THDC INDIA LIMITED

Environmental Studies For Vishnugad Pipalkoti Hydro Electric Project

ADDENDUM No. 1

(EIA, Volume - I, Chapter 3.9.5)

26TH MARCH 2011

3.9.5 II KEDARNATH WILDLIFE SANCTUARY

The Kedarnath Wildlife Sanctuary (KWLS) is located in the Garhwal region of Greater Himalaya in Uttarakhand (30°25′–30°45′N, 78°54′–79°27′E). The area covered by the Sanctuary is 97517.80ha (25293.70ha in Chamoli district and 72224.10ha in Rudraprayag district). Its **boundary** falls within the **10 km** aerial radius of the project, **the location map is given as Map K-1**

The Sanctuary was created in 1972, and takes its name from the famous Hindu Shrine at Kedarnath. Area of the Sanctuary according to the notification is 96,725.61 ha and falls under the IUCN management Category IV (Managed Nature Reserve) in the Biogeographical Province 2.38.12 of Himalayan highlands. It was established mainly to protect the Musk Deer. A Musk Deer Breeding Centre was established in 1982, at Kanchulakharak within the sanctuary, where Musk deer are bred in captivity and then released into the wild.

The sanctuary lies in the upper catchment of the Alaknanda and Mandakini Rivers, which are major tributaries of Ganges. The altitude ranges from 1,160 m to 7,068 m above msl. **There are 45 villages located within the Sanctuary and 128 villages outside the Sanctuary within 5 km from the boundary**. The inhabitants depend substantially on the Sanctuary for fuel wood, fodder, medicinal plants and pastures for livestock grazing. Rights and concession are provided to the villages under settlement rules.

Eco-tourism is an important activity in the sanctuary area. The area also encloses many important shrines, including Madhyamaheshwar (3200 m), Rudranath, (3500 m), Trijuginarayan (2200m) and Tungnath (3750 m), while Kedarnath (3400 m) is almost on its northern boundary. From May to Oct

View of Entry Point to Sanctuary near Chopta

regular pilgrims visit Kedarnath and other shrines. The entry point to the Sanctuary is near Chopta which is 20km away from Gopeshwar on the Western side of the Hill

