway.
- The daily operational log shall include at least the following:

a) Date;

b) Names and duty stations of operating personnel;

c) Operating hours and purpose of operations;

d) Temperature, wind, and weather conditions and changes, with times of changes noted;

e) Record of compliance with daily operational inspection;

f) Position and condition of the tensioning carriage and of the counterweight or other tensioning devices;

g) Accidents, malfunctions, or abnormal occurrences during operation; and

h) Signature of the operator.

7.1.3.4 Maintenance of Ropeway

The maintenance program will comprise of procedures for addressing all

components subject to load, wear, corrosion or fatigue. This would include:

- The types of lubricants required and frequency of application;
- The types of testing required and frequency of testing;
- The definitions and measurements to determine excessive wear and replacement criteria.
- The recommended frequency of service to specific parts and details of the service required.
- Identification of other areas that might require specific attention.

7.1.3.5 Ropeway Management

The ropeway management shall ensure that:

- The ropeway including all safety devices is maintained in accordance with the maintenance and inspection schedules and are kept in safe working condition at all times.
- A procedure is in place which requires any faults found in the ropeway to be reported immediately by the person who finds the fault, investigated and, where necessary, maintained, adjusted, repaired or altered.
- Ropeway that has been subject to maintenance, whether routine maintenance or maintenance in response to a fault found, shall be appropriately tested before re-entering service, to ensure their design compliance.
- All maintenance procedures relating to the ropeway shall be kept in controlled status regularly updated and continually improved and shall be executed by competent persons.

The operator of the ropeway will ensure that:

- The date, time and full details of any maintenance work undertaken and the results of any maintenance procedure carried out.
- Ensure that maintenance records are available for examination by all persons concerned, including equipment inspectors.
- keep record of running hours and/or number of loading cycles operated by

a passenger ropeway and its condition, where a passenger ropeway, or any of its components, is subject to condition monitoring.

7.1.3.6 Inspection of Ropeway

The owner /operator of the ropeway shall ensure that:

- Commissioning inspection has been carried out by an equipment inspector, who shall also witness all relevant tests.
- Formal pre-season inspections are carried out
- The ropeway is inspected in-service at least annually for issue of certificate of inspection.
- Daily and periodic maintenance inspections are carried out.

Inspection Intervals: The operator will ensure that the ropeway is inspected in-service and is:

- Inspected at commissioning, after the first year of service and thereafter at least once in a year.
- Inspected after their re-erection or re-commissioning;
- Inspected after major repairs or alterations; and
- Inspected in the event that they are seriously damaged.

Records: A list of parts to be inspected will be maintained. The operator of the ropeway will maintain records of the date, time, time and results of any inspection carried out and the name of the inspection body engaged.

7.1.3.7 Tests of Ropeway Operation

The ropeway operator will ensure that:

- All routine tests of emergency procedures, and of alarms, and safety devices, relating to the ropeway, are carried out at appropriate intervals.
- Every overload test is carried out under strict conditions, is monitored at all times and does not exceed the limits specified in the relevant design or operating standard; and
- The ropeway is not loaded above its safe working load, except for the

purposes of an overload test.

The records of the following will be maintained:

- The date, time, details and results of any tests carried out are recorded.
- Comments on the performance of ropeway in any test, and on any maintenance done or any adjustment, alteration, or repair made as a result of any test are recorded; and
- Any data arising from testing are readily available for inspection by authorised persons including equipment inspectors.

7.1.4 Security Threat Plan and Action Plan to Meet the Eventualities

An ISO 27001 and 27002, which are the international best practice information security management standards, defining and guiding Information Security Management System (ISMS) development shall be adopted. These will provide the necessary benchmarking for individual users to know the type of cover and the responsibilities that are defined and provided by that institution for its guests. Most importantly, training, to staff needs to be regularly imparted in dealing with such situations.

A four tier security plan will be designed for the project:

Tier I Securing Building Externally and its periphery

Tier II Security of Building from Internal Threats

Tier III Provision of :

a. proper Surveillance System
b. Training and Security Drills (including Contingency plans)
c. Security of Infrastructure Support Service System
d. Making of Standard Operating Procedures

Tier IV Emergency Response Team

7.1.4.1 Description of the Tiers:

Tier 1 Protection against attack from Sky

1. There can be a threat from Microlite suicide squads.

2. In case Terrorists are launched through Helicopters, then Mobile quick reaction team to move on terrace of stations with suitable arms and ammunitions which will be backed by reaction team.
3. Coordination of Security Control Room with Army Defense system through Central Control System of the city/Army/Air Force.

Tier II Securing Building Externally and its periphery

1. **Manual Checks**: At all terminals the visitors shall be manually checked and asked for ID's.
2. **CCTV:** At all important location with a remote viewing facility and record back up. With highest resolution and picture quality. DVR being the back bone, its recording and replaying capabilities must be considered.
3. **X-Ray Scanners**: This may be installed and the bell desk may ensure that all the baggage's while being shifted out or in goes through the machines. One scanner shall be installed at terminal stations entry.
4. **RFID** based access control and smart card applications can also control the movements of guest as well as staff.
5. **Zoning System:** Apart from these equipments there are agencies providing Zoning system. This system would be integrated with the BMS and in the event of terrorists strike it automatically will close the fire exit door and stairs door thus limiting the movement of the terrorist in one place.

Tier III Security of Building from Internal Threats

1. **Staff Profiling**: All the staff shall be requited after proper verification of identity and residential proof. Smart card identification shall be given.
2. **Metal Detectors:** Every visitor will walk through metal detectors. There will be one metal detector at staff entry gate.
3. **Bomb Blankets**: This will reduce the impact of an explosion.
4. **Central Control Room**: This will control the security system from inside.
5. **Safety of weapons:** The weapons shall be kept in security.

6. **Communication Systems:** Proper communication system to security staff shall help them to coordinate better during emergencies.

Tier IV Provision of:

a. Proper Surveillance System

1. **Bio – Meteric Access**: All the electronic locks be replaced as bio matrix access control in the rooms. It is suitable way to have finger prints in the name of a high end technology.
2. **Wireless Mobile Devices**: These can be installed at various locations to intercept people communications.
3. **Glass protection System**: This is a unique product combination of high security laminate films with chemicals which makes it blast resistant and thus protecting human life's and property from the damage caused by splinters.
4. **Explosive detectors**: With the help of this detector, the security personnel can check various zones for traces of explosive.

b. Training and Security Drills (including Surveillance System)

Disaster planning is the responsibility of all sections of the community. The police, fire brigade, civil defense, Home Guards, press, clergy, industrial groups, and community groups must participate in the pre-disaster planning. The community as a whole has the responsibility to teach first aid to groups in the community that could be utilized in disaster situations. The disaster may involve the normal communication network itself. Therefore, two-way radio systems and messenger systems must be included as backups in the event of a communication-system failure.

Proper training, security drill and evacuation drill shall be conducted in a defined time period, so as to train the management people, security personnel's, senior staff and all other working staff to take control of all odds what so ever come in the way. These trainings shall be conducted for use of weapons and Arms by some trained agencies for the said trainings. The training shall be done periodically.

c. Security of Infrastructure Support Service System

1. Hourly checking of building including Toilets and dust bins.
2. Random checking of visitors
3. Installation and Precautions of Public Addressing system.
4. Preventive measures for attack on D.G. Sets, Water Treatment System, Water Storages, Ventilation System.
7. Security against Chemical War & Anti hacking devices

d. Making of Standard Operating Procedures

A standard operating procedure manual shall be prepared, followed and maintained for all the eventualities due to attack by armed intruders.

Tier V Emergency Response Team

An emergency response team shall be formed.

7.1.5 **Rescue Arrangement:**

The Ropeway system would be provided with a rescue arrangement to enable the passengers being evacuated in case of an extreme emergency where cabin are stopped on line.

- *Chair Rescue:* In the event of a breakdown of the Ropeway with passenger on line, rescue operation shall be carried out by rescue chair operation by rescuers.
  In this system, the rescuers reach the cabin from the nearest tower with all the equipments and then the passengers are lowered down to the ground level with the help of rescue chairs being operated manually.
- *Diesel engine* with independent drivel, so that the ropeway system can be operated at reduced speed to bring stranded cabins to the terminal stations in case of failure of electrical power supply or main motor. A full capacity DG set to continue normal operation in case of main power supply disruption.
- As mentioned elsewhere the *Auxiliary Drive* with diesel engine enables the passengers to be evacuated in the event of power failure.

7.1.6 **Emergency Management Cell (Off-site Emergency Planning)**

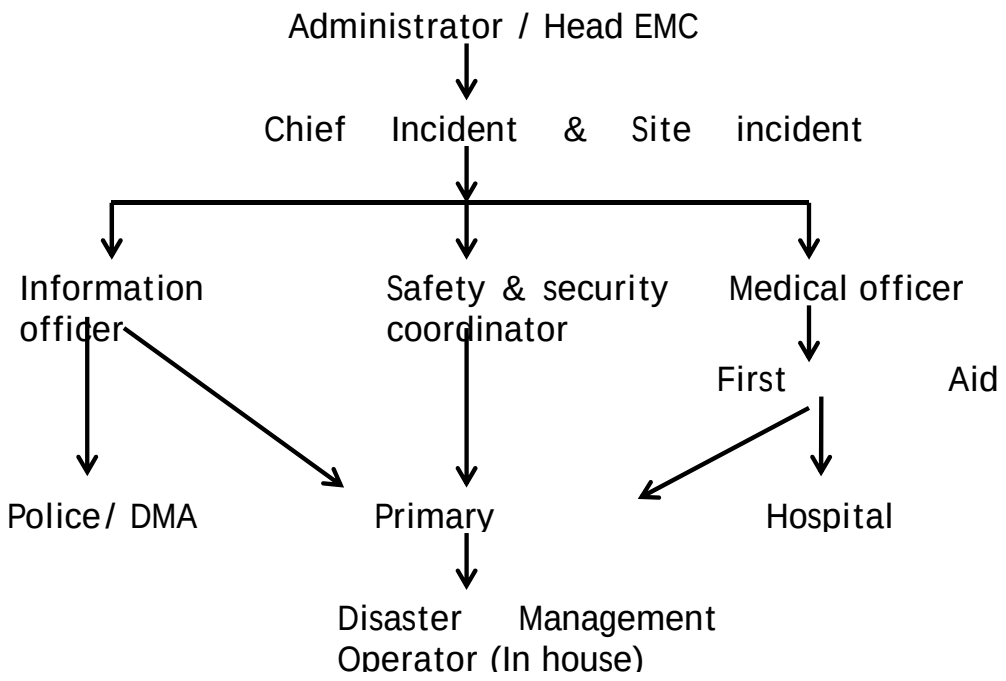
The actions necessary in an emergency depend upon the circumstances. It is imperative that required actions should be initiated and directed by a nominated team having specified responsibilities. An Emergency Management Cell will be formed, so that at the time of any Emergency, the team can work as a coordinator between all affected tourists and medical facilities/ requisite measures.

This avoids confusions arising out of panic situation. The details of proposed Incident Emergency Response Team are as per given hereunder:

1. Site Controller
2. Incident Controller
3. Safety & Security Coordinator
4. Information Officer
5. First aid coordinator
6. Medical Officer
7. Primary Controller

The Emergency Management Cell teams outline is given in figure 7-6:

FIGURE 7-6 EMERGENCY MANAGEMENT CELL TEAMS OUTLINE



7.1.6.1 ROLE OF EXTERNAL AGENCIES DURING EMERGENCY

It is expected that the following roles shall be performed by various agencies:

Medical Facilities

- **Nearest Hospital:** Primary Hospital at Chipsu Village- 1 Km W
- **Other major Hospitals** in Gangtok which is 38 km W from the site**.**

Airport Facility:

Army helipad is present near the site within 1 Km.

Bagdogra Airport, Siliguri is at a distance of 126 km from Gangtok (164 km from site)

7.1.7 **Safety Measures for Wildlife**

From the safety point of view, the aerial ropeway seems to offer no danger of any kind to the Wild Life. However all precautions and safety measures will be taken to ensure Maximum Safety of the any type of Wild life at site during construction as well as Operational Phase, which are discussed as under:

7.1.7.1 During construction phase

- Construction phase is over & no such wildlife was seen in the area during construction.

- Not to disturb the fauna of the area, the construction work was limited to day time only.

7.1.7.2 During Operational Phase

- Minimum required area has been constructed for Terminal Stations & towers at maximum ground coverage of about 40% of the total plot area.
- As the Ropeway Towers are made up of steel and are erected over the ground, the base of the towers shall be of some danger to the Wild Life. Thus they would be closed in a mesh wire enclosure which shall be approximately 6 feet (2 m) high. This would prevent any animals from straying into these steel girder bases of the towers.
- The main stations of the Ropeway housing the pulleys with moving parts shall also be secured for bird hits by enclosing them with bird meshes.

CHAPTER 8: PROJECT BENEFITS

I. **Tourism booster:** By adding a bird eye view of the lake and a beautiful panoramic view of the mountains & surrounding area, it will attract tourists additional attraction to the itinerary of the tourists.

II. **Environment Friendly Transportation:** Aerial Ropeway is a fast emerging technology of providing not only tourism experience but an urban transportation means especially for hilly and tough terrains. It is totally environment friendly with least generation of any type of pollutants. Operation of the plant being pollution free, it shall save the local people and surrounding greeneries from fuming vehicles, if the area is developed by any other means of transportation.

III. **Socio-Economic benefits:** The increase in tourism activities of the area would subsequently increase the ancillary businesses, thereby increasing the local economy of the area and of the state.

IV. **Recreational facility:** The Installation shall also serve as one of the glittering recreational facilities, which can be enjoyed by the tourists.

V. **Safety & Comfort**: Ropeways with approved international code of practice, provide more safe and comfortable journey. Elderly, children and disabled persons which may not be able to take-up the arduous trek to the hill top, would be able to take up the journey and enjoy the beauty of the area.

VI. **Monitoring:** With the ropeway in place, the concerned officials would be able to take up monitoring of the environment and weather conditions in the surroundings more frequently and at regular intervals with ease.

VII. **Revenue generation:** The project will facilitate the Government of Sikkim for generating added revenue to the state.

VIII. **Save Corridor Pollution:** With the ropeway in place, human intervention would be restricted to terminal stations only and the corridor would remain largely undisturbed and unpolluted.

