

CONSOLIDATED ENVIRONMENTAL MANAGEMENT PLAN (Draft)

July, 2018



Nepal: Tanahu Hydropower Project

Prepared by Tanahu Hydropower Limited, the Government of Nepal for the Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
CC	–	Construction Contractor
CDO	–	Chief District Officer
DFO	–	District Forest Office
DoED	–	Department of Electricity Development
EIB	–	European Investment Bank
EIA	–	environmental impact assessment
EMP	–	Environmental Management Plan
ESMU	–	Environmental and Social Management Unit
ESMSP	–	Environmental and Social Management Service Provider
ESU	–	Environmental Sub-Unit
FSL	–	Full Supply Level
GoN	–	Government of Nepal
GRM	–	grievance redress mechanism
Ha	–	Hector
IEE	–	initial environmental examination
JICA	–	Japan International Cooperation Agency
KM	–	Kilometer
kV	–	Kilovolt
M	–	Meter
masl	–	meter above sea level
MCM	–	Million Cubic Meter
MOEn	–	Ministry of Energy
MOFSC	–	Ministry of Forest and Soil Conservation
MOL	–	Minimum operating level
MoPE	–	Ministry of Population and Environment
MW	–	Mega Watt
NEA	–	Nepal Electricity Authority
PPE	–	Personal Protective Equipment
PSC	–	Project Supervision Consultant
RAP	–	Resettlement Action Plan

REP	–	Rural Electrification Program
SEIA	–	Supplementary Environmental Impact Assessment
SEP	–	Site Environmental Plan
SPAF	–	Seriously Project Affected Families
sq. m	–	square meter
THL	–	Tanahu Hydropower Limited
THLP	–	Tanahu Hydropower Project
ToR	–	Terms of Reference
VDC	–	Village Development Committee

Table of Contents

1.0	General	6
2.0	Environmental Project Approvals	6
3.0	Project Description	6
3.1	Project Location and Accessibility	7
4.0	Organizational Structure for Implementation of the EMP	9
5	Environmental Management Plan (EMP).....	10
5.1	System of Environmental Management Plans.....	10
5.2	Contractor's Environmental Management Plan (CEMP)	11
5.3	Monitoring and Reporting Requirements	12
5.2.1	Reporting Mechanism	14
5.4	Environmental Auditing.....	15
5.4.1	Requirements for Environmental Auditing.....	15
5.4.2	Agencies Responsible for Auditing.....	15
5.4.3	Auditing Parameters.....	15
5.5	Environmental Management Cost	16
5.5.1	Cost Estimate as per Supplementary EIA (2017).....	16
5.5.1	Cost Estimate as per Environmental Addendum (2012)	17
5.6	Grievance Redress Mechanism	19
5.6.1	First Level of GRM	19
5.6.2	Second level of GRM	19
5.6.3	Third Level of GRM	19
5.7	EMP Tables	19

List of Figure

Figure 1: Location Map of Tanahu Hydropower Project

Figure 2: Accessibility Map of the Project

Figure 3: Envisaged environmental management structure under the construction contract

List of Table

Table 1: Restructuring of the Project Affected Local Body

Table 2: Environmental Management Roles and Responsibilities

Table 3: Environmental Management Cost for Hydropower Components (SEIA, 2017)

Table 4: Cost Estimates from EMPs (Vol. 2a and 2b of Environmental Addendum, 2012)

Table 5: Consolidated Environmental Management Plan

Table 6: Environmental Monitoring Plan

Appendices

Appendix I: Fish Conservation Management Plan

Appendix II: Forest Management Plan

Appendix III: Wildlife and Watershed Management Plan

Appendix IV: Dam Safety Management Plan/ Water Release and River Safety Management Plan

CONSOLIDATED ENVIRONMENTAL MANAGEMENT PLAN

1.0 General

This Consolidated Environmental Management Plan (EMP) has been prepared for the Tanahu Hydropower Project (THP) to define project environmental management measures and procedures, thereby helping to ensure that all mitigation measures and monitoring requirements specified in the *Environmental Impact Assessment* (EIA, 2009), *Environmental Addendum* (2012) and *Supplementary EIA 2017* are implemented during each phase of project implementation and operation. The EMP outlines the organizational structure of the Environmental and Social Management within the Tanahu Hydropower Limited (THL) and describes the main roles and responsibilities of the parties involved in project environmental management. This report currently covers the hydropower generation system (dam and reservoir components) of the THP.

The EMP will be considered as an environmental operation manual for use by THP management and staff, contractors, and regulatory authorities. It will be updated from time to time as necessary.

2.0 Environmental Project Approvals

Tanahu Hydropower Project *Environmental Impact Assessment* (EIA, 2009) was approved by the Government of Nepal (GoN) in July 2009 (Vikram2066/07/05). An Environmental Addendum (July 2012) was prepared through ADB as a basis for the loan agreement. A supplementary EIA was approved by the Government of Nepal in November 2017.

3.0 Project Description

The Tanahu Hydropower Project (THP) with a dam height of 140m and installed capacity of 140MW is located in the Tanahu District in the Western Development Region, Province-4, Nepal. This is a storage type hydroelectric project proposed on the Seti River which is one of the major tributaries of the Seti River in the Gandaki basin. The proposed dam is located about 2km upstream of the confluence of the Seti and Madi rivers, whereas the underground powerhouse is located downstream of the dam site. This storage project involves the following components: 140m concrete gravity dam with the Full Supply Level at an elevation of 415 masl, 7.26 sq.km surface area of the reservoir with gross storage capacity of 295.1 MCM, 175m long penstock, an underground powerhouse consisting of 2 x 70MW Francis Turbines.

Reservoir: a reservoir with a total surface area of 7.26 sq.km at FSL(EL 415 m) will be created. The reservoir will have a minimum operating level (MOL) of EL 378 m, providing a 37 m available drawdown (fluctuation zone) between MOL and FSL. The total storage volume of the reservoir at FSL will be 295.1 million m³, with 200.3 million m³ (68%) of this being effective storage at the date of completion.

Waterway: a 7.4 m (diameter) by 1,203 m long headrace tunnel will be constructed on the right bank of the reservoir. This will connect to a 160 m long penstock that divides into two (going from 7.4 m in diameter to 2 x 3.1 m in diameter) near its end. A 190 m long tailrace tunnel will be constructed to discharge the flow used for power generation back into the Seti River.

Powerhouse: an underground powerhouse will be constructed 6 km downstream of the dam. Two units of vertical axis Francis turbines, three phase synchronous generator and transformer will be installed. The powerhouse dimensions are 27 m wide by 46 m high by 97 m long. Surface facilities will include an outgoing terminal and administrative buildings.

Access roads: two permanent access roads (totaling 7.3 km) and a number of temporary access roads will be constructed at the Project site.

Workforce camps, work areas and administration buildings: a permanent operation and maintenance workforce camp will be established near the powerhouse site at Kahunshivapur. During Project construction, this camp will serve as the Project management staff camp. Temporary workforce camps are also likely to be established near the dam and powerhouse sites.

3.1 Project Location and Accessibility

The THP is located in Tanahu District of Province 4 (Figure 1). Dam site is located close to the city of Damauli and about 40 km away from Pokhara.

With the recent changes in the structure of local government body, the project affected Rural Municipality and Municipality is renamed as follows:

Table 1: Restructuring of the Project Affected Local Body

SN	Present Local Body	Present Ward No.	Previous Local Body (VDC and Ward No)
1	Vyas Municipality	5	Vyas Municipality, ward -7
2	Bhimad Municipality	5	Risingpokhari VDC-9, Majhkot VDC-9, Samunbhagabatipur VDC-2
		6	Bhimad VDC-1
3	Rising Rural Municipality	1	Kahushivapur VDC-3
		6	Kotdarbar VDC-1
		7	Kotdarbar VDC- 2 and 7
		8	Risingranipokhari VDC-7and 8
4	Myagde Rural Municipality	1	Jamune Bhanjyan VDC-1
		2	Jamune Bhanjyan VDC-4 and 5
		3	Jamune Bhanjyan VDC-6
		4	Chhang VDC-2 and 4
		5	Chhang VDC-7 and 8

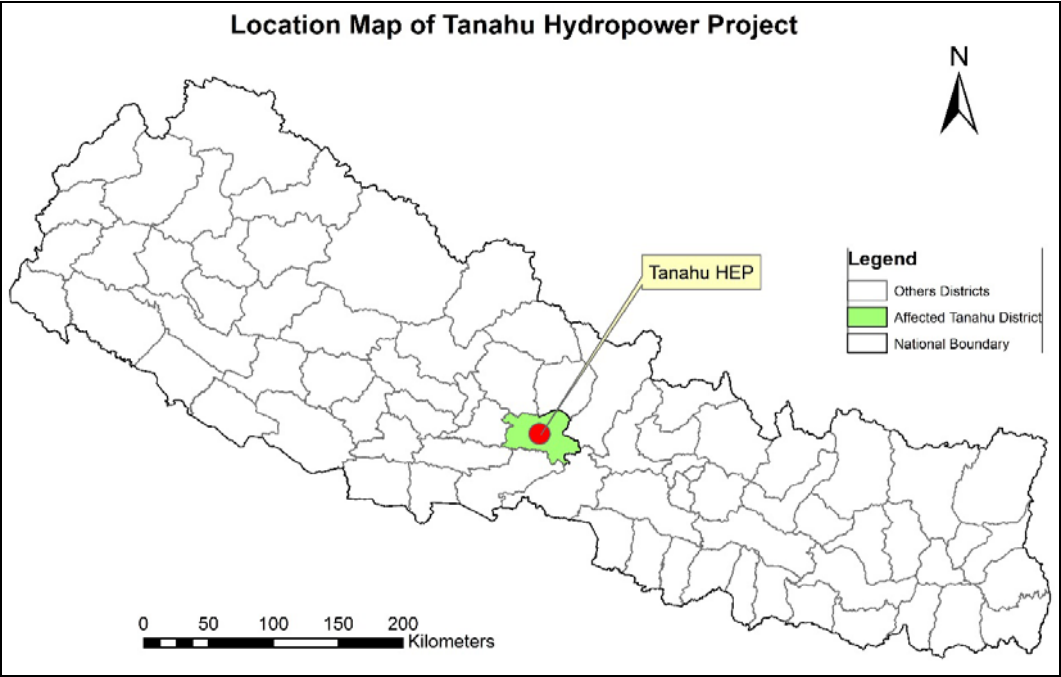


Figure 1: Project Location Map

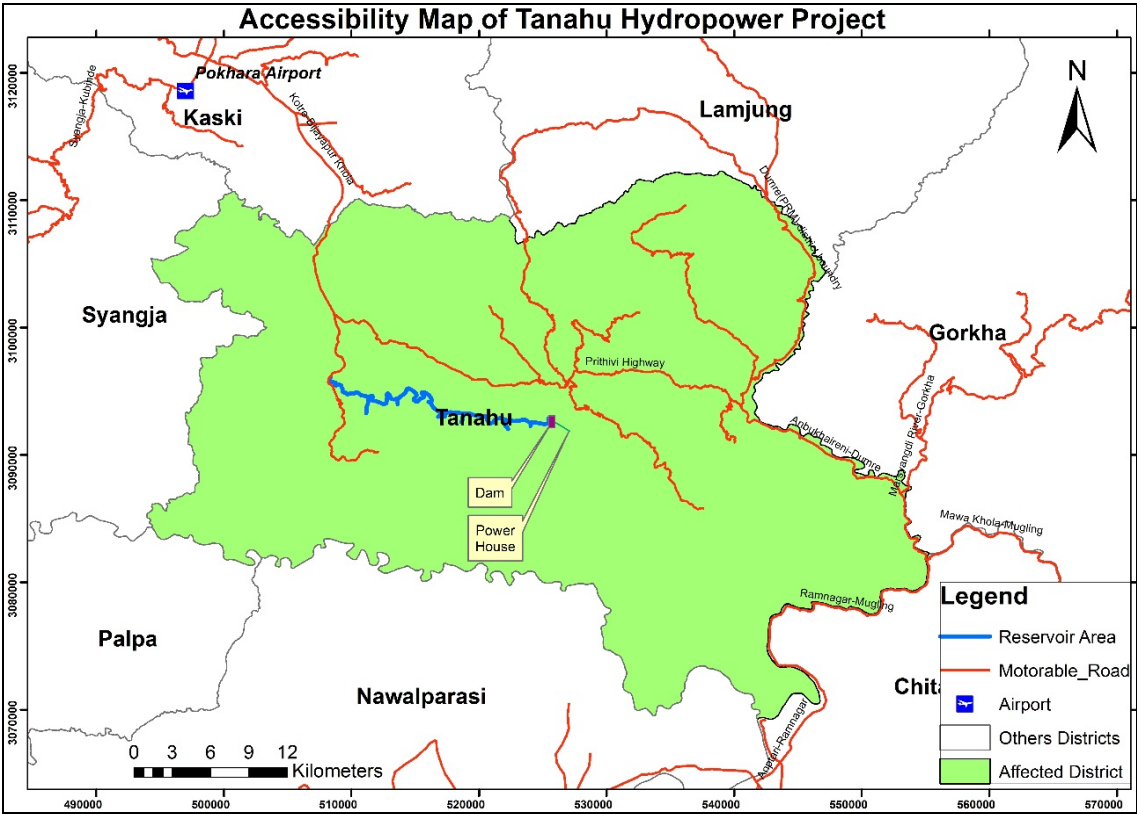


Figure 2: Accessibility Map of the Project

4.0 Organizational Structure for Implementation of the EMP

There are a number of key stakeholders to be involved in the project environmental and social management. The key stakeholders and their main roles and responsibilities are presented below.

