JAPAN INTERNATIONAL COOPERATION AGENCY

NEPAL ELECTRICITY AUTHORITY
ENGINEERING SERVICES
PROJECT DEVELOPMENT DEPARTMENT

THE UPGRADING FEASIBILITY STUDY ON THE DEVELOPMENT OF THE KULEKHANI III HYDROPOWER PROJECT IN THE KINGDOM OF NEPAL

FINAL REPORT

VOLUME III

SUPPORTING REPORT (2)

(ENVIRONMENTAL IMPACT ASSESSMENT)

FEBRUARY 2003

NIPPON KOEI CO., LTD.
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This Report consists of

EXECUTIVE SUMMARY

Volume I	*Main Report*
Volume II	*Supporting Report (1)* *(Engineering Study)*
Volume III	*Supporting Report (2)* *(Environmental Impact Assessment)*

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PART A

NATURAL ENVIRONMENTAL ASSESSMENT

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OF THE KULEKHANI III HYDROPOWER PROJECT
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FINAL REPORT

VOLUME III SUPPORTING REPORT (2)

PART A : NATURAL ENVIRONMENTAL ASSESSMENT

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PART A NATURAL ENVIRONMENTAL ASSESSMENT

CHAPTER A.1 INTRODUCTION

A.1.1 Environmental and Social Background

Knowledge of the environmental background to the Project is generally good with the Kulekhani III HEP being studied twice and numerous visits to the area by experts, consultants and some staff of NEA (NEPCON/DIP, 1998 & NESS, 2002). The impacts on the natural environment are typical of a small hydro project and have been minimized during project planning and design. Extensive intrusions into the Yangran Khola will occur and this will have associated impacts on the natural environment. The impacts on the social environment are such as those caused by land acquisition and compensation and the influx of a construction workforce. Access roads will be provided to previously inaccessible areas, which will cause profound effects and create opportunities. Refinement of these into the Resettlement Plan (RP) and a Social Action Plan (SAP) is included in Part B.

The environmental and social descriptions, impact assessments, management and monitoring plans have been revised to reflect the new project layout and the anticipated effects of the Kulekhani III HEP. All of these aspects are covered in the Supplemental EIA recently completed by Nepal Environmental & Scientific Services (P) Ltd. (NESS) for the JICA Study Team. This study provides considerable inputs and all the documentation contained in this report It is made available as separate documents, the Main Report and the Annexes. Security issues are a minor problem to the Project at the moment, in light of HMG Nepal's emergency in response to Maoists activities.

A.1.2 Nepal Legal and Administrative Framework

An Environmental Impact Assessment (EIA) is required under the present HMG Nepal legislation by the Ministry of Population and Environment (MoPE). This is required under

- Environment Protection Act, 1996
- Environment Protection Regulations, 1997

The NEA commissioned an EIA of the Kulekhani II HEP in 2000/2001. This report and additional information was submitted to MoPE in March and December,2001 with an approval granted in August, 2002 as evident by the stamping of the Cover of the document. This approval of the EIA clears the way from the HMG Nepal for project implementation and allows for revisions to the EIA, the Environmental Management Plan (EMP) and other components. Re-submission of the EIA is not necessary provided that changes are reasonable and

do not affect substantially more people or different District and Village Development Committees.

The EIA for the Transmission Line (a nominal 500 m) is being initiated by Consultants, is scheduled for completion in June, 2003 and the approval should be straight forward with no apparent danger of a delay to project implementation associated with this aspect.

NEA will submit any additional advice to the MoPE after consultation with the Ministry of Water Resources (MoWR), the JICA Study Team and its Transmission Line EIA Consultants.

A list of applicable Nepalese legislation and government policies and guidelines affecting the project are outlined in Volume I, Main Report Section 4.1 and included as Annex A1.

A.1.3 JICA and JIBC Impact Assessment Guidelines

Upgrading of the Feasibility Study for the Kulekhani III HEP study is being funded by JICA and by the project will be financed by JIBC during for its construction. In general, this report covers the guidelines as they apply to the physical, biological, social and cultural including public consultations. The references used are:

- JICA – Environmental Impact Assessment Guidelines for Development Studies (1994)
- JIBC - Environmental Guidelines (Draft Version), January, 2002.

Particular attention was paid to the JIBC guidelines Part 2: Section 4 entitled "Check Sheet for ODA Loan Dam Construction Project" to ensure that such an evaluation took place for the Kulekhani III HEP. The suggested anti-pollution standards in the JICA and JIBC guidelines were considered and compared with other criteria being applied to hydropower projects in Nepal. However, these need to be further rationalization as some guidelines are in draft in Nepal and other standards are used. Examples of these standards are given in Section A.5.

As the JICA and JBIC guidelines tend to deal more with the natural environment and comprehensive policies and guidelines are explicitly defined by the Asian Development Bank (ADB), these have been used for formulating the Resettlement Action Plan (RAP) and the Social Action (SAP).

A.1.4 WCD Report and Recommendations

As a background to the latest requirement the World Commission on Dams report "Dams and Development: A New Framework for Decision-Making (WCD, 2001) have been referred to as appropriate. This report makes many recommendations, contains policies and guidelines relating to the social impacts and involvement of NGOs.

There is currently considerable variation in the acceptance of this report, from outright rejection by some Southeast Asian countries to accommodation with local conditions to apply. This is the attitude of HMG Nepal but the Nepali authorities have not made a definitive response to this document and NEA is treating it with caution. In any case it focuses on large dams and reservoirs whereas the Kulekani III HEP is a run-of-river project involving a small regulating pond and many underground works.

CHAPTER A.2 REVIEW AND STATUS OF EXISTING EIA DOCUMENTS

A.2.1 EIA Prepared by NEPECON / DIP

The "Environmental Impact Assessment of Kulekhani III Hydroelectric Project" (2001) which was prepared by NEPECON in association with DIP for NEA in 2001. As noted above NEA presented this document to the Ministry of Population and Environment (MOPE) and additional information through the Ministry of Water Resources (MOWR). The baseline natural environment described in this document is adequate in terms of the physical and biological environment with the greatest emphasis on the Vegetation/ Forest Resources, Wildlife and Biodiversity, Fish and Aquatic Life and Social and general data on Socioeconomic and Culture. The report is supplemented here with respect to the implications of implementing the project in terms of:

- Land acquisition and compensation and the actual plots affected
- The relationship between mitigation measures and the impacts
- The approach to and make-up of the Environmental Management Plan including staffing, costs and institutional strengthening and monitoring and auditing plans.

The fieldwork carried out by NESS had the benefit of the proposed final design alternative for updating the earlier EIA with respect to these important aspects.

A.2.2 Supplemental EIA Prepared by NESS

The Terms of Reference (ToR) for the Supplementary EIA were drafted in November, 2001 and tendered and the study initiated in February/ March 2002. The main field work was executed in March, 2002 for the dry season and June, 2002 for the wet season. However several intervening visits were made to the project area in respect of the social assessment, household surveys, land ownership mapping and the spring water survey. A draft final report entitled "Supplementary Environmental Assessment of Kulekhani III Hydropower Project" including Annexes was submitted on 1 October, 2002.The main purpose of the supplemental EIA survey are:

- To confirm impacts on the natural environment (water quality, fisheries and aquatic ecology, fauna and flora) and the social environment (socio-economy and culture) around the project area,
- To assess impacts on the natural and the social environment caused by implementation of the project
- To compile basic information on land use, acquisition and compensation and integrate these along with relevant data into Resettlement Plan and Social Action Plan framework

- To review and prepare an updated Environmental Management Plan.

The Contractor, NESS (P) Ltd. has executed this task admirably and their suggestions and recommendations are incorporated into this report and Annexes.

As noted, the Supplementary EIA (NESS, 2002) survey consists of both natural and social EIA surveys. The supplemental natural EIA survey is composed of: 1) water quality survey, 2) comparison with a similar catchment, 3) fisheries and aquatic ecology, 4) flora and fauna survey, 5) downstream consequence (release of peak discharge), 6) river maintenance flow, 7) environmental risk, 8) impacts during construction, and 9) environmental management plan. Survey items relating to the natural environment are shown in Table A.2.1.

The social EIA survey consisted of 1) socioeconomic background, 2) Resettlement Plan, 3) Social Action Plan, 4) Public Consultation, 5) downstream consequences (affects on irrigation and communities) and 6) environment management plan. Survey items and periods of the social environment are shown in the table A.2.2.

The project will have extensive underground excavations for adits, tunnels, power station and tailrace. Domestic water used for villagers along the alignment of such facilities may be affected through seepage into the tunnels and excavations. Therefore, an inventory survey of spring water and surface water supplies was carried out in order to have a record of the present status of location, utilization, and discharges and for mitigation of the social problem during construction or operational phases.

The area covered by the Supplementary EIA survey is shown in Figure A.2.1.

CHAPTER A.3 PROJECT IMPACT ZONES

The assessment of the Kulekani III HEP on the natural environment will occur mainly during the construction phase and all the underground features will have access and spoil banks located at specific sites in the project area. During the operational phase of the project the impacts will focus on the altered regimes, river maintenance, management of the regulating pond, check dams and the Yangran watershed and monitoring needs of the project. Based on this discussion in this section is according to:

- The Headworks Area including de-sanding facilities, open channels to headpond, intake facilities and tunnel portal
- Work Adit and its access road along the Rapti River and Spoil Bank A located on Rapti River floodplain upstream of the Bodgjhora Khola
- Sanutar and Regulation Dam / Pond and Check Dams including access roads and bridge, box culvert across the Kesadi Khola, contractor's camp and facilities, Spoil Banks B and C, regulation dam, regulation pond, two upstream check dams, access adit to the tunnels and power station and transmission line from portal to 132kV line on East side of Rapti River
- Tailrace Outlet and its associated facilities including access road and Spoil Bank D
- Downstream Channel Zone including alteration of regime of Rapti River, riverside communities, irrigation intakes and Engineers' and Contractor's camps.

The general layout of the Kulekhani III HEP will also make extensive use of the Tribhuvan Highway between Nibuwatar and Hetauda. The main features referred to above are shown on Figure A.3.1.

CHAPTER A.4 INVENTORY OF NATURAL ENVIRONMENT AND ITS RESOURCES

This section summarizes the results fieldwork undertaken for the natural environment including water quality measurements, vegetation, fisheries, wildlife and aquatic ecology during the dry season (March) and the wet season (June), 2002. Individual maps are provided of the respective sampling sites which included both the project area and around the similar catchment of the lower Rani Khola.

A.4.1 Surface Water Quality

The results of the water quality sampling are presented in Table A.4.1 for both surveys and for the individual sites in Tables A.4.2 and A.4.3 for the dry and wet seasons, respectively. Sampling of water quality was carried out at nine (9) points as located on Figure A.4.1. Thirteen (13) parameters were measured including: Flow velocity (m/s), Discharge (m^3/s), Ambient temperature (^oC), pH, Conductivity, Total suspended solids (SS), Total phosphorous (P), Total nitrogen (N), Ammonia (NH3), Nitrate, Nitrite, Total Kjedahl nitrogen (TKN), Dissolved oxygen (DO), and Biological oxygen demand (BOD)).

Sketch maps of sampling site locations, photographs and descriptions of the sites were taken and are included in NESS Supplemental Report and its Annex, along with brief comments on the methods and procedures used in analyzing the samples.

The conclusions that can be drawn from this data are as follows:

- There is no evidence of regional or local pollution in the dry season or compared with previous water quality measurements
- As expected, Increases occur in the wet season in respect of Temperature, Conductivity, Total suspended solids, Phosphorus and TKN and a decrease in BOD levels
- High Dissolved Oxygen levels characterize all samples of waters and should be protected during construction
- The values of Total Phosphorus and TKN for both season indicate the potential for algal growth, as outlined in below.

The water quality is good throughout the project area and there should be no problems associated with water quality for the Kulekhani III HEP, other than

increased flows downstream of the tailrace outlet.

A.4.2 Groundwater Resources and Springs

One of the common problems with tunnels and underground power stations is the interception of groundwater flows. In the worst cases concrete lining of tunnels has to be undertaken or remedial actions such as alternate supplies put in place if regular groundwater flows are affected particularly if this source serves for local communities and dry season flows are critical.

An inventory survey of natural spring waters used by the local communities was carried out in the zone affected by the various tunnels and the power station. Monitoring of spring discharges within this zone was completed in the wet season and the dry season. Tables A.4.4 and A.4.5 delineate the results of this survey which recorded the locations, the source (creek), water user communities, number of households, average discharge at time of measurement, pipelines and improvements to the supply and purposes of use. A total of 22 main springs were recorded with additional information gathered during the wet season from springs near the NEA exploration adit. The data was recorded on individual sheets for each spring, including photographs, which are contained in the Annex of the NESS Supplementary EIA (NESS, 2002). The objectives of the spring survey were twofold:

- To assess any impacts during and after tunnel excavation
- To negotiate and design required mitigation packages for communities using these springs over conflicts between the project and communities during construction and operation period of the project.

The area of spring water survey includes Bhaise (Wards 6 nd 8) and Basmadi (Ward 9) Village Development Committees, including the water supply for the following communities:

- Nakoligaon
- Bokedaha
- Sanutar/ Ghumaune
- Shikaribas
- Nayagaon
- Kitini/ Amdanda

The distribution of natural springs within the potentially area influenced by the tunnel is shown in Figure A.4.2. The overall results are shown in Table A.4.6 and indicate:

- A total of 27 springs serving approximately 213 households with drinking water, and stockwater and occasionally irrigation

- Two-thirds of the sprigs are provided with PVC pipes and several have improved terminals for collecting water, including one by PLAN International (Sanutar) and one as supply for Hetauda Cement Limited's canteen (Kitni)
- The discharge ranges from 0.04 to 3.00 lps in the dry season to 0.05 to 8.23 lps in the wet season, with high flow rates at the lower elevations early in the dry season.

A.4.3 Vegetation and Forest Resources

The terrestrial vegetation survey as carried out for the Supplementary EIA involved a total of nine (9) locations with a total of 30 individual sampling plots. Locations of sites surveyed are shown on Figure A.4.3. Details of the inventory for all plots are found in the Annex of the Supplementary EIA (NESS, 2002). This included most of the all of the impact zones and the similar catchment, Rani Khola, as noted in the tables for this section. Data on regional forests have been described and the tree species listed for each site in Table A.4.7. Characteristics, species composition and relative dominance of main species included for estimates of volume of main species impacted in the main access road and regulation pond zones. Shrubs and climbers and herbaceous species are included for all sampling sites (Table A.4.8 and A.4.9) Selected species and medicinal plants listed. Estimates of the number of the protected species (Sal-*Shorea robusa;*Chanp-*Michalia champaca and* Simal-*Bombax ceiba*) are also included in Table A.4.10. The conclusions that are evident from the vegetation and forest survey are as follows:

- The vegetation cover in the access road and Yangran Khola has more species and diversity of trees and shrubs (i.e. twice as many species) being a parts of the Community and National Reserve Forests and thus will require a follow-up inventory compensation survey when the exact areas to be cleared are better defined
- At least eleven (11) tree species are used for timber, fodder or fuelwood and sixteen (16) species as medicinal plants
- Protected trees are only found along the access road and in the Yangran Khola and only about 1/3 of them are trees, the rest being pole or sapling size
- Comparisons between the the Yangran Khola and the Rani Khola will require careful selection as only 6 species of trees and shrubs and 12 species of herbs/ grass are in common, even though both systems are part of a common Subtropical mixed forest classification
- The most common species of shrubs (4 out of 22 species) and herbs/grasses (8 out of 23 species) belonging to the Yangran and Rani Kholas are *Adhota*

vasica, Agritum conyzoides, Solanum verbascifolium, Woodflora fruitcosa and Cymbopogon microthea, Cynodon dactylon, Dryopteris filixmas, Eupatorium adenophorum, Saccharum sponteaeium, Imperata cylindrical, Urena lobota, Vetveria zyanoides.

Presently, the Sanutar-Bokedaha and Yangran Khola areas are covered by two Forest User Groups (FUG); controlling the Bokedaha and Kalika-Kesadi Community Forests. The area impacted by the Check Dams apparently is a National Reserve Forest but the people from Kiteni area are lobbying the Department of Forests for conversion of part of this area to a Community Forest.

A.4.4 Wildlife – Mammals, Birds and Reptiles

Data on mammals, birds and reptiles was collected during sites visits with additional data collected from local informants. These are summarized in Table A.4.11, A.4.12 and A.4.13, respectively.

(a) Mammals – Table A.4.11

With respect to the distribution of mammals, the Jackal, Rhesus macaque, Common langur, Bat, House rat and Red fox are the most common being recorded from at least 3 stations. Eight (8) confirmations are however based on local information or calls and account for the rarer species of concern i.e. the Otter, Leopard and Jackal. The Yangran Khola had the most species thirteen (13) and the only records of the Leopard and Barking deer, as expected due to the heavy vegetation. The Otter a species about which little is known in Nepal but appears to be widespread but rare was recorded at the intake and the tailrace sites on the Khani Khola and the Rapti River.

(b) Birds – Table A.4.12

A total of 35 species were recorded in the Kulekhani III HEP area, with the eleven (11) species in the intake area and the Rani Khola and nineteen (19) species in the regulation dam. There was little commonality in species recorded for the Yangran Khola and the other two sites. Most of the species recorded were classed as Residents and no recorded species is listed as protected either by HMG Nepal or IUCN/CITES.

(c) Reptiles- Table A.4.13

Most of the six (6) species of reptiles recorded for the area are common and only one (1) species, the Rat snake, is listed for threatened under CITES II classification. It is probable that there are species of reptiles in the project area but these could not be identified.

A.4.5 **Fisheries Resources and Use** – Tables A.4.14, A.4.15, A.4.16, A.4.17 & A.4.18

Extensive work was carried out relating to the fisheries aspect of the project area based on seven (7) sampling stretches of river courses to include all types of habitats. The locations of sampling stations are shown on Figure A.4.4 and covered many sections of the river courses directly affected. Sampling was done in the dry and wet seasons, involved use of nets, scoops and traps as appropriate to the site. Sampling was undertaken for a five hours period. The catch per effort was calculated for each site. In addition Phytoplankton, Zooplankton and Aquatic Insects were sampled at each of these locations.

The results of the survey are given in Table A.4.14 and A.4.15 and show that the most species are residents to their local section of the river or creek. The population is dominated by two families (i.e. Carp and Torrent Minnows) comprised of six (6) species. Copper Mahseer (13.5%) and Stone Rollers (29.6%) and Torrent Minnows (Barilius spp) (41.7%) account for 85% of the species overall. A total of 88% of the species are present in both the dry and wet seasons showing very little migration.

There is no IUCN/ CITES classification of rare fish species but a Nepalese classification indicates that the mid-range and long distance migrant species characteristic of the wet season are the rare (Torrent Catfish) and the vulnerable species Copper Mahseer. Golden Mahseer, Snow trout and Point–nosed Snow Trout. Other than the Copper Mahseer these fish account for less than less than 2.5% in the dry season and 6.8% in the wet season.

The Yangran Khola (9species) and Rani Khola (4 species) do not contain any of the rare or vulnerable species except for the Copper Mahseer and the Torrent Catfish, which are widely distributed elsewhere in the system. The short section of the Khani Khola below the existing Check Dam has 10 species of fish in the wet season and 6 species in the dry season.

The catch per hour of effort varies from 3.9 to 5.0 specimens from the dry to the wet season and the catch per unit effort (0.20) and the attempt catch ratio (1:46) are fairly consistent for the sampling program. (Tables A.4.16 and A.4.17, respectively). The spawning habits of the larger species are indicated in Table A.4.18 and show that the importance of gravel beds and short time of incubation times. This is an adaptation to the dynamic nature of the rivers in flood with re-distribution of gravel each monsoon. It is indicated that the fish caught, although small in size have high to medium food value.

Further description relating to the distribution, size and weight of fish for each sampling site and descriptions of the characteristics of the individual sites are found in the Supplemental EIA Report (NESS, 2002).

A.4.6 **Aquatic Insects and Amphibians** – Table A.4.19, A.4.20 & A.4.21

The phytoplankton, zooplankton and aquatic insects were measured during both the dry season and wet season and at the fisheries sampling sites. The collected data is summarized in Tables A.4.19, A.4.20 and A.4.21, respectively. There is an indicated diversity of aquatic primary production in all water bodies with the following being significant:

- Domination of some 76 species of phytoplankton by *Bacillariophyceae* (63%), *Chlorophyceae* (16.6%) and *Phyrophyceae* (10.8%) with the number of species decreasing in the wet season by approximately 25%
- Complete domination of the 32 species of zooplankton by *Rotifera* (75%) and the decreases in the number of species in the wet season by 25% also
- The Rapti River sites completely dominate the numbers of species and actual counts of both phytoplankton and zooplankton and with the Yangran Khola accounting for less than 8% of the numbers

The 31 species of insect larvae are dominated by the *Ephemeropter* (Mayflies) and *Odanata* (Dragonflies) with the number of species increasing significantly in the wet season (25-50%) insects, except at the Rapti River upstream of the Khani Khola..

Additional information on the phytoplankton, zooplankton and insects are given in the Main Report and Annexes of the Supplementary EIA (NESS, 2002).

A.4.7 **Rare and Endangered Species** – Table A.4.22

The occurrence and distribution of protected and rare species were noted for types of vegetation, mammals, reptiles, birds, fish and aquatic insects. The general classifications of the affected species are summarized in Table A.4.22. The protection situation is open to debate in Nepal but recognition and caution should be given to the Yellow throated marten, Leopard and Rat snake which occur in the Yangran Khola and the Otters inhabiting river bank sites in the Rapti River in the vicinity of the headworks and intake.

It is estimated that a total of 41 mature trees, 117 pole-sized trees and 10 saplings of which 32 trees and 109 pole-sized trees are *Shorea robusta or Sal* and will have to be negotiated with the District Forest Office and the local Forest User Groups for explicit actions or compensation. However these figures will change once the actual access route and location of Yangran Khola facilities are surveyed during the pre-construction phase.

A.4.8 **Dust, Noise and Vibrations**

The aspects of dust, noise and vibrations are common major control programs associated with hydropower projects in Nepal. It is not expected that Kulekani III Hep will be any different with the main access road and construction camps located in the rural community of Sanutar and Ghumane. No background measurements

were made in respect of dust, noise and vibrations but it would be advisable to do so at least in Sanutar and Nakoligaon, in view of the Hetauda Cement Limited bucket/ ropeway, which operates overhead.

CHAPTER A.5 IMPACTS DURING CONSTRUCTION

A.5.1 Surface Water Quality

The results of the water quality survey show the uniformity of water quality in the Kulekhani III HEP area. This is good quality water from the biological and physical viewpoint and is not polluted. The onus is on the Kulekhani III HEP to protect this water during construction. This can best be achieved by the following measures:

- Containment and controlled releases from all tunnel portals and spoil disposal areas through containment of waste discharges,
- Containment of all runoff from active construction zones through diversion and treatment and sedimentation of flows to the greatest extent practical,
- Periodic monitoring of potential point sources of pollutants (e.g. workshops, batching plants, construction zones and camps), and
- Provision of alternate supplies for camps, villages affected by project development and regular monitoring of sources and their uses.

Contractors will meet the Water Quality Standards for Effluents, 1992 under the Water Resources Act, 1997. It is recognized that the standard for Total Suspended Solids (TSS) cannot be achieved during the wet season but it must be enforced during the dry season when, the natural river flows are clear and TSS counts are low. Contractors will endeavor to meet the World Health Organization (WHO) Standards for Drinking Water (1993) supplied to camps or alternate sources for affected areas. These standards are given in Tables A.7.1 and A.7.2, respectively. Reference is made to the recent guidelines entitled "Manual Developing And Reviewing Water Quality Monitoring Plans and Results for Hydropower Projects (IRG, 2002).

Fresh material such as that in spoil banks contains fine particles and is nutrient rich, as evident by algal blooms in isolated channels after the recent monsoon (October, 2002). Therefore controls on spoil discharges or seepage must be controlled. Spoil dumps must be designed to cater for internalized settling ponds and these should be constructed at the tunnel portals also.

A.5.2 Groundwater Quality

The biggest risk to groundwater quality is through adverse effects on quantities and quality by tunneling activities. The inventory of springs indicates these risks are to Nayagaon (springs N4, N5 & N6 – 28 HHs), Shikaribas (spring Sh 1- 4 HHs), Sanutar (spring Sh 3- 7 HHs) and Nakoligaon (spring Na 2- 1HH); indicating a total of 40 households. This can only be confirm by direct monitoring the use and flows of these springs during construction of the adits, tunnel and the power station in these regions Periodic monitoring in the dry and wet season of

the remaining 16 springs sampled is recommended.

A.5.3 Vegetation and Forest

The probable impacts of the Kulekhani III HPP on the local vegetation and forests will focus on the main access road at Sanutar and in the Yangran Khola valley. These areas are forested and contain DOF protected species, particularly Sal- *Shorea robusta.* Local losses will be significant to the Yangran valley but no extinctions or threatening losses to the integrity of the vegetation resources on a regional basis are likely to occur. Minimal impacts are associated with the clearing of mature and pole-sized trees necessary at the Headworks, access road and Work Adit and the outlet channel of the Tailrace.