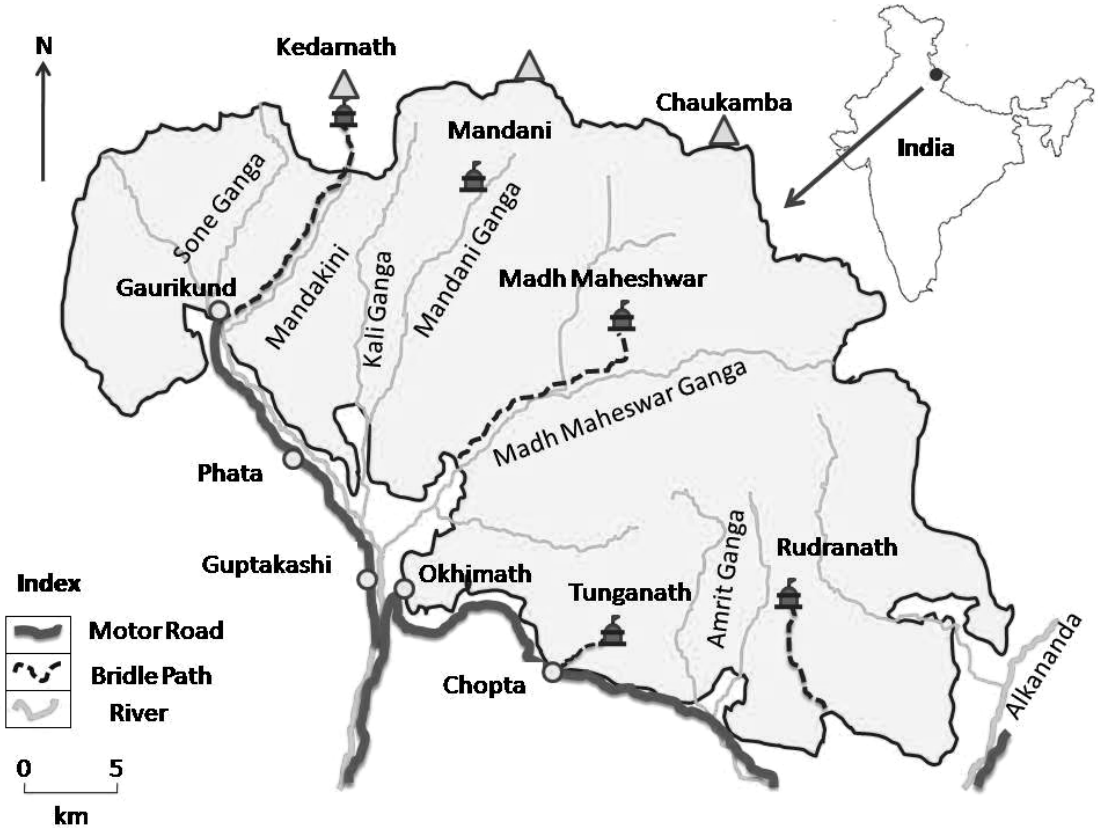


Fig 1: Map showing important locations within Kedarnath Wildlife Sanctuary

Flora of KWLS

There are nineteen types of vegetation in the KWLS based on Champion and Seth (1968) classification. It is estimated that about 44.4% to 48.8% of the sanctuary is forested, 7.7% comprises alpine meadows and scrub, 42.1% is rocky or under permanent snow and 1.5% represents formerly forested areas (Prabhakar et al., 2001). A total of 530 species of dicotyledons and 691 species of monocotyledons have been recorded from KWLS (*Kala and Gaur, 1982*). The major forest types are:

- Subtropical zone – Pine (upto 2000 msl)
- Temperate Oak-fir and Maple (2,500–2,800 msl)
- Subalpine Oak-Fir-Maple (2,850–3,150 msl)
- Krumholtz' or Rhododendron stands (3,100–3,300 msl)
- Sub-alpine fir (2,850–3,150 msl)

- Subalpine scattered tree and scrub (2,800–3,200 msl)
- Alpine meadows and rocks (>3,200 msl)

The subtropical zone is represented mainly by Chir Pine (*Pinus roxburghii*). *Euphorbia royleana* occasionally occurs on dry, southern aspects. Within the temperate zone occur Ban (*Quercus incana*), Moru (*Quercus dilatata*) and Karsu (*Quercus semecarpifolia)* Oak forests. Buras (*Rhododendron arboretum)* often constitutes a second storey. Oak are mixed with Fir (*Abies pindrow)* at higher elevations. The subalpine zone consists of Birch (*Betula utilis)* with an understory of *Rhododendron campanulatum*. Rhododendron extends into the alpine zone. The herb community of the subalpine and alpine meadows may be dominated by *Danthonia cumminsii*, which forms tussocks of grass over extensive areas. The area is home to many endangered plant species. The list of threatened and endangered plants is given in the table below.

Table 1: List of Threatened and Endangered plants of Kedarnath WLS

Botanical name	Family	Habit	Indian RDB	Habitat
Acer caesium	Aceraceae	T	V	5, 6
Acer oblongum	Aceraceae	T	V	5, 6
Var. *membranaceum*	Aceraceae	T	E	6
Aconitum ferox	Ranunculaceae	H	I	1
Allium stracheyi	Alliaceae	H	V	1,3
Arnebia benthamii	Boraginaceae	H	E	1,5
Berberis pseudoumbellata	Berberidaceae	S	I	5
Coelogyne cristata	Orchidaceae	H	I	6
Cyananthus integer	Campanulaceae	H	R	3
Dendrobium normale	Orchidaceae	H	I	6
Kobresia duthiei	Cyperaceae	H	I	1,3
Oreorchis indica	Orchidaceae	H	I	5
Saussurea roylei	Asteraceae	H	I	3
Saussurea bracteata	Asteraceae	H	R	1,3
Schizandra grandiflora	Magnoliaceae	C	I	6
Silene kumaonensis	Caryophyllaceae	H	R	1