Table 2: Environmental Management Roles and Responsibilities

Organizations	Roles and Responsibilities
MoPE	The government agency responsible for environmental management and development approval, will monitor Project environmental management as it sees fit during Project design and construction, and audit the Project after two years of operation to assess compliance against Project approval, license and permit conditions, statutory standards and Project environmental management plans (EMP, etc). MoPE will also conduct an audit of Project environmental performance every two years during Project operation. MoPE will provide formal feedback to THL on non-complying aspects of the Project.
MoEn/ DoED	The Department of Electricity Development (DoED), within the Ministry of Energy (MoEn), is responsible for monitoring Project environmental management during Project design, construction and operation to assess compliance against Project approval and license conditions, statutory standards and Project environmental management plans. This will be undertaken on an as-required basis during construction and operation phase.
Tanahu Hydropower Limited (THL)	THL will be directly responsible for the implementation, management and supervision of THP's environmental management plan. For this purpose, THL has formed an <i>Environmental and Social Management Unit (ESMU)</i> . The ESMU will consist of an Environmental Sub-Unit (ESU), and a Resettlement and Social Action Sub-Unit (RSASU). The ESU will be responsible for: (i) mitigation measures planned in the EMP; (ii) environmental baseline monitoring and environmental compliance monitoring; and, (iii) corrective action and reviewing the EMP during pre-construction, construction and operation. The RSASU will be responsible for implementing the RP, GESI and CDS and liaison with the government and non-governmental organizations on related issues. To support the ESMU in designing, implementing and overseeing the environmental and social safeguards measures, THL will hire consultants, including a consulting firm as Environmental and Social Management Service Provider (ESMSP); and a number of other contractors as necessary. THL will also recruit an independent Panel of Experts to provide periodic review and advice.
Project Supervision Consultant (PSC)	The Project Supervision Consultant (PSC) has been hired by THL for project supervision during pre-construction, construction and initial 5 years of operation. The PSC's team includes one Environmental Specialist and one Social Safeguards Specialist who shall directly assist the ESMU with its duties.
Panel of Experts (PoE)	A Panel of Experts, including environmental experts who will be appointed to provide guidance to the ESMU, will be established for the entire Project. The environmental experts in the Panel will comprise an environmental specialist, a resettlement and social development specialist, and a dam safety specialist. The panel will undertake overall evaluation of the environmental management, dam safety, resettlement and livelihood restoration work planned and undertaken by the THP. Among other tasks, the Panel will (i) review the adequacy of this EMP, the Issue Management Plans (IMPs), Site Environmental Plans (SEPs), RPs, CDS, and GESI and provide recommendations for improvements; (ii) review Project designs, and recommend design changes and other improvements if any (iii) monitor the performance of THL and its consultants and contractors in implementing the designs and safeguards measures.
Construction Contractor (CC)	The Construction Contractors (CCs) shall be primarily responsible for the implementation and internal monitoring of all environmental management measures associated with Project design and construction. The CC shall have the

Organizations	Roles and Responsibilities
	sole responsibility for all activities on sites under its control for the duration of construction. This includes the activities of all subcontractors, whether employed or contracted directly or indirectly by the CC. Accordingly, it shall be the CC's responsibility to ensure that all activities are compliant with Project plans, permit and approval conditions, and any other statutory requirements.
NGOs, CBOs, Rural Municipality/ Municipality and DCCs and other stakeholders	Interactions between local stakeholders and the Project will contribute to ensuring that the environmental and social mitigation measures are implemented in all stages of the project as per the agreed environmental and social mitigation and management plans (including EMPs, RPs, SPAF, etc.); and that the public participation and involvement in the project implementation is maximized by the project owner, consultants and contractors. Two mechanisms will be used to manage these processes: (i) Grievance Redress Mechanism (GRM): The various local governmental and non-governmental organisations and the individual APs will follow the Project's activities to ensure, that their respective interests and expectations are being met by the Project. The Project will capture these concerns and demands via its GRM, and thereby they will become part of the formal monitoring system. (ii) The Project (or its Financers) may formally engage some of these entities (NGOs/civil society organisations) to carry out certain monitoring tasks; e.g. to assist in monitoring the processes of land acquisition and compensation payments.

5 Environmental Management Plan (EMP)

5.1 System of Environmental Management Plans

This EMP provides an overarching environmental framework for all implementing parties, government agencies and stakeholders. All environmental management measures proposed in the *EIA (2009)*, *Environmental Addendum, 2012* and *Supplementary EIA 2017* are updated in this EMP.

Based on the previous EIAs and EMPs, in particular the Environmental Addendum 2012, THL shall prepare and implement four main environmental programmes as follows:

- Fish Conservation Management Plan;
- Water Release and River Safety Management Plan;
- Wildlife Conservation and Awareness Management Plans; and
- Watershed / Forest Management Plans

Implementation of these programmes will start during the pre-construction phase and will continue during the construction and operation phases.

For the construction works, in accordance with the Environmental Addendum 2012, "Volume 2a: Environmental Management Plan - Dam/Reservoir Component", there are three levels of environmental management plans which are to guide and control environmental management on each site:

- 1st level: THL's generic EMP;
- 2nd level: Issue Management Plans (IMPs) – to be prepared by THL for each major environmental topic, providing the principles, procedures and specific measures for the planning and management of each issue;

- 3rd level: Contractor's Environmental Management Plan (CEMP) – specified in the construction contract, based on Site Environmental Plans (SEPs) covering each construction/ancillary site.

The Contractor's CEMP (and the SEPs within it) shall convert THL's EMP and IMPs into site-specific management measures, and shall be subject to review and shall require prior approval by the THL's Environmental Safeguards Unit (ESMU).

5.2 Contractor's Environmental Management Plan (CEMP)

As specified in the construction contract, the Contractor's CEMP (and SEPs) shall be established within the framework of an Environmental Management System (EMS) which shall also include the Contractor's Incident Management Procedures and Emergency Response Procedures, and is to be in full compliance with ISO 14001.

The envisaged environmental management structure under the construction contract is presented diagrammatically in following figure 3.

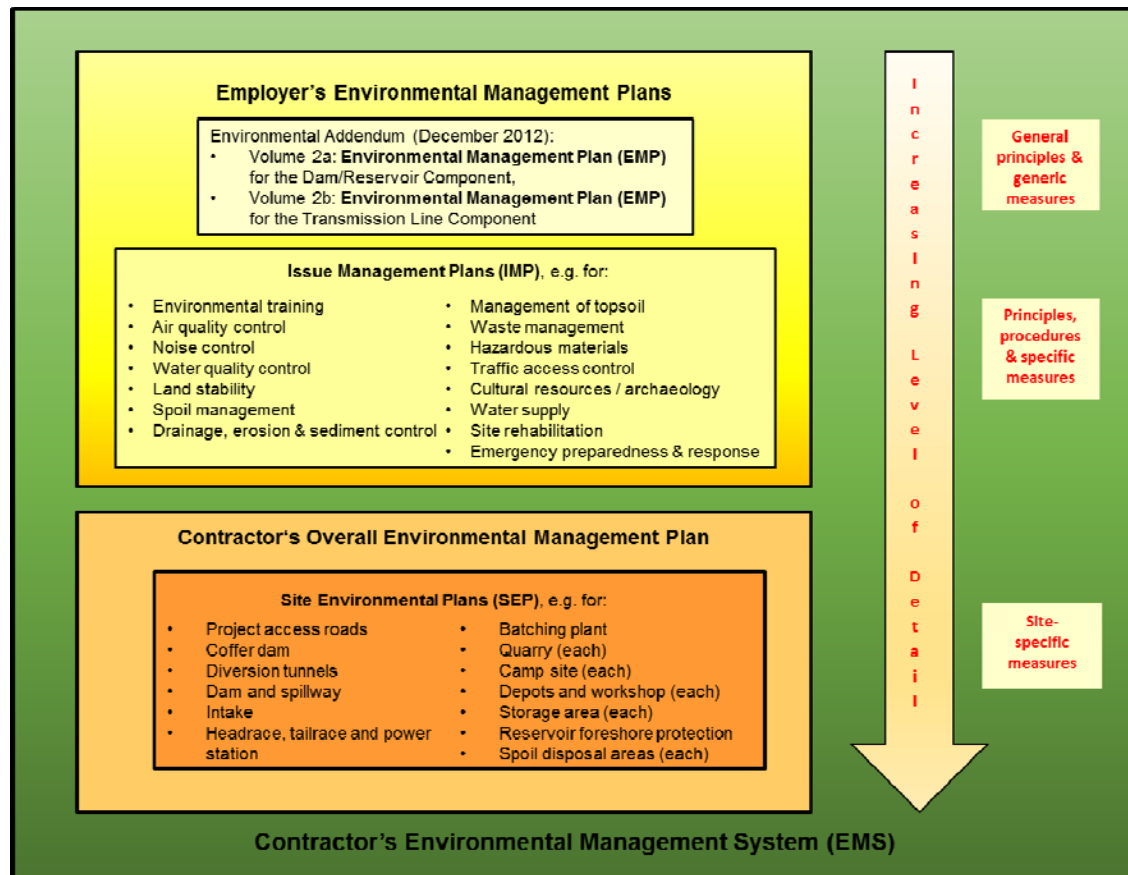


Figure 3: Envisaged environmental management structure under the construction contract

In accordance with the requirements of the Conditions of Contract the Contractor is required to prepare and submit a detailed Contractor's Environmental Management Plan (CEMP) not later than 56 days after the Commencement Date for the approval of both the Engineer and the Employer's THL-ESU.

The Contractor shall thereafter plan, undertake and monitor his operations in accordance with all requirements of the CEMP and the Contract with respect to preventing and mitigating environmental impacts of the Works. The provisions of the CEMP shall remain in force throughout the Contract Period. The Contractor shall be responsible for ensuring that the CEMP identifies and addresses all moderate to significant negative impacts on the environment arising from activities under the Contract, that the impacts are prevented or mitigated, or that residual impacts are confined to a short period.

For each situation and environmental matter the CEMP shall specify the actions to be implemented by the party indicated to have the responsibility. The CEMP shall be in every respect compliant with the relevant requirements set out in the Employer's EMP as cited in the Contract.

Failure by any employee of the Contractor to comply with the instructions regarding environmental protection shall be sufficient cause for the Engineer to order the removal of the offending person from the Site, in terms of the Contract.

The Contractor shall establish and operate a system for recording and communicating any complaints received from the general public or any person employed or contracted to the Contractor. All complaints related to environmental issues shall be communicated in writing to THL-ESU and the Engineer within 24 hours thereafter.

Site Environmental Plans (SEPs) as part of CEMP

As per the Environmental Addendum 2012 (Volume 2a: Environmental Management Plan - Dam/Reservoir Component), a SEP shall be prepared by the Construction Contractor for each construction and ancillary site, converting the principles and generic measures contained in the EMP and IMPs into site-specific controls. Each SEP shall contain a layout map(s) of the main measures and describe: construction activities and associated works that will occur over the construction life; environmental features that have the potential to be impacted by construction activities; the environmental mitigation measures that will be installed over the duration of construction and illustrate these on a plan(s); and, operation and maintenance of mitigation measures. Separate SEPs shall be prepared for the following Project sites:

- SEP 1 Project access roads
- SEP 2 Cofferdam
- SEP 3 Diversion tunnels
- SEP 4 Dam and spillway
- SEP 5 Intake
- SEP 6 Headrace, tailrace and power station
- SEP 7 Batching plant (each)
- SEP 8 Camp site (each)
- SEP 9 Machinery depot / mechanical workshop (each)
- SEP 10 Storage area (each)
- SEP 11 Reservoir foreshore protection
- SEP 12 Spoil disposal sites (each)
- SEP 13 Quarry (each)

Further, additional SEPs shall be prepared by CC as necessary.

5.3 Monitoring and Reporting Requirements

The Environmental Monitoring is required to ensure the implementation and effectiveness of environmental mitigation measures. This section outlines the monitoring activities according to the three main project phases of pre-construction, construction and operation.