Table A.4.10 estimates the quantities of protected trees; the majority of which are Sal accounting for approximately 90%. In all cases detailed forest inventories have to be made of areas designated for clearing for construction. This will be used to negotiate compensation and afforestation measures necessary with the District Forest Office (DFO) and the two local forest user groups (FUG). These are Bokedaha and Kalika-Kesadi Community Forests (CF). The total area of these CFs is 98.9 ha and they have a membership of some 308 households.

It is noted that there are private plantations of Sisau- *Dalbergia sisoo* in the immediate vicinity of the cut and fill section of the tailrace tunnel across the Kesadi Khola at Sanutar and Bokedada and these will have to be compensated for, if affected.

It is obvious that with the major changes in land configuration at the Yangran delta, the intrusions of the dam, regulation pond and check dams covering two-thirds of the catchment and a required afforestation by the DFO, that a Yangran Watershed Management Program (YWMP) will be necessary. This should include the entire catchment and incorporate the present two Community Forests.

These Forest User Groups will be required to control encroachment for the illegal removal of timber and non-timber forest products in their respective areas and ideally in the YWMP. Contractors and sub-contractors will be required to inform employees that such activities are illegal and compliance with these policies made a condition of employment.

The afforestaion and use of other vegetation for erosion control along all access roads, around the regulating pond, check dams, cut embankments and tunnel portals will be an integral part of their design. Similarly the spoil banks should be top-dressed with soil and planted with a suitable tree spacies as additions to the community forest estate.

A.5.4 Wildlife

The construction stage of Kulekhani III HEP will destroy much of the riverine habitat and its wildlife resources in the middle reaches of the Yangran Valley. The

losses in habitat are judged acceptable in other areas such as the headworks, work adit and tailrace channel. All these habitats are already affected to some degree. Current degradation of the habitat and fauna populations are evident in the following areas:

- In the Khan Kohla delta zone downstream of Kulekhjani II HPP,
- In the Sanutar/ Ghumaune area including the Kesadi Khola and the Yangran Khola delta area, which have been seriously affected by the 1993 and 2002 floods and encroachment onto surrounding forest land for agricultural purposes, and
- In the Rapti River floodplain proper, mainly due recent flooding and the large landslide affecting Bodehjora Khola, with impact reaching downstream as far as the Samari Khola, as evident by re-distribution of its deposits.

The list of mammals and the status of rare and endangered species in Table A.4.8 indicates:

- That the Leopard (if it exists) and its prey, the Barking deer (not a rare or endangered species) and the Yellow throated marten are the most vulnerable species due to the losses in forest habitat in the Yangran Khola
- All other species in the Yangran Khola including the Common langur, the Rhesus macaque and the Jackal may lose some habitat but are considered adaptable to the altered environment
- Local populations of the Otter may be adversely affected by the headworks and intake structures but will probably seek new homes in adjacent areas

  The monitoring of impacts on wildlife during construction is difficult but it is suggested that the efforts be made to delineate the numbers and known locations of affected populations of Common langurs, Rhesus macaques and Otters. A provision for this has been made in the construction plan mitigation measures.

A.5.5 Fisheries and Aquatic Ecology

The aquatic life and fisheries resources of the project area subjected to substantial variations through the flooding associated with the monsoon. This annual variation affects their breeding, their population and their distribution across the aquatic habitats. The fish species in the upper Rapti River and its tributaries are limited in number (18 species) and steep creeks such as the Yangran and Rani Khola are particularly so (Tables A.4.14 & A.4.15) accounting for less than 13% of the total weight caught but 29% of the total effort. It is improbable that the various infrastructure in the rivers and creeks will affect any of the fish species or their migration except in the Yangran Khola.

The Yangran Khola fish population is charaterised by resident species of Stone rollers, Torrent Minnows and Loaches with the Copper Mahseer probably present only in the lower reaches. All these species are common not only in the Rapti River catchment but also throughout Nepal and adaptable to upstream conditions after the dam and regulation weir are constructed. Snow trout and other migrant species were not recorded from the Yangran Khola. Thus, the main impact would be on a very small population of Copper Mahseer breeding in the lower Yangran Khola through the barrier effects of the dam.

Temporary adverse effects, limited in scope and extent would occur on local fish populations through the following:

- Disruption to movement, feeding and breeding through river diversions in the Khani and Kesadi Khola
- Visual and smothering effects on feeding potential due to increased sediment loads while working in the river course or through accidental spillages
- Loss of habitat through construction of the headworks and tailrace channel in the Rapti River and the cut and fill in the Kesadi Khola.

The effects on the local populations of the phytoplankton, zooplankton and aquatic insects during construction will also be temporary but the recovery of any such losses or degradation would be within the scope of what occurs annually with the monsoon floods.

A.5.6 Rare or Endangered Species

The effects of the Kulekhani III HEP on the rare and endangered species will be minimal and confined to Yanran Khola. The loss of the protected trees (ie *Shorea robusta, Michalia champaca & Bombax ceiba* – 41 mature trees) is small and these can be compensated for, trees and poles utilized locally and suitable afforestation programs put in place through the Yangran Watershed Management Program (YWMP).

The situation with the mammals being IUCN/ CITES listed species can be stated as follows:

- The Leopard is still only reported as present in the Yangran Khola but it would move to the residual forest areas
- The Common langur and Rhesus macque are common to all areas surveyed and similar habitats throughout Nepal, frequent agriculture fringe areas and are known to be protected for cultural and research purposes: so this is really not a problem

- The Yellow–throated marten and the Jackal are CITES III requiring international cooperation to control trade in skins, are common in Neapl and are adaptable to forests and agricultural areas
- The Otters, if now present, at sites along the Rapti River must be adaptive to change and would move to new suitable habitats along the river, as they would have done after the floods of the 2002 monsoon season.
- No birds surveyed are protected species. The Rat snake, although listed as a possibility of becoming threatened has its presence based on "local information". The Rat snake is considered likely to move and survive in those areas of the Yangran Khola and the intake structure that are affected.

Similarly the fish species, Copper Mahseer is common throughout the project area, the Yangran Kohla is not a key habitat. The Stone Rollers and Loaches can certainly survive and recolonized steep upriver sections. The Kulekhani III HEP will have no marked effect on the relative fish distribution.during construction, except for the occurrence of high turbidity water and temporary covering of feeding habitat, when activities are in the river.

A.5.7 Dust, Noise and Vibrations

The aspects of dust, noise and vibration impacts during construction of the project will be widespread across all the construction zones and to some extent the linking sectors of the Tribhuvan Highway. The present rural background with foot access only to the Sanutar / Yangan valley will change and vibrations, especially during the opening of the tunnels, excavation in the Kesadi Creek, spoil dumping and construction activities at Yangran Kohla, will affect local nearby villages. Those communities and the main centers of construction activities will have to be monitored and appropriate public safety actions put in place. These necessary remedial and mitigation measures have been included in the Environmental Management Plan (EMP) (see Tables A.7.7).

A.5.8 Transport and Operation of Spoil Dumps

Probably the most dominant impact of the construction phase of Kulekhani III HEP will be the access roads, including bridges, and operation and rehabilitation of the spoil dumps. All material excavated either underground or on the surface will be trucked to the nominated spoil dumps. Similarly as much of the access roads are located in steep or zones of poor stability, extensive protection works and re-vegetation of slopes will be necessary to be carried out by the contractor. Spoil dumps have been selected in locations on the upper floodplains and in locations where they will not affect stream flows. The open-cut across the Kesadi Khola will require stability works and careful execution in view of the monsoon and relatively rapid rise in flood flows from this catchment. All these factors have been considered in the engineering plans and cost estimates for the project.

(1) Access Roads and Bridges

At least 4.1 km of permanent access roads to project features are envisaged plus at least another 3.3 km of secondary access roads for camps, to spoil disposal and open cut and refill area at Kesadi Khola are required. The proposed main access road including right of the way has an average width of 30m. A single bridge across the Rapti River at Sanutar is required to provide permanent access to the regulating pond and power station. Improvements would be made to the Hetauda Cement Limited's causeway in association to the access road to Adit 1 alongside the Rapti River. The actual lenth of road and the type of land use crossed are summarized in Table A.5.1.

(2) Spoil Disposal

Spoil disposal (muck) from the various excavations have been estimated but these are quantities based basic road construction, river diversions or excavation from the open-cut for the tunnel. Numerous areas have been investigated and assessed. Currently the following spoil disposal areas are proposed:

- SPOIL BANK "A"– On the Rapti River floodplain just upstream of Baghjora Creek and landslide; to accept muck from the road construction, Headwork, Adit 1 and approximately 2.3 km of tunnel and covering some 1.6 ha with space for over at least 115,000 m^3 of spoil. Alternatively the area directly opposite Adit 1 and presently a playground may be used, if suitable arrangements for replacing this facility are made.
- SPOIL BANK "B" – On the Kesadi Khola floodplain below Sanutar; to accept muck from the access roads, adits, connecting tunnel, the power station adit and cavern, dam, regulation pond and check dams and other works with an area of approximately 2.8 km3 all of which is river flood plain and with storage capacity of approximate volume of 420,000 m^3. In addition there would be a large cut and replace associated with the tailrace open-cut in the Kesadi Khola immediately below Sanutar amounting to approximately 450,000 m^3.
- SPOIL BANK "C" – On the Kesaadi Khola east of Ghumaune Pari, as dry season spoil dump covering 2.1 ha, which will accept spoil from the access roads, tunnels and the right bank operations at the damsite of at least 230,000 m^3.
- SPOIL BANK "D" – On the Rapti River floodplain in the vicinity of the tailrace outlet with excavated material used for stabilizing the outlet and estimated at 40,000 m^3. The spoil dump covers an approximate area of 1.3 ha of which nearly 80% is Rapti River floodplain and 20 % grassland.

All these areas would be secured by locally made gabion walls and rip-rap as necessary. Plans will have to be made for the Contractor to have minimal

materials temporarily stored at work sites during the wet season. A detailed plan for waste disposal will required from the Contractor as part of his Environmental Management Plan.

A.5.9 Camps and Proposed Locations

In order to minimize the land take in the Sanutar area and preserve the agricultural activities the following camps have been proposed:

- One construction camp at the Headworks (Bhaise) using the land and facilities of the Kulekhani II project.
- One construction camp at Ghumaune with the entire settlement of Ghumaune acquired on temporary rental basis during the construction period and with the rehabilitated land and structures being returned to the owners after construction is completed
- Labor camps are proposed for the Kathmandu - Hetauda Ropeway station at Hetauda housing workers for the Sanutar and Yangran areas for using available space at Kulekhani II camp at Nibuwatar for workers working at the Headworks/ Adit 1 areas. Both of these locations lie within 5 km distance from the works area.
- Initially the Nibuwater camp would be used then possibly land at and structures at NEA's diesel power plant at Hetauda are proposed for the engineer's camp for both the construction and operational phases of the Kulekhani III.

A.5.10 River Diversions, Training Works and Structures

River diversions will be necessary for many of the works proposed for Kulekhani III HEP. The diversion of the Kesadi Khola for construction of the box-culvert and of the lower reaches of the Yangran Khola around the dam structure will be necessary. Protective measures to counteract erosion such as gabion walls are required at the following locations:

- Khani Khola around area were various facilities for the intake and other headworks facilities are proposed
- Yangran River – spillway section, lower reaches of the left bank in the vicinity of the construction camp at Ghumane and at other locations where the creek enters the Kesadi Khola, as this is a very dynamic region
- Kesadi Khola – at various locations along its length below the Yangran Khola and on the point of land at Sanutar, if this area is not included in works associated with the open-cut/ tunnel development
- Rapti River- downstream and adjacent to the tailrace outlet and at the Manitar, Chautikole and Hetauda Highway irrigation outlets to guarantee the integrity of these works in the new fluctuating river regime.

It is to be noted that all of the catchments the project area and its surrounds experience regular river erosion which is often exacerbated by periodic heavy rainfall, storms, flooding and landslides. Some of the more significant of these affecting the Kulekhani III HEP area are outlined in Section A.8.

A.5.11 Environmental Risks

The environmental risks for the Kulekhani III HEP are largely geological and/ or hydrological or relate to storm events, and include as follows:

- Tectonic activity or earthquakes associated with the Main Boundary Thrust (MBT), an active slip plane, affecting the underground excavation and structures, particularly the power station cavern and the tailrace tunnel and the unknown extent of fracturing of the local rock formations
- Landslides and erosion risks including slips on access roads and surrounding the regulation pond with its seasonally and daily fluctuating levels and recognized landslide features in its upper margins, hence the needs for Check Dams 1 and 2 in the Yangran valley
- Hydrological risks to surface or spring waters due to the construction of adits, tunnels, and the power station which are assessed (Sections A.4.2 & A.5.2)
- Hydrological risks in terms of storm occurrence and localized flooding, which can be of consequence to project construction or its integrity in the longer term
- Risks to structures (i.e.vibrations from blasting on poorly constructed houses) and to loose accumulation of materials from vibration due to vehicular activity resulting in damaged houses or landslips, noted above
- Risks associated with operating under the Hetauda Cement Limited's ropeway and on their leases; possibly requiring protective measures for traffic underneath the ropeway and frequent liaison during the detailed design and early construction stages of the project.

The patterns of erosion and possible aggradation of the river bed and what this means in terms of the overall effects associated with those ongoing changes due to the flooding regime are addressed in Section A.6. The effects during construction have been considered in the selection of engineering methods and location of the spoil banks and are deemed as minimal, provided the protective works are implemented. The situation in respect of individual structures and the overall works will be consistently monitored during the construction period.

CHAPTER A.6 IMPACTS DURING OPERATIONAL PHASE

A.6.1 Alteration to Regimes

The implementation of the Kilekhani III HEP will alter the regime of the following rivers:

- The lower Khani River, below the power station
- The Rapti River, from the Khani Khola confluence to the Highway Bridge at Hetauda in the dry season through daily fluctuations due to power generation
- The Yangran Khola, from the regulation pondage to the Kesadi Khola junction through storage and diversions of flows through the Kulekhani III HEP power station
- The Kesadi Khola, only marginally as the Yangran Khola represents approximately one-fifth (1/5) of the flows in the Kesadi Khola with this being most noticeable in the dry season.

The alteration to the flows in the river are based on information from Volume I, Main Report Section 3.2 Meteorology and Hydrology and are described in detail below in the following section outlining environmental maintenance flows for the respective rivers.

Overall the effects on the ecological integrity of the rivers affected in the dry season will be minimal and probably not measurable, except for the Yangran Khola. Some effects on fish feeding will occur in the Rapti River but these will be regular and the fish will adapt to the changed regular conditions. The effects on early and late flood season flows in the Rapti River may be more pronounced, directly affecting fish breeding activities as they will alter and disrupt upstream migration and movement to floodplain breeding habitats. The effects in the monsoon season will again be minimal as regular daily flows are frequently altered at present by rainfall and storm events. The remedial or mitigation actions proposed include stocking of the affected sectors of the Rapti River in the 1st and 3rd years after impoundment with native species of fish. Monitoring of the aquatic ecology at the baseline stations is recommended as a means of trying to interpret any effects of the project on the regime of the rivers.

A.6.2 River Maintenance Flows and Environmental Sustainability

The question of environmental maintenance flows is a critical issue for the Kulekhani III HEP. There are both increased seasonal flows below the tailrace and reduced flows in the sections of the Rapti River, the Khani Kohla delta and the lower Yangran Kohla due to diversion for generation. Environmental sustainability of the rivers and their courses has to be viewed in the context that this is a “dynamic environment” characterized by:

- High seasonal and annual variations in flows with resultant changes to the distribution of channels and sand and gravel bars in the river courses
- Daily fluctuations in river levels in the Rapti River downstream of the Khani Kohla, particularly in the dry season due to the irregular releases from the Kulekhani II HPP (i.e. fluctuations from $1m^3/s$ to $15m^3/s$ on a daily basis)
- Local variation in stream gradients and channel width due to local topography ranging from pools to wide riffles to rapids.

Local use of watercourses ranges from bathing, washing and personal ablutions to open grazing by goats and cattle to grinding mills located seasonally by diverting water to specific channels. All infrastructure including vehicular tracks and small footbridges are rebuilt annually due to the re-distribution of channels and riverbed deposits in the flood season.

(1) Legal Requirements and Estimates for River Maintenance Flow

The only legal policy or guidelines for riparian rights or maintaining environmental flows in Nepal is set at 5% for dewatered sections of rivers. (Aquatic Animals Protection Act, 2001). Which flows is not specified but is usually interpreted as average mean flow. However this Act is unlikely to apply to Kulekhani III HEP and natural flows in the Rapti River which are unchanged.

A hierarchy of uses exists under the Water Resources legislation with domestic, livestock watering and irrigation uses ranking higher than power generation. Setting of environmental flow requirements have been set for separately for individual projects such as the Melamchi Water Supply Project and the West Seti HPP. Tthe Medium Hydropower Study Project (CIWEC, 1997) recommended that dry season compensation flows of at least 0.5 m^3/s apply for channels cut-off by run-of-river projects on major rivers. It illustrated this by referring to five existing projects where compensation flows in the driest month ranged from 5 to 18% with the average being 9.9%. This resulted in a recommended criterion of 10% of the lowest monthly flow as a minimum compensatory release for the larger rivers under study.

For Melamchi Water Supply Project with competing uses of water, an analysis of driest 3 months by Nippon-Koei/ SMEC (2000) recommended a minimum environmental flow of 0.15 m^3/s or 7.5 % of the average dry season flow of 2m3/s, based on the formula:

Melamchi Flow Conditions Immediately Upstream	Water Sharing and Environmental Releases
river flow> 2 + 0.5m3/s	Divert 2 m^3/s to supply
2 + 0.5m^3/s> flow > 2m^3/s	Proportional transition
2m^3/s> river flow	Release 0.15 m^3/s to river
0.15m^3/s > river flow	Release all flow to river

JIBC Guidelines

Under the Japan Bank for International Cooperation (JIBC) Environmental Guidelines (2002), there are references to maintenance flows in a several locations including:

- Part 2: Section 1 – Scope of Impacts to be Examined – refers to water usage and ecosystems
- Part 2: Section 2- EIA Reports for Category A Projects- refers to consultations with relevant stakeholders and local residents, which includes to local Irrigation Water User Group at Sanutar
- Check Sheet for ODA Loan-Dam Construction Project: Section III – 1) refers to the setting of maintenance flows, 2) maintaining productive fisheries and 3) preparing reservoir operating rules; 1) ① has queries regarding basis for determination of maintenance flows, ②relevant standards for maintenance flows, ③ consideration for water usage, water quality, and impacts on natural environment in the downstream, 2) ①notification and explanation of the Project to fishermen, and ② compensation and mitigation measures for fisheries, 3) ① reservoir operating rules and ② catchment management plans.

WCD Report

In the section entitled "Sustaining Rivers and Livelihood" the World Commission on Dams report (WCD, 2001) refers to the "environmental management plan to incorporate environmental flows" and other mitigation actions as agreed with stakeholders and defines monitoring programs.

Discussion below is framed around the individual circumstances applicable to the individual river sections.

(2) Khani River

Presently Kulekani II HPP releases up to 13.3 m^3/s into the lower 300m of the

Khani Khola river course. This is combined with the natural flows of the Khani Khola and enters the Rapti River. Kulekhani III HPP plans to divert a maximum of 1.5 m^3/s of the Khani Khola flows plus all the Kulekhani II HPP flows to Yangran Khola regulating reservoir.

The flow characteristic of the Khani River could be explained by referring to monthly average discharge for 33 years and 90% dependable discharge as a result of the runoff analysis:

- Mean monthly flows in the Khani Khola range from 0.20m^3/s (March to May) to over 2.8 m^3/s in September
- The comparable 90 % reliable flows range from 0.1 m^3/s in the February to May period
- The driest months to 1.8 m^3/s in the wet season month of August.

Two 8-15m high check dams exist immediately upstream of the Kulekhani II works, forming a barrier to fish migration. The resident fish population at the Khani/ Rapti confluence consists of torrent species such as Copper Mahseer, Stonerollers and Torrent Minnows (i.e. some 85% of species – Table A.4.14). There is virtually no potential for upstream migration of species such as Copper Mahseer and Snow trout for breeding purposes.

There are no other uses of water from along this section of the Khani Khola presently and access to the area will be curtailed for the Kulekhani III HPP for security purposes. The residual area on the left bank is occupied by the Royal Nepal Army protecting Kulekhani II HPP.

In view of the above situation, there are no environmental maintenance flow reasons for not permitting the Kulekhani III HEP to divert up to 2.0m^3/s of the Khani Khola flows. Sufficient residual flows will exist in the Khani Khola on a seasonal basis to maintain the depleted state of its fisheries resources. The only impact would be during periods of limited flow through the immediate delta of the Khani Khola, which could occur in dry years in the February to May period. Fish species would then retreat to nearby sections of the Rapti River.

(3) Yangran River

Present Status of Yangran River

Presently the Yangran Khola remains a relatively undisturbed over most of its river courses. However the lower 0.5 km of the river has been disturbed as it is occupied, more open, has some dry season cropping on the slopes and provides the route of a local irrigation supply canal to the Santuar/ Ghumaune area. Most recently the area has been disturbed by the exploration Adit to the power station, which includes the dumping of unconsolidated excavated material below this adit.

The flow characteristic of the Yangran Kohla could be explained by referring to

monthly average discharge for 33 years and 90% dependable discharge as a result of the runoff analysis:

- Mean monthly flows in the Yangran Khola are estimated to vary between 0.08m^3/s in March and April to 1.01 m^3/s in August.
- However larger wet season flows occur due to local runoff after localized storms, as happened in late July, 2002.
- Flows in the Yangran Khola represent approximately one-fifth (20%) of the total Kesadi Khola flows.

Irrigation Water taken from Yangran Khola

Present diversions for irrigation during the dry season are about 40 l/s (0.04 m^3/s). There are no diversions from June through September, at present. The quantity diverted is constrained by the intake channel, which is adjusted each year following flooding. The area currently irrigated is about 8.5 ha, giving 4.1cm/day/ha coverage in fields flooded. This appears excessive but this may be due to high channel losses and distribution inefficiency. The exact patterns of irrigation water use in Ghumaune/ Sanutar were not determined as the entire intake for 300 m and the canal in several locations were destroyed in the July, 2002 floods.

River Maintenance Flow of Yangran River

The river maintenance flow of the Yangran Khola is estimated at of 0.06 m^3/s, based on an environmental flow release of 0.02 m^3/s (at least 20% for the driest three months) plus an irrigation release of 0.04 m^3/s. (Alternative A). Present irrigation use is inefficient and irrigation flows in the wet season from June to November are not presently used but this has to be confirmed. Additional wet season releases for aquatic life are planned based on a factor of four times (i.e.4X) dry season flow being equivalent to the average monthly flow during the wet season at 0.08 m^3/s (90 % of reliable flow). Accordingly, the river maintenance flow in the wet season is estimated at 0.12 m^3/s, totaling to the environmental flow release of 0.08 m^3/s and the irrigation release of 0.04 m^3/s. The environmental flow is assumed to be 20% for the driest three months in consideration of relatively small river compared with other projects. The concept of Alternative A is summarized as follows:

Alternative A Yangran Flow Conditions Immediately Upstream	River Maintenance Flow of Yangran River (Aquatic Life + Irrigation Water)
Dry Season Flow 0.07 to 0.16 m^3/s	Release 0.06 m^3/s for river maintenance flow: (Release 0.02 m^3/s for aquatic life & 0.04 m^3/s for irrigation)
Wet Season Flow > 0.26 to 0.99 m^3/s	Release 0.12 m^3/s for river maintenance flow: (Release 0.08 m^3/s for aquatic life and 0.04 m^3/s for irrigation)
Wet Season Additional Releases	Increase release if possible, particularly in late May and June, for fish breeding

Alternative B is based on the 90 % reliable flows (as calculated) on a year round basis. The requirements of Alternative B are felt to be liberal and offer plenty of water for such a small catchment like the Yangran Khola and Nepalese conditions. These environmental flows exceed the requirements felt adequate for a small catchment such as the Yangran Khola and amount to 16.7% of dry season and 8.3% of wet season flows with 3 times the flow in the wet season. Alternative B is summarized as follows:

Alternative B Based on 90 % Reliable Flows of Yangran Khola	River Maintenance Flow of Yangran River (Aquatic Life + Irrigation Water)
Dry Season – December to May	Release 0.10 m^3/s for river maintenance flow: (Release 0.04 m^3/s for irrigation & 0.06 m^3/s for aquatic life)
Wet Season – June to November	Release 0.30 m^3/s for river maintenance flow: (Release 0.04 m^3/s for irrigation & 0.26 m^3/s for aquatic life)

Figure A.6.1 shows a relationship of monthly average discharge, irrigation water supply, and natural environmental maintenance flow in Alternatives A and B. Alternative A is preferred.

Alternative B is the nominated alternative. With Alternative B, there are sufficient flows in the Yangran Khola to plan for irrigation for most months of the year plus retention of surplus flows for hydropower purposes; given the improved efficiency of having a storage scheme (i.e. regulation pond) and efficiency of delivery of irrigation water using pipes, that would occur with the Kulekhani III HPP.