(*Source: Threatened Plants of Kedarnath Wildlife Sanctuary, Western Himalaya; Gajendra Singh & Ishwari Dutt Rai,, Wildlife Institute of India, Dehradun)*

Habit: H=Herb, S=Shrub, T=Tree, C=Climber
RDB Status: V=Vulnerable, E=Endangered, I=Indeterminate, R=Rare

Habitats: 1=Mixed herbaceous meadows, 2= Caves & Caverns, 3= Boulders and scree slopes, 4= Stream courses, 5= Alpine moist scrub, 6= Temperate oak forests

Fauna of KWLS

23 mammalian species are recorded in the in the sanctuary out of which 11 are threatened. The primates are Rhesus macaque (*Macaca mulatta)* and Common Langur (*Presbytis entellus).* Carnivores include Jackal (*Canis aureus)*, Fox (*Vulpes vulpes)*, Black Bear (*Selenarctos thibetanus)*, Yellow-throated Marten (*Martes flavigula)*, Leopard Cat (*Felis bengalensis)*, Common Leopard (*Panthera pardus)* and Snow Leopard (*Panthera uncia)*. Ungulates are Wild Boar (*Sus scrofa)*, Musk Deer (*Moschus chrysogaster)*, Indian Muntjac (*Muntiacus muntjak)*, Sambar (*Cervus unicolor)*, Goral (*Nemorhaedus goral)*, Serow (*Capricornis sumatraensis)*, Himalayan Tahr (*Hemitragus jemlahicus)* and Bharal (*Pseudois nayaur)*.

Over 230 species of birds are reported from the area. Himalayan Monal Pheasant (*Lophophorus impejanu)*, Kalij Pheasant (*Lophura leucomelana)* and Koklass Pheasant (*Pucrasia macrolopha*) are common in occurrence.

THREATS & CONSERVATION ISSUES

The **threats** to the Sanctuary are:

- Poaching
- Forest Fires
- Collection of medicinal plants and other forest produce
- Grazing
- Tourism

Poaching, particularly of Musk Deer, continues in less accessible areas. Grazing by domestic livestock (goats, sheep and buffalo), burning of pastures and collection of forest products and medicinal herbs are unregulated. Forest fires pose a major threat to the moist forest formations, and in recent years considerable damage has been done by them. The large area of KWLS cannot be properly managed without active participation and involvement of local communities. A possible way to reduce biotic pressure of the Sanctuary requires conservation education through training programmes, capacity building and outreach with respect to sustainable harvesting of natural resources.

IMPACT OF PROJECT ON KEDARNATH WILDLIFE SANCTUARY

The project consists of three major construction activities - Dam, Head Race Tunnel and Powerhouse. **The location map of Kedarnath Wildlife Sanctuary with respect to project sites is provided as *Annexure K-1.* The location of the project sites is provided in the Map – K2 (*Annexure K2*).**

Dam: A 65m high concrete dam above the deepest river bed EL 1205m is proposed near Helong Village. The distance of proposed dam site is about 5.20 Km from Kedarnath Wild Life Sanctuary (KWLS) boundary. There is no acquisition of land or tree cutting within the sanctuary area. The foundation of the dam is at **1205 msl** and the elevation of the sanctuary boarder is approximately 1900m above the dam at an elevation of 3100 msl,

Head Race Tunnel (HRT): A 13.4km long HRT of 8.8 m diameter modified horse shoe shaped, is proposed on right bank of the river Alaknanda. The proposed HRT layout is overlain by rock up to depth about 1000m. The major portion (12 Km) of HRT is proposed to be constructed using Tunnel Boring Machine (TBM) from the power house site.