Pre-construction Phase

In this phase, environmental baseline conditions in the Project's area of influence have to be recorded. This information will be used as a basis to detect changes caused by the construction activities once they started; and for the planning of mitigation measures. Several environmental parameters at or near Project sites are being monitored by the ESMU. Baseline measurements started in 2017 with water quality, fish species and fisheries. During 2018, measurements of air quality and noise levels will be added. Monitoring of flow rates of springs at risk to dry up due to tunneling should also start one year before the start of the tunneling works. Monitoring of these parameters will continue over the duration of construction to identify any changes.

Construction Phase

Monitoring of Project construction activities is required to ensure that works are undertaken in accordance with the detailed Project design, environmental plans, permits, approvals, contract conditions, and the principles outlined in this EMP. A system of reviews, approvals, and reporting shall be implemented, as described below.

The construction contract requires the CC to undertake self-monitoring of his activities to document his compliance with government standards and other provisions of the contract, including EMP requirements. Regular reports identifying monitoring results, any non-compliance cases and corrective actions taken/proposed to be taken will be prepared by CC and submitted to the ESMU for review.

Before construction works start at any one site, inspections of each Project site shall be jointly undertaken by the ESMU and CC, once the CC has surveyed and pegged each site. These inspections will serve to: confirm the location of Project sites; identify site specific construction and environmental issues; identify trails and services that will be temporarily cut during construction and shall be temporarily connected during construction and/or reinstated upon the completion of construction; identify stockpile sites and spoil and waste disposal areas; and plan construction phasing at Project sites. During the inspection, the ESMU and CC shall discuss and agree upon the above issues. In particular, the ESMU will document the type and location of all trails and services that are to be temporarily disconnected, and provide a copy of this to the CC. The CC shall sign off on the trails and services that are to be reinstated, and return a signed copy of the description of services to the ESMU.

The ESMU shall undertake daily, weekly and monthly inspections of construction sites and work areas, and monthly inspections of workforce camps during the construction period. This will involve the protocols described below.

- **Daily Environmental Inspections:**
The ESMU will inspect the following works in progress: vegetation clearance; excavation activities; stockpiling; and spoil disposal.
If any activities are not being undertaken in accordance with the contract and EMP conditions, the CC shall be instructed by the ESMU to rectify the situation, and the ESMU shall undertake a follow-up inspection to ensure that it has been rectified. Blasting and rock crushing activities will also be inspected when they are occurring. All drainage works and erosion and sediment controls will be inspected after each major storm event.
- **Weekly Environmental Inspections:**
The ESMU will undertake weekly inspections, accompanied by the CC, of all the sites and activities inspected during the daily inspections, as well as the following Project components, sites and activities: drainage works; erosion and sediment controls; tunneling; chemical, fuel and explosive storage; oil separators; refueling areas; and site

rehabilitation works. If any of these sites or activities are not in accordance with the contract and EMP conditions, the ESMU will document these and specify corrective measures in the Weekly Report. The ESMU will provide a copy of the Weekly Report to the CC within two days of the inspection, for appropriate action, and the CC shall undertake all actions as specified.

- **Monthly Environmental Inspections:**
The ESMU shall undertake a monthly inspection of all workforce camps and work sites in use over the preceding month. The adequacy of services provided at work sites and workforce camps will be inspected, as well as any on-site or off-site environmental degradation caused by camp or workforce activities. If any activities are not being undertaken in accordance with the contract and EMP conditions, the ESMU shall document these activities and specify corrective measures in the Monthly Report. The ESMU will provide a copy of the Monthly Report to the CC within two days of the inspection, and the CC shall undertake all actions as specified.
- **Pre-monsoon Drainage Inspection:**
The ESMU will undertake a joint pre-monsoon inspection of Project sites, in conjunction with the CC, to review monsoon drainage controls in the last two weeks of May each year. The ESMU shall specify the locations and types of any additional drainage and erosion and sediment controls that are required, and provide a written copy of these to the CC.

Throughout the construction phase, the ESMU will continue to undertake impact monitoring for parameters such as noise, air quality, water quality, aquatic ecology, vegetation, wildlife species and habitat conditions. Purpose of the ESMU's impact monitoring is to provide occasional cross-checking for the results of the CC's self-monitoring; and to determine and document the long-term changes of the ecological conditions in the project's area of influence.

Post-Construction Phase

The ESMU shall undertake a post-construction certification inspection of each completed Project site. The ESMU shall inspect all reinstated access and local services and the re-vegetation of all temporarily disturbed land. The ESMU shall certify each Project site if it is in accordance with all contract and EMP conditions, or provide a written list of remedial actions to the CC to be completed prior to certification.

Operation Phase

Details of the environmental monitoring during the operation phase will be developed in due time before the start of operation. The EMP and Monitoring Plan for the operation phase will be updated accordingly.

5.2.1 Reporting Mechanism

The construction contractors will maintain daily records of the mitigation implementation and monitoring works during the construction phase to demonstrate compliance with the environmental management. The ESMU shall carry out monitoring works with the Supervising Engineers and prepare bi-monthly monitoring reports during construction phase. ESMU will also maintain the records of any corrective actions recommended to the contractor and its performance. ESMU will compile the Final Environmental Monitoring Report of the construction phase within 4 months of the construction completion and submit to the Project. The project will distribute the report to stakeholders to get feedback and provide the database of environmental management works of the project for future use.

Records

Full environmental management records will be kept on site by the CC and ESMU for the full respective periods of their activities. Details are provided below.

Construction Phase

The CC will keep records demonstrating environmental compliance during Project construction. The following records shall be kept: all necessary permits and approvals; proof of employee environmental and safety training; a daily record of mitigation measure implementation; all environmental monitoring results; a record of all maintenance of environmental controls; all written instructions and reports provided by the ESMU, including Weekly Reports, Monthly Reports; a register of non-conformances and corrective actions; and all correspondence on environmental management matters, including any complaints received. All records shall be kept at site premises and maintained in a legible state for the full period of construction. Environmental records will be made available to THL, ESMU.

Operation Phase

The project operation office will keep records demonstrating environmental compliance during the operation of the Project. The following records shall be kept: all necessary approvals and permits, including permission for activities on private land; proof of employee environmental and safety training; results of all environmental monitoring; maintenance undertaken; all written instructions and reports provided by the ESMU, including Weekly Reports, Monthly Reports; a register of non-conformances and corrective actions; and correspondence.

5.4 Environmental Auditing

This section outlines the scope of the environmental auditing programs for the Tanahu Hydropower Project. Based on the Environmental Protection Rules, 1997 an environmental audit will be required 2 years after the commencement of the project's operation.

5.4.1 Requirements for Environmental Auditing

Auditing refers to a general class of environmental investigations that are used to verify past and current environmental performance. In the context of the environmental management of a project, environmental impact auditing may assess the actual environmental impact, accuracy of prediction, effectiveness of environmental impact mitigation and enhancement measures, and functioning of pre-construction, construction and operation phase mechanisms.

5.4.2 Agencies Responsible for Auditing

THL as the proponent of the Project will be responsible for the auditing activities. However, agencies like the Ministry of Population and Environment, Ministry of Energy, Ministry of Forest and Soil Conservation and other relevant agencies will be consulted during the auditing. Local NGOs and National NGOs may also be entrusted to carry out the task, if they are engaged to do so by the Government. The results obtained from environmental impact auditing will be made available to the concerned agencies and interested groups.

5.4.3 Auditing Parameters

The Tanahu Hydropower Project being a storage project, the auditing should focus on the socio-economic status of relocatees and other affected people of the affected villages, land use pattern and infrastructure development, impacts of forest clearance, compensatory plantation, geological and soil condition especially around the shoreline of the reservoir. To summarize, the auditing will focus on main parameters like:

Physical Parameters

- Change in shoreline of the reservoir
- Reservoir water Quality
- The condition of the watershed
- Slope Stability
- Land use pattern and land take area
- Sedimentation and river hydrology

Biological Parameters

- Vegetation cover (increase and decrease), Afforestation area
- Numbers of trees felled
- Wildlife affected
- Change in the species of fish in the river and reservoir
- Fish migration
- Development of Fish hatcheries
- Fisheries activities

Socio-economic and Cultural Parameters

- Social status of the relocates
- Social status of the affected people (present and past income and types of livelihoods)
- Review of compensation paid
- Infrastructure development
- Downstream safety
- Other indirect benefits

Environmental Audit will be carried out after 2 years of project completion.

5.5 Environmental Management Cost

5.5.1 Cost Estimate as per Supplementary EIA (2017)

In the Supplementary EIA (2017), the total cost for implementing the Environmental Management Plan for the hydropower generation system (dam and reservoir components) is estimated to be NRs 2355.14 Million or US \$ 22.69 Million (exchange rate = Rs 103.77 US \$, exchange date as per October, 2017). This cost includes mitigation and enhancement cost, monitoring cost and auditing cost. The total Environmental Management Cost amounts to approximately 4.53 % of the total project cost.

Table 3: Environmental Management Cost for Hydropower Components (SEIA, 2017)

S. No	Environmental Management Cost	Reference	Cost in Million (NRs)
1	Environmental Mitigation Cost		
1.1	Physical Environment	Table 7.1 (Approved SEIA, 2017)	3.8

S. No	Environmental Management Cost	Reference	Cost in Million (NRs)
1.2	Biological Environment	Table 7.4(Approved SEIA 2017)	475.292
1.3	Socio-economic and Cultural Environment	Table 7.7(Approved SEIA 2017)	1538.973
2	Environmental Enhancement Cost	Table 7.7(Approved SEIA 2017)	247.6
3	Environmental Monitoring Cost	Table 9.6 (Approved EIA,2009)	53.51
4	Environmental Auditing Cost	Table 9.7(Approved EIA,2009)	35.97
Total Cost			2355.145

5.5.1 Cost Estimate as per Environmental Addendum (2012)

The Environmental Addendum, 2012 (prepared through ADB as an update for the EIA, 2009 and the IEE, 2010) included cost estimates for environmental and social safeguards implementation for both the hydropower generation system and for the transmission components. The cost estimates of the Environmental Addendum, 2012 were the basis for the budgets included in the THP's Project Administration Manual (PAM), 2013. The following table summarises the estimates for environmental cost from both, the EMP of the hydropower components (Volume 2a) and the EMP of the transmission components (Volume 2b).

Table 4: Cost estimates from EMPs (Vol. 2a and 2b of Environmental Addendum, 2012)

Item		Consulting [USD] EMP-estimate Person Months	Other [USD]	Total NRs	Total USD
Miti- gation	Hydro - power Plant	357,679 EMP estimate person months: PCP&CP: 36 (national) OP (1st yr): 4 (national)	18,034,600 (compensation and afforestation)	1,564,631,138	18,392,278
		504,780 EMP estimate person months: PCP & CP: 28/4 (nat./internat.) OP (first 2 yrs): 3 (national)		42,941,635	504,780
		539,718 EMP estimate person months: PCP & CP: 48/6 (nat./internat.) OP (per year): 7 (national)	1,322,440 (fish hatchery)	158,413,810	1,862,158
		337,980 EMP estimate person months: PCP & CP: 24/3 (nat./internat.) OP (first 2 yrs): 4 (national)		28,751,959	337,980

Item			Consulting [USD] EMP-estimate Person Months	Other [USD]	Total NRs	Total USD
		Provisional cost for House repair and drying spring			4,000,000	47,020 ^(c)
		Sub total	1,740,157 ^(a)	19,357,040 ^(c)	1,798,738,541	21,144,217
	Trans- missio n Line	Tree planting and forest management	164,040 EMP estimate person months: PCP&CP: 23 (national) OP (1st yr): 2 (national)	1,368,949 (compensation and afforestation)	130,411,347	1,532,989
		Wildlife conservation and awareness program	244,240 EMP estimate person months: PCP & CP: 17/2.5 (nat./internat.) OP (first 2 yrs): 4 (national)		20,777,497	244,240
		Sub total	408,280 ^(a)	1,368,949 ^(c)	151,188,844	1,777,229
		Moni- toring	Hydro - power Plant	Spring water		
House Crack					500,000	5,878
Vegetation					3,720,000	43,729
Terrestrial fauna					3,720,000	43,729
Aquatic fauna					18,432,000	216,669
Land use					313,060	3,680
Sub total					27,185,060	319,561 ^(b)
Trans- missio n Line	Frontline environ. monitoring				3,500,000	41,143
	Third party monitoring				1,000,000	11,755
	Sub total				4,500,000	52,898 ^(b)
Grand Total (Rp.)					1,981,612,445	23,293,904
Grand Total (USD) 85.07000136					23,293,904	

To compare with the budget lines included in the PAM (2013), these costs are summarized as follows:

- Total consulting (includes all subtotals with note (a)) 2,148,437 USD
- Total monitoring (includes all subtotals with note (b)) 372,459 USD
- Total Consulting & Monitoring (subtotals (a) plus (b)) 2,520,896 USD (this amount corresponds to the ADB budget of \$ 2.5 million according to PAM)
- Total Other (includes all subtotals with note (c)) 20,773,009 USD (this amount corresponds to the GoN budget of \$ 21 million according to the PAM)

To compare with the cost estimate as per Supplementary EIA (2017) (see section 5.5.1), the cost for environmental safeguards implementation of only the hydropower generation components (excluding the transmission components) sums up to 1,826 million NRs.