Environmental flow needs downstream of the dam on the Yangran Khola are minimal in the context of the barrier created by the dam and the effects of probable river protection and training works in its lower course. Similarly this lower section would experience sand and gravel deposition on a relatively large scale due to flushing of the regulating pond. The extent and distribution of these deposits in the lower Yangran Khola and its confluence zone with the Kesadi Khola will be channeled downstream during times of flood flows through the dam, which may result in sand deposits on the floodplain. Present uses of this section of the riverbed are limited to sporadic grazing, stockwatering and a limited domestic source of fish. Fish species are dominated by Copper Mahseer and Torrent Minnows and Snow trout are not recorded as migrating to the Yangran Khola. The Yangran Khola has a relatively low number of species and record of catch per hour of effort compared with the Rapti River and Kesadi Khola (i.e. Table A.4.13). The discharging of sediments from the regulating pond during flood flows may result in sand deposits on the floodplain, thereby affecting fish breeding. However this will be mitigated by the proposed stocking of native species in the pond and proposed aquaculture in cages using selected species of Carp and Rohu.

The nominated environmental flows of 0.10 m3/s in the dry season and 0.30 m3/s in the wet season with Alternative B will allow sufficient residual flows in the Yangran Khola for aquatic life, local domestic use and for irrigation when required plus retention of surplus flows for hydropower purposes. The presence of a storage scheme (i.e. regulation pond) and the efficiency of delivering irrigation water using pipes are planned as an integral part of the Kulekhani III HEP. This will greatly benefit the communities of Sanutar and Ghumane on completion of the project.

A.6.3 Rapti River – Khani Confluence to Tailrace Outlet

The Kulekhani III HEP would affect the section of the Rapti River from the Khani Khola confluence to the Tailrace Outlet just above the Samari Khola by a reduction in instantenous flows of more than 14.8 m^3/s. This reduction would be made up of 13.3 m^3/s of Kulekhani II HPP releases, 1.5 m^3/s from diverted Khani Kholas flows and Yangran Kohla flows retained for power generation. In the wet season, the quantity of water in Kesadi Khola would be increased by releases from the regulating pond during the monsoon season.

These reduced dry season flows in the Rapti River in effect mean a reversal to the flow approximating that prior to the implementation of Kulekhani I HPP (1982) and Kulekhani II HPP (1986). Maximums in mean monthly flows in this section of the Rapti River at present vary from 14.9 m^3/s in March and April to 35.7 m^3/s in August, including some 13.3 m^3/s of diverted flows. However, these do not reflect the peak flood flows, which reach an estimated 293 m^3/s for the 1:1 year flood. These peak flows associated with flooding are important as they cause changes in channels and the distribution of gravel and boulder material on the floodplain.

There are some benefits to these reduced flows in the Khani Khola to Tailrace Outlet section including:

- Greater availability of the causeway at Hetauda Cement Limited's headquarters due to cessation in peak flows in the flood season from generation at Kulekhani II HPP
- Improved access during low water at the Trikandeshwor Mahadev Temple associated with their main festival in October/ November
- Easier access for foot travelers at various locations of access across the Rapti River (e.g. Taubas and Kesadi/ Sanutar).

The changes in river flow patterns would have little impact on the patterns of use at Sundari Mai Ghat located on the Rapti River just downstream at Bhainsedobhan. Similarly the water quality would not undergo any appreciable changes except for slight increases in temperature associated with the lower volumes and no Kulekhani II HPP releases.

Adjustments to the two water-driven grinding mills and their channels located in the Rapti River in the immediate vicinity of Sanutar would be required but these would not be major extensions of their intakes. These channels are relocated each year to adjust to new channels caused by flooding.

The long term effects of reduced flows on the fish population are difficult to predict. It is probable that the following would occur:

- Beneficial changes to the indicated 13-14 species of fish and to the general status and biodiversity of aquatic fauna and flora (i.e. phytoplankton, zooplankton and insects) indicated for these regions through more regular dry season flows and no daily fluctuations
- Possible reductions to fish populations on a seasonal basis due to greater ease of fishing in shallower waters, particularly near the Khani confluence, the Sanutar and Bagjhora Khola regions.

Thus the overall impacts on the Khani Khola to Tailrace Outlet section of the Rapti River although they would be substantial from the viewpoint of changes in regime, are actually quite acceptable and would not cause environmental disruption or degradation. These changes should be viewed as reversing changes to the original regime and the associated ecosystems of the Rapti River; albeit severely altered by the 1993 flood, the Bagjhora Khola landslide and the 2002 floods as noted in Section 4.8.

A.6.4 Rapti River - Downstream of Tailrace Outlet

The operation of the Kulekhani III HPP would result in the release of up to 40 m^3/s into the Rapti River over the 17:00 to 21:00 period on a daily basis. This would result in regular daily fluctuations in river flow at the tailrace outlet zone (Supitar) in the dry season from 2.1 m^3/s to 42.1 m^3/s (Mean Monthly average for December to May) and in the wet season from 13.0 m^3/s to 53.0 m^3/s (Mean Monthly average for June to November). In general these flows would be confined to the dominant channels and less than the 290 m^3/s at 1:1 year flood levels.

Wet season releases during the flood periods should be reviewed and operating rules for the regulation pond set accordingly during the final design phase. The implications of such daily fluctuations in river levels would be experienced beyond Hetauda but are considered acceptable provided adequate mitigation measures are taken. These are outlined as part of the Social Action Plan (SAP) in Section 4.5 of the Final Report. A number of conclusions can be drawn from this study and field observations on this section of the Rapti River including:

- The increased width and depths of the Rapti River during releases requires use of a warning system to protect local residents who may be using the riverbed for activities such as bathing, washing clothes, ablutions or vehicle

washing or who have livestock grazing on the floodplains

- The potentials for dry season bridges to assist pedestrians are substantially reduced and may even be eliminated at certain locations but this will be mitigated by proposed suspension bridges at Manitar and possibly elsewhere as noted in the SAP
- The use of near river bed for vehicular traffic involved in stone collection may have to be adjusted by relocating roads upslope
- Irrigation intakes including in-river diversion structures for canals may need to be improved to cope with the fluctuating water levels (e.g. Mainitar (4 ha), Chauki Tole (20 ha) and Nawalpur-Basmadi (66 ha) irrigation schemes)
- River training or protection works could be required at selected locations (e.g. Mainitar) or near specific infrastructure (e.g. Chauki Tole Irrigation Intakes)
- Some adjustments may be needed to local channels for grinding mills (e.g. Mainitar area).

The results of the hydraulic analysis of the water surface profile by NEA were reviewed through a non-uniform flow analysis in Interim Report stage and a basic diagram of the effects prepared (i.e. Figure A.6.2). The water level variation of the peak discharge and its distribution has since been severely altered to changes in this river sector by the 2002 floods. This aspect will be reviewed during final design phase.

The entire question of land ownership on the Rapti River floodplains including parcels of land adversely affected (dereliction) by the 1993 and the 2002 floods needs assessment and ambient claims to compensation from Kulekhani III HEP are addressed in the Resettlement Plan.

The effects of these daily fluctuations on the fish population and the aquatic ecosystem would be adverse due to the regular switching between inundation and exposure of the river bank fringe community. This would affect the production of phytoplankton, zooplankton and aquatic insects, which are food for fish. Also temporary isolation of fish in pools under such a regime would make them more vulnerable to prey and to exploitation. In general, it must be assumed that the overall result would be some depletion in fish resources. However, only through detailed monitoring of the aquatic ecosystem at carefully selected sites could this be verified. This is a recommended monitoring measure for the operational stage of the project.

A.6.5 Similar Catchment – Rani Khola

The upstream Rani Khola was selected as a similar catchment to the Yangran Khola. However whilst they are similar from the water quality and size and orientation of the catchment, the Rani Khola is just that much higher, has a

steeper stream gradient and different natural vegetation, being in the Mabhurbat Range. It is also more heavily used for agriculture. This is clearly reflected in the trees and shrubs and climbers present in the Rani Khola and in the status of its wildlife population. The comparison between the Yangran and the Rani Khola baseline data is included by NESS. 2002 is included in Table A.6.1 to A.6.8. This comparison shows the Rani Khola to be limited but of definite value with respect to water quality and aquatic ecology. (i.e. phytoplankton, zooplankton and aquatic insects). The fisheries habitat in the lower reaches of the Rani Khola has been seriously degraded due to severe flooding during the 1993 floods and dry season flows are contained within the riverbed. Consequentially the fish population is much poorer. In view of the above, it is recommended that the Rani Khola be maintained for the water quality and aquatic ecology baseline monitoring program for the Kulekhani III HEP.

A.6.6 Yangran Watershed Management Program

The Yangran Watershed Management Program (YWMP) will cover the two Community Forests of Bodeaha and Keasadi/ Kilania and the reset of the Yangran catchment. It will be a program focused on controlling landslides, stabilization and revegetation of slopes (along the roads and around the regulating pond) and upliftment to the Forest User Groups. It will have to commence during construction stage because the remedial measures can not be left until the project is completed. This will require the Contractor and NEA to cooperate with the Forest User Groups.

The costs of setting up the YWMP are estimated at NRs, 70,000 in the early construction stage and NRs. 1,500,000 has been recommended provisionally for the 1st five years of the operational phase. However, all or part of this sum may need to be expended earlier. The Contractor will be required to deal with the local FUGs during the entire construction program to undertake stabilization, rehabilitation and revegetation works as they progress. His plans for this engagement of local FUGs and for the works will form an integral part of the Environmental Management Plan (EMP) presented at the poutset of the contract.

A.6.7 Fisheries Management Program

The fisheries management program for the Kulekhani III HEP during the operational phase will be necessary to mitigate the effects in the Yangran Khola and to ensure that the fish population in the Rapti River is maintained if not enhanced. To achieve this the following basic program is recommended:

- Stocking of the regulating pond with suitable native species of Carp and Rohu (Indian Carp)
- Experimental cage culture of native species in the regulating pond, depending on water quality, primary production (i.e. phytoplankton, zooplankton & aquatic insects) and resident fish population

- Stocking of selected native species in the Rapti River, focusing on the sector between the Khani Khola and Hetauda so that includes the affected zones

This program will use native species from existing fish producing facilities such as that at Hetauda Fisheries Research Station. The estimated costs of the program over the first five (5) years of the project's operational phase is NRs. 500,000; made up of NRs. 100,000 for stocking the regulation pond, NRs. 250,000 for experimental and cage culture development and NRs. 150,000 for the Rapti River fish stocking program. This program will have to have some type of monitoring for its effectiveness but this has not been included, as it is deemed an extension of the KESMU program. The costs of this fisheries program can be and should be revised late in the construction phase.

CHAPTER A.7 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

A.7.1 Background and Objectives

This Environmental Management Plan (EMP) relates to the Kulekhani III Hydroelectric Project and is based on utilizing the staff of the Environmental Department (ED) of Nepal Electricity Authority (NEA) for the main inputs. It follows the practice of previously constructed hydropower projects and findings of the EIA study, the Social Action Plan Framework (SAPF), the Resettlement Plan (RP) and the Public Consultation (PC) program. Organization charts and individual costs are allocated for each of the mitigation and monitoring measures over the design, construction and early operational phases of the project. It has been based on the approach to environmental management contained in the Supplementary Environmental Impact Assessment (SEIA). This plan covers the establishment of the Kulekhani III HEP Environmental and Social Management Unit (KESMU). Some consideration is also given to the roles of the various organization involved for effective implementation of the EMP.

The basic objectives of the Environmental Management Plan (EMP) include:

- Establish the KEMSU to ensure that all mitigation measures and monitoring requirements referred to in previous sections will actually be carried out development
- Define environmental management principles for the pre-construction, construction and operational phases of project development
- Establish the roles and responsibilities of all parties involved in respect of the EMP
- Delineate the mitigation measures and monitoring actions to avoid or mitigate adverse environmental impacts and maximizing the positive one
- Establish a for EMP supervision, monitoring and reporting
- Ensure that the environment of Kulekhani III HEP area and surrounding region are protected and developed to meet the needs of the local people, the stakeholders and safeguard the national interests. As well as those of NEA.

A.7.2 Environmental Legislation and Standards

As outlined in Section A.1.2 the Environmental Protection Act, 1996, And Environmental Protection Rules, 1997 are the main legal requirements and numerous other acts, rules and regulations and guideline from several agencies apply. The main ones are listed in Annex A1.

Since upgrading of the Kulekhani III HEP study is being funded by JIBC its must also meet their ‘ Guidelines for Environmental Consideration” (JIBC,2002).

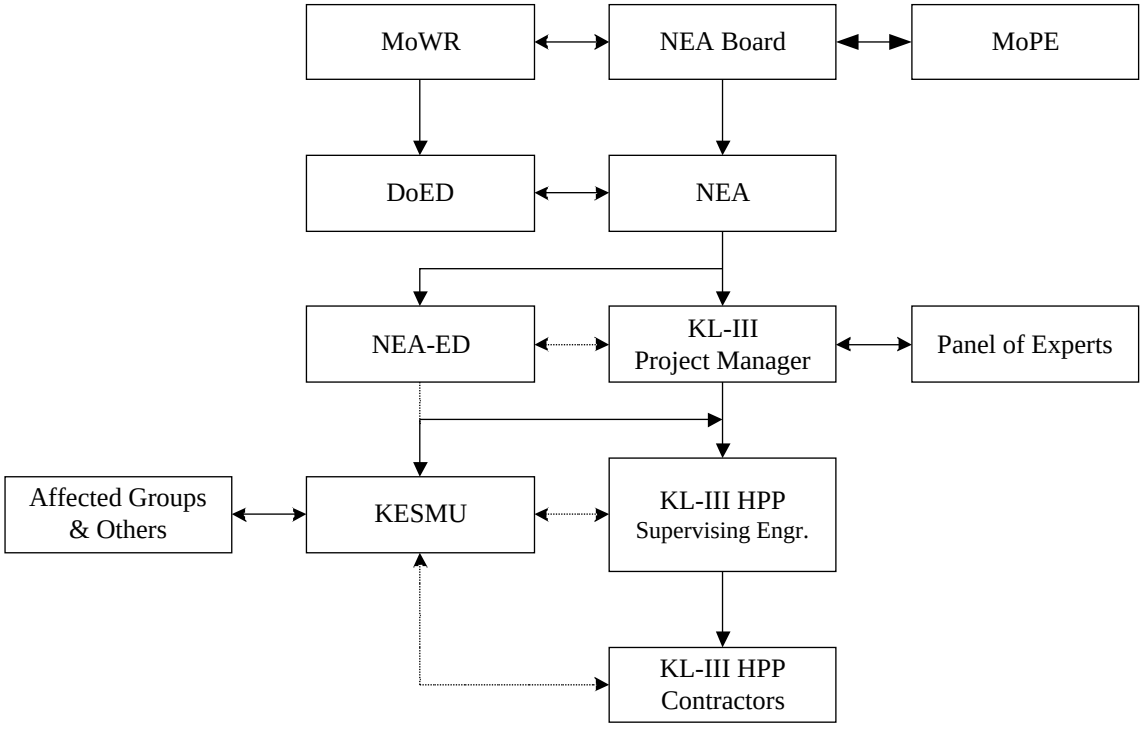
There are very few environmental standards in Nepal by MOPE or other HMG

line agencies. Only the vehicular mass emissions and the tolerance limits for effluent discharges to inland waters have been gazetted. The World Health Organization's (WHO) standard is often quoted for drinking water supply. The two standards relating to effluents and drinking water are included as Tables A.7.1 and A.7.2, respectively. As a consequence, reliance is made on other standards, these and examples of the applicable legislation (i.e. acts and guidelines) from other HMG Nepal autorities which are frequently applicable to hydroelectric projects are given in Annex A2.

A.7.3 Organization for Implementing Environmental Management Plan

The relative position of the Kulekhani III HEP and the Kulekhani Environmental and Social Unit (KESMU) to the NEA Environment Department (ED), the project, its supervising engineers, contractors and stakeholders is shown as follows: The overall responsibility of the KESMU are outlined in Table A.7.3.

Overview of KESMU Organization Project – Environmental Management Plan Structure - Construction Phase



A.7.4 Staffing and Estimated Costs for KESMU

In order to effectively implement the above actions the KESMU will be formed. The suggested composition of the KESMU is shown in the organization framework presented later. Kali Gandaki "A" HEP had a separate office named

Kali Gandaki A Environmental and Social Management Unit for undertaking that project's mitigation measures. At the Middle Marsyangdi HEP, a Resettlement and Rehabilitation Unit along with Environmental Monitoring Consultants look after both mitigation and monitoring measures.

This KESMU should be established at least six (6) months before the start of the project's civil construction. It primarily consist of key staff deputized from NEA's Environmental Department and has provision for a separate Environmental Monitoring Section (EMS), essentially made up of consultants. The KESMU shall function directly under the Project Manager but will co-ordinate with the Supervising Engineer, NEA's Environmental Department and stakeholders such as local VDCs, DDCs, NGOs and affected parties.

The KESMU will have four (4) major roles:

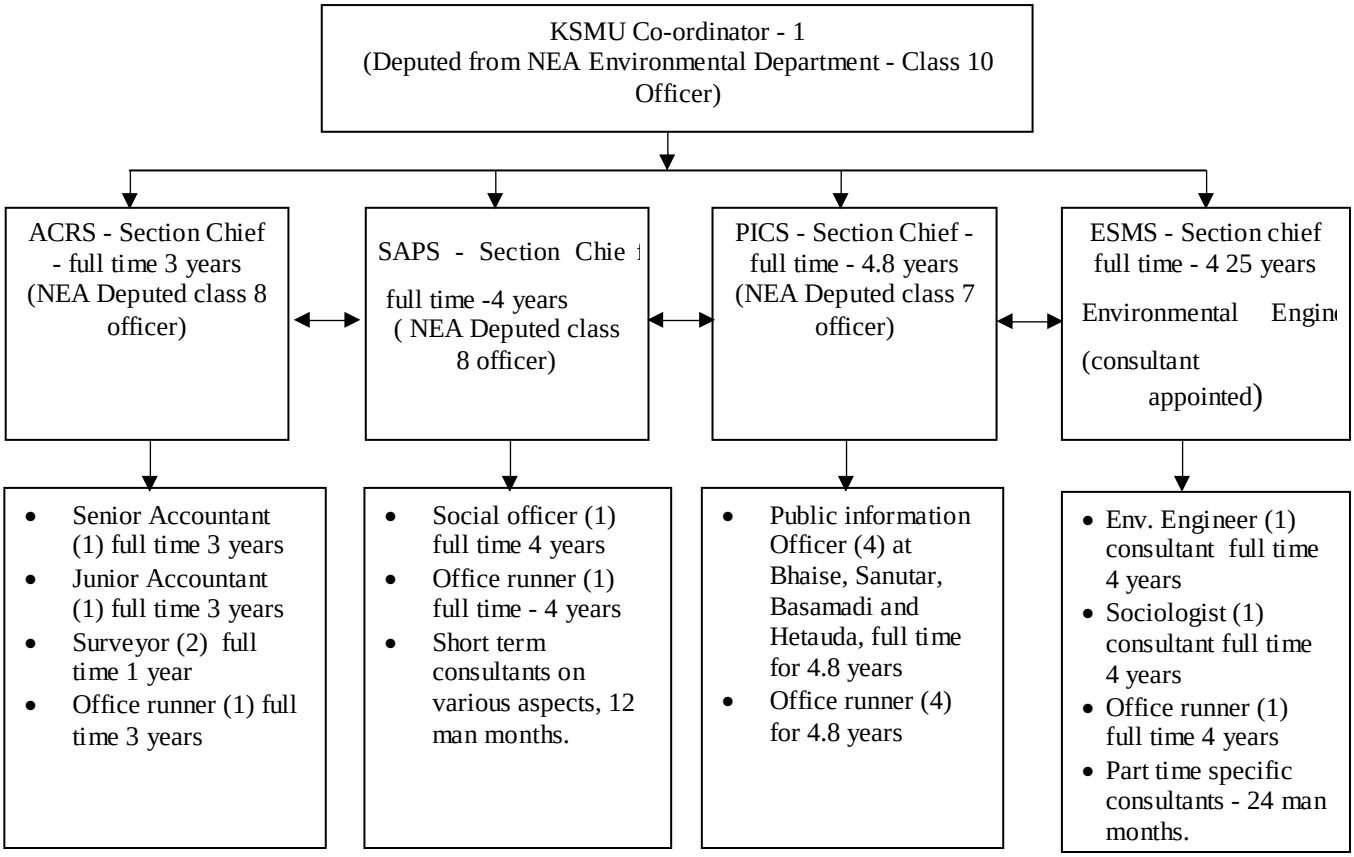
- Implementation and administration of land and property acquisition, compensation and resettlement and rehabilitation of affected parties as per the RP
- Implementation of the SAP in the project-affected areas
- Monitoring of the environmental and social indicators and measurement of the overall performance, as per the various conditions adopted for the EMP
- Co-ordination and liaison with project management and the different line agencies
- Dissemination of information to the project's stakeholders.

Accordingly it is recommended that there be four (4) sections within the KESMU as follows:

- Acquisition, Compensation and Resettlement Section (ACRS)
- Social Action Plan Section (SAPS)
- Project Information and Co-ordination Section (PICS)
- Environmental and Social Monitoring Section (ESMS)

Allocation of staff proposed for the KESMU is comprised of staff seconded from NEA Environment Department and a SMS Section comprised of consultants. This organization is shown as follows:

Organization Framework of KEMSU



NOTES:
1. ACRS section shall function 8 months before civil construction and shall run for 2.25 years in the construction phase. It is envisaged that all acquisition, compensation, and resettlement will be completed within three years
2. PICS section shall function 8 months before civil construction and shall run for the entire construction period of 4 years
3. ESMS sections shall function only for part time during detailed design and full time during construction.

The staffing allocations and from NEA and for the consultants and their associated costs are estimated in Table A.7.4. The office for the KESMU shall be established in the engineer's camp as a part of design and construction supervision team.

The supporting costs for equipment and operating costs for the KEMSU are estimated in Table A.7.5.

A.7. 5 EMP Mitigation and Monitoring Plans and Costs

The components of the environmental mitigation and monitoring plan covering the natural environment summarized in Table A.7.6.

The costs associated with the EMP for both the design and construction phase are estimated at NRs. 18,265,000 including a 10% contingency factor, which is approximately USD 240,000.

To complete the baseline monitoring prior to the start of construction will require

the use of consultants and have a high transport costs and the above costs for Item 1 are likely to be more expensive and have been estimated as NRs. 5,819,000. The final costs of the EMP for the Kulekhani III HEP will be revised for the loan agreement between NEA and JIBC.

(1) Mitigation Measures

The mitigation measures associated with this EMP as proposed by NESS for the natural environment are shown in Table A.7.7. Whereas those associated with the RP and the SAP are contained in the relevant sections. This table lists all those mitigation actions of the detailed design and construction stages including measures such as obtaining approvals, baseline assessment of local springs, surveys for the project area, establishment of camps and measures related to environmental and site rehabilitation.

(2) Monitoring Measures

Three types and levels of environmental monitoring are proposed and include:

- Impact or frontline monitoring during construction
- Independent monitoring to check on the contractor and KSEMU
- Panel of Experts monitoring.

(a) Impact monitoring

Regular impact or frontline environmental monitoring will be completed mainly by the contractor to the satisfaction of the KEMSU. The Environmental Monitoring Plan is outlined in Table A.7.8, which describes the EMP issues, the monitoring action required, individual party responsible, refers to standards and guidelines, timing of actions or frequency of monitoring and designates the responsible authority. Many of the monitoring measures required are to be included as clauses in the contract and where these are undertaken by KEMSU cost estimates are included.

(b) Independent monitoring

Independent monitoring has occurred rarely in respect to hydroelectric projects in Nepal. It is not specified in the JIBC guidelines but is considered essential and is being implemented at the Middle Marsyangdi HEP which is under construction (JIBC, 2002). Accordingly, an independent monitoring of the project is proposed for once in a year. The monitoring team shall comprise of environmentalist, sociologist and a socio-economist. The team may include representatives from MOWR, NEA-ED and MOPE's EIA Division. This costs of this independent monitoring is not included in the budgets but can be if requested by JIBC.

(c) Panel of Experts (POE) monitoring

This is an option on which NEA and JIBC will have to decide. The Khimti, Kali

Gandaki A and Middle Marsyangdi HEPs all had reviews and suggestions for the improvements in the project implementation by an appointed Panel of Experts.

A.7.6 Availability of Records

Compliance with environmental management will be executed by the construction contractors, who will maintain daily records of his mitigation implementation and monitoring works in retrievable forms at their office. The ESMS (KESMU) shall carry out monitoring works with the Supervising Engineers and prepare bi-monthly monitoring reports during construction phase. The ESMS shall also maintain the records of any corrective actions recommended to the contractor and its performance. The bi-monthly reports produced by the ESMS co-ordinating other sections of the KESMU work will be available to all of the stakeholders. Their comments and suggestions will be incorporated, as appropriate after approval by KHEP Project Manager.

The KESMU will compile an Environmental Monitoring Report for the entire project within 3 months of completion of the construction phase and submit this to KHEP. This report will be available to the stakeholders and will provide data for future reference on the environmental management works of the project.

A.7.7 Environmental Audit

As per Environmental Protection Rules, 1997 the Ministry of Population and Environment (MOPE) is required to prepare an environmental audit on the project two years after project construction. However, MOPE lacks adequate resources to cover such works and it is recommended that NEA consider funding the expenses involved.