Power House: The proposed powerhouse on the right bank of Alaknanda River near Hat village will be constructed underground located in moderately jointed and compact dolomite **& Slates**. The horizontal distance of the powerhouse from sanctuary border as seen in the map is approximately 2 km. However the elevation of the sanctuary is about 2000m above Power house site. The power house foundation is at 1010 msl and the sanctuary border is at 2974 msl.

Potential impacts of the project on the Sanctuary have been assessed and suitable mitigation measures have been suggested. These are detailed below.

(A) Influx of Labor Population

During construction stage labor population will influx in the area. Both skilled and unskilled labor will be required for construction activities.

The impact envisaged due to increased level of human interference due to congregation of labor population will be only during construction phase. Appropriate surveillance measures are detailed in mitigation measures. The wildlife inhabiting the sanctuary area is mostly at higher elevation away from labor settlements. However they may roam and

hunt in the area. The wildlife may move in the area during night time. The presences of labor camps are likely to disturb the normal peace of the wildlife and they are likely to move in other areas. Threat of poaching or hunting of wildlife, especially stray animals also exists.

View of the Alaknanda Valley

The labors may also cause damage to the flora by felling trees for fuel and building shelter. Though the approach to project site is restricted through only bridges towards right bank of river Aleksandra however, in and around of Dam site and Power house site area, where construction works congregate, some disturbance to the wildlife population may occur

Mitigation Measures

The proposed mitigation measures which shall be adopted are:

(i) The sanctuary area is not accessible from main construction site i.e. Dam site & Power house site. The access to the project works will be from Eastern Side whereas the sanctuary is on the Western side; the slopes are steep and not accessible from eastern side. **Awareness will provided to the workers on ecological value of the area and check points should be installed near major construction sites to prohibit the entry of labors in sanctuary/forest area.** The check points should be properly manned & should be fully operational during construction phase. The guards deployed at check points should have adequate communication equipments and other facilities.

(ii) The fauna of the Sanctuary dwells at higher elevation; the Musk deer (*Moschus chrysogaster)* inhabit forested area between 2500m and tree line. Thar (*Hemitragus jemlahicus)* inhabits steepest cliff in temperate & alpine zone. The Black Bear (*Selenarctos thibetanus)* inhabits temperate and subtropical zone and move according to the fruiting of wild plants. Incidence of Bear sighting near villages can be heard from the locals. Leopard (*Panthera paradus)* inhabits temperate and subtropical zone. **Incidences of Cattle lifting by Leopard have also occurred in the villages inside and outside Sanctuary area. Taking this into consideration under Wildlife Management the provision for man animal conflict has been**

kept in the CAT plan of VPHEP. An amount of Rs 10,00,000/- is provided under the head man animal conflict.

(iii) Movement of wildlife shall be monitored in association with forest officials in the project area during construction phase. Hunting / poaching should be strictly banned.

(iv) Provision of kerosene and or LPG for all the labors & staff should be made in each major contract to avoid felling of trees in the area especially in the KWLS & forest area.

(v) All the labor camps are proposed to be located on the left bank of river, where as the sanctuary is on right bank of river.

(vi) An awareness program may be undertaken by THDC for the safety and peace of wildlife.

(B) Operation of Construction Machinery

During construction phase various types of equipment such as crushers, batching plant, drilling equipments, heavy earth moving machinery, rock bolters etc shall be brought to the construction sites. The operation of various construction equipments will generate noise and dust. The noise level will be higher due to the vehicular movement & associated activities. The increased noise may disturb the wildlife. The noise level would be marginal up to 1.0 km from the major construction sites. However the sanctuary is away by approximately 2.0 km from construction sites therefore there will not be any significant impact of noise due to construction equipments on wildlife. However following mitigation measure are proposed to reduce noise levels and dust.

Mitigation Measure

(i) Equipments equipped with modern technologies producing low noise may be used during construction.

(ii) Construction equipments & vehicles should be in good working condition, properly lubricated and maintained to keep the noise level within permissible limits.

(iii) Equipments producing excess noise may not be operated during night hours.