IX. **Local Employment:** The project would require local people, who are accustomed of living under the existing conditions, for skilled / unskilled

activities in course of construction and operations of the project. The project will provide direct and indirect employment opportunities to the local people & hence improving their status of living.

X. **Infrastructure development** or facilities like toilets, drinking water, sewage treatment, solid waste management, medical facilities, etc. will be helpful in maintaining the beauty as well as ecology of such alluring place. And, the medical facilities will help the casualties caused to be addressed on time & in proper way.

XI. **Corporate Social Responsibility**: A CSR action plan will be followed, wherein; company will spend at-least 2% of their average net profit in the last three years on CSR activities for the betterment of the project area & its people. The CSR activities to be followed are discussed in Section 9.8 of the EIA.

CHAPTER 9: ENVIRONMENT MANAGEMENT PLAN

The Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmentally sustainable manner where all stakeholders including the project proponents, contractors and subcontractors, including consultants, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage that risk. Adequate environmental management measures need to be incorporated during the entire planning, construction and operating stages of the project to minimize any adverse environmental impact and assure sustainable development of the area.

The EMP presented below has been followed during the construction phase & shall be followed during the operation of ropeway as well and regular monitoring of relevant parameters as stated in Chapter-6 shall be carried out. The EMP should be proactive in nature and will be upgraded if new facilities or modification of existing facilities, with environmental concerns, come up at a later stage.

EMP includes four elements:

- **Commitment and Policy:** Proposed project will strive to provide and implement the Environmental Management Plan that incorporates all issues related to air, land and water, noise, etc.
- **Planning:** This includes identification of environmental impacts, legal requirements and setting environmental objectives.
- **Implementation:** This comprises of resources available to the developers, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.
- **Measurement and Evaluation:** This includes monitoring, corrective actions, and record keeping.

The Environment management planning has been done by keeping in mind the present environment of the site as discussed in Chapter-4 & the impacts & mitigation measures as discussed in Chapter 5.

9.1 LAND ENVIRONMENT:

9.1.1 During Construction Phase

The major factors responsible for Land pollution & Land instability due to this ropeway were mainly:

- ✓ Disposal of waste on land
- ✓ Erosion of soil,
- ✓ Noise & vibrations
- ✓ Weakening of rocks during construction

The project site falls under Kyongnosla Range (forest land). 0.8237 ha of land has been diverted for non-forest purposes. Whereas, no big trees were found & cut in the ropeway corridor. Only herbs & shrubs were cleared at the terminal stations & tower locations.

To minimize the problem of reduced rock stability, landslides, etc. no blasting was done, instead, the foundations were dug manually with the help of drillers, chained excavators and manual stone cutting.

The excess soil generated due to foundation excavation was used as a raw material in construction & top soil has been preserved for landscaping purposes.

To avoid impacts on land due to disposal of waste, oil leaks, etc. separate storage yards with hard paving for waste storage, used oil storage, lubricating oil storage & other raw material storage was made. Waste was being stored at a covered place.

9.1.2 During Operation phase

The impacts during the operation phase include waste disposal, leakage from machineries, runoff near pillars & soil erosion causing instability of land.

The waste disposal will be limited to the stations as the passengers of ropeway can board & de-board at the terminal stations only. Moreover, to avoid spread of waste on land, proper collection bins will be provided at the terminal stations by the ropeway management.

Lubricating oils for ropeway machineries & used oil generated from DG sets, machineries etc. shall be collected properly in leak proof containers so as to avoid leakage & spillage of oil on ground & ultimately contamination of soil.

Collection of rainwater & proper channelization of runoff shall be done to avoid soil erosion & weakening of pillars.

9.2 AIR ENVIRONMENT

9.2.1 During Construction Phase

The only impact on Air Environment seen was the fugitive emissions like particulate matter etc. that were generated due to activities like excavation, drilling, transportation & handling of equipments and materials, etc.

Air Quality was being managed by the following measures:

- As RCC work was being used only for providing the base & foundation, hence, dust emissions were minimal & in limited areas due to localized meteorological conditions. Separate & covered storage yards were made for keeping the construction material & other raw materials.
- Under construction buildings were kept covered with a green cloth.
- Excavated soil was used as a raw material in construction & rest of the soil & top soil has been kept covered.
- Dust generated due to drilling was collected by JCB dust collectors & was being stored at separate & covered place before disposal.
- Water sprinkling was done regularly to settle down the dust generated during construction activities.

9.2.2 During Operation Phase

Although, Ropeway operation is an environment friendly non-polluting transport system, the main source of pollution will be the ropeway machineries.

The management practices to be followed are as follows:

- Adequate Stack height above the roof of terminal stations shall be provided to discharge the effluent gases from machineries at a certain height.

9.3 WATER ENVIRONMENT

9.3.1 During Construction Phase

During construction Phase, total 13 KLD water was taken from the overflow of the lake for curing, ropeway development, and sprinkling purposes.

Water management measures undertaken during construction Phase are as under:

- The solid waste or debris generated was being properly stored & was being given to the Pokhari Sangrakshan Samiti NGO for disposal to avoid slurry discharge in lake & other water courses in the vicinity.
- The construction materials & debris was stored in a covered place to avoid its mixing with the Runoff.
- Toilets are already existing at the LTP whereas Septic tanks followed by soak pits were made available at the hill top to ensure no discharge of wastewater in open or near watercourses.
- A boundary wall is yet to be developed around the LTP to avoid waste diposal to lake by the tourists during the operation phase.

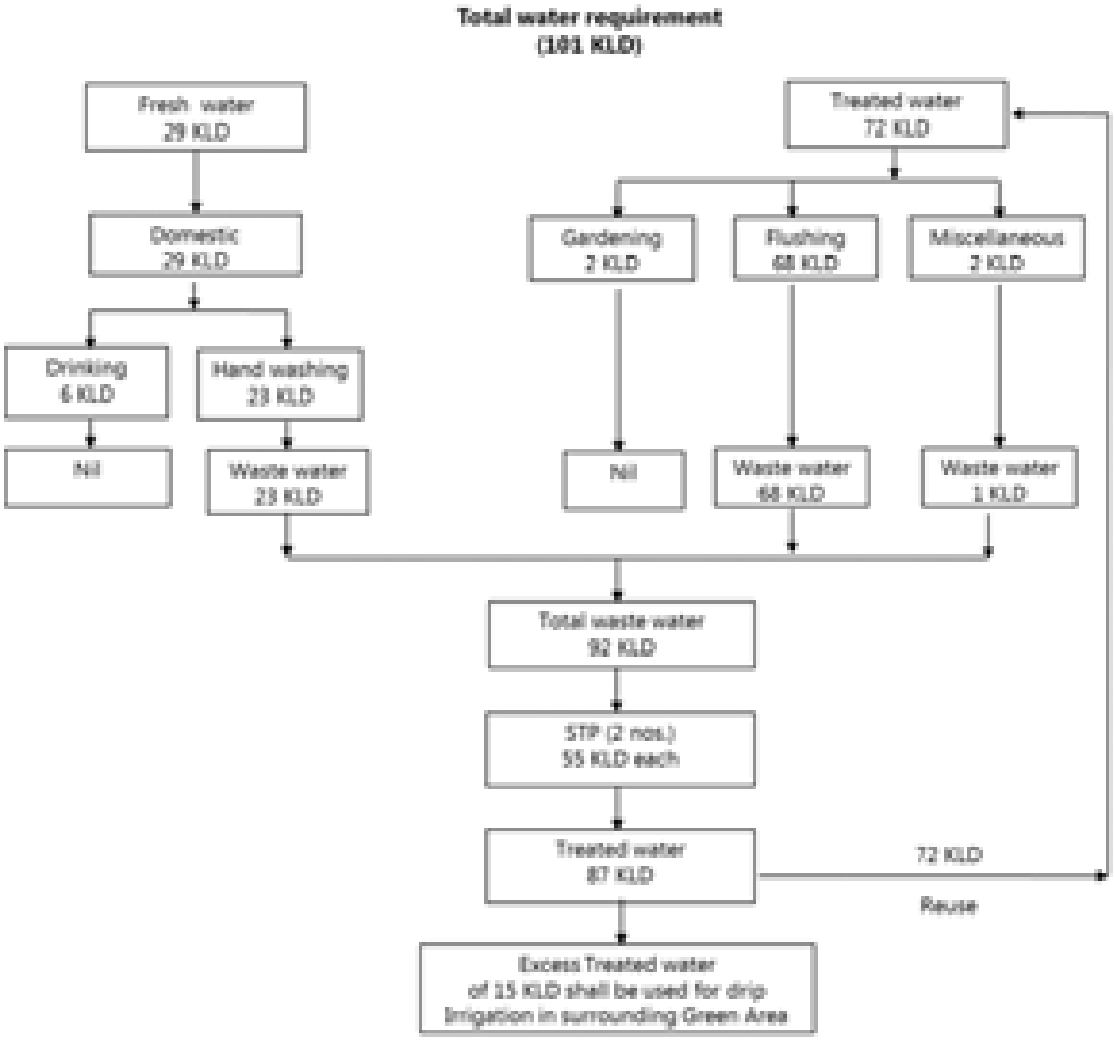
9.3.2 During Operation Phase

As per the maximum peak population load calculation discussed in Section 2.9, total water requirement has been estimated to be 101 KLD as detailed in Table 9-1 and will be met by overflow of the Changu lake as these are the only source of water in the area. Water shall be used mainly for flushing, drinking, hand washing and miscellaneous purposes as shown in figure-9-3. Total quantity of wastewater generation for will be 92 KLD.

TABLE 9-1 WATER MANAGEMENT

S. No.		Population	Factor (lpcd)	Water Requirement (in KLD)	Waste Water Discharge (in KLD)
	Visitors	6400	15	96	
	Staff	15	45	1	
	Sub Total			97	91
1.	Domestic			29 Hand wash- 23 Drinking - 6	23 Hand wash- 23 Drinking - Nil
2.	Flushing			68	68
3.	Gardening			2	Nil
4.	Miscellaneous			2	1
	Total			**101 KLD**	**92 KLD**

FIGURE 9-1 WATER BALANCE



9.3.2.1 Scheme of Sewage Treatment Plant

The generation of total waste water will be about 92 KLD which will be treated in total 2 Sewage Treatment Plants (STPs) of 55 KLD capacities each based on FAB **(Fluidized Aerobic Bio-reactor)** process.

9.3.2.1.1 **Treatment Process**

The sewage is first passed through a **Bar Screen Chamber & an Oil & Grease Chamber** where any extraneous / floating matter gets trapped.

The sewage is then collected in a **Receiving Sump** where the variations in flow and characteristics are dampened, which otherwise can lead to operational problems and moreover it allows a constant flow rate downstream. Here the sewage is kept in mixed condition by means of coarse air bubble diffusion.

The equalized sewage is then pumped to the **Fluidized Aerobic Bed Reactors (FAB)** where BOD/COD reduction is achieved by virtue of aerobic microbial activities. The FAB reactors run in series. The oxygen required is supplied through coarse air bubble diffusers.

The excess bio-solids formed in the biological process are separated in the downstream **Tube Settler Tank**. The clear supernatant after disinfections is sent to the tertiary polishing section comprising of a **Dual Media Filter** and an **Activated Carbon Filter**, passes through **Softener** for reducing the hardness.

The biological sludge generated from the FAB, which is settled in the Tube Settler, is drained through the Filter Press.

TABLE 9-2 RAW SEWAGE CHARACTERISTICS

Flow	m^3 / day	55 KLD
pH	-	7.0 – 8.5
BOD	mg / l	200-300
COD	mg / l	400-500
TSS	mg / l	100
Oil & Grease	mg / l	10

The Sewage Treatment Plant (STP) can give treated water, which can be reused for Flushing, Hand washing & other miscellaneous purposes.

TABLE 9-3 TREATED SEWAGE CHARACTERISTICS

pH	-	6.5 – 8.5
BOD	mg / l	<10
COD	mg / l	<60
TSS	mg / l	< 10
Oil & Grease	mg / l	< 10

9.3.2.1.2 Benefits

1. **Small space requirement**

The concept of compact sewage treatment plant is promoted so that expensive conventional treatment is dispensed herewith. The treatment scheme is also versatile, in the sense that units can be re-arranged in any way in which the space and pile caps are available.

2. **Lower operating power requirements**

The system utilizes aeration tanks of much smaller size, thereby reducing the overall power required in aerating the raw sewage. Since the bio-reactor depth is more, efficient transfer of oxygen takes place, thereby reducing the overall power consumed in treatment.

3. **Simplicity in operation and maintenance**

The system adopted has much less moving parts (only pumps and blowers). Further there is no moving part inside the bio-reactor. This gives the advantage of continuously running the bio-reactor system, under widely fluctuating conditions. All the maintenance on the mechanical systems can be done with normal skilled mechanics available.

The system is unique in operation, such that, only inlet and outlet parameters (i.e. raw sewage BOD / COD / TSS /TP and treated sewage BOD / COD / TSS / TP etc.) need to be analyzed. Since the bio-reactor is self-sustaining, there is no requirement of recycling the biomass from the secondary clarifier. Hence, analysis such as MLSS / MLVSS / SVI (sludge volume index) / F / M ratio etc. is not required to be done. This greatly reduces the analytical load on the plant chemist / supervisor, and makes the system very simple to operate and control.

The bio-reactor system adopted in the FAB based STP is provided with nutrients removal, and removal of disease causing E-coli bacteria.

4. **Nutrient removal**

The bio-reactor system operates at very food to micro-organisms ratio (F / M ratio). This helps in totally converting the Ammonical nitrogen to nitrate nitrogen. In the process of synthesis of organic substrate, about 40 – 50% of the

total phosphates load is also reduced. The remaining phosphates can be precipitated by addition of aluminum ions dosed in form of Poly Aluminum Chloride (PAC). Phosphates react with aluminum ions and precipitate as aluminum phosphate, which is an insoluble salt. Thus the total phosphates load can be easily reduced by more than 90%.