5.6 Grievance Redress Mechanism

A grievance redress mechanism (GRM) will be established to receive and facilitate the resolution of affected people's concerns, complaints, and grievances on social and environmental matters to address their concerns. The GRM will have three levels, with time bound schedules to function.

5.6.1 First Level of GRM

The Public Information Centre (PIC) at the Rural Municipality and Municipality level will be the first intervention to address the grievance. Many grievances can be resolved by providing correct and complete information. The PIC will have full-time staff with full authority to listen and to provide information to project affected families and concerned stakeholders.

5.6.2 Second level of GRM

Should the grievance remain unsolved, the PIC officer will forward the complaint to the Safeguards Unit (ESMU) at THP office. The person filing the grievance will be notified by the officer that his/her grievance was forwarded to the safeguards unit. Grievances will be resolved through ongoing interaction with the affected persons, with THL answering queries and resolving grievances regarding various issues such as social and livelihood impacts and environmental issues. NGOs and Safeguards Unit of THP will undertake corrective measures at the field level for social and livelihood issues within seven days, and environmental safeguards staff will do likewise as required.

5.6.3 Third Level of GRM

Should the grievance remain unsolved, the issue will be referred to the Grievance Redressal Committee (GRC). The GRC will be headed by the Project Director and shall consist of members of the concerned Rural Municipality and Municipality, affected persons, NGOs and local area committee. The affected persons can present his/her concerns/issues to the GRC. The GRC will meet as necessary when there are grievances to be addressed. The GRC will suggest corrective measures at the field level and assign clear responsibilities for implementing its decision within 15 days. If each of the above measures fails, the affected person can seek legal redress of the grievance in the courts, which is the formal legal system.

5.7 EMP Tables

THL's Consolidated EMP is given in following tables:

Table 5: Consolidated Environmental Management Plan

Table 6: Consolidated Environmental Monitoring Plan

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Table 5: Consolidated Environmental Management Plan

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
0. Main Environmental Programmes (as per Addendum EIA 2012) – Implementation during all project phases –						
Fish Conservation Management Plan	Loss / degradation of fish habitat and obstruction of migrating fish.	S	Establish the hatchery techniques. Field Survey and identification of hatchery site. Physical facility construction. Operation hatchery. Distribution of fingerlings to the reservoir. Hatchery capacity building. Experimentation with a "catch-and-haul" program. Habitat survey and management. Identification of compensating fish habitat (offset) for protection. Public awareness-raising and education. Fishing controls: establish a reporting system for fishing methods such as electrical fishing and/or dynamite fishing in the Madi and Seti basin. Water pollution control: check the river water quality regularly and if any pollution is detected, identify the source and take action for them in cooperation with other agencies Biomass clearing of reservoir area before flooding will help address low oxygen concerns and methane production in reservoir; plan for reservoir clearance to be included in Forest Management Plan. Solid waste control: establish a reporting system of disposal of solid waste into the river or on the river bank. If any problems are detected, take action with other responsible organization.	Part of project Cost	THL-ESMU	Detail Plan is given in Appendix

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			River bed mining control: patrol the Madi and Seti basin periodically and check whether it might cause serious effects on fish. Examine the technical feasibility of a “switchback” fish pass.			
Dam Safety Management/ Water Release and River Safety Management Plan	Risk to downstream communities and river users, due to rapid water level changes. Risk of deteriorated water quality below dam.	S	Modelling of water level changes and determination of safe water level rise rates Survey of downstream water users and critical points along river. Preparation of a Disaster and Emergency Response Plan. Design of warning system. Design and implementation of a public awareness programme; Technical assessment of equipment (e.g. types of lights and sirens) options and preparation of river safety program. Installation/testing of equipment. Prepare and broadcast local radio programs and disseminate information materials. Hold explanation meetings. Operation and testing of water gauge plates, sirens, light posts; routine use. Design and construction of a boulder field immediately below the dam for aeration of release water and suspension of sediments. Related monitoring of effectiveness. Detail consultation with rafting associations and prepare mitigation measures for any potential impacts	Part of project Cost	THL-ESMU	Detail Plan is given in Appendix
Wildlife Conservation and Watershed Management Plan	Wildlife habitat loss, possible segmentation of potential wildlife corridors.	S	Wildlife survey. Identification of possible habitats. Environmentally sound design of habitat access arrangements (for example, suspension bridges). Animal encounter protocol (standing contract	Part of project Cost		Detail Plan is given in Appendix