(iv) Noise level monitoring should be conducted during construction place.

(v) The crushers should be provided with cyclones to control the dust generated during crushing of aggregates.

(vi) Continuous sprinkling of water on haul road shall be ensured to control dust.

(C) Impact of Blasting on Wildlife

During construction stage blasting will be carried out at Dam and Power house site. Basting shall be required for excavation for foundation of the Dam and for creating underground cavern for Power house. The blasting at the dam site will be done by conventional method - drill and blast. 1.4 km of HRT from Dam site and the TRT will be also constructed using the conventional drill and blast technique. The major portion of HRT (12km) will be constructed using Tunnel Boring Machine.

Due to blasting in Dam area and underground Powerhouse ground vibration shall be generated besides generating noise in the area. Blasting creates unpleasant ground vibrations besides inducing air over pressure (air pressure waves). The higher frequency portions of over pressure waves are audible and are the sound that accompanies a blast. The unpleasant ground vibration and noise generated by blasting operations may adversely affect the wildlife.

- The induced vibration may interfere with wildlife activity such as feeding, breeding or resting.
- The animals may be frightened by sudden vibration and noise and may start running.
- Faunal responses to vibration and air blast vary from species to species. For example reptiles often feel threatened with blast vibration and at time migrate to places where ground vibration is minimum. While many other animals adapt to occurrence of frequent and regular ground vibration.
- A study was conducted by Hall et al 1998, on impact of blast on wildlife at the Washington Zoo in Portland, Oregon. They evaluated the effects on nearby (as close as 500ft) blasting noise and vibration on Snow Leopards, Red Pandas, Black Rhino, Naked Mole Rat, Elephant, Spotted Owls and several other animals. The intensity of blast–induced ground motion in the study was as high as 0.68 in/s. Maximum air pressure for this blasting was about 130 dBL (linear scale) and ground motion reached 0.25 in/sec. The researchers noted that the tested animals noticed the first blast or two, however they quickly acclimated to the noise and vibration. There was no long term- negative effect on the wildlife from the vibration and noise level.

- No damage to the wildlife habitat is envisaged due to the vibration therefore the impact due to blasting on wildlife and its habitat will be insignificant.

Mitigation Measures

The ground vibration generated due to blasting is basically measure of Peak Particle Velocity (PPV). Researchers have established that if PPV and blast duration are controlled by taking various measures the impact of blast could be reduced to minimum. As per IS Code IS: 14881 : 2001, PPV of 15.0 mm/sec is the permissible limit for overcoming cracks on ancient national monuments and further IS code also indicate that lower limit of PPV of 5.0 mm/sec produce no impacts on the structures.

A study carried out in Turkey on human response to blast induced vibrations refers a short duration blast has generally less than 2.0 seconds and human are comfortable. PPV is a function of Charge/delay and can be controlled if numbers of delay are properly planned. Whereas, blast duration can be controlled by limiting the numbers of holes in a blast, so that total blast duration does not exceeds 2.0 seconds. The blasting impact can be reduced well below the threshold limit by adopting suitable controlled blasting techniques at the Dam and Power house site.

a) Dam:

The foundation of Dam shall be excavated by controlled blasting. The holes are planned to a depth of 3.5 m. The charge required per delay shall be in the order of 105kg. The PPV from the formula given in IS code at a distance of 5.50 km i.e. at the boundary of Kedarnath Wildlife Sanctuary shall be the order of 0.50 mm/sec. The Dam site is at horizontal distance of 5.2 Km away from the boundary of the Sanctuary is approximately 1900m above the dam site. **This PPV of 0.50 mm/sec combined with limited blast duration up to 2.0 sec shall have no impacts on human being and wildlife of KWLS**.