A.7.8 Summary of Environmental Costs

The estimated costs of the EMP for the natural environment for the detailed design and construction phases are given in Table A.7.9.These cause exclude all those costs to be contained in the clauses applicable to the contractor who is responsible for many of the mitigation and monitoring measures. The estimated costs are subject to revision and review as more information on inputs is established. The total estimated costs are NRs.56,246,200 including a 10% contingency factor, which is approximately equivalent to USD 740,000.

CHAPTER A.8 RECENT HYDROLOGICAL EVENTS IN RAPTI WATERSHED

The recent hydrological history of the Rapti River watershed is most dynamic and warrants consideration. This is evident from the widespread damage and devastation caused to the Rapti River in the July, 1993 and the July, 2002 floods. This situation has been aggravated by the ongoing operations of Hetauda Cement Limited (HCL) and the large landslide, which occurred in the Baghjhora Khola. This slide occurred in September, 2001 and has been active ever since with major slides occurring in late May and late July, 2002 with the rainfall and storm event.

A.8.1 Storm Events and Floods in 1993

This storm event which was centered on central south of Nepal, had record rainfalls for 1,3 and 5 days and occurred in mid-July 1993 and averaged over 702 mm over 3 days at Nibuwater. This storm and resultant flooding caused widespread damage in terms of erosion, landslides, debris flow and deposition on the floodplains of the upper Rapti River. This included considerable losses of floodplain land in the Rapti River just North of Hetauda and in the Kesadi Khola/ Yangran Kohla/ Sanutar areas. Persons with land affected in the Rapti River by this flooding were claiming their lands would be again be affected by the Kulekhani III HEP. This was not the case.

A.8.2 Hetauda Cement Operations

Hetauda Cement Limited (HCL) has operated limestone quarries on both sides of the Rapti River located from Baghjhora Kola/ Taubas/ lower Khani Khola since the late 1960s. Random spoil disposal has caused problems to the Kulekhani II HEP in terms of uncontrolled debris in the Khani Khola. The Kulekhani II HPP had to undertake remedial action in the form of erecting selected check dams above the power station of its project.

A.8.3 Baghjhora Khola Landslide

In September, 2001 a major landslide occurred in the upper parts of the Bagjhora Khola catchment. Reportedly this was aggravated by the HCL activities in the area. The landslide affected the approach road to HCL's eastern quarry site and initially filled the creek bed that it excavated. Nevertheless large volumes of landslide material destroyed houses and termporarily blocked the Rapti River with material flows seen on the floodplain at Sanutar. This slide was partially cleared in both its fan and in the Rapti River to facilitate water flows. It was reactivated at the start of the wet season in June,2002 with extensive volumes of material (ie at least 25 thick and 500,000 m3) . During the 2002 floods of late July it again flowed depositing large boulders on the opposite right side of the valley and blocking the river. Natural releases of this swept downstream eroding banks and dumping excessive material in the vicinity of Sanutar.

A.8.4 Storm Event and Floods in 2002

Record rainfalls occurred in the upper Rapti River catchment with 1224 mm recorded over four (4) days in late July, 2002 at Nibuwatar. This caused widespread erosion of river banks and landslides throughout the area as noted below. The widespread damage in the vicinity of the HCL causeway, in the Sanutar area and in the Yangran and Kesadi Khola catchments are of particular concern. Also there is now compete downstream erosion of Rapti River riverbed lands, with no lands in the riverbed (i.e. limited floodplain lands as far as Hetauda). The overall erosion along the Tribhuvan Highway sections is severe with all riverbanks and retaining walls between Baisedobhan and Hetauda all exposed. This has been aggreviated by the instability of the Bagjhora Khola landslide. Extensive erosion occurred in the Sanutar/ Ghumane/ Ghumane Pari area, with erosion of all riverbanks, wiping out the irrigation intakes and initial canals and many landslides along the proposed access route to the damsite.

A.8.5 Present Status of Project Affected Areas

The present condition and status of the upper Rapti River and watershed, especially around those areas affected by the Kulekhani III HEP is uncertain and unstable. Floodplain sections of the Rapti River and the Khani, Yangran and Kesadi Khola and land around the regulation pond, in Sanutar and downstream sectors will require considerable works to stabilize future landslides and erosion. This directly affects the Kulekhani III HEP in a number of ways, including:

- Headworks - The need to consider underground structures or extensive river course stabilization from the Khani Khola Check Dam to the confluence and in the lower section of the Rapti River/ Khani Khola confluence area and upstream on the Rapti River in the immediate area of the confluence and Bhaisedobhan
- Work Adit and Access Road – This area was subject to erosion in the recent 2002 floods and requires careful planning of any raising of the HCL causeway and provisions of means of passing the landslide material from small direct tributaries to the Rapti River carrying HCL spoil and debris
- Spoil Bank A – This is now located just upstream of the Baghjhora landslide, the river course passes through the area and its long term use for spoil disposal questionable. It may pay to reconsider relocating Spoil Bank upstream to the playground park opposite the Work Adit , with subsequent reclamation of the area, as it was damaged in the floods
- Sanutar and Main Access Road – Several (at least six) slides now directly affect the proposed via Sanutar/ Ghumane route which will require stabilization both upslope and downslope and consideration of how to

integrate the defunct Sanutar irrigation canal into their development. Also the access road along the right bank of the Rapti River will require stabilization works and consideration of debris passing invert in the creek to the north of Sanutar

- Regulation Pond, Access Road and Check Dams- This area has been subject to severe erosion and at least three landslides including the areas around the Tunnel Portal and it is recommended that the Kulekhani III HEP implement a Yangran Watershed Management Plan (YWMP) including those areas downstream along both banks of the Yangran (i.e. Ghumane (construction camp) and Ghumane Pari
- Open Cut across the Kisade Khola and Spoil Banks B and C – These areas have substantial new debris including trees and a major landslide at the open cut crossing location. This does not impede their use for spoil disposal but makes stabilization (ie extensive retaining walls) of the outer banks, some locations downslope of the access road and all around the open cut mandatory, not only for slope stability purposes but for safety and protection of remaining properties in the Sanutar area. It is also recommended that the river bank stabilization in Bokedaha area be implemented along the Kesadi Khola from the Yangran Khola to the Rapti River confluence
- Access Road, Tailrace Channel and Spoil Bank D Area- The access road from Kholpani has been washed away and presents a problem due to limited access in this zone, further aggradation of the landslide material in this fan at Khoplpani and changing course of the Rapti River may require final design consideration including the angle of the channel entrance due the experience of large flows in the Samari Khola meeting those of the heavy sediment loads in the Rapti River
- Downstream Rapti River – Complete changes in the location and sediment deposits have occurred in the Rapti River downstream with major erosion of the left bank located floodplain irrigation fields from Chautikole through to Hetauda East West Highway. Both irrigation intakes. The two water mills and approximately 40% of the irrigation lands were washed away in the floods.

  The situation in all areas will alter again with even a limited flood flows. As a consequence, continued awareness of the proposed actions by other Nepalese authorities including District bodies and the HCL and Royal Nepalese Army located at Supitar should be considered during final design. The Kulekhani III HEP will probably have to accept and initiate river bank stabilization works beyond its normal boundaries of influence. It is particularly emphasized that the entire Yangran Watershed Management Plan (YWMP) be implemented as integral to the project.

TABLES

Part A

Table A.2.1 Supplemental Natural Environmental Impact Assessment Survey

	Items	Purpose	Location	Duration
1.	Water Quality	Sampling of water quality: 9 points Parameter to be measured : 11 Flow velocity (m/s), Discharge (m^3/s), Ambient temperature (^oC), PH, Conductivity, Suspended solids (SS), Dissolved oxygen (DO), Biological oxygen demand (BOD), Total phosphorous (P), Total nitrate (N), and Ammonia (NH3)	① Khani Khola: upstream (UP)of KL II tailrace ② Khani K: downstream (DS) of KL II tailrace ③ Rapti K: 1 km DS of Khani Khola at Tauba ④ Rapti: 0.5 km DS of large slide on Bagihara K ⑤ Yangran K: 0.8km US of confluence with Kesadi ⑥ Kesadi K: Below confluence of Yanrgran ⑦ Rapti K: Below KL III outlet ⑧ Rapti K: Hetauda/ Thanabaran Bridge ⑨ Rani K: UP of Churibagaicha Bridge (Similar)	Each 15days in April (dry season) and August (wet season) 2002
2.	Comparison with Adjacent Catchment	Survey of similar ecosystem in neighboring rivers in the vicinity of KL III to prepare mitigation measures against impacted ecosystem in the case that it is possible that the current ecosystem will be largely changed by KL III in the Khani River and the Yangran Rivers	① Khani River ② Yangran River ③ Rani River (Similar ecosystem)	Each 15days in March (dry season) and June (wet season)
3.	Fisheries and Aquatic Ecology (Insects, Aquatic life and Fish)	Survey of impacts on insects, aquatic life and fish in the Khani and Yangran rivers by taking the water at the Khani headworks and the Regulating dam at the Yangran River	① 300m section between KL III tailrace outlet and the confluence of the Khani and the Rapti ② 1,500m section between the Yangran regulating dam and the confluence of the Yangran and Kesadi rivers ③ Rani River (Similar ecosystem)	Each 15days in March (dry season) and June (wet season)
4.	Fauna and Flora Surveys	Survey of fauna and flora inhabiting in the vicinity of KL III for grasping and assessing the degree of impact on fauna and flora	Fauna: Yangran river basin and Raniriver basin Flora: Yangran river basin All access road and camp area Khani headworks Regulating pond Tailrace outlet Adits and spoil banks	Each 15days in March and June
5.	Downstream Consequence (Release of peak discharge)	Survey of impacts on land use and downstream inhabitants by releasing of $40.1m^3/sec$ from the KL III tailrace outlet in the riverbed of the Rapti River	4km downstream from the KL III tailrace outlet in the Rapti River	Each 15 days in March and June
6.	River Maintenance Flow	Survey of the discharge in dry season and the irrigation water used in the Khani River and the Yangran River to prepare the data for determination of the river maintenance flow in the Khani and Yangran rivers	① 300m upstream from the confluence of the Khani and Rapti rivers ② 1.8km upstream from the confluence of the Kesadi and Yangran rivers	15days in March
7.	Environmental Risk	Survey of possibility of landslide and erosion in the vicinity of KL III since KL III is located at the Mahabarat Range and just upstream of MBT, and there is a possibility of further landslides and erosions	Vicinity of KL III	15day in June
8.	Spoil Disposal	Survey of impact by spoil disposal produced by excavation works of KL III	① Main structure sites ② Spoil areas	15days in June
9.	Dust, Noise and Vibrations	Survey of impacts by dust, noise and vibration during construction of KL III	① Sanutar and Shikaribas villages along access road and base camp ② Bhaisedobahan in the Khani headworks	7days in March and 15days in June
10.	Environment Management Plan	Review of all mitigation and monitoring proposed in the EIA	-	15days in August

Table A.2.2 Supplemental Social Environmental Impact Assessment Survey (1/2)

	Item	Purpose	Location and Reference Data	Duration
1.	**Resettlement Plan**	**(RP)**		
1.1	Scope of Land Acquisition and Resettlement	Survey of boundary areas showing permanent and temporarily acquired land, identifying Project 'footprints' (camps, quarries, spoil, facilities, etc), land use (including economic, cultural and religious areas of significance) etc. affected by KL III in scale of 1: 5,000. Identify alternate Project sites for minimizing land acquisition impacts.	① Sanutarr and Shikaribas villages along access road and in base camp ② KL III Tailrace outlet, including affected & acquired areas downstream (small temporary bridges, water mills, washing areas, etc). ③ Intake at Bhaise-Dhoban (Hetauda Cement Lease, KL II Boundaries)	30 days in March, 2002
1.2	Socio-economic Information	Updating of existing database of socio-economic information in the vicinity of KL III	Around KL III project area	15 days in March, 2002
1.3	Policy Framework and Entitlement	Survey of policy, framework and entitlement in Nepal for compensation of household, land, crops and trees, displacement allowances and rehabilitation measures, government property and community facilities Entitlement will be followed by Community Consensus Valuation （CCV）process for land compensation rates in KGA.	Kali Gandaki "A"(KGA), Middle Marsyangdi, Arun III, Modi Khola, Kimiti, Bhote Kosia HPPs and Melamchi Water Supply Project (MWSP)	15days in April 2002
1.4	Consultation and Grievance Redress Participation	Survey of consultation, grievance redress participation. Establishment of Village Advisory Committee（VACs） and KL III Environmental and Social Management Unit (KESMU) will be proposed by referring to KGA	VACs of KGA	15days in April 2002
1.5	Relocation of Housing and Settlements	Survey of existing policy for relocation of housing and settlement	KGA experience and policy of Melamchi Water Supply Project and Middle Narsyandi	15days in April 2002
1.6	Income Restoration Strategy	Survey of income restoration strategy for compensation of PAFs/SPAFs by skill training, project employment, and support for funds and income-generating scheme	PAFs/SPAFs in project areas, especially Sanutarr villages along access road and base camp and households affected by KL III tailrace outlet	15days in April 2002
1.7	Institutional Framework	Survey of institutional framework	NEA and Project Levels	15days in March 2002
1.8	Resettlement Budget and Financing	Updating and itemization of budget and financing of resettlement in NEA's EIA	-	15days in June 2002
1.9	Draft Implementation Plan	Preparation of Implementation Plan	-	15days in June 2002
1.10	Draft Monitoring & Implementation Plan	Preparation of Draft Monitoring & Implementation Plan	-	15days in June 2002
1.11	Spring water and surface water survey	Spring water and surface for utilization of domestic water for villagers on ridges and hills along tunnels and cavern	Amdada, kitini, Kiteni, Nayagaun, Sanutar, Shikaribas, Bokedah akong connection tunnel, headrace tunnel, tailrace and cavern	15days in June and October2002

Table A.2.2 Supplemental Social Environmental Impact Assessment Survey (2/2)

2.	**Social Action Plan** （SAP）			
2.1	Skill Development & Project Employment	Survey of skill training and local employment for PAFs and SPAFs; (Community & Stakeholder Consultation for all SAP components)	Project area	Each 15days in March and June
2.2	Agricultural Development	Survey for minimization impacts on the existing 25ha (40 family) irrigated rice fields at Sanutar Village by review of KGA agricultural development program	Sanutar Village（25ha (40 family) irrigated rice fields）	Each 15days in March and June
2.3	Community Development	Survey of community development program by referring to KGA experience	NEA's EIA and KGA experience	Each 15days in March and June
2.4	Community/Public Health & Education Enhancement	Survey of local education and health facilities affected by influx of about 1,000 workers., including program of adequate schooling, sanitation facilities and health clinic (with HIV-AIDs prevention public education, etc)	Project area	Each 15days in March and June
2.5	Rural Electrification	Assessment of current situation and ongoing program for rural electrification in the vicinity of KL III	① Bhainse VDC (Village Decvelopment Committee) ② Basamadi VDC	Each 15days in March and June
2.6	Environment Awareness（EAC）	Survey of habitat destruction and negative effects of slash-and-burn agriculture for education of local community	① Sanutar and Shikaribas villages ② Bokedaha Forest (KL III tailrace outlet)	Each 15days in March and June
2.7	Direct Construction Social Impacts Mitigation	Survey of direct impacts during construction such as spoil, dust, noise and vibration	Sanutar and Shikaribas villages	Each 15days in March and June
2.8	Siren Warning System	Survey of impact by releasing peak discharge of 40m3/sec from KL III tailrace outlet in the Rapti River of 4km downstream from the outlet	Rapti River of 4km downstream from the outlet	Each 15days in March and June
2.9	Trikandi Mandir – Water Release	Possible water release for annual fair at temple complex just below Bhaise-Dhoban.	Bhaise Dhoban, below KLII Powerhouse	Each 7days in March and August

Table A.4.1 Results of Water Quality Sampling Kulekhani III HEP

Parameters Tested	Dry Season – March 2002 (Ave 9 Sites)	Wet Season – June 2002 (Ave. 9 Sites)
Temperature OC	20.0	25.5
PH	8.44	8.21
Conductivity – umhos/ cm	169	169
Total Suspended Solids –TSS - mg/l	10.0	642.0
Total Phosphorus – P - mg/l	0.04	0.20
TKN – mg/l	0.55	0.85
Ammonium – NH3 - mg/l	<0.05	0.10
Nitrates – NO3 – mg/l	0.80	0.88
Nitrites – NO2 - mg/l	<0.01	<0.01
Dissolved Oxygen – DO - mg/l	8.28	8.17
Biological Oxygen Demand – BOD -mg/l	1.69	0.58

Table A.4.2 Water Quality Monitoring Results – Dry Season - March 2002

S.N.	Parameters	Observed Values								
		1	2	3	4	5	6	7	8	9
1.	Flow Velocity, (m^2/s)	0.359	0.725	0.814	0.770	0.460	0.506	0.154	0.245	0.255
2.	Discharge, (m^3/s)	0.17	0.951	6.86	5.04	5.44	5.71	0.15	0.05	0.075
3.	Ambient Temperature, (^{o} C)	22	22	17	17	21	20	21	21	18
4.	PH	8.5	8.6	8.4	8.5	8.5	8.5	8.7	8.4	7.9
5.	Conductivity, (µmhos/Cm)	202	244	152	140	153	163	244	150	71
6.	Total Suspended Solids, (mg/l)	55.2	3.6	2.8	2.8	9.6	2.8	3.2	8.8	1.2
7.	Total Phosphorous, (mg/l)	0.063	0.035	0.023	0.020	0.023	0.030	0.015	0.033	0.103
8.	TKN, (mg/l)	0.70	0.70	1.41	0.70	0.53	0.70	0.53	0.53	0.53
9.	Ammonia, (mg/l)	0.05	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)	N. D. (<0.05)
10.	Nitrate, (mg/l)	0.78	0.88	0.96	1.10	0.88	0.88	0.29	1.10	0.29
11.	Nitrite, (mg/l)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)	N. D. (<0.01)
12.	Dissolved Oxygen, (mg/l)	7.8	7.8	8.2	8.8	8.3	9.3	8.2	8.0	8.1
13.	BOD_5, (mg/l)	1.63	1.47	1.42	1.33	2.13	1.92	1.27	1.54	2.5

Note: N. D.: Not Detected.

Table A.4.3 Water Quality Monitoring Results –Wet Season - June, 2002

S.N.	Parameters	Observed Values								
		1	2	3	4	5	6	7	8	9
14.	Flow Velocity, (m^2/s)							1.19	0.42	0.24
15.	Discharge, (m^3/s)							2.97	0.65	0.094
16.	Ambient Temperature, (^{o} C)	26	27	23	24	28	26	26	25	25
17.	PH	8.3	8.6	8.2	8.1	8.4	8.2	8.1	8.2	7.8
18.	Conductivity, (µmhos/Cm)	203	191	153	174	185	210	124	116	74
19.	Total Suspended Solids, (mg/l)	46	33	12	1763	94.5	157	3672	<1	<1
20.	Total Phosphorous, (mg/l)	0.32	0.05	0.10	2.42	0.26	0.31	1.77	0.11	0.30
21.	TKN, (mg/l)	0.70	0.52	0.87	1.05	0.52	0.87	1.74	0.52	0.87
22.	Ammonia, (mg/l)	0.12	0.09	0.07	0.13	N.D. (<0.05)	0.07	0.12	0.17	0.07
23.	Nitrate, (mg/l)	1.33	0.78	1	1	0.9	1.33	0.90	0.66	N.D.(< 0.05)
24.	Nitrite, (mg/l)	N.D. (<.01)	N.D. (<.01)	N.D. (<.01)	N.D. (0.01)	N.D. (<0.01)	N.D. (<0.01)	0.03	N.D. (<0.01)	N.D. (<0.01)
25.	Dissolved Oxygen, (mg/l)	8.7	7.6	9.3	8.5	8.2	7.8	7.6	7.9	7.9
26.	BOD_5, (mg/l)	0.61	0.7	0.94	0.33	0.68	0.81	0.35	0.67	0.10

Note: N. D.: Not Detected.

NOTE:

1: Khani Khola adjacent to the KUL II Power House , 2: Rapti River, Upstream of Khani Khola Confluence; 3: Rapti River, Downstream of Khani Khola Confluence; 4: Rapti River, Upstream of Bodegha Khola; 5: Rapti River, Downstream of Samari Confluence; 6: Rapti River, Upstream of East-West Highway Bridge; 7: Kesadi Khola, Downstream of Yangrang Confluence; 8: Yangrang Khola, Downstream of Regulating Pond; 9: Rani Khola, Upstream the confluence with Rapti River.

Table A.4.4 Results of Spring Survey – Wet Season – June 2002

SN	Site No	Location Village	VDC-ward	Source Name	Source Type	Water using community	No. of HH	Average June Discharge (lps)	Pipe Line Supply (Yes/No)	Purpose
	B1	Bokedaha	Basmadi-9	Kundali Nag Kholcha	Spring	Bokedaha	1	0.58	NO	Drinking, Irrigation, Cattle feeding
	B2	Bokedaha	Basmadi-9	Kamansingh Kholcha(Dewali Kholcha)	Spring	Bokedaha	3	0.44	NO	Drinking during Dewali Puja, Trekkers,
	B3	Bokedaha	Basmadi-9	BokedahaKholcha - East	Spring	Bokedaha	1	0.19	YES	Drinking, Irrigation, Cattle feeding
	B4	Bokedaha	Basmadi- 9	BokedahaKholcha -WEST	Spring	Bokedaha	6	1.12	YES	Drinking, Irrigation
	S1	Sanotar	Bhaise-6	Kadam Kholcha -East	Spring	Sanotar	4	0.21	YES	Drinking
	S2	Shikaribas	Bhaise-6	Chepang Kholcha	Spring	Sanotar,Ghumaune	40	1.41	YES	Drinking
	Sh1	Shikaribas	Bhaise-6	Kadam Kholcha -East	Spring	Shikaribas	3	1.14	NO	Drinking
	Sh2	Shikaribas	Bhaise-6	Kadam Kholcha -West	Spring	Shikaribas	2	0.049	NO	Drinking
	Sh3	Shikaribas	Bhaise-6	Kadam Kholcha -West	Spring	Sanotar	7	0.14	YES	Drinking
	N1	Nayagaon	Bhaise-8	Nayagaon Kholcha-South	Spring	Nayagaon	12	3.19	YES	Drinking
	N2	Nayagaon	Bhaise-8	Nayagaon Kholcha-North	Spring	Nayagaon	2	1.28	YES	Drinking
	N3	Nayagaon	Bhaise-8	Sungure Kholcha	Spring	Sungure Tole - Nayagaon	5	8.23	YES	Drinking
	N4	Nayagaon	Bhaise-8	Sano Kholcha	Spring	Nayagaon	5	0.326	YES	Drinking
	N5	Nayagaon	Bhaise-8	Thulo Kholcha	Spring	Nayagaon	5	6.86	YES	Drinking
	N6	Nayagaon	Bhaise-8	Nayagaon Kuwa	Spring	Nayagaon	18	1.12	NO	Drinking, Cattle feeding, Bathing
	N7	Nayagaon	Bhaise-8	Chharara Kholcha	Spring	Nayagaon	16	1.14	YES	Drinking

	N8	Nayagaon	Bhaise-8	Adhrak Kholcha	Spring	Shikaribas	18	1.86	YES	Drinking
	K1	Kitini	Bhaise-8	Kitni Khola Kholcha (Upstream)	Spring	Kitni	45	0.89	YES	Drinking
	K2	Kitjni	Bhaise-8	Kitni Khola Kholcha (Middle)	Spring	Kitni	15	2.26	YES	Drinking
	K3	Kitini	Bhaise-8	Kitni Khola Kholcha (Downstream)	Spring	Cement factory Canteen at Amdada and Kitni	1	1.82	YES	Drinking, Irrigation
	Na1	Nakauli	Basmadi-9	Tower Ko Kholcha	Spring	Nakauli	3	0.41	YES	Drinking, Irrigation
	Na2	Nakauli	Basmadi-9	Nakauli Kholcha	Spring	Nakauli	1	0.163	NO	Drinking

NOTE: lps = litres per second; which is a standard measurement for groundwater flows