5. **Coliform removal**

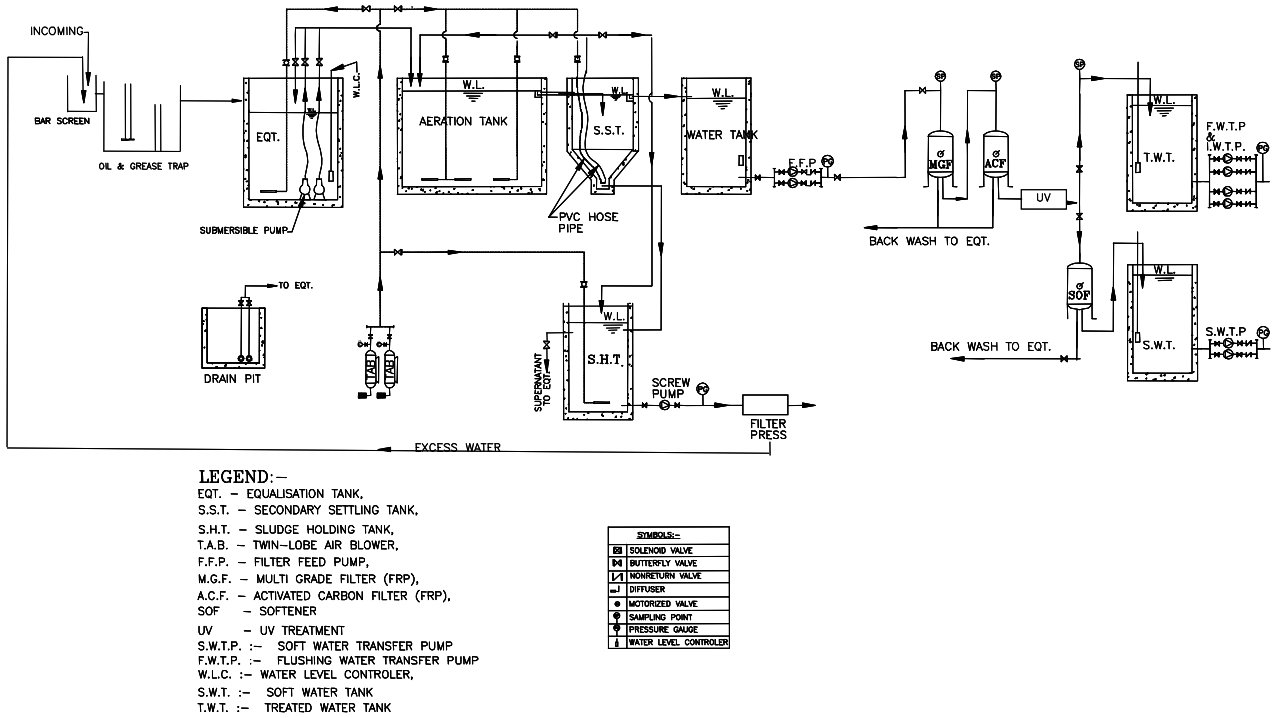
The outlet BOD of the bio-reactor system being very low (in other words, hardly any food is available to the E-coli), most of the coliform are killed in the reactor itself. The treated sewage outlet coliform count will conform to WHO standards.

6. **Sludge handling**

The sludge generated in the bio-reactors is totally digested. Since the F / M ratio in the bio-reactors is very low, the excess sludge generation is lower than compared to the conventional ASP system. Normally, this sludge is anaerobically digested to stabilize the organic matter. The present system does not envisage any sludge digestion (since the sludge is aerobically stabilized in the bioreactors itself), making the system more suitable for operation with less manpower.

The excess sludge is separated in the secondary clarifier, and then disposed off either on drying beds, or can be directly used as soil conditioner.

9.3.2.2 HYDRAULIC FLOW DIAGRAM OF STP



9.4 STORM WATER MANAGEMENT

9.4.1 During Construction Phase

Storm water runoff from the construction site was not allowed to flow down the hill.

The construction material & construction debris were kept in a stored place so as to avoid mixing with the runoff.

9.4.2 During Operation Phase

Maximum collection of rain water shall be done and the stored water shall be reused wherever possible.

Drainage network has been developed in the terminal stations to ensure the proper drainage of the storm water. Regular cleaning & maintenance of the same shall be done.

9.5 NOISE & VIBRATION ENVIRONMENT

9.5.1 During Construction Phase:

The noise emission sources during construction phase were the construction machineries / equipments employed at site. Other source were the construction activities like hammering, drilling, etc. & traffic.

The management measures taken for noise & vibration control are as follows:

- Standard methods and machinery were used and were installed on anti-vibration pads.
- To avoid noise impacts, construction activities were done during the day time only. Manual cutting & drilling operations were followed for excavation of site to avoid noise & vibration generation.
- Temporary noise barriers were installed around the construction area to suppress the noise generated due to construction machineries & activities.
- Seeing that the noise during construction phase could have an impact on the workers, earmuffs were provided to the workers & job rotation was practiced.

9.5.2 During Operation Phase:

Source of Noise & vibrations during operation phase will be the DG sets of capacity 1X150 kVA, ropeway machineries and traffic movement in the area.

The noise & vibration management measures are discussed below:

- Acoustically enclosed DG Set have been installed on proper anti- vibration pads to avoid vibration impacts. The system will be operated mainly on electricity provided by the Power Department, Government of Sikkim. DG sets will be used as a stand-by only at the time of power failure.
- Similarly, other ropeway machineries are kept in closed rooms & are installed over anti vibration pads.
- The noise pollution due to operation of DG set & other machineries can be controlled by installation of silent cowling to a value of 65 dB (A).
- The normal ropeway operations are always lower than 50 dB (A) of noise level. Proper maintenance of the ropeway during the operational phase will

be done to ensure low or no noise and environmental impacts as described in Chapter 7 of the EIA report.

9.6 SOLID & HAZARDOUS WASTE MANAGEMENT

9.6.1 Solid Waste

9.6.1.1 During Construction Phase

Wastes which are likely to be generated during the construction of terminals include the following:

- **Construction Waste & Debris:** It includes waste timber work, spent concrete and cement screening and material and equipment wrappings.
- **Excavated materials:** Excavated soil was generated during foundation excavation.
- Two type of **Municipal Waste** was generated:
    - *Organic Waste*- Approx. 6 Kg/day wastes was generated.
    - *Inert waste,* in form of stones & dust was generated.
- **Hazardous Waste-** Used oil from ropeway machineries, DG set, etc.

The management undertaken for this waste is discussed below:

- The waste was not disposed off on land or to the lake. Rather, it was being collected at a separate place.
- Biodegradable Waste & inert waste was collected & was given to Pokhari Sangrakshan Samiti for further disposal. Recyclable waste was given to authorized vendor.
- Excess soil as discussed in Section 9.1, has been used in leveling & backfilling purposes wherever possible. Top soil generated due to excavation has been preserved to be used for landscaping near UTP and LTP & along the corridor.
- The hazardous waste was stored in leak proof containers & was given to authorized vendors.

9.6.1.2 During operation phase

During operation phase, solid waste will be generated by ropeway users, employees, etc. The estimates of the solid waste generated from the proposed project have been shown in table 9-4:

TABLE 9-4 SOLID WASTE MANAGEMENT

Type of Waste	**Colour of Bin**	**Category**	**Disposal Method**	**Total Waste (kg/day)**
Organic Waste		Bio-degradable	The waste will be disposed by vermicomposting method	677
Recyclable Waste		Recyclable	Collected and given to approved recycler	290
Total Waste				**967 kg/ day**

The above table indicates that the total **967 Kg/day** of waste will be generated. Management of the generated waste can be done as given under:

- No disposal of the waste on land will be done. Proper collection bins will be provided at each terminal. Coloured bins separate for Bio degradable, recyclable waste, etc. will be provided at various locations on terminal stations.
- Bio degradable waste will be composted by vermicomposting as described below:
- Recyclable waste will be given to authorized recycler.

9.6.1.2.1 Treatment Technology (Vermicomposting)

Apart from the use of regular disposal method of solid waste, the project proponent will also take the procedure of vermicomposting.

All waste which are biodegradable in nature, shall be collected in the wodden bins and converted to nutrient rich vermicompost by using earthworms as biological agents. It is healthy and natural process. Vermicompost contains major and minor nutrients in plant-available forms, enzymes, vitamins and plant growth hormones.

Composting is largely a biological process in which microorganisms of aerobic (which require air or oxygen for development) and an anaerobic (which functions in absence of air or free oxygen) decompose organic matter and lower the carbon-nitrogen ratio of the substrate. Compost is prepared from vegetable and other waste from the complex. It is propose to have Vermicomposting in the complex.

In the proposed project, the quantity of the vermicomposting manure after adopting the procedure of vermicomposting is as follows:

Vermicomposting for Wodden Bins

Vermicomposting Wooden pits with broad base and drainage holes will be made. Plastic sheets with small holes at bottom of the box shall be placed. A layer of soil shall be added which is of 3 cm depth and a layer of coconut fibre of 5 cm depth above it for draining of excess moisture. A thin layer of compost and worms shall be added above it. About 250 worms will be sufficient for the box. 7 No. of pits shall be made. Approx. 235 sqm. Area will be required. The daily vegetable wastes shall be spread in layers. The top of the box will be covered with a piece of sac, to provide dim light inside the box. When the box is full, it would be kept without disturbance, for a week. When the compost is ready, the box will be kept outside in the open for 2-3 hours so that the worms come down to the lower fibre layer. Remove compost from the top, dry and sieve. Some species of worms release nitrogen, sulfur, phosphorus, and trace elements from organic matter. Others break down soil minerals and release potassium, phosphorus, magnesium, calcium and iron. Still other species make and release natural plant growth

hormones, which stimulate root growth. The vermicompost produced has an average nutrient status of 1.8 % N (Nitrogen), 1.9 % P_2O_5 (Phosphorous Pentaoxide) and 1.6 % K_2O, (Potassium Oxide) but composition will vary with the substrate used.

Uses of compost

The compost will be used as manure for landscaping. The compost will be sprinkled into the gardens, lawns, pots, flower beds, etc. The major benefit by using this manure is to help plants in taking up nutrients.

Precautions

1. The composting area will be provided with sufficient shade to protect from directsunlight.
2. Adequate moisture level will be maintained by sprinkling water whenever necessary.
3. Preventive measures shall be taken to ward off predatory birds, ants or rats.

Depending on the extent of weathering of leaves used for composting, 70 per cent of the material will be composted within a period of 3-4 weeks At this stage, watering will be stopped to facilitate separation of worms from the compost. Compost can be collected from the top layers, which can be sieved and dried under shade. Earthworms aggregated at the bottom layers can be collected and used for further vermicomposting.

9.6.2 **Hazardous Waste**

Hazardous waste during operation phase will be the used oil & other oil leakages from DG sets and other machineries, which is calculated to be approximately 5-7 lt/ month. The waste oil generated from D.G sets and other machineries shall be stored in HDPE containers and will be given to recycler authorized by SPCB.

9.7 ECOLOGICAL ENVIRONMENT

The project alignment falls under the Kyongnosla range. The LTP of the project exists at a distance of 200 m in South direction from the Kyongnosla alpine sanctuary and more than 5 km in NW direction from the Pangolakha Sanctuary.

The flora & fauna of the area is discussed in Section 4.10.

Gazette notifications have been published by the Sikkim Government for both the wildlife sanctuaries declaring the eco sensitive area around the sanctuaries. The declared eco sensitive zone on southern side of the Kyongnosla sanctuary is 25 m and that of Pangolakha sanctuary in Northern & western side is 25 Km & 50 km respectively.

Moreover, the ropeway is an eco-friendly, silent mode of transportation, hence, no impacts on its ecology are envisaged due to the proposed ropeway.

9.7.1 **During Construction Phase**

Project development involved diversion of 0.8237 ha of forest land for non-forest purpose for which approval had already been granted. There were no trees enroute in the ropeway corridor & only herbs & shrubs have been cut for the development of terminal stations.

However, as per the diversion approval received from Forest Department, State Govt. shall raise compensatory afforestation over 1.65 ha of degraded forest land identified at Yali Reserve Forest for which Funds (15 Lacs) have already been deposited to the Forest department.

Noise which could have impacted the flora & fauna was minimized by following mitigation measures as discussed in Section 5.4 & management measures as discussed in Section 9.5 of this chapter.

9.7.2 **During operation Phase**

During operation phase, plantation of trees is proposed around the LTP, UTP, under the corridor of ropeway & in other open spaces, to enhance the terrestrial ecology of the area.

Main reasons of disturbance to terrestrial and aquatic ecology are increased noise, glare/ lighting impact of ropeway structures on bird species and habitat fragmentation.

Whereas ropeway is an environment friendly transportation method, efforts shall be made to ensure minimum or no disturbance to the ecology of the area.

The alignment has been selected by keeping in sight that no infringement to habitation will be caused.

9.8 SOCIO ECONOMIC SCENARIO & BENEFITS TO ECONOMY & STATE

Socio economic impact includes impact on the local population of the area with respect to employment, resettlement, etc.

At Tsomgo lake, there are no habitation in the area and only few army camps exists, as the site is near to the Nathula border. Few shopping complexes also exist at the site.

The ropeway is proposed on the southern side of the lake in right side of the already existing alpine café. The café will keep working as it is even after the installation of ropeway. In fact, the tourist at alpine café will even increase. And, there are no shops under the route of ropeway.

Further, the hill top upto which the ropeway is proposed is least visited by the tourists due to the poor trek condition and no other means of transportation. No yalk porters work on the route to hill top.

Hence, no negative socio economic impact is envisaged. Instead, positive impacts are seen (benefits discussed in Section- 5.7 of Chapter-5).

9.8.1 **During Construction Phase**

There were no negative impacts seen on socio economy during the construction phase. Instead, the project had positive impacts to the socio-economy by providing employment opportunities in the area.

No displacement or R & R plan was needed as no human habitat exists at the installed stations area for ropeway or in the corridor of the ropeway.

9.8.2 **During operation Phase**

The project will need skilled & semi-skilled staff for the ropeway operation & hence will enhance employment in the area.

This recreational facility will attract more tourists to visit this place & increase in tourists will benefit the existing shops, yalk porters, cafés present in the area. Only positive impacts are seen due to this project.

The positive impacts on socio economy due to proposed ropeway have already been discussed in detail in Section 5.7.