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	(1) S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			for animal rescue). Coordination with forest management planning. Monitoring of effectiveness of measures. Public awareness-raising and education			
Forest Management Plan	Forest loss; impact of habitat loss on terrestrial flora	S	Support to legal aspects of forest compensation. Tree measurements in reservoir and other affected areas. Preparation of the afforestation plan. Land acquisition for nursery. Preparation of tree cutting programme, including plan for reservoir clearance. Monitor the tree cutting program. Nursery/ supervision of tree planting. Coordination with wildlife habitat plan. Monitoring. Public awareness-raising and education regarding watershed management.	Part of project Cost	THL-ESMU	Detail Plan is given in Appendix
1. Pre-construction Phase						
Commencement of land and building acquisition	76 ha and 86 Households affected. 570 families affected due to land acquire	S	Adequate compensation, and according to the agreed procedures/rates	Part of construction cost	THL	
Forest area clearance approval	Loss of forest resources Loss of 417.23 ha forest land and 22,453 nos trees and 67735 pole size tree to be felled from 25 community forests from the reservoir area and project facilities sites trees to be cleared from 25 CF. (Sapling was 91383 in CFs in the reservoir area and	S	Prepare and implement tree cutting plan, Compensatory plantation plan	Part of construction cost	THL	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	(⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
	project facilities sites, total no. with sapling is 181571)					
2. Construction Phase						
2. A Physical Environment						
Excavation on work	Possibility of Soil erosion and landslides	MS	Proper disposal of muck, construction of retaining structures, maintenance of trees and vegetation cover. See also provisions in the General Specs (e.g. clause 7.4.5).	Part of construc- tion cost	THL/CC	
	Change in existing drainage system	MS	Minimize natural slope disturbance	Part of construc- tion cost	THL/CC	
Land use change	1075 ha land change in land use. Forest 417.23, ha, Cultivated 123.64 ha, Barren land 300.37 ha, River and Flood Plain 226.59 ha, Built Up/Residential 1.5 ha.	S	Acquisition of land 1075 ha, minimize as far as possible. Compensation will be provided.	Part of construc- tion cost	THL	
Air quality	Dust impact around the land clearing areas and all construction sites. Air pollution by construction vehicles and transporter vehicle.	MS, T	Spraying of construction area with water. Providing ventilation in all confined areas (i.e. tunnels and power station cavern). Providing breathing protection masks for employees, where required. Using dust suppression methods such as water spraying. Covering stockpiles retained for longer than one month, or during monsoon season. Gravelling/blacktop the main Project access roads and adjacent community roads. On-site speed restrictions for construction traffic. Frequent watering of project access roads each day when visible dust is generated.	Part of construc- tion cost	THL/CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			primarily during the dry season. Erection of roadside fences near houses/villages to reduce windborne dust movement. Vehicle washing prior to leaving the site; Careful handling and containment or damping of dusty materials on site, including the use of dust suppression/filtering on crushing and batching plants. Managing work sites and workforce camps to minimize odor generation. Progressive site re-vegetation as each work site is completed See also provisions in the General Specs (e.g. clause 7.4.1)			
Noise and Vibration	Disturbances to the local people. Noise generated from excavation, back filling and construction of above ground structures, as well as construction vehicles. Vibration generated from and drill & blast activities in the dam, tunnel and powerhouse. Impact on the existing houses and structures due to vibration.	MS, T	Construction activities to be done during the day time. Compensation to the people in case of development of cracks etc., Blasting to be done using detonator in small quantities phases. Locating stationary plant (e.g. generators) as far away as possible from local villages and workforce camps. Maintaining all equipment to manufacturers' specifications. Fitting mufflers to road vehicles and construction equipment. Providing ear muffs to workers operating high decibel equipment or working in close proximity to this equipment. See also provisions in the General Specs	Part of construc tion cost	THL/CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	(1) S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary		(e.g. clause 7.4.2).			
Water Quality	<p>Increase in turbidity and sediment content</p> <p>Deterioration of water quality due to construction waste, spillage of fuel, oils, paints, cement slurry, fecal coliform</p> <p>Water pollution from construction sites, workshops and camp site.</p> <p>Water pollution from siting of all land based construction activities including temporary facilities</p>	MS	Preventing dumping of muck into the river. Regular water quality check. Proper handling of fuel, oils, paints, cement, etc.	Part of construction cost	THL-ESMU/C	
			Restriction of open defecation. Topsoil saving. Excavation controls. Settlement pond for aggregate washing. Sedimentation tanks to arrest the TSS; regular maintenance.	Part of construction cost	THL-ESMU/C	
			Pit toilets at construction sites and temporary camp sites around the dam and reservoir locations. Standard toilets at camps with a central wetland type treatment facility. Set up a settlement pond, treatment plant, or other relevant facilities at work sites, workforce camps, batching plants and other temporary facilities for construction works. See also provisions in the General Specs (e.g. clause 2.3.5; 7.1.2; 7.4.3)	Part of construction cost	THL-ESMU/C	
				Part of construction cost	THL-ESMU/C	
Hydrology and Morphology	<p>Flow changes due to cofferdam installation and river diversion. Risk of breaching of coffer dam.</p> <p>Construction activities in river bed (dam construction, spoil banks, tailrace outlet).</p> <p>Flow and water level changes during reservoir filling; risk of landslides along reservoir shoreline.</p>	MS	<p>Install warning systems and sign boards informing the local people about the danger, regular monitoring</p> <p>Control of boulder collection from riverbed. Reservoir filling plan to be developed and agreed.</p> <p>Monitoring of slope stability. Compensation release of 2.4m³/sec.</p>	Part of construction cost	THL-ESMU/C	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Land stability	Landslides associated with the terrace materials in the upper reservoir area.	MS	Watershed management, vegetation coverage, Gabion at the high risk landslide areas. Drainage, erosion control and sediment control measures. See also provisions in the General Specs, (e.g. clause 7.4.4).	Part of construc- tion cost	THL- ESMU/C C	
Muck Disposal, stockpiling and quarrying activities	Disposal places identified. Proper slope stabilization will be ensured Five disposal locations are identified: at Madi River L/B, Bhateni (area 115000 sq m), Madi River R/B, Chapaghat (110000 sq m), Seti-Madi L/B, Byas (80000 sq m), Seti-Madi R/B, Jaruwa (Camp Site) (24000 sq m) and Seti-Madi L/B, Bel Baas (60000 sq m)	MS	Disposal at appropriate places with proper slopes; bioengineering works; Disposal of excess spoil at designated and pegged spoil disposal areas that have been approved by the ESMU. No side-casting of excess spoil over the edge of excavation sites or placing spoil in drainage lines or watercourses, above houses or at other sites where it is likely to cause damage to structures or natural features. The CC shall instruct the construction workforce on the approved fill disposal locations and supervise the correct placement of fill at sites. Topsoil (where present) stripping and stockpiling prior to spoil placement. Progressive installation of retaining structures, benches and drains to ensure landform stability and minimize erosion and sedimentation. This will include stabilizing the toe of the spoil disposal sites that front onto the Madi and Seti rivers using rock gabion walls, and benching the fill batters of each disposal area that exceeds 7 m in height. Layering and compaction of spoil as the material is placed, with daily inspection by the ESMU.	Part of construc- tion cost	THL- ESMU/C C	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			Topsoil spreading and site re-vegetation of the final landform. The ESMU will inspect and approve the final land shaping at each designated spoil disposal site prior to and following top soiling. See also provisions in the General Specs (e.g. clause 7.4.5).			
	Change in river course in case of excessive quarrying from river banks	MS	Locate quarries within future reservoir area. Prepare quarry operation plan, slopes stabilization works at quarry areas, bio-engineering works. Avoid excessive quarrying from one place, especially from river beds and banks.	Part of construc tion cost	CC	
Waste management	Water pollution from construction waste and smell, health and aesthetic concerns from solid waste	T	Regular solid waste collection with vehicles, to approved land fill sites. Proper storage and handling of all construction materials and waste. See also provisions in the General Specs (e.g. clause 2.3.6)	Part of construc tion cost	CC	
Hazards management	Worker safety risks from accidents and Chemicals.	MS	Safety training to each employee as it relates to his/her job at the commencement of employment and refresher workshops as required. Appropriate relevant safety equipment to each employee. Safety equipment at each work site, including fire-fighting equipment. First aid facilities at all Project sites. Security fences around all work sites and workforce camps, and hazardous locations on construction sites. Designated and signed paths around and through construction sites, work sites and workforce camps. See also provisions in the General Specs (e.g.	Part of construc tion cost	CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			clauses in section 6).			
Workforce management and safety	Worker safety risks from accidents and chemicals	T	Safety training to each employee as it relates to his/her job at the commencement of employment and refresher workshops as required. Appropriate relevant safety equipment to each employee. Safety equipment at each work site, including fire-fighting equipment. First aid facilities at all Project sites. See also provisions in the General Specs, (e.g. clauses in section 6).	Part of construction cost	CC	
Traffic and access control	Vehicle congestion on small rural roads.	T	Identification of project access roads, vehicle types, and schedules. See also provisions in the General Specs (e.g. clauses 2.1.2).	Part of construction cost	THL/CC	
Water Supply	Building and pipe damage caused by construction vehicles and blasting. Spring drying due to tunneling works.	T	Provisional cost for house repairs near the construction site. Reinstate damaged pipe structure providing an alternative source of water supply for drying of spring water. See also provisions in the General Specs (e.g. clauses 2.1.2).	Part of construction cost	THL-ESMU/CC	
Site rehabilitation management	Demobilization	T	Organized retreat and clean-up after construction of all dam facilities, powerhouse, and related structures. See also provisions in the General Specs (e.g. clauses 7.5).	Part of construction cost	CC	
Tunnel construction	Impact on spring above tunnel area	S	Continue monitoring of spring above the tunnel area Provide alternative water supply if spring is damaged.	Part of Project cost	THL-ESMU	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
2. B. Biological Environment						
Loss of forest area	Loss of forest resources Loss of 417.23 ha forest land and 22,453 nos trees and 67,735 pole size tree to be felled down from 25 community forests from the reservoir area and project facilities sites trees to be cleared from 25 CF. (Sapling was 91,383 in CFs in the reservoir area and project facilities sites, total no. with sapling is 181,571).	S	Compensatory plantation and community forest support program for improved forest management will be implemented, to be carried out by THL or DFO.	Part of construc tion cost	THL- ESMU/ DFO	
	Loss of habitat	MS	Afforestation programs Conservation awareness program	Part of construc tion cost	THL- ESMU/ DFO	
	Loss of rare and endangered species	MS	Protection of rare and endangered species, (eg. Shorea robusta, Acacia catechu etc.) compensatory plantation of rare and endangered species.	Part of construc tion cost	THL- ESMU/ DFO/	
Pressure on existing forest resources due to the influx of workforce	Felling of trees for fuel wood	MS	Supply of alternative energy source like LPG and kerosene. where workers' own food is consumed, covered and non-wood fuelled facilities shall be provided for heating food The Contractor shall ensure that no wood is burned by workers on or off the site and shall provide alternative fuel sources for all cooking, heating and lighting needs at workforce camps. Prohibition of any wood burning by workers on or off the site See also provisions in the General Specs, (e.g. clauses 4.2.3.6; 4.2.6.1; 7.1.3).	Part of construc tion cost	THL- ESMU/ CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Disturbances to wildlife and wildlife habitat	Habitat loss Illegal poaching of wildlife	MS	Compensatory plantation Prohibition of illegal hunting and poaching. Implement awareness and enhancement program and other measures defined in Wildlife Conservation and Awareness Management Plan. See also provisions in the General Specs (e.g. clauses 7.1.3; 7.4.6).	Part of construc tion cost	THL- ESMU/ CC	
Impact on Aquatic life	Reduction in fish number Loss in fish habitat Blocking of fish migration.	S	Riparian release of 2.4m3/s; Releasing of fish fingerlings at the upstream Fish farming will be done Catch and Haul program will be done Various measures will be prepared by ESMU and implemented (see Fish Conservation Management Plan)	Part of construc tion cost	THL- ESMU	
2. C. Socio-economic and Cultural Environment						
Project affected households	86 families to be relocated	S	Adequate compensation as per Resettlement plan.	Part of construc tion cost	THL- ESMU	
	570 families affected due to land acquire	S	Adequate compensation, and according to the agreed procedures/rates (see Resettlement Plan).	Part of construc tion cost	THL- ESMU	
Loss of arable land (agricultural production) 660 metric tons/year	Loss of yield, impact on the economic status of the local people	MS	Yield and production support activities; and income generation activities, training will be provided; see Resettlement Plan. Employment of APs in project construction.	Part of construc tion cost	THL- ESMU CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Impact on the cultural environment Impact on Disadvantaged groups of people	Disruption of cremation sites (9 nos)	S	Rehabilitation and construction of affected cremation sites	Part of construc tion cost	THL-ESMU/ CC /Local people	
	Impact on religious historical and archeological Sites		Will be relocated to suitable place with consultation of local people Protection of the religious sites, Co-ordination with local bodies for protection works			
	Disruption of the traditional way of living	MS	Awareness programs	Part of construc tion cost	THL-ESMU	
	Work burden on women, child labor	NS	Ensure no children employed by project, ensure suitable works for the women	Part of construc tion cost	THL-ESMU/ CC	
Impact on Community Services and Institution	Disruption on community structures (access road-2, suspension bridges-7, Thati (Resting Place)-6, Foot trail-20, Irrigation Canals -1, Electricity distribution line -2, Ropeway (Tuine)-1.	S	Relocation of Affected Infrastructures (Motorable road, suspension bridge, ropeway, foot trail, electricity distribution line and irrigation canals) with consultation of local people.	Part of construc tion cost	THL-ESMU/ CC/ Local People	
	Pressure on existing infrastructures due to influx of workers	MS	Development of adequate infrastructure; establishment of subsidized work.	Part of construc tion cost	THL-ESMU/ CC	
	Social instability and conflicts	T	Awareness to workforce; Workers shall be given training and instruction on all regulations necessary to implement the environmental management (alcohol consumption; prevention of communicable diseases). The Contractor shall minimize the risk of such conflicts by developing and implementing appropriate workforce management procedures and regulations.	Part of construc tion cost	CC	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
			see also provisions in the General Specs, (e.g. clauses 7.1.3).			
Impact on health and sanitation	Increase in HIV and other diseases	MS	Public awareness programme, free distribution of condoms, providing health facilities, water supply. Medical screening and health information of employees by CC (see also provisions in General Specs, e.g. clause 6.7.5).	Part of construc- tion cost	THL- ESMU/ CC	
Impact on safety	Possibility in work related injuries, Vehicle accidents etc.	MS	The Contractor shall take all necessary measures, to the approval of the Engineer, in accordance with the Conditions of Contract and the Specification. Insurance, warning systems, Sign Boards, firefighting gears, safety training for workers, safety awareness programs, adequate supply of personal protective equipment (PPE). See also provisions in the General Specs, (e.g. clauses section 6).		CC/ THL- ESMU	
Construction Labor Force Impact	Increase in incidence of diseases, increase in prostitution, in gambling, law and order	MS	Provision of social infrastructure and facilities, clean sanitation program, awareness training. Prohibition of gambling and alcoholism. See also provisions in the General Specs, (e.g. clauses section 4, 7.1.3).	Part of construc- tion cost	CC/ THL- ESMU	
Impact on tourism	Disturbances to tourist visiting the Vyas Caves	NS	Inform the tourist about the construction activities using sign boards and notice in critical areas	Part of construc- tion cost	THL- ESMU	
	Impact on the white-water rafting	S	Warning systems to inform the tourist about the construction activities	Part of construc- tion cost	THL- ESMU	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Water release	Existing water use rights and downstream release	S	Compensation release of 2.4m3/s. Preparation and implementation of Water Release and River Safety Management Plan.	Part of construc- tion cost	THL- ESMU	
3. Operations and Maintenance Period						
3. A. Physical Environment						
Watershed condition	Slope failure, Possibility of Soil erosion and landslides Change in existing drainage system	MS	Protection works and bio-engineering programmes in critical areas, periodic inspection of the watershed and shoreline Proper inspection and maintenance of road slopes to reduce the changes in existing drainage system	Part of operation cost	THL- ESMU/C C	
Microclimate	Increase in humidity in the vicinity of the reservoir and possibility of fog in the morning	MS	Record keeping	Part of operation cost	THL- ESMU	
Hydrology and Morphology	Change in flow downstream Fluctuation of discharge downstream	MS	Compensation release of 2.4 m3/sec, control of boulders collection from riverbed Warning systems and sign boards informing the local people about the danger Implementation of measures defined in Water Release and River Safety Management Plan.	Part of operation cost	THL- ESMU	
Sedimen- tation management	Backwater effects of the reservoir	MS	Dozer work for sedimentation removal	Part of operation cost	THL- ESMU	
Hazards	Dam failure caused by earthquake, floods, landslides (natural disasters).	S	Preparation Disaster Action Plan for people in the possible affected area. Information disclosure to the people in the possible affected area. Implementation of measures defined in Water Release and River Safety Management Plan.	Part of operation cost	THL- ESMU	

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Workforce safety		NS	Training of workers regarding safety and environmental management measures, supply of PPE (but few staff during operational phase).	Part of operation cost	THL-ESMU/ CC	
3. B. Biological Environment						
Loss of forest resources	Encroachment of forest	MS	Continuation of Afforestation programmes and other measures defined in the Watershed / Forest Management Plan.	Part of operation cost	THL-ESMU	
	Loss of rare and endangered species	MS	Awareness for Conservation	Part of operation cost	THL-ESMU	
Wildlife and wildlife habitat	Habitat loss	MS	Awareness Programs and forest management support Continue implementation of Wildlife Conservation and Awareness Management Plan.	Part of operation cost	THL-ESMU	
Fish and aquatic life	Reduction in fish number	S	Riparian release of 2.4 m3/s; Releasing of fish fingerlings at the upstream, Stocking of fish in the reservoir, Fish hatchery development, Cage fish culture, Fish Trapping and Hauling Program Continue implementation of Fish Conservation Management Plan	Part of operation cost	THL-ESMU	
	Loss in Habitat	S	Release of fish fingerlings especially in the downstream region; Protection of compensating (offset) fish habitat in Madi river; Continue implementation of Fish Conservation Management Plan	Part of operation cost	THL-ESMU	
3. C. Socio-economic and Cultural Environment						

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact ⁽¹⁾	Mitigation/Enhancement Measure	Cost	Respon- sibility	
	⁽¹⁾ S-Significant, MS- Moderate significant, NS- Non – significant, T-Temporary					
Project affected households	86 families to be relocated Families affected due to land take	MS	Continue monitoring of the economic status of relocates. Temporary land acquired during the construction phase should be returned. Implement livelihood restoration programmes as foreseen in Resettlement Plan.	Part of operatio n cost	THL- ESMU	
Community service	Impact on infrastructures (bridges, trails, canals, transmission line, road)	MS	Continue maintenance	Part of operatio n cost	THL- ESMU	
Impact on Safety	Fluctuation of flow from the tailrace outlet	S	Warning systems, Sign Boards, and other measures as developed in the Water Release and River Safety Management Plan.	Part of operatio n cost	THL- ESMU	
	Sudden release of water downstream of dam	S	Warning Systems (installation of sirens), Sign Boards, and other measures as developed in the Water Release and River Safety Management Plan.	Part of operatio n cost	THL- ESMU	
Impact on tourism	Impact on the white water rafting	MS	Installation of warning systems, and other measures as developed in the Water Release and River Safety Management Plan.	Part of operatio n cost	THL- ESMU	
Existing water use rights and Downstream Release	Minimum water uses from the river	S	Compensation release of 2.4 m3/s for the riparian ecosystem; and other measures as developed in the Water Release and River Safety Management Plan.	Part of operatio n cost	THL- ESMU	