View of Dam Site

b) Powerhouse:

The underground excavation for cavern of Powerhouse shall be done by controlled blasting. **The holes are planned to a depth of 2.0 M. The charge required per delay shall be the order of 60 kg**. **The PPV from the formula given in IS code at a distance of 1.50 Km shall be the order of 2.50 mm/sec whereas the boundary of Kedarnath Wildlife Sanctuary is approximately 2 Km. away from the P/H site. This PPV of 2.50 mm/sec combined with limited blast duration up to 2.0 sec shall have no impacts on human being and wildlife of KWLS.**

View of Powerhouse site

Dr. R. Anbalagan, Department of Earth Sciences Indian Institute of Roorkee has conducted a study on impact blasting on stability of the terrain and structures for VPHEP. For stability terrain and structures in the villages (the nearest village is Hat 200m from Power House site) following points have been recommended.

- To use charge weight delay value of 10-15kg which may distributed in 7-8 holes with delay detonators
- For controlled blasting, it may be planned to have 5-7 holes per delay in cut holes with Easers 15-20 holes on the periphery. Stemming length in each hole shall not be less than 0.8m

If the recommended weight per delay is adopted no adverse impacts are anticipated at the villages as substantial attenuation of seismic waves may take place on surface.

The HRT (12Km) will be constructed using Tunnel Boring Machine and no blast shall be involved. The TBM will be used from powerhouse end, the dam site is quite far from sanctuary. Hence the impact on wildlife is not envisaged due to the construction of HRT.

View of HRT area

The blasting pattern may be designed so as to produce PPV not more than 5.0 mm/sec and blast duration may also be kept at minimum. **The use of delay detonators may be ensured besides proper stemming of holes. Use of electric detonators may be avoided**. **Least Disruption and concern is caused by blasting when firing times are scheduled to coincide with periods of high activity rather than resting and relaxing times. Thus, blasting times should be established to suit local conditions.**

THDC shall be following blasting procedures as per IS code14881:2001 and controlled shall be exercised on blasting keeping in view the designed PPV and Blast duration, besides other precautionary measures. The enclosed table at *Annexure K-3* shows the Assessment of Blasting Charge required per Delay & no. of Delays and Corresponding PPV at various distances.

The ground vibrations weaken as they progress away from the source. It is certain that in case of the Kedarnath Wildlife Sanctuary that since the lateral and vertical distance between the nearest point of the sanctuary and the proposed powerhouse is about 2000m. This distance is quite large to perceive ground vibrations particularly by the wildlife in the sanctuary.

MANAGEMENT MEASURES FOR KWLS

A detailed Catchment Area Treatment (CAT) Plan has been prepared for VPHEP. Under the CAT, **Eco-Restoration Plan (ERP) has been prepared for Kedarnath Wildlife Forest Division,** Nanda Devi National Park, Alaknanda Soil Conservation and Badrinath Forest Division. The major activities proposed in Kedarnath Division are:

- Forestry work (Rs 54,11,700)
- Soil & Moisture Conservation (Rs 37,75,000)
- Wildlife Management (Rs 10,00,000)

The details eco-restoration activities for Kedarnath Division are given in the table below.

Table 2: Eco-restoration activities planned for Kedarnath Wildlife Division

S. No.	Activity	Unit	Amount (Rs)
1.	Forestry Work		
	Densification	50 ha	12,14,850
	Medicinal Plantation	50 ha	14,53,950
	ANR	300 ha	27,42,900
2.	Soil & Moisture Conservation		
	Stone Check-dam	500 No.	37,75,000

S. No.	Activity	Unit	Amount (Rs)
3.	Wildlife Management		
	Man Animal Conflict	-	10,00,000
	Grand Total		**1,01,86,700**

Total budget for Wildlife Management of the VPHEP Project Area as given under CAT plan is rupees Two Crores Forty Three Lakh Twenty Five Thousand (Rs.2,43,25,000/-)

Table 3: Wildlife Management Activity proposed under CAT plan

Activity	Amount
Anti Poaching Hut	25,00,000
Forest Guard Residence	55,00,000
Wildlife Chetna Centre	30,00,000
Fire Extinguishing Centre	45,00,000
Wireless Room	7,00,000
Watch Tower	30,00,000
Conservation of water Resources	12,50,000
Water Chery	3,75,000
Man animal conflict	30,00,000
Wildlife Monitoring & Evaluation Plan	5,00,000
Total	**2,43,25,000**

An amount of 5 lakh (Rs 5,00,000/-) is also provided for wildlife protection under Biodiversity Management in the EMP for Protection of Wildlife in the area.