Table A.4.5 Results of Spring Survey – Dry Season – October 2002

SN	Site No	Location Village	VDC-ward	Source Name	Source Type	Water using community	No. of HH	Average October Discharge (lps)	Pipe Line Supply (Yes/No)	Purpose
23.	B1	Bokedaha	Basmadi-9	Kundali Nag Kholcha	Spring	Bokedaha	1	0.46	NO	Drinking, Irrigation, Cattle feeding
24.	B2	Bokedaha	Basmadi-9	Kamansingh Kholcha (Dewali Kholcha)	Spring	Bokedaha	3	0.40	NO	Drinking during Dewali Trekkers,
25.	B3	Bokedaha	Basmadi-9	BokedahaKholcha – East	Spring	Bokedaha	1	0.36	YES	Drinking, Irrigation, Cattle feeding
26.	B4	Bokedaha	Basmadi- 9	BokedahaKholcha –WEST	Spring	Bokedaha	6	3.00	YES	Drinking, Irrigation
27.	S1	Sanotar	Bhaise-6	Kadam Kholcha – East	Spring	Sanotar	4	1.25	YES	Drinking
28.	S2	Shikaribas	Bhaise-6	Chepang Kholcha	Spring	Sanotar,Ghumaune	40	1.33	YES	Drinking
29.	S3	Sanotar	Bhaise-6	Bhalu Kholcha	Spring	None	Non	0.047	NO	-
30.	Sh1	Shikaribas	Bhaise-6	Kadam Kholcha – East	Spring	Shikaribas	3	0.07	NO	Drinking
31.	Sh2	Shikaribas	Bhaise-6	Kadam Kholcha – West	Spring	Shikaribas	2	0.176	NO	Drinking
32.	Sh3	Shikaribas	Bhaise-6	Kadam Kholcha – West	Spring	Sanotar	7	0.50	YES	Drinking
33.	N1	Nayagaon	Bhaise-8	Nayagaon Kholcha-South	Spring	Nayagaon	12	0.11	YES	Drinking
34.	N2	Nayagaon	Bhaise-8	Nayagaon Kholcha-North	Spring	Nayagaon	2	2	YES	Drinking
35.	N3	Nayagaon	Bhaise-8	Sungure Kholcha	Spring	Sungure - Nayagaon	5	1.33	YES	Drinking
36.	N4	Nayagaon	Bhaise-8	Sano Kholcha	Spring	Nayagaon	5	1.33	YES	Drinking
37.	N5	Nayagaon	Bhaise-8	Thulo Kholcha	Spring	Nayagaon	5	0.04	YES	Drinking

38.	N6	Nayagaon	Bhaise-8	Nayagaon Kuwa	Spring	Nayagaon	18	0.33	NO	Drinking, Cattle feeding, Bathing
39.	N7	Nayagaon	Bhaise-8	Chharara Kholcha	Spring	Nayagaon	16	2.16	YES	Drinking
40.	N8	Nayagaon	Bhaise-8	Adhrak Kholcha	Spring	Shikaribas	18	0.49	YES	Drinking
41.	N9	Nayagaon	Bhaise-8	Ratmate Kolcha - East	Spring	Ratmate Tole - Nayagaon	1	0.88	NO	Drinking
42.	N10	Nayagaon	Bhaise-8	Ratmate Kolcha - West	Spring	Ratmate Tole - Nayagaon	1	1.40	NO	Drinking
43.	N11	Nayagaon	Bhaise-8	Nayagaon – Tallo Kholcha	Spring	Nayagaon	1	0.057	NO	Drinking
44.	K1	Kitini	Bhaise-8	Kitni Khola Kholcha (Upstream)	Spring	Kitni	45	1.64	YES	Drinking
45.	K2	Kitini	Bhaise-8	Kitni Khola Kholcha (Middle)	Spring	Kitni	15	0.44	YES	Drinking
46.	K3	Kitini	Bhaise-8	Kitni Khola Kholcha (Downstream)	Spring	Cement factory Canteen at Amdada and Kitni	1	0.53	YES	Drinking, Irrigation
47.	Na1	Nakauli	Basmadi-9	Tower Ko Kholcha	Spring	Nakauli	3	1.12	YES	Drinking, Irrigation
48.	Na2	Nakauli	Basmadi-9	Nakauli Kholcha	Spring	Nakauli	1	0.41	NO	Drinking
49.	Y1	Shikaribas	Bhaise-6	Shikaribas Kholcha –1	Spring	None	None	0.94	No	-
50.	Y2	Shikaribas	Bhaise-6	Shikaribas Kholcha-2	Spring	None	None	0.34	NO	-
51.	Y3	Shikaribas	Bhaise-6	Shikaribas Kholcha-3	Spring	None	None	0.36	NO	Drinking, Bathing by construction workers at Tunnel

NOTE: lps = litres per second; which is a standard measurement for groundwater flows

Table A.4.6 Summary Results from Spring Survey in Wet and Dry Seasons – 2002- Kulekhani III HEP

Location and User Village	Number of Springs	Number of HHs	Flow in lps		With PVC Pipe to Communities	Purposes
			June-Wet	Oct-Dry		
Nakoligaoan	2	4	0.16 –0.41	0.41 –1.12	1 spring with pipe	Drinking & Irrigation
Bokedaha	4	11	0.19 – 1.12	0.36 –3.00	2 springs with pipe	Drinking, Irrigation & Stockwater
Sanutar & Ghumane	3	51	0.14 – 1.41	0.05 –1.33	3 springs with pipe	Drinking
Shikaribas	3	23	0.05 –1.86	0.07 –0.50	2 springs with pipe	Drinking
Nayagaon	8	63	0.33 – 8.23	0.04 –2.16	7 springs with pipes	Drinking & Stockwater
Kitni	3	61 + Industry	0.39 – 2.26	0.44 –1.64	3 springs with pipe	Drinking, Stocwater & Canteen
NEA Tunnel Adit	3	-	-	0.34 –0.94	No pipes	Drinking
TOTALS	**27**	**213**	**0.05 –8.23**	**0.04 –3.00**	**18**	**-**

NOTE: lps = litres per second; which is a standard measurement for groundwater flows

Table A.4.7 Occurrences of Tree Species at Sampling Sites

S.n	Tree Species	Study Area								
		1	2	3	4	5	6	7	8	9
1.	*Adina cordifolia*			*	*					
2.	*Acacia catechu*		*							
3.	*Aesandra butyracea*				*					
4.	*Albizia procera*			*			*			
5.	*Alnus nepalensis*				*					*
6.	*Anthocephalus chinensis*			*	*					
7.	*Bassia butyracea*			*						*
8.	*Bauhinia vahlii*									*
9.	*Bauhinia variegata*		*	*	*	*				
10.	*Bombax ceiba*			*	*					
11.	*Buchania latifolia*			*						
12.	*Dalbergia sisso*		*			*				
13.	*Emblica officinalis*									*
14.	*Engelhardia spicata*					*				*
15.	*Ficus auriculata*				*					
16.	*Ficus semicordata*		*	*		*				
17.	*Garuga pinnata*	*		*	*		*			
18.	*Hydrangea anomala*	*		*	*		*		*	
19.	*Lagerstroemia perviflora*	*		*	*		*			
20.	*Mallotus philippensis*			*	*		*		*	*
21.	*Mangifera indica*		*	*		*				
22.	*Michalia champaca*			*	*					
23.	*Neolitsae umbrosa*				*		*			*
24.	*Phylanthus emblica*		*		*					
25.	*Pinus roxburghii*									*
26.	*Prunus cerasoides*			*	*					
27.	*Prunus persica*		*							
28.	*Psidium guajava*					*				
29.	*Rhus javanica*	*					*			
30.	*Rhus succedaena*				*					*
31.	*Sapium insigne*	*			*		*			
32.	*Schima wallichii*				*					*
33.	*Shorea robusta*			*	*	*	*			*
34.	*Spondias pinnata*	*		*	*					
35.	*Terminalia alata*			*	*	*				
36.	*Terminalia chebula*			*	*					
37.	*Trivia nudiflora*			*			*			
38.		6	7	20	22	8	10	0	2	11

Note: Study area 1= Headwork Area; 2 = Plot Study Powerhouse Area; 3 = Access Road Area, 4= Reservoir Area (Yangran Catchment); 5= Tailrace Area; 6= Adit Area (Ward No. 1 of Bhainse VDC); 7= Disposal Area (Near Tribhuwan Highway); 8= Disposal Area Opposite Ghumaune Settlement; 9= Rani Khola Catchment

Table A.4.8 Occurrences of Shrub & Climber Species at Sampling Sites

	Shurbs & Climbers Species	**Study Area**								
		1	2	3	4	5	6	7	8	9
1.	*Acacia pennata*			*						
2.	*Acacia pinnata (s)*	*					*			
3.	*Accacia pennata(s)*				*	*				
4.	*Adhatoda vasica (s)*	*	*	*	*	*	*			*
5.	*Ageratum conyzoides (s)*	*	*		*	*	*		*	*
6.	*Bauhinia vahlii (cl)*			*	*					*
7.	*Boehmeria macrophylla (s)*			*						
8.	*Dioscorea bulbifera (cl)*			*	*					
9.	*Dioscorea pentaphylla (cl)*			*	*					
10.	*Eupatorium adenophorum (s)*				*				*	
11.	*Ipomea spp. (cl)*		*		*					
12.	*Lyonia ovalifolia (s)*	*		*	*				*	
13.	*Mimosa pudica(s)*			*						
14.	*Mimosa rubicaulis (s)*	*		*	*		*			
15.	*Phyllanthus parvifolius(s)*									*
16.	*Rubus elipticus (s)*	*		*	*		*			
17.	*Solanum erbascifolium (s)*	*								
18.	*Solanum spp.(s)*				*					
19.	*Solanum verbascifolium (s)*	*		*	*		*		*	*
20.	*Trachelospermum fragrans (cl)*			*	*					*
21.	*Woodfordia fruticosa (s)*	*	*	*	*		*		*	*
22.	*Zizyphus mauritiana (s)*			*	*				*	
23.		9	4	14	16		7	0	6	7

Note: Study area 1= Headwork Area; 2 = Plot Study Powerhouse Area; 3 = Access Road Area, 4= Reservoir Area (Yangran Catchment); 5= Tailrace Area; 6= Adit Area (Ward No. 1 of Bhainse VDC); 7= Disposal Area (Near Tribhuwan Highway); 8= Disposal Area Opposite Ghumaune Settlement; 9= Rani Khola Catchment

Table A.4.9 Occurrences of Herbs & Grasses Species at Sampling Sites

S.n	**Herbs Species**	**Study Area**								
		1	2	3	4	5	6	7	8	9
1.	*Agave Americana (h)*	*	*			*	*			
2.	*Ageratum conyzoides (h)*			*					*	
3.	*Ananas comosus(h)*					*				
4.	*Artemisia indica (h)*		*		*	*			*	*
5.	*Artemisia vulgaris* (h)	*					*			
6.	*Bambusa arundinacea (h)*				*	*				
7.	Boehmeria macrophylla (h)	*					*			
8.	*Brea arvensis((h)*					*				
9.	*Centela asiatica (h)*	*			*		*		*	*
10.	*Circium argeracanthum (h)*			*	*					*
11.	*Cymbopogon microtheca (h)*			*	*					*
12.	*Cynodon dactylon (h)*	*	*	*	*	*	*			*
13.	*Cyprus rotundus (h)*	*		*	*		*		*	*
14.	*Dandrocalamus strictus (h)*					*				
15.	*Dryopteris filix- mas (h)*	*	*	*	*	*	*		*	*
16.	*Eulaliopsis binnata (h)*		*		*	*				*
17.	*Eupatorium adenophorum (h)*	*	*	*		*	*			*
18.	*Imperata cylindrica (h)*	*	*	*	*	*	*			*
19.	*Musa paradisiaca (h)*			*		*			*	
20.	*Saccharum spontaenium (h)*	*		*	*	*	*		*	*
21.	*Thysanolaena maxima (h)*			*	*					
22.	*Urena lobota (h)*		*	*	*	*			*	*
23.	*Vetivaria zyzanoides (h)*	*	*	*	*	*			*	*
24.	**TOTAL SPECIES**	11	9	13	14	15	10		9	13

Note: Study area 1= Headwork Area; 2 = Plot Study Powerhouse Area; 3 = Access Road Area, 4= Reservoir Area

(Yangran Catchment); 5= Tailrace Area; 6= Adit Area (Ward No. 1 of Bhainse VDC); 7= Disposal Area (Near Tribhuwan Highway); 8= Disposal Area Opposite Ghumaune Settlement; 9= Rani Khola Catchment

Table A.4.10 Number of Protected Trees to be Cleared in Project Sites

Location	Species' Name	Number of Plant			Total
		Mature	Pole size	Sapling Size	
Headwork Area	-	-	-	-	-
Access Road Area	1. *Shorea robusta (P)*	20	69	-	89
	2. *Bombax ceiba (P)*	-	3	-	3
	3. *Michalia champaca (P & E)*	3	1	1	5
Total		**23**	**73**	**1**	**97**
Reservoir Area	1. *Shorea robusta(P)*	12	-	3	15
	2. Michalia champaca(P & E)	5	4	3	12
	3. Bombax ceiba(P	1	-	3	4
Total		**18**	**4**	**9**	**31**
Tailrace Area	1. *Shorea robusta(P)*	-	40	-	40
Adit Area	-	-	-	-	-
Disposal Area (T.H)	-	-	-	-	-
Disposal Area (G.H)	-	-	-	-	-
Total Matured Trees, Pole-sized Trees & Saplings		**41**	**117**	**10**	**168**

NOTE:: P = Protected and E = Endangered

Table A.4.11 Mammals of the Project Area

S.No	Scientific Name	Common Name	Habitat Use	Distribution Status	Protected Status	Locality					Method of confirmation
						Intake	Regulating Reservoir	Camp site	Tailrace	Rani Khola	
1	*Canis aerus*	Jackal	F, A	Common	CITES III	-	+	-	+	+	Call
3	*Felis chaus*	Jungle cat	F,A, G	Common	-	-	+	-	-		Local Information
4	*Herpestes spp*	Mangoose	G, F, C	Common	-	+	+	-	+	+	Local Information
5	*Hystrix indica*	Porcupine	F,G, A	Common	-	-	+	-	+	+	Spriants observe
6	*Funambulus pennatis*	Squirrel	F,G,C,A	Common		+	+	-	+	+	Local Information
7	*Lutra perspitala*	Otter	F, G, C	Common	IUCN/K	+	-	-	+		Local Information
8	*Macaca mulatta*	Rhesus macaque	F,G,C,A	Common	CITES II	+	+	+	+	+	Observation
9	*Martes flavigula*	Yellow throated marten	F, A	Common	CITES III	-	+	-	-		Observation
10	*Mus musculus*	House mouse	A	Common	-	+	-	+	-		Observation
11	*Panthera paradus*	Leopard	F	Uncommon	CITES I	-	+	-	-		Local Information
12	*Presbytis entellus*	Common langur	F,G,C,A	Common	CITES I	+	+	+	+	+	Observation
13	*Pteropus spp*	Bat	G, C	Common	-	+	+	-	+	+	Observation
14	*Rattus rattus*	House rat	A	Common	-	+	-	+	+	-	Local Information
15	*Rhinolophus luctusperniger*	Himalaya horse shoe bat	G, C	Common	-	+	+	-	-	+	Observation
16	*Vulpes vulpes*	Red fox	A, C, G	Common	-	+	+	-	+		Local Information
17	*Munticus muntjack*	Barking deer	F	Uncommon		-	+	-	-		

NOTES: Habitat

F= Forest
G= Grass and Shrubs
A= Agriculture area
C= Rocky area and cliffs
+ Present
- Not present

Protected Status

CITIES I= Species threatened with extinction
CITIES II= Species not necessary threatened but could became so.
CITES III= Species required international cooperation to control trade
IUCN (K) = Insufficiently known
HMG/P= Protected by HMG/N

Remarks: Although listed by CITES and other organization these species are common and widely distributed in Nepal

Table A.4.12 Birds of the Project Area

S.No	Scientific Name	Common Name	Habitat	Distribution Status			Migratory Status
				Khani Khola	Regulating Reservoir	Rani Khola	
1	*Chainarrornis leucocephalus*	White Capped Red Start	F	-	+	-	Resident
2	*Copsychus saularis*	Magipie Robin	F	-	+	-	Resident
3	*Corvus macrorhychos*	Jungle Crow	F	+	-	+	Resident
4	*Corvus splendens*	House Crow	O	+		+	Resident
5	*Cuculas canorus*	Eurasian Cuckoo	F	-	+	+	Summer Migrant
6	*Cuculus micropterus*	Indian Cuckoo	F	+	-	-	Summer Migrant
7	*Dicrurus leucophelus*	Ashy Drongo	F	+	-	+	Resident
8	*Dicrurus macrocerus*	Black Drongo	O	+	-	+	Resident
9	*Enieurus immaculatus*	Black backed Forktail	F	-	+	-	Resident
10	*Gallus gallus*	Jungle Fowl	F	-	+	-	Resident
11	*Garrulax albogularis*	White throated Laughing Thrush	F	-	+	-	Resident
12	*Gypaetus barbates*	Lammergier	F	-	-	+	Resident
13	*Gypus bengalensis*	White Backed Vulture	F	-	-	+	Resident
14	*Gypus himalayensis*	Himalayan Griffon Vulture	F	-	-	+	Resident
15	*Lophura leucomelana*	Kalij Phesant	F	-	+		Resident
16	*Milvus migrans*	Dark Kite	O	+	-	+	Passage Migrant
17	*Myiophoneus caeruleus*	Blue Whisting Thrush	R	-	+	-	Resident
18	*Orthotomus sutorius*	Tailor bird	F	+	+	-	Resident
19	*Pericroocotus ethologus*	Longtailed Minivet	F	-	+	-	Resident
20	*Phalacrocorax carbo*	Large Cormorant	F	-	+	-	Resident
21	*Picus canus*	Wood Pecker	F	+	-	+	Resident
22	*Picus squamatus*	Green Wood Pecker	F	+	+	-	Resident
23	*Pucrasia macrolopha*	Koklass Pheasant	F	-	+	-	Resident
24	*Pycnonotus cafer*	Red Vented Bulbul	F	-	-	-	Resident
25	*Pycnonotus leucogenys*	White Cheeked Bulbul	F	-	+	-	Resident
26	*Rhipidura hypoxantha*	Yellow Billed Fantail	F	-	+	-	Resident
27	*Seicercus xanthoschistos*	Grey Hooded Warbler	F	-	+	-	Resident
28	*Urocissa erythrorhyncha*	Red Billed Magpie	F	-	+	-	Resident
29	*Ceryle rudis*	Small Pied King Fisher	R	+		-	Resident
30	*Francolinus sp*	Partrdge	F	-	+	-	Resident
31	*Psittacula sp*	Common Pea Fowl	F	-	-	-	Resident
32	*Prinia cringer*	Brown Hill Prinia	F	-	-	-	Migrant
33	*Streptppelia orientalis*	Rufous Turtle Dove	F	-	+	-	Resident
34	*Upupa ipops*	Hoogoe	F	-	+	-	Resident
35	*Pycnonotus sp*	Bulbul	O	+	-	+	Resident
		TOTAL SPECIES		11	19	11	

Legend:
Habitat F= Forest, O= Open grass and shrub land, R= River

Table A.4.13 Reptiles of the Project Area

S. No.	Scientific Name	Common Name	Distribution Status					Protected Status	Methods of Confirmation
			Head Work	Regulating Reservoir	Camp Site	Tailrace area	Rani Khola		
1	*Calotes versicolor*	Garden Lizard	-	+	-	+	-	Common	Visual
2	*Hemydactylus flavivirides*	Common Lizard	+	+	+	+	+	Common	Visual
3	*Ptyas mucosus*	Dhaman (Rat snake)	-	+	-	+	-	CITES II	Local information
4	*Trimeresurus albolaris*	Green Pit Viper	+	-	-	-	+	Common	Local information
5	*Trimeresurus monticola*	Mountain Pit Viper	+	-	-	-	+	Common	Local information
6	*Varanus monitor*	Monitar Lizard	+	+	-	+	+	Common	Visual
		TOTAL SPECIES	4	4	1	4	4		

Legend :
CITES II= Species not necessary threatened but could became so.

Table A.4.14: Fish Fauna of the Project Area

S. No.	Scientific Name	English Name	Common Name	Migratory Status	Protected Status	Economic Importance
1	*Barilius barila (Ham)*	Minor carp	Faketa	R	C	1, M
2	*Barilius bendalisis (Ham)*	Minor carp	Faketa	R	C	1, M
3	*Barilius barna*	Minor carp	Faketa	R	C	1 L
4	*Botia lohachata*	Loach	Baghi	R	I	1 L
5	*Channa gachua*	Murrels	Hile	R	C	1 L
6	*Garra annandalei (Ham)*	Stone roller	Nakatuwa	R	C	1, M
7	*Garra gotyla (Gray)*	Stone roller	Buduna	R	FC	1, M
8	*Glyptothorax trilineatus*	River Catfish	Kapree	R	R	1, M
9	*Labeo dero (Ham)*	Minor carp	Gardi	MD	C	1 H
10	*Mastacembelus armatus*	Spiny eel	Bam	R	C	1, M
11	*Neolissocheilus hexagonolepis (Mc CI)*	Copper mahseer	Katle	MD	V	1 H2
12	*Noemachcius rupicola (Mc. CI)*	Stone loach	Gadela	R	C	1 L
13	*Noemachelius botia*	Stone loach	Gadela	R	C	1 L
14	*Puntius conchonius*	Barbs	Karange	R	C	1, M
15	*Schizothorax plagiostomus (Ham)*	Snow-Trout	Buchhe Alsa	MD	V	1 H
16	*Schizothoraichthys progastus (Mc. CI)*	Pont nosed snow trout	Chuhhe Asala	MD	V	1 H
17	*Semiplotus semiplotus*		Khurpe	R	C	1 H
18	*Tor putitora (Ham)*	Golden Mahseer	Sahar	LD	V	1, H, 2,3

Legend:

Migratory Status
R= Resident
MD=Midrange Migrant
LD= Long distance Migrant

Economic Importance
1= Food value
H= High food value
M=Medium Food value
L=Low food value

3= Medicine

Protected Status
V= Vulnerable (4)
R=Rare(1)
C=Common(13)
I= Insufficiantly known (1)

Table A.4.15: Species Composition

SN	Scientific Name	English Name	Local Name	No. Fish Caught in dry season	No. Fish Caught in wet season	Total	%
1	*Barilius bendelisis*	Torrent minnows	Faketa	18	152	170	18.20
2	*Barilius barila*	Torrent minnows	Jhuli	138	58	196	20.98
3	*Barilius barna*	Torrent minnows	Pate Faketa	12	12	24	2.56
4	*Botia lohachata*	Loach	Baghi	0	1	1	0.10
5	*Channa gachua*	Murrels	Bhoti	5	4	9	0.96
6	*Cyprinon semiplotus*	Minor carps	Rewa	0	3	3	0.32
7	*Garra gotyla*	Stone Roller	Nakatuwa	102	54	156	16.70
8	*Garra annandalei*	"	Buduna	21	100	121	12.95
9	*Glyptothorax trilineatus*	Catfish	Kabre	0	15	15	1.60
10	*Labeo dero*	Minor carps	Gardi	0	30	30	3.21
11	*Mastacembelus armatus*	Spiny eel	Bam	4	2	6	0.64
12	*Neolischeilus hexagonolepis*	Copper Mahseer	Katle	80	46	126	13.49
13	*Nemacheilus botia*	Stone loach	Gadela	0	6	6	0.64
14	*Nemacheilus rupicola*	Stone loach	Gadela	4	9	13	1.39
15	*Puntius conchonius*	Barbs	Sidra	16	11	27	2.89
16	*Schixothorax plagiostomus*	Snow Trout	Asala	10	0	10	1.07
17	*Schizothoraichthys progastus*	Point Nosed Snow Trout	Chuche Asala	0	16	16	1.71
18	*Tor putitora*	Mahseer	Sahar	0	5	5	0.3
	Total			**410**	**524**	**934**	**100**

Source: Field Survey, 2002

Table A.4.16 Fish Catch per Hour Effort at Sampling Stations

Sampling Station	March 2002 Sampling (Dry Season)			June 2002 Sampling (Wet season)			Total CPH
	Sampling Hour	No. of fish caught	Catch per hour effort (CPH)	Sampling Hour	No. of fish caught	CPH	
1	15	3	0.2	15	11	0.73	0.46
2	15	46	3.06	15	62	4.13	3.6
3	15	33	2.2	15	46	3.06	2.63
4	15	67	4.46	15	91	6.06	5.26
5	15	44	2.93	15	60	4	3.46
6	15	98	6.53	15	109	7.26	6.9
7	15	119	7.93	15	145	9.66	8.8
Total	**105**	**410**	**3.90**	**105**	**524**	4.99	**4.44**

Source: Field Survey, 2002

Table A.4.17 Fish Catch per Unit Effort at Sampling Stations

Sampling Station	March 2002 Sampling Dry Season				June 2002 Wet Season				Total CPU	Total Attempt catch Ratio
	Level of effort	No. of fish caught	Catch per Unit effort (CPU)	Attempt catch Ratio	Level of effort	No. of fish caught	CPU	Attempt catch Ratio		
1	107	3	0.02	1:35.6	120	11	0.09	1:10.9	0.06	1:16.2
2	372	46	0.12	1:8	400	62	0.15	1:6.4	0.13	1:7.1
3	194	33	0.17	1:5.8	227	46	0.20	1:4.9	0.18	1:5.3
4	403	67	0.15	1:6	467	91	0.19	1:5.1	0.18	1:5.5
5	248	44	0.17	1:5.6	300	60	0.2	1:5	0.18	1:5.2
6	281	98	0.34	1:2.8	410	109	0.26	1:3.7	0.29	1:3.3
7	416	119	0.28	1:3.4	421	145	0.34	1:2.9	0.31	1:3.1
Total	**2021**	**410**	**0.20**	**1:4.9**	**2345**	**524**	**0.22**	**1:4.4**	**0.21**	**1:4.6**

Source: Field Survey, 2002

Table A.4.18: Fish Spawning Locations and Data, Typical Food and Ecology in Project Area

Species	Spawning season	Spawning substrate	Spawning Sites	Age at spawning	Growth Rate	Incubation time	Size by spawning	Food source and feeding Habit	Behavior
Tor putitora	Sept- Oct	Gravel bed	Rapti river near Samari confluence and Kesadi Khola	2.5 years	16cm at first year	12-48 hours	45 cm	Fruit, algae, aquatic insects, fish fry adult fish etc.	Jumping and migrate in group
Schizothoraichthys progastus (Point nosed snow trout)	Sept-Oct and March-April	Gravel beds	Rapti river near Shiva temple and Khani confluence area	6 to 12 cm at first year	1 year (Size 25-35cm)	15days	20-40	Mud, Aquatic insect, fish fry, algae, drift food	Seen in school of 20-40 fishes during spawning females are cricled by male
Schizothorax plagiostomus (Snow trout)	Sept-Oct and March-April	Gravel beds	Rapti river near Shiva temple and Khani confluence area	6 to 12 cm at first year	2 years(Size 20-35 cm)	15days	25-60	Mud aquatic insects, fish fry algae, drift food	Seen in group during spawning, grazing and creeping
Neolischcheilus hexagonolepis (Copper mahseer)	Sept-Oct	Gravel beds	Rapti river and Kesadi Khola	8-12 cm at 1st year	2years(Size 20-28cm	12 days	22-55	Aquatic Insects, algae, fish fry	Seen in group of 10-15 fishes swim, dart and jump to cross obstacles.
Labeodero (Minor carps/Thed)	June -July	Gravel beds	Rapti river near Samari confluence and Kesadi Khola	_	2years	_	10-12	Filamentous algae, portion of higher plants, decaying organic matter	Resting in deep pools
Glyptothorax trilineatus (Torrent Catfish)	May-June	Gravel and sand	Kesadi, Khani Khola and Yangrang Khola	2 years	3.5 cm in a year	8-12 days	9 cm	Aquatic insects	Live in cohesive schools, exhibit mass migration to creeks for spawning
Garra gotyla (Rock Carp)	May-June	Gravel, sand and pebbles, algae bed	Kesadi, Khani Khola and Yangrang Khola	2 years	4.5cm in a year	7-10 days depending on temperature	7.5 cm	Algae, slime moss	Live in school. Mass migration to spawning tributaries, rice fields and springs
Garra annandalei (Stone Roller)	Sept.-Oct.	Gravel, sand, Hydrilla blooms	Kesadi, Khani Khola and Yangrang Khola	2 year	5 cm in a year	10 days	12 cm	Algae	Exhibit local migration in monsoon for spawning season in rice fields, irrigation canal and water mill facility areas.