9.8.3 **Corporate Social Responsibility**

The Companies Act, 2013 encourages companies to spend at-least 2% of their average net profit in the last three years on CSR activities under a **Corporate Social Responsibility Program.** The Ropeway project being developed under a private sector company, would result in spending the stipulated percentage of net-profit under the following activities, for the betterment of the project area & its people:

I. **Drinking Water Facility-** Safe drinking water facilities will be made available for the local people in Village Changu & Village Chipsu.
II. **Waste Management**- Help Pokhari Sangrakshan Samiti in waste collection, treatment & disposal.
III. **Sanitation**- Provision of toilets in nearby schools and display & awareness through signboards indicating steps to keep environment & surroundings clean.
IV. **Toilet facilities-** The Terminal Stations would have provision of waiting area and toilet facilities for general public.

V. **Medical Aid Facilities-** Provision of oxygen cylinders will be made at UTP & first aid facility will be made at Base station.

The costing of CSR to be borne by owner is given as under:

S. No.	Activity	Expenditure (Rs. in lacs)
1.	Drinking Water Facility	5.0
2.	Waste Management	2.0
3.	Sanitation	5.0
4.	Toilet facilities	5.0
5.	Medical Aid Facilities	1.5
	Total	Rs. 18.5 lacs

9.9 TRAFFIC MANAGEMENT

The ropeway project will attract tourists and hence will lead to cumulative yearly increase in traffic. But, since there are no accommodation facilities present at the project site, the tourists stay at Gangtok City and visit Changu Lake as a part of their itinerary.

There are two government parking spaces available for parking of vehicles out of which one is under construction. The space is sufficient enough to accommodate the vehicles of the visitors.

Moreover, the visit to Changu lake is based on permit systems being near to Nathula border. Hence, a limited no. of tourists are allowed to visit the site at a time.

The permit based system will help in management of traffic to manage the one time load on the area in terms of traffic as well as in terms of environment load.

Hence, it is envisaged that parking needs will be fulfilled in the provided spaces.

9.10 CONSERVATIONS METHODS FOR ELECTRICAL SYSTEM

Usage of electricity will mainly be for the operation of ropeway & services. However conservation of energy will be practiced by the following:

- The main drive motor will be energy efficient.
- The motor will be driven by variable voltage variable frequency (VVVF) controller which will increase the efficiency of the motor.
- Day light provision shall be made in the terminal stations by using openable windows (use of sunlight in lieu of conventional power).
- LED & T5 lights will be used in common areas like waiting area, corridors, etc.
- Low loss electronic ballast for all lights used in the electrical rooms.
- Solar lights shall be provided.
- Energy efficient motors shall be used for water pumping and STP.

9.11 ENVIRONMENT MANAGEMENT CELL

An environment management cell shall be created in consultation with SPCB Sikkim, which shall perform the following functions:

- Achieve objectives of the 'Environment Management Plan'.
- Collect information from regular monitoring and create a database.
- Analyze the data and decide thrust area.
- Based on the data collected, decide target for each thrust area.
- Carry out 'Projects' in each thrust area to arrive at practical solutions to environmental problems.
- Discuss the reports of study on environment and disseminate the information.
- Work out 'Action plan' for implementation of the recommendations made in the reports.

- Prepare Management Information System (MIS) reports and budget for environment management program.
- The Plant Manager will be responsible for environmental issues at plant.
- The responsibilities of the various members of the environment management cell are given in Table 9-6 as follows:

TABLE 9-5 ENVIRONMENT MANAGEMENT CELL

S.No.	Designation	Proposed responsibility
1.	Unit Head	Overall responsibility for environmental management and decision making for all environmental issues. To identify and recommend all kinds of major improvements to be taken in a Financial year
2.	Site In charge	Ensure environmental monitoring as per appropriate procedures as discussed in Chapter-6 of this EIA report. Ensure correct records of generation, handling, storage, transportation and disposal of solid hazardous wastes. To monitor and ensure implementation of the improvements. To co-ordinate with the Emergency Management Cell for rescue and evacuation during disaster.

9.12 COST ON ENVIRONMENT MANAGEMENT PLAN

The cost of project is estimated to be about Rs. 9.0 crores.

Rs. 87.5 lacs of capital cost & **Rs. 8.6 lacs/year** of recurring cost shall be spent on Environment Management Plan. Details are given in Table 9-7:

TABLE 9-6 CAPITAL COST ON EMP

S. No	Description	Estimated Capital Cost (Rs. In Lacs)	Estimated Recurring Cost (Rs. In Lacs/ Year)
1.	STP/ Waste Water Treatment	70.0	7.2
2.	DG set stack	1.0	0.3
3.	Environmental Monitoring	-	1.0
4.	Solid Waste Management (Wooden composting pit 7 No.)	1.5	0.1
5.	Funds deposited for afforestation to forest department for 1.65 Ha forest land	15.0	-
	Total	**Rs. 87.5 lacs**	**Rs. 8.6 lacs/ year**

CHAPTER 10: SUMMARY & CONCLUSION

10.1 SUMMARY

The project is a 625 m long ropeway proposed from the southern side of Changu (Tsomgo) Lake to the southern hill top in East of Sikkim District, Sikkim. The site is located adjacent to the Gangtok – Nathula Highway (Jawaharlal Nehru Marg) at a distance of 38 Km from the Capital City Gangtok. The lake is situated at an altitude of 3780 m. The whole alignment falls under the Kyongnosla Range.

The project is aimed to provide a convenient facility to the tourists visiting Tsomgo Lake for visiting the mountain top and enjoy the scenic beauty of the lake, greenery, mountains of the surrounding area which is not visited by most of the tourists due to poor trek condition. It will also increase tourism & will help in generating added revenue to the state.

The project had already been granted **Environmental Clearance** from SEIAA, Sikkim and the project is on the verge of completion. Construction work of the project is almost complete.

A legal notice was served to the project according to which Environmental clearance from the Ministry of Environment, forests & Climate change is required. The earlier EC has been suspended by the SEIAA.

The summarized details of the project are as follows:

- 8237 sq m of the Land has been diverted from the forest land with prior permission from Forest department. Out of the diverted land, 8072 sq m area has been developed into the terminal stations, towers & corridor of ropeway.
- The alignment is 625 m long having an elevation difference of 230 m approximately. The maximum design capacity of the ropeway is 800 PPH but it will be initially equipped for 400 PPH.
- The total power requirement for the project is 150 kW and will be provided by Power Department, Government of Sikkim. 1 DG sets of 150 kVA has been installed as a backup to be used only in the case of power failure.

- Water supply during construction phase was met by the overflow of the lake being the only source of water in the area. The water source will remain the same during the operation phase. The total water requirement has been estimated to be 101 KLD and the waste water generation will be 92 KLD. The wastewater will be treated in 2 STPs of 55 KLD each and the treated water will be reused for flushing, gardening & miscellaneous purposes.
- The LTP of the project exists at a distance of 200 m in South direction from the Kyongnosla alpine sanctuary and more than 5 km in NW direction from the Pangolakha Sanctuary which are very rich in flora as well as fauna.
- Solid waste during construction phase will mainly be waste generated due to site clearance, construction waste (spent concrete, waste iron or steel bars and cement screenings), excavation waste and labor waste. During operation phase, 967 kg /day of waste will be generated due to human activities. The waste during construction will be given to the Pokhari Sangrakshan Samiti for further disposal. The solid waste during operation phase will be treated by composting method.
- The total estimated cost of project is Rs. 9.0 Crores.

10.2 CONCLUSION

Tsomgo lake is one of the most attractive tourist destination of East of Sikkim and is visited by almost all of the visitors of Sikkim. The view of the lake & surrounding area is breathtaking from the southern hill top, but, the breathtaking view could not be enjoyed by each of the tourist due to the tough nature & poor condition of the trek route and because no other means of transportation exists as yet to reach the hill top.

The Ropeway system is an environment friendly approach to be adopted. By the ropeway mode of transportation to the hill top, the tourists can enjoy the even enhanced beauty of the panoramic view of the lake & surroundings and at the same time the eco- sensitivity of the region will not be disturbed.

The ropeway project will add even better waste & wastewater management strategies in the area. In addition, it can act as a mode for monitoring as well as evacuation measure at the time of bad weather & emergency situations.

Moreover, the ropeway would act as a recreational facility & will increase the tourism in the area and hence the economy of the state.

Hence, it is concluded that the ropeway will prove to be beneficial for **locals** (in the form of employment), **the visitors of the place** (in the form of convenience & added attraction), **state** (in the form of economy) and the **environment** (preservation of its pleasant nature).

1. ROPEWAY PROFILE MAP

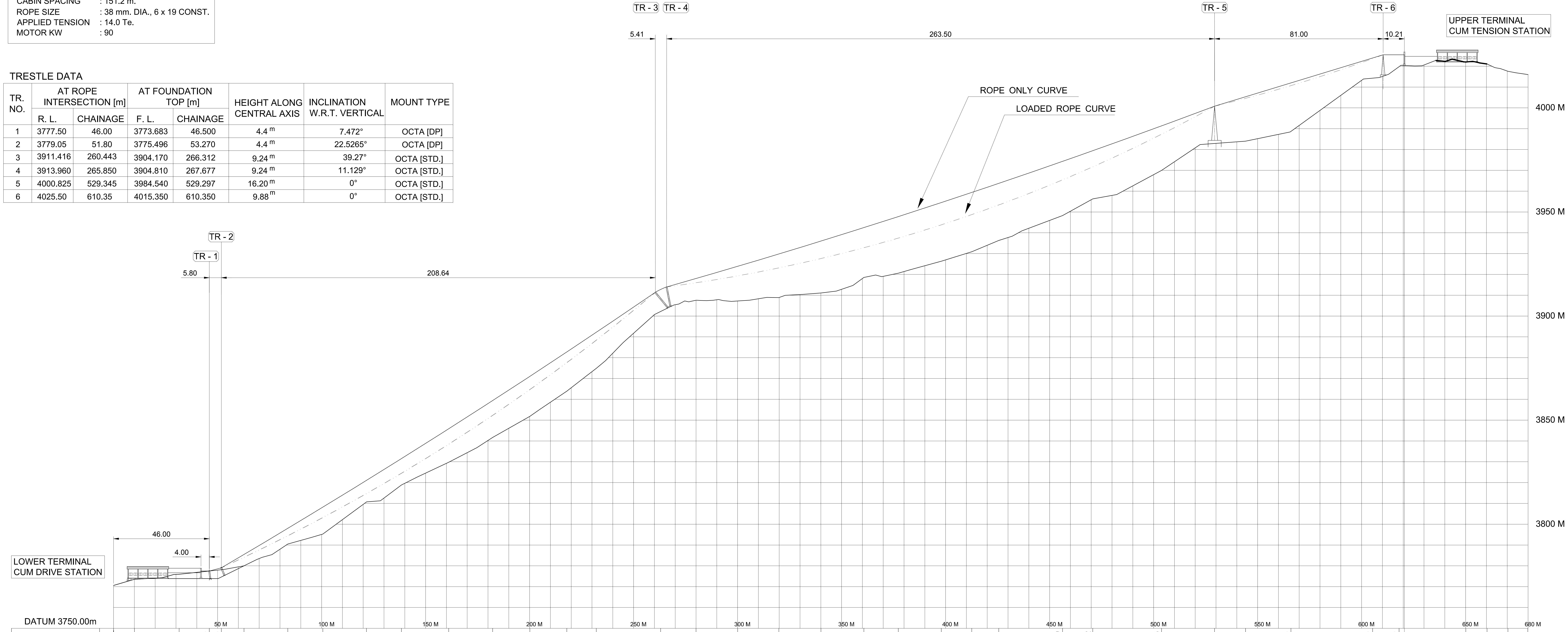
DO NOT SCALE
ASK IF IN DOUBT

SYSTEM DATA

TYPE : MONOCABLE GONDOLA
CAPACITY : 500 PPH
SPEED : 3.5 m. / Sec (MAX.)
CABIN CAPACITY : 6 PSG.
CABIN SPACING : 151.2 m.
ROPE SIZE : 38 mm. DIA., 6 x 19 CONST.
APPLIED TENSION : 14.0 Te.
MOTOR KW : 90

TRESTLE DATA

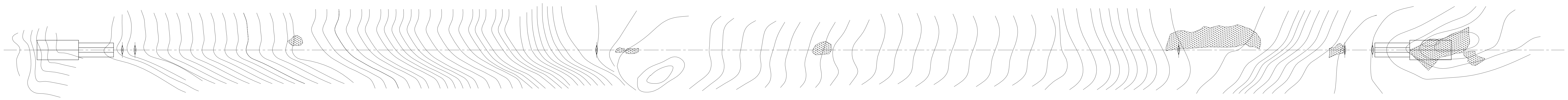
TR. NO.	AT ROPE INTERSECTION [m]		AT FOUNDATION TOP [m]		HEIGHT ALONG CENTRAL AXIS	INCLINATION W.R.T. VERTICAL	MOUNT TYPE
	R. L.	CHAINAGE	F. L.	CHAINAGE			
1	3777.50	46.00	3773.683	46.500	4.4 m	7.472°	OCTA [DP]
2	3779.05	51.80	3775.496	53.270	4.4 m	22.5265°	OCTA [DP]
3	3911.416	260.443	3904.170	266.312	9.24 m	39.27°	OCTA [STD.]
4	3913.960	265.850	3904.810	267.677	9.24 m	11.129°	OCTA [STD.]
5	4000.825	529.345	3984.540	529.297	16.20 m	0°	OCTA [STD.]
6	4025.50	610.35	4015.350	610.350	9.88 m	0°	OCTA [STD.]