Table 6: Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
1. Baseline Monitoring – Pre-Construction Phase (PC-)						
1.A. Physical Environment in Pre-Construction (PC-) Phase						
PC- Watershed	Erosion, slope stability	Observation	Upstream of dam, around the project area	Once a year	THL-ESMU/CC	Project cost
PC- River Hydrology	Flow rate of Seti and its tributary Madi	Gauging Station and measurements	Upstream of dam, powerhouse area, Madi Khola	Quarterly	THL-ESMU/CC	Project cost
PC- River Water quality	Ambient Temperature (°C), pH, Conductivity (µmhos / cm), Total Suspended Solids (mg/l), Total Phosphorus (mg/l), Total Kjeldahl Nitrogen (mg/l), Ammoniacal Nitrogen, (NH ₃ –N) (mg/l), Nitrate Nitrogen (NO ₃ – N) (mg/l), Nitrite Nitrogen, (NO ₂ – N) (mg/l) Dissolved Oxygen (mg/l), Biological Oxygen Demand (BOD ₅ @ 20°C) (mg/l), Chemical Oxygen Demand (COD) (mg/l), Total Sulphate (mg/l), Fecal Coliform Count (MPN Index / 100ml)	Water sampling and testing and comparison to ambient standards	Upstream of reservoir (W1 – W9) to d/s of powerhouse, and in Madi river	Dry season, Pre monsoon and monsoon season	THL/ESMU/CC	Project cost
PC- Air Quality	TSP, PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂	Sampling, measurements and tests	Project area (Beltar, Jhaputar, Betini, Damsite)	Dry Season	THL-ESMU/CC	Project cost
PC- Climate	Baseline monitoring (measurement)	Rainfall, temperature	Dam site	Monthly	THL-ESMU/CC	
PC- Noise	Noise pressure level in dBA	Baseline data	Project area (Beltar, Jhaputar, Betini, damsite)	Once a year	THLESMU/CC	Project cost
PC- For springs used for domestic purposes	Discharge rate (liter/min)	Baseline monitoring of flow rate of springs	Five sites (Jhaputar village, Chhap and Jikhabari villages, Lokma village)	Dry Season	THL-ESMU,CC	Project cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
located above the tunnels may be dried up						
1.B Biological Environment in Pre-Construction (PC-) Phase						
PC- Fish population, spawning and migration	Identification of aquatic species and their status (threatened/ protected species, invasive species, migratory species, etc.), spawning areas, habitat conditions, fisheries activities, etc.	Aquatic life and ecology survey (fish, phytoplankton, zooplankton and aquatic insects)	9 baseline stations; additional stations in Madi river to be added for offset habitat planning as necessary.	Every month (dry season and wet season)	THL-ESMU	Project cost
PC- Wildlife	Mapping of wildlife habitat types, presence of Wildlife species, foot marks	discussions with local people, footprint observation; other survey techniques to be defined.	In and around the project area	Once a year	THL-ESMU	Project cost
PC- Forest cover and management	Forest cover, density, types and intensity of forest uses (logging, firewood collection, NTFP collection)	Discussions with users group, observation, local people and District forest Office, mapping of vegetation units, quadrat survey at selected sampling locations to determine species composition	In and around the project area	Once a year	THL-ESMU	Project cost
1.C. Socio-economic and Cultural Environment in Pre-Construction (PC-) Phase						
PC- Settlements	Growth of settlements	Observation	In and around the project area	Once a year	THL-ESMU	Project cost
PC- Health and sanitation	Diseases prevailing in the area, outbreak of diseases	Discussions with local people, information from the local health posts and District Health office	Project area and adjacent Rural Municipalities	Once a year	THL-ESMU	Project cost
2. Impact and Compliance Monitoring during Construction Phase (C-)						
2.A. Physical Environment in Construction Phase (C-)						
C- Dust generation	Dust (TSP/PM10, PM 2.5)	Measurement of ambient air quality	Beltar, Jhaputar and Betini, dams site (close to the District	Three times a year in dry season	CC/THL-ESMU	Part of Constructi

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
(Excavation works; Foundation works; Spoil disposal; Batching plants; other works as relevant)			Public Health Office); Other locations if required.	(Nov., Feb., and May). Baseline data shall be taken before construction in dry season		on cost
C- Various works	a) Vegetation clearance only to required limits b) Excavation works only to required limit by the design c) Side casting of excavated earth d) Management of spoil in the designated area e) Maintenance of toe protection structure, and drainage structure at spoil disposal; and sedimentation tank at batching yard, spoil disposal area and tunnel discharge areas f) Civil and bio-engineering protection works and their maintenance (including side drains) at access roads	Compliance of mitigation measures for land instability and erosion	a) Along the project boundary such as FSL 415m area for the reservoir, dam site, and project facility sites. b) All over the construction site c) All over the construction site d) All over the construction site e) Batching yard, spoil disposal area and tunnel discharge areas f) Along the access roads	a) Once a month b) Once a week c) Once a day d) Once a day e) Once a month f) Once a month	CC/THL-ESMU	Part of Construction cost
C- Various works	a) Graveling of road and its maintenance b) Control on vehicle speed c) Watering of roads d) Careful handling the contaminant or dumping of dusty materials e) Covering of exposed areas and site restoration f) Provision of PPE to workers and drivers	Compliance of mitigation measures for air pollution	a) Along the construction road b) Along the construction road c) Along the construction road d) Temporary waste stock facility and disposal site e) Excavated area, spoil disposal area	a) Once a month b) Once a day c) Once a day d) Once a week e) Once a week f) Once a week	CC/THL-ESMU	Construction cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
			f) Construction sites			
C- Water quality	Ambient Temperature (oC), pH, Conductivity (µmhos / cm), Total Suspended Solids (mg/l), Total Phosphorus (mg/l), Total Kjeldahl Nitrogen (mg/l), Ammoniacal Nitrogen, (NH ₃ – N) (mg/l), Nitrate Nitrogen (NO ₃ – N) (mg/l), Nitrite Nitrogen, (NO ₂ – N) (mg/l) Dissolved Oxygen (mg/l), Biological Oxygen Demand (BOD ₅ @ 20oC) (mg/l), Chemical Oxygen Demand (CODCr) (mg/l), Total Sulphate (mg/l), Fecal Coliform Count (MPN Index / 100ml)	Water sampling and testing and comparison to ambient standards	Upstream of reservoir to downstream of powerhouse (W1 –W9), and in Madi river	4 times a year in 4 seasons (November, March, June, and September)	CC/ESMU-THL	Part of Construction cost
C- Pollution control	<p>A) Adequacy and operation of water supply and sanitation facilities at workers, engineers camps, construction camps and construction sites</p> <p>b) Collection of solid waste and safe disposal practices at workers, engineers camps, construction camps and construction sites</p> <p>c) Awareness program on health and sanitation</p> <p>d) Prohibition on open defecation and solid waste disposal</p> <p>e) Storage facilities for fuel, lubricants, spent oils, and toxic chemicals</p> <p>f) Treatment facilities for waste water of batching plant, aggregate washing and tunnel seepages and its effective operation</p> <p>g) Water quality test for discharge of treated wastewater from batching plant aggregate washing plant, and tunnel discharges</p> <p>h) Disposal of construction spoils only in designated areas</p>	Compliance of mitigation measures for water pollution, Testing of potable water supplies; Testing of discharged effluents.	<p>a) Engineers camps, construction camps and construction sites</p> <p>b) Engineers camps, construction camps and construction sites</p> <p>c) All over the construction site</p> <p>d) All over the construction site</p> <p>e) Storage facilities</p> <p>f) Treatment facilities</p> <p>g) Batching plant aggregate washing plant, and tunnel discharges</p> <p>h) All over the construction site</p>	<p>a) Monthly inspections of facilities; weekly testing of potable water supplies</p> <p>b) Weekly inspection</p> <p>c) Every six months</p> <p>d) Weekly inspection</p> <p>e) Weekly inspections</p> <p>f) Weekly inspections; effluent testing once every 3 hours for the first week of operation of any effluent treatment or mixing facility, after which time</p>	CC/ESMU-THL	Part of Construction cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
				a lower frequency will be approved by ESMU provided that the hourly results have demonstrated the satisfactory performance of the treatment facilities g) same as f) h) Once a week		
C- Noise-generating activities	Noise level	Measurement of noise level	Beltar, Jhaputar and Betini (close to District Public Health Office), and Beltar (near the school)	During construction, monitor noise levels as necessary to document compliance with ambient noise standards.	CC/ESMU-THL	Part of Construction cost
	a) Placement of noise arresting equipment b) Correct fitting of silencers, mufflers and acoustic shields c) Maintenance of plant and equipment d) Blasting design and follow ups	Compliance of mitigation measures for noise	a) Construction site near the residential area b) Construction vehicles and machineries c) All over the construction sites d) Blasting site	a) Before start of construction and when complaints are received b) Once a month c) Once a month d) Once a week	CC/ESMU-THL	Part of Construction cost
C- Spring flows	Impact Monitoring visual observation and discharge rate (liter/min)	Measurement of flow rate, taking photos	Springs above tunnel area	4 times/ year	CC/ ESMU-THL	Part of Construction cost
C-	Impact Monitoring - Damage condition	Visual observation of	Buildings near the	Before start of	CC/ ESMU-	Part of

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
Building Survey		damages, documentation by written records and photographs	construction site	construction works and 4 times/ year during construction	THL	Construction cost
C-Waste Management	Compliance with all required waste management measures	Review and approval of CCs Solid Waste Management Plan; Regular inspection of facilities and sites, and review of relevant records.	All Project sites	Weekly	CC/ESMU-THL	Part of Construction cost
C-Hazards/Risk	Compliance with all health and safety requirements; Compliance with all requirements for handling and storage of hazardous substance; Compliance with all requirements for emergency preparedness.	Review and approval of CCs Health and Safety and Environmental Management Plans; Regular inspection of facilities and operations, PPE, training records, incident records and others as relevant.	All Project sites	Weekly	CC/ESMU-THL	Part of Construction cost
C-Traffic/Access	Compliance with all required traffic management measures	Review and approval of CCs Traffic Management Plan; Regular inspection of access roads and sites, and review of relevant records.	All Project sites	Weekly	CC/ESMU-THL	Part of Construction cost
C-Workforce Management and Safety	Enforcement of workforce rules and regulations Provision of adequate and well maintained services and facilities Provision of fuel for cooking , heating and light	visual observation of facilities	All project sites	Monthly	CC/ESMU-THL	
2.B. Biological Environment in Construction Phase (C-)						
C-Vegetation clearing/ tree cutting	Progress of reservoir clearance	Monitor tree cutting programme in reservoir area; interfaces with construction works and timing for reservoir filling.	Reservoir area	Monthly	ESMU-THL	Part of Construction cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
C-	Only approved trees to be felled Identification of illegal tree cutting, firewood collection and use of fuelwood Identification of wildlife killing / poaching	Compliance of mitigation measures for illegal tree cutting and poaching through: - frequent patrol activity; - consultations with wildlife and forest officers and other key informants; - check availability of non-wood fueled cooking facilities for workforce; - review of records on awareness trainings; - review of records on translocation of animals	All over the construction site and adjacent area	Frequent and at random patrol; monthly reviews	CC/ESMU-THL	Part of Construction cost
C-	Extent of habitat loss (compared to habitat identified before construction)	Mapping of habitat loss around the project sites	All over the construction site and adjacent area	Every four months	CC/ESMU-THL	Part of Construction cost
C-	Number of wildlife species	Species occurrence around project sites	All over the construction site and adjacent area	Every four months	CC/ESMU-THL	Part of Construction cost
C-	Damage to habitat and/or death of wildlife due to construction activity	Construction disturbances around project sites	All over the construction site and adjacent area	Once a week	CC/ESMU-THL	Part of Construction cost
C-	Implementation of the measures defined in Wildlife Conservation and Awareness Management Plan; based on designated schedule.	Evaluate mitigation measures compliance for wildlife conservation	All over the construction site and adjacent area	Every four months	ESMU-THL	Part of Construction cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
C- Dam construction, blocking of fish migration Reservoir formation	Changes to aquatic habitats and species: Aquatic species composition; spawning/breeding habitats; fish migration.	Aquatic ecology survey for impact analysis	Baseline stations: Upstream of reservoir to downstream of powerhouse (W1 –W9), and in Madi river	Every six months	ESMU-THL	Part of Construction cost
C-	Fisheries activities: Numbers of fishermen; fishing locations, techniques; catches; contribution of fishing to their livelihoods.	Fisheries survey (interviews with fishermen and other key informants)	Project-affected river stretches	Once per year	ESMU-THL	Part of Construction cost
C-	Implementation of the measures defined in Fish Conservation Management Plan; based on designated schedule. Including: a) Compliance to release of environmental flows at Seti; b) Compliance to restriction of fishing activities below tailrace, in newly protected habitat in Madi river, and other locations as will be defined in fish conservation management plan; c) Compliance to hatchery construction and operation, fish stocking, fish farming, fish release in the reservoir and downstream area.	Evaluate mitigation measures compliance for fish conservation.	a) Dam site b) Downstream area of the tailrace; Madi river; others as defined c) Reservoir and downstream area	Every four months	ESMU-THL	Part of Construction cost
2.C Socio-economic and Cultural Environment in Construction Phase (C-)						
C-	Monitoring compensation payments and socio-economic status of APs (e.g. housing assets, living conditions, income etc.)	Will be defined in Resettlement Plan	Project affected and resettled area	Will be defined in Resettlement Plan	CC/ESMU-THL	Part of Construction cost
C-	Health issues/ sanitation	Record of diseases (workers), inspection of camps	Project area and particularly camps	Monthly inspection of camps, and whenever there is disease outbreak	CC/THL-ESMU	Part of Construction cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
C-	Occupational and Safety hazards	Records of accidents, direct site inspections	Project sites	Once a day	CC/ESMU-THL	Part of Construction cost
C-	Tourism	Records of tourist entering the area	Project area	Once a year	ESMU-THL	
C-	Employment in the Project (local persons, affected persons, persons from other parts of Nepal, persons from other countries; women employment; child labour)	Records kept by management; Inspection on Child Labour	Project sites	Review of records once a month; site inspections once weekly	CC/ESMU-THL	
C-	Law and Order	Review of official records, interviews with key informants, grievance records.	Project area	Once a year; and whenever required due to current events	ESMU-THL	
C-	Impact on Women/Children	Review of official records of women employment; children education; Child Labor. Interviews with key informants; grievance records.	Project area	Once a year; and whenever required due to current events	ESMU-THL	
C-	Changes in social values, cultural heritage, religious practices etc.	Observation, record of new behavior; cultural festivals etc.	Project area	Before project and after project	ESMU-THL	
C-	Indirect economic benefits	Trade and business revenues, observation, survey	Project area	Before project, during the project and after the project	ESMU-THL	