Table A.4.19 Phytoplankton Species Recorded at Sampling Stations in March (Dry Season) and June (Wet Season)

S.N.	Order	Sampling Stations / Number of Species Recorded													
		1		2		3		4		5		6		7	
		D	W	D	W	D	W	D	W	D	W	D	W	D	W
1	*Cyanophyceae*	7	6	5	4	7	4	9	8	4	3	6	4	8	6
2	*Phyrrophyceae*	0	0	2	1	1	0	2	2	1	0	1	1	2	2
3	*Xanthophyceae*	2	1	2	1	2	0	2	1	2	1	2	1	2	1
4	*Bacillariophyceae*	25	21	20	15	19	14	26	22	19	16	22	18	26	24
5	*Chlorophyceae*	16	12	10	9	12	8	14	11	11	7	9	7	15	11
		50	40	39	30	41	26	53	44	37	27	40	31	53	44

Table A.4.20 Zooplankton Species Recorded at Stations in March (Dry Season) and June (Wet Season) -2002

S.N.	Order	Sampling Stations / Number of Species Recorded													
		1		2		3		4		5		6		7	
		D	W	D	W	D	W	D	W	D	W	D	W	D	W
1	*Rotifera*	8	5	6	5	6	4	12	11	8	4	8	7	8	7
2	*Copepoda*	2	2	2	1	2	2	7	6	0	0	0	0	3	2
3	*Cladocera*	2	2	1	1	2	2	5	5	1	1	1	1	2	2
		12	9	9	7	10	8	24	22	9	5	9	8	13	11

Table A.4.21 List of Aquatic Insects Collected at Sampling Stations in March (Dry Season) and June (Wet Season) -2002

S.N.	Order	Sampling Stations / Number of Species Recorded													
		1		2		3		4		5		6		7	
		D	W	D	W	D	W	D	W	D	W	D	W	D	W
1	*Plecoptera*	1	3	3	2	2	3	2	2	2	3	2	3	2	3
2	*Ephemeroptera*	3	4	4	2	4	6	3	5	4	7	3	6	2	2
3	*Trichoptera*	2	1	2	2	2	4	2	3	1	1	1	3	1	2
4	*Coleptera*	1	0	2	1	1	2	1	1	1	0	0	1	0	1
5	*Odonata*	3	6	2	1	3	7	2	6	3	5	1	2	2	3
6	*Hemiptera*	1	1	1	0	0	0	0	0	0	1	0	0	0	0
7	*Amphibae*	0	0	0	0	0	1	0	0	0	1	0	0	0	0
		11	15	14	8	12	23	10	17	11	18	7	15	7	11

Table A.4.22 List of Protected Species in Kulekani III HEP Area

Species by Scientific Name	Common Name	Protected Nepal	IUCN Category	Location in Project	Comments
1. Vegetation					
- *Shorea robusta*	Sal	Protected		Bridge Site, Regulation Pond, Main Access Road	-Banned from local felling, transport & export - Sal accounts for majority of trees & saplings BUT can be reafforested
- *Michalia champaca*		Protected		Regulation Pond, Access Road	
- *Bombax ceiba*	Silky Cotton	Protected		Regulation Pond	
- *Acacia catechu*	Cutch	Protected		Power Station	
2. Mammals					
-*Canis aerus*	Jackal		Cites III	Regulation Pond, Tailrace, Rani Khola	-Based on call & local information
- *Luta perspita*	Otter		IUCN/K	Intake, Tailrace	- Species of concern
-*Macca mulatta*	Rhesus macaque		Cites II	Intake, Regulation Pond, Tailrace, Rani Khola	- Both species observed & common in Nepal - Protected for religious purposes
-*Presbytis entellus*	Common langur		Cites I	Intake, Regulation Pond, Tailrace, Rani Khola	
- *Martes flagivula*	Yellow throated marten		Cites III	-Regulation Pond	- Species of concern
- *Panthera paradus*	Leopard		Cites I	Regulation Pond	- May not occur based on local knowledge only
3. Birds					
- 35 Species-Recorded in Area BUT None of These Listed as Rare and Endangered					
4. Reptiles					
- *Pyas muscos*	Rat snake		Cites II	Regulation Pond, Tailrace	-Based on local information
5. Fish					
- *Glypotorax trilineaus*	River catfish	Rare		Rapti, Kesadi, Khani , Rani Khola	-Not in Yangran Khola – wet season only
- *Neolissochelius hexangonolepis*	Copper mahseer	Vulnerable		Rapti, Kesadi, Khani , Yangran, Rani Khola	-Widespread & dry and wet season
- *Schizothorax plagiostomus*	Snow trout	Vulnerable		Rapti River (3 sites)	-Dry season only in Rapti River
- *Schizothoraichthys progastus*	Point nosed snow trout	Vulnerable		Rapti, Khani Khola	-Wet season migrant to area
- *Tor puttiora*	Golden mahseer	Vulnerable		Rapti & Kesadi Khola	-Wet season migrant to area
6. Insects					
31Species- Recorded BUT Butterflies Not Analysed AND None of These Listed as Rare or Endangered					
Total Species					

NOTE: (1) All trees are protected from felling and transport by Department of Forests (DoF) local widespread use but clearing can be negotiated in terms of replacement plantings at locations designated by the DoF.

(2) CITES I = threatened with extinction
CITES II = Species not threatened with extinction but could become so
CITES III = Species requiring international cooperation to control trade

(3) Fish species preliminarily classified for Nepal and subject to clarification.

Table A.5.1 Lengths of Access Road in Various Land Uses - Kulekhani III HEP

Access Road	Total Length (m)	Length in Agricultural Land (m)	Length in Forest Land (m)	Length in Grassland (m)	Length in River and Flood Plain (m)
Main Access Road from Sanutar to Check Dam 2	3700	1335	2100	90	175
Access road from Ghumaune to Access Tunnel	675	300	375	0	0
Access Road from Ghumaune to Spoil Bank C	850	410	0	125	315
Access Road from Ghumaune to Spoil Bank B	200	50	0	50	100
Access Road from Bhiase to Headworks and Work Adit	1100	0	285	140	675
Access Road from Kholpan to Tailrace Outlet	850	115	0	520	215
TOTAL LENGTHS	**7375**	**2210**	**2760**	**925**	**1480**

Table A.6.1 : Water Quality Monitoring Results, March 2002

S.N.	Location		
	Parameters	Yangrang Khola	Rani Khola
1.	Flow Velocity, (m^2/s)	0.245	0.255
2.	Discharge, (m^3/s)	0.05	0.075
3.	Ambient Temperature, (^{o}C)	21	18
4.	pH	8.4	7.9
5.	Conductivity, (µmhos/Cm)	150	71
6.	Total Suspended Solids, (mg/l)	8.8	1.2
7.	Total Phosphorous, (mg/l)	0.033	0.103
8.	TKN, (mg/l)	0.53	0.53
9.	Ammonia, (mg/l)	N. D. (<0.05)	N. D. (<0.05)
10.	Nitrate, (mg/l)	1.10	0.29
11.	Nitrite, (mg/l)	N. D. (<0.01)	N. D. (<0.01)
12.	Dissolved Oxygen, (mg/l)	8.0	8.1
13.	BOD_5, (mg/l)	1.54	2.5

Table A.6.2 : Water Quality Monitoring Results, June, 2002

S.N.	Location		
	Parameters	**Yangrang Khola**	**Rani Khola**
14.	Flow Velocity, (m^2/s)	0.42	0.24
15.	Discharge, (m^3/s)	0.65	0.094
16.	Ambient Temperature, (^{o}C)	25	25
17.	pH	8.2	7.8
18.	Conductivity, (µmhos/Cm)	116	74
1.	Total Suspended Solids, (mg/l)	<1	<1
2.	Total Phosphorous, (mg/l)	0.11	0.30
3.	TKN, (mg/l)	0.52	0.87
4.	Ammonia, (mg/l)	0.17	0.07
5.	Nitrate, (mg/l)	0.66	N.D.(<0.05)
19.	Nitrite, (mg/l)	N.D.(<0.01)	N.D.(<0.01)
20.	Dissolved Oxygen, (mg/l)	7.9	7.9
21.	BOD_5, (mg/l)	0.67	0.10

Note: ND - Not Detected
Yangrang Khola, Downstream to Regulating Pond.
Ranikhola, before the confluence with Rapti River.

Table A.6.3 : Mammal Species of Yangran and Rani Khola Catchment

S. No	Scientific Name	Common Name	Distribution Status	Protected Status	Locality	
					Yangran	Ranikhola
1	*Canis aerus*	Jackal	Common	CITES III	+	+
2	*Felis chaus*	Jungle cat	Common	-	+	
3	*Herpestes spp*	Mangoose	Common	-	+	+
4	*Hystrix indica*	Porcupine	Common	-	+	+
5	*Funambulus pennatis*	Squirrel	Common	-	+	+
6	*Macaca mulatta*	Rhesus macaque	Common	CITES II	+	+
7	*Martes flavigula*	Yellow throated marten	Common	CITES III	+	
8	*Panthera paradus*	Leopard	Uncommon	CITES I	+	
9	*Presbytis entellus*	Common langur	Common	CITES I	+	+
10	*Pteropus spp*	Bat	Common	-	+	+
11	*Rhinolophus luctusperniger*	Himalaya horse shoe bat	Common	-	+	+
12	*Vulpes vulpes*	Red fox	Common	-	+	
13	*Munticus muntjack*	Barking deer	Uncommon		+	

Legend : Protected Status
CITIES I= Species threatened with extinction CITIES II= Species not necessary threatened but could became so.
CITES III= Species required international cooperation to control tradeIUCN (K) = Insufficiently known

Table A.6.4 : Bird Species of Yangran and Rani Khola Catchment

S.No	Scientific Name	Common Name	Distribution Status	
			Yangran	Rani Khola
1	*Chainarrornis leucocephalus*	White Capped Red Start	+	-
2	*Copsychus saularis*	Magipie Robin	+	-
3	*Corvus macrorhychos*	Jungle Crow	-	+
4	*Corvus splendens*	House Crow		+
5	*Cuculas canorus*	Eurasian Cuckoo	+	+
7	*Dicrurus leucophelus*	Ashy Drongo	-	+
8	*Dicrurus macrocerus*	Black Drongo	-	+
9	*Enieurus immaculatus*	Black backed Forktail	+	-
10	*Gallus gallus*	Jungle Fowl	+	-
11	*Garrulax albogularis*	White throated Laughing Thrush	+	-
12	*Gypaetus barbates*	Lammergier	-	+
13	*Gypus bengalensis*	White Backed Vulture	-	+
14	*Gypus himalayensis*	Himalayan Griffon Vulture	-	+
15	*Lophura leucomelana*	Kalij Phesant	+	
16	*Milvus migrans*	Dark Kite	-	+
17	*Myiophoneus caeruleus*	Blue Whisting Thrush	+	-
18	*Orthotomus sutorius*	Tailor bird	+	-
19	*Pericroocotus ethologus*	Longtailed Minivet	+	-
20	*Phalacrocorax carbo*	Large Cormorant	+	-
21	*Picus canus*	Wood Pecker	-	+
22	*Picus squamatus*	Green Wood Pecker	+	-
23	*Pucrasia macrolopha*	Koklass Pheasant	+	-
24	*Pycnonotus cafer*	Red Vented Bulbul	-	-
25	*Pycnonotus leucogenys*	White Cheeked Bulbul	+	-
26	*Rhipidura hypoxantha*	Yellow Billed Fantail	+	-
27	*Seicercus xanthoschistos*	Grey Hooded Warbler	+	-
28	*Urocissa erythrorhyncha*	Red Billed Magpie	+	-
30	*Francolinus sp*	Patridge	+	-
33	*Streptppelia orientalis*	Rufous Turtle Dove	+	-
34	*Upupa ipops*	Hoogoe	+	-
35	*Pycnonotus sp*	Bulbul	-	+

Table A.6.5 : Species Diversity and Distribution Pattern

S.No.	Scientific Name	Station	
		Rani Khola	Yangran Khola
1	*Barilius bendelisis*		W
2	*Barilius barila*		W,D
3	*Barilius barna*		D
5	*Channa gachua*	D	W,D
7	*Garra gotyla*		W,D
8	*Garra annandalei*		W,D
9	*Glyptothorax trilineatus*	W	
12	*Neolischeilus hexagonolepis*		W,D
13	*Nemacheilus botia*		W
14	*Nemacheilus rupicola*	W,D	D
		4sp.	**9sp**

Note; W = Wet Season, D = Dry Season

Table A.6.6 : Phytoplankton Species Recorded at Rani Khola and Yangran Stations in March (Dry Season) and June (Wet Season)

S.N	Order	Rani Khola		Yangran Khola	
		D	W	D	W
1	*Cyanophyceae*	7	6	4	3
2	*Phyrrophyceae*	0	0	1	0
3	*Xanthophyceae*	2	1	2	1
4	*Bacillariophyceae*	25	21	19	16
5	*Chlorophyceae*	16	12	11	7
	Total	50	40	37	27

Table A.6.7: Zooplankton Species Recorded at Rani Khola and Yangran Stations in March (Dry Season) and June (Wet Season)

S.N	Order	Rani Khola		Yangran Khola	
		D	W	D	W
1	*Rotifera*	8	5	8	4
2	*Copepoda*	2	2	0	0
3	*Cladocera*	2	2	1	1
		12	9	9	5

Table A.6.8 : List of Aquatic Insect Collected in the Rani and Yangran Stations

S.N	Order	Rani Khola		Yangran Khola	
		D	W	D	W
1	*Plecoptera*	1	3	2	3
2	*Ephemeroptera*	3	4	4	7
3	*Trichoptera*	2	1	1	1
4	*Coleptera*	1	0	1	0
5	*Odonata*	3	6	3	5
6	*Hemiptera*	1	1	0	1
7	*Amphibae*	0	0	0	1
		11	15	11	18

Table A.7.1 Proposed Standards for Effluents Discharged into Inland Waters from the Construction Sites and Camps

(Adopted from Ne. Gun. 229-2047with modifications)

S.N.	Parameters	Tolerance Limits
	PH	5.5-9
	Temperature (within 15 m downstream from the outlet), ^{o}C	40
	Turbidity	50 maximum
	Total Suspended Solids (mg/l)	150.0 maximum
	BOD_5 at $20^{o}C$ (mg/l)	100 maximum
	COD (mg/l)	250 maximum
	Oil and Grease (mg/l)	10 maximum
	Ammonical Nitrogen (mg/l)	50 maximum
	Phenols (mg/l)	1.0 maximum
	Sulphide (mg/l)	2.0 maximum
	Total Residual Chlorine (mg/l)	1.0
	Fluoride (mg/l)	2.0 maximum
	Arsenic (mg/l)	0.2 maximum
	Cadmium (mg/l)	2.0 maximum
	Chromium (mg/l)	0.1 maximum
	Copper (mg/l)	3.0 maximum
	Lead (mg/l)	0.1 maximum
	Mercury (mg/l)	0.01 maximum
	Nickel (mg/l)	3.0 maximum
	Zinc (mg/l)	5.0 maximum

Source: Ne. Gun. 229 – 2047.

Table A.7.2 Proposed Drinking Water Quality Standards for Construction Camps and Construction Sites

(Adopted from WHO Guideline Values)

S.N.	Parameters	Recommended Limits
	Colour (units)	15
	Odour	Unobjectionable
	Taste	Unobjectionable
	Turbidity (NTU)	5
	Total Dissolved Solids (mg/l)	500
	Arsenic (mg/l)	0.01
	Cadmium (mg/l)	0.003
	Chloride (mg/l)	250
	Chromium (mg/l)	0.05
	Copper (mg/l)	1.0
	Fluoride (mg/l)	1.5
	Cyanide (mg/l)	0.07
	Iron (mg/l)	0.03
	Phenol (mg/l)	0.001
	Sodium (mg/l)	200
	Boron (mg/l)	0.3
	Hydrogen Sulphide (mg/l)	0.05
	Lead (mg/l)	0.01
	Manganese (mg/l)	0.1
	Mercury (mg/l)	0.001
	Nitrate (mg/l)	50
	Selenium (mg/l)	0.01
	Zinc (mg/l)	3
	Nickel (mg/l)	0.02
	PH	6.5-8.5
	Nitrite (mg/l)	3
	Ammonia (mg/l)	1.5
	Total Phosphate (mg/l)	250
	E-coli (Index/100ml)	0
	Total Coliform Count (MPN/Index 100 ml)	0

Source: WHO (1993).

Table A.7.3 Responsibilities and Interventions of KESMU

Organisation	Responsibilities	Timings
KESMU	• Implementation, supervision and monitoring of land acquisition, compensation and resettlement as per RAP and record keeping of NEA	Pre-construction and construction phase
	• Implementation, supervision and monitoring of SAP	Construction phase
	• Supervision of environmental and social mitigation measures implementation as per EMP/RAP/SAPF , recommend concerned engineers and sections for corrective actions and bi-monthly report preparation	Construction phase
	• Environmental impact and compliance monitoring of construction works as per EMP, recommend corrective actions to supervising engineers and bi-monthly report preparation.	Construction phase
	• Information dissemination through PIC and other media and collection of feed back through regular consultation with the various stakeholders.	Pre-construction and construction phase
	• Distribution of the Project's bimonthly monitoring reports to different central and local level stakeholders	Construction phase
	• Project grievance handling	Pre-construction and construction phase
	• Environmental audits of construction contractors activities and audit reports	End of construction phase
	• Environmental and social monitoring and preparation of six monthly environmental monitoring report and distribution to stakeholders	Operational phase

Table A.7.3a Supplemental Responsibilties of Interventions of KESMU

Organisations	*Responsibilities*	*Timings*
MOPE	• Ensure that the environmental measures and cost required are included in the project documents and tender clauses	Prior to Final Project approval
	• Monitoring of the project design, construction and operation activities against approved EIA and EMP measures and national environmental standards	At least once a year during construction
	• Auditing of project general performance during operation phases	After two years of project completion - operation phase
MOWR/ DoED	• Ensure that the environmental measures and cost required are included in the project documents and tender clauses	Prior to Final Project approval
	• Monitoring of the project design, construction and operation activities against approved EIA and EMAP measures, national environmental standards and license conditions	At least twice a year during construction and once during operation
NEA Board/ NEA/ NEA-ED/KHEP	• Ensure that the EIA and EMP measures are incorporated in the final project design and costs.	Prior to contract award
	• Acquire necessary permits and approval for project construction and operation.	Before construction phase
	• Ensure that the project construction activities are in	During construction phase

Organisations	*Responsibilities*	*Timings*
	accordance with EMP and other HMG legislative requirements. • Implementation of repair and maintenance of project components including environmental safeguards as recommended by EMP, MOWR, DoED and MOPE • Monitoring and record keeping regarding environmental measures and impacts as per EMP • Ensure public participation and involvement in all phases of project implementation	During operation Phase During operation phase During Project period
Panel of Experts	• Review and recommend the final design of the project and ensure that the EMP measures are included in the design and Tender • Review monitoring and auditing reports of the supervising consultants and KESMU and recommend corrective measures to meet the objectives of EMP	Prior to contract call in Detail Design Phase During construction phase every six month
Detail Design Consultants	• Incorporate environmental mitigation measures as per POE recommendation in the design, project cost and tender documents • Include EIA recommendations in the design, project cost and tender documents	During Detail Design Phase During Detail Design Phase
EIA Consultant	• Verify and improve upon the earlier EIA reports and EMP and recommend environmental measures to Detail design consultants • Verify and prepare detailed programs for SAPF and recommend final SAPF costs to Detail Design engineers • Verify and complete RAP and recommend final RAP measures and costs to Detail Design engineers	Detail Design Phase Detail Design Phase Detail Design
Supervising Consultants	• Approval of civil construction as per design • Monitoring of civil construction as per detail design • Ensure that the EMP provisions are implemented and recorded • Ensure that the KESMU corrective actions are duly implemented.	Construction phase Construction phase Construction phase Construction phase
KESMU	• Implementation, supervision and monitoring of land acquisition, compensation and resettlement as per RAP and record keeping • Implementation, supervision and monitoring of SAP as per SAPF • Supervision of environmental and social mitigation measures implementation as per EMP/RAP/SAPF , recommend concerned engineers and sections for corrective actions and bi-monthly report preparation • Environmental impact and compliance monitoring of construction works as per EMP, recommend corrective actions to supervising engineers and bi-monthly report preparation. • Information Dissemination through PIC and other media and collection of feed back through regular consultation with the various stakeholders. • Distribution of the Project's bimonthly monitoring reports to different central and local level stakeholders • Project grievance handling	Pre-construction and construction phase Construction phase Construction phase Construction phase Pre-construction and construction phase Construction phase

Organisations	*Responsibilities*	*Timings*
	• Environmental audits of construction contractors activities and audit reports • Environmental and social monitoring and preparation of six monthly environmental monitoring report and distribution to stakeholders	Pre-construction and construction phase At the end of construction phase Operation phase continuously
Construction Contractor	• Implement civil construction as approved by supervising engineers • Implement mitigation measures as specified in EMP and recommended by Supervising engineers • Front line Monitoring and record keeping of environmental mitigation measures as per EMP through a special monitoring unit • Maintain good public relationship with the project area people	Construction phase Construction phase Construction phase Construction phase
NGOs, CBOs, VDCs, and DDCs and Other Stakeholders	• Monitor that the environmental and social mitigation measures are implemented in all stages of the project as per EMP, RAP, SPAF • Ensure that the public participation and involvement in the project implementation is maximized by the project owner, consultants and contractors.	Project period Project period

Table A.7.4 Estimate of Staffing Costs for KEMSU

	Position	Period Years	Number Of Staff	Allowance/ Month (NRs.)	Total NRs.
	NEA Staff				
	KSMU Co-ordinator (class 10 officer)	5	1	25,000	1,500,000
	ACRS - Section Chief (class 8 officer)	4	1	15,000	720,000
	SAPS – Section Chief (class 8 officer)	4	1	15,000	720,000
	PICS - Section Chief (class 8 officer)	4.8	1	15,000	840,000
	Senior Accountant (deputed) (ACRS)	3	1	10,000	360,000
	Junior Accountant (deputed) (ACRS)	3	1	8,000	288,000
	Surveyors (deputed) (ACRS)	2	2	8,000	384,000
	Social Officer (deputed) (SAPS)	4	1	10,000	480,000
	Public Information Officer (deputed) (PICS)	4.8	4	8,000	1,792,000
	Office Runner (ACRS)	3	1	5,000	180,000
	Office Runner (SAPS)	4	1	5,000	240,000
	Office Runners (PICS)	4.8	4	5000	1,152,000
	Short Term Consultants (SAPS)	2		70,000	1,680,000
	Sub-Total				**10,336.000**
	Consultants				
	ESMS - Section Chief (Environmental Engineer -Consultant)	4.25	1	75,000	3,825,000
	Environmental Engineer (ESMS)	4	1	45,000	2,160,000
	Sociologist (ESMS)	4	1	45,000	2,160,000
	Office Runner (ESMS)	4	1	5,000	240,000
	Part time Consultants (Socio-economist/ Terrestrial ecologist/ Aquatic ecologist)	2		45,000	1,080,000
	Sub-Total				**9,465,000**
	TOTAL				**19,801,000**
	NEA Staff - NRs. 10,336,000				***USD 136,400***
	Consultants – NRs. 9,465,000				***USD 124,500***
	TOTAL – NRs. 19,801,000				***USD 260,900***