NATURAL SURFACE LEVEL (M)	3770.575	3773.550	3775.956	3777.500	3779.050	3779.999	3790.483	3795.290	3810.756	3818.859	3829.777	3841.706	3851.817
CHAINAGE (M)	0.000	10.017	31.520	46.000	51.800	62.700	83.758	100.580	121.585	138.376	161.117	182.226	200.137

NATURAL SURFACE LEVEL (M)	3863.930	3874.868	3913.000	3907.617	3907.230	3908.883	3911.085	3918.488	3920.573	3926.358	3930.871	3936.312	3948.289
CHAINAGE (M)	217.891	232.050	263.000	280.038	300.039	319.845	340.081	360.652	377.236	397.940	412.559	425.553	456.244

NATURAL SURFACE LEVEL (M)	3956.292	3969.966	4001.000	3984.003	3988.400	4024.300	4025.500		4022.035	4020.677	4017.568	4015.997
CHAINAGE (M)	470.744	503.794	529.300	544.229	566.006	605.300	618.000	620.500	650.100	660.300	670.355	679.876



UNLESS MENTIONED OTHERWISE :-

1. ALL DIMENSIONS ARE IN Mtr.

THIS DRG. WILL SUPERSEDE
EARLIER DRG. NO. 01.0978.101 SINCE
ALIGNMENT LOCATION CHANGED

DRG. NO.	TITLE	REV.	ZONE	REVISION DESCRIPTION	BY	DATE
		5				
		4				
		3		DATA TABLE MODIFIED	RD	14.08.12
		2		TR. NOS. 3 - 6 & UPPER STN. RELOCATED TO CLEAR OUT OF STONE OUTCROP	RD	22.07.11
		1		LOCATION AND RL OF TR. 3, 4 & 5 MODIFIED TO SUIT SITE CONDITION	RD	

REFERENCE DRAWING

DRAWN	B.D		14.12.09
CHECKED - A	A.G		06.03.15
CHECKED - B	U.C		06.03.15
APPROVED	KB		06.03.15

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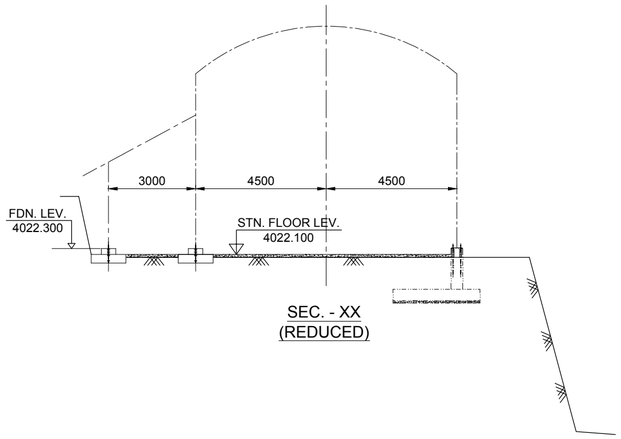
CONVEYOR & ROPEWAY SERVICES PVT. LTD.
75-C, PARK STREET, 6TH FLOOR, KOLKATA- 700 016

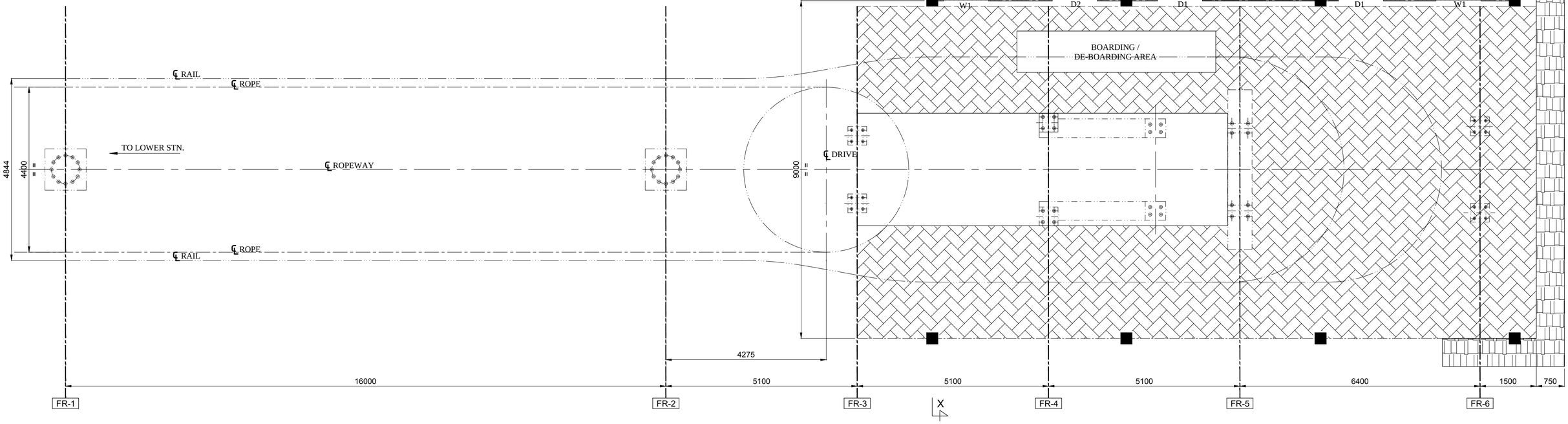
CLIENT CRSPL
PROJECT PASSENGER ROPEWAY
TITLE:- ROPEWAY PROFILE
SCALE :- 1:1
FILE : ROPEWAY PROFILE
DRG. NO. 01 . 0978 . 101
SHEET 1 OFF 1
REV. 1 2 3

2. LTP & UTP LAYOUT

DO NOT SCALE
ASK IF IN DOUBT



SEC. - XX
(REDUCED)



UNLESS MENTIONED OTHERWISE :-

DRG. NO.	TITLE	REV.	ZONE	REVISION DESCRIPTION	BY	DATE
		5				
		4				
		3				
		2				
		1				
REFERENCE DRAWING						

DRAWN	M.C		10.02.15
CHECKED - A	A.G		06.03.15
CHECKED - B	U.C		06.03.15
APPROVED	K.B		06.03.15

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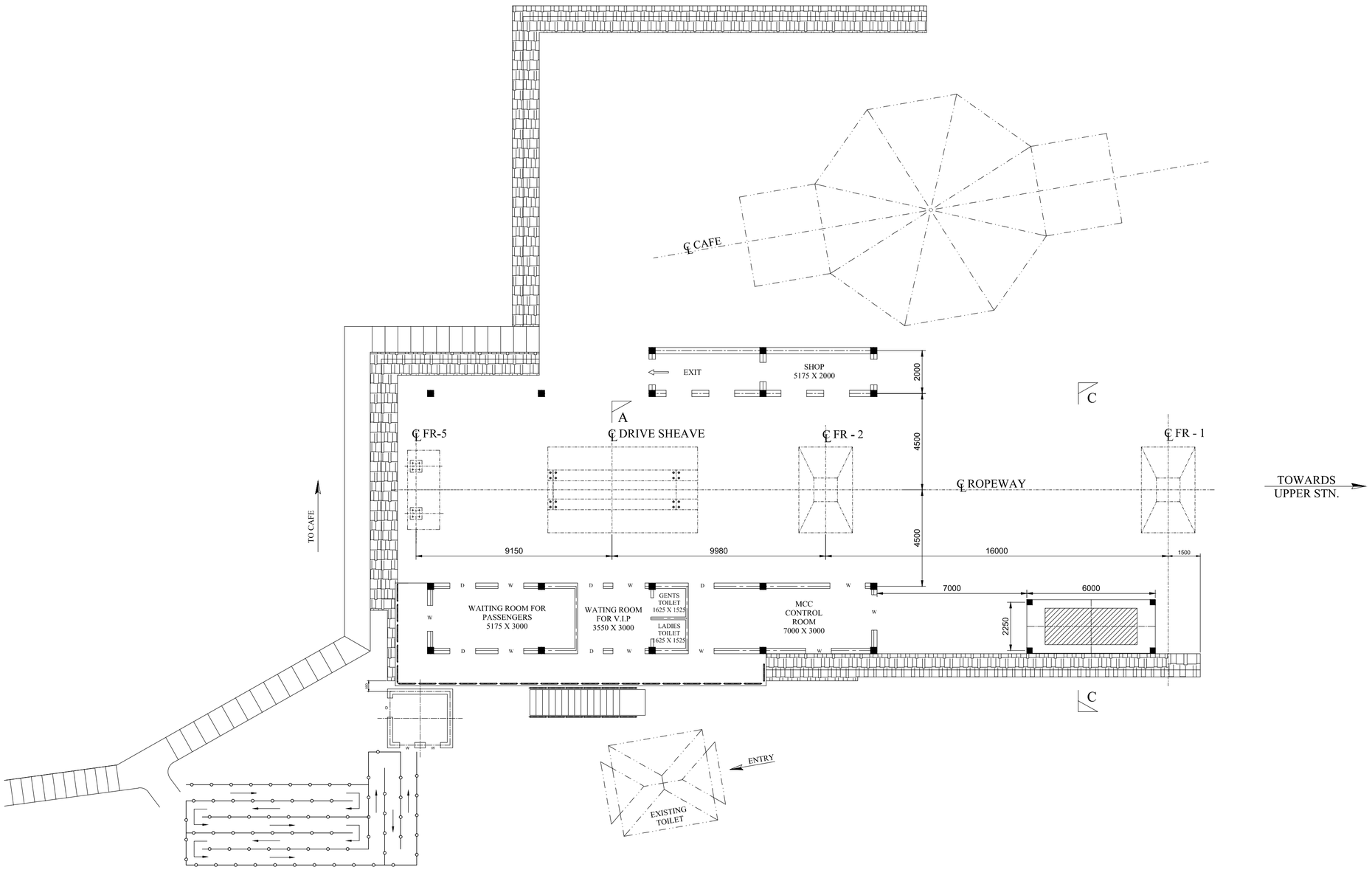
CLIENT	CRSPL	TITLE:-	LAYOUT OF UPPER STN.
PROJECT	PASSENGER ROPEWAY AT CHANGU		
SCALE 1 : 75		DRG. NO. 02.0978.226	SHEET 1 OFF 1
FILE :			REV.

DO NOT SCALE
ASK IF IN DOUBT



UNLESS MENTIONED OTHERWISE :-

DRG. NO.	TITLE	REV.	ZONE	REVISION DESCRIPTION	BY	DATE
		5				
		4				
		3				
		2				
		1				
REFERENCE DRAWING						

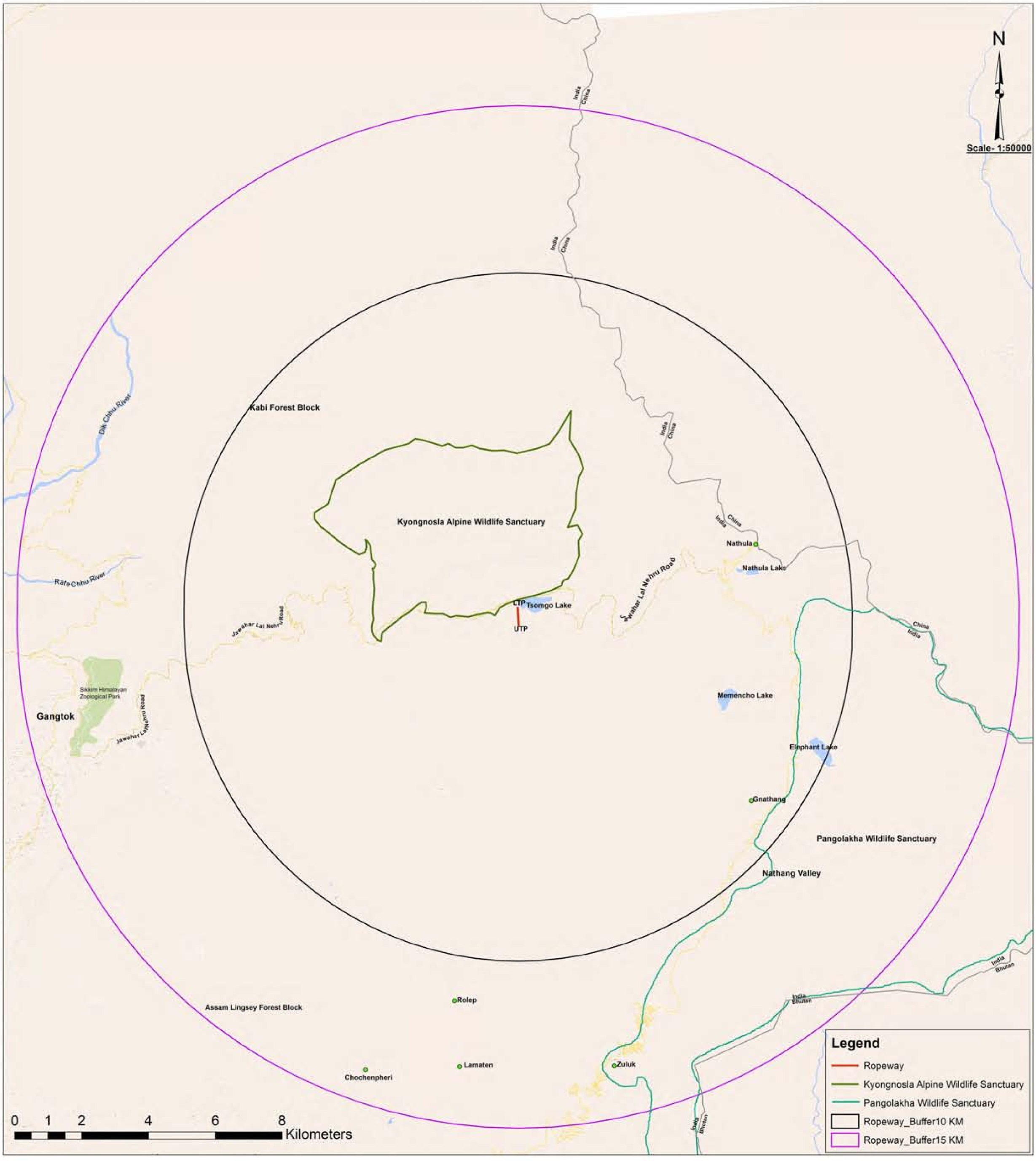
DRAWN	M.C		05.04.11
CHECKED - A	A.G		06.03.15
CHECKED - B	U.C		06.03.15
APPROVED	K.B		06.03.15

CONVEYOR & ROPEWAY SERVICES PVT. LTD.
75-C, PARK STREET, 6TH FLOOR, KOLKATA- 700 016

CLIENT	CRSPL	TITLE:- LAYOUT FOR LOWER STATION
PROJECT	PASSENGER ROPEWAY AT CHANGU	
SCALE:- 1 : 100	DRG. NO. 02.0978.208	SHEET 1 OFF 1
FILE :		REV.