The DFO, Badrinath Forest Division, Gopeshwar shall be the nodal implementing agency who will be the Nodal officer in charge of Project Management Cell (PMC). The responsibility of implementing the ERP in Kedarnath Division will lie with the concerned DFO who will be responsible for implementing the prescribed works. The project will be monitored in terms of physical, financial progress and quality by Conservator of Forests, Garhwal, Pauri & Conservator of Forest/Director, Nanda Devi Biosphere Reserve, Gopeshwar.

Monitoring Plan

Hourly and daily monitoring of blasting activity should be done at the Dam and Power house site during construction phase. The Construction contractor will be responsible for blasting monitoring and THDC & Supervision Consultant will supervise the activity. **An amount of Rs 15,00,000 (Rupees Fifteen Lakh) is proposed for the monitoring during construction period.**

Table 4: Wildlife monitoring activity for KWLS

Activity	Amount
Monitoring of impact of blasting vibration at three points Powerhouse , Dam site and HRT	9,00,000
Watch tower near streams (2 No.)	1,00,000
Awareness program on Wildlife Protection	2,00,000
Man animal conflict	3,00,000

A memorandum of understanding (MoU) should be made between THDC and Forest Department for monitoring the Impact of Blasting on Wildlife during construction phase

Recommendation

On the basis of above assessment it is apparent that the impact of VPHEP on the KWLS is not significant. This has been inferred due to use of TBM technique for construction of HRT and the location of the sanctuary w.r.t. to the project facilities:

- The Dam site is at horizontal distance of 5.2 Km away from the boundary of the KWLS and is approximately 1900m above the dam site.
- The horizontal distance of the powerhouse from sanctuary border is approximately 2 km. The elevation of the sanctuary is about 2000m above Power house site.

However the wildlife may move in the area for water or disturbance due to blasting during construction. Therefore mitigation measures have been proposed. These measures have been included in the CAT plan as part of environmental management of VPHEP, **Rupees Two Crores Forty Three Lakh Twenty Five Thousand (Rs.2,43,25,000/-)is proposed for Wildlife Management of the project area.**

An amount of 5 lakh (Rs 5,00,000/-) is also provided for Wildlife Protection under Biodiversity Management in the EMP for Protection of Wildlife in the area.