NOTE: NRs. 76 = USD 1.00

Table A.7.5 Estimate of Support Facilities and Costs for KEMSU

	Particulars	Units	Unit Costs	Totals in NRs.
	Computers and printers	10 sets	150,000	1,500,000
	4 wheel drive vehicles	3	3,000,000	9,000,000
	Fuel and maintenance costs for vehicles	3Years	80,000/month	2,880,000
	Furniture		Lump Sum	500,000
	Other equipment (camera, tape recorders, powerpoint projector, pH meter, turbidity meter, flow meter, photocopier etc.)		Lump Sum	1,000,000
	Office consumables	5 years	40,000/month	2,400,000
	Telephone and electricity	5 years	15,000/month	900,000
	TOTAL COSTS in NRs.			**18,180,000**
	TOTAL COSTS – NRs. 18,180,000 in USD			***USD 239,200***

NOTE: NRs. 76 = USD 1.00

Table A.7.6 Natural Environmental Mitigation & Monitoring Plan Costs – Kulekhani III HEP

Description	Type	Sampling Stations	Frequency	Unit Costs	Costs in NRp
1. PROJECT DESIGN & PRE-CONSTRUCTION PHASE					
1.1 Mitigation Measures					
Status Survey of Houses on Tunnel	Baseline	100	1x	3500	350,000
Forest Inventory & Volumes along Access Roads, Regulation Pond, Portals, Check Dams & Tailrace	Baseline	Road & Reg Pond Misc Area	5 km + 15 ha = 30ha	10,000	300,000
Forest Compensation to DOF/ Owners	Baseline	As Above	30 ha	60,000	1,800,000
Habitat Survey- Otters, Leopard, Marten & Primates	Baseline	6	2x	10,000	120,000
1.2 Monitoring Measures					
Ambient Air Quality	Baseline	2	2x	25,000	100,000
Vibration & Noise Levels	Baseline	3	1x	25,000	75,000
Water Quality	Baseline	8	4 x1	13,000	416,000
Total					3,161,000
2.CONSTRUCTION PHASE – 4 YEARS					
2.1 Mitigation Measures					
Compensation Fund – Houses & Water	Impact		Provisional Lump Sum		5,000,000
Warning Sirens & Awareness Program	Impact	6			3,000,000
Environmental Awareness re Firewood & Protected Wildlife	Impact	-	4	75,000	300,000
Revegetation & Stabilization of Affected Areas	Impact	Road & Reg Pond	4 Yrs 30 ha	50,000	450,000
Yangran Watershed Mgmt Preparation	Impact	Consultant	6 Mos	LS	70,000
2.2 Monitoring Measures					
Ambient Air Quality	Impact	2	3x 4 Yrs	25,000	600,000
Vibration Monitoring	Impact	3	2x 4 Yrs	25,000	600,000
Spring Water along Tunnels & P'house	Impact	10	2x 4 Yrs	15,000	1,200,000
Water Quality Project Facilities	Co'liance	5	3x 4Yrs	12,000	720,000
Water Quality of Baseline Stations	Impact	8	2x 4 Yrs	13,000	832,000
Aquatic Ecology of Affected Rivers	Impact	7	2x 4Yrs	12,000	672,000
Total					**13,444,000**
3. TOTAL COST OF MITIGATION & MONITORING PROGRAM					16,605,000
4. TOTAL COST OF MITIGATION & MONITORING + 10 % Contingency					18,265,500
5. Total Costs of Mitigation & Monitoring + 10% Contingency in USD					*USD 24O,000*

NOTE: NRs. 76 = USD 1.00

Table A.7.7 : Environmental Mitigation Management Plan

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
			Detail Design phase				
1.	**Public consultation**	Public consultation at various sites	Design consultants	EIA	During detailed design	NEA	969750.00
2.	**Preparation of social action plans**	Preparation of social action plans mobilizing the NGOs/INGOs working in the sector	Design consultants	EIA	During detail design	NEA	1,550,000.00
3.	**Resettlement Plan**	Carryout detailed HH survey of the leftout HH and improve RP	Design Consultant	EIA	During detail design	NEA	500,000.00
4.	**Survey of springs**	Monitoring of the spring discharges in the peak dry season	Design consultants	EIA	During detail design	NEA	250,000.00
Total							**3,269,750.00**
			Pre-construction Phase				
5.	**Permits and Approval and co-ordination**	Take all necessary permits and approvals from different organizations, agencies and individuals and co-ordinate with the stakeholders, government offices and other institutions for the project works	KESMU	EIA, RAP,SAPF, EMP	Start of pre-construction and onwards	KHEP/NEA	
6.	**Public Relation**	Establishment of PIC in the project area (Bhaise, Sanutar, Basamadi and Hetauda) and information dissemination on the project to media and people	PICS (KESMU)	SAPF	Do	Do	Refer administrative and management cost
		Regular stakeholders meeting, and feed back	PICS (KESMU)	SAPF	Do	Do	
7.	**Grievance handling**	Take all complaints of affected parties and stakeholders, record and reply of the status	KESMU	EMP/RAP/SAPF	Do	Do	
8.	**Land and property acquisition, compensation and resettlement**	Survey verify and peg the land and property affected and prepare the list of affected property, respective affected parties and individuals	ACRS (KESMU)	RAP	Do	Do	41,532,960.0
9.		Publish first public notification of likely affected property and further verify the land and property from the affected parties and publish the final list of affected property and individuals	ACRS (KESMU	RAP	Do	Do	
10.		Prepare for the Compensation Fixation Committee meetings for the finalization of compensation rate and notify the compensation rates	ACRS (KESMU	RAP	Do	Do	
11.		Compensate the affected parities and individuals as per CFC decisions and keep records	ACRS (KESMU	RAP	Do	Do	
12.		Resettle the affected parties and implement rehabilitation programs as per RAP and keep records	ACRS (KESMU	RAP	Do	Do	
13.	**Environmental Awareness Program on accidental risks**	Community Awareness Programs against accidental risks of increased traffic communities of Tribhuvan Rajpath and project construction sites)	SAPS (KESMU)	SAPF	Do	Do	300,000.00
14.		Placing of traffic signs along the Highway	SAPS (KESMU)	SAPF	Do	Do	275,000.00

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
15.	**Skill Development**	Skill Survey and certification of the skilled and semiskilled persons from recognised institutions after tests	SAPS (KESMU)	SAPF	Do	Do	250,000.00
16.		Training for electrician, plumber, mechanical welde, scafolding, jack hammer operation, tunnel excavations etc. required for project construction works	SAPS (KESMU)	SAPF	Do	Do	1,000,000.00
17.	**Survey and Pegging of Project Area for vegetation and habitat protection**	All construction sites, installation and work sites, labour camps be surveyed and pegged in accordance with the approved design	Contractor	EIA	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
18.		Documentation of the trees and vegetation within the pegged area	Contractor	EIA	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
19.		Documentation of the archaeological and cultural sites within the pegged area	Contractor	EIA	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
20.		Documentation of the services within the pegged areas	Contractor	EIA	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
21.		Identification of trees for protection	ESMS (KESMU)	EIA	Prior to site preparation	KHEP	Include in contract clause
22.		Approval of the site for vegetation clearance, with recommendations	ESMS (KESMU)	EIA	Prior to site preparation	KHEP	Include in contract clause
23.	**Environmental Management Plans**	Prepare and submit plans for labor camps and construction camps for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
24.		Prepare and submit waste management plans for construction phase for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
25.		Prepare and submit Occupational health and safety plans for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
26.		Prepare and submit Spoil disposal plan in designated areas for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
27.		Prepare and submit top soil saving plan for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
28.		Prepare and submit bio-engineering plans for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
29.		Prepare and submit burrow pits and quarry plans for aggregated excavation for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause
30.		Prepare and submit Accident and Emergency plan with provisions to be adopted and the emergency response methods for approval	Contractor	EMP	Prior to site preparation	SE/ESMS (KESMU)	Include in contract clause

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
Construction Phase							
31.	**Job opportunity**	Set up a transparent employment mechanism to provide job opportunities to the local people in preferential order from SPAF/PAF/Project VDC/Adjoining VDC/ Project District/Nepal	Contractor	EMP/RAP/SAPF	Start of Construction	SE/ ESMS (KESMU)	Include in contract clause
32.	**Environmental Awareness to construction workers**	Provide environmental awareness training to construction workforce on various environmental issues as per EIA recommendations	Contractor	EIA	Start of Construction and onwards	SE/ ESMS (KESMU)	Include in contract clause
33.	**Construction Preparation**	Establishment of labor camps with all facilities of water supply, sanitation, canteen, recreation, housing and waste management.	Contractor	EIA	Start of construction	SE/ ESMS (KESMU)	Include in contract clause
34.		Fencing of the Project construction area	Contractor	EIA	After labor camp establishment	SE/ ESMS (KESMU)	Include in contract clause
35.		Establishment of construction camp with all facilities of water supply, sanitation, storage yards, mechanical yards etc.	Contractor	EIA	After labor camp establishment	SE/ ESMS (KESMU)	Include in contract clause
36.		Establishment of contractor's camp with all facilities of water supply, sanitation, storage, office, and living houses etc.	Contractor	EIA	After labor camp establishment	SE/ ESMS (KESMU)	Include in contract clause
37.	**Water Quality**	Establishment of water supply and sanitation facilities and waste collection and management facilities in the construction work camps and labor camps	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
38.		Prohibition on the open deification and discharge of solid/liquid waste into the adjoining rivers/water bodies	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
39.		Establishment of a bonded storage facilities for fuels, lubricants and other toxic chemicals	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
40.		Establishment of a bonded collection facilities of spent oils, lubricants and other unused toxic chemicals of construction with a provision of periodic safe disposal practices	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
41.		Discharge of batching plant, aggregate washing plant, and tunnel seepage waters only after appropriate treatment to the natural water bodies.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
42.		Prohibition on the direct discharge of solid and liquid waste of construction into the natural water bodies.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
43.		Disposal of construction related spoils only into defined and well protected spoil disposal yards.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
	EMP Issues	**Descriptions of Action Required**	**Individuals**	**National**	**Timing of**	**Competent**	**Financial**

			responsible	Standards or Guidelines	Actions	Authority/agency	commitment (indicative)
44.	**Air Quality**	Gravelling of the access roads	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
45.		On-site vehicle speed restrictions and vehicle washing before leaving the site;	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
46.		Careful handling the containment or damping of dusty materials;	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
47.		Frequent watering of the gravel road in the dry season ensuring that the road surface does not generate dust	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
48.		Frequent watering of the dusty barren areas or spoil disposal areas or covering of exposed areas of ground and prompt site restoration	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
49.		Efficient ventilation facility in the underground works	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
50.		Evacuate all tunnel workers other than transportation drivers during spoil transportation in the underground tunnels	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
51.	**Noise and Vibration**	Care in the placement and orientation of noisy plant away from sensitive receivers	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
52.		The use and correct fitting of silencers, mufflers and acoustic shields;	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
53.		Regular maintenance of plant and equipment.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
54.		Restriction of blasting only during day time zone	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
55.		Information shearing with the communities on the noise related issues	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
56.		Inspect present conditions of surrounding buildings	Contractor	EIA	Start of construction phase	SE/ ESMS (KESMU)	Include in contract clause
57.		Perform damage susceptibility study to establish vibration control limits	Contractor	EIA	Start of construction phase	SE/ ESMS (KESMU)	Include in contract clause
58.		Measure vibration background at the area under investigation	Contractor	EIA	Start of construction phase	SE/ ESMS (KESMU)	Include in contract clause
59.		Assess problems such as cracking of building or foundation failure	Contractor	EIA	Start of construction phase	SE/ ESMS (KESMU)	Include in contract clause

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
60.	**Flood Associated Risks**	Construction of flood protection embankment particularly at the tailrace facility	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
61.		Construction of erosion protection gabions/ embankments on the riverside of the spoil banks	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
62.		Construct access road on the flood plains that withstand the erosional activities of the rivers	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
63.		Schedule the construction works in the potentially flood affected areas only during the dry season	Contractor	EIA	Start of construction	SE/ ESMS (KESMU)	Include in contract clause
64.	**Landslide and Erosion Risks**	Construct main access road across the hill slope based on the principal of balancing of cut and fills.	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
65.		Avoid excess cutting of slope at steep angles. All the cut slope should be at the angles less than the angle of repose of the slope material.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
66.		Minimise use of explosive and excavators to avoid disturbance of the ground stability.	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
67.		Construct roadside drainage to adequately pass the surface runoff. Bypass the roadside drainage at regular intervals to the stable natural drainage lines.	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
68.		Prohibit side casting of spoil materials. Avoid stockpiling of the spoils on the drainage lines and on the construction sites. Dispose the spoil materials only at the protected spoil banks as approved.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
69.		Limit vegetation clearance only at levels that is essential for the construction of facility. Vegetation in other areas shall be protected with special care.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
70.		Save all the topsoil excavated in protected banks for later use in site rehabilitation and plantation as approved.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
71.		Carry out stabilisation works of on the ground excavated sites by the use of bioengineering as approved. Use of local grass and vegetation is recommended for the bioengineering works.	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
72.		Plantation of the barren areas. Ensure the plantation of local species, if possible the cleared species of vegetation.	Contractor	EIA	As the work proceeds	SE/ ESMS (KESMU)	Include in contract clause
73.		Clear all the loose materials from the reservoir and place excavated material in the spoil bank.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
74.		Apply gully control measures for all the gullies across the access roads and around the reservoir.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
75.	**Risks Associated with Tunnel, Powerhouse Cavern, and Tailrace Tunnel Excavation**	Limit the explosive charges at the levels required only. Avoid using high explosive charges at one go.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
76.		Apply standard measures to avoid collapse of hanging wall	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
77.		Apply measures to minimize the water seepage into the tunnel	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
78.		Compensate to the lost or damaged property in case of damage to house or to the land based on the principals of good practices	Contractor	EIA	After verification of complain	SE/ ESMS (KESMU)	Include in contract clause
79.		Provide alternative water supply provisions to the affected communities in case of drying out of the water sources used by communities for drinking or irrigation propose due to excessive water seepage in the tunnel.	ACRS (KESMU)	EIA	After verification of complain		5,000,000.00
80.	**Risks Associated with Upstream Catchment Erosion and Downstream Aggradation**	Implementation of Yangran Watershed Management	SAPS (KESMU)	SAPF	Start of construction	NEA	1,500,000.00
81.	**Accidental and Occupational Health Risks**	Restrict speed limits to all the vehicles to less than 25 km/hour in the affected highway corridor and within the project construction sites.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
82.		Prohibit parking of vehicles on the main highway and on the access roads of the project influence area.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
83.		Provide separate area for the vehicle parking within the construction site and in the construction camps.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
84.		Place signs for danger at the hazardous areas which are eligible from distance	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
85.		Strictly adhere to the Occupational Safety and Health provisions for the First Aid, Personnel protective equipment, and Fire protection required for the surface and underground works.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
86.		Training programs/or briefings to the workers on the occupational health safety issues that he or she is employed prior to work assignment.	Contractor	EIA	start of employment	SE/ ESMS (KESMU)	Include in contract clause
87.		Provide adequate ventilation facilities and ensure their effective functioning on under ground works.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
88.		Provide adequate water pumping facilities and ensure their effective functioning on all the underground works	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
89.	**Accidental and Occupational Health Risks**	Provision of a health clinic manned by a medical doctor and nurses with all medical supplies and health stabilization requirements.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
90.		Provision of stand by ambulance for evacuation of injured persons at headwork site and dam construction sites.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
91.		Install warning system and audible-warning devices at appropriate locations in all the construction related sites	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
92.		Implement approved Occupational health and safety plans.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
93.		Implement approved Accident and Emergency plan	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
94.	**Vegetation/Forest**	Restrict to tree felling as identified and approved by the engineers	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
95.		Compensation to the loss of timber, fodder, and fruit trees of the private land	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
96.		Establish a planted buffer zone around the reservoir as EIA recommendation	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
97.		Prohibition on the use of firewood in the construction camps and labor camps for cooking purpose and provision of alternative fuels.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
98.		Prohibition on the felling of trees in the adjoining forest areas by the construction workforce	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
99.		Placing of warning signs at critical locations for the protection and conservation of the forests with lists of what is right action and what is wrong action?.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
100.	**Wildlife**	Placing of warning signs at critical locations for the protection and conservation of the wildlife with lists of what is right action and what is wrong action?.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
101.		Prohibition on the poaching and use of wild animal and birds meat in the construction camps and labor camps.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
102.	**Fish and Aquatic life**	Restriction on the excavation of boulders and gravels as construction aggregates from the river's wet channel	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause
103.		Prohibition on the fish trapping, killing, and poisioning from the construction workforce and their dependents within the project influence area.	Contractor	EIA	Throughout construction phase	SE/ ESMS (KESMU)	Include in contract clause

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
104.	**Sanutar Irrigation**	Pump irrigation of Sanutar area in construction phase	contractor	EIA	Throughout construction	SE/ ESMS (KESMU)	Estimate and include in civil contract
105.	**Warning sirens downstream tailrace**	Establishment of Warning Sirens at least in the six locations	Contractor	EIA	Towards the end of construction phase	SE/ ESMS (KESMU	Estimate and Include in civil contract
106.	**Fencing downstream tailrace**	Fencing of the Rapti Left Bank between Hetauda Bridge - Chaukitole (about 3 km)	SPAS	EIA	Towards the end of construction phase	ESMS (KESMU)	1,950,000.00
107.		Fencing of the Rapti Right Bank Maintar -Laljhundi (about 1.5 km)	SPAS	EIA	Towards the end of construction phase	ESMS (KESMU)	975,000.00
108.	**Access across Rapti tailrace downstream**	Construction of two suspension bridges at Maintar and Chaukitole across Rapti River	Contractor	EIA	Towards the end of construction phase	ESMS (KESMU)	30,000,000.00
109.	**Irrigation canal tailrace downstream**	Construction of five irrigation canals (Maintar canal, Satghatte canal, and Ghatte canal, Nawalpur - Basamadi canal and Simaltar- Golpingtar) and required canal extention located down stream of tailrace	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Design engineer estimate and include in civil contract
110.	**Agricultural Development Programs**	Agricultural Development Program for the affected irrigated lands downstream tailrace	SPAS/KESMU	RAP/SPAF	After the start of construction, throughout construction phase	ESMS (KESMU	1,000,000.00
111.		Agricultural Development Program for the directly impacted landowners of Sanutar, Ghumaune and Nakoligaon	SPAS/KESMU	SPAF	Do	ESMS (KESMU	550,000.00
112.		Agricultural Development Program for the Yangran hinterland and adjoining settlements of the project	SPAS/KESMU	SPAF	Do	ESMS (KESMU	2,000,000.00

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
113.	**Community/Public Health & Education Enhancement**	Extension and improvements of Water supply systems and taps, Construction of Public toilets and waste management systems in the boom towns at Sanutar/Ghumaune Pari, Bhaise, and Nibuwatar	SPAS/KESMU	SPAF	After the start of construction	ESMS (KESMU	750,000.00
114.		Support to educational institutions at Sanutar, Bhaise, and Nibuwatar to cater the additional school going children (room space, teacher, etc.)	SPAS/KESMU	SPAF	After the start of construction	ESMS (KESMU	450,000.00
115.		Rotational Clinical facility manned with a Medical Doctor during construction phase at Sanutar and Bhaise	Contractor	SAPF	Throughout construction phase	ES/ESMU (KESMU)	Include in civil contract
116.		Education and prevention programs on environmental sanitation, water related disease, STD, HIV AIDS, and Malaria at the construction camps, labor camps, boom towns and settlements close to project camp sites	SPAS/KESMU	SPAF	Do	ESMS (KESMU	800,000.00
117.	**Rural Electrification**	Rural Electrification of settlements of Yangran Catchment in ward No 6 and 8 of Bhaise VDC and settlements of ward no 9 and 8 of Basmadi VDCs, approximately 10 km of TL length	SPAS/KESMU	SPAF	Within construction period	ESMS (KESMU	2,500,000.00
118.	**Neighborhood Support Programs**	Local development assistance to Bhaise ward 1,6,8; Basamadi ward 9 and Hetauda ward 1	SPAS/KESMU	SPAF	Within construction period	ESMS (KESMU	**3,750,000.00**
119.	**Woman Development Program**	Education program on family health, haousehold sanitation, STD, HIV AIDS, family planning, girl trafficking etc.	SPAS/KESMU	SPAF	Within construction period	ESMS (KESMU	350,000.00
120.		Livelihood skill training to women	SPAS/KESMU	SPAF	Within construction period	ESMS (KESMU	750,000.00
121.		Micro-credit funds for women	SPAS/KESMU	SPAF	Within construction period	ESMS (KESMU	500,000.00

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
Post Construction Phase							
122.	**Rehabilitation and Revegetation**	All the cut and fill areas are rehabilitated and revegetated.	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
123.		Cut batters of the access roads will be protected by bioengineering measures	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
124.		The temporary sites used during construction be rehabilitated and returned in conditions similar to before lease	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
125.		The stock piled top soil is spread on the spoil banks and planted with vegetation	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
126.		Maintain vegetation in buffer zone	Contractor	EIA	after construction	SE/ ESMS (KESMU)	Include in contract clause
127.	**Reinstatement of Services**	Reinstatement of all the temporary and permanent service facilities	Contractor	EIA	after construction	SE/ ESMS (KESMU)	Include in contract clause
128.		Renovation of present irrigation canal at Guhumaune - Sanutar and provision to release irrigation water to Ghumaune - Sanutar through the dam by a Polly pipe facility in the operation period	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in civil contract
129.	**Settlement of Dealings with Locals**	Settle the previous dealings related to the private property temporarily used for construction purposes	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
130.		Provide copy of settlements with locals to Engineers	Contractor	EIA	after construction	SE/ ESMS (KESMU)	Include in contract clause
131.	**Demolition**	Demolition of all temporary structures constructed at site installation, camps, cement batch plants, crushing plants, stores, tunnel audits etc.	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
132.		Removal of all the construction materials and building materials from the sites	Contractor	EIA	Soon after construction	SE/ ESMS (KESMU)	Include in contract clause
133.	**Restoration of Impacted Infrastructures**	Improvement of intakes of 5 water mill canals	SPAS/KESMU	SPAF	Soon after construction	ESMS (KESMU)	125,000.00
134.		Improvement of intakes of 3 irrigation canals upstream tailrace based on Rapti and Keasadi Rivers	SPAS/KESMU	SPAF	Soon after construction	ESMS (KESMU)	100,000.00
135.	**Environmental Awareness Program against Accidental Risks Downstream Tailrace**	Placement of Display Boards and warning signs (Tailrace downstream areas)	SPAS/KESMU	SPAF	Soon after construction	ESMS (KESMU)	300,000.00
136.		Community Awareness Programs against accidental risks of tailrace water)	SPAS/KESMU	SPAF	Soon after construction	ESMS (KESMU)	500,000.00
137.		Sanitation Program to the River Bank communities downstream tailrace (Chaukitole, Maintar, Laljundi)	SPAS/KESMU	SPAF	Soon after construction	ESMS (KESMU)	1,500,000.00
			Total mitigation cost for pre-construction, construction and post construction				**98,707,960.00**

Note: The cost does not include 10% contingency costs

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
Operation Phase							
138.	**River maintenance flow**	Release environmental and irrigation flows as recommended	KESMU	EIA	Throughout operation	ED - NEA	No cost required
139.	**Fish and aquatic life**	Reservoir stocking of Fish indiginous and exotic for the first five year	KESMU	EIA	First five years of operation	ED - NEA	10,000.00/year
140.		Stocking in Upstream of Reservoir/ Riverine Condition of Rapti and Kesadi for the first five year	KESMU	EIA	First five years of operation	ED - NEA	15,000.00/year
141.		Fish caging in limited reservoir area	KESMU	EIA	First year of operation	ED - NEA	25,000.00/year
142.		Inspection to enforce mechanism to prohibit illigal havesting of fish downstream tailrace	KESMU	EIA	Throughout operation	ED - NEA	60,000.00/year
			Total yearly recurrent cost for operation phase				**110,000.00**