3.10 & 15 KM RADIUS MAP

10 & 15 Km Radius Map for the Ropeway Project at Tsomgo lake, East Sikkim, Sikkim



4. LICENSE AGREEMENT

AGREEMENT
DTP 22/5/09
CBSPL + SK Tours

GOVERNMENT OF SIKKIM
TOURISM DEPARTMENT
GANGTOK

Ref. No. 155(787) Ec/TD/06-07/60 Dated. 22/05/09

To

Mr. Shekhar Chakravarty, Managing Director,
M/S. CONVEYOR AND ROPEWAY SERVICES PRIVATE LIMITED,
75-C, Park Street, 6th Floor,
Kolkata – 700 016,
West Bengal.

Sub: License Agreement for construction and operation of Passenger Ropeway near Tsomgo Lake in East Sikkim on Build, Own, Operate and Transfer (BOOT) basis.

Sir,

Please find enclosed herewith the License Agreement drawn between the Tourism Department signed by the Secretary, Tourism Department on behalf of the Governor of Sikkim and M/S.Conveyor and Ropeway Services Private Limited your firm signed by the General Manager (M&O) on behalf of your firm of for construction and operation of the Passenger Ropeway near Tsomgo Lake in East Sikkim on Build, Own, Operate and Transfer (BOOT) basis.

I have been directed to request you to commence the preliminary activities including the investigation, study and design the ropeway project with immediate effect. However, as the project site being forest land, the physical commencement of the project shall be started after the receipt of final clearance of the Ministry of the Environment & Forest, Government of India, for which the first phase clearance has been already obtained.

Please acknowledge the receipt of the License Agreement

Yours faithfully,

Enclosed: As above.

RUPEES

दस रुपया

LICENSE AGREEMENT

This agreement is made on this the 22nd day of May, (two thousand and nine) 2009 at Gangtok.

BETWEEN

HE GOVERNOR OF SIKKIM, through the Secretary, Department of Tourism, Government of Sikkim, hereinafter referred to as **"LICENSOR"** (which expression shall unless it be repugnant to the context or meaning thereof shall be deemed to include its successors, administrators, executors and assigns of the First Part).

AND

M/S. CONVEYOR AND ROPEWAY SERVICES PRIVATE LIMITED, a Company incorporated under the Companies Act, 1956, having its Registered Office at 75 C, Park Street, 6th Floor, Kolkata – 700 016, West Bengal, represented by its Managing Director, Mr. Shekhar Chakravarty, hereinafter referred to as **"LICENSEE"** (which expression shall unless it be repugnant to the context or meaning thereof shall be deemed to include its successors, administrators, executors and assigns of the Second Part).

WHEREAS, The LICENSOR is keen to implement a project under the tourism infrastructure development programme of the Government of Sikkim, envisaging Construction, Operation and Maintenance of a Passenger Ropeway near Tsomgo Lake in East Sikkim more particularly described in Schedule-"A" and hereinafter referred to as "the Project" with private sector participation on Build, Own, Operate and Transfer (BOOT) basis.

the Licensor for annual increment of fares or at any time it may deem necessary other than that set forth in this agreement.

1.2 **License Period**

The License shall be granted for a period of 20 (twenty) years nil months and nil days to be reckoned from the date of start of commercial operation of the Ropeway project. The period for the commercial operation of the Ropeway project is described in ARTICLE-6.

The extension of License period will be at the exclusive discretion of the Licensor. In the event of the License Period being extended by the Licensor beyond the said period of 20 (twenty) years, the License Period shall include the period by which the License is so extended.

1.3 **Acceptance of the License**

The Licensee hereby accepts the License and agrees to undertake to implement the project / provide project facility to perform / discharge all of its obligations in accordance with the terms set forth in this License Agreement.

1.4 Project Site

(a) The Licensor will make available the forest land measuring 0.6127 Hectare required for the Construction of the Ropeway Project and all its allied components to the Licensee after the formal diversion of said land to the Licensor by the Forest, Environment and Wildlife Management Department, Government of Sikkim. Licensor will accord all the clearances from the Forest, Environment and Wildlife Management Department and make it available to the Licensee for the purpose of implementing the project. That, the Licensee shall utilize the diverted land made available for the project entirely for the purpose it is diverted and the legal status of the land/ownership will remain unchanged.

(b) In pursuant to above clause, the Licensee shall have the rights to use the Project Site and to make at its cost, charges and expenses such development activities for the purpose of the project and as per the additional terms and conditions as may be defined in the formal letter of approval for the diversion of forest land by the Forest,

1.5 **Information about the Project Site**

Information about the Project Site is as enumerated in Annexed hereto.

1.6 **Rights and Title over the Project Site**

The Licensee shall have rights to use the Project Site in accordance with the provisions at clause 1.4 above and for this purpose it may regulate the entry and use of the same by the project implementing party of the Licensee duly adhering to all relevant conditions as may be applicable at the project site as per the regulations of the State Government as well as the Government of India.

1.7 **Forest, Environment and other Clearances**

The Licensor shall obtain No Objection Certificates (NOCs) and Permits applicable to this project from the Forest, Environment and Wildlife Management Department and after the receipt of the same by the Licensor, it will be intimated to the Licensee of such Permits having obtained, and in case, any more Permits are required, the Licensee in assistance with the Licensor will procure the same.

ARTICLE-2

FARE

2.1 **Levy, Collection and Appropriation of Fare**

(a) Subject to the provisions of this Agreement, the Licensee shall be entitled to levy, demand and collect the appropriate fare from the passenger of the Ropeway users with prior approval of such fare by the Licensor.

(b) The Licensee may formulate, publish and implement appropriate scheme(s) for frequent users as may reasonably be required by local circumstances from time to time with the prior written consent of the Licensor.

(c) The aforesaid fare will be collected from the users of the facility on issuing specific tickets by the Licensee.

(d) In case of applicability of any Taxes and Duties payable on the Tickets, the same

shall be collected from the Passengers in addition to the Normal rate of Fare with the prior approval of the Licensor.

(e) "Exempted Persons" means the Engineers and officers on duty, the body authority of the Licensor, the children below the age of three years, VIP's as will be specified by the Licensor.

(f) The Licensee will make available the detail statement of accounts of the fares collected from the Ropeway passengers to the Licensor on daily basis. Licensee will also allow the body authority of the Licensor or persons authorized by the Licensor to check, scrutinize and take the statement of the accounts of the fares collected by the Licensee at any time.

2.2 **Ticket Fare and Revision of Ticket Fare**

The Licensee shall be entitled during the Operation and Maintenance of the Ropeway to levy and collect the Ticket fees from the users of the said Ropeway as under, namely.

(a) From Proposed Right side of the lake Tsomgo starting from in front of Alpine Cafe to hill top on the Right Hill surrounding Tsomgo Lake, East Sikkim and back, Fare of per ticket will be charged @ Rs. 100/- per passenger to begin with.

(b) 10% (ten per cent) over the current fare after every year of operation to be increased rounded off to nearest multiple of Rs 5/- (Rupees five only).

ARTICLE-3
ROYALTY

3.1 Subject to the provision of this Agreement, the Licensee shall be liable to pay the Royalty to the Licensor on quarterly basis in accordance with the Royalty structure as under.

Period	Share of Gross Ticket Receipts
1st year to 3rd year of Operation	7.5% (seven point five per cent)
4th year to 8th year of Operation	10% (ten per cent)
9th year to 13th year of Operation	15% (fifteen per cent)
13th year onwards	17.5% (seventeen point five per cent)

SECRETARY

ARTICLE-4
OBLIGATIONS AND UNDERTAKINGS

4.1 **The Licensee at its own cost and expenses, shall:-**

(a) investigate study, design, construct, operate and maintain the project assets / project facility in accordance with the provisions of this Agreement, Good Industry Practice and Applicable Laws;

(b) ensure highest standard of quality of the Ropeway in form of its technology and safety parameters. To ensure best of aesthetics and safety features, the Licensee will use the latest imported haulage rope and cabins, well tested and proven quality;

(c) ensure the use of such technology that the Ropeway system is environment friendly, pollution-free and having least impact on the fragile ecology and also that it shall cause no virtual damage to the existing flora of the region;

(d) use Indian Standard Institute/Indian Standard Organization certified materials for all the features of the Ropeway including civil, mechanical and electrical installations as per the provisions under the relevant Indian Standard code of practice to ensure best of quality, beauty and safety of the system;

(e) ensure the use of Special Steel for the Ropeway as per the specification recommended under the relevant Indian Standard code for sub-zero temperature along with the adoption all the methodology for the civil constructions, electrical and mechanical installations including the use of materials/ equipments as per the stipulations made under the relevant IS code of practice for such constructions/ installations at sub-zero temperature as required at the project site;

(f) present the design,-architecture, specification and drawings pertaining to the Ropeway project with detail technical and commercial parameters to the Licensor for comments, suggestions, modification and approval prior to implementation of the project either in part or in full;

(g) comply with the instructions of the authority/engineers appointed or authorized by the Licensor with regard to maintaining the quality, specifications and progress of work pertaining to the Ropeway project as per the approved drawings, design and schedule target of progress;

(h) be responsible to implement the Ropeway project as per the detail design, drawings and the specifications approved by the Licensor and also liable to achieve the work progress as per the Bar-Chart specified in the Detail Project Report approved/ to be approved by the Licensor;

(i) submit the certificate of the quality of materials to be used for the Ropeway, certificate of quality and make of the Ropeway components, certificates of the indigenous or imported components and all such certificates for proof of quality and specifications to the Licensor on requisition for approval prior to commencement or installation of any components of the Ropeway at the project site;

(j) submit the quarterly progress report to the Licensor and furnish the reason justifying any deviation in achieving desired progress as per the original Bar Chart either in part or in whole, the schedule period of completion remaining unchanged;

(k) display advertisements that are legally permissible on station structures with written consent of the Licensor;

(l) appoint, supervise, monitor and control activities of the Contractor;

(m) undertake routine maintenance including prompt repairs of all the components of the Ropeway to ensure successful operation;

(n) take all reasonable precautions for the prevention of accidents in an around the project site / project facility;

(o) be responsible for safety, soundness and durability of the project facility;

(p) operate and maintain the project at all times during the Operation Period as per Agreement;

(q) remove all surplus construction machinery and materials from the project site;

(r) be responsible for prompt removal and safe disposal of garbage, muck and other undesirable materials from the Project site to such designated dumping site as may be specified by the Licensor at any time during the construction period and also during the operation of the Ropeway;

(s) maintain fair wages to the workers employed in the project which shall not be less then the mandatory basic minimum wage as per the provisions of the Government of Sikkim at the high altitude range of the Project site;

(t) appoint any Contractor for sub-leasing the various jobs of the Ropeway with prior written consent and approval of the Licensor;

(u) comply with the provisions under the relevant Forest and Environment Act to be stipulated in the formal letter of diversion of forestland;

(v) observe and comply with all its obligations set forth in this Agreement;

(w) be responsible for opening of Insurance Coverage in respect of project and Group Accident Insurance or Accident Insurance in respect of the ropeway passengers, workers, construction personnel, maintenance staff.

4.2 **Obligations of the Licensor**

(a) The Licensor shall make available the land at the project site with necessary right of way to the Licensee.

(b) Issue the No Objection Certificates and Permits as may be applicable to the Licensee.

(c) Ensure peaceful use of the project site upon the compliance of the mandatory provisions within the diverted forestland by the Licensee.

(d) Upon written requests from the Licensee, assist the Licensee in obtaining access to all necessary infrastructure facilities and utilities, including water, electricity and tele-communication facility at rates on terms no less favourable to the Licensee than those generally available to commercial customers.

(e) Assist the Licensee in obtaining necessary authority to regulate traffic on the project site.

(f) Assist the Licensee in obtaining Police Assistance in case of requirement.

(g) Assist in obtaining dedicated electrical Power Supply. However, the cost of electrical installations, transformer and the electric charges will be borne by the Licensee as per the costrate fixed by the Licensor.

(h) Assist the Licensee for availing all possible and admissible priorities / concessional status in respect of procurement, Customs Duty for imported items and Local Taxes and Duties as applicable to such Ropeway Project.

ARTICLE- 5
PROJECT COMPLETION

5.1 Ropeway Installation Project shall be completed within 12 (twelve) working months to be reckoned excluding the hibernating winter season, from the date of receipt of all applicable permits / No Objection Certificates / Certificates etc and physical possession of land as per clause 1.4 above.

ARTICLE- 6
COMMERCIAL OPERATION DATE

6.1 The Date of Commercial Operation will be fixed after Completion of the Project and Smooth Running of the Ropeway for a period of 3 (three) days at a stretch without any hindrance. The maximum allowable period for starting the commercial operation of the Ropeway

project will be 18 (eighteen) months from the date of handing over of land as per ARTICLE-1, clause 1.4 under **Project Site**, which is not subject to extension unless prior approval of the Licensor under special circumstance. The Licensor will have the full authority upon the period of such extension with or without incorporating any other special criteria, condition or penalty clause.

ARTICLE-7
LICENSE PERIOD

7.1 **Reckoning of License Period**

License Period under this Agreement will be for a period of 20 (twenty) years from the date of commercial operation of the Ropeway project. The period for the commercial operation is described in Article 6. The extension of License period will be at the exclusive discretion of the Licensor.

ARTICLE-8
HANDING OVER THE PROJECT ASSETS

8.1 Upon the expiry of the License Period or extended License Period granted by the Licensor, the Licensee shall hand over peaceful possession of all the Project Assets including Project Site in Good Running Condition against no transfer cost or obligations.

ARTICLE-9
PROJECT COST

9.1 Rs. 6.25 Crore (Rupees Six Crore and twenty five lakh only) as was given in the Feasibility Report, will stand enhanced after application of Price Index Formula of the Reserve Bank of India.

ARTICLE-10
ARBITRATION

10.1 Any dispute not resolved amicably settled between the Licensor and the Licensee, shall be settled by an Arbitrator under the Arbitration and Conciliation Act, 1996. Arbitrator will be nominated on the consent of both the parties. The place of Arbitration shall be Gangtok, East Sikkim.

ARTICLE-11
FORCE MAJEURE

11.1 Standard Force Majeure Clause will be applicable to this License Agreement.

ARTICLE 12
RAISING OF LOANS AND FINANCING THROUGH ASSIGNMENT OF LICENSE RIGHTS

12.1 The Licensee shall be entitled to raise loans and / or financial facilities from financial institutions, banks or any other such body / financier as it may deem fit for development and completion of the project and for this purpose the Licensee may, if required, by such banks and / or financial institutions / lenders, assign all or any part of the License Rights or hypothecate or otherwise encumber all or any of the other assets of Licensee as and when required.