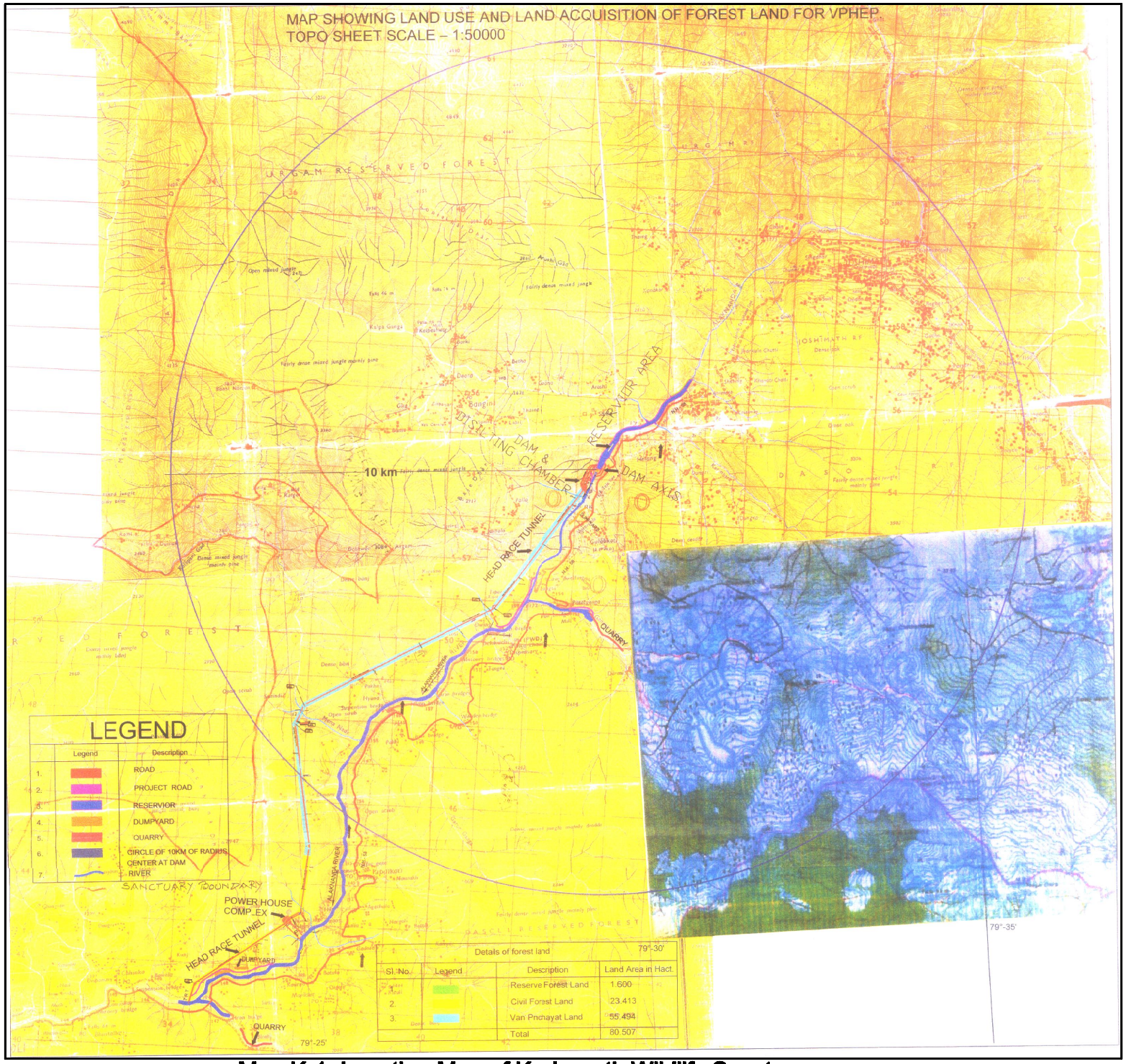
An amount of Rs 15,00,000/- (Rupees Fifteen Lakh) is proposed for the monitoring of KWLS during construction phase.

References

Kala, S. P., Gaur, R. D. 1982. *A contribution to the flora of Gopeshwar* (Chamoli-Garhwal). In: Paliwal, G. S. (ed.). The vegetation wealth of Himalayas, Puja Publishers, Delhi. pp.347-413.

Prabhakar, B., Sharma, S.S., Singh, R.L. 2001. Management plan of Kedarnath musk deer Sanctuary (from 2000-2001 to 2009-2010) Part I and II, Wildlife preservation organization, Forest department, U.P.

Hall S, Fraser J, Mellen J and Shephardson D.J 1998. Response of Zoo animals to Air blast and Ground Vibration Resulting from Rail Train Construction, Metro Washington Park Zoo, Portland Oregon.



Map K-1: Location Map of Kedarnath Wildlife Sanctuary


elevation 9221 ft.
elevation 8752 ft.
elevation 5969ft.
Kedarnath Wildlife Sanctury boundary
elevation 4785 ft.
HRT Alignment proposed
Alaknanda River
Alaknanda River
Under ground Power House elevation 4711ft.
Haat
Birahi
© 2011 Cnes/Spot Image
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Image © 2011 DigitalGlobe
elev 4411 ft
Jun 11, 2006