Note: The cost does not include 10% contingency costs

Table A.7.8 : Environmental Monitoring Plan

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
Pre-construction Phase							
1.	**Permits and Approval and co-ordination**	Records of permits and approval	KESMU	EIA	Monthly up to construction period	KHEP	Included in administrative costs
2.	**Grievance handling**	Records of grievances and action taken	ESMS (KESMU)	EIA	Monthly up to construction period	KHEP	Included in administrative costs
3.	**Environmental Awareness Program on accidental risks**	Compliance to provisions and record keeping	Contractor/ ESMS (KESMU)	EIA	Monthly up to construction period		Included in administrative costs
4.	**Job opportunity**	Records of employment particularly SPAF, PAF, Local area people, Nepali and foreigners	Contractor	EIA	Monthly up to construction period	ESMS (KESMU)	Included in administrative costs
5.	**Public Relation**	PIC established and information shearing as per recommendations	ESMS (KESMU)	EIA	Monthly up to construction period	KHEP	Included in administrative costs
6.	**Land and property acquisition, compensation and resettlement**	Compliance to RAP provisions, record keeping	ESMS (KESMU)	EIA	Monthly till the end of process	KHEP	Included in administrative costs
7.	**Irrigation canal tailrace downstream**	Baseline study and database of the diverted irrigation water volume downstream tailrace areas	ESMS (KESMU)	Baseline study	Before operation	KHEP	1,000,000.00
8.		Baseline database on the type and agricultural produce on annual basis	ESMS (KESMU)	Baseline study	Before operation	KHEP	
9.	Water Quality	Pre-project baseline monitoring of 8 baseline monitoring stations for 4 season	KHEP	Baseline parameter of SEIA	Before construction	ED - NEA	430000.00
10.	Air Quality	Ambient air quality baseline monitoring of TSP at Sanotar and Bhaise stations for 2 consecutive 24 hours averaging period in the dry season	KHEP	Baseline TSP	Before construction in dry season	ED - NEA	100000.00
11.	Noise and vibration	Baseline noise level monitoring at 3 baseline monitoring stations,	KHEP	Baseline Noise	Before construction once	ED - NEA	80,000.00
12.		Survey of the structures within 400m radius of tunnel line and photographic recording of the house conditions	KHEP	Baseline records	Before construction	ED -NEA	450000.00
13.	Vegetation/Forest	Accounting of the vegetation identified for protection with numbers in map	ESMS (KESMU)	EIA	Before clearance	KHEP	Included in administrative costs

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
Construction Phase							
14.	Water Quality	Water quality monitoring of the treatment facilities (batch plant,aggregate washing plant, tunnel seepage waters)	ESMS (KESMU)	EMP parameters	Every three months for construction period	KHEP	500000.00*
15.		Water quality monitoring of the 8 baseline station,	ESMS (KESMU)	Baseline parameters	Every three months for construction period	KHEP	650000.00*
16.		Compliance to water quality mitigation measures through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
17.		Water quality monitoring of water supply in the camps	Contractor	EMP	Monthly	ESMS (KESMU)	Include in contract clause
18.	Air Quality	Ambient air quality monitoring of TSP in the 2 baseline station, one 24 four hour averaging sampling	ESMS (KESMU)	EMP	Every four months for construction period	KHEP	840,000.00
19.		Compliance to air quality mitigation measures through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
20.		Underground air quality monitoring of tunnels and caverns	Contractor	Health and safety parameters	Daily	ESMS (KESMU)	Include in contract clause
21.	Noise and Vibration	Noise level monitoring of the baseline sites twice in the peak season	ESMS (KESMU)	EMP	Twice a year (Nov./Aprl)	KHEP	640,000.00
22.		Compliance to Noise and vibration mitigation measures through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
23.	Landslide and Erosion Risks	Compliance landslide and erosion risk mitigation measures through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
24.		Accounting of the cases and number of landslide and erosion in the project construction and facility	ESMS (KESMU)	EIA	areas once after monsoon every year		Included in administrative costs
25.	Risks Associated with Tunnel, Powerhouse Cavern, and Tailrace Tunnel Excavation	Compliance mitigation measures for risks associated with tunnel etc. through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
26.		Structural defects of house in comparison to baseline data	ESMS (KESMU)	EIA	in case of complain	KHEP	Included in administrative costs
27.		Water discharges of the in use water sources	ESMS (KESMU)	EIA	once in a year in the dry season	KHEP	Included in administrative costs

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
28.	**Risks Associated with Upstream Catchment Erosion and Downstream Aggradation**	Compliance to mitigation measures for risks associated with Associated with Upstream Catchment Erosion and Downstream Aggradation. through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
29.		Accounting of vegetation status of Yangran catchment including Bokedaha and Kalika Community forests	ESMS (KESMU)	EIA	once every year	KHEP	Included in administrative costs
30.	**Accidental and Occupational Health Risks**	Compliance to mitigation measures on accidental and occupational health risks	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
31.		Accounting of the occupational safety and health record (fatal and major incidents) once every month.	Contractor	EMP	Daily, weekly and monthly	/ESMS (KESMU)	Include in contract clause
32.		Accounting of accidents, in the Bhaise-Hetauda highway section and in the access road corridors of the project	Contractor	EMP	once in a month.	/ESMS (KESMU)	Include in contract clause
33.	**Vegetation/Forest**	Accounting of the felled trees	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
34.		Compliance to mitigation measures for vegetation protection through supervision, observation and records	ESMS (KESMU)	EMP	Daily, weekly and monthly	KHEP	Included in administrative costs
35.		Restriction on the use of firewood in the camps	ESMS (KESMU)	EMP	Monthly	KHEP	Included in administrative costs
36.		Firewood collection from forest	ESMS (KESMU)	EMP	Monthly	KHEP	Included in administrative costs
37.		Plantation of trees in the barren areas within construction site	ESMS (KESMU)	EMP	Three monthly	KHEP	Included in administrative costs
38.	**Vegetation/Forest**	Buffer zone establishment and plantation of indigenous trees including protected trees	ESMS (KESMU)	EMP	Three monthly	KHEP	Included in administrative costs
39.		Plot studies of the baseline plots around construction sites	ESMS (KESMU)	EMP	Once a year	KHEP	Included in administrative costs
40.	**Wildlife**	Habitat Loss around project sites	ESMS (KESMU)	EIA	Four monthly	KHEP	Included in administrative costs
41.		Species Occurrence around project sites	ESMS (KESMU)	EIA	Four monthly	KHEP	Included in administrative costs
42.		Construction disturbances around project sites	ESMS (KESMU)	EIA	weekly	KHEP	Included in administrative costs
43.		Mitigation measures compliance	ESMS (KESMU)	EMP	Monthly	KHEP	Included in administrative costs

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
44.	**Fish and Aquatic life**	Aquatic ecology survey for impact analysis in the 7 Baseline stations	ESMS (KESMU)	EIA	Six monthly	KHEP	600000.00
45.		Mitigation measures compliance	ESMS (KESMU)	EIA	Monthly	KHEP	Included in administrative costs
			Total monitoring costs for pre-construction, and construction phase				**5,290,000.00**

	EMP Issues	Descriptions of Action Required	Individuals responsible	National Standards or Guidelines	Timing of Actions	Competent Authority/agency	Financial commitment (indicative)
46.	Community Health of Project area	Records of health epidemics in the project area community	ESMS (KESMU)	EIA	Six monthly	KHEP	Included in administrative costs
47.		Information on STD/ HIV AIDS	ESMS (KESMU)	EIA	Six monthly		Included in administrative costs
48.	Social Action Plan	Compliance to social action plan measures	ESMS (KESMU)	EIA	Monthly	KHEP	Included in administrative costs
			Operation Phase				
49.	Water Quality	Water quality monitoring of the 8 baseline station twice annually	KHEP	Baseline parameters	Twice a year	ED- NEA	80000.00/year
50.	**Fish and Aquatic life**	Aquatic ecology survey for impact Analysis in the 7 Baseline stations	KHEP	Baseline parameters	6 monthly for 4 years of operation	ED- NEA	800000.00
51.		Compliance to release of environmental flows at Yangran	KHEP	EIA	Daily	ED- NEA	Included in administrative costs
52.		Compliance to fish stocking, fish release in the reservoir and other areas	KHEP	EIA	Yearly, for five years	ED- NEA	Included in administrative costs
53.		Compliance to restiction of fishing activities below tailrace	KHEP	EIA	Daily	ED- NEA	Included in administrative costs
54.	**Irrigation canal tailrace downstream**	Operation phase monitoring of diverted water volumes in the irrigation and water mill canals and their sufficiency to meet the requirements at pre-project levels	KHEP	Baseline conditions	Once a year for two years after operation	ED- NEA	1,500,000.00
55.		Operation phase monitoring of the coverage of the irrigated land by the irrigation canal and type and volume of agricultural produce annually	KHEP	Baseline conditions	Once a year for two years after operation	ED- NEA	
						Yearly monitoring cost **One time monitoring cost**	**80,000.00 yearly** **2,300,000.00 once**

Note: The cost does not include 10% contingency costs

Table A.7.9 Summary Costs of Staffing, Support and Program for Environmental Management Plan (EMP) – Kulekhani III HEP

Description	Cost in NRs.	Cost in USD
1. NEA Staff and Consultants	NRs. 19,801,000	USD 260,500
2. Support and Operating Expenses	NRs. 18,180,000	USD 239,200
3. EMP Program	NRs. 18,265, 500	USD 240, 300
TOTALS	**NRs, 56,246,500**	**USD 740,000**

FIGURES

Part A

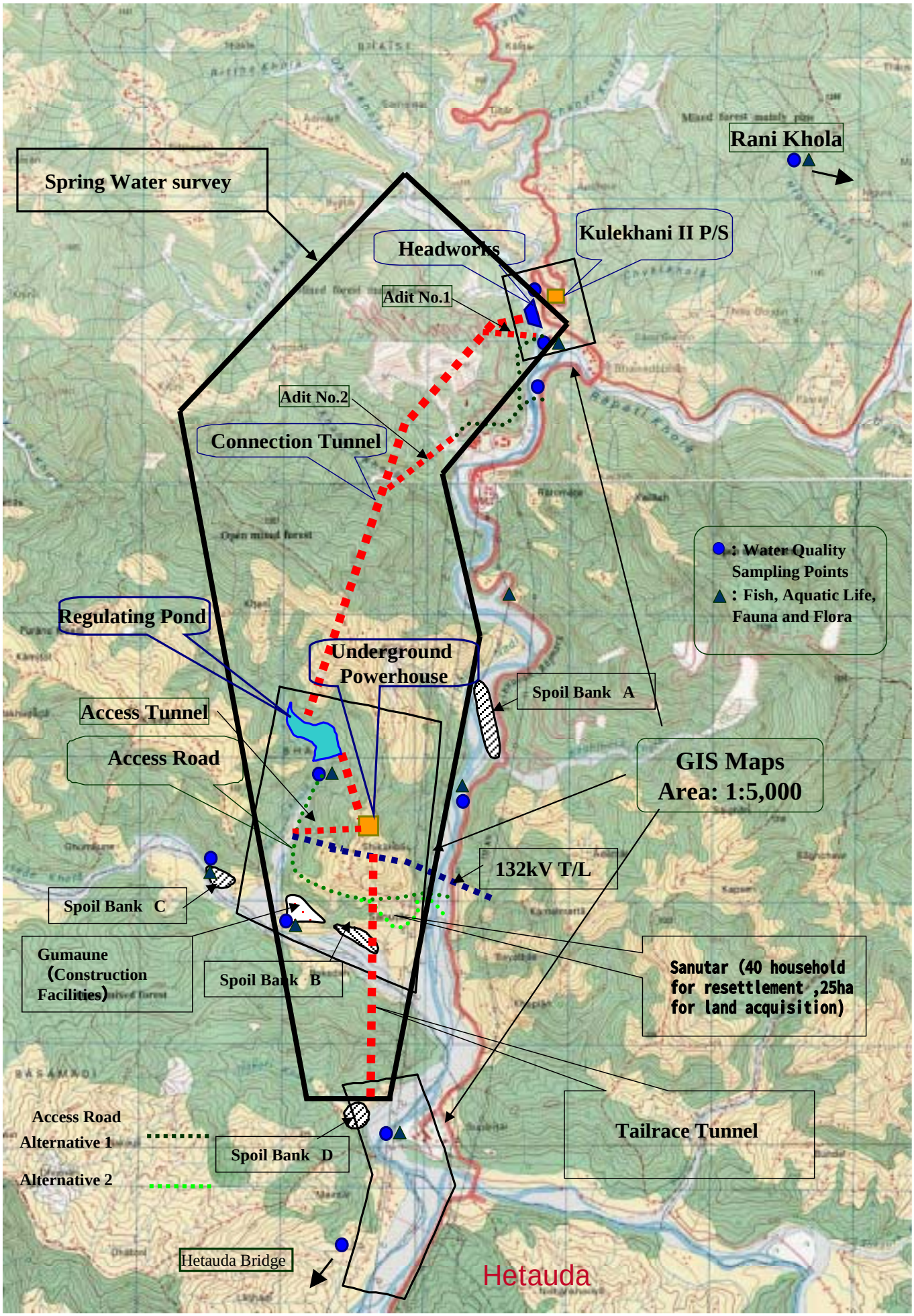
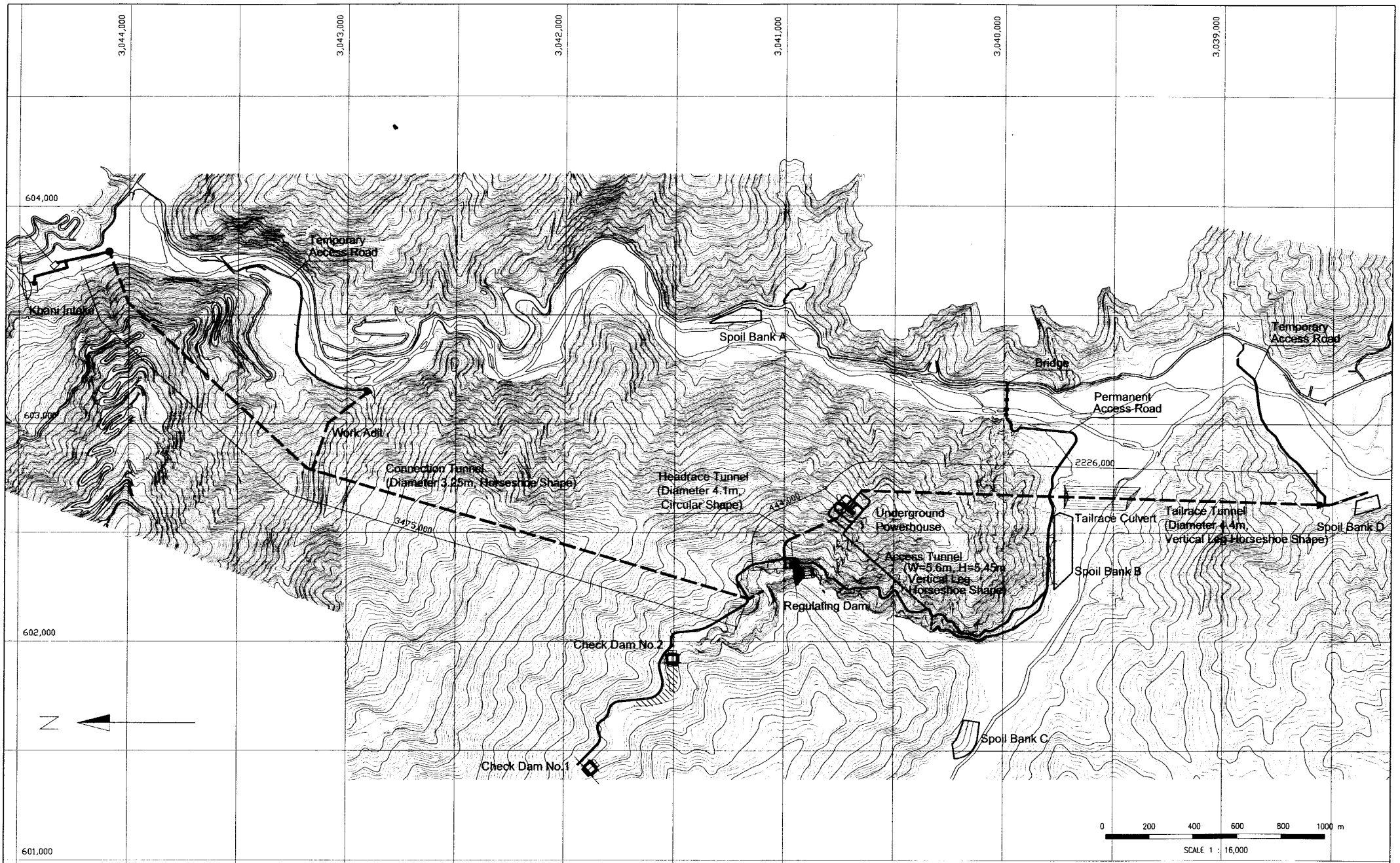


Figure A.2.1 Supplemental EIA Survey



THE UPGRADING FEASIBILITY STUDY ON THE DEVELOPMENT OF THE KULEKHANI III HYDROPOWER PROJECT IN THE KINGDOM OF NEPAL	Figure A.3.1 Project Layout
JAPAN INTERNATIONAL COOPERATION AGENCY	

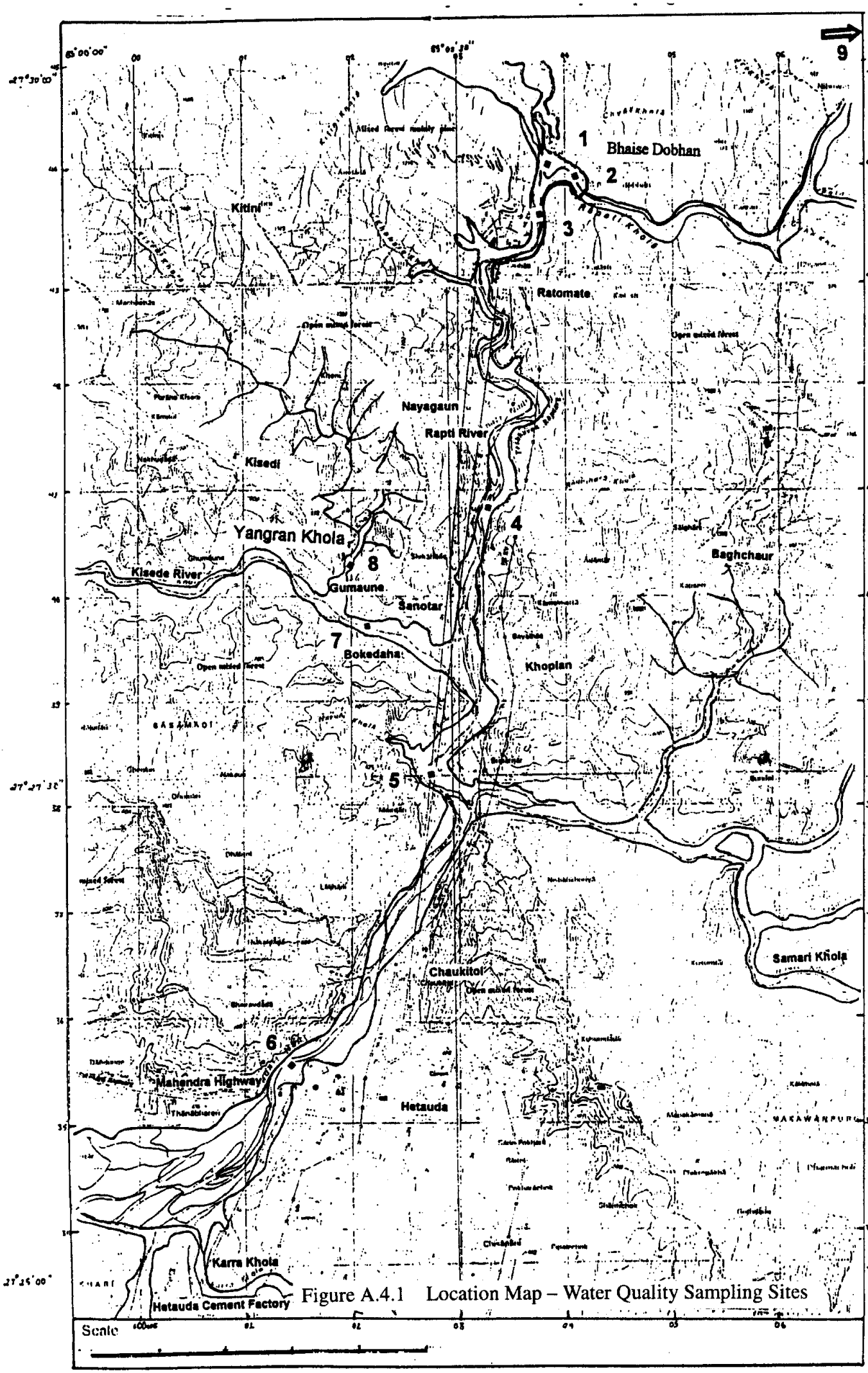


Figure A.4.1 Location Map – Water Quality Sampling Sites

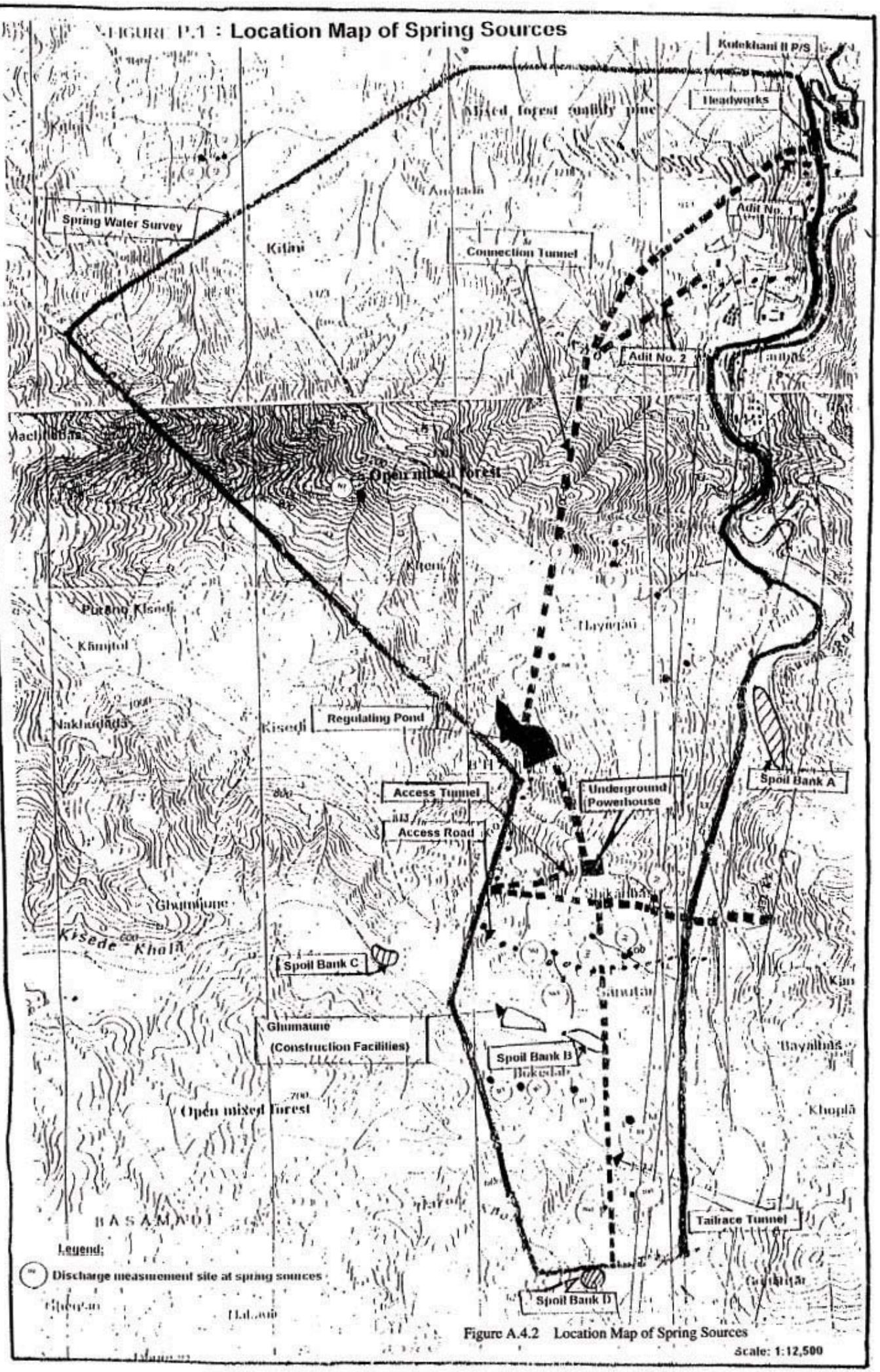


FIGURE P.1 : Location Map of Spring Sources
Kulekhani II P/S
Headworks
Mixed forest mainly pine
Spring Water Survey
Kiling
Connection Tunnel
Adit No. 1
Adit No. 2
Open mixed forest
Khem
Purano Kisedi
Khanjol
Nakhuwa03
Kisedi
Regulating Pond
Access Tunnel
Underground Powerhouse
Access Road
Spoil Bank A
Ghumaune
Kisede Khola
Spoil Bank C
Ghumaune
(Construction Facilities)
Spoil Bank B
Open mixed forest
Tailrace Tunnel
BASAMADI
Legend:
Discharge measurement site at spring sources
Spoil Bank D
Figure A.4.2 Location Map of Spring Sources
Scale: 1:12,500