12.2 **Counterparts**

This Agreement may be executed in two Originals, each of which will be retained by the parties hereto.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE SET AND SUBSCRIBED THEIR RESPECTIVE HANDS AND SEALS THE DAY, MONTH AND YEAR FIRST ABOVE WRITTEN.

WITNESS: 1. (R. KHANNA)
Chief Engineer
Deptt. Of Tourism
Govt. Of Sikkim
Gangtok

2. 27/5/09
Superintending Engineer
Deptt. of Tourism
Govt. of Sikkim

For and on behalf of Governor of Sikkim
SECRETARY
Department of Tourism
Govt. of S

(RANJIT PAKRASHI)
For and on behalf of M/S Coxon
Services Private Limited

SCHEDULE-A
SCOPE OF WORK

The work shall broadly envisage the construction of an Aerial Passenger Ropeway with the following :

Design, Manufacturing, Supply, Erection, Commissioning, Operation & Maintenance of an Aerial Passenger Ropeway having approximate horizontal length of 957 meters including all its components (imported and indigenous), auxiliary and subsidiary Civil Construction, Mechanical and Electrical Installations necessary to Run and Operate at the Commercial and professional levels in the Proposed Route (i.e from right side of lake Tsomgo staring from in front of the Parking Yard below the Shopping Complex to Hill Top on the right side surrounding Tsomgo Lake) having transport capacity of 800 Passenger Per Hour (PPH) with total security and protection on Built-Own-Operate-Transfer (BOOT) basis in East District, Sikkim.

The land required for this project is 0.8273 Hectare

SECRETARY
Department of Tourism
Govt. of Sikkim, Gangtok

KOLKATA

5. DIVERSION OF FOREST LAND APPROVAL

GOVERNMENT OF SIKKIM
OFFICE OF THE DIVISIONAL FOREST OFFICER
EAST TERRITORIAL DIVISION
FORESTS, ENVIRONMENT AND WILD LIFE MANAGEMENT
DEPARTMENT
P.S. Road, Gangtok -737101.

No. ...../ED/T Date: .....

To,

The Range Officer,
Kyongnosla Range,
Department of Forest env. & Wildlife Management.

Subject: HANDING AND TAKING - Proposal for the diversion of 0.8237 Ha of Forest Land for the construction of Passenger ropeway at Tsongmo (Right side of Lake) in the East District of Sikkim by the Tourism Department – FINAL APPROVAL.

Reference letter No. 8(6)1134/FCA/FB/WMD/57-55 dated 22.04.2010, the final approval has been accorded by the Ministry of Environment and Forest North Eastern Regional Office, Govt. of India vide their letter No. 2 -5/C (i) 025/2008-NEI/84-85, dated 13.04.2010 under section 2 of the Forest (Conservation) Act, 1980.

Hence please take steps for handing and taking of the 0.8237 Ha of the diverted forest land.

As per the approval the following conditions are to be complied with before handing and taking over is done.

1. The legal status of the forest shall remain un-changed.
2. The state Government shall raise Compensatory Afforestation over 1.65 Ha of degraded forest land identified at Yali RF as per the fund deposited by the User Agency.
3. The forest land shall not be used for any other purposes other than that specified in the proposal.
4. The additional amount of NPV of the diverted forest land if any becoming due after the finalization/ revision of the same by the Hon'ble Supreme Court of India shall be charged by the State Government from the user agency.
5. Demarcation of Forest Land shall be done in ground by the user agency on its own cost using four feet high reinforced cement concrete pillars with serial numbers, forward and back bearing and distances from pillar to pillar super scribed on pillars.
6. The user agency shall take all necessary measures to check the rolling of debris, soil etc out of the diverted area and it shall also be ensured that dumping of debris if any shall not be done over forest land either during project implementing period or thereafter.
7. Provision for proper garbage disposal and bare minimum facilities like waiting room, toilet, drinking water availability etc. shall form the necessary part of the project.
8. No damage to surrounding forests, environment, wildlife , natural resources and other properties and if any, the same shall be compensated along with reclamation measures.
9. Only bare minimum felling of trees shall be undertaken and the blank areas if any created shall be immediately planted during and after construction of the project.
10. There should be no labor camp on any diverted or non-diverted forest land.
11. In case of non- compliance of any of the above conditions, the Nodal Officer, Sikkim Forest Department shall suspend the non-forest use of land and submit a report to this office.
12. Any other conditions as may be found appropriate in future for the betterment of environment & Wildlife, may be imposed by the CCF (C), North Hills Regional Office.

For necessary action please and submission of report please.

Sd/-
Divisional Forest Officer,
East Territorial Division

No. 4326 /ED/T Date: 30/04/10

Copy to:

Divisional Engineer, Tourism Department- For information please.

Yours faithfully,

Divisional Forest Officer
East Territorial Division

6. EARLIER EC

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GOVERNMENT OF SIKKIM
OFFICE OF THE CHAIRMAN (STATE POLLUTION CONTROL BOARD)
STATE LEVEL ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
FORESTS, ENVIRONMENT & WILDLIFE MANAGEMENT DEPARTMENT
DEORALI, FOREST SECRETARIAT

Ref.No.805/FEWMD Date.11/8/10.

To,

The Secretary,
Tourism Department,
Government of Sikkim.

Sub:- Passenger ropeway system at Tsomgo Lake, East Sikkim, EC regarding.

Sir,

This has reference to your letter No. 155(787)EC/TD/10-11/898 dated 15/05/2010, additional information's submitted vide letter No. 155(787)EC/TD/06-07/1000 dated 17/07/2010, letter No. 155(787)EC/TD/06-07/1030 dated 27/07/2010 and the subsequent meeting with officers of your organization.

The above referred proposal was examined by the SEAC (State Level Expert Appraisal Committee) with reference to the project proposal and other documents submitted by the Tourism Department, Government of Sikkim, and the site verification report of the SEAC conducted on 30/07/2010 and was considered for Passenger Ropeway Project at its meeting held on 05/08/2010.

The Passenger Ropeway system of Tsomgo has the total horizontal length of 663.30 mts at a level difference of 250 mts with 2 Nos of boarding and deboarding stations having Transport Capacity of 800 PPH (Passengers per hour) and is prepared and designed by "Conveyor & Ropeway Services Pvt. Ltd". The total forest land required for the project is 0.8273 Hac. and no human population will be displaced. The total estimated cost of the Project exclusive of the cost of the land is Rs. 6.50 Crore.

The State Environmental Impact Assessment Authority (SEIAA) hereby accords Environmental Clearance to the above project in accordance with the provisions of Environmental Impact Assessment Notification No. 1533(E) dated 14th Sept. 2006, based on the recommendation of the State Level Environmental Appraisal Committee (SEAC) and their field visit subject to the following conditions:

1. No permanent structures shall be made for providing accommodation for the tourist at the terminal station of the ropeway.

2. The excavated materials/debris etc. should be properly restored and covered by turfing and other measures.

3. Provision may be made for the scientific/safe treatment/disposal of the solid waste generated in the course of operation of the ropeway system.

4. At the end point of the ropeway, proper fencing should be provided to debar the tourists from entering the neighbouring forest area to avoid damage and pilferage to the flora and fauna.

5. Necessary medicines, first aid and oxygen should be provided for the safety of the tourist.

6. Accommodation for staffs should be provided at the base station points with adequate waste disposal system in place. If at all necessary, one or two security guard will be allowed to stay at night at the terminal station of the ropeway but without kitchen facilities.

7. The project authority should ensure that the structures so constructed are safe and technically sound.

8. The construction contractor should ensure that construction materials such as stone, sand, stone chips etc are extracted only from the approved quarries.

9. A Monitoring committee should be formed by the Tourism Department in consultation with the PCCF cum Secretary Forest to oversee the effective implementation of the suggested environmental and other suggested safeguard measures.

10. Controlled blasting with very low charge and mild explosives should be used with strict supervision and should strictly follow the explosive manuals and rules of the government.

11. Adequate free fuel arrangement should be made to the labour force engaged in the construction work at the project cost so that indiscriminate felling of trees is prevented.

12. All the labourers should be thoroughly examined by the health personnel before issuing work permit.

13. Adequate financial provisions should be made in the total budget for the implementation of all suggested safeguard measures.

14. Six monthly monitoring report should be submitted to the FEWMD, Ministry and Regional office Shillong for review.

15. The responsibility of implementation of Environmental safeguard measures rests fully with the Tourism Department, GoS.

16. In case of change in the scope of the project, it would require a fresh appraisal and approval.

17. The FEWMD, GoK, reserves right to add additional safeguard measures if found necessary and to take action including revoking of the clearance under the provision of the Environment (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.

18. This clearance is valid for a period of 5 years from the date of issue of this letter for the commencement of construction works.

19. A copy of the clearance letter will be marked to the concerned Panchayat, local NGO, if any, from whom any suggestion/representation has been received while processing the proposal.

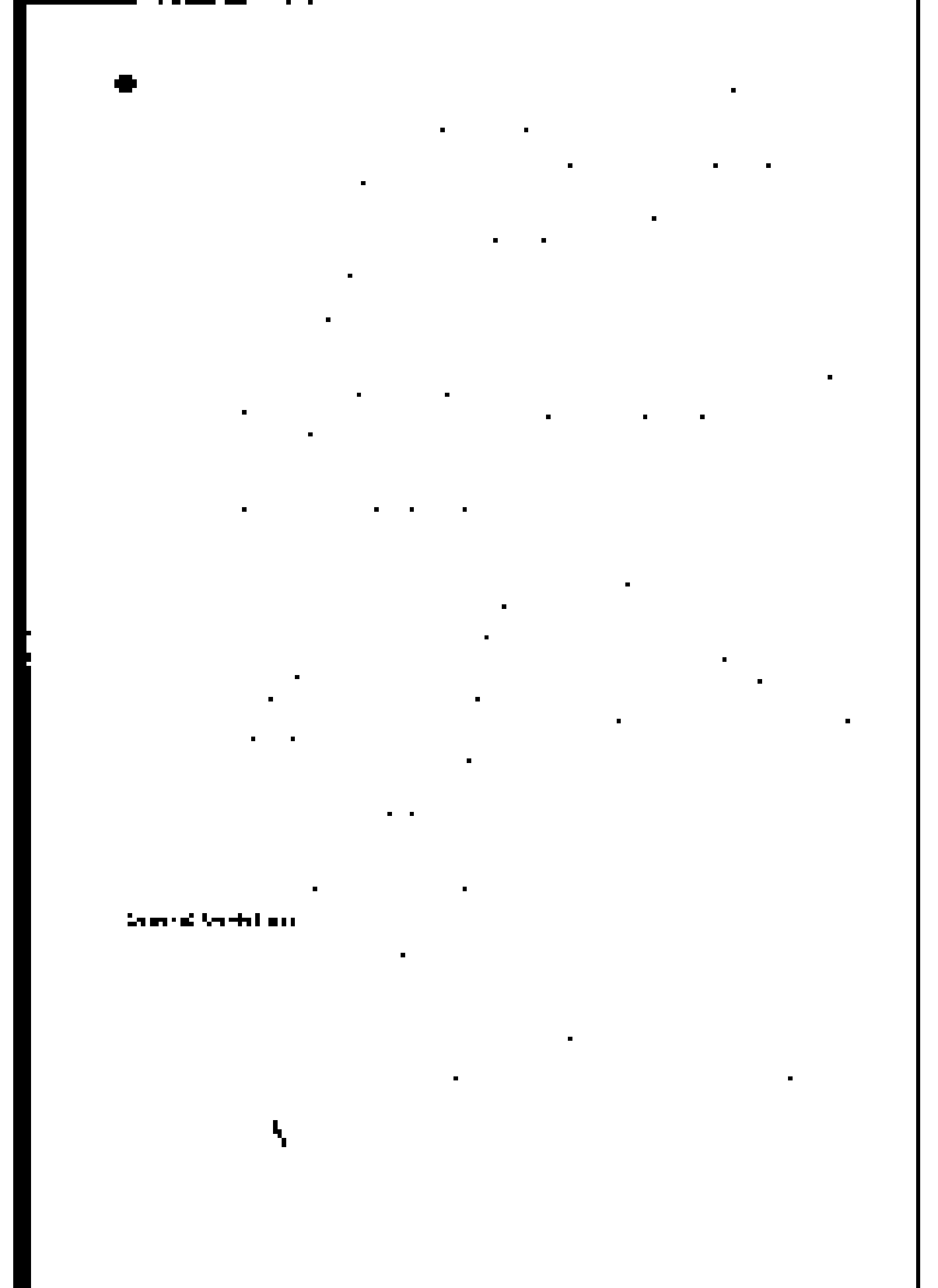
20. A copy of the Clearance letter should be displayed at District Collectorate, nearby Panchayat houses for a period of 30 days.

21. The project proponent should advertise atleast in 2 local newspapers widely circulated in the region around the project one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded Environmental Clearance and the copies of the clearance letter are available with the FEWMD and ENVIS website www.sak@envis.nic.in.

Yours faithfully,

(T.R. Poddyal, IFS)
(Retd. PCCF cum Secretary)
Chairman, (State Level Environmental Impact Assessment Authority.
(SEIAA)

7. TOR LETTER FROM MOEF



8. GEOTECHNICAL REPORT

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GEO-TECHNICAL STUDY OF THE AREA AROUND TSOMGO LAKE FOR THE PROPOSED CONSTRUCTION OF A ROPEWAY

Department of Mines, Mineral & Geology
Government of Sikkim
Gangtok

GEO TECHNICAL STUDY OF THE AREA AROUND TSOMGO LAKE FOR THE PROPOSED CONSTRUCTION OF A ROPEWAY

A ropeway is proposed to be constructed to ferry the tourists from Tsomgo Lake side to the southern hilltop in the area. This would provide the tourists to view beautiful scenic snowy landscape of adjoining area. Geographically, Tsomgo area is located over rugged mountain terrain at an altitude of 3750 mts. amsl. The slope profile facing northerly comprises of rock soil mix overburden of varied thickness over the high grade metamorphic rock sequence. The proposed ropeway towards south of Tsomgo would provide accessibility to the tourist upto an altitude of about 3922 mts. amsl on the hill top.