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
3. Operation and Maintenance (O&M-) Period						
[Note: It is expected that the EMP for the Operation Period will be updated and refined, once the operating procedures are being developed in detail.]						
3.A. Physical Environment in Operation and Maintenance (O&M-) Period						
O&M- Operation and maintenance of dam	Hydrology changes, causing: Increased flood water levels at upstream end of reservoir; Rapid changes of water levels due to peaking operations; Changes of water levels during reservoir flushing; Release of prescribed environmental flows	Gauge readings; Operational records; Information / complaints from local stakeholders	Surrounding of reservoir; downstream of dam; downstream of tailrace.	To be defined after review of operational procedures.	CC/ ESMU-THL	
O&M- Operation and maintenance of dam	Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH ₃), nitrate, nitrite, dissolved oxygen (DO), and BOD ₅ Other parameters as may be required (e.g. coliform bacteria)	Water sampling and analysis (except reservoir area)	1) Upstream of the reservoir, 2) Confluence with the Madi River, 3) Immediate downstream of the tailrace outlet	5 times a year in 4 seasons (November, March, beginning of June before the sediment flushing operation, end of July after the sediment flushing operation, and September)	ESMU-THL	Part of operation cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
O&M-	a) Water temperature, turbidity, DO b) pH, BOD/COD, SS, coliform counts, chlorophyll a, Pheophytin, inorganic nitrogen (I-N), inorganic phosphorus (I-P) c) Ingredient of bottom sediment d) Phytoplankton e) Heavy metals, hazardous substances, carcinogenic substance f) Other parameters as may be required	Water sampling and analysis (reservoir area: close to the dam site; other areas if required)	a) 0.1 m from the water surface, 0.5 m from the water surface, 1 m interval from the water surface to the bottom b) Surface layer (0.5 m from the water surface) Middle layer (half of the water depth) Bottom layer (1 m above from the bottom) c) First surface layer of the sediment d) Surface layer of water e) Surface layer of water f) as required	a) Once a month b) Once a month c) Twice a year (End of May just before the sediment flushing operation, and November after stabilizing the bottom condition) d) Once a month e) Twice a year in dry season and rainy season) f) as required	CC/ESMU-THL	Part of operation cost
O&M-	Riverbed sedimentation and erosion	Monitoring of riverbed sedimentation and erosion	Several designated locations in the downstream riverbed	Once a year in dry season	CC/ESMU-THL	Part of operation cost
O&M-	Sedimentation and flooding at upstream end of reservoir (backwater)	Monitoring of extent of sedimentation and extent (areas affected) and frequency of flooding	Upstream end of reservoir (backwater affected area)	Yearly	THL-ESMU	
O&M-	Slope stabilities, landslide risks (reservoir area, access roads);	Inspections, interviews with key informants, review of official records and grievance records.	Reservoir area, access roads	Twice a year (before and after rainy season)	THL-ESMU	
O&M-	Spoil disposal areas (stability, functioning of drainage, vegetation development)	Inspections, interviews with key informants, review of official records and grievance records.	Spoil disposal areas	Yearly	THL-ESMU	

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
3.B. Biological Environment in Operation and Maintenance (O&M-) Period						
O&M-	Adequacy of compensatory tree plantation, afforestation program, enhancement of community forestry	Evaluate success of compensatory tree plantation (extent, survival of trees; ecological status of afforested areas); Evaluate success of support to Community Forest User Groups (production and ecological state of CF; socio-economic state of users)	Project area, watershed area /afforested areas	Once a year	ESMU-THL/DFO	
O&M-	Wildlife species and population, habitat condition	Transect survey for wildlife	All over the construction site and adjacent area, reservoir surrounding	Every 3 years for 20 years	ESMU-THL	Part of operation cost
O&M-	Adequacy wildlife management program	Evaluate success of awareness program, illegal hunting restrictions	Project area	Once a year	ESMU-THL/DFO	
O&M-	Implementation of the measures defined in Fish Conservation Management Plan; including: a) Compliance to release of environmental flows at Seti b) Compliance to restriction of fishing activities below tailrace, in newly protected habitat in Madi river, and other locations as will be defined in fish conservation management plan c) Compliance to hatchery operation, fish stocking, fish farming, fish release in the reservoir and downstream area	Evaluate compliance of mitigation measures for aquatic lives	a) Dam site b) Downstream area of the tailrace; Madi river; others as defined c) Reservoir and downstream area	a) Daily b) Daily c) Once a year for project life	ESMU-THL	Part of project operation cost

Consolidated Environmental Management Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
O&M-	Aquatic species composition; spawning/breeding habitats; Fisheries activities	Aquatic ecology survey for impact analysis	Baseline stations	Every six months after 2 years of the project operation, Once a year for 10 years	ESMU-THL	
3.B. Socio-economic and Cultural Environment in Operation and Maintenance (O&M-) Period						
O&M-	Implementation of measures defined in Water Release and River Safety Management Plan; e.g. including: Compliance with agreed safe modes of operation; Awareness programmes; Requirements for emergency preparedness; Provision of public safety and warning system for downstream people; safety signs, sirens; Flood warnings for upstream end of reservoir.	Evaluate compliance with agreed mitigation measures for water release and river safety.	Areas affected by dam and reservoir operation	Once a year	ESMU-THL	
O&M-	Public structures	Reinstate, relocation, maintenance of public structures	Project area	Once a year	ESMU-THL	
O&M-	Settlement development and land use changes	Remote sensing; direct observation in the field	Surrounding of reservoir area; downstream area	Once every five years	ESMU-THL	

CC- Construction contractor, THL- Tanahu hydropower limited, ESMU- Environmental and Social Management Unit

Appendix II: Forest Management Plan

Appendix III: **WILDLIFE AND WATERSHED CONSERVATION PLAN****1. WILDLIFE CONSERVATION**

Project area has identified that there may be tiger corridors in and around the surrounding project area, although these were not clearly demarcated or confirmed by the Forest ranger in the area. Stakeholders confirmed 14 (animals) in and around the project area. The species recorded are shown in the Table below.

Wildlife Survey: A preliminary sample survey was undertaken November 2017. Due to the limited staff resources, the survey was mainly based on consultation of local people; direct observations of wildlife made by the specialist while in the field were recorded in addition. Survey locations were at Rising Patan, Phedikhola, Kahushivapur/Jamune and Phulbari. Questions focus on type of wild animal found in the project area, frequency of appearance, and incidents of crop raiding by wild animals. The species recorded are shown in the Table 1. As reported by the local people, *Pantheratigris* (Tiger) is not known to be present in the project area.

Table 1: Wild Animal Found in Project Area

Scientific Name	Name of Wildlife		Frequency of Appearance				Conservation Status
	English Name	Local Name	Common	Frequent	Occasional	Rare	
<i>Macacamulatta</i>	Rhesus monkey	Badar	Y				
<i>Presbytis entellus</i>	Grey Langur	Langur		Y			CITES Appendix I
<i>Canis aureus</i>	Jackal	Syal		Y			CITES Appendix III
<i>Felis lynx</i>	Wild cat	Banbiralo			Y		CITES-II, IUCN-E
<i>Funambulus sp.</i>	Squirrel	Lokharke		Y			
<i>Hystrix indica</i>	Porcupine	Dumsi		Y			
<i>Panthera pardus</i>	Leopard	Chituwa			Y		CITES Appendix I
<i>Lepus nigricollis</i>	Indian hare	Kharayo		Y			
<i>Melursus ursinus</i>	Sloth bear	KatheBhalu				Y	CITES Appendix I, IUCN-VN
<i>Muntiacus muntjak</i>	Barking deer	Ratuwa/Mriga		Y			
<i>Herpestes edwardsii</i>	Common Mongoose	Nyauri Muso	Y				
<i>Martes flavigula</i>	Yellow-throated Marten	Malsapro		Y			CITES Appendix III
<i>Rattus rattus</i>	Rat	Musa	Y				
<i>Sus scrofa</i>	Wild boar	Bandel			Y		

E- Endangered, VN- Vulnerable, Y-Presence

Rescue and Release Program: Land clearing may result in encounters with wildlife; all wildlife encountered will be logged. A program for capturing, treating/rehabilitating, and releasing wild

animals / avifauna found in pain or distress, particularly as a result of human interference and project activities, will be initiated with the local authorities (DFO) with assistance of national authority (Department of National Parks and Wildlife Conservation), and nearest local Animal hospital. The primary goal will be to treat and rehabilitate the wildlife / avifauna and release them back to the habitat from which they were collected (or safe adjacent areas). This component includes allocation of a site, design and construction of animal accommodation/ enclosures, treatment facilities, and equipment for the capture, treatment and release procedures, medicines, trained manpower/veterinarian, and a caretaker, as well as a data management and record keeping system.

Promote Wildlife Surveys and Monitoring in and around the Project Area: This activity is aimed at adding to the existing knowledge base on wildlife presence and movements in the vicinity of the project area. This is recommended so that the data collected can add to the baseline information collected during the EIA preparatory phase (adding to the seasonal data). Also, the surveys will improve the understanding of wildlife presence, distribution, movements and seasonality in the wider vicinity of the project area. This will ensure strict monitoring of any encroachments, and also add to the biodiversity database. The presence of wildlife could be monitored by using camera traps provided by the project. This wildlife survey will be conducted with the assistance of the national authority (Department of National Parks and Wildlife Conservation) and WWF.

Compensatory afforestation program for restoring habitat for avifauna: Disturbance of avifauna is expected during construction and operation activities in the project area. Habitat loss will be compensated via compensatory afforestation program and planting of species based on the climatic and edaphic conditions of the locality, ensuring composition of different species (trees and shrub) for successful growth. Species composition selection will be important in ensuring diversity of avifauna (this shall apply to wildlife as well) and will be decided in consultation with the local and national authorities (Department of National Parks and Wildlife Conservation). For power evacuation system (transmission line), the operation of transmission lines will constitute a persistent threat to birds and the fact that conductors are thin and difficult for birds to detect and avoid. The impact on avifauna could be relatively high in low visibility conditions, especially bad weather, but it is very difficult to quantify the risks. Bird mortalities that are observed and that can be attributed to the transmission line will be recorded. Note that the project activities are not expected to alter bird migration or affect any important bird areas / species on the IUCN list.

Conservation actions as proposed by IUCN (during construction and during the initial project operation) such as conducting a comprehensive survey and monitoring in and around the project area to establish range, distribution and population status of vulnerable and critical habitats in the project area for assessing its habitat requirements and identifying threats will be undertaken through engagement of IUCN or WWF.

1.1 ANTI-POACHING MEASURES

Hunting and poaching is a possibility due to the presence of construction workers. The possibility of hunting and trapping by workers during construction period will be site-specific and will decrease once the work is completed. The overall magnitude of impact is considered to be low, extent is site specific and duration is short period.

Awareness Raising Programs: With the construction of the access roads, the accessibility of humans to the project area will increase, which may increase the risk of poaching. Raising awareness will be an important means to mitigate this risk. Awareness will be raised among workers and contractors regarding illegal poaching and copies of the national Wildlife Act, Biodiversity Act, other relevant Rules and Regulations will be made available in the local language. Copies will be made available at the project site and forest ranger stations of the vicinity. Workers must be made aware of the fines and penalties for poaching, as well as the risk of job loss, if caught in these illegal activities. This will be done after the Contractor has been selected and continue intermittently through the construction phase.

Strengthen Patrolling: To minimize the risks of poaching, awareness raising programs will be combined with an increase in patrolling by local forest rangers (in coordination with national authorities) and construction of check posts and watch towers at key locations. The choices of location of check posts and watch towers will be guided by consultations with forest rangers in the area. To support enhanced patrolling, the project may consider to provide assistance through purchase of equipment such as GPS, binoculars cameras, bikes, camera traps, etc.

Community Watch Program: The project will also discuss possibilities for funding a community watch program, through hire of village guards to alert forest rangers officials of any illegal activities in the worker camps or at project sites.