Tsomgo Lake area is one of the famous and important tourist destinations in Sikkim. The area has its importance due to Tsomgo Lake and presence of snowy mountains in the area during winter months (November- April). The construction of ropeway in the area would further add attraction which would take a tourist over the hilltop to have view of the surrounding snowy peaks.

The lake area is located at an altitude of 3750mts. amsl and the southern hilltop, the Endpoint of the proposed ropeway is at 3922 mts. amsl The area is accessible through all weather metalled road of 45 Kms approximately from Gangtok, capital of Sikkim.

The area around Tsomgo forms a part of central Crystalline Axial belt of Sikkim Himalayas and predominantly comprise of poorly dissected young ridges and topography with drainage fed by snowmelt streams/nalas that flow south westerly initially and south easterly before joining Rangpo River.

The area enjoys a cold temperate climate with serve winters, heavy snow falls and mild summers. The winter temperature can be sub-zero and during summer the temperature rises upto 10° C.

SENIOR GEOLOGIST
Mines, Minerals & Geology Deptt
Govt. of Sikkim

GENERAL GEOLOGY

Sikkim-Darjeeling Himalayas are Techno-stratigraphically defined by four domains with characteristic stratigraphic and structural attributes. From south to north they are i. Foot hill belt ii. Inner Belt iii. Axial Belt and iv. Trans-Axial Belt.

Foot-Hill Belt comprises of the lower areas with Gondwana and Buxa sequence of rocks. The main rock types in Gondwana are Sand stone, Shale and coal seams and in Buxas are Dolomite, limestone, Calcareous and non-calcareous phyllites.

Inner belt comprises of the metamorphic sequence with Daling formation with the rock types phyilite, schist and quartzite containing isolated pockets "window zone" where Gondwana and Buxa sequence of rocks are found. The presence of these rocks is due to deep erosion and weathering of overlying Daling sequence.

Axial belt can be defined by high grade metamorphic sequence with high grade gneisses, schist, calc-silicate rocks with marble bands and veins of Pegmatite.

Trans-Axial Belt comprises of the rock of Tethyan sequence has rock types of Mt. Everest pelites and limestones.

GEOLOGY OF THE AREA :-

The area under study falls within the central crystalline axial belt of Sikkim Himalayas. The rocks within and around Tsomgo area are mainly high grade gneiss with interbands of calc-silicate/calc granulate and marble. The high grade gneiss are often intruded by Tourmaline bearing pegmatite veins etc

High Grade Gneiss :- The high grade gneiss occupy the major portion of the study area. Megascopically, the composition varies from Quartz-Felspar with streaks of Biotitic to Quartz-Biotite gneiss with

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association of garnet, sillimanite and or Kyanite. According to the mineral composition and lineation, the gneisses occurring in the area are banded Gneiss, Augen gneiss and Streaky Gneiss. Gradual change of one variety to the other in the area is common. The Banded Gneiss variety is medium grained light colored rock in which pure quartzo-felspatic layers alternate with mafic (Mostly Biotite) layers. The Augen gneiss is a medium to coarse grained quartzo felspatic gneiss within which occur augens of quartz and felspar or aggregate of both. The augens are both deformed and stretched parallel to the gneissic foliation shown by stretched biotite flakes and lenticular quartz and felsper.

The high grade gneiss is often intruded by unaffiliated Tourmaline granite, basic intrusive and epidote quartz veins which are associated with interbands of calc-silicate/calc-granitite/ marble to the western side of Tsomgo Lake. Presence amphibolites as intrusive is common in the area.

The western part of Tsomgo Lake shows the presence calc-silicate, calc-granulite and marble with interbands of high grade gneiss. The rock bands attribute north-south strike dipping 70° to 80° either easterly or westerly. Calc- granulites are course grained rock with equigranular carbonate and silicate minerals. The minerals are mainly Pyroxenes and amphiboles and show granulitic texture.

GEOLOGICAL AND GEO-TECHNICAL DESCRIPTION OF THE AREA PROPOSED FOR ALIGNING THE ROPEWAY

The Ropeway is proposed to be aligned along south easterly direction from the south-western flank of Tsomgo Lake to reach the ridge line. The slope angle is high at the upper part or near the ridge line and is moderate to low at lower part or near the lake. Geologically, the area comprises of high grade massive gneiss. The major portion of area comprises of high grade Garnetiferous-Quartzo-Felspathic gneiss along with thin calc-granulite bands at places. Seventy Five parent of the area along south is covered with

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the gneissic rock sequence and two interbands of Calc granulite occur towards the western portion of mapped area.

Calc-granulite is Greenish white course grained rock with equigranular carbonate or silicates. The silicates and mainly Pyroxenes and Amphiboles. The rock show granulitic texture the high grade gneiss in the area is composed pre-dominantly of Quartz, Orthoclase, Microcline, Plogioclese, Biotite, and Garnet with or without kyanite and sillimenite at places. Muscovite and Chlorite are the secondary minerals altered from Biotite and Sephene, Apatite and Zircone occur as minor accessories. Opagues are Magnetite and or Illimanite.

The area under study comprised mainly of sequence of high grade gneissic rocks associated with few interbands of calc-granulite of Central Crystalline Axial belt of Sikkim Himalayas. This completely granatized terrain that has undergone a polyphase deformation and metamorphism.

CONCLUSION AND RECOMMENDATIONS

1. Select rock samples were subjected to Point Load Test and Brazilian Test. The results are almost identical & points to high competency of the rocks.
2. Four soil samples were collected from the study are and subjected to grain size analysis and shear Test. The soils are invariably course grained and are of high shear strength.
3. Considering the geological setting of the area and favorable test results of the rocks & soils, there should be no problem in installing the proposed short length ropeway. The location is subjected to high magnitude earthquakes & high speed wind besides snow in winter.

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Point Load Test

Location of Sample : Chungu
Date of Test : 24/06/09

Point Load $q_t = 0.96 \times P/D^2$

P = Load (Kn)
D = Dia of core sample (cm)

IS:10082- 1981

Sample No.	D = Diameter (cm)	P = Pressure (Kn)	t/m2
Top(T_1)	5	9	345.6 t/m^2
Middle(T_2)	5	13	499.2 t/m^2

Average Strength as per Point Load test = 422.40 t/m^2

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Direct Shear Test

Location of Sample Changu
Sample No. T_2 2nd point (South East of STDC cafe)
Date of test 24/06/09

IS=72720

Sl. No.	Strain	stress 0.1	stress 0.10	stress 0.15
1	50	14.00	20.00	22.00
2	100	21.00	29.00	34.00
3	150	33.00	36.00	45.00
4	200	43.00	43.00	56.00
5	250	53.00	48.00	65.00
6	300	63.00	53.00	70.00
7	350	69.00	56.00	77.00
8	400	73.00	59.00	82.00
9	450	73.00	62.00	84.00
10	500		63.00	84.00
11	550		63.00	
12	600			
13	650			
14	700			
15	800			

Ao = 36cm² Ac_1= 31.32 cm² Ac_2=29.88cm² Ac_3= 30.60cm²
$Load_1$= 0.34kn $Load_2$= 0.30kn $Load_3$= 0.40kn

Shear Stress (Ss) Ss^1 =1.09 kg/cm² = 10.90t/m²
Ss^2 = 1.00kg/cm² = 10.00 t/m²
Load/Area Ss_3 = 1.31 kg/cm² = 13.10 t/m²

Average Allowable Bearing Capacity as per direct shear test = 11.33 t/m²

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Direct Shear Test

Location of Sample Changu
Sample No. T_2 2nd point (South East of STDC cafe)
Date of test 24/06/09

IS=72720

Sl. No.	Strain	stress 0.1	stress 0.10	stress 0.15
1	50	14.00	20.00	22.00
2	100	21.00	29.00	34.00
3	150	33.00	36.00	45.00
4	200	43.00	43.00	56.00
5	250	53.00	48.00	65.00
6	300	63.00	53.00	70.00
7	350	69.00	56.00	77.00
8	400	73.00	59.00	82.00
9	450	73.00	62.00	84.00
10	500		63.00	84.00
11	550		63.00	
12	600			
13	650			
14	700			
15	800			

Ao = 36cm² Ac_1= 31.32 cm² Ac_2=29.88cm² Ac_3= 30.60cm²
$Load_1$= 0.34kn $Load_2$= 0.30kn $Load_3$= 0.40kn

Shear Stress (Ss)
Ss ¹ =1.09 kg/cm² = 10.90t/m²
Ss ² = 1.00kg/cm² = 10.00 t/m²
Load/Area
Ss ₃ = 1.31 kg/cm² = 13.10 t/m²

Average Allowable Bearing Capacity as per direct shear test = 11.33 t/m²

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Direct Shear Test

Location of Sample Changu
Sample No. T_4 Fourth point (Near Settlement or New Taxi Stant)
Date of Test 24/06/09

IS=72720

Sl. No.	Strain	stress 0.5	stress 1.0	stress 1.5
1	50	15.00	19.00	27.00
2	100	21.00	27.00	37.00
3	150	27.00	34.00	45.00
4	200	33.00	41.00	55.00
5	250	37.00	46.00	63.00
6	300	43.00	50.00	71.00
7	350	47.00	54.00	77.00
8	400	51.00	57.00	81.00
9	450	54.00	59.00	85.00
10	500	55.00	59.00	87.00
11	550	55.00		89.00
12	600			89.00
13	650			
14	700			
15	800			

Ao = 36cm² Ac_1=29.88 cm^2 Ac_2=30.60cm^2 Ac_3=29.52cm^2
$Load_1$=0.26kn $Load_2$=0.28kn $Load_3$=0.42kn

Shear Stress (Ss) = Ss ¹ =0.87 kg/cm² = 8.70 t/m²
Ss ² =0.92 kg/cm² = 9.20 t/m²
Load/Area Ss ₃ =1.42 kg/cm² = 14.20 t/m²

Average Allowable Bearing Capacity as per direct shear test =10.70 t/m²

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Direct Shear Test Report

Location of Sample : Changu
Sample No. : T_1 (Topmost point)
Date of Test : 24/06/09

IS=72720

Sl. No.	Strain	stress 0.5	stress 1.0	stress 1.5
1	50	19.00	25.00	22.00
2	100	30.00	35.00	38.00
3	150	38.00	44.00	48.00
4	200	44.00	52.00	56.00
5	250	51.00	60.00	65.00
6	300	57.00	67.00	72.00
7	350	61.00	73.00	77.00
8	400	64.00	76.00	82.00
9	450	66.00	78.00	85.00
10	500	68.00	80.00	85.00
11	550	68.00	83.00	
12	600		86.00	
13	650		86	
14	700			
15	800			

Ao = 36cm² Ac_1=29.88 cm² Ac_2=28.80cm² Ac_3=30.60cm²
$Load_1$=0.32kn $Load_2$=0.40kn $Load_3$=0.40kn

Shear Stress (Ss) / Load/Area

Ss ¹ =1.07kg/cm² = 10.70 t/m²
Ss ² =1.39 kg/cm² = 13.90 t/m²
Ss ³ =1.31 kg/cm² = 13.10 t/m²

Average Allowable Bearing Capacity as per direct shear test = 12.57 t/m²

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Sieve Analysis Report

Location of Sample Changu
Sample No. T_4 Fourth point (Near Settlement or New Taxi Stant)
Date of Test 27/06/09

IS=1498-1970

IS sieves sizes (mm)	wt.of retained sample(gms)	sample retained (%)	sample passing (%)
4.75	9.27	9.27	90.54
2.36	26.41	26.41	64.13
1.18	16.74	16.74	47.39
0.600	10.84	10.84	36.50
0.425	5.57	5.57	30.98
0.300	5.16	5.16	25.82
0.150	13.44	13.44	12.38
0.075	9.05	9.05	3.33
Pan	3.33	3.33	0.00

Gravel (%)=35.68 **Sand (%)=51.75** **Silt (%)=9.05** **Soil & Clay(%)=3.33**

Moisture content(%) = 26.83

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Sieve Analysis Report

Location of Sample Changu
Sample No. T_1 (Topmost point)
Date of Test 27/06/09

IS=1498-1970

IS sieves sizes (mm)	wt.of retained sample(gms)	sample retained (%)	sample passing (%)
4.75	20.05	20.05	79.68
2.36	20.04	20.04	59.64
1.18	16.93	16.93	42.71
0.600	10.49	10.49	32.22
0.425	4.82	4.82	27.40
0.300	5.51	5.51	21.89
0.150	9.97	9.97	11.92
0.075	6.58	6.58	5.34
Pan	5.34	5.34	0.00

Gravel (%)=40.09 **Sand (%)=47.72** **Silt (%)=6.58** **Soil & Clay(%)= 5.34**

Moisture content(%) =19.62

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Sieve Analysis Report

Location of Sample Changu
Sample No. T_3 Third point (Near STDC café)
Date of Test 27/06/09

I.S=1498 1970

IS sieves sizes (mm)	wt.of retained sample(gms)	sample retained (%)	sample passing (%)
4.75	30.38	30.38	69.48
2.36	17.59	17.59	51.89
1.18	20.43	20.43	31.46
0.600	10.59	10.59	20.87
0.425	3.31	3.31	17.56
0.300	5.73	5.73	11.83
0.150	6.96	6.96	4.87
0.075	2.75	2.75	2.12
Pan	2.12	2.12	0.00

Gravel (%)=47.97 **Sand (%)=47.02** **Silt (%)=2.75** **Soil & Clay(%)=2.12**

Moisture content(%) =12.58

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Sieve Analysis Report

Location of Sample Changu
Sample No. T_2 2nd point (South East of STDC cafe)
Date of Test 27/6/09

I.S=1498-1970

IS sieves sizes (mm)	wt.of retained sample(gms)	sample retained (%)	sample passing (%)
4.75	28.21	28.21	71.55
2.36	12.91	12.91	58.64
1.18	14.19	14.19	44.45
0.600	11.67	11.67	32.78
0.425	4.81	4.81	27.97
0.300	6.44	6.44	21.53
0.150	12.29	12.29	9.24
0.075	5.56	5.56	3.68
Pan	3.68	3.68	0.00

Gravel (%)=41.12 **Sand (%)=49.40** **Silt (%)=5.56** **Soil & Clay(%)= 3.68**

Sand (%)=49.40
Silt (%)=5.56
Soil & Clay(%)= 3.68
Moisture content(%) = 19.30

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