1.2 MITIGATION OF HUMAN-WILDLIFE CONFLICT

Construction of roads and other infrastructure projects destroy and fragment natural habitat, and allow encroachment, logging, and poaching to occur. As a consequence, wildlife will have less space to live and may lose access to migratory route. Human-wildlife conflicts have the potential to increase. To minimize the human-wildlife conflict, a proposal will be developed for mitigation of such conflicts and for strict monitoring of encroachment into wildlife habitat. This plan will be formulated with assistance from the local and national authorities; and once approved, will be disseminated through workshops and meetings and implemented as per the proposal. The program will be tested in one village in PAI and if successful, then it may be replicated in other villages.

2. WATERSHED MANAGEMENT – AVAILABLE TECHNIQUES

Watershed management is the optimal use of soil and water resources within a given geographical area so as to enable sustainable production. It implies changes in land use, vegetative cover, and other structural and non-structural action that are taken in a watershed to achieve specific watershed management objectives. The overall objectives of watershed management programme are to:

- increase infiltration into soil;
- control excessive runoff;
- manage & utilize runoff for useful purpose.

Following Engineering and Biological measures shall be suggested depending upon the requirement and suitability:

- a. Engineering measures
 - Stone masonry
 - Check dams
- b. Biological measures
 - Development of nurseries
 - Plantation/afforestation
 - Pasture development
 - Gap Plantation

The basis of site selection for different biological and engineering treatment measures are given in Table 2.

Table 2: Basis for selection of catchment area treatment measures

Treatment Measures	Basis for Selection
Social forestry, fuel wood and fodder grass development	Near settlements (away from flooding zones) to control tree felling
Pasture Development (plain areas in downstream sections)	Open canopy, barren land, degraded surface
Afforestation	Open canopy, degraded surface, high soil erosion, gentle to moderate slope
Barbed wire fencing (in some cases)	In the vicinity of afforestation work to protect it from grazing by farm animals, etc.
Step drain	To check soil erosion in small streams, steps with concrete base are prepared in sloppy area where silt erosion in the stream and bank erosion is high due to turbidity of current.
Nursery	Centrally located points for better supervision of proposed afforestation, minimize cost of transportation of seedling and ensure better survival.

Appendix IV: Dam Safety Management/Water Release and River Safety Management Plan

DAM SAFETY MANAGEMENT PLAN**1. Status of Emergency**

The emergency planning for dam break scenario is devised on the basis of results of dam break analysis mainly the travel time of flood wave to various locations in the downstream stretch of the river. The plan is, therefore, based on such measures, which are purely preventive in nature. The degree of alertness has to enhance during high stage of river manifested with sharp increase in discharge. Though there cannot be very sharp edge demarcation between different levels of emergency yet the following flood conditions have been contemplated and the preventive measures suggested against each as given in Table 1.

Table 1: Status of Emergency

S. No.	Status of emergency	Water Level	Preventive measures
1.	Normal Flood	Below Full Reservoir Level (FRL)	Utmost vigil by project proponent observed in regulation of spillway gates. It will not affect downstream properties.
3.	Level –1 Emergency	Above FRL but below top of dam	Communication & public announcement system (refer B.6 below) should be put into operation and flood warning issued to people.
4.	Level –2 Emergency	Top of dam	(1) All staff from dam site to move to safer places (2) Possibility of dam failure should be flashed to District Administration. (3) Local communities are informed about possible dam failure. (4) Evacuation plan kept on alert.
5.	Disaster	Rising above top of dam and the breach appears in any form	District Administration and Project authorities be intimated. Life saving measures should be resorted. Warning and evacuation plan implemented on ground. The nearest riverside communities are located about 20 km downstream from the dam site.

2 Dam Safety and Maintenance Manual

Based on standard recommended guidelines for the safety inspection of dams, a manual should be prepared by the project proponents in respect of dam safety surveillance and monitoring aspects. This should be updated with the availability of instrumentation data and observation data with periodical review. The need for greater vigil has to be emphasized during first reservoir impoundment and first few years of operation. The manual should also delve on the routine maintenance schedule of all hydro-mechanical and electrical instruments. It should be eloquent in respect of quantum of specific construction material needed for emergency repair along with delineation of the suitable locations for its stocking and also identify the much needed machinery and equipment for executing emergency repair work and for accomplishing the evacuation plan. Dam shall be inspected on an annual basis by experts for the entire lifetime of

the dam and recommendations on the report shall be implemented on a priority basis.

3 Emergency Action Plan

Once the Emergency situation is foreseen, the Emergency Action Plan (EAP) may be put in operation, which may include:

- In rural areas warning sirens will be used to communicate with people along with traditional communications.
- Areas likely to be evacuated with priorities to be notified.
- Safe routes to be used for evacuation. Such routes have to be identified, discussed and planned sufficiently in advance for proper implementation of the Plan.
- Means of transportation.
- Traffic Control.
- Shelters for evacuees.
- Procedures for evacuation of people from hospitals, public places, prisons etc.
- Procedures for care and security of property from evacuated areas from anti-social elements.
- Instructions regarding assignment of specific functions and responsibilities of various members of evacuation teams.

4 Emergency Action Committee

The emergency action committee may comprise of:

- Concerned Chief Engineer of the Project
- Concerned Superintending Engineer of the Project
- Representative of Water Resource Department
- Representative of Transport Department
- Representative of Civil Supplies Department
- District Agricultural Officer
- District Health Officer
- District Commandant of Home Guards
- District Publicity Office
- Local Community Representatives
- Special Invitee from Local Social Organization/NGO

5 Public Information System

During a crisis following an accident, the affected people, public and media representatives would like to know about the situation from time to time and the response of the emergency authorities to the crisis. It is important to give timely information to the public in order to prevent panic and rumors. The emergency public information can be carried out in three phases.

(i) Before the crisis

This will include the safety procedure to be followed during an emergency through posters, talks, and mass media in local language. Leaflets containing do's/ don'ts should be circulated to educate the affected population.

(ii) During the crisis

Dissemination of information about the nature of the incident, actions taken and instructions to the public about protective measures to be taken, evacuation, etc. are the important steps.

(iii) After the crisis

Attention should be focused on information concerning restoration of essential services, movement/restrictions, etc. Various tasks of the public information system would include:

- Quick dissemination of emergency instructions to the personnel and public
- To receive all calls from public regarding emergency situations and respond meticulously
- Obtain current information from the Central Control Room
- Prepare news release
- Brief visitors/media
- Maintain contact with hospitals and get information about the casualties
- Damaged infrastructure (due to dam failure) will be rehabilitated by the project proponent

6 Efficient Communication System

An efficient communication system is absolutely essential to achieve a successful Emergency Preparedness Plan and this has to be finalized in consultation with local authorities and administrative setup as well involving local communities. More often the entire communication facility gets disrupted in a disaster situation. The wireless facility which is comparatively free from general encumbrances of the communication system shall be invariably a part of emergency preparedness plan. The respective department of police, who generally has this facility, must have standing instructions to convey disaster messages effectively in time. In addition, telephone facility shall be available at dam site, vulnerable points and population centers. Vehicles equipped with sirens and public address system may also be kept ready for densely populated areas (however there are no density populated areas d/w impact zone of the dam. Warning sirens may also be installed in the likely affected population to save warning time.

7 Special Preparedness before First Filling of Reservoir

Many failures of dams have reportedly occurred at the time of first filling of reservoirs. The period of first filling is a critical period in the life of a dam. Hence special vigilance and precautionary steps are necessary at the time of first filling of the dam in order to avoid failure of the dam. It is, therefore, necessary to inspect the performance of the dam carefully during this period. The preparedness shall be carried out for the first filling of reservoir as indicated below:

- Before starting the first filling of reservoir, the EAP of the project should be completed and implemented as far as possible.
- The installation of Spillway gates including hoisting arrangement, emergency power supply etc. should be completed and trial operation of gates must be made before it becomes actually operational.
- The copy of the first filling schedule shall be sent to the District Administration, and State Dam Safety Organization, if any.
- Proper lighting facilities on and nearby the dam area shall be provided before the onset of monsoon to facilitate close vigilance of the dam behavior during the night time also. A generator and flood light shall also be provided for emergency purpose.

- The control room of the dam is to be connected with the office and residence of officers-in-charge of the dam by telephone or by wireless set. The wireless/telephone stations and telephone lines should be completely out of the flood zone.
- Sufficient amount of materials such as sand, shingle, rubble etc. should be stock piled at convenient locations near the dam site.
- Sufficient number of filled sand bags should also be kept ready for emergency purposes.
- Machineries like tippers, trucks, excavators etc. along with sufficient number of labor are to be kept ready on both the flanks of dam to start remedial measures within a very short notice.
- Access roads along the downstream of the dam as well as on the top of the dam should be established for proper movement of the machines and vehicles.

8 Vigilance during first year of filling of a reservoir

During the first year of filling of dam, careful vigilance needs to be kept at the dam site and in the deepest river bed portion. The dam should be inspected by the Dam Incharge in three phases.

- The first phase inspection is to be carried out just before the onset of first heavy rain.
- The second phase of the inspection will be conducted after the filling of the reservoir to half the height of the dam.
- After the second inspection, if no untoward behavior of the Barrage is observed, third inspection will be made when the reservoir would be filled up to FRL.

When the spillway starts working, the Superintending Engineer should inspect the Barrage periodically during the entire period of overflowing. If any sweat, excessive settlement, leakage, cracking or sloughing of slopes is noticed, it should be brought to the attention of the higher authorities immediately. Daily reports about stage of reservoir filling, condition and behavior of the dam must be submitted by the Engineer responsible to his immediate superior as a part of the continuous vigilance of the dam.

9 Actions following Discovery of Problems

A close vigilance of the dam by Executive Engineer a competent person is the basic requirement for the EAP. When some distress in the dam is noticed, the nature and potentialities of the problems are required to be identified immediately by the Executive Engineer in charge of dam. Immediately, initiative for remedial measures and further activities for involving the operation of EAP be taken.

The information of any unusual development on the dam should be immediately flashed/ conveyed by the Executive Engineer in charge of the dam to the higher officials in the Department by means of the fastest available communication facilities such as wireless message/ telephone or telegram. In the event of likely failure of dam, any person within the locality shall initiate the actions as described in notification procedure and possible construction repairs depending on the seriousness of the development. Therefore, it is necessary that the staff posted on the vigilance and maintenance of the dam be adequately trained/ experienced to handle various emergent situations.

10 Notification Procedures

Notification procedures are an integral part of any EAP. Separate procedures should be established for slowly and rapidly developing situations and failure. Notifications would include communication of either an alert situation or an alert situation followed by a warning situation. An alert situation would indicate that although failure or flooding is not imminent, a more serious situation could occur unless conditions improve. A warning situation would indicate that flooding is imminent as a result of an impending failure of the dam. It would normally include an order for evacuation of delineated inundation areas.

Copies of the EAP shall be displayed at prominent locations, in the rooms and locations of the personnel named in the notification chart. For a regular watch on the flood level situation, it is necessary that the flood cells be manned by two or more people so that an alternative person is always available for notification round the clock. For speedy and unhindered communication, a wireless system is a preferable mode of communication. Telephones may be kept for back up, wherever available. It is also preferred that the entire flood cells, if more than one, are tuned in the same wireless channel. It will ensure communication from the dam site to the control rooms. The communication can be established by messenger service in the absence of such modes of communication.

- Using multiple warning channels (police, radio, television, telephone, sirens, loudspeakers, mobiles etc.)
- Using official sources for warning (city civil officials, police, fire fighting etc.)
- Repeat warnings
- Ensuring that warnings are consistent and accurate
- Giving specific instructions about what actions should and should not be taken by people of the area to protect themselves
- Conveying to the affected persons, possible extent of duration of flood/danger and urgency. However, this should not be overplayed to cause panic

All departments, which are charged with the emergency preparedness, shall be identified and nodal officer in each department shall be identified from each department in advance. Such officers shall be provided residential telephone/cell phone in addition to their office telephones during the flood season. It is evident that the emergency preparedness plan is an integrated matter requiring technical expertise, specific administrative skill and spontaneous public participation (if is required) to be practical, pragmatic and successful.

11 Management after receding of Flood Water

The officer-in-charge of relief camp shall assist in the process of timely evacuation and rehabilitation of the persons likely to be affected, cattle and property. He / She shall also maintain record of persons/families in the camp and make arrangements for essential items of daily use and ensure reasonable health, sanitation, water supply and street lighting facilities. A daily situation report shall be sent to the control room. Some of the measures which need to be implemented are listed as below:

- Provision of various food items and shelter to the evacuees.
- Provision of fuel for various evacuees.
- Provision of adequate fodder supply.
- Arrangements for potable water supply.
- Commissioning of low cost sewage treatment and sanitation facilities, and disposal of treatment sewage.
- Expeditious disposal of dead bodies human and livestock.

- Immunization programmes for prevention of outbreak of epidemics of various water related diseases.
- Adequate stocks of medicines of various diseases, especially water-related diseases.